11-13-68

PRICE $2.00

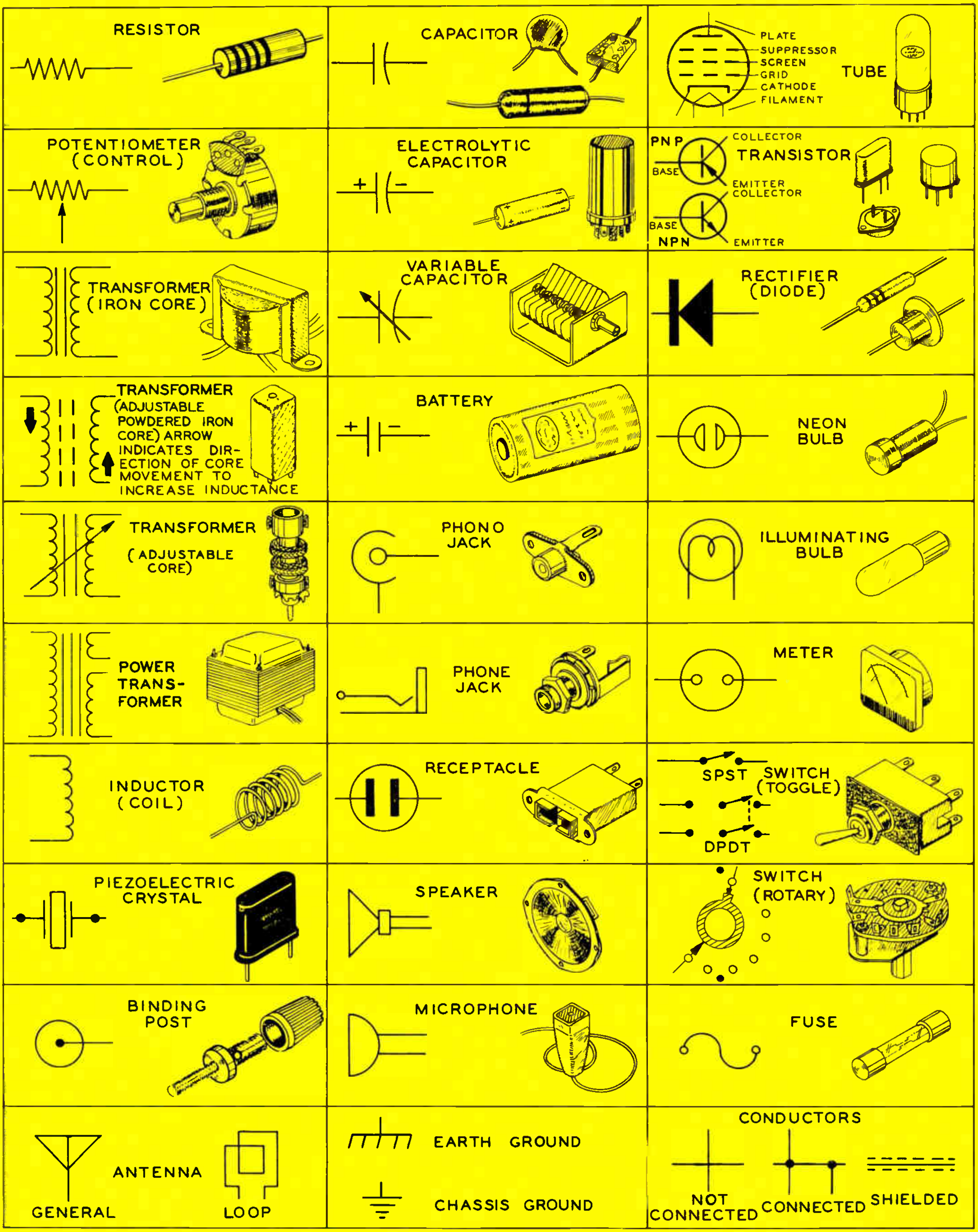
HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATHKIT®
ASSEMBLY MANUAL

COLOR TELEVISION SET
MODEL GR-295

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



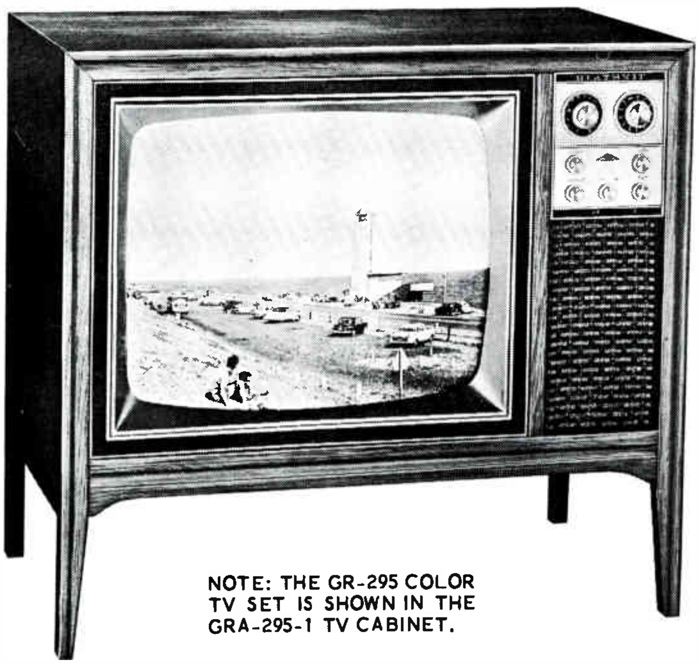
Assembly and Operation

of the

HEATHKIT

COLOR TELEVISION SET

Model GR-295



NOTE: THE GR-295 COLOR TV SET IS SHOWN IN THE GRA-295-1 TV CABINET.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

8/23/68

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INTRODUCTION

The Model GR-295 Color Television Set is an assemble-it-yourself color television receiver of the highest quality. After assembly, it can be installed in the Heath Model GRA-295-1 TV Cabinet, or it can be custom installed.

This Television Set is quite easy to assemble. All critical circuits are furnished preassembled and pretested, and all circuits are designed to keep the chassis unusually neat and clutter-free. The preassembled units include the UHF and VHF tuners, the horizontal output and high voltage circuits, and a circuit board that includes the IF amplifiers and sound detector. Almost all the circuits that you build are designed into three circuit boards.

Only the most sophisticated TV circuitry has been used in this kit to insure stable, high-definition, noise-free pictures. Kit assembly helps you to become familiar with your Heath Color Television Set inside and out. This enables you to do any minor maintenance that may be needed in the future, such as tube replacements or picture adjustments.

Twenty-seven tubes and a transistor are used in this Color Television Set. The picture is displayed on a rectangular color picture tube that has safety glass bonded to the viewing surface. A built-in dot generator makes it easy and convenient to make all the adjustments necessary to put the Television Set into operation.

The deluxe VHF tuner provides individual fine tuning adjustments for each channel. A noise-limiting sync-clipper circuit assures you of a steady jitter-free picture, even in high interference areas. Gated AGC provides a balanced picture, even under fast-changing signal conditions, such as those that occur when airplanes fly over the receiving area. A color-killer circuit cuts off all color signals when a black and white picture is being received.

The 24,000 volt regulated high voltage power supply assures you of a sharp, clear picture. The low voltage power supply includes a power transformer, a circuit breaker, and a thermistor for safe dependable operation. An automatic degaussing circuit is used to degauss (demagnetize) the TV Set each time it is turned on: this eliminates the need for manual degaussing whenever the TV Set is moved. Two pincushion transformers and associated circuits have been included for dynamic pincushion control: this will assure you of straight vertical and horizontal lines in the picture.

A cathode follower audio output circuit is provided for connection to your high fidelity system, and an audio power amplifier circuit is provided for use with an 8 Ω speaker. All of the above features, as well as many others, will bring you the best in color television reception.

Two sections of this Manual have been provided to give you some understanding of how this Color Television Set operates: the Color TV Theory explains color television in elementary terms; the Circuit Description is more technically oriented.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures. After reading the Kit Builders Guide, be sure to read the information on Page 5 of this Manual before you start to unpack the kit.

CIRCUIT BOARDS

This section of the Manual contains a Parts List and Step-By-Step Assembly instructions for each of the three circuit boards to be assembled.

SOUND-SYNC CIRCUIT BOARD

PARTS LIST

NOTE: This parts list contains only the parts in pack #1. They will be used in the assembly of the sound-sync circuit board. Set all other parts packs aside until they are called for later.

To avoid intermixing the parts, do not open any pack at this time except those called for. Do not open small envelopes with part numbers on them until the part is called for in a step. Some of these parts, such as solder and hook-up wire, will also be used in the Color Circuit Board, Convergence Circuit Board, and the Chassis Assembly sections of the Manual.

Unpack pack #1 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers in the Parts Pictorial (fold-out from Page 7).

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1)1-45	1	220 Ω (red-red-brown)
1-9	1	1000 Ω (brown-black-red)
1-10	1	1200 Ω (brown-red-red)
1-81	1	1500 Ω (brown-green-red)
1-14	1	3300 Ω (orange-orange-red)
1-20	1	10 KΩ (brown-black-orange)
1-109	1	12 KΩ 5% (brown-red-orange-gold)
1-21	2	15 KΩ (brown-green-orange)
1-23	1	27 KΩ (red-violet-orange)
1-24	1	33 KΩ (orange-orange-orange)
1-47	1	56 KΩ (green-blue-orange)
1-60	2	68 KΩ (blue-gray-orange)
1-102	1	82 KΩ (gray-red-orange)
1-26	6	100 KΩ (brown-black-yellow)
1-30	3	270 KΩ (red-violet-yellow)
1-31	2	330 KΩ (orange-orange-yellow)
1-32	2	390 KΩ (orange-white-yellow)
1-33	3	470 KΩ (yellow-violet-yellow)
1-34	2	680 KΩ (blue-gray-yellow)
1-35	1	1 megohm (brown-black-green)
1-37	3	2.2 megohm (red-red-green)
1-38	1	3.3 megohm (orange-orange-green)
1-71	1	4.7 megohm (yellow-violet-green)
1-40	2	10 megohm (brown-black-blue)
Other Resistors		
(2)1-22-1	1	1500 Ω 1 watt (brown-green-red)
1-12-2	1	470 Ω 2 watt (yellow-violet-brown)
(3)1-4-2	1	15 KΩ 2 watt (brown-green-orange)
CAPACITORS		
Mica		
(4)20-118	1	15 μμf
20-109	1	62 μμf
20-115	1	300 μμf
20-122	1	1000 μμf

PART No.	PARTS Per Kit	DESCRIPTION
Disc		
(5)21-6	1	27 μμf
21-32	1	47 μμf
21-21	1	200 μμf
21-22	1	220 μμf
21-13	2	500 μμf
21-24	1	800 μμf
21-14	3	.001 μfd
21-25	1	.0013 μfd (1300 μμf)
21-26	1	.003 μfd
21-16	2	.01 μfd
21-31	1	.02 μfd
Tubular		
(6)29-1	1	3900 μμf
(7)23-40	1	.0068 μfd
23-100	1	.015 μfd
23-11	2	.1 μfd
Resin		
(8)27-59	1	.0047 μfd
27-57	1	.018 μfd
27-47	1	.1 μfd 50 V or 100 V

NOTE: Capacitor 27-47 is physically smaller than capacitor 27-28.

PART No.	PARTS Per Kit	DESCRIPTION
27-28	4	.1 μfd 400 V
MISCELLANEOUS		
(9)40-492	1	Horizontal oscillator coil
(10)57-32	1	Dual selenium diode
(11)84-32	2	P.E.C. (printed electronic circuit)
85-145-5	1	Sound-sync circuit board
344-51	1	Brown hookup wire
(12)434-130	3	9-pin tube socket
(13)434-156	1	9-pin novar tube socket
331-6		Solder
597-423	1	Picture tube warranty card, (inserted into this Manual)
597-308	1	Kit Builders Guide
391-34	1	Blue and white label
597-260	1	Parts order form
595-838	1	Manual

STEP-BY-STEP ASSEMBLY

Before starting to assemble this kit, read the Kit Builders Guide for complete information on wiring, soldering, and step-by-step assembly procedures.

Position all parts as shown in the Pictorials. Follow the instructions carefully, and read the entire step before performing the operation.

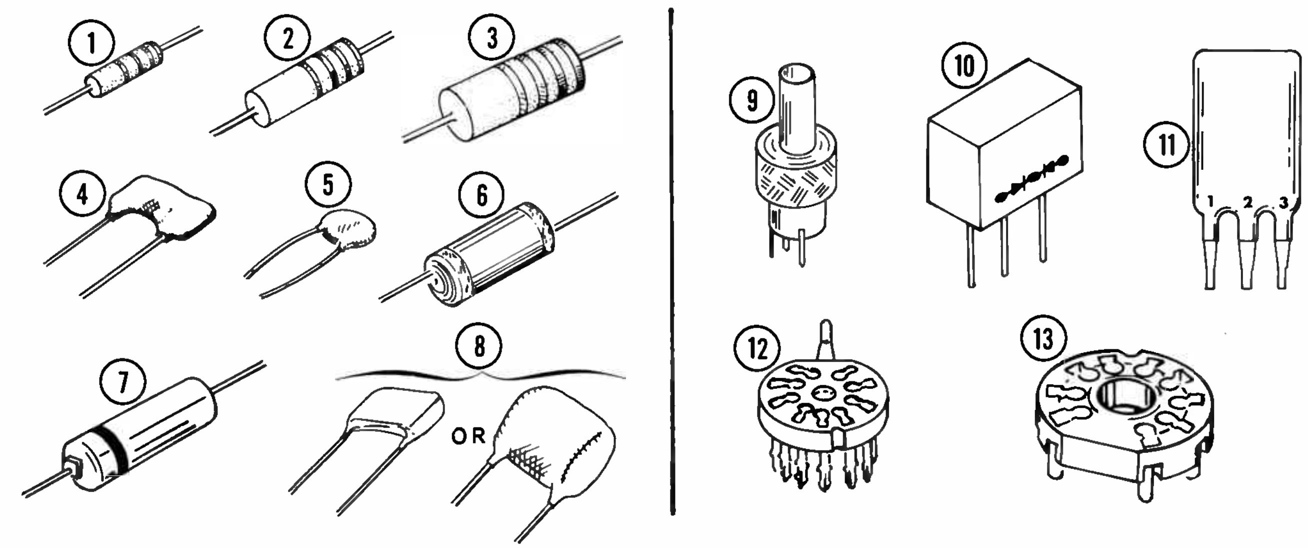
Use 1/2 watt resistors unless directed otherwise in a step. All resistors will be called out by only the resistance value (in Ω, KΩ, or megohms); the color code will also be given for color-coded resistors. Capacitors will be called out by only the capacitance value and type; the color code will also be given for color-coded capacitors.

When a circuit board is finished, set it aside until it is called for later in the assembly instructions.

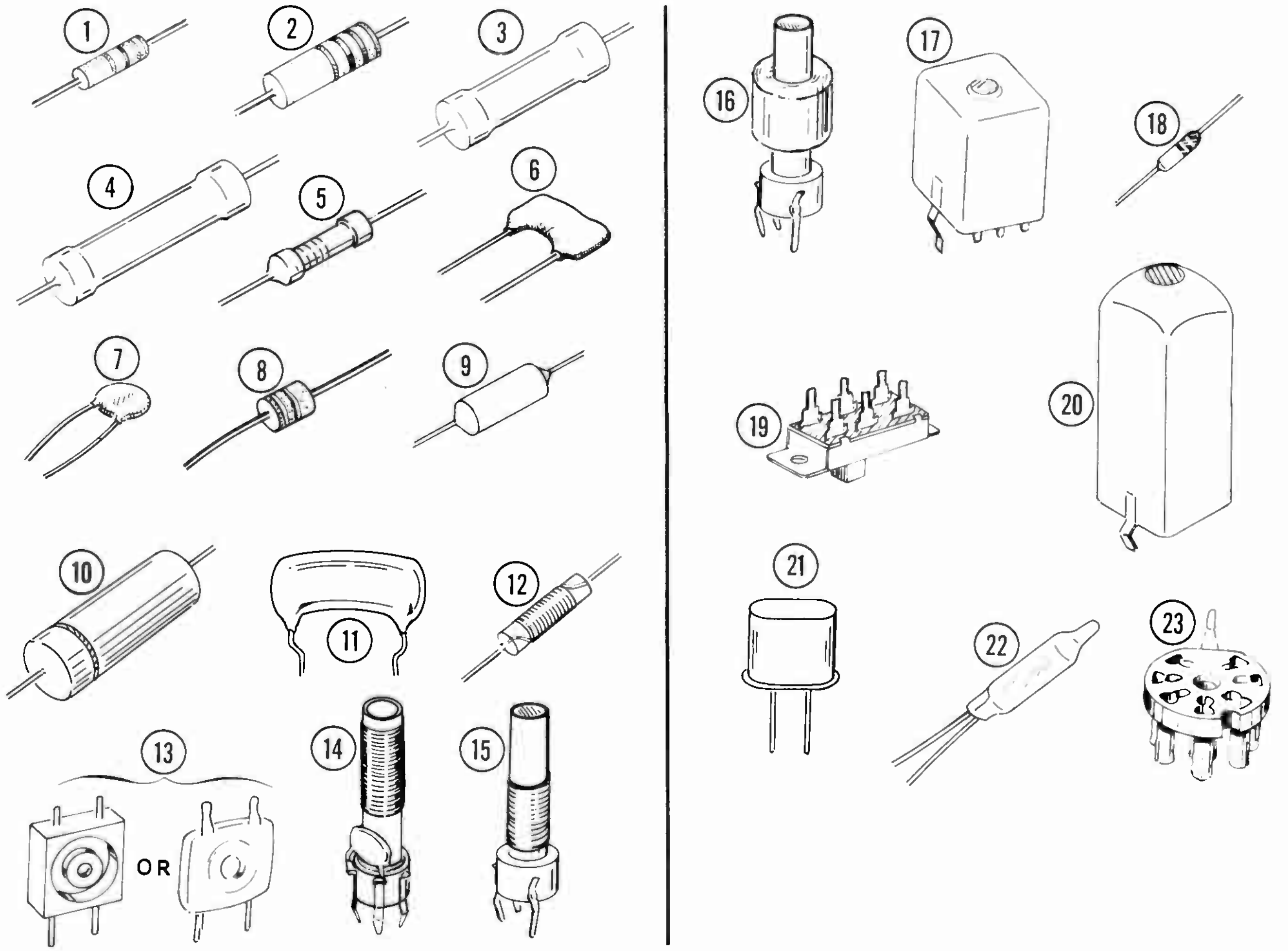
NOTE: Only one-half of the sound-sync circuit board is shown in Pictorials 1-1 and 1-2. A small drawing at the top of the Pictorial shows the area of the circuit board to be assembled in each of these Pictorials.

( ) Position the sound-sync circuit board as shown in Pictorial 1-1. Complete each step on the Pictorial.

SOUND-SYNC CIRCUIT BOARD PARTS PICTORIAL



COLOR CIRCUIT BOARD PARTS PICTORIAL



START

(✓) 220 Ω (red-red-brown).

(✓) 100 KΩ (brown-black-yellow).

(✓) 270 KΩ (red-violet-yellow).

(✓) 27 μμf disc.

(✓) .02 μfd disc.

(✓) 270 KΩ (red-violet-yellow).

(✓) 500 μμf disc.

(✓) 1000 Ω (brown-black-red).

(✓) 1500 Ω 1 watt (brown-green-red).

(✓) Solder all connections and cut off excess leads.

(✓) 68 KΩ (blue-gray-orange).

(✓) 2.2 megohm (red-red-green).

NOTE: When installing tubular and resin capacitors, position the marked end as shown. See Detail 1-1A.

(✓) .1 μfd tubular. Note marked end.

(✓) 330 KΩ (orange-orange-yellow).

(✓) 56 KΩ (green-blue-orange).

(✓) 3900 μμf tubular. Note banded end.

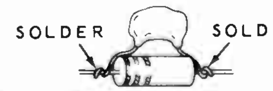
(✓) 47 μμf disc.

(✓) 62 μμf mica.

(✓) 800 μμf disc.

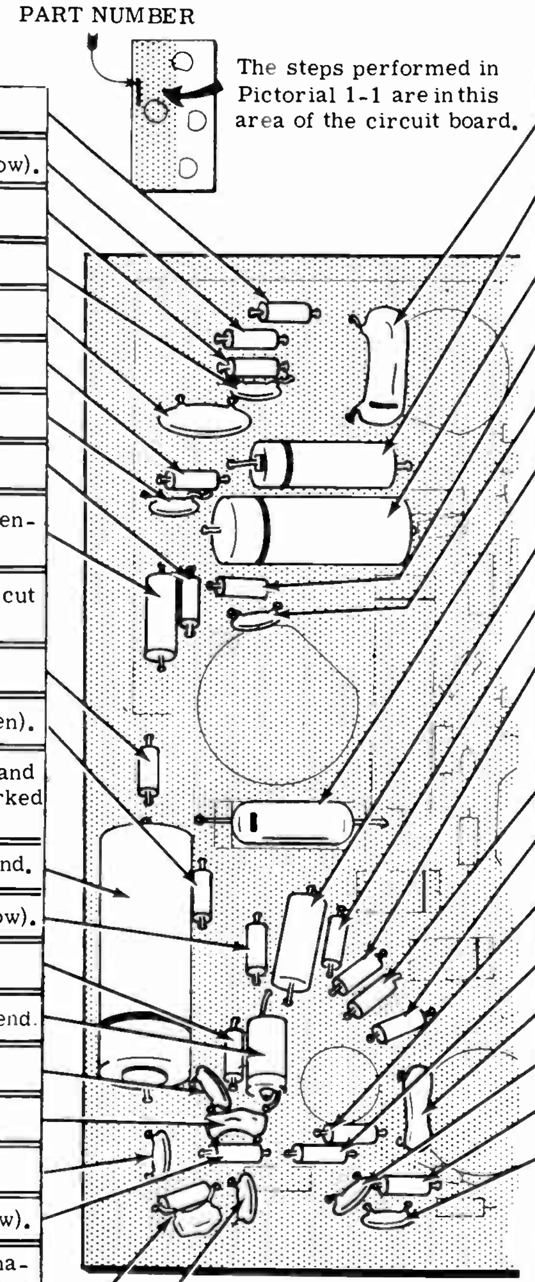
(✓) 390 KΩ (orange-white-yellow).

(✓) Resistor - capacitor combination. Prepare as shown with a 100 KΩ resistor (brown-black-yellow) and a 15 μμf mica capacitor. After soldering, Clip off the excess capacitor leads.



(✓) .001 μfd disc.

( ) Solder all connections and cut off excess leads.



CONTINUE

(✓) .0047 μfd resin. Note marked end.

(✓) .0068 μfd tubular. Note marked end.

(✓) .015 μfd tubular. Note marked end.

(✓) 4.7 megohm (yellow-violet-green).

(✓) 500 μμf disc.

(✓) .018 μfd resin. Note marked end.

(✓) 15 KΩ 2 watt (brown-green-orange).

(✓) 2.2 megohm (red-red-green).

(✓) 680 KΩ (blue-gray-yellow).

( ) Solder all connections and cut off excess leads.

(✓) 2.2 megohm (red-red-green).

(✓) 68 KΩ (blue-gray-orange).

(✓) 12 KΩ 5% (brown-red-orange-gold).

(✓) 390 KΩ (orange-white-yellow).

(✓) 1000 μμf mica.

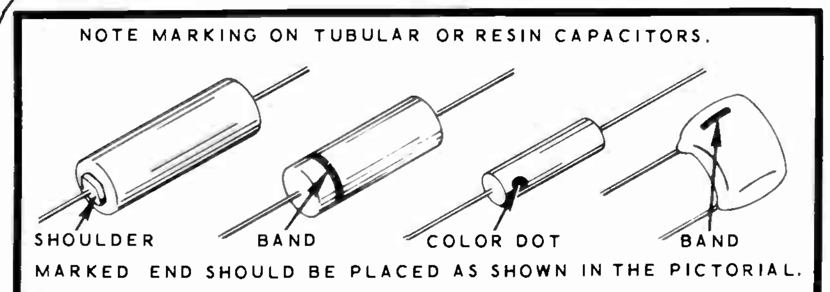
(✓) .001 μfd disc.

(✓) 680 KΩ (blue-gray-yellow).

(✓) .001 μfd disc.

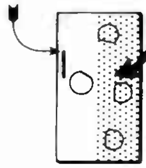
( ) Solder all connections and cut off excess leads.

PROCEED TO PICTORIAL 1-2.



Detail 1-1A

PICTORIAL 1-1



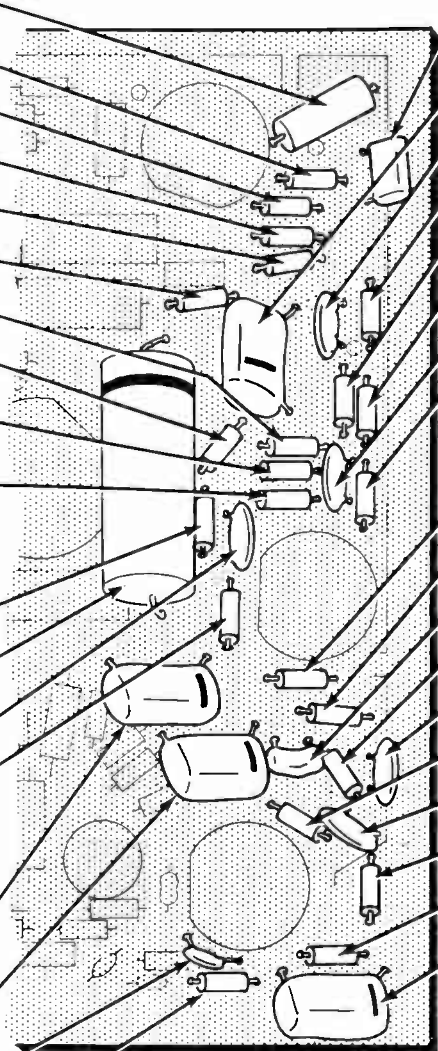
The steps performed in Pictorial 1-2 are in this area of the circuit board.

START

- ( ) 470 Ω 2 watt (yellow-violet-brown).
- ( ) 1500 Ω (brown-green-red).
- ( ) 470 KΩ (yellow-violet-yellow).
- ( ) 10 KΩ (brown-black-orange).
- ( ) 3300 Ω (orange-orange-red).
- ( ) 82 KΩ (gray-red-orange).
- ( ) 100 KΩ (brown-black-yellow).
- ( ) 33 KΩ (orange-orange-orange).
- ( ) 3.3 megohm (orange-orange-green).
- ( ) 330 KΩ (orange-orange-yellow).
- ( ) Solder all connections and cut off excess leads.
- ( ) 100 KΩ (brown-black-yellow).
- ( ) .1 μfd tubular. Note marked end.
- ( ) .003 μfd disc.
- ( ) 10 megohm (brown-black-blue).

NOTE: Do not use the .1 μfd resin capacitor (#27-47) marked 50 V or 100 V until it is called for in a step.

- ( ) .1 μfd 400 V resin. Note marked end.
- ( ) .1 μfd 400 V resin. Note marked end.
- ( ) 200 μμf disc.
- ( ) 100 KΩ (brown-black-yellow).
- ( ) Solder all connections and cut off excess leads.



CONTINUE

- ( ) .1 μfd 50 V or 100 V resin.
- ( ) .1 μfd 400 V resin. Note marked end.
- ( ) 220 μμf disc.
- ( ) 470 KΩ (yellow-violet-yellow)
- ( ) 100 KΩ (brown-black-yellow).
- ( ) 15 KΩ (brown-green-orange).
- ( ) .01 μfd disc.
- ( ) 270 KΩ (red-violet-yellow).
- ( ) Solder all connections and cut off excess leads.
- ( ) 1 megohm (brown-black-green).
- ( ) 10 megohm (brown-black-blue).
- ( ) 300 μμf mica.
- ( ) 15 KΩ (brown-green-orange).
- ( ) .01 μfd disc.
- ( ) 27 KΩ (red-violet-orange).
- ( ) .0013 μfd (1300 μμf) disc.
- ( ) 470 KΩ (yellow-violet-yellow).
- ( ) 1200 Ω (brown-red-red).
- ( ) .1 μfd 400 V resin. Note marked end.
- ( ) Solder all connections and cut off excess leads.

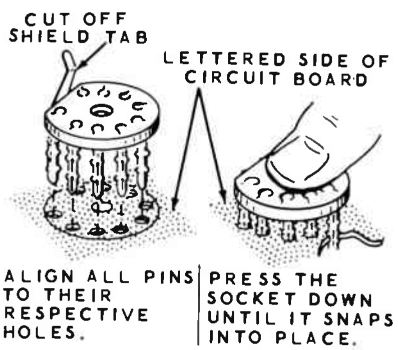
PROCEED TO PICTORIAL 1-3

PICTORIAL 1-2

START

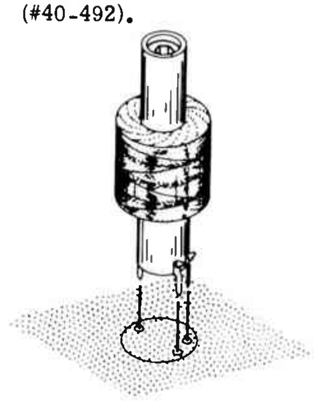
NOTE: Solder the connections of each part as it is installed. Cut off the excess leads of the dual diode only.

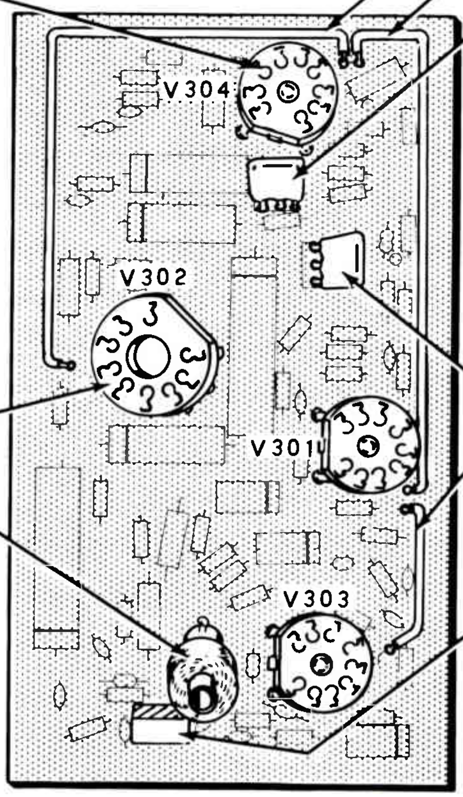
(✓) Cut off the shield tab on the three 9-pin tube sockets. Then install these sockets at V301, V303, and V304. On each socket, solder all the pins that connect to a foil.



(✓) Install a 9-pin Novar tube socket at V302.

(✓) Horizontal oscillator coil (#40-492).





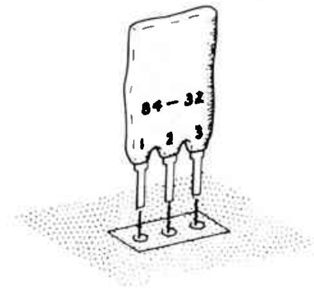
CONTINUE

NOTE: Use hookup wire of the color specified, when wire is called for in a step. Cut the wire to the proper length, and remove 1/4" of insulation from each end. Position each wire as shown.

(✓) 7" brown wire.

(✓) 6" brown wire.

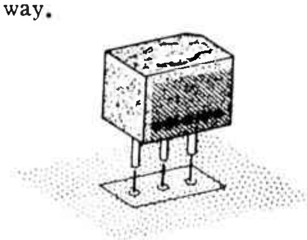
(✓) P.E.C. #84-32. The P.E.C. can be installed either way.



(✓) P.E.C. #84-32. The P.E.C. can be installed either way.

(✓) 2-1/4" brown wire.

(✓) Dual selenium diode (#57-32). The diode can be installed either way.



( ) Check to see that all connections are soldered and cut off the excess leads of the dual diode.

FINISH

Set the circuit board aside temporarily. Proceed to Page 11.

PICTORIAL 1-3

COLOR CIRCUIT BOARD

PARTS LIST

Unpack pack #2 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers in the Parts Pictorial (fold-out from Page 8).

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1) 1-49	1	22 Ω (red-red-black)
1-83	2	56 Ω 5% (green-blue-black-gold)
1-3	1	100 Ω (brown-black-brown)
1-66	1	150 Ω (brown-green-brown)
1-45	1	220 Ω (red-red-brown)
1-48	1	390 Ω (orange-white-brown)
1-6	1	470 Ω (yellow-violet-brown)
1-52	1	680 Ω 5% (blue-gray-brown-gold)
1-9	2	1000 Ω (brown-black-red)
1-81	2	1500 Ω 5% (brown-green-red-gold)
1-14	3	3300 Ω (orange-orange-red)
1-46	1	3900 Ω (orange-white-red)
1-16	1	4700 Ω (yellow-violet-red)
1-19	1	6800 Ω (blue-gray-red)
1-22	2	22 KΩ (red-red-orange)
1-23	1	27 KΩ (red-violet-orange)
1-24	2	33 KΩ (orange-orange-orange)
1-67	1	39 KΩ (orange-white-orange)
1-25	3	47 KΩ (yellow-violet-orange)
1-60	1	68 KΩ (blue-gray-orange)
1-26	9	100 KΩ (brown-black-yellow)
1-27	1	150 KΩ (brown-green-yellow)
1-29	2	220 KΩ (red-red-yellow)
1-30	3	270 KΩ (red-violet-yellow)
1-31	1	330 KΩ (orange-orange-yellow)
1-32	1	390 KΩ (orange-white-yellow)
1-35	7	1 megohm (brown-black-green)
1-37	1	2.2 megohm (red-red-green)
1-71	1	4.7 megohm (yellow-violet-green)
1-40	1	10 megohm (brown-black-blue)
1 Watt		
(2) 1-54-1	1	270 Ω 5% (red-violet-brown-gold)
1-25-1	1	6800 Ω (blue-gray-red)
1-27-1	1	33 KΩ (orange-orange-orange)
1-7-1	2	47 KΩ (yellow-violet-orange)
Other Resistors		
(3) 5-1-2	2	3900 Ω (3.9 K) 2 watt, film
5-5-2	1	10 KΩ 2 watt, film
5-4-2	3	27 KΩ 2 watt, film
5-3-2	2	47 KΩ 2 watt, film
(4) 5-2-3	1	270 Ω 3 watt, film
5-1-3	1	2700 Ω (2.7 K) 3 watt, film
Packaged and matched resistors (#4-10) consisting of:		
(5) 4-6	2	1 megohm 5% low-noise (brown-black-green-gold)
Packaged and matched resistors (#4-11) consisting of:		
4-7	4	2.2 megohm 5% low-noise (red-red-green-gold)
CAPACITORS		
Mica		
(6) 20-52	1	7.5 μμf
20-104	1	130 μμf
20-105	1	180 μμf
20-139	4	330 μμf
Disc		
(7) 21-61	1	6.8 μμf (6.8K)
21-3	1	10 μμf
21-5	2	20 μμf
21-7	3	33 μμf
21-86	1	75 μμf
21-11	1	150 μμf
21-22	3	220 μμf
21-17	1	270 μμf
21-14	3	.001 μfd
21-36	1	.002 μfd
21-26	1	.003 μfd
21-27	3	.005 μfd
21-16	14	.01 μfd
21-31	2	.02 μfd

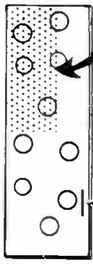
PART No.	PARTS Per Kit	DESCRIPTION
Other Capacitors		
(8) 28-4	1	1.5 $\mu\mu$f phenolic (brown-green-white)
(9) 21-29	1	4.7 $\mu\mu$f ceramic
(10) 23-52	1	.047 μfd 400 V tubular
(11) 27-36	6	.01 μfd resin
27-28	4	.1 μfd resin
27-35	1	.22 μfd resin
COILS		
(12) 45-39	1	4.7 μh choke
(13) 40-583	1	10μh peaking (brown-black-black)
40-582	1	62 μh peaking (blue-red-black)
40-599	1	112 μh peaking (brown-brown-brown)
40-488	2	180 μh peaking (brown-gray-brown)
40-581	3	620 μh peaking (blue-red-brown)
(14) 40-577	1	3.58 megacycle reactance
(15) 40-578	1	Color amplifier plate
(16) 40-585	1	Dot generator
TRANSFORMERS		
(17) 52-75	1	Burst phase
52-77	1	3.58 megacycle coupling
52-76	1	Color bandpass
MISCELLANEOUS		
(18) 56-20	1	1N295 crystal diode (red-white-green)
(19) 60-21	1	DPDT slide switch
85-148-7	1	Color circuit board
(20) 206-207	1	Coil shield
344-56	1	Blue hookup wire
346-1	1	Small sleeving
(21) 404-238	1	3579.545 kilocycle crystal
(22) 412-11	1	NE-2 neon lamp
(23) 434-129	3	7-pin tube socket
434-130	7	9-pin tube socket

STEP-BY-STEP ASSEMBLY

Only a portion of the color circuit board is shown in each of the next four Pictorials, due to the large size of the circuit board. A small drawing at the top of each Pictorial shows the area of the circuit board to be assembled.

NOTE: In some instances, resistors will be mounted vertically on the circuit board.

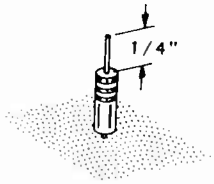
(✓) Position the color circuit board as shown in Pictorial 1-4. Complete each step on the Pictorial.



The steps performed in Pictorial 1-4 are in this area of the circuit board.

START

(✓) 100 KΩ (brown-black-yellow). Solder one lead to the foil and cut the free lead to 1/4".



(✓) .01 μfd disc.

(✓) 100 KΩ (brown-black-yellow).

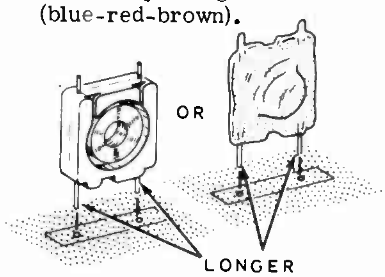
(✓) 270 KΩ (red-violet-yellow).

(✓) 270 KΩ (red-violet-yellow).

(✓) 1 megohm (brown-black-green).

(✓) .01 μfd resin. Note marked end.

(✓) 620 μh peaking coil #40-581 (blue-red-brown).



(✓) Solder all connections and cut off excess leads.

(✓) 33 μμf disc.

(✓) 150 Ω (brown-green-brown).

(✓) 56 Ω 5% (green-blue-black-gold).

(✓) 1-1/4" blue wire.

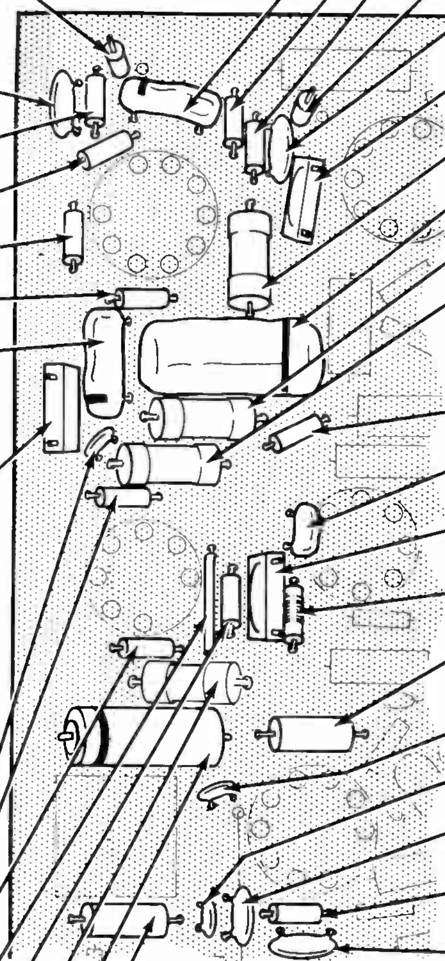
(✓) 56 Ω 5% (green-blue-black-gold).

(✓) 10 KΩ 2 watt film.

(✓) .047 μfd 400 V tubular. Note marked end.

(✓) 6800 Ω 1 watt (blue-gray-red).

( ) Solder all connections and cut off excess leads.



PICTORIAL 1-4

CONTINUE

(✓) .01 μfd resin. Note marked end.

(✓) 1 megohm (brown-black-green).

(✓) 100 KΩ (brown-black-yellow).

(✓) 100 KΩ (brown-black-yellow). Solder one lead to the foil and cut the free lead to 1/4".

(✓) .01 μfd disc.

(✓) 620 μh peaking coil #40-581 (blue-red-brown).

(✓) 27 KΩ 2 watt film.

(✓) .22 μfd resin. Note marked end.

(✓) 27 KΩ 2 watt film.

(✓) 3900 Ω (3.9 K) 2 watt film.

( ) Solder all connections and cut off excess leads.

(✓) 3300 Ω (orange-orange-red).

(✓) 180 μμf mica.

(✓) 10 μh peaking coil #40-583 (brown-black-black).

(✓) 4.7 μh choke coil (#45-39).

(✓) 47 KΩ 1 watt (yellow-violet-orange).

(✓) 6.8 μμf disc.

(✓) 10 μμf disc.

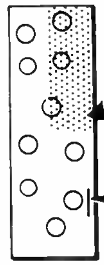
(✓) .01 μfd disc.

(✓) 680 Ω 5% (blue-gray-brown-gold).

(✓) .01 μfd disc.

( ) Solder all connections and cut off excess leads.

PROCEED TO PICTORIAL 1-5

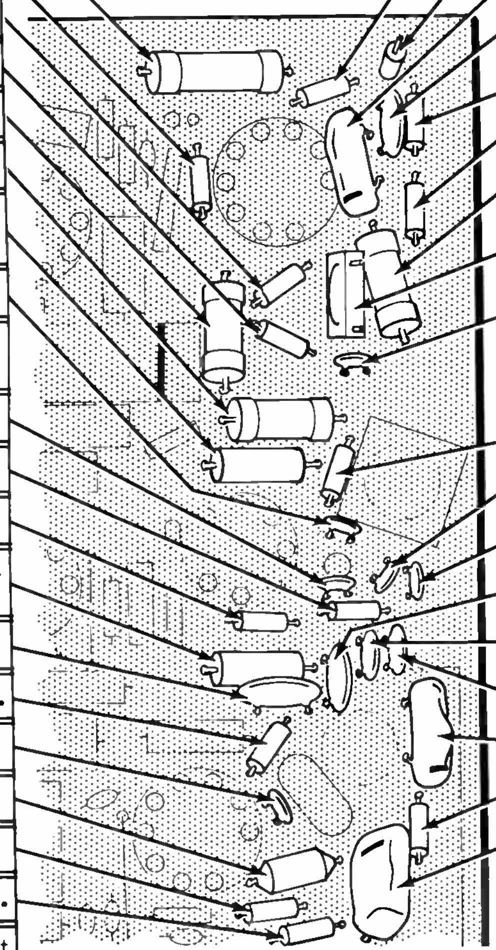


The steps performed in Pictorial 1-5 are in this area of the circuit board.

PART NUMBER

START

- (✓) 270 Ω 3 watt film. Do not use the 2700 Ω (2.7 K) resistor.
- (✓) 68 KΩ (blue-gray-orange).
- (✓) 330 KΩ (orange-orange-yellow).
- (✓) 1 megohm (brown-black-green).
- (✓) 47 KΩ 2 watt film.
- (✓) 3900 Ω (3.9 K) 2 watt film.
- (✓) 270 Ω 5% 1 watt (red-violet-brown-gold).
- (✓) .002 μfd disc.
- (✓) Solder all connections and cut off excess leads.
- (✓) 220 μμf disc.
- (✓) 220 KΩ (red-red-yellow).
- (✓) 100 Ω (brown-black-brown).
- (✓) 47 KΩ 1 watt (yellow-violet-orange).
- (✓) 75 μμf disc.
- (✓) 47 KΩ (yellow-violet-orange).
- (✓) 220 μμf disc.
- (✓) 4.7 μμf ceramic.
- (✓) 27 KΩ (red-violet-orange).
- (✓) 33 KΩ (orange-orange-orange).
- (✓) Solder all connections and cut off excess leads.

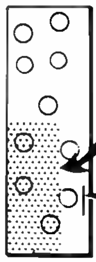


CONTINUE

- (✓) 1 megohm (brown-black-green).
- (✓) 100 KΩ (brown-black-yellow). Solder one lead to the foil and cut the free lead to 1/4".
- (✓) .01 μfd resin. Note marked end.
- (✓) .01 μfd disc.
- (✓) 100 KΩ (brown-black-yellow).
- (✓) 270 KΩ (red-violet-yellow).
- (✓) 27 KΩ 2 watt film.
- (✓) 620 μh peaking coil #40-581 (blue-red-brown).
- (✓) 33 μμf disc.
- (✓) Solder all connections and cut off excess leads.
- (✓) 2.2 megohm (red-red-green).
- (✓) 20 μμf disc.
- (✓) 33 μμf disc.
- (✓) .01 μfd disc.
- (✓) 20 μμf disc.
- (✓) .005 μfd disc.
- (✓) .01 μfd resin. Note marked end.
- (✓) 100 KΩ (brown-black-yellow).
- (✓) .1 μfd resin. Note marked end.
- (✓) Solder all connection and cut off excess leads.

PROCEED TO PICTORIAL 1-6

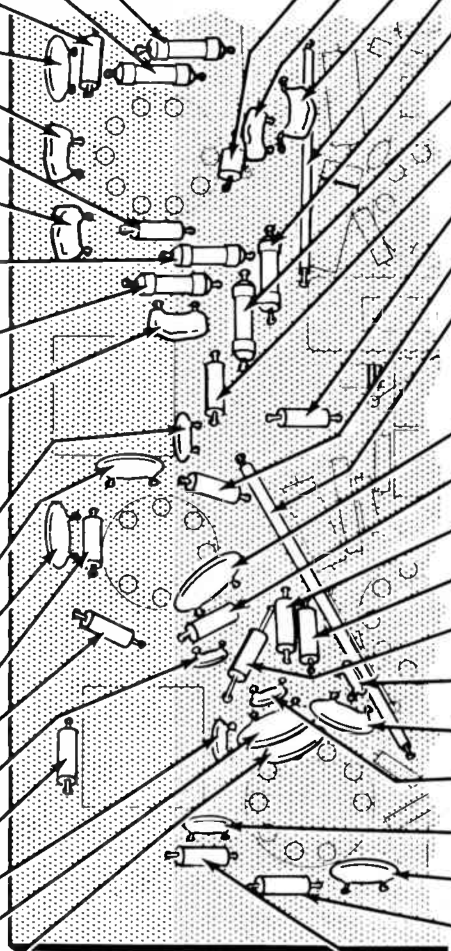
PICTORIAL 1-5



The steps performed in Pictorial 1-6 are in this area of the circuit board.

START

- (✓) 1 megohm 5% <u>low-noise</u> (brown-black-green-gold).
- (✓) 1 megohm 5% <u>low-noise</u> (brown-black-green-gold).
- (✓) 220 Ω (red-red-brown).
- (✓) .01 μfd disc.
- (✓) 330 μμf mica.
- (✓) 22 KΩ (red-red-orange).
- (✓) 130 μμf mica.
- (✓) 2.2 megohm 5% <u>low-noise</u> (red-red-green-gold).
- (✓) 2.2 megohm 5% <u>low-noise</u> (red-red-green-gold).
- (✓) 330 μμf mica.
- (✓) Solder all connections and cut off excess leads.
- (✓) .001 μfd disc.
- (✓) .01 μfd disc.
- (✓) .01 μfd disc.
- (✓) 39 KΩ (orange-white-orange).
- (✓) 47 KΩ (yellow-violet-orange).
- (✓) 150 μμf disc.
- (✓) 470 Ω (yellow-violet-brown).
- (✓) .001 μfd disc.
- (✓) .02 μfd disc.
- (✓) .01 μfd disc.
- (✓) Solder all connections and cut off excess leads.

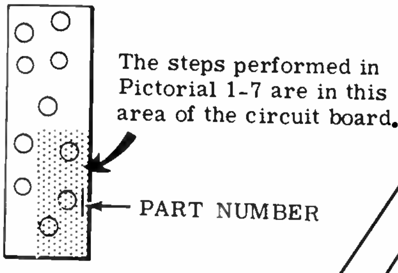


CONTINUE

- (✓) 1.5 μμf phenolic (brown-green-white).
- (✓) 330 μμf mica.
- (✓) 330 μμf mica.
- (✓) 2-1/4" blue wire.
- (✓) 2.2 megohm 5% <u>low-noise</u> (red-red-green-gold).
- (✓) 2.2 megohm 5% <u>low-noise</u> (red-red-green-gold).
- (✓) 1000 Ω (brown-black-red).
- (✓) 1 megohm (brown-black-green).
- (✓) 1000 Ω (brown-black-red).
- (✓) 3" blue wire.
- (✓) Solder all connections and cut off excess leads.
- (✓) .02 μfd disc.
- (✓) 100 KΩ (brown-black-yellow).
- (✓) 47 KΩ (yellow-violet-orange).
- (✓) 100 KΩ (brown-black-yellow).
- (✓) 3300 Ω (orange-orange-red).
- (✓) 220 μμf disc.
- (✓) .01 μfd disc.
- (✓) 270 μμf disc.
- (✓) .001 μfd disc.
- (✓) .01 μfd disc.
- (✓) 10 megohm (brown-black-blue).
- (✓) 390 Ω (orange-white-brown).
- (✓) Solder all connections and cut off excess leads.

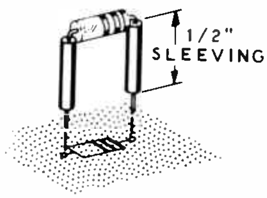
PICTORIAL 1-6

PROCEED TO PICTORIAL 1-7

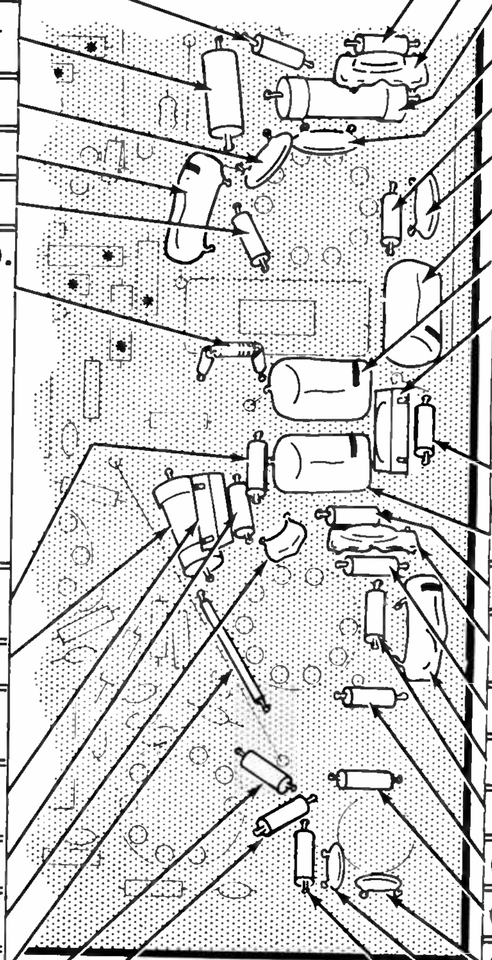


START

- (✓) 1500 Ω 5% (brown-green-red-gold).
- (✓) 33 KΩ 1 watt (orange-orange-orange).
- (✓) .01 μfd disc.
- (✓) .01 μfd resin. Note marked end.
- (✓) 22 Ω (red-red-black).
- (✓) Crystal diode (red-white-green). Use 1/2" of small sleeving on each diode lead. Position the banded end as shown.



- (✓) 4.7 megohm (yellow-violet-green).
- (✓) 47 KΩ 2 watt film.
- (✓) Solder all connections and cut off excess leads.
- (✓) 112 μh peaking coil #40-599 (brown-brown-brown).
- (✓) 6800 Ω (blue-gray-red).
- (✓) 7.5 μμf mica.
- (✓) 1-1/2" blue wire.
- (✓) 4700 Ω (yellow-violet-red).
- (✓) 150 KΩ (brown-green-yellow).
- (✓) Solder all connections and cut off excess leads.



PICTORIAL 1-7

CONTINUE

- (✓) 3900 Ω (orange-white-red).
- (✓) 180 μh peaking coil #40-488 (brown-gray-brown).
- (✓) 2700 Ω (2.7 K) 3 watt film.
- (✓) .003 μfd disc.
- (✓) 220 KΩ (red-red-yellow).
- (✓) .01 μfd disc.
- (✓) .1 μfd resin. Note marked end.
- (✓) .1 μfd resin. Note marked end.
- (✓) 62 μh peaking coil #40-582 (blue-red-black).
- (✓) Solder all connections and cut off excess leads.
- (✓) 1500 Ω 5% (brown-green-red-gold).
- (✓) .1 μfd resin. Note marked end.
- (✓) 33 KΩ (orange-orange-orange).
- (✓) 180 μh peaking coil #40-488 (brown-gray-brown).
- (✓) 3300 Ω (orange-orange-red).
- (✓) .01 μfd resin. Note marked end.
- (✓) 1 megohm (brown-black-green).
- (✓) 1 megohm (brown-black-green).
- (✓) 22 KΩ (red-red-orange).
- (✓) .005 μfd disc.
- (✓) .005 μfd disc.
- (✓) 390 KΩ (orange-white-yellow).
- (✓) Solder all connections and cut off excess leads.

PROCEED TO PICTORIAL 1-8

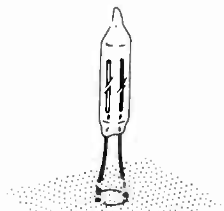
START

NOTE: Solder the connections of each part or wire as it is installed. Do not cut off the pins of the coils, transformers, or switch.

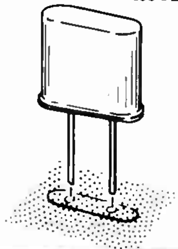
(✓) Install 7-pin tube sockets at V404, V405, and V406.

(✓) Install 9-pin tube sockets at the remaining seven tube socket locations.

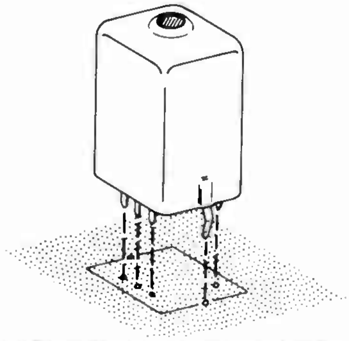
(✓) Neon lamp. After soldering cut off the excess leads.



(✓) 3579.545 kc crystal. Board is lettered 3.58 mc. After soldering, cut off the excess leads.

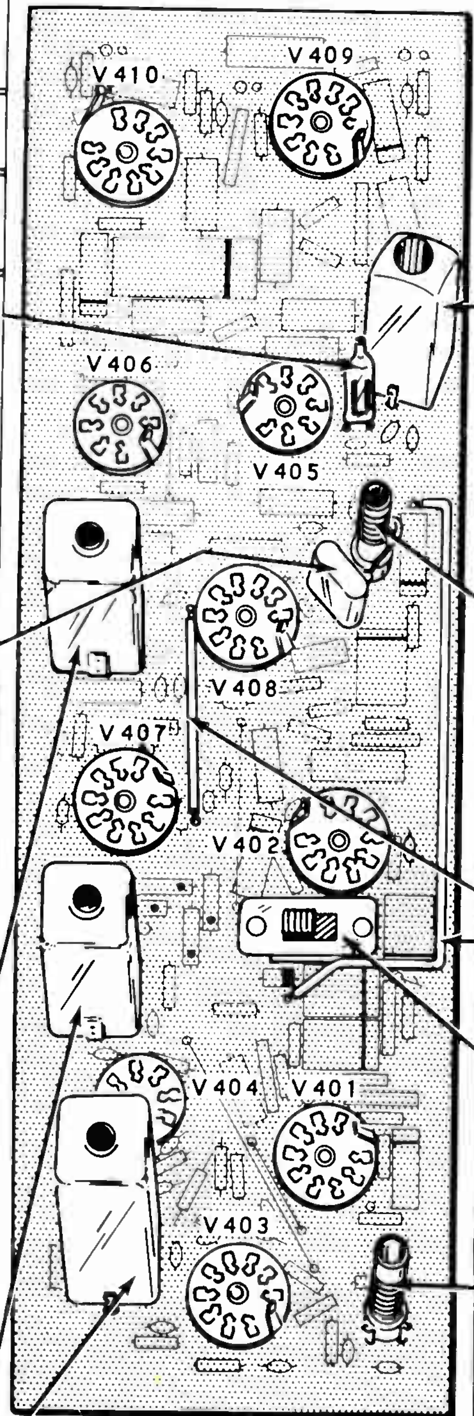


(✓) 3.58 megacycle coupling transformer (#52-77).



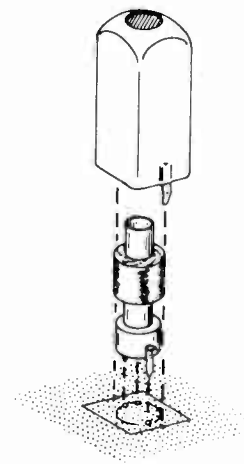
(✓) Burst phase transformer (#52-75).

(✓) Color bandpass transformer (#52-76).

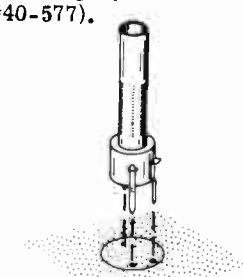


CONTINUE

(✓) Dot generator coil (#40-585) and coil shield (#206-207).



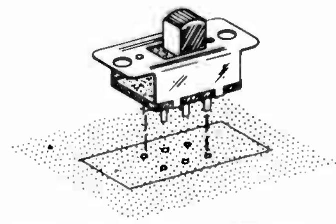
(✓) 3.58 megacycle reactance coil (#40-577).



(✓) 2-1/2" blue wire.

(✓) 7" blue wire.

(✓) DPDT slide switch (#60-21).



(✓) Color amplifier plate coil (#40-578).

(✓) Check to see that all connections are soldered and cut off only the excess neon lamp and crystal leads.

FINISH

Set the circuit board aside temporarily. Proceed to Page 18.

PICTORIAL 1-8

CONVERGENCE CIRCUIT BOARD

PARTS LIST

Unpack pack #3 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers in the Parts Pictorial (fold-out from Page 19).

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
(1) 1-1	1	47 Ω 1/2 watt (yellow-violet-black)
(2) 1-15-1	1	47 Ω 1 watt (yellow-violet-black)
1-17-1	2	100 Ω 1 watt (brown-black-brown)
1-18-1	1	150 Ω 1 watt (brown-green-brown)
1-54-1	1	270 Ω 5% 1 watt (red-violet-brown-gold)
CAPACITORS		
(3) 27-54	2	.082 μfd resin
27-28	2	.1 μfd resin
27-55	1	.15 μfd resin
27-56	1	.27 μfd resin
(4) 25-44	1	25 μfd electrolytic

PART No.	PARTS Per Kit	DESCRIPTION
CONTROLS		
(5) 11-56	3	60 Ω (white knob)
11-66	1	60 Ω (gray knob)
11-57	2	120 Ω (black knob)
11-59	2	150 Ω (blue knob)
11-67	1	500 Ω (yellow knob)
COILS		
(6) 40-736	1	Convergence
(7) 40-738	1	Convergence
(8) 40-739	1	Convergence
(9) 40-737	1	Convergence
MISCELLANEOUS		
(10) 57-43	1	4-section selenium diode
85-147-2	1	Convergence circuit board
(11) 262-8	2	Terminal pin

STEP-BY-STEP ASSEMBLY

(V) Position the convergence circuit board as shown in Pictorial 1-9. Complete each step on the Pictorial.

START

NOTE: Solder the connections of each part as it is installed. Cut off only the excess resistor and capacitor leads.

(✓) 47 Ω 1 watt (yellow-violet-black).

(✓) 100 Ω 1 watt (brown-black-brown).

(✓) .15 μfd resin. Note marked end.

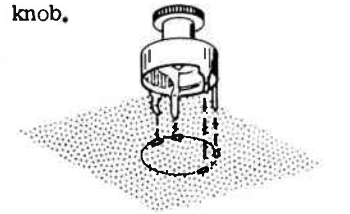
(✓) 100 Ω 1 watt (brown-black-brown).

(✓) .1 μfd resin. Note marked end.

(✓) 4-section selenium rectifier (#57-43).

(✓) 270 Ω 5% 1 watt (red-violet-brown-gold).

(✓) 120 Ω control (#11-57) black knob.



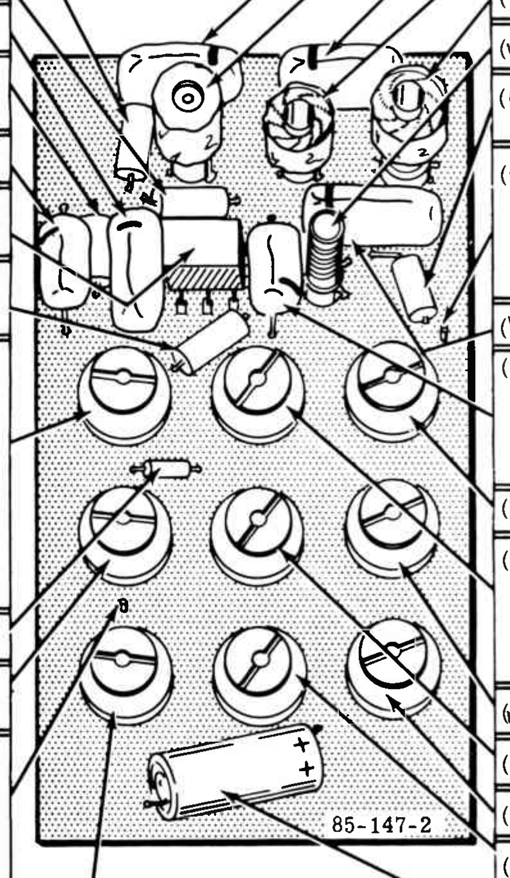
(✓) 47 Ω (yellow-violet-black).

(✓) 120 Ω control (#11-57) black knob.

(✓) Install and solder a terminal pin at H on the foil side of the circuit board. Cut off the excess on the lettered side of the circuit board.

FOIL SIDE OF CIRCUIT BOARD

( ) 500 Ω control (#11-67) yellow knob.



PICTORIAL 1-9

CONTINUE

(✓) .082 μfd resin. Note marked end.

(✓) Convergence coil (#40-737).

(✓) .082 μfd resin. Note marked end.

(✓) Convergence coil (#40-738).

(✓) Convergence coil (#40-739).

(✓) Convergence coil (#40-736).

(✓) 150 Ω 1 watt (brown-green-brown).

(✓) Install and solder a terminal pin at G on the foil side of the circuit board. Cut off the excess on the lettered side of the circuit board.

(✓) .27 μfd resin. Note marked end.

(✓) .1 μfd resin. Note marked end. NOTE: Do not push the capacitor down against the circuit board or the coil may be damaged.

(✓) 60 Ω control (#11-66) gray knob.

(✓) 150 Ω control (#11-59) blue knob. Position this control with all four lugs connected to circuit board foils. Do not use the two holes without foils.

(✓) 60 Ω control (#11-56) white knob.

(✓) 150 Ω control (#11-59) blue knob.

(✓) 60 Ω control (#11-56) white knob.

(✓) 60 Ω control (#11-56) white knob.

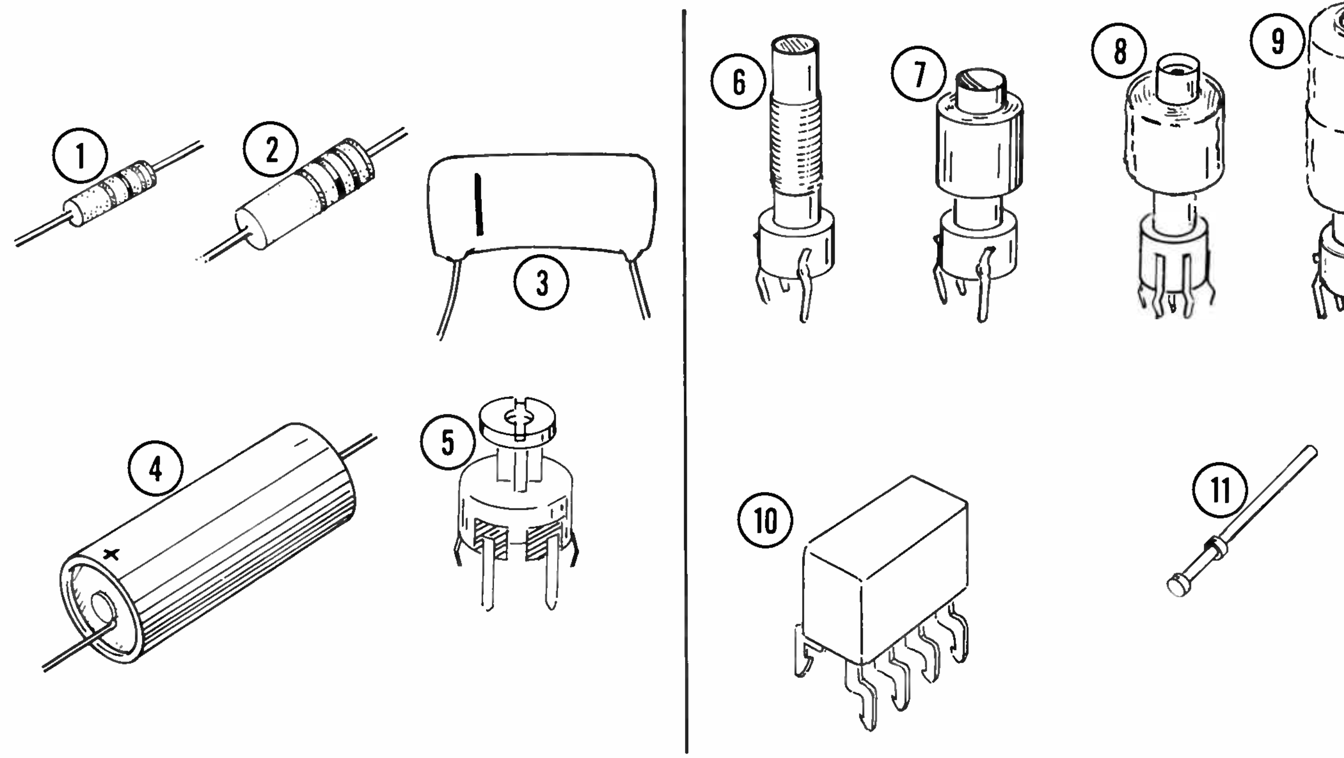
(✓) 25 μfd electrolytic. Position the lead from the (+) end in the (+) marked hole of the circuit board.

(✓) Check to see that all connections are soldered, and cut off only the excess resistor and capacitor leads.

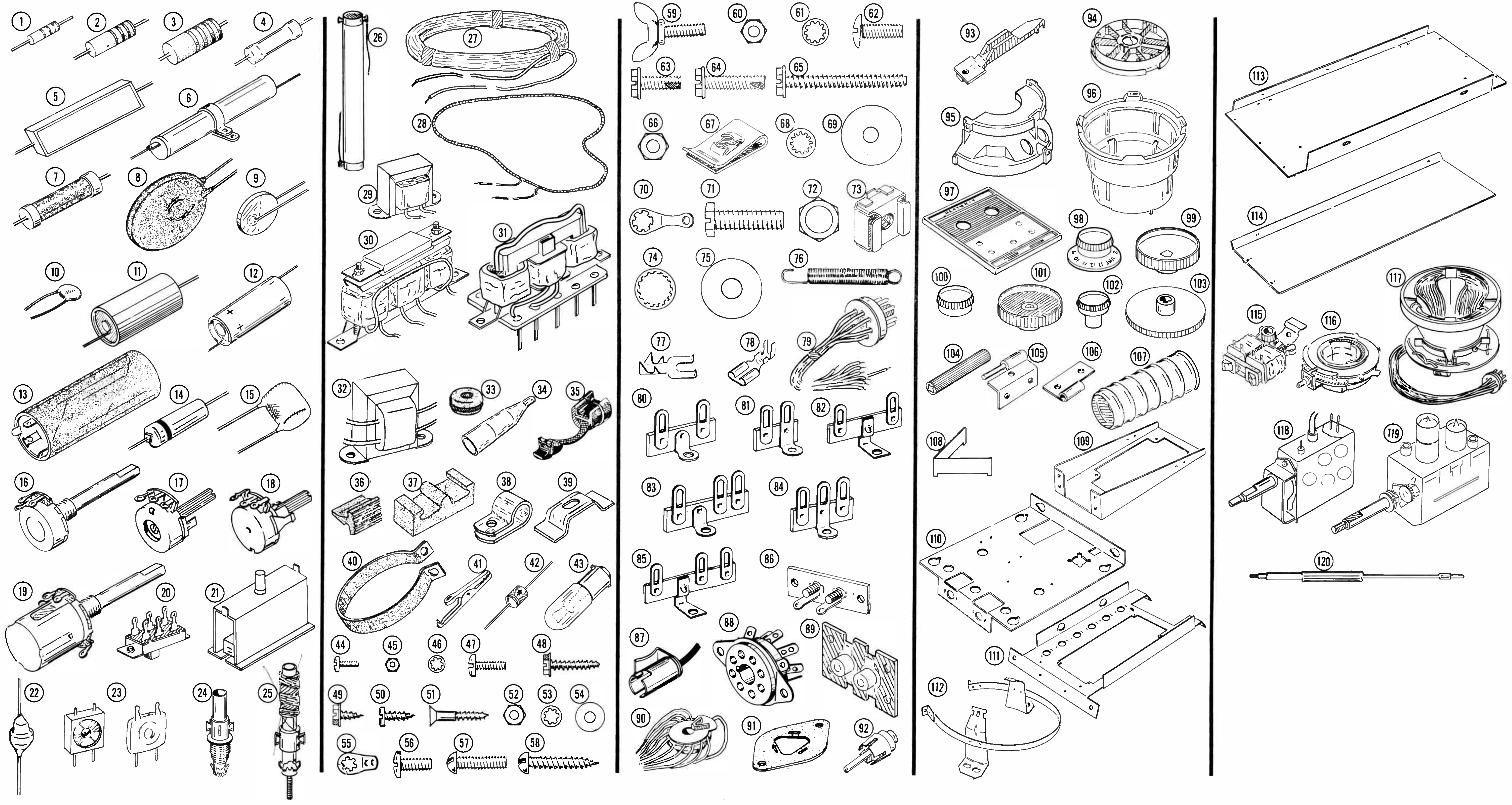
FINISH

Set the circuit board aside temporarily. Proceed to Page 21.

CONVERGENCE CIRCUIT BOARD PARTS PICTORIAL



CHASSIS PARTS PICTORIAL



CHASSIS

This section of the Manual contains a Parts List and the Step-By-Step Assembly instructions for the chassis.

PARTS LIST

Unpack pack #4 and all remaining parts; then check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Parts Pictorial (fold-out from Page 20).

The large parts that are not packed in bags, such as the chassis, picture tube, etc., should be set aside until they are called for in the assembly instructions.

NOTE: Do not remove the picture tube from its carton until you are ready to install it.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1) 1-129	1	4.7 Ω (yellow-violet-gold)
1-3	4	100 Ω (brown-black-brown)
1-66	1	150 Ω (brown-green-brown)
1-112	1	180 Ω 5% (brown-gray-brown-gold)
1-45	1	220 Ω (red-red-brown)
1-4	1	330 Ω (orange-orange-brown)
1-9	3	1000 Ω (brown-black-red)
1-44	1	2200 Ω (red-red-red)
1-73	1	8200 Ω (gray-red-red)
1-21	1	15 KΩ (brown-green-orange)
1-26	1	100 KΩ (brown-black-yellow)
1-27	1	150 KΩ (brown-green-yellow)
1-126	1	180 KΩ (brown-gray-yellow)
1-29	1	220 KΩ (red-red-yellow)
1-33	1	470 KΩ (yellow-violet-yellow)
1-37	1	2.2 megohm (red-red-green)
Other Resistors-Thermistor		
(2) 1-8-1	1	68 KΩ 1 watt (blue-gray-orange)
(3) 1-17-2	1	6800 Ω 2 watt (blue-gray-red)
(4) 5-1-2	1	3900 Ω (3.9 K) 2 watt, film
5-3-2	1	47 KΩ 2 watt, film
5-3-3	1	1000 Ω (1 K) 3 watt, film
5-1-4	1	5600 Ω (5.6 K) 4 watt, film
5-2-4	1	39 KΩ 4 watt, film
(5) 3-13-7	1	6500 Ω 7 watt, wire-wound
3-7-10	1	10 KΩ (10000) 10 watt, wire-wound
3-8-10	1	15 KΩ 10 watt, wire-wound
(6) 3-10-25	1	750 Ω 25 watt, wire-wound
(7) 9-14	1	VDR (voltage dependent resistor)
(8) 9-15	1	VDR (voltage dependent resistor)
(9) 9-8	1	Thermistor
CAPACITORS		
Disc		
(10) 21-32	1	47 μμf
21-75	1	100 μμf
21-14	3	.001 μfd
21-36	1	.002 μfd
21-16	2	.01 μfd

PART No.	PARTS Per Kit	DESCRIPTION
Electrolytic		
(11) 25-75	1	5 μfd nonpolarized
(12) 25-44	1	25 μfd
25-36	1	40 μfd
25-28	1	100 μfd
(13) 25-139	1	160 μfd
25-141	1	80-50-10-20 μfd
25-140	1	160-30-10-10 μfd
Other Capacitors		
(14) 23-38	1	.0033 μfd tubular
23-45	1	.047 μfd 600 V tubular
23-56	1	.5 μfd tubular
(15) 27-34	1	.2 μfd resin (if this capacitor is color coded, refer to fold-out from Page 7)
CONTROLS		
(16) 10-186	1	500 Ω
10-184	1	1200 Ω (1.2 K)
10-187	1	5000 Ω (5 K)
10-185	1	100 KΩ
10-78	1	15 KΩ
(17) 11-68	1	2000 Ω (2 K) tab-mount
10-183	1	10 KΩ tab-mount
10-192	1	35 KΩ tab-mount
10-181	2	1 megohm tab-mount
10-191	1	1 megohm tab-mount
10-182	2	5 megohm tab-mount
(18) 10-193	1	6000 Ω (6 K) tab-mount, green shaft
10-188	1	6000 Ω (6 K) tab-mount, blue shaft
10-189	1	1.5 megohm tab-mount, red shaft
10-194	1	1.5 megohm tab-mount, green shaft
10-195	1	1.5 megohm tab-mount, blue shaft
(19) 19-100	1	2 megohm with SPST switch
SWITCHES-CIRCUIT BREAKER		
(20) 60-2	1	DPDT slide (6 lugs)
60-10	1	DPTT slide (8 lugs)
(21) 65-11	1	Circuit breaker
COILS		
(22) 40-598	1	100 μh peaking (brown-black-brown)
(23) 40-485	1	250 μh peaking (red-green-brown)
(24) 40-745	1	Pincushion phase

PART No.	PARTS Per Kit	DESCRIPTION
Coils (cont'd.)		
~~(25) 40-750~~	~~1~~	~~Width~~
(26) 41-1	1	Delay line
(27) 40-586	1	Degaussing
(28) 40-744	1	Automatic degaussing
CHOKE-TRANSFORMERS		
(29) 46-37	1	Filter choke
(30) 51-132	1	Top-bottom pincushion transformer
(31) 51-136	1	Side pincushion transformer
(32) 51-104	1	Audio output transformer
51-135	1	Vertical output transformer
54-149	1	Power transformer
GROMMETS-INSULATORS		
(33) 73-4	4	5/16" grommet
73-1	5	3/8" grommet
73-3	4	1/2" grommet
73-2	2	3/4" grommet
(34) 73-34	2	Test clip insulator
(35) 75-24	1	Line cord strain relief
(36) 261-24	4	Yoke mount rubber bumper
(37) 261-22	4	Picture tube rubber bumper
CLAMPS-CLIPS		
(38) 207-4	1	1/4" cable clamp
207-18	1	3/8" cable clamp
207-22	1	1/2" cable clamp
(39) 207-48	3	Yoke positioning clamp
(40) 207-47	1	Yoke mounting clamp
(41) 260-16	2	Small alligator clip
260-1	1	Large alligator clip

DIODE-PILOT LAMP-TUBES

NOTE: Some tubes may have the suffix A or B following the type number. Example: 6GF7A instead of 6GF7.

PART No.	PARTS Per Kit	DESCRIPTION
(42) 57-27	3	750 ma silicon diode, 500V PIV
(43) 412-1	2	#47 pilot lamp
411-170	1	6EW6 tube
411-177	1	6FQ7 tube
411-216	1	6GF7 tube
411-193	3	6GH8 tube
411-217	2	6GU7 tube
411-173	1	6GW8 tube
411-175	1	6HS8 tube
411-222	2	6HZ6 tube
411-195	1	6JU8 tube
411-237	1	12HG7 tube
411-213	1	25AP22A/25XP22

NOTE: Do not remove the picture tube from its carton until you are ready to install it.

PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE		
#3 Hardware		
(44) 250-49	20	3-48 x 1/4" screw
(45) 252-1	20	3-48 nut
(46) 254-7	20	#3 lockwasher
#6 Hardware		
(47) 250-89	60	6-32 x 3/8" screw
(48) 250-252	10	#6 x 5/8" bronze screw
(49) 250-365	4	#6 x 1/4" sheet metal screw
(50) 250-8	28	#6 x 3/8" sheet metal screw
(51) 250-290	2	#6 x 5/8" flat head wood screw
(52) 252-3	58	6-32 nut
(53) 254-1	74	#6 lockwasher
(54) 253-60	4	#6 flat washer
(55) 259-1	2	#6 solder lug
#8 Hardware		
(56) 250-137	6	8-32 x 3/8" screw
(57) 250-92	1	8-32 x 5/8" screw
(58) 250-35	3	#8 x 7/8" sheet metal screw
(59) 250-289	3	8-32 x 1/2" wing-head screw
(60) 252-4	4	8-32 nut
(61) 254-2	6	#8 lockwasher
#10 Hardware		
(62) 250-126	4	10-32 x 1/2" screw
(63) 250-255	10	10-24 x 1/2" self-tapping screw
(64) 250-264	8	10-24 x 3/4" self-tapping screw
(65) 250-261	2	#10 x 1-1/2" sheet metal screw
(66) 252-5	4	10-32 nut
(67) 252-54	2	#10 speednut
(68) 254-3	18	#10 lockwasher
(69) 253-19	8	#10 flat washer
(70) 259-5	4	#10 solder lug
Other Hardware		
(71) 250-253	4	1/4-20 x 7/8" screw
(72) 252-7	6	Control nut
(73) 252-67	4	1/4-20 self-retaining nut
(74) 254-5	6	Control lockwasher
(75) 253-31	4	1/4" flat washer
(76) 258-33	1	Coil spring
(77) 259-22	1	Spade lug
(78) 432-66	2	Terminal strip connector

WIRE-CABLE-SLEEVING

PART No.	PARTS Per Kit	DESCRIPTION
89-13	1	Line cord
340-2	1	Bare wire
344-52	1	Red hookup wire
344-53	1	Orange hookup wire
344-54	1	Yellow hookup wire
344-55	1	Green hookup wire
344-58	1	Gray hookup wire
344-59	1	White hookup wire
344-15	1	Black stranded wire
344-31	1	Brown stranded wire
343-6	1	Shielded cable
347-3	1	2-wire shielded cable
343-9	1	75 Ω coaxial cable
347-2	1	300 Ω twin lead
(79) 134-110	1	8-wire cable assembly with octal plug
134-129	1	12-wire cable assembly
134-166	1	Wiring harness
346-7	1	1/4" clear sleeving
346-6	2	3/8" fiberglas sleeving

TERMINAL STRIPS

PART No.	PARTS Per Kit	DESCRIPTION
(80) 431-2	2	Small 2-lug
(81) 431-14	1	Small 2-lug, 1 lug ground
(82) 431-41	1	Large 2-lug
(83) 431-3	2	Small 3-lug
(84) 431-10	1	Small 3-lug, center lug ground
(85) 431-43	2	Large 3-lug
431-5	2	Small 4-lug
431-42	3	Large 5-lug
431-45	1	Small 6-lug
431-35	1	Small 7-lug
(86) 431-54	1	2-lug screw type
431-68	1	4-lug screw type, VHF and UHF

SOCKETS-PLUG

PART No.	PARTS Per Kit	DESCRIPTION
(87)434-85	2	Pilot lamp socket
(88)434-39	2	Octal socket
(89)434-82	1	Double phono socket
(90)434-157	1	Picture tube socket and lead assembly
(91)481-4	1	Capacitor mounting wafer
(92)438-4	2	Phono plug

PLASTIC PARTS

PART No.	PARTS Per Kit	DESCRIPTION
(93)266-88	1	Plastic lever
(94)95-27	1	Pole piece holder
(95)95-28-1	1	Yoke half-shell

Plastic Parts (cont'd.)

PART No.	PARTS Per Kit	DESCRIPTION
(96)95-26	1	Yoke mount
(97)203-459	1	Control panel
210-30	1	Picture tube mask

KNOBS

PART No.	PARTS Per Kit	DESCRIPTION
(98)462-197	1	VHF channel selector
(99)462-202	1	VHF fine tuning
(100)462-198	1	UHF tuning
(101)462-271	1	UHF channel indicator
(102)462-200	5	Front panel
(103)462-224	2	Thumbwheel
(104)462-204	1	Focus

METAL PARTS

PART No.	PARTS Per Kit	DESCRIPTION
(105)265-10	2	Half hinge with pin
(106)265-11	2	Half hinge with 2 holes
(107)206-77	1	Small tube shield
206-206	4	Large tube shield
(108)206-263	1	Circuit board shield
(109)204-701	1	VHF tuner bracket
(110)204-887	1	Tuner bracket
(111)204-702-1	1	Convergence bracket
(112)100-581	2	Picture tube mounting assembly
(113)206-297	1	Left picture tube shield
206-301	1	Right picture tube shield
206-296	1	Top picture tube shield
206-300	1	Bottom picture tube shield
(114)206-298	1	Internal picture tube shield
200-534	1	Chassis

MISCELLANEOUS

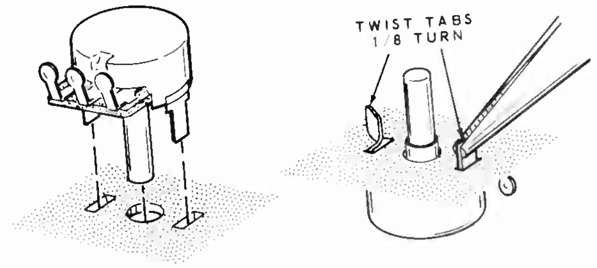
PART No.	PARTS Per Kit	DESCRIPTION
390-135	1	FCC certification label
390-173	1	Control panel label
330-11	18	Felt strip
(115)58-6	3	Pole piece assembly
(116)100-582	1	Blue lateral and purity assembly
(117)58-7	1	Deflection yoke
401-95	1	Speaker
(118)110-37	1	UHF tuner
(119)110-42	1	VHF tuner (packed with IF circuit board assembly, #100-685)
100-685	1	IF circuit board assembly
100-580	1	Horizontal output assembly
(120)490-1	1	Alignment tool
490-5	1	Plastic nut starter

STEP-BY-STEP ASSEMBLY

CONVERGENCE BRACKET ASSEMBLY

Refer to Pictorial 2-1 (fold-out from Page 25) for the following steps.

(✓) Position the convergence bracket as shown in the Pictorial.



Detail 2-1A

Refer to Detail 2-1A and mount the controls on the convergence bracket as directed in the following steps:

(✓) 2000 Ω (2 K) tab-mount control (#11-68) at CD.

(✓) 5 megohm tab-mount control (#10-182) at CE.

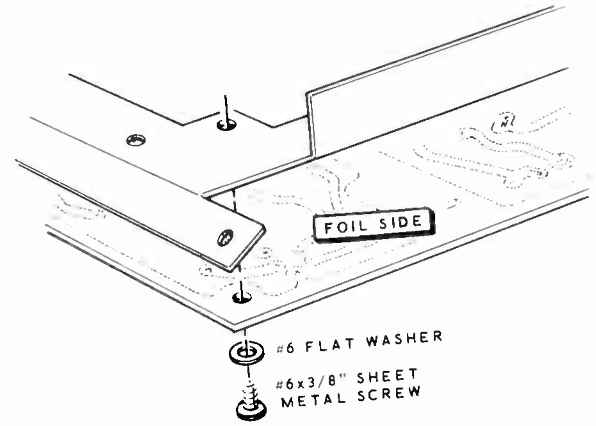
(✓) 10 KΩ tab-mount control (#10-183) at CF.

(✓) 1 megohm tab-mount control (#10-181) at CG.

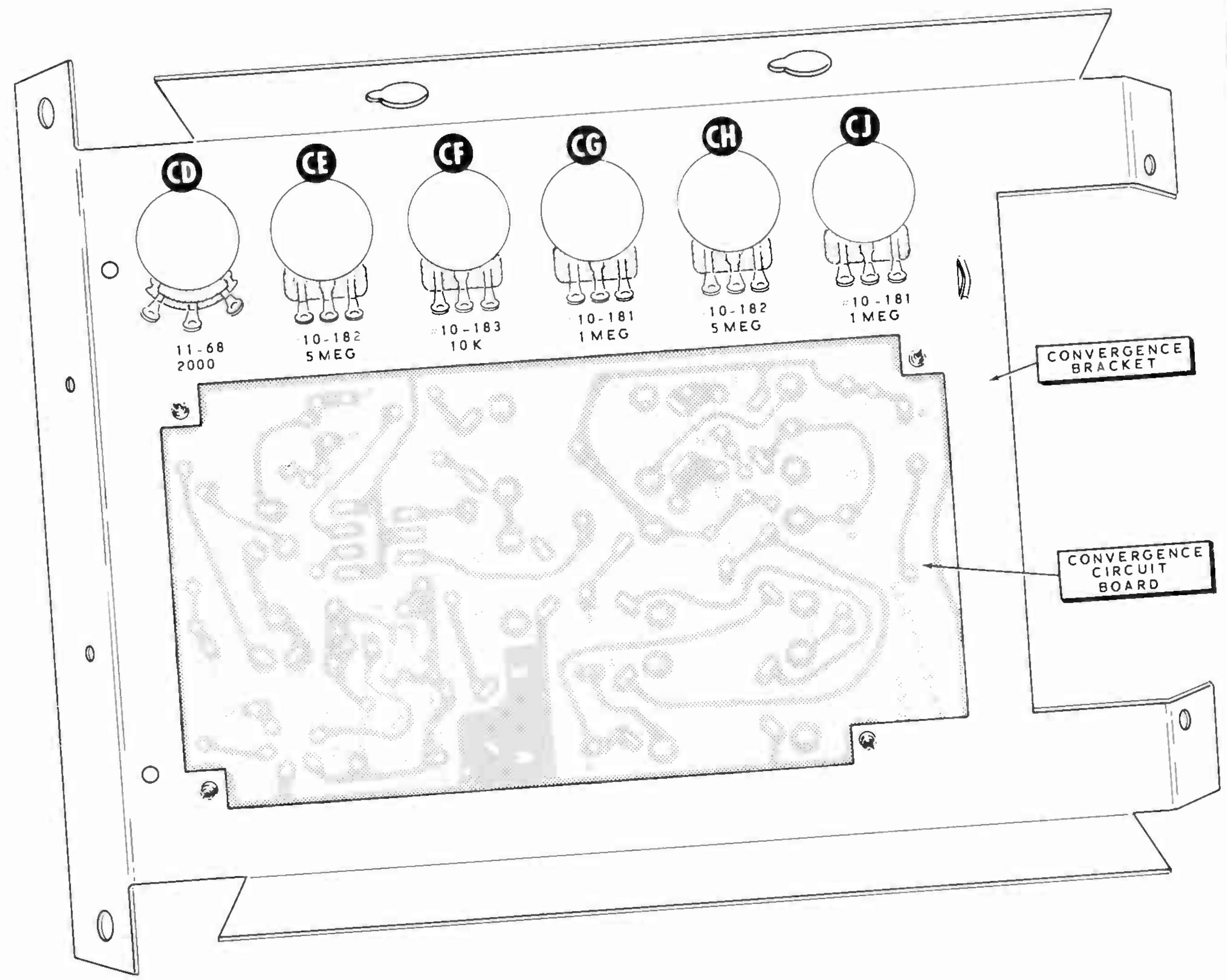
(✓) 5 megohm tab-mount control (#10-182) at CH.

(✓) 1 megohm tab-mount control (#10-181) at CJ.

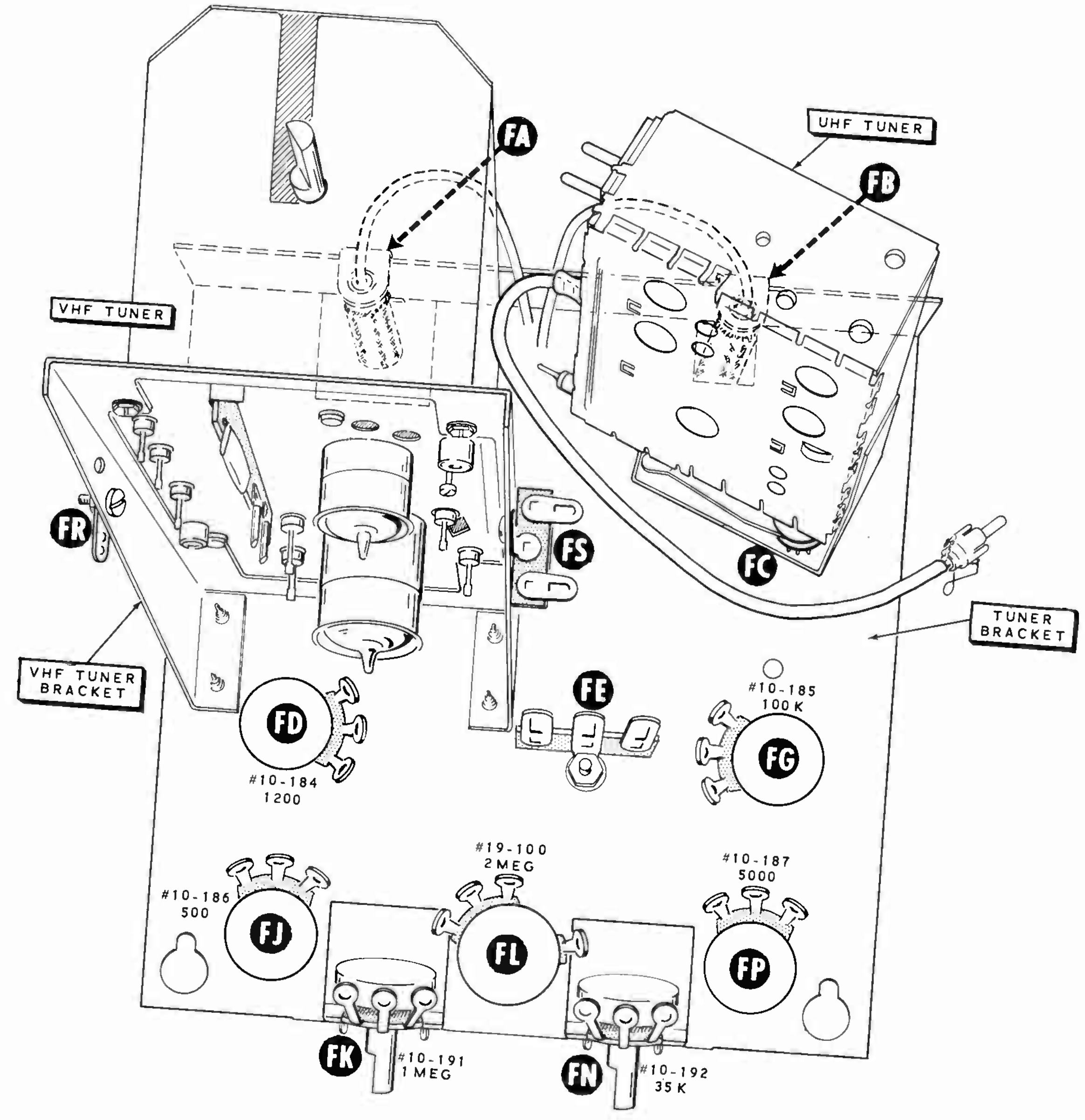
(✓) Refer to Detail 2-1B and mount the assembled convergence circuit board (#85-147-2) as shown in the Pictorial, with the foil side of the board next to the bracket. Use four #6 x 3/8" sheet metal screws and four #6 flat washers.



Detail 2-1B



PICTORIAL 2-1



PICTORIAL 2-4

Connect the wires of the 8-wire cable assembly (with octal plug) to the foil side of the convergence circuit board in the following steps. See Pictorial 2-2.

(√) Red to U (S-1).

NOTE: When connecting a wire to a terminal pin, the wire will be soldered even though more wires will be connected later. The solder instructions in each step indicate the number of wires connected to the terminal pin.

(√) Black to terminal pin G (S-1).

(√) Brown to D (S-1).

(√) Yellow to B (S-1).

(√) Gray to C (S-1).

(√) Red-white to E (S-1).

(√) Yellow-green to F (S-1).

(√) White to terminal pin H (S-1).

Refer to Pictorial 2-3 for the following steps.

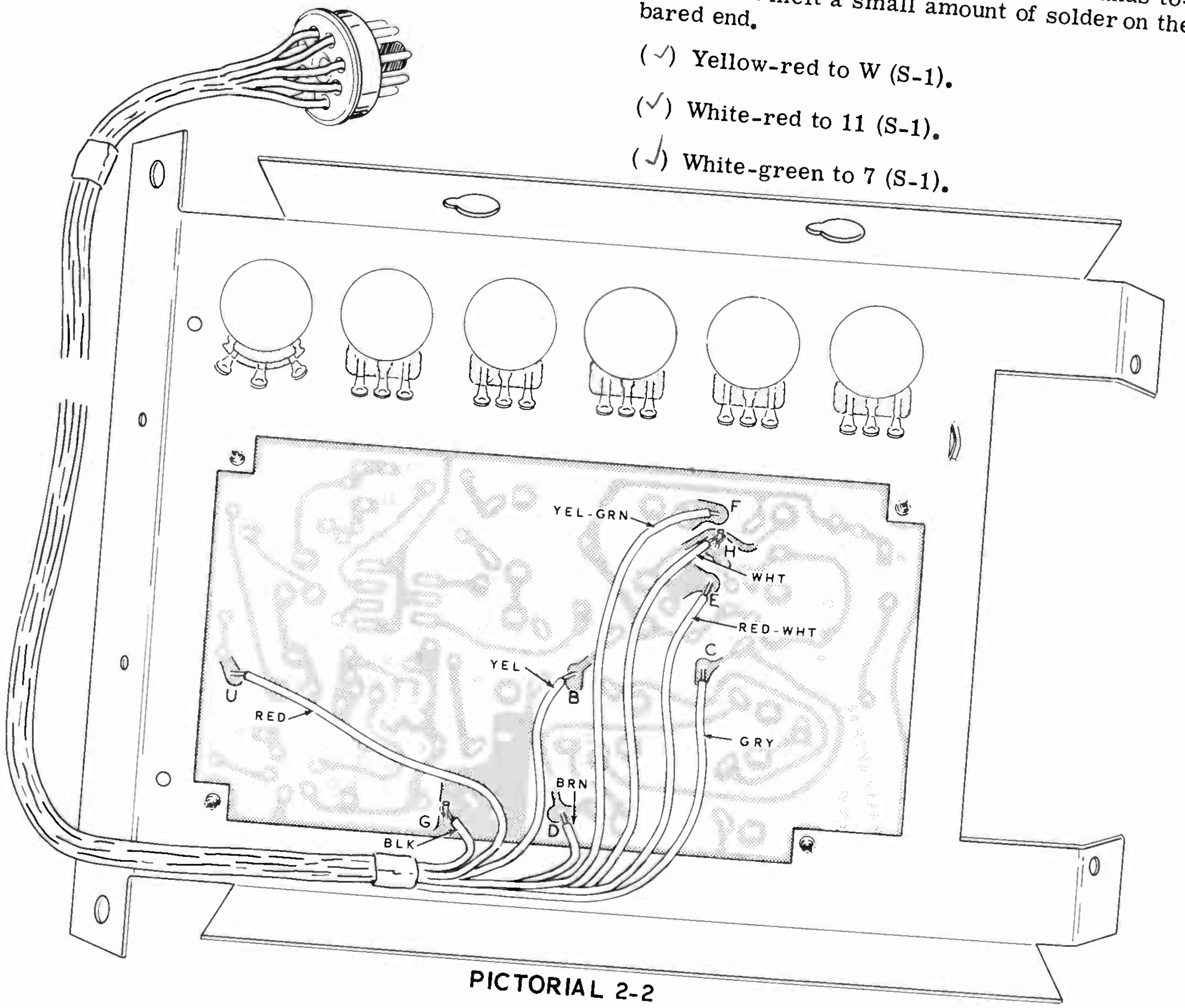
Connect the 12-wire cable assembly (#134-129) to the foil side of the convergence circuit board in the following steps. Use the end of the cable that does not have the three separate breakouts.

NOTE: Prepare each wire before connecting it to the circuit board. Twist the wire strands together and melt a small amount of solder on the bared end.

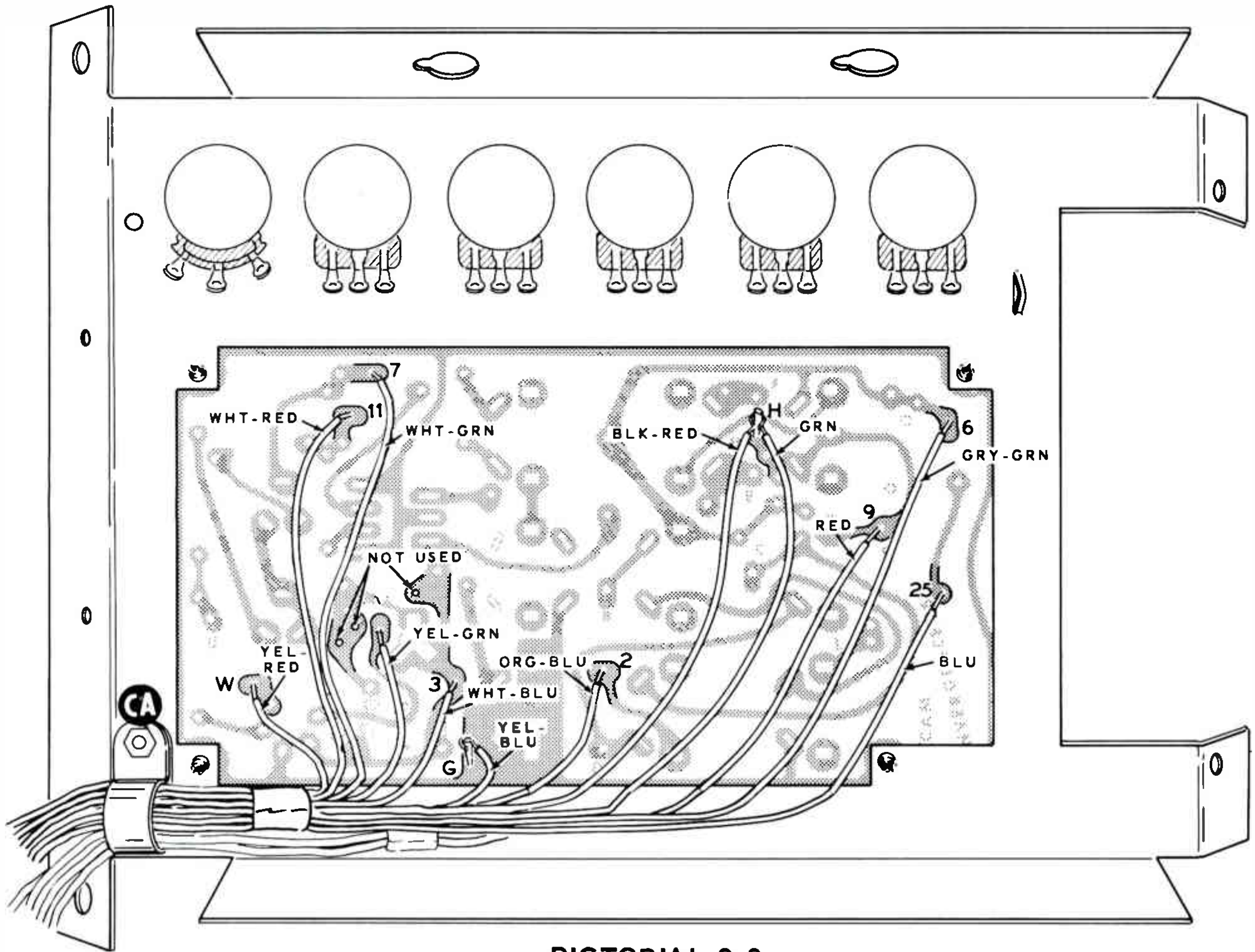
(√) Yellow-red to W (S-1).

(√) White-red to 11 (S-1).

(√) White-green to 7 (S-1).



PICTORIAL 2-2



PICTORIAL 2-3

(✓) Yellow-green to V (S-1). NOTE: Three holes near hole V are not used, as shown on the Pictorial.

(✓) White-blue to 3 (S-1).

(✓) Yellow-blue to terminal pin G (S-2).

(✓) Orange-blue to 2 (S-1).

(✓) Black-red to terminal pin H (S-2).

(✓) Green to terminal pin H (S-3).

(✓) Red to 9 (S-1).

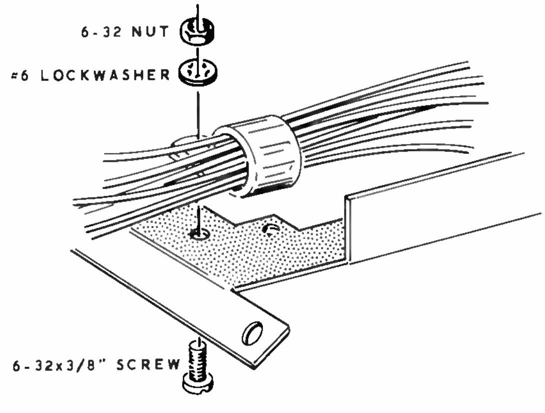
(✓) Blue to 25 (S-1).

(✓) Gray-green to 6 (S-1).

NOTE: The plastic nut starter will make it easier to hold 6-32 or 3-48 nuts and start them on the threads of a screw. Refer to the Tools section of the Kit Builders Guide.

(✓) Slip a 3/8" cable clamp over the 8-wire and 12-wire cable assemblies. Then mount the cable clamp at CA with a 6-32 x 3/8" screw, a #6 lockwasher, and a 6-32 nut as shown in Detail 2-3A.

Set the convergence bracket assembly aside until it is called for in a later step.



Detail 2-3A

TUNER BRACKET ASSEMBLY

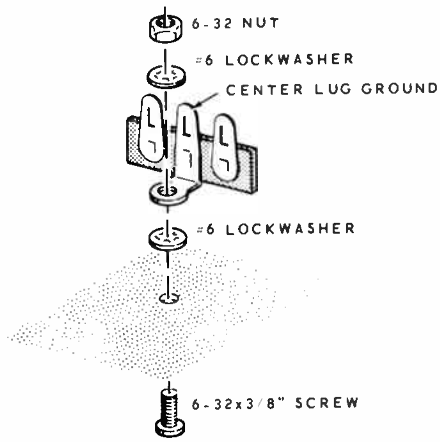
The term "hardware" will be used to refer to the screws, nuts, and lockwashers when parts are being mounted in some of the following steps. The phrase "Use 6-32 x 3/8" hardware," for example, means to use a 6-32 x 3/8" screw, one or more #6 lockwashers, and a 6-32 nut. Refer to the detail called out in the step for the correct number of lockwashers to use and the correct way to install the hardware.

NOTE: Two lockwashers will be used to mount terminal strips, one between the mounting surface and the mounting leg, and the other under the nut.

Refer to Pictorial 2-4 (fold-out from Page 26) for the following steps.

NOTE: It may be necessary to refer to the Parts List and Parts Pictorial (fold-out from Page 20) to identify terminal strips when they are called for in the following steps.

(✓) Position the tuner bracket as shown in the Pictorial.



Detail 2-4A

(✓) Refer to Detail 2-4A and mount a small 3-lug terminal strip, center lug ground (#431-10), at FE with 6-32 x 3/8" hardware.

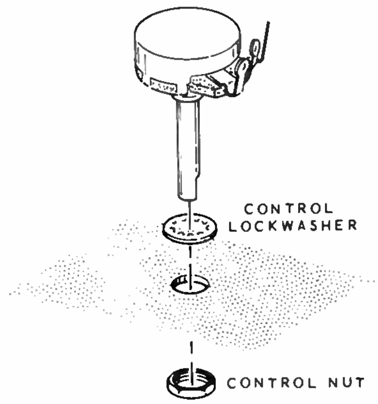
In the next five steps, mount the indicated control with a control lockwasher and a control nut as shown in Detail 2-4B. Position each control with its lugs as shown in Pictorial 2-4.

(✓) 1200 Ω (1.2 K) control (#10-184) at FD.

(✓) 500 Ω control (#10-186) at FJ.

(✓) 100 KΩ control (#10-185) at FG.

(✓) 5000 Ω (5 K) control (#10-187) at FP.

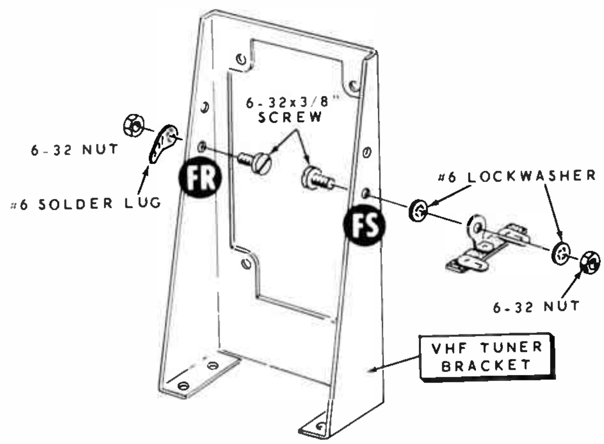


Detail 2-4B

(✓) 2 megohm control with SPST switch (#19-100) at FL.

(✓) Mount a 1 megohm tab-mount control (#10-191) at FK. Insert the mounting tabs in the slots and twist the tabs 1/8 turn.

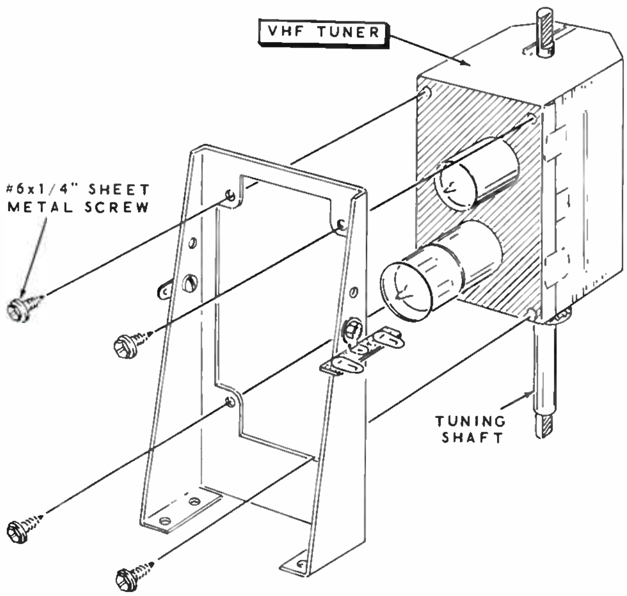
(✓) Similarly, mount a 35 KΩ tab-mount control (#10-192) at FN.



Detail 2-4C

(✓) Install a #6 solder lug at FR on the VHF tuner bracket, and position the solder lug as shown in Detail 2-4C. Use a 6-32 x 3/8" screw and a 6-32 nut.

(✓) Mount a small 2-lug terminal strip (#431-2) at FS and position the terminal strip as shown. Use 6-32 x 3/8" hardware.



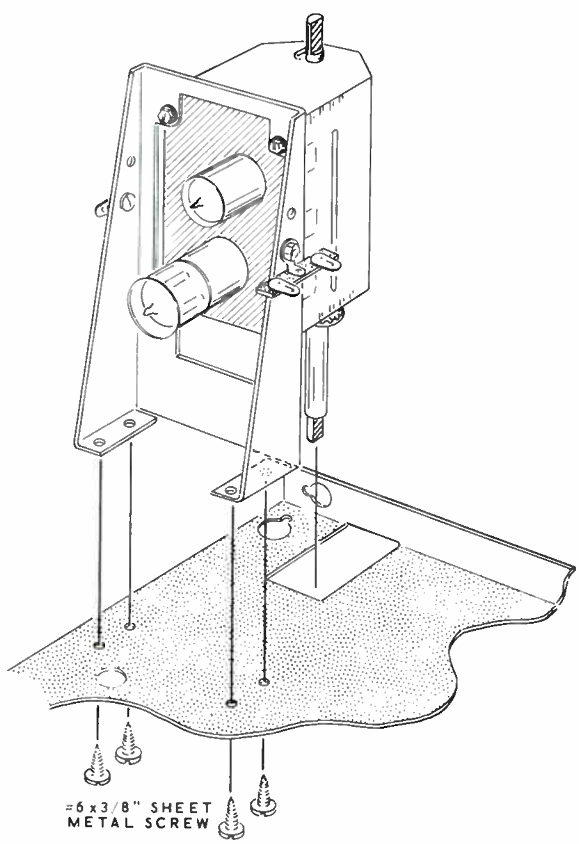
Detail 2-4D

NOTE: It may be necessary, in the next step, to separate the VHF tuner (#110-42) from the IF circuit board assembly by unplugging the coaxial cable from the tuner.

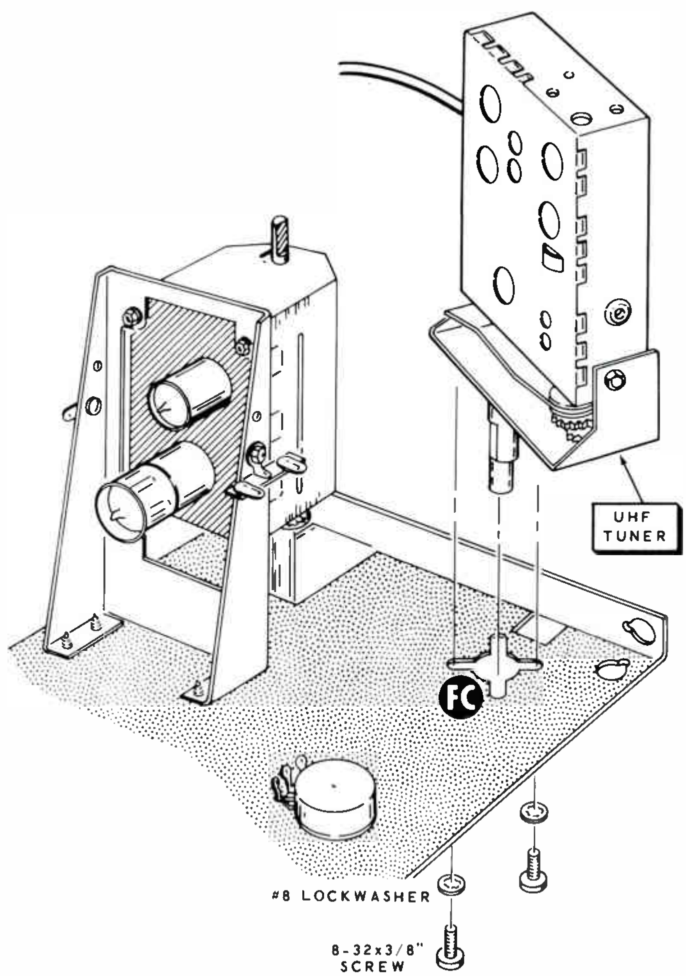
(✓) Refer to Detail 2-4D and mount the VHF tuner on the VHF tuner bracket with four #6 x 1/4" sheet metal screws. Position the VHF tuner with its tuning shaft as shown.

(✓) Mount the VHF tuner and bracket assembly on the tuner bracket as shown in Detail 2-4E. Use four #6 x 3/8" sheet metal screws.

(✓) Refer to Detail 2-4F and mount the UHF tuner (#110-37) at FC with 8-32 x 3/8" screws and #8 lockwashers. Position the tuner as shown.



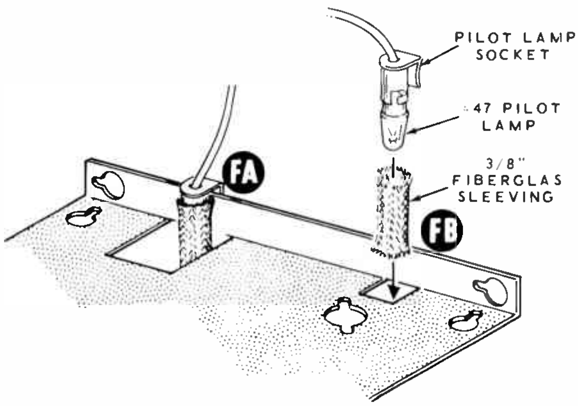
Detail 2-4E



Detail 2-4F

(✓) Install #47 pilot lamps in the two pilot lamp sockets.

(✓) Push a length of 3/8" fiberglas sleeving over each pilot lamp and socket until the sleeving is even with the end of the pilot lamp. Then clip the pilot lamp sockets on the tuner bracket at FA and FB as shown in Detail 2-4G. The leads on the pilot lamp sockets will be connected later.



Detail 2-4G

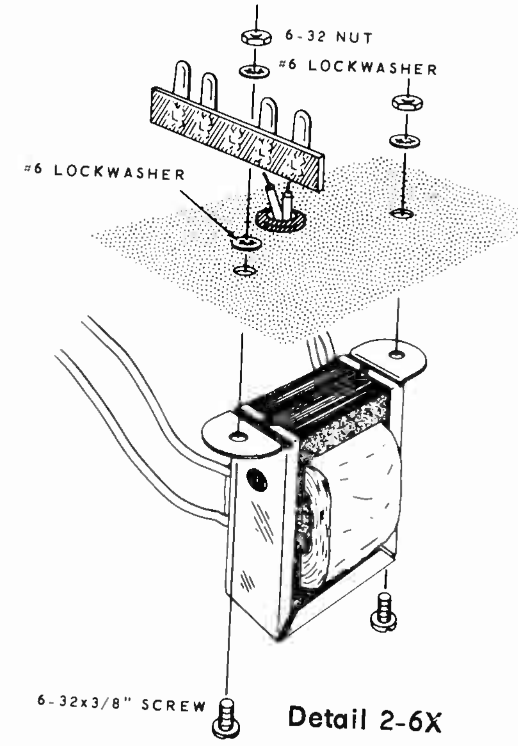
Refer to Pictorial 2-5 (fold-out from Page 31) for the following steps.

NOTE: Position all wires and parts as neatly as possible when wiring your TV Set. Many of the wires will be longer than required to reach their connecting points. The wires should therefore be positioned down against the chassis. Use square corners (bent 90 degrees) when positioning the wires to make the completed kit as neat as possible.

The leads of resistors, capacitors, and similar components should be cut to proper length before the part is installed. Refer to the Kit Builders Guide for general information on kit assembly; refer also to the Chassis Photographs on Page 173 through 178 which show a typically well-assembled TV Set.

(✓) Connect a 3-1/2" bare wire from lug 3 of control FK (S-1), through lug 1 of control FN (NS), to lug 1 of control FP (NS).

(✓) Connect a 2-1/2" bare wire from lug 2 of terminal strip FE (NS) to lug 1 of control FP (NS).



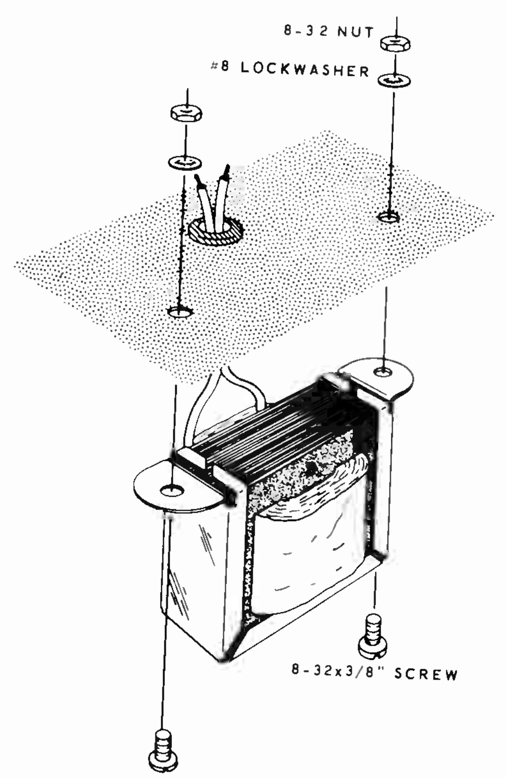
Detail 2-6X

( ) Mount the audio output transformer at TA and a small 4-lug terminal strip at BF with 6-32 x 3/8" hardware, as shown in Detail 2-6X. Position the transformer and terminal strip as shown. Insert only the black and green leads through grommet GK.

( ) Mount the filter choke (#46-37) at TD with 8-32 x 3/8" hardware as shown in Detail 2-6Y. Position the choke as shown, and insert the two leads through grommet GR.

NOTE: When mounting the circuit boards in the following steps, only the circuit board foils at the outer edges of each board should touch the chassis. If necessary, remove any excess solder from the other foil connections to keep them from touching the chassis.

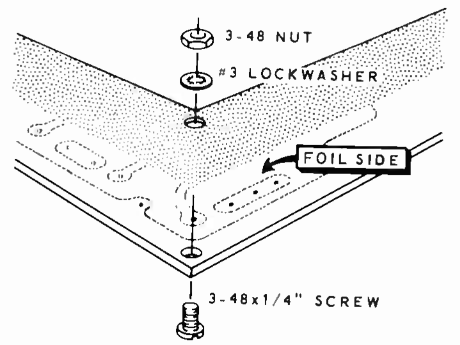
( ) Mount the assembled sound-sync circuit board #85-145-4 on top of the chassis with its foil pattern positioned as shown in the Pictorial. Use 3-48 x 1/4" hardware as shown in Detail 2-6Z.



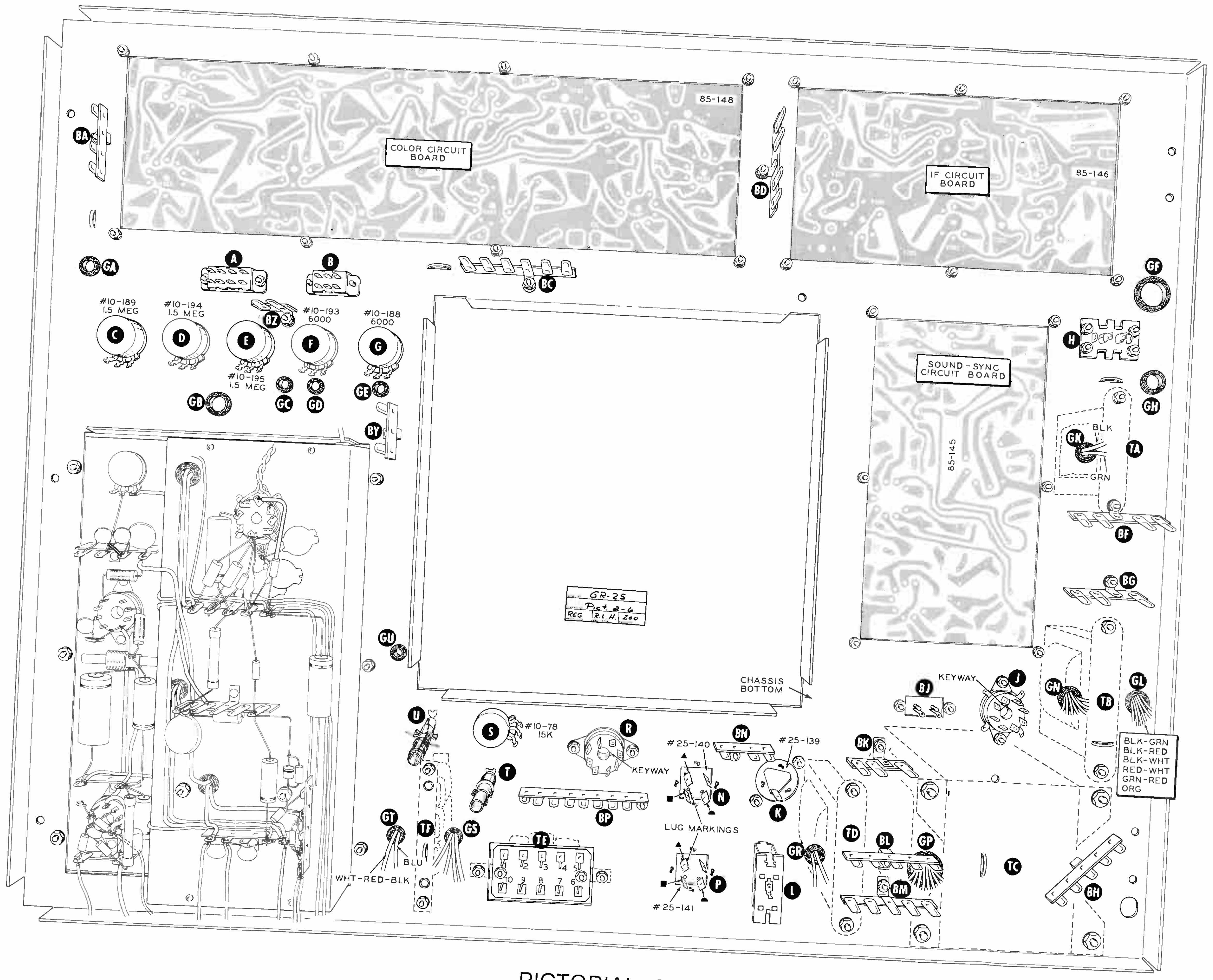
Detail 2-6Y

( ) Similarly, install the preassembled IF circuit board assembly (#100-685) with 3-48 x 1/4" hardware. NOTE: The foil side of this circuit board is marked 85-146.

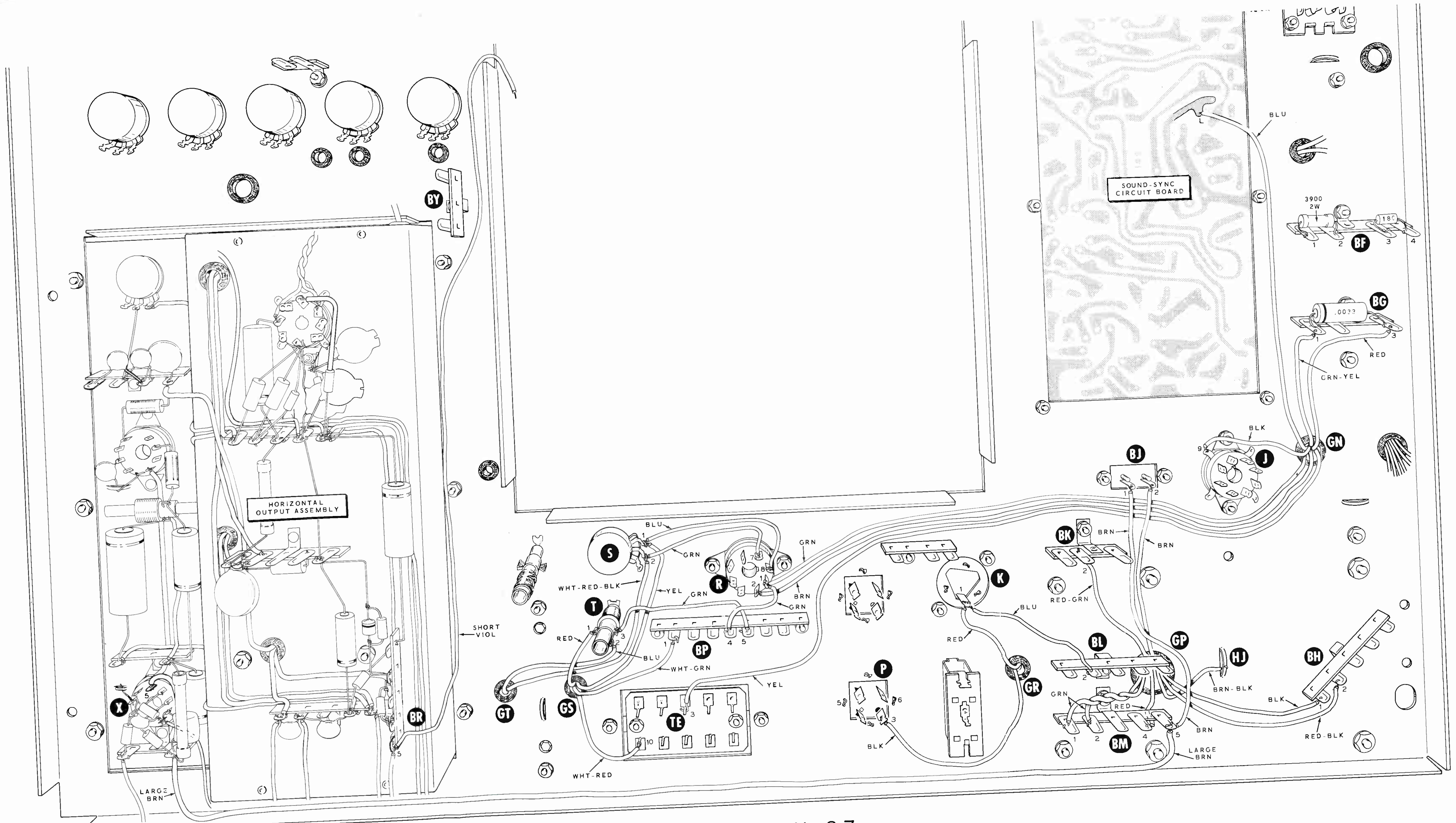
( ) Install the assembled color circuit board (#85-148-7) with 3-48 x 1/4" hardware.



Detail 2-6Z



PICTORIAL 2-6



PICTORIAL 2-7

CHASSIS BOTTOM WIRING

NOTE: Position all wires and parts as neatly as possible when wiring your TV Set. Many of the wires will be longer than required to reach their connecting points. The wires should therefore be positioned down against the chassis. Use square corners (bent 90 degrees) when positioning the wires to make the kit as neat as possible. Look at the horizontal output assembly for examples of proper parts mounting and soldering.

To simplify the wiring, the following Pictorials show only the upper or the lower section of the chassis.

For the following steps, refer to Pictorial 2-7, which shows the preliminary wiring of the lower chassis section.

Connect the vertical output transformer leads coming from grommet GN in the following steps:

(✓) Black to ground lug 9 of socket J (S-1).

(✓) Yellow to lug 3 of transformer TE (NS).

(✓) Brown to lug 2 of socket R (NS).

(✓) Green to lug 1 of socket R (NS).

(✓) Green-yellow to lug 1 of terminal strip BG (NS).

(✓) Red to lug 3 of terminal strip BG (NS).

NOTE: When connecting wires to the circuit board foils, it may be easier to solder the connections with the circuit board and chassis laying down. This may stop the melted solder from flowing away from the connection or prevent shorted foils.

(✓) Blue to hole L of the sound-sync circuit board (S-1).

Connect the power transformer leads coming from grommet GP in the following steps:

(✓) Brown-black to chassis tab HJ (S-1).

(✓) Black to lug 1 of terminal strip BH (NS).

(✓) Red-black to lug 2 of terminal strip BH (NS).

(✓) Red to lug 4 of terminal strip BM (NS).

(✓) Red-green to the eyelet (lower hole) in lug 2 of terminal strip BK (NS).

(✓) Brown to lug 2 of terminal strip BJ (S-1).

(✓) Twist the two green power transformer leads together. Connect one green lead to lug 1 (NS) and the other green lead to lug 2 (NS) of terminal strip BM.

Connect the filter choke leads coming from grommet GR in the next two steps.

(✓) Red to lug 1 of capacitor K (NS).

(✓) Black to lug 3 of capacitor P (NS).

(✓) Solder mounting lug 5 of capacitor P to the chassis (S-1).

Connect the top-bottom pincushion transformer leads coming from grommet GT in the next two steps.

(✓) White-red-black to lug 2 of control S (NS).

(✓) Blue to lug 2 of coil T (S-1).

Connect the top-bottom pincushion transformer leads coming from grommet GS in the following steps:

(✓) Yellow to lug 1 of control S (NS).

(✓) White-green to lug 1 of terminal strip BP (NS).

(✓) White-red to lug 10 of transformer TE (NS).

(✓) Red to lug 1 of coil T (S-1).

(✓) Separate the wires that come from the horizontal output assembly. Do not untwist the two green wires connected to socket Y.

(✓) Connect the large brown wire, coming from lug 5 of socket X on the horizontal output assembly, to lug 5 of terminal strip BM (NS). Position the wire as shown.

NOTE: Use only 1/2 watt resistors in all steps unless larger wattage resistors are specifically called for.

(✓) Connect a 2.2 megohm (red-red-green) resistor from lug 1 of terminal strip FE (NS) to lug 3 of control FG (NS).

(✓) Connect a 220 KΩ (red-red-yellow) resistor from lug 3 of terminal strip FE (NS) to lug 4 of control FL (NS).

(✓) Connect a .002 μfd disc capacitor from lug 2 (NS) to lug 3 (S-2) of terminal strip FE.

NOTE: When connecting a lead with sleeving on it, before soldering the connection, be sure the sleeving is not pushed into the connecting lug. This will allow the solder to flow into the connection.

(✓) Place 3/4" of small sleeving on each lead of a 15 KΩ (brown-green-orange) resistor. Then connect this resistor from lug 1 of control FG (S-1) to lug 1 of control FP (S-3).

(✓) Place 1/2" of small sleeving on each lead of a 47 μμf disc capacitor. Then connect the capacitor from lug 3 (NS) to lug 4 (S-2) of control FL.

(✓) Connect a 100 μμf disc capacitor from lug 2 (NS) to lug 3 (NS) of control FP.

(✓) Connect a 100 Ω (brown-black-brown) resistor from lug 2 (S-1) to lug 3 (NS) of the VHF tuner.

NOTE: When wire is called for, use the color of hookup wire specified in the step. Do not use stranded wire, shielded cable, or the degaussing coil until they are specifically called for.

(✓) Connect a 5" brown wire from lug 6 of the VHF tuner (S-1) to lug 2 of terminal strip FS (NS).

(✓) Connect the free end of the lead from pilot lamp socket FA to lug 1 of terminal strip FS (NS).

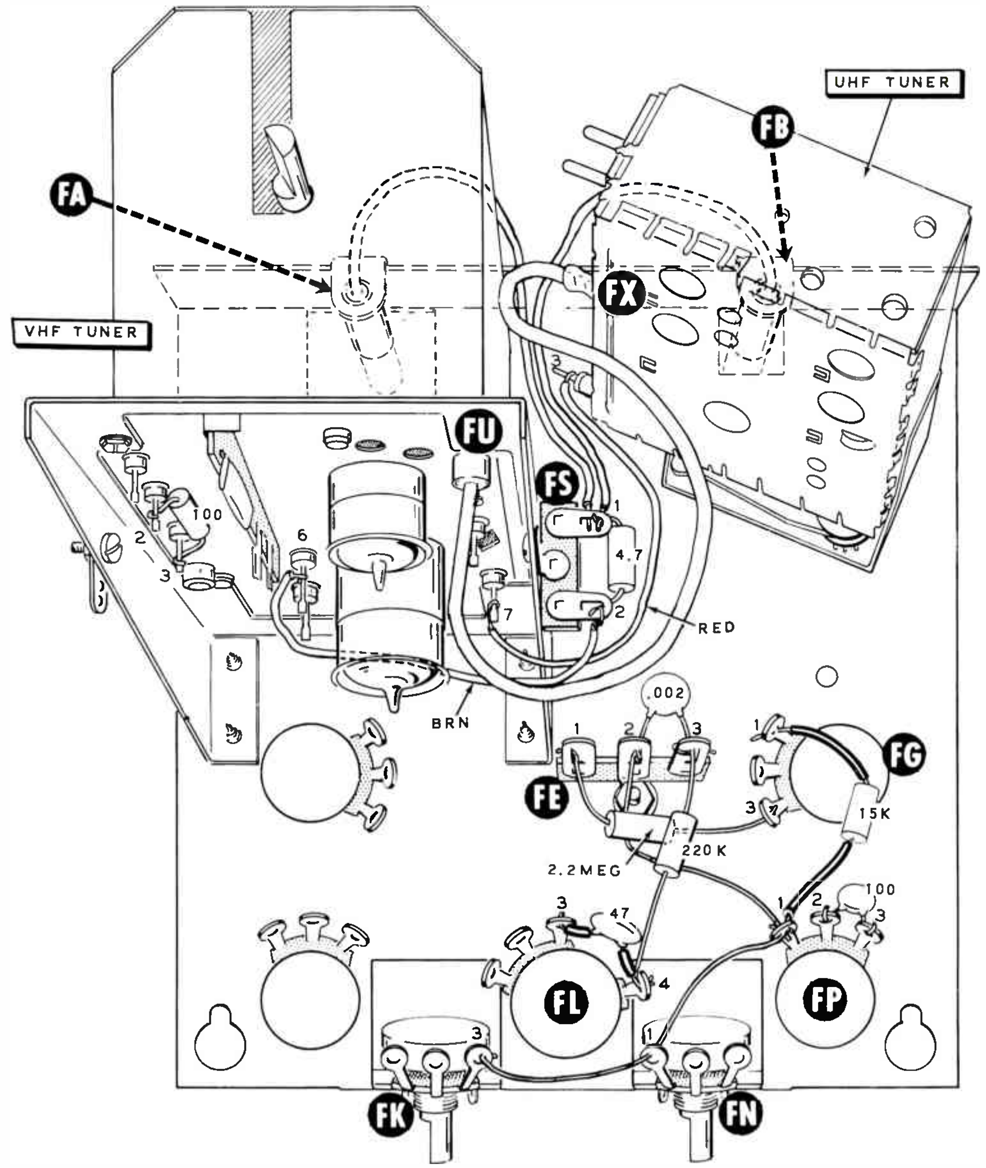
(✓) Connect the free end of the lead from pilot lamp socket FB to lug 1 of terminal strip FS (NS).

(✓) Connect a 4.7 Ω (yellow-violet-gold) resistor from lug 1 (S-3) to lug 2 (NS) of terminal strip FS.

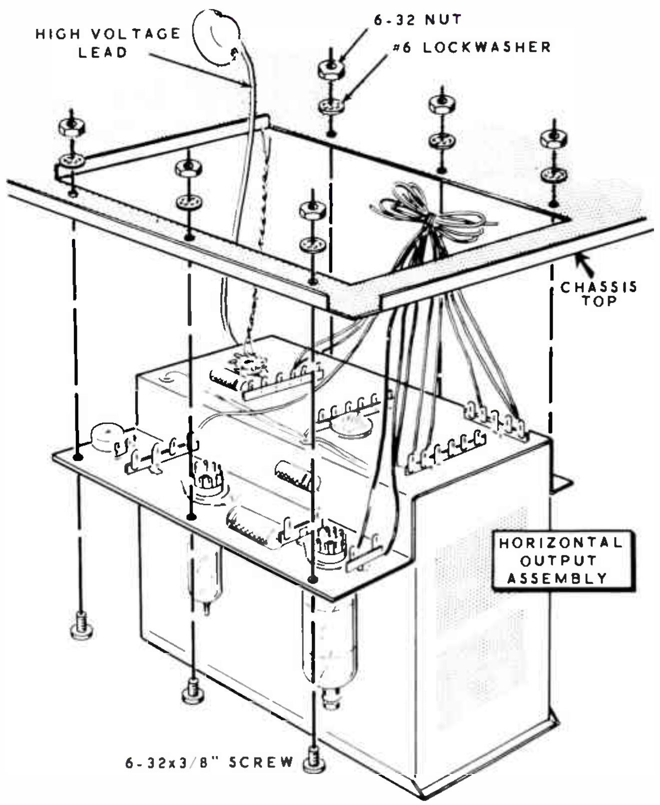
(✓) Connect a 6" red wire from lug 7 of the VHF tuner (S-1) to lug 3 of the UHF tuner (S-1).

(✓) Plug the end of the coaxial cable coming from FX of the UHF tuner into socket FU of the VHF tuner.

Set the tuner bracket assembly aside until called for later.



PICTORIAL 2-5



Detail 2-6G

CHASSIS PARTS MOUNTING

Refer to Pictorial 2-6 (fold-out from Page 37) for the following steps.

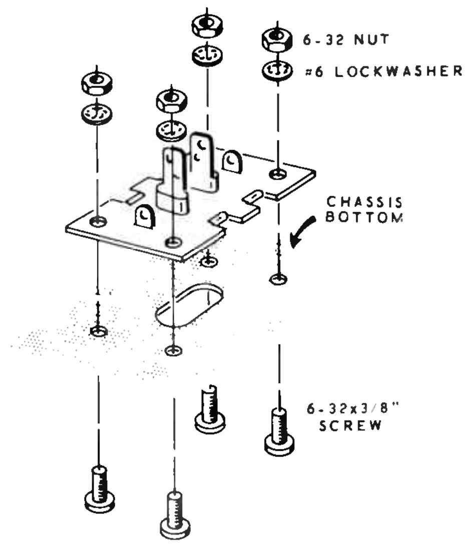
(✓) Install 3/8" grommets in holes GA, GK, GR, GS, and GT of the chassis.

(✓) Install 5/16" grommets at GC, GD, GE, and GU.

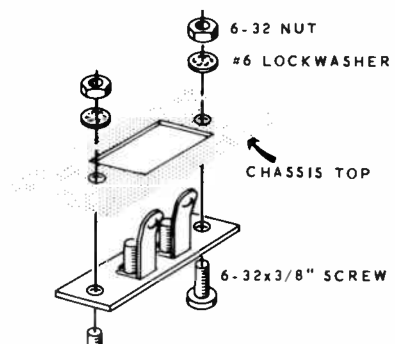
(✓) Install 1/2" grommets at GB, GH, GL, and GN.

(✓) Install 3/4" grommets at GF and GP.

(✓) Refer to Detail 2-6A and mount a double phono socket at H with 6-32 x 3/8" hardware.

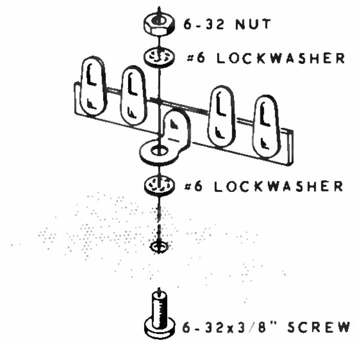


Detail 2-6A



Detail 2-6B

(✓) Mount a 2-lug screw type terminal strip at BJ from the top of the chassis as shown in Detail 2-6B. Use 6-32 x 3/8" hardware.



Detail 2-6C

Mount the terminal strips on the bottom of the chassis at the locations called out in the following steps. Refer to the Pictorial to identify and position each terminal strip. Use 6-32 x 3/8" hardware as shown in Detail 2-6C. NOTE: It may be necessary to refer to the Parts List and to the Parts Pictorial (fold-out from Page 20) to identify the terminal strips.

(✓) Small 4-lug terminal strip at BD.

(✓) Small 3-lug terminal strips at BG and BN.

(✓) Large 5-lug terminal strips at BH, BL, and BM.

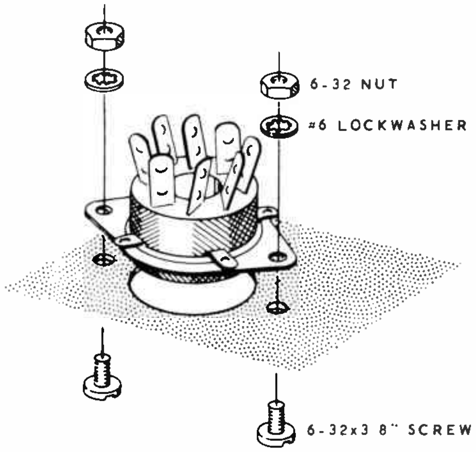
(✓) Large 3-lug terminal strips at BA and BK.

(✓) Small 7-lug terminal strip at BP. Use 6-32 x 3/8" hardware for each mounting foot.

(✓) Large 2-lug terminal strip at BY.

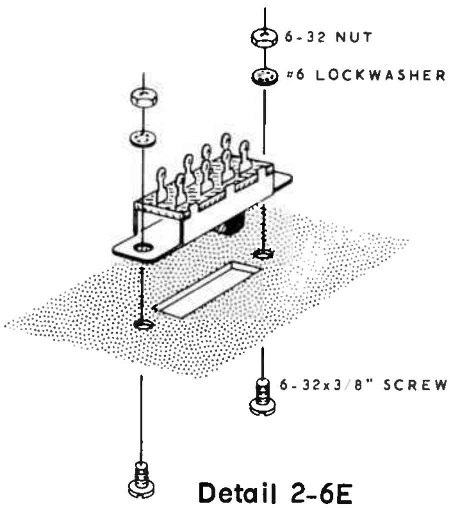
(✓) Small 2-lug (1 lug ground) terminal strip at BZ.

(✓) Small 6-lug terminal strip at BC.



Detail 2-6D

(✓) Refer to Detail 2-6D and mount octal sockets at J and R with 6-32 x 3/8" hardware. Position each socket with the keyway as shown in the Pictorial.

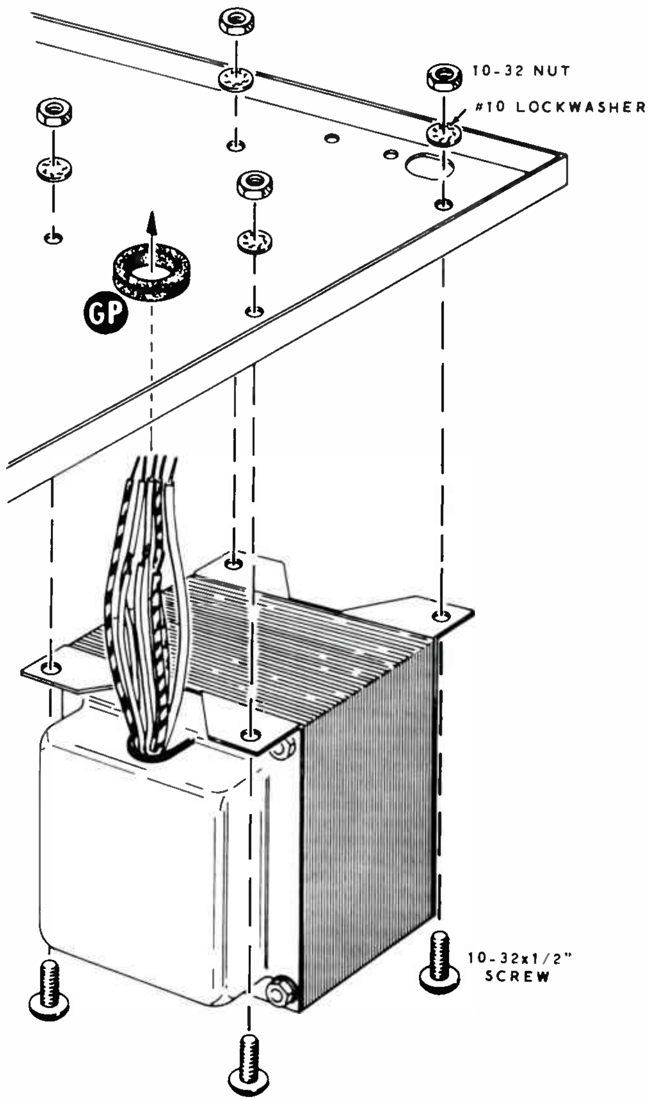


Detail 2-6E

(✓) Mount the DPTT slide switch (#60-10) at A with 6-32 x 3/8" hardware as shown in Detail 2-6E.

(✓) Mount the DPDT slide switch (#60-2) at B with 6-32 x 3/8" screws only.

(✓) Refer to Detail 2-6F and mount the power transformer (#54-149) at TC with 10-32 x 1/2" hardware. Insert the transformer leads through grommet GP.

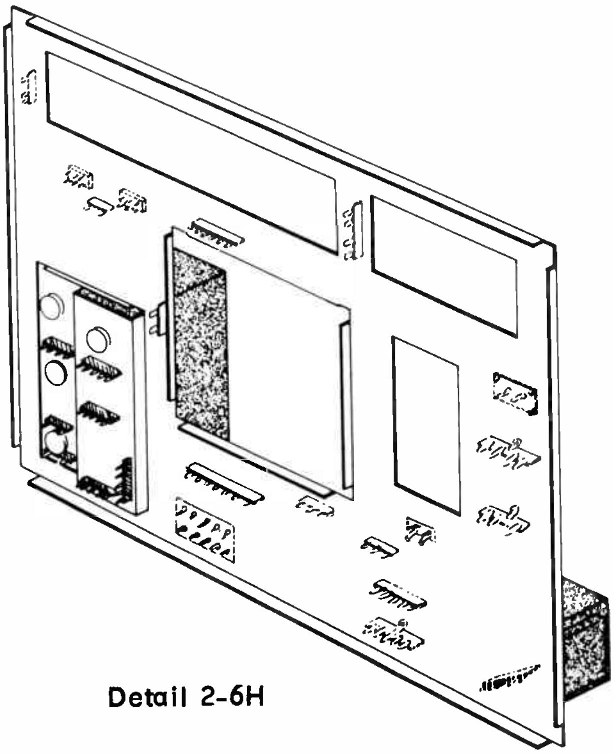


Detail 2-6F

Before you perform the next step, carefully unpack the horizontal output assembly (#100-580) and remove all packing material. Lift the cover of the assembly and check the placement of the leads to the caps on tubes V704 and V705. These leads and caps should be positioned as shown in the photograph on Page 178.

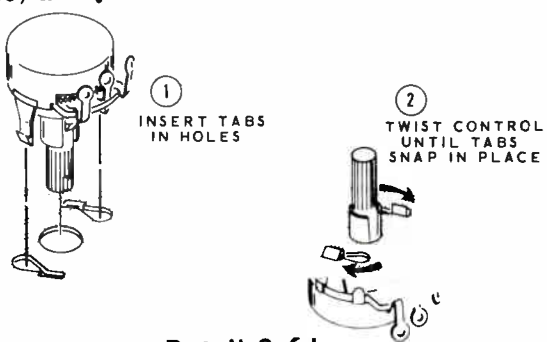
( ) Mount the horizontal output assembly (#100-580) on top of the chassis, and insert the free wires through the large cutout at the left side of the chassis. Position the assembly with the high voltage lead as shown in Detail 2-6G (fold-out from Page 32). Use 6-32 x 3/8" hardware. Be sure you do not pinch the wires between the assembly and the chassis. CAUTION: Do not change the setting of the control and coil on the horizontal output assembly, as they have been preset at the factory.

NOTE: Chassis assembly will be easier if the chassis is positioned on one edge, resting on the power transformer as shown in Detail 2-6H.



Detail 2-6H

( ) Refer to Detail 2-6J and install the 1.5 megohm tab-mount control with red shaft (#10-189) at C.



Detail 2-6J

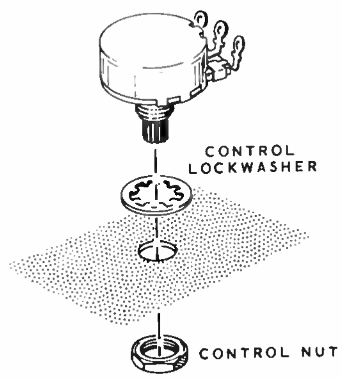
( ) Install the 1.5 megohm tab-mount control with green shaft (#10-194) at D.

( ) Install the 1.5 megohm tab-mount control with blue shaft (#10-195) at E.

( ) Install the 6000 Ω (6 K) tab-mount control with green shaft (#10-193) at F.

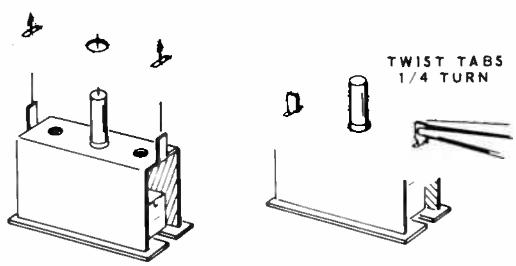
( ) Install the 6000 Ω (6 K) tab-mount control with blue shaft (#10-188) at G.

( ) Refer to Detail 2-6K and mount a 15 KΩ control (#10-78) at S with a control lockwasher and control nut. Position the control with its lugs as shown in the Pictorial.

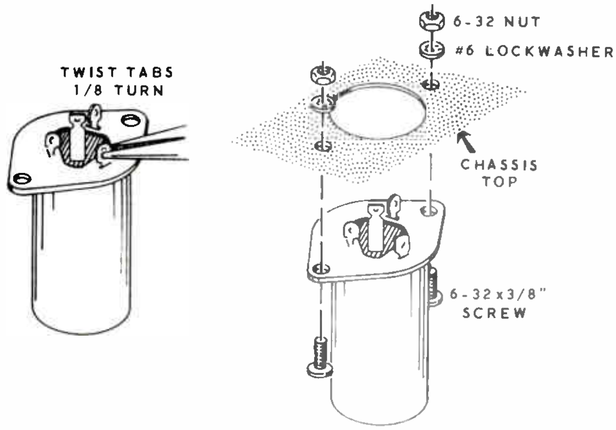


Detail 2-6K

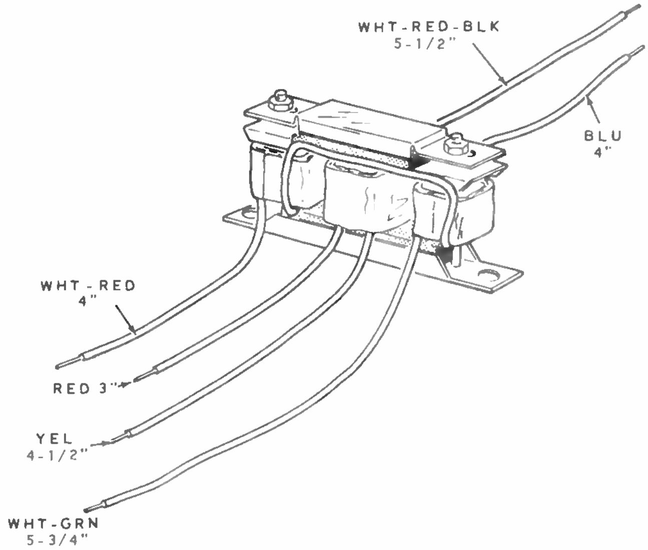
( ) Mount the circuit breaker (#65-11) at L. Insert the circuit breaker tabs into the slots of the chassis, and twist each tab 1/4 turn as shown in Detail 2-6L.



Detail 2-6L



Detail 2-6M



Detail 2-6N

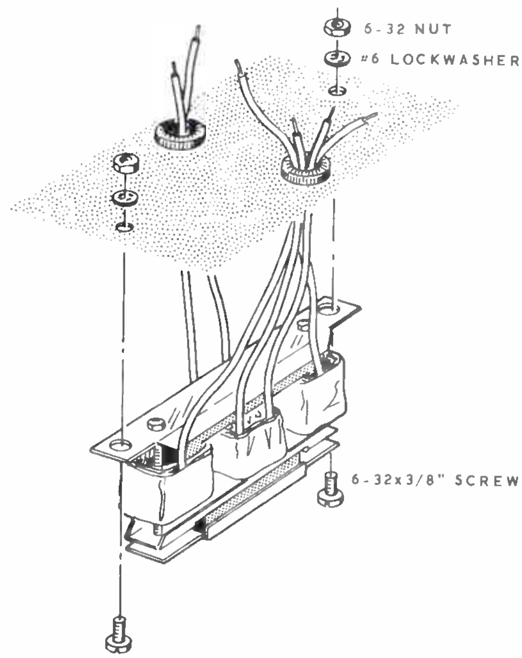
(✓) Install a capacitor mounting wafer on a 160 μfd electrolytic capacitor (#25-139) as shown in Detail 2-6M. Twist the mounting tabs 1/8 turn.

(✓) Mount this electrolytic capacitor and mounting wafer on top of the chassis at K. Position the capacitor lug as shown in the Pictorial. Use 6-32 x 3/8" hardware.

(✓) Install an 80-50-10-20 μfd electrolytic capacitor (#25-141) at P. Position the capacitor with its lug markings as shown in the Pictorial; then twist the mounting tabs 1/8 turn.

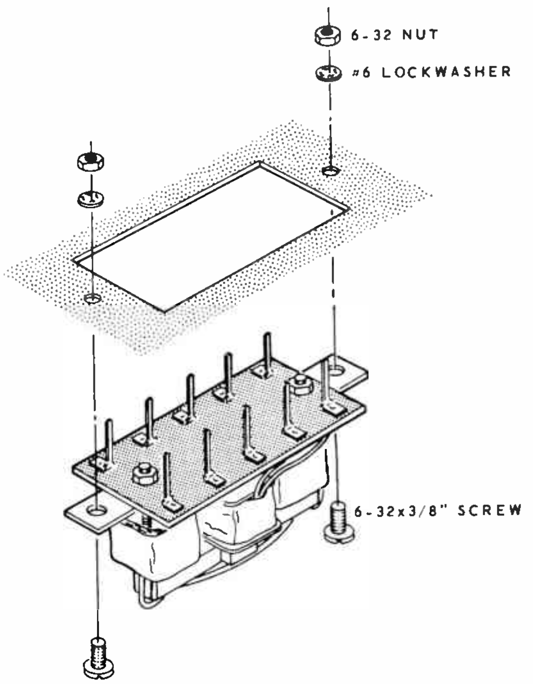
(✓) Similarly, install a 160-30-10-10 μfd electrolytic capacitor (#25-140) at N. Position the capacitor with its lug markings as shown.

(✓) Prepare the leads of the top-bottom pincushion transformer (#51-132) as shown in Detail 2-6N. Measure each lead from the point where it breaks out from the transformer, cut the lead to length, and remove 1/4" of insulation from the end.

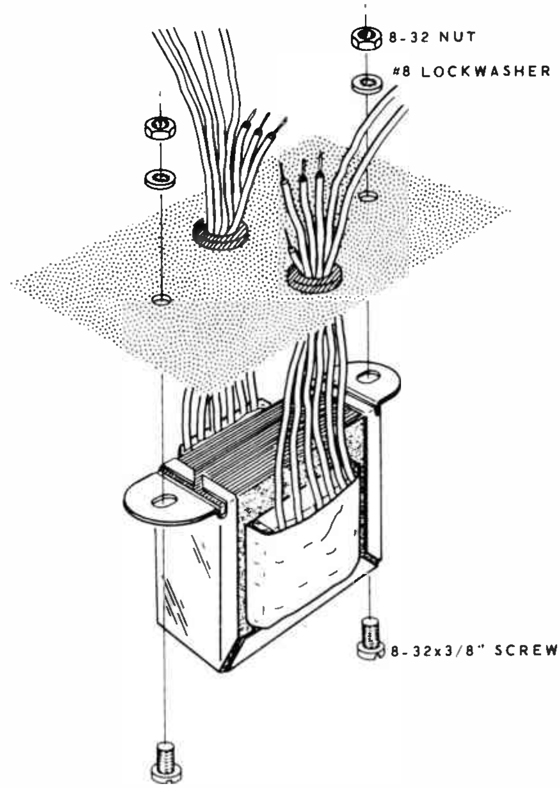


Detail 2-6P

(✓) Refer to Detail 2-6P and mount the top-bottom pincushion transformer on top of the chassis at TF. Insert the blue and white-red-black leads through grommet GT; insert the other leads through grommet GS. Use 6-32 x 3/8" hardware.



Detail 2-6R

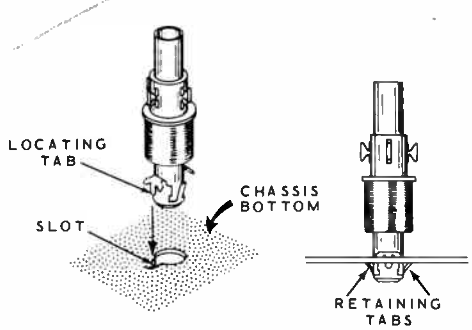


Detail 2-6T

(✓) Refer to Detail 2-6R and mount the side pincushion transformer (#51-136) at TE with 6-32 x 3/8" hardware. Position the transformer with the numbered lugs as shown in the Pictorial.

( ) Install the pincushion phase coil (#40-745) on the bottom of the chassis at T. Place the locating tab in the slot, as shown in Detail 2-6S, and press down until both retaining tabs snap in place.

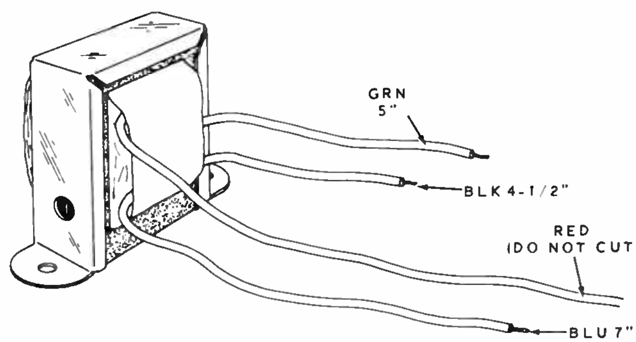
( ) Similarly, install the width coil (#40-750) on the bottom of the chassis at U. Place the locating tab in the slot and press down until both retaining tabs snap in place.



Detail 2-6S

( ) Refer to Detail 2-6T and mount the vertical output transformer (#51-135) at TB with 8-32 x 3/8" hardware. Position the transformer with six leads (colors called out on the Pictorial) inserted through grommet GL. Insert the remaining leads through grommet GN.

(✓) Prepare the leads of the audio output transformer (#51-104) as shown in Detail 2-6U. Measure each lead from the point where it breaks out from the transformer, cut the lead to length, and remove 1/4" of insulation from the end.



Detail 2-6U

In the following step, position the wire from the horizontal output assembly as shown in the Pictorial. This wire will be connected in a later step.

(✓) Position the shorter violet wire coming from lug 5 of terminal strip BR, next to terminal strip BY. Hook this wire over the chassis cutout to hold it in place as shown in the Pictorial.

When wiring this kit, you may find it easier to prepare the lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length; then strip 1/4" of insulation from each end. When stranded wire is called for, melt a small amount of solder on the bare wire ends to hold the small wire strands together. The wires are listed in the order in which they will be used.

(✓) Prepare the following lengths of hookup and stranded wire:

3-1/2" green	4" blue
4" green	3-1/2" blue
2-1/2" green	6" brown stranded

(✓) Connect a 3-1/2" green wire from lug 3 of coil T (S-1) to lug 5 of terminal strip BP (NS).

(✓) Connect a 4" green wire from lug 2 of control S (NS) to lug 7 of socket R (S-1).

(✓) Connect a 2-1/2" green wire from lug 1 of socket R (S-2) to lug 4 of terminal strip BP (NS).

(✓) Connect a 4" blue wire from lug 1 of control S (NS) to lug 8 of socket R (S-1).

(✓) Connect a 3-1/2" blue wire from lug 1 of capacitor K (S-2) to lug 2 of terminal strip BL (NS).

(✓) Connect a 6" brown stranded wire from lug 1 of terminal strip BJ (NS) to lug 5 of terminal strip BM (NS).

(✓) Connect the lead at the marked end of a .0033 μfd tubular capacitor to lug 1 (S-2) and the other lead to lug 3 (NS) of terminal strip BG.

(✓) Connect a 180 Ω 5% (brown-gray-brown-gold) resistor from lug 3 (NS) to lug 4 (NS) of terminal strip BF.

(✓) Connect a 3900 Ω (3.9 K) 2 watt film resistor from lug 1 (NS) to lug 2 (NS) of terminal strip BF.

Refer to Pictorial 2-8 (fold-out from Page 41) for the following steps.

Connect the vertical output transformer leads coming from grommet GL to socket J in the following steps:

(✓) Black-white to lug 3 (S-1).

(✓) Black-red to lug 4 (S-1).

(✓) Green-red to lug 5 (S-1).

(✓) Orange to lug 6 (S-1).

(✓) Red-white to lug 7 (S-1).

(✓) Connect the black-green transformer lead coming from grommet GL to chassis tab HE (NS).

Connect the free ends of the wires coming from the horizontal output assembly in the following steps. Position the wires as shown.

(✓) Locate the twisted pair of green wires coming from lugs 2 and 7 of socket Y. Connect one of these wires to lug 1 (NS) and the other to lug 2 (NS) of terminal strip BY.

(✓) Connect the black wire coming from lug 4 of terminal strip BW to lug 1 of control C (NS). IMPORTANT: Be sure to route this wire as shown.

(✓) Connect the white wire coming from lug 5 of terminal strip BW to lug 3 of capacitor P (NS).

(✓) Connect the large red wire coming from lug 2 of terminal strip BS to lug 5 of socket R (S-1).

(✓) Connect the large blue wire coming from lug 1 of terminal strip BS to lug 4 of socket R (S-1).

(✓) Connect the green wire coming from lug 1 of terminal strip BT to hole AB of the sound-sync circuit board (S-1).

( ) Connect the longer violet wire coming from lug 5 of terminal strip BR to lug 8 of socket J (NS). NOTE: Do not use the shorter violet wire from lug 5 of terminal strip BR that was positioned near terminal strip BY in a previous step.

( ) Solder the ground foil of the sound-sync circuit board to the chassis at the two locations shown in the Pictorial.

( ) Prepare the following lengths of hookup and bare wire:

3" blue	3" green
1" bare	11" white
7-1/2" green	

( ) Connect a 3" blue wire from lug 8 of socket J (S-2) to hole AE of the sound-sync circuit board (S-1).

( ) Connect a 1" bare wire from lug 1 (S-1) to ground lug 10 (S-1) of socket J.

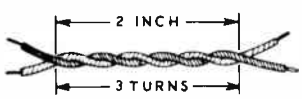
( ) Connect a 7-1/2" green wire from lug 2 of socket J (S-1) to lug 3 of terminal strip BF (NS).

( ) Connect a 3" green wire from lug 1 of terminal strip BF (NS) to hole R of the sound-sync circuit board (S-1).

( ) Connect an 11" white wire from lug 2 of terminal strip BG (NS) to lug 3 of terminal strip BN (NS).

( ) Connect a 1000 Ω (1K) 3 watt film resistor from lug 2 (S-2) to lug 3 (NS) of terminal strip BG.

Detail 2-8A



( ) Refer to Detail 2-8A and prepare a twisted pair of wires, using two 54" lengths of black stranded wire.

( ) At one end of this twisted pair, connect one wire to lug 1 (S-2) and the other wire to lug 5 (NS) of terminal strip BH. Push the other end of this twisted pair through grommet GH to be connected later.

( ) Prepare the following lengths of hookup wire:

12-1/2" red	8-1/2" white
5-1/2" red	4-1/2" white
5-1/2" red	4" green
10" orange	2" blue
4-1/2" orange	

( ) Connect a 12-1/2" red wire from lug 4 of terminal strip BH (NS) to lug 4 of capacitor P (NS).

( ) Connect a 5-1/2" red wire from lug 4 of capacitor P (S-2) to lug 2 of terminal strip BN (NS).

( ) Connect a 5-1/2" red wire from lug 4 of terminal strip BM (S-2) to lug 1 of circuit breaker L (S-1).

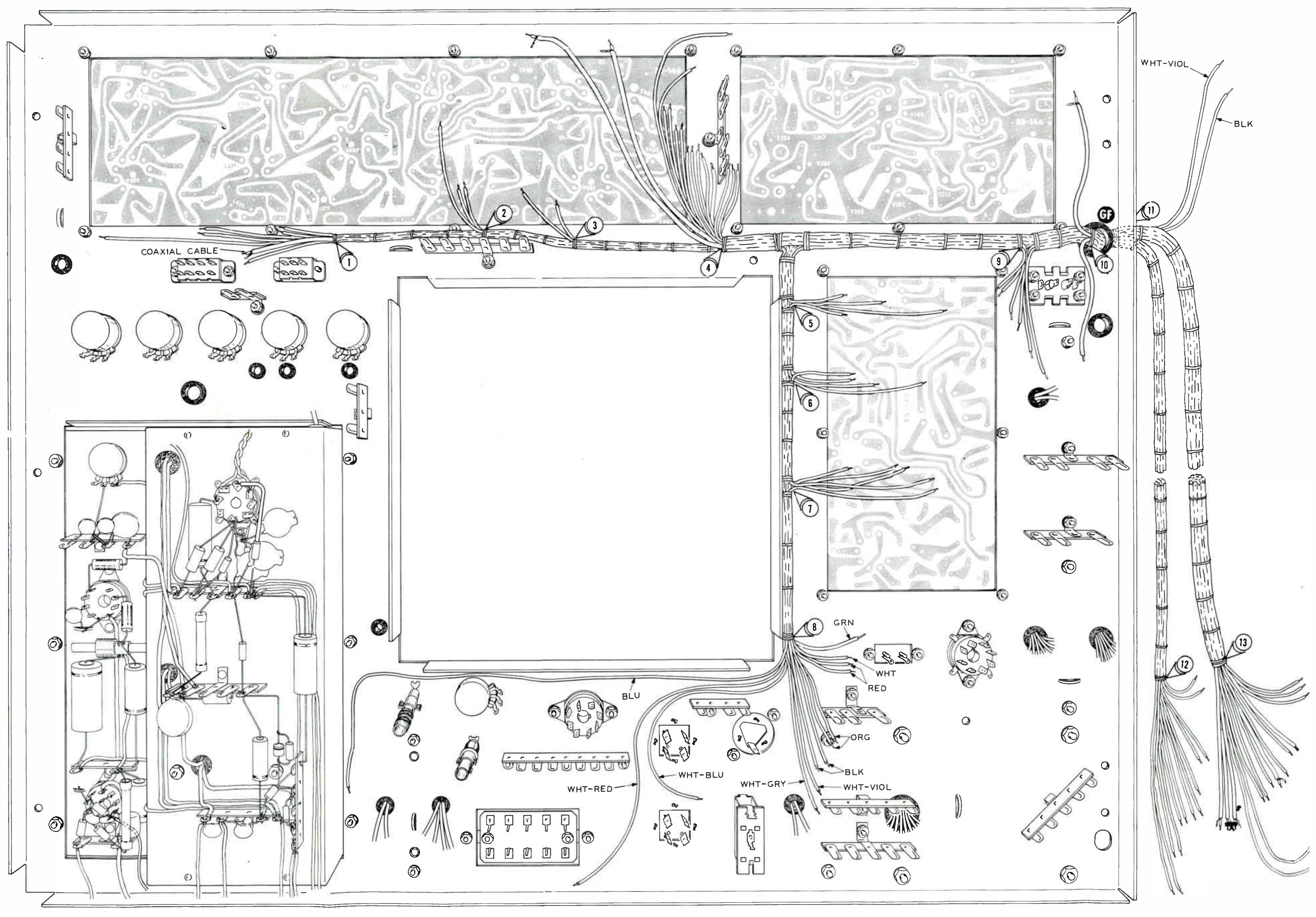
( ) Connect a 10" orange wire from lug 5 of terminal strip BL (NS) to lug 1 of capacitor P (NS).

( ) Connect a 4-1/2" orange wire from lug 1 of capacitor P (S-2) to lug 1 of terminal strip BN (NS).

( ) Connect an 8-1/2" white wire from lug 4 of terminal strip BL (NS) to lug 3 of capacitor P (NS).

( ) Connect a 4-1/2" white wire from lug 3 of capacitor P (S-4) to lug 3 of terminal strip BN (NS).

( ) Connect a 4" green wire from lug 1 of terminal strip BL (NS) to lug 2 of circuit breaker L (S-1).



PICTORIAL 2-9

NOTE: When installing the wiring harness, position it against the chassis. Fold the excess wire lengths from each breakout under the wiring harness after connecting the wires.

(✓) Refer to Pictorial 2-9 and locate BO#1 through BO#10 (breakouts #1 through #10) of the wiring harness (#134-128). Note that six hookup wires and one coaxial cable come from BO#1 at one end of the wiring harness.

(✓) Insert the wires from BO#11, #12, and #13 through grommet GF from the bottom side of the chassis. The white-violet and black wires should breakout (BO#11) from the wiring harness near grommet GF on the top side of the chassis.

(✓) Place the wiring harness against the chassis, and position the wires from BO#5 through BO#10 as shown.

(✓) Insert the wires coming from BO#1 through BO#3 through the large chassis cutout to hold the harness in place.

Refer to Pictorial 2-10 (fold-out from Page 45) for the following steps.

Connect the wires coming from BO#7 to the marked holes of the sound-sync circuit board in the following steps:

(✓) White-black to AA (S-1).

(✓) Center conductor of the violet coaxial cable to AC (S-1).

(✓) White-brown to X (S-1).

(✓) Red to Y (S-1).

(✓) Black to U (S-1).

(✓) Connect a 9-1/2" brown wire from lug 5 of terminal strip BM (S-3) to hole AD in the sound-sync circuit board (S-1).

Connect the wires coming from BO#8 in the following steps:

(✓) Green to lug 1 of terminal strip BJ (S-2). NOTE: If this wire does not fit in the hole of the lug, wrap the wire around the lug before soldering.

(✓) White to lug 3 of terminal strip BN (S-3).

(✓) Two red wires to lug 2 of terminal strip BN (S-3).

(✓) Two orange wires to lug 1 of terminal strip BN (S-3).

(✓) Two black wires to lug 2 of capacitor N (S-2).

(✓) White-violet to lug 1 of capacitor N (S-1).

(✓) White-gray to lug 4 of capacitor N (S-1).

(✓) White-blue to lug 2 of capacitor P (S-1).

(✓) White-red to lug 2 of terminal strip BP (S-4).

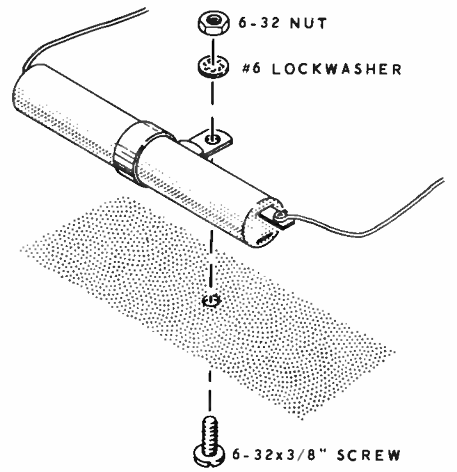
(✓) Blue to lug 1 of terminal strip BR (S-1). Note that two leads have already been soldered to the eyelet in this lug.

(√) Connect a 2" blue wire from lug 3 of capacitor N (S-1) to mounting lug 2 of capacitor K (NS).

(√) Prepare a twisted pair of wires using two 24" green wires.

(√) At one end of this twisted pair, connect one wire to lug 1 (S-2) and the other wire to lug 2 (NS) of terminal strip BM.

(√) At the other end of this twisted pair, connect one wire to lug 2 (NS) and the other wire to lug 1 (NS) of terminal strip BY.



Detail 2-8B

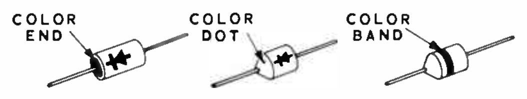
(√) Refer to Detail 2-8B and mount the 750 Ω 25 watt wire-wound resistor at HK with 6-32 x 3/8" hardware. Position all wires away from this resistor.

(√) Connect one lead of this resistor to lug 4 of terminal strip BL (S-2) and the other lead to lug 4 of terminal strip BH (NS).

(√) Connect a 10 KΩ (10000) 10 watt wire-wound resistor from lug 5 of terminal strip BL (S-2) to lug 4 of terminal strip BH (S-3).

NOTE: Refer to Detail 2-8C to identify the cathode end of the silicon diodes that will be installed in the next two steps.

NOTE: WHEN INSTALLING SILICON DIODES, THE CATHODE END SHOULD BE PLACED AS DIRECTED. THE CATHODE END IS MARKED WITH EITHER A COLOR END, COLOR DOT OR COLOR BAND.



Detail 2-8C

(√) Connect the lead from the cathode end of a silicon diode to lug 1 (NS) and connect the other lead to lug 3 (NS) of terminal strip BL.

(√) Connect the cathode lead of a silicon diode to lug 2 (NS) and the other lead to lug 1 (NS) of terminal strip BL.

(√) Connect a .01 μfd disc capacitor from mounting lug 6 of capacitor N (S-1) to mounting lug 2 of capacitor K (S-2).

(√) Solder mounting lug 5 of capacitor N to the chassis.

(√) Connect the lead at the marked end of a .2 μfd resin capacitor to lug 1 (S-3) and the other lead to lug 2 (S-3) of control S.

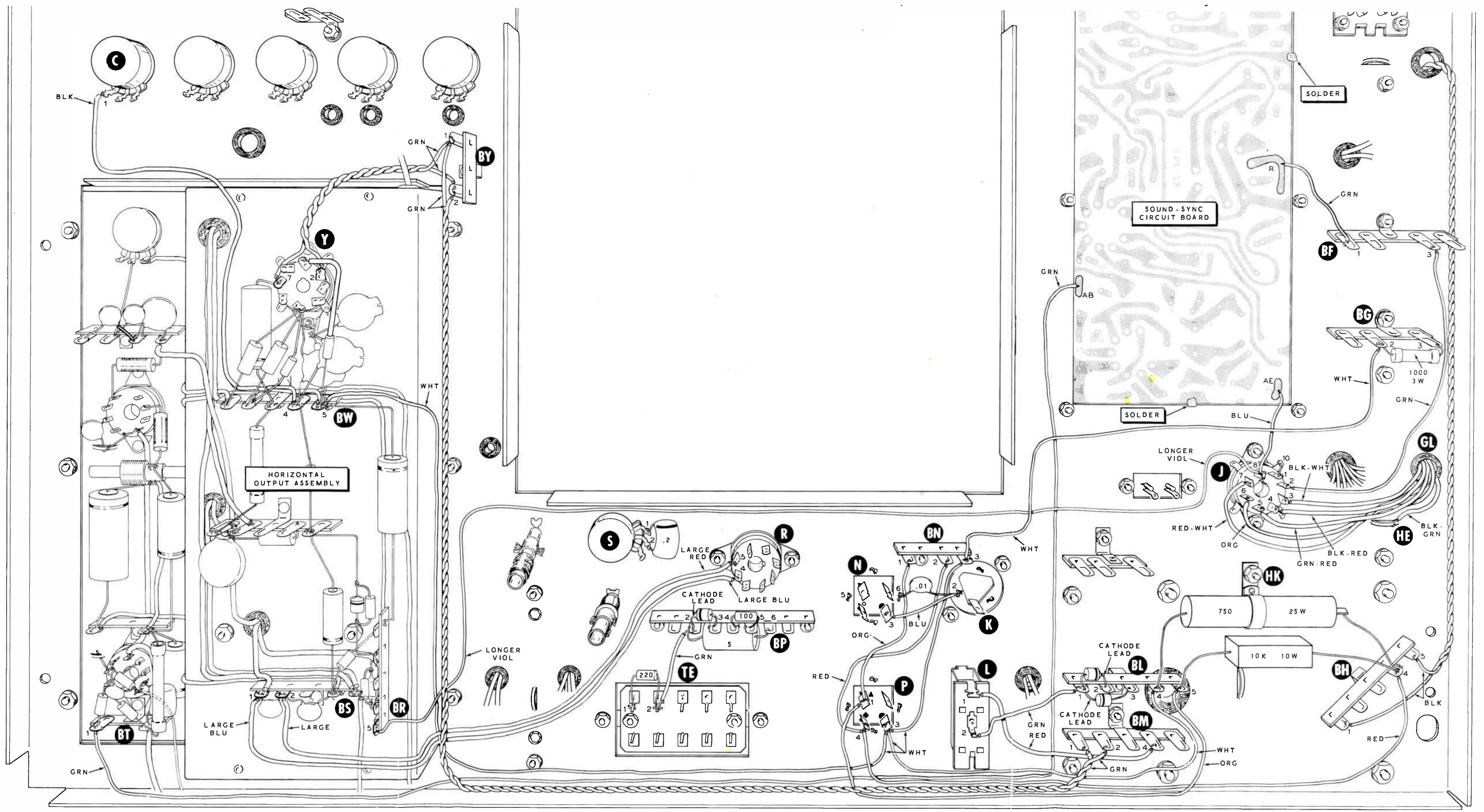
(√) Identify the cathode lead of a silicon diode; then connect this lead to lug 2 of terminal strip BP (NS). Connect the other lead of this diode to lug 3 of terminal strip BP (NS).

(√) Connect a 100 Ω (brown-black-brown) resistor from lug 4 (S-2) to lug 5 (NS) of terminal strip BP.

(√) Connect a 5 μfd nonpolarized electrolytic capacitor from lug 2 (NS) to lug 6 (NS) of terminal strip BP.

(√) Connect a 220 Ω (red-red-brown) resistor from lug 1 (NS) to lug 2 (NS) of transformer TE.

(√) Connect a 2-1/2" green wire from lug 2 of terminal strip BP (NS) to lug 2 of transformer TE (S-2).



PICTORIAL 2-8

Connect the free ends of the wires coming from the horizontal output assembly in the next three steps:

(✓) Connect the large orange wire coming from lug 5 of terminal strip BS to lug 6 of transformer TE (S-1).

(✓) Connect the small brown wire coming from lug 9 of socket X to lug 2 of terminal strip BF (S-2).

(✓) Connect the yellow wire coming from lug 2 of terminal strip BW to lug 10 of transformer TE (NS).

(✓) Locate the picture tube socket and lead assembly (#434-157), and insert the black lead through grommet GU from the top side of the chassis.

(✓) Connect this black lead to lug 4 of terminal strip BU (S-1). Another lead has been soldered to the eyelet in this lug previously.

(✓) Insert the twisted pair of brown leads from the picture tube socket through grommet GB.

(✓) Connect one brown lead to lug 1 (S-3) and the other brown lead to lug 2 (S-3) of terminal strip BY.

The remaining picture tube socket leads will be connected later.

( ) Prepare the following lengths of hookup and bare wire:

~~5-1/2" brown stranded~~
3-1/2" brown stranded
2-1/2" bare wire
1" bare wire

( ) ~~Connect a 5-1/2" brown stranded wire from lug 1 of coil U (S-1) to lug 6 of socket R (S-1).~~

(✓) Connect a 3-1/2" brown stranded wire from lug ~~2~~ 6 of ~~coil U (S-1)~~ to lug 1 of terminal strip BP (NS). socket R(S-1)

(✓) Connect a 2-1/2" bare wire from lug 1 of transformer TE (S-2) to chassis tab HN (S-1).

(✓) Connect a 1" bare wire from lug 2 of socket R (S-2) to lug 6 of terminal strip BP (NS).

(✓) Connect a 150 Ω (brown-green-brown) resistor from lug 3 of terminal strip BP (S-2) to lug 3 of transformer TE (S-2).

( ) Connect a 100 Ω (brown-black-brown) resistor from lug 5 (S-3) to lug 6 (S-3) of terminal strip BP.

( ) Connect the VDR resistor (#9-14) from lug 1 of terminal strip BP (S-3) to lug 10 of transformer TE (S-3). Do not allow the body of the VDR to touch any other lug of transformer TE.

( ) Place a 1-1/4" length of sleeving on a 2" bare wire. Then connect this wire from mounting lug 3 of capacitor K (S-1) to the eyelet in lug 1 of terminal strip BK (NS).

( ) Connect the thermistor (#9-8) from the eyelet in lug 1 (S-2) to the eyelet in lug 2 (NS) of terminal strip BK.

( ) Connect the VDR resistor (#9-15) from the eyelet in lug 2 (S-3) to the eyelet in lug 3 (S-1) of terminal strip BK.

( ) Refer to the inset drawing on the Pictorial and bend lug 2 of terminal strip BK as shown. Position the thermistor and the VDR resistor on terminal strip BK so they do not touch the chassis or wires.

( ) Connect a .01 μfd disc capacitor from lug 1 (S-4) to lug 3 (S-2) of terminal strip BL.

( ) Connect a 180 KΩ (brown-gray-yellow) resistor from lug 2 of terminal strip BL (S-3) to lug 2 of terminal strip BM (NS).

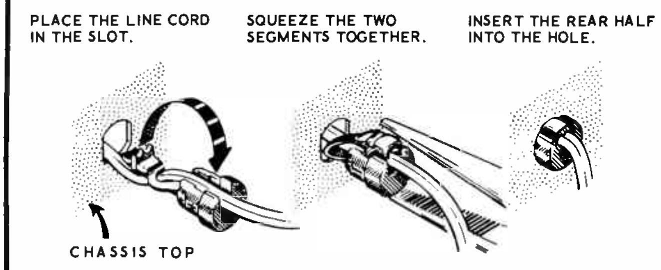
( ) Connect a 150 KΩ (brown-green-yellow) resistor from lug 2 (S-4) to lug 3 (S-1) of terminal strip BM.

( ) Connect the positive (+) lead of a 40 μfd electrolytic capacitor (#25-36) to lug 3 of terminal strip BG (S-4). Connect the other lead of this capacitor to chassis tab HE (S-2).

( ) Connect the lead at the marked end of a .047 μfd tubular capacitor to lug 5 (NS) and the other lead to lug 2 (NS) of terminal strip BH.

( ) Melt a small amount of solder on the bare lead ends of the line cord to hold the small wire strands together.

( ) Insert the leads of the line cord through hole HG from the top side of the chassis; then connect one lead to lug 2 (S-3) and the other lead to lug 5 (S-3) of terminal strip BH.



Detail 2-10A

( ) Refer to Detail 2-10A and install the line cord strain relief in hole HG from the top side of the chassis.

Refer to Pictorial 2-11 (fold-out from Page 47) for the following steps.

( ) Connect the lead at the marked end of a .5 μfd tubular capacitor to chassis tab HD (NS). Connect the other lead to lug 3 of terminal strip BF (NS).

( ) Connect the positive (+) lead of a 25 μfd electrolytic capacitor (#25-44) to lug 4 of terminal strip BF (S-2). Connect the other lead of this capacitor to chassis tab HD (NS).

( ) Connect the positive (+) lead of a 100 μfd electrolytic capacitor (#25-28) to lug 1 (S-3) and the other lead to lug 3 (S-4) of terminal strip BF.

Connect the free ends of the leads coming from grommet GK in the next two steps:

( ) Black to chassis tab HD (NS).

( ) Green to lug 2 of socket H (NS).

(✓) Prepare the following lengths of hookup and bare wire:

2" green	3" green
1-1/2" bare wire	8" gray

(✓) Connect a 2" green wire from lug 1 (NS) to lug 4 (NS) of socket H.

(✓) Connect a 1-1/2" bare wire from lug 4 of socket H (S-2) to chassis tab HD (NS).

(✓) Connect a 3" green wire from lug 2 of socket H (NS) to hole F of the sound-sync circuit board (S-1).

(✓) Connect an 8" gray wire from lug 3 of socket H (S-1) to hole B of the sound-sync circuit board (S-1).

Connect the wires coming from BO#9 to the marked holes of the sound-sync circuit board in the following steps:

(✓) Yellow to H (S-1).

(✓) White-blue to J (S-1).

(✓) Violet to K (S-1).

(✓) Gray to Z (S-1).

Connect the remaining wires coming from BO#9 to the IF circuit board in the next two steps:

(✓) White-black to hole G (S-1).

(✓) Brown to hole F (S-1).

(✓) Place a 6" green wire under the wiring harness and connect the wire from hole D of the IF circuit board (S-1) to hole P of the sound-sync circuit board (S-1).

(✓) Solder the ground foil of the IF circuit board to the chassis at the three locations shown in the Pictorial.

Connect the wires coming from BO#6 to the sound-sync circuit board in the following steps:

(✓) One orange wire to either of the holes marked S (S-1).

(✓) Other orange wire to the other hole marked S (S-1).

(✓) White to hole T (S-1).

(✓) White-yellow-yellow to hole N (S-1).

Connect the wires coming from BO#5 to the sound-sync circuit board in the following steps:

(✓) One red wire to either of the holes marked A (S-1).

(✓) Other red wire to the other hole marked A (S-1).

(✓) White-gray to hole C (S-1). Hole C is the smaller hole at this location.

(✓) White-blue to hole AF (S-1).

Position the wires coming from BO#4 as shown, and connect these wires to terminal strip BD in the following steps:

(✓) Three brown wires to lug 4 (NS).

(✓) Two white wires to lug 2 (NS).

(✓) Three red wires to lug 1 (NS).

(✓) Position the wires connected to terminal strip BD away from the IF circuit board.

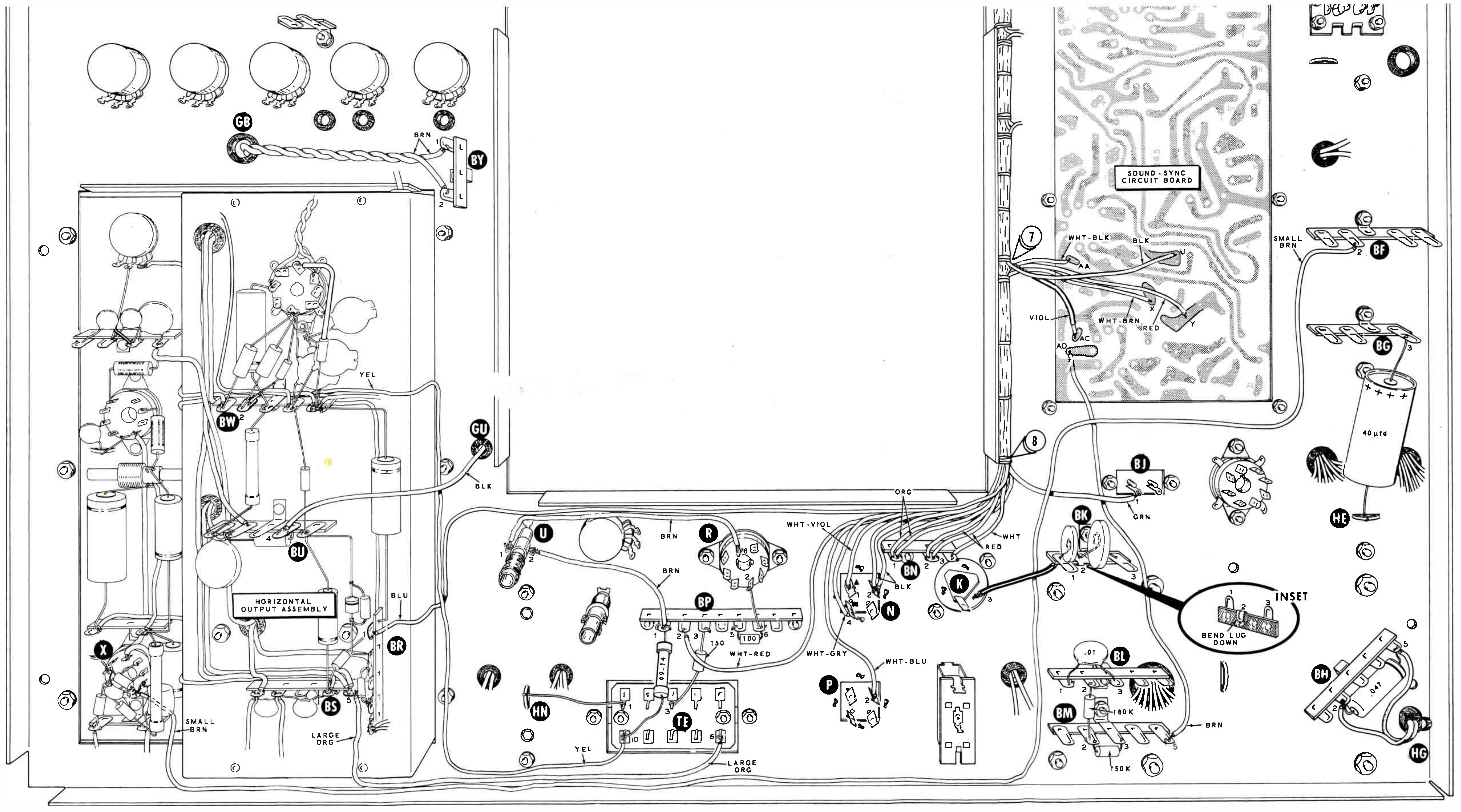
(✓) Solder the ground foil of the color circuit board to the chassis at the four locations shown in the Pictorial.

Connect the wires coming from BO#4 to the marked holes of the color circuit board in the following steps:

(✓) White-yellow to CK (S-1).

(✓) White-red-red to CJ (S-1).

(✓) White-green to CB (S-1).



PICTORIAL 2-10

(✓) Temporarily position the free end of the wiring harness down over the large chassis cutout as shown.

Mount the circuit board shield on the color circuit board as directed in the next four steps.

(✓) Apply a small amount of solder to both sides of each of the three mounting tabs of the circuit board shield.

(✓) Refer to the inset drawing on Pictorial 2-11 and note where the shield mounts on the circuit board. Cut off any lead ends that are long enough to reach up from the circuit board and touch the shield when it is in position.

(✓) Place the shield in position as shown. Position mounting tab A against the center post, and place the shield over pin 1 of socket V407; position the center mounting tab, B, around the center post of socket V408; position mounting tab C over alignment hole T403 and touch the foil near the chassis.

(✓) Solder each mounting tab to the circuit board foil. Mounting tab C should be soldered both to the foil and to the chassis.

(✓) Twist lug 1 of controls C, D, E, F, and G so the holes in these lugs are in line with each other.

(✓) Similarly, twist lug 3 on each of the same five controls so the holes in all five lugs are in line with each other.

NOTE: When connecting a lead with sleeving on it, do not allow the sleeving to touch the connection when soldering as it will not allow the solder to flow properly.

Where a wire passes through a connection and then goes to another point, it will count as two wires (one entering and one leaving the connection) in the solder instructions.

(✓) Connect a 3-1/4" bare wire from lug 1 of control C (NS), through lug 1 of control D (NS), to lug 1 of control E (NS). Use two 1-1/8" lengths of small sleeving between the lugs of the controls as shown.

(✓) Connect a 3-1/4" bare wire from lug 3 of control C (S-1), through lug 3 of control D (NS), to lug 3 of control E (S-1). Use two 1-1/8" lengths of small sleeving between the lugs of the controls as shown.

(✓) Place 1-1/8" of small sleeving on a 2" bare wire. Connect this wire from lug 1 of control F (NS) to lug 1 of control G (S-1).

(✓) Place 1-1/8" of small sleeving on a 2" bare wire. Connect this wire from lug 3 of control F (NS) to lug 3 of control G (NS).

(✓) Connect the gray wire coming from lug 1 of terminal strip BX on the horizontal output assembly to hole C of the color circuit board (S-1). IMPORTANT: Be sure to route this wire as shown.

(✓) In a previous step a violet wire from the horizontal output assembly was positioned next to terminal strip BY and hooked over the chassis cutout. Connect this wire to lug 6 of terminal strip BC (NS).

In the following steps, connect the free leads from the picture tube socket as follows: Insert each lead through a grommet and connect the lead as called out in the step.

(✓) White-red through grommet GB; then connect the lead to lug 2 of control C (NS).

(✓) White-green through grommet GB; then connect the lead to lug 2 of control D (NS).

(✓) White-blue through grommet GB; then connect the lead to lug 2 of control E (NS).

(✓) Yellow-red through grommet GC; then connect the lead to lug 1 of terminal strip BZ (NS).

(✓) Yellow-green through grommet GD; then connect the lead to lug 2 of control F (S-1).

(✓) Yellow-blue through grommet GE; then connect the lead to lug 2 of control G (S-1).

IMPORTANT: Route the following three wires away from the edge of the chassis.

(✓) Blue through grommet GA; then connect the lead to lug 3 of terminal strip BA (NS).

(✓) Green through grommet GA; then connect the lead to lug 2 of terminal strip BA (NS).

(✓) Red through grommet GA; then connect the lead to lug 1 of terminal strip BA (NS).

(✓) Cut both leads of three 1000 Ω (brown-black-red) resistors to 3/4". These resistors will be installed in the next three steps.

NOTE: When installing the next three resistors, do not apply too much heat to the circuit board foil, or the three resistors that are mounted on the other side of the board might fall off.

(✓) Connect a 1000 Ω resistor from lug 1 of terminal strip BA (S-2) to hole A of the color circuit board (S-1).

(✓) Connect a 1000 Ω resistor from lug 2 of terminal strip BA (S-2) to hole B of the color circuit board (S-1).

(✓) Connect a 1000 Ω resistor from lug 3 of terminal strip BA (S-2) to hole D of the color circuit board (S-1).

(✓) Prepare the following lengths of hookup and bare wire:

3-3/4" green	4-3/4" gray
2-1/4" white	1-1/4" bare wire
6-1/2" white	6-1/4" yellow

(✓) Connect a 3-3/4" green wire from lug 1 of switch A (NS) to hole F of the color circuit board (S-1).

(✓) Remove 1/4" of additional insulation from one end of the 2-1/4" white wire. Then connect the 1/2" bared end through lug 3 (NS) to lug 7 (NS) of switch A. Connect the other end to hole H of the color circuit board (S-1).

(✓) Connect a 6-1/2" white wire from lug 3 of switch A (S-3) to lug 2 of terminal strip BC (NS).

(✓) Connect a 4-3/4" gray wire from lug 1 of control F (S-2) to lug 2 of switch B (NS).

(✓) Connect a 1-1/4" bare wire from lug 2 of terminal strip BZ (S-1) to lug 4 of switch B (NS).

(✓) Connect a 6-1/4" yellow wire from lug 3 of control G (S-2) to lug 3 of terminal strip BC (NS).

(✓) Place 3/4" of small sleeving on one lead of a 39 KΩ 4 watt film resistor; then connect this lead to lug 4 of switch B (S-2). Connect the other lead to lug 3 of control F (NS).

(✓) Connect a 100 KΩ (brown-black-yellow) resistor from lug 7 of switch A (S-2) to lug 3 of control D (S-3).

(✓) Connect a .001 μfd disc capacitor from lug 1 (S-3) to lug 2 (S-2) of control C.

(✓) Connect a .001 μfd disc capacitor from lug 1 (S-3) to lug 2 (S-2) of control D.

(✓) Connect a .001 μfd disc capacitor from lug 1 (S-2) to lug 2 (S-2) of control E.

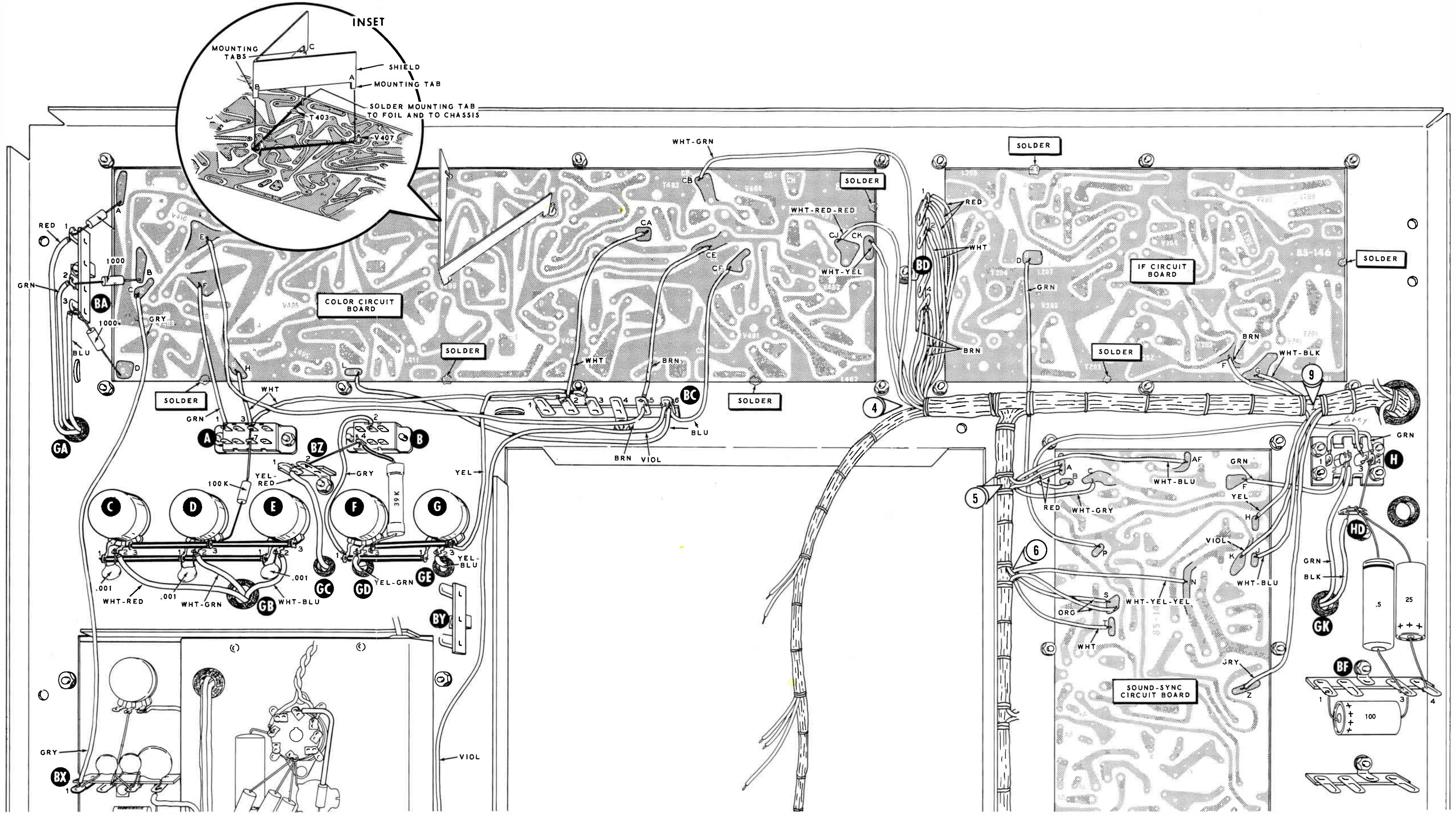
(✓) Prepare the following lengths of hookup wire:

7-1/4" blue	11" brown
4" blue	5" white
4" brown	

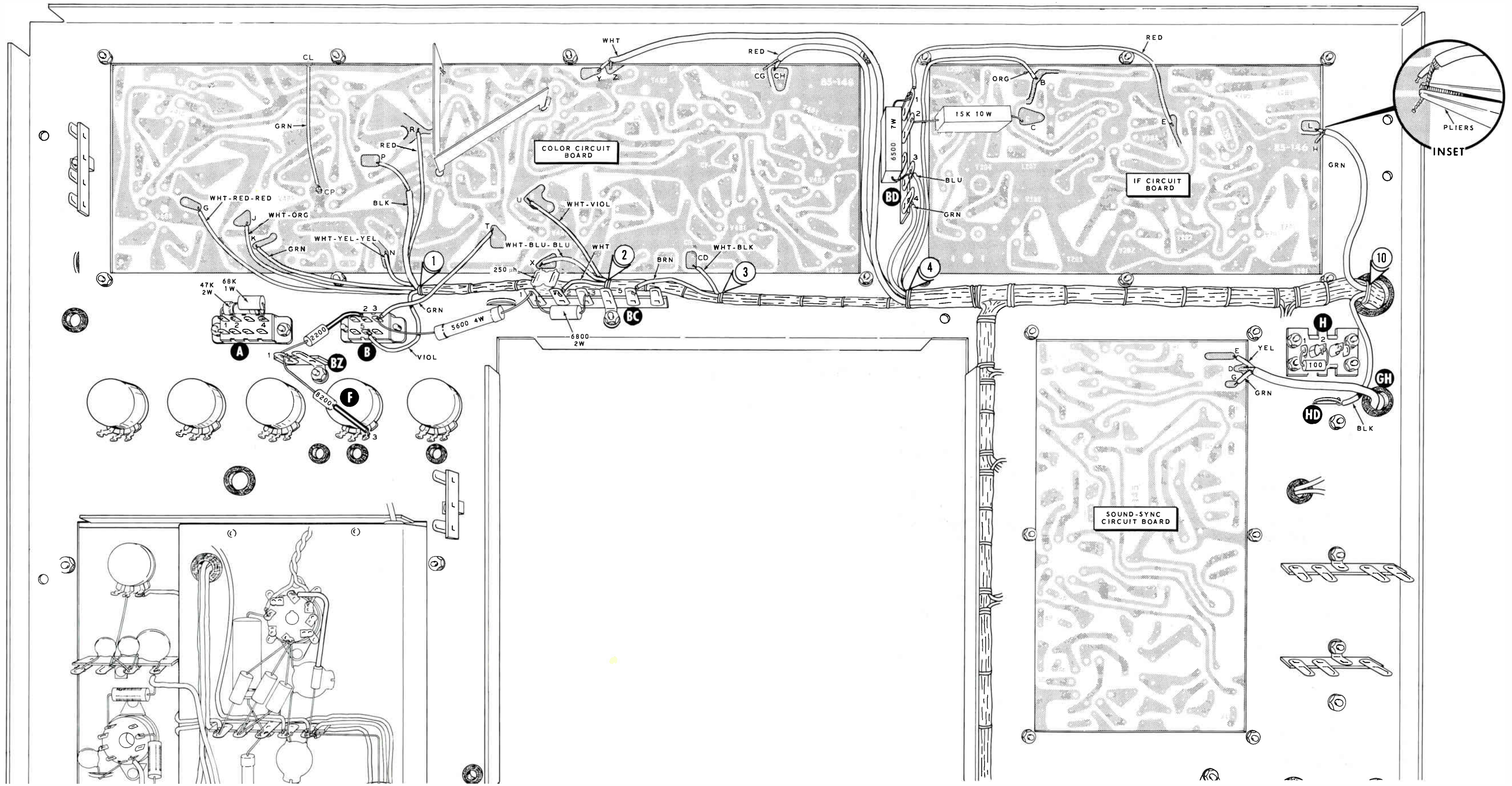
(✓) Connect the 7-1/4" blue wire from hole L of the color circuit board (S-1) to lug 6 of terminal strip BC (NS). Be sure to route the wire as shown.

Connect the wires from terminal strip BC to holes of the color circuit board in the following steps:

WIRE	FROM TERMINAL STRIP BC	TO COLOR CIRCUIT BOARD
(✓) 4" blue	lug 6 (S-3)	hole CF (S-1).
(✓) 4" brown	lug 5 (NS)	hole CE (S-1).
(✓) 11" brown	lug 5 (NS)	hole E (S-1).
(✓) 5" white	lug 2 (NS)	hole CA (S-1).



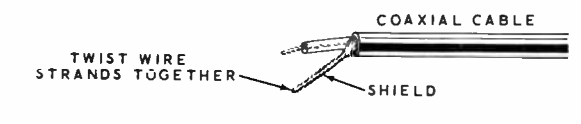
PICTORIAL 2-11



PICTORIAL 2-12

Refer to Pictorial 2-12 for the following steps.

NOTE: Before connecting each coaxial cable to the circuit board, prepare the end in the following manner. Refer to Detail 2-12A. Twist together the small strands of wire at the end of the shield. This will allow the shields to fit in the holes of the circuit board.



Detail 2-12A

Connect the wires coming from BO#10 in the next two steps:

NOTE: The coaxial cables are color-coded with tape or paint. The cables that are not marked will be referred to as black cables.

When soldering the shield lead of the coaxial cables in the wiring harness, clamp a pair of long-nosed pliers on the shield as shown in the inset drawing on Pictorial 2-12. The pliers will act as a heat sink and prevent the insulation on the inner leads from melting.

( ) The inner lead of the green coaxial cable to hole L (S-1) and the shield to hole H (S-1) of the IF circuit board.

( ) Black wire to chassis tab HD (S-5).

( ) Connect a 100 Ω (brown-black-brown) resistor from lug 1 (S-2) to lug 2 (S-3) of socket H.

( ) Prepare a 42" length of 2-wire shielded cable as shown in Detail 2-12B.

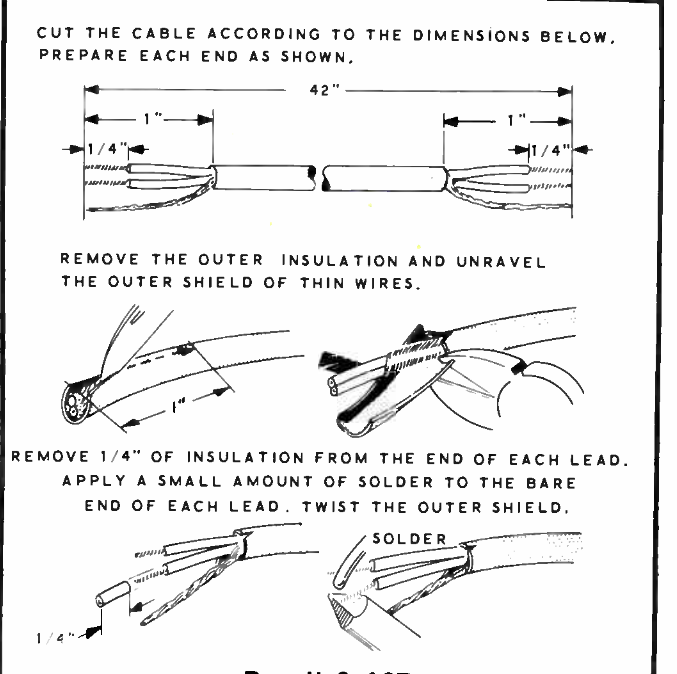
( ) Insert one end of this shielded cable through grommet GH to be connected later.

At the other end of this shielded cable, connect the leads to the marked holes of the sound-sync circuit board in the following steps:

( ) Yellow to hole E (S-1).

( ) Shield to hole D (S-1).

( ) Green to hole G (S-1).



Detail 2-12B

Connect the leads coming from BO#4 in the following steps:

( ) Green to lug 4 of terminal strip BD (S-4).

( ) Blue to lug 3 of terminal strip BD (NS).

( ) Inner lead of red coaxial cable to hole CH (S-1), and shield to hole CG (S-1) of the color circuit board.

( ) Inner lead of white coaxial cable to hole Y (S-1), and shield to hole Z (S-1) of the color circuit board.

( ) Orange to hole B of the IF circuit board (S-1).

( ) Connect an 8" red wire from lug 1 of terminal strip BD (NS) to hole E of the IF circuit board (S-1).

( ) Cut one lead of a 15 KΩ <u>10 watt</u> wire-wound resistor to 3/4".

( ) Connect the longer lead of this resistor to lug 2 of terminal strip BD (S-3). Connect the other lead to hole C of the IF circuit board (S-1).

( ) Connect a 6500 Ω 7 watt wire-wound resistor from lug 1 (S-5) to lug 3 (S-2) of terminal strip BD. Position the resistor away from the wires. Be sure all five leads are soldered at lug 1 of terminal strip BD.

Connect the wires coming from BO#3 in the following steps:

( ) Brown to lug 5 of terminal strip BC (S-3).

( ) White-black to hole CD of the color circuit board (S-1).

Connect the wires coming from BO#2 in the next three steps:

( ) White to lug 2 of terminal strip BC (NS).

( ) White-blue-blue to hole X of the color circuit board (S-1).

( ) White-violet to hole U of the color circuit board (S-1).

Connect the remaining wires coming from BO#1 to the color circuit board in the following steps:

( ) White-yellow-yellow to hole N (S-1).

( ) Red to hole R (S-1).

( ) Cut off the shield from the black coaxial cable, then connect the inner lead of this cable to hole P (S-1).

( ) Green to hole K (S-1).

( ) White-orange to hole J (S-1).

( ) White-red-red to hole G (S-1).

( ) Connect the violet wire coming from BO#1 of the wiring harness to lug 5 of switch B (S-1).

This completes the wiring harness connections on the bottom of the chassis. Position the harness and the harness wires close to the chassis as shown in the Pictorial.

( ) Connect a 47 KΩ 2 watt film resistor from lug 1 (S-2) to lug 4 (NS) of switch A.

( ) Connect a 68 KΩ (blue-gray-orange) 1 watt resistor from lug 2 (S-1) to lug 4 (S-2) of switch A.

( ) Place 1/2" of small sleeving on one lead of a 2200 Ω (red-red-red) resistor; then connect this lead to lug 2 of switch B (S-2). Connect the other lead to lug 1 of terminal strip BZ (NS).

( ) Place 3/4" of small sleeving on one lead of 8200 Ω (gray-red-red) resistor; then connect this lead to lug 3 of control F (S-3). Connect the other lead to lug 1 of terminal strip BZ (S-3).

( ) Connect a 5600 Ω (5.6 K) 4 watt film resistor from lug 3 of switch B (NS) to lug 1 of terminal strip BC (NS).

( ) Connect a 6800 Ω (blue-gray-red) 2 watt resistor from lug 1 (NS) to lug 3 (S-2) of terminal strip BC.

( ) Connect a 250 μh (red-green-brown) peaking coil (#40-485) from lug 1 (S-3) to lug 2 (S-4) of terminal strip BC.

( ) Connect a 3-1/2" green wire from lug 3 of switch B (S-2) to hole T of the color circuit board (S-1). Position this wire up and as far as possible away from the wiring harness.

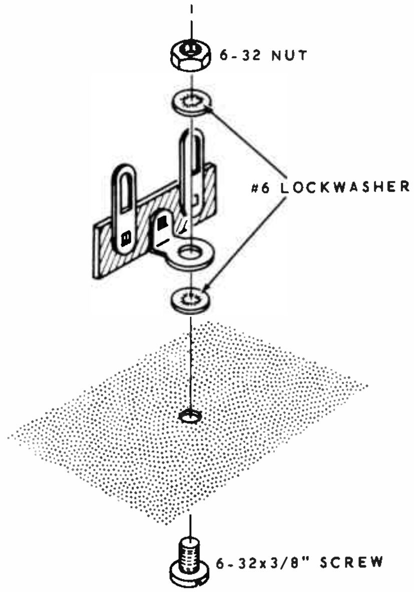
( ) Connect a 3" green wire from CP (S-1) to CL (S-1) on the color circuit board. NOTE: These letters are not screened on the circuit board. At CP, wrap the bared wire end around the center post of socket V405 before soldering. Solder the end of the wire at CL to both the foil and the chassis as shown.

This completes the wiring on the bottom of the chassis. Carefully check to be sure there are no unsoldered connections, loose or broken leads, or short circuits. Turn the chassis over and shake out any loose bits of solder or wire clippings.

Carefully check to be sure that the wires connected in the holes of the circuit boards are not touching the coil shields or component leads on the top side of the circuit boards. If necessary, cut off the excess wire or cable ends on the top side of each circuit board.

CHASSIS TOP ASSEMBLY AND WIRING

Refer to Pictorial 2-13 (fold-out from Page 51) for the following steps.



Detail 2-13A

(✓) Refer to Detail 2-13A and mount a small 2-lug terminal strip on the top side of the chassis at BE. Use 6-32 x 3/8" hardware.

(✓) Connect the blue lead coming from transformer TA to hole BLUE of the sound-sync circuit board (S-1).

(✓) Connect the red lead coming from transformer TA to hole RED of the sound-sync circuit board (S-1).

(✓) Connect an 8" yellow wire from hole A of the IF circuit board (S-1) to hole YEL of the sound-sync circuit board (S-1).

(✓) Connect an 11" yellow wire from hole R of the IF circuit board (S-1) to hole B of the color circuit board (S-1).

Connect the wires coming from BO#11 in the next two steps:

(✓) Black to lug 1 of terminal strip BE (NS).

(✓) White-violet to hole A of the color circuit board (S-1).

(✓) At the end of the delay line (#41-1) that has two lugs, push the lead through the hole at chassis tab HB. Then connect it to chassis tab HB on the bottom side of the chassis (NS).

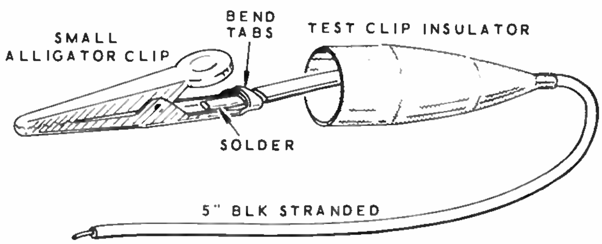
(✓) Connect the lead from the other end of the delay line to lug 2 of terminal strip BE (NS).

(✓) Connect a 100 μh (brown-black-brown) peaking coil (#40-598) from the open lug (no lead attached) of the delay line (S-1) to hole C of the color circuit board (S-1).

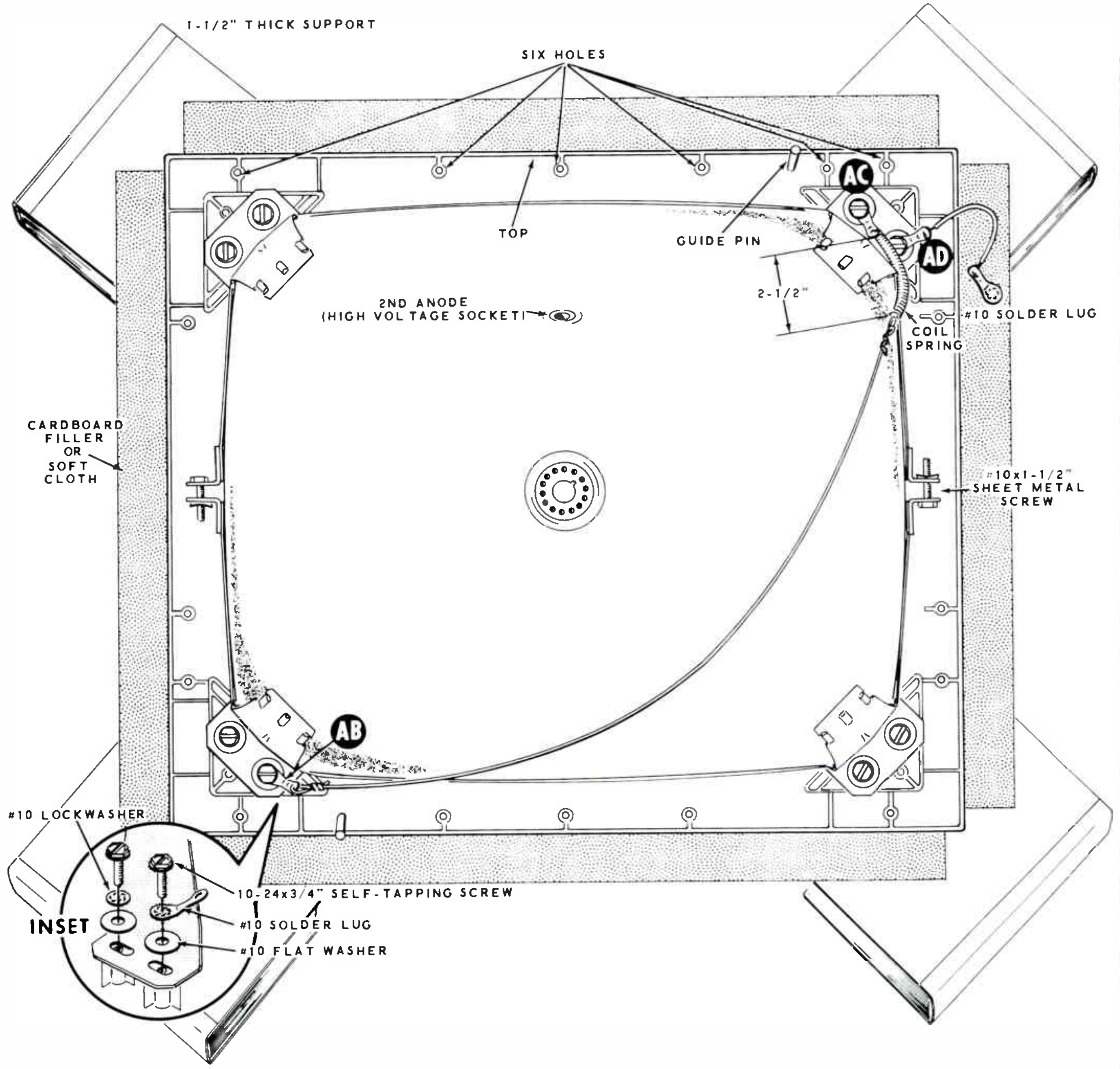
(✓) Connect a 330 Ω (orange-orange-brown) resistor from lug 1 (S-2) to lug 2 (S-2) of terminal strip BE.

NOTE: Be sure the delay line is positioned so it is flat against the chassis.

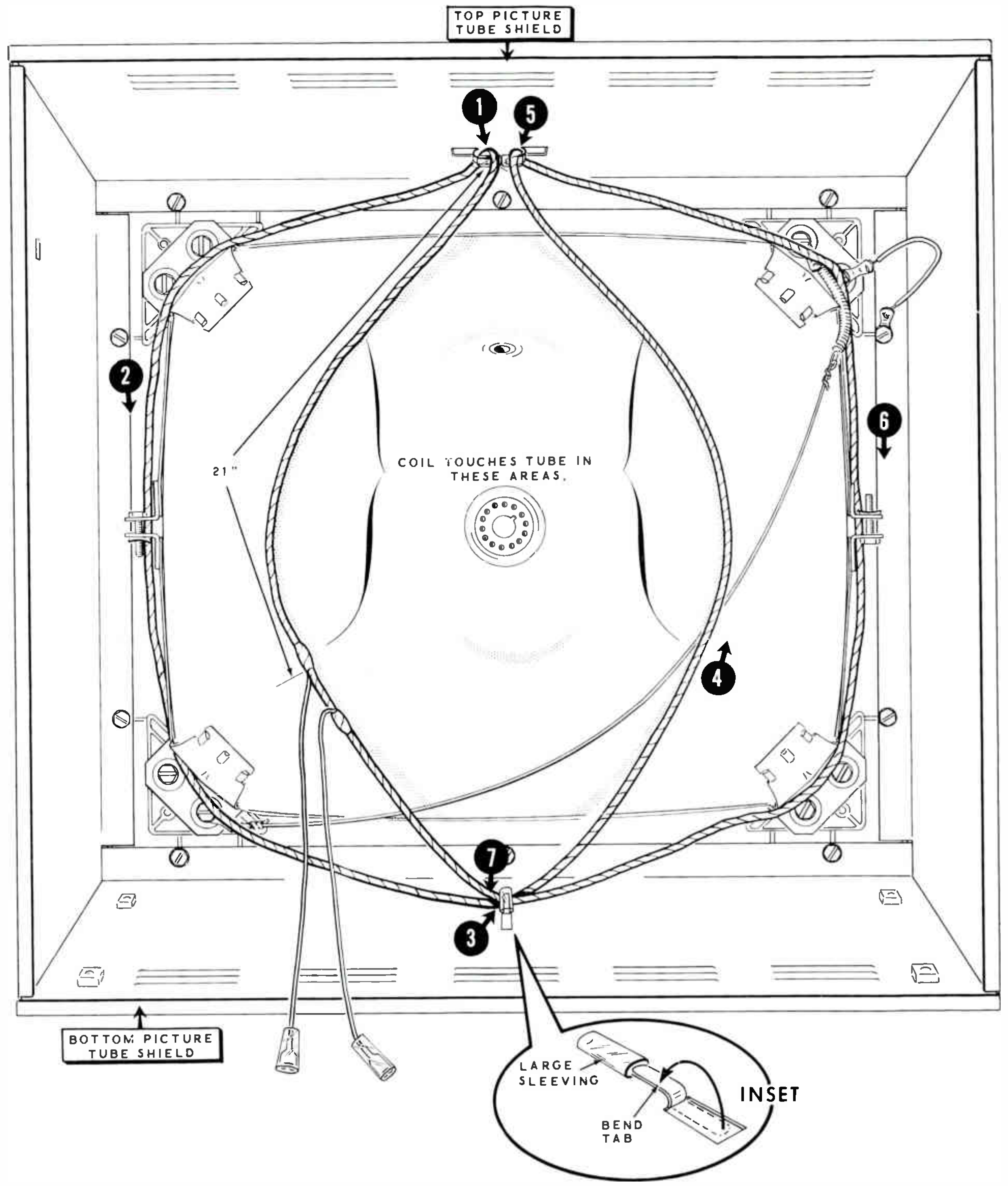
(✓) Prepare two test leads using two 5" black stranded wires as shown in Detail 2-13B. Attach a small alligator clip on one end of each wire; then slip a test clip insulator over each alligator clip.



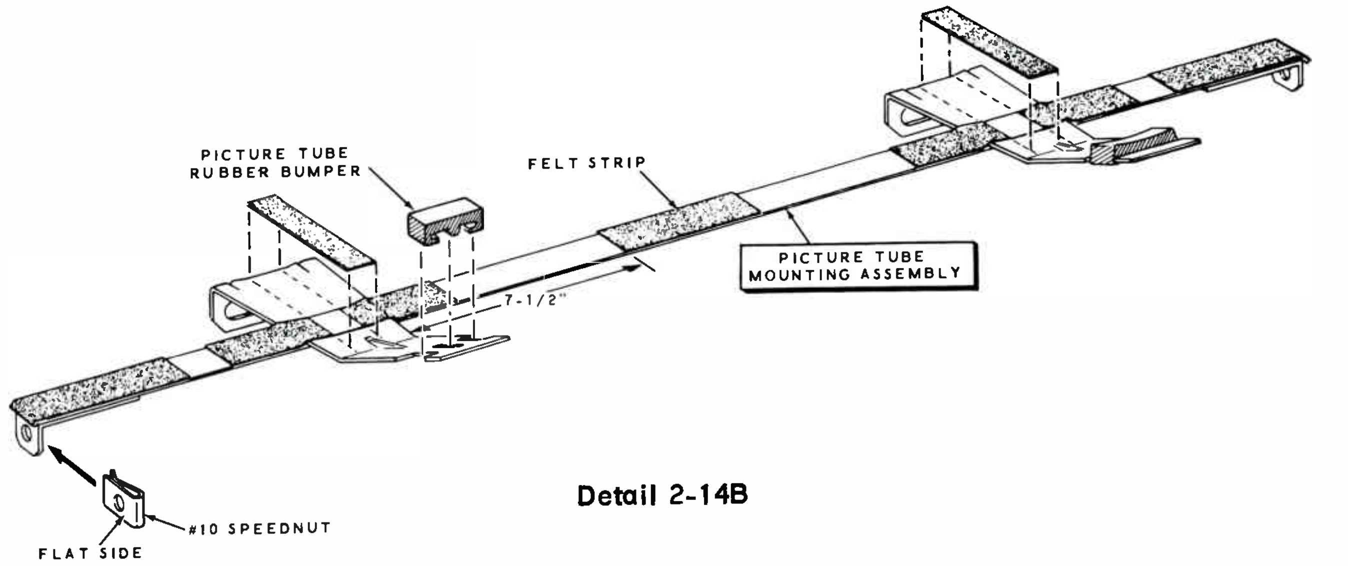
Detail 2-13B



PICTORIAL 2-14



PICTORIAL 2-15



Detail 2-14B

Refer to Detail 2-14B for the following steps.

( ) Position the two picture tube mounting assemblies as shown. Then install a picture tube rubber bumper on each bracket of the assemblies.

( ) Place nine lengths of felt strip on each picture tube mounting assembly. Remove the paper backing from the felt strips and press them in place at the locations shown in the Detail.

( ) Install a #10 speednut on the left end of each picture tube mounting assembly. Position the flat side of the speednuts as shown.

CAUTION

Extreme care must be exercised when handling the picture tube, due to its high vacuum and large glass surface area. DO NOT strike, scratch, or subject the picture tube to more than moderate pressure at any time. Never lift the picture tube by its neck. A fracture of the glass could result in an implosion of considerable violence capable of causing personal injury.

IMPORTANT: Do not set the picture tube down so any part of its weight rests on the neck of the tube. Place a soft cloth over any surface on which the picture tube will be placed; then place the tube face down on the cloth.

Refer to Pictorial 2-14 for the following steps.

NOTE: It will be easier if another person helps in handling the picture tube.

( ) Place four 1-1/2" thick supports on your work area. Books may be used for this purpose.

( ) Open the shipping box of the picture tube by following the instructions on the box. Remove the cardboard filler that is placed next to the face of the tube. This cardboard filler can be used in the next step if desired.

CAUTION: When handling the picture tube, be careful not to touch the 2nd anode socket as you may get a dangerous electrical shock from the socket.

( ) Place the cardboard filler, or a soft cloth, on top of these four supports to protect the picture tube. Then place the picture tube mask face down on the supports and protective covering. Position the top side of the mask as shown. Note that the top side has six holes and a guide pin.

( ) Carefully remove the picture tube from its carton and place it face down on the picture tube mask. Position the tube with its 2nd anode socket toward the top side of the mask, as shown.

( ) Insert the free end of each test lead through the cutout at chassis tab HA. Then connect them to chassis tab HA on the bottom side of the chassis (S-2).

( ) Clip the alligator clip of each test lead to its insulated lead as shown in Pictorial 2-13.

( ) Insert one end of a 1-1/2" bare wire through the hole at chassis tab HB. Then connect this wire to the tab on the bottom side of the chassis (S-2).

( ) Position the three picture tube socket leads that come from grommet GA as shown in Pictorial 2-13. Bend the free end of the bare wire at chassis tab HB around the three leads to hold them in place.

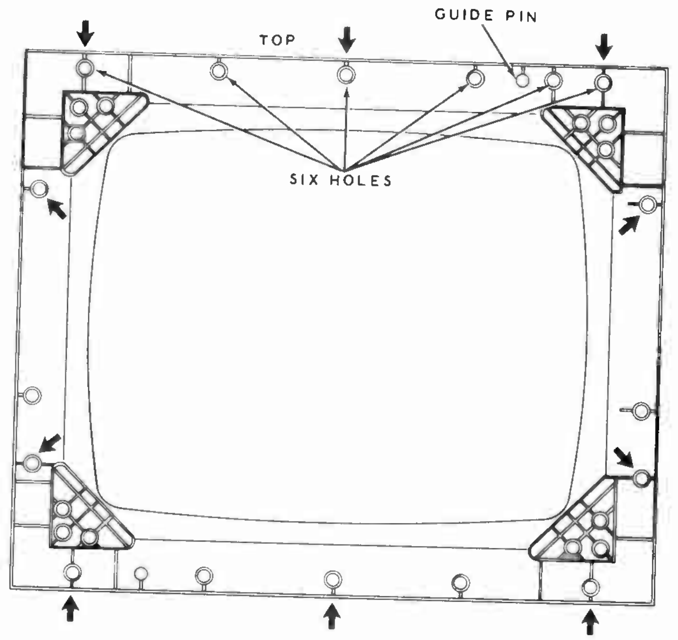
( ) Install the tubes in their respective tube sockets on the color and the sound-sync circuit boards. The tube types are marked near the sockets on the circuit boards.

( ) Install a small tube shield at V404 on the color circuit board.

( ) Install large tube shields at V401, V403, V407, and V408 on the color circuit board.

( ) Install the focus knob on the adjustment screw at the top of the horizontal output assembly, as shown. This knob fits loosely on the adjustment screw.

( ) Set the chassis aside temporarily.



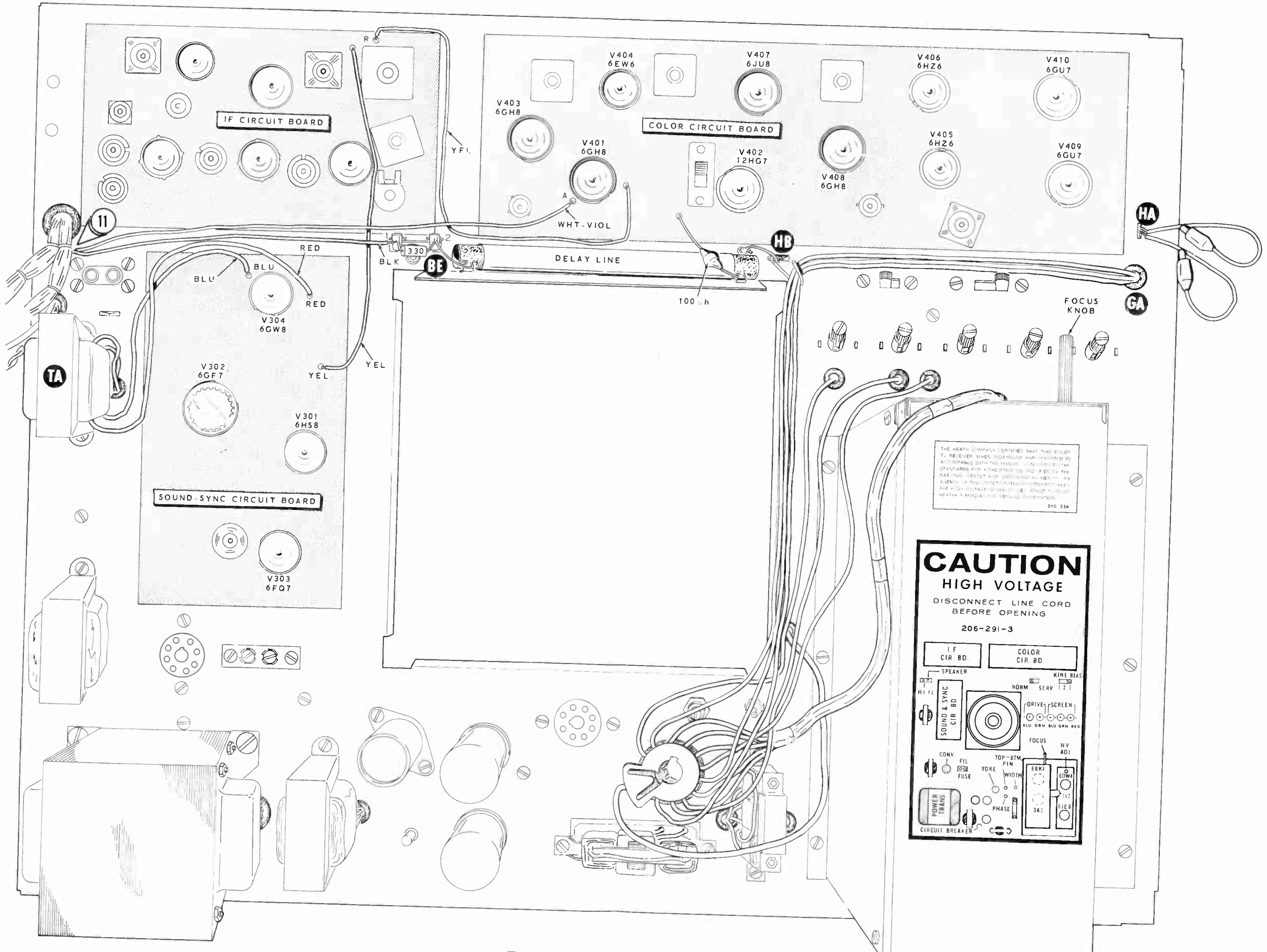
Detail 2-14A

PICTURE TUBE AND SHIELD ASSEMBLY

Refer to Detail 2-14A for the following steps.

( ) Place the picture tube mask face down on a rug, or on a soft cloth on your work surface. Position the top side of the picture tube mask as shown. Note that the top side has six holes and a guide pin.

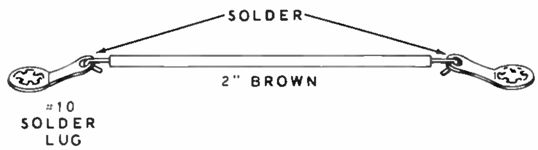
( ) Prethread the ten holes in the picture tube mask that are shown by the arrows on the Detail. Use a 10-24 x 1/2" self-tapping screw: turn the screw half-way in, then remove the screw. NOTE: You may find it easier to prethread the holes if a different 10-24 screw is used after three or four holes are prepared.



PICTORIAL 2-13

( ) Record the picture tube serial number on the picture tube warranty card. The serial number can be found on the base or on the rim around the face of the picture tube. Fill in the rest of this card and mail it as soon as possible.

( ) Install the picture tube mounting assemblies on the picture tube in the following manner, using two #10 x 1-1/2" sheet metal screws: Position the assemblies so the bracket holes line up with the holes in the picture tube mask. Push the brackets down against the mask, then tighten the two screws just enough to hold the assemblies in place.



Detail 2-14C

( ) Connect a #10 solder lug to each end of a 2" brown stranded wire as shown in Detail 2-14C. Solder both connections. This assembly will be installed later.

Refer to the inset drawing on the Pictorial, and fasten the brackets of the picture tube assemblies to the picture tube mask in the following steps. NOTE: Be sure to use 10-24 x 3/4" self-tapping screws.

( ) Install 10-24 x 3/4" self-tapping screws, #10 solder lugs, and #10 flat washers at locations AB and AC. Position the solder lugs as shown and do not tighten the screws.

( ) Install the solder lug at either end of the prepared 2" brown wire at location AD with a 10-24 x 3/4" self-tapping screw and a #10 flat washer. Do not tighten the screw. The other solder lug will be mounted later.

( ) Start 10-24 x 3/4" self-tapping screws, #10 lockwashers, and #10 flat washers in the remaining five holes of the brackets. Do not tighten the screws.

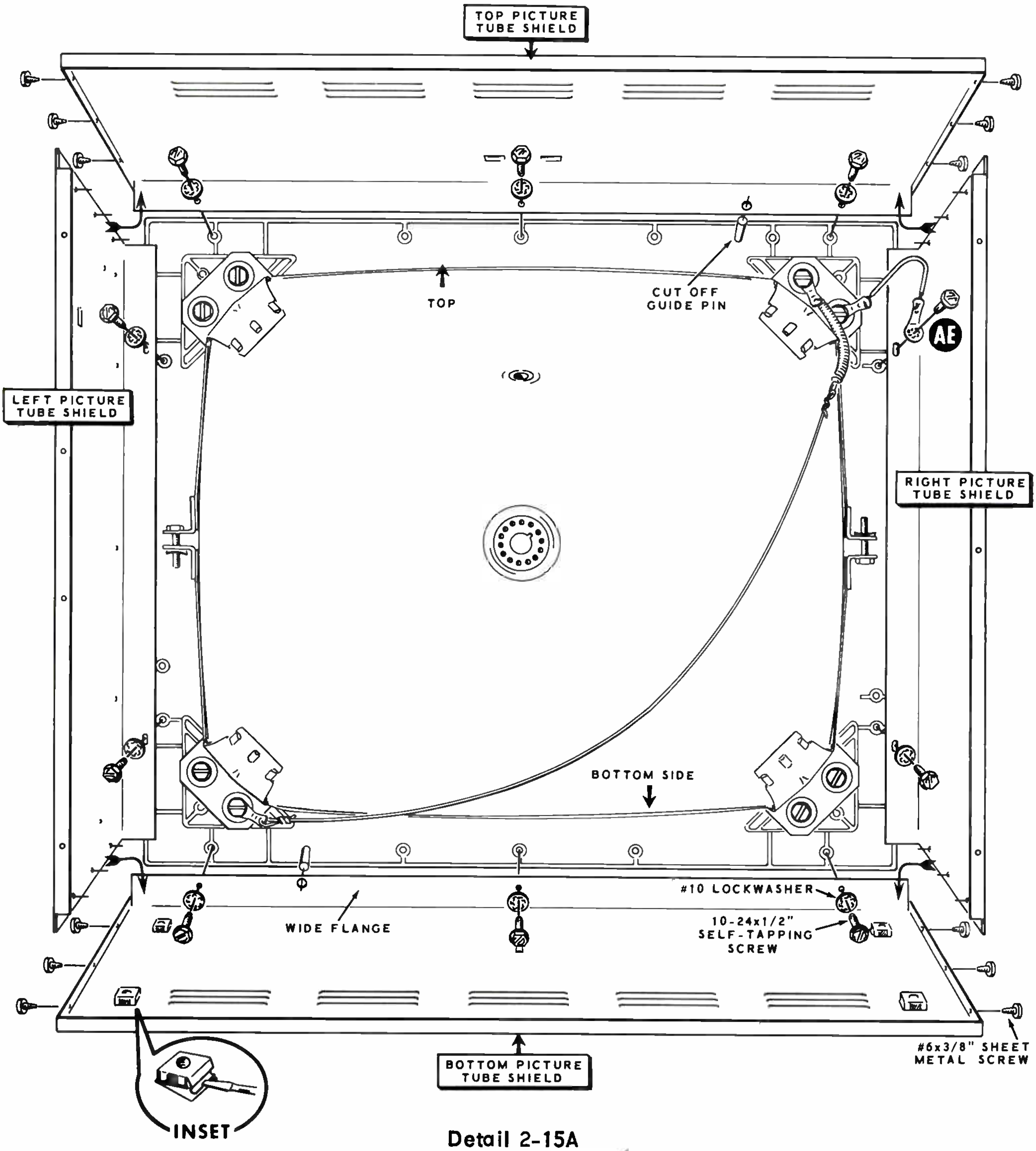
( ) Tighten the two screws that hold the picture tube mounting assemblies to the picture tube.

( ) Tighten the eight screws in the brackets of the picture tube assemblies. The face of the picture tube should touch the picture tube mask.

Detail 2-14D

( ) Refer to Detail 2-14D and connect one end of a 33" bare wire to the closed loop end of the coil spring.

( ) Hook the free end of the spring to solder lug AC, and connect the free end of the wire to solder lug AB. Position the wire as shown. The spring should be stretched to a length of about 2-1/2".



Detail 2-15A

Refer to Pictorial 2-15 (fold-out from Page 52) and Detail 2-15A for the following steps.

( ) Position the bottom picture tube shield as shown. Then install four 1/4-20 self-retaining nuts on this shield as shown in the inset drawing on Detail 2-15A.

( ) Refer to the inset drawing on Pictorial 2-15 and use a screwdriver to bend the tab on the bottom picture tube shield as shown. Slip a 1-1/2" length of 1/4" clear sleeving on this tab.

( ) Fasten the wide flange of this shield to the bottom side of the picture tube mask with three 10-24 x 1/2" self-tapping screws and three #10 lockwashers. NOTE: It may be easier to install these screws if the lockwasher is placed on each screw before installing it.

( ) Locate the left picture tube shield. This shield has four holes in the narrow flange and a tab in the large section.

( ) Mount the left picture tube shield on the picture tube mask with two 10-24 x 1/2" self-tapping screws and two #10 lockwashers. Position the bottom end of the left shield inside the flange on the bottom shield.

( ) Fasten the bottom shield to the left shield with three #6 x 3/8" sheet metal screws.

( ) Mount the right picture tube shield on the picture tube mask. Use two 10-24 x 1/2" self-tapping screws, with the solder lug that is connected to the brown wire under the screw at AE, and with a #10 lockwasher under the other screw. Position the bottom end of the right shield inside the flange on the bottom shield.

( ) Fasten the bottom shield to the right shield with three #6 x 3/8" sheet metal screws.

( ) Cut off the guide pin at the top side of the picture tube mask, as shown in Detail 2-15A.

( ) Bend the two tabs on the top picture tube shield toward the middle of the shield as shown in Pictorial 2-15. Slip a 1-1/2" length of 1/4" clear sleeving on each tab. There should be a 1/2" space between the ends of these tabs to install the degaussing coil in a later step.

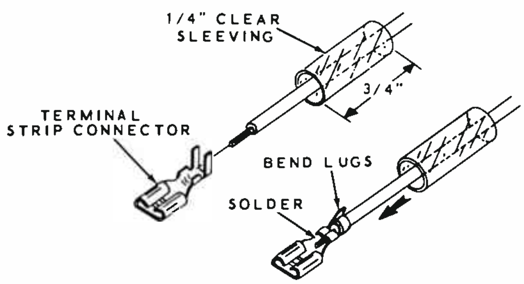
( ) Mount the top picture tube shield on the picture tube mask with three 10-24 x 1/2" self-tapping screws and three #10 lockwashers. Position the flange at the ends of the top shield on the outside of the left and right shields.

( ) Fasten the top shield to the left and right shields with #6 x 3/8" sheet metal screws.

Refer to Pictorial 2-15 for the following steps.

NOTE: When soldering the connectors to the leads in the following steps, do not allow the solder to flow in the connector grooves.

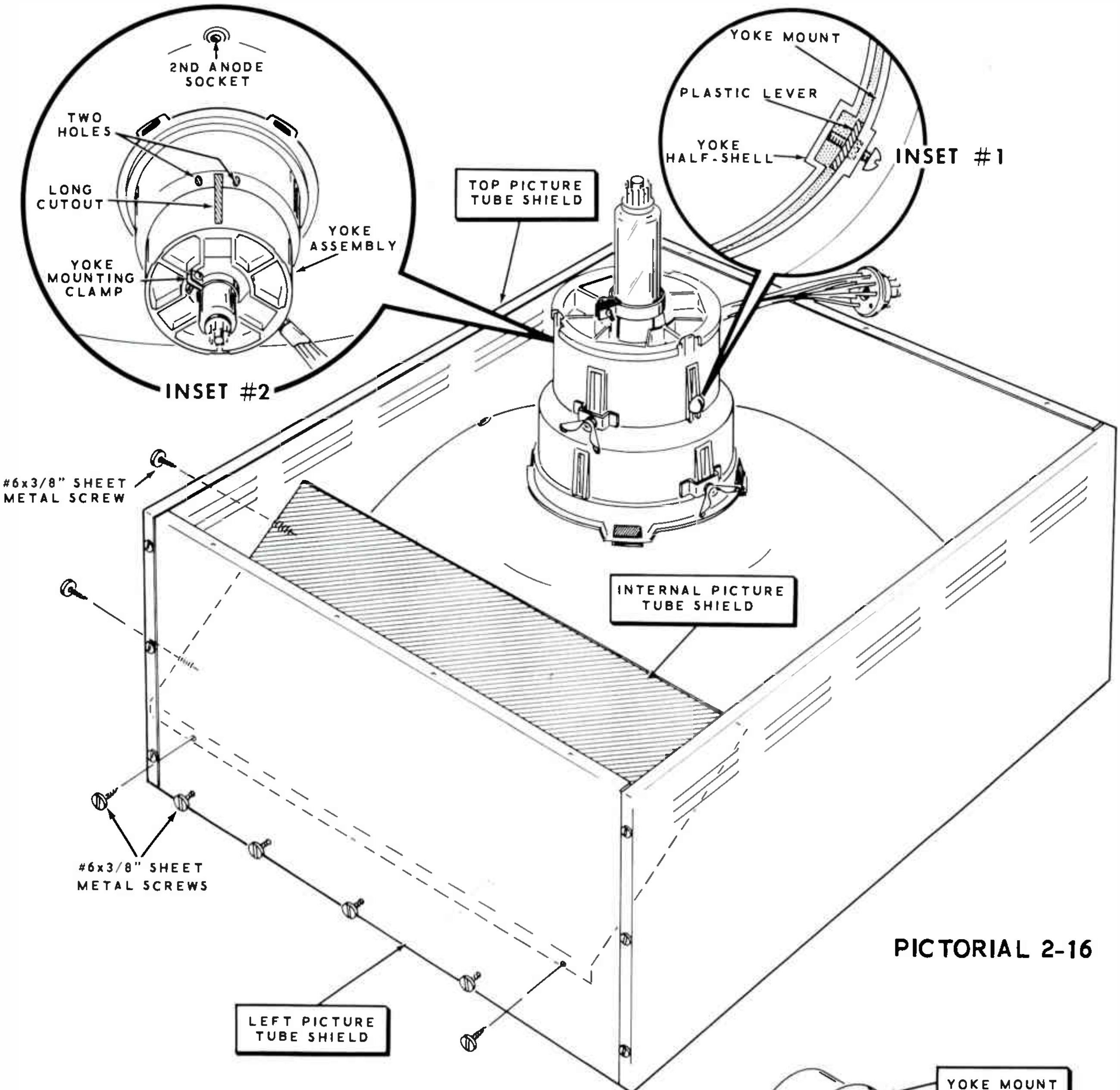
( ) Refer to Detail 2-15B and slip a 3/4" length of 1/4" clear sleeving onto one lead of the automatic degaussing coil (#40-744). Install a terminal strip connector on this lead (S-1), and bend the lugs down. Then push the sleeving over the connector.



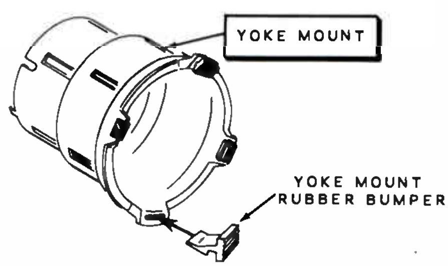
Detail 2-15B

( ) Similarly, slip a 3/4" length of 1/4" clear sleeving onto the other lead of the automatic degaussing coil. Install a terminal strip connector (S-1), bend the lugs down, and push the sleeving over the connector.

( ) Install the automatic degaussing coil in the following manner: At a location 21" from the two free leads, hook the coil on the tab at arrow #1. Then follow the numbered arrows and hook the coil on the other tabs. Position the coil over the brackets at the four corners of the picture tube and in front of the two screws holding the mounting assemblies on the picture tube. NOTE: The coil should touch the picture tube at the approximate areas shown in Pictorial 2-15.



PICTORIAL 2-16



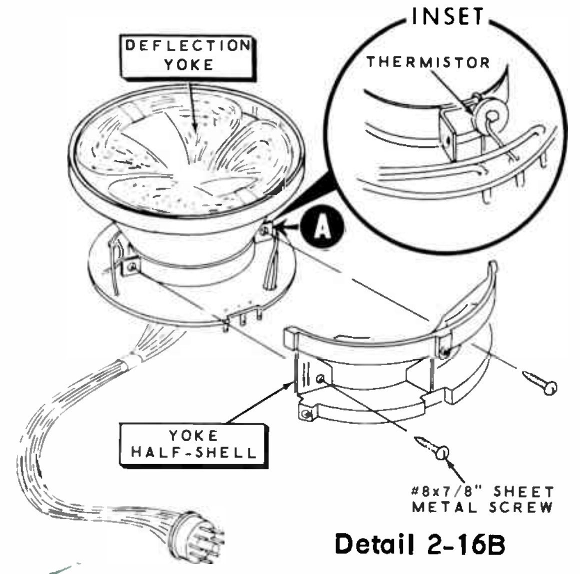
Detail 2-16A

Refer to Pictorial 2-16 for the following steps.

(✓) Install the internal picture tube shield with two #6 x 3/8" sheet metal screws through the left picture tube shield. Also, fasten the internal shield to the top picture tube shield with two #6 x 3/8" sheet metal screws.

(✓) Start #6 x 3/8" sheet metal screws into the four holes near the bottom side of the left picture tube shield, as shown.

(✓) Refer to Detail 2-16A and install four yoke mount rubber bumpers on the yoke mount. Push each rubber bumper into the slot until it locks in place.



Detail 2-16B

( ) Install the yoke half-shell on the deflection yoke (#58-7) with two #8 x 7/8" sheet metal screws as shown in Detail 2-16B. Tighten each screw an equal amount. Make sure the screw at A does not touch the lead of the thermistor which is connected to the yoke. Refer to the inset drawing on Detail 2-16B.

Refer to Detail 2-16C and Pictorial 2-16 for the following steps.

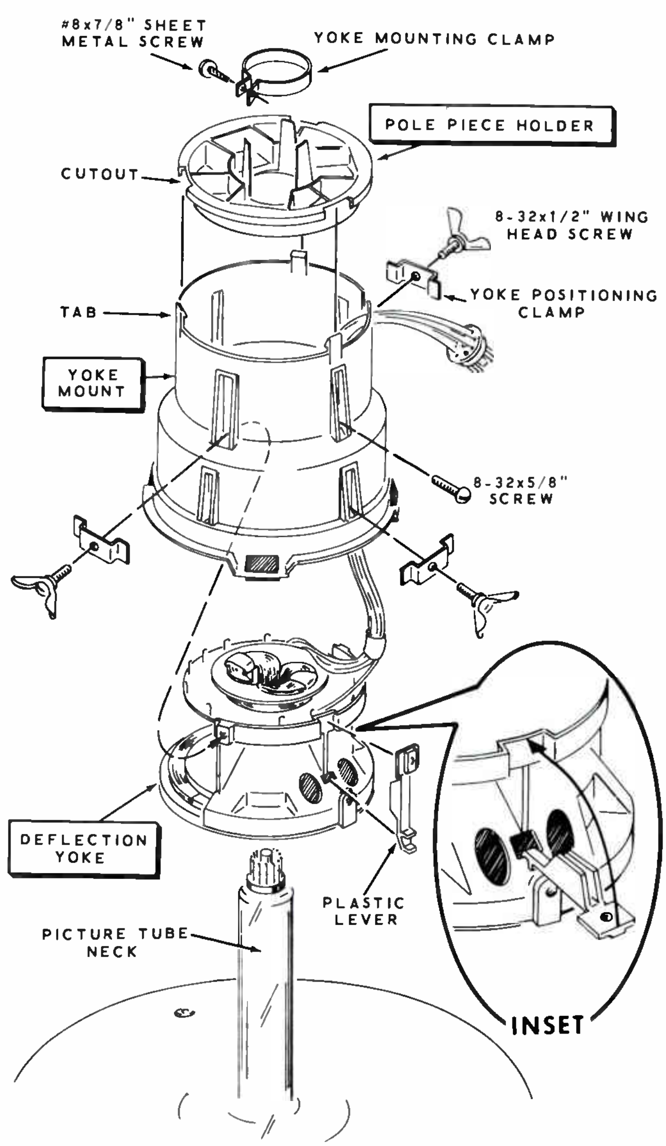
( ) Install the deflection yoke on the neck of the picture tube. Position the yoke with its cable as shown.

( ) Refer to the inset drawing on Detail 2-16C and insert the plastic lever in the hole on the side of the deflection yoke. Then, while holding this lever in place, slip the yoke mount down over the deflection yoke.

( ) Fasten the yoke mount to the deflection yoke with an 8-32 x 1/2" wing-head screw and a yoke positioning clamp at each of the three locations shown on the Detail.

( ) Install an 8-32 x 5/8" screw through the yoke mount and into the plastic lever. Tighten this screw so it just touches the yoke half-shell and the lever is tight against the yoke mount. See inset drawing #1 on Pictorial 2-16.

( ) Install the pole piece holder into the yoke mount as follows: Position the pole piece holder with its cutouts over the three tabs on the yoke mount; then push the pole piece holder into the yoke mount until it snaps in place.



Detail 2-16C

( ) Refer to inset drawing #2 on Pictorial 2-16 and position the yoke assembly with its long cutout in line with the 2nd anode socket of the picture tube. This long cutout is located between two holes in the yoke mount.

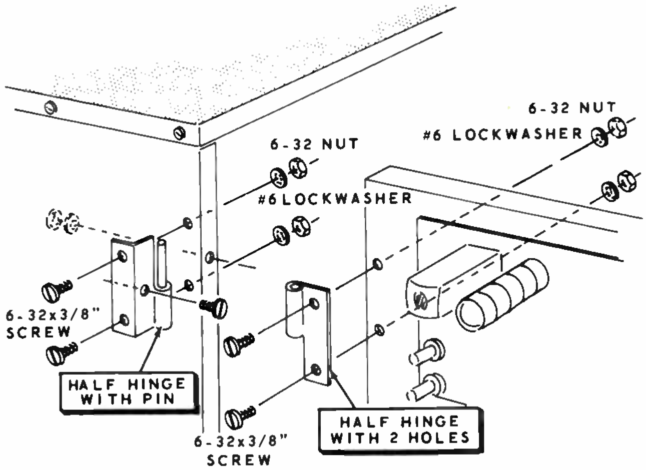
( ) Fasten the yoke assembly on the picture tube neck with a yoke mounting clamp and a #8 x 7/8" sheet metal screw. Be sure to position the yoke assembly correctly and tighten the screw just enough to hold the assembly in place.

CHASSIS, SHIELD, AND BRACKET ASSEMBLY

Refer to Pictorial 2-17 (fold-out from Page 63) for the following steps.

( ) Position the picture tube and shield assembly with the bottom of the shield on your work surface as shown.

( ) Refer to Detail 2-17A and mount a half hinge with pin (#265-10) at each of the two locations shown on the picture tube shield. Use 6-32 x 3/8" hardware.



Detail 2-17A

( ) Mount a half hinge with 2 holes (#265-11) at each location shown on the chassis. Use 6-32 x 3/8" hardware. Position the half hinges as shown in the Detail.

NOTE: Be careful not to bump the neck of the picture tube while handling the chassis in the following step.

( ) Line up the half hinges on the chassis with the half hinges on the picture tube shield; then hang the chassis on the picture tube shield as shown.

( ) Bend up the tab on the left picture tube shield as shown in Pictorial 2-17. Slip a 1-1/2" length of 1/4" clear sleeving on this tab.

Refer to Detail 2-17B and Pictorial 2-17 for the following steps.

( ) Connect a 4-1/2" brown wire from lug 3 of control CF (S-1) to tab CK (NS) on the convergence bracket assembly.

( ) Connect a 470 KΩ (yellow-violet-yellow) resistor from lug 3 of control CJ (S-1) to tab CK (S-2).

( ) Locate BO#12 of the wiring harness. There are no coaxial cables at this breakout.

Connect the wires coming from BO#12 to the controls on the convergence bracket in the following steps:

( ) White-red to lug 1 of control CD (S-1).

( ) White-blue to lug 2 of control CD (S-1).

( ) Gray to lug 1 of control CE (S-1).

( ) Blue to lug 2 of control CE (S-1).

( ) Black to lug 2 of control CF (S-1).

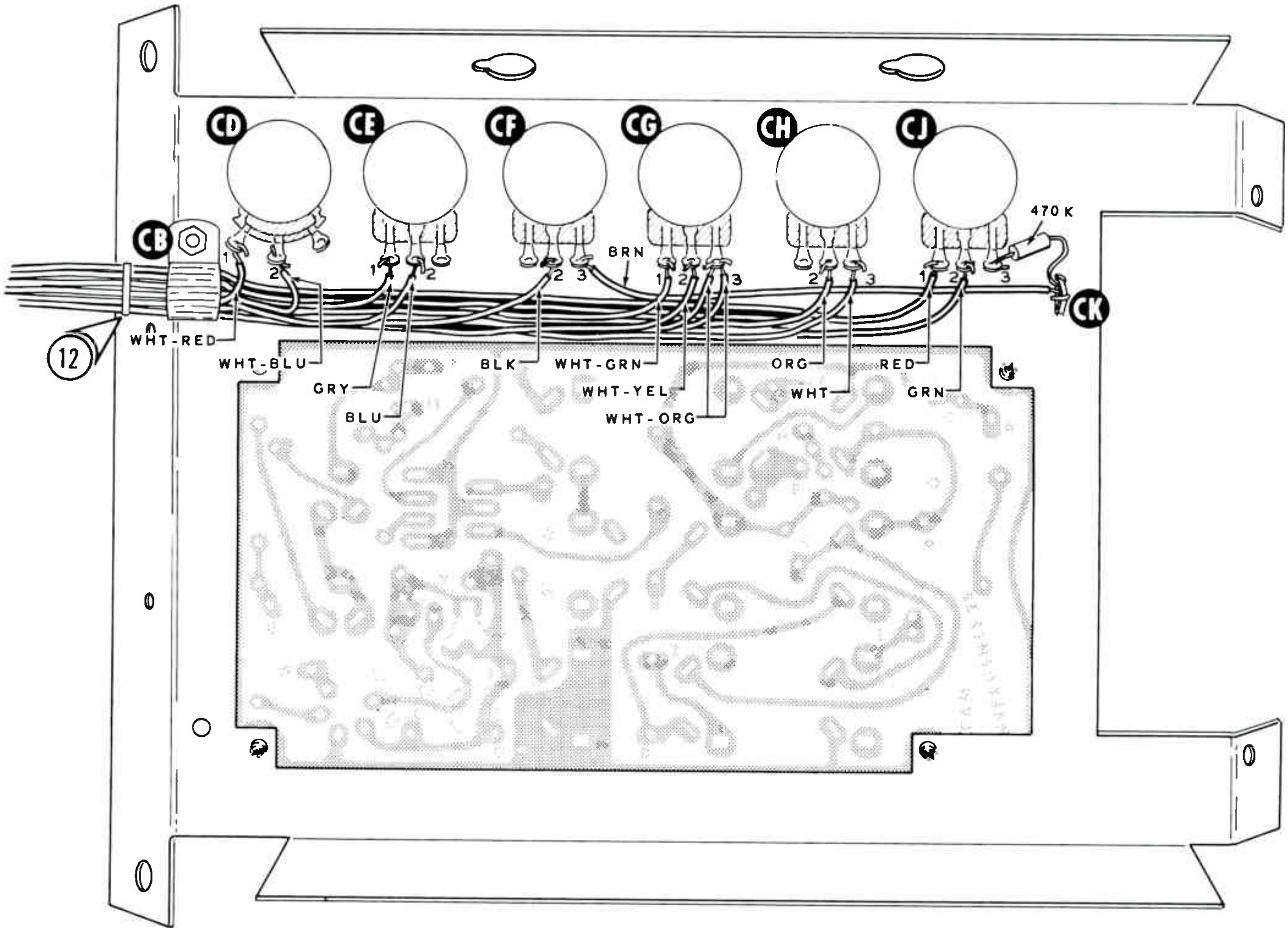
( ) White-green to lug 1 of control CG (S-1).

( ) White-yellow to lug 2 of control CG (S-1).

( ) Two white-orange wires to lug 3 of control CG (S-2).

( ) Orange to lug 2 of control CH (S-1).

( ) White to lug 3 of control CH (S-1).



Detail 2-17B

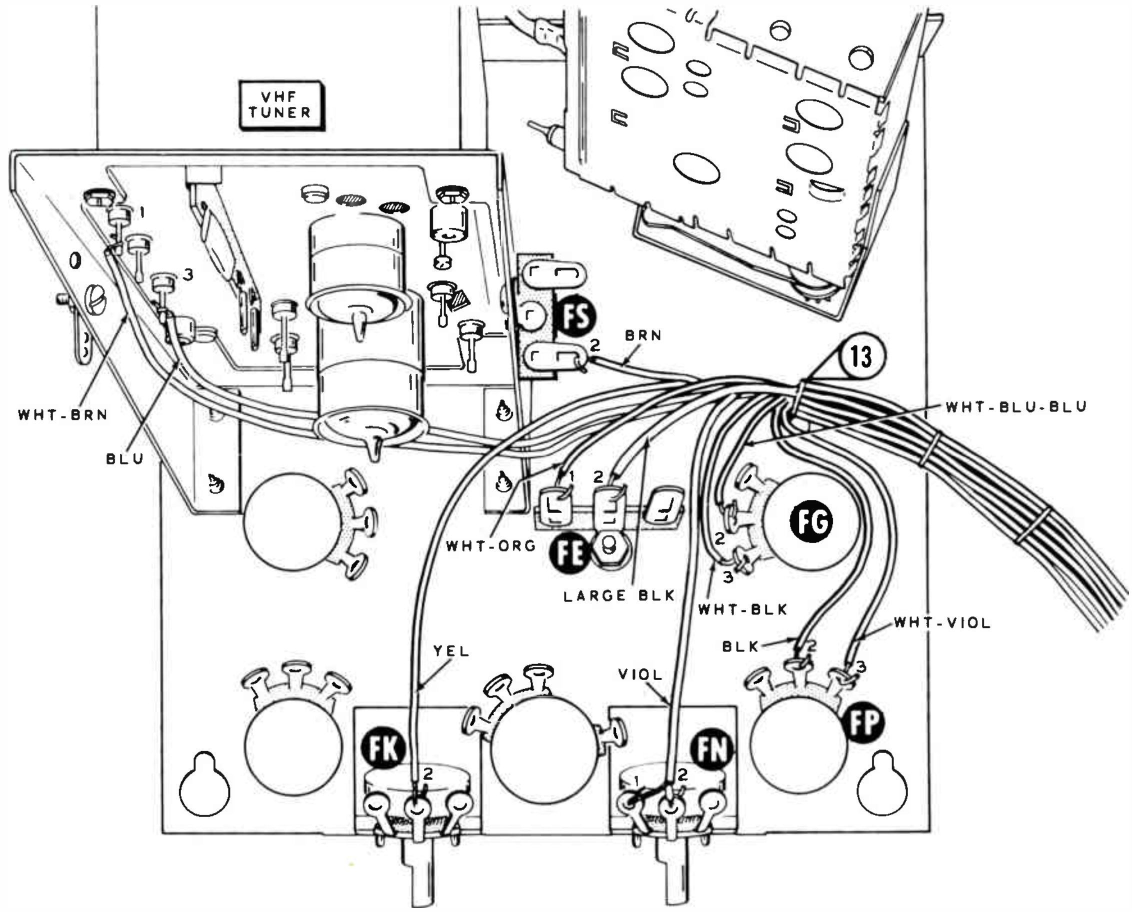
( ) Red to lug 1 of control CJ (S-1).

( ) Green to lug 2 of control CJ (S-1).

( ) Slip a 1/4" cable clamp over the wiring harness and mount the clamp at CB with 6-32 x 3/8" hardware.

This completes the wiring of the convergence bracket assembly.

( ) Refer to Pictorial 2-17 and hang the convergence bracket on the picture tube shield using the two screws near the top of the shield; then tighten the screws.



Detail 2-17C

Refer to Detail 2-17C for the following steps.

Connect the wires coming from BO#13 to the locations called out on the tuner bracket in the following steps:

( ) White-blue-blue to lug 2 of control FG (S-1).

( ) White-black to lug 3 of control FG (S-2).

( ) Large black to lug 2 of terminal strip FE (S-3).

( ) White-orange to lug 1 of terminal strip FE (S-2).

( ) White-violet to lug 3 of control FP (S-2).

( ) Black to lug 2 of control FP (S-2).

( ) Center conductor of violet coaxial cable to lug 2 of control FN (S-1).

( ) Shield of violet coaxial cable to lug 1 of control FN (S-3).

( ) Yellow to lug 2 of control FK (S-1).

( ) Brown to lug 2 of terminal strip FS (S-3).

( ) Blue to lug 3 of the VHF tuner (S-2).

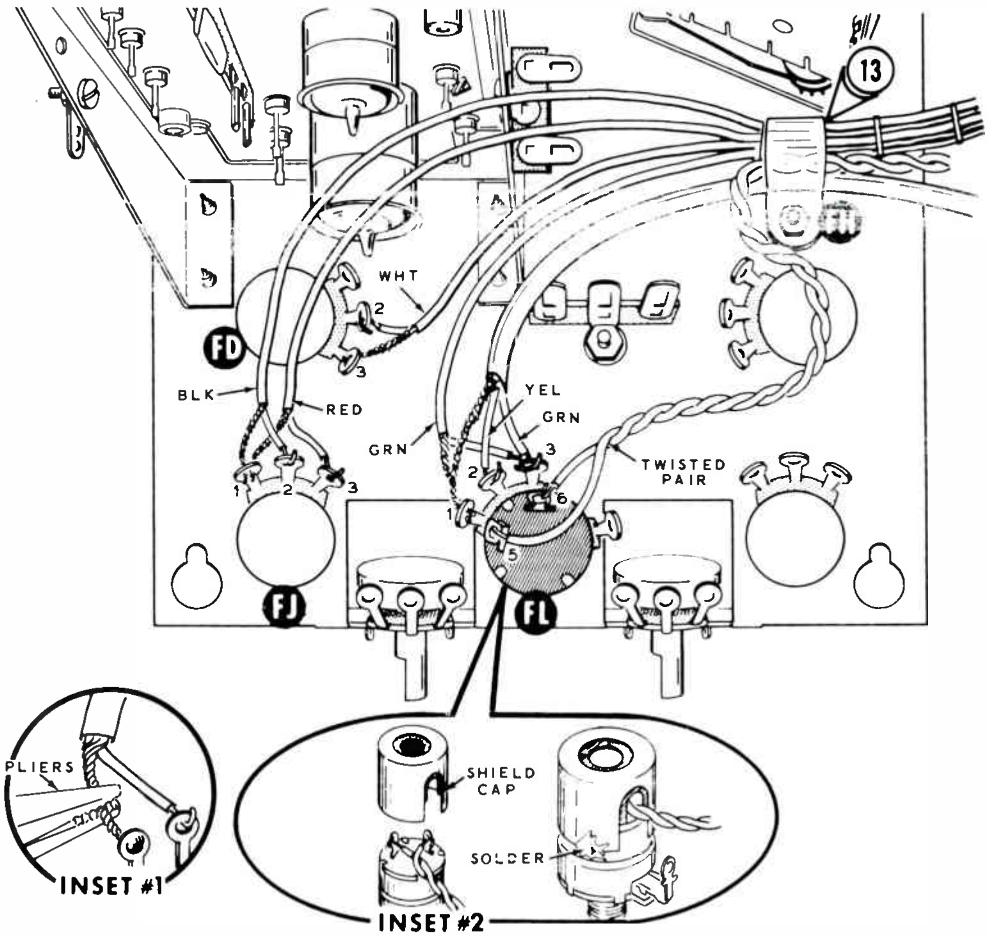
( ) White-brown to lug 1 of the VHF tuner (S-1).

Refer to Detail 2-17D for the following steps.

Connect the coaxial cables coming from BO#13 in the following steps.

NOTE: When soldering the shield lead on each of these cables, clamp a pair of long-nosed pliers on the shield as shown in inset drawing #1 on Detail 2-17D. The pliers will act as a heat sink and prevent the insulation on the inner lead from melting.

( ) Inner lead of white coaxial cable to lug 2 (S-1) and the shield to lug 3 (S-1) of control FD.



Detail 2-17D

( ) Inner lead of black coaxial cable to lug 2 (S-1) and the shield to lug 1 (NS) of control FJ.

( ) Inner lead of red coaxial cable to lug 3 (S-1) and the shield to lug 1 (S-2) of control FJ.

( ) Inner lead of green coaxial cable to lug 3 (NS) and the shield to lug 1 (NS) of control FL.

Connect the free end of the 2-wire shielded cable to control FL in the next three steps:

( ) Green wire to lug 3 (S-3).

( ) Yellow wire to lug 2 (S-1).

( ) Shield to lug 1 (S-2).

( ) Remove the shield cap from control FL. Then connect either wire of the twisted pair of black wires to lug 5 (S-1) and the other wire to lug 6 (S-1) of control FL.

( ) Reinstall the shield cap on control FL, and position the twisted pair in the cutout on the side of the shield cap. See inset drawing #2 on Detail 2-17D.

( ) Solder the bottom edge of the shield cap to the control as shown in the inset drawing on Detail 2-17D.

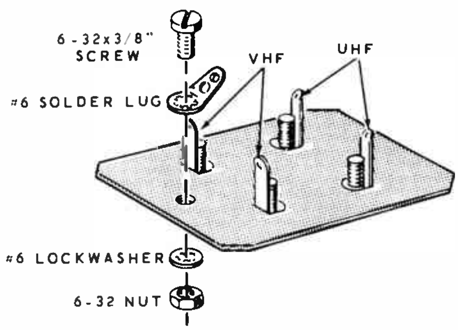
( ) Slip a 1/2" cable clamp over the wiring harness, twisted pair, and 2-wire shielded cable. Mount the clamp at FH with 6-32 x 3/8" hardware.

( ) Plug the octal plug that is on a cable connected to the convergence bracket, in the convergence socket of the chassis. This socket is located near the sound-sync circuit board.

( ) At the free end of the coaxial cable connected to the IF circuit board, plug the phono plug in socket FT of the VHF tuner.

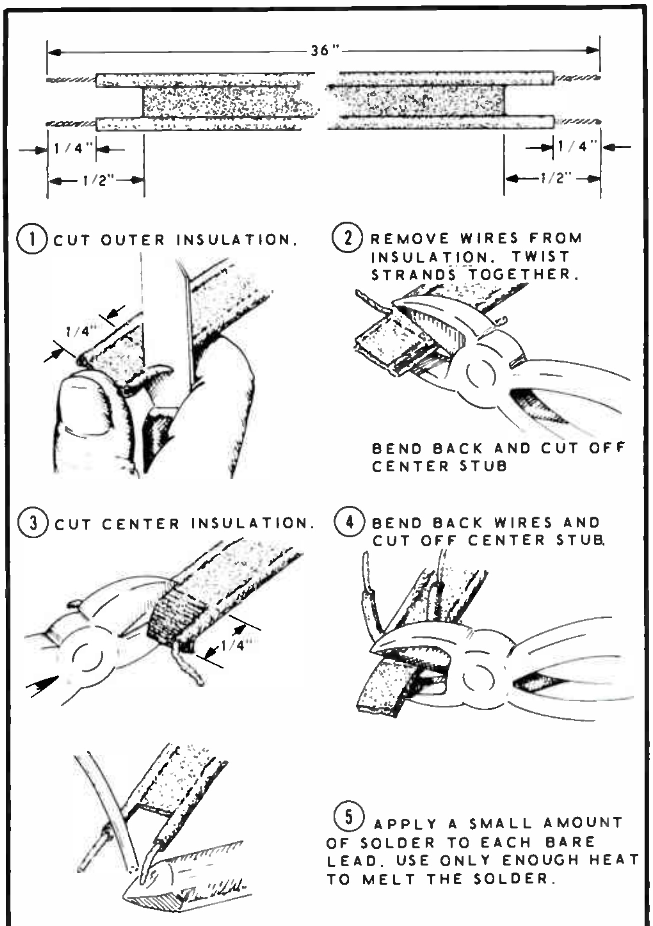
Refer to Pictorial 2-18 (fold-out from Page 63) for the following steps.

( ) Install a #6 solder lug with 6-32 x 3/8" hardware near the lugs marked VHF on the antenna (4-lug screw type) terminal strip. Refer to Detail 2-18A and position the solder lug as shown.



Detail 2-18A

( ) Prepare the 36" length of 300 Ω twin lead by completing the five steps in Detail 2-18B.



Detail 2-18B

( ) At one end of the prepared twin lead, connect either lead to lug 1 (S-1) and the other lead to lug 2 (S-1) of the antenna terminal strip. See the inset drawing on Pictorial 2-18. Lugs 1 and 2 on the antenna terminal strip are marked UHF.

(✓) At the other end of the twin lead, connect one lead to lug 1 (S-1) and the other lead to lug 2 (S-1) of the UHF tuner.

(✓) Refer to Detail 2-18C and prepare two 36" lengths of 75 Ω coaxial cable. Be sure to use the cable that is marked 75 ohm.

(✓) At one end of a prepared length of 75 Ω coaxial cable, connect the inner lead to lug 3 (S-1) and the shield to the solder lug (NS) of the antenna terminal strip.

(✓) At the other end of this shielded cable, connect the inner lead to lug 4 (S-1) and the shield to solder lug FR (NS) of the VHF tuner.

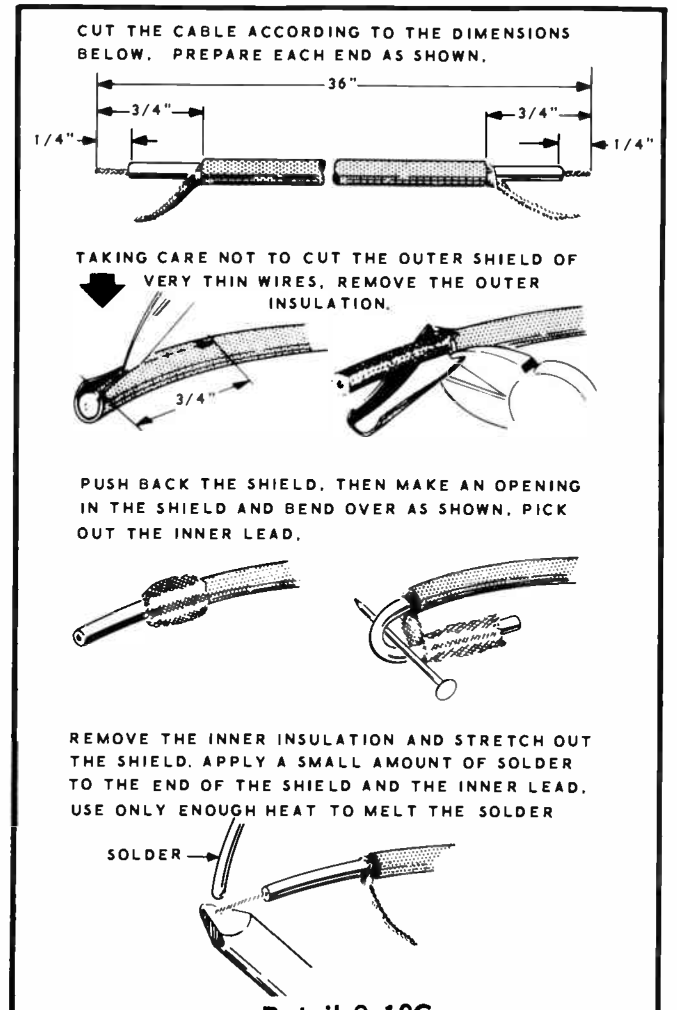
(✓) At one end of the other prepared length of 75 Ω coaxial cable, connect the inner lead to lug 4 (S-1) and the shield to the solder lug (S-2) of the antenna terminal strip.

(✓) At the other end of this shielded cable, connect the inner lead to lug 5 (S-1) and the shield to solder lug FR (S-2) of the VHF tuner.

(✓) Refer to Pictorial 2-17 (fold-out from this page) and hang the tuner bracket on the two screws near the bottom of the picture tube shield. Then tighten the screws.

(✓) Read, sign, and date the FCC certification label. Remove the protective backing and press the label into position on the picture tube shield. See Pictorial 2-17.

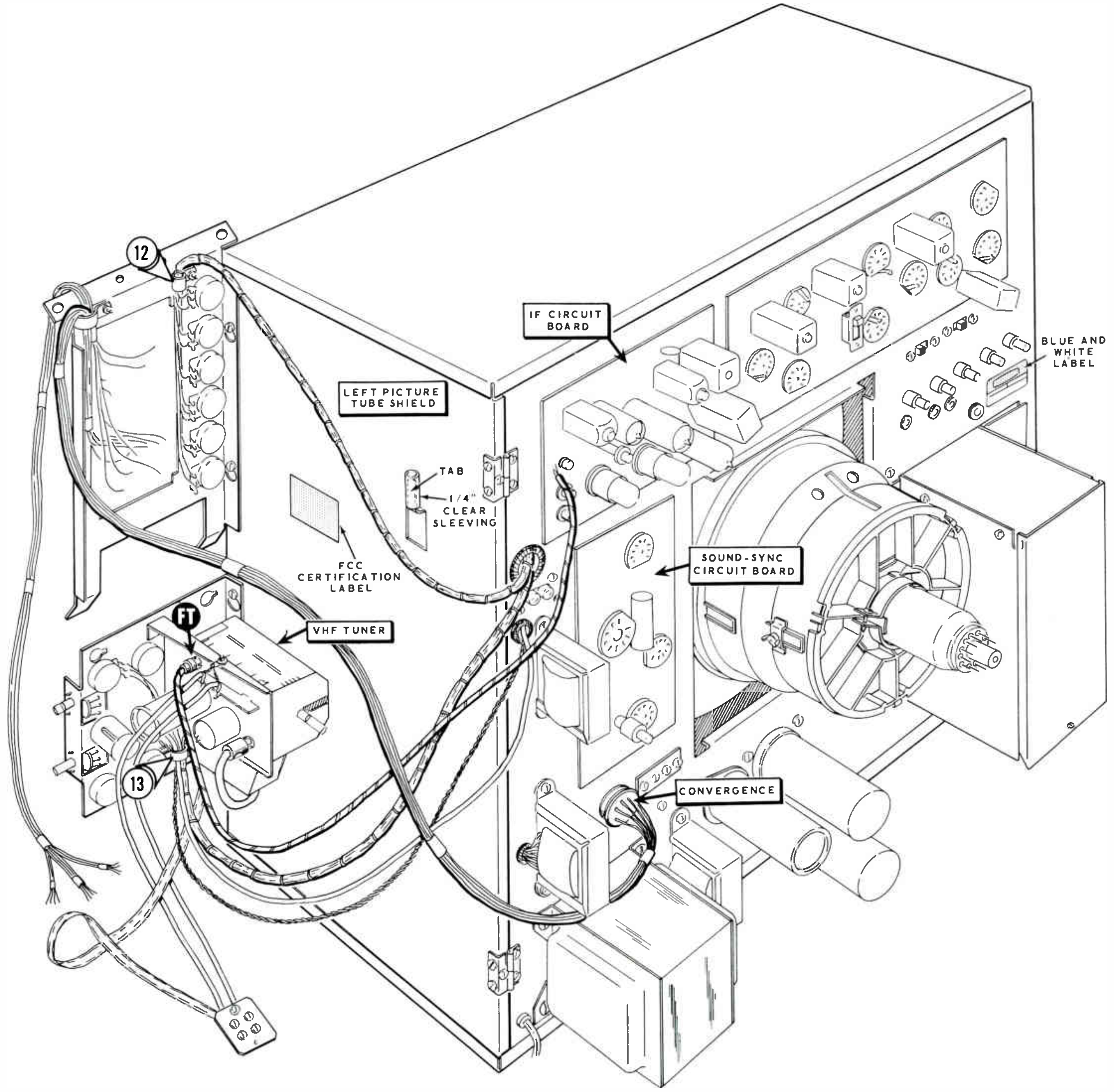
(✓) Refer to Pictorial 2-17 and install the blue and white label on the chassis (near the horizontal output assembly) as follows: Carefully peel away the backing paper and press the label into position. NOTE: The Model Number and Production Series Number of your kit is shown on this label. Refer to these numbers in any communications with the Heath Company.



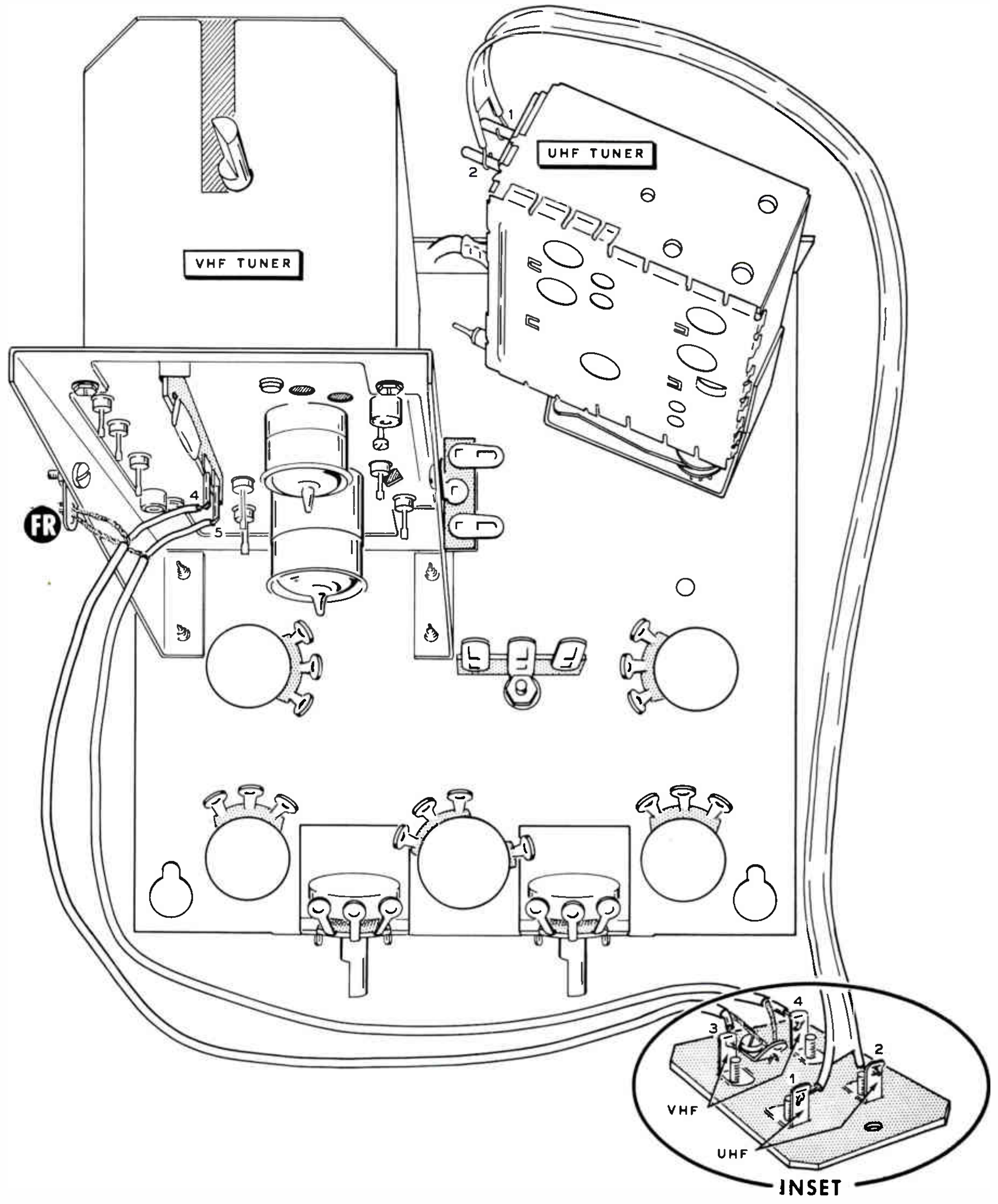
Detail 2-18C

If an ohmmeter is available, it is suggested that the following resistance check be made to insure against a possible short circuit. If the resistance measurement does not check correctly the first time, try reversing the ohmmeter test leads.

(✓) Connect the ohmmeter leads between the chassis and lug 1 of the large 5-lug terminal strip, BL. (Refer to Pictorial 2-8 fold-out from Page 41 to identify the terminal strip.) The ohmmeter should indicate a reading of about 20 KΩ after the meter pointer stops moving. A lower reading indicates a short circuit, a wiring error, or a faulty component. If the ohmmeter indicates a lower reading, check the installation of the silicon diodes. Also check the wiring of terminal strip BL, and capacitors K, N, and P. Do not turn the TV Set on until the difficulty is corrected.



PICTORIAL 2-17



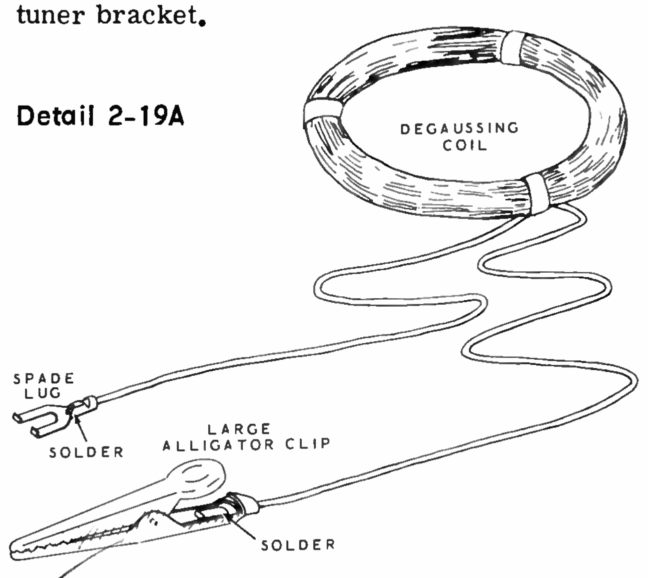
PICTORIAL 2-18

DEGAUSSING

Refer to Pictorial 2-19 for the following steps.

The following degaussing process is used to remove stray magnetism from the picture tube and the metal objects around it. Even the very weakest magnetic field can cause distortion in the form of impure colors. The parts that must be degaussed (demagnetized) in your Color TV Set are the picture tube, the picture tube shield, the chassis, the convergence bracket, and the tuner bracket.

Detail 2-19A

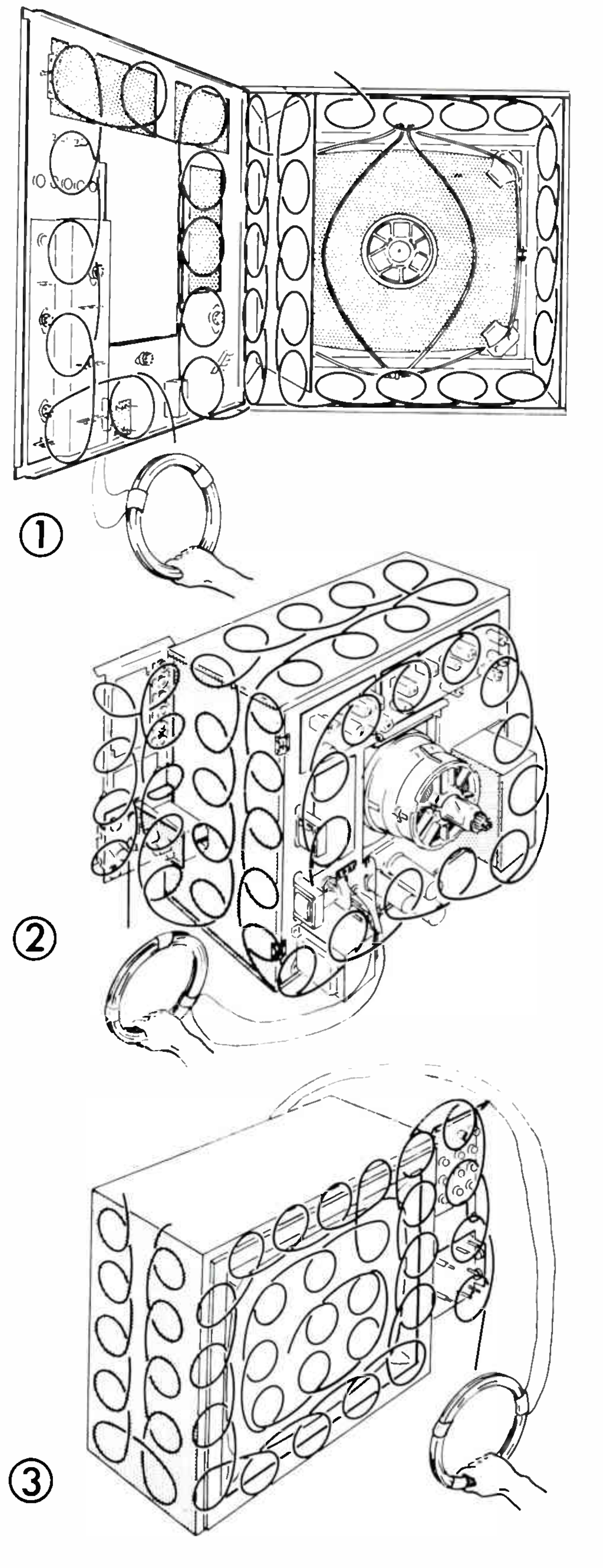


(✓) Refer to Detail 2-19A and locate the degaussing coil (#40-586), which consists of a coil of large wire. Remove 1/4" of insulation from the ends of the two coil wires. Connect a spade lug to one wire (S-1) and connect a large alligator clip to the other wire (S-1) of the degaussing coil.

(✓) Connect the degaussing coil lead with the spade lug to terminal G of terminal strip BJ as shown in Detail 2-19B. Tighten the screw at terminal G to hold the spade lug in place. CAUTION: Be sure the screw is tightened securely on the spade lug; if it were loose, the spade lug could twist to one side and touch the terminal strip mounting screw. This would burn out the power transformer.

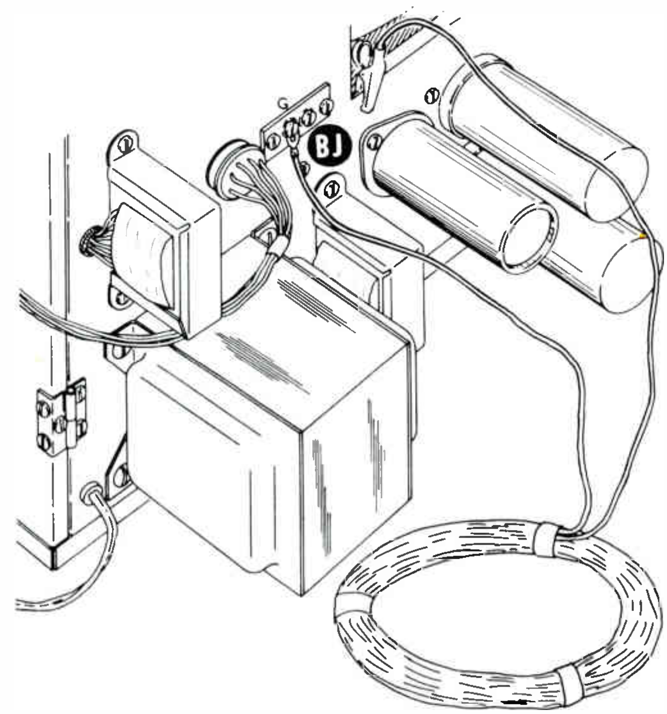
(✓) Clip the degaussing coil lead with the alligator clip to the chassis in the corner of the large chassis cutout as shown.

CAUTION: When the TV Set is placed in operation in the following steps, B+ voltage will be present at various points on the bottom side of the chassis. Do not touch any of the chassis components during the degaussing process.



PICTORIAL 2-19

NOTE: The degaussing coil will vibrate when power is applied, and will also tend to get warm if left turned on for too long a period of time. The entire degaussing process should take no longer than one or two minutes. When performing the degaussing process, the coil should be moved with small circular motions near the objects being degaussed. The coil should be kept parallel to, and at a distance of about one to two inches from the objects being degaussed. When you have completed the degaussing process, move the coil away from the TV Set as far as the leads will permit before turning the power off.



Detail 2-19B

WARNING: Do not place the degaussing coil near the pole piece assemblies while power is applied to the coil. These pole piece assemblies have not been installed yet. To identify these assemblies, refer to item #116 on the Chassis Parts Pictorial (fold-out from Page 20).

( ) Position the chassis as shown in drawing #1 of Pictorial 2-19, so the bottom side of the chassis and the inside of the picture tube shield can be degaussed first.

( ) Check to be sure the TV Set is turned off by pushing in on the VOLUME control shaft. See Pictorial 2-21 on Page 68.

( ) Plug the line cord from the TV Set into a standard 110 volt AC outlet.

NOTE: It will not be necessary to connect the free bared ends of the wires coming from the convergence bracket before degaussing the TV Set.

( ) Turn the TV Set on by pulling out on the shaft of the VOLUME control.

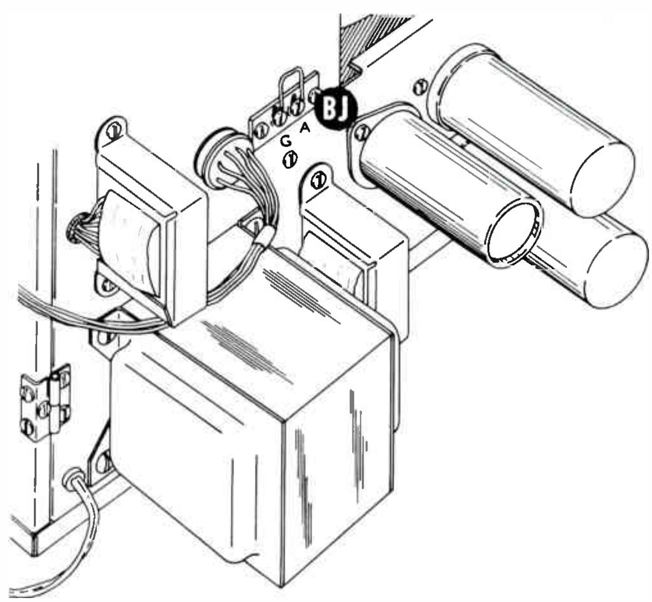
( ) Move the degaussing coil in a circular motion near the bottom side of the chassis, and around the inside of the picture tube shield, as shown in drawing #1 of the Pictorial.

( ) Similarly, degauss the top side of the chassis, the outside of the picture tube shield, the two brackets, and the picture tube face as shown in drawings #2 and #3.

( ) Move the degaussing coil as far away as possible from the TV Set; then turn the TV Set off by pushing in on the VOLUME control shaft.

( ) Unplug the line cord and disconnect the degaussing coil leads from the chassis and terminal strip.

( ) Prepare a filament fuse by removing all of the insulation from a 1-3/4" green wire. Connect this fuse wire between lugs A and G of terminal strip BJ, as shown in Detail 2-19C. Form this fuse into a loop and be sure it does not touch the chassis.



Detail 2-19C

FINAL ASSEMBLY AND WIRING

CAUTION: Before proceeding, check to be sure you have connected the ground wire and coil spring between the brackets at the lower left and upper right corners of the picture tube. Also, be sure the picture tube shield is connected with a short wire to the bracket on the upper right corner of the picture tube. If necessary, refer to Pictorial 2-15 (fold-out from Page 52) to check these connections. If the outside of the picture tube and the picture tube shield are not properly connected to chassis ground, you may receive a severe electrical shock while operating the TV Set.

Refer to Pictorial 2-20 (fold-out from Page 77) for the following steps.

( ) Clip one of the automatic degaussing coil leads on lug 1 and the other lead on lug 3 of terminal strip BK. Note that lug 2 of this large 3-lug terminal strip was bent down previously.

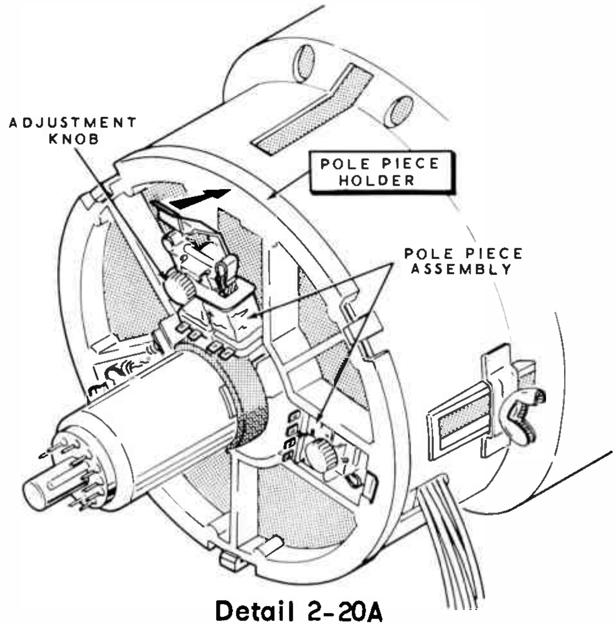
( ) Connect the high voltage lead from the horizontal output assembly to the 2nd anode socket of the picture tube. Be sure both clips are inside the hole as shown in the inset drawing on the Pictorial, and be sure the anode connector is turned as shown.

( ) Insert the free end of the yoke cable through the large chassis cutout and insert the octal plug in the socket marked YOKE. Refer to the lettering on the cover of the horizontal output assembly for the location of this socket.

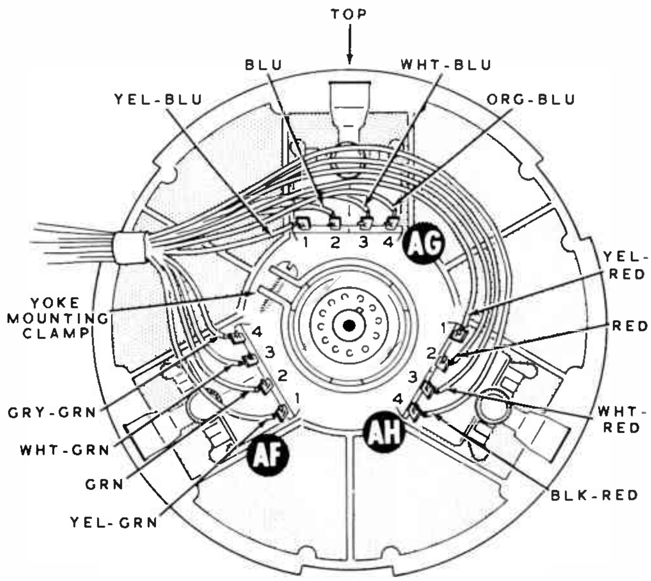
( ) Fasten the right side of the chassis to the picture tube shield with three 6-32 x 5/8" bronze screws. Be careful not to pinch any wires or cables between the bottom and right-hand sides of the chassis and the shield.

( ) Locate the three pole piece assemblies (#58-6). WARNING: When installing the pole piece assemblies in the next step, do not push on the adjustment knobs, as they can be broken very easily. See Detail 2-20A.

( ) Refer to Detail 2-20A and install each of the three pole piece assemblies as follows: Insert the end of the pole piece assembly with lugs into the pole piece holder next to the picture tube neck; then push the assembly in until the clip snaps in place. Be sure each pole piece assembly is touching the neck of the picture tube.



Detail 2-20A



Detail 2-20B

Refer to Detail 2-20B for the following steps.

( ) Check the position of the yoke mounting clamp and screw, to be sure the screw does not touch the lugs of the pole piece assemblies. If necessary, loosen this screw and reposition the yoke mounting clamp.

Connect the free end of the 12-wire cable assembly coming from the convergence bracket, to the pole piece assemblies in the following steps. NOTE: Pole piece assembly AG is located at the top, and pole piece assemblies AF and AH are at the left and right sides of the pole piece holder.

NOTE: Prepare each wire before connecting it to a lug. Twist the wire strands together and melt a small amount of solder on the bared end.

(✓) Yellow-green to lug 1 of pole piece assembly AF (S-1).

(✓) Green to lug 2 of pole piece assembly AF (S-1).

(✓) White-green to lug 3 of pole piece assembly AF (S-1).

(✓) Gray-green to lug 4 of pole piece assembly AF (S-1).

(✓) Yellow-blue to lug 1 of pole piece assembly AG (S-1).

(✓) Blue to lug 2 of pole piece assembly AG (S-1).

( ) White-blue to lug 3 of pole piece assembly AG (S-1).

(✓) Orange-blue to lug 4 of pole piece assembly AG (S-1).

(✓) Yellow-red to lug 1 of pole piece assembly AH (S-1).

(✓) Red to lug 2 of pole piece assembly AH (S-1).

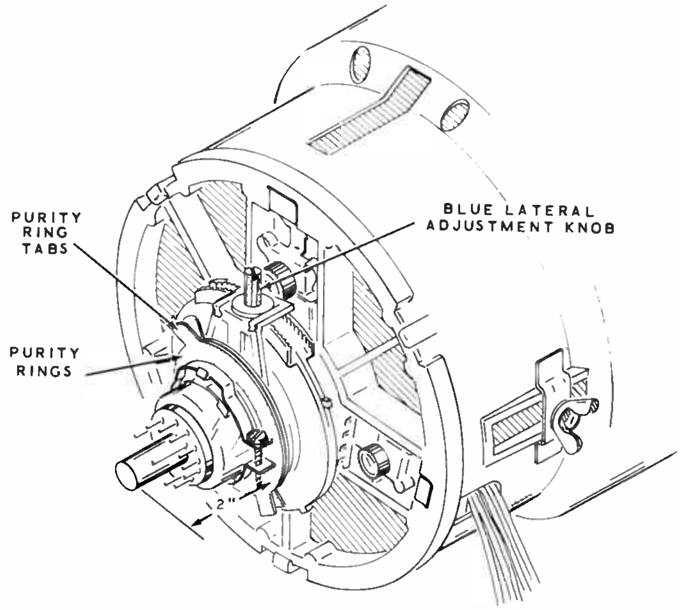
(✓) White-red to lug 3 of pole piece assembly AH (S-1).

(✓) Black-red to lug 4 of pole piece assembly AH (S-1).

(✓) Remove the plastic pin protector from the base of the picture tube.

(✓) Refer to Detail 2-20C and install the blue lateral and purity assembly (#100-582) on the neck of the picture tube. Position this assembly as follows: Position the blue lateral adjustment knob and two of the purity ring tabs at the top; position the purity rings 2" from the end of the picture tube base as shown. Tighten the clamp screw to hold the assembly in place.

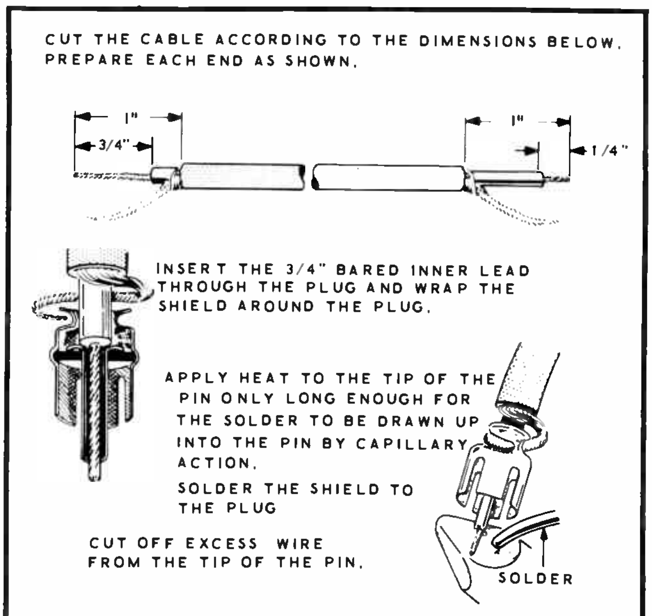
CAUTION: The area of the blue lateral magnet assembly that contacts the neck of the picture tube is coated with a heat-sensitive adhesive. If you have to remove the blue lateral assembly for any reason after the TV Set has been in operation for some time, you can twist the assembly to break the adhesive contact. Do not pry the assembly from the neck of the picture tube as this could break the glass and destroy the tube.



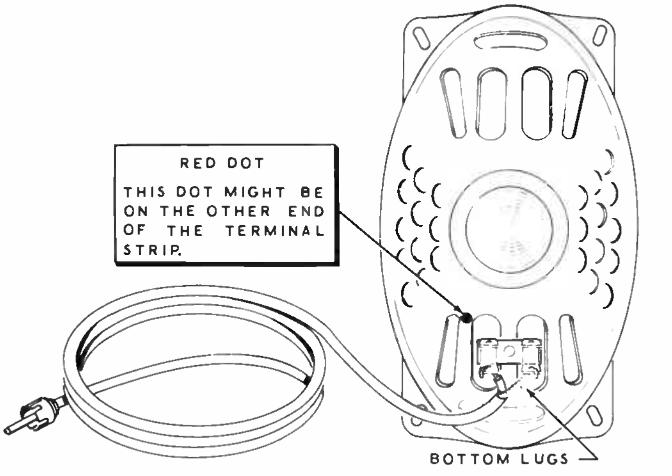
Detail 2-20C

(✓) Push the picture tube socket on the base of the picture tube until it is against the base of the tube. NOTE: Be sure the socket is pushed tightly against the base of the tube.

(✓) Refer to Detail 2-20D and prepare the ends of the 4 foot length of shielded cable. At the end of this shielded cable with the 3/4" bared inner lead, install a phono plug as shown.



Detail 2-20D



Detail 2-20E

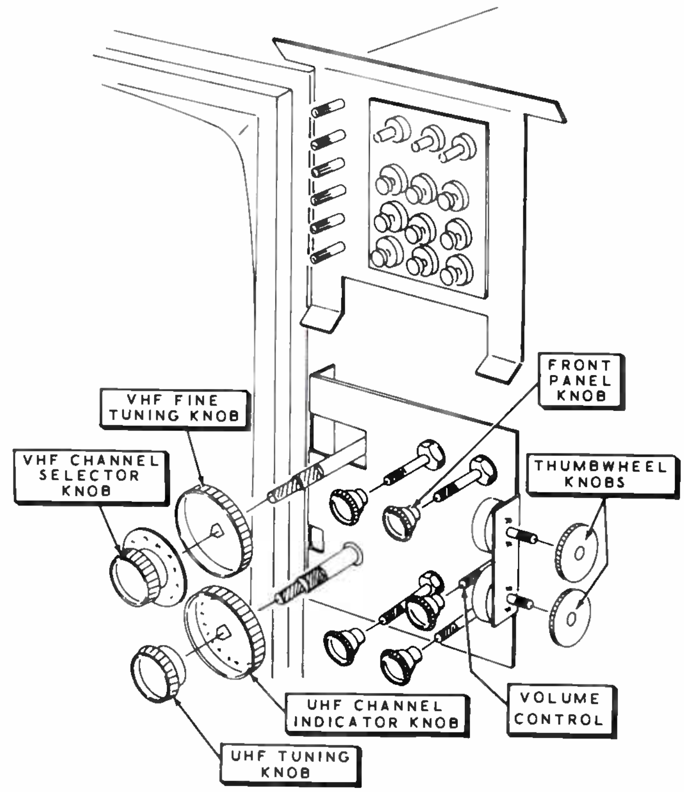
( ) Refer to Detail 2-20E and connect the other end of this cable to the speaker as follows: Connect the inner lead to the bottom lug near the red dot (S-1) and the shield to the other bottom lug (S-1). NOTE: The red dot may be located at either end of the speaker terminal strip.

NOTE: It is suggested that you punch a few holes in one side of the speaker shipping box. Then reinsert the speaker in the box to protect it during the Initial Test and Adjustment of the TV Set. Also, if you plan to use the Hi-Fi output of the TV Set, it will be necessary to prepare a shielded cable long enough to reach from this output to the input of your hi-fi amplifier. An extra phono plug is supplied for use on this cable.

( ) Plug the phono plug of the speaker cable into the SPEAKER socket. Locate this socket by referring to the lettering on the horizontal output assembly cover.

Refer to Pictorial 2-21 and install the knobs on the tuner bracket in the following steps:

( ) VHF fine tuning and VHF channel selector knobs on the VHF tuner shaft.



PICTORIAL 2-21

( ) UHF channel indicator and UHF tuning knobs on the UHF tuner shaft.

( ) Two thumbwheel knobs on the HORIZONTAL and VERTICAL HOLD control shafts.

( ) A front panel knob on each of the five remaining control shafts.

Save the left-over hardware as it will be used later to install your TV Set.

CAUTION: It will be easier if another person helps you handle the TV Set if you plan to move it to another location for test and adjustment. Use extreme care and be careful not to bump the neck of the picture tube while handling the TV Set.

NORMAL OPERATING CHARACTERISTICS

This section of the Manual explains the normal operating characteristics of your Color TV Set. Since you are observing the operation of your TV Set out of its cabinet, and you are concerned with its operation, the following conditions may appear to be difficulties. However, these operating conditions are normal for most color television receivers.

LOUD HUM AND BUZZ FROM SPEAKER DURING WARMUP

The loud hum and buzz from the speaker during warmup of the TV Set is normal for the first 30 to 60 seconds. The tubes in various circuits of the TV Set warm up at a different rate. Some of these circuits produce hum and buzz until they receive a signal from circuits that warm up at a slower rate.

LOUD BUZZ IN SOUND DURING INTENSE COLOR OR ONE COLOR SIGNAL

An intense color signal or a signal of predominantly one color is usually stronger than the average signal for which the AGC control has been set. Therefore, when these occasional strong signals are received, the AGC is overdriven, causing the buzz. This condition usually exists on commercials or program titles. The buzz will disappear as soon as the commercial or title is over.

SNAPPING NOISE

An occasional snapping (arcing) may be heard during the first two weeks of operation. This arcing, which occurs between the elements of the color picture tube, is normal during the initial aging of the picture tube.

TRAILING EDGES OR GHOSTS ON LETTERS OR TITLES

Trailing edges or ghosts on letters or titles is a television signal transmission problem and is not a fault of the TV Set. This is indicated by noticing that this condition will appear only on some channels and not on other channels.

VERTICAL LINES

You may notice faint vertical lines on the extreme left-hand edge of the picture. This is a normal characteristic which cannot be totally eliminated in TV Sets. However, this characteristic has been minimized through careful circuit design.

NORMAL TRANSFORMER OPERATION

Power

The power transformer normally feels quite hot to the touch. This condition is caused by the normal heating of the transformer itself and by the heat radiated by tubes in the Set. This was taken into consideration in the transformer design.

High Voltage

A small quantity of wax may melt from high voltage transformer T701. This is caused by the high operating temperatures in this area. This condition has been taken into consideration in the design of the transformer.

Vertical Output Transformer

The vertical output transformer normally will buzz. This is caused by the physical makeup of the transformer and the frequency at which its circuitry operates.

INITIAL TEST AND ADJUSTMENTS

INITIAL TEST

The locations of all necessary adjustments are shown in Figure 1-1 (fold-out from Page 77). This Figure is divided into two sections: a rear view of the chassis and a front view of the chassis.

Refer to Figure 1-1 for the following steps.

( ) Set all front controls except the UHF and VHF CHANNEL SELECTORS as follows:

BRIGHTNESS - Center of rotation.
TINT - Center of rotation.
CONTRAST - Center of rotation.
VOLUME - Off (pushed in).
HORIZONTAL HOLD - Center of rotation.
VERTICAL HOLD - Center of rotation.
COLOR - Fully counterclockwise.
VERTICAL LINEARITY - Fully counterclockwise.
HEIGHT - Fully counterclockwise.
AGC - Center of rotation.
COLOR KILLER - Center of rotation.
SYNC - Center of rotation.
DOTS - Center of rotation.

( ) Set all the controls on the convergence circuit board (but not the coils) to the center of their range.

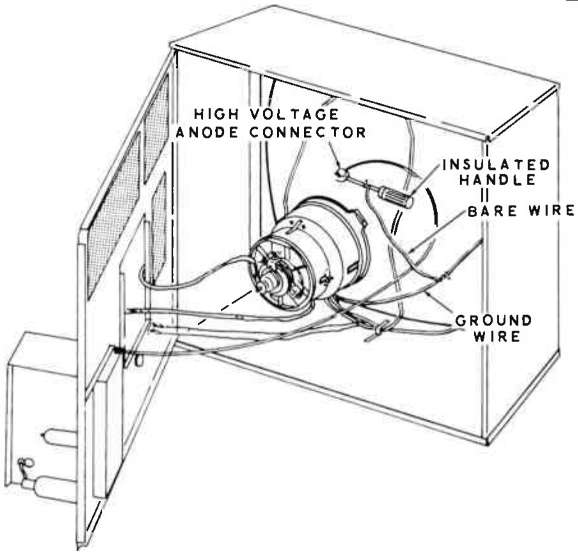
( ) Set the rear chassis controls and switches as follows:

NORMAL-SERVICE - NORMAL
KINE-BIAS - Position 3.
BLUE DRIVE - Center of rotation.
GREEN DRIVE - Center of rotation.
BLUE SCREEN- Center of rotation.
GREEN SCREEN - Center of rotation.
RED SCREEN - Center of rotation.
TOP-BOTTOM PINCUSHION - Center of rotation.
DOTS-NORMAL - NORMAL.

Be sure the speaker is connected to the SPEAKER socket.

( ) Connect the lead-in wire or wires from your VHF and/or UHF antennas to the correct antenna terminals.

WARNING: Extremely high voltage (24,000 volts) is present in the horizontal output assembly and at the high voltage anode of the picture tube. A very high voltage is also present at the cap on the top of horizontal output tube V701. Extreme care should be taken to make sure that you do not touch any of these parts while the TV Set is in operation. A safe rule to remember when you work around any high voltage is to use only one hand to work on a circuit and keep the other hand behind you. This helps prevent your body from becoming part of an electrical circuit by being connected from the high voltage to ground.



NOTE: TO DISCHARGE THE HIGH VOLTAGE ANODE, WRAP ONE END OF A BARE WIRE AROUND THE GROUND WIRE. WRAP THE OTHER END OF THE BARE WIRE AROUND THE METAL PART OF A SCREWDRIVER. HOLD THE SCREWDRIVER BY THE INSULATED HANDLE AND TOUCH THE BLADE TO THE WIRES UNDER THE RUBBER CAP OF THE HIGH VOLTAGE ANODE CONNECTOR.

Figure 1-2

The capacitance between the inner and outer conductive coatings of the picture tube allows a high voltage charge to be stored at the high voltage anode. Be sure to discharge the picture tube as shown in Figure 1-2 before disconnecting the high voltage anode connector.

( ) Plug the line cord into a standard AC outlet.

NOTE: Three images, one of each color, will probably appear when the TV Set is first turned on and tuned to a station in the next step. This condition, which is shown in Figure 1-3 (fold-out from Page 81), will be remedied during this adjustment procedure.

If any sign of malfunctioning appears in the following step, turn the TV Set off and refer to the In Case Of Difficulty section on Page 96. Prolonged operation of a malfunctioning set could result in damaged tubes or components. For example: no light on the picture tube may be caused by a lack of high voltage. In this case, tube V203 (6EJ7) should be removed until light appears on the screen again. (A malfunctioning high voltage circuit causes no AGC to be produced, and no AGC allows tube V203 to overload and draw excessive current. Refer to the Circuit Description on Pages 155 and 156).

NOTE: An occasional snapping (arcing) may be heard when the TV Set is first turned on. This arcing occurs between the elements of the color picture tube during its initial aging process.

( ) Turn the TV Set on by pulling outward on the VOLUME control. After a few moments light should appear on the face of the picture tube and sound should be heard from the speaker. If a picture and sound can be tuned in, proceed with the following steps, even if the picture does not have the correct color and size. In case you have no picture at all, check the settings of the BRIGHTNESS, AGC, HORIZONTAL HOLD, and VERTICAL HOLD controls.

PRELIMINARY ADJUSTMENTS

( ) Turn the CHANNEL SELECTOR to your strongest local station. Use the FINE TUNING and the other front panel controls to tune in the best possible black and white picture. Make sure the COLOR control is turned fully counterclockwise. (Refer to Figure 2-3 fold-out from Page 82 for information on how to operate the controls of the TV Set.) Do not tune in a color broadcast. When possible, a test pattern should be tuned in since the following adjustments are much easier to make with a test pattern. Generally test patterns are available for a short time in the morning when the TV station first comes on the air. Do not be concerned if some colors appear in the picture since the color circuits have not been adjusted yet.

( ) Turn the AGC control clockwise until the picture tears and/or a loud buzz is heard in the sound. Now turn the AGC control counterclockwise just enough for the tearing and buzz to disappear, or until the contrast control gives sufficient contrast when it is in the upper third of its rotation.

NOTE: If the sound is noisy or distorted when the FINE TUNING control is adjusted for the best picture, it may be necessary to adjust the quadrature coil L209, the IF plate coil L208, and the sound take-off coil L207. Refer to Sound IF And Detector Alignment Without Instruments on Page 122.

In some of the following steps, adjustments must be made at the rear of the TV Set while you watch the picture. It is often easier to make these adjustments if a large mirror is placed in front of the TV Set. Place the mirror so the picture can be easily seen while you work at the rear of the Set.

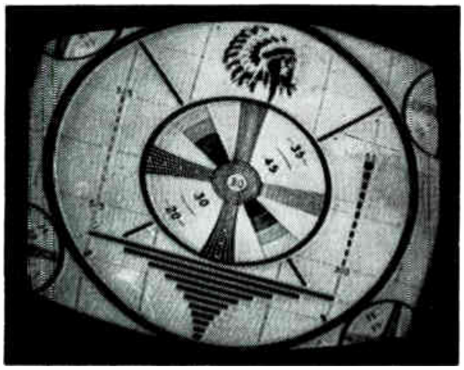


Figure 1-4

( ) If the picture is tilted, straighten it by rotating the yoke mount slightly. Do not rotate the pole piece holder. See Figures 1-4 and 1-5.

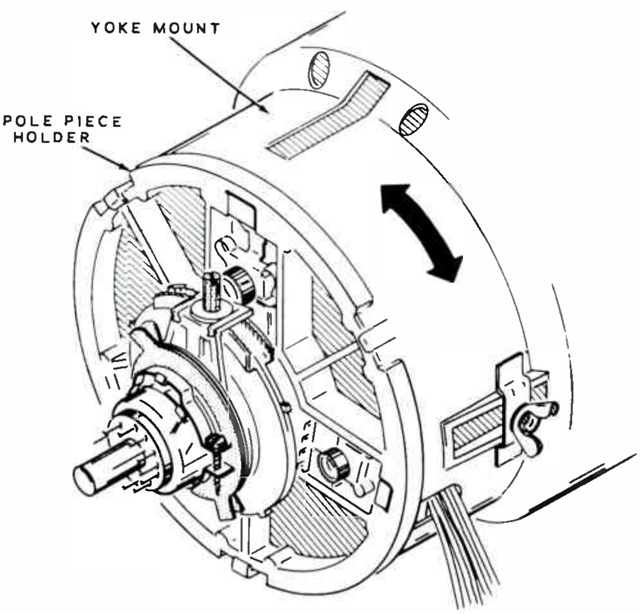
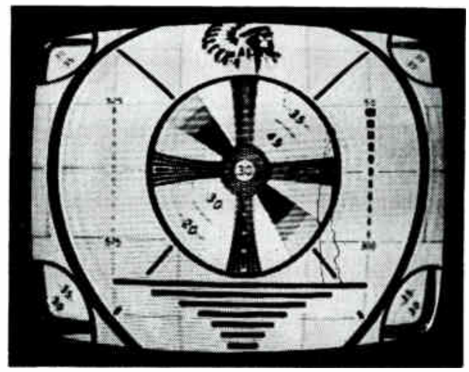


Figure 1-5

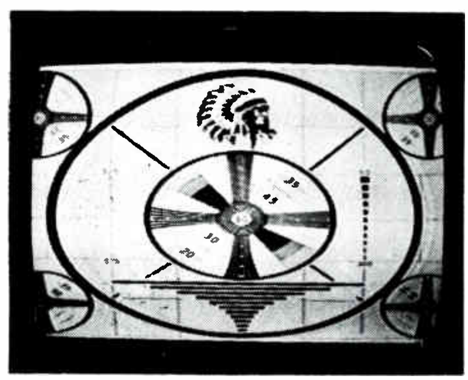
NOTE: Keep the picture locked in with the VERTICAL HOLD control while making the following adjustments for the correct height and linearity of the picture.

( ) Adjust the HEIGHT and the VERTICAL LINEARITY controls so there is approximately 1/2" of black space at the top and bottom of the picture. This size can only be obtained by compromising between the two adjustments; first adjust one control a small amount, then adjust the other. The HEIGHT adjustment primarily adjusts the bottom of the picture; the VERTICAL LINEARITY primarily adjusts the top of the picture. See Figures 1-6A, 1-6B, and 1-6C (Page 74).



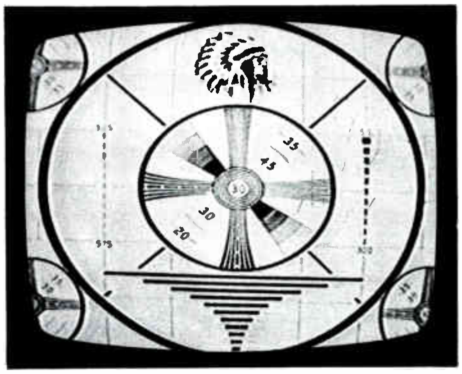
VERTICAL LINEARITY control too far counterclockwise; HEIGHT control too far clockwise.

Figure 1-6A



VERTICAL LINEARITY and HEIGHT controls too far counterclockwise.

Figure 1-6B



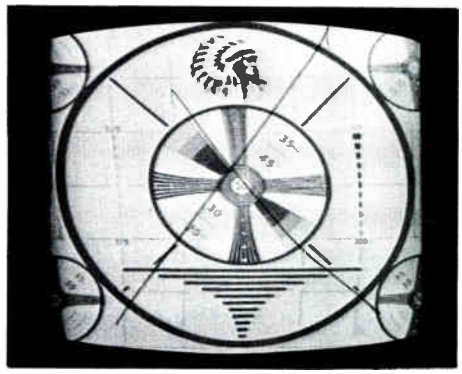
VERTICAL LINEARITY and HEIGHT controls are adjusted properly.

Figure 1-6C

NOTE: In another method that can be used to adjust height and vertical linearity, the VERTICAL HOLD control is adjusted so the picture rolls slowly downward. The controls are then adjusted so that the black bar that moves down the screen stays the same height (or thickness) all the way down the screen.

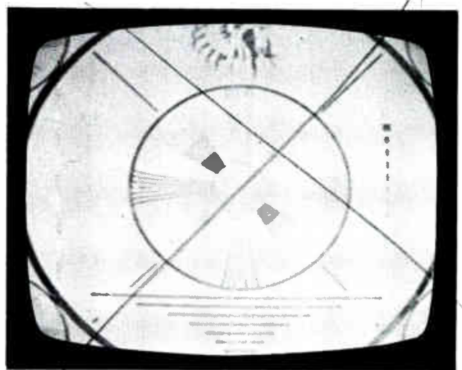
(✓) Now adjust the HEIGHT and VERTICAL LINEARITY controls to fill out the picture. When these controls are adjusted correctly, the top of the picture should seem to be about 1/2" beyond the top of the picture tube; the bottom of the picture should seem to be approximately 1/2" beyond the bottom of the picture tube.

The WIDTH coil, L807, has been preset at the factory. If the picture has the proper width as shown in Figure 1-6C, then coil L807 should not be readjusted. If the picture has insufficient or excessive width as shown in Figures 1-7 and 1-8, adjust coil L807 as follows:



Insufficient width.

Figure 1-7



Excessive width.

Figure 1-8

( ) If the picture has insufficient width, turn the adjustment screw of coil L807 counterclockwise; or if the picture has excessive width, turn the adjustment screw of coil L807 clockwise until the picture width is proper. Use a screwdriver with a thin blade to adjust this coil.

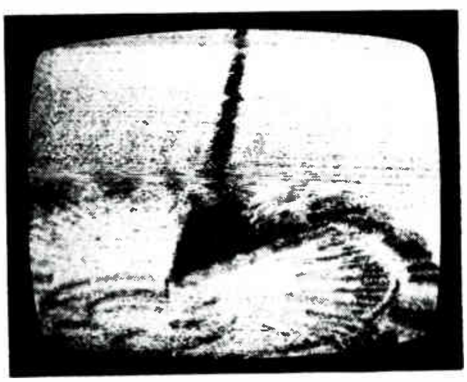


Figure 1-9A

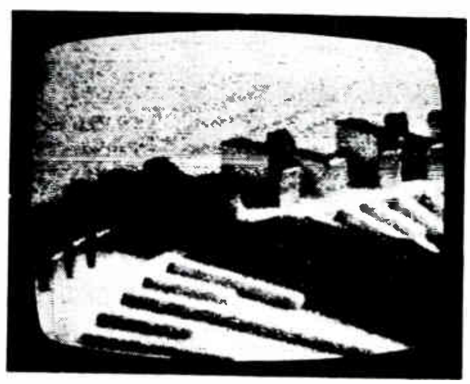


Figure 1-9B

( ) Turn the CHANNEL SELECTOR to the weakest channel and adjust the FINE TUNING for the best picture. Now adjust the SYNC control for the most stable, most solidly locked-in picture. See Figures 1-9A and 1-9B.

NOTE: The SYNC control will have the most effect in weak signal areas where there is strong electrical interference such as ignition noise, etc. The normal setting of this control is approximately 1/4 turn from the maximum counterclockwise position. If you are in a strong, noise-free signal area, the control will have little effect and should be set to this position.

DC CONVERGENCE ADJUSTMENTS

Color dots from the dot generator circuits in this TV Set (these dots are oblong in shape) are placed on the screen for the following adjustments. The purpose of these adjustments is to converge the red, blue, and green dots together to make white dots in the center area of the screen.

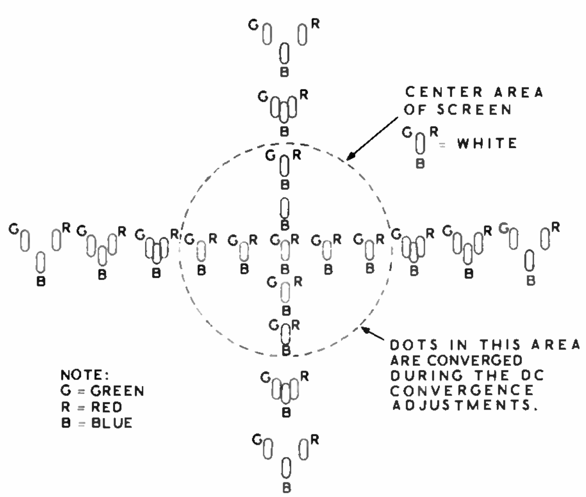


Figure 1-10A

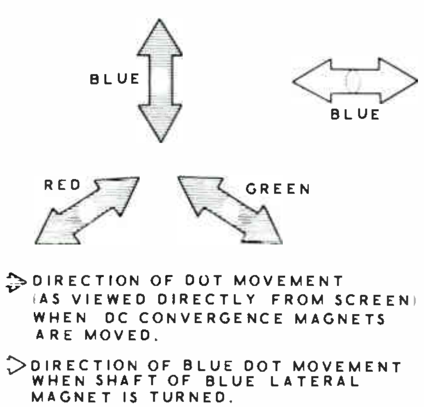


Figure 1-10B

NOTE: The DC convergence adjustments only converge the dots in the center area of the picture tube. See Figure 1-10A. Do not try to converge the dots in other areas at this time. Refer to Figure 1-10B to see which way each dot will move on the screen when you adjust the DC convergence magnets.

( ) Tune in a strong station transmitting a black and white picture, or if only color programs are available, tune in a color program and turn the COLOR control to the full counterclockwise position.

( ) Place the DOTS-NORMAL switch in the DOTS position. Note that the brightness of the dots may vary from time to time. These changes in brightness are caused by changes in light level in the TV program you are tuned to, which controls most of the circuits in the TV Set, even though dots are seen on the screen.

Keep the BRIGHTNESS control at a relatively low level when dot patterns are being used; this will keep the dots smaller in size and sharper, making them easier to work with. If the brightness level is too high a smear may appear between some rows of dots.

( ) Turn the DOTS control (see Figure 1-1 fold-out from Page 77) to obtain between 8 and 15 horizontal rows of dots, as shown in Figure 1-11 (fold-out from Page 81). Use this same adjustment to stop the dots if they should start to move or vibrate.

( ) Turn the adjustment slug in coil L405 with the alignment tool to the point where the dots are sharpest and clearest on the screen.

WARNING: Note the three upright resistors (marked BLUE TEST POINT, GREEN TEST POINT, and RED TEST POINT in Figure 1-1) at the right end of the color circuit board. Do not touch the chassis and the free ends of these resistors at the same time, since a high DC voltage is present at these three points.

These three test points are used several times to turn off the red, blue, and green guns of the picture tube. This is done by connecting one of the shorting clips to the free end of one of the resistors. Be sure to hold only the rubber insulator while connecting the shorting clips.

( ) Turn off the blue gun by connecting one of the shorting clips to the BLUE TEST POINT.

( ) Merge the green and red dots at the center of the picture tube to make yellow dots. See Figure 1-11 (fold-out from Page 81). Do this by turning the adjustment knobs of the red and green DC convergence magnets until you find the correct positions. It may be easier to merge the two colors if you move each dot back and forth first, as far as it will go, to see where it will travel to. See Figure 1-10B which shows the movement of each dot.

( ) Remove the shorting clip from the BLUE TEST POINT.

( ) Merge the blue dots with the yellow dots at the center of the picture tube by turning the blue DC convergence magnet and the shaft of the blue lateral magnet. See Figures 1-12 and 1-13 (fold-out from Page 81). When this is completed, you should have pure white dots at the center of the picture tube screen. Readjust the red or green dots slightly, if a red or green line appears at one edge of the white dots. NOTE: Some red may show around the edges of the dots. This is due to the red dots being normally slightly larger than the blue and green dots.

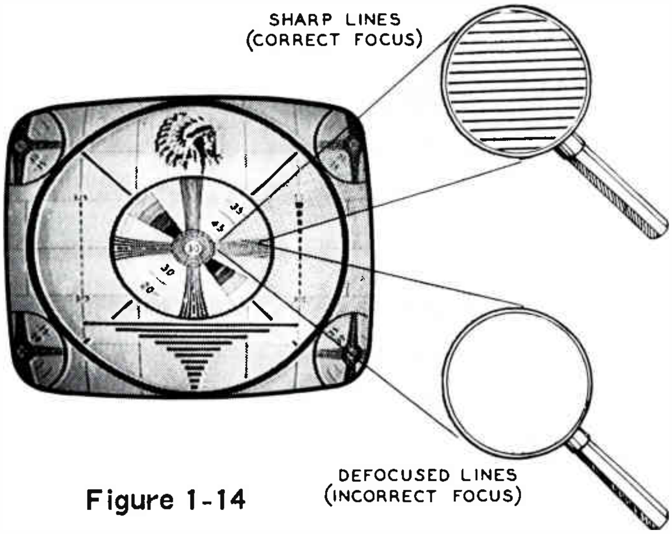


Figure 1-14

( ) Place the DOTS-NORMAL switch back in the NORMAL position and tune in a black and white broadcast.

( ) Adjust FOCUS coil L704 for the sharpest separation between the trace lines in the center of the picture as shown in Figure 1-14. You will find that you have to get quite close to the picture tube to see these individual lines and to judge when they are most sharply defined.

GRAY SCALE ADJUSTMENTS

The purpose of the adjustments in this section is to remove any predominant color shade that appears in the black and white picture.

( ) Put the NORMAL-SERVICE switch in the SERVICE position.

( ) Turn each of the following controls fully counterclockwise: BLUE SCREEN, GREEN SCREEN, RED SCREEN. The CRT screen should now be completely dark.

NOTE: If lines do not appear when you adjust any one of the three SCREEN controls in the next two steps, place the KINE-BIAS switch in position #2 or #1. Leave the KINE-BIAS switch in the highest numbered position that permits proper adjustment of all three SCREEN controls.

( ) Turn the RED SCREEN control up until a red line appears; then turn the control back to that point where this line just disappears.

( ) Repeat the previous step with the GREEN SCREEN and BLUE SCREEN controls.

( ) Put the NORMAL-SERVICE switch back in the NORMAL position.

( ) Alternately adjust the GREEN DRIVE and BLUE DRIVE controls until the shade of the picture is black and white in both the highlight and in the dimly lit areas of the picture. Some discoloring will still be seen at the top, bottom, and sides of the picture. Usually, the final settings of these controls will be approximately three-fourths of the way up from the fully counterclockwise position.

IMPORTANT: If, at this time, there is no predominant color shade in the black and white picture, disregard the following steps and proceed to the Purity Adjustments. If the screen still appears slightly purple or yellow, it will be necessary to complete the following steps.

To obtain proper gray scale adjustment and maximum response from your particular picture tube, proceed as follows: If the screen appears slightly purple, complete steps 1 and 3. If the screen appears slightly yellow, complete steps 2 and 3.

Refer to Pictorial 2-11 (fold-out from Page 47) for the following steps.

1. ( ) If the screen appears purple, interchange the yellow-red lead connected to lug 1 of terminal strip BZ and the yellow-green lead connected to lug 2 of control F.

2. ( ) If the screen appears yellow, interchange the yellow-red lead connected to lug 1 of terminal strip BZ and the yellow-blue lead connected to lug 2 of control G.

3. ( ) Now repeat the last step in the right-hand column on Page 76, under Gray Scale Adjustments. NOTE: If the wires in Step #1 were interchanged, the GREEN drive knob will not correspond to the color change on the screen. If the wires in step #2 were interchanged, the color of the BLUE drive knob will not correspond to the color change on the screen. However, this will not interfere with the adjustments.

PURITY ADJUSTMENTS

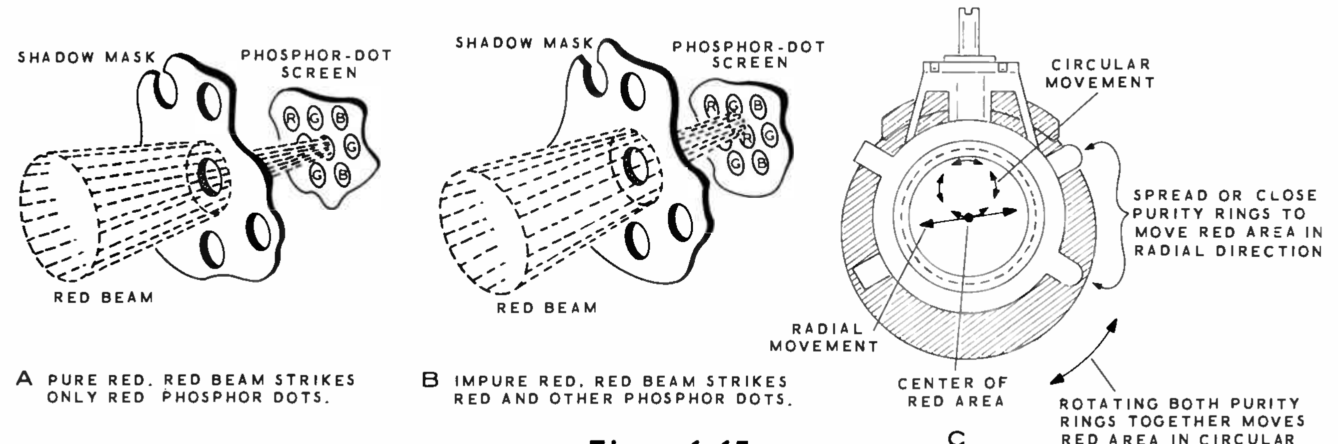


Figure 1-15

NOTE: The following adjustments should be made with the front of the picture tube facing either a North or South direction. This reduces the effect of the earths magnetic field when the TV Set is turned in another direction.

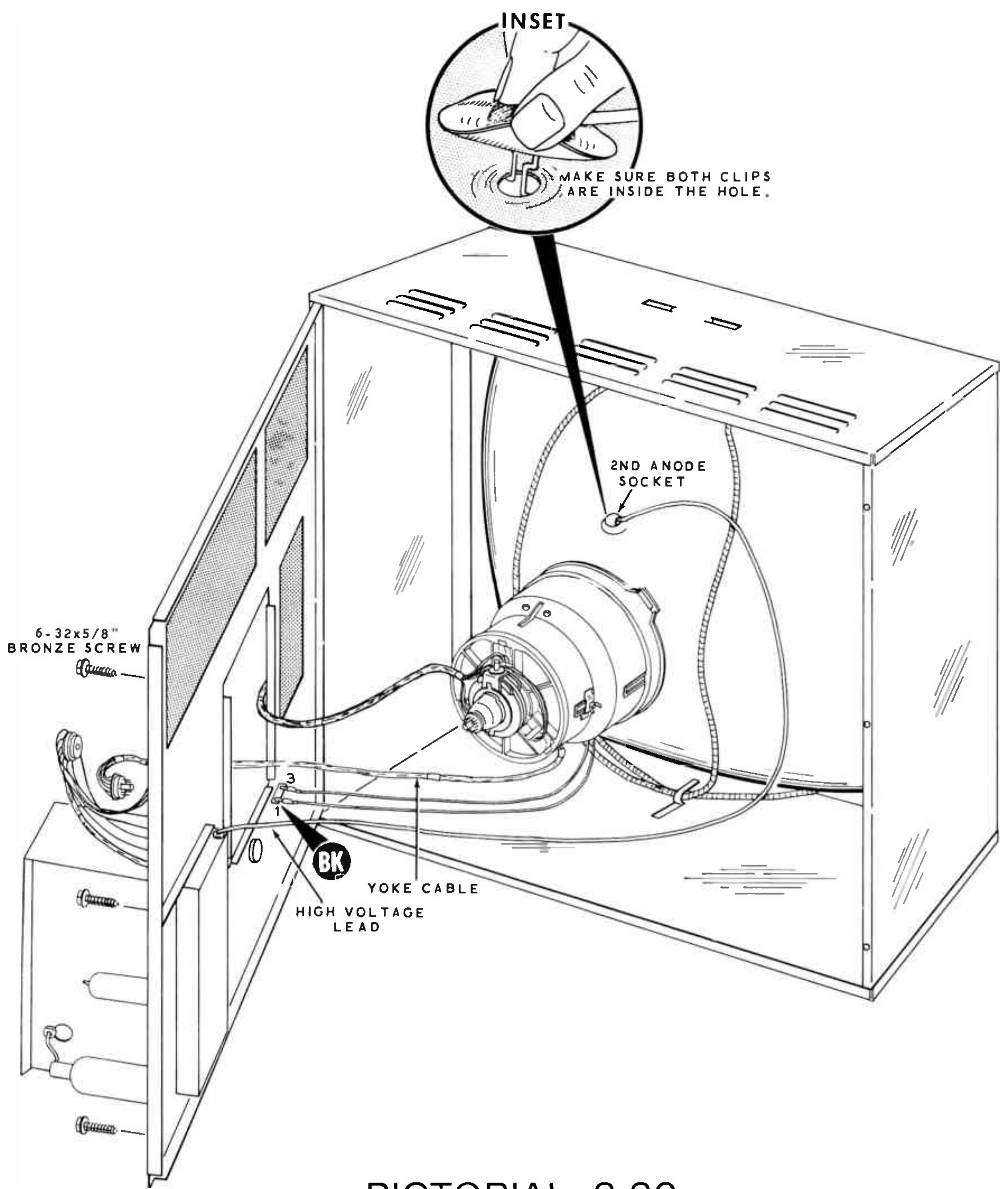
The purpose of the purity adjustment is to align the electron beams so the red beam strikes only the red phosphor dots on the screen, the green beam strikes only the green dots, and the blue beam strikes only the blue dots. This is done to remove impure color areas from the screen. See Figure 1-15.

1. (✓) Turn the CONTRAST control to the full counterclockwise position. Turn the BRIGHTNESS control clockwise until color is visible on the screen.

2. ( ) Position the purity rings with the two round-end tabs pointing straight up before starting these adjustments.

3. ( ) Turn the blue and green guns off by connecting shorting clips to the BLUE TEST POINT and GREEN TEST POINT.

4. ( ) Loosen the three wing-head screws that secure the deflection yoke in the yoke mount. Pull on these screws to move the deflection yoke back as far as possible in the yoke mount.



PICTORIAL 2-20

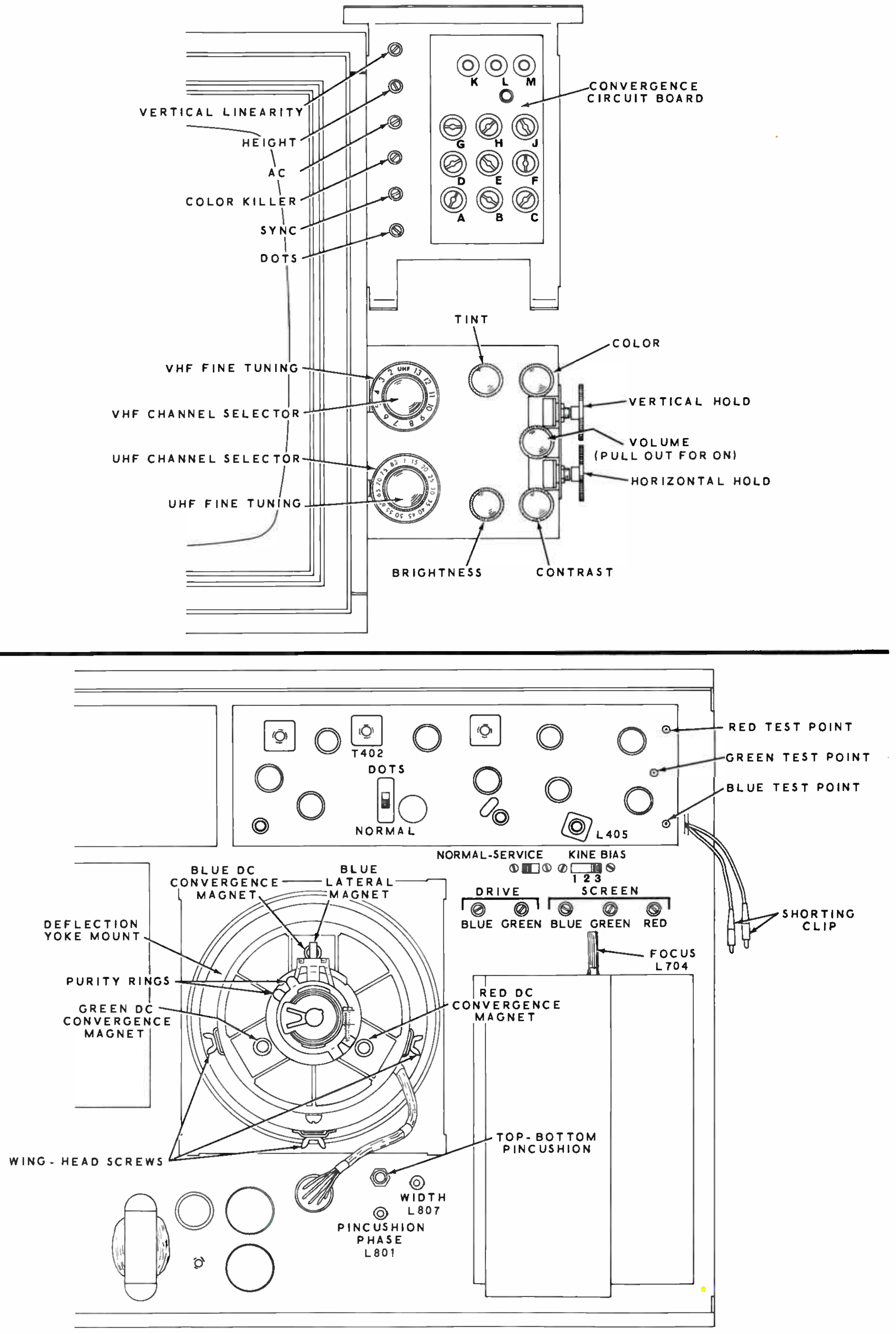


FIGURE 1-1

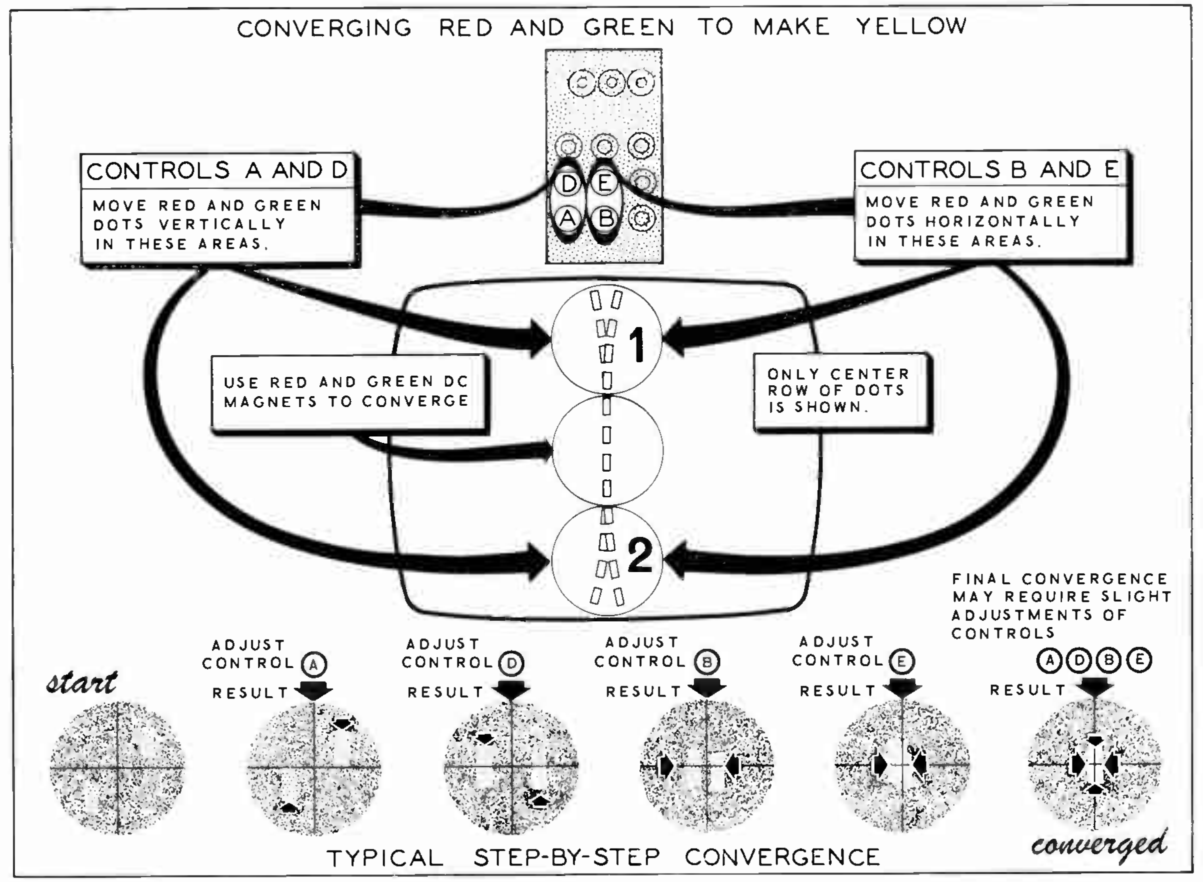


FIGURE 1-22A

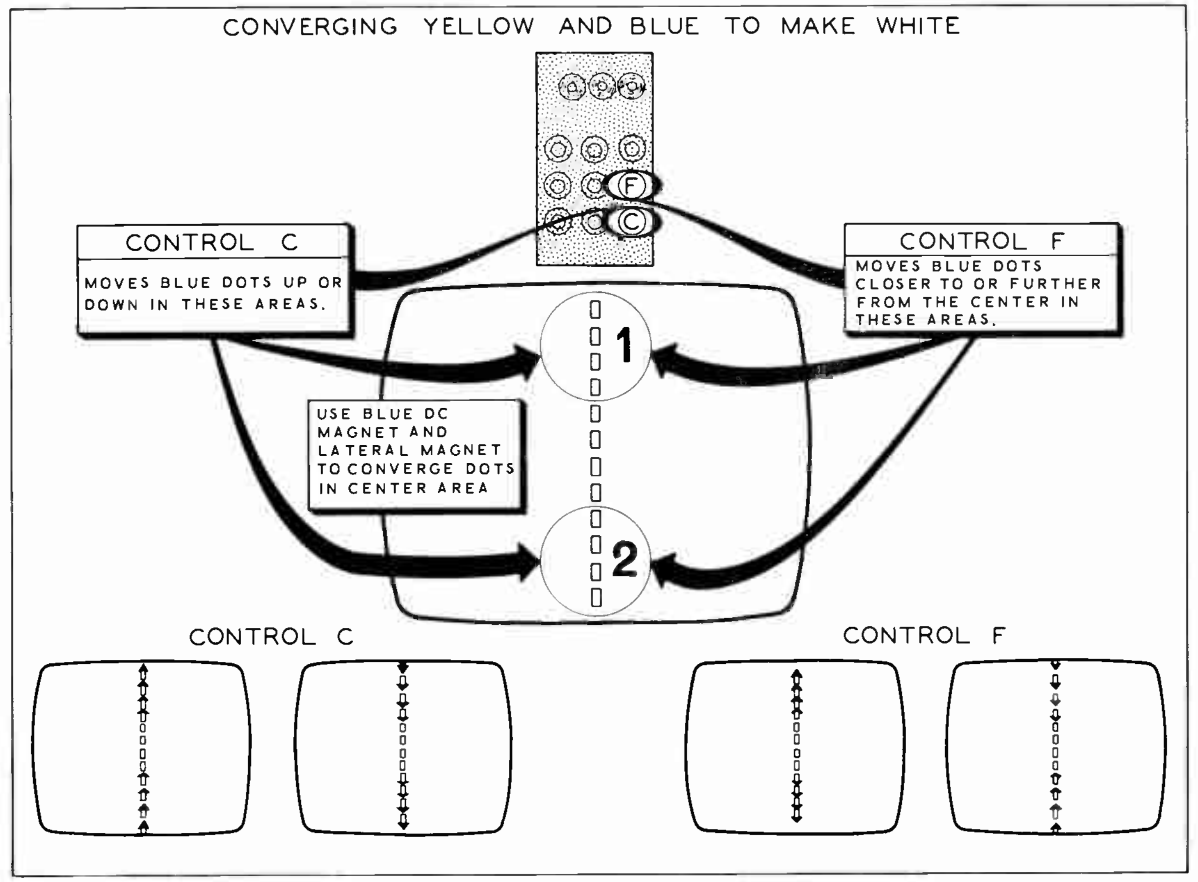


FIGURE 1-22B

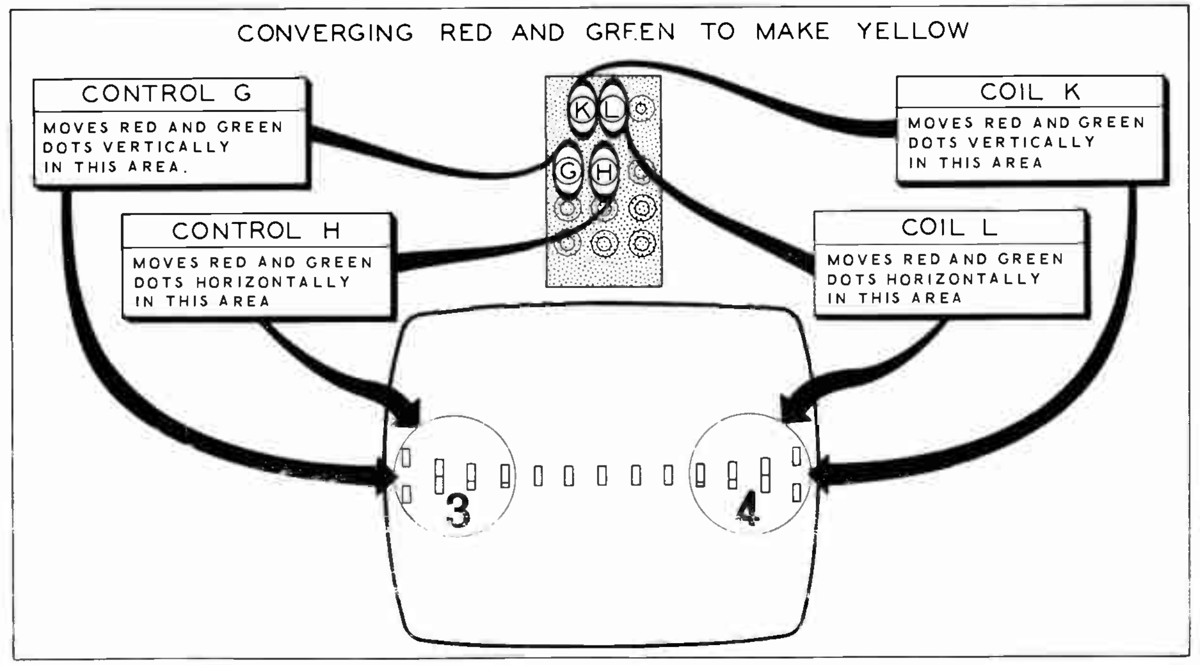


FIGURE 1-23A

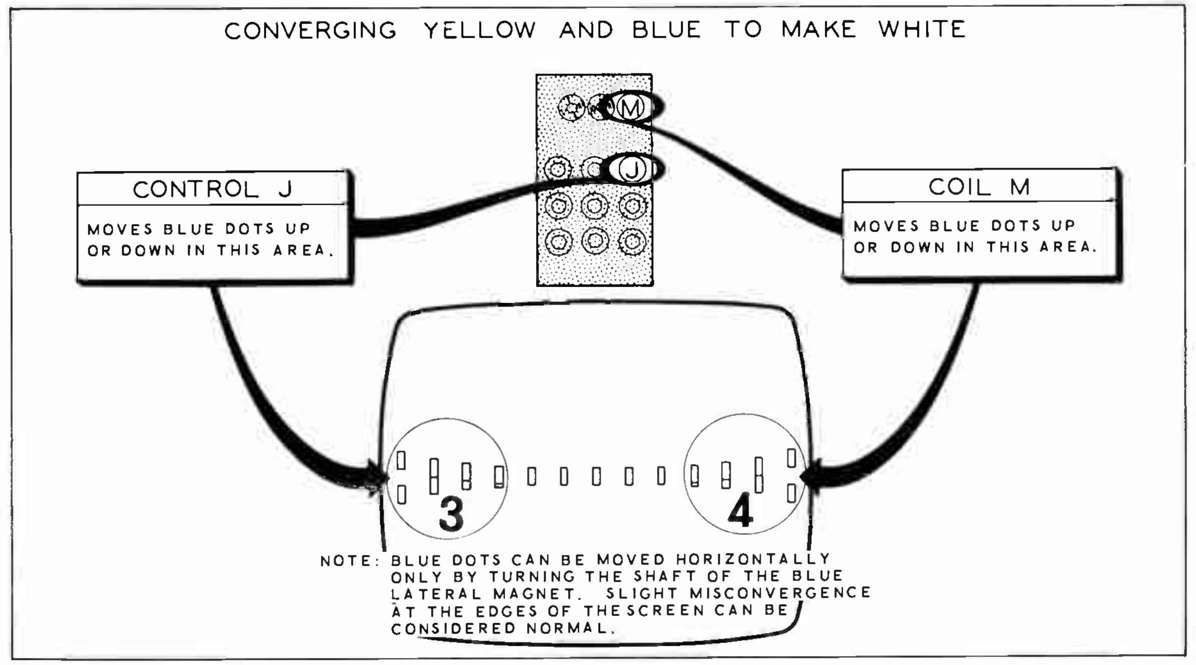


FIGURE 1-23B

NOTE: The following adjustments will be easier to make if the room lights are dimmed. The movement of the yoke is the coarse adjustment, and the movement of the purity rings is the fine adjustment of color purity.

5.(✓) Turn the purity rings until you obtain a red area in the center of the screen. See Figures 1-16 and 1-17 (fold-out from Page 81).

Figure 1-15C shows the action of the purity rings on the red area. Spreading the tabs apart or pushing them closer together moves the red area in a radial direction. Rotating both purity rings in the same direction (maintaining the space between the tabs) will cause the red area to move in a circular path.

First, move only one ring about an inch in either direction; then move both rings in the same direction to move the red area toward the center of the screen. It may be necessary to increase or decrease the spread between the tabs. The tabs may end up in any position around the neck of the tube when the best results are finally obtained.

Finally, adjust each of the rings separately to move the red area to the center of the screen.

6.( ) Slowly move the yoke a small amount toward the face of the tube to make the red area larger. Alternately adjust the yoke and the purity rings until the screen becomes pure red. See Figure 1-18 (fold-out from Page 81).

After obtaining a pure red screen, retighten the three wing-head screws to secure the deflection yoke in its mount.

If you are unable to obtain a pure red screen, remove the shorting clips from the BLUE and GREEN TEST POINTS, and recheck the DC convergence. Make sure the dots at the center of the screen are still pure white: if they are not pure white, repeat the DC Convergence Adjustments on Page 75, then repeat previous steps 3 and 6.

7.( ) Place the DOTS-NORMAL switch in the DOTS position. Make sure the picture is not tilted. If necessary, straighten the picture by rotating the yoke mount slightly.

8.( ) Remove the shorting clips from the BLUE and GREEN TEST POINTS and recheck the DC convergence.

NOTE: It may be helpful, as a more exact method of checking purity, to look at the TV screen with a magnifying glass. When only the red beam is turned on, as in the adjustments above, only the red dots should be illuminated. See Figure 1-15 on Page 77. The green dots and blue dots may be rechecked in the same manner if the green and blue beams are turned on individually.

DYNAMIC CONVERGENCE ADJUSTMENTS

The adjustments in this section should be performed twice to obtain the best dynamic convergence. Go through all the steps in the Dynamic Convergence section the <u>first</u> time to obtain <u>approximately</u> the correct merging of dots. The <u>second</u> time you go through these steps, you will be more familiar with the procedure; thus, good dynamic convergence will be much easier to attain.

These adjustments converge the red, blue, and green dots into white dots at those areas away from the center of the screen. First, all the dots that lie along a vertical line that runs through the center of the screen, are converged to obtain a row of pure white dots. Then, all the dots that lie along a horizontal line that runs through the center of the screen, are converged.

Do not try to get <u>perfect</u> convergence at all corners of the screen, since this cannot be realized. Careful examination of any color receiver will show slight misconvergences, especially near the corner of the picture. When all the dots appear as pure white at a normal viewing distance (at least five feet away), convergence can be considered to be satisfactory.

NOTE: Improper DC convergence could prevent you from obtaining proper dynamic convergence in the following steps. If the <u>center</u> area of the screen becomes misconverged while performing the dynamic convergence steps, go back and repeat DC convergence. Then continue with dynamic convergence.

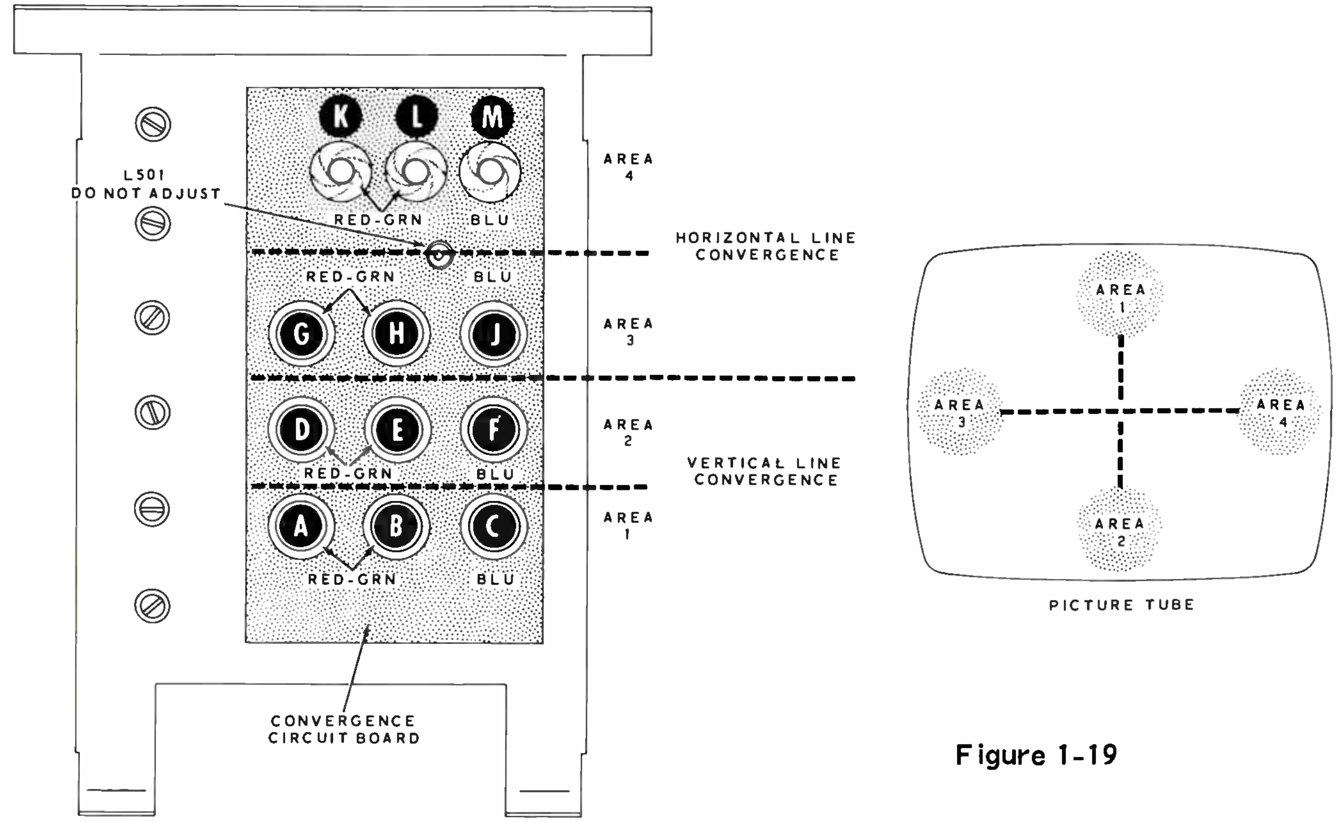


Figure 1-19

VERTICAL LINE CONVERGENCE

Refer to Figure 1-19. Note that the convergence circuit board is divided into four rows of controls and coils. The two rows at the bottom converge the vertical center line in areas 1 and 2 on the picture tube screen. The two rows at the top converge the horizontal center line in areas 3 and 4 of the screen.

( ) Turn off the blue gun by connecting a shorting clip to the BLUE TEST POINT.

( ) Be sure the DOTS-NORMAL switch is in the DOTS position.

NOTE: Only the center vertical row of dots will be adjusted in areas 1 and 2 in the following steps. Since a certain amount of interaction will occur between the controls, it will be necessary to repeat the next two steps several times before the dots become converged in both areas. See Figures 1-20 and 1-21 (fold-out from Page 81).

Refer to Figure 1-22A (fold-out from Page 78).

( ) Adjust control A, and then control D to move the red and green dots closer together vertically in area 1 and area 2.

( ) Adjust control B, and then control E to converge the red and green dots into yellow dots in area 1 and area 2.

( ) Check all of the dots in the vertical line in areas 1 and 2. Make sure that all red and green dots are merged together to form pure yellow dots. If the dots near the center of the screen are not properly converged, readjust the red and green DC convergence magnets, then repeat the previous two steps.

( ) Remove the shorting clip from the BLUE TEST POINT.

Refer to Figure 1-22B (fold-out from Page 78).

( ) Merge the blue dots with the yellow dots to make white dots in area 1 and area 2, by adjusting controls C and F.

( ) Check all the dots in the center vertical row to make sure they are all white. If the blue dots at the center of the screen are not properly converged, readjust the blue DC convergence magnet and the blue lateral magnet; then repeat the previous step.

This completes convergence of the vertical center row of dots.

RESISTANCE CHART

6HA5 V101		6GJ7 V102		6JH6 V201		6GM6 V202		6EJ7 V203		6AW8 V204		6HZ6 V205	
Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms
1	2.4M	1	0	1	300K	1	79K	1	270	1	270	1	12
2	0	2	220K	2	1600	2	INF	2	0	2	100K	2	560
5	30K[1]	3	0	5	INF	5	18K[1]	3	270	3	75K[1]	5	490K[1]
6	0	6	28K[1]	6	INF	6	18K[1]	7	20K[1]	6	56	6	30K[1]
7	0	7	46K[1]	7	1600	7	INF	8	20K[1]	7	370[4]	7	480K
		8	48K[1]					9	0	8	22K[1]		
		9	47K							9	28K[1]		

6HS8 V301		6GF7 V302		6FQ7 V303		6GW8 V304		6GH8 V401		12HG7 V402		6GH8 V403	
Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms
1	5K[2]	1	0	1	30K[1]	1	490K	1	16K[1]	1	22	1	580K
2	31K[1]	2	4.7M	2	1.5M	2	12.5K	2	3.5M	2	350K[2]	2	420K[1]
3	820K[1]	3	1600[2]	3	1200	3	16K[1]	3	60K[1]	3	0	3	110K[1]
6	255K	6	20K[1]	6	100K[1]	6	18K[1]	6	60K[1]	7	20K[1]	6	22K
7	1.6M[2]	8	7M[1,2]	7	36K[2]	7	220	7	0	8	52K[1]	7	390
8	100K[1]	9	500K[2]	8	1200	8	90K[2]	8	1600[2]	9	0	8	0
9	10M					9	16K[1]	9	700K			9	4.5M[2]

6EW6 V404		6HZ6 V405		6HZ6 V406		6JU8 V407		6GH8 V408		6GU7 V409		6GU7 V410		YOKE SOCKET (Plugged In)		YOKE SOCKET (Unplugged)	
Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms
1	33K	1	70[2]	1	70[2]	1	INF	1	20K[1]	1	44K[1]	1	44K[1]	1	2	1	2
2	39K	2	100	2	150	2	220	2	47K	2	1M	2	1M	2	.6	2	.6
5	18K[1]	5	20K[1]	5	20K[1]	3	INF	3	60K[1]	3	270	3	270	4	1.5M	3	1.5M[1]
6	18K[1]	6	29K[1]	6	29K[1]	7	4.8M	6	22K[1]	6	65K[1,3]	6	42K[1]	5	1.5M[1]	5	INF
7	39K	7	2	7	.8	8	22K	7	0	7	330K	7	1M	6	1.5M[1]	6	1.5M[1]
						9	4.8M	8	680	8	390	8	270	7	4.5	7	100
								9	INF					8	5	8	100

6JE6A V701		6DW4 or 6CL3 V702		1V2 V703		3A3 V704	6BK4B V705		25AP22A or 25XP22 V801		CONVERGENCE SOCKET[5]		CONVERGENCE PLUG[5]	
Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms		Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms	Lug No.	Ohms
1	30K[1]	2	16K[1]	2	2.4M[6]	Do Not Make Measurements On This Tube Socket	1	20K[1]	1	90K	1	0	1	0
2	10M	7	16K[1]	4	66M		2	90K	2	20K[1]	2	1M[1]	2	220
3	0	9	2.4M[1]	5	66M		5	1.1M[2]	3	140K[1]	3	INF	3	300[2]
6	10M			6	66M		7	90K	4	580K[1]	4	1.4	4	360[2]
7	30K[1]			9	2.4M[1]		Plate Cap	Do Not Measure	5	600K[1]	5	1	5	360[2]
8	0 or 1600[7]								6	22K[1]	6	INF	6	360[2]
9	1600								7	150K[1]	7	INF	7	310[2]
Plate Cap	2.2M[1]								9	70M[1]	8	1	8	INF
									11	20K[1]				
									12	150K[1]				
									13	650K[1]				
									14	90K				

NOTES:

Resistance measurements taken with a vacuum tube voltmeter, from the point indicated to chassis ground (K = 1000, M = 1,000,000). The yoke, convergence assembly, speaker, and picture tube leads are measured with the TV Set unplugged from the AC outlet.

Resistance readings may vary ±20%. Those readings marked with footnote numbers may vary more than 20%.

1. Varies with charge on filter capacitors.
2. Varies with control settings.
3. Varies with Kine Bias switch setting.
4. Varies with diode D201.
5. Measured with convergence plug removed.
6. Depends on internal wiring of tube.
7. Depends on wiring.

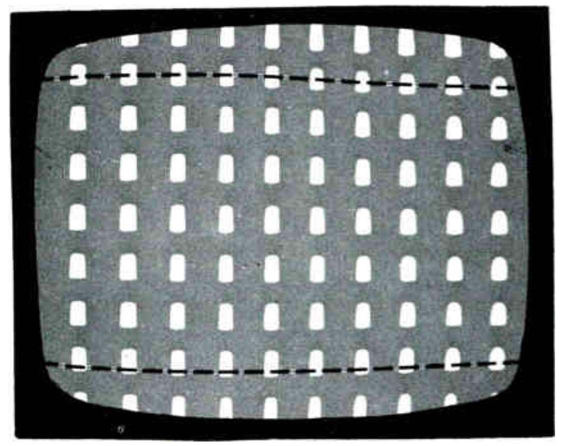


FIGURE 1-26A

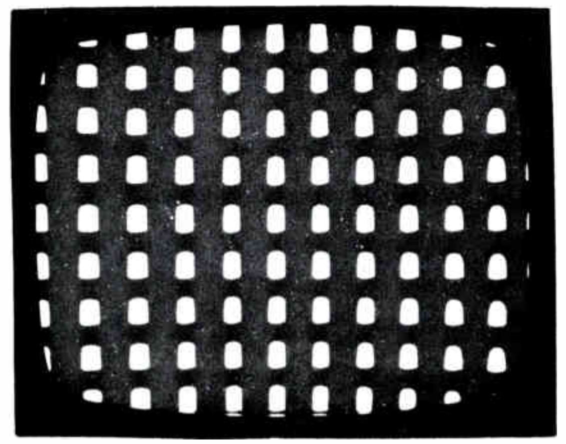


FIGURE 1-26B

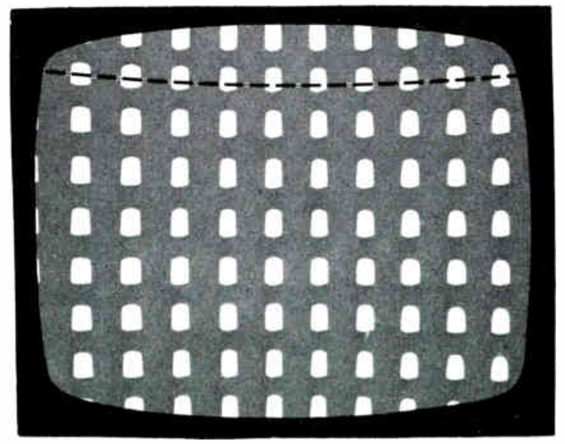


FIGURE 1-26C

HORIZONTAL LINE CONVERGENCE

Figures 1-23A and 1-23B (fold-out from Page 78) show the area where each horizontal convergence control or coil is most effective. Refer to these Figures to see which dots each control or coil will move, and to see which way they will move.

(✓) Turn off the blue gun by connecting a shorting clip to the BLUE TEST POINT.

To overcome the interaction between the controls, repeat the next two steps as many times as necessary, until the dots are merged at both locations. See Figure 1-23A.

( ) Adjust controls G and H to converge the red and green dots in area 3 on the picture tube.

NOTE: Use the alignment tool supplied with this kit to adjust coils K, L, and M on the convergence board. The coil adjustments are not as responsive as the controls adjusted previously. Two or three turns of each coil may be necessary to cause noticeable dot movement. Do not adjust coil L501.

(✓) Adjust coils K and L to converge the red and green dots in area 4 on the picture tube.

(✓) Remove the shorting clip from the BLUE TEST POINT.

(✓) Merge the blue dots with the yellow dots at areas 3 and 4 by adjusting coil M and control J. See Figure 1-23B and Figures 1-24 and 1-25 (fold-out from Page 81).

This completes the Dynamic Convergence Adjustments. Now recheck the FOCUS and GRAY SCALE adjustments. See Page 76. Keep in mind that the SCREEN controls affect the shade of the low light areas of the picture, and that the DRIVE controls affect the high light areas of the picture. For example, if a dimly lit background scene is predominantly green, the GREEN SCREEN control should be turned down slightly. If a bright area was predominantly blue, the blue drive should be turned down slightly.

PINCUSHION ADJUSTMENTS

NOTE: The pincushion adjustments in the following steps affect the top and bottom of the picture. When making the adjustments, watch the rows of dots closely to observe the changes.

( ) Place the DOTS-NORMAL switch in the DOTS position.

( ) Turn the TOP-BOTTOM PINCUSHION control fully clockwise. Note that there is a slight bow or tilt in the top horizontal row of dots. See Figure 1-26A.

( ) Adjust PINCUSHION PHASE coil L801 until the upward bowing of the top horizontal row of dots is exactly in the middle of the screen.

( ) Reduce the setting of the TOP-BOTTOM PINCUSHION control until the first top horizontal row of dots is straight when your eyes are level with this row of dots. See Figure 1-26B.

Figure 1-26C shows the top horizontal row of dots bowed down in the middle as a result of turning theTOP-BOTTOM PINCUSHION control too far counterclockwise.

FINAL ADJUSTMENTS

WARNING: Make sure that you turn only the coil you are directed to turn in the following steps. Do not turn any other coils.

( ) Place the DOTS-NORMAL switch in the NORMAL position.

( ) Tune in a color picture. See Figure 1-27 (fold-out from this page).

( ) Set the TINT control to the center of its range and set the COLOR control for a normal amount of color.

( ) Using the alignment tool, carefully adjust burst phase transformer T402 (on the color circuit board) for normal flesh tones on the people in the picture. It should not be necessary to turn the slug of this coil more than one turn in either direction. After this adjustment, the TINT control should change the flesh tones from purple, through normal to green. See Figure 1-1 (fold-out from Page 77) for the location of T402.

( ) Tune in a weak black and white program and check to see if any colored confetti (small flashing colored spots) appear in the picture.

( ) If colored confetti (colored noise, see Figure 1-28) appears on black and white programs, adjust the COLOR KILLER control clockwise slightly until the colored noise is removed. Recheck the color program to make sure the color signal is still received normally.

The COLOR KILLER control is set properly when color programs are reproduced in color, and black and white programs are free from colored noise.

This completes the adjustment of your Color TV Set. Next, the TV Set will be custom mounted or installed in a cabinet. It is important that the TV Set be handled very carefully in its installation. Any unnecessary jarring of the TV Set could disturb the convergence adjustments, making readjustment necessary after installation.

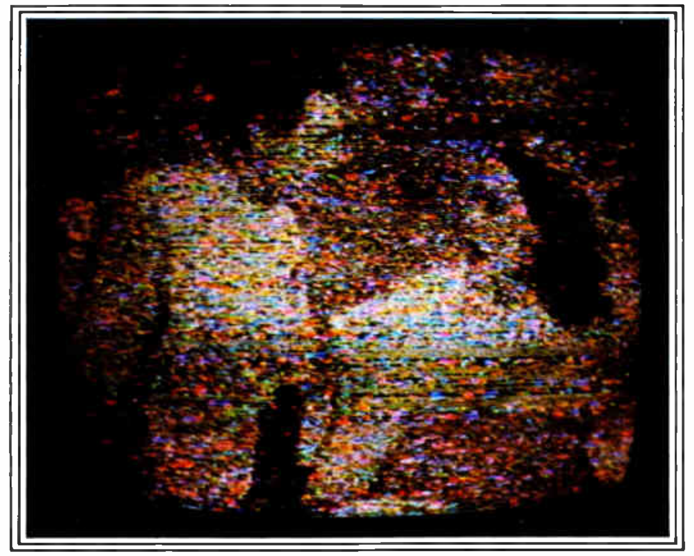


Figure 1-28

All color photographs are actual unretouched photographs of the screen of the Heath Color TV. The faulty pictures were artificially induced in the TV Set by engineering personnel of the Heath Company. Permission to reproduce the program material was given by WGN TV, Chicago, Illinois.

Figure 1-3

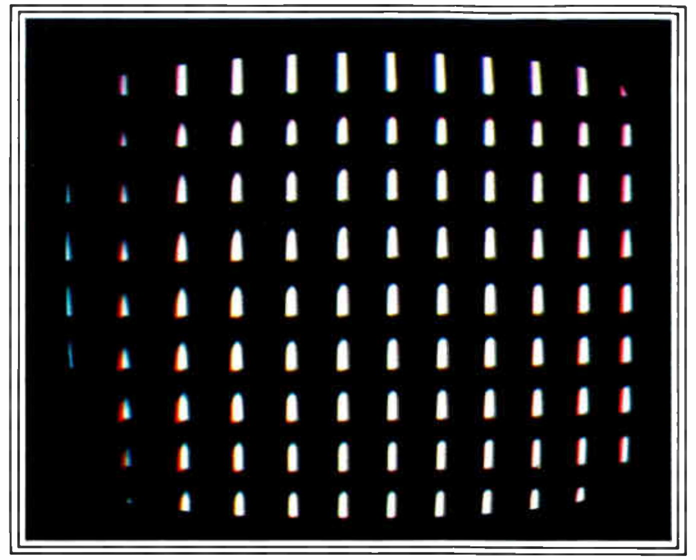


Figure 1-13

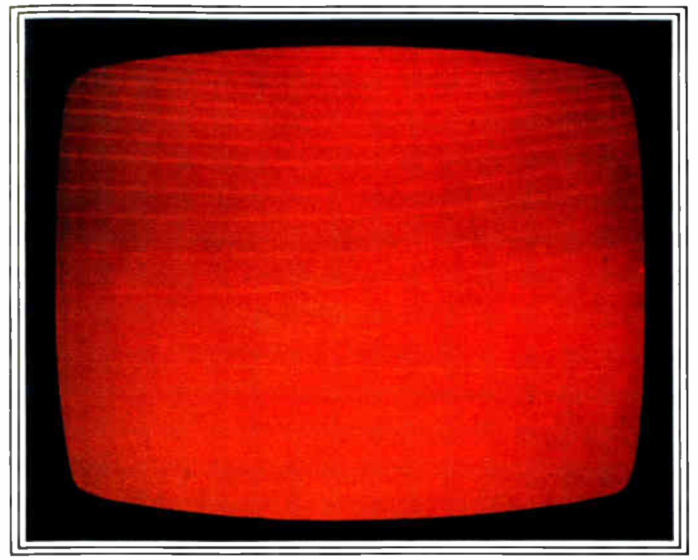


Figure 1-18

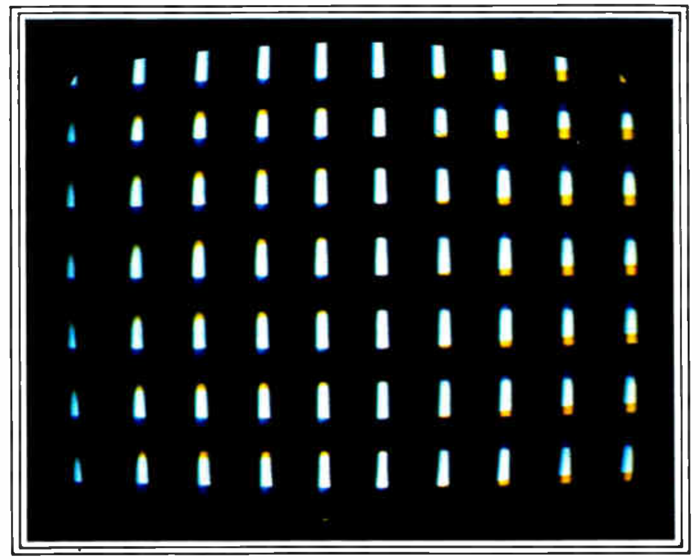


Figure 1-24

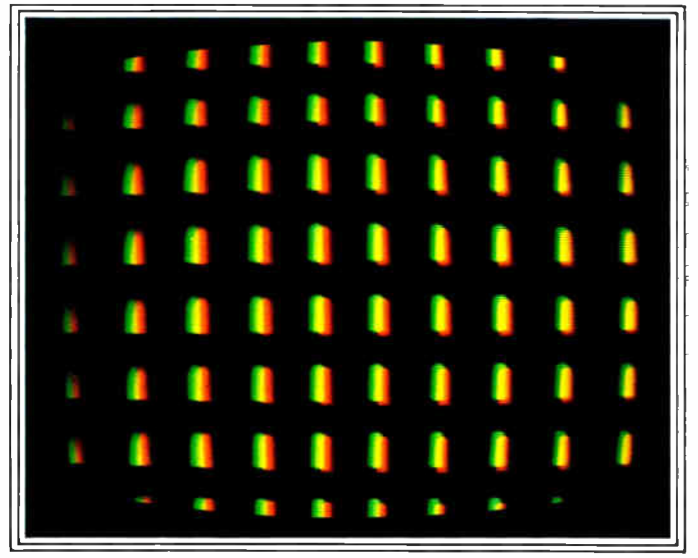


Figure 1-11

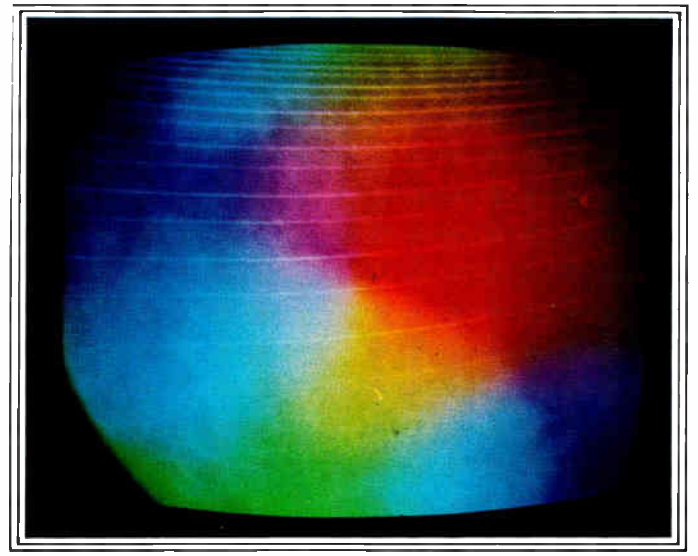


Figure 1-16

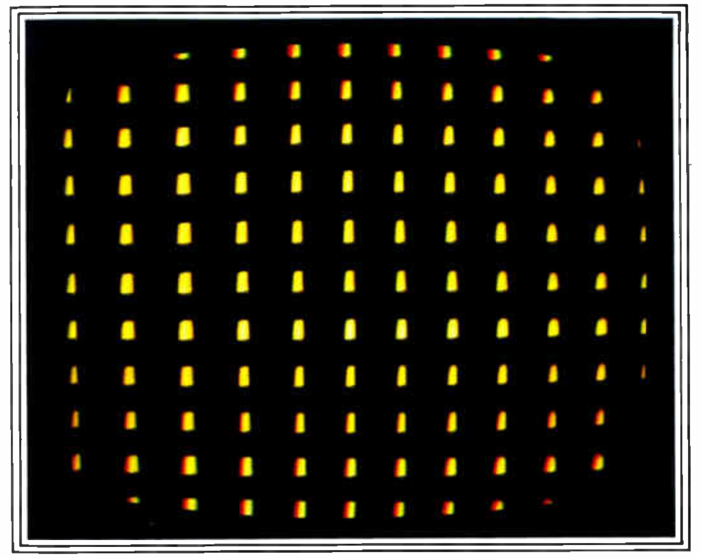


Figure 1-20

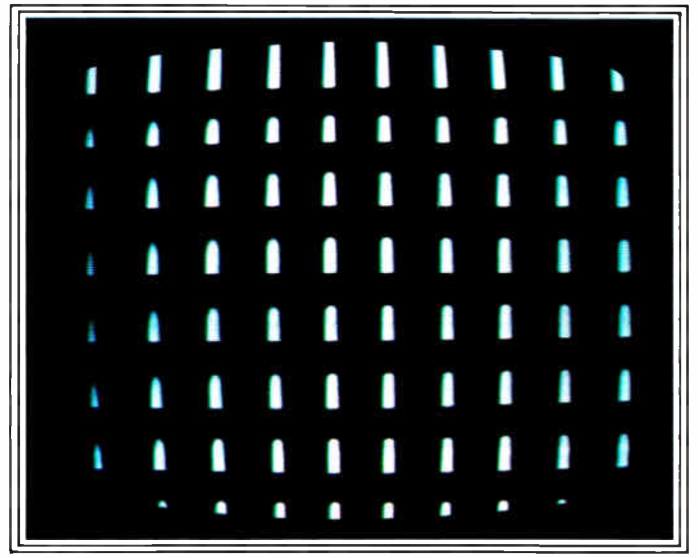


Figure 1-25

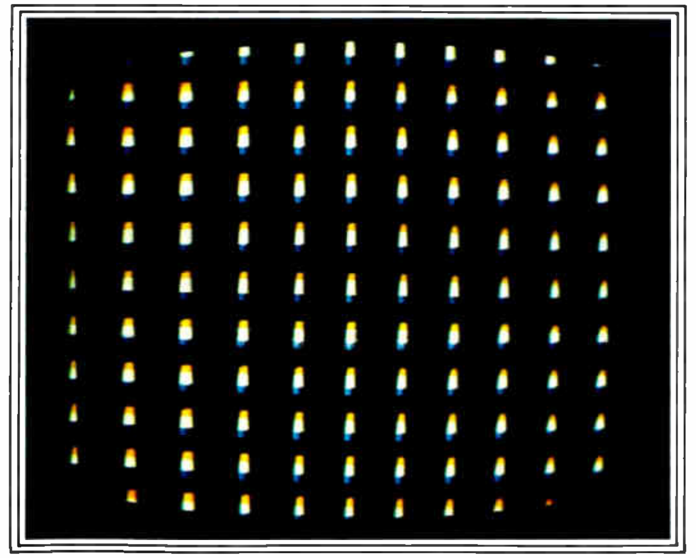


Figure 1-12

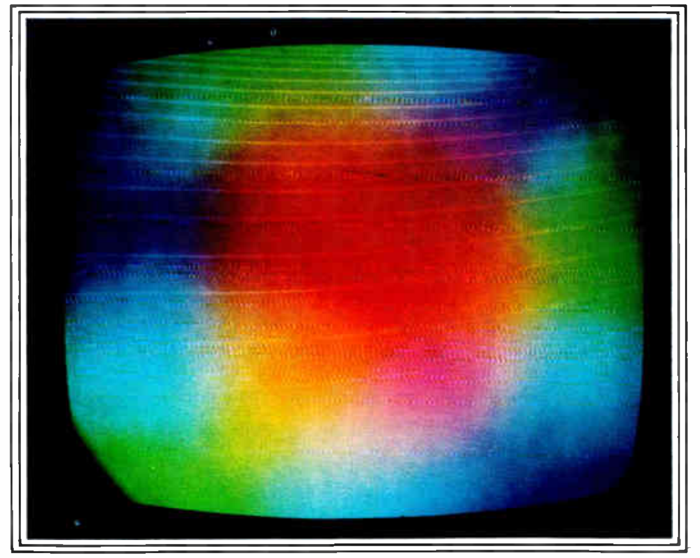


Figure 1-17

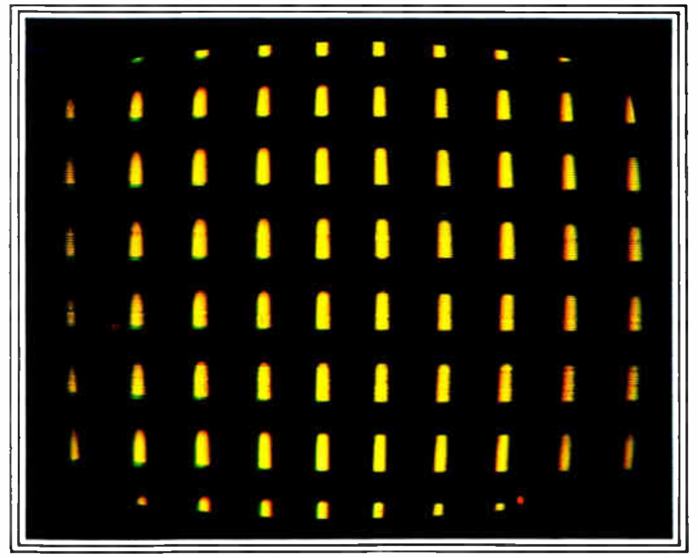


Figure 1-21

Figure 1-27

Figure 2-4

Figure 2-5

Figure 2-6

Figure 2-7

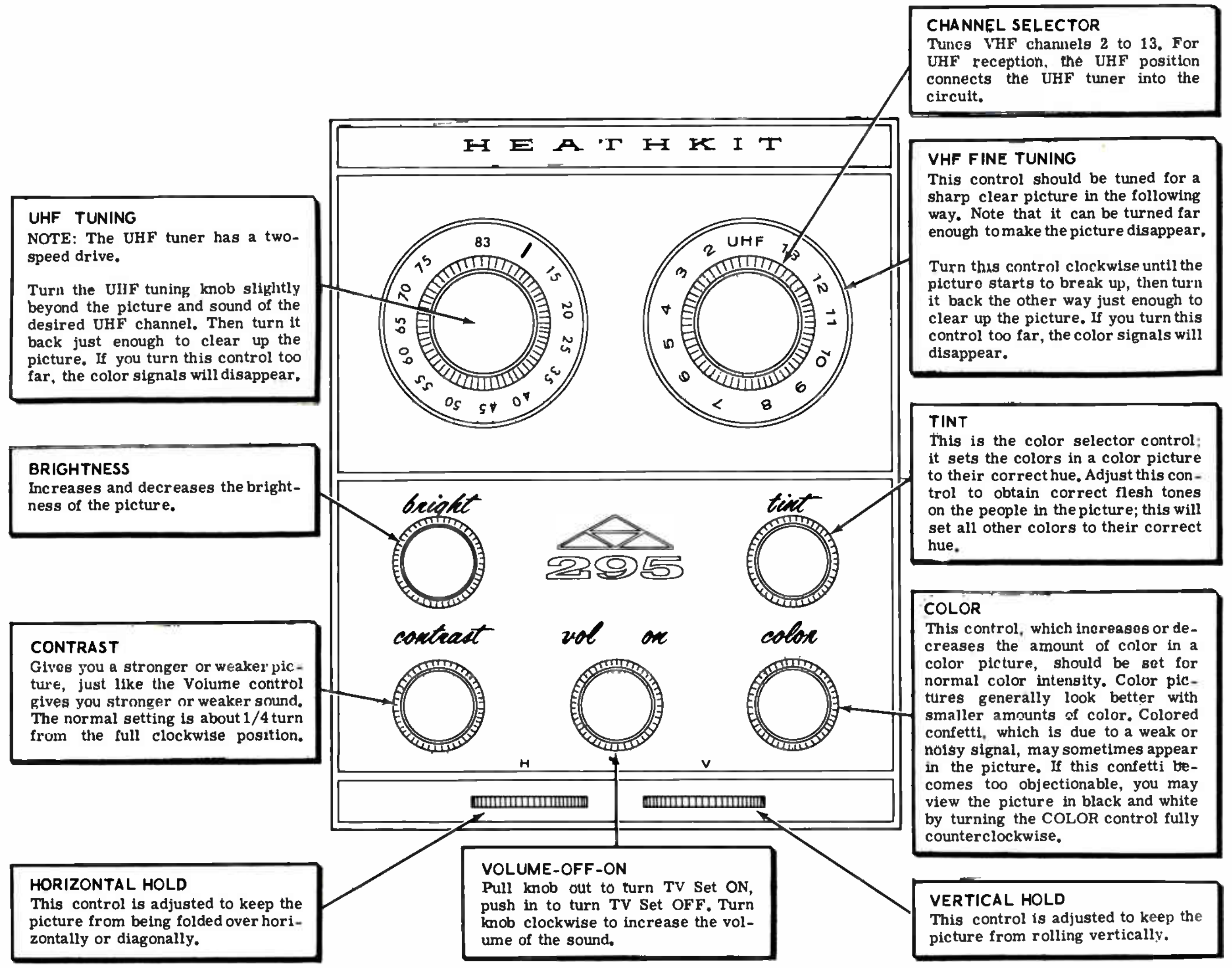


Figure 2-3

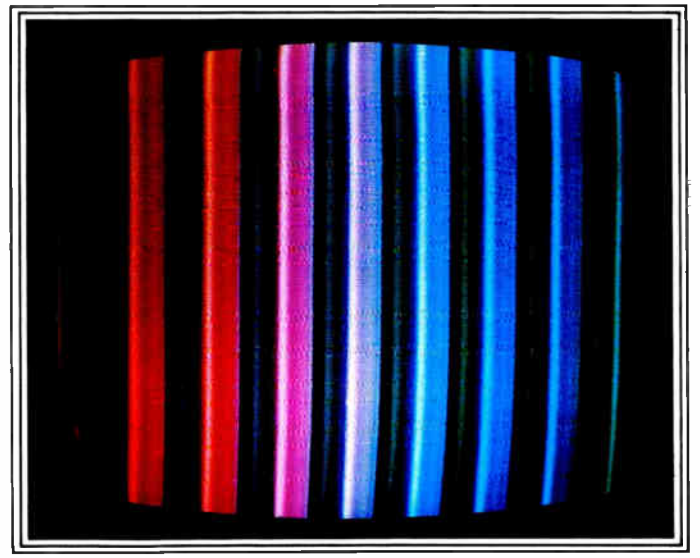


Figure 4-7

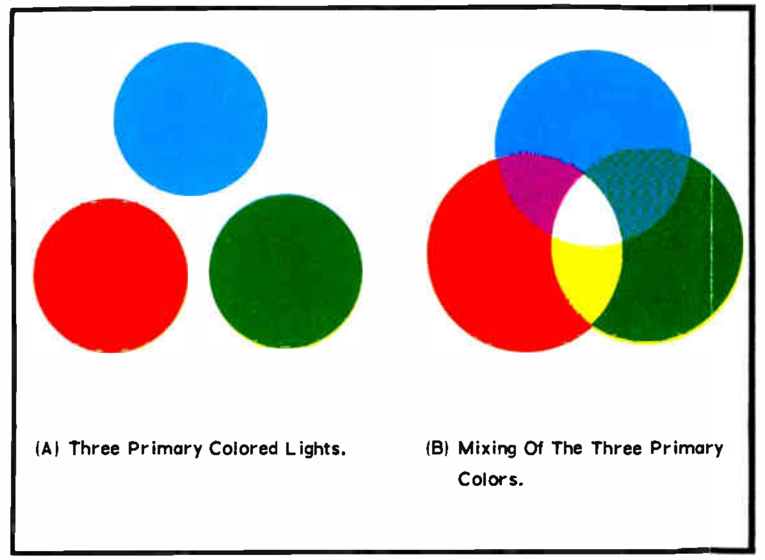


Figure 5-10A

INSTALLATION

This section tells you how to install your TV Set in the Model GRA-295-1 TV Cabinet, or how to custom mount it. If you plan to custom mount the TV Set, disregard the Cabinet Installation section and proceed directly to the Custom Installation section on Page 88.

NOTE: Since the TV Set is heavy and bulky it is suggested that you have another person help you with either the Cabinet or Custom installation.

Be careful not to jar the TV Set during installation as this could disturb the TV Set adjustments.

> CAUTION: DO NOT BUMP OR ATTEMPT TO MOVE THE TV SET BY THE NECK OF THE PICTURE TUBE, AS BREAKING THE PICTURE TUBE WOULD RESULT IN AN IMPLOSION OF CONSIDERABLE VIOLENCE.

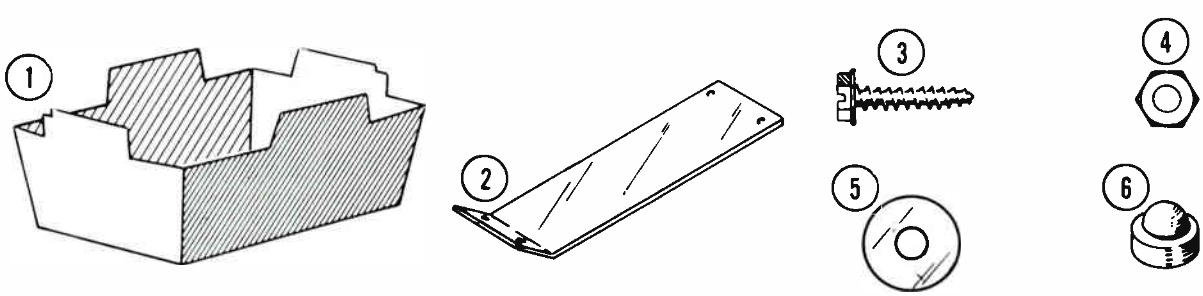
CABINET INSTALLATION

Check the Cabinet parts supplied against the following Parts List; then proceed with the steps for installing the TV Set in the Cabinet.

CABINET PARTS LIST

The numbers in parentheses are keyed to the numbers in the parts pictorial below.

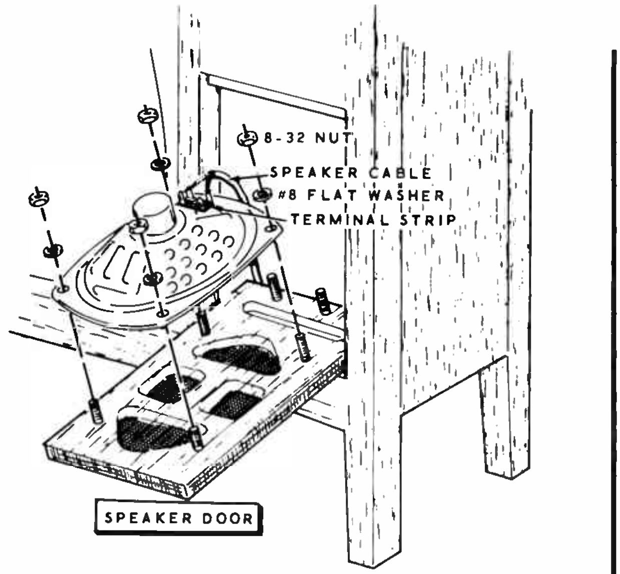
PART No.	PARTS Per Kit	DESCRIPTION
91-140	1	Walnut cabinet
94-419	1	Cabinet back panel
(1) 206-247	1	Picture tube back panel shield
(2) 204-704	1	Convergence support bracket
(3) 250-252	10	#6 x 5/8" bronze screw
(4) 252-4	8	8-32 nut
(5) 253-45	4	#8 flat washer
(6) 261-1	2	Rubber bumper



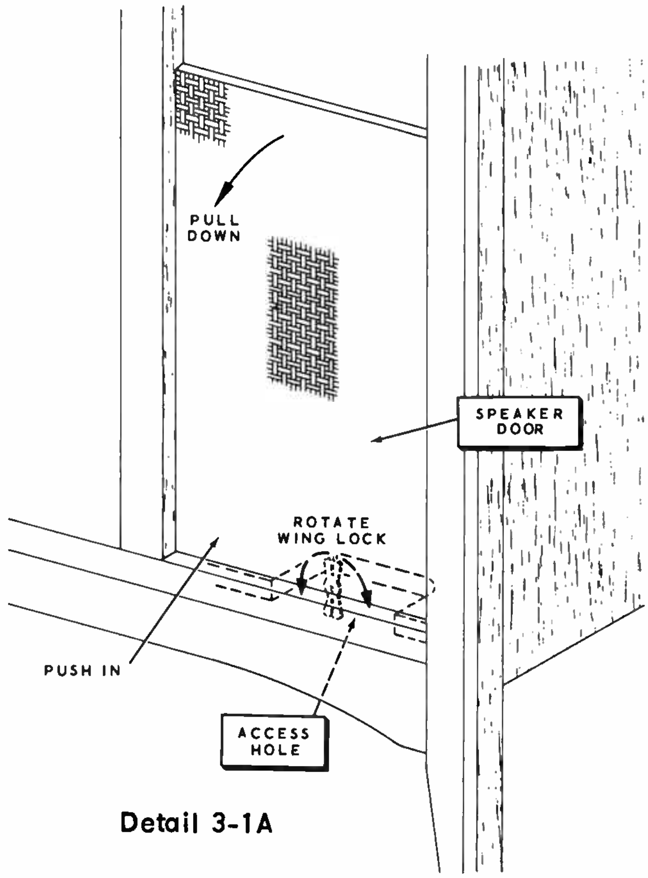
CABINET STEP-BY-STEP ASSEMBLY

NOTE: Some of the following items, which are used to mount the TV Set in the Cabinet, were furnished with the TV Set.

Refer to Pictorial 3-1 for the following steps.



PICTORIAL 3-1



Detail 3-1A

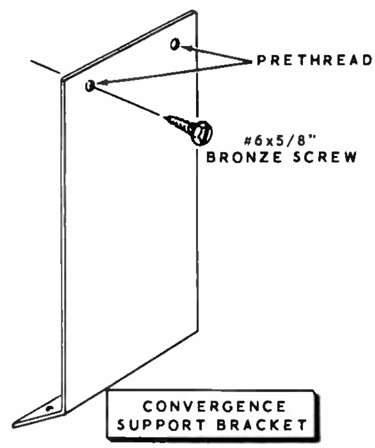
( ) Refer to Detail 3-1A and unlock the speaker door. The wing lock can be rotated by reaching up through the access hole at the right bottom front of the cabinet.

( ) Open the speaker door by pushing in on the bottom and pulling down the top.

( ) Unplug the speaker from the TV Set.

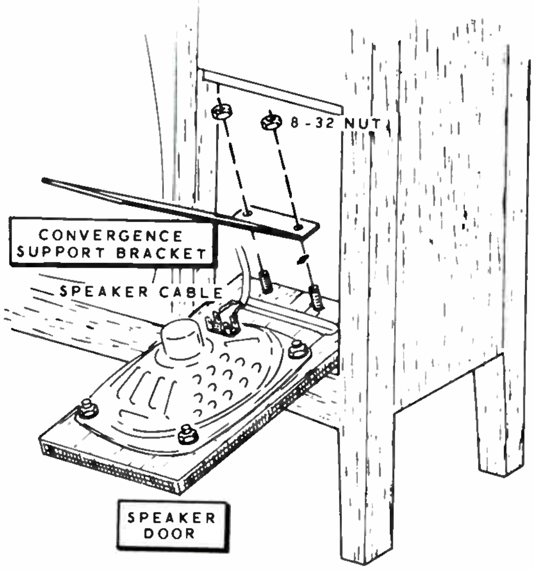
( ) Remove the speaker from its box and mount it on the inside of the speaker door with four 8-32 nuts and four #8 flat washers. Align the holes of the speaker carefully with the studs so you do not puncture the cone of the speaker. Position the terminal strip of the speaker as shown.

( ) Prethread the two indicated holes in the convergence support bracket with a #6 x 5/8" bronze screw. See Detail 3-2A.



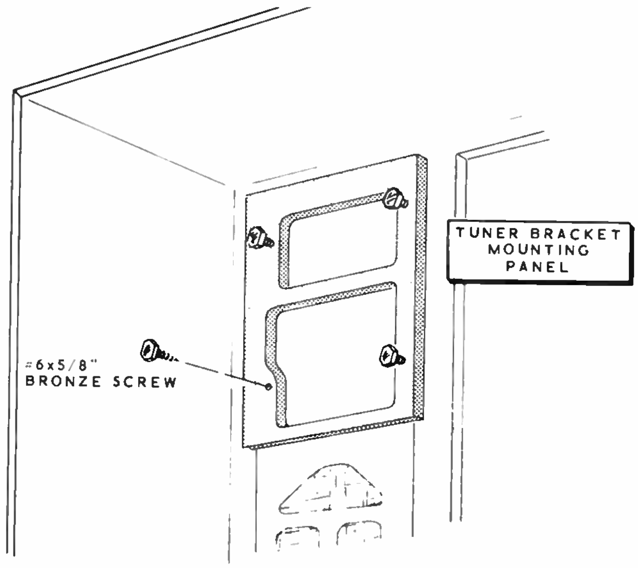
Detail 3-2A

( ) Refer to Pictorial 3-2, and mount the convergence support bracket on the inside of the speaker door with two 8-32 nuts. Position the speaker cable as shown.



PICTORIAL 3-2

( ) Refer to Detail 3-2B, and start four #6 x 5/8" bronze screws in the starting holes of the tuner bracket mounting panel.



Detail 3-2B

( ) Remove all knobs, except the Horizontal and Vertical Hold thumbwheel knobs, from the tuner bracket.

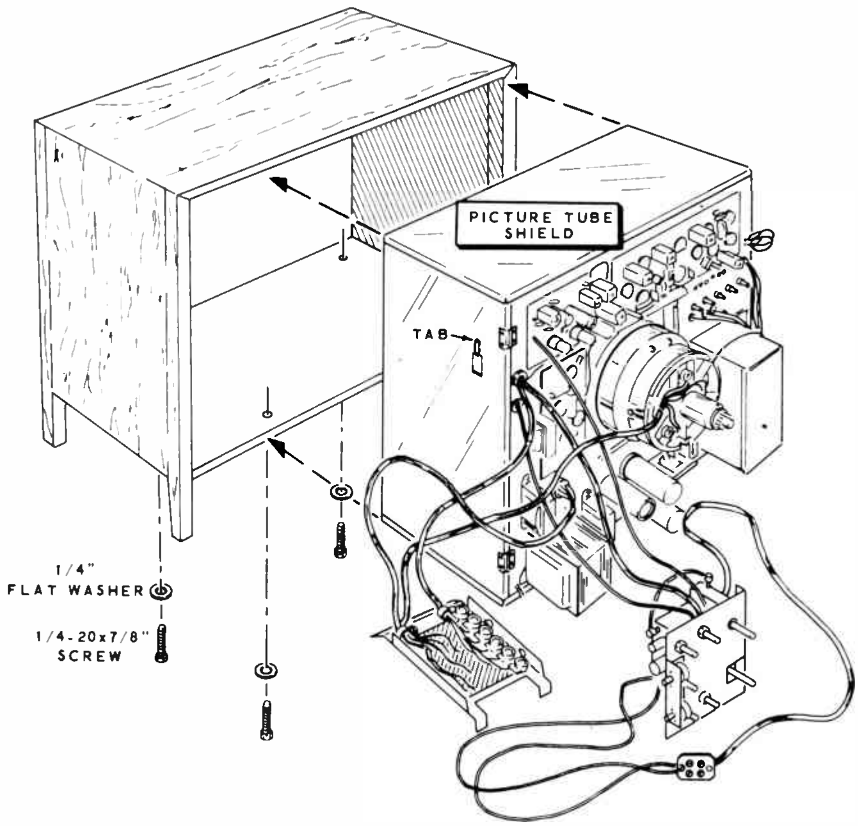
Refer to Pictorial 3-3 for the following steps.

( ) Carefully position the TV Set on the floor directly behind the Cabinet.

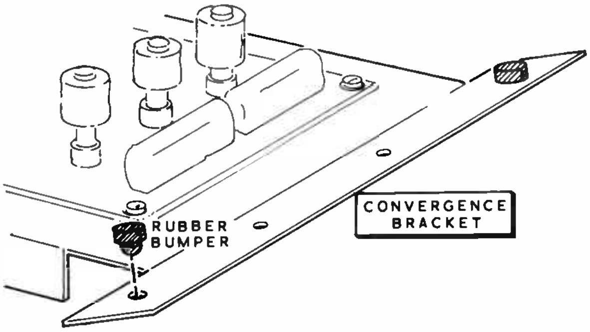
( ) Remove the convergence and tuner brackets from the TV Set, and position them on the floor next to the TV Set as shown. Leave the #6 x 3/8" mounting screws installed in the side of the picture tube shield in case you should want to remove the TV Set from the Cabinet at some future date.

( ) Lift the TV Set into the Cabinet. Slide it forward as far as possible so that the picture tube mask fits into the opening in the front of the Cabinet.

( ) Secure the TV Set to the Cabinet with four 1/4-20 x 7/8" screws and four 1/4" flat washers. The screws should pass through the bottom of the Cabinet and into the self-retaining nuts of the picture tube shield.



PICTORIAL 3-3



Detail 3-4A

Refer to Pictorial 3-4 for the following steps.

( ) Refer to Detail 3-4A, and mount two rubber bumpers in the proper holes of the convergence bracket.

( ) From the inside of the Cabinet, slip the convergence bracket through the Cabinet opening for the speaker door.

( ) Mount the convergence bracket on the speaker door as follows: Position the convergence bracket with its rubber bumpers hooked inside the Cabinet opening as shown. Lift up the speaker door, and then fasten the bracket on the top speaker mounting studs with two 8-32 nuts.

( ) Secure the convergence bracket to the convergence support bracket with two #6 x 5/8" bronze screws.

( ) Close and lock the speaker door.

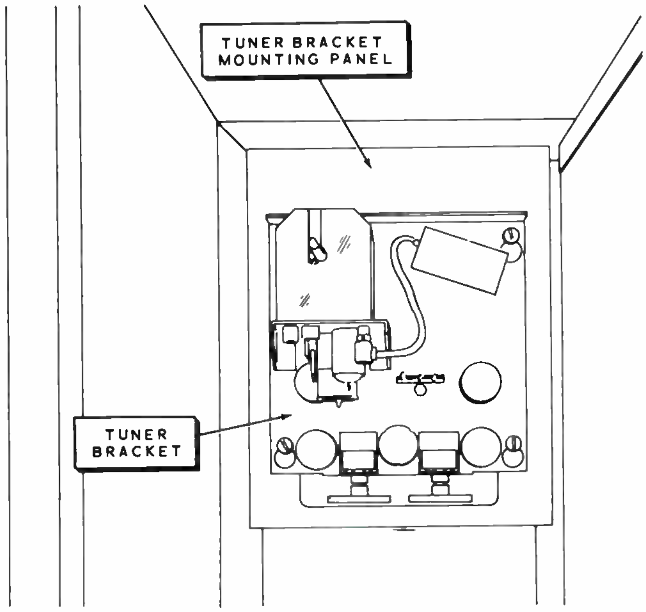
( ) Refer to Detail 3-4B and position the tuner bracket on the screws in the tuner bracket mounting panel. Tighten the screws. Be sure the wires to this bracket are not twisted together with the wires going to the convergence bracket.

( ) Carefully remove the protective backing from the control panel label.

( ) Position the control panel label on the control panel as shown, and line up the holes in the label with the control panel holes. Press the label firmly into place.

( ) Secure the control panel to the Cabinet with two #6 x 5/8" flat head wood screws.

NOTE: If the knob shafts extending from the tuner bracket are not centered in the holes of the control panel, loosen the tuner bracket mounting screws and reposition the tuner bracket as required. The thumbwheel knobs on the Horizontal and Vertical Hold controls may be repositioned to center the knobs in the control panel openings. Retighten the tuner bracket mounting screws.



Detail 3-4B

( ) Check the position of the pilot lamps on the back of the tuner bracket. The pilot lamps should be directly behind the pilot light holes in the control panel. Pictorial 3-4 shows the location of these holes.

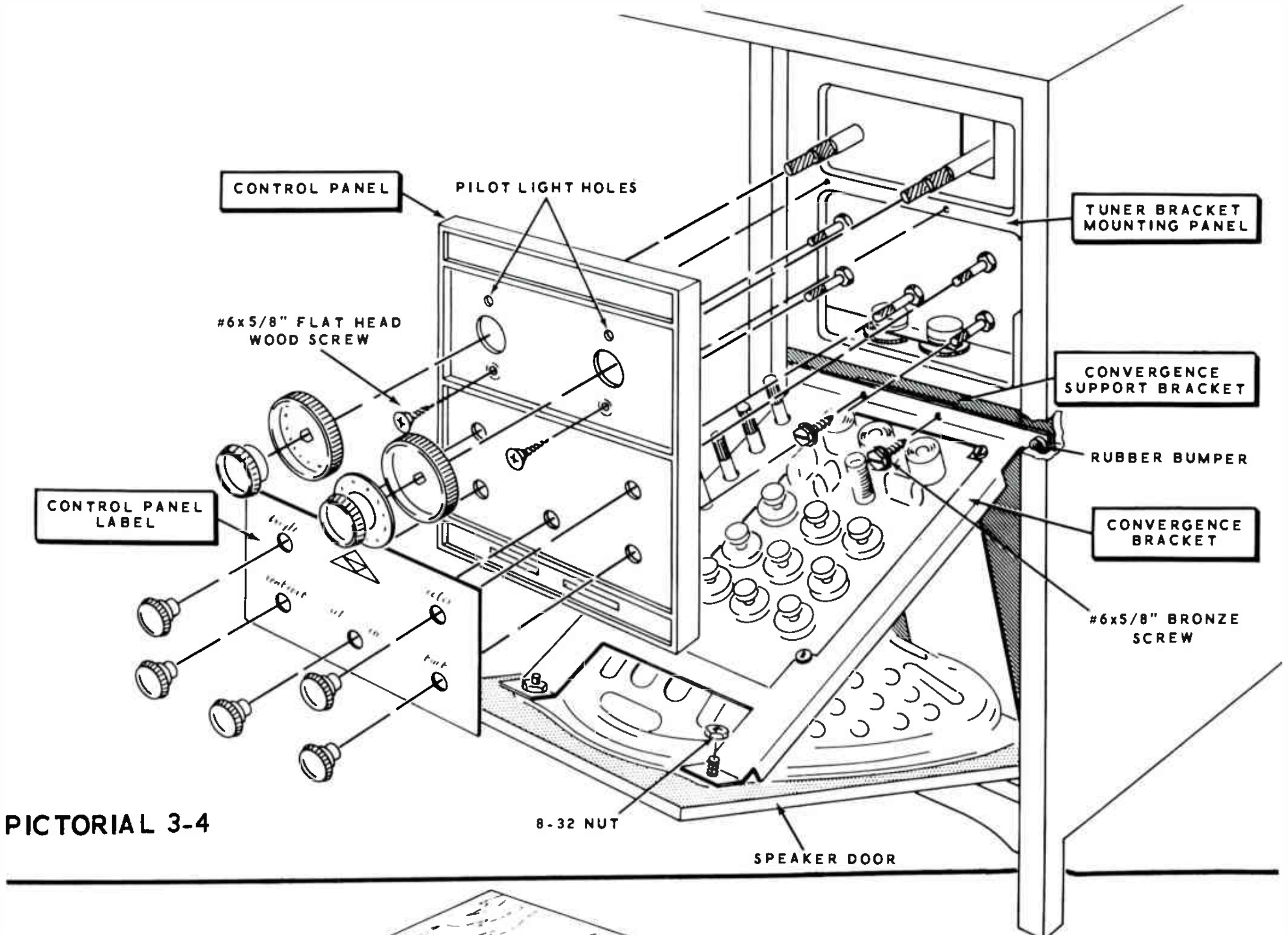
( ) Replace the knobs on the shafts extending through the control panel.

( ) Hook the wiring harness and cables coming from the tuner bracket (all cables except those connected to the antenna terminal strip) behind the tab on the picture tube shield. The tab location is shown in Pictorial 3-3 on Page 85. Then these cables will not interfere with opening the speaker door.

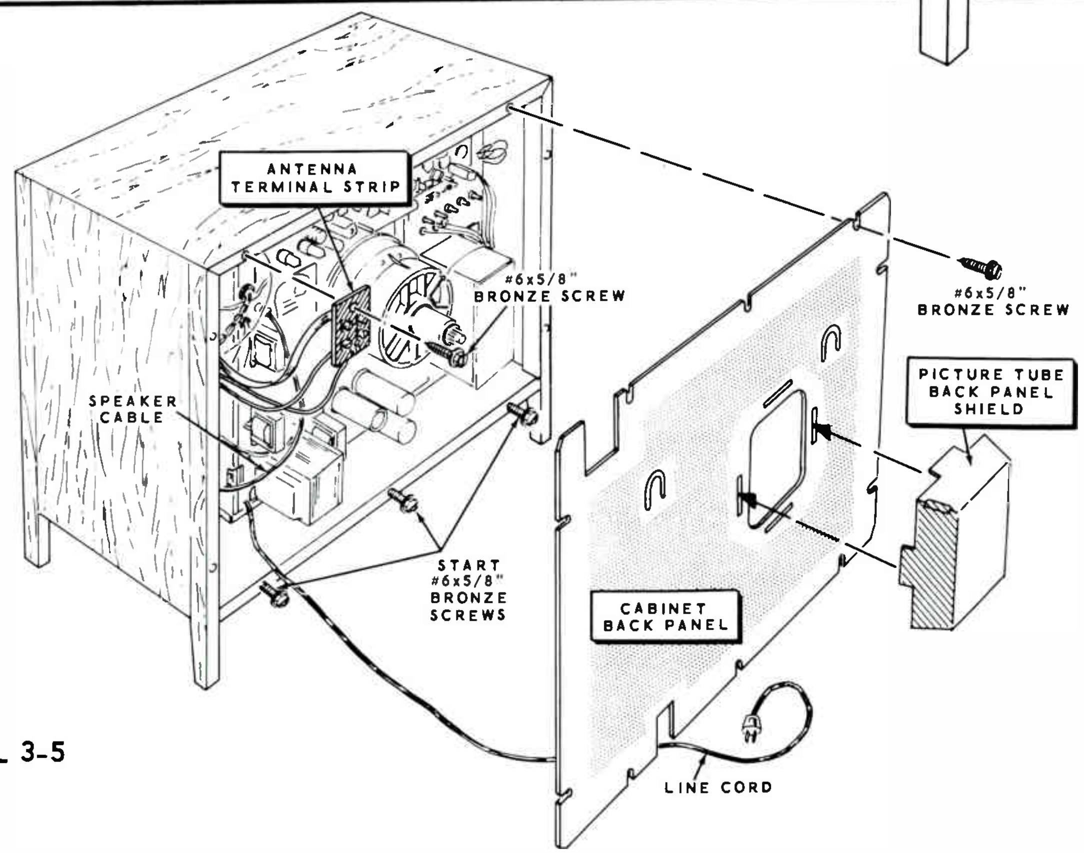
( ) Refer to Pictorial 3-5 and mount the antenna terminal strip at the location shown on the rear of the cabinet. Use a #6 x 5/8" bronze screw.

( ) Form the excess antenna cables in a loop and secure them with a string or a rubber band. NOTE: Do not hook the antenna cables over the tab on the picture tube shield.

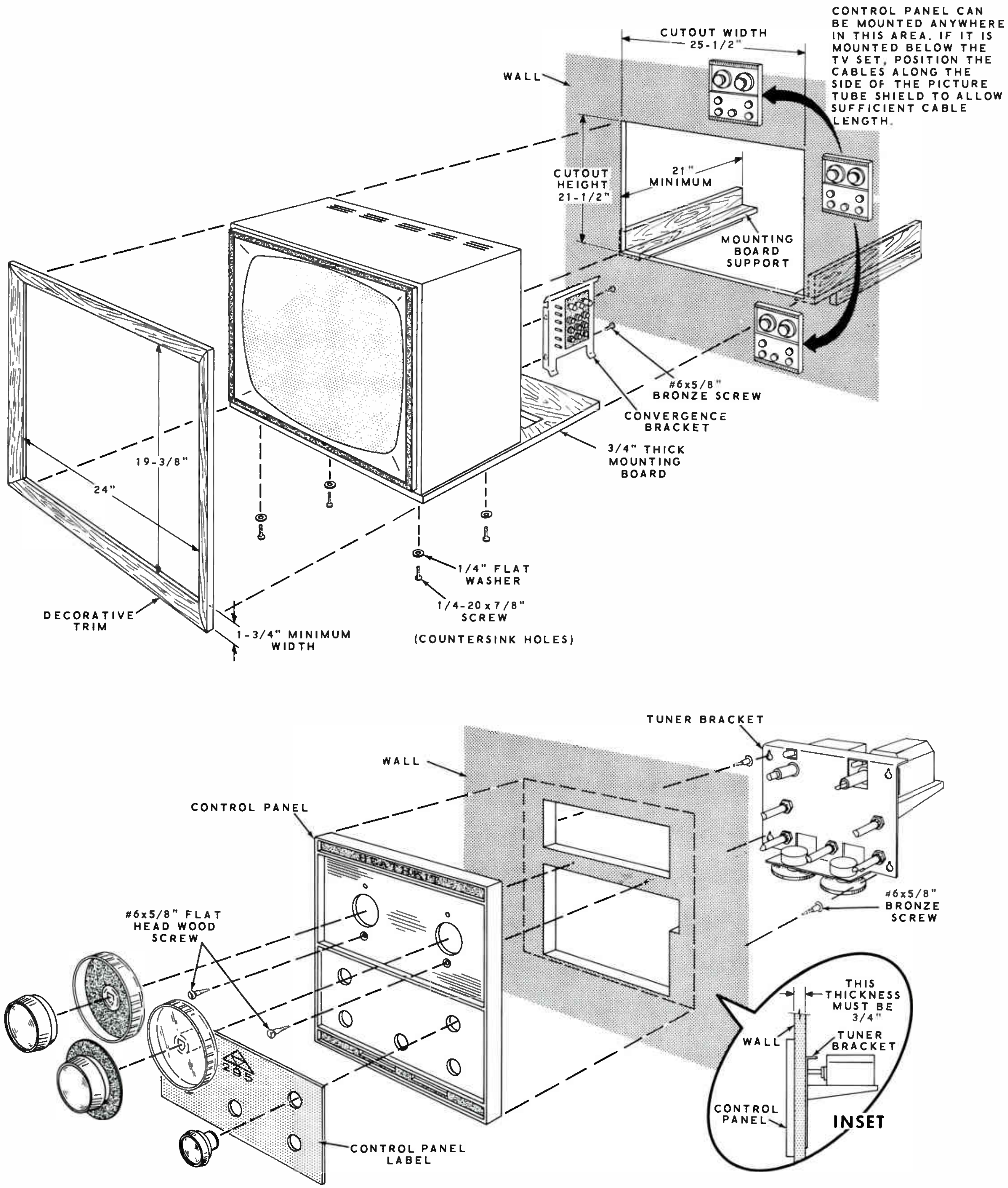
This completes the Cabinet installation. The Cabinet back panel will be installed later. Proceed to the Installation Adjustments on Page 90.



PICTORIAL 3-4



PICTORIAL 3-5



PICTORIAL 3-6

CUSTOM INSTALLATION

There are many ways the Color TV Set can be custom mounted. This section of the Manual describes only one of these ways, to provide you with a guide for your installation. You may want to read the cabinet installation instructions (starting on Page 84) to help in planning your installation.

There are three important considerations that must be studied carefully when you plan your installation. These are the viewing angles, chassis ventilation, and access to the chassis. The next three paragraphs briefly describe each of these considerations.

The angles from which the TV Set will be viewed should be considered carefully, especially in a wall-mounted installation where the position of the Set cannot be changed.

Be sure to have adequate ventilation around the chassis. Most TV Sets develop a considerable amount of heat while they are operating. This heat must be able to escape or the TV Set will be damaged due to overheating.

Install the TV Set so there is easy access to the convergence controls and chassis controls at the rear of the Set. As the components age, it may be necessary to make minor adjustments of these controls. Also, the tubes should be accessible in case servicing should be necessary at some future date.

Pictorial 3-6 shows a typical installation. The TV Set is installed on a mounting board and then mounted in a wall cutout. Three possible locations are shown for the control panel (tuner bracket). The convergence board is mounted on the picture tube shield.

PREPARATION

1. Make the wall cutout for the TV Set, using the dimensions shown in Pictorial 3-6.

2. Install the mounting board supports. Pictorial 3-6 shows one type of support that may be used.

3. Prepare a mounting board as shown in Pictorial 3-7 (fold-out from Page 89). Check to see that the mounting board fits properly in the wall cutout. Make any necessary adjustments in fitting the mounting board at this time.

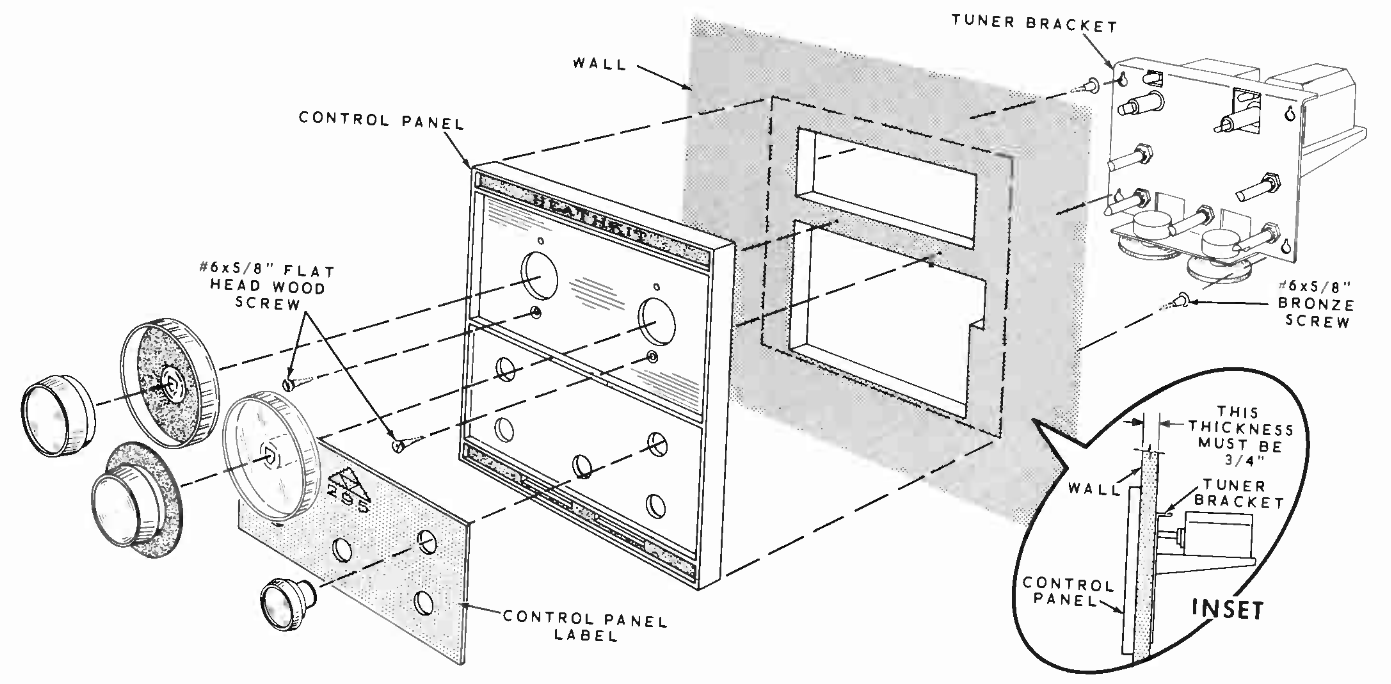
4. Pictorial 3-6 shows the area in which the control panel (tuner bracket) may be mounted. This location is limited by the length of the tuner bracket cables. Select the desired control panel location, then make the wall cutout and mark the locations for the four mounting screws. See Detail 3-7A (fold-out from Page 89) which is a full-size template and may be cut from the Manual. CAUTION: Do not change the length of any of the wires to the tuner bracket.

5. If a speaker cutout is required, it can be made now, using Detail 3-7B (fold-out from Page 89), a full-size speaker template. This template can be removed from the Manual.

MOUNTING

1. Mount the TV Set on the mounting board as shown in Pictorial 3-6.

2. Now, while the chassis controls are still accessible, complete the Installation Adjustments that start on Page 90. Then complete the custom mounting as follows:



Detail 3-6A

3. Remove the tuner bracket and convergence bracket from the side of the picture tube shield. Then lay them on the mounting board behind the picture tube shield.

4. Install the TV Set in the wall cutout. Then mount the convergence bracket on the rear of the picture tube shield as shown in Pictorial 3-6. Alternately, the convergence bracket can be mounted so it is accessible from the front of the TV Set. Detail 3-7C (fold-out from Page 89) gives dimensions for the convergence bracket.

5. Install the control panel label on the control panel as follows: Remove the backing paper and position the label on the control panel by lining up the holes in the label with the control panel holes. Then press the label firmly in place. See Detail 3-6A.

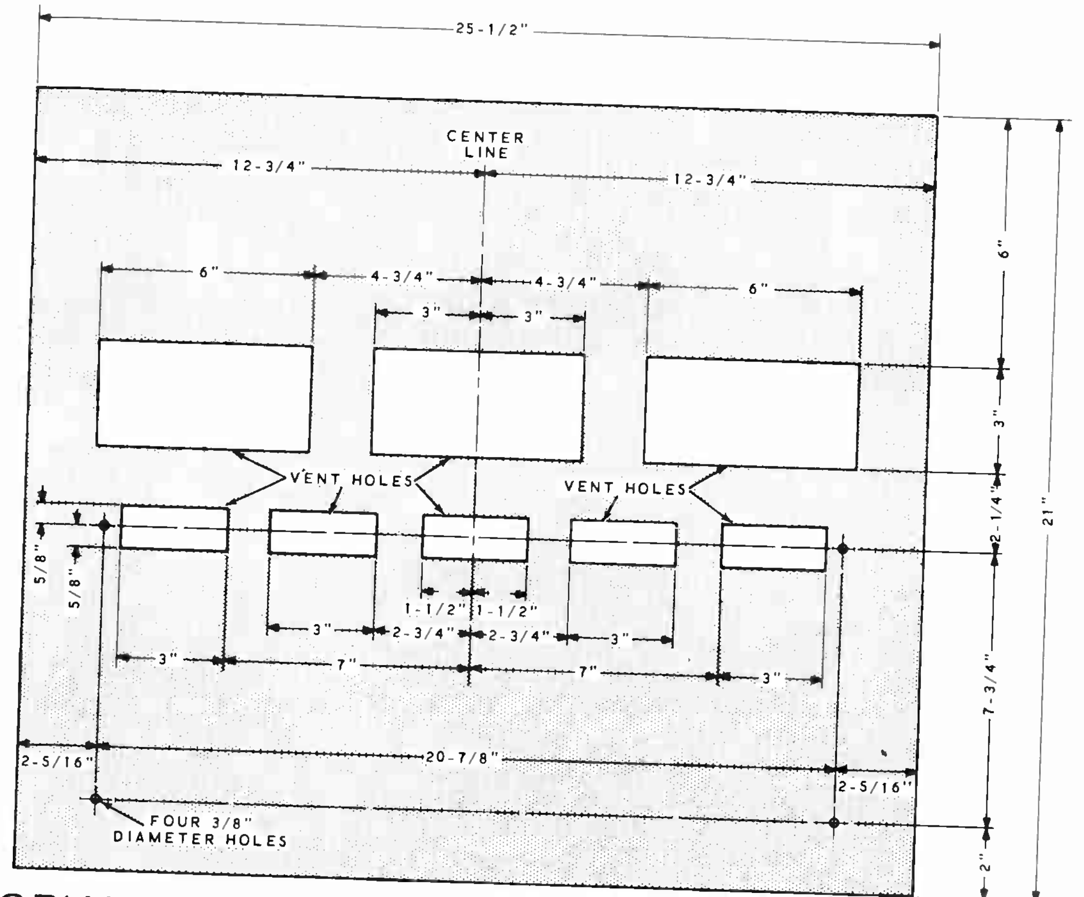
6. Mount the control panel and tuner bracket in the control panel wall cutout as shown in Detail 3-6A. Mounting will be easier if the mounting screws for the tuner bracket are started into the wall first. The thickness between the control panel and tuner bracket must be 3/4", as shown in the inset drawing, or the knobs will not be the correct distance away from the control panel.

7. For a more professional appearance, a decorative trim should be constructed and installed around the front of the TV Set.

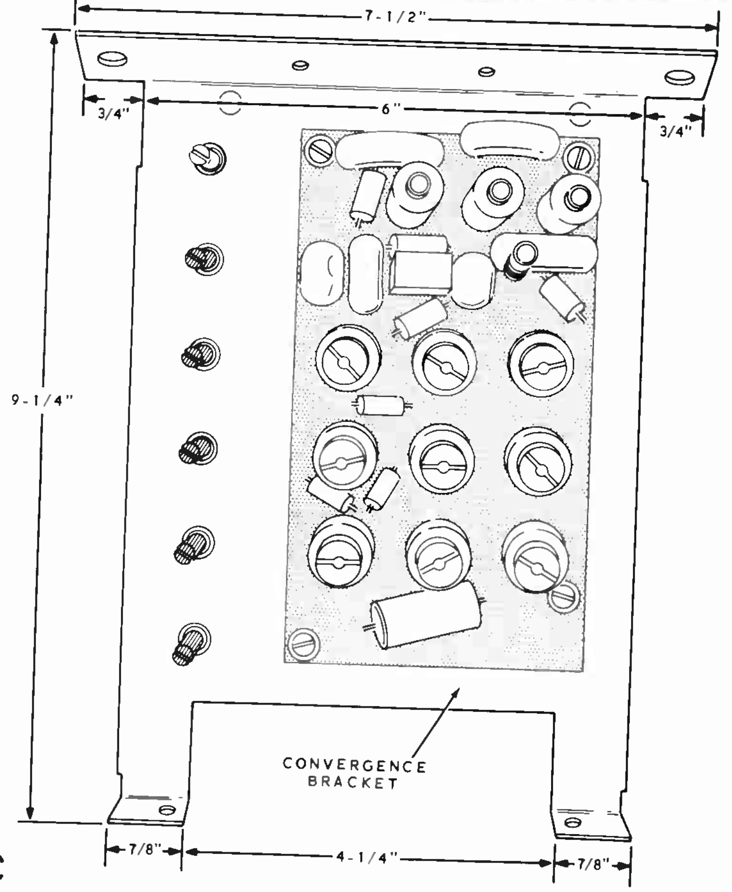
8. Mount the speaker in the prepared area.

9. Reinstall the knobs on the shafts extending through the control panel.

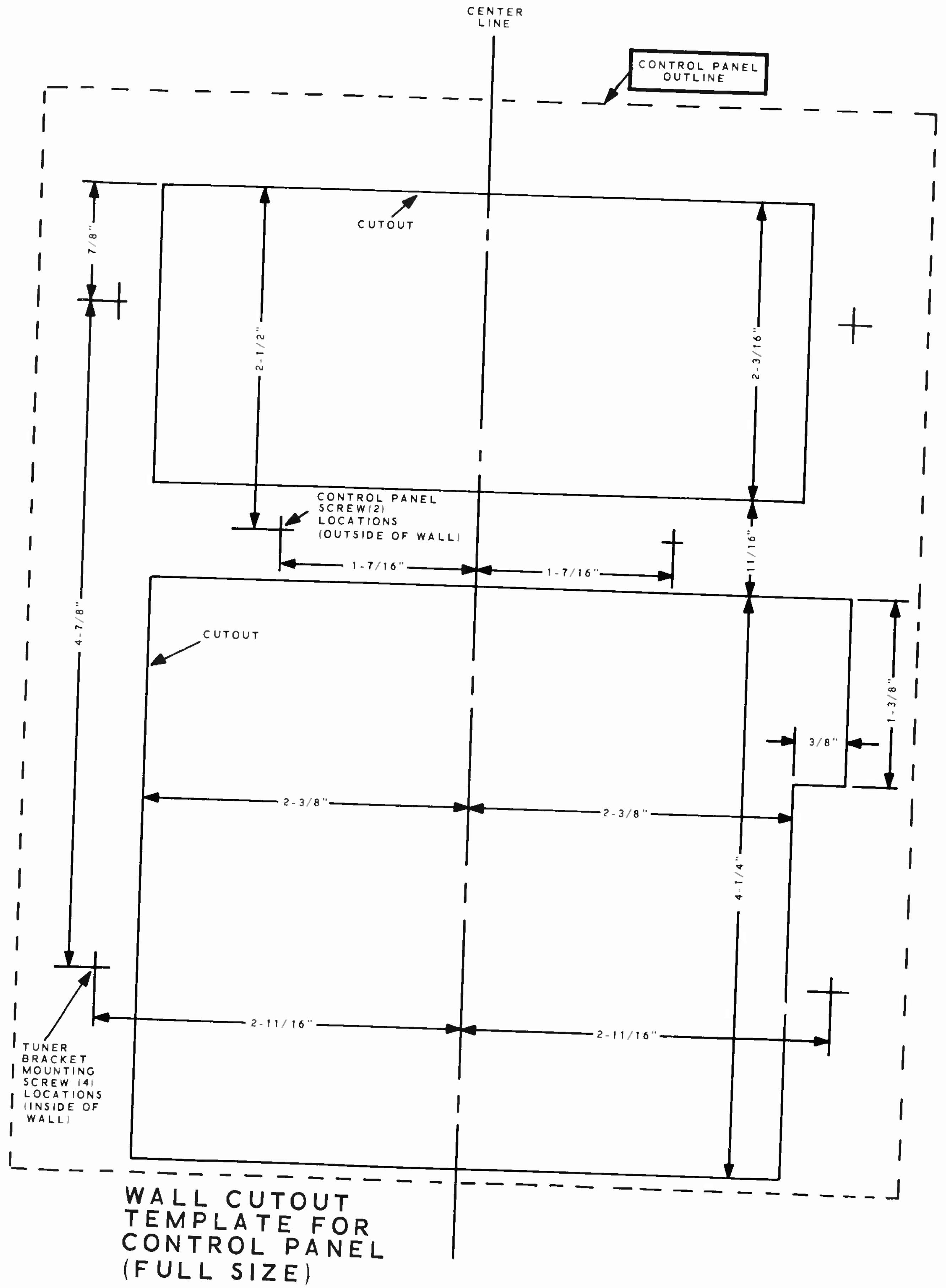
This completes the typical custom installation.



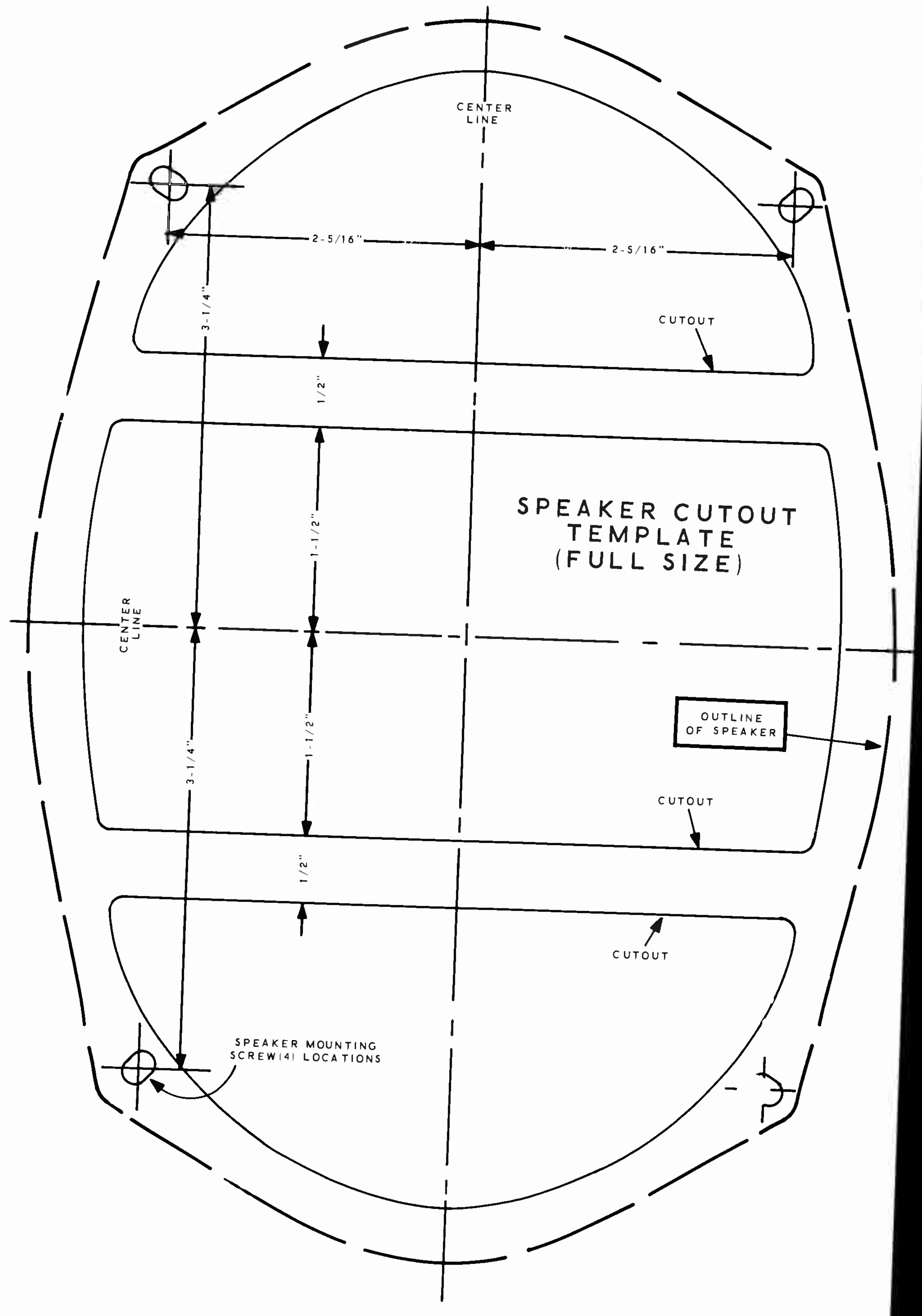
PICTORIAL 3-7 (MOUNTING BOARD TOP VIEW (3/4" PLYWOOD OR COMPOSITION BOARD))



DETAIL 3-7C



DETAIL 3-7A



DETAIL 3-7B

INSTALLATION ADJUSTMENTS

( ) Plug the speaker plug into the SPEAKER socket on the TV Set.

NOTE: The GRA-295-2 TV Cabinet has provisions for the mounting of a second speaker. The following parts are necessary, if a second speaker is added.

1. 6" x 9" oval speaker; 8 ohm impedance. (NOTE: This speaker must have a shielded magnet to prevent convergence problems in the picture tube. To insure proper operation, it is suggested that a 401-95 speaker be purchased from the Heath Company.)

2. 56" of shielded cable.

3. Four 8-32 nuts.

The second speaker can be installed as follows:

( ) Unplug the line cord.

( ) Refer to Detail 2-20D, (on Page 67) and prepare the ends of a 56" length of shielded cable. Remove only 1/4" of insulation from the inner lead at both ends of the cable.

( ) Open the speaker door (see Pictorial 3-1 on Page 84).

( ) At one end of the prepared shielded cable, connect the inner lead to the lug next to the red dot (S-2) and the shield to the other lug (S-2) of the speaker.

( ) At the other end of this cable, connect the inner lead to the lug next to the red dot (S-1) and the shield to the other lug (S-1) of the second speaker. The red dot may not be next to the same lug on both speakers.

( ) Close the speaker door.

( ) Mount the second speaker to the inside of the cabinet at the right side of the cabinet. Use four 8-32 nuts. Position the shielded cable around the rear of the picture tube shield.

This completes the installation of the second speaker.

NOTE: If you plan to use a hi-fi amplifier with your TV Set, a shielded cable should be connected from the Hi-Fi output of the TV Set to the input of your amplifier at this time.

( ) Connect the antennas to the antenna terminal strip of the TV Set.

( ) Plug the line cord of the TV Set into a wall outlet. Turn the Set on and tune in a program. After an operating period of approximately one hour, it is suggested that you repeat all the adjustments starting with the DC Convergence Adjustments on Page 75. Each time these adjustments are repeated some improvement, even through minor, should be realized.

After the adjustments have been completed to your satisfaction, proceed to Final Assembly.

FINAL ASSEMBLY

A tube and coil location chart for your Color TV Set is included in the Manual (Figure 3-1, fold-out from Page 99). Signal paths for the picture, sound, color, and sync signals are also on this chart. This Figure is duplicated on the fold-out sheet from Page 177. Cut off this duplicate Figure 3-1 and attach it to the inside of the Cabinet or Custom enclosure.

Be sure to fill in the picture tube warranty card and mail it to the Heath Company within 10 days to validate the warranty.

The following steps are separated into two sections: Cabinet Installation and Custom Installation. Complete only the group of steps that apply to your installation.

CABINET INSTALLATION

Refer to Pictorial 3-5 on Page 87 for the following steps.

( ) Install the picture tube back panel shield by placing the four tabs into their respective slots of the Cabinet back panel. Push the tabs in until they lock in place.

( ) Start #6 x 5/8" bronze screws into the three starting holes along the bottom edge of the Cabinet as shown.

( ) Set the Cabinet back panel on the three bronze screws started in the bottom edge of the Cabinet. Then fasten the back panel to the Cabinet with #6 x 5/8" bronze screws in the other seven Cabinet starting holes. Be sure to position the line cord in the back panel cutout as shown.

NOTE: Now that the Color TV Set has been completely assembled and adjusted, it is suggested that you read the remaining sections of this Manual. Then place the Manual in a large envelope and staple it to the Cabinet back, or in a place near the TV Set, for future reference.

CABINET CARE

Protect the surface of the Cabinet with a high-grade furniture wax.

Clean the Cabinet now and then by dusting with a soft dry cloth to remove fingerprints and any dull film.

CUSTOM INSTALLATION

( ) Complete the custom installation.

NOTE: Now that the Color TV Set has been completely assembled and adjusted, it is suggested that you read the remaining sections of this Manual. Then place the Manual in a large envelope and staple it on the back of your custom enclosure, or in a place near the TV Set, for future reference.

ANTENNAS

INTRODUCTION

This section will provide you with information concerning antennas, antenna lead-ins (twin lead and coaxial cable), proper antenna orientation, and signal preamplifiers for fringe areas. This information will help you select the proper antenna installation for maximum performance from your Color Television Set.

TYPES OF ANTENNAS

Your Color TV Set is designed to operate with one of the broadband types of antennas such as the in-line types recommended for color TV reception. It is very important to use an antenna which is suited for your area. Indoor antennas and some of the outdoor types of antennas that are used satisfactorily with black and white TV sets do not provide sufficient signal pickup and bandwidth for color television. The impedance of the antenna can be either 300 Ω or 75 Ω.

ANTENNA LEAD-INS

The color television signal is carried from the antenna to the television set by a length of twin lead or by a coaxial cable. The most commonly used types of twin lead and coaxial cable are listed below, with a description of how they respond to good and bad weather.

Flat twin lead - Little signal loss in fair weather. High signal loss in bad weather, especially at UHF frequencies.

Tubular twin lead - Little signal loss in fair weather. Less signal loss in bad weather than with flat twin lead.

Encapsulated twin lead - Little signal loss in fair weather. Less signal loss in bad weather than with tubular twin lead.

The signal loss may be even greater with the preceding three types of twin lead if they have accumulated a noticeable amount of foreign matter (dirt, etc.). Also, do not route these types of lead inside a metal pipe or on any metal surface. Figure 2-1A shows how to connect any one of the above three types of twin lead to the antenna terminal strip.

Shielded twin lead - This type does not perform as well in fair weather as the preceding three types do. However, the signal is hardly affected by bad weather. Figure 2-1B shows how to connect this twin lead to the antenna terminal strip.

Low loss coaxial cable - This cable has an impedance of 75 Ω and the same characteristics as the shielded twin lead. It should be used whenever a 75 Ω antenna is used. Figure 2-1C shows how to connect it to the antenna terminal strip. This cable can be used with a 300 Ω antenna when a balun coil (300 Ω to 75 Ω matching transformer) is used between the antenna and the 75 Ω cable. See Figure 2-1D.

NOTE: The preceding two types of lead can be routed inside a metal pipe or on any metal surface.

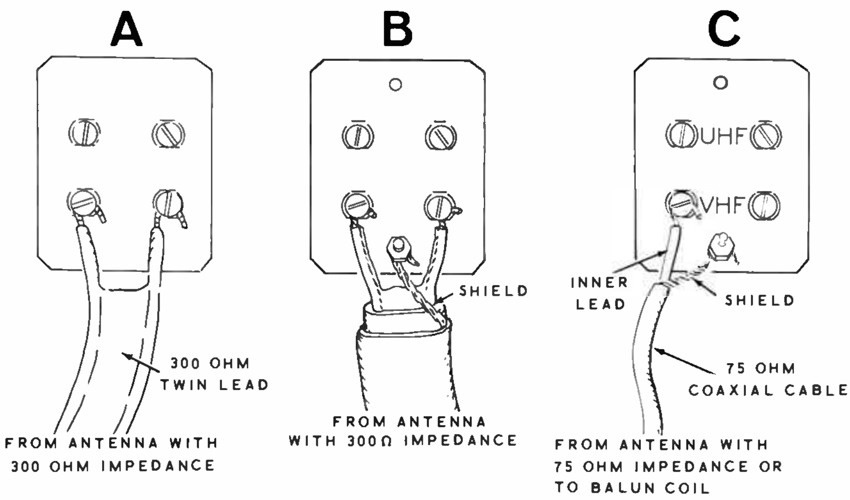


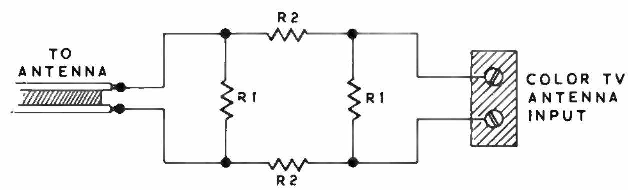
Figure 2-1

ANTENNA ORIENTATION

Antennas often need more careful orientation for good color TV reception than for black and white reception. Some antenna positions could result in good black and white pictures, but poor color pictures. This is mainly because the color information is transmitted differently than the black and white information. If a new antenna is being installed, or if the position of an older antenna seems questionable, orient it during a color program for best reception.

If the antenna is not oriented properly, signals from several directions may be reaching the antenna at the same time. These signals are usually reflected from objects such as large buildings or large metal structures. The reflected signals may cause slight phase shifts in the television signal. On black and white pictures, this would result in a very slight ghost (a duplicate image appearing right next to the actual image) or smear. On color pictures, however, the phase shift can cause excessive color smear and incorrect color areas. To eliminate this problem, turn the antenna until the best picture is received.

Distorted pictures can sometimes be caused by too strong a signal, especially in metropolitan areas, where the transmitting antenna is quite close to the receiving antenna. In these cases, the signal from the antenna can be reduced by using an attenuator pad, like the one shown in Figure 2-2, and connecting it between the antenna and the Color TV Set, as shown. Resistors for making these pads can be obtained locally.



FOR A SMALL AMOUNT OF ATTENUATION (6DB)
R1 = 910Ω
R2 = 110Ω

FOR A MEDIUM AMOUNT OF ATTENUATION (12DB)
R1 = 510Ω
R2 = 270Ω

FOR A LARGE AMOUNT OF ATTENUATION (18DB)
R1 = 390Ω
R2 = 560Ω

Figure 2-2

SIGNAL PREAMPLIFIERS

If you live in a fringe area where it is difficult to receive a strong TV signal, a preamplifier may be a solution to your problem. A preamplifier will amplify the weak signal received by the antenna. If a unit of this type is purchased, make sure the specifications qualify it to be used for color as well as black and white signals. If the bandpass specification is too narrow, a phase shift could occur which could cause color smear and incorrect color areas (a black and white picture would not be affected).

There are two types of preamplifiers; outdoor and indoor. The outdoor type will be described first.

The outdoor preamplifier is mounted on the antenna mast near the antenna. The antenna is connected to the input terminals, and the lead is connected to the output terminals. The other end of the lead is connected to the antenna terminal strip. The power supply which supplies operating voltages for the preamplifier is mounted in the house, and the voltages are fed up to the unit through a cable.

The main advantage in using an outdoor preamplifier of this type is that only the TV signal from the antenna is amplified and not the noise picked up by the lead. This gives a better signal-to-noise ratio and less snow in the picture.

The indoor preamplifier is installed inside the house between the lead and TV set. This unit amplifies the signal as well as the outdoor unit, however, the noise picked up by the lead-in is also modified. This causes the signal-to-noise ratio to stay approximately the same, and you may still have a snowy picture.

NOTE: Make sure that the lead going to the TV set is not routed next to the lead coming from the antenna. This could cause the preamplifier to oscillate and cause interference in the picture.

The indoor preamplifier is a good unit to use for couplers when more than one TV set is used. This type of unit can usually be purchased with more than one set of output terminals. Additional TV sets can be connected to these terminals. This would serve as an amplifier stage for each TV set, and also keep the sets from interfering with each other.

When using preamplifiers as multi-set couplers in strong signal areas, the input of the preamplifier (depending on the circuitry), may be overdriven. This would result in cross-modulation problems in the preamplifier and cause interference on one or more channels. Be sure to use an attenuator pad in these cases, such as the one shown in Figure 2-2, on the input of the preamplifier to reduce the amount of signal to the Color Television Set.

OPERATION

Refer to Figure 2-3 (fold-out from Page 82) while reading the following information on the operation of the controls of your Color TV Set. Tune in a color TV program and turn the different front panel controls back and forth to become familiar with them.

NOTE: Figures 2-4 through 2-7 (fold-out from Page 82) are examples that show how the color controls should be used.

Figure 2-5 is a normal color picture.

Figures 2-4 and 2-6 show what happens if the TINT control is turned too far in either direction.

Figure 2-7 shows what happens when the COLOR control is advanced too far.

Slight color fringes may sometimes be seen around objects that are near the edges of black and white pictures. A small amount of this "color fringing" is normal for all color TV receivers. Color fringing is caused by slight misconvergences between the red, blue, and green beams in the picture tube.

NOTE: Do not place antenna rotor controls, electric clocks, telephones, etc., on top of the Cabinet of your Color TV Set. These devices may produce undesirable magnetic effects that could distort the colors in the picture.

AGING IN

After one to two weeks of operation, the Dynamic Convergence Adjustments on Page 78 should be repeated. This time period will allow for the initial "aging in" period which most color TV receivers must go through before the components stabilize. After readjusting the dynamic convergence circuits, the Set will only require slight readjustment from time to time to maintain optimum performance.

COLOR PROGRAMS

There are many variables that affect the quality of the colors and the sharpness of the images. In general, live programs and some color film will produce better pictures on your screen than programs that have been recorded on video tape. When you judge the quality of the color picture, be sure to consider the source of the program before deciding that there is a problem in the TV Set.

Color programs that are televised outdoors may appear quite different from color programs that are televised indoors, due to the differences between natural light and artificial light. Often, slight differences can even be seen between the signals from different TV cameras on the same program.

Color quality may also change when you tune from one channel to another. It may be necessary to adjust the COLOR, TINT, and FINE TUNING controls when a color program is being tuned in, or when switching from one channel to another.

IN CASE OF DIFFICULTY

NOTE: Refer to the Kit Builders Guide for Service and Warranty information.

This section of the manual is divided into several parts. The first part, titled General, describes what to do about any difficulties that occur right after the Color TV Set is assembled. The second part, titled Troubleshooting, tells what to do if some problem occurs after the TV Set has been in operation for some time.

A Troubleshooting Chart is also provided. This Chart lists a number of possible difficulties that could arise. It also shows what the TV picture would look like for these difficulties, and lists several possible causes.

A tube and coil location chart for your Color TV Set (Figure 3-1, fold-out from Page 99) is included at the end of this section of the Manual.

Signal paths for the picture, sound, color, and sync signals are also shown on this chart.

Circuit Board X-Ray Views (Page 171) and Chassis Photographs (Page 173) have been furnished as an aid in locating components on the circuit boards and chassis. The foil pattern has been inked on the top of the circuit boards to help you locate parts when troubleshooting.

Before you try to locate the cause of a difficulty, be sure to check the operation of the controls on your TV Set. Difficulties may also be due to improper adjustments of the chassis and convergence controls. A recheck of these adjustments as outlined in the Initial Test And Adjustments section may help to locate the source of trouble.

WARNING: Since high voltages are present at many points throughout the TV Set, caution should be taken to avoid personal shock.

GENERAL

The following paragraphs deal with the types of difficulties that may show up right after a kit is assembled, before you can put it into operation. These difficulties are most likely to be caused by assembly errors or faulty soldering.

The following checks will help you locate any error of this type that might have been made.

1. The first step in looking for your difficulty is to make a quick visual check of the whole unit to make sure there are no obvious difficulties, such as unsoldered connections, burned or overheated parts, bare wires touching each other, obviously faulty solder connections, etc. Make sure there are no bits of solder, wire ends or other foreign matter lodged in the wiring. Carefully check all terminals that have several wires attached to make sure that all wires, especially the lower ones, are soldered.

2. Check all wires to make sure they are connected to the right places. Usually, it is quite helpful to have a friend help you check your work. Often, someone not familiar with the unit will notice an error that you have overlooked consistently.

3. Check to make sure that each of the tubes is in its proper location and that its filament is lit. (Normally, only a slight glow will be seen in tube V704, the high voltage rectifier.)

4. Check all solder connections carefully to make sure they are bright and shiny. It is interesting to note that about 90% of the kits that are returned to the Heath Company for repair do not operate properly due to poor solder connections. Reheat and, if necessary apply a little more solder to all questionable connections to make sure they are soldered as described in the Soldering section of the Kit Builders Guide.

5. Check all leads soldered to the foil side of the circuit boards. Be sure these leads do not protrude through the circuit board and short to coil shields or component leads on the component side of the circuit boards.

6. Check the values of resistors and capacitors to make sure the proper part is wired into the circuit in each position. It is sometimes easy to misread the third color band on a resistor. For example, if a 22 KΩ (red-red-orange) resistor were installed instead of a 220 KΩ (red-red-yellow) resistor, the circuit would not operate properly.

7. If all of the checks listed above have been made and the trouble still is not located, it may be helpful to refer to the Troubleshooting Chart, and to the Troubleshooting information on the following pages.

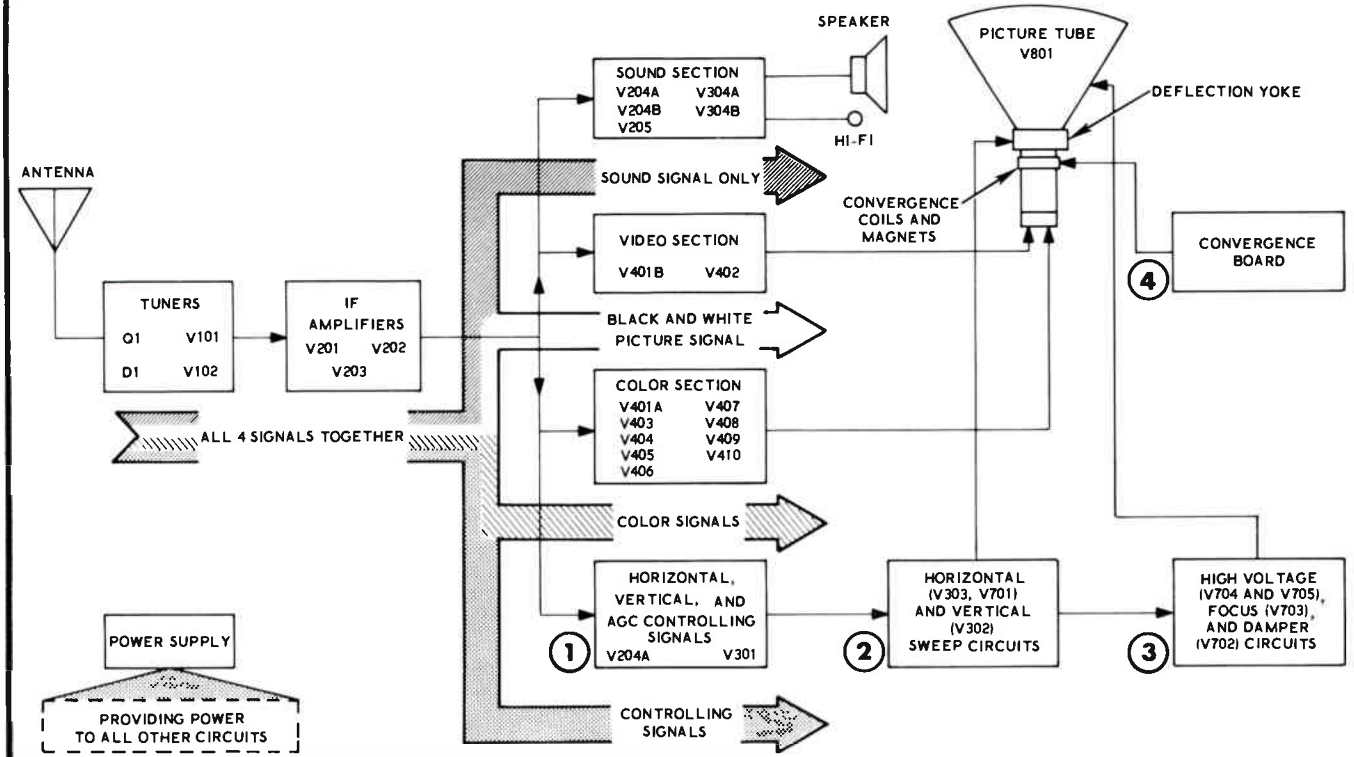
TROUBLESHOOTING

The following information will most often be used to deal with the type of difficulties that occur after the TV Set has been in operation for some time. This type of difficulty is usually caused by tube failure or parts breakdown.

Troubleshooting your TV Set means the process of searching through it to find out why it is not operating properly. First, you must determine what general area the trouble is in; then you must find the trouble itself and correct it.

FINDING THE AREA

Studying a faulty TV Set is like a detective trying to solve a crime; the source of the trouble must be determined by analyzing the symptoms, or clues, that are shown by the TV Set. Figure 3-2 on Page 98 is provided to help you find out what part of the TV Set your trouble is in. Careful reading of the Color TV Theory and Circuit Description sections of this Manual will also help you to analyze the problem.



(1) These circuits hold the picture stationary on the screen.

(2) Horizontal sweep circuits fill the picture out horizontally.
Vertical sweep circuits fill the picture out vertically.

(3) High voltage circuits cause the screen to light up, using a signal it gets from V303 and V701. The damper circuit aids circuit V701, and supplies extra operating power to picture tube screen and vertical sweep circuit.

(4) Convergence circuits make the red, blue and green beams in the picture tube strike the same spot on the screen at the same time.

Figure 3-2

Figure 3-2 is a block diagram that shows the major sections of your Color TV Set and the tubes that are used in each section. It also shows the signals present in each section. Note that all four parts of the Color TV signal pass through the tuners and IF amplifiers. Then this signal is divided into four separate parts: the sound signal, the black and white picture signal, the color signals, and the controlling (or synchronizing) signals.

Carefully study the symptoms shown by your TV Set and try to determine which section could cause the type of trouble you are having. Suppose, for example, there is no sound, but the picture looks normal. Since all four signals pass through the tuners and IF amplifiers together, these circuits are probably OK. Thus the trouble is probably in the sound section, in the circuits of V204, V205, or V304.

A case where you had no light on the screen could also be used as an example of the trouble-shooting process. Figure 3-2 shows that the high voltage circuits cause the screen to light up, so the trouble may well be in the circuit of V702, V703, V704, and V705, or in the circuits of V303 and V701 which supply an operating signal to the high voltage section.

Another example might be a case where the picture rolls vertically very rapidly, and cannot be made to stop. In this case, the trouble might be either in the vertical sweeping circuits of V302, or in V204A, or V301 which supply controlling signals to V302.

FINDING THE TROUBLE

When you have determined the section the trouble is most likely to be in, search through that area carefully to find the exact cause of the trouble. Start by making more complete visual checks in this area, as listed below.

1. Search through the trouble area carefully to make sure all of the solder connections are good. Trouble can sometimes be eliminated by reheating all questionable connections to make sure they are soldered properly.

2. Check the tubes in this section by substituting tubes of the same types that are known to be good, or by using a tube tester. The substituting of good tubes is always the better of these two methods.

3. Carefully check the values of the parts in this section to make sure the proper part is wired into each position.

VOLTAGE AND RESISTANCE MEASUREMENTS

If the trouble still is not located and a voltmeter is available, check the voltage readings against those shown on the Schematic. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 20%.

The voltage measurements should be made with all components in the circuit. The deflection yoke, convergence assembly, speaker, and picture tube leads should all be connected.

In some cases it is not possible to turn on the TV Set to make voltage measurements due to the nature of the trouble in the Set. Under these conditions resistance measurements throughout the circuit can be very useful in troubleshooting the TV Set. A complete Resistance Chart is provided on the fold-out from Page 79. These measurements were made with a vacuum tube voltmeter. All resistance readings may vary as much as 20%. Those readings marked in the chart with footnotes may vary more than 20%.

The resistance measurements should be made with all components in the circuit and with the Set unplugged from the AC outlet. The deflection yoke, convergence assembly, speaker, and picture tube leads should all be connected.

The complete Color TV Set can be removed from the Cabinet or from the custom mount by reversing the process that was used to install it. See Pictorials 3-1 through 3-6.

REPAIRING THE TV SET

In repairing your TV Set, make sure you eliminate both the cause and effects of your trouble. For example, suppose you found a burned-up resistor and a bad tube, one with a short circuit in it. If you only replace the resistor, the shorted tube will also cause the new resistor to burn up.

Since a color television set is an extremely complex device, a case may sometimes arise where the trouble is not found, even after making the checks listed above. If this condition should occur, you may avail yourself of the help provided by the Heath Technical Consultation Department or Service Department as described in the Kit Builders Guide.

NOTE: When writing to the Heath Company, be sure to include the following information: kit Model Number, Series Number, purchase date, and date of the kit assembly manual (date at bottom of Page 1).

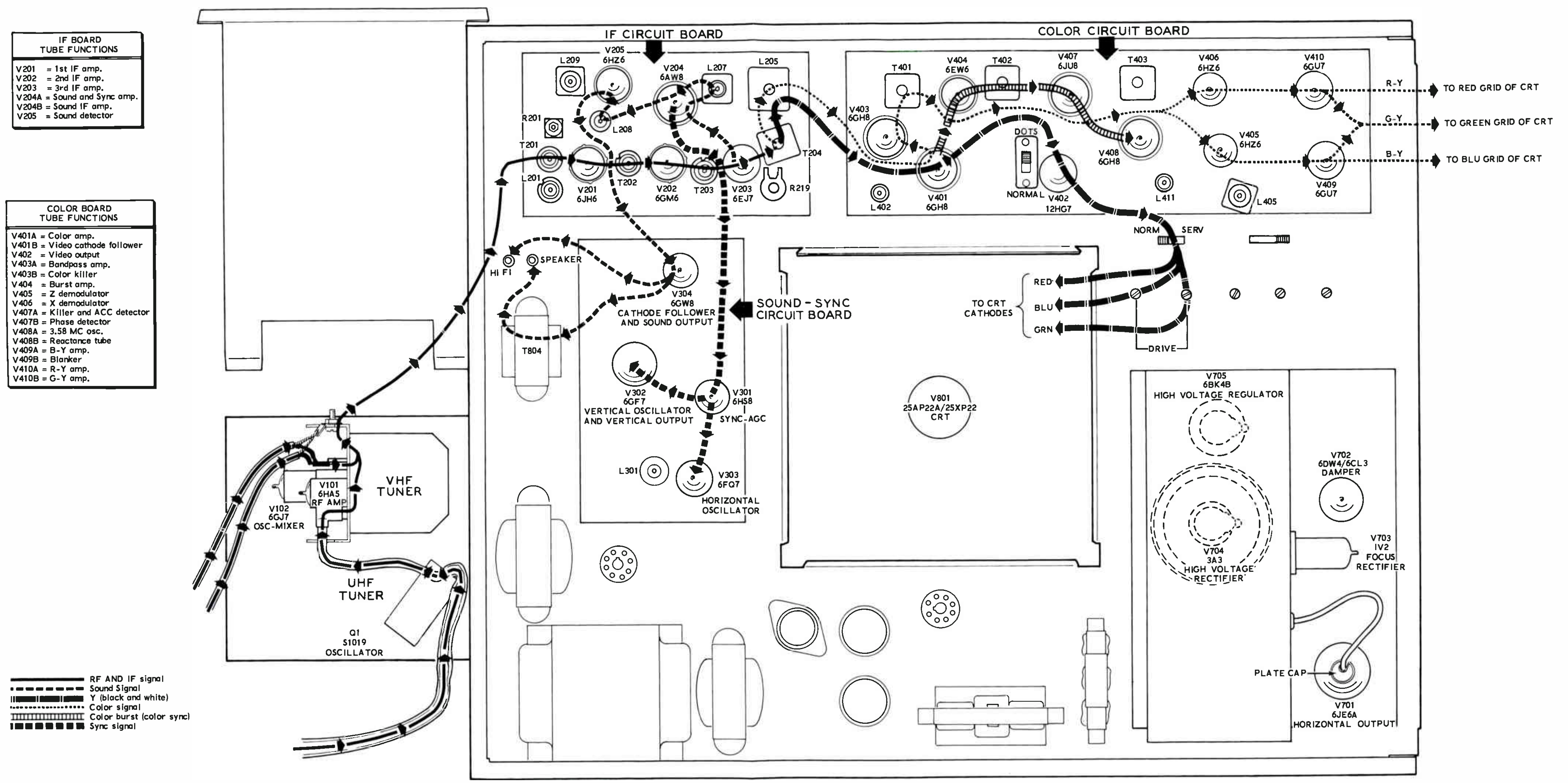
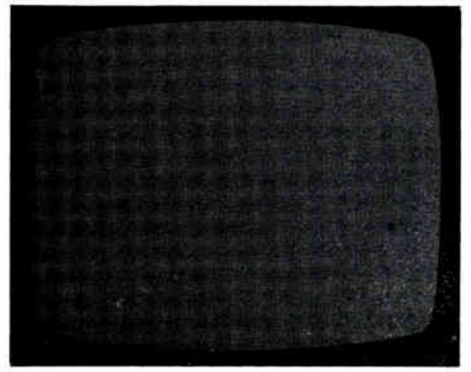
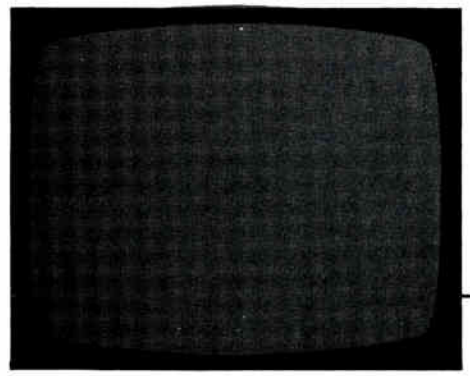
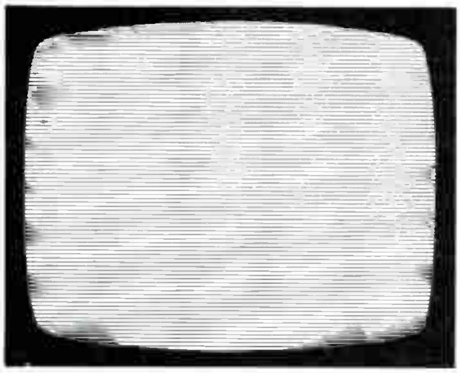
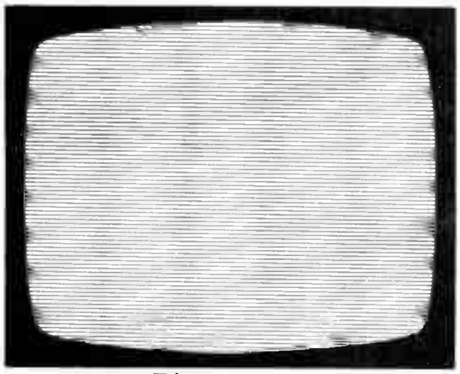
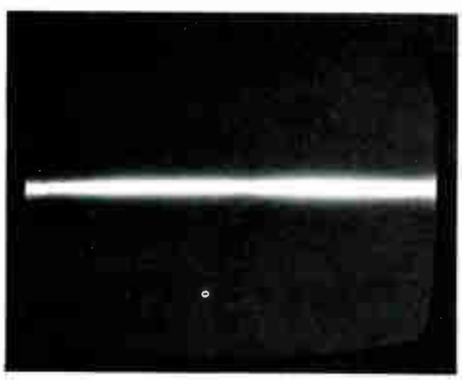


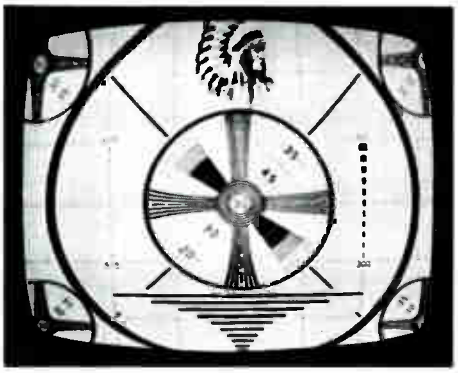
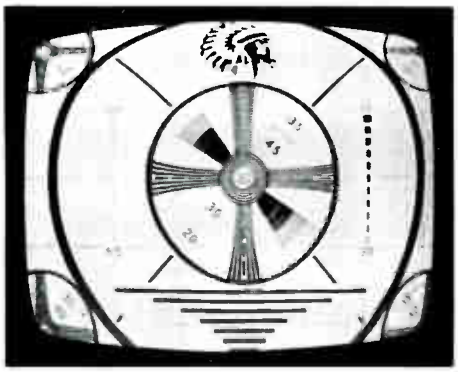
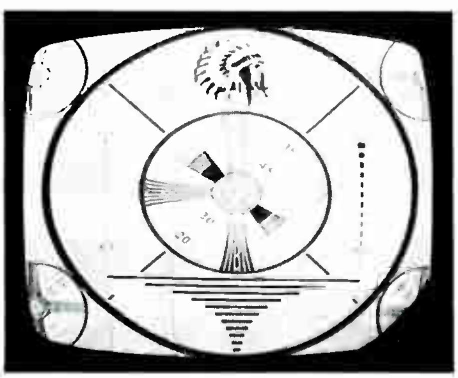
FIGURE 3-1

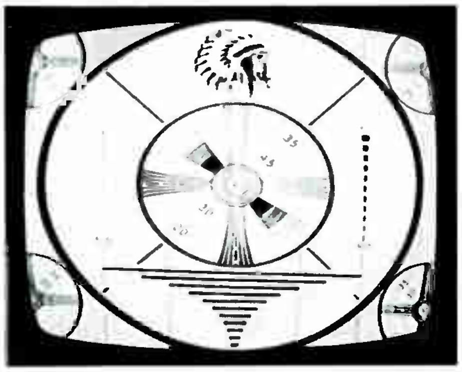
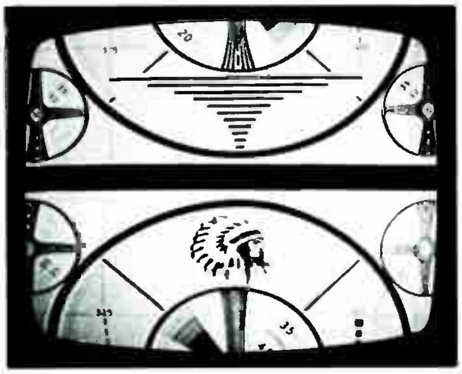
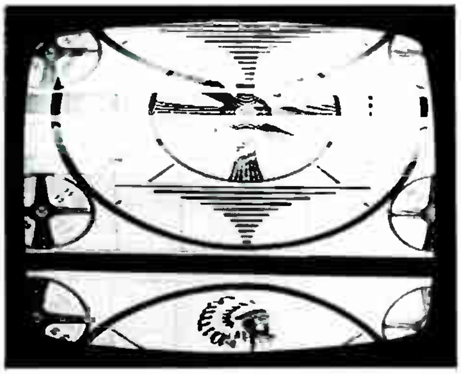
TROUBLESHOOTING CHART

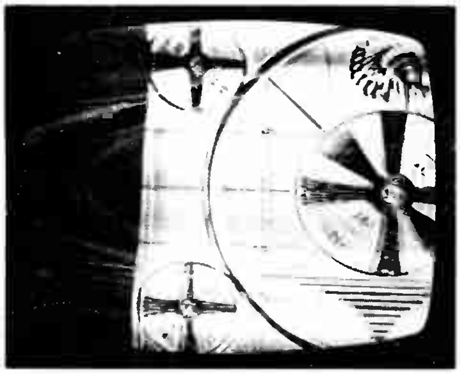
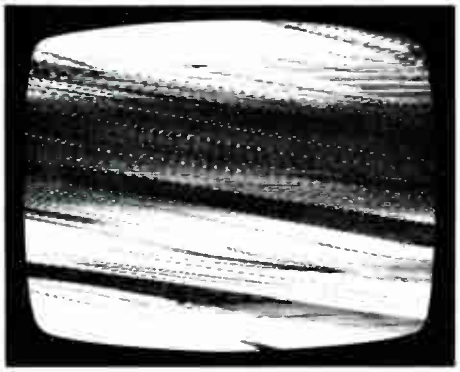
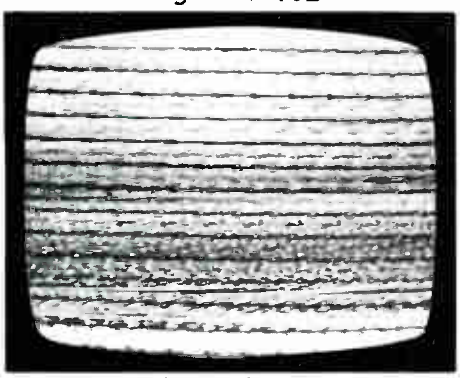
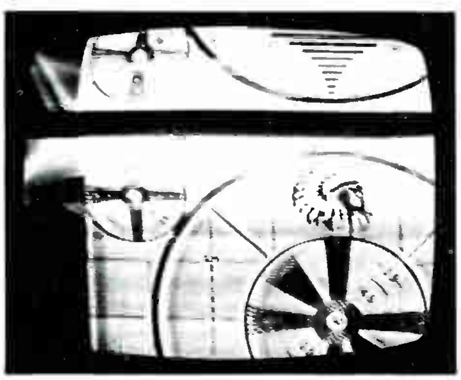
This Troubleshooting Chart lists some possible difficulties that might arise in the adjustment and operation of your Television Set. It may be necessary to refer to more than one trouble listed in the Chart to help locate the difficulty. The suggested corrective measures are given primarily to direct your attention to the areas most likely to be faulty; they do not definitely rule out all other possibilities. The Area Of Trouble column refers to the sections of the TV Set shown in Figure 3-2.

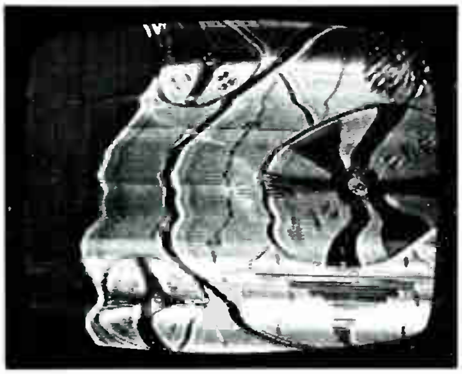
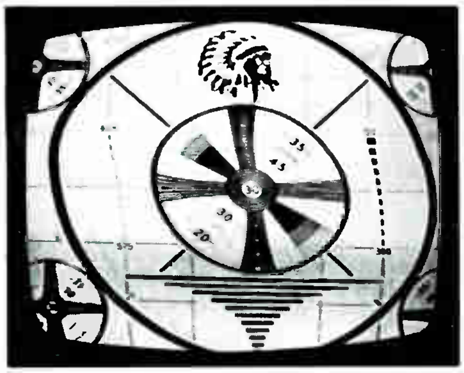
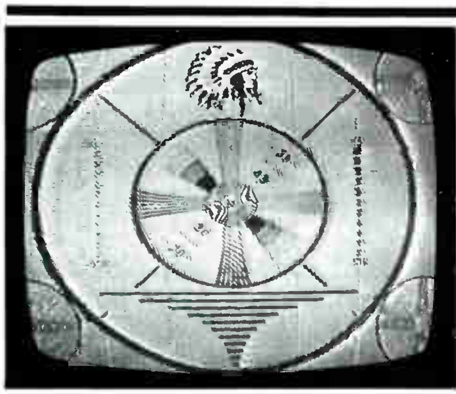
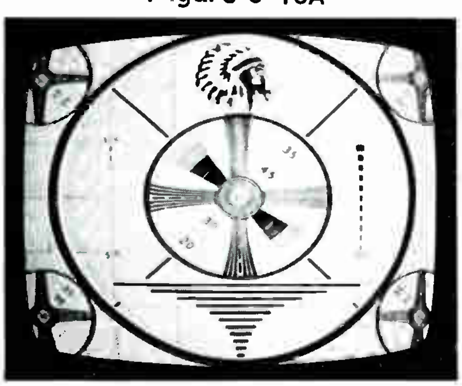
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-3	TV Set completely dead.	Power Supply	1. Line cord unplugged, unsoldered or broken. 2. Circuit breaker open.* 3. Thermistor not soldered, cracked, or burned out. This can be caused by diodes D601 or D602; see possible cause #5. 4. Filament fuse wire not connected or open** (the #22 bare wire between lugs A and G on terminal strip at the rear of chassis). 5. Diode D601 or D602 not connected properly or defective. This could cause the circuit breaker to open or the thermistor to crack. 6. Resistor R603 open. 7. Coil L601 open. 8. Tube V703 shorted. * Push button to reset. If the circuit breaker will not stay closed, there is a short circuit in the power supply: +390 V, +275 V, or +140 V supply. ** A burned out filament fuse indicates that a filament lead is shorted to chassis ground.
 Figure 3-4	No light on screen, sound ok.	Horizontal circuits, or high voltage circuits.	1. Normal-Service switch in wrong position. 2. High voltage anode not connected. 3. Brightness control not turned up. 4. Tube V303. 5. Components in the circuit of horizontal oscillator V303. 6. Tubes V701, V702, V704, V705, and associated circuit components.
	No light on screen, sound ok, tubes V701, V704, and V705 get red.		1. Check picture tube voltages. 2. Resistors R412 and R485 interchanged. 3. Coil L802 open. 4. Tube V303.

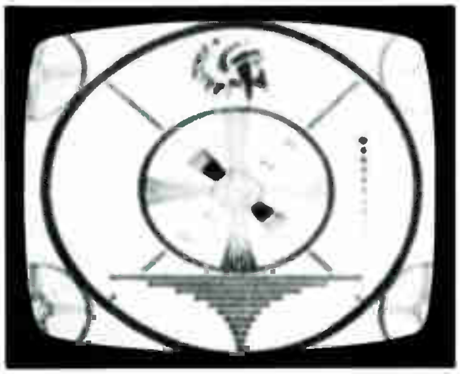
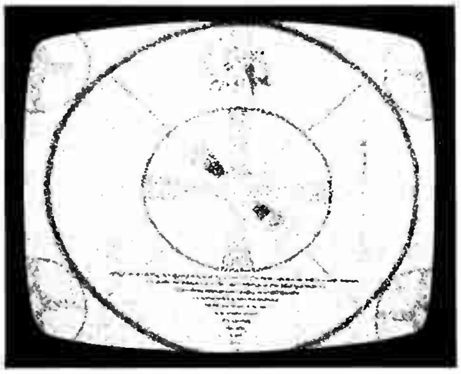
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-5	Light on screen, no picture, no sound.	Tuners, or IF amplifier sections.	1. No antenna or faulty antenna connections. 2. AGC control misadjusted. 3. Fine Tuning badly misadjusted. 4. IF input cable not plugged into VHF tuner. 5. Check all connections to IF circuit board and tuner. 6. Tubes V101, V102, V201, V202, V203, V401B, V402, and associated circuits. (Also, UHF tuner transistor Q1.)
 Figure 3-6	Light on screen, sound ok, no picture or picture jumbled.	Video section, controlling signals section, or horizontal (V303) section.	1. Fine tuning misadjusted. 2. Horizontal Hold misadjusted. 3. Vertical Hold misadjusted. 4. AGC control misadjusted. 5. Contrast turned off. 6. V301, V303, V204, V401, and associated circuits.
 Figure 3-7	No vertical deflection (line across center of screen).	Vertical sweep circuits.	1. Normal-Service switch in wrong position or defective switch. 2. Height and Vertical Linearity controls misadjusted. 3. Tube V302. 4. Vertical output transformer T801. 5. Deflection yoke.

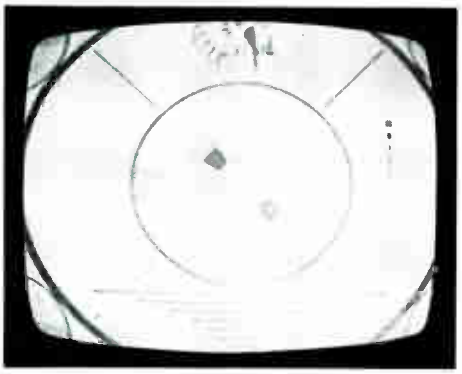
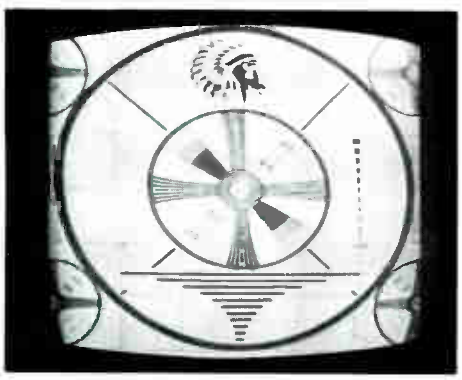
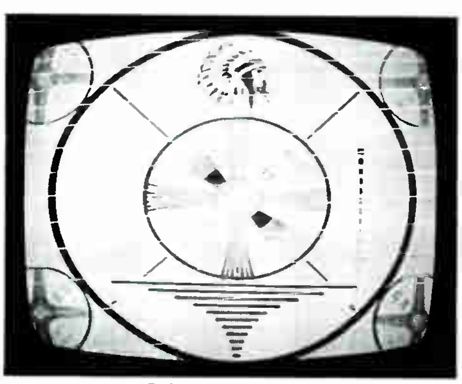
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-8	Top of picture stretched (heads of people are too long).	Vertical sweep circuits.	1. Adjustment of Vertical Linearity control. 2. Tube V302. 3. Resistors R318 and R339. 4. Capacitor C806. 5. Controls R341 and R513.
 Figure 3-9	Bottom of picture stretched (legs of people are too long).	Vertical sweep circuits.	1. Adjustment of Height control. 2. Tube V302. 3. Resistors R318 and R339. 4. Capacitor C806. 5. Controls R341 and R513.
 Figure 3-10	Neck shadow (corner of picture black and not filled in).	Deflection yoke.	1. Deflection yoke positioned too far back on picture tube neck. Refer to Purity adjustments on Page 77.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-11	Picture ok, no sound.	Sound section.	1. Speaker or hi-fi amplifier not connected. 2. Speaker connected to Hi-fi jack instead of Speaker jack. 3. Hi-fi amplifier not turned on. 4. Hi-fi amplifier selector not turned to TV input position. 5. Shielded cable to volume control shorted out. 6. Tubes V204, V205, V304, and associated circuits.
 Figure 3-12A  Figure 3-12B	Picture rolls (no vertical sync).	Vertical sweep circuits, controlling signal circuits.	1. Adjust Vertical Hold control. 2. AGC and Sync controls. 3. Tubes V302, V301. 4. Faulty vertical integrator (P.E.C. #1). 5. Circuit components of tube V302. 6. Capacitor C312.

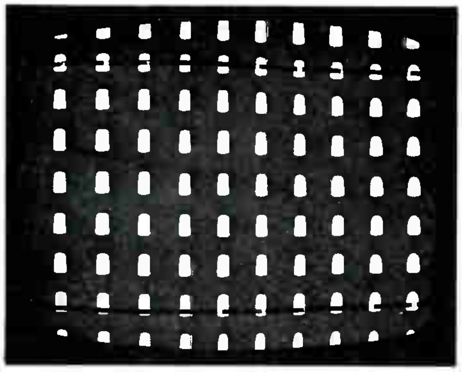
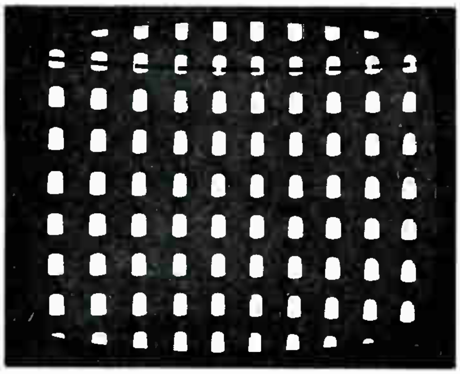
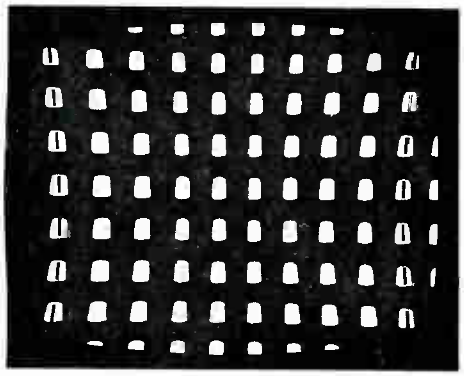
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-13A  Figure 3-13B  Figure 3-13C	No horizontal hold.	Controlling signal circuits, horizontal sweep circuit (V303).	1. Adjust Horizontal Hold control. 2. AGC and Sync controls. 3. Adjustment of horizontal stabilizing coil L301 (see Page 125). 4. Tubes V303, V301. 5. Capacitor C307. 6. AFC dual diode D301. 7. V303 and associated circuitry. 8. Diode D201.
 Figure 3-14	Picture not stationary on screen (no horizontal or vertical sync).	Controlling signal circuits.	1. AGC control. 2. Sync control. 3. Tube V301 and associated circuit components. 4. Tube V204A. 5. Diode D201.

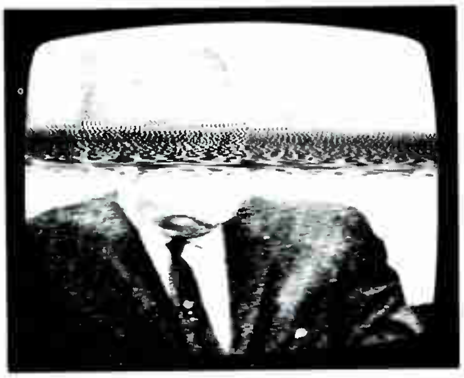
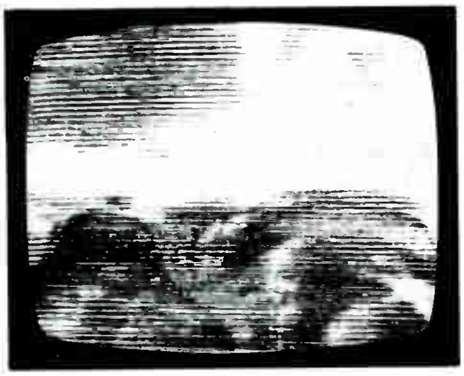
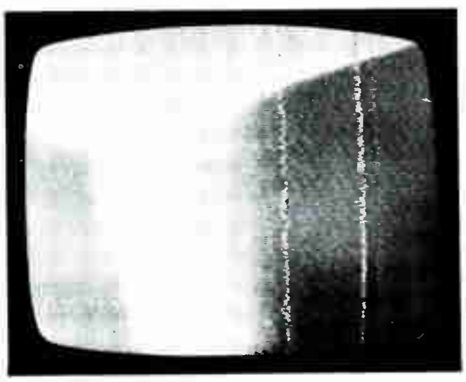
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-15A	Picture tears or bends.	Controlling signal circuits.	1. AGC and Sync controls. 2. Tubes V101, V102, V201, V202, and V301.
 Figure 3-15B	Picture rolls, tears and/or bends in strong signal area.	Tuner	1. Use an attenuator pad in series with the antenna lead. See Figure 2-1 on Page 93.
 Figure 3-16A  Figure 3-16B	Herringbone interference in picture.	Tuners, IF amplifiers section.	1. Fine Tuning misadjusted. 2. Local RF interference. 3. 4.5 mc trap alignment with instruments (see Page 123).

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-17	Picture smears, (not clear).	Tuners, video section, focus circuit.	1. Fine Tuning misadjusted. 2. Improper adjustment of Focus coil L704. 3. Tube V703 defective. 4. Open peaking coil, L403, L404, or delay line. 5. Poor video IF alignment.
 Figure 3-18	No picture contrast (washed-out picture).	Tuners, IF amplifiers section, video section.	1. Contrast control. 2. Brightness control. 3. AGC control. 4. Tubes V101, V102, V201, V202, V203, V401A, V402, and associated circuits. 5. Diode D202 defective. 6. Control R219 open.
 Figure 3-19	Picture snowy.	Tuners.	1. VHF and UHF antenna leads interchanged at TV Set. 2. Poor antenna. 3. Tube V101 or V102.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-20	Picture blooms more than normal (grows in size) when brightness is turned up.	High voltage section.	1. High Voltage Adjust control turned too far counterclockwise. 2. High voltage too low. 3. Tube V704.
	Excessive width.	Horizontal or damper circuits.	1. High AC line voltage. ~~2. Width coil L807 misadjusted or defective.~~ 3. Coil L703 misadjusted or defective. 4. Defective capacitor C708 or C711.
 Figure 3-21	Picture takes a long time to come on, and does not fill screen horizontally.	Horizontal or damper circuits.	1. Check tubes V701 and V702.
	Insufficient width.		1. Low AC line voltage. 2. ~~Width coil L807~~ misadjusted. 3. High Voltage adjust control set too high. 4. Connect a jumper wire between lugs 1 and 2 of Width coil L807.
 Figure 3-22	White lines run diagonally across picture (retrace lines). *	Video section.	1. No vertical retrace blanking, check R413, C411. * Some retrace lines will normally be seen if the Contrast control is set at minimum and the Brightness control at maximum.

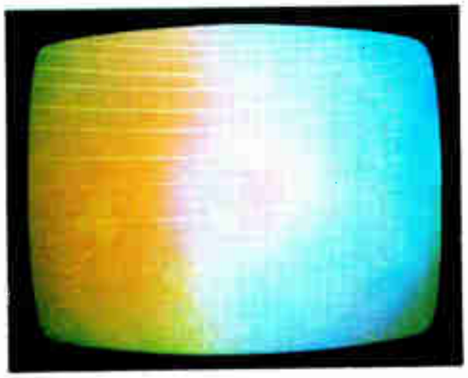
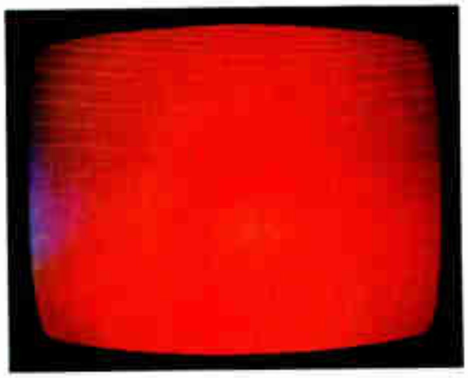
TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
Weak or distorted sound.	Tuners, sound circuits.	1. Fine Tuning misadjusted. 2. Tubes V204, V205, V304. 3. Adjustment of coils L207, L208, L209. 4. Capacitors C606B, C608D.
VHF channel selector indicates wrong channel.	VHF tuner.	1. Fine Tuning misadjusted. 2. Defective VHF channel selector knob (if all VHF channels are wrong).
Intermittent picture or sound.		1. See Cleaning The VHF Tuner Contacts on Page 118.
Unable to obtain dot pattern.	Video section.	1. Defective neon lamp (type NE-2) in color dot circuit. 2. Open, defective, or improperly connected diode D401.
Unable to obtain dots but can get vertical bars.		1. Defective NE2 neon lamp or diode D401. 2. Defective capacitors C405 and C412.
Unable to obtain dots but can get horizontal bars.		1. Defective coil L405. 2. Defective capacitors C413 and C414.
Smear between rows of dots.		1. Brightness control advanced too far. 2. Coil L405 misadjusted.
Dots bloom (grow in size).		1. Brightness control advanced too far. 2. Diode D401 installed with leads reversed.
One or more convergence controls have no effect.	Convergence circuit board.	1. Check wiring and solder connections.

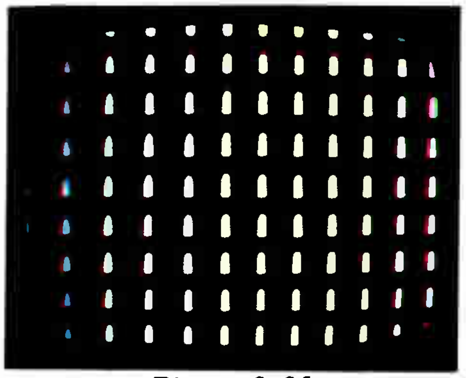
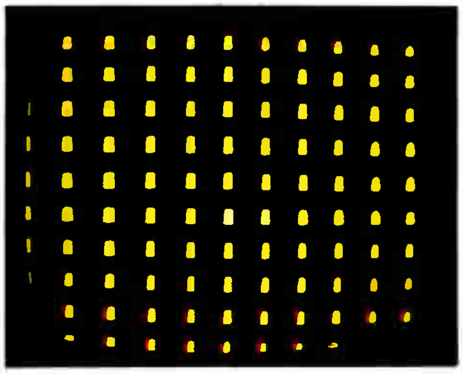
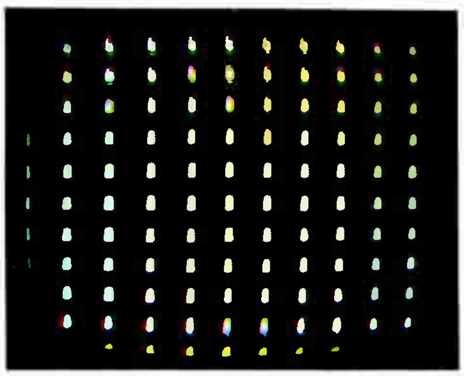
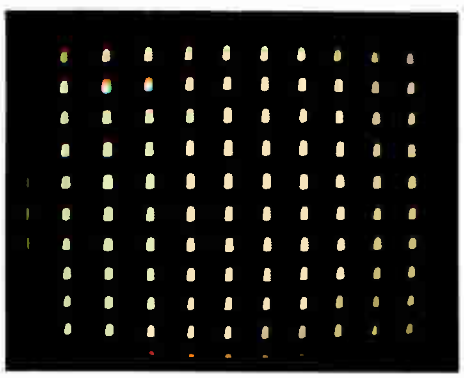
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-23	Upward bow in top row of dots not centered.	Sweep circuits.	1. Pincushion phase coil improperly adjusted. 2. Defective transformer T803 or coil L801.
 Figure 3-24	Top and bottom rows of dots bowed inward.		1. Top-Bottom Pincushion control too far counterclockwise. 2. Pincushion Phase coil slug too near the ends of its adjustment range. 3. Capacitor C802. 4. Defective coil L801.
 Figure 3-25	Outside rows of dots bowed.		1. Defective voltage dependent resistor R803. 2. Defective transformer T802.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-26	Diathermy interference	Outside inter-ference.	1. Interference from a diathermy machine in your vicinity.
 Figure 3-27	Co-channel interference.	Outside inter-ference.	1. Tune to a different channel. 2. Turn antenna to a different direction. 3. Use a more directional type of antenna.
 Figure 3-28	Barkhausen interference.	Horizontal sweep circuit.	1. You are receiving too weak a signal. 2. Remove jumper wire between lugs 8 and 9 on tube socket V701, then install jumper wire between lugs 3 and 8 of same socket. NOTE: If tube V701 is ever re-placed, and the Barkhausen in-terference is noticed, reverse the preceding connections. 3. Change tube V701, the horizontal output tube.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-29	Screen predominately one color, other than white (when tuned to a black and white picture).	Color and video sections.	1. Adjustment of Screen and Drive controls. 2. Tubes V405, V406, V409, V410, and associated circuit components. NOTE: If only left half of screen is green, check for open coil L409.
 Figure 3-30	Colored confetti in black and white pictures.	Color section.	1. Color control advanced too far. 2. Extremely weak signal. 3. Color Killer control not properly adjusted. 4. Check V403, V407, and associated circuit components.
 Figure 3-31	Color stripes in black and white or color picture. Stripes seem to twist and turn around in picture.		1. Local RF interference.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-32	Unable to complete purity adjustments, dynamic convergence adjustments do not work.	Convergence circuits.	1. Convergence assembly not plugged into chassis.
 Figure 3-33A  Figure 3-33B	White objects in black and white picture are outlined in color (color fringing*).	Convergence board.	1. Misconvergence (see Convergence Adjustments on Pages 75 to 80). *NOTE: If this color fringing can not be seen at normal viewing distance, it can be considered normal.

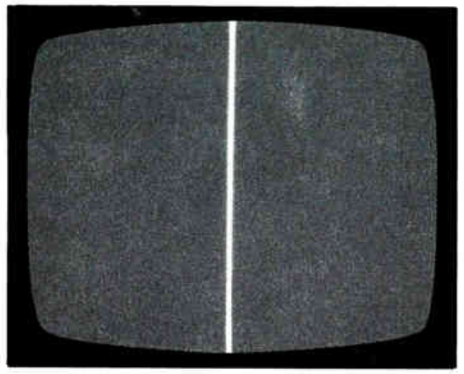
PICTURE	TROUBLE	POSSIBLE CAUSE
 Figure 3-34A  Figure 3-34B	Small areas of picture predominantly one color (especially noticeable when viewing black and white pictures).	1. Repeat purity adjustments (see Page 77). 2. Degauss picture tube (see Page 64). Temporarily remove the filament fuse from terminal strip BJ during the degaussing process. See Detail 2-19C on Page 65. CAUTION: Degauss only the face of the picture tube and the picture tube shield. While power is being applied to the degaussing coil, do not place it near the pole piece assemblies on the neck of the picture tube.
 Figure 3-35	Unable to obtain pure red screen during purity adjustments.	1. Repeat purity adjustments (see Page 77). 2. Degauss picture tube (see Page 64). Temporarily remove the filament fuse from terminal strip BJ during the degaussing process. See Detail 2-19C on Page 65. CAUTION: Degauss only the face of the picture tube and the picture tube shield. While power is being applied to the degaussing coil, do not place it near the pole piece assemblies on the neck of the picture tube. 3. Check positions of the deflection yoke and the blue lateral and purity assembly.

PICTURE	TROUBLE	POSSIBLE CAUSE
 Figure 3-36	Unable to converge screen properly.	1. Check position of the blue lateral and purity assembly. 2. Check Vertical Height and Linearity adjustments.
 Figure 3-37	Vertical dynamic convergence controls (areas 1 and 2 on convergence board) have no effect.	1. Check R813, C806, C808, and vertical output transformer T801. 2. Defective convergence coil L502 or L503 or transformer T501.
 Figure 3-38	Unable to obtain vertical dynamic convergence.	1. Defective diode D501. 2. Defective vertical output transformer T801. 3. Defective deflection yoke.
 Figure 3-39	Horizontal dynamic convergence controls (areas 3 and 4 on convergence board) have no effect.	1. Check diode D501 on convergence board. 2. Violet wire from horizontal output assembly not properly connected to lug 8 of convergence socket. 3. Defective convergence coils L502 or L503 or transformer T501.
	Control H (area 3 on convergence board) has no effect.	1. Red-green left control R506 incorrectly installed.

Each of the following troubles assumes that you are able to
TUNE IN A NORMAL BLACK AND WHITE PICTURE.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-40	No color, or not enough color, on color broadcasts.	Color section.	1. Fine Tuning misadjusted. 2. Color Killer control advanced too far. 3. Color control turned down. 4. Leads on foil side of circuit boards shorted to parts on component side of circuit boards. 5. Poor antenna. 6. Tubes V401, V403, V408, and associated circuit components.
 Figure 3-41	No color sync (colors may seem to float around), colors keep changing.	Color section.	NOTE: Do not confuse this problem with a normal occurance in some video-taped color programs called "video tape lines". These lines will be narrow and sharply defined, extending horizontally across the screen. 1. Tube V408 and associated circuit components. 2. Coil L411 misadjusted. See Page 125. 3. Weak signal. 4. Tubes V404, V407, and associated circuit components.
 Figure 3-42	Color Picture predominantly green when Color control is advanced.	Color section.	1. Transformer T403 misadjusted. See Page 124. 2. Coil L411 misadjusted or defective. 3. Defective 3.58 mc crystal.

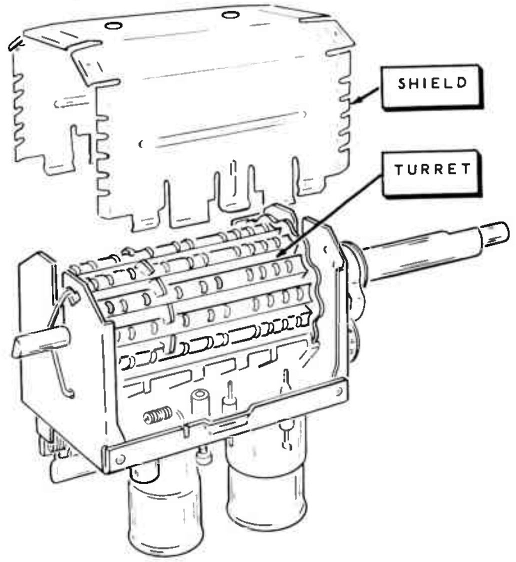
PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
 Figure 3-43	Weak color signal.	Color and video sections.	1. Fine tuning misadjusted. 2. Weak signal. 3. Poor antenna (narrow bandwidth) or lead-in line. 4. Tubes V401, V403, and associated circuit components. 5. Misadjustment of coil L402, or transformers T401 or T403. See Pages 124 and 125.
 Figure 3-44A  Figure 3-44B	Cannot get proper flesh tones.	Color section.	1. Poor quality color signal being transmitted. 2. Transformer T402 misadjusted. 3. Tubes V405, V406, V407, V409, and V410, and associated circuit components.

PICTURE	TROUBLE	AREA OF TROUBLE	POSSIBLE CAUSE
	Light on screen with flickering, sound ok.	High voltage circuit.	1. Arcing in high voltage section between components. 2. Improper routing of high voltage lead on V704.
 Figure 3-45	No horizontal deflection (vertical line down center of screen).	Deflection yoke.	1. Deflection coils in yoke.
	Unable to obtain a black and white picture, and the screen is predominantly yellow, purple, or greenish blue.	Picture tube.	NOTE: Be sure to obtain the opinion of a qualified color TV service technician before replacing your picture tube.
	Black and white pictures are predominantly one color, approximately the first one-half hour after the TV Set is turned on.		

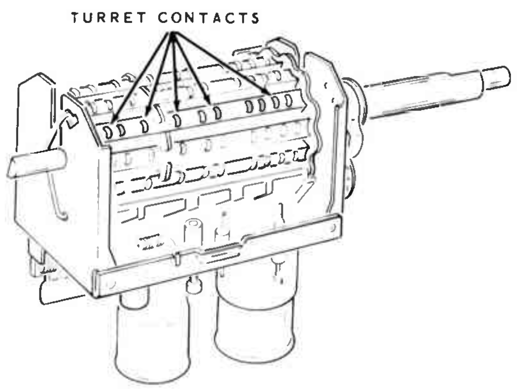
PICTURE TUBE TESTERS.

Some types of picture tube testers may falsely indicate a bad color picture tube, due to insufficient filament voltage. Make sure the picture tube tester supplies at least 6 volts during the test.

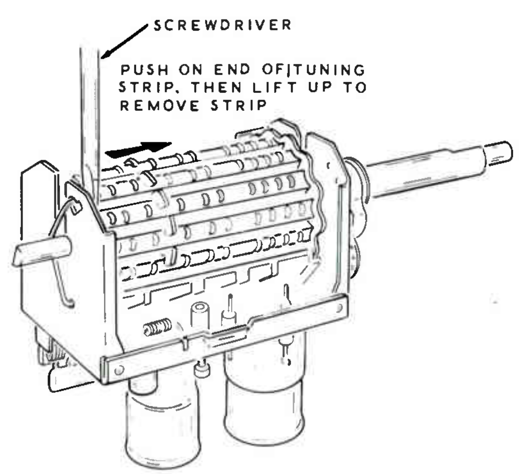
Ⓐ Remove the shield, exposing the turret.



Ⓑ Spray the turret contacts and then wipe them with a soft cloth. Rotate the channel Selector several times and respray the contacts leaving a thin film.



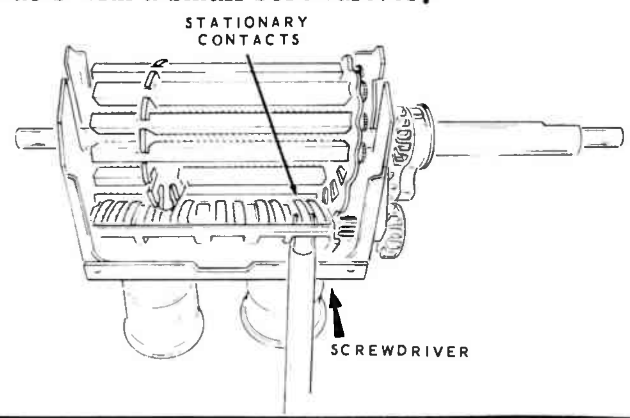
Ⓒ Remove any three tuning strips.



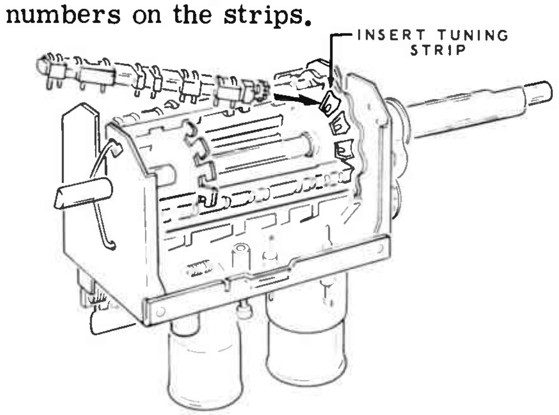
Ⓓ Rotate the Channel Selector until the stationary contacts can be reached.

Ⓔ Spray the stationary contacts and then wipe them with a soft cloth.

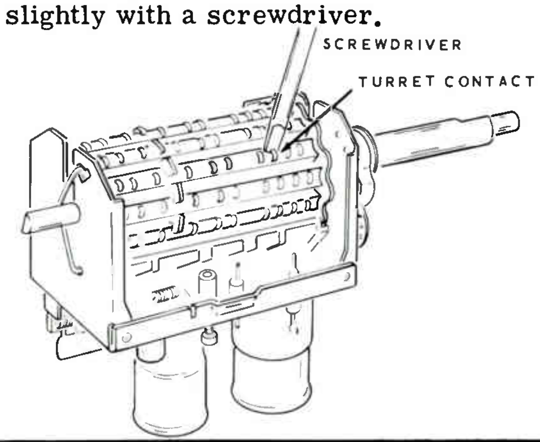
Ⓕ Check the contacts to make sure they are all protruding an equal amount toward the turret. Bend the contacts toward the turret slightly by carefully applying pressure underneath the contacts with a small screwdriver.



Ⓖ Reinstall the tuning strips, being careful to note the numbers on the strips.



Ⓗ Rotate the Channel Selector while viewing both the turret and stationary contacts simultaneously. If any individual turret contact does not touch the stationary contact, bend the turret contact out slightly with a screwdriver.



Ⓙ Install the tuner shield.

FIGURE 3-46

CLEANING THE VHF TUNER CONTACTS

The contacts in the VHF tuner are plated with a high quality gold or silver alloy. However, they can become tarnished and cause a poor electrical connection. These contacts, when tarnished, would cause an intermittent picture or sound when the VHF tuner knob is moved up and down or turned slightly. To correct this problem, it is necessary to clean the contacts with a commercial contact cleaner, which can be obtained from your local radio and television dealer.

The following two steps must be completed to gain access to the VHF tuner. You will have to use the assembly instructions in your Manual on the specified Pages as a guide when removing the tuner. NOTE: It is not necessary to disconnect any wires for this procedure.

1. Remove the TV Set from the cabinet (Page 85).

2. Remove the tuner bracket (Page 63).

Refer to Figure 3-46 (fold-out from this page) and complete the steps for cleaning the tuner contacts.

ALIGNMENT

Alignment of this TV Set is not normally required, since both the tuners and the IF amplifiers have been carefully prealigned at the factory. The following information is given in case alignment is needed at some future time due to parts replacement.

WARNING!

Do not attempt to align this TV Set unless you have previous TV alignment experience, a thorough knowledge of the theory involved, and the necessary equipment.

EQUIPMENT NEEDED

VHF-TV sweep and marker generator.

UHF-TV sweep and marker generator (if UHF tuner alignment is to be done).

Accurate RF generator with a range of 4 mc to 50 mc.

Oscilloscope, such as the Heath Laboratory Oscilloscope, and an oscilloscope demodulator probe.

Vacuum tube voltmeter such as the Heath VTVM.

High Voltage Probe.

Color bar generator, such as Heath Color Bar And Dot Generator.

Bias Supply, capable of furnishing bias voltages from 0 to 2.5 V. (Batteries and a control can be used.)

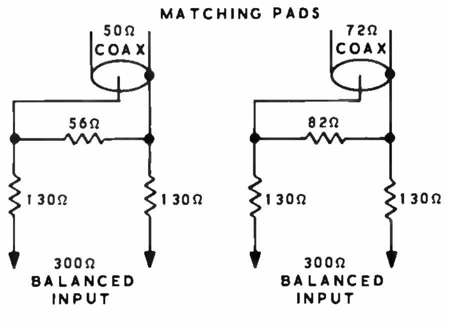


Figure 4-1

Matching Pads, as needed; see Figure 4-1. Use 1/2 watt 5% composition resistors.

VIDEO IF ALIGNMENT (FIGURE 4-2)

PREPARATION

1. Remove the plate cap from tube V701. Refer to Figure 3-1 (fold-out from Page 99) for the location of this plate cap.

2. Connect a 2500 Ω 100 watt resistor from lug 4 of terminal strip BL (+390 V) to ground. Refer to Pictorial 2-8 (fold-out from Page 41) for this connection.

3. Set the NORMAL-SERVICE switch in the SERVICE position.

4. Connect a 1 megohm resistor from the IF AGC to ground (from the point marked G to the center post of socket V201 on the IF circuit board).

5. Solder one lead of a 47 KΩ resistor to TP5 (test point 5) on the IF circuit board.

6. Connect the oscilloscope and the VTVM, set to the lowest AC range, to the free lead of the 47 KΩ resistor. Set the vertical gain of the oscilloscope to near maximum; set the horizontal range to line sweep, or use the horizontal sweep from the sweep generator.

7. Set the VHF tuner to the highest unused channel or, if all channels are used, remove a tuning strip.

NOTE: Be sure to terminate the output cable (or cables) of the sweep and marker generator in its characteristic impedance. Use the matching pads, as needed. Refer to Figure 4-1 on page 119.

TRAP ALIGNMENT

( ) Connect an RF generator with 400 cps modulation to TP1 (grid of mixer tube V102A) on the VHF tuner. The ground lead of the generator should be connected to the square cutout adjacent to TP1.

( ) Complete the steps in the Trap Alignment Chart. NOTE: Each of the frequencies listed in the Chart should be of crystal controlled accuracy.

TRAP ALIGNMENT CHART

	TRAP	RF GENERATOR FREQUENCY	ADJUST FOR MINIMUM
1	Sound trap	41.25 mc	Top slug of T204, R219.
2	Adjacent channel sound trap	47.25 mc	L201, R201.

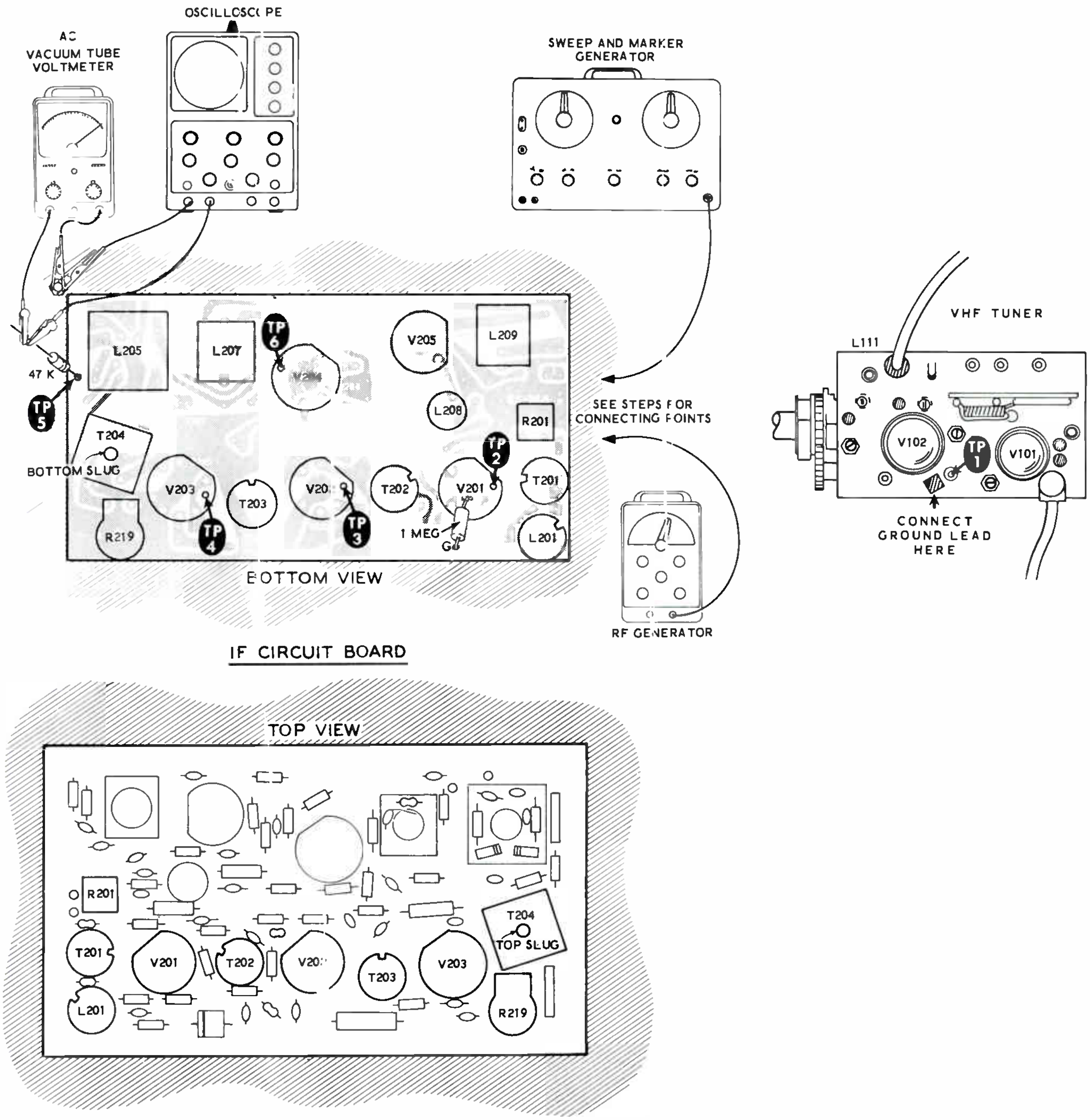

AC
VACUUM TUBE
VOLTMETER
SWEEP AND MARKER
GENERATOR
VHF TUNER
L111
V102
V101
TP 1
CONNECT
GROUND LEAD
HERE
L205
L207
TP 6
V205
L209
47 K
TP 5
L208
R201
SEE STEPS FOR
CONNECTING POINTS
T204
BOTTOM SLUG
TP 2
T201
V203
T203
T202
V201
TP 4
TP 3
1 MEG
R219
L201
BOTTOM VIEW
RF GENERATOR
IF CIRCUIT BOARD
TOP VIEW
R201
T204
TOP SLUG
T201
V201
T202
T203
V203
L201
R219

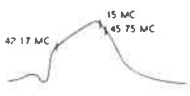
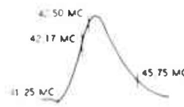
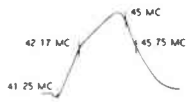
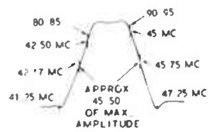
Figure 4-2

SWEEP ALIGNMENT

( ) Remove the 1 megohm resistor and replace it with a jumper wire (from point G to the center post of socket V201 on the IF circuit board).

( ) Complete the steps in the Sweep Alignment Chart.

SWEEP ALIGNMENT CHART

	STAGE	Connect the sweep and marker generator through a .001 μfd capacitor to test point.*	Sweep generator center frequency approximately 43.5 mc. Sweep width approximately 8 mc.	Marker generator Frequency CW (Unmodulated)	Adjust for maximum gain and bandwidth	REMARKS
1	3rd IF T204	TP4 (pin 2 of V203)		42.17 MC 45 mc 45.75 mc	T204 (bottom slug)	Adjust output of sweep generator for approximately 2" of deflection. Keep marker output low enough so that it does not distort the waveform.
2	2nd IF T203	TP3 (pin 1 of V202)		41.25 mc 42.17 mc 42.50 mc 45.75 mc	T203	Reduce output of sweep and marker generator.
3	1st IF T202	TP2 (pin 1 of V201)		41.25 mc 42.17 mc 45 mc 45.75 mc	T202	Reduce output of sweep and marker generator.
4	Overall IF response	TP1 (mixer grid)		41.25 mc 42.17 mc 42.50 mc 45 mc 45.75 mc 47.25 mc	L111 Mixer plate coil T201 IF input coil	Reduce output of sweep and marker generator. If necessary, retouch preceding IF adjustments to obtain the correct overall response.

*Connect the generator ground lead to the center ground pin of the tube socket.

( ) Disconnect the test leads. Disconnect the 47 KΩ resistor from TP5 and disconnect the jumper wire between point G and socket V201.

SOUND ALIGNMENT (FIGURE 4-3)

CAUTION: Make sure you adjust only the coils you are directed to adjust in the following steps. Do not adjust any other coils.

SOUND IF AND DETECTOR ALIGNMENT WITHOUT INSTRUMENTS

( ) Set the Channel Selector to your weakest local station.

( ) Tune the Fine Tuning control until the sound gets weak and noisy.

( ) Adjust coils L207 (top and bottom slugs), L208, and L209 for the loudest clearest sound.

SOUND IF AND DETECTOR ALIGNMENT WITH INSTRUMENTS

Preparation

1. Connect one lead of a .001 μfd capacitor to TP6 (pin 7 of V204).

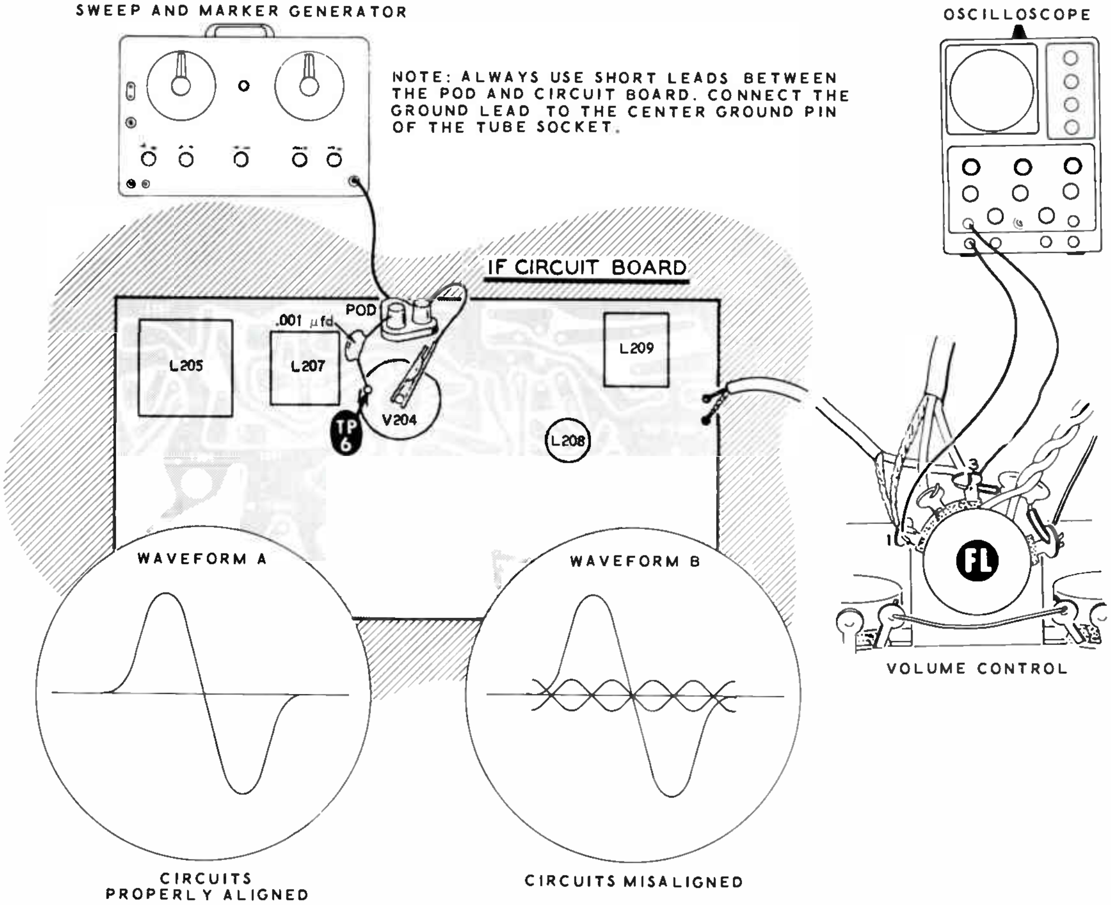


Figure 4-3

2. Connect the sweep and marker generator to the other lead of this .001 µfd capacitor. Set the marker generator to 4.5 mc. Set the sweep generator to a center frequency of 4.5 mc, with a sweep width of about 100 kc.

3. Connect the oscilloscope to lug 3 of the VOLUME control.

NOTE: Keep the output signals from the generators adjusted to a low amplitude during the following steps to keep from distorting the signal by overloading the circuits.

Adjust the following coils to obtain waveform A as shown in Figure 4-3. When these coils are tuned properly, a turn in either direction on any coil will produce the misaligned pattern of waveform B.

( ) L207 (top and bottom slugs).

( ) L208.

( ) L209.

4.5 MC TRAP ALIGNMENT WITH INSTRUMENTS

( ) Put the NORMAL-SERVICE switch in the SERVICE position.

( ) Connect an AM Generator, tuned to 4.5 mc, 400 cps modulated, to TP5. Connect an oscilloscope and/or audio voltmeter through demodulator probe to TP7 (TP7 is the green wire on the NORMAL-SERVICE switch).

( ) Adjust 4.5 mc trap L205 for minimum output.

( ) Put the NORMAL-SERVICE switch back in the NORMAL position.

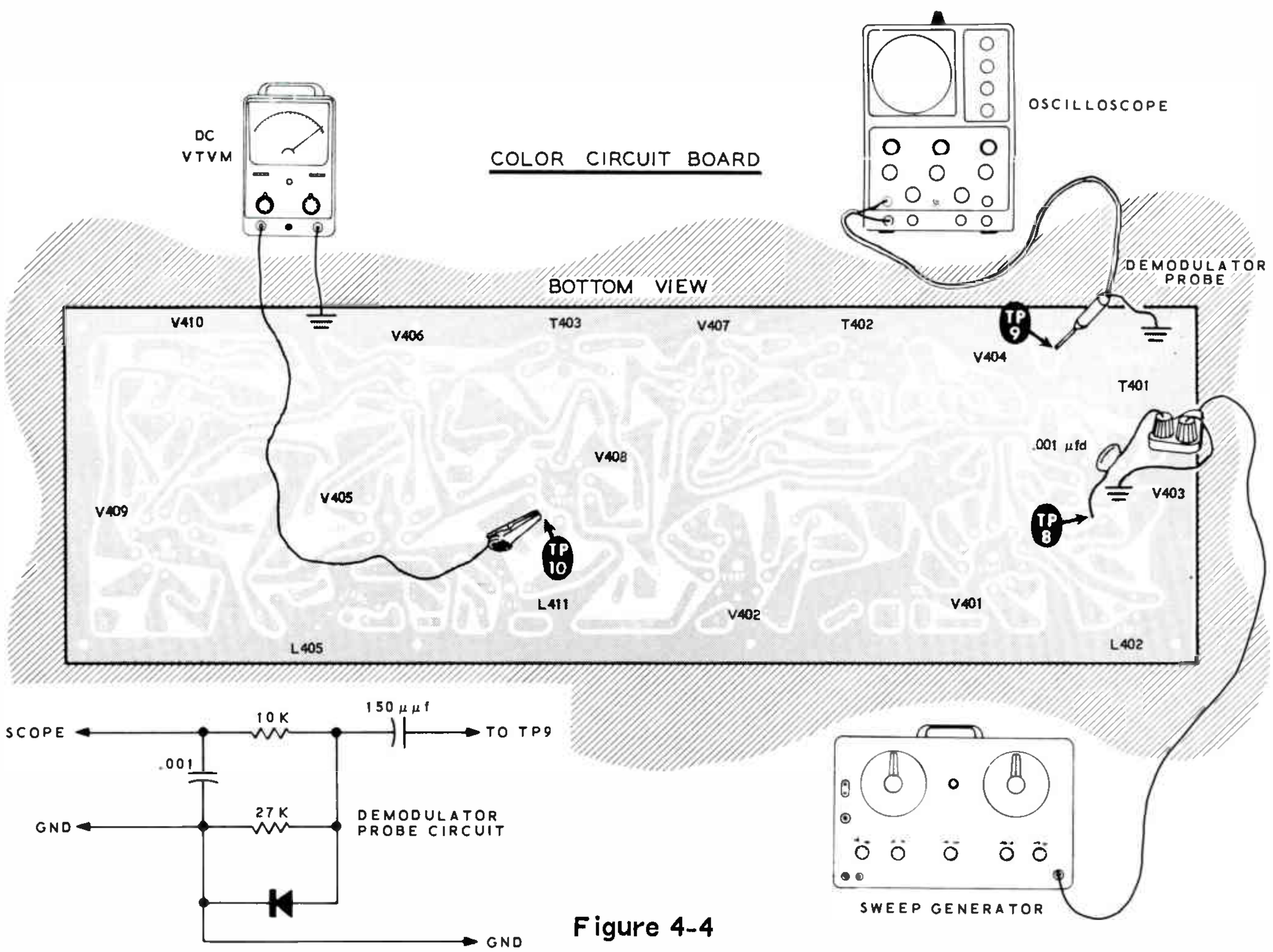


Figure 4-4

COLOR ALIGNMENT (FIGURE 4-4)

3.58 MC TRANSFORMER (T403) ADJUSTMENT

( ) Connect a VTVM, set to read negative DC voltage on the 15 volt scale, to TP10 (pin 2 of V408).

( ) Adjust T403 for maximum grid voltage.

( ) Disconnect the VTVM.

BANDPASS ALIGNMENT

( ) Remove tubes V303 and V203. Refer to Figure 3-1 (fold-out from Page 99).

( ) Remove the plate cap from tube V701. See Figure 3-1 for the location of this plate cap.

( ) Connect a 2500 Ω 100 watt resistor from lug 4 of terminal strip BL (+390 V) to ground. Refer to Pictorial 2-8 (fold-out from Page 41) for this connection.

( ) Set the COLOR control to midrange.

( ) Connect the oscilloscope through a demodulator probe to TP9.

( ) Connect the sweep generator to TP8 through a .001 μfd capacitor. Set the sweep generator for a center frequency of 3.58 mc, with a sweep width of about 2 mc.

( ) Adjust the top and bottom slugs of T401 for the response curve shown in Figure 4-5.

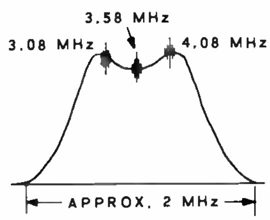


Figure 4-5

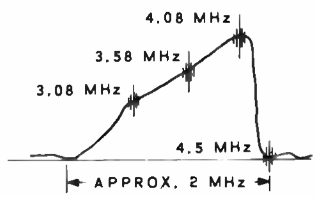


Figure 4-6

( ) Remove the sweep generator lead from TP8 and connect it to TP5 on the IF circuit board (see Figure 4-2). Reduce the output of the generator.

( ) Adjust L402 for the response curve shown in Figure 4-6. (NOTE: The 3.58 mc marker from the TV Set 3.58 mc oscillator will be present on this response curve.)

( ) Disconnect the oscilloscope and sweep generator. Replace tubes V303 and V203. Disconnect the 2500 Ω resistor. Replace the plate cap on tube V701.

ADJUSTMENT OF REACTANCE COIL L411 WITHOUT INSTRUMENTS

( ) Tune TV Set to a color program.

( ) Set the TINT control to the center of its range.

( ) Remove burst amplifier tube V404 from the color circuit board.

( ) Carefully adjust reactance coil L411 for the most stable color picture. (There is only one correct setting for this coil.) After this coil is properly adjusted, the entire picture should be in color, but the flesh tones and background hues will gradually change. NOTE: The entire picture should be predominately one color, and not bars of color as shown in Figure 3-41 on Page 115.

( ) Replace tube V404.

( ) If necessary, adjust burst phase transformer T402 so that proper flesh tones are obtained with the TINT control near the center of its range.

Alternate Method Of Adjusting L411

NOTE: Use this alternate method only when the previous method has not achieved the desired results.

( ) Tune the TV Set to a color program.

( ) If the picture is normal (Figure 1-27, fold-out from Page 81) no adjustment is required.

If the picture is out of color sync (Figure 3-41), proceed as follows:

( ) Set the TINT control to the center of its range.

( ) Carefully adjust reactance coil L411 for a normal color picture.

( ) Tune the TV Set from station to station. If the color sync does not hold, readjust L411 until the color holds on all stations.

ADJUSTMENT OF BURST PHASE TRANSFORMER T402 AND REACTANCE COIL L411 WITH A COLOR BAR GENERATOR

( ) Connect the color bar generator to the antenna terminals of the TV Set. Tune the generator for a color display on the TV Set screen. Figure 4-7 (fold-out from Page 82) shows a normal color picture with a Heathkit Color Bar Generator.

( ) Set the TINT control to the center of its range.

( ) Remove burst amplifier tube V404.

( ) Adjust reactance coil L411 for the most stable colors.

( ) Replace tube V404.

( ) Adjust T402 for proper sequence of color bars (the third bar should be bright red if the Heath Color Bar Generator is being used).

( ) Disconnect the color bar generator.

HORIZONTAL AND HIGH VOLTAGE ADJUSTMENTS

This Color Television Set has been designed with adequate metal shielding around the high voltage power supply and the picture tube to prevent the emission of any harmful x-rays.

The high voltage power supply has been adjusted and tested at the factory so the high voltage will be maintained within the safety zone.

These important precautions insure you that your Television Set meets the required standards set by the National Center for Radiological Health, an agency of the United States Government.

NOTE: Turn off the TV Set when making connections in the horizontal and high voltage sections.

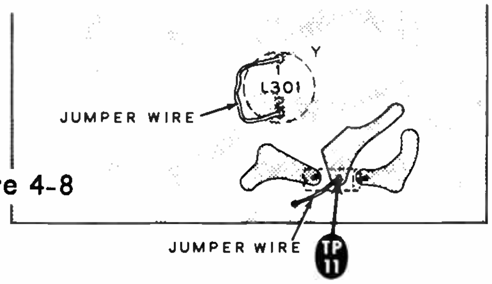


Figure 4-8

HORIZONTAL STABILIZING COIL (L301) ADJUSTMENT (Figure 4-8)

( ) Tune in a station.

( ) Connect a jumper wire from lug 1 to lug 2 of coil L301.

( ) Connect a jumper wire from test point TP11 to ground.

( ) Adjust the HORIZONTAL HOLD control to obtain as stable a picture as possible.

( ) Remove the jumper wire from coil L301. Adjust L301 to obtain as stable a picture as possible.

( ) Remove the jumper wire from TP11 to ground.

HORIZONTAL EFFICIENCY COIL (L703) ADJUSTMENT

( ) Remove the ground connection from pin 3 (cathode) of horizontal output tube V701. See Figure 4-9.

( ) Connect a 0-500 ma DC milliammeter from pin 3 of V701 to ground.

( ) Adjust coil L703 for minimum current (approximately 200 ma); then turn the coil slug clockwise until the meter reading increases 3 ma. Refer to the Chassis Photographs on Page 1·74 for the coil location.

( ) Remove the milliammeter and reconnect the ground wire to pin 3 of V701.

HIGH VOLTAGE ADJUSTMENT

IMPORTANT: Be sure to make the following adjustments carefully so the high voltage power supply will continue to meet the standards set by the National Center For Radiological Health. The adjustments should be made with the line voltage between 110 and 130 volts (normal line voltage).

( ) Tune in a station.

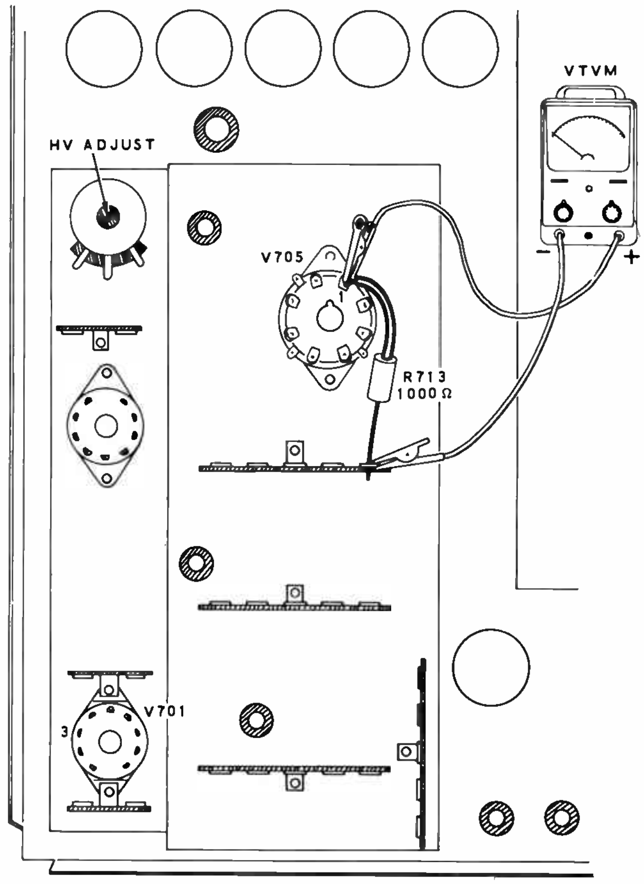


Figure 4-9

( ) Connect the high voltage probe to the second anode of the picture tube. Refer to Pictorial 2-20 (fold-out from Page 77) for the location of the second anode.

( ) Set the Brightness and Contrast controls to minimum.

Refer to Figure 4-9 for the following steps.

( ) Turn the High Voltage Adjust control to obtain a reading of 24 KV on the voltmeter.

( ) Disconnect the high voltage probe.

( ) Connect a VTVM, set to read a positive voltage on the 1.5 volt range, across 1000 Ω resistor R713. The positive probe of the VTVM should be connected to the resistor lead that connects to V705.

( ) The voltage across R713 should be between 1.4 V (1.4 V across 1000 Ω = 1.4 ma) and .85 V:

If the voltage across R713 is higher than 1.4 V, reset the High Voltage Adjust control to read 1.4 V.

If the voltage across R713 is less than .85 V, reset the High Voltage Adjust control to read .85 V. (After this adjustment, you may not have a full 24 KV, but this will not materially affect the quality of the picture.)

( ) Disconnect the VTVM.

TUNER ALIGNMENT

VHF TUNER ALIGNMENT

Refer to Figure 4-10 for the following steps.

( ) Connect the oscilloscope, sweep and marker generator, and bias supply (set to -2.5 volts) to the VHF tuner as shown in the Figure.

( ) Turn the Channel Selector to the channel 10 position.

( ) Adjust the sweep generator to a center frequency of 196 mc, with a sweep width of 10 mc.

( ) Adjust the marker generator for markers at 193.25 mc (Pix Carrier) and 197.75 mc (Sound Carrier).

( ) Adjust capacitors C113 and C114 for the correct response, as shown.

( ) If the tilt or valley between the markers cannot be adjusted to within the 30% maximum tolerance, it can be brought within limits by physically compressing or expanding coil L107 for this channel.

( ) Check the other channels for the correct bandwidth and tilt or valley. Use the accompanying Tuner Frequency Chart on Page 128 for the correct marker frequencies for each channel. Compress or expand coil L107 to bring the tilt or valley within the 30% tolerance on any channels where the valley is over 30% of the overall waveform amplitude.

NOTE: If the bandwidth is too wide or too narrow on most of the high channels, it can be corrected by compressing or expanding coil L112. If tube V101, the 6HA5 RF amplifier is changed, it may also be necessary to adjust RF neutralizing capacitor C109.

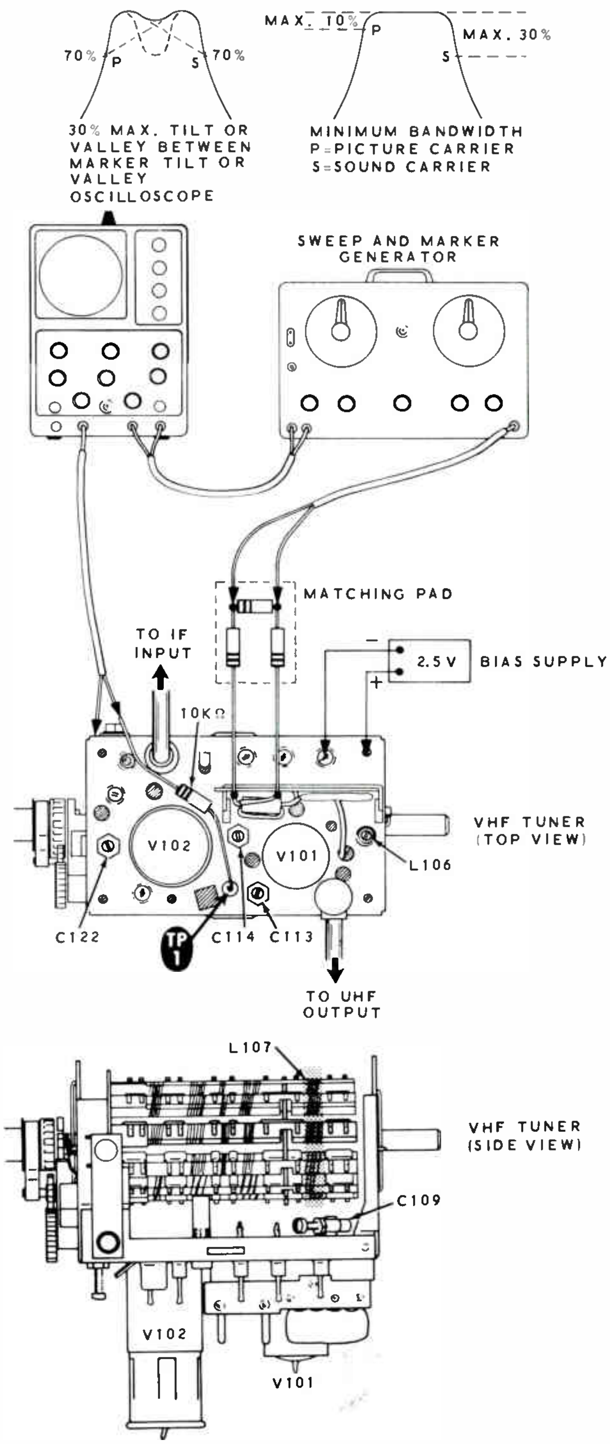


Figure 4-10

VHF OSCILLATOR ALIGNMENT

NOTE: Disregard these steps if your tuner does not have an oscillator trimmer capacitor.

Do not use the following procedure unless the Fine Tuning control will not tune through a station.

( ) Connect the VHF antenna to the antenna input terminals of the tuner.

( ) Tune through each of the channels normally received in your locality. If the Fine Tuning control does not properly tune all of these channels, set the Channel Selector to the Channel on which the Fine Tuning Control has the least effect (the one that is farthest off frequency).

( ) Turn the Fine Tuning control two full turns clockwise, then turn it back counter-clockwise exactly one turn. This will center the Fine Tuning control mechanically for this channel.

( ) Adjust oscillator trimmer capacitor C122 to obtain the best sound and picture. This will automatically adjust the Fine Tuning range for all the other channels.

This completes the VHF tuner alignment.

TUNER FREQUENCY CHART

U.S. TELEVISION CHANNEL FREQUENCIES

CHANNEL	BAND	CENTER FREQ. MC.	PIX CARRIER	SOUND CARRIER
2	54-60	57	55.25	59.75
3	60-66	63	61.25	65.75
4	66-72	69	67.25	71.75
5	76-82	79	77.25	81.75
6	82-88	85	83.25	87.75
7	174-180	177	175.25	179.25
8	180-186	183	181.25	185.75
9	186-192	189	187.25	191.75
10	192-198	195	193.25	197.75
11	198-204	201	199.25	203.75
12	204-210	207	205.25	209.75
13	210-216	213	211.25	215.75
45	656-662	659	657.25	661.75

UHF TUNER ALIGNMENT

NOTE: The complete VHF tuner and IF strip must be aligned properly before aligning the UHF tuner.

( ) Connect a UHF sweep generator to the UHF antenna terminals through the matching pad used in the VHF alignment procedure. See Figure 4-1 on Page 119.

( ) Connect a jumper wire from the IF AGC to ground (from the point marked G to the center post of socket V201 on the IF circuit board. See Figure 4-2 on Page 121.

( ) Connect the direct oscilloscope probe to TP1 through a 10 KΩ resistor. See Figure 4-2.

( ) Turn the VHF Channel Selector to the UHF position. Tune the UHF dial to channel 50.

( ) Tune the sweep generator to a center frequency of 698 mc, with a sweep width of approximately 15 mc.

( ) Adjust coil L106 for maximum gain and bandwidth. See Figure 4-10 on Page 127.

This completes the alignment procedure.

REPLACEMENT PARTS LIST

This list covers replacement parts for the preassembled units supplied with your TV Set.

IF CIRCUIT BOARD ASSEMBLY (#100-685)

PART No.	DESCRIPTION
RESISTORS	
	All resistors are 1/2 watt unless specified otherwise.
1-41	10 Ω (brown-black-black)
1-83	56 Ω (green-blue-black)
1-2	68 Ω (blue-gray-black)
1-3	100 Ω (brown-black-brown)
1-66	150 Ω (brown-green-brown)
1-42	270 Ω (red-violet-brown)
1-4	330 Ω (orange-orange-brown)
1-119	560 Ω (green-blue-brown)
1-14	3300 Ω (orange-orange-red)
1-16	4700 Ω (yellow-violet-red)
1-18	5600 Ω (green-blue-red)
1-73	8200 Ω (gray-red-red)
1-22	22 KΩ (red-red-orange)
1-47	56 KΩ (green-blue-orange)
1-60	68 KΩ (blue-gray-orange)
1-26	100 KΩ (brown-black-yellow)
1-27	150 KΩ (brown-green-yellow)
1-29	220 KΩ (red-red-yellow)
1-33	470 KΩ (yellow-violet-yellow)
1-37	2.2 megohm (red-red-green)
1-22-1	1500 Ω 1 watt (brown-green-red)
5-1-3	2700 Ω (2.7 K) 3 watt, film

PART No.	DESCRIPTION
CAPACITORS	
20-130	12 μμf mica
20-97	50 μμf mica
20-103	150 μμf mica
20-120	220 μμf mica
20-107	680 μμf mica
21-33	3.3 μμf disc
21-78	5 μμf disc
21-96	85 μμf disc
21-24	800 μμf disc
21-14	.001 μfd disc
21-27	.005 μfd disc
21-16	.01 μfd disc
21-31	.02 μfd disc
21-48	.05 μfd disc
28-4	1.5 μμf tubular
21-29	4.7 μμf tubular
27-28	.1 μfd resin
COILS-CHOKES-TRANSFORMERS	
40-583	10 μh peaking coil
40-488	180 μh coil
40-489	Sound take-off coil
40-490	4.5 mc sound IF coil
40-491	Quadrature coil
40-576	4.5 mc sound trap coil
40-740	Input IF transformer

PART No.	DESCRIPTION
Coils-Chokes-Transformers (cont'd.)	
40-741	1st IF transformer
40-742	2nd IF transformer
40-743	47.25 mc trap coil
45-35	1.7 μh choke
45-57	10 μh choke
52-74	3rd IF transformer and 41.25 mc trap
TUBES-SOCKETS-SHIELDS	
411-96	6AW8 tube
411-160	6EJ7 tube
411-169	6GM6 tube
411-222	6HZ6 tube
411-188	6JH6 tube
206-77	7-pin tube shield
Tubes-Sockets-Shields (cont'd.)	
206-206	9-pin tube shield
206-207	Small coil shield
206-205	Large coil shield
434-129	7-pin tube socket
434-130	9-pin tube socket
434-132	7-pin tube socket with shield
MISCELLANEOUS	
10-155	750 Ω control
10-180	15 KΩ control
56-20	1N295 crystal diode
134-127	IF input cable with phono plug
85-146-3	IF circuit board

HORIZONTAL OUTPUT ASSEMBLY (#100-580)

RESISTORS

All resistors are 1/2 watt unless specified otherwise.

PART No.	DESCRIPTION
1-1	47 Ω (yellow-violet-black)
1-3	100 Ω (brown-black-brown)
1-9	1000 Ω (brown-black-red)
1-44	2200 Ω (red-red-red)
1-26	100 KΩ (brown-black-yellow)
1-35	1 megohm (brown-black-green)
1-34-1	1 megohm 1 watt (brown-black-green)
1-35-1	1.5 megohm 1 watt (brown-green-green)
1-40	10 megohm (brown-black-blue)
3-3-2*	2.7 Ω 2 watt (red-violet-gold)
1-32-2	4.7 megohm 2 watt (yellow-violet-green)
5-1-7	13 KΩ 7 watt, film
2-12-2	66 megohm 6 KV

*NOTE: These resistors are 2 watt wire-wound resistors, but are the same size as 1 watt composition resistors.

PART No.	DESCRIPTION
CAPACITORS	
21-106	22 μμf 1 KV disc
21-49	68 μμf 4 KV disc
21-107	130 μμf 6 KV disc
21-11	150 μμf disc
21-108	180 μμf 1 KV disc
21-120	500 μμf 3 KV disc
21-16	.01 μfd disc
21-117	.01 μfd 1.4 KV disc with spark gap
23-102	.0022 μfd tubular
23-45	.047 μfd tubular
23-11	.1 μfd tubular
23-99	.12 μfd tubular
23-48	.15 μfd tubular
27-28	.1 μfd resin
COILS-CHOKE-TRANSFORMER	
40-580	Horizontal efficiency coil
40-735	Focus coil
45-42	8.5 μh choke
51-131	Horizontal output transformer

PART No.	DESCRIPTION
TUBES-SOCKETS	
411-65	1V2 tube
411-189	3A3 tube
411-190	6BK4B tube
411-191	6DW4/6CL3 tube
411-192	6JE6A tube
434-39	Octal tube socket
434-144	9-pin novar tube socket
434-155	9-pin miniature tube socket

PART No.	DESCRIPTION
MISCELLANEOUS	
57-27	750 ma silicon diode, 500 V PIV
75-62	High voltage socket insulator
260-40	HV rectifier plate cap and lead
260-46	HV regulator plate cap and lead
432-49	2nd anode connector and lead assembly

VHF TUNER (#110-42)

NOTE: Refer to Figure 4-11 below for replacing the converter strip and tuning strips in the VHF tuner.

PART No.	DESCRIPTION
411-226	6GJ7
411-220	6HA5 tube
246-59	Channel 1 UHF converter strip
246-60	Channel 2 tuning strip
246-61	Channel 3 tuning strip
246-62	Channel 4 tuning strip
246-63	Channel 5 tuning strip
246-64	Channel 6 tuning strip
246-65	Channel 7 tuning strip
246-66	Channel 8 tuning strip
246-67	Channel 9 tuning strip
246-68	Channel 10 tuning strip
246-69	Channel 11 tuning strip
246-70	Channel 12 tuning strip
246-71	Channel 13 tuning strip
246-57	Antenna balun assembly

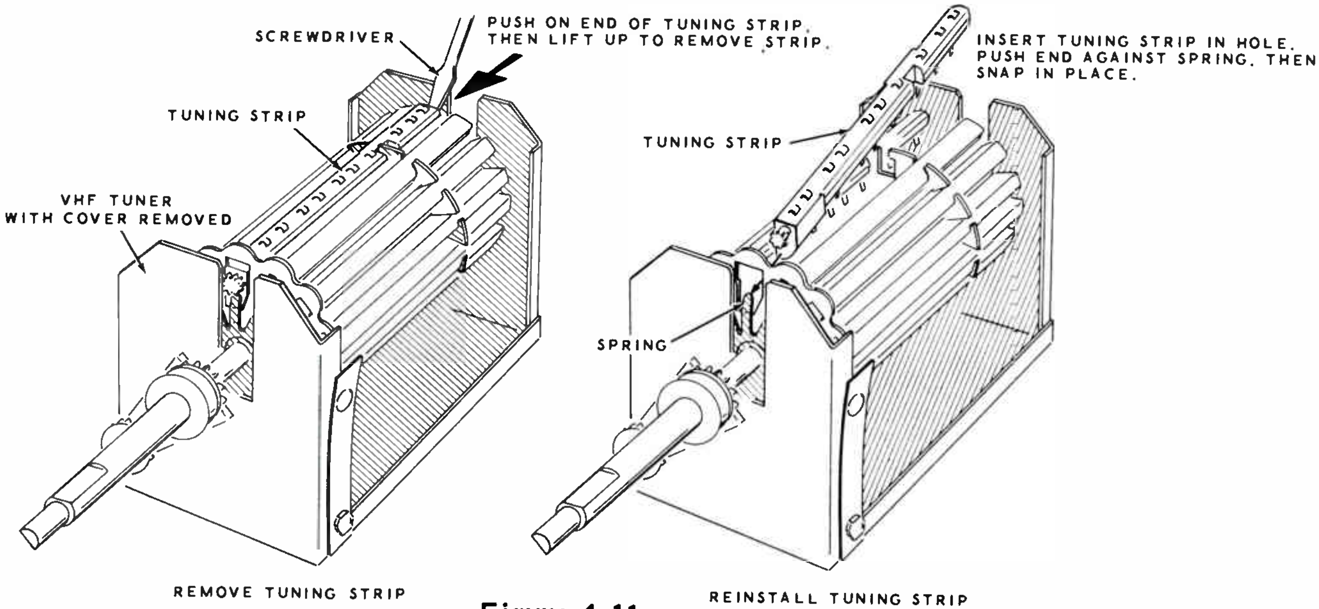


Figure 4-11

MISCELLANEOUS

PART No.	DESCRIPTION

NOTE: Refer to Figure 4-12 for replacing a pole piece magnet in a pole piece assembly.

474-13	Pole piece magnet

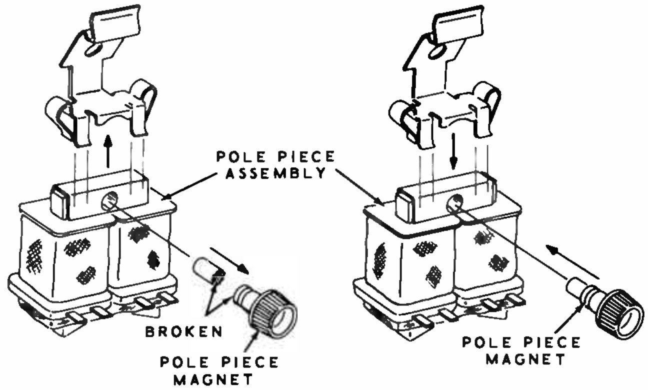


Figure 4-12

SPECIFICATIONS

Picture Size	295 square inches.
Deflection	Magnetic, 90 degrees.
Focus	Electrostatic.
Convergence	Magnetic.
Antenna Input Impedance	300 Ω balanced or 75 Ω unbalanced.
Tuning Range	VHF TV channels 2 through 13. UHF TV channels 14 through 83.
Picture IF Carrier	45.75 megacycles.
Sound IF Carrier	41.25 megacycles.
Color IF Subcarrier	42.17 megacycles.
Sound IF Frequency	4.5 megacycles.
Video IF Bandpass	3.58 megacycles.
Tube Complement	6HA5 - RF amplifier. 6GJ7 - Oscillator and mixer. 6JH6 - 1st IF amplifier. 6GM6 - 2nd IF amplifier. 6EJ7 - 3rd IF amplifier. 6GH8 - Video cathode follower and color amplifier. 12HG7 - Video output. 6AW8 - Sound and sync amplifier. 6HZ6 - Sound detector. 6GW8 - Cathode follower and sound output. 6HS8 - Sync and AGC. 6GF7 - Vertical oscillator and vertical output. 6FQ7 - Horizontal oscillator. 6JE6A - Horizontal output. 6DW4/6CL3 - Damper.

Tube Complement (cont'd.)	6BK4B - High voltage regulator. 3A3 - High voltage rectifier. 1V2 - Focus rectifier. 6GH8 - Bandpass amplifier and color killer. 6JU8 - Color killer detector and ACC and phase detector. 6GH8 - 3.58 megacycle oscillator and reactance tube. 6EW6 - Burst Amplifier. 6HZ6 - X demodulator. 6HZ6 - Z demodulator. 6GU7 - R-Y and G-Y amplifier. 6GU7 - B-Y amplifier and blanker. 25AP22A/25XP22 - Rectangular color picture tube.
Diodes And Transistor	1 - 1N82AG diode: UHF mixer. 3 - 1N295 crystal diode: video detector, sound and sync detector, dot generator. 5 - Silicon diodes: pincushion correction, low voltage B+, boosted boost B+. 1 - Four-section selenium diode: convergence. 1 - Dual selenium diode: horizontal AFC. 1 - Transistor: UHF oscillator.
Sound Cathode Follower	Output impedance - 3000 Ω. Frequency response - ±1 db, 50-15000 cps. Harmonic distortion - less than 1%. Output voltage - 2 volts.
Audio Output	Output impedance - 8 Ω. Output power - 2 watts. Frequency response - ±3db, 50-10,000 cps. Harmonic distortion - less than 3%.
Power Requirements	110 to 130 volts AC, 60 cps, 330 watts.
Net Weight	115 lbs.
Accessory Cabinet (Model GRA-295-1)	Walnut-finished cabinet for housing the TV Set; overall cabinet size, with TV Set installed - 34-1/2" wide x 31" high x 22" deep.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

COLOR TV THEORY

While it is not necessary to understand color television theory to successfully build the Heathkit Color TV Set, a basic knowledge of the functions of the various sections is invaluable for future care. These fundamentals can also add to your enjoyment of the completed TV Set.

This section of the Manual is designed to take you as deeply into circuit operation as you wish to go. It starts with the basic functions of television, and then advances to the more unique color TV circuitry. A detailed technical Circuit Description of this TV Set is also given on Pages 151 through 170 of this Manual.

If you wish to continue your study of the subjects discussed in this Manual, we recommend that you contact local educational institutions for their recommendations; they can recommend books or courses which are available locally.

BASIC TELEVISION FUNCTIONS

The picture that you see on a black and white television set is caused by a moving electron beam striking a phosphor coated screen inside the picture tube. Color TV operates on the same principle, except there are three electron beams in the tube, and phosphor dots of the three basic colors: red, blue, and green. Black and white television, therefore, is the foundation on which color TV is built. For this reason, the fundamental principles of black and white television will be explained first.

The black and white television picture is made up of very small dark and lighted areas. Note that the photograph at the left in Figure 5-1 appears to be shades of gray as well as black and white. Actually, it too is an arrangement of small black and white areas, as the enlargement on the right shows.

A complete picture is assembled on the picture tube by "scanning" the phosphor screen with the electron beam. The process of scanning is similar to the way that you are reading this page.

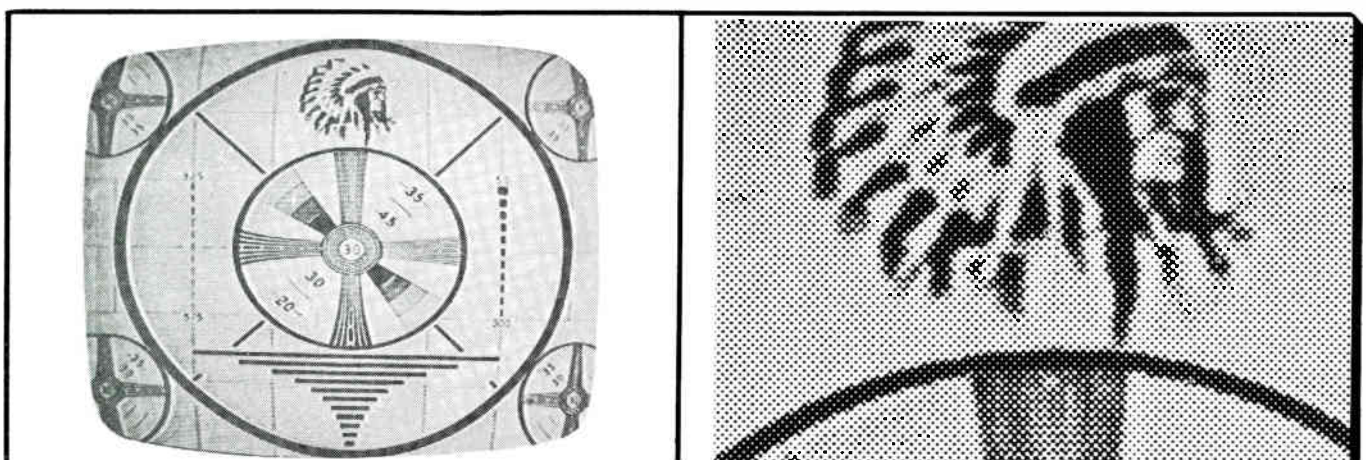


Figure 5-1

Your eyes read one line from left to right, then drop down one line and move again from left to right. An electron beam inside the black and white picture tube scans the screen in a similar manner to form a black and white picture. It moves across the entire screen many times in 1/30 of a second; a speed that is faster than the human eye can detect. This beam causes a white glow when it hits the phosphor coating on the inside of the screen; when the beam is interrupted, dark areas are produced on the screen.

The complete TV picture is made up of 525 individually scanned horizontal lines; but for purposes of illustration, Figure 5-2 uses only six scans to cover the screen. Note that when the dark and light areas of the six scanned lines are stacked on top of each other, the letter H is formed on the TV picture tube.

The objectives of a black and white television receiver may be set forth as follows. See Figure 5-3.

1. To select only one channel's signal from the air and strengthen it (receiver circuits).
2. To scan or "sweep" the screen horizontally with an electron beam (horizontal scanning circuits).
3. To deflect the electron beam vertically. This fills in the screen to form a rectangular pattern called a "raster" (vertical scanning circuits).
4. To turn the beam on and off to create the black and white areas which form a picture on the raster (beam controlling circuits).

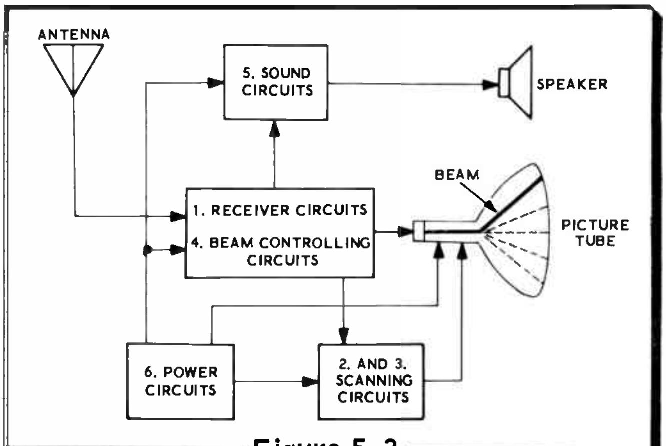


Figure 5-3

5. To provide sound for the picture (sound circuits).
6. To convert ordinary household power to usable types of power in the TV set (power circuits).

These six functions are shown graphically in the block diagrams in Figure 5-3. By expanding this block diagram in Figures 5-4, 5-5, 5-6, 5-7, 5-8, and 5-9, the individual stages or sections are shown. The function of each group of blocks in each Figure is listed, along with the visual effect on the screen. The "V-numbers" are the tube designations, and the "Q-number" is the transistor designation, so that if you wish, you may correlate the block diagrams with corresponding parts of the complete electronic Schematic (fold-out from Page 175) and the complete Block Diagram (fold-out from Page 150) for this Color TV Set.

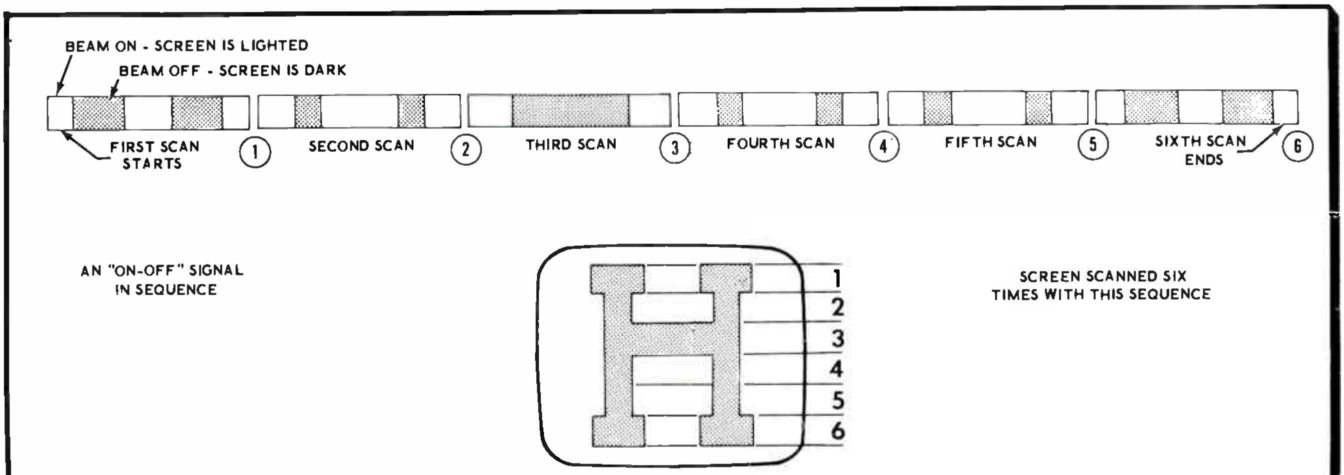


Figure 5-2

RECEIVER CIRCUITS

A. Selects one channel's signal.

B. Converts the signal to the proper frequency for the (IF) intermediate frequency amplifiers.

C. Amplifies the signal.

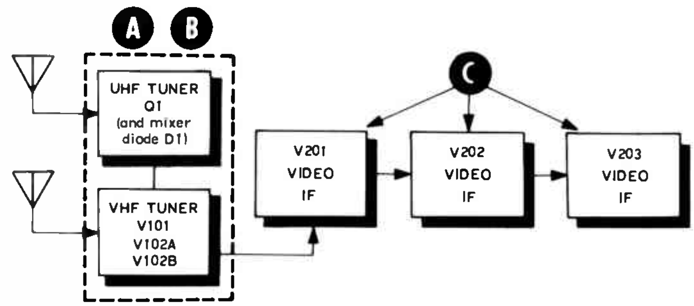
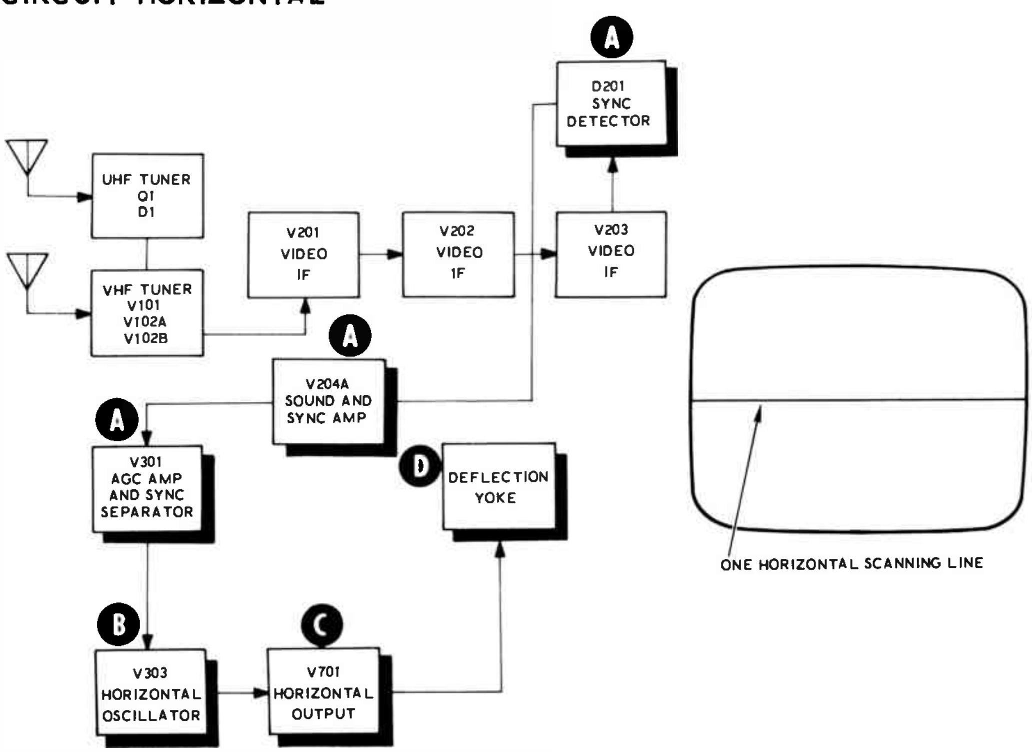


Figure 5-4

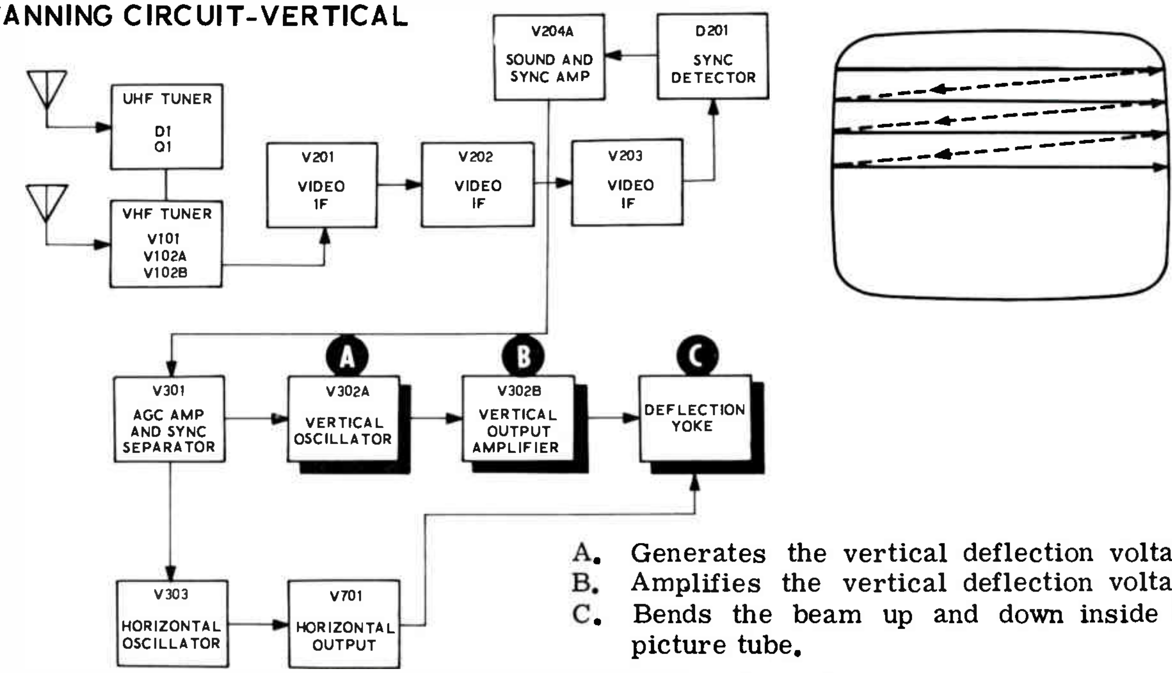
SCANNING CIRCUIT-HORIZONTAL



A. Separates and amplifies the synchronization pulse used for proper timing of the horizontal scanning lines (horizontal sweep voltage).
B. Generates the horizontal sweep voltage.
C. Amplifies the horizontal sweep voltage.
D. Causes the electron beam to bend side-ways inside the picture tube. This causes the beam to sweep across the phosphor screen.

Figure 5-5

SCANNING CIRCUIT-VERTICAL

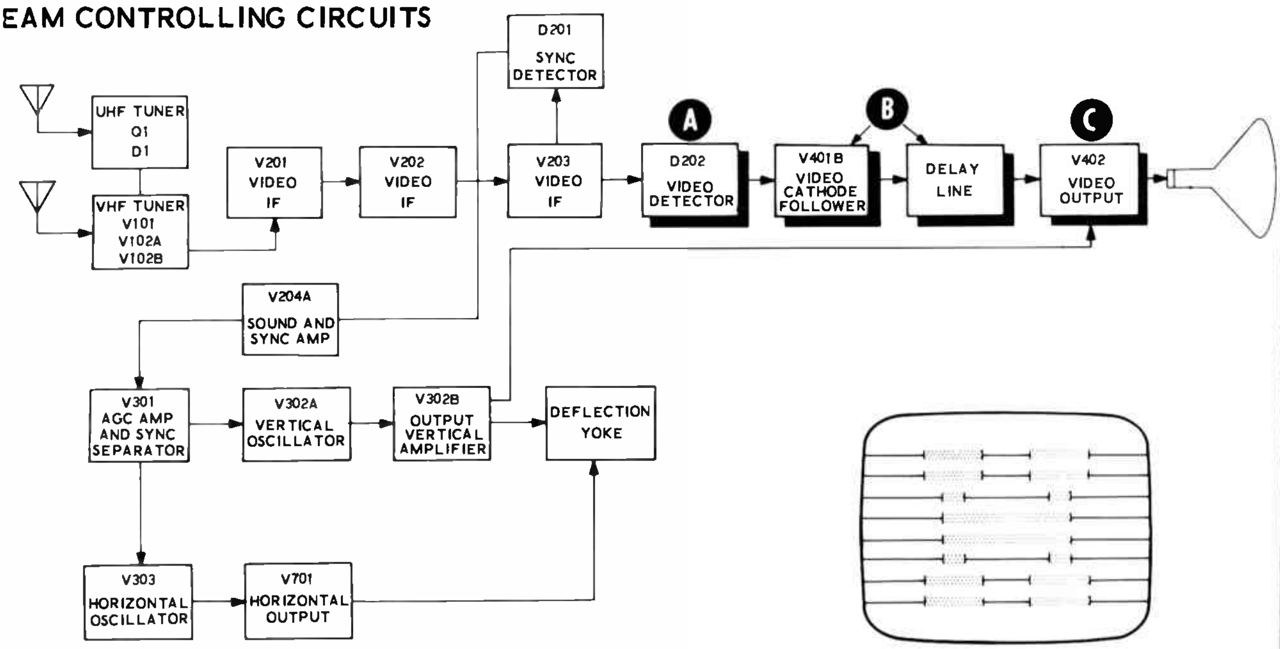


A. Generates the vertical deflection voltage.
B. Amplifies the vertical deflection voltage.
C. Bends the beam up and down inside the picture tube.

Each horizontal scanning line (solid line) is moved down from the previous line by the vertical deflection voltage (shown by the dotted lines).

Figure 5-6

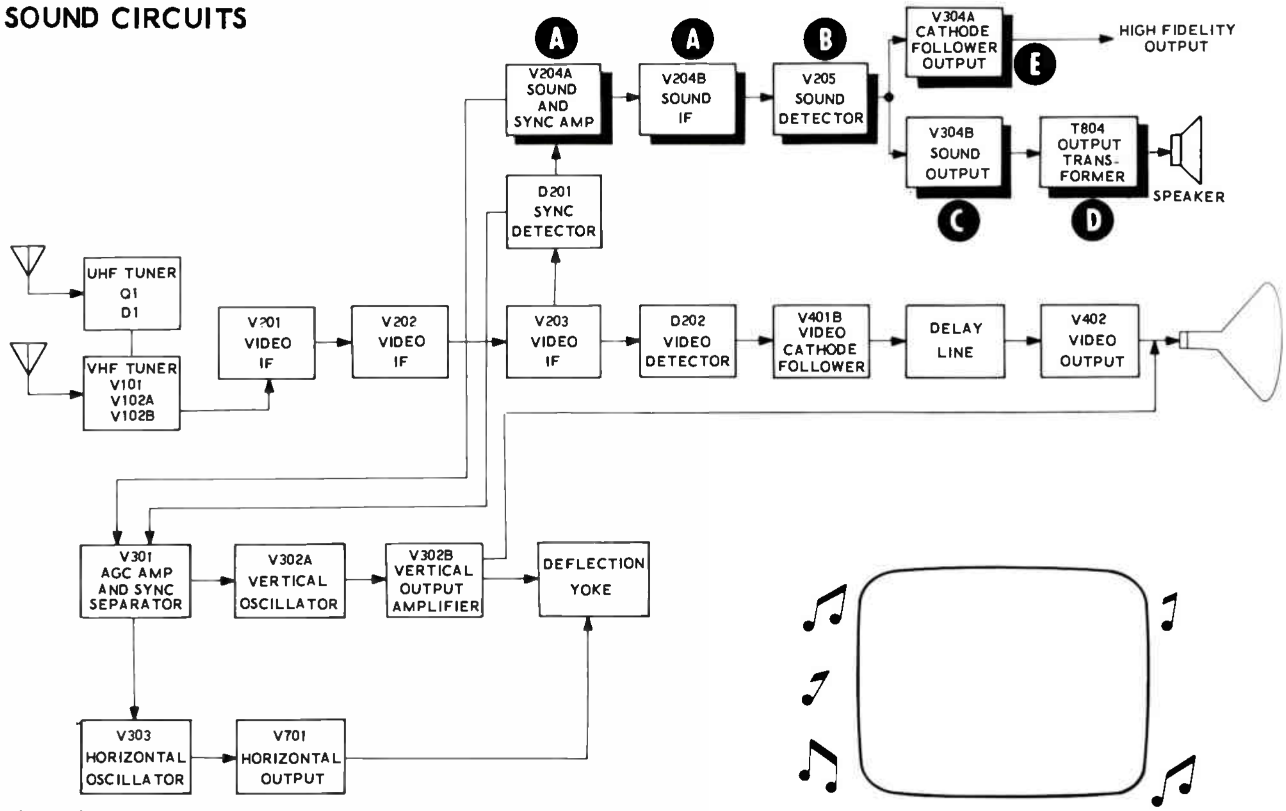
BEAM CONTROLLING CIRCUITS



A. Detects the picture signal.
B. Together, these stages delay the black-and-white signal so the color signals can get to the picture tube at the same time.
C. Turns the beam on and off to create the black and white areas, which form a picture.

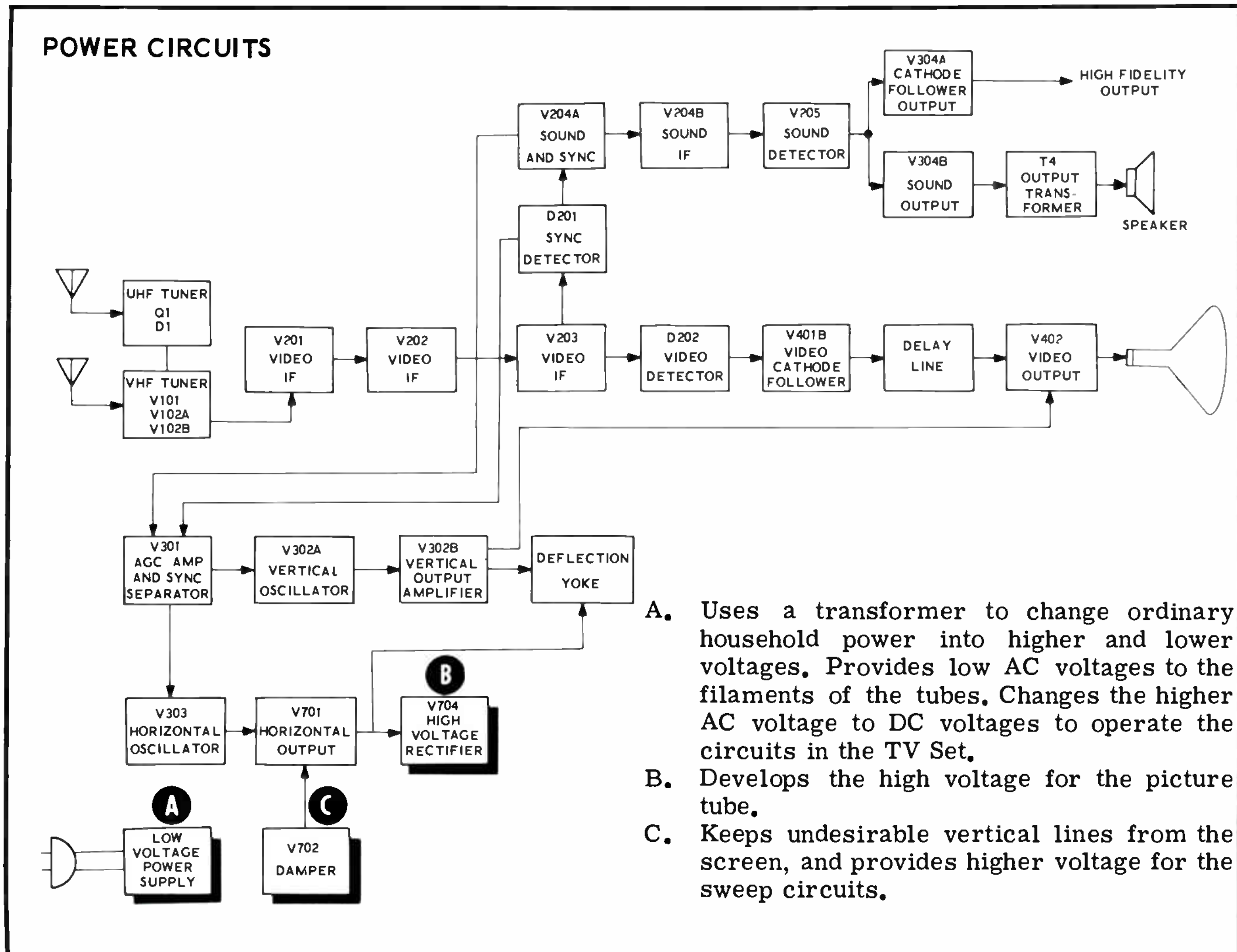
Figure 5-7

SOUND CIRCUITS



A. Amplifies the sound information.
B. Detects the sound signal.
C. Increases audio power.
D. Drives the speaker to audibly reproduce the sound.
E. Provides proper audio output for hi-fi systems.

Figure 5-8



A. Uses a transformer to change ordinary household power into higher and lower voltages. Provides low AC voltages to the filaments of the tubes. Changes the higher AC voltage to DC voltages to operate the circuits in the TV Set.

B. Develops the high voltage for the picture tube.

C. Keeps undesirable vertical lines from the screen, and provides higher voltage for the sweep circuits.

Figure 5-9

COLOR BEAMS

Photographs may be printed in color, as well as black and white. Looking at the Sunday comic strips with a magnifying glass will demonstrate how a few colors in the form of organized dots can be blended to look like many colors. Similarly, the picture on a color TV screen is made up of an organization of color dots.

All colors shown on the picture tube screen are combinations, or blends, of the red, blue, and green dots that light up on the screen. Black is obtained by stopping all dots from glowing. White is produced when all three color dots glow in the right proportion.

Separate electron beams are used to light the blue, red, and green dots. Each of these three beams control only one color of dots. To show blue on the screen, the red and green beams are turned off, therefore only the blue dots will glow. See Figure 5-10A (fold-out from Page 82). These are examples that show how the three primary colors, red, blue, and green can be blended to obtain other colors.

A device called a shadow mask is built into the picture tube to allow only one group of dots (triad) to glow at one instant of scanning. The three

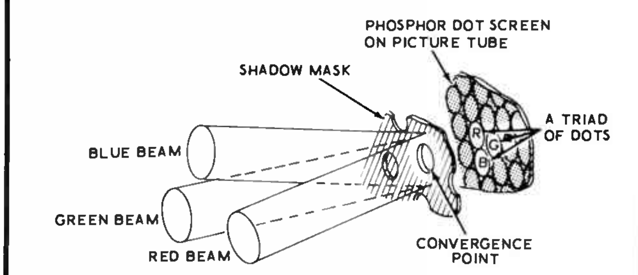


Figure 5-10B

beams scan the screen together just like the single beam scans the screen of a black and white TV. See Figure 5-10B.

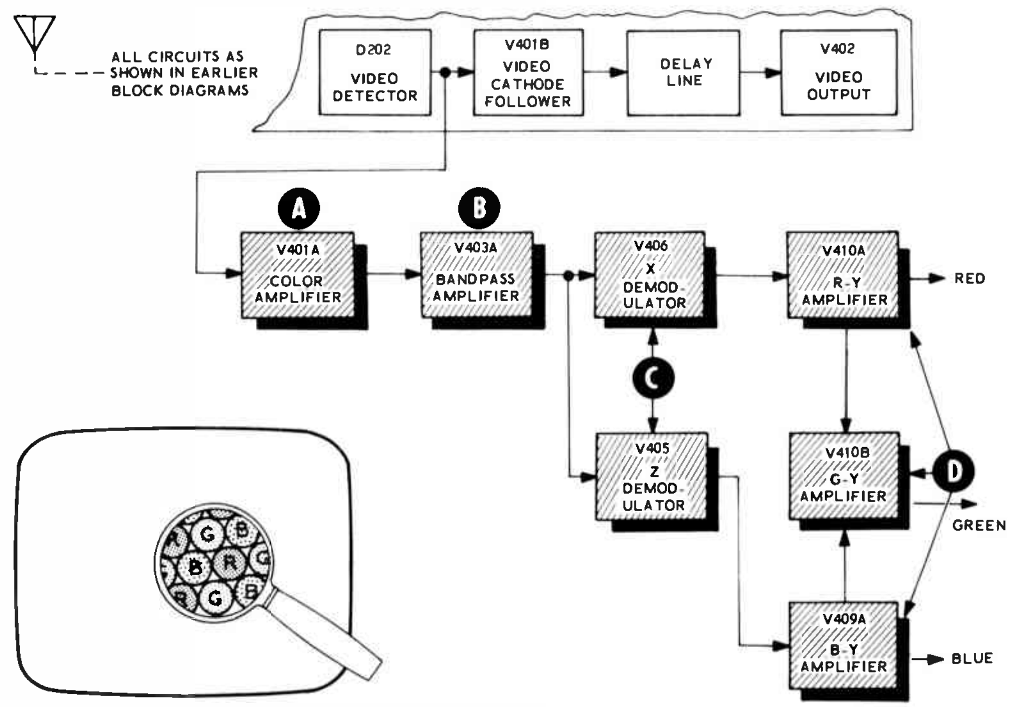
For demonstration purposes, the color dots have been considered to be either on or off, but actually the intensity with which each dot glows can be varied by varying the strength of the electron beam.

The objectives and circuits that a color TV receiver has, in addition to the black and white receiver, may be listed as follows:

1. To receive the color signals and separate them.
2. To use the three color signals to operate each color's beam independently.
3. To determine the proper intensity of each beam so the proper blend of colors will occur in each triad of dots.
4. To turn off the color circuits when there is a black and white broadcast.
5. To cause the electron beams to always hit the right dots on the screen.

These five functions are shown graphically in the block diagrams in the following Figures. Objectives 1 and 2 are shown in Figure 5-11; objectives 3, 4, and 5 are shown in Figures 5-12, 5-13, and 5-14, respectively.

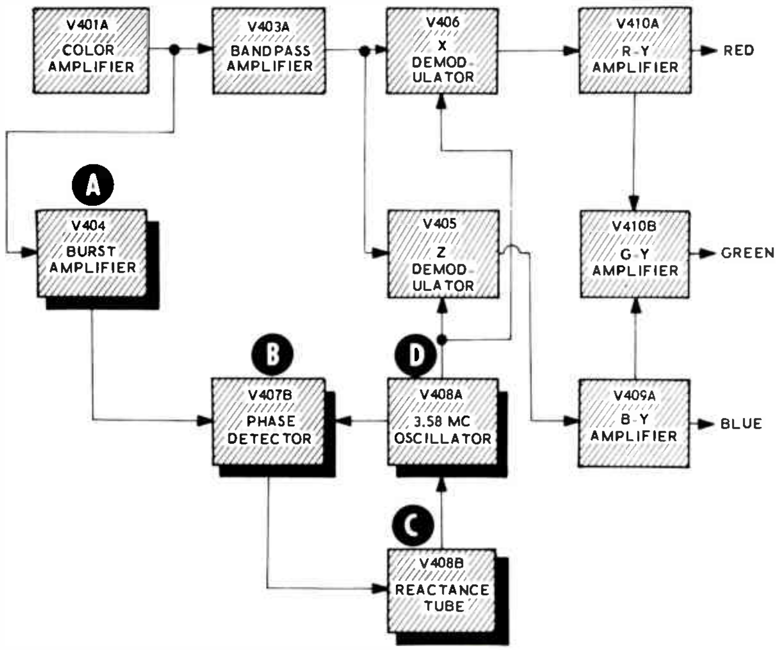
CIRCUITS TO TURN BEAMS ON AND OFF



A. Amplifies the signal containing color information.
B. Passes only color information.
C. Separates the information into two color signals.
D. Combines the two color signals to obtain the three primary color signals: red, blue, and green.

Figure 5-11

CIRCUITS TO DETERMINE THE PROPER AMOUNT OF EACH COLOR



A. Amplifies the 3.58 mc "burst" signal that is transmitted by the TV station. This signal is used as a reference for the demodulators to determine the intensity of each beam. The beam intensity, in turn, determines the proper amount of each color.

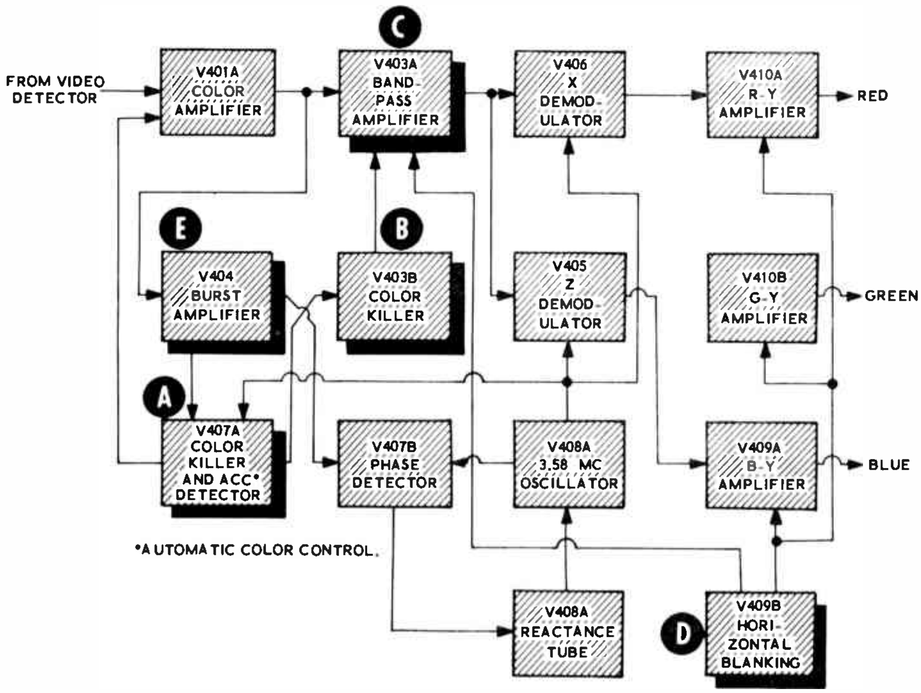
B. Compares the output frequency of the 3.58 mc reference signal oscillator with the burst frequency, and generates a correction voltage based on the comparison.

C. Reacts to correct the 3.58 mc oscillator and make it the same frequency as the burst signal.

D. Creates a continuous 3.58 mc reference voltage; provides the reference to the demodulators to obtain correct color signals.

Figure 5-12

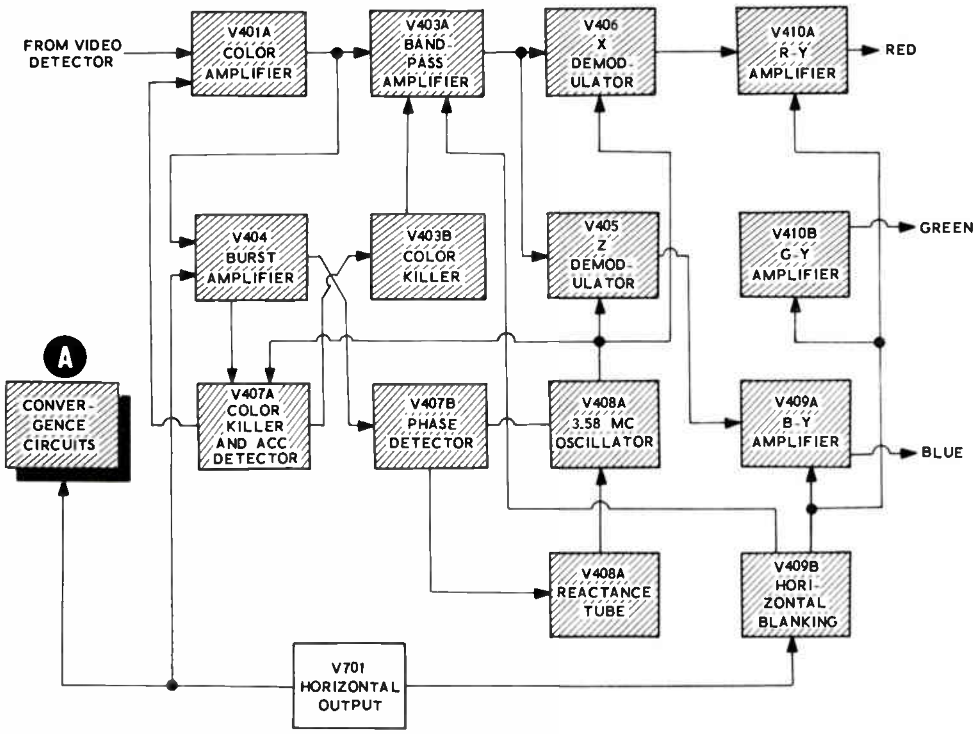
HOW THE COLOR CIRCUITS ARE TURNED OFF FOR BLACK AND WHITE BROADCASTS



A. Determines when there is no color (no burst signal is present).
B. Provides voltage to disable color circuitry.
C. Voltage from color killer stops stray color signals from passing through the bandpass amplifier on black and white broadcasts.
D. Stops the beams temporarily while the beams go back to start the sweep again.
E. Controls the strength of color signals based on the strength of the burst.

Figure 5-13

CIRCUITS THAT CAUSE THE ELECTRON BEAMS TO ALWAYS HIT THE RIGHT DOTS



A. Develops voltages to correctly aim the electron beams in the picture tube. The picture tube uses these voltages to compensate for the curvature of the screen.

Figure 5-14

THE COLOR SIGNAL

The color signal is sent over the same channel as the black and white signal. The black and white or "luminance" signal is used to illuminate the screen, and the color signal is used to color the picture. The luminance signal, which is applied to the cathodes of the picture tube, furnishes a controlling voltage to all three beams simultaneously. The color signal, which is applied to the control grids of the picture tube, stops all but the desired color beams. See Figure 5-15.

The absence of a blocking color signal allows a black and white picture to be shown, since the controlling voltages for all three beams are provided (in the proper proportions) by the luminance signal. In other words, with no color signal voltage applied to them, the grids cannot stop the beams, thus the beams will be controlled by the luminance signal only, making a black and white picture. Black and white TV sets use only the luminance signal which is the sum of the brightness contained in all three color signals. The color broadcasting system is therefore compatible with either black and white or color TV sets.

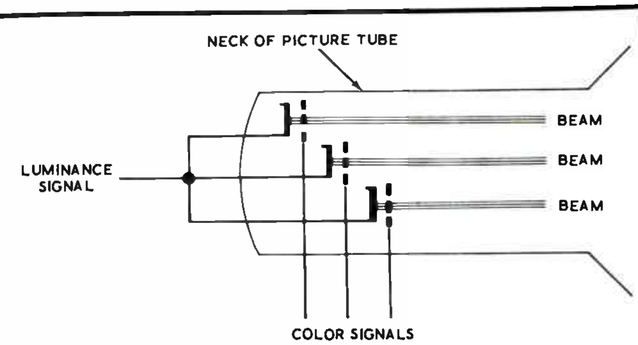


Figure 5-15

The luminance signal is often called the "Y" signal. This Y signal causes three beams of properly proportioned strength to be formed. The color signal must only pass or stop these beams, but must not add to them. Therefore, the color signal is only the pure color information without the Y, or luminance signal. This is expressed as: "R-Y" (R minus Y) for the red signal less the luminance signal, as "B-Y" (B minus Y) for the blue signal less the luminance signal, and as "G-Y" (G minus Y) for the green signal less the luminance signal.

With no controlling signals on the cathodes or grids of the picture tube, there will be a raster on the screen. Each beam will be at a moderate level. The "Y" voltages either add to or detract from the beam's intensity, and the color signals stop the unwanted color beams.

Blanking, or "darkening," pulses are applied to the picture tube so retrace lines are not visible when the beams return across the screen to start a new scanning line. The synchronization ("Sync") pulses that start each scanning line at exactly the right time, are transmitted during this darkened period. The signals that form the letter H in Figure 5-2 for a black and white broadcast, will resemble those at the cathodes in Figure 5-16 for a color broadcast, except that the blanking and sync pulses have been added.

Even if the luminance signal at the cathode tries to brighten the picture, the color signals at the control grids can stop the electron beams. Figure 5-16 shows the color signals that put color in the "H".

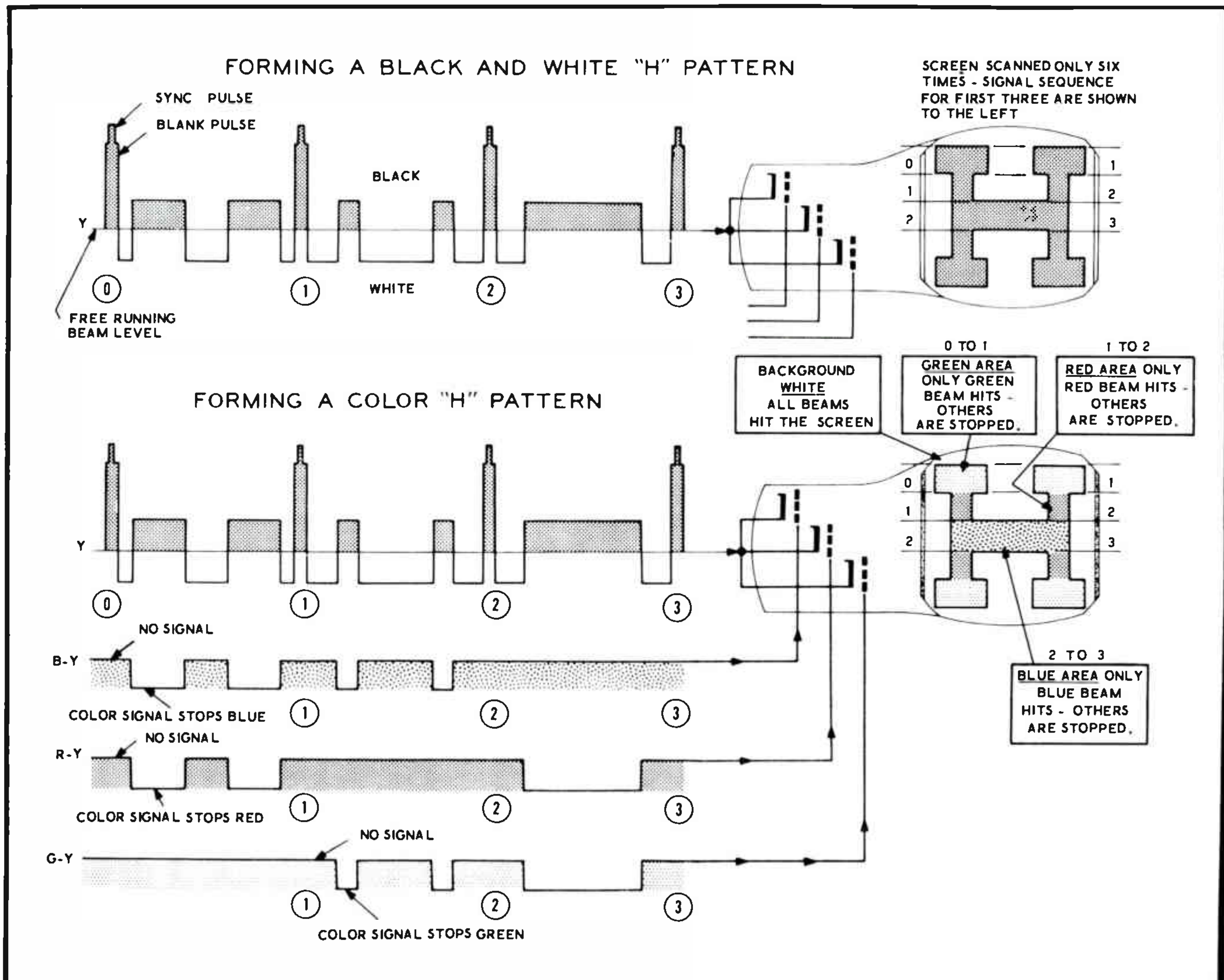


Figure 5-16

DEMODULATION

The demodulators separate the color information into two signals: red and blue. They may be looked upon as switches, as they are shown in the simplified block diagram in Figure 5-17A. The X demodulator is switched "on" only during the time that the red (or R-Y) information is present in the combined color signal. Similarly, the blue demodulator is switched "on" only during the time the blue (or B-Y) information is present. In the actual circuit, there is no switch; the tubes are switched "on" and "off" by the reference signal.

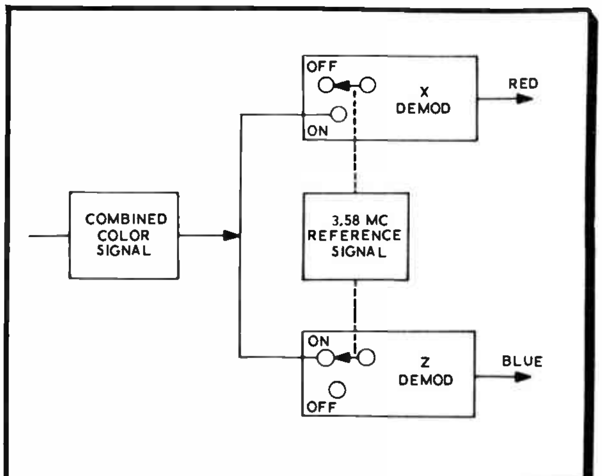


Figure 5-17A

For a more technical analysis, it is necessary to associate time with this switching or "phase demodulation" process. Time, with respect to the 3.58 mc reference signal, is measured in phase degrees. One complete cycle of the reference signal is 360 degrees; when the waveform repeats itself, it starts at 0 degrees again.

The color signal that is recreated in the receiver is a result of the information the transmitter sends out. This transmitted information is a combination of the R-Y and B-Y signals. The two signals are combined in such a way that they can be separated by taking a sample of the color signal at 0 and 90 degrees. A wave built on samples taken at 0 degrees is the R-Y color signal, and a wave built on samples taken at 90 degrees is the B-Y color signal. Figure 5-17B shows the sampling process graphically.

Figure 5-18 is a schematic-type drawing that shows how the sampling is accomplished electronically. The tubes will conduct only on the peaks of the reference signal. Since the reference wave is shifted by 90 degrees before it is applied to the Z demodulator, the X demodulator and Z demodulator tubes conduct at 0 degrees and 90 degrees, respectively. NOTE: A 90 degree phase shift of the X and Z demodulators is used in this description to simplify the explanation of demodulator operation. In actual use, the X and Z demodulators are about 60 degrees apart to satisfy the overall color balance of the receiver.

The color signal is applied to the control grid of each tube. The strength of the color signal at the time of the sample determines the output signal from that stage. Detection in either tube, can occur only during its sampling period, since current is allowed to flow through it during that time.

Even when there is no color signal, a certain amount of current will flow due to the positive portion of the reference signal. The color signal varies the output above or below this level. In the actual circuit, the two tubes are V406 and

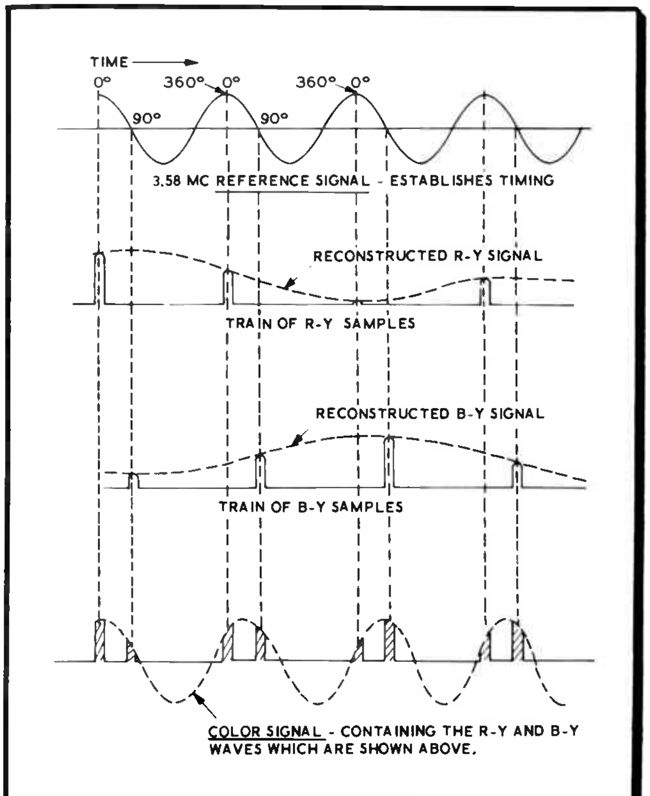


Figure 5-17B

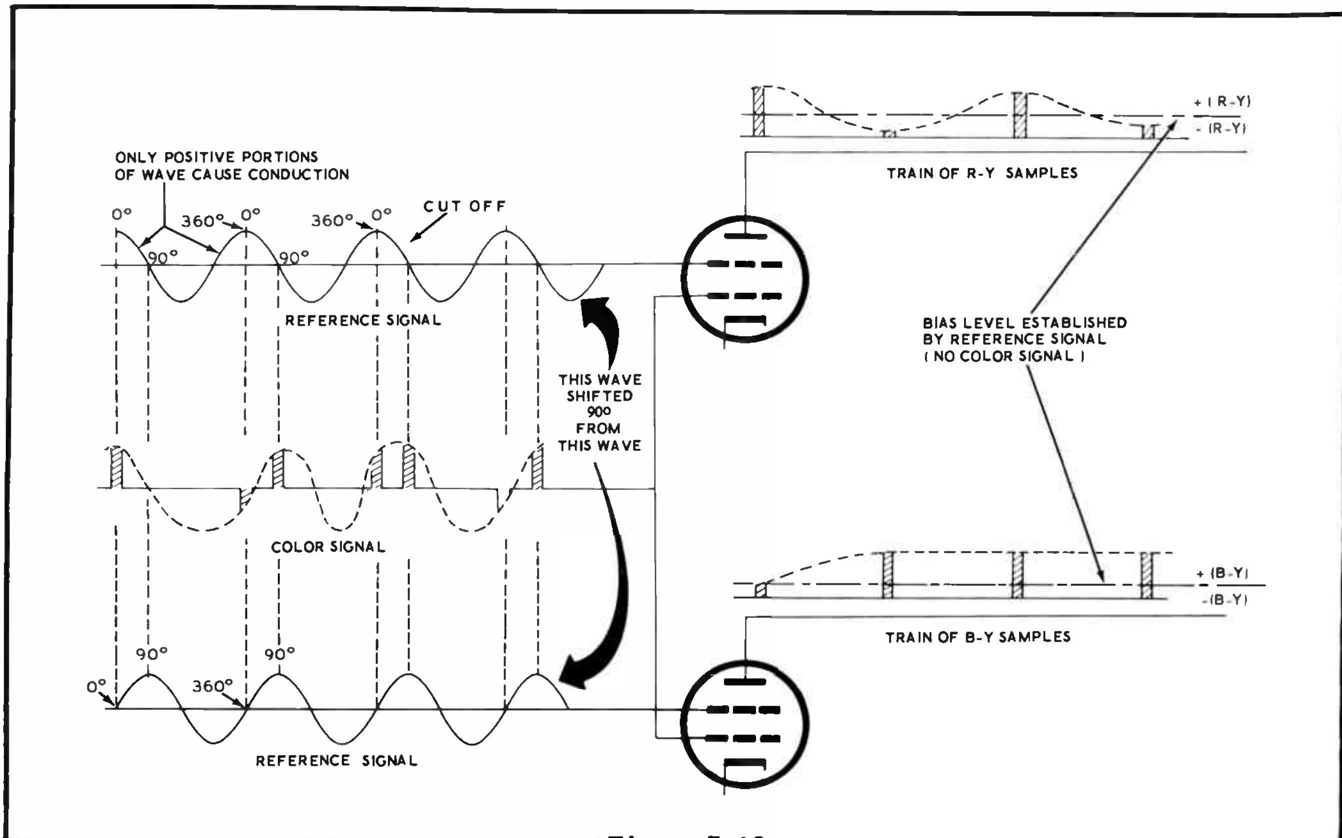


Figure 5-18

V405 and the phase shifting network is made up of L408, C454 and R463.

A crystal-controlled oscillator is used to maintain the reference frequency between color bursts. The burst is only transmitted for a short time between the scanning lines. It is transmitted right after the horizontal sync pulse. The beams are all turned off at that time so there is no effect on the screen. It is often said that the color burst is on the "back porch" of the horizontal blanking pulse. See Figure 5-19.

To insure that the internal oscillator is in phase, or correctly timed, with the 3.58 mc color burst from the station, a phase detector and reactance tube are used. A little of the oscillator's output is fed back to the phase detector. It compares the oscillator's output with the reference color burst, and any phase difference between them results in either a positive or negative correction voltage. This correction voltage is fed back to the oscillator's reactance tube, which in turn corrects the oscillator phase. In this way, a high degree of oscillator stability is maintained.

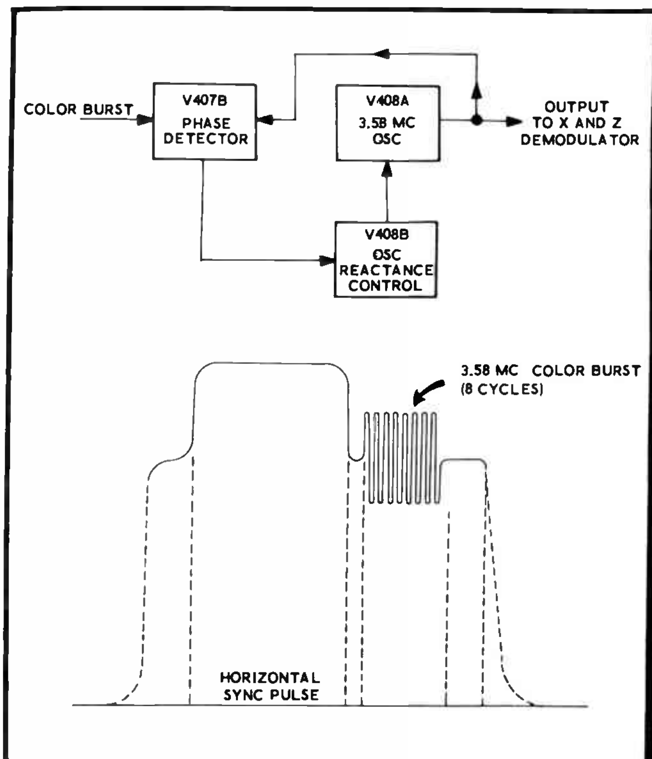


Figure 5-19

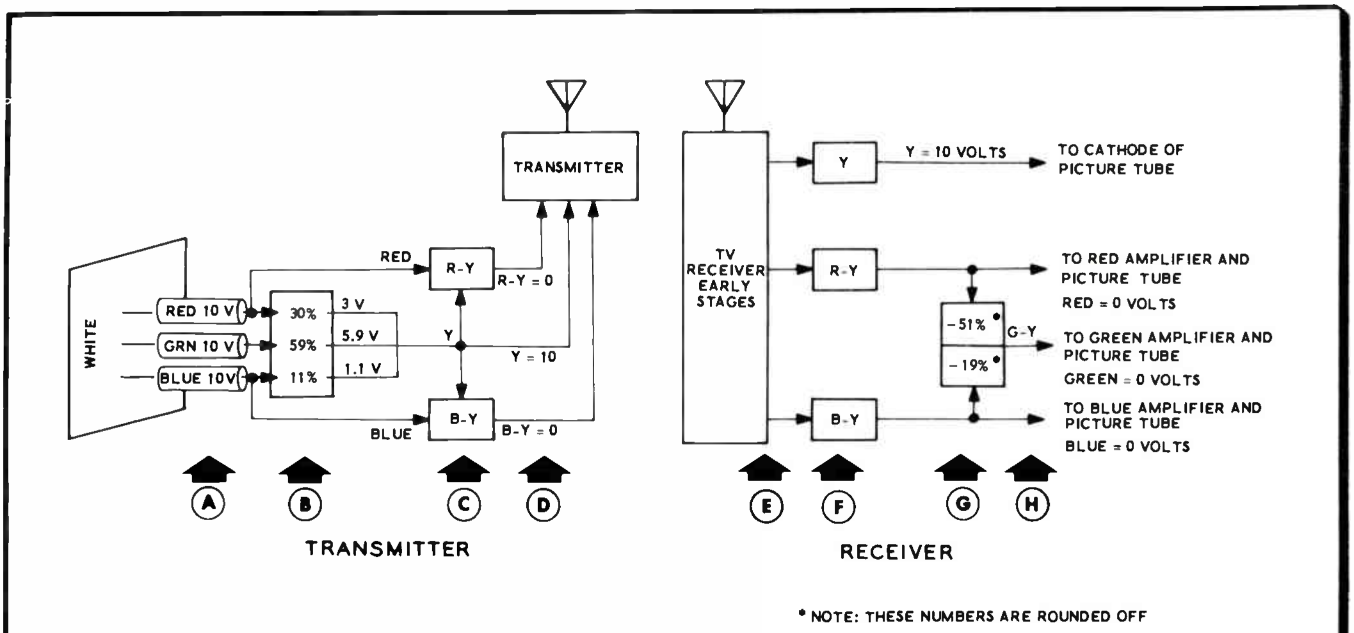


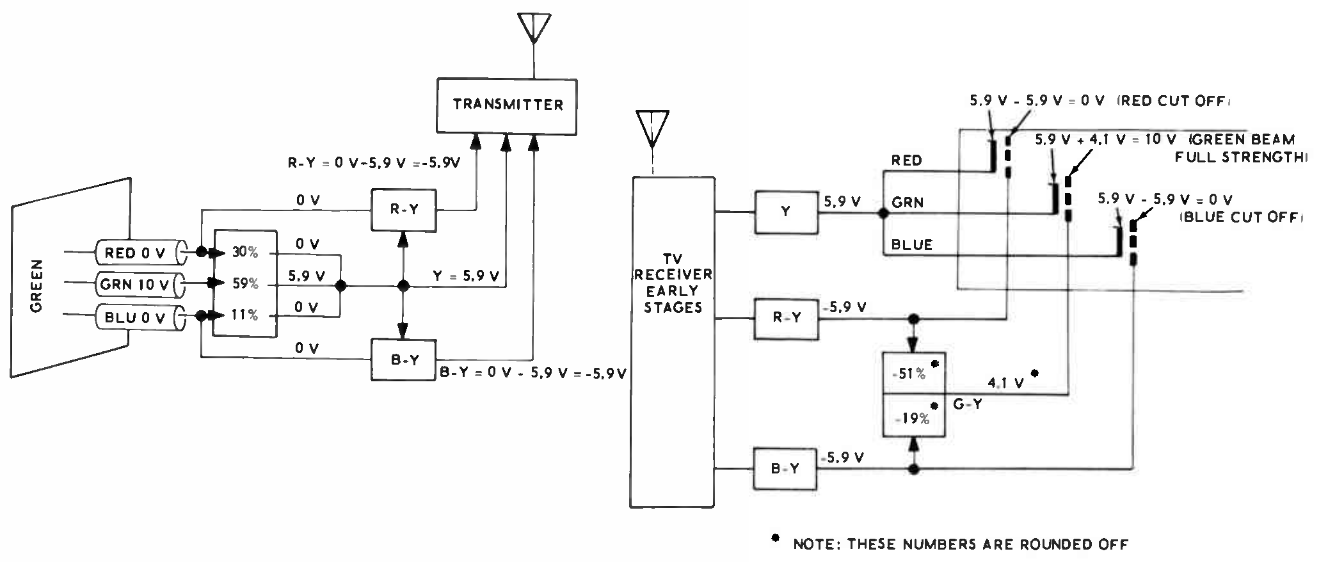
Figure 5-20

OBTAINING THE G-Y SIGNAL FROM THE B-Y AND R-Y SIGNALS

To show how the R-Y and B-Y signals are combined to make the G-Y signal, it will be necessary to show the composition of both signals. The left portion of Figure 5-20 represents the transmitter. NOTE: Numeric values are given to the various voltages in Figure 5-20 for demonstration purposes only. They do not necessarily represent typical voltages.

A. To produce white, the camera lenses at the transmitter each see maximum color and their output is 10 volts.
B. The matrix takes 30% of the red lens circuitry's output, 59% of the green's, and 11% of the blue's and combines them to make the Y signal. In this example: Y = 3 + 5.9 + 1.1 = 10 V. Colors mixed in these proportions appear "white" to the human eye.
C. R-Y is generated by subtracting the Y signal voltage from the Red lens circuitry's output voltage; in this example R-Y = 10-10 = 0 V. Similarly, B-Y is generated by taking the Y signal from the Blue lens voltage. Example: B-Y = 10-10 = 0. NOTE: G-Y is not transmitted.
D. Represents the components of the broadcast containing color (R-Y and B-Y) and luminance (Y) elements.
E. Represents the received signal components after they are separated into color and luminance components.
F. R-Y and B-Y signals are separated by their demodulators.
G. This section of the circuit takes 51% of R-Y signal and 19% of the B-Y signal. The output wave is inverted which is shown by a minus sign. Since the R-Y signal voltage is 0 volts, 51% of it is still 0, and 19% of the 0, B-Y voltage is also 0 volts. Therefore, adding the two derived voltages still equals 0 for the G-Y signal voltage.
H. With no color signal voltage on the grids of the picture tube, the "Y" potential on the cathode will cause white to be shown.

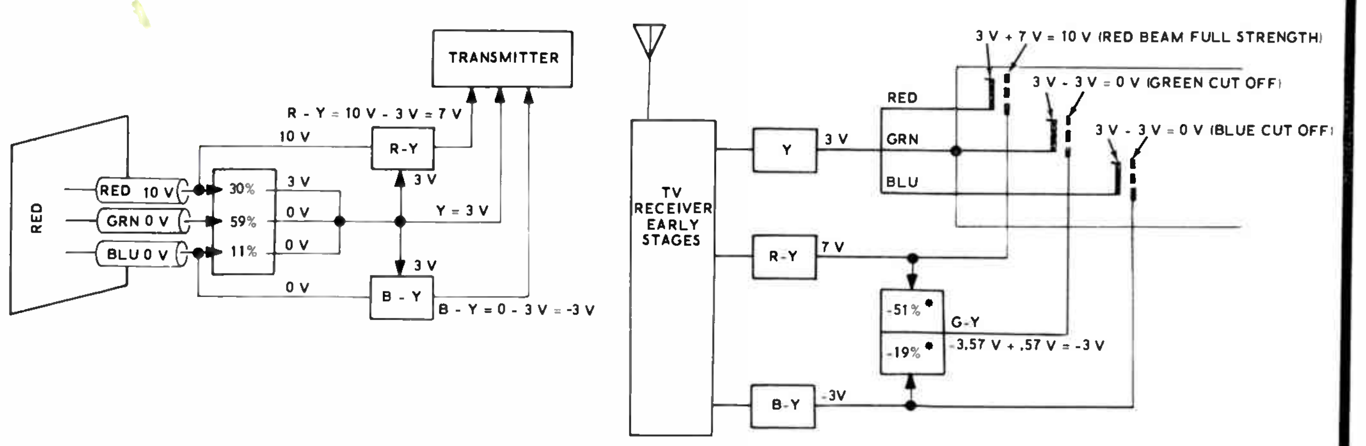
Figure 5-21 shows how the G-Y signal is developed to produce a green color, and Figure 5-22 shows how the R-Y signal is developed to produce a red color, using the same process as described for white, except with different values of voltage. The B-Y signal is developed in a similar manner to produce a blue color.



FOR GREEN ONLY

How the G-Y signal is developed.

Figure 5-21

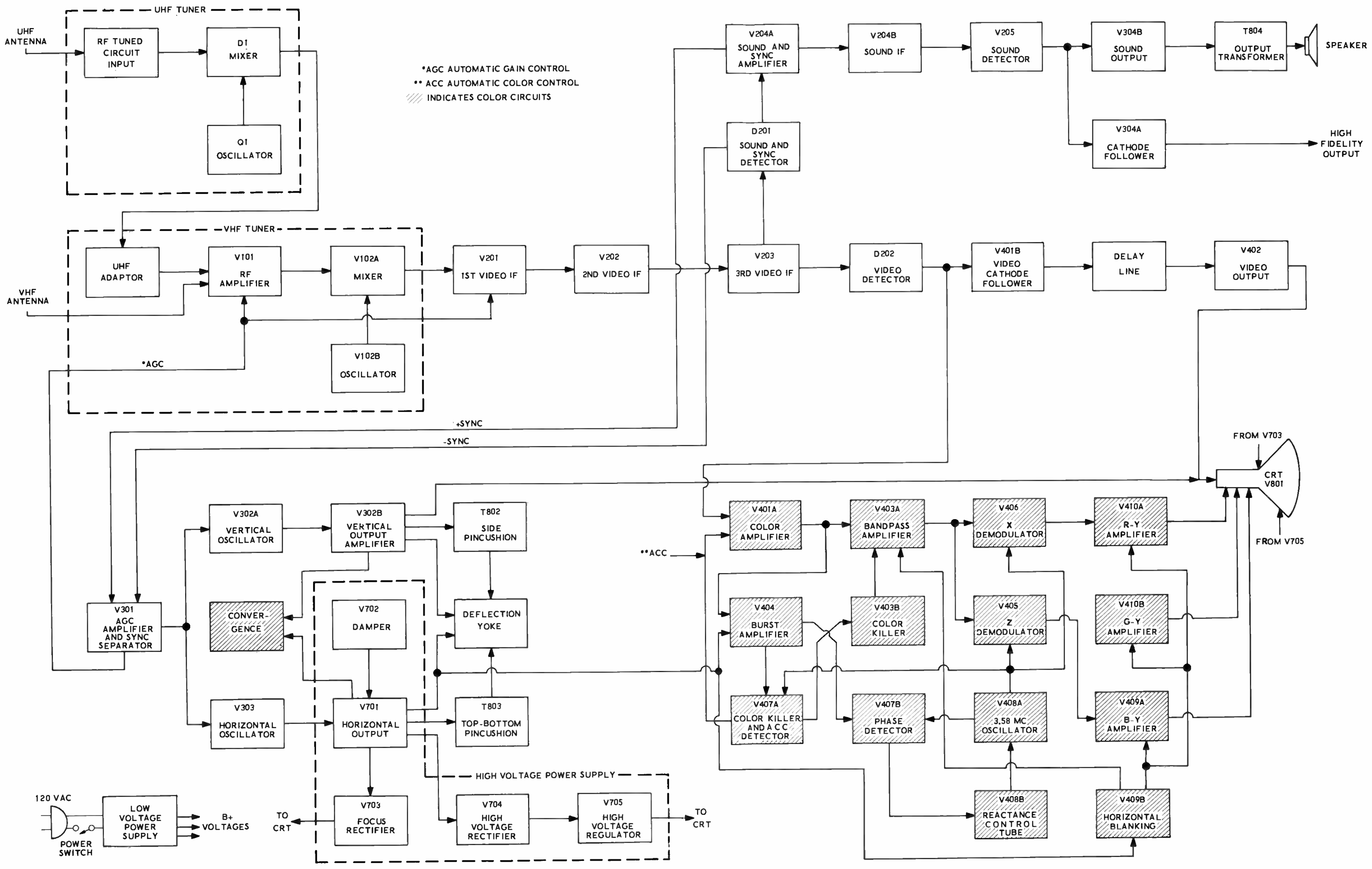


FOR RED ONLY

The objective is to produce the same proportion of voltage at the picture tube gun that is on the camera lens. Blue and green are stopped.

Figure 5-22

BLOCK DIAGRAM
FIGURE 6-1



CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 175) as well as to the Block Diagram (Figure 6-1, fold-out from Page 150) while reading this Description. The circuit part numbers (R1, C101, L201, etc.) for all resistors, capacitors, coils, and transformers have been put into the following groups. This grouping will make specific circuit parts easier to locate, both on the TV chassis and Schematic.

0 to 99	Parts in UHF tuner.
100 to 199	Parts in VHF tuner.
200 to 299	Parts on IF circuit board.
300 to 399	Parts on sound-sync circuit board.
400 to 499	Parts on color circuit board.
500 to 599	Parts on convergence circuit board.
600 to 699	Parts in low voltage power supply (mounted on the chassis).
700 to 799	Parts on horizontal output assembly.
800 to 899	Parts mounted on the chassis.

UHF TUNER

For shielding purposes, the UHF tuner is divided into three compartments; the RF compartment, the mixer compartment, and the oscillator compartment. These compartments, which are shown by the ground (dotted) lines on the Schematic, prevent undesirable feedback.

The input TV signal from the UHF antenna is coupled from coil L1 to the input tuned circuit, which consists of coil L2 and capacitor C1 (one section of the tuning capacitor). This circuit tunes in the desired UHF channel signal and rejects all others. The signal is then coupled to coil L3 in the mixer compartment.

In the oscillator compartment, capacitor C4 (a section of the tuning capacitor) tunes transistor oscillator Q1 to oscillate 45.75 mc (megacycles) above the video carrier frequency (41.25 mc above the sound carrier frequency). Coil L6, a single loop of wire, then couples the oscillator signal to the mixer compartment.

In the mixer compartment, capacitor C2 (a section of the tuning capacitor) is tuned with coil L3 to the frequency of the desired input signal. Coil L4 then picks up this signal and feeds it to diode D1. The incoming frequency and the oscillator frequency are combined in the diode mixer, resulting in an IF difference signal which is coupled through RF choke L5 and the output cable to the VHF tuner.

A UHF converter strip, for the UHF position in the VHF tuner, alters the circuits of tubes V101 and V102 so the VHF tuner operates as two additional IF amplifiers. See the Schematic of the converter strip. The output signal from the UHF tuner is coupled to the UHF converter strip through coil L106 of the VHF tuner. This signal is then coupled through input coil L113 on the converter strip to the grid of tube V101. Here the signal is amplified and coupled through coils L114 and L115 to the grid of V102A. The amplified signal from the plate of V102A is coupled through coil L111 and capacitor C123 to the output terminal of the VHF tuner. Oscillator stage V102B in the VHF tuner is disabled when the VHF tuner is set to the UHF position.

VHF TUNER

The signal received from the antenna is changed from a balanced to an unbalanced signal by the input "balun" coil, L101. From L101, the signal passes through a high-pass filter that attenuates all frequencies below channel 2. This filter consists of L102, L103, L104, and capacitors A, B, C, and D of P.E.C. (printed electronic circuit) 101.

From the high-pass filter, the input signal passes through feedthrough capacitor C105 and antenna coil L107 to the grid of RF amplifier tube V101. Neutralizing capacitor C109 balances the feedback voltage to V101.

A set of four coils for each VHF channel (mounted in the rotating turret) selects the correct channel. These four coils are antenna coil L107, RF plate coil L108, mixer grid coil L109, and oscillator coil L110.

The amplified signal from RF amplifier V101 is coupled through RF plate coil L108 and mixer grid coil L109 to the grid of the mixer stage, V102A. Capacitor C113 is the RF plate trimmer, and capacitor C114 is the mixer grid trimmer.

Tube V102B is connected as a Colpitts oscillator tuned to oscillate 45.75 mc above the picture carrier frequency (41.25 mc above the sound carrier frequency). The output signal from the oscillator is connected through capacitor C117 to the grid of the mixer tube.

The input signal from tube V101 and the oscillator signal from tube V102B beat together in mixer stage V102A, resulting in an IF difference signal that contains the picture and sound information. The picture IF carrier is at 45.75 mc and the sound IF carrier is at 41.25 mc. This IF signal is then coupled through mixer plate coil L111 and capacitor C123 to the IF output terminal of the VHF tuner. B+ voltage, filament voltage, AGC voltage, and the test points are all connected to the VHF tuner through feedthrough capacitors.

IF AND VIDEO AMPLIFIER

Figure 6-2 shows a complete television signal for channel 2. The IF amplifiers must be able to pass the complete bandwidth of this signal.

COMPLETE TELEVISION SIGNAL FOR CHANNEL 2

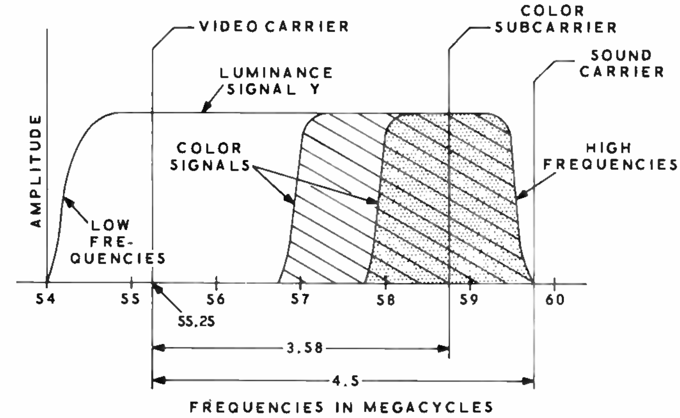


Figure 6-2

The IF signal from the VHF tuner is connected through a shielded cable and through capacitor C201 to the first IF transformer, T201. An adjacent-channel sound trap, composed of L201 and C202, along with control R201 is used to lower the level of the sound carrier.

From the secondary of the first IF transformer, the signal is coupled to the grid of first IF amplifier tube V201. AGC voltage is applied to this grid through a decoupling network consisting of R202 and C204, through the 47.25 mc trap, and through the secondary of T201.

Amplified signal from the plate of V201 is coupled through second IF transformer T202 to the grid of second IF amplifier tube V202. Note that the plate voltage of V201 comes from B+ through resistors R211 and R212 and through IF amplifier tube V202. Thus, the AGC voltage controls the gain of both stages, V201 and V202. The first IF stage, V201, is tuned close to the picture IF carrier frequency and is arranged to have slightly more gain than V202 when less AGC voltage is developed. This causes the IF bandwidth to become narrow on weak signals, giving greater amplification to the sync signals and the other low frequency components of the picture signal.

The signal from the plate of V202 is coupled through IF transformer T203 to third IF amplifier tube V203. IF signal from V203 is coupled through detector transformer T204 to video detector diode D202. The secondary of T204 has a "bridged T" sound trap made up of control R219, coil L202, and the secondary winding of T204. This trap is tuned to 41.25 mc, which severely attenuates the sound carrier before it reaches the video detector.

The video detector demodulates the IF signal so that the luminance (brightness) and color picture signals are available at the output of the detector circuit. The luminance signal from D202 passes through a "tweet filter" consisting of capacitors C221 and C222, and coil L204. This filter prevents any harmonics of the IF frequency from radiating back into the input circuits and producing an unwanted beat frequency. Coil L206 and resistor R221 form the detector load. From the filter, the luminance signal passes through a "bridged T" 4.5 mc sound carrier trap made up of R222, L205, and C223. This trap further attenuates any sound signal that is in the luminance signal. The luminance signal then passes through a series peaking network to the grid of video cathode follower tube V401B. This series peaking network is formed by R402 and L403. Tube V401B matches the impedance of the output circuit of the video detector to the delay line impedance.

The luminance signal from the cathode of V401B is connected to Contrast control R410. Capacitor C403 compensates the Contrast control so that it presents a flat frequency response to the signal over the Contrast control range. The amount of luminance signal chosen with the Contrast control is then coupled through resistor R406 and through the delay line. The delay line is made up of a coil of wire with a specific inductance and capacitance. This combination of inductance and capacitance is placed in the signal path to introduce a slight delay in the luminance signal. This delay is necessary, since the color signal must go through much more circuitry than the luminance signal before it reaches the CRT (cathode ray tube). From the delay line, the luminance signal is coupled through series peaking coil L413. It is then coupled through C404 to the Dots-Normal switch.

Brightness control R400 varies the brightness of the picture. This is done by varying the DC bias on the grid of V402, which varies the B+ voltage on the plate of this tube. Since the three cathodes of the CRT are connected to the plate circuit of V402, their emission is affected by the setting of the Brightness control. The DC component of the luminance signal is coupled from the video detector circuit to a voltage divider consisting of R403, Brightness control R400, and R460. From the Brightness control, a portion of this DC component is coupled through the Dots-Normal switch to the grid of video amplifier tube V402.

The Dots-Normal switch provides a means of switching a dot signal into the video circuit to make convergence (picture) adjustments. The dot generating circuit is made up of D401, NE-2, C405, C414, C415, C416, C417, R416, R417, R418, Vertical Dots control R420, and L405, the Horizontal Dots coil. The operation of the dot generating circuit will be explained later with the sweep circuits.

The luminance signal from the Dots-Normal switch is connected to the grid of video amplifier tube V402. Amplified luminance signal is coupled from the plate of V402 through a series peaking network consisting of coil L404 and R414 to the Normal-Service switch. The Normal-Service switch disables the vertical oscillator and places a set-bias on the cathodes of the CRT. This switch is used when making the "gray scale" picture adjustment.

The luminance signal from the Normal-Service switch is coupled through R819 to the red cathode of CRT V801. The luminance signal is also coupled through Blue Drive control R817 to the blue cathode, and through Green Drive control R820 to the green cathode of the CRT. These controls are used to vary the level of the blue and green video signals in relationship to the fixed red signal.

SOUND IF, DETECTOR, CATHODE FOLLOWER, AND OUTPUT STAGES

The sound and picture carriers of a standard television signal are always separated by 4.5 mc. (Example: The separation between the 41.25 mc and 45.75 mc IF frequencies is 4.5 mc.) The sound carrier is frequency modulated and the picture carrier is amplitude modulated. See Figure 6-2.

These two signals beat together at sound and sync detector diode D201 to form a 4.5 mc difference frequency. This 4.5 mc sound signal is coupled through a tweet filter consisting of coil L203 and capacitor C219, to the grid of sound and sync amplifier tube V204A. (The sync signal will be explained later.)

The sound signal is then coupled from the plate of sound-sync amplifier V204A, through capacitor C229, to the grid of sound IF amplifier V204B. The sound take-off coil, L207, and capacitors C226 and C228 are connected in a parallel resonant circuit that is tuned to select only the 4.5 mc sound signal and couple it to V204B.

The 4.5 mc sound signal is amplified in tube V204B and coupled through capacitor C231 to sound IF plate coil L208. This coil is divided into three sections. The center section of this coil is connected in a swamped tuned circuit that is tuned to 4.5 mc. The small bottom portion of the coil (actually part of the same winding) along with capacitor C232 forms a neutralization circuit for tube V204B. The upper portion of coil L208 is tuned in series resonance with the input grid capacitance of tube V205. This produces the gain and bandwidth required for the 4.5 mc FM IF stage.

THE LOCKED OSCILLATOR (QUADRATURE GRID) DETECTOR AND SOUND OUTPUT CIRCUITS

Tube V205, which is connected in a locked oscillator detector circuit, separates the FM modulation from the 4.5 mc sound signal and converts it into an audio signal. The audio signal is then coupled to Volume control R342. The circuit operates in the following manner.

The 4.5 mc frequency modulated input signal coupled to control grid #1 (pin 1) of tube V205, density modulates the electron stream flowing through the tube. This density modulated stream, as it flows by control grid #2 (pin 7), induces a similar 4.5 mc oscillation at control grid #2. This oscillation is reinforced by a tuned circuit, composed of quadrature coil L209 and capacitor C239. Resistor R236 is a swamping resistor to lower the Q of L209. The stray capacitance between control grid #2 and control grid #1 furnishes the feedback path that sustains the oscillations, therefore, the circuit oscillates much like a tuned-grid, tuned-plate oscillator.

The frequency induced at control grid #2 will remain locked to the frequency present at control grid #1 over a range of frequencies near 4.5 mc, but control grid #2 voltage will lag behind control grid #1 voltage by 90 degrees. These voltages are shown in Figure 6-3.

The locking range is the range of frequencies where the oscillator frequency locks onto the frequency of the incoming signal; this range becomes wider as the input signal becomes larger in amplitude. Within the locking range, the oscillator frequency changes with the frequency of the input signal. Outside the locking range, the oscillator fails to synchronize with the incoming signal and no audio signal is produced.

As the oscillator follows (locks onto) the frequency changes of the input signal, the phase angle between control grid #1 and control grid #2 becomes either less than 90 degrees or larger than 90 degrees, depending on which way the frequency changes. These phase changes cause amplitude changes in the plate current of V205. The average plate current of the tube thus varies with the frequency changes of the 4.5 mc frequency modulated sound signal.

Refer to Figure 6-3 and note that the plate current can be changed by shifting the phase of the control grid #2 voltage slightly forward or backward. Note also that plate current only flows when the instantaneous voltage at control grid #2 is at zero. Thus, amplitude modulation of the input signal does not affect the output of the detector.

Sound Output Circuits

The audio signal is coupled from the plate of detector tube V205, through capacitor C241, and to Volume control R342. Capacitors C242 and C243, and resistor R238 are used for loudness compensation.

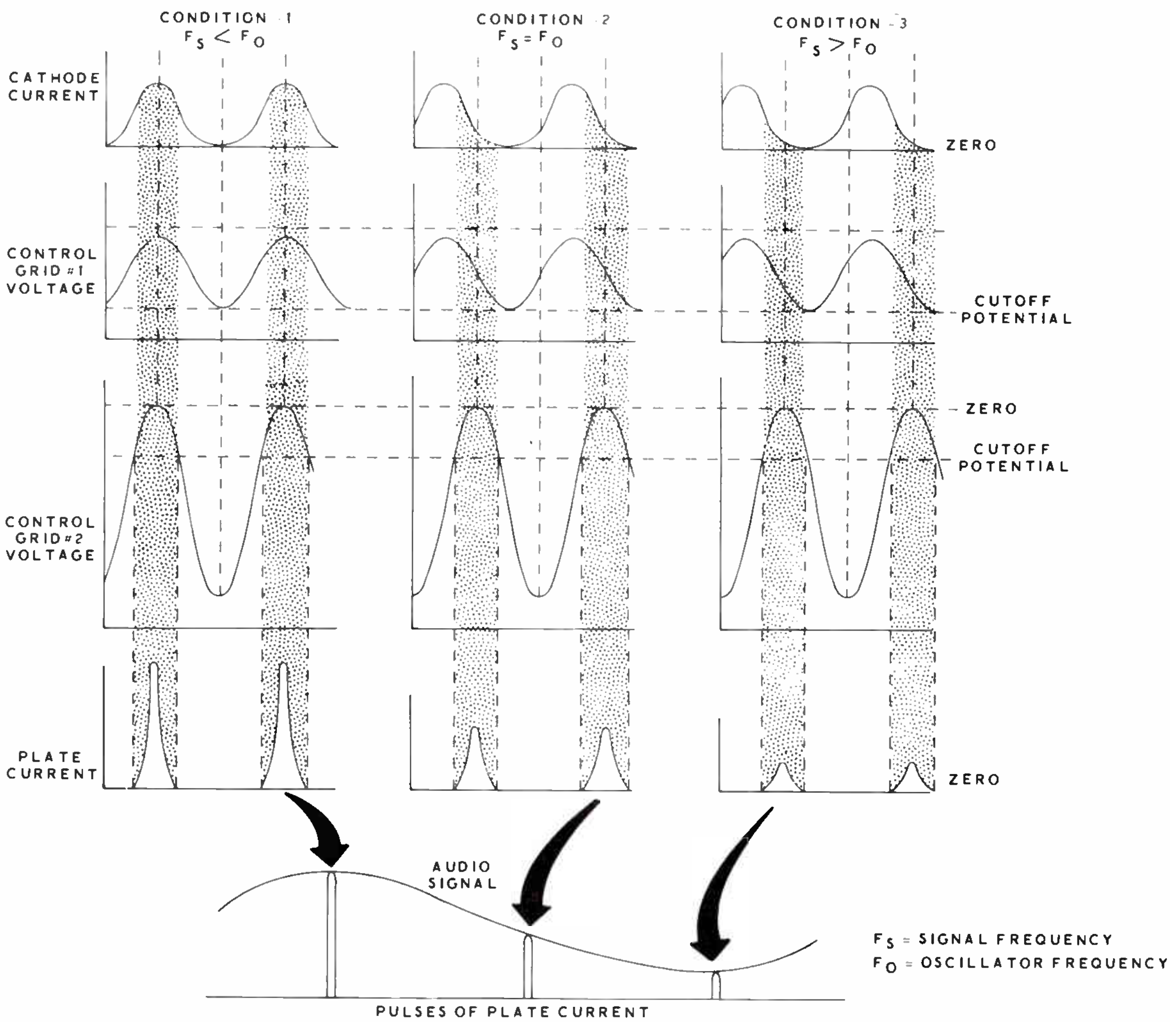


Figure 6-3

Two types of sound output are available. Cathode follower stage V304A provides a low impedance output that can be connected to your high fidelity system. Power amplifier stage V304B amplifies the signal and connects it to output transformer T804. An 8 Ω speaker is connected to the secondary of T804. Resistor R814 provides a load for the sound output stage when a speaker is not used.

GATED AGC AND SYNC SEPARATOR

Tube V301 is a twin pentode used in the gated AGC and sync separator circuits. The cathode, grid #1, and grid #2 of the tube are common to both sections. There is a separate grid #3 and plate for each section.

The Gated AGC Circuit

The left-hand section of tube V301 is used to develop AGC bias voltage to control the gain of the tuner and the IF amplifiers. This prevents changes in contrast with changes in signal strength; it also prevents the receiver from overloading in strong signal areas. The circuit operates in the following manner.

The sync signal, with negative-going sync pulses, is coupled from the sound and sync detector circuit through resistor R223 and capacitor C302 to grid #1 (pin 7) of V301. The Sync control R300 is adjusted so that the tip of this negative sync pulse almost drives the grid to cutoff. Then any noise pulses that are received on this grid cause it to cut off the tube and the noise signals do not appear in either of the plate circuits.

A sync signal is also coupled from the plate circuit of sound and sync amplifier V204A, through sound take-off coil L207, R226, R308, R304, and C301 to grid #3 (pin 6) of V301. This signal has a positive-going sync pulse. Since this positive pulse was amplified by V204A it is much larger than the negative pulse at pin 7. It has a much larger effect on the plate current of V301.

Another pulse is coupled from a winding on the horizontal flyback transformer, through capacitor C308, to the AGC plate (pin 3) of V301. The polarity of this pulse is such that it places a large positive voltage on the AGC plate during horizontal retrace time. Current flows to the AGC plate only when both of these pulses, the pulse on the AGC plate and the pulse on grid #3 are present at the same time.

How large or how small these gated pulses become depends on how large or how small the sync signal is that is received from the sync amplifier. The pulses are filtered in the AGC plate circuit by two separate AGC filters. One filter comprised of R306 and C203 supplies a varying negative AGC voltage to the first video IF amplifier; the other filter, comprised of R307 and C303 supplies AGC voltage to the VHF tuner.

Bias voltages for grids #1 and #3 of this section of V301 are adjusted by Sync control R300, which is connected in a voltage divider that consists of resistors R301, R302, R303, and R304. AGC control R310 adjusts the positive bias on the cathode of V301, thus it sets the level of the developed AGC voltage.

The biggest advantage of a gated AGC circuit such as this, is that noise pulses and sync signal level changes such as from airplane flutter, do not have much affect on the AGC voltage since the AGC amplifier only conducts during the horizontal sync pulse retrace time.

Sync Separator Circuit

The positive-going sync signal from the plate circuit of the sound and sync amplifier V204A is coupled through capacitors C306 and C307, and resistor R312 to grid #3 (pin 9) of the sync separator portion of V301. This signal causes grid current to flow, and the long time constant of capacitor C307 and resistor R313 causes this grid to be biased approximately to the blanking level of the composite video signal. This allows this portion of the tube to conduct only on signals which are greater in amplitude than the blanking level, or only on the sync pulses.

The same noise-cancelling effects, which were mentioned previously, are obtained both in the sync section and in the AGC section by the action of grid #1. Large noise pulses cause grid #1 to be cut off, and the noise pulses do not appear at the plate of the sync amplifier.

SWEEP CIRCUITS

Vertical Sweep Circuit

The vertical sync signals are coupled through isolating resistor R316 to the vertical integrating network which is contained in P.E.C. 1. This network adds the vertical sync pulses to form a large single pulse that triggers the vertical oscillator stage, V302A and V302B.

The free-running frequency of the vertical multivibrator is controlled by Vertical Hold control R330 which adjusts the time constant in the grid circuit of V302A. The actual vertical frequency is then locked to the televised signal by the vertical sync pulse from the vertical integrating network. This sync pulse is coupled through capacitors C310 and C314 to tube V302B.

From V302B, the vertical sweep waveform is coupled through vertical output transformer T801, and through the yoke plug and socket to vertical deflection coils L803 and L804. The pincushioning and convergence circuits, which will be explained later, are also connected to T801. Thermistor R826 is used to damp out any oscillations that might appear in the vertical deflection coils.

The vertical sweep waveform is also coupled from V302B to the dot generating circuit, and through capacitor C411 and resistor R413 to the cathode of each gun in the CRT. This vertical sweep waveform synchronizes the dot generating circuit to oscillate at a multiple of the vertical sweep frequency. The dot patterns are used to make color adjustments of the CRT. In the CRT, the vertical waveform is used to cut off the CRT during vertical retrace time.

Secondary windings on the vertical output transformer provide the vertical sweep waveform through pins 3, 4, 5, 6, and 7 of the convergence plug and socket to the convergence circuits. (The convergence circuits will be explained later.)

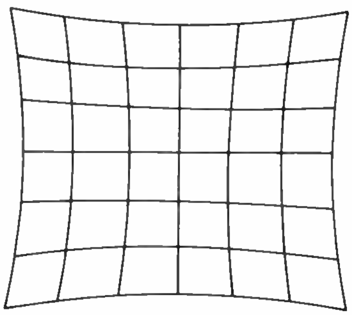


Figure 6-4

Pincushioning

Pincushioning, the stretching out of the raster at all four corners of the CRT, is a condition found in all wide-angle deflection rectangular picture tubes. Figure 6-4 shows the shape of the vertical and horizontal lines in a raster with pincushioning. Note that the greatest "stretch" distortion is in the areas furthest from the center of the CRT.

Figure 6-5 illustrates top and bottom pincushioning. Top and bottom pincushioning is

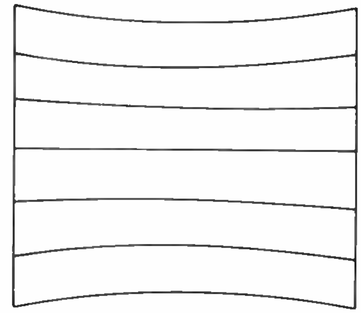


Figure 6-5

corrected in the vertical deflection circuits by adding vertical sweep amplitude at the top and bottom of the raster.

The vertical sweep waveform is coupled from V302B through vertical output transformer T801 to the top and bottom pincushion circuit. A simplified version of this circuit is shown in Figure 6-6. The vertical sawtooth current passes through the two control (center) windings of switching reactor T803. The path is from one vertical yoke winding, through a control winding, through one winding of coil L801, back through the other coil of L801, through the other control winding to the other vertical yoke winding.

The vertical sawtooth current, passing through the control winding of T803 controls the reluctance of the cores on which the outer (load) coils are wound. The horizontal sawtooth current passes through these load windings on its way to the horizontal deflection yoke. Any change in the reluctance in these cores changes the inductance of the load windings.

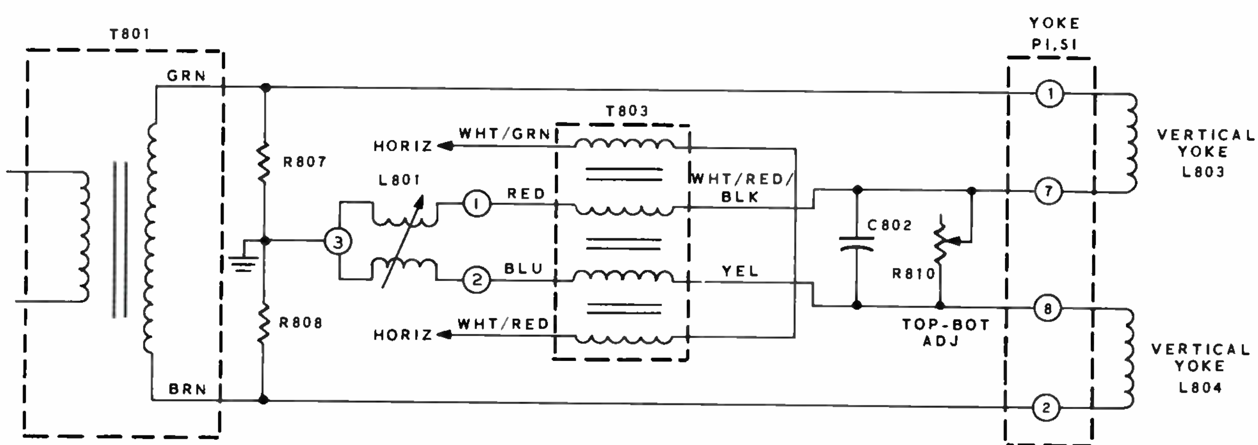


Figure 6-6

On one half of the vertical sawtooth, one load winding becomes higher in inductance than the other load winding; on the other half of the vertical sawtooth these inductances are reversed. These alternating changes in the load windings induce horizontal pulses into the control windings. These pulses are filtered into sine waves by pincushion phase coil L801 and capacitor C802. These sine waves are then added to the vertical sawtooth current in the control windings to correct top and bottom pincushioning.

These sine waves must be properly phased with the vertical sawtooth current to correct parabolic bending. Parabolic bending is the elongation of the scanning spot as it nears the edge of the CRT. Proper phase relationship, between the sine wave and the vertical sawtooth current is accomplished by adjusting L801. Top-Bottom control R810 is adjusted for the required amount of top and bottom pincushion correction.

Horizontal Sweep Circuit

The horizontal sync discriminator circuit includes the dual selenium diodes D301, resistors R328 and R329, and capacitors C323, C324, and C325. The 15,750 cps horizontal sync signals are coupled from the plate of the sync separator, through capacitor C309, to this discriminator. Pulses from the horizontal output transformer are also coupled to this circuit through resistor R331.

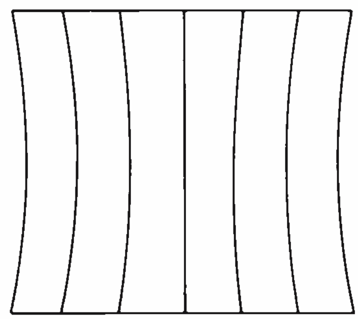
This discriminator compares the horizontal sync pulses to the horizontal output pulses, and produces a DC voltage that represents the phase difference between the two signals. This DC voltage is filtered and then coupled to the grid (pin 2) of V303 in the horizontal oscillator (multivibrator) circuit.

The DC voltage from the discriminator adjusts the conduction point of V303, thus adjusting the horizontal oscillator to the same frequency as the sync signals. The purpose of this horizontal discriminator circuit is to prevent noise pulses from coupling through and triggering the horizontal oscillator.

The horizontal oscillator circuit uses a dual triode, connected as a stabilized cathode-coupled multivibrator. The free-running frequency of this multivibrator is adjusted by Horizontal Hold control, R340, which adjusts the time constant in the grid (pin 7) circuit.

Stabilizing coil L301 is adjusted to develop a sine wave of voltage at the correct horizontal oscillator frequency. This sine wave steepens the slope of the grid (pin 7) waveform of V303, thus stabilizing the multivibrator frequency during weak sync signal periods and lessening the chance of noise accidentally triggering the oscillator.

The horizontal sweep waveform is formed across capacitor C328 and resistor R337. This waveform is coupled through capacitor C322 and resistor R701 to horizontal output tube V701. The horizontal sweep waveform is then amplified by V701. From here it is fed to horizontal output (flyback) transformer T701.



SIDE PINCUSHIONING

Figure 6-7

Side pincushioning, as shown in Figure 6-7, is corrected by subtracting from the horizontal deflection width at the top and bottom of the vertical scanning line. Side pincushioning correction takes place in the horizontal deflection circuit and is accomplished with the use of saturable reactor T802. Figure 6-8 shows a simplified version of this circuit.

The center (control) winding of T802 has a low DC voltage applied through it to set up the proper operating inductance. The horizontal sweep waveform passes through the two outside (load) windings of T802 ~~through width coil L807~~, and through both horizontal yoke coils, L805 and L806. A vertical pulse from T801 is fed to the control winding of T802, which changes the reluctance of the cores in the load windings.

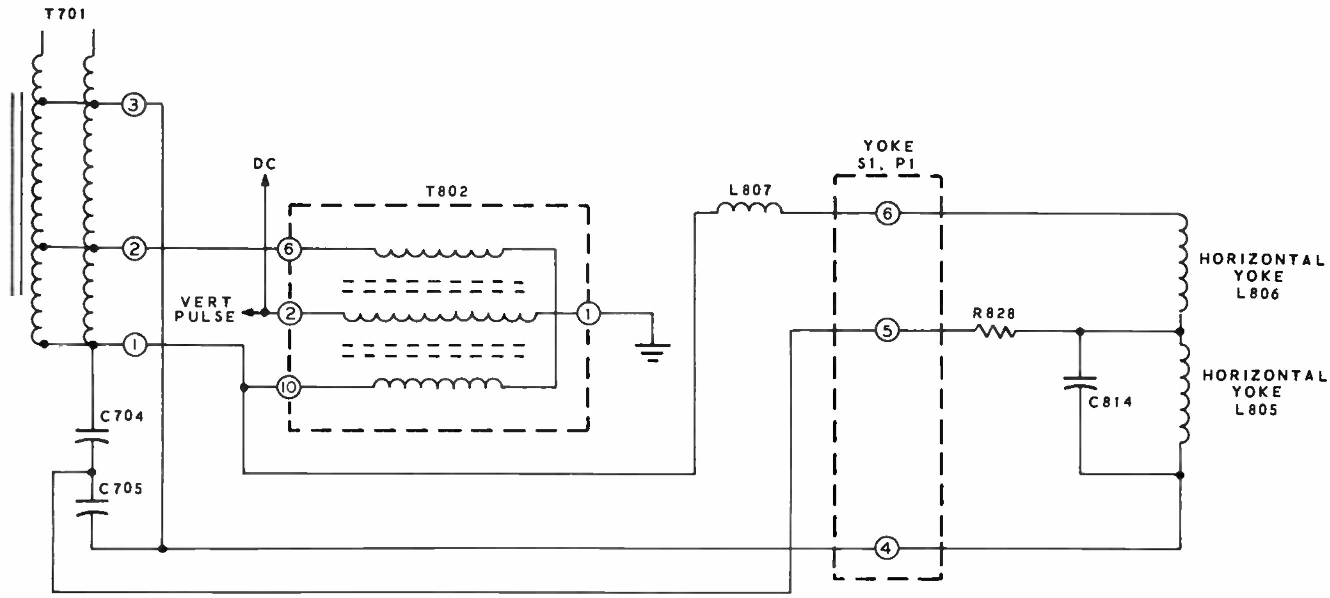


Figure 6-8

This change in reluctance affects the inductance of the load windings. As each vertical pulse passes through the control winding, the horizontal sweep waveform is reduced in amplitude, and thus reduces the horizontal deflection width to correct the side pincushioning effect.

Capacitor C814, along with resistor R828, tune the horizontal deflection coil to prevent the ringing (vertical lines in the picture) that the quick discharge of the horizontal waveform might tend to cause in the deflection circuit.

The horizontal output transformer and deflection coil circuit is tuned to a resonant frequency of approximately 71 kc (kilocycles) by the associated circuit capacitances. When the horizontal output tube is cut off during retrace time, the circuit oscillates for one half cycle at this frequency, thus obtaining the necessary rapid retrace.

After the retrace cycle of the horizontal waveform (the "flyback") has occurred, the polarity of the voltage on the transformer reverses, the next trace starts, and the voltage at the plate of damper tube V702 becomes positive. Thus the damper tube begins to conduct, and acts as a load across the terminals of the deflection coil system; this damps out any further tendency of the circuit to oscillate at 71 kc. The horizontal waveform thus increases at a linear rate until the next retrace cycle occurs.

Coil L703 is adjusted to present the correct impedance load to V702, thereby increasing the efficiency of the damper circuit. Coils L701 and L702 act as chokes to prevent high frequency oscillations from the damper stage from feeding into the RF stages. A horizontal retrace pulse is also coupled through capacitor C413 to the dot generating circuit.

The operation of the dot generating circuit is as follows. Neon lamp NE-2, capacitor C415 and resistor R417 make up a relaxation oscillator. An oscillation is generated when voltage to C415 causes it to charge to a point where the neon lamp fires. This discharges C415 and it then starts charging again. This oscillation rate is controlled by varying the amount of voltage to C415. The higher the voltage, the faster it charges to the firing potential across the neon lamp. How fast it charges depends on the setting of Vertical Dots control R420. This control is used to vary the amount of voltage applied to the oscillator circuitry. The oscillations from the oscillator are synchronized at a multiple of the vertical sweep rate and applied through C417 to diode D401.

Coil L405 is tuned to a multiple of the horizontal retrace frequency (15,750 cps). When the horizontal retrace pulse is applied to L405, a ringing pulse, or train of pulses, are generated. These pulses are mixed with the relaxation oscillator pulses and coupled through C417 to D401. Diode D401 is biased so that only the positive tips of the pulses are passed to V402. The Vertical Dots control provides a means of varying the number of horizontal rows of dots; the Horizontal Dots coil varies the number of vertical rows of dots. These dot patterns are used to make CRT color adjustments.

At the beginning of the retrace cycle, a positive pulse from T701 is applied through capacitors C706 and C715 and resistor R494 to the grid of blanker tube V409B. This pulse causes V409B to conduct and places a negative pulse across resistor R485. The strength of the negative pulse across this resistor is controlled by the bias on blanker tube V409B which, in turn, is governed by the position of the Kine-Bias switch.

The three-position Kine-Bias switch changes the grid bias at each color grid of the picture tube in the following manner: This switch changes the gain of tube V409B, thus changing the amplitude of the pulse at its plate. The amplitude of this pulse determines the bias on tubes V409A, V410A, and V410B, which determine the picture tube grid bias.

Resistor R485 is common to color amplifier tubes V409A, V410A, and V410B. As these tubes conduct, a negative pulse is DC coupled to the color grid of each gun in the CRT and cuts them off. Therefore, the CRT is cut off during the horizontal retrace time. Tubes V409A, V410A, and V410B are also used to amplify and apply the color signals to the color grids of the CRT. Operation of the color circuits will be explained later.

The supply of B+ voltage to the plate of vertical oscillator tube V302A, horizontal output tube V701 and the #2 grid of each gun in the CRT is increased from +390 volts to approximately +800 volts by the action of the damper tube. The pulses of current that flow through the damper tube keep capacitor C711 charged to a voltage of approximately +410 volts. Since this voltage on C711 is in series with the B+ voltage of +390 volts, the two voltages can be added together to realize a total "B+ boost" voltage of +800 volts.

The boosted B+ voltage is then applied through T701 to the plate of horizontal output tube V701. This boosted B+ is applied through resistor R714, Height control R320, and resistor R319 to the plate of V302A.

A voltage pulse from T701 is applied to diodes D701 and D702 to provide a B+ boosted boost voltage. The B+ boosted boost voltage is applied to the #2 CRT grids through the Red, Green, and Blue Screen controls (R822, R823, and R824). These controls are used to vary the amount of B+ boosted boost applied to the #2 grids for proper gray scale tracking of the CRT.

NOTE: Proper gray scale tracking for black and white pictures is obtained when the Brightness and Contrast controls can be adjusted over their full range without any color (only variations of gray) appearing on the screen of the CRT.

Voltage pulses from T701 are also applied to focus rectifier tube V703 and coupled through R708 to the focusing grid (pin 9) of the CRT. Coil L704 provides a means of varying the focus voltage for the clearest picture on the CRT.

HIGH VOLTAGE POWER SUPPLY

During retrace time, the steep sides of the horizontal "flyback" waveform cause very high voltage pulses to be induced in transformer T701. Another winding on the transformer steps up these voltages to still higher levels by autotransformer action. These stepped-up pulses are applied to the plate of high voltage rectifier V704; they are used in this circuit to produce high voltage for the CRT.

This high voltage is regulated (held at a constant level) by voltage regulator tube V705. The grid of V705 is connected to the bottom of T701 through R711. High Voltage Adjust control R710 is connected through R712 to the grid of V705 and is adjusted so that the high voltage is held constant at approximately 24,000 volts over the range of picture brightness.

Regulator tube V705 operates as follows: During the time of an all-white picture, the beam currents in the CRT are very high. This keeps the high voltage near 24,000 volts and very little current is drawn by V705 for regulation purposes. During the time of an all-black picture, there are no beam currents in the CRT. As a result, the high voltage tends to increase; this causes V705 to conduct, holding the high voltage constant near 24,000 volts.

Filament voltage for V703 and V704 is obtained from small (one-turn) windings on transformer T701. High voltage from the filament of V704 is filtered by the capacitance between the inside and outside coatings of the CRT. C709 and C713 are spark-gap capacitors which provide arc protection for the CRT.

COLOR CIRCUITS

This section describes the color circuits of the TV Set. The purpose of these circuits is to extract the color signal from the luminance signal. The color signal is developed into three primary color signals which are applied to the CRT. The color stages are represented by the shaded blocks in Figure 6-1.

The signal path through the color stages will be mentioned first, then each stage in the color circuit will be described. This should give you a better understanding of how and where each color stage affects the color signal. The color signal is amplified by color amplifier stage V401A and coupled to bandpass amplifier V403A. Amplified color signal is then coupled to X and Z demodulator stages V406 and V405. After demodulation, the color signals are coupled to color amplifier stages V410A (R-Y), V410B (G-Y), and V409A (B-Y). The amplified color signals are then coupled to the red, green, and blue control grids in the CRT.

Color, Burst, and Color Killer Amplifiers

The video signal is coupled from the video detector through capacitor C418 to the grid of color amplifier tube V401A. Coil L401 and capacitor C418 form a wave-shaping network. Since the color signal is in the higher frequencies of the luminance signal (see Figure 6-2), the wave-shaping network passes the higher frequencies to be amplified and limits the lower frequencies of the luminance signal. The amplified color signal from V401A is coupled through capacitor C430 to the grid of bandpass amplifier, V403A.

At the beginning of the horizontal retrace, a pulse applied from horizontal output transformer T701 causes blanker tube V409B to conduct. This conduction develops a pulse at the cathode of V403A during retrace time, causing the bandpass amplifier tube to be cut off. This prevents the burst signal from being passed by V403A during retrace time and being seen on the CRT. At the same time, T701 also couples a positive pulse through R428 to the grid of burst amplifier stage V404, causing this tube to conduct only during the horizontal retrace time.

Color Killer and ACC Detector

The color "burst" signal is a small portion of the 3.58 mc color carrier signal used in the TV transmitter. This burst signal is transmitted with the horizontal sync pulse. The burst signal is used as a reference to determine the proper phase and frequency of the 3.58 mc signal developed in the TV Set.

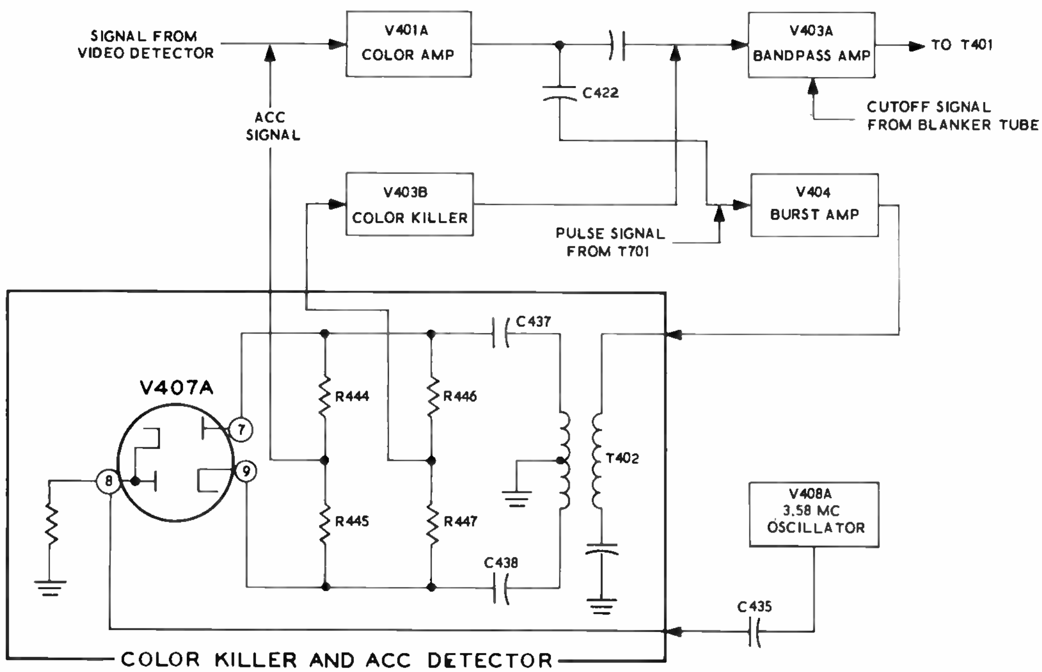


Figure 6-9

The color burst signal from the plate of V401A is coupled through capacitor C422 to the grid of V404. Here the burst signal is amplified and then is coupled through burst phase transformer T402. The burst signal is coupled through C437 and C438 and placed across the plate and cathode (pins 7 and 9) of the color killer and ACC (automatic color control) detector, V407A. See Figure 6-9. At pin 8 of this tube (plate and cathode tied together), a 3.58 mc signal is applied from 3.58 mc oscillator tube V408A. When the burst signal is present, a negative voltage is developed at the junction of R446 and R447. This negative voltage is applied to the grid of color killer amplifier tube V403B.

Color Killer control R430 is adjusted to provide a reference bias voltage on the grid of V403B. This causes this tube to be cut off during the time the burst signal is being transmitted. The positive pulse from the plate of V403B is DC coupled to the grid of bandpass amplifier V403A, causing V403A to conduct and pass the color signal. When no color signal is being received, there is no burst signal and color killer amplifier V403B holds V403A in cutoff. This prevents the bandpass amplifier from operating when no color signal is being received.

During the time the burst signal is received, a negative voltage is also developed at the junction of R444 and R445. This negative voltage is coupled through R421 and R419 to the grid of V401A. This is the ACC (automatic color control) voltage which controls the gain of tube V401A. If the burst signal is weak, a small negative voltage is applied to the grid of V401A, allowing greater amplification of the color signal; when the burst signal is strong, a large negative voltage is fed to the grid of V401A, causing less amplification of the color signal in this tube. This ACC action holds the color signal going through color amplifier V401A at a constant level.

3.58 MC Oscillator, Phase Detector, and Reactance Control Tube (Color Sync)

Tube V408A is a modified tuned-grid, tuned-plate crystal-controlled oscillator stage designed to operate at 3.58 mc (3579.545 kc). See Figure 6-10. A 3.58 mc crystal is used in the tuned-grid circuit and determines the frequency of the oscillator signal. The voltage set up by the crystal as it vibrates, is applied to the grid (pin 2). This controls the signal frequency in the tuned-plate circuit. Feedback voltage is directly coupled from the screen grid (pin 3) to the crystal.

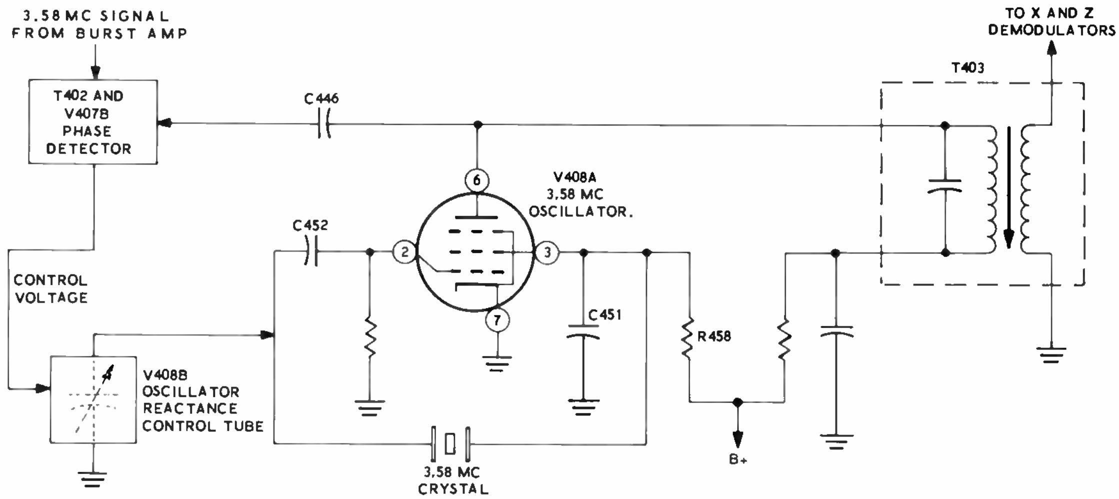


Figure 6-10

A 3.58 mc signal from this tube is coupled through C446 to pin 2 (plate and cathode tied together) of phase detector tube V407B. A 3.58 mc burst signal from the transmitter is coupled from T402, through C442 and C443 to the plate and cathode (pins 1 and 3) of phase detector tube V407B. These two 3.58 mc signals are compared (phase and frequency) in this tube. The 3.58 mc signal from V408A must be locked in phase and frequency with the 3.58 mc burst signal from the transmitter. If the two signals are not in phase, a DC voltage is developed at the junction of R449 and R451. This control voltage is DC coupled through R454 to the grid of reactance control tube V408B.

The control voltage from the phase detector will vary in proportion, plus or minus, depending on the direction of the error in frequency or phase, with respect to the 3.58 mc burst signal. This varying control voltage on the grid of V408B causes the plate current to change, which in turn causes the tube circuit reactance to change. Oscillator tube V408A sees the reactance tube as a variable capacitor connected in parallel with its grid circuit. As the control voltage varies, the changing reactance of V408B tunes the grid circuit of V408A, which in turn causes the oscillator frequency to increase or decrease until it is locked in phase and frequency with the 3.58 mc burst signal.

Bandpass Amplifier and Demodulators

The signal from color amplifier V401A is amplified by bandpass amplifier V403A and is then coupled through bandpass transformer T401 to Color control R440. Tube V403A amplifies and transformer T401 passes only the range of frequencies containing the color signal. Therefore, the color portion of the signal appears across the Color control. Any remaining 4.5 mc signal has been attenuated, the lower frequency luminance signal has been blocked, and the color burst and sync signals have filtered out.

Color signal from the Color control is fed through coil L406 to control grid #1 (pin 1) of V406 and V405, the X and Z demodulators. The 3.58 mc signal from T403 is fed to control grid #2 (pin 7) of V405 and V406. V405 receives its signal from T403 through a phase shifting network consisting of L408, R463, and C454. This network shifts the phase of the 3.58 mc signal approximately 60 degrees.

The X demodulator operates as follows: The 3.58 mc signal applied to control grid #2 is of constant amplitude and frequency. The color signal applied to control grid #1 is constantly varying in phase and amplitude; these variations in the color signal represent changes in the colors in the transmitted TV picture. As the color signal varies, it controls the conduction of V406 during the time this tube is turned on by positive half cycles of the 3.58 mc oscillator signal on control grid #2.

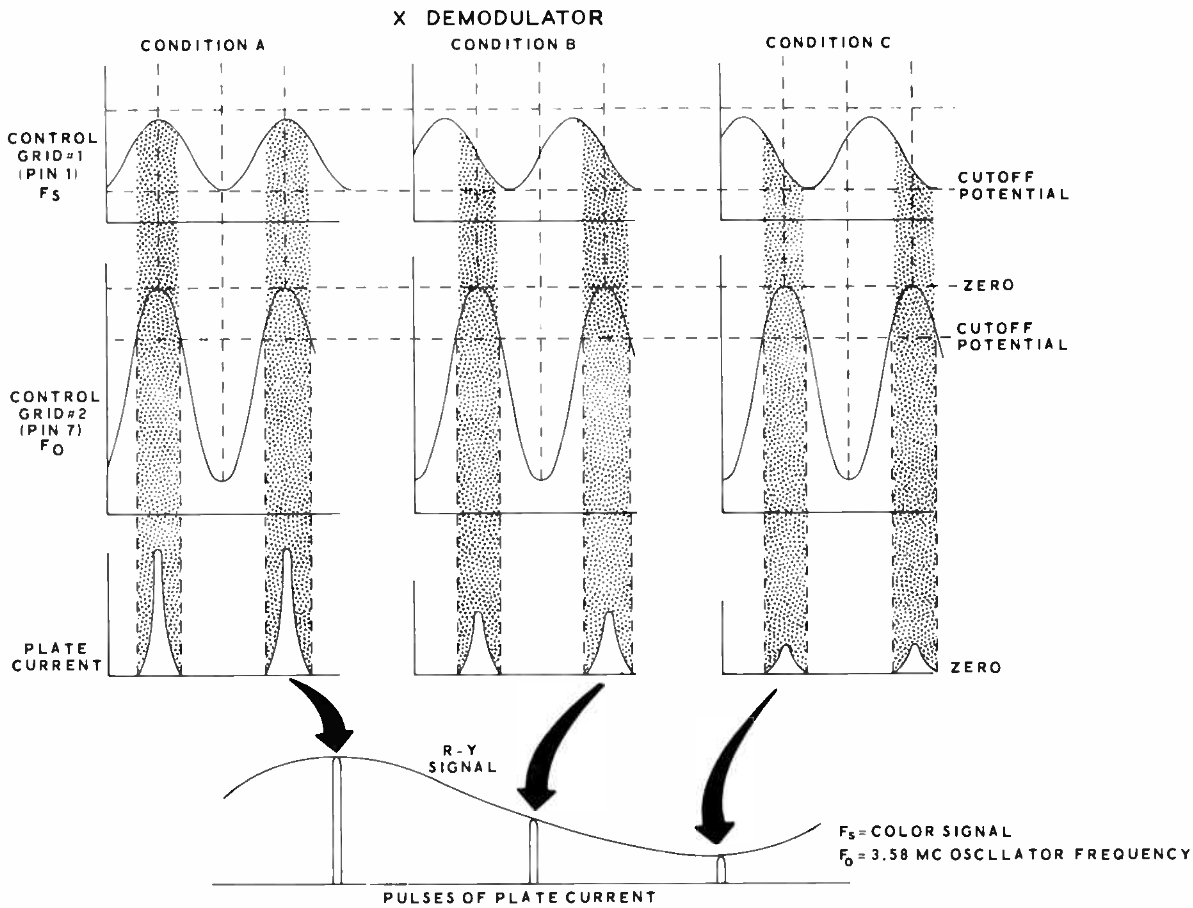


Figure 6-11

See Figure 6-11. In condition A, the color signal is in phase with the oscillator signal and the tube conducts heavily. As the phase of the color signal goes negative, at the same time the oscillator signal is positive, the tube conducts less, as in condition B. In condition C, the color signal is going highly negative. This increases the negative voltage on control grid #1 and causes the average current through the tube to decrease. Therefore, the current through the tube is proportional to the amplitude of the in-phase portion of the color signal. Amplitude modulation of the color signal does not affect the output signal of the tube.

Operation of the Z demodulator is the same as that of the X demodulator, except that the oscillator signal applied to control grid #2 has been shifted 60 degrees. Since the reference wave is shifted by 60 degrees before it is applied to the Z demodulator, the X demodulator and Z demodulator tubes conduct at 0 degrees and 60 degrees, respectively.

The color signals from the demodulators are coupled through a filter network formed by a capacitor and a coil, C457 and L407 for the X demodulator, and C456 and L410 for the Z demodulator. This filter network filters out the 3.58 mc oscillator signal that was used for demodulation and passes the color signal. The red, green, and blue color signals are designated as R-Y, G-Y, and B-Y, respectively. They are expressed in this manner to indicate their relationship to the Y (luminance) signal.

Color Amplifiers

From the X demodulator filter network, the R-Y color signal is coupled through C458 to R-Y amplifier tube V410A. Amplified R-Y signal is then DC coupled through resistors R471 and R472 to the control grid (pin 3) of the red gun in the CRT. The B-Y color signal from the Z demodulation filter network is coupled through C463 to B-Y amplifier tube V409A. After amplification, the B-Y signal is DC coupled through resistors R487 and R488 to the control grid (pin 12) of the blue gun in the CRT.

As the R-Y and B-Y tubes conduct, due to the color signals they receive from the demodulators, a bias voltage is developed across resistor R485. This resistor is common to the cathodes of V409A, V410A and V410B. The bias voltage developed across R485 due to color signals in V409A and V410A, affects the conduction of V410B. As V410B conducts, it develops the G-Y signal which is amplified and then is DC coupled through resistors R478 and R479 to the control grid (pin 7) of the green gun in the CRT. Thus, a G-Y signal is produced by combining the proper proportion of R-Y and B-Y signals. R475, L409, and C461 form a matching network in the grid circuit of V410B so that it has the same gain and frequency response characteristics as V409A and V410A. Figure 5-21 on Page 149 gives additional information on how the G-Y signal is obtained.

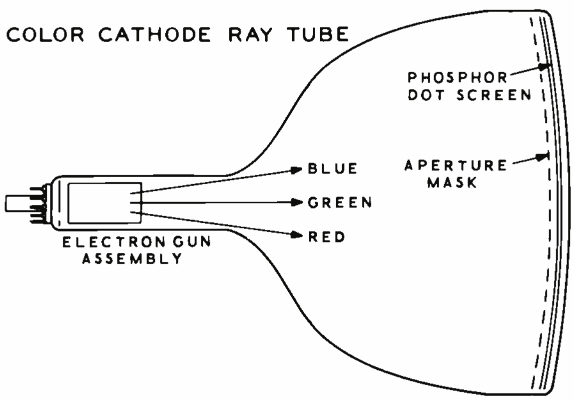


Figure 6-12

CATHODE RAY TUBE, DEFLECTION YOKE, AND CONVERGENCE YOKE

The three main parts of the color CRT are the phosphor-dot screen, the aperture mask, and the three-electron gun assembly. See Figure 6-12. The phosphor screen has three different types of phosphors placed in triangular dot patterns (triads) on it. The dots are placed very close together but do not touch each other. See Figure 6-13. Each dot in each triad glows a different color (red, green, and blue) when an electron beam strikes it.

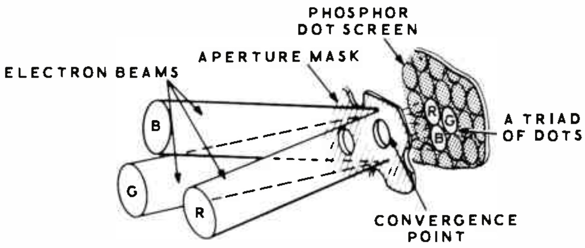


Figure 6-13

The characterisitics of the human eye are such that the light emissions from a triad of phosphor dots cannot be distinguished separately at normal viewing distances. The eye blends the three light emissions to give the appearance of a single color. For example, when the light outputs of a triad of dots are equal, each dot glows with its respective color, but the eye blends them together so that the screen will appear to be white. By controlling the energization of the dots, it is possible to produce a variety of colors.

There is an electron beam for each of the three color dots. These beams must be made to strike their respective set of dots at all times. An aperture mask is placed between the electron guns and the dots for this purpose.

The aperture mask is a thin sheet of metal that has been etched with a series of small holes. These holes are positioned so that each one is aligned with a triad of phosphor dots. The three electron beams from the guns must converge at a hole in the aperture mask to properly strike a triad of phosphor dots. The three beams are controlled so that each beam strikes only its respective color dot as the beams are scanned across the screen.

By varying the intensity of the three beams together, the brightness of the triad of dots can be controlled. In addition, the intensity of each individual beam can be controlled, making it possible to change the mixture of colors and thus produce all desired colors.

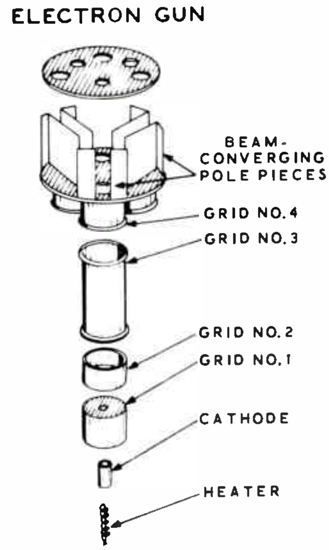


Figure 6-14

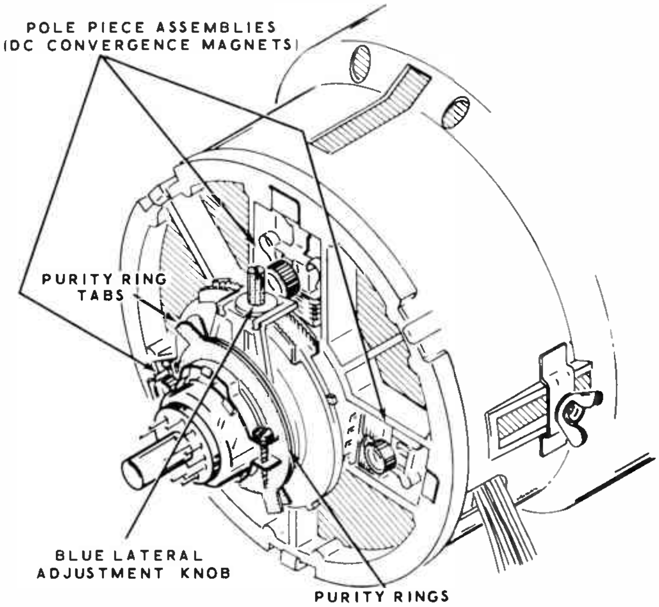


Figure 6-15

The CRT employs three electron guns; red, green, and blue. The guns are spaced equidistant, 120 degrees apart from each other, around the center axis of the gun assembly. Each gun is identical and complete within itself. That is, each gun contains a filament, #1 grid (control), #2 grid (accelerating anode), and a #3 grid (focus electrode). The #4 grid is a high voltage anode that is connected to the aperture mask and the inside coating of the CRT. See Figure 6-14. Each gun has a pair of pole pieces mounted at the end of the #4 grid. These pole pieces are used in conjunction with the convergence electromagnets to provide a means of positioning each beam for correct convergence. In addition, a pair of extra pole pieces are mounted on the focus electrode of the blue gun only. These pole pieces are used in conjunction with a lateral correction magnet to properly converge the blue beam.

The physical relationship between the electron beams, aperture mask, and phosphor screen is very precise. Very close tolerances are used during manufacture of the CRT, but some variations still exist. Static magnetic beam controls are mounted outside the neck of the CRT and are used to compensate for these variations. See Figure 6-15.

A lateral correction magnet is used to provide a magnetic field that will move the blue beam in a horizontal direction.

A beam positioning magnet (pole piece assembly) is mounted directly over each gun. Each magnet provides a magnetic field that will move the beam of its gun toward or away from the center axis of the CRT. Their fields act on the pole pieces mounted at the end of each gun.

In addition, a purity magnet is placed completely around the neck of the CRT. This magnet is actually two magnetic rings. Each ring has a north and a south pole and can be rotated 360 degrees. With unlike poles adjacent to each other, no appreciable magnetic field exists. As one ring is rotated, the field becomes strongest when the like poles are adjacent to each other. This field is uniform and exerts an equal force on all three beams. Depending on the position of both rings, the force the field exerts can position the three beams vertically, horizontally, or anywhere between the vertical or horizontal axis.

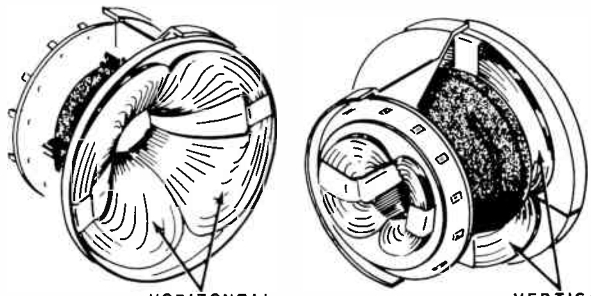


Figure 6-16

Deflection Yoke

The deflection yoke is made up of two different pairs of coils. The coils are positioned perpendicular to each other and are shaped in such a manner as to fit over the neck of the CRT. See Figure 6-16. The ends of the coils are sharply flared away from the center. This is done to prevent the magnetic fields around these sections from interacting with the beam positioning magnets and convergence coils. When current is applied through the deflection yoke coils, a magnetic field is formed between them. This field varies in strength and direction in proportion to the signal current applied to the coils. This exerts an equal force on all three beams and deflects them vertically, and horizontally across the screen.

The physical position of the yoke on the neck of the CRT is very critical. If the yoke is improperly positioned, the beams may strike the wrong color dots, giving the wrong color purity to the picture.

CONVERGENCE CIRCUITS

As the beams scan toward the outer edges of the screen, the distance between the guns and the screen becomes longer than when the beams were scanning the center area of the screen. This varying distance between the guns and the screen must be compensated for while the beams are scanning.

To accurately control where the three beams converge, as they are scanning the screen, a horseshoe shaped magnet is placed directly over each gun. A horizontal and vertical coil is placed over each magnet. The horseshoe magnets and the horizontal and vertical coils are located in the pole piece assemblies as shown in Figure 6-15. An AC signal, that is in step with the horizontal and vertical sweep signals, is applied to each coil to produce a resultant magnetic field. This field corrects the direction of the beams before the field of the deflection yoke acts on them. These convergence coils are called the dynamic beam controls.

The AC signal for the convergence coils is taken from the vertical and horizontal sweep circuits. It is the job of the convergence circuits to modify the sweep waveforms in amplitude, shape, and phase, and then to couple the resultant waveforms into the convergence coils.

VERTICAL CONVERGENCE

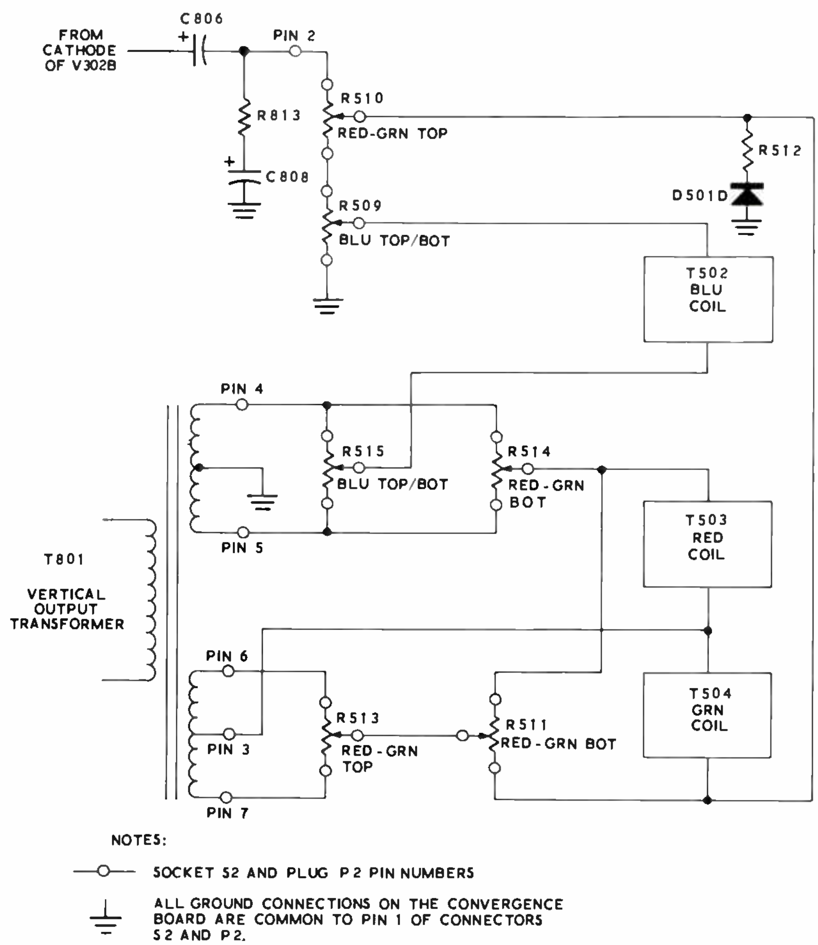


Figure 6-17

For explanation purposes, the horizontal and vertical convergence circuits have been separated in Figures 6-17 and 6-18. The vertical circuit will be explained first. Controls R509 and R510 vary the overall amplitude of the input signal and the remaining controls vary the waveshape of the input signal.

Vertical

A sweep waveform from the cathode of vertical output tube V302B is coupled through capacitor C806 and through pin 2 of the connectors to controls R510 and R509. The wave-shaping network made of R813, C807, and C808 tends to change the sawtooth shape at the cathode of V302B, to a more parabolic shape. Part of this waveform is tapped from R510 and through controls R511 and R513 for the red and green convergence coils; and from R509 for the blue convergence coil. Resistor R512 and diode D501D provide more shaping of the waveform.

Two waveforms of opposite polarity are coupled from a secondary winding of T801, through pins 4 and 5 of the connectors, to controls R515 and R514. Here, the resultant waveforms from the arms of the controls can be varied in amplitude and polarity, depending on the setting of the controls. The waveform at the controls corresponds to a sawtooth with the steepness and direction of the sawtooth shape variable with the setting of the controls. The waveform from R515 is coupled to the blue coils where it is mixed with the parabolic waveform from R509. The waveform from R514 is coupled to the red and green coils where it is mixed with the parabolic waveform from R510.

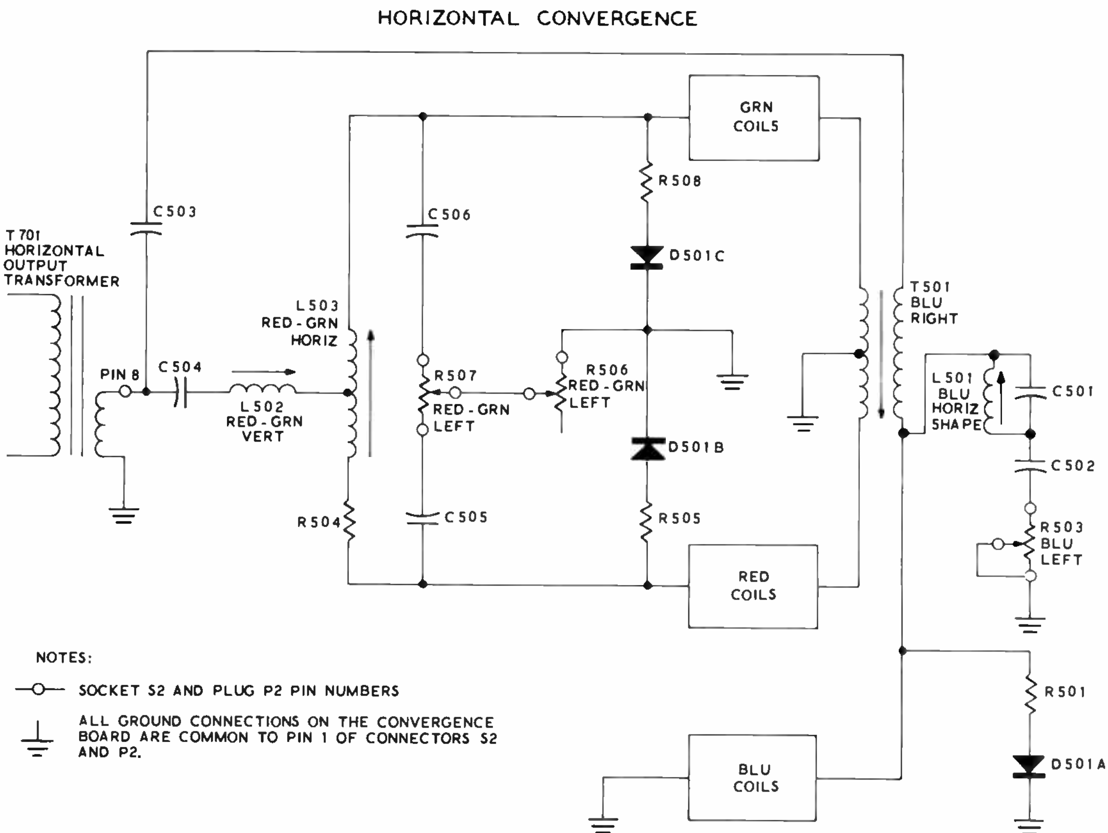


Figure 6-18

Horizontal

In the horizontal convergence circuitry (Figure 6-18), each control is labeled to indicate the convergence coil affected when adjusting that control. A pulse waveform is coupled from a secondary winding on T701 through pin 8 of the connectors to the convergence circuitry. As this waveform is coupled through C503, and T501 to the blue coils, C503 and T501 cause the shape of the waveform to beome parabolic. Adjusting T501 varies the amplitude of the waveform. C501, C502 and Blue Left control R503 broadens or narrows the waveform. Diode D501A clamps the peak AC portion of the waveform.

The secondary of T501 couples two waveforms of equal and opposite polarity to the red and green convergence coils. The main red-green input waveform is coupled through C504 and L502 to the center of L503. The wave-shaping network of C504 and L503 tends to make the waveform parabolic in shape. Adjusting L503 varies the amount of waveform applied to either the red or green convergence coils. The wave-shaping network made up of C505, C506, and control R507, varies the amplitude and the polarity of the waveform applied to the coils. Control R506 varies the amplitude of the waveform, while diodes D501B and D501C clamp the peak AC portion of the waveforms. The resultant waveforms are coupled to the red and green convergence coils where they are mixed with the waveforms from T501.

LOW VOLTAGE POWER SUPPLY

Power is supplied from the AC power line through the Power Switch and through transformer T601. The high voltage secondary of T601 uses diodes D601 and D602 with capacitors C605 and C606A as a full-wave voltage doubler.

An automatic degaussing circuit, consisting of thermistor R606, voltage dependent resistor R605, and degaussing coil L602, is connected in series with the high voltage secondary winding of T601. When cold, R606 offers a high resistance to the secondary current, while R605 has a low resistance due to the high voltage that is across it. Thus, most of the current from T601 goes through R605 and coil L602 to degauss the CRT.

As R606 heats, its resistance drops allowing more current to pass through it. The decrease of current through R605 causes its resistance to increase. This action continues until all the current is going through R606, and automatic degaussing stops. This circuit action occurs each time the TV Set is turned on from a cold (not warmed up) start.

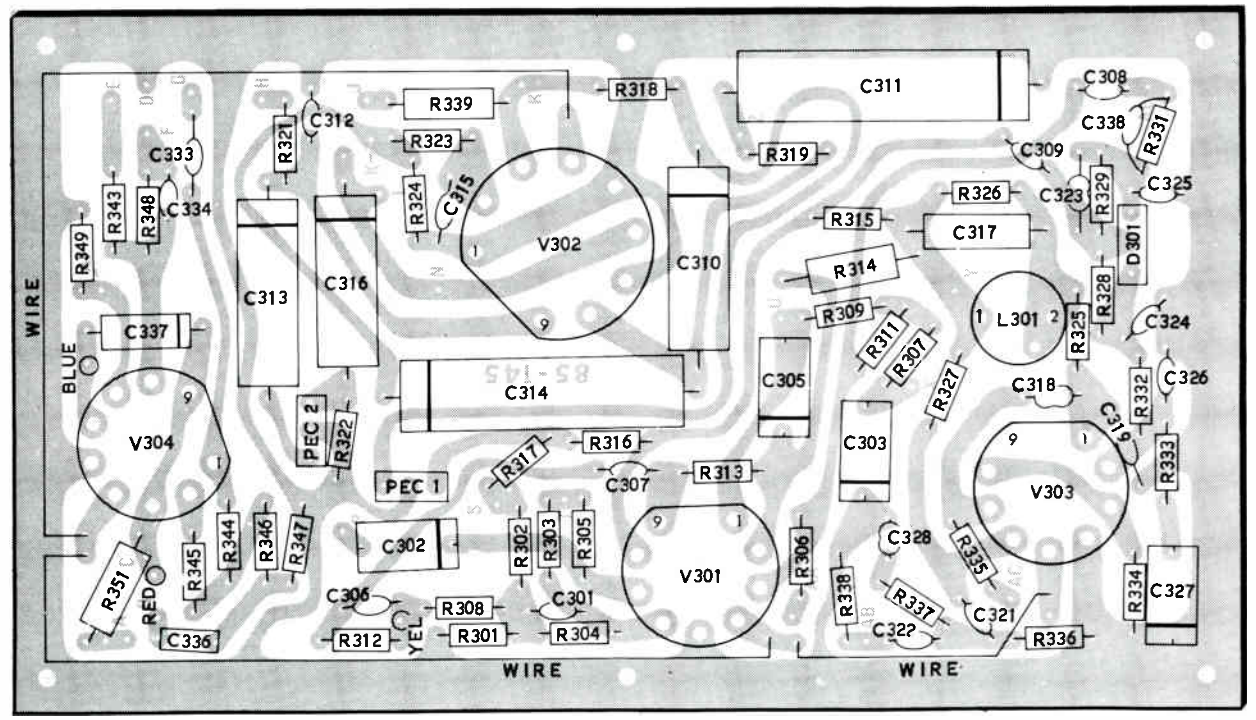
A circuit breaker is also connected in series with the high voltage secondary of T601 to protect the transformer in case of a short circuit. The rectified output from this winding is fed through filter choke L601 to a three-section filter network made up of capacitors C608A, C608B, and C608C, and resistors R603 and R604. This filter network provides decoupling and smooths out power supply ripple.

A voltage divider network consisting of R601 and R602 provides a DC bias voltage to the tube filament winding for V705 and V801. This provides a safe operating voltage difference between the cathode and filament in these two tubes.

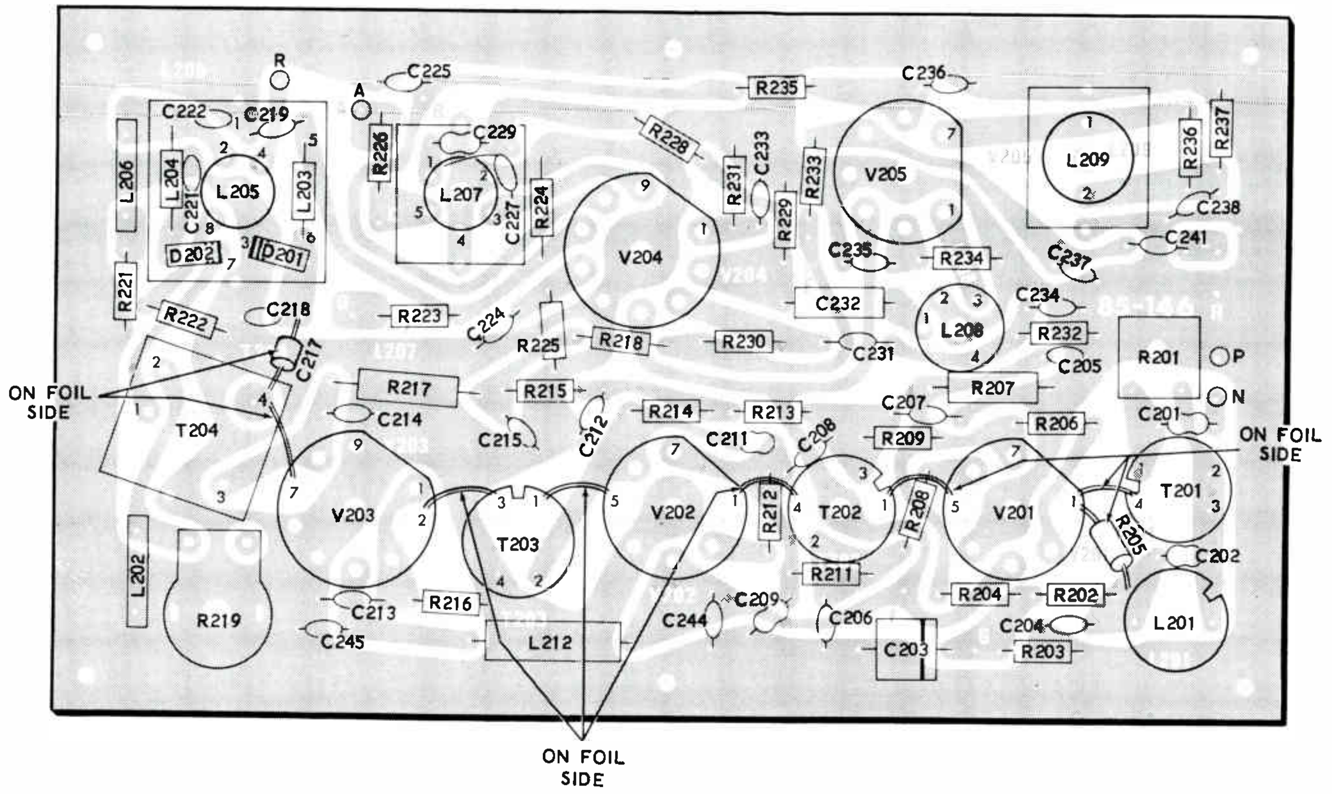
Another filament winding supplies filament voltage to all the remaining tubes. A short length of #22 wire, which is connected between this winding and the filament string, acts as a fuse to protect the transformer in case of a short in the filament wiring. The pi-filter made up of C244, C245, and L212 prevents high frequencies from being coupled from the filament of V203 to the rest of the filaments.

Filament voltage is connected to the VHF tuner through feedthrough capacitor C127. This capacitor keeps any high frequencies which may appear on the filament string from entering the tuner.

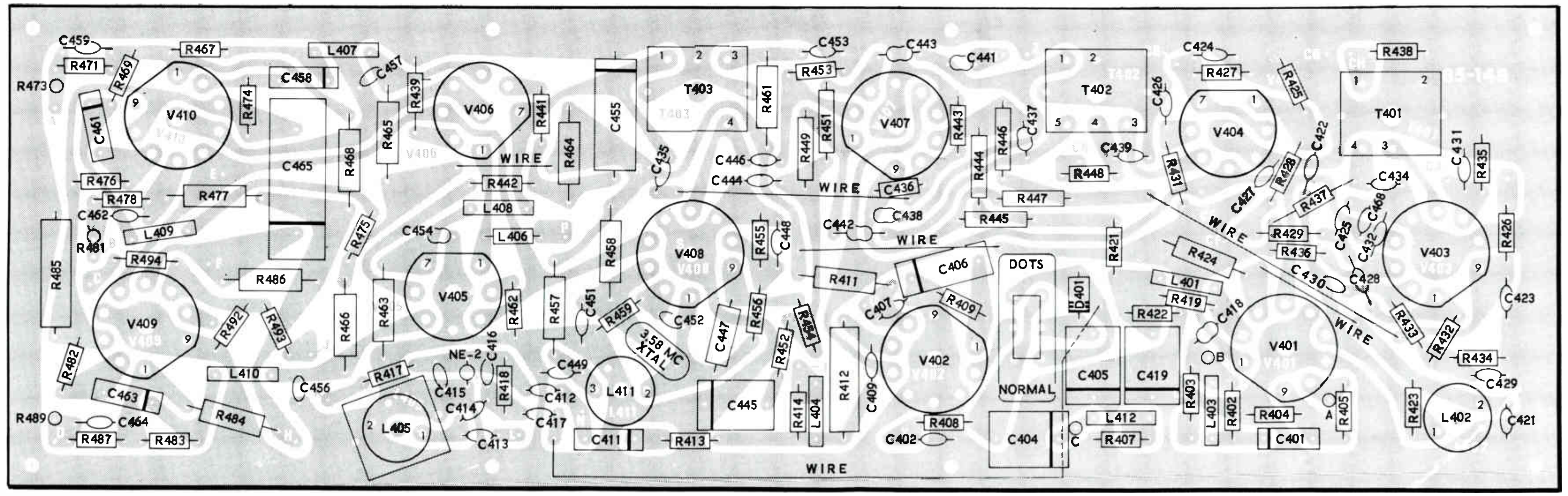
CIRCUIT BOARD X-RAY VIEWS



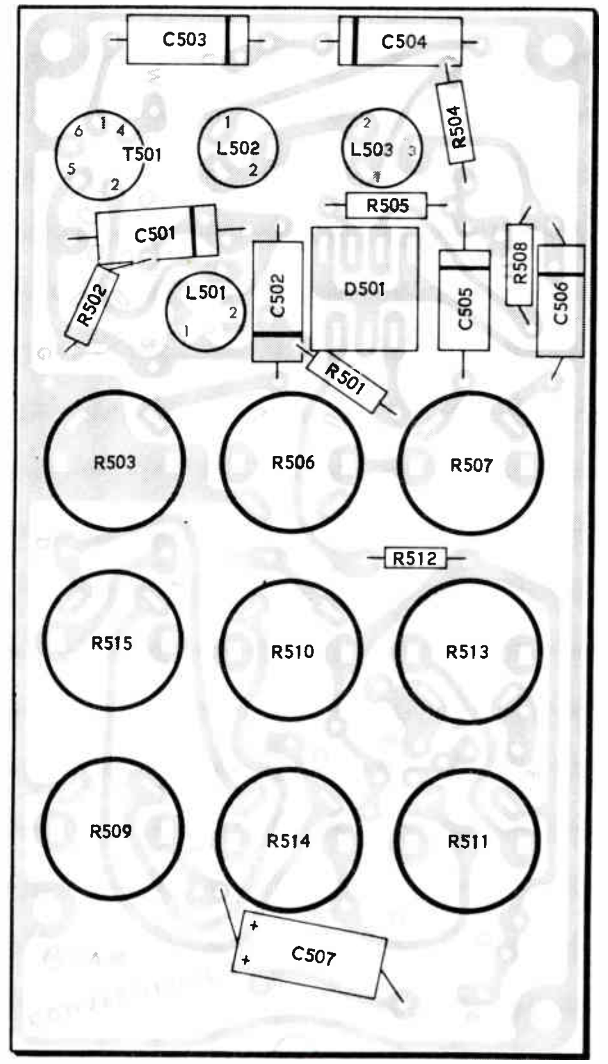
SOUND-SYNC CIRCUIT BOARD
(VIEWED FROM FOIL SIDE)



IF CIRCUIT BOARD
(VIEWED FROM FOIL SIDE)

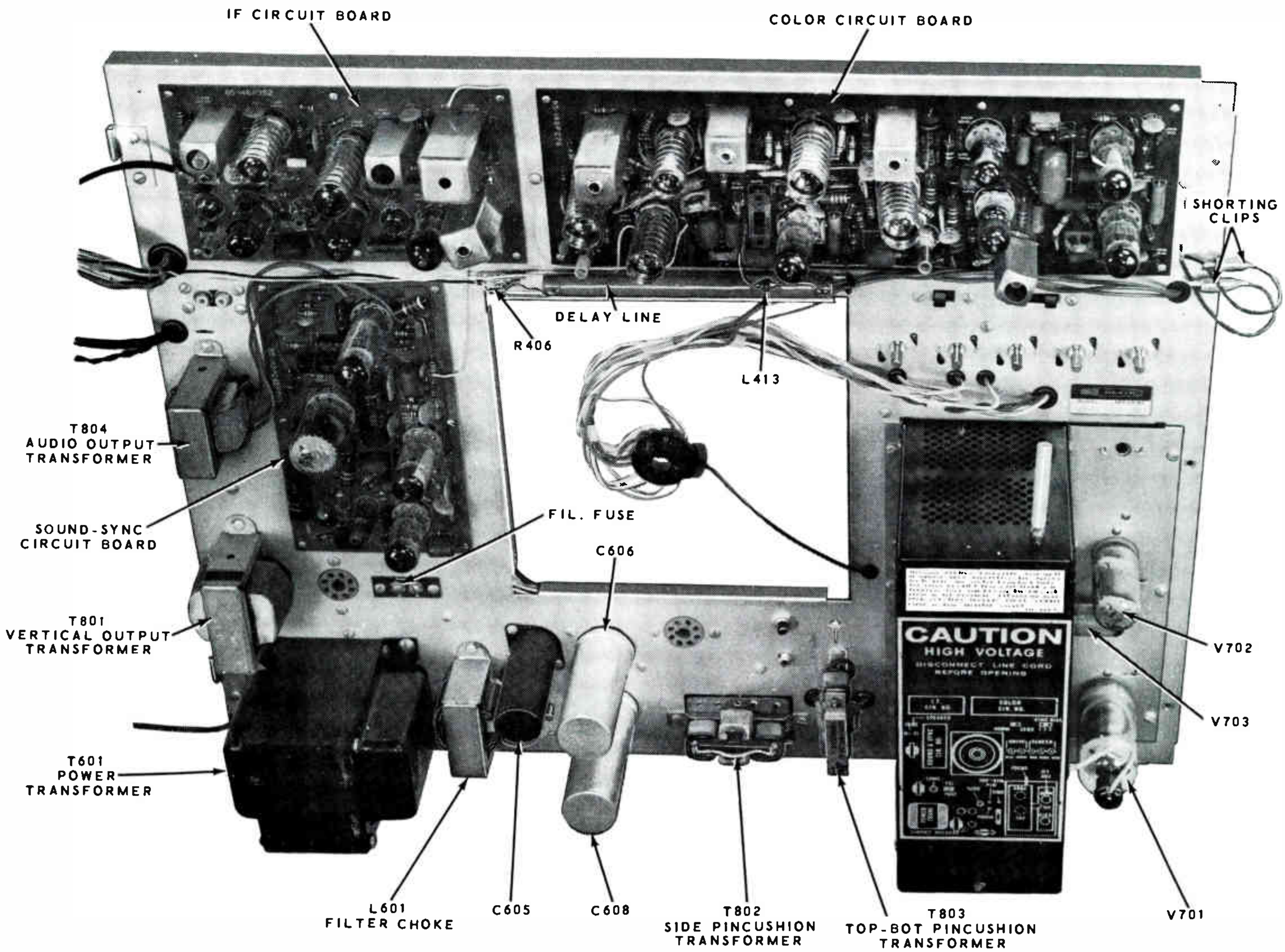


COLOR CIRCUIT BOARD
(VIEWED FROM FOIL SIDE)

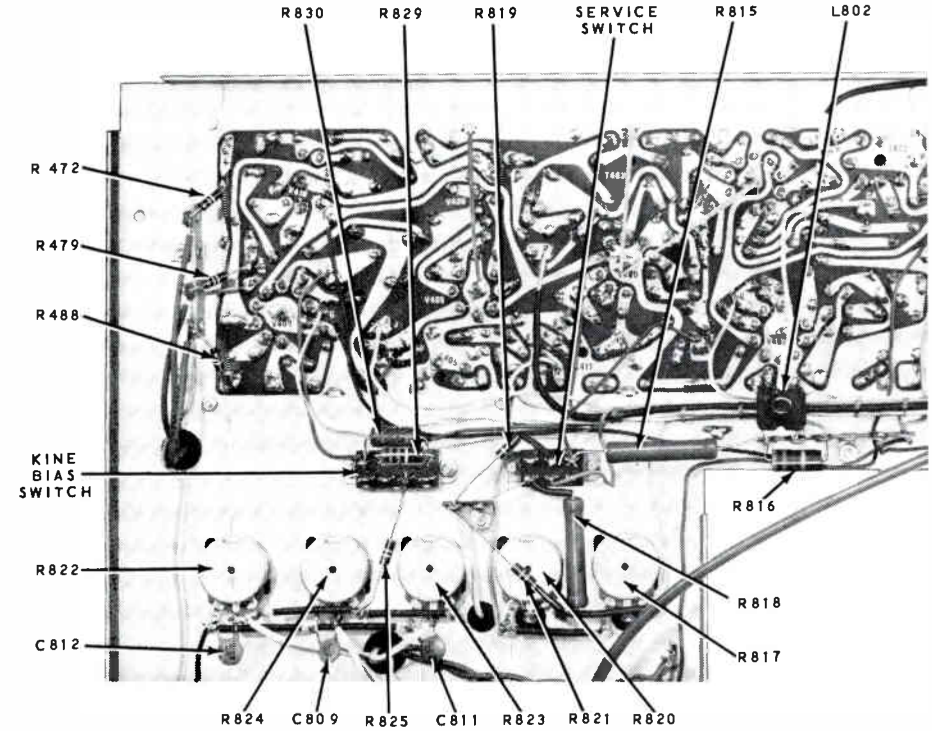


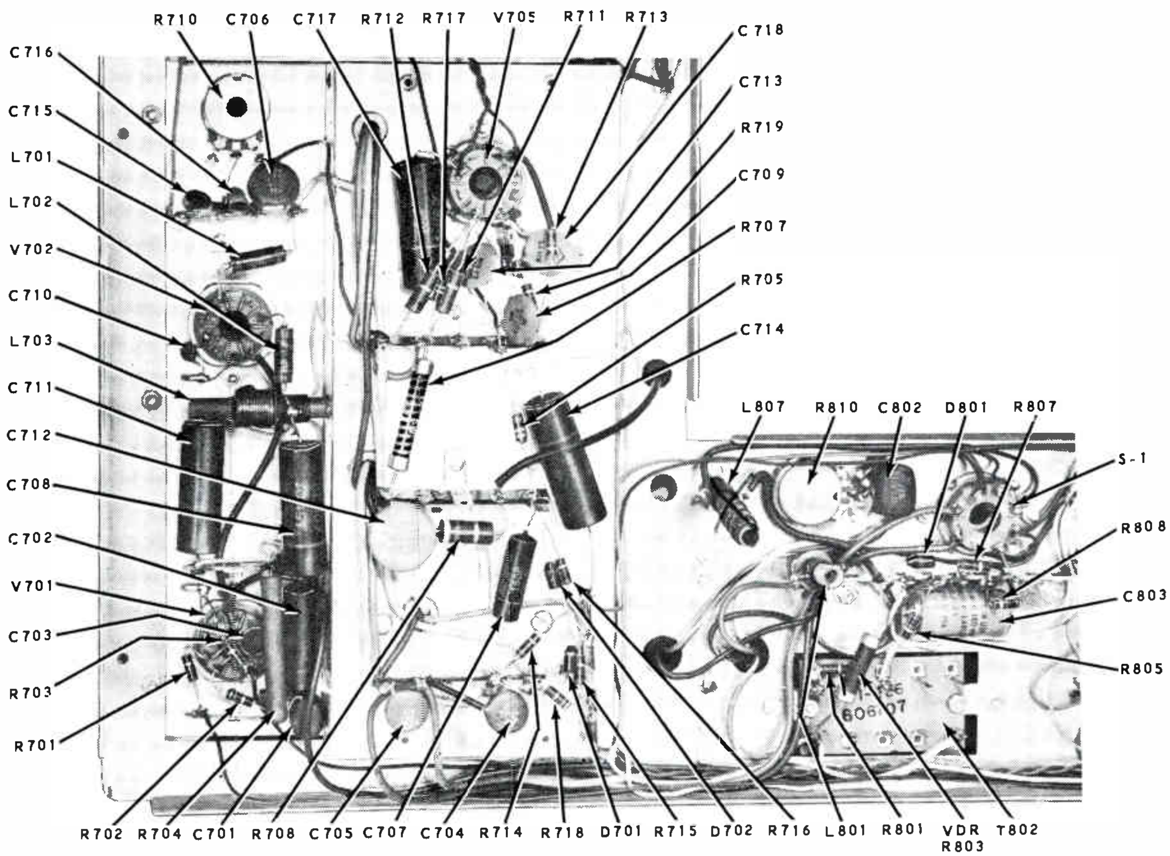
CONVERGENCE CIRCUIT BOARD
(VIEWED FROM FOIL SIDE)

CHASSIS PHOTOGRAPHS

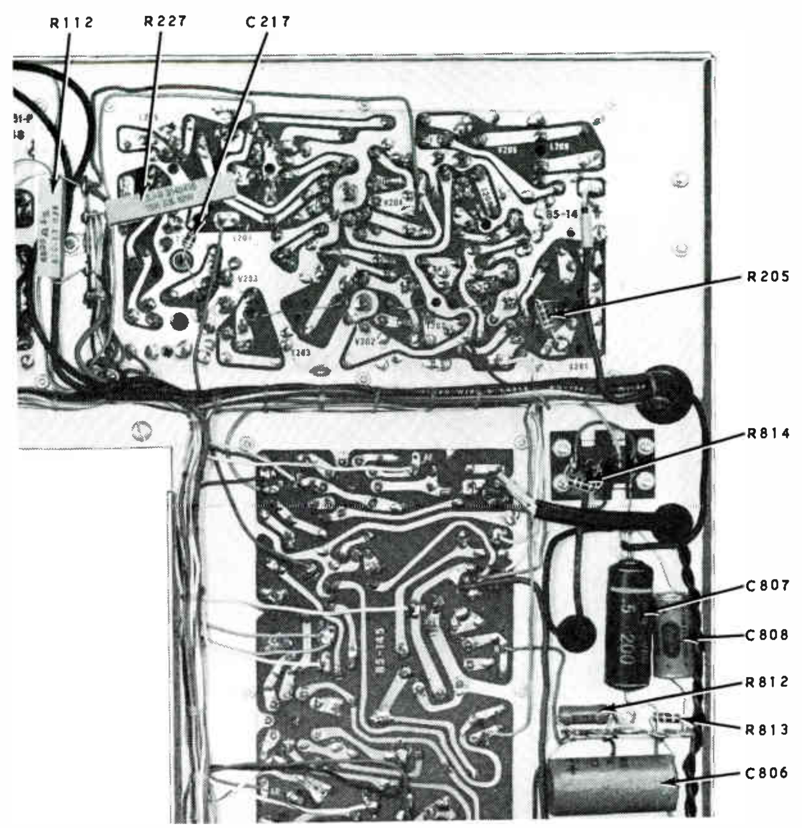


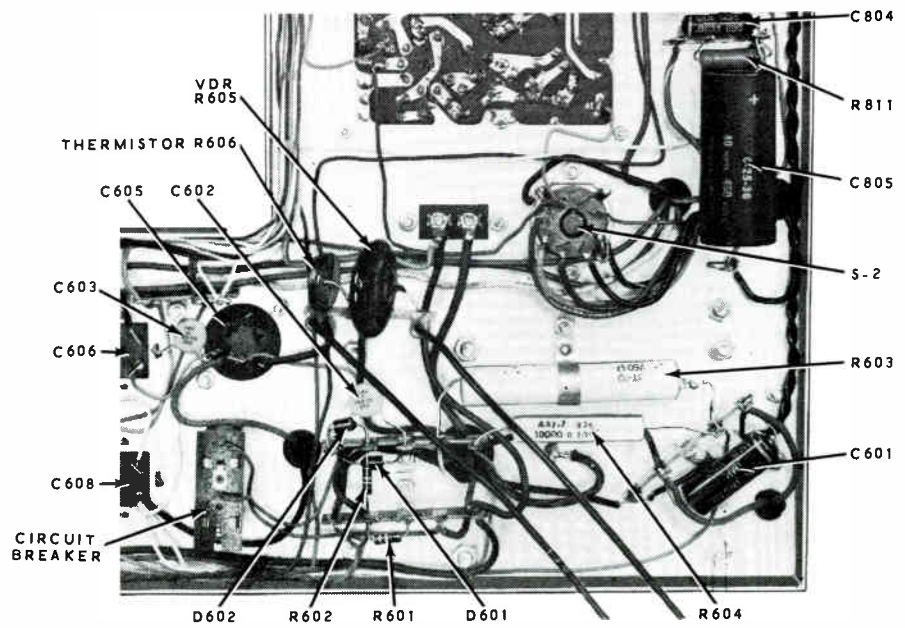
TOP VIEW OF CHASSIS



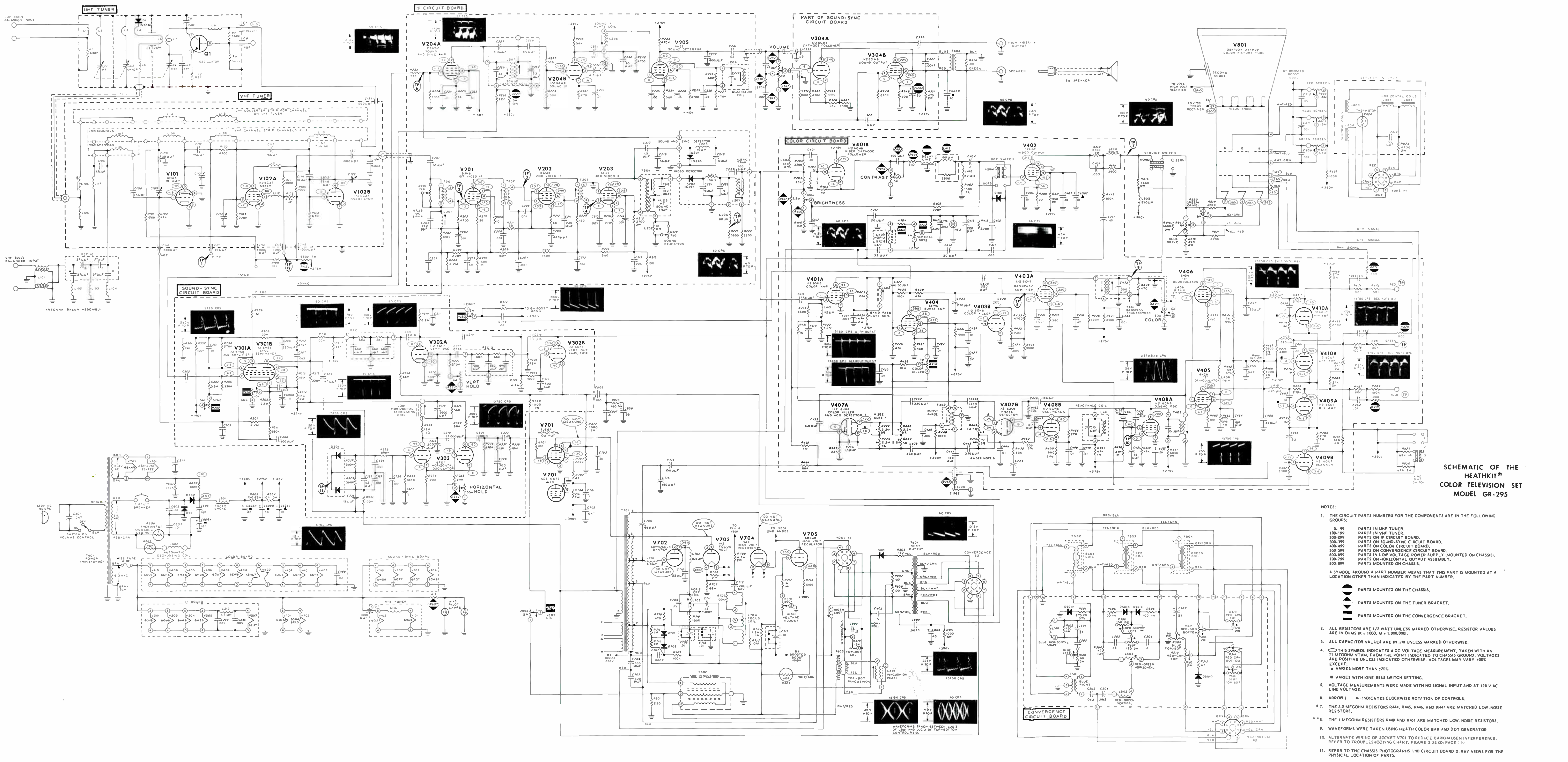


BOTTOM VIEW OF





CHASSIS IN FOUR SECTIONS



SCHEMATIC OF THE HEATHKIT®
COLOR TELEVISION SET
MODEL GR-295

NOTES:

1. THE CIRCUIT PARTS NUMBERS FOR THE COMPONENTS ARE IN THE FOLLOWING GROUPS:

0- 99	PARTS IN UHF TUNER.
100-199	PARTS IN VHF TUNER.
200-299	PARTS ON IF CIRCUIT BOARD.
300-399	PARTS ON SOUND-SYNC CIRCUIT BOARD.
400-499	PARTS ON COLOR CIRCUIT BOARD.
500-599	PARTS ON CONVERGENCE CIRCUIT BOARD.
600-699	PARTS IN LOW VOLTAGE POWER SUPPLY (MOUNTED ON CHASSIS).
700-799	PARTS ON HORIZONTAL OUTPUT ASSEMBLY.
800-899	PARTS MOUNTED ON CHASSIS.

A SYMBOL AROUND A PART NUMBER MEANS THAT THIS PART IS MOUNTED AT A LOCATION OTHER THAN INDICATED BY THE PART NUMBER.

PARTS MOUNTED ON THE CHASSIS.

PARTS MOUNTED ON THE TUNER BRACKET.

PARTS MOUNTED ON THE CONVERGENCE BRACKET.

2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K = 1000, M = 1,000,000).

3. ALL CAPACITOR VALUES ARE IN μfd UNLESS MARKED OTHERWISE.

4. THIS SYMBOL INDICATES A DC VOLTAGE MEASUREMENT, TAKEN WITH AN 11 MEGOHM VTVM, FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES ARE POSITIVE UNLESS INDICATED OTHERWISE. VOLTAGES MAY VARY ±20% EXCEPT:
   ▲ VARIES MORE THAN ±20%.
   ■ VARIES WITH KINE BIAS SWITCH SETTING.

5. VOLTAGE MEASUREMENTS WERE MADE WITH NO SIGNAL INPUT AND AT 120 V AC LINE VOLTAGE.

6. ARROW (——►) INDICATES CLOCKWISE ROTATION OF CONTROLS.

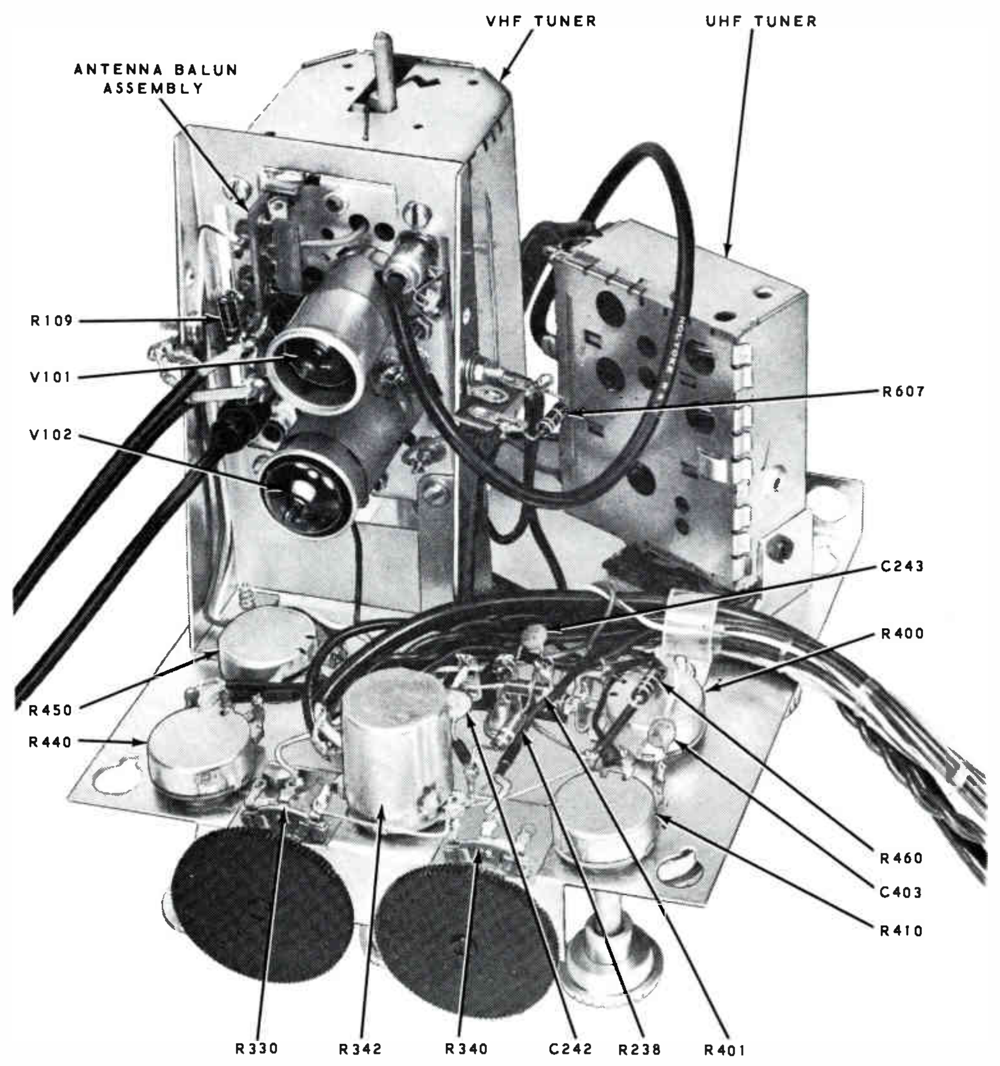
*7. THE 2.2 MEGOHM RESISTORS R444, R445, R446, AND R447 ARE MATCHED LOW-NOISE RESISTORS.

**8. THE 1 MEGOHM RESISTORS R449 AND R451 ARE MATCHED LOW-NOISE RESISTORS.

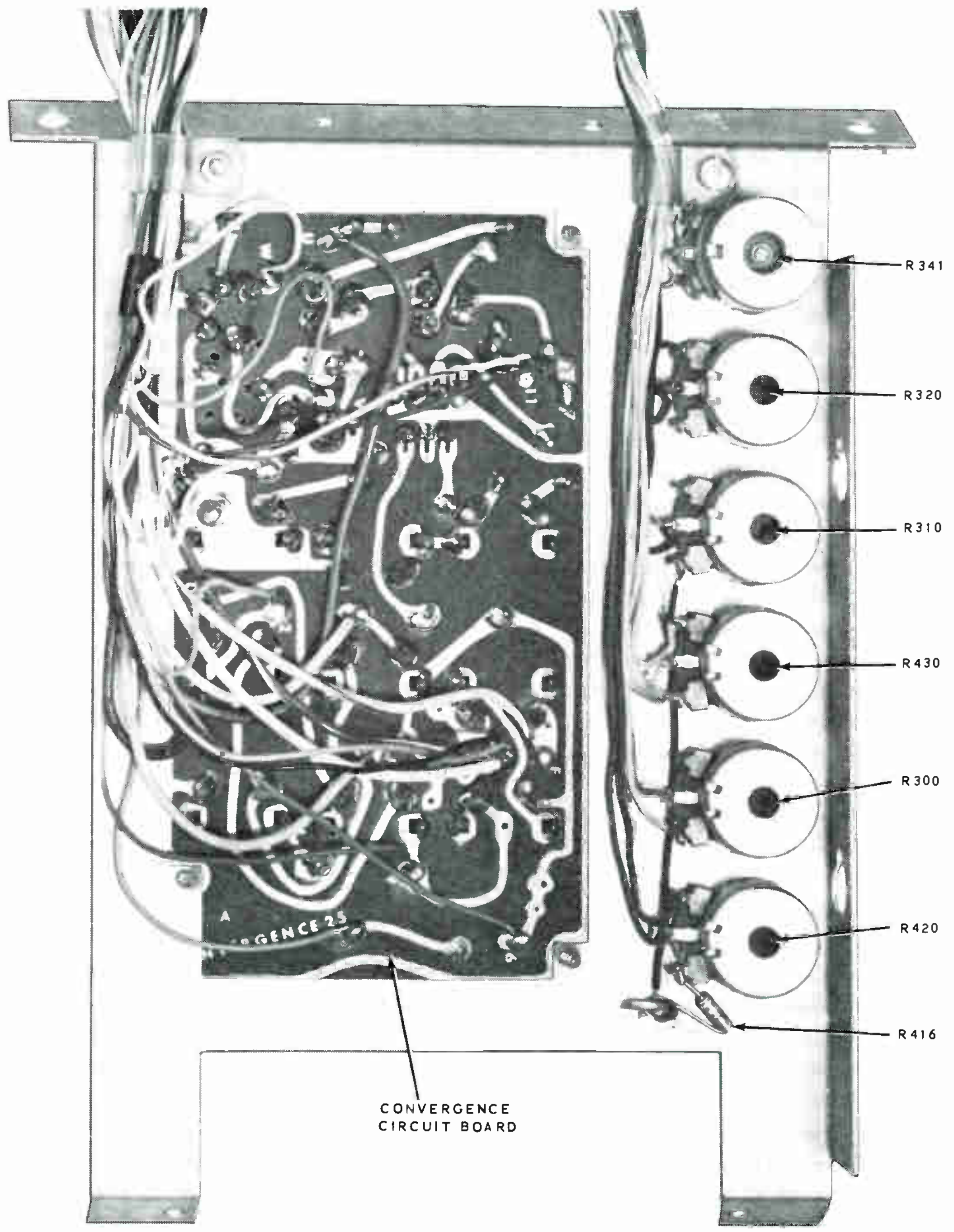
9. WAVEFORMS WERE TAKEN USING HEATH COLOR BAR AND DOT GENERATOR.

10. ALTERNATE WIRING OF SOCKET V701 TO REDUCE BARKHAUSEN INTERFERENCE. REFER TO TROUBLESHOOTING CHART, FIGURE 3-28 ON PAGE 110.

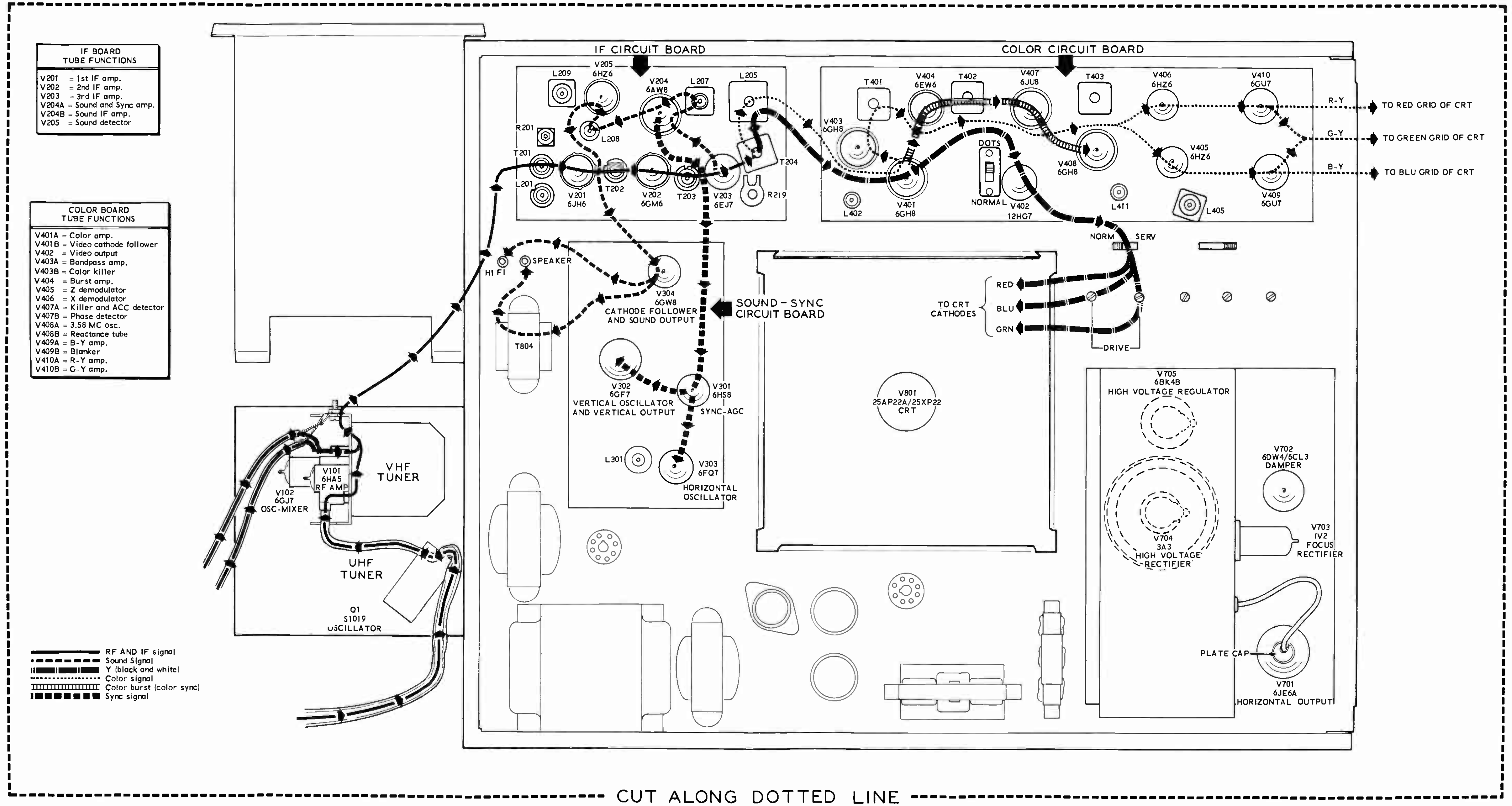
11. REFER TO THE CHASSIS PHOTOGRAPHS AND CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.



TUNER BRACKET

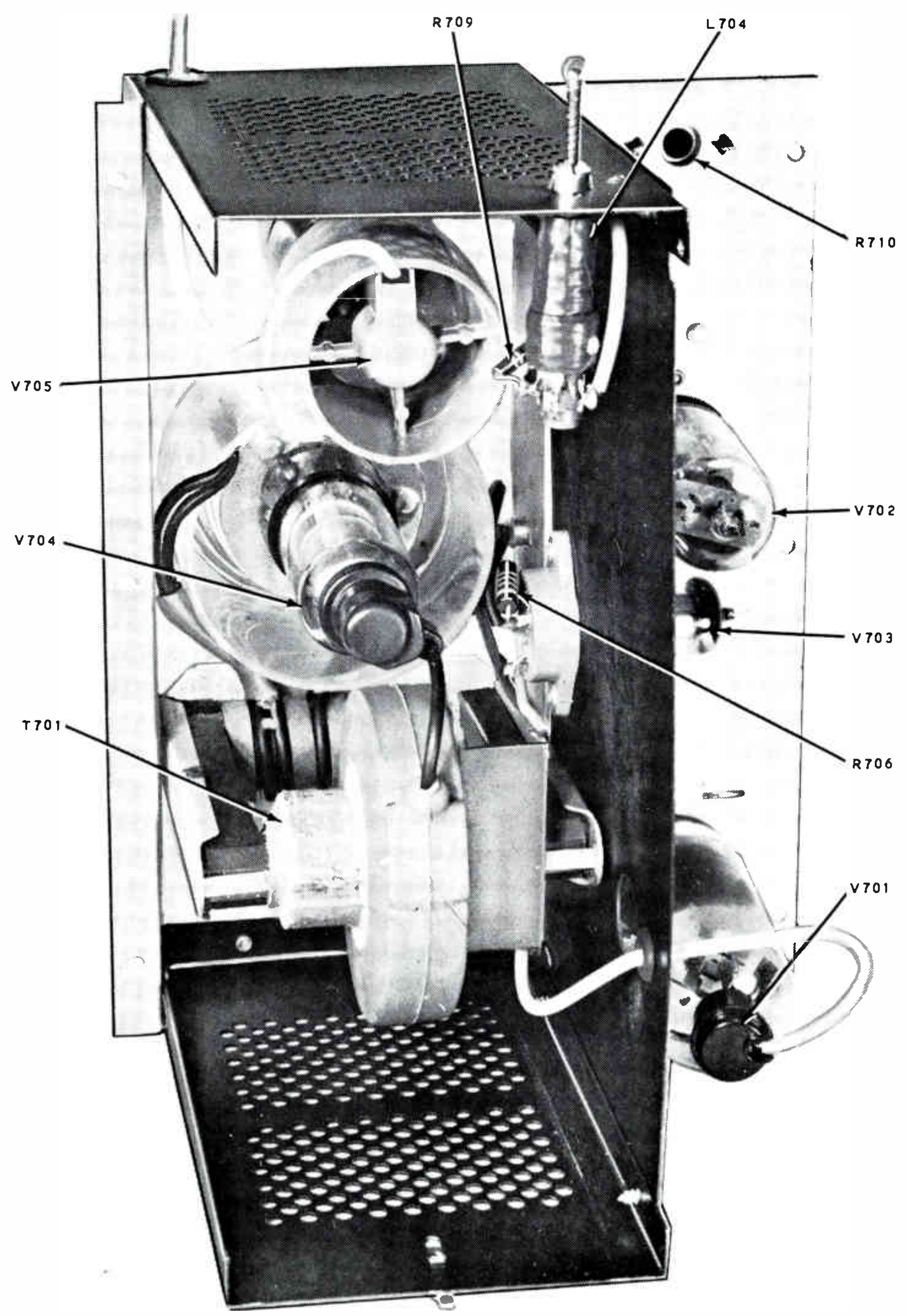


CONVERGENCE BRACKET



NOTE: THIS FIGURE SHOULD BE GLUED INSIDE THE CABINET OR ON AN INSIDE WALL FOR CUSTOM MOUNTING.

FIGURE 3-1
(DUPLICATE)



HORIZONTAL OUTPUT ASSEMBLY

REPLACEMENT PARTS PRICE LIST

SOUND-SYNC CIRCUIT BOARD

The following prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from an authorized Service Center or Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

A completely assembled sound-sync circuit board (#100-650), for replacement purposes only, can be obtained for $18.55. Individual parts can be purchased for the prices listed below.

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1/2 Watt		
1-45	.10	220 Ω
1-9	.10	1000 Ω
1-10	.10	1200 Ω
1-81	.10	1500 Ω
1-14	.10	3300 Ω
1-20	.10	10 KΩ
1-109	.10	12 KΩ 5%
1-21	.10	15 KΩ
1-23	.10	27 KΩ
1-24	.10	33 KΩ
1-47	.10	56 KΩ
1-60	.10	68 KΩ
1-102	.10	82 KΩ
1-26	.10	100 KΩ
1-30	.10	270 KΩ
1-31	.10	330 KΩ
1-32	.10	390 KΩ
1-33	.10	470 KΩ
1-34	.10	680 KΩ
1-35	.10	1 megohm
1-37	.10	2.2 megohm
1-38	.10	3.3 megohm
1-71	.10	4.7 megohm
1-40	.10	10 megohm

PART No.	PRICE Each	DESCRIPTION
Other Resistors		
1-22-1	.10	1500 Ω 1 watt
1-12-2	.20	470 Ω 2 watt
1-4-2	.20	15 KΩ 2 watt
CAPACITORS		
Mica		
20-118	.15	15 μμf
20-109	.15	62 μμf
20-115	.25	300 μμf
20-122	.30	1000 μμf
Disc		
21-6	.10	27 μμf
21-32	.10	47 μμf
21-21	.10	200 μμf
21-22	.10	220 μμf
21-13	.10	500 μμf
21-24	.10	800 μμf
21-14	.10	.001 μfd
21-25	.10	.0013 μfd (1300 μμf)
21-26	.10	.003 μfd
21-16	.10	.01 μfd
21-31	.10	.02 μfd
Tubular		
29-1	.15	3900 μμf
23-40	.15	.0068 μfd
23-100	.30	.015 μfd
23-11	.35	.1 μfd

PART No.	PRICE Each	DESCRIPTION
Resin		
27-59	.15	.0047 μfd
27-57	.15	.018 μfd
27-47	.20	.1 μfd 50 V or 100 V
27-28	.20	.1 μfd
MISCELLANEOUS		
40-492	.55	Horizontal oscillator coil
57-32	.55	Dual selenium diode
84-32	.30	P.E.C. (printed electronic circuit)
Miscellaneous (cont'd.)		
85-145-5	1.70	Sound-sync circuit board
344-51	.05/ft	Brown hookup wire
434-130	.15	9-pin tube socket
434-156	.20	9-pin novar tube socket
331-6	.10	Solder
595-838	2.00	Manual

COLOR CIRCUIT BOARD

A completely assembled color circuit board (#100-649), for replacement purposes only, can be obtained for $35.00. Individual parts can be purchased for the prices listed below.

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1/2 Watt		
1-49	.10	22 Ω
1-83	.15	56 Ω 5%
1-3	.10	100 Ω
1-66	.10	150 Ω
1-45	.10	220 Ω
1-48	.10	390 Ω
1-6	.10	470 Ω
1-52	.10	680 Ω 5%
1-9	.10	1000 Ω
1-81	.15	1500 Ω 5%
1-14	.10	3300 Ω
1-46	.10	3900 Ω
1-16	.10	4700 Ω
1-19	.10	6800 Ω
1-22	.10	22 KΩ
1-23	.10	27 KΩ
1-24	.10	33 KΩ
1-67	.10	39 KΩ
1-25	.10	47 KΩ
1-60	.10	68 KΩ
1-26	.10	100 KΩ
1-27	.10	150 KΩ
1-29	.10	220 KΩ
1-30	.10	270 KΩ
1-31	.10	330 KΩ
Resistors - 1/2 Watt (cont'd.)		
1-32	.10	390 KΩ
1-35	.10	1 megohm
1-37	.10	2.2 megohm
1-71	.10	4.7 megohm
1-40	.10	10 megohm
1 Watt		
1-54-1	.20	270 Ω 5%
1-25-1	.10	6800 Ω
1-27-1	.10	33 KΩ
1-7-1	.10	47 KΩ
Other Resistors		
5-1-2	.30	3900 Ω (3.9 K) 2 watt, film
5-5-2	.15	10 KΩ 2 watt, film
5-4-2	.15	27 KΩ 2 watt, film
5-3-2	.20	47 KΩ 2 watt, film
5-2-3	.20	270 Ω 3 watt, film
5-1-3	.20	2700 Ω (2.7 K) 3 watt, film

Packaged and matched resistors (#4-10) consisting of:

4-6	.25*	1 megohm 5% low-noise * Matched pair.

Packaged and matched resistors (#4-11) consisting of:

4-7	.50**	2.2 megohm 5% low-noise **Matched set of four.

PART No.	PRICE Each	DESCRIPTION
CAPACITORS		
Mica		
20-52	.15	7.5 $\mu\mu$f
20-104	.15	130 $\mu\mu$f
20-105	.20	180 $\mu\mu$f
20-139	.25	330 $\mu\mu$f
Disc		
21-61	.10	6.8 $\mu\mu$f (6.8K)
21-3	.10	10 $\mu\mu$f
21-5	.10	20 $\mu\mu$f
21-7	.10	33 $\mu\mu$f
21-86	.10	75 $\mu\mu$f
21-11	.10	150 $\mu\mu$f
21-22	.10	220 $\mu\mu$f
21-17	.10	270 $\mu\mu$f
21-14	.10	.001 μfd
21-36	.10	.002 μfd
21-26	.10	.003 μfd
21-27	.10	.005 μfd
21-16	.10	.01 μfd
21-31	.10	.02 μfd
Other Capacitors		
28-4	.10	1.5 $\mu\mu$f phenolic
21-29	.15	4.7 $\mu\mu$f ceramic
23-52	.20	.047 μfd 400 V tubular
27-36	.15	.01 μfd resin
27-28	.20	.1 μfd resin
27-35	.35	.22 μfd resin

PART No.	PRICE Each	DESCRIPTION
COILS		
45-39	.20	4.7 μh choke
40-583	.20	10 μh peaking
40-582	.15	62 μh peaking
40-599	.15	112 μh peaking
40-488	.15	180 μh peaking
40-581	.15	620 μh peaking
40-577	.65	3.58 megacycle reactance
40-578	.50	Color amplifier plate
40-585	.50	Dot generator
TRANSFORMERS		
52-75	.90	Burst phase
52-77	.95	3.58 megacycle coupling
52-76	1.35	Color bandpass
MISCELLANEOUS		
56-20	.55	1N295 crystal diode
60-21	.20	DPDT slide switch
85-148-7	3.30	Color circuit board
206-207	.15	Coil shield
344-56	.05/ft	Blue hookup wire
346-1	.10/ft	Small sleeving
404-238	3.00	3579.545 kilocycle crystal
412-11	.20	NE-2 neon lamp
434-129	.15	7-pin tube socket
434-130	.15	9-pin tube socket

CONVERGENCE CIRCUIT BOARD

A completely assembled convergence circuit board (#100-651), for replacement purposes only, can be obtained for $24.15. Individual parts can be purchased for the prices listed below.

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1-1	.10	47 Ω 1/2 watt
1-15-1	.10	47 Ω 1 watt
1-17-1	.10	100 Ω 1 watt
1-18-1	.10	150 Ω 1 watt
1-54-1	.20	270 Ω 5% 1 watt
CAPACITORS		
27-54	.25	.082 μfd resin
27-28	.20	.1 μfd resin
27-55	.25	.15 μfd resin
27-56	.35	.27 μfd resin
25-44	.50	25 μfd electrolytic

PART No.	PRICE Each	DESCRIPTION
CONTROLS		
11-56	.35	60 Ω (white knob)
11-66	.35	60 Ω (gray knob)
11-57	.35	120 Ω (black knob)
11-59	.35	150 Ω (blue knob)
11-67	.35	500 Ω (yellow knob)
COILS		
40-736	.40	Convergence
40-738	.45	Convergence
40-739	.60	Convergence
40-737	.55	Convergence
MISCELLANEOUS		
57-43	.85	4-section selenium diode
85-147-2	1.00	Convergence circuit board
262-8	.05	Terminal pin

IF CIRCUIT BOARD ASSEMBLY (#100-685)

A completely assembled IF circuit board (#100-685) can be obtained for $38.80. Individual parts can be purchased for the prices listed below.

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1-41	.10	10 Ω
1-83	.15	56 Ω
1-2	.10	68 Ω
1-3	.10	100 Ω
1-66	.10	150 Ω
1-42	.10	270 Ω
1-4	.10	330 Ω
1-119	.10	560 Ω
1-14	.10	3300 Ω
1-16	.10	4700 Ω
1-18	.10	5600 Ω
1-73	.10	8200 Ω
1-22	.10	22 KΩ
1-47	.10	56 KΩ
1-60	.10	68 KΩ
1-26	.10	100 KΩ
1-27	.10	150 KΩ
1-29	.10	220 KΩ
1-33	.10	470 KΩ
1-37	.10	2.2 megohm
1-22-1	.10	1500 Ω 1 watt
5-1-3	.20	2700 Ω (2.7 K) 3 watt, film
CAPACITORS		
20-130	.15	12 μμf mica
20-97	.15	50 μμf mica
20-103	.15	150 μμf mica
20-120	.20	220 μμf mica
20-107	.40	680 μμf mica
21-33	.10	3.3 μμf disc
21-78	.10	5 μμf disc
21-96	.10	85 μμf disc
21-24	.10	800 μμf disc
21-14	.10	.001 μfd disc
21-27	.10	.005 μfd disc
21-16	.10	.01 μfd disc
21-31	.10	.02 μfd disc
21-48	.15	.05 μfd disc
28-4	.10	1.5 μμf tubular
21-29	.15	4.7 μμf tubular
27-28	.20	.1 μfd resin

PART No.	PRICE Each	DESCRIPTION
COILS-CHOKES-TRANSFORMERS		
40-583	.20	10 μh peaking coil
40-488	.15	180 μh coil
40-489	.75	Sound take-off coil
40-490	.70	4.5 mc sound IF coil
40-491	.40	Quadrature coil
40-576	.70	4.5 mc sound trap coil
40-740	.30	Input IF transformer
40-741	.30	1st IF transformer
40-742	.30	2nd IF transformer
40-743	.25	47.25 mc trap coil
45-35	.15	1.7 μh choke
45-57	.30	10 μh choke
52-74	1.60	3rd IF transformer and 41.25 mc trap
TUBES-SOCKETS-SHIELDS		
411-96	1.80	6AW8 tube
411-160	1.80	6EJ7 tube
411-169	1.40	6GM6 tube
411-222	1.40	6HZ6 tube
411-188	1.25	6JH6 tube
206-77	.15	7-pin tube shield
206-206	.15	9-pin tube shield
206-207	.15	Small coil shield
206-205	.25	Large coil shield
434-129	.15	7-pin tube socket
434-130	.15	9-pin tube socket
434-132	.30	7-pin tube socket with shield
MISCELLANEOUS		
10-155	.40	750 Ω control
10-180	.65	15 KΩ control
56-20	.55	1N295 crystal diode
134-127	.75	IF input cable with phono plug
85-146-3	1.70	IF circuit board

CHASSIS PARTS

RESISTORS

1/2 Watt

PART No.	PRICE Each	DESCRIPTION
1-129	.10	4.7 Ω
1-3	.10	100 Ω
1-66	.10	150 Ω
1-112	.15	180 Ω 5%
1-45	.10	220 Ω
1-4	.10	330 Ω
1-9	.10	1000 Ω
1-44	.10	2200 Ω
1-73	.10	8200 Ω
1-21	.10	15 KΩ
1-26	.10	100 KΩ
1-27	.10	150 KΩ
1-126	.10	180 KΩ
1-29	.10	220 KΩ
1-33	.10	470 KΩ
1-37	.10	2.2 megohm

Other Resistors-Thermistor

PART No.	PRICE Each	DESCRIPTION
1-8-1	.10	68 KΩ 1 watt
1-17-2	.20	6800 Ω 2 watt
5-1-2	.30	3900 Ω (3.9 K) 2 watt, film
5-3-2	.20	47 KΩ 2 watt, film
5-3-3	.20	1000 Ω (1 K) 3 watt, film
5-1-4	.20	5600 Ω (5.6 K) 4 watt, film
5-2-4	.30	39 KΩ 4 watt, film
3-13-7	.15	6500 Ω 7 watt, wire-wound
3-7-10	.30	10 KΩ (10000) 10 watt, wire-wound
3-8-10	.30	15 KΩ 10 watt, wire-wound
3-10-25	.75	750 Ω 25 watt, wire-wound
9-14	.70	VDR (voltage dependent resistor)
9-15	.70	VDR (voltage dependent resistor)
9-8	1.00	Thermistor

CAPACITORS

Disc

PART No.	PRICE Each	DESCRIPTION
21-32	.10	47 μμf
21-75	.10	100 μμf
21-14	.10	.001 μfd
21-36	.10	.002 μfd
21-16	.10	.01 μfd

Electrolytic

PART No.	PRICE Each	DESCRIPTION
25-75	.55	5 μfd nonpolarized
25-44	.50	25 μfd
25-36	1.00	40 μfd
25-28	.70	100 μfd
25-139	1.65	160 μfd
25-141	2.60	80-50-10-20 μfd
25-140	2.30	160-30-10-10 μfd

Other Capacitors

PART No.	PRICE Each	DESCRIPTION
23-38	.15	.0033 μfd tubular
23-45	.20	.047 μfd 600 V tubular
23-56	.40	.5 μfd tubular
27-34	.25	.2 μfd resin

CONTROLS

PART No.	PRICE Each	DESCRIPTION
10-186	.50	500 Ω
10-184	.50	1200 Ω (1.2 K)
10-187	.50	5000 Ω (5 K)
10-185	.50	100 KΩ
10-78	.45	15 KΩ
11-68	.90	2000 Ω (2 K) tab-mount
10-183	.30	10 KΩ tab-mount
10-192	.35	35 KΩ tab-mount
10-181	.30	1 megohm tab-mount
10-191	.35	1 megohm tab-mount
10-182	.30	5 megohm tab-mount
10-193	.40	6000 Ω (6 K)tab-mount, green shaft
10-188	.40	6000 Ω (6 K) tab-mount, blue shaft
10-189	.40	1.5 megohm tab-mount, red shaft
10-194	.40	1.5 megohm tab-mount, green shaft
10-195	.40	1.5 megohm tab-mount, blue shaft
19-100	1.30	2 megohm with SPST switch

SWITCHES-CIRCUIT BREAKER

PART No.	PRICE Each	DESCRIPTION
60-2	.25	DPDT slide (6 lugs)
60-10	.35	DPTT slide (8 lugs)
65-11	.60	Circuit breaker

PART No.	PRICE Each	DESCRIPTION
COILS		
40-598	.25	100 μh peaking (brown-black-brown)
40-485	.15	250 μh peaking (red-green-brown)
40-745	.75	Pincushion phase
40-750	1.00	Width
41-1	1.95	Delay line
40-586	1.65	Degaussing
40-744	5.25	Automatic degaussing
CHOKE-TRANSFORMERS		
46-37	2.20	Filter choke
51-132	4.05	Top-bottom pincushion transformer
51-136	4.90	Side pincushion transformer
51-104	3.75	Audio output transformer
51-135	5.35	Vertical output transformer
54-149	12.25	Power transformer
GROMMETS-INSULATORS		
73-4	.10	5/16" grommet
73-1	.10	3/8" grommet
73-3	.10	1/2" grommet
73-2	.10	3/4" grommet
73-34	.10	Test clip insulator
75-24	.10	Line cord strain relief
261-24	.05	Yoke mount rubber bumper
261-22	.05	Picture tube rubber bumper
CLAMPS-CLIPS		
207-4	.10	1/4" cable clamp
207-18	.10	3/8" cable clamp
207-22	.10	1/2" cable clamp
207-48	.30	Yoke positioning clamp
207-47	.25	Yoke mounting clamp
260-16	.10	Small alligator clip
260-1	.15	Large alligator clip

DIODE-PILOT LAMP-TUBES

NOTE: Some tubes may have the suffix A or B following the type number. Example: 6GF7A instead of 6GF7.

PART No.	PRICE Each	DESCRIPTION
57-27	.60	750 ma silicon diode, 500V PIV
412-1	.15	#47 pilot lamp
411-170	1.20	6EW6 tube

Diodes-Pilot Lamp-Tubes (cont'd.)

PART No.	PRICE Each	DESCRIPTION
411-177	1.20	6FQ7 tube
411-216	2.45	6GF7 tube
411-193	1.60	6GH8 tube
411-217	1.60	6GU7 tube
411-173	1.55	6GW8 tube
411-175	1.80	6HS8 tube
411-222	1.40	6HZ6 tube
411-195	1.70	6JU8 tube
411-237	1.95	12HG7 tube
411-213	189.95	25AP22A/25XP22

HARDWARE

PART No.	PRICE Each	DESCRIPTION
#3 Hardware		
250-49	.05	3-48 x 1/4" screw
252-1	.05	3-48 nut
254-7	.05	#3 lockwasher
#6 Hardware		
250-89	.05	6-32 x 3/8" screw
250-252	.05	#6 x 5/8" bronze screw
250-365	.05	#6 x 1/4" sheet metal screw
250-8	.05	#6 x 3/8" sheet metal screw
250-290	.05	#6 x 5/8" flat head wood screw
252-3	.05	6-32 nut
254-1	.05	#6 lockwasher
253-60	.05	#6 flat washer
259-1	.05	#6 solder lug
#8 Hardware		
250-137	.05	8-32 x 3/8" screw
250-92	.05	8-32 x 5/8" screw
250-35	.05	#8 x 7/8" sheet metal screw
250-289	.05	8-32 x 1/2" wing-head screw
252-4	.05	8-32 nut
254-2	.05	#8 lockwasher
#10 Hardware		
250-126	.05	10-32 x 1/2" screw
250-255	.05	10-24 x 1/2" self-tapping screw
250-264	.05	10-24 x 3/4" self-tapping screw
250-261	.10	#10 x 1-1/2" sheet metal screw
252-5	.05	10-32 nut
252-54	.15	#10 speednut
254-3	.05	#10 lockwasher
253-19	.05	#10 flat washer
259-5	.05	#10 solder lug

Other Hardware

PART No.	PRICE Each	DESCRIPTION
250-253	.10	1/4-20 x 7/8" screw
252-7	.05	Control nut
252-67	.10	1/4-20 self-retaining nut
254-5	.05	Control lockwasher
253-31	.05	1/4" flat washer
258-33	.10	Coil spring
259-22	.05	Spade lug
432-66	.10	Terminal strip connector

WIRE-CABLE-SLEEVING

PART No.	PRICE Each	DESCRIPTION
89-13	.40	Line cord
340-2	.05/ft	Bare wire
344-52	.05/ft	Red hookup wire
344-53	.05/ft	Orange hookup wire
344-54	.05/ft	Yellow hookup wire
344-55	.05/ft	Green hookup wire
344-58	.05/ft	Gray hookup wire
344-59	.05/ft	White hookup wire
344-15	.05/ft	Black stranded wire
344-31	.05/ft	Brown stranded wire
343-6	.05/ft	Shielded cable
347-3	.15/ft	2-wire shielded cable
343-9	.10/ft	75 Ω coaxial cable
347-2	.05/ft	300 Ω twin lead
134-110	.95	8-wire cable assembly with octal plug
134-129	1.35	12-wire cable assembly
134-166	5.00	Wiring harness
346-7	.10/ft	1/4" clear sleeving
346-6	.05/ft	3/8" fiberglas sleeving

TERMINAL STRIPS

PART No.	PRICE Each	DESCRIPTION
431-2	.10	Small 2-lug
431-14	.10	Small 2-lug, 1 lug ground
431-41	.10	Large 2-lug
431-3	.10	Small 3-lug
431-10	.10	Small 3-lug, center lug ground
431-43	.10	Large 3-lug
431-5	.10	Small 4-lug
431-42	.10	Large 5-lug
431-45	.10	Small 6-lug
431-35	.10	Small 7-lug
431-54	.10	2-lug screw type
431-68	.20	4-lug screw type, VHF and UHF

SOCKETS-PLUG

PART No.	PRICE Each	DESCRIPTION
434-85	.20	Pilot lamp socket
434-39	.15	Octal socket
434-82	.10	Double phono socket
434-157	1.15	Picture tube socket and lead assembly
481-4	.10	Capacitor mounting wafer
438-4	.10	Phono plug

PLASTIC PARTS

PART No.	PRICE Each	DESCRIPTION
266-88	.15	Plastic lever
95-27	.60	Pole piece holder
95-28-1	.60	Yoke half-shell
95-26	1.50	Yoke mount
203-459	2.15	Control panel
210-30	5.00	Picture tube mask

KNOBS

PART No.	PRICE Each	DESCRIPTION
462-197	1.00	VHF channel selector
462-202	.35	VHF fine tuning
462-198	.65	UHF tuning
462-271	.75	UHF channel indicator
462-200	.50	Front panel
462-224	.30	Thumbwheel
462-204	.10	Focus

METAL PARTS

PART No.	PRICE Each	DESCRIPTION
265-10	.10	Half hinge with pin
265-11	.10	Half hinge with 2 holes
206-77	.15	Small tube shield
206-206	.15	Large tube shield
206-263	.10	Circuit board shield
204-701	.25	VHF tuner bracket
204-887	.30	Tuner bracket
204-702-1	3.00	Convergence bracket
100-581	1.20	Picture tube mounting assembly
206-297	1.90	Left picture tube shield
206-301	1.80	Right picture tube shield
206-296	2.10	Top picture tube shield
206-300	2.10	Bottom picture tube shield
206-298	.85	Internal picture tube shield
200-534	5.00	Chassis

MISCELLANEOUS

PART No.	PRICE Each	DESCRIPTION
390-135	.10	FCC certification label
390-173	.75	Control panel label
330-11	.10	Felt strip
58-6	2.40	Pole piece assembly
100-582	2.85	Blue lateral and purity assembly
58-7	16.70	Deflection yoke
401-95	5.00	Speaker
110-37	8.45	UHF tuner

Miscellaneous (cont'd.)

PART No.	PRICE Each	DESCRIPTION
110-42	15.25	VHF tuner (packed with IF circuit board assembly, #100-685)
100-685	38.80	IF circuit board assembly
100-580	28.50	Horizontal output assembly
490-1	.10	Alignment tool
490-5	.10	Plastic nut starter

MODEL GRA-295-1 CABINET PARTS

PART No.	PRICE Each	DESCRIPTION
206-247	.45	Picture tube back panel shield
204-704	.20	Convergence support bracket
250-252	.05	#6 x 5/8" bronze screw
252-4	.05	8-32 nut
253-45	.05	#8 flat washer
261-1	.05	Rubber bumper

NOTE: The Walnut Cabinet (#91-140) and the Cabinet back panel (#94-419) are not available as replacement parts.

HORIZONTAL OUTPUT ASSEMBLY (#100-580)

A completely assembled horizontal output assembly (#100-580) can be obtained for $28.50. Individual parts can be purchased for the prices listed below.

RESISTORS

PART No.	PRICE Each	DESCRIPTION
1-1	.10	47 Ω
1-3	.10	100 Ω
1-6	.10	470 Ω
1-9	.10	1000 Ω
1-44	.10	2200 Ω
1-26	.10	100 KΩ
1-35	.10	1 megohm
1-34-1	.10	1 megohm 1 watt
1-35-1	.10	1.5 megohm 1 watt
1-40	.10	10 megohm
3-3-2	.25	2.7 Ω 2 watt
1-32-2	.20	4.7 megohm 2 watt
5-1-7	.25	13 KΩ 7 watt, film
2-12-2	.70	66 megohm 6 KV

CAPACITORS

PART No.	PRICE Each	DESCRIPTION
21-106	.10	22 µµf 1 KV disc
21-49	.20	68 µµf 4 KV disc
21-107	.35	130 µµf 6 KV disc
21-11	.10	150 µµf disc
21-108	.10	180 µµf 1 KV disc
21-120	.15	500 µµf 3 KV disc
21-16	.10	.01 µfd disc
21-117	.20	.01 µfd 1.4 KV disc with spark gap
23-102	.20	.0022 µfd tubular
23-45	.20	.047 µfd tubular
23-11	.35	.1 µfd tubular
23-99	.30	.12 µfd tubular
23-48	.30	.15 µfd tubular
27-28	.20	.1 µfd resin

PART No.	PRICE Each	DESCRIPTION
COILS-CHOKE-TRANSFORMER		
40-580	.80	Horizontal efficiency coil
40-735	1.25	Focus coil
45-42	.20	8.5 μh choke
51-131	6.80	Horizontal output transformer
TUBES-SOCKETS		
411-65	1.10	1V2 tube
411-189	1.60	3A3 tube
411-190	3.80	6BK4B tube
411-191	1.80	6DW4/6CL3 tube
411-192	4.25	6JE6A tube
Tubes-Sockets (cont'd.)		
434-39	.15	Octal tube socket
434-144	.20	9-pin novar tube socket
434-155	.20	9-pin miniature tube socket
MISCELLANEOUS		
57-27	.60	750 ma silicon diode, 500 V PIV
75-62	.35	High voltage socket insulator
260-40	.35	HV rectifier plate cap and lead
260-46	.75	HV regulator plate cap and lead
432-49	.35	2nd anode connector and lead assembly

VHF TUNER (#110-42)

NOTE: Refer to Figure 6-19 below for replacing the converter strip and tuning strips in the VHF tuner.

PART No.	PRICE Each	DESCRIPTION
411-226	2.25	6GJ7 tube
411-220	1.85	6HA5 tube
246-59	1.80	Channel 1 UHF converter strip
246-60	1.60	Channel 2 tuning strip
246-61	1.60	Channel 3 tuning strip
246-62	1.60	Channel 4 tuning strip
246-63	1.60	Channel 5 tuning strip
246-64	1.60	Channel 6 tuning strip
246-65	1.60	Channel 7 tuning strip
246-66	1.60	Channel 8 tuning strip
246-67	1.60	Channel 9 tuning strip
246-68	1.60	Channel 10 tuning strip
246-69	1.60	Channel 11 tuning strip
246-70	1.60	Channel 12 tuning strip
246-71	1.60	Channel 13 tuning strip
246-57	2.70	Antenna balun assembly

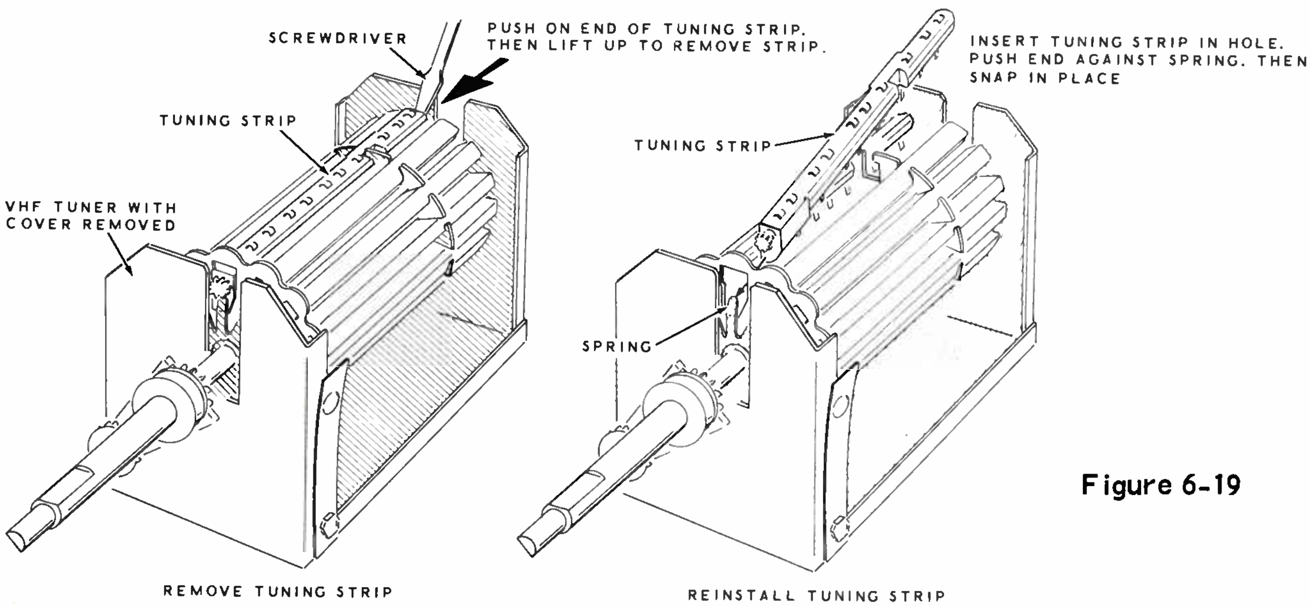


Figure 6-19

YOKE REPLACEMENT PARTS

PART No.	PRICE Each	DESCRIPTION
1-2-2	.20	4700 Ω 2 watt resistor
9-22	.50	Thermistor

NOTE: The 100 pf capacitor in the yoke assembly is not available as a replacement part.

MISCELLANEOUS

PART No.	PRICE Each	DESCRIPTION

NOTE: Refer to Figure 6-20 for replacing a pole piece magnet in a pole piece assembly.

474-13	.30	Pole piece magnet

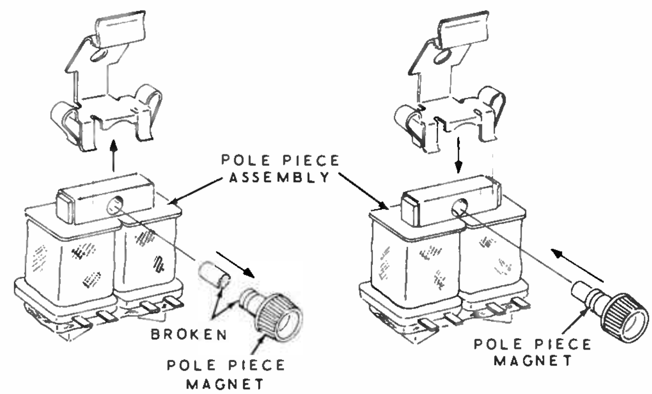


Figure 6-20

HEATH COMPANY

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

595-838

LITHO IN U. S. A.

SCHEMATIC OF THE HEATHKIT® COLOR TELEVISION SET MODEL GR-295

NOTES:

1. THE CIRCUIT PARTS NUMBERS FOR THE COMPONENTS ARE IN THE FOLLOWING GROUPS:

0- 99	PARTS IN UHF TUNER.
100-199	PARTS IN VHF TUNER.
200-299	PARTS ON IF CIRCUIT BOARD.
300-399	PARTS ON SOUND-SYNC CIRCUIT BOARD.
400-499	PARTS ON COLOR CIRCUIT BOARD.
500-599	PARTS ON CONVERGENCE CIRCUIT BOARD.
600-699	PARTS IN LOW VOLTAGE POWER SUPPLY (MOUNTED ON CHASSIS).
700-799	PARTS ON HORIZONTAL OUTPUT ASSEMBLY.
800-899	PARTS MOUNTED ON CHASSIS.

   A SYMBOL AROUND A PART NUMBER MEANS THAT THIS PART IS MOUNTED AT A LOCATION OTHER THAN INDICATED BY THE PART NUMBER.

   PARTS MOUNTED ON THE CHASSIS.

   PARTS MOUNTED ON THE TUNER BRACKET.

   PARTS MOUNTED ON THE CONVERGENCE BRACKET.

2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K = 1000, M = 1,000,000).
3. ALL CAPACITOR VALUES ARE IN μfd UNLESS MARKED OTHERWISE.
4. THIS SYMBOL INDICATES A DC VOLTAGE MEASUREMENT, TAKEN WITH AN 11 MEGOHM VTVM, FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES ARE POSITIVE UNLESS INDICATED OTHERWISE. VOLTAGES MAY VARY ±20% EXCEPT:
   ▲ VARIES MORE THAN ±20%.
   ■ VARIES WITH KINE BIAS SWITCH SETTING.
5. VOLTAGE MEASUREMENTS WERE MADE WITH NO SIGNAL INPUT AND AT 120 V AC LINE VOLTAGE.
6. ARROW (——►) INDICATES CLOCKWISE ROTATION OF CONTROLS.

*7. THE 2.2 MEGOHM RESISTORS R444, R445, R446, AND R447 ARE MATCHED LOW-NOISE RESISTORS.

**8. THE 1 MEGOHM RESISTORS R449 AND R451 ARE MATCHED LOW-NOISE RESISTORS.

9. WAVEFORMS WERE TAKEN USING HEATH COLOR BAR AND DOT GENERATOR.
10. ALTERNATE WIRING OF SOCKET V701 TO REDUCE BARKHAUSEN INTERFERENCE. REFER TO TROUBLESHOOTING CHART, FIGURE 3-28 ON PAGE 110.
11. REFER TO THE CHASSIS PHOTOGRAPHS AND CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.

8/23/68


UHF TUNER
VHF TUNER
ANTENNA BALUN ASSEMBLY
IF CIRCUIT BOARD
V201
V202
V203
V204A
V204B
V205
PART OF SOUND-SYNC CIRCUIT BOARD
V304A
V304B
VOLUME
SPEAKER
HIGH FIDELITY OUTPUT
COLOR CIRCUIT BOARD
V401B
V402
CONTRAST
BRIGHTNESS
V401A
V403A
V403B
V404
V405
V406
V410A
V410B
COLOR
SERVICE SWITCH
V801
DEFLECTION YOKE
SOUND-SYNC CIRCUIT BOARD
V301A
V301B
V302A
V302B
VERT. HOLD
V101
V102A
V102B
Q1
V408A