Color-TV Service Handbook

Volume 2

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RCA

Electronic Components
Harrison, N J

Color-TV Service Handbook

Volume 2

1A1759

This handbook includes service data on the following makes of Color TV sets (1966-1968 Models)

Admiral
Airline
Curtis Mathes
Emerson
General Electric
Hoffman
Magnavox
Motorola
Olympic
Packard Bell
Philco
RCA
Silvertone
Sylvania
Zenith

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ADJ.....Adjust (adjustment)
AF.....Audio-frequency amplifier (driver)
ACC.....Automatic color control
AFT.....Automatic Fine Tuner
AGC.....Automatic gain control
ANI.....Automatic noise inverter
AO.....Audio output tube
BAL.....Balance
BKR.....Blanker (tube, stage)
BLU.....Blue
BOT.....Bottom
BPA.....Bandpass amplifier
1BPA- first bandpass amplifier
BRST.....Burst amplifier tube
BRST XFMR..Burst-phase transformer
B-Y.....B-Y amplifier
CENT.....Centering (control)
CHR.....Chroma
CK.....Color killer
CKD.....Color killer detector
CO.....Color oscillator (3.58-MHz oscillator)
CONT.....Control
CONV.....Converter (mixer-oscillator)
CRT.....Cathode-ray tube (picture tube)
DET.....Detector
DMD.....Demodulator
DMP.....Damper (tube, stage)
FMD.....FM detector
FR.....Focus rectifier
FREQ.....Frequency
GRN.....Green
G-Y.....G-Y amplifier
HAFC.....Horizontal frequency control tube or stage
H DISCH.....Horizontal discharge (tube)
H EFF.....Horizontal efficiency control
HO.....Horizontal oscillator
HOR.....Horizontal
HOR CENT...Horizontal centering
HOT.....Horizontal output tube
H STAB.....Horizontal stabilizer adjustment
HTR.....Heater
HV.....High voltage
HVR.....High-voltage rectifier
HV REG.....High-voltage regulator
IC.....Integrated circuit
LIN.....Linearity
LVR.....Low-voltage rectifier
NORM/SVC...Normal-service switch
NI.....Noise inverter (or noise gate)
OSC.....Oscillator
OUT.....Output
PIF.....Picture (video) if stage
3PIF- third picture if stage
PIN.....Pincushion
POS.....Positioning
PUR.....Purity
PWR.....Power
Q.....Transistor
QUAD.....Quadrature
RAS.....Raster
REAC.....Reactance tube (AFPC control tube)
RF.....rf amplifier
R-Y.....R-Y amplifier
S.....Sound
SCA.....Sub-carrier amplifier
SENS.....Sensitivity
SIF.....Sound-if amplifier (4.5 MHz)
SYNC.....Separator/Amplifier tube
VERT.....Vertical
VID.....Video
VOT.....Vertical output tube
XFMR.....Transformer
X DMD.....X demodulator
XTAL.....Crystal
YA.....Video amplifier (Y or monochrome section)
Y DMD.....Y demodulator
YOT.....Video output tube (Y or monochrome section)
Z DMD.....Z demodulator
ϕ.....Phase
ϕ DET.....Phase detector

The purpose of this handbook is to provide the service technician with one convenient source of field-service information for color-TV receivers made by 15 manufacturers during the model years 1967-1968. The book contains step-by-step procedures for routine service and set-up adjustments that can be performed in the customer's home. It is assumed that the user has a basic understanding of the principles of color television receivers and is familiar with troubleshooting and alignment techniques.

Although the service information contained in the book is based on the individual manufacturer's service notes, the book is not intended to replace the service notes. The procedures given in the book are only intended for field servicing. If any of these procedures do not provide the desired results, consult the set manufacturer's service notes for additional information such as alignment and shop procedures.

RCA also has other valuable Color-TV service publications available to the service technician. These publications include: the RCA COLOR-TV TROUBLESHOOTING PICT-O-GUIDE, the RCA FIELD-SERVICE GUIDE for RCA Color-TV Receivers Vols. 1 and 2, and the RCA COLOR-TV SERVICE HANDBOOK, Vol. 1. For information concerning the price and availability of these publications please contact your local RCA distributor, or Commercial Engineering, RCA Electronic Components, 415 South 5th Street. Harrison, New Jersey 07029.

RCA acknowledges the cooperation and expresses appreciation to the manufacturers whose service notes provided the sources of information for this handbook.

We regret that it was impossible to include the information on all color-TV manufacturers.

The RCA Color-TV Service Handbook is composed of 12 sections each dealing with a specific aspect of servicing. These sections are: CHASSIS LAYOUT, PURITY, CONVERGENCE, BLACK-AND-WHITE SETUP, AFPC, AGC, HORIZONTAL HOLD, COLOR KILLER, PINCUSHION and MISCELLANEOUS. In addition, there are sections on TEST EQUIPMENT and on RECEIVING TUBES FOR COLOR TV.

Color-TV receivers are listed in the CHASSIS INDEX either by model number or chassis number. The CHASSIS INDEX is arranged alphabetically by manufacturers with color-TV receivers listed numerically-alphabetically under the manufacturers' names. The chassis view and the procedures used for a particular receiver model are listed by letter in the adjacent columns. For example, the letter B under the CONVERGENCE heading refers to Procedure B in the CONVERGENCE section. Each heading in the index is a separate section of the book.

CHASSIS LAYOUT – Chassis views keyed by capital letters show tube and solid-state component locations and other major components such as the location of the burst-phase transformer. Rear-panel controls are also given as well as fuse information. The receiving-tube complement of the tuner is also given. More than one tube may be listed for a specific socket; however, **the tube types may not be directly interchangeable**. Replace the tube with a type having the same number as the original or use a superseding type or substitute recommended by the manufacturer.

PURITY – Step-by-step procedures for obtaining overall purity are given.

CONVERGENCE – Specific dynamic-convergence adjustments are given for each chassis. The adjustments are keyed to a series of drawings which show the convergence board for the chassis and the effect of each control on the convergence pattern.

Static-convergence adjustments are the same for all sets; therefore, one static-convergence procedure is given at the beginning of the section.

CONVERGENCE BOARD – The convergence board is keyed in the index with a number, such as CB-10. This number identifies the convergence board in the series of drawings relating to the convergence procedure.

BLACK-AND-WHITE SETUP – Procedures for performing the black-and-white setup adjustments are given in this section. At the beginning of this section, there is a general procedure which applies to most sets for correcting "incorrect highlights" that cannot be corrected during the normal black-and-white setup adjustment.

AFPC – The AFPC section contains various procedures for adjusting AFPC in the field. The locations of the transformers and coils, etc., which are adjusted during the AFPC procedure are shown on the chassis drawings in the CHASSIS-LAYOUT section.

The AGC, HORIZONTAL-HOLD, COLOR-KILLER, and PINCUSHION sections of the book contain specific adjustment procedures from the manufacturers' service notes. All controls and test points referred to in this section are also shown on the chassis views in the CHASSIS-LAYOUT section.

MISCELLANEOUS – Any adjustments which are peculiar to a chassis of a specific manufacturer are given in this section.

CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD CB-	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
ADMIRAL											
1D11	A	A	A	1	A	A	A	A	A	-	-
1G-11	B	A	A	1	B1	A	A	B	A	-	-
1G-13	B	A	A1	2	B1	A	A	B	A	A	-
1H-12	F	A	A2	3	B1	A	A	B	A	A	-
2D-11	A	A	A	1	A	A	A	A	A	-	-
2G-11	B	A	A	1	B1	A	A	B	A	-	-
2G-13	B	A	A1	2	B1	A	A	B	A	A	-
2H-12	F	A	A2	3	B1	A	A	B	A	A	-
3D-11	A	A	A	1	A	A	A	A	A	-	-
3G-11	B	A	A	1	B1	A	A	B	A	-	-
3G-13	B	A	A1	2	B	A	A	B	A	A	-
3H-10	E	A	A2	3	B1	A	A	B	A	A	-
4D-11	A	A	A	1	A	A	A	A	A	-	-
4G-13	B	A	A1	2	B1	A	A	B	A	A	-
4H-10	E	A	A2	3	B1	A	A	B	A	A	-
4H-12	F	A	A2	3	B1	A	A	B	A	A	-
5G-13	B	A	A1	2	B1	A	A	B	A	A	-

5H-10	E	A	A2	3	B1	A	A	B	A	A	-
6G-13	B	A	A1	2	B	A	A	B	A	A	-
6H-10	E	A	A2	3	B1	A	A	B	A	A	-
9H-10	E	A	A2	3	B1	A	A	B	A	A	-
12G-13	D	A	A1	2	B	A	A	B	A	A	-
D-11	A	A	A	1	A	A	A	A	A	-	-
G-11	B	A	A	1	B	A	A	B	A	-	-
G-13	B	A	A1	2	B1	A	A	B	A	A	-
H-10	E	A	A2	3	B1	A	A	B	A	A	-
H-12	F	A	A2	3	B1	A	A	B	A	A	-
K-15	D	A	A2	3	B	A	A	B	A	A	-
AIRLINE											
GEN-8077A	AB	F	J	6	C	A	A	C	A	B	-
-8147A	AC	F	J	6	C	A	A	D	A	C	-
-8157A	AC	F	J	6	C	A	A	D	A	C	-
-8447A	AB	F	J	6	C	A	A	C	A	B	-
-12069A	AD	A	J	6	N	A	A	-	B	-	E, F
-12078A	AE	F	J	6	C	A	A	-	-	D	L
-12349A	AD	A	J	6	N	A	A	-	B	-	E, F
-12448A	AE	F	J	6	C	A	A	-	-	D	L
-17148A	AE	F	J	6	C	A	A	-	-	D	L
-17158A	AE	F	J	6	C	A	A	-	-	D	L
GHJ-7147A	AF	A	A	5	D3	A	A	E	B	-	L
-7157A	AF	A	A	5	D3	A	A	E	B	-	L
-7347A	AF	A	A	4	D3	A	A	E	A	-	L
-7357A	AF	A	A	4	D3	A	A	E	A	-	L
-7447A	AF	A	A	4	D3	A	A	E	A	-	L
-7457A	AF	A	A	4	D3	A	A	E	A	-	L
-7477A	AF	A	A	4	D3	A	A	E	A	-	L
-7747A	AF	A	A	4	D3	A	A	E	B	-	L
-7757A	AF	A	A	4	D3	A	A	E	B	-	L
-7927A	AF	A	A	4	D3	A	A	E	B	-	L
-7927A(B)	AF	A	A	4	D3	A	A	E	B	-	L
-7977A	AF	A	A	4	D3	A	A	E	B	-	L

CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
AIRLINE (CONT'D.)				CB-							
GHJ-7977A(B)	AF	A	A	4	D3	A	A	E	B	-	L
-8087A	AF	A	A	5	D3	A	A	E	B	-	L
-8097A	AF	A	A	5	D3	A	A	E	B	-	L
-8097B	AF	A	A	5	D3	A	A	E	B	-	L
-8247A	AG	A	A	5	D	A	A	F	A	-	L
-8257A	AG	A	A	5	D	A	A	F	A	-	L
-8746A	AF	A	A	4	D3	A	A	E	B	-	L
GMW-7627A	AC	A	A	4	C1	A	A	E	A	-	L
-7627B	AC	A	A	4	C1	A	A	E	A	-	L
-7647A	AC	A	A	4	C1	A	A	E	A	-	L
-7647B	AC	A	A	4	C1	A	A	E	A	-	L
-7657A	AC	A	A	4	C1	A	A	E	A	-	L
-7657B	AC	A	A	4	C1	A	A	E	A	-	L
-17447A	AC	A	A	4	C1	A	A	E	A	-	L
-17447B	AC	A	A	4	C1	A	A	E	A	-	L
CURTIS MATHES											
CMC-15	R	A	A	7	C1	A	A	E	A	E	L
-21	R	A	A	7	C1	A	A	E	A	E	L

CMC-24	R	A	F	8	C1	A	A	E	A	E	L
-26	S	A	F	8	C1	A	A	G	A	E	-
-27	S	A	F	8	C1	A	A	G	A	E	-
-28	S	A	F	8	C1	A	A	G	A	E	-
-29	S	A	F	8	C1	A	A	G	A	E	-
EMERSON											
120814A	AK	B	A	1	C2	A	A	-	-	E	-
120822A	AK	B	A	1	C2	A	A	-	-	E	-
120835A	AK	B	A	1	C2	A	A	-	-	E	-
120844A	AK	B	A	1	C2	A	A	-	-	E	-
120858A	AK	B	A	1	C2	A	A	-	-	E	-
120858B	AK	B	A	1	C2	A	A	-	-	E	-
120859A	AK	B	A	1	C2	A	A	-	-	E	-
120859B	AK	B	A	1	C2	A	A	-	-	E	-
120871A	AK	B	A	1	C2	A	A	-	-	E	-
120883B	AJ	B	A	1	C2	A	A	-	-	E	-
120884A	AJ	B	A	1	C2	A	A	-	-	E	-
120884B	AJ	B	A	1	C2	A	A	-	-	E	-
120890B	AJ	B	A	1	C2	A	A	-	-	E	-
120893A	AK	B	A	1	C2	A	A	-	-	E	-
120893B	AK	B	A	1	C2	A	A	-	-	E	-
120893C	AK	B	A	1	C2	A	A	-	-	E	-
120896A	AJ	B	A	1	C2	A	A	-	-	E	-
GENERAL ELECTRIC											
CB	AU	B	A	7 or 28	M	B	A	H	-	F	L
HB	AV	Refer to Dynamic Convergence Procedure Q			S	D	-	J	-	-	-
HC	AV				S	D	-	J	-	-	-
KC	AW	B	A	29	M	C	A	K	-	G	H
KD	AW	B	A	29	M	C	A	K	-	G	H
HOFFMAN											
FP-5004	AF	A	A	4	D	A	A	E	A	F	L
-5004B	AF	A	A	4	D	A	A	E	A	F	L
IP-5001	AF	A	A	4	D	A	A	E	A	F	L

CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
HOFFMAN (CONT'D.)				CB-							
IP-5001B	AF	A	A	4	D	A	A	E	A	F	L
-7001	AF	A	A	4	D	A	A	E	A	C	L
MS-5322	AF	A	A	4	D	A	A	E	A	F	L
-7005	AF	A	A	4	D	A	A	E	A	C	L
SP-5003	AF	A	A	4	D	A	A	E	A	F	L
-5003B	AF	A	A	4	D	A	A	E	A	F	L
-5311	AF	A	A	4	D	A	A	E	A	F	L
-5331	AF	A	A	4	D	A	A	E	A	F	L
-7003	AF	A	A	4	D	A	A	E	A	C	L
W-5002	AF	A	A	4	D	A	A	E	A	F	L
-5002B	AF	A	A	4	D	A	A	E	A	F	L
-5310	AF	A	A	4	D	A	A	E	A	F	L
-5320	AF	A	A	4	D	A	A	E	A	F	L
-5330	AF	A	A	4	D	A	A	E	A	F	L
-7002	AF	A	A	4	D	A	A	E	A	C	L
WP-7419A	AG	A	A	4	D	A	A	F	A	-	L

MAGNAVOX											
T-911	N	B	C	9	E	A	A	L	A	H	L
-918	N	B	D	10	E	A	A	L	A	H	L
-919	N	B	C	9	E	A	A	L	A	H	L
-920	N	B	C	9	E	A	A	L	A	H	L
-922	P	A	K	11	C4	A	A	-	A	E	-
-924	Q	G	C	9	F	A	A	M	A	-	-
-931	N	B	C	9	E	A	A	L	A	H	L
MOTOROLA											
20TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-921	AZ	A	P	26	G	F	A	N	B	J	J,L
22TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-918A	AZ	A	E	24	G	F	A	N	B	J	J,L
23TS-915A	BA	A	P	27	Q	E	C	N	-	K	A,G,L
-915B	BA	A	P	27	R	E	C	N	-	K	A,G,L
-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-919	BG	A	P	27	Q	E	C	N	-	K	A,G,L
A22TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
AG23TS-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L
ANTS-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L
C23TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-919A	BG	A	P	27	Q	E	C	N	-	K	A,G,L
-919B	BG	A	P	27	R	E	C	N	-	K	A,G,L
-921	AZ	A	P	26	G	F	A	N	B	J	J,L
D23TS-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
E23TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-919	BG	A	P	27	Q	E	C	N	-	K	A,G,L
-921	AZ	A	P	26	G	F	A	N	B	J	J,L
-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L

CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
MOTOROLA (CONT'D.)				CB-							
F20TS-921	AZ	A	P	26	G	F	A	N	B	J	J,L
F23TS-918	AZ	A	E	24	G	F	A	N	B	J	J,L
-921	AZ	A	P	26	G	F	A	N	B	J	J,L
-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L
H23TS-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L
J23TS-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914D	AZ	A	E	25	G	F	A	N	B	J	J,L
-A914E	AZ	A	E	25	G	F	A	N	B	J	J,L
NTS-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
PTS-A914	AZ	A	E	25	G	F	A	N	B	J	J,L
OLYMPIC											
CTC-16	T	B	F	8	C1	A	A	E	B	F	-
-17	T	B	F	8	C1	A	A	E	B	F	-
-18	T	B	F	8	C1	A	A	E	B	F	-
-19	U	B	F	8	C2	A	A	P	B	C	-
-20	V	B	F	8	C2	A	A	P	B	C	-
-21	U	B	F	8	C2	A	A	P	B	C	-
CT-910	W	B	B1	12	H	A	A	Q	B	C	-

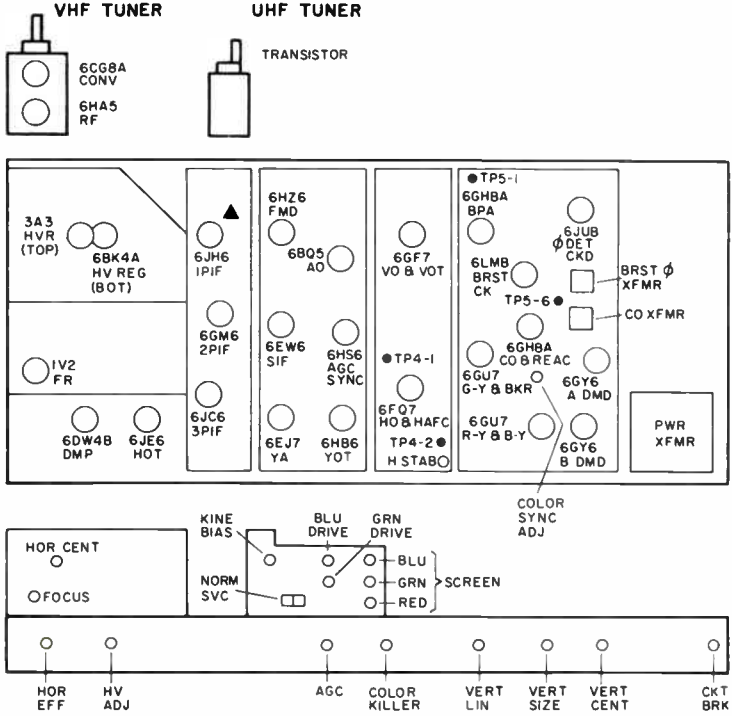
PACKARD BELL												
98C8	AQ	A	A	30	C	A	B	N	C	G	B
98C9	AQ	A	A	30	C	A	B	N	C	G	B
98C10	AQ	A	A	30	C	A	B	N	C	G	B
98C11	AX	A	A3	31	C	A	B	N	C	G	B
98C15	AR	A	A3	31	C	A	B	N	C	G	B
98C17	AR	A	A3	31	C	A	B	N	C	G	B
98C18A	AS	A	A3	31	C	A	B	N	C	G	B
98C19	AS	A	A3	31	C	A	B	N	C	G	B
99C1	AT	A	A	30	C	A	B	N	C	-	-
PHILCO												
16M91	X	A	L	13	C	A	A	R	A	-	-
16M91A	X	A	L	13	C	A	A	R	A	-	-
16NT82	Y	A	L	13	C	A	A	S	A	G	-
16QT85	Y	A	L	13	C	A	A	S	A	G	-
16QT85A	Y	A	L	13	C	A	A	S	A	G	-
17KT50	Y	A	L	13	C	A	A	S	A	G	-
17MT80	Y	A	L	13	C	A	A	S	A	G	-
17MT80A	Y	A	L	13	C	A	A	S	A	G	-
17MT80B	Y	A	L	13	C	A	A	S	A	G	-
17NT82	Y	A	L	13	C	A	A	S	A	G	-
17QT85A	Y	A	L	13	C	A	A	S	A	G	-
RCA												
CTC-19	G	B	F	8	D2	A	A	U	A	E	L
-20	G	B	F	8	D2	A	A	U	A	E	L
-21	J	B	F	8	D	A	A	E	A	E	L
-22	K	C	H	14	J	A	A	V	A	-	D,L
-24	G	B	F	8	D2	A	A	U	A	E	L
-25	J	B	F	8	D	A	A	E	A	E	L
-25X	J	B	F	8	D	A	A	E	A	E	L
-27	L	B	F	8	D1	A	A	W	A	E	B,L
-27X	L	B	F	8	D1	A	A	W	A	E	B,L
-28	M	B	F	8	D1	A	A	E	A	E	L
-30	M	B	F	8	D1	A	A	E	A	E	L
-31	L	B	F	8	D1	A	A	W	A	E	B,L
-35	M	B	F	8	D1	A	A	E	A	E	L

CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD CB-	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
SEARS/SILVERTONE											
528.62256	AL	A	A	1	K	A	A	E	D	A	-
.62257	AL	A	A	1	K	A	A	E	D	A	-
.62258	AL	A	A	1	K	A	A	E	D	A	-
.62262	AL	A	A	7	K	A	A	E	D	A	-
.62330	AL	A	A	1	K	A	A	E	D	A	-
.62552	AM	A	A	21	L	A	A	-	D	-	-
.62553	AM	A	A	21	L	A	A	-	D	-	-
.62554	AM	A	A	21	L	A	A	-	D	-	-
.62555	AM	A	A	21	L	A	A	-	D	-	-
.62561	AM	A	A	21	L	A	A	-	D	-	-
.62562	AM	A	A	21	L	A	A	-	D	-	-
.62563	AM	A	A	21	L	A	A	-	D	-	-
.62642	AM	A	A	21	L	A	A	-	D	-	-
.62643	AM	A	A	21	L	A	A	-	D	-	-
.62644	AM	A	A	21	L	A	A	-	D	-	-
.62645	AM	A	A	21	L	A	A	-	D	-	-
.62651	AM	A	A	21	L	A	A	-	D	-	-

528.62652	AM	A	A	21	L	A	A	–	D	–	–
.62653	AM	A	A	21	L	A	A	–	D	–	–
529.62256	AL	A	A	1	K	A	A	E	D	A	L
.62257	AL	A	A	1	K	A	A	E	D	A	L
.62258	AL	A	A	1	K	A	A	E	D	A	L
.62262	AL	A	A	7	K	A	A	E	D	A	L
.62330	AL	A	A	1	K	A	A	E	D	A	L
.62552	AM	A	A	21	L	A	A	–	D	–	–
.62553	AM	A	A	21	L	A	A	–	D	–	–
.62554	AM	A	A	21	L	A	A	–	D	–	–
.62555	AM	A	A	21	L	A	A	–	D	–	–
.62561	AM	A	A	21	L	A	A	–	D	–	–
.62562	AM	A	A	21	L	A	A	–	D	–	–
.62563	AM	A	A	21	L	A	A	–	D	–	–
.62642	AM	A	A	21	L	A	A	–	D	–	–
.62643	AM	A	A	21	L	A	A	–	D	–	–
.62644	AM	A	A	21	L	A	A	–	D	–	–
.62645	AM	A	A	21	L	A	A	–	D	–	–
.62651	AM	A	A	21	L	A	A	–	D	–	–
.62652	AM	A	A	21	L	A	A	–	D	–	–
.62653	AM	A	A	21	L	A	A	–	D	–	–
562.10200	AN	E	B	22	C3	A	A	T	D	L	–
.10201	AN	E	B	22	C3	A	A	T	D	L	–
.10210	AN	E	B	22	C3	A	A	T	D	L	–
.10220	AO	A	B	23	C3	A	A	–	D	M	–
.10221	AO	A	B	23	C3	A	A	–	D	M	–
.10222	AO	A	B	23	C3	A	A	–	D	M	–
.10410	AO	A	B	23	C3	A	A	–	D	M	–
.10411	AO	A	B	23	C3	A	A	–	D	M	–
564.10200	AP	A	G	19	C4	A	A	–	D	E	–
SYLVANIA											
DO1-1	Z	A	A	7	P	A	A	X	A	–	L
-2	Z	A	A	7	P	A	A	X	A	–	L

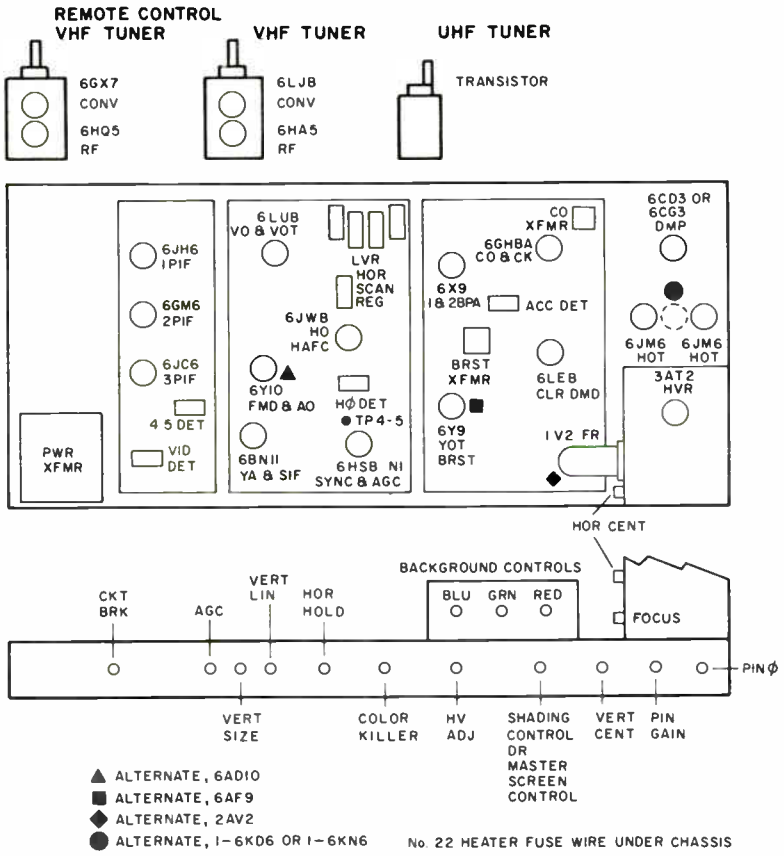
CHASSIS No.	CHASSIS LAYOUT	FIELD ADJUSTMENTS									
		PURITY	CONVERGENCE	CONV BOARD	B & W SETUP	AFPC	AGC	HORIZONTAL HOLD	COLOR KILLER	PINCUSHION	MISCELLANEOUS
SYLVANIA (CONT'D.)				CB-							
DO1-8	Z	A	A	7	P	A	A	X	A	-	L
DO2-1	Z	A	M	15	P	A	A	X	A	-	L
-2	Z	A	M	15	P	A	A	X	A	-	L
-5	Z	A	M	15	P	A	A	X	A	-	L
-6	Z	A	M	15	P	A	A	X	A	-	L
-7	Z	A	M	15	P	A	A	X	A	-	L
-8	Z	A	M	15	P	A	A	X	A	-	L
-9	Z	A	M	15	P	A	A	X	A	-	L
-10	Z	A	M	15	P	A	A	X	A	-	L
-11	Z	A	M	15	P	A	A	X	A	-	L
-12	Z	A	M	15	P	A	A	X	A	-	L
DO6-1	AA	A	N	16	M	A	A	Y	A	-	D
-2	AA	A	N	16	M	A	A	Y	A	-	D
DO9-2	AY	A	N	16	T	A	A	Z	A	H	L
-4	AY	A	N	16	T	A	A	Z	A	H	L
DO10-1	AY	C	N	16	T	A	A	Z	A	H	L
-2	AY	C	N	16	T	A	A	Z	A	H	L
-4	AY	C	N	16	T	A	A	Z	A	H	L

ZENITH											
20X1C36	BE	A	G	18	C	A	A	AA	B	N	B, C, K
20X1C38	BE	A	G	18	C	A	A	AA	B	N	B, C, K
20Y1C37	BE	A	G	18	C	A	A	AA	B	N	B, C, K
20Y1C38	BE	A	G	18	C	A	A	AA	B	N	B, C, K
20Y1C48	BF	A	G	18	C	A	A	AA	B	N	B, C, K
20Y1C50	BF	A	G	18 or 20	C	A	A	AA	B	N	B, C, K
20Z1C37	BE	A	G	18 or 20	C	A	A	AA	B	N	B, C, K
23XC36	BE	A	G	18	C	A	A	AA	B	N	B, C, K
23XC38	BE	A	G	18	C	A	A	AA	B	N	B, C, K
23XC38Z	BE	A	G	18	C	A	A	AA	B	N	B, C, K
24NC31	BB	A	G	17	C	A	A	AA	B	N	B, C, K
25MC46	BC	A	G	17	C	A	A	AA	B	N	B, C, K
25NC37	BD	A	G	18	C	A	A	AA	B	N	B, C, K
25NC38	BD	A	G	18	C	A	A	AA	B	N	B, C, K

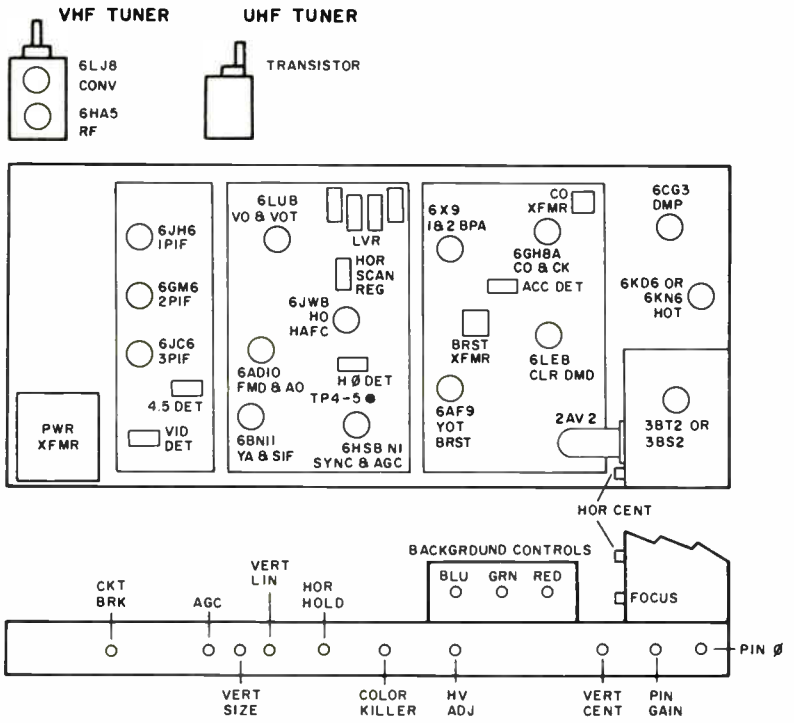


▲ ALTERNATE, 6BZ6

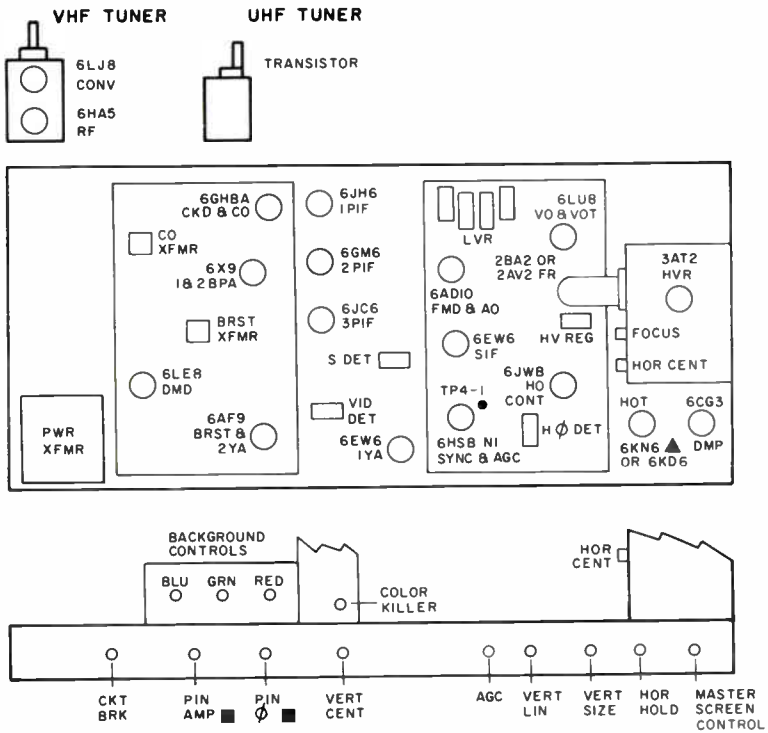
No. 22 HEATER FUSE WIRE UNDER CHASSIS



Chassis B



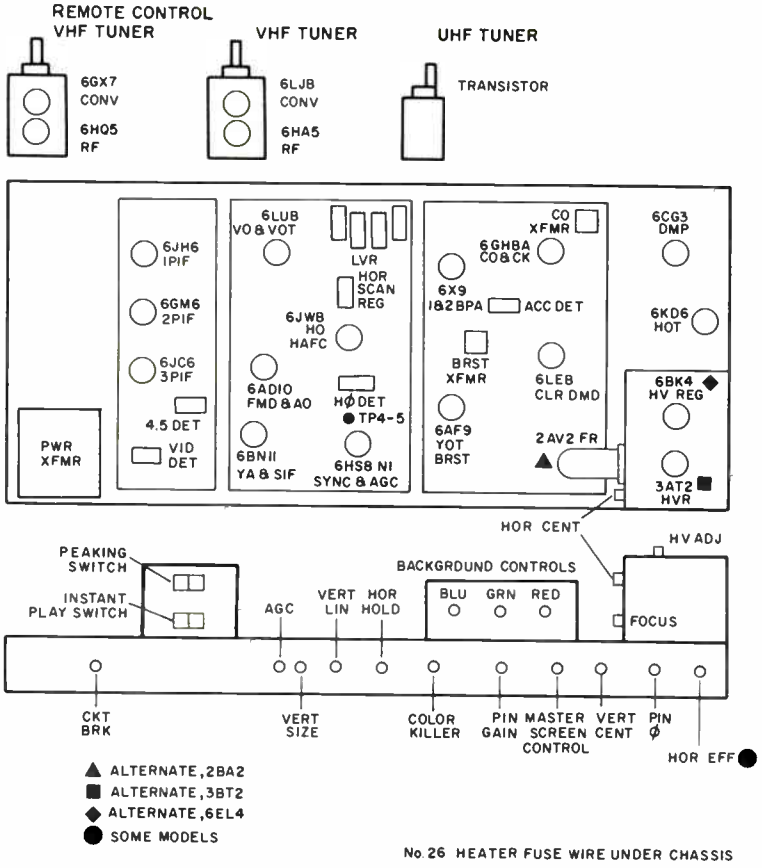
HEATER FUSE WIRE UNDER CHASSIS.

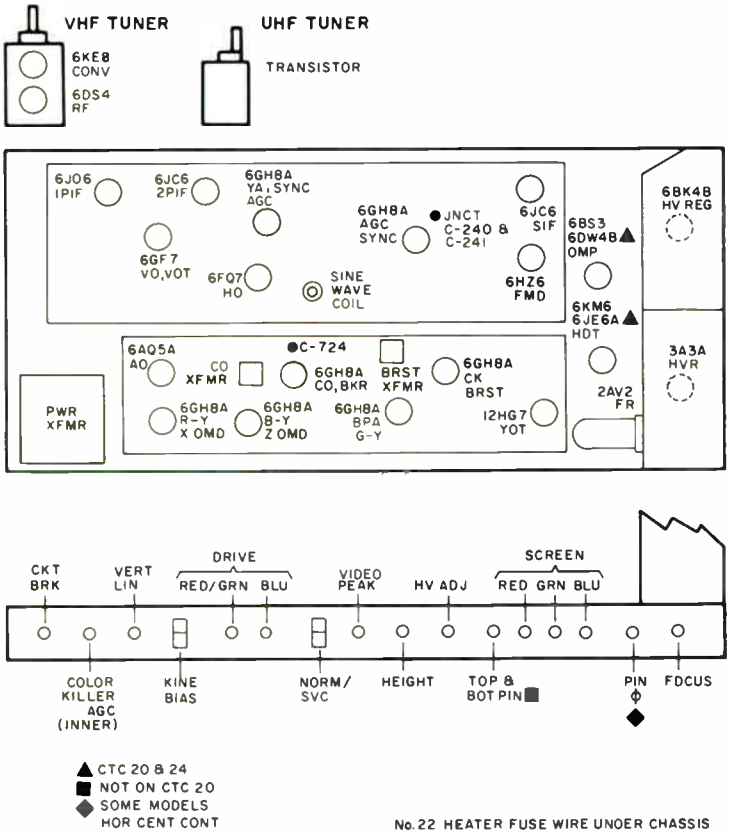


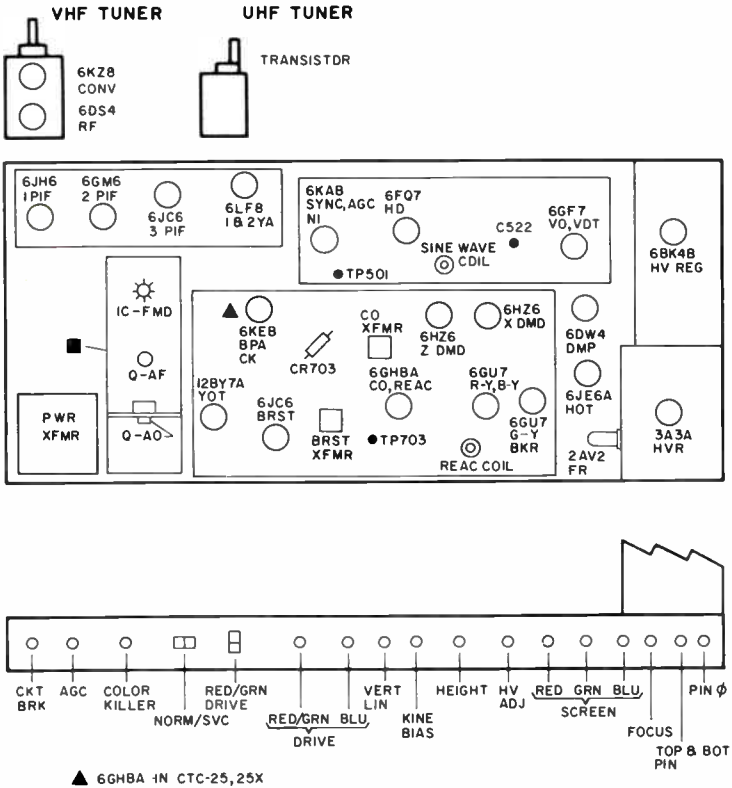
▲ ALTERNATE TYPE, 6KG6
■ SOME MODELS

No. 22 HEATER FUSE WIRE UNDER CHASSIS

Chassis E





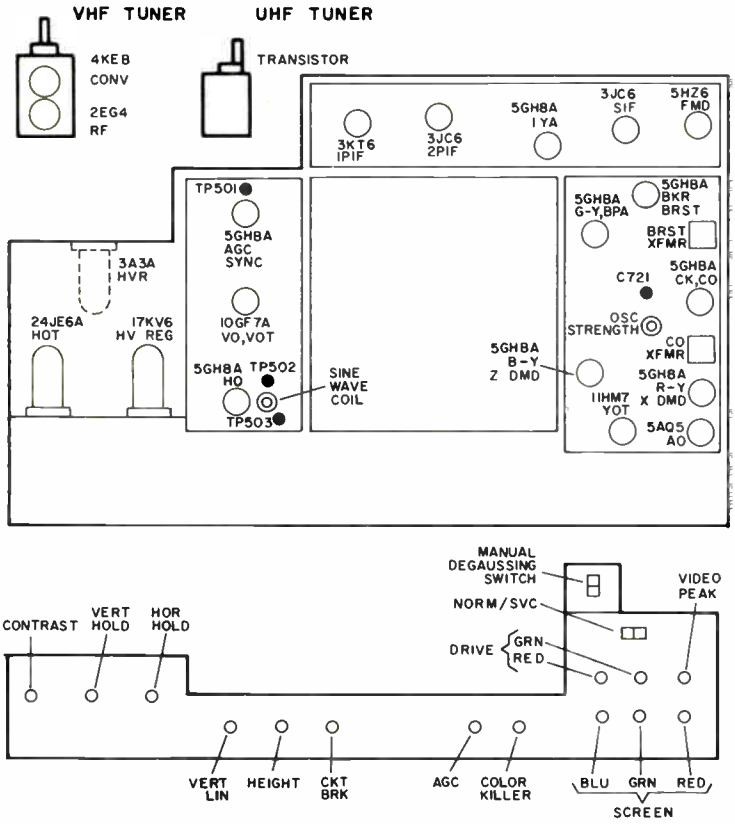


▲ 6GH8A IN CTC-25, 25X

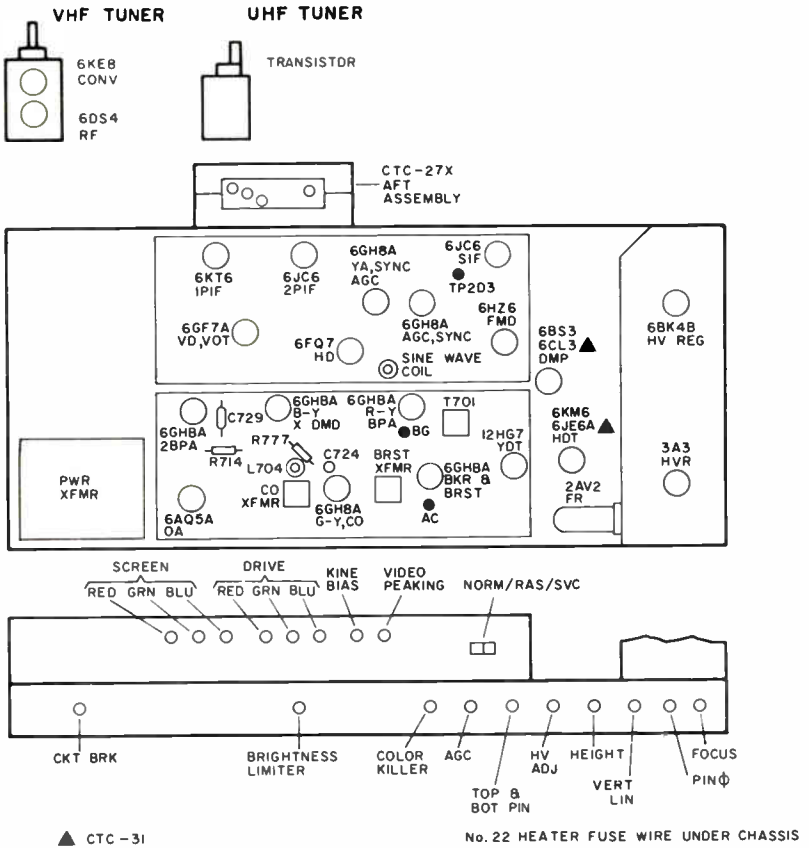
■ CTC-25X AUDIO-6EW6, 6HZ6, 6AQ5A

AFC CHASSIS ON CTC-21 NOT SHOWN

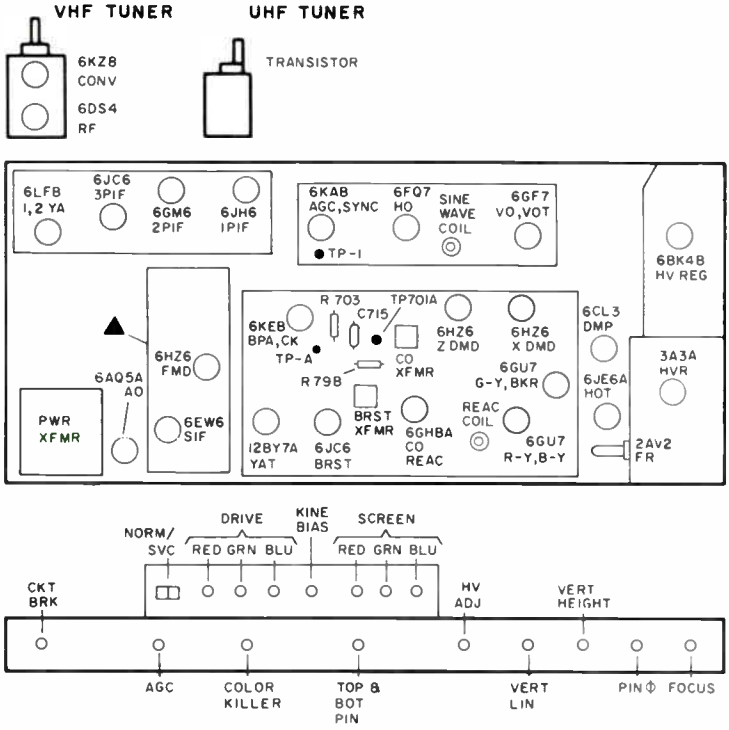
No 22 HEATER FUSE WIRE UNDER CHASSIS



Chassis K

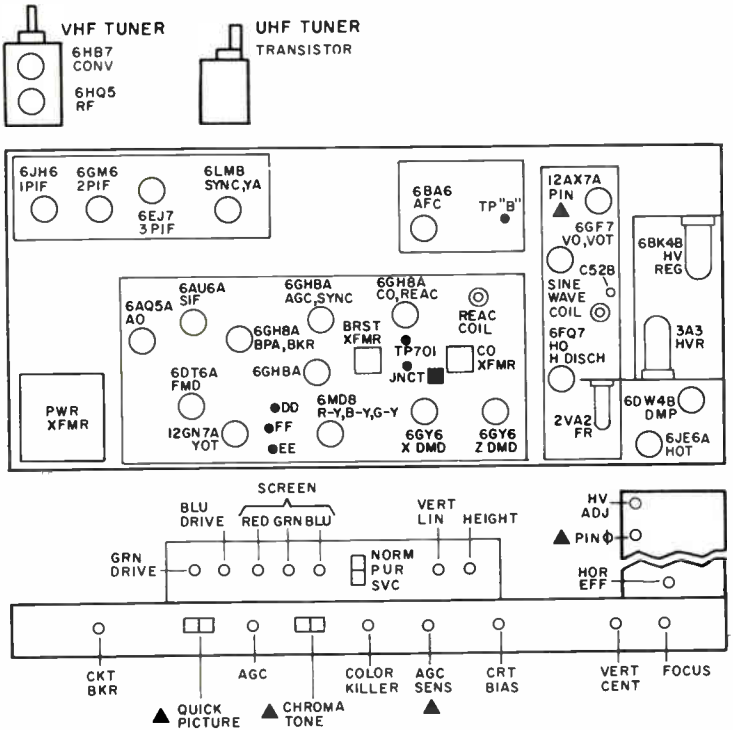


Chassis L



▲ CTC-30, SOLID STATE AUDIO

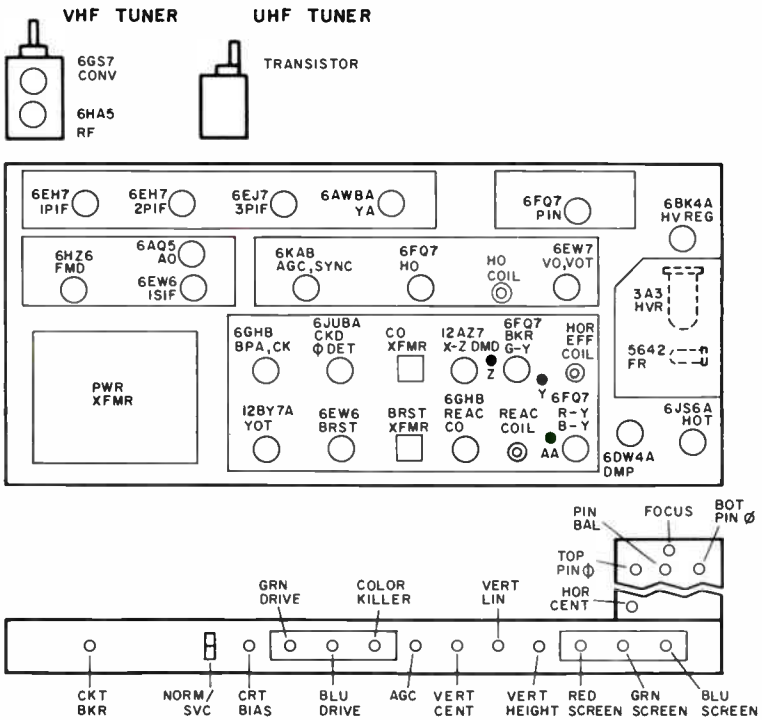
No. 22 HEATER FUSE WIRE UNDER CHASSIS



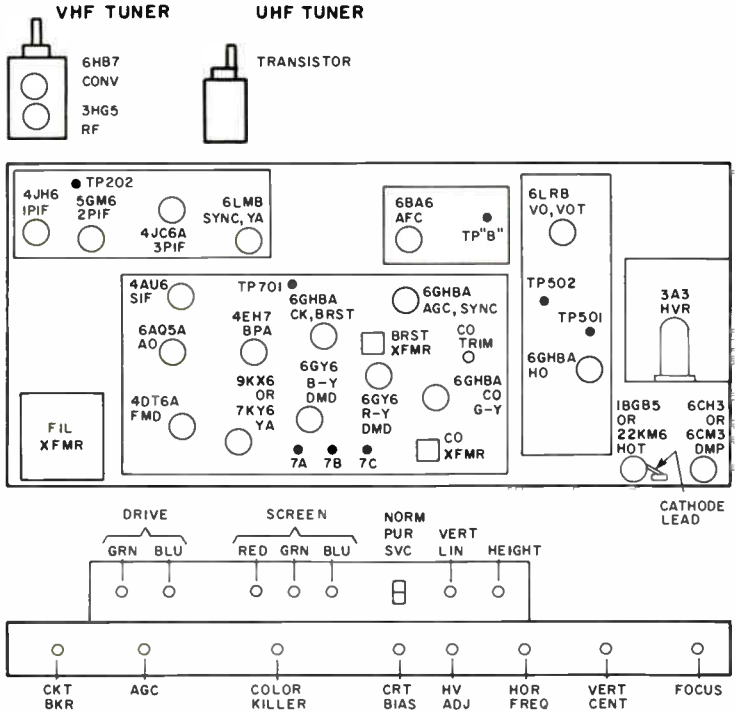
▲ SOME MODELS

■ R-759B & CR-7028

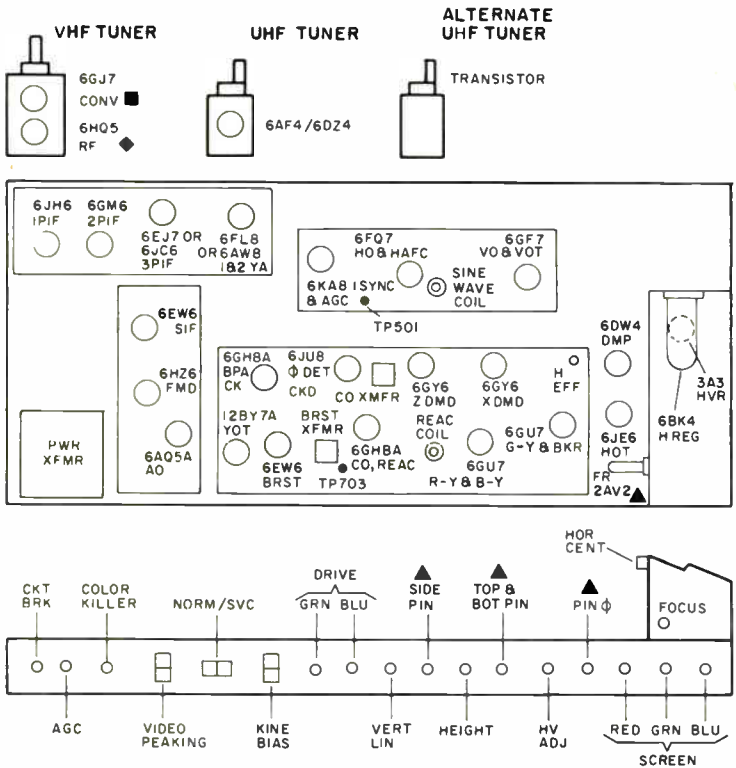
No. 22 HEATER FUSE WIRE UNDER CHASSIS



TWO No. 22 HEATER FUSE WIRES UNDER CHASSIS

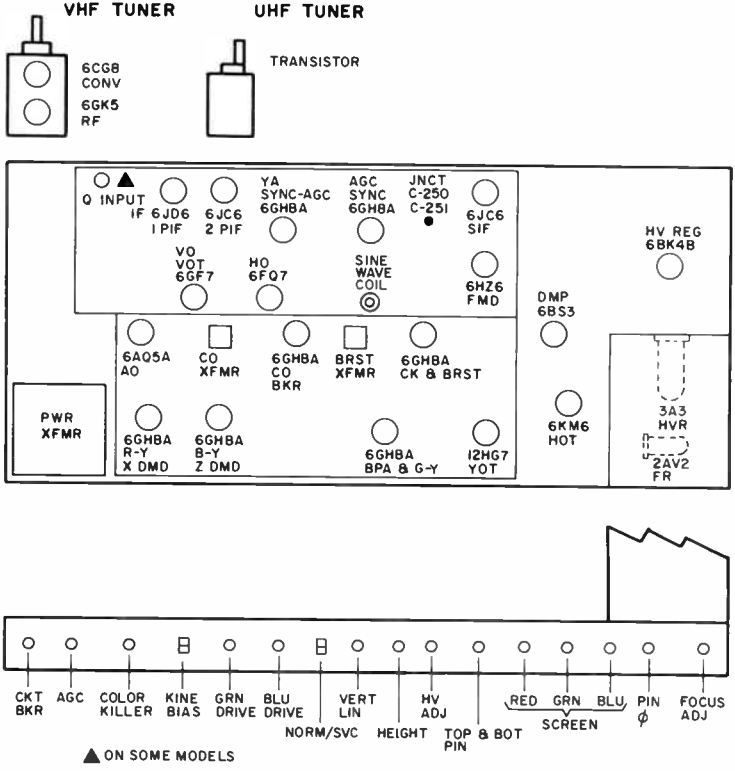


No. 24 HEATER FUSE WIRE UNDER CHASSIS

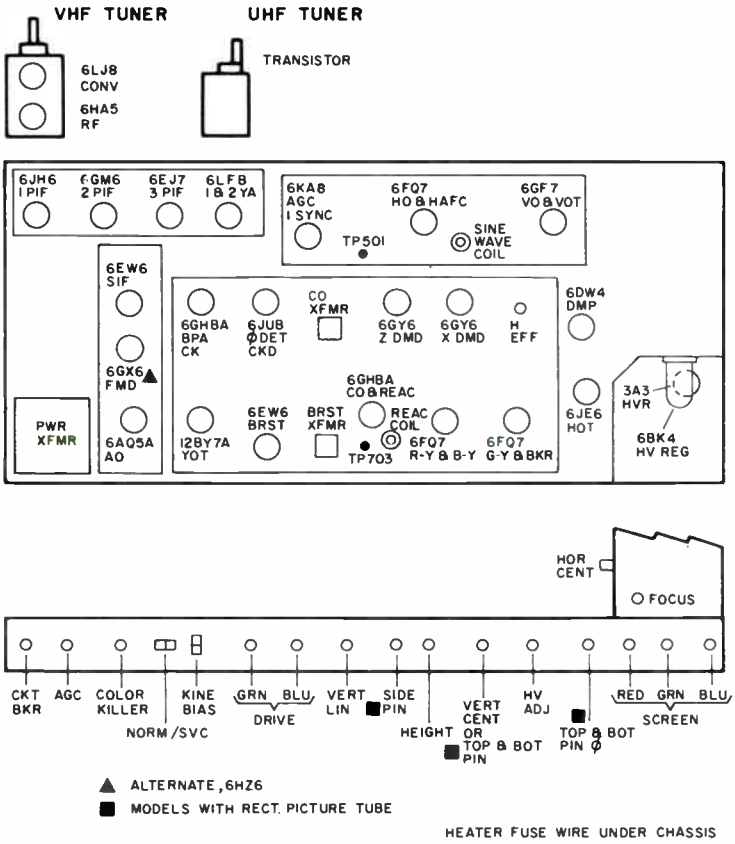


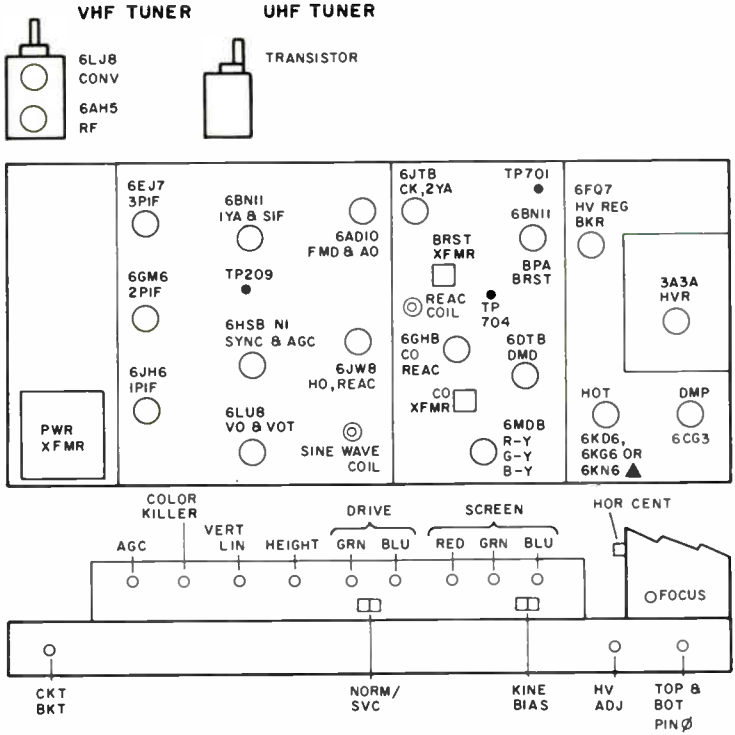
▲ ON SOME MODELS
■ ALTERNATE TYPES 6CGBA, 6FG7, 6GX7
◆ ALTERNATE TYPES 6HA5, 6DS4

No 26 HEATER FUSE WIRE UNDER CHASSIS



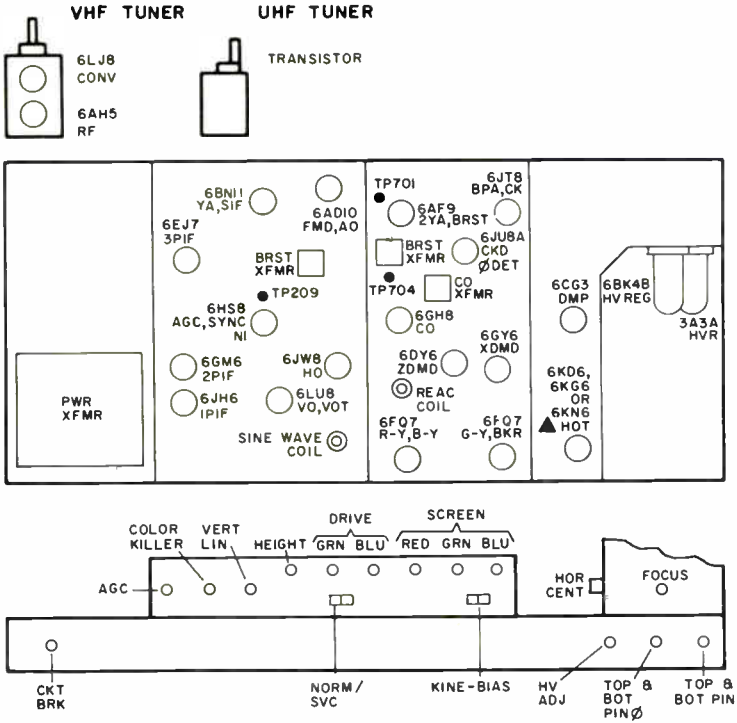
No. 26 HEATER FUSE WIRE UNDER CHASSIS





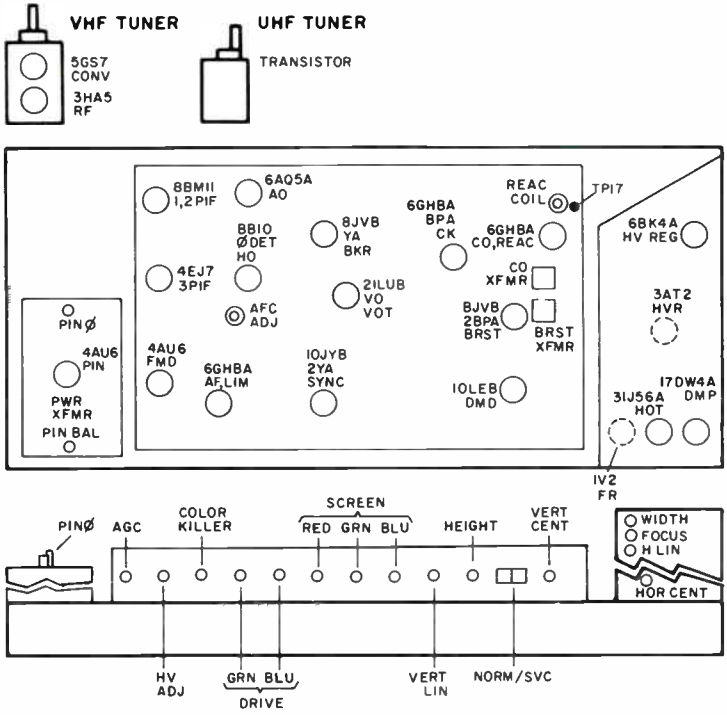
▲ REPLACE ONLY WITH SAME TYPE

HEATER FUSE WIRE UNDER CHASSIS

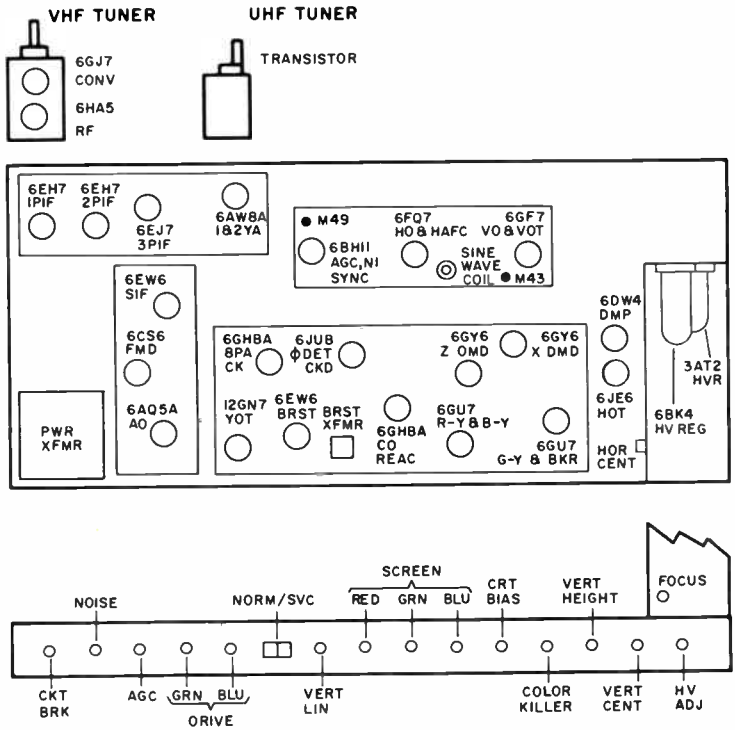


▲ REPLACE WITH ORIGINAL TYPE

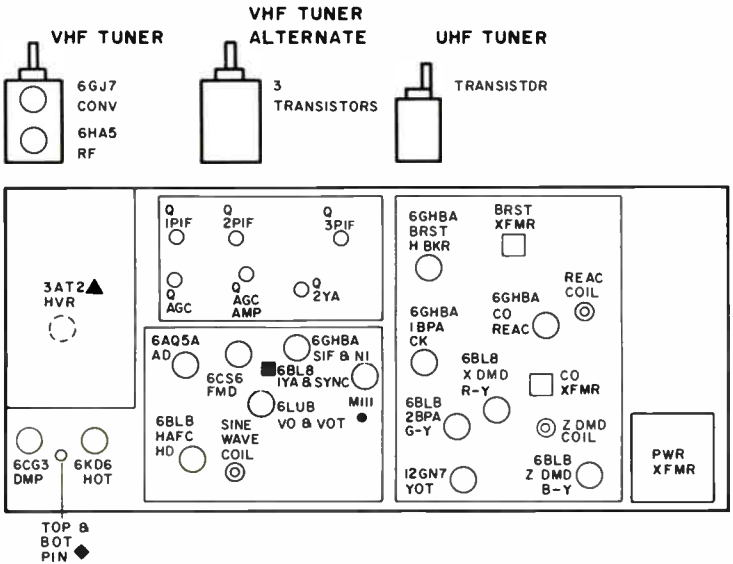
HEATER FUSE WIRE UNDER CHASSIS



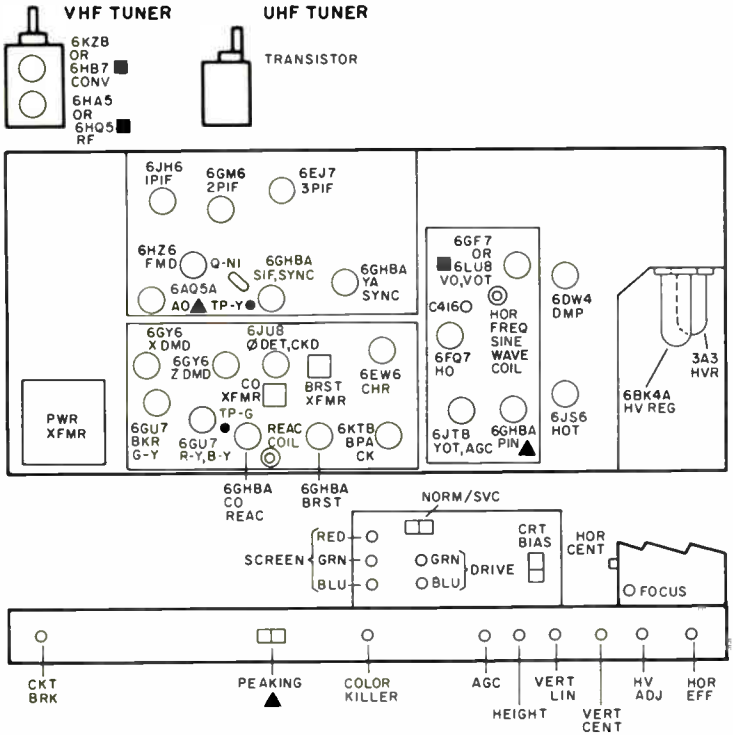
LINE FUSE WIRE UNDER POWER SUPPLY



HEATER FUSE WIRE UNDER CHASSIS



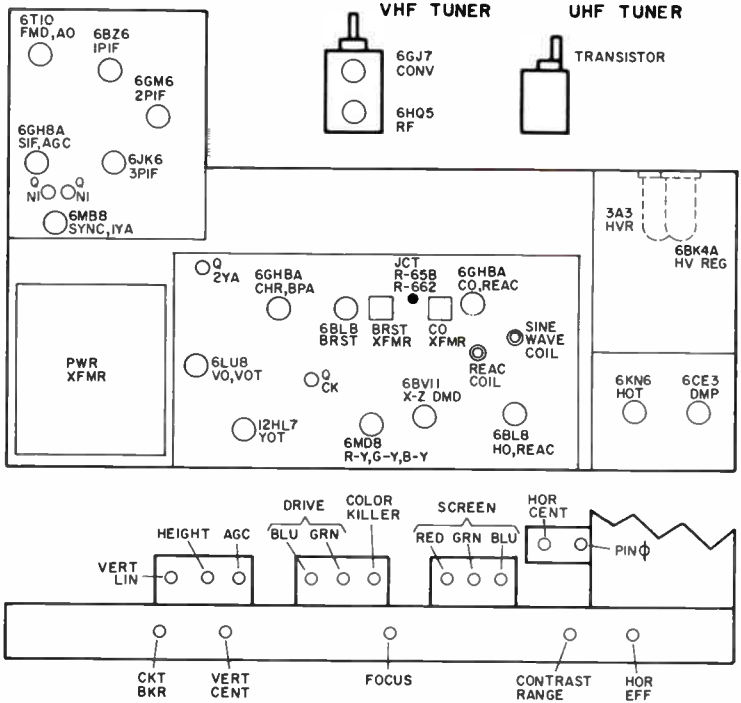
HEATER FUSE WIRE UNDER CHASSIS



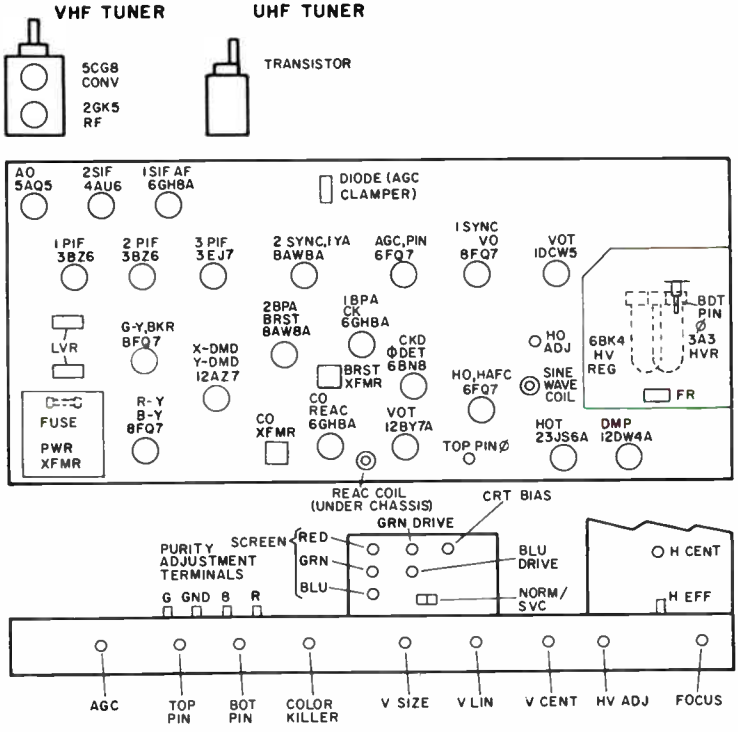
▲ SOME MODELS

■ REPLACE WITH ORIGINAL TUBE TYPE ONLY

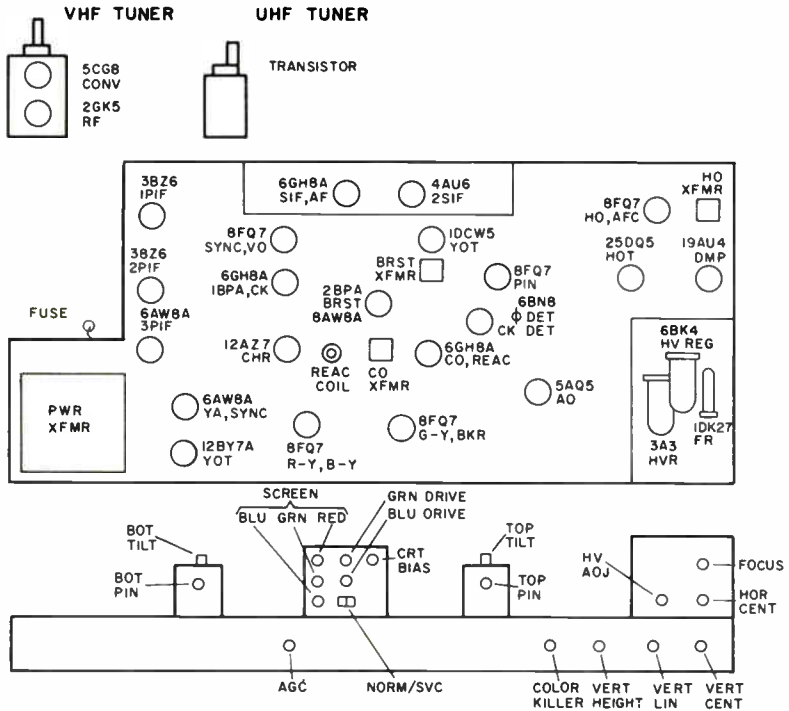
No 24 HEATER FUSE WIRE UNDER CHASSIS



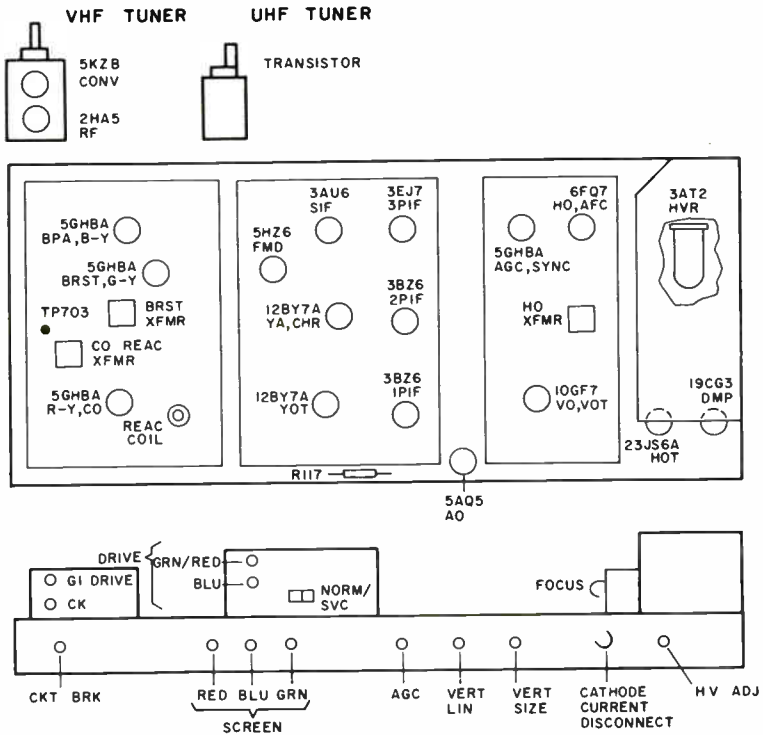
No. 24 HEATER WIRE UNDER CHASSIS

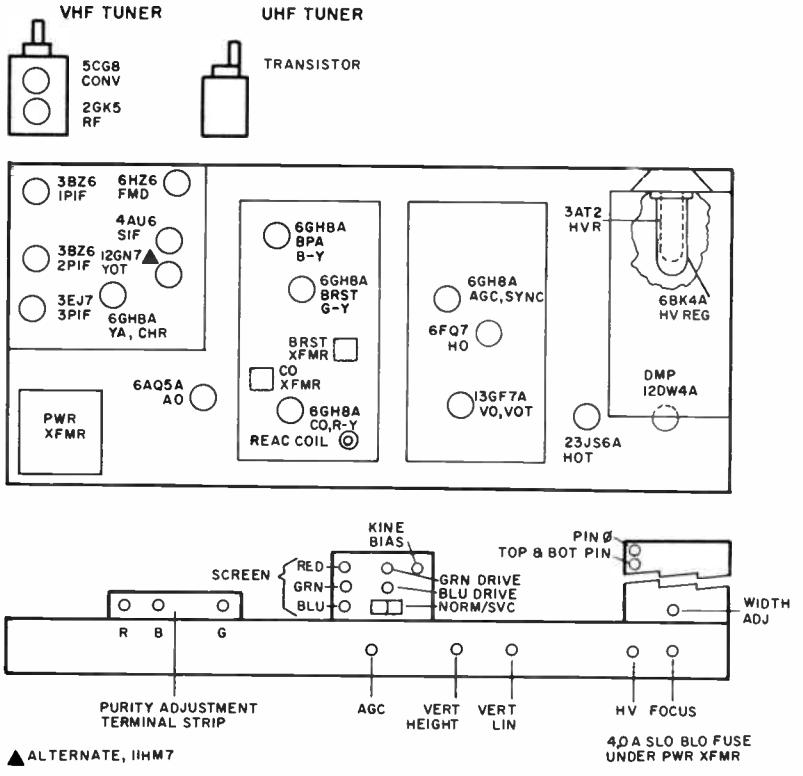


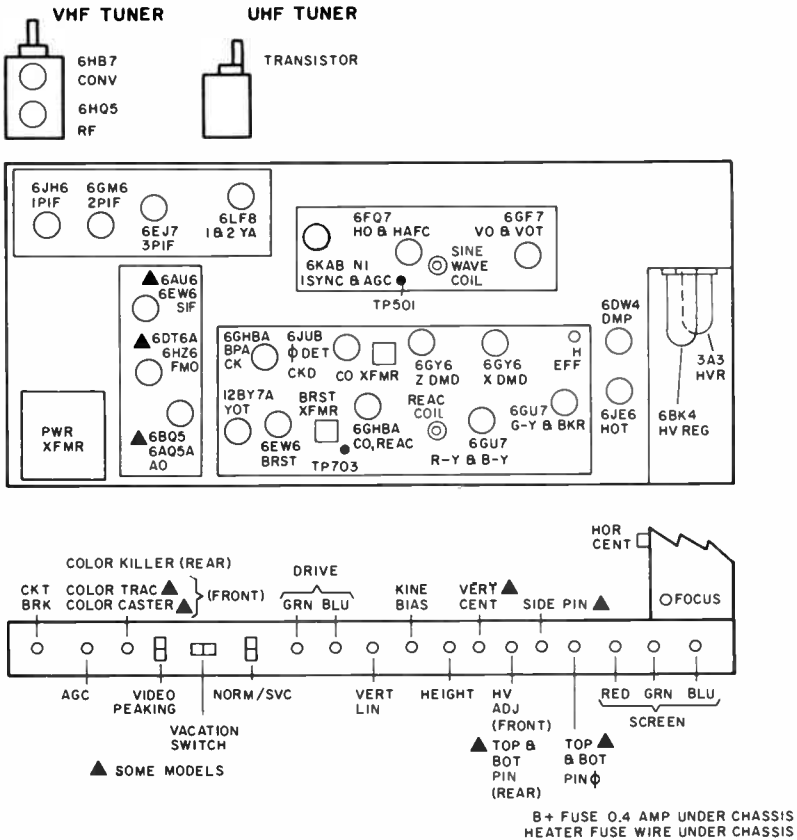
4.0 A SLO BLO FUSE UNDER PWR XFMR

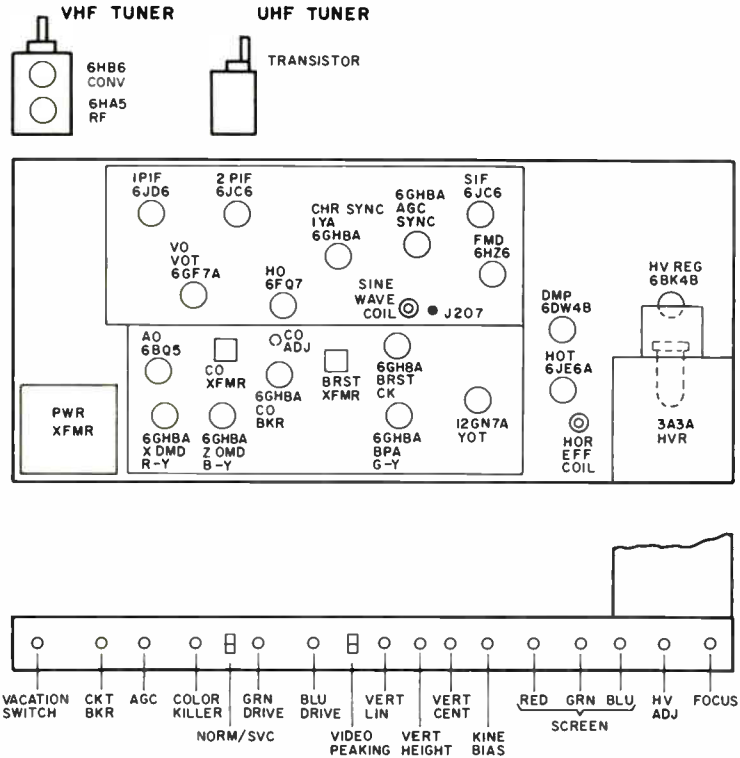


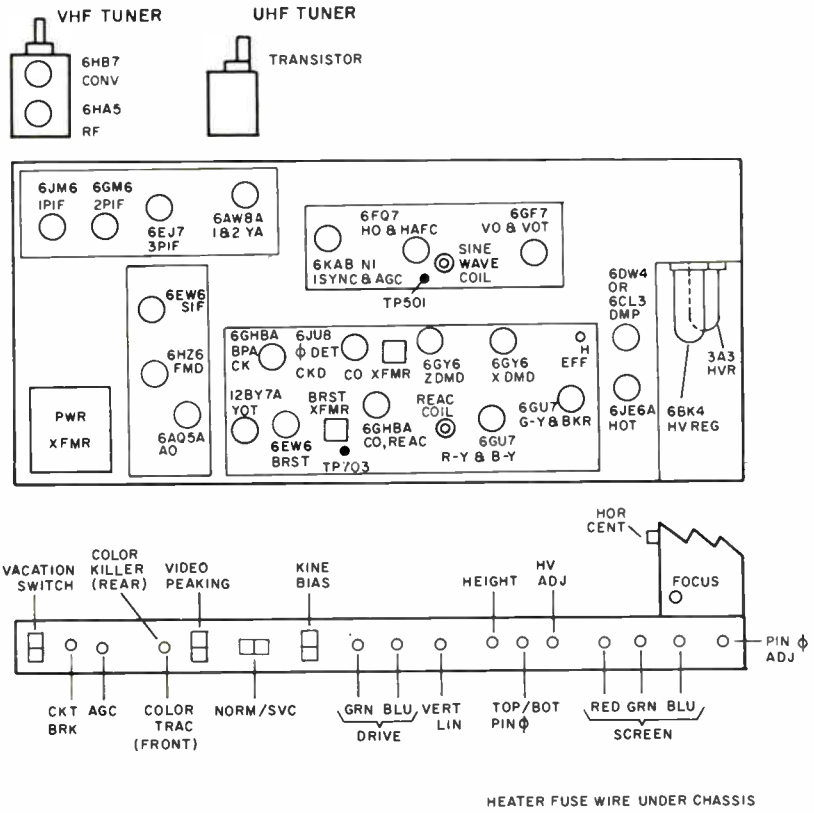
3,2 A SLO BLO FUSE

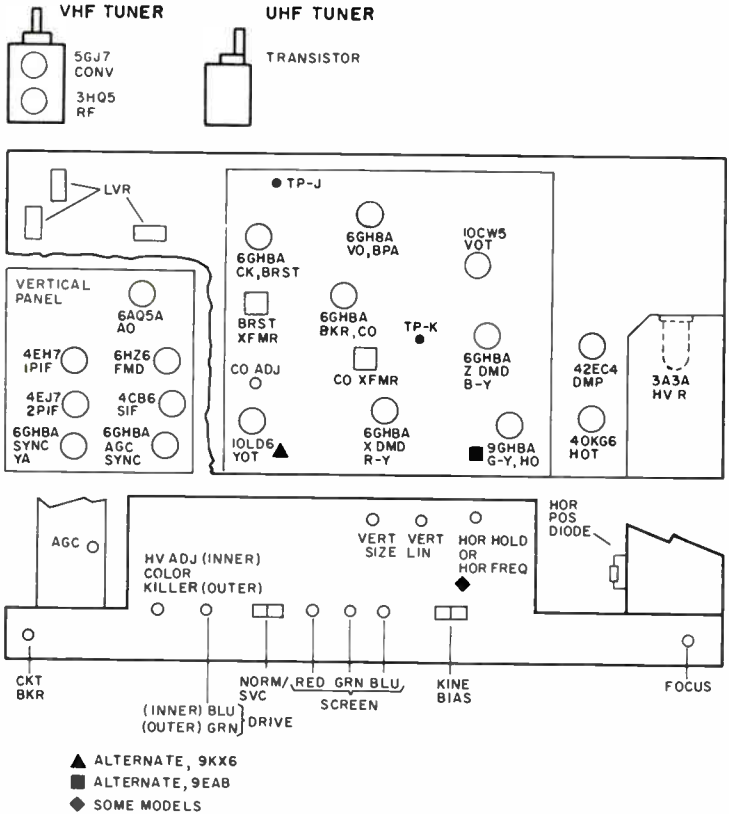


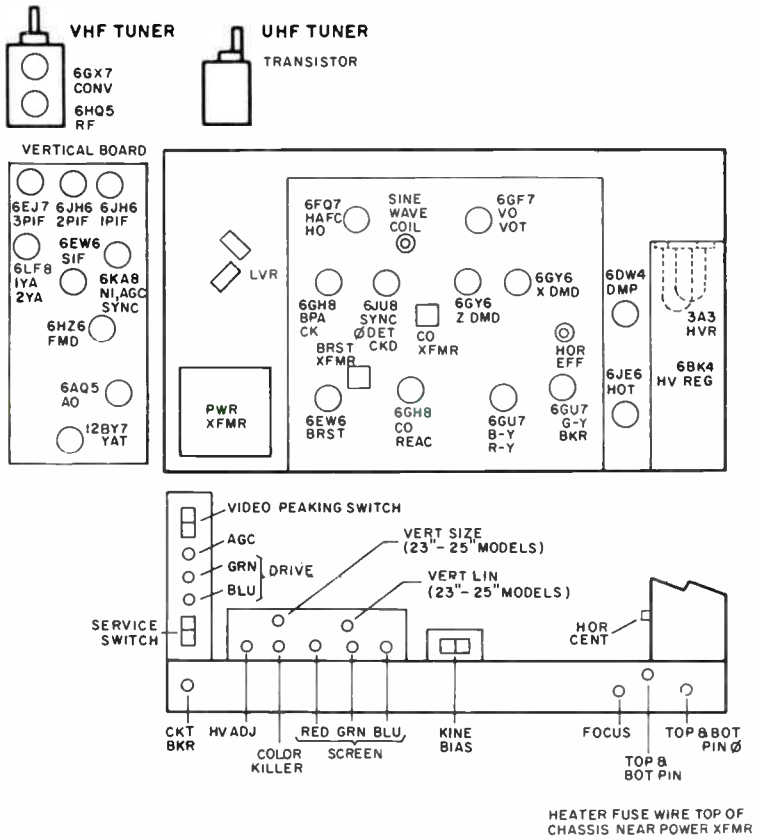


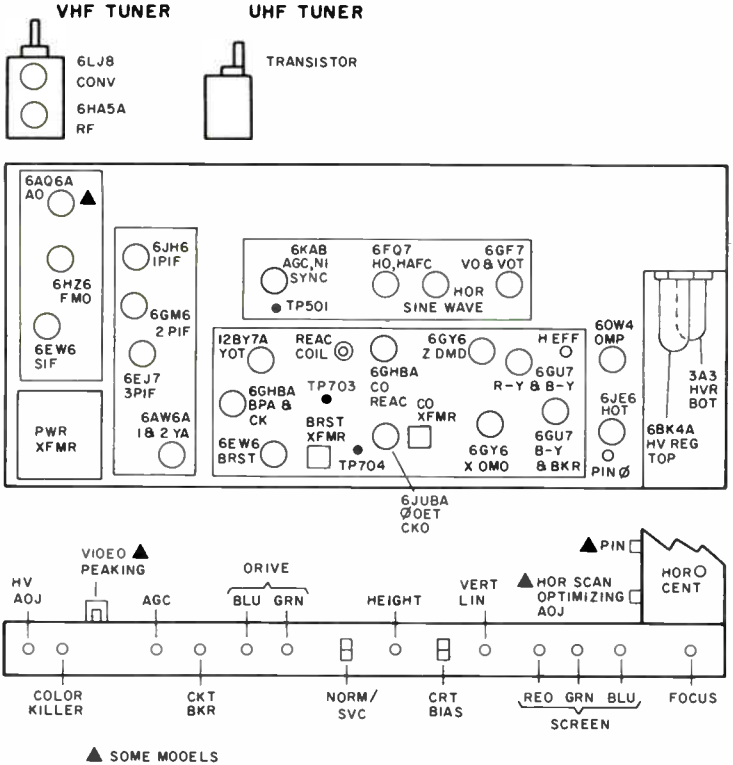




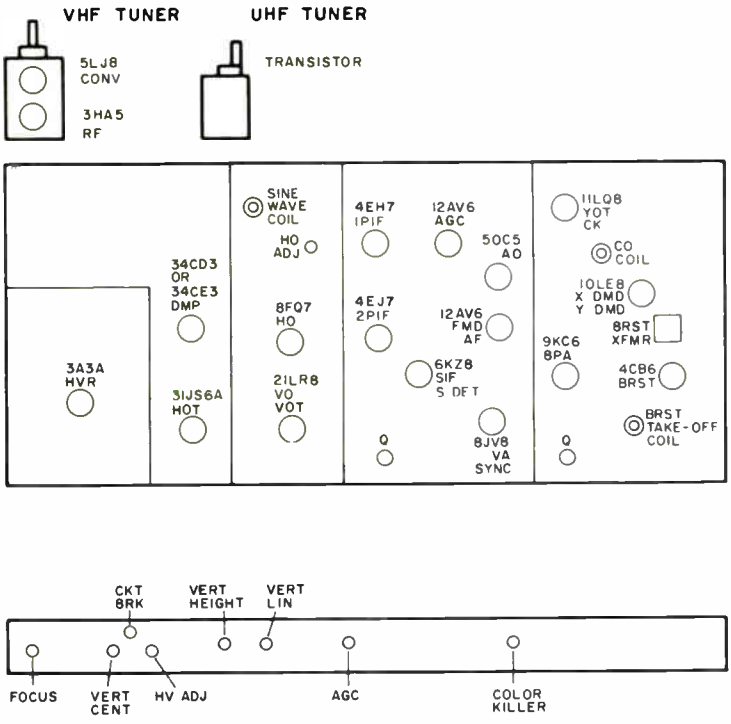


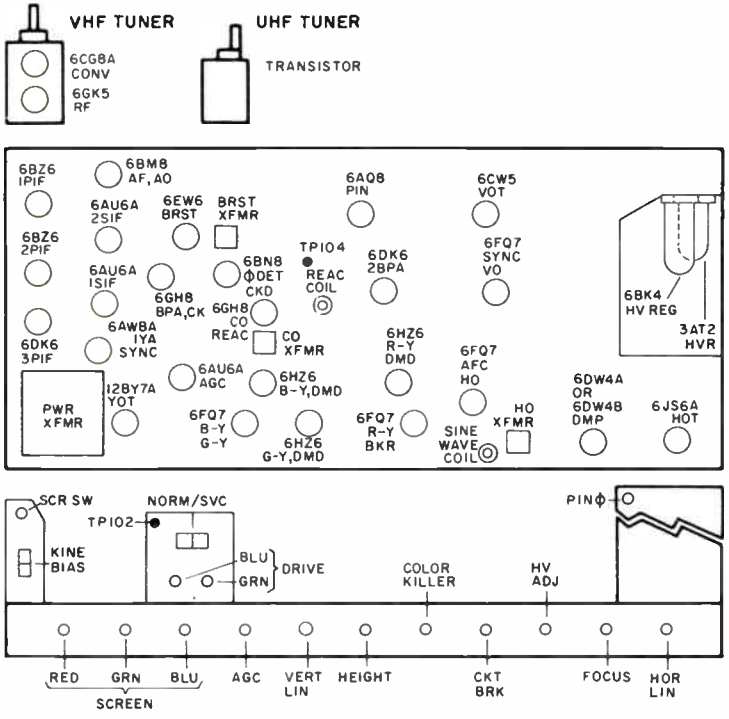




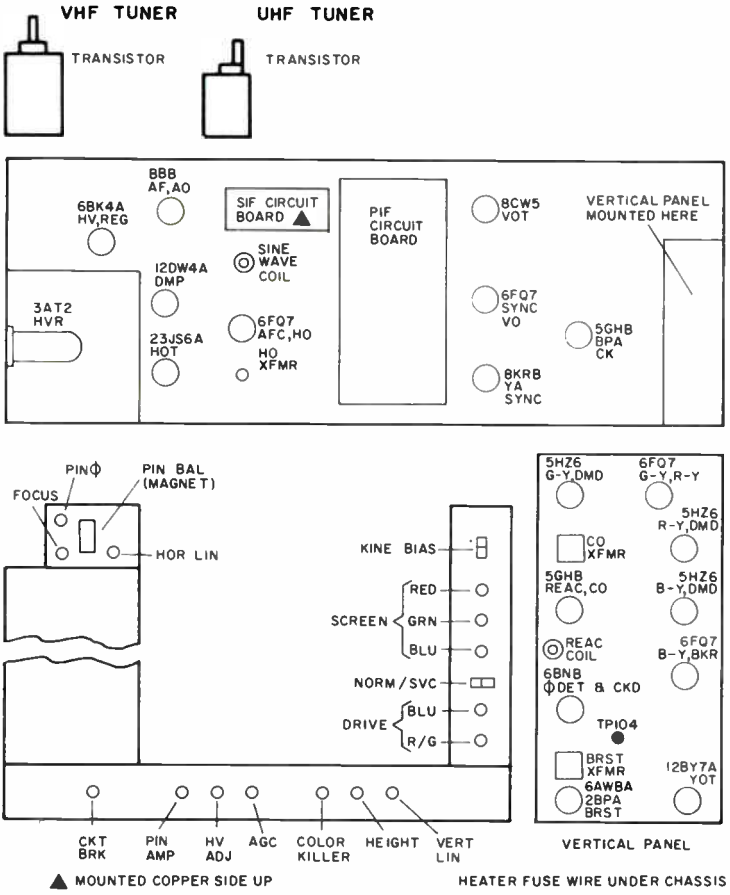


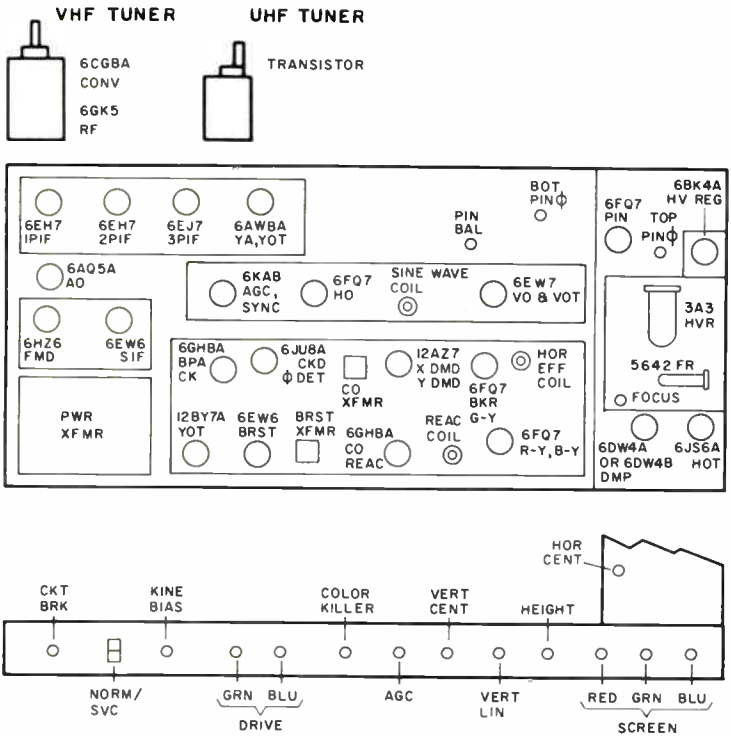
HEATER FUSE WIRE UNDER CHASSIS



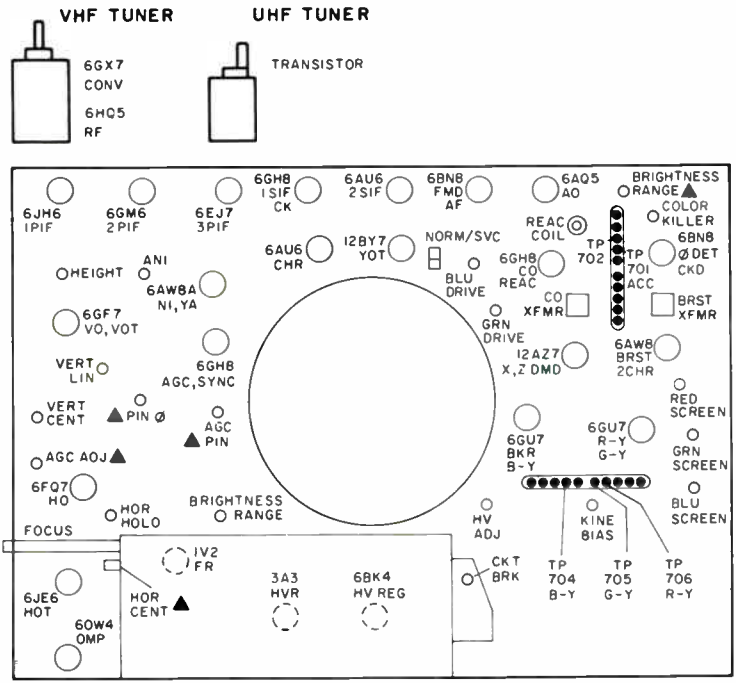


HEATER FUSE WIRE UNDER CHASSIS

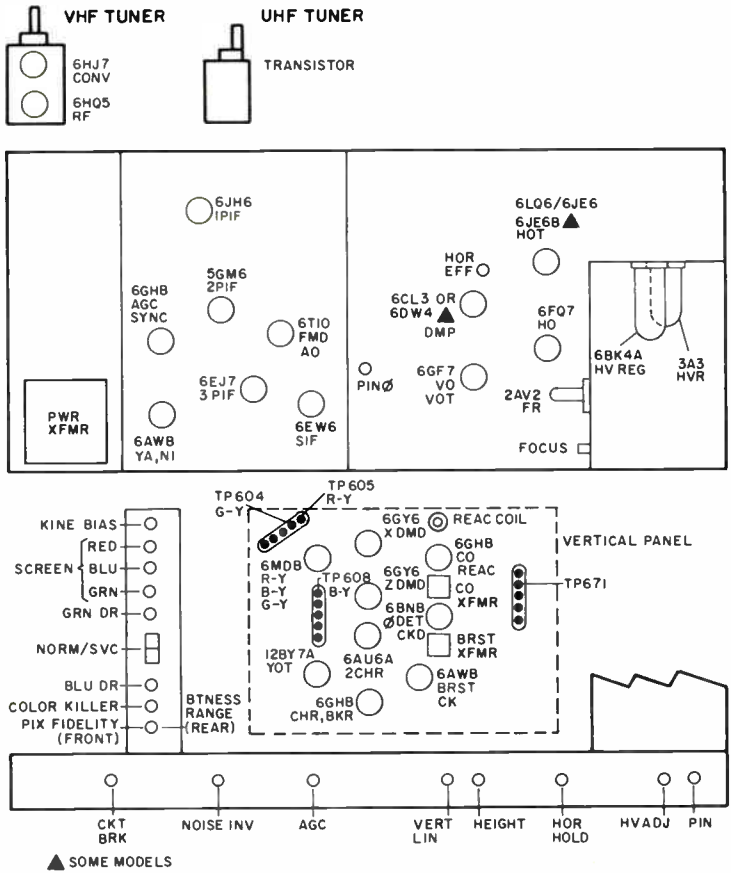




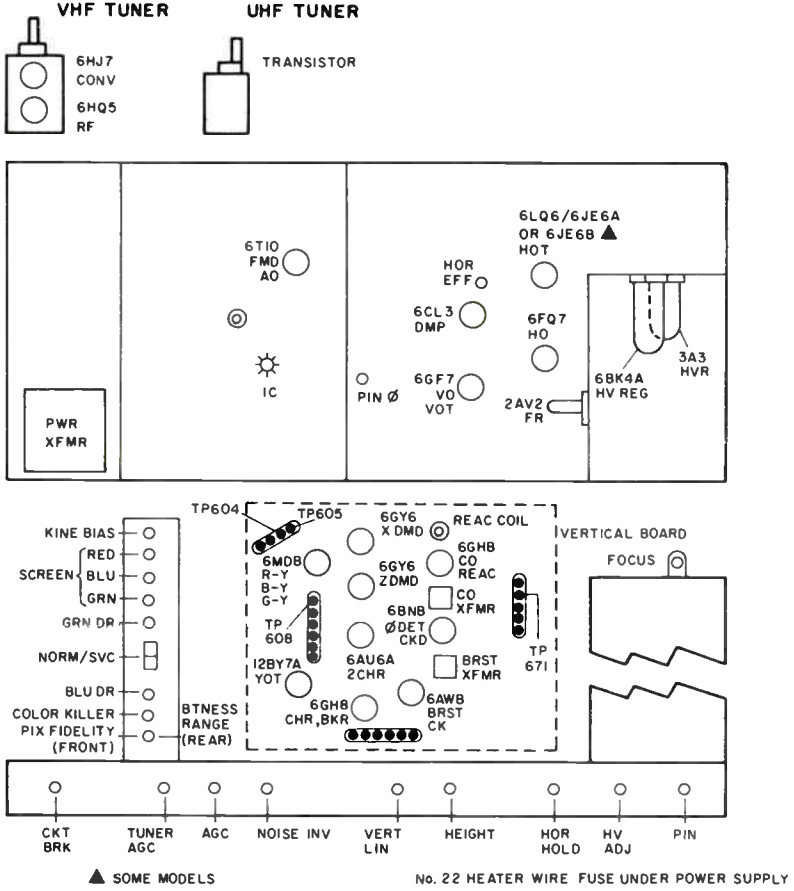
HEATER FUSE WIRE UNDER CHASSIS



▲ SOME MODELS

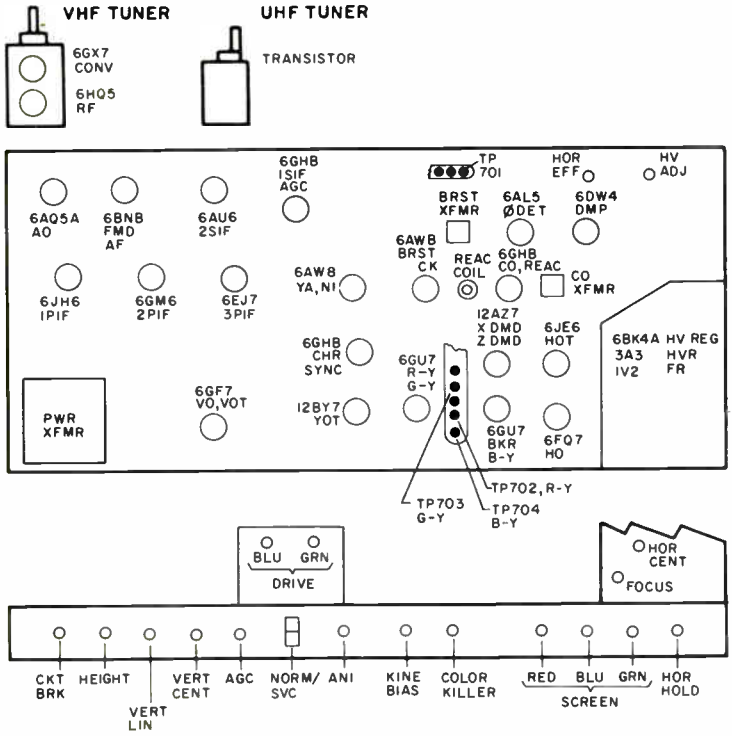


No. 22 HEATER FUSE WIRE UNDER CHASSIS



▲ SOME MODELS

No. 22 HEATER WIRE FUSE UNDER POWER SUPPLY



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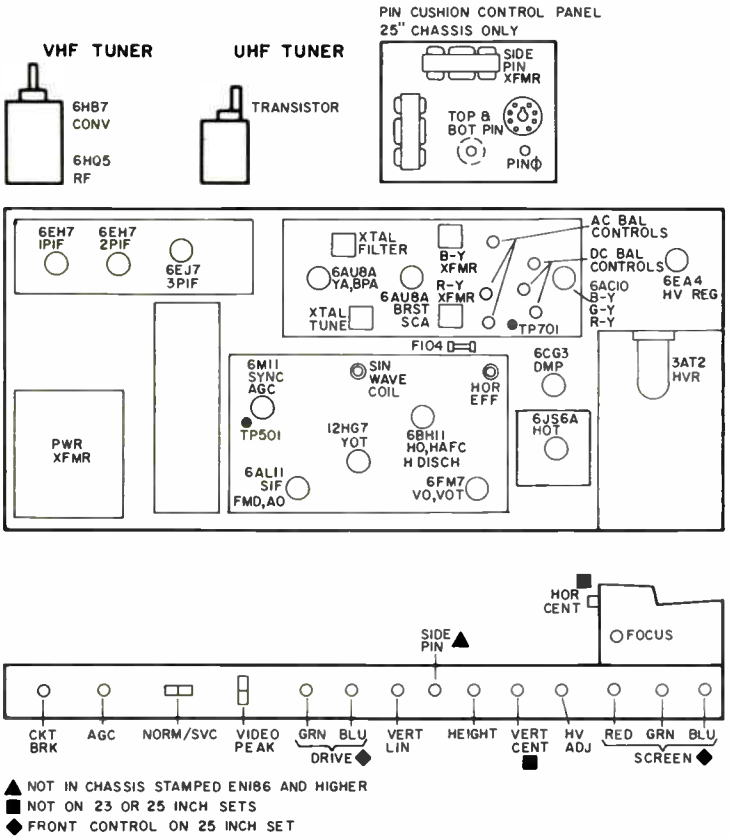
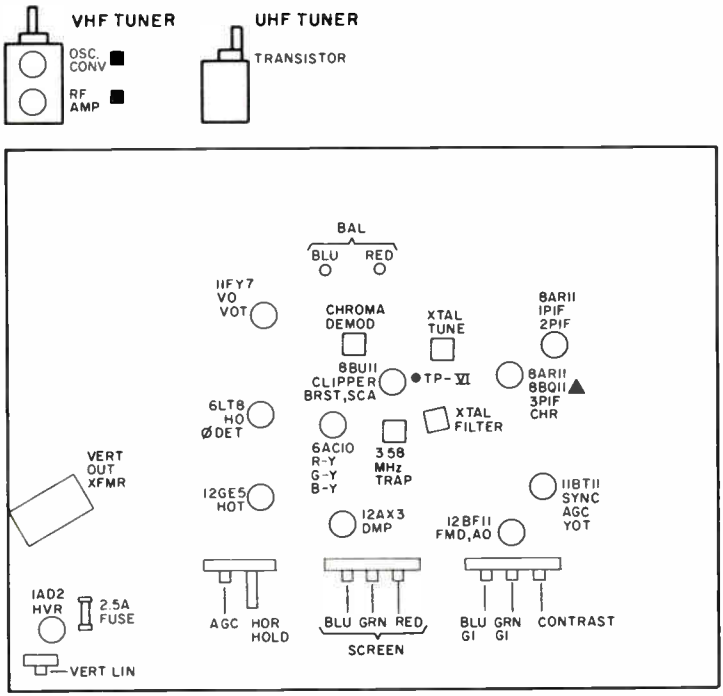
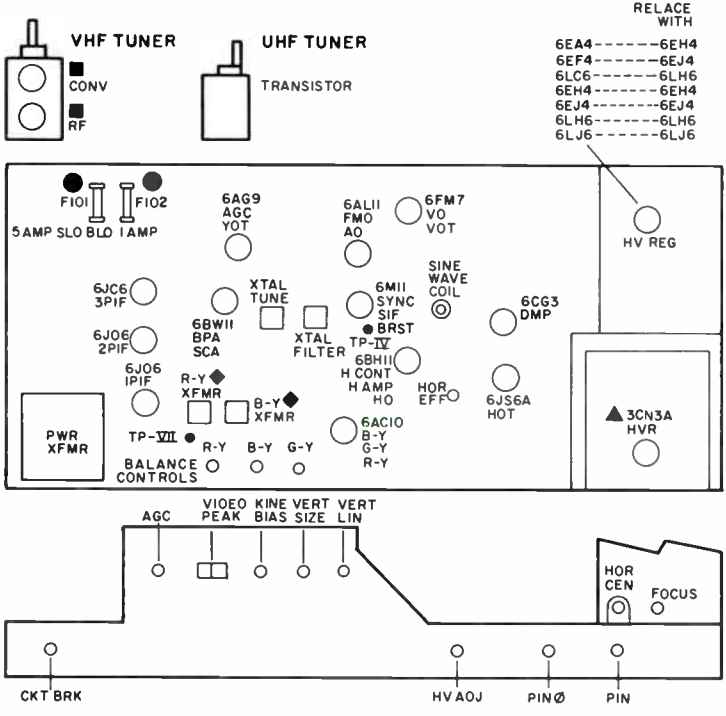


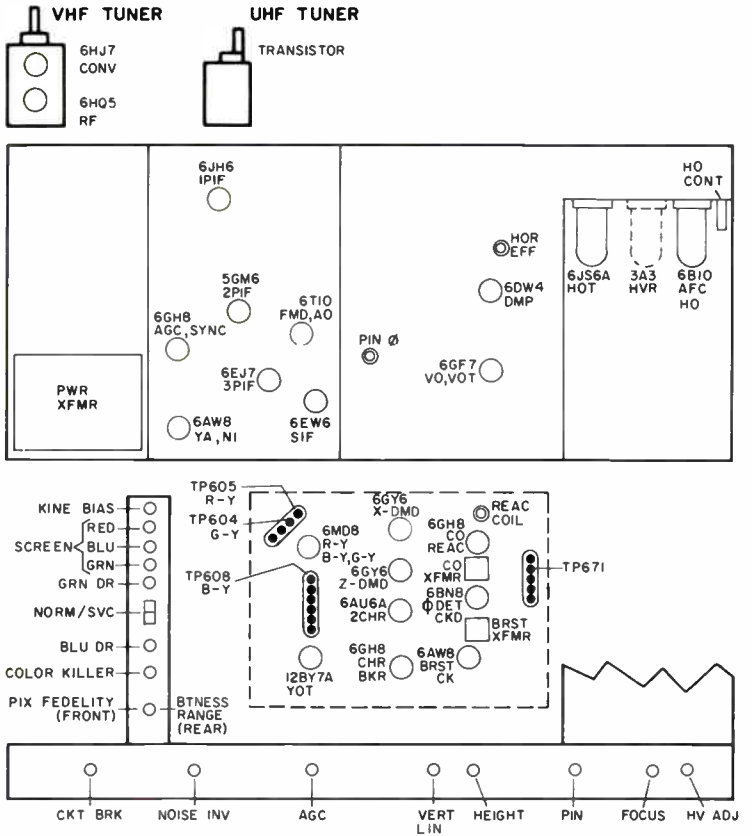


▲ SOME MODELS
■ REPLACE WITH SAME TYPE

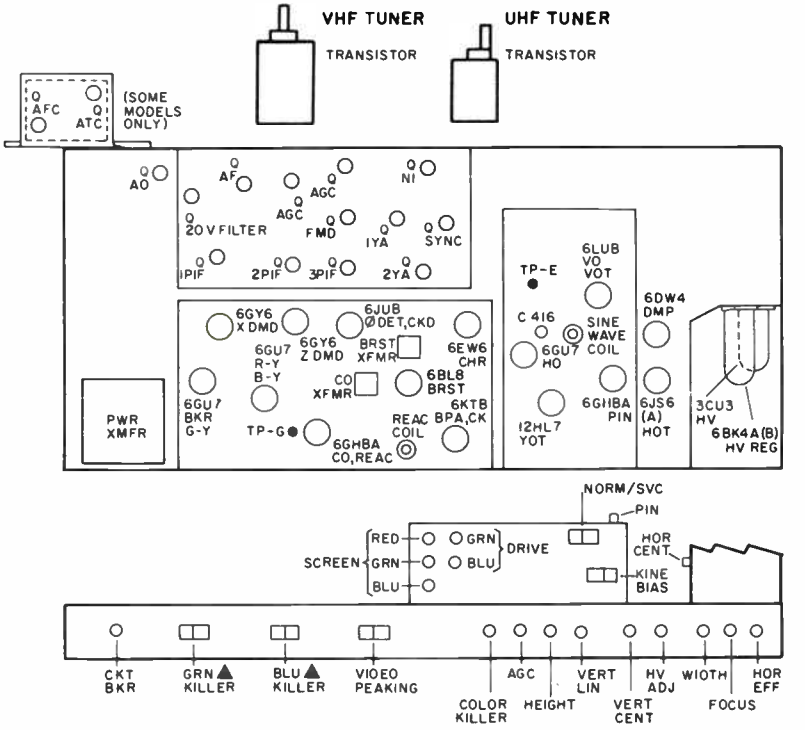


▲ 3A3 ALTERNATE TYPE
■ REPLACE ONLY WITH SAME TYPE
◆ R-Y & B-Y XFMRS IN SAME CAN, SOME MODELS
● INSTANT-ON MODELS

HEATER FUSE WIRE UNDER CHASSIS

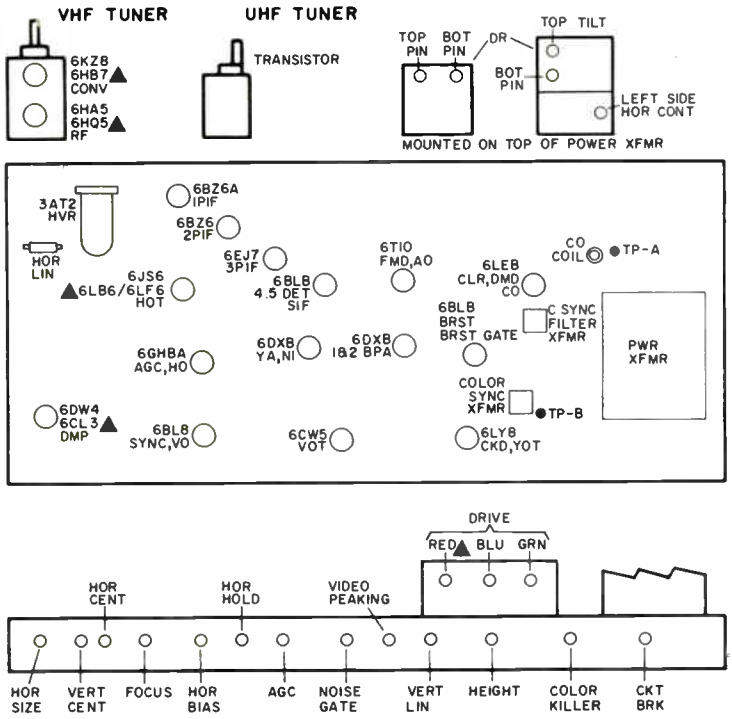


No.22 HEATER FUSE WIRE UNDER POWER SUPPLY



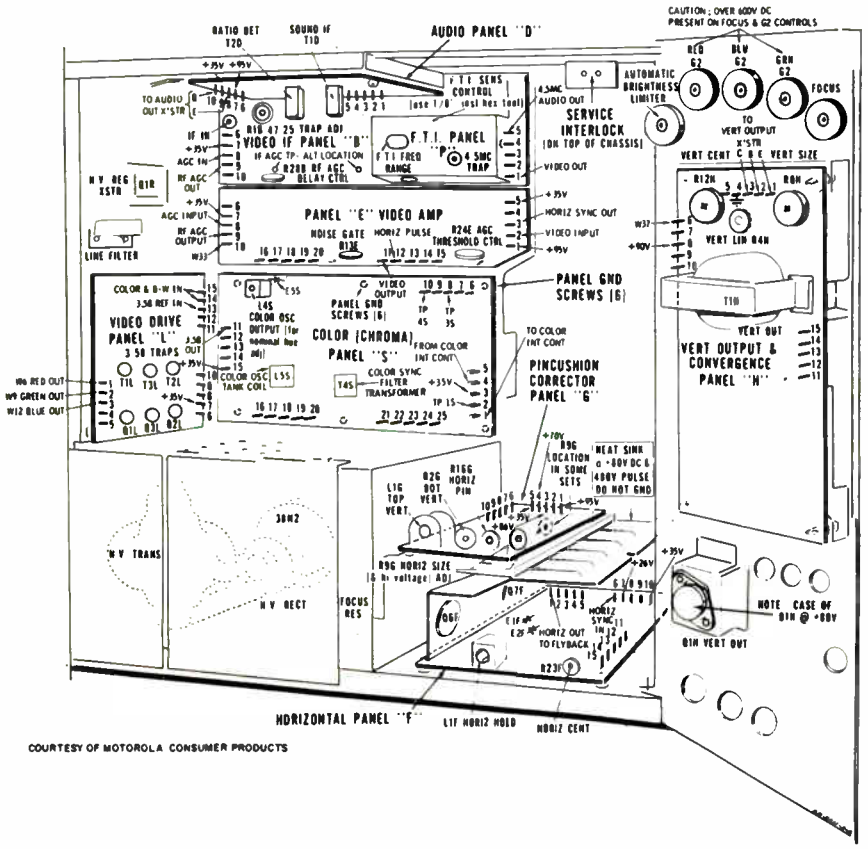
▲ SOME MODELS

No. 22 HEATER FUSE WIRE UNDER CHASSIS

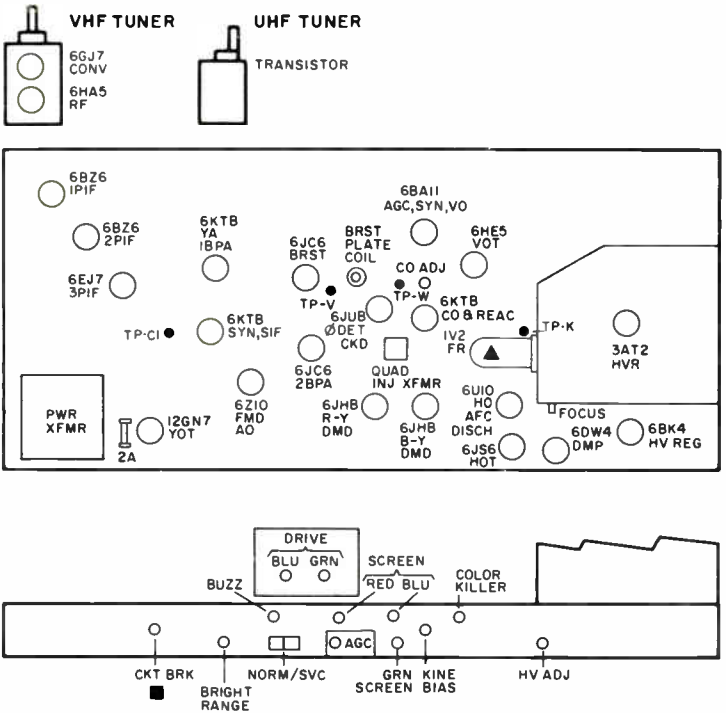


▲SOME MODELS

No.24 HEATER FUSE WIRE UNDER CHASSIS NEAR PWR XFMR
No.31 PRIMARY WIRE FUSE TOP OF CHASSIS NEAR FILTER COND

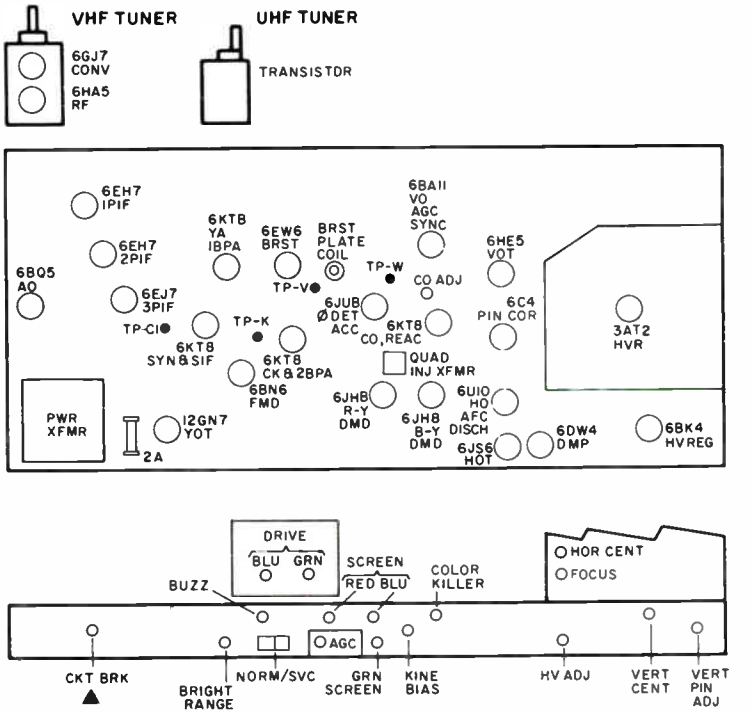


COURTESY OF MOTOROLA CONSUMER PRODUCTS



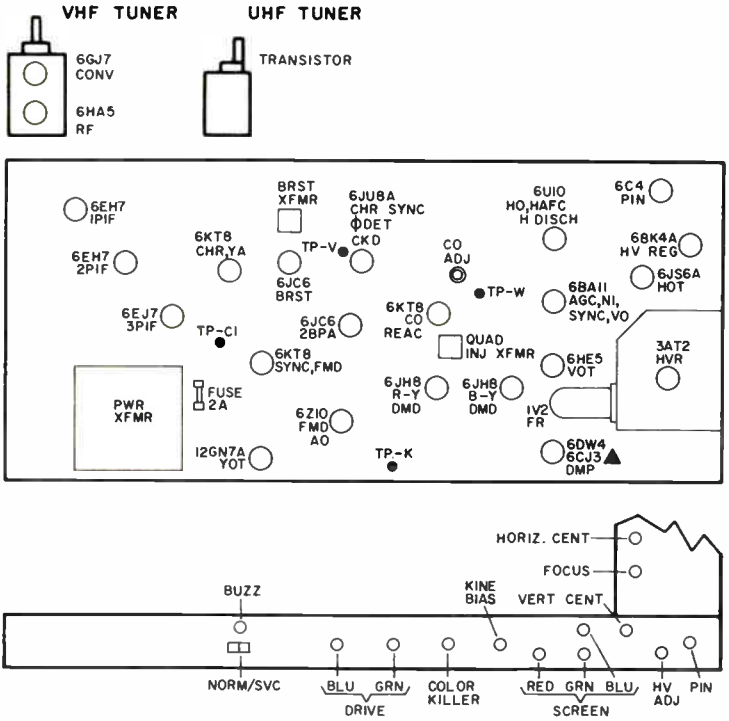
▲ SOME MODELS
■ "Z" MODELS HAVE FUSE INSTEAD OF CKT BRK

No 24 HEATER FUSE WIRE UNDER CHASSIS

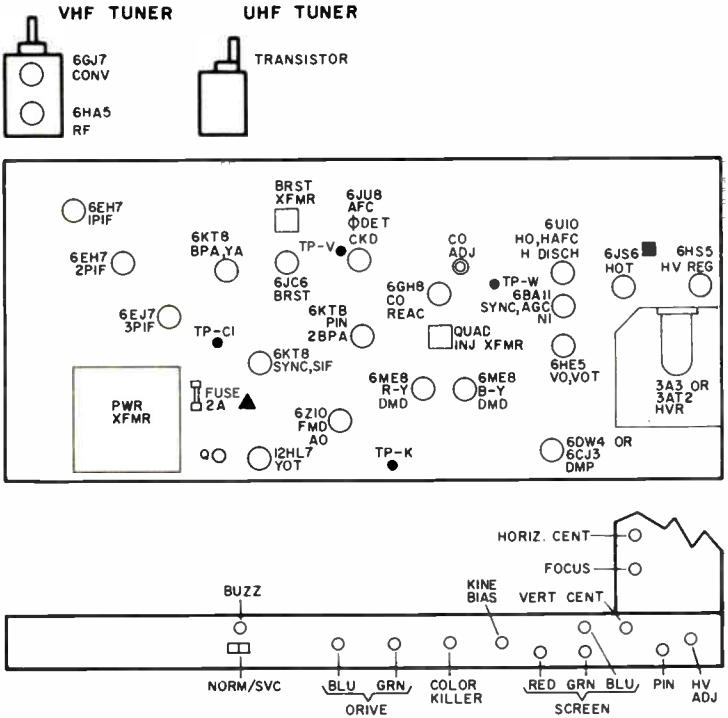


▲ "Z" MODELS HAVE FUSE INSTEAD OF CKT BRK

TWO No 24 HEATER FUSE WIRES UNDER CHASSIS

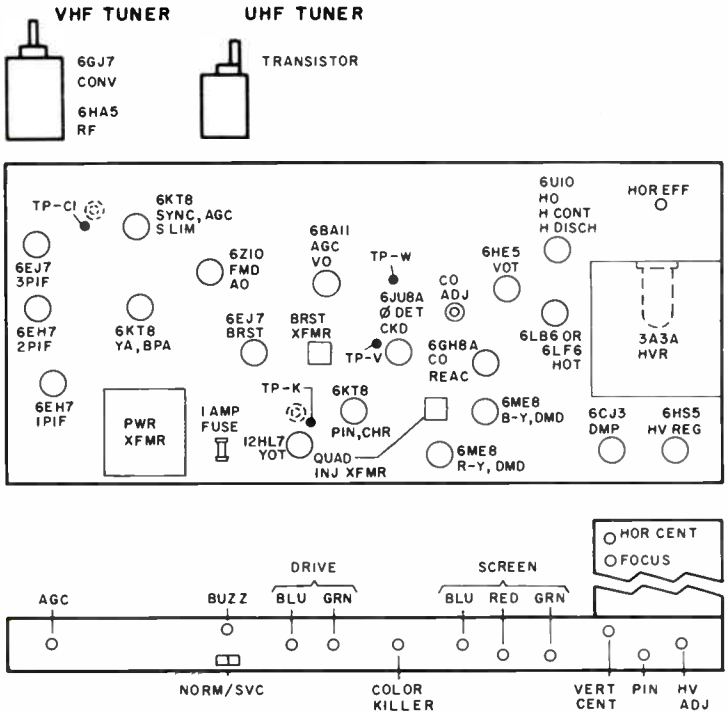


▲ SOME MODELS

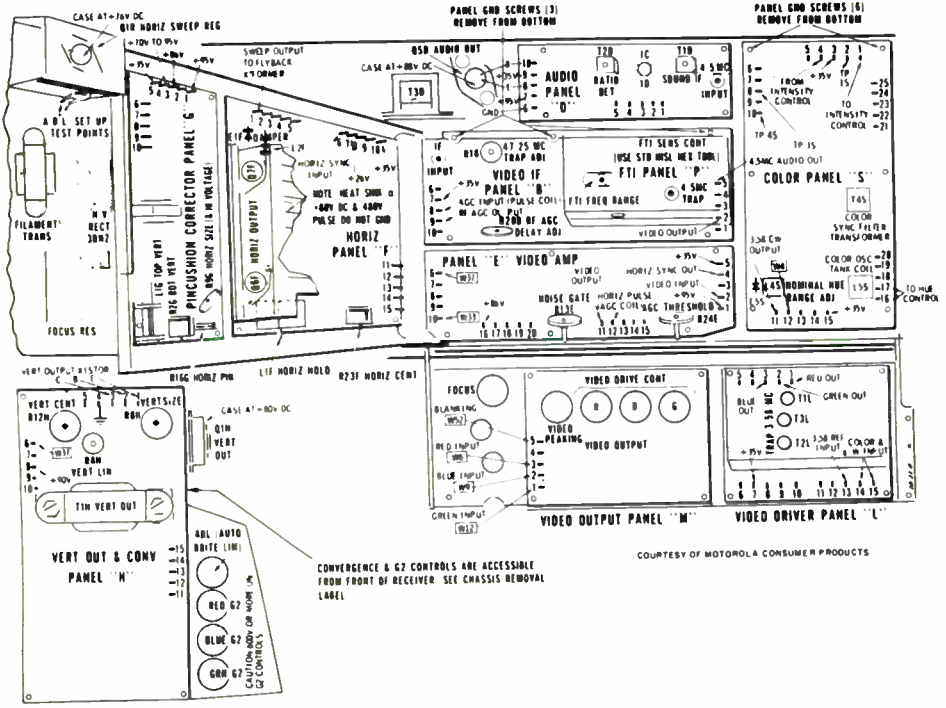


▲ 1 AMP FUSE SOME MODELS
■ ALTERNATES 6LB6,6LF6

No.24 HEATER FUSE WIRES UNDER CHASSIS



2 No. 24 HEATER FUSE WIRES UNDER CHASSIS



Purity adjustments are performed so that the beam from each of the three guns in the color picture tube lands only on its associated color-phosphor dot.

Most color-TV manufacturers recommend a nominal receiver warm-up time before purity adjustments are performed. Allow the receiver to operate for ten to fifteen minutes at high brightness level (without blooming) before adjusting purity. Check PRELIMINARY SETUP, then perform the procedure listed in the Index.

Adjustments. The two adjustments made to obtain purity are:

1. The adjustment of the purity ring assembly.
2. Proper positioning of the deflection yoke.

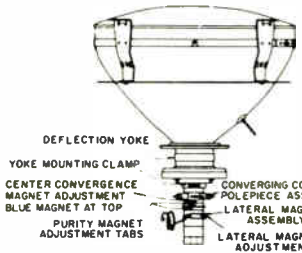
Generally, color-TV manufacturers recommend starting the purity adjustment with the deflection yoke positioned toward the base of the picture tube. With only the red gun on, adjust the purity magnets to position the red area in the center of the screen and then move the yoke towards the bell of the tube to obtain overall purity. In some receivers, however, the red area cannot be centered by adjusting the purity magnets when the yoke is positioned towards the base of the tube. In these receivers, start the purity adjustment with the yoke positioned towards the bell of the tube, adjust the purity magnets to center the red area, and then move the yoke towards the base of the tube to obtain purity.

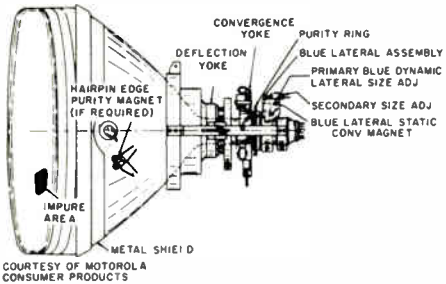
PRELIMINARY SETUP

The following conditions should be checked before purity adjustments are made.

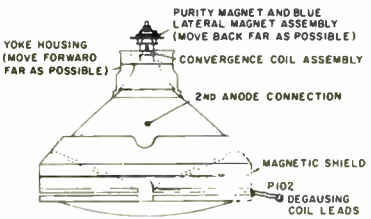
1. Check for proper picture size, linearity and focus. Readjust if necessary. **Note:** A change in size or linearity adjustments may require a touch-up of dynamic-convergence adjustments.

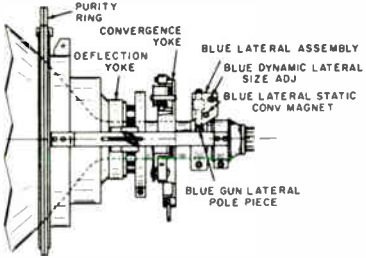
Typical Deflection Yokes





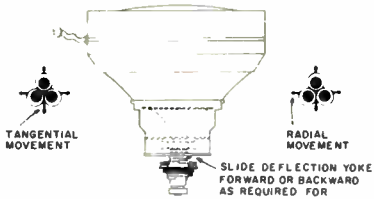
COURTESY OF MOTOROLA CONSUMER PRODUCTS



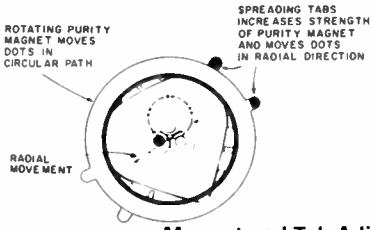


COURTESY OF MOTOROLA CONSUMER PRODUCTS

Purity Adjustments



Yoke Adjustment



Magnet and Tab Adjustment

2. Check convergence in the center area of the screen. Correct center convergence if necessary. See STATIC-CONVERGENCE ADJUSTMENTS.

3. Degauss receivers not equipped with automatic degaussing. Move the degaussing coil slowly over the top, side and front surfaces of the cabinet. Slowly withdraw the degaussing coil as far away from the receiver as the line cord will permit and lay the degaussing coil flat on the floor before disconnecting the line cord. The receiver should be in the desired viewing location and preferably facing north or south during the degaussing and purity adjustments to minimize the effects of the earth's magnetic field.

4. Obtain a blank raster by removing the last picture-IF-amplifier tube or by unplugging the cable that connects the tuner to the picture-IF-amplifier circuits. **Note:** Many receivers are equipped with a three-position SERVICE (SETUP) switch. The "RASTER" ("PURITY" position biases off the IF amplifiers for making purity adjustments. An alternate way to obtain a steady blank raster is to connect a color-bar generator, such as the RCA WR-64B or WR-502A, to the receiver, set the generator and the receiver to produce a color-bar display, and then turn the CHROMA control on the generator fully counterclockwise.

5. Adjust the BRIGHTNESS control to obtain a raster having maximum brightness without blooming.

6. Turn the COLOR or COLOR-LEVEL control fully counterclockwise.

7. Bias off the blue and green guns of the picture tube. Use a convergence-grid-shunt switch, the switch on the generator, or return the control grid leads of both the blue and green guns to chassis ground through 100k-ohm resistors and the necessary clip leads. An alternate method of disabling the guns in most chassis is to turn the SCREEN controls completely counterclockwise.

The foregoing steps result in a blank red raster. If the raster shows areas of color contamination or dark areas, proceed with PURITY ADJUSTMENTS.

PURITY Procedure A

1. Loosen the hardware that holds the deflection yoke in place. On most round color picture tubes the deflection yoke is clamped to the neck of the tube by a simple clamp at the rear of the yoke assembly. On rectangular picture tubes, the yoke may be mounted in a metal frame or inside a cylindrical plastic housing. Loosen the screws or wingnuts that hold the yoke and slide the yoke back, by grasping the screws or wingnuts, as far as it will go inside the frame or plastic housing. The frame or housing should remain tight against the bell of the tube. Pull the yoke back towards the base of the picture tube until it comes up against the convergence-magnet assembly. Do not disturb the convergence-magnet assembly.

2. Spread the tabs of the purity-ring assembly and rotate the assembly until the red area (cloud-shaped area) is exactly in the center of the screen. On most round color picture tubes the purity-ring assembly mounts on the neck of the picture tube just to the rear of the convergence-magnet assembly and the blue-lateral magnet. On some rectangular color picture tubes the purity ring is a large-diameter assembly mounted on the forward (towards the screen) edge of the deflection-yoke housing. On those sets that use the large-diameter purity ring (post-deflection purity) it is good practice to degauss the screen of the picture tube following each adjustment of the purity ring. In Admiral and RCA models using the rectangular tube, the purity-ring assembly is the assembly closest to the base of the color picture tube. Spreading the tabs of the purity ring makes the red area move radially out towards the screen edge. Rotating the entire assembly moves the red area on a circle around the axis of the tube.

3. Push the deflection yoke forward until the red area spreads out evenly all over the viewing area. Correct yoke position is obtained when the screen is uniformly red having no discolored or dark patches. **Note:** It is possible to move the yoke too far forward, in which case purity will deteriorate. Clamp the yoke where purity is best.

4. Check purity on the blue and green screens by biasing off the red-green and red-blue guns respectively. Touch up both purity adjustments if impurity is noted on either the blue or green screens.

5. Recheck red, blue, and green screens.

6. Check for raster tilt. This check can be made conveniently in most sets by turning the NORMAL/SERVICE switch to the "SERVICE" position. Increase the BRIGHTNESS until a line becomes visible on the screen. Rotate the deflection yoke until the line on the screen is horizontal.

7. Tighten the hardware that holds the deflection yoke in place. **Note:** If the screen controls were used to disable the picture-tube guns, perform a black-and-white setup adjustment. See BLACK-AND-WHITE SETUP ADJUSTMENTS.

PURITY Procedure B

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Procedure Step 3. Position the deflection yoke as given in Step 3, Procedure A. However, observe this precaution: if purity adjustments are made when the receiver is cold (ON for less than ½ hour) the yoke should be clamped as far to the rear as good purity permits. If the set is hot (ON for 2 or 3 hours) the yoke should be clamped as far forward (towards the screen) as purity permits.

PURITY Procedure C

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Procedure Step 1. Loosen the beveled nut located at the upper left of the yoke-retainer housing and the lock nuts at diagonal corners of the yoke housing. Run the thumb-wheel

nuts completely towards the picture tube. Slide the yoke completely forward against the bell of the tube.

Procedure Step 3. Slide the yoke back to obtain a uniformly red raster having no dark or discolored patches. Tighten the yoke in the best position.

PURITY Procedure D

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Step 7 of Preliminary Setup. To obtain a steady blank red raster, set the BLUE KILLER and GREEN KILLER switches to "on". Refer to the appropriate chassis layout for the location of the switches.

PURITY Procedure E

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Step 7 of Preliminary Setup. To obtain a steady blank red raster, set the SCREEN switch to the "R" position. Refer to the appropriate chassis layout for the location of the switch.

PURITY Procedure F

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Step 7 of Preliminary Setup. To obtain a steady blank red raster, ground the GREEN and BLUE PURITY ADJUSTMENT TERMINALS. Refer to the appropriate chassis layouts for the locations of the terminals. **For sets which have edge-purity magnets include the following steps:**

Procedure Step 1. Move the four small magnets fastened to each corner of the magnetic shield away from the picture tube and slide the deflection yoke back towards the base of the picture tube until it comes against the convergence-magnet assembly. Do not disturb the convergence-magnet assembly.

Procedure Step 3. Slide the yoke forward to obtain a uniformly red raster having no dark or discolored patches. Tighten the yoke in the best position. Move the four small magnets towards or away from the bell of the picture tube to correct any edge impurity.

PURITY Procedure G

Follow PRELIMINARY SETUP and PROCEDURE A, except for the following:

Procedure Step 1. Move the two small magnets on each side of the deflection yoke away from the picture tube and slide the deflection yoke back towards the base of the picture tube until it comes up against the convergence-magnet assembly. Do not disturb the convergence-magnet assembly.

Procedure Step 3. Slide the yoke forward to obtain a uniformly red raster having no dark or discolored patches. Tighten the yoke in the best position.

Adjust the two small magnets mentioned in Step 1 after the color-temperature adjustment has been performed. Set the SERVICE switch to "PURITY" and move the two magnets towards or away from the bell of the picture tube to correct any edge impurity.

Convergence adjustments are necessary in color-TV receivers to get proper registration of the electron beams anywhere on the face of the color picture tube.

To obtain overall convergence, two adjustments must be made:

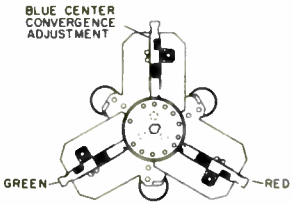
1. **Static (Center) Convergence.** These adjustments are made to insure that each electron beam will pass through the correct hole in the shadow mask at the center of the screen and strike only its associated phosphor dot in the proper dot trio. In modern color-TV receivers static (center) convergence is accomplished by adjusting permanent magnets mounted on the neck of the picture tube. The drawings on the following pages show some typical static-convergence assemblies as well as some blue-lateral-magnet assemblies. When static (center) convergence adjustments have been completed, proceed with the dynamic-convergence procedure given in the INDEX.

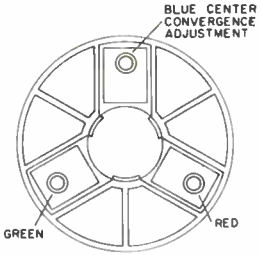
2. **Dynamic Convergence.** These adjustments are necessary to obtain registration of the three electron beams as they are deflected across the face of the color picture tube. To compensate for the changes in the arcs of the three electron beams as they are deflected, proper correction waveforms are applied to the horizontal-and-vertical deflection coils. The waveforms are adjusted during the dynamic-convergence adjustments.

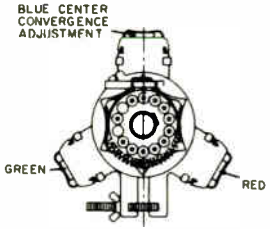
STATIC CONVERGENCE

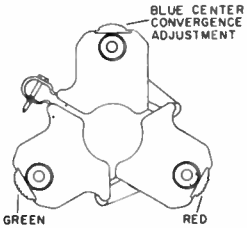
Preliminary Adjustments

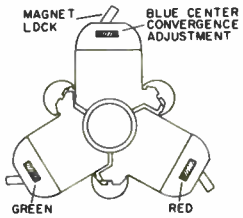
1. Adjust Purity. (See PURITY ADJUSTMENTS.)
2. Connect a color-bar/dot/crosshatch generator, such as the RCA WR-64B or WR-502A, to the receiver and set the generator to produce a crosshatch pattern. Keep brightness low during convergence adjustments.
3. Check picture size, linearity and focus. Readjust if necessary

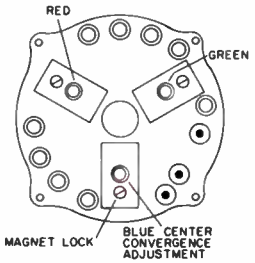




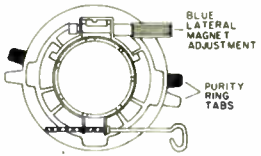


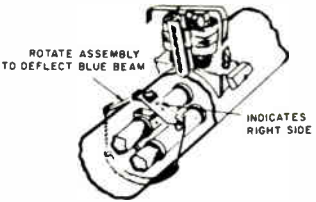


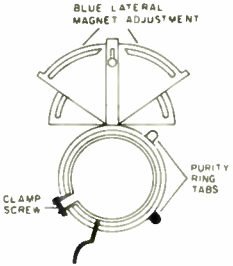


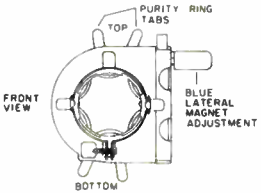


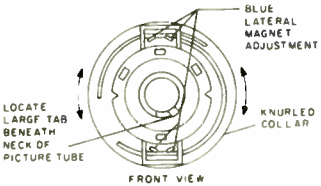
Typical Convergence Assemblies

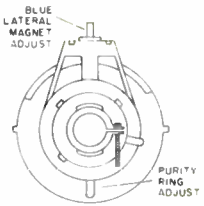


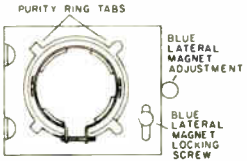


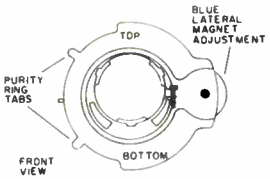






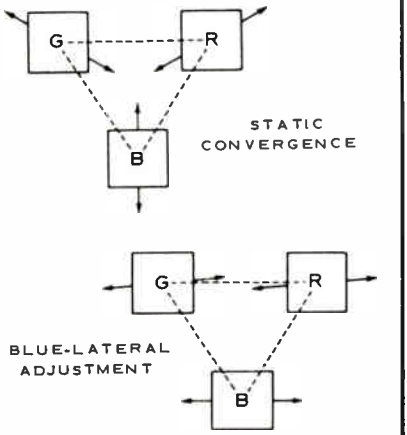






Typical Blue-Lateral Magnets

before making convergence adjustments.



Static Convergence

STATIC-CONVERGENCE

Procedure---All Models

Note: For GE chassis HB and HC refer directly to DYNAMIC CONVERGENCE, PROCEDURE Q.

1. Switch the generator to produce a dot pattern.
2. **Bias off the blue gun** (see PURITY ADJUSTMENTS for methods).
3. Adjust red and green static-convergence adjustments to merge the red and green dots in the center of the screen. **Note:** When working with sets having round picture tubes, and rod-type holders for the static-convergence magnets, you may find that the range of the static-convergence adjustment is not great enough. In that case, pull the rod holding the magnet out of its holder, rotate the rod 180° along its long axis and push it back into the holder.
4. **Remove bias from the blue gun.**
5. Adjust the blue static-convergence magnet and the blue-lateral magnet to merge the blue dots with the yellow (red and green) dots in the center of the screen.

DYNAMIC CONVERGENCE

Preliminary Adjustments

A crosshatch pattern is required to make dynamic-convergence adjustments.

The RCA WR-64B or WR-502A, or equivalent, should be used. To simplify the dynamic-convergence procedure, each procedure is keyed to a series of drawings which show the effect of the effect of the convergence-board controls on the pattern. The controls on the board have been numbered for reference. **Note:** The numbers do not appear on the actual controls.

1. Adjust static (center) convergence. Refer to STATIC CONVERGENCE, page

2. Set the generator to crosshatch.

DYNAMIC CONVERGENCE

Procedure A

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

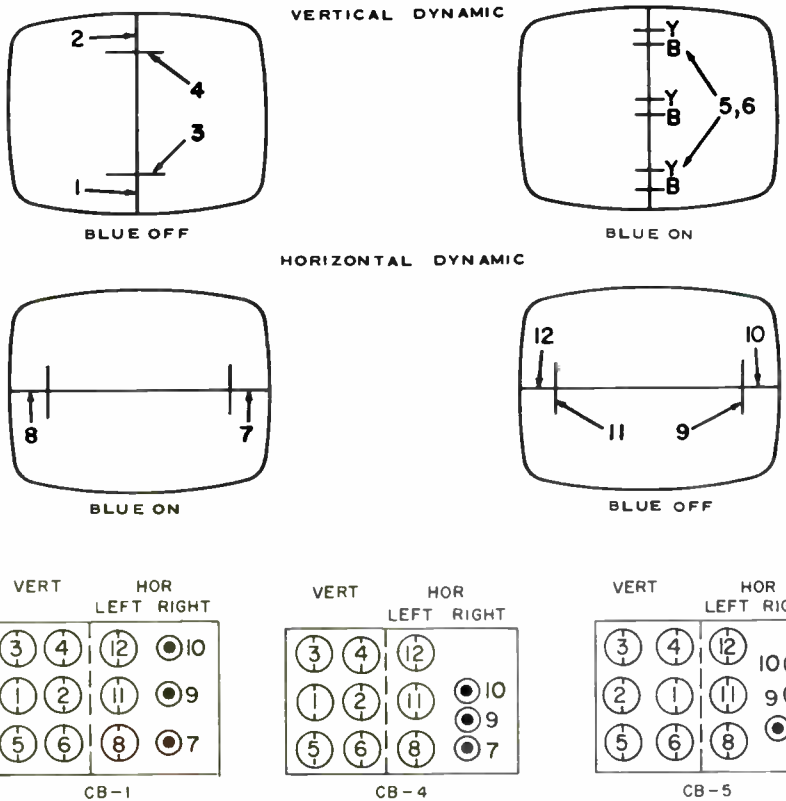
1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

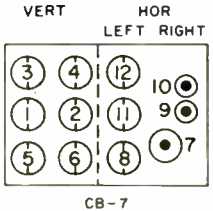
2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen.
Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in separate red and green lines parallel to the vertical center line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

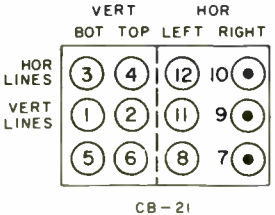
4. Adjust **control 4** to converge the red and green horizontal lines at the top center of the screen. Repeat steps 3 and 4 to obtain convergence through the center of the screen. Correct adjustment may result when red and green horizontal lines are equally displaced along the center vertical line of the screen. In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.
5. Adjust **control 5** clockwise until

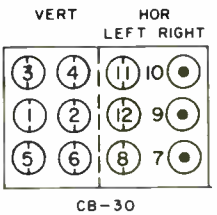




CB-7



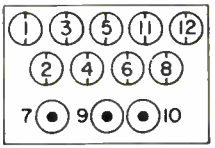
CB-21



CB-30

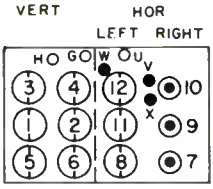
CB-28

BEHIND SPEAKER GRILL ON SOME MODELS



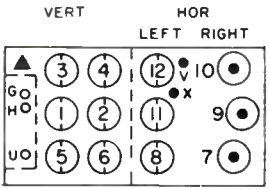
CB-29

BEHIND SPEAKER GRILL ON SOME MODELS



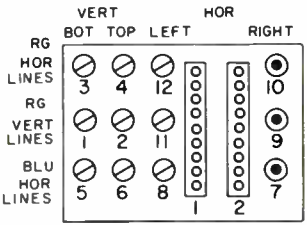
CB-2

○ HOR JUMPER PIN
● VERT JUMPER PIN



CB-3

▲ SOME CHASSIS
○ HOR JUMPER PIN
● VERT JUMPER PIN



CB-31

a displacement between the blue and yellow horizontal lines at the top and bottom of the center area of the screen is noticed. Blue should be displaced in the same direction (above or below) the yellow lines at both top and bottom.

6. Adjust **control 6** until the displacement between the blue and yellow horizontal lines is equal at the top and bottom of the screen.

7. Readjust **control 5** counterclockwise until the blue and yellow horizontal lines converge at the top and bottom of the screen. If either top or bottom lines converge first, readjust **control 6** so that the yellow lines are displaced equally at the top and bottom of the screen. Adjust **control 5** counterclockwise until the top and bottom lines converge. If necessary, repeat steps 6 and 7. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced in a vertical band through the center of the acreen. In this case, readjust the blue static-convergence magnet.

8. Adjust **control 7** (coil) to make the blue horizontal line at the right center of the screen a straight line. (Coils are adjusted with a hex-head alignment tool, 1/10 inch across the flats.)

9. Adjust **control 8** to make the blue horizontal line at the left center of the screen a straight line.

Bios off the blue gun.

10. Adjust **control 9** (coil) to converge the red and green vertical lines at the right side of the screen.

11. Adjust **control 10** (coil) to converge the red and green horizontal lines at the right side of the screen.

12. Adjust **control 11** to converge the red and green vertical lines at the left side of the screen.

13. Adjust **control 12** to converge the red and green horizontal lines at the left side of the screen.

Remove bias from the blue gun.

14. Readjust **control 7** (coil) to

converge the blue horizontal line at the right center of the screen with the yellow (red and green) horizontal line.

15. Readjust **control 8** to converge the blue horizontal line at the left center of the screen with the yellow (red and green) horizontal line.
The convergence adjustments should now be complete.

Procedure A1.

Follow PROCEDURE A and refer to **CB-2.** If necessary, connect the jumper wire from point "Y" to pins "W", "V", or "X" to extend the ranges of **controls 1** and **2.** Connect the other jumper wire to pins "H", "G", or "U" to extend the ranges of **controls 3** and **4.**

Procedure A2

Follow PROCEDURE A and refer to **CB-3.** If necessary, connect the jumper wire from point "Y" to pins "V", or "X" to extend the ranges of **controls 1 and 2.** Connect the other jumper wire to pins "H", "G", or "U" to extend the ranges of **controls 3** and **4.**

Procedure A3

Follow PROCEDURE A and refer to **CB-31.** If necessary, reverse leads 1 and 2 to the blue-horizontal-line connectors to extend the ranges of **controls 5** and **6.**

DYNAMIC CONVERGENCE

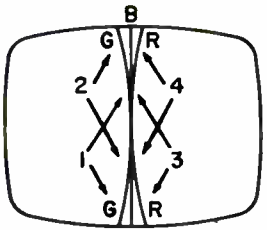
Procedure B

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

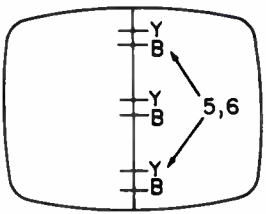
1. Turn **control 1** fully clockwise. This will displace the green line from the center blue vertical line.

2. Adjust **control 2** so that the displacement of the green line from the center blue vertical line is equal at both the top and bottom of

VERTICAL DYNAMIC

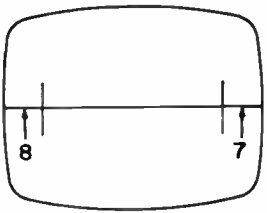


RED OFF GREEN OFF



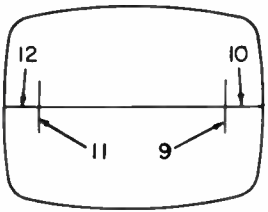
ALL ON

HORIZONTAL DYNAMIC

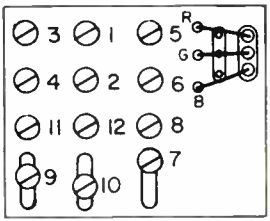


BLUE ON

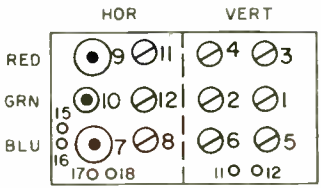
HORIZONTAL DYNAMIC



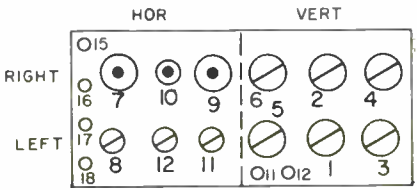
BLUE OFF



CB-12



CB-22



CB-23

Dynamic Convergence B

the screen.

3. Readjust **control 1** counterclockwise until the green and blue lines converge at either the top or bottom of the screen. (Occasionally, they will converge at both the top and bottom at this point, in which case this adjustment is complete - proceed to step 6.)

4. Readjust **control 2** so that the green line is equally displaced at the top and bottom of the center blue vertical line.

5. Readjust **control 1** to converge the green line with the blue line at both the top and bottom of the center blue vertical line. If necessary repeat steps 4 and 5.

Remove bias from the red gun; bias off the green gun.

6. Turn **control 3** fully clockwise. This will displace the red line from the center blue vertical line at both the top and bottom of the screen.

7. Adjust **control 4** so that the displacement of the red from the center blue vertical line is equal at both the top and bottom of the screen.

8. Readjust **control 3** counterclockwise until the red and blue lines converge at either the top or bottom of the screen. (Occasionally, they will converge at both the top and bottom at this point, in which case this adjustment is complete - proceed to step 11.)

9. Readjust **control 4** so that the red line is equally displaced at the top and bottom of the center blue vertical line.

10. Readjust **control 3** to converge the red line with the blue line at both the top and bottom of the center blue vertical line. If necessary, repeat steps 9 and 10.

Remove bias from the green gun.

11. Adjust **control 5** clockwise to displace the blue and yellow horizontal lines at the top and bottom of the center area of the screen.

12. Adjust **control 6** until the displacement between the blue and yellow horizontal lines is equal at the top and bottom of the

screen.

13. Readjust **control 5** counterclockwise until the blue and yellow horizontal lines converge at the top and bottom of the screen. If either the top or bottom lines converge first, readjust **control 6** so that the yellow line is equally displaced at the top and bottom of the screen. Adjust **control 5** counterclockwise until both the top and bottom lines converge. If necessary, repeat steps 12 and 13. Correct adjustment may occur when blue and yellow lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet. **Note:** For chassis using **CB-22** and **CB-23,** if convergence cannot be obtained with **controls 5** and **6** switch the tip plugs on terminals 11 and 12 and repeat steps 11 through 13.

14. Adjust **control 7** to make the blue line at the right center of the screen a straight line.

15. Adjust **control 8** to make the blue line at the left center of the screen a straight line.

Bias off the blue gun.

16. Adjust **control 9** to converge the red and green vertical lines at the right side of the screen.

17. Adjust **control 10** to converge the red and green horizontal lines at the right side of the screen.

18. Adjust **control 11** to converge the red and green vertical lines at the left side of the screen.

19. Adjust **control 12** to converge the red and green horizontal lines at the left side of the screen. **Note:** For chassis using **CB-22** and **CB-23,** if convergence cannot be obtained with **controls 11** and **12** switch the tip plug from terminal 15 to 16 and from terminal 17 to 18 and repeat steps 18 and 19.

Remove bias from the blue gun.

20. Readjust **control 7** to converge the blue line at the right center of the screen with the yellow (red and green) horizontal line.

21. Readjust **control 8** to converge the blue line at the left center

of the screen with the yellow (red and green) horizontal line.
The convergence adjustments should now be complete.

Procedure B1

Follow PROCEDURE B and refer to **CB-12.** If necessary, move the appropriate clips on the convergence board to extend the ranges of **controls 8, 11,** and **12,** and readjust all controls affecting left side convergence.

DYNAMIC CONVERGENCE

Procedure C

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen. Repeat steps 1 and 2 to converge the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

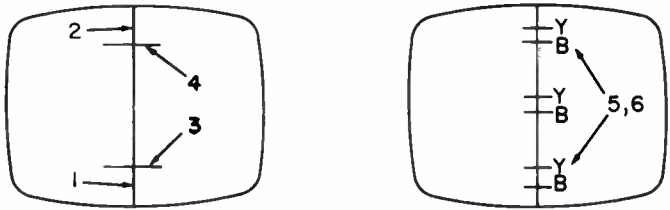
3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may result when red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

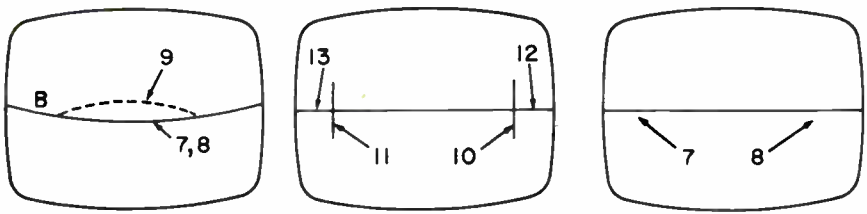
5. Adjust **control 5** clockwise until a displacement between blue and yellow horizontal lines at the top and bottom of the center area

VERTICAL DYNAMIC

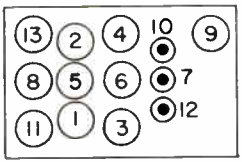


BLUE OFF BLUE ON

HORIZONTAL DYNAMIC



RED & GREEN OFF BLUE OFF BLUE ON



CB-9

of the screen is noticed. Blue should be displaced in the same direction (above or below) the yellow lines at the top and bottom of the screen.

6. Adjust **control 6** until the displacement between blue and yellow horizontal lines becomes equal at the top and bottom of the screen.

7. Turn **control 5** counterclockwise until the blue and yellow horizontal lines converge at the top and bottom of the screen. If the top or bottom lines converge first, readjust **control 6** to equalize the displacement. Turn **control 5** counterclockwise until the top and bottom lines converge. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet.

Bias off the red and green guns.

8. Adjust **control 7** for maximum displacement (bowing) of the blue horizontal line in the center of the screen.

9. Adjust **control 8** to put the droop or sag in the blue horizontal line in the center of the screen. (Adjust coils with a hex-head alignment tool, 1/10th inch across the flats.)

10. Adjust **control 9** until the droop or sag in the blue horizontal line is pushed upwards at the center of the screen.

11. Readjust **control 7** to straighten the blue horizontal line.

Bias off the blue gun.

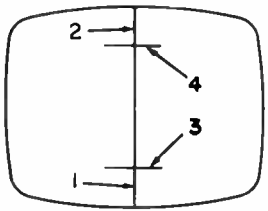
12. Adjust **control 10** to converge the red and green vertical lines at the right side of the screen.

13. Adjust **control 11** to converge the red and green vertical lines at the left side of the screen. Repeat steps 12 and 13 for best convergence of the red and green vertical lines at the left and right sides of the screen.

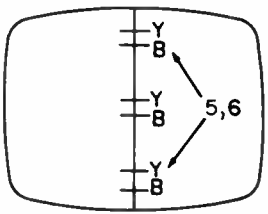
14. Adjust **control 12** to converge the red and green horizontal lines at the right side of the screen.

15. Adjust **control 13** to converge

VERTICAL DYNAMIC

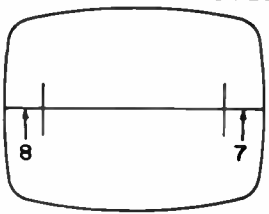


BLUE OFF

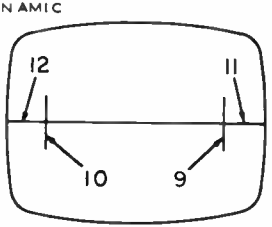


BLUE ON

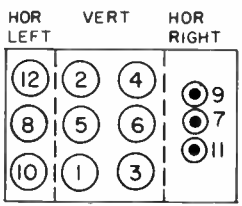
HORIZONTAL DYNAMIC



BLUE ON



BLUE OFF



CB-10

Dynamic Convergence D

the red and green horizontal lines at the left side of the screen.

Remove bios from the blue gun.

16. Repeat adjustments of **controls 7** and **8** to converge the blue horizontal line with the yellow (red and green) horizontal line.
Touch up static-convergence adjustments if necessary.
The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure D

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bios off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen.
Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in the red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the top center of the screen.
Repeat steps 3 and 4 to obtain convergence of the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may result when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bios from the blue gun.

5. Adjust **control 5** clockwise until a displacement between the blue and yellow horizontal lines at the top

and bottom of the center area of the screen is noticed. Blue should be displaced in the same direction (above or below) the yellow lines at the top and bottom.

6. Adjust **control 6** until the displacement between the blue and yellow horizontal lines becomes equal at the top and bottom of the screen.

7. Turn **control 5** counterclockwise until the blue and yellow horizontal lines converge at the top and bottom of the screen. If the top or bottom lines converge first, readjust **control 6** to equalize the displacement. Turn **control 5** counterclockwise until the top and bottom lines converge. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet.

8. Adjust **control 7** to make the blue horizontal line at the right side of the screen a straight line.

(Adjust coils with a hex-head alignment tool, 1/10th inch across the flats.)

9. Adjust **control 8** to make the blue horizontal line at the left side of the screen a straight line.

Bias off the blue gun.

10. Adjust **control 9** to converge the red and green vertical lines at the right side of the screen.

11. Adjust **control 10** to converge the red and green vertical lines at the left side of the screen. Repeat steps 10 and 11 for best convergence of the red and green vertical lines in a horizontal band from left to right. Correct adjustment may occur when the red and green vertical lines become equally spaced. In this case, readjust the red and green static-convergence magnets to obtain convergence.

12. Adjust **control 11** to converge the red and green horizontal lines at the right side of the screen.

13. Adjust **control 12** to converge the red and green horizontal lines

at the left side of the screen. Repeat steps 12 and 13 to obtain convergence of the red and green horizontal lines from left to right. Correct adjustment may result in the red and green horizontal lines becoming parallel. In this case, readjust the static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

14. Readjust **controls 7** and **8** to converge the blue horizontal lines with the yellow (red and green) lines at the right and left sides of the screen.

The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure E

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bios off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

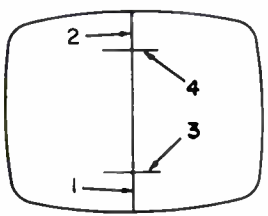
1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen. Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in the red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence. **Note:** For chassis using **CB-24**, if the ranges of **controls 1** and **2** are insufficient reverse the setting of the R-G RANGE SWITCH.

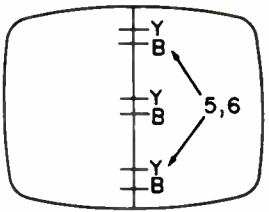
3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the top center of the screen. Repeat steps 3 and 4 to converge the red and green horizontal lines in a vertical band through the

VERTICAL DYNAMIC

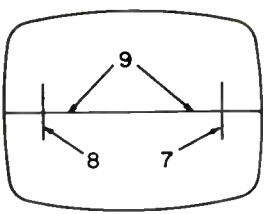


BLUE OFF

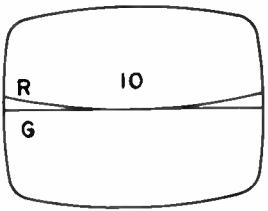


BLUE ON

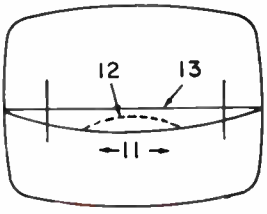
HORIZONTAL DYNAMIC



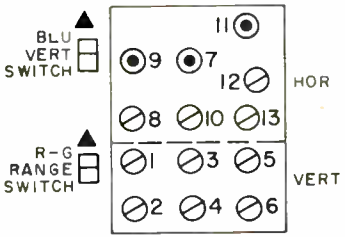
BLUE OFF



BLUE OFF

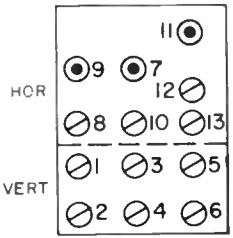


BLUE ON



CB-24

▲TOP PANEL SOME MODELS



CB-25

center of the screen. Correct adjustment may result when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

5. Adjust **control 5** clockwise until a displacement between the blue and yellow horizontal lines at the top and bottom of the center area of the screen is noticed. Blue should be displaced in the same direction (above or below) the yellow lines at the top and bottom of the screen.

6. Adjust **control 6** until the displacement between the blue and yellow horizontal lines becomes equal at the top and bottom of the screen.

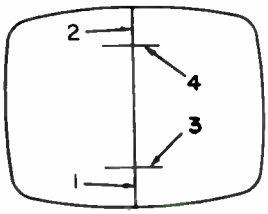
7. Turn **control 5** counterclockwise until the blue and yellow horizontal lines converge at the top and bottom of the screen. If the top or bottom lines converge first, readjust **control 6** to equalize the displacement. Turn **control 5** counterclockwise until the top and bottom lines converge. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet. **Note:** For chassis using **CB-24** if the ranges of **controls 5** and **6** are insufficient reverse the setting of the BLUE VERTICAL SWITCH.

Bias off the blue gun.

8. Adjust **control 7** to converge the red and green vertical lines at the right side of the screen. (Adjust coils with a hex-head alignment tool, 1/10th inch across the flats.)

9. Adjust **control 8** to converge the red and green vertical lines at the left side of the screen.

10. Adjust **control 9** to converge the red and green horizontal lines at both sides of the screen.
Repeat steps 8, 9, and 10 to obtain the best convergence at the sides



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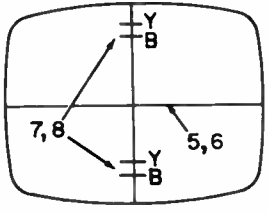

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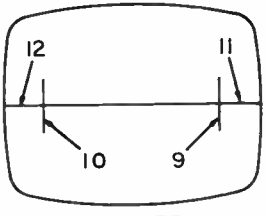

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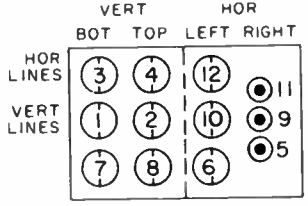


CB-8

of the screen. Correct adjustment may result in the red and green horizontal lines being parallel or the red and green vertical lines being equally spaced across the screen. In these cases, readjust the red and green static-convergence magnets to obtain convergence.

11. Adjust **control 10** to converge the red and green horizontal lines at the center, or to obtain parallel red and green horizontal lines. In the latter case, adjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

12. Turn **control 13** to maximum (fully clockwise).

13. Adjust **control 11** until the droop or sag in the blue line is centered horizontally.

14. Adjust **control 12** until the droop or sag in the blue line is pushed upwards in the center.

15. Turn **control 13** counterclockwise until the blue horizontal line is converged with the yellow horizontal line in the center of the screen. Correct adjustment may occur if the blue and yellow lines become parallel. In this case, reset the blue static-convergence magnet to obtain convergence. The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure F

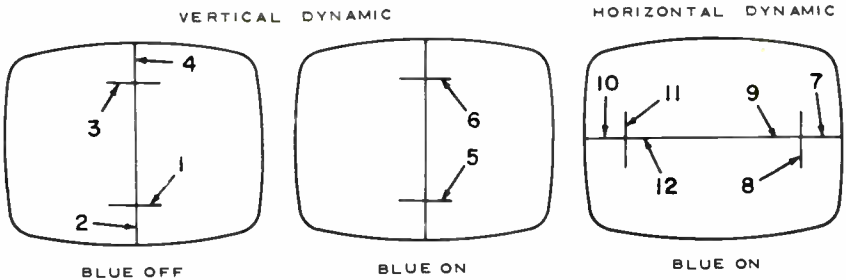
a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

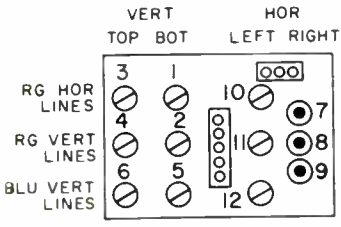
1. Adjust **controls 1** and **2** to converge the red and green vertical center lines. Readjust the static-convergence magnets, if necessary.

2. Adjust **control 3** to converge the bottom red and green horizontal lines and **control 4** to converge the top red and green horizontal lines at the center line of the screen.

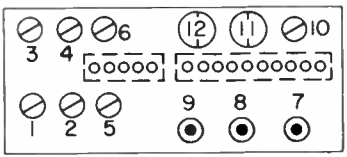
Remove bias from the blue gun.

3. Adjust **controls 5** and **6** to obtain a straight horizontal blue

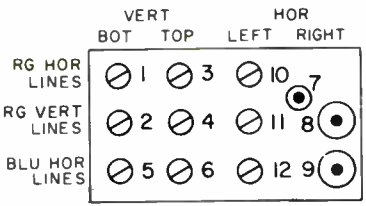




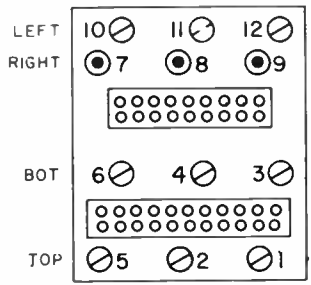
CB-17



CB-18



CB-19



CB-20

center line. (Adjust coils with a hex-head alignment tool, 1/10 inch across the flats.)

4. Adjust **controls 7** and **8** to obtain a uniform displacement of the blue horizontal lines along the center vertical line. Converge the blue horizontal lines with the red-green (yellow) horizontal line by adjusting the blue static-convergence magnet. Adjust the red and green static-convergence magnets, if necessary. Repeat steps 3 and 4, if necessary.

5. Adjust **controls 9** and **10** alternately to converge the red and green vertical lines at the right and left sides of the screen.

6. Adjust **controls 11** and **12** alternately to converge the red and green horizontal center lines. Converge the center of the screen and repeat steps 5 and 6, if necessary.

7. Minor touch-up adjustments may be made using the appropriate controls. If wide blue-field correction is necessary because of the blue field overscanning the red and green, loosen the yoke thumb screws and tighten the wide blue-correction screw on the bottom of the deflection yoke. The wide blue-correction screw positions the yoke vertically for proper blue-beam scan. If wide blue correction is adjusted, purity must be rechecked, and convergence may require a "touch-up" adjustment.

The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure G

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green horizontal lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the bottom center of the screen.

3. Adjust **control 3** to converge the

red and green horizontal lines at the top center of the screen.

4. Adjust **control 4** to converge the red and green vertical lines at the top center of the screen. Repeat steps 1 through 4 to achieve the best convergence of both horizontal and vertical red and green lines from the top center to the bottom center of the screen. Correct adjustment may occur if the displacement of the red and green lines is uniform (equally displaced or parallel). In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

5. Adjust **control 5** to converge the blue horizontal lines with the yellow horizontal lines at the bottom center of the screen.

6. Adjust **control 6** to converge the blue horizontal lines with the yellow horizontal lines at the top center of the screen. Repeat steps 5 and 6 to obtain convergence between the blue and yellow horizontal lines in a vertical band from the top to the bottom of the screen. Correct adjustment may occur if the blue lines are equally displaced from the yellow lines from top to bottom of the screen. In this case, readjust the blue static-convergence magnet to obtain convergence.

7. Adjust **control 7** to converge the red and green horizontal lines at the right side of the screen. (Adjust coils with a hex-head alignment tool, 1/10th inch across the flats.)

8. Adjust **control 8** to converge the red and green vertical lines at the right side of the screen.

9. Adjust **control 9** to converge the blue horizontal lines with the yellow (red and green) horizontal lines at the right side of the screen.

10. Adjust **control 10** to converge the red and green horizontal lines at the left side of the screen.

11. Adjust **control 11** to converge the red and green vertical lines at the left side of the screen.

12. Adjust **control 12** to converge

the blue horizontal lines with the yellow (red and green) horizontal lines at the left side of the screen.
The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure H

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.

1. Adjust **controls 1** and **2** to obtain a straight horizontal blue center line.

2. Adjust **controls 3** and **4** to obtain a uniform displacement of the blue horizontal lines along the center vertical line.

3. Adjust **controls 5** and **6** to converge the red and green vertical center lines. Readjust the static-convergence magnets, if necessary.

4. Adjust **control 7** to converge the bottom red and green horizontal lines and **control 8** to converge the top red and green horizontal lines at the center of the screen. Converge the blue horizontal lines with the red-green (yellow) horizontal lines by adjusting the blue static-convergence magnet. Adjust the red and green static-convergence magnets, if necessary.

5. Adjust **controls 9** and **10** alternately to converge the red and green vertical lines at the right and left sides of the screen.

6. Adjust **controls 11** and **12** alternately to converge the red and green horizontal center lines. Converge the center of the screen and repeat steps 5 and 6, if necessary. Minor touch-up adjustments may be made using the appropriate controls.

The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure J

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bios off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green horizontal lines at the top center of the screen.

2. Adjust **control 2** to converge the red and green horizontal lines at the bottom center of the screen.

3. Adjust **control 3** to converge the red and green vertical lines at the top center of the screen.

4. Adjust **control 4** to converge the red and green vertical lines at the bottom center of the screen.

5. Adjust **control 5** to converge the red and green vertical lines at the right side of the screen.

6. Adjust **control 6** to converge the red and green horizontal lines at the right side of the screen.

7. Adjust **control 7** to converge the red and green vertical lines at the left side of the screen.

8. Adjust **control 8** to converge the red and green horizontal lines at the left side of the screen.
Note: If necessary, slide the RED or GREEN SWITCH, or both, to the opposite position to increase the ranges of **controls 5, 6, 7,** and **8.**

Repeat steps 5 through 8 to obtain convergence of the red and green horizontal and vertical lines at the left and right sides of the screen.

Remove bios from the blue gun.

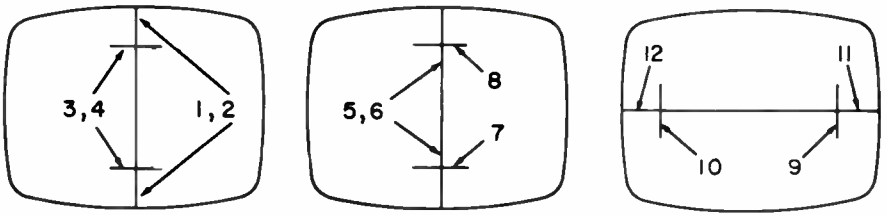
9. Adjust **control 9** to converge the blue horizontal lines with the yellow (red and green) horizontal lines at the top center of the screen.

10. Adjust **control 10** to converge the blue horizontal lines with the yellow (red and green) horizontal lines at the bottom center of the screen. Correct adjustment may occur if the blue and yellow lines become parallel. In this case, readjust the blue static-convergence magnet to obtain convergence.

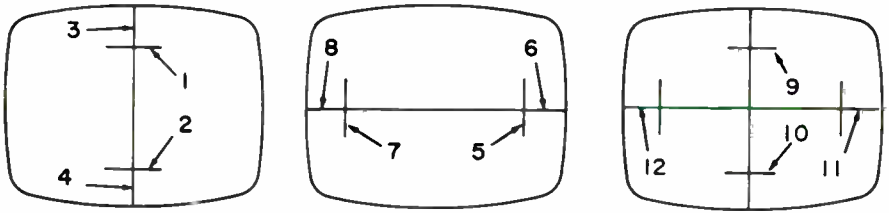
11. Adjust **control 11** to converge the blue horizontal lines with the yellow horizontal lines at the right side of the screen.

12. Adjust **control 12** to converge the blue horizontal lines with the yellow horizontal lines at the

Dynamic Convergence H



Dynamic Convergence J



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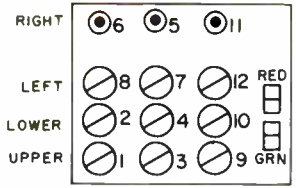
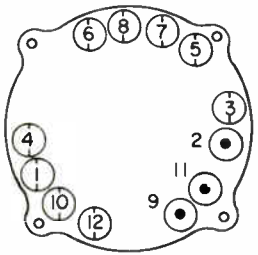
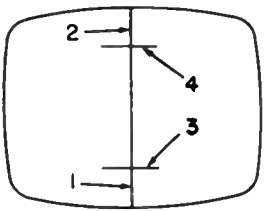


CB-6



CB-14

VERTICAL DYNAMIC



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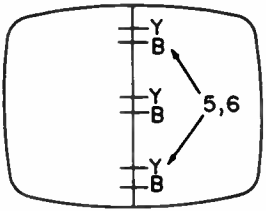
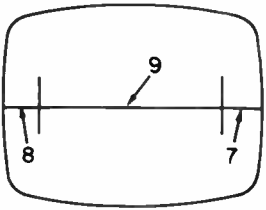


BLUE ON

HORIZONTAL DYNAMIC



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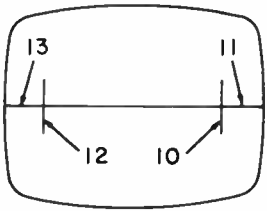

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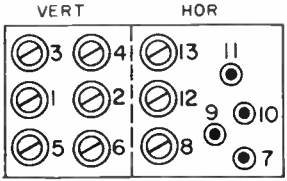


CB-11

left side of the screen.
The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure K

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen. Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in the red and green lines being parallel along the center vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the top center of the screen. Repeat steps 3 and 4 to obtain convergence of the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may occur when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

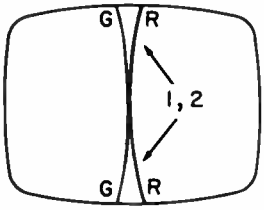
Remove bias from the blue gun.

5. Adjust **control 5** to converge the blue horizontal lines with the yellow (red and green) horizontal lines at the bottom center of the screen.

6. Adjust **control 6** to converge the blue horizontal lines with the yellow horizontal lines at the top center of the screen.

7. Adjust **control 7** to make the

VERTICAL DYNAMIC



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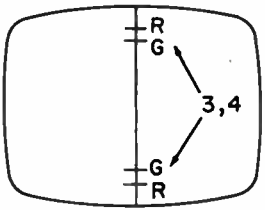

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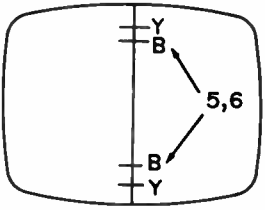

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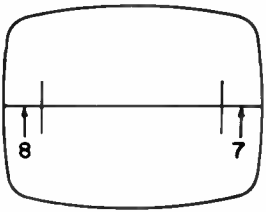
HORIZONTAL DYNAMIC



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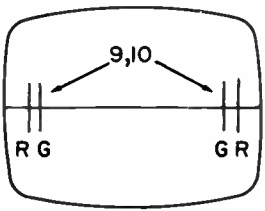

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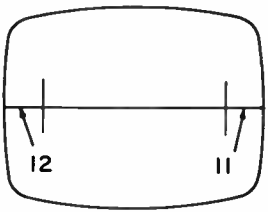

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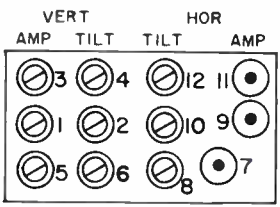


CB-13

center blue horizontal line at the right side of the screen a straight line.

8. Adjust **control 8** to make the center blue horizontal line at the left side of the screen a straight line.

9. Adjust **control 9** to make the blue horizontal line in the center of the screen a straight line.

Bias off the blue gun.

10. Adjust **control 10** to converge the red and green vertical lines at the right side of the screen.

11. Adjust **control 11** to converge the red and green horizontal lines at the right side of the screen.

12. Adjust **control 12** to converge the red and green vertical lines at the left side of the screen.

13. Adjust **control 13** to converge the red and green horizontal lines at the left side of the screen.

Remove bias from the blue gun.

14. Readjust **controls 7, 8,** and **9** to converge the center blue horizontal line with the center yellow (red and green) horizontal line at the right, left, and center of the screen.

The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure L

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green center vertical lines, or to obtain crossover of the lines with equal displacement at the top and bottom of the screen.

2. Adjust **control 2** to reduce the displacement between the red and green center vertical lines until the lines converge. Repeat steps 1 and 2, if necessary. Correct adjustment may result in the red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets.

3. Adjust **control 3** to converge the red and green horizontal lines at the top and bottom of the screen, or to obtain equal but opposite displacement of the red and green lines at the top and bottom of the screen. Red should be displaced above green at the top of the screen and below green at the bottom.

4. Adjust **control 4** to reduce the displacement between the red and green horizontal lines at the top and bottom of the screen until the red and green lines converge. Repeat steps 3 and 4 to obtain convergence of the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may occur when the red and green horizontal lines are equally displaced along the center vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

Remove bias from the blue gun.

5. Adjust **control 5** to converge the blue and yellow horizontal lines, or to obtain equal but opposite displacement of the lines at the top and bottom of the screen. Blue should be displaced below the yellow horizontal line at the top of the screen and above the yellow line at the bottom of the screen.

6. Adjust **control 6** to reduce the displacement between the blue and yellow horizontal lines at the top and bottom of the screen until the blue and yellow lines converge. Repeat steps 5 and 6 to obtain convergence of the blue and yellow horizontal lines along the center vertical line. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced along the center vertical line. In this case, readjust the blue static-convergence magnet to obtain convergence.

7. Adjust **control 7** to make the blue horizontal center line at the right side of the screen a straight line.

8. Adjust **control 8** to make the blue horizontal center line at the

left side of the screen a straight line.

Bias off the blue gun.

9. Adjust **control 9** to converge the red and green vertical lines at the right and left sides of the screen, or to obtain equal but opposite displacement of the red and green lines at the right and left sides of the screen. Red should be displaced to the left of the green vertical line at the left side of the screen and to the right of the greeen vertical line at the right side of the screen.

10. Adjust **control 10** to reduce the displacement between the red and green vertical lines at the right and left sides of the screen until the red and green lines converge. Repeat steps 9 and 10, if necessary.

11. Adjust **control 11** to converge the red and green horizontal lines at the right side of the screen.

12. Adjust **control 12** to converge the red and green horizontal lines at the left side of the screen.

Remove bias from the blue gun.

13. Readjust **controls 7** and **8** to converge the blue horizontal line with the yellow (red and green) horizontal line at the right and left sides of the screen.
The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure M

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.
b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green vertical lines at the top center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the bottom center of the screen.
Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in

the red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

3. Adjust **control 3** to converge the red and green horizontal lines at the top center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the bottom center of the screen. Repeat steps 3 and 4 to obtain convergence of the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may result when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

5. Adjust **control 5** to converge the red and green vertical lines at the right side of the screen.

6. Adjust **control 6** to converge the red and green vertical lines at the left side of the screen.

7. Adjust **control 7** to converge the red and green horizontal lines at the right side of the screen.

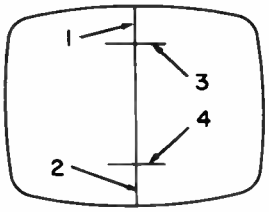
8. Adjust **control 8** to converge the red and green horizontal lines at the left side of the screen.

Remove bias from the blue gun.

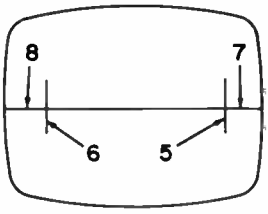
9. Adjust **control 9** until a displacement is obtained between the blue and yellow (red and green) horizontal lines at the top and bottom of the center area of the screen. Blue should be displaced in the same direction (above or below) the yellow lines at the top and bottom of the screen.

10. Adjust **control 10** until the displacement between the blue and yellow horizontal lines is equal at the top and bottom of the screen.

11. Readjust **control 9** until the blue and yellow horizontal lines converge at the top and bottom of the screen. If either top or bottom lines converge first, readjust **control 10** so that the yellow line is displaced equally at the top and bottom of the screen.



BLUE OFF



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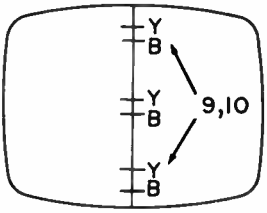

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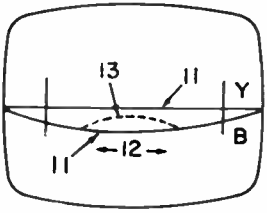

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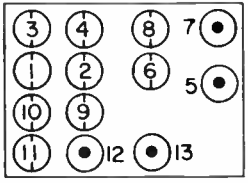
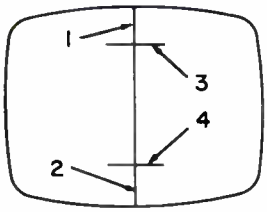


CB-15



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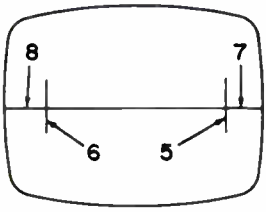

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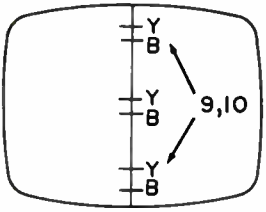
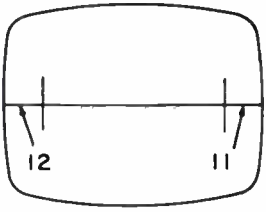
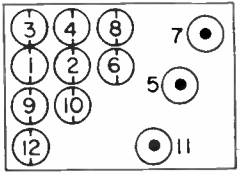


BLUE ON



BLUE ON



CB-16

Readjust **control 9** until the top and bottom lines converge. Correct adjustment may occur when the blue and yellow lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet to obtain convergence.

12. Adjust **control 11** to obtain a droop or sag in the blue horizontal line.

13. Adjust **control 12** until the droop or sag in the blue horizontal line is centered horizontally.

14. Adjust **control 13** until the droop or sag in the blue horizontal line is pushed upwards at the center.

15. Readjust **control 11** counterclockwise until the blue horizontal line is converged with the yellow horizontal line in the center of the screen. Correct adjustment may occur if the blue and yellow lines become parallel. In this case, readjust the blue static-convergence magnet to obtain convergence.

The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure N

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.

b. **Bios off the blue gun.** Refer to PURITY ADJUSTMENTS for methods.

1. Adjust **control 1** to converge the red and green vertical lines at the top center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the bottom center of the screen. Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in the red and green lines being parallel on the vertical line. In this case, readjust the red and green static-convergence magnets to obtain convergence.

3. Adjust **control 3** to converge the

red and green horizontal lines at the top center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the bottom center of the screen. Repeat steps 3 and 4 to converge the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may result when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence magnets to obtain convergence.

5. Adjust **control 5** to converge the red and green vertical lines at the right side of the screen.

6. Adjust **control 6** to converge the red and green vertical lines at the left side of the screen.

7. Adjust **control 7** to converge the red and green horizontal lines at the right side of the screen.

8. Adjust **control 8** to converge the red and green horizontal lines at the left side of the screen.

Remove bios from the blue gun.

9. Adjust **control 9** until a displacement is obtained between the blue and yellow (red and green) horizontal lines at the top and bottom of the center area of the screen. Blue should be displaced in the same direction (above or below) the yellow lines at the top and bottom of the screen.

10. Adjust **control 10** until the displacement between the blue and yellow horizontal lines is equal at the top and bottom of the screen.

11. Readjust **control 9** until the blue and yellow horizontal lines converge at the top and bottom of the screen. If either top or bottom lines converge first, readjust **control 10** so that the yellow line is displaced equally at the top and bottom of the screen. Readjust **control 9** until the top and bottom lines converge. Correct adjustment may occur when the blue and yellow lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-

convergence magnet to obtain convergence.

12. Adjust **control 11** to converge the center horizontal blue line with the yellow (red and green) line at the right side of the screen.

13. Adjust **control 12** to converge the center horizontal blue line with the yellow (red and green) line at the left side of the screen. The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure P

a. See DYNAMIC CONVERGENCE, Preliminary Adjustments, page 84.

b. **Bias off the blue gun.** Refer to PURITY ADJUSTMENTS for bias methods.

1. Adjust **control 1** to converge the red and green vertical lines at the bottom center of the screen.

2. Adjust **control 2** to converge the red and green vertical lines at the top center of the screen. Repeat steps 1 and 2 to obtain convergence of the red and green lines along the vertical line through the center of the screen. Correct adjustment may result in the red and green lines being parallel on the vertical line. In this case, readjust the red and green static convergence magnets to obtain convergence. **Note:** For chassis using **CB-26**, if the ranges of **controls 1** and **2** are insufficient reverse the setting of the R-G RANGE SWITCH.

3. Adjust **control 3** to converge the red and green horizontal lines at the bottom center of the screen.

4. Adjust **control 4** to converge the red and green horizontal lines at the top center of the screen. Repeat steps 3 and 4 to converge the red and green horizontal lines in a vertical band through the center of the screen. Correct adjustment may result when the red and green horizontal lines are equally displaced through the area in question. In this case, readjust the red and green static-convergence

magnets to obtain convergence.

5. Adjust **control 5** to converge the red and green vertical lines at the right side of the screen.

6. Adjust **control 6** to converge the red and green vertical lines at the left side of the screen. Repeat steps 5 and 6 to obtain the best convergence at both sides of the screen. Correct adjustment may result in red and green vertical lines being equally spaced across the screen. In this case, readjust the red and green static-convergence magnets to obtain convergence.

7. Set **control 8** to mid-range.

8. Adjust **control 7** to converge the center horizontal red and green lines at both sides of the screen.

9. Adjust **control 8** to converge the center horizontal red and green lines at the center of the screen. Repeat steps 8 and 9 to obtain the best overall convergence. Correct adjustment may result in the red and green lines being parallel. In this case, readjust the red and green static-convergence magnets to obtain convergence.
Remove bios from the blue gun.

10. Turn **control 11** to maximum (fully clockwise).

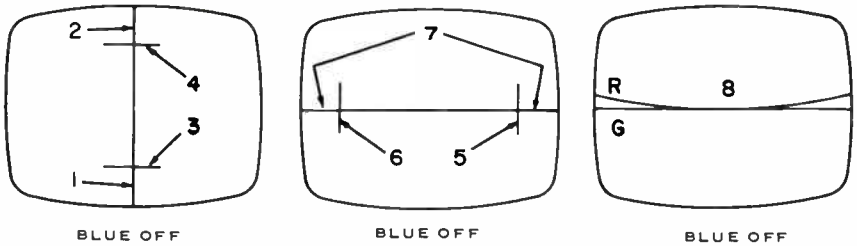
11. Adjust **control 9** until the blue line is centered horizontally.

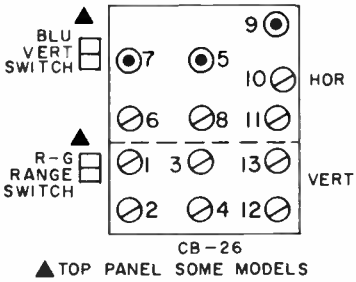
12. Adjust **control 10** until the droop or sag in the blue line is pushed upwards in the center.

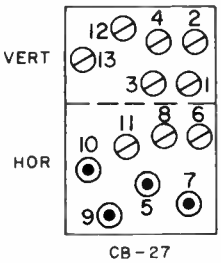
13. Readjust **control 11** counterclockwise until the blue horizontal line is converged with the yellow horizontal line in the center of the screen. Correct adjustment may occur if the blue and yellow lines become parallel. In this case, readjust the blue static-convergence magnet to obtain convergence. Repeat steps 11 through 13, if necessary.

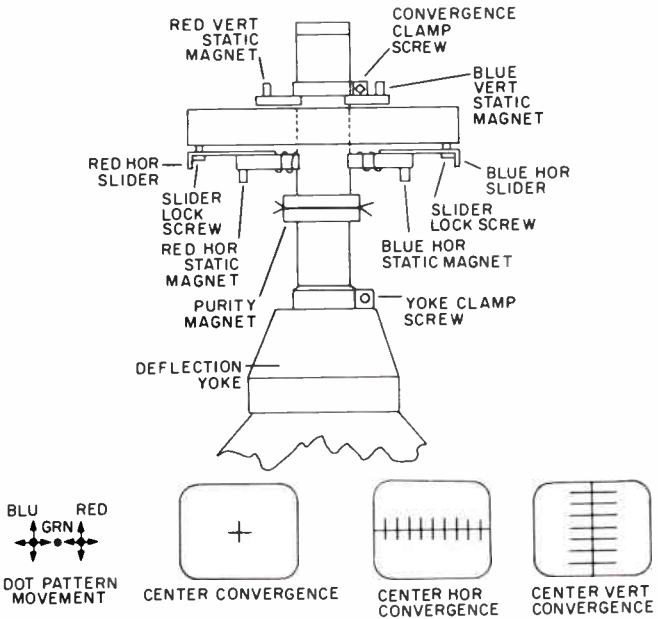
14. Turn **control 13** to minimum (fully counterclockwise).

15. Adjust **control 12** until a displacement between the blue and yellow lines at the top and bottom of the center area of the screen is noticed. Blue should be displaced in the same direction (above or









Dynamic Convergence Q

below) the yellow lines at the top and bottom of the screen.

16. Readjust **control 13** until the blue and yellow horizontal lines converge at the top and bottom of the screen. If either the top or bottom lines converge first, readjust **control 12** to equalize the displacement. Readjust **control 13** to converge the lines at the top and bottom of the screen. Correct adjustment may occur when the blue and yellow horizontal lines are equally displaced in a vertical band through the center of the screen. In this case, readjust the blue static-convergence magnet to obtain convergence. **Note:** For chassis using **CB-26,** if the ranges of **controls 12** and **13** are insufficient reverse the setting of the BLUE VERTICAL SWITCH. The convergence adjustments should now be complete.

DYNAMIC CONVERGENCE

Procedure Q

Note: Convergence and purity are adjusted together for these chassis.

a. Degauss the receiver.

b. Connect the color-bar/dot/crosshatch generator, such as the RCA WR-64B or WR-502A, to the antenna terminals of the receiver and set the generator and receiver to produce a crosshatch pattern.

c. Check picture size, linearity, and focus. Readjust, if necessary, before making convergence adjustments.

d. Switch the generator to "off".

1. Loosen the screws on the horizontal convergence sliders and move each slider to place the core end approximately 1/8 inch from the neck of the picture tube.

2. Adjust the purity rings so that the square tab on each ring is 180 degrees from the other. Then position the purity-ring assembly on the neck of the picture tube so that the square tabs are on a vertical plane.

3. Position the red and blue vertical static-convergence magnets

so that the line marked on the end of each magnet is on a vertical plane. Position the red and blue horizontal static-convergence magnets so that the line marked on the end of each magnet is on a horizontal plane.

4. Set the MASTER BRIGHTNESS (Front Panel) control to approximately mid-range and set the CONTRAST control completely counterclockwise.

5. Set the SCREEN controls completely clockwise and adjust the GREEN AND BLUE G1 controls for a semblance of black-and-white tracking.

6. Switch the generator to produce a dot pattern.

7. Adjust the four static-convergence magnets to merge red and blue dots with the green dots in the center of the screen. Switch the generator to "off".

8. Set the GREEN and BLUE G1 controls completely counterclockwise. Loosen the yoke-clamp screw and slide the yoke back as far as possible. Tighten the clamp screw to permit the yoke to just slide and turn.

9. Spread the tabs of the purity-ring assembly and rotate the assembly until the red area is exactly in the center of the screen.

10. Switch the generator to produce a dot pattern. Advance the GREEN G1 control to obtain green and red dots on the screen. Adjust the red static-convergence magnets to converge the green and red (yellow) dots in the center of the screen.

11. Advance the BLUE G1 control to obtain blue and yellow dots in the center of the screen. Adjust the blue static-convergence magnets to converge the blue and yellow (white) dots in the center of the screen. Switch the generator to "off".

12. Set the GREEN and BLUE G1 controls completely counterclockwise and slide the yoke forward to obtain the best overall pure red raster and proper leveling of the picture. Repeat steps 8 through 12 to obtain the best overall

center convergence consistent with good overall purity.

13. Switch the generator to produce a crosshatch pattern. Advance the GREEN G1 control and observe the relationship between the red and green vertical lines at the right and left sides of the screen. Move the red horizontal slider towards the neck of the tube if red appears inside of green (closer to the center of the raster). Move the red horizontal slider away from the neck of the tube if red appears outside of green (closer to the edge of the raster).

14. Adjust the red vertical static-convergence magnet to converge the red and green vertical lines along the center horizontal line.

15. Advance the BLUE G1 control and observe the relationship between the yellow (red and green) and blue vertical lines at the right and left sides of the screen. Adjust the blue horizontal slider and the blue static-convergence magnets to converge the blue lines with the yellow. Repeat steps 13 through 15 to obtain best overall center convergence consistent with good purity. Lock the sliders in place after the adjustment has been completed.

16. Check convergence of the horizontal lines along the center vertical line. If additional adjustment is necessary, the connections to each vertical convergence coil may be changed to either reverse the polarity of the coil or remove the coil completely from the circuit. Clips and lugs are provided on the top of the assembly for this purpose.

17. Set the GREEN and BLUE G1 controls completely counterclockwise and position the yoke to obtain the best overall red raster. Check purity on the blue and green screens. Clamp the yoke in the position which gives the best overall purity.

Black-and-white setup adjustments, sometimes called color-temperature adjustments or gray-scale tracking, are made to obtain a neutral white-and-gray scale in the black-and-white picture. In these setup adjustments, signal levels and operating voltages applied to the three guns of the picture tube are adjusted to maintain the proper balance of electron-gun currents for all values of bias between cut-off and maximum highlight brightness.

The object of these adjustments is to obtain the brightest picture possible, while maintaining proper black-and-white tracking of the picture tube at all brightness levels.

Incorrect Highlights

If proper black-and-white tracking cannot be obtained according to the following procedures, it may be necessary to rearrange the signals applied to the cathodes of the picture tube.

Rearranging the signals might be necessary because maximum video drive is normally applied to the red gun and an adjustable, but lower amplitude signal is applied to the green and blue guns. This arrangement is used because red, usually the least efficient phosphor, requires the most drive.

However, improvements in the red phosphors used in more recent picture tubes have brought about a condition that might require the blue or green gun to have maximum drive.

In older sets, loss of emission in the green or blue gun might be counteracted by applying the greatest drive to the weak gun.

The choice of cathode lead to be interchanged with the red lead depends on which change provides the

most satisfactory results. In receivers which use a fixed-video-drive ratio and background and screen controls for tracking, it is recommended that the blue and green cathode leads be disconnected from their normal receiver tie points and connected to the red cathode lead tie point.

To interchange cathode leads proceed as follows:
1. If the picture lacks green in the highlights (looks magenta or violet in highlights), even though the GREEN-DRIVE control is turned to maximum interchange the cathode leads to the red and green guns of the picture tube.
2. If the picture lacks blue in the highlights (appears yellow in the highlights), even though the BLUE-DRIVE control is turned to maximum, interchange the cathode leads of the red and blue guns of the picture tube.

Cathode leads in most sets are yellow with a red, green, or blue tracer to identify the gun. To swap leads, disconnect them where they join to tie points on the chassis.

BLACK-AND-WHITE SETUP
Procedure A

1. Set the KINE-BIAS, DRIVE, and SCREEN controls to mid-range. Set the CONTRAST control fully counter-clockwise and set the BRIGHTNESS control fully clockwise. Set the COLOR-FIDELITY control (if used) to mid-range. Set the NORMAL/SERVICE switch to the "SERVICE" position.
2. Starting with the RED-SCREEN control, advance each SCREEN control to produce a horizontal line on the screen.

If any SCREEN control fails to produce a line, leave the associated SCREEN control at maximum and adjust the KINE-BIAS control to produce a line. Alternately adjust the remaining SCREEN controls to produce a horizontal white line which is barely visible.

3. Return the NORMAL/SERVICE switch to the "NORMAL" position and adjust the CONTRAST and BRIGHTNESS controls to the highest settings, without causing picture "blooming". If the color of the bright white area does not match that of the white line produced in Step 2, alternately adjust the DRIVE controls to obtain a proper match.
4. Check the picture from lowlights to highlights throughout the usable range of the BRIGHTNESS control. If black-and-white tracking is not correct, readjust the DRIVE controls. **Note:** After adjustment, it is normal for the picture to bloom at the maximum settings of the BRIGHTNESS or CONTRAST controls.

BLACK-AND-WHITE SETUP
Procedure B

1. Set the COLOR control fully counterclockwise. Set the TINT and COLOR-FIDELITY controls to mid-range.
2. Set the BRIGHTNESS control to 90% of full clockwise rotation. Set the CONTRAST control to obtain a normal picture.
3. Adjust the BACKGROUND controls to produce a correct, neutral black-and-white picture at maximum brightness, but below the blooming point.
4. Check for a proper neutral gray scale throughout the normal range of the BRIGHTNESS control.
5. Reduce the BRIGHTNESS control to a slightly below normal setting. If one primary color is predominate, reduce the setting of the associated BACKGROUND control of the setting slightly. If you cannot achieve proper gray-scale tracking throughout the range of the BRIGHTNESS control, proceed with Step 6.
6. It may be necessary to rearrange the leads to the cathodes of the picture tube. Cathode wires are the yellow leads with red, green, or blue tracers to identify the associated electron gun. If one primary color is predominate in the highlights, the cathode lead to this gun should be connected to Pin P (low drive). If one primary color

is missing from the highlights, the associated cathode lead should be connected to Pin M (high drive). Arrange the cathode leads to achieve the best black-and-white picture at all settings of the BRIGHTNESS control. (Pin P low drive; Pin N medium drive; Pin M high drive.)

Procedure B1

Follow PROCEDURE B, except for the following:

Add to Step 1. Set the MASTER-SCREEN control to 75% of maximum clockwise rotation.

Add to Step 4. If detail is lacking at high brightness levels, advance the setting of the MASTER-SCREEN control; if retrace lines are visible, reduce the setting of the control.

BLACK-AND-WHITE SETUP

Procedure C

1. Set the KINE-BIAS control and the SCREEN controls fully counter-clockwise. Set the BRIGHTNESS and CONTRAST controls to mid-range. Set the COLOR-FIDELITY control, if used, to mid-range.
2. Set the NORMAL/SERVICE switch to the "SERVICE" position.
3. Advance each SCREEN control to produce a barely visible horizontal line on the screen. **Note:** The lines may not be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE switch is in the "SERVICE" position. It is important that the line produced by each primary color is barely visible. Adjust each SCREEN control until the associated color is just barely visible.

If any SCREEN control fails to produce a line, leave the associated SCREEN control at maximum and advance the KINE-BIAS control to produce a barely visible line. The remaining SCREEN controls may have to be readjusted so that a barely visible line of each primary color is obtained.

Accuracy in setting the SCREEN controls is very important. It may be

found that settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting the control until the line is just extinguished.
4. Return the NORMAL/SERVICE switch to the "NORMAL" position.
5. Alternately adjust the DRIVE controls to produce a normal black-and-white picture.
Check the picture from highlights to lowlights. If SCREEN controls were set accurately in Step 3, the picture should be neutral (black-and-white).

Procedure C1

Follow PROCEDURE C, except for the following:
Step 1. The KINE-BIAS control has been replaced by a KINE-BIAS switch. Start with the KINE-BIAS switch in the top position.
Step 3. If it is not possible to produce a line of one or more of the primary colors, move the slide down as necessary.

Procedure C2

Follow PROCEDURE C, except for the following:
Step 1. The KINE-BIAS control has been replaced by a KINE-BIAS switch. Start with the KINE-BIAS switch set to the right.
Step 3. If it is not possible to produce a line of one or more of the primary colors, move the slide to the left, as necessary.

Procedure C3

Follow PROCEDURE C, except for the following:
Step 1. The KINE-BIAS control has been replaced by a KINE-BIAS switch. Start with the KINE-BIAS switch in the bottom position.
Step 3. If it is not possible to produce a line of one or more of the primary colors, move the slide up, as necessary.

Procedure C4

Follow PROCEDURE C, except for the following:

Add Step 6. Set the BRIGHTNESS control completely clockwise. Adjust the SUB-BRIGHTNESS control clockwise until the picture just begins to lose focus and then readjust the control counterclockwise until normal focus is obtained. If sufficient brightness cannot be obtained after this procedure, advance the KINE-BIAS control until the picture begins to lose focus and then readjust the SUB-BRIGHTNESS control to obtain proper focus.

BLACK-AND-WHITE SETUP

Procedure D

1. Set the KINE-BIAS control and the SCREEN controls fully counterclockwise. Set the BRIGHTNESS, CONTRAST, and CINEMA (if used) controls to mid-range.
2. Set the three-position NORMAL/SERVICE/RASTER switch to the "SERVICE" position.
3. Advance the SCREEN controls to produce a barely visible horizontal line or lines on the screen.

Note: The lines may not be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE/RASTER switch is in the "SERVICE" position. It is important that the line produced by each primary color is barely visible. Adjust each SCREEN control until the line is just barely visible.

If any SCREEN control fails to produce a line, leave the associated SCREEN control at maximum and reset the KINE-BIAS control to produce a barely visible line. The remaining SCREEN controls may have to be readjusted so that a barely visible line of each color is obtained. **Accuracy in setting the SCREEN controls is very important.** It may be found that settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting each control until the line is just

extinguished.
4. Set the BRIGHTNESS control to maximum and set the NORMAL/SERVICE/RASTER switch to the "RASTER" ("PURITY") position.
5. Alternately adjust the DRIVE controls to produce a gray raster.
6. Set the NORMAL/SERVICE/RASTER switch to "NORMAL" and adjust the BRIGHTNESS and CONTRAST controls to produce a normal black-and-white picture. Check the picture from lowlights to highlights. If the SCREEN controls were set accurately in Step 3, the picture should be neutral (black to white). Some chassis have a RED/GREEN DRIVE switch. If the picture appears too "brassy", change the RED/GREEN DRIVE switch to the GREEN position and readjust the DRIVE controls for proper black-and-white tracking.

Procedure D1

Follow PROCEDURE D, except for the following:
Add to Step 5. At least one of the DRIVE controls should be set at maximum upon completion of this adjustment.

Procedure D2

Follow PROCEDURE D, except for the following:
Step 1. The KINE-BIAS control has been replaced by a KINE-BIAS switch. Start with the KINE-BIAS switch in the top position.
Step 3. If it is impossible to produce a line of one or more of the primary colors, move the slide down, as necessary.

Procedure D3

Follow PROCEDURE D, except for the following:
Add to Step 1. Set the DRIVE controls fully counterclockwise.

BLACK-AND-WHITE SETUP
Procedure E

1. Set the BRIGHTNESS, KINE-BIAS, and the SCREEN controls fully

counterclockwise. Set the CHROMA-TONE (SEPIA) switch (if used) to the "OFF" position. Set the DRIVE controls fully clockwise. Set the three-position NORMAL/SERVICE/PURITY switch to "SERVICE" position.

2. Advance each SCREEN control to produce a barely visible horizontal line. If any SCREEN control fails to produce a line, leave the associated SCREEN control at maximum and advance the BRIGHTNESS control until a line is obtained. Readjust the other SCREEN controls to produce a barely visible line of each primary color.

3. Set NORMAL/SERVICE/PURITY switch to the "NORMAL" position. Adjust the DRIVE controls to produce a normal black-and-white picture. If the SCREEN and DRIVE controls are adjusted properly, a neutral gray should be obtained throughout the usable range of the BRIGHTNESS control. Readjust the DRIVE controls as necessary.

4. Set the BRIGHTNESS control fully clockwise. Adjust the KINE-BIAS control until the picture just begins to bloom. Recheck tracking and readjust the SCREEN and DRIVE controls, if necessary.

BLACK-AND-WHITE SETUP
Procedure F

1. Set the BRIGHTNESS, KINE-BIAS, and the SCREEN controls fully counterclockwise. Set the CHROMA-TONE (SEPIA) switch (if used) to the "OFF" position. Set the DRIVE controls fully clockwise. Set the three-position NORMAL/SERVICE/PURITY switch to the "SERVICE" position.

2. Advance each SCREEN control to produce a barely visible horizontal line.

If any SCREEN control fails to produce a faint line, leave the associated SCREEN control at maximum and advance the KINE-BIAS control until a line is obtained. Readjust the other SCREEN controls to produce a barely visible line of each primary color.

3. Set NORMAL/SERVICE/PURITY

switch to the "NORMAL" position and slowly adjust the BRIGHTNESS control clockwise while observing the picture. A black-and-white picture should be obtained through the entire range of the BRIGHTNESS control.
4. Reverse the leads to the RED and GREEN cathodes of the picture tube, if the picture appears reddish. Repeat the procedure; however, set the GREEN-DRIVE control completely counterclockwise.
5. Set the BRIGHTNESS control for normal brightness and set the NORMAL/SERVICE/PURITY switch to the "PURITY" position. If any impurity exists at the outer edges of the screen, adjust the two small edge-purity magnets. Refer to PURITY ADJUSTMENTS, PROCEDURE G.

BLACK-AND-WHITE SETUP
Procedure G

1. Set the DRIVE and TINT controls to mid-range.
2. Set the MASTER G-1 control fully counterclockwise (Front Panel).
3. Tune the set to an unused channel. Set the CONTRAST control fully counterclockwise.
4. Set all G-2 (SCREEN) controls fully clockwise (Front Panel).
5. Adjust the BRIGHTNESS control until the raster is just visible.
6. Check the color of the raster. If any primary color predominates, reduce the setting of the associated G-2 control. The G-2 control for the weakest color should be left at maximum. Adjust the remaining G-2 controls, as necessary, to produce a gray raster.
7. Set the BRIGHTNESS control fully clockwise. Set the CONTRAST control fully counterclockwise. Set the CHANNEL SELECTOR between channels.
8. Starting with the MASTER G-1 control at the full-counterclockwise setting, slowly advance this control until the picture just starts to go out of focus (begins to bloom). Then turn the G-1 control back about 45°.

9. Adjust the BRIGHTNESS control to obtain normal brightness and check the color of the raster. If the screen is a neutral white or grey, setup is complete. If a color is predominant proceed with Steps 10 and 11.
10. Adjust the DRIVE controls to produce a white raster.
11. Reduce the BRIGHTNESS control setting to produce a gray raster. Touch up the G-2 controls to produce a neutral gray.

BLACK-AND-WHITE SETUP
Procedure H

1. Set the GRID controls completely counterclockwise. Set the BRIGHTNESS and CONTRAST controls to mid-range.
2. Set the NORMAL/SERVICE switch to the "SERVICE" position.
3. Advance each GRID control to produce a barely visible horizontal line or lines on the screen.
It is important that the line produced by each primary color be barely visible. Adjust each GRID control until the line is just barely visible. It may be found that the settings can be improved by adjusting each GRID control until the associated color is seen and then readjusting the control until the line is just extinguished.
4. Return the NORMAL/SERVICE switch to "NORMAL".
5. Alternately adjust the DRIVE controls to produce a normal black-and-white picture. Check the picture from highlights to lowlights. If the GRID controls were set accurately in Step 3, the picture should be neutral (black to white).

BLACK-AND-WHITE SETUP
Procedure J

1. Set the SCREEN controls fully counterclockwise.
2. Set the COLOR control fully counterclockwise and set the TINT control to mid-range.
3. Set the BRIGHTNESS and CONTRAST controls to mid-range.
4. Set the NORMAL-SERVICE switch to the "SERVICE" position.

5. Advance each SCREEN control to produce a barely visible horizontal line or lines on the screen. **Note:** The lines may not be converged because the vertical-convergence signals are not present when the service switch is in the "SERVICE" position. There may also be a second horizontal blue line, slightly bowed, visible across the screen. The second blue line is normal in this chassis because the horizontal blanking pulse is not available to the cathodes of the picture tube when the switch is in the "SERVICE" position. It is possible, therefore, for retrace lines to be seen on the screen when the vertical sweep is collapsed.

Accuracy in setting the SCREEN controls is very important. It may be found that the settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting each control until the line is just extinguished.

6. Set the NORMAL/SERVICE switch to the "RASTER" position and adjust the BRIGHTNESS control to obtain normal brightness.

7. Alternately adjust the DRIVE controls to obtain a gray raster.

8. Set the NORMAL/SERVICE switch to the "NORMAL" position and check the picture from lowlights to highlights throughout the usable brightness range. If the SCREEN controls were set accurately the picture should be neutral (black to white).

Note: During the setting of the SCREEN controls in Step 5, if a horizontal line cannot be obtained when the respective SCREEN control is advanced, it will be necessary to remove **R134** (on the wiring side of the picture tube setup board) from the drive circuits.

In some CTC-22 chassis **R134** was omitted from the circuit. If any horizontal line cannot be extinguished during the setting of the SCREEN controls in Step 5, it will be necessary to install **R134** (22kΩ,3W) in the drive-control circuit. **R134** is part of a voltage-

divider network from the bottom side of the drive controls to ground. The divider network consists of R134 and R119 in parallel, and R122 from the voltage tap to ground.

BLACK-AND-WHITE SETUP
Procedure K

1. Set the KINE-BIAS switch in the top position. Set the CHROMIX control (if used) to mid-range. Set the SCREEN controls fully counterclockwise.
2. Set the NORMAL/SERVICE switch to the "SERVICE" position.
3. Advance the SCREEN controls until each control produces a barely visible horizontal line of the associated color on the screen. If any SCREEN control fails to produce a horizontal line, move the KINE-BIAS switch down one or two notches, as necessary, to make the extinguished color visible. Readjust the three SCREEN controls so that the three primary-color lines are barely visible.
4. Switch the NORMAL/SERVICE switch to the "NORMAL" position.
5. Advance the BRIGHTNESS control to obtain maximum brightness without blooming.
6. Adjust the DRIVE controls to produce a neutral black-and-white picture.
7. Check for a neutral gray scale throughout the useful range of the BRIGHTNESS control.

BLACK-AND-WHITE SETUP
Procedure L

1. Set the CHROMIX control, if used, to mid-range. Set the SCREEN controls (mounted on the convergence board) completely clockwise and set the DRIVE, BRIGHTNESS, and CONTRAST controls completely counterclockwise.
2. Advance the BRIGHTNESS control 1/4 turn.
3. Adjust the RED-DRIVE control to obtain a dim red raster.
4. Adjust the BLUE and GREEN-DRIVE controls (mounted on the convergence board) to obtain a dim

neutral black-and-white raster.
5. Check for proper black-and-white tracking throughout the useful range of the BRIGHTNESS control.

BLACK-AND-WHITE SETUP
Procedure M

1. Set the BRIGHTNESS, CONTRAST, COLOR, and SCREEN controls completely counterclockwise.
2. Set the NORMAL/SERVICE switch to the "SERVICE" position.
3. Advance each SCREEN control to produce a barely visible horizontal line on the screen. **Note:** the lines may not be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE switch is in the "SERVICE" position. It is important that the line produced by each primary color be barely visible. Adjust each SCREEN control until the associated color is just barely visible.
Accuracy in setting the SCREEN controls is very important. It may be found that the settings can be improved by adjusting each SCREEN control until the associated color is seen, and then readjusting each control until the line is just extinguished.
4. Return the NORMAL/SERVICE switch to the "NORMAL" position.
5. Adjust the DRIVE controls to produce a normal black-and-white picture. Check the picture from highlights to lowlights. If the SCREEN controls were set accurately, the picture should be neutral (black to white).

BLACK-AND-WHITE SETUP
Procedure N

1. Check that the G1 DRIVE control is properly adjusted. Refer to MISCELLANEOUS ADJUSTMENTS for the adjustment procedure.
2. Set the BRIGHTNESS and CONTRAST controls completely clockwise. Set the SCREEN controls completely counterclockwise.
3. Set the NORMAL/SERVICE switch to the "SERVICE" position.
4. Advance each SCREEN control to

produce a barely visible horizontal line on the screen. **Note:** The lines may not be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE switch is in the "SERVICE" position. It is important that the line produced by each primary color be barely visible. Adjust each SCREEN control until the associated color is just barely visible.

If any SCREEN control fails to produce a line, leave the associated control at maximum and advance the G1 DRIVE control to produce a barely visible line. The remaining SCREEN controls may have to be readjusted so that a barely visible line of each primary color is obtained.

Accuracy in setting screen controls is very important. It may be found that settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting each control until the line is just extinguished.

5. Return the NORMAL/SERVICE switch to the "NORMAL" position.
6. Adjust the BRIGHTNESS and CONTRAST controls for normal viewing. Alternately adjust the DRIVE controls to produce a normal black-and-white picture. If the SCREEN controls were set accurately, the picture should be neutral (black to white).

BLACK-AND-WHITE SETUP
Procedure P

1. Set the BRIGHTNESS and CONTRAST controls to mid-range. Set the NORMAL/SERVICE switch to the "SERVICE" position.
2. Set the KINE-BIAS switch to the lowest position (toward the base of the chassis).
3. Set the DRIVE controls to 75% of maximum clockwise rotation.
4. Set the SCREEN controls completely counterclockwise and then adjust each SCREEN control clockwise to produce a barely visible horizontal line or lines on the screen. **Note:** The lines may not

be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE switch is in the "SERVICE" position. **Accuracy in setting the SCREEN controls is very important.** It may be found that settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting each control until the line is just extinguished. **Return the KINE-BIAS switch to the top position for normal set operation.**

5. Set the NORMAL/SERVICE switch to the "NORMAL" position.
6. Increase the setting of the BRIGHTNESS control and observe the picture. If excessive blooming occurs at high brightness levels, repeat the above procedure with special attention given to the settings of the SCREEN controls.

BLACK-AND-WHITE SETUP
Procedure Q

1. Tune the receiver to a black-and-white picture. Set the TINT control to mid-range. Set the G2 (SCREEN) and DRIVE controls fully clockwise.
2. Set the BRIGHTNESS and CONTRAST controls to minimum. If there is no raster, proceed with Step 3. If a raster is visible, increase the BRIGHTNESS control, if necessary, until a raster composed of the three primary colors is obtained. Turn the G2 (SCREEN) control of the predominant color completely counterclockwise. Then turn the G2 (SCREEN) control of the next most predominant color completely counterclockwise. Leave the remaining G2 control of the weakest gun set to maximum for the remaining steps of the procedure. Readjust the two G2 controls to produce a white raster. Proceed to Step 4.
3. Increase the BRIGHTNESS control until one of the guns just produces a raster. Set the G2 control of this gun completely counterclockwise. Continue to advance the BRIGHTNESS control until a second

gun just produces a raster. Set the G2 control of this gun completely counterclockwise. Continue to advance the BRIGHTNESS control until the remaining gun just produces a raster. Leave the BRIGHTNESS control at this setting. Readjust the two G2 controls that were set to minimum to produce a white raster.
4. Set the CONTRAST and BRIGHTNESS controls fully clockwise.
5. Readjust the DRIVE controls to produce white in the highlights of the picture. Set the DRIVE control for the weakest gun to maximum.
6. Adjust the AUTOMATIC-BRIGHTNESS LIMITER control as described in MISCELLANEOUS ADJUSTMENTS.

BLACK-AND-WHITE SETUP
Procedure R

1. Tune the receiver to a black-and-white picture. Set the TINT and G2 (SCREEN) controls to mid-range. Set the DRIVE controls completely clockwise.
2. Alternately turn the G2 controls counterclockwise to determine which gun extinguishes first. Reset the G2 control of the gun that extinguishes first to mid-range. Readjust the remaining G2 controls to produce a white raster.
3. Set the BRIGHTNESS and CONTRAST controls to maximum. Readjust the DRIVE controls to produce white in the highlights of the picture. Set the DRIVE control for the weakest gun to maximum.
4. Adjust the AUTOMATIC BRIGHTNESS LIMITER control as described in MISCELLANEOUS ADJUSTMENTS.

BLACK-AND-WHITE SETUP
Procedure S

1. Short the antenna terminals together and set the CHANNEL SELECTOR to an unused VHF channel.
2. Set the SCREEN controls completely clockwise. Set the CONTRAST control completely counterclockwise.
3. Adjust the MASTER-BRIGHTNESS control (Front Panel) clockwise until the picture just begins to bloom.

4. Adjust the G1 controls to eliminate any color shading of the raster.
5. Turn the MASTER-BRIGHTNESS control counterclockwise to obtain a very dim raster.
6. Adjust the SCREEN controls to eliminate any color shading of the raster. At least one of the SCREEN controls should be set at maximum upon completion of this step.
7. Check the raster from lowlights to highlights throughout the usable range of the BRIGHTNESS control. If black-and-white tracking is not correct, readjust the DRIVE controls to correct any color shading at high brightness levels; readjust the SCREEN controls to correct any color shading at low brightness levels.

BLACK-AND-WHITE SETUP
Procedure T

1. Set the COLOR control and the SCREEN controls completely counterclockwise.
2. Set the BRIGHTNESS, CONTRAST, and DRIVE controls to mid-range.
3. Set the KINE-BIAS switch to the top position.
4. Set the NORMAL/SERVICE switch to the "NORMAL" position.
5. Adjust each SCREEN clockwise to produce a barely visible horizontal line or lines on the screen. **Note:** The lines may not be converged because the vertical-convergence signals are not present when the NORMAL/SERVICE switch is in the "SERVICE" position.
Accuracy in setting the SCREEN controls is very important. It may be found that settings can be improved by adjusting each SCREEN control until the associated color is seen and then readjusting each control until the line is just extinguished.
6. Set the NORMAL/SERVICE switch to the "NORMAL" position.
7. Advance the setting of the BRIGHTNESS control. If insufficient brightness occurs at high settings of the BRIGHTNESS control, move the KINE-BIAS switch to the middle or

bottom position. However, the SCREEN controls must be adjusted with the KINE-BIAS switch in the top position.

8. Set the BRIGHTNESS and CONTRAST controls to a low setting. If the screen is not gray, readjust the SCREEN controls.

9. Set the BRIGHTNESS and CONTRAST controls to high settings. If the screen is not gray, readjust the DRIVE controls.

Problems in the AFPC circuit can result in a loss of color sync, no color or wrong color, or a narrow range of adjustment with the tint control. Circuit trouble may also be indicated if color locks well on strong channels but loses sync on weaker channels.
Color AFPC alignment should also be checked whenever the 3.58-MHz oscillator and reactance tube have been replaced.

COLOR AFPC
Procedures A1 & A2

Two procedures are given. Both procedures apply to most color-TV receivers using reactance-tube controlled crystal-oscillator circuits. Procedure A1 requires only a color-bar generator and should be used as a first attempt to correct problems in the AFPC circuit. Procedure A2 requires a color-bar generator and a VTVM and should be used if the circuit does not respond to the touch-up adjustments given in Procedure A1. **Note:** In chassis which have controls for varying the white background (SEPIA, CHROMATONE, etc.) during a black-and-white telecast, be sure to set the control to a neutral position before performing an AFPC adjustment.

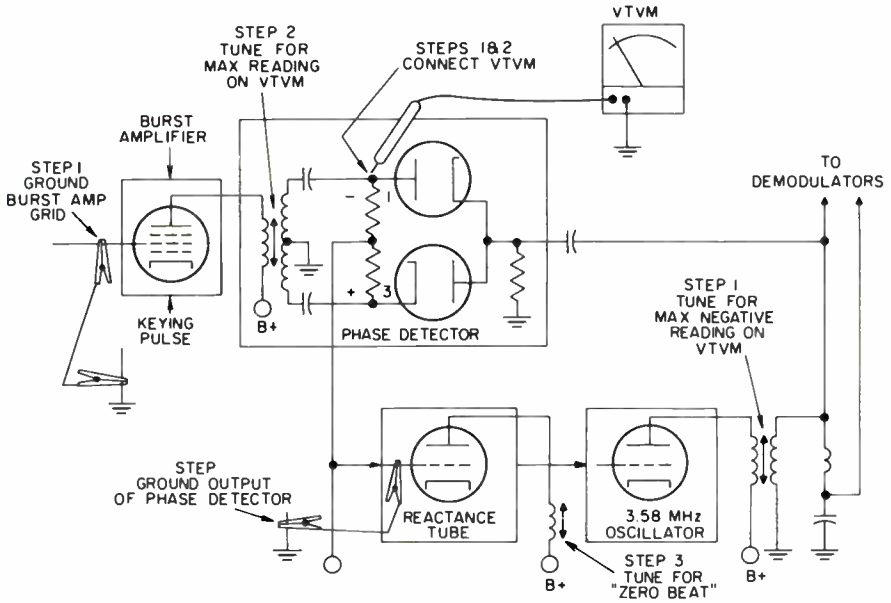
Procedure A1

1. Connect a color-bar generator to the antenna terminals and adjust the generator and receiver to produce a normal color-bar pattern.
2. Check the AGC and horizontal-deflection circuits for proper operation.
3. Set the TINT control to mid-range and set the COLOR-KILLER control completely counterclockwise. Shunt the green and blue picture-tube grids to ground. Refer to PURITY ADJUSTMENTS for bias methods.
4. Adjust the BURST-PHASE transformer to make the sixth bar the

same brightness as the background. Do not adjust the core of the transformer more than one turn in either direction. Touch up the 3.58-MHz Oscillator transformer, if necessary.
5. Rotate the TINT control through its entire range. At one extreme the fifth bar should be the same brightness as the background; at the other extreme the seventh bar should be the same brightness as the background.
6. Return the TINT control to the center of its range. Remove the shunt from the blue picture-tube grid and shunt the red picture-tube grid to ground. The third and ninth bars should be the same brightness as the background. Similarly, with only the green gun "on" the first and seventh bar should be the same brightness as the background.
7. Remove the grid shunts and readjust the COLOR-KILLER control until colored snow just disappears from the raster. Check with a color program or a low-level color-bar pattern to make sure the control is properly adjusted.

Procedure A2

1. Connect the color-bar generator to the antenna terminals and adjust the generator and receiver to produce a normal color-bar pattern.
2. Check the AGC and horizontal-deflection circuits for proper operation.
3. Set the TINT control to mid-range and set the COLOR-KILLER control completely counterclockwise.
4. Connect the VTVM to the cathode of the phase-detector diode that is coupled to one side of the burst transformer.
5. Short the grid of the burst-amplifier tube to ground. Use a very short clip-lead.
6. Adjust the core of the 3.58-MHz OSCILLATOR transformer to get a maximum negative voltage reading on the VTVM. Remove the clip-lead from the burst-amplifier grid.
7. Leave the VTVM connected to the



cathode of the phase detector and tune the core of the BURST-PHASE transformer to get a maximum reading on the VTVM.
8. Ground the output of the phase detector. Use a very short clip lead. Adjust the REACTANCE-TUBE PLATE COIL for "zero beat". Tune the coil in the direction that reduces the number of horizontal bands of color. (Zero beat occurs when the color bars are not divided into horizontal colored bands but each bar has a uniform hue from top to bottom. Bars may change color slowly as hues appear to drift from bar to bar. Remove the clip-lead from the output of the phase detector.

Troubleshooting Notes:

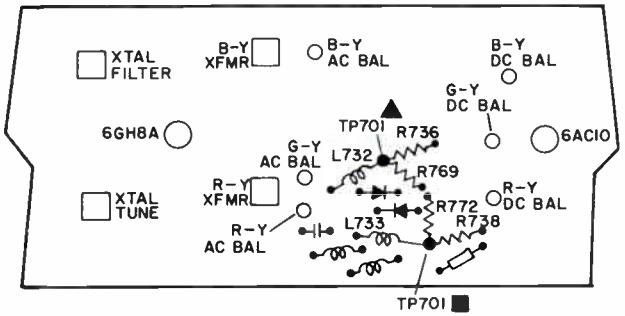
1. Loss of color on the screen and inability to peak the 3.58-MHz oscillator indicates a failure in the oscillator circuit. Replace the oscillator-reactance tube. Reset the reactance-tube plate coil, if necessary, to start the oscillator.

2. Inability to peak the phase-detector transformer indicates a failure in the burst-amplifier circuit. Replace the burst-amplifier tube. Check to determine if keying pulses are present at the burst amplifier. Be sure the horizontal hold is set properly to get proper burst keying.

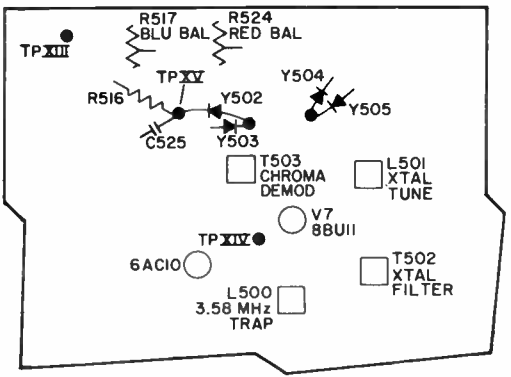
3. Failure to obtain a "zero beat" in step 8 indicates a problem in the frequency-determining components of the 3.58-MHz oscillator. Try replacing the oscillator-reactance tube.

4. If proper "zero beat" can be obtained with the input to the reactance tube shorted, but a large frequency error (barber-pole effect) is noted when the short is removed, trouble is indicated in the phase-detector circuit. Replace the phase-detector tube and repeat the adjustment.

Procedures B, C,



Procedure D



COLOR AFPC Procedure B

The tint control is either a variable capacitor or a potentiometer. Preset the TINT control as follows: Capacitor -- set 90° from maximum counterclockwise position; Potentiometer -- set to center of its mechanical range. Connect a color-bar generator to the receiver terminals, and adjust for a normal color-bar display. Connect a VTVM to TP701. Set the R-Y DC BAL, B-Y DC BAL, and G-Y DC BAL to the center of their mechanical ranges. Set the COLOR control completely counterclockwise.

1. Adjust the XTAL FILTER, XTAL TUNING, and R-Y transformer for maximum dc voltage on the VTVM.
2. Adjust the B-Y transformer for minimum dc voltage on the VTVM.
3. Repeat Steps 1 and 2. Disconnect the meter.

AC Balance

4. Adjust the R-Y AC BAL and R-Y DC BAL for minimum ac voltage measured at pin 11 of V703 (6AC10). Repeat until minimum ac voltage is obtained.
5. Adjust the B-Y AC BAL and B-Y DC BAL for minimum ac voltage measured at pin 7 of V703. Repeat until minimum ac voltage is obtained. In chassis stamped EN186 and higher, the R-Y and B-Y AC-BAL controls are tuneable coils.
6. Adjust the G-Y AC BAL and G-Y DC BAL for minimum ac voltage measured at pin 9 of V703. Repeat until minimum ac voltage is obtained. In chassis stamped EN121 and higher, disregard this step.

DC Balance

7. Adjust the R-Y DC BAL for 0 volts dc measured at pin 11 of V703.
8. Adjust the B-Y DC BAL for 0 volts dc measured at pin 7 of V703.
9. Adjust the G-Y DC BAL for 0 volts dc measured at pin 9 of V703. Recheck steps 7, 8, and 9.
10. Vary the FINE-TUNING control. If a shift in the gray scale is seen, repeat steps 7, 8, and 9.

11. Set the COLOR CONTROL for a normal bar pattern and vary the FINE-TUNING control from picture crystalization to smear. If a shift of color highlights is seen, repeat steps 4, 5, and 6.
12. Set the TINT control to the center of its range. A normal color-bar pattern should be produced. Varying the TINT control should cause the red bar to turn slightly magenta at one end of the range, and the blue bar to turn slightly magenta at the other end of the range. If the tint-control range is off center, readjust the core of the R-Y transformer no more than one turn. Turning the core toward the chassis causes red to go to magenta; away from the chassis causes blue to go to magenta.

COLOR AFPC Procedure C

1. Connect a color-bar generator to the receiver terminals and adjust for a normal color-bar display.
2. Adjust the TINT control to obtain 10 volts dc measured at the end of the TINT control connected to the 220-kΩ resistor. Set the COLOR control fully counterclockwise.
3. Connect a VTVM to TP$\overline{\text{VII}}$, the junction of R769, R736, and L732.
4. Adjust the XTAL FILTER and XTAL TUNING for maximum dc voltage on the VTVM. Set the core at the peak away from the circuit board.
5A. KC chassis "EN476" and lower; and KD chassis "EN277" and lower. Adjust the R-Y transformer for maximum dc voltage and the B-Y transformer for minimum dc voltage on the VTVM. Set the cores at the peaks nearest the circuit board. Repeat Steps 1 through 4. Reset the B-Y core one sixth (1/6) turn away from the circuit board. Disconnect the VTVM.
5B. KC chassis "EN477" and higher; and KD chassis "EN278" and higher have the R-Y and B-Y transformer in a single unit (T700). Adjust

the R-Y core (nearest circuit board) for maximum dc voltage on the peak nearest the circuit board. Adjust the B-Y core (top) for minimum dc voltage at the point nearest the top. Repeat Steps 1 through 4. Reset the B-Y core one-sixth (1/6) turn toward the circuit board. Disconnect the VTVM.

6. Set the R-Y, B-Y, G-Y BAL controls to the center of their ranges.
7. Adjust the R-Y BAL for 0 volt dc measured at pin 11 of 6AC10.
8. Adjust the B-Y BAL for 0 volt dc measured at pin 7 of 6AC10.
9. Adjust the G-Y BAL for 0 volt dc measured at pin 9 of 6AC10.
10. Vary the FINE-TUNING control. If a shift in the gray scale is seen, repeat steps 7, 8, and 9.
11. Set the COLOR and TINT controls to the center of their ranges. A normal color-bar display should be produced. Varying the TINT control should cause the red bar to turn slightly magenta at one end of the range, and the blue bar to turn slightly magenta at the other end of the range. If the tint-control range is off center, readjust the XTAL TUNING no more than one turn. Turning the core away from the chassis causes the red to go to magenta; toward the chassis causes the blue to go to magenta.

COLOR AFPC Procedure D

1. Set the TINT control fully clockwise and clip an 18pF capacitor across it.
2. Connect a color-bar generator to the receiver antenna terminals or tune in a color program and adjust the receiver for normal color reception.
3. On receivers with a tunable 3.58-MHz trap (L500), connect an oscilloscope through a 22pF capacitor to pin 4 of V7 (8BU11). Tune L500 for minimum 3.58 MHz.
4. Set the BLUE BAL and RED BAL to mechanical center and adjust the COLOR control fully counterclockwise.
5. Connect a VTVM to TP$\underline{XV}$ the

junction of Y502, C525, (36pF), and R516 (6800Ω).
6. When making the following adjustments maintain the burst amplitude at a low input level by turning the receiver fine-tuning control slightly toward smear after each adjustment.
7. Adjust the XTAL FILTER and XTAL TUNING for maximum dc voltage on the VTVM at TPXV.
8. Detune the top core of the CHROMA-DEMOD transformer by moving the core away from the circuit board.
9. Adjust the bottom core of CHROMA-DEMOD transformer for maximum dc voltage on the VTVM at TPXV. Readjust the top core for maximum dc voltage at TPXV.
10. Connect the VTVM between TPXIII (Pin 11 of 6AC10, or the wiper of the BLUE BAL) and the junction of Y502-Y503. Adjust the BLUE BAL for 0 volt dc. The meter should indicate zero when the FINE TUNING control is varied from smear to crystalization.
11. Connect VTVM between TPXIV (Pin 7 of 6AC10, or wiper of RED BAL) and the junction of Y504-Y505. Adjust the RED BAL for 0 volt dc. The meter should indicate zero when the FINE-TUNING control is varied from smear to crystalization.

COLOR AFPC Procedure E

1. Tune the receiver to a color program.
2. Adjust the SYNC-FILTER transformer T4S (top core) to obtain minimum color viewed on the screen. Refer to Chassis Layouts BA and BG in the CHASSIS LAYOUT section.
3. Adjust the COLOR-OSCILLATOR-TANK COIL L5S to obtain best sync.
4. Set the HUE and TINT controls to mid-range. Adjust the COLOR-OSCILLATOR-OUTPUT COIL to obtain correct flesh tone.

COLOR AFPC Procedure F

1. Tune the receiver to a color program. If a color program is not

available, connect a color-bar generator to the antenna terminals and adjust for a normal color-bar display.

2. Set the TINT and HUE controls to mid-range. Set the COLOR-INTENSITY control to produce a normal picture (or color-bar display).

3. If proper fleshtone or a correct color-bar pattern is not obtained with the HUE control at mid-range, adjust the SYNC INTER-STATE transformer no more than one turn in either direction to obtain correct flesh tone or a proper color-bar display.

AGC Procedure A

Tune the receiver to the strongest channel and adjust all controls for a normal picture. Adjust the AGC control until the picture becomes unstable, distorts or a buzz is heard in the sound. Retune the AGC control until the picture stabilizes and the buzz disappears. Check all channels for AGC action. Reduce the AGC control setting if the picture does not reappear immediately when changing channels.

AGC Procedure B

Tune the set to a strong channel and adjust all controls for a normal picture. Turn the ANI control fully counterclockwise and then adjust clockwise until picture distortion occurs. Retune the AGC control until the distortion disappears. Tune the set to the weakest channel and adjust the ANI control clockwise until the picture goes out of sync. Retune the ANI control until the picture stabilizes. Check the ANI control setting on all channels.

AGC Procedure C

Tune receiver to the strongest channel. Set the NOISE-GATE control fully counterclockwise. Turn the IF-AGC control counter clockwise until the picture becomes unstable. Then readjust the control clockwise until the picture stabilizes. Check all channels. Readjust the IF-AGC control if necessary. If picture still is unstable set the RF-AGC control to mid-range and repeat the IF-AGC procedure. Turn the NOISE-GATE control clockwise until picture becomes unstable, then readjust for picture stability.

HORIZONTAL HOLD Procedure A

Tune the receiver to the weakest channel. Set the BRIGHTNESS and CONTRAST controls for a normal picture. With short clip leads, short TP 4-1 and TP 4-2 to ground. Adjust the HORIZONTAL-HOLD control until the picture floats (with sides vertical). Remove the jumper from TP 4-2. Adjust the HORIZONTAL-STABILIZER coil to bring the picture into sync (floating). Remove the remaining jumper.

HORIZONTAL HOLD Procedure B

Tune the receiver to a weak signal and adjust the AGC control correctly. Disconnect the antenna, if necessary, to obtain a weak signal. With a short clip lead, ground TP 4-5. Adjust the HORIZONTAL-HOLD control (rear of chassis) for the most stable picture (picture will slowly float back and forth). Remove the clip lead and check operation on all channels.

HORIZONTAL HOLD Procedure C

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Connect a short jumper across pins 2 and 3 of the HORIZONTAL-OSCILLATOR transformer (T601). Slide out the chassis to reach pins 2 and 3. Adjust the core of the OSCILLATOR coil until the picture stands still. Remove the jumper and adjust the core of the SINE-WAVE coil until the picture again stands still. Rotate the HORIZONTAL-HOLD control thru its entire range. The picture should be in sync when the control is in the center of its range.

HORIZONTAL HOLD Procedure D

Tune in a local station and set the HORIZONTAL-HOLD control to mid-range. Connect a jumper across pins 2 and 3 of the HORIZONTAL-OSCILLATOR transformer (T601). Slide out the chassis to reach

pins 2 and 3. Adjust the top core of the HORIZONTAL-OSCILLATOR transformer until the picture stands still. Remove the jumper and adjust the bottom core of the HORIZONTAL-OSCILLATOR transformer until the picture again stands still. Rotate the HORIZONTAL-HOLD control through its range. The picture should be in sync when the control is in the center of its range.

HORIZONTAL HOLD Procedure E

Tune the receiver for a normal picture. Connect a short jumper from TP 501 to ground. Connect a short jumper from pin 8 of the HORIZONTAL-OSCILLATOR tube (or C522) to ground. Adjust the HORIZONTAL-HOLD control until the picture floats with its sides vertical. Remove the jumper from the HORIZONTAL-OSCILLATOR tube and adjust the SINE-WAVE coil until the picture floats with its sides vertical. Remove the remaining jumper.

HORIZONTAL HOLD Procedure F

Tune the receiver for a normal picture. Ground pin 1 of the AGC tube with a short clip lead. Short the SINE-WAVE coil (at JNCT-207) to the ground with a short clip lead. Adjust the HORIZONTAL-HOLD control until the picture floats with its sides vertical. Remove the short from the SINE-WAVE coil and adjust the coil until the sides of the picture are vertical. Remove the remaining short.

HORIZONTAL HOLD Procedure G

Tune the receiver for a normal picture. Connect a short jumper from the junction of C250 and C251 to ground. Connect a short jumper from pin 8 of the HORIZONTAL-OSCILLATOR tube to ground. Adjust the HORIZONTAL-HOLD control until the sides of the picture are vertical. Remove the jumper from pin 8 of the HORIZONTAL-OSCILLATOR tube and adjust the SINE-WAVE coil

until the sides of the picture are vertical. Remove the remaining jumper.

HORIZONTAL HOLD Procedure H

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Connect a short jumper from TP501 to ground. Adjust the SINE-WAVE coil until the picture drifts very slowly and the sides are vertical. Remove the jumper and check the HORIZONTAL-HOLD control at both ends of its range.

HORIZONTAL HOLD Procedure J

Tune the receiver for a normal picture. Set the CONTRAST control to maximum and the BRIGHTNESS control to minimum. Short TP VI to ground. Adjust the HORIZONTAL-HOLD control to obtain a floating picture with its sides vertical. The core of the HORIZONTAL-HOLD control should be positioned away from the front of the set. Remove the short and the picture should lock into sync.

HORIZONTAL HOLD Procedure K

Tune the receiver to a normal picture. Set the HORIZONTAL-HOLD control to the center of its range. Short TP IV to ground with a short jumper. Adjust the SINE-WAVE coil until the picture floats slowly and its sides are vertical. Remove the jumper. Check the HORIZONTAL-HOLD control throughout its range.

HORIZONTAL HOLD Procedure L

Tune the receiver for a normal picture. Connect a short jumper from the top of C528 to ground. Connect a short jumper from pin 9 of the AGC, SYNC tube to ground. Adjust the HORIZONTAL-HOLD control until the picture stops moving horizontally. Remove the jumper from C528 and adjust the SINE-WAVE coil until the picture stops moving. Remove the remaining short.

HORIZONTAL HOLD Procedure M

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Short TP 502 to ground and adjust the SINE-WAVE coil until the picture stops moving (or drifts slowly) horizontally. Remove the short and check the control through its entire range.

HORIZONTAL HOLD Procedure N

Tune the receiver for a normal picture. Adjust the HORIZONTAL-HOLD control on the rear of the set (side of chassis on CH-BA) to obtain the most stable horizontal and color sync when switching from channel to channel.

HORIZONTAL HOLD Procedure P

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Short TP 209 to ground. Adjust the SINE-WAVE coil to bring the picture into sync. Remove the short.

HORIZONTAL HOLD Procedure Q

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Adjust the AFC coil for picture sync.

HORIZONTAL HOLD Procedure R

Tune the receiver for a normal picture. Connect short jumpers from M43 and M49 to ground. Adjust the HORIZONTAL-FREQUENCY coil (bottom core) to bring the picture into sync (sides vertical). Remove the jumper from M 43 and adjust the HORIZONTAL-FREQUENCY coil (top core) to bring the picture into sync (sides vertical). Remove the remaining jumper.

HORIZONTAL HOLD Procedure S

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Connect a short jumper from lug M111 to ground. Adjust the SINE-WAVE

coil until the picture comes into horizontal sync. Remove the jumper.

HORIZONTAL HOLD Procedure T

Tune the receiver for a normal picture. Short pins 1 and 2 of the SINE-WAVE coil. Turn the HORIZONTAL-HOLD control to mid-range. Adjust the HORIZONTAL-OSCILLATOR transformer until the picture comes into sync. Remove the short.

HORIZONTAL HOLD Procedure U

Tune the receiver for a normal picture. Ground the junction of C240 and C241 with a short jumper. Ground terminal B of the SINE-WAVE coil. Adjust the HORIZONTAL-HOLD control until the sides of the picture are vertical. Remove the short from the SINE-WAVE coil and adjust the coil until the sides of the picture are vertical. Remove the remaining short.

HORIZONTAL HOLD Procedure V

Tune the receiver for a normal picture. Connect a short jumper from TP 501 to ground. Connect a short jumper from TP 502 to TP 503. Adjust the HORIZONTAL-HOLD control until the picture stops (floating with sides vertical). Remove the jumper from TP 502 to TP 503 and adjust the SINE-WAVE coil until the picture stops (floating with sides vertical). Remove the remaining jumper.

HORIZONTAL HOLD Procedure W

Tune the receiver for a normal picture. Short TP 203 to ground. Short pin 8 of the HORIZONTAL-OSCILLATOR tube (or C254) to ground. Adjust the HORIZONTAL-HOLD control until the picture stops (floating with sides vertical). Remove the jumper from pin 8 and adjust the SINE-WAVE coil until the picture stops (floating with sides vertical). Remove the remaining jumper.

HORIZONTAL HOLD Procedure X

Tune the receiver to a strong channel. Short TP Y to ground. Connect a short jumper across C416. Adjust the HORIZONTAL-HOLD control until the sides of the picture are vertical. Remove the jumper from C416. Adjust the SINE-WAVE coil until the sides of the picture are vertical. Remove the short from TP Y.

HORIZONTAL HOLD Procedure Y

Tune the receiver for a normal picture. Set the HORIZONTAL-HOLD control to mid-range. Adjust the HORIZONTAL-OSCILLATOR coil until picture falls into sync.

HORIZONTAL HOLD Procedure Z

Tune the receiver for a normal picture. Short TP E to ground. Connect a short jumper across C416. Adjust the HORIZONTAL-HOLD control until the sides of the picture are vertical. Remove the jumper across C416 and adjust the SINE-WAVE coil until the sides of the picture are vertical. Remove the short from TP E.

HORIZONTAL HOLD Procedure AA

The HORIZONTAL-HOLD control is a front-panel control equipped with stops that limit the rotation to 270°. To adjust for horizontal AFC, remove the knob and turn the shaft to a position where it is virtually impossible to lose horizontal sync when changing channels. Leave the shaft set in this position and replace the knob with its pointer centered between the stops.

COLOR KILLER Procedure A

Set the CONTRAST and BRIGHTNESS controls for a normal picture. Set the COLOR control at mid-range. Turn the set off channel to obtain a snowy raster. Adjust the COLOR-KILLER control until color just disappears from the snow. Check with a low-level color signal to make sure the control is properly set.

COLOR KILLER Procedure B

Tune the receiver to a normal black-and-white program. Adjust the COLOR-KILLER control until color disappears from the screen. Check all channels with a black-and-white picture and readjust the control if necessary. Check the control setting when tuned to a color picture to make sure that the control is properly set.

COLOR KILLER Procedure C

Tune the receiver to a normal black-and-white program. Turn the COLOR-GAIN control to mid-range. Rotate the FINE-TUNING control clockwise until sound bars and colored noise are visible on the screen. Adjust the COLOR-KILLER control until the color in the noise pattern disappears.

COLOR KILLER Procedure D

Turn the set to an unused channel to obtain a snowy raster. Turn the CHROMA (COLOR) control to mid-range. Turn the TINT control fully counterclockwise. Adjust the COLOR-KILLER control just enough to remove the color from the snow. Check with a color signal. Rotate the TINT control through its range. If the color fades, the COLOR-KILLER control is set too high.

PINCUSHION Procedure A

Connect a crosshatch generator to the receiver. Set the PIN (or VERTICAL-GAIN) control fully clockwise. Adjust the PIN-PHASE control to obtain symmetrical barreling of the top and bottom horizontal lines. Reset the PIN (or VERTICAL-GAIN) control to obtain straight horizontal lines.

PINCUSHION Procedure B

Connect a crosshatch generator to the receiver. Turn the TOP-PIN and BOT-PIN controls fully clockwise. Adjust the TOP-PIN-PHASE control until the upper picture is symmetric to the center line of the picture. Turn the TOP-PIN control fully counterclockwise. Adjust the BOT-PIN-PHASE control until the lower picture is symmetric to the center line of the picture. Adjust the TOP-PIN control until the horizontal line at the center of the picture is straight. Adjust the BOT-PIN control until the picture is correct.

PINCUSHION Procedure C

Connect a crosshatch generator to the receiver. Turn the TOP-PIN (BAL) and BOT-PIN (BAL) controls fully clockwise. Adjust the TOP-TILT (PHASE) and BOT-TILT (PHASE) controls to move the curvature to the center of the screen. Adjust the TOP-PIN (BAL) and BOT-PIN (BAL) controls to straighten the horizontal lines across the entire screen.

PINCUSHION Procedure D

Connect a crosshatch generator to the receiver. Set the TOP-and-BOT-PIN control fully clockwise. Adjust the PIN-PHASE control to move the curvature to the center of the screen. Adjust the PIN-TRANSFORMER to straighten the horizontal lines in the center of the screen. Adjust the TOP-and-BOT-

PIN control to straighten the horizontal lines at the top and bottom of the screen.

PINCUSHION Procedure E

Connect a crosshatch generator to the receiver. Set the TOP-and-BOT-PIN (or BAL) control fully clockwise. Adjust the TOP-and-BOT-PIN-PHASE control to move the curvature to the center of the screen. Adjust the TOP-and-BOT-PIN (or BAL) control to straighten the top and bottom horizontal lines.

PINCUSHION Procedure F

Connect a crosshatch generator to the receiver. Set the TOP-and-BOT-PIN controls fully clockwise. Adjust the PIN-PHASE control to move the curvature to the center of the screen. Readjust the TOP-and-BOT-PIN controls to obtain straight horizontal lines.

PINCUSHION Procedure G

Connect a crosshatch generator to the receiver. Adjust the PIN-PHASE control to move the curvature to the center of the screen. Adjust the PIN (or PIN-BAL) control to straighten the horizontal lines.

PINCUSHION Procedure H

Connect a crosshatch generator to the receiver. Adjust the PIN-PHASE control to straighten the top line of the pattern.

PINCUSHION Procedure J

Connect a crosshatch generator to the set. Turn the BOT-PIN control fully clockwise. Adjust the TOP-TILT (PIN) control to obtain the straightest line near the top of the screen. Readjust the BOT-PIN to obtain the straightest line near the bottom of the screen. Adjust the HORIZONTAL-CONTROL for optimum correction at the left side of

the screen. Over correction of the left side will cause barreling at the right side of the screen.

PINCUSHION Procedure K

Connect a crosshatch generator to the receiver. Reduce the BRIGHTNESS control until the raster is just visible. Adjust the HORIZONTAL-PIN control until the side vertical lines just become straight. Turn the BOT-PIN control fully counterclockwise. Adjust the TOP-PIN control for maximum downward bow at center and bottom of raster. Readjust the BOT-PIN control for straight horizontal lines at bottom of raster. Readjust the TOP-PIN control for straight horizontal lines at top of raster. Repeat the procedure if necessary.

PINCUSHION Procedure L

Connect a crosshatch generator to the receiver. Adjust the PIN-PHASE control to move the curvature to the center of the screen.

PINCUSHION Procedure M

Connect a crosshatch generator to the receiver. Set the PIN (AMP) control fully clockwise. Set the PIN-BAL (magnet) to mid-range. Adjust the PIN-PHASE control to move the curvature to the center of the screen. Adjust the PIN-BAL (magnet) to balance the top-and-bottom pincushion. Adjust the PIN (AMP) control to obtain straight horizontal lines. Repeat the procedure, if necessary.

PINCUSHION Procedure N

Connect a crosshatch generator to the set. Adjust the PIN-PLATE-COIL until the top and bottom horizontal lines are symmetrical with the picture tube mask.

A. AUTOMATIC BRIGHTNESS LIMITER (ABL)

Tune the receiver for a normal picture. Set the CONTRAST and BRIGHTNESS controls to maximum. Advance the ABL control to the point where highlights just begin to bloom. Retard the control to a point just below blooming. Reduce the CONTRAST and BRIGHTNESS controls for normal viewing. Increase the BRIGHTNESS control until some highlight blooming is evident. Further increase should not change the brightness level or the degree of blooming. If blooming is excessive repeat the procedure.

B. BRIGHTNESS LIMITER

Tune the receiver for a normal picture. Turn the BRIGHTNESS control fully clockwise and set the CONTRAST control to mid-range. Adjust the BRIGHTNESS-LIMITER (or CONTRAST-RANGE) control until the raster just blooms. Then adjust the BRIGHTNESS and CONTRAST controls to obtain a normal picture.

C. BUZZ ADJUSTMENT

Adjust the BUZZ control for minimum buzz with the receiver tuned to a normal picture.

D. FOCUS ADJUSTMENT
Procedure A

Tune the receiver for a normal picture. Connect the black jumper from PW 600 -9B to PW 600Z, PW600P or PW 600L (whichever potential gives the best focus). The jumper and PW terminals are located just below the screen controls.

E. FOCUS ADJUSTMENT
Procedure B

Tune the receiver to a black-and-white program and adjust the CONTRAST control to obtain a normal picture. Set the BRIGHTNESS control fully clockwise. Remove

the back of the cabinet. Three voltage sources are available. Plug the jumper into the receptacle that provides the best focus. The jumper and receptacles are located just to the left of the high voltage cage. **Note:** Turn the set "off" when changing the jumper to prevent injury from shock.

F. G1 DRIVE ADJUSTMENT

This adjustment affects the operation of the BRIGHTNESS control. Measure the voltage drop across resistor R-117. Adjust the G1-DRIVE control to obtain a voltage drop of 7 to 8 volts.

G. HUE (AFPC) ADJUSTMENT

Tune the receiver to a color picture. Set the HUE and TINT controls to mid-range. Adjust the COLOR-OSC coil for correct flesh tones.

H. KINE-BIAS ADJUSTMENT

Tune the receiver to a normal picture. Set the BRIGHTNESS and CONTRAST controls completely clockwise. Adjust the KINE-BIAS control until the picture just starts to bloom. Readjust the control until the blooming is just eliminated.

J. NOISE GATE ADJUSTMENT

Tune in a channel and adjust for the best picture and sound. Turn the NOISE-GATE control clockwise until the picture becomes unstable. Then adjust the control until the picture returns to normal. Check all channels and readjust if necessary.

K. PICTURE CENTERING

Those receivers that are not equipped with electrical centering controls employ permanent-magnet centering rings mounted inside the deflection yoke. Each ring is controlled by a pair of strings that are joined to

make a loop. The two loops extend out from the back of the yoke. Both rings have "stops"; therefore, the loops cannot be pulled out. To center the picture, apply a pattern that can be used for centering or reduce the line voltage until the sides of the picture can be seen. Alternately, pull the string on either side of a loop straight back until the picture is centered. Be careful not to disturb the placement of the convergence yoke when making this adjustment. Return the line voltage to normal if line voltage was reduced.

Note: A change in centering may upset purity and convergence. Check both after centering adjustments have been made. DO NOT adjust centering to compensate for improper vertical size or linearity.

L. VIDEO PEAKING (or SHARPNESS) PROCEDURE

Set the VIDEO-PEAKING (or SHARPNESS) control (or switch), which may be on the front panel, to give the most pleasing picture under existing signal conditions.

It is generally true that any test instrument useful in black-and-white TV servicing is equally useful for color work. But color servicing requires at least one additional instrument—a color-bar/dot/crosshatch generator. Color servicing also demands that the oscilloscope have wide bandwidth along with other features to make it useful in routine shop and outside work.

In selecting a color-bar/dot/crosshatch generator or an oscilloscope for color work, the service technician should check several features. Some of the most important are listed below.

COLOR-BAR/DOT/CROSS-HATCH GENERATORS

These instruments provide various color-bar signals for use in checking and adjusting color phasing and matrixing circuits. When the signals are fed to the receiver antenna terminals, they provide a complete check of over-all receiver performance.

A service color-bar/dot/crosshatch generator must include several features. The most important are these:

1. **10 Color Bars Spaced at 30-Degree Intervals** -- the 10-color-bar pattern is the accepted standard of the service industry. The waveforms and procedures in nearly all color-TV service notes are based on this system.
2. **An RF Sound Carrier**--both an rf-picture carrier and an rf-sound carrier are needed to permit accurate setting of the receiver fine-tuning control before color-circuit adjustments are made.
3. **Zero-Axis Color-Bar Output** -- bar pulses from the generator should be centered on the zero axis of the over-all output signal to permit checking of receiver phasing in the customer's home without use of an oscilloscope.
4. **Accurately Phased Color-Bar Signals** -- the phase angles of the

output color-bar signals must be closely controlled. The frequency of the subcarrier oscillator should be within ±20 Hz of 3.563745 MHz.

5. **Stable Dot/Crosshatch Patterns For Convergence Adjustments** – These patterns should be stable, and not jitter, ripple, or jump sync. Dot size and bar width should be large enough to permit easy viewing under average room lighting conditions.

6. **Vertical and Horizontal Bar Pulses Should Have Approximately Equal Brightness** – pulses which form the vertical bars represent high video frequencies; horizontal bar pulses represent low frequencies. If these vertical and horizontal bar pulses have the same amplitude, the comparative brightness of the reproduced vertical and horizontal crosshatch bars can indicate the general response of receiver circuits.

A color-bar/dot/crosshatch generator must have other facilities and features to make it a dependable, useful instrument. One useful feature is gun killer switches. Unless it has the essential electrical features described above, however, the generator cannot meet the critical needs of color-TV servicing.

OSCILLOSCOPES

All of the qualities which make a good color-TV oscilloscope cannot be found in its electrical specifications. However, here are some of the important electrical features a color-TV service-scope should have:

1. **Wide Bandpass** – frequency response of the vertical amplifier should be flat from approximately 30 Hz to 4.5 MHz to prevent distortion of waveform amplitude and shape. Vertical and horizontal sync pulses contain both low-and-high-frequency components which can be attenuated by a scope having inadequate bandpass. Sweep-response tests, which are usually

Oscilloscopes

WO-91C

WO-33A

Color-Bar Generators

WR-502A

WR-64B

made at a 60 Hz rate, require good low-frequency response, but display of the 3.58-MHz signal requires flat response to beyond 4 MHz.

2. **High Sensitivity** – vertical-amplifier sensitivity of at least 50 millivolts per inch of deflection is needed to permit display of waveforms in low-level circuits. High sensitivity is also needed to compensate for the signal attenuation which occurs when a low-capacitance probe is used.

3. **Matched Probes and Cables** – unless the scope has a shielded input cable and probe, severe radiation and extraneous pickup can interfere with measurements. Probes and cables should be matched to the scope to insure faithful waveform reproduction. A low-capacitance probe is also essential to measurements in circuits which would not function normally if loaded by the high capacitance of a direct probe and cable.

4. **Positive Sync Action** – good sync action is especially important at the vertical and horizontal frequencies of 60 to 15,750 Hz. Because much TV troubleshooting work involves locking in at these frequencies, a scope having a built-in sync amplifier and sync positions preset for vertical and horizontal signals can make TV work much easier.

5. **Voltage Calibration** – the peak-to-peak amplitude as well as the shape of a waveform are important in troubleshooting analysis. If the scope has built-in voltage calibration, it can be used simultaneously to display the waveform and measure its voltage amplitude.

A service scope must have these basic features to qualify for color-TV work. It is important to remember that the scope must faithfully reproduce the waveform put into it. If it does not, the user cannot be sure if the distortion originates in the TV receiver or in his scope.

Following is a list of RCA receiving tube types, used in color-TV receivers that are currently available for replacement use.

These types will be found in color-TV sets of all makes produced from 1955 to date. Types shown with an asterisk are among the industry's 50 highest volume replacement types in color-TV receivers.

1AD2	3DT6A	5GH8A	6AL11
1G3GT/1B3GT*	3GK5	5GJ7	6AN8A
1V2*	3HQ5	5GX7	6AQ5A*
1X2B/1X2A	3JC6A	5HZ6	6AQ8/ECC85
2AF4B/2DZ4	3KT6	5JK6	6AS8
2AV2*	4AU6	5JL6	6AT8
2CN3A	4BL8/XCF80	5KZ8	6AT8A
2DV4	4BQ7A	5LJ8	6AU4GTA*
2EG4	4BZ6	5U4G	6AU6A*
2GK5	4CB6	5U4GB*	6AU8A
2HQ5	4DT6A	5U9/LCF201	6AV5GA
3A2	4EH7/LF183	5V3A	6AV6
3A3A/3B2*	4EJ7/LF184	5V6GT	6AV11
3AL5	4GK5	5Y3GT	6AW8A*
3AT2*	4HA5/PC900	6AC10	6AX4GTB*
3AW2	4JC6A	6AD10	6AZ8
3AW3 Use 3A3A/3B2	4KE8	6AF4	6BA5/EF93
3BN6	4LJ8	6AF4A	6BA8A
3BY6	5AM8	6AF9	6BA11
3BZ6	5AN8	6AG7	6BC7
3CA3	5AQ5	6AG9	6BC8/6BZ8
3CN3A	5AT8	6AH4GT	6BE3/6BZ3
3CS6	5BC3A	6AH6	6BG6G
3CU3	5BT8	6AH9	6BH6
3DG4	5CG8	6AL5*	6BH8

6BH11
6BJ7
6BJ8
6BK4B*
6BK5

6BK7B
6BL7GTA
6BL8/ECF80
6BM8/ECL82
6BN4A

6BN6/6K56
6BN8
6BQ5/EL84*
6BQ6GTB/6CU6*
6BQ7A*

6BR8A/6FV8A
6BS3A
6BS8
6BU8
6BV8

6BV11
6BY6
6BZ6*
6BZ7
6C4

6CB5A
6CB6A/6CF6*
6CD6GA
6CG3/6CE3/6CD3*
6CG8A*

6CJ3/6CL3*
6CL6
6CL8A
6CM3
6CM6

6CN7
6CQ8
6CS6
6CW4
6CW5/EL86

6CZ5
6DC6
6DE6
6DK6
6DQ5*

6DS4
6DT6A
6DT8
6DV4
6DW4B*

6DX8/ECL84
6DZ4
6EA8
6EH4A
6EJ4A

6EH7/EF183
6EJ7/EF184*
6EM5
6EM7*
6ER5

6EW6*
6EZ5
6FG7
6FH5
6FJ7

6FM7
6FQ7/6CG7*
6GC5
6GF7A*
6GH8A*

6GJ7/ECF801
6GK5
6GK6
6GL7
6GM6*

6GQ7
6GU7*
6GW6/6DQ6B*
6GW8/ECL86
6GX6

6GX7
6GY6*
6HB6/6HA6
6HB7
6HE5

6HF5
6HF8
6HG8/ECF801
6HL8
6HM5/6HA5*

6HQ5
6HS5
6HS8
6HZ6
6J6A

6JC6A*
6JD6
6JE6A*
6JH6
6JH8

6JK8
6JM6A
6JN6
6JQ6
6JS6B*

6JT8
6JU8A*
6JW8/ECF802
6KA8
6KE8

6KM6
6KT6
6KT8
6KZ8*
6L6GC

6LB6
6LE8
6LF8
6LH6A
6LJ6

6LJ8
6LM8
6LN8/LCF80
6LQ6/6JE6C
6LT8

6LU8
6LY8
6M11
6MD8
6ME8

6MF8
6MJ8
6MK8
6MQ8
6S4A

6SN7GTB*
6T4
6T8A
6T10
6U8A/6KD8*

6U10
6V6GTA*
6W6GT
6X8A*
6X9/ECF200

6Y9
6Z10/6J10
7AU7
8AR11
8BM11

8BQ11
8BU11
8FQ7/8CG7*
8GU7
8JU8A

8JV8
9A8/PCF80
9KC6
10CW5/LL86
10GF7A

10JT8
10LB8
10LE8
11BT11
11FY7

11HM7
11LQ8
12AT7/ECC81*
12AU7A/ECC82*
12AV6*

12AV7
12AX3
12AX7A/ECC83*
12AZ7A
12BF11

12BH7A*
12BK5
12BY7A/12BU7/12DQ7*
12CL3
12GC6

12GE5
12GN7A
12HG7
12HL7
12MD8

12T10
15CW5/PL84
15DQ8
15HB6
15LE8

16A8
17KV6
19AU4GTA
21LR8
21LU8

22KM6
24LQ6/24JE6C
31JS6A
40KD6
42KN6