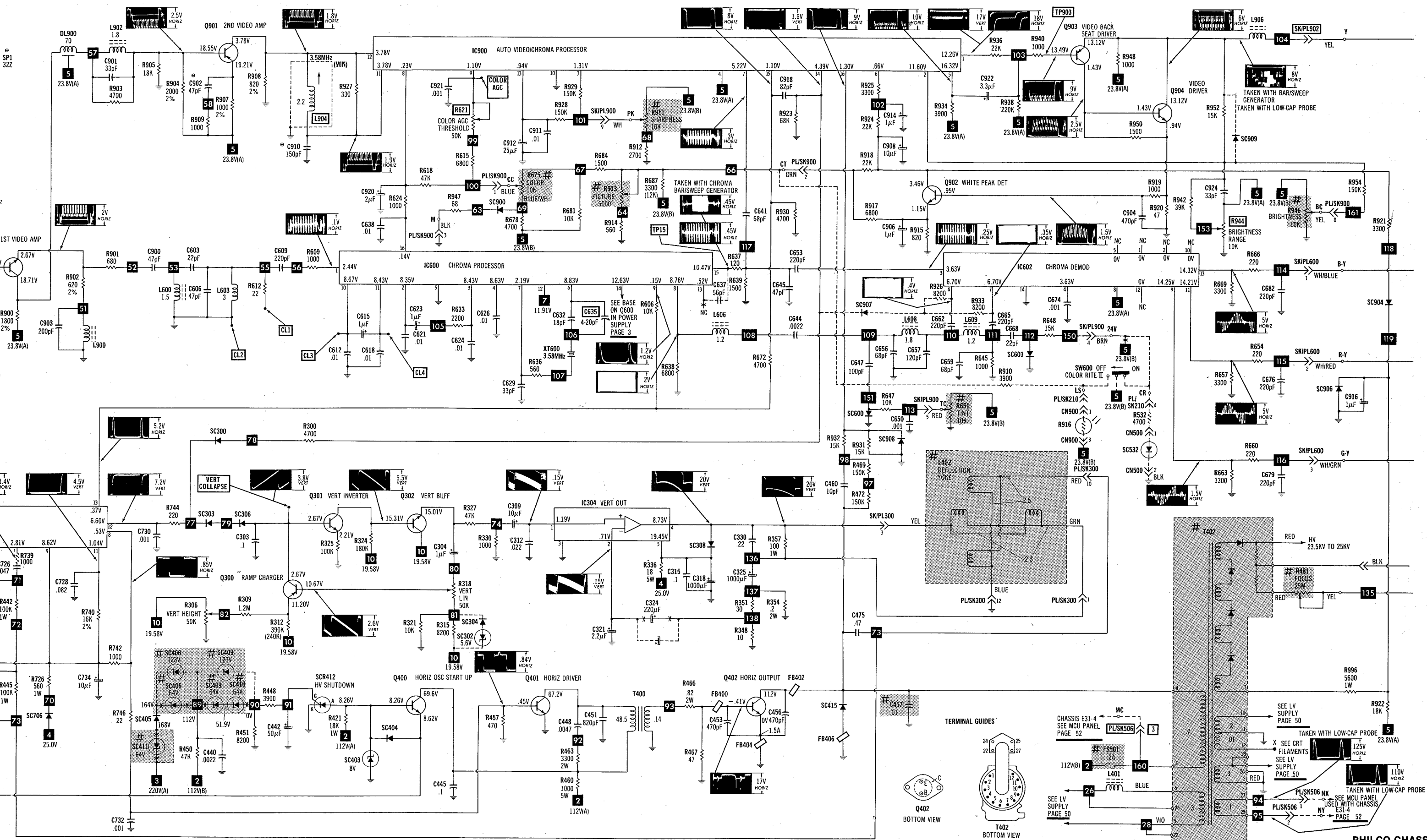


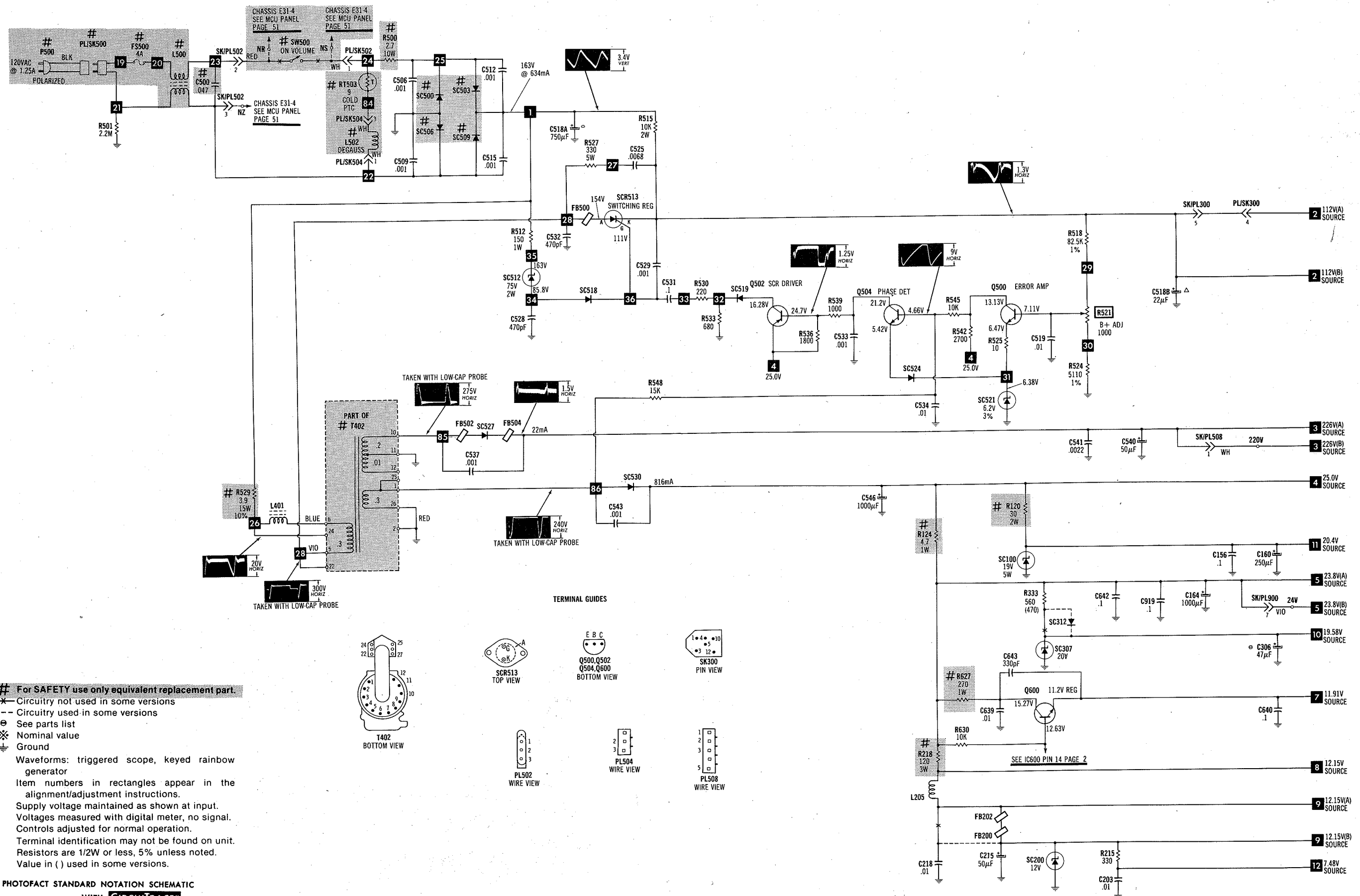
MCU TUNER CLUSTER

Courtesy of the Manufacturer









SAFETY PRECAUTIONS

Warning

Chassis connected to one side of AC line, use isolation transformer when applying power to exposed chassis.

Product Safety Guidelines for all Products

Caution: Do not modify any circuit. Service work should be performed only after you are thoroughly familiar with all of the following safety checks. Risk of potential hazards and injury to the user increases if safety checks are not adhered to.

Safety Checks

Subject: Fire & Shock Hazard

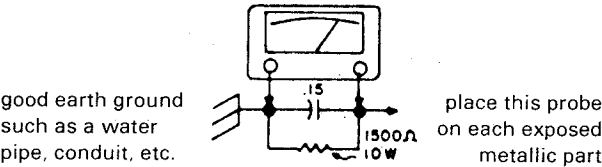
- 1. Be sure that all components are positioned in such a way to avoid possibility of shorts to adjacent components. This is especially important on those chassis which are transported to and from the repair shop.
  - 2. Always replace all protective devices such as insulators and barriers after working on a set.
  - 3. Check for damaged insulation on wires including the AC cord.
  - 4. Check across-the-line components for damage and replace if necessary.
  - 5. After re-assembly of the set, always perform an AC leakage test on the exposed metallic parts of the cabinet such as the knobs, antenna terminals, etc. to be sure the
- Important: Avoid mistakes, order Philco parts by part number.

Subject: Fire & Shock Hazard (Continued)

set is safe to operate without danger of electrical shock. Do not use a line isolation transformer during this test. Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner: Connect a 1500 ohm 10 watt resistor, paralleled by .15MFD AC type capacitor, between a known good earth ground (water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination 1500 ohm resistor and .15MFD capacitor. Reverse the AC plug on the set and repeat AC voltage measurements again for each exposed metallic part. Voltage measured must not exceed .3 volts R.M.S. This corresponds to 0.2 milliamp AC.

Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.

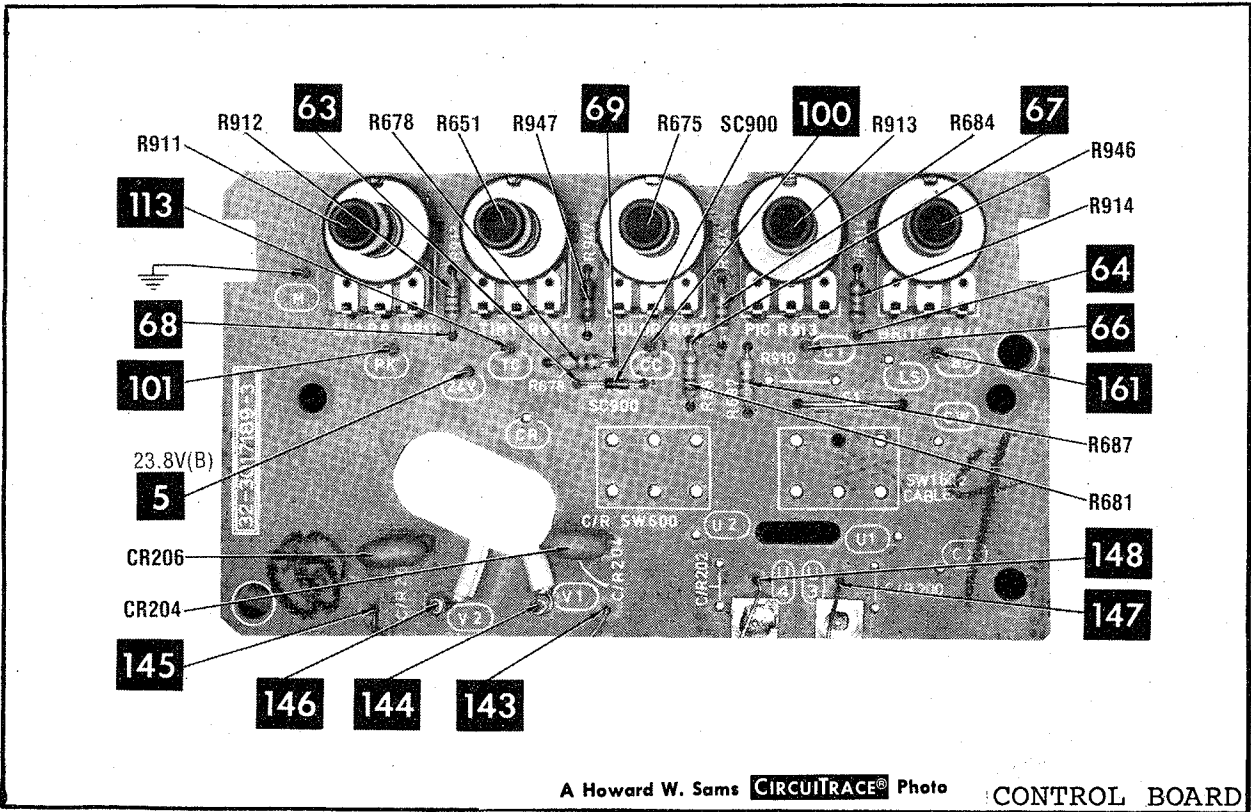
AC VOLTMETER



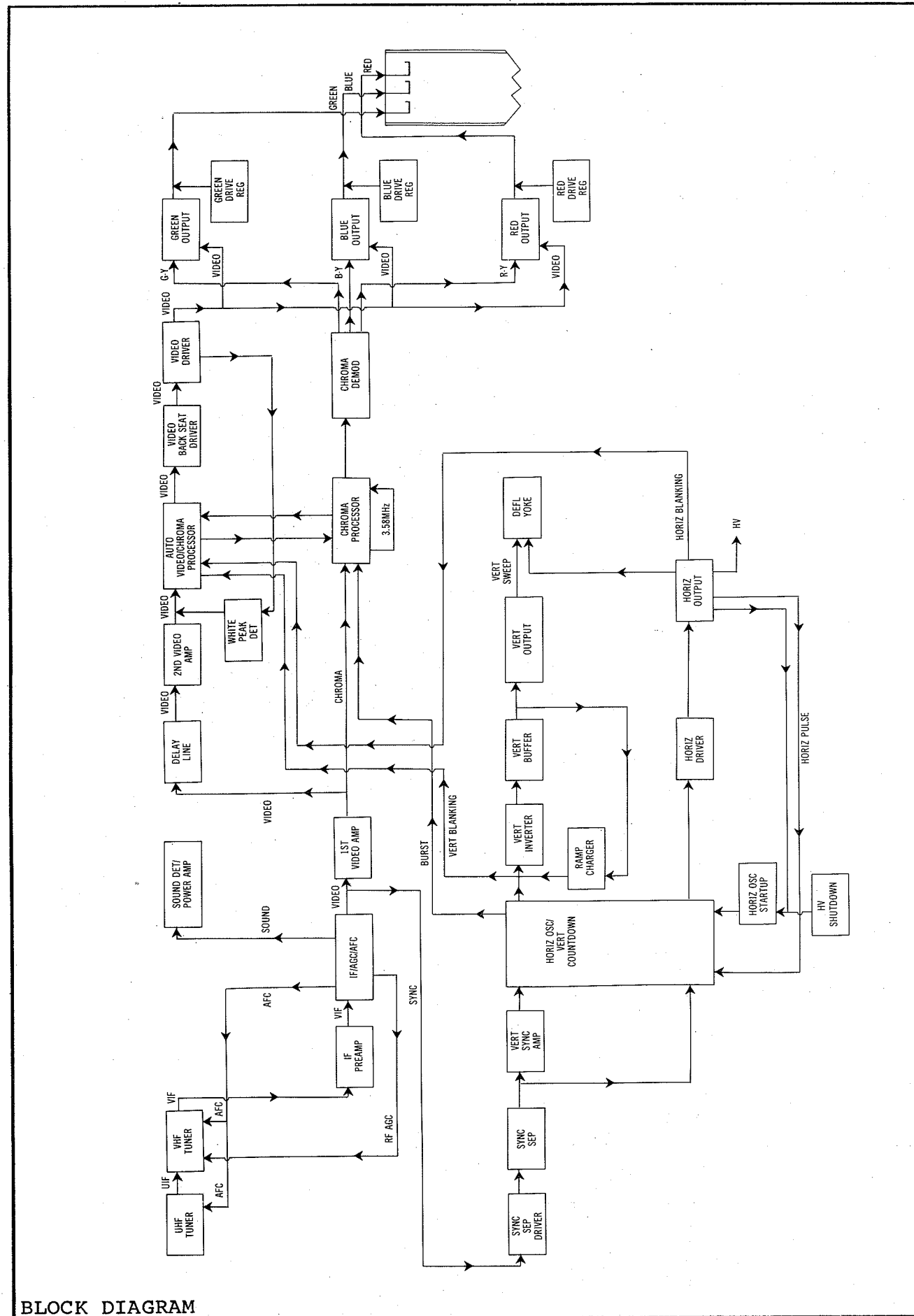
RESISTANCE MEASUREMENTS

MEASUREMENTS BELOW TAKEN WITH METER HAVING .08V MAX BETWEEN PROBE TIPS														
ITEM	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12	PIN 13	PIN 14
IC102	14K	14K	14K	0	0	4000	4000	2500	INF	INF	INF	0	0	574
													PIN 15	PIN 16
													3980	INF
IC204	11K	8980	1620	5020	9900	9890	13K	2960	2960	13K	589	2210	0	330K
													PIN 15	PIN 16
													8900	11K
IC304	94K	INF	0	INF	554									
IC600	4540	INF	INF	5020	0	8620	3510	2090	19K	INF	INF	INF	5200	10K
													PIN 15	PIN 16
													1590	52K
IC602	INF	INF	3690	3700	INF	7320	7270	528	3230	INF	3260	INF	3230	0
IC700	17K	INF	INF	1680	3660	2990	0	490	1475	12K	18K	INF(1)	9240	5650
IC900	238K	11K	152K	528	4380	49K	9010	51K	33K	0	824	824	152K	67K
													PIN 15	PIN 16
													4610	13K
V901	70M	NC	INF	NC	NC	FIL	FIL	INF	1000	10M	NC	INF		
ITEM	E	B	C		ITEM	E	B	C		ITEM	E	B	C	
Q200	39	1194	841		Q504	INF	7040	3300		Q904	47	1514	940	
Q300	300K	9030	INF		Q600	INF	10K	800		Q905	1170	3800	INF	
Q301	100K	INF	180K		Q700	433	6830	2720		Q906	INF	67K	64K	
Q302	48K	180K	1018		Q701	0	INF(1)	5120		Q907	1085	3760	INF	
Q400	1475	86K	71K		Q702	470	12K	50K		Q908	INF	67K	64K	
Q401	0	470	71K		Q900	612	1829	1391		Q909	1214	3770	INF	
Q402	0	1.22	70K		Q901	1524	1390	823		Q910	INF	67K	64K	
Q500	INF	5300	2870		Q902	741	1027	24K		SCR412	K O	G 12K	A 86K	
Q502	531	2310	1.6M(1)		Q903	940	221K	1514		SCR513	K 70K	G 70K	A 79K	

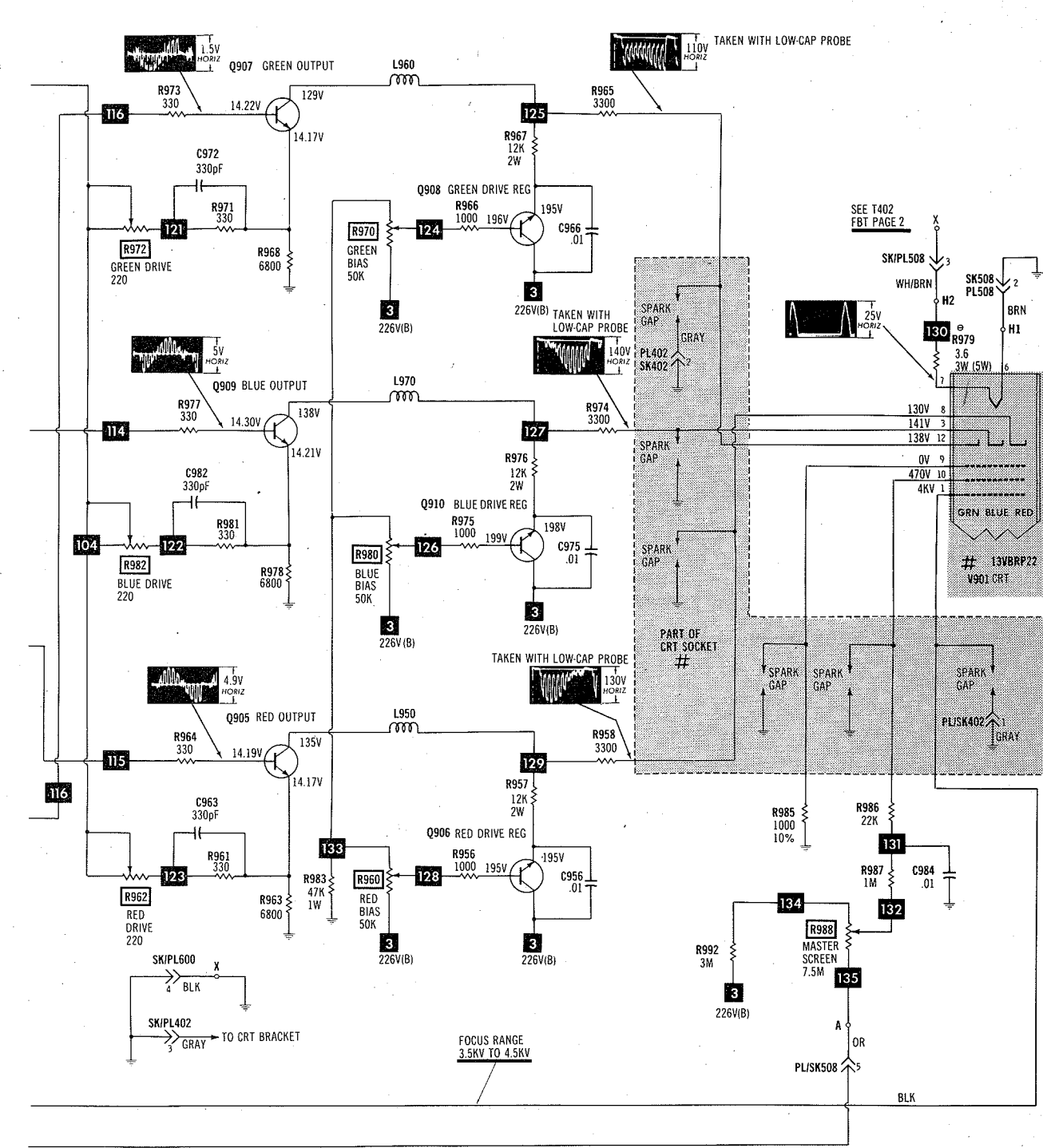
(1) Reading depends upon polarity of meter connections.



Courtesy of the Manufacturer

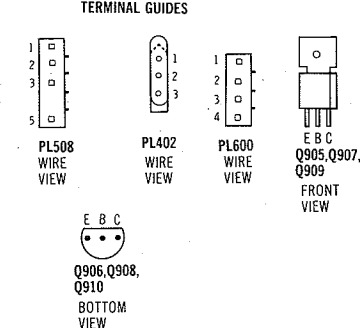


BLOCK DIAGRAM



# For SAFETY use only equivalent replacement part.  
 - Circuitry not used in some versions  
 - - - Circuitry used in some versions  
 @ See parts list  
 \* Nominal value  
 = Ground.

Waveforms: triggered scope, keyed rainbow generator  
 Item numbers in rectangles appear in the alignment/adjustment instructions.  
 Supply voltage maintained as shown at input.  
 Voltages measured with digital meter, no signal.  
 Controls adjusted for normal operation.  
 Terminal identification may not be found on unit.  
 Resistors are 1/2W or less, 5% unless noted.  
 Value in ( ) used in some versions.



A PHOTOFAC STANDARD NOTATION SCHEMATIC  
 WITH CIRCUITRACE<sup>®</sup>  
 © Howard W. Sams & Co., Inc. 1982

PHILCO CHASSIS  
 E81-1.E31-4

FOLDER 1

# TV ALIGNMENT INSTRUCTIONS

Use an isolation transformer, or observe polarity, and maintain line voltage at 120VAC.  
Allow a 20-minute warm-up period for receiver and test equipment.  
Suggested Alignment Tools: GC ELECTRONICS  
L104, L202, L206, L208, VHF Tuner IF Output Coil.....9296, 9297, 9300  
L108, L204, L210, L904.....9440

## PRELIMINARY INSTRUCTIONS

Set the channel selector to the highest unused channel. Set scope sweep to external.  
Connect scope vertical input to scope vertical input on sweep/marker generator. Connect  
scope external horizontal input to scope horizontal input on sweep/marker generator.  
Ground test equipment to TV chassis unless specified otherwise. Use only enough generator  
output to provide a usable indication.  
Note: Response may vary slightly from that shown.  
Connect a +5.5 to +6.0V bias to Test Point AGC.

## VIDEO IF ALIGNMENT (SWEEP MARKER GENERATOR)

DIRECT PROBE FROM SWEEP/MARKER GENERATOR	SWEEP GENERATOR OUTPUT	SWEEP GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	REMARKS
To Test Point PD	To TP on VHF Tuner	44MHz (10MHz Sweep)	45.75MHz (Modulated)	Note: Use a Modulated 45.75MHz marker for this adjustment. Adjust L206 for Maximum response. See Figure 1.
"	"	"	39.75MHz 41.25MHz 42.17MHz 44.00MHz 45.75MHz 47.25MHz	Connect a 100-ohm resistor from Test Points DC1 to DC2. Adjust L202, L204 and VHF Tuner IF Output Coil for Maximum gain of response. L202 affects 42.17MHz and 45.75MHz. L204 and VHF Tuner IF Output Coil affect overall gain of response. See Figure 2. Remove 100 ohm resistor.

## VIDEO IF ALIGNMENT (BAR SWEEP GENERATOR)

BAR SWEEP GENERATOR	SCOPE INPUT	REMARKS
To TP on VHF Tuner	To Test Point PD	Perform Video IF Adjustments per SWEEP/MARKER GENERATOR instructions above. See Figure 4.

## 4.5MHz TRAP ALIGNMENT

Tune in a strong TV station and set the contrast to Maximum. Set Color Control to Maximum. Adjust L210 for MINIMUM beat interference.

## SOUND IF ALIGNMENT

Tune in a station and adjust L104 and L108 for Maximum sound. Reduce signal strength at the antenna terminals until distortion appears. Continue to reduce the signal while aligning for undistorted output by adjusting L108.

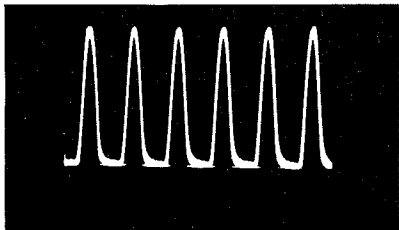


Figure 1

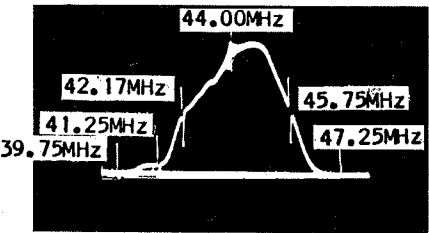
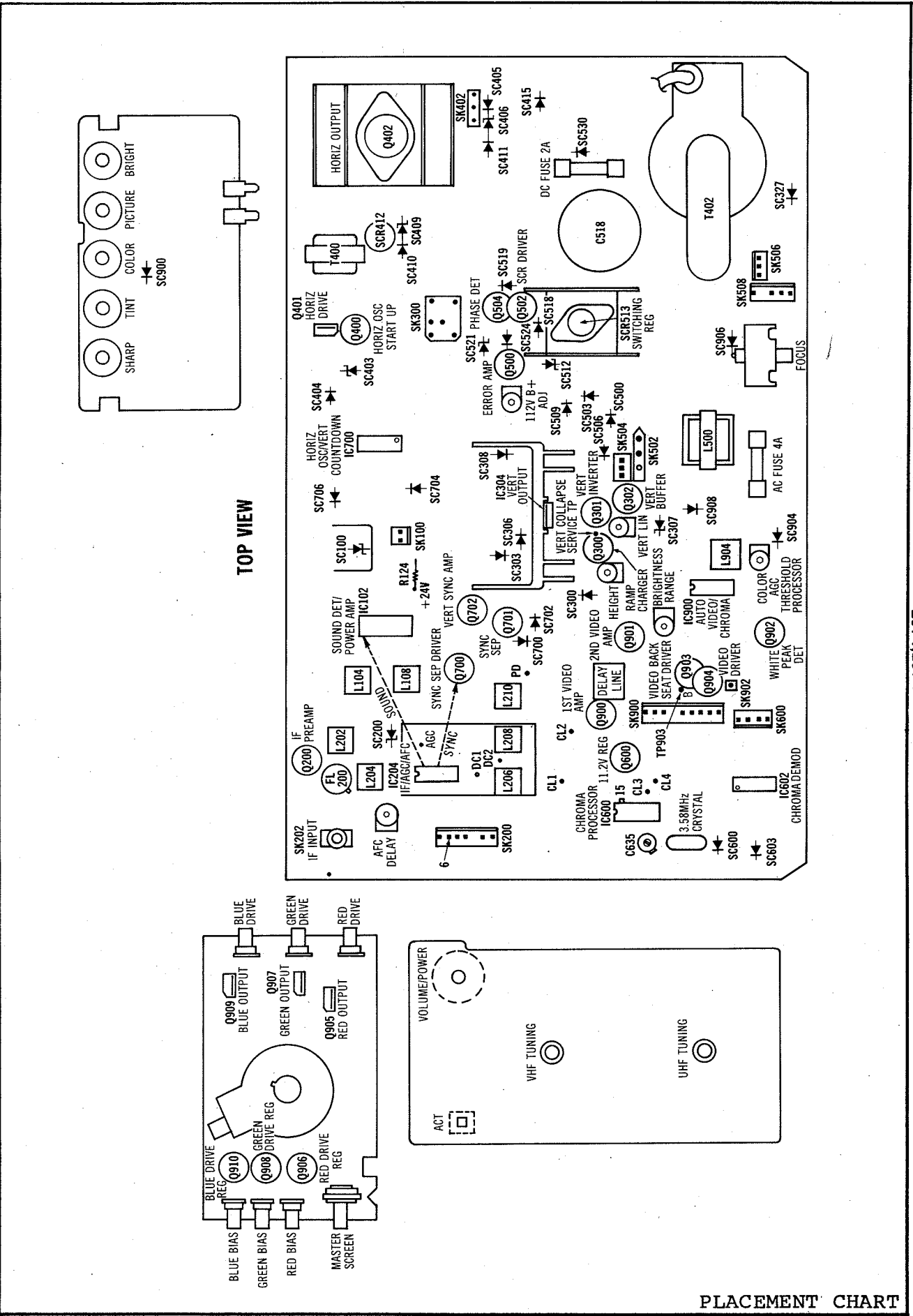
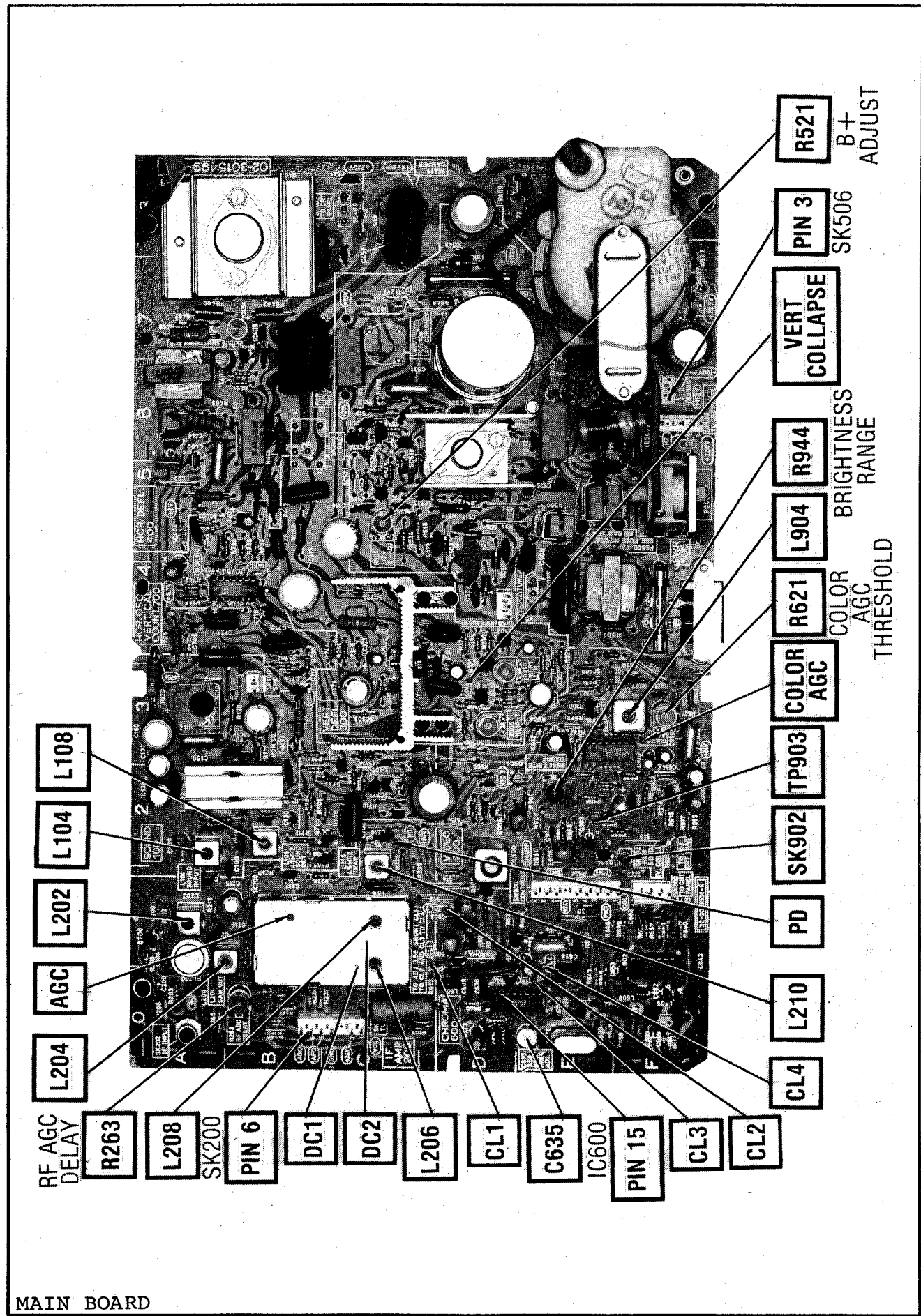


Figure 2





MAIN BOARD

## TV ALIGNMENT INSTRUCTIONS (Continued)

### AUTOMATIC FINE TUNING ALIGNMENT (ACT)

Connect as explained in preliminary instructions unless specified otherwise.  
Disconnect lead from Pin 6 of SK200.

DIRECT PROBE FROM SWEEP/MARKER GENERATOR	SWEEP GENERATOR OUTPUT	SWEEP GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	REMARKS
To Pin 6 of SK200	To TP on VHF Tuner	44MHz (10MHz Sweep)	45.75MHz	Adjust L208 to place 45.75MHz marker at crossover. See Figure 3. Reconnect lead to Pin 6 of SK200.

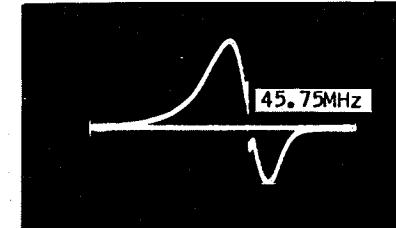


Figure 3

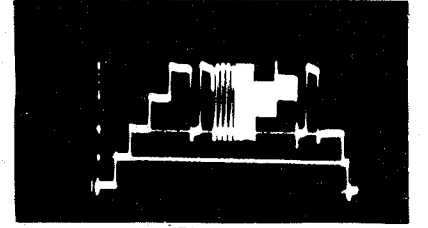
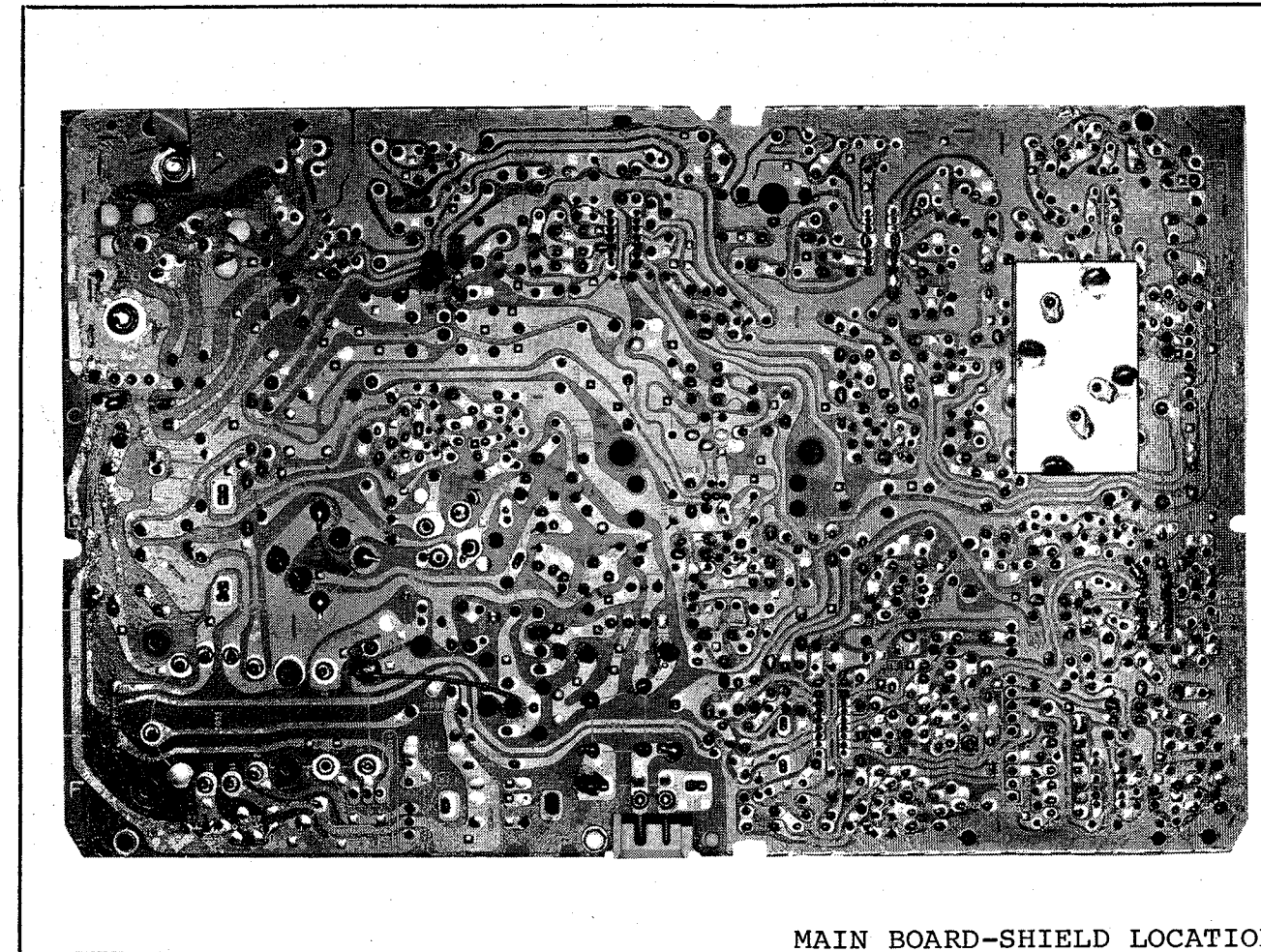
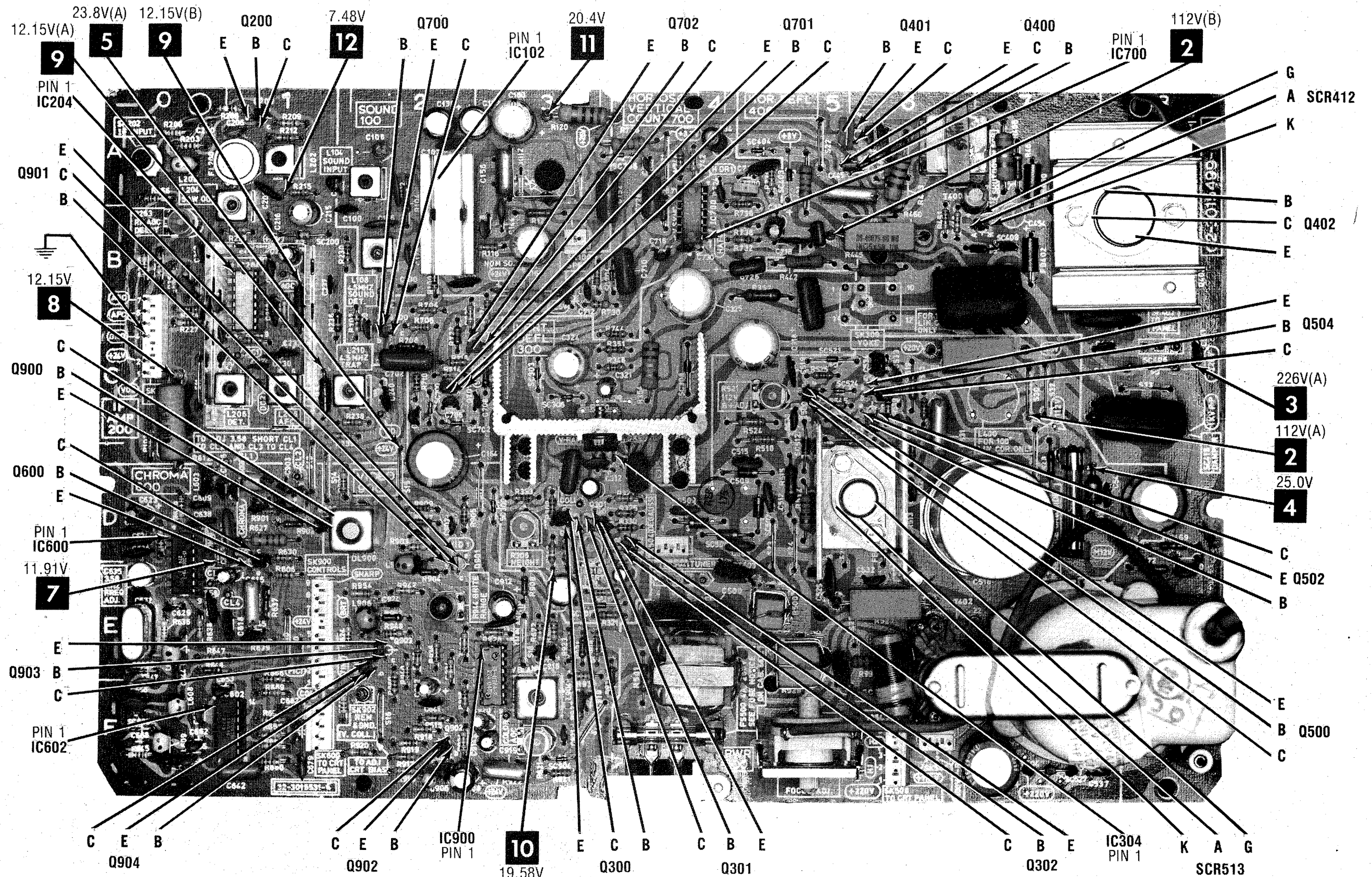


Figure 4

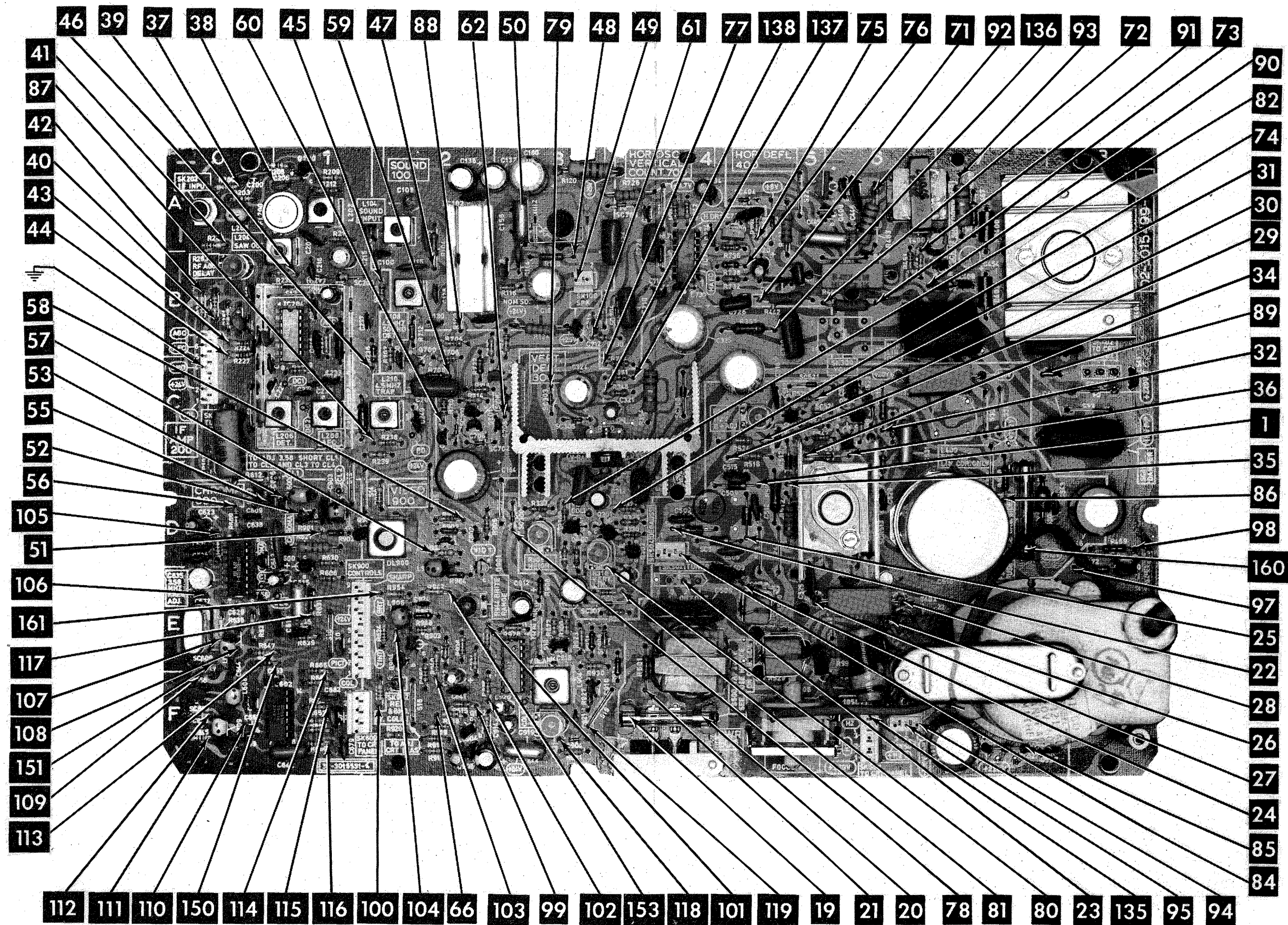


MAIN BOARD-SHIELD LOCATION









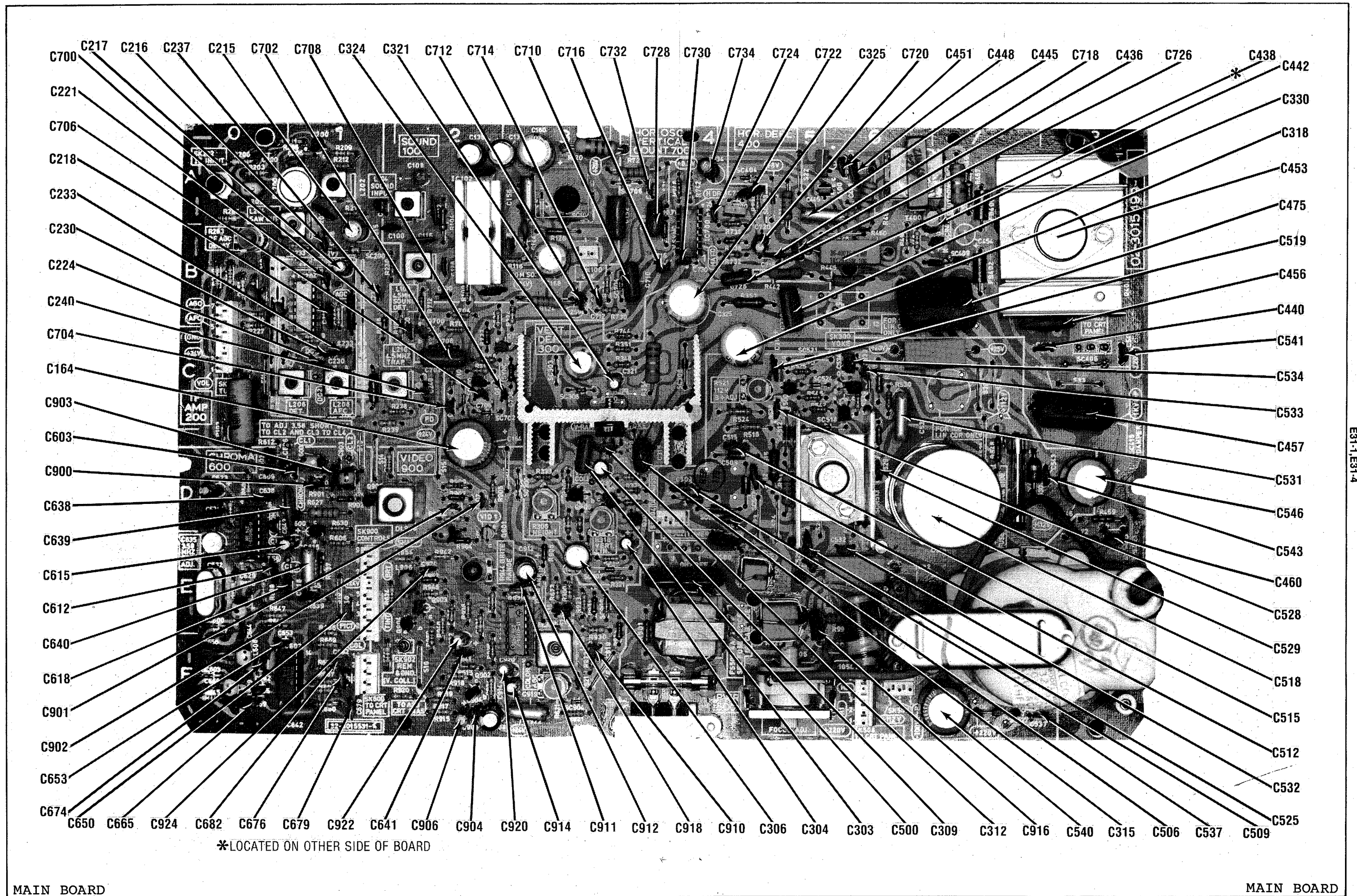
MAIN BOARD

A Howard W. Sams CIRCUITRACE® Photo

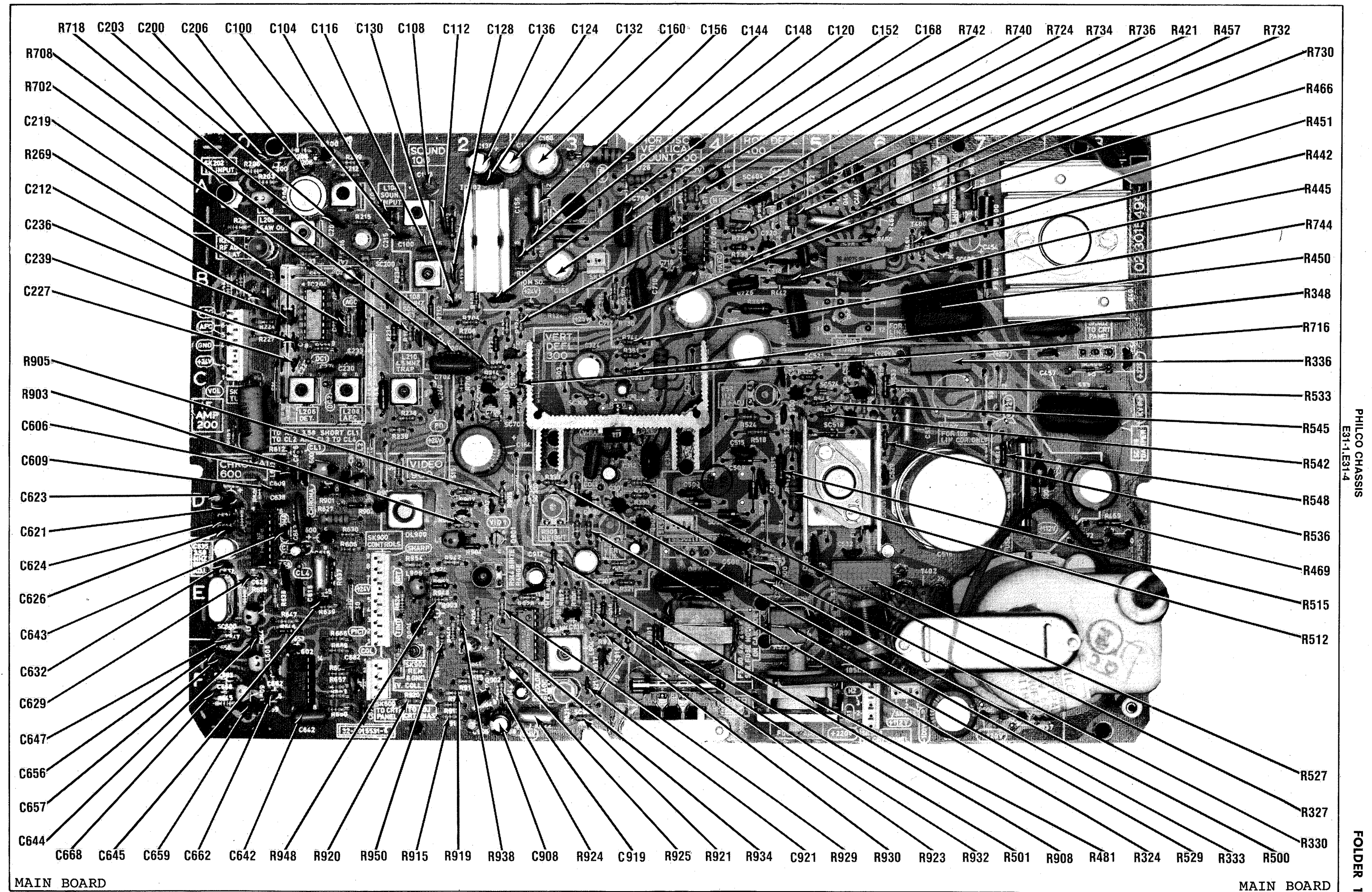
MAIN BOARD

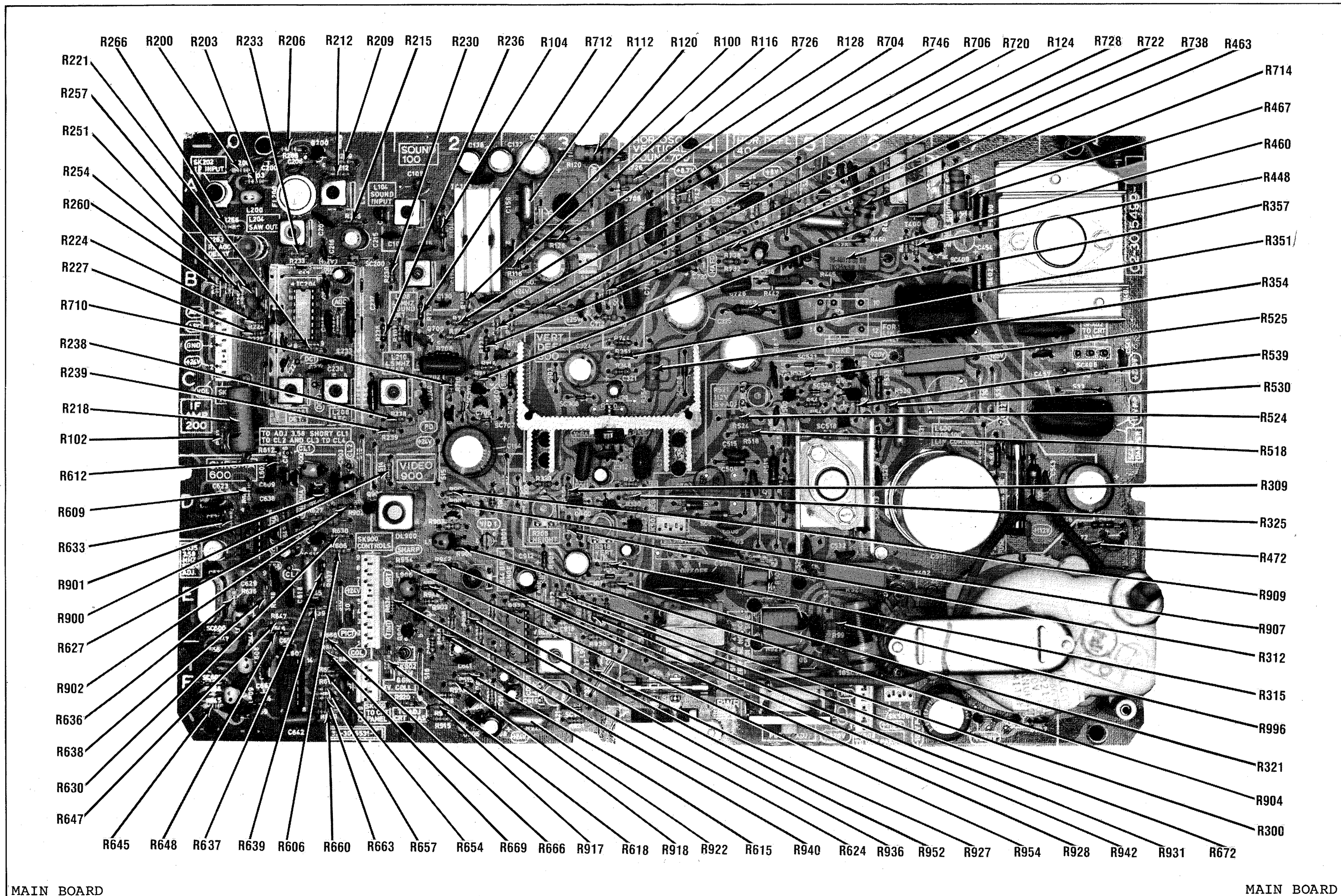
PHILCO CHASSIS  
E31-1, E31-4

FOLDER 1









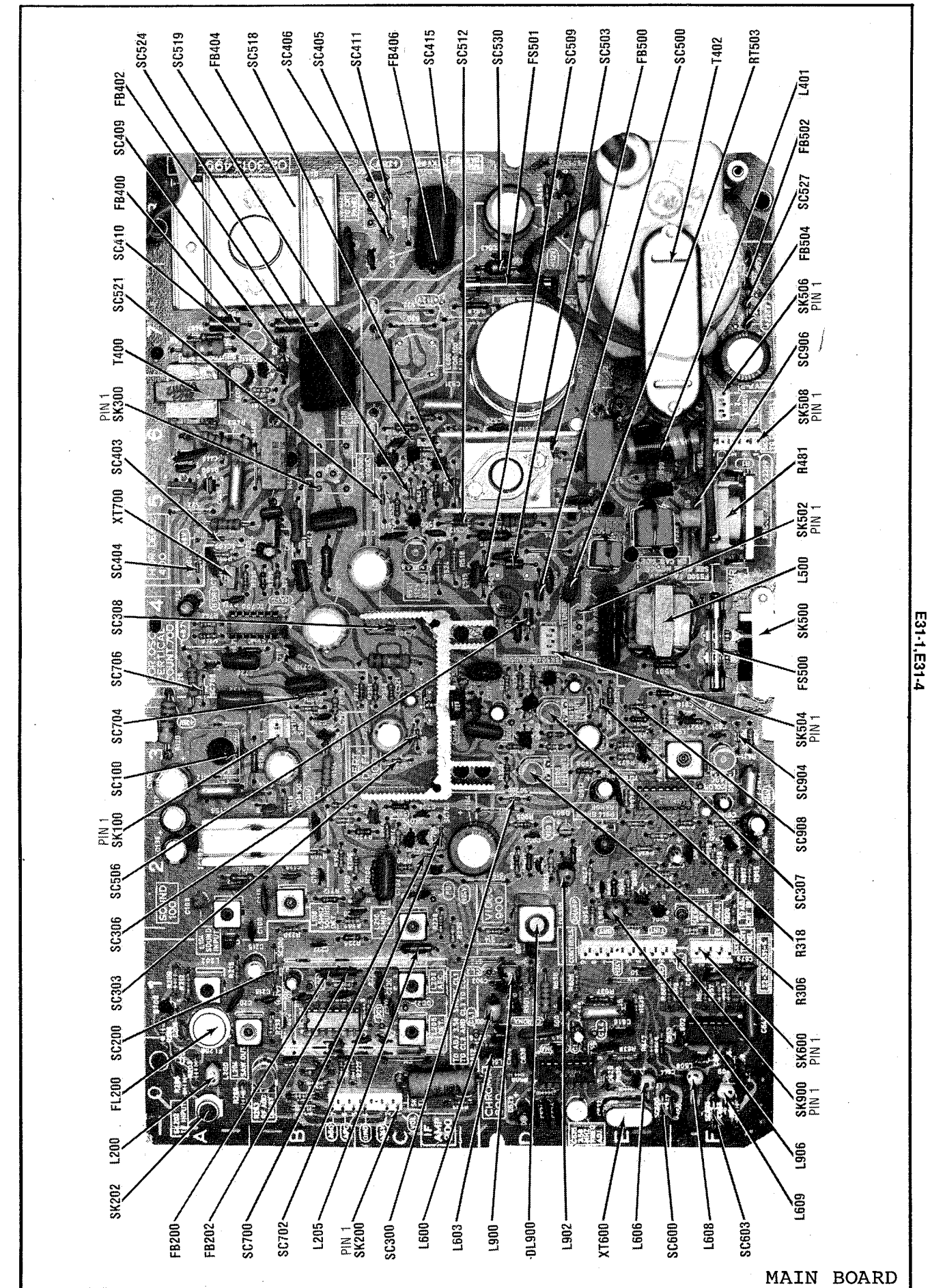
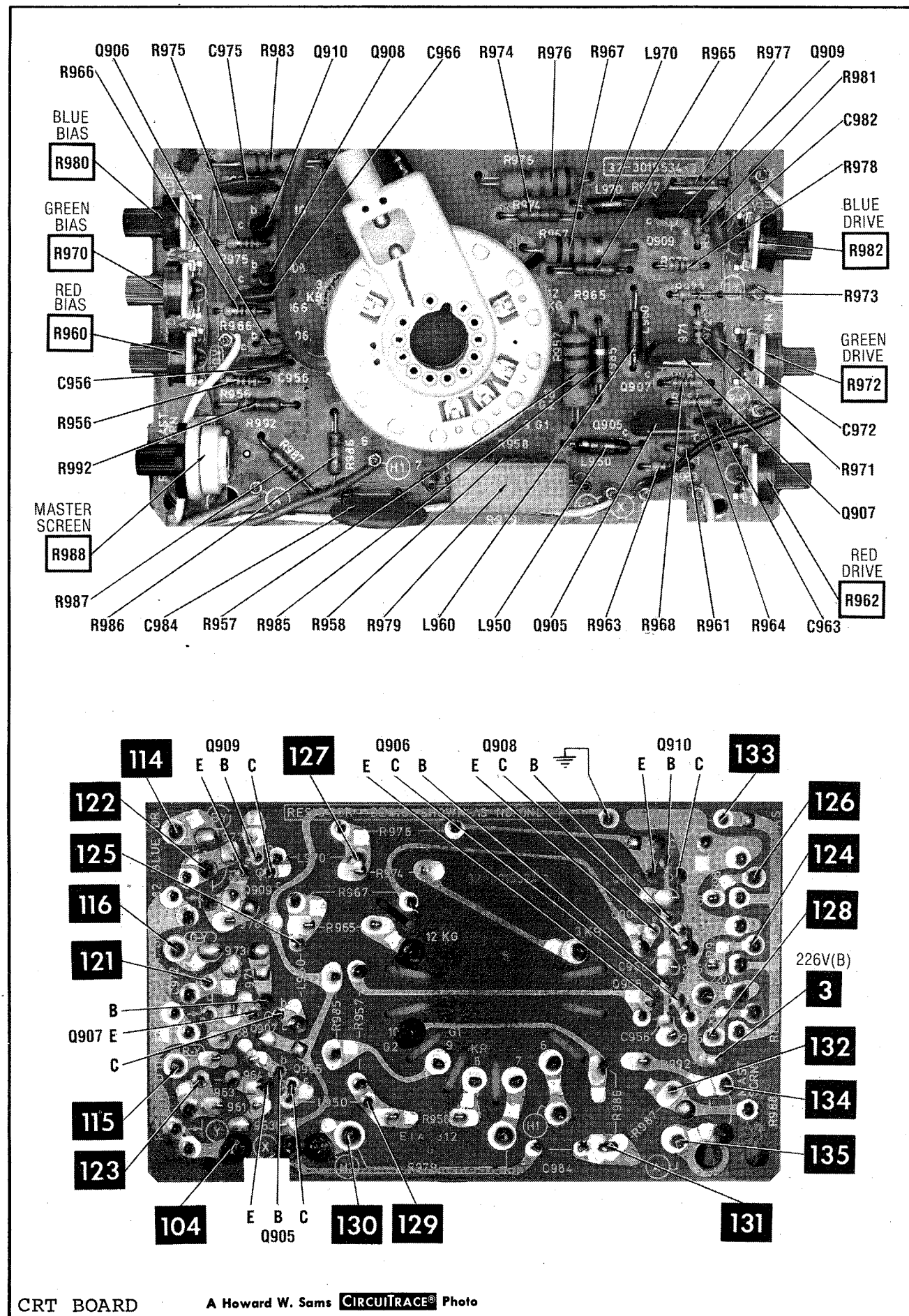
MAIN BOARD

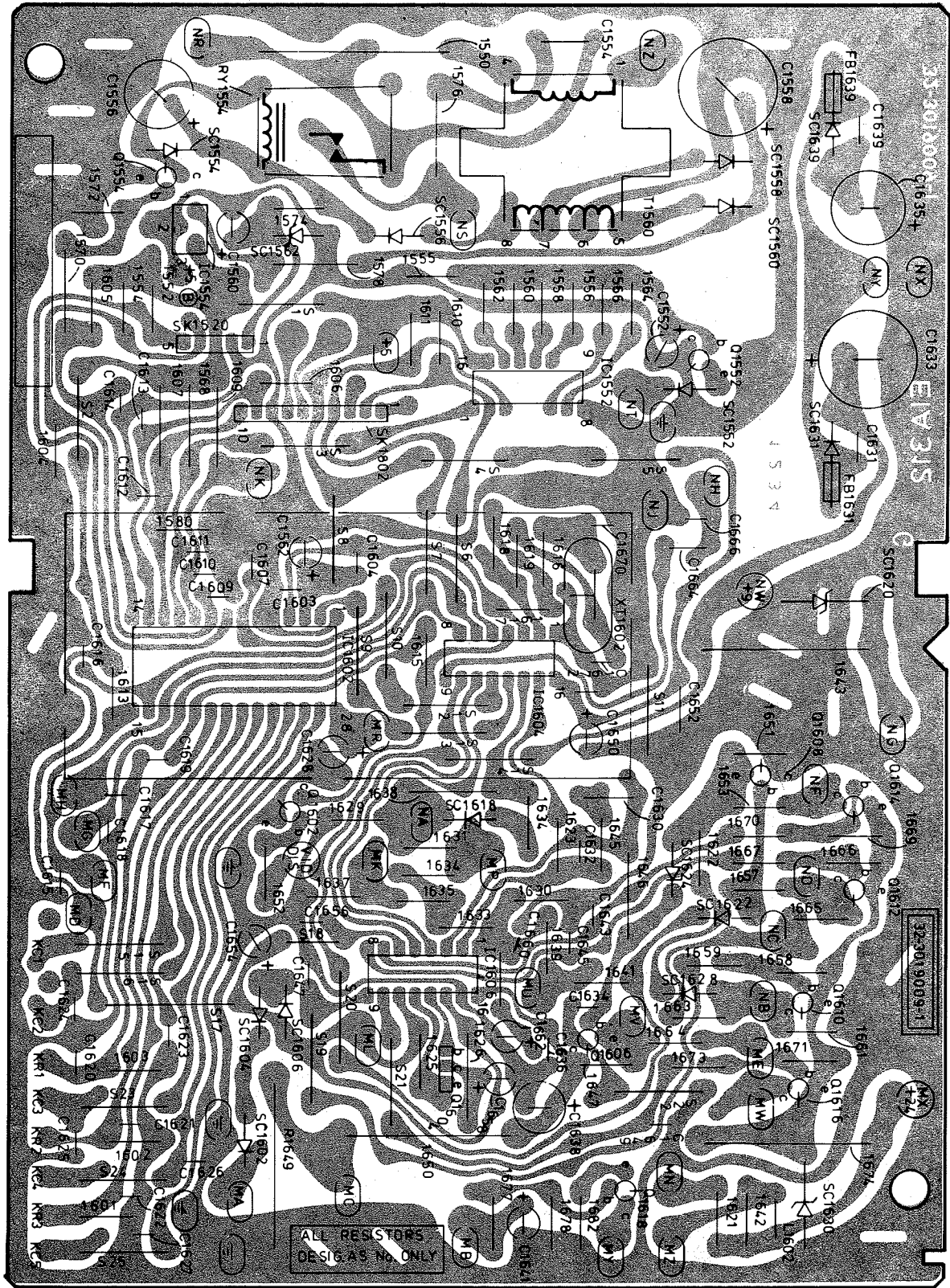
MAIN BOARD

PHILCO CHASSIS  
E31-1, E31-4

FOLDER 1









Band Switching Charts - Logic System

The following tables will be very important for use in future troubleshooting procedures. They must be exact for each band for proper channel tuning.

Band Switch decoding is done in two stages.

- A. Two logic level outputs from IC1604 to IC1606.
- B. Four logic level outputs from IC1606 to tuner.

A. IC1604 band switch data is available at Pins 10, 11.

Test the pins with the logic probe for one channel in each tuner band and record logic level

Cable/Norm Switch	Band	Pin 10	Pin 11
Normal	2 - 6	H	H
Normal	7 - 13	H	L
Normal	14 - 83	L	L
Cable *	14 - 22	H	L
Cable	23 - 36	L	H

B. IC1606 band switch data is available at Pins 7, 8, 9, 10 after being decoded within the IC.

Test the pins with the logic probe for one channel in each tuner band and record logic level.

Cable/Norm Switch	Norm	Norm	Norm	Cable*	Cable
TV Band	2 - 6	7 - 13	14 - 83	14 - 22	23 - 36
Pin 7	L	L	H	L	L
8	H	L	L	L	L
9	H	H	H	H	L
10	H	H	L	H	H

\*Note: Band switch logic is the same for VHF Hi Band and Mid Band.

Band Switch Voltage Chart

Connect the DVM to the test points listed in the chart below and enter a channel within each band.

Norm/Cable Switch	Norm	Norm	Norm	Cable	Cable
TV Band	2 - 6	7 - 13	UHF 14 - 83	MB 14 - 22	SB 23 - 36
Superband T.P. <b>NB</b>	-18.2V	-18.5V	-18.3V	-17.8V	+11.6V
Hi/Lo T.P. <b>ND</b>	-19.3V	+11.8V	+11.8V	+11.7V	+11.6V
VHF T.P. <b>NF</b>	+12.1V	+12.1V	+0.8V	+11.9V	+11.7V
UHF T.P. <b>MW</b>	0V	0V	+11.9V	0V	0V

BAND SWITCH CHARTS,  
MCU TUNER CLUSTER

Logic Probe Servicing Method

The following is a suggested procedure to analyze system operation to confirm logic levels by using a logic probe.

Preliminary Instructions

- 1. Remove tuner cluster assembly from cabinet and carefully place on protective material or padding on servicing bench behind the receiver.

- 2. Connect logic probe power cable to +5.4V regulated source voltage on MCU panel and common ground lead to chassis ground. (Refer to instruction manual of the manufacturer type of logic probe you are using.)
- 3. Switch logic probe to "TTL" mode.

Note:  
Pin 17 will be "L" except for a few entries when data ends with a high. We consider it normally "L".

MCU Operation - Logic System

IC1602 Confirm Logic Levels

Remote Control Chassis		Non-Remote Control Chassis - Set On	
Pin 2	H	Pin 2	H
3	H	3	H
4	L*	4	L*
7	H/L*	7	H/L*
8	H	8	H
9	L	9	L
10	H	10	H/L
11	L	11	H
12	L	12	H
13	H	13	H
14	H	14	H
15	H	15	H
16	H	16	H
17	L	17	L
18	L	18	L
19	H	19	H
20	L	20	L
21	L	21	L
22	L	22	L
23	H	23	H
24	H	24	H
25	H	25	H
26	H	26	H
27	H	27	H
28	H	28	H

L with TV set off/pwr. on.

H - Normal  
L - Cable

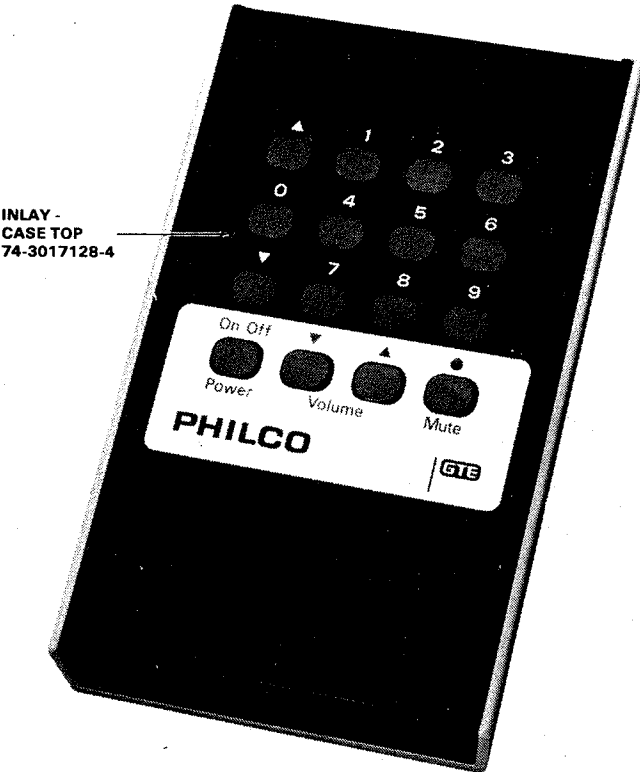
L with power on - off

"L" w/no signal

\*Pulse

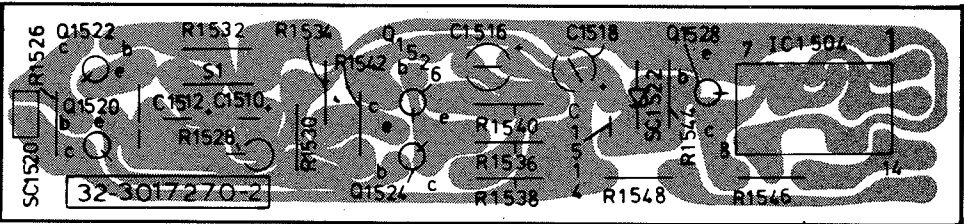
Normal "H"/  
Cable "L"

Remote Transmitter (E31-4 Ch.)  
RC27



INLAY -  
CASE TOP  
74-3017128-4

Remote Pre-Amp (E31-4 Ch.)



Top View

Q1506

C +9.1V(+9.8V)  
B +.08V(0V)  
E +9.1V(+9.8V)

Q1508

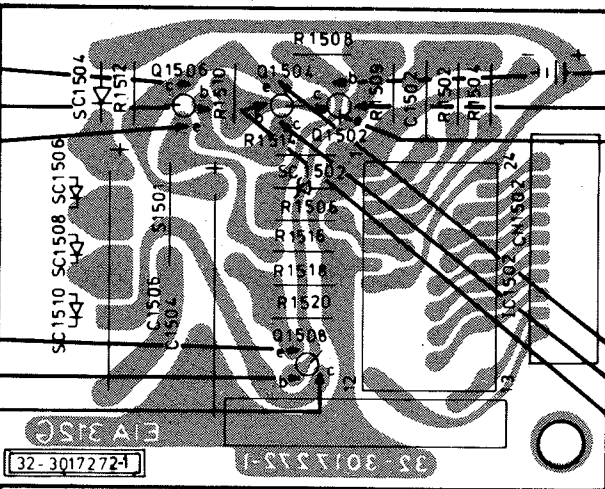
E 0V(0V)  
B 0V(0V)  
C +6.8V(+7.6V)

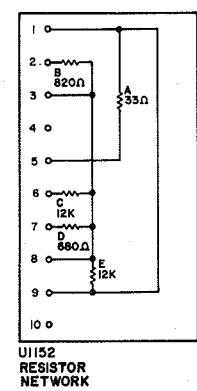
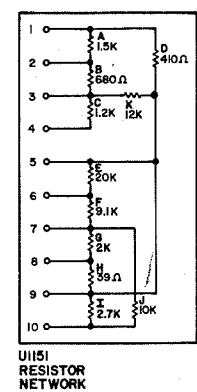
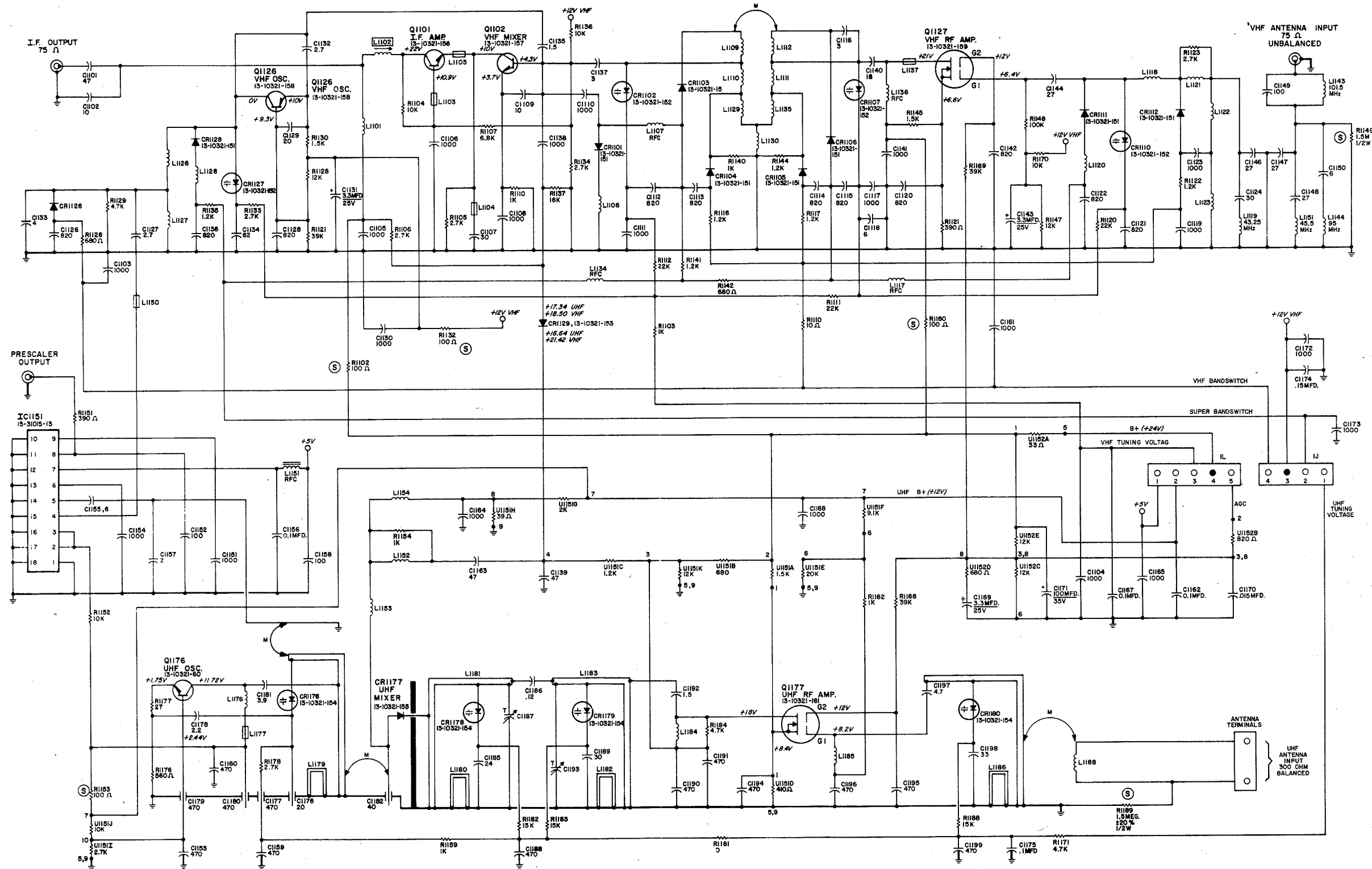
Q1502

0V(0V)  
0V(0V)  
+9.1V(+9.8V)

Q1504

+9.1V(+9.8V)  
+.08V(0V)  
+9.1V(+9.8V)





NOTES:  
1. RESISTORS ARE 1/4 W,  
±5% TOLERANCE, FILM  
UNLESS OTHERWISE  
SPECIFIED.  
2. CAPACITORS ARE IN  
PICOFARADS UNLESS  
OTHERWISE SPECIFIED.

[illegible]

<u>Schematic Coding</u>	<u>Part No.</u>	<u>Description</u>
<b>Diodes (Continued)</b>		
SC1502	13-33187-32	Zener, +3.3V
SC1504	13-17596-10	Bias
SC1506	16-3015812-1	IR Emitter
SC1508	16-3015812-1	IR Emitter
SC1510	16-3015812-1	IR Emitter
SC1520	16-3015813-1	IR Detector
SC1522	13-17596-10	Bias
SC1554	13-41122-2	Damping
SC1556	13-41122-2	Power Rectifier
SC1558	13-41122-2	Power Rectifier
SC1560	13-41122-2	Power Rectifier
SC1562	13-33187-36	Zener, +18V Zener
SC1602	13-41122-2	Bias
SC1604	13-41122-2	Bias
SC1606	13-41122-2	Bias
SC1618	13-17596-10	AFC Gain Control
SC1620	13-3015735-5	Zener, +5V, 5W
SC1622	13-34056-1	Clamp
SC1624	13-34056-1	Bias
SC1628	13-34056-1	Superband Clamp
SC1630	13-3015735-4	Zener, +12V, 5W
SC1631	13-43777-2	Power Rectifier
SC1639	13-43777-2	Power Rectifier

Q1502	13-29033-3	Pulse Amp.
Q1504	13-39115-3	DC Clamp Driver
Q1506	13-39114-3	DC Clamp
Q1508	13-39114-3	IR Emitter Driver
Q1520	13-29033-3	IR Pre-Amp.
Q1522	13-29033-3	DC Feedback Amp
Q1524	13-29033-3	First IR Amp.

MCU TUNER CLUSTER

<u>Schematic</u>	<u>Description</u>
<b>Capacitors (All values in PF unless specified; 50V Disc unless specified)</b>	

C1101	47, $\pm 5\%$
C1102	10, $\pm .25PF$
C1103	1000, GMV
C1104	1000, $\pm 10\%$
C1105	1000, $\pm 10\%$
C1106	1000, $\pm 10\%$
C1107	30, $\pm 5\%$
C1108	1000, $\pm 10\%$
C1109	10, $\pm 5\%$
C1110	1000, $\pm 10\%$
C1111	1000, $\pm 10\%$
C1112	820, +80-20%, 400V, Leadless
C1113	820, +80-20%, 400V, Leadless
C1114	820, +80-20%, 400V, Leadless
C1115	820, +80-20%, 400V, Leadless
C1116	3, $\pm .25PF$
C1117	1000, $\pm 10\%$
C1118	6, $\pm .25PF$
C1119	1000, $\pm 10\%$
C1120	820, +80-20%, 400V, Leadless
C1121	820, +80-20%, 400V, Leadless
C1122	820, +80-20%, 400V, Leadless
C1123	1000, $\pm 10\%$
C1124	30, $\pm 5\%$
C1126	820, +80-20%, 400V, Leadless
C1127	2.7, $\pm 10\%$ , Tubular
C1128	820, +80-20%, 400V, Leadless
C1129	20, $\pm 5\%$
C1130	1000, $\pm 10\%$
C1131	3.3MFD, +50% -10%, 25V,

C1162		1MFD, $\pm 10\%$ , 100V, Polyester
C1163		47, $\pm 5\%$ , N470
C1164		1000, $\pm 10\%$
C1165		1000, $\pm 10\%$
C1167		.1MFD, $\pm 10\%$ , 100V, Polyester
C1168		1000, $\pm 10\%$
C1169		3.3MFD, +50-10%, 25V, Electrolytic
C1170		.015MFD, $\pm 10\%$ , 100V, Polyester
C1171		100MFD, +50-10%, 35V, Electrolytic
C1172		1000, $\pm 10\%$
C1173		1000, $\pm 10\%$
C1174		.15MFD, $\pm 10\%$ , 100V, Polyester
C1175		.1MFD, $\pm 10\%$ , 100V, Polyester
C1176	43-96130-177	20, $\pm 5\%$ , 100V, Feedthrough
C1177	43-96130-178	470, $\pm 20\%$ , 100V, Feedthrough
C1178		2.2, $\pm .25$ PF, 500V NPO
C1179	43-96130-178	470, $\pm 20\%$ , 100V, Feedthrough
C1180	43-96130-178	470, $\pm 20\%$ , 100V, Feedthrough
C1181		3.9, $\pm 5\%$ , 400V, Mini Ceramic
C1182	43-96130-179	40, $\pm 10\%$ , 100V, Feedthrough
C1185		24, $\pm 5\%$ , 400V, Leadless
C1186		.12, $\pm 10\%$ , 500V, Gimmick
C1187		Trimmer Plate
C1188		470 GMV, 400V, Leadless
C1189		30, $\pm 5\%$ , 400V, Leadless
C1190		470 GMV, 400V, Leadless
C1191		470 GMV, 400V, Leadless
C1192		1.5, $\pm 5\%$ , 400V, Leadless
C1193		Trimmer Plate
C1194		470 GMV, 400V, Leadless
C1195		470 GMV, 400V, Leadless
C1196		470 GMV, 400V, Leadless
C1197		4.7MFD, $\pm 5\%$ , 400V, Leadless
C1198		33, $\pm 5\%$ , 400V, Leadless
C1199		470 GMV, 400V Leadless

CR1101	13-10321-151	Diode - Mixer Superband Boost Switch
CR1102	13-10321-152	Diode - Mixer Varactor
CR1103	13-10321-151	Diode - Mixer Superband Switch
CR1104	13-10321-151	Diode - Mixer VHF Switch
CR1105	13-10321-151	Diode - RF VHF Switch
CR1106	13-10321-151	Diode - RF Superband Switch
CR1107	13-10321-152	Diode - RF Varactor
CR1110	13-10321-152	Diode - Antenna Varactor
CR1111	13-10321-151	Diode - Antenna Superband Switch
CR1112	13-10321-151	Diode - Antenna VHF Switch
CR1126		Diode - VHF Oscillator Bandswitch
CR1127	13-10321-152	Diode - VHF Oscillator, Varactor
CR1128	13-10321-151	Diode - Oscillator Superband Switch
CR1129	13-10321-153	Diode - Switching UHF IF
CR1176	13-10321-154	Diode - UHF Oscillator Vari-Cap.
CR1177	13-10321-155	Diode - UHF Mixer Asm.

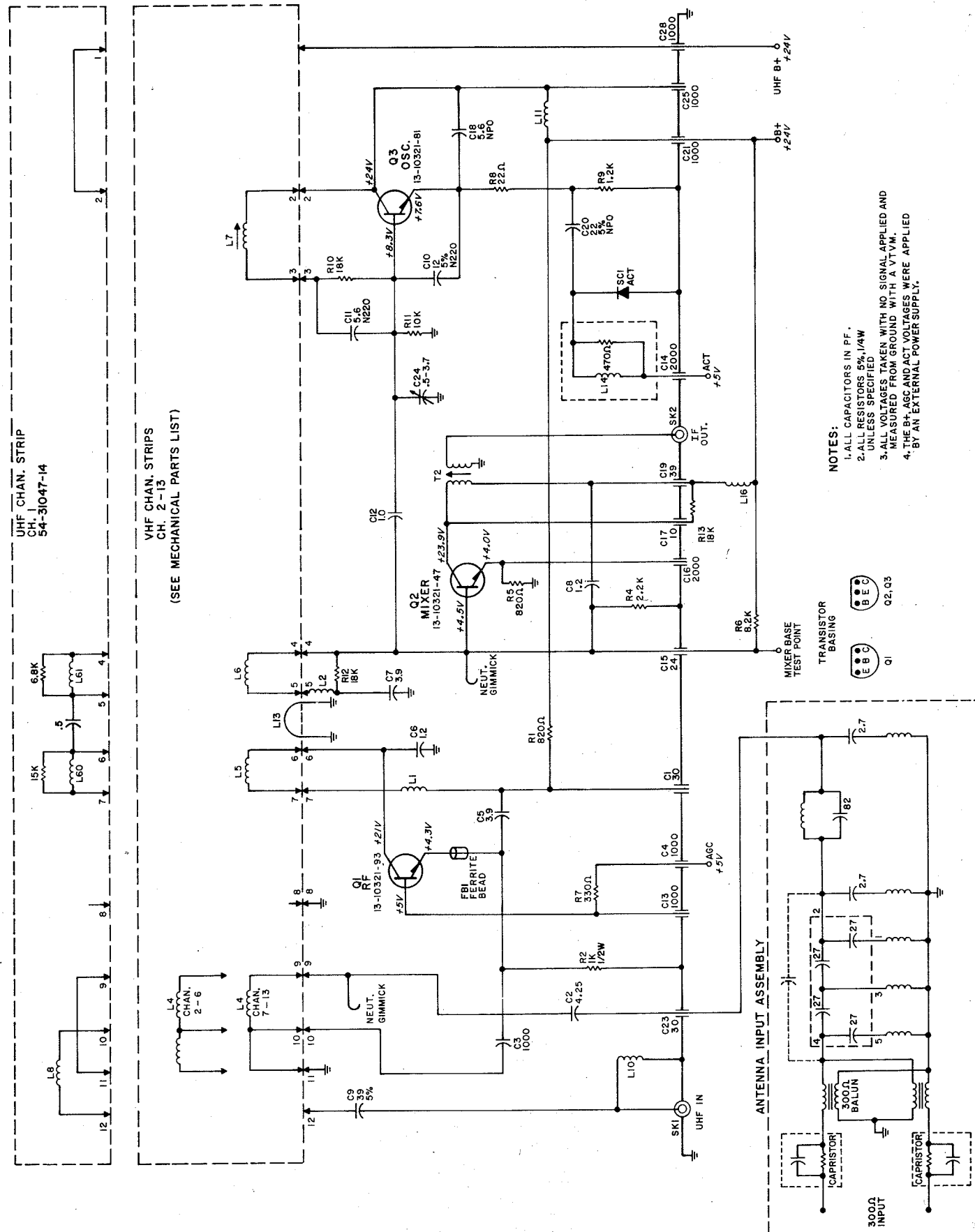
CR1178	13-10321-154	Diode - UHF Vari-Cap.
CR1179	13-10321-154	Diode - UHF Vari-Cap.
CR1180	13-10321-154	Diode - UHF Vari-Cap.
IC1151	15-31015-13	Integrated Circuit
Q1101	13-13021-156	Transistor - NPN Silicon
Q1102	13-13021-157	Transistor - NPN Silicon
Q1126	13-13021-158	Transistor - PNP Silicon
Q1127	13-13021-159	Transistor - N Channel FET
Q1176	13-13021-160	Transistor - NPN Silicon
Q1177	13-13021-161	Transistor - N Channel Dual

L1101	50-96187-58	Coil - Converter Tap, IF Output Parallel
L1102	50-96187-59	Coil - Tunable IF Output
L1103		Ferrite Bead
L1104		Ferrite Bead
L1105		Ferrite Bead
L1106		Coil - Super Channel Boost
L1107		Choke - RCF Asm.
L1109		Coil - Super Channel Mixer
L1110		Coil - High Channel Mixer
L1111		Coil - High Channel RF
L1112		Coil - Super Channel RF
L1117		Choke - RF
L1118		Coil - High Channel Antenna
L1119	50-96187-60	Coil - IF Series
L1120		Coil - Super Channel Antenna
L1121		Coil - Low Channel Antenna
L1122		Coil - Low Channel Antenna Parallel
L1123		Coil - High Channel Antenna Parallel
L1126		Coil - High Channel Oscillator
L1127		Coil - Low Channel Oscillator
L1128		Coil - Super Channel Oscillator
L1129		Coil - Low Channel Mixer
L1130		Coil - Low Channel Mutual Coupling
L1134		Coil - RF Choke Asm.
L1135		Coil - Low Channel RF
L1136		Coil - RF Choke Asm.
L1137		Ferrite Bead
L1140	50-96187-61	Coil - IF Shunt
L1141	50-96187-62	Coil - IF Series
L1143		Coil - FM Parallel
L1144		Coil - FM Series
L1150		Ferrite Bead
L1151		Coil - RF Choke Asm.
L1152	50-96187-63	Coil - IF Output
L1153	50-96187-64	Coil - IF Input
L1154	50-96187-65	Coil - Mixer IF
L1176		Coil - Oscillator Collector
L1177		Ferrite Bead
L1178		Stamping Metal UHF Tuner Oscillator
L1179		Trimmer Inductance (Part of L1178)
L1180		Trimmer Inductance
L1181		Coil - Stamped Metal Mixer Line
L1182		Trimmer Inductance
L1183		Coil - Stamped Metal Drain Line
L1184		Coil - Drain Boost
L1185		Coil - GI Boost
L1186		Trimmer Inductance
L1187		Coil - Stamped Metal Gate Line
L1188	50-96187-66	Balun - UHF

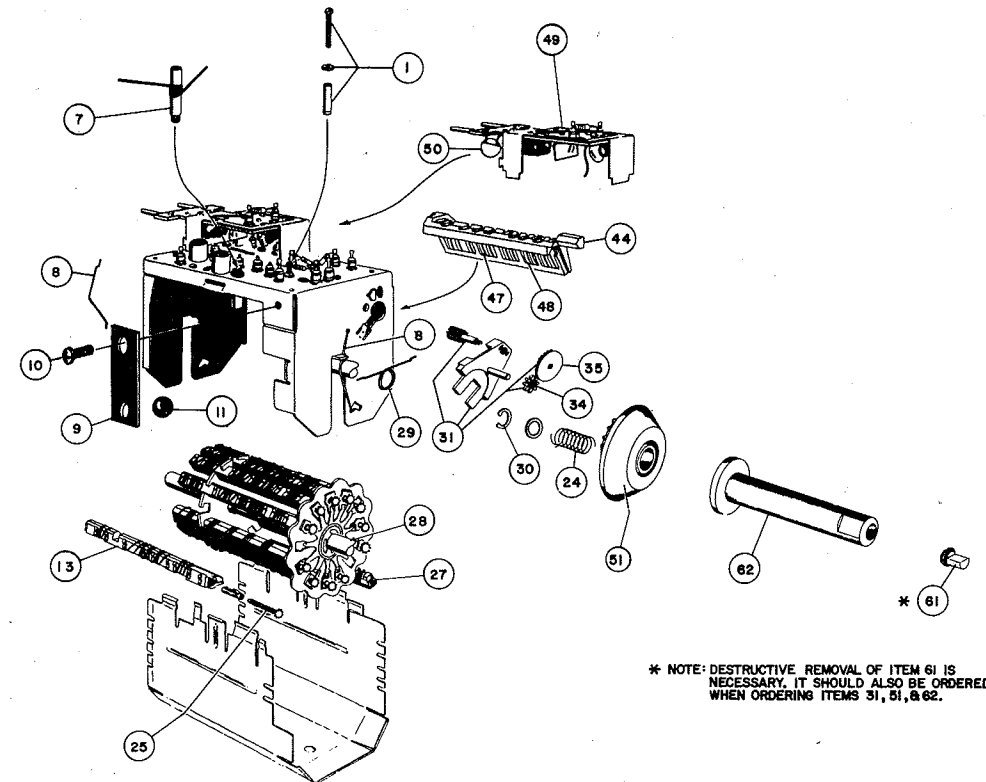
**FOLDER 1**

Courtesy of the Manufacturer

## VHF/UHF TUNER



Mechanical Parts Layout (Exploded View) VHF 54-3015951-1

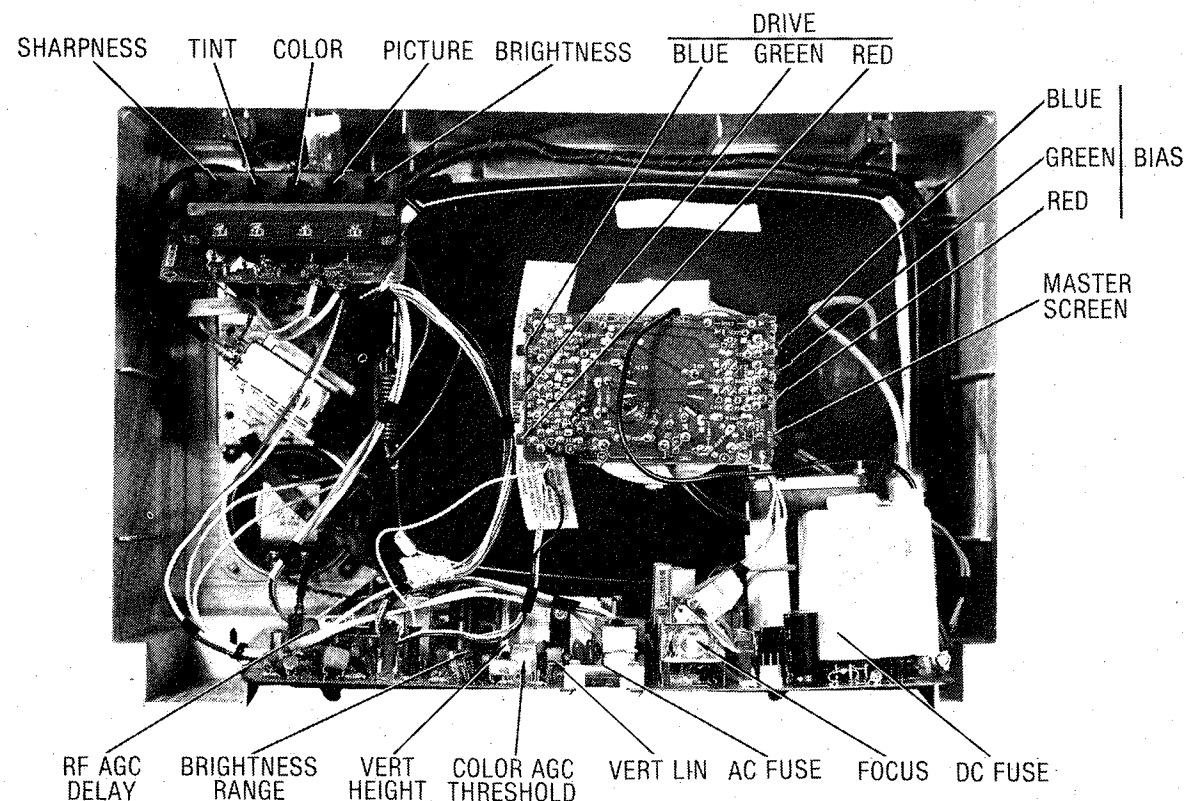


### Mechanical Parts List

Item No.	Service Part No.	Description	Item No.	Service Part No.	Description
1	42-96176-26	Trimmer - Osc. - C24	24	54-28973-13	Strip - VHF - Channel 13
7	50-96187-52	Transformer - IF Output - T2	25		Spring - Cone Return
8		Drum Retaining Spring	27	54-28973-1	Tuning Screw
9		Detent Spring	28	54-13817-46	Strip - UHF - Channel 1
10		Screw - Mounting	29		Spring Slide Return
11		Detent Ball	30	229-191-21	"C" Ring Limiter
13	54-28973-2	Strip - VHF - Channel 2	31	54-13815-79	Preset Slide Asm.
	54-28973-3	Strip - VHF - Channel 3	44		Stator
	54-28973-4	Strip - VHF - Channel 4	45		Lock Pin
	54-28973-5	Strip - VHF - Channel 5	46		Stator Contact
	54-28973-6	Strip - VHF - Channel 6	47		Ground Spring
	54-28973-7	Strip - VHF - Channel 7	49	54-96135-67	Ant. Input Asm. (Isolated)
	54-28973-8	Strip - VHF - Channel 8	50		Capristor
	54-28973-9	Strip - VHF - Channel 9	51	54-96188-73	Cone - Tuning
	54-28973-10	Strip - VHF - Channel 10	61	54-96174-18	Boot
	54-28973-11	Strip - VHF - Channel 11	62	54-96188-87	Fine Tune Shaft
	54-28973-12	Strip - VHF - Channel 12			

Note: Item numbers with no part number are not stocked.

Important: Avoid mistakes, order Philco parts by part number.



## DISASSEMBLY INSTRUCTIONS CABINET-REAR VIEW

### CHASSIS REMOVAL

Remove knobs from cabinet front, remove six screws holding cabinet back and remove back. Disconnect HV anode, CRT socket, deflection yoke connector, degaussing coil connector, speaker connector and ground leads. Remove one screw holding control and antenna terminal assembly to cabinet top and remove assembly from cabinet. Remove three screws holding tuner assembly to cabinet front and remove

assembly from cabinet. Release latch (at front edge of board) holding main board to cabinet bottom and slide board out of cabinet.

### CRT REMOVAL

Follow "Chassis Removal" procedure and lay set facedown on a soft protective surface. Loosen and remove CRT neck assemblies, remove four screws holding CRT mounts to cabinet front. Lift CRT out of cabinet. Do Not lift CRT by the neck.

## SERVICING IN THE FIELD

### CRT IMPLOSION PROTECTION AND CLEANING

Implosion protection is an integral part of the picture tube, cleaning accomplished without CRT removal.

### FUSE DEVICES

A 4-amp fuse is used for AC line protection. (See photo, Cabinet-Rear View.)

A 2-amp fuse is used for horizontal sweep circuit protection. (See Placement Chart.)

### VHF TUNER

The fine tuning mechanically engages oscillator

slug for adjustment (one slug for each channel).

### UHF TUNER

The UHF tuner employs a detent mechanism for channel selection. Fine tuning is adjusted by rotating the fine tuning knob.

### FOCUS

The focus may be varied by a focus control. (See photo, Cabinet-Rear View.)

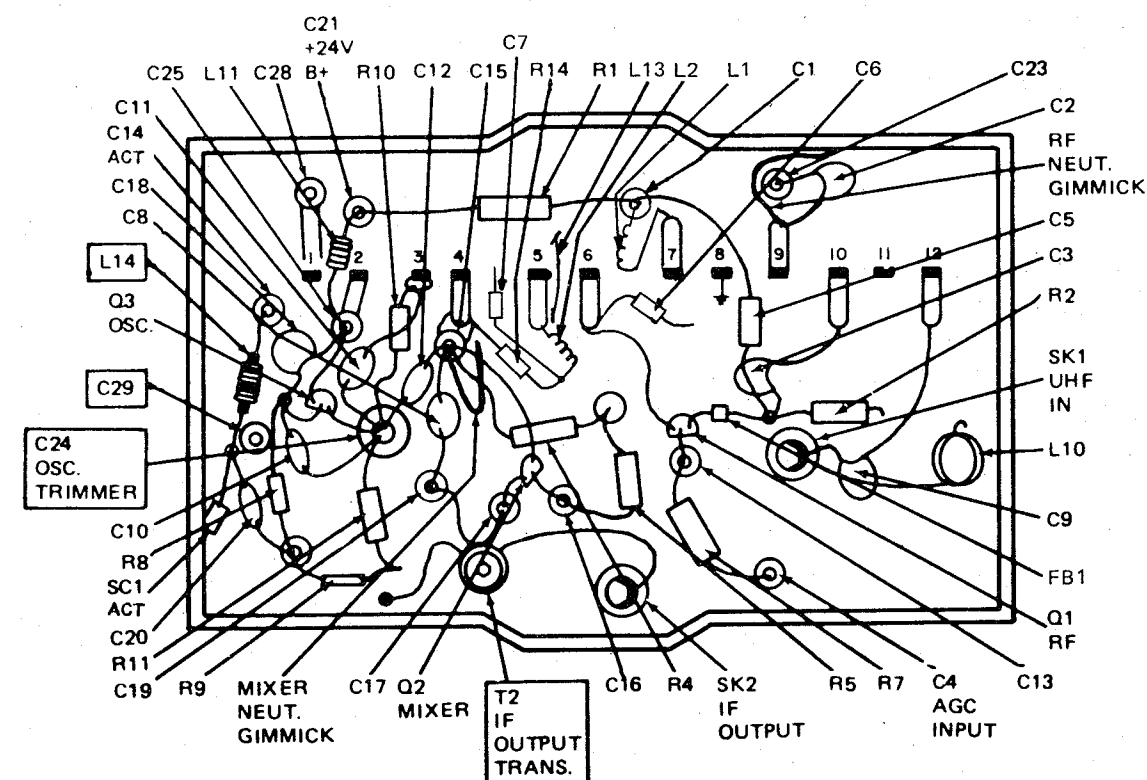
### AGC

The AGC may be varied by an RF AGC Delay control. (See Placement Chart.)

## Replacement Parts List

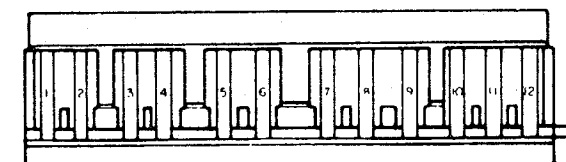
Schematic Coding	Service Part No.	Description	Schematic Coding	Service Part No.	Description
<b>Capacitors (All values in Picofarads)</b>			<b>Resistors (Continued)</b>		
C1	43-96130-78	30 ± 5%	R2		1K ohm, 1/2W
C2		4.25 ± .3	R4		2.2K ohm
C3		1000	R5		820 ohm
C4	43-96130-45	100 GMV, Feedthrough - AGC	R6		8.2K ohm
C5		3.9	R7		330 ohm
C6		1.2	R8		22 ohm
C7		3.9	R9		1.2K ohm
C8		1.2	R10		18K ohm, 10%
C9		39 ± 5%	R11		10K ohm
C10		12 ± 5%, N220	R12		18K
C11		5.6 ± 25%, N150	R13		18K
C12		1.0	<b>Coils and Transformers</b>		
C13	43-96130-45	1000 GMV, Feedthrough	L1		RF Collector
C14	43-96130-51	2000 GMV, Feedthrough - ACT	L2		Mixer Base
C15	43-96130-173	24 Feedthrough	L10		Channel No. 1 Ground Return
C16	43-96130-62	2000 GMV, Feedthrough	L11		Isolation Choke
C17	43-96130-49	10 Feedthrough	L13		Interstage Shade
C18		5.6 - NPO	L14		ACT Coil (wound on 47 ohm Resistor)
C19	43-96130-52	39 Feedthrough	L16		Choke Coil
C20		22 ± 5%, NPO	T1	54-96135-67	Antenna Input Asm. (Isolated)
C21	43-96130-45	1000 GMV, Feedthrough	T2	50-96187-52	IF Output Transformer
C23	43-96130-78	30 Feedthrough	<b>Miscellaneous</b>		
C24		.5 - 3.7 Osc. Trimmer	Q1	13-10321-93	Transistor - RF
C25	43-96130-45	1000 GMV, Feedthrough	Q2	13-10321-47	Transistor - Mixer
C28	43-96130-45	1000 GMV, Feedthrough	Q3	13-10321-81	Transistor - Osc.
			SC1	13-10321-80	ACT Diode
<b>Resistors (All 5%, 1/4W unless otherwise specified)</b>					
R1		820 ohm			

### Bottom View



### Stator Assembly

Courtesy of the Manufacturer



VHF TUNER  
54-3015951-1

SET 2094 FOLDER 1

PHILCO CHASSIS  
E31-1.E31-4

FOLDER 1

TROUBLESHOOTING AID

Note: Waveforms taken with triggered scope, Keyed-Rainbow generator. Schematic voltages measured with digital meter, no signal. Controls adjusted for normal operation.

PICTURE or SOUND

NO PIC, NO SOUND, NO RASTER: Check AC power supply and supplies generated from Horizontal Output Transformer (T402). Refer to "Troubleshooting" Power Supply and Horizontal circuits.

NO PIC, NO SOUND, HAS RASTER: Check IF-AGC and supply voltages from Horizontal Output Transformer (T402). Refer to "Troubleshooting" IF-AGC and Horizontal circuits.

NO PIC, HAS SOUND, NO RASTER: Check Horizontal Output Transformer (T402) sources and Video circuit. Refer to "Troubleshooting" Horizontal and Video circuits.

NO PIC, HAS SOUND, HAS RASTER: Refer to "Troubleshooting" Video circuit.

HAS PIC, NO SOUND: Refer to "Troubleshooting" Audio circuit.

OVERLOADED PICTURE: Refer to "Troubleshooting" IF-AGC circuit.

LOW OR EXCESSIVE BRIGHTNESS: Refer to "Troubleshooting" Video circuit.

SWEEP

NO RASTER, HAS SOUND: Check HV rectifier Part of Horizontal Output Transformer (T402) and Horizontal circuit. Refer to "Troubleshooting" Horizontal circuit.

NO RASTER, NO SOUND: Refer to "Troubleshooting" Horizontal circuit.

NO VERT DEFLECTION: Refer to "Troubleshooting" Vertical circuit.

POOR VERT LIN OR FOLDOVER: Refer to "Troubleshooting" Vertical circuit.

POOR HORIZ LIN OR FOLDOVER: Refer to "Troubleshooting" Horizontal circuit.

NARROW PICTURE: Refer to "Troubleshooting" Horizontal circuit.

VERT OFF FREQUENCY: Refer to "Troubleshooting" Vertical circuit.

HORIZ OFF FREQUENCY: Refer to "Troubleshooting" Horizontal circuit.

SYNC

NO VERT/HORIZ SYNC: Refer to "Troubleshooting" Sync circuit.

RASTER

YELLOW (NO BLUE): Check Chroma and CRT Blue Output circuits. Refer to "Troubleshooting" Raster circuit.

CYAN (NO RED): Check Chroma and CRT Red Output circuits. Refer to "Troubleshooting" Raster circuit.

MAGENTA (NO GREEN): Check Chroma and CRT Green Output circuits. Refer to "Troubleshooting" Raster circuit.

COLOR (B/W operating normally)

NO COLOR: Refer to "Troubleshooting" Color circuit.

WEAK COLOR: Refer to "Troubleshooting" Color circuit.

NO COLOR SYNC: Refer to "Troubleshooting" Color circuit.

NO GREEN: Check Chroma and CRT Green Output circuits. Refer to "Troubleshooting" Color and Raster circuits.

NO BLUE: Check Chroma and CRT Blue Output circuits. Refer to "Troubleshooting" Color and Raster circuits.

NO RED: Check Chroma and CRT Red Output circuits. Refer to "Troubleshooting" Color and Raster circuits.

INCORRECT HUE (TINT): Refer to "Troubleshooting" Color circuit.

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements.

Have your local distributor check Sams COUNTER FACTS for the most up-to-date replacement.

MISCELLANEOUS (cont)

ITEM No.	PART NAME	MFCR. PART No.	NOTES
#	UHF Tuner	54-41526-3	PTS Part No. 54-41526-3, Used in Chassis E31-1.
#	UHF/VHF Tuner	54-3017407-1	PTS Part No. 54-3017407-1, Used in Chassis E31-4.
#	VHF Tuner	54-3015951-1	PTS Part No. 54-3015951-1, Used in Chassis E31-1.
	Wedge	86-3015339-3	Yoke

# For SAFETY use only equivalent replacement part.

CABINETS & CABINET PARTS (When ordering specify model, chassis & color)

ITEM	PART No.	PART No.	PART No.	PART No.
	MODEL C2301PBK	MODEL C2321PAL	MODEL C2322PW	MODEL C2327PWR
Cabinet Back	10-3017164-2	10-3017164-1	10-3017164-2	10-3017164-3
Cabinet Front	10-3017162-7	10-3017162-1	10-3017162-2	10-3017264-3
Inlay, UHF/VHF (1)	74-3017979-2			
Nameplate (1)		74-3017166-5	74-3017166-6	74-3017368-1
Overlay, Secondary Controls	74-3017370-3	74-3017370-8	74-3017370-3	74-3017370-5
UHF Dial Assembly	74-14443-10	74-14443-10	74-14443-10	
Knob-ACT	74-41310-2	74-41310-1	74-41310-1	
Knob-On/Off/Volume	74-41121-3	74-41121-3	74-41121-3	
Knob-UHF Channel Selector	74-43577-14	74-45946-4	74-45946-4	
Knob-UHF Fine Tuning	74-41304-502	74-41305-501	74-41305-501	
Knob-VHF Channel Selector	74-44577-13	74-45946-6	74-45946-6	
Knob-VHF Fine Tuning	74-41304-504	74-41304-506	74-41304-506	
Spring-Fine Tuning Knobs	77-33963-1	77-33963-1	77-33963-1	
	MODEL C2310QW			
Cabinet Back	10-3017164-2			
Cabinet Front	10-3017162-7			
Inlay, UHF/VHF (1)	74-3017979-4			
Overlay-Secondary Controls	74-3017370-9			
Knob-ACT	74-41310-1			
Knob-On/Off/Volume	74-37814-10			
Knob-UHF Channel Selector	74-45946-4			
Knob-UHF Fine Tuning	74-41305-4			
Knob-VHF Channel Selector	74-45946-6			
Knob-VHF Fine Tuning	74-41304-6			
Spring-Fine Tuning Knob	77-33963-1			

(1) Order with Cabinet Front.

PHILCO CHASSIS  
E31-1, E31-4

FOLDER 1



PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements. Have your local distributor check Sams COUNTER FACTS for the most up-to-date replacement.

SPEAKER

ITEM No.	TYPE	REPLACEMENT DATA		NOTES
		MFGR. PART No.	QUAM PART No.	
SP1	3 1/2" PM 32 Ohm	12-3017604-1	35A05Z32	

FUSE DEVICES

ITEM No.	DESCRIPTION	REPLACEMENT DATA				NOTES
		MFGR. PART No.		BUSS PART No.		
		DEVICE	HOLDER	DEVICE	HOLDER	
# FS500	4A @ 250V Fast-Acting	29-37730-27	73-34919-1			
# FS501	2A @ 250V Fast-Acting	29-37730-29	73-34919-1			

# For SAFETY use only equivalent replacement part.

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
# CR204	Component Combination	32-45344-2	Used in Chassis E31-1.
# CR206	Component Combination	32-45344-2	Used in Chassis E31-1.
FB200	Ferrite Bead	22-28072-2	
FB202	Ferrite Bead	22-28072-2	
FB400	Ferrite Bead	22-28072-4	
FB402	Ferrite Bead	22-28072-4	
FB404	Ferrite Bead	22-28072-4	
FB406	Ferrite Bead	22-28072-4	
FB500	Ferrite Bead	22-28072-4	
FB502	Ferrite Bead	22-28072-3	
FB504	Ferrite Bead	22-28072-3	
FL200	Filter	32-3017157-1	SAW
L502	Degauss Coil	50-3017875-2	
# P500	Cord	73-43044-2	AC Power
SC532	LED	16-45202-1	Color Rite II (1.77V @ 4.5mA)
SW200	Switch	33-35548-6	ACT (AFC), Used in Chassis E31-1.
SW500	Switch	37-35105-35	Power On/Off (Part of Volume Control R108), Used in Chassis E31-1.
SW600	Switch	33-16011-15	Color-Rite II, Used in Chassis E31-4.
V901	CRT	13VBRP22	
XT600	Crystal	26-16162-2	3.58MHz
XT700	Crystal	26-3017158-1	503.5kHz
#	AC Interlock	73-27392-4	Large Pin
#	AC Interlock	73-27392-3	Small Pin
	Antenna	73-15297-1	Terminal
	Antenna	27-17941-3	UHF, RUSSELL Replacement Antenna BOW-1H.
	Antenna	27-3015372-3	VHF, RUSSELL Replacement Assembly POR-2H.
			RUSSELL Replacement Rod SIM-4H.
	Cable	73-16070-24	MCU Board to Prescaler,
	Cable	73-16070-33	UHF Tuner to VHF Tuner, Used in Chassis E31-1.
	Cable	73-3017156-10	UHF/VHF Tuner to Main Board, Used in Chassis E31-4.
	Cable	73-3017156-10	VHF Tuner to Main Board
	Magnet	22-3015851-1	Concentric Converger
	P.C. Board	02-3015501-2	CRT
	P.C. Board	02-3017971-1	Main, Used in Chassis E31-1.
	P.C. Board	02-3017971-2	Main, Used in Chassis E31-4.
	P.C. Board	02-3017327-3	MCU, Used in Chassis E31-4 (Early Production).
	P.C. Board	02-3017327-7	MCU, Used in Chassis E31-4 (Later Production).
	P.C. Board	02-3017278-1	Remote Preamp, Used in Chassis E31-4.
	P.C. Board	02-3017179-1	Secondary Control, Used in Chassis E31-1.
	P.C. Board	02-3017179-3	Secondary Control, Used in Model C2301PBK.
	P.C. Board	02-3017179-4	Secondary Control, Used in Chassis E31-4.
#	Socket	73-3015919-1	CRT
	Remote Transmitter	RC27	Complete, Used in Chassis E31-4.
	Remote Transmitter	74-3015081-4	Case, Bottom, Used in Chassis E31-4.
	Remote Transmitter	74-3017128-1	Inlay, Case Top, Used in Chassis E31-4.
	Remote Transmitter	89-28841-4	Key Top Assembly, Used in Chassis E31-4.
#	Retainer	81-87861-1	AC Line Cord

TROUBLESHOOTING

POWER SUPPLY

Check the AC Line Fuse (FS500) and replace if bad. If AC Line Fuse (FS500) was bad, check for possible shorts at the Bridge Rectifier Diodes (SC500, SC503, SC506 and SC509), De-gaussing Coil (L502) and the B+ sources. Apply power and check for 120V AC from cathode of Bridge Rectifier Diode (SC500) to cathode of Bridge Rectifier Diode (SC506). If 120V AC is not present, check On-Off Switch (SW500), Resistor R500, Plug PL502 and Line Choke Coil (L500). If 120V AC is present, check for 112V at the cathode of the Switching Regulator SCR (SCR513). If 112V is not present, check the HV Shutdown SCR (SCR412) voltages for possible shutdown (See the HV Shutdown SCR (SCR412) Voltage Chart for shutdown voltages). If HV Shutdown SCR (SCR412) is in shutdown, refer to "Troubleshooting" HV and 112V Shutdown Defeat circuits. If the 112V is not present or not regulated, check the voltages and waveforms on the Error Amp Transistor (Q500), Phase Detector Transistor (Q504), SCR Driver Transistor (Q502) and Switching Regulator SCR (SCR513). Also check the winding on Horizontal Output Transformer (T402) from pins 5 to 6 and Coil L401 for possible opens or shorts. Check B+ sources from the Horizontal Output Transformer (T402). Refer to "Troubleshooting" Horizontal circuit.

HV SHUTDOWN SCR (SCR412) VOLTAGE CHART

ITEM	K	G	A
SCR412	0V	.63V	.70V

Note: Voltages measured with SCR412 in shutdown.

HORIZONTAL

Check the HV Shutdown SCR (SCR412) to see if it is On (See HV Shutdown SCR (SCR412) Voltage Chart). If it is On, refer to "Troubleshooting" HV and 112V Shutdown Defeat circuit. Check for 112V at pin 3 of the Horizontal Output Transformer (T402). If 112V is not present, check Fuse FS501 and the power supply circuits. Refer to "Troubleshooting" Power Supply circuit. Inject a horizontal signal at the base of the Horizontal Output Transistor (Q402). If the HV returns, check the 503.5kHz oscillator frequency at pin 4 of the Horizontal Oscillator/Vertical Countdown IC (IC700), check voltages and waveforms on pins 1 thru 6, 8 and 14 of the Horizontal Oscillator/Vertical Countdown IC (IC700) and on the Horizontal Driver Transistor (Q401) and associated circuitry. If no HV appears, check the Horizontal Output Transistor (Q402), Damper Diode (SC415), Deflection Yoke (L402) and associated circuitry. Also check the Horizontal Output Transformer (T402) and check for shorted B+ sources from the Horizontal Output Transformer (T402) that could load down the horizontal circuit. Check the B+ sources rectified by Diodes SC527 and SC530. The HV Rectifier is part of the Horizontal Output Transformer (T402) and may be defective. Poor horizontal linearity or foldover may be caused by the condition of Capacitors C453, C456, C457 and C475 and by Damper Diode (SC415).

IF-AGC

Inject an IF signal at the IF input cable and check for picture information on the CRT. If picture is present, check tuners and tuner AGC and ACT(AFC) circuits. If picture is not present, check for a video waveform at the base of the 1st Video Amp Transistor (Q900). If the video waveform is present, refer to "Troubleshooting" Video circuit. If video waveform at the 1st Video Amp Transistor (Q900) is not present, apply AGC bias to Test Point AGC. If video returns, check the AGC section (pins 3, 4 and 14) of IF/AGC/ACT(AFC) IC (IC204). See the AGC voltage chart for AGC voltages with signal. If video doesn't return to base of 1st Video Amp Transistor (Q900), inject an IF signal at pin 16 of IF/AGC/ACT(AFC) IC (IC204) while monitoring the waveform at the base of the 1st Video Amp Transistor (Q900). If the correct waveform appears, check the voltages and associated circuits of the IF Preamp Transistor (Q200). If the correct waveform doesn't appear, check the voltages and associated circuits of the IF/ AGC/ACT(AFC) IC (IC204).

AGC VOLTAGE CHART

ITEM	PIN 3	PIN 4	PIN 14
IC204	7.05V	7.57V	7.66V

Note: Voltages taken using a Keyed-Rainbow generator.

AUDIO

Check the audio B+ voltage at the pin 14 of the Sound Detector/Power Amp IC (IC102). If voltage is not present, check the 25.0V source and associated circuitry at the Horizontal Output Transformer (T402). Inject a sound IF signal at pin 1 of Sound Detector/Power Amp IC (IC102). If audio is present, check the sound take-off circuitry from pin 12 of IF/AGC/ACT (AFC) IC (IC204) to pins 1 and 2 of Sound Detector/Power Amp IC (IC102). If audio is not present, check the Speaker (SP1), Plug PL100 and the voltages and circuitry on the Sound Detector/Power Amp IC (IC102).

VIDEO

Check CRT. Check voltages and waveforms on the Red, Green and Blue Driver Regulator Transistors (Q906, Q908 and Q910), the Red, Green and Blue Output Transistors (Q905, Q907 and Q909) and the CRT. To help determine defective stages, inject a video signal at the bases of the Video Driver Transistor (Q904) and Video Back Seat Driver Transistor (Q903), pin 12 of the Auto Video/Chroma Processor IC (IC900) and the bases of the 1st and 2nd Video Amp Transistors (Q900 and Q901). Check voltages and waveforms on the White Peak Detector Transistor (Q902). Check the horizontal and vertical blanking waveforms at pins 14, 15 and 16 of Auto Video/Chroma Processor IC (IC900). If any of the waveforms are not correct, check the associated circuitry.

TROUBLESHOOTING (Continued)

SYNC

Check B+ source voltages at the Sync Separator Driver Transistor (Q700), Sync Separator Transistor (Q701) and Vertical Sync Amp Transistor (Q702). Check for video waveforms at the base of the Sync Separator Driver Transistor (Q700) and Sync Separator Transistor (Q701). Check for vertical and horizontal sync pulses at the collector of the Sync Separator Transistor (Q701). Check for proper vertical waveforms at the base of the Vertical Sync Amp Transistor (Q702) and at pin 10 of the Horizontal Oscillator/Vertical Countdown IC (IC700). Check for proper horizontal waveform at pin 14 of the Horizontal Oscillator/Vertical Countdown IC (IC700).

VERTICAL

Inject a vertical signal at the emitter of the Vertical Buffer Transistor (Q302). If the vertical deflection returns, check the 503.5kHz oscillator frequency at pin 4 of the Horizontal Oscillator/Vertical Countdown IC (IC700) and the voltages and waveforms at pins 3 thru 6, 9, 11 and 12 of the Horizontal Oscillator/Vertical Countdown IC (IC700). Check voltages and waveforms at the Ramp Charger Transistor (Q300), Vertical Inverter Transistor (Q301) and Vertical Buffer Transistor (Q302). If the vertical is not present, check the Vertical Output IC (IC304) waveforms, voltages and associated circuitry. Check the Deflection Yoke (L402) for possible shorts or opens. Vertical linearity or foldover may be caused by vertical feedback and bias circuits. Check Diode SC308 and condition of Electrolytic Capacitors C318, C325, C324, C321 and C309. See the Resistance Measurements Chart for possible changes in feedback and bias circuitry resistance.

RASTER

Check CRT and CRT voltages. If the raster is magneta, check voltages and waveforms on the Chroma Demodulator IC (IC602), Green Driver Regulator Transistor (Q908) and Green Output Transistor (Q907). If the raster is yellow, check voltages and waveforms on the Chroma Demodulator IC (IC602), Blue Driver Regulator Transistor (Q910) and Blue Output Transistor (Q909). If the raster is cyan, check voltages and waveforms on the Chroma Demodulator IC (IC602), Red Driver Regulator Transistor (Q906) and Red Output Transistor (Q905).

COLOR

If there is no color or weak color, check the voltages and waveforms on pins 7, 8 and 9 of the Auto Video/Chroma Processor IC (IC900), Chroma Processor IC (IC600), 11.2V Regulator Transistor (Q600), input pins 3, 6, 7 and output pins 9, 11, 13 of Chroma Demodulator IC (IC602) and associated circuitry. If there is no color sync or incorrect hue, check the waveforms on pins 1, 8 and 9 of the Chroma Processor IC (IC600), the voltages on the Chroma Processor IC (IC600), pins 7, 8 and 9 of the Auto Video/Chroma Processor IC (IC900) and the 11.2V Regulator Transistor (Q600). Check the frequency of the 3.58MHz oscillator on pin 8 of the Chroma Processor IC (IC600). See Chroma Voltage Chart for chroma voltages with signal.

CHROMA VOLTAGE CHART

ITEM	PIN 6	PIN 7	PIN 8
IC600	8.44V	2.14V	8.38V
IC900		5.33V	2.69V
ITEM	PIN 9	PIN 11	PIN 16
IC600	.15V	8.48V	2.61V
IC900	1.15V		

NOTE: Voltages taken with Keyed-Rainbow generator.

HV AND 112-VOLT SHUTDOWN DEFEAT

To defeat the HV Shutdown circuit, remove Zener Diode SC409 from the circuit. If this doesn't defeat the HV Shutdown circuit, check HV Shutdown SCR (SCR412), Horizontal Oscillator Start-Up Transistor (Q400) and associated circuitry.

NOTE: Care should be taken in defeating the HV Shutdown circuit, as this may cause excessive high voltage and damage to the Horizontal Output Transformer (T402), CRT or other circuits supplied B+ from the Horizontal Output Transformer (T402). Monitor the high voltage, if it becomes excessive, do not defeat the HV Shutdown circuit. Use an isolation transformer with stepdown control for AC power supply to troubleshoot a set with excessive high voltage.

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements. Have your local distributor check Sams COUNTER FACTS® for the most up-to-date replacement.

CONTROLS (All wattages 1/2 watt, or less, unless listed)

ITEM No.	FUNCTION	RESISTANCE	MFR. PART No.	REPLACEMENT DATA		NOTES
				TRW PART No.		
# R108	Volume/Power On/Off Switch	12K	37-35105-35(1)			
R263	RF AGC Delay	5000	37-3015152-7	U260R502B		
R306	Vert Height	50K	37-3015152-9	U260R503B		
R318	Vert Linearity	50K	37-3015152-9	U260R503B		
# R481	Focus	25M	37-39627-7			
R521	B+ Adjust	1000	37-3015152-6	U260R102B		
R621	Color AGC Threshold	50K	37-3015152-9	U260R503B		
# R651	Tint	10K	37-3015871-8			
# R675	Color	10K	37-3015871-8			
# R911	Sharpness	10K	37-3015871-8			
# R913	Picture	5000	37-3015871-7			
R944	Brightness Range	10K	37-3015152-8	U260R103B		
# R946	Brightness	10K	37-3015871-8			
R960	Red Bias	50K	37-3015151-13	U260R503B		
R962	Red Drive	220	37-3015151-16	X201R251B		
R970	Green Bias	50K	37-3015151-14	X260R503B		
R972	Green Drive	220	37-3015151-17	X201R251B		
R980	Blue Bias	50K	37-3015151-15	X260R503B		
R982	Blue Drive	220	37-3015151-18	X201R251B		
R988	Master Screen	7.5M	37-3017000-3			

# For SAFETY use only equivalent replacement part.  
(1) Used in Chassis E31-1.

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFR. PART No.	SPRAGUE/ Q-LINE PART No.	WORKMAN PART No.
# R120	30 5% 2W Metal Oxide	35-553005-1		
# R124	4.7 5% 1W Metal Oxide	35-454795-6		
# R218	120 5% 3W Metal Oxide	35-651215-1		
# R336	18 5% 5W WW	36-40075-54		
R460	1000 5% 5W WW	36-40075-96		
# R500	2.7 5% 10W WW	36-3015511-2	243E1025	
R518	82.5K 1% 1/2W Metal Oxide			
R524	5110 1% 1/2W Metal Oxide			
R527	330 5% 5W WW	36-40075-84		
# R529	3.9 10% 15W WW	36-3015511-3		
# R627	270 5% 1W Metal Oxide	35-452715-6		22-3082
R740	16K 2% 1/4W Carbon Film		QUP-1254	
R900	1800 2% 1/4W Carbon Film		QUP-1208	22-2244
R902	620 2% 1/4W Carbon Film		QUP-1186	
R904	2000 2% 1/4W Carbon Film		QUP-1210	
R907	1000 2% 1/4W Carbon Film		QUP-1196	22-2241
R908	820 2% 1/4W Carbon Film		QUP-1192	22-2240
R916	LDR	38-43364-2(1)		
R979	3.6 5% 3W WW			
	3.6 5% 5W WW	36-40074-37		
# RT503	PTC 9 Cold	38-33206-4		FR605

# For SAFETY use only equivalent replacement part.  
(1) Used in Chassis E31-4.

COILS & TRANSFORMERS (Sweep Circuits)

ITEM No.	FUNCTION	REPLACEMENT DATA			
		MFR. PART No.	OTHER IDENTIFICATION	THORDARSON PART No.	TRIAD PART No.
# L402	Yoke Horiz 2mH 90° Vert 5mH	51-3017304-1			
T400	Horiz Driver	56-3015312-1	312-1		
# T402	Horiz Output	50-3017131-2			

# For SAFETY use only equivalent replacement part.

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements.  
Have your local distributor check Sams COUNTER FACTS for the most up-to-date replacement.

CAPACITORS (cont)

ITEM No.	RATING	MFR. PART No.	REPLACEMENT DATA		
			SPRAGUE PART No.		
			Q-LINE	GENERAL LINE	
C676	220 N750 50V 5%	45-41275-7	QCP-5166-01	10TCC-Q68	
C679	220 N750 50V 5%			431P2249R5	
C682	220 NPO 50V 5%			10TS-T33	
C700	68 NPO 50V 5%			10TS-T33	
C702	.22 50V 10%			5GA-D10	
C704	330 50V			431P1049R5	
C706	330 50V			10TS-D27	
C708	.001 50V			10TS-T47	
C710	.1 50V 10%		QCP-5198-01	5GA-S10	
C712	.0027 50V 10%			10TS-D10	
C714	.0018 50V 10%		QCP-6211-01	1FT-S47	
C716	470 50V			PP4-S81S	
C718	.01 50V			10TS-D10	
C722	130 NPO 50V 5%			10TS-D10	
C724	.001 50V 10%		QCP-5198-01	10TCC-Q47	
C726	.047 50V 10%			10TCC-Q33	
C728	.082 50V 5%			5GA-S10	
C730	.001 50V			10TCC-Q82	
C732	.001 50V			431P1049R5	
C900	47 NPO 50V 5%			10TS-D10	
C901	33 NPO 50V 5%			10TCC-Q33	
C902	47 N750 50V 5%			5GA-D18	
C903	220 N750 50V 5%	(1)		10TS-T33	
C904	220 N150 50V 5%	(1)		5GA-S10	
C910	470 50V			10TS-T47	
C911	150 N750 50V 5%	43-11028-22	QCP-5198-01	5GA-S10	
C918	220 N750 50V 5%			10TCC-Q82	
C919	.01 50V			431P1049R5	
C921	82 NPO 50V 5%			10TS-D10	
C924	.1 50V			10TCC-Q33	
C926	.001 50V			5GA-D18	
C928	33 NPO 50V 5%			10TS-T33	
C930	.01 500V			5GA-S10	
C932	330 50V 10%			10TS-T33	
C934	.01 500V			5GA-S10	
C936	330 50V 10%			10TS-T33	
C938	.01 500V			5GA-S10	
C940	330 500V 10%			10TS-T33	
C942	.01 2KV			10TS-T33	

# For SAFETY use only equivalent replacement part.  
(1) Used In Chassis E31-4.

COILS (RF-IF)

ITEM No.	FUNCTION	MFR. PART No.	ITEM No.	FUNCTION	MFR. PART No.
DL900	Delay Line	32-3017029-1	L600	Peaking (39uH)	50-41509-51
L104	Sound Take-Off	50-3017153-3	L603	Peaking (18uH)	50-43392-4
L108	Sound Detector	50-3017155-2	L606	Peaking (27uH)	50-41509-27
L200	Peaking (.68uH)	50-41509-7	L608	Peaking (68uH)	50-41509-31
L202	Video IF (.55uH)	50-3017153-1	L609	Peaking (27uH)	50-41509-27
L204	Video IF	50-3017155-1	L900	Peaking (10uH)	50-41509-22
L205	RF Choke (5.6uH)	50-15904-4	L902	Peaking (68uH)	50-41509-31
L206	Video Detector	50-3017153-2	L904	3.58MHz Trap (27uH)	50-3017154-1
L208	ACT (AFC)	50-3017153-2	L906	Peaking (3.3uH)	50-41509-15
L210	4.5MHz Trap	50-3017152-1	L950	RF Choke (5.6uH)	50-15904-4
L274	Peaking (100uH)	50-17985-7 (1)	L960	RF Choke (5.6uH)	50-15904-4
L401	RF Choke (220uH)	50-3017793-1	L970	RF Choke (5.6uH)	50-15904-4
L500	Line Filter	50-3017623-1			

# For SAFETY use only equivalent replacement part.  
(1) Used In Chassis E31-1.

CIRCUIT DESCRIPTION

HV AND 112V SHUTDOWN

If the high voltage becomes excessive, the 226V Source will also rise. When the 226V Source exceeds approximately 246V, Zener Diodes SC406, SC409 and SC410 will conduct causing the voltage to rise at the junction of Resistors R451 and R448. This voltage is applied to the gate of HV Shutdown SCR (SCR412) thru Resistor R448 turning HV Shutdown SCR (SCR412) On. The HV Shutdown circuit also monitors the 112V Source. If the 112V Source exceeds approximately 124V, Zener Diodes SC409 and SC410 will conduct and cause HV Shutdown SCR (SCR412) to turn On. When HV Shutdown SCR (SCR412) turns On, it grounds the base of the Horizontal Oscillator/Start Up Transistor (Q400) turning it Off. When the Horizontal Oscillator/Start Up Transistor (Q400) turns Off it removes the 8.62V from pin 9 of the Horizontal Oscillator/Vertical Countdown IC (IC700). This in turn kills the horizontal and vertical drive signals at pins 8 and 12 of Horizontal Oscillator/Vertical Countdown IC (IC700) to shutdown the TV.

VERTICAL AND HORIZONTAL COUNTDOWN

The vertical and horizontal drive signals are created by counting down from a 503.5kHz oscillator at pins 4, 5 and 6 of Horizontal Oscillator/Vertical Countdown IC (IC700) which is phased locked to the horizontal sync pulses coming in at pin 14 of Horizontal Oscillator/Vertical Countdown IC (IC700). The horizontal drive signal at pin 8 of Horizontal Oscillator/Vertical Countdown IC (IC700) is developed by feeding the 503.5kHz oscillator to a divide by 16 divider and a divide by 2 divider. The vertical drive signal at pin 12 of Horizontal Oscillator/Vertical Countdown IC (IC700) is developed by feeding the signal from the divide by 16 divider to a vertical timing counter which further divides the signal down to a vertical rate and compares it to the vertical sync pulses coming in at pin 10 of Horizontal Oscillator/Vertical Countdown IC (IC700) to keep proper vertical synchronization.

MISCELLANEOUS ADJUSTMENTS

B+ ADJUSTMENT

Tune in a TV station, set Brightness and Picture Controls for a moderate picture. Connect a DC meter to Pin 3 of SK506, adjust B+ Adjust Control (R521) for ±112V. Remove meter. NOTE: B+ Adjustment determines the remaining voltages in the set including high voltage. High voltage should measure 23.5KV ±5%.

RF AGC DELAY ADJUSTMENT

Tune in a TV station. Adjust RF AGC Delay Control (R263) fully clockwise, until snow (noise) appears in the picture, then adjust counterclockwise until the snow (noise) is minimized. Check all channels.

BRIGHTNESS RANGE ADJUSTMENT

Tune in a TV station. Set Picture Control to midrange, Brightness Control to Maximum and Color Control to MINIMUM. Adjust Brightness Range Control (R944) so that blacks in the picture are illuminated.

3.58MHz OSCILLATOR ADJUSTMENT

Connect a color bar generator to the antenna terminals, tune in a color bar pattern. Set Picture and Brightness Controls for normal viewing, Tint Control to midrange and Color Control to Maximum. Connect jumper leads from Test Points CL1 to CL2 and CL3 to CL4. Adjust 3.58MHz Oscillator Frequency Adjustment (C635) so that correct color bars stop or slowly drift in the picture. Remove jumpers.

COLOR AGC THRESHOLD ADJUSTMENT

Connect a color bar generator to the antenna terminals and tune in a color bar pattern. Set Picture Control to midrange and Color AGC Threshold Control (R621) to midrange. Connect a 47K Ohm resistor from Color AGC Test Point to 23.8V (A) supply. Connect a scope (low cap probe) from Pin 15 of IC600, low side to ground. Rotate Color Control to produce an 800mV p-p waveform on the scope. Remove the 47K Ohm resistor and adjust Color AGC Threshold Control (R621) for a 400mV p-p waveform.

COLOR TEMPERATURE ADJUSTMENT

Turn set on and set the tuner to an unused channel. Connect a jumper from Test Point (Vert Collapse) to nearest ground (CL2). Disconnect PL902 plug from SK902. Set Red (R960), Green (R970) and Blue (R980) Bias Controls to MINIMUM (counterclockwise). Set Master Screen Control (R988) to MINIMUM (counterclockwise). Set Red (R962), Green (R972) and Blue (R982) Drive Controls fully clockwise position. Adjust Master Screen Control until a horizontal line is just visible on the screen, observe the color of the line and adjust the two other Color Bias Controls to achieve a dim white horizontal line. Remove jumper, reconnect PL902 to SK902. Set Brightness and Picture Controls to midrange, adjust Drive Controls for the best black and white picture in the high light areas. NOTE: One Drive Control should remain fully clockwise, otherwise a degradation of contrast will be apparent.

3.58MHz TRAP ADJUSTMENT

NOTE: Normally factory adjusted. Should not be performed unless malfunction occurs. Connect a color bar generator to the antenna terminals and tune in a color bar pattern. Connect a scope to TP903 and adjust L904 for MINIMUM color information in the peaks of the color bar waveform.

CONVERGENCE ADJUSTMENTS CENTER CONVERGENCE

Connect a color bar generator to the antenna terminals and tune in a crosshatch pattern. Spread and rotate the Red/Blue Tabs (4 Pole) to converge the Red and Blue lines at the center of the screen. (Red/Blue Magnets are the center pair on the Convergence Assembly). Spread and rotate the Red/Blue on Green Tabs (6 Pole) to converge the Red/Blue line onto the Green line at the center of the screen. (Red/Blue on Green Magnets are the pair closest to the CRT socket).

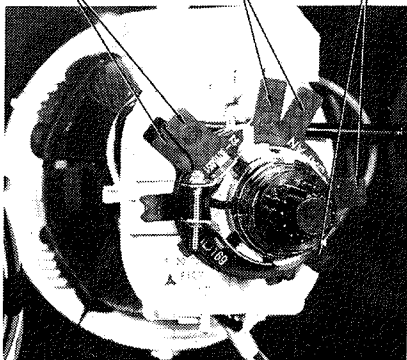
PERIMETER CONVERGENCE

Loosen the yoke clamp and tilt the yoke up and down, and side to side to converge the perimeter of the screen. Install wedges between the yoke and CRT at 2 o'clock, 6 o'clock and 10 o'clock positions. Tighten yoke clamp.

PURITY ADJUSTMENTS

Turn TV set on and allow a 10 minute warm-up time with Brightness Control set at normal level. Degauss CRT. Set channel selector to an unused channel. Set Bias Controls to MINIMUM (counterclockwise), Drive Controls to Maximum (clockwise), Master Screen Control to midrange. Adjust Red (R960) Bias Control to Maximum (clockwise), adjust Picture Control to MINIMUM (counterclockwise). Loosen the yoke clamp, remove wedges, slide the yoke full forward against the CRT funnel to produce a wide vertical Red area on the screen. Spread the 2 Purity Tabs and rotate (if necessary) (clockwise or counterclockwise) to produce a centered Red area on the screen. (The Purity Magnets are the pair closest to the CRT on the Convergence Assembly). Slide the yoke back to obtain a uniform Red screen. Insert wedges and tighten yoke clamp. Perform Convergence Adjustments if necessary.

RED/BLUE ON GREEN (6 POLE) TABS RED/BLUE (4 POLE) TABS PURITY TABS



CRT NECK ASSEMBLY

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

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CAPACITORS (cont)

ITEM No.	RATING	MFR. PART No.	REPLACEMENT DATA		
			SPRAGUE PART No.		
			Q-LINE	GENERAL LINE	
C233	82 N150 50V 5%	43-11028-27	QCP-5211-01	10TS-D10	
C236	.001 50V 10%			10TCC-Q47	
C237	47 NPO 50V 5%			10TS-D10	
C239	.001 50V 10%				
C240	82 N150 50V 5%			431P1049R5	
C303	.1 50V 10%			5GA-S20	
C312	.022 50V			431P1049R5	
C315	.1 50V 20%			431P2249R5	
C330	.22 50V 20%			192P2239R8	
C436	.022 50V 10%				
C438	10 1KV				
C440	.0022 50V			5GA-D22	
C445	.1 200V			2PB-P10	
C448	.0047 500V			5GA-D47	
C451	820 500V			10TS-T18	
C453	470 50V	10TS-T47			
C456	470 N2200 2KV				
	470 1.5KV	43-11028-28			
C457	.01 1.2KV 5%	45-33037-20			
C460	10 1KV 10%	43-11028-27			
C475	.47 200V 5%				
C500	.047 125V AC	45-29666-7			
C506	.001 1KV			10TS-D10	
C509	.001 1KV			10TS-D10	
C512	.001 1KV			10TS-D10	
C515	.001 1KV 10%			10TS-D10	
C519	.01 50V		QCP-5198-01	5GA-S10	
C525	.0068 500V		QCP-5188-01	5GA-D68	
C528	470 500V			10TS-T47	
C529	.001 500V			10TS-D10	
C531	.1 200V			2PB-P10	
C532	470 500V			10TS-T47	
C533	.001 50V			10TS-D10	
C534	.01 50V		QCP-5198-01	5GA-S10	
C537	.001 500V 10%			10TS-D10	
C541	.0022 500V		QCP-5172-01	5GA-D22	
C543	.001 500V			10TS-D10	
C603	22 NPO 50V			10TCC-Q22	
C606	47 NPO 50V 5%			10TCC-Q47	
C609	220 50V			10TCC-T22	
C612	.01 50V		QCP-5198-01	5GA-S10	
C618	.01 50V		QCP-5198-01	5GA-S10	
C621	.01 50V		QCP-5198-01	5GA-S10	
C624	.01 50V		QCP-5198-01	5GA-S10	
C626	.01 50V		QCP-5198-01	5GA-S10	
C629	33 NPO 50V 5%			10TCC-Q33	
C632	18 NPO 50V			10TCC-Q18	
C635	4-20pF Trimmer	42-43372-3			
C637	56 N150 50V				
C638	.01 50V		QCP-5198-01	5GA-S10	
C639	.01 1KV			10TS-D10	
C640	.1 50V			431P1049R5	
C641	68 NPO 50V 5%			10TCC-Q68	
C642	.1 50V			431P1049R5	
C643	330 50V			10TS-T33	
C644	.0022 50V		QCP-5172-01	5GA-D22	
C645	47 NPO 50V 5%			10TCC-Q47	
C647	100 NPO 50V 5%			10TCC-T10	
C650	.001 50V 10%			10TS-D10	
C653	220 50V			10TS-T22	
C656	68 NPO 50V 5%			10TCC-Q68	
C657	120 N150 50V 5%				
C659	68 NPO 50V 5%		10TCC-Q68		
C662	220 50V		10TS-T22		
C665	220 50V		10TS-T22		
C668	22 NPO 50V		10TCC-Q22		
C674	.001 50V		10TS-D10		

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements.  
Have your local distributor check Sams COUNTER FACTS for the most up-to-date replacement.

ELECTROLYTIC CAPACITORS

ITEM No.	RATING	MFR. PART No.	REPLACEMENT DATA		NOTES
			SPRAGUE PART No.		
			Q-LINE	GENERAL LINE	
C132	50 25V	41-32477-50	QCP-4158-01	TVA-1206	
C136	50 25V	41-32477-50	QCP-4158-01	TVA-1206	
C160	250 25V	41-32477-52	QCP-4250-01	TVA-1208*	
C164	1000 35V	41-32477-68	QCP-4284-01	TVA-1316	
C168	250 25V	41-32477-52	QCP-4250-01	TVA-1208*	
C215	50 16V	41-32477-36	QCP-4158-01	TVA-1150*	
C217	.33 50V	41-39148-63			
C242	10 50V NP	41-3017711-1 (1)	QCP-4148-01	TVAN-1304.1	
C245	5 25V	41-23765-5 (1)	QCP-4138-01	TVA-1203*	
C304	1 50V	41-43680-77	QCP-3107-01	EV-1615	
C306	47 25V		QCP-3154-01	EV-1426.1	
	250 25V	41-32477-52	QCP-4250-01	TVA-1208*	
C309	10 25V	41-43681-51	QCP-3132-01	EV-1422	
C318	1000 35V	41-32477-68	QCP-4284-01	TVA-1316	
C321	2 50V	41-43681-78	QCP-4110-01	TVA-1301*	
C324	250 25V	41-32477-52	QCP-4250-01	TVA-1208*	
C325	1000 35V	41-43599-8	QCP-4284-01	TVA-1316	
C442	50 16V	41-32477-36	QCP-4158-01	TVA-1150*	
C518A	750 200V	41-3017218-1			
B	22 200V				
C540	50 250V	41-43599-6			
C546	1000 35V	41-32477-68	QCP-4284-01	TVA-1316	
C615	1 50V	41-43682-77	QCP-3107-01	EV-1615	
C623	1 50V	41-43682-77	QCP-3107-01	EV-1615	
C720	1 50V	41-43681-77	QCP-3107-01	EV-1615	
C734	10 25V	41-43680-51	QCP-3132-01	EV-1422	
C906	1 50V	41-43680-77	QCP-3107-01	EV-1615	
C980	10 50V	41-43681-81	QCP-3132-01	EV-1622	
C912	25 25V	41-32477-48	QCP-4178-01	TVA-1205*	
C914	1 50V	41-43681-77	QCP-3107-01	EV-1615	
C916	1 50V	41-43681-77	QCP-3107-01	EV-1615	
C920	2 50V	41-43681-78	QCP-4110-01	TVA-1301*	
C922	3.3 50V	41-3015983-4	QCP-3118-01	EV-1618.1	

(1) Used in chassis E31-1.  
\* Axial replacement for radial device.

CAPACITORS

ITEM No.	RATING	MFR. PART No.	REPLACEMENT DATA		
			SPRAGUE PART No.		
			Q-LINE	GENERAL LINE	
C100	47 NPO 50V 5%			10TCC-Q47	
C104	12 NPO 50V 5%			10TCC-Q12	
C108	.0015 160V 2.5%		QCP-6112-01	6PS-D15	
C112	.047 50V		QCP-5236-01	TG-S50	
C116	.047 50V		QCP-5236-01	TG-S50	
C120	.01 50V 10%		QCP-5198-01	5GA-S10	
C124	.0082 50V 10%				
C128	120 N150 50V 5%			10TCC-T12	
C130	8.2pF NPO 50V ±.25				
C144	220 N750 50V 5%				
C148	.001 50V 10%			10TS-D10	
C152	.22 50V			431P2249R5	
C156	.1 50V 20%		QCP-5247-01	TG-P10	
C200	.001 50V 10%			10TS-D10	
C203	.01 50V 10%		QCP-5198-01	5GA-S10	
C206	.001 50V 10%			10TS-D10	
C212	.001 50V 10%			10TS-D10	
C216	.001 50V 10%			10TS-D10	
C218	.01 50V 10%		QCP-5198-01	5GA-S10	
C219	.001 50V 10%			10TS-D10	
C221	.001 50V 10%			10TS-D10	
C224	82 N150 50V 5%				
C227	1.8pF NPO 50V				
C230	1.8pF NPO 50V				

PARTS LIST AND DESCRIPTION

(When ordering parts, state Model, Part Number, and Description.)

Replacement parts shown may be superseded by the availability of newly introduced replacements.  
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WIRING DATA

High voltage Lead .....	Use BELDEN No. 9867 (30 KV)
Shielded Hook-up Wire .....	Use BELDEN No. 8401 or 8421 (Single-Conductor)
General-use Unshielded Hook-up Wire .....	8208 (Two-Conductor)
	8528 (Solid) Available in 13 Colors
	8522 (Stranded) Available in 13 Colors
300-Ohm Tuner Input Lead .....	Use BELDEN No. 8225
75-Ohm Tuner Input Lead .....	Use BELDEN No. 8241
300-Ohm Antenna Lead-in .....	Use BELDEN No. 8275 (Foam Core) or 8285 (Foam Jacketed)
Antenna Rotor Cable .....	8464 (Flat) or 8484 (Round) 4-Conductor
	8485 (Round) 5-Conductor
	8488 (Round) 8-Conductor

SEMICONDUCTORS (Select replacement transistor for best results)

ITEM No.	TYPE No.	MFR. PART No.	REPLACEMENT DATA						ZENITH PART No.	WORKMAN PART No.	MOTOROLA PART No.
			GENERAL ELECTRIC PART No.	NEW-TONE PART No.	RCA PART No.	ECG PART No.	THORDARSON PART No.	EGG PART No.			
IC102		15-3017045-1	GE-1232	TCG1231A	SK3852/1232	ECG1231A	TM1232	ECG1232	221-Z9041	WEP2150/1232	TDA2002AV
IC204		15-3015734-1	GE-1233	TCG1232	SK3158/797	ECG1232	TM797	ECG797	221-Z9154	WEP2045/797	
IC304		15-3015131-1		TCG797	SK3882/821	ECG821	TM821	ECG821			
IC602		15-41627-2		TCG821	SK9248						
					SK3919/822	ECG822	TM822	ECG822	221-Z9155	WEP956/229	MPSH34
IC700		15-3017119-1	GE-39*	TCG822	SK3246A/229	ECG229	TM229	ECG229	121-Z9021	WEP62/159	2N5401
IC900		15-41764-2	GE-82	TCG229	SK3466/159	ECG159	TM159	ECG159	121-Z9003	WEP736/123A	MPSA05
Q200		13-23824-1	GE-123AP	TCG159	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	MPSA05
Q300		13-3017150-1		TCG123AP	SK3232/191	ECG190	TM190	ECG190	121-Z9054	WEP749/190	MPSU10
Q301		13-3017149-1	GE-27	TCG123AP	SK3232/191	ECG28A	TM28A	ECG28A	121-Z9028	WEP854/191	MPSU10
			GE-38	TCG123AP	SK3710/238	ECG165	TM165	ECG165	121-1029	WEP740B/165	BU208
Q302		13-3017149-1	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	MPSA05
Q400		13-3017629-1	GE-123AP	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	
Q401		13-45018-1	GE-249	TCG190	SK3232/191	ECG190	TM190	ECG190	121-Z9000A	WEP736/123A	2N5401
Q402		13-43463-2	GE-27	TCG228A	SK3854/123AP	ECG28A	TM28A	ECG28A	121-Z9000A	WEP736/123A	MPSA05
Q500		13-43773-1	GE-58	TCG165	SK3710/238	ECG165	TM165	ECG165	121-Z9000A	WEP736/123A	MPSA05
			GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP			
Q502		13-29776-2	GE-82	TCG159	SK3466/159	ECG159	TM159	ECG159	121-Z9003	WEP62/159	
Q504		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	
Q600		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	MPSA05
Q700		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	MPSA05
Q701		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	ECG123AP	121-Z9000A	WEP736/123A	MPSA05



PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)  
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SEMICONDUCTORS (Select replacement transistor for best results) (cont)

ITEM No.	TYPE No.	MFR. PART No.	REPLACEMENT DATA						ZENITH PART No.	MOTOROLA PART No.
			GENERAL ELECTRIC PART No.	NEW-TONE PART No.	RCA PART No.	ECG PART No.	THORDARSON PART No.	WORKMAN PART No.		
Q702		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	WEP736/123A	121-Z9000A	MPSA05
Q900		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	WEP736/123A	121-Z9000A	MPSA05
Q901		13-29776-2	GE-82	TCG159	SK3466/159	ECG159	TM159	WEP62/159	121-Z9003	2N5401
Q902		13-29033-3	GE-62*	TCG123AP	SK3854/123AP	ECG123AP	TM123AP	WEP736/123A	121-Z9000A	MPSA05
Q903		13-29776-3	GE-82	TCG159	SK3466/159	ECG159	TM159	WEP62/159	121-Z9003	2N5401
Q904		13-39114-3	GE-63	TCG192+	SK3854/123AP	ECG192+	TM192+	WEP753/192	121-Z9014*	MPSU06
Q905		13-45321-1	GE-27	TCG171	SK3201/171	ECG171	TM171	WEP702/171	121-822	MPSU10
Q906		13-3015132-1	GE-264	TCG382*	SK3854/123AP	ECG382*	TM382*	WEP59/128	921-1114*	2N5681
Q907		13-45321-1	GE-27	TCG171	SK3201/171	ECG171	TM171	WEP702/171	121-822	MPSU10
Q908		13-3015132-1	GE-264	TCG382*	SK3854/123AP	ECG382*	TM382*	WEP59/128	921-1114*	2N5681
Q909		13-45321-1	GE-27	TCG171	SK3201/171	ECG171	TM171	WEP702/171	121-822	MPSU10
Q910		13-3015132-1	GE-264	TCG382*	SK3854/123AP	ECG382*	TM382*	WEP59/128	921-1114*	2N5681
SC100		13-3015735-1	GE5ZD-19	TCG5134A	SK3400/5134A	ECG5134A	TM5134A	WEP1628/5134	103-Z9003	1N5356A
SC200		13-33179-14	GEZD-12	TCG142A	SK3062/142A	ECG142A	TM142A	WEP1112/142	103-Z9003	1N4742A
SC300		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC302		13-33187-12	GEZD-5.6	TCG5011A	SK3777/5011A	ECG5011A	TM5011A	WEP1412/5011	103-Z9007	1N5232B
SC303		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC304		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC306		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC307		13-33187-31	GEZD-20	TCG5029A	SK3795/5029A	ECG5029A	TM5029A	WEP1431/5029	103-Z9023	1N5250B
SC308		13-41122-2	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC312		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC403		13-33187-38	GEZD-8.2	TCG5016A	SK3782/5016A	ECG5016A	TM5016A	WEP1417/5016	103-Z9019	1N5237B
SC404		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC405		13-29867-2	GE-300	TCG177	SK9091/177	ECG177	TM177	WEP1062/177	103-131	1N4935
SC406		13-33187-27	(1)							
SC409		13-33187-27	(1)							
SC410		13-33187-27	(1)							

PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)  
Replacement parts shown may be superseded by the availability of newly introduced replacements.  
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SEMICONDUCTORS (Select replacement transistor for best results) (cont)

ITEM No.	TYPE No.	MFR. PART No.	REPLACEMENT DATA						ZENITH PART No.	MOTOROLA PART No.
			GENERAL ELECTRIC PART No.	NEW-TONE PART No.	RCA PART No.	ECG PART No.	THORDARSON PART No.	WORKMAN PART No.		
SC411		13-45147-3	GE-533	TCG525	SK3925/525	ECG525	TM116	WEP177/525	212-Z9010	1N4003
SC415		13-39860-1	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC500		13-39860-1	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC503		13-39860-1	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC506		13-39860-1	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC509		13-39860-1	GE-504A	TCG116	SK3311	ECG116	TM116	WEP156	212-76-02	1N4003
SC512		13-3017630-1	GE-300	TCG5152A	SK3418/5152A	ECG5152A	TM177	WEP1650/5152	103-131	1N5374A
SC518		13-29867-1	GE-514	TCG177	SK9091/177	ECG177	TM519	WEP1062/177	103-131	1N4935
SC519		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC521		13-33187-39	GEZD-6.2	TCG5013A	SK3779/5013A	ECG5013A	TM5013A	WEP1414/5013	103-Z9008	1N5234B
SC524		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC527		13-43777-2	GE-511	TCG552	SK9000/552	ECG552	TM552	WEP152/552	103-287	MR1-1400
SC530		13-43956-2	GE-511	TCG552	SK9000/552	ECG552	TM552	WEP152/552	103-287	MR1-1400
SC600		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC603		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC700		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC702		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC704		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC706		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC900		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC904		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC906		13-29867-1	GE-300	TCG177	SK9091/177	ECG177	TM177	WEP1062/177	103-131	1N4935
SC907		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SC908	1N295	(1)	1N295	TCG109	SK3090/109	ECG109	TM109	WEP134/109	103-Z9001	1N295
SC909		13-17596-10	GE-514	TCG519	SK3100/519	ECG519	TM519	WEP925/519	103-131	1N4935
SCR412		13-18924-8		TCG5400	SK3950/5400	ECG5400		WEP6320/5400	185-Z9004	2N5060
SCR513		13-3017148-1		TCG5511	SK3683/5511	ECG5511			185-Z9011	

# For SAFETY use only equivalent replacement part.  
\* Lead configuration may vary from original.  
+ Rotate 180° to conform with original lead configuration.  
(1) Used in some versions.