BROADCAST TELEVISION EQUIPMENT

Color Bar Generator

MI-34001-C

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT CAMDEN, N. J.

IB—24957

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INSTRUCTIONS

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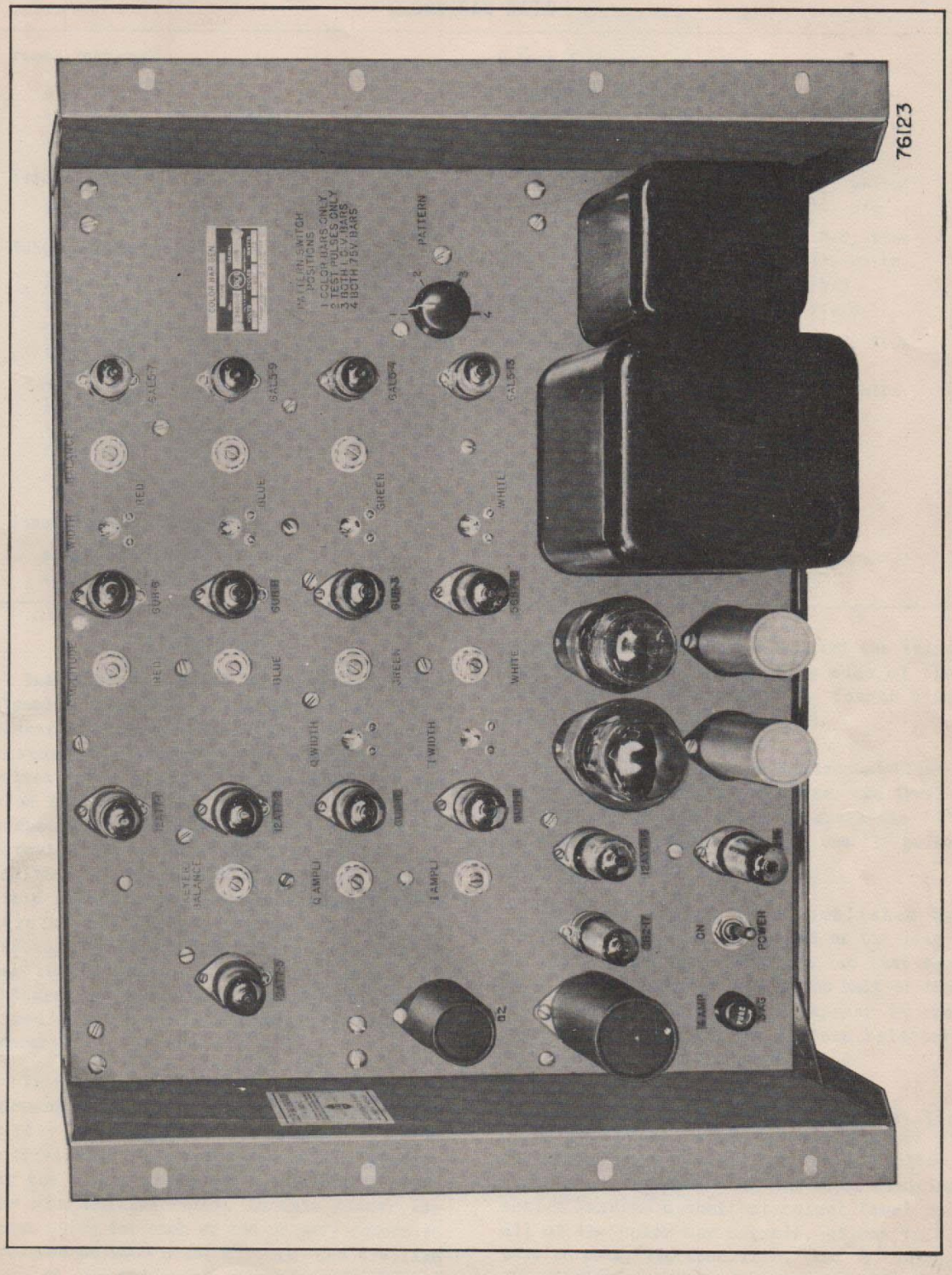


Figure 1 - Front View of Color Bar Generator, MI-34001-C

TECHNICAL DATA

Power Required

117 volts
60 cycles, single phase
135 watts

Fuse

4 amperes

Tube Complement

3 RCA 12AT7
5 RCA 6U8
4 RCA 6AL5
1 RCA 5687
1 RCA 6CL6
1 RCA 6AS7
1 RCA 12AX7
1 RCA 0B2
1 RCA 5V4

Input Signals Required

4 volts p/p Mixed Blanking
4 volts p/p Vertical Drive

Output Signals

Selector Switch	*Signals*
Pos. 1	Green, Red, Blue 1.0 volt p/p
Pos. 2	"Q", "I", White 1.0 volt, p/p
Pos. 3	Green, Red, Blue "Q", "I", White 1 volt p/p Split Field
Pos. 4	Green, Red, Blue 0.75 v p/p "Q", "I", White 1.0 volt p/p Split Field

Dimensions and Weight

Height - 14 inches
Width - 19 inches
Depth - 9 inches
Weight - 30 pounds

DESCRIPTION

The MI-34001-C Color Bar Generator is designed to facilitate adjustment of the colorplexer in a colored television transmitting system. It generates video waveforms or pulses which, when fed to the green, red and blue input circuits of the colorplexer - connected to a color monitor - cause the formation of a color bar test pattern. In addition, it is capable of providing a split field color bar pattern with standard color bars at the top of the raster, and two special "Q" and "I" test bars, and a white bar in the bottom half of the raster. An integral regulated power supply and stabilized circuit design insure stability of operation.

In operation, the trailing edge of the horizontal blanking pulse triggers the green multivibrator; the firing of the green multivibrator trips the red multivibrator, and the firing of the red multivibrator trips the blue multivibrator. In this manner the first pulse for each of the primary colors is produced on each color circuit. The trailing edge of the red pulse initiates the second blue pulse; the trailing edge of the green pulse triggers the second red and the third blue pulse, and the trailing edge of the second red pulse triggers the fourth blue pulse. Refer to figures 2 and 3.

The trailing edge of the horizontal blanking pulse initiates the "Q" pulse, the trailing edge of the "Q" pulse triggers the "I" pulse and the trailing edge of the "I" pulse triggers the white pulse.

Field splitting is accomplished by electronic switching, triggered by the leading edge of the vertical drive, so that the color bars will appear in the top half of the picture while the test bars appear in the lower half, whenever the pattern selector switch is in either position 3 or 4.

The equipment is so designed that the color bars occur in the descending order of their luminance content, i.e. white, yellow, cyan, green, magenta, red, and blue. Limiting action insures a constant output level for all of the color bar signals, of one volt, peak to peak. The special "Q" and "I" pulses are provided to simplify phase adjustment of the subcarrier signals. The white signal is

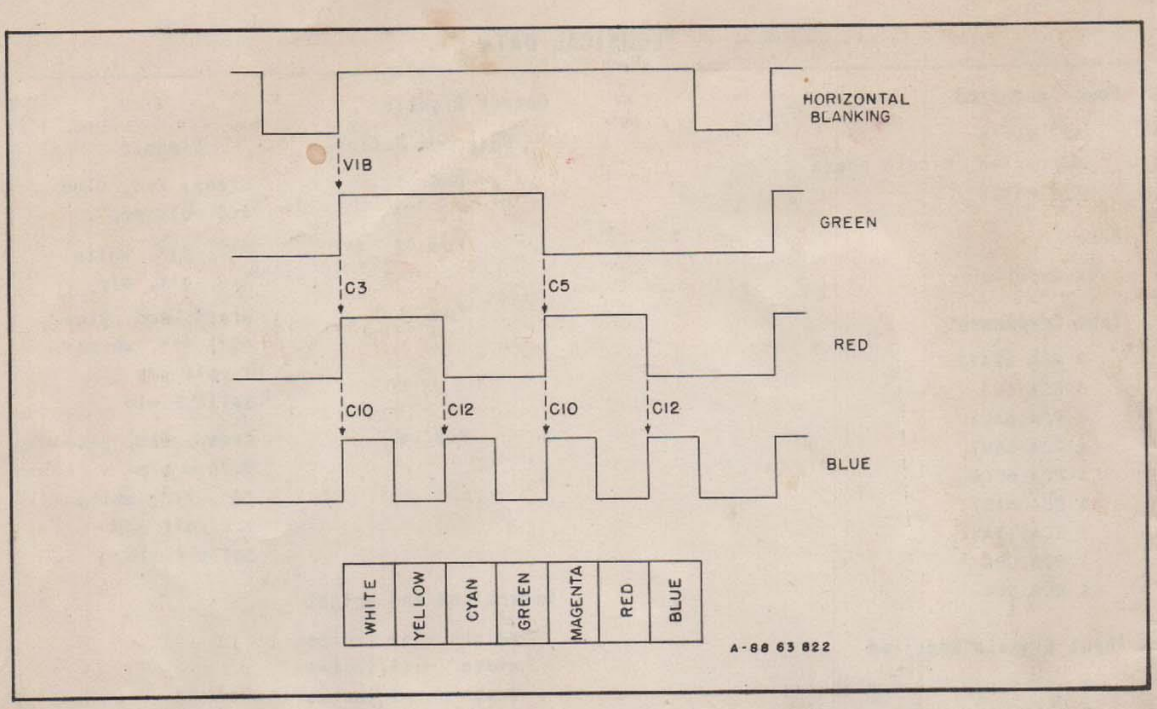


Figure 2 - Color Bar Pulses and Pattern

provided to facilitate white balance adjustments in the colorplexer.

A four position selector switch provides outputs as follows:

Position 1: Full raster - red, blue, and green output pulses at a one volt level.

Position 2: Full raster - "Q" and "I" pulses at a one volt level from separate output jacks, and a pulse of one volt level from each of the red, blue and green output jacks for producing a white signal.

Position 3: Half raster each - alternating - of the outputs provided by positions 1 and 2.

Position 4: Same pattern as position 3, except that the red, blue and green outputs are reduced to 0.75 volt or 75 percent of the higher level.

NOTE: The reduced level of the color bar outputs is provided to prevent overmodulation of the transmitter when using the bar pattern. At the higher level, saturated yellow would exceed 100 percent modulation.

The generator is assembled upon a bath-tub type chassis, 14 inches high designed to mount in a standard 19 inch rack. Input and output connectors are mounted on brackets in the rear of the chassis.

Circuit

Refer to the schematic diagram figure 6. Composite blanking arriving at J1 is the primary timing signal for the generation of the color bars. This signal is amplified by tube V1A (the grid of which is clamped to ground by diode CR1), differentiated by C2 and R6, and applied to the cathodes of tubes V1B and V2A. The polarity is such that the trailing edge of horizontal blanking produces a negative pulse at this point. With PATTERN switch S1 in position 1, COLOR BARS ONLY, the grid of tube V1B is connected to ground and the grid of tube V2A is biased negatively. The cathode of tube V1B is biased positively by R4 so that this tube conducts only during the negative pulses at the trailing edge of horizontal blanking. The biasing of tube V2A is such that it never conducts when switch S1 is in this position.

When the triode is non-conducting, a current is flowing through the output termination, through tube V4, and resistors R13 and R14 to the -80 volt supply. This current may be adjusted by R13 to be exactly the value which would produce minus one (1) volt across the output termination (approximately 13 ma). Then, when the multivibrator is triggered by tube V1B, conduction will be switched from the pentode to the triode section of tube V3, the triode will conduct enough current to cut off tube V4, which changes the current in the output termination by the same amount set by resistance R13, producing an output pulse of exactly one volt amplitude. This circuit depends only on the value of the negative plate supply voltage which is accurately regulated and not the tubes, so that the output signal level is very stable.

Timing of the multivibrator circuit is by the discharge of capacitor C4 through resistor R16 during the time when the triode section is conducting. This timing is also highly stabilized by the action of the current-regulating circuit in the cathode of the triode section.

When the PATTERN selector switch S1 is in the second position TEST PULSES ONLY, the biasing of tube V1B and tube V2A is such that tube V1B never conducts, and tube V2A amplifies the triggers. In this case, the color bar circuits are non-operative, and the "Q" multivibrator tube V10 is triggered. This circuit operates the same as one of the color bar multivibrators to produce an output on the "Q" test pulse line. Width is adjustable by capacitor C16 to be equal to the first color bar. The output of tube V10 triggers tube V11 in sequence, to produce the "I" test pulse. Similarly the trailing edge of the "I" test pulse triggers the white pulse multivibrator tube V12. This multivibrator is similar in operation to the others already described, but the output couples simultaneously to all three color lines so that exactly equal signals may be generated in all three colors.

The output of the white multivibrator is coupled from the cathode of tube V12A through the white balance controls and their respective diodes V4, V7, V9 to the three color bar outputs. The diodes only conduct during the white pulse, and they therefore do not interfere with the normal operation of the color bar circuits. However, during the white pulse these diodes connect the same pulse to all three outputs providing exactly corresponding signals. The amplitude of the three white pulses may be balanced to the same level by adjustable resistors R37, R42 and R52.

On the third position of S1, BOTH 1.0 V BARS, the operation of the color bar generator is switched electronically from color bars to test pulses in each field so that color bars appear in the top half of the raster, and test bars appear in the bottom half of the raster. All signal amplitudes are one volt. The electronic switching signal is generated by a 60-cycle square wave stabilized multivibrator tube V5 triggered by the leading edge of the vertical drive through tube V2B. The timing of the switching point is adjusted by resistor R26, the Keyer Balance Control.

The fourth position of PATTERN switch S1 provides the same test pattern as the third position except that the output level of the color bars is 0.75 volt. All other signals including the white test pulse remain at 1.0 volt. This is accomplished by shunting the termination resistance of the color bar outputs down to 56 ohms. The output of the white pulse circuit is increased by 25% to keep this level at 1.0 volt by shorting out resistors R99 - R100. The output waveforms of the color bar generator for this test pattern are shown in figure 3.

The amplitude controls on the "Q" and "I" test pulses may be adjusted on positions 2, 3 or 4, since these pulses do not change amplitude when S1 changes.

The power supply for the color bar generator uses tube V18 as the rectifier. Tube V15 is a conventional series regulator driven by the d.c. amplifier tube V16. Tube V17 is the voltage reference tube, connected so that the circuit regulates the -80 volts. The positive 205 volt supply is determined by the load current of the negative regulated supply and is shunt regulated slightly by tube V14.

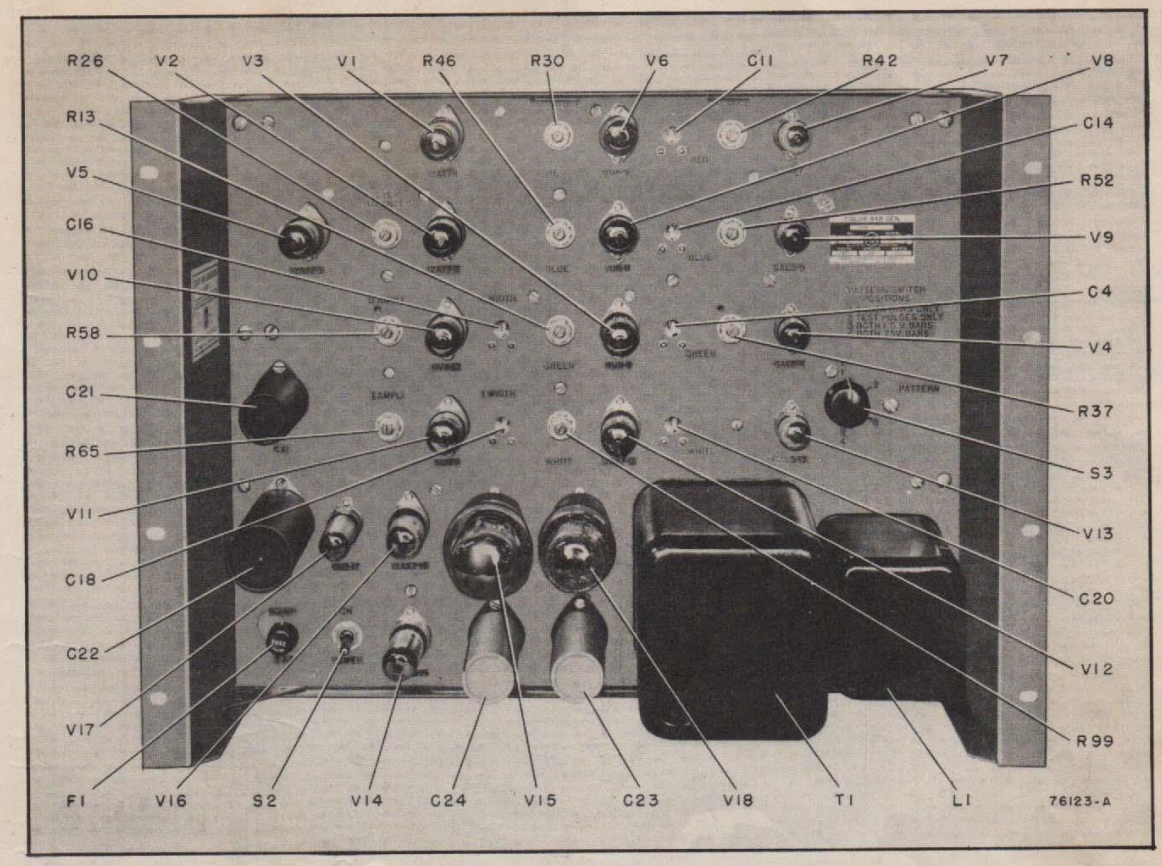


Figure 4 - Location of Parts (front view)

INSTALLATION

Mounting

The MI-34001-C Color Bar Generator may be mounted in any standard 19 inch rack; such as the RCA Type BR-84 (MI-30951 series) Cabinet Rack. The generator occupies 14 vertical inches of panel space.

Connections

All connections are made at the rear of the unit. Input connections are made to four bracket mounted connectors on the right hand side of the chassis - rear view. Connect blanking lines to the upper pair of connectors, and connect vertical drive lines to the lower pair.

Five output connectors are bracket mounted on the left side of the chassis. Connect these outputs to the corresponding receptacles on the colorplexer. Connect the two pronged male connector to a 117-volt 60-cycle single-phase current.

OPERATION

The generator may be turned on and off by a POWER switch, conveniently mounted at the lower left side, on the front of the chassis.

A four position PATTERN selector switch, mounted on the right of the chassis provides the following outputs:

Position	*Output*
1	Red, blue, and green output pulses at a one volt level. With the generator connected to a colorplexer and colored television monitor these pulses will produce colored bars occupying the full raster.

Position (Cont'd.)	*Output (Cont'd.)*
2	"Q" and "I" test pulses at a one (1) volt level from separate output jacks, and a pulse of one volt level from each of the red, blue and green output jacks. The three simultaneous color pulses constitute the white signal. Test bars occupy the full raster.
3	Combination of outputs provided by positions 1 and 2. Color bars occupy upper half of raster, and test bars the lower half.
4	Same as position 3, except red, blue and green outputs reduced to 0.75 volt.

SERVICE

Alignment of Color Bars

1. Refer to the schematic diagram figure 6. Set the pattern switch to the first, or COLOR BARS ONLY position.

2. Connect the GREEN OUTPUT to the input of a cathode ray oscilloscope.

3. Synchronize the oscilloscope with mixed blanking pulses.

4. Feed mixed blanking signal through a 500 mmf capacitor to the oscilloscope. This will serve to indicate the length of one line.

5. Adjust the oscilloscope so that the interval between the trailing edge and the

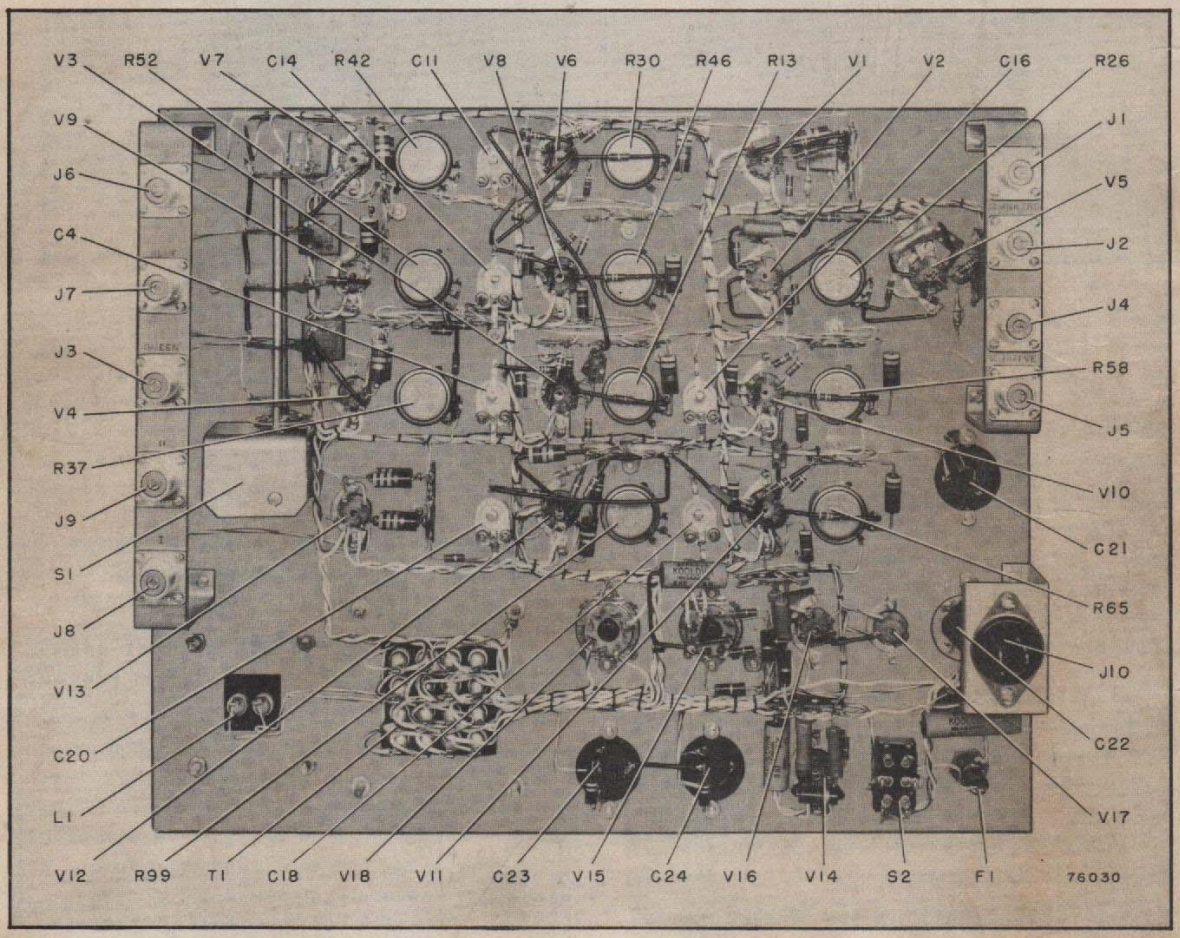


Figure 5 - Location of Parts (rear view)

leading edge of the horizontal blanking pulse equals seven (7) centimeters.

6. Adjust the green bar width - by C4 - to equal 4/7 of a line or four (4) centimeters.

7. Adjust the green bar amplitude - by R13 - to equal one (1) volt p/p.

8. Remove the GREEN OUTPUT, and connect the RED OUTPUT to the oscilloscope.

NOTE: Both red and green pulses may be fed, simultaneously, to a single trace oscilloscope if each signal is taken off its output through a 56 mmf capacitor. In all that follows this method of connecting two signals to the oscilloscope simultaneously is optional.

9. Adjust the red bar width - by C11 - to equal one-half (1/2) the width of the green pulse, or two (2) centimeters wide.

10. Adjust the red amplitude - by R30 - to equal one (1) volt p/p.

11. Remove the RED OUTPUT, and connect the BLUE OUTPUT to the oscilloscope, or connect both the RED and BLUE OUTPUTS to the oscilloscope through separate 56 mmf capacitors.

12. Adjust the blue bar width - by C14 - to equal one-half (1/2) the width of the red pulse, or one (1) centimeter wide.

13. Adjust the blue amplitude - by R46 - to equal one (1) volt p/p.

Alignment of Test Pulses

* see modification #1 page 4(1)

1. Set the PATTERN switch - S1 - to the third, or BOTH 1.0 V BARS (color bars and test pulses).

2. Remove the BLUE OUTPUT, and connect the "Q" OUTPUT to the oscilloscope, or connect both outputs to the oscilloscope through separate 56 mmf capacitors.

3. Adjust the "Q" bar width - by C16 - to equal the width of the blue pulse - one (1) centimeter.

4. Adjust the "Q" amplitude - by R58 - to equal one (1) volt p/p.

5. Remove the "Q" OUTPUT and connect the "I" OUTPUT to the oscilloscope. Alternatively, connect both BLUE and "I" OUTPUTS, through 56 mmf capacitors.

6. Adjust the "I" pulse bar width - by C18 - to equal the width of the blue pulse - one (1) centimeter.

7. Adjust the "I" amplitude - by R65 - to equal one (1) volt p/p.

8. Remove the "I" OUTPUT - and BLUE if connected - and connect the RED OUTPUT to the oscilloscope.

9. Adjust the WHITE BAR WIDTH - C20 - to equal the width of the red pulse - two (2) centimeters.

10. Adjust the WHITE BALANCE - R42 - on the red channel, so that the amplitude of the white pulse equals that of the red pulse.

11. Remove the RED OUTPUT and connect the BLUE OUTPUT to the oscilloscope.

12. Adjust the WHITE BALANCE - R52 - on the blue channel so that the white pulse amplitude equals that of the blue pulse.

13. Remove the BLUE OUTPUT and connect the GREEN OUTPUT to the oscilloscope.

14. Adjust the WHITE BALANCE - R37 - on the green channel, so that the white pulse amplitude equals that of the green pulse.

see modification #1 page 4

NOTE: There may be a slight change in the width of the pulses when the amplitude of the pulse is adjusted, However, once the amplitude is set properly, the width of the pulse may be changed without affecting the amplitude.

Fuse Replacement

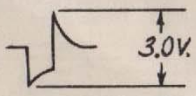
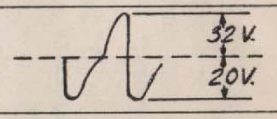
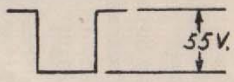
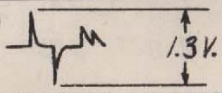
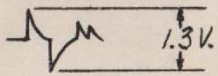
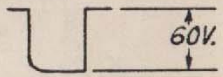
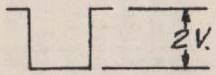
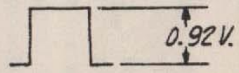
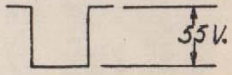
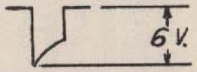
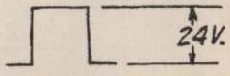
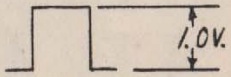
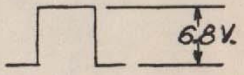
When replacing a blown fuse, make sure that the replacement fuse is of the same type and rating - four (4) amperes - as the one furnished with the generator.

Tube Check

Refer to the tables of tube voltages for typical tube operating voltages. Voltages should not vary more than five (5) percent from the indicated values.

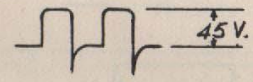
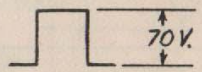
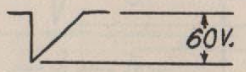
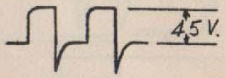
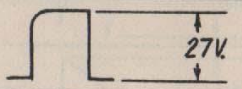
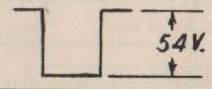
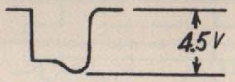
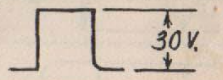
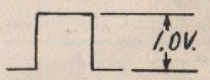
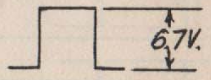
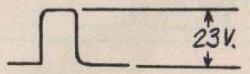
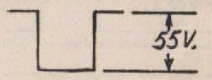
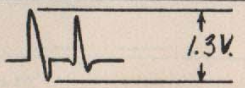
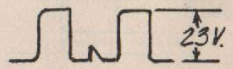
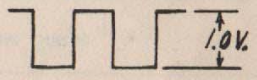
TUBE VOLTAGES

All but filament voltages are D.C. and to ground except where otherwise indicated.
Plate supply volts is 205 V, except 5V4 tube which has 580 V.A.C. plate to plate.
All filaments are 6.3 V.A.C. except 5V4 filament which is 5.0 V.A.C.

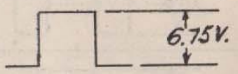
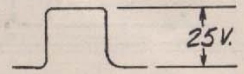
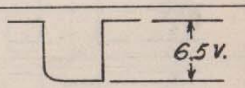
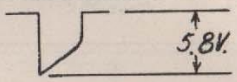
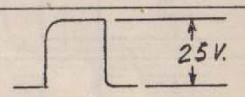
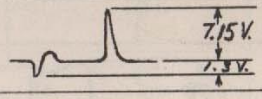
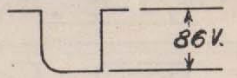
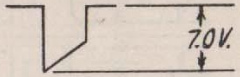
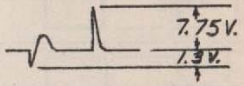
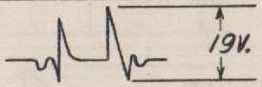
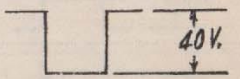
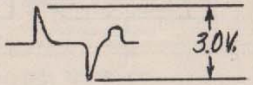
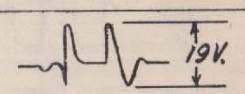
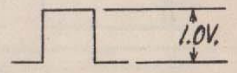
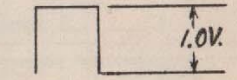
Tube	*Type*	*Designation*	*Plate Volts.*	*Cathode Bias. Volts.*	*Grid Fixed Bias. Volts.*	*Grid Leak Bias Volts.*	*Remarks. or. Wave Shape* Grid	Plate
V1A	12AT7	Amplifier	85	0.65	0.7	0		
V1B	12AT7	Amplifier	205	9.8	-37	0	① NO SIGNAL	
							② 	NO SIGNAL
V2A	12AT7	Amplifier	205	9.8	-15	0		
V2B	12AT7	Amplifier	170	4.0	0	0		— —
V3A	6U8	MV	200	-3.0	-12.5	0		
V3B	6U8	MV	-15	0	-19.5	-76		
V4A	6AL5	Clipper	-1	-2			— —	
V4B	6AL5	Clipper	-2.0	0			— —	

1. Selector Switch Position #1
2. Selector switch Position #2

TUBE VOLTAGES (Continued)

Tube	*Type*	*Desig-nation*	*Plate Volts.*	*Cathode Bias. Volts.*	*Grid Fixed Bias. Volts.*	*Grid Leak Bias. Volts.*	*Remarks or Wave Shape*	
							Grid	*Plate*
V5A	12AT7	MV	+165	+0.3	-24.5	0		
V5B	12AT7	MV	75	0	-21	-89		
V6A	6U8	MV	200	-2	-13	0		
V6B	6U8	MV	-15	0	-21.5	-80		
V7A	6AL5	Clipper	-1	0			— —	
V7B	6AL5	Clipper	-2	0			— —	
V8A	6U8	MV	210	-0.25	-14	0		
V8B	6U8	MV	-15V	0	-21	-76		
V9A	6AL5	Clipper	-1	-80			— —	

TUBE VOLTAGES (Continued)

Tube	*Type*	*Designation*	*Plate Volts.*	*Cathode Bias. Volts.*	*Grid Fixed Bias. Volts.*	*Grid Leak Bias. Volts.*	*Remarks or Wave Shape* Grid	Plate
V9B	6AL5	Clipper	-2	-2.1			— —	
V10A	6U8	MV	210	-2.8	-18	0		
V10B	6U8	MV	-20	0	-24	-76		
V11A	6U8	MV	210	-2.4	-19	0		
V11B	6U8	MV	-20	0	-20	-76		
V12A	5687	MV	205	6.8	-24	0		
V12B	5687	MV	-25	0	-2.4	-76		
V13A	6AL5	Clipper	-1	-76			— —	
V13B	6AL5	Clipper	-2	-76			— —	

TUBE VOLTAGES (Continued)

Tube	*Type*	*Desig-nation*	*Plate Volts.*	*Cathode Bias. Volts.*	*Grid Fixed Bias. Volts.*	*Grid Leak Bias. Volts.*	*Remarks or Wave Shape*	
							Grid	*Plate*
V14	6CL6		175	-0.15	-5.8	0	—— ——	—— ——
V15A	6AS7	VR	265	215	203	0	—— ——	—— ——
V15B	6AS7	VR	265	215	203	0	—— ——	—— ——
V16A	12AX7	Amplifier	25	0	-0.5	0	—— ——	—— ——
V16B	12AX7	Amplifier	200	0	-2.3	0	—— ——	—— ——
V17	OB2	Voltage Regulator	105	0			—— ——	—— ——
V18	5V4	Rectifier	580 plate to plate				—— ——	—— ——

Replacement Parts

The following parts list is included to provide identification when ordering replacement parts. Order from *RCA Replacement Parts Department, Camden, N.J.*, giving the *Description* and *Stock Number* of the parts wanted. Replacement parts supplied may be slightly different in form or size from the original parts, but will be completely interchangeable with them.

LIST OF PARTS

Symbol No.	*Description*	*Stock No.*
C1	Capacitor, mica, 4700 mmf, ±10%, 500 v	39668
C2	Capacitor, mica, 150 mmf, ±5%, 500 v	99652
C3	Capacitor, mica, 15 mmf, ±5%, 500 v	93943
C4	Capacitor, variable, ceramic trimmer, 7-45 mmf	54221
C5	Capacitor, mica, ~~47~~ 33 mmf, ±5%, 500 v	95320
C6	Capacitor, mica, ~~680~~ 270 mmf, ±5%, 500 v	39648
C7	Capacitor, mica, 1100 mmf, ±5%, 500 v	99667
C8	Capacitor, paper tubular .01 mf, ±10%, 400 v	94928
C9	Capacitor, mica, 470 mf, ±5%, 300 v	76992
C10	Same as C3	
C11	Same as C4	
C12	Same as ~~C5~~ 33mmf	
C13	Same as ~~C6~~ 68mmf	
C14	Same as C4	
~~C15~~	~~Same as C6~~	
C16	Same as C4	
C17	Same as C5	
C18	Same as C4	
C19	Same as C5	
C20	Same as C4	
C21	Capacitor, electrolytic, 20 mf, 450 v	32400
C22	Capacitor, dry electrolytic, 125 mf, 350 v	93406
C23,24	Capacitor, electrolytic, 40 mf, 450 v	37308
CR1,2, 3	Crystal, diode 1N34A	59395
F1	Fuse, 4 amp, 3 AG	95255
J1 to J9 Incl.	Connector, coaxial	51800
J10	Connector, 2 contact male A.C.	48743
L1	Reactor, iron core, 12 henries, 150 milliamps. d.c., 150 ohms resistance	99668
P1 to P9 Incl.	Plug, male connector	66344

Symbol No.	*Description*	*Stock No.*
R1	Resistor, composition, 1000 ohms, ±10%, 1/2 w	502210
R2	Resistor, composition, 2.2 meg, ±10%, 1/2 w	30649
R3	Resistor, composition, 22,000 ohms, ±10%, 2 w	522322
R4	Resistor, composition, 220,000 ohms, ±10%, 1/2 w	502422
R5	~~Resistor, composition, 100 ohms, ±10%, 1/2 w~~	502110
R6	Resistor, composition, 10,000 ohms, ±10%, 1/2 w	502310
R7	Same as R3	
R8	Resistor, composition, 15,000 ohms, ±10%, 1/2 w	36714
R9	Resistor, composition, 39,000 ohms, ±10%, 1/2 w	502339
R10	Resistor, composition, 3900 ohms, ±5%, 1/2 w	502239
R11	Resistor, composition, 470,000 ohms, ±10%, 1/2 w	502447
R12	Resistor, composition, 33,000 ohms, ±10%, 1/2 w	502333
R13	Resistor, variable carbon, ~~2500~~ 5000 ohms, ±10%	72523
R14	Resistor, composition, ~~4300~~ 4700 ohms, ±5%, 2 w	522243
R15	Resistor, composition, 3900 ohms, ±10%, 1 w	512239
R16	Resistor, composition, 2 meg, ±5%, 1/2 w	502520
R17	~~Resistor, composition, 4700 ohms, ±10%, 1/2 w~~	502247
R18	Resistor, composition, 47,000 ohms, ±10%, 2 w	44211
R19	Resistor, composition, 220 ohms, ±5%, 1/2 w	502122
R20	Same as R18	
R21	Resistor, composition, 1000 ohms, ±10%, 1/2 w	502210
R22	Resistor, composition, 22,000 ohms, ±10%, 1/2 w	502322
R23	Resistor, composition, 33,000 ohms, ±5%, 1/2 w	502333
R24	Same as R22	
R25	Resistor, composition, 820,000 ohms, ±5%, 1/2 w	502482
R26	Resistor, variable, carbon, 1 meg, ±10%	33709
R27	Same as R23	

LIST OF PARTS (Continued)

Symbol No.	Description	Stock No.
XV4	Socket, tube, 7 pin min.	94879
XV5,6	Same as XV1	
XV7	Same as XV4	
XV8	Same as XV1	
XV9	Same as XV4	
XV10, 11,12	Same as XV1	

Symbol No.	Description	Stock No.
XV13	Same as XV4	
XV14	Same as XV1	
XV15	Socket, tube, 8 pin	54414
XV16	Same as XV1	
XV17	Same as XV4	
XV18	Same as XV15	

R_{105} 47K 5-90

R_{106} 47K 5-90

CR4 1N34A
CR5 1N34A
CR6 1N34A
CR7 1N34A

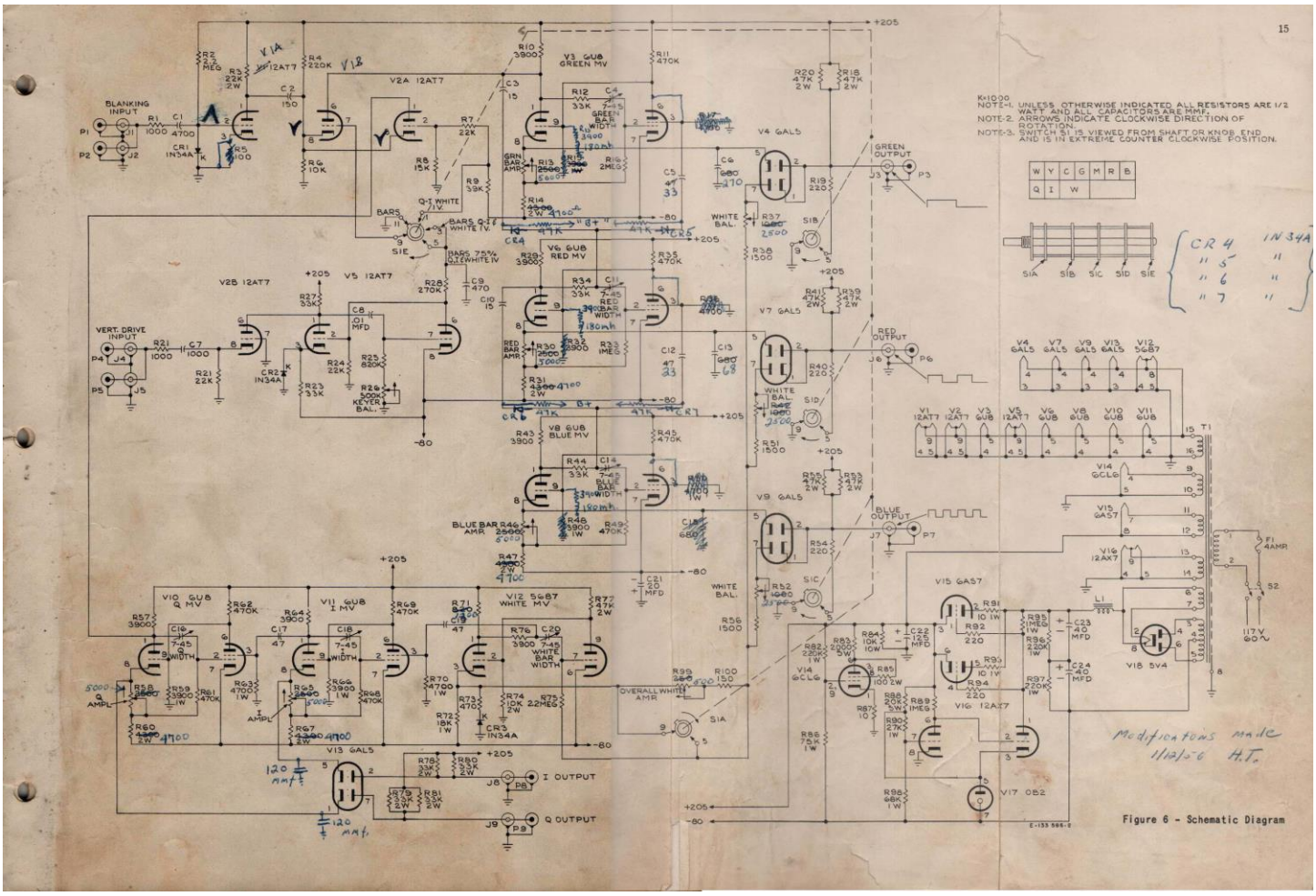
R_{107} 47K 5-90

R_{108} 47K 5-90.

L_1 - 180 mh

L_2 - 180 mh

L_3 - 180 mh.


K-1000
NOTE-1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/2 WATT AND ALL CAPACITORS ARE MMF.
NOTE-2. ARROWS INDICATE CLOCKWISE DIRECTION OF ROTATION.
NOTE-3. SWITCH S1 IS VIEWED FROM SHAFT OR KNOB END AND IS IN EXTREME COUNTER CLOCKWISE POSITION.
W Y C G M R B
Q I W
S1A S1B S1C S1D S1E
CR4 IN34A
" 5 "
" 6 "
" 7 "
BLANKING INPUT
VERT. DRIVE INPUT
V1A 12AT7
V1B
V2A 12AT7
V2B 12AT7
V3 6U8 GREEN MV
V4 6AL5
V5 12AT7
V6 6U8 RED MV
V7 6AL5
V8 6U8 BLUE MV
V9 6AL5
V10 6U8 Q MV
V11 6U8 I MV
V12 5687 WHITE MV
V13 6AL5
V14 6CL6
V15 6AS7
V16 12AX7
V17 0B2
V18 5V4
GREEN OUTPUT
RED OUTPUT
BLUE OUTPUT
I OUTPUT
Q OUTPUT
+205
-80
Modifications made 11/12/56 H.T.
Figure 6 - Schematic Diagram

RADIO CORPORATION OF AMERICA

ENGINEERING PRODUCTS DEPARTMENT CAMDEN, N. J.