GRATING GENERATOR

TYPE WA-3A

MI-30003-A

TEST AND MEASURING EQUIPMENT SECTION
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden, New Jersey, U.S.A.

IB-4003-6

ADDENDA TO INSTRUCTIONS IB-4003-6 FOR

Grating Generator

Type WA-3A

MI-30003-A

To correspond to the latest circuit improvements, modify instruction book IB-4003-6 as follows:

1. On page 1, under *Electrical Characteristics, Vertical Bars* substitute "40 bars" for "64 bars".

2. On page 2 under *Installation*, add the following:

"When the equipment is mounted directly over a power supply, an asbestos baffle should be placed directly under the grating generator to prevent direct flow of heat to components under the chassis."

3. On page 3, Figure 1, under *6AG5 Multivibrator*, delete "109 KC-1000 KC" and substitute "125 KC-835 KC". Also under *6SN7 Multivibrator*, delete "500-2500 cps" and substitute "720-2500 cps".

4. On page 4 delete figure 2, and paragraph starting with: "When the synchronizing input voltage is too high......"

5. On page 5, substitute the following for information in table headed *Vertical Bar MV:*

Range Switch Position	Multiple No. with Frequency Control at Minimum	Multiple No. with Frequency Control at Maximum
1	8	10
2	10	13
3	12	17
4	16	25
5	24	53

6. On pages 6 and 7, modify *Replacement Parts List* to include following information:

C-23 is changed to "Capacitor mica, 2200 mmf, 500 v, stock number 39660"

C-24 is changed to "Capacitor, mica 1000 mmf, 500 v, stock number 39652".

R-53 is changed to "Resistor, 10,000 ohms 1/2 w, ±10%".

7. On page 8, Figure 5, delete dashed line, and following note:

"First space too wide because of too high a level of vertical sync voltage."

8. Substitute schematic diagram included in this addenda for Figure 9 on page 13.

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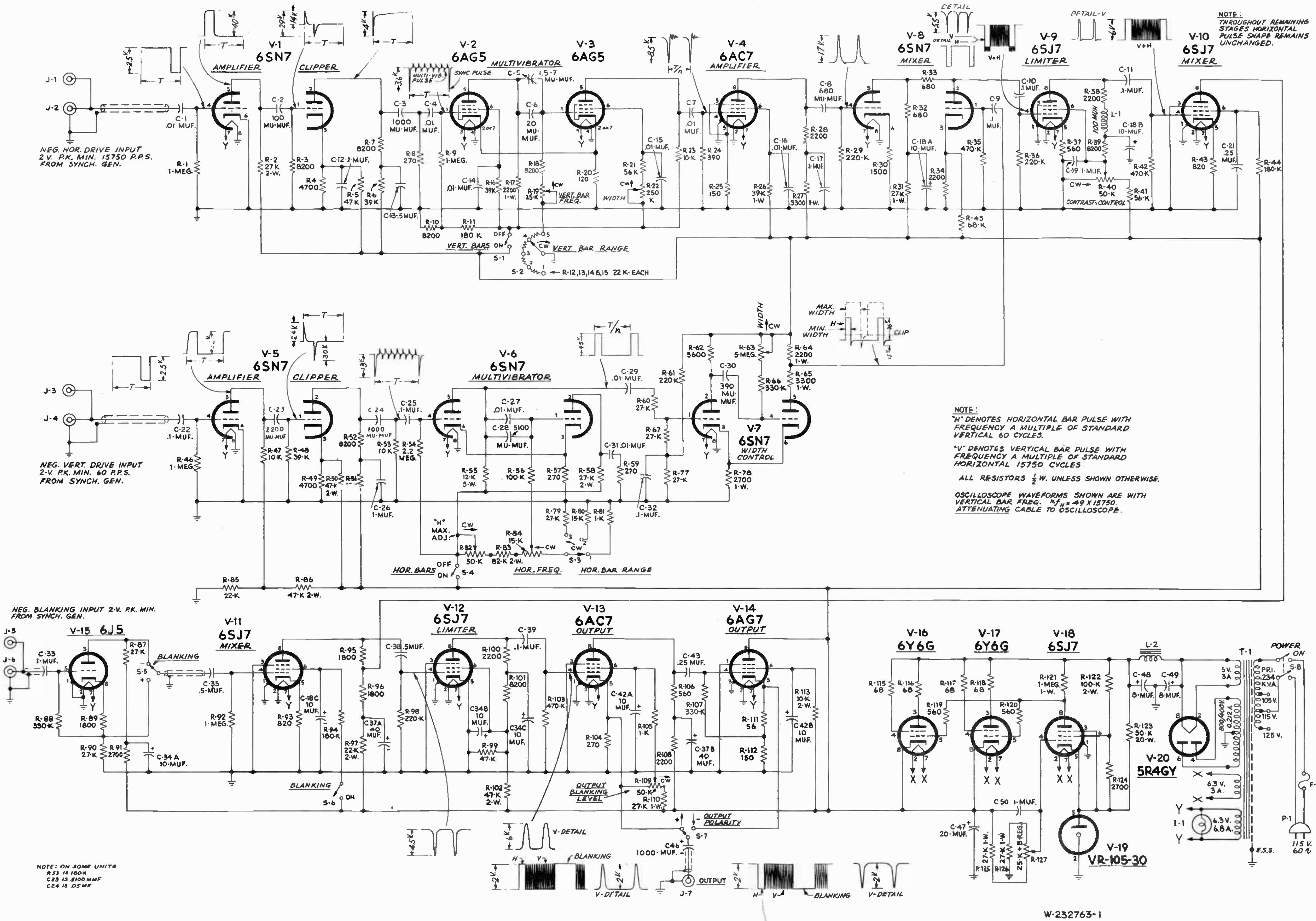

Figure 9A - Schematic
WA-3A Grating Generator

GRATING GENERATOR

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MI-30003-A

INSTRUCTIONS

TEST and MEASURING EQUIPMENT SECTION
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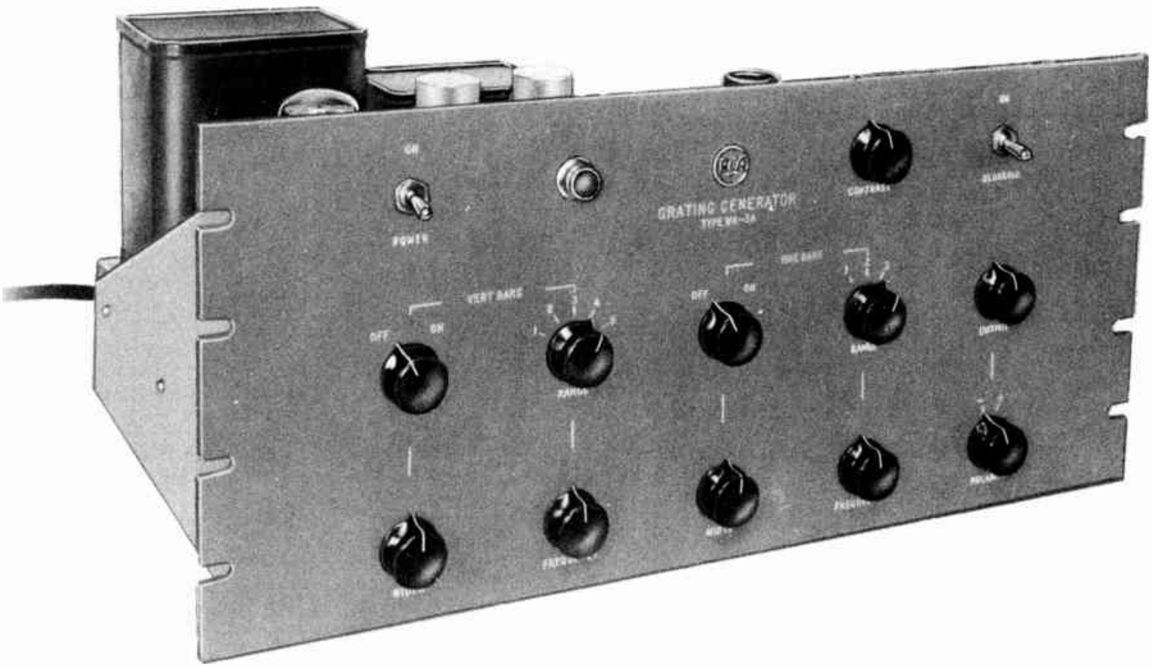

WA-3A Grating Generator, Front View

TYPE WA-3A GRATING GENERATOR

TECHNICAL SUMMARY

●

ELECTRICAL CHARACTERISTICS

Output . . . . Horizontal and vertical bar pulses combined with blanking pulses when desired. Adjustable from 0 to 2 volts peak to peak (75-ohm load).

Output Impedance . . . . 75 ohms

Output Polarity . . . . Positive or Negative

Required Synchronizing Signals . . Standard 60 cycle vertical and 15750 cycle horizontal synchronizing signals (2 volts minimum).

Blanking Signal. . . . . A standard television blanking signal (2 volts minimum) input circuit with polarity changing and mixing features is provided.

Horizontal Bars . . . . . . .Adjustable from 12 to 36 bars. Bar width adjustable to 10 percent of space between bars.

Vertical Bars. . . . . .Adjustable from 10 to 64 bars (minimum width control setting). Bar width adjustable to approximately 10 percent of space between bars.

Power Requirements . . . . .105-125 volts, 60 cycles, 175 watts

Tube Complement:

2	RCA 6SN7	Amplifier - Clipper
2	RCA 3AG5	Multivibrator
1	RCA 6SN7	Multivibrator
1	RCA 6AC7	Amplifier
1	RCA 6SN7	Mixer
2	RCA 6SJ7	Mixer
2	RCA 6SJ7	Limiter
1	RCA 6SN7	Horizontal Bar Width Control
1	RCA 6J5	Blanking Polarity Control
1	RCA 6AC7	Output and Blanking Level Control
1	RCA 6AG7	Output
2	RCA 6Y6G	Voltage Regulator
1	RCA 6SJ7	Regulator Control
1	RCA VR105-30	Voltage Regulator
1	RCA 5R4GY	Rectifier

MECHANICAL SPECIFICATIONS

Height	8 3/4 inches
Width	19 inches
Depth	14 inches
Weight	42 pounds
Finish	Umber Gray

DESCRIPTION

A uniform distribution of picture detail on the kinescope of a receiver or monitor requires a constant uniform velocity of scanning by the deflection circuits since this characteristic is standard in the operation of television cameras. If the scanning characteristic deviates from the standard, picture detail will be compressed over part of the area and expanded over the balance of the area of the kinescope. The WA-3A Grating Generator provides a convenient means for checking and adjusting the linearity of television deflection circuits.

The WA-3A Grating Generator generates a timing signal synchronized by standard television synchronizing pulses and injects this signal into the video circuit under test. The pattern produced on the kinescope has the appearance of a grating. The number of vertical bars is a multiple of the horizontal scanning frequency minus 15 - 18 percent which are lost during the horizontal blanking interval. The number of horizontal bars is a multiple of the vertical scanning frequency minus 7 - 8 percent which are lost during the vertical blanking interval. Separate switches are provided for independent operation of the horizontal bar, vertical bar and blanking signal circuits. Control of the bar pulse level independent of the output (blanking) level provides for contrast control.

Equal spacing between the vertical bars over the width of the raster shows linearity of scanning by the horizontal deflection circuit. Equal spacing between the horizontal bars over the height of the raster shows linearity of scanning by the vertical deflection circuit. See Figures 5, 6, and 7.

The effect of stray magnetic fields in the vicinity of the kinescope is shown by curvature of the bars.

Monoscope scanning linearity can be checked by injecting its signal and the grating generator signal into a monitor. The monoscope test pattern will have the grating pattern superimposed on it, and, with the horizontal and vertical bars set at a convenient number, the blocks of the test pattern will be subdivided by the bars. The same number of bars will divide each block equally when the scanning is linear.

Figure 1 shows a block diagram of the WA-3A Grating Generator.

A negative driving pulse of 15,750 cycles is amplified, clipped and differentiated to synchronize a multivibrator. With a pulse of short duration the multivibrator synchronizes over its entire range. The pulse output of this multivibrator which is the vertical bar signal is amplified and fed into a mixer stage.

A negative driving pulse of 60 cycles is amplified, clipped and differentiated to synchronize another multivibrator, the output of which is a multiple of 60 cycles. The multivibrator output is fed to a width control circuit where the pulse width can be adjusted to be 10 percent of the cycle over the entire frequency range. This pulse is the horizontal bar signal and is mixed with the vertical bar signal. The mixed signals are held to approximately equal levels by a limiter stage whose output can be adjusted to provide a range of contrast.

A standard blanking signal from the video sync generator is connected to a polarity control stage with output taken from the cathode or plate circuit (depending on the polarity desired). Separate tubes having a common load combined the blanking and bar signals. A limiter stage prevents the bar signal from exceeding the blanking signal level.

The output of positive polarity is taken from the cathode of one output stage, with coupling from its plate to a second output stage. The output of negative polarity is taken from the cathode of the second output stage.

INSTALLATION

The Type WA-3A Grating Generator is designed for mounting on a standard 19-inch rack. It may also be installed in a standard cabinet 21 inches x 10 1/2 inches x 15 inches. The power supply is self contained, and connected for operation at 115 volts. Terminals are provided on the power transformer for operation at 105 or 125 volts.

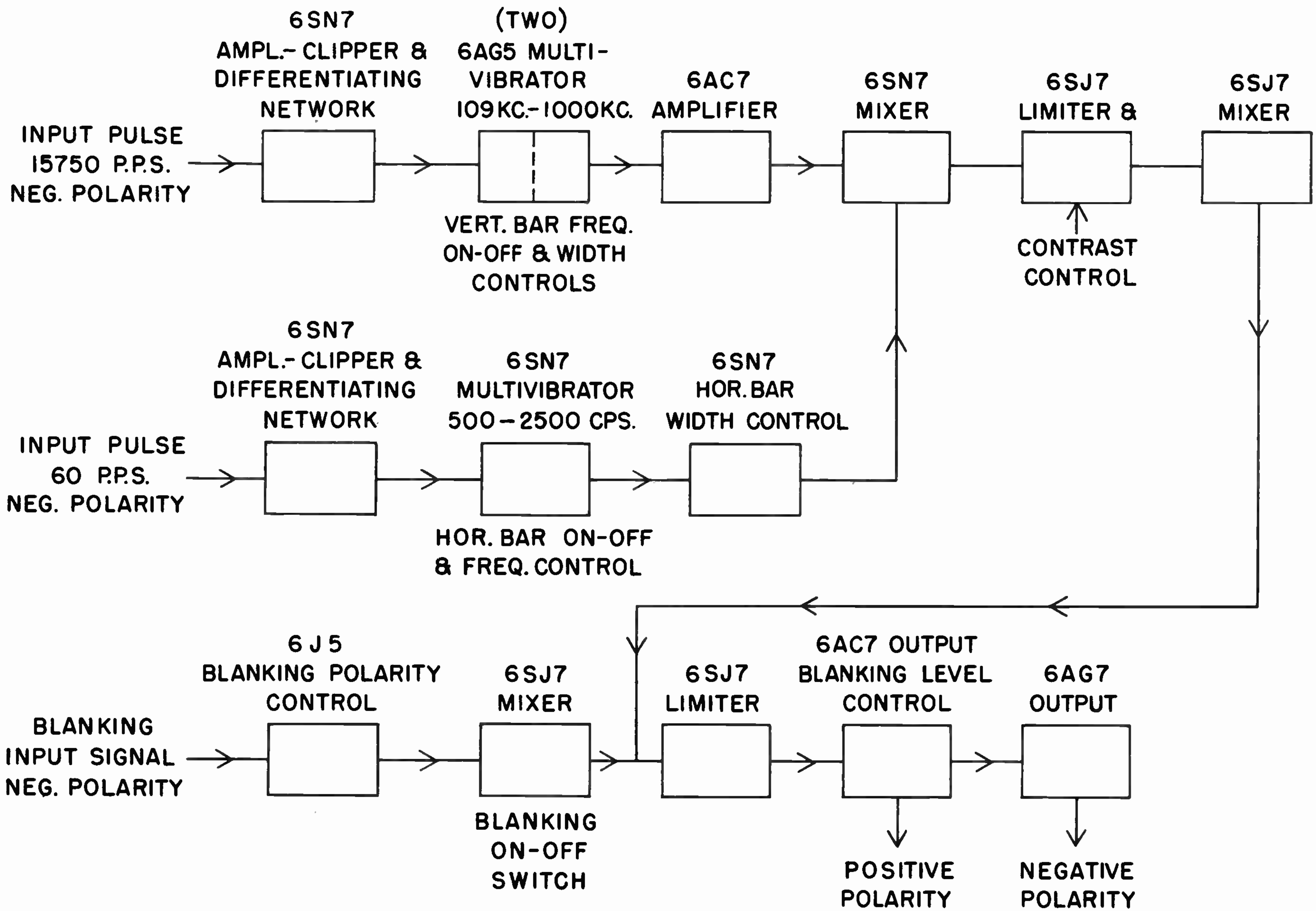

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Figure 1 - Block Diagram, WA-3A Grating Generator

OPERATION

The Type WA-3A Grating Generator is designed for use in a video signal test system. Signals of negative polarity consisting of a horizontal drive of 15,750 cycles per second, a vertical drive of 60 cycles per second, and mixed blanking are obtained from a video synchronizing signal generator and fed to the appropriate connectors at the rear of the WA-3A chassis. The output is connected to a distribution amplifier channel. The video synchronizing signal from the synchronizing generator is connected to a second distribution amplifier channel from a 75-ohm control with which the correct sync level can be adjusted. The output of the two distribution amplifier channels are connected together to provide a composite signal made up of grating, blanking and synchronizing signals. This composite signal is then connected to the input of each distribution amplifier channel serving a distribution line.

Television camera deflection linearity can be checked and adjusted in a similar manner by focusing the camera on a test chart.

Television receiver deflection linearity can be checked and adjusted by injecting the composite grating signal into the receiver video circuit or by remote pick-up of a transmitter modulated with the composite grating signal or grating signal and video test pattern superimposed.

For setting the linearity of monoscope camera and monitor equipment, the output of the WA-3A may be fed into one channel of a distribution amplifier, the monoscope camera fed into another channel and the output of the two channels from the distribution amplifier tied together and fed into the master monitor. To check the linearity of the monoscope camera it is necessary to adjust the master monitor linearity controls with the Grating Generator. Then adjust the monoscope linearity to conform. Field equipment may be preset by this method before remote pickup.

For a signal of standard negative polarity, with black bars, proceed as follows:

1. Turn "POWER" switch to "ON" and allow a short time for warm-up.
2. Turn the "CONTRAST" control fully counterclockwise.
3. Switch the output at the monitoring control switch panel to the monitor oscilloscope or to a separate oscilloscope.
4. Turn "BLANKING" switch to "ON" and adjust "OUTPUT" control until the output is between 1 and 2 volts. Blanking polarity should be set at the negative position at the rear of the chassis.
5. Adjust the sync signal level until it is 20 to 25 percent greater than the blanking level.
6. Turn "VERT. BARS" and "HOR. BARS" switches to "ON" and adjust the "CONTRAST" control until the bar level is nearly the same as the blanking level.
7. Switch the signal to the monitor and adjust the number of horizontal and vertical bars by means of the respective "RANGE" and "FREQ." controls. If the return trace is observed, the blanking and sync level should be increased until it disappears.

The width of the vertical bars can be adjusted and is usually satisfactory between 50 and 100 percent of the clockwise setting of the "WIDTH" control. This control affects the vertical bar frequency which necessitates readjustment of the "FREQ." control for the desired number of lines. The width of the horizontal bars can be adjusted to be equal to the width of the vertical bars. In some applications it may be desirable to produce white bars, in which case the "POLARITY" and "BLANKING" (rear of chassis) switches should be set at the "+" position.

In an application where a signal of positive polarity is desired the "POLARITY" switch should be set to the "+" and the "BLANKING" (rear of chassis) switch should be set to the "-" position.

When the grating signal is to be superimposed on a video test pattern, the "BLANKING" switch should be off.

When the synchronizing input voltage is too high the first space of the grating pattern may be wider than the succeeding spaces (see Figure 5). This can be corrected by inserting a sync level control at the WA-3A sync input circuit. A schematic of such a control is shown in Figure 2.

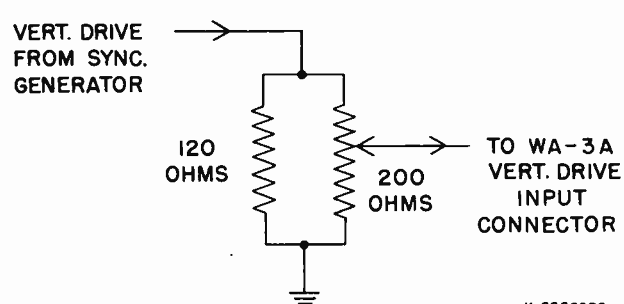


Figure 2
Sync Level Control

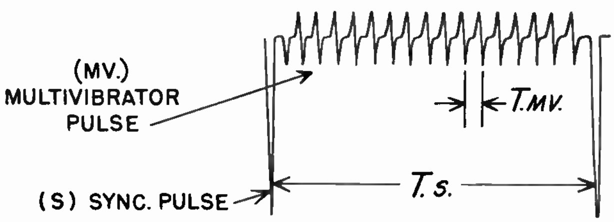
Each input signal circuit is brought out to two connectors at the rear of the chassis. When the generator is used at the end of a 75-ohm line which is normally terminated, remove the termination and connect the line to its respective input connector. To terminate the line connect one of the special 75-ohm terminating resistors (furnished with the WA-3A) to the other connector.

To use the generator at any point in a line, open the line and connect the ends to their respective input connectors.

MAINTENANCE

A schematic diagram of the WA-3A is shown in Figure 9.

A table of operating voltages is shown in Figure 8. All voltages are measured with the plate voltage supply set at 250 volts, and are measured to ground unless otherwise noted. Any abnormal deviation from the values indicated should be investigated and corrective steps taken.



$$f_{S.} = 15750 \quad \text{OR} \quad 60$$

$$f_{MV.} = 15750(N) \quad \text{OR} \quad 60(N)$$

$$T_{S.} = \frac{1}{f_{S.}} = \frac{1}{15750} \quad \text{OR} \quad \frac{1}{60}$$

$$T_{MV.} = \frac{1}{15750(N)} \quad \text{OR} \quad \frac{1}{60(N)}$$

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Figure 3
Frequency Check Pattern

The frequency range of the multivibrator can be checked by connecting a square wave generator set at 15750 or 60 cycles to the respective input circuits of the WA-3A. An oscilloscope is connected at the junction of the coupling capacitors between the clipper and the multivibrator. The pattern produced on the oscilloscope will be similar to that shown in Figure 3. The number of pips during one cycle T_s is the multiple of the sync frequency at which the multivibrator is operating, and depends mainly on the RC circuit values and operating voltages. The multiple of the synchronizing frequency for the vertical and horizontal multivibrator is approximately as given in Figure 4.

The percent blanking times the multiple number equals the number of bars which will be lost when observed on a monitor or receiver kinescope.

When circuit checking the WA-3A with an oscilloscope, a low capacity attenuating cable will be required for all high frequency vertical bar signals. The signal pattern on the oscilloscope should be as shown on the schematic (Figure 8). A check of the width control circuit with an oscilloscope will show whether the horizontal bar signal pulse width can be

VERTICAL BAR MV		
Sync. Freq. = 15750 cps Width Control at Minimum		
Range Switch Position	Multiple No. with Frequency Control at	
	Minimum	Maximum
1	9	12
2	11	14
3	14	19
4	19	29
5	29	67

HORIZONTAL BAR MV		
Sync. Freq. = 60 cps		
Range Switch Position	Multiple No. with Frequency Control at	
	Minimum	Maximum
1	12	27
2	25	36
3	33	43

Figure 4

adjusted to approximately 10 percent of the period at the minimum and maximum frequency. The pulse width range is determined largely by the coupling capacity (390 mmfd.), grid resistance and bias.

With an oscilloscope connected to the WA-3A output (75-ohm load) a 60 cycle square wave signal applied to the blanking signal input should show a good square wave response. The response is affected by RC coupling values and electrolytic capacity values.

REPLACEMENT PARTS LIST

GRATING GENERATOR
TYPE WA-3A

SYMBOL	DESCRIPTION	STOCK NO.
C-1, 4, 7, 14, 15, 16, 29, 31	Capacitor, paper, 0.01 mfd. 400 V	10610
C-2	Capacitor, mica, 100 mmf, 500 V	39628
C-3	Capacitor, mica, 1000 mmf, 500 V	39652
C-5	Capacitor, trimmer, 1.5-7 mmf	73685
C-6	Capacitor, ceramic, 20 mmf, 500 V, ±5%, 0 Temp. Coeff.	55086
C-8	Capacitor, mica, 680 mmf, 500 V	39648
C-9, 10, 11, 12, 17, 22, 25, 32, 33, 39	Capacitor, paper, 1 mfd, 400 V	10617
C-13, 35, 38	Capacitor, paper, 0.5 mfd, 400 V	10619
C-18, A, B, C	Capacitor, electrolytic, 10-10-10 mfd, 450 V	28113
C-19, 26	Capacitor, paper, 1 mfd, 400 V	56404
C-21, 43	Capacitor, paper, 0.25 mfd, ±10%, 400 V	70618
C-23, 28	Capacitor, mica, 5100 mmf, ±5%, 500 V	39669
C-24	Capacitor, paper, 0.05 mfd, 400 V	10615
C-27	Capacitor, mica, 0.01 mfd	
C-30	Capacitor, mica, 390 mmf, ±5%, 500 V	13513
C-34	Same as C-18	
C-37, A, B	Capacitor, electrolytic, 40-40 mfd, 450 V	52532
C-42, A, B	Capacitor, electrolytic, 10-10 mfd, 450 V	32342
C-46	Capacitor, electrolytic, 1000 mfd, 25 V	56956
C-47	Capacitor, electrolytic, 20 mfd, 450 V	55369
C-48, 49	Capacitor, electrolytic, 8 mfd, 600 V	50727
C-50	Capacitor, 1 mfd, 450 V	70620
F-1	Fuse, 3 amperes	10907
I-1	Lamp, 6.3 V	11891
J-1, 2, 3, 4, 5, 6, 7	Connector, chassis	51800
L-1	Coil, peaking	56954
L-2	Reactor	56407
	Clamp, elect. capacitor mounting	56957
	Clip, capacitor mounting	56955
	Connector, cable	65956
	Holder, Fuse	48551
	Knob	30075
	Light, pilot	48553
	Socket, miniature	53014
	Socket, octal	18008
	Termination (75 ohm)	54256
R-1, 9, 46, 92	Resistor, 1 meg., 1/2 W, ±10%	
R-2, 58	Resistor, 27000 ohm, 2 W, ±10%	
R-3, 7, 10, 18, 39, 52, 101	Resistor, 8200 ohm, 1/2 W, ±10%	

SYMBOL	DESCRIPTION	STOCK NO.
R-4,49	Resistor, 4700 ohm, 1/2 W, ±10%	
R-5,50,86,102	Resistor, 47,000 ohm, 2 W, ±10%	
R-6,16,48	Resistor, 39,000 ohm, 1/2 W, ±10%	
R-8,57,59,104	Resistor, 270 ohm, 1/2 W, ±10%	
R-11,44,53,94	Resistor, 180,000 ohm, 1/2 W, ±10%	
R-12,13,14,15,85	Resistor, 22,000 ohm, 1/2 W, ±10%	
R-17,64	Resistor, 2200 ohm, 1 W, ±10%	
R-19	Potentiometer, Carbon, 25,000 ohm	53091
R-20	Resistor, 120 ohm, 1/2 W, ±5%	
R-21	Resistor, 56,000 ohm, 1/2 W, ±10%	
R-22	Potentiometer, carbon, 250,000 ohms	53076
R-23,47	Resistor, 10,000 ohm, 1/2 W, ±10%	
R-24	Resistor, 390 ohm, 1/2 W, ±10%	
R-25,112	Resistor, 150 ohm, 1/2 W, ±10%	
R-26	Resistor, 39,000 ohm, 1 W, ±10%	
R-27,65	Resistor, 3300 ohm, 1 W, ±10%	
R-28,34,38,100, 108	Resistor, 2200 ohm, 1/2 W, ±10%	
R-29,36,61,98	Resistor, 220,000 ohm, 1/2 W, ±10%	
R-30	Resistor, 1500 ohm, 1/2 W, ±10%	
R-31,110,125,126	Resistor, 27,000 ohm, 1 W, ±10%	
R-32,33	Resistor, 680 ohm, 1/2 W, ±10%	
R-35,42,103	Resistor, 470,000 ohm, 1/2 W, ±10%	
R-37, 106	Resistor, 560 ohm, 1/2 W, ±10%	
R-40,82,109	Potentiometer, 50,000 ohm	44901
R-41	Resistor, 56,000 ohm, 2 W, ±10%	
R-43,93	Resistor, 820 ohm, 1/2 W, ±10%	
R-45	Resistor, 68,000 ohm, 1/2 W, ±10%	
R-51,99	Resistor, 47,000 ohm, 1/2 W, ±10%	
R-54	Resistor, 2.2 meg., 1/2 W, ±10%	
R-55	Resistor, 12,000 ohm, 5 W, ±10%	55549
R-56	Resistor, 100,000 ohm, 1/2 W, ±10%	
R-60,67,77,79, 87,90	Resistor, 27,000 ohm, 1/2 W, ±10%	
R-62	Resistor, 5600 ohm, 1/2 W, ±10%	
R-63	Potentiometer, carbon, 5 meg.	56958
R-66,88,107	Resistor, 330,000 ohm, 1/2 W, ±10%	
R-78	Resistor, 2700 ohm, 1 W, ±5%	
R-80	Resistor, 15,000 ohm, 1/2 W, ±10%	
R-81,105	Resistor, 1000 ohm, 1/2 W, ±10%	
R-83	Resistor, 82,000 ohm, 2 W, ±10%	
R-84	Potentiometer, 15,000 ohm	44974
R-89,95,96	Resistor, 1800 ohm, 1/2 W, ±10%	
R-91,124	Resistor, 2700 ohm, 1/2 W, ±10%	
R-97	Resistor, 22,000 ohm, 2 W, ±10%	
R-111	Resistor, 56 ohm, 1/2 W, ±10%	
R-113	Resistor, 10,000 ohm, 2 W, ±10%	
R-115,116,117,118	Resistor, 68 ohm, 1/2 W, ±10%	
R-119,120	Resistor, 560 ohm, 1 W, ±10%	
R-121	Resistor, 1 meg., 1 W, ±10%	
R-122	Resistor, 100,000 ohm, 2 W, ±10%	
R-123	Resistor, wire wound, 50,000 ohm, 20 W	49014
R-127	Potentiometer, 25,000 ohm	18277
S-1,4	Switch, SPST	56959
S-2,3	Switch, selector	56960
S-5,7	Switch, selector	52980
S-6	Switch, SPST	44376
S-8	Switch, DPST	17762
T-1	Transformer, power	56406

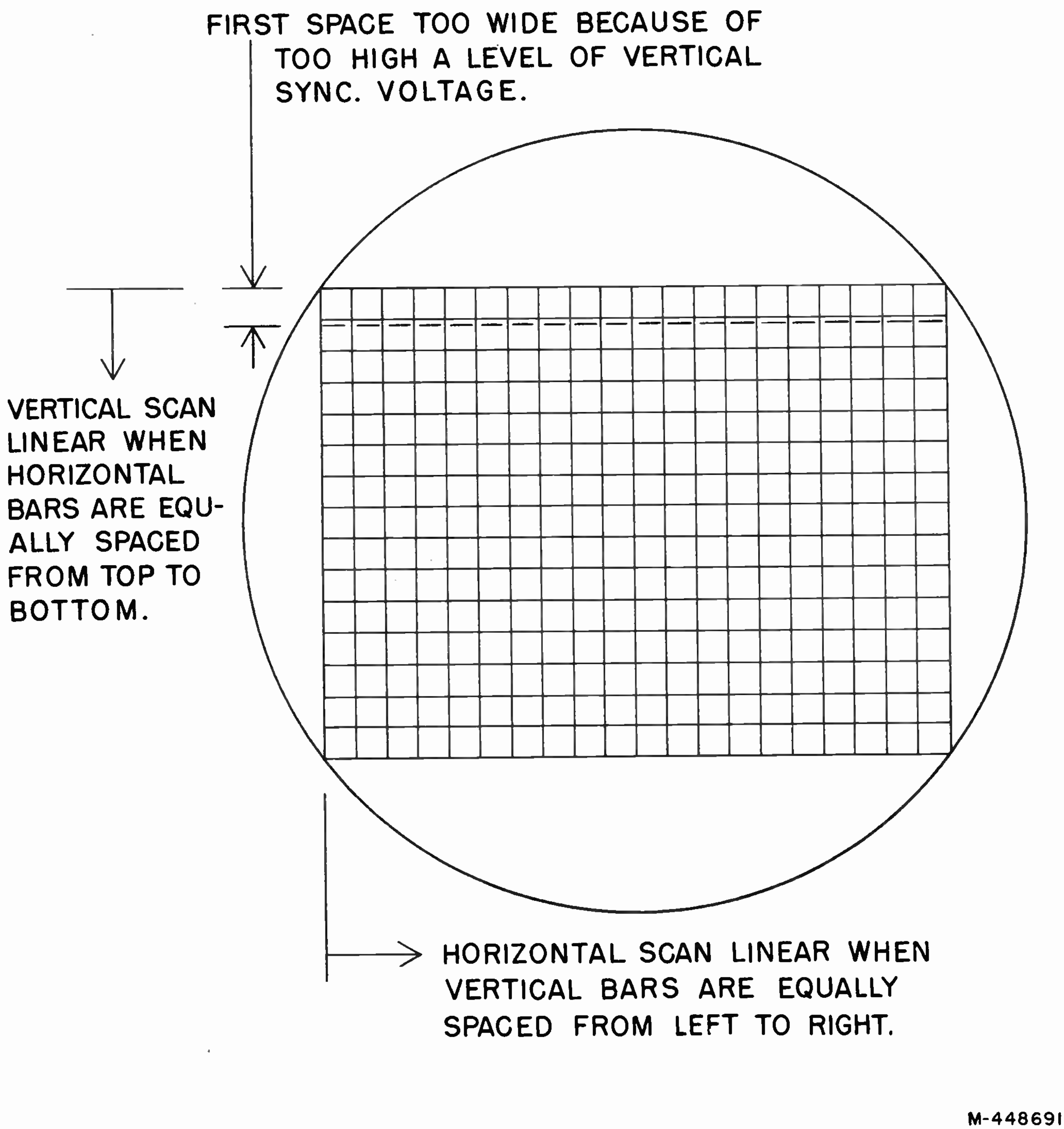

Figure 5
Grating Pattern on Kinescope with Linear Horizontal and Vertical Deflection

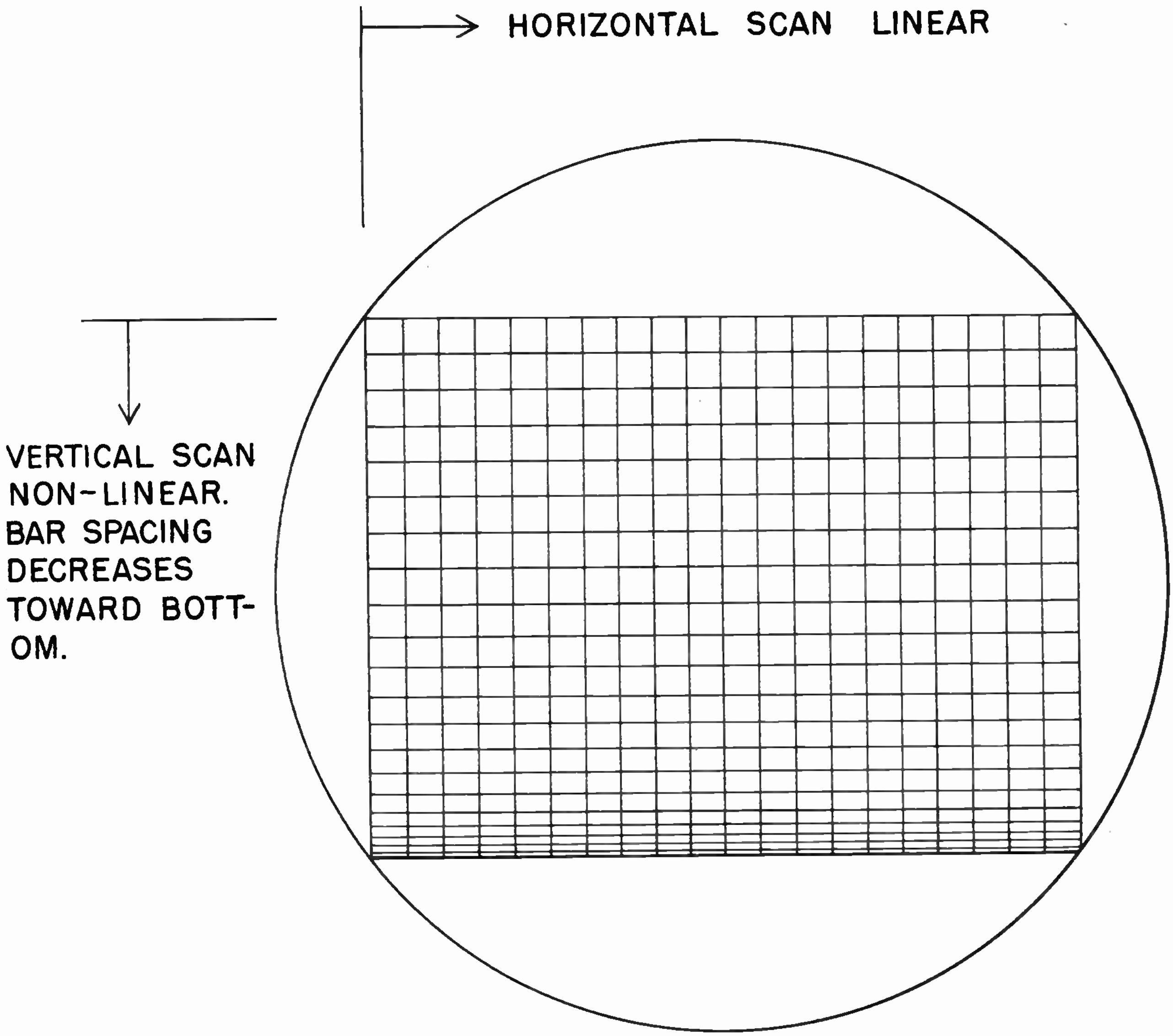

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Figure 6
Non-linear Vertical Deflection
Checked by Horizontal Bar Spacing

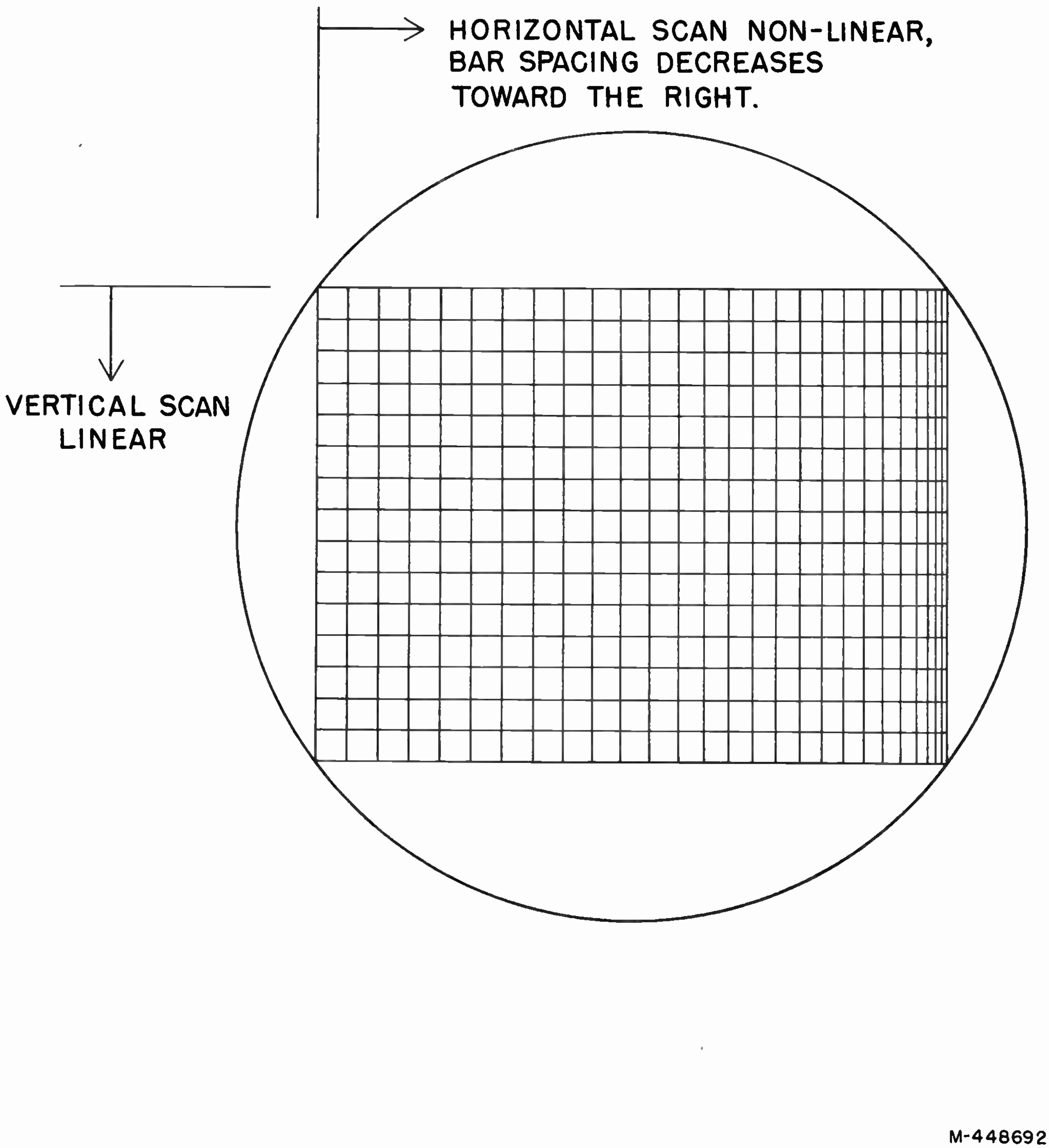

Figure 7
Non-linear Horizontal Deflection Checked by Vertical Bar Spacing

OPERATING VOLTAGES AS MEASURED WITH BAR SWITCHES OFF, OTHER SWITCHES ON.

All Controls Clockwise Except Where Indicated.

Δw *Denotes change of width control from clockwise position.*

Δf *Denotes change of frequency control from maximum to minimum.*

TUBE	TYPE	TERMINALS	PLATE	SCREEN	CATHODE	
V-1	6SN7	4-5-6 1-2-3	68 245		- 20	
V-2	6AG5		225	120	See V-3	Vertical Bar Switch on while measuring
V-3	6AG5		Δw ← 180-225 Δf ← 180-210	Δw ← 145-80 Δf ← 145-190	Δw ← 2.7-2.1 Δf ← 2.7-2.2	Voltages of V-2 and V-3
V-4	6AC7		180	160	2.2	
V-5	6SN7	4-5-6 1-2-3	34 240		21.5	
V-6	6SN7	4-5-6 1-2-3	Δf ← 105-100 Δf ← 150-185		Δf ← 4-4.5	Horizontal Bar Switch on while measuring voltages of V-6
V-7	6SN7	1-2-3 4-5-6	245 Δw ← 155-160		Δw ← 40-45	
V-8	6SN7	4-5-6 1-2-3	140 145		5 7.8	
V-9	6SJ7		36	54	1.5	
V-10	6SJ7		175	100	3.2	
V-11	6SJ7		100	88	2.8	
V-12	6SJ7		20	45		
V-13	6AC7		230	145	2.5	
V-14	6AG7		250	140	* 2.4	* (Grid to Cathode)
V-15	6J5		175		* 3.8	* (Grid to Cathode)

Figure 8 - Table of Socket Voltages

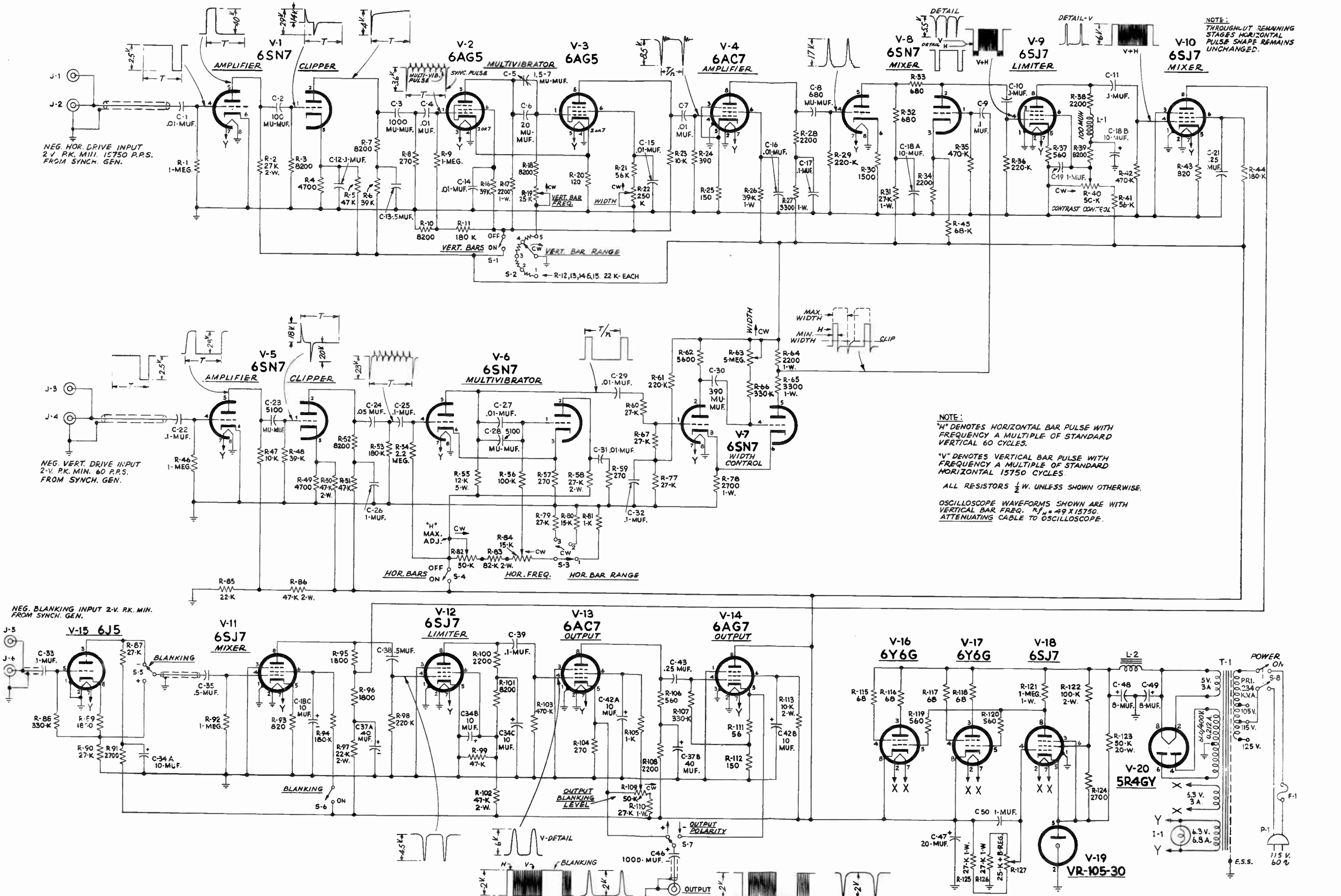

Figure 9 - Schematic
WA-3A Grating Generator

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