VIDEO SWEEP GENERATOR

WA-21A

RADIO CORPORATION OF AMERICA

Camden, New Jersey, U. S. A.

IB-40211-2

ADDENDA TO IB-4021-2

TO INCLUDE

TYPE WA-21B VIDEO SWEEP GENERATOR

MI-30021-B

Information pertaining to the Type WA-21A Video Sweep Generator included in instruction book IB-4021-2 also applies to the Type WA-21B Equipment, with the following changes:

1. Under *Tube Complement,* opposite *Video Amplifier* (page 4) change "1 RCA-6C4" to "1 RCA-6J6." Also, opposite *Video Amplifier* change "2 RCA-6AG5" to "2 RCA-6AH6."

2. Under *Circuit Description, Mixer* (page 9) substitute "RCA-6J6" for "RCA-6C4."

3. In Figure 13 (page 12) change the symbol number of the Adjustment marked "L21," to "L28," and delete adjustment "C88."

4. Delete the entire section headed *Adjustment of the Modulation Capacitor,* including figures 15, 16 and 17 (pages 13, 14 and 15).

5. Under *Aligning the Video Amplifier,* on page 15, change "L21" to "L28."

6. Use the following *Replacement Parts List* and *Schematic Diagram* instead of those in the instruction book.

7. Refer to *Connection Diagram* in this addenda for wiring and parts location.

PARTS LIST

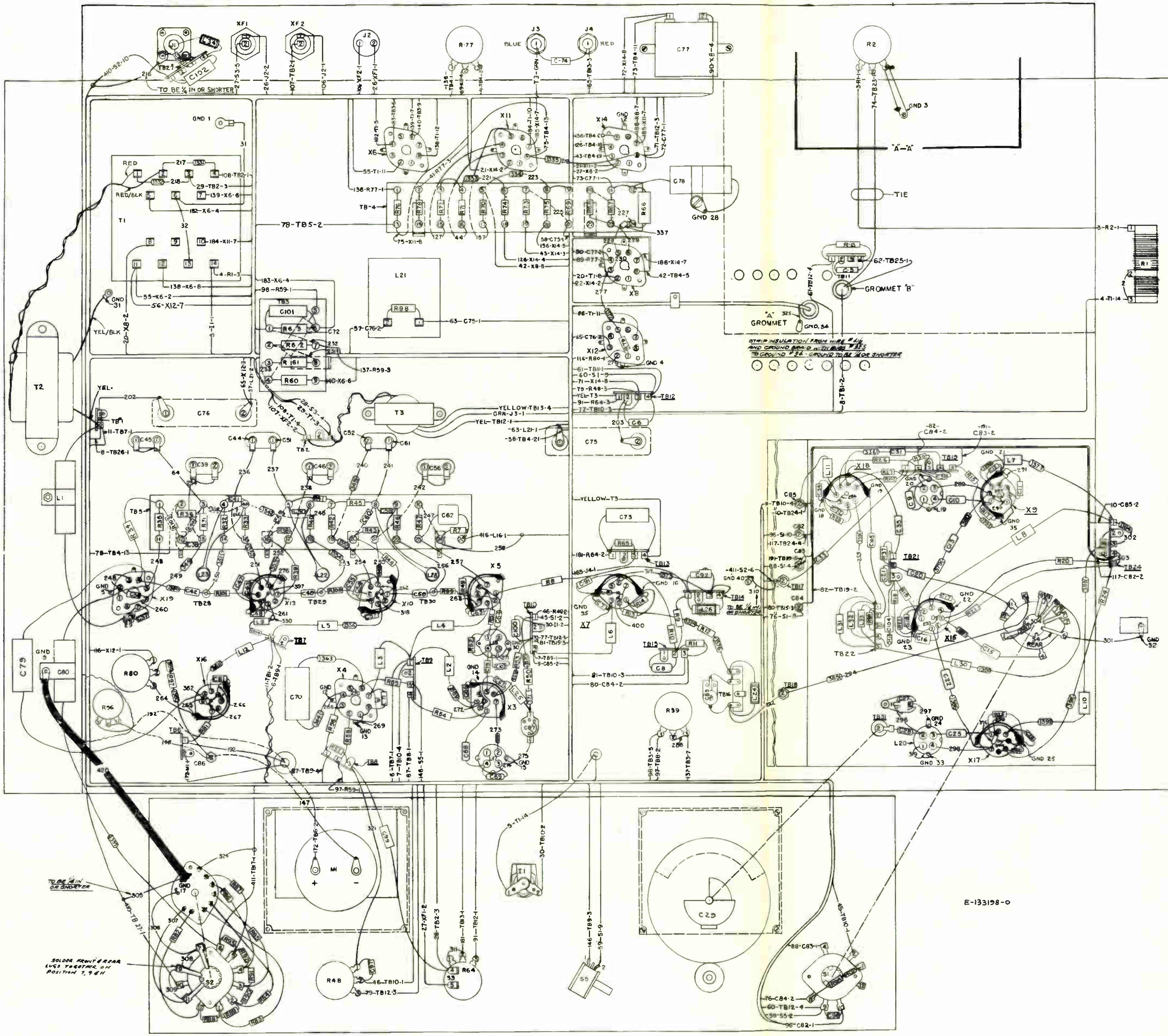
Symbol No.	*Description*	*Stock No.*
C1	Capacitor, fixed, mica, 2700 mmf ±10%, 500 v	39662
C2, C3	Capacitor, fixed, mica, 56 mmf ±10%, 500 v	39622
C4	Capacitor, ceramic, high "K" type, 1000 mmf ±20%, 300 v	71929
C5	Same as C1	
C6	Capacitor, fixed, mica, 3300 mmf ±20%, 500 v	39664
C7	Same as C4	
C8	Capacitor, fixed, mica, 5600 mmf	39670
C9	Capacitor, fixed, mica, 82 mmf ±10%, 300 v	55328
C10	Capacitor, fixed, mica, 10 mmf ±10%, 500 v	75245
C11, C12	Same as C4	
C13	Capacitor, fixed, mica, 22 mmf ±10%, 500 v	39612
C15	Capacitor, fixed, mica, 1000 mmf ±10%, 500 v.	39652
C16	Same as C1	
C17, C18	Same as C4	
C19	Capacitor, molded head lead type, 4.7 mmf, 500 v	54402
C20	Same as C4	
C21	Capacitor, ceramic, high "K" type, 1500 mmf ±20%, 300 v	58244
C22	Same as C13	
C23, C24	Same as C4	
C25	Same as C10	
C26	Same as C4	
C27	Capacitor, variable, ceramic, 5-20 mmf	55301
C28	Capacitor, fixed, mica, 100 mmf ±10%, 300 v	39628
C29	Capacitor, variable, 7-100 mmf	18384

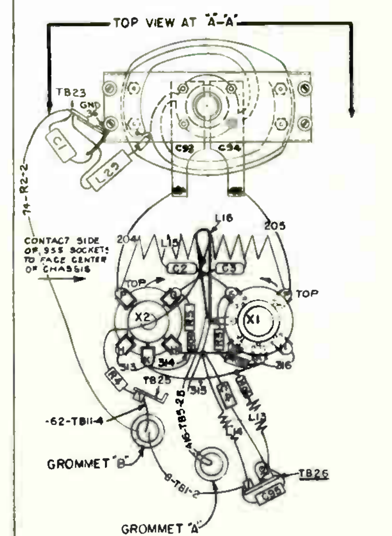
Symbol No.	*Description*	*Stock No.*
C30	Same as C4	
C31	Same as C8	
C32	Same as C4	
C33	Capacitor, fixed, mica, 12 mmf	39606
C34, C35	Same as C28	
C36	Same as C2	
C37, C38	Same as C4	
C39	Capacitor, paper oil filled, 2 sections, .5 mf each ±15%, 400 v	71673
C40	Same as C4	
C41	Capacitor, ceramic, non-insulated, 9 mmf ±10%, 500 v	55571
C42	Capacitor, fixed, mica, 200 mmf ±5%, 500 v	39635
C43	Same as C4	
C44, C51	Same as C39; C44 section 1, C51 section 2	
C45	Same as C39	
C46	Same as C39	
C47, C48	Same as C4	
C49	Same as C42	
C50	Same as C41	
C51	See C44	
C52, C61	Same as C39; C52 section 2, C61 section 1	
C53, C54, C55	Same as C4	
C56	Same as C39	
C57	Same as C4	
C58	Same as C41	
C59	Same as C42	
C60	Same as C4	
C61	See C52	
C62	Same as C1	
C63	Same as C4	

PARTS LIST (Cont.)

Symbol No.	*Description*	*Stock No.*
C64	Capacitor, fixed, mica, 33 mmf ±10%, 300 v	39616
C66, C67	Same as C4	
C68	Capacitor, fixed, mica, 39 mmf ±10%, 300 v	39618
C69	Same as C13	
C70	Capacitor, paper tubular, .25 mf ±20%, 400 v	54145
C71	Same as C4	
C72	Capacitor, paper tubular, .025 mf ±10%, 400 v	70612
C73	Same as C70	
C74	Capacitor, paper tubular, .1 mf ±20%, 400 v	73551
C75, C76	Capacitor, paper, 10 mf, 600 v	52734
C77	Capacitor, mineral oil treated, 1 mf ±10%, 400 v	45807
C78	Capacitor, dry electrolytic, 20 mf ±10%, 450 v	56243
C79, C80	Same as C70	
C81	Same as C4	
C82 to C86 inc.	Capacitor, feed-thru, 500 mmf ±20%, 350 v	55300
C87	Capacitor, variable trimmer, 2-6 mmf	54678
C89	Capacitor, variable trimmer, 5-20 mmf	64689
C91	Capacitor, fixed, mica, 4700 mmf ±5%, 500 v	53112
C92	Capacitor, variable trimmer, 5-50 mmf	54681
C95, C96, C97	Same as C4	
C99	Same as C4	
C100	Same as C91	
C101	Capacitor, paper tubular, .005 mf ±10%, 1000 v	70648
C102	Capacitor, molded, paper, .47 mf ±20%, 200 v	73787
C103	Same as C41	
C104	Same as C33	
C105, C106	Same as C13	
F1, F2	Fuse, 3 amp, cartridge type, glass body	10907
J1	Plug, output, amphenol, single contact, chassis mtg.	51800
J2	Connector, motor connector base	47594
J3	Jack, pin jack (Blue)	55239
J4	Jack, pin jack (Red)	55238
L1	Not Stocked	
L2, L3	Coil, filament choke	95850
L4, L5	Coil, filament choke	95851
L6, L7, L8	Same as L2	
L9	Same as L4	
L10, L11, L12	Same as L2	
L13, L14	Not Stocked	
L15, L16	Not Stocked	
L17	Transformer, sweep heterodyne freq. control adjusting	55563
L18	Transformer, doubler	55564
L19	Transformer, fixed marker oscillator freq. control inductor	55565
L20	Transformer, variable marker osc., freq. control inductor	55566
L21	Coil, choke	48554
L22, L23	Coil, peaking	94832
L24	Coil, R.F. choke	54683
L25	Coil, R.F. choke	55570
L26	Same as L24	
L27	Capacitor, vibrator capacitor assem. (Includes C93, C94)	59756
L28	Same as L22	

Symbol No.	*Description*	*Stock No.*
L29	Coil, R.F. choke, 4.7 micro. hen.	76510
L30, L31, L32	Coil, R.F. choke, 10 micro. hen.	95849
L33	Same as L29	
L34	Coil, R.F. choke, .47 micro. hen.	95848
M1	Meter, D.C., 0 to 200 micro. amps. D.C. calibrated 0 to .6 volts	55557
R1	Resistor, adjustable, wire wound, 15 ohms	48547
R2	Resistor, variable, 6 ohms, 25 w	55567
R3	Resistor, fixed, composition, 12,000 ohms, ±10%, ½ w	30436
R4	Resistor, fixed, composition, 680 ohms, ±10%, 1 w	19233
R5	Same as R3	
R6	Resistor, fixed, composition, 2700 ohms, 2 w	523227
R7	Resistor, fixed, composition, 100 ohms, ±10% ½ w	502110
R8	Resistor, fixed, composition, 4700 ohms, ±10%, ½ w	502247
R9	Resistor, fixed, composition, 820 ohms, ±10% 1 w	68025
R10	Same as R3	
R11	Resistor, fixed, composition, 10,000 ohms, ±10%, 1 w	71914
R12	Resistor, fixed, composition, 680 ohms, ±10%, ½ w	12262
R13	Resistor, fixed, composition, 220 ohms, ±10%, ½ w	5201
R14	Resistor, fixed, composition, 100,000 ohms, ±10%, ½ w	502410
R15	Resistor, fixed, composition, 82,000 ohms, ±10%, ½ w	8064
R17	Resistor, fixed, composition, 330,000 ohms, ±10%, ½ w	14983
R18, R19	Resistor, fixed, composition, 47,000 ohms, ±10%, ½ w	30787
R20	Resistor, fixed, composition, 1000 ohms, ±10%, ½ w	34766
R21	Resistor, fixed, composition, 22,000 ohms	503322
R22	Resistor, fixed, composition, 270 ohms, ±10%, ½ w	30929
R24	Resistor, fixed, composition, 120 ohms, ±10%, ½ w	502112
R25	Same as R17	
R26	Same as R18	
R27	Resistor, fixed, composition, 68,000 ohms, ±10%, 1 w	38897
R28	Resistor, fixed, composition, 330 ohms, ±10%, ½ w	8063
R29	Resistor, fixed, composition, 680 ohms, ±10%, ½ w	12262
R30	Resistor, fixed, composition, 3900 ohms, ±10%, ½ w	30694
R31	Resistor, fixed, composition, 100 ohms, ±10%, 1 w	31215
R32	Resistor, fixed, composition, 680 ohms, ±5%, 1 w	512168
R33	Resistor, fixed, composition, 39,000 ohms, ±10%, ½ w	30147
R34	Same as R14	
R35	Resistor, fixed, composition, 180 ohms, ±10%, ½ w	502118
R36	Same as R31	
R37	Same as R15	
R38	Resistor, fixed, composition, 68 ohms, ±10%, ½ w	34763
R39	Resistor, fixed, composition, 180,000 ohms, ±10%, ½ w	11959





WIRE NO. (INCLUSIVE)	DESCRIPTION		ITEM NUMBER SEE K-8886317-501	OPEN WIRE NUMBERS
1 TO 10	PS592-32	BROWN	229	11 TO 19
26 TO 32	PS592-32	BLACK	230	33 TO 40
41 TO 46	PS592-31	BLUE	231	47 TO 54
55 TO 65	PS592-29	RED	232	66 TO 70
71 TO 82	PS592-31	BLUE/RED	233	82 TO 86
20 TO 22	PS592-29	RED/BLACK	234	23 TO 25
156 TO 157	PS697-4	GREEN	235	158 TO 164
87 TO 91	PS592-32	YELLOW	236	92 TO 95
96 TO 98	PS592-32	GREEN	237	99 TO 105
202 TO 206	PS105	WIRE (TINNED COPPER) .064 DIA.	238	200 TO 201, 206 TO 215
216 TO 223, 225, 227 TO 238, 240 TO 242, 244 TO 280, 282 TO 284, 286 TO 319, 321, 324 TO 325.	PS105	WIRE (TINNED COPPER) .032 DIA.	239	224, 226, 239, 243, 281, 285, 320, 322 TO 323, 326 TO 329
420	PS499	BRAID 1/4"	252	421 & UP
106 TO 108	PS592-32	BROWN/YELLOW	243	109 TO 115
116 TO 117	PS592-32	BROWN/BLK	244	118 TO 125
126 TO 127	PS592-32	RED/BLK	245	128 TO 135
136 TO 140	PS663-31	BLK/GRN-WHITE	246	141 TO 145
146 TO 148	PS592-31	BLK/YEL.	247	149 TO 155
165	PS663-32	BLUE/YEL.-WHITE	248	166 TO 171
172	PS592-31	RED/GRN	249	173 TO 180
181 TO 186	PS663-31	GRN/YEL.-WHITE	250	187 TO 190
191 TO 192	PS592-31	RED/YEL.	251	193 TO 199
410 TO 411	K-99259-2	CABLE (RG59U)	240	412 TO 415
416	K-99262-2	CABLE (RG62U)	241	417 TO 419
330 TO 342, 349 TO 356, 357 TO 362, 373 TO 374, 376 TO 381, 383 TO 388, 390 TO 392, 394 TO 400, 402 TO 405, 408 TO 409	PS722-3	EXTRUDED TUBING .034 I.D.	242	343 TO 347, 357, 365 TO 368, 375, 382, 389, 401, 407
348, 358, 363 TO 364, 393, 406	PS722-4	EXTRUDED TUBING .042 I.D.	265	[illegible]

NOTE 1
SOLDER ALL ELECTRICAL CONNECTIONS USING K-8886317-227 PER STD NOTICE 96-1-1
ALL WIRING TO BE IN ACCORDANCE WITH STD. NOTICE 96-1-1

NOTE 2
NUMBERS IN WIRES REFER TO WIRE TABLE & WIRE DESTINATIONS RESPECTIVELY

NOTE 3
NUMBERS IN BALLOONS REFER TO PARTS LIST K-8886317

NOTE 4
CABLE & LACE WIRES WHERE POSSIBLE USING LACING CORD K-8886317-253

NOTE 5
DO NOT CABLE T2 & T3 TRANSFORMER LEADS WITH OTHER LEADS

NOTE 6
ALL PARTS MARKED THUS INDICATE SOLDER JOINT

E-133198-0

Figure 20—Connection diagram, MI-30021-B

RADIO CORPORATION OF AMERICA

ENGINEERING PRODUCTS DEPARTMENT CAMDEN, N. J.

PRINTED IN U.S.A.
552

VIDEO SWEEP GENERATOR

WA-21A

INSTRUCTIONS

RADIO CORPORATION OF AMERICA

Camden, New Jersey, U. S. A.

IB-4021-2

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure 1—WA-21A Video Sweep Generator

TECHNICAL SUMMARY

Electrical Characteristics

Sweep Output

Swept Frequency Range	100 kc to 10 mc
Output Voltage	.0005 min. to one max. volts rms
Output Impedance	75-ohm terminated line
Output Amplitude Characteristics	flat within one db of mid-frequency output from 100 kc to 10 mc
Distortion and Spurious Output	total less than 5%

C-W Output

Frequency Range	continuously variable from 100 kc to 10 mc
Dial Scale Error	less than 2% or 50 kc (whichever is greater) at any frequency setting
Output Voltage	.0005 min. to one max. volts rms
Output Impedance	75-ohm terminated line
Output Amplitude Characteristics	essentially flat from 100 kc to 10 mc
Distortion and Spurious Output	total less than 5%

Power Requirements .... 105-125 volts, 50-60 cycles, 180 watts

Fuse Protection .... 3 amperes

Tube Complement

2 RCA-955	sweep oscillator
1 RCA-6BA6	oscillator-doubler
1 RCA-6SQ7	blanking tube
1 RCA-6C4	sweep mixer
2 RCA-6AG5	video amplifier
1 RCA-6AG7	video output
1 RCA-6BE6	marker mixer
1 RCA-6AG5	fixed marker oscillator
1 RCA-6AG5	variable marker oscillator
1 6AS6	c-w mixer
1 RCA-6AG5	buffer amplifier
1 RCA-5U4G	rectifier
1 RCA-OD-3	voltage regulator
1 RCA-6SJ7	d-c amplifier
2 RCA-6Y6G	voltage regulator
1 RCA-6AL5	voltmeter diode

Mechanical Characteristics

Dimensions	10½ in. high, 22 in. wide, 15 in. deep
Weight	80 pounds (approx.)

GENERAL DESCRIPTION

Designed to facilitate rapid testing of video-frequency networks and routine maintenance checking of television transmitter and terminal equipment, the Video Sweep Generator, Type WA-21A, in connection with a suitable detector and a general-purpose oscilloscope, permits continuous observation of the gain-versus-frequency characteristic of the circuit under test. It also provides sine-wave signals tuneable from 100 kc to 10 mc for point-by-point or steady-state tests.

The section of the circuit which produces the continuous-wave signal is separate from that which generates the swept signal, thus allowing the c-w signal to serve as a calibrating marker signal on the oscilloscope trace.

The swept signal covers the range from 100 kc to 10 mc at the rate of 60 complete excursions per second. Over this range, the output is uniform within one decibel of the mid-range output. Stability of the sweep signal is insured by the use of a mechanically-operated modulating capacitor. Distortion and spurious signal outputs are less than five percent of the fundamental output voltage.

A blanking circuit is provided to cut off the signal during the return portion of the oscilloscope trace (from 10 mc to 100 kc) if so desired, thus furnishing a zero-output base line on the trace. If the marker is utilized, a clearly visible "pip" appears on the trace, the frequency at which this mark occurs being read directly from the marker tuning dial. The full marker frequency range from 100 kc to 10 mc is covered by a single dial scale having an error of less than 2% or 50 kc (whichever is greater).

A method of developing the marker pip is employed which minimizes spurious responses and makes the pip uniform in size over the entire tuning range.

A panel switch permits selection of sweep alone, sweep plus the marker signal, or the c-w signal alone. The c-w output is supplied through the same coaxial line as the sweep signal.

A source of 60-cycle voltage, adjustable in phase, is provided for connection to the oscilloscope horizontal deflection terminals for convenience in case this feature is not already included in the oscilloscope.

A metering circuit is provided to indicate the rms value of the output signal voltage. This circuit consists of a diode-type voltmeter used in connection with a resistive step attenuator. Continuous coverage of the output voltage range from one volt to 0.5 millivolt is achieved through the use of a fine output control and the step attenuator.

The instrument is designed for table-top mounting and is normally furnished in a table-model cabinet; however, the unit is suitable for rack mounting if desired. A dust-cover is provided which serves to protect the top of the chassis when relay-rack mounting is used. This cover is superfluous for cabinet mounting, and may be discarded to afford added ventilation. Standard relay-rack mounting slots are furnished on the front panel.

INSTALLATION

After carefully unpacking the instrument, prepare it for operation as follows:

1. Remove the eight screws from the front panel and withdraw the panel-and-chassis assembly from the case.

2. Remove the screws on the rear of the instrument which hold the dust-cover in place, then lift off the dust-cover.

3. Inspect the tubes, and see that they are all firmly seated in their sockets.

4. Turn the SCOPE PHASING control fully counterclockwise. See that the two fuses on the rear apron are marked three amperes and are in good condition. Insert the power cord supplied with the instrument into the receptacle on the rear apron, and plug the other end of the cord into an a-c outlet supplying 105-125 volts, 50-60 cycles.

5. Adjust the VOLTAGE REGULATOR control as described in the Maintenance section of this book.

6. If cabinet mounting is preferred, store the dust-cover for possible future use, and replace the panel-and-chassis assembly within the cabinet.

7. If relay-rack mounting is preferred, replace the dust-cover, and store the cabinet for future use. Bolt the panel-and-chassis assembly to the relay rack with 10/32 nuts and bolts.

8. Insert the output cable into its receptacle on the rear apron. The instrument is now ready for use.

FUNCTION OF OPERATING CONTROLS

SWEEP-MARKER-CW Switch—This switch selects the mode of operation of the instrument. In the "SWEEP" position, the switch makes a sweep signal available at the end of the output cable. When the switch is on "MARKER," a sweep signal with a superimposed marker "pip" is present at the end of the cable. A c-w signal is made available when the switch is on "CW."

TUNING Control — This control adjusts the frequency of the marker signal or of the c-w signal to the value shown on the dial scale.

BLANKING Switch — When this switch is in the "OFF" position, a conventional double trace is made to appear on the oscilloscope screen. A reference baseline representing zero level is caused to appear on the screen when the switch is in the "ON" position. The blanking is timed to occur during the return sweep interval (from 10 mc to 100 kc).

SCOPE PHASING Control—Power is applied to the instrument when this control is rotated clockwise. Turning the control to its extreme counterclockwise position turns the instrument off. As the control is rotated, the phase of the horizontal deflection voltage available at the SCOPE PHASING terminals on the back apron is varied.

OUTPUT Control—This control is used as a vernier output level adjustment.

MULTIPLY BY Switch—Rough adjustments in output level are made with this switch. When the BLANKING switch is set to "OFF," the setting of the MULTIPLY BY switch times the panel-meter reading equals the rms value of the output voltage.

OPERATION

Initial Adjustments — The Video Sweep Generator, a suitable oscilloscope, and a detector should be set up as shown in Figure 2.

The HORIZONTAL DEFLECTION terminals on the WA-21A should be connected to the horizontal deflection terminals of the oscilloscope. The detector input should be connected to the WA-21A output, and the output of the detector should be connected to the vertical terminals of the oscilloscope. Both the detector output circuit and the oscilloscope should have good 60-cycle square-wave response. A suitable detector, used in forming the curves shown in this book, is shown in Figure 2.

Turn the instrument on by rotating the SCOPE PHASE control clockwise. Place the BLANKING switch in the OFF position, and the SWEEP-MARKER-CW switch on SWEEP. A pattern similar to that shown in Figure 3A should appear on the screen. The two notches represent zero frequency, and if they are displaced, the SCOPE PHASE control should be rotated until the notches are superimposed, as shown in Figure 3B. The reduced output at fre-

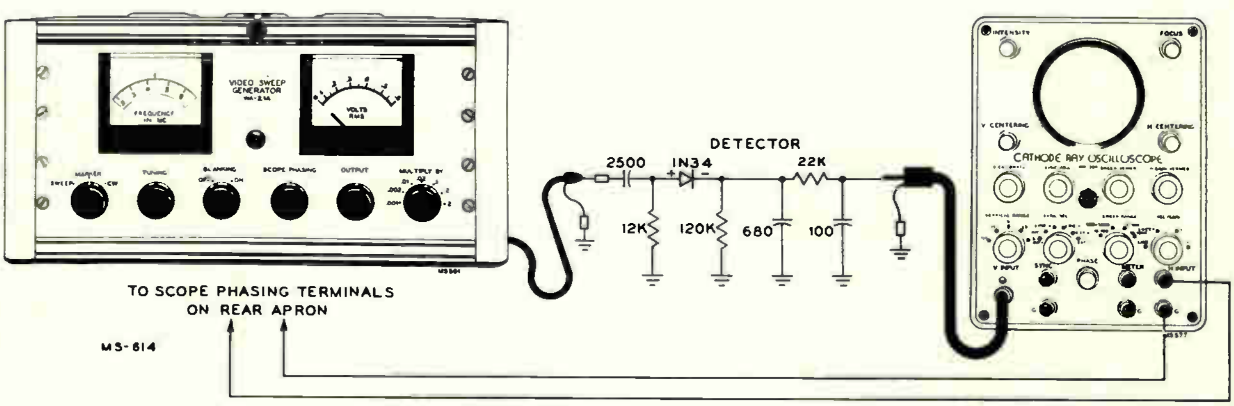


Figure 2—Setup for Initial Adjustment

quencies approaching zero is characteristic of the peak rectifying detector used in making the curves and is partially due to the limited low-frequency response of the instrument.

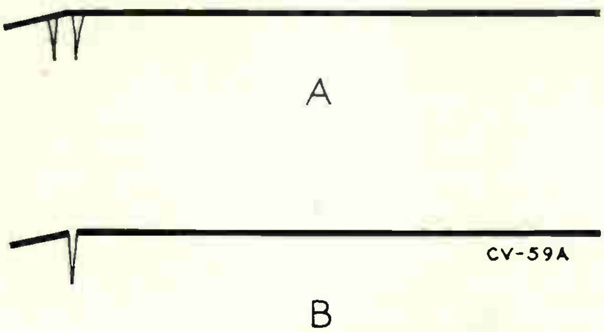


Figure 3—Response Curves with Blanking Off

Throw the BLANKING switch to the "ON" position. A pattern similar to that shown in Figure 4 should be visible on the oscilloscope screen. If this pattern is obtained, the Video Sweep Generator is ready for testing a wide-band video amplifier or other device as covered in the section on Applications.

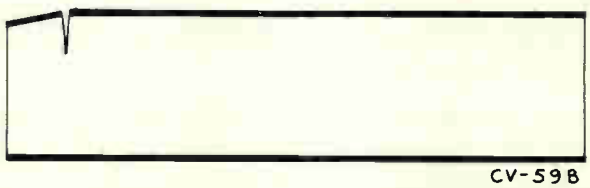


Figure 4—Response Curve with Blanking On

APPLICATIONS

Testing and Adjusting Video Amplifiers — The test setup is shown in Figure 5 and the general procedure follows:

1. Make the preliminary adjustments on the Video Sweep Generator as described under Operation. Adjust the controls on the oscilloscope for a trace of the desired height, width, and brilliance.

2. When the video amplifier is connected between the WA-21A and the detector, a trace representing the frequency-vs-amplitude characteristic of the amplifier will be seen on the oscilloscope. A baseline, representing zero response, may be obtained by rotating the BLANKING switch to "ON." The frequency of any point on the response may be determined by setting the SWEEP-MARKER-CW switch on "MARKER," and adjusting the TUNING control until the marker pip rests on the point under consideration. The frequency is then read from the tuning dial scale.

3. Adjust the peaking coils in the video amplifier for a response of the desired shape.

When testing video amplifiers, certain precautions must be observed to avoid erroneous results. One improper indication of the response of a video amplifier may be obtained when the output of the WA-21A is too great, causing limiting in the video amplifier. Figure 6 shows the effect obtained with this condition. The actual response is shown at "A"; but when the output of the WA-21A is of such magnitude as to cause limiting in the video amplifier, the curve of "B" is obtained. To avoid any confusion, the OUTPUT and MULTIPLY-BY controls on the Video Sweep Generator should be initially set for low output, then gradually advanced. If the shape of the response curve changes as the WA-21A output is increased, then limiting is indicated, and the OUTPUT control should be backed off.

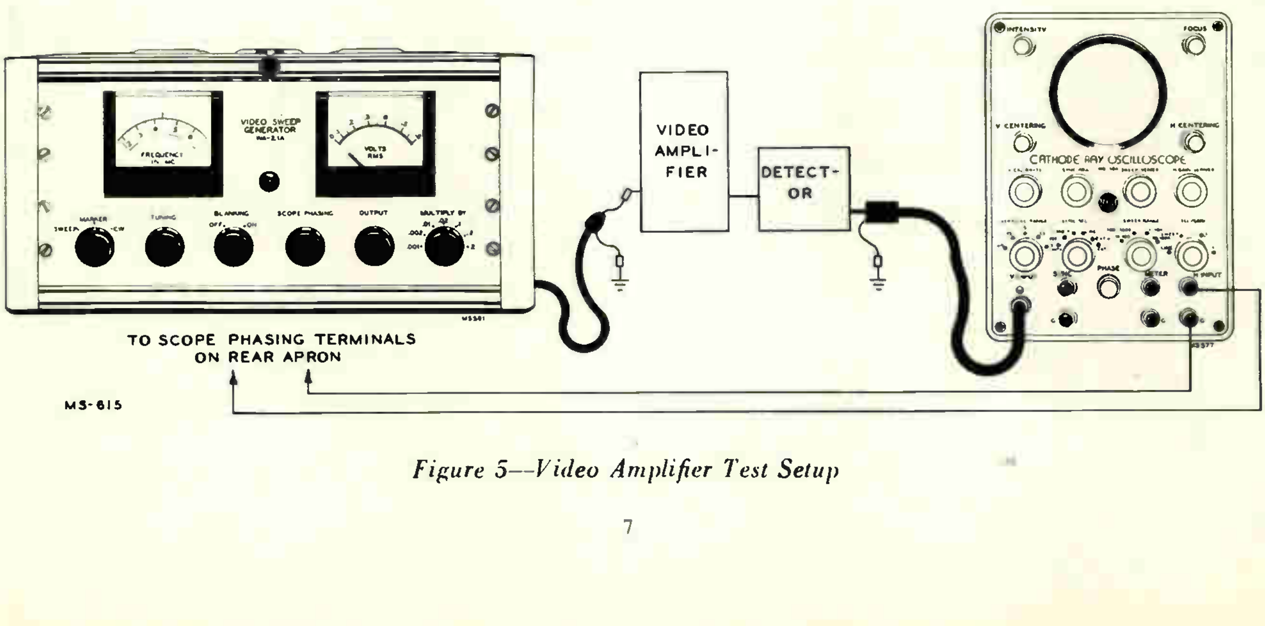


Figure 5—Video Amplifier Test Setup

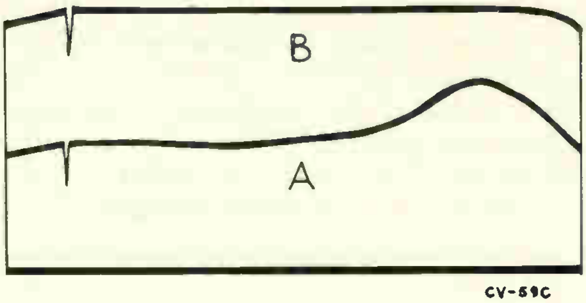


Figure 6—Effect of Limiting on Response

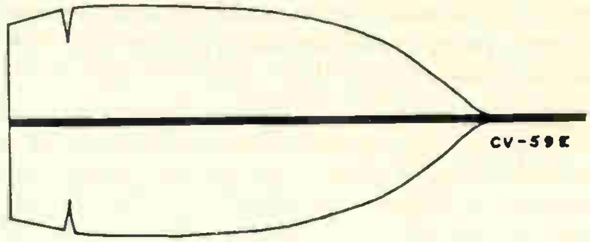


Figure 8—Response Without Detector

Another erroneous indication of the true response of a vidco amplifier may be obtained if the input impedance of the detector is of the same order of magnitude or less than the impedance of the circuit across which it is connected.

If the particular section of the amplifier where the detector is connected is of relatively low impedance, such as the output of a cathode follower, then no special precautions are necessary; however, if the detector is connected across a high-impedance interstage coupling network, the additional capacity loading will cause the observed response to be inaccurate. This effect must be taken into consideration when interpreting response curves.

One way to check the response of a high-impedance circuit feeding the grid of a following stage is shown in Figure 7. The 200-ohm resistor across the plate load of V2 minimizes the capacity loading effect of the detector on the preceding stage (V1). In this method V2 acts essentially as a buffer, and the response observed is the response of the circuit only up to the grid of V2. This method does not show the response of the stage to which the detector and the loading resistor are connected; i. e., in the circuit of Figure 7, the effect of the peaking coils in the plate circuit of V2 is not shown.

If the oscilloscope used to observe the response of the circuit under test utilizes a wide-band video amplifier, then it is not necessary to employ a detector in the test setup. In this case, the output of the video amplifier is fed directly to the vertical amplifier of the oscilloscope. A trace obtained using this method is shown in Figure 8. The successful employment of this method requires that the frequency response of the oscilloscope vertical amplifier be flat over a range at least as great as the entire band passed by the video amplifier under test.

When aligning high-gain video amplifiers consisting of a number of stages in cascade, with the Video Sweep Generator connected to the input, and the oscilloscope connected to the output, undesirable coupling between the input and the output through the power-supply lines may be experienced. This coupling usually evidences itself as a change in the shape of the response curve when the cases or the cables of the equipment used in the test setup are touched. To minimize this effect, place a large sheet of metal under all of the equipment, and connect or bypass all units to this common metal plate.

Testing and Adjusting Filters and Frequency-Selective Networks — The test setup is the same as that shown for adjusting video amplifiers, except that the filter under investigation replaces the video amplifier of Figure 5. Different frequencies on the response trace can be identified by employing the marker. The filter variables are adjusted to give the required response as observed on the oscilloscope.

If the response of a relatively narrow-band filter is to be examined in detail, then the swept bandwidth of the WA-21A can be reduced. Figure 9 shows the effect of observing the response of a narrow-band circuit on the 0-10 mc sweep and on a sweep of reduced bandwidth. The Video Sweep Generator can be adjusted to sweep the required band of frequencies

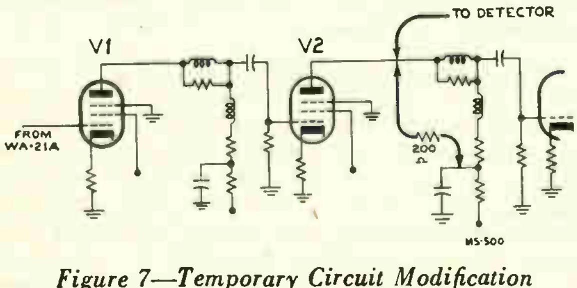


Figure 7—Temporary Circuit Modification of Video Amplifier

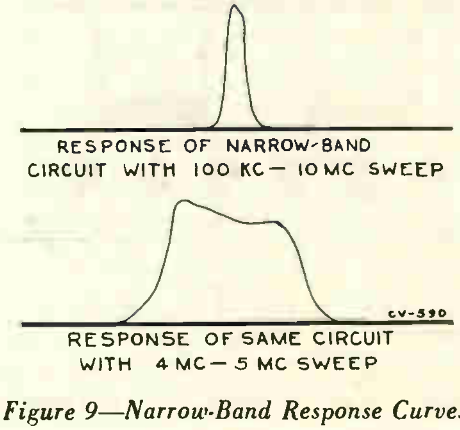


Figure 9—Narrow-Band Response Curves

according to the instructions given in the Maintenance section of this book. For examining the characteristics of very narrow-band circuits, such as broadcast-receiver i-f transformers, this method is not recommended.

When observing the frequency characteristic of a network having a sharp cutoff or steep sides in its response, a detector with good transient response must be used. Filters of different characteristics will require detectors of different design; i. e., a circuit having a high output impedance will require a detector that may be unsuitable for use with a circuit having sharp-cutoff characteristics.

In certain cases where a sharp-cutoff circuit is designed to operate into a relatively high impedance, the detector may have to be isolated from the circuit under investigation by means of a buffer stage, such as a cathode follower. In any case, a circuit consisting of a cathode follower feeding a detector having good transient response represents probably the most universally adaptable device for use with the Video Sweep Generator.

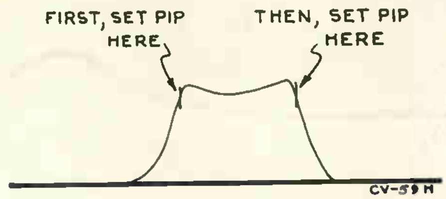


Figure 10—Determining Bandwidth

Determining Bandwidth of Frequency-Selective Circuits — The circuit under test is first set up in the usual manner so that its frequency response is displayed on the oscilloscope. The marker pip is then set first on one side of the response, and then on the other, as shown in Figure 10. The difference between the two frequencies, as read from the tuning-dial scale, is the bandwidth of the circuit under test.

CIRCUIT DESCRIPTION

The WA-21A Video Sweep Generator circuit is shown schematically in Figure 18 and in functional block form in Figure 11.

Sweep Oscillator — Two RCA type 955 triodes (V1, V2) are employed in a push-pull oscillator circuit which is frequency-modulated over an approximate range of 70-80 mc by a vibrating capacitor (C93, C94) of special design. One plate of this capacitor is mechanically coupled to an actuating coil (L27) which is excited from the 60-cycle power source. The frequency deviation produced by the modulation capacitor is dependent upon the amplitude of its vibration, which is a function of the amount of excitation applied to the actuating coil. The excitation, and hence the frequency deviation, is adjusted by means of the SWEEP WIDTH CONTROL (R2). For CW operation of the instrument, the oscillator plate voltage is removed.

Fixed Oscillator-Doubler — This circuit generates a fixed r-f signal of 70 mc which is heterodyned with the frequency-modulated signal provided by the sweep oscillator to form the final 0-10 mc video-frequency sweep. An RCA-6BA6 (V3) oscillates at 35 mc in an electron-coupled Hartley circuit. Frequency doubling is accomplished in the plate circuit of the tube since L18, the plate load, is tuned to 70 mc. A variable resistor (R48, OUTPUT control) adjusts the output of the oscillator-doubler by varying its plate voltage. Since varying the amplitude of the 70-mc signal varies the efficiency with which this signal is mixed with the sweep-oscillator signal, the OUTPUT control governs the amplitude of the 0-10 mc sweep signal fed to the video amplifier.

Mixer — An RCA-6C4 triode is utilized as a mixer. The 70-mc signal is injected into the grid of the mixer; the 70-80 mc signal generated by the sweep oscillator is fed in at the cathode. As a result of the heterodyne action occurring in the mixer tube, a video-frequency signal which is constantly swept 60 times a second over a range from 0 to 10 mc is developed in the mixer plate circuit. This sweep-frequency signal is coupled to the grid of the first video amplifier (V10).

Video Amplifier — A conventional two-stage, wide-band video amplifier is employed in the instrument. The response characteristics of the amplifier are such that the output is flat within one db from 100 kc to 10 mc.

Video Output Stage — The output of the video amplifier is fed to the grid of an RCA-6AG7 (V19) connected as a cathode follower. This circuit, by virtue of its low internal impedance, permits the use of a low-impedance output and its attendant relative freedom from capacity-loading effects. Sweep voltage from the cathode of the video-output tube is fed to the output jack (J1) through a ladder-type attenuator (R82 to R93). This attenuator (MULTIPLY BY switch) is used to vary the output of the instrument in fixed steps. The coaxial cable which plugs into the output jack is fitted with an internal 75-ohm resistive termination.

Voltmeter and Voltmeter Diode — A sample of the video output is fed to the voltmeter diode just ahead of the attenuator circuit. The a-c axis of the output voltage is shifted in a negative direction by the diode (V16), which functions as a d-c restorer. The meter reading is thus made proportional to the peak value of the voltage fed to the attenuator. A variable resistor (R96) is used to calibrate the meter in rms values. The zero-signal meter current due to diode contact

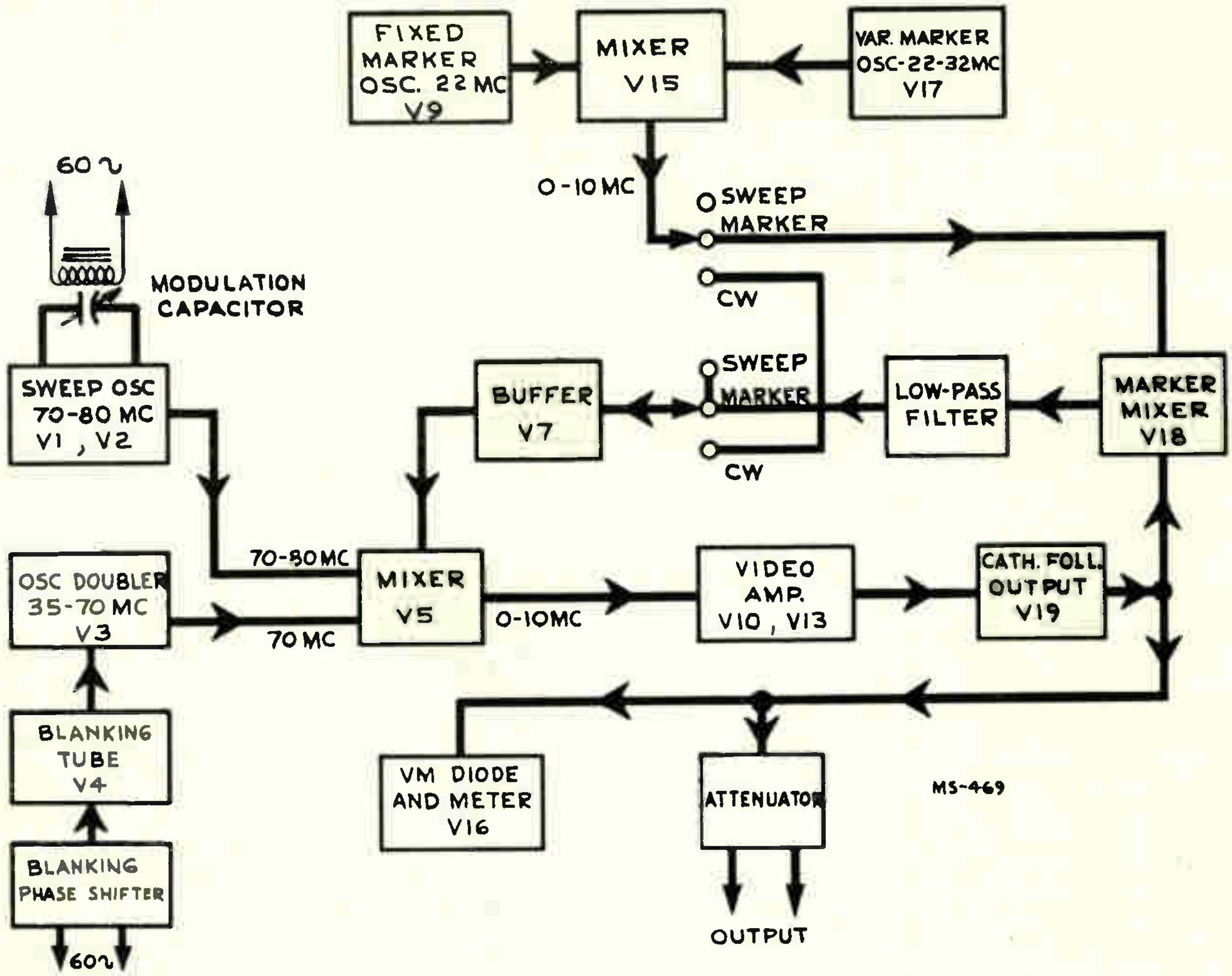


Figure 11—Block Diagram of WA-21A

potential is balanced out with the METER ZERO control (R80). The time-constant of the diode circuit is not sufficiently large to provide accurate readings when the blanking is on.

Marker and C-W Signal Generator — The marker generator comprises a 22-mc oscillator, a variable-frequency oscillator which can be tuned to any frequency between 22 and 32 mc, and a mixer which combines the two oscillator signals to produce the marker signal.

The 22-mc oscillator is an RCA-6AG5 (V9) in a conventional Hartley circuit. The variable-frequency oscillator (V17) is similar to the 22-mc oscillator except that its frequency can be tuned over the 22-32 mc range by means of the front-panel TUNING control (C29). Signals from the two oscillators are combined in the mixer (V15) to form, at the mixer plate, a marker signal which can be set anywhere between zero beat and 10 mc with the TUNING control.

When a marker signal is not desired, plate voltage for all tubes in the marker generator (V9, V15, V17) is removed by setting the front-panel selector switch (S1, S4) to "SWEEP."

Marker Mixer — This tube (V18) combines the marker signal with a sample of the video sweep output obtained from the video output tube (V19). The output of the marker mixer contains a beat between the marker frequency and the swept video frequency. This beat is fed to a low-pass filter, which passes only the low-frequency components of the beat. Since the low-frequency components are present only for an instant while the swept video frequency is sweeping through the marker frequency, the output of the low-pass filter contains a signal only during this instant. This signal is fed to the buffer amplifier through the selector switch (S4, front).

Buffer Amplifier — The output of the low-pass filter is received and amplified by an RCA-6AG5 (V7). Since the plate of this tube is conductively coupled to the plate of the mixer (V5), the 100 kc-10 mc sweep output of the mixer is amplitude modulated by the signal fed to the buffer grid. This amplitude modulation of the swept video voltage as it sweeps through the marker frequency is observed on the cathode-ray tube trace as a marker "pip."

C-W Output — When the selector switch (S1, S4) is on "CW," the sweep oscillator (V1, V2) plate voltage is removed and the output of the marker mixer (V18) is disconnected; therefore, no video sweep voltage is available from the instrument. The marker generator (V9, V15, V17), however, still functions as a variable-frequency source. Its output is switched to the buffer amplifier, which feeds the c-w signal to the video amplifier. The output voltage is controlled by the MULTIPLY BY switch and the OUTPUT control (R48), which varies the plate voltage of the 22-mc oscillator (V9).

Blanking Generator — When the BLANKING switch is turned to "ON," plate voltage is applied to the blanking tube (V4). The tube amplifies and clips the 60-cycle voltage which is applied to its grid through the phase-shifting network R59 and C72. The square wave on the plate of the tube is fed to a d-c restorer (diodes of V4). The output of the d-c restorer consists of highly negative pulses which occur at every other alternation of power-line frequency. These pulses are applied to the oscillator-doubler (V3) grid, and succeed in stopping the oscillator while the video-sweep output of the instrument sweeps back from 10 mc to 100 kc. A baseline representing zero level is thus obtained on the oscilloscope trace during this period.

Power Supply — All plate and heater power requirements are supplied by a built-in power supply incorporating an electronic voltage regulator of conventional design. The instrument also supplies, at the SCOPE PHASING jacks, a 60-cycle voltage of adjustable phase for the horizontal deflection plates of an oscilloscope.

MAINTENANCE

Tube Replacement — Most of the troubles which develop in the instrument can be attributed to vacuum tubes which have reached the end of their useful lives, or which have developed defects. All tubes should be tested periodically. Since all tube sockets are marked with the tube type numbers, removal and replacement of tubes is a relatively simple matter. To obtain access to the tubes, lift the lid of the case. The two RCA 955 acorn tubes are located in a shielded compartment at the rear left-hand side of the chassis. Access to these tubes may be obtained by removing the compartment cover, which is held in place with six screws.

Sweep Output Bandwidth Adjustment — Normally, the instrument is preset at the factory for a swept bandwidth of 10 megacycles. To obtain this bandwidth, the sweep oscillator is adjusted to sweep a band of frequencies from 70 to 80 mc (approx.) and the oscillator doubler is adjusted to produce a c-w output of approximately 70 mc. Figure 12 illustrates the pattern of the output signal as seen on an oscilloscope when the instrument is properly adjusted for a 10-mc bandwidth. If the 10-mc marker does not fall near the right-hand side of the trace, or if the zero-frequency beat does not fall near the left-hand side of the trace, the following adjustments should be made:

1. Connect the SCOPE PHASING terminals on the rear apron of the WA-21A to the horizontal terminals of an oscilloscope.

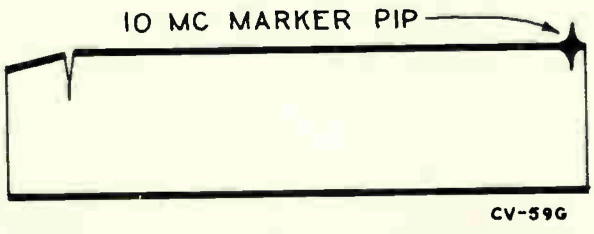


Figure 12—Response Curve for 10-Mc Bandwidth

2. Connect the WA-21A output cable, through a suitable detector, to the vertical terminals of the oscilloscope (same setup as Figure 2).

3. Set the SWEEP-MARKER-CW switch on "MARKER"; set the TUNING control for a marker frequency of 10 mc; place the BLANKING switch on "OFF."

4. Rotate the OUTPUT control to its approximate maximum position; turn the power switches of the oscilloscope and the WA-21A on.

5. A horizontal line should appear on the cathode-ray tube. This line may or may not contain the 10-mc marker and the zero-frequency beat, depending upon the degree of misalignment. If the zero-frequency beat does not appear on the line, then adjust the core of L17 (see Figure 13 for location) until the beat appears at the left-hand side of the trace.

6. Adjust the SCOPE PHASING control for a single, overlapping trace, then carefully reset the core of L17 until the zero-frequency beat rests near the left-hand side of the trace (this beat should not be set exactly on the extreme left-hand side of the trace, as any subsequent drift in the oscillators may cause the beat to disappear).

7. Throw the BLANKING switch to "ON."

8. Adjust the SWEEP WIDTH control on the rear apron until the 10-mc marker rests near the right-hand side of the sweep. This adjustment may necessitate resetting the zero-frequency beat to the left-hand side of the trace by adjusting L17. These two adjustments (L17 and SWEEP WIDTH) must be made alternately until the zero-frequency beat rests near the left-hand side of the trace, and the 10-mc marker pip rests near the right-hand side (see Figure 12).

9. Adjust the core in L18 (see Figure 13 for location) until the trace is of maximum amplitude.

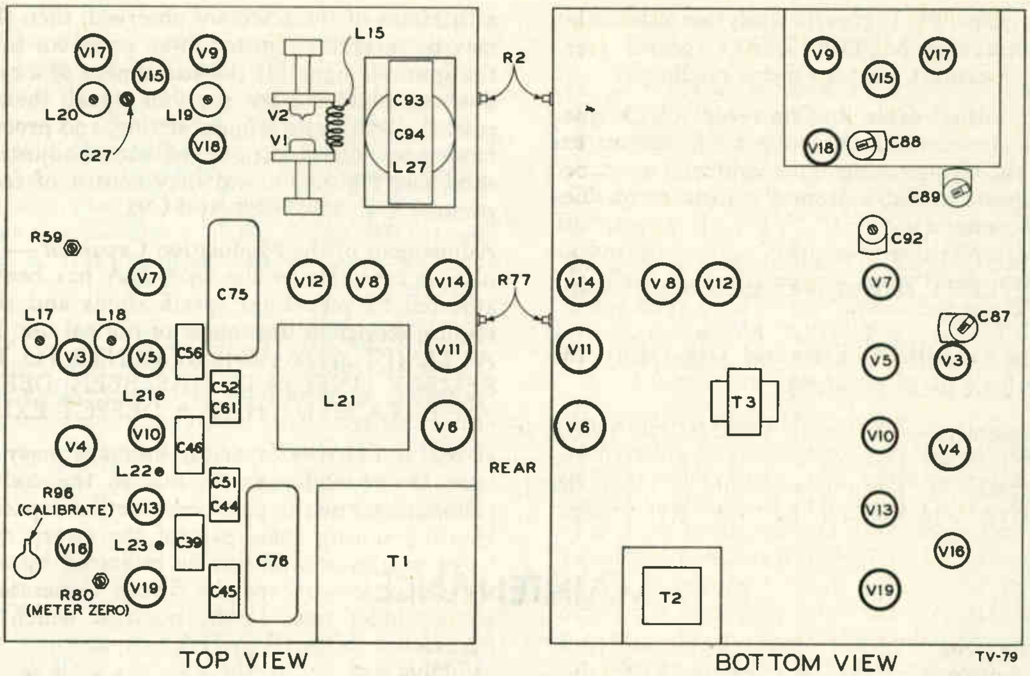


Figure 13—Tube and Adjustment Locations

Adjusting Bandwidth for Frequencies Less Than 10 Mc — If the Video Sweep Generator is to be used in testing equipment which has a bandwidth appreciably less than 10 mc, it may be desirable to adjust the instrument to sweep the required frequency band. By reducing the swept bandwidth, the trace of a narrow-band circuit can be made wider and thus more easily investigated. The general procedure for setting the WA-21A to sweep a desired frequency band can best be described by means of an example.

Suppose it is desired to investigate the frequency characteristics of a 500-kc band-pass filter with a mid frequency of six megacycles. The WA-21A should be set to sweep a band of frequencies from about 5.5 to 6.5 megacycles. This is accomplished as follows:

1. Follow steps 1 to 4 described under the previous heading, "Sweep Output Bandwidth Adjustment."

2. Rotate the TUNING control until two marker pips appear on the trace, then adjust the SCOPE PHASE control until these pips coincide. Throw the BLANKING switch to "ON."

3. Retard the setting of the SWEEP WIDTH control until a band of frequencies one mc wide (6.5 mc-5.5 mc) is swept. This can be checked by setting the marker pip first on one side of the trace, then on the other, and noting the difference on the tuning dial scale.

4. Set the TUNING control for a frequency of 5.5 mc.

5. Adjust L17 (see Figure 13 for location) until the 5.5-mc marker pip rests at the left-hand side of the trace. Adjust L18 (see Figure 13 for location) for a trace of maximum height.

6. The Video Sweep Generator is now set to sweep the frequency band from 5.5 mc to 6.5 mc, and the filter to be tested can be connected between the WA-21A output cable and the detector. Other frequency bands may be obtained in a manner similar to that described in the foregoing steps.

Phasing the Blanking Circuit — When the blanking circuit is correctly phased, the baseline of the oscilloscope trace will fall exactly under the upper portion of the pattern as shown in Figure 4. This trace is obtained on the oscilloscope as described under the heading, "Operation." An improperly phased blanking circuit is indicated when the reference baseline is displaced, as shown in Figure 14. To phase the blanking circuit, adjust R59 (see Figure 13 for location) for the pattern shown in Figure 4.

Voltmeter Calibration — The following procedure is recommended:

1. Turn the instrument on by rotating the SCOPE PHASING control clockwise.

2. Set the SWEEP-MARKER-CW switch to "CW." Set the TUNING control to about one mc.

Figure 14—Improperly Phased Response

3. Turn the OUTPUT control fully counterclockwise, and adjust the METER ZERO control (see Figure 13 for location) for zero meter reading.

4. Insert the output cable into its receptacle on the rear apron, and connect an accurate a-c voltmeter to the leads on the output cable. This voltmeter must be flat at least up to one mc, and must read in rms value for sine-wave voltage.

5. Set the MULTIPLY BY switch to "2" and advance the OUTPUT control until the external voltmeter reads one volt.

6. Adjust the CALIBRATE control (see Figure 13 for location) for a panel-meter indication of 0.5.

7. Check the other positions of the MULTIPLY BY switch by comparing the panel-meter indication with the a-c voltmeter reading. The panel-meter reading times the MULTIPLY-BY switch setting should equal the a-c voltmeter reading for any setting of the OUTPUT control or the MULTIPLY BY switch. If checks at lower levels are desired, direct comparison of the c-w output signal level with the output of a reliable signal generator may be made using a receiver with a signal-level meter. The input impedance of the receiver should be considered when calculating absolute signal levels at the cable ends of the WA-21A and the comparison signal generator.

Marker Oscillator Adjustment — The following procedure is recommended if the marker signal is suspected of being off frequency:

1. Set the SWEEP-MARKER-CW switch on "CW," turn the OUTPUT control fully clockwise, and apply power to the instrument by rotating the SCOPE PHASING control clockwise. Allow a half-hour warm-up period.

2. Couple a lead from a heterodyne frequency meter loosely to the wiring near the fixed marker oscillator tube socket (V9).

3. Tune the frequency meter to 22 mc and adjust L19 (see Figure 13 for location) for zero beat as noted on the frequency meter.

4. Remove the frequency-meter lead from the wiring near the socket of the fixed marker oscillator, and couple it to the output cable.

5. Tune the frequency meter to 9 mc, and set the TUNING control on the WA-21A to this same frequency. Adjust C27 (see Figure 13 for location) for zero beat (in the frequency-meter output).

6. Tune the frequency meter, and the TUNING control on the WA-21A, to one mc. Adjust L20 (see Figure 13 for location) for zero beat (in the frequency-meter output).

7. Repeat steps 5 and 6 until the tuning-dial scale on the WA-21A tracks properly.

Spurious Responses — Several trap circuits have been included in the instrument to eliminate spurious responses in the output of the instrument. If spurious responses, such as a stationary or a movable beat, or a fuzziness of the trace are observed, then these traps may be carefully adjusted in an endeavor to eliminate the spurious signal. If the adjustment of a certain trap does not eliminate the spurious signal, then carefully reset the trap to its original setting, and proceed to the next one. The locations of these adjustments are shown in Figure 13, and they consist of trimmer capacitors C87, C88, C89, and C92.

Adjustment of the Modulation Capacitor — The modulation capacitor in the WA-21A has been factory-adjusted to very rigid specifications and should not require service in the course of normal use. DO NOT ATTEMPT ANY ADJUSTMENTS TO THIS ASSEMBLY UNLESS IT HAS BEEN DEFINITELY ASCERTAINED THAT A DEFECT EXISTS.

If the modulation capacitor becomes noisy in operation, the trouble may be due to the coil assembly rubbing against the pole piece, or the capacitor plates shorting during some part of the sweep cycle. This latter condition will also be indicated by a break in the response curve of the Sweep Generator (or the circuit under test) at the point at which the short occurs.

The following procedure should be followed when the capacitor is serviced:

1. Remove the capacitor assembly from the WA-21A.

2. Remove the bakelite top plate by removing the four bolts ("A" in Figure 15). Place the top plate to one side; be careful not to damage the stator plates.

3. Apply 0.5 volt a-c to the unit. If the noise still continues, the coil is rubbing against the pole piece. (The noise which indicates faulty operation is different from the normal, smooth buzzing sound of a unit in good operating condition. It is louder and often erratic.) If the rubbing noise is no longer present when the stator assembly is removed, skip section 4 below and continue with section 5.

4. Loosen the four clamps, "C" in Figure 15, and, with the coil energized, shift the coil-support ring slightly until the noise disappears. Tighten the ring clamps, and make sure that the coil is not rubbing after the clamps are tightened. DO NOT LOOSEN ANY OF THE SUPPORT SCREWS ("N"), FOR THE STRAP CLAMPS OR THE CAPACITOR WILL PROBABLY BE DAMAGED BEYOND REPAIR.

5. Carefully replace the bakelite plate; do not tighten the mounting bolts.

6. The stator plates can be roughly centered by shifting the bakelite plate until the rubbing noise is not present. In order to insure maximum linearity, however, it will be necessary to center the stator plates exactly. The setup illustrated in Figure 16 is suggested for centering the stator.

7. Connect the vibrating capacitor as shown in Figure 16. Make the connecting leads to the capacitor plates as short as possible.

8. Apply 0.5 volt a-c to the terminals of the coil.

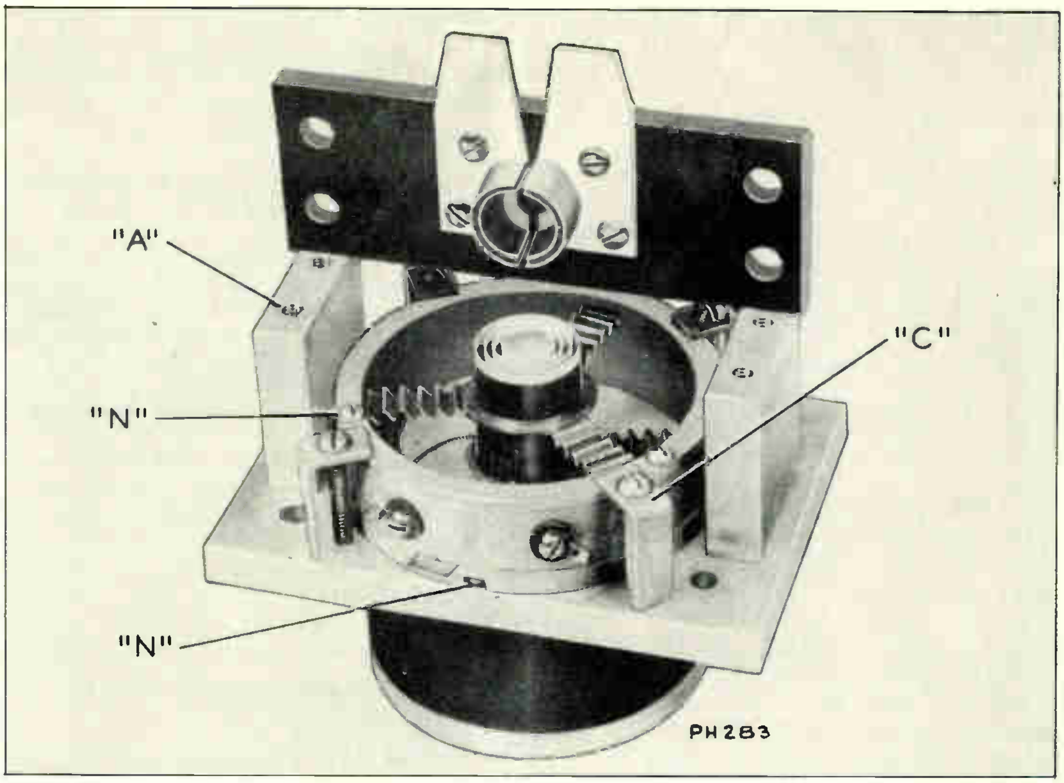


Figure 15—Modulation Capacitor

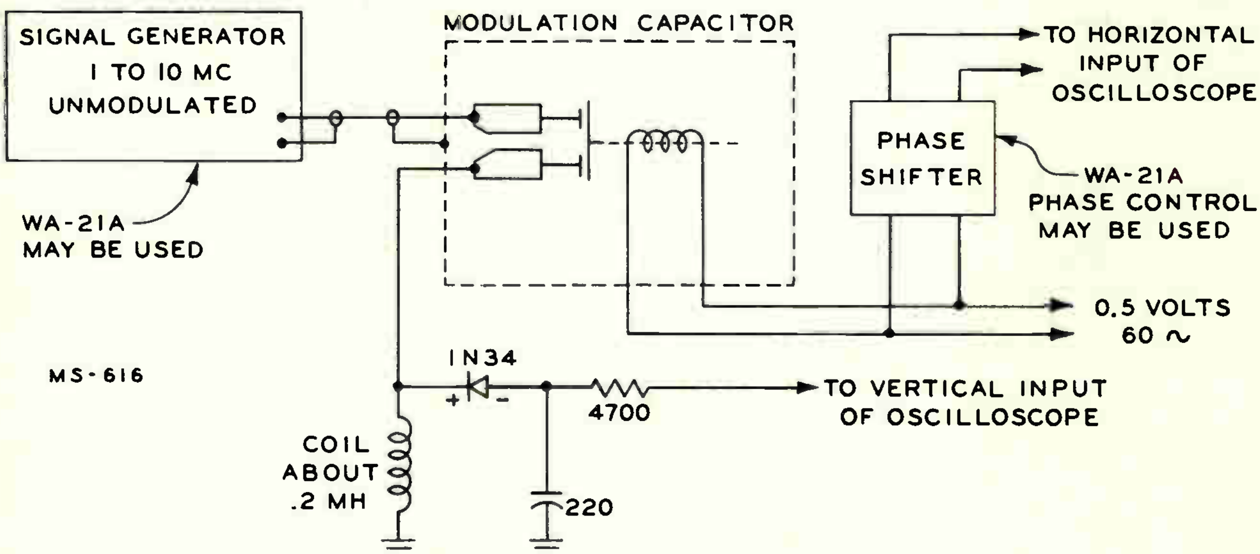


Figure 16—Modulation Capacitor Test Setup

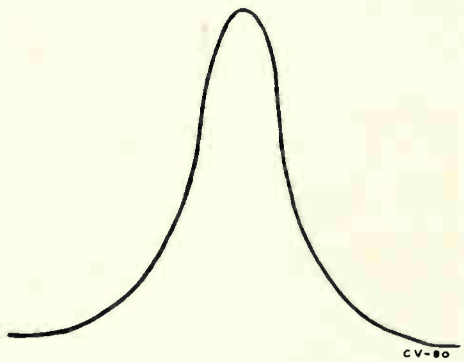


Figure 17—Response Curve

9. Adjust the signal generator output to approximately 0.1 volt.

10. Vary the frequency of the signal generator until the tuning of the vibrating capacitor and the test coil is found to sweep through the generator frequency (This should be approximately 4 mc for the coil shown in Figure 16.)

11. Adjust the phase shifter until the trace illustrated in Figure 17 is obtained.

12. Slowly increase the frequency of the signal generator and note in which direction the trace of Figure 17 moves.

13. Shift the bakelite plate until the curve is moved the maximum amount in the OPPOSITE direction from that noted in step 12. At this point the stator plates will be most nearly centered within the movable plates.

14. Tighten the support bolts for the bakelite plate.

Voltage Measurements — Operating voltages should be within ±20% of those indicated on the schematic diagram, Figure 18, when measured with a high-resistance voltmeter and a power source of 117 volts a-c.

Resistance Measurements — All resistances should be within ±10% of the values shown on the schematic diagram.

Voltage-Regulator Adjustment — Adjust the VOLTAGE REGULATOR control (R77) on the rear apron for a d-c voltage of 260 volts, as measured from the cathode of either V11 or V14 to ground.

Fuse Replacement — Two cartridge fuses are located on the rear apron for protection against overload and internal short circuits. If fuse replacement is necessary, use only fuses with a 3-ampere rating.

Aligning the Video Amplifier — If, when the instrument is set up as described in the section on Operation, with the BLANKING switch set to "ON," the top line of the rectangular trace obtained is not straight and parallel to the bottom line (see Figure 4 for correct trace shape) then the video amplifier may need realignment. This is accomplished by adjusting L21, L22, and L23 (see Figure 13 for location) for the required flat-top response. This response should be obtained when the core studs are in their approximate mid-position.

REPLACEMENT PARTS LIST

VIDEO SWEEP GENERATOR

TYPE WA-21A

Symbol No.	DESCRIPTION	Stock No.
C-1	Capacitor—Mica, 2700 mmfd., ±10% 500 Volts	39662
C-2, 3	Capacitor—Mica, 56 mmfd., ±10% 500 Volts	39622
C-4	Capacitor—Ceramic, 1000 mmfd., ±20% 300 Volts	71929
C-5	Same as C-1	
C-6	Capacitor—Mica, 3300 mmfd., ±20% 500 Volts	39664
C-7	Same as C-4	
C-8	Capacitor—Mica, 5600 mmfd., ±10% 500 Volts	39670
C-9	Capacitor—Mica, 82 mmfd., ±10% 300 Volts	55328
C-10	Capacitor—Mica, 10 mmfd., ±10% 300 Volts	39604
C-11, 12	Same as C-4	
C-13	Capacitor—Mica, 22 mmfd., ±10% 300 Volts	39612
C-15	Capacitor—Mica, 560 mmfd., ±10% 300 Volts	53111
C-16	Same as C-1	
C-17, 18	Same as C-4	
C-19	Capacitor—Molded Head Lead Type, 4.7 mmfd., 500 V.	54402
C-20	Same as C-4	
C-21	Capacitor—Ceramic, 1500 mmfd., ±20% 300 Volts	58244
C-22	Same as C-13	
C-23, 24	Same as C-4	
C-25	Same as C-10	
C-26	Same as C-4	
C-27	Capacitor—Variable, Ceramic 5-20 mmfd.	55301
C-28	Capacitor—Mica, 100 mmfd., ±10% 300 Volts	39628
C-29	Capacitor—Variable, 7 to 100 mmfd.	18384
C-30	Same as C-4	
C-31	Same as C-1	
C-32	Same as C-4	
C-33	Capacitor—Mica. 12 mmfd., ±10% 500 Volts	39606
C-34	Same as C-4	
C-35	Same as C-28	
C-36	Same as C-2	
C-37, 38	Same as C-4	
C-39-1 & 2	Capacitor—Paper, Dual .5-.5 mfd., 400 Volts .71673 &	91577
C-40	Same as C-4	
C-41	Capacitor—Ceramic, 9 mmfd., 500 Volts	55571
C-42	Capacitor—Mica, 200 mmfd., ±5% 500 Volts	39635
C-43	Same as C-4	
C-44, 51	Same as C-39	
C-45	Same as C-39	
C-46	Same as C-39	
C-47, 48	Same as C-4	
C-49	Same as C-42	
C-50	Same as C-41	
C-52, 61	Same as C-39	
C-53, 54, 55	Same as C-4	
C-56	Same as C-39	
C-57	Same as C-4	
C-58	Same as C-41	
C-59	Same as C-42	
C-60	Same as C-4	
C-62	Same as C-1	
C-63	Same as C-4	

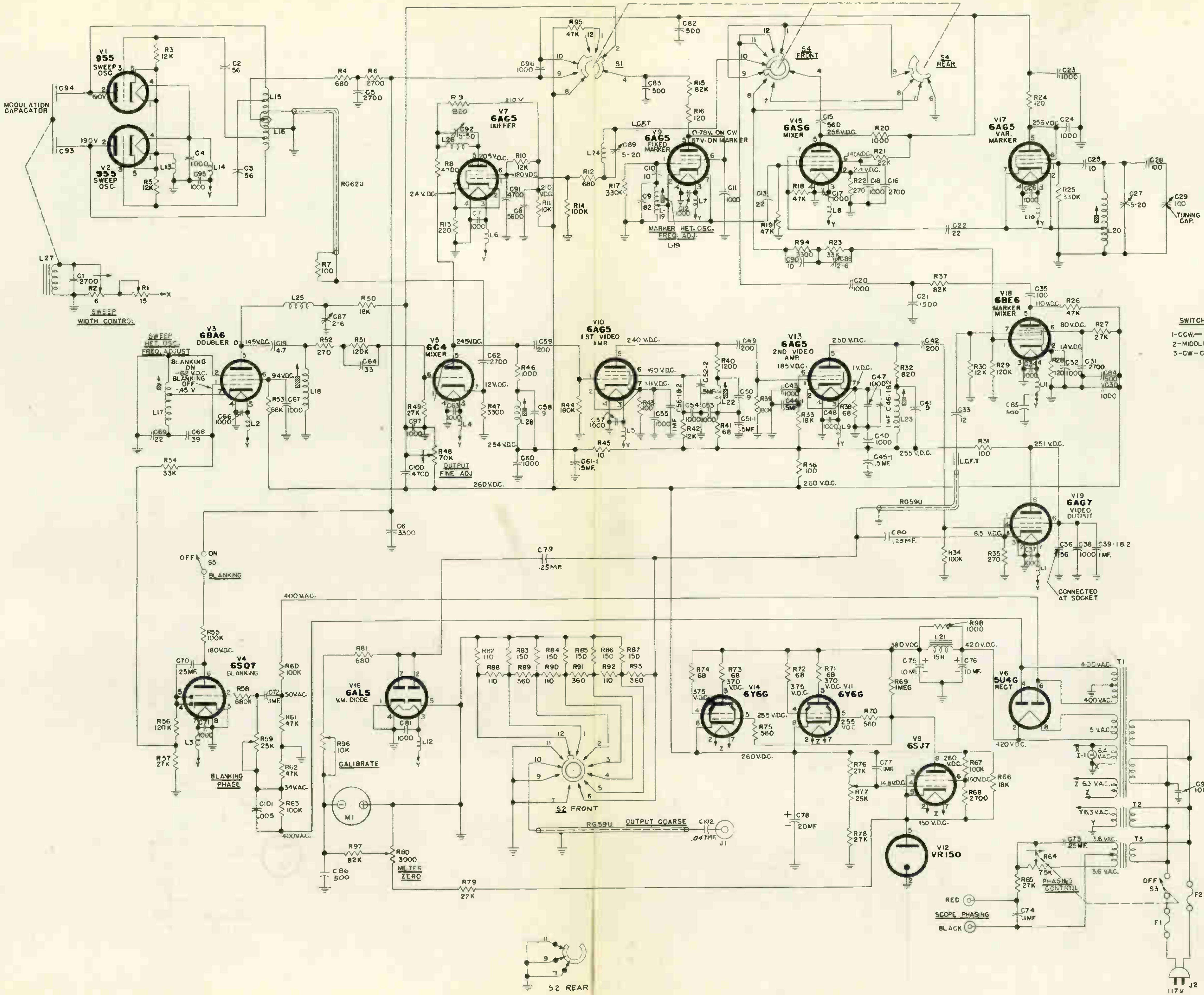
Symbol No.	DESCRIPTION	Stock No.
C-64	Capacitor—Mica, 33 mmfd., ±10% 300 Volts	39616
C-66, 67	Same as C-4	
C-68	Capacitor—Mica, 39 mmfd., ±10% 300 Volts	39618
C-69	Same as C-13	
C-70	Capacitor—Tubular, .25 mfd., ±20% 400 Volts	70618
C-71	Same as C-4	
C-72	Capacitor—Tubular, .1 mfd., ±20% 400 Volts	73551
C-73	Same as C-70	
C-74	Same as C-72	
C-75, 76	Capacitor—Paper, 10 mfd., 600 Volts	52734
C-77	Capacitor—Oil Treated, 1 mfd., 400 Volts	45807
C-78	Capacitor—Dry Electrolytic, 20 mfd., ±10% 450 V.	56243
C-79, 80	Same as C-70	
C-81	Same as C-4	
C-82, 83, 84, 85, 86	Capacitor—Feed Thru, 500 mmfd.	55300
C-87	Capacitor—Trimmer, 2-6 mmfd.	47456
C-88	Capacitor—Trimmer, 2-6 mmfd.	51481
C-89	Capacitor—Trimmer. 5-20 mmfd.	64689
C-90	Same as C-10	
C-91	Capacitor—Mica, 4700 mmfd., ±5% 500 Volts	53112
C-92	Capacitor—Trimmer, 5-50 mmfd.	54681
C-93, 94	Part of L-27	
C-95, 96, 97	Same as C-4	
C-99	Same as C-4	
C-100	Same as C-91	
C-101	Capacitor—Paper Tubular, .005 mfd., 1000 Volts D.C.	70648
C-102	Capacitor—Molded Paper, .047 mfd., ±20% 500 Volts	73558
J-1	Holder—Fuse Holder	48551
L-2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	Reactor—R.F. Choke Insulated, 1.8 MU. H. ±10%, 1.6 Ohms ±20% .56 Amp.	59430
L-17	Transformer — Sweep Heterodyne Freq. Control Adjusting	55563
L-18	Transformer—Doubler	55564
L-19	Transformer—Frequency Control Inductor	55565
L-20	Transformer—Variable, Marker Osc., Freq. Control Inductor	55566
L-21	Coil—Choke, Impedance at 3 Volts, 60 Cy. A.C. and .175 Amp. D.C. shall be 4050 Ohms	48554
L-22, 23	Coil—Peaking	55569
L-24	Coil—R.F. Choke	54683
L-25	Coil—R.F. Choke	55570
L-26	Same as L-24	
L-27	Capacitor—Vibrator Capacitor Assem. (Incl. C-93 & C-94)	55533
L-28	Same as L-22	
R-1	Resistor—Adjustable, Wire Wound 15 Ohms	48547
R-2	Resistor—Variable, 6 Ohms, 25 Watt	55567
R-3	Resistor—Carbon, 12,000 Ohms ±10% ½ Watt	30436

Symbol No.	DESCRIPTION	Stock No.
R-4	Resistor — Carbon, 680 Ohms ±10% 1 Watt	19233
R-5	Same as R-3	
R-6	Resistor — Fixed Composition, 2700 Ohms, ±10% 2 Watt	33855
R-7	Resistor — Carbon, 100 Ohms, ±10% ½ Watt	34765
R-8	Resistor — Carbon, 4700 Ohms, ±10% ½ Watt	30494
R-9	Resistor — Carbon, 820 Ohms, ±10% ½ Watt	30158
R-10	Same as R-3	
R-11	Resistor—Carbon, 10,000 Ohms, ±10% 1 Watt	71914
R-12	Resistor — Carbon, 680 Ohms, ±10% ½ Watt	12262
R-13	Resistor — Carbon, 220 Ohms, ±10% ½ Watt	5201
R-14	Resistor — Carbon, 100,000 Ohms, ±10% ½ Watt	3252
R-15	Resistor—Carbon, 82,000 Ohms, ±10% ½ Watt	8064
R-16	Resistor—Carbon, 120 Ohms, ±10% ½ Watt	30189
R-17	Resistor — Carbon, 330,000 Ohms, ±10% ½ Watt	14983
R-18, 19	Resistor—Carbon, 47,000 Ohms, ±10% ½ Watt	30787
R-20	Resistor—Carbon, 1,000 Ohms, ±10% ½ Watt	34766
R-21	Resistor—Carbon, 22,000 Ohms, ±10% ½ Watt	30492
R-22	Resistor—Carbon, 270 Ohms, ±10% ½ Watt	30929
R-23	Resistor—Carbon, 33,000 Ohms, ±10% ½ Watt	30685
R-24	Same as R-16	
R-25	Same as R-17	
R-26	Same as R-18	
R-27	Resistor — Fixed Composition, 27,000 Ohms, ±10% 2 Watt	44213
R-28	Same as R-16	
R-29	Resistor — Carbon, 120,000 Ohms, ±10% ½ Watt	30180
R-30	Same as R-3	
R-31	Resistor—Carbon, 100 Ohms, ±10% 1 Watt	31215
R-32	Resistor—Carbon, 820 Ohms, ±5% ½ Watt	30158
R-33	Resistor—Carbon, 18,000 Ohms, ±10% ½ Watt	3219
R-34	Same as R-14	
R-35	Resistor—Carbon, 270 Ohms, ±10% 1 Watt	30497
R-36	Same as R-31	
R-37	Same as R-15	
R-38	Resistor — Carbon, 68 Ohms, ±10% ½ Watt	34763
R-39	Resistor — Carbon, 180,000 Ohms, ±10% ½ Watt	11959
R-40	Resistor—Carbon, 1200 Ohms, ±5% ½ Watt	30731
R-41	Same as R-38	
R-42	Same as R-3	
R-43	Same as R-7	
R-44	Same as R-39	
R-45	Resistor — Carbon, 10 Ohms, ±10% ½ Watt	34761
R-46	Resistor—Carbon, 1000 Ohms, ±5% ½ Watt	34766
R-47	Resistor—Carbon, 3300 Ohms, ±10% ½ Watt	30733
R-48	Resistor—Variable Wire Wound (Output) 70,000 Ohms	55558

Symbol No.	DESCRIPTION	Stock No.
R-49	Resistor—Carbon, 27,000 Ohms, ±10% ½ Watt	30409
R-50	Same as R-33	
R-51	Same as R-29	
R-52	Same as R-22	
R-53	Resistor—Carbon, 68,000 Ohms, ±10% ½ Watt	14138
R-54	Same as R-23	
R-55	Same as R-14	
R-56	Same as R-29	
R-57	Same as R-49	
R-58	Resistor — Carbon, 680,000 Ohms, ±10% ½ Watt	30562
R-59	Resistor—Variable, Wire Wound, 25,000 Ohms, Screw Driver Slot	55562
R-60	Resistor — Carbon, 100,000 Ohms, ±10% 1 Watt	3252
R-61, 62	Resistor—Carbon, 47,000 Ohms, ±10% 1 Watt	71988
R-63	Same as R-60	
R-64	Resistor — Variable Composition, 75,000 Ohms, ±10% (Scope Phasing) (Includes S-3)	55561
R-65	Same as R-49	
R-66	Resistor—Carbon, 18,000 Ohms, ±10% 2 Watt	18757
R-67	Same as R-60	
R-68	Resistor—Carbon, 2700 Ohms, ±10% 1 Watt	14421
R-69	Resistor—Carbon, 1 Megohm, ±10% 1 Watt	71993
R-70	Resistor — Carbon, 560 Ohms, ±10% 1 Watt	38884
R-71, 72, 73, 74	Resistor — Carbon, 68 Ohms, ±10% 1 Watt	36976
R-75	Same as R-70	
R-76	Resistor—Carbon, 27,000 Ohms, ±10% 1 Watt	71990
R-77	Same as R-59	
R-78	Same as R-76	
R-79	Resistor—Carbon, 22,000 Ohms, ±10% 1 Watt	71989
R-80	Resistor — Variable, Composition, 3000 Ohms, ±10%	71674
R-81	Same as R-12	
R-82	Resistor — Carbon, 110 Ohms, ±5% ½ Watt	37968
R-83, 84, 85, 86, 87	Resistor — Carbon, 150 Ohms, ±5% ½ Watt	30880
R-88	Same as R-82	
R-89	Resistor — Carbon, 360 Ohms, ±5% ½ Watt	32065
R-90	Same as R-82	
R-91	Same as R-89	
R-92	Same as R-82	
R-93	Same as R-89	
R-94	Same as R-47	
R-95	Resistor—Carbon, 47,000 Ohms, ±10% ½ Watt	30787
R-96	Resistor—Variable, W.W. 10,-000 Ohms	56381
R-97	Same as R-15	
R-98	Resistor—Carbon, 1,000 Ohms, ±10% 2 Watt	37496
S-1	Switch—Sweep Marker, 1 Section, 3 Position	55556
S-2	Switch—Multiplier, 1 Section, 7 Position	55560
S-4	Switch—Sweep Marker, 1 Section, 3 Position	55568
S-5	Switch — Single Pole, Single Throw Turn Switch, 1 Amp, 250 Volts (Blanking), 3 Amp., 125 Volts	30073

Symbol No.	DESCRIPTION	Stock No.
T-1	Transformer — Power — 50/60 Cycle	48556
T-2	Transformer—Filament — Outline Pri., 117 V., 60 Cy., Sec., 6.3 Volts—6 Amps.	54726
T-3	Transformer—Pri., 115 Volts, Sec., 6.3 Volts Sec. Amps. 1, Pri. VA 14	64306
	Adapter — Male Adapter for Cable to Connector	54246
	Cable—Test Cable with Clip Connector	54663
	Cable—Test Cable with Clip Connector	54664
	Clip—Alligator Clip	53677
	Coil — Voice Coil, Suspension & Ring Assem.	55285
	Connector — Motor Connector Base	47594
	Connector — Single Contact (Male) For Output Cable	66344
	Cord — Power, 96" Long—2 Conductor — Right Angle, 2 Prong Male Plug—Standard Straight Female 2 Contact Plug	52556
	Drive—Vernier Friction Drive (Tuning)	55559
	Fuse—3 Amp. Cartridge Type Glass Body	10907

Symbol No.	DESCRIPTION	Stock No.
	Jack—Pin Jack (Blue)	55239
	Jack—Pin Jack (Red)	55238
	Knob — Control, For Sweep Marker, Tuning, Blanking Scope Phasing, Output Multiply By. (Includes 2 Set Screws)	17268
	Lamp—Pilot Lamp 6-8 Volts	11891
	Meter—RCA Styling, 0 to 200 Micro Amps. D.C., Calibrated 0 to .6 Volt	55557
	Moulding — Shell for Output Cable consists of one Right and 1 Left Hand	47452
	Plug—Output, Amphenol, Single Contact Chassis, Mounting Type	51800
	Plug—Pin Jack	47062
	Resistor — Fixed Composition, 75 Ohms, ±5% ½ Watt	34764
	Socket—Pilot Light Assembly (Red)	48553
	Socket—Tube, 8 Contact, Elastic Stop Nut Mounting	69976
	Socket — Tube, Acorn Type, Ceramic Base, 5 Contacts	9925
	Socket—Tube, Miniature, 7 Pin Type	54271



SWITCH POSITIONS

1-CCW—SWEEP OUTPUT
2-MIDDLE—SWEEP PLUS MARKER
3-CW—CONTINUOUS WAVE OUTPUT

SWITCHES SHOWN FULLY CLOCKWISE (IN CW POSITION).

ALL RESISTANCE VALUES IN OHMS.

ALL CAPACITANCE VALUES BELOW ONE IN MF. AND ABOVE ONE IN MMF. UNLESS OTHERWISE NOTED.

ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION.

ALL VOLTAGES MEASURED TO GROUND USING RCA VOLTOHMYST.

LINE VOLTAGE - 117V. RMS.

Figure 18—Schematic Diagram