

KS-15512 LIST 5
VIDEO FREQUENCY OSCILLOSCOPE
TESTS AND ADJUSTMENTS

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 1. GENERAL		
1.01 This issue replaces Issue 1 to revise the tests and requirements pertaining to the new standard 1958A IRE curve. Marginal arrows indicate changes made to this section.		

- 1 — 358A Plug (shorting plug with bare strap between center conductor and shield)
- 1 — 368A Plug (75-ohm termination)
- 1 — 341F Plug (124-ohm termination)
- 6 — P2BJ Cords, 3 feet long

Notes:

(a) Reference should be made to Section 103-700-100 for use of 28A or 28B impedance matching pads when the 61B Signal Generator is substituted for the 61C or when the 70A Power Meter is substituted for the 70B.

(b) When using the 13A attenuator, attach the coaxial connectors (Schramm connectors) furnished with the attenuator through 75-ohm cables to 358A plugs.

(c) If the H.P. 211A Square Wave Generator or equivalent is not available, the 15.75 kc video signal of the 61C Signal Generator may be substituted. See note in Paragraph 6.03 (j).

1.07 Input Connections:

(a) Apply applicable signal to the desired front or side input jacks. The signal may be balanced or unbalanced. Table I and Table II indicate the proper terminations and terminating points to be used.

TABLE I

For Side Jacks with INPUT Switch in SIDE Position.

SIDE JACK CONNECTIONS FOR VARIOUS SIGNAL INPUTS

JACK DESIGNATION	75-OHM INPUT UNBALANCED VIDEO		124-OHM BALANCED VIDEO
	CONDITION 1 Black Negative Video	CONDITION 2 Black Positive Video	CONDITION 3 Balanced Video
IN-3-T	Signal Input	Short	Signal Input 124-ohm Termination
IN-3-R	Short	Signal Input	
IN-4-T	75-ohm Term.	Open	
IN-4-R	Open	75-ohm Term.	

TABLE II

For Front Jacks with INPUT Switch in FRONT Position.

FRONT JACK CONNECTIONS FOR VARIOUS SIGNAL INPUTS

JACK DESIGNATION	75-OHM INPUT UNBALANCED VIDEO		124-OHM BALANCED VIDEO
	CONDITION 4* Black Negative Video	CONDITION 5* Black Positive Video	CONDITION 6* Balanced Video
IN-1-T	Signal Input	Short	Signal Input 124-ohm Termination
IN-1-R	Short	Signal Input	
IN-2-T	75-ohm Term.	Open	
IN-2-R	Open	75-ohm Term.	

* **Note:** Condition 4 may be used with INPUT switch in 1:1, 10:1, or 100:1 position. Condition 5 or 6 must be used *only* with the INPUT switch in the *1:1 position*. This is also true when using the probe, with which no 75-ohm termination is used.

1.08 Maintenance Caution:

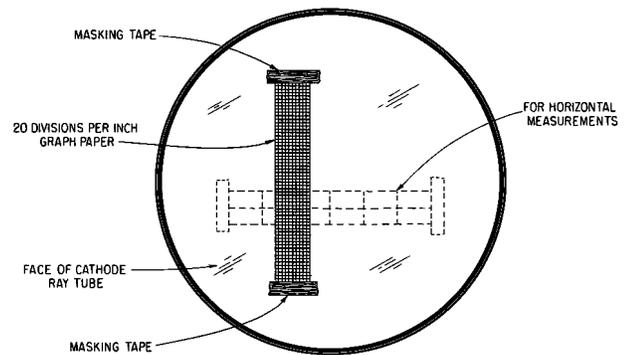
- (a) Make all repairs with power turned OFF.
- (b) When handling the cathode-ray tube, use extreme care. DO NOT hold the tube by the neck when transporting it.
- (c) DO NOT leave the tube exposed on a table, bench, etc. Carefully place the tube in an empty carton with protective insulating material around it.
- (d) DO NOT remove protective shield cover unless power is turned OFF.

1.09 Operating Checks:

- (a) Check that clockwise rotation of the INT control causes an increase of image brightness.
- (b) Check that clockwise rotation of the V CENT and H CENT controls cause the image to move upward and to the right, respectively.
- (c) Check that the FOCUS, H CENT and V CENT controls, when adjusted for normal use, are within 25 to 75 per cent of full rotation.

1.10 Many of the following test procedures utilize the display of the oscilloscope under test as an indicating device. To maintain the necessary accuracy of measurement, the following steps should be taken:

- (a) Adjust the oscilloscope trace for a sharp focus and medium intensity. (This adjustment must be maintained throughout any specific test.)
- (b) Remove the protective front window of the oscilloscope by loosening the four Camlock fasteners holding it to the oscilloscope.
- (c) Remove the scale from the face of the cathode-ray tube.
- (d) Attach a piece of graph paper (20 divisions per inch) approximately 3-inches (60 divisions) long and 1/2 inch wide to the face of the cathode-ray tube vertically or horizontally as illustrated in Fig. 1.
- (e) Make vertical or horizontal deflection measurements by *visually* comparing the signal to the number of divisions on the graph paper. Use the H CENT and V CENT controls to facilitate the measurements.

**Fig. 1**

Caution: Do not subject the face of the cathode-ray tube to any shock or strain. Make all measurements visually.

2. ASTIGMATISM ADJUSTMENT

2.01 The ASTIG control is mounted on the front panel of the oscilloscope and should be adjusted as follows:

- (a) With the INPUT switch turned to CAL, and the SWEEP FREQ control in LO position, adjust the CAL VOLTS control to give a reasonable deflection of a 60-cycle sine wave of about 140 divisions on the modified IRE scale. Adjust the SYNC and FINE-FREQ controls to lock the 60-cycle sine-wave display.
- (b) Adjust the FOCUS and INT controls for sharpest focus at the center of the CRT and for medium intensity.
- (c) Adjust the ASTIG control until the displayed signal has a uniform focus throughout its trace.
- (d) Readjust the FOCUS control for sharpest focus. If necessary, repeat the adjustments of the ASTIG and FOCUS controls.

3. LOW-VOLTAGE REGULATOR ADJUSTMENT

3.01 The following procedure may be used to set the +185V ADJ control.

3.02 Using the KS-14510, L1, Volt-Ohm-Milliammeter, measure the voltage at pin 3 of V13B. Rotate the +185 VOLT ADJ control, located on the right center section of the chassis, for +185 volts, and set with locknut.

4. LOW-FREQUENCY ADJUSTMENT

4.01 The following procedure may be used to set the LOW-FREQ ADJ control.

4.02 Apparatus:

- 1 — 61C Signal Generator
- 1 — 358A Plug
- 1 — 368A Plug
- 1 — P2BJ Cord

4.03 Procedure:

(a) Set the 61C Signal Generator to 60-cycle SQUARE WAVE OUTPUT, (Output 1 and Output 2 switches to 60-cycle SQUARE WAVE).

(b) Using a P2BJ cord, connect the signal generator to the oscilloscope under test. Use input condition 4 (Paragraph 1.07).

(c) Set the SWEEP FREQ control on the LO position and the BANDWIDTH control to WIDE position. Adjust the LOW-FREQ ADJ control, located on the top, left rear of the vertical amplifier subchassis, for optimum transmission of the 60-cycle square wave. Repeat for the 1958A IRE position of the BANDWIDTH switch and leave the LOW-FREQ ADJ control with this setting which should result in a 60-cycle square wave containing no tilt and less than two divisions of bow when the square wave measures 40 divisions. (See Fig. 2.)

Note: Where additional low-frequency compensation is required, remove jumpers from R52 and R53 (see schematic diagram in Section 103-745-102).

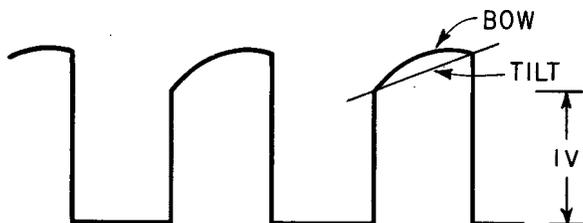


Fig. 2 — 60-Cycle Square-Wave Test Signal

5. HORIZONTAL TRACKING ADJUSTMENT**5.01 Procedure:**

(a) With a composite video signal from a video test signal or an equivalent signal from the broadcaster and with the SWEEP FREQ control in LO position, lock the signal to display two vertical intervals on the oscilloscope by means of the FINE-FREQ and SYNC controls.

(b) Operate the SWEEP FREQ control to the HI position.

(c) Adjust the HOR TRACK ADJ capacitor, C57, for a locked-in display of two horizontal sync pulses on the scope.

(d) The HOR TRACK ADJ capacitor is located on the top to the left front side of the sweep amplifier subchassis.

6. INPUT ATTENUATOR ADJUSTMENT AND CHECK

6.01 The following procedure may be used to adjust the input attenuator.

6.02 Apparatus:

- 1 — 61C Signal Generator
- 1 — P2BJ Cord
- 1 — 358A Plug
- 1 — 368A Plug
- 1 — 100-ohm Resistor, 1/2 Watt
- 1 — CAB-28 Type Inductor or equivalent
- 1 — H.P. 211A Square Wave Generator or equivalent (If not available see note (c) in Paragraph 1.05.)
- 1 — W2DC Cord

6.03 Procedure:

(a) In order to form a series resonance circuit with the oscilloscope input capacity, tie a CAB type 28 coil (slug approximately midway in coil form) and a 100-ohm resistor to the front tip jack, IN-1-T, of the oscilloscope vertical amplifier, as shown in Fig. 3. Short the front jack IN-1-R, and leave the IN-2-T jack unterminated.

(b) With the V GAIN control set approximately 90 per cent maximum counter-clockwise, set the 61C Signal Generator output switch No. 1 to SINE-WAVE OUTPUT, the

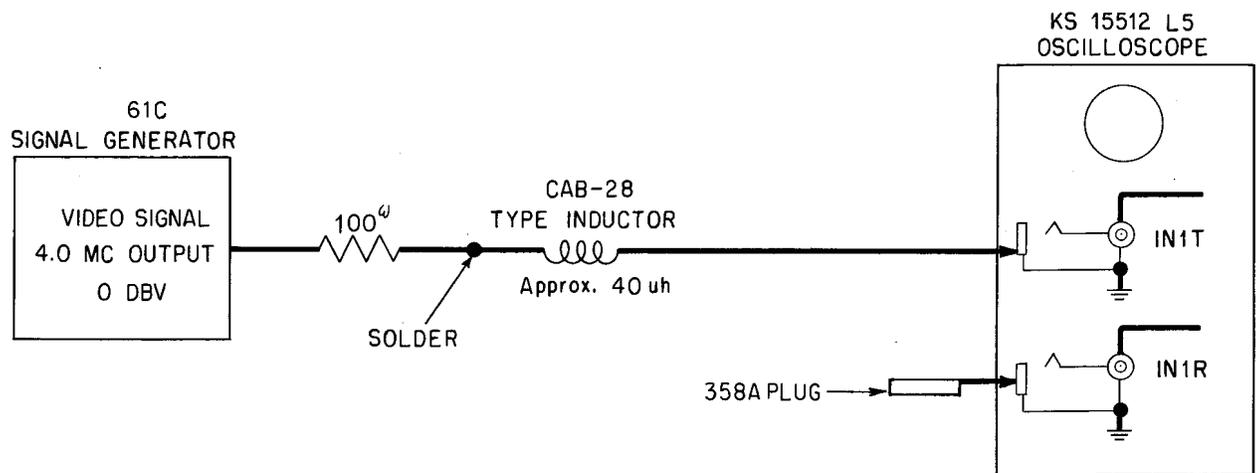


Fig. 3 – Adjusting Input Attenuator

IMPEDANCE switch to 75 ohms, and the sine-wave frequency to 4.0 mc. Set the SINE-WAVE OUTPUT LEVEL switch to give a deflection of 100 IRE divisions on the scope.

(c) Set the oscilloscope INPUT switch to the 1:1 FRONT position and the BANDWIDTH switch to the WIDE position. Peak the series resonant circuit consisting of the CAB coil and the scope input capacity by varying the frequency of the signal generator for a maximum level reading on the scope. Readjust the V GAIN control for a convenient reading (of approximately 140 divisions).

(d) Reset the oscilloscope INPUT switch to the 10:1 position. Reset the V GAIN control for a convenient signal display (of approximately 140 divisions). Adjust C7 (on the INPUT switch) for a maximum signal level reading on the oscilloscope.

(e) Reset the oscilloscope INPUT switch to 100:1 position. Increase the signal generator sine-wave level or the V GAIN control for a convenient signal indication of approximately 140 divisions. Adjust C5 for a maximum signal level reading on the scope.

(f) Remove the CAB-28 type inductor and the 100-ohm resistor. With a P2BJ cord, connect the 75-ohm SINE-WAVE OUTPUT of the 61C Signal Generator to the oscilloscope,

using input condition 4. (See Paragraph 1.07.) Set the oscilloscope BANDWIDTH switch to the NARROW position.

(g) Retaining the 100:1 position of the INPUT switch, set the V GAIN control maximum clockwise and operate the 61C Signal Generator for a 50 kc sine wave with a +10 dbv output. Record the oscilloscope reading. For more accurate readings, use graph paper as described in Paragraph 1.10.

(h) Set the oscilloscope INPUT switch to the 10:1 position and the signal generator level to -10 dbv. (Do not vary the V GAIN control.) The oscilloscope reading should be within $\pm 10\%$ of the reading recorded in (g) above.

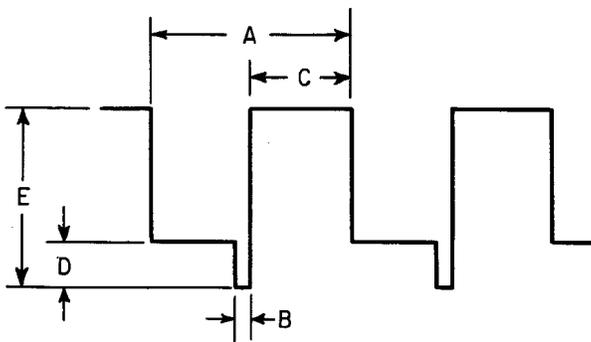
(i) Set the oscilloscope INPUT switch to the 1:1 position and the signal generator level to -30 dbv. (Do not vary the V GAIN control.) The oscilloscope reading should be within 10% of the reading recorded in (h) above.

(j) Set the 211A Square Wave Generator for a 20 kc square-wave output. Connect it to the oscilloscope with a W2DC cord using input condition 4. (See Paragraph 1.07.) If a square-wave generator is not available, a 61C Signal Generator may be substituted using the 15.75 kc video signal. It should be connected to the oscilloscope with a P2BJ cord.

Note: If the 61C is used, a presentation should be observed on another oscilloscope checking for overshoots. If any overshoots are observed, they should be compensated for on the following tests.

(k) Set the INPUT switch to 1:1 position, and the SWEEP FREQ control to HI position. Synchronize and lock in the pattern with the FINE-FREQ and SYNC controls. Set the V GAIN control for a convenient signal amplitude display of about 140 divisions (E in Fig. 4) as observed on the oscilloscope with about 40 divisions of sync (D in Fig. 4).

(l) Reset the INPUT switch to 10:1 position and readjust V GAIN control for a convenient picture display. Adjust C4 to obtain the same wave response as that observed on the 1:1 position. (See Fig. 5.)



- A- COMPLETE VIDEO SIGNAL
- B- SYNC. WIDTH 8% OF A
- C- PICTURE WIDTH 50% OF A
- D- SYNC. AMPLITUDE 25% OF E
- E- SIGNAL AMPLITUDE (MAX)

Fig. 4 - Video Test Signal

(m) Reset the INPUT switch to the 100:1 position and repeat the above procedure, adjusting C2 for the same wave response.

Note: This test cannot be done if a 61C is substituted for the square-wave generator.

7. PROBE ADJUSTMENT

7.01 The following procedure may be used to adjust the oscilloscope for use with its high-impedance probe.

7.02 Apparatus:

- 1 — 211A Square Wave Generator or equivalent
- 1 — Coaxial Multiple Box
- 1 — 358A Plug
- 1 — 368A Plug
- 2 — W2DC Cords

7.03 Procedure:

(a) Connect the square-wave generator to the oscilloscope with a W2DC cord using input condition 4 (Paragraph 1.07). Set the generator for a 20 kc square wave with an output level of 0 dbv. Adjust the V GAIN control of the scope for a convenient picture display with the INPUT switch in 1:1 position. Record presentation.

Note: If a square-wave generator is not available, a 15.75 kc video signal of a 61C Signal Generator may be used. See note in Paragraph 6.03 (j).

(b) Remove the connection from the generator to the oscilloscope. Connect the probe to the oscilloscope. The probe should be inserted into the IN-1-T jack. Insert the 358A

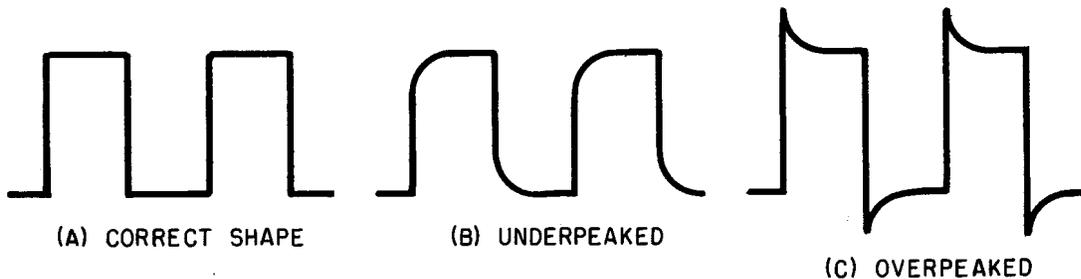


Fig. 5 - Square-Wave Response

shorting plug into the IN-2-R jack. (Do not terminate other jacks.) Set the INPUT switch to the 1:1 position. Feed same signal as in (a) above from the generator to the multiple box with a 368A termination in one jack of the box. Connect the probe to the box with a W2DC cord.

(c) Adjust C70 for the same presentation on the scope as that of the signal fed directly into the scope as in (a) above.

Note: Probes are serialized and adjusted for particular sets and under no circumstances should they be used with other oscilloscopes.

8. HIGH-VOLTAGE ADJUSTMENT

8.01 The following procedure may be used to adjust the second anode voltage on the cathode-ray tube.

8.02 Procedure:

- (a) Check that the ac power to the oscilloscope is 115 volts \pm 1 volt.
- (b) Using the KS-14510, L1, Volt-Ohm-Milliammeter and the KS-14709, L1, High-Voltage Probe, adjust the HIGH VOLTAGE ADJ control, located on terminal board TB-5, for -1400 volts across C46 to ground.

Caution: High-voltage caution to both personnel and equipment should be exercised.

9. VERTICAL AMPLIFIER ALIGNMENT

9.01 The following simplified procedure may be used to align the vertical amplifier.

9.02 Apparatus:

- 1 — 61C Signal Generator
- 1 — 70B Power Meter
- 1 — 13A Pad
- 1 — 13A Attenuator
- 1 — 9A Pad (5 db)
- 1 — 358A Plug
- 1 — 368A Plug
- 5 — P2BJ Cords

9.03 Procedure:

- (a) Set up the equipment as illustrated in Fig. 6.

(b) Adjust the signal source for a 1-volt peak-to-peak, 100 kc, 0 dbv sine-wave reading on the power meter.

(c) Arrange the oscilloscope for input condition 1 (Paragraph 1.07) with the BANDWIDTH switch in the WIDE position and the V GAIN control set maximum clockwise. (Tape graph paper — 20 lines per inch — to oscilloscope per Paragraph 1.10.)

(d) Adjust the 13A attenuator and if necessary the V GAIN control for a vertical deflection of 2 inches (40 divisions on graph paper) on the scope.

(e) Reset the signal generator frequency to 5 mc at the same level as indicated by a 0 dbv reading on the 70B Power Meter. Then adjust L7 on the vertical amplifier panel for a 2-inch (40 divisions on graph paper) deflection. Do not vary the 13A Attenuator or the V GAIN control from the setting used in Paragraph (d), above, during this adjustment.

(f) Use equipment arrangement illustrated in Fig. 7 and maintain input condition 1 to the oscilloscope. Adjust the signal source for a 1-volt peak-to-peak, 100 kc, 0 dbv indication on the power meter. Readjust the V GAIN control for a 1-inch deflection on the CRT.

(g) Apply a 5 mc signal at the same level as indicated by the 70B Power Meter (0 dbv). Do not vary the 13A Attenuator or the V GAIN control from their previous settings. Adjust L1 for the same 1-inch deflection.

Note: L1, L2, L3, and L4 are located to the front, on the top side of the vertical amplifier chassis.

(h) Set the oscilloscope for input condition 2 (Paragraph 1.07). Adjust the signal source for a 1-volt peak-to-peak, 100 kc, 0 dbv reading on the 70B Power Meter. Adjust the V GAIN control for a 1-inch deflection on the cathode-ray tube.

(i) Apply a 5 mc signal at the same level as indicated on the 70B Power Meter (0 dbv). Do not vary the 13A attenuator or the V GAIN control from their previous settings. Adjust L2 for the same 1-inch deflection.

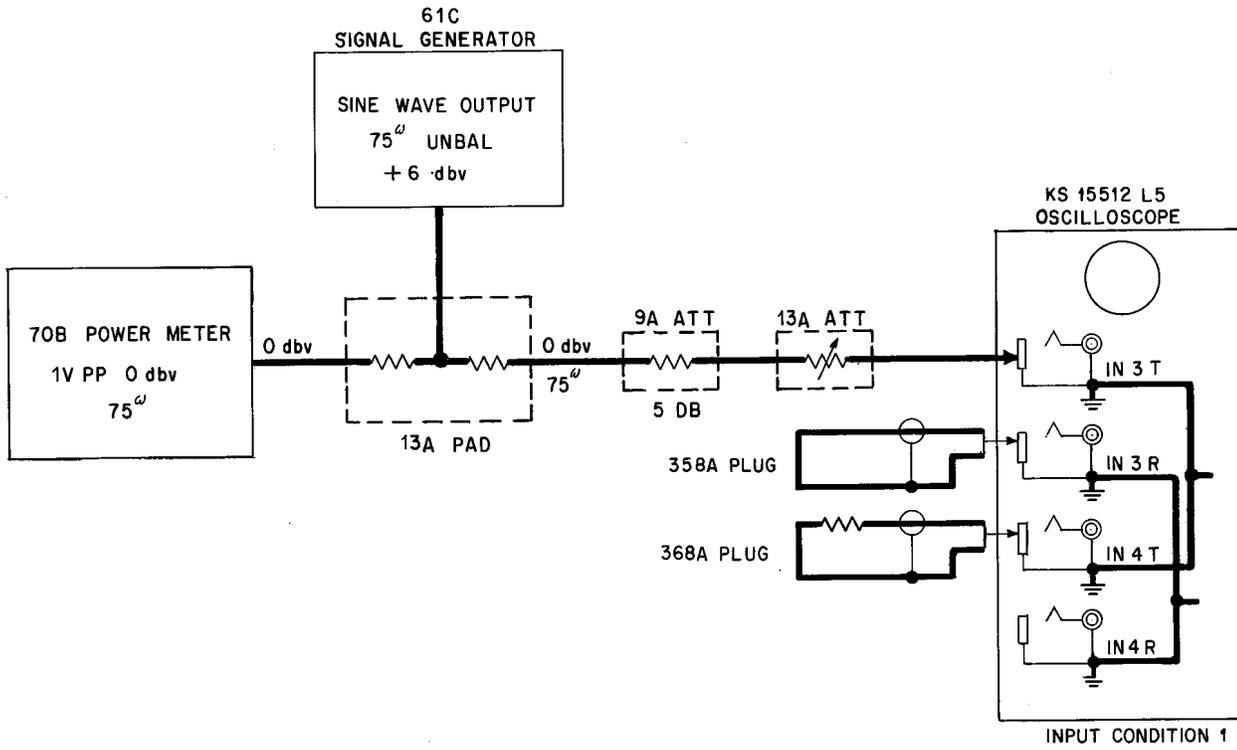


Fig. 6 – Vertical Amplifier Alignment

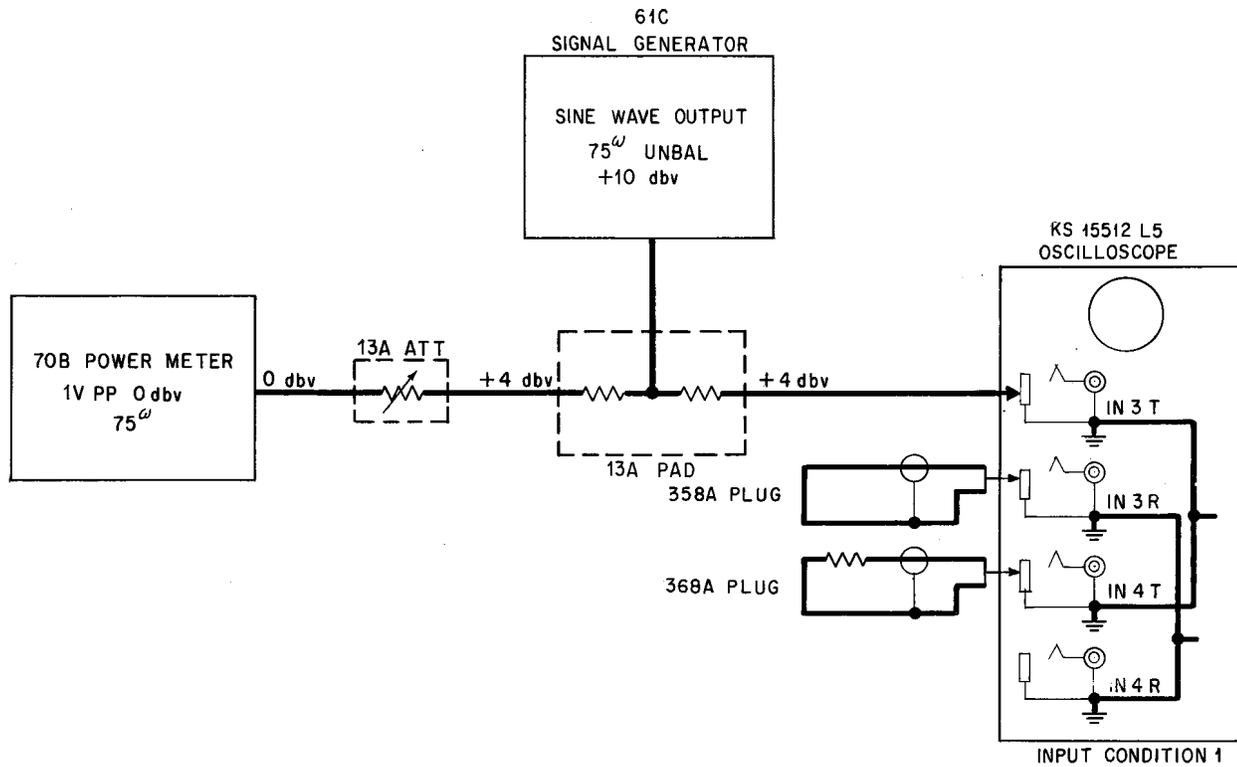


Fig. 7 – Vertical Amplifier Frequency Response

(j) Set the BANDWIDTH switch to the NARROW position and the signal generator for a 3.58 mc signal with a level of 0 dbv as read on the 70B Power Meter. Adjust L3 and L4 for a null on the cathode-ray tube.

10. VERTICAL AMPLIFIER FREQUENCY RESPONSE AND SENSITIVITY CHECK

10.01 For a frequency response check of the vertical deflection amplifier, the following procedure may be used.

10.02 Apparatus:

- 1 — 61C Signal Generator
- 1 — 70B Power Meter
- 1 — 13A Pad
- 1 — 13A Attenuator
- 1 — 9A Attenuator (5 db)
- 1 — 9A Attenuator (20 db)
- 1 — 358A Plug
- 1 — 368A Plug
- 6 — P2BJ Cords

10.03 Procedure:

(A) WIDE Bandwidth (high and low level checks)

(1) Set up the equipment as illustrated in Fig. 7. On the oscilloscope use input condition 1 (Paragraph 1.07). Set the INPUT switch to SIDE position, the BANDWIDTH switch to WIDE position, and the SWEEP FREQ switch to HI position, and the H GAIN control fully counterclockwise. Adjust the signal source for a 1-volt peak-to-peak, 100 kc sine wave with a level of 0 dbv as read on the power meter. Set the V GAIN for a readable vertical deflection of about 2 inches. Check the trace for high-frequency crosstalk pickup, which would appear as a horizontal spreading at either end of the vertical trace in the form of a loop which should not exceed one division of 20 lines to the inch graph paper. Also by switching the SYNC SELECTOR control from + to -, high-frequency crosstalk pickup is indicated by a rotation of the axis of the vertical trace. This rotation of axis

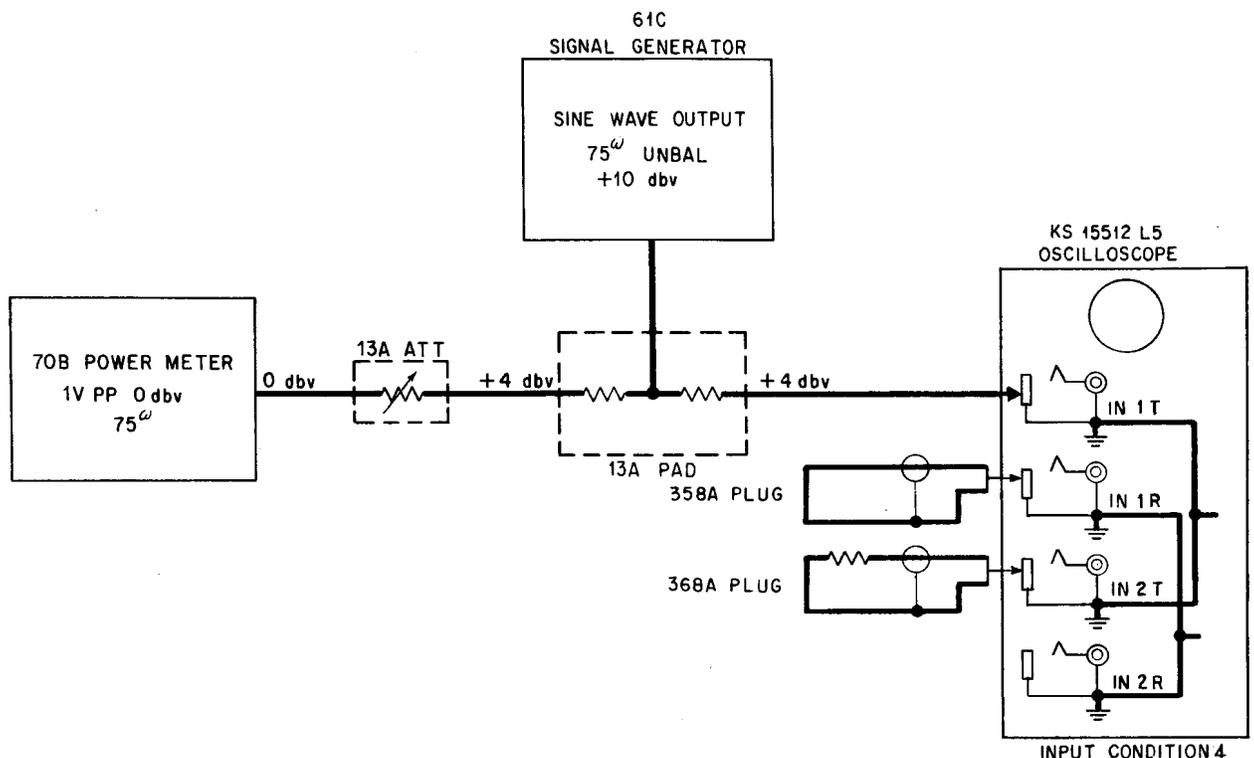


Fig. 8 — Vertical Amplifier Frequency Response

should not exceed a displacement of one division (on graph paper) at either end of the trace.

(2) Set the SWEEP FREQ control to LO position and adjust the H GAIN control for desired width of the horizontal sweep. Adjust the V GAIN control for a vertical deflection of 1-inch (20 divisions on graph paper) on the scope. Without readjusting the V GAIN control, maintain the reference output level of the generator to measure the gain frequency response of the vertical amplifier over the range from 100 kc to 10 mc, which should fall within the limits specified below where values in parentheses indicate differences from 20 divisions expressed in db (see below).

(3) Readjust the signal generator to furnish a 100 kc sine-wave signal sufficient to provide a 0 dbv reading on the 70B Power Meter and a 1-inch (20 divisions on graph paper) deflection on the oscilloscope. Without readjustment of the V GAIN control set up condition 4 (Paragraph 1.07) on the scope. (See Fig. 8.) The vertical deflection should be 1-inch ± 0.025 inch (20 divisions ± 0.5 division on graph paper).

(4) Readjust the V GAIN control for a 1-inch deflection. Still using input condition 4, measure the gain-frequency re-

sponse by repeating steps outlined in Paragraph 10.03 (A-1).

(5) Rearrange the test equipment to conform with the arrangement illustrated in Fig. 6. Set the oscilloscope for input condition 1 (Paragraph 1.07). Adjust the signal generator for a 1-volt peak-to-peak, 100 kc sine-wave signal with a 0 dbv level as read on the power meter. Set the V GAIN control maximum clockwise and vary the 13A attenuator (if necessary, also readjust the V GAIN control) for a 2-inch (40 divisions on graph paper) deflection on the scope. Without readjusting the V GAIN control or the attenuator, maintain the reference output of the generator to measure the gain-frequency response of the vertical amplifier over the range from 100 kc to 10 mc which should fall within the limits specified below where values in parentheses indicate differences from 40 divisions expressed in db (see table on page 11).

→ (B) 1958A IRE Bandwidth

(1) Readjust the signal generator for a 1-volt peak-to-peak, 100 kc sine wave with a level of 0 dbv as read on the power meter. Operate the BANDWIDTH switch to 1958A IRE position. The deflection should be 2 inches ± 0.05 inch (40 divisions ± 1 division on graph paper).

WIDE

FREQUENCY	DIVISIONS (db)		
	Min	Norm	Max
*100 kc	20.0 (0.0)	20.0 (0.0)	20.0 (0.0)
500 kc	19.8 (-0.1)	20.0	20.2 (+0.1)
1 mc	19.8	20.0	20.2
* 2 mc	19.8	20.0	20.2
* 3 mc	19.8	20.0	20.2
4 mc	19.8	20.0	20.2
* 5 mc	19.8	20.0	20.2
* 6 mc	18.9 (-0.5)	20.0	20.2
7 mc	17.9 (-1.00)	19.8 (-0.10)	20.2
8 mc	16.8 (-1.5)	19.4 (-0.25)	20.2
9 mc	15.9 (-2.0)	18.6 (-0.75)	20.2
* 10 mc	15.0 (-2.5)	16.6 (-1.6)	20.0

*Test requirements check points unless otherwise specified.

(2) Readjust the 13A attenuator and the V GAIN control for a 2-inch deflection. Without readjusting the V GAIN control or attenuator, maintain the reference level of the generator to measure the response of the amplifier over the range from 100 kc to 5 mc which should fall within the limits specified below where values in parentheses indicate differences from 40 divisions expressed in db (see below).

(3) Readjust the signal generator for a 1-volt peak-to-peak, 10 kc sine-wave signal with a level of 0 dbv as read on the power meter. Adjust the V GAIN or attenuator for a 2-inch deflection on the scope. Without readjustment of the V GAIN control, set up input condition 5 on the scope (Paragraph 1.07). Adjust the output of the

signal generator for a reading of 0 dbv on the power meter. The vertical deflection should be 2 inches \pm 0.05 inch (40 divisions \pm 1 division on graph paper).

(C) NARROW Bandwidth

(1) Readjust the V GAIN control or the attenuator for a 2-inch deflection on the scope. Insert a 20 db 9A attenuator into the line. Operate the BANDWIDTH switch to NARROW position. The vertical deflection should be 2.05 inches \pm 0.1 inch (41 divisions \pm 2 divisions on graph paper).

(2) Readjust the 13A attenuator or the V GAIN control for a 2-inch deflection. Without further readjustment of the V GAIN control or the attenuator, maintain

WIDE

FREQUENCY	DIVISIONS (db)		
	Min	Norm	Max
*100 kc	40 (0.0)	40 (0.0)	40 (0.0)
500 kc	39.6 (-0.1)	40	40.5 (+0.1)
1 mc	39.6	40	40.5
* 2 mc	39.6	40	40.5
3 mc	39.6	40	40.5
4 mc	39.6	40	40.5
* 5 mc	39.6	40	40.5
6 mc	37.8 (-0.5)	40	40.5
7 mc	35.6 (-1.0)	39.6 (-0.1)	40.5
8 mc	33.6 (-1.5)	37.8 (-0.5)	40.0
9 mc	30.0 (-2.5)	34.6 (-1.25)	37.8 (-0.5)
* 10 mc	26.8 (-3.5)	30.2 (-2.25)	35.6 (-1.0)

*Test requirements check points unless otherwise specified.

1958A IRE

FREQUENCY	DIVISIONS (db)		
	Min	Norm	Max
100 kc	40.0 (0)	40.0 (0)	40.0 (0)
500 kc	36.0 (-0.9)	36.9 (-0.7)	37.5 (-0.55)
1 mc	27.4 (-3.3)	29.2 (-2.5)	31.7 (-1.9)
2 mc	12.6 (-10.1)	14.5 (-8.8)	17.8 (-7.2)
3 mc	5.6 (-17.2)	6.4 (-15.9)	7.9 (-14.2)
4 mc	—	2.9 (-22.7)	4.4 (-19.2)

the reference level of the generator to measure the response of the amplifier over the range from 10 kc to 10 mc which should fall within the limits specified below where values in parentheses are differences from 40 divisions expressed in db (see below).

(3) Readjust the signal source for a 1-volt peak-to-peak, 10 kc sine-wave signal with a 0 dbv level as indicated on the power meter. On the oscilloscope, set up input condition 4 (Paragraph 1.07). The vertical deflection should be 2 inches \pm 0.5 inch (40 divisions \pm 1 division on graph paper).

(D) Sensitivity Check of the Vertical Deflection Amplifier

(1) Set up the equipment as illustrated in Fig. 9. Set the oscilloscope for input condition 4 (Paragraph 1.07). Set the BANDWIDTH switch to WIDE position and the INPUT switch to 1:1 position and the V GAIN control maximum clockwise. Set the signal generator for a 1-volt peak-to-peak, 60-cycle sine wave with a level of 0 dbv as read on the power meter. The amplifier sensitivity should indicate a vertical deflection of 0.5 inch (10 divisions on graph paper) or better. Record the deflection.

(2) Operate the INPUT switch to the 10:1 position and remove the 20 db 9A attenuator from the line. The resulting deflection should be within \pm 10% of that noted in Paragraph (1) above.

(E) Vertical Gain Range Control Check

Operate the V GAIN control fully clockwise. Record the deflection. Operate the INPUT switch to 1:1 position and the V GAIN control fully counterclockwise. Record the deflection. The deflection should be less in the 1:1 position with V GAIN control fully counterclockwise than in 10:1 position with V GAIN control fully clockwise.

11. CALIBRATED VOLTAGE AND HUM MEASUREMENT CHECK

11.01 The following simplified tests may be used to check the CAL VOLTS circuit, and also apparent hum voltages existing in the vertical amplifier.

11.02 *Apparatus:*

- 1 — 61C Signal Generator
- 1 — 70B Power Meter
- 1 — 13A Pad
- 1 — 358A Plug
- 1 — 368A Plug
- 4 — P2BJ Cords

NARROW

FREQUENCY	DIVISIONS (db)		
	Min	Norm	Max
* 10 kc	40.0 (0)	40.0 (0.0)	40.0 (0.0)
* 100 kc	36.5 (-0.8)	38.2 (-0.4)	40.0 (0.0)
500 kc	16.0 (-8.0)	20.0 (-6.0)	26.0 (-3.8)
1 mc	8.0 (-14.0)	11.5 (-10.8)	15.6 (-8.2)
2 mc	2.5 (-24.0)	4.8 (-18.4)	7.0 (-15.2)
3 mc	0.8 (-34.0)	2.2 (-25.0)	3.3 (-21.6)
*3.579 mc	0.2 (-46.1)	1.0 (-32.2)	2.0 (-26.0)
* 4 mc	4.6 (-18.8)	9.0 (-13.0)	12.7 (-10.0)
5 mc	3.9 (-21.4)	5.6 (-17.4)	8.6 (-13.4)
6 mc	2.9 (-22.8)	4.2 (-19.6)	5.3 (-17.6)
7 mc	2.5 (-23.9)	3.6 (-20.8)	4.4 (-19.2)
8 mc	2.4 (-24.4)	3.2 (-21.9)	3.9 (-20.2)
9 mc	2.3 (-24.8)	3.0 (-22.6)	3.7 (-20.8)
* 10 mc	2.2 (-25.2)	2.8 (-23.1)	3.4 (-21.4)

*Test requirements check points.

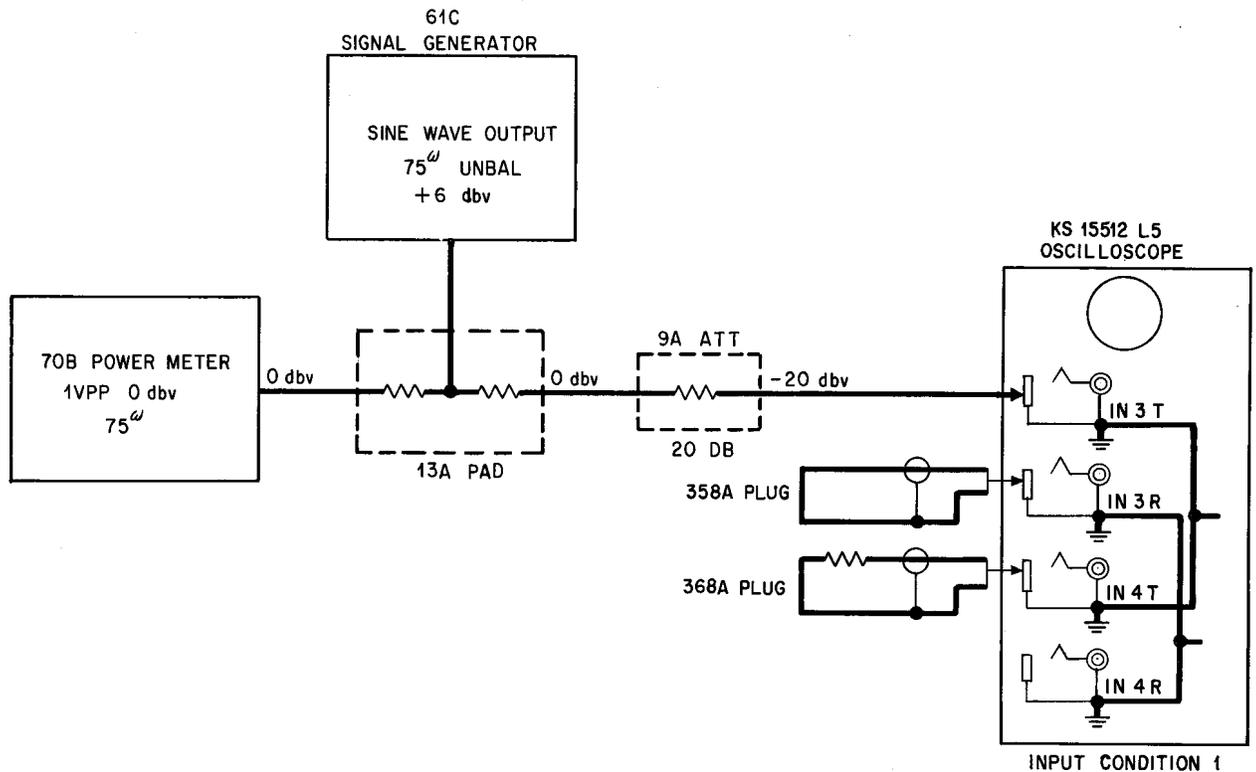


Fig. 9 – Vertical Amplifier Sensitivity

11.03 Set up the equipment as illustrated in Fig. 10. Adjust the signal source for a 1-volt peak-to-peak, 100 kc sine-wave signal at a 0 dbv level as read on the power meter.

11.04 Adjust the V GAIN control for a 2-inch vertical deflection on the scope. Set the scope for input condition 4 (Paragraph 1.07). Set the INPUT switch on 1:1 position. Operate the INPUT switch to CAL position and adjust the CAL VOLT control for a 2-inch deflection. The voltage reading on the meter should be 1-volt \pm 0.1 volt.

11.05 Turn the H GAIN control fully counter-clockwise and examine the vertical trace for any low-frequency crosstalk or noise that will appear as a horizontal displacement in the form of an added tail at the bottom of the trace. This displacement should not exceed two divisions (20 lines per inch graph paper).

11.06 Remove the input signal from the IN-1-T jack. Remove the 358A plug and 368A plug from the IN-1-R jack and IN-2-T jack, respectively. Insert a 341F plug into the IN-1-T and IN-1-R jacks. Measure the deflection on the oscilloscope resulting from hum voltages with the control settings as follows:

INPUT	1:1
BANDWIDTH	NARROW
V GAIN	MAX CLOCKWISE
CAL VOLTS	MAX COUNTER-CLOCKWISE
SWEEP FREQ	LO
H GAIN	APPROXIMATELY 1/4 INCH
SYNC SELECTOR	60 cps
INTENSITY	MINIMUM (for visible trace)

Requirement: The hum voltages should not exceed 0.05 inch (1.0 division).

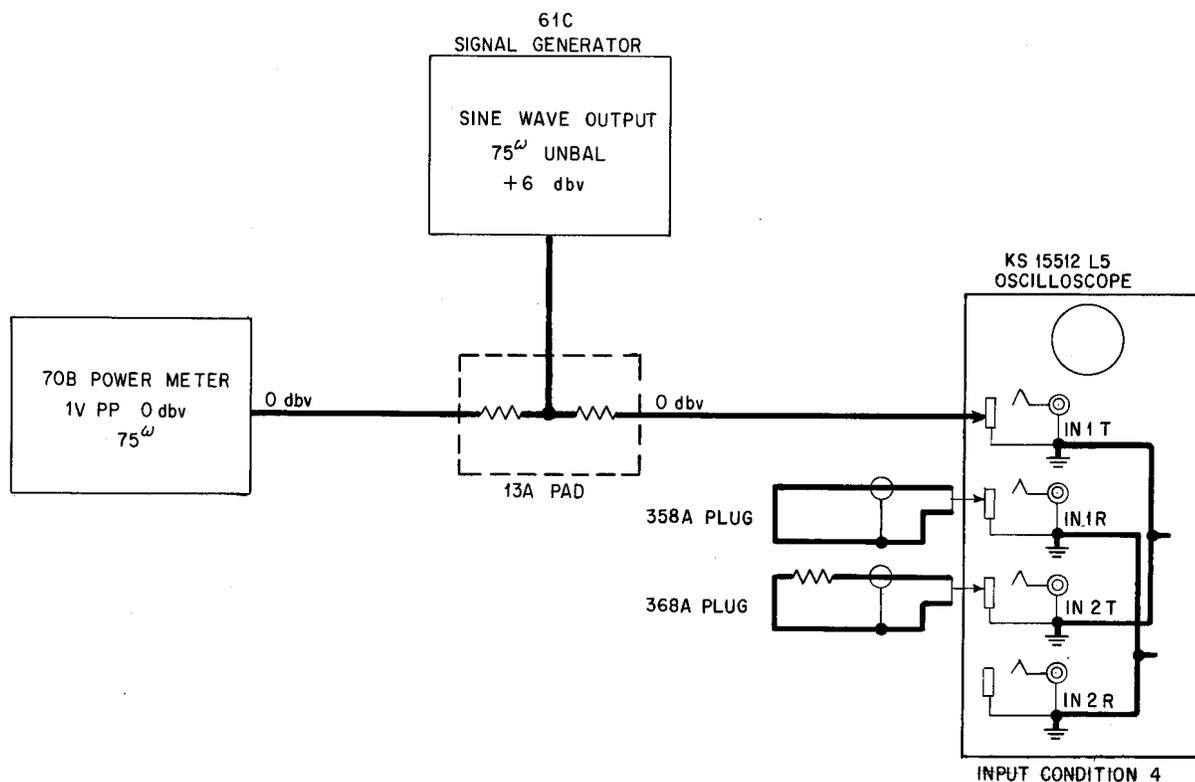


Fig. 10 – Calibrated Voltage Check

12. VERTICAL AND HORIZONTAL AMPLIFIER LINEARITY AND STABILITY CHECKS

12.01 The following simplified tests may be used to check the linearity and stability of the vertical and horizontal amplifiers.

12.02 Apparatus:

- 1 — 61C Signal Generator
- 1 — 13A Attenuator
- 1 — 358A Plug
- 1 — 368A Plug
- 2 — P2BJ Cords

12.03 Measure the video signal compression as follows:

(a) Set up condition 1 (Paragraph 1.07), with the BANDWIDTH switch in the WIDE position, the SWEEP FREQ switch in the H1 position, and the test equipment arranged to conform with the arrangement illustrated in Fig. 11 to supply a video signal with a 50% white picture as shown in Fig. 12.

(b) With no loss inserted in the line, operate the INPUT switch to the CAL position

and adjust the V GAIN control for a 1-volt peak-to-peak indication of 50 divisions.

(c) Operate the INPUT switch SIDE position and adjust amplitude "B" (Fig. 12) for a 1-volt peak-to-peak indication of 50 divisions by varying the 61C picture amplitude control.

(d) Adjust signal amplitude "A" (Fig. 12), if necessary, to equal B/4 or 12.5 divisions by varying the 61C sync amplitude control.

(e) Insert a 10 db loss to the oscilloscope input through the attenuator. (This can be accomplished by adjusting amplitude "B" to 16 divisions by means of the V GAIN control.)

(f) Measure the number of divisions of amplitudes "A" and "B." Note the ratio of "A" to "B" in per cent.

Requirement: The ratio determined should be 25% \pm 1.0%.

12.04 Another approved method for measuring video signal compression using a standard NTSC Color Bar Signal is as follows: Set up

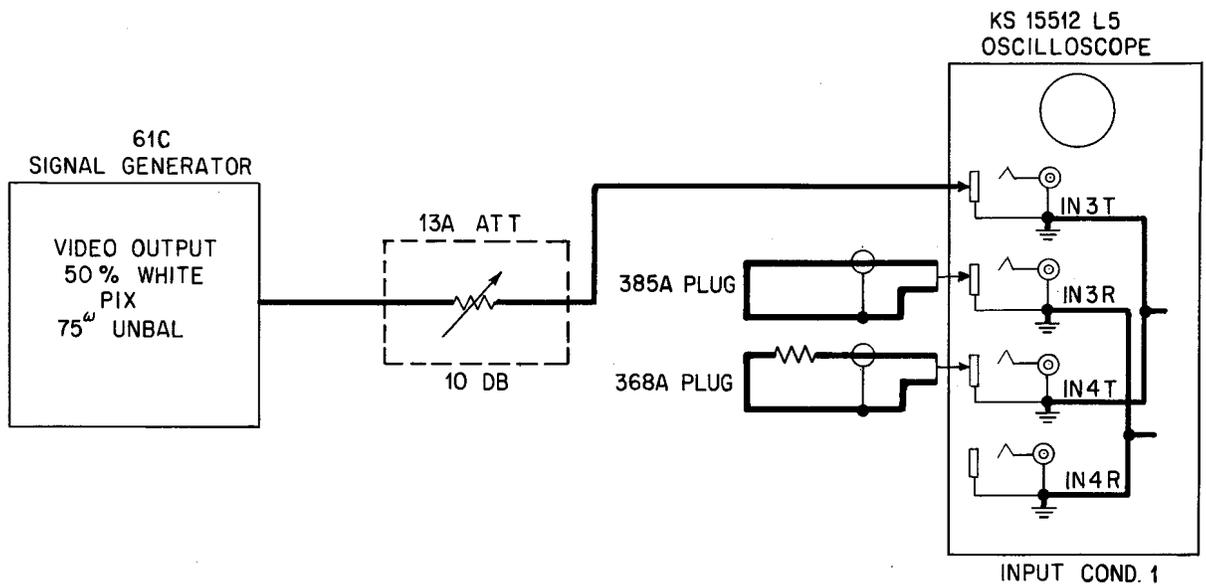


Fig. 11 – Linearity Check

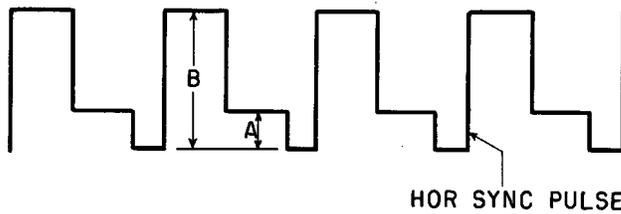


Fig. 12 – Video Signal with 50% White Picture

the Black-to-White levels of the color signal for a 40-division (2-inch) deflection on the scope. Note any compression of this level when the chroma signal is alternately introduced and removed. The compression should not vary more than $\pm 1.0\%$ (0.4 division).

12.05 With a composite video signal from a television test signal or equivalent signal from a broadcaster in which the sync pulses consist of 25 per cent of the total amplitude, the oscilloscope should lock in to give a steady pattern at one-half field frequency (30 cycles) and one-half line frequency (7875 cycles) with input signal amplitudes from 0.25 to 2 volt peak-to-peak (always adjusting the V GAIN control for a 2-inch deflection). With the oscilloscope locked in at one-half line frequency and SWEEP FREQ switch in HI position, adjust the H GAIN con-

trol to expand a 5 microsecond horizontal sync pulse to 2 inches at the base. The pattern obtained should be like that shown in the lower figure (B) of Fig. 13 at all signal amplitudes listed above. If the pattern appears like that of the upper figure (A) and cannot be cleared up by means of the SYNC control, the oscilloscope does not synchronize properly and should be returned for repair to the video equipment maintenance center. Slow drift is not considered to be jitter. Due allowance must also be made for jitter in the test signal.

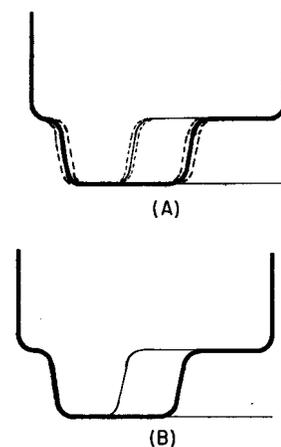


Fig. 13 – Horizontal Sync Pulse Interval

12.06 Synchronize the oscilloscope to lock in at one-half field frequency (30 cps) to display the vertical blanking interval. Reset the H GAIN control maximum clockwise. The width of the vertical blanking interval should not be less than 4 inches. Insert a line voltage noise source (such as turning on an off a power drill). The vertical blanking display should not jump or be displaced more than one division on 20 lines per inch graph paper.

12.07 Apply a 1-volt peak-to-peak composite signal and synchronize the scope to lock in at one-half field frequency rate (30 cps) with the back vertical interval appearing as the display. Operate the SWEEP switch from NORMAL to SPECIAL. Set the H GAIN control maximum clockwise. The width of any of the first three horizontal lines after the vertical blanking pulse should not be less than 2.5 inches.

12.08 Measure the linearity of the 30 cps (LO) sweep by first synchronizing the oscilloscope to lock in at one half of the field frequency and then applying a square wave of a frequency such that 10 waves are displayed on the scope. Adjust the sweep length so that a square wave in the center of the display is 1 inch (20 divisions on graph paper) from leading edge to leading edge. Using the H CENT control to line up successive square waves with the graph paper, measure each square wave from leading edge to leading edge ignoring the first and last waves. The distance measured for any wave should be 1 inch \pm 0.05 inch (20 divisions \pm 1 division on graph paper).

12.09 Operate the SWEEP FREQ switch to EXT position and apply a 20 kc square-wave signal to the EXT SWEEP jack. Check that a horizontal deflection is obtained when the H GAIN control is adjusted maximum clockwise.

13. VOLTAGE AND WAVE-FORM MEASUREMENTS

13.01 Fig. 14 indicates the proper control settings for wave-form and voltage measurements. Voltage measurements were made with the KS-14510, L1, Volt-Ohm-Milliammeter plus a KS-14709, L1, High-Voltage Probe, using a 60 megohm internal resistor, for high-voltage measurements. Ac peak-to-peak voltages were determined with a calibrated oscilloscope having a bandwidth of better than 2 mc. When using Fig. 14, reference should be made to the schematic drawing in Section 103-745-102.

14. PERIODIC TESTS AND TEST INTERVALS

14.01 Table III lists the tests to be made on the KS-15512, List 5, Oscilloscope and gives suggested test intervals. Also for each test listed, corresponding reference paragraph numbers in the section are given for the testing methods and requirements to be employed.

14.02 Oscilloscopes used at remote locations over extended periods should be returned to the serving test room for routine at least once every three months. All other should be routine at the suggested intervals.

TABLE III
PERIODIC TESTS AND TEST INTERVALS
KS-15512, LIST 5, OSCILLOSCOPE

TEST	INTERVAL	PARAGRAPH REFERENCE
1. Operating Checks	(W)	1.09
2. Astigmatism Adjustment	(AR)	2.01
3. Low-Voltage Regulator Adjustment	(AR)	3.01 — 3.02
4. Low-Frequency Adjustment	(AR)	4.01 — 4.03
5. Horizontal Tracking Adjustment	(AR)	5.01
6. Input Attenuator Adjustment and Check	(AR)	6.01 — 6.03
7. Probe Adjustment	(AR)	7.01 — 7.03
8. High-Voltage Adjustment	(AR)	8.01 — 8.02
9. Vertical Amplifier Alignment	(AR)	9.01 — 9.03
10. Vertical Amplifier Frequency Response and Sensitivity Check	(M)	10.01 — 10.03
11. Calibrated Voltage and Hum Measurement Check	(M)	11.01 — 11.06
12. Vertical and Horizontal Amplifier Linearity and Stability Checks	(AR)	12.01 — 12.09
13. Voltage and Wave-form Measurements	(AR)	13.01
Legend: (W) Weekly (M) Monthly (AR) As Required		

SECTION 103-745-502

TEST CONDITIONS FOR VOLTAGE AND WAVEFORM MEASUREMENTS

Controls	Test Conditions	NOTES
Line Voltage	115V., 60 cps	AC voltage measurements are made peak to peak on an oscilloscope with a wide band amplifier such as Tektronix Model 524D.
Video Signal Input	61C Video Signal (100% All White)	
Sweep Frequency	Hi-Position (7875 cps)	DC voltage measurements are made with a 20,000 ohms-per-volt meter.
Sync	Negative	
Intensity	Normal	
Focus	Normal	
Bandwidth	Wide	
Input	1:1 (Unbalanced Input Used)	
H. Gain	5 inch Deflection	
V. Gain	2 inch Deflection	
Normal - Special Switch	Normal - Off	

TUBE			PLATE				GRID				CATHODE			SCREEN	
REF SYM	TYPE	FUNC	PIN NO.	VOLTAGE		WAVEFORM	PIN NO.	VOLTAGE		WAVEFORM	PIN NO.	VOLTAGE		PIN NO.	VOLT D.C.
				D.C.	A.C.			D.C.	A.C.			D.C.	A.C.		
V1	404A	VERT AMP	6	220	.88		1	45	1		4	48	.8	8	220
V2	404A	VERT AMP	6	215	.84		1	45			4	48	.14	8	225
V3	404A	VERT AMP	6	330	1.3		1	205	.88		4	220	.78	8	340
V4	404A	VERT AMP	6	330	1.3		1	205	.84		4	220	.72	8	340
V5	418A	VERT AMP	2	150	43		8	6.5	1.3		4	9		5	170
V6	418A	VERT AMP	2	160	43		8	6.5	1.3		4	9		5	165
V7A	1/2-6AL5	D.C. SETTER	2	55							5	85	43		
V7B	1/2-6AL5	D.C. SETTER	7	65	43						1	110			
V8A	1/2-396A	CATH FOLL	6	180			7	2	0		8	8	8		
V8B	1/2-396A	CATH FOLL	4	180			3	2	1		2	7	8		
V9A	1/2-6SN7	SWEEP GEN	2	100	65		1	0	1.8		3	3	9		
V9B	1/2-6SN7	SWEEP GEN	5	40	10		4	-10	45		6	3	9		
V10A	1/2-6SL7	H. V. REG	2	110			1	2.7			3	7.5			
V10B	1/2-6SL7	BLANK AMP	5	340	41		4	-4	6		6	0			
V11A	1/2-6AW8A	HOR AMP	3	105	4		2	15	.7		1	17	.5		
V11B	1/2-6AW8A	HOR AMP	9	250	120		7	105	.7		6	115	1.6	8	280
V12A	1/2-6AW8A	HOR AMP	3	105	1.7		2	15			1	17	.06		
V12B	1/2-6AW8A	HOR AMP	9	250	120		7	105	1.7		6	115	.6	8	280
V13A	1/2-6BL7	D.C. Series Rect	2	340			1	175			3	185			
V13B	1/2-6BL7	Sweep Bootstrap	5	185			4	39	10		6	50	9		
V14	5R4GY	L. V. RECT									2	360			
V15	2X2A	H. V. RECT	CAP	-1700											
V16	5U1	DISP	8	115			2	-1350			3	-1000		8	115
V17A	1/2-6AW8A	L. V. SHUNT REG	3	175			2	80			1	6.8			
V17B	1/2-6AW8A	SYNC SEP AMP	9	100	28		7	0	.7		6	2.7		8	110
V18	OG 3/85A2	VOLT REG	5	82											
V19A	1/2-6SL7	SYNC SEP	2	90	15		1	-3	7.5		3	0	0		
V19B	1/2-6SL7	CATH FOLL	5	185			4	2	16		6	6	12		

Fig. 14 - Voltage and Wave-form Chart