KS-15512 LIST 4
VIDEO FREQUENCY OSCILLOSCOPE
TESTS AND ADJUSTMENTS

CONTENTS PAGE

1. GENERAL

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

1.02 This section describes the tests, adjustments and requirements associated with the KS-15512, List 4 Oscilloscope.

1.03 The tests and adjustments described in this section should be made in accordance with Part 13. In addition to periodic tests, certain tests may be required from time to time as a result of observation of trouble conditions in connection with routine monitoring tests. The particular tests required in such cases must be determined by the character of the trouble.

1.04 Descriptive and operating principles for the oscilloscopes are contained in Section 103-745-101.

1.05 General instructions on the maintenance and handling of electronic equipment involving hazardous voltages and cathode ray tubes as contained in Sections 010-110-001 and 010-110-002 should be observed.

1.06 ***Test Equipment:*** The tests throughout this section require the use of the following test equipment:

- 1 — KS-14510, List 1, Volt-ohm-milliammeter or equivalent
- 1 — KS-14709, List 1 Test Leads (High Voltage Probe) or equivalent
- 1 — KS-15560, List 1, Vacuum Tube Test Set or equivalent
- 1 — 61C Signal Generator or equivalent
- 1 — 70B Power Meter or equivalent
- 1 — Telechrome Model 1005A Video Transmission Signal Generator or equivalent
- 1 — Variac
- 1 — 13A Attenuator, 75 ohm, 5 db or equivalent
- 1 — 13A Pad
- 1 — 9A Attenuator (20 db)
- 1 — 9A Attenuator (5 db)
- 1 — 368A Plug (75 ohm)
- 1 — 358A Plug (shorting plug with bare strap between center conductor and shield)

3 — P2BJ (unbalanced) cords, 3 feet long

1 — W2DC cord, 3 feet long (with clip on one end)

1 — 1000-ohm Resistor — 1/2 w ±10%

1 — CAB Type 28 Inductor or equivalent (40 μh)

Notes:

(a) Reference should be made to Section 103-700-100 for use of 28A and 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.

1.07 ***Input Connections:***

(a) Apply applicable signal to the desired front or side input jacks. The signal may be balanced or unbalanced. Table 1 and Table 2 indicate the proper terminations and terminating points to be used.

TABLE 1

For Side Jacks with INPUT Switch in SIDE Position

SIDE JACK CONNECTIONS FOR VARIOUS SIGNAL INPUTS

JACK DESIGNATION	75 OHMS INPUT UNBALANCED VIDEO		124 OHMS BALANCED VIDEO
	Condition—1 Black Negative Video	Condition—2 Black Positive Video	Condition—3 Balanced Video
IN-3-T	Signal Input	Short	Signal Input
IN-3-R	Short	Signal Input	
IN-4-T	75 Ohms Term.	Open	124-Ohm Termination
IN-4-R	Open	75 Ohms Term.	

Note: Conditions 1, 2 or 3 may be used with the INPUT switch in the side position only.

TABLE 2

For Front Jacks with INPUT Switch in FRONT Position

FRONT JACK CONNECTIONS FOR VARIOUS SIGNAL INPUTS

JACK DESIGNATION	75 OHMS INPUT UNBALANCED VIDEO		124 OHMS BALANCED VIDEO
	Condition—4* Black Negative Video	Condition—5* Black Positive Video	Condition—6* Balanced Video
IN-1-T	Signal Input	Short	Signal Input
IN-1-R	Short	Signal Input	
IN-2-T	75 Ohms Term.	Open	124-Ohm Termination
IN-2-R	Open	75 Ohms 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 covers unless the power is turned off.

1.09 ***Operating Checks***

(a) Check that clockwise rotation of the INTENSITY 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 approximately centered.

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.

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

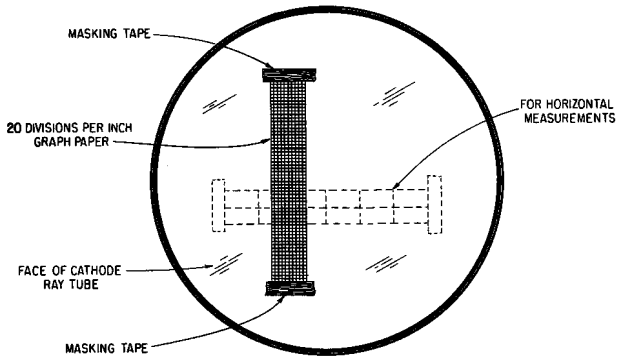


Fig. 1 – Method of Attaching Scale to Cathode Ray Tube

2. ASTIGMATISM ADJUSTMENT

2.01 The ASTIGMATISM control is mounted on the oscilloscope chassis and should be adjusted as follows:

(a) With the INPUT switch turned to CAL, and the Sweep Frequency in LO position, adjust the CAL VOLTS control to give a reasonable deflection of a 60-cycle sine wave of about 140 divisions of the modified IRE scale. Adjust the SYNC and FINE FREQUENCY controls to lock the 60-cycle sine wave display.

(b) Adjust the FOCUS and INTENSITY controls for sharpest focus at center of CRT and medium intensity.

(c) Adjust the ASTIGMATISM control until the displayed signal has a uniform focus throughout its trace.

(d) Readjust FOCUS control for sharpest focus. If necessary repeat adjustments of ASTIGMATISM and FOCUS controls.

3. LOW FREQUENCY ADJUST

3.01 The following procedure may be used to set the LOW FREQUENCY ADJUST control.

3.02 ***Apparatus:***

1 — 61C Signal Generator
1 — P2BJ Cord (unbalanced) 3 feet
1 — 75-ohm Plug (368A Plug)
1 — Shorting Plug (358A Shorted Plug)

3.03 ***Procedure:***

(a) Set the 61C Signal Generator to 60-cycle SQUARE WAVE OUTPUT, (Output 1 and Output 2 Switches to 60-cycle SQUARE WAVE) and use the 1-volt peak-to-peak output signal as illustrated in Fig. 2.

(b) Using a P2BJ Cord connect the square wave signal output to the Oscilloscope under test. Use Input Condition 1 or 4. (See Paragraph 1.07).

(c) On the Oscilloscope, set the BANDWIDTH switch to the WIDE position. Set the Sweep Frequency to LO (SYNC SELECTOR may be set at any position) and lock in the square wave display by adjusting the FINE FREQUENCY and SYNC controls. Set the V GAIN control for a two inch scope deflection.

(d) Vary the LOW FREQUENCY ADJUST control for a minimum of tilt as observed on the square wave display as illustrated in Fig. 2. This control is located on the top, left rear of the vertical amplifier subchassis.

Requirement: No tilt and less than 2 divisions of bow when the square wave measures 40 divisions.

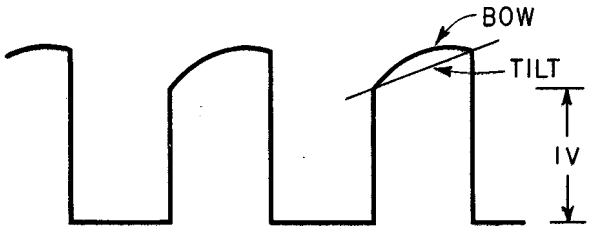


Fig. 2 – 60-Cycle Square Wave Test Signal

Note: When using a 61B Signal Generator, set the MOD-UNMOD switch to MOD and use the Modulated Video output in place of a 60-cycle square wave signal for the low frequency adjust check.

4. HORIZONTAL TRACKING ADJUST

4.01 ***Procedure:***

(a) With a composite video signal from the Telechrome Model 1005A or an equivalent signal from the Broadcaster and with the Sweep Frequency in the LO position, lock the signal in to display two vertical intervals on the oscilloscope under test by means of the FINE FREQUENCY and SYNC controls.

(b) Rotate the Sweep Frequency Control to the HI position.

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

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

5. INPUT ATTENUATOR ADJUSTMENT AND CHECK

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

5.02 ***Apparatus:***

1 — 61B or 61C Signal Generator
1 — P2BJ (unbalanced) Cord, 3 feet long
1 — 368A Plug (75-ohm)
1 — Shorting Plug (358A Shorted Plug)
1 — W2DC Cord with clip end
1 — 1000-ohm Resistor, 1/2 watt
1 — CAB type 28 coil or equivalent

5.03 ***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 1000-ohm resistor to the Front Tip jack, IN-1-T, of the Oscilloscope Vertical Amplifier, as shown in Fig. 3. Short the Front Ring jack IN-1-R, and leave the IN-2-T jack unterminated.

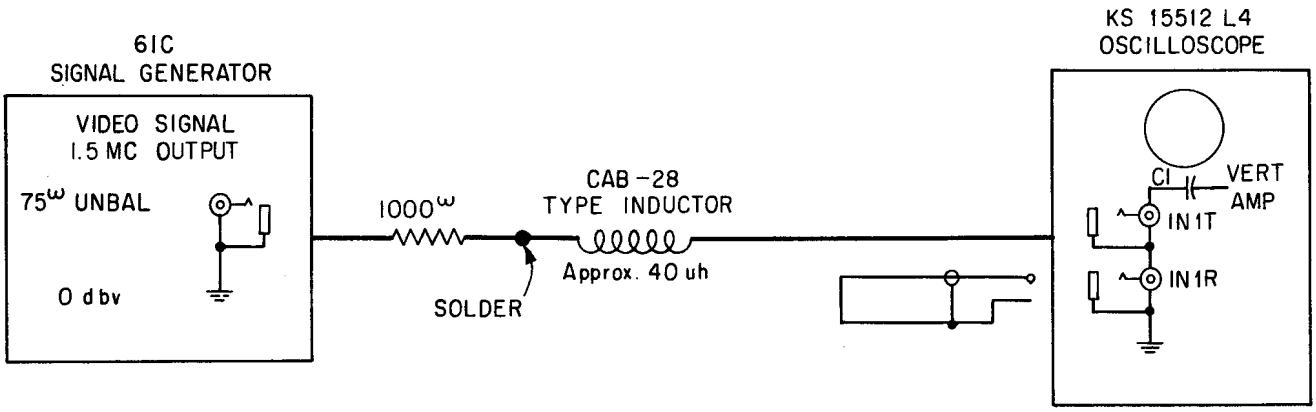


Fig. 3 – Adjusting Input Attenuator

(b) Set the 61-type signal generator Output Switch No. 1 to SINE WAVE OUTPUT, the IMPEDANCE Switch to 75 ohms, and the sine wave frequency to 1.5 mc with the SINE WAVE OUTPUT LEVEL switch at 0 dbv.

(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 61C oscillator frequency 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 signal generator sine wave level or 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 Inductor and the 1000-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 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 +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 ± 10% of the reading recorded in (g) above.

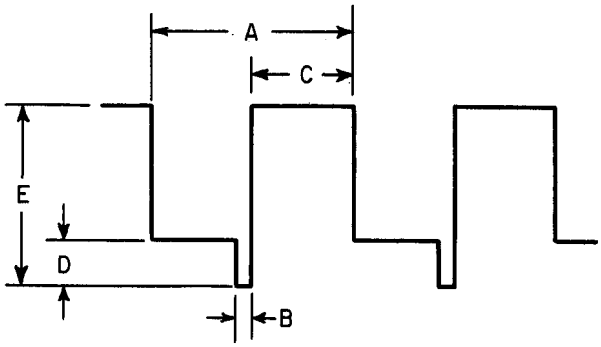
(i) Set the oscilloscope INPUT Switch to the 1:1 position and the signal generator level to −30 dbv. The oscilloscope reading should be within ±10% of the reading recorded in (h) above. (Do not vary the V GAIN control.)

5.04

(a) Set the 61C signal generator to VIDEO SIGNAL OUTPUT, (Output Switch 1 to VIDEO position [Left] Output Switch 2 to UNMOD) for a maximum video signal output. Connect the 61C signal generator to the oscilloscope with a P2BJ (unbalanced) cord, using Input condition 4 (See Paragraph 1.07) and with the INPUT switch in the 1:1 position.

Set the SWEEP FREQUENCY control to the HI position, then synchronize and lock in the

pattern with the FINE FREQUENCY and SYNC controls. Set the V GAIN control for a convenient signal amplitude display (E in Fig. 4) as observed on the oscilloscope screen with about 25% of sync. (D in Fig. 4.)



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

(b) Reset INPUT switch to 10:1 position and readjust V GAIN control for a convenient picture display. Adjust C-4 to obtain the same wave response as that observed on the 1:1 position.

(c) Reset the INPUT switch to the 100:1 position and repeat procedure, adjusting C-2 for the same wave response. If there is not sufficient signal from the 61 Generator for a convenient display, then a signal from a square wave generator should be used to make this 100:1 attenuator adjustment.

6. PROBE ADJUSTMENT

6.01 The following procedure may be used to adjust the probe.

6.02 ***Apparatus:***

1 — 61B or C Signal Generator
1 — P2BJ (unbalanced) Cord
1 — 368A Plug (75-ohm termination)
1 — 358A Shorted Plug
1 — W2DC Cord (with clip)

6.03 ***Procedure:***

(a) Set 61-type Signal Generator per Paragraph 5.04(a) and Fig. 4.

(b) Connect the probe to the oscilloscope. The probe should be inserted into the IN-1-T jack, with a shorting plug applied to the IN-2-R jack. (Do not terminate other jacks.) Set the INPUT switch to the 1:1 position. Feed the video signal from the signal generator to a multiple box with a 75-ohm termination and use a W2DC cord with clip to probe the input to the multiple box.

(c) Adjust C-70 for the same representation on the scope as that of signal when fed directly into the scope. [See Paragraph 5.04(b).]

7. HIGH VOLTAGE ADJUSTMENT

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

7.02 ***Apparatus:***

1 — Variac
1 — KS-14510, L1 Volt-ohm-milliammeter
1 — KS-14709, L1 High Voltage Probe

7.03 ***Procedure:***

(a) Use a Variac in the a-c power feed to the Oscilloscope and set the a-c line voltage for 115 volts indication on the KS-14510, L1 Volt-ohm-milliammeter.

(b) Adjust the HIGH VOLTAGE ADJ control, located on terminal board TB-5, for −1400 volts across C46 to ground.

8. VERTICAL AMPLIFIER ALIGNMENT

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

8.02 ***Apparatus:***

1 — 61B or C Signal Generator
1 — 70B Power Meter
1 — 13A Pad
1 — 13A Attenuator or Equivalent
1 — 9A Attenuator (5 db)
3 — P2BJ (unbalanced) Cords
1 — 358A Shorted Plug
1 — 368A Plug (75-ohm termination)

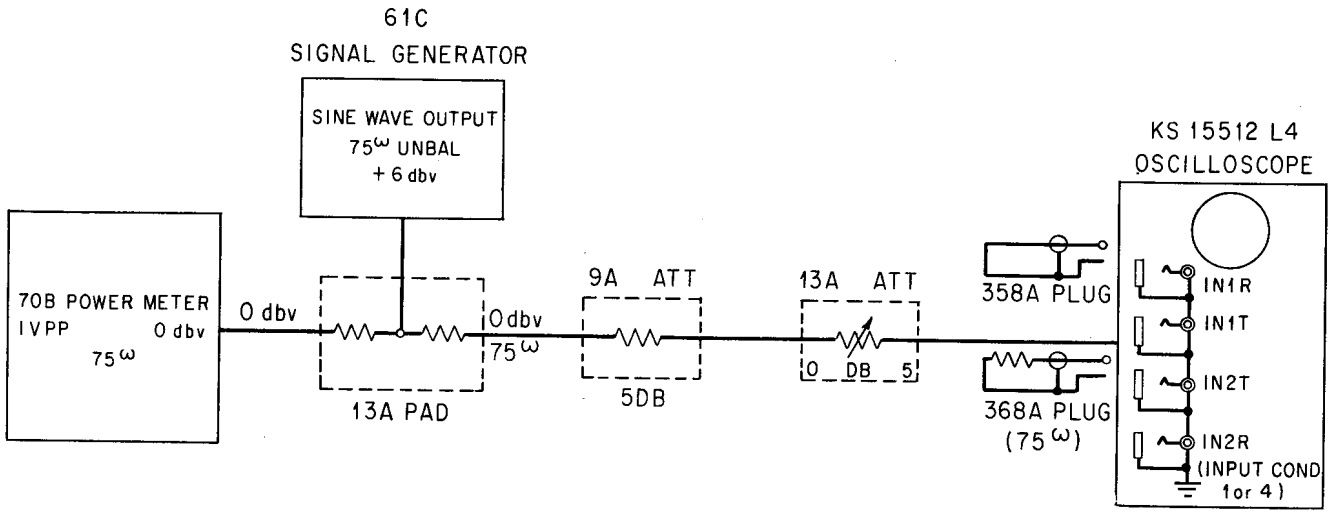


Fig. 5 – Vertical Amplifier Alignment

8.03 ***Procedure:***

(a) Use the equipment arrangement illustrated in Fig. 5.

(b) Adjust the signal source for a 1V, PP, 100 kc, 0 dbv sine wave reading on the power meter.

(c) Arrange the oscilloscope for input condition 1 or 4 (Paragraph 1.07) with the BANDWIDTH switch in the WIDE position and the V GAIN control set maximum clockwise.

(d) Readjust 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 oscillator frequency to 5 mc at the same input 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 division) 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. 6 and maintain input condition 1 or 4 to the oscilloscope. Adjust the signal source for a 1V P-P, 100 kc, 0 dbv indication on the power meter. Readjust the V GAIN control counterclockwise for a one inch deflection on the CRT.

(g) Apply a 5 mc signal at the same input 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 on Vertical Amplifier panel for the same 1-inch deflection.

(h) Set oscilloscope for input condition 2 or 5 (Paragraph 1.07).

(i) Adjust the signal source for a 1V, PP, 100 kc, 0 dbv reading on the power meter. Readjust the V GAIN control for a 1-inch deflection on the CRT.

(j) Apply a 5 mc signal at the same input 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 L2 for the same 1-inch deflection. L1, L2, L3 and L4 are located to the front, on the top side of the vertical amplifier chassis.

(k) Adjust the Signal Generator for a 3.58 mc signal. Set the oscilloscope for Input Condition 1 or 4 (Paragraph 1.07) with the BANDWIDTH switch in the NARROW position. Adjust L3 for a minimum indication on the CRT.

(*l*) Reset the oscilloscope for Input Conditions 2 or 5 (Paragraph 1.07) and adjust L4 for a minimum indication on the CRT.

9. VERTICAL AMPLIFIER FREQUENCY RESPONSE AND SENSITIVITY CHECK

9.01 For a frequency response check of the Vertical Deflection Amplifier, the following procedure may be used.

9.02 ***Apparatus:***

1 — 61C Signal Generator
1 — 368A Plug (75 ohms)
1 — 358A Plug (shorting plug with bare strap between center conductor and shield)
3 — P2BJ (unbalanced) Cord, 3 feet long
1 — 70B Power Meter
1 — 13A Pad
1 — 13A Attenuator, 75 ohms, 5 db
1 — 9A Attenuator (5 db)

9.03 ***Wide Bandwidth (High and Low Level Checks)*** Use the equipment arrangement illustrated in Fig. 6 for this test. Set up Condition 1 or 4 with the BANDWIDTH switch in the WIDE position and the V GAIN control set maximum counterclockwise. Adjust the signal source for a 1V, PP, 100 kc, 0 dbv reading on the power meter. Readjust the V GAIN control setting for a vertical deflection of 1 inch (20 divisions) on the scope. Without readjustment of 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:

	WIDE		
FREQUENCY	DIVISIONS (db)		
	MIN	NORM	MAX
*100 kc	20.0 (0.0)	20.0	20.0
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 Requirement check points unless otherwise specified.

Note: These limits may be increased by ±0.1 db for Conditions 4, 5, 6 (Paragraph 1.07).

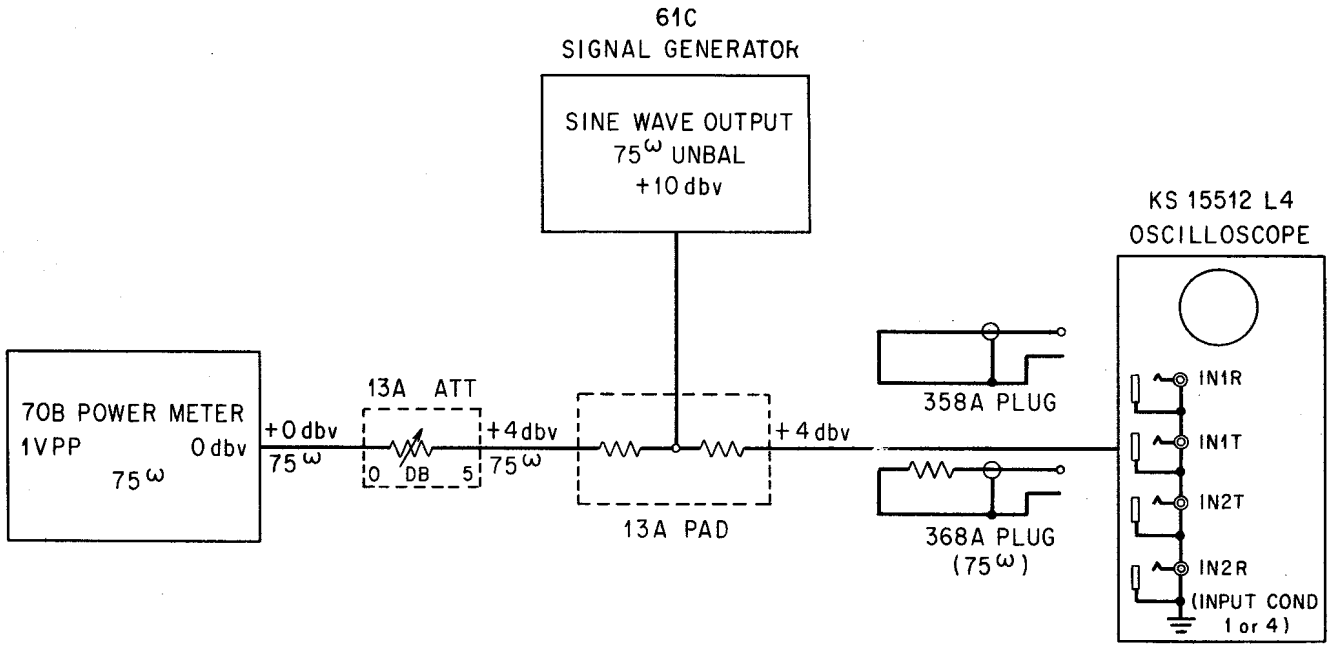


Fig. 6 — Vertical Amplifier Frequency Response

9.04 Readjust the signal generator to furnish a 100 kc sine wave signal with a 0 dbv reading on the 70B Power Meter. Without readjustment of the V GAIN control or the 13A Attenuator set up Condition 2 or 5, respectively, (Paragraph 1.07). The vertical deflection should be 1 inch ± 0.25 inch (±.5 division) (± .2 db). Oscilloscopes which fail to meet this requirement should be returned for repair to Telephone Company Video Repair Shop.

9.05 Rearrange the test equipment to conform with the arrangement illustrated in Fig. 5. Readjust the signal generator for a 1V, PP, 100 kc sine wave signal indicated as 0 dbv on the power meter. Set the V GAIN control maximum clockwise and vary the 13A Attenuator for a 2-inch deflection (40 division on the graph paper) on the scope. (If necessary vary the V GAIN control also.) Without readjustment of the 13A Attenuator and the V GAIN control, maintain the 0 dbv power meter reference output 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 as follows:

WIDE

FREQUENCY	DIVISIONS (db)		
	MIN	NORM	MAX
*100 kc	40 (0.0)	40	40
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.

Note: These limits may be increased by ±0.1 db for Conditions 4, 5, 6 (Paragraph 1.07).

9.06 ***IRE Bandwidth:*** Readjust the signal generator for a 1V, PP, 100 kc sine wave signal as indicated on the power meter. Operate the BANDWIDTH switch to the IRE position. The deflection should be 2 inches ± 0.5 inch (± 1 division).

9.07 Readjust the V GAIN control for a 2-inch deflection. Without further readjustment of the V GAIN control maintain the 0 dbv power meter reference level to measure the response of the amplifier over the range from 100 kc to 5 mc which should fall within the limits specified in the IRE table.

1958A IRE

FREQUENCY	MIN 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)

Note: These limits may be increased by ±0.1 db for Conditions 4, 5, 6 (Paragraph 1.07).

9.08 ***Narrow Bandwidth:*** Readjust the signal generator for a 1V, PP, 10 kc sine wave signal as indicated by a 0 dbv reading on the power meter. Readjust the 13A Attenuator and the V GAIN control for a 2-inch oscilloscope deflection, then insert an added 20 db loss to the line with the 9A Attenuator (20 db). Operate the BANDWIDTH switch to the NARROW position. The vertical deflection should be 2.05 inches ±0.1 inch (41 ±2 division). (If no 20 db Attenuator is available, then use input Condition 4 and set the calibrated input Attenuator to the 10:1 position.)

9.09 Set the V GAIN control maximum clockwise and vary the 13A Attenuator (if necessary readjust the V GAIN control) for a 2-inch deflection. Without readjustment of the V GAIN control maintain the 0 dbv power meter reference level to measure the response of the amplifier over the range from 10 kc to 10 mc

which should fall within the limits specified below:

	FREQUENCY	NARROW DIVISIONS (db) MIN	NORM	MAX
*	10 kc	40.0(0)	40.0	40.0
*	100 kc	36.5(−0.8)	38.2(−0.4)	40.0
	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.

Note: These limits may be increased ± 0.1 db for Conditions 4, 5, 6 (Paragraph 1.07).

9.10 ***Sensitivity check of the Vertical Deflection Amplifier.*** The following procedure may be used.

9.11 Use the equipment arrangement illustrated in Fig. 7.

9.12 Readjust the signal source for a 1V, PP, 60-cycle signal as indicated by the power meter. Set up Condition 1 or 4 (Paragraph 1.07). Return the BANDWIDTH switch to the WIDE position. With the V GAIN control set maximum clockwise, the amplifier sensitivity should indicate a vertical deflection of 0.5 inches (10 divisions) or better. ***Note the deflection.*** (If no 9A Attenuator is available, then use input Condition 4 and set the calibrated input attenuator to the 10:1 position.)

9.13 ***Vertical Gain Range Control Check —*** Readjust the V GAIN control maximum counterclockwise and remove the 9A Attenuator (20 db) from the line (or operate the INPUT switch back to the 1:1 position). The resulting deflection shall be less than the deflection noted in Paragraph 9.12 above.

10. CALIBRATED VOLTAGE AND HUM MEASUREMENT CHECK

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

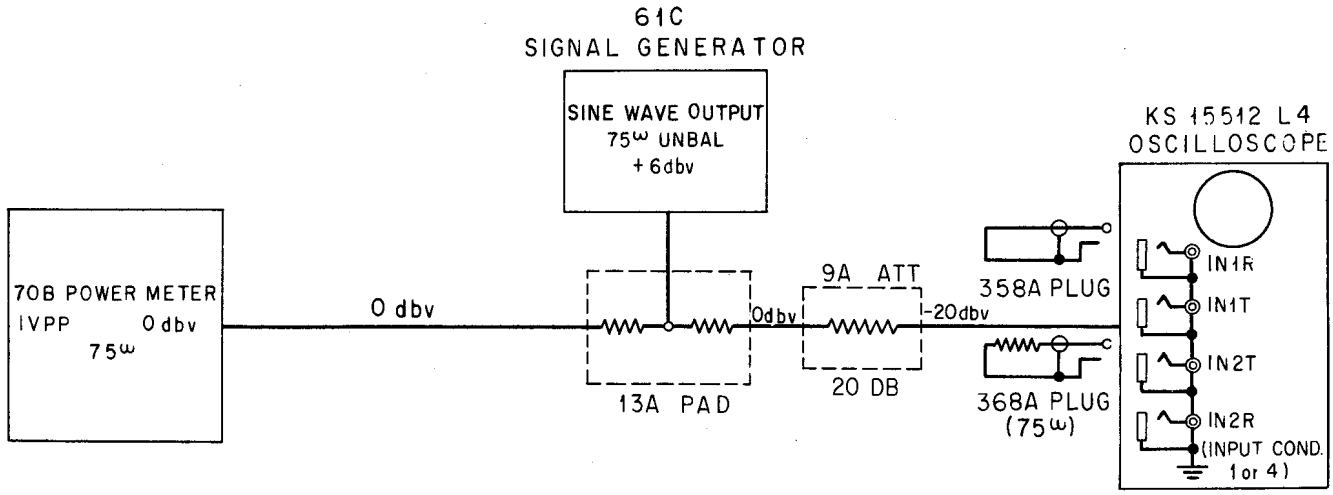


Fig. 7 – Vertical Amplifier Sensitivity

10.02 ***Apparatus:***

1 — 61C Signal Generator

1 — 70B Power Meter

1 — 13A Pad

3 — P2BJ (unbalanced) Cords

1 — 358A Shorted Plug

1 — 368A (75-ohm) Termination Plug

10.03 Use the equipment arrangement illustrated in Fig. 8 to obtain 1V, P-P calibrated signal for the oscilloscope.

10.04 Adjust the V GAIN control for a 2-inch vertical deflection on the oscilloscope, with the 1V, P-P input signal. Operate the INPUT switch to the CAL position and adjust the CAL VOLT control for a 2-inch deflection. The voltage reading on the meter should be 1 volt ± 0.10 volt.

10.05 Remove the input signal from the W-1-T jack and measure the deflection on the oscilloscope resulting from vertical amplifier hum voltages when no signal is applied to the terminated tip jacks with the ring jacks shorted and the following control settings:

INPUT	1:1
BANDWIDTH	NARROW
V GAIN	MAX CLOCKWISE
CAL VOLTS	MAX COUNTER-CLOCKWISE
SWEEP FREQUENCY	LOW
H GAIN	APPROXIMATELY 1/4 INCH
SYNC SELECTOR	60 cps.
INTENSITY	MINIMUM

Requirement: The hum voltages should not exceed .05 inch (1 division).

11. VERTICAL AND HORIZONTAL AMPLIFIER LINEARITY AND STABILITY CHECKS

11.01 The following simplified tests may be used to check the linearity and stability of the Vertical and Horizontal Amplifiers.

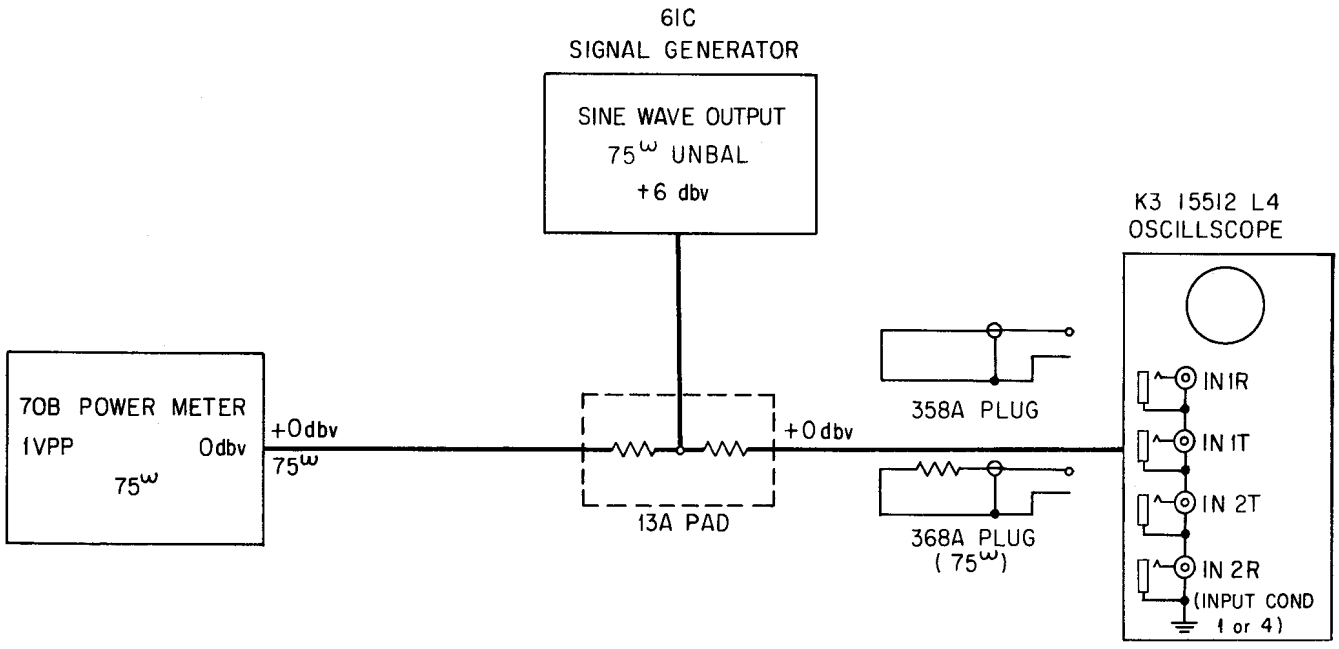


Fig. 8 – Calibrated Voltage Check

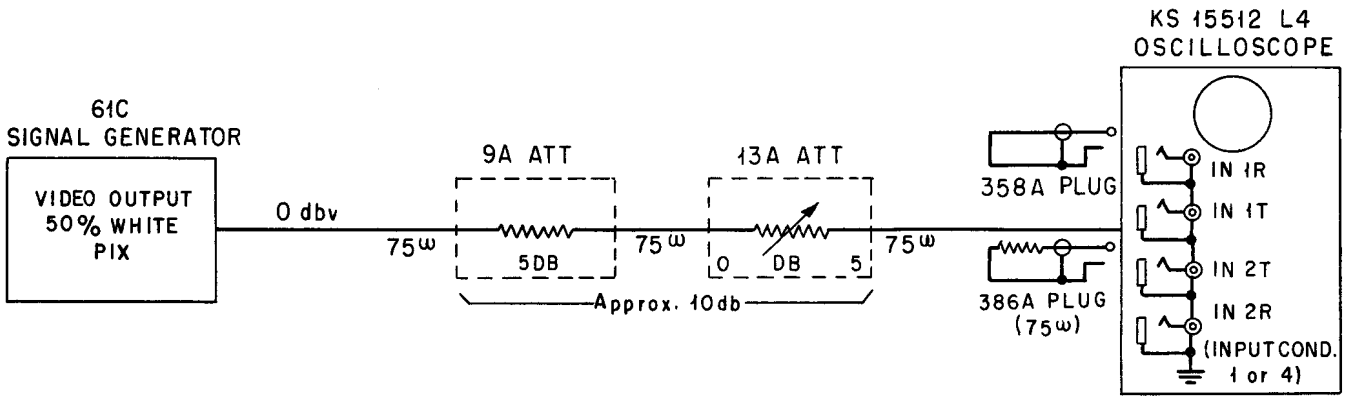


Fig. 9 – Linearity Check

11.02 ***Apparatus:***

1 — 61C Signal Generator
1 — Telechrome Model 1005A Video Transmission Signal Generator or equivalent
1 — 13A Attenuator, 75 ohm, 5 db or equivalent
1 — 9A Attenuator (5 db)
1 — 368A Plug (75 ohm)
1 — 358A Shorted Plug
2 — P2BJ (unbalanced) Cords

11.03 Measure the video signal compression as follows:

(a) Set up Input Condition 1 or 4 (Paragraph 1.07) with the BANDWIDTH switch in the WIDE position, and the test equipment arranged to conform with the arrangement illustrated in Fig. 9 to supply a video signal with a 50% white picture as shown in Fig. 4.

(b) With no loss inserted in the line, operate the INPUT switch to the CAL position and adjust the CAL VOLT control for a 1V, PP signal as measured with the KS-15512 calibration circuit. Adjust the V GAIN control for 50 divisions.

(c) Operate the INPUT switch to the SIDE or FRONT position (according to Condition 1 or 4) and adjust the sync amplitude D, if necessary, to equal E/4 or 12.5 divisions by varying the 61C sync amplitude control. Adjust amplitude E for a 1V, PP indication of 50 divisions by varying the 61C picture amplitude control.

(d) Insert a 10 db loss to the oscilloscope input through the 13A and 9A Attenuators.

(e) Measure the number of divisions of amplitudes D and E. Note the ratio of D to E in per cent.

Requirement: The ratio determined should be 25% ± 1%.

11.04 With a composite video signal from Telechrome Model 1005A or equivalent signal from Broadcaster in which the sync pulses consist of 40/140 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 volts peak-to-peak. With the oscilloscope locked in at one-half line frequency (SWEEP Frequency switch in HI position), adjust the H GAIN control to expand a 5 microsecond horizontal sync tip to 1 inch at the base. The pattern obtained should be like that shown in Fig. 6B of Section 103-745-101 at all signal amplitudes listed above. If the pattern appears like that shown in Fig. 6A of Section 103-745-101 and cannot be cleared up by means of the SYNC control, the oscilloscope does not synchronize properly and should be returned for repair to Telephone Company Video Repair Shop.

11.05 Synchronize the oscilloscope at one-half field frequency (30 cps — SWEEP Frequency switch in LO position) to display the vertical blanking interval. Adjust the H GAIN con-

trol to maximum clockwise. Measure and record the width of the vertical blanking interval.

Requirement: The width of the vertical blanking interval should not be less than 3.5 inches. Operate the SWEEP Frequency switch to the HI position and check for sync lock.

11.06 The linearity of both the 30 (LO) and 7875 (HI) cps horizontal sweeps should be such that when a square wave signal of about 300 or 7900 cps, respectively, is used, the minimum distance between the leading edges of adjacent pulses should not be less than 60% of the maximum distance between the leading edges of adjacent pulses disregarding the first and tenth pulses. (This requirement is normally waived for locations not having a square wave generator.)

11.07 Operate the SWEEP Frequency switch to EXT and apply a 20 kc square wave signal to the EXT SWEEP and GND terminals. Check that a horizontal deflection is obtained when the H GAIN control is adjusted maximum clockwise. (This requirement is normally waived for locations not having a square wave generator.)

12. VOLTAGE AND WAVEFORM MEASUREMENTS

12.01 Fig. 10 indicates the proper control settings for waveform 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. 10, reference should be made to the schematic drawing in Section 103-745-101.

13. PERIODIC TESTS AND TEST INTERVALS

13.01 Table 3 lists the tests to be made on the KS-15512, List 4 Oscilloscope and gives suggested test intervals. Also for each test listed, corresponding reference paragraph numbers in this section are given for the testing methods and requirements to be employed.

13.02 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 others should be routined at the suggested intervals.

TEST CONDITIONS FOR VOLTAGE AND WAVEFORM MEASUREMENTS

Controls	Test Conditions
Line Voltage	115V., 60 cps
Video Signal Input	61C Video Signal (100% All White)
Sweep Frequency	Hi-Position (7875 cps)
Sync	Negative
Intensity	Normal
Focus	Normal
Bandwidth	Wide
Input	1:1 (Unbalanced, Front Input Used)
H. Gain	5 inch Deflection
V. Gain	2 inch Deflection

NOTE

AC voltage measurements are made peak to peak on an oscilloscope with a wide band amplifier such as Tektronix Model 524D.

DC voltage measurements are made with a 20,000 ohms-per-volt meter.

TUBE			PLATE				GRID				CATHODE				SCREEN	
REF SYM	TYPE	FUNC.	PIN NO.	VOLTAGE DC	VOLTAGE AC	WAVEFORM	PIN NO.	VOLTAGE DC	VOLTAGE AC	WAVEFORM	PIN NO.	VOLTAGE DC	VOLTAGE AC	WAVEFORM	PIN NO.	VOLT D.C.
V1	404A	VERT. AMP.	6	200	.88		1	50	1.0		4	50	.8		8	210
V2	404A	VERT. AMP.	6	200	.84		1	50			4	50	.14		8	210
V3	404A	VERT. AMP.	6	310	1.3		1	190	.88		4	205	.78		8	330
V4	404A	VERT. AMP.	6	310	1.3		1	190	.84		4	205	.72		8	330
V5	418A	VERT. AMP.	2	150	43		8	6.0	1.3		4 & 9	9			5	165
V6	418A	VERT. AMP.	2	145	43		8	6.0	1.3		4 & 9	9			5	155
V7A	½6AL5	D.C. SETTER	2	155							5	155	43			
V7B	½6AL5	D.C. SETTER	7	120	43						1	200				
V8A	½396A	CATH. FOLL.	6	105			7		0		8	6.8	0.8			
V8B	½396A	CATH. FOLL.	4	105			3		1.0		2	5.4	0.8			
V9A	½6SN7	SWEEP GEN.	2	190	80		1	0	1.8		3	6.6	16			
V9B	½6SN7	SWEEP GEN.	5	50	13		4	-15	74		6	6.6	16			
V10A	½6SL7	H.V. REG.	5	420			4	-4.0			6	0				
V10B	½6SL7	BLANK AMP	2	135	50		1	-10	16		8	0				
V11	6AC7	HOR. AMP.	8	220	130		4	29	2		5	58	.8		6	255
V12	6AC7	HOR. AMP.	8	240	135		4	28	2.2		5	58	.8		6	255
V13A	½6SN7	HOR. INVERT	2	120	1.6		1	0	.3		3	5.5	.15			
V13B	½6SN7	HOR. INVERT	5	115	2		4	0	0		6	5.5	.15			
V14	5R4GY	L.V. RECT.									2	350				
V15	2X2A	H.V. RECT.	CAP	-1.5K												
V16	5UP1	DISP.	8	155			2	-1.1K			3	-1K			8	150
V17	6AC7	SYNC. SEP. AMP.	8	220	33		4	0	.7		5	2.5			6	150
V18	0A2	VOLT REG.	5	150												
V19A	½6SL7	SYNC. SEP.	2	75	17		1	-17	30		3	0	0			
V19B	½6SL7	CATH. FOLL.	5	340			4	1	16		6	8	12			

Fig. 10 – Voltage and Waveform Chart

TABLE 3

Periodic Tests and Test Intervals

KS-15512, List 4 Oscilloscope

TEST	INTERVAL	PARAGRAPH REFERENCE
1. Operating Checks	(AR)	1.09
2. Astigmatism Adjustment	(AR)	2.01
3. Low-Frequency Adjust	(AR)	3.01-3.03
4. Horizontal Tracking Adjust	(AR)	4.01
5. Input Attenuator Adjustment and Check	(AR)	5.01-5.04
6. Probe Adjustment	(AR)	6.01-6.03
7. High Voltage Adjustment	(AR)	7.01-7.03
8. Vertical Amplifier Alignment	(AR)	8.01-8.03
9. Vertical Amplifier Frequency Response and Sensitivity Check	(W)	9.01-9.13
10. Calibrated Voltage and Hum Measurement Check	(W)	10.01-10.05
11. Vertical and Horizontal Amplifier Linearity and Stability Checks	(AR)	11.01-11.07
12. Voltage and Waveform Measurements	(AR)	12.01
Legend: (W) Weekly; (AR) As Required		