

## TYPE 535 OSCILLOSCOPE

### SUGGESTED FACTORY CALIBRATION PROCEDURE

Preset front-panel controls as follows:\*

<u>POWER SWITCH--OFF.</u>	<u>Delaying Sweep TRIGGERING LEVEL--O.</u>
<u>Main Sweep TRIGGERING LEVEL--O.</u>	<u>" " STABILITY--CCW.</u>
<u>" " STABILITY--CCW.</u>	<u>SLOPE (toggle)--+.</u>
<u>TRIGGER SLOPE--+INT.</u>	<u>ATTEN. (toggle)--X1.</u>
<u>TRIGGERING MODE--AC SLOW.</u>	<u>TIME/CM OR DELAY TIME--1 millisec.</u>
<u>TIME/CM--100 usec.</u>	<u>HORIZONTAL POSITION--MS.</u>
<u>MULTIPLIER--X1.</u>	<u>VERNIER--MS.</u>
<u>5X MAGNIFIER--OFF.</u>	<u>CALIBRATOR--OFF.</u>
<u>HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.</u>	<u>INTENSITY--CCW.</u>

Preset R64 to CW. (This is a small screwdriver-slotted potentiometer control without shaft, situated at right center of top deck.)

Preset DELAY STOP ADJ to about 30 from CCW stop.

The following controls may be left at the settings where they are found--that is, they do not require presetting: (1) CAL ADJ, and (2) R99M--the latter being a small screwdriver-slot control mounted on the MULTIPLIER switch bracket.

Preset the remaining fourteen internal screwdriver-slotted controls to MS.

Preset the following capacitors to MS: C240; C254; C278; C286.

Carry out the following calibration procedure:

1. To check relay time delay.--With power-test plug-in unit in position, turn POWER SWITCH on. Check that the time required for the relay to operate lies between 15 sec and 45 sec.
2. To check low-voltage power-supply operation.--
  - a. Give a quick check to each low-voltage supply so as to determine that it is delivering approximately its correct voltage. This quick check helps to reveal overloads or other gross irregularities in operation.
  - b. Set the -150 VOLTS ADJ control for correct output from the -150-volt supply.
  - c. Determine that the low-voltage supplies regulate between the following limits:

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\*Front-panel controls are indicated by UNDERLINED CAPITALS. Internal adjustments are indicated by PLAIN CAPITALS. These abbreviations are used: CW, clockwise; CCW, counter-clockwise; MS, mid-scale.

Lower limit--line volts, 105; plug-in set at HI load.

Upper limit--line volts, 125; plug-in set at LO load.

Regulation should not exceed 2% within these limits. (Usually the regulation is much smaller than this value.)

- d. Low-voltage supplies, other than the -150-volt supply, should check within these tolerances:

+100-volt supply	100 volts $\pm$ 2%
+225-volt supply	225 volts $\pm$ 3%
+350-volt supply	350 volts $\pm$ 3%
+500-volt supply	500 volts $\pm$ 3%

- e. Set the test oscilloscope for 1 millisec/div X5 sweep speed and for 0.01 volts/div. Determine that the power-supply ripple does not exceed

10 mv for -150-, +100- and +225-volt supplies, and

15 mv for +350- and +500-volt supplies.

The predominant ripple frequency should be 120 cps, as evidenced by a display of approximately six cycles over the graticule of the test oscilloscope.

3. To set CAL ADJ.--Use 117 line volts. With calibrator turned off, set CAL ADJ for +100 volts at Pin 3 of V246 (bottom of oscilloscope). To assure suitable symmetry of the calibrator waveform, this voltage should drop to not more than 55 volts and not less than 45 volts when the calibrator is turned on.

4. To adjust and check high-voltage supply.--

- a. Set -1350-volt output of high-voltage supply to its rated value with HV ADJ control. (Measure at first left-hand terminal of ceramic strip adjacent to CRT GEOM ADJ control.)

- b. Check regulation of -1350-volt output between these limits:

Lower limit--line volts, 105; plug-in set at HI load; INTENSITY advanced to produce a (defocused) spot or glow.

Upper limit--line volts, 125; plug-in set at LO load; INTENSITY at CCW.

5. To check main sweep, delaying sweep and vertical system for operation.--

- a. Bring up INTENSITY control slowly from CCW position until a spot or glow appears on screen. Position spot on screen, keeping INTENSITY setting at minimum useful point. Bring up STABILITY control from CCW position until sweep is produced. Adjust FOCUS, INTENSITY and ASTIGMATISM controls to produce a trace of suitable sharpness and stability.

- b. Rotate CRT so that trace coincides with horizontal graticule line when properly positioned with VERTICAL POSITION control. Clamp CRT in position. Recheck trace orientation.

- c. Apply 0.2 volts from calibrator to input connector of plug-in unit. With



TRIGGERING LEVEL and STABILITY controls, obtain a stable trace. Then remove calibrator signal.

- d. Set HORIZONTAL DISPLAY at DELAYING SWEEP position. Turn Main Sweep STABILITY CCW. Set Delaying Sweep TIME/CM at 1 millisec; set Delaying Sweep TRIGGERING LEVEL at 0. Connect VERT. SIG. OUT to TRIGGER OR EXT. SWEEP IN. With EXT SWEEP ATTEN. switch at X1 and with SLOPE toggle switch at +, adjust Delaying Sweep STABILITY for stable sweep. Increase INTENSITY setting if necessary to view trace.
- e. Using the settings of Part d above, set the Main Sweep TIME/CM control at 100 usec and bring the Main Sweep STABILITY control CW to check that a portion of the sweep is brightened (during Main Sweep operation).
- f. Check oscilloscope for microphonics.

6. To check for vertical shift with varying line voltage.--The vertical position of the trace may shift as the power-line voltage is changed. This shift may be due to either or both of two independent causes: (1) a variation in emission unbalance with heater temperature of the 6CL6 vertical driver tubes, V508 and V509; or (2) a possible redirection of the electron streams, because of the magnetic effects of heater current, causing a change in the screen- to plate-current ratios in V508 and V509. To check for this vertical shift from either cause:

With the power-line voltage set at 105 volts, center the trace vertically with the VERTICAL POSITION control. Raise the line voltage to 125 volts. If any resulting shift in vertical position of the trace exceeds 0.5 cm, V508 or V509 should be changed.

7. To adjust vertical AMPL GAIN.--Use 117 line volts. Again apply 0.2 volts from calibrator to input of power-test plug-in unit. Set AMPL GAIN control for 2 cm vertical deflection (peak-to-peak). (This is a preliminary adjustment only.)
8. To adjust CRT GEOM control.--
- a. Apply more vertical signal from the calibrator than is needed to cover the graticule vertically. Position the display vertically so that the flat tops of the square waves are off the screen both above and below the graticule. Turn up the INTENSITY control so that the spot, moving rapidly in the vertical direction, makes a visible trace. Now set the CRT GEOM adjustment so that the vertical traces near the ends of the graticule are as nearly straight and vertical as possible.
  - b. As a further check on the CRT GEOM adjustment, remove the calibrator signal, and position the simple trace first at the uppermost graticule line and then at the lowest line of the graticule. The trace should lie along the upper and lower graticule lines without noticeable upward or downward bowing.



- c. Within the limits of a and b above, the adjustment should be that which produces the least noticeable amount of flare on the screen.
9. To check for compression in the vertical system.--Apply a calibrator signal which provides 2 cm vertical deflection when the display is centered vertically. This deflection should not be reduced by more than 1 mm when the display is raised to the top of the graticule or lowered to the bottom of the graticule by the VERTICAL POSITION control.
10. To check dc balance of vertical system.--
- a. Remove calibrator signal. Short-circuit vertical plates of CRT, and observe the trace position. With the short-circuit removed, adjust the VERTICAL POSITION control for the same position of the trace.
  - b. Short-circuit Pins 2 and 7 of V606. Change V606 if the resulting vertical shift in trace position exceeds 0.25 cm. (If at any point in the present Step 9 it becomes necessary to interchange or replace tubes, redo Part a after the change.)
  - c. Short-circuit Pin 2 of V570 to Pin 2 of V580. Interchange or replace these tubes if the resulting vertical shift in trace position exceeds 1 cm.
  - d. Short-circuit Pins 2 and 7 of V558, and change V558 if the resulting vertical shift in trace position exceeds 1 cm.
  - e. Short-circuit Pin 2 (or Pin 9) of V508 to Pin 2 (or Pin 9) of V509, by operating push-button switch on panel of power-test plug-in unit. Interchange or replace these tubes if resulting vertical shift in trace position exceeds 2 cm.
11. To adjust DC SHIFT COMP control.--
- a. Insert 53C plug-in unit into oscilloscope. Set INPUT SELECTOR to DC. Set OPERATING MODE switch to "A ONLY" or "B ONLY." Position the trace at -3 cm (that is, 3 cm below the graticule center line).
  - b. Connect a 1.5-volt cell (or an ohmmeter) between GND on the oscilloscope and the plug-in input connector. Adjust the VOLTS/CM control on the plug-in unit so that the trace moves to +3 cm. (That is, make the settings such that the trace is at -3 cm when the cell is disconnected, but rises to +3 cm when the cell is connected.)
  - c. Note the position of the trace immediately upon connecting the cell. Leaving the cell connected for several seconds, observe whether or not the trace slowly drifts 1 or 2 mm up or down. If it does, adjust DC SHIFT COMP control so that the drift occurring when the cell is connected is a minimum.
12. To recheck vertical AMPL GAIN adjustment, and to check the calibrator attenuator.--
- a. Reinsert power-test plug-in unit. Set AMPL GAIN control so that 0.2 volts from the calibrator produces a vertical deflection of 2 cm.
  - b. Replace the power-test plug-in unit with the 53C plug-in. Set INPUT SELECTOR at DC. Set VOLTS/CM control at 0.05 and feed in 100 millivolts



from the calibrator. Be sure that the red VARIABLE knob on the VOLTS/CM control is CW. A deflection of 2 cm should be obtained. Other positions of the calibrator should be checked similarly. The results should be those tabulated:

<u>VOLTS/CM setting</u> <u>on plug-in</u>	<u>Calibrator</u> <u>attenuator</u> <u>setting</u>	<u>Deflection</u>
0.05	100 mv	2 cm
0.05	0.2 volt	4
0.1	0.5	5
0.2	1	5
0.5	2	4
1	5	5
2	10	5
5	20	4
10	50	5
20	100	5

13. To set TRIGGERING LEVEL controls to physical center.--(For this adjustment, the TRIGGERING MODE control should NOT be set to AC AUTO.)

- a. Connect a voltmeter from the junction of R16 and R17 to chassis. (R16 is connected to center arm of Main Sweep TRIGGERING LEVEL control.) Set Main Sweep TRIGGERING LEVEL so that zero deflection is obtained even on the 3-volt range of the voltmeter.
- b. Loosen the Main Sweep TRIGGERING LEVEL knob on its shaft. Turn the knob on its shaft so that its index points to "0" on the panel, and tighten the knob. Recheck that a voltmeter reading of zero is obtained when the knob index is at "0."
- c. Now move the voltmeter ungrounded connection to the junction of R107 and R108. (R107 is connected to center arm of Delaying Sweep TRIGGERING LEVEL control.) Set Delaying Sweep TRIGGERING LEVEL control so that zero deflection is obtained even on the 3-volt range of the meter.
- d. Loosen the Delaying Sweep TRIGGERING LEVEL knob on its shaft. Turn the knob on its shaft so that its index points to "0" on the panel, and tighten the knob. Recheck that a voltmeter reading of zero is obtained when the knob index is at "0."

14. To adjust TRIGGERING LEVEL CENTERING.--Settings:

<u>Main Sweep TRIGGERING LEVEL</u> --0.	<u>TIME/CM</u> --1 millisec.
<u>TRIGGER SLOPE</u> --+INT.	<u>5X MAGNIFIER</u> --OFF.
<u>TRIGGERING MODE</u> --AC SLOW.	<u>HORIZONTAL DISPLAY</u> --MAIN SWEEP NORMAL.

- a. Display calibrator signal. Set calibrator output and the VOLTS/CM switch for 3 or 4 mm of vertical deflection. Set Main Sweep STABILITY control and the TRIGGERING LEVEL CENTERING control so that a stable display is obtained. Then make further adjustments of TRIGGERING LEVEL CENTERING so that the sweep triggers equally well on +INT and -INT settings of the TRIGGER SLOPE switch.

- b. Check the polarity of the TRIGGER SLOPE switch on +INT and -INT positions. The leading edge at the left end of the graticule should be a rising edge when the switch is in the +INT position, and it should be a falling edge when the switch is in the -INT position.
- c. Connect VERT. SIG. OUT to TRIGGER IN. In a manner similar to that of Part b of this step, check the polarity of the TRIGGER SLOPE switch on +EXT and -EXT positions. Leading edge at left end of graticule should be a rising edge when the switch is in the +EXT position, and vice versa.

15. To adjust TRIGGER SENSITIVITY control.--Settings of the oscilloscope being calibrated:

Main Sweep TRIGGERING LEVEL--0.  
Main Sweep STABILITY--CCW.  
TRIGGER SLOPE--+LINE.  
TRIGGERING MODE--AC SLOW.  
HORIZ. DISPLAY--MAIN SWEEP NORMAL.

TIME/CM--100 usec.  
5X MAGNIFIER--OFF.  
MULTIPLIER--X1.  
INTENSITY--CCW.

Settings of test oscilloscope:

TRIGGER SELECTOR--+LINE.  
TIME/DIVISION--1 millisecc.  
MULTIPLIER--X1

5X MAGNIFIER--ON.  
VOLTS/DIVISION--1 (AC).  
MULTIPLIER--X1.

Connect 2X probe of test oscilloscope to Pin 1 of V20 (or to lead from that pin to the TRIGGERING MODE switch). With TRIGGER SENSITIVITY turned CW, the waveform of Fig. 1 should be seen on the test oscilloscope. (Figure may be inverted. If so, switch to -LINE triggering on test oscilloscope.)

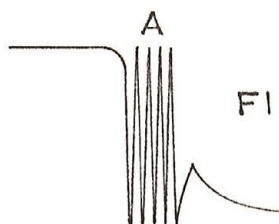


FIG. 1

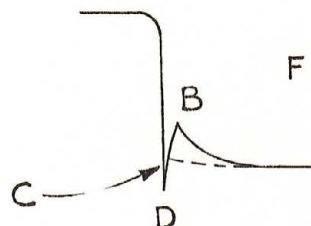


FIG. 2

The TRIGGER SENSITIVITY control should now be gradually turned CCW until the self-oscillation indicated at A just dies out. The result is a display shown in the solid line of Fig. 2. The TRIGGER SENSITIVITY control should be turned further in the CCW direction until the peak B drops to a point C (dotted line, Fig. 2) which has a height above D equal to one-half its original height.

After this adjustment, it is often possible to return to Step 14, and by slightly readjusting the TRIGGERING LEVEL CENTERING control, to obtain triggering on both the +INT and -INT positions with deflections appreciably smaller than the 3 to 4 mm used initially.



16. To set INT TRIG DC LEVEL.--Display calibrator waveform at about 2 cm deflection, keeping the display centered vertically on the graticule horizontal centerline. Use these settings:

Main Sweep TRIGGERING LEVEL--0.  
TRIGGER SLOPE--INT.  
5X MAGNIFIER--OFF.  
HORIZ. DISPLAY--MAIN SWEEP NORMAL.

TRIGGERING MODE--DC.  
TIME/CM--10 usec.  
MULTIPLIER--X1.

Adjust the Main Sweep STABILITY control and the INT TRIG DC LEVEL control for a stable trace. With correct adjustment of INT TRIG DC LEVEL control, the sweep will trigger equally well on +INT and -INT slope settings, with a given setting of the Main Sweep STABILITY control. Also, the leading edges of the displays obtained with +INT and with -INT slope settings should be symmetrical with each other about the horizontal center line of the graticule.

17. To check AC AUTO operation.--Settings:

Main Sweep TRIGGERING LEVEL--0.  
Main Sweep STABILITY--CCW.  
TRIGGER SLOPE--EXT.  
TRIGGERING MODE--AC AUTO.

TIME/CM--100 usec.  
MULTIPLIER--X1.  
5X MAGNIFIER--OFF.  
HORIZ. DISPLAY--MAIN SWEEP NORMAL.

Use no signal input. Operation of the AC AUTO mode is indicated if, upon advancing the Main Sweep STABILITY control slowly CW, you obtain a trace--and if further advance of this control results abruptly in a brightening of the trace. (The first trace results from triggering of the sweep by the trigger-shaper multivibrator operating in a free-running manner at about 50 cps. The brightening occurs when the sweep-generating circuits themselves become free-running at advanced Main Sweep STABILITY settings.)

18. To adjust EXT SWP AMPL DC BAL.--Ground EXTERNAL SWEEP IN. Set:

HORIZONTAL DISPLAY--EXT SWP.  
5X MAGNIFIER--ON.  
Main Sweep STABILITY--CCW.

EXT. SWEEP ATTEN. (knob)--CW.  
ATTEN. (Toggle)--X1.  
Delaying Sweep STABILITY--CCW.

Position the spot on the screen by means of the HORIZONTAL POSITION control. Adjust EXT SWP AMPL DC BAL control so that the spot remains stationary on the screen as EXTERNAL SWEEP ATTENUATOR knob is turned back and forth throughout its range.

19. To set C240 and C254.--Settings:

TRIGGERING LEVEL--0.  
TRIGGER SLOPE--EXT.  
TRIGGERING MODE--AC SLOW.  
HORIZONTAL DISPLAY--EXT SWEEP.  
SLOPE (toggle)--+.

5X MAGNIFIER--ON.  
ATTEN. (toggle)--X1.  
EXT. SWP. ATTEN.--CW.  
TIME/CM--1 millise.  
MULTIPLIER--X1.  
VOLTS/CM--10.



- a. Connect 1-kc output from Type 105\* to TRIGGER OR EXT. SWEEP IN. Connect Sync Output of Type 105 to TRIGGER INPUT. Connect SAWTOOTH MAIN SWEEP to input of plug-in preamplifier. Adjust STABILITY of Main Sweep for a stable square-wave display which is displayed vertically rather than horizontally on the screen. Set Output Amplitude of Type 105 for about 4 cm of horizontal deflection. Adjust C240 (at right rear of top deck) for best square-wave reproduction.
  - b. Next turn the 5X MAGNIFIER off, and increase the Output Amplitude from the Type 105 for a horizontal deflection of about 2 cm. Adjust C254 (near C240) for best square-wave response.
20. To check SLOPE switch for correct polarity.--Using same settings as for Step 19, check that (+) position of SLOPE toggle switch provides a display at the right-hand side of the screen, while the (-) position moves the display to the left-hand side.
  21. To adjust C110, C101, C100.--This operation is performed to adjust the horizontal-amplifier input capacitance to the standardized value.
    - a. Use the same settings as for Step 19, with 5X MAGNIFIER on. Temporarily remove the 52-ohm terminating resistor from the Type 105 Output connector. Connect cable directly to Output of Type 105. Temporarily replace L pad at oscilloscope end of cable with 4.5X Input Capacitance Standardizer. Set Output Amplitude control of Type 105 for about 5 cm of horizontal deflection. With fingers, adjust C110 (behind ATTEN. toggle switch) for best square-wave reproduction. (This adjustment will no longer be correct when the fingers are removed; cabinet capacitance will later restore the waveform.) Operate SLOPE switch up and down rather fast during the adjustment of C110 to produce a display which "alternates" to right and left sides of screen; this permits a better appraisal of the square wave. Consider only that portion of the waves extending vertically along the middle of the "alternating" display.
    - b. Switch ATTEN. toggle switch to X10. Repeat Part a of this step, but this time adjust with the fingers C100 (which affects the "slope" of the square wave) and C101 (which affects the "spike"). C100 and C101 interact.

Now reinsert the standard terminations on the cable from the Type 105 for future use.
  22. To adjust delay line and set vertical amplifier coils.--
    - a. Insert special "high-frequency" plug-in unit, identified by its plastic chassis.\*\*

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\* Unless otherwise indicated in these procedures, the Type 105 is terminated in a 52-ohm terminating resistor and is connected to its load through a 52-ohm cable having a 5:1 (14-db) 52-ohm L pad at the load end.

\*\* There is a possibility, at the time these procedures are prepared, that the 53/54K plug-in unit may later be specified for this step, rather than the special high-frequency unit mentioned above.



- b. Check that the video leads from the preamplifier plug are clear of each other and of other wires. Similarly for the video leads to the delay-line input. Use spudger, if necessary, to dress the cabled leads back under the preamplifier plug and away from the video circuits.
- c. Make sure that R570 and R580 (in vertical output amplifier) are dressed well away from the CRT shield and other objects.
- d. Preset L570 and L580 (in vertical output amplifier) so that slugs project about 3/16" below the lowest turns of the coils, as seen when the light source is placed on the opposite side of the translucent coil form from the viewer.
- e. Preset the delay-line input coils so that the slugs are five turns in from their outermost position.
- f. Settings:

Main Sweep TRIGGERING LEVEL--0.  
TRIGGER SLOPE--EXT.

HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.  
5X MAGNIFIER--OFF.

- g. Feed 300-kc to 500-kc output of Type 105 to input of plug-in. Use about 4 cm of deflection. Also connect Sync Output of Type 105 to TRIGGER INPUT. Adjust STABILITY control for stable display.
- h. The delay line affects only the first half microsecond of the square wave. Delay-line "trimmer" capacitors at the bottom of the oscilloscope affect the early part of the wave; upper capacitors affect later parts of the wave. The portion of the wave affected by a particular capacitor can be identified by the downward bump occurring when that capacitor is touched with the metal bit of a screwdriver.

#### C A U T I O N

The capacitors have +200 volts on them. Do not touch them with the fingers.

Adjust the capacitors of the delay line so that "wrinkles" of magnitude greater than the trace width are absent, and so that the "level" of the trace is constant across the top of the square wave. Avoid use of the first positive wave triggered on + slope. (This may have a slight curvature in these instruments.) Neglect negative portions of the wave--the Type 105 provides a wave which is square only on the position portion of its cycle. Vary the TIME/CM settings and MULTIPLIER settings to obtain faster sweeps for checking the general level.

(NOTE: A small residual wrinkle called a "termination bump" may sometimes remain at about the mid-point of the square wave. If this is excessive, the values of the line termination resistors and their associated capacitors should be checked.)

- i. When the wrinkles have been eliminated and the general level of the square wave has been made satisfactory, try small increases in L570 and L580. These changes have the effect of raising the level of the early portion of the wave. The level may be restored to normal by readjusting the first



trimmer capacitors. The overall result is a "squaring up" of the leading edge of the wave. This process should be continued, a half-turn or a turn of each coil at a time, as far as practicable from the viewpoint of obtaining a good square wave response.

- j. The delay-line input coils should now be adjusted for increased inductance. These affect the leading edge only. Make equal small adjustments on both coils. Then make any needed compensating adjustments of the first trimmers. Continue this process as far as needed.
23. To check bandwidth of vertical system.--Feed into the plug-in unit connection a frequency in the lowest-frequency band of the Type 190. A 52-ohm terminating resistor should be inserted between the output cable attenuator of the Type 190 and the input connector of the oscilloscope. With TIME/CM set at 100 usec, set the vertical deflection exactly upon some whole number of centimeters--say 3 cm or 4 cm. Without disturbing the other settings, increase the output frequency of the Type 190 until the deflection decreases to a value which is 70% of the original deflection. The frequency which gives this deflection is the 3-db-down frequency of the oscilloscope vertical system. Typical values obtained range from 12.1 mc to 12.3 mc. If the bandwidth is insufficient, recheck items 21b, 21c, 21i and 21j.
24. To check HF SYNC operation.--Supply a 30-mc signal from the Type 190, with amplitude sufficient to produce 4 mm of deflection. Use these settings:

<u>HORIZ. POSITION</u> --MAIN SWEEP NORMAL.	<u>TIME/CM</u> --0.1 usec.
<u>Main Sweep TRIGGERING LEVEL</u> --0.	<u>MULTIPLIER</u> ---X1.
<u>TRIGGERING SLOPE</u> --+TNT.	<u>5X MAGNIFIER</u> --ON.
<u>TRIGGERING MODE</u> --HF SYNC.	

A setting of the Main Sweep STABILITY control should be found at which the 30-mc sine-wave display is stable.

25. To adjust SWP CAL.--Insert the Type 53C plug-in unit. Settings:

<u>HORIZONTAL DISPLAY</u> --DELAYING SWEEP.	Delaying Sweep <u>TIME/CM</u> --1 millisec.
<u>SLOPE (toggle)</u> --+.	<u>LENGTH</u> --CW.
<u>5X MAGNIFIER</u> --OFF.	

Connect a jumper from VERT. SIG. OUT to TRIGGER OR EXT. SWEEP IN. Display 1-millisec markers from Type 180, and adjust Delaying Sweep STABILITY and Delaying Sweep TRIGGERING LEVEL for stable display. Keeping the second marker precisely beneath the 1-cm graticule line with the HORIZONTAL POSITION control, adjust the SWP CAL control so that the tenth marker falls precisely under the 9-cm graticule line.

26. To set the Delaying Sweep LENGTH.--Set the Delaying Sweep to free-run at 1 millisec/cm. Connect the middle (black) wire of the "resistance selector" to the upper end of the 12-K resistor, R182, in the Delaying Sweep chassis. Connect the right-hand (red) wire to the lower end of R182. Connect the left-hand (red) wire to the upper end of R180 (15-K). Set the knobs of the "resistance selector" to values that make the shortest sweep obtainable with the LENGTH control lie between 3.2 and 3.8 cm, while making the longest sweep obtainable with the LENGTH control lie between 10.3 and 10.8 cm. Remove the "resistance selector" cables from the Type 535. Connect a  $\frac{1}{2}$ -watt carbon



resistor (R181-B) having the value shown on the left dial of the "resistance selector" between the upper ends of R182 and R180. Connect a  $\frac{1}{2}$ -watt carbon resistor (R182-B) having the value shown on the right dial of the "resistance selector" across R182. Recheck the range of sweep lengths obtainable by operation of the LENGTH control.

27. To time main sweep to delaying sweep.--Settings:

HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.

5X MAGNIFIER--OFF.

TRIGGER SLOPE--+INT.

TIME/CM--1 millisc.

TRIGGERING MODE--AC SLOW.

MULTIPLIER--X1.

Display 1-millisc markers from Type 180, and adjust STABILITY and TRIGGERING LEVEL controls for stable display. Keeping the second marker precisely beneath the 1-cm graticule line with the HORIZONTAL POSITION control, adjust R99M (on Main Sweep TIME/CM switch bracket) so that the tenth marker falls precisely under the 9-cm graticule line.

28. To adjust main SWP LENGTH.--With the same settings as those used in Step 27, adjust SWP LENGTH control for sweep of  $10\frac{1}{2}$  cm.

29. To adjust MAG GAIN.--

a. With the same settings as those used in the step just completed, feed in 1-millisc and 100-usec markers from Type 180. Adjust STABILITY and TRIGGERING LEVEL for a stable display.

b. Now turn 5X MAGNIFIER on. With the HORIZONTAL POSITION control, set the sixth 1-millisc marker approximately under the vertical center line of the graticule.

c. Adjust MAG GAIN and HORIZONTAL POSITION so that 100-usec markers fall precisely under the 1-cm and the 9-cm graticule lines, with two markers for each cm in the region between these lines. At graticule lines within the middle 8 cm, the markers should align with the graticule lines within  $\pm 1\%$  of full scale.

30. To adjust SWP/MAG REGIS.--After completing the above step, position the first marker beneath the graticule center line by means of the HORIZONTAL POSITION control. Then turn the 5X MAGNIFIER off, and reposition the first marker beneath the center line by means of the SWP/MAG REGIS. control.

31. To check main sweep timing, 5 sec/ to 100 usec/cm.--After completing the step above, and using the same setup, position the second 1-millisc marker (with 5X MAGNIFIER off) under the 1-cm graticule line by means of the HORIZONTAL POSITION control. Then:

a. Switch TIME/CM to 100 usec, and check that the markers coincide with the middle 8 cm of the graticule.

b. Return the TIME/CM switch to 1 millisc. Turn off the 100 usec markers on the Type 180, and make any necessary readjustment of TRIGGERING LEVEL for a stable display. Now check the timing over the middle 8 cm of the graticule on the MULTIPLIER X2 (2 markers/cm) and on the MULTIPLIER X5 (5 markers/cm). Here, also, the tolerance is  $\pm 2\%$ . (This checks the multiplier resistors for the ranges from 10 usec/cm to 100 millisc/cm, inclusive.)



- c. With the MULTIPLIER in the 2.5-1 position, check that the red variable multiplier knob provides control of the number of markers per cm over at least the range from 2.5 to 1.
- d. With the MULTIPLIER in the 5-2 position, check that the red variable multiplier knob provides control of the number of markers per cm over at least the range from 5 to 2.
- e. Turn the MULTIPLIER knob to the 12-5 position, and set the red variable multiplier knob CW. Switch to a TIME/CM position of 100 usec. Six markers should appear, approximately filling the graticule space horizontally. At least 13 markers should appear in the same horizontal distance when the red variable multiplier knob is turned CCW.
- f. Set TIME/CM at 10 millisec and MULTIPLIER at X1. Feed in 10-millisec markers. Check that timing (1 marker/cm) is within tolerance of  $\pm 2\%$  over the middle 8 cm of the graticule.
- g. Repeat Part f of this step, but use 100-millisec markers and a TIME/CM setting of 100 millisec. Tolerance,  $\pm 2\%$ .
- h. Inserting 1-sec markers, and using a TIME/CM setting of 1 sec, check timing on MULTIPLIER settings of X1, X2 and X5. Tolerance,  $\pm 2\%$ . (On X1 multiplier position, one marker/cm should be observed. On X2, two markers/cm should be observed. On X5, five markers/cm should be observed.)

32. To set timing of main sweep. 10 usec/cm to 0.1 usec/cm.--

- a. Preset C278 and C286 to mid-range positions.
- b. Set TIME/CM at 10 usec with MULTIPLIER X1. Display 10-usec markers for this purpose. The adjustment is made on C99F (on TIME/CM switch) for proper timing (1 marker/cm) over the middle 8 cm of the graticule. Tolerance,  $\pm 2\%$ .
- c. Repeat Part b of this step, but this time display 1-usec markers with a TIME/CM setting of 1 usec. This time, adjust C99H. Check timing on MULTIPLIER X2 and X5 positions. (On X1 position, you should observe 1 marker/cm; on X2 position, two markers/cm; on X5 position, five markers/cm.) Tolerance,  $\pm 2\%$ .
- d. Set TIME/CM at 0.1 usec and MULTIPLIER at X5. Insert 1-usec markers. Position the first marker off the screen to the left with the HORIZONTAL POSITION control, and position the second marker under the 1-cm graticule line. Maintaining this position of the second marker with the HORIZONTAL POSITION control, adjust C99J so that the sixth marker lies under the 9-cm graticule line (that is, the separation between markers is 2 cm).
- e. Set TIME/CM at 0.1 usec and MULTIPLIER at X1. Feed in 10 mc sine waves from Type 180. Tune up C254 and adjust C267 for best linearity and timing of display, obtaining 1 cycle of the 10-mc sine wave for each centimeter of graticule length, over the middle 8 cm of the graticule. Settings of C254 and of C267 interact; C254 serves principally to set the sweep speed while C267 serves principally as a linearity adjustment.
- f. Adjustments d and e interact. They should be repeated as many times as necessary.



33. To adjust C278 and C286.--Settings:

<u>TRIGGERING LEVEL--0.</u>	<u>TIME/CM--0.1 usec.</u>
<u>TRIGGER SLOPE--EXT.</u>	<u>MULTIPLIER--X1.</u>
<u>TRIGGERING MODE--AC SLOW.</u>	<u>5X MAGNIFIER--ON.</u>
<u>HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.</u>	

Connect Trigger Output of Type 180 to TRIGGER INPUT on oscilloscope, setting Trigger Rate Selector of Type 180 at 10kc. Capacitively couple the 50-mc output of the Type 180 to one of the vertical plates of the CRT. (The value of the coupling capacitor is not at all critical---a suggested value is 20 uuf.) Set the STABILITY control for a stable display of the 50-mc sine wave. Make these adjustments:

- a. Set the VERNIER of the horizontal position control at mid-scale. Set the HORIZONTAL POSITION control at about the position of 1100 hours. (slightly CCW from mid-scale). Adjust C278 and C286 (keeping them approximately balanced with respect to each other) for best timing and linearity of the display. There should be one cycle of the sine-wave display for each cm along the horizontal length of the graticule. Tolerance,  $\pm 2\%$ .
- b. Turn the HORIZONTAL POSITION and VERNIER knobs CCW. Check the trace for timing and linearity. Tolerance,  $\pm 2\%$ .
- c. Turn the HORIZONTAL POSITION knob CW until the left end of the display becomes visible. Now turn the control a short way CCW until the first few cycles, which are obviously non-linear, are positioned off the left end of the screen. Check the trace for linearity and timing. Tolerance,  $\pm 2\%$ .

34. To check the horizontal gain.--Settings:

<u>HORIZONTAL DISPLAY--EXT SWEEP.</u>	<u>SLOPE (toggle)--+.</u>
<u>EXT. SWEEP ATTEN.--CW.</u>	<u>ATTEN. (toggle)--X1.</u>
<u>5X MAGNIFIER--ON.</u>	

Feed 0.2 volt from calibrator to TRIGGER OR EXT. SWEEP IN. Position the sweep on the screen with the HORIZONTAL POSITION control. Length of sweep should be not less than 1 cm.

Now increase the calibrator output to 2 volts. Adjust EXT. SWEEP ATTEN. knob for a horizontal deflection of 10 cm. Throw the ATTEN. toggle switch to the X10 position, and turn the calibrator output to 20 volts. The new horizontal deflection should be 10 cm  $\pm 1$  minor division.

35. To set DELAY START ADJ. and DELAY STOP ADJ.--Settings:

<u>Main Sweep TRIGGERING LEVEL--CW or CCW.</u>	<u>5X MAGNIFIER--OFF.</u>
<u>Main Sweep STABILITY--CW.</u>	<u>Delaying Sweep TIME/CM--500 usec.</u>
<u>TRIGGER SLOPE--INT.</u>	<u>LENGTH--CW.</u>
<u>Main Sweep TIME/CM--10 usec.</u>	<u>SLOPE (toggle)--+.</u>
<u>MULTIPLIER--X1.</u>	<u>ATTEN. (toggle)--X1.</u>
<u>HORIZONTAL DISPLAY--DELAYING SWEEP.</u>	



- a. Advance Delaying Sweep STABILITY to obtain trace. Adjust INTENSITY for moderate brightness. Observe that a short brightened region (due to Main Sweep unblanking) appears on trace. The brightened portion should move along the trace when the DELAY-TIME MULTIPLIER is turned.
- b. Connect VERT. SIG. OUT to TRIGGER OR EXT SWEEP IN. Display 500-micro-sec markers from Type 180. Adjust Delaying Sweep STABILITY and TRIGGERING LEVEL for stable display. Align display with graticule, using HORIZONTAL POSITION control.
- c. Check the registration of the DELAY-TIME MULTIPLIER dial. (Dial should read 0.0 when knob is rotated CCW until stop is encountered.)
- d. Set DELAY-TIME MULTIPLIER at 1.0. With DELAY START ADJ. make the left end of brightened portion of the trace coincide with 1-cm marker. (The left end of brightened section of the trace indicates start of main sweep.) Then, set DELAY-TIME MULTIPLIER at 9.0. With DELAY STOP ADJ., make the left end of brightened portion of the trace coincide with the 9-cm marker. These adjustments of DELAY START ADJ. and DELAY STOP ADJ. interact. They should be repeated so that the final adjustments are as nearly accurate as possible.

(Some workers prefer, after getting a close initial adjustment as above, to make final adjustments with the HORIZONTAL DISPLAY switch in the MAIN SWEEP DELAYED position. Here the coincidence of the marker and the start of the main sweep is seen directly.)

Adjustment of the DELAY START ADJ. control produces approximately equal effects at the 1-cm and at the 9-cm positions. Adjustment of the DELAY STOP ADJ. produces about one-tenth the effect at the 1-cm position as at the 9-cm position. Various "tricks," based on these relationships, have been devised to get a quick initial adjust of DELAY START ADJ. and DELAY STOP ADJ. One of these tricks is as follows:

Observe the error (which we shall call  $E_9$ ) at the 9-cm point. The error is indicated by the number of minor divisions by which it is necessary to displace the DELAY-TIME MULTIPLIER from its 9.0-cm reading in order to make the start of the brightening coincide with the 9-cm marker. (A + error is one which puts the brightening too far to the right of the marker.) Next, observe the error at the 1-cm point. With the DELAY START ADJ., correct the 1-cm error by an amount

$$C_1 = \frac{10E_1 - E_9}{9} \quad \text{minor divisions.}$$

(If  $C_1$  is positive, move the brightened section to the left.) Then, with the DELAY-TIME MULTIPLIER at 9.0, set the DELAY STOP ADJ. so that the left end of the brightening coincides with the 9-cm marker. Now make any necessary final adjustments of the DELAY START ADJ. at the 1-cm point, and of the DELAY STOP ADJ. at the 9-cm point.



36. To check the Delaying Sweep linearity on the 500-usec/cm range.--After completing Step 35, check that the left end of the trace brightening coincides with the 2-cm marker, the 3-cm marker, etc., when the DELAY-TIME MULTIPLIER is set at the 2.0, the 3.0, etc., positions, for each major graticule line within the middle 8 cm of graticule length. Maximum permissible error in this indication is 2 minor divisions on the DELAY-TIME MULTIPLIER.
37. To check DELAY-TIME MULTIPLIER indications on ranges from 10 millisc/cm to 200-usec/cm.--After completing Step 36, display 100-usec/cm markers from the Type 180, using the 200-usec/cm position on the Delaying Sweep TIME/CM control. Observe the displacement in minor divisions of the DELAY-TIME MULTIPLIER dial from the 1.0 position required to make the left end of the brightened portion of the trace coincide with the 1-cm marker. Next, observe the corresponding displacement at the 9-cm position. The difference between the displacements must not be more than 5 minor divisions.

Carry out this process on all ranges from 10 millisc/cm to 200 usec/cm. On each range, use an appropriate marker rate from Type 180. The 500-usec/cm range does not have to be rechecked; it has already been adjusted by means of the DELAY START ADJ. and DELAY STOP ADJ. On no range is the difference between the displacements to be greater than 5 minor divisions.

(In each operation in this step, use settings of the Main Sweep TIME/CM and MULTIPLIER which will make the length of the brightened region satisfactory to the person doing the calibration. Also, in each operation, use a marker period selection on the Type 535 which is suitable for the range being checked on the Type 535 Delaying Sweep TIME/CM switch.)

It is advisable to make, during the above check, a table showing the displacements obtained. This table, which may be discarded after the calibration, helps to identify which component may be at fault if the 5-minor-division tolerance is not met on any range or ranges. An example of such a table follows (indicating, in this particular case, satisfactory compliance with the tolerance requirements).

Range (Delaying Sweep <u>TIME/CM</u> switch)	Displacement in minor divisions at	
	1 cm	9 cm
200 usec/cm	-1.2	+1.1
500 usec/cm	0	0
1 millisc/cm	+2.3	+2.4
2 "	-1.3	+1.2
5 "	-0.4	-0.2
10 "	+2.0	+2.1

38. To adjust C190-D and to check the linearity of the DELAY-TIME MULTIPLIER indication on the 50-usec/cm range.--Use the same settings as for Step 35, except that the Main Sweep TIME/CM switch should be at 1 usec/cm, and the Delaying Sweep TIME/CM switch should be at 50 usec/cm.



- a. Same as Part a of Step 35.
  - b. Connect VERT. SIG. OUT to TRIGGER OR EXT SWEEP IN. Display 50-usec/cm markers from Type 180. Adjust Delaying Sweep STABILITY and TRIGGERING LEVEL for stable display. Make a preliminary adjustment of C190-D (situated on Delaying Sweep TIME/CM switch), obtaining 1 marker per cm of graticule length. Align the display with the graticule, using the HORIZONTAL POSITION control.
  - c. Set the DELAY-TIME MULTIPLIER so that the left end of the brightened portion of the trace coincides with the 1-cm marker. Observe the deviation, in minor divisions, of the dial reading from 1.0.
  - d. Set the DELAY-TIME MULTIPLIER dial for the same deviation from 9.0 as that observed from the 1.0 position in Part c. Adjust C190-D for coincidence of the left end of the trace brightening and the 9-cm marker.
  - e. The adjustment made in Part d will change the deviation at the 1.0-cm marker. Therefore, Parts c and d must be repeated several times, or until the same deviations from 1.0 and 9.0 dial readings occur for coincidence of the left end of the trace brightening with the 1-cm or with the 9-cm marker.
  - f. The linearity of the DELAY-TIME MULTIPLIER indications on this range must now be checked in the manner of Step 36. Use 50-usec markers.
39. To adjust C190-F and to check the linearity of the DELAY-TIME MULTIPLIER indication on the 5-usec/cm range.--Proceed as in Step 38, except that here you use the 5-usec/cm range of the Delaying Sweep TIME/CM switch, and display 5-usec markers from the Type 180. Use 0.1-usec/cm speed on Main Sweep. Adjust C190-F instead of C190-D.
40. To check Delaying Sweep for operation on the 100-usec/cm to 2-usec/cm ranges.--  
Settings:

<u>Main Sweep TRIGGERING LEVEL</u> --CW or CCW.	
<u>Main Sweep STABILITY</u> --CW.	<u>5X MAGNIFIER</u> --OFF.
<u>TRIGGER SLOPE</u> --+INT.	<u>LENGTH</u> --CW.
<u>MULTIPLIER</u> --X1.	<u>SLOPE</u> (toggle)--+.
<u>HORIZONTAL DISPLAY</u> --DELAYING SWEEP.	<u>ATTEN.</u> (toggle)--X1.

With VERT. SIG. OUT connected to TRIGGER OR EXT. SWEEP IN, display successively the markers listed below at the Delaying Sweep speeds indicated. For each display, use Main Sweep speed shown. In each case, observe that the Delaying Sweep functions so as to produce a trace, and that the brightening indicative of Main Sweep triggering by the Delay Pickoff occurs.

<u>Marker Interval</u> <u>from Type 180</u>	<u>Delaying Sweep</u> <u>TIME/CM</u>	<u>Main Sweep</u> <u>TIME/CM</u>
1 usec	2 usec/cm	0.1 usec/cm
10 usec	10 usec/cm	1 usec/cm
10 usec	20 usec/cm	1 usec/cm
100 usec	100 usec/cm	10 usec/cm



41. To check the Delaying Sweep for 50-kc repetition rate.-- Operate the Delaying Sweep in a free-running manner, with the Delaying Sweep TIME/CM switch at the 2-usec/cm position and with the LENGTH control set CCW. Connect a test oscilloscope 10X probe to the right-hand end of C240. Observe the Delaying Sweep waveform, using a test oscilloscope sweep speed of 10 usec/div. Each cycle of the waveform, including holdoff, should require not more than 2 major divisions on the test oscilloscope screen.
42. To check waveforms of both sweeps for sufficient holdoff.--
- a. After completing Step 41, turn the Delaying Sweep LENGTH control CW. Set the Delaying Sweep for free-running. Connect 10X probe of test oscilloscope to right hand end of C240. Observe waveforms on all sweep speeds obtained by turning the Delaying Sweep TIME/CM switch. Have test oscilloscope set for DC input. Holdoff in each case should be sufficient to prevent any retrace transients from extending into trace. As a general guide, the horizontal interval from the end of retrace to beginning of trace usually has a duration of 5 usec or more, even on fastest sweeps.
- b. Settings:
- |  |   |
|--|---|
| <u>Main Sweep TRIGGERING LEVEL--0.</u>         | <u>HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.</u> |
| <u>Main Sweep STABILITY--Set for free-run.</u> | <u>5X MAGNIFIER--OFF.</u>                     |
| <u>TRIGGER SLOPE--+INT.</u>                    | <u>MULTIPLIER--X1.</u>                        |
| <u>TRIGGERING MODE--AC SLOW.</u>               | <u>Delaying Sweep STABILITY--CCW.</u>         |
- Repeat observations of Part a of this step using Main Sweep TIME/CM switch.
43. To adjust R64 for proper waveform at Pin 8, V37-B.--Settings:
- |  |  |
|--|--|
| <u>HORIZONTAL DISPLAY--DELAYING SWEEP.</u> | <u>Main Sweep TRIGGERING LEVEL--0.</u>     |
| <u>Main Sweep TIME/CM--100 usec.</u>       | <u>Delaying Sweep TRIGGERING LEVEL--0.</u> |
| <u>MULTIPLIER--X1.</u>                     | <u>Delaying Sweep STABILITY--CW.</u>       |
| <u>5X MAGNIFIER--OFF.</u>                  | <u>Delaying Sweep TIME/CM--200 usec.</u>   |
| <u>TRIGGER SLOPE--+INT.</u>                | <u>LENGTH--CW.</u>                         |
| <u>TRIGGERING MODE--AC SLOW.</u>           |  |

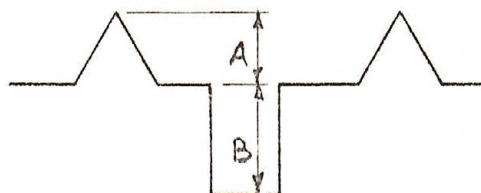
Connect 10X probe of test oscilloscope to Pin 8, V37-B. Use the following settings of test oscilloscope:

<u>TIME/DIVISION--100 usec.</u>	<u>TRIGGER SELECTOR--+INT.</u>
<u>MULTIPLIER--X5.</u>	<u>AMPLITUDE--1 volt/division.</u>
<u>5X MAGNIFIER--OFF.</u>	<u>MULTIPLIER--1-10 position.</u>

IMPORTANT: In the following adjustment, constantly have the Main Sweep STABILITY control sufficiently clockwise to allow reliable triggering--but no further clockwise.



This waveform should be observed on the test oscilloscope:



Adjust R64 so that the height of the peak A is two-thirds that of the pedestal B.

44. To check waveforms available on panel terminals.--Observe waveforms as follows with test oscilloscope:

- a. +GATE, MAIN SWEEP.--This should be a rectangular wave with an amplitude of 18 to 35 volts. It should be observed with the Main Sweep free-running.
- b. SAWTOOTH, MAIN SWEEP.--This sawtooth wave should have an amplitude of 135 to 165 volts. It should be observed with the Main Sweep free-running.
- c. DEL'D TRIG. FROM MAIN OR DEL'G SWEEP.--Settings on oscilloscope being tested:

HORIZONTAL DISPLAY--DELAYING SWEEP.

Main Sweep TRIGGERING LEVEL--0.

Main Sweep STABILITY--CW.

TRIGGER SLOPE--+INT.

TRIGGERING MODE--AC SLOW.

Main Sweep TIME/CM--10 usec.

Delaying Sweep TRIGGERING LEVEL--0.

Delaying Sweep STABILITY--CW.

Delaying Sweep TIME/CM--10 usec.

Using a 2X probe, observe on the test oscilloscope, the output from the DEL'D TRIG. FROM MAIN OR DEL'G SWEEP connector. Use these settings for the test oscilloscope:

TRIGGERING SELECTOR--+INT.

TIME/DIV.--10 usec.

MULTIPLIER--X5.

VOLTS/DIV--0.1 AC.

MULTIPLIER--X5.

You should observe on the test oscilloscope positive triggers of 5 to 10 volts amplitude, and negative triggers of about 0.5 volt amplitude. The time relationship between the + and - triggers should be controllable by means of the DELAY TIME MULTIPLIER.

- d. +GATE, DEL'G SWEEP.--This should be a rectangular wave with an amplitude of 18 to 35 volts. It should be observed with the Delaying Sweep free-running.
- e. VERT. SIG. OUT.--Insert calibrator signal into plug-in input. Reproduction of the square wave should be obtained at VERT. SIG. OUT. This reproduction is only approximate because the bandwidth of the channel which feeds this terminal is restricted to about 6 mc. The amplitude of the reproduction is about 2 volts for each centimeter of deflection.



- f. 6.3 V 1A. AC.--Using the 2X probe, you should set the test oscilloscope as follows:

TRIGGERING SELECTOR--+LINE.    VOLTS/DIV.--1 AC.  
TIME/DIV.--1 millise.        MULTIPLIER--X1.  
MULTIPLIER--X5.

A wave of approximately sinusoidal form and of about 18 volts (9 divisions) peak-to-peak amplitude should be observed.

45. To check reset of Main Sweep.--Settings:

Main Sweep TRIGGERING LEVEL--0.    5X MAGNIFIER--OFF.  
TRIGGER SLOPE--+INT.            Delaying Sweep TRIGGERING LEVEL--0.  
TRIGGERING MODE--AC SLOW.       Delaying Sweep STABILITY--CCW.  
Main Sweep TIME/CM--1 millise.   LENGTH--CW.  
MULTIPLIER--X1.                   HORIZONTAL DISPLAY--MAIN SWEEP NORMAL.

- a. Display about 2 cm of vertical deflection from calibrator, setting Main Sweep STABILITY for stable trace. Observe that READY lamp is on. Now switch HORIZONTAL DISPLAY to MAIN SWEEP DELAYED position. The trace should no longer appear, and the READY lamp should be extinguished. If now you operate the RESET MAIN SWEEP button, you should observe a single trace displaying the calibrator waveform across the screen. The trace should not recur until the RESET MAIN SWEEP button is again operated. Operate the button several times to assure that reliable operation of the sweep is obtained.
- b. Next, remove the calibrator signal by breaking the connection at the plug-in INPUT connector. Operate the RESET MAIN SWEEP push button. The READY light should now glow steadily. Apply calibrator signal by making a connection at the plug-in INPUT connector. This should result in a single trace across the screen, displaying the calibrator signal. The trace should not recur, and the READY light should now be extinguished. Repeat this operation several times to assure consistent operation.
46. To check neons and scale illumination.--With the HORIZONTAL and VERTICAL POSITION controls, move the trace off the screen--both up and down, and right and left. Check that the appropriate neon directional indicators light up in each case. Then bring up the SCALE ILLUM. control, and check that it provides control of the graticule scale illumination. See that the lamps associated with this circuit are positioned into the subpanel and panel by the proper amount and are firmly mounted.
47. To check dual-trace operation.--Feed calibrator signal into Channel A of 53C plug-in unit. Check that the square-wave display is obtained on "A ONLY" position of the OPERATING MODE switch, while a simple trace is obtained on the "B ONLY" position. These displays should be independently positionable by means of the appropriate VERTICAL POSITION controls. On the "CHOPPED" position of the OPERATING MODE switch, both the square wave and the simple trace should be seen--and the vertical position controls should again be checked. Similarly for the "ALTERNATE SWEEPS" position of the OPERATING MODE switch.



48. To check CRT cathode input circuit.--Get a stable display of calibrator signal with 4- or 5-cm vertical deflection. Remove the jumper connecting CRT CATHODE to GND, at back of oscilloscope. Connect VERT. SIG. OUT to the CRT CATHODE terminal. If the INTENSITY control is not set too high, a very noticeable decrease in brightness of the top of the square wave, and a corresponding increase in brightness at the bottom, should occur.