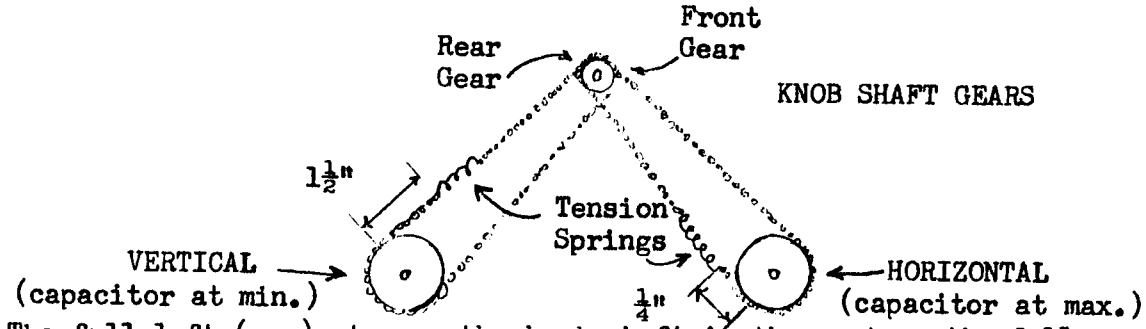
FACTORY
CALIBRATION PROCEDURE

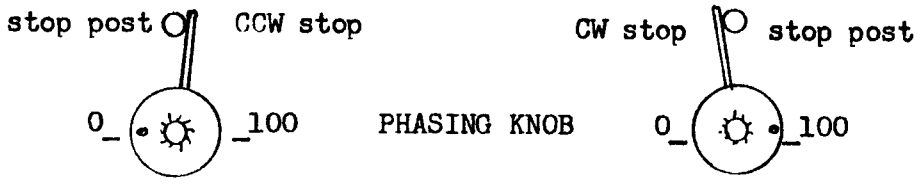
Check for long ends, unsoldered joints, poor wire dress, misaligned or loose knobs, etc. Check to see that the crt pin connections are tight. Preset all pots to mid-range. Preset the INTENSITY and SCALE ILLUM. controls full left (ccw). Set the INTENSITY MODULATION mode switch to INT. UNBLANK.

1. ADJUST PHASING CONTROL LINKAGE AND STOPS.

The AMPLIFIER PHASING control linkage is arranged as illustrated in the following diagram. With the vertical variable capacitor at its minimum capacitance position and the horizontal variable capacitors both at their maximum capacitance positions, the linkage is arranged such that the tension spring on the vertical drive chain is approximately 1½ inches from contact with the vertical capacitor gear and the horizontal drive chain tension spring is about ¼ inch from the horizontal capacitor gear.



The full left (ccw) stop on the knob shaft is then set so the full left (ccw) rotation of the AMPLIFIER PHASING knob will be checked with the linkage in the illustrated position. The AMPLIFIER PHASING knob corresponding to 0 divisions on the front panel scale as illustrated below (left). Rotate the knob to indicate 100 divisions and set the other stop to check full right (cw) rotation at this point as illustrated below (right).



2. CHECK POWER SUPPLY RESISTANCE TO GROUND.

Check the resistance to ground of the power transformer primary and the power supplies. The power transformer primary must have infinite resistance to ground (as measured with test vom) and typical power supply resistances are as follows:

POWER SUPPLY	RESISTANCE TO GROUND	
-150	15 KΩ	
+100	500 Ω	
+100	2.5 KΩ	(with underload relay hand actuated)
+225	15 KΩ	
+350	20 KΩ	

Install V254 shield.

3. CHECK TIME-DELAY RELAY.

Install 2 TEST LOAD UNITS and turn scope on. Check for a delay of from 15 to 45 seconds before the B+ relay energizes.

4. CHECK UNDERLOAD RELAY.

Ascertain that the underload relay is energized. Remove either plug-in and insure de-energization of the underload relay.

5. SET -150 ADJ. AND CHECK LOW-VOLTAGE SUPPLIES.

Set -150 v supply with the -150 ADJ. Measure all power supply voltages and ascertain a deviation of not more than ±2% from their rated values.

Insure proper operation of the scope by advancing the INTENSITY control slowly until a spot is observed. Rotation of the horizontal and vertical position controls should deflect the spot over the graticule assuming the deflection amplifiers are operating properly. If it is noticed that operational defects exist they should be corrected before proceeding.

With the test scope, measure the ripple of all of the power supplies at 117 line volts. Ripple should not exceed 30 millivolts on any supply. Typical ripple is as follows:

POWER SUPPLY	RIPPLE	
-150	5 mv	
+100	10 mv	
+225	5 mv	
+350	20 mv	(The ripple on the 350 v supply may reach 50 mv just before going out of regulation on low line high load.)

Regulation is checked by noting that the ripple voltages do not exceed 30 millivolts under varying line and load conditions. These conditions are specified as follows:

5. Con't.

LINE VOLTS	TEST LOAD UNIT SET TO
105	HIGH LOAD
125	LOW LOAD

6. SET CAL. ADJ.

Return line voltage to **117** v. Turn the SQUARE-WAVE CALIBRATOR OFF. **Set** CAL. ADJ. for 100 v measured at the CAL. VOLT. CHECK pin jack located towards the front of the power chassis. Check the calibrator symmetry by turning the SQUARE-WAVE CALIBRATOR ON. The voltage at the pin jack should drop to 50 v ±5 v.

7. SET H.V. ADJ. AND CHECK REGULATION.

Adjust high voltage by setting the H.V. ADJ. for -800 v measured at the forward end of the 10k resistor which returns to the plate of V822. While monitoring this voltage, rotate the INTENSITY control (do not burn crt) noting that the reading remains reasonably constant (approximately a 10 v change).

From SQUARE-WAVE CALIBRATOR, apply 2 v of signal to the "HORIZONTAL" TEST LOAD UNIT input. Advance the INTENSITY control until the resultant trace is visible. Align the trace with the horizontal graticule lines and push the crt forward against the graticule. Clamp the crt in this position.

8. CHECK SCALE ILLUM. CONTROL.

Check the SCALE ILLUM. control to see that there are no open spots in the pot and that it is wired so that the graticule lights are brightest when the control is full right (cw).

9. SET GEOM. ADJ.

From SQUARE-WAVE CALIBRATOR apply 2 v of signal to the "VERTICAL" TEST LOAD UNIT input and set the GEOM. ADJ. for minimum curvature of the vertical trace while positioning from one side of the graticule to the other. Deviation from a straight vertical line must not exceed 0.75 minor division within the graticule. Transfer the signal from the "VERTICAL" TEST LOAD UNIT input to the "HORIZONTAL" TEST LOAD UNIT input. The resultant trace must not deviate more than 0.75 minor division from a straight horizontal line within the graticule.

10. CHECK HUM AND MICROPHONICS.

Check for hum and microphonics in the horizontal amplifier.

11. CHECK DC BALANCE.

Short the horizontal deflection plates to determine crt electrical center. Short the grids of the 5894 and check for not more than 3 major divisions of unbalance. Short the 6BQ7 grids and check for not more than 1 major division of unbalance in the 6BQ7 stage. Depress the PRESS TO SHORT INPUT button on the horizontal TEST LOAD UNIT and check for not more than 2 major divisions of unbalance in the 12BY7 stage and the overall amplifier balance is not more than 2 major divisions from crt electrical center.

12. SET GAIN ADJ.

Switch the TEST LOAD UNIT attenuator to 250:1 and apply 100 v of calibrator signal to the horizontal input. Adjust horizontal GAIN ADJ. for 4 major divisions of deflection.

13. SET SCREEN VOLTS ADJ. FOR MINIMUM COMPRESSION AND EXPANSION.

Check for compression and/or expansion in the horizontal amplifier by positioning 4 major divisions of calibrator signal to the horizontal extremes of the graticule and observing the change in amplitude. If compression and/or expansion exceeds 0.5 minor division, set the horizontal SCREEN VOLTS ADJ. to bring it within 0.5 minor divisions. (Setting SCREEN VOLTS ADJ. affects the setting of the GAIN ADJ. which should be reset before rechecking compression and/or expansion.)

14. ADJUST BEAM-POSITION-INDICATOR CENTERING CONTROLS.

Adjust the beam-position-indicator centering (R275 horiz. - R375 vert.) so that the indicator neons fire equidistant from the graticule center.

15. SET SIG. OUT DC LEVEL ADJ.

Position the spot to the center of the graticule and set the HORIZ. SIG. OUT DC ADJ. for 0 volts measured at the HORIZ. SIG. OUT post on the front panel. (Repeat steps 10 through 15 to calibrate the vertical amplifier by substituting vertical for horizontal in the text.)

16. CHECK ALTERNATE-SWEEP OPERATION.

Remove the "HORIZONTAL" TEST LOAD UNIT and install a 53/54 T unit. Advance the STABILITY control on the 53/54 T unit until a trace appears. Switch the VERTICAL TEST LOAD UNIT to DUAL TRACE and check alternate sweep operation.

Turn the scope OFF, and install the 5894 shield on the horizontal amplifier. This is necessary to prevent interference between the horizontal and vertical amplifiers at high frequencies. Remove the "VERTICAL" TEST LOAD UNIT and install a 53/54 K unit. Turn the scope ON.

17. CHECK SQUARE-WAVE CALIBRATOR VOLTAGE STEPS AND THE VOLTS TO MILLIVOLTS DIVIDE

Apply .2 v signal from the SQUARE-WAVE CALIBRATOR to the vertical INPUT. Connect VERT. SIG. OUT to TRIGGER INPUT, trigger the sweep and check the calibrator waveform. Free-run the sweep and check the calibrator voltage steps with the K UNIT VOLTS/CM switch. Compare the VOLTS range to the MILLIVOLTS range.

17. Con't.

PEAK-TO-PEAK	VOLTS/CM	Deflection
.2 v	.05	4 divisions
.5 v	.1	5 divisions
1 v	.2	5 divisions
2 v	.5	4 divisions
5 v	1	5 divisions
10 v	2	5 divisions
20 v	5	4 divisions
50 v	10	5 divisions
100 v	20	5 divisions
100 mv	.05	2 divisions

18. ADJUST D.C. SHIFT COMP.

Using an ohm meter as a source of DC voltage, deflect the trace 6 major divisions and adjust DC SHIFT COMP. for minimum shift after deflection.

19-20. ADJUST SIG. OUT WAVESHAPE AND CHECK AMPLITUDE. ADJUST HF COMPENSATIONS.

From a TYPE 105 SQUARE-WAVE GENERATOR, apply a square-wave of approximately 50 kc to the VERTICAL 53/54 K INPUT. Set the VOLTS/CM to .05 and the VARIABLE control full right (cw). Adjust the TYPE 105 OUTPUT AMPLITUDE control for about 4 major divisions of deflection. Preset the two output coil slugs (located above the 5894 in both the VERTICAL and the HORIZONTAL amp.) so that they project about $\frac{1}{4}$ inch from the chassis and preset the two input coil slugs (L204, L224 horizontal - L304, L324 vertical) so that they are flush with the tops of the coil forms. Preset the l-r coil slugs (L223 horizontal - L323 vertical) about $\frac{1}{2}$ way into the coil. Preset the capacitor across the horizontal deflection plate (C266) to minimum capacitance. Connect a properly compensated 10X (P510) probe to the VERT. SIG. OUT post and obtain a triggered display on the test scope. Adjust the signal-output compensation capacitor (C292 horizontal - C392 vertical) for optimum flatness of the output waveform. The waveform should be approximately 1.5 volts/division of amplitude. Remove the test scope probe and increase the TYPE 105 frequency to about 400 kc. Adjust all coils for best risetime with no overshoot of the observed waveform. The l-r adjustment is a relatively long time constant and is best adjusted at approximately 100 kc. It is important that the input coils are adjusted with the slugs to the outward side of the coil winding.

21. CHECK AMPLIFIER FREQUENCY RESPONSE.

From a TYPE 190 CONSTANT AMPLITUDE SIGNAL GENERATOR obtain 6 divisions of vertical deflection at about 500 kc. (53/54 K unit VOLTS/CM switch at .05 and VARIABLE VOLTS/CM full right.) Determine the frequency at which the 3db down point occurs using a ratio of 6 to 4.2 major divisions. A slight variation in high frequency response may be noticed when turning the PHASING CONTROL.

22. CHECK INTENSITY MOD. INPUT.

Interchange the 53/54 K UNIT and the 53/54 T UNIT. Switch INTENSITY MODULATION to EXT DC and connect +GATE OUT to INTENSITY MOD. INPUT. Free-run the sweep and switch INTENSITY MODULATION to AC and note considerable dimming of the trace. Return the INTENSITY MODULATION switch to DC and repeat Steps 18, 19, 20 and 21 for the horizontal amplifier. The horizontal and vertical amplifier frequency response should be as near identical as possible. If necessary, adjust C266 (across horizontal deflection plates) to decrease the horizontal amplifier bandwidth.

23. CENTER AMPLIFIER PHASING CONTROL RANGE.

Remove the 53/54 T unit from the vertical amplifier and install a 53/54 K unit. Apply a 10 mc signal from a TYPE 190 CONSTANT-AMPLITUDE SIGNAL GENERATOR to both the VERTICAL and HORIZONTAL 53/54 K units simultaneously. (Take care to insure equal cable lengths and terminations.) Set both 53/54 K units VOLTS/CM switch to .05 and VARIABLE VOLTS/CM full right (cw). Adjust the TYPE 190 OUTPUT AMPLITUDE for 10 divisions of horizontal and vertical deflection. (This will be a trace extending from the lower left corner of the upper right corner of the graticule.) Adjust C254 so that rotation of the AMPLIFIER PHASING control results in equal and opposite phase shift from zero degrees. (Zero degrees may not necessarily be the mechanical mid-range of the AMPLIFIER PHASING control.)

24. CHECK AMPLIFIER PHASING range at 10 mc.

From the TYPE 190 obtain 10 divisions of deflection at 10 mc (as in step 23). Rotation of the AMPLIFIER PHASING control must effect an overall amplifier phase shift of at least 5 degrees.

25. CHECK PHASE SHIFT OF AMPLIFIERS (DC TO 15 MC).

With the TYPE 190 at 10 mc and 10 divisions of horizontal and vertical deflection, adjust the AMPLIFIER PHASING control for a 1 degree phase shift display (see introduction). Reduce the generator frequency (maintaining 10 divisions of deflection) and observe the display diviation from the 10-mc pattern. The deviation must not exceed 1 degree from dc to 10 mc. If 1 degree is exceeded, return to 10 mc and readjust the AMPLIFIER PHASING for an opposite 1 degree phase shift pattern and repeat the check. Also insure that the relative phase shift does not exceed 1 degree from dc to 15 mc using less than 10 divisions of deflection, not overdriving the amplifiers.

26. CHECK AMPLIFIER PHASE SHIFT BALANCE TO 30 MC.

Set the TYPE 190 to 20 mc and adjust the OUTPUT AMPLITUDE for approximately 5 divisions of horizontal and vertical deflection. The amplifier must balance (0 degrees phase shift) with the adjustment of AMPLIFIER PHASING control. The amplifiers must also balance at 30 mc with 2 divisions of horizontal and vertical deflection.

27. CHECK CRT CATHODE INPUT.

Apply sufficient signal from the SQUARE-WAVE CALIBRATOR for 4 divisions of deflection to the VERTICAL 53/54 K input. Connect a lead from the VERT. SIG. OUT post to the CRT CATHODE input at the rear of the scope. The top spot on the trace should dim and the lower spot should brighten.

28. RECORD CRT TYPE AND SERIAL NUMBER ON THE CALIBRATION RECORD.