

TYPE 555 OSCILLOSCOPE

F A C T O R Y C A L I B R A T I O N P R O C E D U R E

Quick check for long ends, unsoldered joints, wire dress, etc. Preset all pots and trimmers to mid-range, except delay lines. Check to see that the crt pin connections are tight. Install a test load unit in each vertical. Install a type 21 plug-in in the left hand side and a type 22 in the right hand side. Connect power cable to INDICATOR and POWER SUPPLY. Turn INTENSITY ccw.

1. CHECK RESISTANCE TO GROUND OF TRANSFORMER PRIMARIES AND ALL SUPPLIES.
Primaries of transformers should have infinite resistance to ground. -150 1.5K Ω , +100 2K Ω , +225 6K Ω , +350 5K Ω , +500 15K Ω . Resistance readings taken with power supply and indicator connected.
2. CHECK THERMAL TIME DELAY
Turn scope on and check the time delay relay delay. (15 to 45 seconds)
3. SET -150 V ADJ., CHECK POWER SUPPLY VOLTAGES AND REGULATION
Set the -150 ADJ. Check the +100 v, 225 v, 350 v, and 500 v supplies to be within 2% of the rated value. Check regulation from 105 to 125 line volts. The ripple will be approximately: -150 v, 5 mv; +100 v, 5 mv; +225, 3 mv; +350 v, 5 mv; +500 v, 10 mv.
4. CHECK ELEVATED HEATERS
Check for 225 v on T750 terminals #6, 7, 8, 9, 21, 22. Check for 100 v on terminals #19, 20, 23, 24 of T750. Check for -HV on terminals #17, 18, 13, 14, of T750.
5. SET 6.3 V REGULATED HEATERS
Connect an accurate AC voltmeter from terminal #26 on the indicator power transformer to ground. Adjust REG. HEATER ADJ. for a reading of 6.3 volts. Check regulation from 105 to 125 line volts.
6. SET ASTIG. BAL. (MODELS BELOW SERIAL 220)
Adjust ASTIG. BAL. pot for a zero voltage reading between the two blue and white wires that run from near the thermal cutout to the distributed amplifiers.
7. SET CALIBRATOR
With the SQUARE WAVE CALIBRATOR OFF, adjust CAL. ADJ. for 100 v at the CAL. TEST PT. Turn the SQUARE WAVE CALIBRATOR ON. The voltage at the CAL. TEST PT. should be between 45 and 55 volts.
8. SET HV ADJ.
There are two -1350 v supplies, one on each side of the upper deck, and both of these have a test point (indicated on hv shield) and a high voltage adjustment. Both should be set for -1350 v to ground or -1200 v to the -150 v supply. Install high voltage shields.
9. SET BEAM ROTATION, CHECK POSITION NEONS, SCALE ILLUM CONTROL AND CHECK REGULATION
Check the SCALE ILLUM control and check the position controls against the corresponding position-indicating neon lights. Advance stability and INTENSITY controls

9. (continued)

to obtain traces. Align the traces with the graticule by adjusting the BEAM ROTATION control. If the traces are not exactly aligned, adjust for half way between the two. Push the crt against the graticule and tighten the clamp. Check hv regulation by varying the line voltage from 105 to 125 v. There should be no trace blooming with high or low intensity. Check for vertical shift as the line voltage is varied.

10. SET GEOMETRY

Apply enough calibrator signal to the two inputs so that only the vertical portions of the signal are visible. Adjust STABILITY and TRIGGERING LEVEL controls for stable displays. Adjust both geometry controls for minimum curvature of the vertical lines. The two adjustments interact so they may have to be adjusted several times. Check the geometry on both the upper and lower sections of the graticule with the respective beams.

11. CHECK SHIELD VOLTAGE

The shield voltage will measure about 300 v at the junction of R863 and R862.

12. SET ASTIGMATISM

Display about 2 cm of CALIBRATOR signal on each channel. Adjust FOCUS and ASTIGMATISM controls in each channel for the sharpest line presentation obtainable.

13. CHECK VERTICAL DISTRIBUTED AMPLIFIER BIAS

Invert the Indicator and place a short clip lead across the grid lines of the distributed amplifier in the UPPER BEAM vertical. Check the bias of each pair of 6DK6's for at least 1 v. Steps 13 thru 28 are the same in both verticals. They may be done one vertical at a time or both at the same time.

14. CHECK VERTICAL AMPLIFIER BALANCE

With the grid lines shorted, short the UPPER BEAM vertical deflection plates to determine the electrical center. Check the 6DK6 stage balance to be within 2 mm of electrical center. Remove the clip lead from the grid lines and short the 6DJ8 grids. (pins 2) Check for not more than 1 cm of unbalance in the 6DJ8 stage. Depress the PRESS TO SHORT INPUT button and check for not more than 1 cm unbalance in the 12BY7 stage with the overall amplifier unbalance not to exceed 1.5 cm.

15. SET VERTICAL GAIN

With the vertical attenuator of both TEST LOAD UNITS set to 250:1, apply 100 v of calibrator signal to the UPPER BEAM vertical input. Set the vertical GAIN ADJ. for 4 cm of deflection.

16. CHECK COMPRESSION AND EXPANSION

Switch the vertical attenuators to 1:1 and the SQUARE WAVE CALIBRATOR to .2 v. The resultant deflection should be 2 cm. Position the 2 cm of deflection up and down from the graticule center and check the compression or expansion at both extremes. Compression or expansion should not exceed .5 mm.

17. ADJUST DELAY LINE AND VERTICAL AMPLIFIER HF COMPENSATIONS

With the VOLTS/CM switch of K UNIT set at .05 and the VARIABLE VOLTS/CM control full cw, apply a 400 kc fast risetime square wave to the UPPER BEAM vertical INPUT. Adjust the AMPLITUDE for approximately 3 cm of deflection. Switch TIME/CM to 1 μ sec X .2. Adjust the trimmers in the delay line and distributed amplifier with an in-

17. (continued)

sulated tool for optimum square wave response. The variable coils control the amount of spike on the leading edge of the waveform.

18. CHECK VERTICAL RESPONSE (NOT MORE THAN 30% DOWN AT 30 MC)

From a constant amplitude Sine Wave Generator, apply a 50 kc signal to the UPPER BEAM vertical INPUT. Adjust the amplitude for 3 cm of deflection. Increase the Sine Wave Generator frequency to 30 mc and check for at least 2.1 cm of deflection.

19. CHECK HF SYNC

The scope should trigger on a 10 mc sine wave of 2 cm amplitude (Internally)

20. CHECK DUAL TRACE AND CHOPPED BLANKING OPERATION

With no signal to the vertical inputs, switch both TEST LOAD UNITS to ALTERNATE SWEEP and observe the four (4) alternating sweeps. Check that both channels work on both sweeps. Switch to CHOPPED and using normal intensity, switch CRT CATHODE SELECTOR switch to DUAL TRACE CHOPPED BLANKING. The transient spikes on the CHOPPED waveform should be blanked out. Install "K" plug-in unit.

21. CHECK SQUARE WAVE CALIBRATOR VOLTAGE STEPS

Check the calibrator ranges against the VOLTS/CM switch of the "K" unit. ($\pm 2\%$). Do on one channel only.

22. ADJUST VERTICAL DC SHIFT COMPENSATIONS

Using a meter as a dc source, deflect the UPPER BEAM trace approximately 4 cm. Adjust the UPPER BEAM vertical DC SHIFT control for minimum drift after deflection.

23. CHECK TRIGGER AND SWEEP SWITCHING

It must be possible to trigger either sweep + or - from either vertical. It must be possible to drive either beam from either time base or both beams from either time base.

24. CHECK LINE TRIGGER

Connect a 10X probe from the INPUT of the UPPER BEAM to the line fuse holder on the power supply. Check that it triggers + and - on the correct polarity.

25. ADJUST MAG GAIN (R372 and R472 of A and B Horiz. Amps.)

Apply 100 μ sec, 1 msec, and 5 msec time marks to both Vertical Amplifiers.

Set HORIZ. DISPLAY, both UB and LB, to TIME BASE A X.2. Set Time Base A (Type 21) SWEEP FUNCTION to NORMAL, VARIABLE to CALIBRATED and TIME/CM to 1 ms. The trigger should be set to UPPER BEAM, AC, +, and + LEVEL. (Time Base B SWEEP FUNCTION to NORMAL.)

Adjust MAG GAIN of both A and B Horiz. Amps. for two time marks/CM. Always time between the 1st and 9th centimeter (CM) graticule mark. (See specification sheet for all timing tolerances.)

26. ADJUST SWEEP CAL (R351 and R451 of A and B Horiz. Amps.)

Switch HORIZ. DISPLAY, both UB and LB, to TIME BASE A X1. Adjust SWP CAL of both A and B Horiz. Amps. for one 1msec time mark/CM.

27. ADJUST SWEEP MAG. REG. (R358 and R458 of A and B Horiz. Amps.)

Return HORIZ DISPLAY, both UB and LB, to TIME BASE A X.2. Position both UB and LB displays so the middle 5 msec time mark falls at the graticule center. Switch both HORIZ. DISPLAY to A X1. Adjust UB and LB SWP. MAG. REG. so the time mark again falls at the graticule center.

28. ADJUST TIME BASE A SWEEP LENGTH

Adjust SWEEP LENGTH for 10.5 cm of horizontal deflection.

29. CHECK VARIABLE TIME/CM (Time Base A)

Check VARIABLE TIME/CM for smooth operation and a complete range of control between the TIME/CM steps. The UNCALIBRATED neon must light whenever the VARIABLE TIME/CM is rotated away from full clockwise.

30. ADJUST TIME BASE B SWEEP LENGTH

Set HORIZ. DISPLAY, both UB and LB, to TIME BASE B X1 and TIME/CM to 1 msec/cm. The trigger should be set to LOWER BEAM, AC, +, and +LEVEL. Adjust SWEEP LENGTH for 10.5 cm of horizontal deflection.

Remove time base extensions and insert the Type 21 and Type 22 sweep generators into their compartments.

31. CHECK VARIABLE TIME/CM (Time Base B.)

Set TIME/CM to 1 ms and apply 5 ms time marks. Check VARIABLE TIME/CM and UNCALIBRATED neon as in Step 5.

32. CHECK TIME BASE B SWEEP RATES (.1 msec to 5 sec/cm)

Apply 100 μ sec time marks. Set TIME/CM to .1 msec. Re-adjust +LEVEL if necessary. Check the sweep rates as follows:

<u>TIME/CM</u>	<u>TIME/MARK GENERATOR</u>	<u>OBSERVE</u>
.1 msec	100 μ sec	1 mark/cm
.2 msec	100 μ sec	2 mark/cm
.5 msec	500 μ sec	1 mark/cm
1 msec	1 msec	1 mark/cm
2 msec	1 msec	2 mark/cm
5 msec	5 msec	1 mark/cm
10 msec	10 msec	1 mark/cm
20 msec	10 msec	2 mark/cm
50 msec	50 msec	1 mark/cm
.1 sec	100 msec	1 mark/cm
.2 sec	100 msec	2 mark/cm
.5 sec	500 msec	1 mark/cm
1 sec	1 sec	1 mark/cm
2 sec	1 sec	2 mark/cm
5 sec	5 sec	1 mark/cm

33. ADJUST C330 and C430 (A and B Horiz. Amps.)

Set HORIZ. DISPLAY, both UB and LB, to TIME BASE B X.2. Set Time Base B TIME/CM to .1 msec. Apply 10 μ sec time marks. Readjust +LEVEL. Adjust separately C330 and C430, A and B Horiz. Amps., for minimum shift of the sweep start while switching TIME/CM alternately between 50 μ sec and .1 msec.

34. ADJUST TIME BASE B, HORIZ. AMP. A, & HORIZ. AMP. B HIGH FREQUENCY TIMING.

Apply 10 μ sec trigger pulses to Time Base B INPUT and 1 μ sec time marks to each vertical. Set trigger to EXT., AC, +, and +LEVEL. (Replacing the cabinet sides will affect the HF timing so this should be checked in order to make compensations.)

<u>TIME/CM</u>	<u>TIME MARK GEN.</u>	<u>LOCATION</u>	<u>ADJ.</u>	<u>OBSERVE</u>
(Set <u>HORIZ. DISPLAY</u> , UB and LB, to <u>TIME BASE B X1</u>)				
.5 μ sec	1 μ sec	Time Base B	C160A	1 mark/2cm
.1 μ sec	10 MC	Horiz. Amp. A	C350	1 cycle/cm
			C372	Linearity
		Horiz. Amp. B	C450	1 cycle/cm
			C472	Linearity

(Set HORIZ. DISPLAY, UB and LB, to TIME BASE B X.2)

.1 μ sec	50 MC	Horiz. Amp. A	C364	Linearity
			C384	and timing.
		Horiz. Amp. B	C464	Linearity
			C484	and timing.

Re-Check all above positions for interaction.

Set HORIZ. DISPLAY, UB and LB, to TIME BASE B X1.
Apply 100 μ sec trigger pulses.

<u>TIME/CM</u>	<u>TIME MARK GEN.</u>	<u>LOCATION</u>	<u>ADJ.</u>	<u>OBSERVE</u>
1 μ sec	1 μ sec	Time Base B	C160C	1 mark/cm
2 μ sec	1 μ sec			2 mark/cm
5 μ sec	5 μ sec			1 mark/cm
10 μ sec	10 μ sec		C160E	1 mark/cm
20 μ sec	10 μ sec			2 mark/cm
50 μ sec	50 μ sec			1 mark/cm

35. ADJUST SWEEP DELAY START AND DELAY STOP (R576, R572)

Apply 1 msec time marks to each vertical. Set UB HORIZ. DISPLAY to TIME BASE A X1. Set Time Base A TIME/CM to 1 msec and Time Base B TIME/CM to 10 μ sec. Switch SWEEP FUNCTION to SWEEPS ONCE FOR EACH "A" DEL'D. TRIG..

The 1-10 MULTIPLIER should be set to 1.00. At this point, Time Base A +LEVEL may require slight re-adjustment. Also position both UB and LB sweeps for normal display. Adjust DELAY START so the leading edge of the second UB marker is brightened and the LB marker occurs at the sweep start.

Now set the 1-10 MULTIPLIER to 9.00. Adjust DELAY STOP so the leading edge of the tenth UB marker is brightened and the LB marker occurs at the sweep start. Interaction may require re-adjustment of DELAY START and DELAY STOP. Check linearity of the 1-10 MULTIPLIER at all major divisions. (See spec. sheet).

36. CHECK DELAY SWEEP JITTER

Set Time Base B TIME/CM to 1 μ sec. Check horizontal jitter of LB pulse at 1.00 and 9.00 settings of the 1-10 MULTIPLIER.

37. CHECK TIME BASE A SWEEP RATES USING 1-10 MULTIPLIER. (.1 ms to 5 sec.)

Check each of the following positions between 1.00 and 9.00 on the 1-10 MULTIPLIER. At 1.00, note error in delay start due to the trigger circuit; add or subtract this error at 9.00.

TIME BASE A	TIME BASE B	TIME-MARK GEN.
.1 ms/cm	1 μ sec/cm	100 μ sec
.2 ms/cm	1 μ sec/cm	100 μ sec
.5 ms/cm	1 μ sec/cm	500 μ sec
1 ms/cm	10 μ sec/cm	1 msec
2 ms/cm	10 μ sec/cm	1 msec
5 ms/cm	10 μ sec/cm	5 msec
10 ms/cm	.1 msec/cm	10 msec
20 ms/cm	.1 msec/cm	10 msec
50 ms/cm	.1 msec/cm	50 msec
.1 sec/cm	1 msec/cm	100 msec
.2 sec/cm	1 msec/cm	100 msec
.5 sec/cm	1 msec/cm	500 msec
1 sec/cm	20 msec/cm	1 sec
2 sec/cm	20 msec/cm	1 sec
5 sec/cm	msec/cm	5 sec

38. ADJUST TIME BASE A H.F. SWEEP RATES.

Apply 10 μ sec time marks to both verticals. Set Time Base A TIME/CM to 10 μ sec and Time Base B TIME/CM to .5 μ sec/cm. Readjust TimeBase A +LEVEL. Adjust C160E and C160C using 1-10 MULTIPLIER for timing between 1.00 and 9.00. At 1.00, note error in delay start due to trigger circuit; add or subtract this error at 9.00.

TIME BASE A	TIME BASE B	TIME-MARK GEN.	ADJUST
10 μ sec/cm	.5 μ sec/cm	10 μ sec marker	C160E
20 μ sec/cm	.5 μ sec/cm	10 μ sec marker	
50 μ sec/cm	.5 μ sec/cm	50 μ sec marker	
1 μ sec/cm	.1 μ sec/cm	1 μ sec marker	C160C
2 μ sec/cm	.1 μ sec/cm	1 μ sec marker	
5 μ sec/cm	.1 μ sec/cm	5 μ sec marker	

Because of the very fast sweep rate of .1 μ sec/cm, the 1-10 MULTIPLIER cannot be used when adjusting C160A. Therefore, the following procedure is necessary:

Switch LB HORIZ. DISPLAY to TIME BASE A X1. Apply 10 μ sec trigger pulses to Time Base A INPUT and set trigger to EXT, AC, +, and + LEVEL. Set Time Base B SWEEP FUNCTION to NORMAL.

38. (Continued)

TIME BASE A	TIME-MARK GEN.	ADJ.	OBSERVE
.1 μ sec/cm	10 mc	C160A	1 cycle/cm
.2 μ sec/cm	10 mc		2 cycle/cm
.5 μ sec/cm	1 μ sec		1 marker/2cm

Set HORIZ. DISPLAY, UB and LB, to TIME BASE A X.2.

.1 μ sec/cm	50 mc		1 cycle/cm
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39. CHECK EXTERNAL AMPLIFIER

(The adjustment of both external amplifiers will be the same.) Switch to EXTERNAL X1. Apply 2 volts to INPUT on the rear of the scope. This voltage should produce 10 cm of deflection or more. Check operation of the VARIABLE control. Set the VARIABLE for 10 CM of deflection. Switch to 20 volts input and X10. The resulting deflection should be the same as that obtained before $\pm 2\%$. Sync externally and apply a 1 kc fast risetime square wave to the external amplifier. Adjust the 10X position for the same presentation as obtained in the 1X position.

40. CHECK DELAYED GATE TRIGGER OUT

The DELAYED GATE TRIGGER OUT should be a sharp spike with more than 5 volts of amplitude.

41. CHECK CRT CATHODE INPUTS

Remove CRT CATHODE GND. straps from rear of scope and insert signal from calibrator and check sweeps for intensity modulation. With normal intensity, 20 V of calibrator signal will modulate the trace.

