

NOTE REGARDING FACTORY CALIBRATION PROCEDURES
AND TEST SPECIFICATIONS

Factory Calibration Procedures and Test Specifications are intended for use at the factory as a general guide for calibrators and quality control men. Most of the tolerances listed in these sheets are closer than advertised specifications. This is done purposely in order to insure that the instrument will meet or exceed advertised specifications when it reaches the customer.

These calibration procedures and test specifications should be used, therefore, as a guide only.

Some of the test equipment referred to in the calibration procedures is not available commercially; the Tektronix field engineer will be glad to suggest alternate approaches.

N UNIT

FACTORY CALIBRATION PROCEDURE
(Tentative)

1. Visual check for errors, unsoldered joints, wire dress, loose hardware, etc.
2. Resistance checks to ground.

Check on interconnecting plug at rear of plug-in.

Pin 1	65 K	Pin 9	60 K	+20 Volt Supply 170 Ω
2	0	10	7.5 K	-20 Volt supply 250 Ω
3	65 K	11	20 K	
4	Infinity	12	100 K	
5	" "	13	Infinity	
6	" "	14	" "	
7	" "	15	70 Ω	
8	" "	16	Infinity	

Signal Input Connector - 50 Ω $\pm 5\%$

Regenerated Trigger Input - 50 Ω $+40\%$ with neg. lead on grid.

3. VOLTAGE CHECKS TO GROUND (NO TRANSISTORS IN SOCKETS) POWER ON.

Connect unit to scope with flexible cable.

+20 volt supply $\pm 10\%$

-20 volt supply $\pm 10\%$

If either voltage is extremely low, check the AC voltage across the power supply. If the 6.3 is low, turn power off and check.

-150

+100

+225

+350

= \pm tolerance of indicator scope. These will read about 2% low because of decoupling resistors.

Turn STABILITY and DELAY controls CCW.

-17 volts at collector of Q5493 (1st E.F.)

-150 volts at collector of Q5430 (Fast Ramp Gen.)

+1 volt at base of Q5430

-15 volts at collector of Q5410

+1.7 volts at base of Q5410

4. TURN POWER OFF AND INSTALL ALL TRANSISTORS EXCEPT Q5444

5. PRESET 110 AND MAKE CONNECTIONS TO "N"

Connect 110 REGENERATED TRIGGER OUT to the "N" REGENERATED TRIGGER IN. Terminate TRIGGER TAKE-OFF SIGNAL OUT 98% signal cable with 50 Ω X10 attenuator or 50 Ω pigtail.

Connect a 20 Nsec charge line from CHG line 1 to CHG line 2 on the 110. Remove the cathode ground strap on the scope and connect lead from "N" to CRT CATHODE to CRT cathode INPUT.

Connect PULSE GENERATOR OUT to TRIGGER TAKE-OFF SIGNAL IN on the 110. Connect to EXTERNAL HORIZONTAL IN on the "N" to the scope EXTERNAL HORIZONTAL INPUT.

Terminate the "N" SIGNAL IN with a 50 Ω pigtail.

5. cont.

Set 110 front panel controls as follows:

Amplitude	6
Voltage Range	0.5
Pulse Polarity	+
Mode	<u>Free Run</u>
Trigger mode	Less than 1 mc
Take-off	Take-off
Attenuator	0.1
Inverter	+1
Amp. 1	X10
Amp. 2	X10
Ext. out/regen.	Regen.
Trigger sensitivity	Sweep triggered - not free run
Delay	Minimum
Inverter	+10 V

6. CHECK REGENERATED TRIGGER

Connect a 10X probe from a test scope to the junction of R5416 and R5417. The waveshape at this point should have an amplitude of 5V. The width of the waveshape at the 50% level should be at least 200 Nsec.

7. CHECK RAMP VOLTAGE

Use the junction of R5412 and D5416 for external trigger to the test scope.

Turn Delay oow. Set Nsec/cm to 1.

Check Ramp Voltage at emitter of Q5430. Note the step at the front of the ramp. The ramp voltage should be 2 volts, 200 Nsec wide. If the Comparator is running, all of the ramp will not be visible but look for slewing.

Preset the SWEEP RATE to its center. The baseline DC level should be +.6 V to +.9 V.

8. CHECK FAST RAMP GENERATOR OUTPUT

Connect the test scope probe to the junction of R5440 and C5441. Note the pulse waveshape. The pulse should be approximately 7 V in amplitude and 80 Nsec to 120 Nsec wide.

9. CHECK OUTPUT OF DELAY B.O.

Connect the test scope probe to the junction of R5455 and R5456. Note the waveshape. The negative portion will be rounded with an amplitude of approximately 4 volts and a width of .75 to 1.25 μ sec. The positive portion will be approximately 8 volts in amplitude and spiked with a width of approximately 1 μ sec.

10. CHECK OUTPUT OF UNBLANKING B.O.

Connect the test scope probe to the CRT cathode output jack. The waveshape will be approximately 15 V negative with a .75 to 1.25 μ sec width. The amplitude of the positive portion will be approximately 7 volts.

11. CHECK OUTPUT OF RESET AMPLIFIER

CONNECT the test scope probe to the collector of Q5464. The waveshape will be ap-

proximately 1.4 μ sec wide. The amplitude varies with the DOTS ADJ. SETTING.

12. ADJUST SWEEP LENGTH

Apply 50 volts of calibrator signal to the scope EXTERNAL HORIZ. IN jack. Set the VERT. POS. LIMIT pot for a presentation on the test scope screen. Adjust the EXTERNAL VARIABLE control for a sensitivity of 5 V/CM. (10 divisions of deflection)

Remove the CALIBRATOR signal and insert the lead from the "N" EXTERNAL HORIZ. jack in the scope EXTERNAL jack.

Adjust the SWEEP control for 10 cm of deflection.

13. CHECK RETRACE OFFSET AMPLIFIER

Switch the SAMPLES/DISPLAY switch to 500. Connect the test scope probe to the EXTERNAL HORIZ. OUTPUT jack. Check for a retrace offset step at the top of the staircase. The retrace offset pulse amplitude should be at least 5 V in amplitude.

The staircase should start at -25 volts and rise to +25 volts. The fall time of the staircase waveform should be less than 10 μ sec.

14. SET DOTS ADJ.

Adjust 110 TRIGGER SENSITIVITY for triggered operation with 50 KC signal input. Set SAMPLE/DISPLAY switch to 100. Increase the horizontal sensitivity to .5 volts/cm. Adjust the DOTS ADJ. for 1 dot/cm. Check other 3 ranges for $\pm 3\%$ accuracy.

Return horizontal sensitivity to 5 volts/cm.

15. ADJUST AVALANCHE SET AND AVALANCHE SENSITIVITY

Turn the indicating scope off and install Q5444.

Set the AVALANCHE SET to mid-range.

Set the AVALANCHE SENSITIVITY CCW.

Set the AVALANCHE SET CAPACITOR to mid-range

Trigger the test scope externally from the junction of R5416 and R5417.

Connect the test probe to the junction of C5479 and R5478.

(Test scope sweep speed .1 μ sec/cm)

Adjust the AVALANCHE SET and the AVALANCHE SENSITIVITY for a stable pulse, but be sure it is not free-running.

Center the AVALANCHE SET in the range where the transistor is avalanching.

16. ADJUST C5479 (Vertical channel)

Preset the vertical position control to mid-range.

Connect the test probe to the collector of Q5479 and adjust C5479 for 1.8 V, of negative avalanche signal.

17. SET DRIVER ADJ.

With the scope still externally triggered, set the vertical to DC coupled and connect the test probe to the collector of Q6424. Set the DRIVER ADJ. to the point where the base line just begins to rise.

18. SET INVERTER ADJ.

Connect the test scope probe to the collector of Q6414. Set the INVERTER ADJ. to bring collector -2 volts away from saturation. (Saturation is the most positive voltage obtainable.) This level must not be over -5 volts DC.

19. SET CLIPPER ADJ. AND VERT. POS. LIMIT

Center C6417 to mid-range.

Introduce 50 mv from special Cal-Adaptor, attached to square wave calibrator on Ind. Scope, to SIGNAL INPUT CONNECTOR of the N unit.

Rotate CLIPPER ADJ. to observe crushing of signal on Ind. Scope. (It may be necessary to rotate VERT. POS. LIMIT to position trace on screen.)

Set CLIPPER ADJ. so that upper portion of trace just starts to crush. Move the upper trace 2 cm above top graticule line with the Vertical Position Limit Adjust. Readjust CLIPPER ADJ. to center display back on screen.

20. SET GAIN

Using the settings of the previous step, adjust C6417 for 5 cm of signal deflection.

21. CHECK LINEARITY

After the gain has been set, reduce the CALIBRATOR output voltage to 20V. Set the SAMPLES/DISPLAY switch to 500. Position the signal from the bottom to the top of the graticule and check for compression/expansion. Compression/expansion limit ± 1 mm.

22. SET TIMING

Remove the charge line from the 110. (CHG line to CHG line 2)

Remove pigtail from 110 SIGNAL OUT. Connect cable from 113 to SIGNAL OUT of 110 and to timing standard.

Set the 110:

Voltage Range	50
Variable	Approx. 35
Trigger Sens.	Triggered
Timing Std.	5 NANOsec/cycle

Turn the DELAY POT to the cw end and select the first group of damped oscillations as the control is turned ccw.

Set the N:

<u>SAMPLE/DISPLAY</u>	<u>200</u> or <u>500</u>
Nsec/cm	5

Set R5413 for 1 cycle/cm between 1 and 9 cm marks. Check the timing on the other 3 sweep ranges. If necessary, readjust R5413 so that no range has an error greater than 2%.

23. RECHECK AVALANCHE SET AND AVALANCHE SENSITIVITY

Reduce the 110 voltage range to 5. Replace timing standard with a 10X attenuator. Replace the 20 Nsec charge line on the 110 from Chg. line 1 to Chg line 2. Adjust the 110 AMPLITUDE for 5 cm of deflection.

Adjust AVALANCHE SET and AVALANCHE SENSITIVITY for best risetime less than .6 Nsec and minimum noise, (less than 2mm trace width) and maximum signal shift to the right.

24. SELECT R5426A

Set the "N" NANOSECOND/CM switch to 1.0. Set the DELAY knob full CW. Select R5426A so the leading edge of the pulse just goes off the right hand side of the graticule.

25. CHECK DELAY ON ALL RANGES

Disconnect the cable from the PULSE OUT to SIGNAL IN on the 110.

Connect the output of the PULSE TRAIN to the 110 SIGNAL IN.

Set the 110 SYNC MODE to GREATER THAN 1 MC.

Set the 110 AMP. 1 to X10. Use a suitable attenuator at the input of the "N" unit.

Adjust the TRIG. SENSITIVITY on the 110 for best display.

Check for 205 Nsec or more total display on all ranges using the DELAY control.

26. ADJUST MAXIMUM REP RATE

Set the "N" TRIGGER SENSITIVITY control CW. Connect the test scope probe to the junction of R5412 and R5416. The pulse here should have an amplitude of +5 V and a width of 220 Nsec or more. Set the test scope to 10 μ sec/cm, triggered internally. Adjust the MAX. REP RATE pot for 1 mark/division. (Approximately 100 KC)

27. CHECK TRIGGER B.O.

Trigger the "N" externally from a 105. Adjust the trigger amplitude for not more than 2 V. Run the frequency of the 105 past 100 KC and note that the B.O. scales down at approximately 90 - 110 KC. Using the TU50, check triggering at 50 cps and 50 mc. (+0.5 V to +2.0 V)

28. CHECK EFFECT OF INCREASED TRIGGER RATE

Reconnect 50 mv from Cal.-Adaptor to SIGNAL INPUT connector. Trigger N unit from TU50. Scan trigger rate from 50 KC to 120 KC and check that pedestal does not move over 3 mm, that gain does not change over 4%, and that trace does not shift horizontally over 1/2 cm.

29. CHECK DISPLAY JITTER

Reconnect pulse from 110 to SIGNAL INPUT and use regenerated trigger from 110. Set the "N" for a sweep speed of 1 Nsec/cm. Adjust the horizontal sensitivity for 0.5 v/cm. Adjust the signal amplitude (110 pulse) so that the leading edge appears at a 45 degree slope across the center of the graticule. Return the horizontal sensitivity to 5.0 V/CM.

A. Read the vertical jitter in mm on the top of the pulse.

Switch the horizontal sensitivity to 0.5 V/CM.

B. Read the mm of vertical jitter on the leading edge of the pulse.

Subtract A from B and multiply the result by 10 for time jitter in pico seconds.
20 - 50 is nominal

Repeat this check, only trigger N unit from 50 Ω EXT. OUT of the 110.