

FACTORY CALIBRATION PROCEDURE

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INTRODUCTION:

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

INCLUDES FACTORY
TEST LIMIT CHANGES
THROUGH JUN 27 1968

May 1966

For all serial
numbers.

Supersedes
July 1963



3B3

FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or check-out methods and test equipment differ substantially from those in this procedure.

ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261. (NC)



EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- 1 TYPE 531A OSCILLOSCOPE
- 1 TYPE B PLUG-IN UNIT
- 1 TYPE 561A OSCILLOSCOPE
- 1 TYPE 3A1 PLUG-IN UNIT
- 1 TYPE 106 SQUARE-WAVE GENERATOR
- * 1 TYPE 184 TIME MARK GENERATOR
- 1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR

b. Test Fixtures and Accessories

- 1 50 Ω Coaxial Cable with BNC connectors (012-0057-00)
- 1 Plug-in extension (012-0066-00)
- 1 BNC to UHF Adapter (103-0032-00)
- 1 P6006 10X Passive Probe with Pincher tip (010-0128-00)
(013-0071-00)
- 1 1K Ω 1% resistor (309-0115-00)
- 1 600 VDC Variable Supply (Dwg #1421-A)

c. Miscellaneous Equipment

- 1 20,000 Ω /VDC Multimeter

* This equipment must be traceable to NBS for instrument certification.

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

FACTORY TEST LIMITS

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

1. PRELIMINARY INSPECTION

2. ZENER VOLTAGE

13.0-16.5V

3. SWEEP GATING THRESHOLD

4. ALTERNATE SWEEP

5. NORMAL AND DELAYED SWEEP TRIGGER

- a. Check Normal Internal Trigger:
Sensitivity: ≤ 0.2 div
LEVEL centering: $\pm 30^\circ$ from 0
- b. Check Delayed Internal Trigger:
Sensitivity: ≤ 0.2 div
LEVEL Centering: $\pm 30^\circ$ from 0
- c. Check Delayed External Trigger:
Sensitivity: $\leq 0.5V$, X10 $\leq 5V$
- d. Check Normal External Trigger:
Sensitivity: $\leq 0.5V$, X10 $\leq 5V$
- e. Check LEVEL Range: $\geq +$ & $- 15V$
- f. Check Trigger Overload: $\geq \pm 500VDC$
- g. Check Normal HF Trigger:
INT 5 MHz: ≤ 0.2 div
INT 10 MHz: ≤ 0.5 div
EXT 10 MHz: ≤ 0.5 V
X10 EXT 10 MHz: $\leq 5V$

5. (cont'd)

h. Check Delayed HF Trigger:

- INT 5 MHz: ≤ 0.2 div
- INT 10 MHz: ≤ 0.5 div
- EXT 10 MHz: $\leq 0.5V$
- X10 EXT 10 MHz: $\leq 5V$

- i. Check Line Trigger: slope of display must correspond to the setting of the SLOPE switch
- j. Check LF Auto Trigger: ≤ 10 Hz
- k. Check Single Sweep

6. SWEEP GENERATOR

- * b. Adjust SWEEP CAL: range: 5-15%
above and below calibrated setting (depends on CRT SENS)
- c. Adjust Normal Sweep Length:
10.2 - 10.8 div
- d. Check Variable TIME/DIV Ratio:
 $\geq 2.5:1$
- e. Adjust Delayed Sweep Length:
10.2 - 10.8 div

7. HORIZONTAL AMPLIFIER

- * b. Adjust 5X Gain
- c. Check Magnified Timing Change: $\leq \pm 1\%$
- d. Check Sweep Linearity: $\leq \pm 1\%$
- e. Adjust Swp Mag Registration:
 ≤ 0.2 div shift from electrical center mag to norm
- f. Check position Range: $\geq +$ & $- 0.2$ div past CRT electrical center

8. DELAYED SWEEP TIMING

- * b. Check Delayed Sweep Timing Accuracy
(1s-50 μ s): 0.2s-50 μ s: $\pm 2\%$
0.5s & 1s: $\pm 2.5\%$
- * c. Check Delayed Sweep Timing Accuracy
(20 s-0.5 μ s): $\pm 2\%$, with 5X
MAG: $\pm 3\%$

9. DELAY TIME

- * b. Adjust Delay Start and Stop
- * c. Check Delay Time Linearity: ± 0.8
minor div

10. NORMAL SWEEP TIMING

- * a. Check Normal Sweep Timing ($50\mu\text{s}$ - 0.2s):
 $\pm 0.625\%$ of DELAY DIAL full scale
- * b. Check Normal Sweep Timing (0.5 & 1s):
 $\pm 2.5\%$
- * c. Check Normal Sweep Timing ($5\mu\text{s}$ - $20\mu\text{s}$):
 $\pm 0.625\%$ of DELAY DIAL full scale
- * d. Check Normal Sweep Timing (0.5 - $2\mu\text{s}$;
 0.5 & 1s): $\pm 2\%$
- * e. Check Normal Sweep Magnified Timing:
Accuracy: $\pm 3\%$
Linearity: $\pm 1\%$

11. DELAY JITTER

≤ 1 part in 50,000 @ 1.00
 ≤ 1 part in 25,000 @ 9.00 } of total delay time

12. DELAYED SWP SHIFT

$\pm 250\text{ns}$

13. HOLDOFF

| Check Normal Sweep Holdoff: | |
|-------------------------------|----------------------|
| TIME/DIV | Holdoff |
| .5, 1 & $2\mu\text{SEC}$ | 5- $10\mu\text{s}$ |
| 5, 10 & $20\mu\text{SEC}$ | 10- $25\mu\text{s}$ |
| 50 SEC, .1 & .2mSEC | 40- $170\mu\text{s}$ |
| .5, 1 & 2mSEC | 0.5 -1.5ms |
| 5, 10 & 20mSEC | 5-10ms |
| 50mSEC, .1, .2, .5 & 1 SEC | 50-100ms |

14. SAWTOOTH CURRENT

- b. Check Sawtooth Current: 60 - $70\mu\text{A/div}$

* Indicates measurement characteristic; test equipment used must be traceable to NBS for instrument certification.

1. PRELIMINARY INSPECTION*a. General Inspection*

Check for unsoldered joints, rosin joints, lead dress and long leads. Check for loose hardware and protruding parts. Check controls for smooth mechanical operation, proper indexing, and knob spacing from front panel.

b. Check DELAY TIME Dial

Turn DELAY TIME full ccw until it hits the stop and check for a dial reading of 0.00.

If dial does not read 0.00 at ccw stop, loosen dial set screw and reposition dial on shaft. Tighten set screw and check that dial operates smoothly throughout its range.

c. Preset TYPE 3B3 Control

| | |
|-----------------------------------|------------------|
| POSITION | midr |
| 5X MAG | off |
| MODE | NORM |
| NORMAL SWEEP | |
| TIME/DIV | 1mSEC |
| DELAYED SWEEP | |
| TIME/DIV | 1mSEC |
| VARIABLE | CALIB |
| DELAY TIME | midr |
| SWEEP CAL | midr |
| LEVEL (both) | cw |
| SLOPE (both) | + |
| COUPLING (both) | AC |
| SOURCE (both) | INT |
| EXT TRIG ATTEN | push in |
| NORM/SINGLE SWP | NORM |
| Threshold, R130 and R230 | 90° cw from midr |
| All other internal adjustments | midr |

Leave controls and adjustments, for any step as they were in the step preceding unless otherwise noted.

1. (cont'd)

d. Check Amphenol Plug Resistance

Check resistances to GND. (-meter lead connected to GND)

| <u>Use</u> | <u>Amphenol pin</u> | <u>Approx resistance</u> |
|------------------|---------------------|--------------------------|
| 6.3 VAC | 1, 2 | 75 Ω |
| unused | 3 | inf |
| multi-trace | | |
| sync pulse | 4 | 5k Ω |
| GND | 5 | 0 Ω |
| 300V | 6 | 45k Ω |
| unused | 7, 8 | inf |
| GND | 9 | 0 Ω |
| 300V | 10 | 45k Ω |
| unused | 11 | inf |
| int trig sig | 12 | inf |
| unblanking pulse | 13 | 60k Ω |
| intensifying | | |
| pulse | 14 | 3k Ω |
| +125V | 15 | 5k Ω |
| -12.2V | 16 | 3 Ω |
| output | 17 | 60k Ω |
| SAWTOOTH | | |
| CURRENT | 18 | 120k Ω |
| GND | 19 | 0 Ω |
| +125V | 20 | 5k Ω |
| output | 21 | 65k Ω |
| GND | 22 | 0 Ω |
| -100V | 23 | 4.5k Ω |
| unused | 24 | inf |

d. Pins 18 and 19 read inf and are not used on serial numbers below 4270.

2. ZENER VOLTAGE

a. Setup

Place the TYPE 3A1 into the vertical compartment of the TYPE 561A. Connect the TYPE 3B3 to the horizontal compartment of the TYPE 561A via a plug-in extension. Turn power on. Allow the equipment to operate for 15 min before continuing.

b. Check Zener Voltage 13.0-16.5V

Check voltage from D398 cathode to GND: +13.0V to 16.5V.

3. SWEEP GATING THRESHOLD

a. Setup

Preset controls as follows:

MODE NORM

normal sweep

SOURCE EXT

Connect a shorting strap across R143
(17.8k Ω).

b. Adjust Normal Swp Gating Threshold R130

Adjust Normal Swp Gating Threshold R130
until the sweep just free runs. Check
for same setting of R130 at all sweep
speeds.

Remove the short from R143 and check that
trace disappears. Check at all sweep speeds.

c. Adjust Delayed Swp Gating Threshold

Preset controls as follows:

normal sweep

COUPLING AUTO

delayed sweep

SOURCE EXT

MODE TRIG DLY'D SWP

DELAYED SWEEP

TIME/DIV 1mSEC

Connect a shorting strap across R243
(17.8k Ω).

Adjust Delayed Swp Gating Threshold R230
until the sweep just free runs.

Remove the short from R243 and check that the
trace disappears. Check at all sweep speeds.

4. ALTERNATE SWEEP

Remove plug-in extension and insert the TYPE
3B3 into scope. Set MODE to NORM.

Set the TYPE 3A1 MODE switch to ALTER. Check
for an alternate sweep in all TIME/DIV settings
with TYPE 3B3 MODE in NORM and DLY'D SWP.

Return TYPE 3A1 MODE switch to CH 1.

5. NORMAL AND DELAYED TRIGGER

a. Check Normal Internal Trigger

Sensitivity: ≤ 0.2 div

LEVEL: $\pm 30^\circ$ from 0

Set the MODE to NORM and the normal sweep SOURCE to INT. Connect the test scope CAL OUT to the TYPE 3A1 CH 1 input. Adjust the AMPLITUDE CALIBRATOR and the TYPE 3A1 VOLTS/DIV to provide a 0.2 div display.

Check for stable triggering, in + and - SLOPE, by adjusting the LEVEL control, with the COUPLING set to AUTO, AC and DC. Stable triggering in AUTO and AC must occur with the LEVEL control within $\pm 30^\circ$ of 12 o'clock.

Check for stable triggering in DC with the display at the top and bottom of the graticule area.

b. Check Delayed Internal Trigger

Sensitivity: ≤ 0.2 div

LEVEL: $\pm 30^\circ$ from 0

Change the MODE to TRIG DLY'D SWP, delayed sweep SOURCE to INT and normal sweep COUPLING to AUTO. Set the normal TIME/DIV to .5mSEC and the delayed TIME/DIV to .2mSEC. Check for stable triggering in + and - SLOPE, by adjusting the LEVEL control, with the COUPLING in AD and DC.

Stable triggering in AC must occur with the LEVEL control within $\pm 30^\circ$ of 12 o'clock. Check DC triggering with the display at the top and bottom of the graticule area.

c. Check Delayed External Trigger

Sensitivity: $\leq 0.5V$, X10 $\leq 5V$

Connect the test scope CAL OUT to the TYPE 3A1 input and the delayed sweep EXT TRIG input. Set the test scope AMPLITUDE CALIBRATOR to .5 VOLTS. Check for stable triggering by adjusting the LEVEL control, in + and - SLOPE, AC and DC coupled.

Pull out the EXT TRIG ATTEN (LEVEL knob). Check that the display will not trigger with any setting of the LEVEL control. Change the test scope AMPLITUDE CALIBRATOR to 5 VOLTS. Check that stable triggering can be obtained by adjusting the LEVEL control. Push in the EXT TRIG ATTEN.

5. (cont'd)

*d. Check Normal External Trigger**Sensitivity: $\leq 0.5V$, $\times 10 \leq 5V$*

Change the MODE to NORM and connect the test scope CAL OUT to the normal sweep EXT TRIG input. Check the normal sweep external trigger as was done in step 5e for the delayed sweep.

Remove the calibrator signal from the TYPE 3A1 and EXT TRIG input and push in the EXT TRIG ATTEN.

e. Check LEVEL range $\geq +$ & $- 15V$

Connect the HI AMPLITUDE OUTPUT of the TYPE 106 to the TYPE 3A1 and normal EXT TRIG input. Adjust the TYPE 106 frequency to 1 kHz, AMPLITUDE to 30V P to P and SYMMETRY for 50% duty cycle.

Check that display will not trigger with extreme cw and ccw settings of the LEVEL control.

Change the MODE to TRIG DLY'D SWP, connect the TYPE 106 OUTPUT to the delayed sweep EXT TRIG input and repeat the check for the delayed sweep LEVEL control. Remove the TYPE 106 signal from the TYPE 3A1 and EXT TRIG input.

f. Check Trigger Overload $\geq \pm 500$ VDC

Connect the output of the special Variable DC Supply to the delayed sweep EXT TRIG input. Set the delayed sweep SOURCE to EXT and COUPLING to AC. Adjust the Variable DC Supply for +500 VDC. Depress the ON button, hold down for approx 5 seconds and release. Change the Variable DC Supply to -500 VDC and repeat the check.

Change the MODE to NORM, the normal sweep COUPLING to AC and SOURCE to EXT. Connect the Variable DC Supply to the normal EXT TRIG input. Check + and - overload as was done for the delayed sweep trigger.

Remove the Variable DC Supply from the EXT TRIG input.

5f. This is an operational check of the protection circuitry. A component failure should be apparent when the high frequency trigger requirements are checked.

5. (cont'd)

g. Check Normal HF Trigger

int 5 MHz: ≤ 0.2 div
 int 10 MHz: ≤ 0.5 div
 ext 10 MHz: ≤ 0.5 volts
 ext X10 10 MHz: ≤ 5 volts

Connect the TYPE 191 to a 50 Ω coaxial
 cable -- 50 Ω Termination -- BNC T
 connector -- normal sweep EXT TRIG
 -- TYPE 3A1 CH 1 input

Set the TYPE 3A1 CH 1 VOLTS/DIV to 1.
 Check for stable triggering in + and -
 SLOPE, with the following control
 settings and input signals.

| normal sweep | | TYPE 191 | |
|--------------|--------|-----------|-----------|
| COUPLING | SOURCE | Frequency | Amplitude |
| AC | INT | 5 MHz | 0.2 div |
| DC | INT | 5 MHz | 0.2 div |
| AUTO | INT | 5 MHz | 0.2 div |
| AUTO | INT | 10 MHz | 0.5 div |
| DC | INT | 10 MHz | 0.5 div |
| AC | INT | 10 MHz | 0.5 div |
| AC | EXT | 10 MHz | 0.5 div |

Pull out the EXT TRIG ATTEN.

| | | | |
|----|-----|--------|---------|
| AC | EXT | 10 MHz | 5 volts |
|----|-----|--------|---------|

h. Check Delayed Sweep HF Trigger

int 5 MHz: ≤ 0.2 div
 int 10 MHz: ≤ 0.5 div
 ext 10 MHz: ≤ 0.5 volts
 ext X10 10 MHz: ≤ 5 volts

Change the MODE to TRIG DLY'D SWP. Connect
 the TYPE 191 signal to the delayed sweep
 EXT TRIG input. Check for stable triggering
 in + and - SLOPE with the following control
 settings and input signals:

| delayed sweep | | TYPE 191 | |
|------------------------------|--------|-----------|-----------|
| COUPLING | SOURCE | Frequency | Amplitude |
| Pull out the EXT TRIG ATTEN. | | | |
| AC | EXT | 10 MHz | 5 volts |
| Push in the EXT TRIG ATTEN. | | | |
| AC | EXT | 10 MHz | 0.5 volts |
| AC | INT | 10 MHz | 0.5 div |
| DC | INT | 10 MHz | 0.5 div |
| DC | INT | 5 MHz | 0.2 div |
| AC | INT | 5 MHz | 0.2 div |

Remove the TYPE 191 signal from the TYPE 3A1
 and EXT TRIG input.

5. (cont'd)

i. Check Line Trigger

Set the front panel controls as follows:

| | |
|-------------------|-------|
| MODE | NORM |
| TIME/DIV (normal) | 2mSEC |
| TRIGGER (normal) | |
| COUPLING | AC |
| SOURCE | LINE |
| SLOPE | + |

Connect a 10X probe to the TYPE 3A1 CH 1 input. Set the CH 1 VOLTS/DIV to 5. Connect the probe tip to 117 VAC on the TYPE 561A power connector. Adjust the LEVEL control for a stable triggered display.

Check that the slope of the display corresponds to the + and - settings of the SLOPE switch.

With the TIME/DIV set at 2mSEC, vary the LEVEL control and/or the VARIABLE TIME/DIV so the sweep ends on the same slope that it is triggered on. Check that the display does not double trigger (see notes).

i. A double trigger may indicate that D101 (normal sweep) or D201 (delayed sweep) is open.

Change the TIME/DIV to 10mSEC and the DELAY TIME RANGE to 5mSEC. Change the MODE to INTEN (TRIG) and adjust the DELAYED SWEEP TRIGGER LEVEL for a triggered intensified display. Adjust the DELAY TIME so the intensified portion of the sweep starts to jump between the second and third positive going edge of the 60Hz sine-wave. Set the DELAY TIME so the intensified portion of the sweep is just triggered on the third positive going edge. Change the MODE to DLY'D SWP (TRIG) and check that the display does not double trigger (see notes).

Change the MODE to NORM and remove the 10X probe.

j. *Check Low Frequency Auto Trigger*
≤10 Hz

Apply .1 S time marks from the TYPE 184 to the TYPE 3A1 input. Set the front panel controls as follows:

| | |
|-------------------|-------|
| TIME/DIV (normal) | 5mSEC |
| TRIGGER (normal) | |
| COUPLING | AUTO |
| SLOPE | + |
| SOURCE | INT |

Check that a stable triggered display can be obtained by adjusting the LEVEL control.

Remove the TYPE 184 signal.

k. *Check Single Sweep*

Set the front panel controls as follows:

| | |
|--------------|--------|
| normal sweep | |
| COUPLING | AC |
| SOURCE | INT |
| TIME/DIV | .5mSEC |

Connect the test scope CAL OUT to the TYPE 3A1 CH 1 input. Adjust the CH 1 VOLTS/DIV and the test scope AMPLITUDE CALIBRATOR for a 1 minor div display. Adjust the normal sweep LEVEL control for a triggered display. Remove the calibrator signal from the CH 1 input. Change the NORM, SINGLE SWEEP switch to SINGLE SWEEP. Check that the READY neon

5k. (cont'd)

is extinguished. Push the NORM, SINGLE SWEEP switch to RESET and release. Check that the READY neon is lit. Reconnect the calibrator signal to the CH1 input. Check that a single sweep occurs and the READY neon extinguishes. Repeat the check several times to insure correct operation.

6. SWEEP GENERATOR

a. Setup

Preset the front panel controls as follows:

| | |
|--------------|-------|
| MODE | NORM |
| normal sweep | |
| SOURCE | INT |
| COUPLING | AUTO |
| SLOPE | + |
| TIME/DIV | 1mSEC |

Connect the MARKER OUTPUT of the TYPE 184 to the TYPE 3A1 CH 1 input. Set the TYPE 184 for .1mS and 1mS markers.

* b. Adjust SWEEP CAL

Rotate the SWEEP CAL adjustment throughout its range. Check for the correct range of adjustment above and below the calibrated setting (one 1mS mark/major div).

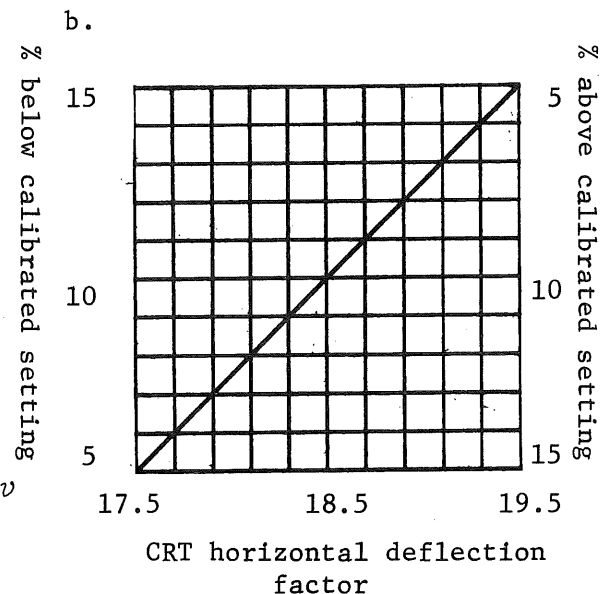
Adjust the SWEEP CAL for one 1mS mark/major div.

c. Adjust Normal Sweep Length 10.2-10.8 div

Adjust the Normal Swp Length (R168) for a trace length of 10.5 div.

d. Check Variable Time/Div Ratio $\geq 2.5:1$

Change the TYPE 184 time marks to 10mS. Slowly turn the VARIABLE control full ccw. There must be a smooth change in timing and the UNCAL neon must be lit when the VARIABLE is out of the CALIB detent. The distance between the first two time marks when the VARIABLE is full ccw must be ≤ 4 div.



6. (cont'd)

- e. *Adjust Delayed Sweep Length*
10.2-10.8 div

Set the front panel controls as follows:

MODE

delayed sweep

SOURCE INT

SLOPE +

TIME/DIV 1mSEC

normal sweep

TIME/DIV 2mSEC

DELAY TIME approx 3.00

Change the TYPE 184 time marks to 1mS and .1mS. Adjust the delayed sweep LEVEL for a stable display. Adjust the Delayed Swp Length (R268) for 10.5 div trace length.

7. HORIZONTAL AMPLIFIER

- a. *Setup*

Change the MODE to NORM and the normal sweep TIME/DIV to 1mSEC. Set the TYPE 184 for 0.1ms, 1ms and 5ms time marks.

- * b. *Adjust 5X Gain*

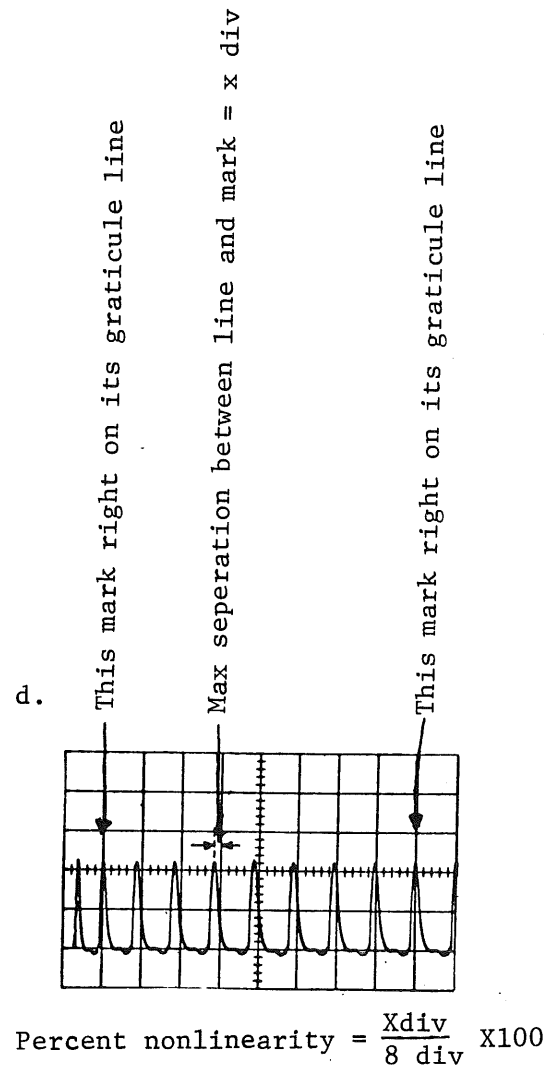
Pull out the 5X MAG (POSITION) and position the middle 5ms time mark to the center graticule line. Adjust the 5X Gain (R355) for two 0.1ms time marks/major div.

- c. *Check Magnified Timing Change* $\leq \pm 1\%$

Check the timing for each 10cm segment of the magnified sweep. The timing error for any segment must not exceed $\pm 1\%$.

- d. *Check Sweep Linearity* $\leq \pm 1\%$

Check the sweep linearity, over the middle 8cm, for each 10cm segment of the magnified sweep. The non-linearity for any segment must not exceed 1%.



7. (cont'd)

e. Adjust Sweep Mag Registration
 ≤ 0.2 div shift

Locate the CRT horizontal electrical center by shorting the horizontal deflection plates together. Position the middle 5ms time mark to the CRT horizontal electrical center. Push the 5X MAG (POSITION control) in and adjust the Swp Mag Regis (R368) so the middle 5ms time mark falls on the CRT horizontal electrical center.

Repeat the Swp Mag Regis adjustment until the middle 5ms time mark remains at the CRT electrical center when the 5X magnifier is turned on and off.

f. Check Position Range
 $\geq +$ & $- 0.2$ div

Turn the 5X MAG off. Turn the POSITION control full cw. The start of the trace must position at least 0.2 div to the right of the CRT electrical center.

Turn the POSITION control full ccw. The end of the trace must position at least 0.2 div to the left of the CRT electrical center.

8. DELAYED SWEEP TIMING*a. Setup*

Set the TYPE 184 for 50 μ s time marks. Change the TIME/DIV to 50 μ SEC and adjust the normal sweep LEVEL control for a triggered display. Change the MODE to TRIG DLY'D SWP and adjust the delayed sweep LEVEL control for a triggered display. Adjust the DELAY TIME control for approx 10cm sweep length.

** b. Check Delayed Sweep Timing Accuracy*
(1s-50 μ s) 0.2s-50 μ s: $\pm 2\%$
0.5s & 1s: $\pm 2.5\%$

Check the delayed sweep timing accuracy with the controls set as follows:

8b. (cont'd)

| <u>TIME/DIV</u> <u>(both)</u> | <u>TYPE</u> <u>184</u> | <u>Marks/</u> <u>div</u> | <u>Max error</u> |
|----------------------------------|---------------------------|-----------------------------|------------------|
| 50μSEC | 50μS | 1 | 0.16 div |
| .1mSEC | .1mS | 1 | 0.16 div |
| .2mSEC | .1mS | 2 | 0.16 div |
| .5mSEC | .5mS | 1 | 0.16 div |
| 1mSEC | 1mS | 1 | 0.16 div |
| 2mSEC | 1mS | 2 | 0.16 div |
| 5mSEC | 5mS | 1 | 0.16 div |
| 10mSEC | 10mS | 1 | 0.16 div |
| 20mSEC | 10mS | 2 | 0.16 div |
| 50mSEC | 50mS | 1 | 0.16 div |
| .1 SEC | .1 S | 1 | 0.16 div |
| .2 SEC | .1 S | 2 | 0.16 div |
| .5 SEC | .5 S | 1 | 0.2 div |
| 1 SEC | 1 S | 1 | 0.2 div |

c. *Check Delayed Sweep Timing*
 (20μs-0.5μs) ±2%
 5X MAG: ±3%

Check or adjust the delayed sweep timing accuracy with the controls set as follows:

| <u>TIME/DIV</u> <u>(both)</u> | <u>TYPE</u> <u>184</u> | <u>adjust</u> | <u>check or</u> <u>adjust for</u> |
|----------------------------------|---------------------------|---------------|--------------------------------------|
| 1μSEC | 1μS | C260B | 1 mark/div ±0.16 div |
| .5μSEC | .5μS | | 1 mark/div ±0.16 div |

† Check timing accuracy for each 10 div segment of the magnified sweep. Exclude the first two and last five time marks.

Turn the 5X MAG on.

| | | |
|--------|------|-----------------------|
| .5μSEC | .1μS | ±1 mark/div ±0.24 div |
|--------|------|-----------------------|

Check the incremental linearity between the 1st and 2nd time mark. There must be 0.9 to 1.1 div between the 1st and 2nd time mark.

Turn the 5X MAG off.

| | | |
|--------|------|----------------------------|
| 2μSEC | 1μS | 2 marks/div ±0.16 div |
| 10μSEC | 10μS | C260D 1 mark/div ±0.16 div |
| 20μSEC | 10μS | 2 marks/div ±0.16 div |
| 5μSEC | 5μS | 1 mark/div ±0.16 div |

9. DELAY TIME*a. Adjust Delay Start and Stop (rough)*

Set the front panel controls as follows:

| | |
|------------------|------------------|
| MODE | INTEN (not trig) |
| Normal TIME/DIV | 1mSEC |
| Delayed TIME/DIV | 10μSEC |
| SLOPE | + |
| COUPLING | AC |
| SOURCE | INT |

Set the TYPE 184 for 1mS time marks.
Adjust the Normal trigger LEVEL control for a triggered display. Set the DELAY TIME control to 1.00 and adjust the Delay Start (R430) so the intensified part of the sweep starts on the 2nd time mark (time = 1ms).

Set the DELAY TIME control to 9.00 and adjust the Delay Stop (R439) so the intensified part of the sweep starts on the 10th time mark (time = 9ms).

** b. Adjust Delay Start and Stop (fine)*

Change the MODE to DLY'D SWP. With the DELAY TIME still at 9.00, adjust the Delay Stop so the leading edge of the 10th time mark starts at the beginning of the trace.

Set the DELAY TIME to 1.00. Adjust the Delay Start so the leading edge of the 2nd time mark starts at the beginning of the trace.

The Delay Start and Delay Stop adjustments interact and it will be necessary to repeat the adjustments several times.

c. Check Delay Time Linearity
±0.8 minor div

9c. 50 minor div = one turn of the DTM dial.

Adjust the DELAY TIME so the sweep starts on the leading edge of the 2nd time mark (approx 1.00). Note the dial reading. Adjust the DELAY TIME so the sweep starts on the leading edge of the 3rd time mark (approx 2.00). Note the dial reading. The difference between the two noted readings must be 49.2 to 50.8 minor div.

Repeat this check for each major dial division from 1.00-9.00 (i.e. 2.00 to 3.00, 3.00 to 4.00, etc).

10. NORMAL SWEEP TIMING

- * a. *Check Normal Sweep Timing*
 (50 μ SEC-.2 SEC) $\pm 0.625\%$

Set the normal sweep TIME/DIV to 50 μ SEC and the delayed sweep TIME/DIV to 5 μ SEC. Set the TYPE 184 for 50 μ S time marks. Adjust the DELAY TIME so the sweep starts on the leading edge of the 2nd time mark. Note the dial reading. Adjust the DELAY TIME so the sweep starts on the leading edge of the 10th time mark. Note the dial reading. The difference between the two dial readings must be 400 ± 2.5 minor div.

Repeat this procedure to check the normal sweep timing with the following control settings:

| TIME/DIV (normal) | TIME/DIV (delayed) | TYPE 184 | max error (minor div on delay dial) |
|----------------------|-----------------------|-------------|--|
| .1mSEC | 10 μ SEC | .1mS | ± 2.5 |
| .2mSEC | 10 μ SEC | .1mS | ± 2.5 |
| .5mSEC | 50 μ SEC | .5mS | ± 2.5 |
| 1mSEC | .1mSEC | 1mS | ± 2.5 |
| 2mSEC | .1mSEC | 1mS | ± 2.5 |
| 5mSEC | .5mSEC | 5mS | ± 2.5 |
| 10mSEC | 1mSEC | 10mS | ± 2.5 |
| 20mSEC | 1mSEC | 10mS | ± 2.5 |
| 50mSEC | 5mSEC | 50mS | ± 2.5 |
| .1 SEC | 10mSEC | .1 S | ± 2.5 |
| .2 SEC | 10mSEC | .1 S | ± 2.5 |

- * b. *Check Normal Sweep Timing (.5 & 1 SEC)*
 $\pm 2.5\%$ Magnified: $\pm 3\%$

Change the MODE to NORM. Check the normal sweep timing accuracy with the controls set as follows:

| TIME/DIV (normal) | TYPE | check for |
|----------------------|------|--------------------------|
| .5 SEC | .5 S | 1 mark/div ± 0.2 div |
| 1 SEC | 1 S | 1 mark/div ± 0.2 div |

Turn the 5X MAG on.

| | | |
|--------|------|---------------------------|
| .5 SEC | .1 S | 1 mark/div ± 0.24 div |
|--------|------|---------------------------|

- a. A difference in main frame -100V supplies will cause an error in timing accuracy. i.e., if the Delay Start and Delay Stop is adjusted in one main frame and the timing accuracy checked in another, there may be a timing error unless the Delay Start and Delay Stop are re-adjusted.

10. (cont'd)

- * c. *Check/Adjust Normal Sweep Timing*
 (5 μ SEC to 20 μ SEC) $\pm 0.625\%$

Change the MODE to NORM, normal TIME/DIV to 10 μ SEC and the delayed TIME/DIV to 1 μ SEC.
 Set the TYPE 184 for 10 μ S time marks.
 Adjust C160D for 1 mark/div. Return the MODE to DLY'D SWP. Adjust the DELAY TIME so the sweep starts on the leading edge of the 2nd time mark.

Note the DELAY TIME dial reading. Increase the DELAY TIME dial reading exactly 400 minor div. Adjust C160D so the sweep starts on the leading edge of the 10th time mark.

Check the normal sweep timing, as was done in step a, with the following control settings:

| TIME/DIV (normal) | TIME/DIV (delayed) | TYPE 184 | max error (minor div) |
|----------------------|-----------------------|------------|--------------------------|
| 20 μ SEC | 1 μ SEC | 10 μ S | ± 2.5 |
| 5 μ SEC | .5 μ SEC | 5 μ S | ± 2.5 |

- * d. *Check Normal Sweep Timing* (0.5-2 μ SEC;
 .5 & 1 SEC) $\pm 2\%$

Change the MODE to NORM. Check the normal sweep timing accuracy with the controls set as follows:

| TIME/DIV | TYPE | | check or adjust for |
|--------------|------------|--------|----------------------------|
| both | 184 | adjust | |
| 1 μ SEC | 1 μ S | C160B | 1 mark/div ± 0.16 div |
| 2 μ SEC | 1 μ S | | 2 marks/div ± 0.16 div |
| .5 μ SEC | .5 μ S | | 1 mark/div ± 0.16 div |

- * e. *Check Normal Sweep Magnified Timing*
 accuracy: $\pm 3\%$
 linearity: $\pm 1\%$

Change the TYPE 184 time marks to .1 μ S and turn 5X MAG on. Check the entire magnified sweep (with the exception of the first 50ns) for 1 mark/div ± 0.24 div.

Check each 10 div segment of the sweep for a linearity of $\pm 1\%$ (see step 7d).

Check for 0.9 to 1.1 div between the 1st and 2nd time mark.

11. DELAY JITTER

<1 part in 50,000 @ 1.00

<1 part in 25,000 @ 9.00

Set the front panel controls as follows:

| | |
|--------------------|-----------|
| TIME/DIV (normal) | 1mSEC |
| TIME/DIV (delayed) | 1μSEC |
| MODE | DLY'D SWP |
| DELAY TIME | 1.00 |
| 5X MAG | OFF |

Change the TYPE 184 time marks to 1mS.
Adjust the DELAY TIME to display the leading edge of the 2nd time mark. The horizontal jitter must not exceed 0.2 div.

Turn the DELAY TIME to approx 9.00 to display the leading edge of the 10th time mark. The horizontal jitter must not exceed 0.4 div.

12. DELAYED SWP SHIFT ±250ns

Set the front panel controls as follows:

| | |
|-----------------|-------|
| MODE | NORM |
| TIME/DIV (both) | 1μSEC |
| DELAY TIME | 1.00 |

Change the TYPE 184 time marks to 1μS. Adjust the normal sweep LEVEL control so the sweep starts on an easy to identify point on the 1st time mark.

Change the MODE to DLY'D SWP and turn the DELAY TIME until the sweep starts at the same point as noted before.

The DELAY TIME dial must read between 0.75 and 1.25.

Remove the TYPE 184 signal.

13. HOLDOFF

a. Setup

Set the MODE to NORM and the normal sweep COUPLING to AUTO. Connect a 10X probe from the test scope to the CRT right-hand deflection plate lead. Set the test scope vertical input coupling to AC and deflection factor to 5 V/CM.

13. (cont'd)

b. *Check Normal Sweep Holdoff*

Check for the specified holdoff time with the controls set as follows:

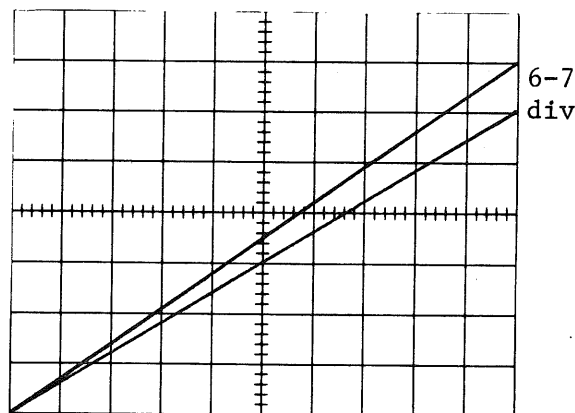
| TIME/DIV | Holdoff time |
|-------------------------------|----------------|
| .5, 1 & 2 μ SEC | 5-10 μ s |
| 5, 10 & 20 μ SEC | 10-25 μ s |
| 50 μ SEC, .1 & .2mSEC | 40-170 μ s |
| .5, 1 & 2mSEC | 0.5 01.5ms |
| 5, 10 & 20mSEC | 5-10ms |
| 50mSEC, .1, .2, .5 & 1 SEC | 50-100ms |

14. SAWTOOTH CURRENTa. *Setup*

Change the TIME/DIV to 1mSEC. Set the TYPE 3A1 CH1 VOLTS/DIV to .1, DC coupled. Connect a 1k Ω 1% resistor between GND and pin 18 on the TYPE 3B3 amphenol plug. Connect a test lead (e.g. meter lead) from pin 18 of the amphenol plug to the TYPE 3A1 input.

b. *Check Sawtooth Current*
60-70 μ A/div

Adjust the HORIZONTAL and VERTICAL POSITION control so the displayed ramp waveform starts at the bottom left-hand corner of the graticule. The ramp waveform must rise 6.0 to 7.0 vertical div in 10 horizontal div.



THE END