

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.).

Tek form number:

0-430

August 1967

For all serial numbers.



11B2A

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)



PMSE

COMPANY CONFIDENTIAL

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- 1 TYPE 546 OSCILLOSCOPE
- 1 TYPE 1A1 DUAL-TRACE PLUG-IN UNIT test scope
- 1 TYPE 647A OSCILLOSCOPE
- 1 TYPE 10A2A DUAL-TRACE AMPLIFIER
- * 1 TYPE 184 TIME MARK GENERATOR
- * 1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
- 1 TYPE 106 SQUARE-WAVE GENERATOR

b. Test Fixtures and Accessories

- 1 Calibration Fixture (067-0544-00)
- * 1 Standard Amplitude Calibrator (SAC) (067-0502-00)
- 2 50 Ω coaxial cables, BNC (012-0057-00)
- 1 T connector, BNC (103-0030-00)
- 2 10X attenuator, BNC (011-0059-00)
- 1 GR 50 Ω Power Divider (017-0082-00)
- 2 50 Ω Termination, BNC (011-0049-00)
- 2 GR to BNC Female Adapter (017-0063-00)
- 1 Cannon Connector Checker (PMPE Dwg #1190A)

c. Other 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.

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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

- a. Make General Inspection
- b. Preset Front Panel Controls
- c. Check Amphenol Pin Resistance

2. DTM CALIBRATION

- * b. Adjust Delay Start/A Swp Cal
- * c. Check DTM Incremental Linearity:
within 0.1%

3. HORIZONTAL GAIN AND REGISTRATION

- * a. Adjust Norm Gain
- b. Check A Swp Length and VARIABLE Range
Swp Length: 10.5-11.0cm
Var Range: $\geq 2.5:1$
- c. Adjust Mag Gain and Registration
 ≤ 0.1 cm shift X10 to OFF
- d. Check Horizontal Position Range
Start and end of trace must
position 0.2cm past graticule center

4. B SWEEP

- * a. Adjust B Swp Cal
- b. Check B Sweep Length and Variable
Swp Length: 10.5-11.0cm
Variable: $\geq 2.5:1$

5. TIMING

- a. Adjust C160C
- * b. Check A Timing (1 μ s to 5s)
 $\leq 0.75\%$ Error (1 μ s-50ms)
 $\leq 2\%$ Error (1s-5s)
- * c. Check A Timing (.1 μ s to .5 μ s)
 $\leq 1\%$ Error
- * d. Check/Adjust B Timing (.1 μ s to 5 μ s)
 $\leq 1\%$ Error
- * e. Check Magnified Timing and Linearity
Timing: $\leq 3\%$ Error (0.5s-0.05 μ s)
 $\leq 4\%$ Error (0.01 & 0.02 μ s)
Linearity: $\leq 4\%$ Error in any two cm
- * f. Check B Timing (10 μ s-5s)
 $\leq 1\%$ Error (10 μ s-50ms)
 $\leq 2.5\%$ Error (0.1s-5s)
- g. Check Delay Jitter: ≤ 1 part in 33,000

6. FIXED DELAY TIME

- b. Check Fixed Delay Time ≤ 100 ns

7. AUTO TRIGGER RECOVERY TIME

≥ 50 ms and ≤ 100 ms

8. TRIGGER PREAMP

- a. Adjust Trigger Preamp DC Level:
Adjusted for OV
- b. Check Trigger Preamp Gain and Overload
Gain: 1.2-1.6 @ TP 23
Overload: + and - 5V min

9. AC LF REJ

Differentiated square-wave decays to 20% of total amplitude in 11.5-21 μ s.

10. LINE TRIGGER

- b. Check Line Trigger Phase:
Slope of display must correspond
to setting of SLOPE switch

11. TRIGGER

- a. Check A TRIG LEVER Range:
EXT + & - 5V EXT ÷ + & - 50V
- b. Check A External Triggering
(50kHz-20 MHz): stable trigger
on $\leq 100\text{mV}$
- c. Align A TRIG LEVEL knob
- d. Check A External Triggering
(100 MHz): trigger on $\leq 200\text{mV}$, $\leq 1\text{mm}$ jitter
- e. Check A Internal Triggering:
 $\leq 0.2\text{cm}$ (20 MHz) $\leq 1.5\text{cm}$, $\leq 1\text{mm}$ jitter
(100 MHz)
- f. Check B External Triggering
(50kHz-20 MHz): stable trigger on
 $\leq 175\text{mV}$
- g. Align B TRIG LEVEL Knob
- h. Check B External Triggering
(100 MHz): trigger on $\leq 250\text{mV}$,
 $\leq 1\text{mm}$ jitter
- i. Check B Internal Triggering:
 $\leq 2.5\text{cm}$, $\leq 1\text{mm}$ jitter (100 MHz)
 $\leq 0.4\text{cm}$ (20 MHz)
- j. Check B TRIG LEVEL Range: + & - 10V
- k. Check Fast Transient Triggering:
stable trigger on TYPE 106
fast rise square-wave

12. FRONT PANEL WAVEFORMS

- a. Check + Gate Waveform: $15\text{V} \pm 10\%$
- b. Check Sweep Waveform: $10\text{V} \pm 10\%$

13. HOLDOFF

- a. Check Holdoff Time

<u>DELAY TIME (A swp)</u>	<u>HOLDOFF</u>
5, 2, 1 SEC	115-165ms
.5, .2, .1 SEC	115-165ms
50, 20, 10mSEC	13-17 ms
5, 2, 1mSEC	1.3-2.1ms
.5, .2, .1mSEC	130-180 μs
50, 20, 10 μSEC	17-25 μs
5, 2, 1 μSEC	11-18 μs
.5, .2, .1 μSEC	5.5-6.5 μs

- b. Check HF STABILITY Range: 130-350ns

14. EXT HORIZONTAL

- * a. Check External Horizontal Deflection
Factor: $1\text{V/cm} \pm 10\%$
- * b. Check External Horizontal Bandwidth:
DC to $\geq 4\text{ MHz}$ @ - 3dB

15. SINGLE SWEEP

- a. Check Single Sweep Operation
- b. Check Single Sweep Automatic Reset

16. ALTERNATE TRACE SYNC PULSE $\geq 4\text{V}$

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

1. PRELIMINARY INSPECTION*a. Make general inspection*

Check for unsoldered joints, rosin joints, improper lead dress and long ends. Check for loose hardware and protruding parts. Check front panel controls for smooth mechanical operation, proper indexing (see notes) and knob spacing. Check all internal adjustments for smooth mechanical operation and preset to midr.

a. The DELAY TIME MULTI should read 0.30 at the CCW stop.

b. Preset Front Panel Controls

HORIZ DISPLAY	A
MAG	OFF
DELAY TIME (A swp)	1mSEC
TIME/CM (B swp)	5μSEC
VARIABLE A	CALIB
B	CALIB
TRIG MODE	AUTO

A & B Trigger

SLOPE	+
SOURCE	INT
COUPLING	AC

c. Check Amphenol Pin Resistance

Check for the following resistance between gnd and each pin on the amphenol plug. Use the X1k scale (except where noted) and connect the - meter lead to gnd.

<u>Pin No.</u>	<u>Approx Resistance</u>
1	1.4kΩ
2	2.5kΩ
3	15Ω (X1 scale)
4-7	∞ (not used)
8	15kΩ
9	15kΩ
10 & 11	∞ (not used)
12	0Ω
13	100Ω
14	0Ω
15	100Ω
16	0Ω
17	400Ω
18	300Ω
19	∞ (not used)
20	3kΩ

1c. (cont'd)

<u>Pin No.</u>	<u>Approx Resistance</u>
21	600k Ω (X100k scale)
22	500 Ω
23	0 Ω
24	40k Ω
25	4k Ω
26	300 Ω
27	100k Ω
28 & 29	∞ (not used)
30	9.5k Ω
31 & 32	0 Ω

2. DTM CALIBRATION*a. Setup*

Install the TYPE 11B2A and the TYPE 10A2A in the TYPE 647A HORIZONTAL and VERTICAL plug-in compartments. Apply power to the TYPE 647A. Allow 20 minutes operating time before making adjustments.

Set the TYPE 10A2A front panel controls as follows:

MODE	CH 1
TRIGGER	NORM
VOLTS/CM (CH 1)	.5
AC-DC-GND (CH 1)	DC
INVERT PULL (CH 1)	IN

Connect the output of the TYPE 184 to the TYPE 10A2A CH 1 INPUT. Set the TYPE 184 for 1ms time marks and adjust the A TRIG LEVEL for a triggered display.

b. Adjust Delay Start/A Swp Cal

Change the HORIZ DISPLAY to A INTEN BY B (left) and set the DTM dial to 1.00. Adjust Delay Start (R150) so the intensified portion of the sweep starts on the second time mark. Change the DTM dial to 9.00 and adjust A Swp Cal (R 160W) so the intensified portion of the sweep starts on the tenth time mark.

Change the HORIZ DISPLAY TO B DLY'D BY A (left) and adjust A Swp Cal so the tenth time mark starts at the beginning of the sweep. Change the DTM dial to 1.00 and adjust Delay Start so the second time mark starts at the beginning of the sweep.

2b. (cont'd)

Delay Start and A Swp Cal adjustments interact, repeat the adjustments as necessary.

*c. Check DTM Incremental Linearity
within 0.1%*

Adjust the DTM dial so the sweep starts on the leading edge of the second time mark. Note the dial reading. Adjust the DTM dial so the sweep starts on the leading edge of the third time mark. Note the dial reading. The difference between the two readings must be 99 to 101 minor div (100 minor div is equal to 1 major div or one complete turn of the DTM).

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

3. HORIZONTAL GAIN AND REGISTRATION

a. Adjust Norm Gain

Set the TYPE 184 for .1ms, 1ms and 5ms time marks. Change the HORIZ DISPLAY to A and adjust A TRIG LEVEL for a triggered display.

Adjust Norm Gain (R 331) for one 1ms time mark/cm (see note).

*b. Check A Swp Length and VARIABLE A
Range Sweep Length: 10.5-11.0cm
Var Range: $\geq 2.5:1$*

Check the trace for a length of 10.5 to 11.0cm. Slowly turn the VARIABLE A control full ccw. There must be a smooth decrease in sweep speed and the UNCAL neon must be lit when the VARIABLE A control is out of the CALIB detent. The distance between the 5ms time marks when the control is full ccw must be 2cm or less.

Return the VARIABLE A to the CALIB detent.

3a. Unless noted otherwise make all timing adjustments and checks in the middle 8cm of the graticule area.

3. (cont'd)

- c. *Adjust Mag Gain and Registration*
<0.1cm shift from X10 to OFF

Change the MAG to X10 and adjust Mag Gain (R334) for one .1ms time mark/cm.

With the MAG set to X10 position the middle 5ms time mark to the middle graticule line. Change the MAG to OFF and adjust Mag Regis (R339) so the middle 5ms time mark is again aligned to the middle graticule line. Repeat this adjustment until the middle 5ms time mark remains on the middle graticule line when the MAG is switched from X10 to OFF.

- d. *Check Horizontal Position Range*

Rotate the TYPE 647A POSITION and FINE controls full cw. The start of the trace must position at least 2mm to the right of graticule center.

Rotate the POSITION and FINE controls full ccw. The end of the trace must position at least 2mm to the left of graticule center.

4. B SWEEP

- a. *Adjust B Swp Cal*

Set the front panel controls as follows:

DELAY TIME (A swp)	2mSEC
TIME/CM (B swp)	1mSEC
HORIZ DISPLAY	B DLY'D BY A (left)
DELAY TIME MULT	2.5

Adjust the DTM dial so the sweep starts on one of the 5ms time marks. Adjust B Swp Cal for one 1ms time mark/cm.

- b. *Check B Swp Length and Variable*
Swp Length: 10.5-11.0cm
Variable: >2.5:1

Check the trace for a length of 10.5 to 11.0cm. Slowly turn the B variable ccw. There must be a smooth decrease in sweep speed and the UNCAL neon must be lit when the variable is out of the CALIB detent. The distance between the 5ms time marks when the control is full ccw must be

4b. (cont'd)

2cm or less.

5. TIMING*a. Adjust C160C*

Set the front panel controls as follows:

HORIZ DISPLAY	A
DELAY TIME (A swp)	1 μ SEC
TIME/CM (B swp)	.1 μ SEC

Set the TYPE 184 for 1 μ s time marks.
Adjust C160C for one time mark/cm
(rough adjustment).

Change the HORIZ DISPLAY to B DLY'D BY
A (left). Adjust the DTM dial so the
sweep starts at the top of the second
time mark (dial reading of approx 1.00).
Note the DTM difference from 1.00 and
turn the dial to 9.00 + or - previously
noted difference. Adjust C160C so the
sweep starts on the top of the tenth
time mark.

Recheck the dial reading at the second
time mark and readjust C160C at the
tenth time mark. Repeat until there is
no interaction.

b. Check A Timing 1 μ s to 5s

1 μ s-50ms: <0.75% error
.1s-5s: <2% error

Check the accuracy of the following sweep
rates by adjusting the DTM dial so the
sweep starts on the top of the second (or
third) time mark. Note the dial reading
and turn the DTM so the sweep starts on
the top of the tenth (or nineteenth) time
mark and note the dial reading. The diff-
erence between the two noted readings must
be 800 minor dial div \pm the specified
maximum error.

NOTE: 100 minor dial div is equal to
1 major div or one complete rotation of
the DTM dial.

5b. (cont'd)

Set the controls as follows:

DELAY TIME (A swp)	TIME/CM (B swp)	TYPE 184	MAX ERROR
1 μ SEC	.1 μ SEC	1 μ s	adjustable
2 μ SEC	.1 μ SEC	1 μ s	6 minor div
5 μ SEC	.5 μ SEC	5 μ s	6 minor div
10 μ SEC	1 μ SEC	10 μ s	6 minor div
20 μ SEC	1 μ SEC	10 μ s	6 minor div
50 μ SEC	5 μ SEC	50 μ s	6 minor div
.1mSEC	10 μ SEC	.1ms	6 minor div
.2mSEC	10 μ SEC	.1ms	6 minor div
.5mSEC	50 μ SEC	.5ms	6 minor div
1mSEC	.1mSEC	1ms	6 minor div
2mSEC	.1mSEC	1ms	6 minor div
5mSEC	.5mSEC	5ms	6 minor div
10mSEC	1mSEC	10ms	6 minor div
20mSEC	1mSEC	10ms	6 minor div
50mSEC	5mSEC	50ms	6 minor div
.1 SEC	10mSEC	.1s	16 minor div
.2 SEC	10mSEC	.1s	16 minor div
.5 SEC	50mSEC	.5s	16 minor div
1 SEC	.1 SEC	1s	16 minor div
2 SEC	.1 SEC	1s	16 minor div
5 SEC	.5 SEC	5s	16 minor div

c. Check A Timing .1 μ s-.5 μ s <1% error

Change the HORIZ DISPLAY to A and the DELAY TIME (A swp) to .1 μ SEC. Change the TYPE 184 time marks to .1 μ s and adjust C160A for one mark/cm. Change the DELAY TIME to .2 μ SEC and check for 2 marks/cm \pm 0.8mm. Change the DELAY TIME to .5 μ SEC and the TYPE 184 time marks to .5 μ s. Check for 1 mark/cm \pm 0.8mm.

d. Check/Adjust B Timing .1 μ s-5 μ s
<1% error

Set the front panel controls as follows:

HORIZ DISPLAY	B DLY'D BY A
TIME/CM (B swp)	.1 μ SEC
DELAY TIME (A swp)	1 μ SEC

Check or adjust the B swp timing accuracy with the controls set as follows:

TIME/CM (B swp)	TYPE 184	CHECK OR ADJUST	FOR
.1 μ SEC	.1 μ	C260A	1 mark/cm \pm 0.8mm
.2 μ SEC	.1 μ	check	2 mark/cm \pm 0.8mm
.5 μ SEC	.5 μ	check	1 mark/cm \pm 0.8mm

5d. (cont'd)

Change the DELAY TIME (A swp) to 10 μ SEC

TIME/CM (B swp)	TYPE 184	CHECK OR ADJUST	FOR
1 μ SEC	1 μ S	C260C	1 mark/cm \pm 0.8mm
2 μ SEC	1 μ S	check	2 mark/cm \pm 0.8mm
5 μ SEC	5 μ S	check	1 mark/cm \pm 0.8mm

e. Check Magnified Timing and Linearity

Timing: $<3\%$ error (0.5s-0.05 μ s) $<4\%$ error (0.01 & 0.02 μ s)Linearity: $<4\%$ error

Change the MAG to X10 and check for the specified timing accuracy. Except for the first 100ns and last 60ns check that the timing over any two cm (within center 8cm) has no more than 4% error.

TIME/CM (B swp)	TYPE 184	CHECK FOR
5 μ SEC	.5 μ S	1 mark/cm \pm 2.4mm
2 μ SEC	.1 μ S	2 mark/cm \pm 2.4mm
1 μ SEC	.1 μ S	1 mark/cm \pm 2.4mm

Change the DELAY TIME (A swp) to 1 μ SEC

.5 μ SEC	50nS	1 mark/cm \pm 2.4mm
.2 μ SEC	20nS	1 mark/cm \pm 3.2mm
.1 μ SEC	10nS	1 mark/cm \pm 3.2mm

Change the HORIZ DISPLAY to A and repeat the check for A swp.

f. Check B Timing 10 μ s-5s $<1\%$ error 10 μ s-50ms
 $<2.5\%$ error .1s-5s

Change the MAG to OFF and the HORIZ DISPLAY to B DLY'D BY A (left). Check for the specified timing accuracy with the controls set as follows:

TIME/CM	184	CHECK FOR
10 μ SEC	10 μ S	1 mark/cm \pm 0.8mm
20 μ SEC	10 μ S	2 mark/cm \pm 0.8mm
50 μ SEC	50 μ S	1 mark/cm \pm 0.8mm
.1mSEC	.1mS	1 mark/cm \pm 0.8mm
.2mSEC	.1mS	2 mark/cm \pm 0.8mm
.5mSEC	.5mS	1 mark/cm \pm 0.8mm
1mSEC	1mS	1 mark/cm \pm 0.8mm
2mSEC	1mS	2 mark/cm \pm 0.8mm
5mSEC	5mS	1 mark/cm \pm 0.8mm
10mSEC	10mS	1 mark/cm \pm 0.8mm

5f. (cont'd)

<u>TIME/CM</u>	<u>184</u>	<u>CHECK FOR</u>
20mSEC	10mS	2 mark/cm \pm 0.8mm
50mSEC	50mS	1 mark/cm \pm 0.8mm
.1	.1 S	1 mark/cm \pm 2mm
.2	.1 S	2 mark/cm \pm 2mm
.5	.5 S	1 mark/cm \pm 2mm
1 SEC	1 S	1 mark/cm \pm 2mm
2 SEC	1 S	2 mark/cm \pm 2mm
5 SEC	5 S	1 mark/cm \pm 2mm

g. Check Delay Jitter ≤ 1 part in 33,000

Set the DELAY TIME (A swp) to 1mSEC and TIME/CM to 1 μ SEC. Change the TYPE 184 time marks to 1ms. Adjust the DTM dial to approx 1.00 so the leading edge of the time mark is displayed. Jitter on the leading edge must not exceed 3mm. Change the DTM dial to approx 9.00 and repeat the check

6. FIXED DELAY TIME

a. Setup

Set the front panel controls as follows:

DELAY TIME (A swp)	.5 μ SEC
TIME/CM	.5 μ SEC
DELAY TIME MULT	2.00
HORIZ DISPLAY	A

Change the TYPE 184 time marks to 1 μ S.

b. Check Fixed Delay Time ≤ 100 ns

Adjust the A TRIG LEVEL so the sweep starts at an easily identifiable point on the 1 μ s time mark. Change the HORIZ DISPLAY to B DLY'D BY A (left). Turn the DELAY TIME MULT dial ccw until the sweep starts on the same point as it did in A swp. The DTM dial reading must be between 1.80 and 2.00.

7. AUTO TRIGGER RECOVERY TIME ≥ 50 ms and ≤ 100 ms

Change the DELAY TIME and TIME/CM to 1mSEC, HORIZ DISPLAY to A and TRIG MODE to AUTO. Change the time marks to 50ms. Check that a triggered display can be obtained by adjusting the A TRIG LEVEL.

7. If the recovery time of automatic triggering is greater than the interval between trigger pulses the sweep will trigger as in normal mode. If the recovery time is less

7. (cont'd)

Change the time marks to 100ms. It must not be possible to trigger the sweep on the leading edge of the time mark.

7. (cont'd) than the interval between pulses, the sweep will run erratically and cannot be triggered on the leading edge of the time mark.

8. TRIGGER PREAMPa. *Adjust Trigger Preamp DC Level* 0V

Remove the TYPE 10A2A from the main frame. Connect a 10X probe from test scope to TP 23. Set the test scope input coupling to DC and vertical deflection factor to the most sensitive DC range. Find gnd reference on the test scope and adjust Int Trig DC Level for 0 volts at TP 23.

b. *Check Trigger Preamp Gain and Overload*

Gain: 1.2-1.6 PTP @ TP 23

Overload: + & - 5 V min

Re-insert the TYPE 10A2A and set the front panel controls as follows:

11B2A

HORIZ DISPLAY	A
DELAY TIME	1mSEC
TRIG MODE	FREE RUN

10A2A

MODE	CH 1
TRIGGER	NORM
INPUT (CH 1)	DC

Connect the TYPE 647A calibrator signal to CH 1 input, obtain 2cm vertical deflection and center the display. The PTP signal amplitude at TP 23 must be 1.2 to 1.6 V.

Rotate the TYPE 10A2A POSITION control cw and ccw to overload the trigger preamp. Overload must be clean and occur at + and - 5 V, min, relative to gnd.

9. AC LF REJECT

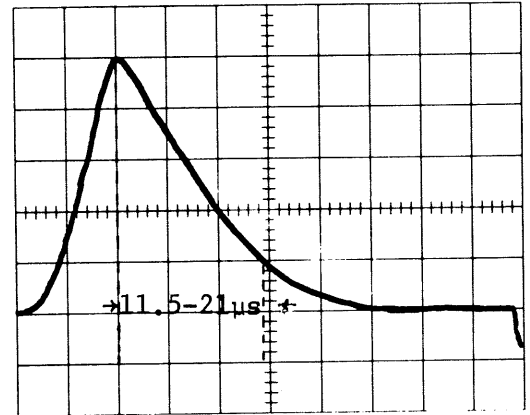
Differentiated square-wave decays to 20% amplitude in 11.5-21 μ s

Connect the 10X probe to the junction of

9. (cont'd)

of R30A and R30C. Change the A COUPLING switch to AC LF REJ. Adjust the test scope vertical gain for a peak display amplitude of 5cm. Set the test scope TIME/CM to 5 μ SEC. Check that the waveform decays to 20% (1cm) of the total amplitude between 11.5 and 21 μ s.

Remove the 10X probe and the calibrator signal.



10. LINE TRIGGER

a. Setup

Set the front panel controls as follows:

TYPE 11B2A

DELAY TIME (A swp)	5mSEC
TRIG MODE	NORM
COUPLING (A)	AC
SOURCE (A)	LINE
SLOPE (A)	+

Connect a 10X probe from the TYPE 10A2A CH 1 INPUT to the TYPE 647A thermal relay and set CH 1 VOLTS/CM to 10.

b. Check Line Trigger Phase

Slope of display must correspond to SLOPE sw.

Adjust the A TRIG LEVEL for a triggered display. Check that the slope of the display, at the start of the sweep, corresponds to the + and - setting of the SLOPE switch. Check that the display triggers on the same point when the TRIG MODE is changed from NORM to AUTO.

11. A TRIGGER

a. Check A TRIG LEVEL Range *Ext: + & - 5V*
Ext:10: + & - 50V

Connect a BNC T connector to the TYPE 647A CAL OUT. Connect a 50 Ω BNC cable from one side of the T to the TYPE 10A2A CH 1 INPUT. Connect a 50 Ω BNC cable from the other side of the T to the TYPE 11B2A A TRIG IN. Set CH 1 VOLTS/CM to 2, TRIG MODE to AUTO, SOURCE to EXT and COUPLING to AC.

11a. (cont'd)

Set the CALIBRATOR to 10 VOLTS and check that the display free runs at extreme cw and ccw settings of the TRIG LEVEL control.

Change the SOURCE to EXT: 10 and the CALIBRATOR to 100 VOLTS. Change the CH 1 VOLTS/CM to 20 and check that the display free runs at extreme cw and ccw settings of the TRIG LEVEL control.

*b. Check A External Triggering
(50kHz-20 MHz) Stable Trigger on $\leq 100\text{mV}$*

Connect the TYPE 191 OUTPUT -- GR Power Divider -- $\left[\begin{array}{l} \text{-- } 50\Omega \text{ cable -- } 10\text{X Atten} \\ \text{-- } 50\Omega \text{ cable -- } 10\text{X Atten} \end{array} \right.$
50 Ω terminator -- TYPE 10A2A CH 1 INPUT
50 Ω terminator -- TYPE 11B2A A TRIG IN

Set the TYPE 10A2A CH 1 VOLTS/CM to .05 and the TYPE 191 frequency to 50 kHz. Set the TYPE 11B2A DELAY TIME (A swp) to 20 μSEC , TRIG MODE to AUTO and SOURCE to EXT. Adjust the TYPE 191 amplitude for a 2cm display (100mV).

Check for stable triggering with NORM and AUTO settings of TRIG MODE and all settings of SLOPE and COUPLING switch.

Increase the TYPE 191 frequency to 20 MHz and repeat the check.

c. Align A TRIG LEVEL knob

Change the TYPE 191 frequency to 50 kHz and the COUPLING to AC LF REJ. Adjust the TRIG LEVEL for a triggered display. Loosen the set screw in the TRIG LEVEL knob and position the knob so the indexing dot is at 0, tighten the set screw.

*d. Check A External Triggering (100 MHz)
trigger on $\leq 200\text{mV}$, $\leq 1\text{mm}$ jitter*

Increase the TYPE 191 amplitude for a 4cm display (200mV). Change the DELAY TIME (A swp) to .1 μSEC , MAG to X10 and TRIG MODE to NORM. Increase the TYPE 191 frequency to 100 MHz.

Check that stable triggering can be obtained by adjusting the TRIG LEVEL and STABILITY controls. Check with MODE in NORM and AUTO and all settings of COUPLING and SLOPE switch. Display jitter must not exceed 1mm.

11. (cont'd)

- e. *Check A Internal Triggering*
100 MHz $<1.5\text{cm}$, $<1\text{mm}$ jitter
20 MHz $<0.2\text{cm}$

Change the A trigger SOURCE switch to INT.
Set the TRIG MODE to AUTO and decrease the
TYPE 191 amplitude for a 1.5cm display. Check
for stable triggering with TRIG MODE in NORM
and AUTO and all settings of SLOPE and
COUPLING switch. Display jitter must not
exceed 1mm.

Change the TYPE 191 frequency to 20 MHz and
decrease the amplitude for a 0.2cm display.
Change the MAG to OFF and check for stable
triggering.

- f, *Check B External Triggering (50 kHz-20 MHz)*
stable triggering on $<175\text{mV}$.

Connect the cable that was connected to the
A external TRIG IN to the B external TRIG IN.
Set the front panel controls as follows:

DELAY TIME (A swp)	20 μ SEC
TIME/CM (B swp)	20 μ SEC
DELAY TIME MULT	1.00
TRIG MODE	AUTO
B SOURCE	EXT

Set the TYPE 191 frequency to 50 kHz and
adjust the amplitude for a 3.5cm display
(175mV). Adjust the A TRIG LEVEL for a
triggered display. Change the HORIZ DISPLAY
to B DLY'D BY A (right). Check that stable
triggering can be obtained by adjusting the
B TRIG LEVEL control. Check with all settings
of the B sweep SLOPE and COUPLING switch.

Increase the TYPE 191 frequency to 20 MHz
and repeat the check.

- g. *Align B TRIG LEVEL knob*

Adjust B TRIG LEVEL for a triggered display.
Loosen the set screw in the B TRIG LEVEL
knob and position the indexing mark to 0,
tighten the set screw.

11. (cont'd)

*h. Check B External Triggering (100 MHz)
trigger on $\leq 250\text{mV}$ $\leq 1\text{mm}$ jitter*

Adjust the TYPE 191 amplitude for a 5cm display (250mV) and change the frequency to 100 MHz. Change the TIME/CM (B swp) and DELAY TIME (A swp) to .1 μSEC and MAG to X10. Check that stable triggering can be obtained by adjusting the B TRIG LEVEL knob. Display jitter must not exceed 1mm. Note: It may be necessary to adjust the A TRIG LEVEL and STABILITY in order to obtain stable triggering for B sweep.

*i. Check B Internal Triggering
100 MHz: $\leq 2.5\text{cm}$, $\leq 1\text{mm}$ jitter
20 MHz: $\leq 0.4\text{cm}$*

Change the B SOURCE switch to INT and the HORIZ DISPLAY to A. Adjust the TYPE 191 amplitude for a 2.5cm display. Change the HORIZ DISPLAY to B DLY'D BY A and check that stable triggering can be obtained by adjusting B TRIG LEVEL.

Change the HORIZ DISPLAY to A, TYPE 191 frequency to 20 MHz and adjust the amplitude for a 0.4cm display. Change the HORIZ DISPLAY to B DLY'D BY A and check that stable triggering can be obtained by adjusting the B TRIG LEVEL.

Remove the cables from the TYPE 191.

j. Check B TRIG LEVEL Range + & -10V

Connect a BNC T connector to the TYPE 647A CAL OUT. Connect a 50 Ω coax cable from one side of the T to B external TRIG IN. Connect a 50 Ω coax cable from the other side of the T to the TYPE 10A2A CH 1 INPUT.

Set the front panel controls as follows:

HORIZ DISPLAY	A
TIME/CM	1mSEC
DELAY TIME	1mSEC
MAG	OFF
B COUPLING	AC
B SOURCE	EXT

Set the TYPE 10A2A CH 1 VOLTS/CM to 5 and the TYPE 647A CALIBRATOR to 20V. Adjust the A TRIG LEVEL for a triggered display.

11j. (cont'd)

Change the HORIZ DISPLAY to B DLY'D BY A (right). Check that the display will not trigger at extreme cw and ccw settings of the B TRIG LEVEL control.

- k. *Check Fast Transient Triggering
stable triggering on TYPE 106
fast rise square-wave*

Connect the TYPE 106 FAST RISE + OUTPUT to the TYPE 10A2A CH 1 INPUT via a 5ns GR cable and a 50Ω GR to BNC termination. Set the TYPE 106 HI AMPLITUDE/FAST RISE to FAST RISE and frequency to 100 kHz. Change the HORIZ DISPLAY to A, DELAY TIME and TIME/CM to .1μSEC, MAG to X10 and TRIG MODE to AUTO. Adjust the TYPE 106 + TRANSITION AMPLITUDE for a 2cm display. Adjust the A TRIG LEVEL for a triggered display. Check that the leading edge of the display is stable and free of jitter.

Change the DELAY TIME to .2μSEC and HORIZ DISPLAY to B DLY'D BY A (right) and repeat the check for B trigger.

12. FRONT PANEL WAVEFORMS

- a. *Check +Gate Waveform 15V ±10%*

Change the TRIG MODE to FREE RUN. Connect a 10X probe from the test scope to A +GATE connector. The gate waveform amplitude must be 15 volts ±10%.

Change the HORIZ DISPLAY to B DLY'D BY A (left) and connect the probe to B +GATE connector. The gate waveform amplitude must be 15 volts ±10%.

- b. *Check Sweep Waveform 10V ±10%*

Connect the test scope probe to the B SWEEP jack. The sweep waveform amplitude must be 10V ±10%.

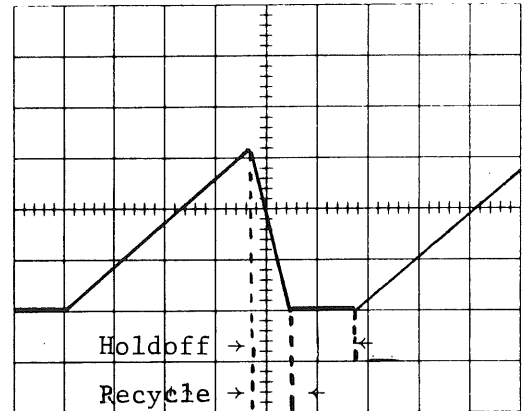
Change the HORIZ DISPLAY to A and connect the test scope probe to the A SWEEP jack. The sweep waveform amplitude must be 10V ±10%.

a. The risetime of the gate waveform, when checked with a 10X probe, should be approx 0.12μs. If the GATE output is connected to the test scope via coaxial cable the risetime will be much longer due to the capacitance loading of the cable.

13. HOLDOFF*a. Check A Sweep Holdoff Time*

Leave the test scope probe connected to the A SWEEP jack and check for the specified holdoff.

<u>DELAY TIME (A swp)</u>	<u>Holdoff</u>	<u>Typical Recycle Time</u>
5, 2, 1 SEC	115-165ms	40ms
.5, .2, .1 SEC	115-165ms	40ms
50, 20, 10mSEC	13-17 ms	5ms
5, 2, 1mSEC	1.3-2.1ms	.5ms
.5, .2, .1mSEC	130-180 μ s	40 μ s
50, 20, 10 μ SEC	17-25 μ s	5 μ s
5, 2, 1 μ SEC	11-18 μ s	1 μ s
.5, .2, .1 μ SEC	5.5-6.5 μ s	1 μ s

*b. Check HF STABILITY 130-350ns*

With the DELAY TIME set at .1 μ SEC vary the HF STABILITY from full cw to full ccw. The holdoff time must change by 130-350ns.

Remove the test scope probe.

14. EXT HORIZONTAL*a. Check External Horizontal Deflection Factor 1V/cm \pm 10%*

Change the HORIZ DISPLAY to EXT and the B COUPLING to EXT. Connect a 5 volt square-wave from the SAC to the B external TRIG IN jack. Check the horizontal deflection for 5cm \pm 10%.

b. Check External Horizontal Bandwidth DC to >4 MHz @ -3dB

Remove the SAC signal and connect the TYPE 191 OUTPUT to the B external TRIG IN jack. Set the TYPE 191 frequency to 50 kHz and adjust the amplitude for 6cm horizontal deflection. Increase the frequency until the horizontal deflection is reduced to 4.2cm. The frequency at 4.2cm must be 4 MHz or greater.

15. SINGLE SWEEP*a. Check Single Sweep Operation*

Change the HORIZ DISPLAY to A and the TRIG MODE to NORM. Adjust the A TRIG LEVEL for a triggered display. Change the TYPE 10A2A input selector to GND and the HORIZ DISPLAY to SINGLE SWEEP. Depress the RESET button and check that the RESET neon lights. Unground the TYPE 10A2A INPUT and check that the sweep runs once and the RESET neon extinguishes.

b. Check Single Sweep Automatic Reset

Connect the Cannon Connector Checker (PMPE Dwg. #1190A) to J101 on the TYPE 647A rear panel. Connect the TYPE 647A calibrator signal to the TYPE 10A2A INPUT and the CAL IN jack on the Cannon Connector Checker. Change the TRIG MODE to NORM, CALIBRATOR to 5 VOLTS, and VOLTS/CM to 2. Adjust the A TRIG LEVEL for a triggered display.

Change the TRIG MODE to SINGLE SWEEP. Check that the display remains triggered and the RESET neon stays lit.

16. ALTERNATE TRACE SYNC PULSE >4V

Remove the TYPE 10A2A and install the 067-0544-00 Calibration Fixture in the plug-in compartment. Connect a 10X probe from the test scope to the Sync Pulse Test Point (pin 17) on the Calibration Fixture. The amplitude of the sync pulse must be at least 4V.

THE END