#### **CONTENTS**:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

#### Equipment Required

<u>Factory Test Limits</u> - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

<u>Main Procedure</u> - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

#### CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 39-307.

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This procedure is company confidential

533A

December 1968

For all serial numbers.





## EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- 1 TYPE 530 SERIES OSCILLOSCOPE
- 1 TYPE 1A1 DUAL-TRACE PLUG-IN UNIT and
- 1 P6006 X10 PASSIVE PROBE (010-0127-00)
- 1 P6028 X1 PASSIVE PROBE (010-0074-00)
- 1 TYPE 1A2 DUAL-TRACE PLUG-IN UNIT
- \*1 TYPE 184 TIME-MARK GENERATOR
- \*1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
- 1 TYPE 76TU LINE-VOLTAGE CONTROL UNIT
- b. Test Fixtures and Accessories
- 1 CALIBRATION FIXTURE (1M) (067-0521-00)
- 4  $50\Omega$  coax cables, BNC (012-0057-00)
- 1 50Ω Termination, BNC (011-0049-00)
- 1 BNC "T" Connector (103-0030-00)
- 2 BNC to binding post adapters (103-0033-00)
- 1 BNC to clip lead adapter (013-0076-00)
- 3 18 inch patch cords with banana plugs (012-0031-00)
- \*1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
- 1 Micro Shock Hammer (PMPE Dwg #1283-B)
- 1 47pF ceramic capacitor (281-0518-00)
- c. Other equipment
- 1 20,000Ω/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.

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Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (setups, presets, etc.) are not listed. 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

- b. Check CRT face plate tilt: <3/64"
- 4. LOW VOLTAGE SUPPLIES
- a. Time-delay relay: 15 to 60sec
- c. Check power supply voltage and regulation:

Supply	Tolerance	<u>Max Ripple</u>
-150V	±2%	5mV
+100V	±2%	10 mV
+225V	±2%	5mV
+350V	±2%	20mV
+500V	±2%	20mV

#### 5. HIGH VOLTAGE

- a. High Voltage: -1350V ±2%b. High voltage regulation:
- $\leq 20V$ , no blooming
- 6. AMPLITUDE CALIBRATOR
- \*b. .1 Volts position: ±2%
- \*c. 50V to .2V position observed error: ±2% observed error plus 1000:1 observed error: ±2% e. Symmetry: 45 to 55%
- f. Frequency: 1kHz ±20%

7. CRT

a. Align CRT: <1mm tilt

- 8. VERTICAL AMPLIFIER BALANCE
- b. Microphonics: <2.5mm, no ringing
- c. Amplifier balance: <0.75cm
- d. Vertical amplifier balance: <2cm
- 9. BEAM POSITION INDICATORS AND SCALE ILLUM
- a. Check beam position indicators: correct one on, other off before spot leaves the graticule
- b. Check SCALE ILLUM: max cw, off ccw

## 10. GEOMETRY AND FOCUS

- a. Adjust Geometry, R842: <a><br/>
  <u>-</u>1mm, bowing</a>
  - b. Check horizontal focus: definition of 1mm marks center 8.8cm
  - c. Check horizontal geometry: <a href="mailto:</a> <a href="mailto:lmm">lmm</a>, bowing
  - d. Check vertical focus: definition of 1mm spaced traces

#### 11. VERTICAL AMPLIFIER

- \* a. Gain: range at least + & 10%, accuracy ±2%
  - b. Gain change with line voltage change: <5%</p>

- c. Compression or expansion: <a href="mailto:</a>lmm
  d. Drift with line voltage change:
   <0.5cm</pre>
- e. DC shift: <2mm
- 12. DUAL TRACE AND CHOPPED BLANKING
- a. Alternate Sweep: all sweep ratesb. Multi-trace sync pulse
- <u><</u>60V amplitude <u><</u>1µs negative pulse risetime
- c. Chopped blanking: transients blanked
- 13. TRIGGERING
- b. Triggering Level Centering
   + & 0.2V
- c. Trig Sens: will not trigger on 0.1V
- d. Int Trig DC Level Adj: 4mm within 4mm of center
- e. TRIGGERING LEVEL knob: + & at 0
- f. PRESET STABILITY: 50% of range, ±25%
- g. Triggering:

INT		$\mathbf{E}\mathbf{X}\mathbf{T}$	
AC	2mm	AC	0.2V
AC LF	REJ 2mm	AC LF REJ	0.2V
DC	4mm within 4mm	DC	0.2V
AUTO		AUTO	0.2V

- h. TRIGGERING LEVEL range: at least + & 10V
- i. Line triggering: correct slope
- 14. HIGH FREQUENCY SYNC
- a. External HF SYNC: 1.5V at 5MHz and 30MHz <1mm jitter

- 15. HORIZONTAL AMPLIFIER
- \*a. X10 Cal: ±4%
- **\*b.** X100 Cal: ±4%
- \*c. Check Horiz jitter: <0.5mm
- **\*d.** X1 Cal: ±2%
- e. Sweep Length: 10.5cm ±0.3cmg. DC Shift: <2mm</li>
- \*h. SWEEP MAGNIFIED accuracy: ±4%
- i. VARIABLE TIME/CM: ratio >2.5:1
- \*16. SLOW SPEED TIMING

±2%; except 1, 2 & 5sec: ±2.5%

- 17. HORIZONTAL POSITIONING AND AMPLIFIER TIME CONSTANT
- a. POSITION control: + & 5cm
  b. Horizontal amplifier input time constant: <4cm</li>
- 18. FAST SWEEP TIMING
- \*a. 10µsec timing: accuracy ±2%
- \*b. lµsec timing: accuracy ±2% \*c. .5µsec timing: accuracy ±2%
- \*d. .lusec timing: accuracy ±2%
- \*e. 20nsec timing: accuracy ±4%
  - linearity ±1%
- \*f. Fast sweep magnified timing: accuracy ±4%
- h. MAGNIFIER ON and UNCALIBRATED lights: ON, lit when sweep is magnified; UNCALIBRATED, lit when sweep rate is faster than 20nsec/cm
- 19. SINGLE SWEEP
- a. Lockout Level: +11V ±10% from free
   run
- b. SINGLE SWEEP and READY light single sweep on triggering signal; READY light lit when sweep is armed

# 20. INTENSITY MODULATION

<20V

a.

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## 21. FRONT PANEL WAVEFORMS

VERT SIG OUT  $\geq 1.5V/cm$ SAWTOOTH OUT  $\geq 130V$ +GATE OUT  $\geq 20V$ 

22. HOLDOFF

.1, .2 and  $.5\mu SEC$  $4-9\mu s$ 1, 2 and  $5\mu SEC$  $15-40\mu s$ 10, 20 and  $50\mu SEC$  $15-40\mu s$ .1, .2 and .5m SEC $150-400\mu s$ 1, 2 and 5m SEC1.5-4m s10, 20 and 50m SEC15-40m s.1, .2, .5, 1, 2and 5 SECand 5 SEC150-400m s

# 23. EXTERNAL HORIZONTAL AMPLIFIER

- a. Ext Horiz Amp DC Bal: <1cm
- \*b. Gain: range at least ±10% accuracy ±2%
- c. EXTERNAL HORIZONTAL VARIABLE VOLTS/CM: ratio >10:1
- d. Compensate attenuator: ±2% of
   .1 VOLTS/CM
- \*e. Bandwidth: -3dB at >500kHz

## 24. HIGH FREQUENCY RESPONSE

- c. Delay line termination: <1% aberration
- d. Delay line: <1% aberration
   and deviation from level</pre>
- e. Transient response: <1% overshoot or rolloff

\*25. VERTICAL AMPLIFIER BANDWIDTH

 $\geq$ 15MHz at -3dB

#### THE END

\*Indicates measurement characteristic; test equipment used must be traceable to NBS for instrument certification. This instrument must meet Factory Test Limits before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, this procedure may require that some checks and adjustments be made so that performance is better than that required by Factory Test Limits.

## 1. PRELIMINARY INSPECTION

- a. Check CRT
- b. Check CRT face plate tilt: <3/64"
- c. Check fuse
- d. Install Current modifications
- e. Check tubes
- 2. PRESET CONTROLS
- a. Preset external controls
- b. Preset internal controls
- c. Preset 1ml
- 3. RESISTANCE CHECKS

Check power supply resistance

- 4. LOW VOLTAGE SUPPLIES
- a. Check time-delay relay: 15 to 60sec
- b. Adjust -150V Adj
- c. Check power supply voltage and regulation
- d. Check elevated heaters
- 5. HIGH VOLTAGE
- a. Adjust High voltage Adj
- b. Check High Voltage Regulation

- 6. AMPLITUDE CALIBRATOR
- a. Adjust Cal Adj
- b. Check .1 VOLTS position: ±2%
- c. Check 50V to .2V position
- d. Check 50mV to .2mV operation
- e. Check symmetry: 45 to 55%
- f. Check frequency: 1kHz ±20%
- 7. CRT
- a. Align CRT
- b. Align the graticule
- c. Check CRT defects
- 8. VERTICAL AMPLIFIER BALANCE
- a. Find CRT electrical center
- b. Check microphonics: <2.5mm
- c. Check amplifier balance: <0.75cm
- d. Check vertical amplifier balance: <2cm
- 9. BEAM POSITION INDICATORS AND SCALE ILLUM
- a. Check beam position indicators
- b. Check SCALE ILLUM
- 10. GEOMETRY AND FOCUS
- a. Adjust Geometry
- b. Check horizontal focus
- c. Check horizontal geometry: <<u>l</u>mm bowing
- d. Check vertical focus

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# 11. VERTICAL AMPLIFIER

- a. Set Gain
- b. Check gain change with line voltage change: <5%</p>
- c. Check compression or expansion: <1mm
- d. Check drift with line voltage change: <0.5cm</pre>
- e. Check DC shift: <2mm
- 12. DUAL TRACE AND CHOPPED BLANKING
- a. Check alternate sweep
- b. Check multi-trace sync pulse >60V amplitude <1µs negative pulse risetime</p>
- e. Check chopped blanking
- 13. TRIGGERING
- b. Adjust Triggering Level Centering
- c. Adjust Trig Sens
- d. Adjust Int Trig DC Level Adj
- e. Set TRIGGERING LEVEL knob
- f. Set PRESET STABILITY
- g. Check triggering
- h. Check TRIGGERING LEVEL range
- i. Check line triggering: correct slope
- 14. HIGH FREQUENCY SYNC
- a. Check external HF sync
- b. Check internal HF sync

- 15. HORIZONTAL AMPLIFIER
- a. Adjust X10 Cal
- b. Adjust X100 Cal
- c. Check Horiz Jitter: <0.5mm
- d. Adjust X1 Cal
- e. Adjust Sweep Length
- f. Adjust Swp/Mag Regis
- g. Adjust DC Shift
- h. Check SWEEP MAGNIFIED accuracy: ±4%
- 16. SLOW SPEED TIMING

Check slow speed timing

- 17. HORIZONTAL POSITIONING AND AMPLIFIER TIME CONSTANT
- a. Check POSITION control: + and 5cm
- b. Adjust Horizontal Amplifier input time constant

# 18. FAST SPEED TIMING

- a. Adjust 10µs timing
- b. Adjust lµs timing
- c. Adjust .5 $\mu$ s timing
- d. Adjust .1µs timing
- e. Adjust 20ns timing
- f. Adjust fast sweep magnified timing
- g. Check fast sweep unmagnified timing: ±2%
- h. Check MAGNIFIER ON and UNCALIBRATED lights

19. SINGLE SWEEP

25. VERTICAL AMPLIFIER BANDWIDTH

Check bandwidth:  $\geq 15MHz$  at -3dB

- a. Adjust Lockout Level Adj
- b. Check SINGLE SWEEP and READY 1ight
- 20. INTENSITY MODULATION

<20V

THE END

- 21. FRONT PANEL WAVEFORMS
- b. Check VERT SIG OUT:  $\geq 3$  volts c. Check SAWTOOTH OUT:  $\geq 130$  volts
- d. Check + GATE OUT: >20V
- 22. HOLDOFF

Check holdoff

# 23. EXTERNAL HORIZONTAL AMPLIFIER

- a. Adjust EXT HORIZ Amp DC Bal
- b. Adjust gain
- c. Check EXTERNAL HORIZONTAL VARIABLE VOLTS/CM: >10:1
- d. Compensate attenuator: ±2% of .1 volts/cm
- e. Check bandwidth: >500kHz at -3dB
- 24. HIGH FREQUENCY RESPONSE
- b. Preset delay line
- c. Adjust delay line termination: <1%
- d. Adjust delay line: <1% aberration and deviation from level
- e. Adjust transient response: <1% overshoot or rolloff

## PRELIMINARY INSPECTION

a. Check CRT

Inspect the CRT for phosphor defects, scratches, chips and cracks around neck pins. Check neck pins for proper connection and tightness.

b. Check CRT face plate tilt: <3/64"

Loosen CRT clamp, remove graticule, push CRT forward to a straight edge firmly placed against the front panel, across a diameter of the CRT. Check gap within phospor area: <3/64".

d. Install current modifications

e. Check tubes

V564 & 554 same V504 & 524 checked pair with same #. V364 & 354 same V374 & 384 same V161 must be 8426A, and must have tube shield.

# 2. PRESET CONTROLS

a. Preset external controls

FOCUS	CCW
INTENSITY	CCW
ASTIGMATISM	ccw
SCALE ILLUM	CW
TRIGGERING LEVEL	
STABILITY	ccw (not PRESET)
TRIGGER SLOPE	+ INT
TRIGGERING MODE	AC
TIME/CM	1mSEC
VARIABLE	CALIBRATED

a. Do not reject a CRT without consulting a trained CRT checker or referring to the Cathode Ray Tube Checkout Procedure.

c. Check fuse

<sup>6</sup> amp fast blo

HORIZONTAL DISPLAY	NORMAL (X1)
SINGLE SWEEP	NORMAL SWEEP
HORIZONTAL POSITION	midr
VERNIER	midr
EXTERNAL HORIZONTAL	
VOLTS/CM	10
VARIABLE	CALIBRATED
AMPLITUDE CALIBRATOR	OFF
POWER	OFF

NOTES

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b. Preset internal controls

Preset all internal controls to midr.

c. Preset 1m1

VERTICAL POSITION midr	
VARIABLE midr	
AMPLITUDE midr	
TEST FUNCTION HIGH L	DAO
REPETITION RATE HIGH	

Install 1ml in TYPE 533A.

# 3. RESISTANCE CHECKS

Measure the resistance to gnd of the following supplies. These supplies may be found on the ceramic strip inboard from T601.

Supp.	ly		Approx	x Resista	nce	
-150	VDC			<b>3k</b> Ω		
+100	VDC			<b>500</b> Ω		
+225	VDC			$6k\Omega$		
+350	VDC		$20k\Omega$	(reverse	meter	leads)
+500	VDC			<b>30k</b> Ω		
+325	VDC	unreg		<b>3.5k</b> Ω		
+75	VDC			<b>400</b> Ω		

Check the resistance of T601 term 1 and 4 to gnd, infinity.

Check time-delay relay:

Connect the TYPE 533A power cord to the TYPE 76TU. Set the TYPE 76TU for 117V as read on its meter.

check for 15 to 60sec before audible click is heard.

#### Turn TYPE 533A POWER switch ON,

4.

b. Adjust -150V Adj

LOW VOLTAGE SUPPLIES

15 to 60sec

α.

Connect the multimeter leads from the -150V supply to gnd and adjust R616, -150V Adj, for -150 VDC.

c. Check power supply voltage and regulation

Set line voltage at 105V. Check the power supply voltages and ripple as given below:

Supp1	у	Tole	erance	Max	Ripple
-150	VDC	-	±3V		5mV
+100	VDC	:	±2V	1	.OmV
+225	VDC	:	±4.6V		5mV
+350	VDC	:	±7V	2	20mV
+500	VDC	5	±10V	2	.OmV

Repeat with 1M1 at LOW LOAD and line voltage at 125V. Return the TYPE 76TU to 117V.

#### d. Check elevated heaters

Check the following terminals of T601 for elevation.

T601 term	Approx DC voltage to gnd
22 and 23	+95V
27 and 28	+220V
9 and 16	+350V
24 and 25	-1350V

#### c. +100 VDC Supply Ripple

The max ripple for the +100 VDC supply includes high voltage hash.

## 5. HIGH VOLTAGE

## a. Adjust High Voltage Adj

Connect the multimeter leads between the filament end of R856 and gnd. Adjust the High Voltage Adj, R811 for -1350V, ±2%.

## b. Check High Voltage Regulation: <20V, no blooming

Set the TYPE 533A STABILITY cw. Slowly increase INTENSITY and adjust 1M1 VERTICAL POSITION control for a trace. With trace defocused, set the INTENSITY control cw. Set the TYPE 76TU to 105V and check for -1350V ±20V with no blooming.

Set the TYPE 76TU to 125V and check for -1350V ±20V with no blooming. Return TYPE 76TU to 117V. Set INTENSITY ccw.

#### 6. AMPLITUDE CALIBRATOR

a. Adjust Cal Adj

Connect a  $50\Omega$  coax cable from the TYPE 533A CAL OUT to the SAC UN-KNOWN INPUT. Set the AMPLITUDE CALIBRATOR to 100 VOLTS. Connect a  $50\Omega$  coax cable from the SAC OUTPUT to the test scope TYPE 1A1 DUAL TRACE PLUG-IN UNIT, INPUT 1. Set the TYPE 1A1 CHANNEL 1 VOLTS/CM to .5 and the INPUT SELECTOR to AC. Set the SAC to 100V, +DC, MIXED.

Remove V875 from the TYPE 533A. Set test scope TIME/CM to 5mSEC and trigger controls to AUTO, +LINE.

Set the Cal Adj, R879, for a null voltage (the display is a straight line).

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- 6. (CONT)
  - b. Check .1 VOLTS position: ±2%
  - c. Check 50V to .2V position observed error: ±2% observed error plus 1000:1 divider error: ±2%
  - d. Check 50mV to .2mV operation

Replace V875 and check 50mV to .2mV positions for a square wave of approximately the correct amplitude.

e. Check symmetry: 45 to 55%

Set the test scope TRIGGER SLOPE to +INT and TIME/CM to  $50\mu$ SEC. Set the TYPE 1A1 MODE switch to CH 1 and the CHANNEL 1 VOLTS/CM to .05. Set TYPE 533A AMPLITUDE CALIBRATOR to .2 VOLTS and trigger test scope for a stable display. Adjust the test scope VARIABLE TIME/ CM for 1 cycle of square-wave in 10cm. Check the length of the half cycles, 4.5 to 5.5cm.

f. Check frequency: 1kHz ±20%

Set the test scope TIME/CM to 1mSEC, return VARIABLE to CALIBRATED. Check for 8 to 12 cycles in 10cm. Remove SAC connections.

#### 7. CRT

a. Align CRT: <1mm tilt

Slowly rotate the TYPE 533A INTENSITY control until the trace appears. Adjust the FOCUS and ASTIGMATISM controls for minimum trace width. Tighten the CRT clamp and use the 1M1 VERTICAL POSITION control and CRT rotator (located on the CRT clamp) to align the trace with the graticule center line, <1mm tilt. b. If 100V is exactly 100V the error read in c is the divider error. If 100V is not adjusted to exactly 100V subtract algebraically the 100 VOLTS error (including sign) from .1 VOLT error (including sign) to find 1000:1 divider error (include sign).

b. Align the graticule

Connect the TYPE 191 to the 1M1 EXT INPUT and set it for a 50kHz, 5 volts signal. Position the display to cover the CRT. Adjust the graticule cam to center the graticule over the CRT display.

Remove the TYPE 191 signal.

c. Check CRT defects

Check the CRT for double-peaking, flare, grid emission, cathode interface, charging, burrs and adequate scan area.

## 8. VERTICAL AMPLIFIER BALANCE

a. Find CRT electrical center

Short the CRT vertical deflection plates together with an insulated soldering aid and note trace vertical position (CRT electrical center).

b. Check microphonics <2.5mm, no ringing

Use the micro shock hammer on top of 533A and check display for microphonics: 2.5mm, max; with no ringing.

c. Check amplifier balance: <0.75cm

Use a jumper to connect output amplifier grids together (V533 pin 8 to V543 pin 8). Check trace shift from CRT electrical center: ±0.75cm, max. Remove jumper. Short V533 pin 7 to V543 pin 7. Check trace shift from CRT electrical center: ±0.75cm, max. Remove jumper.

## d. Check vertical amplifier balance: <2mm

Set the 1M1 TEST FUNCTION to COMMON MODE. Check trace shift from the CRT electrical center; ±2cm, max. c. Do not reject a CRT without consulting a trained CRT checker or referring to the Cathode Ray Tube Checkout Procedure.

#### c. Vertical Balance

Proper vertical amplifier balance is essential for minimum vertical compression or expansion, minimum vertical trace shift with varying line voltages and proper delay line-tuning.

## 9. BEAM POSITION INDICATORS AND SCALE ILLUM

a. Check beam position indicators: correct one on, other one off before spot leaves the graticule NOTES

Change the HORIZONTAL DISPLAY switch to EXT. Center the spot with the positioning controls. With the 1M1 VERTICAL POSITION control move the spot up 3cm,  $\uparrow$  on  $\downarrow$  off. Repeat in the other direction,  $\downarrow$  on  $\uparrow$  off. Return the spot to graticule center.

With the HORIZONTAL POSITION control move the spot to the left 5cm,  $\leftarrow$  on  $\rightarrow$ off. Repeat in the other direction,  $\rightarrow$  on  $\leftarrow$  off. Return the HORIZONTAL DISPLAY switch to NORMAL (X1).

b. Check SCALE ILLUM: max cw, off ccw

Set the SCALE ILLUM control ccw and check for no graticule illumination. Slowly rotate the SCALE ILLUM cw, check for increasing brilliance with max at cw.

## 10. GEOMETRY AND FOCUS

a. Adjust Geometry: <1mm bowing

Connect the MARKER AMPLIFIER OUTPUT of the TYPE 184 to the 1M1 EXT INPUT. Set the TYPE 184 for .1mS time marks. Adjust the STABILITY and TRIGGERING LEVEL for a stable display. It may be necessary to adjust Trig Level Centering, R39, to trigger the display. Position the display down so that the baseline is not visible. Adjust R842, Geometry, for minimum bowing of marks.

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b. Check horizontal focus: definition of 1mm marks center 8.8cm

Set the TYPE 184 for lmS time marks. Set TYPE 533A TIME/CM to .5mSEC. Adjust TRIGGERING LEVEL and STABILITY for a stable display if necessary. Adjust the VARIABLE TIME/CM and R368, if necessary, for 1 mark/cm.

Change the TYPE 184 to .1mS time marks. Readjust TRIGGERING LEVEL and STABILITY if necessary. Adjust INTENSITY, FOCUS and ASTIGMATISM for the best defined display. Check for no overlap of time marks anywhere in the center 8.8cm of the graticule. Return VARIABLE TIME/CM to CALIBRATED.

# c. Check horizontal geometry: <1mm bowing

Remove the time marks from the 1M1 EXT INPUT. Set the STABILITY cw. Check geometry at the bottom, center and top of the graticule, 1mm or less bowing.

# d. Check vertical focus: definition of 1mm spaced traces

Connect a coax cable from the SAC OUTPUT to the 1M1 EXT INPUT. Set the SAC to 1 VOLT \_\_\_\_. Adjust the 1M1 VARIABLE for a display amplitude of 1cm. Set the SAC to .1 VOLT. Adjust the FOCUS, ASTIGMATISM and INTENSITY for best resolution. Position the display to the top, center and bottom of the graticule, check for no overlap of the traces.

## 11. VERTICAL AMPLIFIER

a. Set Gain: range, at least + and - 10%; accuracy ±2%

Set the 1M1 TEST FUNCTION to GAIN SET. Change SAC AMPLITUDE to 100 VOLTS. Set Gain, R570, cw and check for 4.4cm or more of display. Set Gain ccw and check for 3.6cm or less amplitude. Set Gain, R570, for 4cm.

# b. Check gain change with line voltage change: <5%

Set the TYPE 76TU to 105V and check amplitude, 4cm ±2mm. Set the TYPE 76TU to 125V and check amplitude, 4cm ±2mm. Return TYPE 76TU to 117V.

c. Check compression or expansion: <1mm

Set the 1M1 TEST FUNCTION switch to LOW LOAD. Adjust the VARIABLE and VERTICAL POSITION for a 2cm display at graticule center. Position the display to the top and then the bottom of the graticule, check for 2cm ±1mm at top and bottom.

## d. Check drift with line voltage change: <0.5cm

Remove the coax cable from the 1M1 EXT INPUT. Change the TYPE 76TU to 105V, wait until trace stops drifting. Position trace to graticule center line. Change TYPE 76TU to 125V. Check trace shift, 0.5cm or less. Return TYPE 76TU to 117V.

#### e. Check DC shift: <2mm

Set the 1M1 TEST FUNCTION switch to COMMON MODE, check position of trace. Change TEST FUNCTION switch to HIGH LOAD and position the trace 3cm from COMMON MODE position. Turn TEST FUNCTION switch to COMMON MODE, wait several seconds. Change the TEST FUNCTION switch to HIGH LOAD, the trace will shift rapidly 3cm. Check for 2mm or less drift following the initial trace shift.

## 12. DUAL TRACE AND CHOPPED BLANKING

a. Check alternate sweep: all sweep rates

Set the 1M1 TEST FUNCTION switch to ALTERNATE. Check the TYPE 533A display for 2 traces on all sweep rates from .1 $\mu$ SEC to 5 SEC.

## b. Check Multi-trace Sync pulse >60V amplitude <1µs negative pulse risetime

Connect the test scope 10X probe to pin 16 of J11. Set the TYPE 1M1 for an ALTERNATE display and check for a negative-going pulse if  $\geq 60V$  with  $\leq 1\mu$ s risetime.

## c. Check chopped blanking: transients blanked

Set the 1M1 TEST FUNCTION switch to CHOPPED. Set the TIME/CM switch to  $2\mu$ SEC and adjust the STABILITY control for a stable display of square-waves.

Change the CRT CATHODE SELECTOR (scope rear panel) to DUAL TRACE CHOPPED BLANKING and check for blanking of vertical lines (chopping transients). Return CRT CATHODE SEL-ECTOR to EXTERNAL CRT CATHODE and 1M1 TEST FUNCTION to HIGH LOAD.

#### 13. TRIGGERING

a. Setup

Set the TYPE 533A as follows:

TIME/CM	50µSEC
TRIGGERING MODE	DC
TRIGGER SLOPE	+EXT ·
STABILITY	for display on the CRT
1M1 VARIABLE	CW

a. Slow sweep alternate

Alternate sweep must operate on all sweep rates. Sweep rates slower than 5mSEC are difficult to check. If in doubt apply 10 volts from the calibrator to the 1M1 EXT INPUT and check for two traces every other sweep.

3
(

TYPE 1A1 unit

CHANNEL	1	VOLTS/CM	.02	
CHANNEL	2	VOLTS/CM	1	
INPUT S	ELI	ECTORS	AC	
MODE			CH	1

Connect the X10 probe from the TYPE 1A1 INPUT 2 to V45 pin 6. Connect a grounding strap from the junction of R19-T20 to gnd.

Attach a BNC "T" connector to the 1M1 EXT INPUT. Connect the TYPE 191 to one side of the "T" with a  $50\Omega$ cable. Connect a  $50\Omega$  cable and  $50\Omega$ Termination from the other side of the "T" to the 1A1 INPUT 1. Set the TYPE 191 FREQUENCY RANGE to 50kHz. Adjust the AMPLITUDE controls for an output of .1 VOLTS as read on the test scope. Change the coax cable and  $50\Omega$  Termination to the TYPE 533A TRIGGER INPUT. Switch TYPE 1A1 MODE to CH 2.

b. Adjust Triggering Level Centering

Switch TYPE 533A TRIGGER SLOPE switch back and forth between + & - EXT and adjust the Triggering Level Centering, R39 for a stable display on the test scope. Continue to adjust R39 for stable triggering in both +EXT and -EXT while adjusting TRIG SENS, R37, for the minimum sensitivity which will still permit stable triggering.

## c. Adjust Trig Sens: will not trigger on 0.1V

Reduce the sensitivity of the trigger circuit by adjusting R37, to the point where a stable trigger cannot be obtained in either +EXT or -EXT.

d. Adjust Int Trig DC Level Adj: 4mm within 4mm of center

Set the TYPE 191 AMPLITUDE controls for 4mm of signal on the TYPE 533A. Position the bottom of the display to the graticule center line.

Set the TYPE 533A TRIGGERING MODE to DC and TRIGGER SLOPE to +INT. Adjust the Int Trig DC Level Adj, R3, for a stable display. Switch the TRIGGER SLOPE between +INT and -INT and adjust R3 for stable triggering.

e. Set TRIGGERING LEVEL knob: + & - at 0

Set the TYPE 533A TRIGGERING MODE to AC. Adjust the TYPE 191 for 2mm of display. Remove the strap from the junction of R19-R20. Tighten the TRIGGERING LEVEL knob set screw enough to allow movement of the pot. Set the knob to the position where a stable trigger is obtained. Switch the TRIGGER SLOPE switch between +INT and -INT and adjust the TRIGGERING LEVEL for stable triggering in both slopes.

Loosen the TRIGGERING LEVEL knob set screw and set the index dot straight up and retighten. Check that a stable trigger in both + and - INT slopes is obtained at 0. Remove the Xl probe from V45 pin 6.

f. Set PRESET STABILITY: 50% of range, ±25%

Set the 1M1 TEST FUNCTION switch to COMMON MODE, the TYPE 533A TRIGGER SLOPE to +LINE. Set the STABILITY control to PRESET. Connect the multimeter from the center arm of the PRESET STABILITY pot to gnd.

d. It is important that the lMl be in HIGH LOAD. The DC trigger level shifts downward with less load.

Adjust the PRESET ADJUST until the display appears, check the meter reading. Rotate the PRESET ADJUST clockwise until the trace brightens and check the meter readings. Set the PRESET ADJUST for a reading half-way between the two readings.

Remove the meter leads, set the 1M1 TEST FUNCTION to HIGH LOAD and the TYPE 533A TRIGGER SLOPE to +INT.

g. Check triggering

Use the following table to check triggering:

TRIGGERING	signal	
MODE	amplitude	condition
AUTO	2mm	INT + & -
AC LF REJ	2mm	INT + & - use TRIGGERING LEVEL
AC .	2mm	INT + & - use TRIGGERING LEVEL
DC	4mm	INT + & - within 4mm of graticule center,
		+INT within 4mm of -INT, use
		VERTICAL POSITION
DC	0.2V	EXT use TRIGGERING LEVEL
AC	0.2V	EXT + & - use TRIGGERING LEVEL
AC LF REJ	0.2V	EXT + & - use TRIGGERING LEVEL
AUTO	0.2V	EXT + & -

#### h. Check TRIGGERING LEVEL range: at least + & - 10V

Remove the  $50\Omega$  cable connected to the TYPE 191 from the "T" connector. Remove the  $50\Omega$  Termination from the TYPE 533A TRIGGER INPUT and reconnect the cable. Connect the SAC OUTPUT to the "T" connector. Set the SAC to 10 VOLTS, +DC, MIXED. Set the TRIG-GERING MODE to DC, TRIGGER SLOPE to +EXT and adjust the STABILITY and TRIGGERING LEVEL for a stable display. Rotate the TRIGGERING LEVEL to the + extreme and check for enough range to lose triggering.

Change TRIGGER SLOPE to -EXT, SAC to -DC, rotate the TRIGGERING LEVEL to the - extreme and check for enough range to lose triggering.

- 13. (CONT)
  - i. Check line triggering: correct slope

Remove the SAC signal and connect a 10X probe from the "T" connector to the fuse holder. Set the TRIGGERING MODE to AC, TRIGGER SLOPE to +LINE and TIME/CM to 10mSEC. Adjust the STABILITY and TRIGGERING LEVEL for a stable display. Check for the correct phase in both + and - LINE. Remove the 10X probe from the fuse holder and "T" connector-

#### 14. HIGH FREQUENCY SYNC

a. Check external HF Sync: 1.5V at 5MHz and 30MHz <1mm jitter

Set the TRIGGERING MODE to HF SYNC, TRIGGER SLOPE to +EXT and TIME/CM to .1 $\mu SEC.$ 

Connect the  $50\Omega$  cable from the TYPE 191 to the "T" connector. Remove the  $50\Omega$  cable from the TYPE 533ATRIGGER INPUT, connect a  $50\Omega$ Termination to the cable and connect the termination to the TYPE 1A1 INPUT 1. Set the TYPE 191 for 1.5 volts of 50kHz signal. Remove the  $50\Omega$  cable and  $50\Omega$  Termination from the TYPE 1A1 and connect it to the TYPE 533ATRIGGER INPUT. Change the TYPE 191 frequency to 5MHz and adjust the TYPE 533A STABILITY for a stable display, lmm or less jitter.

Set the TYPE 191 frequency to 30MHz and set the TYPE 533A HORIZONTAL DIS-PLAY to SWEEP MAGNIFIED X5. Adjust the STABILITY for a stable display, 1mm or less display jitter.

b. Check internal HF SYNC: 1.5cm at 5MHz and 30MHz <1mm jitter

Remove the  $50\Omega$  cable and  $50\Omega$  Termination from the "T" connector and TRIGGER INPUT. Increase the signal amplitude to 1.5cm. Set the TRIGGER SLOPE to +INT. Adjust the STABILITY control for a stable display, 1mm or less of jitter.

Change the TYPE 533A HORIZONTAL DIS-PLAY to NORMAL (X1) and the TYPE 191 frequency to 5MHz. Adjust the TYPE 191 AMPLITUDE controls for 1.5cm of display. Adjust the TYPE 533A STABILITY for a stable display, 1mm or less of jitter.

Remove the cable and "T" connector from the 1M1.

# 15. HORIZONTAL AMPLIFIER

a. Adjust X10 Cal

Set the TYPE 533A TRIGGERING MODE to AC and the TRIGGER SLOPE to +EXT. Set the TIME/CM to 1mSEC. Set the TYPE 184 TRIGGER SELECTOR to 1mS and connect the TRIGGER OUTPUT to the TYPE 533A TRIGGER INPUT. Connect  $10\mu$ S, .1mS and 1mS marks from the TYPE 184 to the 1M1 EXT INPUT. Adjust the TYPE 533A TRIGGERING LEVEL and STABILITY controls for a stable display.

Turn the HORIZONTAL DISPLAY switch to X10 and adjust the 10 Ca1, R342 (located on C337 shield) for one  $100\mu$ S mark/cm.

b. Adjust X100 Cal

Set the HORIZONTAL DISPLAY switch to X100 and adjust the X100 Cal, R356 for one  $10\mu S$  mark/cm.

## c. Check Horiz jitter: <0.5mm

Check the jitter at the end of the sweep. Must be 0.5mm or less.

.d. Adjust X1 Cal

Set the HORIZONTAL DISPLAY switch to NORMAL (X1) and adjust the X1 Cal, R368, for one lmS mark/cm. Recheck the X10, X100 and X1 for interaction.

## e. Adjust Sweep Length

Set the HORIZONTAL DISPLAY switch to NORMAL (X1), and adjust the Sweep Length, R176, for 10.5cm.

## f. Adjust Swp/Mag Regis

Set the HORIZONTAL DISPLAY switch to X100. Use the TYPE 533A HORIZONTAL POSITION control to bring the start of the sweep to the graticule center line. Change the HORIZONTAL DISPLAY switch to NORMAL (X1) and return the start of the sweep to the center with the Swp/Mag Regis, R359.

#### g. Adjust DC Shift

Set the HORIZONTAL DISPLAY switch to X100. Use the HORIZONTAL POSITION control to position the start of the sweep to graticule center. Set the SINGLE SWEEP switch to SINGLE SWEEP. Wait a few seconds, then return SINGLE SWEEP switch to NORMAL SWEEP and adjust the DC Shift, R365, to eliminate trace drift.

Set the HORIZONTAL POSITION control to midr, and use the VERNIER control to align time marks with the graticule lines. Use the following table to check out magnified accuracy:

HORI ZONTAL

DISPLAY	1	time marks/cm	max error
X100	1	10µS mark/cm	±3.2mm
X50	2	10µS mark/cm	±3.2mm
X20	1	.1mS mark/2cm	±3.2mm
X10	1	.1mS mark/cm	±3.2mm
X5	2	.1mS mark/cm	±3.2mm
X2	1	1mS mark/2cm	±3.2mm

i. Check VARIABLE TIME/CM: ratio >2.5:1

Set the TYPE 184 for 1mS time marks only. Set the TYPE 533A HORIZONTAL DISPLAY switch to NORMAL (X1). Slowly rotate the VARIABLE TIME/CM ccw. Check that the UNCALIBRATED neon is lit when the VARIABLE is out of the CALIBRATED position. Check for 5 time marks or more/2cm at the ccw end of rotation. Return the VARIABLE TIME/CM to CALIBRATED.

# 16. SLOW SPEED TIMING

Check slow speed timing ±2%; except 1, 2 & 5SEC ±2.5%

Using the following table check slow sweep rate accuracy:

TYPE 533A	TYPE 184	time	max
TIME/CM	time marks	marks/cm	error
.1mSEC	.1mS	1	1.6mm
.2mSEC	.lmS	2	1.6mm
.5mSEC	.5mS	1	1.6mm
1mSEC	1mS	1	1.6mm
2mSEC	1mS	2	1.6mm

h. Check SWEEP MAGNIFIED accuracy: ±4%

Change the TYPE 184 TRIGGER SELECTOR to .1 S.

NOTES

TYPE 53	33A	TYPE	184	time	max
TIME/(	CM	time n	narks	marks/cm	error
5mSEC		5m8	5	1	1.6mm
10mSEC		10mS	3	1	1.6mm
20mSEC		10m5	5	2	1.6mm
50mSEC		50mS	3	1	1.6mm
.1 SEC		.1 9	5	1	1.6mm
.2 SEC		.1 5	5	2	1.6mm
Change 1 S.	the	TYPE 18	34 TRIG	GER SELECI	OR to
.5 SEC		.5 5	5	1	1.6mm
1 SEC		1 5	5	1	2mm
2 SEC		1 5	5	2	2mm
Change +INT.	the	TYPE 53	3A TRIO	GGER SLOPE	to
5 SEC		5 5		1	2.mm

## 17. HORIZONTAL POSITIONING AND AMPLIFIER TIME CONSTANT

a. Check POSITION control: + & - 5cm

Set the TYPE 184 time marks to 1mS. Set the TYPE 533A TIME/CM to 1mSEC. Rotate the HORIZONTAL POSITION control and VERNEIR cw. Check that the start of the trace is to the right of the graticule center line. Set the HORIZONTAL POSITION control and VERNIER ccw, and check that the number 10 time mark is to the left of the graticule center line.

# b. Adjust Horizontal Amplifier input time constant: <4cm shift

Set the TYPE 184 for  $10\mu$ S time marks. Change the TYPE 533A TIME/CM to .1mSEC. Adjust the TRIGGERING LEVEL for a stable display. Set the HORIZONTAL DISPLAY switch to X100. Use the HORIZONTAL POSITION control to move the start of the trace to the graticule center line. Change the TIME/CM to  $50\mu$ SEC and adjust C337 to return the start of the trace to graticule center.

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#### 18. FAST SWEEP TIMING

a. Adjust  $10\mu S$  timing

Set the TYPE 184 TRIGGER SELECTOR to  $10\mu$ S and set the TYPE 533A TRIGGER SLOPE to +EXT. Set the TYPE 533A TIME/CM to 10 SEC and the HORIZONTAL DISPLAY to NORMAL (X1).

# b. Adjust 1µS timing

Change the TYPE 184 to  $1\mu$ S time marks. Set the TYPE 533A TIME/CM to  $1\mu$ SEC, and adjust C160C for 1 mark/cm.

c. Adjust .5µS timing

Change the TYPE 533A TIME/CM to .5 $\mu$ SEC, and adjust C160A for 1 mark/2cm.

d. Adjust .1µS timing

Change the TYPE 184 to .1 $\mu$ S. Set the TYPE 533A TIME/CM to .1 $\mu$ SEC, and adjust C361A for 1 mark/cm.

e. Adjust 20nS timing: accuracy ±4%; linearity ±1%

Remove the coax cable from the 1M1EXT INPUT. Connect a BNC to clip lead adapter to the cable. Connect a 47pFcapacitor to the red lead. Connect the other end of the 47pF capacitor to one of the vertical CRT leads. Change the TYPE 184 to 20nSv.

Set the TYPE 533A TIME/CM to  $2\mu$ SEC and the HORIZONTAL DISPLAY to X100. Set C387 and C388 to 1/4 inch out. Locate the portion of sweep being adjusted by turning HORIZONTAL DISPLAY to NORMAL X1 and postioning the trace as indicated below. Change HORIZONTAL DISPLAY to X100 and adjust timing as follows:

position of trace unmagnified	portion of sweep ad	justment	adjust for
start of trace at 0 graticule line	center 10cm	C394	best linearity
start at number 4 graticule line	20th 10cm	C378	best timing
end of trace at number 6 grati- cule line	80th 10cm	C382	best timing
start of trace at O graticule line	center 10cm	C387 & C388	best timing

e. Time mark and graticule line identification.

533A

Check and readjust C394, C378, C382, C387 and C388 using the preceding table until the sweep accuracy is  $\pm 4\%$  or less over the center 800cm of sweep.

f. Adjust fast sweep magnified timing: accuracy ±4%

Check or adjust all magnified fast sweep rates using the following table:

TYPE 533A	HORIZONTAL	TYPE		adjust or
TIME/CM	DISPLAY	184	adjust	check for
10µSEC	X100	20nS	<u></u>	5 cycles/cm
				±3.2mm
5µSEC	X100	20nS		5 cycles/cm
				±3.2mm
$2\mu SEC$	X100	20nS		1 cycle/cm
				±3.2mm
$1 \mu \text{SEC}$	X50	20nS		1 cycle/cm
				±3.2mm
.5µSEC	X20	20nS	C361J	5 cycles/cm
				±3.2mm
.2µSEC	X10	20nS	C361G	l cycle/cm
				±3.2mm
.1µSEC	X5	20nS	C361E	l cycle/cm
				±3.2mm
.1µSEC	X2	20nS	C361C	5 cycles/cm
				±3.2mm

Remove the TYPE 184 signal from the CRT vertical deflection plate. Reconnect the TYPE 184 signal to the 1M1. Set the TYPE 184 for .1µS. Set the HORIZONTAL DISPLAY to NORMAL X1. Recheck for 1 cycle/cm ±2%. Continue checking magnified sweep rates using the following table:

TYPE 533A	HORI ZONTAL	TYPE	
TIME/CM	DISPLAY	184	check for
.2µSEC	X2	.1µS	1 mark/cm ±3.2mm
.5µSEC	X2	$.1 \mu S$	5 marks/2cm ±3.2mm
.5µSEC	X5	.lµS	1 mark/cm ±3.2mm
$1 \mu \text{SEC}$	X5	$.1 \mu S$	2 marks/cm ±3.2mm
$1 \mu \text{SEC}$	X10	$.1 \mu S$	1 mark/cm ±3.2mm
$2\mu SEC$	X10	$.1 \mu S$	2 marks/cm ±3.2mm
2µSEC	X20	$.1 \mu S$	1 mark/cm ±3.2mm
5µSEC	X20	.lµS	5 marks/2cm ±3.2mm
5µSEC	X50	.lµS	1 mark/cm ±3.2mm
$10 \mu SEC$	X50	.lµS	2 marks/cm ±3.2mm
$10 \mu SEC$	X100	.lµS	1 mark/cm ±3.2mm

# f. OUT OF TOLERANCE MAGNIFIED SWEEP

Readjust C160A, C160C and C160E as required to bring in magnified sweep accuracy. Unmagnified sweep must remain within tolerance. g. Check fast sweep unmagnified timing: accuracy ±2%

Set the TYPE 533A HORIZONTAL DISPLAY to NORMAL and TIME/CM to  $50\mu$ SEC. Set the TYPE 184 TRIGGER SELECTOR to .1mS and time marks to  $50\mu$ S. Using the following table, check all sweep rates to .1 $\mu$ SEC.

TYPE **533**A TYPE **184** 

TIME/CM	time marks	check for	max error
50µSEC		1 mark/cm	1.6mm
20µSEC	10µS	2 marks/cm	1.6mm
$10\mu SEC$	10µS	1 mark/cm	1.6mm
5µSEC	5μS	1 mark/cm	1.6mm
2µSEC	1μS	2 marks/cm	1.6mm
$1 \mu \text{SEC}$	1μS	l mark/cm	1.6mm
.5µSEC	.5μS	1 mark/cm	1.6mm
.2µSEC	.1µS	2 marks/cm	1.6mm
.lµSEC	.1µS	1 mark/cm	1.6mm

h. Check MAGNIFIER ON and UNCALIBRATED lights: ON, lit when sweep is magnified; UNCALIBRATED, lit when sweep is faster than 20ns/cm

Change the TYPE 533A HORIZONTAL DISPLAY switch to X2 and check the operation of the MAGNIFIER UNCALIBRATED and ON lights as follows:

	HORIZONTAL	MAGNIFIER		
TIME/CM	DISPLAY	ON	-	UNCALIBRATED
.1µSEC	X2	on		off
.1µSEC	X5	on		off
.1 $\mu$ SEC	X10	on		on
.2µSEC	X10	on		off
.2µSEC	X20	on		on
.5µSEC	X20	on		off
.5µSEC	X50	on		on
$1 \mu \text{SEC}$	X50	on		off
$1 \mu SEC$	X100	on		on
$2\mu SEC$	X100	on		off
$2\mu SEC$	EXT	òff		off
$2\mu SEC$	NORMAL (X1)	off		off

#### 19. SINGLE SWEEP

a. Adjust Lockout Level Adj: +11V from free run ±10%

Set the TYPE 533A TIME/CM to .5mSEC. Remove all connections from the 1M1 and TYPE 533A. Set TRIGGER SLOPE to +INT. Connect the multimeter from V125 pin 2 to gnd. Set the STABILITY control to the point just before the sweep runs, and note the meter reading.

Set the TYPE 533A SINGLE SWEEP switch to SINGLE SWEEP. Set the TYPE 533A STABILITY control cw. Adjust the Lockout Level Adj, R125, for a reading 11 volts less negative then the original reading. Remove the meter leads.

b. Check SINGLE SWEEP and READY light: single sweep on triggering signal; READY light lit when sweep is armed

Set the SINGLE SWEEP switch to NORMAL, and return the STABILITY control to the point where the sweep just starts. Set the SINGLE SWEEP switch to SINGLE SWEEP and rotate the STABILITY control cw. Check that the READY light and sweep do not come on. Set the SINGLE SWEEP switch to NORMAL SWEEP. Connect a coax cable from the TYPE 533A CAL OUT to the 1M1 EXT INPUT. Set the TYPE 533A AMPLITUDE CALIBRATOR to .5 VOLTS. Using the STABILITY, TRIGGERING LEVEL and 1M1 VARIABLE controls, obtain a stable display of 2mm amplitude. Set the SINGLE SWEEP switch to SINGLE SWEEP and check that the display extinguishes. Push the SINGLE SWEEP switch to RESET. observe the READY light lights and a sweep is generated.

Remove the coax cable from the 1M1 EXT INPUT. Push the SINGLE SWEEP switch to RESET and check that the READY light is lit. Reconnect the coax cable to the 1M1 EXT INPUT and check that a sweep is generated and the READY light extinguishes. Return SINGLE SWEEP switch to NORMAL SWEEP.

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NOTES

#### CALIBRATION

#### 20. INTENSITY MODULATION <20V

Remove the coax cable from the 1M1 EXT INPUT. Remove the strap between the EXTERNAL CRT CATHODE and GND, on the TYPE 533A rear panel. Check that the CRT CATHODE SELECTOR switch is in EXTERNAL CRT CATHODE. Connect a 20 volt signal from the SAC to the EXTERNAL CRT CATHODE binding post. Set the STABILITY control cw. Set the TYPE 533A TIME/CM switch to 1mSEC and check the trace for intensity modulation; a series of bright dots or dashes. Remove the signal from the binding post and reinstall the strap and change the CRT CATHODE SELECTOR to DUAL TRACE CHOPPED BLANKING.

#### 21. FRONT PANEL WAVEFORMS

a. Setup

Connect the TYPE 533A CAL OUT to the 1M1 EXT INPUT with a coax cable. Set the AMPLITUDE CALIBRATOR for 2 VOLTS. Adjust the 1M1 VARIABLE for 2cm of vertical display. Set the test scope TYPE 1A1 INPUT SELECTOR to DC. Set the test scope TRIGGERING MODE to DC and TRIGGER SLOPE to -INT.

b. Check VERT SIG OUT: >3 volts

Connect X10 probe from test scope and check for >3 volts.

c. Check SAWTOOTH OUT: >130 volts

Connect X10 probe from test scope and check for >130V.

d. Check +GATEOUT >20V

Connect X10 Probe from test scope and check for >20V.

#### 22. HOLDOFF

With the test scope X10 probe connected to the + GATE OUT jack measure holdoff using the following table:

TYPE 533A	test scope	
TIME/CM	TIME/CM	holdoff
.1, .2 and		
.5µSEC	$2\mu SEC$	4-9µs
1, 2 and		
5µSEC	$10 \mu \text{SEC}$	15-40µs
10, 20 and		
50µSEC	$10 \mu \text{SEC}$	15-40µs
.1, .2 and		
.5mSEC	.lmSEC	1 <b>50-4</b> 00μs
1, 2 and		
5mSEC	lmSEC	1.5-4ms
10, 20 and		
50mSEC	10mSEC	15-40ms
.1, .2, .5,		
1, 2 and 5 SEC	.1 SEC	150-400ms

Remove the X10 probe.

# 23. EXTERNAL HORIZONTAL AMPLIFIER

#### a. Adjust Ext Horiz Amp DC Bal

Set the TYPE 533A TIME/CM switch to 2mSEC. Install a BNC to binding post adapter on the 1M1 EXT INPUT. Connect a patch cord from the SAWTOOTH OUT binding post to the 1M1 EXT INPUT. Set the HORIZONTAL DISPLAY switch to EXT. Set the EXTERNAL HORIZONTAL VOLTS/CM to .1. Use the HORIZONTAL POSITION control to keep the display on the graticule. Rotate the EXTERNAL HORIZONTAL VARIABLE back and forth while adjusting the Ext Horiz Amp DC Bal, R334, for no trace shift. Set the EXTERNAL HORIZONTAL VARIABLE to CALIBRATED.

## b. Adjust gain: range at least ±10% accuracy ±2%

Install a BNC "T" connector on the TRIGGER INPUT connector. Install a BNC to binding post adapter on one side of the "T" connector. Connect a patch cord from the EXT HORIZ IN to the BNC to binding post adapter. Connect the output coax cable from the SAC to the other side of the "T" connector. Set the TRIGGER SLOPE to +EXT and the SAC to .5 VOLTS. Position the display to the center of the graticule with the HORIZONTAL POSITION control. Check the cw extreme of R361M for 5.5cm or more of display amplitude and ccw for 4.5cm or less. Adjust R361M for 5cm amplitude.

Set the EXTERNAL HORIZONTAL VOLTS/CM to 1 and the SAC to 5 VOLTS. Check for 5cm ±1mm. Set the EXTERNAL HORI-ZONTAL VOLTS/CM to 10 and the SAC to 50 volts and check for 5cm ±1mm.

## c. Check EXTERNAL HORIZONTAL VARIABLE VOLTS/CM: ratio >10:1

Rotate the VARIABLE ccw set the EXTERNAL HORIZONTAL VOLTS/CM to 1 and check for 5cm or less of horizontal amplitude. Return the VARIABLE to CALIBRATED.

# d. Compensate attenuator: ±2% of .1 volts/cm

Set the SAC to .5 VOLTS and set the EXTERNAL HORIZONTAL VOLTS/CM to .1. Set the TYPE 533A TIME/CM to 5mSEC. Adjust the TRIGGERING LEVEL and STABILITY for a stable display. Check the amount of rolloff or overshoot. Change the EXTERNAL HORIZONTAL VOLTS/CM to 1 and the SAC to 5 VOLTS. Adjust C310 to match the waveform at .1 volts/cm.

Set the SAC to 50 VOLTS and the EXTERNAL HORIZONTAL VOLTS/CM to 10. Adjust C313 to match the waveform at .1 volt/cm.

#### e. Check bandwidth: <u>>500kHz</u> at <u>-</u>3dB

Remove the patch cords and adapters from the TRIGGER INPUT and EXTERNAL HORIZ IN. Set the EXTERNAL HORIZONTAL VOLTS/CM switch to .1. Set the STABILITY control cw. Connect the TYPE 191 to the EXTERNAL HORIZ IN with a 50 $\Omega$  cable, a 50 $\Omega$  Termination and a BNC to clip lead adapter. Set the TYPE 191 FREQUENCY RANGE to 50kHz and adjust the AMPLITUDE and AMPLITUDE RANGE controls for 6cm of display. Change the TYPE 191 frequency to .5MHz and check for 4.2cm or more remaining. Remove the TYPE 191, 50 $\Omega$  cable, 50 $\Omega$ Termination and adapter from the TYPE 533A and set the HORIZONTAL DISPLAY switch to NORMAL (X1). Remove the patch cord and adapter from the 1M1 EXT INPUT and SAWTOOTH OUT.

## 24. HIGH FREQUENCY RESPONSE

a. Setup

Set the TYPE 533A TIME/CM to .1 SEC, TRIGGER SLOPE to INT -. Set the 1M1 TEST FUNCTION switch to + PULSE. Adjust the TYPE 533A STABILITY and TRIGGERING LEVEL for a stable display.

b. Preset delay line

Preset the vertical amplifier and delay line as follows:

L506 and L523 slugs just below the windings L553 and L563 bottom slugs just into the windings and top slugs 1/8 inch from top of coil form C553 and C563 midr delay line trimmers C903 thru C940 1/4 inch out L955 and L956 1/4 of the slug into the windings

- 24. (CONT)
  - c. Adjust delay line termination: <1% aberration

Adjust the TYPE 533A VARIABLE TIME/CM for approx 1 cycle/10cm. Adjust 1M1 AMPLITUDE and VERTICAL POSITION con-trols for 3cm, centered.

Adjust L553, L563 (both top and bottom slugs) C553 and C563 to eliminate the termination aberration. Keep the slugs in L563 even with the slugs in L553.

d. Adjust delay line: <1% aberration and deviation from level

Adjust the delay line trimmer capacitors a little at a time (1/2 turn or so) keeping them even. After each time trimmers have been adjusted, change the TYPE 533A TIME/CM switch to  $2\mu$ SEC and check the slant of the top of the pulses. This is the deviation from level, 1% (0.5mm) max. If the top is not level repeat steps 25c. and d.

e. Adjust transient response: <1% overshoot or rolloff

Return the TYPE 533A TIME/CM switch to  $.1\mu$ SEC and adjust L955 and L956 for the best front corner, 1% (0.5mm) or less overshoot or rolloff. If the range of L955 and L956 is not adequate L506 and L523 may need to be adjusted. Keep the coil slugs in L955 and L956, and L506 and L523 equal. Recheck the termination and delay line trimmers for 1% or less aberration and 1% or less deviation from level.

NOTES

## 25. VERTICAL AMPLIFIER BANDWIDTH

Check bandwidth: >15MHz at -3dB

Remove the 1M1 from the TYPE 533A and install a TYPE 1A2 PLUG-IN UNIT. Set the TYPE 1A2 MODE to CH 1, CHANNEL 1 INPUT SELECTOR to DC and VOLTS/CM to .05.

Connect the TYPE 191 to the TYPE 1A2 CHANNEL 1 INPUT with a  $50\Omega$  coax cable and  $50\Omega$  Termination. Set the TYPE 191 FREQUENCY RANGE to 50kHz. Adjust the TYPE 191 AMPLITUDE controls for 4cm of display amplitude with the TYPE 533A TIME/CM at 1mSEC and STABILITY cw.

Set the TYPE 191 FREQUENCY RANGE to 8-18 MEGAHERTZ and adjust the frequency dial for 2.8cm of deflection remaining (-3dB point). Check the reading of the TYPE 191 frequency dial for  $\geq 15$ MHz.

THE END

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