FACTORY CALIBRATION PROCEDURE

CONTENTS:

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

Equipment Required

Factory Test Limits - 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.

Main Procedure - 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).

This procedure is company confidential

556

Tek form number:
0-126
January 1968
For all serial numbers 2000 and

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.

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

1	TYPE 547 OSCILLOSCOPE
1	TYPE 1A1 DUAL TRACE PLUG-IN UNIT
*1	TYPE 184 TIME MARK GENERATOR
*1	TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
1	TYPE P6019 CURRENT PROBE
1	TYPE P6006 X10 PROBE
1	TYPE P6028 X1 PROBE
1	TYPE 77TU LINE VOLTAGE CONTROL UNIT

b. Test Fixture and Accessories

2	CALIBRATION FIXTURE (067-0521-00) (1M1)
2	50Ω BNC Terminations (011-0049-00)
1	BNC T connector (103-0030-00)
2	50Ω BNC cables (012-0057-00)
3	50Ω BNC cables (012-0076-00)
1	Patch cord (012-0031-00)
1	Passive Termination (011-0078-00)
1	DC Voltage Bridge (DCVB) (067-0543-99)
*1	STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
*1	50Ω Termination ±0.1% (067-0515-00)
1	Peak Line Voltage Comparator (067-0527-00)
*1	LF Sine Wave Generator (067-0542-99)

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.

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.

QUALIFICATION

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 (set-ups, 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.

4. POWER SUPPLIES

c. Power supply voltages

Supply	Max Error
-150V	±1%
+100V	±1%
+225V	+125V above +100V Supply ±0.2%, max

d. Ripple and regulation

Supply	Max Error	Max Ripple
-150V	±1%	5mV
+100V	±1%	5mV
+225V	+125V above 100V Supply ±0.2%, max	10mV
+350V	±2%	15mV
+10V	±0.75V	
+6V	+2V, -1V	

e. High Voltage: -1850
Error: ±1%, max
Regulation: ±1%, max

5. AMPLITUDE CALIBRATOR

a. Cal Ampl
Error: ±0.25%, max
b. Cal accuracy from 50 to .1 VOLTS
Error: ±1.25%, max
c. Cal risetime
1.5µs, max
d. Cal frequency
1kHz ±25%
e. Cal duty cycle
45% to 55%
f. Terminated voltage accuracy
Error: ±1.5%, max
5g. 5mA Current Loop
Waveform present

6. CRT

b. Horizontal deflection plate and graticule alignment
Tilt: ±3°, max
c. TRACE ROTATION
Range: 3°, min
d. Horizontal geometry
Deviation: 1mm, max
e. Vertical geometry
Deviation: 1mm, max in 6cm
f. Orthogonality
Deviation: ±1mm, max in 6cm
g. Horizontal focus
Resolution: 200 marks/10cm, no overlap in center 8cm
h. Vertical focus
Resolution: no overlap of 0.5mm signal
i. Scan area: ≥ graticule height

7. ALTERNATE TRACE LOGIC

b. Requirements: Trace alternates; No sweep wraparound

8. VERTICAL AMPLIFIERS

a. CRT electrical center
±0.5cm, max from graticule center
b. Transistor stage unbalance
0.5cm, max from CRT electrical center
c. DC Bal
Error: ±0.5cm, max
Range: + & - 2cm, min from graticule center
d. Gain
Error: ±2%, max
Range: + & - 5%, min
e. Crossover Gain
Error: ±2%, max
Range: + & - 5%, min
f. Compression and expansion
0.5mm, max
g. Gain change with line voltage change: ±1%, max

8h. Common mode rejection
30:1, min

i. Trace shift with line voltage change: ±2mm, max

9. DUAL TRACE AND CHOPPED OPERATION

a. Alternate waveform
Amplitude: 60V, min
Risetime: 1μs, max

b. Alternate operation:
All sweep rates

c. Dual Trace Chopped
Blanking: Chopping transients blanked

10. TRIGGERING

b. Trigger Level Centering, and Trigger Sensitivity
Stable triggering: + & - on 0.1V
No Stable triggering: + or - on 50mV

c. Trigger Level range, knob zero, and EXT triggering
Range: Normal, + & - 2V, min;
X10, + & - 20V, min
+ & - EXT Triggering: 200mV with LEVEL fixed; 100mV with LEVEL adjustable

d. Internal triggering
Stable trigger: 2mm at 10MHz

e. HF REJ triggering
No trigger on 1cm at 6MHz
Stable trigger on 2mm, 30Hz to 60kHz

f. LINE and LF REJ triggering
LF REJ: No trigger on 3cm at 30Hz; must trigger on 2mm at 2.5kHz

g. AUTO STABILITY
Trigger on 1cm, 20Hz
Free run with no signal

h. PLUG-IN INT triggering:
200mV, min

i. Crossover triggering
2mm at 10MHz

j. DC triggering:
Stable triggering within graticule area

11. SINGLE SWEEP

5mm of signal

13. TRACE SEPARATION

Range: Upper beam must overlap lower beam by 3mm, and separate from lower beam by 4.1cm

16. BASIC TIMING

a. UPPER BEAM X10 Cal
Error: ±2%, max

b. UPPER BEAM X1 Cal
Error: ±2%, max

c. UPPER BEAM Swp Mag Regis:
±2mm shift, max

d. A Sawtooth Amplitude
Sweep Length: 10.1 to 10.5cm

e. B Sawtooth slope
Error: ±2%, max

f. B Sawtooth Amplitude
10.1 to 10.5cm

g. LOWER BEAM X10 Cal
Error: ±2%, max

h. LOWER BEAM X1 Cal
Error: ±2%, max

i. LOWER BEAM Swp/Mag Regis:
±2mm shift, max

j. LOWER BEAM A Sweep Gain
Error: ±2%, max

k. A & B Sawtooth Current
Error: ±3%, max

17. DELAY PICKOFF

c. Incremental accuracy
Error: ±1.5 minor div, max

18. CONTRAST RANGE

Visible change

19. TIME BASE A TIMING

a. 10μSEC timing
Error: ±0.9%, max (DTM)
±2%, max (on screen)

19b. 1μSEC timing
ERROR: ±0.9%, max (DTM)
±2%, max (on screen)

c. 0.1 and 0.5μSEC timing
Error: ±0.9%, max (DTM)
±2%, max (on screen)

d. 0.2μSEC timing
Error: ±0.9%, max (DTM)
±2%, max (on screen)

e. A TIME/CM 2μSEC to 5 SEC
Error: ±0.9%, max (DTM)
±2%, max (on screen)

20. TIME BASE B TIMING

a. TIME BASE B timing
Error: ±2%, max

b. Sweep crossover compensation
Error: ±2%, max (±4%, max with X10 mag)

21. DELAY JITTER

2.5mm, max

22. VARIABLE TIME/CM

Range: 2.5:1, min

23. HORIZONTAL AMPLIFIER 50MHz COMPENSATION

b. Compensations:
Error: ±3%, max

c. X10 Mag Comp
Error: ±3% between 4th and 70th cm

24. TRIGGER DELAY

a. Trigger Delay:
100 to 200ns

25. EXTERNAL HORIZONTAL AMPLIFIERS

b. Ext Horiz DC Bal
Unbalance: 2cm, max

c. Compensations, deflection factor, and VAR 1-10
Aberrations: ±3%, max
Deflection factor: ≤0.1V/CM
VAR 1-10 ratio: ≥10:1

25d. X1 compensation
Aberrations: ±3%, max

e. Attenuation accuracy
Error: ±2%, max

f. Ext Horiz bandwidth
DC to 400kHz -3dB

h. Crossover external horizontal gain
Gain: at least 5cm in X10; at least 0.5cm in X1

26. EXT CRT CATHODE

Modulation with 10V or less

27. EXTERNAL WAVEFORMS

a. A & B SAWTOOTH
Amplitude: 94.5V, min

b. A & B GATE
Amplitude: 8V, min

c. DLY'D TRIG
Amplitude: 7V, min

28. HOLDOFF

TIME/CM	A and B Holdoff T1	T2
.1μSEC	≥2μs	≤25μs
.2μSEC	≥1.5μs	≤15μs
.5μSEC	≥1μs	≤12μs
1μSEC	≥1μs	≤10μs
2μSEC	≥1μs	≤10μs
5μSEC	≥1μs	≤10μs
10μSEC	≥5μs	≤25μs
20μSEC	≥5μs	≤25μs
50μSEC	≥5μs	≤25μs
.1mSEC	0.25ms to 0.4ms	
.2mSEC	0.25ms to 0.4ms	
.5mSEC	0.25ms to 0.4ms	
1mSEC	2.0ms to 5.0ms	
2mSEC	2.0ms to 5.0ms	
5mSEC	2.0ms to 5.0ms	
10mSEC	30.0ms to 45.0ms	
20mSEC	30.0ms to 45.0ms	
50mSEC	30.0ms to 45.0ms	
.1 SEC	0.25s to 0.5s	
.2 SEC	0.25s to 0.5s	
.5 SEC	0.25s to 0.5s	
1 SEC	1.0s to 3.0s	
2 SEC	1.0s to 3.0s	
5 SEC	1.0s to 3.0s	

29. VERTICAL AMPLIFIER

b. Transient response
Risetime: 6.25ns, max
Aberrations: ±1.25%, peak, max

c. + PULSE position effect
Aberration change: within 1%, peak, of centered display

d. - PULSE transient response
Aberrations: within 1.25%, peak, of + PULSE aberrations

e. - PULSE position effect
Aberration change: within 1%, peak, of centered display

30. HF TRIGGERING

Amplitude: 1.0cm
Jitter: 2ns, max

31. HORIZONTAL POSITION

a. Horizontal Position
Range: past graticule center in both directions

b. Horizontal Position vernier
Range: $\geq$2.5cm at center of display; $\geq$1cm at display ends

Factory TEST LIMITS are limits an instrument must meet 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, it is necessary to set up some circuits so their performance is better than required by Factory Test Limits. Therefore, the instructions given in the Factory Calibration Procedure may call for checks or adjustments which result in less error than that allowed by the Factory Test Limits.

1. PRELIMINARY INSPECTION

a. Make a general examination
b. Check fuses
c. Align and inspect CRT
d. Check DELAY TIME MULTIPLIER (DTM)

2. PRESET CONTROLS

a. Preset TYPE 556 controls
b. Install two 1M1's and preset controls

3. RESISTANCE

4. POWER SUPPLIES

a. Setup
b. Check 115VAC -230VAC line
c. Adjust power supply voltages

Supply	Adjust
-150V	R1498
+100V	R1459
+225V	R1439

d. Check ripple and regulation

Supply	Max Error	Max Ripple
-150V	±1%	5mV
+100V	±1%	5mV
+225V	+125V above +100V supply ±0.2%, max	10mV
+350V	±2%	15mV
+10V	0.75V	
+6V	+2V, -1V	

4e. Adjust -1850V and check regulation, R1382 (R1332); Regulation ±1%, max

5. AMPLITUDE CALIBRATOR

a. Adjust Cal Ampl, R1628
b. Check accuracy from 50 to .1 VOLTS Error: ±1.25%, max
c. Check risetime: 1.5µs, max
d. Check frequency: 1kHz ±25%
e. Check duty cycle: 45% to 55%
f. Check terminated voltage accuracy Error: ±1.5%, max
g. Check 5mA current loop: waveform present

6. CRT

a. Check visible defects
b. Check Horizontal Deflection Plate & Graticule alignment: ±3°, max
c. Check and adjust TRACE ROTATION Range: 3°, min
d. Check Horizontal Geometry Deviation: 1mm, max
e. Adjust Vertical Geometry, R1391, R1342; Deviation: 1mm, max in 6cm
f. Check Orthogonality Deviation: ±1mm in 6cm, max
g. Check horizontal focus Resolution: 200 marks/10cm
h. Check Vertical focus No overlap of 0.5mm signal
i. Check scan area ≥ graticule height

7. ALTERNATE TRACE LOGIC

a. Setup
b. Check alternate trace logic Reguirements: Trace alternates; No sweep wraparound

8. VERTICAL AMPLIFIERS

a. Find CRT electrical center ±0.5cm, max from graticule center
b. Check transistor stage unbalance 0.5cm, max from CRT electrical center

8c. Adjust DC Bal, R5 (R205)
Range: + & - 2cm, min, from graticule center

d. Adjust Gain, R12 (R212)
Range: + & - 5%, min

e. Adjust crossover gain, R34
Range: + & - 5%, min

f. Check compression and expansion: 0.5mm, max

g. Check Gain change with line voltage change: ±1%, max

h. Check common mode rejection: 30:1, min

i. Check trace shift with line voltage change: ±2mm, max

9. DUAL TRACE AND CHOPPED OPERATION

a. Check alternate waveform
Amplitude: 60V, min
Risetime: 1μs

b. Check alternate operations:
All sweep rates

c. Check dual-trace chopped blanking:
Chopping transients blanked

10. TRIGGERING

a. Setup

b. Adjust Trigger Level Centering, R545 (R745) and Trigger Sensitivity, R556 (R756)
Stable triggering: + & - on 0.1V
No stable triggering: + or - on 50mV

c. Check Trigger Level Range, Zero Knob, and EXT Triggering
Range: Normal, + & - 2V, min;
X10, + & - 20V, min
+ & - EXT Triggering: 200mV with LEVEL fixed; 100mV with LEVEL adjustable

d. Check internal triggering
Triggering: 2mm at 10MHz

e. Check HF REJ Triggering:
No trigger on 1cm signal at 6MHz or above. Must trigger on 2mm, 30Hz to 60kHz

f. Check LINE and LF REJ
LF REJ: must not trigger with 3cm 30Hz signal. Must trigger with 2mm 2.5kHz signal.

g. Check AUTO STABILITY
Trigger on 1cm, 20Hz signal
Free run with no signal

h. Check PLUG-IN INT
Must trigger on 200mV from plug-in

i. Check crossover triggering
Must trigger on 2mm of 10MHz

j. Check DC: stable triggering within graticule area

11. SINGLE SWEEP

Normal operation on 5mm of signal

12. BEAM FINDER

Check that traces remain on the CRT for all combinations of position controls

13. TRACE SEPARATION

Check trace separation range: Upper beam must overlap lower beam by 3mm, and separate from lower beam by 4.1cm

14. SCALE ILLUMINATION

15. UNCALIBRATED AND MAG INDICATORS

16. BASIC TIMING

a. Adjust UPPER BEAM X10 Cal, R1146

b. Adjust UPPER BEAM X1 Cal, R1167

c. Adjust UPPER BEAM Swp/Mag Regis, R1168

d. Adjust A Sawtooth Amplitude, R678

e. Adjust B Sawtooth Slope, R861

f. Adjust B Sawtooth Amplitude, R878

g. Adjust LOWER BEAM X10 Cal, R1246

h. Adjust LOWER BEAM X1 Cal, R1267

i. Adjust LOWER BEAM Swp/Mag Regis, R1268

j. Adjust LOWER BEAM A Swp Gain, R683

k. Adjust A & B Sawtooth Current, R884, R684

17. DELAY PICKOFF

a. Preset TYPE 556 controls
b. Set Delay Start and Stop
c. Check incremental accuracy
Error: ±1.5 minor div, max

18. CONTRAST RANGE

Check contrast range: visible change

19. TIME BASE A TIMING

a. Adjust 10μSEC timing, C660G
b. Adjust 1μSEC timing, C660H
c. Adjust .5 and .1μSEC timing, R660J, R681
d. Check .2μSEC timing
Error: ±0.8%, max
e. Check A TIME/CM 2μSEC to 5SEC
Error: ±0.8%, max

20. TIME BASE B TIMING

a. Adjust and check TIME BASE B, C860G, C860H, C860J, C881
Error: ±1%
b. Adjust A sweep crossover compensation, C683. Error: ±1%, max (±3%, max with X10 MAG)

21. DELAY JITTER

2.5mm, max

22. VARIABLE TIME/CM

Range: 2.5:1, min

23. HORIZONTAL AMPLIFIER 50MHz COMPENSATION

a. Setup
b. Adjust compensations
Error: ±3%, max
c. Adjust X10 mag comp, C1165 (C1265)
Error: ±3% between 4th and 70th cm

24. TRIGGER DELAY

a. Check trigger delay
Delay: 100 to 200ns
b. Check DLY'D BY A function displayed on upper beam

25. EXTERNAL HORIZONTAL AMPLIFIERS

a. Setup
b. Adjust Ext Horiz DC Bal, R110 (R1210)
c. Adjust Compensations, C1115 (1215), check deflection factor and VAR 1-10
Aberrations: ±3%, max
Deflection factor: $\leq$0.1v/cm
VAR 1-10 ratio: $\geq$10:1
d. Adjust X1 compensation, C1100B (C1200B); Aberrations: ±3%, max
e. Check attenuation
Error: ±2%, max
f. Check Ext Horiz bandwidth
DC to 400kHz at -3dB
g. Check Lower Beam EXT Horizontal
h. Check crossover external horiz ontal gain
Gain: at least 5cm in X10; at least 0.5cm in X1.

26. EXT CRT CATHODE

Modulation with 10V or less

27. EXTERNAL WAVEFORMS

a. Check A & B SAWTOOTH
Amplitude: 94.5V, min
b. Check A & B GATE
Amplitude: 8V, min
c. Check Dly'd Trig
Amplitude: 7V, min

28. HOLDOFF

TIME/CM	A and B Holdoff T1	T2
.1µSEC	>2µs	<25µs
.2µSEC	>1.5µs	<15µs
.5µSEC	>1µs	<12µs
1µSEC	>1µs	<10µs
2µSEC	>1µs	<10µs
5µSEC	>1µs	<10µs
10µSEC	>5µs	<25µs
20µSEC	>5µs	<25µs
50µSEC	>5µs	<25µs
.1mSEC	0.25ms to 0.4ms	
.2mSEC	0.25ms to 0.4ms	
.5mSEC	0.25ms to 0.4ms	
1mSEC	2.0ms to 5.0ms	
2mSEC	2.0ms to 5.0ms	
5mSEC	2.0ms to 5.0ms	
10mSEC	30.0ms to 45.0ms	
20mSEC	30.0ms to 45.0ms	
50mSEC	30.0ms to 45.0ms	
.1 SEC	0.25s to 0.5s	
.2 SEC	0.25s to 0.5s	
.5 SEC	0.25s to 0.5s	
1 SEC	1.0s to 3.0s	
2 SEC	1.0s to 3.0s	
5 SEC	1.0s to 3.0s	

29. VERTICAL AMPLIFIER

a. Setup
b. Adjust transient response
   Risetime: 6.25ns, max
   Aberrations: ±1.25%, peak, max
c. Adjust + PULSE position effect R69 (R259). Aberration change: within 1%, peak, of centered display
d. Check - PULSE transient response
   Aberrations: within 1.25%, peak, of + PULSE aberrations
e. Check - PULSE position effect
   Aberration change: within 1%, peak, of centered display

30. HF TRIGGERING

Amplitude: 1.0cm
Jitter: 2ns, max

31. HORIZONTAL POSITION

a. Check horizontal POSITION
   Traces must position past graticule center in both directions
b. Check horizontal POSITION vernier
   ≥2.5cm of range at center of display; ≥1cm of range at cw and ccw ends

1. PRELIMINARY INSPECTION

a. Make General Examination

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. Correct all defects found and install HV Shields (200-0644-00 and 200-0645-00).

b. Check Fuses

Line Voltage			
	F1401	10A	Slo-Blo
	F1402	5A	Slo-Blo
-150	F1482	.75A	
+100	F1478	1A	
+225	F1446	1.5A	
+350	F1424	.75A	

c. Align and inspect CRT

Align the CRT so the faceplate is even with the light guide. Orient the CRT Horizontal Graticule lines by placing a scribed external graticule over the CRT faceplate. Tighten CRT clamp and recheck alignment. Check CRT for scratches, cracks around neck pins and phosphor defects. Check tightness of CRT rear support bracket holding screws. Place shield or filter over CRT faceplate and light guide and replace graticule cover.

c. Do not reject a CRT without consulting a trained CRT Checker or referring to the CRT Check Out Procedure.

d. Check DELAY TIME MULTIPLIER (DTM)

Set DTM fully ccw and if necessary, position dial on shaft for a reading of 0.20. Check for a dial reading of 10.20 min at full cw setting.

2. PRESET CONTROLS

a. Preset TYPE 556 controls

POWER ON	OFF
DTM	1.0
AMPLITUDE CALIBRATOR	OFF
SCALE ILLUMINATION	0
TRACE SEPARATION	midr
TRACE ROTATION	midr

2.a (cont'd)

	UPPER BEAM	LOWER BEAM
TRIGGERING LEVEL	cw (push in)	cw (push in)
MODE	AUTO	AUTO
SLOPE	+	+
COUPLING	AC	AC
SOURCE	NORM INT,	NORM INT.
	LEFT	RIGHT
TIME/CM	1mSEC	1mSEC
VARIABLE TIME/CM	CALIBRATED	CALIBRATED
DISPLAY	LEFT PLUG-IN A	RIGHT PLUG-IN B
DISPLAY MAG	X1	X1
A AND B MODE	NORM	NORM
VAR 1-10	cw	cw
HORIZ POSITION	midr	midr
INTENSITY	0	0
FOCUS	0	0
ASTIGMATISM	0	0
CONTRAST	cw	cw
CRT CATHODE SELECTOR	EXT CRT	EXT CRT
(rear of scope)	CATHODE	CATHODE
all internal adjusts	midr	midr

b. Install two 1M1's and preset controls

TEST FUNCTION	LOW LOAD
VARIABLE	midr
AMPLITUDE	midr
VERTICAL POSITION	midr
REPETITION RATE	MED

3. RESISTANCE

Check power supply resistance from the fuses to ground as in the following table:

3. The power supply fuses are located on the bottom of the instrument to either side of the power supply board.

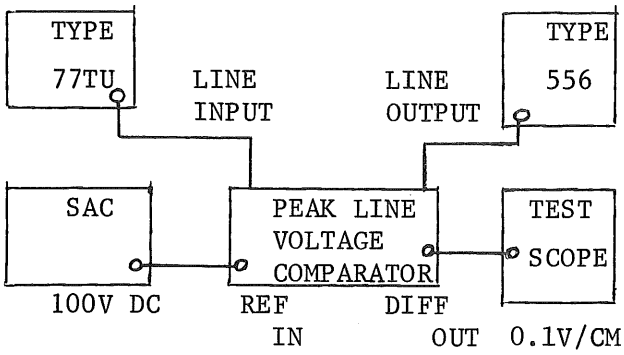
Power Supply	test point	Approximate Resistance Pos lead to Gnd	Neg lead to Gnd	meter scale
+100V	F1478	200Ω	200Ω	X100
-150V	F1482	750Ω	850Ω	X100
+225V	F1446	1100Ω	900Ω	X100
+350	F1424	3300Ω	1800Ω	X100

Set the power line selector to 115VAC and M.

4. POWER SUPPLIES

a. Setup

Make connections as in the following diagram:



Set the COMPARISON VOLTAGE switch to 110 and the COMPARISON VOLTAGE helidial to 5.0. Slowly increase the output of the TYPE 77TU until waveform peaks 2cm in amplitude are displayed on the test scope.

a. For first time turn-on reduce the line to 10 VAC and check heater supplies for approximately .5 VAC.

b. Check 115 VAC-230 VAC line

Measure and note the AC voltage between power supply board terminals H & I (approximately 145 VAC). Remove the TYPE 556 power cord and change Power line selector to 230VAC.

Reconnect the TYPE 556 power cord and check that AC voltage between power supply board terminals H & I is one half that previously measured. Return the Power line selector to 115 VAC line.

c. Adjust power supply voltages

Connect the DCVB to the output side of the fuses. Adjust each supply in turn for a null indication as in the following table:

Supply	Adjust	Max Error	Test Point
-150V	R1498	±1%	F1482
+100V	R1459	±1%	F1478
+225V	R1439	+125V above +100V supply ±0.2%, max	F1446

d. Check ripple and regulation

Use the DCVB and test scope to check power supply, ripple and regulation from 100 VAC to 130 VAC line high load, then at low load as in the following table:

4.d (cont'd)

Supply	Max Error	Max Ripple
-150V	±1%	5mV
+100V	±1%	5mV
+225V	+125V above +100V supply ±0.2%, max	10mV
+350V	±2%	15mV
+ 10V	±0.75V	----
+ 6V	+2V -1V	(See Notes)

Remove power and change the Power line selector to Lo. Check power supply ripple and regulation from 87VAC to 113VAC line at high load and at low load as before.

Remove power and change the Power line selector to Hi. Check power supply ripple and regulation from 108VAC to 140VAC line at high load and at low load as before. Remove Power and change the power line selector to M. Connect Power and set line to 115VAC.

e. Adjust -1850V and check regulation
error: ±1%, max
regulation: ±1%, max

Connect the DCVB to the UPPER BEAM HV Test Point and adjust High Voltage, R1382 for null indication.

Rotate INTENSITY control from full ccw to full cw and check HV test points for -1850 ±1% from 100VAC line to 130VAC line. Repeat step for LOWER BEAM adjusting R1332. Return line voltage to 115VAC.

d. Use the peak line voltage comparator to measure line voltage.

For high load set the 1M1 TEST FUNCTION to HIGH LOAD, TYPE 556 A & B TRIGGERING MODE switches to AUTO STABILITY, DISPLAY MAG switches to X10 and AMPLITUDE CALIBRATOR on.

For low load set the 1M1 TEST FUNCTION to LOW LOAD, TYPE 556 A & B TRIGGERING MODE switches to AUTO STABILITY, DISPLAY MAG switches to X1 and AMPLITUDE CALIBRATOR OFF.

+6V is typically 8.2V to 8.3V unless TRIGGERING COUPLING switches are in AC HF REJECT and/or RESET lights are on.

5. AMPLITUDE CALIBRATOR

a. Adjust Cal Ampl error: ±.25%, max

From TYPE 556 CAL OUT connect a cable to the UNKNOWN IN on SAC. Set SAC mode to +DC, MIXED and SAC AMPLITUDE to 100 VOLTS. Connect the SAC OUTPUT to the test scope vertical, AC coupled. Set TYPE 556 AMPLITUDE CALIBRATOR to 100 VOLTS (not DC) and place a clip lead from the -150 volt supply to V1605B, pin 8. Adjust R1628 for null deflection on test scope. Switch AMPLITUDE CALIBRATOR to 100 VDC and check for null on test scope.

a. The SAC chops between the SAC precision calibrator and the TYPE 556 calibrator. The test scope display is a square-wave with an amplitude equal to the difference between the two calibrators. With the test scope triggered in -LINE the first complete half cycle is the SAC, therefore the polarity of the next half cycle indicates the direction of the error in the TYPE 556 calibrator.

b. Check accuracy from 50 to .1 VOLTS error: ±1.25%, max

Note the TYPE 556 AMPLITUDE CALIBRATOR error at the following control settings:

AMPLITUDE CALIBRATOR & SAC VOLTS	TYPE 1A1 VOLTS/CM	max deflection
50	.5	1.25cm
20	.2	1.25cm
10	.1	1.25cm
5	.05	1.25cm
2	.02	1.25cm
1	.01	1.25cm
.5	.005	1.25cm
.2	.005	0.5cm
.1	.005	0.25cm

Add the % error found in the .1 volts SAC position to the largest % error in the same direction in previous positions. This total error must not exceed 1.25%.

Remove the clip lead and connect the AMPLITUDE CALIBRATOR CAL OUT to the test scope input using the 20" BNC cable (012-0076-00). Check the remaining switch positions for approx voltage amplitude.

c. Check risetime: 1.5µs, max

Check risetime from the 10% to 90% amplitude points of the leading edge. Check risetime from .1V through 100V positions of the AMPLITUDE CALIBRATOR switch.

d. Check frequency: 1kHz ±25%

Set test scope TIME/CM to .2mSEC and chec- for 2 cycle calibrator signal ±.5 cycle over the 10cm.

e. Check duty cycle: 45% to 55%

Set test scope TIME/CM to 50µSEC and adjust VARIABLE TIME/CM for one cycle of signal over 10cm. Check pulse duration at the 50% amplitude points: 4.5 to 5.5cm.

5. (Cont'd)

f. Check terminated voltage accuracy
Error: ±1.5%, max

Set SAC AMPLITUDE to .1 VOLTS and MODE to⌐_. Connect SAC OUTPUT to test scope vertical input. Set test scope vertical deflection factor to .02 VOLTS/CM and adjust the VARIABLE VOLTS/CM for exactly 5cm deflection. Remove SAC connections.

Set TYPE 556 AMPLITUDE CALIBRATOR to .2 VOLTS, terminate the CAL OUT in 50 ±0.1% and connect to test scope vertical input. Check for 5cm ±1.5% waveform on the test scope.

g. Check 5mA current loop: waveform present

Connect TYPE 556 5mA -- P6019 probe -- Passive Termination -- TYPE 1A1 input. Set the passive termination slide switch to 2mA/mV and the TYPE 1A1 VOLTS/CM to .05. Check that a waveform is present in the 5mA position of the AMPLITUDE CALIBRATOR switch and not in other positions.

g. The accuracy of the 5mA current waveform is determined by the resistor string that was checked previously with the SAC.

6. CRT

a. Check visible defects

Check CRT for double peaking, grid emission, flare, interface, charging and burrs. (See CRT Check Out Procedure for test methods).

a. Do not reject CRT without the authorization of a trained CRT checker or reference to the CRT Check Out Procedure.

b. Check Horizontal Deflection Plate & Graticule alignment: ±3°, max

Set A and B TRIGGERING MODE to AUTO, connect voltmeter across terminals of trace rotator coil L1390 and adjust TRACE ROTATION for zero voltage.

Position the start of the traces to the left edge and to the center horizontal graticule line. Note where the traces intersect the 10th graticule line: ±0.5cm from graticule vertical center. Remove the meter.

The TYPE 556 has two overlapping 6cm scan areas. The bottom edge of the UPPER BEAM graticule is 1cm below the LOWER BEAM graticule center. The top of the LOWER BEAM graticule is 1cm above UPPER BEAM graticule center.

Adjustments listed are for upper beam. Lower beam adjustments are in parenthesis.

6. (Cont'd)

c. Check and adjust TRACE ROTATION
range: 3°, min

Turn TRACE ROTATION fully cw and ccw. Note the point the traces intersect the 10th graticule line at the controls extremes, + and -0.5cm from previously noted trace position with 0V across L1390.

Adjust TRACE ROTATION so the traces are aligned within 0.33mm of their respective horizontal graticule centers. Maximum beam deviation from each other 0.5mm.

d. Check Horizontal Geometry
deviation: 1mm, max

Position the traces to the top and bottom of their respective graticules and check for horizontal deviation: ≤1mm.

d. If the difficulty is encountered triggering the display, attach a 50Ω BNC cable from the TYPE 184 TRIGGER OUTPUT to TYPE 556 TRIGGER INPUT.

e. Adjust Vertical Geometry
deviation: 1mm, max in 6cm

Set A and B TIME/CM to .5mSEC. Adjust sawtooth amplitude R678 (R878) for approx 10.5cm sweep length. Connect TYPE 184 MARKER AMPLIFIER OUTPUT to both 1M1 EXT INPUTS. Press 1MS MARKER SELECTOR and set MARKER AMPLIFIER to -. Set TRIGGERING SLOPE to - and trigger the sweep. Adjust VARIABLE TIME/CM for 1 mark/cm. Adjust the 1M1 VARIABLE for full screen deflection. Adjust the TRACE ROTATION to align the center marker with the center graticule line.

Adjust Edge Geom, R1391 and Center Geom, R1342 for minimum bowing.

Remove the markers and recheck TRACE ROTATION setting.

6. (Cont'd)

f. Check Orthogonality
deviation: ±1mm
6cm, max

Press .1ms and 1ms MARKER SELECTOR button. Position the top of the display 1cm below the upper beam graticule center and check that the baseline is parallel with the horizontal graticule line. (Adjust TRACE ROTATION as necessary) Align the 1ms time marks with the vertical graticule lines at the bottom of the upper beam graticule. Check that the time marks are not displaced from the graticule lines more than 1mm at a point 6cm above the bottom of the upper beam graticule.

Position the bottom of the display 1cm below the lower beam graticule center and check that the baseline is parallel with the horizontal graticule line. (Adjust TRACE ROTATION as necessary). Align the 1ms time marks with the vertical graticule lines at the bottom of the lower beam graticule. Check that the time marks are not displaced from the graticule lines more than 1mm at a point 6cm above the baseline.

g. Check horizontal focus
Resolution: 200 marks/10cm

Use A and B VARIABLE TIME/CM to display 20 1ms marks/10cm and note that all .1ms markers in the center 8cm have no overlap. Remove markers.

h. Check vertical focus:
No overlap of 0.5mm signal

Connect CAL OUT to 1M1 EXT INPUT, set TIME/CM to 5μSEC, set AMPLITUDE CALIBRATOR to 2V, and adjust 1M1 VARIABLE for 1cm deflection.

Set AMPLITUDE CALIBRATOR to 0.1V, and adjust FOCUS, ASTIGMATISM and INTENSITY for well-defined trace at graticule center. Position the traces vertically over full 6cm of their respective graticule areas and check that both traces have no overlap. Remove calibrator signal.

6. (Cont'd)

i. Check scan area:
≥graticule height

Set TYPE 184 to 10ns and connect to both 1M1 EXT INPUTS. Increase intensity settings to flood the screen and note that the vertical scan area is slightly greater than the graticule height. Check for phosphor defects. Remove TYPE 184 signal.

7. ALTERNATE TRACE LOGIC

a. Setup

UPPER BEAM DISPLAY
A TRIGGERING SOURCE
A TIME/CM

LOWER BEAM DISPLAY	RIGHT PLUG-IN B
B TRIGGERING SOURCE	RIGHT
B TIME/CM	1mSEC

b. Check alternate trace logic
Requirements: Trace alternates
No sweep wraparound

Use TRACE SEPARATION to space the traces 2 or 3cm apart. Apply TYPE 184 1μs markers to the lower beam 1M1. Vary B TIME/CM and check that the upper beam sweep runs once for each lower beam sweep.

Change:
UPPER BEAM DISPLAY to RIGHT PLUG-IN B
LOWER BEAM DISPLAY to RIGHT PLUG-IN A

Check that the lower beam sweep runs once for each upper beam sweep.

Change:

A TIME/CM to	1mSEC
B TIME/CM to	.1mSEC
UPPER BEAM DISPLAY to	RIGHT
B MODE to	DLY'D BY A

Adjust the CONTRAST controls to display brightened segments on both traces. Rotate B TIME/CM to 50mSEC, Check that the brightened segment does not wrap around to the start of the sweep.

7b. (Cont'd)

Change the LOWER BEAM DISPLAY to RIGHT PLUG-IN B. Again check that the intensified segment does not wrap around to the start of the sweep. Change the LOWER BEAM DISPLAY to RIGHT PLUG-IN A and the UPPER BEAM DISPLAY to RIGHT PLUG-IN B. Again check for no sweep wraparound.

8. VERTICAL AMPLIFIERS

a. Find CRT electrical center ±0.5cm, max from graticule center

Use a short jumper to connect the upper beam CRT vertical deflection plate leads together and note the trace vertical position relative to upper beam graticule center.

Remove the connection from the upper beam CRT vertical deflection plate leads. Short the lower beam CRT vertical deflection plate leads together and note the trace position relative to lower beam graticule center. Remove the short.

b. Check transistor stage unbalance: 0.5cm, max from CRT electrical center

b. CAUTION: Care must be taken to avoid grounding any transistor stage

Short the bases of Q43 and Q143 (Q233 and Q433) together and note the vertical trace position. Remove the short. Short the bases of Q3 and Q103 (Q203 and Q403) together and note the trace vertical position. Remove the short.

c. Adjust DC Bal
error: ±0.5cm, max
range: + & -2cm, min from graticule center

Set 1M1's to COMMON MODE. Set Vert DC Bal, R5 (R205) full cw, then full ccw. Check range. Adjust R5 (R205 to set trace at graticule center.

8. (Cont'd)

d. Adjust Gain
range: + & - 5%, min

Connect the SAC OUTPUT to left 1M1 EXT INPUT. Set SAC to 100 VOLTS and both 1M1's to GAIN SET. Adjust R12 (R212) through its entire range and check for a deflection change of $\leq$3.8cm to $\geq$4.2cm. Center display and set Vert Gain for exactly 4cm. Repeat for right plug-in.

d, e. Use the same 1M1 to adjust gain of both vertical amplifiers.

e. Adjust crossover gain
error: ±1%, max; range: + & -5%, max

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A. Adjust R34 through its entire range and check for 3.8 to 4.2cm of range. Adjust for 4cm. Set UPPER BEAM DISPLAY to LEFT PLUG-IN A.

f. Check compression and expansion: 0.5mm, max

Set SAC to 50V and position display to upper and lower limits of their respective graticules. Check UPPER BEAM and LOWER BEAM displays for no more than 0.5mm compression and/ or expansion.

g. Check Gain change with line voltage change: ±1%, max

Vary line voltage source from 100 to 130 VAC and check UPPER BEAM and LOWER BEAM displays for no more than ±1% gain change.

h. Check common mode rejection: 30:1, min

Set both 1M1's to COMMON MODE, SAC AMPLITUDE to 1 VOLT and note deflection of UPPER BEAM and LOWER BEAM displays: 3mm, max. Remove SAC signal.

i. Check trace shift with line voltage change: ±2mm, max

Remove input signal and vary line voltage source from 100 to 150VAC. Check UPPER BEAM and LOWER BEAM for no more than 2mm trace shift.

9. DUAL TRACE AND CHOPPED OPERATION

a. Check alternate waveform
amplitude: 60V, min
risetime: 1μs, max

Connect 10X probe from test scope to pin 1 of V1043 and check waveform amplitude and risetime of negative excursion at all sweep rates. Change 10X probe to pin 1 of V1063 and repeat Step 9a.

Also check with UPPER BEAM DISPLAY in PLUG-IN B, RIGHT PLUB-IN A & B and LOWER BEAM DISPLAY in RIGHT PLUG-IN A. Return UPPER BEAM DISPLAY to PLUG-IN A and LOWER BEAM DISPLAY to RIGHT PLUG-IN B.

b. Check alternate operations:
all sweep rates

Connect SAC to both 1M1 INPUTS. Set the SAC to 10V. Set both 1M1's to ALTERNATE, check upper beam and lower beam displays for alternate trace operation from 1mSEC to 0.1μSEC positions of A and B TIME/CM switches. SAC signal will be displayed on one trace only. Set UPPER BEAM display to LEFT PLUG-IN B and check alternate trace operation from 1mSEC to .1μSECof B TIME/CM.

Check alternate trace operation with UPPER BEAM DISPLAY set to RIGHT PLUG-IN A and to RIGHT PLUG-IN B.

Also check with LOWER BEAM DISPLAY in RIGHT PLUG-IN A.

9. (cont'd)

c. Check dual-trace chopped blanking

Change both 1M1 TEST FUNCTIONS to CHOPPED. Set UPPER BEAM DISPLAY to LEFT PLUG-IN A. Adjust a TIME/CM and TRIGGERING LEVEL for a stable display of several cycles of chopped waveform. Change UPPER BEAM CRT CATHODE SELECTOR (scope rear) to CHOPPED BLANKING and check that fast chopping transients (vertical lines) disappear. Repeat check of chopped waveform using LOWER BEAM CRT CATHODE SELECTOR switch and B sweep.

Repeat for UPPER BEAM with DISPLAY in LEFT PLUG-IN B; RIGHT PLUG-IN A; RIGHT PLUG-IN B; using appropriate time base and trigger level controls. Switch both CRT CATHODE SELECTOR switches to EXTERNAL CRT CATHODE and set the 1M1's to LOW LOAD.

Repeat with LOWER BEAM DISPLAY in RIGHT PLUG-IN A.

10. TRIGGERING

a. Setup

Set AMPLITUDE CALIBRATOR to .1 VOLTS and connect CAL OUT -- 50Ω cable -- BNC T connector at left (right) 1M1 EXT INPUT 50Ω cable -- TYPE 556 A (B) TRIGGER INPUT. Set the UPPER BEAM DISPLAY to LEFT PLUG-IN A and the LOWER BEAM DISPLAY to B. Set B TRIGGERING to TRIG, +, AC, EXT and RIGHT. Set A TRIGGERING to TRIG, +, AC, EXT and LEFT. Use a clip lead to ground point Y on the A (B) sweep trigger switch board.

Set the test scope TYPE 1A1 CHANNEL 1 INPUT SELECTOR to AC, VOLTS/CM to .01 and MODE to CH1. Connect a X10 probe from the rear lead of R555 (R755) to TYPE 1A1 INPUT 1.

a. R555 (R755) is a 43.2k precision resistor located at the top rear of the trigger circuit board.

On all trigger steps, stable triggering indicates triggering on proper polarity, as indicated by the slope switches.

10.

b. Adjust Trigger Level Centering, R545 (R745) and Trigger Sensitivity, R556 (R756) stable triggering: + & - on 0.1V no stable triggering: + or - on 50mV

Turn the Trigger Sensitivity ccw, then slowly cw until the display on the test scope increases in amplitude. Adjust the Triggering Level Centering for equal amplitude displays on the test scope as A TRIGGERING SLOPE (B TRIGGERING SLOPE) is changed from + to -. Reduce the SAC AMPLITUDE to 50mVOLTS. Adjust the Trigger Sensitivity for no stable trigger in either + or - positions of the SLOPE switch.

c. Check Trigger Level Range, Zero Knob, and Check EXT Triggering Range: Normal +&-2V, min; X10 +&-20V, min +&-EXT Triggering: 200mV with LEVEL fixed; 100mV with LEVEL adjustable

Remove clip lead and connect the X10 probe, DC coupled, to pin A of Trigger switch Circuit board. Rotate the A(B) TRIGGERING LEVEL from stop to stop and note voltage excursion on test scope: + & -2 volts min. Repeat with TRIGGERING LEVEL knob pulled out and note voltage excursion: + & -20 volts min. Remove probe and push TRIGGERING LEVEL knob in. Adjust control for stable SAC display on TYPE 556 and without disturbing setting, zero the knob on the shaft. Set A(B) SOURCE to EXT. TYPE 556 must trigger on 100mV with an adjustment of TRIGGERING LEVEL. TYPE 556 must trigger on 200mV, + & - SLOPE with one setting of TRIGGERING LEVEL. Remove SAC signal and set A(B) SOURCE to NORM INT.

d. Check internal triggering Triggering: 2mm at 10MHz

Connect a TYPE 191 to both 1M1 EXT INPUT's. Adjust the TYPE 191 for a 2mm display of 10MHz signal. Check for stable triggering in the AC and LF REJECT positions of the A(B) COUPLING switches.

10. (Cont'd)

e. Check HF REJ Triggering: must not trigger on 1cm signal at 6MHz or above. Must trigger on 2mm, 30Hz to 60kHz.

Switch A(B) COUPLING to HF REJ and from the LF Sine Wave Generator apply 2mm of 60kHz to left (right) 1M1 EXT INPUT. Check for stable triggering. Change generator frequency to 30Hz and again check for stable triggering.

Remove the LF Sine Wave Generator connections and connect the TYPE 191 to left (right) 1M1 EXT INPUT. Apply 1cm of 6 MHz signal and check for no triggering.

f. Check LINE and LF REJ
LF REJ: must not trigger with 3cm 30Hz signal. Must trigger with 2mm 2.5kHz signal.

Set A(B) SOURCE to LINE and connect 10X probe from the left (right) 1M1 to line voltage source. Check for correct line trigger polarity with + and - TRIGGERING SLOPE settings. Set SOURCE to INT and check for triggered display, adjusting LEVEL if necessary. Switch COUPLING to LF REJ.

Connect 3cm of 30Hz signal from the LF Sine Wave Generator to the left (right) 1M1 and check that display will not trigger. Change the LF Sine Wave Generator to supply 2mm of 2.5kHz and check for stable triggering.

g. Check AUTO STABILITY
Trigger on 1cm, 20Hz signal
Free run with no signal

Change the COUPLING switches to AC and MODE switches to AUTO STABILITY. Adjust the LF Sine Wave Generator controls for 1cm of 20Hz signal display. Set the TYPE 556 A TIME/CM (B TIME/CM) to 20mSEC. The TYPE 556 must trigger with an adjustment of TRIGGERING LEVEL controls. Check that the traces free run as the TRIGGERING LEVEL controls are rotated beyond the triggered area in either direction.

10. (Cont'd)

h. Check PLUG-IN INT

Set A(B) SOURCE to PLUG-IN INT and apply 5 volts SAC signal to the left (right) 1M1. Connect the test scope X10 probe to the junction of R526 and R528 (R726-R728) and adjust the 1M1 VARIABLE's for 200mV test scope display. Check for stable triggering with adjustment of TRIGGERING LEVEL.

h. The R526-R528 (R726-R728) junction is at the bottom end of the 100k resistor .005μF capacitor combination on the trigger switch board.

Also, move A SOURCE switch to RIGHT, B SOURCE switch to LEFT, and check for stable triggering.

i. Check crossover triggering

From the TYPE 191 apply 2mm of 10MHz signal to the 1M1's. Set A and B TIME/CM to 0.1μ SEC, A & B TRIGGERING MODE to TRIG, and A & B SOURCE to NORM. Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A and A SOURCE to RIGHT. Check for stable A triggering. Switch B SOURCE to LEFT and check for stable triggering.

Return UPPER BEAM DISPLAY switch to LEFT PLUG-IN A, A SOURCE to LEFT and B SOURCE to RIGHT.

j. Check DC: stable triggering within graticule area.

Change A and B COUPLING to DC. Set the TYPE 191 for a 3.5mm display at the center line of the respective graticules. Adjust the LEVEL knob to 0. Check for stable A and B triggering within the graticule area by changing the VERTICAL POSITION control until stable triggering is obtained.

11. SINGLE SWEEP

Apply 5mm of SAC signal to both 1M1's and adjust TRIGGERING LEVEL's for a stable display. Set A and B MODE switches to SINGLE SWEEP and remove SAC signal. Push both RESETS and note both lights are on. Reapply SAC signal and note that both sweeps run once and lights extinguish.

Return A and B MODE switches to NORM and TRIGGERING MODE switches to AUTO STABILITY.

12. BEAM FINDER

Push BEAM FINDER and check that traces will remain on CRT as the POSITION controls are rotated through their range.

13. TRACE SEPARATION

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A and LOWER BEAM DISPLAY to B. Change both 1M1 TEST FUNCTION switches to COMMON MODE. Check range of TRACE SEPARATION control as viewed on CRT; upper beam trace must overlap lower beam trace by 3mm, min and must separate from lower beam by 4.1cm, min.

14. SCALE ILLUMINATION

Rotate SCALE ILLUM and check that lights are brightest at the cw position and extinguished at the ccw extreme. Illumination should change smoothly as control is rotated.

15. UNCALIBRATED AND MAG INDICATORS

Check that UNCAL Indicators are lit at any position of the VARIABLE TIME/CM controls except full cw (detent). Check that the X10 indicators are on at the X10 DISPLAY MAG positions.

16. BASIC TIMING

a. Adjust UPPER BEAM X10 Cal
Error: ±1%, max

Presets:

	UPPER BEAM	LOWER BEAM
DISPLAY	LEFT PLUG-IN A	B
TIME/CM	1mSEC	1mSEC
DISPLAY MAG	X10	X10

16a. (Cont'd)

Apply TYPE 184 1mS and .1mS markers to both 1M1 INPUTS. Adjust A and B TRIGGERING LEVEL for a stable display and adjust X10 Cal, R1146 for one .1mS marker/cm.

b. Adjust UPPER BEAM X1 Cal
Error: ±1%, max

Set UPPER BEAM DISPLAY MAG to X1 and adjust X1 cal, R1167 for one 1mS marker/cm.

c. Adjust UPPER BEAM Swp/Mag Regis:
±2mm shift, max

Switch UPPER BEAM DISPLAY MAG to X10 and position start of trace to the graticule center line. Switch UPPER BEAM DISPLAY MAG to X1 and adjust R1168 to again place start of trace at graticule center. Repeat as necessary.

d. Adjust A Sawtooth Amplitude:
Sweep length 10.1 to 10.5cm

Apply TYPE 184 1mS and .5mS markers to both 1M1 INPUTS. Adjust R678 for 10.5cm sweep length. Return UPPER BEAM DISPLAY MAG to X10.

e. Adjust B Sawtooth Slope Adjust

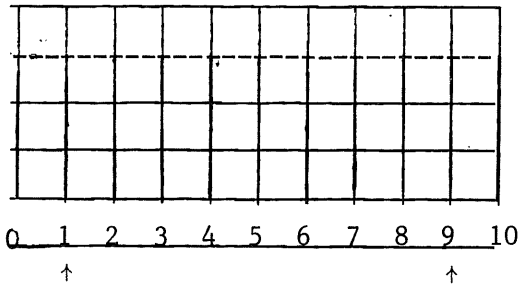
Set UPPER BEAM DISPLAY to LEFT PLUG-IN B and apply TYPE 184 1mS and .1mS markers. Adjust R861 for one .1mS marker/cm on the upper beam display. Change UPPER BEAM DISPLAY MAG to X1 and UPPER BEAM DISPLAY to LEFT PLUG-IN A.

f. Adjust B Sawtooth Amplitude:
Sweep length 10.1 to 10.5cm

Observe the end of A sweep. Change UPPER BEAM DISPLAY from A to B (Mag X10). Adjust R878 to match B sweep length to A sweep length.

a. While making timing adjustments place top of markers to graticule horizontal center line to compensate for geometry deviations.

Unless noted otherwise, use the middle 8 horizontal centimeters when making horizontal amplifier gain and timing checks or adjustments.



16. (Cont'd)

g. Adjust LOWER BEAM X10 Cal
Error: ±1%, max

Observe lower beam. Adjust R1246 for one .1mS marker/cm.

h. Adjust LOWER BEAM X1 Cal
Error: ±1%, max

Switch LOWER BEAM DISPLAY MAG to X1. Adjust R1267 for one 1mS marker/cm.

i. Adjust LOWER BEAM Swp/Mag Regis:
±2mm shift, max

Switch LOWER BEAM DISPLAY MAG to X10 and position start of trace to graticule center line. Switch LOWER BEAM DISPLAY MAG to X1 and adjust R1268 to again place start of trace to graticule center. Repeat adjustment as necessary to compensate for interaction.

j. Adjust Lower Beam A Swp Gain.
R683 Error: ±1%, max

Apply 1ms and .1ms markers.
Set the UPPER BEAM DISPLAY switch to LEFT PLUG-IN A, A TIME/CM to 1mSEC, LOWER BEAM DISPLAY to A and lower beam DISPLAY MAG to X10. Adjust R683 for one .1ms marker per cm on the lower beam display.

k. Adjust A & B Sawtooth Current
Error: ±3%, max

Connect a 2 VOLT SAC signal through a compensated X10 probe to test scope TYPE 1A1 INPUT 1. Set TYPE 1A1 VOLTS/CM to .05 and adjust VARIABLE VOLTS/CM for exactly 4cm of deflection. Move the X10 probe tip to the junction of R884 and R885. Adjust R884 for a 4cm sawtooth display on the test scope. Repeat for A Sawtooth at the junction of R684 and R685, adjusting R684.

k. R884-R885 are directly in front of and slightly below the B sweep X10 Cal pot. R684 and R685 are similarly situated in the A sweep chassis.

17. DELAY PICKOFF

a. Preset TYPE 556 controls

	UPPER BEAM
DISPLAY	RIGHT PLUG-IN A
TRIGGERING	TRIG, +, AC, NORM INT, RIGHT (not triggered)
A MODE	NORM
A TIME/CM	1mSEC

	B LOWER BEAM
DISPLAY	
TRIGGERING	AUTO, +, AC, NORM INT, RIGHT (free run)
B MODE	DLY'D BY A
B TIME/CM	10μSEC

Apply 1mS markers from TYPE 184 to the 1M1 on the right.

b. Set Delay Start and Stop

Set DTM to 1.00 adjust R918 to place intensified zone on the 1st cm marker (second time mark) and to place the rising portion of the delayed sweep marker to the start of the delayed sweep trace. Set DTM to 9.00 and adjust R914 to place intensified zone on the 9th cm marker and to place the rising portion of the delayed sweep marker to the start of the trace. Repeat adjustments until the rising portion of the sweep markers are at the start of the sweep with the DTM at 1.00 and 9.00.

c. Check incremental accuracy
Error: ±1.5 minor div, max

Set DTM to place rising portion of each marker between 1.00 and 9.00 at the start of the trace, note dial error: 1.5 minor div, max.

18. CONTRAST RANGE visible change

Set A TIME/CM to 1mSEC, A TRIGGERING MODE to AUTO STABILITY, A TRIGGERING LEVEL fully cw, and A & B CONTRAST controls cw. Set B TIME/CM to .5mSEC, B TRIGGERING MODE to AUTO STABILITY, B TRIGGERING LEVEL fully cw, and switch B MODE to DLY'D BY A. Set the DTM to 5.00. Turn UPPER BEAM INTENSITY cw until the first 5cm of trace start to appear. Turn the CONTRAST control through-out its range and check that the intensity of the first 5cm of the upper beam changes.

Also set LOWER BEAM DISPLAY to A and check lower beam CONTRAST controls as above.

Return LOWER BEAM DISPLAY to B.

19. TIME BASE A TIMING

a. Adjust 10μSEC timing Error: ±0.8%, max ≤(6.4 minor div)

Apply TYPE 184 10μS markers. Set A TIME/CM to 10μSEC, B TIME/CM to 1μSEC and set DTM so the delayed sweep starts at the top of the second marker. Note the dial reading difference from 1.00. Change the DTM to 9.00 plus or minus the noted difference and adjust C660G so the top of the tenth marker is at the start of the sweep. Recheck adjustment and repeat as needed.

b. Adjust 1μSEC timing Error: ±0.8%, max ≤(6.4 minor div)

Set TYPE 184 to 1μS, set A TIME/CM to 1μSEC, B TIME/CM to .1μSEC and adjust C660H for 8.00 differnece between second and tenth markers. Recheck and readjust if necessary.

19. (Cont'd)

c. Adjust .1 and .5μSEC timing
Error: ±0.8%, max

Externally trigger the A sweep with 10μS triggering from the TYPE 184. Set A TIME/CM to .5μSEC and apply 1μS markers. Adjust C660J for one marker/2cm on the upper beam display. Disregard first marker. Set B DISPLAY MAG to X10. Set A TIME/CM to .1μSEC, TYPE 184 to .1μS and adjust C681 for cycle/cm. C681 and C660J interact, repeat adjustments as necessary. Set DTM to 1.00 and note position of marker on delayed sweep. Set DTM to 9.00 and adjust C660J to place marker as noted at 1.00. Check incremental accuracy of all markers between first and ninth, error: ≤6.4 minor div of DTM.

c. To achieve higher resolution place the time mark on the delayed sweep at a horizontal and vertical graticule intercept point.

d. Check .2μSEC timing
Error: ±0.8%, max

Set A TIME/CM to .2μSEC and DTM to 1.00. Apply .1μS markers from TYPE 184 and note position of marker on the delayed sweep.

Rotate DTM cw and count 16 markers. Place 16th marker to position noted at 1.00. Dial should read 9.00 ±6.4 minor div.

e. Check A TIME/CM 2μSEC to 5 SEC
Error: 0.8%, max

Set A TIME/CM to 2μSEC, SOURCE to NORM INT, DISPLAY MAG to X1 and set TYPE 184 to 1μS markers. Adjust DTM so the 1st cm marker is intensified and the delayed sweep starts on the top point of the delayed sweep marker. Note the dial reading difference from 1.00. Change the DTM to about 9.00 so as to intensify the 9th cm marker and to place the top point of the delayed sweep marker at the sweep start. Note the difference from reading at 1.00: ≤6.4 minor div. Check the remaining A TIME/CM positions similarly using the following table:

19e. (Cont'd)

A TIME/CM	B TIME/CM	TYPE 184	MARKS/CM	MAX ERROR On Screen	MAX ERROR DTM
2µSEC	1µSEC	1µS	2	±1%	±0.8% (6.4 div)
5µSEC	1µSEC	5µS	1	±1%	±0.8% (6.4 div)
10µSEC*	1µSEC	10µS	1	±1%	±0.8% (6.4 div)
20µSEC	1µSEC	10µS	2	±1%	±0.8% (6.4 div)
50µSEC	1µSEC	50µS	1	±1%	±0.8% (6.4 div)
.1mSEC	10µSEC	.1mS	1	±1%	±0.8% (6.4 div)
.2mSEC	10µSEC	.1mS	2	±1%	±0.8% (6.4 div)
.5mSEC	10µSEC	.5mS	1	±1%	±0.8% (6.4 div)
1mSEC	.1mSEC	1mS	1	±1%	±0.8% (6.4 div)
2mSEC	.1mSEC	1mS	2	±1%	±0.8% (6.4 div)
5mSEC	.1mSEC	5mS	1	±1%	±0.8% (6.4 div)

* Adjusted previously.

10mSEC	1mSEC	10mS	1	±1%	±0.8% (6.4 div)
20mSEC	1mSEC	10mS	2	±1%	±0.8% (6.4 div)
50mSEC	1mSEC	50mS	1	±1%	±0.8% (6.4 div)
.1 SEC	10mSEC	.1 S	1	±1%	±0.8% (6.4 div)
.2 SEC	10mSEC	.1 S	2	±1%	±0.8% (6.4 div)
.5 SEC	10mSEC	.5 S	1	±1%	±0.8% (6.4 div)
1 SEC	.1 SEC	1 S	1	±1%	±0.8% (6.4 div)
2 SEC	.1 SEC	1 S	2	±1%	±0.8% (6.4 div)
5 SEC	.1 SEC	1 S	5	±1%	±0.8% (6.4 div)

Set B MODE to NORMAL and set A TIME/CM to 1mSEC.

20. TIME BASE B TIMING

a. Adjust and check TIME BASE B Error: ±1%, max

a. Check for interaction and readjust fast speeds as necassary.

Adjust and check time base B accuracy following the table below:

B TIME/CM	TYPE 184	Check or adjust	Marks/ cm, ±1%
10µSEC	10µS	C860G	1
20µSEC	10µS	check	2
50µSEC	50µS	check	1
1µSEC	1µS	C860H	1
2µSEC	1µS	check	2
5µSEC	5µS	check	1
.5µSEC	.5µS	C860J	1
.1µSEC	.1µS	C881	1
.2µSEC	.1µS	check	2

20a. (Cont'd)

Set B TIME/CM to .1μSEC. Set UPPER BEAM DISPLAY to LEFT PLUG-IN B, B TRIGGERING SOURCE to LEFT. Apply .1μS markers to left 1M1 and adjust C882 for 1 mark/cm. Move TYPE 184 signal back to right 1M1 and B TRIGGERING SOURCE to RIGHT.

.1mSEC	.1mS	check	1
.2mSEC	.1mS	check	2
.5mSEC	.5mS	check	1
1mSEC	1mS	check	1
2mSEC	1mS	check	2
5mSEC	5mS	check	1
10mSEC	10mS	check	1
20mSEC	10mS	check	2
50mSEC	50mS	check	1
.1 SEC	.1 S	check	1
.2 SEC	.1 S	check	2
.5 SEC	.5 S	check	1
1 SEC	1 S	check	1
2 SEC	1 S	check	2
5 SEC	5 S	check	1

b. Adjust A sweep crossover compensation, C683 Error: ±1%, max (±3%, max with X10 MAG)

Set the UPPER BEAM DISPLAY switch to RIGHT PLUG-IN A, LOWER BEAM DISPLAY switch to A, A TRIGGERING SOURCE to RIGHT, A TIME/CM to .1μSEC and lower beam DISPLAY MAG to X1. Apply .1μS markers from the TYPE 184 to the right 1M1. Adjust C683 for one marker/cm. Change the lower beam DISPLAY MAG to X10 and TYPE 184 to 20ns. Check for 1Hz/cm display ±2.4mm in 8cm.

Check all ranges of A sweep on lower beam display. Recheck after lower beam 50MHz horizontal compensation.

21. DELAY JITTER: 2.5mm, max

Set DTM to observe the 9th cm marker on the delayed sweep at each of the following settings and check for 2.5mm or less of jitter on markers leading edge:

A TIME/CM	B TIME/CM	TYPE 184
5mSEC	5μSEC	5mS
2	2	1
1	1	1
.5	.5	.5
.2	.2	.1
.1	.1	.1

22. VARIABLE TIME/CM range: 2.5:1, min

Set both TIME/CM switches to 1mSEC and set TYPE 184 to supply 10ms markers to both verticals. Set B VARIABLE TIME/CM full ccw and note distance between markers: 4cm max. Repeat with UPPER BEAM DISPLAY set to LEFT PLUG-IN A and check A VARIABLE TIME/CM. Note that UNCAL neons are lit in any position of VARIABLE but CALIBRATED (detent). Return both VARIABLES to CALIBRATED.

23. HORIZONTAL AMPLIFIER 50 MHz COMPENSATION

a. Setup

Connect TYPE 184 MARKER OUTPUT -- 50Ω cable -- 50Ω termination -- BNC T connector at one 1M1 EXT INPUT -- 50Ω cable -- other 1M1 EXT INPUT. Connect TYPE 184 TRIGGER OUTPUT -- 50Ω cable -- 50Ω termination -- BNC T at one TYPE 556 TRIGGER INPUT -- 50Ω cable -- other TYPE 556 TRIGGER INPUT. Set TYPE 184 MARKER SELECTOR to 10nS∿ and TRIGGER SELECTOR to 1μS. Set TYPE 556 A & B TIME/CM switches to .1μSEC and A & B TRIGGERING SOURCE switches to EXT.

23. (Cont'd)

b. Adjust compensations Error: ±3%, max

Position start of sweep to left graticule edge and set DISPLAY MAG to X10. Use an insulated tool to adjust C1172 and C1182 (C1272 and C1282) for maximum expansion of the sweep and adjust C1193 (C1293) for max sweep expansion and best linearity (to be reset later). Adjust C1174 and C1184 (C1274 and C1284) for best timing at sweep center. If the sweep seems to long with C1174 and C1184 (C1274 and C1284) at this setting, adjust C1172 (1272) to reduce displayed gain.

b. If more signal amplitude is needed, apply the signal to one input at a time.

c. Adjust X10 mag comp Error: ±3% between 4th and 70th cm

Position start of sweep to graticule left edge and adjust TRIGGERING LEVEL so a sinewave peak falls at the 4th graticule line. Position trace so this peak falls at the first centimeter line and adjust C1165 (C1265) for 1 cycle/2cm. Readjust C1193 (C1293) for best linearity and recheck center of sweep. Readjust C1172 (C1272) for correct timing.

Check timing error throughout 65cm range: ±3%. If nonlinearity is noted in the 20cm range, recheck C1192 (C1293) and C1172 (C1272). Recheck timing throughout 65cm range.

24. TRIGGER DELAY

a. Check trigger delay 100 to 200ns

Apply 1µS markers to lower beam vertical and preset TYPE 556 as follows:

	UPPER BEAM	LOWER BEAM
DISPLAY	RIGHT PLUG-IN A	B
DISPLAY MAG	X1	X1
A MODE	NORM	
B MODE	DLY'D BY A	
DTM	10.00	
A & B TIME/CM	.1µSEC	
A TRIGGERING	TRIG, +, AC, NORM, INT, RIGHT	
B TRIGGERING	AUTO, +, AC, NORM, INT, RIGHT	

24a. (Cont'd)

Position traces to start at same point and adjust DTM to superimpose B marker on that of A. Note dial reading difference to be 100-200ns. Each minor dial division equals 1ns. Change the UPPER BEAM DISPLAY to RIGHT PLUG-IN B and LOWER BEAM DISPLAY to RIGHT PLUG-IN A. Recheck that sweeps start at same point. Check trigger delay for 100 to 200ns.

b. Check DLY'D BY A function displayed on upper beam

Apply TYPE 184 1ms markers to right 1M1. Set TYPE 556 controls as follows:

UPPER BEAM DISPLAY	RIGHT PLUG-IN B
LOWER BEAM DISPLAY	RIGHT PLUG-IN A
B TIME/CM	10μSEC

Turn the DTM dial both directions. The intensified segment of the lower beam should move as the DTM dial is rotated. Rotate the lower beam CONTRAST control and check that the intensified portion of the trace remains constant while the intensity of the remainder of the trace varies with the control setting.

25. EXTERNAL HORIZONTAL AMPLIFIERS

a. Setup

A SAWTOOTH -- 50Ω cable -- 1M1 EXT INPUT (Left).

SAC output -- BNC T to UPPER BEAM EXT HORIZ IN and A TRIGGER INPUT.

Preset controls:

UPPER BEAM DISPLAY	LEFT PLUG-IN EXT
DISPLAY MAG	X10
A TIME/CM	1mSEC
A TRIGGERING	AUTO, +, AC, EXT
SAC	.5 VOLTS

25. (Cont'd)

b. Adjust Ext Horiz DC Bal
Unbalance: 2cm, max

position the left edge of the display to graticule center and adjust R1110(R1210) for no baseline shift as VAR 1-10 is rotated through its range. Set VAR 1-10 full cw.

c. Adjust Compensations, check deflection factor and VAR 1-10
deflection factor: ≤.1V/cm
aberrations: ±3%, max
VAR 1-10 ratio: ≥10:1

Note horizontal deflection: 5cm, min. Adjust C1115(1215) for best front corner and flat top. Check aberrations. Rotate VAR 1-10 full ccw and note deflection. Must be less than 1/10 of previous deflection. Return VAR 1-10 full cw. Set SAC to .5 volts and DISPLAY MAG to X1.

d. Adjust X1 compensation
Aberrations: ±3%, max

Adjust C1100B (C1200B) for best front corner and flat top. Check aberration.

e. Check attenuation accuracy
Error: ±2%, max

Note deflection at X1, switch DISPLAY MAG to X10 and SAC AMPLITUDE to .5 VOLTS. Check deflection to be within 2% of that observed previously. Remove SAC signal.

f. Check Ext Horiz Bandwidth:
DC to 400kHz at -3dB

Set the LF Sine Wave Generator to supply 20kHz and apply to UPPER BEAM EXT HORIZ IN. Use LF Sine Wave Generator Amplitude control to obtain 4cm of horizontal deflection and change generator frequency to 400kHz. Note 2.8cm horizontal deflection minimum.

g. Check Lower Beam EXT Horizontal

Repeat steps a through f for LOWER BEAM using adjustments listed in parenthesis.

25. (CONT'D)

h. Check crossover external horizontal gain

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN EXT. Move SAC output from LOWER BEAM EXT HORIZ IN to UPPER BEAM EXT HORIZ IN. With UPPER BEAM DISPLAY MAG in X10, display gain should be 5cm, min; with UPPER BEAM DISPLAY MAG in X1, display gain should be 0.5cm, min.

26. EXT CRT CATHODE

Remove BNC grounding caps from EXT CRT CATHODE. Set A TIME/CM to 1mSEC and connect 10V calibrator signal to EXT CRT CATHODE. Note that the display is intensity modulated at normal intensity with CRT CATHODE SELECTOR set to EXT CRT CATHODE.

Remove calibrator signal and replace BNC grounding cap. Repeat check for lower beam.

27. EXTERNAL WAVEFORMS

a. Check A & B Sawtooth
Amplitude: 94.5 volts, min

Connect test scope X10 probe to A SAWTOOTH and check waveform amplitude. Repeat for B SAWTOOTH.

b. Check A & B GATE
Amplitude: 8 volts, min

Connect probe to A GATE and measure waveform amplitude. Repeat for B GATE.

c. Check Dly'd Trig
Amplitude: 7 volts, min

Connect probe to DLY'D TRIG and measure waveform amplitude at all sweep speeds.

28. HOLDOFF

Connect test scope X10 probe to junction of D681-D675 (D881-D875) and check holdoff as follows:

TIME/CM	A and B holdoff T1	T2
.1μSEC	>2μs	<25μs
.2μSEC	>1.5μs	<15μs
.5μSEC	>1μs	<12μs
1μSEC	>1μs	<10μs
2μSEC	>1μs	<10μs
5μSEC	>1μs	<10μs
10μSEC	>5μs	<25μs
20μSEC	>5μs	<25μs
50μSEC	>5μs	<25μs
.1mSEC		0.25ms to 0.4ms
.2mSEC		0.25ms to 0.4ms
.5mSEC		0.25ms to 0.4ms
1mSEC		2.0ms to 5.0ms
2mSEC		2.0ms to 5.0ms
5mSEC		2.0ms to 5.0ms
10mSEC		30.0ms to 45.0ms
20mSEC		30.0ms to 45.0ms
50mSEC		30.0ms to 45.0ms
.1 SEC		0.25 s to 0.5 s
.2 SEC		0.25 s to 0.5 s
.5 SEC		0.25 s to 0.5 s
1 SEC		1.0 s to 3.0 s
2 SEC		1.0 s to 3.0 s
5 SEC		1.0 s to 3.0 s

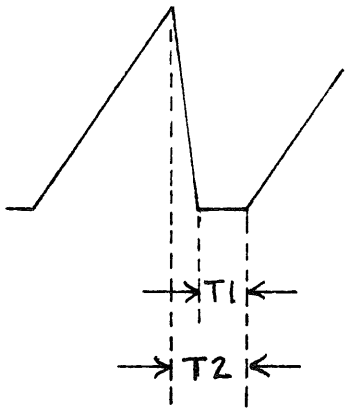
29. VERTICAL AMPLIFIER

a. Setup

Set UPPER BEAM DISPLAY to LEFT PLUG-IN A, A TIME/CM to .1μSEC and A TRIGGERING to AUTO, AC, NORM INT. Set 1M1 TEST FUNCTION to + PULSE and adjust amplitude for 5cm display. Position pulse to graticule center.

b. Adjust transient response
Risetime: 6.25ns, max
Aberrations: ±1.25%, peak, max

Make the following adjustments and repeat as necessary to obtain optimum flat top and front corner on waveform. Make final adjustments with DISPLAY MAG set at X10, switching between X10 and X1 to check over-all level. Check risetime and



29b. Calculating risetime:

The risetime of the system under test is determined by the formula:

$$T_r = \sqrt{(T_r\ 556)^2 + (T_r\ 1M1)^2}$$

Where:

T_r = observed risetime
T_r 556 = actual risetime of the Type 556
T_r 1M1 = actual risetime of the 1M1

Therefore the risetime of the 1M1 must be known before the risetime of the TYPE 556 can be determined. For example, if the T_r of the 1M1 is 2.55ns and the specification for the TYPE 556 calls for a T_r of $\leq$6.25ns, then the maximum observed risetime of the system is:

$$T_r = \sqrt{(6.25)^2 + (2.55)^2} = 6.75\text{ns}$$

Preset R69(R259) for optimum long term flattop. (TIME/CM @ .1mSEC and 1M1 REP RATE to LO).

29b. (cont'd)

aberrations as in the following table:

Adjustment	Area of waveform effected
L64	first 10ns (adjust with L164)
L164	first 10ns (adjust with L64)
L43	leading edge (adjust with L143)
L143	leading edge (adjust with L43)
C55	first 10 to 30ns
C53	first 20ns
C54	first 5ns
C51	level at front (TIME/CM at 10μSEC)
C17	termination bump
C10	first 5ns
R54	damping of faster ringing
R52	damping of slower ringing

Preset L64, L164 with tops of slugs near center of coil forms.

Preset L43, L143, L255, L454, L224, L424 with tops of slugs near tops of coil forms.

The same 1M1 should be used to adjust the upper vertical first, the lower vertical second, and the crossover amp last.

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A and make following adjustments to obtain optimum front corner and flat top. Check risetime and aberrations as in the following table:

Adjustment	Area of waveform effected
C30	minimum ringing (adjust with R31)
C31	first 75ns
C32	level at front (TIME/CM at 10μSEC)
C19	termination bump
R31	minimum ringing (adjust with C30)

Set LOWER BEAM DISPLAY to RIGHT PLUG-IN B and make following adjustments to obtain front corner and flat top. Check rise-time and aberrations as in the following table:

Adjustment	Area of waveform effected
L254	first 10ns (adjust with L454)
L454	first 10ns (adjust with L254)
L224	leading edge (adjust with L424)
L424	leading edge (adjust with L224)
C245	10 to 30ns
C242	first 20ns
C241	level (TIME/CM at 10 SEC)
C218	termination bump
C210	first 5ns
C244	first 5ns
R244	damping of faster ringing
R242	damping of slower ringing

29. (continued)

c. Adjust + PULSE position effect: Aberration change must be within 1%, peak, of the aberrations seen with the display centered

Set UPPER BEAM DISPLAY to LEFT PLUG-IN A, position top of upper beam waveform over the entire upper beam graticule area, and adjust R69 for minimum corner change.

When checking crossover position effect, separate the upper beam 2cm above the lower beam.

Position the lower beam waveform over the entire lower beam graticule area, and adjust R259 for minimum corner change.

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A, and check + PULSE crossover position effect.

d. Check - PULSE transient response: Aberrations within 1.25%, peak, of centered + PULSE aberrations

Set UPPER BEAM DISPLAY to LEFT PLUG-IN A, 1M1 TEST FUNCTION to -PULSE, center display in upper beam graticule area, and check aberrations.

Repeat for lower beam.

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A, and check - PULSE crossover aberrations.

e. Check - PULSE position effect: Aberrations within 1%, peak, of centered - PULSE aberrations

Set UPPER BEAM DISPLAY to LEFT PLUG-IN A, and position upper beam waveform over its graticule area, checking aberrations.

Repeat for lower beam.

Set UPPER BEAM DISPLAY to RIGHT PLUG-IN A, and check -PULSE crossover position effect.

30. HF TRIGGERING

Amplitude: 1.0cm
Jitter: 2ns, max

Switch 1m1's to LOW LOAD, A and B TRIGGERING MODE to TRIG and apply 1.0cm of 50MHz signal from TYPE 191 to both verticals. Check for stable display with ≤2mm jitter on both beams and on + and - SLOPE. Change TYPE 191 AMPLITUDE to observe 2cm, switch COUPLING to DC and check for stable triggering.

Switch A TRIGGERING SOURCE to RIGHT and B TRIGGERING SOURCE to LEFT. Check for stable triggering on both beams and + and - SLOPE.

31. HORIZONTAL POSITION-

a. Check horizontal POSITION range

Set A and B TIME/CM to 1mSEC and remove all connections except power.

Position both extremes horizontally to the extremes and check that traces can be positioned past the center of the graticule in both directions.

b. Check horizontal POSITION vernier

Connect .1mS and 1mS time marks from TYPE 184 to both 1M1 EXT INPUTS. Change A and B DISPLAY MAG to X10. Check for at least 2.5cm of range of UPPER BEAM and LOWER BEAM DISPLAY POSITION vernier at the center of the display. Check ccw and cw ends of rotation for at least 1cm of vernier control.