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

TYPE 585A

November 1968
For all serial numbers.

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 535A OSCILLOSCOPE with
1 TYPE B PLUG-IN UNIT (test scope) (modified PMIE Dwg #2145A)
*1 TYPE 184 TIME-MARK GENERATOR
*1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
1 TYPE 76TU LINE VOLTAGE CONTROL UNIT
1 TYPE P6028 1X PROBE
1 TYPE P6006 10X PROBE

b. Test Fixtures and Accessories

*1 Standard Amplitude Calibrator (SAC) (067-0502-00)
1 Bandwidth Plug-In (PMIE Dwg 1348B - 1345B)
*1 Calibration Fixture (067-0523-00) (TYPE 84) (modified PMIE Dwg #1897-C)
1 Variable Attenuator (PMIE Dwg #2090-B)
1 Ohms picker (067-0076-00)
3 50Ω BNC cables (012-0057-00)
1 50Ω Termination, BNC (011-0049-00)
1 Clip Lead Adapter (013-0076-00)
1 BNC T connector (017-0069-00)
1 Micro shock hammer (PMIE Dwg #1283B)
1 DC Voltage Bridge (DCVB) (067-0543-99)
1 Low Frequency Sinewave Generator (LFSWG) (067-0542-99)

c. Other Equipment

1 Multimeter 20,000Ω/Volt

d. Equipment for Sample Checks

1 Constant Amplitude Signal Generator (067-0532-00)
1 50Ω Termination (GR to BNC) (017-0083-00)

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.

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

FACTORY TEST LIMITS

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

d. CRT faceplate tilt, ±3/64; Graticule align, ±1mm

g. Fuse, 3ag, 7a mdx slo-blo

3. RESISTANCE

b. Cal Test Pt: approx 20kΩ to ground

4. LOW VOLTAGE POWER SUPPLIES

a. Time-delay relay: 15 to 60 sec

b. Low voltage power supply regulation and ripple:

Supply	Tolerance	Ripple
-150V	±3V	5mV
+100V	±2V	15mV
+225V	±4.5V	5mV
+350V	±7V	30mV
+500V	±10V	30mV

d. Regulation of +12.6V supply, ±1% ripple 15mV, max

5. HIGH VOLTAGE AND CRT

a. HV Supply: -1350 ±2%

b. HV regulation: no trace blooming or voltage change >20V from 105 to 125 VAC

d. Trace alignment range: 6°min; alignment ±1mm, max

6. GEOMETRY

b. Vertical geometry: 0.67mm max bowing

c. Horiz geometry: 0.67mm max bowing

7. FOCUS

a. Horizontal focus: no overlap of 1mm marks in the center 8.8cm

b. Vertical focus: no overlap of 1mm spaced lines

8. BEAM INDICATORS AND SCALE ILLUMINATION

b. Beam position indicators: the correct neon must be lit and the opposite neon off before the spot leaves the graticule.

c. SCALE ILLUM: max cw, off ccw

d. TIME BASE indicators: B on except in A and A SINGLE SWEEP

e. Alternate sweep: all sweep rates and modes.

9. VERTICAL AMPLIFIER LF

d. Vertical amplifier balance: 0.5cm max from electrical center

e. Microphonics: 0.25cm, max no ringing type

f. Vert Gain Adj: range +15% to -5%.

g. Compression/expansion: 0.5mm, max

h. DC shift: 1mm, max

i. Vertical drift, 105 to 125 VAC: 2mm max

10. CRT CATHODE INPUT

b. Intensity modulation: 20V

11. AMPLITUDE CALIBRATOR

*b. .1 VOLTS position: ±2%
*c. 50V to .2V position
observed error: ±2%
observed error plus 1000:1 divider error: ±2%
e. Calibrator frequency: 1 kHz ±20%
f. Calibrator duty cycle: 45 to 55%

12. TIME BASE A TRIGGERING

b. Trig Level Centering: + & - triggering on 1mm
c. Trig Sens: + & - triggering on 1/2mm, no triggering on 1/4mm
d. Internal and external midrange triggering: 1 kHz; 2mm INT, 0.2V EXT
10 MHz; 2mm INT, 0.3V EXT
3mm INT, 0.3V EXT
0.2V EXT HF SYNC

13. TIME BASE B TRIGGERING

b. Trig Level Centering: + & - 4mm
c. B internal and external triggering:
1 kHz; 2mm INT, 0.2V EXT
5 MHz; 1.5cm INT, 1.5V EXT

14. LINE TRIGGERING

b. Line triggering: correct slope

15. PRESET ADJUST

b. A PRESET ADJUST: center of range, ±25%
c. B PRESET ADJUST: center of range, ±25%

16. TRIGGERING LEVEL RANGE

b. TIME BASE B TRIGGERING LEVEL range: 15V min
c. TIME BASE A TRIGGERING LEVEL range: 15V min

17. MAGNIFIER GAIN

*b. Mag Gain Adj: ±3%
Magnified sweep linearity: ±1%

*18. SWEEP CALIBRATION ±2%

19. MATCHING TIME BASES

b. Time bases matched ±2mm

20. TIME BASE A SWEEP LENGTH

10.2 to 10.8cm

21. NORMAL-MAGNIFIED REGISTRATION

±2mm at graticule center

22. TIME BASE A VARIABLE TIME/CM

a. VARIABLE TIME/CM ratio: 2.5:1 min
b. VARIABLE neon: lit except in CALIBRATED

23. TIME BASE A TIMING

*a. Timing:
.1mSEC-.5 SEC: ±2%, max
1 and 2 SEC: ±2.5%, max
*c. Timing:
.05μSEC-50μSEC: ±2%, max
Magnified sweep: ±3%, max
Linearity: ±1%, max

24. DELAY START AND STOP

a. Delay start and stop ±5 minor dial div
b. Linearity: ±2 minor dial div

25. DELAY PICKOFF JITTER

b. Delay jitter at 1:00: 2mm, max
c. Delay jitter at 9:00: 4mm, max

26. TIME BASE B TIMING

a. Slow sweep rate accuracy: ±0.625% error, max; except .2, .5 and 1 SEC ±1%, max
b. Fast sweep rate: ±0.625%, max

27. + GATE INTERVAL AND FRONT PANEL WAVEFORMS

b. + GATE Interval: Limits in table, Amplitude; 20V min

TIME/CM	A
.05 to .5μSEC	3-9μS
1 to 50μSEC	15-40μS
.1 to .5mSEC	150-400μS
1 to 5mSEC	1.5-4mS
10 to 50mSEC	15-40mS
.1 to 2 SEC	150-400mS

TIME/CM	B
2-10μSEC	5-15μS
20μSEC-.1mSEC	50-150μS
.2-1mSEC	.5-1.5mS
2-10mSEC	5-15mS
20mSEC-1 SEC	50-150mS

c. DLY'D TRIG OUT: 5V min

28. LOCKOUT LEVEL

a. Lockout Level Adj: ≈2:3
b. Gate amplitude: 9V min
c. SINGLE SWEEP triggering: sweeps once on triggering signal

29. EXTERNAL HORIZONTAL

a. Ext Horiz DC Bal: ±1cm max shift
b. Grid current: ±0.5cm max shift
c. X10 to X1 match ±5%
d. External deflection factor: .2 VOLTS/CM max
29e. EXT X10 attenuation: divides X1 gain by 10 ±2%
f. VARIABLE 10:1 ratio: 10:1 min
*g. Bandwidth: 350 kHz or more at -3dB

30. VERTICAL HF COMPENSATIONS

*c. Vertical gain ±2% max
h. Vertical aberrations: Flatness ≤2% P-P from 1mSEC to .05μSEC

31. VERTICAL DELAY

Vertical delay: 40nsec, min

32. VERTICAL BANDWIDTH

b. Vertical bandwidth: 95 MHz or more at -3dB

33. TIME BASE A HIGH FREQUENCY TRIGGERING

a. External HF triggering: 0.4V at 50 MHz, 1.2V at 100 MHz, 1.5V at 150 MHz, HF SYNC 0.2V at 150 MHz
b. Internal HF triggering: INT 1cm at 50 MHz, 2cm at 100 MHz, 2.5cm at 150 MHz, HF SYNC 3mm at 150 MHz

34. LOW FREQUENCY TRIGGERING

a. TIME BASE A LF triggering:
INT 2mm 15 Hz & 15 kHz
EXT 0.3V 15 Hz & 15 kHz
b. TIME BASE B LF triggering:
INT 4mm 15 Hz & 15 kHz
EXT 0.5V 15 Hz & 15 kHz

35. TIME BASE B SWEEP LENGTH

b. B Sweep Length -- cw: 10.2 to 10.8cm, ccw: 3.2 to 3.8cm

SAMPLE CHECKS

I. HF SYNC at 250 MHz
INT 4mm: EXT 0.2V P-P

THE END

* Indicates measurement characteristics; 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 for current modifications
b. Check tubes
c. Align CRT
d. Check CRT pins
e. Check CRT
f. Check fuse
g. Check anode button

2. PRESET CONTROLS

3. RESISTANCE

b. Measure resistance

4. LOW VOLTAGE POWER SUPPLIES

a. Check time-delay relay: 15 to 60 sec
b. Adjust -510V and check regulated voltages
c. Check elevated heaters
d. Adjust and check regulation of +12.6V supply: ±1%, ripple 15mV max

5. HIGH VOLTAGE AND CRT

a. Adjust HV Adj R840: -1350
b. Check HV regulation
c. Adjust Shield Volts Adj R860
d. Check trace align range: 6° min
Align trace: ±1mm

6. GEOMETRY

b. Adjust geometry R861: 0.67mm max bowing
c. Check horiz geometry: 0.67mm max bowing

7. FOCUS

a. Check horiz focus
b. Check vert focus

8. BEAM INDICATORS AND SCALE ILLUMINATION

b. Check beam position indicators
c. Check SCALE ILLUM: max cw, off ccw
d. Check TIME BASE indicators: B on except in A and A single sweep
e. Check alternate sweep: all sweep rates and modes

9. VERTICAL AMPLIFIER LF

a. Find CRT electrical center
b. Adjust R1294
c. Check for loose tube socket connections
d. Check vertical amplifier balance 0.5cm max, from electrical center
e. Check for microphonics 0.25cm max no ringing
f. Check range: +15%, -5%, Set gain: ±2%
g. Check compression/expansion 0.5mm max
h. Check DC shift 1mm, max
i. Check vertical drift, 105 to 125 VAC 2mm, max

10. CRT CATHODE INPUT

a. Remove CRT GND strap
b. Check intensity modulation 20V

11. AMPLITUDE CALIBRATOR

b. Check .1 VOLTS position: ±2%
c. Check 50V to .2V positions
observed error: ±2%
observed error + 1000:1 divider: ±2%
d. Check 50mV to .2mV operation
e. Check calibrator frequency: 1 kHz ±20%
f. Check calibrator duty cycle: 45 to 55%

12. TIME BASE A TRIGGERING

a. Set TRIGGERING LEVEL mechanical zero: 0V
b. Adjust Trig Level Centering R25: + & - triggering on 1mm
c. Adjust Trig Sens R47: + & - triggering on ½mm, no triggering on ¼mm
d. Check internal and external midrange triggering:
1 kHz, 2mm INT, 0.2V EXT
10 MHz, 2mm INT, 0.3V EXT
3mm INT HF SYNC, 0.2V EXT HF SYNC

13. TIME BASE B TRIGGERING

a. Set TRIGGERING LEVEL mechanical zero: 0V
b. Adjust Trig Level Centering R78: + & - 4mm
c. Check B Internal and External Triggering: 1 kHz; 2mm INT, 0.2V EXT
5 MHz; 1.5cm INT, 1.5V EXT

14. LINE TRIGGERING

b. Check triggering: correct slope

15. PRESET ADJUST

b. Adjust A PRESET ADJUST: center of range
c. Adjust B PRESET ADJUST: center of range

16. TRIGGERING LEVEL RANGE

b. Check TIME BASE B TRIGGERING LEVEL range: 15V min

16c. Check TIME BASE A TRIGGERING LEVEL range: 15V min

17. MAGNIFIED GAIN

b. Adjust Mag Gain Adj R372: ±3%

18. SWEEP CALIBRATION

Adjust Swp Cal R348

19. MATCHING TIME BASES

b. Adjust R160Z: Time bases matched ±2mm

20. TIME BASE A SWEEP LENGTH

Adjust Swp Length R176: 10.5cm

21. NORMAL-MAGNIFIED REGISTRATION

Adjust Norm Mag Regis, R358: ±2mm

22. TIME BASE A VARIABLE TIME/CM

a. Check VARIABLE TIME/CM ratio: 2.5:1 min
b. Check neon: lit except in CALIBRATED

23. TIME BASE A TIMING

a. Check timing
.1mSEC-.5 SEC: ±2% max
1 and 2 SEC: ±2.5% max
b. Adjust C330
c. Adjust and check timing
.05 SEC-5 SEC: ±2%, max
Magnified Sweep: ±3%, max
Linearity: ±1%, max

24. DELAY START AND STOP

a. Set Delay Start Adj, R436 and Delay Stop Adj, R432: ±2 minor div
b. Check linearity: ±2 minor dial div

25. DELAY PICKOFF JITTER

b. Check jitter at 1:00: 2mm, max
c. Check jitter at 9:00: 4mm, max

26. TIME BASE B TIMING

a. Check slow sweep rate accuracy: ±0.625% Error, max; except .2, .5 and 1 SEC ±1% max
b. Adjust Fast sweep rates C260C & C260A: ±0.625% max

27. + GATE INTERVAL

b. Check + GATE Interval: Amplitude 20 V min
c. Check DLY'D TRIG (5V, min) and SAWTOOTH A (130V, min) Front panel waveforms

28. LOCKOUT LEVEL

a. Adjust Lockout Level Adj R125: Approx 2:3
b. Check gate amplitude: 9V min
c. Check SINGLE SWEEP triggering: sweeps once on triggering signal

29. EXTERNAL HORIZONTAL

a. Adjust EXT Horiz DC Bal, R317: ±1cm max shift
b. Check for grid current: ±0.5cm shift
c. Adjust C3016: X10 to X1 match ±5%
d. Check external horizontal deflection factor: 0.2 VOLTS/CM max
e. Check EXT X10 attenuation: divides X1 gain by 10 ±2%
29f. Check VARIABLE 10:1 ratio: 10:1 min
g. Check bandwidth: 350 kHz or more at -3dB

30. VERTICAL HF COMPENSATIONS

b. Preset amplifier
c. Recheck vertical gain ±2% max
d. Adjust C1209, C1006
e. Adjust C1214 thru C1254
f. Adjust C1260, C1261
g. Adjust R1293, C1276
h. Check Vertical aberrations: Flatness ≤2% P-P from 1mSec to .05μSec
i. Select R1204, C1204, R1205 and C1205
j. Check with side panels

31. VERTICAL DELAY 40mSEC, min

32. VERTICAL BANDWIDTH

b. Check Vertical Bandwidth: 95 MHz or more at -3dB

33. TIME BASE A HIGH FREQUENCY TRIGGERING

a. Check external HF triggering: EXT 0.4V at 50 MHz; 1.2V 100 MHz; 1.5V at 150 MHz; HF SYNC 0.2V at 150 MHz
b. Check internal HF triggering: INT 1cm at 50 MHz; 2cm at 100 MHz; 2.5cm at 150 MHz; HF SYNC 3mm at 150 MHz

34. LOW FREQUENCY TRIGGERING

a. Check TIME BASE A LF triggering INT 2mm 15 Hz and 15 kHz, EXT 0.3V 15 Hz and 15 kHz
b. Check TIME BASE B LF triggering INT 5mm at 15 Hz and 15 kHz EXT 0.5V at 15 Hz and 15 kHz

35. TIME BASE B SWEEP LENGTH

b. Set B Sweep LENGTH - cw: 10.2 to 10.8cm, ccw: 3.2 to 3.8cm

SAMPLE CHECKS

I HF SYNC at 250 MHz

Check HF SYNC INT 4mm; EXT 0.2V P-P, at 250 MHz.

THE END

1. PRELIMINARY INSPECTION

a. Check modification

Check that instruments have all current modifications

b. Check tubes

Check all tubes for proper type and installation:

Horizontal Amplifier	No G.E.
Vertical Output	All tubes are the same brand and manufactured in the same country
Distrubuted Amplifier	Same
Delay line drivers	Same

c. Align CRT: CRT faceplate tilt, ±3/64; Graticule align ±1mm

Loosen allen screws on CRT clamp and position the CRT so that the faceplate is equal distance from light deflector on both sides and top of CRT. Tighten the allen screws. Loosen CRT clamp and position CRT so that the faceplate is flush with the light deflector. Place scribed graticule over the CRT and align internal graticule with scribed graticule. Tighten the CRT clamp and remove the scribed graticule.

d. Check CRT pins

Check that the CRT pins cannot be pulled off of the neck pins using a pair of 6" tweesers.

1. (Cont)

e. Check CRT

Check that the CRT serial number and code date match that on the records. Check CRT for structural defects.

f. Do not reject a CRT without consulting a CRT checker or referring to the cathode ray tube checkout procedure.

f. Check Fuse

Check that the fuse is a 3ag, 7a mdx slo-blo

g. Check anode button

Check that the anode button is properly seated.

2. PRESET CONTROLS

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

POWER ON	OFF
FOCUS	CCW
INTENSITY	CCW
ASTIGMATISM	CCW
SCALE ILLUM	CW
HORIZONTAL DISPLAY	A
5X MAGNIFIER	OFF
TIME BASE A:	
STABILITY	CCW
TRIGGER SLOPE	+
TRIGGERING SOURCE	INT AC
TIME/CM	1mSEC
VARIABLE TIME/CM	CALIBRATED
PRESET ADJ	CCW
TIME BASE B	Same as A
All internal adjustments	midr

3. RESISTANCE

a. Setup

Install the TYPE 84 in the TYPE 585A and preset it as follows:

LOAD	NORM
DISPLAY SELECTOR	EXT INPUT
VERTICAL POSITION	midr

3. (Cont)

b. Measure resistance

Connect ohmmeter to proper slots on ceramic strips next to power transformer. Measure the resistance to ground as follows:

Terminal or slot	Approx Resistance
Transformer term 1	infinite
Transformer term 4	infinite
+12.6	.7Ω
-150V	3k
+100V	1.5k
+225V	2.2k
+350V	20k
+500V	30k
+325V unreg	3.5k

Check Cal Test Pt. for approx 20kΩ to ground

4. LOW VOLTAGE POWER SUPPLIES

a. Check time-delay relay: 15 to 60sec

Apply power to the TYPE 585A via a TYPE 76TU and check time-delay relay as follows: Set the line voltage to 117VAC with the TYPE 76TU. Turn the POWER ON switch ON. Check that no regulated power supply voltages are present before the time delay relay closes. Check for a delay of 15 to 60 seconds before audible click is heard.

b. Adjust -150V and check regulated voltages

Adjust -150V Adj for -150V. Switch the TYPE 84 LOAD switch to HIGH LOAD. Measure the regulated voltages (on power supply chassis). Check regulation at 105VAC line voltage. Switch TYPE 84 to LOW LOAD and check regulation and ripple at 125VAC.

b. Use the test scope to measure ripple and DC Voltmeter to measure voltage amplitude. The +100V max ripple limit includes HV hash.

The -150V supply may be adjusted anywhere within its ±3V limit to bring other supplies in tolerance.

4b. (Cont)

SUPPLY	TOLERANCE	RIPPLE
-150V	±3V	5mV
+100V	±2V	15mV
+225V	±4.5V	5mV
+350V	±7V	30mV
+500V	±10V	30mV

Return line voltage to 117VAC

c. Check elevated heaters

Check elevated heater supplies for the proper voltage above GND:

Transformer terminal	Approx DC Voltage to GND
22 and 23	+50
27 and 28	+225
24 and 25	-1200 to -1500
9 and 16	+350

d. Adjust and check regulation of +12.6V supply ±1%, ripple 15mV max

Connect DCVB to the front end of C786 and adjust R785 for +12.6V. Check regulation between 105VAC, HIGH LOAD and 125VAC LOW LOAD. Connect X1 probe from test scope and check +12.6V ripple over the same AC voltage and Load range. Return line to 117V.

5. HIGH VOLTAGE AND CRT

a. Adjust HV Adj R840: -1350 ±2%

Connect DCVB to HV Test Pt. Set High Voltage Adj R840 for -1350

b. Check regulation: No trace blooming or voltage change >20V from 105 to 125VAC

Set FOCUS and ASTIGMATISM controls ccw, A STABILITY and INTENSITY cw. Check for trace blooming and voltage change while varying line voltage from 105 to 125VAC: No blooming and no voltage change greater than 20V (-1330 to -1370).

5b. (Cont)

Return line voltage to 117VAC, and TYPE 84 LOAD switch to NORM. Set INTENSITY to minimum usable level and adjust FOCUS and ASTIGMATISM controls for a focused trace.

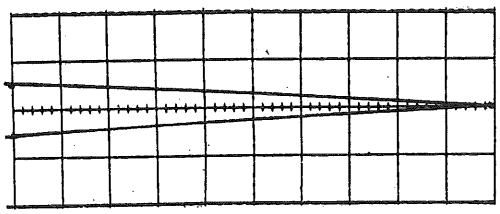
c. Adjust Vert Shield Volts Adj R860: 0V

Connect the DC Voltmeter between one of the rear CRT neck pins and the center arm of R860. Set the trace to graticule center. (Adjust trace rotation if necessary.) Set the Vert Shield Volts Adj, R860 for 0V.

d. Check trace alignment range: 6° min, alignment 1mm, max

Set TRACE ROTATION at each extreme and check for 6 degrees or more total tilt. Cw pot rotation must cause cw trace rotation. Adjust trace parallel with horizontal graticule lines.

d. TRACE ROTATION is adjusted through center of ASTIGMATISM knob. 6 degrees = 1cm difference in vertical height in 10cm of trace length. (See drawing)



6. GEOMETRY

a. Setup

Apply 1mS and .1mS markers to the TYPE 84 EXT INPUT from TYPE 184. Set TIME/CM to 1mSEC. Adjust the VARIABLE TIME/CM control to get exactly 15 1mS markers in 10cm. The distance between .1mS markers is now 0.67mm.

b. Adjust geometry R861: 0.67mm max bowing

Adjust for minimum bowing of the vertical lines. Check over the entire graticule for 0.67mm or less bowing in 4cm.

c. Check horizontal geometry: 0.67mm max bowing

Remove TYPE 184 markers off and turn TIME BASE A STABILITY cw. Use the TYPE 84 VERTICAL POSITION to check for bowing of the trace within the graticule area.

b. It may be necessary to use external triggers to obtain a stable display.

7. FOCUS

a. Check horizontal focus: no overlap of 1mm marks in the center 8.8cm

Turn TIME/CM to 1mSEC and apply .1mS markers from the TYPE 184.

Adjust the VARIABLE TIME/CM for 10 markers/cm. Adjust FOCUS and ASTIGMATISM so that all .1mS markers over the center 8.8cm of the graticule are clearly defined with no overlap.

Remove the TYPE 184 signal.

b. Check vertical focus: no overlap of 1mm spaced lines

Connect the SAC OUTPUT cable to the TYPE 84 EXT INPUT. Set the SAC for a display amplitude of 1mm or less at graticule center.

Use the TYPE 84 VERTICAL POSITION to check for no overlap of the traces at top, center, and bottom of the graticule. It may be necessary to set the TYPE 585A Vert Gain Adj for 1mm display amplitude. Remove signal and return VARIABLE TIME/CM to CALIBRATED.

7. R860 may be adjusted for optimum focus

8. BEAM INDICATORS AND SCALE ILLUMINATION

a. Setup

HORIZ DISPLAY	EXT
INTENSITY	to obtain spot

b. Check beam position indicators

The spot must move off screen in the direction indicated. The proper beam position indicator must come on and the opposite neon must go off before the spot leaves the graticule area.

a. Use care to avoid burning CRT phosphor by keeping intensity at minimum usable level.

8b. (Cont)

Position control	Turn	Spot must move	Beam position indicator
CALIBRATION FIXTURE VERTICAL POSITION	cw	up	↑
CALIBRATION FIXTURE VERTICAL POSITION	ccw	down	↓
TYPE 585A HORIZONTAL POSITION	cw	right	→
TYPE 585A HORIZONTAL POSITION	ccw	left	←

Turn 5X MAGNIFIER OFF and switch HORIZ DISPLAY to B

c. Check SCALE ILLUM: max cw, off ccw

Turn SCALE ILLUM cw, max brilliance. Turn SCALE ILLUM ccw. No illumination.

d. Check TIME BASE indicators: B on except in A and A SINGLE SWEEP

HORIZONTAL DISPLAY	A neon	B neon
B	--	on
B INTENSIFIED BY A	--	on
A DLY'D BY B	--	on
A	on	--
A SINGLE SWEEP	on	--
X10 EXT	--	on
X1 EXT	--	on

e. Check alternate sweep: all sweep rates and modes

Switch TYPE 84 to ALTERNATE. Check all sweep rates 10msec/cm and faster of both "A" and "B" sweep. Check 'A' DLY'D BY 'B' and 'B' INTENSIFIED BY 'A', by rotating the A TIME/CM switch in 'A' DLY'D BY 'B' INTENSIFIED BY 'A'.

Set A TIME/CM switch to 1mSEC and HORIZONTAL DISPLAY switch to A.

9. VERTICAL AMPLIFIER LF

a. Find CRT electrical center

Set the STABILITY cw (free run) and refocus. Short front CRT vertical deflection plates together and note trace vertical position (CRT electrical center). Remove short.

b. Adjust R1294

Connect a jumper between pin 2 of V1274 and pin 2 of V1284. Position the trace to electrical center with R1294. Remove the jumper.

c. Check for loose tube socket connections

Move the vertical amplifier tubes in their sockets while observing the trace. Check for no erratic shift.

d. Check vertical amplifier balance 0.5cm max, from electrical center

Short V1214 pin 2 to pin 7. The trace must not shift more than 0.5cm from previous stage or CRT electrical center.

Press the TYPE 84 SCOPE AMPL BALANCE CHECK button. The trace must not shift more than 0.5cm from previous stage or electrical center.

e. Check for microphonics 0.25cm max no ringing type

Set the A TIME/CM switch to 10mSEC. Use the micro shock hammer on top of the TYPE 585 and check for 0.25cm or less of microphonics, with no ringing.

f. Check range: +15% -5%, Set gain: 2cm ±2%

Set TYPE 84 DISPLAY SELECTOR to PULSER. Connect PULSER AMPLITUDE OUT to UNKNOWN INPUT of the SAC. Set SAC AMPLITUDE to 50Volts, + DC, MIXED and connect SAC OUTPUT to the test scope. Set TYPE 84 PULSER AMPLITUDE for exactly 50Volts. Turn the Vert Gain Adj R1015 from full cw to full ccw: range must be 1.9 to 2.3cm. Adjust R1015 for exactly 2.0cm deflection.

10. CRT CATHODE INPUT

a. Remove CRT GND strap

Loosen EXTERNAL CRT CATHODE and GND binding posts (scope rear) and swing strap away from EXTERNAL CRT CATHODE (strap must pivot around GND binding post).

b. Check Intensity Modulation 20V

Connect 20V SAC signal to EXTERNAL CRT CATHODE. Note that the trace is intensity modulated with the display at normal intensity. Remove SAC signal and replace ground strap.

11. AMPLITUDE CALIBRATOR

a. Setup

Preset the test scope as follows:

VOLTS/CM	.5
VARIABLE VOLTS/CM	CALIBRATED
Input Selector	A, AC

Connect the AMPLITUDE CALIBRATOR under test to the SAC/UNK IN connector. Connect the SAC OUTPUT through a coaxial cable to the TYPE B INPUT A. Set the SAC to +100V, DC MIXED. Set the AMPLITUDE CALIBRATOR under test to 100 VOLTS. Remove V875 from the instrument under test.

Trigger the test scope in AUTO, + LINE and set TIME/CM to 5mSEC.

Set the Cal Adj, R879 for a null voltage (the point where the display appears as a straight line).

b. Check .1 VOLTS position: ±2%

**c. Check 50V to .2V position*
observed error: ±2%
observed error plus 1000:1 divider error: ±2%

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).

11. (cont'd)

d. Check 50mV to .2mV operation

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

e. Check calibrator frequency: 1kHz ±20%

Set the SAC to UNKNOWN ONLY. Reinstall V875 in the instrument under test. Set the test scope TRIGGER SLOPE to + INT, and set the TIME/CM to 1mSEC. Set the test scope VOLTS/CM to .1. Check calibrator frequency 1kc ±20% (8 to 12 cycles in 10cm).

f. Check calibrator duty cycle: 45 to 55%

Set the test scope TIME/CM switch to 50μSEC and adjust the VARIABLE for 1 cycle in 10cm. Check that ½ cycle is 4.5 to 5.5cm in duration. Return test scope VARIABLE to CALIBRATED.

b. Check the falling edge of the calibrator waveforms for rounding and the bottom of the waveform for 60 cycle hum.

12. TIME BASE A TRIGGERING

a. Set TRIGGERING LEVEL mechanical zero: 0V

Connect: SAC OUTPUT -- 50Ω cable -- BNC T--Variable Atten -- TYPE 84 INPUT --50Ω cable to TYPE 585A TIME BASE A TRIGGER INPUT. Set TYPE 84 to EXT INPUT. Set TRIGGER SLOPE at + and TRIGGERING SOURCE to INT AC.

Connect meter to R14-R15 junction (on TRIGGERING SOURCE switch) and turn TRIGGERING LEVEL for zero volts on meter, use most sensitive meter range for final setting. Loosen TRIGGERING LEVEL knob set screw, position knob on shaft so white dot aligns with "0". Re-tighten set screw, making sure that TRIGGERING LEVEL remains at zero (watch the meter).

b. Adjust Trig Level Centering R25: + & - triggering on 1mm

Set SAC to 2VOLTS and adjust the Variable Atten for 2cm of vertical deflection. Change SAC to .1VOLTS, and A TIME/CM to .1mSEC.

a. Allow sufficient clearance so the TRIGGERING LEVEL knob does not rub against the panel. Tighten the set screw securely enough to prevent the knob turning on the shaft, but not enough to cause the concentric shafts to bind.

12b. (Cont)

Pre-adjust Trig Level Centering R26 to midrange, and Trig Sins R47 near cw end. Ground R14-R15 junction.

Set test scope to .5mSEC, AUTO + INT and .05VOLTS, AC coupled. Connect the 10X PROBE to the junction of R41 and C45. Adjust Trig Level Centering R26 and Trig Sens R47 for a stable display of square-waves on test scope. Switch TRIGGER SLOPE switch between + & -, touch up R26 and R47 for stable + & - triggering.

c. Adjust Trig Sens R47: + & - triggering on 1/2mm, no triggering on 1/4mm

Change SAC to 50mVOLTS, and adjust Trig Sens R47 (and Trig Level centering R26) for stable triggering + & -. Reduce signal amplitude to 1/4mm with the Variable Atten control and check that the TYPE 585A does not trigger. If the scope triggers readjust Trig Sens R47 so that the scope does not trigger on 1/4mm signal.

Remove the ground from R14-R15 junction.

d. Check internal and external mid range triggering: 1kHz, 2mm INT, 0.2V EXT
10MHz, 2mm INT, 0.3V EXT
3mm INT HF SYNC, 0.2V EXT HF SYNC

d. In checking EXT trigger sensitivities use the test scope to set the amplitude of the TYPE 191. Set the amplitudes with the TYPE 191 RANGE SELECTOR in the 50KC position.

TRIGGERING SOURCE	TRIGGERING LEVEL	SIGNAL 1kHz	SLOPE	Signal Generator
INT AC	fixed	2mm	+ & -	SAC
LF REJ	variable	2mm	+ & -	SAC
EXT AC	variable	.2V P-P	+ & -	SAC
EXT DC	variable	.2V P-P	+ & -	SAC

Replace SAC and variable atten with TYPE 191

		10MHz		
EXT DC	variable	.3V PtP	+ & -	TYPE 191
EXT AC	variable	.3V PtP	+ & -	TYPE 191
EXT HF SYNC	---	.2V PtP	+ & -	TYPE 191
INT AC	variable	2mm	+ & -	TYPE 191
LF REJ	variable	2mm	+ & -	TYPE 191
INT HF SYNC	---	3mm	±	TYPE 191

13. TIME BASE B TRIGGERING

a. Set TRIGGERING LEVEL mechanical zero: 0V

Change HORIZONTAL DISPLAY to B. Set TRIGGER SLOPE at + and TRIGGERING SOURCE to INT AC. Remove the TYPE 191 from the "T" connector and connect in its place the output cable from the SAC thru the variable atten. Change cable from A TRIGGER INPUT to B TRIGGER INPUT.

Connect meter to R63-R64 junction (on TRIGGERING SOURCE switch) and adjust TRIGGERING LEVEL for zero volts on meter (use most sensitive meter range for final setting). Loosen TRIGGERING LEVEL knob set screw, position knob on shaft so that white dot aligns with "0". Re-tighten screw, making sure TRIGGERING LEVEL remains at zero (watch meter).

a. Allow sufficient clearance so the TRIGGERING LEVEL knob does not rub against the panel. Tighten the set screw securely enough to prevent the knob turning on the shaft, but not enough to cause the concentric shafts to bind.

b. Adjust Trig Level Centering R78: + & -4mm

Change SAC to 1VOLT and adjust the Variable Atten for 2cm of amplitude.

Change SAC to .2VOLTS, B TIME/CM to .1mSEC and ground the R69-R64 junction.

Set test scope to .5mSEC, AUTO, + INT, 1VOLT, AC coupled and connect test scope 10X probe to R93-C221 junction. Switch TRIGGER SLOPE back and forth between + and -, and adjust Trig Level Centering R78 for stable square-wave.

Remove the ground from R63-R64 junction.

c. Check B Internal and External Triggering:
1kHz; 2mm INT, 0.2V EXT
5MHz; 1.5cm INT, 1.5V EXT

13c. (Cont)

Check triggering as follows:

TRIGGERING SOURCE	TRIGGERING LEVEL	Signal	SLOPE	Signal Generator
INT AC	fixed	4mm	+ & -	SAC
INT AC	variable	2mm	+ & -	
INT AC LF REJ	variable	2mm	+ & -	
EXT AC	variable	0.2V P-P	+ & -	
EXT DC	variable	0.2V P-P	+ & -	
INT AC	variable	1.5cm	+ & -	TYPE 191
INT AC LF REJ	variable	1.5cm	+ & -	
EXT AC	variable	1.5V PtP	+ & -	
EXT DC	variable	1.5V PtP	+ & -	

c. In checking EXT trigger sensitivities use the test scope to set the amplitude of the TYPE 191. Set the amplitudes with the TYPE 191 RANGE SELECTOR in the 50KC position.

14. LINE TRIGGERING

a. Setup

Remove the TYPE 191 and cables from the TYPE 84 and connect a 10X probe to the Variable Atten. Connect probe tip to 117VAC at fuse holder. Set B TIME/CM to 5mSEC and change TRIGGER SOURCE to LINE. Adjust the Variable Atten for a 4cm display.

b. Check triggering: correct slope

Check for correct triggering slope both + and -.

Change HORIZONTAL DISPLAY to A. Set A TIME/CM at 5mSEC and change TRIGGER SOURCE to LINE.

Check for correct triggering slope both + and -.

Remove probe from fuse holder and the Variable Atten.

15. PRESET ADJUST

a. Setup

Both time bases.

TRIGGER SLOPE	+
TRIGGERING SOURCE	LINE
TIME/CM	.1mSEC

Connect a DC voltmeter to TIME BASE A PRESET ADJUST center arm and ground.

b. Adjust A PRESET ADJUST: center of range

Set STABILITY full ccw (PRESET). Turn TIME BASE A PRESET ADJUST fully ccw, then slowly turn it cw until trace appears, note the meter reading. Continue turning cw until trace brightens and note meter reading. Set PRESET ADJUST halfway between the readings. Remove the meter.

b. PRESET ADJUST range

Range on preset between trace appearing and brightening should be approx 15volts.

c. Adjust B PRESET ADJUST: center of range

Switch HORIZONTAL DISPLAY to B, connect the meter to PRESET ADJUST wiper arm.

Adjust TIME BASE B PRESET ADJUST as in step b.

c. PRESET ADJUST range

Range of preset between trace appearing and brightening should be approx 12volts.

16. TRIGGERING LEVEL RANGE

a. Setup

Apply 20V square wave from SAC to test scope through the Variable Attenuator. Adjust the Variable Attenuator for 15volts as indicated on test scope.

b. Check TIME BASE B TRIGGERING LEVEL range: 15V min

Move the Variable Attenuator to the TIME BASE B TRIGGER INPUT. Set the TRIGGER SOURCE to EXT AC, STABILITY to PRESET and TIME/CM to 1mSEC.

Rotate the TRIGGERING LEVEL from cw to ccw and check that the sweep stops at the extremes.

16. (Cont)

c. Check TIME BASE A TRIGGERING LEVEL range: 15V min

Change the variable attenuator to the TIME BASE A TRIGGER INPUT and set the TRIGGERING SOURCE to EXT AC. Set the HORIZONTAL DISPLAY switch to A and check TRIGGERING LEVEL range as in b.

17. MAGNIFIER GAIN

a. Setup

Connect the TYPE 184 MARKER OUT to the TYPE 84. Set TYPE 184 for 1ms and .1ms markers.

Set HORIZONTAL DISPLAY to B and B TIME/CM at 1mSEC. Turn 5X MAGNIFIER to ON. Set B TRIGGERING SOURCE to INT AC, TRIGGER SLOPE to + and set STABILITY and TRIGGERING LEVEL for a stable display.

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

b. Adjust Mag Gain Adj R372: ±3%
Magnified sweep linearity: ±1%

Adjust Mag Gain Adj R372 for two .1ms marks per cm at center of sweep. Check timing accuracy over entire sweep. Error: ±0.8mm, max.

b. Sweep linearity

There should be no non-linearity that causes a timing change of greater than ±1% in any 8cm time window of the magnified sweep. The total timing error with MAGNIFIER ON must be 3% or less for all sweep rates (basic timing errors + errors caused by non-linearity of magnified sweep).

18. SWEEP CALIBRATION ±2%

Change MAGNIFIER to OFF and adjust Swp Cal R348 for one 1ms mark per cm.

19. MATCHING TIME BASES

a. Setup

Set TIME BASE A TIME/CM to 1mSEC. Turn TIME BASE A STABILITY full cw. Turn 5X MAGNIFIER ON. Set HORIZONTAL DISPLAY to 'B' INTENSIFIED BY 'A', adjust TIME BASE B TRIGGERING LEVEL for a stable display. Switch the HORIZONTAL DISPLAY switch between 'B' INTENSIFIED BY 'A' and A DLY'D BY 'B' and adjust the DELAY TIME MULTIPLIER so the second time mark is in the same position for both positions of the HORIZONTAL DISPLAY switch.

19. (Cont)

b. Adjust R160Z
Time bases matched ±2mm

Switch the HORIZONTAL DISPLAY back and forth between 'B' INTENSIFIED BY 'A' and 'A' DLY'D BY 'B' and adjust R160Z for identical sweep timing between the second and ninth graticule lines. Set HORIZONTAL DISPLAY to A and turn 5X MAGNIFIER OFF.

20. TIME BASE A SWEEP LENGTH 10.2 to 10.8cm

Adjust Swp Length R176 for a trace length of 10.5cm.

21. NORMAL-MAGNIFIED REGISTRATION ±2mm at graticule center

Set 5X MAGNIFIER to ON. Use HORIZONTAL POSITION controls to position the trace start at graticule center.

Switch MAGNIFIER OFF and adjust Norm Mag Regis, R358 to position trace start at graticule center. Switch MAGNIFIER ON to OFF and check that the trace start remains at the graticule center line ±2mm.

Set the 5X MAGNIFIER to OFF, and recenter the trace with HORIZONTAL POSITION control.

22. TIME BASE A VARIABLE TIME/CM

a. Check VARIABLE TIME/CM ratio:
2.5:1min

Apply 1mSEC markers only. Adjust A TRIGGERING LEVEL for a stable display. Turn the VARIABLE TIME/CM fully ccw and check for at least 5 marks per 2cm.

22. (Cont)

b. Check neon: lit except in CALIBRATED

Check that the UNCALIBRATED neon is lit. Turn the VARIABLE TIME/CM cw, and check that the neon remains lit until the control actuates the CALIBRATED switch.

23. TIME BASE A TIMING

a. Check timing:
.1mSEC - .5SEC: ±2%, max
1 and 2SEC: ±2.5%, max

TIME BASE A TIME/CM	TYPE 184 markers	Markers per cm	Maximum error in mm
.1mSEC	.1mS		1.6
.2mSEC	.1mS	2	1.6
.5mSEC	.5mS	1	1.6
1mSEC	1mS	1	1.6
2mSEC	1mS	2	1.6
5mSEC	5mS	1	1.6
10mSEC	10mS	1	1.6
20mSEC	10mS	2	1.6
50mSEC	50mS	1	1.6
.1SEC	.1S	1	1.6
.2SEC	.1S	2	1.6
.5SEC	.5S	1	1.6
1SEC	1S	1	2
2SEC	1S	2	2

b. Adjust C330

Adjust TRIGGERING LEVEL and STABILITY as necessary. Change 5X MAGNIFIER to ON and TYPE 184 to 10μS. Switch TIME BASE A TIME/CM back and forth between 50μSEC and .1mSEC and adjust C330 for coincidence of the first time mark.

c. Adjust and check timing:
.05SEC - 5SEC: ±2%, max
Magnified Sweep: ±3%, max
Linearity: ±1%, max

c. Exclude all sweep in excess of first 50cm for any sweep rate faster than 50μs/cm.

23c. (Cont)

TIME BASE A TIME/CM	TYPE 184	Adjust	For
.05μSEC	10nS	C384	Midr
.05μSEC	10nS	C364	Long as possible
.05μSEC	10nS	C160A	1 cycle/cm
.05μSEC	10nS	C372	1 cycle/cm

Check C160A and C372 for interaction.

Check Mag on timing from 5th to 45th cycle for less than ±3% and linearity as in 17b. Turn 5X MAGNIFIER OFF.

A T/CM	184	Adjust	Check for	Tolerance
.05μS	50nS	C384	1 cycle/cm	±2%
.1μS	.1μS	C160B	1 cycle/cm	±2%
.2μS	.1μS	C160B	2 cycle/cm	±2%
.5μS	.5μS	C160B	1 cycle/cm	±2%
1μS	1μS	C160C	1 cycle/cm	±2%
2μS	1μS	C160C	2 cycle/cm	±2%
5μS	5μS	C160C	1 cycle/cm	±2%
10μS	10μS	C160E	1 cycle/cm	±2%
20μS	10μS	--	2 cycle/cm	±2%
50μS	50μS	--	1 cycle/cm	±2%

Check the .1μS to 5μS 5X MAGNIFIER ON timing for ±3%.

c. C384, C364 and C160A are adjusted in the center of a magnified sweep. C372 is adjusted at center three divisions with sweep start set on 0 graticule line. Sweep start is found by increasing intensity.

Retiming with C384 timing short will indirectly lengthen the .5μS range in relation to .1μsec.

24. DELAY START AND STOP

a. Set Delay Start Adj R436 and Delay Stop Adj R432

Change HORIZONTAL DISPLAY to B INTENSIFIED BY A. Set TIME BASE B TIME/CM at .5mSEC and set TIME BASE A TIME/CM at 10μSEC. Set TYPE 184 for .5mS markers and adjust TIME BASE B STABILITY and TRIGGERING LEVEL for a stable display.

Set DELAY-TIME MULTIPLIER at 1.00 and adjust Delay Start Adj R436 so that the intensification begins at the first time mark.

24a. (Cont)

Set DELAY-TIME MULTIPLIER at 9.00 and adjust R432 so that the intensification begins at the top of the 9th time mark. Repeat the Delay Start and Delay Stop adjustments until no further adjustment is necessary. Make final adjustments with HORIZONTAL DISPLAY switch at A DLY'D BY B.

b. Check linearity: ±2 minor dial div

With HORIZONTAL DISPLAY at A DLY'D BY B, check linearity at each major dial division between 1.00 and 9.00 as follows:

TYPE 184 time mark at start of trace	DELAY TIME MULTI-PLIER	Tolerance: minor dial divisions
1st	1.00	Adjustable
2nd	2.00	2
3rd	3.00	2
4th	4.00	2
5th	5.00	2
6th	6.00	2
7th	7.00	2
8th	8.00	2
9th	9.00	Adjustable

25. DELAY PICKOFF JITTER

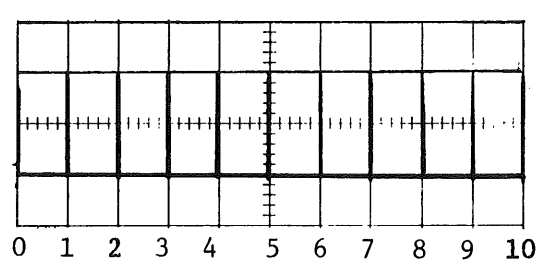
a. Setup

Set the TYPE 184 for 1mS markers. Adjust the Variable Atten and VERTICAL POSITION control to obtain 4cm of vertical amplitude with the display centered.

Set the TYPE 585A controls as follows:

HORIZONTAL DISPLAY	B INTENSIFIED BY A
TIME BASE B TIME/CM	1mSEC
TIME BASE A TIME/CM	1μSEC
TIME BASE A STABILITY	cw
TIME BASE B STABILITY and TRIGGERING LEVEL	Adjust for a stable display

The marker which appears at the beginning of the trace is the "zero" time mark since it marks the beginning of time or "time zero". The next marker is the first time mark since it denotes the end of the first time increment. With TIME/CM at 1mSEC and with 1mS markers applied, the markers are illustrated in the following drawing:



25. (Cont)

b. Check jitter at 1.00: 2mm, max

Adjust DELAY-TIME MULTIPLIER so that the first time mark is intensified. Change HORIZONTAL DISPLAY to A DLY'D BY B and if necessary, adjust DELAY-TIME MULTIPLIER to position the leading edge of the first time mark on the CRT. Check the leading edge of the marker for horizontal jitter (2mm or less).

b. In addition to jitter some slow drift may be present. Drift at the rate of 2cm/sec, or less is normal.

c. Check jitter at 9.00: 4mm, max

Change the HORIZONTAL DISPLAY to B INTENSIFIED BY A and adjust the DELAY-TIME MULTIPLIER so that the leading edge of the ninth time mark is displayed on the CRT. Change the HORIZONTAL DISPLAY to A DLY'D BY B and check the leading edge of the marker for horizontal jitter. (4mm or less)

Repeat the jitter checks with TIME BASE A TIME/CM at .5μSEC and TIME BASE B TIME/CM at .5mSEC. Use .5mS markers from the TYPE 184.

Repeat the jitter checks again using 1st and 18th markers, with TIME BASE A TIME/CM at .2μSEC and TIME BASE B TIME/CM at .2mSEC. Use .1mS markers from the TYPE 184.

26. TIME BASE B TIMING

a. Check slow sweep rate accuracy: ±0.625% error max; except .2, .5 and 1SEC ±1% max

Set TIME BASE B TIME/CM to .2mSEC. Set the TYPE 184 to .1mS. Use the following table to check slow sweep rate accuracy. Use B INTENSIFIED BY A to locate time marks and check accuracy with the HORIZONTAL DISPLAY in A DLY'D BY B.

a. Slow sweep rates

The delay time at slow sweep rates keeps the repetition rate low. One method of speeding up this check is to use min LENGTH while finding the time mark at 1.00 then increasing the LENGTH to max to measure accuracy at 9.00.

26a. (Cont)

TIME BASE B TIME/CM	TIME BASE A TIME/CM	TYPE 184	minor div difference between 1.00 & 9.00
.2mSEC	5μSEC	.1mS	±5 max
.5mSEC	10μSEC	.5mS	±5 max
1mSEC	10μSEC	1mS	±5 max
2mSEC	20μSEC	1mS	±5 max
5mSEC	50μSEC	5mS	±5 max
10mSEC	.1mSEC	10mS	±5 max
20mSEC	.2mSEC	10mS	±5 max
50mSEC	.5mSEC	50mS	±5 max
.1SEC	1mSEC	.1S	±5 max
.2SEC	2mSEC	.1S	±8 max
.5SEC	5mSEC	.5S	±8 max
1SEC	10mSEC	1S	±8 max

b. Adjust fast sweep rates C260C & C260A: error ±0.625%, max

Set TIME BASE B TIME/CM to 50μSEC; TIME BASE A TIME/CM to 2μSEC. Change TYPE 184 to 50μS. Set the HORIZONTAL DISPLAY to B INTENSIFIED BY A. Adjust C260C for 1 mark/cm. Change HORIZONTAL DISPLAY to A DLY'D BY B for final adjustment (1.00 to 9.00).

Change TIME BASE B TIME/CM to 5μSEC, TIME BASE A TIME/CM to .2μSEC and TYPE 184 to 5μS. Set the HORIZONTAL DISPLAY to B INTENSIFIED BY A and adjust C260A for 1 mark/cm. Make final adjustment in A DLY'D BY B. (1.00 to 9.00).

Use the following table to check fast sweep accuracy:

TIME BASE B TIME/CM	TIME BASE A TIME/CM	TYPE 184	minor div difference between 1.00 & 9.00
2μSEC	.1μSEC	1μS	±5 max
5μSEC	.2μSEC	5μS	±5 max
10μSEC	.5μSEC	10μS	±5 max
20μSEC	1μSEC	10μS	±5 max
50μSEC	2μSEC	50μS	±5 max
.1mSEC	5μSEC	.1mS	±5 max

27. + GATE INTERVAL

a. Setup

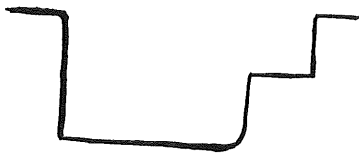
Remove the TYPE 184 signal and change the HORIZONTAL DISPLAY to A. Set the test scope input coupling to DC and connect a 10X probe to the Vertical Input. Connect the probe tip to the + GATE A binding post.

b. Check + GATE Interval: limits listed in table; Amplitude: 20V min

Check A & B + GATE Interval as listed in the table below. Change test scope TIME/CM TRIGGERING LEVEL and STABILITY control settings as necessary.

TIME/CM	TIME BASE A + GATE Interval	TIME BASE B + GATE Interval
.05μSEC	3 to 9μs	
.1μSEC	3 to 9μs	
.2μSEC	3 to 9μs	
.5μSEC	3 to 9μs	
1μSEC	15 to 40μs	
2μSEC	15 to 40μs	5 to 15μs
5μSEC	15 to 40μs	5 to 15μs
10μSEC	15 to 40μs	5 to 15μs
20μSEC	15 to 40μs	50 to 150μs
50μSEC	15 to 40μs	50 to 150μs
.1mSEC	150 to 400μs	50 to 150μs
.2mSEC	150 to 400μs	.5 to 1.5ms
.5mSEC	150 to 400μs	.5 to 1.5ms
1mSEC	1.5 to 4ms	.5 to 1.5ms
2mSEC	1.5 to 4ms	5 to 15ms
5mSEC	1.5 to 4ms	5 to 15ms
10mSEC	15 to 40ms	to to 15ms
20mSEC	15 to 40ms	50 to 150ms
50mSEC	15 to 40ms	50 to 150ms
.1SEC	150 to 400ms	50 to 150ms
.2SEC	150 to 400ms	50 to 150ms
.5SEC	150 to 400ms	50 to 150ms
1SEC	150 to 400ms	50 to 150ms
2SEC	150 to 400ms	

b. The + GATE A waveform with TIME BASE A TIME/CM at 1mSEC and .05μSEC and the + GATE B waveform with TIME BASE B TIME/CM at .1mSEC and 2μSEC should resemble the following illustration with the final portion flat.



27. (Cont)

c. Check DLY'D TRIG (5V min), and SAWTOOTH A (130V min) front panel waveforms

Connect probe to the DLY'D TRIG and SAWTOOTH A output jacks and check for proper amplitude and waveform.

c. The SAWTOOTH A waveform should display a flat segment between sawtooth waveforms with TIME BASE A TIME/CM at .05μs, indicating holdoff time. A worthwhile practice is to check the DLY'D TRIG waveform in all positions of the HORIZONTAL DISPLAY switch with TIME BASE A TIME/CM at .05μSEC and TIME BASE B TIME/CM at 2μSEC.

28. LOCKOUT LEVEL

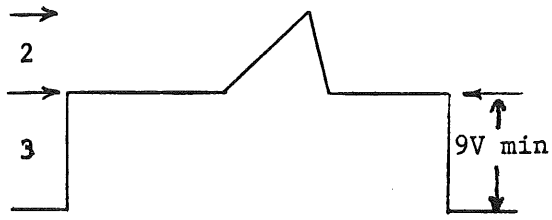
a. Adjust Lockout Level Adj R125: Approx 2:3

Change the HORIZONTAL DISPLAY to B INTENSIFIED BY A. Set both TIME/CM controls to .1mSEC and TRIGGERING LEVEL controls cw. Turn TIME BASE B STABILITY cw and TIME BASE A STABILITY ccw.

Connect the test scope 10X probe to pin 2 of V125. Set test scope TIME/CM to .2mSEC and VOLTS/CM to .5.

Slowly turn TIME BASE A STABILITY cw until the sawtooth-gate waveform appears on the test scope. Adjust Lockout Level Adj R125 for a sawtooth to gate amplitude ratio of approximately 2:3. Readjust TIME BASE A STABILITY as necessary. Remove the probe.

The waveform illustrated can be obtained by adjustment of the test scope VARIABLE TIME/CM and VARIABLE VOLTS/CM controls. With a total waveform amplitude of 5cm, adjust LOCKOUT LEVEL ADJ.



b. Check gate amplitude: 9V min

Check the amplitude of the gate portion of the waveform for 9volts or more.

c. Check SINGLE SWEEP triggering: sweeps once on triggering signal

Set Horizontal Display to A. Apply a .2V SAC signal to the TYPE 84 EXT INPUT. Adjust Variable atten control for 2mm of deflection. Adjust TIME BASE A STABILITY and TRIGGERING LEVEL for a stable display.

28c. (Cont)

Remove the signal from the INPUT and switch the HORIZONTAL DISPLAY to SINGLE SWEEP. Press the RESET button. The READY neon should light. Reconnect the signal to the INPUT and check that a single sweep is initiated and the READY light extinguished.

29. EXTERNAL HORIZONTAL

a. Adjust Ext Horiz DC Bal, R317: ±1cm max shift

Connect a jumper lead from SAWTOOTH A to TYPE 84 EXT INPUT thru the Variable Atten and switch the HORIZONTAL DISPLAY to EXT X1. Turn TIME BASE A STABILITY cw. Center the vertical trace on the graticule.

Rotate the VARIABLE 10:1 control back and forth while adjusting Ext Horiz DC Bal, R317 for no trace shift. Leave the VARIABLE 10:1 control cw.

b. Check for grid current: ±0.5cm max shift

Connect a jumper to HORIZ INPUT. Connect the other end of the jumper to ground while watching the trace for a horizontal shift.

c. Adjust C301C: X10 to X1 match ±5%

Connect a .5VOLT SAC signal to the HORIZ INPUT and to TIME BASE A TRIGGER INPUT. Set TIME BASE A TIME/CM at .2mSEC, TRIGGER SLOPE at +, and TRIGGERING SOURCE at EXT AC. Adjust STABILITY and TRIGGERING LEVEL for a stable display. Adjust the Variable Atten for 1 complete cycle of square-wave. Check the waveform aberrations. Change the HORIZONTAL DISPLAY switch to EXT X10 and the SAC to 5VOLTS.

Adjust C301C to match the X1 waveform ±5%.

29. (Cont)

d. Check external horizontal deflection factor: 0.2VOLTS/CM max

With the vertical trace displayed and the HORIZONTAL DISPLAY at EXT X1, switch the STANDARD SQUARE-WAVE CALIBRATOR to 1VOLT. Check the X1 deflection for 5.0cm or more with the VARIABLE 10:1cw.

e. Check EXT X10 attenuation: divides X1 gain by 10 ±2%

Switch the SAC to 2VOLTS and adjust the VARIABLE 10:1 for 8cm of horizontal deflection. Switch the HORIZONTAL DISPLAY to EXT X10 and switch SAC to 20VOLTS and check for 8cm ±2%.

f. Check VARIABLE 10:1 ratio: 10:1 min

Change the SAC to 10VOLTS and change the HORIZONTAL DISPLAY to EXT X1. Turn the VARIABLE 10:1 ccw and note the deflection.

Switch the HORIZONTAL DISPLAY to EXT X10 and turn the VARIABLE 10:1 cw. The deflection is equal to, or greater than before.

g. Check bandwidth: 350kHz or more at -3dB

Remove the SAC signal. Set the HORIZONTAL DISPLAY to EXT X1 and turn the VARIABLE 10:1 fully cw. Apply a 50kHz signal from the TYPE 191; through a 50Ω attenuator to the HORIZ INPUT. Adjust the TYPE 191 OUTPUT AMPLITUDE for exactly 4cm of horizontal deflection.

Without changing the TYPE 191 OUTPUT AMPLITUDE increase the frequency until the amplitude decreases to 2.8cm. Check the frequency for 0.35MHz or more.

30. VERTICAL HF COMPENSATIONS

a. Setup

Set TIME BASE A TIME/CM at .2μSEC. Set the TYPE 84 LOAD to NORM and DISPLAY SELECTOR to PULSER. Adjust PULSER AMPLITUDE for a 2cm signal. Trigger scope for a stable display. Adjust FOCUS, ASTIGMATISM and INTENSITY for a sharp, waveform of min intensity. Vertically center the waveform.

b. Vertical amplifier presets

C1260 and C1261	near min capacity (slug out) located to rear of V1254
C1254 and C1214	near max capacity (slug in)
C1224, C1234 and C1244	mid r
C1276	near max capacity (located near rear vertical deflection plates)
R1293	about 10° from cw (located near front vertical deflection plates)
C1041 and C1042	near min capacity (slug out) located on V1044 tube socket

c. Recheck vertical gain ±2% max

Connect PULSER AMPLITUDE OUT to UNKNOWN INPUT of the SAC. Set SAC AMPLITUDE to 50Volts, + DC MIXED and connect SAC OUTPUT to the test scope. Set TYPE 84 PULSER AMPLITUDE for exactly 50Volts.

Check the Vert Gain for exactly 2.0cm deflection.

d. Adjust C1209, C1006

With TIME/CM at .1 or .2μSEC and X5 MAGNIFIER ON, adjust C1209 (near V1214) and C1006 (front tube side of delay line driver stage) for best level and min aberrations.

d. Over-all level

Check over-all level by periodically switching from fast to slow sweep speeds.

30. (Cont)

e. Adjust C1214 thru C1254

Starting with C1214, adjust C1214 thru C1254 for best level and min aberrations.

f. Adjust C1260, C1261

Adjust C1260 and C1261 for a square corner and min aberrations.

f. C1260, C1261 -- ringing

Ringing will occur if C1260 and C1261 are not kept near min capacity.

g. Adjust R1293, C1276

Change TIME/CM to 1 or 2μSEC and adjust R1293 and C1276 for best over-all level. Set TIME/CM to .05μSEC.

h. Check Vertical aberration: Flatness ≤2% P-P from 1mSec to .05μSec

Most of the vertical hf adjustments interact, repeat as necessary to obtain a waveform with flat top and minimum aberrations: 0.4mm, max.

h. Adjustment of R1293 effects gain, therefore Vert Gain Adj R1015 must be rechecked.

i. Selected R1204, C1204, R1205 and C1205

Select values of R1204, C1204, R1205, and C1205 (input of vert output stage) for no peaks or dip on 5μSEC and 50μSEC. Do not select parts until all efforts to adjust for best waveform have been exhausted. Nominal values are 4Ω and .01μF. Present value limits are 2 to 7Ω, 1/2W 1% and .1 to .005μF capacitors.

A rolloff or peak can usually be corrected by changing resistive elements, decreasing for a peak and increasing for rolloff. A hump or dip can usually be corrected by changing capacitive elements, decreasing for a hump and increasing for dip.

i. Selected parts

The selected parts provide compensation for mismatch in termination networks. The mismatch appears as a deviation from a flat top waveform behind the leading edge as observed at slower sweep speeds (.5μSEC and slower). Picking components often requires much trial and error before achieving success. Do not attempt unless aberrations are actually out of limits.

j. Check with side panel

Install the left side panel (cabinet, RM585A) or shield the output stage -- CRT deflection plate area. Recheck the front corner and overall level. It may be necessary to slightly readjust R1293.

31. VERTICAL DELAY 40nsec, min

Set the TYPE 585A TIME/CM to .05μSEC.
Set 5X MAGNIFIER to ON.

Adjust TRIGGERING LEVEL so that rising portion of the waveform is 4cm or more from the sweep start. (40nsec or more)

32. VERTICAL BANDWIDTH

a. Setup

Remove the TYPE 84 and install the Bandwidth Plug-In. Set the TYPE 585A TIME BASE A TRIGGER SOURCE to INT HF SYNC.

Apply 20nS markers from the TYPE 184 to the Bandwidth Plug-In INPUT. Adjust the TIME BASE A STABILITY and TRIGGERING LEVEL for a stable display. With the HORIZONTAL POSITION control near midr, check the timing accuracy over the full 10cm of the graticule. If the timing is short, note the amount. If the timing is long use the VARIABLE TIME/CM to set it for exactly 5 cycles in 10cm.

Remove the TYPE 184 signal. Set the AMPLITUDE SET switch to AMPLITUDE SET, and the CONSTANT switch to CONSTANT VERTICAL IN BANDWIDTH. Set the TYPE 585A STABILITY control cw and adjust the Bandwidth Plug-In AMPLITUDE control for 2cm of vertical amplitude.

b. Check Vertical Bandwidth: 95MHz or more at -3dB

Set the AMPLITUDE SET switch to 50 to 100MHz and adjust the FREQUENCY control for 1.4cm of vertical amplitude. (-3dB) Adjust TRIGGERING LEVEL and STABILITY for a stable display. Check for 9.5 cycles or more in 10cm. (95MHz) Return VARIABLE TIME/CM to CALIBRATED.

33. TIME BASE A HIGH FREQUENCY TRIGGERING

a. Check external HF triggering: EXT 0.4V at 50MHz; 1.2V 100MHz; 1.5V at 150MHz; HF SYNC 0.2V at 150MHz

Connect 50Ω cable from Bandwidth Plug-In TRIG OUT to A TRIGGER INPUT. Use the following table to check External HF triggering. Set amplitude with the Bandwidth Plug-in at AMPLITUDE SET.

a. Triggering frequency is read from the TYPE 585A display:
50MHz = 1 cycle/2cm
100MHz = 1 cycle/cm
150MHz = 3 cycles/2cm

(TIME/CM .1μSEC, 5X MAGNIFIER ON)

TRIGGERING SOURCE	amplitude	frequency	TRIGGER SLOPE
EXT AC	0.4V P-P	50MHz	---
EXT DC	0.4V P-P	50MHz	+ or -
EXT DC	1.2V P-P	100MHz	+ or -
EXT AC	1.2V P-P	100MHz	+ or -
EXT AC	1.5V P-P	150MHz	+ or -
EXT DC	1.5V P-P	150MHz	+ or -
EXT HF SYNC	0.3V P-P	150MHz	+ or -

Variable TRIGGERING LEVEL and STABILITY

b. Check Internal HF triggering: INT 1cm at 50MHz; 2cm at 100MHz; 2.5cm at 150MHz; HF SYNC 3mm at 150MHz

Change the TYPE 585A TIME BASE A TRIGGERING SOURCE to INT HF SYNC. Set the Bandwidth Plug-In CONSTANT switch to CONSTANT VERTICAL IN BANDPASS. Adjust the AMPLITUDE control for 2.5cm of 150MHz signal. Check INT HF triggering using the following table.

TRIGGERING SOURCE	amplitude	frequency	TRIGGER SLOPE
INT HF SYNC	3mm	150MHz	---
INT AC	2.5cm	150MHz	+ or -
INT AC LF REJ	2.5cm	150MHz	+ or -
INT AC LF REJ	2.0cm	100MHz	+ or -
INT AC	2.0cm	100MHz	+ or -
INT AC	1.0cm	50MHz	+ or -
INT AC LF REJ	1.0cm	50MHz	+ or -

Variable TRIGGERING LEVEL and STABILITY

34. LOW FREQUENCY TRIGGERING

Set TIME/CM switches to 50μSEC when checking 15kHz.

a. Check TIME BASE A LF triggering
INT 2mm 15Hz and 15kHz
EXT 0.3V 15Hz and 15kHz

Install a BNC "T" connector on the INPUT of the Bandwidth Plug-In. Connect a 50Ω coax cable from the "T" connector to the A TRIGGER INPUT.

Connect the output of the LFSWG to the "T" connector. Set TIME BASE A and B TIME/CM switches to 50mSEC. Use the following table to check LF triggering. Check EXT triggering amplitude with test scope.

TRIGGERING SOURCE	amplitude	frequency	TRIGGERING SLOPE
INT AC	2mm	15Hz	+ & -
INT AC	2mm	15kHz	+ & -
INT AC LF REJ	2mm	15kHz	+ & -
EXT AC and DC	0.3V P-P	15Hz	+ & -
EXT AC and DC	0.3V P-P	15kHz	+ & -

Variable TRIGGERING LEVEL

b. Check TIME BASE B LF triggering
INT 4mm at 15Hz and 15kHz
EXT 0.5V at 15Hz and 15kHz

Set HORIZONTAL DISPLAY to B and move 50Ω cable to B TRIGGER INPUT. Use the following table to check LF triggering. Check EXT triggering amplitude with test scope.

TRIGGERING SOURCE	amplitude	frequency	TRIGGERING SLOPE
INT AC	4mm	15Hz	+ & -
INT AC	4mm	15kHz	+ & -
INT AC LF REJ	4mm	15kHz	+ & -
EXT AC and DC	0.5V P-P	15Hz	+ & -
EXT AC and DC	0.5V P-P	15kHz	+ & -

Variable TRIGGERING LEVEL

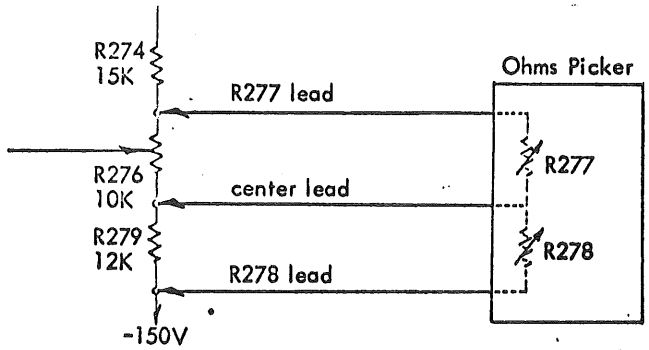
Set HORIZONTAL DISPLAY to A and remove LFSWG Signal.

35. TIME BASE B SWEEP LENGTH

a. Setup

Set the TYPE 184 for 1mS and .1mS marks. Change HORIZONTAL DISPLAY to B, B TIME/CM to 1mSEC and use STABILITY and TRIGGERING LEVEL to obtain stable display.

Connect Ohms Picker.



b. Set B Sweep LENGTH -- cw: 10.2 to 10.8cm, ccw: 3.2 to 3.8cm

Set ohms picker R277 and R278 controls so that when TIME BASE B LENGTH is cw, trace is 10.2 to 10.8cm and 3.2 to 3.8cm with LENGTH at ccw. Remove ohms picker.

Note ohms picker R277 and R278 values. Select 10% 1/2W comp resistors to correspond to ohms picker values and install them in the TYPE 585A.

Check sweep length with LENGTH ccw and cw and TIME/CM at 50mSEC.

SAMPLE CHECKS

[THE FOLLOWING CHECK IS NOT MADE ON 100% of the INSTRUMENTS BUT IS DONE ON A SAMPLING BASIS.]

I. HF SYNC at 250MHz INT 4mm; EXT 0.2V P-P

Connect the output of the CASG (067-0532-00) to bandpass plug-in INPUT.

Check INT HF SYNC with a 4mm display amplitude at 250MHz.

Check EXT HF SYNC with a 0.2V P-P 250MHz singal. Use 3MHz Amplitude reference to determine amplitude.