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

565

December 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 540 series OSCILLOSCOPE
1	TYPE 1A1 PLUG-IN UNIT
2	TYPE 3A1 PLUG-IN UNITS
* 1	TYPE 184 TIME-MARK GENERATOR
* 1	TYPE 191 CONSTANT-AMPLITUDE SIGNAL GENERATOR
1	TYPE 106 SQUARE-WAVE GENERATOR
1	TYPE 76TU LINE-VOLTAGE CONTROL UNIT

b. Test Fixtures and Accessories

2	TEST LOAD UNITS (TU-4) (067-0065-00)
* 1	STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
1	CRT CAPACITANCE NORMALIZER (3M1) (067-0500-00)
1	565 Auxiliary Load (PMIE drawing no. 655-A)
4	50Ω, 42 inch BNC cables (012-0057-00)
2	6" banana plug jumpers (012-0024-00)
4	18" banana plug jumpers (012-0031-00)
2	BNC 'T' connectors (103-0030-00)
1	10X PROBE, P6010 (010-0188-00)
1	1X PROBE, P6011 (010-0193-00)
1	UHF male to BNC female adapter (103-0015-00)
1	GR to BNC female adapter (017-0063-00)
1	50Ω BNC Termination (011-0049-00)
1	Graticule (331-0047-00)

c. Other Equipment

1	Multimeter, 20,000Ω/VDC

d. Equipment for Sample Checks

*1	ESI Model 300 P.V.B.
1	BNC to dual binding post adapter (103-0035-00)

* 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.

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 alignment: ≤1 minor div in 10 div.

4. POWER SUPPLIES

c. Ripple and regulation
105 VAC to 125 VAC: high load

Supply	Tolerance	Max Ripple
-100V	±2%	5mV
+125V	±2%	10mV
+300V	±2%	80mV
-12.2V	±2.5%	5mV

d. Other voltages:

CAMERA POWER 6.3 VAC
AUX POWER JACK

A.+300	F. gnd
B.+125	H. 100
C.6.3 VAC	J. gnd
D.gnd (6.3 VAC)	K.+420 unreg
E.-12.2	

5. HIGH VOLTAGE -3900V, ±3%

6. SCALE ILLUM

No illumination ccw
Max illumination cw

7. ALTERNATE SWEEP

All sweep rates

8. CHOPPED BLANKING

Upper portion of display blanks

9. CRT ALIGNMENT

a. TRACE ALIGNMENT control range: ≥1 div in 10 div
b. Upper and lower trace alignment: ≤1 minor div in 10 div.
c. Upper and lower trace Parallax: ≤1 minor div in 10 div.

10. CRT PLATES COMPENSATION

b. CRT compensation: flat topped, ±0.5 minor div

11. HORIZONTAL DC BALANCE AND GRID CURRENT

a. Horizontal DC balance: must position off the graticule in both directions
b. Grid current: 1 div, max

12. ASTIGMATISM AND GEOMETRY

c. Geometry: ≤0.5 minor div in 8 div

13. VERTICAL DEFLECTION FACTOR AND ELECTRICAL CENTER

a. Deflection factor: 17.4 to 19.6V/div

b. Electrical center:

Deflection factor	Max distance in minor div
17.4	3.50
18.0	3.25
18.5	3.00
19.0	2.75
19.6	2.50

14. HORIZONTAL ELECTRICAL CENTER

≤2.5 minor div.

15. AMPLITUDE CALIBRATOR

* b. Amplitude Calibrator: ≤2% error

c. Calibrator frequency: 1kHz, ±20% max

d. Calibrator duty cycle: 40-60%

17. RF NEUTRALIZATION

b. Check for minimum RF modulation

18. INTERNAL TRIGGER

b. AUTO: + & - on 1 minor div

c. AC: + & - on 1 minor div

d. AC FAST: + & - on 1 minor div

e. DC: + & - on 1 minor div

f. UPPER BEAM-LOWER BEAM switches: Must select proper beam

g. Crosstalk: no sweep

h. Sine-wave triggering:
+ & - on 0.3 major div at 1 MHz
+ & - on 1.0 major div at 2 MHz

19. EXTERNAL TRIGGER

b. AUTO, AC, AC FAST & DC:
+ & - on 1V at 2 MHz
+ & - on 0.5V at 50 kHz

c. LEVEL centering: ±20° of 0

d. LEVEL range & FREE RUN: ±10V, min

20. LINE TRIGGER

+ & - on right polarity

21. HORIZONTAL AMPLIFIERS AND SWEEP LENGTH

b. X1 Gain and Sweep Length:
X1 gain: ±2%, max
Sweep Length: 10.5div, ±0.3div

22. MAGNIFIER GAIN

* b. Magnified timing: ±0.4 minor div, max

23. SWEEP/MAGNIFIER REGISTRATION AND POSITION RANGE

a. Registration: ≤1 minor div

b. POSITION range: position past graticule center with 10X MAG on.

24. VARIABLE TIME/DIV AND NEONS

a. VARIABLE range: 2.5:1, min

b. UNCAL neons:
off in CALIBRATED
on in UNCAL

25. 'A' AND 'B' FAST TIMING

b. Beam registration: ≤1% over center 4 div

26. 'A' SWEEP TIME/DIV AND MAGNIFIER

*a. TIME BASE 'A' Timing

TIME/DIV	A on UB	A on LB
1μSEC-5μSEC	±2%, max	±3%, max
10μSEC-.5SEC	±2%, max	±2%, max
1 SEC-5 SEC	±2.5%, max	±2.5%, max

*b. 'A' 10X MAG
UB: ±3%, max
LB: ±5%, max

27. 'B' SWEEP TIME/DIV AND MAGNIFIER

*a. TIME BASE 'B' Timing

TIME/DIV	B on LB	B on UB
1μSEC-5μSEC	±2%, max	±3%, max
10μSEC-.5 SEC	±2%, max	±2%, max
1 SEC-5 SEC	±2.5%, max	±2.5%, max

*b. 'B' 10X MAG
LB: ±3%, max
UB: ±5%, max

28. LOCKOUT LEVEL AND CONTRAST CONTROL

b. Lockout level: sawtooth to gate amplitude of 2:3, ±0.5div in 5div
c. Contrast control:
full ccw, min contrast
full cw, max contrast

29. DELAY INTERVAL

*c. DELAY INTERVAL incremental error: ±0.4%, max
d. Delay jitter: 2 minor div, max
e. Bright up shift: 1 minor div, max
f. Delay start: 0.20 max at 10μSEC
*g. TIME BASE 'A' error using DELAY INTERVAL dial: .1mSEC-.5 SEC, ±1.5% max
1, 2,& 5 SEC, ±2% max

30. EXTERNAL HORIZONTAL

*a. Deflection factor: 0.08V/div, min
*b. Bandwidth: 350kHz @-3dB

31. HOLDOFF

b. Holdoff

TIME/DIV	holdoff
1, 2, 5μSEC	12-60μs
10, 20, 50μSEC	17-68μs
.1, .2, .5mSEC	125-375μs
1, 2, 5mSEC	1.25-3.75ms
10, 20, 50mSEC	12.5-37.5ms
.1, .2, .5 SEC	125-375ms
1, 2, 5 SEC	125-375ms

32. REAR PANEL OUTPUTS AND CRT INPUT

b. Output waveforms:

output jack	min signal
UPPER VERT SIG OUT	20V square-wave
LOWER VERT SIG OUT	20V square-wave
UPPER HORIZ SIG OUT	5V sawtooth
LOWER HORIZ SIG OUT	5V sawtooth
'A' + GATE OUT	20V pulse
'B' + GATE OUT	20V pulse

c. Delayed trigger out: 10V min
d. CRT grid: modulates with 10V
e. Random triggering of alternate sweep: ≤4 random triggers in 20sec

SAMPLE CHECKS

*33. CALIBRATOR ACCURACY

AMPLITUDE CALIBRATOR	resistance
.001	10Ω (9.90 to 10.14)
.01	99.02Ω (98.03 to 100.01)
.1	901.9Ω (893.03 to 911.5)

THE END

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

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. Check DELAY INTERVAL dial
   Check for a dial reading of 0.00
b. Check fuses
   F601 6.25A slow blow 115V
   F601 3.0A slow blow 234V
   F640 2.0A slow blow -12.2V
   F606 1.0A fast blow 6.3VAC
c. Check CRT
d. Check CRT alignment: ≤1 minor div in 10div

2. TYPE 565 PRESET

a. Preset external controls
b. Preset internal adjustments

3. RESISTANCE CHECKS

a. Check supplies
b. Check transformer
c. Check EXT HORIZ GAIN controls

4. POWER SUPPLIES

b. Adjust -100V, R624
c. Check ripple and regulation
   Check while varying TYPE 76TU from 105 to 125VAC

Supply	Tolerance	Max Ripple
-100V	±2%	5mV
+125V	±2%	10mV
+300V	±2%	80mV
-12.2V	±2.5%	5mV

d. Check other voltages
   Check pin #35 on T601 for approx +125V
   Check CAMERA POWER for 6.3VAC
   AUXILIARY LOAD for the following:

4d. (cont)

Pin	Voltage	Pin	Voltage
A	+300	F	gnd
B	+125	H	-100
C	6.3VAC	J	gnd
D	gnd	K	+420 unreg
E	-12.2		

5. HIGH VOLTAGE

Adjust R861 for -3900V ±3%

6. SCALE ILLUM

No illumination ccw
Max illumination cw

7. ALTERNATE SWEEP

Alternates at all sweep speeds

8. CHOPPED BLANKING

Upper portion of display blanks

9. CRT ALIGNMENT

a. Check TRACE ALIGNMENT control range: ≥1div in 10div
b. Check upper and lower trace alignment: ≤1 minor div in 10div
c. Check upper and lower trace parallax: ≤1 minor div in 10div

10. CRT PLATES COMPENSATION

b. Adjust CRT compensation: C741, C751
Adjust for flat topped square wave
±0.5 minor div

11. HORIZONTAL DC BALANCE AND GRID CURRENT

a. Check horizontal DC balance: must position off graticule in both directions.
b. Check grid current: 1div, max

12. ASTIGMATISM AND GEOMETRY

b. Adjust astigmatism and focus.
c. Check geometry: ≤0.5 minor div over 8div, each beam
Adjust R852 and R872 for best geometry on both beams.

13. VERTICAL DEFLECTION FACTOR AND ELECTRICAL CENTER

a. Check deflection factor: 17.4 to 19.6V/div
b. Check electrical center:

Deflection Factor V/div	V X 8div	Max distance Minor div
17.4	139.2	3.5
18.0	144	3.25
18.5	148	3.0
19.0	152	2.75
19.6	156.8	2.5

14. HORIZONTAL ELECTRICAL CENTER

Short horizontal deflection plates together. Check electrical center ≤2.5 minor div

15. AMPLITUDE CALIBRATOR

b. Check AMPLITUDE CALIBRATOR error: ≤2%
Remove V905 and adjust R910. Check AMPLITUDE CALIBRATOR as follows:

15b. (cont)

SAC and 565 CALIBRATOR	TYPE 1A1 VOLTS/CM	Max error allowed
.001V	.005	——
.01V	.005	0.4mm
.1V	.005	4mm
1V	.01	2cm
10V	.1	2cm
100V	1	2cm

c. Check calibrator frequency: 1kHz, ±20%
Check for 8 to 12 cycles in 10cm

d. Check calibrator duty cycle: 40 - 60%
Set for 1 cycle in 10cm. Length of the half cycle should be 4 to 6cm.

16. STABILITY

Set STABILITY half-way between the point where the sweep starts and where it free runs.

17. RF NEUTRALIZATION

b. Adjust C808 for minimum modulation

18. INTERNAL TRIGGER

b. Check AUTO: + & - on 1 minor div
c. Check AC: + & - on 1 minor div
d. Check AC FAST: + and - on 1 minor div
e. Check DC: + & - on 1 minor div
f. Check UPPER BEAM-LOWER BEAM switches: Must select proper beam
g. Check crosstalk: no sweep
h. Check sine-wave triggering:
+ and - on 0.3div at 1MHz
+ & - on 1.0div at 2MHz

19. EXTERNAL TRIGGER

b. Check AUTO, AC, AC FAST and DC:
+ & - on 1V at 2MHz
+ & - on 0.5V at 50kHz
c. Check LEVEL centering: ±20° of 0
d. Check LEVEL range and FREE RUN: ±10V min

20. LINE TRIGGER

Check that sweep triggers on the right polarity for SLOPE switch in + & -.

21. HORIZONTAL AMPLIFIER AND SWEEP LENGTH

b. Adjust X1 Gain and Sweep Length:
Adjust R434 for 1msec mark/div.
Adjust R178 for 10.5div, ±0.3div.
Adjust R484 for same marks as upper beam.
Adjust R278 for 10.5div, ±0.3div.

c. Adjust sweep balance:
Adjust R989 and R979 for exact coincidence of time marks on both beams

22. MAGNIFIER GAIN

a. Set upper beam 10X Gain:
Adjust R431 for exact coincidence of time marks on both beams

b. Check magnified timing:
Check X10 timing error, ±0.4 minor div, max
With TIME BASE 'B' 10X on adjust R481.

23. SWEEP MAGNIFIER REGISTRATION AND POSITION RANGE

a. Adjust Upper and Lower Beam Sweep Mag Regis: ≤1 minor div

b. Check POSITION range: must position past graticule center with 10X MAG on

24. VARIABLE TIME/DIV AND NEONS

a. Check VARIABLE range: 2.5:1, min

b. Check UNCAL neons:
off in CALIBRATED
on in UNCAL

25. 'A' AND 'B' FAST TIMING

a. Adjust 'A' and 'B' fast speed timing
Adjust C160C for one 10μSEC mark/div on A
Adjust C160A for one 1μSEC mark/div on A
Adjust C260C for one 10μSEC mark/div on B
Adjust C260A for one 1μSEC mark/div on B

b. Check beam registration: ≤1% over center 4div

26. 'A' SWEEP TIME/DIV AND MAGNIFIER

a. Check all ranges of TIME BASE 'A' as follows:

TIME/DIV	A on UB	A on LB
1μSEC - 5μSEC	±2%, max	±3%, max
10μSEC - .5SEC	±2%, max	±2%, max
1SEC - 5SEC	±2.5%, max	±2.5%, max

b. Check 'A' 10X MAG:
UB: ±3%, max
LB: ±5%, max

27. 'B' SWEEP TIME/DIV AND MAGNIFIER

a. Check all ranges of TIME BASE 'B' as follows:

TIME/DIV	B on LB	B on UB
1μSEC - 5μSEC	±2%, max	±3%, max
10μSEC - .5SEC	±2%, max	±2%, max
1SEC - 5SEC	±2.5%, max	±2.5%, max

b. Check 'B' 10X MAG:
LB: ±3%, max
UB: ±5%, max

28. LOCKOUT LEVEL AND CONTRAST RATIO

b. Adjust Lockout Level (R225)
Adjust R225 for a sawtooth to gate amplitude of 2:3 ±0.5div

c. Contrast Control (R848)
CCW min contrast
CW max contrast

29. DELAY INTERVAL

b. Adjust Delay Start and Delay Stop (R336, R332)
c. Check DELAY INTERVAL incremental error: ±0.4%, max
d. Check delay jitter: 2 minor div, max
e. Check bright up shift: 1 minor div, max
f. Check delay start: 0.20 max at 10μSEC
g. Check TIME BASE 'A' error using DELAY INTERVAL dial:
.1mSEC - .5SEC, ±1.5%, max
1SEC - 5SEC, ±2%, max

30. EXTERNAL HORIZONTAL

a. Check deflection factor: 0.08V/div, min
b. Check bandwidth: 350kHz @-3dB

31. HOLDOFF

b. Check holdoff:

TIME/DIV	Holdoff
1,2,5μSEC	12 - 60μSEC
10,20,50μSEC	17 - 68μSEC
.1,.2,.5mSEC	125 - 375μSEC
1,2,5mSEC	1.25 - 3.75mSEC
10,20,50mSEC	12.5 - 37.5mSEC
.1,.2,.5SEC	125 - 375mSEC
1,2,5SEC	125 - 375mSEC

32. REAR PANEL OUTPUTS AND CRT INPUT

b. Check output waveforms:

Output jack	Min signal
UPPER VERT SIG OUT	20V square-wave
LOWER VERT SIG OUT	20V square-wave
UPPER HORIZ SIG OUT	5V sawtooth
LOWER HORIZ SIG OUT	5V sawtooth
'A' + GATE OUT	20V pulse
'B' + GATE OUT	20V pulse

c. Check DLY'D TRIG OUT: 10V, min
d. Check CRT grid: modulates with 10V
e. Check random triggering of alternate sweep: ≤4 random triggers in 20SEC

THE FOLLOWING CHECK IS NOT MADE ON 100% OF THE INSTRUMENTS BUT IS DONE ON A SAMPLING BASIS

33. CALIBRATOR ACCURACY

Using an ESI model 300 PVB measure the following ranges:

AMPLITUDE CALIBRATOR	Resistance
.001	10Ω (9.9 - 10.14)
.01	99.02Ω (98.03 - 100.01)
.1	901.9Ω (893.03 - 911.5)

THE END

1. PRELIMINARY INSPECTION

a. Check DELAY INTERVAL dial

Set DELAY INTERVAL dial full ccw until it hits the stop. Check for a dial reading of 0.00.

b. If dial does not read 0.00 at ccw loosen dial set screw and reposition dial on shaft. Tighten set screw and check that dial operates smoothly without binding.

b. Check fuses

115V	F601	6.25A	SLO
234V	F601	3.0A	SLO
-12.2V	F640	2A	SLO
6.3 VAC	F606	1A	FAST

c. Check CRT

Inspect CRT for physical defects: Phosphor defects, scratches, chips, cracks around neck pins, etc. Push CRT against the graticule and check faceplate tilt. Check CRT for proper phosphor, serial number and code-date.

d. CRT specifications

Do not reject a CRT without consulting a CRT checker or the CRT Check-Out Procedure.

d. Check CRT alignment: ≤1 minor div in 10 div

Install an external graticule on the graticule studs. Align the internal graticule to the external graticule and tighten the CRT clamp. The error between the horizontal graticule lines must be ≤1 minor div in 10 div.

2. TYPE 565 PRESETS

a. Preset external controls

UPPER BEAM and LOWER BEAM	
INTENSITY	full ccw
FOCUS	midr
ASTIG	midr
SCALE ILLUM	full cw
TRACE ALIGNMENT	midr
CALIBRATOR	OFF
UPPER HORIZ DISPLAY	EXT
LOWER HORIZ DISPLAY	EXT

2a. (cont'd)

EXT HORIZ GAIN (both)	full cw
POWER	ON
DELAY INTERVAL	5.00
'B' MODE	NORMAL TRIGGER

	TIME BASE A	TIME BASE B
TRIGGER	UPPER BEAM INT	LOWER BEAM INT
COUPLING	AC	AC
SLOPE	+	+
LEVEL	full ccw (not AUTO)	full ccw (not AUTO)
STABILITY	full ccw	full ccw
POSITION	midr	midr
10X MAG	pushed in	pushed in
TIME/DIV	1mSEC	.2mSEC
VARIABLE	full cw	full cw

b. Preset internal adjustments

Set all internal adjustments to midr.

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

b. Do not preset internal adjustments for recalibration unless you are sure that a "start from scratch" policy is best.

3. RESISTANCE CHECKS

a. Check supplies

Check power supply resistance to ground.

Supply	approx resistance
-100V	2kΩ
+125	2kΩ
+300	7kΩ
-12	8Ω
+80 unreg	2kΩ
+210 unreg	3kΩ
+420 unreg	20kΩ
+ 6 unreg	12Ω

b. Check transformer

Check transformer resistances to ground.

Terminal	approx resistance
1	∞
2	∞
3	∞
4	∞
A	∞
B	∞
C	∞
D	∞
24	≥12MΩ

3. (cont'd)

c. Check EXT HORIZ GAIN controls

Measure the resistance to ground of both EXT HORIZ IN connectors while rotating the EXT HORIZ GAIN controls. The resistance should be approximately 100kΩ for all positions of the controls. Set the UPPER HORIZ DISPLAY switch to 'A' TIME BASE, the LOWER HORIZ DISPLAY switch to 'B' TIME BASE and the POWER ON switch to OFF.

4. POWER SUPPLIES

a. Setup

Plug the TEST LOAD UNITS into the TYPE 565 and the AUXILIARY LOAD to the AUX POWER JACK. Set both TEST LOADS as follows: SUPPLY, -100V; POSITION, midr; LOAD, NO LOAD; INDICATOR, 561. Set the TYPE 1A1 VOLTS/CM to .01 and the INPUT SELECTOR to DC. Connect a 50Ω cable from the TYPE 1A1 INPUT to the TEST LOAD RIPPLE & DC ERROR connector, using a BNC to UHF adapter. Connect the TYPE 565 to 117 VAC from the variable line voltage source and turn the POWER switch to ON and wait 10 minutes.

a. For first time power application the following steps should be done: Use about 20 VAC line (1/6 normal line voltage) and check all transformer secondarys for about 1/6 normal voltage (any very low reading indicates a shorted condition). Check all electrolytic filter caps for correct polarity. Check all raw DC outputs for full wave rectification waveform (an abnormal waveform may indicate a defective or improperly wired rectifier).

b. Adjust -100V Adj, R624

Push the PUSH FOR GND REF button and center the trace on the test scope, this indicates the zero error point. Release the button and adjust R624 for no error.

c. Check ripple and regulation

Check each power supply for ripple and regulation while varying the line voltage from 105 to 125 VAC. Return line voltage to 117 VAC.

c. At .01 volts/cm on the test scope each cm represents a 1% error in the supply being observed. Supply error is read in cm from the zero reference point.

Supply	Tolerance	Max Ripple
-100V	±2%	5mV
+125V	±2%	10mV
+300V	±2%	80mV
-12.2V	±2.5%	5mV

4. (cont'd)

d. Check other voltages

Check pin #35 on T601 for approx +125V and the back of CAMERA POWER for 6.3 VAC. Check the AUX POWER JACK (J780 on back of scope) using the AUXILIARY LOAD for the following voltages:

Pin	Voltage	Pin	Voltage
A	+300	F	gnd
B	+125	H	-100
C (htr)	6.3 AC	J	gnd
D (gnd)	gnd	K	+420 unreg
E	-12.2		

5. ADJUST HIGH VOLTAGE -3900V ±3%

Connect a multimeter to the HIGH VOLTAGE TEST POINT and adjust High Voltage, R861, for -3900V ±3%. Check for regulation from 105 VAC to 125 VAC line.

6. SCALE ILLUM No illumination ccw
Max illumination cw

Rotate the SCALE ILLUM control through its range. Check for smoothness of operation, open spots, no illumination at full ccw and maximum at full cw.

7. ALTERNATE SWEEP All sweep rates

Turn both LEVEL controls to FREE RUN. Switch both TEST LOADS to DUAL TRACE. Check each beam for a dual trace on all TIME/DIV settings of 50mSEC and faster.

7. Alternate sweep at sweep rates slower than 50mSEC exceed the capability of the TEST LOADS. Use the TYPE 3A1's if in doubt.

8. CHOPPED BLANKING

Set the TEST LOADS to NORMAL. Apply a 100 kHz, 1 div signal from the TYPE 106 to the SIGNAL INPUT fo the UPPER BEAM TEST LOAD. Connect a jumper from SIGNAL INPUT to Z AXIS INPUT of the TEST LOAD. The upper portion of the display should blank. Repeat step 8 for lower beam.

8. If the lower portion of the trace brightens appreciably, check the CRT cathode DC resistor diodes; D882, upper beam and D892, lower beam.

9. CRT ALIGNMENT

a. Check TRACE ALIGNMENT control range ≥1 div in 10div

With no signal applied, position both traces to the center graticule line. Rotate the TRACE ALIGNMENT control through its range. Both traces must have greater than 1 div of tilt in 10 div at full cw and full ccw.

b. Check upper and lower trace alignment ≤1 minor div in 10 div

Align the upper beam trace to the center graticule line with the TRACE ALIGNMENT control.

c. Check upper and lower trace parallax ≤1 minor div in 10 div

Position the lower beam trace to the upper beam trace. They must be parallel within one degree (≤1 minor div in 10 div).

10. CRT PLATES COMPENSATION

a. Setup

Replace the upper beam TEST LOAD with the CAPACITANCE NORMALIZER. Apply a 100V ⌐⌙ AMPLITUDE CALIBRATOR signal from the scope under test to the NORMALIZER input. Adjust TIME BASE 'A' TIME/DIV to 2mSEC, TRIGGER LEVEL and STABILITY for a stable display.

b. Adjust CRT compensation, C741, C751

Adjust CRT compensation C741 for the best square-wave, flat topped, ±0.5 minor div. Repeat step 10 for the lower beam using TIME BASE 'B' and adjusting C751.

11. HORIZONTAL DC BALANCE AND GRID CURRENT

a. Check horizontal DC balance

Install two TYPE 3A1 plug-ins. Defocus the trace. Set UPPER HORIZ DISPLAY and LOWER HORIZ DISPLAY to EXT. Each beam's POSITION controls must move the spot beyond both edges of the graticule.

11. (cont'd)

b. Check grid current 1 div, max

Turn both EXT HORIZ GAIN controls from full ccw to full cw. Check the spot shift, 1 div, max.

12. ASTIGMATISM AND GEOMETRY

a. Setup

Set the UPPER HORIZ DISPLAY switch to 'A' TIME BASE and the LOWER HORIZ DISPLAY switch to 'B' TIME BASE. Apply .1mS markers from the TYPE 184 to both TYPE 3A1 CH1 inputs. Set the CH1 VOLTS/DIV switches to 1. Set TIME BASE 'A' and TIME BASE 'B' TIME/DIV switches to 1mSEC and adjust STABILITY and TRIGGER LEVEL controls as needed to get a stable display.

b. Adjust astigmatism and focus

Adjust the FOCUS and ASTIG controls for each beam to obtain the best definition of the markers.

c. Check geometry *$\frac{<0.5 \text{ minor div over}}{8 \text{ div, each beam}}$*

Set the CH1 VOLTS/DIV switches to .5. Adjust STABILITY and TRIGGER LEVEL controls as needed to get a stable display. Position the markers so they go above and below the graticule. Adjust R852, Isolation Shield and R872, Intergun Shield (located above the mid-section of the CRT) for best geometry on both beams, readjusting FOCUS and ASTIG controls as needed. Note deviation from straight line, 0.5 minor div max over 8 div, each beam. Remove the signals from the TYPE 3A1 inputs.

c. It may be necessary to externally trigger the scope under test to get a stable display. Use the 1mS triggers from the TYPE 184 TRIGGER OUTPUT to the TRIG IN connectors using 2 50Ω cables and a "T" connector. Remove these after completing step 12, being sure to return the TRIGGER switches to INT.

13. VERTICAL DEFLECTION FACTOR AND ELECTRICAL CENTER

a. Check deflection factor
17.4 to 19.6V/div

Turn both LEVEL controls to free run and obtain a focused trace. Connect a multimeter across the upper beam vertical deflection plates. Set the trace to an extreme graticule line. Note meter reading. Move the trace eight divisions and again note meter reading. Total meter reading, divided by eight, must be between 17.4 and 19.6V.

b. Check electrical center

Short the upper beam deflection plates together. Note the distance from the trace to the CRT graticule center. Compare it to the table given. Repeat step 13 for the lower beam.

Deflection Factor V/div	Vx8 div	Max distance minor div
17.4	139.2	3.50
18.0	144.0	3.25
18.5	148.0	3.00
19.0	152.0	2.75
19.6	156.8	2.50

14. HORIZONTAL ELECTRICAL CENTER ≤2.5 minor div

Short the upper beam horizontal deflection plates together. Note the distance from the spot to the CRT graticule center. Repeat step 14 for the lower beam.

15. AMPLITUDE CALIBRATOR

a. Setup

Test Scope

TIME/CM	5mSEC
TRIGGERING MODE	AUTO
TRIGGERING SLOPE	-LINE

TYPE 1A1 PLUG-IN

1 & 2 INPUT SELECTOR	AC
1 & 2 VOLTS/CM	.1
1 & 2 VARIABLE	CALIBRATED
MODE	CH2

a. The SAC chops between the SAC precision calibrator and the TYPE 565 calibrator. The test scope display shows a square-wave with an amplitude equal to the voltage difference between the two calibrators. With the test scope triggered as directed in the setup the start of the test scope sweep will be the SAC voltage , therefore the polarity of the first

15a. (cont'd)

TYPE 565
AMPLITUDE CALIBRATOR .1

SAC

AMPLITUDE	.1
MODE	+DC, MIXED

Connect a 50Ω coax from the TYPE 565 CAL OUT to the SAC UNKNOWN INPUT. Connect a 50Ω coax from the SAC OUTPUT to the TYPE 1A1 INPUT 1 and one from CH1 SIGNAL OUT to INPUT 2.

15a. (cont'd)

square-wave indicates the direction of the error in the TYPE 565 calibrator.

b. Check AMPLITUDE CALIBRATOR error ≤2.0%

Remove V905 and adjust the Cal Ampl (R910) for min error (≤0.5cm) as read on the test scope (see notes column). Switch the TYPE 1A1 MODE to CH1 and check the AMPLITUDE CALIBRATOR accuracy with the controls set as follows:

b. The measurement accuracy is not adequate for the .01 and the .001 positions of the AMPLITUDE CALIBRATOR. For these two ranges refer to the sample check at the end of this procedure (step 33).

SAC & 565 CALIBRATOR	TYPE 1A1 VOLTS/CM	max error allowed
.001V	.005	---
.01V	.005	0.4mm
.1V	.005	4mm
1V	.01	2cm
10V	.1	2cm
100V	1	2cm

c. Check calibrator frequency 1 kHz ±20%

Reinstall V905. Change the SAC to UNKNOWN. Change the TYPE 1A1 VOLTS/CM to .005, the test scope TIME/CM to 1mSEC and TRIGGERING SLOPE to +INT. Set the AMPLITUDE CALIBRATOR to .001. Check for 8 to 12 cycles in 10cm.

d. Check calibrator duty cycle 40-60%

Change the AMPLITUDE CALIBRATOR to .01 and the test scope TIME/CM to 50μSEC. Adjust test scope VARIABLE TIME/CM for 1 cycle in 10cm. Check the length of the half cycle, 4.0 to 6.0cm. Remove the cables from the CAL OUT, SAC and TYPE 1A1.

d. Alternate method

Connect the voltmeter to V915B, pin 8. Note meter reading, 40 to 60V. Voltmeters may vary several volts from one meter to another.

16. STABILITY

Set 'A' and 'B' TIME/DIV switches to .1mSEC and both TRIGGER LEVEL controls to AUTO. Rotate A STABILITY control cw until the sweep starts. Note the trace brightness. Continue cw rotation until the sweep free runs (trace will get brighter). Set the STABILITY control half-way between the point the sweep starts and where it free runs. Repeat step 16 for the other STABILITY control.

17. RF NEUTRALIZATION

a. Setup

Set UPPER BEAM TYPE 3A1 VOLTS/DIV to .05, MODE to CH1 and input switch to AC. Connect 10X probe to CH1 and lay the probe body near enough to the high voltage section to obtain 0.5 to 1 div of signal. Set TIME BASE 'A' TIME/DIV switch to 50μSEC and the INTENSITY for a minimum usable trace.

b. Adjust RF neutralization minimum modulation

Rotate C808 (located on high voltage deck) and notice the change in intensity. Adjust C808 for uniform intensity (minimum modulation).

18. INTERNAL TRIGGER

a. Setup

Connect a 0.1 volt square-wave signal from the SAC to both TYPE 3A1 CH1 inputs using 2 50Ω cables and a "T" connector. Set both TYPE 3A1 VOLTS/DIV switches to .1 and the TIME/DIV switches to .2mSEC. Adjust the TYPE 3A1 CALIB control for 1 div of signal on upper and lower beam. Switch the VOLTS/DIV switches to .5.

18. (cont'd)

b. Check AUTO + & - on 1 minor div

Switch both TRIGGER SLOPE switches from + to -. Check that both sweeps trigger on the proper polarity. Change the COUPLING switches to AC FAST, DC and back to AC. There should be no change in the triggering of either display.

c. Check AC + & - on 1 minor div

Check that both beams trigger on + and - TRIGGER SLOPE settings by using the LEVEL control and that vertical position has no effect on the stability of the triggering.

d. Check AC FAST + & - on 1 minor div

Change the COUPLING switches to AC FAST. It must be possible to get stable triggering on both + and - polarity signals regardless of the SLOPE switch setting.

e. Check DC + & - on 1 minor div

Change the COUPLING switches to DC. Check that both beams trigger on + and - TRIGGER SLOPE settings by using the TYPE 3A1 POSITION controls.

e. When the TRIGGER LEVEL control is centered the TYPE 3A1 POSITION control will normally trigger within 1 major div of each beams center graticule line. If triggering is outside these limits check the DC level at V713 pin 2 or 7 (lower beam) and V703 pin 2 or 7 (upper beam). It should be 0 ±2V DC. If not it can be set to this level by using the TYPE 3A1 POSITION controls.

f. Check UPPER BEAM-LOWER BEAM switches

Set TIME BASE 'A' TRIGGER to LOWER BEAM and TIME BASE 'B' TRIGGER to UPPER BEAM. The UPPER BEAM TYPE 3A1 POSITION control must control the LOWER BEAM triggering and the LOWER BEAM TYPE 3A1 must control the UPPER BEAM triggering.

g. Check crosstalk no sweep

Change the SAC AMPLITUDE to 2V and switch each TYPE 3A1 CH1 input switch to GND, one at a time. The opposite sweep should stop when the input switch is grounded. Remove the SAC signal and return the input switches to AC.

18. (cont'd)

h. Check sine-wave triggering
+ & - on 0.3 div at 1 MHz
+ & - on 1.0 div at 2 MHz

Set 'A' TRIGGER to UPPER BEAM, AUTO and 'B' TRIGGER to LOWER BEAM, AUTO. Set both TIME/DIV switches to 1μSEC. Connect a 1 MHz signal from the TYPE 191 to both TYPE 3A1 CH1 inputs. Adjust the signal amplitude for 0.3 div. It must be possible to get stable triggering on SLOPE + & -. Adjust the TYPE 191 for 1 div of 2 MHz signal and check for stable triggering on SLOPE + and -.

19. EXTERNAL TRIGGER

a. Setup

Connect the TYPE 191 signal to the UPPER BEAM TYPE 3A1 CH1 input and TIME BASE 'A' TRIG IN. Adjust the TYPE 191 for 1V of 2 MHz signal.

b. Check AUTO, AC, AC FAST & DC:
+ & - on 1V at 2 MHz
+ & - on 0.5V at 50 kHz

Check all positions of the COUPLING switch and AUTO for stable triggering + and - using the TRIGGER LEVEL control. Change the TYPE 191 to 0.5V of 50 kHz signal, the 'A' TIME/DIV switch to 5μSEC and check all positions of the COUPLING switch and AUTO for stable triggering. Check that AC FAST triggers only on the proper polarity of the SLOPE switch.

c. Check LEVEL centering ±20° of 0

Increase the signal amplitude until triggering is obtained on + and - without moving the LEVEL control. Adjust LEVEL to the point it will trigger with the least signal amplitude. The dot on the LEVEL control should point at some part of the word LEVEL. Repeat step 19 for TIME BASE 'B'.

c. The signal amplitude at this point is about 1.5 to 2.0 volts P to P.

19. (cont'd)

d. Check LEVEL range and FREE RUN ±10V min

Replace the TYPE 191 signal with a 20V square-wave from the SAC. Set the LOWER BEAM TYPE 3A1 VOLTS/DIV switch to 5; 'B' TIME/DIV switch to .5mSEC and TRIGGER to -, AC.

Turn LEVEL control full ccw (not AUTO) and check that display is not triggered. Change SLOPE to +, turn LEVEL control full cw (not FREE RUN) and check that display is not triggered. Turn LEVEL control to FREE RUN. Sweep should run but not be triggered. Repeat step 19d for UPPER BEAM.

20. LINE TRIGGER + and - on right polarity

CAUTION: Disconnect probe from AC line before changing it to the LOWER BEAM input.

Remove the SAC signal and connect a 10X probe to the UPPER BEAM TYPE 3A1 CH1 input. Connect the probe to the AC line fuse holder. Set TIME BASE 'A' TIME/DIV switch to 1mSEC, TRIGGER to LINE and LEVEL to 0. Check that the sweep triggers on the right polarity for the SLOPE switch in + and -. Repeat step 20 for LOWER BEAM then remove the probe from the fuse holder and the TYPE 3A1.

21. HORIZONTAL AMPLIFIER AND SWEEP LENGTH

a. Setup

a. Make all timing adjustments and checks over the middle 8 divisions on the graticule unless otherwise instructed.

If desired set the TRIGGER switch to EXT and trigger both time bases with 1mS triggers from the TYPE 184 TRIGGER OUTPUT.

	TIME BASE 'A'	TIME BASE 'B'
TIME/DIV	1mSEC	1mSEC
VARIABLE	CALIBRATED	CALIBRATED
TRIGGER	UPPER BEAM	LOWER BEAM
	INT	INT
COUPLING	AC	AC
SLOPE	+	+
10X MAG	pushed in	pushed in

Both TYPE 3A1's CH1, AC and VOLTS/DIV at .5.

Apply 1mS and .1mS markers from the TYPE 184 to both TYPE 3A1 CH1 inputs.

21. (cont'd)

b. Adjust X1 Gain and Sweep Length 10.5 div ±0.3 div

Adjust the upper beam X1 Gain (R434) for exactly 1mSEC mark per division between the 1st and 9th graticule lines. Set 'A' Sweep Length (R178) for 10.5 div ±0.3 div. Adjust the lower beam X1 Gain (R484) for exact coincidence with the upper beam markers at the 1st and 9th graticule lines. Set 'B' Sweep Length (R278) for 10.5 div ±0.3 div.

c. Adjust sweep balance

Set LOWER BEAM HORIZ DISPLAY switch to 'A' TIME BASE. Adjust Lower Beam Swp Bal (R989) for exact coincidence of time marks on both beams. Set both HORIZ DISPLAY switches to 'B' TIME BASE. Adjust Upper Beam Swp Bal (R979) for exact coincidence of time marks on both beams. Set the UPPER HORIZ DISPLAY switch to 'A' TIME BASE.

c. Lower Beam Swp Bal (R989) is on a ceramic strip located behind and outboard of the UPPER HORIZ DISPLAY switch and R979 is similarly located behind the LOWER HORIZ display switch.

22. MAGNIFIER GAIN

a. Adjust upper beam 10X Gain

Center both traces horizontally. Pull TIME BASE 'A' 10X Mag on. Adjust the upper beam 10X Gain (R431) for exact coincidence of the upper beam markers and the lower beam markers at the 1st and 9th graticule lines.

b. Check magnified timing ±0.4 minor div, max

Check the magnified timing error at the start of the upper sweep (do not use the first div) and the end of the sweep (do not use any of the sweep to the right of the last 1mS markers). Markers must coincide, ±0.4 minor div, max. Repeat step 22 with the TIME BASE 'A' 10X MAG, off and the TIME BASE 'B' 10X on, adjusting lower beam 10X Gain (R481).

23. SWEEP/MAGNIFIER REGISTRATION AND POSITION RANGE

a. Adjust upper and Lower Beam Sweep Mag Regis; ≤1 minor div

Position the trace so the first lower beam time marker falls on the center of the graticule. Push the 10X MAG to off and adjust Lower Beam Swp Mag Regis (R483) so the time marker again falls on the center of the graticule, repeat adjustment as needed. Check the registration at the middle and end of the sweep. There must be no more than 1 minor div of error when switching from 10X MAG on to off. Pull the upper beam 10X MAG on and repeat Step 23a adjusting Upper Beam Swp Regis (R433).

b. Check POSITION range: past graticule center with 10X MAG on

Steps 21, 22 and 23 interact, repeat as needed.

With both 10X MAG switches on turn the POSITION controls full cw then full ccw. The start of the sweep must position to the right of the graticule center line and the last (11th) 1ms marker must position to the left of the graticule center line. Push both 10X MAG switches to off.

24. VARIABLE TIME/DIV AND NEONS

a. Check VARIABLE range 2.5:1, min

Turn both 'A' and 'B' TIME/DIV switches to .1mSEC. There should be a 1ms marker at each graticule edge. Turn both TIME/DIV VARIABLE controls full ccw. There should be 2 marks in less than 4 divisions.

b. Check UNCAL neons

The UNCAL neons should light when the VARIABLE controls is moved from the CALIBRATED position and go out when the VARIABLE controls are in CALIBRATED position. Leave in CALIBRATED position.

25. 'A' AND 'B' FAST TIMING

a. Adjust "A" and "B" fast speed timing.

Change the TYPE 184 to 1μS and 10μS markers. Change 'A' and 'B' TIME/DIV switches to 10μSEC and obtain a stable display. Adjust C160C ('A' TIME/DIV switch) for one 10μs mark per div. Change 'A' TIME/DIV switch to 1μSEC and adjust C160A for one 1μs mark per div.

Change 'A' TIME/DIV switch to 10μSEC. Adjust C260C ('B' TIME/DIV switch) for coincidence of upper beam and lower beam markers. Change both TIME/DIV switches to 1μSEC and adjust C260A for coincidence of time markers.

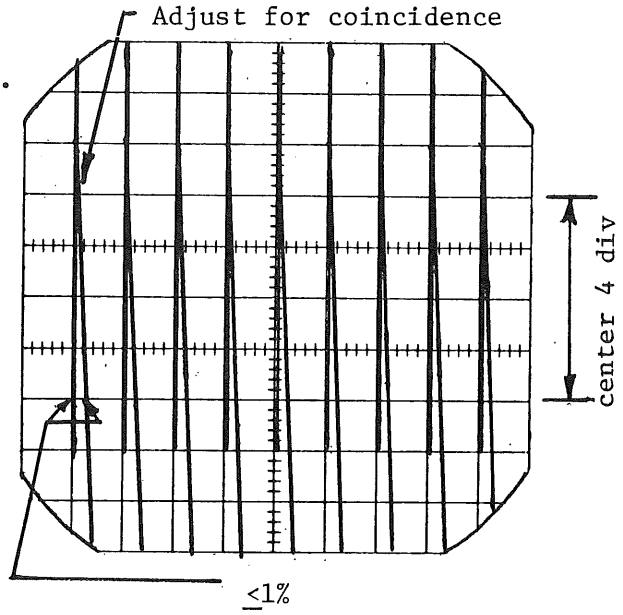
a. External triggering of the time base may be necessary for display stability on step 25, 26 and 27.

b. Check beam registration ≤1% over center 4 div

Change the TYPE 184 to 10μS markers. Set both TYPE 3A1 CH1 VOLTS/DIV switches to .1. Set both TIME/DIV switches to 10μSEC and both HORIZ DISPLAY switches to 'A' TIME BASE. Position the base lines off the screen. Check for a registration error of 1% or less over the center 4 div, vertically and the center 8 div horizontally.

Change the TYPE 184 to 1mS markers, the TIME/DIV switches to 1mSEC and repeat step 25b.

b.



26. 'A' SWEEP TIME/DIV AND MAGNIFIER

a. Check all ranges of TIME BASE 'A' as follows:

A TIME/DIV	TYPE 184	CHECK FOR	A on UB	A on LB
1μSEC	1μS	1 mark/div	±2%, max	±3%, max
2μSEC	1μS	2 marks/div	±2%, max	±3%, max
5μSEC	5μS	1 mark/div	±2%, max	±3%, max
10μSEC	10μS	1 mark/div	±2%, max	±2%, max
20μSEC	10μS	2 marks/div	±2%, max	±2%, max
50μSEC	50μS	1 mark/div	±2%, max	±2%, max
.1mSEC	100μS	1 mark/div	±2%, max	±2%, max
.2mSEC	100μS	2 marks/div	±2%, max	±2%, max
.5mSEC	500μS	1 mark/div	±2%, max	±2%, max
1mSEC	1mS	1 mark/div	±2%, max	±2%, max
2mSEC	1mS	2 marks/div	±2%, max	±2%, max
5mSEC	5mS	1 mark/div	±2%, max	±2%, max
10mSEC	10mS	1 mark/div	±2%, max	±2%, max
20mSEC	10mS	2 marks/div	±2%, max	±2%, max
50mSEC	50mS	1 mark/div	±2%, max	±2%, max

26a. (cont'd).

.1 SEC	100mS	1 mark/div	±2%, max	±2%, max
.2 SEC	100mS	2 marks/div	±2%, max	±2%, max
.5 SEC	500mS	1 mark/div	±2%, max	±2%, max
1 SEC	1 S	1 mark/div	±2.5%, max	±2.5%, max
2 SEC	1 S	2 marks/div	±2.5%, max	±2.5%, max
5 SEC	5 S	1 mark/div	±2.5%, max	±2.5%, max

b. Check 'A' 10X MAG as follows:

TIME/DIV	TYPE 184	CHECK FOR	UB	LB
1µSEC	.1µS	1 mark/div	±3%, max	±5%, max
2µSEC	.2µS	2 marks/div	±3%, max	±5%, max
5µSEC	.5µS	1 mark/div	±3%, max	±5%, max
10µSEC	1µS	1 mark/div	±3%, max	±5%, max
20µSEC	2µS	2 marks/div	±3%, max	±5%, max
50µSEC	5µS	1 mark/div	±3%, max	±5%, max

27. 'B' SWEEP TIME/DIV AND MAGNIFIER

a. Check all ranges of TIME BASE 'B' as follows:

TIME/DIV	TYPE 184	CHECK FOR	B on LB	B on UB
1µSEC	1µS	1 mark/div	±2%, max	±3%, max
2µSEC	1µS	2 marks/div	±2%, max	±3%, max
5µSEC	5µS	1 mark/div	±2%, max	±3%, max
10µSEC	10µS	1 mark/div	±2%, max	±2%, max
20µSEC	10µS	2 marks/div	±2%, max	±2%, max
50µSEC	50µS	1 mark/div	±2%, max	±2%, max
.1mSEC	100 S	1 mark/div	±2%, max	±2%, max
.2mSEC	100 S	2 marks/div	±2%, max	±2%, max
.5mSEC	500 S	1 mark/div	±2%, max	±2%, max
1mSEC	1mS	1 mark/div	±2%, max	±2%, max
2mSEC	1mS	2 marks/div	±2%, max	±2%, max
5mSEC	5mS	1 mark/div	±2%, max	±2%, max
10mSEC	10mS	1 mark/div	±2%, max	±2%, max
20mSEC	10mS	2 marks/div	±2%, max	±2%, max
50mSEC	50mS	1 mark/div	±2%, max	±2%, max
.1 SEC	100mS	1 mark/div	±2%, max	±2%, max
.2 SEC	100mS	2 marks/div	±2%, max	±2%, max
.5 SEC	500mS	1 mark/div	±2%, max	±2%, max
1 SEC	1 S	1 mark/div	±2.5%, max	±2.5%, max
2 SEC	1 S	2 marks/div	±2.5%, max	±2.5%, max
5 SEC	5 S	1 mark/div	±2.5%, max	±2.5%, max

27. (cont'd)

b. Check 'B' 10X MAG as follows:

TIME/DIV	TYPE 184	CHECK FOR	LB	UB
1μSEC	.1μS	1 mark/div	±3%, max	±5%, max
2μSEC	.2μS	2 marks/div	±3%, max	±5%, max
5μSEC	.5μS	1 mark/div	±3%, max	±5%, max
10μSEC	1μS	1 mark/div	±3%, max	±5%, max
20μSEC	2μS	2 marks/div	±3%, max	±5%, max
50μSEC	5μS	1 mark/div	±3%, max	±5%, max

28. LOCKOUT LEVEL AND CONTRAST RATIO

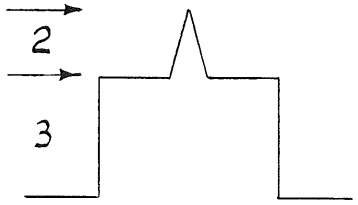
a. Setup

	TIME BASE 'A'	TIME BASE 'B'
TIME/DIV	1mSEC	.1mSEC
TRIGGER	UPPER BEAM	LOWER BEAM
	INT	INT
LEVEL	TRIGGERED	TRIGGERED
COUPLING	AC	AC
SLOPE	+	+
10X MAG	pushed in	pushed in
UPPER HORIZ	DISPLAY	'A' TIME BASE
LOWER HORIZ	DISPLAY	'B' TIME BASE
'B' MODE		NORMAL
DELAY INTERVAL		5.00
AMPLITUDE CALIBRATOR		1

Both TYPE 3A1's switches CH1, DC and VOLTS/DIV at .5.

b. Adjust Lockout Level, R225, 2:3 ±0.5div max, with 5div amplitude display

Connect the AMPLITUDE CALIBRATOR signal to each TYPE 3A1's input. Switch the 'B' MODE switch to STARTS AFTER DELAY INTERVAL.



Connect the test scope probe to pin 8 of V245. Adjust the test scope display for a 5div sawtooth - gate display (see illustration). Adjust the Lockout Level, R225, for a sawtooth to gate amplitude ratio of 2:3 ±0.5div in a 5div display.

28. (cont'd)

c. Check contrast control
full ccw, min contrast
full cw, max contrast

Rotate the Contrast control, R848, (left side of F & I chassis) from full ccw to full cw and check the contrast level of the intensified portion of 'A' TIME BASE. There should be smooth operation of the control with min contrast at full ccw and max contrast at full cw. Leave the Contrast Control at full cw. Note: Full ccw position of R848 does not have to extinguish the brightened portion of the sweep.

29. DELAY INTERVAL

a. Setup

Replace the AMPLITUDE CALIBRATOR signal with 1mS markers from the TYPE 184. Set 'B' TIME BASE TIME/DIV switch to 10μSEC.

b. Adjust Delay Start and Delay Stop

Turn the DELAY INTERVAL dial to 1.00. Adjust Delay Start, R336 until the left hand edge of the bright spot touches the top of the second time marker. Turn the DELAY INTERVAL dial to 9.00 and adjust Delay Stop, R332 so the left hand edge of the bright spot touches the top of the tenth time marker. Repeat adjustment of R336 and R332 until there is no more interaction.

b. An alternate method of adjustment is to use 'B' TIME BASE and adjust R336 and R332 so the sweep starts at the time marker.

c. Check DELAY INTERVAL incremental error ±0.4%, max

With 1.00 and 9.00 of the DELAY INTERVAL dial exactly aligned with their respective time marks, the divisions 2.00 through 8.00 must align within 4 minor divisions of the DELAY INTERVAL dial.

d. Check delay jitter 2 minor div, max

Change 'B' TIME/DIV switch to 1μSEC and adjust the DELAY INTERVAL dial to about 9.00 to display pulse on screen. Note jitter on pulse leading edge: 2 minor div, max.

29d. (cont'd)

Change the DELAY INTERVAL dial to about 1.00 to display pulse on screen. Note jitter on pulse leading edge: 2 minor div, max.

e. Check bright up shift 1 minor div, max

Change the 'B' TIME/DIV switch from 10μSEC to 1mSEC, noting any shift in the start of the brightened portion; 1 minor div, max.

f. Check delay start 0.20 max at 10μSEC

Set the 'B; TIME/DIV switch to 10μSEC. Rotate the DELAY INTERVAL dial from 0.00 until the 'B' sweep starts and note the dial reading, 0.20, max.

g. Check TIME BASE 'A' error using DELAY INTERVAL dial
.1mSEC-.5 SEC ±1.5%, max
1, 2, & 5 SEC ±2%, max

Check the following sweep speeds by adjusting the DELAY INTERVAL dial so the start of the sweep starts at the top of the 2nd marker. Note the dial reading. Move the DELAY INTERVAL dial until the sweep starts at the top of the 10th marker. Note the dial reading. Subtract the 1st reading from the second; the difference should be 8.00 ± any error.

'A' TIME/DIV	'B' TIME/DIV	TYPE 184	Max DELAY INTERVAL error
.1mSEC	10μSEC	100μS	±15 minor div
.2mSEC	10μSEC	100μS	±15 minor div
.5mSEC	50μSEC	500μS	±15 minor div
1mSEC	.1mSEC	1mS	±15 minor div
2mSEC	.1mSEC	1mS	±15 minor div
5mSEC	.5mSEC	5mS	±15 minor div
10mSEC	1mSEC	10mS	±15 minor div
20mSEC	1mSEC	10mS	±15 minor div
50mSEC	5mSEC	50mS	±15 minor div
.1 SEC	10mSEC	100mS	±15 minor div
.2 SEC	10mSEC	100mS	±15 minor div
.5 SEC	50mSEC	500mS	±15 minor div
1 SEC	50mSEC	1 S	±20 minor div
2 SEC	50mSEC	1 S	±20 minor div
5 SEC	50mSEC	5 S	±20 minor div

30. EXTERNAL HORIZONTAL

a. Check deflection factor 0.08V/div, min

Connect a 0.5 volt from the SAC to both EXT HORIZ IN jacks. Defocus both traces. Set both EXT DISPLAY switches to EXT. Rotate the EXT HORIZ GAIN controls. The display should be a single spot at full ccw. The display must be at least 6 major div at full cw.

b. Check bandwidth 350kHz @-3dB

Set both GAIN controls at full cw. Obtain a 6 div 50 kHz signal from a TYPE 191. Change the TYPE 191 to 350 kHz and note signal amplitude, 4.2 div, min.

31. HOLDOFF

a. Setup

Remove the TYPE 191 signal. Set the TRIGGER LEVEL controls to FREE RUN. Change 'B' MODE switch to NORMAL TRIGGER, UPPER HORIZ DISPLAY to 'A' TIME BASE and LOWER HORIZ DISPLAY to 'B' TIME BASE.

b. Check holdoff

Check the duration of the negative portion of 'A' +GATE OUT and 'B' +GATE OUT as follows:

TIME/DIV	holdoff
1, 2, 5μSEC	12-60μs
10, 20, 50μSEC	17-68μs
.1, .2, .5mSEC	125-375μs
1, 2, 5mSEC	1.25-3.75ms
10, 20, 50mSEC	12.5-37.5ms
.1, .2, .5 SEC	125-375ms
1, 2, 5 SEC	125-375ms

b. Holdoff may also be measured by connecting a probe from the test scope (set for DC input) to a horizontal deflection plate. Measure the time from the end of one sweep to the start of the next.

32. REAR PANEL OUTPUTS AND CRT INPUT

a. Setup

Set both TIME/DIV switches to 1mSEC. Apply a 1 volt AMPLITUDE CALIBRATOR signal to both verticals and adjust for an 8 div triggered display.

32. (cont'd)

b. Check output waveforms

Using the test scope check the output waveforms as follows:

output jack	min signal
UPPER VERT SIG OUT	20V square-wave
LOWER VERT SIG OUT	20V square-wave
UPPER HORIZ SIG OUT	5V sawtooth
LOWER HORIZ SIG OUT	5V sawtooth
'A' +GATE OUT	20V pulse
'B' +GATE OUT	20V pulse

c. Check delayed trigger out: 10V, min

Connect test scope probe to DEL'D TRIG OUT. Trigger the test scope externally using the 'A' +GATE signal. Observe that the delayed trigger is movable by operating the DELAY INTERVAL dial and is 10V, min.

d. Check CRT grid: modulates with 10V

Connect a 10V AMPLITUDE CALIBRATOR signal to the upper beam vertical and to the UPPER BEAM CRT GRID using the BNC T connector, 2 cables and the BNC to Alligator Clip adapter. Note that applying the signal to the CRT grid causes the top of the trace to increase in intensity and the bottom to decrease. Repeat step 32d for the lower beam vertical.

e. Check random triggering of alternate sweep: $\leq$4 random triggers in 20s

Set both 3A1's to ALTER and the input switches to GND. Set both TIME/DIV switches to 1SEC and both LEVEL controls to FREE RUN. Allow a sweep for each channel while watching for random switching in the alternate mode.

THE FOLLOWING CHECKS ARE NOT MADE ON 100% OF THE INSTRUMENTS BUT ARE DONE ON A SAMPLING BASIS.

33. CALIBRATOR ACCURACY

The TYPE 565 POWER ON switch must be off. The AMPLITUDE CALIBRATOR switch should be in the OFF position for several minutes.

Using an ESI Model 300 PVB measure the resistance of the following ranges:

AMPLITUDE CALIBRATOR	resistance
.001	10Ω (9.90 to 10.14)
.01	99.02Ω (98.03 to 100.01)
.1	901.9Ω (893.03 to 911.5)

THE END

33. The 10Ω position has been allowed an additional 0.04Ω on the high side to allow for lead and switch resistance.