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

Bob Bellamy

310A

INCLUDES FACTORY TEST LIMIT CHANGES THROUGH AUG 18 1969

October 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 453 OSCILLOSCOPE
1	TYPE P6006 10X PROBE
1	TYPE P6011 1X PROBE
*1	TYPE 184 TIME MARK GENERATOR
1	TYPE 106 SQUARE WAVE GENERATOR
*1	TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR

b. Test Fixtures and Accessories

*1	STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
1	BNC to Binding Post Adapter (103-0032-00)
3	50Ω Cables, BNC (012-0057-01)
1	50Ω Termination, BNC (011-0049-00)
1	50Ω 5:1 attenuator, BNC (011-0060-00)
3	UHF male to BNC female adapter (103-0015-00)
1	BNC Female to clip leads (013-0076-00)
1	TYPE TU76 Line Voltage Control (067-0048-00)
1	Variable Normalizer (Dwg #1761-C)
1	Micro Shock Hammer (PMPE Dwg #1283-B)

c. Other Equipment

1	20,000Ω/VDC Multimeter

* Equipment must be traceable to NBS for certification of measurement characteristics.

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

b. Align CRT: CRT face place tilt ±3/64"

4. LV POWER SUPPLY

Supply	error	max P-P ripple 105 to 125VAC
-150V	±4.5V	10mV
+100V	±3V	10mV
+300V	±9V	15mV at 117VAC 40mV at 105VAC 25mV at 125VAC

5. HV POWER SUPPLY

a. -1675 ±3%
b. HV regulation:
Sweep timing change: ±2%, max from minimum visible INTENSITY setting to full cw INTENSITY setting between 105 VAC line and 125 VAC line.

6. CALIBRATOR

* a. Error: ±2%
b. Frequency: 750 to 1250CPS
c. Duty Cycle: 45 to 55%

7. HOLDOFF

TIME/DIV	hold-off
.5 to 2μSEC	4 to 12μsec
5 to 20μSEC	15 to 35μsec
50 to 200μSEC	100 to 200μsec
500μSEC to 2mSEC	.5 to 2msec
5 to 20mSEC	5 to 20msec
50mSEC to .2SEC	25 to 130msec

9. ALIGN CRT, SCALE ILLUM

a. Align trace: ±0.5 minor div
b. Max illumination ccw
no illumination cw

11. CRT

b. Focus: max trace width anywhere in graticule, .035 inch
max trace width in center 9div .025 inch
c. Vertical geometry: .75 minor div
d. Horizontal geometry: .5 minor div

12. DC BALANCE

b. Vertical amp balance: within 1div of graticule center
c. Grid current: .1div
d. Coupling cap: .5 minor div

13. MICROPHONICS

a. .1 VOLTS/DIV: 1div
b. .01 VOLTS/DIV: 2.5div

14. VERTICAL GAIN

a. Vertical gain range: 4.5 to 5.5div
b. AC DC gain match: ±2%
c. Variable Volts/Div range: 2.5:1
* e. VOLTS/DIV accuracy: ±2%

15. COMPRESSION, EXPANSION

Compression, expansion: -.5 to +.75 minor div

16. VERTICAL POSITION RANGE

VERTICAL POSITION range
cw and ccw off Crt

17. HUM BALANCE

Hum Balance: .25 minor div

18. TRIGGERING

a. ± INT, AC: .25div
b. ± INT, AUTO: .25div
c. ± INT, DC: 1div within
   2div of graticule center
d. ± EXT, AC, DC, AUTO: .2V

19. EXTERNAL HORIZONTAL

a. Sensitivity: 1.5V/div min
* c. Bandpass
   no more than -3dB down at
   500kc

20. CRT CATHODE INPUT

Intensity Modulation: 20V

24. BANDPASS

* a. Main amp
   no more than -3dB at 4.1MHz
* b. Preamp
   no more than -3dB at 3.5MHz

25. HF TRIGGER

a. 5MHz internal: 2div
b. 5MHz external: 2 volts

27. SWEEP TIMING

* b. X5 MAG accuracy: ±3% except
   .5µsec ±4%
d. Sweep length: 10.2 to 10.8
e. Variable time/div: 2.5 to 1
* f. 100µSEC to .2SEC
   timing error ±2%
   linearity error ±1%
* h. 50 to .1µSEC
   unmagnified timing ±2%
   mag timing ±3%
   except 4% at .5µSEC
   unmagnified linearity ±1%

THE END

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

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

1. PRELIMINARY INSPECTION

a. Install current modifications
b. Align CRT
c. Inspect CRT
d. Position graticule lights
e. Check fuses

2. PRESETS

a. Preset external controls
b. Preset internal controls

3. RESISTANCE CHECKS

a. Check supplies
b. Check between supplies

4. LV POWER SUPPLY

a. Adjust -150, R610
b. Check tolerance, ripple, and regulation

supply	max error	max ptp ripple 105 to 125 vac
-150V	±3%	10mV
+100V	±3%	10mV
+300V	±3%	15mV at 117VAC, 40mV at 105VAC, and 25mV at 125VAC

c. Check elevated heaters

5. HV POWER SUPPLY

a. Adjust HV R741: -1675V
b. Check HV regulation

6. CALIBRATOR

a. Check accuracy
b. Check frequency
c. Check duty cycle

7. HOLDOFF

Check holdoff

8. PRESET ADJUST

Adjust PRESET ADJUST

9. ALIGN CRT, SCALE ILLUM

a. Align trace
b. Check SCALE ILLUM

10. UNCALIBRATED NEONS, ASTIGMATISM

a. Check uncalibrated neons
b. Adjust ASTIGMATISM R750

11. CRT

a. Check CRT
b. Check FOCUS
c. Check vertical geometry
d. Check horizontal geometry
e. Check double peaking

12. DC BALANCE

a. Adjust DC BALANCE
b. Check vertical amp balance
c. Check grid current

13. MICROPHONICS

a. Check micro: .1 VOLTS/DIV
b. Check micro: .01 VOLTS/DIV

14. VERTICAL GAIN

a. Check vertical gain range R442: 4.5 to 5.5 div
b. Check AC DC gain match ±2%
c. Check Variable VOLTS/DIV range: 2.5:1
d. Set Preamp gain, R322
e. VOLTS/DIV accuracy: ±2%

15. COMPRESSION, EXPANSION

Check compression expansion -.5 to +.75 minor div

16. VERTICAL POSITION RANGE

Check VERTICAL POSITION range: OFF CRT

17. HUM BALANCE

Adjust Hum balance R470: min hum

18. TRIGGERING

a. Check ±INT, AC triggering: .25 div
b. Check ±INT, AUTO triggering: .25 div
c. Check ±INT, DC triggering: 1 div within 2 div of graticule center
d. Check ±EXT: AC, DC, AUTO triggering: .2V
e. Check ±LINE; AC, AUTO triggering Proper Slope

19. EXTERNAL HORIZONTAL

a. Check Sensitivity 1.5 volts/div min
b. Check C218
c. Check bandpass No more than -3dB down at 500kc

20. CRT CATHODE INPUT

Check intensity modulation: 20V CAL signal

21. VOLTS/DIV COMPENSATION

a. Setup -- Type 106 to 310A
b. Adjust compensations

.2	C310 and C413
.5	C307
.1	C304
.2	C309
5	C306
10	C301
.02	C320

Connect variable normalizer between 50Ω term and TYPE 310A INPUT and adjust or check the following for best square corner:

VOLTS/DIV

.1	Adjust probe
.2	Check
.5	Check

If the .2 or .5 VOLTS/DIV positions are somewhat distorted, readjust C309 (.2) or C306 (.5)

1	C303
2	Check
5	Check
10	C300
20	Check
50	Check
.01	Check
.02	Check
.05	Check

22. LF COMPENSATIONS

a. Setup -- VOLTS/DIV .1, input selector DC, TIME/DIV 5mSEC
b. Adjust low freq. R345 match .01 to .1 position

23. HF COMPENSATIONS

a. Adjust HF compensations L409, L418, L450 and L451
b. Adjust Preamp high frequency L325, L341

24. BANDPASS

a. Check bandpass Main Amp
   no more than -3dB at 4.1MHz
b. Check bandpass preamp
   no more than -3dB at 3.5MHz

25. HF TRIGGER

a. Check 5MHz internal triggering: 2div
b. Check 5MHz external triggering: 2V

26. HORIZ JITTER

Check Horiz Jitter - use .2V Cal
Out Signal

27. SWEEP TIMING

a. Adjust sweep cal, R250
b. Check X5 MAG accuracy: ±3% except .5μSEC ±4%
c. Adjust mag center, R215
d. Adjust Sweep length, R161: 10.2 to 10.8
e. Check Variable time/div 2.5:1
f. 100μSEC to .2 SEC timing:
   timing error ±2%
   linearity error ±1%
g. Adjust high speed linearity, C205, C213
h. Adjust and check 50 to .1μSEC timing

THE END

1. PRELIMINARY INSPECTION

a. Install current modifications

b. Align Crt: Crt face plate tilt, ±3/64"

Loosen Crt clamp and remove graticule cover and graticule. Push Crt forward to a straight edge placed against the casting. Check gap within phosphor area ±3/64" tighten CRT clamp.

c. Inspect CRT

Check that the CRT serial number and code date match those on the records. Check CRT for physical defects: phosphor defects, scratches, chips, cracks around neck pins, etc.

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

d. Position graticule lights

Replace graticule. Check that graticule lights are properly positioned. Replace graticule cover.

e. Check fuses

117VAC 159-034 1.6a
234VAC 159-018 .8a

2. PRESETS

a. Preset External controls

VOLTS.DIV	.1
VARIABLE VOLTS/DIV	CALIBRATED
INPUT selector	AC
VERTICAL POSITION	midr
HORIZONTAL POSITION	midr
FOCUS	midr
INTENSITY	ccw
SCALE ILLUM	PWR OFF
CALIBRATOR	OFF
TIME/DIV	.5μSEC
VARIABLE TIME/DIV	CALIBRATED
TRIGGER SOURCE	+INT
TRIGGER MODE	AC
MAG	X1
TRIG LEVEL	midr
STABILITY	ccw
PRESET ADJUST	midr

2. (CONT)

b. Preset Internal adjustments

L450, L451	slugs out about 3/8"
C175A	6 o'clock
C175B	7 o'clock
C413C	4 o'clock
L418, L409	about 3 turns into coil
L341	slug to lower end of coil

All other internal adjustments midr

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

3. RESISTANCE CHECKS

a. Check supplies

supply	approx resistance
T600 primary	inf w/o pwr cord
-150V	6k
+100V	6k to 13K
+300V	10k to 15K

b. Check between supplies

4. LV POWER SUPPLY

a. Adjust -150

Connect TYPE 310A to TYPE TU76, set source to 117 AC, and turn TYPE 310A power on.

Connect multimeter between ground and -150V test point. Adjust R610 to within ±4.5V of -150V.

4. (CONT)

b. Check tolerance, ripple, and regulation

supply	error	max ptp ripple 105 to 125VAC
-150V	±4.5V	10mV
+100V	±3V	10mV
+300V	±9V	15mV at 117VAC, 40mV at 105VAC, and 25mV at 125VAC

c. Check elevated heaters

check point	approx elevation
T600 term 24 or 23	+300V
T600 term 27 or 28	+100V
T600 term 20 or 21	-1675V

5. HV POWER SUPPLY

a. Adjust HV -1675V

Adjust R741 for -1675 at T600 terminal 20 or 21.

b. Check HV regulation

Sweep timing change ±2%, max from minimum visible INTENSITY setting to full cw INTENSITY setting over 105VAC line to 125VAC line.

Connect TYPE 184--50Ω cable--TYPE 310A INPUT. Turn on TYPE 184 1ms markers, Set the TIME/DIV and variable controls to display exactly 10 markers/ 10div. Increase the line voltage to 125VAC. Turn TYPE 310A INTENSITY ccw to a point where the trace is barely visible and check for 10 time marks/ 10 div ±2% (1 minor div). Reduce the line voltage to 105VAC. Turn the INTENSITY fully cw. Check for 10 time marks/10div ±2% (1 minor div). Remove the TYPE 184 signal and return the line to 117VAC.

6. CALIBRATOR

a. Check accuracy: ±2% all settings

Preset the test scope as follows:

VOLTS/CM	.5
VARIABLE VOLTS/CM	CALIBRATED
INPUT SELECTOR	AC

Connect the AMPLITUDE CALIBRATOR under test to the SAC/UNK IN connector. Connect the SAC/OUTPUT through a coaxial cable to the test scope vertical input.

Set the SAC to +100V, DC mixed. Set the AMPLITUDE CALIBRATOR under test to 100 VOLTS. Remove V520 from the instrument under test.

Trigger the test scope in AUTO, + LINE and set TIME/CM to 5mSEC. The start of the test scope sweep will be the SAC voltage or reference point. The direction of error can be determined by the direction of the first difference voltage. A positive going waveform would indicate a positive going error and a negative going waveform would indicate a negative error.

Set the Cal adj, R510 for a null voltage (the point where the display appears as a straight line).

Change the instrument controls as listed in the table below while noting the AMPLITUDE CALIBRATOR error (trace separation).

		test scope	
TYPE 310A CALIBRATOR	SAC VOLTS	VOLTS CM	deflection max
100 VOLTS	100	.01	adjustable
50	50	.5	2cm
20	20	.2	2cm
10	10	.1	2cm
5	5	.05	2cm
2	2	.02	2cm
1	1	.01	2cm
.5	.5	.005	2cm
.2	.2	.005	.8cm
.1	.1	.005	.4cm
.05	.05	.005	.2cm

6. (Cont)

b. Check Calibrator frequency
750 to 1250cps
(1.35ms to .8ms)

Set the SAC to UNKNOWN ONLY. Reinstall V520 in the instruments under test. Set the test scope to + INT, and set the TIME/CM to 1mSEC. Set the test scope VOLTS/CM to .1. Check calibrator frequency 750 to 1250cps.

c. Check duty cycle: 45 to 55%

Change test scope triggering from + to - and note test scope display: center of calibrator waveform (point where calibrator switches from plus to minus) lies at center of test scope graticule, ±.5cm, indicating duty cycle between 45 and 55%.

Remove TYPE 310A CALIBRATOR signal from SAC.

7. HOLDOFF

Check holdoff

Set STABILITY full cw (freerun). Set test scope to DC and connect 10X probe to front of C205 and check holdoff as follows:

Set trig to +
check positive section.

TIME/DIV	holfoff	Test Scope	
.5µSEC to 2µSEC	4 to 12µsec	2 µsec	2cm - 6cm
5µSEC to 20µSEC	15 to 35µsec	5 µsec	3cm - 7cm
50µSEC to 200µSEC	100 to 200µsec	.1 msec	1cm - 2cm
500µSEC to 2mSEC	.5 to 2msec	1 msec	0.5cm - 2cm
5mSEC to 20mSEC	5 to 20msec	5msec	1cm - 4cm
50mSEC to .2 SEC	25 to 130msec	~~50msec~~ 50 msec .2	0.5cm - 2.6cm.

Reset TIME/DIV to 100µSEC.

8. PRESET ADJUST

Adjust PRESET ADJUST

Set TRIGGER MODE AUTO, TRIGGER SOURCE + LINE, and TIME/DIV to 100μSEC.

Connect meter to C101-R100 junction.

Run PRESET ADJUST thru its range noting the voltage when the trace first comes on and when the trace brightens. Set PRESET ADJUST mid-way between the two noted voltages.

Remove meter and set TRIGGER source to INT.

9. ALIGN CRT, SCALE ILLUM

a. Align trace ±0.5 minor div

Rotate crt so trace is parallel with center graticule line. Tighten crt clamp and recheck trace position and faceplate in relation to crt shield mount casting.

b. Check SCALE ILLUM

Turn SCALE ILLUM full ccw, but not off: graticule bulbs must increase brilliance.

Turn SCALE ILLUM full cw: graticule bulbs must completely extinguish.

10. UNCALIBRATED NEONS, ASTIGMATISM

a. Check uncalibrated indicators

Note: TIME BASE UNCALIBRATED neon lights when variable time/div is out of CALIBRATED.

Note: VERTICAL UNCALIBRATED neon lights when variable volts/div is out of CALIBRATED.

Return to CALIBRATED, both neons must be extinguished.

10. (CONT)

b. Adjust Astig

Apply a 2 VOLTS CALIBRATOR signal to 310A INPUT. Set VOLTS/DIV to 1.

Adjust INTENSITY, FOCUS and Astig R750 (rear) for a well-defined display.

Change TRIGGER mode to AC and free-run sweep.

11. CRT

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

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

b. Check Focus

Set TIME/DIV to 1mSEC and preadjust Vert Gain Adj R442 for 2 major div deflection.

Change CALIBRATOR to .1 VOLTS. This gives two traces separated by about .025 inches which is maximum trace width allowable anywhere within the center 9 major div. The allowable trace width in the outside .5 major div of the graticule is .035 inch.

Check for no overlap within the center 9 major div.

Remove CALIBRATOR signal from vertical INPUT and apply it to EXT HORIZ INPUT. Connect a cable from sawtooth out of test scope to vertical INPUT. Set TYPE 310A to EXT HORIZ.

Using VOLTS/DIV, Horiz Gain R217 and CALIBRATOR, obtain two traces separated by .025 inch sweeping at about 1msec.cm.

Check for no overlap within the center 9 major div.

Remove cables and set TYPE 310A to X1 MAG.

11. (CONT)

c. Check Vertical geometry .75 minor

Set TYPE 184 to 1msec and 100μsec markers. Adjust TRIG LEVEL and STABILITY for a stable display. Switch TIME/DIV to 500μSEC. Adjust variable TIME/DIV for one 1msec mark per major div. Note marker deviation within graticule area: .75 minor div, max in 8 major div.

d. Check Horiz geometry .5 minor

Move the trace to the top and bottom graticule lines and check bowing: .5 minor div, max, within the scribed graticule area.

e. Check double peaking

Run INTENSITY cw thru its range and note any double peaking of the trace.

12. DC BALANCE

a. Adjust DC Bal

Set VOLTS/DIV to .1 and ground INPUT connector.

Adjust DC Bal R344 for no trace movement while rotating variable volts/div back and forth thru its range. Leave variable at CALIBRATED.

b. Check vertical amp balance 1 major div

Set VERTICAL POSITION to midr and note trace distance from graticule center: 1 major div, max.

c. Check Grid Current: ≤ .2div

Change input selector to DC and note trace shift: 1 minor div, max.

12. (CONT)

d. Check coupling cap: ≤ .5 minor div

Change VOLTS/DIV from .1 to .05 and note shift due to preamp output coupling cap: .5 minor div, max. Reset VOLTS/DIV to .1.

13. MICROPHONICS

a. Check Micro, .1 VOLTS/DIV: ≤1 major div

Ground INPUT with short jumper. Using Micro Hammer check display for microphonics: 1div, max; no ringing type allowed.

b. Check Micro, .01 VOLTS/DIV: ≤2.5 major div

Set VOLTS/DIV to .01 and check microphonics: 2.5 major div, max; no ringing type allowed.

Remove INPUT ground. Reset VOLTS/DIV to .1.

14. VERTICAL GAIN

a. Check Vertical gain range 4.5 to 5.5div and adjust gain

Check input selector to AC. Apply .5V SAC signal and adjust R442 thru its range. (4.5 to 5.5div) set at 5div.

b. Check AC-DC gain match: ±2% of each other

Change input selector to DC and note 5 major div: ±2%, max. Return to AC.

c. Check Variable VOLTS/DIV range: ≥2.5:1

Rotate variable volts/div to max atten. Note deflection: 2 major div, max. Note any noise or open spots during a full rotation of the variable. Return to CALIBRATED.

14. (CONT)

d. Set Preamp Gain R322

Set VOLTS/DIV to .01 and SAC to .05V. Adjust Preamp Gain R322 for 5div deflection.

e. VOLTS/DIV accuracy error: ±2%

VOLTS/ DIV	SAC	deflection ±2%m max
.01	.05V	5 major div
.02	.1V	5 major div
.05	.2V	4 major div
.1	.5V	5 major div
.2	1V	5 major div
.5	2V	4 major div
1	5V	5 major div
2	10V	5 major div
5	20V	4 major div
10	50V	5 major div
20	100V	5 major div
50	100V	2 major div

15. COMPRESSION, EXPANSION

Check compression expansion: -0.5 to +0.75 minor div

Adjust standard calibrator, VOLTS/DIV, and variable volts/div for 2 major div display at graticule center.

Position top of display to top graticule line. Note compression or expansion. Position bottom of display to bottom graticule line. Note compression, .5 minor div max, or expansion, .75 minor div max, at either extreme.

Remove SAC signal.

16. VERTICAL POSITION RANGE

Check VERTICAL POSITION range: positions off CRT

Set VERTICAL position max cw. Note the distance from the center graticule line to the trace: off CRT

16. (CONT)

Set VERTICAL position max ccw. Note the distance from the center graticule line to the trace: off CRT

17. HUM BALANCE

Adjust Hum Balance

Ground the TYPE 310A input. Set VOLTS/DIV to .01.

Set test scope volts/cm to .05 and connect 10X probe to the rear of graham cracker resistor R451, directly below Hum Bal R470.

Adjust Hum Balance for min trace width on test scope.

Remove INPUT ground and test scope probe. Set VOLTS/DIV to .1.

18. TRIGGERING

a. Check ±INT, AC triggering: .25div

Connect CAL OUT to vertical INPUT and EXT TRIG INPUT. Obtain .25div deflection.

Adjust TRIG LEVEL to one position that will give a stable display in either + or -INT.

Loosen TRIG LEVEL knob set screw, position knob on shaft so white dot lies at its upper-most position (midr), then retighten screw, making sure a stable display can be obtained in ±INT.

18. (CONT)

b. Check ±INT, AUTO triggering: .25div

Set TRIGGER mode to AUTO. Must produce a stable display in ±INT.

c. Check ±INT, DC triggering: 1div within 2div of graticule center

Obtain 1div deflection. Set TRIGGER MODE to DC. Must trigger ± within 2div of graticule center.

d. Check ±EXT; AC, DC, AUTO triggering: .2V

Set CALIBRATOR to .2 VOLTS and connect signal to Vertical input and EXT TRIG INPUT. A stable trigger must be obtained in ±EXT; AC, DC, AUTO.

Remove CALIBRATOR signal.

e. Check ±LINE; AC, AUTO triggering

Connect a 10X probe to TYPE 310A INPUT, set VOLTS/DIV to 20, and connect probe tip to 117VAC at fuse holder of TYPE 310A. Set TIME/DIV to 5mSEC.

A stable display of proper slope must be obtained in +LINE and -LINE; AC, AUTO.

Remove probe connections.

19. EXTERNAL HORIZONTAL

a. Check Sensitivity: ≥1.5V/div

Set TYPE 310A to EXT HORIZ and Horiz Gain R217 full cw.

Connect CAL OUT to EXT HORIZ INPUT. Set CALIBRATOR to 10 VOLTS and note deflection: 6.67div, min, controllable by Horiz Gain R217.

19. (CONT)

b. Check C218

Switch to MAG X1. Set VOLTS/DIV to 2 and connect vertical INPUT to CAL OUT and EXT HORIZ INPUT. Trigger the time base internally with TIME/DIV at .2mSEC.

Note the square wave display. Rotate Horiz Gain R217 through its range. The display should become rolled off at one end of the range.

If C218 is open, rotating R217 will have no significant effect. If C218 is shorted, the deflection of the display will vary considerably.

Remove all connections.

c. Check Bandpass: ≥500kHz at -3dB

Connect 191 to 310A EXT HORIZ INPUT using the BNC to alligator clips adapter. Check that HORIZ GAIN, R217, is at max cw. Adjust TYPE 191 for 6 major div of 50kc. Set TYPE 191 to 500Hz and note deflection: 4.2div min. Remove TYPE 191 signal and return MAG switch to X1.

20. CRT CATHODE INPUT

Check intensity modulation 20V

Change TIME/DIV to 1mSEC. Loosen CRT CATHODE and GND binding posts (rear) and swing strap away from CRT CATHODE (strap must pivot around GND binding post).

Connect CAL OUT to CRT CATHODE. Set CALIBRATOR to 20 VOLTS.

Note an intensity modulated trace at normal intensity.

Remove CAL OUT connection and re-connect crt gnd strap.

21. VOLTS/DIV COMPENSATION

a. Setup

TYPE 106--50Ω cable--50Ω Terminator--TYPE 310A INPUT

Keep TYPE 106 adjusted for about 5 major div of 1kc signal. Add attenuator to TYPE 106 output if necessary.

b. Adjust Compensations

Adjust the following for best top front corner of TYPE 106 signal.

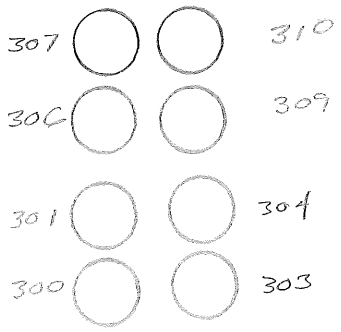
VOLTS/DIV	adjust
.2	C310

Turn variable volts/div fully ccw.

.2	C413

C310 and C413 interact, repeat as necessary. Leave variable volts/div fully cw.

.5	C307
1	C304
2	C309
5	C306
10	C301
.02	C320



Connect variable normalizer between 50Ω term and TYPE 310A INPUT and adjust or check the following for best square corner:

VOLTS/DIV	adjust or check
.1	adjust probe
.2	check
.5	check

If the .2 or .5 VOLTS/DIV positions are somewhat distorted, readjust C309 (.2) or C306 (.5).

1	C303
2	check
5	check
10	C300
20	check
50	check

21b. (CONT)

.01	check
.02	check
.05	check

Remove variable normalizer.

22. LF COMPENSATION

a. Setup

TYPE 106--50Ω cable--50Ω term
TYPE 310A INPUT

TYPE 310A presets:

VOLTS/DIV	.1
INPUT selector	AC
TIME/DIV	5mSEC

b. Adjust Low Freq

Adjust TYPE 106 for about 8 major div of 50cps.

Note amount of wave-top slope. Change VOLTS/DIV to .01 and readjust TYPE 105 for same deflection as before. Adjust R345 for same wave-top slope as in .1 position.

23. HF COMPENSATION

a. Adjust HF Compensation

Set VOLTS/DIV to .1 and TIME/DIV to .5μSEC.

Adjust TYPE 106 for 5 major div of 400kHz.

Adjust TRIG LEVEL and STABILITY for stable display. Adjust L409, L418, L450 and L451 for best waveform as described.

23a. (CONT)

A small hump followed by a small dip after the leading edge is normal. The top of the hump should be even with the general level of the rest of the waveform. Try to get the leading edge as steep as possible without causing excessive hump or dip.

L409 and L418 affect the leading edge. L450 and L451 affect the portion just folliwing the leading edge. L450 and L451 present a good waveform when the slugs are in either one of two positions: most of the way out or most of the way in. Set them so the slugs are most of the way in.

All four coils should be adjusted so that each pair of slugs is at approvimately the same height (L409 even with L418 and L450 even with L451; however L409 won't necessarily be even with L450).

b. Adjust Preamp high frequency L325, L341

Set VOLTS/DIV to .01. Readjust TYPE 106 for 5 major div of centered display. Adjust L325 and L341 for a wave form as nearly like that of previous step as possible. Again try to get the leading edge as steep as possible without causing either excessive hump or dip.

L341 affects the leading edge and L325 affects the general level.

Remove TYPE 106 signal.

24. BANDPASS

a. Check Bandpass main amp: ≥4.1MHz at -3dB

Connect TYPE 191--50Ω cable--50Ω Term--TYPE 310A INPUT

24a. (CONT)

Set VOLTS/DIV to .1, AC/DC to DC. Adjust TYPE 191 for 6 major div of 50kHz. Set TYPW 191 to 4.1MHz and note deflection: 4.2 div, min.

b. Check Bandpass Preamp: ≥3.5MHz at -3dB

Change VOLTS/DIV to .01. Adjust TYPE 191 for 6 major div of 50kHz Set TYPE 191 to 3.5MHz and note deflection: 4.2div, min.

25. HF TRIGGER

a. Check 5MHz Internal triggering 2div

TYPE 310A presets:

TRIG LEVEL	midr
TRIGGER source	+INT
TRIGGER mode	AC
VOLTS/DIV	.1
TIME/DIV	.5μSEC
MAG	X5

Adjust TYPE 191 for 2 major div of 5MHz.

Check that you can obtain a stable trigger with STABILITY and TRIG LEVEL controls.

b. Check 5MHz external triggering 2 volts

Set VOLTS/DIV to 2. Switch TRIGGER to +EXT. Connect a BNC "T" connector to the TYPE 191 to one side of the "T" and a BNC to BINDING POST adapter to the other side. Run a short jumper from there to the EXT TRIG INPUT. Set TYPE 191 output with test scope for 2V of 5MHz. You must obtain a stable trigger with adjustment of STABILITY and TRIG LEVEL controls. Changing the VOLTS/DIV switch to the higher input positions should not affect the triggering.

Return VOLTS/DIV to .1. Remove TYPE 191 signal.

26. HORIZ JITTER

Check for Horiz jitter

Connect .2 VOLTS CAL OUT signal to TYPE 310A input set TIME/DIV to .5mSEC with MAG at X5. Trigger on the signal and note the last falling portion of the square wave. Horiz jitter is present if you can see two vertical lines.

27. SWEEP TIMING

a. Adjust Sweep Cal

TYPE 184 marker out--50Ω cable--50Ω Term--TYPE 310A INPUT

TYPE 310A presets:

TIME/DIV	1mSEC
TRIGGER source	+INT
TRIGGER mode	AC
MAG	X1

Set TYPE 184 to 1msec and 100μsec markers and adjust R250 for one 1msec marker per division.

b. Check X5 MAG accuracy
error: ±3% except .5μSEC; ±4%

Set MAG to X5 and note timing error: ±3% max except .5μSEC position; ±4%

c. Adjust Mag Center

Move the first marker to graticule center.

Set MAG to X1 and adjust R215 to return the first marker to graticule center.

d. Adjust Sweep Length 10.2 to 10.8

Set 184 to 1msec markers and adjust Sweep Length R161 for 10.5div trace length.

27. (CONT)

e. Check Variable time/div: ≥2.5:1

Set TYPE 184 to 10msec markers and trigger TYPE 310A.

Rotate variable time/div to max atten, examining trace for any open spots in its range.

Note distance between markers: 4cm, max. Return to CALIBRATED.

f. 100µSEC to .2 SEC timing timing error: ±2%, unmagnified linearity error: ±1%

DIV	TYPE 184 signal	display
100µSEC	100µsec	1 mark/div
200µSEC	100µsec	2 marks/div
500µSEC	500µsec	1 mark/div
1mSEC	1msec	1 mark/div
2mSEC	1msec	2 marks/div
5mSEC	5msec	1 marks/div
10mSEC	10msec	1 mark/div
20mSEC	20msec	2 marks/div
50mSEC	50msec	1 mark/div
.1 SEC	100msec	1 mark/div
.2 SEC	100msec	2 marks/div

g. Adjust high speed linearity

Set TIME/DIV to 10µSEC and MAG to X5.

Set TYPE 184 to 10µsec markers.

Turn STABILITY ccw until sweep turns off. Increase INTENSITY until a single marker appears. Position this marker to graticule center.

Rock STABILITY back and forth between a spot and a stable trace, adjusting C205, as necessary, until spot and first marker coincide.

27. Timing and linearity explanation

(1) Timing is the relationship of the timing markers to the first and ninth graticule lines.

(2) Linearity is the relationship of the timing markers to any other graticule line between the first and ninth graticule lines, divided by the length of measurement, and multiplied by 100.
i.e.....

27g. (CONT)
Turn MAG to X1 and adjust C213 to position the first marker to graticule center.

C205 and C213 interact, repeat adjustments as necessary.

h. Adjust and check 50 to .5µSEC timing
unmagnified timing error: ±2%
mag timing error: ±3% except 4% at .5µSEC
unmagnified linearity error: ±1%

TIME/ DIV	184 signal	adjust or check	for
10µSEC	10µsec	C175B	1 mark/div
20µSEC	10µsec	check	2 marks/div
50µSEC	50µsec	check	1 mark/div
1µSEC	1µsec	C175A	1 mark/div
2µSEC	1µsec	check	2 marks/div
5µSEC	5µsec	check	1 mark/div

Set MAG to X5.

.5µSEC	10MHz	C250	1 cycle/div

THE END