FACTORY CALIBRATION PROCEDURE

CONTENTS:

INTRODUCTION:

545B

This is the guide for calibrating brand-new instruments that have never been turned on. Therefore, it calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is for factory use only.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj.).

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For all serial numbers.

Supersedes November 1965

QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers listed beside the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or check-out methods and test equipment differ substantially from those in this procedure.

TEST EQUIPMENT:

Substitute test equipment may be used. The Plant Staff Engineer must determine that the substitute equipment is equivalent and must determine proper control settings, etc. It is assumed that all equipment listed is within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-214.

ABBREVIATIONS and SYMBOLS:

A	ampere
AC	alternating current
approx	approximately
b	base
c	collector
ccw	counterclockwise
cm	centimeter
coax	coaxial
c/s	cycles per second
CRT	cathode ray tube
CS	ceramic strip
cw	clockwise
dB	decibel
DC	direct current
dcpl	decoupled
div	division
e	emitter
fil.	filament
freq	frequency
Gc/s	gigacycles per second
GHz	gigahertz
gnd	chassis ground
H	henry
Hz	hertz (cycles per second)
HF	high frequency
HV	high voltage
∞ or inf	infinity
int	internal
k	kilo (10^3)
kΩ	kilohm
kc/s	kilocycles per second
kHz	kilohertz
LF	low frequency
M	mega (10^6)
m	milli (10^{-3})
mA	millampere
max	maximum
Mc/s	megacycles per second
MHz	megahertz
MΩ	megohm
mH	millihenry
midr	midrange or centered
min	minimum
mm	millimeter
ms	millisecond
mV	millivolt
μ	micro (10^{-6})
μF	microfarad
μH	microhenry
μs	microsecond
μV	microvolt
NBS	National Bureau of Standards
n	nano (10^{-9})
ns	nanosecond
Ω	ohm
p	pico (10^{-12})
pF	picofarad (μμf)
PIV	peak inverse voltage
pot	potentiometer
P to P	peak to peak
reg	regulated
RM	rackmount
SAC	Standard Amplitude Calibrator
s	second
SN	serial number
SSWC	Standard Square-Wave Calibrator
term	terminal
THz	terahertz
unreg	unregulated
V	volt
VAC	volts, alternating current
VDC	volts, direct current
var	variable
W	watt
xfmr	transformer
Z	impedance
#	number
+	plus
-	minus
±	plus or minus
+ & -	plus and minus
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
≃	approximately
Bxxx	bulb (number xxx)
Cxxx	capacitor (number xxx)
Dxxx	diode (number xxx)
Fxxx	fuse (number xxx)
Jxxx	jack (number xxx)
Kxxx	relay (number xxx)
Qxxx	transistor (number xxx)
Lxxx	inductor or coil (number xxx)
Rxxx	resistor (number xxx)
SWxxx	switch (number xxx)
Txxx	transformer (number xxx)
Vxxx	vacuum tube (number xxx)

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers listed beside the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

NOT INTENDED FOR INCOMING INSPECTION

We initially calibrate the instrument to factory test limits. These limits usually are tighter than advertised performance requirements, thus helping to insure the instrument will meet or be within advertised performance requirements after shipment and during subsequent recalibrations. Instruments that have left our factory may not meet factory test limits but should meet catalog or instruction manual performance requirements.

1. EQUIPMENT REQUIRED

2. PRELIMINARY INSPECTION

b. Set DELAY-TIME MULTIPLIER dial: 0.0 to >10.0

e. Adjust graticule lights: bulbs projecting into light injector

f. Check fuse: 108 to 122V 6.25A slo-blo
216 to 244V 3A slo-blo

3. PRESETS

4. RESISTANCE CHECKS

5. LOW VOLTAGE SUPPLIES

a. Check time-delay relay: delay >15 sec

b. Adjust -150V Adj: -150Vdc ±2%

5c. Check power supply voltage and regulation

supply	tolerance	max ripple
-150V	±2%	5mV
+100V	±2%	10mV
+225V	±2%	5mV
+350V	±2%	20mV
+500V	±3%	20mV

6. HIGH VOLTAGE

a. Adjust High Voltage Adj: -1700V ±2%

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

c. Check TRACE ROTATION and alignment:
range >6°
alignment ±1°

7. GEOMETRY AND FOCUS

a. Adjust Geometry <1mm bowing or tilt

b. Check horizontal focus: no overlap of 20 marks/cm in 10cm

c. Check horizontal geometry <1mm bowing

d. Check vertical focus: no overlap of 0.5mm spaced traces in 6cm

8. SCALE ILLUMINATION, TIME BASE INDICATORS AND BEAM POSITION INDICATORS

a. Check SCALE ILLUM: max cw, off ccw

b. Check TIME BASE indicators: A on in A and 'A' SINGLE SWEEP, B on for all others

c. Check vertical beam position indicators: correct indicator on, other off by 2cm from center.

d. Check horizontal beam position indicators: correct indicator on, other off by 4cm from center

9. VERTICAL GAIN

a. Adjust DC Bal: range >+ & - 2cm
balance $\leq \pm$1cm

b. Set Gain: range > + & - 10%
accuracy ±1%

9c. Check gain change with line voltage change: <1% from 103.5V to 126.5V
d. Check low frequency linearity: < 1.5mm compression or expansion
e. Check trace drift with line voltage change: < 1cm from 103.5V to 126.5V

10. DUAL TRACE AND CHOPPED BLANKING

a. Check alternate operation: dual trace all sweep rates.
b. Check chopped blanking: transients blanked

11. AMPLITUDE CALIBRATOR

a. Adjust Cal Adj: 100V ±2%
b. Check Voltage accuracy: ±2%
c. Check .1V into 50Ω accuracy: ±2%
d. Check symmetry: 45 to 55%
e. Check frequency: 1 kHz ±20%

12. TIME BASE A TRIGGER

b. Adjust Trig Level Centering: + & - 1mm
c. Adjust Trig Sens: AUTO repetition rate of 40 Hz ±10%
d. Adjust Int Trig DC Level: + & - 2mm at graticule center.
e. Check triggering:

±EXT AC and DC	0.1V at 150 Hz
±EXT AC LF REJECT	0.1V at 150 Hz will not trigger
±EXT AC LF REJECT	0.1V at 30 kHz
±INT AC LF REJECT	1mm at 30 kHz
±INT AC LF REJECT	1mm at 150 Hz will not trigger
±INT AC	1mm at 150 Hz
±INT DC	4mm at 150 Hz within 2mm of graticule center.

13. TIME BASE B TRIGGER

b. Adjust Trig Level Centering: + & - 1mm
c. Adjust Int Trig DC Level: + & - 2mm at graticule center

13d. Check triggering:

±INT AC	1mm at 300 Hz
±INT DC	4mm at 300 Hz within 2mm of graticule center
±EXT AC & DC	0.1V at 300 Hz

14. PRESET STABILITY

a. Adjust TIME BASE A PRESET ADJUST: 50% of range
b. Adjust TIME BASE B PRESET ADJUST: 50% of range
c. Check automatic triggering
TIME BASE B; + & - INT 4mm, + & - EXT 0.5V at 300 Hz
TIME BASE A; + & - INT 4mm, + & - EXT 0.5V at 150 Hz

15. LINE TRIGGERING

Trigger on correct slope

16. HORIZONTAL AMPLIFIER GAIN

a. Adjust Mag Gain: ±4%
b. Adjust Swp Cal: ±2%
c. Match time bases: ±0.5mm
d. Adjust TIME BASE A Sweep Length: 10.5cm ±0.3cm
e. Adjust Norm/Mag Regis: ±1mm
f. Adjust TIME BASE B sweep length: max 10.5cm ±0.3cm; min 3.5cm ±0.3cm

17. TIME BASE A TIMING

a. Check VARIABLE TIME/CM: range; >2.5:1 neon; lit except calibrated
b. Check slow sweep rates: ±2%, except 2.5% 1, 2, & 5 sec/cm
c. Adjust fast sweep rates: ±2%, ±4% 5X MAGNIFIER ON

18. DELAY PICKOFF

a. Set Delay Start and Delay Stop ±0.2%
b. Check jitter: 1.00 <2mm, 9.00 <4mm
c. Check incremental accuracy: ±0.2%

19. TIME BASE B TIMING

a. Check slow sweep rates: ±0.6%
.2, .5 and 1 SEC ±1%
b. Adjust fast sweep rates: ±0.6%

20. 'A' SINGLE SWEEP

a. Set Lockout Level Adj: ratio >1:1
to <3:2 gate min amplitude 9V
b. Check single sweep triggering: 1mm
READY neon on when armed

21. +GATE INTERVAL AND FRONT PANEL WAVEFORMS

a. Check TIME BASE A and B + gate interval:
4µsec to 400msec.
b. Check + GATE amplitude: 0 to >20V
c. Check SAWTOOTH A amplitude: 0V ±5V
to >130V
d. Check DLY'D TRIG amplitude: >5V
e. Check VERT SIG OUT: >1.2V/cm of display

22. EXTERNAL HORIZONTAL AMPLIFIER

a. Adjust Ext Horiz DC Bal: <1cm
b. Check deflection factor: <.15 V/cm
c. Check X10 attention: ±2%
d. Adjust X10 compensation: <3% aberration
e. Check VARIABLE 10-1 ratio: >10:1
f. Check bandpass: -3dB at >350 kHz

23. Z AXIS MODULATION

modulates on <15V

24. VERTICAL TRANSIENT RESPONSE

a. Adjust DC Shift: <1% tilt
b. Adjust high frequency compensation:
<1% aberration
c. Check positioning effect on transient
response: <1%
d. Recheck vertical gain: 4cm ± <1%
e. Check risetime: <10nsec

25. VERTICAL BANDPASS

b. Check vertical bandpass: -3dB at
>33 MHz

26. HIGH FREQUENCY TRIGGERING

a. Check TIME BASE B, 5 MHz:
INT AC 2mm
INT DC 6mm
EXT AC & DC 0.2V
EXT & INT
AUTO any amplitude
b. Check TIME BASE B; 10 MHz:
INT AC 1cm; <1mm jitter
EXT AC & DC 1V; <1mm jitter
c. Check TIME BASE A, 10 MHz:
INT AC & AC
LF REJECT 2mm
INT DC 6mm
EXT AC, AC
LF REJECT
& DC 0.2V
EXT & INT
AUTO any amplitude
d. Check TIME BASE A, 30 MHz:
INT AC & AC
LF REJECT 1cm, <1mm jitter
EXT AC, AC
LF REJECT
& DC 1V, <1mm jitter

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

I. LOW VOLTAGE POWER SUPPLY DC STABILITY

Change from 103.5V to 126.5V:
-150Vdc ± 0.05%
+100Vdc ± 0.5%
+225Vdc ± 0.1%
+350Vdc ± 0.5%
+500Vdc ± 0.5%

II. VISUAL WRITING RATE

No bright spot at start of trace with sweep rate of 0.02µsec, triggered at 10 Hz.

1. EQUIPMENT REQUIRED

a. TEKTRONIX instruments

1 TYPE 545B OSCILLOSCOPE
1 TYPE B PLUG-IN UNIT
1 TYPE 1A2 PLUG-IN UNIT
1 TYPE 1M1 PLUG-IN TEST UNIT
1 TYPE 180A TIME MARK GENERATOR
1 TYPE 190B CONSTANT-AMPLITUDE SIGNAL GENERATOR

b. Test accessories (TEKTRONIX catalog)

3 50Ω coax cables 42" long (012-0057-00)
1 P6006 10X PASSIVE PROBE (010-0127-00)
1 P6028 1X PASSIVE PROBE (010-0074-00)
1 50Ω TERMINATION (011-0049-00)
3 18" patch cords (012-0031-00)
1 30" patch cords (012-0014-00)

c. Special equipment (not TEKTRONIX catalog items)

1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
1 LINE VOLTAGE CONTROL UNIT with metered output TYPE 76 TU
1 20,000 Ω/Vdc multimeter
1 50Ω TERMINATION special (±.2%)
1 Audio Generator (1 volt p to p at 150 Hz, 300 Hz and 30 kHz

2. PRELIMINARY INSPECTION

a. General

Check for:

unsoldered joints
rosin joints
improper lead dress
long ends
wiring errors
foreign material
loose hardware
smooth control operation
proper indexing and spacing of front panel knobs.

Correct any defects found.

b. Set DELAY-TIME MULTIPLIER dial 0.0 to >10.0

Set DELAY-TIME MULTIPLIER dial cw. Loosen set screw and set the dial to 0.0. Rotate the dial ccw and check for a reading >10.0.

NOTES

1. SUBSTITUTE EQUIPMENT

Substitute equipment may be used; however, the user must determine that the substitute equipment is equivalent and must determine proper control settings, etc. It is assumed that all equipment listed is within its manufacturer's specifications. If there is any doubt, the test equipment should be calibrated before it is used. All substitutions at the factory must be approved by the plant staff engineer.

It is assumed that all equipment is provided with BNC connectors. If equipment has other than BNC connectors, adapters, not listed, may be needed.

2. (cont'd)

c. Pretighten TRIGGERING LEVEL knobs

Use care not to dimple the shafts. Tighten the TRIGGERING LEVEL knobs just secure enough to allow the TRIGGERING LEVEL controls to be used, they will be set later in the procedure.

d. Check CRT

Adjust the CRT mounting bracket so that the CRT and light injector are flush.

Place an external graticule over the CRT, tighten the CRT clamp, and adjust the CRT for alignment with the external graticule.

Inspect the CRT for:
- phosphor defects
- scratches
- cracks
- bubbles

Record the CRT serial number and bake date.

d. CRT specifications

Do not reject a CRT without consulting the CRT checker or the CRT check-out procedure.

e. Adjust graticule lights: bulbs projecting into light injector

Adjust the graticule lights so that the bulbs extend into but do not rest on the light injector.

f. Check fuse: 108 to 122V 6.25A slo-blo
216 to 244V 3A slo-blo

Check for the correct fuse value.

108V, 115V, or 122V 50-60 and 400 Hz
6.25A Slo-Blo 3ag (159-0011-00)
216V, 230V, or 244V 50-60 and 400 Hz
3A Slo-Blo 3ag (159-0005-00)

3. PRESETS

a. TYPE 545B external controls

FOCUS	ccw
INTENSITY	ccw
ASTIGMATISM	ccw
SCALE ILLUM	cw
HORIZONTAL DISPLAY	A
5X MAGNIFIER	OFF
DELAY-TIME MULTIPLIER	1.00
VARIABLE 10:1	cw
AMPLITUDE CALIBRATOR	OFF

3a. (cont'd)

TIME BASE A	
STABILITY	ccw
TRIGGER SLOPE	+ INT
TRIGGERING MODE	AC
TIME/CM	1mSEC
VARIABLE TIME/CM	CALIBRATED
PRESET ADJ	ccw
TIME BASE B	
STABILITY	ccw
TRIGGER SLOPE	+ INT
TRIGGERING MODE	AC
TIME/CM	1mSEC
LENGTH	10cm
PRESET ADJ	ccw
CRT CATHODE SELECTOR	
(scope rear)	EXT CRT CATHODE

b. Preset TYPE 545B internal adjustments

C375	1/4 turn from max
All others	mid r

c. Preset TYPE 1M1

Install TYPE 1M1 in TYPE 545B and preset as follows:

TEST FUNCTION	LOW LOAD
VARIABLE	cw
VERTICAL POSITION	midr
REPETITION RATE	LOW
AMPLITUDE	ccw

4. RESISTANCE CHECKS

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

Supply	approx resistance
-150Vdc	3kΩ
+100Vdc	500kΩ
+225Vdc	2.2kΩ
+350Vdc	20kΩ*
+500Vdc	30kΩ
+325Vdc unreg	3.5kΩ
+ 75Vdc	400kΩ

* Reverse meter leads.

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

5. LOW VOLTAGE SUPPLIES

a. Check time-delay relay: delay >15 sec

Connect the TYPE 545B power cord to the TYPE 76 TU. Set the TYPE 76 TU for 115V as read on its meter. Turn TYPE 545B POWER switch ON, check for 15 seconds or more before the audible click.

b. Adjust -150V adj R616: -150Vdc ±2%

Connect the multimeter leads from the -150V supply to gnd and adjust R616 -150V adj for -150Vdc.

c. Check power supply voltage and regulation

Supply	Tolerance	Max ripple
-150V	±2%	5mV
+100V	±2%	10mV
+225V	±2%	5mV
+350V	±2%	20mV
+500V	±3%	20mV

Use the multimeter to check the power supply voltages. Check the power supply ripple with the test scope and X1 probe. Set TYPE 1M1 at HIGH LOAD for line voltage of 103.5V and LOW LOAD for line voltage of 126.5V. Use the following table:

Supply	Tolerance	Max ripple
-150Vdc	±3V	5mV
+100Vdc	±2V	10mV
+225Vdc	±4.5V	5mV
+350Vdc	±7V	20mV
+500Vdc	±15V	20mV

Return the TYPE 76 TU to 115V.

d. Check elevated heaters:

Check the following terminals of T601 for elevation.

T601 term	approx dc voltage to gnd
22 and 23	+95V
9 and 16	+220V
18 and 19	+350V
24 and 25	-1500 to -1900

e. Check export windings

Connect T601 term B and C together. Check term A and D for approx 14Vac. Remove the connection between term B and C.

a. Raw Instruments

Instruments that have not been turned on previously should be pre-caled, using the procedure authorized by the plant.

c. Supply Ripple

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

6. HIGH VOLTAGE

a. Adjust High Voltage Adj R840: -1700V ±2%

Connect the multimeter leads between the filament end of R857 and gnd. Adjust the High Voltage Adj R840 for -1700V.

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

Set the TIME BASE A STABILITY cw. Slowly increase INTENSITY until a trace appears, it may also be necessary to adjust the TYPE 1M1 VERTICAL POSITION control. Defocus the trace and set the INTENSITY control cw. Set the TYPE 76 TU to 103.5V and check for -1700V ±20V with no blooming.

Set the TYPE 76 TU to 126.5V and check for -1700V ±20V with no blooming. Return TYPE 76 TU to 115V. Set INTENSITY FOCUS and ASTIGMATISM for a well-defined trace.

c. Check TRACE ROTATION range and alignment: range: >6°; alignment: ±1°

Set TRACE ROTATION to both extremes and check for 6° (1cm) or more of range. Check for cw rotation when control is moved cw. Adjust the TRACE ROTATION to parallel the trace with a horizontal graticule line.

7. GEOMETRY AND FOCUS

a. Adjust Geometry R861: <1mm bowing

Connect the MARKER OUTPUT of the TYPE 180A to the TYPE 1M1 EXT INPUT. Set the TYPE 180A for 100µsec time marks. Adjust the TIME BASE A STABILITY and TRIGGERING LEVEL for a stable display. It may be necessary to adjust Trig Level Centering R39 to trigger the display.

Use the TYPE 1M1 VERTICAL POSITION control to position the display so that only the time marks are visible. Adjust R861 Geometry for min bowing of markers.

7. (cont'd)

b. Check horizontal focus: no overlap of 20 marks/cm in 10cm

Set the TYPE 180A for 500µsec time marks. Readjust TRIGGERING LEVEL and STABILITY if necessary. Adjust the TIME BASE A VARIABLE TIME/CM for 2 marks/cm. It may also be necessary to adjust the Swp Cal R348.

Change the TYPE 180A to 50µsec time marks. Readjust TRIGGERING LEVEL and STABILITY if necessary. Adjust INTENSITY FOCUS and ASTIGMATISM for the best resolution. Check for no overlap of time marks anywhere on the graticule.

c. Check horizontal geometry: <1mm bowing

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

d. Check vertical focus: no overlap of 0.5mm spaced traces in 6cm

Connect a coax cable from the SAC OUTPUT to the TYPE 1M1 EXT INPUT. Set the SAC to 1 VOLT . Adjust the TYPE 1M1 VARIABLE for a display amplitude of 0.5cm. Set the SAC to .1 VOLT. Adjust the FOCUS, ASTIGMATISM and INTENSITY for best resolution. Position the display to the top, center and bottom of the graticule, check for no overlap of the traces.

8. SCALE ILLUMINATION, TIME BASE INDICATORS AND BEAM POSITION INDICATORS

a. Check SCALE ILLUM: max cw, off ccw

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

b. Check TIME BASE indicators: A on in A and 'A' SINGLE SWEEP, B on for all others

Remove the coax cable from the TYPE 1M1 EXT INPUT. Set the HORIZONTAL DISPLAY switch to B. Switch the HORIZONTAL DISPLAY through all positions. The B neon should be on in all positions except A and 'A' SINGLE SWEEP. Check that both neons are not lit at the same time. Leave the HORIZONTAL DISPLAY switch in EXT X1.

8. (cont'd)

c. Check vertical beam positions indicators: correct indicator on, other off by 2cm from center

Center the spot with the positioning controls. With the TYPE 1M1 VERTICAL POSITION control move the spot up 2cm ↑ on ↓ off. Repeat in the other direction, ↓ on ↑ off. Return the spot to graticule center.

d. Check horizontal beam position indicators: correct indicator on, other off by 4cm from center

With the HORIZONTAL POSITION control move the spot to the left 4cm, ← on, → off. Repeat in the other direction → on ← off.

9. VERTICAL GAIN

a. Adjust DC BAL R495: range >+ & - 2cm balance ≤±1cm

9a. The DC Bal must be set at graticule center to compensate for circuit drift.

Set the HORIZONTAL DISPLAY to A and the TYPE 1M1 TEST FUNCTION switch to COMMON MODE. Rotate DC Bal R495 and check for 2cm or more of movement from graticule center in both directions. Position the trace to graticule center with the DC Bal R495.

b. Set Gain R520: range >+ & - 10% accuracy ±1%

Set the TYPE 1M1 TEST FUNCTION to GAIN SET. Apply a 100 Volt from the SAC. Set Gain R520 cw and check for 4.4cm or more of display. Set Gain ccw and check for 3.6cm or less amplitude. Set Gain R520 for 4cm.

c. Check gain change with line voltage change: <1% from 103.5V to 126.5V

Set the TYPE 76 TU to 103.5V and check amplitude, 4cm ±.4mm. Set the TYPE 76 TU to 126.5V and check amplitude, 4cm ±.4mm. Return TYPE 76 TU to 115V.

d. Check low frequency linearity: <1.5mm compression or expansion

Set the TYPE 1M1 TEST FUNCTION switch to LOW LOAD. Adjust the VARIABLE and VERTICAL POSITION for a 2cm display at graticule center. Position the display to the top and then the bottom of the graticule, check for 2cm ±1.5mm max at top and bottom.

9. (cont'd)

e. Check trace drift with line voltage change: <1cm from 103.5V to 126.5V

Remove the SAC signal from the TYPE 1M1 EXT INPUT. Set the TYPE 76 TU to 103.5V wait 30 sec and position trace to graticule center. Change TYPE 76 TU to 126.5V. Wait 30 sec, check trace drift, 1cm max. Return TYPE 76 TU to 115V.

10. DUAL TRACE AND CHOPPED BLANKING

a. Check ALTERNATE operation: dual trace all sweep rates.

Check all sweep rates of TIME BASE A, form .1μSEC to 10mSEC. (This will assure operation at all sweep rates.) Change the HORIZONTAL DISPLAY switch to B and check from 2μSEC to 10mSEC for dual trace.

b. Check chopped blanking: transients blanked

Set both TIME BASE A and B TIME/CM switches to 2μSEC. Set the TYPE 1M1 TEST FUNCTION switch to CHOPPED. Switch the CRT CATHODE SELECTOR, located on rear panel, to CHOPPED BLANKING. Check for blanking of the rising and falling portion of the waveform. Change the HORIZONTAL DISPLAY switch to A. Change the CRT CATHODE SELECTOR to EXTERNAL CRT CATHODE, check that rising and falling portion of waveform reappears.

11. AMPLITUDE CALIBRATOR

a. Adjust Cal Adj R875: 100V ±2%

Connect a 50Ω coax cable from the TYPE 545B CAL OUT to the SAC UNKNOWN INPUT. Set the AMPLITUDE CALIBRATOR to 100 VOLTS. Connect a 50Ω coax cable from the SAC OUTPUT to the test scope TYPE B UNIT. Set the TYPE B VOLTS/CM to .5 input selector to AC. Set the SAC to 100V +DC MIXED.

Remove V875 from the TYPE 545B.

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 then be determined by the direction of

11a. (cont'd)

the first difference voltage. A positive going waveform is a positive error.

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

b. Check voltage accuracy: ±2%

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

SAC VOLTS	TYPE B VOLTS/CM	MAX DEFLECTION
100	.5	adjustable
50	.5	2cm
20	.2	2cm
10	.1	2cm
5	.05	2cm
2	.02	2cm
1	.01	2cm
.5	.005	2cm
.2	.005	8mm
.1	.005	4mm

Add the error found in the .1 volt position to the worst error of the same direction in the previous positions. This total error must still be less than the 2% error indicated in the test limits.

c. Check .1V into 50Ω accuracy: ±2%

Set AMPLITUDE CALIBRATOR to .5 VOLTS (.1V into 50Ω) and insert a special 50Ω TERMINATION (±.2%) into the signal path between the AMPLITUDE CALIBRATOR and the SAC UNKNOWN INPUT. Check for 4mm or less.

d. Check symmetry: 45 to 55%

Remove the special 50Ω TERMINATION from the signal path. Reinsert V875. Set the test scope TRIGGER SLOPE to +INT and TIME/CM to 50μSEC. Set the TYPE B VOLTS/CM to .2. Change the SAC to UNKNOWN INPUT. Adjust the test scope VARIABLE TIME/CM for 1 cycle of square-wave in 10cm. Check the length of the half cycles, 4.5 to 5.5cm.

e. Check frequency: 1 kHz ±20%

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

12. TIME BASE A TRIGGER

a. Tighten TRIGGERING LEVEL knob:

Connect the multimeter between the junction of R19-R20 (TRIGGER SLOPE switch) and gnd. Set the TRIGGERING LEVEL knob for 0V, on the most sensitive Vdc range. Loosen the TRIGGERING LEVEL knob set screw, align the index dot with "0" and retighten set screw. Make sure the meter remains at 0V.

b. Adjust Trig Level Centering R39: + & - 1mm

Change the multimeter to its highest current range. Connect 2 VOLTS⌐⌐ from the SAC to the TYPE 1M1 EXT INPUT. Change the TYPE 1M1 TEST FUNCTION switch to LOW LOAD. Adjust the VARIABLE for 2cm amplitude. Set the SAC to .1 VOLTS. (This is 1mm of vertical amplitude). Connect the test scope X10 probe to R49-C131 junction (C of Q45).

Adjust Trig Level Centering R39 for a stable square-wave on the test scope, while switching TIME BASE A TRIGGER SLOPE between +INT and - INT. Optimum setting is reached when the square-wave is symmetrical.

c. Adjust Trig Sens R47: AUTO repetition rate of 40 Hz ±10%

Set the test scope TIME/CM to 5mSEC. Change the TYPE 545B TRIGGERING MODE to AUTO. Remove the coax cable from the TYPE 1M1 EXT INPUT. Adjust the Trig Sens R47 for 5cm/cycle of square-wave ±.5cm.

d. Adjust Int Trig DC Level R3: + & - 2mm at graticule center

Change the TRIGGERING MODE to DC, reconnect the SAC signal to the TYPE 1M1 EXT INPUT. Set the SAC to .2 VOLTS. Position the TYPE 545B display to graticule center with the TYPE 1M1 VERTICAL POSITION control. Set the test scope TIME/CM to 1mSEC. Adjust the Int Trig DC Level R3 for a stable square-wave display on the test scope while switching the TRIGGER SLOPE switch between +INT and - INT.

Remove the meter leads from the junction of R19-R20 and gnd.

d. Int Trig DC Level

The setting of R3 and R39 with drift. Do not reset R39, R47 or R3 to compensate for this drift, unless you cannot make the test limits in step 12e.

12. (cont'd)

e. Check triggering:

±EXT AC and DC	*0.1V at 150 Hz*
±EXT AC LF REJECT	*0.1V at 150 Hz will not trigger*
±EXT AC LF REJECT	*0.1V at 30 kHz*
±INT AC LF REJECT	*1mm at 30 kHz*
±INT AC LF REJECT	*1mm at 150 Hz will not trigger*
±INT AC	*1mm at 150 Hz*
±INT DC	*4mm at 150 Hz within 2mm of graticule center*

Remove the SAC cable from the TYPE 1M1 EXT INPUT. Install a "T" connector on the EXT INPUT. Connect a 50Ω coax cable from the "T" connector to the test scope TYPE B.

Connect a 50Ω coax cable from the Audio Generator to the "T" connector. Set the Audio Generator frequency to 150 Hz. Adjust the amplitude for 0.1 volts displayed on the test scope. Change the coax cable from the test scope TYPE B to the TYPE 545B TIME BASE A TRIGGER INPUT. Check both + and - slopes for triggering using the following table. Adjust TRIGGERING LEVEL and STABILITY as necessary.

TRIGGERING MODE	TRIGGER SLOPE	Audio Generator Frequency	Amplitude
AC	±EXT	150 Hz	0.1V
DC	±EXT	150 Hz	0.1V
AC LF REJECT	±EXT	150 Hz	0.1V will not trigger
AC LF REJECT	±EXT	30 kHz	0.1V (check amplitude with test scope)
AC LF REJECT	±INT	30 kHz	1mm
AC LF REJECT	±INT	150 Hz	1mm will not trigger
AC	±INT	150 Hz	1mm
DC	±INT	150 Hz	4mm within 2mm of graticule center

Remove Audio Generator cable from the "T" connector.

13. TIME BASE B TRIGGER

a. Tighten TRIGGERING LEVEL knob

Connect the multimeter between the junction of R69-R70 (trigger slope switch) and gnd.

Set the TRIGGERING LEVEL knob for 0V, on the most sensitive Vdc range. Loosen the TRIGGERING LEVEL knob set screw, align the index dot with "0" and retighten the set screw. Make sure the meter remains at 0V.

b. Adjust Trig Level Centering R82: + & - 1mm

Connect the SAC output cable to the TYPE 1M1 EXT INPUT. Set the multimeter to the highest current range. Set the HORIZONTAL DISPLAY switch to B, and set the TIME BASE B STABILITY cw. Connect the test scope X10 probe to the junction of R95-C231 (Q95-C).

Set the SAC to 2 VOLTS, adjust the TYPE 1M1 VARIABLE for 2cm of display amplitude. Change the SAC to .1 VOLTS. Adjust Trig Level Centering R95 for a stable square-wave on the test scope, while switching the TIME BASE B TRIGGER SLOPE between +INT and - INT. Optimum setting is reached when the square-wave is symmetrical.

c. Adjust Int Trig DC Level R53: + & - 2mm at graticule center

Change the SAC to .2 VOLTS. Position the display to graticule center with the TYPE 1M1 VERTICAL POSITION control. Change the TRIGGERING MODE to DC. Adjust the Int Trig DC Level R53 for a stable test scope display while switching the TRIGGER SLOPE between +INT and -INT. Remove the probe and multimeter leads.

d. Check triggering:

±INT AC	*1mm at 300 Hz*
±INT DC	*4mm at 300 Hz within 2mm of graticule center*
±EXT AC & DC	*0.1V at 300 Hz*

Remove SAC cable from the "T" connector on the EXT INPUT. Change the coax cable from the A TRIGGER INPUT to the TIME BASE B TRIGGER INPUT. Connect the Audio Generator output cable to the "T" connector. Set the Audio Generator frequency to 300 Hz. Adjust the TIME BASE B TRIGGERING LEVEL and STABILITY as necessary to check triggering using the following table. (Check both + & - trigger slopes.)

13d. (cont'd)

TRIGGERING MODE	TRIGGER SLOPE	Audio Generator Frequency	Amplitude
AC	±INT	300 Hz	1mm
DC	±INT	300 Hz	4mm within 2mm of graticule center

Set Audio Generator amplitude with the test scope.

AC & DC	±EXT	300 Hz	0.1V

14. PRESET STABILITY

a. Adjust TIME BASE A PRESET ADJUST: 50% of range

Remove the AUDIO GENERATOR coax cable from the "T" connector. Set the TIME BASE A TRIGGERING MODE to AUTO, TRIGGER SLOPE to + LINE and TIME/CM to .1mSEC. Change the HORIZONTAL DISPLAY to A. Set the multimeter to read -150V and connect it from the center arm of the TIME BASE A PRESET ADJUST to gnd. Adjust the PRESET ADJUST cw until a trace appears on the CRT. Check the meter reading. Advance the PRESET ADJUST until the trace brightens, read the meter. Set the PRESET ADJUST for a reading halfway between the previous readings.

b. Adjust TIME BASE B PRESET ADJUST: 50% of range

Change the HORIZONTAL DISPLAY switch to B. Set the TIME BASE B TRIGGERING MODE to AUTO, TRIGGER SLOPE to +LINE and TIME/CM to .1mSEC. Connect the multimeter from the center arm of the TIME BASE B PRESET ADJUST to gnd. Adjust the PRESET ADJUST until a trace appears. Check meter reading. Advance the PRESET ADJUST until the trace brightens, read the meter. Set the PRESET ADJUST halfway between previous readings. Remove the meter.

c. Check automatic triggering:
TIME BASE B + & - INT 4mm, + & - EXT 0.5V at 300Hz
TIME BASE A + & - INT 4mm, + & - EXT 0.5V at 150Hz

Change both A and B TRIGGER SLOPE switches to +INT and TIME/CM switches to 5mSEC. Reconnect Audio Generator to the "T" connector. (Use test scope to set external triggering amplitudes.)

14c. (cont'd)

Check AUTO triggering using the following table:

	TRIGGER SLOPE	Frequency	Amplitude
TIME BASE B			
	INT + & -	300 Hz	4mm
	EXT + & -	300 Hz	0.5V
TIME BASE A			
	INT + & -	150 Hz	4mm
	EXT + & -	150 Hz	0.5V

Remove "T" connector and coax cable.

15. LINE TRIGGERING

Triggers on correct slope

Connect a X10 probe from the TYPE 1M1 EXT INPUT to the TYPE 545B fuse holder. Set both TIME BASE A and B TRIGGER SLOPE switches to +LINE, TRIGGERING MODE switches to AC and STABILITY controls to PRESET.

Check both A and B line triggering for a positive going sine-wave in +LINE and a negative going sine-wave in LINE -. Use TRIGGERING LEVELS as necessary. Remove X10 probe from fuse holder and TYPE 1M1.

16. HORIZONTAL AMPLIFIER GAIN

a. Adjust Mag Gain R375: ±4%

Set both TIME BASE A and B TRIGGER SLOPE switches to +INT and TIME/CM switches to 1mSEC. Set the HORIZONTAL DISPLAY switch to B. Connect the MARKER OUTPUT coax cable from the TYPE 180A to the TYPE 1M1 EXT INPUT. Set the TYPE 180A for 1msec and 100μsec time marks. Adjust the TIME BASE B STABILITY and TRIGGERING LEVEL controls for a stable display. Adjust the TYPE 1M1 for a display amplitude of 2cm.

Turn TYPE 545B 5X MAGNIFIER switch ON. Set the HORIZONTAL POSITION and VERNIER controls to approx mid r. Adjust Mag Gain R375 for 2 time marks/cm.

16. (cont'd)

b. Adjust Swp Cal R348: ±2%

Turn the TYPE 545B 5X MAGNIFIER, OFF. Adjust Swp Cal R348 for 1 large and 10 small marks/cm.

c. Match time bases R160Z: ±0.5mm

Change the TYPE 545B HORIZONTAL DISPLAY switch to A. Adjust the TIME BASE A STABILITY and TRIGGERING LEVEL for a stable display. Adjust R160Z for 1 large and 10 small marks/cm.

d. Adjust TIME BASE A Sweep Length R176: 10.5cm ±0.3cm

Align the start of the display with the 0 graticule line. Adjust A Sweep Length R176 for 10.5cm of sweep length.

e. Adjust Norm/Mag Regis R358: ±1mm

Turn TYPE 545B 5X MAGNIFIER, ON. Position the start of the display to the graticule center line. Turn the 5X MAGNIFIER OFF, adjust the Norm/Mag Regis R358 to return the start of the display to graticule center. Switch 5X MAGNIFIER, ON and OFF several times. Readjust R358 until the start of the display remains at graticule center. Turn 5X MAGNIFIER OFF and return start of the display to the 0 graticule line.

f. Adjust TIME BASE B sweep length R277 and R273: max 10.5cm ±0.3cm; min 3.5cm ±0.3cm

Change the HORIZONTAL DISPLAY switch to B. With the LENGTH control cw, adjust Max Swp Length R277 for 10.5cm.

Rotate LENGTH control ccw and adjust Min Swp Length R273 for 3.5cm ±0.3cm. Recheck sweep length with LENGTH control cw. Readjust R277 and R273 until interaction is eliminated.

17. TIME BASE A TIMING

a. Check VARIABLE TIME/CM: range; >2.5:1 neon; lit except CALIBRATED

Rotate the VARIABLE TIME/CM ccw. Check that the UNCALIBRATED neon light is lit. Check for 5 or more large time marks/2cm at ccw. Return

17a. (cont'd)

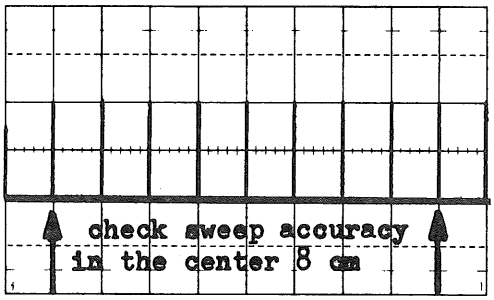
VARIABLE TIME/CM to CALIBRATED and check that the UNCALIBRATED neon extinguishes.

b. Check slow sweep rates: ±2%, except 2.5% 1, 2 & 5 SEC/CM

Set the TYPE 180A for 100µsec time marks only. Use the following table to check slow sweep rate timing:

TIME/CM	TYPE 180A markers	time marks/cm	max error at number 9
.1mSEC	100µsec	1	1.6mm
.2mSEC	100µsec	2	1.6mm
.5	500µsec	1	1.6mm
1	1msec	1	1.6mm
2	1	2	1.6mm
5	5	1	1.6mm
10	10	1	1.6
20	10	2	1.6
50	50	1	1.6
.1mSEC	100msec	1	1.6
.2mSEC	100msec	2	1.6
.5mSEC	500msec	1	1.6
1 SEC	1 sec	1	2mm
2 SEC	1 sec	2	2mm
5 SEC	1 sec	1	2mm

b. Sweep Accuracy



c. Adjust fast sweep rates: ±2%, ±4% 5X MAGNIFIER ON

Set the TIME BASE A TIME/CM to .1mSEC, 5X MAGNIFIER ON and the TYPE 180A to 10µsec. Position the start of the display to the graticule center line. Switch the TIME/CM to 50µSEC and adjust C330 to bring the start of the display to graticule center. Switch several times between .1mSEC and 50µSEC and readjust C330 to eliminate interaction.

Use the following table to adjust fast sweep rate timing:

TIME/CM	TYPE 180A	adjust	for	max error at 9	
10µSEC	10µsec	C160E	1 mark/cm	±1.6mm	
1µSEC	1µsec	C160C	1 mark/cm	±1.6mm	
.5µSEC	10mc	C160A	1 cycle/cm	±3.2mm	with 5X MAGNIFIER, ON
.1µSEC	10mc	C348	1 cycle/cm	±1.6mm	with 5X MAGNIFIER, OFF
.1µSEC	50mc	C375	1 cycle/cm	±3.2mm	with 5X MAGNIFIER, ON (7 cycles from start of display.)
.2µSEC	50mc	check	1 cycles/cm	±3.2mm	with 5X MAGNIFIER, ON (at center of display)

C160A, C348 and C375 interact, adjust until interaction is eliminated. Turn 5X MAGNIFIER OFF and check timing as follows:

17c. (cont'd)

TIME/CM	TYPE 180A	display	max error at 9
.1μSEC	10mc	1 cycle/cm	1.6mm
.2μSEC	5mc	1 cycle/cm	1.6mm
.5μSEC	1μsec	2 marks/cm	1.6mm
1 μSEC	1μsec	1 mark/cm	1.6mm
2 μSEC	1μsec	2 marks/cm	1.6mm
5 μSEC	5μsec	1 mark/cm	1.6mm
10μSEC	10μsec	1 mark/cm	1.6mm
20μSEC	10μsec	2 marks/cm	1.6mm
50μSEC	50μsec	1 mark/cm	1.6mm

18. DELAY PICKOFF

a. Set Delay Start R436 and Delay Stop R432 ±0.2%

Set the TIME BASE B TIME/CM to .5mSEC, A TIME/CM to 10μSEC. Set the TIME BASE A STABILITY cw. Set the DELAY-TIME MULTIPLIER to 1.00. Change the HORIZONTAL DISPLAY switch to 'B' INTENSIFIED 'A'. Adjust Delay Start R436 so that the number 1 time mark is intensified. Change the DELAY-TIME MULTIPLIER to 9 and adjust the Delay Stop R432 to intensify the number 9 time mark. Repeat until both time marks are intensified without readjustment of R436 and R432.

Change the HORIZONTAL DISPLAY switch to 'A' DLY'D by 'B'. Set the DELAY-TIME MULTIPLIER to 1.00. Adjust R436 Delay Start to bring the pulse leading edge to the start of the trace (0 graticule line). Change the DELAY-TIME MULTIPLIER to 9.00 and adjust R432 until the pulse is at the start of the trace (0 graticule line). Repeat until interaction is eliminated.

b. Check jitter: 1.00 <2mm, 9.00 <4mm

Change the TIME BASE A TIME/CM to 1μSEC and TIME BASE B TIME/CM to 1mSEC. Set the TYPE 180A for 1msec time marks. Set the DELAY-TIME MULTIPLIER to 1.00 and check for 2mm or less jitter. Set the DELAY-TIME MULTIPLIER to 9.00 and check for 4mm or less jitter. Repeat jitter checks with TIME BASE B TIME/CM at .5mSEC and .2mSEC with TIME BASE A TIME/CM at .5μSEC and .2μSEC.

c. Check incremental accuracy: ±0.2%

Set the TIME BASE A TIME/CM to 10μSEC and TIME BASE B TIME/CM to 1mSEC. Set TYPE 180A to 1msec. Set the DELAY-TIME MULTIPLIER to 1.00. Check the reading of the DELAY-TIME MULTIPLIER

18c. (cont'd)

when the number 1 time mark is at the 0 graticule line. Use the following table to check the incremental accuracy of the DELAY-TIME MULTIPLIER:

DELAY-TIME MULTIPLIER	time mark	amount of change	+ or - 0.2%
1.00	1	1.00	1.6 minor div
2.00	2	1.00	1.6 minor div
3.00	3	1.00	1.6 minor div
4.00	4	1.00	1.6 minor div
5.00	5	1.00	1.6 minor div
6.00	6	1.00	1.6 minor div
7.00	7	1.00	1.6 minor div
8.00	8	1.00	1.6 minor div
9.00	9	1.00	1.6 minor div

19. TIME BASE B TIMING

a. Check slow sweep rates: ±0.6% except .2, .5 and 1 SEC ±1%

Set the TYPE 545B TIME BASE B TIME/CM to .2mSEC. Set the TYPE 180A to 100µsec. Use the following table to check slow sweep rate accuracy. Use 'B' INTENSIFIED BY 'A' to locate time marks. Check accuracy with HORIZONTAL DISPLAY in A DLY'D BT 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 minimum B sweep LENGTH while finding the time mark at 1.00 then increasing the LENGTH to maximum while checking accuracy at 9.00.

TIME BASE B TIME/CM	TIME BASE A TIME/CM	TYPE 180A	minor div difference between 1.00 & 9.00
.2mSEC	5µSEC	100µsec	5 max
.5mSEC	10µSEC	500µsec	5 max
1mSEC	10µSEC	1msec	5 max
2mSEC	20µSEC	1msec	5 max
5mSEC	50µSEC	5msec	5 max
10mSEC	.1mSEC	10msec	5 max
20mSEC	.2mSEC	10msec	5 max
50mSEC	.5mSEC	50msec	5 max
.1 SEC	1mSEC	100msec	5 max
.2 SEC	2mSEC	100msec	8 max
.5 SEC	5mSEC	500msec	8 max
1 SEC	10mSEC	1 second	8 max

b. Adjust fast sweep rates C260C and C260A: ±0.6%

Set the TIME BASE B TIME/CM to 50µSEC, TIME BASE A TIME/CM to 2µSEC. Set the TYPE 180A to 50µSEC. Set the HORIZONTAL DISPLAY switch to B INTENSIFIED BY A. Adjust C260C for 1 mark/cm. Change HORIZONTAL DISPLAY switch to A DLY'D BY B for final adjustment. (1.00 to 9.00)

19b. (cont'd)

Change TIME BASE B TIME/CM to 5μSEC, TIME BASE A TIME/CM to .2μSEC and TYPE 180A to 5μsec. Set the HORIZONTAL DISPLAY to 'B' INTENSIFIED by 'A' and adjust C260A for 1 time mark/cm. Make final adjustment in 'A' DLY'D BY 'B'. (1.00 to 9.00)

Use the follwoing table to check fast sweep rate accuracy:

TIME BASE B TIME/CM	TIME BASE A TIME/CM	TYPE 180A	minor div difference between 1.00 & 9.00
2μSEC	.1μSEC	1μsec	5 max
5μSEC	.2μSEC	5μsec	5 max
10μSEC	.5μSEC	10μsec	5 max
20μSEC	1μSEC	10μsec	5 max
50μSEC	2μSEC	50μsec	5 max
.1mSEC	5μSEC	100μsec	5 max

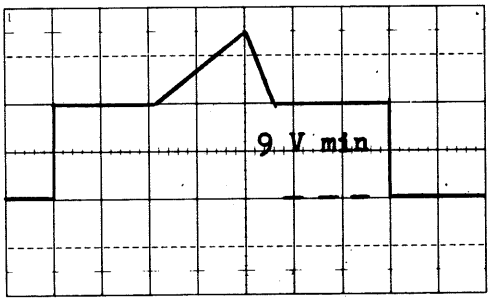
20. 'A' SINGLE SWEEP

a. Set Lockout Level Adj R125: ratio > 1:1 to < 3:2 gate min amplitude 9V

Set TIME BASE A TIME/CM to .1mSEC. Remove the TYPE 180A output coax cable from the TYPE 1M1 EXT INPUT. Set the TIME BASE B STABILITY cw and the TIME BASE A STABILITY ccw. Connect the test scope X10 probe to V125 pin 2. Set test scope TIME/CM at .2mSEC and vertical sensitivity to .5 VOLTS/CM.

Slowly turn TIME BASE A STABILITY cw until the gate-sawtooth waveform appears on the test scope. Adjust the Lockout Level Adj for a ratio between gate and sawtooth of 1:1 and 3:2. Check the gate portion of the waveform for 9V min amplitude. Remove X10 probe.

a. Gate Sawtooth Waveform



b. Check single sweep triggering: 1mm ready neon on when armed

Set the TYPE 545B HORIZONTAL DISPLAY switch to A. Connect a square-wave from the SAC to the TYPE 1M1 EXT INPUT. Set the TIME BASE A TIME/CM to 1mSEC. Adjust the TYPE 1M1 VARIABLE for 1mm signal amplitude. Adjust the STABILITY and TRIGGERING LEVEL for a stable display. Change the HORIZONTAL DISPLAY switch to 'A' SINGLE SWEEP. Check for no sweep and the READY light out. Push the RESET button check for 1 trace and the READY LIGHT flashes.

20b. (cont'd)

Remove the coax cable from the TYPE 1M1 EXT INPUT. Push the RESET button, check for lit READY light. Reconnect the coax cable to the TYPE 1M1, check for 1 sweep and the READY light extinguishes.

21. +GATE INTERVAL AND FRONT PANEL WAVEFORMS

a. Check TIME BASE A and B + gate interval: 4μsec to 400msec

Set both TIME BASE A and TIME BASE B STABILITY controls cw. Connect the test scope probe to the + GATE binding post listed in the following table and measure + gate interval.

TIME/CM	TIME BASE A +gate interval	TIME BASE B +gate interval
.1μSEC	4-9μsec	
.2μSEC	4-9μsec	
.5μSEC	4-9μsec	
1μSEC	15-40μsec	
2μSEC	15-40μsec	10-20μsec
5μSEC	15-40μsec	10-20μsec
10μSEC	15-40μsec	10-20μsec
20μSEC	15-40μsec	50-150μsec
50μSEC	15-40μsec	50-150μsec
.1mSEC	150-400μsec	50-150μsec
.2mSEC	150-400μsec	0.5-1.5msec
.5mSEC	150-400μsec	0.5-1.5msec
1mSEC	1.5-4msec	0.5-1.5msec
2mSEC	1.5-4msec	5-15msec
5mSEC	1.5-4msec	5-15msec
10mSEC	15-40msec	5-15msec
20mSEC	15-40msec	50-150msec
50mSEC	15-40msec	50-150msec
.1 SEC	150-400msec	50-150msec
.2 SEC	150-400msec	50-150msec
.5 SEC	150-400msec	50-150msec
1 SEC	150-400msec	50-150msec
2 SEC	150-400msec	
5 SEC	150-400msec	

b. Check + GATE amplitude: 0 to >20V

Set both TIME/CM switches to .2mSEC. Set the test scope to AUTO with a DC input to the vertical. Gnd the X10 probe tip and set a 0V dc level. Check both + GATE A and + GATE B for an amplitude of 20V or more starting from 0V.

21. (cont'd)

c. Check SAWTOOTH A amplitude 0V ±5V to >130V

Check the amplitude of the SAWTOOTH A with the test scope. Check that the sawtooth starts at 0V ±5V and rises to 130V or more.

d. Check DLY'D TRIG amplitude: >5V

Check the amplitude of the DLY'D TRIG with the test scope. Check for spikes of 5V or more amplitude.

e. Check VERT SIG OUT: >1.2V/cm of display

Set the SAC and TYPE 1M1 VARIABLE for 5cm of amplitude. Measure the VERT SIG OUT with the test scope. (6V or more) Remove SAC coax cable from TYPE 1M1 EXT INPUT.

22. EXTERNAL HORIZONTAL AMPLIFIER

a. Adjust Ext Horiz DC Bal R317: <1cm

Install a BNC male to UHF female adapter on the TYPE 1M1 EXT INPUT. Connect an 18" patch cord from the SAWTOOTH A to the TYPE 1M1 EXT INPUT. Set the TYPE 545B HORIZONTAL DISPLAY to EXT X1. Adjust the TYPE 1M1 VARIABLE, VERTICAL POSITION and TYPE 545B HORIZONTAL POSITION controls for a single vertical trace. Rotate the VARIABLE 10-1 back and forth, adjust the Ext Horiz DC Bal R317 for no trace shift.

b. Check deflection factor: <.15V/cm

Install BNC male to UHF female adapters on the CAL OUT, and TIME BASE A TRIGGER INPUT. Connect 18" patch cords from the CAL OUT to the HORIZ INPUT and from the TRIGGER INPUT to the HORIZ INPUT. Set the AMPLITUDE CALIBRATOR to 1 VOLT.

Set the TYPE 545B TIME BASE A TIME/CM to .5mSEC and the TRIGGER SLOPE switch to +EXT, adjust the TRIGGERING LEVEL and STABILITY for a stable display. Check the horizontal amplitude. (6.7cm?V = <.15V/cm)

22. (cont'd)

c. Check X10 attenuation: ±2%

Adjust the TYPE 545B VARIABLE 10-1 for 5cm of display amplitude. Change the HORIZONTAL DISPLAY switch to X10 set the AMPLITUDE CALIBRATOR to 10 VOLTS, check for 5cm ± 1mm.

d. Adjust X10 compensation C301C: <3% aberration

Adjust C301C for square corner. Set the AMPLITUDE CALIBRATOR to 1 VOLT and HORIZONTAL DISPLAY to EXT X1 and compare the EXT X1 to EXT X10. 3% or less (1.5mm) aberration of the EXT X10 compared to EXT X1.

e. Check VARIABLE 10-1 ratio: >10:1

Set the TYPE 545B VARIABLE 10-1 cw. Set the AMPLITUDE CALIBRATOR to 10 VOLTS and HORIZONTAL DISPLAY switch to EXT X10. Check the display amplitude. Rotate the VARIABLE 10-1 ccw, set the HORIZONTAL DISPLAY switch to EXT X1 and check for the same deflection or less.

f. Check bandpass: -3dB at >350 kHz

Remove the patch cords from the TIME BASE A TRIGGER INPUT, HORIZ INPUT and CAL OUT. Set the TIME BASE A STABILITY cw. Set the VARIABLE 10-1 cw.

Connect the TYPE 190B ATTENUATOR to the HORIZ INPUT. Set the TYPE 190B to 50KC, and adjust the TYPE 190B for 6cm of amplitude. Change the TYPE 190B to 350KC, check for 4.2cm or more deflection remaining. Remove the TYPE 190B ATTENUATOR from the HORIZ INPUT. Set the TYPE 545B HORIZONTAL DISPLAY switch to A and remove the patch cord from the SAWTOOTH A and TYPE 1M1 EXT INPUT. Remove adapters.

23. Z AXIS MODULATION

Modulates on <15V

Connect the SAC output coax cable to the TYPE 1M1 EXT INPUT. Connect 30" patch cord to the TYPE 545B VERT SIG OUT. Connect the test scope X10 probe to the patch cord. Set the SAC to 20 VOLTS. Adjust the TYPE 1M1 VARIABLE

23. (cont'd)

for a test scope amplitude of 15 volts.

Position the display up until the baseline is on the CRT. Set the TIME BASE A TRIGGER SLOPE switch to +INT. Adjust the STABILTIY and TRIGGERING LEVEL for a stable display.

Remove the test scope X10 probe from the patch cord. Remove the CRT gnd strap (rear panel). Plug the end of the patch cord into the EXTERNAL CRT CATHODE binding post. Set the CRT CATHODE SELECTOR to EXT CRT CATHODE. Check for brightening of a portion of the display. Remove the patch cord, SAC coax cable and replace the CRT GND strap.

24. VERTICAL TRANSIENT RESPONSE

a. Adjust DC Shift R502: <1% tilt

Set the TYPE 545B on its right side. Set the TYPE 1M1 TEST FUNCTION to + PULSE. Set the AMPLITUDE for 6cm. Adjust the TIME BASE A STABILITY and TRIGGERING LEVEL for a stable display. Adjust DC Shift R502 for waveform flat top.

b. Adjust high frequency compensation: <1% aberration

Set the TYPE 1M1 REPETITION RATE to HIGH. Set the TIME BASE A TIME/CM to .2µSEC. Adjust TRIGGERING LEVEL for a stable display. Make the following adjustments with the TIME/CM at .2µSEC. Adjust L588, L598, L589, L599, C520 and R580 for min rolloff or overshoot.

Adjust L554, C551 and C581 for min rolloff or overshoot with the TIME/CM at .5µSEC. Adjust C568 for min ringing at 1µSEC. Adjust L560 for min tilt at 2µSEC.

c. Check positioning effect on transient response: <1%

Adjust the TYPE 1M1 AMPLITUDE control for a 4cm display. Set the TYPE 545B TIME BASE A TIME/CM to .5µSEC. Position the top of the display to the top ½cm line and check the display aberration. Position the top of the display to the bottom ½cm line and check the change in aberration, 0.4mm max.

24. (cont'd)

d. Recheck Vertical Gain: 4cm ± <1%

Set the TYPE 545B TIME BASE A STABILITY cw. Change the TYPE 1M1 TEST FUNCTION switch to GAIN SET. Connect a 100V square-wave from the SAC to the TYPE 1M1 EXT INPUT. Check for 4cm ±0.4mm. Readjust R520 Gain Adj if necessary to return gain to 4cm.

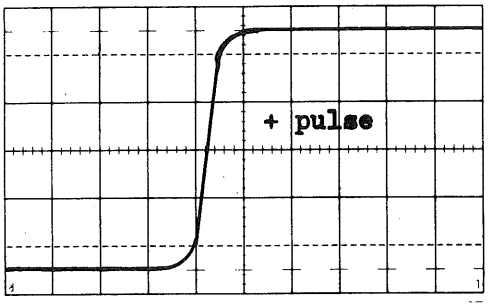
If R520 is readjusted step 24a., b., and c. must be repeated. Remove the SAC cable from the TYPE 1M1 EXT INPUT.

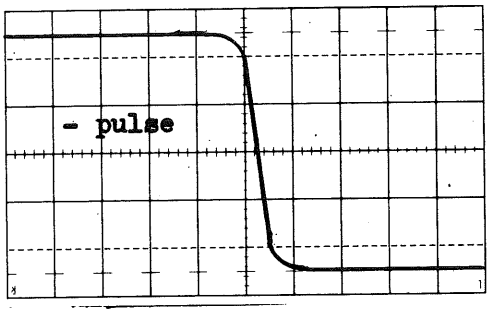
e. Check risetime: <10nsec

Set the TYPE 1M1 TEST FUNCTION to +PULSE and the TYPE 545B TIME BASE A TRIGGER SLOPE to -INT. Adjust the STABILITY and TRIGGERING LEVEL for a stable display. Adjust the TYPE 1M1 AMPLITUDE for 5cm of display. Set the TIME BASE A TIME/CM to .1μSEC, turn 5X MAGNIFIER to ON. Check for a risetime of 10ns or less. Change the TYPE 1M1 TEST FUNCTION to -PULSE and the TYPE 545B TRIGGER SLOPE to +INT. Check for a risetime of 10ns or less.

If risetime is greater than 10ns, repeat all of step 24.

e. Risetime





25. VERTICAL BANDPASS

a. Setup

Remove the TYPE 1M1 from the TYPE 545B. Install in its place the TYPE 1A2. Preset as follows:

MODE	CH 1
POSITION	mid r
VOLTS/CM	.05
VARIABLE	CALIBRATED
INPUT 1	DC

Connect the output of the SAC to INPUT 1. Set the SAC to .2 volts and adjust the TYPE 1A2 GAIN for 4cm.

b. Check vertical bandpass: -3dB at >33 MHz

Set the TYPE 545B TIME BASE A TIME/CM to .1mSEC and STABILITY cw. Connect the TYPE 190B ATTENUATOR to the TYPE 1A2 INPUT 1. Set the TYPE 190B for 50KC, adjust the TYPE 190B ATTENUATOR and OUTPUT AMPLITUDE for 4cm of display.

25b. (cont'd)

Without changing the ATTENUATOR or OUTPUT AMPLITUDE change the RANGE SELECTOR switch to 21-50 and adjust the RANGE IN MEGACYCLES dial for a display of 2.8cm (-3dB), check for a reading of 33 MHz or more.

26. HIGH FREQUENCY TRIGGERING

a. Check TIME BASE B 5 MHz:

INT AC	*2mm*
INT DC	*6mm*
EXT AC & DC	*0.2V*
EXT & INT AUTO	*any amplitude*

Remove the TYPE 190B ATTENUATOR, install a BNC "T" connector to the TYPE 1A2 INPUT 1 and reconnect the TYPE 190B attenuator to the "T" connector. Connect a 50Ω coax cable from the "T" connector to the TIME BASE B TRIGGER INPUT. Set HORIZONTAL DISPLAY to B.

Use the following table to check TIME BASE B triggering in both + and - slope. Use TRIGGERING LEVEL as necessary.

TRIGGERING MODE	TRIGGER SLOPE	Amplitude	
AC	±INT	2mm	
DC	±INT	6mm	
AC	±EXT	0.2V	
DC	±EXT	0.2V	
AUTO	+ & - EXT	any amplitude	Use any TIME/CM setting and any setting of the LENGTH.
AUTO	+ & - INT	any amplitude	

b. Check TIME BASE B 10 MHz:

INT AC	*1cm; <1mm jitter*
EXT AC & DC	*1V; <1mm jitter*

Set the TYPE 1A2 CHANNEL 1 VOLTS/CM to 1 and adjust the TYPE 190B for 1cm of amplitude. Check INT AC both slopes and EXT AC and DC both slopes for stable triggering with 1mm or less jitter. (trace width)

c. Check TIME BASE A 10 MHz:

INT AC & AC LF REJECT	*2mm*
INT DC	*6mm*
EXT AC, AC LF REJECT & DC	*0.2V*
EXT & INT AUTO	*any amplitude*

Change the coax cable from the TIME BASE B TRIGGER INPUT to the TIME BASE A TRIGGER INPUT. Set the HORIZONTAL DISPLAY switch to A.

26c. (cont'd)

Use the following table to check TIME BASE A triggering in both + and - slope. Use TRIGGERING LEVEL as necessary.

TRIGGERING MODE	TRIGGER SLOPE	Amplitude	
AC LF REJECT	±INT	2mm	
AC	±INT	2mm	
DC	±INT	6mm	
DC	±EXT	0.2V	
AC	±EXT	0.2V	
AC LF REJECT	±EXT	0.2V	
AUTO	+ & - EXT	any amplitude	Any setting of TIME/CM and VARIABLE.
AUTO	+ & - INT	any amplitude	

d. Check TIME BASE A 30 MHz:

INT AC & AC LF REJECT	*1cm; <1mm jitter*
EXT AC, AC LF REJECT & DC	*1V; <1mm jitter*

Set the TYPE 190B for 30 MHz. Check INT TRIGGER SLOPE both + and -, TRIGGERING MODE AC and AC LF REJECT using the TRIGGERING LEVEL control for stable triggering. Use 1cm of amplitude and check for 1mm or less jitter (trace width).

Set the TYPE 190B RANGE SELECTOR to 50KC and obtain 1V of amplitude. Set the TYPE 190B RANGE SELECTOR for 30 MHz. Check EXT AC, AC LF REJECT and DC both + and - slopes for stable triggering with 1mm or less jitter. Use TRIGGERING LEVEL as required.

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

I. LOW VOLTAGE POWER SUPPLE DC STABILITY

Change from 103.5V to 126.5V:

-150Vdc	±<0.05%
+100Vdc	±<0.5%
+225Vdc	±<0.1%
+350Vdc	±<0.5%
+500Vdc	±<0.5%

Install the TYPE 1M1 in the TYPE 545B. Set the TYPE 1M1 TEST FUNCTION to HIGH LOAD. Set TYPE 545B TRIGGERING MODES (both) to AC

STABILITY (both)	ccw
AMPLITUDE CALIBRATOR	OFF
5X MAGNIFIER	OFF

Set the TYPE 76 TU to 103.5V. Connect the DC VOLTAGE BRIDGE - lead to TYPE 545B gnd, + lead to the -150Vdc supply. Set the test scope TYPE B VOLTS/CM to .02 and input selector to AC. Set the DC VOLTAGE BRIDGE for a null. Change the TYPE 1M1 TEST FUNCTION to LOW LOAD and change the TYPE 76 TU to 126.5V readout the error on the test scope, 0.075V (3.75cm).

Use the above test method to check the supplies listed in the following table:

Supply	Test scope VOLTS/CM	max deflection allowed at 126.5V
+100Vdc	.1	5cm
+225Vdc	.1	2.25cm
+350Vdc	.5	3.5cm
+500Vdc	1	2.5cm

I. Equipment required

1 DC VOLTAGE BRIDGE (special)

II. VISUAL WRITING RATE

No bright spot at start of trace with sweep rate of 0.02μsec, triggered at 10 Hz.

Install a CRT Viewing Hood on the TYPE 545B. Apply a 10 Hz trigger from the TYPE 180A to the TYPE 545B TIME BASE A TRIGGER INPUT. Set the TIME/CM to .1mSEC. Set the TRIGGER SLOPE switch to +EXT, TRIGGERING MODE to AC. Adjust the TRIGGERING LEVEL for a triggered trace. (Trace will flicker when triggered.) Change the TYPE 545B TIME BASE A TIME/CM to .1μSEC and turn 5X MAGNIFIER ON.

II. Equipment required

1 CRT VIEWING HOOD (016-0057-00)

II. (cont'd)

Slowly advance the INTENSITY control until the trace is barely visible, position the start of the trace to the graticule center line. Check for no bright spot at the start of the trace.

THE END