PERFORMANCE CHECK PROCEDURE

INTRODUCTION

The Performance Check Procedure is used to verify the Performance Requirements listed in Table 1-1 and to help determine the need for readjustment. These checks may also be used as an acceptance test or as a trouble-shooting aid.

You do not have to remove the wrap-around cabinet from the 2245A to do this procedure. All checks can be made with controls and connectors accessible from the outside.

TEST EQUIPMENT REQUIRED

Table 4-1 lists the test equipment required for both the Performance Check Procedure in this section and the Adjustment Procedure in Section 5. Test equipment specifications described are the minimum necessary to provide accurate results. For test equipment operating information, refer to the appropriate test equipment instruction manual.

If the exact equipment given as an example in Table 4-1 is not available, use the Minimum Specification column to determine if any other test equipment can be used for the check. When you use equipment other than that recommended, you may have to make some changes to the test setups.

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check the performance of the 2245A after every 2000 hours of operation, or once each year if used infrequently. If the checks indicate a need for readjustment or repair, refer the instrument to a qualified service person.

PREPARATION

This procedure is divided into subsections so that individual sections of the instrument may be checked whenever a complete Performance Check is not needed. An "Equipment Required" block at the beginning of each subsection lists the equipment from Table 4-1 that is needed to do the checks in that subsection.

The initial front-panel control settings at the beginning of each subsection prepare the instrument for the first step of the subsection. Do each of the steps in a subsection completely and in order, to ensure the correct control settings for steps that follow.

To ensure the performance accuracies given in Table 1-1, let the instrument warm up for 20 minutes and then run the SELF CAL MEASUREMENTS routine. To run the SELF CAL MEASUREMENTS routine:

Press the CH 1 and CHOP/ALT VERTICAL MODE buttons at the same time to display the SERVICE MENU. Underline and select SELF CAL MEASUREMENTS by pressing the ADD (down-arrow) button. Press the CH 2 (RUN) button to start the routine, then CH 4 (QUIT) button to return to the normal oscilloscope mode.

NOTE

Performance accuracies are ensured only when the SELF CAL MEASUREMENTS routine is done AFTER the 20-minute warmup.

Table 4-1
Test Equipment Required

Item and Description	Minimum Specification	Use	Example of Test Equipment
Leveled Sine-Wave Generator	Frequency: 250 kHz to above 150 MHz. Output amplitude: variable from 10 mV to 5 V p-p. Output impedance: 50 Ω. Amplitude accuracy: constant within 1.5% of reference frequency to 100 MHz.	Vertical, horizontal, triggering, measurement bandwidth, and Z-Axis checks and adjustments.	TEKTRONIX SG 503 Leveled Sine-Wave Generator.[a]
Calibration Generator	Standard-amplitude signal levels (dc and square wave): 5 mV to 50 V. Accuracy: ± 0.25%. High-amplitude signal levels: 1 V to 60 V. Repetition rate: 1 kHz. Fast-rise signal level: 1 V. Repetition rate: 1 MHz. Rise time: 1 ns or less. Flatness: ± 0.5%.	Signal source for gain and transient response checks and adjustments.	TEKTRONIX PG 506 Calibration Generator.[a]
Time-Mark Generator	Marker outputs: 5 ns to 0.5 s. Marker accuracy: ± 0.1%. Trigger output: 1 ms to 0.1 ms, time-coincident with markers.	Horizontal checks and adjustments, display adjustment, and time cursor checks.	TEKTRONIX TG 501 Time-Mark Generator.[a]
Function Generator	Range: less than 1 Hz to 1 kHz; sinusoidal output; amplitude variable up to greater than 10 V p-p open circuit with dc offset adjust.	Low-frequency checks.	TEKTRONIX FG 502 Function Generator.[a]
Coaxial Cable (2 required)	Impedance: 50 Ω. Length: 42 in. Connectors: BNC.	Signal interconnection.	Tektronix Part Number 012-0057-01.
Precision Coaxial Cable	Impedance: 50 Ω. Length: 36 in. Connectors: BNC.	Used with PG 506 Calibration Generator and SG 503 Sine-Wave Generator.	Tektronix Part Number 012-0482-00.

[a] Requires a TM500-series power module.

Table 4-1 (cont)

Item and Description	Minimum Specification	Use	Example of Test Equipment
Termination (2 required)	Impedance: 50 Ω. Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0049-01.
10X Attenuator	Ratio: 10X. Impedance: 50 Ω. Connectors: BNC.	Triggering checks.	Tektronix Part Number 011-0059-02.
2X Attenuator	Ratio: 2X. Impedance: 50 Ω. Connectors: BNC.	Triggering checks.	Tektronix Part Number 011-0069-02.
Adapter	Connectors: BNC male-to-miniature-probe tip.	Signal interconnection.	Tektronix Part Number 013-0084-02.
Alignment Tool	Length: 1-in shaft. Bit size: 3/32 in. Low capacitance; insulated.	Adjust TRACE ROTATION pot. Adjust variable capacitors and resistors.	Tektronix Part Number 003-0675-00.
Test Oscilloscope	Bandwidth: 20 MHz.	Z-Axis response adjustment.	TEKTRONIX 2246A.
Dual-Input Coupler	Connectors: BNC female-to-dual-BNC male.	Signal interconnection.	Tektronix Part Number 067-0525-01.
T-Connector	Connectors, BNC.	Signal interconnection.	Tektronix Part Number 103-0030-00.
Precision Normalizer	Input resistance: 1 MΩ. Input capacitance: 20 pF.	Input capacitance adjustments.	Tektronix Part Number 067-1129-00.
TV Signal Generator	Provide composite TV video and line sync signals.	Check TV Trigger circuit.	Tektronix 067-0601-00. Calibration fixture with 067-5002-00 (525/60) and 067-5010-00 (1201/60) plug-ins.
Digital Multimeter (DMM)	Dc volts range: 0 to 140 V. Dc voltage accuracy: ± 0.15%. 4 1/2 digit display.	Power supply voltage checks and adjustments.	Tektronix DM 501A Digital Multimeter.[a]

[a] Requires a TM500-series power module.

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DISPLAY

Equipment Required (See Table 4-1)

Time-mark generator	50 Ω BNC coaxial cable
50 Ω BNC termination	

1. TRACE ROTATION

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	0.1 V
CH 1 COUPLING	AC
SCOPE BW	Off
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	VERT
TRIGGER CPLG	DC
TRIGGER SLOPE	⎍ (positive-going)
TRIGGER HOLDOFF	Min
TRIGGER LEVEL	12 o'clock
Horizontal MODE	A
Horizontal POSITION	12 o'clock
A SEC/DIV	2 μs
CLEAR MEAS'MT	Press to remove measurement cursors.
FOCUS	For best defined display

b. Position trace vertically to the center graticule line.

c. CHECK—trace rotation control range is adequate to align trace with center graticule line using a small straight-bladed alignment tool.

d. ADJUST—trace parallel to center horizontal graticule line.

2. Geometry

a. Connect time-mark generator (TG 501) to CH 1 via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

b. Set generator for 0.2 μs time markers.

c. Position the bottom of the CH 1 signal below the bottom graticule line.

d. CHECK—deviation of any vertical line within the center eight horizontal divisions does not exceed 0.1 division (half a minor division).

e. Set CH 1 COUPLING to GND.

f. Position trace slowly from the bottom graticule line to the top graticule line while making the following check.

g. CHECK—bowing or tilt of baseline trace doesn't exceed 0.1 division (half a minor division) within the eight vertical divisions.

h. Disconnect test signal from the 2245A.

VERTICAL

Equipment Required (See Table 4-1)

- Leveled sine-wave generator
- Calibration generator
- Function generator
- 50 Ω BNC coaxial cable
- 50 Ω precision BNC coaxial cable
- 50 Ω termination
- Adapter BNC-male-to-miniature probe tip
- Dual-input coupler

1. Input COUPLING Functional Check

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1 and CH 2
CH 1 and CH 2 VOLTS/DIV	1 V
CH 1 and CH 2 Input COUPLING	DC
SCOPE BW	Off
CH 2 INVERT	Off
A/B SELECT	A TRIGGER
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	VERT
TRIGGER CPLG	DC
TRIGGER SLOPE	⎍ (positive-going)
TRIGGER LEVEL	12 o'clock
TRIGGER HOLDOFF	Min
Horizontal POSITION	12 o'clock
Horizontal MODE	A
SEC/DIV	0.5 ms
FOCUS	For best-defined display
CLEAR MEAS'MT	Press to remove measurement cursors

b. Connect function generator (FG 502) sine-wave output to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set function generator output for 1 kHz sine-wave signal of five divisions peak-to-peak with maximum positive dc offset.

d. Position the bottom of the signal to the center horizontal graticule line.

e. Set CH 1 Input COUPLING to AC.

f. CHECK—display is centered about the center horizontal graticule line.

g. Move the test signal to the CH 2 input.

h. Set CH 2 VERTICAL MODE to on (CH 1 off).

i. Repeat the procedure for CH 2.

j. Disconnect the test signal from the 2245A.

2. CH 1 and CH 2 VOLTS/DIV Trace Shift

a. Set:

CH 1 and CH 2 VERTICAL MODE	On
CH 1 and CH 2 VOLTS/DIV	2 mV
CH 1 and CH 2 Input COUPLING	GND

b. Set VERTICAL MODE to CH 1 (CH 2 off).

c. Position trace to center horizontal graticule line.

d. Switch CH 1 VOLTS/DIV through all positions from 2 mV to 5 V.

e. CHECK—trace shift does not exceed 0.2 division between steps.

f. Set VERTICAL MODE to CH 2 (CH 1 off).

g. Position CH 2 trace to the center horizontal graticule line.

h. Switch CH 2 VOLTS/DIV through all positions from 2 mV to 5 V.

i. CHECK—trace shift does not exceed 0.2 division between steps.

3. CH 3 and CH 4 VOLTS/DIV Trace Shift

a. Set VERTICAL MODE to CH 3 (CH 2 off).

b. Position trace to the center horizontal graticule line.

c. Switch CH 3 VOLTS/DIV between 0.1 V and 0.5 V.

d. CHECK—trace shift does not exceed one division.

e. Set VERTICAL MODE to CH 4 (CH 3 off).

f. Position trace to the center horizontal graticule line.

g. Switch CH 4 VOLTS/DIV between 0.1 V and 0.5 V.

h. CHECK—trace shift does not exceed one division.

4. CH 1 and CH 2 VAR VOLTS/DIV Trace Shift

a. Set:

VERTICAL MODE	CH 1 (CH 4 off)
CH 1 VOLTS/DIV	2 mV

b. Position trace to center graticule line.

c. Set CH 1 VAR VOLTS/DIV fully CCW (counterclockwise).

d. CHECK—trace shift does not exceed one division.

e. Set:

CH 1 VAR VOLTS/DIV	Detent (calibrated)
VERTICAL MODE	CH 2 (CH 1 off)
CH 2 VOLTS/DIV	2 mV

f. Position trace to center graticule line.

g. Set CH 2 VAR VOLTS/DIV fully CCW.

h. CHECK—trace shift does not exceed one division.

i. Set CH 2 VAR VOLTS/DIV to detent (calibrated) position.

5. CH 1 and CH 2 Input COUPLING Trace Shift

a. Position trace to center graticule line.

b. Set CH 2 Input COUPLING to DC.

c. CHECK—trace shift does not exceed 0.25 division.

d. Set:

VERTICAL MODE	CH 1 (CH 2 off)
CH 1 Input COUPLING	GND

e. Position trace to center graticule line.

f. Set CH 1 Input COUPLING to DC.

g. CHECK—trace shift does not exceed 0.25 division.

6. CH 2 INVERT Trace Shift

a. Set:

VERTICAL MODE	CH 2 (CH 1 off)
CH 2 Input COUPLING	GND

b. Position trace to center horizontal graticule line.

c. Set CH 2 INVERT On.

d. CHECK—trace shift does not exceed one division.

e. Set:

CH 2 INVERT	Off
CH 2 Input COUPLING	DC

7. CH 1 and CH 2 VAR VOLTS/DIV Range

a. Set VERTICAL MODE to CH 1 and CH 2.

b. Position CH 1 and CH 2 traces to the center horizontal graticule line.

c. Connect calibration generator (PG 506) Std Ampl output to the CH 1 input via 50 Ω precision BNC coaxial cable. Set generator Std Ampl output to 50 mV.

d. Set:

CH 1 and CH 2 VOLTS/DIV	10 mV
CH 1 VAR VOLTS/DIV	Fully CCW

e. CHECK—the signal amplitude is two divisions or less.

f. Set:

CH 1 VAR VOLTS/DIV	Detent (calibrated)
CH 1 VERTICAL MODE	Off

g. Move the test signal to the CH 2 input.

h. Set CH 2 VAR VOLTS/DIV fully CCW.

i. Repeat the CHECK procedure for CH 2.

j. Set CH 2 VAR VOLTS/DIV to detent (calibrated) position.

8. Low-Frequency Linearity

a. Set:

VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	10 mV
SCOPE BW	On

b. Set calibration generator to Std Ampl output, 20 mV.

c. Move the test signal to the CH 1 input.

d. Position the top of the signal to top graticule line.

e. Check the signal amplitude is between 1.9 and 2.1 divisions.

f. Set bottom of the signal to bottom graticule line.

g. Check the signal amplitude is between 1.9 and 2.1 divisions.

h. Repeat the procedure for CH 2.

9. CH 1 and CH 2 Vertical Deflection Accuracy

a. Set CH 2 VOLTS/DIV to 2 mV.

b. Set calibration generator to Std Ampl output, 10 mV.

c. CHECK—all positions of the VOLTS/DIV settings for correct signal to graticule accuracy, using the settings in Table 4-2, Signal-to-Graticule Accuracy, for the checks.

d. Set calibration generator to Std Ampl output, 10 mV.

e. Move the test signal to the CH 1 input.

f. Set:

VERTICAL MODE	CH 1 (CH 2 off)
CH 1 VOLTS/DIV	2 mV

g. Repeat CHECK procedure for CH 1.

10. CH 3 and CH 4 Vertical Deflection Accuracy

a. Set:

VERTICAL MODE	CH 3 and CH 4 on; CH 1 off
CH 3 and CH 4 VOLTS/DIV	0.1 V

b. Position CH 3 and CH 4 traces to the second graticule line down from the center horizontal graticule line.

Table 4-2
Signal-to-Graticule Accuracy

VOLTS/DIV Setting	Std Ampl Setting	Deflection Accy (in divisions)
2 mV	10 mV	4.90 to 5.10
5 mV	20 mV	3.92 to 4.08
10 mV	50 mV	4.90 to 5.10
20 mV	100 mV	4.90 to 5.10
50 mV	200 mV	3.92 to 4.08
0.1 V	500 mV	4.90 to 5.10
0.2 V	1 V	4.90 to 5.10
0.5 V	2 V	3.92 to 4.08
1 V	5 V	4.90 to 5.10
2 V	10 V	4.90 to 5.10
5 V	10 V	3.92 to 4.08

c. Move CH 1 test setup to the CH 3 input.

d. Set calibration generator to Std Ampl output, 0.5 V.

e. CHECK—the signal amplitude is between 4.90 and 5.10 divisions.

f. Move the test signal to the CH 4 input.

g. Set CH 3 VERTICAL MODE to Off.

h. Repeat CHECK for CH 4.

i. Set CH 3 and CH 4 VOLTS/DIV to 0.5 V.

j. Set calibration generator to Std Ampl output, 2 V.

k. CHECK—the signal amplitude is between 3.92 and 4.08 divisions.

l. Set CH 3 VERTICAL MODE On (CH 4 off).

m. Move the test signal to the CH 3 input.

n. Repeat CHECK procedure for CH 3.

o. Disconnect the test setup from the 2245A.

11. ADD Mode and CH 2 INVERT Deflection Accuracy

a. Set:

VERTICAL MODE	ADD (all others off)
CH 1 and CH 2 VOLTS/DIV	0.1 V
CH 1 and CH 2 Input COUPLING	DC

b. Connect calibration generator Std Ampl output to the CH 1 and CH 2 inputs via 50 Ω precision BNC coaxial cable and a BNC dual-input coupler.

c. Set the calibration generator to Std Ampl output, 0.2 V.

d. Position the ADD signal to the center of the crt graticule with the CH 1 and CH 2 POSITION controls.

e. CHECK—that the ADD signal amplitude is between 3.92 and 4.08 divisions.

f. Set CH 2 INVERT On.

h. CHECK—that the ADD signal amplitude is 0.08 division (less than half a minor graticule division) or less excluding trace width (sweep will free run).

g. Disconnect the test setup from the 2245A.

12. Vertical POSITION Range (all channels)

a. Set:

A SEC/DIV	0.1 ms
VERTICAL MODE	CH 1 On (ADD off)
CH 1 VOLTS/DIV	1 V
CH 2 INVERT	Off
SCOPE BW	Off
CH 1 and CH 2 Input COUPLING	AC

b. Connect leveled sine-wave generator (SG 503) output to the CH 1 and CH 2 inputs via a 50 Ω BNC coaxial cable, a 50 Ω BNC termination, and a BNC dual-input coupler.

c. Position trace to center horizontal graticule line.

d. Set leveled sine-wave generator output for two-division signal at 50 kHz.

e. Set:

CH 1 VOLTS/DIV	0.1 V
CH 1 POSITION	Fully CW (clockwise)

f. CHECK—that the bottom of the waveform is at least one division above the center horizontal graticule line.

g. Set CH 1 POSITION fully CCW.

h. CHECK—that the top of the waveform is at least one division below the center horizontal graticule line.

i. Set:

CH 1 POSITION	12 o'clock
VERTICAL MODE	CH 2 (CH 1 off)
CH 2 POSITION	Fully CW

j. CHECK—that the bottom of the waveform is at least one division above the center horizontal graticule line.

k. Set CH 2 POSITION fully CCW.

l. CHECK—that the top of the waveform is at least one division below the center horizontal graticule line.

m. Set CH 2 POSITION to 12 o'clock.

n. Move the BNC dual-input coupler from the CH 1 and CH 2 inputs to the CH 3 and CH 4 inputs.

o. Set:

VERTICAL MODE	CH 3 (CH 2 off)
CH 3 and CH 4 VOLTS/DIV	0.1 V
CH 3 POSITION	Fully CW

p. CHECK—that the bottom of the waveform is at least one division above the center graticule line.

q. Set CH 3 POSITION fully CCW.

r. CHECK—that the top of the waveform is at least one division below the center graticule line.

s. Set:

CH 3 POSITION	12 o'clock
VERTICAL MODE	CH 4 (CH 3 off)

t. Repeat the procedure for CH 4.

u. Set CH 4 POSITION to 12 o'clock.

v. Disconnect the test setup from the 2245A.

13. CH 1 to CH 2 Signal Delay Match

a. Set:

VERTICAL MODE	CH 1 and CH 2
CH 1 and CH 2 Input COUPLING	DC
CH 1 and CH 2 VOLTS/DIV	0.1 V
SEC/DIV	20 ns
TRIGGER SOURCE	CH 3

b. Superimpose the CH 1 and CH 2 traces at the 100% graticule marking.

c. Connect calibration generator (PG 506) fast rise, rising-edge signal to the CH 1 and CH 2 inputs via a 50 Ω precision BNC coaxial cable, a 50 Ω BNC termination, and a BNC dual-input coupler.

d. Connect calibration generator trig out signal to the CH 3 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

e. Set the calibration generator output for five divisions of signal amplitude at 1 MHz.

f. Position the rising edges of the superimposed waveforms horizontally to the center vertical graticule line.

g. Set X10 MAG On (for 2 ns/div sweep speed).

h. CHECK—that the leading edges of the two waveforms have less than or equal to 0.1 horizontal division separation at the center graticule line excluding trace width.

14. CH 1 to CH 4 Signal Delay Match

a. Set VERTICAL MODE to CH 1 and CH 4 (CH 2 off).

b. Move the CH 2 signal to the CH 4 input connector.

c. Superimpose the CH 4 waveform on the CH 1 waveform.

d. CHECK—that the leading edges of the two waveforms have less than or equal to 0.2 horizontal division separation at the center graticule line excluding trace width.

15. CH 3 to CH 4 Signal Delay Match

a. Set:

VERTICAL MODE	CH 3 and CH 4 (CH 1 off)
TRIGGER SOURCE	CH 2

b. Move the CH 1 signal to the CH 3 input and the CH 3 trigger signal to the CH 2 input.

c. Superimpose CH 3 and CH 4 waveforms at the center graticule line.

d. CHECK—that the leading edges of the two waveforms have less than or equal to 0.1 horizontal division separation at the center graticule line.

e. Disconnect the test setup.

16. CH 1 and CH 2 Vertical Bandwidth

a. Set:

X10 MAG	Off
VERTICAL MODE	CH 1 (CH 3 and CH 4 off)
SEC/DIV	0.1 ms
CH 1 VOLTS/DIV	2 mV
CH 1 and CH 2 Input COUPLING	DC
TRIGGER SOURCE	VERT
Horizontal POSITION	12 o'clock

b. Connect leveled sine-wave generator (SG 503) output to the CH 1 input via a 50 Ω precision BNC coaxial cable and a 50 Ω BNC termination.

c. Set the leveled sine-wave generator output for a six-division signal amplitude at 50 kHz.

d. Set the generator Frequency Range and Frequency Variable controls for a 90 MHz output signal.

e. CHECK—the displayed signal amplitude is 4.2 divisions or more.

f. Repeat the frequency setup and CHECK procedure for VOLTS/DIV settings of 5 mV through 1 V, except perform CHECK at 100 MHz.

g. Move the test signal to the CH 2 input.

h. Set:

VERTICAL MODE	CH 2 (CH 1 off)
CH 2 VOLTS/DIV	2 mV

i. Repeat the complete Bandwidth check procedure for Channel 2.

17. CH 3 and CH 4 Vertical Bandwidth

a. Set:

VERTICAL MODE	CH 3 (CH 2 off)
CH 3 and CH 4 VOLTS/DIV	0.1 V

b. Connect leveled sine-wave generator (SG 503) output to the CH 3 input via a 50 Ω precision BNC coaxial cable and a 50 Ω BNC termination.

c. Set the generator output for a six-division signal display at 50 kHz.

d. Set the generator Frequency Range and Frequency Variable controls for a 100 MHz output frequency.

e. CHECK – that the signal display amplitude is 4.2 divisions or more.

f. Repeat the procedure for 0.5 VOLTS/DIV setting.

g. Move the test signal to the CH 4 input.

h. Set VERTICAL MODE to CH 4

i. Repeat the procedure for CH 4.

18. SCOPE BW (Bandwidth Limit) Accuracy

a. Set:

VERTICAL MODE	CH 1 (CH 4 off)
CH 1 VOLTS/DIV	10 mV
SCOPE BW	On

b. Move test signal from the CH 4 input to the CH 1 input.

c. Set leveled sine-wave generator (SG 503) output for a six-division signal amplitude at 50 kHz.

d. Set the leveled sine-wave generator Frequency Range and Frequency Variable controls to produce a signal display amplitude of 4.2 divisions.

e. CHECK – that the sine-wave generator output frequency is between 17 MHz and 23 MHz.

f. Disconnect the test setup.

19. Common-mode Rejection Ratio

a. Connect leveled sine-wave generator (SG 503) output to the CH 1 and CH 2 input connectors via a 50 Ω precision BNC coaxial cable, a 50 Ω BNC termination, and a BNC dual-input coupler.

b. Set the leveled sine-wave generator output for an eight-division signal-display amplitude at 50 kHz.

c. Set:

ADD MODE	On
CH 2 VOLTS/DIV	10 mV
CH 2 INVERT	On
CH 1 VERTICAL MODE	Off
SCOPE BW	Off

d. Adjust CH 1 or CH 2 VAR VOLTS/DIV (as needed) for smallest signal amplitude.

e. Set the leveled sine-wave output frequency to 50 MHz.

f. Set:

CH 1 VERTICAL MODE	On
ADD MODE	Off

g. Set the leveled sine-wave output amplitude for an eight-division display.

h. Set:

ADD MODE	On
CH 1	Off

i. CHECK – the signal is less than 0.8 division in amplitude.

j. Disconnect the test setup.

20. Channel Isolation

a. Set:

CH 1 and CH 2 VERTICAL MODE	On (ADD off)
CH 2 INVERT	Off
CH 1, CH 2, CH 3, and CH 4 VOLTS/DIV	0.1 V
TRIGGER SOURCE	CH 1

b. Connect the leveled sine-wave generator (SG 503) output to the CH 1 input via a 50 Ω precision BNC coaxial cable and a 50 Ω BNC termination.

c. Set the leveled sine-wave generator (SG 503) output for a five-division signal display amplitude at 100 MHz.

d. Set CH 2, CH 3, and CH 4 VERTICAL MODE On (CH 1 off).

e. CHECK – display amplitude is 0.1 division or less, excluding trace width, on the CH 2, CH 3, and CH 4 traces.

f. Move sine-wave generator signal to the CH 2 input.

g. Set:

CH 1, CH 3, and CH 4 VERTICAL MODE	On (CH 2 off)
TRIGGER SOURCE	CH 2

h. CHECK—display amplitude is 0.1 division or less, excluding trace width, on the CH 1, CH 3, and CH 4 traces.

i. Move sine-wave generator signal to the CH 3 input.

j. Set:

CH 1, CH 2, and CH 4 VERTICAL MODE	On (CH 3 off)
TRIGGER SOURCE	CH 3

k. CHECK—display amplitude is 0.1 division or less, excluding trace width, on the CH 1, CH 2, and CH 4 traces.

l. Move sine-wave generator signal to the CH 4 input.

m. Set:

CH 1, CH 2, and CH 3 VERTICAL MODE	On (CH 4 off)
TRIGGER SOURCE	CH 4

n. CHECK—display amplitude is 0.1 division or less, excluding trace width, on the CH 1, CH 2, and CH 3 traces.

o. Disconnect the test setup.

21. AC-Coupled Lower -3 dB Point

a. Set:

A SEC/DIV	10 ms
VERTICAL MODE	CH 1 (all others off)
TRIGGER SOURCE	VERT
TRIGGER MODE	NORM
TRIGGER HOLDOFF	Fully CW

b. Connect function generator (FG 502) output to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set the function generator output controls to produce a six-division sine-wave display at 10 Hz (with no dc offset).

d. Set CH 1 Input COUPLING to AC.

e. CHECK—display amplitude is 4.2 divisions or more.

f. Set VERTICAL MODE to CH 2 (CH 1 off).

g. Repeat the procedure for CH 2.

h. Disconnect the test equipment from the 2245A.

22. Vertical ALT and CHOP Modes

a. Set:

VERTICAL MODE	CH 1, CH 2, CH 3, CH 4 On
CHOP VERTICAL MODE	Off (ALT mode)
CH 1 and CH 2 VOLTS/DIV	10 mV
CH 3 and CH 4 VOLTS/DIV	0.1 V
CH 1 and CH 2 Input COUPLING	DC
Horizontal MODE	A
SEC/DIV	1 ms
TRIGGER MODE	AUTO LEVEL

b. Position all traces for two divisions of separation with the CH 1 trace near the top; then in order down the graticule area with the CH 4 trace near the bottom.

c. Set SEC/DIV to 10 ms.

d. CHECK—that four traces are sweeping across the screen alternately.

e. Set CHOP VERTICAL MODE On.

f. CHECK—that four traces are sweeping across the screen simultaneously.

23. BEAM FIND Functional Check

a. Push BEAM FIND in and hold.

b. CHECK—the signal is visible and compressed fully within the graticule area as the horizontal and vertical position controls are rotated through their ranges.

c. Release the BEAM FIND button.

d. Set all Vertical and Horizontal POSITION controls at the 12 o'clock position.

24. A and B Trace Separation

a. Set:

A SEC/DIV	1 ms
VERTICAL MODE	CH 1 (others off)
Horizontal MODE	ALT
B SEC/DIV	0.5 ms
A/B SELECT	B
B Trigger MODE	RUNS AFTER
TRACE SEP	Fully CW

b. Position the CH 1 trace below the center horizontal graticule line to display the separated B trace.

c. CHECK—for at least four divisions of upward trace separation between the B trace and the A trace.

d. Set TRACE SEP fully CCW.

e. Position the CH 1 trace above the center horizontal graticule line to display the separated B trace.

f. CHECK—for at least four divisions downward trace separation of the B trace from the A trace.

TRIGGERING

Equipment Required (See Table 4-1)

Leveled sine-wave generator	Function generator
50 Ω BNC coaxial cable	10X BNC attenuator
2X BNC attenuator	50 Ω BNC termination
Dual-input coupler	TV signal generator

1. 500 Hz Trigger Sensitivity

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1
SCOPE BW	On
CH 1 and CH 2 Input COUPLING	DC
CH 1 VOLTS/DIV	0.1 V
Horizontal MODE	A
A SEC/DIV	2 ms
Horizontal POSITION	12 o'clock
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	VERT
TRIGGER CPLG	AC
TRIGGER SLOPE	⌐ (positive-going)
TRIGGER HOLDOFF	Min
FOCUS	For best-defined display
CLEAR MEAS'MT	Press to remove measurement cursors.

b. Connect function generator (FG 502) output to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set function generator (FG 502) output to produce a 7.0 division sine-wave display at 500 Hz.

d. Add a 10X and a 2X BNC attenuator before the 50 Ω BNC termination (for a 0.35 division display).

NOTE

The TRIGGER LEVEL control may be used to obtain a stable display.

e. CHECK—that the display is stably triggered with DC, HF REJ, and AC Trigger CPLG; and that the display will not trigger on NOISE REJ or LF REJ Trigger CPLG.

f. Set:

Horizontal MODE	B
TRIGGER CPLG	DC
A/B SELECT	B Trigger
TRIGGER MODE	NORM
TRIGGER SOURCE	VERT
TRIGGER SLOPE	⌐ (positive-going)
B SEC/DIV	0.5 ms
DELAY Time	?0.000 ms (minimum delay time)
B INTEN	For viewable display

NOTE

It may be necessary to adjust the TRIGGER LEVEL control to obtain a display.

g. CHECK—that, using the Trigger LEVEL control, the display can be stably triggered in DC, HF REJ, and AC Trigger CPLG; and that the display cannot be triggered in NOISE REJ or LF REJ Trigger CPLG.

h. Disconnect the test setup from the CH 1 input.

2. 500 kHz Trigger Sensitivity

a. Set:

SCOPE BW	Off
Horizontal MODE	A
A/B SELECT	A Trigger
A SEC/DIV	2 μs

b. Connect leveled sine-wave generator (SG 503) output to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set leveled sine-wave generator output to produce a 7.0 division sine-wave display amplitude at 500 kHz.

d. Add a 10X and a 2X BNC attenuator before the 50 Ω BNC termination (for a 0.35 division display amplitude).

e. CHECK—that the display cannot be triggered in either HF REJ of NOISE REJ CPLG.

f. Set:

Horizontal MODE	B
A/B SELECT	B Trigger
B SEC/DIV	1 μs

g. CHECK—that the display cannot be triggered in HF REJ or NOISE REJ CPLG by adjusting the Trigger LEVEL control.

3. 25 MHz Trigger Sensitivity

a. Set:

Horizontal MODE	A
A/B SELECT	A Trigger
TRIGGER CPLG	DC
A SEC/DIV	50 ns

b. Remove the 10X and 2X BNC attenuators from the signal path.

c. Set leveled sine-wave generator output to produce a 7.0 division display amplitude at 25 MHz.

d. Add a 10X and a 2X BNC attenuator before the 50 Ω BNC termination.

e. CHECK—that the display is stably triggered in DC, LF REJ, and AC Trigger CPLG; the display is not triggered in NOISE REJ and HF REJ Trigger CPLG settings.

f. Set:

TRIGGER CPLG	AC
Horizontal MODE	B
A/B SELECT	B Trigger
B SEC/DIV	20 ns

g. CHECK—that, using the Trigger LEVEL control, the display can be stably triggered in DC, LF REJ, and AC Trigger CPLG; the display cannot be triggered in NOISE REJ and HF REJ Trigger CPLG settings.

h. Set leveled sine-wave generator (SG 503) to produce a 1.4 division display at 25 MHz.

i. CHECK—that the display can be stably triggered with NOISE REJ Trigger CPLG but does not trigger with HF REJ CPLG.

j. Set:

Horizontal MODE	A
A/B SELECT	A Trigger

k. CHECK—that the display is stably triggered with NOISE REJ Trigger CPLG but does not trigger with HF REJ CPLG. (The Trigger LEVEL control may be adjusted to improve display stability in NOISE REJ CPLG.)

4. 150 MHz Trigger Sensitivity

a. Set:

TRIGGER MODE	AUTO
TRIGGER CPLG	DC

b. Set leveled sine-wave generator to produce a 1.0 division display at 150 MHz.

c. CHECK—that the display is stably triggered in DC, LF REJ, and AC Trigger CPLG.

d. Set:

Horizontal MODE	B
A/B SELECT	B Trigger

e. CHECK—that, using the Trigger LEVEL control, the display can be stably triggered in DC, LF REJ, and AC Trigger CPLG.

f. Set:

Horizontal MODE	A
VERTICAL MODE	CH 2 (CH 1 off)
CH 2, CH 3, and CH 4	
VOLTS/DIV	0.1 V
A/B SELECT	A Trigger
TRIGGER CPLG	DC

g. Move test signal from CH 1 to the CH 2 input.

h. Set leveled sine-wave generator output to produce a 1.0 division display amplitude at 150 MHz.

i. CHECK – that a stable display can be obtained. (The Trigger LEVEL control may be adjusted to improve the display stability.)

j. Repeat the procedure for CH 3 and CH 4 (turn on the appropriate VERTICAL MODE and move the test signal as required).

k. Move test signal to the CH 1 input.

l. Set VERTICAL MODE to CH 1 (others off).

m. Remove the 2X BNC attenuator from the test signal path.

n. Set leveled sine-wave generator output for a 2.2 division display amplitude at 100 MHz.

o. CHECK – that the display is stably triggered with NOISE REJ Trigger CPLG.

p. Set leveled sine-wave generator output for a 0.5 division display amplitude at 100 MHz.

q. CHECK – that the display is not triggered in NOISE REJ Trigger CPLG.

r. Set leveled sine-wave generator output for a 1.0 division display amplitude at 100 MHz.

s. CHECK – that the display is not triggered in HF REJ Trigger CPLG.

t. Set:

TRIGGER CPLG	DC
Horizontal MODE	B
A/B SELECT	B Trigger

u. Repeat parts n through u for the B Trigger.

5. Single Sweep Mode

a. Set:

Horizontal MODE	A
A SEC/DIV	10 μs
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL

b. Remove the 10X BNC attenuator from the test signal path.

c. Set leveled sine-wave generator output to produce a 7.0 division display amplitude at 50 kHz.

d. Add a 10X and a 2X BNC attenuator before the 50 Ω BNC termination. (Display should stably trigger with AUTO LEVEL finding the correct trigger level setting.)

e. Set:

A TRIGGER MODE	NORM
CH 1 Input COUPLING	GND
TRIGGER MODE	SGL SEQ

f. CHECK – that the Trigger READY LED turns on and remains on.

g. Set:

A INTEN	3/4 fully CW
CH 1 Input COUPLING	DC (see CHECK below)

h. CHECK – that the TRIG'D LED flashes, and the READY LED turns off after a single sweep and readout display occurs when the Input COUPLING switches to DC.

6. Trigger LEVEL Control Range

a. Set:

TRIGGER MODE	AUTO (not AUTO LEVEL)
TRIGGER LEVEL	Fully CCW
A INTEN	For a good viewing intensity

b. Remove 10X and 2X BNC attenuators from the test signal path.

c. Increase leveled sine-wave generator output level until a stably triggered display is just obtainable.

d. Set TRIGGER LEVEL fully CW.

e. Set leveled sine-wave generator output for a stable display (if necessary).

f. Set CH 1 VOLTS/DIV to 1 V.

g. CHECK – that the CH 1 signal display amplitude is four divisions or more (peak-to-peak). Note that the signal is not triggered.

h. Disconnect the test setup from the 2245A.

7. TV Field Trigger Sensitivity

a. Set:

VERTICAL MODE	CH 2 (CH 1 off)
CH 2 VOLTS/DIV	2 V
SEC/DIV	0.2 ms
TRIGGER SLOPE	⌝⌞ (negative-going)
TRIGGER MODE	TV FIELD

b. Connect TV signal generator negative-going sync pulse output to the CH 1 input via a 50 Ω BNC cable.

c. Set CH 2 VAR VOLTS/DIV control for a 0.5 division composite sync signal.

d. CHECK – that a stable display is obtained.

e. Set:

CH 2 INVERT	On
TRIGGER SLOPE	⎍ (positive-going)

f. CHECK – that a stable display is obtained.

8. TV Line Trigger Sensitivity

a. Set:

SEC/DIV	20 μs
TRIGGER MODE	TV LINE
TRIGGER HOLDOFF	For a single triggered display

b. CHECK – that a stable display is obtained.

c. Set:

CH 2 INVERT	Off
TRIGGER SLOPE	⎍ (negative-going)

d. CHECK – that a stable display is obtained.

e. Set CH 2 VAR VOLTS/DIV to detent position (calibrated).

f. Disconnect the TV signal generator from the 2245A.

9. Line Trigger Functional Check

a. Set:

CH 2 VOLTS/DIV	0.1 V (without a 10X probe attached)
CH 2 Input COUPLING	DC
A SEC/DIV	5 ms
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	LINE
TRIGGER CPLG	DC

b. Connect a 10X probe to the CH 2 input connector.

c. CHECK – that the display can be triggered in both ⎍ (positive-going) and ⎍ (negative-going) slopes.

d. Disconnect the test setup.

HORIZONTAL

Equipment Required (See Table 4-1)

Time-mark generator	50 Ω BNC coaxial cable
50 Ω BNC termination	

1. A and B Sweep Length

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1
CH 1 and CH 2 Input COUPLING	DC
CH 1 VOLTS/DIV	0.5 V
Horizontal MODE	A
A SEC/DIV	2 ms
Horizontal POSITION	12 o'clock
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	VERT
TRIGGER CPLG	AC
TRIGGER SLOPE	⎍ (positive-going)
TRIGGER HOLDOFF	Min
TRIGGER LEVEL	12 o'clock
CLEAR MEAS'MT	Press to remove measurement cursors.
FOCUS	For best-defined display

b. Connect time-mark generator (TG 501) to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set generator for 2 ms time markers.

d. CHECK—sweep length of the A trace is greater than 10 divisions.

e. Set:

Horizontal MODE	B
B SEC/DIV	1 ms
A/B SELECT	B Trigger
TRIGGER MODE	RUNS AFTER
⇤ OR DELAY Control	CCW to the lowest DELAY readout value
B INTEN	For a visible display

f. CHECK—the Delay Time readout is ?0.000 ms, and the B Sweep length is greater than 10 divisions.

2. Horizontal POSITION Range

a. Set:

Horizontal MODE	A
Horizontal POSITION	Fully CW

b. CHECK—that the start of trace positions past the center vertical graticule line.

c. Set Horizontal POSITION fully CCW.

d. CHECK—that the 11th time marker is positioned to the left of the center vertical graticule line.

3. VAR SEC/DIV Range

a. Set:

SEC/DIV	1 ms
SEC/DIV VAR	Fully CCW
Horizontal POSITION	12 o'clock

b. Set time-mark generator for 5 ms time markers.

c. CHECK – the time-marker spacing is equal to or less than two divisions.

d. Set SEC/DIV VAR fully CW (calibrated detent).

4. Magnifier Registration

a. Set X10 MAG on.

b. Position a time marker to the center vertical graticule line.

c. Set X10 MAG off.

d. CHECK – for less than 0.5 division horizontal trace shift.

5. A and B Timing Accuracy and Linearity

a. Set A SEC/DIV to 20 ns.

b. Set time-mark generator for 20 ns time markers.

c. Position the time marker peaks vertically to the center horizontal graticule line (allows use of the minor division graticule markings as an aid in making the accuracy checks).

NOTE

For the fastest sweep speeds, where the time marker peaks are rounded and not well defined, greater resolution can be achieved by vertically centering the display and using the point where the rising edge of the time marks cross the center horizontal graticule line as a reference.

d. Position the second time marker to the second vertical graticule line.

e. CHECK – that the tenth time marker is within 0.16 divisions (left or right) of the tenth graticule line.

f. CHECK – that the spacing of time markers over any two division interval within the center eight divisions does not deviate from the value measured at the center two division by more than 0.1 division.

g. Repeat the procedure for all other A SEC/DIV settings. Use the SEC/DIV and Time Mark Generator settings in the column labeled Normal (X1) given in Table 4-3, Settings for Timing Accuracy Checks.

h. Set SEC/DIV to 20 ns.

i. Set time-mark generator for 20 ns time markers.

j. Set:

Horizontal MODE	B
B INTEN	For a viewable display

k. Repeat the CHECK procedure for all the B SEC/DIV settings.

6. A and B Magnified Timing Accuracy and Linearity

a. Set time-mark generator for 5 ns time markers.

b. Set:

Horizontal MODE	A
A SEC/DIV	20 ns
Horizontal MODE	B
B SEC/DIV	20 ns
X10 MAG	On (for 2 ns/div sweep speed)
CH 1 VOLTS/DIV	0.5 V (use 0.2 V for the 5 ns time markers if necessary)

c. Set the Horizontal POSITION control to 12 o'clock, and then align the rising edge of the nearest time marker to the second vertical graticule line (center the display vertically).

NOTE

For the fastest sweep speeds, where the time marker peaks are rounded and not well defined, greater resolution can be achieved by vertically centering the display and using the point where the rising edge of the time marks cross the center horizontal graticule line as a reference.

d. CHECK – that the rising edge of the fourth displayed time marker crosses the center horizontal graticule line at between 8.27 divisions and 8.73 divisions.

e. CHECK – that the spacing of the time markers over any 2.5 division interval within the center eight divisions does not deviate from the value measured at the center 2.5 divisions by more than 0.12 division. Use the fifth vertical graticule line as a starting point for the measurement at the center 2.5 divisions. Exclude the first 1/4 division or 25 ns and any portion of the sweep past the 100th magnified division.

f. Set SEC/DIV to 5 ns.

g. Set the Horizontal POSITION control to 12 o'clock, and then align the nearest time marker to the second vertical graticule line.

h. CHECK – that the tenth displayed time marker is within 0.24 division (left or right) of the tenth graticule line.

i. CHECK – that the spacing of the time markers over any two division interval within the center eight divisions does not deviate from the value measured at the center two divisions by more than 0.1 division. Exclude the first 1/4 division or 25 ns and any portion of the sweep past the 100th magnified division.

j. Repeat the timing and linearity checks for all SEC/DIV settings between 10 ns and 50 ms. Use the SEC/DIV and Time Mark Generator X10 MAG settings given in Table 4-3.

k. Set:

Horizontal MODE	A
SEC/DIV	2 ns (with X10 MAG on)

l. Set time-mark generator for 5 ns time markers.

m. Repeat the magnified accuracy and linearity checks for the A Sweep at all SEC/DIV settings.

Table 4-3

Settings for Timing Accuracy Checks

SEC/DIV Setting		Time-Mark Setting	
Normal	**X10 MAG**	**Normal**	**X10 MAG**
20 ns	2 ns	20 ns	5 ns
50 ns	5 ns	50 ns	5 ns
0.1 µs	10 ns	0.1 ns	10 ns
0.2 µs	20 ns	0.2 µs	20 ns
0.5 µs	50 ns	0.5 µs	50 ns
1 µs	0.1 µs	1 µs	0.1 µs
2 µs	0.2 µs	2 µs	0.2 µs
5 µs	0.5 µs	5 µs	0.5 µs
10 µs	1 µs	10 µs	1 µs
20 µs	2 µs	20 µs	2 µs
50 µs	5 µs	50 µs	5 µs
0.1 ms	10 µs	0.1 ms	10 µs
0.2 ms	20 µs	0.2 ms	20 µs
0.5 ms	50 µs	0.5 ms	50 µs
1 ms	0.1 ms	1 ms	0.1 ms
2 ms	0.2 ms	2 ms	0.2 ms
5 ms	0.5 ms	5 ms	0.5 ms
A Sweep only			
10 ms	1 ms	10 ms	1 ms
20 ms	2 ms	20 ms	2 ms
50 ms	5 ms	50 ms	5 ms
0.1 s	10 ms	0.1 s	10 ms
0.2 s	20 ms	0.2 s	20 ms
0.5 s	50 ms	0.5 s	50 ms

7. Delay Time Jitter

a. Set:

X10 MAG	Off
A SEC/DIV	1 ms
Horizontal MODE	ALT
B SEC/DIV	0.5 μs

b. Set the time-mark generator for 1 ms time markers.

c. Position the intensified dot to the leading edge of the 10th time marker to display the rising edge on the B Trace (using the |← OR DELAY control).

d. Set:

Horizontal MODE	B
B INTEN	Fully CW (maximum intensity)

d. CHECK—that the jitter on the leading edge does not exceed one division over a two-second interval. Disregard slow drift.

8. Delay Time Accuracy

a. Set:

Horizontal MODE	ALT
B SEC/DIV	10 μs
TRACE SEP	Fully CCW (maximum downward position)
CH 1 POSITION	To display both the ALT and the B Delayed Traces

b. Position the first time marker on the ALT trace to first vertical graticule line (left-most edge).

c. Position the intensified dot to full left position (counterclockwise rotation of the |← OR DELAY control).

d. CHECK—that the readout is ?0.000 ms.

e. Position the intensified zone to the second time marker and align the leading edge of the time marker displayed on the B Trace to the left-most (first) graticule line. Using the Readout Accuracy Limits given in Table 4-4, check the delay time accuracy.

f. Repeat the procedure for the third through 10th time markers.

Table 4-4
Delay Time Accuracy

Time Marker	Readout Accuracy Limits
1st	? 0.000 ms
2nd	0.975 ms to 1.025 ms
3rd	1.970 ms to 2.030 ms
4th	2.965 ms to 3.035 ms
5th	3.960 ms to 4.040 ms
6th	4.955 ms to 5.045 ms
7th	5.950 ms to 6.050 ms
8th	6.945 ms to 7.055 ms
9th	7.940 ms to 8.060 ms
10th	8.935 ms to 9.065 ms

9. Delay Time Position Range

a. Set time-mark generator for 0.1 ms.

b. Set:

A SEC/DIV	1 ms
B SEC/DIV	5 μs
|← OR DELAY control	?0.000 ms

c. CHECK—that the intensified dot is positioned at or before the second time marker.

d. Turn the |← OR DELAY control clockwise until the delay readout stops increasing (largest number).

e. CHECK—that the intensified dot is positioned at or after the 99th time marker (located at a Delay Time of 9.9 ms).

f. Disconnect the time-mark generator from the 2245A.

10. X-Axis Gain Accuracy

a. Set:

Horizontal MODE	X-Y
VERTICAL MODE	CH 2 (CH 1 off)
CH 1 and CH 2 VOLTS/DIV	10 mV
CH 1 Input COUPLING	DC
CH 2 Input COUPLING	GND

b. Connect calibration generator Std Ampl output to the CH 1 and CH 2 inputs via a 50 Ω precision BNC coaxial cable and a BNC dual-input coupler.

c. Set calibration generator for Std Ampl output, 50 mV.

d. CHECK—X-Axis amplitude is between 4.85 and 5.15 horizontal divisions.

e. Disconnect calibration generator.

11. X-Y Phase Difference

a. Set:

HORIZONTAL MODE	A
VERTICAL MODE	CH 1 (CH 2 off)
CH 1 Input COUPLING	DC

b. Connect leveled sine-wave generator output to the CH 1 input via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination.

c. Set leveled sine-wave generator output for six divisions of signal display amplitude at 50 kHz.

d. Set:

Horizontal MODE	X-Y
CH 1 Input COUPLING	GND

e. Position dot to graticule center.

f. Set CH 1 Input COUPLING to DC.

g. CHECK—ellipse opening at the center is 0.3 division or less, measured horizontally.

12. X-Axis Bandwidth

a. Set VERTICAL MODE to CH 2 (CH 1 off).

b. Set leveled sine-wave generator output frequency to 3 MHz.

c. CHECK—X-Axis display is 4.2 horizontal divisions or more.

d. Disconnect the test equipment from the 2245A.

MEASUREMENT CURSORS

Equipment Required (See Table 4-1)

Time mark generator	Calibration generator
50 Ω BNC coaxial cable	50 Ω BNC termination

1. |← SEC →| and |← 1/SEC →| Cursor Accuracy

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	0.5 V
CH 1 and CH 2 Input COUPLING	DC
CH 2 INVERT	Off
SCOPE BW	Off
Horizontal MODE	A
A SEC/DIV	1 ms
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL
TRIGGER CPLG	DC
TRIGGER SOURCE	VERT
TRIGGER SLOPE	⎍ (positive-going)
TRIGGER HOLDOFF	Min
FOCUS	For best defined display

b. Connect time-mark generator (TG 501) output via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination to the CH 1 input.

c. Set time-mark generator for 1 ms time markers.

d. Position first time marker horizontally to the first vertical graticule line (left-most edge of the graticule).

e. Press TIME MEASUREMENTS button to display the |← SEC →| cursors.

f. Position the reference cursor to the second time marker and the delta cursor to the tenth time marker.

g. CHECK – that the readout is 7.940 ms to 8.060 ms.

h. Press the TIME button to display the TIME menu.

i. Set |← 1/SEC →| on.

j. CHECK – that the readout is 124 Hz to 126 Hz.

2. |← VOLTS →| Cursor Accuracy

a. Set:

CH 1 VOLTS/DIV	0.1 V
SEC/DIV	0.5 ms

b. Connect calibration generator (PG 506) output to the CH 1 input via a 50 Ω precision BNC coaxial cable.

c. Set the calibration generator to Std Ampl, 0.5 V.

d. Position bottom of the signal to the second horizontal graticule line from the bottom.

e. Press the CURSOR VOLTS button to display the |← VOLTS →| cursors.

f. Position the reference cursor to the bottom of the signal and the delta cursor to the top of the signal (both cursors move with the |← OR DELAY control).

g. CHECK – that the readout is between 0.493 V to 0.507 V.

h. Disconnect calibration generator.

EXTERNAL Z-AXIS, PROBE ADJUST AND AUTO SETUP FUNCTIONS

Equipment Required (See Table 4-1)

Calibration Generator
Two 50 Ω BNC coaxial cables
50 Ω precision BNC coaxial cable
BNC T-connector
Test oscilloscope w/10X probe

1. Check External Z-Axis Input

a. Set:

READOUT (Intensity)	For a viewable readout
A INTEN	For a viewable trace
VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	1 V
CH 2 INVERT	Off
SCOPE BW	Off
CH 1 Input COUPLING	DC
Horizontal MODE	A
A SEC/DIV	0.5 ms
Horizontal POSITION	12 o'clock
A/B SELECT	A Trigger
TRIGGER MODE	AUTO LEVEL
TRIGGER CPLG	DC
TRIGGER SOURCE	VERT
TRIGGER SLOPE	⌐ (positive-going)
TRIGGER HOLDOFF	Min
FOCUS	For best defined display

b. Connect calibration generator (PG 506) Std Ampl output to the CH 1 and the EXT Z-AXIS inputs via a 50 Ω precision BNC coaxial cable, a BNC T-connector, and two 50 Ω BNC coaxial cables. Set generator to Std Ampl output, 5 V.

c. CHECK—waveform display intensity has noticeable modulation at 3.8 V or less.

d. Disconnect the test equipment from the 2245A.

2. PROBE ADJUST Output

a. Set:

Test Oscilloscope VOLTS/DIV	10 mV
Test Oscilloscope SEC/DIV	0.2 ms

b. Connect a 10X probe to the test oscilloscope and connect the probe tip to the 2245A PROBE ADJUST output.

c. CHECK—For a 0.5 V (± 2% into 1 MΩ) of PROBE ADJUST square-wave signal (square-wave period is typically 1 ms, within 25%).

NOTE

Remember to take in to account the test oscilloscope and probe specifications/accuracies when determining the accuracy of the PROBE ADJUST square wave signal.

d. Disconnect the test setup.

3. AUTO SETUP Functional Check

a. Set:

CH 1 COUPLING	GND
CH 1 VOLTS/DIV	2 mV
A SEC/DIV	20 ns

b. Connect a 10X probe from the 2245A CH 1 input connector and connect the probe tip to the 2245A PROBE ADJUST output.

c. Press the AUTO SETUP button.

d. Check that the Probe Adjust waveform is stably displayed on the upper half of the crt.

e. Disconnect the test setup.

OPTION 15

Equipment Required (See Table 4-1)

Calibration Generator	50 Ω precision BNC coaxial cable
Leveled Sine-Wave Generator	50 Ω BNC Termination
50 Ω BNC coaxial cable	Test ocsilloscope

1. Check CH 2 Signal Output

a. Set:

VERTICAL MODE	CH 1 and CH2 (CH 3 and 4 Off)
VOLTS/DIV	2 mV
CH 2 INVERT	Off
SCOPE BW	Off
Input COUPLING	
CH 1 and CH 2	GND
A an B SEC/DIV	1 ms
TRIGGER MODE	AUTO LEVEL
TRIGGER CPLG	NOISE REJ
TRIGGER SOURCE	VERT

b. Push the CH 2 VERTICAL MODE button so that light is off.

c. Connect the CH 2 signal from the rear-panel CH 2 SIGNAL OUT connector to the CH 1 OR X input connector via a 50-Ω BNC cable.

d. Align the CH 1 trace to the center graticule line.

e. Set CH 1 Input Coupling to DC.

f. CHECK—Displayed trace is within 0.5 division of the ground reference set above (neglect trace width).

g. Connect a 1 kHz, 10 mV standard-amplitude signal from the Calibration Generator to the CH 2 Input Connector via a 50-Ω BNC cable.

h. Set CH 2 Input Coupling to DC.

i. Set CH 1 VOLTS/DIV to 20 mV.

j. CHECK—Display amplitude is 4.5 to 5.5 divisions (neglect trace width).

k. Connect a 50-Ω terminator to the CH 1 Input.

l. Set CH 1 VOLTS/DIV to 10 mV.

m. CHECK—Display amplitude is 4.5 to 5.5 divisions (neglect trace width).

n. Set CH 2 VOLTS/DIV to .1 V.

o. Connect a 50 kHz signal from the Leveled Sine-Wave Generator to the CH 2 input connector via a precision 50-Ω BNC cable and a 50-Ω Termination.

p. Adjust the generator output level to produce a 6-division CH 1 display.

q. Increase the generator frequency to 25 MHz.

r. CHECK—Display amplitude is 4.24 divisions or greater.

s. Disconnect the test setup.

2. Check A GATE Output

a. Set:

A and B SEC/DIV	0.1 ms
TRIGGER MODE	Auto
HOLDOFF	Minimum (CCW)

b. Connect a test oscilloscope to the A GATE OUT Connector from the rear-panel via a 50-Ω BNC cable.

c. CHECK—Test oscilloscope displays a signal with a high level between 2 V and 5.25 V and a low level between 0 V and 0.7 V.

d. CHECK—Duration of the high level is greater than or equal to 0.2 ms.

e. Set HOLDOFF Control to maximum (CW).

f. CHECK—Duration of the high level is greater than or equal to 2 ms.

g. Disconnect the test setup.

ADJUSTMENT PROCEDURE

INTRODUCTION

IMPORTANT—PLEASE READ BEFORE USING THIS PROCEDURE

PURPOSE

This Adjustment Procedure returns the instrument to conformance with the Performance Requirements as listed in the specification tables in Section 1. Adjustments should be done only after the checks in the Performance Check Procedure (Section 4) have indicated a need for readjustment of the instrument.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-1 (Section 4) is required to complete the Adjustment Procedure in this section and the Performance Check Procedure in Section 4. Test equipment specifications described in Table 4-1 are the minimum necessary to provide accurate results; you must use equipment that meets or exceeds these specifications. Detailed operating instructions for test equipment are not given in this procedure; if more operating information is required, refer to the appropriate test equipment instruction manual.

When equipment other than that recommended is used, control settings given for the test setup may have to be changed. If the exact item of equipment given as an example in Table 4-1 is not available, first check the "Use" column to verify use of the item. Then use the "Minimum Specification" column to decide whether other available test equipment can be used.

LIMITS AND TOLERANCES

The limits and tolerances stated in this procedure are instrument specifications only if they are listed in the Performance Requirements column of Table 1-1, Electrical Characteristics. Tolerances given apply only to the instrument under adjustment and do not include test equipment error. Adjustments must be made at an ambient temperature between +20°C and +30°C, and the instrument must have had a warm-up period of at least 20 minutes.

PARTIAL PROCEDURES

This procedure is divided into subsections to permit adjustment of individual sections of the instrument (except the Power Supply) whenever a complete readjustment is not required. For example, if only the Vertical section fails to meet the Performance Requirements (or has had repairs made or components replaced), it can be readjusted with little or no effect on other sections of the instrument. However, if the Power Supply section has undergone repairs or adjustments that change the absolute value of any of the supply voltages, a complete readjustment of the instrument is required.

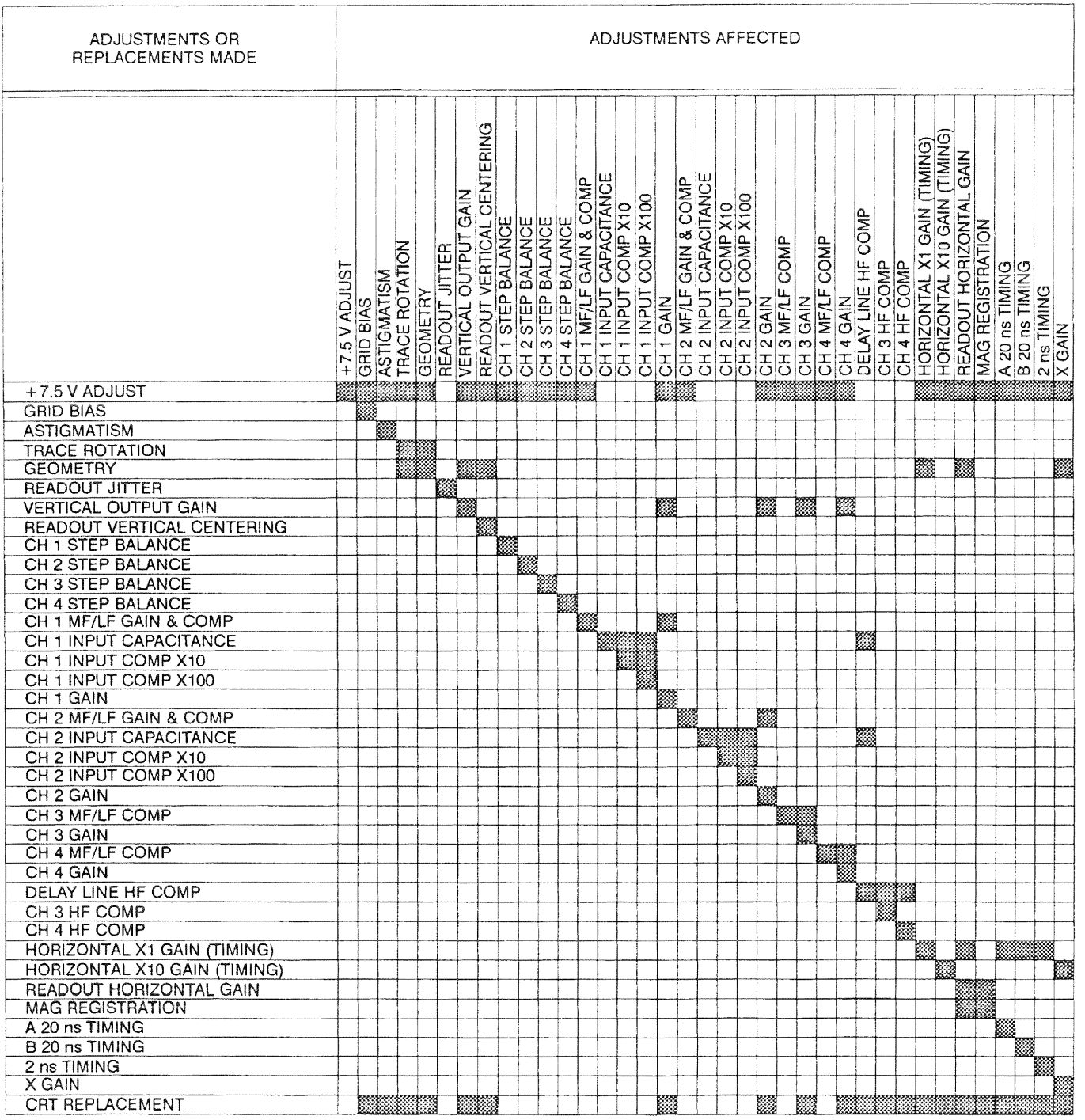
At the beginning of each subsection is a list of the initial front-panel control settings required to prepare the instrument for Step 1 in that subsection. Each succeeding step within a subsection should then be done completely and in the sequence given to ensure that control settings will be correct for steps that follow.

INTERNAL ADJUSTMENTS AND ADJUSTMENT INTERACTION

Do not preset any internal controls, since that may make it necessary to recheck or readjust a major portion of the instrument when only a partial check or adjustment might otherwise have been required. To avoid unnecessary checks and adjustments, change an internal control setting only when a Performance Characteristic cannot be met with the original setting. When independently changing the setting of any internal control, always check Table 5-1 for possible interacting adjustments that might be required.

Table 5-1

Adjustment Interactions



The use of Table 5-1 is particularly important if only a partial procedure is done or if a circuit requires readjustment due to a component replacement. To use this table, first find the adjustment that was made (extreme left column). Then move to the right, across the row, until you come to a darkened square. From the darkened square, move up the table to find the affected adjustment at the heading of that column. Check the accuracy of this adjustment by using the Performance Check Procedure in Section 4. Then, if necessary, make a readjustment.

Specific interactions are called out within some adjustment steps to indicate that the adjustments must be repeated until no further improvement is noted.

PREPARATION FOR ADJUSTMENT

It is necessary to remove the cabinet to do the Adjustment Procedure. See the cabinet removal instructions in the Maintenance section of this manual.

All test equipment items required to do the complete Adjustment Procedure are described in Table 4-1 at the beginning of Section 4, Performance Check Procedure. The specific items of equipment needed to do each subsection in this procedure are listed at the beginning of that subsection.

Connect the test equipment and the 2245A to an appropriate ac-power source and allow 20 minutes warmup before making any adjustments.

INDEX TO ADJUSTMENT PROCEDURE

POWER SUPPLY, DISPLAY, AND Z-AXIS

Equipment Required (See Table 4-1):

Digital multimeter (DMM)	50 Ω coaxial cable
Leveled sine-wave generator	50 Ω termination
Test oscilloscope w/10X probe	

See ADJUSTMENT LOCATIONS *at the back of this manual for test points and adjustment locations.*

INITIAL CONTROL SETTINGS

Set:

VERTICAL MODE	CH 1
CH 1 COUPLING	DC
VOLTS/DIV	0.1 V
VERTICAL POSITION Controls	12 o'clock
HORIZONTAL MODE	A
A/B SELECT	A
SEC/DIV	0.1 ms
TRIGGER LEVEL	12 o'clock
HOLDOFF	Min (CCW)
SLOPE	⎍
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	CH 1
TRIGGER COUPLING	DC
MEASUREMENTS	OFF
A INTEN	10 o'clock
READOUT	12 o'clock
FOCUS	For well-defined display
SCALE ILLUM	Fully CCW

PROCEDURE

1. Power Supply DC Levels (R2252)

a. Connect a digital multimeter (DMM) negative lead to chassis ground. Connect the positive lead to the first test point listed in Table 5-2 (all test points on J1204, Main board).

b. CHECK – Voltage reading is within the range given in Table 5-2.

c. Move DMM positive lead to each of the other supply voltages in Table 5-2 and check that voltage ranges are within limits.

NOTE

If all supply voltages are within the limits given in Table 5-2, it is not necessary to adjust the power supply. If voltages are not within limits, you will have to adjust the +7.5 V supply, recheck the other voltages, and continue with a complete readjustment of the instrument.

d. Connect a digital multimeter (DMM) negative lead to chassis ground and positive lead to +7.5 V test point (J2104-8).

e. ADJUST – +7.5 V Adj (R2252) for +7.5 V and check that all supply voltages in Table 5-2 are within limits. The +7.5 V Adjustment is accessible through the right side frame.

f. Disconnect digital multimeter.

Table 5-2
Power Supply Voltage Limits

Nominal Supply Voltage	Test Point (+ lead)	Limits (0°C to 50°C) Min	Max
+130 V	J1204-11	+127 to	+135
+58 V	J1204-10	+55.7 to	+59.2
+15 V	J1204-7	+14.6 to	+15.6
+7.5 V	J1204-8	+7.4 to	+7.6
+5.0 V	J1204-1,2	+5.0 to	+5.3
-5.0 V	J1204-5	-5.1 to	-5.4
-7.5 V	J1204-9	-7.4 to	-7.8
-15 V	J1204-6	-15.5 to	-16.6

2. Grid Bias (R2719)

a. Set:

HORIZ MODE	X-Y
CH 1 VOLTS/DIV	5 V
CH 1 COUPLING	GND
SCOPE BW	On
A INTEN	Fully CCW (off)
B INTEN	Fully CCW (off)
READOUT (Intensity)	Fully CCW (off)
SCALE ILLUM	Fully CCW (off)

b. ADJUST—Grid Bias (R2719) for a visible dot.

c. Position dot just off center screen with vertical or horizontal POSITION controls.

d. Set FOCUS control for a well-defined dot.

e. ADJUST—Grid Bias (R2719) so that dot is no longer visible.

3. Astigmatism (R2788)

a. Set:

HORIZ MODE	A
A INTEN	10 o'clock
READOUT (Intensity)	12 o'clock
SEC/DIV	5 μs
VAR SEC/DIV	Detent (fully CW)
CH 1 VOLTS/DIV	10 mV
CH 1 COUPLING	DC

b. Connect leveled sine-wave generator output to the CH 1 input connector via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination. Set for a 5-division display at 50 kHz.

c. ADJUST—Astigmatism (R2788) together with front-panel FOCUS control for best overall resolution of the sine-wave display.

d. DISCONNECT—Leveled sine-wave generator.

4. Trace Rotation

a. Set CH 1 COUPLING to GND.

b. Position trace to center horizontal graticule line and beginning of trace to first vertical graticule line.

c. ADJUST—TRACE ROTATION (front panel) to align trace parallel with center horizontal graticule line.

5. Geometry (R2784)

a. Set:

CH 1 VOLTS/DIV	0.1 V
CH 1 COUPLING	DC
SEC/DIV	50 μs
READOUT (intensity)	Fully CCW (off)

b. Connect the time-mark generator to CH 1 via a 50 Ω cable and a 50 Ω termination. Display 10 μs time markers.

c. Position base trace below bottom graticule line.

d. ADJUST—Geometry (R2784) for minimum bowing of time markers across the full graticule area. Vertical bowing of time marker across screen should be no more than 0.1 division.

e. Disconnect time-mark generator.

6. Readout Jitter (R724)

a. Set:

READOUT (intensity)	12 o'clock
SEC/DIV	10 ms
CH 1 COUPLING	DC
A INTEN	Fully CCW (off)

b. Connect calibration generator to CH 1 input via 50 Ω precision coaxial cable. Set generator for STD AMPL and 1 volt.

c. ADJUST—Readout Jitter (R724) for the least amount of jitter or sway in the readout.

d. Disconnect calibration generator.

VERTICAL

Equipment Required (See Table 4-1):

- Calibration generator (PG 506)
- Leveled sine-wave generator
- 50 Ω precision coaxial cable
- 50 Ω termination
- Precision normalizer (20 pF)

See ADJUSTMENT LOCATIONS *at the back of this manual for test points and adjustment locations.*

INITIAL CONTROL SETTINGS

Set:

VERTICAL MODE	CH 1 and CH 2
INPUT COUPLING	DC
VOLTS/DIV	0.1 V
VERTICAL POSITION Controls	12 o'clock
HORIZONTAL MODE	A
A/B SELECT	A
SEC/DIV	0.1 ms
TRIGGER LEVEL	12 o'clock
HOLDOFF	Min (CCW)
SLOPE	⌐
TRIGGER MODE	AUTO LEVEL
TRIGGER SOURCE	VERT
TRIGGER COUPLING	DC
MEASUREMENTS	OFF
A INTEN	10 o'clock
READOUT	12 o'clock
FOCUS	For well-defined display
SCALE ILLUM	Fully CCW

PROCEDURE

1. Vertical Output Gain (R703) and Readout Vertical Centering (R260)

a. Run ADJUST VERTICAL OUTPUT routine.

Select the SERVICE MENU by pressing the CH 1 and CHOP/ALT VERTICAL MODE buttons at the same time. Press the ADD (down-arrow button) four times to underline INTERNAL SETTINGS MENU, then press CH 2 (SELECT) button. Press ADD (down-arrow) button twice to underline ADJUST VERTICAL OUTPUT, then press CH 2 (RUN) button.

NOTE

For this adjustment, the 2245A must be placed in the "normal" operating position to avoid incorrect alignment due to the effects of the earth's magnetic field.

b. ADJUST – Vertical Output Gain (R703) and Readout Vertical Centering (R260) alternately until dashed lines produced by the diagnostics are aligned with dotted lines on the graticule.

c. To end the ADJUST VERTICAL OUTPUT routine, either press the CLEAR MEAS'MT button or press CH 1 (END) and then press CH 4 (QUIT).

2. CH 1 Step Balance (R12)

a. Set:

VERTICAL MODE	CH 1 (CH 2 off)
CH 1 COUPLING	GND
SCOPE BW	On

b. Position trace to center horizontal graticule line.

c. ADJUST – CH 1 Step Balance (R12) so the trace does not move vertically while switching CH 1 VOLTS/DIV switch from 10 mV to 50 mV.

3. CH 2 Step Balance (R22)

a. Set:

VERTICAL MODE	CH 2 (CH 1 off)
CH 2 COUPLING	GND

b. Position trace to center of graticule.

c. ADJUST—CH 2 Step Balance (R22) so that trace does not move vertically while switching CH 2 VOLTS/DIV switch from 10 mV to 50 mV.

4. CH 3 Step Balance (R141)

a. Set VERTICAL MODE to CH 3 (CH 2 off).

b. Position trace to center of graticule.

c. ADJUST—CH 3 Step Balance (R141) so that trace does not move vertically while switching CH 3 VOLTS/DIV switch from 0.1 V to 0.5 V.

5. CH 4 Step Balance (R161)

a. Set VERTICAL MODE to CH 4 (CH 3 off).

b. Position trace to center of graticule.

c. ADJUST—CH 4 Step Balance (R161) so that trace does not move vertically while switching CH 4 VOLTS/DIV switch from 0.1 V to 0.5 V.

6. CH 1 MF/LF Gain (R13) and Compensation (C1)

a. Set:

VERTICAL MODE	CH 1 (CH 4 off)
CH 1 VOLTS/DIV	50 mV
CH 1 COUPLING	DC
SEC/DIV	50 μs

b. Connect calibration generator to CH 1 input via 50 Ω BNC coaxial cable and 50 Ω BNC termination. Set generator for High Amplitude. Set Period to 10 kHz and adjust Pulse Amplitude for a 5-division display.

c. ADJUST—CH 1 MF/LF Gain (R13) and Compensation (C1) for the flattest response.

7. CH 1 Input Capacitance (C114)

a. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.2 ms

b. Add precision normalizer between termination and CH 1 input connector. Set calibration generator Period to 1 kHz and adjust Pulse Amplitude for a 5-division display.

c. ADJUST—CH 1 Input Capacitance (C114) for best flat top.

d. Remove precision normalizer from the input cable.

8. CH 1 Input Compensation X10 (C11)

a. Set:

CH 1 VOLTS/DIV	0.1 V
SEC/DIV	50 μs

b. Set calibration generator Period to 10 kHz and adjust Pulse Amplitude for a 5-division display.

c. ADJUST—CH 1 Input Compensation X10 (C11) for flattest response.

9. CH 1 Input Compensation X100 (C10)

a. Set CH 1 VOLTS/DIV to 1 V.

b. Set calibration generator amplitude for a 5-division display.

c. ADJUST—CH 1 Input Compensation X100 (C10) for flattest response.

10. CH 1 Gain (R211)

a. Set calibration generator to Standard Amplitude and Amplitude to 50 mV. Remove 50 Ω termination from input cable.

b. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.2 ms

c. ADJUST—CH 1 Gain (R211) for exactly 5 divisions display amplitude.

11. CH 2 MF/LF Gain (R23) and Compensation (C2)

a. Set:

VERTICAL MODE	CH 2 (CH 1 off)
CH 2 VOLTS/DIV	50 mV
CH 2 COUPLING	DC
SEC/DIV	50 μs

b. Move calibration generator signal to CH 2 input. Add 50 Ω termination.

c. Set calibration generator for High Amplitude. Set Period to 10 kHz and adjust Pulse Amplitude for a 5-division display.

d. ADJUST—CH 2 MF/LF Gain (R23) and Compensation (C2) for flattest response.

12. CH 2 Input Capacitance (C124)

a. Set:

CH 2 VOLTS/DIV	10 mV
SEC/DIV	0.2 ms

b. Add precision normalizer between termination and CH 2 input connector. Set calibration generator Period to 1 kHz and adjust Pulse Amplitude for a 5-division display.

c. ADJUST—CH 1 Input Capacitance (C124) for best flat top.

d. Remove precision normalizer from the input cable.

13. CH 2 Input Compensation X10 (C21)

a. Set:

CH 2 VOLTS/DIV	0.1 V
SEC/DIV	50 μs

b. Set calibration generator Period to 10 kHz and adjust Pulse amplitude for a 5-division display.

c. ADJUST—CH 2 Input Compensation X10 (C21) for flattest response.

14. CH 2 Input Compensation X100 (C20)

a. Set CH 2 VOLTS/DIV to 1 V.

b. Set calibration generator amplitude for a 5-division display.

c. ADJUST—CH 2 Input Compensation X100 (C20) for flattest response.

15. CH 2 Gain (R221)

a. Set calibration generator to Standard Amplitude and Amplitude to 50 mV. Remove 50 Ω termination from the input cable.

b. Set:

CH 2 VOLTS/DIV	10 mV
SEC/DIV	0.2 ms

c. ADJUST—CH 2 Gain (R221) for exactly 5 divisions display amplitude.

16. CH 3 MF/LF Compensation (C134)

a. Set:

VERTICAL MODE	CH 3 (CH 2 off)
CH 3 VOLTS/DIV	0.1 V
SEC/DIV	50 μs

b. Move calibration generator signal to CH 3 input. Add 50 Ω termination.

c. Set calibration generator for High Amplitude. Set Period to 10 kHz and adjust Pulse Amplitude for a 5-division display.

d. ADJUST—CH 3 MF/LF Compensation (C134) for flattest response.

17. CH 3 Gain (R231)

a. Set:

CH 3 VOLTS/DIV	0.5 V
SEC/DIV	2 ms

b. Set calibration generator for Standard Amplitude. Set amplitude to 2 V. Remove 50 Ω termination.

c. ADJUST—CH 3 Gain (R231) for exactly 4 divisions display amplitude.

18. CH 4 MF/LF Compensation (C154)

a. Set:

VERTICAL MODE	CH 4 (CH 3 off)
CH 4 VOLTS/DIV	0.1 V
SEC/DIV	50 μs

b. Move calibration generator signal to CH 4 input. Add 50 Ω termination.

c. Set calibration generator for High Amplitude. Set Period to 10 kHz and adjust Pulse Amplitude for a 5-division display.

d. ADJUST—CH 4 MF/LF Compensation (C154) for flattest response.

19. CH 4 Gain (R241)

a. Set:

CH 4 VOLTS/DIV	0.5 V
SEC/DIV	0.2 ms

b. Set calibration generator for Standard Amplitude. Set amplitude to 2 V. Remove 50 Ω termination.

c. ADJUST—CH 4 Gain (R241) for exactly 4 divisions display amplitude.