

# ADJUSTMENT PROCEDURE

## INTRODUCTION

### PURPOSE

The "Adjustment Procedure" is a set of logically sequenced instructions intended to return the instrument to conformance with the Performance Requirement statements listed in Table 1-1. Adjustments contained in this procedure should only be performed after checks from the "Performance Check Procedure" (Section 4) have indicated a need for readjustment or after repairs have been made to the instrument.

### STRUCTURE

This procedure is structured into four major subsections, each of which can be performed independently to permit adjustment of individual sections of the instrument. For example, if only the Vertical section fails to meet the Performance Requirements or has had repairs made, it can be readjusted with little or no effect on other sections of the instrument.

The Power Supply section, however, affects all other sections of the instrument. Therefore, if repairs or readjustments have been made that change the absolute value of any of the supply voltages, the entire Adjustment Procedure should be performed.

At the beginning of each subsection is a list of all the front-panel control settings required to prepare the instrument for performing Step 1 in that subsection. Each succeeding step within a subsection should be performed in sequence and in its entirety to ensure that control settings will be correct for ensuing steps. All steps within a subsection should be completed.

### TEST EQUIPMENT

The test equipment listed in Table 4-1 is a complete list of the equipment required to accomplish both the "Performance Check Procedure" in section 4 and the "Adjustment Procedure" in this section. To assure accurate measurements, it is important that test equipment used for making these checks meet or exceed the specifications described in

Table 4-1. When considering use of equipment other than that recommended, utilize the "Minimum Specification" column to determine whether available test equipment will suffice.

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.

### 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. Tolerances given are applicable only to the instrument undergoing adjustment and do not include test equipment error. Adjustment of the instrument must be accomplished 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.

### ADJUSTMENT INTERACTION

Some adjustments interact with and affect other adjustment settings. Table 5-1 identifies these interaction areas. Refer to this table if a partial procedure is performed or if a circuit requires readjustment due to a component replacement. To use Table 5-1, 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 column to find the interactive adjustment. Check the accuracy and, if necessary, readjust the adjustment.

### PREPARATION FOR ADJUSTMENT

The instrument cabinet must be removed to perform the Adjustment Procedure. See the "Cabinet" remove and replace instructions located in the "Maintenance" section of the manual.

## Adjustment Procedure—2235 Service

All test equipment items listed in Table 4-1 are required to accomplish a complete Adjustment Procedure. At the beginning of each subsection there is an equipment-required list showing only the test equipment necessary for performing the steps in that subsection. In this list, the item number following each piece of equipment corresponds to the item number listed in Table 4-1.

Before performing this procedure, do not preset any internal adjustments and do not change the -8.6-V power-supply adjustment. Altering this adjustment may necessitate a complete readjustment of the instrument, whereas only a partial adjustment might otherwise be required. Only change

an internal adjustment setting if a Performance Characteristic cannot be met with the original setting. If it is necessary to change the setting of an internal adjustment, check Table 5-1 for possible adjustment interactions.

Before performing any procedure in this section, set the POWER switch to ON and allow a 20-minute warm-up period.

The most accurate display adjustments are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and TRIGGER LEVEL controls as needed to view the display.

Table 5-1  
Adjustment Interactions

Adjustments or Replacements Made	Adjustments Affected																			
	TRACE ALIGNMENT	GEOMETRY	2/5mV DC BALANCE	CH 1 VAR BALANCE	MF/LF GAIN BAL & FREQ COMP	VERTICAL GAIN	ATTENUATOR COMP	DELAY LINE COMP	CH 2 HIGH FREQ MATCH	HORIZ GAIN	HORIZ X10 GAIN	MAGNIFIER REGISTRATION	DELAY DIAL TIMING	HIGH-SPEED TIMING	5ms TIMING AND LINEARITY	TRIGGER OFFSET	TRIGGER SENSITIVITY	SLOPE BALANCE	P-P AUTO TRIGGER CENTERING	
-8.6V POWER SUPPLY																				
TRACE ALIGNMENT	■																			
GEOMETRY		■																		
2/5mV DC BALANCE			■																	
CH 1 VAR BALANCE				■																
MF/LF GAIN BAL & FREQ COMP					■															
VERTICAL GAIN						■														
ATTENUATOR COMP							■													
DELAY LINE COMP								■												
CH 2 HIGH FREQ MATCH									■											
HORIZ GAIN										■										
HORIZ X10 GAIN											■									
MAGNIFIER REGISTRATION												■								
DELAY DIAL TIMING													■							
HIGH-SPEED TIMING														■						
5ms TIMING AND LINEARITY															■					
TRIGGER OFFSET																■				
TRIGGER SENSITIVITY																	■			
SLOPE BALANCE																		■		
P-P AUTO TRIGGER CENTERING																			■	
CRT REPLACEMENT	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

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# POWER SUPPLY AND CRT DISPLAY

## Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)	Digital Voltmeter (Item 10)
Time-Mark Generator (Item 3)	DC Voltmeter (Item 12)
50-Ω BNC Cable (Item 4)	Screwdriver (Item 13)
50-Ω BNC Termination (Item 5)	

See 

at the back of this manual for location of test points and adjustments.

## INITIAL CONTROL SETTINGS

### Vertical

POSITION (both)	Midrange
VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	5 mV
CH 1 VOLTS/DIV Variable	CAL detent
Channel 1 AC-GND-DC	GND

### Horizontal

POSITION	Midrange
HORIZONTAL MODE	A
A SEC/DIV	X-Y
SEC/DIV Variable	CAL detent
X10 Magnifier	Off (knob in)

### A TRIGGER

VAR HOLDOFF	NORM
Mode	P-P AUTO
SLOPE	OUT
LEVEL	Midrange
A&B INT	VERT MODE
A SOURCE	INT

## PROCEDURE STEPS

### 1. Check/Adjust Power Supply DC Levels (R938)

#### NOTE

Review the information at the beginning of the Adjustment Procedure before starting this step.

a. Connect the digital voltmeter low lead to chassis ground and connect the volts lead to the  $-8.6\text{-V}$  supply (TP961).

b. CHECK—Voltmeter reading is  $-8.56$  to  $-8.64\text{ V}$ . If the reading is within these limits, skip to part d.

c. ADJUST—The  $-8.6\text{ V}$  Adj potentiometer (R938) for a voltmeter reading of  $-8.6\text{ V}$ .

d. CHECK—Voltage levels of the remaining power supplies listed in Table 5-2 are within the specified limits.

**Table 5-2**  
**Power Supply Limits**

Power Supply	Test Point	Reading (Volts)
$-8.6\text{ V}$	TP961	$-8.56$ to $-8.64$
$+5.2\text{ V}$	W968	$+5.04$ to $+5.36$
$+8.6\text{ V}$	W960	$+8.43$ to $+8.77$
$+30\text{ V}$	W956	$+29.1$ to $+30.9$
$+100\text{ V}$	W954	$+97.0$ to $+103.0$

e. Disconnect the test equipment from the instrument.

## 2. Check High-Voltage Supply

**WARNING**

*Instrument must be turned off when removing or replacing the crt cover and cap.*

a. Remove the crt cover and cap and connect a dc voltmeter capable of measuring at least  $-2500$  V between pin 2 of the crt socket and chassis ground. Pin 2 of the crt is negative with respect to the chassis.

b. CHECK—Voltmeter reading is between  $-1900$  V and  $-2100$  V.

c. Disconnect the voltmeter leads and replace the crt cap and cover.

## 3. Adjust CRT Grid Bias (R851)

a. Connect a  $50\text{-}\Omega$  termination to the EXT Z AXIS INPUT connector located on the rear panel.

b. Adjust the front-panel FOCUS control to produce a well-defined dot.

c. Rotate the A INTENSITY control fully counter clockwise.

d. ADJUST—Grid Bias (R851) for a visible dot. Then back off the Grid Bias potentiometer until the dot just disappears.

e. Disconnect the  $50\text{-}\Omega$  termination from the EXT Z AXIS INPUT connector.

## 4. Adjust Astigmatism (R874)

a. Set:

A INTENSITY	Visible display
CH 1 VOLTS/DIV	5 mV
Channel 1 AC-GND-DC	DC
A SEC/DIV	5 $\mu$ S

b. Connect  $50\text{-}\mu$ s time markers from the time-mark generator via a  $50\text{-}\Omega$  cable and a  $50\text{-}\Omega$  termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50-kHz, 4-division display.

d. ADJUST—Astig (R874) and the front-panel FOCUS control for the best defined waveform.

e. Disconnect the test equipment from the instrument.

## 5. Adjust Trace Alignment

a. Position the trace to the center horizontal graticule line.

b. ADJUST—The front-panel TRACE ROTATION control for optimum alignment of the trace with the center horizontal graticule line.

## 6. Adjust Geometry (R870)

a. Set:

CH 1 VOLTS/DIV	50 mV
A SEC/DIV	0.1 ms

b. Connect  $50\text{-}\mu$ s time markers from the time-mark generator via a  $50\text{-}\Omega$  cable and a  $50\text{-}\Omega$  termination to the CH 1 OR X input connector.

c. Adjust the Channel 1 POSITION control to position the baseline part of the display below the bottom horizontal graticule line.

d. Adjust the SEC/DIV Variable control for 5 markers per division.

e. ADJUST—Geom (R870) for minimum curvature of the time markers at the left and right edges of the graticule.

f. Set the Channel 1 AC-GND-DC switch to GND.

g. ADJUST—Geom (R870) for minimum curvature of the baseline trace when positioned at the top and bottom horizontal graticule lines using the Channel 1 POSITION control.

h. Set the Channel 1 AC-GND-DC switch to DC.

i. Repeat parts e through h for optimum compromise between the vertical and horizontal displays.

j. Disconnect the test equipment from the instrument.

# VERTICAL

## Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	10X Attenuator (Item 7)
Leveled Sine-Wave Generator (Item 2)	Adapter (Item 9)
50-Ω BNC Cable (Item 4)	Screwdriver (Item 13)
50-Ω BNC Termination (Item 5)	Low-Capacitance Alignment Tool (Item 14)
Dual-Input Coupler (Item 6)	10X Probe (included with instrument)

See



and



at the back of this manual for locations of test points and adjustments.

## INITIAL CONTROL SETTINGS

## PROCEDURE STEPS

### Vertical (Both Channels)

POSITION	Midrange
VERTICAL MODE	CH 1
BW LIMIT	On (button in)
VOLTS/DIV	50 mV
VOLTS/DIV Variable	CAL detent
INVERT	Off (button out)
AC-GND-DC	GND

### 1. Adjust Attenuator Step Balance (R10 and R60)

a. Position the trace on the center horizontal graticule line using the Channel 1 POSITION control.

b. Set the CH 1 VOLTS/DIV switch to 5 mV.

c. ADJUST—Ch 1 Step Bal (R10) to set the trace on the center horizontal graticule line.

d. Set the CH 1 VOLTS/DIV switch to 50 mV.

e. Repeat parts a through d until there is no trace shift when changing the CH 1 VOLTS/DIV switch from 50 mV to 5 mV.

f. Set the VERTICAL MODE switch to CH 2.

g. Repeats parts a through e for Channel 2, adjusting Ch 2 Step Bal (R60) in part c.

### Horizontal

POSITION	Midrange
HORIZONTAL MODE	A
A SEC/DIV	0.5 ms
SEC/DIV Variable	CAL detent
X10 Magnifier	Off (knob in)

### A TRIGGER

VAR HOLDOFF	NORM
Mode	P-P AUTO
SLOPE	OUT
LEVEL	Midrange
A&B INT	VERT MODE
A SOURCE	INT
A EXT COUPLING	AC

**2. Adjust 2/5 mV DC Balance (R33 and R83)**

- a. Set the CH 2 VOLTS/DIV switch to 5 mV.
- b. Position the trace on the center horizontal graticule line using the Channel 2 POSITION control.
- c. Set the CH 2 VOLTS/DIV switch to 2 mV.
- d. ADJUST—Ch 2 2/5 mV Dc Bal (R83) to set the trace on the center horizontal graticule line.
- e. Repeat parts a through d until there is no trace shift when changing the CH 2 VOLTS/DIV switch from 5 mV to 2 mV.
- f. Set the VERTICAL MODE switch to CH 1.
- g. Repeat parts a through e for Channel 1, adjusting Ch 1 2/5 mV Dc Bal (R33) in part d.

**3. Adjust Channel 1 Variable Balance (R25)**

- a. Set both VOLTS/DIV switches to 10 mV.
- b. Rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise.
- c. Position the trace on the center horizontal graticule line using the Channel 1 POSITION control.
- d. Rotate the CH 1 VOLTS/DIV Variable control clockwise to the CAL detent.
- e. ADJUST—Ch 1 Var Bal (R25) to set the trace to the center horizontal graticule line.
- f. Repeat parts b through e until there is no trace shift between the fully clockwise and the fully counterclockwise positions of the CH 1 VOLTS/DIV Variable control.
- g. Return the CH 1 VOLTS/DIV Variable control to the CAL detent.

**4. Adjust Channel 2 Invert Balance (R75)**

- a. Set the VERTICAL MODE switch to CH 2.

- b. Position the trace on the center horizontal graticule line using the Channel 2 POSITION control.
- c. Set the INVERT button to On (button in).
- d. ADJUST—Ch 2 Invert Bal (R75) to set the trace to the center horizontal graticule line.
- e. Set the INVERT button to Off (button out).
- f. Repeat parts b through e until there is no trace shift when switching the INVERT button between the On and Off positions.
- g. Repeat Steps 2 and 3 for Channel 1 until no further improvement is noted.
- h. Repeat Steps 2 and 4 for Channel 2 until no further improvement is noted.

**5. Adjust MF/LF Compensation and Gain Balance (C53, R97, C3, and R47).**

- a. Set:

VERTICAL MODE	CH 2
VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	DC
A SEC/DIV	20 $\mu$ s

- b. Connect the high-amplitude square wave output via a 50- $\Omega$  cable, a 10X attenuator, and a 50- $\Omega$  termination to the CH 2 OR Y input connector.
- c. Set the generator to produce a 10-kHz, 5-division display.
- d. Set the top of the display on the center horizontal graticule line using the Channel 2 POSITION control.
- e. ADJUST—Ch 2 MF/LF Comp (C53) and Ch 2 MF/LF Gain Bal (R97) for the best front corner and flat top.
- f. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the VERTICAL MODE switch to CH 1.

- g. Set the top of the display on the center horizontal graticule line using the Channel 1 POSITION control.

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h. ADJUST—Ch 1 MF/LF Comp (C3) and Ch 1 MF/LF Gain Bal (R47) for the best front corner and flat top.

i. Disconnect the test equipment from the instrument.

### 6. Adjust Vertical Gain (R145, R195, R76, and R26)

a. Connect a 50-mV standard-amplitude signal via a 50- $\Omega$  cable to the CH 1 OR X input connector.

b. Set the A SEC/DIV switch to 0.2 ms.

c. ADJUST—Ch 1 Gain (R145) for an exact 5-division display.

d. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

e. ADJUST—Ch 2 Gain (R195) for an exact 5-division display.

f. Change the generator output to 10 mV and set both VOLTS/DIV switches to 2 mV.

g. ADJUST—Ch 2 2-mV Gain (R76) for an exact 5-division display.

h. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the VERTICAL MODE switch to CH 1.

i. ADJUST—Ch 1 2-mV Gain (R26) for an exact 5-division display.

j. Set both AC-GND-DC switches to GND.

k. CHECK—That no trace shift occurs when switching between the 5 mV and 2 mV positions of the CH 1 VOLTS/DIV switch. If trace shift is observed, repeat Step 2 of this procedure.

l. Set the VERTICAL MODE switch to CH 2.

m. CHECK—That no trace shift occurs when switching between the 5 mV and 2 mV positions of the CH 2

VOLTS/DIV switch. If trace shift is observed, repeat Step 2 of this procedure.

### 7. Check Deflection Accuracy and Variable Range

a. Set:

VERTICAL MODE	CH 1
AC-GND-DC (both)	DC

b. CHECK—Deflection accuracy is within the limits given in Table 5-3 for each CH 1 VOLTS/DIV switch setting and corresponding standard-amplitude signal. When at the 20-mV VOLTS/DIV switch setting, rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise and CHECK that the display decreases to 2 divisions or less. Then return the CH 1 VOLTS/DIV Variable control to the CAL detent and continue with the 50-mV check.

**Table 5-3**  
**Deflection Accuracy Limits**

VOLTS/DIV Switch Setting	Standard Amplitude Signal	Vertical Deflection (Divisions)	Accuracy Limits (Divisions)
2 mV	10 mV	5	4.90 to 5.10
5 mV	20 mV	4	3.92 to 4.08
10 mV	50 mV	5	4.90 to 5.10
20 mV	0.1 V	5	4.90 to 5.10
50 mV	0.2 V	4	3.92 to 4.08
0.1 V	0.5 V	5	4.90 to 5.10
0.2 V	1 V	5	4.90 to 5.10
0.5 V	2 V	4	3.92 to 4.08
1 V	5 V	5	4.90 to 5.10
2 V	10 V	5	4.90 to 5.10
5 V	20 V	4	3.92 to 4.08

c. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

d. Repeat part b using the Channel 2 controls.

### 8. Check Input Coupling

a. Set both VOLTS/DIV switches to 10 mV.



b. Set the calibration generator to produce a 20-mV signal.

c. Set the bottom of the signal on the center horizontal graticule line using the Channel 2 POSITION control.

d. Set the Channel 2 AC-GND-DC switch to AC.

e. CHECK—Display is centered about the center horizontal graticule line.

f. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the VERTICAL MODE switch to CH 1.

g. Repeat parts c through e using the Channel 1 controls.

h. Disconnect the test equipment from the instrument.

### 9. Adjust Attenuator Compensation (C12, C11, C5, C4, C62, C61, C55, and C54)

a. Set both AC-GND-DC switches to DC.

b. Connect the high-amplitude square wave output via a 50- $\Omega$  termination, a probe-tip-to-BNC adapter, and the 10X probe to the CH 1 OR X input connector.

c. Set the generator to produce a 1-kHz, 5-division display and compensate the probe using the probe compensation adjustment (see the probe instruction manual).

d. Set the CH 1 VOLTS/DIV switch to 0.1 V.

e. Replace the probe and probe-tip-to-BNC adapter with a 50- $\Omega$  cable.

f. Set the generator to produce a 5-division display.

#### NOTE

*Use Table 5-4 to identify the correct capacitor for each channel adjustment.*

g. ADJUST—The 10X LF Comp capacitor for best front corner.

**Table 5-4**  
**Attenuator Compensation Adjustments**

Adjustment	Channel 1	Channel 2
10X LF Comp	C12	C62
10X Input C	C11	C61
100X LF Comp	C5	C55
100X Input C	C4	C54

h. Replace the 50- $\Omega$  cable and 50- $\Omega$  termination with the probe and probe-tip-to-BNC adapter.

i. Set the generator to produce a 5-division display.

j. ADJUST—The 10X Input C capacitor for best flat top.

k. Repeat parts e through j until no further improvement is noted.

l. Set the CH 1 VOLTS/DIV switch to 1 V.

m. Replace the probe and probe-tip-to-BNC adapter with the 50- $\Omega$  cable and 50- $\Omega$  termination.

n. Set the generator to produce a 5-division display.

o. ADJUST—The 100X LF Comp capacitor for best front corner.

p. Replace the 50- $\Omega$  cable and 50- $\Omega$  termination with the probe and probe-tip-to-BNC adapter.

q. Set the generator to produce a 5-division display.

r. ADJUST—The 100X Input C capacitor for best flat top.

s. Repeat parts m through r until no further improvement is noted.

t. Set the VERTICAL MODE switch to CH 2.

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- u. Repeat parts b through s for Channel 2.
- v. Disconnect the test equipment from the instrument.

### 10. Check Alternation Operation

a. Set:

VERTICAL MODE	BOTH and ALT
AC-GND-DC (both)	GND
A and B SEC/DIV	50 ms
A&B INT	CH 1

b. Position the Channel 1 and Channel 2 traces about 2 divisions apart using the Channel 1 and Channel 2 POSITION controls.

c. CHECK—Sweeps alternate for all the A SEC/DIV switch settings.

#### NOTE

*At sweep speeds of 2 ms per division or faster, the trace alternations occur too rapidly to be observed.*

### 11. Check Chop Operation

a. Set:

VERTICAL MODE	BOTH and CHOP
A SEC/DIV	1 $\mu$ s
A&B INT	VERT MODE
A SOURCE	EXT

b. Connect the 10X probe to the EXT INPUT connector.

c. Connect the 10X probe tip to TP537.

d. CHECK—Period of one complete square-wave cycle is between 1.6 and 2.6 horizontal divisions.

e. Disconnect the 10X probe from TP537 and the EXT INPUT connector.

f. CHECK—Two traces are visible for all A SEC/DIV switch settings.

### 12. Adjust High-Frequency Compensation (C237), Delay Line Compensation (R240 and R241), and Channel 2 High-Frequency Compensation (C180)

a. Set:

VERTICAL MODE	CH 1
BW LIMIT	Off (button out)
VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	DC
A SEC/DIV	0.05 $\mu$ s
A SOURCE	INT

b. Connect the positive-going fast-rise square wave output via a 50- $\Omega$  cable, a 10X attenuator, and a 50- $\Omega$  termination to the CH 1 OR X input connector.

c. Set the generator to produce a 1-MHz, 5-division display.

d. Set the top of the display to the center horizontal graticule line using the Channel 1 POSITION control.

e. ADJUST—HF Peak Comp (C237) for 2% overshoot (0.1 division) on the displayed signal.

f. ADJUST—DL Comp1 (R240) and DL Comp2 (R241) for best flat top on the front corner.

g. Repeat parts e and f until no further improvement is noted.

h. Set the CH 1 VOLTS/DIV switch to 5 mV.

i. Set the generator to produce a 5-division display.

j. CHECK—Display aberrations are within  $\pm 4\%$  (0.2 division or less).

k. Repeat part j for each of the following CH 1 VOLTS/DIV switch settings: 5 mV through 0.5 V. Adjust the generator output and add or remove the 10X attenuator as necessary to maintain a 5-division display at each VOLTS/DIV switch setting.

l. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

m. Adjust the generator to produce a 5-division display.

n. Set the top of the display to the center horizontal graticule line using the Channel 2 POSITION control.

o. ADJUST—Ch 2 High-Freq Comp (C180) for 2% overshoot (0.1 division) on the displayed signal.

p. Set the CH 2 VOLTS/DIV switch to 5 mV.

q. Repeat parts i through k for Channel 2.

### 13. Adjust 2-mV Peaking Compensation (C76 and C26)

a. Set both VOLTS/DIV switches to 2 mV.

b. Set the generator to produce a 5-division display.

c. Set the top of the display to the center horizontal graticule line using the Channel 2 POSITION control.

d. ADJUST—Ch 2 2-mV Peak Comp (C76) for 2% overshoot of the displayed signal.

e. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the VERTICAL MODE switch to CH 1.

f. Repeat parts b through d for Channel 1, adjusting Ch 1 2-mV Peak Comp (C26) in part d.

g. Disconnect the test equipment from the instrument.

### 14. Check Trigger View Gain

a. Set:

VOLTS/DIV (both)	0.1 V
A SEC/DIV	0.2 ms

b. Connect a 0.5-V standard-amplitude signal via a 50-Ω cable to the CH 1 OR X input connector.

c. While holding in the TRIG VIEW button, use the A TRIGGER LEVEL control to vertically center the display.

d. CHECK—Display amplitude is 4 to 6 divisions while holding in the TRIG VIEW button.

e. Move the cable from CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

f. Repeat parts c and d.

g. Move the cable from the CH 2 OR Y input connector to the EXT INPUT connector. Set the A SOURCE switch to EXT.

h. Repeat parts c and d.

i. Set the A EXT COUPLING switch to DC.

j. Repeat parts c and d.

k. Set the A EXT COUPLING switch to DC ÷ 10.

l. Set the generator to produce a 5-V signal.

m. Repeat parts c and d.

### 15. Check Position Range

a. Set:

VOLTS/DIV (both)	50 mV
AC-GND-DC (both)	AC
A SOURCE	INT

b. Move the cable from the EXT INPUT connector to the CH 1 OR X input connector.

c. Set the generator to produce a 0.5-V signal.

d. Adjust the CH 2 VOLTS/DIV Variable control to produce a 4.4-division display. Set the CH 2 VOLTS/DIV switch to 10 mV.

e. CHECK—The bottom and top of the trace may be positioned above and below the center horizontal graticule

## Adjustment Procedure—2235 Service

line by rotating the Channel 2 POSITION control fully clockwise and counterclockwise respectively.

f. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the VERTICAL MODE switch to CH 1.

g. Repeat parts d and e using the Channel 1 controls.

h. Disconnect the test equipment from the instrument.

### NOTE

*Install the instrument cabinet for the remaining vertical checks and allow a 20-minute warm-up period before continuing with the Adjustment Procedure. See the "Cabinet" remove and replace instructions located in the "Maintenance" section of the manual.*

## 16. Check Bandwidth Limit Operation

a. Set:

Vertical POSITION (both)	Midrange
BW LIMIT	On (button in)
VOLTS/DIV Variable (both)	CAL detent
AC-GND-DC (both)	DC
A SEC/DIV	20 $\mu$ s

b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50-kHz, 6-division display.

d. Increase the generator output frequency until the display amplitude decreases to 4.2 divisions.

e. CHECK—Generator output frequency is between 18 MHz and 22 MHz.

## 17. Check Bandwidth

a. Set:

BW LIMIT	Off (button out)
VOLTS/DIV (both)	2 mV

b. Set the generator to produce a 50-kHz, 6-division display.

c. CHECK—Display amplitude is 4.2 divisions or greater as the generator output frequency is increased up to the value shown in Table 5-5 for the corresponding VOLTS/DIV switch setting.

**Table 5-5**  
**Settings for Bandwidth Checks**

VOLTS/DIV Switch Setting	Generator Output Frequency
2 mV	90 MHz
5 mV to 5 V	100 MHz

d. Repeat parts b and c for all indicated CH 1 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.

e. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

f. Repeat parts b and c for all indicated CH 2 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.

## 18. Check Channel Isolation

a. Set:

VOLTS/DIV (both)	1 V
Channel 1 AC-GND-DC	GND
A SEC/DIV	0.1 $\mu$ s

b. Set the generator to produce a 50-MHz, 5-division display.

c. Set the VERTICAL MODE switch to CH 1.

d. CHECK—Display amplitude is 0.05 division or less.

e. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

f. Set:

VERTICAL MODE	CH 2
Channel 1 AC-GND-DC	DC
Channel 2 AC-GND-DC	GND

- g. CHECK—Display amplitude is 0.05 division or less.
- h. Disconnect the test equipment from the instrument.

### 19. Check Common-Mode Rejection Ratio

a. Set:

VOLTS/DIV (both)	10 mV
INVERT	On (button in)
Channel 2 AC-GND-DC	DC

b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable, a 50- $\Omega$  termination, and a dual-input coupler to the CH 1 OR X and CH 2 OR Y input connectors.

c. Set the generator to produce a 50-MHz, 6-division display.

d. Vertically center the display using the Channel 2 POSITION control. Then set the VERTICAL MODE switch to CH 1 and vertically center the display using the Channel 1 POSITION control.

e. Set the VERTICAL MODE switches to BOTH and ADD.

f. CHECK—Display amplitude is 0.6 division or less.

g. If the check in part f meets the requirement, skip to part p. If it does not, continue with part h.

h. Set the VERTICAL MODE switch to CH 1.

i. Set the generator to produce a 50-kHz, 6-division display.

j. Set the VERTICAL MODE switch to BOTH.

k. Adjust the CH 1 or CH 2 VOLTS/DIV Variable control for minimum display amplitude.

l. Set the VERTICAL MODE switch to CH 1.

m. Set the generator to produce a 50-MHz, 6-division display.

n. Set the VERTICAL MODE switch to BOTH.

o. CHECK—Display amplitude is 0.6 division or less.

p. Disconnect the test equipment from the instrument.

### 20. Check Input Gate Current

a. Set:

VERTICAL MODE	CH 1
VOLTS/DIV (both)	2 mV
VOLTS/DIV Variable (both)	CAL detent
AC-GND-DC (both)	GND

b. Position the trace on the center horizontal graticule line using the Channel 1 POSITION control.

c. CHECK—For 0.1 division or less trace shift while alternating the Channel 1 AC-GND-DC switch between the AC and GND positions.

d. Set the VERTICAL MODE switch to CH 2.

e. Repeat parts b and c using the Channel 2 controls.



#### NOTE

*To continue with the Adjustment Procedure, remove the instrument cabinet and allow a 20-minute time period to elapse before continuing with the Adjustment Procedure. See the "Cabinet" removal instructions located in the "Maintenance" section of the manual.*

# HORIZONTAL

**Equipment Required (see Table 4-1):**

Calibration Generator (Item 1)	50-Ω BNC Termination (Item 5)
Leveled Sine-Wave Generator (Item 2)	Test Oscilloscope (Item 11)
Time-Mark Generator (Item 3)	Screwdriver (Item 13)
50-Ω Cable (Item 4)	Low-Capacitance Alignment Tool (Item 14)

See  and   
 at the back of the manual for test points and adjustments locations.

## INITIAL CONTROL SETTINGS

## PROCEDURE STEPS

### Vertical

POSITION (both)	Midrange
VERTICAL MODE	CH 1
BW LIMIT	Off (button out)
CH 1 VOLTS/DIV	0.5 V
CH 1 VOLTS/DIV Variable	CAL detent
Channel 1 AC-GND-DC	DC

### Horizontal

POSITION	Midrange
HORIZONTAL MODE	A
A and B SEC/DIV	0.1 ms
SEC/DIV Variable	CAL detent
X10 Magnifier	Off (knob in)
B DELAY TIME POSITION	Fully counterclockwise

### B TRIGGER

SLOPE	OUT
LEVEL	Fully clockwise

### A TRIGGER

VAR HOLDOFF	NORM
Mode	P-P AUTO
SLOPE	OUT
LEVEL	Midrange
A&B INT	VERT MODE
A SOURCE	INT

### 1. Adjust Horizontal Amplifier Gain (R740 and R730)

a. Connect 0.1-ms time markers from the time-mark generator via a 50-Ω cable and a 50-Ω termination to the CH 1 OR X input connector.

b. Align the first time marker with the first (extreme left) vertical graticule line using the Horizontal POSITION control.

c. ADJUST—A Sweep Gain (R740) for 1 time marker per division over the center 8 divisions.

**NOTE**

*When making timing measurements, use as a reference the tips of the time markers positioned at the center horizontal graticule line.*

d. Set the HORIZONTAL MODE switch to B.

e. ADJUST—B Sweep Gain (R730) for 1 time marker per division.

**2. Adjust X10 Horizontal Amplifier Gain (R754)**

a. Set:

HORIZONTAL MODE	A
X10 Magnifier	On (knob out)

b. Select 10- $\mu$ s time markers from the time-mark generator.

c. Align the nearest time marker to the first vertical graticule line with the first graticule line.

d. ADJUST—X10 Gain (R754) for 1 time marker per division.

**3. Adjust Magnifier Registration (R749)**

a. Set the A SEC/DIV switch to 0.2 ms.

b. Select 1-ms time markers from the time-mark generator.

c. Position the middle time marker to the center vertical graticule line using the Horizontal POSITION control.

d. Set the X10 Magnifier to Off (knob in).

e. ADJUST—Mag Regis (R749) to position the middle time marker to the center vertical graticule line.

f. Set the X10 Magnifier to On (knob out) and CHECK for no horizontal shift in the time marker.

g. Repeat parts c through f until no further improvement is noted.

**4. Check Sweep Length**

a. Set:

Channel 1 AC-GND-DC	GND
X10 Magnifier	Off (knob in)

b. Position the start of the sweep at the first vertical graticule line using the Horizontal POSITION control.

c. CHECK—End of the sweep is to the right of the 11th vertical graticule line.

**5. Check Position Range**

a. Set:

Channel 1 AC-GND-DC	DC
A SEC/DIV	10 $\mu$ s

b. Select 10- $\mu$ s time markers from the time-mark generator.

c. CHECK—Start of the sweep can be positioned to the right of the center vertical graticule line by rotating the Horizontal POSITION control fully clockwise.

d. CHECK—The 11th time marker can be positioned to the left of the center vertical graticule line by rotating the Horizontal POSITION control fully counterclockwise.

e. Select 50- $\mu$ s time markers from the time-mark generator.

f. Align the 3rd time marker with the center vertical graticule line using the Horizontal POSITION control.

g. Set the X10 Magnifier to On (knob out).

h. CHECK—Magnified time marker can be positioned to the left of the center vertical graticule line by rotating the Horizontal POSITION control fully counterclockwise.

i. CHECK—Start of the sweep can be positioned to the right of the center vertical graticule line by rotating the Horizontal POSITION control fully clockwise.

**6. Check Variable Range**

a. Set:

Horizontal POSITION	Midrange
A SEC/DIV	0.2 ms
SEC/DIV Variable	Fully counterclockwise
X10 Magnifier	Off (knob in)

b. Select 0.5-ms time markers from the time-mark generator.

c. CHECK—Time markers are 1 division or less apart.

### 7. Adjust Delay Dial Timing (R646 and R652)

a. Set:

HORIZONTAL MODE	ALT
A SEC/DIV	0.1 ms
B SEC/DIV	1 $\mu$ s
SEC/DIV Variable	CAL detent
B DELAY TIME POSITION	1.00

b. Select 0.1-ms time markers from the time-mark generator.

c. Adjust the A/B SWP SEP control to separate the A and B Sweeps.

d. ADJUST—Delay Start (R646) so that the 2nd A-Sweep time marker is intensified and the B-Sweep time marker's rising edge starts at the beginning of the B Sweep.

e. Set the B DELAY TIME POSITION dial to 9.00.

f. ADJUST—Delay End (R652) so that the 10th A-Sweep time marker is intensified and the B-Sweep time marker's rising edge starts at the beginning of the B Sweep.

g. Set the B DELAY TIME POSITION dial to 1.00.

h. Repeat parts d through g until no further improvement is noted.

### 8. Adjust High-Speed Timing (C703 and C713)

a. Set:

HORIZONTAL MODE	A
A SEC/DIV	0.1 $\mu$ s

b. Select 0.1- $\mu$ s time markers from the time-mark generator.

c. ADJUST—A High Speed Timing (C703) for 1 time marker per division over the center 8 divisions.

d. Set:

HORIZONTAL MODE	B
A SEC/DIV	0.2 $\mu$ s
B SEC/DIV	0.1 $\mu$ s

e. ADJUST—B High Speed Timing (C713) for 1 time marker per division over the center 8 divisions.

### 9. Adjust 5-ns Timing and Linearity (C775 and C785)

a. Set:

CH 1 VOLTS/DIV	0.2 V
HORIZONTAL MODE	A
A SEC/DIV	0.05 $\mu$ s
X10 Magnifier	On (knob out)

b. Select 10-ns time markers from the time-mark generator.

c. Align the time markers with the vertical graticule lines using the Horizontal POSITION control.

d. ADJUST—5-ns Timing (C775 and C785 alternately) for one time marker every 2 divisions over the center 8 divisions of the magnified sweep.

e. CHECK—Time markers between the 2nd and 4th vertical graticule lines should be aligned within 0.05 division. If not, a slight compromise between timing and linearity should be made by readjusting the 5-ns Timing capacitors (C775 and C785).

### 10. Check Timing Accuracy and Linearity

a. Set:

CH 1 VOLTS/DIV	0.5 V
X10 Magnifier	Off (knob in)
A TRIGGER Mode	NORM

b. Select 50-ns time markers from the time-marker generator.

c. Adjust the A TRIGGER LEVEL control for a stable, triggered display.

d. Use the Horizontal POSITION control to align the second time marker with the second vertical graticule line.

e. CHECK—Timing accuracy is within 2% (0.16 division at the 10th vertical graticule line), and linearity is within 5% (0.1 division over any 2 of the center 8 divisions).



**Table 5-6**  
**Settings for Timing Accuracy Checks**

SEC/DIV Switch Setting	Time-Mark Generator Setting	
	Normal	X10 Magnified
0.05 $\mu$ s	50 ns	10 ns
0.1 $\mu$ s	0.1 $\mu$ s	10 ns
0.2 $\mu$ s	0.2 $\mu$ s	20 ns
0.5 $\mu$ s	0.5 $\mu$ s	50 ns
1 $\mu$ s	1 $\mu$ s	0.1 $\mu$ s
2 $\mu$ s	2 $\mu$ s	0.2 $\mu$ s
5 $\mu$ s	5 $\mu$ s	0.5 $\mu$ s
10 $\mu$ s	10 $\mu$ s	1 $\mu$ s
20 $\mu$ s	20 $\mu$ s	2 $\mu$ s
50 $\mu$ s	50 $\mu$ s	5 $\mu$ s
0.1 ms	0.1 ms	10 $\mu$ s
0.2 ms	0.2 ms	20 $\mu$ s
0.5 ms	0.5 ms	50 $\mu$ s
1 ms	1 ms	0.1 ms
2 ms	2 ms	0.2 ms
5 ms	5 ms	0.5 ms
10 ms	10 ms	1 ms
20 ms	20 ms	2 ms
50 ms	50 ms	5 ms
A Sweep Only		
0.1 s	0.1 s	10 ms
0.2 s	0.2 s	20 ms
0.5 s	0.5 s	50 ms

**NOTE**

*For checking the timing accuracy of the A SEC/DIV switch settings from 50 ms to 0.5 s, watch the time marker tips only at the 2nd and 10th vertical graticule lines while adjusting the Horizontal POSITION control.*

f. Repeat parts c through e for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 5-6 under the "Normal" column.

g. Set the X10 Magnifier to On (knob out).

h. Select 50-ms time markers from the time-mark generator when checking the A Sweep and 5-ms time markers when checking the B Sweep.

i. Use the Horizontal POSITION control to align the first time marker that is 25 ns beyond the start of the sweep with the second vertical graticule line.

j. CHECK—Timing accuracy is within 3% (0.24 division at the 10th vertical graticule line), and linearity is within 5% (0.1 division over any 2 of the center 8 divisions). Exclude any portion of the sweep past the 100th magnified division.

k. Repeat parts i and j for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 5-6 under the "X10 Magnified" column.

i. Set:

HORIZONTAL MODE	B
A SEC/DIV	0.1 $\mu$ s
B SEC/DIV	0.05 $\mu$ s
X10 Magnifier	Off (knob in)

m. Repeat parts b through k for the B Sweep. Keep the A SEC/DIV switch one setting slower than the B SEC/DIV switch.

**11. Check Delay Time Dial Range and Accuracy**

a. Set:

Channel 1 AC-GND-DC	GND
HORIZONTAL MODE	ALT
A and B SEC/DIV	0.2 ms
X10 Magnifier	Off (knob in)
B DELAY TIME POSITION	Fully counterclockwise
A TRIGGER Mode	P-P AUTO

b. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.

c. CHECK—Intensified portion of the trace starts within 0.5 division of the start of the sweep.

d. Rotate the B DELAY TIME POSITION control fully clockwise.

e. CHECK—Intensified portion of the trace is past the 11th vertical graticule line.

f. Set:

A and B SEC/DIV	0.5 $\mu$ s
B DELAY TIME POSITION	Fully counterclockwise

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g. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.

h. CHECK—Intensified portion of the trace starts within 1.1 divisions of the start of the sweep.

i. Repeat parts d and e.

j. Set:

Channel 1 AC-GND-DC	DC
HORIZONTAL MODE	B
A SEC/DIV	0.5 $\mu$ s
B SEC/DIV	0.05 $\mu$ s
B DELAY TIME POSITION	1.00

k. Select 0.5- $\mu$ s time markers from the time-mark generator.

l. Adjust the Horizontal POSITION control so that the top of the first fully displayed time marker is aligned with the center vertical graticule line.

m. Without changing the Horizontal POSITION control setting, set the B DELAY TIME POSITION dial to 9.00. Slightly readjust the B DELAY TIME POSITION dial to align the top of the time marker with the center vertical graticule line.

n. CHECK—The B DELAY TIME POSITION dial setting is between 8.905 and 9.095.

o. Repeat parts l through n for the remaining A and B SEC/DIV and time-mark generator setting combinations shown in Table 5-7.

**Table 5-7**  
**Settings for Delay Time Accuracy Checks**

A SEC/DIV Switch Setting	B SEC/DIV Switch Setting	Time-Mark Generator Setting
0.5 $\mu$ s	0.05 $\mu$ s	0.5 $\mu$ s
5 $\mu$ s	0.5 $\mu$ s	5 $\mu$ s
0.5 ms	50 $\mu$ s	0.5 ms
5 ms	0.5 ms	5 ms
0.5 s	50 ms	0.5 s

p. Set:

A SEC/DIV	5 $\mu$ s
B SEC/DIV	0.5 $\mu$ s
B DELAY TIME POSITION	1.00

q. Select 5- $\mu$ s time markers from the time-mark generator.

r. Adjust the Horizontal POSITION control so that the rising edge of the displayed time marker is aligned with the center vertical graticule line.

s. Without changing the Horizontal POSITION control setting, turn the B DELAY TIME POSITION dial clockwise to position the next time marker leading edge to the center vertical graticule line.

t. CHECK—The B DELAY TIME POSITION dial setting is 0.975 to 1.025 greater than the previous setting.

u. Set the B DELAY TIME POSITION dial to the exact integer setting.

v. Repeat parts r through u for each successive time marker up to the marker corresponding to the B DELAY TIME POSITION dial setting of 10.00.

## 12. Check Delay Jitter

a. Set:

A SEC/DIV	0.5 ms
B SEC/DIV	0.5 $\mu$ s
B DELAY TIME POSITION	10.00

b. Select 50- $\mu$ s time markers from the time-mark generator.

c. Rotate the B DELAY TIME POSITION dial counter-clockwise to position a time marker within the graticule area for each major dial division and CHECK that the jitter on the leading edge does not exceed 0.5 division. Disregard slow drift.

d. Disconnect the test equipment from the instrument.

**13. Check Sweep Separation**

a. Set:

HORIZONTAL MODE	ALT
A and B SEC/DIV	0.5 ms

b. Use the Channel 1 POSITION control to set the A Sweep at the center horizontal graticule line.

c. CHECK—The B Sweep can be positioned more than 3.5 divisions above and below the A Sweep when the A/B SWP SEP control is rotated fully clockwise and counter-clockwise respectively.

**14. Adjust X Gain (R760)**

a. Set:

CH 1 VOLTS/DIV	10 mV
A SEC/DIV	X-Y

b. Connect a 50-mV standard-amplitude signal via a 50- $\Omega$  cable to the CH 1 or X input connector.

c. ADJUST—X Gain (R760) for exactly 5-divisions of horizontal deflection.

d. Disconnect the test equipment from the instrument.

**15. Check X Bandwidth**

a. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 OR X input connector.

b. Set the generator to produce a 5-division horizontal display at an output frequency of 50 kHz.

c. Increase the generator output frequency to 3 MHz.

d. CHECK—Display is at least 3.5 horizontal divisions.

e. Disconnect the test equipment from the instrument.

**16. Check A-Sweep Holdoff**

a. Set:

HORIZONTAL MODE	A
A SEC/DIV	1 ms
VAR HOLDOFF	NORM

b. Connect the test oscilloscope and its 10X probe tip to the front end of R707 (toward the front panel) which is located on the Timing circuit board.

c. CHECK—The A-Sweep holdoff is greater than 3 ms but less than 7 ms.

d. Rotate the VAR HOLDOFF control to the maximum clockwise position (MAX).

e. CHECK—The A-Sweep holdoff has increased by a factor of 10 or more.

f. Disconnect the test oscilloscope 10X probe from R707.

# TRIGGER

## Equipment Required (see Table 4-1):

Leveled Sine-Wave Generator (Item 2)	10X Attenuator (Item 7)
50- $\Omega$ BNC Cable (Item 4)	Digital Voltmeter (Item 12)
50- $\Omega$ BNC Termination (Item 5)	Screwdriver (Item 13)

See 

at the back of this manual for test points and adjustment locations.

## INITIAL CONTROL SETTINGS

## PROCEDURE STEPS

### Vertical (Both Channels)

POSITION	Midrange
VERTICAL MODE	BOTH-ALT
BW LIMIT	Off (button out)
VOLTS/DIV	0.5 V
VOLTS/DIV Variable	CAL detent
INVERT	Off (button out)
AC-GND-DC	GND

### Horizontal

POSITION	Midrange
HORIZONTAL MODE	A
A and B SEC/DIV	1 ms
SEC/DIV Variable	CAL detent
X10 Magnifier	Off (knob in)
B DELAY TIME POSITION	Fully counterclockwise

### B TRIGGER

SLOPE	OUT
LEVEL	Midrange

### A TRIGGER

VAR HOLDOFF	NORM
Mode	P-P AUTO
SLOPE	OUT
LEVEL	Midrange
A&B INT	CH 2
A SOURCE	INT
A EXT COUPLING	DC

### 1. Adjust Trigger Offset (R309)

a. Set the Channel 1 trace and the Channel 2 trace to the center horizontal graticule line using the Channel 1 and Channel 2 POSITION controls.

b. Connect the digital voltmeter low lead to chassis ground and the high (volts) lead to W4000-1 (Alt Sweep Logic circuit board connector to the Main circuit board).

c. CHECK—The offset voltage reading is less than 80 mV. Note the reading for use in part e.

d. Set the A&B INT switch to CH 1.

e. ADJUST—Trigger Offset (R309) so that the voltage reading is the same as that obtained in part c.

f. Set the A&B INT switch to CH 2.

g. Repeat parts c through f until there is 1 mV or less difference in the voltmeter readings between the CH 1 and CH 2 positions of the A&B INT switch.

### 2. Adjust Trigger Sensitivity (R479)

a. Set:

VERTICAL MODE	CH 1
CH 1 VOLTS/DIV	0.1 V
AC-GND-DC (both)	AC
A SEC/DIV	10 $\mu$ S

b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50-kHz, 2.2-division display.

d. Set the CH 1 VOLTS/DIV switch to 1 V.

e. ADJUST—Trigger Sensitivity (R479) while rotating the A TRIGGER LEVEL control slowly so that the A Trigger is just able to be maintained.

### 3. Adjust Slope Balance (R471)

a. Set the CH 1 VOLTS/DIV switch to 50 mV.

b. Set the generator to produce a 4-division display.

c. ADJUST—Slope Bal (R471) for a downward vertical shift of 0.22-division at the start of the sweep when changing the A TRIGGER SLOPE switch between the OUT and IN positions.

### 4. Adjust P-P Auto Trigger Centering (R434 and R435)

a. Set:

A TRIGGER SLOPE           OUT  
A TRIGGER LEVEL           Fully clockwise

b. Set the generator to produce a 50-kHz, 5-division display.

c. Set the CH 1 VOLTS/DIV switch to 0.5 V.

d. ADJUST—(+ ) Auto (R434) so that the vertical display just solidly triggers on the positive peak of the signal.

e. Set:

A TRIGGER SLOPE           IN  
A TRIGGER LEVEL           Fully counterclockwise

f. ADJUST—(- ) Auto (R435) so that the display just solidly triggers on the negative peak of the signal.

### 5. Check Internal Triggering

a. Set:

CH 1 VOLTS/DIV           5 mV  
CH 2 VOLTS/DIV           50 mV  
A and B SEC/DIV           0.2  $\mu$ s  
A&B INT                    CH 1

b. Set the generator to produce a 10-MHz, 3-division display.

c. Set the CH 1 VOLTS/DIV switch to 50 mV.

d. CHECK—Stable display can be obtained by adjusting the A TRIGGER LEVEL control for each switch combination given in Table 5-8.

Table 5-8  
Switch Combinations for A Triggering Checks

A TRIGGER Mode	A TRIGGER SLOPE
NORM	OUT
NORM	IN
P-P AUTO	IN
P-P AUTO	OUT

e. Set the HORIZONTAL MODE switch to B.

f. CHECK—Stable display can be obtained by adjusting the B TRIGGER LEVEL control in a position other than the B RUNS AFTER DLY position for both the OUT and IN positions of the B TRIGGER SLOPE switch.

g. Set:

VERTICAL MODE            CH 2  
HORIZONTAL MODE         A  
A&B INT                    CH 2

h. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector.

i. Repeat parts d through f.

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j. Set:

HORIZONTAL MODE	A
A SEC/DIV	0.1 $\mu$ s
X10 Magnifier	On (knob out)

k. Set the generator to produce a 60-MHz, 1.0-division display.

l. Repeat parts d through f.

m. Set:

VERTICAL MODE	CH 1
HORIZONTAL MODE	A
A&B INT	VERT MODE

n. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

o. Repeat parts d through f.

p. Set:

HORIZONTAL MODE	A
A SEC/DIV	0.05 $\mu$ s

q. Set the generator to produce a 100-MHz, 1.5-division display.

r. Repeat parts d through f.

s. Set:

VERTICAL MODE	CH 2
HORIZONTAL MODE	A

t. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector.

u. Repeat parts d through f.

v. Disconnect the test equipment from the instrument.

## 6. Check External Triggering

a. Set:

VERTICAL MODE	CH 1
HORIZONTAL MODE	A
X10 Magnifier	Off (knob in)
A SOURCE	EXT

b. Connect a 35-mV, 10-MHz leveled sine-wave signal via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the EXT INPUT connector.

c. Push in and hold the TRIG VIEW button.

d. CHECK—Stable display can be obtained by adjusting the A TRIGGER LEVEL control for each switch combination given in Table 5-8. Then release the TRIG VIEW button.

e. Set the generator output voltage to 120 mV and the frequency to 60 MHz. Set the X10 Magnifier to On (knob out).

f. Repeat parts c and d.

g. Set the generator output voltage to 200 mV and the frequency to 100 MHz.

h. Repeat parts c and d.

i. Disconnect the test equipment from the instrument.

## 7. Check External Trigger Ranges

a. Set:

CH 1 VOLTS/DIV	0.5 V
A SEC/DIV	20 $\mu$ s
X10 Magnifier	Off (knob in)
A TRIGGER Mode	NORM

b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable, a 50- $\Omega$  termination, and a dual-input coupler to both the CH 1 OR X and EXT INPUT connectors.

c. Set the generator to produce a 50-kHz, 6.4-division display.

d. CHECK—Display is triggered along the entire positive slope of the waveform as the A TRIGGER LEVEL control is rotated.

e. CHECK—Display is not triggered (no trace) at either extreme of rotation.

f. Set the A TRIGGER SLOPE button to IN.

g. CHECK—Display is triggered along the entire negative slope of the waveform as the A TRIGGER LEVEL control is rotated.

h. CHECK—Display is not triggered (no trace) at either extreme of rotation.

### 8. Check Single Sweep Operation

a. Adjust the A TRIGGER LEVEL control to obtain a stable display.

b. Set:

Channel 1 AC-GND-DC	GND
A SOURCE	INT

c. Press in the SGL SWP button. The READY LED should illuminate and remain on.

d. Set the Channel 1 AC-GND-DC switch to DC.

e. CHECK—READY LED goes out and a single sweep occurs.

#### NOTE

*The A INTENSITY control may require adjustment to observe the single-sweep trace.*

f. Press in the SGL SWP button several times.

g. CHECK—Single-sweep trace occurs, and the READY LED illuminates briefly every time the SGL SWP button is pressed in and released.

h. Disconnect the test equipment from the instrument.

# EXTERNAL Z-AXIS AND PROBE ADJUST

## Equipment Required (see Table 4-1):

Leveled Sine-Wave Generator (Item 2)	BNC T-Connector (Item 8)
Two 50- $\Omega$ BNC Cables (Item 4)	10X Probe (provided with instrument)
50- $\Omega$ BNC Termination (Item 5)	

## INITIAL CONTROL SETTINGS

### Vertical

Channel 1 POSITION	Midrange
VERTICAL MODE	CH 1
BW LIMIT	Off (button out)
CH 1 VOLTS/DIV	1 V
CH 1 VOLTS/DIV Variable	CAL detent
Channel 1 AC-GND-DC	DC

### Horizontal

POSITION	Midrange
HORIZONTAL MODE	A
A SEC/DIV	20 $\mu$ s
SEC/DIV Variable	CAL detent
X10 Magnifier	Off (knob in)

### A TRIGGER

VAR HOLDOFF	NORM
Mode	P-P AUTO
SLOPE	OUT
LEVEL	Midrange
A&B INT	VERT MODE
A SOURCE	INT

## PROCEDURE STEPS

### 1. Check External Z-Axis Operation

a. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a T-connector to the CH 1 OR X input con-

connector. Then connect a 50- $\Omega$  cable and a 50- $\Omega$  termination from the T-connector to the EXT Z AXIS INPUT connector on the rear panel.

b. Set the generator to produce a 5-V, 50-kHz signal.

c. CHECK—For noticeable intensity modulation. The positive part of the sine wave should be of lower intensity than the negative part.

d. Disconnect the test equipment from the instrument.

### 2. Check Probe Adjust Operation

a. Set:

CH 1 VOLTS/DIV	10 mV
A SEC/DIV	0.5 ms

b. Connect the 10X Probe to the CH 1 OR X input connector and insert the probe tip into the PROBE ADJUST jack on the instrument front panel. If necessary, adjust the probe compensation for a flat-topped square-wave display.

c. CHECK—Display amplitude is 4.75 to 5.25 divisions.

d. Disconnect the probe from the instrument.