PERFORMANCE CHECK AND FUNCTIONAL VERIFICATION PROCEDURE

NOTE

Perform the SELF-CAL procedure before doing this procedure. A demonstration procedure of SELF CAL is given in "Operator's Familiarization," Section 2, and a detailed description of the built-in calibration and diagnostics is given in Appendix A of this manual.

INTRODUCTION

Use this procedure to verify proper operation of instrument controls and to check the instrument's performance against the requirements listed in Section 6. This procedure verifies instrument function and may be used to determine need for readjustment (all internal adjustments should be referred to qualified service personnel). These checks may also be used as an acceptance test.

Do not remove this instrument's cabinet to perform this procedure. All checks are made using the operator-accessible front- and rear-panel controls and connectors.

Within the procedure, there are steps that verify proper operation of instrument controls or functions that are not specified as Performance Requirements in Section 6. These steps use the word "VERIFY" when indicating the characteristic for which to test. The functions tested by these steps ARE NOT Performance Requirements and should not be interpreted as such. Steps to check Performance Requirements use the word "CHECK", rather than "VERIFY".

PREPARATION

THIS PROCEDURE ASSUMES THAT OPERATORS ARE SUFFICIENTLY ACQUAINTED WITH INSTRUMENT OPERATION TO SET IT UP AS DIRECTED IN THE PROCEDURE STEPS. Familiarization procedures are found in Sections 1 and 2 of the Operators Manual included with this instrument. Section 5 of that manual is a reference for operation of all front- and rear-panel controls and connectors. Refer to those sections of the Operators Manual if instructions for obtaining the various operation modes of this instrument are needed.

Test equipment items 1 through 24 listed in Table 4-1 are required to perform this procedure (items 20 and 22 through 24 are only needed with instruments having the Video Option). The specific pieces of equipment required to perform the checks within each subsection are listed at the beginning of that subsection. The item numbers in parenthesis next to each piece of equipment refer to the numbered equipment list of Table 4-1. Items 25 through 28 are used for instrument calibration only (see the Adjustment Procedure—Section 5).

Before performing this procedure, ensure that the LINE VOLTAGE SELECTOR switch is set for the ac power source being used (see "Preparation for Use" in Section 2 of this manual). Connect the instrument to be checked and the test equipment to an appropriate power source. Turn the instrument on and ensure that no error message is displayed on the CRT. If an error message is present, have the instrument repaired by a qualified service technician before performing this procedure.

This procedure is divided into subsections (VERTICAL SYSTEM, TRIGGERING SYSTEM, etc.), and further into steps (Verify CH1 and CH2 50 Ω Overload Protection, etc.). This arrangement allows verification of the functionality of the instrument's individual sections, as well as its conformance to individual specifications, without requiring performance of the entire procedure. Any number of

Table 4-1
Test Equipment Required

NOTE

Item numbers 20 and 22 through 24 are needed for checking the 2440 TV Option 05 only.

Item and Description	Minimum Specification	Purpose	Example of Suitable Test Equipment
1. Leveled Sine-Wave Generator (Primary)	Frequency: 250 kHz to 250 MHz. Output amplitude: variable from 5 mV to 5 V p-p. Output impedance: 50 Ω. Reference frequency: 50 kHz. Amplitude accuracy: constant within 3% of reference frequency as output frequency changes.	Vertical, horizontal, and triggering checks and adjustments.	TEKTRONIX SG 503 Leveled Sine Wave Generator.[a]
2. Leveled Sine-Wave Generator (Secondary)	Frequency: 245 MHz to 500 MHz. Output amplitude: variable from 500 mV to 4 V p-p. Reference frequency: 6 MHz. Amplitude accuracy (at reference): within 3% of indicated amplitude.	Bandwidth and transient response checks and adjustments.	TEKTRONIX SG 504 Leveled Sine Wave Generator with Leveling Head.[a]
3. Calibration Generator	Standard-amplitude signal levels: 5 mV to 50 V. Accuracy: ±0.25%, ±1 μV. Repetition Rate: 1 kHz. High-amplitude signal levels: 1 V to 60 V. Repetition rate: 1 kHz. Fast-rise signal level: 100 mV to 1 V. Repetition rate: 100 Hz to 100 kHz. Rise time: 1 ns or less. Flatness: ±0.5%.	Signal source for gain.	TEKTRONIX PG 506 Calibration Generator.[a]
4. Time-Mark Generator	Marker outputs: 10 ns to 0.5 s. Marker accuracy: ±0.0002%. Trigger output: 1 ms to 0.1 μs, time-coincident with markers.	Horizontal checks.	TEKTRONIX TG 501 Time Mark Generator.[a]
5. Function Generator	Range: less than 1 Hz to 80 kHz; sinusoidal output; amplitude variable to greater than 10 V p-p open circuit with dc offset adjust.	Low-frequency checks.	TEKTRONIX FG 502 Function Generator.[a]
6. Power Supply	Range: 0 to 20 VDC.	50 Ω Overload verification.	TEKTRONIX PS 503A Power Supply.[a]
7. Digital Voltmeter (DMM)	Range: 0 to 140 V. Dc voltage accuracy: ±0.15%. 4-1/2 digit display.	Sequencer Input/Outputs Verification	TEKTRONIX DM 501A Digital Multimeter.[a]
8. GPIB Controller	Conform to IEEE-488 (1978) standard.	Check GPIB operation.	TEKTRONIX 4041 System Controller.
9. GPIB Cable	Conform to IEEE-488 (1978) standard.	Check GPIB operation.	Tektronix Part Number 012-0630-03.
10. Coaxial Cable (2 required)	Impedance: 50 Ω. Length: 42 in. Connectors: BNC.	Signal interconnection.	Tektronix Part Number 012-0057-01.
11. Precision Coaxial Cable	Impedance: 50 Ω. Length: 36 in. Connectors: BNC.	Used with Calibration Generator.	Tektronix Part Number 012-0482-00.

Table 4-1 (cont)

Item and Description	Minimum Specification	Purpose	Example of Suitable Test Equipment
12. Termination	Impedance: 50 Ω. Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0049-01.
13. 10X Attenuator (2 required)	Ratio: 10X. Impedance: 50 Ω. Connectors: BNC.	Vertical and triggering checks.	Tektronix Part Number 011-0059-02.
14. 5X Attenuator	Ratio: 5X. Impedance: 50 Ω. Connectors: BNC.	Vertical and triggering checks.	Tektronix Part Number 011-0060-00.
15. 2X Attenuator	Ratio: 2X. Impedance: 50 Ω. Connectors: BNC.	External triggering checks.	Tektronix Part Number 011-0069-02.
16. 10X Standard Accessory Probe (supplied with instrument)	DC to 250 MHz probe.	Signal input connector.	TEKTRONIX P6136.
17. 1X Probe	DC to 34 MHz probe.	Signal input connector.	TEKTRONIX P6101A.
18. Dual-Input Coupler	Connectors BNC female-to-dual-BNC male.	Signal interconnection.	Tektronix Part Number 067-0525-01.
19. BNC Female-to-Dual Adapter (2 required)	Connectors BNC female-to-dual-banana male.	Signal interconnection.	Tektronix Part Number 103-0090-00.
20. Sine-Wave Oscillator	Frequency: adjustable to 60 Hz. Amplitude: adjustable to 3 V p-p into 75 Ω.	Check TV triggers for back-porch clamp operation.	TEKTRONIX SG 502 Oscillator.[a]
21. Pulse Generator	Period Range: 1 ms to 2 μs. Pulse Range: 0.5 ms to 1 μs. Amplitude variable from −5 to +5 V, independent pulse top and pulse bottom.	Verify and Check Sequencer Input/Outputs. Check TV triggers for sync separation, Option 05 only.	TEKTRONIX PG 502 Pulse Generator.
22. Sync and Linearity Test Generator	Conforms to TV System requirements.	Check TV triggers for back-porch clamp and video modes operation.	TEKTRONIX R147A NTSC Test Signal Generator. TEKTRONIX R148 Insertion Test Signal Generator.
23. Coaxial Cable (2 required)	Impedance: 75 Ω. Length: 42 in. Connectors: BNC.	Signal interconnection.	Tektronix Part Number 012-0074-00.
24. Termination	Impedance: 75 Ω. Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0055-00.
25. Alignment Tool	Length: 1 in. shaft. Bit size: 3/32 in. Low capacitance; insulated.	Adjust variable capacitors and resistors.	Tektronix Part Number 003-0675-00.
26. Normalizer	Input Resistance: 1 MΩ. Input Capacitance: 15 pF.	Check input capacitance.	Tektronix Part Number 067-0537-00.
27. Tunnel-Diode Pulser	Rise time: 125 ps or less.	Adjust transient response.	Tektronix Part Number 067-0681-01.
28. 2.5X Attenuator	Ratio: 2.5X. Impedance: 50 Ω. Connectors: BNC.	Adjust transient response.	Tektronix Part Number 011-0076-01.

[a]Requires a TM 500-Series Power-Module Mainframe.

steps (in any order) can be performed as long as ALL the parts of a step are performed in sequence and in their entirety.

BEFORE PERFORMING THE REMAINDER OF THIS PROCEDURE, DO THE "INITIAL SETUP" AT THE BEGINNING OF THE PROCEDURE STEPS. The Initial Setup is a procedure for setting up and storing a complete front-panel setup that can be recalled. When performing almost any step in this procedure, the first part (part a) requires that this stored front-panel setup be recalled and specifies the changes (if any) to be made to that setup. Make ONLY those changes specified; do not change any other control settings (including vertical and horizontal position settings).

NOTE

This instrument must be powered up for at least 20 minutes before performance requirements can be checked.

"Select" means to press the appropriate front panel button to obtain the stipulated menu on the CRT screen. "Set", when preceded by a menu selection, indicates the stipulated menu function should be turned on or off by pressing the appropriate menu button. The function will appear underlined in the menu when turned on, not underlined when turned off. Control settings not listed do not affect the procedure.

INITIAL SETUP

a. Select PRGM.

Push:		INIT PANEL
Select TRIGGER MODE		
Set:	AUTO	ON
Select VERTICAL MODE		
Set:	CH2	On
Select CH1 COUPLING/INVERT		
Set:	50Ω ON;OFF	ON
Select CH2 COUPLING/INVERT		
Set:	50Ω ON;OFF	ON
Set:	A SEC/DIV	500 μs

b. Select the A/B TRIG button to enable the B Trigger System.

c. Select TRIGGER MODE to display B TRIG MODE menu and set TRIG AFTER ON. Select the A/B TRIG button to return to the A Trigger System.

d. Select STORAGE ACQUIRE and set REPET ON;OFF ON. Repeatedly press the menu button labeled AVG until a "16" appears above the AVG. Repeatedly press the ENVELOPE button until a "16" appears above ENVELOPE. Set NORMAL back on.

e. Select PRGM to display the main SEQUENCER menu. Press SAVE in the main menu to display the SAVE Sequence menu.

f. Use the arrows under ROLL-CHARS to create a label (use FPNL) for the front-panel setup as outlined here in steps a-d:

1. Select the first character for the label. Use the arrow-labeled buttons to select the first letter for the sequence label. Press the ↓ button to step forward in the alphabet and digit (0-9) and the ↑ button to step backwards. Holding down the buttons moves through the character continuously; a single press moves forward or backward one character. (There is a "blank space" character between the digit 9 and letter A.)

2. When the letter for the first character of the label is displayed, push CURSOR <> to move to the next character. Repeat step a to select the letter for the next character of the label.

3. Repeat last step until "FPNL" is spelled out. (Any character can be returned to for editing by continually pushing the cursor button, since it reverses the selection order after the first and sixth character is selected.)

g. Push menu button labeled SAVE when the label is complete.

NOTE

In part h, Trigger Mode is set back to AUTO LEVEL. (AUTO LEVEL was initially turned off to make the front-panel changes in parts a through g faster to set.) Throughout the remainder of this Performance Check procedure, the scope is switched to AUTO

LEVEL when the initial setup is recalled, providing automatic triggering of displays. If preferred, you can switch to AUTO and use INIT @50% and/or the TRIGGER LEVEL control to trigger manually. When AUTO is the required mode for a procedure (such as for checking the Trigger Level Readout accuracy, etc.) AUTO is specified in that procedure.

Occasionally, AUTO LEVEL may fail to find a stable trigger if you connect the triggering signal to the front panel between auto-level cycles; if so, push INIT @50% to obtain the triggered display.

h. Pushing the menu button saves the label for the sequence and displays the message "SETUP CONTROLS, PUSH PRGM TO CONTINUE." Select TRIGGER MODE and set AUTO LEVEL on. *DO NOT CHANGE ANY OTHER FRONT-PANEL SETTINGS AT THIS TIME.* Instead, save the current front-panel setup by doing the following:

1. Push the front-panel button PRGM. This will bring up the action selection menu.

2. Do not select any actions. Push the menu button labeled SAVE SEQ to store the sequence under the label "FPNL".

i. Later in this procedure, when instructed to recall the "Initial Front-Panel Setup", perform the following steps:

1. Push PRGM to display the main SEQUENCER menu.

2. Push RECALL in the main menu to display the menu used for recalling the front-panel Setup.

3. Use the arrow-labeled buttons to move the underline to the label "FPNL".

4. Push RECALL and the front-panel settings will change to those settings that were stored for FPNL.

Remember this four-step procedure for recalling FPNL.

NOTE

The following steps turn the Trigger Point Indicator (a small "T" displayed on waveforms) and the BELL on for use in this procedure. These functions cannot be stored in the front-panel setup, but remain in effect until changed by the operator. Leave these functions turned on for the remainder of this procedure.

j. Press the MENU OFF/EXTENDED FUNCTIONS button twice to display the EXTENDED FUNCTION menu. Press the menu button labeled SYSTEM (menu will change).

k. Press the menu button labeled MISC (menu will change). Set TRIG T ON¦OFF and BELL ON¦OFF to ON for the displayed menu.

l. Press MENU OFF/EXTENDED FUNCTIONS to exit the extended functions.

VERTICAL SYSTEM

NOTE

Before performing the steps in this subsection, perform the INITIAL FRONT PANEL CONTROL SETUP at the beginning of this procedure.

EQUIPMENT REQUIRED (see Table 4-1)

Leveled Sine-Wave Generator (Item 1)
Calibration Generator (Item 3)
Power Supply (Item 6)
Coaxial Cable (Item 10)
Precision Coaxial Cable (Item 11)
10X Attenuator (Item 13)
5X Attenuator (Item 14)
2X Attenuator (Item 15)
10X Probe (Item 16)
1X Probe (Item 17)
Dual-Input Coupler (Item 18)

1. Verify CH 1 and CH 2 50 Ω OVERLOAD Protection.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select TRIGGER MODE		
Set:	AUTO	ON
Set:	CH 1 VOLTS/DIV	1V
	CH 2 VOLTS/DIV	1V
Select VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF

b. Connect the Power Supply (Power Supply should be turned off) to the CH 1 OR X input connector via a BNC female-to-dual banana adapter and a 50-Ω BNC cable.

c. Using the CH 1 VERTICAL POSITION control, align the trace to the bottom graticule line.

d. Turn on the Power Supply.

e. Adjust the Power Supply output level until the CH 1 trace rises to 1 division above the center graticule line (5 V).

f. Select CH 1 COUPLING/INVERT and set 50Ω ON¦OFF to ON.

g. VERIFY—For a period of 1 minute, the readout display does not indicate any overload condition (50Ω OVERLOAD).

h. Set 50Ω ON¦OFF to OFF and the CH 1 VOLTS/DIV to 5 V.

CAUTION

To prevent damage to the input circuitry when in 50-Ω DC coupling mode, the 20V Power Supply should be turned off immediately if automatic OVERLOAD switching does not occur within 15 seconds after applying the power source and setting the 50-Ω coupling on in part j.

i. Increase the Power Supply output level until the CH 1 trace rises to the center graticule line (+20 V).

j. Set 50Ω ON¦OFF to ON.

k. VERIFY—Approximately 10 seconds (no longer than 15 seconds) after CH 1 50Ω ON¦OFF is set to ON, the readout display indicates "50Ω OVERLOAD" and the CH 1 COUPLING switches to GND.

l. Turn the Power Supply off.

m. Disconnect the Power Supply.

n. Clear the 50Ω OVERLOAD condition by setting CH 1 COUPLING to DC.

o. VERIFY—The readout display no longer indicates "50Ω OVERLOAD" and the CH 1 COUPLING/INVERT menu indicates DC on.

p. Select VERTICAL MODE and set CH 1 off and CH 2 on.

q. Repeat b through n using CH 2 control settings and input to verify 50Ω OVERLOAD protection for CH 2.

2. Check CH 1 and CH 2 AC/DC/GND COUPLING/INVERT Modes.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	CH 1 VOLTS/DIV	200mv
	CH 2 VOLTS/DIV	200mV
Select VERTICAL MODE		
Set:	CH 2	Off
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
	GND	On
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
	GND	On
Set:	A SEC/DIV	5ms

b. Connect the CALIBRATOR output signal to the CH 1 OR X input connector using a 1x probe.

c. Set the CH 1 COUPLING/INVERT menu to DC on (a GND symbol disappears next to the CH 1 scale factor readout).

d. CHECK—Display for a square wave which steps positive (upwards) approximately 2 divisions from the center horizontal graticule line.

e. Set CH 1 COUPLING to AC (a sine wave symbol appears next to the CH 1 scale factor readout in upper left-hand corner of CRT).

f. CHECK—Display for a tilted square wave of approximately 2 divisions (average) amplitude centered vertically around the center horizontal graticule line.

g. Set 50Ω ON¦OFF to ON (the sine wave symbol is replaced by an ohm symbol next to the CH 1 scale factor readout).

h. CHECK—Display for a square wave which steps positive (upwards) approximately 0.5 division from the center horizontal graticule line. VERIFY—That CH 1 COUPLING automatically switched from AC on to DC on.

i. Set INVERT ON¦OFF to ON (an inverted arrow appears left of the CH 1 scale factor readout.

j. CHECK—Displayed square wave now steps downwards from the center horizontal graticule line and is approximately 0.5 division in amplitude.

NOTE

Amplitudes are less than 1 division (200 mV) for checks h and j since the X1 probe's resistance is significant when compared to the 50-Ω inputs of the scope.

k. Select VERTICAL MODE and set CH 2 on and CH 1 off. Select CH 2 COUPLING/INVERT to display that menu.

l. Move the probe from the CH 1 input connector to the CH 2 input connector.

m. Repeat parts c through j using the CH 2 input and controls.

n. Disconnect the test setup.

3. Check CH 1 and CH 2 VOLTS/DIV Display and Readout Accuracies. Check the A and B TRIGGER LEVEL Readout Accuracies.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
Select BANDWIDTH		
Set:	20 MHz	On
Select TRIGGER MODE		
Set:	AUTO	On

b. Connect the Calibration Generator's STD AMPLITUDE output to the CH 1 OR X input connector via a 50-Ω cable. Do not use a termination.

c. CHECK—CH 1 and CH 2 VOLTS/DIV and TRIGGER LEVEL readout accuracies as follows:

1. Set VOLTS/DIV control to the first position listed in Table 4-2.

2. Set the Calibration Generator STD AMPLITUDE output level to the corresponding Standard Amplitude Input Level in Table 4-2. Use the TRIGGER LEVEL control as necessary to obtain a stable display.

NOTE

To properly verify TRIGGER LEVEL readout accuracy the Calibration Generator's output must have rising and falling transition times (10% to 90%) > 20 nanoseconds. No overshoot should appear on the waveform.

3. Verify that the generator output meets the requirements noted above.

4. Use the VERTICAL POSITION control to set the bottom of the signal 3 divisions below graticule center.

5. Select CURSOR FUNCTION and set VOLTS on.

6. Using the CURSOR/DELAY control, align the selected cursor (segmented) with the bottom of the displayed waveform.

7. PUSH the CURSOR SELECT button to select the other cursor (it will change from solid to segmented).

8. Use the CURSOR/DELAY control to align this cursor to the top of the waveform. Take care to use the same reference points (top edge, bottom edge, or center) of the waveform and cursor as in subpart 6.

9. CHECK—That the voltage reading displayed by the cursor readout is within the limits given in Table 4-2 under the Readout Accuracy Limits-NORMAL MODE column.

10. Select STORAGE ACQUIRE and set ENVELOPE on.

11. Using the CURSOR/DELAY control, readjust the cursors as necessary to align them to the top or bottom (discount noise) of the waveform. Press CURSOR SELECT as needed to toggle between the two cursors.

12. CHECK—That the voltage reading displayed is within the limits given in Table 4-2 under the Readout Accuracy—ENVELOPE MODE column.

13. Set the ACQUIRE menu back to NORMAL on.

14. Set the TRIGGER LEVEL control at the most positive voltage that produces a barely triggered, jittering display for the positive (+) setting for the slope switch.

15. CHECK—The A Trigger Level readings (upper-right corner of display) are within the limits listed in the (+) Peak column under DC Coupling in Table 4-2.

16. Set the TRIGGER LEVEL control at the most negative voltage that produces a barely triggered, jittering display for negative (—) setting for the slope switch.

17. CHECK—The A Trigger Level readings are within the limits listed in the (—) Peak column under DC Coupling in Table 4-2.

18. Set the TRIGGER LEVEL control for a stable display.

19. Press the A/B TRIG button to set the B Trigger System on.

20. Set HORIZ MODE to B.

21. Set the TRIGGER LEVEL control at the most positive voltage that produces a barely triggered, jittering display for the positive (+) setting for the slope switch.

22. CHECK—That the B Trigger Level readings (upper-right corner of display) are within the limits listed in the (+) Peak column under DC Coupling in Table 4-2.

23. Set the TRIGGER LEVEL control at the most negative voltage that produces a barely triggered, jittering display for negative (—) setting for the slope switch.

24. CHECK—That the B Trigger Level readings are within the limits listed in the (—) Peak column under DC Coupling in Table 4-2.

25. Set the HORIZ MODE to A.

26. Press the A/B TRIG button to set the A Trigger System on.

27. Set the VOLTS/DIV control to the next position listed in Table 4-2.

28. Set the Calibration Generator STD AMPLITUDE output level to the corresponding Standard Amplitude Input Level in Table 4-2.

29. Use the VERTICAL POSITION control to set the bottom of the signal 3 divisions below graticule center.

30. Repeat subparts 6 through 29 for each VOLTS/DIV setting listed in Table 4-2. Skip subparts 26 through 29 when checking the last VOLTS/DIV setting in the table.

31. Press A/B TRIG to set the B Trigger System on. Select TRIGGER CPLG and set REJECT NOISE on.

32. Press A/B TRIG to set the A Trigger System on (the A TRIG CPLG menu will be displayed). Set REJECT NOISE on.

33. CH 1 VOLTS/DIV control to 50 mV.

34. Set the Calibration Generator's STD AMPLITUDE output level to .2 V.

35. Repeat subparts 14 through 24, using 147 mV to 253 mV as the limits to check against in subparts 15 and 22 and +47 mV to —47 mV as the limits for subparts 17 and 24.

36. Set the B COUPLING mode back to DC on (B TRIGGER CPLG menu is still displayed from subpart 24).

37. Press the A/B TRIG button to set the A Trigger System on (the A COUPLING menu will be displayed). Set A COUPLING to DC on.

38. Set HORIZONTAL MODE to A.

39. Set the CH 1 VOLTS/DIV control to 1 V and the Calibration Generator's output level to 5 V.

40. Select CH 1 VARIABLE and press and hold down the menu button labeled "↓" until the displayed waveform no longer decreases in amplitude.

41. CHECK—That the amplitude of the displayed waveform is two divisions or less. VERIFY—That a ">" symbol appears immediately left of the CH 1 scale factor readout.

42. VERIFY—That the amplitude of the displayed waveform increases when the menu button labeled "↑" is pushed.

43. Press CAL. VERIFY—That the waveform has returned to its original amplitude and that the ">" symbol is no longer displayed.

44. Select CH 1 COUPLING/INVERT and set INVERT ON¦OFF to ON.

45. Using the VERTICAL POSITION control, set the bottom of the waveform 3 divisions below graticule center.

46. Repeat subparts 6 through 9 to check INVERT accuracy.

47. Return INVERT ON¦OFF to OFF.

48. Select VERTICAL MODE and set CH 2 on and CH 1 off. Move the cable to CH 2 OR Y.

49. Repeat subparts 1 through 48 (skipping 5) to check the functions and accuracies for CH 2.

50. Select TRIGGER MODE and set AUTO LEVEL on.

Table 4-2

Accuracy Limits CH 1 and CH 2 CURSOR VOLTS Readout and A and B TRIGGER LEVEL Readouts

VOLTS/DIV Control	Standard Ampl Out	CURSOR VOLTS Readout Accuracy		TRIGGER LEVEL Readout Limits—DC Coupling	
		NORMAL (2% + 0.04 div)	ENVELOPE (3% + 0.04 div)	+ Peak	− Peak
2 mV	10 mV	9.72 mV-10.28 mV	9.62 mV-10.38 mV	8.5 mV-11.5 mV	±1.2 mV
5 mV	20 mV	19.40 mV-20.60 mV	19.20 mV-20.80 mV	17.2 mV-22.8 mV	±2.2 mV
10 mV	50 mV	48.60 mV-51.40 mV	48.10 mV-51.90 mV	44.4 mV-55.6 mV	±4.0 mV
20 mV	0.1 V	97.20 mV-102.80 mV	96.20 mV-103.80 mV	89.6 mV-110.4 mV	±7.2 mV
50 mV	0.2 V	194.00 mV-206.00 mV	192.00 mV-208.00 mV	178.0 mV-222.0 mV	±16.0 mV
100 mV	0.5 V	486.00 mV-514.00 mV	481.00 mV-519.00 mV	448.0 mV-552.0 mV	±36.0 mV
200 mV	1 V	972.00 mV-1.03 V	962.00 mV-1.04 V	896.0 mV-1.1 V	±72.0 mV
500 mV	2 V	1.94 V-2.06 V	1.92 V-2.08 V	1.8 V-2.2 V	±160.0 mV
1 V	5 V	4.86 V-5.14 V	4.81 V-5.19 V	4.5 V-5.5 V	±360.0 mV
2 V	10 V	9.72 V-10.28 V	9.62 V-10.38 V	9.0 V-11.0 V	±710.0 mV
5 V	20 V	19.40 V-20.60 V	19.20 V-20.80 V	17.8 V-22.2 V	±1.6 V

51. Remove the cable from CH 2 OR Y input and connect the 5-V standard amplitude signal to CH 1 OR X and CH 2 OR Y through a Dual-Input Coupler.

52. Using the CH 2 VERTICAL POSITION control, set the bottom of the CH 2 waveform to graticule center.

53. Select VERTICAL MODE and set CH 1 on. Use the CH 1 VERTICAL POSITION to superimpose the CH 1 waveform exactly over the CH 2 waveform.

54. Set CH 1 and CH 2 VOLT/DIV controls to 5 V. Set CH 1 and CH 2 off and ADD on.

55. Align the cursors to the top and bottom of the displayed waveform as in subparts 6 and 7.

56. VERIFY—That the readout indicates about 10V.

57. Set CH 1 and CH 2 VOLTS/DIV to 2 V and set MULT on (ADD will be turned off).

58. Align the cursors to the top and bottom of the displayed waveform as in subparts 6 to 7.

59. VERIFY:—That the readout indicates about 25 V^2.

d. Set MULT off and CH 1 on. Set CH 1 to 1 V.

e. Precisely align one voltage cursor to the graticule line 3 divisions above graticule center and the other cursor to the line 3 divisions below graticule center.

f. CHECK—That the voltage reading displayed is within 1% of 6.00 Volts (5.94 to 6.06).

g. Disconnect the test setup.

4. Check LF Linearity.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF

b. Connect the Calibration Generator's STD AMPLITUDE output to the CH 1 OR X input connector via a 50-Ω cable. Do not use a termination.

c. Set the Calibration Generator's STD AMPLITUDE output level to .2 V.

d. Use the CH 1 POSITION control to center the waveform vertically around the center horizontal graticule line.

e. Use the generator's VARIABLE control to adjust the waveform for exactly 2 vertical divisions on screen (discount trace width).

f. Use the CH 1 POSITION control to align the top of the waveform to the top horizontal graticule line.

g. CHECK—That the amplitude of the displayed waveform is between 1.88 and 2.12 divisions.

h. Use the CH 1 POSITION control to align the bottom of the waveform to the bottom horizontal graticule line.

i. CHECK—That the amplitude of the displayed waveform is between 1.88 and 2.12 divisions.

j. Select STORAGE ACQUIRE and set ENVELOPE on.

k. Repeat parts d through i to check the LF Linearity for the ENVELOPE mode. Discount the noise and the

envelope "fill" when performing parts g and i and use 1.84 and 2.16 divisions as limits for those parts.

l. Set the STORAGE ACQUIRE mode back to NORMAL on.

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

n. Select VERTICAL MODE and set CH 2 on and CH 1 off.

o. Repeat parts d through k to check CH 2 using CH 2 control settings and menus.

p. Disconnect the test setup.

5. Check CH 1 and CH 2 Position Range.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	CH 1 VOLTS/DIV	20mV
	CH 2 VOLT/DIV	20mV
	A SEC/DIV	10μs
Select VERTICAL MODE		
Set:	CH 2	Off

b. Connect a 50-kHz reference frequency signal from the Leveled Sine-wave Generator to the CH 1 OR X input connector via a 50-Ω BNC cable and a 5X attenuator.

c. Adjust the generator's output level for a 4-division display on screen.

d. Remove the 5X attenuator and connect the cable directly to the CH 1 input.

e. Rotate the CH 1 POSITION control full clockwise and hold until the waveform no longer moves up screen.

f. CHECK—That the bottom of the waveform is within +0.4 to −0.7 division of the center horizontal graticule line.

g. Rotate the CH 1 POSITION control full counterclockwise and hold until the waveform no longer moves down screen.

h. CHECK—That the top of the waveform is within +0.7 to −0.4 division of the center horizontal graticule line.

i. Reinstall the 5X attenuator and move the cable to the CH 2 OR Y input.

j. Select VERTICAL MODE and set CH 2 on and CH 1 off.

k. Repeat parts c through h to check CH 2's position range, using the CH 2 input connector and controls.

6. Check CH 1 and CH 2 Bandwidth and Bandwidth Limit (20 MHz and 100 MHz).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see Step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	CH 1 VOLTS/DIV	2mV
	A SEC/DIV	100ns
	CH 2	Off

b. Connect the output of the secondary Leveled Sine-wave Generator (item 2) to the CH 1 input connector via the leveling head included with the generator and any combination of the 10X, 5X, and 2X attenuators that reduces the signal amplitude to the level called for in part c.

c. Set the generator output level for a 6-division display at the 6-MHz reference frequency, then change the output frequency to 300 MHz.

d. Set A SEC/DIV to 2 ns.

e. CHECK—The display amplitude is 4.2 divisions or greater.

f. Return the A SEC/DIV to 100 ns and set the CH 1 VOLT/DIV control to the next higher setting.

g. Repeat parts c through f for all CH 1 VOLTS/DIV settings through 500 mV, removing and/or adding attenuators as necessary to allow adjusting the generator output level to 6 divisions.

h. Select VERTICAL MODE and set CH 2 on and CH 1 off.

i. Set CH 2 VOLTS/DIV to 2 mV and A SEC/DIV to 100 ns.

j. Repeat parts b through g to check CH 2 bandwidth, substituting CH 2 controls and input connector.

k. Set the A SEC/DIV to 10 μs.

l. Disconnect the secondary generator.

m. Connect the output of the primary Leveled Sine-wave Generator (item 1) to the CH 2 input connector via a precision 50- cable and any combination of the 10X, 5X, and 2X attenuators that reduces the signal amplitude to the level called for in part n.

n. Set the primary Leveled Sine-wave Generator to a 50-kHz reference frequency and, changing attenuators as necessary, adjust the output level for a 6-division display.

o. Select VERTICAL BANDWIDTH and set to 20 MHz. Set the A SEC/DIV to 20 ns.

p. Increase the generator's output frequency until the display amplitude is 4.2 divisions.

q. CHECK—That the generator's output frequency is from 13 MHz to 24 MHz.

r. Set VERTICAL BANDWIDTH to 100 MHz and the A SEC/DIV to 5 ns.

s. Increase the generator's output frequency until the display amplitude is 4.2 divisions.

t. CHECK—That the generator's output frequency is from 80 MHz to 120 MHz.

u. Set VERTICAL BANDWIDTH to FULL and A SEC/DIV to 10 μs. Select VERTICAL MODE and set CH 1 on and CH 2 off.

v. Repeat parts m through t to check CH 1 20 MHz and 100 MHz bandwidth limit, substituting CH 1 controls and input connector.

w. Disconnect the test setup.

7. Check Common Mode Rejection Ratio (CMRR).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	A SEC/DIV	10μs
Select VERTICAL MODE		
Set:	CH2	Off
	ADD	On
Select CH1 COUPLING/INVERT		
Set:	INVERT ON!OFF	ON
Select TRIGGER SOURCE		
Set:	CHAN1!2	1
Select CURSOR FUNCTION		
Set:	VOLTS	On
Menu displayed: ATTACH CURSORS TO:		
Set:	ADD	On
Select STORAGE ACQUIRE		
Set:	AVG	On

NOTE

When the Initial Front Panel Setup is recalled in part a, the CH 1 and CH 2 traces will be centered vertically. DO NOT adjust the CH 1 or CH 2 POSITION controls during the remainder of this CMRR check to avoid exceeding the dynamic range of the CH 1 and/or CH 2 Vertical systems. If the controls are accidently adjusted, go back to part a and repeat this check.

b. Connect a 50-kHz reference frequency signal from the Leveled Sine-wave Generator to the CH 1 OR X and CH 2 OR Y input connectors via a 50-Ω BNC cable and a Dual-Input Coupler.

c. Set the generator output level for a 5-division display of the reference signal on CH 1.

d. Set the CH 1 and CH 2 VOLT/DIV controls to 50 mV.

e. Select VERTICAL MODE and set CH 1 off.

f. Select CH 2 VARIABLE and, using the menu buttons under the arrow symbols, adjust for minimum ADD display amplitude.

g. Set the A SEC/DIV to 20 ns.

h. Set the generator's output frequency to 50 MHz.

i. Using the CURSOR/DELAY control, align the movable cursor (segmented) to the bottom of the ADD waveform.

j. Press CURSOR/SELECT to enable the alternate cursor.

k. Use the CURSOR/DELAY control to align this cursor to the top of the ADD waveform. Take care to use the same reference points (top edge, bottom edge, or center) of the waveform and cursor as in part i.

l. CHECK—That the cursor readout (upper right corner of display) indicates 50.0 mV or less.

m. Set the generator's output frequency back to 50 kHz.

n. Set the VARIABLE menu back to CAL and return the A TIME/DIV control to 10 μs.

o. Select CH 1 COUPLING/INVERT and set INVERT ON|OFF to OFF.

p. Select CH 2 COUPLING/INVERT and set INVERT ON|OFF to ON.

q. Repeat parts f through l to check CMRR with CH 2 inverted. Be sure to use the CH 2 VARIABLE for part f (cursor readout will be in DIV instead of V units if CH 1 VARIABLE is used).

r. Remove the test setup.

8. Check Channel Isolation.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see Step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	A SEC/DIV	5 ns
Select CURSOR FUNCTION		
Set:	VOLT	On

(The ATTACH CURSOR menu will be displayed).

NOTE

When the Initial Front Panel Setup is recalled in part a, the CH 1 and CH 2 traces will be centered vertically. DO NOT adjust the CH 1 or CH 2 POSITION controls during the remainder of this Channel Isolation check to avoid exceeding the dynamic range of the CH 1 and/or CH 2 Vertical systems. If the controls are accidently adjusted, go back to part a and repeat this check.

b. Connect the Leveled Sine-wave Generator to the CH 1 OR X input connector via a precision 50-Ω BNC cable.

c. Set the generator frequency to 100 MHz and adjust the output level for a 5-division display.

d. Set the CH 1 and CH 2 VOLTS/DIV controls to 50 mV.

e. Using the CURSOR/DELAY control, align the movable cursor (segmented) to the bottom of the CH 2 waveform.

f. Press CURSOR/SELECT to enable the alternate cursor.

g. Use the CURSOR/DELAY control to align this cursor to the top of the CH 2 waveform. Take care to use the same reference points (top edge, bottom edge, or center) of the waveform and cursor as in part e.

h. CHECK—That the cursor readout (upper right corner of display) indicates 5.00 mV or less.

i. Move the cable to CH 2 input and change CH 2 VOLT/DIV control to 100 mV.

j. Select Trigger Source and set CH 2 on.

k. Set the generator for a 5 divisions in CH 2. Return the CH 2 VOLT/DIV control to 50 mV.

l. Perform parts e-h checking the CH 1 waveform instead of CH 2's to check channel isolation from CH 2 to CH 1.

m. Set both VOLT/DIV controls to 100 mV, the SEC/DIV control to 2 ns, and the Trigger Source back to CH 1.

n. Connect the secondary generator (item 2) to the CH 1 input through the leveling head included with the generator.

o. Set the generator frequency to 300 MHz and adjust the output level for a 5-division display.

p. Repeat parts d-l, using 10.00 mV as the limit for part h, to check 300 MHz channel isolation.

q. Disconnect the test setup.

9. Check the CH 2 Output Voltage Accuracy and Bandwidth.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	CH 1 VOLTS/DIV	20mV
Select CH 2 COUPLING/INVERT		
Set:	50-Ω ON¦OFF	OFF
Select TRIGGER SOURCE		
Set:	CHAN1¦2	2
Select CURSOR FUNCTION		
Set:	VOLTS	On
Menu displayed: ATTACH CURSORS TO		
Set:	CH 1	On

b. Connect the Calibration Generator's STD AMPLITUDE output to the CH 2 OR Y input connector via a 50-Ω cable. Do not use a termination.

c. Set the Calibration Generator STD AMPLITUDE output level to .5 V.

d. Use the CH 2 VERTICAL POSITION control to align the bottom of the displayed waveform to the graticule line three divisions below graticule center.

e. Use the generator's VARIABLE AMPLITUDE control to adjust the CH 2 display for precisely 5 divisions amplitude.

f. Connect the CH 2 OUT connector (on the rear panel) to the CH 1 OR X input connector via a 50-Ω BNC cable. Do not use a terminator.

g. Select VERTICAL MODE and set CH 2 off.

h. Use the CH 1 VERTICAL POSITION control to align the bottom of the displayed waveform to the graticule line three divisions below graticule center.

i. Using the CURSOR/DELAY control, align the movable cursor (segmented) to the bottom of the CH 1 waveform.

j. Press CURSOR/SELECT to enable the alternate cursor.

k. Use the CURSOR/DELAY control to align this cursor to the top of the CH 1 waveform. Take care to use the same reference points (top edge, bottom edge, or center) of the waveform and cursor as in part i.

l. CHECK—That the cursor readout (upper right corner of display) indicates 45.00-55.00 mV.

m. Select CH 1 COUPLING/INVERT and set 50 Ω ON¦OFF to OFF.

n. Align the cursors to the displayed waveform as in parts i and k.

o. CHECK—That the cursor readout indicates 90.00-110.00 mV. Set 50Ω ON!OFF back to ON.

p. Disconnect the 50-Ω cable from the Calibration Generator's output and connect it to the output of a Leveled Sine-wave Generator.

q. Select CH 2 COUPLING/INVERT and set 50-Ω ON!OFF to ON.

r. Set the A SEC/DIV control to 200 ns.

s. Set the generator output level for a 6-division display at the 3-MHz reference frequency, then change the output frequency to 50 MHz. Adjust the CH 1 VERTICAL POSITION control as required to view the display.

t. Set the A SEC/DIV control to 5 ns.

u. CHECK—The display amplitude is 4.2 divisions or greater.

v. Disconnect the 50-Ω cable from the CH 2 input.

w. Select CH 1 COUPLING/INVERT and set GND on. Set the A SEC/DIV control to 500 μs.

x. Use the CH 1 VERTICAL POSITION control to align the grounded trace to the center horizontal graticule line.

y. Set the CH 1 VOLTS/DIV to 5 mV and the CH 1 COUPLING to DC.

z. VERIFY—That the trace is within ±2 divisions of the center graticule line.

aa. Disconnect the test setup.

10. Check Display Versus Graticule Centering and Dot Versus Vector Display Offset. Check VECTOR Response for NORMAL and ENVELOPE Acquisition modes.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF

b. Press the front-panel button labeled SELECT, and set VECTORS ON!OFF to OFF for the menu displayed.

c. CHECK—That the CH 1 trace is no more than 0.1 division above or below the center horizontal graticule line.

d. Select CURSOR FUNCTION and set TIME on. Note that one cursor is displayed 4 divisions left, one 4 divisions right of the center graticule line. Do NOT adjust the placement of the time cursors displayed.

e. CHECK—That each cursor is located within ±0.1 division of the intersection of the center horizontal graticule line and the vertical graticule line to which it is aligned.

f. Press the menu button labeled TIME to turn off the cursors.

g. Connect the STD AMPL OUTPUT of a Calibration Generator to the CH 1 OR X input connector via a 50-Ω BNC cable.

h. Set the AMPLITUDE control of the generator for a .2 V setting.

i. Select STORAGE ACQUIRE and set AVG on.

j. Press the front-panel button labeled SELECT.

k. Toggle the VECTORS ON!OFF button for the displayed menu, between the ON!OFF settings while making the check in the following part.

l. CHECK—That the display shifts no more than ±0.05 division while performing part k.

m. Disconnect the Calibration Generator from CH 1 connector.

n. Select PRGM and press the menu button labeled INIT PANEL.

o. Select TRIGGER MODE and set AUTO on.

p. Select STORAGE ACQUIRE and set ENVELOPE on. Repeatedly press the ENVELOPE menu button down until CONT (Continuous) appears above the label.

q. Use the CH1 VERTICAL POSITION control to move the displayed trace up 3 divisions and down 3 divisions to create a 6-division "filled" envelope on screen.

r. Press the SELECT button (next to the INTENSITY control).

s. CHECK—For no more than a 0.06-division change in amplitude between the "filled" envelope and the non-filled envelope as VECTORS ON!OFF is switched between the ON AND OFF settings for the displayed menu.

TRIGGERING SYSTEMS

NOTE

The CH 1 and CH 2 Trigger Level Readout Accuracies are checked in the Vertical Systems subsection.

NOTE

In this procedure, a "stable trigger" refers to a consistent trigger; that is, one that results in a uniform, regular display triggered on the selected slope (±). A stably-triggered display should NOT have the trigger point switch between opposite slopes on the waveform, nor should it "roll" across the screen, as successive acquisitions occur. At TIME/DIV settings of 2 ms/DIV and faster, the TRIG'D LED is constantly lit if display is stably triggered (note that, for Tables 4-3 and 4-4, the LED will flash for the 10 ms/DIV checks).

EQUIPMENT REQUIRED (see Table 4-1)

- Primary Leveled Sine-Wave Generator (Item 1)
- Secondary Leveled Sine-Wave Generator (Item 2)
- Time-Mark Generator (Item 4)
- Function Generator (Item 5)
- Coaxial Cable (Item 10)
- Precision Coaxial Cable (Item 11)
- Termination (Item 12)
- 5X Attenuator (Item 14)
- 10X Probe (Item 17)
- Dual-Input Coupler (Item 18)

1. Check A and B Internal Source Trigger Sensitivity.

NOTE

This step checks the CH 1 trigger source for all trigger coupling settings for both A and B Horizontal Modes. The other sources are checked for DC coupling only. Normally, checking all coupling modes for one trigger source is adequate since all the sources share common coupling circuitry; other sources need only be checked in the DC trigger coupling setting to verify their signal paths. However, if a source's trigger sensitivity is very near the limits specified in Table 4-3, this procedure will specify additional checks for the other trigger coupling settings.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select TRIGGER MODE		
Set:	AUTO	ON

b. Connect the sine-wave output of the appropriate generator through a 50-Ω cable and a 50-Ω terminator to the CH 1 input connector. Use the Function Generator (item 5) for Test Frequencies below 50 MHz, the Primary Leveled Sine-wave Generator (item 1) for the 50 MHz Test Frequency; and the Secondary Leveled Sine-wave Generator (item 2) for the 300 MHz Test Frequency.

c. Adjust the generator's output frequency to the first Test Frequency setting specified in Table 4-3.

d. Set the SEC/DIV control to the setting used with the Test Frequency.

e. Set the output amplitude of the specified Test Frequency to the level given in Table 4-3 for the A Trigger System with DC Trigger Coupling.

NOTE

When amplitudes of less than 1 division are required, adjust the generator for 10X the specified amplitude with the CH 1 VOLT/DIV set to 100 mV and change the setting to 1 V before making the checks. For amplitudes ≥ to 1 division, simply adjust for the required amplitude with the VOLT/DIV set to 100 mV.

Table 4-3
Minimum Display Level for CH 1 or CH 2 Triggering (in divisions)

Trigger System	Test Frequency	SEC/DIV Setting	TRIGGER COUPLING				
			DC	AC	NOISE REJ	HF REJ	LF REJ
A	60 Hz	10 ms	0.35	0.35	[a]	[a]	(0.35)[b]
B	60 Hz	10 ms	0.70	0.70	[a]	[a]	(0.70)[b]
A	30 kHz	20 μs	0.35	0.35	[a]	0.5	[a]
B	30 kHz	20 μs	0.70	0.70	[a]	1.0	[a]
A	80 kHz	10 μs	0.35	0.35	[a]	[a]	0.5
B	80 kHz	10 μs	0.70	0.70	[a]	[a]	1.0
A	50 MHz	20 ns	0.35	0.35	1.2	(1.2)[b]	0.5
B	50 MHz	20 ns	0.70	0.70	2.4	(2.4)[b]	1.0
A	300 MHz	2 ns	1.0	1.0	3.0	(3.0)[b]	1.0
B	300 MHz	2 ns	2.0	2.0	6.0	(6.0)[b]	2.0
ADD Vertical Mode							
A	300 MHz	2 ns	1.5	1.5	4.5	[a]	1.5
B	300 MHz	2 ns	3.0	3.0	9.0	[a]	3.0

[a]Not necessary to check.

[b]Not triggered at the specified amplitude.

f. Select TRIGGER CPLG to display the A COUPLING menu.

NOTE

When checking for triggers in parts g and h, use the TRIGGER LEVEL control to trigger (or to attempt to trigger) on the waveform.

g. CHECK—For a stable, triggered display on both + and – slopes for all TRIGGER COUPLING settings that are specified at the present Test Frequency.

h. CHECK—For no stable trigger (display free-runs) for any TRIGGER COUPLING setting specifying footnote b—"Not Triggered at specified amplitude."

i. Change the generator output amplitude as necessary and repeat parts g through h for any Trigger Coupling setting specifying a different Minimum Display Level for triggering other than the initial setting for that row. (For example, NOISE, HF, and LF settings usually—but not always—require different amplitudes than the initial setting.)

j. Set the generator's output to the next Test Frequency in Table 4-3.

k. Repeat parts d through j (skip part f) to check A Triggers for each test frequency setting in Table 4-3. Change generators (as specified in part b) as needed to obtain the test frequency required. Return the TRIGGER COUPLING menu to DC when completed.

l. Select VERTICAL MODE and set CH 1 off and CH 2 on.

m. Repeat parts b through k to check CH 2 triggers, using CH 2 control settings and input connector. Skip parts f, h and i and check only for DC trigger coupling in part g if the DC trigger sensitivity is NOT near the specified limits; otherwise, check as for CH 1.

n. Select VERTICAL MODE and set ADD on and CH 2 off.

o. Repeat parts b through k to check ADD triggers, using CH 2 control settings and input connector. Skip parts h and i and check only for DC trigger coupling in part g if the DC trigger sensitivity is NOT near the specified limits; otherwise, check as for CH 1.

p. Select VERTICAL MODE and set ADD off and CH 1 on.

q. Set TRIGGER CPLG back to DC and set the HORIZONTAL MODE to B.

r. Press A/B TRIG to select the B Trigger System (the B COUPLING menu will be displayed).

s. Repeat part b through o to check B triggers, using the TRIGGER LEVEL control to trigger the display. Use the generator amplitude settings specified in the Trigger System-B rows of Table 4-3.

NOTE

When checking 50-MHz and 300-MHz Triggers for the B TRIGGER SYSTEM, the REPET mode acquisitions can require a long time to complete. When setting the B SEC/DIV control for those TEST FREQUENCIES, set the HORIZONTAL MODE to A and set the A SEC/DIV control to the SEC/DIV setting specified in the table. This adjustment will set BOTH A and B Acquisition Systems to the specified SEC/DIV setting and reduce the time required to complete the B REPET acquisition sequence. Set the HORIZONTAL MODE back to B.

t. Disconnect the test setup.

2. Check Trigger Sensitivity for A and B External Sources.

NOTE

This step checks the trigger sensitivity of the external sources for the DC trigger coupling setting only. Normally, checking all coupling modes for one trigger source (checked in step 1 of this subsection) is adequate since all the sources share common coupling circuitry; other sources need only be checked in the DC trigger coupling setting to verify their signal paths. However, if a source's trigger sensitivity is very near the limits specified in Table 4-4, this procedure will specify additional checks for the other trigger coupling settings.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE		
Set:	CH 2	Off
Select CH 1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH 2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select TRIGGER MODE		
Set:	AUTO	ON

b. Connect the sine wave output of the appropriate generator through a 50-Ω cable, a 5X attenuator, a 50-Ω terminator (install terminator between the 5X attenuator and the Dual-Input Coupler) and a Dual-Input Coupler to the CH 1 and the EXT TRIG 1 input connectors. Use the Function Generator (item 5) for Test Frequencies below 50 MHz, the Primary Leveled Sine-wave Generator (item 1) for the 50 MHz Test Frequency, and the Secondary Leveled Sine-wave Generator for the 300 MHz Test Frequency (when using the secondary generator, substitute the generator's leveling head for the 50-Ω cable in the test setup).

c. Select TRIGGER SOURCE and push the EXT menu button. Set A EXT SOURCE 1!2 to 1.

d. Press the A/B TRIG button to select the B Trigger System (the B TRIG SOURCE menu will be displayed). Push the EXT menu button and set B EXT SOURCE 1!2 to 1. Press the A/B TRIG button to return to the A Trigger System.

e. Adjust the generator's output frequency to the first Test Frequency setting specified in Table 4-4.

f. Set the A SEC/DIV control to the setting used with that Test Frequency.

g. Set the CH 1 VOLTS/DIV control to the setting used with that Test Frequency setting.

h. Select TRIGGER CPLG to display the A COUPLING menu.

Table 4-4

Minimum Signal Level for EXT1 or EXT2 Triggering
(in millivolts)

Trigger System	Test Frequency	VOLTS/DIV Setting	SEC/DIV Setting	TRIGGER COUPLING				
				DC	AC	NOISE REJ	HF REJ	LF REJ
A	60 Hz	5 mV	10 ms	17.5	17.5	[a]	[a]	(17.5)[b]
B	60 Hz	5 mV	10 ms	35.0	35.0	[a]	[a]	(35.0)[b]
A	30 kHz	5 mV	20 μs	17.5	17.5	[a]	25	[a]
B	30 kHz	5 mV	20 μs	35.0	35.0	[a]	50	[a]
A	80 kHz	10 mV	10 μs	17.5	17.5	[a]	[a]	25
B	80 kHz	10 mV	10 μs	35.0	35.0	[a]	[a]	50
A	50 MHz	10 mV	20 ns	17.5	17.5	60	(60)[b]	25
B	50 MHz	10 mV	20 ns	35.0	35.0	120	(120)[b]	50
A	300 MHz	50 mv	2 ns	50.0	50.0	150	(150)[b]	50
B	300 MHz	50 mV	2 ns	100.0	100.0	300	(300)[b]	100

[a]Not necessary to check.
[b]Not triggered at specified amplitude.

NOTE

The Minimum Signal Amplitude Level for Triggering for EXT TRIG÷5 are 5X the levels that are listed in Table 4-4. This procedure obtains the 5X levels by removing a X5 attenuator from the test setup after setting the generator's output level as specified in Table 4-4.

i. Set the output amplitude of the specified Test Frequency to the level given in Table 4-4 for the A Trigger System with DC Trigger Coupling.

NOTE

When checking for triggers in part j, use the TRIGGER LEVEL control to trigger (or to attempt to trigger) on the waveform.

j. CHECK—For a stable, triggered display at the DC trigger coupling setting. Press TRIGGER SLOPE to check for both + and − slopes.

k. Remove the 5X attenuator from the test setup and reconnect the setup as in part b.

l. Set CH 1 VOLTS/DIV for an on-screen display.

m. Select TRIGGER SOURCE and push the EXT menu button. Set A and B EXT GAIN to EXT 1/5 on in the menu displayed.

n. Select TRIGGER CPLG and repeat part j to check A EXT/5 coupling.

o. If trigger sensitivity was near the specified limits for the EXT 1 or EXT/5 sources with the trigger coupling set to DC on, repeat parts i through n for all other coupling settings in that test frequency row, changing the trigger coupling settings and generator amplitude as required.

p. Set the generator's output to the next Test Frequency in Table 4-4.

q. Select TRIGGER SOURCE and push the EXT menu button. Set A and B EXT GAIN back to EXT 1 in the menu displayed. Reinstall the 5X attenuator in the test setup.

r. Repeat parts f through q to check the trigger sensitivity for each test frequency in Table 4-4. Change generators (as specified in part b) as needed to obtain the test frequency required.

s. Move the leg of the Dual-Input-Connector connected to the EXT 1 input to the EXT 2 input.

t. Select TRIGGER SOURCE and push the EXT menu button. Set the A EXT SOURCE 1!2 TO 2. Select TRIGGER COUPLING.

u. Repeat parts e through r to check the EXT 2 trigger source, setting EXT 2/5 and EXT 2 in parts m and q, respectively.

v. Select TRIGGER SOURCE and set VERT on (the VERT source will ensure that the A Acquisition System is stably triggered—required for the following B Trigger checks).

w. Press A/B TRIG to select the B Trigger System and set the HORIZONTAL MODE to B.

x. Repeat parts b to u to check B Trigger System sensitivity. Use generator amplitude levels in the TRIGGER SYSTEM—B rows for checking the B Trigger sensitivity.

NOTE

When checking 50-MHz and 300-MHz Triggers for the B TRIGGER SYSTEM, the REPET mode acquisitions can require a long time to complete. When setting the B SEC/DIV control for those TEST FREQUENCES, set the HORIZONTAL MODE to A and set the A SEC/DIV control to the SEC/DIV setting specified in the table. This adjustment will set BOTH A and B Acquisition Systems to the specified SEC/DIV setting and reduce the time necessary to complete the B REPT acquisition sequence. Set the HORIZONTAL MODE back to B.

y. Disconnect the test setup.

3. Check A*B Trigger Source.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	A SEC/DIV	10μs
Select TRIGGER MODE		
Set:	AUTO	On
Select TRIGGER SOURCE		
Set:	A*B!WORD	A*B

Press A/B TRIG to display the B TRIG SOURCE menu.

Set:	CHAN 1!2	2

b. Ensure that the B Trigger Level Readout is set to 0.0 V. Adjust if necessary using the TRIGGER LEVEL control.

c. Press the A/B TRIG button to select the A Trigger System.

d. Select VERTICAL MODE and set CH2 off.

e. Connect the output of a Leveled Sine-wave Generator through a 50-Ω cable and a Dual-Input Coupler to the CH1 and CH2 input connectors. Do not use a terminator.

f. Set the generator's frequency to 50 kHz and its amplitude for a 4-division display.

g. Use the TRIGGER LEVEL control to adjust the A Trigger Level Readout while performing parts h through n.

h. VERIFY—That for Trigger Level Readout settings of approximately ≤ 0 V the display is stably triggered with the Trigger indicator (a small "T") approximately centered vertically on the waveform.

i. VERIFY—That for Trigger Level settings between approximately 0 V and 200 mV the display is stably triggered and the Trigger Indicator moves along the upper-positive going slope of the waveform.

j. VERIFY—That for settings greater (more positive) than approximately 200 mV the display is not triggered (free-runs). Press A/B TRIG to select the B Trigger System and set SLOPE to – (negative).

k. Press A/B TRIG to select the A Trigger System and set SLOPE to – (negative).

k. VERIFY—That for Trigger Level Readout settings of ≥ approximately 0 V or more the display is stably triggered with the Trigger indicator approximately centered vertically on the waveform.

m. VERIFY—That for Trigger Level settings between approximately 0 mV and −200 mV the display is stably triggered and the Trigger Indicator moves along the lower-negative going slope of the waveform.

n. VERIFY—That for settings which are less (more negative) than approximately 200 mV the display is not triggered (free-runs).

o. Set the A Trigger Level Readout for a reading of 0.0 V and SLOPE to + (positive).

p. Press A/B TRIG to select the B Trigger System and set SLOPE to + (positive).

q. Repeat parts h through o to verify the B Trigger System as a source for the A*B composite trigger. Do NOT change the HORIZONTAL MODE to B. Note that the Trigger Level Readout will indicate B Trigger Level settings for parts h through o and that performance of part j will select the A Trigger System, while part k will select the B Trigger System.

r. Disconnect the test setup.

4. Verify the Normal and Single Sequence Trigger Functions.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select:	VERTICAL MODE	
Set:	CH2	Off
Set:	A SEC/DIV	10μs

b. Connect the Leveled Sine-wave Generator output to CH1 input through a 50-Ω cable.

c. Set the generator's frequency and amplitude for a 50-kHz, 4-division display.

d. Select TRIGGER MODE and set NORMAL on.

e. Using the TRIGGER LEVEL control, VERIFY that the display can be triggered on the positive going slope of the ac waveform for the + (plus) selection of the SLOPE button and on the negative going slope for the − (minus) selection of the SLOPE button.

f. VERIFY—That for TRIGGER LEVEL settings outside the range of the display (approximately ±200 mV), the acquisition stops and the waveform is saved on screen.

g. Trigger the display and set SINGLE SEQUENCE on.

h. VERIFY—That for each press of the STORAGE ACQUIRE button, a waveform is acquired and saved on screen.

i. Disconnect the test setup.

5. Check Trigger Noise Rejection.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select:	VERTICAL MODE	
Set:	CH2	Off
Set:	A SEC/DIV	10μs

b. Connect the sine wave output of the Function Generator through a 50-Ω cable and a 50-Ω terminator to the CH1 input connector.

c. Set the generator's frequency to 50 kHz and its amplitude for a 4-division display.

d. Change the CH1 VOLTS/DIV to 1 V (yields a 0.4-division display).

e. Select TRIGGER COUPLING and set NOISE REJECT on.

f. CHECK—For a non-triggered, free-running display for both the + (positive) and − (negative) settings of the SLOPE button.

g. Set the A COUPLING menu back to DC on.

h. Press the A/B TRIG button to select the B Trigger System (the B COUPLING menu will be displayed) and set the HORIZONTAL MODE to B.

i. Set the B COUPLING menu to NOISE REJECT on.

j. CHECK—That the display cannot be stably triggered with the TRIGGER LEVEL control for either positive or negative setting of the SLOPE button.

k. Set the B COUPLING menu to DC on and disconnect the test setup.

6. Check Slope Selection and Verify Line Trigger.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE
Set: CH2 Off

Select CH1 COUPLING/INVERT
Set: 50Ω ON:OFF OFF

Set: CH1 VOLTS/DIV 5V
A SEC/DIV 5ms

Select: TRIGGER SOURCE
Set: LINE On

CAUTION

DO NOT connect the probe ground lead to the ac (line) power source when performing this step.

b. Connect a 10X probe to the CH1 input connector and connect the probe tip to an ac (line) source.

c. Using the TRIGGER LEVEL control, VERIFY that the display can be triggered on the positive going slope of the ac waveform for the + (plus) selection of the SLOPE button and on the negative going slope for the − (minus) selection of the SLOPE button.

NOTE

The Trigger Point Indicator, a small "T" riding on the displayed waveform, indicates the point on which the instrument is triggered for the displayed waveform.

d. Disconnect the test setup.

7. Verify A and B Trigger Position Function.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE
Set: CH2 Off

Set: CH1 VOLTS/DIV 1V

b. Connect the MARKER output of the Time Mark Generator to the CH1 input through a 50-Ω cable.

c. Set the generator's marker period to 1 ms.

d. Position the start of the display to the extreme left graticule line.

e. Select TRIG POSITION and set 1/8 on.

f. VERIFY—That the Trigger Point Indicator (a "T" symbol on screen) is positioned on a time marker approximately 2.5 divisions to the right of the extreme left graticule line.

g. Set the TRIGGER POSITION menu to 1/4 and verify that the Trigger Point Indicator moves to a time marker that is approximately at center screen.

h. Use the HORIZONTAL POSITION control to position the time marker with superimposed Trigger Point Indicator to the extreme left graticule line.

i. Set the TRIGGER POSITION menu to 1/2 and verify that the Trigger Point Indicator moves to a time marker that is approximately at center screen.

j. Use the HORIZONTAL POSITION control to position the time marker with superimposed Trigger Point Indicator to the extreme left graticule line.

k. Set the TRIGGER POSITION menu to 3/4 and verify that the Trigger Point Indicator moves to a time marker that is approximately at center screen.

l. Set the TRIGGER POSITION menu to 7/8 and verify that the Trigger Point Indicator is positioned on a time marker approximately 2.5 divisions to the right of the center graticule line.

m. Press A/B TRIG to select the B Trigger System and set the HORIZONTAL mode to B. Use the TRIGGER LEVEL control to trigger the display as required.

n. Repeat parts d through k to check the B TRIGGER POSITION function.

o. Disconnect the test setup.

HORIZONTAL SYSTEM

EQUIPMENT REQUIRED (see Table 4-1)

Time-Mark Generator (Item 4)	Termination (Item 12)
Coaxial Cable (Item 10)	10X Probe (Item 16)
Precision Coaxial Cable (Item 11)	1X Probe (Item 17)

1. Check Cursor Readout Accuracies for the A and B Acquisition Systems.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Set:	CH1 VOLTS/DIV	1V
	CH2 VOLTS/DIV	2V

Select CURSOR FUNCTION

Set:	TIME	On

b. Use the CURSOR/DELAY control to align the movable cursor (it will have more dots than the alternate cursor) to the third graticule line to the left of center screen.

c. Press CURSOR SELECT to enable the alternate cursor.

d. Use the CURSOR/DELAY control to align cursor to the third graticule line to the right of center screen.

e. CHECK—That the Cursor Time Readout indicates 2.9700 to 3.0300 ms.

f. Set the HORIZONTAL MODE to B.

g. CHECK—That the Cursor Time Readout indicates 2.9700 to 3.0300 ms.

2. Verify the Sample Rate of the A and B Acquisition Systems and Check the Horizontal Display Accuracy.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE

Set:	CH2	Off

Set:	CH1 VOLTS/DIV	500mV
	A SEC/DIV	100ns
	A/B TRIG	B

b. Connect the MARKER OUT signal of a Time Mark Generator to the CH1 input through a 50-Ω cable. Do not use a terminator.

c. Set the generator's marker period to 0.1 μs.

d. Push INIT @ 50% to set the B Trigger level.

e. VERIFY—That one time marker per horizontal division is displayed.

f. CHECK—That the spacing between the time markers nearest the third and ninth vertical graticule lines is 6 divisions, ±0.06 division.

g. Set HORIZONTAL MODE to B and set the B SEC/DIV control to 100 ns.

h. VERIFY—That one marker per horizontal division is displayed.

i. CHECK—That the spacing between the time markers nearest the third and ninth vertical graticule lines is 6 divisions, ±0.06 division.

j. Rotate the A and B SEC/DIV control counterclockwise one position to set both acquisition systems one speed slower.

k. Set the generator's marker period to match the acquisition rate set in the last part.

l. VERIFY—That one marker per horizontal graticule line is displayed.

m. CHECK—That the spacing between the time markers nearest the third and ninth vertical graticule lines is 6 divisions, ±0.06 division.

n. Set HORIZONTAL MODE to A.

o. VERIFY—That one marker per horizontal division is displayed.

p. CHECK—That the spacing between the time markers nearest the third and ninth vertical graticule lines is 6 divisions, ±0.06 division.

q. Set HORIZONTAL MODE to B.

r. Repeat parts j through q to verify all A and B acquisition rate settings down to 500 ms.

s. Disconnect the test setup.

3. Verify the DELAY TIME and Δ DELAY TIME Functions, Check Δ DELAY TIME Resolution, and Check Accuracy of the Time-Base Reference (using the Δ DELAY TIME function).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select:	VERTICAL MODE	
Set:	CH2	Off
Set:	CH1 VOLTS/DIV	500mV
	A SEC/DIV	20μs
	HORIZONTAL MODE	A INTEN
	B SEC/DIV	500ns
	A/B TRIG	B

b. Select TRIGGER MODE and set RUNS AFTER on. Set A/B TRIG to A.

c. Use the HORIZONTAL POSITION control to align the Trigger Point Indicator (a small "T" on the displayed trace) to the vertical graticule line 3 divisions left of center screen.

d. Connect the MARKER OUT signal of a Time Mark Generator to the CH1 input through a 50-Ω cable. Do not use a terminator.

e. Set the generator's marker period to 20 μs. Vertically position the bottom of the CH 1 display to 1 division below center screen.

f. Select DELAY TIME and use the CURSOR/DELAY control to adjust the DELAY TIME Readout for a reading of 120.00 μs.

g. VERIFY—That the intensified zone is on the time marker that is 3 divisions right of center screen.

h. Set the HORIZONTAL MODE to B. VERIFY—the B Trigger Point Indicator is on the rising edge of the displayed time marker.

i. Set the HORIZONTAL MODE to A INTEN and use the HORIZONTAL POSITION control to position the A Trigger Point Indicator to the graticule line 4 divisions left of center screen.

j. Use the CURSOR/DELAY control to adjust the DELAY TIME Readout for a reading of 20.00 μs (the intensified zone will be aligned to the time marker 3 divisions left of center screen).

k. Press the Δ TIME ON/OFF menu button to set Δ TIME ON.

l. Using the CURSOR/DELAY control, adjust the Δ DELAY TIME Readout for a reading of 120.00 μs.

m. VERIFY—That the Δ DELAY intensified zone is on the marker 3 divisions right of center screen.

n. Slightly rotate the CURSOR/DELAY control to increase the Δ DELAY TIME reading the least amount possible.

o. CHECK—That the readout can be advanced in increments at least as small as 0.04 μs.

p. Rotate the CURSOR/DELAY control to set the Δ DELAY TIME readout to 500 μs.

q. Set the HORIZONTAL MODE to B, then set the B SEC/DIV control to 5 ns.

r. Use the HORIZONTAL POSITION control to align the two Trigger Point Indicators to the center vertical graticule line.

s. CHECK—That the two time markers displayed are not horizontally separated by more than 1.5 divisions at the points where their rising edges cross the center horizontal graticule line.

t. Disconnect the test setup.

4. Verify the DELAY EVENTS function.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH2 COUPLING/INVERT		
Set:	50Ω ON|OFF	OFF
Set:	CH1 VOLTS/DIV	1V
	CH2 VOLTS/DIV	2V
	A SEC/DIV	5ms
	A/B TRIG	B

b. Select TRIGGER MODE and set RUNS AFTER on. Set A/B TRIG to A.

c. Connect the MARKER OUT signal of a Time Mark Generator to the CH1 input through a 50-Ω cable. Do not use a terminator.

d. Set the generator's marker period to 5 ms.

e. Connect the A TRIG (TTL) output at the scope's rear panel to the CH2 input connector with a 50-Ω BNC cable. Do not use a terminator.

f. Use the VERTICAL POSITION controls to position the CH1 and CH2 displays for easy viewing.

g. Select TRIGGER SOURCE and push the EXT menu button. Set A AND B EXT to EXT1/5.

h. Press the A/B TRIG button to select the B Trigger System.

i. Select TRIGGER SOURCE and push the EXT menu button. Set B EXT SOURCE 1\|2 to 1. Press the A/B TRIG button to return to the A Trigger System.

j. Connect the output of a Leveled Sine-wave Generator to the EXT TRIG 1 input via a 50-Ω BNC cable and a 50-Ω terminator.

k. Set the Leveled Sine-wave Generator's amplitude to 3 volts and its frequency to 2 MHz.

l. Set the HORIZONTAL MODE to B and set the B SEC/DIV control to 50 μs.

m. Use the HORIZONTAL POSITION control to align the Trigger Point Indicators to the graticule line 3 divisions right of center screen.

n. Set the HORIZONTAL MODE to A.

o. Select DELAY EVENTS and set EVENTS ON\|OFF to ON. Use the CURSOR/DELAY control to set the EVENTS COUNT to 60001 B TRIGS.

p. VERIFY—That the falling edge of the A Trigger signal displayed in CH2 is 3 divisions left of center screen.

q. Set the HORIZONTAL MODE to B.

r. VERIFY—That the rising edge of the displayed time marker can be aligned to the Trigger Point Indicator approximately 3 divisions right of center screen using the CURSOR/DELAY control.

s. Disconnect test setup.

ADDITIONAL VERIFICATIONS AND CHECKS

NOTE

Items 20 and 22 through 24 are only needed to check instruments equipped with the Video Option (Option 05). Item 21 is needed to check both the standard instrument and the option 5 instrument.

EQUIPMENT REQUIRED (see Table 4-1)

Calibration Generator (Item 3)
Digital Voltmeter (DMM) (Item 7)
GPIB Controller (Item 8)
GPIB Interface Cable (Item 9)
Coaxial Cable (Qty 2) (Item 10)
Termination (Item 12)
10X Attenuator (Qty 2) (Item 13)
1X Probe (Item 17)
BNC Female-to-Dual Adapter (Item 19)
Sine-Wave Oscillator (Item 20)
Pulse Generator (Item 21)
Sync and Linearity Test Generator (Item 22)
Coaxial Cable (Qty 2) (Item 23)
Termination (Qty 2) (Item 24)

1. Check Gain Match Between NORMAL and Save Acquisition Modes.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH1 COUPLING/INVERT		
Set:	50Ω ON:OFF	OFF
Select STORAGE ACQUIRE		
Set:	AVG	On
Select VERTICAL MODE		
Set:	CH 2	Off

b. Connect the Calibration Generator's STD AMPLITUDE output to the CH1 input connector. Set the generator's output level to .5 V and center the displayed square wave on screen.

c. Select CURSOR FUNCTION and set VOLTS on.

d. Using the CURSOR/DELAY control, align the enabled cursor (segmented) to the top of the displayed square wave.

e. Press CURSOR SELECT to enable the alternate cursor (it will change from solid to segmented). Align the cursor to the bottom of the square wave.

f. Note the CURSOR VOLTS readout value.

g. Select STORAGE SAVE to save the display. Realign the cursors to the saved square wave if required.

h. CHECK—That the CURSOR VOLTS readout value is within 12 mV of the value noted in part f.

i. Disconnect the test setup.

2. Verify the Cursor Units and Functions.

NOTE

This check VERIFIES the functionality of the cursors. The accuracy of the cursor readout is checked in the Vertical and Horizontal Systems subsections of this procedure.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE		
Set:	CH2	Off
Select CH1 COUPLING/INVERT		
Set:	50Ω ON¦OFF	OFF
Select TRIGGER MODE		
Set:	AUTO	On
Select CURSOR FUNCTION		
Set:	TIME	On

b. Use the CURSOR DELAY control to align the enabled time cursor to the vertical graticule line 2 divisions left of center screen.

c. Press the CURSOR SELECT button to enable the alternate cursor (realign the Trigger Point Indicator (small "T") to center screen (if necessary) and align it to the graticule line 2 divisions right of center screen.

d. VERIFY—That the cursor readout indicates approximately 2.00 ms.

e. Select CURSOR UNITS and set Δ¦ABS to ABS. VERIFY—That the cursor readout indicates approximately 1.00 ms.

f. Return Δ¦ABS to Δ and set DEGREES on. Press the NEW REF menu button.

g. VERIFY—That the cursor readout indicates approximately 360.00° and that TIME CURSOR REF = indicates approximately 2.00 ms.

h. Set Δ¦ABS to ABS. VERIFY—That the cursor readout indicates approximately 180.00°.

i. Set % on. VERIFY—That the cursor readout indicates approximately 50.00%.

j. Set SEC on and Δ¦ABS to Δ.

k. Select CURSOR FUNCTION and set 1/TIME on. VERIFY—That the cursor readout indicates approximately 500.00 Hz.

l. Set VOLTS on. Select CURSOR UNITS and set dB on.

m. Use the CURSOR DELAY control to align one volt cursor to the graticule line 2 divisions above center screen and the other volt cursor to the line 2 divisions below center screen. Use the CURSOR SELECT button to toggle between cursors.

n. Press the NEW REF menu button. VERIFY—That the cursor readout indicates 0.0 dB.

o. Align the enabled cursor to the center horizontal graticule line. VERIFY—That the cursor readout indicates approximately −6.00 dB.

p. Connect the CALIBRATOR signal to the CH1 input connector through a X1 probe.

q. Vertically center the display (do not position horizontally). Use the TRIGGER LEVEL control to trigger the display.

r. Set the CURSOR UNITS menu to VOLTS and select the CURSOR FUNCTION menu. Set V@T on.

s. Position one time cursor to 1 division left of center screen; position the other time cursor to 1 division right of center screen. VERIFY—That the cursor readout indicates approximately 400.00 mV.

t. Set the CURSOR FUNCTION menu to SLOPE. VERIFY—That the cursor readout indicates approximately 400.00 V/s.

u. Disconnect test setup.

3. Verify STORAGE SAVE Functions.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select TRIGGER MODE
Set: AUTO On

b. Use the VERTICAL POSITION controls to position the CH 1 trace 2 divisions above graticule center and the CH 2 trace 2 divisions below graticule center.

c. Select VERTICAL MODE and set ADD on (ADD trace will be at graticule center).

d. Select STORAGE SAVE and press the menu button labeled CH1 (the menu will change from SAVEREF SOURCE to SAVEREF DESTINATION).

e. Press the menu button labeled REF1 (the menu will change back to SAVEREF SOURCE). Press CH2, REF2, ADD, REF3, REF, REF1, and REF4 in that order (menu will change for each button push) to store CH2 in REF2, ADD in REF3, and REF1 in REF4.

f. Select VERTICAL MODE and set CH1, CH2, and ADD off.

g. Select STORAGE DISPLAY REF and press the REF1, REF2, and REF3 buttons. VERIFY—That the REF1 trace is displayed 2 divisions above, the REF2 trace 2 divisions below, and the REF3 trace at center screen.

h. Press the HORIZ POS REF menu button (menu will change) and set REF1 on for the displayed menu. VERIFY—That the HORIZONTAL POSITION control can position the REF1 trace horizontally. Repeat verification for REF2 and REF3.

i. Set REF HPOS REF!LOCK to LOCK. VERIFY—That the HORIZONTAL POSITION control now positions all displayed REF traces simultaneously.

j. Press the DISPLAY REF menu button to return to that menu. Set REF1 off and REF4 on. VERIFY—That the REF4 trace replaces the REF1 trace.

4. Verify Auto Setup.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE
Set: CH2 Off

Select: CH 1 COUPLING/INVERT
Set: 50Ω ON!OFF Off

Select: CH 2 COUPLING/INVERT
Set: 50Ω ON!OFF Off

b. Connect the output of a pulse generator to the CH 1 and CH 2 inputs through a 50-Ω cable, a 10X attenuator, and a dual-input coupler.

c. Set the CH 1 VOLTS/DIV to 100 mV and the A SEC/DIV to 20 μs.

d. Set the generator's output for a 500 mV pk-pk amplitude with the peak levels ±250 mV around the ground indicator ("+", at the left side of the screen).

e. Set the generator period for 100 μs (5 divisions) and the pulse duration (positive duration) for approximately 25 μs (1.25 divisions).

f. Push the front-panel button labeled AUTO to do an Auto Setup on the input waveform for CH 1.

g. VERIFY—That the scope displays the Auto Setup menu and the message "AUTOSETUP WORKING: PLEASE WAIT" as it acquires information about the CH 1 waveform.

h. VERIFY—That the Auto Setup mode is VIEW (from the recalled front-panel setup).

i. VERIFY (after the message is removed)—That several cycles of the Channel One cycle are displayed centered vertically on screen. The display amplitude should be approximately 5 divisions, and the Trigger Point Indicator (a small "T", riding on the waveform) should be at center screen.

j. Set the input coupling to AC in the CH 1 COUPLING/INVERT menu to remove the average dc component from the waveform and create waveform with DC offset from ground (that is, one not centered vertically around ground).

k. Push AUTO. VERIFY—That the scope sizes the waveform to handle the offset by increasing the VOLT/DIV setting. The display amplitude should be about 2.5 divisions on screen.

l. Return the CH 1 coupling to DC.

m. Select VERTICAL MODE and set CH 2 on.

n. Push AUTO. VERIFY—That the scope scales both the CH 1 and CH 2 waveforms and positions the CH 1 waveform to the top half of the screen and the CH 2 waveform to the bottom half. The amplitude of each display should be about 2.5 divisions.

o. Set the Auto Setup MODE to PERIOD. VERIFY—that the menu entry RES HI¦LO appears with the setting LO.

p. Select VERTICAL MODE and set CH 2 back off.

q. Push the AUTO button. VERIFY—That between 1 and 2 cycles of the waveform are displayed on screen. The amplitude should be about 2.5 divisions and the Trigger Point Indicator should be near the beginning of the 20-division waveform record. The trigger slope should be positive.

r. Set the input coupling to AC in the CH 1 COUPLING/INVERT menu to remove the average dc component from the waveform and create waveform with DC offset from ground.

s. Push AUTO. VERIFY—That the scope handles DC offset by positioning the ground indicator ("+") down about ½ division below center screen.

t. Set RES HI¦LO to HI in the Auto Setup menu.

u. Return the CH 1 coupling to DC.

v. Push AUTO. VERIFY—That the waveform is displayed with about a 5-division amplitude, with about 1-2 cycles included in the ENTIRE 20-division waveform record. Use the HORIZONTAL POSITION control to view the entire waveform. The waveform should be triggered on the positive slope with the Trigger Point Indicator near the beginning of the record.

w. Set the RES (Resolution) back to LO and the Auto Setup mode to PULSE.

x. Push AUTO. VERIFY—That the positive ¼-cycle of the waveform is displayed on screen. The amplitude is about 2.5 divisions, and the trigger point is near the beginning of the record, triggered on the positive slope.

y. Set the generator to produce a COMPLEMENT pulse; that is, one with a negative ¼-cycle pulse duration.

z. Push AUTO. VERIFY—That the negative ¼-cycle of the waveform is displayed on screen. The amplitude is about 2.5 divisions, and the trigger point is near the beginning of the record, triggered on the negative slope.

aa. Set the RES to HI.

bb. Push AUTO. VERIFY—That the negative ¼-cycle of the waveform is displayed over about 10 of the 20 divisions in the waveform record. The amplitude is about 5 divisions, and the trigger point is near the beginning of the record, triggered on the negative slope.

cc. Set the RES to LO and the mode to _/‾.

dd. Push AUTO. VERIFY—That the positive-going (rising) edge of the waveform is displayed on screen with the Trigger Indicator at center screen. Waveform amplitude is about 2.5 divisions.

ee. Set the MODE to ‾_.

ff. Push AUTO. VERIFY—That the falling (negative-going) edge of the waveform is displayed on screen with the Trigger Indicator at center screen. Waveform amplitude is about 2.5 divisions.

gg. Set the RES to HI.

hh. Push AUTO. VERIFY—That the falling (negative-going) edge of the waveform is displayed over about 10 of the 20 divisions in the waveform record with the same triggering as for RES LO setting. Waveform amplitude is about 5 divisions.

ii. Disconnect the test setup.

5. Verify MEASURE for SNAPSHOT and Continuous-Update Modes.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE		
Set:	CH2	Off
Select: CH 1 COUPLING INVERT		
Set:	50Ω ON!OFF	Off
Select: CH 1 COUPLING INVERT		
Set:	50Ω ON!OFF	Off

b. Connect the STD OUTPUT of the Calibration Generator to the CH 1 and CH 2 waveforms via a 50-Ω cable and a dual-input coupler.

c. Set the output of the generator to .5 volts.

d. Push AUTO to do an Auto Setup on the CH 1 waveform. Since AUTOsetup executed in VIEW mode, there should be several cycles of the square wave displayed on screen.

e. Set the AUTOsetup mode to PERIOD and push AUTO.

f. Push MEASURE (next to PRGM, which is right of AUTO) to display that menu.

g. Push SETUP in the menu and set METHOD to HIST and MARK to ON.

h. Press MEASURE again and then SNAPSHOT. VERIFY—That the SNAPSHOT menu is displaying values for 20 parameters approximately agreeing with the expected values. For instance, P-P (peak-to-peak) and TOP should be about 500 mV, and DUTY (duty cycle) should be about 50%.

i. Set the generator to .2 V.

j. Press the INIT@50% front-panel button (located in the TRIGGER section of the controls) to trigger the display.

k. Push AGAIN. VERIFY—That SNAPSHOT readou updates the parameters (P-P and TOP are now abou 200 mV).

l. Set CH 2 on in the VERTICAL MODE menu (leave CH 1 on). Set the CH 2 VOLT/DIV to the same setting as CH 1.

m. Select MEASURE and push SNAPSHOT. Push CH 2 in the TARGET menu displayed.

n. VERIFY—That the parameter values are now displayed for CH 2 (screens read "SNAPSHOT OF CH2").

o. Push the upward-arrow menu button to return to the main MEASURE menu.

p. Set CH 2 off in the VERTICAL MODE menu.

q. Push MEASURE and set WINDOW ON.

r. Push MEAS TYPE and use the direction arrows in the displayed menu to move the underline to PK-PK and press the on button to display the parameter. Repeat for BASE, FREQ, and PERIOD. VERIFY—That as each is turned on the value displayed approximately agrees with the expected values (200 mV, 0 V, 1 kHz, and 1 ms, respectively).

s. VERIFY—That two X's (MARKs) bracket one cycle of the squarewave to indicate where FREQ and PERIOD are being measured (MARKs are displayed for time measurements only).

t. Push CURSOR FUNCTION and set TIME on in the menu displayed.

u. Use the CURSOR/DELAY knob to adjust the active cursor to the center of one positive ½-cycle of the waveform.

v. Push CURSOR SELECT to select the alternate cursor. Adjust it to the center of the following negative ½-cycle of the waveform.

w. VERIFY—That the BASE and PK-PK values displayed are still approximately correct, but the values for FREQ and PERIOD are replaced with the message "NEED 3 EDGES".

x. Adjust the active cursor to the same ½-cycle as the other cursor. VERIFY—That the PK-PK value drops to approximately 0 volts.

y. Use the CURSOR/DELAY and SELECT controls to bracket slightly more than one cycle (3 EDGES) of the waveform. All 4 parameters should be as verified in part r.

z. Disconnect the test setup.

6. Verify Operation of the AutoStep Sequencer.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select: VERTICAL MODE		
Set:	CH2	Off
Set:	A SEC/DIV	50 ms

b. Press the PRGM front-panel button. VERIFY—The AUTOSTEP SEQUENCER menu is displayed.

c. Press the SAVE menu button. This calls up a submenu for labeling the front-panel setup with a 1-6 character name so it can be recalled later.

d. VERIFY—That a sequence can be labeled and that label saved by doing the following:

Use the arrows under ROLL-CHARS to create a label (use TEST1) for the front-panel setup as outlined here in steps a-d:

1. Select the first character for the label. Use the arrow-labeled buttons to select the first letter for the sequence label. Press the ↓ button to step forward in the alphabet and digit (0-9) and the ↑ button to step backwards. Holding down the buttons moves through the character continuously; a single press moves forward or backward one character. (There is a "blank space" character between the digit 9 and letter A.)
2. When you have displayed the letter for the first character of the label, push CURSOR <> to move to the next character. Repeat part 1 to select the letter for the next character of your label.
3. Repeat the last step until "TEST1" is spelled out. (You can return to any character by continually pushing CURSOR <>, since it reverses the selection order after the first and sixth character is selected.)

e. Push menu button labeled SAVE when the label is complete.

f. VERIFY—That, when SAVE is pushed, the scope displays a message indicating "SEQUENCE TEST1 STEP 1" and the remaining memory in percent.

g. Position the CH 1 trace to the graticule line 3 divisions above graticule center. Push PRGM to advance to sequencer step 1 actions.

h. VERIFY—That the SET STEP ACTIONS for Step 1 is displayed.

i. Use the arrow buttons to move the underline to the "<N>" following the ACTION called REPEAT. Push Y/N to toggle the action to Y ("Y" stands for Yes or On).

j. Now move the underline to the ACTION called BELL, and turn BELL on (set to Y). Using the same procedure, turn PAUSE on also.

k. Push NEXT STEP. VERIFY—That the on-screen message indicates STEP 2.

l. Position the CH 1 trace to the graticule line 1 division above graticule center. Push PRGM to advance to sequencer step 2 actions.

m. VERIFY—That REPEAT, PAUSE, and BELL are the only actions on.

n. Push Y/N to turn REPEAT off. Push NEXT STEP.

o. The message should now say STEP 3. Position the CH 1 trace to the graticule line 1 division below graticule center. Push PRGM to advance to sequencer step 3 actions.

p. PAUSE and BELL are the only actions on. Push NEXT STEP to advance to sequencer step 4.

q. Position the CH 1 trace to the graticule line 3 divisions below graticule center. Push PRGM to advance to sequencer step 4 actions. PAUSE and BELL should be the only action on.

r. Push SAVE SEQ to save the sequence. VERIFY—That the main AUTOSTEP SEQUENCER menu is returned and the message "SEQUENCE SAVED" is displayed.

s. Push RECALL to display the menu for recalling sequences. VERIFY—That TEST1 appears in the list of CURRENT SEQUENCES.

t. Use the arrow buttons to move the underline (select) TEST1.

u. Push RECALL. VERIFY—That the BELL rings and the setup stored as step 1 is displayed. The CH 1 trace should be located 3 divisions above graticule center.

v. Push PRGM (front-panel button). VERIFY—That the BELL rings and the setup stored as step 2 is displayed. The CH 1 trace should be located 1 division above graticule center.

w. Push PRGM. VERIFY—That the BELL rings and the setup stored as step 3 is displayed. The CH 1 trace should be located 1 division below graticule center.

x. Push PRGM. VERIFY—That the BELL rings and the setup stored as step 4 is displayed. The CH 1 trace should be located 3 divisions below graticule center.

y. Push PRGM. VERIFY—That the BELL rings and the sequence loops back to display step 1 of the sequence.

z. Connect the STEP COMPLETE output BNC (rear panel) to the banana plug inputs of a DMM via a 50-Ω cable and a BNC female-to-banana adapter. When connecting the adapter to the DMM, put the side with the bump marked "GRD" to the LOW or (—) input jack.

aa. Set the DMM to the 20 DC VOLT range. CHECK—That the DMM reading is ≤ 0.5 V.

bb. Push PRGM to advance to sequence step 2. CHECK—That the DMM reading momentarily jumps to a level ≥ 2.5 V and ≤ 3.5 V before returning to the level measured in subpart aa.

cc. Move the 50-Ω cable from the STEP COMPLETE output to the SEQ OUT output BNC. CHECK—That the DMM reading is ≥ 2.5 V and ≤ 3.5 V.

dd. Push PRGM once to advance to sequence step 3. Wait until step 3 is loaded and then push PRGM again to advance to step 4.

ee. CHECK—That the DMM reading is ≤ 0.5 volts.

ff. Connect the square wave output of a generator (such as Item 19) capable of outputting nominal TTL levels to the SEQ IN input via a 50-Ω cable. Set the output frequency of the generator to 10 Hz.

gg. VERIFY—That the scope continuously loops through sequencer steps 1 to 4 in response to the generator input.

hh. Push EXIT. VERIFY—That the RECALL menu is returned.

ii. Push EXIT. VERIFY—That the main AUTOSTEP SEQUENCER menu is returned.

7. GPIB Functionality Verification.

NOTE

Verification Step 7 assumes a TEKTRONIX 4041 Controller will be used for verifying GPIB Functionality. Examples of Talk-Listen Programs for some other controllers can be found in the Programmers Reference Guide included with this instrument. Users will have to adapt this verification step for use with controllers other than the TEKTRONIX 4041.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure).

b. Select OUTPUT (the button to the lower right of SEC/DIV control) and press the menu button labeled SETUP (menu will change).

c. Press the menu button labeled MODE to display that menu.

d. Set T/L on. VERIFY—That the ADDR light is off.

e. Set L/ONLY on. VERIFY—That the ADDR light is on.

f. Set T/ONLY on. VERIFY—That the ADDR remains on. Set the mode back to T/L.

g. Select OUTPUT and press the menu button labeled SETUP.

h. Press the menu button labeled ADDR to select that menu.

i. Press the menu button labeled ↑ or ↓ to set the GPIB ADDRESS to 1. The ↑ increments the address and the ↓ decrements it.

j. Select OUTPUT and press the menu button labeled SETUP. Press the menu button labeled TERM (menu will change).

k. Set either EOI or LF/EOI on according to the specification of the controller.

l. Turn on the controller and enter a program that can deliver commands and queries to, as well as receive response from the scope.

m. Connect the GPIB controller to the oscilloscope's rear-panel GPIB CONNECTOR using the GPIB cable.

n. Run the program entered for subpart l.

o. Enter 1 in response to the controller's prompt for the oscilloscope's address (the controller may or may not issue an error code and event number in response).

p. Enter the command RQS ON.

q. Press the instrument's POWER button twice to power the instrument OFF and then ON.

r. VERIFY—That all three GPIB STATUS lights illuminate during the instrument's power-up sequence.

s. VERIFY—The GPIB STATUS SRQ light is still illuminated when the power-up sequence is finished.

t. Enter a carriage return at the controller.

u. VERIFY—That the GPIB STATUS SRQ light is no longer illuminated.

v. Enter the command LOCK ON on the controller. VERIFY—That the LOCK light is illuminated.

w. Enter the following commands on the controller:

1. ↓ VMOde ADD!ON
2. CH1 VOLts!1E-1, VARiable—50, POSition:2, COUpling:GND, FIFty:OFF, INVert:ON
3. CH2 VOLts:1E-1, VARiable:50, POSit-2, COUpling:GND, FIFty:OFF, INVert:ON
4. BWLimit TWEnty
5. HORizontal ASEC:1E-3,BSEC:1E-4
6. DLTime DELta:ON,DLY1:1E-3,DLY2:1E-3

x. Enter the command RTL to the controller. VERIFY—That the LOCK light is extinguished.

y. Select BEAMFIND. VERIFY—That front panel STATUS readout indicates the control setting changes sent over the controller in part I have been performed.

z. Press the MENU OFF/EXTENDED FUNCTIONS button.

aa. VERIFY—That the CH1 trace is displayed 2 divisions above the center graticule line with an intensified zone 1 division right of center screen.

bb. VERIFY—That the CH2 trace is displayed 2 divisions below the center graticule line with an intensified zone 2 divisions right of center screen.

cc. Enter the command VMOde? to the controller.

dd. VERIFY—That the controller's display indicates that the oscilloscope's VERTICAL MODE setting is CH1 on, CH2 on, and ADD On.

ee. Disconnect the test setup.

8. Check A TRIGGER and RECORD TRIGGER Outputs for Logic Polarity and Minimum HI/LO (50-Ω loads).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Set:	CH 1 VOLTS/DIV	200mV
	CH 2 VOLTS/DIV	200mV
Select TRIGGER SOURCE		
Set:	LINE	On

b. Connect the RECORD TRIGGER OUTPUT (rear panel) to the CH 1 input connector via a 50-Ω cable and a 50-Ω terminator.

c. Connect the TRIGGER OUTPUT (rear panel) to the CH 2 input connector via a 50-Ω cable and a 50-Ω terminator.

d. Using the CH 1 and CH 2 VERTICAL POSITION controls, position the CH 1 waveform to the top-half of the screen and the CH 2 to the bottom-half for easy viewing.

e. CHECK—That both of the waveforms are displayed with their falling edges aligned to the Trigger Point Indicator (a small "T" riding on each waveform).

f. Select CURSORS FUNCTION and set VOLTS ON.

g. Select CURSOR UNITS and set Δ!ABS to ABS.

h. Use the CURSOR/DELAY control to align the Voltage cursor to the top flat portion of the CH 1 waveform.

i. CHECK—That the Cursor Readout indicates a voltage ≥ 450 mV.

j. Align the Voltage cursor to the bottom flat portion of the CH 1 waveform.

k. CHECK—That the Cursor Readout indicates a voltage <= 150 mV.

l. Press the CURSOR FUNCTION button twice to display the Attach Cursors menu and set CH 2 on for the displayed menu.

m. Repeat parts h through k, aligning the cursor to the CH 2 waveform instead of the CH 1.

n. Disconnect the test setups.

9. Check Square-Wave Flatness (Video Option 05 only).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Set:	CH1 VOLTS/DIV	200 mV
	CH2 VOLTS/DIV	50 mV
	A SEC/DIV	2 ms
Select: VERTICAL MODE		
Set:	CH2	Off

b. Connect the fast-rise, positive going square-wave output to the CH1 input connector via a 50-Ω cable and a 50-Ω terminator. The square wave should step from −1 V to 0 V.

c. Set the generator to produce a 60-Hz, five-division display and use the CH1 POSITION control to center the display as required.

d. Set the CH1 VOLTS/DIV control to 50 mV.

e. CHECK—Display front-corner aberrations are within 1% (0.2 division or less). Exclude the first 20 ns immediately following the positive going transition from the measurement.

f. Set CH2 on and CH1 off.

g. Move the cable from the CH1 input connector to the CH2 input connector.

h. CHECK—Display front-corner aberrations are within 1% (0.2 division or less). Exclude the first 20 ns immediately following the positive going transition from the measurement.

i. Set the CH2 VOLTS/DIV control to 5 mV.

j. Install a 10X attenuator between the 50-Ω cable and the terminator and reconnect the setup.

k. CHECK—Display front-corner aberrations are within 1% (0.2 division or less). Exclude the first 20 ns immediately following the positive going transition from the measurement.

l. First set the CH 2 VOLTS/DIV control to 50 mV, then set CH1 on and CH2 off.

m. Move the cable from the CH2 input connector to the CH1 input connector. Set the CH1 VOLTS/DIV control to 5 mV.

n. CHECK—Display front-corner aberrations are within 1% (0.2 division or less). Exclude the first 20 ns immediately following the positive going transition from the measurement.

o. Set the CH1 VOLTS/DIV control to 200 mV and set the A SEC/DIV control to 10 μs.

p. Remove the 10X attenuator and reconnect the test setup.

q. Set the generator to produce a 15-kHz, 5-division display.

r. Repeat parts d through n to check square-wave flatness at 15 kHz.

s. Disconnect test setup.

10. Check Frequency Response Flatness (FULL and 20 MHz BANDWIDTH Modes) (Video Option 05 only).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Set:	CH1 VOLTS/DIV	10 mV
	CH2 VOLTS/DIV	10 mV
	A SEC/DIV	20 μs
Select: VERTICAL MODE		
Set:	CH2	Off
Select: BANDWIDTH		
Set:	20 MHz	On

b. Connect the output of a Leveled Sine-Wave Generator to the CH1 input connector via a 50-Ω cable, two 10X attenuators, and a 50-Ω terminator.

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

d. Increase the generator output frequency to 5 MHz and set the A SEC/DIV control to 200 ns.

e. CHECK—Display amplitude is between 4.80 and 5.05 divisions.

f. Set the BANDWIDTH LIMIT menu to FULL. Set the A SEC/DIV control back to 20 μs.

g. Repeat parts c and d.

h. CHECK—Display amplitude is between 4.95 and 5.05 divisions.

i. Increase the generator frequency to 10 MHz and set the A SEC/DIV control to 50 ns.

j. CHECK—Display amplitude is between 4.90 and 5.05 divisions.

k. Increase the generator frequency to 30 MHz and set the A SEC/DIV control to 20 ns.

l. CHECK—Display amplitude is between 4.85 and 5.10 divisions.

m. Set the CH1 VOLTS/DIV control to 50 mV and the A SEC/DIV to 20 μs. Set 20 MHz on for the displayed BANDWIDTH menu.

n. Remove one of the 10X attenuators from the test setup.

o. Repeat parts c through l.

p. Set the CH1 VOLTS/DIV control to 200 mV and the A SEC/DIV control to 20 μs. Set 20 MHz on for the displayed BANDWIDTH menu.

q. Remove the last 10X attenuator from the test setup.

r. Repeat parts c through l.

s. Move the cable from the CH1 input connector to the CH2 input connector. Insert the two 10X attenuators back into the test setup.

t. Select VERTICAL MODE and set CH2 on and CH1 off. Return the A SEC/DIV control to 20 μs.

u. Select BANDWIDTH and set 20 MHz on.

v. Repeat parts c through r using the CH2 VOLTS/DIV control.

w. Disconnect the test setup.

11. Check Video Back-Porch Clamp (CH2 only) (Video Option 05 only).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select CH2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Set:	CH1 VOLTS/DIV	500 mV
	CH2 VOLTS/DIV	50 mV
	A SEC/DIV	5 ms
Select TRIGGER SOURCE		
Set:	LINE	On
Select: BANDWIDTH		
Set:	20 MHz	On

b. Connect the output of a Sine-Wave RC Oscillator to the CH2 input connector via a 75-Ω cable.

c. Connect the composite sync output of a Video Sync Generator to the CH1 input connector via a 75-Ω cable and a 75-Ω termination. Select VERTICAL MODE and set CH1 off.

d. Set the oscillator to produce a 60-Hz, six-division display. Slightly adjust the output frequency of the oscillator to stabilize the 60-Hz display.

e. Set the A SEC/DIV control to 100 μs. Select TRIGGER SOURCE and set CH1 on.

f. Select SET VIDEO and set CLAMP ON/OFF to ON and TV LINE on.

g. CHECK—The amplitude of the sine wave is 1 division or less.

NOTE

An easy method of checking the expanded 60-Hz sine wave's amplitude is to observe the vertical "jitter" of the top of the Trigger Point Indicator (a small "T" riding on the sine wave). The top of the "T" should not jitter more than 1 division.

h. Set the CH2 VOLTS/DIV control to 100 mV and the A SEC/DIV control back to 5 ms.

i. Set CLAMP off for the displayed menu. Select TRIGGER SOURCE and set LINE on.

j. Repeat parts d through g.

k. Set the CH2 VOLTS/DIV control to 200 mV and the A SEC/DIV control back to 5 ms.

l. Set CLAMP off for the displayed menu. Select TRIGGER SOURCE and set LINE on.

m. Repeat parts d through g.

n. Disconnect the test setup.

12. Check Back-Porch Clamp Reference (CH2 only) (Video Option 05 only).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH1	Off
Set:	CH2 VOLTS/DIV	50 mV
	A SEC/DIV	1 μs
Select: BANDWIDTH		
Set:	20 MHz	On
Select CH2 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF

b. Connect a 100% modulated, composite video signal to the CH2 input connector via a 75-Ω cable and a 75-Ω termination. Do NOT adjust the CH2 POSITION control.

c. Select SET VIDEO and set CLAMP on.

d. CHECK—That the back-porch level is within 1 division of the center graticule line.

e. Disconnect the test setup.

13. Check Sync Separation (±SLOPE) (Video Option 05 only).

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH2	Off
Set:	CH1 VOLTS/DIV	50 mV
	A SEC/DIV	2 μs
	TRIGGER SLOPE	– (Minus)
Select: BANDWIDTH		
Set:	20 MHz	On
Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF

b. Connect the square-wave output of a Pulse Generator to the CH1 input connector via a 50-Ω cable and a 50-Ω termination.

c. Set the amplitude for a 3-division pulse, stepping negative from ground.

d. Use the HORIZONTAL POSITION control to position the Trigger Point Indicator (small "T" riding on the waveform) to the vertical graticule line 4 divisions left of graticule center.

e. Adjust the generator's PERIOD control for a 7.5-division (approximately 15 μs) period for the displayed square wave.

f. Adjust the generator's PULSE DURATION control until the negative going portion of the square wave is approximately 1 horizontal division in duration.

g. Switch the A SEC/DIV control to 500 ns.

h. Select CURSOR FUNCTION and set TIME on.

i. Use the CURSOR/DELAY control to align the left-most cursor to the falling edge of the negative going pulse (aligned to the graticule line in part d).

j. Press CURSOR SELECT to select the right-most cursor and adjust it for a readout of 2.000 μs.

k. Adjust the generator's PULSE DURATION until the negative-going portion of the square wave is aligned to the two cursors (i.e., is equal to 2.000 μs).

l. Select TRIGGER CPLG and set VIDEO on.

m. Select SET VIDEO and set TV LINE on.

n. Return the A SEC/DIV control to 2 μs. Press CURSOR SELECT and use the CURSOR/DELAY control to realign the left-most cursor to the falling edge of the pulse.

o. Press CURSOR SELECT and use the CURSOR/DELAY control to adjust the right-most cursor for a readout value of 13.000 μs.

p. Set the CH1 VOLTS/DIV control to 200 mV.

q. Adjust the generator to reduce the PERIOD of the waveform. Reduce the period until the display is stably triggered, but any further decrease in period causes an unstable display.

r. CHECK—That the negative-going edge of the second negative pulse is located between the two cursors.

s. Adjust the generator to return the waveform PERIOD to 7.5 divisions.

t. Select CH1 COUPLING/INVERT and set INVERT ON!OFF to ON. Switch TRIGGER SLOPE to + (plus).

u. Adjust the generator to reduce the PERIOD of the waveform. Reduce the period until the display is stably triggered, but any further decrease in period causes an unstable display.

v. CHECK—That the positive-going edge of the second negative pulse is located between the two cursors.

w. Disconnect the test setup.

14. Check VIDEO Trigger Modes.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see step i in "INITIAL SETUP" at the start of this procedure). Make the following changes to the front-panel setup:

Select VERTICAL MODE		
Set:	CH2	Off
Set:	CH1 VOLTS/DIV	200 mV
	A SEC/DIV	100 μs
	TRIGGER SLOPE	— (Minus)
Select: BANDWIDTH		
Set:	20 MHz	On
Select CH1 COUPLING/INVERT		
Set:	50Ω ON!OFF	OFF
Select TRIGGER CPLG		
Set:	VIDEO	On
Select SET VIDEO		
Set:	FIELD 1	On

b. Push the front-panel button labeled "MENU OFF/EXTENDED FUNCTIONS" twice to display the Extended Functions menu. Push VIDEO OPT in the menu. Set M!NON/M to M and CNT BOTH!F1 to F1.

c. Connect the composite sync output of a Sync Generator to the CH1 input connector via a 75-Ω cable and a 75-Ω termination.

NOTE

For NTSC composite sync input signals, the first field will have 263 lines, while the second field will have 262. The scope will display the line number in the extreme upper-right corner of the screen and the TVF (TV Field) number immediately to the right of the line number.

d. Adjust the TRIGGER LEVEL control for a line number reading of 1 and a field number reading of TVF1.

e. CHECK—That for the readout Trigger Point Indicator (a small "T" riding on the displayed waveform) indicates the scope is triggered on the first line of field 1.

f. Rotate the TRIGGER LEVEL control slightly counterclockwise while performing the CHECK during the following part.

g. CHECK—That the readout indicates the highest line number of the previous field for the multi-field input signal. For example, using an NTSC signal, the readout should indicate "TVF2 262".

h. CHECK—That the readout Trigger Point Indicator (a small "T" riding on the displayed waveform) indicates the scope is triggered on the last line of field 2.

i. Continue to rotate the TRIGGER LEVEL control counterclockwise while performing the CHECK during the following part.

j. CHECK—That the readout indicates progressively lower line numbers are being displayed for field 2 and that eventually the readout indicates the highest line number of the previous field for the multi-field input is being displayed. For example, using an NTSC signal, the readout should indicate "TVF1 263".

k. CHECK—That the readout Trigger Point Indicator (small "T" riding on the displayed waveform) indicates the scope is triggered on the last line of field 2.

l. Set the A VIDEO COUPLING (SET VIDEO menu) to ALT.

m. Use the TRIGGER LEVEL control to set the readout to "TVFLD 1", indicating that the first lines of both fields are displayed.

n. CHECK—That the readout Trigger Point Indicator (a small "T" riding on the displayed waveform) indicates the scope is triggered on the first lines of both fields.

NOTE

By switching A VIDEO COUPLING (SET VIDEO menu) between FIELD 1, FIELD 2, and ALT, it is easier to see which line for which field the scope is triggered on for ALT VIDEO COUPLING.

o. Rotate the TRIGGER LEVEL control slightly counterclockwise while performing the CHECK during the following part.

p. CHECK—That the readout indicates the highest line number common to both fields for the multi-field input signal. For example, using an NTSC signal, the readout should indicate "TVFLD 262".

q. CHECK—That the readout Trigger Point Indicator (a small "T" riding on the displayed waveform) indicates the scope is triggered on the last line COMMON to both fields. See the *NOTE* following part m above.

r. Push the front-panel button labeled "MENU OFF/EXTENDED FUNCTIONS" twice to display the Extended Functions menu. Push VIDEO OPT in the menu. Set CNT BOTH!F1 to F1.

s. Select SET VIDEO and set to FIELD 1. Repeat parts d to g to check that the line count displayed in step e is "TVF1 1" (set in step d) and continues to "TVF2 525" in step g (set in step f).

r. Disconnect the test setup.

15. Verify Teksecure Erase Memory Function (For instruments serial numbered B011821 and above only; instruments B011820 and below do not have this function.)

CAUTION

PERFORMANCE OF THIS STEP (15) IS OPTIONAL. If performed, it will erase from sequencer memory the Initial Setup established and stored at the beginning of this procedure. Any other sequences, stored reference waveforms, and waveforms saved on screen will be irretrievably lost.

This step uses the front panel to verify that the Teksecure Erase Memory feature erases sequencer and reference memories, as well as any waveforms currently saved on screen. It also verifies that the current front-panel setup is changed to the default values normally established when an INIT front-panel is performed.

NOTE

In addition to this step, an audit procedure is orderable (call (503) 627-2400) that performs a more direct verification of the status of the internal memory blocks. It requires removal of the instrument's cabinet and uses an emulator to look at memory contents. If such verification is necessary, it is strongly recommended that it be performed by Tektronix service personnel only. In any case, any procedure requiring cabinet removal must be referred to qualified service personnel.

a. Recall the Initial Front-Panel Setup, labeled "FPNL" (see Step i in "INITIAL SETUP" at the start of this procedure).

Select TRIGGER MODE		
Set:	AUTO	On
Select VERTICAL MODE		
Set:	CH2	Off
Set:	CH1 VOLTS/DIV	5 V
	A SEC/DIV	100 μs

b. Save CH 1 trace in REF memory 1: Position the CH 1 trace to the graticule line 3 divisions above center screen, then push SAVE to display the SAVEREF SOURCE menu. Now push CH1 in the menu and, when the menu changes, push REF1.

c. Reposition CH 1 trace and save in REF memory 2: Position the CH 1 trace to the graticule line 1 division above center screen. Now push CH1 and, when the menu changes, push REF2.

d. Reposition CH 1 trace and save in REF memory 3: Position the CH 1 trace to the graticule line 1 division below center screen. Now push CH 1 and, when the menu changes, push REF3.

e. Reposition CH 1 trace and save in REF memory 4: Position the CH 1 trace to the graticule line 3 divisions below center screen. Now push CH 1 and, when the menu changes, push REF4.

f. Reposition CH 1 trace and display REF memories 1-4: Push ACQUIRE and move the "live" CH 1 trace to the bottom of the graticule. Push DISPLAY REF, and then push REF1 through REF4 to display the saved CH 1 traces. Five traces should now be displayed.

g. Display Teksecure Erase Memory menu: Push the front-panel button labeled "MENU OFF/EXTENDED FUNCTIONS" twice to display the Extended Functions menu. Next, push SYSTEM and, when the menu changes, push PANEL. Now push the TEKSECURE ERASE MEMORY to display that menu.

h. Execute Teksecure Erase Memory: Push ERASE. The instrument screen will blank momentarily and then the message "RUNNING SELF TEST" will appear.

Failure of the SELF TEST that runs when Erase Memory is executed—even for reasons not related to internal RAM memory blocks—causes the Extended Diagnostics menu to be displayed, rather than the Teksecure Status menu. If this is *not* the case, continue this procedure at part i. If the Extended Diagnostics menu *is* displayed, do the following:

1. Push the MENU OFF/EXTENDED FUNCTIONS button once to force display of the Teksecure Status menu.

2. Perform part i and determine the Erase Memory status as instructed.

3. If status is determined ERASED, continue this procedure at part j; otherwise, perform part g again to access the Teksecure Erase Memory

menu, and push ERASE to execute another Erase Memory. Then, if the Erase Memory Status menu is not already displayed, push the MENU, OFF/EXTENDED FUNCTIONS button once to force the display of the Teksecure Status menu. Now perform part i, and, if the status is not ERASED, refer the instrument to qualified service personnel for repair.

NOTE

Even if the Erase Memory status is determined successfully, the failure that resulted in the SELF TEST failure should be serviced. After completing this procedure, run the Self Calibration procedure, followed by the Self Diagnostics procedure. (See Sections 5 and 6 of this manual or Appendix A of the Operators Manual for instructions on how to perform these procedures). If both are not successful, refer the instrument to qualified service personnel.

i. VERIFY—Internal memory status: Confirm that the message ERASED appears immediately following the TEKSECURE ERASE MEMORY STATUS caption, as well as after each of the captions for the individual blocks of RAM memory. If FAILED appears after any caption, perform parts g and h again to reexecute an Erase Memory. If status is still failed, this verification fails and the instrument should be referred to qualified service personnel for repair.

j. VERIFY—Front-panel and screen status: Confirm that CH 1 is set to 100 mV (was set to 5 V in part a) and that the A SEC/DIV is set to 1 ms (was set to 100 μs in part a). Confirm that the four traces that were saved in and displayed from REF memories 1-4 are no longer displayed, and that the "live" CH 1 trace is displayed at or near center screen.

k. VERIFY—Reference Memory status: Push DISPLAY REF. Confirm that the status "EMPTY" is displayed above the REF 1-4 labels in that menu. Now use the menu buttons to first display and then remove each REF memory. Confirm that each memory displays an invalid "waveform" that is, a horizontal line at center screen that is broken by (alternates with) full-screen fill areas.

l. VERIFY—Sequencer Memory Status: Push PRGM to display the AUTOSTEP SEQUENCER menu; then push RECALL to switch to the menu for recalling sequences. Confirm that the label FPNL (the label for the Initial Setup sequence), is no longer listed for recall. Further, confirm that no other sequences are listed for recall.

Confirmation of parts i through l constitutes a verification of the Teksecure Erase Memory feature.