Technical Reference

Tektronjx

TDS 500B, TDS 600B & TDS 700A Digitizing Oscilloscopes Performance Verification and Specifications

070-9720-01

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

Injury Precautions

Use Proper Power Cord	To avoid fire hazard, use only the power cord specified for this product.		
Avoid Electric Overload	To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.		
Ground the Product	This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.		
Do Not Operate Without Covers	To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.		
Use Proper Fuse	To avoid fire hazard, use only the fuse type and rating specified for this product.		
Do Not Operate in Wet/Damp Conditions	To avoid electric shock, do not operate this product in wet or damp conditions.		
Do Not Operate in Explosive Atmosphere	To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.		

Product Damage Precautions

Use Proper Power Source	Do not operate this product from a power source that applies more than the voltage specified.
Provide Proper Ventilation	To prevent product overheating, provide proper ventilation.
Do Not Operate With Suspected Failures	If you suspect there is damage to this product, have it inspected by qualified service personnel.
Do Not Immerse in Liquids	Clean the probe using only a damp cloth. Refer to cleaning instructions.

Safety Terms and Symbols

Terms in This Manual	These terms may appear in this manual:		
\bigwedge	WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.		
•			
\triangle	CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.		
Terms on the Product	These terms may appear on the product:		
	DANGER indicates an injury hazard immediately accessible as you read the marking.		

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product

The following symbols may appear on the product:



Certifications and Compliances

CSA Certified Power Cords CSA Certification includes the products and power cords appropriate for use in the North America power network. All other power cords supplied are approved for the country of use.

Preface

This is the Performance Verification and Specifications for the TDS 500B, TDS 600B, and TDS 700A Oscilloscopes. It contains procedures suitable for determining if each instrument functions, was adjusted properly, and meets the performance characteristics as warranted. The following models are covered:

TDS 500B:	TDS 520B and TDS 540B
TDS 600B:	TDS 620B, TDS 644B, TDS 680B, and TDS 684B
TDS 700B:	TDS 724A, TDS 754A, TDS 782A, and TDS 784A

This document also contains the technical specifications for these oscilloscopes.

Related Manuals

The following documents are related to the use or service of the digitizing oscilloscope:

- The TDS 500B, 600B & 700A User Manual (Tektronix part number 070-9719-XX).
- The TDS Family Programmer Manual (Tektronix part number 070-9556-XX) describes using a computer to control the digitizing oscilloscope through the GPIB interface.
- The *TDS 500B*, 600B & 700A Reference (Tektronix part number 070-9382-XX) gives you a quick overview of how to operate your digitizing oscilloscope.
- The TDS 500B, 600B & 700A Service Manual (Tektronix part number 070-9721-XX) provides information for maintaining and servicing the digitizing oscilloscope to the module level.

Preface

Performance Verification Procedures

Performance Verification Procedures

Two types of Performance Verification procedures can be performed on this product; *Brief Procedures* and *Performance Tests*. You may not need to perform all of these procedures, depending on what you want to accomplish.

• To rapidly confirm that the oscilloscope functions and was adjusted properly, just do the brief procedures under *Self Tests*, which begin on page 1–5.

Advantages: These procedures are quick to do, require no external equipment or signal sources, and perform extensive functional and accuracy testing to provide high confidence that the oscilloscope will perform properly. They can be used as a quick check before making a series of important measurements.

■ To further check functionality, first do the *Self Tests* just mentioned; then do the brief procedures under *Functional Tests* that begin on page 1–7.

Advantages: These procedures require minimal additional time to perform, require no additional equipment other than a standard-accessory probe, and more completely test the internal hardware of the oscilloscope. They can be used to quickly determine if the oscilloscope is suitable for putting into service, such as when it is first received.

If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 1–15, after doing the *Functional* and *Self Tests* just referenced.

Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (See *Equipment Required* beginning on page 1–16.)

If you are not familiar with operating this oscilloscope, read the *TDS 500B*, *TDS 600B & TDS 700A Reference* (070-9382-XX) or the *TDS 500B*, *TDS 600B & TDS 700A User Manual* (070-9719-XX). These contain instructions that will acquaint you with the use of the front-panel controls and the menu system.

Input Channels vs. Model

When performing the procedures in this section, be aware that some TDS models refer to input channels Ch 3 and Ch 4 as Aux 1 and Aux 2 respectively. Where appropriate, both names will appear in the procedure, for example, Ch 3 (Aux 1). The channel names for the various TDS models are shown below.

TDS Model	Channel Names
TDS 540B, 644B, 684B, 754A, and 784A	Ch 1, Ch 2, Ch 3, and Ch 4
TDS 520B, 620B, 680B, 724A, and 782A	Ch 1, Ch 2, Aux 1, and Aux 2

Conventions

Throughout these procedures the following conventions apply:

• Each test procedure uses the following general format:

Title of Test

Equipment Required

Prerequisites

Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:
 - 1. First Step
 - a. First Substep
 - First Subpart
 - Second Subpart
 - b. Second Substep
 - 2. Second Step
- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it, as in the example step below, "*Initialize the oscilloscope*" by doing "Press save/recall SETUP. Now, press the main-menu button...".

Initialize the oscilloscope: Press save/recall **SETUP**. Now, press the main-menu button **Recall Factory Setup**; then the side-menu button **OK Confirm Factory Init**.

Where instructed to use a front-panel button or knob, or select from a main or side menu, or verify a readout or status message, the name of the button or knob appears in boldface type: "press SHIFT; then UTILITY, press the main-menu button System until Cal is highlighted in the pop-up menu. Verify that the status message is *Pass* in the main menu under the Voltage Reference label."

STOP. The symbol at the left is accompanied by information you must read to do the procedure properly.

Refer to Figure 1–1: "Main menu" refers to the menu that labels the seven menu buttons under the display; "side menu" refers to the menu that labels the five buttons to the right of the display. "Pop-up menu" refers to a menu that pops up when a main-menu button is pressed.



area move here when CLEAR MENU is pressed.

Figure 1–1: Map of Display Functions

Brief Procedures

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The *Functional Tests* utilize the probe-compensation output at the front panel as a test-signal source for further verifying that the oscilloscope functions properly. A probe, such as the P6243 or P6245, is required to do these test procedures.

Self Tests

This procedure uses internal routines to verify that the oscilloscope functions and was adjusted properly. No test equipment or hookups are required.

Verify Internal Adjustment, Self Compensation, and Diagnostics	Equipment Required	None
	Prerequisites	Power on the Digitizing Oscilloscope and allow a 20 minute warm-up before doing this procedure.

- **1.** *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.
 - a. Display the System diagnostics menu:
 - Press **SHIFT**; then press **UTILITY**.
 - Repeatedly press the main-menu button System until Diag/Err is highlighted in the pop-up menu.
 - **b.** Run the System Diagnostics:
 - First disconnect any input signals from all four channels.
 - Press the main-menu button Execute; then press the side-menu button OK Confirm Run Test.
 - **c.** *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification will take up to three and a half minutes on some models. At some time during the wait, a "clock" icon (shown at left) will appear on-screen. When the verification is finished, the resulting status will appear on the screen.
 - **d.** *Confirm no failures are found:* Verify that no failures are found and reported on-screen.



•.)

- e. Confirm the three adjustment sections have passed status:
 - Press SHIFT; then press UTILITY.
 - Highlight **Cal** in the pop-up menu by repeatedly pressing the main-menu button **System**. See Figure 1–2.
 - Verify that the word *Pass* appears in the main menu under the following menu labels: Voltage Reference, Frequency Response, and Pulse Trigger. See Figure 1–2.
- **f.** *Run the signal-path compensation:* Press the main-menu button **Signal Path**; then press the side-menu button **OK Compensate Signal Paths**.
- **g.** *Wait:* Signal-path compensation may take five minutes on the TDS 500B/700A and fifteen minutes on the 600B to run. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When compensation completes, the status message will be updated to *Pass* or *Fail* in the main menu. See step h.
- **h.** *Confirm signal-path compensation returns passed status:* Verify that the word *Pass* appears under **Signal Path** in the main menu. See Figure 1–2.



Figure 1–2: Verifying Adjustments and Signal-Path Compensation



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2. *Return to regular service:* Press CLEAR MENU to exit the system menus.

Functional Tests

The purpose of these procedures is to confirm that the oscilloscope functions properly. The only equipment required is one of the standard-accessory probes and, to check the file system, a 3.5 inch, 720 K or 1.44 Mbyte floppy disk.



CAUTION. The optional P6243 and P6245 probes that can be used with this oscilloscope provide an extremely low loading capacitance (<1 pF) to ensure the best possible signal reproduction. These probes should not be used to measure signals exceeding ± 8 volts, or errors in signal measurement will be observed. Above 40 volts, damage to the probe may result. To make measurements beyond ± 10 volts, use either the P6139A probe (good to 500 volts), or refer to the catalog for a recommended probe.

STOP. These procedures verify functions; that is, they verify that the oscilloscope features operate. They do not verify that they operate within limits.

Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on-screen "that is about five divisions in amplitude" or "has a period of about six horizontal divisions," etc., do NOT interpret the quantities given as limits. Operation within limits is checked in Performance Tests, which begin on page 1-15.

STOP. DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure will require you to set the oscilloscope to certain default settings before verifying functions. If you make changes to these settings, other than those called out in the procedure, you may obtain invalid results. In this case, just redo the procedure from step 1.

When you are instructed to press a menu button, the button may already be selected (its label will be highlighted). If this is the case, it is not necessary to press the button.

Verify All Input Channels

Equipment Required	One probe such as the P6243, P6245 or P6139A	
Prerequisites	None	

- **1.** Install the test hookup and preset the oscilloscope controls:
 - a. Hook up the signal source: Install the probe on CH 1. Connect the probe tip to PROBE COMPENSATION SIGNAL on the front panel; connect the probe ground (typically black) to PROBE COMPENSA-TION GND. If using a P6243 or P6245 probe, you may want to attach a Y-lead connector and two SMD KlipChips as shown in Figure 1–3.



Figure 1–3: Universal Test Hookup for Functional Tests – TDS 600B Shown

- **b.** *Initialize the oscilloscope:*
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.

- **2.** *Verify that all channels operate:* Do the following substeps test CH 1 first, *skipping substep a and b since CH 1 is already set up for verification and as the trigger source from step 1.*
 - **a.** Select an unverified channel:
 - Press WAVEFORM OFF to remove the channel just verified from display.
 - Press the front-panel button that corresponds to the channel you are to verify.
 - Move the probe to the channel you selected.
 - **b.** Match the trigger source to the channel selected:
 - Press **TRIGGER MENU**.
 - Press the main-menu button **Source**.
 - Press the side-menu button that corresponds to the channel selected, Ch2, Ch3, or Ch4. (Some TDS models use Ax1 and Ax2 instead of Ch3 and Ch4).
 - **c.** Set up the selected channel:
 - Set the vertical **SCALE** to 200 mV.
 - Set the horizontal SCALE to 200 μs. Press CLEAR MENU to remove any menu that may be on the screen.
 - **d.** *Verify that the channel is operational:* Confirm that the following statements are true.
 - The vertical scale readout for the channel under test shows a setting of 200 mV, and a square-wave probe-compensation signal about 2.5 divisions in amplitude is on-screen. See Figure 1–1 on page 1–3 to locate the readout.
 - The vertical **POSITION** knob moves the signal up and down the screen when rotated.
 - Turning the vertical SCALE knob counterclockwise decreases the amplitude of the waveform on-screen, turning the knob clockwise increases the amplitude, and returning the knob to 200 mV returns the amplitude to about 2.5 divisions.
 - e. *Verify that the channel acquires in all acquisition modes:* Press **SHIFT**; then press **ACQUIRE MENU**. Use the side menu to select, in turn, each of the three hardware acquire modes and confirm that the following statements are true. Refer to the icons at the left of each statement as you confirm those statements.

Verify

	Prerequisites	None	
the Time Base	Equipment Required	One probe such as the P6243, P6245 or P6139A	
	3. <i>Remove the test</i> the probe-comp	<i>hookup:</i> Disconnect the probe from the channel input and ensation terminals.	
	f. Test all char	nnels: Repeat substeps a through e until all four input	
I	 Average mode displays an actively acquiring waveform on-screen with the noise reduced. 		
г.	Envelop with the	be mode displays an actively acquiring waveform on-screen e noise displayed.	
I	 Hi Rest acquirir Sample 	mode (TDS 500B and 700A only) displays an actively ng waveform on-screen with the noise that was present in mode reduced.	
.୮.	Peak De on-scree	etect mode displays an actively acquiring waveform en with the noise present in Sample mode "peak detected."	
.f .	 Sample mode displays an actively acquiring waveform on-screen. (Note that there is noise present on the peaks of the square wave.) 		

- **1.** Install the test hookup and preset the oscilloscope controls:
 - **a.** *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. See Figure 1–3 on page 1–8.
 - **b.** Initialize the oscilloscope:
 - Press save/recall **SETUP**.
 - Press the main-menu button Recall Factory Setup; then press the side-menu button OK Confirm Factory Init.
 - **c.** *Modify default settings:*
 - Set the vertical **SCALE** to 200 mV.
 - Set the horizontal SCALE to 200 μs.
 - Press CLEAR MENU to remove the menus from the screen.
- 2. Verify that the time base operates: Confirm the following statements.

- **a.** One period of the square-wave probe-compensation signal is about five horizontal divisions on-screen for the 200 µs horizontal scale setting (set in step 1c).
- **b.** Rotating the horizontal **SCALE** knob clockwise expands the waveform on-screen (more horizontal divisions per waveform period), counterclockwise rotation contracts it, and returning the horizontal scale to 200 µs returns the period to about five divisions.
- c. The horizontal **POSITION** knob positions the signal left and right on-screen when rotated.
- 3. *Remove the test hookup:* Disconnect the probe from the channel input and the probe-compensation terminals.

Verify the Main and Delayed Trigger Systems	Equipment Required	One probe such as the P6243, P6245, or P6139A
	Prerequisites	None

- **1.** *Install the test hookup and preset the oscilloscope controls:*
 - a. Hook up the signal source: Install the probe on CH 1. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to PROBE COMPENSATION GND. See Figure 1–3 on page 1–8.
 - **b.** *Initialize the oscilloscope:*

- Press save/recall SETUP.
- Press the main-menu button Recall Factory Setup.
- Press the side-menu button **OK Confirm Factory Init**.
- **c.** *Modify default settings:*
 - Set the vertical SCALE to 200 mV.
 - Set the horizontal SCALE for the M (main) time base to 200 µs.
 - Press TRIGGER MENU.
 - Press the main-menu button Mode & Holdoff.
 - Press the side-menu button Normal.
 - Press CLEAR MENU to remove the menus from the screen.

- **2.** *Verify that the main trigger system operates:* Confirm that the following statements are true.
 - The trigger level readout for the main trigger system changes with the trigger-LEVEL knob.
 - The trigger-LEVEL knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal *untriggered*, which is indicated by the display not updating.)
 - Pressing SET LEVEL TO 50% triggers the signal that you just left untriggered. (Leave the signal triggered.)
- **3.** Verify that the delayed trigger system operates:
 - **a.** Select the delayed time base:
 - Press HORIZONTAL MENU.
 - Press the main-menu button **Time Base**.
 - Press the side-menu button Delayed Triggerable; then press the side-menu button Delayed Only.
 - Set the horizontal SCALE for the D (delayed) time base to 200 μs.
 - **b.** Select the delayed trigger level menu:
 - Press SHIFT; then press DELAYED TRIG.
 - Press the main-menu button Level; then press the side-menu button Level.
 - c. Confirm that the following statements are true:
 - The trigger-level readout for the delayed trigger system changes as you turn the general purpose knob.
 - As you rotate the general purpose knob, the square-wave probe-compensation signal can become triggered and untriggered. (Leave the signal *un*triggered, which is indicated by the display not updating.)
 - Pressing the side-menu button Set to 50% triggers the probe-compensation signal that you just left untriggered. (Leave the signal triggered.)
 - **d.** Verify the delayed trigger counter:
 - Press the main-menu button **Delay by** *Time*.
 - Use the keypad to enter a delay time of 1 second. Press 1, then press ENTER.

- Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on-screen.
- **4.** *Remove the test hookup:* Disconnect the probe from the channel input and the probe-compensation terminals.

Verify the File System	Equipment Required	One probe such as the P6243, P6245 or P6139A			
		One 720 K or 1.44 Mbyte, 3.5 inch DOS-compatible disk. You can use a disk of your own or you can use the Programming Examples Software 3.5 inch disk (Tektronix part number 063-1134-XX) contained in the TDS Family Programmer Manual (Tektronix part number 070-9556-XX).			
	Prerequisites	None			

- **1.** *Install the test hookup and preset the oscilloscope controls:*
 - **a.** *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. See Figure 1–3 on page 1–8.
 - **b.** *Insert the test disk:* Insert the disk in the disk drive to the left of the monitor.
 - Position the disk so the metal shutter faces the drive.
 - Position the disk so the stamped arrow is on the top right side. In other words, place the angled corner in the front bottom location.
 - Push the disk into the drive until it goes all the way in and clicks into place.
 - c. Initialize the oscilloscope:
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.
 - d. Modify default settings:
 - Set the vertical **SCALE** to 200 mV.
 - Set the horizontal SCALE for the M (main) time base to 200 µs. Notice the waveform on the display now shows two cycles instead of five.
 - Press **CLEAR MENU** to remove the menus from the screen.

- e. Save the settings:
 - Press SETUP.
 - Press the main-menu button Save Current Setup; then press the side-menu button To File.
 - Turn the general purpose knob to select the file to save. Choose TEK????.SET (or fdo:). With this choice, you will save a file starting with TEK, then containing 5-numbers, and a .SET extension. For example, the first time you run this on a blank, formatted disk or on the Example Programs Disk, the oscilloscope will assign the name TEK00000.SET to your file. If you ran the procedure again, the oscilloscope would increment the name and call the file TEK00001.SET.
 - Press the side-menu button **Save To Selected File**.
- 2. Verify the file system works:
 - Press the main-menu button Recall Factory Setup and the side-menu button OK Confirm Factory Init to restore the 500 µs time base and the five cycle waveform.
 - Press the main-menu button Recall Saved Setup; then press the side-menu button From File.
 - Turn the general purpose knob to select the file to recall. For example, if you followed the instructions above and used a blank disk, you had the oscilloscope assign the name TEK00000.SET to your file.
 - Press the side-menu button **Recall From Selected File**.
 - Verify that Digitizing Oscilloscope retrieved the saved setup from the disk. Do this by noticing the horizontal SCALE for the M (main) time base is again 200 µs and the waveform shows only two cycles just as it was when you saved the setup.
- **3.** *Remove the test hookup:*
 - Disconnect the probe from the channel input and the probe-compensation terminals.
 - Remove the disk from the disk drive. Do this by pushing in the tab at the bottom of the disk drive.

Performance Tests

This section contains a collection of procedures for checking that the TDS 500B, TDS 600B, and TDS 700A Digitizing Oscilloscopes perform as warranted.

The procedures are arranged in four logical groupings: *Signal Acquisition System Checks, Time Base System Checks, Triggering System Checks, and Output Ports Checks.* They check all the characteristics that are designated as checked in *Specifications.* (The characteristics that are checked appear in **boldface** type under *Warranted Characteristics* in *Specifications.*)

STOP. These procedures extend the confidence level provided by the basic procedures described on page 1–5. The basic procedures should be done first, then these procedures performed if desired.

Prerequisites

The tests in this section comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the Digitizing Oscilloscope.
- You must have performed and passed the procedures under *Self Tests*, found on page 1–5, and those under *Functional Tests*, found on page 1–7.
- A signal-path compensation must have been done within the recommended calibration interval and at a temperature within ±5° C of the present operating temperature. (If at the time you did the prerequisite *Self Tests*, the temperature was within the limits just stated, consider this prerequisite met.)
- The Digitizing Oscilloscope must have been last adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between +4° C and either +45° C for the TDS 600B or +50° C for the TDS 500B and 700A. (The warm-up requirement is usually met in the course of meeting the Self Tests and Functional Tests prerequisites listed above.)

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. The required equipment list follows this introduction.

Iten Des	n Number and scription	Minimum Requirements	Example	Purpose
1.	Attenuator,10X (two required)	Ratio: 10X; impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Signal Attenuation
2.	Attenuator, 5X	Ratio: 5X; impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0060-02	Signal Attenuation
3.	Adapter, BNC female to Clip Leads	BNC female to Clip Leads	Tektronix part number 013-0076-00	Signal Coupling for Probe Compensator Output Check
4.	Terminator, 50 Ω	Impedance 50 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal Termination for Channel Delay Test
5.	Cable, Precision 50 Ω Coaxial (two required)	50 Ω , 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Signal Interconnection
6.	Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103-0090-00	Various Accuracy Tests
7.	Connector, BNC "T"	Male BNC to dual female BNC	Tektronix part number 103-0030-00	Checking Trigger Sensitivity
8.	Coupler, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067-0525-02	Checking Delay Between Channels
9.	Generator, DC Calibra- tion	Variable amplitude to ± 104 V; accuracy to 0.1%	Data Precision 8200	Checking DC Offset, Gain, and Measurement Accuracy
10.	Generator, Calibration	500 mV square wave calibrator amplitude; accuracy to 0.25%	Wavetek 9100 with options 100 and 250 (or, optionally, Tektronix PG 506A Calibra- tion Generator ¹)	To check accuracy of CH 3 Signal Out
11.	Generator, Time Mark	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	Wavetek 9100 with options 100 and 250 (or, optionally, Tektronix TG 501A Time Mark Generator ¹⁾	Checking Sample-Rate and Delay-time Accuracy
12.	Probe, 10X	A P6139A, P6243, or P6245 probe ²	Tektronix part number P6139A or P6245	Signal Interconnection
13.	3.5 inch, 720 K or 1.44 Mbyte, DOS-com- patible floppy disk		Programming Examples Software Disk (Tektronix part number 063-1134-XX) that comes with the TDS Family Programmer Manual (Tektro- nix part number 070-9556-XX)	Checking File System Basic Functionality

Table 1–1: Test Equipment

Table 1–1: Test Equ	ipment (Cont.)
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Item Number and Description		Minimum Requirements	Example	Purpose	
14.	Generator, Video Signal	Provides PAL compatible outputs	Tektronix TSG 121	Used to Test Video Option 05 Equipped Instruments Only	
15.	Oscillator, Leveled Sine wave Generator	60 Hz Sine wave	Wavetek 9100 with options 100 and 250 (or, optionally, Tektronix SG 502)	Used to Test Video Option 05 Equipped Instruments Only	
16.	Pulse Generator		Tektronix CFG280 (or, optionally, PG 502)	Used to Test Video Option 05 Equipped Instruments Only	
17.	Cable, Coaxial (two required)	75 Ω , 36 in, male to male BNC connectors	Tektronix part number 012-1338-00	Used to Test Video Option 05 Equipped Instruments Only	
18.	Terminator, 75 Ω (two required)	Impedance 75 Ω ; connectors: female BNC input, male BNC output	Tektronix part number 011-0102-01	Used to Test Video Option 05 Equipped Instruments Only	
19.	Generator, Sine Wave	100 kHz to at least 400 MHz. Variable amplitude from 12 mV to 2 V_{p-p} . Frequency accuracy >2.0%	Rohde & Schwarz SMY ³	Checking Analog Bandwidth, Trigger Sensitivity, Sample- rate, External Clock, and Delay-Time Accuracy	
20.	Meter, Level and Power Sensor	Frequency range:10 MHz to 400MHz. Amplitude range: 6 mVp-p to 2 V _{p-p}	Rohde & Schwarz URV 35, with NRV-Z8 power sensor ³	Checking Analog Bandwidth and Trigger Sensitivity	
21.	Splitter, Power	Frequency range: DC to 1 GHz. Tracking: >2.0%	Rohde & Schwarz RVZ ³	Checking Analog Bandwidth	
22.	Generator, Function	Frequency range 5 MHz to 10 MHz. Square wave transition time \leq 25 ns. Amplitude range: 0 to 10 V _{p-p} into 50 Ω	Tektronix CFG280	Checking External Clock	
23.	Adapter (four required)	Male N to female BNC	Tektronix 103–0045–00	Checking Analog Bandwidth	
24.	Adapter	Female N to male BNC	Tektronix 103-0058-00	Checking Analog Bandwidth	
25.	Generator, Leveled Sine Wave, Medium-Frequency (optional)	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 $V_{p\text{-}p}$ into 50 Ω	Tektronix SG 503 Leveled Sine Wave Generator ^{1, 3}	Checking Trigger Sensitivity at low frequencies	
26.	Generator, Leveled Sine Wave, High-Frequency (optional)	250 MHz to 1 GHz; Variable amplitude from 500 mV to 4 V_{p-p} into 50 Ω ; 6 MHz reference	Tektronix SG 504 Leveled Sine Wave Generator ¹ with SG 504 Output Head ³	Checking Analog Bandwidth and Trigger Sensitivity at high frequencies	

¹ Requires a TM 500 or TM 5000 Series Power Module Mainframe.

² Warning: The optional P6243 and P6245 probes that may be used with this oscilloscope provide an extremely low loading capacitance (<1 pF) to ensure the best possible signal reproduction. These probes should not be used to measure signals exceeding ±8 V, or errors in signal measurement will be observed. Above 40 V, damage to the probe may result. To make measurements beyond ±8 V, use either the P6139A probe (good to 500 V), or refer to the catalog for a recommended probe.</p>

³ You can replace items 19, 20, or 21 with a Tektronix SG503 (item 25) or SG504 (item 26) – if available.

TDS 600B Test Record

Photocopy this and the next three pages and use them to record the performance test results for your TDS 600B.

TDS 600B Test Record

Instrument Serial Number:		Certificate Number:			
Date of Calibration:		Technician:			
TDS 60	TDS 600B Performance Test Minimum			Outgoing	Maximum
Offset A	Accuracy				
CH1 Of	ffset +1 mV +101 mV +1.01 V	– 1.45 mV – 69.1 mV – 691 mV			+ 1.45 mV + 69.1 mV + 691 mV
CH2 Of	ffset +1 mV +101 mV +1.01 V	– 1.45 mV – 69.1 mV – 691 mV			+ 1.45 mV + 69.1 mV + 691 mV
CH3 or Offset	AX1 +1 mV +101 mV +1.01 V	– 1.45 mV – 69.1 mV – 691 mV			+ 1.45 mV + 69.1 mV + 691 mV
CH4 or Offset	AX2 +1 mV +101 mV +1.01 V	– 1.45 mV – 69.1 mV – 691 mV			+ 1.45 mV + 69.1 mV + 691 mV
DC Volt	tage Measurement Accuracy (Averaged)				
CH1	5 mV Vert scale setting, –5 Div position setting, +1 V offset	+ 1.0329 V			+ 1.0471 V
CH1	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0471 V			- 1.0329V
CH1	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.4165 V			+ 11.7835 V
CH1	200 mV Vert scale setting, +5 Div position setting, –10 V offset	– 11.7835 V			– 11.4165 V
CH1	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.2425 V			+ 18.7575 V
CH1	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.7575 V			– 17.2425 V
CH2	5 mV Vert scale setting, –5 Div position setting, +1 V offset	+ 1.0329 V			+ 1.0471 V
CH2	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0471 V			- 1.0329V
CH2	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.4165 V			+ 11.7835 V
CH2	200 mV Vert scale setting, +5 Div position setting, –10 V offset	– 11.7835 V			– 11.4165 V

TDS 600B Test Record (Cont.)

Instrument Serial Number:		Certificate Number:				
Temperature:			RH %:			
Date of Calibration:			Technician:			
TDS 600	B Performance Test	Minimum	Incoming	Outgoing	Maximum	
CH2	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.2425 V			+ 18.7575 V	
CH2	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.7575 V			– 17.2425 V	
CH3 or AX1	5 mV Vert scale setting, –5 Div position setting, +1 V offset	+ 1.0329 V			+ 1.0471 V	
CH3 or AX1	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0471 V			– 1.0329V	
CH3 or AX1	200 mV Vert scale setting, -5 Div position setting, +10 V offset	+ 11.4165 V			+ 11.7835 V	
CH3 or AX1	200 mV Vert scale setting, +5 Div position setting, −10 V offset	– 11.7835 V			– 11.4165 V	
CH3 or AX1	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.2425 V			+ 18.7575 V	
CH3 or AX1	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.7575 V			– 17.2425 V	
CH4 or AX2	5 mV Vert scale setting, –5 Div position setting, +1 V offset	+ 1.0329 V			+ 1.0471 V	
CH4 or AX2	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0471 V			– 1.0329V	
CH4 or AX2	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.4165 V			+ 11.7835 V	
CH4 or AX2	200 mV Vert scale setting, +5 Div position setting, −10 V offset	– 11.7835 V			– 11.4165 V	
CH4 or AX2	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.2425 V			+ 18.7575 V	
CH4 or AX2	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.7575 V			– 17.2425 V	
Analog Bandwidth						
CH1	100 mV	424 mV			N/A	
CH2	100 mV	424 mV			N/A	
CH3 or AX1	100 mV	424 mV			N/A	
CH4 or AX2	100 mV	424 mV			N/A	

TDS 600B Test Record (Cont.)

Instrument Serial Number:		Certificate Number:			
Temperature:					
Date of Calibration:		Technician:			
TDS 600B Performance Test	Minimum	Incoming	Outgoing	Maximum	
Delay Between Channels					
Delay Between Channels	N/A			100 ps	
Time Base System					
Long Term Sample Rate/ Delay Time @ 500 ns/10 ms	–2.0 Div			+2.0 Div	
Trigger System Accuracy					
Pulse-Glitch or Pulse-Width, Hor. scale ≤ 1 μs Lower Limit Upper Limit	3.5 ns 3.5 ns			6.5 ns 6.5 ns	
Pulse-Glitch or Pulse-Width, Hor. scale > 1 μs Lower Limit Upper Limit	1.9 μs 1.9 μs			2.1 μs 2.1 μs	
Main Trigger, DC Coupled, Positive Slope	9.863 V			10.137 V	
Main Trigger, DC Coupled, Negative Slope	9.863 V			10.137 V	
Delayed Trigger, DC Coupled, Positive Slope	9.863 V			10.137 V	
Delayed Trigger, DC Coupled, Negative Slope	9.863 V			10.137 V	
CH1 Sensitivity, 50 MHz, Main	Pass/Fail			Pass/Fail	
CH1 Sensitivity, 50 MHz, Delayed	Pass/Fail			Pass/Fail	
CH1 AUX Trigger Input	Pass/Fail			Pass/Fail	
CH1 Sensitivity, 1 GHz, Main	Pass/Fail			Pass/Fail	
CH1 Sensitivity, 1 GHz, Delayed	Pass/Fail			Pass/Fail	
Output Signal Checks					
MAIN TRIGGER OUTPUT, 1 MΩ High Low	High ≥ 2.5 V			$Low \le 0.7 V$	
MAIN TRIGGER OUTPUT, 50 Ω High Low	High ≥ 1.0 V			$Low \le 0.25 \text{ V}$	
DELAYED TRIGGER OUTPUT, 50 Ω	High ≥ 1.0 V			$Low \le 0.25 \text{ V}$	
DELAYED TRIGGER OUTPUT, 1 MΩ	High \ge 2.5 V			$Low \le 0.7 V$	

TDS 600B Test Record (Cont.)

Instrument Serial Number: Temperature: Date of Calibration:		Certificate Number:		
TDS 600B Performance Test	Minimum	Incoming	Outgoing	Maximum
CH 3 or AX1 SIGNAL OUTPUT, 1 M Ω	Pk-Pk ≥ 80 mV			$Pk-Pk \le 120 \text{ mV}$
CH 3 or AX1 SIGNAL OUTPUT, 50 Ω	Pk-Pk ≥ 40 mV			$Pk-Pk \le 60 \text{ mV}$
Probe Compensator Output Signal				
Frequency (CH1 Freq.)	950 Hz			1.050 kHz
Voltage (difference)	495 mV			505 mV
TDS 500B/700A Test Record

Photocopy this and the next three pages and use them to record the performance test results for your TDS 500B/700A.

TDS 500B/700A Test Record

Instrument Serial Number:			Certificate Number:			
Tempe	rature:		RH %:			
Date o	f Calibration:		Technician:			
TDS 5	00B/700A Performance Test	Minimum	Incoming	Outgoing	Maximum	
Offset	Accuracy					
CH1 O	ffset +1 mV +101 mV +1.01 V	– 1.6 mV – 25.1 mV – 251 mV			+ 1.6 mV + 25.1 mV + 251 mV	
CH2 O	ffset +1 mV +101 mV +1.01 V	– 1.6 mV – 25.1 mV – 251 mV			+ 1.6 mV + 25.1 mV + 251 mV	
CH3 or	r AX1 Offset +1 mV +101 mV +1.01 V	– 1.6 mV – 25.1 mV – 251 mV			+ 1.6 mV + 25.1 mV + 251 mV	
CH4 or	r AX2 Offset +1 mV +101 mV +1.01 V	– 1.6 mV – 25.1 mV – 251 mV			+ 1.6 mV + 25.1 mV + 251 mV	
DC Vo	Itage Measurement Accuracy (Averaged)					
CH1	5 mV Vert scale setting, –5 Div position setting, +1 V offset	+ 1.0355 V			+ 1.0445 V	
CH1	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0445 V			– 1.0355 V	
CH1	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.5195 V			+ 11.6805 V	
CH1	200 mV Vert scale setting, +5 Div position setting, –10 V offset	– 11.6805 V			– 11.5195 V	
CH1	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.7575 V			+ 18.2425 V	
CH1	1 V Vert scale setting, +5 Div position setting, −10 V offset	– 18.2425 V			– 17.7575 V	
CH2	5 mV Vert scale setting, -5 Div position setting, +1 V offset	+ 1.0355 V			+ 1.0445V	
CH2	5 mV Vert scale setting, +5 Div position setting, -1 V offset	– 1.0445 V			– 1.0355 V	
CH2	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.5195 V			+ 11.6805 V	
CH2	200 mV Vert scale setting, +5 Div position setting, –10 V offset	– 11.6805 V			– 11.5195 V	

TDS 500B/700A Test Record (Cont.)

Instrument Serial Number:			Certificate Number:			
Tempera	ature:		RH %:			
Date of	Calibration:		Technician:			
TDS 500	0B/700A Performance Test	Minimum	Incoming	Outgoing	Maximum	
CH2	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.7575 V			+ 18.2425 V	
CH2	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.2425 V			– 17.7575 V	
CH3 or AX1	5 mV Vert scale setting, -5 Div position setting, +1 V offset	+ 1.0355 V			+ 1.0445 V	
CH3 or AX1	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0445 V			– 1.0355 V	
CH3 or AX1	200 mV Vert scale setting, –5 Div position setting, +10 V offset	+ 11.5195 V			+ 11.6805 V	
CH3 or AX1	200 mV Vert scale setting, +5 Div position setting, –10 V offset	– 11.6805 V			– 11.5195 V	
CH3 or AX1	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.7575 V			+ 18.2425 V	
CH3 or AX1	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.2425 V			– 17.7575 V	
CH4 or AX2	5 mV Vert scale setting, -5 Div position setting, +1 V offset	+ 1.0355 V			+ 1.0445 V	
CH4 or AX2	5 mV Vert scale setting, +5 Div position setting, –1 V offset	– 1.0445 V			– 1.0355 V	
CH4 or AX2	200 mV Vert scale setting, -5 Div position setting, +10 V offset	+ 11.5195 V			+ 11.6805 V	
CH4 or AX2	200 mV Vert scale setting, +5 Div position setting, −10 V offset	– 11.6805 V			– 11.5195 V	
CH4 or AX2	1 V Vert scale setting, –5 Div position setting, +10 V offset	+ 17.7575 V			+ 18.2425 V	
CH4 or AX2	1 V Vert scale setting, +5 Div position setting, –10 V offset	– 18.2425 V			– 17.7575 V	
Analog E	Bandwidth					
CH1	100 mV	424 mV			N/A	
CH2	100 mV	424 mV			N/A	
CH3 or AX1	100 mV	424 mV			N/A	
CH4 or AX2	100 mV	424 mV			N/A	

TDS 500B/700A Test Record (Cont.)

Instrument Serial Number:	Certificate Number:							
Temperature:		RH %:						
Date of Calibration:		Technician:						
TDS 500B/700A Performance Test	Minimum	Incoming	Outgoing	Maximum				
Delay Between Channels								
Delay Between Channels	N/A			50 ps				
Time Base System								
Long Term Sample Rate/ Delay Time @ 100 ns/10.0 ms	–2.5 Div			+2.5 Div				
Trigger System Accuracy								
Pulse-Glitch or Pulse-Width, Hor. scale ≤ 1 μs Lower Limit Upper Limit	3.5 ns 3.5 ns			6.5 ns 6.5 ns				
Pulse-Glitch or Pulse-Width, Hor. scale > 1 μs Lower Limit Upper Limit	1.9 μs 1.9 μs			2.1 μs 2.1 μs				
Main Trigger, DC Coupled, Positive Slope	9.9393 V			10.1147 V				
Main Trigger, DC Coupled, Negative Slope	9.9393 V			10.1147 V				
Delayed Trigger, DC Coupled, Positive Slope	9.9393 V			10.1147 V				
Delayed Trigger, DC Coupled, Negative Slope	9.9393 V			10.1147 V				
CH1 Sensitivity, 50 MHz, Main	Pass/Fail			Pass/Fail				
CH1 Sensitivity, 50 MHz, Delayed	Pass/Fail			Pass/Fail				
CH1 AUX Trigger Input	Pass/Fail			Pass/Fail				
CH1 Sensitivity, full bandwidth, Main	Pass/Fail			Pass/Fail				
CH1 Sensitivity, full bandwidth, Delayed	Pass/Fail			Pass/Fail				
Output Signal Checks								
MAIN TRIGGER OUTPUT, 1 MΩ High Low	High \ge 2.5 V			$Low \leq 0.7 \; V$				
MAIN TRIGGER OUTPUT, 50 Ω High Low	High ≥ 1.0 V			$Low \le 0.25 \text{ V}$				
DELAYED TRIGGER OUTPUT, 50 Ω High Low	High ≥ 1.0 V			$Low \le 0.25 V$				
DELAYED TRIGGER OUTPUT, 1 MΩ High Low	High \geq 2.5 V			$Low \le 0.7 V$				

TDS 500B/700A Test Record (Cont.)

Instrument Serial Number: Temperature: Date of Calibration:	Certificate Number: RH %: Technician:			
TDS 500B/700A Performance Test	Minimum	Incoming	Outgoing	Maximum
CH 3 or AX 1 SIGNAL OUTPUT, 1 M Ω	Pk-Pk≥88 mV			$Pk-Pk \le 132 \text{ mV}$
CH 3 or AX 1 SIGNAL OUTPUT, 50 Ω	Pk-Pk≥44 mV			Pk-Pk ≤ 66 mV
Probe Compensator Output Signal				
Frequency (CH1 Freq.)	950 Hz			1.050 kHz
Voltage (difference)	495 mV			505 mV

Signal Acquisition System Checks

These procedures check those characteristics that relate to the signal-acquisition system and are listed as checked under *Warranted Characteristics* in *Specifica-tions*.

Check Offset Accuracy (Zero Setting)

Equipment Required	None
Prerequisites	The oscilloscope must meet the prerequisites listed on page 1–15.
	See Input Channels vs. Model on page 1-2.

- **1.** *Preset the instrument controls:*
 - **a.** *Initialize the oscilloscope:*
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.
 - Press **CLEAR MENU** to remove the menus from the screen.
 - **b.** *Modify the default settings:*
 - Press **SHIFT**; then press **ACQUIRE MENU**.
 - On the TDS 600B, press the main-menu button Mode; then press the side-menu button Average 16.
 - On the TDS 500B and 700A, press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
 - Press CURSOR.
 - Press the main-menu button Function; then press the side-menu button H Bars.
 - Press CLEAR MENU.
 - Be sure to disconnect any input signals from all four channels.
- **2.** Confirm input channels are within limits for offset accuracy at zero offset: Do the following substeps — test CH 1 first, skipping substep a since CH 1 is already set up to be checked from step 1.
 - **a.** *Select an unchecked channel:* Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front-panel button that corresponds to the channel you are to confirm.

- **b.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 1–2 that is not yet checked. (Start with the first setting listed.)
 - Press VERTICAL MENU. Press the main-menu button Fine Scale.
 - Use the keypad to enter the vertical scale. For the 1 mV setting, press 1, SHIFT, m, then ENTER. For the 101 mV setting, press 101, SHIFT, m, then ENTER. For the 1.01 V setting, press 1.01, then ENTER.
 - Press CLEAR MENU.

Vertical Scale Setting	Vertical Position and Offset Setting ¹	TDS 600B Offset Accuracy Limits	TDS 500B/700A Offset Accuracy Limits
1 mV	0	±2.1 mV	±1.6 mV
101 mV	0	±75.6 mV	±25.1 mV
1.01 V	0	±756 mV	±251 mV

Table 1–2: DC Offset Accuracy (Zero Setting)

¹ Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

- **c.** *Display the test signal:* The waveform position and offset were initialized for all channels in step 1 and are displayed as you select each channel and its vertical scale.
- **d.** *Measure the test signal:* Align the active cursor over the waveform by rotating the general purpose knob. Ignore the other cursor. See Figure 1–4.
- e. Read the measurement results at the absolute (@:) cursor readout, not the delta (Δ :) readout on screen. That is, read the offset relative to the ground reference. See Figure 1–4.
- f. *Check against limits:* Do the following subparts in the order listed.
 - CHECK that the measurement results are within the limits listed for the current vertical scale setting.
 - Enter voltage on test record.
 - Repeat substeps b through f until all vertical scale settings listed in Table 1–2, are checked for the channel under test.



Figure 1–4: Measurement of DC Offset Accuracy at Zero Setting

- g. *Test all channels:* Repeat substeps a through f for all input channels.
- 3. Disconnect the hookup: No hookup was required.

Check DC Voltage Measurement Accuracy



WARNING. The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Equipment Required	Two dual-banana connectors (Item 6) One BNC T connector (Item 7) One DC calibration generator (Item 9)		
	Two precision coaxial cables (Item 5)		
Prerequisites	The oscilloscope must meet the prerequisites listed on page 1–15		
	See Input Channels vs. Model on page 1-2.		

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** Hook up the test-signal source:
 - Set the output of a DC calibration generator to 0 volts.
 - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 1–5.
 - Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to CH 1. See Figure 1–5.



Figure 1–5: Initial Test Hookup

- **b.** *Initialize the oscilloscope:*
 - Press save/recall SETUP.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button OK Confirm Factory Init.
- **c.** *Modify the default settings:*
 - Press SHIFT; then press ACQUIRE MENU.
 - Press the main-menu button Mode; then press the side-menu button Average 16.
- **2.** Confirm input channels are within limits for DC accuracy at maximum offset and position: Do the following substeps test CH 1 first, skipping substep 2a since CH 1 is already selected from step 1.

- **a.** Select an unchecked channel:
 - Press WAVEFORM OFF to remove the channel just confirmed from the display.
 - Press the front-panel button that corresponds to the channel you are to confirm.
 - Set the generator output to 0 V.
 - Move the test hookup to the channel you selected.
- **b.** *Turn on the measurement Mean for the channel:*
 - Press MEASURE, then press the main-menu button Select Measrmnt for CHx.
 - Press the side-menu button more until the menu label Mean appears in the side menu (its icon is shown at the left). Press the side-menu button Mean.
 - Press CLEAR MENU.
- **c.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 1–3 that is not yet checked. (Start with the first setting listed.)

Scale Setting	Position Set- ting (Divs)	Offset Setting	Generator Setting	TDS 600B Accuracy Limits	TDS 500B/700A Accuracy Limits
5 mV	-5	+1 V	+1.040 V	+1.0329 V to +1.0471 V	+1.0355 V to +1.0445 V
	+5 V	–1 V	–1.040 V	-1.0471 V to -1.0329 V	-1.0445 V to -1.0355 V
200 mV	-5	+10 V	+11.6 V	+11.4165 V to +11.7835 V	+11.5195 V to +11.6805 V
	+5	–10 V	–11.6 V	-11.7835 V to -11.4165 V	-11.6805 V to -11.5195 V
1 V	-5	+10 V	+18V	+17.2425 V to +18.7575 V	+17.7575 V to +18.2425 V
	+5	–10 V	–18 V	-18.7575 V to -17.2425 V	-18.2425 V to -17.7575 V

Table 1–3: DC Voltage Measurement Accuracy

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d. *Display the test signal:*

- Press **VERTICAL MENU**. Press the main-menu button **Position**.
- Use the keypad to set vertical position to -5 divisions (press -5, then ENTER, on the keypad). The baseline level will move off screen.
- Press the main-menu button **Offset**.

- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level will remain off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check is failed for the current vertical scale setting of the current channel.)
- e. *Measure the test signal:* Press CLEAR MENU. Read the measurement results at the Mean measurement readout. See Figure 1–6.





- f. Check against limits:
 - CHECK that the readout for the measurement Mean readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings. Enter value on test record.
 - Repeat substep d, reversing the polarity of the position, offset, and generator settings as is listed in the table.
 - CHECK that the Mean measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/ generator settings. Enter value on test record.

- Repeat substeps c through f until all vertical scale settings, listed in Table 1–3, are checked for the channel under test.
- g. Test all channels: Repeat substeps a through f for all four channels.
- **3.** *Disconnect the hookup:*
 - **a.** Set the generator output to 0 V.
 - **b.** Disconnect the cable from the generator output at the input connector of the channel last tested.

Check Analog Bandwidth	Equipment Required	One sine wave generator (Item 19)
		One level meter and power sensor (Item 20)
		One power splitter (Item 21)
		One female N to male BNC adapter (Item 24)
		Four male N to female BNC adapters (Item 23)
		Two 50 Ω precision cables (Item 5)
		Two 10X attenuators (Item 1).
		Optional: One high-frequency leveled sine wave generator and its leveling head (Item 26) – replaces items 19, 20, 21, 23, 24, and 5
	Prerequisites	See page 1–15

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** *Initialize the oscilloscope:*
 - Press save/recall SETUP. Press the main-menu button Recall Factory Setup; then press the side-menu button OK Confirm Factory Init.
 - **b.** *Modify the default settings:*
 - Press **TRIGGER MENU**.
 - Press the main-menu button Coupling. Then press the side menu button Noise Rej.
 - Turn the horizontal SCALE knob to 50 ns. Press SHIFT; then press ACQUIRE MENU.
 - Press the main-menu button Mode; then press the side-menu button Average 16.
 - Press MEASURE. Press the main-menu button High-Low Setup; then press the side-menu button Min-Max.

NOTE. *Refer to the* Sine Wave Generator Leveling Procedure *on page 1–84 if your sine wave generator does not have automatic output amplitude leveling.*

c. Hook up the test-signal source: Connect the sine wave output of a leveled sine wave generator to CH 1. Set the output of the generator to a reference frequency of 10 MHz or less. See Figure 1–7. For the optional setup using a leveled sine wave generator with a leveling head (item 26) see Figure 1–8 and, if using this optional setup with the example Tektronix SG 504, set the generator output to 6 MHz.







Figure 1–8: Optional Initial Test Hookup

- 2. Confirm the input channels are within limits for analog bandwidth: Do the following substeps test CH 1 first, skipping substeps a and b since CH 1 is already set up for testing from step 1.
 - a. Select an unchecked channel:
 - Press WAVEFORM OFF to remove the channel just confirmed from display.

- Press the front-panel button that corresponds to the channel you are to confirm.
- Move the leveling output of the sine wave generator to the channel you selected.
- **b.** *Match the trigger source to the channel selected:*
 - Press TRIGGER MENU. Press the main-menu button Source; then press the side-menu button that corresponds to the channel selected.
- **c.** Set its input impedance:
 - Press VERTICAL MENU; then press the main-menu button Coupling.
 - **Press the side-menu** Ω button to toggle it to the **50** Ω setting.
- **d.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 1–4 not yet checked. (Start with the 100 mV setting.)

			Test Frequency			
Vertical Scale	Reference Amplitude	Horizontal Scale	TDS 680B TDS 684B TDS 782A TDS 784A	TDS 620B TDS 644B	TDS 520B TDS 540B TDS 724A TDS 754A	Limits
100 mV	600 mV (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥424 mV
1 V	5 V (5 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥3.535 V
500 mV	3 V (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥2.121 V
200 mV	1.2 V (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥848 mV
50 mV	300 mV (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥212 mV
20 mV	120 mV (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥84.8 mV
10 mV	60 mV (6 divisions)	1 ns	1 GHz	500 MHz	500 MHz	≥42.4 mV
5 mV	30 mV (6 divisions)	1 ns	750 MHz	450 MHz	500 MHz	≥21.2 mV
2 mV	12 mV (6 divisions)	1 ns	600 MHz	300 MHz	500 MHz	≥8.48 mV
1 mV	6 mV (6 divisions)	1 ns	500 MHz	250 MHz	450 MHz	≥4.24 mV

Table 1–4: Analog Bandwidth

- e. *Display the test signal:* Do the following subparts to first display the reference signal and then the test signal.
 - Press MEASURE; then press the main-menu button Select Measrmnt for CHx.

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Press the side-menu button more, if needed, until the menu label
 Frequency appears in the side menu (its icon is shown at the left).
 Press the side-menu button Frequency.

- Press the side-menu button more until the menu label Pk-Pk appears in the side menu (its icon is shown at the left). Press the side-menu button Pk-Pk.
- Press CLEAR MENU.
- Set the generator output so the CHx Pk-Pk readout equals the reference amplitude in Table 1–4 that corresponds to the vertical scale set in substep d.
- Press the front-panel button SET LEVEL TO 50% as necessary to trigger a stable display. At full bandwidth, you may also want to make small, manual adjustments to the trigger level. You can use the TRIGGER LEVEL knob to do this. (Full bandwidth varies with TDS model as is shown in Table 1–4.)
- **f.** *Measure the test signal:*
 - Set the frequency of the generator, as shown on screen, to the test frequency in Table 1–4 that corresponds to the vertical scale set in substep d. See Figure 1–9.
 - Set the horizontal SCALE to the horizontal scale setting in Table 1–4 that corresponds to the vertical scale set in substep d. Press SET LEVEL TO 50% as necessary to trigger the signal.
 - Read the results at the CHx Pk-Pk readout, which will automatically measure the amplitude of the test signal. See Figure 1–9.



Figure 1–9: Measurement of Analog Bandwidth

- g. Check against limits:
 - CHECK that the **Pk-Pk** readout on screen is within the limits listed in Table 1–4 for the current vertical scale setting.
 - Enter voltage on test record.
 - When finished checking, set the horizontal **SCALE** back to the 50 ns setting.

STOP. Checking each channel's bandwidth at all vertical scale settings is time consuming and unnecessary. You may skip checking the remaining vertical scale settings in Table 1–4 (that is, skip the following substep, h) if this digitizing oscilloscope has performed as follows:

- Passed the 100 mV vertical scale setting just checked in this procedure.
- Passed the Verify Internal Adjustment, Self Compensation, and Diagnostics procedure found under Self Tests, on page 1–5.

NOTE. Passing the signal path compensation confirms the signal path for all vertical scale settings for all channels. Passing the internal diagnostics ensures that the factory-set adjustment constants that control the bandwidth for each vertical scale setting have not changed.

- **h.** Check remaining vertical scale settings against limits (optional):
 - If desired, finish checking the remaining vertical scale settings for the channel under test by repeating substeps d through g for each of the remaining scale settings listed in Table 1–4 for the channel under test.
 - When doing substep e, skip the subparts that turn on the CHx Pk-Pk measurement until you check a new channel.
 - Install/remove 10X attenuators between the generator leveling head and the channel input as needed to obtain the six division reference signals listed in the table.
- i. *Test all channels:* Repeat substeps a through g for all four channels.
- **3.** *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last tested.

Check Delay Between Channels	Equipment Boguirod	One sine wave generator (Item 19, or optionally, item 25)
	nequireu	One precision coaxial cable (Item 5)
		One 50 Ω terminator (Item 4)
		One dual-input coupler (Item 8)
	Prerequisites	See page 1–15
		See Input Channels vs. Model on page 1-2.

STOP. DO NOT use the vertical position knob to reposition any channel while doing this check. To do so invalidates the test.

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** *Initialize the front panel:*
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.

- **b.** *Modify the initialized front-panel control settings:*
 - Do *not* adjust the vertical position of any channel during this procedure.
 - Set the horizontal **SCALE** to 500 ps.
 - Press SHIFT; then press ACQUIRE MENU.
 - Press the main-menu button Mode, and then press the side-menu button Average 16.
- **c.** Hook up the test-signal source:
 - Connect the sine wave output of a sine wave generator (item 19 or, optionally, 25) to a 50 Ω precision coaxial cable followed by a 50 Ω termination, and a dual-input coupler. See Figure 1–10.
 - Connect the coupler to both **CH 1** and **CH 2**. See Figure 1–10.



Figure 1–10: Initial Test Hookup

- 2. Confirm all four channels are within limits for channel delay:
 - **a.** *Set up the generator:* Set the generator frequency to 250 MHz and the amplitude for about six divisions in CH 1.

Hint: As you are adjusting the generator amplitude, push **SET LEVEL TO 50%** frequently to speed up the updating of the waveform amplitude on screen.

- b. The horizontal SCALE should already be set to 500 ps. On the TDS 782A, 784A, and 600B, now set it to 200 ps. On the TDS 520B, 540B, 724A, and 754A, push the front-panel ZOOM button, press the side-menu On button, set the horizontal SCALE to 250 ps, and be sure the vertical scale factor is kept at 1.0X and the horizontal scale factor is 2.0X.
- *c.* Save a CH 2 waveform: Press CH 2. Be sure the vertical scale factor is kept at 1.0X. Then press save/recall WAVEFORM. Now, press the main-menu button Save Wfm; then press the side-menu button To Ref 2.
- d. Save CH 3 (AX1 on some TDS models) waveform:
 - Move the coupler from CH 2 to CH 3, so that CH 1 and CH 3 are driven. Press WAVEFORM OFF. Press CH 3. Be sure the vertical scale factor is kept at 1.0X. Then press the side-menu button To Ref 3.
- e. Display all test signals:
 - Press WAVEFORM OFF to remove CH 3 (AX1 on some TDS models) from the display.
 - Display the live waveform. Move the coupler from CH 3 to CH 4, so that CH 1 and CH 4 are driven. Press CH 4 to display. Be sure the vertical scale factor is kept at 1.0X. See Figure 1–11 on page 1–41. (Use AX1 and AX2 instead of CH3 and CH4 if your TDS model is so equipped.)
 - Display the reference waveforms. To do this, press the front-panel button MORE. Press the main-menu buttons Ref 2 and Ref 3. You may notice their overlapping ground reference indicators. See Figure 1–11 on page 1–41.
- **f.** *Measure the test signal:*
 - Locate the time reference points for these waveforms. Do this by first identifying the point where the rising edge of the left-most waveform crosses the center horizontal graticule line. Next, note the corresponding *time reference point* for the right-most waveform. See Figure 1–11 on page 1–41.
 - Press CURSOR.
 - Press the main-menu button Function; then press the side-menu button V Bars.
 - Press CLEAR MENU.

- Align one V bar cursor to the *time reference point* of the left-most waveform edge and the other cursor to the *time reference point* of the right-most waveform edge by rotating the General Purpose knob. (Press SELECT to switch between the two cursors.) See Figure 1–11 on page 1–41.
- Read the measurement results at the Δ : cursor readout, not the @: readout on screen.



Figure 1–11: Measurement of Channel Delay – TDS 684B Shown

- **g.** Check against limits: CHECK that the cursor readout on screen is ≤ 100 ps for the TDS 600B or ≤ 50 ps for the TDS 500B/700A.
- **h.** If the channel skew is within the limits, enter time on the test record and proceed to step 3. Otherwise, proceed with steps i through p.
- i. Use the cursors to measure the skew from CH1 to CH2, CH1 to CH3, and CH1 to CH4 (use AX1 and AX2 instead of CH3 and CH4 if your TDS model is so equipped). Write down these three numbers in the first measurement column of Table 1–5. Note that these numbers may be either positive or negative.

- j. Repeat the procedure from step 1.c through 2.e.
- **k.** Again use the cursors to measure the skew from CH1 to CH2, CH1 to CH3, and CH1 to CH4. Write down these numbers in the second measurement column of Table 1–5. Note that these numbers may be either positive or negative.
- **1.** Add the first CH1 to CH2 skew measurement to the second CH1 to CH2 skew measurement and divide the result by 2. Use Table 1–5.
- **m.** Add the first CH1 to CH3 (AX1 on some TDS models) skew measurement to the second CH1 to CH3 skew measurement and divide the result by 2. Use Table 1–5.
- **n.** Add the first CH1 to CH4 (AX2 on some TDS models) skew measurement to the second CH1 to CH4 skew measurement and divide the result by 2. Use Table 1–5.
- **o.** Check against limits: CHECK that the largest of the three results from steps l, m, and n is between -100 ps and + 100 ps for the TDS 600B or between -50 ps and + 50 ps for the TDS 500B/700A.
- **p.** Enter time on the test record.

Table 1–5: Delay Between Channels Worksheet

Coupling	First Measurement	Second Measurement	Add First and Second Measurements	Divide Sum by 2
CH1 to CH2 skew				
CH1 to CH3 skew				
CH1 to CH4 skew				

3. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connectors of the channels.

Time Base System Checks

These procedures check those characteristics that relate to the Main and Delayed time base system and are listed as checked under *Warranted Characteristics* in *Specifications*.

Check Accuracy for Long-Term Sample Rate, Delay Time, and Delta Time Measurements

Equipment Required	One time-mark generator (Item 11)
	One 50 Ω , precision coaxial cable (Item 5)
Prerequisites	See page 1–15



Figure 1–12: Initial Test Hookup

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** Hook up the test-signal source: Connect, through a 50 Ω precision coaxial cable, the time-mark output of a time-mark generator to **CH 1**. Set the output of the generator for 10 ms markers.
 - **b.** *Initialize the oscilloscope:*
 - Press save/recall SETUP. Press the main-menu button Recall
 Factory Setup. Press the side-menu button OK Confirm Factory
 Init.
 - c. Modify the initialized front-panel control settings:
 - Set the vertical SCALE to 200 mV (or 500 mV with the optional Tektronix TG 501A Time Mark Generator)
 - Press VERTICAL MENU; then press the main-menu button Coupling. Press the side-menu button Ω to toggle it to the 50 Ω setting.
 - Press SET LEVEL TO 50%.

- Use the vertical **POSITION** knob to center the test signal on screen.
- Set the horizontal **SCALE** of the Main time base to 1 ms.
- Press TRIGGER MENU; then press the main-menu button Mode & Holdoff. Press the side-menu button Normal.
- 2. Confirm Main and Delayed time bases are within limits for accuracies:
 - **a.** *Display the test signal:*
 - Align the trigger T to the center vertical graticule line by adjusting the horizontal **POSITION**. See Figure 1–13 on page 1–45.
 - Press HORIZONTAL MENU.
 - Set horizontal modes. To do this, press the main-menu button Time Base. Press the side-menu buttons Delayed Only and Delayed Runs After Main. See Figure 1–13.
 - **b.** *Measure the test signal:*
 - Set the horizontal SCALE of the D (delayed) time base to 500 ns for the TDS 600B or to 100 ns for the TDS 500B/700A.
 - Set delayed time to 10 ms. Do this on the keypad by pressing 10, then SHIFT, then m followed by ENTER.)
 - c. Check long-term sample rate and delay time accuracies against limits:
 - CHECK that the rising edge of the marker crosses the center horizontal graticule line at a point within either ±2.0 divisions, for the TDS 600B, or ±2.5 divisions, for the TDS 500B/700A, of center graticule. See Figure 1–13.
 - Enter number of divisions on test record.



Figure 1–13: Measurement of Accuracy — Long-Term and Delay Time

3. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of **CH 1**.

Trigger System Checks

These procedures check those characteristics that relate to the Main and Delayed trigger systems and are listed as checked in *Specifications*.

Check Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering

Equipment Required	One medium-frequency sine wave generator (Item 19 or, optionally, item 25)	
	One 10X attenuator (Item 1)	
	One 50 Ω , precision coaxial cable (Item 5)	
Prerequisites	See page 1–15	

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** Initialize the instrument:
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button OK Confirm Factory Init.
 - **b.** *Modify the default setup:*
 - Press VERTICAL MENU.
 - Press the main-menu button Coupling; then press the side-menu Ω button to select 50 Ω coupling.
 - Set the horizontal SCALE to 10 ns on the TDS 600B and 12.5 ns on the TDS 500B/700A.
 - c. Hook up the test-signal source: Connect the output of a medium-frequency leveled sine wave generator (Item 25) to CH 1. Do this through a 50 Ω precision coaxial cable, followed by a 10X attenuator. See Figure 1–14.



Figure 1–14: Initial Test Hookup

- 2. Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (Horizontal Scale $\leq 1 \mu s$):
 - a. *Display the test signal:* Set the output of the sine wave generator for a 100 MHz, five-division sine wave on screen. Press SET LEVEL TO 50%.

- **b.** *Set the trigger mode:* Press **TRIGGER MENU**. Now press the main-menu button **Mode & Holdoff**; then press the side-menu button **Normal**.
- **c.** *Set upper and lower limits that ensure triggering:* See Figure 1–15.
 - Press the main-menu button Type; then repeatedly press the same button until Pulse is highlighted in the menu that pops up.
 - Press the main-menu button Class; then repeatedly press the same button until Width is highlighted in the menu that pops up.
 - Press the main-menu button Trig When; then press the side-menu button Within Limits.
 - Press the side-menu button Upper Limit. Use the keyboard to set the upper limit to 10 ns: press 10, then SHIFT, then n, and ENTER.
 - Press the side-menu button Lower Limit. Use the keypad to set the lower limit to 2 ns.
- d. Change limits until triggering stops:
 - Press SET LEVEL TO 50%.
 - While doing the following subparts, monitor the display (it will stop acquiring) and the front-panel light **TRIG** (it will extinguish) to determine when triggering is lost.
 - Press the side-menu button Lower Limit.
 - Use the general purpose knob to *increase* the **Lower Limit** readout until triggering is lost.
 - CHECK that the **Lower Limit** readout, after the oscilloscope loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
 - Enter time on test record.
 - Use the keypad to return the Lower Limit to 2 ns and reestablish triggering.
 - Press the side-menu button Upper Limit; then use the general purpose knob to slowly *decrease* the Upper Limit readout until triggering is lost.
 - CHECK that the Upper Limit readout, after the oscilloscope loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
 - Enter time on test record.



Figure 1–15: Measurement of Time Accuracy for Pulse and Glitch Triggering

- **3.** Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (horizontal scale $> 1 \mu s$):
 - **a.** Set upper and lower limits that ensure triggering at 250 kHz:
 - Press the side-menu button Upper Limit. Use the keyboard to set the upper limit to 4 μs.
 - Press the side-menu button Lower Limit. Use the keypad to set the lower limit to 500 ns.
 - **b.** *Display the test signal:*
 - Set the horizontal SCALE to 5 μs.
 - Set the output of the sine wave generator for a 250 kHz, five-division sine wave on screen. Set the vertical SCALE to 20 mV (the waveform will overdrive the display).
 - Press **SET LEVEL TO 50%**.
 - c. *Check against limits:* Do the following subparts in the order listed.
 - Press the side-menu button **Lower Limit**.
 - Use the general purpose knob to *increase* Lower Limit readout until triggering is lost.

- CHECK that the **Lower Limit** readout, after the oscilloscope stops triggering, is within 1.9 µs to 2.1 µs, inclusive.
- Enter time on test record.
- Use the keypad to return the **Lower Limit** to 500 ns and reestablish triggering.
- Press the side-menu button Upper Limit; then use the general purpose knob to slowly *decrease* the Upper Limit readout until triggering stops.
- CHECK that the **Upper Limit** readout, after the oscilloscope loses triggering, is within 1.9 µs to 2.1 µs, inclusive.
- Enter time on test record.
- 4. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of CH 1.

Check Accuracy, Trigger-Level or Threshold, DC Coupled	Equipment Required	One DC calibration generator (Item 9) One BNC T connector (Item 7) Two 50 Ω, precision coaxial cables (Item 5)
	Prerequisites	See page 1–15.



Figure 1–16: Initial Test Hookup

- 1. Install the test hookup and preset the instrument controls:
 - **a.** Hook up the test-signal source:
 - Set the output of the DC calibration generator to 0 volts.

- Connect the output of the DC calibration generator, through a dual-banana connector followed by a 50 Ω precision coaxial cable, to one side of a BNC T connector.
- Connect the Sense output of the generator, through a second dual-banana connector followed by a 50 Ω precision coaxial cable, to other side of the BNC T connector. Now connect the BNC T connector to CH 1.
- **b.** *Initialize the oscilloscope:*
 - Press save/recall **Setup**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.
- **2.** Confirm Main trigger system is within limits for Trigger-level/Threshold accuracy:
 - **a.** *Display the test signal:*
 - Set the vertical **SCALE** to 200 mV.
 - Press VERTICAL MENU, then press the main-menu button Position.
 - Set vertical position to -3 divisions (press -3, then ENTER, on the keypad.) The baseline level will move down three divisions. See Figure 1–17 on page 1–51.
 - Press the main-menu button **Offset**.
 - Set vertical offset to +10 volts with the keypad. The baseline level will move off screen.
 - Set the standard output of the DC calibration generator equal to the offset (+10 volts). The DC test level will appear on screen. See Figure 1–17.
 - **b.** *Measure the test signal:*
 - Press SET LEVEL TO 50%.
 - Press TRIGGER MENU.
 - Read the measurement results from the readout below the label
 Level in the main menu, not the trigger readout in the graticule area.

- c. *Read results (Check against limits):* See Figure 1–17.
 - CHECK that the Level readout in the main menu is within 9.863 V to 10.137 V, inclusive, for the TDS 600B or is within 9.9393 V to 10.1147 V, inclusive, for the TDS 500B/700A.
 - Enter voltage on test record.
 - Press the main-menu button Slope; then press the side-menu button for negative slope. See icon at left. Repeat substep b.
 - CHECK that the Level readout in the main menu is within 9.863 V to 10.137 V, inclusive, for the TDS 600B or is within 9.9393 V to 10.1147 V, inclusive, for the TDS 500B/700A.



Enter voltage on test record.

Figure 1–17: Measurement of Trigger-Level Accuracy

- **3.** Confirm Delayed trigger system is within limits for Trigger-level/Threshold accuracy:
 - **a.** Select the Delayed time base:

- Press HORIZONTAL MENU.
- Press the main-menu button **Time Base**.
- Press the side-menu buttons Delayed Only and Delayed Triggerable.
- Set D (delayed) horizontal SCALE to 500 μs.
- **b.** Select the Delayed trigger system:
 - Press SHIFT; then press the front-panel DELAYED TRIG button.
 - Press the main-menu button Level.
- *Measure the test signal:* Press the side-menu button SET TO 50%.
 Read the measurement results in the side (or main) menu below the label Level.
- d. Check against limits: Do the following subparts in the order listed.
 - CHECK that the Level readout in the side menu is within 9.863 V to 10.137 V, inclusive, for the TDS 600B or is within 9.9393 V to 10.1147 V, inclusive, for the TDS 500B/700A.
 - Enter voltage on test record.
 - Press the main-menu button Slope; then press the side-menu button for negative slope. See icon at left. Press the main-menu button Level. Repeat substep c.
 - CHECK that the Level readout in the side menu is within 9.863 V to 10.137 V, inclusive, for the TDS 600B or is within 9.9393 V to 10.1147 V, inclusive, for the TDS 500B/700A.
 - Enter voltage on test record.
- **4.** *Disconnect the hookup:*
 - **a.** *First set the output of the DC calibration generator to 0 volts.*
 - **b.** Disconnect the cable from the generator output at the input connector of **CH 1**.

Sensitivity, Edge Trigger, DC Coupled			
	Equipment Required	One sine wave generator (Item 19 or, optionally, items 25 and 26)	
		Two precision 50 Ω coaxial cables (Item 5)	
		One 10X attenuator (Item 1)	
		One BNC T connector (Item 7)	
		One 5X attenuator (Item 2)	
	Prerequisites	See page 1–15.	

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** Initialize the oscilloscope:
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.
 - **b.** Modify the initialized front-panel control settings:
 - Set the horizontal SCALE for the M (main) time base to 20 ns on the TDS 600B or 25 ns on the TDS 500B/700A.
 - Press HORIZONTAL MENU; then press the main-menu button Time Base.
 - Press the side-menu button Delayed Only; then press the side-menu button Delayed Triggerable.
 - Set the horizontal SCALE for the D (delayed) time base to 20 ns on the TDS 600B or 25 ns on the TDS 500B/700A; then press the side-menu button Main Only.
 - Press TRIGGER MENU; then press the main-menu button Mode & Holdoff. Press the side-menu button Normal.
 - Press VERTICAL MENU; then press the main-menu button Coupling. Press the side-menu button Ω to select the 50 Ω setting.
 - Press SHIFT; then press ACQUIRE MENU. Press the main-menu button Mode; then press the side-menu button Average 16.
 - c. Hook up the test-signal source:
 - Connect the signal output of a medium-frequency sine wave generator (item 19 or, optionally, item 25) to a BNC T connector. Connect one output of the T connector to CH 1 through a 50 Ω precision coaxial cable. Connect the other output of the T connector to the AUX TRIG INPUT at the rear panel. See Figure 1–18.



Figure 1–18: Initial Test Hookup

- **2.** Confirm Main and Delayed trigger systems are within sensitivity limits (50 MHz):
 - **a.** *Display the test signal:*
 - Set the generator frequency to 50 MHz.
 - Press MEASURE.
 - Press the main-menu button High-Low Setup; then press the side-menu button Min-Max.
 - Press the main-menu button **Select Measrmnt for** *Ch1*.
 - Press the side-menu button -more- until Amplitude appears in the side menu (its icon is shown at the left). Press the side-menu button Amplitude.
 - Press **SET LEVEL TO 50%**.
 - Press CLEAR MENU.
 - Set the test signal amplitude for about three and a half divisions on screen. Now fine adjust the generator output until the CH 1
 Amplitude readout indicates the amplitude is 350 mV. Readout may fluctuate around 350 mV.
 - Disconnect the 50 Ω precision coaxial cable at CH 1 and reconnect it to CH 1 through a 10X attenuator.
 - **b.** Check the Main trigger system for stable triggering at limits:
 - Read the following definition: A stable trigger is one that is consistent; that is, one that results in a uniform, regular display triggered on the selected slope (positive or negative). This display should *not* have its trigger point switching between opposite slopes, nor should it roll across the screen. At horizontal scale settings of

2 ms/division and faster, **TRIG'D** will remain constantly lighted. It will flash for slower settings.

- Press **TRIGGER MENU**; then press the main-menu button **Slope**.
- Press SET LEVEL TO 50%. Adjust the TRIGGER LEVEL knob so that the TRIG'D light is on. Set the level to near the middle of the range where the TRIG'D light is on. CHECK that the trigger is stable for the test waveform on both the positive and negative slopes. Use the side menu to switch between trigger slopes.
- Enter pass/fail result for main trigger on the test record.
- Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step.





- **c.** *Check Delayed trigger system for stable triggering at limits:* Do the following subparts in the order listed.
 - Press HORIZONTAL MENU; then press the main-menu button Time Base. Press the side-menu button Delayed Only; then press Delayed Triggerable in the same menu.

- Press SHIFT; then press DELAYED TRIG. Press the main-menu button Level.
- Press the side-menu button **SET TO 50%**.

CHECK that a stable trigger is obtained for the test waveform for both the positive and negative slopes of the waveform. Use the **TRIGGER LEVEL** knob to stabilize the Main trigger. Use the general purpose knob to stabilize the Delayed trigger. Press the main-menu button **Slope**; then use the side menu to switch between trigger slopes. See Figure 1–19.

- Enter pass/fail result for delayed trigger on the test record.
- Leave the Delayed trigger system triggered on the positive slope of the waveform before continuing to the next step. Also, return to the main time base: Press HORIZONTAL MENU; then press the main-menu button Time Base. Press the side-menu button Main Only.
- Press CLEAR MENU.
- 3. Confirm the AUX Trigger input:
 - **a.** Display the test signal:
 - Remove the 10X attenuator and reconnect the cable to **CH 1**.
 - Set the test signal amplitude for about 2.5 divisions on screen.
 - Now fine adjust the generator output until the CH 1 Amplitude readout indicates the amplitude is 250 mV. (Readout may fluctuate around 250 mV.)
 - **b.** *Check the AUX trigger source for stable triggering at limits:* Do the following in the order listed.
 - Use the definition for stable trigger from step 2.
 - Press **TRIGGER MENU**; then press the main-menu button **Source**.
 - Press the side-menu button -more- until the side-menu label DC Aux appears; then press DC Aux.
 - Press SET LEVEL TO 50%. CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. Press the main-menu button Slope; then use the side menu to switch between trigger slopes. Use the TRIGGER LEVEL knob to stabilize the trigger if required.
 - Enter the pass/fail result on the test record.

- Leave the Main trigger system triggered on the positive slope of the waveform before proceeding to the next check.
- Press the main-menu button Source; then press the side-menu button -more- until CH 1 appears. Press CH 1.
- **4.** Confirm that the Main and Delayed trigger systems are within sensitivity limits (full bandwidth):
 - **a.** *Hook up the test-signal source:* Disconnect the hookup installed in step 1. Connect the signal output of a high-frequency sine wave generator (item 19 or, optionally, item 26) to **CH 1**.
 - **b.** Set the Main and Delayed Horizontal Scales:
 - Set the horizontal **SCALE** to 500 ps for the **M** (Main) time base.
 - Press HORIZONTAL MENU. Now press the main-menu button Time base; then press the side-menu button Delayed Triggerable.
 - Press the side-menu button **Delayed Only**.
 - Set the horizontal SCALE to 500 ps for the D (Delayed) time base. Press the side-menu button Main Only.
 - c. Display the test signal:
 - Set the generator frequency to full bandwidth as follows:

TDS 680B, 684B, 782A, & 784A:	1 GHz
TDS 520B, 540B, 620B, 644B, 724A, & 754A:	500 MHz

- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the CH 1 Amplitude readout indicates the amplitude is 500 mV. (Readout may fluctuate around 500 mV.)
- Disconnect the leveling head at CH 1 and reconnect it to CH 1 through a 5X attenuator.
- **d.** Repeat step 2, substeps b and c only, since only the full bandwidth is to be checked here.

NOTE. You just checked the trigger sensitivity. If desired, you may repeat steps 1 through 4 for the other channels (CH2, CH3, and CH4).

5. *Disconnect the hookup:* Disconnect the cable from the channel last tested.

Output Signal Checks

The procedure that follows checks those characteristics of the output signals that are listed as checked under *Warranted Characteristics* in *Specifications*. The oscilloscope outputs these signals at its front and rear panels.

Check Outputs — CH 3 (AX1 on some models) Main and Delayed Trigger

Equipment Required	Two 50 Ω precision cables (Item 5) One calibration generator (Item 10)
Prerequisites	See page 1–15. Also, the Digitizing Oscilloscope must have passed <i>Check DC Voltage Measurement Accuracy</i> on page 1–29.
	See Input Channels vs. Model on page 1–2.

1. Install the test hookup and preset the instrument controls:



Figure 1–20: Initial Test Hookup

- **a.** Hook up test-signal source 1:
 - Connect the standard amplitude output of a calibration generator through a 50 Ω precision coaxial cable to CH 3 (AX1 on some TDS models).
 - Set the output of the calibration generator to 0.500 V.
- **b.** Hook up test-signal source 2: Connect the Main Trigger Out at the rear panel to CH 2 through a 50 Ω precision cable.
- c. Initialize the oscilloscope:
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.
- **d.** *Modify the initialized front-panel control settings:*
 - Set the horizontal SCALE to 200 μs.
 - Press SHIFT; then press ACQUIRE MENU.
 - Press the main-menu button Mode; then press the side-menu button Average.
 - Select 64 averages. Do this with the keypad or the general purpose knob
- 2. Confirm Main and Delayed Trigger outputs are within limits for logic levels:
 - **a.** *Display the test signal:*
 - Press WAVEFORM OFF to turn off CH 1.
 - Press **CH 2** to display that channel.
 - Set the vertical **SCALE** to 1 V.
 - Use the vertical **POSITION** knob to center the display on screen.
 - **b.** Measure logic levels:

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- Press MEASURE; then press the main-menu button Select Measurement for Ch2.
- Select high and low measurements. To do this, repeatedly press the side-menu button -more- until High and Low appear in the side menu (their icons are shown at the left). Press both side-menu buttons High and Low.
- c. Check Main Trigger output against limits:
 - CHECK that the Ch2 High readout is ≥2.5 volts and that the Ch2 Low readout is ≤0.7 volts. See Figure 1–21.
 - Enter high and low voltages on test record.
 - Press VERTICAL MENU; then press the main-menu button Coupling. Now press the side-menu button Ω to toggle it to the 50 Ω setting.
 - CHECK that the **Ch2 High** readout is ≥1.0 volt and that the **Ch2** Low readout ≤0.25 volts.
 - Enter high and low voltages on test record.



Figure 1–21: Measurement of Main Trigger Out Limits

- **d.** Check Delayed Trigger output against limits: See Figure 1–21.
 - Move the precision 50 Ω cable from the rear-panel Main Trigger Output BNC to the rear-panel Delayed Trigger Output BNC.
 - CHECK that the Ch2 High readout is ≥1.0 volt and that the Ch2 Low readout ≤0.25 volts.
 - Enter high and low voltages on test record.
 - Press the side-menu button Ω to select the 1 M Ω setting.
 - Press CLEAR MENU.
 - CHECK that the Ch2 High readout is ≥2.5 volts and that the Ch2 Low readout is ≤0.7 volts.
 - Enter high and low voltages on test record.
- 3. Confirm CH 3 (Ax1 on some TDS models) output is within limits for gain:
 - **a.** *Measure gain:*
 - Move the precision 50 Ω cable from the rear-panel DELAYED TRIGGER OUTPUT BNC to the rear-panel SIGNAL OUT BNC.
 - Push **TRIGGER MENU**.

- Press the main-menu button **Source**.
- Press the side-menu button Ch3. (Ax1 on some TDS models)
- Set vertical **SCALE** to 100 mV.
- Press **SET LEVEL TO 50%**.
- Press MEASURE; then press the main-menu button Select Measrmnt for Ch2.
- Repeatedly press the side-menu button –more– until Pk-Pk appears in the side menu (its icon is shown at the left). Press the side-menu button Pk-Pk.
- Press CLEAR MENU.
- **b.** Check against limits:
 - CHECK that the readout Ch2 Pk-Pk is between 80 mV and 120 mV, inclusive, for the TDS 600B or is between 88 mV and 132 mV, inclusive, for the TDS 500B/700A.
 - Enter voltage on test record.
 - Press VERTICAL MENU; then press the side-menu button Ω to toggle to the 50 Ω setting.
 - Press CLEAR MENU.
 - CHECK that the readout Ch2 Pk-Pk is between 40 mV and 60 mV, inclusive, for the TDS 600B or is between 44 mV and 66 mV, inclusive, for the TDS 500B/700A.
 - Enter voltage on test record.
- **4.** *Disconnect the hookup:* Disconnect the cables from the channel inputs and the rear panel outputs.

Check Probe Compensator Output	Equipment Required	One female BNC to clip adapter (Item 3) Two dual-banana connectors (Item 6) One BNC T connector (Item 7) Two 50 Ω precision cables (Item 5) One DC calibration generator (Item 9)
	Prerequisites	See page 1–15. Also, the Digitizing Oscilloscope must have passed Check Accuracy For Long-Term Sample Rate, Delay Time, and Delta Time Measurements on page 1–43.

- **1.** Install the test hookup and preset the instrument controls:
 - **a.** *Hook up test-signal:*
 - Connect one of the 50 Ω cables to **CH 1**. See Figure 1–22.
 - Connect the other end of the cable just installed to the female BNC-to-clips adapter. See Figure 1–22.
 - Connect the red clip on the adapter just installed to the PROBE COMPENSATION SIGNAL on the front panel; connect the black clip to PROBE COMPENSATION GND. See Figure 1–22.



Figure 1–22: Initial Test Hookup

- **b.** *Initialize the oscilloscope:*
 - Press save/recall **SETUP**.
 - Press the main-menu button **Recall Factory Setup**.
 - Press the side-menu button **OK Confirm Factory Init**.

- **c.** *Modify the initialized front-panel control settings:*
 - Set the horizontal SCALE to 200 μs.
 - Press **SET LEVEL TO 50%**.
 - Use the vertical **POSITION** knob to center the display on screen.
 - Press SHIFT; then press ACQUIRE MENU.
 - Press the main-menu button Mode; then press the side-menu button Average.
 - Select **128** averages with the keypad or the general purpose knob.
- 2. Confirm that the Probe Compensator signal is within limits for frequency:
 - **a.** *Measure the frequency of the probe compensation signal:*
 - Press MEASURE; then press the main-menu button Select Measrmnt for Ch1.
 - Repeatedly press the side-menu button -more- until Frequency appears in the side menu (its icon is shown at the left). Press the side-menu button Frequency.
 - **b.** Check against limits:

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- CHECK that the CH 1 Freq readout is within 950 Hz to 1.050 kHz, inclusive. See Figure 1–23.
- Enter frequency on test record.
- Press MEASURE; then press the main-menu button Remove Measrmnt for *Ch1*. Press the side-menu Measurement 1.

TDS 500B, TDS 600B & TDS 700A Performance Verification and Specifications



Figure 1–23: Measurement of Probe Compensator Frequency

- **c.** Save the probe compensation signal in reference memory:
 - Press SAVE/RECALL WAVEFORM; then press the main-menu button Save Wfm Ch 1.
 - Press the side-menu button To Ref 1 to save the probe compensation signal in reference 1.
 - Disconnect the cable from CH 1 and the clips from the probe compensation terminals.
 - Press MORE; then press the main-menu button Ref 1 to displayed the stored signal.
 - Press CH 1.
- **d.** Hook up the DC standard source:
 - Set the output of a DC calibration generator to 0 volts.
 - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 1–24.
 - Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to



the other side of the BNC T connector. Now connect the BNC T connector to **CH 1**. See Figure 1–24.

Figure 1–24: Subsequent Test Hookup

- e. Measure amplitude of the probe compensation signal:
 - Press SHIFT; then press ACQUIRE MENU. Press the side-menu button AVERAGE then enter 16 using the keypad or the general purpose knob.
 - Adjust the output of the DC calibration generator until it precisely overlaps the top (upper) level of the stored probe compensation signal. (This value will be near 500 mV.)
 - Record the setting of the DC generator.
 - Adjust the output of the DC calibration generator until it precisely overlaps the base (lower) level of the stored probe compensation signal. (This value will be near zero volts.)
 - Record the setting of the DC generator.
- **f.** Press **CLEAR MENU** to remove the menus from the display. See Figure 1–25.



Figure 1–25: Measurement of Probe Compensator Amplitude

- g. Check against limits:
 - Subtract the value just obtained (base level) from that obtained previously (top level).
 - CHECK that the difference obtained is within 495 mV to 505 mV, inclusive.
 - Enter voltage difference on test record.
- 3. *Disconnect the hookup:* Disconnect the cable from CH 1.

Option 05 Video Trigger Checks

Check Video Trigger	Equipment Required	PAL signal source (Item 14)
		60 Hz. sine wave generator (Item 15)
		Pulse generator (Item 16)
		Two 75 Ω cables (Item 17)
		Two 75 Ω terminators (Item 18)
		One BNC T connector (Item 7)
		50 Ω cable (Item 5)
		50 Ω terminator (Item 4)
	Prerequisites	See page 1–15. These prerequisites include running the signal path compensation routine.

- **1.** Set up digitizing oscilloscope to factory defaults by completing the following steps:
 - a. Press save/recall SETUP.
 - b. Press the main-menu Recall Factory Setup.
 - c. Press the side-menu OK Confirm Factory Init.
 - **d.** Wait for the Clock Icon to leave the screen.
 - e. CONFIRM the digitizing oscilloscope is setup as shown below.

Channel: CH1

Volt/div: 100 mV

Horizontal scale: 500 µs/div

- **2.** Set up digitizing oscilloscope for TV triggers by completing the following steps:
 - a. Press TRIGGER MENU.
 - b. Press the main-menu Type pop-up until you select Video.
 - c. Press the main-menu Standard pop-up until you select 625/PAL.
 - d. Press the main-menu Line.
 - e. Use the keypad to set the line number to 7 (press 7, then ENTER).
 - f. Press VERTICAL MENU.

- g. Press the main-menu Bandwidth.
- h. Select 250 MHz from the side menu.
- i. Press the main-menu Fine Scale.
- **j.** Use the keypad to set the fine scale to 282mV (press **282**, **SHIFT**, **m**, then **ENTER**).
- k. Press HORIZONTAL MENU.
- I. Press the main-menu Horiz Scale.
- m. Use the keypad to set the horizontal scale to 200 ns (press 200, SHIFT, n, then ENTER).
- 3. Check Jitter vs. Signal Amplitude
 - **a.** Set up equipment for Jitter Test. See Figure 1–26.
 - Connect one of the rear panel composite outputs marked COMPST on the TSG121 through a 75 Ω cable and a 75 Ω terminator to the CH1 input of the TDS.
 - Press the 100% FIELD control (the fourth TSG121 front-panel button from the left) of the PAL signal source.



Figure 1–26: Jitter Test Hookup

b. CHECK that the oscilloscope lights up its front panel **TRIG'D** LED and it displays the waveform on screen. See Figure 1–27.



Figure 1–27: Jitter Test Displayed Waveform – TDS 684B Shown

- c. Press SHIFT; then press ACQUIRE MENU.
- d. Press the main-menu Mode.
- e. Select the side-menu Average. It should be already set to 16.
- f. Press the main-menu Create Limit Test Template.
- g. Press the side-menu V Limit.
- h. Use the keypad to set V Limit to 180 mdiv (press 180, SHIFT, m, then ENTER)
- i. Press the side-menu OK Store Template.
- j. Press MORE.
- k. Press the main-menu Ref1.
- l. Press CH1.
- m. Press SHIFT; then press ACQUIRE MENU.
- n. Press the main-menu Limit Test Setup.
- o. Toggle the side-menu Limit Test to ON.
- p. Toggle the side-menu Ring Bell if Condition Met to ON.

- q. Press the main-menu Mode.
- r. Press the side-menu Envelope.
- s. Use the keypad to set envelope to use 100 acquisitions (press 100, then ENTER).
- t. Press the main-menu Stop After button.
- u. Press the side-menu Single Acquisition Sequence.
- v. Confirm that the oscilloscope successfully makes 100 acquisitions. If not successful, the oscilloscope bell will ring. When the word **Run** in the top left corner of the display changes to **STOP**, the test is complete. See Figure 1–28.



Figure 1–28: Jitter Test When Completed – TDS 684B Shown

- w. Press the main-menu Limit Test Setup.
- x. Toggle the side-menu Ring Bell if Condition Met to OFF.
- y. Toggle the side-menu Limit Test to OFF.
- 4. Check Triggered Signal Range.

Set up oscilloscope for Triggered Signal Test.

a. Press MORE.

- b. Press WAVEFORM OFF.
- c. Press HORIZONTAL MENU.
- **d.** Use the keypad to set horizontal scale (/div) to 50 μ s (press **50**, **SHIFT**, μ , then **ENTER**).
- e. Press SHIFT; then press ACQUIRE MENU.
- f. Press the main-menu Stop After.
- g. Press the side-menu RUN/STOP button only.
- h. Press the main-menu Mode.
- i. Press the side-menu Sample.
- j. Press RUN/STOP.
- k. Press VERTICAL MENU.
- **1.** Use the keypad to set fine scale to 300 mV (press **300**, **SHIFT**, **m**, then **ENTER**).
- m. CONFIRM that the TRIG'D LED stays lighted and that the waveform on screen is stable. That is, it does not move horizontally or vertically. Also, CONFIRM that the waveform on the screen has one positive pulse and a number of negative pulses. See Figure 1–29.



Figure 1–29: Triggered Signal Range Test – 300 mV

- n. Use the keypad to set the fine scale to 75 mV (press 75, SHIFT, m, then ENTER).
- **o.** CONFIRM that the **TRIG'D** LED stays lighted and that the waveform on screen is stable. That is, it does not move horizontally or vertically. Also, CONFIRM that the waveform on the screen has one positive pulse and a number of negative pulses. See Figure 1–30.



Figure 1–30: Triggered Signal Range Test – 75 mV

- **p.** Disconnect all test equipment (TSG121) from the digitizing oscilloscope.
- 5. Check 60 Hz Rejection.
 - a. Set up oscilloscope for 60 Hz Rejection Test.
 - Use the keypad to set the Ch1 Fine Scale to 282 mV (press 282, SHIFT m, then ENTER).
 - Press WAVEFORM OFF.
 - Press CH2.
 - Press VERTICAL MENU.
 - Use the keypad set the fine scale to 2 V (press 2, then ENTER).
 - Press HORIZONTAL MENU.
 - Use the keypad to set the horizontal scale (/div) to 5 ms (press 5, SHIFT, m, then ENTER).
 - **b.** Set up 60 Hz signal generator.
 - Connect the output of the signal generator to the CH2 input through a 50 Ω cable. See Figure 1–31.



Figure 1–31: 60 Hz Rejection Test Hookup

Adjust the signal generator for three vertical divisions of 60 Hz signal. See Figure 1–32. The signal will not be triggered. That is, it will run free.



Figure 1–32: 60 Hz Rejection Test Setup Signal

- c. Check 60 Hz rejection.
 - Use the keypad to set the horizontal scale (/div) to 50 μs (press 50, SHIFT, μ, then ENTER).
 - Reconnect the output of the signal generator. Connect the composite signal connector of the PAL signal source (labeled COMPST on the

TSG 121) to a 75 Ω cable and a 75 Ω terminator. Connect both signals to the CH1 input through a BNC T. See Figure 1–33.

- Press VERTICAL MENU.
- If needed, press the main-menu **Fine Scale**.
- Use the keypad to set fine scale to 500 mV (press **500**, **SHIFT**, **m**, then **ENTER**).
- Connect another composite signal connector of the PAL signal source (labeled COMPST on the TSG 121) through a 75 Ω cable and a 75 Ω terminator to the CH2 input. See Figure 1–33.



Figure 1–33: Subsequent 60 Hz Rejection Test Hookup

- CONFIRM that the TRIG'D LED stays lighted and that the waveform on screen is stable. In other words, be sure the waveform does not move horizontally or vertically. Also, confirm that the waveform on the screen has one positive pulse and a number of negative pulses. See Figure 1–34.
- Disconnect all test equipment from the digitizing oscilloscope.



Figure 1–34: 60 Hz Rejection Test Result – TDS 684B Shown

- 6. Check Line Count Accuracy.
 - a. Set up oscilloscope for Line Count Accuracy Test.
 - Press WAVEFORM OFF.
 - Press CH1.
 - Press HORIZONTAL MENU.
 - Press the main-menu **Record Length**.
 - Press the side-menu –**more** until you see the appropriate menu.
 - Press the side-menu **5000 points in 100divs**.
 - Press the main-menu Horiz Scale (/div).
 - Use the keypad to set the horizontal scale to 200 ns (press 200, SHIFT, n, then ENTER).
 - **b.** Check Line Count Accuracy.
 - Connect a composite output signal from the rear of the PAL signal source (labeled COMPST on the TSG 121) to the CH1 input through a 75 Ω cable and a 75 Ω terminator. See Figure 1–35.



Figure 1–35: Line Count Accuracy Test Hookup

- Press the main-menu **Trigger Position**.
- Press the side-menu to **Set to 50%**.
- Press the main-menu to **Horiz Pos**.
- Press the side-menu to **Set to 50%**.
- Use the HORIZONTAL POSITION knob to move the falling edge of the sync pulse to two divisions to the left of center screen. See Figure 1–36.



Figure 1–36: Line Count Accuracy Test Setup Waveform – TDS 684B Shown

- Press CURSOR.
- Press the main-menu **Function**.
- Press the side-menu V Bars.
- Using the General Purpose knob, place the left cursor directly over the trigger 'T' icon.
- Press SELECT.
- Turn the General Purpose knob to adjust the right cursor for a cursor delta reading of 6.780us.
- Use the HORIZONTAL POSITION knob to position the right cursor to center screen.
- Verify that the cursor is positioned on a positive slope of the burst signal. See Figure 1–37.



Figure 1–37: Line Count Accuracy Correct Result Waveform

- Disconnect all test equipment (TSG 121) from the digitizing oscilloscope.
- Turn off cursors by pressing CURSOR, then the main-menu
 Function button, and, finally, Off from the side menu.
- 7. Check the Sync Duty Cycle.
 - a. Set up digitizing oscilloscope for Sync Duty Cycle Test.
 - Press TRIGGER MENU.
 - Press the Standard pop-up to select FlexFmt. Trigger Type should already be set to Video.
 - Press the main-menu **Setup**.
 - Press the side-menu **Field Rate**.
 - Use the keypad to set the field rate to 60.05 Hz (press 60.05, then ENTER).
 - Press the side-menu Lines.
 - Use the keypad to set the field rate to 793 lines (press 793, then ENTER).

- Press the side-menu **Fields**.
- Use the keypad to set the number of fields to 1 (press 1, then ENTER).
- Press the side-menu **Sync Width**.
- Use the keypad to set the width to 400 ns (press 400, SHIFT, n, then ENTER).
- Press the side-menu -more-1 of 2. Then press V1 Start Time.
- Use the keypad to set V1 start time to 10.10 μs (press 10.10, SHIFT, μ, then ENTER).
- Press the side-menu V1 Stop Time.
- Use the keypad to set V1 stop time to 10.50 μs (press 10.50, SHIFT, μ, then ENTER).
- Press the main-menu **Type** pop-up to select **Edge**.
- Press HORIZONTAL MENU.
- Press the main-menu Record Length.
- Select the side-menu 1000 points in 20div. If needed, first press the side-menu –more– until you see the appropriate side-menu item.
- Turn the HORIZONTAL POSITION knob to position the trigger 'T' two divisions to the left of the center screen.
- Press MEASURE.
- If needed, press the main-menu Select Measrmnt.
- Press the side-menu Negative Width.
- Press the side-menu Period.
- **b.** Set up the pulse generator for Sync Duty Cycle Test.
 - Set **PULSE DURATION** to 50 ns.
 - Set **PERIOD** to $10 \, \mu s$.
 - Set OUTPUT (VOLTS) to -1 for LOW LEVEL and +1 for HIGH LEVEL.
 - Depress the COMPLEMENT button.
 - Be sure BACK TERM is depressed (in).

- c. Check Sync Duty Cycle.
 - Connect the pulse generator through a 50 Ω cable and a 50 Ω terminator to the oscilloscope CH1 input. See Figure 1–38.



Figure 1–38: Setup for Sync Duty Cycle Test

Turn the pulse generator OUTPUT (VOLTS) control until the signal on the oscilloscope shows a one division negative going pulse. See Figure 1–39.

NOTE. You may need to adjust the trigger level control to obtain a stable trigger.



Figure 1–39: Sync Duty Cycle Test: One-Div Neg Pulse Waveform

- Turn the pulse generator PULSE DURATION variable control to adjust the negative pulse so the oscilloscope's CH1 – Width measurement displays 400ns +/-10 ns.
- Turn the HORIZONTAL SCALE knob to set the oscilloscope time base to 5µs/div.
- Turn the pulse generator PERIOD variable control to adjust the period until the oscilloscope CH1 Period measurement reads
 21.000µs -25/+50 ns. See Figure 1–40. Read note shown below.

NOTE. The pulse duration and period adjustments are critical in making this measurement. If the pulse duration and/or the duty cycle are not stable, the *FLEXFMT* function may not function. You must take care when making these adjustments.



Figure 1–40: Sync Duty Cycle Test: Critically Adjusted Pulse

- Press TRIGGER MENU.
- Press the main-menu **Type** pop-up until you select **Video**.

If the **TRIG'D** LED is not lighted, check that the **CH1** – **Width** and **CH1 Period** measurements are adjusted correctly. See note above. CONFIRM that the setup is correct and the oscilloscope will trigger.

- CONFIRM that the **TRIG'D** LED is lighted and the waveform is stable.
- Disconnect the signal source from CH1, wait a few seconds, then reconnect the signal.
- CONFIRM that the **TRIG'D** LED is lighted and the waveform is stable.
- Press Sync Polarity.
- Press **Pos Sync**.
- Push the pulse generator **COMPLEMENT** button out.
- CONFIRM that the **TRIG'D** LED is lighted and the waveform is stable.

- Disconnect the signal source from CH1, wait a few seconds, then reconnect the signal.
- CONFIRM that the **TRIG'D** LED is lighted and the waveform is stable.
- Disconnect all test equipment from the digitizing oscilloscope.
- Press save/recall SETUP, the main-menu button Recall Factory Setup, and the side-menu OK Confirm Factory Init.

Sine Wave Generator Leveling Procedure

Some procedures in this manual require a sine wave generator to produce the necessary test signals. If you do not have a leveled sine wave generator, use one of the following procedures to level the output amplitude of your sine wave generator.

Equipment Required	Sine wave generator (Item 19) Level meter and power sensor (Item 20) Power splitter (Item 21) Two male N to female BNC adapters (Item 23)	
	One precision coaxial cable (Item 5)	
Prerequisites	See page 1–15	



Figure 1–41: Sine Wave Generator Leveling Equipment Setup

- 1. Install the test hookup: Connect the equipment as shown in Figure 1–41.
- 2. Set the Generator:
 - Set the sine wave generator to a reference frequency of 10 MHz.
 - Adjust the sine wave generator amplitude to the required number of divisions as measured by the digitizing oscilloscope.
- 3. *Record the reference level:* Note the reading on the level meter.
- 4. Set the generator to the new frequency and reference level:
 - Change the sine wave generator to the desired new frequency.
 - Input the correction factor for the new frequency into the level meter.
 - Adjust the sine wave generator amplitude until the level meter again reads the value noted in step 3. The signal amplitude is now correctly set for the new frequency.

Equipment Required	Sine wave generator (Item 19) Level meter and power sensor (Item 20) Two male N to female BNC adapters (Item 23)
	Two precision coaxial cables (Item 5)
Prerequisites	See page 1–15

1. *Install the test hookup:* Connect the equipment as shown in Figure 1–42 (start with the sine wave generator connected to the digitizing oscilloscope).



Figure 1–42: Equipment Setup for Maximum Amplitude

- 2. Set the Generator:
 - Set the sine wave generator to a reference frequency of 10 MHz.
 - Adjust the sine wave generator amplitude to the required number of divisions as measured by the digitizing oscilloscope.
- 3. Record the reference level:
 - Disconnect the sine wave generator from the digitizing oscilloscope.
 - Connect the sine wave generator to the power sensor.
 - Note the level meter reading.

- **4.** Set the generator to the new frequency and reference level:
 - Change the sine wave generator to the desired new frequency.
 - Input the correction factor for the new frequency into the level meter.
 - Adjust the sine wave generator amplitude until the level meter again reads the value noted in step 3. The signal amplitude is now correctly set for the new frequency.
 - Disconnect the sine wave generator from the power sensor.
 - Connect the sine wave generator to the digitizing oscilloscope.

Specifications

Specifications

This section begins with a general description of the traits of the TDS 500B, TDS 600B, and TDS 700A oscilloscopes. Three sections follow, one for each of three classes of traits: *nominal traits, warranted characteristics,* and *typical characteristics*.

Product Description

The TDS 500B, TDS 600B and TDS 700A Digitizing Oscilloscopes are portable, four-channel instruments suitable for use in a variety of test and measurement applications and systems. Table 2–1 lists key features.

Feature	TDS 600B	TDS 500B & TDS 700A	
Digitizing rate, maximum	TDS 684B: 5 GS/s on ea. of 4 ch TDS 680B: 5 GS/s on ea. of 2 ch TDS 644B: 2.5 GS/s on ea. of 4 ch TDS 620B: 2.5 GS/s on ea. of 2 ch	TDS 784A: 4 GS/s TDS 540B, 754A, 782A: 2 GS/s TDS 520B, 724A: 1 GS/s Opt. 1G, TDS 540B: 1 GS/s	
Analog bandwidth	TDS 680B, 684B, 782A and 784A: 1 GHz TDS 520B, 540B, 620B, 644B, 724A and 754A: 500 MHz		
No. of Channels	TDS 644B & 684B: 4 TDS 620B & 680B: 2 + 2 ¹	TDS 540B, 754A & 784A: 4 TDS 520B, 724A & 782A: 2 + 2 ¹	
Record lengths, maximum	15,000 samples	50,000 samples (500,000 with option 1M)	
Acquisition modes	Sample, envelope, peak detect and average	Sample, envelope, average, high-resolution, and peak-detect	
Trigger modes	Include: edge, logic, and pulse. Video trigger, with option 05, modes include: NTSC, SECAM, PAL, HDTV, and FlexFormat.		
Display	TDS 520B, 540B, 620B, 680B: Monochrome TDS 644B, 684B, 724A, 754A, 782A, 784A: Color		
Storage	1.44 Mbyte, 3.5 inch, DOS 3.3-or-later floppy disk (optional on TDS 520B, 540B, 620B & 680B). NVRAM storage for saving waveforms, hardcopies, and setups		
I/O	Full GPIB programmability. Hardcopy output using GPIB, RS-232, or Centronics ports		
¹ Two plus Two channel operation allows up to two of the four channels to be displayed simultaneously. Channels not displayed can be used to couple a triggering signal to the oscilloscope.			

Table 2–1: Key Features of the TDS 500B, 600B and 700A Oscilloscopes

User Interface

Use a combination of front-panel buttons, knobs, and on-screen menus to control the many functions of the oscilloscope. The front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Set a function you adjust often, such as vertical positioning or the time base setting, directly by its own front-panel knob. Set a function you change less often, such as vertical coupling or horizontal mode, indirectly using a selected menu.

- **Menus** Pressing one (sometimes two) front-panel button(s), such as vertical menu, displays a *main* menu of related functions, such as coupling and bandwidth, at the bottom of the screen. Pressing a main-menu button, such as coupling, displays a *side* menu of settings for that function, such as AC, DC, or GND (ground) coupling, at the right side of the screen. Pressing a side-menu button selects a setting such as DC.
- Indicators On-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale and trigger level. Some readouts use the cursors or the automatic parameter extraction feature (called measure) to display the results of measurements made or the status of the instrument.

General Purpose Knob Assign the general purpose knob to adjust a selected parameter function. More quickly change parameters by toggling the **SHIFT** button. Use the same method as for *selecting* a function, except the final side-menu selection assigns the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the setting for a channel fine gain.

GUI The user interface also makes use of a GUI, or Graphical User Interface, to make setting functions and interpreting the display more intuitive. Some menus and status are displayed using iconic representations of function settings, such as those shown here for full, 250 MHz and 20 MHz bandwidth. Such icons allow you to more readily determine status or the available settings.

Signal Acquisition System

The signal acquisition system provides four, full-featured vertical channels with calibrated vertical scale factors from 1 mV to 10 V per division. All channels can be acquired simultaneously.

Each of the full-featured channels can be displayed, vertically positioned, and offset, can have their bandwidth limited (250 MHz or 20 MHz) and their vertical coupling specified. Fine gain can also be adjusted.

Besides these channels, up to three math waveforms and four reference waveforms are available for display. (A math waveform results when you specify dual waveform operations, such as add, on any two channels. A reference waveform results when you save a waveform in a reference memory.)

Horizontal System

There are three horizontal display modes: main only, main intensified, and delayed only. You can select among various horizontal record length settings.

A feature called "Fit to Screen" allows you to view entire waveform records within the 10 division screen area. Waveforms are compressed to fit on the screen. See Table 2–2.

Both the delayed only display and the intensified zone on the main intensified display may be delayed by time with respect to the main trigger. Both can be set to display immediately after the delay (delayed runs after main mode). The delayed display can also be set to display at the first valid trigger after the delay (delayed-triggerable modes).

The delayed display (or the intensified zone) may also be delayed by a selected number of events. In this case, the events source is the delayed-trigger source. The delayed trigger can also be set to occur after a number of events plus an amount of time.

	Record Length	Divisions per Record	
Models		FTS ¹ Off ²	FTS ¹ On ³
All TDS 500B, TDS600B & TDS 700A	500	10 divs	10 divs
Models; all channels* Option 1M equipped or not	1000	20 divs	10 divs
	2500	50 divs	10 divs
	5000	100 divs	10 divs
	15000	300 divs	15 divs
TDS 500B & TDS 700A, all channels	50000	1,000 divs	10 divs
TDS 500B & TDS 700A, all channels Option 1M equipped only	75000	1,500 divs	15 divs
TDS 500B & TDS 700A, all channels Option 1M equipped only	100000	2,000 divs	10 divs
TDS 500B & TDS 700A, all channels Option 1M equipped only	130000	2,600 divs	13 divs
TDS 520B, TDS 724A & TDS 782A, one channel only	250000	5,000 divs	10 divs
TDS 540B, TDS 754A & TDS 784A, two channels only			
Option 1M equipped only			
TDS 540B, TDS 754A & TDS 784A, one channel only	500000	10,000 divs	10 divs
Option 1M equipped only			

Table 2–2: Record Length and Divisions per Record vs. TDS Model

¹ Fit to Screen setting

- ² Fit to Screen off preserves 50 samples/division in a 1–2–5 sec/division sequence.
- ³ Fit to Screen on lets the samples/division and the sec/division sequence vary.
- ⁴ All channels means all that may be displayed at one time: four channels for some models, two for others. See Table 2–1 and its footnote on page 2–1.

Trigger System

The triggering system supports a varied set of features for triggering the signal-acquisition system. Trigger signals recognized include:

Edge (main- and delayed-trigger systems): This familiar type of triggering is fully configurable for source, slope, coupling, mode (auto or normal), and holdoff.
- Logic (main-trigger system): This type of triggering can be based on pattern (asynchronous) or state (synchronous). In either case, logic triggering is configurable for sources, for boolean operators to apply to those sources, for logic pattern or state on which to trigger, for mode (auto or normal), and for holdoff. Time qualification may be selected in pattern mode. Another class of logic trigger, setup/hold, triggers when data in one trigger source changes state within the setup and hold times that you specify relative to a clock in another trigger source.
- Pulse (main-trigger system): Pulse triggering is configurable for triggering on runt or glitch pulses, or on pulse widths or periods inside or outside limits that you specify. It can also trigger on a pulse edge that has a slew rate faster or slower than the rate you specify. The timeout trigger will act when events do *not* occur in a defined time period. The pulse trigger is also configurable for source, polarity, mode, and holdoff.
- Video (with option 05: Video Trigger): Video triggering is compatible with standard NTSC, PAL, SECAM, and HDTV formats. An additional feature called FlexFormatTM (flexible format) allows the user to define the video format on which to trigger.

You can choose where the trigger point is located within the acquired waveform record by selecting the amount of pretrigger data displayed. Presets of 10%, 50%, and 90% of pretrigger data can be selected in the horizontal menu, or the general purpose knob can be assigned to set pretrigger data to any value within the 0% to 100% limits.

Acquisition Control

You can specify a mode and manner to acquire and process signals that matches your measurement requirements.

- Select the mode for interpolation (linear or sin (x)/x). This can increase the apparent sample rate on the waveform when the maximum real-time rate is exceeded.
- Use sample, envelope, average and peak detect modes to acquire signals.
 With the TDS 500B/700A, also use high-resolution mode.
- Set the acquisition to stop after a single acquisition (or sequence of acquisitions if acquiring in average or envelope modes) or after a limit condition has been met.
- Select channel sources for compliance with limit tests. You can direct the TDS to signal you or generate hard copy output either to a printer or to a floppy-disk file based on the results. Also, you can create templates for use in limit tests.

On-Board User Assistance

Help and autoset can assist you in setting up the Digitizing Oscilloscope to make your measurements.

- **Help** Help displays operational information about any front-panel control. When help mode is in effect, manipulating any front-panel control causes the Digitizing Oscilloscope to display information about that control. When help is first invoked, an introduction to help is displayed on screen.
- Autoset Autoset automatically sets up the Digitizing Oscilloscope for a viewable display based on the input signal.

Measurement Assistance

Once you have set up to make your measurements, the cursor and measure features can help you quickly make those measurements.

Cursor Three types of cursors are provided for making parametric measurements on the displayed waveforms. Horizontal bar cursors (H Bar) measure vertical parameters (typically volts). Vertical bar cursors (V Bar) measure horizontal parameters (typically time or frequency). Paired cursors measure both amplitude and time simultaneously. These are delta measurements; that is, measurements based on the difference between two cursors.

Both H Bar and V Bar cursors can also be used to make absolute measurements. For the H Bars, either cursor can be selected to read out its voltage with respect to any channel's ground reference level. For the V Bars, the cursors measure time with respect to the trigger point (event) of the acquisition. The cursors can also control the portion of the waveform on which automatic measurements are made.

For time measurements, units can be either seconds or hertz (for 1/time).

With the video trigger option installed (Option 05), you can measure the video line number using the vertical cursors. You can measure IRE amplitude (NTSC) using the horizontal cursors with or without the video trigger option installed.

Measure Measure can automatically extract parameters from the signal input to the Digitizing Oscilloscope. Any four out of the 25 parameters available can be displayed to the screen. The waveform parameters are measured continuously with the results updated on-screen as the Digitizing Oscilloscope continues to acquire waveforms.

Digital Signal Processing (DSP)

An important component of the multiprocessor architecture of this Digitizing Oscilloscope is Tektronix's proprietary digital signal processor, the DSP. This dedicated processor supports advanced analysis of your waveforms when doing such compute-intensive tasks as interpolation, waveform math, and signal averaging. It also teams with a custom display system to deliver specialized display modes (See *Display*, later in this description.)

Storage

Acquired waveforms may be saved in any of four nonvolatile REF (reference) memories or on a 3.5 inch, DOS 3.3-or-later compatible disk. Any or all of the saved waveforms may be displayed for comparison with the waveforms being currently acquired.

The source and destination of waveforms to be saved may be chosen. You can save any of the four channels to any REF memory or move a stored reference from one REF memory to another. Reference waveforms may also be written into a REF memory location via the GPIB interface.

I/0

The oscilloscope is fully controllable and capable of sending and receiving waveforms over the GPIB interface (IEEE Std 488.1–1987/IEEE Std 488.2–1987 standard). This feature makes the instrument ideal for making automated measurements in a production or research and development environment that calls for repetitive data taking. Self-compensation and self-diagnostic features built into the Digitizing Oscilloscope to aid in fault detection and servicing are also accessible using commands sent from a GPIB controller.

The oscilloscope can also output copies of its display using the hardcopy feature. This feature allows you to output waveforms and other on-screen information to a variety of graphic printers and plotters from the TDS front panel, providing hard copies without requiring you to put the TDS into a system-controller environment. You can make hardcopies in a variety of popular output formats, such as PCX, TIFF, BMP, RLE, EPS, Interleaf, and EPS mono or color. You can also save hardcopies in a disk file in any of the formats above. The hardcopies obtained are based on what is displayed on-screen at the time hardcopy is invoked. The hardcopies can be stamped with date and time and spooled to a queue for printing at a later time. You can output screen information via GPIB, RS-232C, or Centronics interfaces.

Display

The TDS 500B, TDS 600B and TDS 700A Digitizing Oscilloscopes offer flexible display options. You can customize the following attributes of your display:

- Color (TDS 644B, TDS 684B, and TDS 700A): Waveforms, readouts, graticule, and variable persistence with color coding
- Intensity: waveforms, readouts, and graticule
- Style of waveform display(s): vectors or dots, intensified or nonintensified samples, infinite persistence, and variable persistence
- Interpolation method: Sin(x)/x or Linear
- Display format: xy or yt with various graticule selections including NTSC and PAL to be used with video trigger (option 05)
- **Zoom** This oscilloscope also provides an easy way to focus in on those waveform features you want to examine up close. By invoking zoom, you can magnify the waveform using the vertical and horizontal controls to expand (or contract) and position it for viewing.

Nominal Traits

This section contains a collection of tables that list the various *nominal traits* that describe the TDS 500B, TDS 600B, and TDS 700A oscilloscopes. Electrical and mechanical traits are included.

Nominal traits are described using simple statements of fact such as "Four, all identical" for the trait "Input Channels, Number of," rather than in terms of limits that are performance requirements.

Table 2–3: Nominal Traits — Signal Acquisition System

Name	Description		
Bandwidth Selections	20 MHz, 250 MHz, and FULL		
Samplers, Number of	TDS 540B, 644B, 684B, 754A, and 784A: Four, simultaneous TDS 520B, 620B, 680B, 724A, and 782A: Two, simultaneous		
Digitized Bits, Number of	8 bits ¹		
Input Channels, Number of	Four		
Input Coupling	DC, AC, or GND		
Input Impedance Selections	1 MΩ or 50 Ω		
Ranges, Offset	Volts/Div Setting	Offset Range	
	1 mV/div – 100 mV/div	±1 V	
	101 mV/div – 1 V/div	±10 V	
	1.01 V/div – 10 V/div	±100 V	
Range, Position	±5 divisions		
Range, 1 M Ω Sensitivity	1 mV/div to 10 V/div ²		
Range, 50 Ω Sensitivity	1 mV/div to 1 V/div ²		

Displayed vertically with 25 digitization levels (DLs) per division and 10.24 divisions dynamic range with zoom off. A DL is the smallest voltage level change of the oscilloscope input that can be resolved by the 8-bit A-D Converter. Expressed as a voltage, a DL is equal to 1/25 of a division times the volts/division setting.

² The sensitivity ranges from 1 mV/div to 10 V/div (for 1 M Ω) or to 1 V/div (for 50 Ω) in a 1–2–5 sequence of coarse settings with Fit-to-Screen off. Between coarse settings, the sensitivity can be finely adjusted with a resolution equal to 1% of the more sensitive coarse setting. For example, between 50 mV/div and 100 mV/div, the volts/division can be set with 0.5 mV resolution.

Name	Description		
Range, Sample-Rate ^{1,3}	TDS 684B: 5 Samples/sec to 5 GSamples/sec on four channels simultaneously		
	TDS 680B: 5 Samples/sec to 5 GSamples/sec on two channels simultaneously		
	TDS 644B: 5 Samples/sec to 2.5 GSamples/sec on four channels simultaneously		
	TDS 620B: 5 Samples/sec to 2.5 GSamples/sec on two channels simultaneously		
	TDS 520B and 724A: 5 Samples/sec to 1 GSamples/sec when acquiring 1 channel, to 500 MSamples/sec when acquiring 2 channels		
	TDS 540B and 782A: 5 Samples/sec to 2 GSamples/sec when acquiring 1 channel, to 1 G Sample/sec when acquiring 2 channels, or, for TDS 540B only, to 500 MSamples/sec when acquiring 3 or 4 channels		
	TDS 540B with option 1G: 5 Samples/sec to 1 GSamples/sec when acquiring 1 channel, to 1 G Sample/sec when acquiring 2 channels, or to 500 MSamples/sec when acquiring 3 or 4 channels		
	TDS 754A: 5 Samples/sec to 2 GSamples/sec when acquiring 1 or 2 channels, to 1 GSamples/sec when acquiring 3 or 4 channels		
	TDS 784A: 5 Samples/sec to 4 GSamples/sec when acquiring 1 channel, to 2 G Sample/sec when acquiring 2 channels, or to 1 GSamples/sec when acquiring 3 or 4 channels		
Range, Interpolated Waveform Rate ^{2,3}	TDS 600B: 10 GSamples/sec to 250 GSamples/sec		
	TDS 520B, 540B, 724A, and 754A: 1 GSamples/sec to 100 GSamples/sec		
	TDS 782A and 784A: 2 GSamples/sec to 250 GSamples/sec		
Range, Seconds/Division	TDS 600B: 0.2 ns/div to 10 s/div		
	TDS 500B, 724A, and 754A: 0.5 ns/div to 10 s/div		
	TDS 782A and 784A: 0.2 ns/div to 10 s/div		
Record Length Selection	500 samples, 1000 samples, 2500 samples 5000 samples, 15000 samples		
	The TDS 520B, 724A and 782A also offer: 50000 samples and, with option 1M, 75000, 100000, 130000 (1 or 2 channels), or 250000 (1 channel) samples		
	The TDS 540B, 754A, and 784A also offer: 50000 samples and, with option 1M, 75000, 100000, 130000, 250000 (1 or 2 channels), or 500000 (1 channel) samples		

Table 2–4: Nominal Traits — Time Base System

¹ The range of real-time rates, expressed in samples/second, at which a digitizer samples signals at its inputs and stores the samples in memory to produce a record of time-sequential samples.

² The range of waveform rates for interpolated (or equivalent-time on the TDS 700A) waveform records.

³ The Waveform Rate (WR) is the equivalent sample rate of a waveform record. For a waveform record acquired by real-time sampling of a single acquisition, the waveform rate is the same as the real-time sample rate; for a waveform created by interpolation of real-time samples from a single acquisition or, on applicable products, the equivalent-time sampling of multiple acquisitions, the waveform rate created is faster than the real time sample rate. For all these cases, the waveform rate is 1/(Waveform Interval) for the waveform record, where the waveform interval (WI) is the time between the samples in the waveform record.

Table 2–5: Nominal Traits — Triggering System

Name	Description		
Range, Delayed Trigger Time Delay	16 ns to 250 s		
Range, Events Delay	TDS 600B; 2 to 10,000,000		
	TDS 500B/700A: 1 to 10,000,000		
Range (Time) for Pulse-Glitch, Pulse-Width, Time-Qualified Runt, Timeout, or Slew Rate Trigger, Delta Time	1 ns to 1 s		
Ranges, Setup and Hold for	Feature	Min to max	
TimeSetup/Hold Violation Trigger	Setup Time	–100 ns to 100 ns	
	Hold Time	–1 ns to 100 ns	
	Setup + Hold Time	2 ns	
	For Setup Time, positive numbers mean a data transition before the clock edge and negative means a transition after the clock edge.		
	For Hold Time, positive numbers mean a data transition after the clock edge and negative means a transition before the clock edge.		
	Setup + Hold Time is the algebraic sum of the Setup Time and the Hold Time programmed by the user.		
Ranges, Trigger Level or Threshold	Source	Range	
	Any Channel	\pm 12 divisions from center of screen	
	Auxiliary	±8 V	
	Line	±400 V	
Video Trigger Modes of Operation	Supports the following video standards:		
(Option 05 video Trigger)	 NTSC (525/60) – 2 field mono or 4 field 		
	 PAL (625/50) – 2 field mono or SECAM, 8 field 		
	HDTV -		
	(787.5/60) (1050/60) (1125/60) (1250/60)		
	 FlexFormatTM (user definable standards) 		
	User can specify: field rate, number of lines, sync pulse width and polarity, line rate, and vertical interval timing.		

Table 2–6: Nominal Tra	aits — Display System
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Name	Description
Video Display	7 inch diagonal, with a display area of 5.04 inches horizontally by 3.78 inches vertically TDS 520B, 540B, 620B, and 680B: Monochrome display TDS 644B, 684B, 724A, 754A, 782A, and 784A: Color display
Video Display Resolution	640 pixels horizontally by 480 pixels vertically
Waveform Display Graticule	Single Graticule: 401 \times 501 pixels, 8 \times 10 divisions, where divisions are 1 cm by 1 cm
Waveform Display Levels/Colors	TDS 520B, 540B, 620B, and 680B: Sixteen levels in infinite-persistence or variable persistence display TDS 644B, 684B, 724A, 754A, 782A, and 784A: Sixteen colors in infinite-persistence or variable persistence display

Table 2–7: Nominal Traits — GPIB Interface, Output Ports, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE Std 488-1987
Interface, RS-232	RS-232 interface complies with EIA/TIA 574 (talk only) Optional on the TDS 520B and 540B
Interface, Centronics	Centronics interface complies with Centronics interface standard C332-44 Feb 1977, REV A
Interface, Video	VGA video output with levels that comply with EIA RS 343A standard. DB-15 connector
Logic Polarity for Main- and Delayed- Trigger Outputs	Negative TRUE. High to low transition indicates the trigger occurred.
Fuse Rating	Either of two fuses ¹ may be used: a $0.25'' \times 1.25''$ (UL 198.6, 3AG): 6 A FAST, 250 V or a 5 mm \times 20 mm (IEC 127): 5 A (T), 250 V.

¹ Each fuse type requires its own fuse cap.

Table 2–8: Nominal Traits — Data Handling and Reliability

Name	Description
Time, Data-Retention, Nonvolatile Memory ^{1, 2}	Battery life \geq 5 years
Floppy disk, (optional on the TDS 520B and 540B)	3.5 inch, 720 K or 1.44 Mbyte, DOS 3.3-or-later compatible

¹ The times that reference waveforms, stored setups, and calibration constants are retained.

² Data is maintained by small lithium-thionyl-chloride batteries internal to the memory ICs. The amount of lithium is so small in these ICs that they can typically be safely disposed of with ordinary garbage in a sanitary landfill.

Name	Description
Cooling Method	Forced-air circulation with no air filter. Clearance is required.
Construction Material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass laminate. Cabinet is aluminum and is clad in Tektronix Blue vinyl material.
Finish Type	Tektronix Blue vinyl-clad aluminum cabinet
Weight	Standard Digitizing Oscilloscope
	14.1 kg (31 lbs), with front cover. 24.0 kg (53 lbs), when packaged for domestic shipment
	Rackmount Digitizing Oscilloscopes
	14.1 kg (31 lbs) plus weight of rackmount parts, for the rackmounted Digitizing Oscilloscopes (Option 1R).
	Rackmount conversion kit
	2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), parts plus package for domestic shipping
Overall Dimensions	Standard Digitizing Oscilloscope
	Height: 193 mm (7.6 in), with the feet installed
	Width: 445 mm (17.5 in), with the handle
	Depth: 434 mm (17.1 in), with the front cover installed
	Rackmount Digitizing Oscilloscope
	Height: 178 mm (7.0 in)
	Width: 483 mm (19.0 in)
	Depth: 558.8 mm (22.0 in)

 Table 2–9: Nominal Traits — Mechanical

Nominal Traits

Warranted Characteristics

This section lists the various *warranted characteristics* that describe the TDS 500B, TDS 600B, and TDS 700A oscilloscopes. Electrical and environmental characteristics are included.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

NOTE. In these tables, those warranted characteristics that are checked in the procedure Performance Verification appear in **boldface type** under the column **Name**.

As stated above, this section lists only warranted characteristics. A list of *typical characteristics* starts on page 2–23.

Performance Conditions

The performance limits in this specification are valid with these conditions:

- The oscilloscope must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The oscilloscope must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The oscilloscope must have had a warm-up period of at least 20 minutes.
- The oscilloscope must have had its signal-path-compensation routine last executed after at least a 20 minute warm-up period at an ambient temperature within ±5° C of the current ambient temperature.

Name	Description			
Accuracy, DC Gain	TDS 600B: \pm 1.5% for all sensitivities from 2 mV/div to 10 V/div \pm 2.0% at 1 mV/div sensitivity			
	TDS 500B, 700A: $\pm 1\%$ for all sensitivities from 1 mV/div to 10 V/div with offset from 0 V to $\pm 100V$			
Accuracy, DC Voltage Measurement,	Measurement Type DC Accuracy			
Averaged (using Average mode)	Average of \geq 16 waveforms	TDS 600B: \pm ((1.5% × reading – Net Offset ¹) + Offset Accuracy) + (0.06 div × V/div))		
		TDS 500B, 700A: \pm ((1.0 ^o Offset ¹ I) + Offset Accura	$\% \times $ reading – Net cy + (0.06 div \times V/div))	
	Delta volts between any two averages	TDS 600B: ±((1.5% × r (0.1 div × V/div) + 0.3 m	eading I) + /)	
	of \geq 16 waveforms acquired under the same setup and ambient conditions	TDS 500B, 700A: ±((1.0% × reading) + (0.1 div × V/div) + 0.3 mV)		
Accuracy, Offset	Volts/Div Setting	TDS 600B Offset Accuracy	TDS 500B/700A Off- set Accuracy	
	1 mV/div – 100 mV/div	±((0.2% × Net Off- set ¹) + 1.5 mV + (0.6 div x V/div))	±((0.2% × Net Off- set ¹) + 1.5 mV + (0.1 div x V/div))	
	101 mV/div – 1 V/div	±((0.25% × Net Off- set ¹) + 15 mV + (0.6 div x V/div))	±((0.25% × Net Off- set ¹) + 15 mV + (0.1 div x V/div))	
	1.01 V/div – 10 V/div	±((0.25% × Net Off- set ^{1)} + 150 mV + (0.6 div x V/div))	±((0.25% × Net Off- set ¹) + 150 mV + (0.1 div x V/div))	
Analog Bandwidth, DC-50 Ω Coupled and Bandwidth selection is FULL, TDS 600B	Volts/Div	TDS 620B & 644B Bandwidth ²	TDS 680B & 684B Bandwidth ²	
	10 mV/div – 1 V/div	DC – 500 MHz	DC – 1 GHz	
	5 mV/div – 9.95 mV/div	DC – 450 MHz	DC – 750 MHz	
	2 mV/div – 4.98 mV/div	DC – 300 MHz	DC – 600 MHz	
	1 mV/div – 1.99 mV/div	DC – 250 MHz	DC – 500 MHz	
Analog Bandwidth, DC-50 Ω Coupled and Bandwidth selection is FULL, TDS 500B/700A	Volts/Div	TDS 520B, 540B, 724A & 754A Bandwidth ²	TDS 782A & 784A Bandwidth ²	
	10 mV/div – 1 V/div	DC – 500 MHz	DC – 1 GHz	
	5 mV/div – 9.95 mV/div	DC – 500 MHz	DC – 750 MHz	
	2 mV/div – 4.98 mV/div	DC – 500 MHz	DC – 600 MHz	
	1 mV/div – 1.99 mV/div	DC – 450 MHz	DC – 500 MHz	
Crosstalk (Channel Isolation)	\geq 100:1 at 100 MHz and \geq 30:1 at the rated bandwidth for the channel's Volt/Div setting, for any two channels having equal Volts/Div settings			

Table 2–10: Warranted Characteristics — Signal Acquisition System

Name	Description	
Delay Between Channels, Full Bandwidth	TDS 600B: \leq 100 ps for any two channels with equal Volts/Div and Coupling settings and both channels' deskew values set to 0	
	TDS 500B/700A: \leq 50 ps for any two channels with equal Volts/Div and Coupling settings	
Input Impedance, DC–1 M Ω Coupled	1 M Ω $\pm 0.5\%$ in parallel with 10 pF ± 3 pF	
Input Impedance, DC–50 Ω Coupled	50 Ω $\pm1\%$ with VSWR ${\leq}1.3{:}1$ from DC – 500 MHz, ${\leq}1.5{:}1$ from 500 MHz – 1 GHz	
Input Voltage, Maximum, DC–1 M Ω , AC–1 M Ω , or GND Coupled	± 300 V (DC + peak AC), 400 V peak; derate at 20 dB/decade above 1 MHz, CAT II	
Input Voltage, Maximum, DC-50 Ω or AC–50 Ω Coupled	5 V _{RMS} , with peaks $\leq \pm 30$ V	
Lower Frequency Limit, AC Coupled	\leq 10 Hz when AC–1 M Ω Coupled; \leq 200 kHz when AC–50 Ω Coupled ³	

Table 2–10: Warranted Characteristics — Signal Acquisition System (Cont.)

Net Offset = Offset – (Position × Volts/Div). Net Offset is the nominal voltage level at the oscilloscope input that corresponds to the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

² The limits given are for the ambient temperature range of 0°C to +30°C. Reduce the upper bandwidth frequencies by 5 MHz for the TDS 600B or by 2.5 MHz for the TDS 500B/700A for each °C above +30°C.

³ The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X passive probes are used.

Table 2–11: Warranted Characteristics — Time Base System

Name	Description
Accuracy, Long Term Sample Rate and	TDS 600B: ± 100 ppm over any ≥ 1 ms interval
Delay Time	TDS 500B/700A: ±25 ppm over any ≥1 ms interval

Name	Description	
Sensitivity, Edge-Type Trigger, Coupling set to "DC" ¹	Trigger Source	Sensitivity
	Any Channel	TDS 620B & 644B: 0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz
		TDS 680B & 684B: 0.35 division from DC to 50 MHz, increasing to 1 division at 1 GHz MHz
		TDS 500B, 724A, & 754A: 0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz
		TDS 782A & 784A: 0.35 division from DC to 50 MHz, increasing to 1 division at 1 GHz
	Auxiliary	TDS 600B: 250 mV from DC to 50 MHz, increasing to 500 mV at 100 MHz
		TDS 500B, 724A, & 754A: 400 mV from DC to 50 MHz, increasing to 750 mV at 100 MHz
		TDS 782A & 784A: 250 mV from DC to 50 MHz, increasing to 500 mV at 100 MHz
Accuracy (Time) for Pulse-Glitch or	Time Range	Accuracy
Pulse-Width Triggering	1 ns to 1 µs	±(20% of setting + 0.5 ns)
	1.02 µs to 1 s	±(100 ns + 0.01% of Setting)
Input Signal Sync Amplitude for Stable	Field selection "Odd", "Even", or "All": 0.6 division to 4 divisions	
Triggering, NTSC and PAL modes (Option 05 Video Trigger)	Field selection "Nume	eric": 1 division to 4 divisions (NTSC mode)
Jitter (Option 05 Video Trigger)	60 ns _{n-n} on NTSC or PAL signal	

Table 2–12: Warranted Characteristics — Triggering System

¹ The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

Table 2–13: Warranted Characteristics — Output Ports, Probe Compensator, and Power Requirements

Name	Description		
Logic Levels, Main- and Delayed-Trigger	Characteristic	Limits	
Outputs	Vout (HI) ≥2.5 V d		
	Vout (LO)	load to ground	
		≤0.7 V into a load of ≤4 mA; ≤0.25 V into a 50 Ω load to ground	

Name	Description		
Output Voltage and Frequency,	Characteristic	Limits	
Probe Compensator	Output Voltage	0.5 V (base-top) \pm 1% into a \geq 50 Ω load	
	Frequency	1 kHz ±5%	
Output Voltage, Signal Out (CH 3 ¹)	For TDS 600B: 20 mV/division $\pm 20\%$ into a 1 M Ω load; 10 mV/division $\pm 20\%$ into a 50 Ω load		
	For TDS 500B/700A: 22 mV/division $\pm 20\%$ into a 1 M Ω load; 11 mV/division $\pm 20\%$ into a 50 Ω load		
Source Voltage	90 to 250 VAC _{RMS} , continuous range		
	TDS 500B/700A: CAT II		
Source Frequency	45 Hz to 440 Hz		
Power Consumption	≤300 W (450 VA)		

Table 2–13: Warranted Characteristics — Output Ports, Probe Compensator, and Power Requirements (Cont.)

¹ CH 3 signal out is present at the rear panel if CH 3 (AUX 1 on the TDS 620B or 680B) is selected as the trigger source for the main and/or delayed trigger systems. It is not available when a channel other than CH3 (AUX 1 on the TDS 620B or 680B) is the source for the Video Trigger when Option 05 is installed.

Table 2–14: Warranted	Characteristics —	Environmental
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Name	Description		
Atmospherics	Temperature (no diskette in floppy drive):		
	TDS 600B: Operating: +4 $^{\circ}$ C to +45 $^{\circ}$ C		
	TDS 500B/700A: Operating: +4 $^{\circ}$ C to +50 $^{\circ}$ C		
	Nonoperating: –22 $^{\circ}$ C to +60 $^{\circ}$ C		
	Relative humidity (no diskette in floppy drive):		
	Operating: 20% to 80%, at or below +32 $^\circ$ C, upper limit derates to 30% relative humidity at +45 $^\circ$ C		
	Nonoperating: 5% to 90%, at or below +41 $^{\circ}$ C, upper limit derates to 30% relative humidity at 60 $^{\circ}$ C		
	Altitude:		
	To 4570 m (15,000 ft.), operating		
	To 12190 m (40,000 ft.), nonoperating		
Dynamics	Random vibration (floppy diskette not installed):		
	0.31 g rms, from 5 to 500 Hz, 10 minutes each axis, operating 3.07 g rms, from 5 to 500 Hz, 10 minutes each axis, nonoperating		

Name	Description		
Emissions (TDS 500B/700A) ^{1, 2}	Meets or exceeds the requirements of the following standards:		
	FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A		
	European Community Requirements		
	EN 55011 Class A Radiated Emissions		
	EN 55011 Class A Conducted Emissions		
	EN 50081–1		
	EN60555–2 Power Line Harmonic Emissions		
Emissions (TDS 600B) ^{1, 2}	Meets or exceeds the requirements of the following standards:		
	FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A		
	EN 50081-1 European Community Requirements		
	EN 55022 Radiated Emissions Class B		
	EN 55022 Class B Conducted Emissions		
	EN60555–2 Power Line Harmonic Emissions		
Susceptibility ^{1, 2}	Meets or exceeds the EMC requirements of the following standards:		
	EN 50082–1 European Community Requirements		
	IEC 801-2 Electrostatic Discharge Performance Criteria B		
	IEC 801-3 Radiated Susceptibility 3 V/meter from 27 MHz to 500 MHz unmodulated		
	IEC 801-4 Fast Transients Performance Criteria B		
	IEC 801-5 AC Surge Performance Criteria B		

Table 2–14: Warranted Characteristics — Environmental (Cont.)

Table 2–14: Warranted Characteristics — Environmental (Cont.)

Name	Description		
Third Party Certification	Conforms to and is certified where appropriate to:		
	UL 3111–1 ³		
	CSA 22.2 no. 1010.1 ³		

¹ VGA output cable needs to be terminated, if connected at all, for the Instrument to meet these standards. The test will pass with LCOM part # CTL3VGAMM–5.

- ² The GPIB cable connected to the instrument for certain of the emissions tests must be "low EMI" having a high-quality outer shield connected through a low impedance to both connector housings. Acceptable cables are Tektronix part numbers 012-0991-00, -01, -02, and -03. In order to maintain the EMI performance conforming to the above regulations, the following cables, or their equivalent, should be used: a shielded Centronics cable, 3 meters in length, part number 012-1214-00, and a shielded RS-232 cable, 2.7 meters in length, CA part number 0294-9.
- ³ IEC 1010, UL 3111, CSA 1010 Safety Certification Compliance: Temperature (operating) 5 to +40 C Altitude (maximum operating): 200 meters Equipment Type: Test and Measurement Safety Class: Class I (as defined in IEC 1010–1, Annex H) – grounded product Overvoltage Catregory: Overvoltage Category II (as defined in IEC 1010–1, Annex J) Pollution Degree: Pollution Degree 2 (as defined in IEC 1010–1) Note – Rated for indoor use only

EC Declaration of Conformity	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:		
	EMC Directive 89/336/EEC:		
	EN 55011	Class A Radiated and Conducted Emissions	
	EN 55011	Class B Radiated and Conducted Emissions	
	EN 50081-1 Emissions: EN 55022		
	Class B Radiated and Condu	ucted Emissions	
	EN 60555-2	AC Power Line Harmonic Emissions	
	EN 50082-1 Immunity:		
	IEC 801-2	Electrostatic Discharge Immunity	
	IEC 801-3	RF Electromagnetic Field Immunity	
	IEC 801-4	Electrical Fast Transient/Burst Immunity	
	IEC 801-5	Power Line Surge Immunity	
	Low Voltage Directive 73/23/EEC		
	EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use	
	EN 61010-2-031:1994	Particular requirements for hand-held probe assemblies for electrical measurement and test	

Table 2–15: Certifications and compliances

Typical Characteristics

This subsection contains tables that list the various *typical characteristics* which describe the TDS 500B, TDS 600B and TDS 700A oscilloscopes.

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

Table 2–16: Typical Characteristics — Signal Acquisition System

Name	Description			
Analog Bandwidth, DC-50 Ω Coupled	Volts/Div as Read Out on Screen	520B, 540B, 724A & 7	754A Bandwidth ¹	
with P6243 or P6245 Probe and Bandwidth selection is FULL	10 V/div – 100 V/div	Not Applicable		
TDS 520B, 540B, 724A & 754A	100 mV/div – 10 V/div	DC – 500 MHz		
	50 mV/div – 99.5 mV/div	DC – 500 MHz		
	20 mV/div – 49.8 mV/div	DC – 500 MHz		
	10 mV/div – 19.9 mV/div	DC – 450 MHz (P6243) DC – 500 MHz (P6245)		
Analog Bandwidth, DC-50 Ω Coupled	Volts/Div as Read Out on Screen	TDS 782A & 784A		
with P6245 Probe and Bandwidth selection is FULL	10 V/div –100 V/div	(Not Applicable)		
TDS 782A & 784A	100 mV/div – 10 V/div	DC – 1 GHz		
	50 mV/div – 99.5 mV/div	DC – 750 MHz		
	20 mV/div – 49.8 mV/div	DC – 600 MHz		
	10 mV/div – 19.9 mV/div	DC – 500 MHz		
Analog Bandwidth, DC-1M Ω Coupled with P6139A Probe and Bandwidth selection is FULL TDS 520B 540B 724A 754A 782A &	Volts/Div as Read Out on Screen	520B, 540B, 724A, 754A, 782A & 784A Bandwidth ¹		
	10 V/div – 100 V/div	500 MHz		
784A	100 mV/div – 10 V/div	500 MHz		
	50 mV/div – 99.5 mV/div	500 MHz		
	20 mV/div – 49.8 mV/div	500 MHz		
	10 mV/div – 19.9 mV/div	500 MHz		
Analog Bandwidth, DC-50 Ω Coupled with P6243 Probe (TDS 620B & 644B) or P6245 Probe (TDS 680B & 684B) and Bandwidth selection is FULL TDS 600B	Volts/Div as Read Out on Screen	620B & 644B Bandwidth ¹	680B & 684B Bandwidth ¹	
	10 V/div – 100 V/div	(Not Applicable)	(Not Applicable)	
	100 mV/div – 10 V/div	DC – 500 MHz	DC – 1 GHz	
	50 mV/div – 99.5 mV/div	DC – 450 MHz	DC – 750 MHz	
	20 mV/div – 49.8 mV/div	DC – 300 MHz	DC – 600 MHz	
	10 mV/div – 19.9 mV/div	DC – 250 MHz	DC – 500 MHz	

Name	Description			
Accuracy, Delta Time Measurement	The limits are given in the following table for signals having amplitude greater than 5 divisions, reference level = 50%, filter set to (sinX/X), acquired at 5 mV/div or greater. For the TDS 700A, pulse duration < 10 div. Channel skew not included.			
	For the Single Shot condition, $1.4 \le T_r/S_i \le 4$, where S_i is the sample interval and T_r is the displayed rise time.			
	TDS 600B: For the averaged condition, $1.4 \le T_r/W_i \le 40$, where W_i is the Waveform Interval, as described elsewhere in these specifications. TDS 600B: Extra error in the measurement will occur for two-channel measurements due to channel-to-channel skew. This is described elsewhere in these specifications.			
	Time Measurement Accuracy			
Conditions for accuracy listed at right	TDS 600B:±((0.20 \times sample interval) +	(100 ppm \times Reading) + (0.05 \times W _i))	
are: Single Shot or Sample mode (or HiRes mode on the TDS 500B/700A), with Full Bandwidth selected.	TDS 600B example: at 5 GS/s, 5 ns/div, ps + 4 ps + 5 ps) = \pm 49 ps.	measuring a 40 ns wide	e pulse, accuracy = \pm (40	
	TDS 500B/700A: $\pm \ge 0.15$ sample interv	al + (25 ppm $ imes$ Readin	g l) + t/div/1000	
	TDS 500B/700A example: at 4 Gs/s, acc	curacy = 37.5 ps		
Conditions for accuracy listed at right	TDS 600B: ±(10 ps + (100 ppm × Reading) + (0.25 × W _i)) TDS 500B/700A: 20 ps + (25 ppm × Reading) + t/div/1000			
are: \geq 100 Averages, will Full Band- width selected, and for TDS 500B/700A, repetitive mode.				
Calculated Rise Time, TDS 600B ²		620B & 644B	680B & 684B	
	Volts/Div Setting	Rise Time	Rise Time	
	10 mV/div – 1 V/div	900 ps	450 ps	
	5 mV/div – 9.95 mV/div	1 ns	600 ps	
	2 mV/div – 4.98 mV/div	1.5 ns	750 ps	
	1 mV/div – 1.99 mV/div	1.8 ns	900 ps	
Calculated Rise Time, TDS 500B/700A ²	Volts/Div Setting	520B, 540B, 724A, 754A Rise Time	782A & 784A Rise Time	
	10 mV/div – 1 V/div	800 ps	400 ps	
	5 mV/div – 9.95 mV/div	800 ps	530 ps	
	2 mV/div – 4.98 mV/div	800 ps	600 ps	
	1 mV/div – 1.99 mV/div	890 ps	800 ps	
Effective Bits — TDS 600B	Input Frequency	Effective Bits		
The chart on the right gives the typical	98 MHz	6.3 bits		
effective bits for a 9-division p-p sine-wave input, 50 mV/div, 10 ns/div	245 MHz	6.0 bits		
(5 GS/s), with a record length of 1000	490 MHz	5.5 bits		
points	990 MHz	5.2 bits (TDS 680B & 6	684B only)	

Table 2–16: Typical Characteristics — Signal Acquisition System (Cont.)

Name	Description				
Effective Bits — TDS 520B & 724A	Sample Rate				
The chart on the right gives the typical	Input Frequency	1 GS/s	10 MS/s	& HiRes	
effective bits for a sine wave adjusted	1 MHz – 9.2 divs	6.8 bits	9.7 bits		
25° C.	500 MHz	6.8 bits	N/A		
Effective Bits — TDS 540B & 754A		Sample Rate			
The chart on the right gives the typical	Input Frequency	2 GS/s	2 GS/s 10 MS/s & HiRes		
effective bits for a sine wave adjusted	1 MHz – 9.2 divs	6.8 bits	9.7 bits		
25° C.	500 MHz	6.8 bits	N/A		
Effective Bits — TDS 782A & TDS 784A	Sample Rate				
The chart on the right gives the typical effective bits for a sine wave adjusted to 9.2 divisions at 1 MHz, 50 mV/div @	Input Frequency	2 GS/s (782A) 4 GS/s (784A)	10 MS/s	& HiRes	i
	1 MHz – 9.2 divs	6.6 bits	9.7 bits		
	1 GHz – 6.5 divs	5.5 bits N/A			
Frequency Limit, Upper, 250 MHz Bandwidth Limited	250 MHz				
Frequency Limit, Upper, 20 MHz Bandwidth Limited	20 MHz				
Step Response Settling Errors	Settling Error (%) ³ at) ³ at	
	Volts/Div Setting	\pm Step Amplitude	20 ns	100 ns	20 ms
	1 mV/div – 100 mV/div	≤2 V	0.5%	0.2%	0.1%
	101 mV/div – 1 V/div	≤20 V	1.0%	0.5%	0.2%
	1.01 V/div – 10 V/div	≤200 V	1.0%	0.5%	0.2%

Table 2–16: Typical Characteristics — Signal Acquisition System (Cont.)

¹ The limits given are for the ambient temperature range of 0°C to +30°C. Reduce the upper bandwidth frequencies by 5 MHz for the TDS 600B or by 2.5 MHz for the TDS 500B/700A for each °C above +30°C.

² The numbers given are valid 0°C to +30°C and will increase as the temperature increases due to the degradation in bandwidth. Rise time is calculated from the bandwidth. It is defined by the following formula:

TDS 600B Rise Time (ns) =
$$\frac{450}{BW (MHz)}$$
 TDS 500B/700A Rise Time (ns) = $\frac{400}{BW (MHz)}$

Note that if you measure rise time, you must take into account the rise time of the test equipment (signal source, etc.) that you use to provide the test signal. That is, the measured rise time (RT_m) is determined by the instrument rise time (RT_i) and the rise time of the test signal source (RTgen) according to the following formula:

$$RT_m^2 = RT_i^2 + RT_{gen}^2$$

³ The values given are the maximum absolute difference between the value at the end of a specified time interval after the midlevel crossing of the step and the value one second after the midlevel crossing of the step, expressed as a percentage of the step amplitude.

Name	Description				
Accuracy, Trigger Level or Threshold, DC	Trigger Source		Accuracy		
Coupled (for signals having rise and fall times ≥ 20 ns)	Any Channel		\pm ((2% × Setting – Normal Volts/div + (0.3 div × Volts/div Accuracy)	et Offset I) Setting) + Offset	
	Auxiliary		Not calibrated or spec	ified	
Input, Auxiliary Trigger	The input resistance is $\pm 20 \text{ V}$ (DC + peak AC	s ≥1.5 kΩ; the maximu ;).	m safe input voltage is		
Trigger Position Error,	Acquisition Mode		Trigger-Position Erro	or ^{1,2}	
Edge Triggering	Sample, Average		±(1 Waveform Interva	±(1 Waveform Interval + 1 ns)	
	Envelope		±(2 Waveform Interva	ls + 1 ns)	
Holdoff, Variable, Main Trigger	For all Time/Division r seconds. The minimu	anges, the minimum ho m resolution is 8 ns for s	ldoff is 250 ns and the i settings \leq 1.2 μ s.	maximum holdoff is 12	
Lowest Frequency for Successful Operation of "Set Level to 50%" Function	30 Hz				
Sensitivity, Edge Trigger, Not DC Coupled ³	Trigger Source		Typical Signal Level Triggering	for Stable	
	AC Same as the DC-coupled cies above 60 Hz. Attenu 60 Hz. Noise Reject Three times the DC-coupled cies above 60 Hz. Attenu 60 Hz. High Frequency Reject One and one-half times the DC-coupled cies above 30 kHz. Low Frequency Reject One and one-half times the DC to 30 kHz. Low Frequency Reject One and one-half times the DC to 30 kHz. AC Description of the temperature of the temperature of t		Same as the DC-coup cies above 60 Hz. Atte 60 Hz.	upled limits for frequen- ttenuates signals below	
			oupled limits.		
			es the DC-coupled Hz. Attenuates signals		
			es the DC-coupled above 80 kHz. Iow 80 kHz.		
Sensitivities, Logic Trigger and Events Delay, DC Coupled ⁴	1.0 division, from DC to 500 MHz, at vertical settings $>$ 10 mV/div and \leq 1 V/div at the BNC input			$d \le 1$ V/div at the	
Sensitivities, Pulse-Type Runt Trigger ⁵	1.0 division, from DC to 500 MHz, at vertical settings $>$ 10 mV/div and \leq 1 V/div at the BNC input			$d \le 1$ V/div at the	
Sensitivities, Pulse-Type Trigger Width and Glitch ⁶	1.0 division, at vertical settings $>$ 10 mV/div and \leq 1 V/div at the BNC input				
Width, Minimum Pulse and Rearm, for Logic Triggering or Events Delay	For vertical settings $> 10 \text{ mV/div}$ and $\leq 1 \text{ V/div}$ at the BNC input				
	Triggering Type	Minimum Pulse Width	Minimum Re-Arm Width	Minimum Time Between Channels ⁷	
	Logic	Not Applicable	1 ns	1 ns	
	Events Delay	1 ns (for either + or - pulse widths)	Not Applicable	2 ns	

Table 2–17: Typical Characteristics — Triggering System

Name	Description			
Width, Minimum Pulse and Rearm, for	For vertical settings > 10 mV/div. and 3 1 V/div at the BNC input			
Pulse Triggering	Pulse Class	Minimum Pulse Width	Minimum Re-Arm Width	
widths and transition times ⁸ required for	Glitch	1 ns	2 ns + 5% of Glitch Width Setting	
Pulse-Type triggering.	Runt	2 ns	2 ns	
	Time-Qualified Runt	2 ns	TDS 600B: 7 ns + 5% of Width Setting	
			TDS 700A: 8.5 ns + 5% of Width Setting	
	Width	1 ns	2 ns + 5% of Width Upper Limit Setting	
	Timeout	1 ns	2 ns + 5% of Width Upper Limit Setting	
	Slew Rate	600 ps ⁸	TDS 600B: 7 ns + 5% of Delta Time Setting	
			TDS 700A: 8.5 ns + 5% of Delta Time Setting	
Input Signal Sync Amplitude for Stable Triggering, HDTV and FLEXFMT modes (Option 05 Video Trigger)	All field selections: 0.6 division to 4 divisions			
Jitter for HDTV mode (Option 05 Video Trigger)	17 ns _{p-p}			
Sync Width Flex Format and HDTV modes (Option 05 Video Trigger)	min. 400 ns			
Sync Duty Cycle, Flex Format and HDTV modes (Option 05 Video Trigger)	min. 50 to 1			
Hum Rejection (Option 05 Video Trigger)	NTSC and PAL: -20 dB without any trigger spec deterioration. Triggering will continue down to 0 dB with some performance deterioration.			

Table 2–17: Typical Characteristics — Triggering System (Cont.)

¹ The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of \geq 0.5 division/ns.

² The waveform interval (WI) is the time between the samples in the waveform record. Also, see the footnote for the characteristics *Sample Rate Range or Interpolated Waveform Rates* in Table 2–4, on page 2–10.

- ³ The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.
- ⁴ The minimum signal levels required for stable logic or pulse triggering of an acquisition, or for stable counting of a DC-coupled, events-delay signal. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events and produces no extra, phantom events.)
- ⁵ The minimum signal levels required for stable runt pulse triggering of an acquisition. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

- ⁶ The minimum signal levels required for stable pulse width or glitch triggering of an acquisition. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)
- ⁷ For Logic, time between channels refers to the length of time a logic state derived from more than one channel must exist to be recognized. For Events, the time is the minimum time between a main and delayed event that will be recognized if more than one channel is used.
- ⁸ For Slew Rate Triggering, this is the minimum transition time, defined to be the time the user's signal spends between the two trigger threshold settings.