

# Performance Verification

**Tektronix**

**TDS 820**  
**Digitizing Oscilloscope**  
**070-8696-00**

**Please check for change information at the rear of this manual.**

First Printing: February 1993

### **Instrument Serial Numbers**

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

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# Preface

This is the Performance Verification for the TDS 820 Oscilloscope. It contains procedures suitable for determining if the instrument functions, was adjusted properly, and meets the performance characteristics as warranted.

Also contained in this document is a copy of the *Specification* found in Appendix B of the *TDS 820 User Manual*. It is included here as a convenient reference.

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## Related Manuals

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

- The *TDS 820 User Manual*.
- The *TDS 800 Series Family Programmer Manual* describes using a computer to control the digitizing oscilloscope through the GPIB interface.
- The *TDS 820 Reference* gives you a quick overview of how to operate your digitizing oscilloscope.
- The *TDS 820 Service Manual* provides information for maintaining and servicing your digitizing oscilloscope to the module level.
- The *TDS Family Option 2F Instruction Manual* describes use of the Advanced DSP Math option (for TDS oscilloscopes equipped with that option only).
- The *TDS Family Option 13 Instruction Manual* describes using the optional Centronic<sup>®</sup> TDS oscilloscopes equipped with that option only).



<b>Safety</b> .....	<b>v</b>
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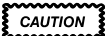

# Safety

Please take a moment to review these safety precautions. They are for your protection and to prevent damage to the digitizing oscilloscope. This safety information applies to all operators and service personnel.

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## Symbols and Terms

These two terms appear in manuals:

-  statements identify conditions or practices that could result in damage to the equipment or other property.
-  statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

This symbol appears in manuals:



Static-Sensitive Devices

These symbols appear on equipment:



DANGER  
High Voltage



Protective  
ground (earth)  
terminal



ATTENTION  
Refer to  
manual

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## Specific Precautions

Observe all of these precautions to ensure your personal safety and to prevent damage to either the digitizing oscilloscope or equipment connected to it.

### Power Source

The digitizing oscilloscope operates from a power source that will not apply more than 250 V<sub>rms</sub> between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

### Grounding the Digitizing Oscilloscope

The digitizing oscilloscope is grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the digitizing oscilloscope.

Without the protective ground connection, all parts of the digitizing oscilloscope are potential shock hazards. This includes knobs and controls that may appear to be insulators.

### Use the Proper Power Cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

### Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your product, matched by type, voltage rating, and current rating.

### Do Not Remove Covers or Panels

To avoid personal injury, do not operate the digitizing oscilloscope without the panels or covers.

### Take Antistatic Precautions

Wear an antistatic grounding wrist strap when working with the input connectors on the digitizing oscilloscope.

### Electric Overload

Never apply to a connector on the digitizing oscilloscope a voltage that is outside the range specified for that connector.

## **Do Not Operate in Explosive Atmospheres**

The digitizing oscilloscope provides no explosion protection from static discharges or arcing components. Do not operate the digitizing oscilloscope in an atmosphere of explosive gases.





# **Performance Verification Procedures**





# 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 1 MHz Test Signal output at the rear panel as a test-signal source for further verifying that the oscilloscope functions properly. Standard-accessory SMA cables, included with this oscilloscope, are the only equipment required.

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## General Instructions

Besides the *Brief Procedures*, the set of procedures that can be used to verify oscilloscope performance includes the *Performance Tests*, found later in this section. You may not need to perform all of these procedures, depending on what you want to accomplish:

- To rapidly confirm that this oscilloscope functions and was adjusted properly, just do the procedures under *Self Tests*, which begin on page 1-3.

**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 procedures under *Functional Tests* that begin on page 1-5.

**Advantages:** These procedures require minimal additional time to perform, require no additional equipment other than standard-accessory SMA cables, and more completely test the internal hardware of this 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 1-11, 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* on page 1-12.)

If you are not familiar with operating this oscilloscope, read *General Operating Instructions* in Section 3 of this manual. These instructions will acquaint you with the use of the front-panel controls and the menu system.

If you are not familiar with operating this oscilloscope, read *At a Glance* in Section 2 of the *TDS 820 User Manual*.

## Conventions

Throughout these procedures the following conventions apply:

- Tighten all SMA connectors to 8.5 inch pounds (0.96 N · m).
- 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: 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 **AC-QUIRE MENU**”, “press the main-menu button **Slope**”, or “verify that the status message is *Pass*”.



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 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.

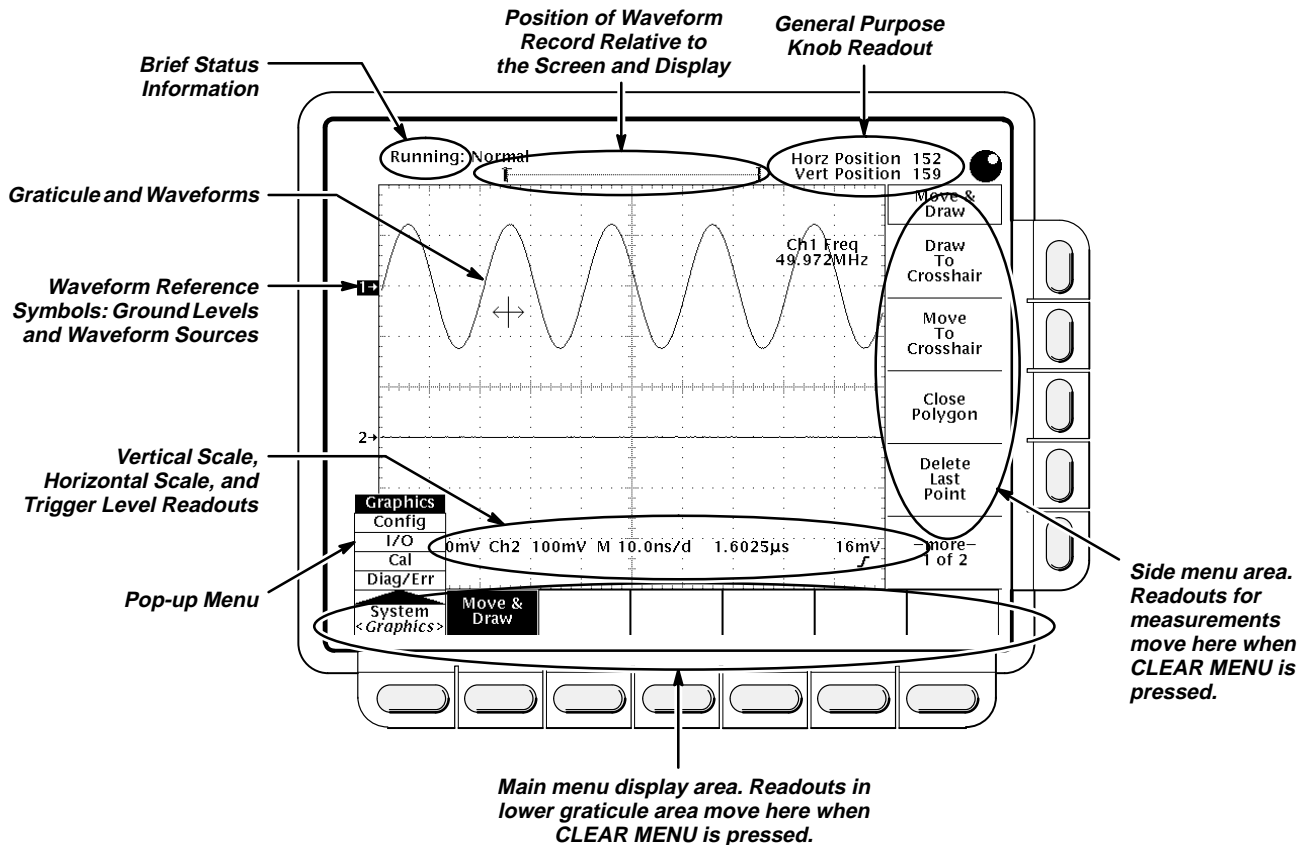


Figure 1-1: Map of Display Functions

## Self Tests

This procedure uses internal routines to verify that this 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 up the digitizing oscilloscope and allow a 20 minute warm-up before doing this procedure.

Appendix C: Performance Verification 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. *Display the Area diagnostics menu:* Repeatedly press the main-menu button **Area** until **All** is highlighted in the pop-up menu.



Remove all input signals from the inputs.



- c. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.
- d. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. When finished, the resulting status will appear on the screen.
- e. *Confirm no failures are found:* Verify that no failures are found and reported on-screen.

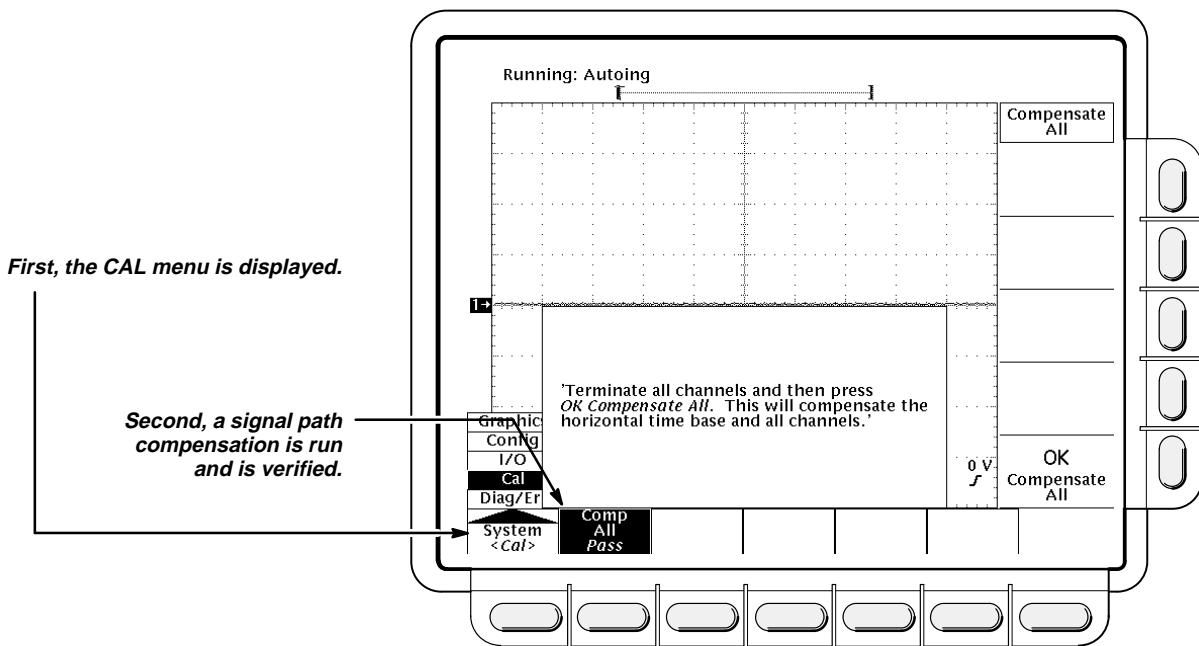


Figure 1-2: Verifying Adjustments and Signal-Path Compensation

- f. *Run the signal-path compensation:*
  - Press **SHIFT**; then press **UTILITY**.



- Press the main menu button **System**; then press the side-menu button **Comp All** to bring up the pop-up menu.
  - Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate All**.
- g. *Wait:* Signal-path compensation runs in about thirty seconds. 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 the word **Pass** appears under **Comp All** in the main menu. (See Figure 1-2.)
2. *Return to regular service:* Press **CLEAR MENU** to exit the system menu.

---

## Functional Tests

The purpose of these procedures is to confirm that this oscilloscope functions properly. The only equipment required is one of the standard-accessory SMA cables.



These procedures verify functions; that is, they verify that 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 1-11.



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

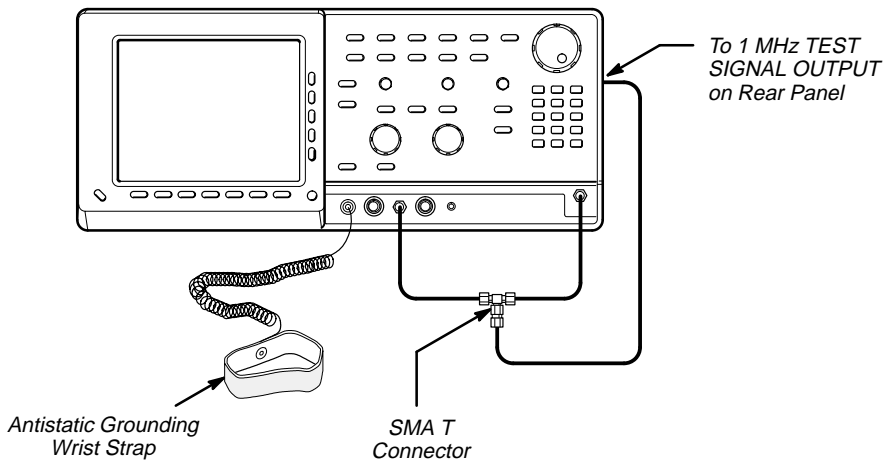
**Equipment Required:** Three SMA cables and a T connector.

**Prerequisites:** None.

**Procedure:**

1. *Install the test hookup and preset the oscilloscope controls:*

Appendix C: Performance Verification



**Figure 1-3: Universal Test Hookup for Functional Tests**



*Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.*

- a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and the **EXT TRIGGER INPUT** on the front panel.
- 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 input channels operate:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up for verification from step 1.*
  - a. *Select an unverified channel:*
    - Press **WAVEFORM OFF** to remove from display the channel just verified.
    - Press the front-panel button that corresponds to the channel you are to verify.
    - Move the SMA cable to the channel you selected.

- b. *Set up the selected channel:* **Appendix C: Performance Verification**
- Press **AUTOSET** to obtain a viewable, triggered display in the selected channel.
  - Set the horizontal **SCALE** to 200 ns. Press **CLEAR MENU** to remove any menu that may be on the screen.
- c. *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 either 50 mV or 100 mV, and a square-wave signal about 350 mV to 700 mV 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 its original setting (50 mV or 100 mV) returns the amplitude to its original number of divisions.
- d. *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 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.
- **NORMAL** mode displays an actively acquiring waveform on-screen. (Note that there is noise present on the peaks of the square wave.)
  - **Envelope** mode displays an actively acquiring waveform on-screen with the noise displayed.
  - **Average** mode displays an actively acquiring waveform on-screen with the noise that was present in Normal mode reduced.
- e. *Test all channels:* Repeat substeps a through d until all input channels are verified.
3. *Remove the test hookup:* Disconnect the SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.



Appendix C: Performance Verification **Verify the Time Base**

**Equipment Required:** Three SMA cables and a T connector.

**Prerequisites:** None.

**Procedure:**



*Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.*

1. *Install the test hookup and preset the oscilloscope controls:*
  - a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and the **EXT TRIGGER INPUT** on the front panel. (See Figure 1-3 on page 1-6.)
  - 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:*
    - Press **AUTOSET** to obtain a viewable, triggered display.
    - Set the horizontal **SCALE** to 200 ns.
    - 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 test signal is about five horizontal divisions on-screen for the 200 ns 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), and that counterclockwise rotation contracts it, and that returning the horizontal scale to 200 ns 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 SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.

## Verify the Trigger System

Appendix C: Performance Verification

**Equipment Required:** Three SMA cables and a T connector.

**Prerequisites:** None.

**Procedure:**



*Inputs to this oscilloscope can be damaged by static discharge. Wear your antistatic wrist strap whenever making connections the oscilloscope.*

1. *Install the test hookup and preset the oscilloscope controls:*
  - a. *Hook up the signal source:* Connect one end of an SMA cable to the **1 MHz TEST SIGNAL OUTPUT** on the rear panel. Connect the other end of the cable to the T connector. Connect the T connector, through SMA cables, to the **CH 1** input and **EXT TRIGGER INPUT** on the front panel. (See Figure 1-3 on page 1-6.)
  - 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:*
    - Press **TRIGGER MENU**.
    - Press the main-menu button **Source**; press the side-menu button **External Input**.
    - Press the main-menu button **Mode**; press the side-menu button **Normal**.
    - Press **AUTOSET** to obtain a viewable, triggered display.
    - Set the horizontal **SCALE** to 200 ns.
    - Press **CLEAR MENU** to remove the menus from the screen.
2. *Verify that the trigger system operates:* Confirm that the following statements are true.
  - The trigger level readout for the 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.)

## Brief Procedures

- Appendix C: Performance Verification**
- Pressing **SET LEVEL TO 50%** triggers the signal that you just left untriggered. (Leave the signal triggered.)
3. *Remove the test hookup:* Disconnect the standard-accessory SMA cables and T connector from the front panel inputs and the **1 MHz TEST SIGNAL OUTPUT** connector.



This subsection contains a collection of procedures for checking that TDS 800 Digitizing Oscilloscopes perform as warranted.

The procedures are arranged in three logical groupings: *Signal Acquisition System Checks*, *Time Base System Checks*, and *Triggering System Checks*. They check all the characteristics that are designated as checked in Section 1, *Specification*. (The characteristics that are checked appear in **boldface** type under *Warranted Characteristics* in Section 1.)



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

## Prerequisites

The tests in this subsection 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 1-3, and those under *Functional Tests*, found on page 1-5.
- A signal-path compensation must have been done within the recommended calibration interval (after the prerequisite warm-up period listed below) and at a temperature within  $\pm 2^\circ \text{C}$  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  $+20^\circ \text{C}$  and  $+30^\circ \text{C}$ , must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between  $0^\circ \text{C}$  and  $+50^\circ \text{C}$ . (The warm-up requirement is usually met in the course of meeting the first prerequisite listed above.)

**Related Information** — Read *General Instructions* and *Conventions* that start on page 1-1. Also, if you are not familiar with operating this digitizing oscilloscope, read *General Operating Instructions* in Section 2 before doing any of these procedures.

**Related Information**—Read *General Instructions* and *Conventions* that start on page 1-1. Also, if you are not familiar with operating this Digitizing Oscilloscopes, read *At a Glance* in Section 3 before doing any of these procedures.

### Equipment Required

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

**Table 1-1: Test Equipment**

Item Number and Description	Minimum Requirements	Example	Purpose
1 Attenuator, 10X (three required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Signal Attenuation
2 Cable, Precision Coaxial (two required)	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Signal Interconnection
3 Cable, Precision Coaxial (two required)	50 Ω, 12 in, male to male SMA connectors	Tektronix part number 174-1364-00	Signal Interconnection
4 Cable, Precision Coaxial	50 Ω, 60 in, male to male SMA connectors	Tektronix part number 174-1428-00	Signal Interconnection
5 Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103-0090-00	Various Accuracy Tests
6 Connector, BNC "T"	Male BNC to dual female BNC	Tektronix part number 103-0030-00	Checking Trigger Sensitivity
7 Coupler, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067-0525-02	Checking Delay Between Channels
8 Adapter, BNC to SMA	Female BNC to male SMA	Tektronix part number 015-0554-00	Various Accuracy Tests
9 Adapter, SMA	SMA female to female	Tektronix part number 015-1012-00	Various Accuracy Tests
10 Adapter, SMA	SMA male to male	Tektronix part number 015-1011-00	Various Accuracy Tests
11 Adapter, N to BNC	Male N to female BNC	Tektronix part number 103-0045-00	Various Accuracy Tests
12 Divider, Power (two required)	50 Ω, SMA Female	Tektronix part number 015-0565-00	Various Accuracy Tests
13 Generator, Function	10 kHz; Variable amplitude from 5 mV to 2 V <sub>p-p</sub> into 50 Ω	TEKTRONIX FG 502 Function Generator <sup>1</sup>	Checking Trigger Level Accuracy

<sup>1</sup>Requires a TM 500 or TM 5000 Series Power Module Mainframe.

Table 1-1: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
14 Generator, DC Calibration	Variable amplitude to 2 V; accuracy to 0.1%	Data Precision 8200	Checking DC Offset, Gain, and Measurement Accuracy
15 Generator, Sine-Wave, High-Frequency	10 MHz to 2 GHz; Variable amplitude to 20 mW; Accuracy $<5 \times 10^{-10}$ /day with temperature $<5 \times 10^{-9}$ over 0–55° C; Resolution 1 kHz	Wiltron 67xxB–20 with Option 2	Various Accuracy Tests
16 Generator, Calibration Step		TEKTRONIX 067–1338–00 Calibration Step Generator	Checking Rise Time
17 DMM	Resistance from 0 $\Omega$ to 2 k $\Omega$ ; accuracy within 2 ppm	Fluke 8842A	Checking Input Resistance Accuracy
18 Power Supply, Dual Output	0–35 V and 60 V 2 A; current limit without foldback	TEKTRONIX PS 280 Power Supply	Power Supply Troubleshooting

<sup>1</sup>Requires a TM 500 or TM 5000 Series Power Module Mainframe.

## Test Record

Photocopy the next three pages and use them to record the performance test results for your instrument.

**Performance Tests**

**TDS 820 Test Record**

Instrument Serial Number: _____	Certificate Number: _____
Temperature: _____	RH %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

**Net Offset Accuracy**

<b>CH1 (With Delay Line)</b>				
+0 V	-4 mV	_____	_____	+4 V
+1.2 V (-) -1.2 V	2.391 V	_____	_____	+2.407 V
<b>Option 1D (Without Delay Line)</b>				
+0 V	-2 mV	_____	_____	+2 mV
+1.0 V (-) -1.0 V	1.9935 V	_____	_____	+2.0065 V
<b>CH2 (With Delay Line)</b>				
+0 V	-4 mV	_____	_____	+4 V
+1.2 V (-) -1.2 V	2.391 V	_____	_____	+2.407 V
<b>Option 1D (Without Delay Line)</b>				
+0 V	-2 mV	_____	_____	+2 mV
+1.0 V (-) -1.0 V	1.9935 V	_____	_____	+2.0065 V

**Voltage Measurement Accuracy**

<b>CH1 (With Delay Line)</b>				
+0.8 V (-) -0.8 V	+1.5796 V	_____	_____	+1.6204 V
<b>Option 1D (Without Delay Line)</b>				
+0.4 V (-) -0.4 V	+0.7902 V	_____	_____	+0.8098 V
<b>CH2 (With Delay Line)</b>				
+0.8 V (-) -0.8 V	+1.5796 V	_____	_____	+1.6204 V
<b>Option 1D (Without Delay Line)</b>				
+0.4 V (-) -0.4 V	+0.7902 V	_____	_____	+0.8098 V

**Rise Time**

<b>CH1 (With Delay Line)</b>				
$\sqrt{\left(\frac{\text{Measured Rise Time}}{\text{Time}}\right)^2 - \left(\frac{\text{Generator Rise Time}}{\text{Time}}\right)^2}$	N/A	_____	_____	58.3 ps
<b>Option 1D (Without Delay Line)</b>				
$\sqrt{\left(\frac{\text{Measured Rise Time}}{\text{Time}}\right)^2 - \left(\frac{\text{Generator Rise Time}}{\text{Time}}\right)^2}$	N/A	_____	_____	43.8 ps

## TDS 820 Test Record (Cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<b>Rise Time (Cont.)</b>				
CH2 (With Delay Line)				
$\sqrt{\left(\text{Measured Rise Time}\right)^2 - \left(\text{Generator Rise Time}\right)^2}$	N/A	_____	_____	58.3 ps
Option 1D (Without Delay)				
$\sqrt{\left(\text{Measured Rise Time}\right)^2 - \left(\text{Generator Rise Time}\right)^2}$	N/A	_____	_____	43.8 ps
<b>Input Resistance</b>				
CH1 (With Delay Line)				
Option 1D (Without Delay Line)	49 Ω	_____	_____	51 Ω
CH2 (With Delay Line)				
Option 1D (Without Delay Line)	49.5 Ω	_____	_____	50.5 Ω
CH2 (With Delay Line)				
Option 1D (Without Delay Line)	49 Ω	_____	_____	51 Ω
Option 1D (Without Delay Line)				
	49.5 Ω	_____	_____	50.5 Ω
<b>Delta Time (Between Channels)</b>				
Delta Time Between Channels (CH 1 and CH 2 Deskew = 0)				
	N/A	_____	_____	20 ps
<b>Delta Time (Single Channel)</b>				
CH1				
1 ns	984 ps	_____	_____	1.016 ns
100 ps	95 ps	_____	_____	105 ps
10 ps	8 ps	_____	_____	12 ps
100 ns	99.885 ps	_____	_____	100.115 ns
CH2				
1 ns	984 ps	_____	_____	1.016 ns
100 ps	95 ps	_____	_____	105 ps
10 ps	8 ps	_____	_____	12 ps
100 ns	99.885 ps	_____	_____	100.115 ns
<b>Trigger Level</b>				
CH1 (With Delay Line)				
+400 mV	+310 mV	_____	_____	+490 mV
-400 mV	-310 mV	_____	_____	-490 mV
CH2 (With Delay Line)				
+400 mV	+310 mV	_____	_____	+490 mV
-400 mV	-310 mV	_____	_____	-490 mV
External				
+400 mV	+310 mV	_____	_____	+490 mV
-400 mV	-310 mV	_____	_____	-490 mV

Performance Tests

TDS 820 Test Record (Cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<b>Trigger Sensitivity</b>				
CH1 (With Delay Line)				
10 MHz	80 mV	_____	_____	N/A
200 MHz	80 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
CH2 (With Delay Line)				
10 MHz	80 mV	_____	_____	N/A
200 MHz	80 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
External Trigger				
10 MHz	40 mV	_____	_____	N/A
200 MHz	40 mV	_____	_____	N/A
1 GHz	200 mV	_____	_____	N/A
<b>Random Noise</b>				
CH1 (With Delay Line)	N/A	_____	_____	1.2 mV
Option 1D (Without Delay Line)	N/A	_____	_____	600 $\mu$ V
CH2 (With Delay Line)	N/A	_____	_____	1.2 mV
Option 1D (Without Delay Line)	N/A	_____	_____	600 $\mu$ V
<b>Delay Jitter</b>				
CH1	N/A	_____	_____	9 ps
CH2	N/A	_____	_____	9 ps

## 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 Section 1, *Specification*.

### Check Accuracy of Net Offset

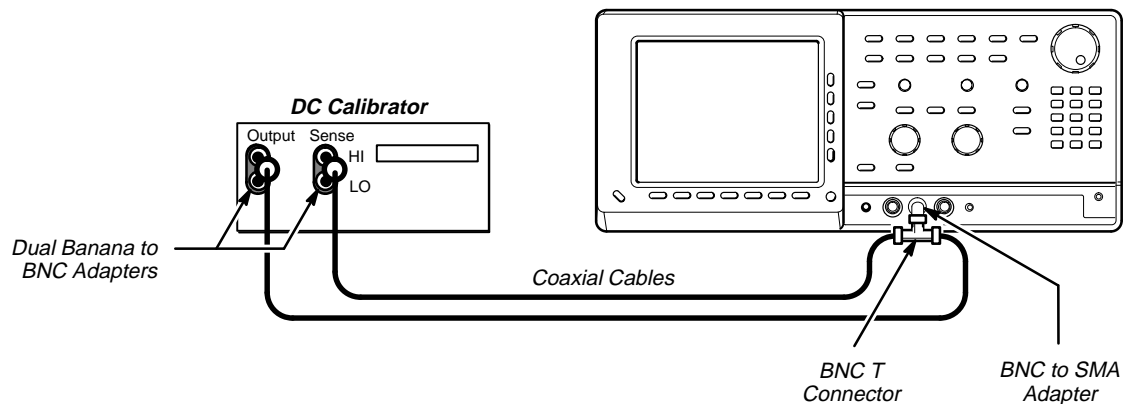


*Be sure to set the DC calibration generator to 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.*

*Do not connect more than  $\frac{1}{2}$   $\frac{1}{2}$  inputs of the oscilloscope.*

**Equipment Required:** Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 14), one BNC to SMA adapter (Item 8), and two precision coaxial cables (Item 2).

**Prerequisites:** The oscilloscope must meet the prerequisites listed on page 1-11.



**Figure 1-4: Initial Test Hookup**

#### Procedure:

1. *Preset the instrument controls and install the test hookup:*
  - 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 **SHIFT**; then **UTILITY**.
- Press the main-menu button **System** until **Cal** is highlighted in the pop-up menu.
- Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate All**.
- Wait for the oscilloscope to finish the compensation.
- Press **CLEAR MENU** to remove the menus from the screen.

b. *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  $\Omega$  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  $\Omega$  precision coaxial cable to the other side of the BNC T connector. Connect the BNC to SMA adapter to **CH 1**. Now connect the BNC T connector to the BNC to SMA adapter.

c. *Modify the default settings:*

- Set the horizontal **SCALE** to 100 ns.
- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
- Press **DISPLAY**.
- Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
- Press **TRIGGER MENU**.
- Press the main-menu button **Source**; then press the side-menu button **Internal Clock**.
- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.



2. *Confirm input channels are within limits for offset accuracy:* 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.

Table 1-2: Net Offset at 20° C to 30° C<sup>b</sup> — With Delay Line

Vertical Scale Setting	Generator Voltage Setting <sup>a</sup>	Vertical Position Setting <sup>a</sup>	Offset Setting <sup>a</sup>	Measurement	Offset Accuracy Limits
200 mV	0 V	0	0 V	V <sub>1</sub>	–4 mV to 4 mV
	1.2 V	0	1.2 V	V <sub>2</sub>	Record measurement as V <sub>2</sub>
	–1.2 V	0	–1.2 V	V <sub>3</sub>	Record measurement as V <sub>3</sub>
					V <sub>2</sub> – V <sub>3</sub> = 2.3910 V to 2.4070 V

<sup>a</sup>Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

<sup>b</sup>Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

Table 1-3: Net Offset at 20° C to 30° C<sup>b</sup> — Without Delay Line

Vertical Scale Setting	Generator Voltage Setting <sup>a</sup>	Vertical Position Setting <sup>a</sup>	Offset Setting <sup>a</sup>	Measurement	Offset Accuracy Limits
100 mV	0 V	0	0 V	V <sub>1</sub>	–2 mV to 2 mV
	1.0 V	0	1.0 V	V <sub>2</sub>	Record measurement as V <sub>2</sub>
	–1.0 V	0	–1.0 V	V <sub>3</sub>	Record measurement as V <sub>3</sub>
					V <sub>2</sub> – V <sub>3</sub> = 1.9935 V to 2.0065 V

<sup>a</sup>Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

<sup>b</sup>Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

- Press **MEASURE**.
- Press the main-menu button **Select Measurement**
- 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**.



- b. *Set the vertical scale, generator voltage, position, and offset:* Change the setup to one of the settings listed in Table 1-2 or Table 1-3 that is not yet checked. (Start with the first setting listed.) Table 1-2 is for instruments with a delay line (standard instrument). Table 1-3 is for instruments without delay lines (Option 1D).
- Set the vertical **SCALE** to the setting in the table.

- Set the generator voltage to the setting in the table.
  - Press **VERTICAL MENU**.
  - Press the main-menu button **Position**; and then set the vertical position to the setting in the table.
  - Press the main-menu button **Offset**; and then set the offset to the setting in the table.
  - Press **CLEAR MENU**.
- c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1. Be sure *not* to use the vertical **POSITION** knob while checking any channel for accuracy of offset, since varying the position invalidates the check.
- d. Read the measurement results at the mean readout on screen. See Figure 1-5. Record the results for later use.
- e. *Check against limits:* Do the following subparts in the order listed.
- CHECK that the measured or calculated offset is within the limits listed for the current vertical scale and generator voltage setting.
  - Repeat substeps b through e until all settings listed in Table 1-2 or Table 1-3 are checked for the channel under test.
- f. *Test all channels:* Repeat substeps a through e for all input channels.
3. *Disconnect the hookup:*
- a. *Set the generator output to 0 V.*
  - b. Then disconnect the cable from the generator output at the input connector of the channel last tested.

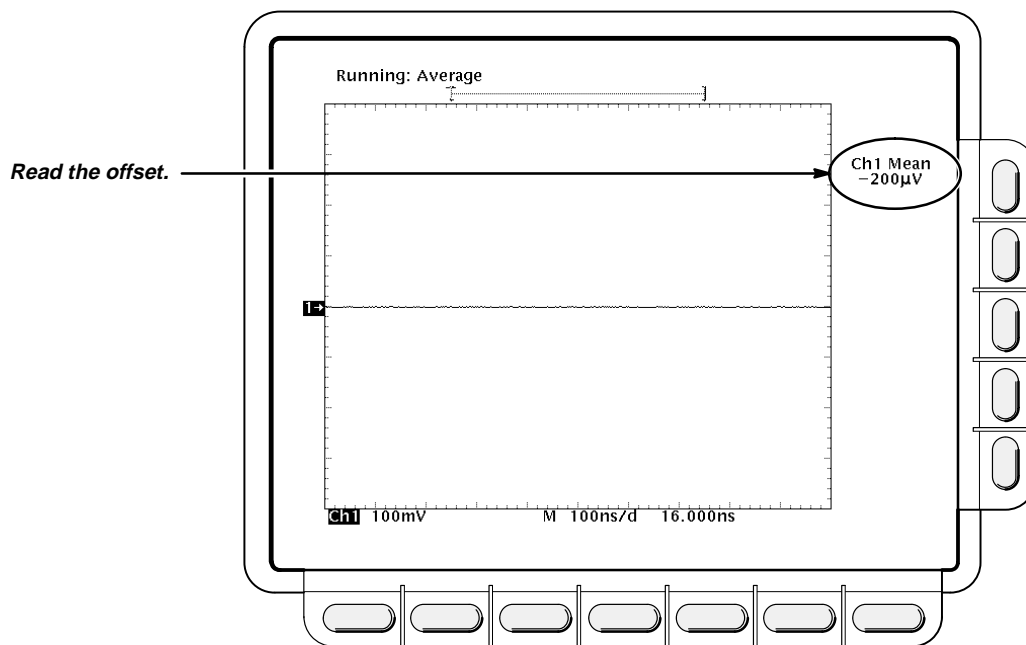


Figure 1-5: Measurement of DC Offset Accuracy

## Check Voltage Measurement Accuracy



*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.*

*Do not connect more than  $\frac{1}{2}$   $\frac{1}{2}$  inputs of the oscilloscope.*

**Equipment Required:** Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 14), one BNC to SMA adapter (Item 8), and two precision coaxial cables (Item 2).

**Prerequisites:** The oscilloscope must meet the prerequisites listed on page 1-11.

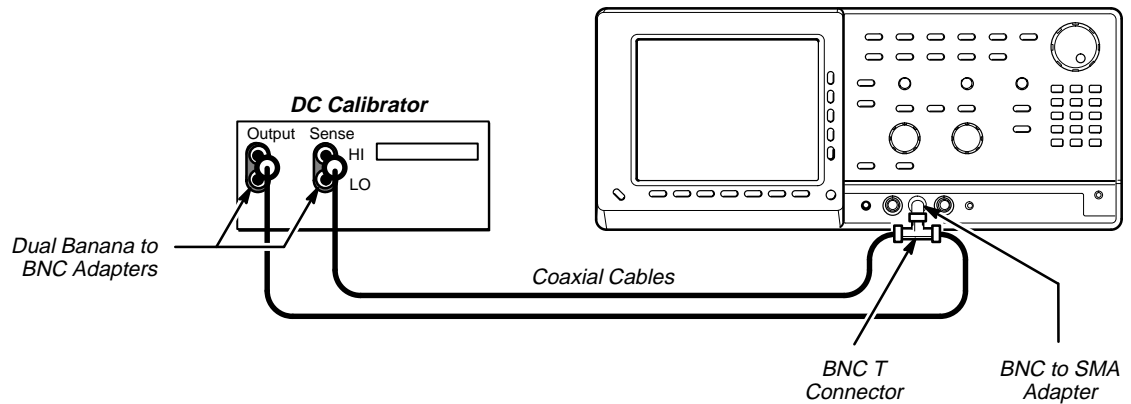


Figure 1-6: Initial Test Hookup

**Procedure:**

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**.
    - Press **SHIFT**; then **UTILITY**.
    - Press the main-menu button **System** until **Cal** is highlighted in the pop-up menu.
    - Press the main-menu button **Comp All**; then press the side-menu button **OK Compensate ALL**.
    - Press **CLEAR MENU** to remove the menus from the screen.
  - b. *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  $\Omega$  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  $\Omega$  precision coaxial cable to the other side of the BNC T connector. Connect the BNC to SMA adapter to **CH 1**. Now connect the BNC T connector to the BNC to SMA adapter.
  - c. *Modify the default settings:*
    - Set the horizontal **SCALE** to 100 ns.
    - Press **SHIFT**; then **ACQUIRE MENU**.



- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
  - Press **DISPLAY**.
  - Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
  - Press **TRIGGER MENU**.
  - Press the main-menu button **Source**; then press the side-menu button **Internal Clock**.
  - Press **MEASURE**.
  - Press the main-menu button **Select Measurement**
  - 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**.
2. *Confirm input channels are within limits for voltage measurement accuracy: 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.

Table 1-4: Voltage Measurement at 20° C to 30° C<sup>b</sup> — With Delay Line

Vertical Scale Setting	Generator Voltage Setting <sup>a</sup>	Vertical Position Setting <sup>a</sup>	Offset Setting <sup>a</sup>	Measurement	Offset Accuracy Limits
200 mV	0.8 V	0	0 V	V <sub>1</sub>	Record measurement as V <sub>1</sub>
	-0.8 V	0	0 V	V <sub>2</sub>	Record measurement as V <sub>2</sub>
					V <sub>1</sub> – V <sub>2</sub> = 1.5796 V to 1.6204 V

<sup>a</sup>Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

<sup>b</sup>Outside the 20° C to 30° C range, calculate accuracy limits using the specification.

Table 1-5: Voltage Measurement at 20° C to 30° C<sup>b</sup> — Without Delay Line

Vertical Scale Setting	Generator Voltage Setting <sup>a</sup>	Vertical Position Setting <sup>a</sup>	Off-set Setting <sup>a</sup>	Measurement	Offset Accuracy Limits
100 mV	0.4 V	0	0 V	V <sub>1</sub>	Record measurement as V <sub>1</sub>
	-0.4 V	0	0 V	V <sub>2</sub>	Record measurement as V <sub>2</sub>
					V <sub>1</sub> – V <sub>2</sub> = 0.7902 V to 0.8098 V

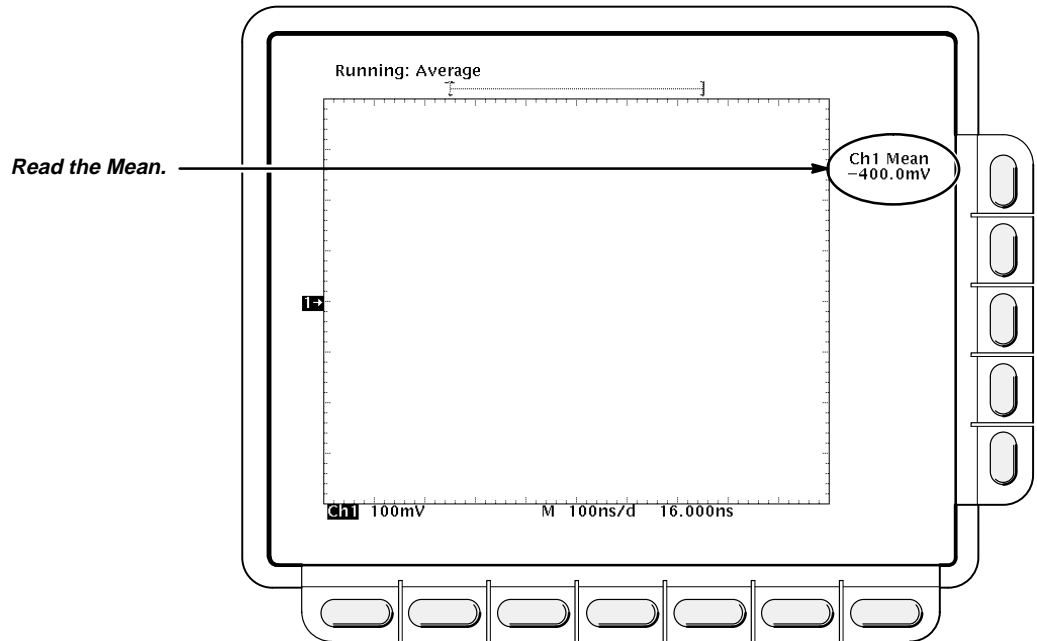
<sup>a</sup>Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

<sup>b</sup>Outside the 20° C to 30° C range, calculate the accuracy limits using the specification.



- Press **MEASURE**.
  - Press the main-menu button **Select Measurement**
  - 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**.
- b. *Set the vertical scale, generator voltage, position, and offset:* Change the setup to one of the settings listed in Table 1-4 or Table 1-5 that is not yet checked. (Start with the first setting listed.) Table 1-4 is for instruments with a delay line (standard instrument). Table 1-5 is for instruments without delay lines (Option 1D).
- Set the vertical **SCALE** to the setting in the table.
  - Set the generator voltage to the setting in the table.
  - Press **VERTICAL MENU**.
  - Press the main-menu button **Position**; and then set the vertical position to the setting in the table.
  - Press the main-menu button **Offset**; and then set the offset to the setting in the table.
  - Press **CLEAR MENU**.
- c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1. Be sure *not* to use the vertical **POSITION** knob while checking any channel for accuracy of voltage measurement, since varying the position invalidates the check.
- d. Read the measurement results at the mean readout on screen. Record the results for later use. See Figure 1-7.
- e. *Check against limits:* Do the following subparts in the order listed.
- Repeat substeps b through e until all settings listed in Table 1-4 or Table 1-5 are checked for the channel under test.
  - CHECK that the calculated voltages are within the limits listed for the vertical scale and generator voltage settings.

- f. *Test all channels:* Repeat substeps a through e for all input channels.
3. *Disconnect the hookup:*
  - a. *Set the generator output to 0 V.*
  - b. Then disconnect the cable from the generator output at the input connector of the channel last tested.



**Figure 1-7: Measurement of Voltage Measurement Accuracy**

## Check Rise Time

**Equipment Required:** One calibration step generator (Item 16), and an SMA cable (Item 4).

**Prerequisites:** See page 1-11.

**Procedure:**

1. *Preset the instrument and controls Install the test hookup:*
  - a. *Initialize the oscilloscope:*
    - Press save/recall **SETUP**. Then press the main-menu button **Recall Factory Setup**.
    - Press the side-menu button **OK Confirm Factory Init**.
  - b. *Modify the default settings:*
    - Press **MEASURE**.
    - Press the main-menu button **Reference Levels**; then press the side-menu button **Set Levels in**.
    - Set the horizontal **SCALE** to 100 ns.
    - Press **SHIFT**; then **ACQUIRE MENU**.
    - Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **128**, on the keypad; then press **ENTER**.
    - Press **TRIGGER MENU**.
    - Press the main-menu button **Source**.
    - Press the side-menu button **Internal Clock**. Press **100**, **SHIFT**, **k**, and then **ENTER**, on the keypad.

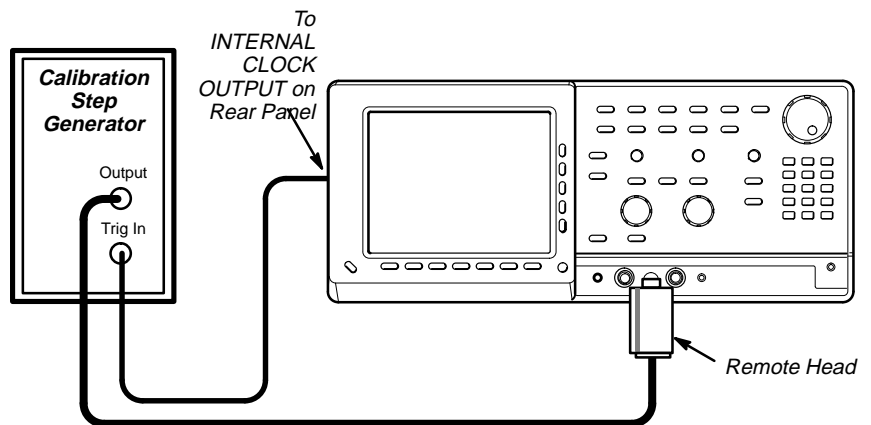


Figure 1-8: Initial Test Hookup



c. *Hook up the test-signal source:*

- Connect, through its remote head, the output of the calibration step generator to **CH 1**.
- Turn on the output of the calibration step generator.
- Using an SMA cable, connect the trigger input of the calibration step generator to the **INTERNAL CLOCK OUTPUT** at the rear of the oscilloscope

2. *Confirm the input channels are within limits for rise time:* Do the following substeps — test CH 1 first, *skipping substep a 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 remote head to the channel you select.
- Set the Horizontal **SCALE** to 100 ns.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base Position**; then press **0**, and **ENTER** on the keypad. (On instruments without delay lines this step sets the time base position to 16 ns.)

b. *Set the vertical scale:*

- Set the vertical **SCALE** to 50 mV.
- Press **VERTICAL MENU**.
- Press the main-menu button **Offset**. Press **-125**, **SHIFT**, **m**, and **ENTER** on the keypad.

c. *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 Measurement for CHx**.
- Now press the side menu button **more** until the menu label **Rise Time** appears in the side menu (its icon is shown at the left). Press the side-menu button **Rise Time**.
- Now press the side menu button **more** until the menu labels **High** and **Low** appear in the side menu (their icons are shown at the left). Press the side-menu buttons **High** and **Low**.
- Press the main-menu button **High-Low Setup**; then press the side-menu button **Histogram**.
- Read and record the high and low readouts for later use.



- Calculate the 10% and 90% points:

$$\Delta V = V_{high} - V_{low}$$

$$90\% \text{ point} = V_{high} - 0.1(\Delta V)$$

$$10\% \text{ point} = V_{low} + 0.1(\Delta V)$$

- Press the main-menu button **Reference Levels**.
  - Press the side-menu button **High Ref**; then use the keypad to enter the 90% voltage point calculated above.
  - Press the side-menu button **Low Ref**; then use the keypad to enter the 10% voltage point calculated above.
  - Press the main-menu button **Remove Measrmt**; then press the side-menu buttons **Measurement 3** and **Measurement 2**.
  - Set the horizontal **SCALE** to 20 ps.
  - Press **HORIZONTAL MENU**.
  - Press the main-menu button **Time Base Position**; then press the side-menu **Main Position**.
  - Turn the general purpose knob to position the rising edge of the waveform to the center of the screen (approximately 35 ns).
- d. *Measure the test signal:* Read, and record for later use, the results at the CHx Rise Time readout, which will automatically measure the rise time of the test signal.
- e. *Check against limits:*
- If your oscilloscope *has* delay lines (standard instrument), CHECK that the measured rise time is

$$Instrument \text{ RiseTime} = \sqrt{\left(\text{Observed RiseTime}\right)^2 - \left(\text{Generator RiseTime}\right)^2} \leq 58.3^a \text{ ps}$$

<sup>a</sup>Outside the 20° C to 30° C range, calculate the limits using the specification.

- If your oscilloscope *does not* have delay lines (Option 1D), CHECK that the measured rise time is

$$Instrument \text{ RiseTime} = \sqrt{\left(\text{Observed RiseTime}\right)^2 - \left(\text{Generator RiseTime}\right)^2} \leq 43.8 \text{ ps}$$

- f. *Test all channels:* Repeat substeps a through e for all channels.
3. *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last confirmed.

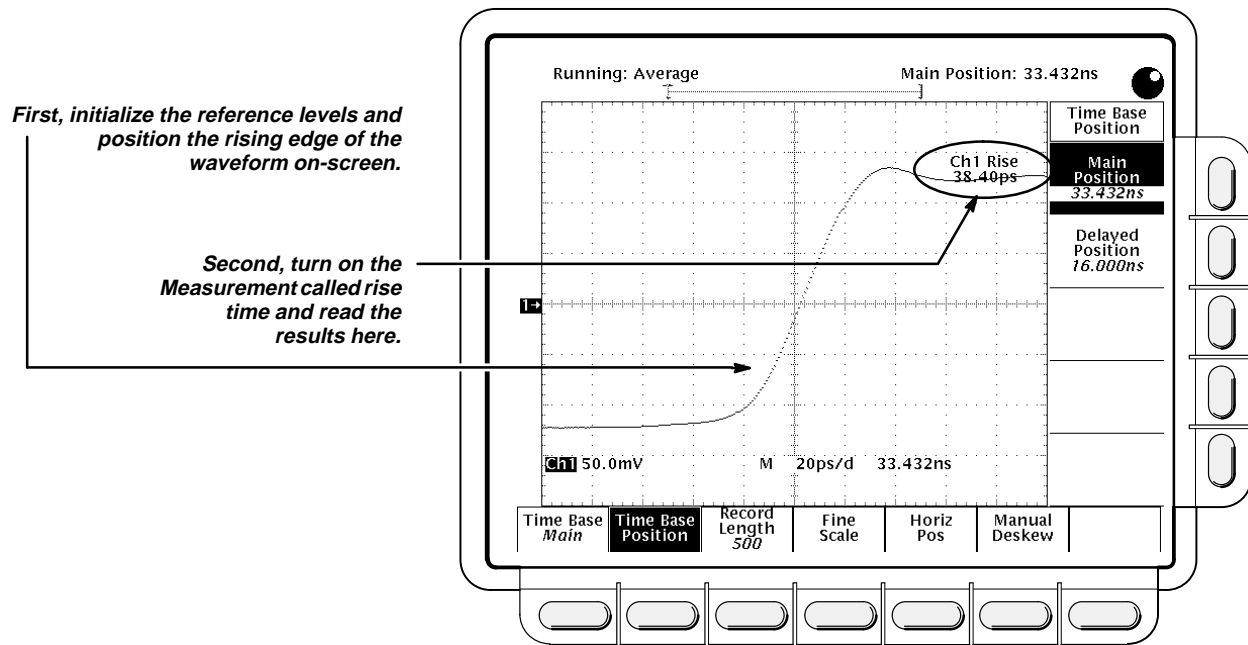


Figure 1-9: Measurement of Rise Time

### Check Input Resistance

**Equipment Required:** One DMM (Item 17), two precision BNC cables (Item 2), one BNC to SMA adapter (Item 8), one BNC T (Item 6), and two BNC to dual binding post adapters (Item 7).

**Prerequisites:** See page 1-11.

**Procedure:**

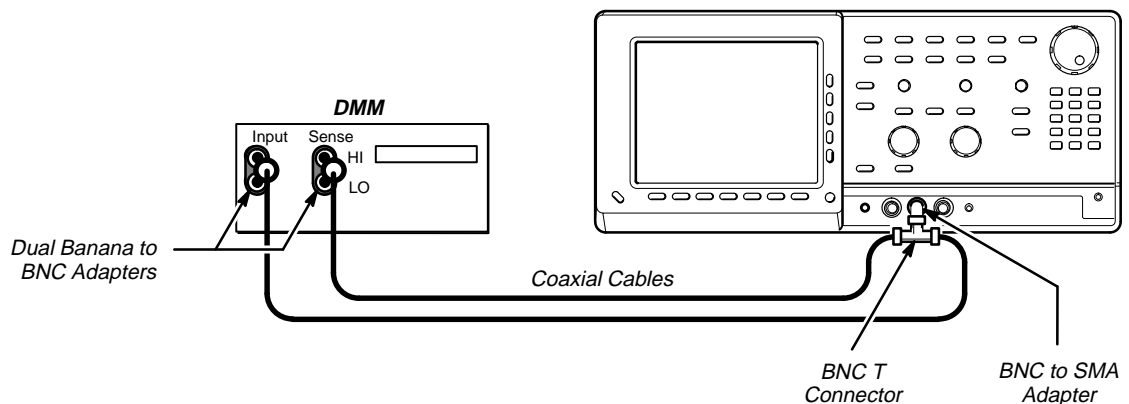


Figure 1-10: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
  - a. *Install the test hookup and initialize the front panel controls:*
    - Set the DMM to measure ohms.
    - Connect the output of the DMM through a dual-banana connector followed by a 50  $\Omega$  precision coaxial cable to one side of a BNC T connector. See Figure 1-10.
    - Connect the Sense output of the DMM, through a second dual-banana connector followed by a 50  $\Omega$  precision coaxial cable, to other side of the BNC T connector. Now connect the BNC T connector, through a BNC to SMA adapter, to **CH 1**.
    - Repeatedly press **WAVEFORM OFF** to remove all waveforms from the screen.
  - b. *Hook up the test-signal source:*
    - Connect the BNC to SMA adapter to the CH 1 input. Connect the BNC to dual binding post adapter to the input of the DMM. Connect the BNC to dual binding post adapter to the BNC to SMA adapter through a BNC cable.
    - Set the DMM to measure ohms.
2. *Check against limits:*
  - If your oscilloscope has delay lines (standard instrument), CHECK that the DMM readout is 49 to 51  $\Omega$ .
  - If your oscilloscope does not have delay lines (Option 1D), CHECK that the DMM readout is 49.5 to 50.5  $\Omega$ .
3. *Test all channels:* Move the test hook up to the next unchecked channel, and repeat step 2.
4. *Disconnect the hookup:* Disconnect both the cable from the DMM and the two adapters.

## Time Base System Checks

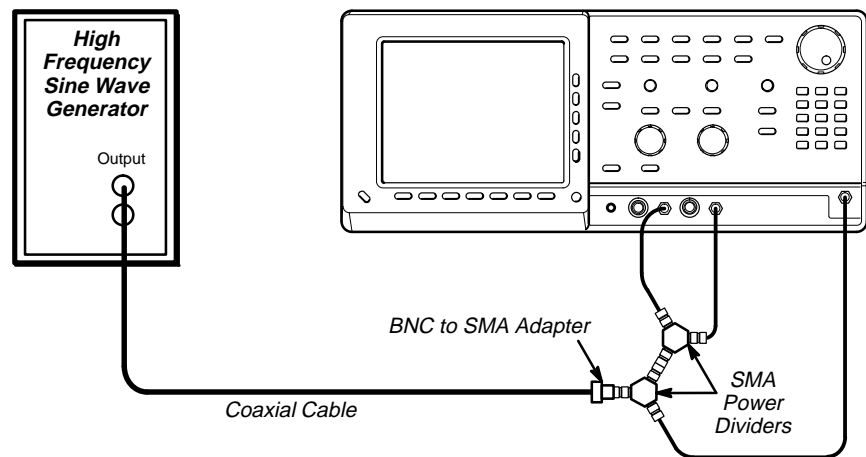
These procedures check those characteristics that relate to the Main and Delayed time base system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification*.

### Check Accuracy of Delta Time Measurement Between Channels

**Equipment Required:** One high-frequency sine-wave generator (Item 15), three 50  $\Omega$  SMA cables (Items 3 and 4), two 50  $\Omega$  power dividers (Item 12), one SMA male to male adapter (Item 10), one BNC to SMA adapter (Item 8), one N to BNC adapter (Item 11), and one precision coaxial cable (Item 2).

**Prerequisites:** See page 1-11.

**Procedure:**



**Figure 1-11: Initial Test Hookup**

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

#### **NOTE**

*The two cables going to the **CH 1** and **CH 2** inputs must be the same length and they must both connect to the same power divider.*

- a. Hook up the test-signal source:
  - Connect, through an N to BNC adapter, a coaxial cable, and a BNC to SMA adapter, the sine wave generator to 50  $\Omega$  power divider.

- Connect one side of the power divider, through an SMA cable to the **EXT TRIGGER INPUT**. Connect the other side of the power divider, through an SMA male to male adapter, another power divider, and two SMA cables to the **CH 1** and **CH 2** inputs.
  - Tighten SMA connectors to 8.5 inch pounds (0.96 N · m).
  - Set the output of the generator to 666.666 MHz and about 400 mV.
- 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 50 mV.
  - Set the horizontal **SCALE** of the Main time base to 200 ps.
  - Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
  - Press **SET LEVEL TO 50%**.
  - Press **HORIZONTAL MENU**.
  - Press the main-menu button **Manual Deskew**.
  - If you want to restore the present deskew values after completion of this test, record the CH 1 and CH 2 deskew values for later use.
  - Press the side-menu button **CH 1**. Press **0**, on the keypad; then press **ENTER**.
  - Press the side-menu button **CH 2**. Press **0**, on the keypad; then press **ENTER**.
  - Press the main-menu button **Time Base Position**. Using the general purpose knob, adjust the horizontal position until the waveform crosses zero at the left side of the graticule.
  - Press **SHIFT**; then press **ACQUIRE MENU**. Press the main-menu button **Mode**. Press the side-menu **Average**.
  - Press **CH 2**; then set the CH 2 vertical scale to 50 mV.
  - Press **MEASURE**; then press the main-menu button **Select Measrmt**.
  - Press the side-menu button **–more–**, until **Pk-Pk** appears in the side menu. Press **Pk-Pk**.
  - Press **CLEAR MENU**.



- Adjust the generator amplitude for a **Pk-Pk** readout of 191 mV. See Figure 1-12.
- Press **MEASURE**.
- Press the main-menu button **Remove Measrmtnt**; then press the side-menu buttons **Measurement 1**.
- Press **MATH REF**.
- Press the main-menu button **Math 2**; then press the side-menu button **Change Math Waveform Definition**.
- Press the main-menu button **Dual Wfm Math**.
- Press the side-menu button **Set 1st Source to**; then, using the general purpose knob, set the source to **Ch 1**.
- Press the side-menu button **Set Operator to**; then, using the general purpose knob, set the operator to **-**.
- Press the side-menu button **Set 2nd Source to**; then, using the general purpose knob, set the source to **Ch 2**.
- Press the side-menu button **OK Create Math Wfm**.
- Set the **Math2** vertical scale to 10 mV.

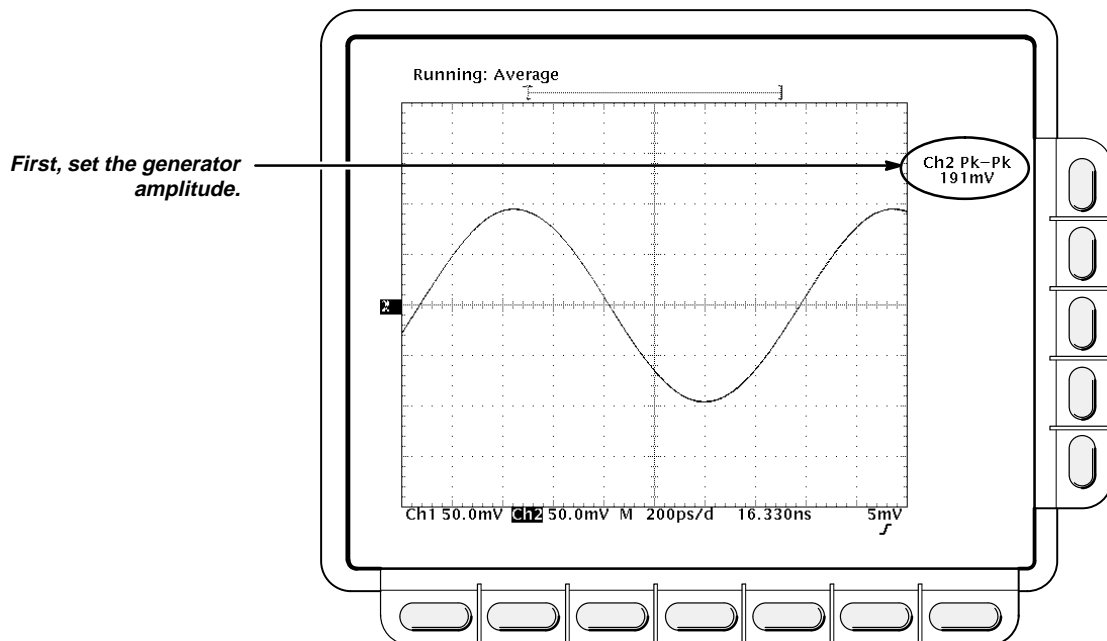


Figure 1-12: Generator Settings for Delta Time Measurement Between Channels

## Performance Tests

2. *Confirm Delta Time Measurement Between Channels is within limits for accuracies:*
  - a. *Display the test signal:*
    - Press **HORIZONTAL MENU**.
    - Press the main-menu button **Fine Scale**. Press **75**, on the keypad; then press **SHIFT**. Press **n**, on the keypad; then press **ENTER**.
  - b. *Check delta-time accuracy against limits:*
    - Press **CURSOR**.
    - Press the main-menu button **Function**; then press the side-menu button **H Bars**.
    - Use the general purpose knob to precisely align the active cursor to the bottom of the **Math2** waveform.
    - Press **TOGGLE**. Use the general purpose knob to precisely align the alternate cursor to the top of the **Math2** waveform.
    - Press **CLEAR MENU**.
    - CHECK that (see Figure 1-13):

$$\Delta \text{Volts Readout} \leq 12.0 \text{ mV}$$

### Example:

$$\frac{\Delta \text{Volts Readout}}{\text{Slew rate}} \leq 30 \text{ ps} + 0.1\%(\text{measured delta time} + \text{CH1deskew} - \text{CH2deskew}) + 30 \text{ ps} \left( \text{smaller of remainder between } \frac{\text{CH1deskew} - \text{CH2deskew}}{3.2768 \text{ ns}} \text{ and } \frac{\text{CH1deskew} - \text{CH2deskew} + 1.6384 \text{ ns}}{3.2768 \text{ ns}} \right)$$

where:  $\text{Slew rate} = 2 \pi f \left( \frac{Pk - Pk}{2} \right)$  or for our procedure:  $\text{Slew rate} = 2 \pi 666.666 \text{ MHz} \left( \frac{191 \text{ mV}}{2} \right) = 0.4 \frac{\text{mV}}{\text{ps}}$

and assuming that the CH 1 and CH 2 deskews are both 0.0 ns:

$$\frac{\Delta \text{Volts Readout}}{0.4 \frac{\text{mV}}{\text{ps}}} \leq 30.0 \text{ ps}$$

$$\Delta \text{Volts Readout} \leq 12.0 \text{ mV}$$



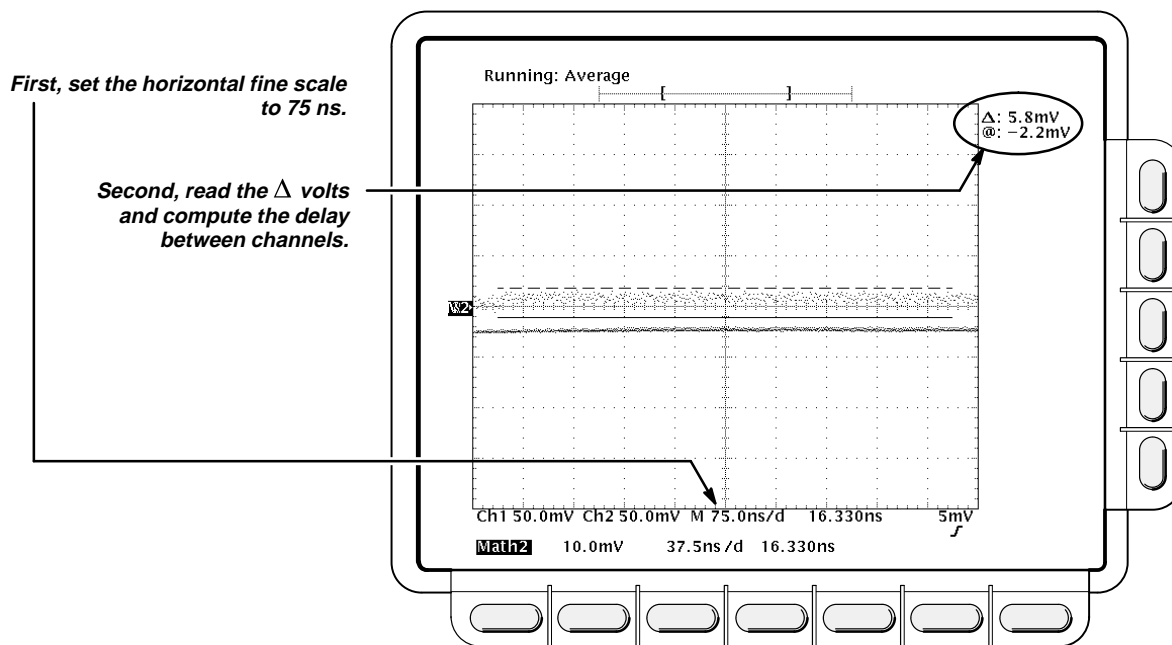


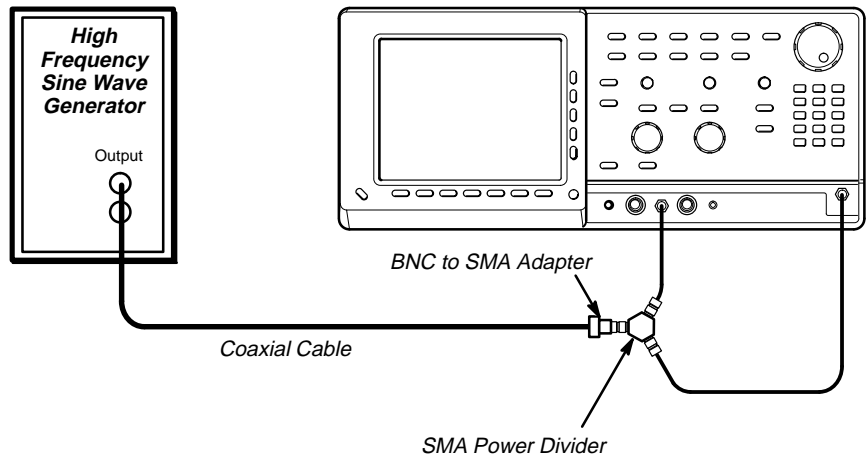
Figure 1-13: Measurement of Accuracy — Delta Time Measurement Between Channels

3. *Disconnect the hookup:* Disconnect the cables, divider, and adapter from the generator output at the input connectors of **CH 1** and **CH 2**.

### Check Accuracy of Single Channel Delta Time Measurements

**Equipment Required:** One high-frequency sine-wave generator (Item 15), one N to BNC adapter (Item 11), one precision coaxial cable (Item 2), two 50  $\Omega$  SMA cables (Item 3), one 50  $\Omega$  power divider (Item 12), and one BNC to SMA adapter (Item 8).

**Prerequisites:** See page 1-11.



**Figure 1-14: Initial Test Hookup**

**Procedure:**

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

**NOTE**

*The two cables going to the **CH 1** and **EXT TRIGGER INPUT** inputs must be the same length.*

- a. *Hook up the test-signal source:* Connect through an N to BNC adapter, a precision coaxial cable, a BNC to SMA adapter, a 50  $\Omega$  power divider, and two SMA cables, the sine wave generator to **CH 1** and the **EXT TRIGGER INPUT**. Set the output of the generator to 1.000 GHz.
- 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 ps.
  - Set the vertical **SCALE** to 20 mV.
  - Set the generator amplitude for an 8 division vertical display.
  - Press **SET LEVEL TO 50%**.

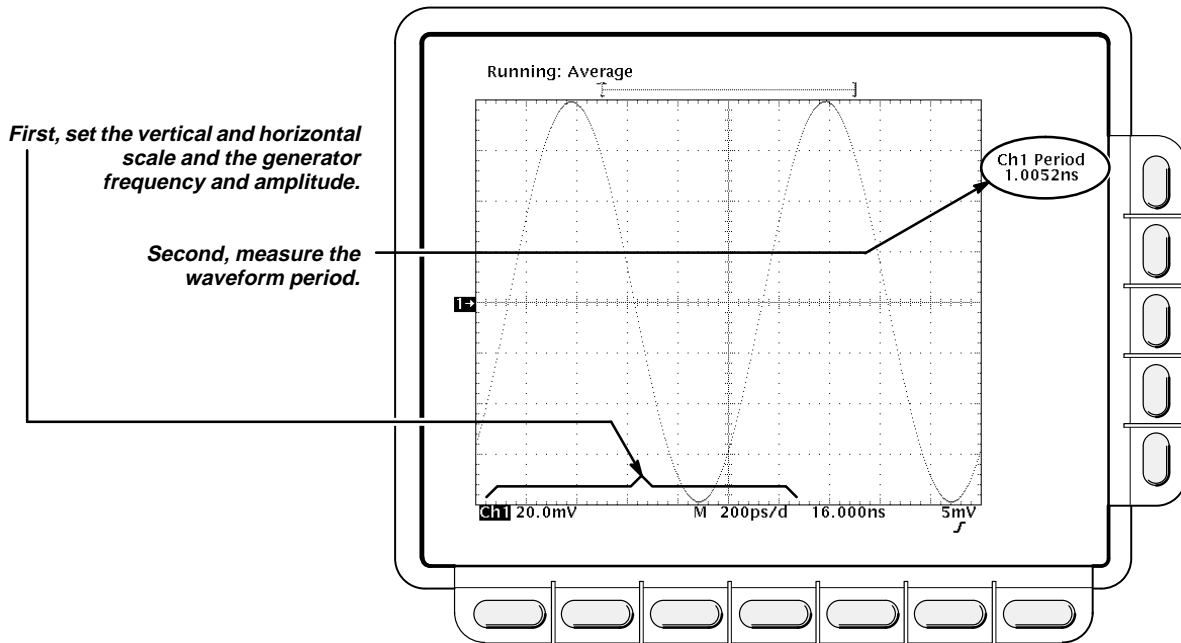




Figure 1-15: Measurement of Accuracy — Single Channel Delta Time Measurement at 1 ns

2. Confirm that time measurements are within limits for accuracies at 1 ns:
  - a. Display the test signal:
    - Press **SHIFT**; then **ACQUIRE MENU**. Now press the main-menu button **Mode**; then press the side-menu button **Average**.
  - b. Check single channel delta-time measurement accuracy at 1 ns against limits:
    - Press **MEASURE**.
    - Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
    - Press the main-menu button **Select Measurement for Chx**.
    - Press the side-menu button **-more-**, until **PERIOD** appears in the side menu. Press **PERIOD**.
    - Press **HORIZONTAL MENU**.
    - Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (–1.5 ns for the standard instrument and 16 ns for Option 1D).
    - Press **CLEAR MENU**.
    - CHECK that the period readout is within 984 ps to 1.016 ns (see Figure 1-15).



3. *Confirm measurements are within limits for accuracies at 100 ps:*a. *Display the test signal:*

- Press **MEASURE**.
- Press the main-menu button **Select Measurement for Chx**.
- Press the side-menu button **—more—**, until **Positive Cross** appears in the side menu. Press **Positive Cross**.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (–1.5 ns for the standard instrument and 16 ns for Option 1D).
- If your oscilloscope contains delay lines (standard instrument) adjust the general purpose knob for a **+Cross** readout of 3.5 ns  oscilloscope does not contain delay lines (Option 1D) adjust the general purpose knob for a **+Cross** readout of 23.0 ns  (the seventh positive cross).
- Press **CLEAR MENU**.
- Record the **+Cross** and **Period** readouts for later use.
- Set the generator frequency to 909.090 MHz.

b. *Set positive cross level:*

- Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep a. If you can adjust to the same **+Cross** readout, skip to substep c.
- Press **SET LEVEL TO 50%**.
- Record the **+Cross** and **Period** readouts for later use.
- Set the generator frequency to 1.000 GHz.
- Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep b. If you still can not adjust to the same **+Cross** readout, repeat substeps a and b using one more positive crossing.

c. *Check single channel delta-time measurement accuracy at 100 ps against limits:*

- Press **CLEAR MENU**.
- Read the **Period** readout.
- Subtract the **Period** readout from the period you recorded either in substep 3a or substep 3b.
- CHECK that the difference in periods is within 95 ps to 105 ps (see Figure 1-16).



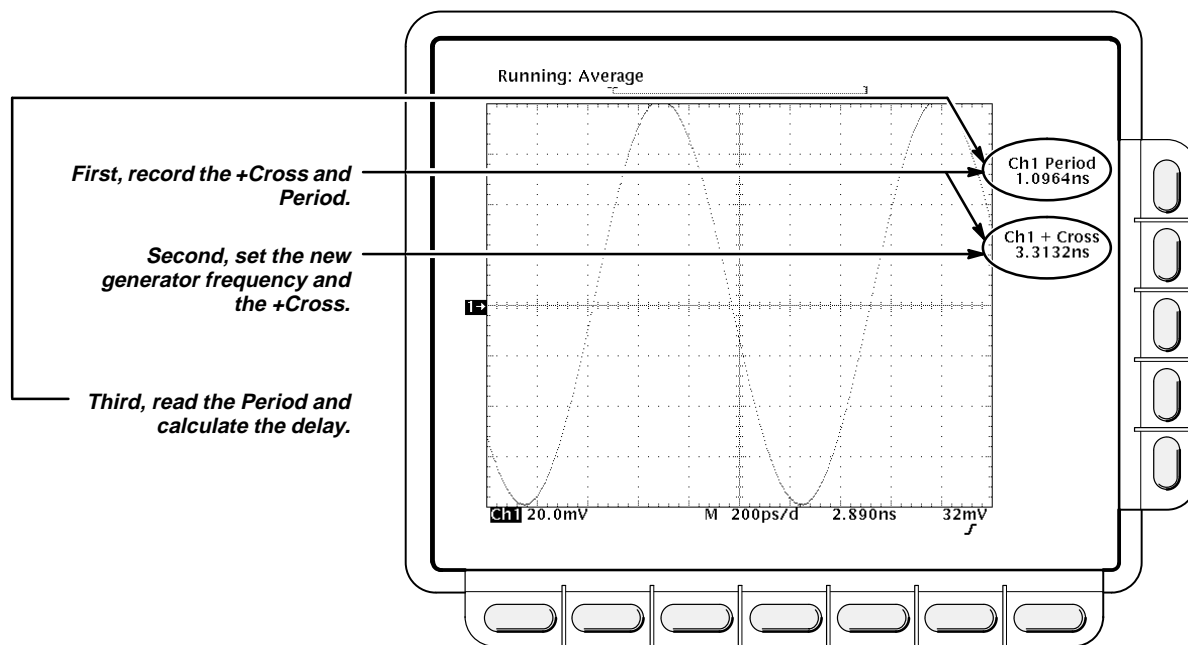


Figure 1-16: Measurement of Accuracy — Single Channel Delta Time Measurement at 100 ps

4. Confirm measurements are within limits for accuracies at 10 ps:
  - a. Display the test signal:
    - Set the generator frequency to 1.000 GHz.
    - Press **SET LEVEL TO 50%**.
    - Press **HORIZONTAL MENU**.
    - Press the main-menu button **Time Base Position**; then adjust the general purpose knob clockwise to its minimum setting (–1.5 ns for the standard instrument and 16 ns for Option 1D).
    - If your oscilloscope contains delay lines (standard instrument) adjust the general purpose knob for a **+Cross** readout of 3.5 ns  does not have delay lines (Option 1D) adjust the general purpose knob for a **+Cross** readout of 20 ns  (crossing).

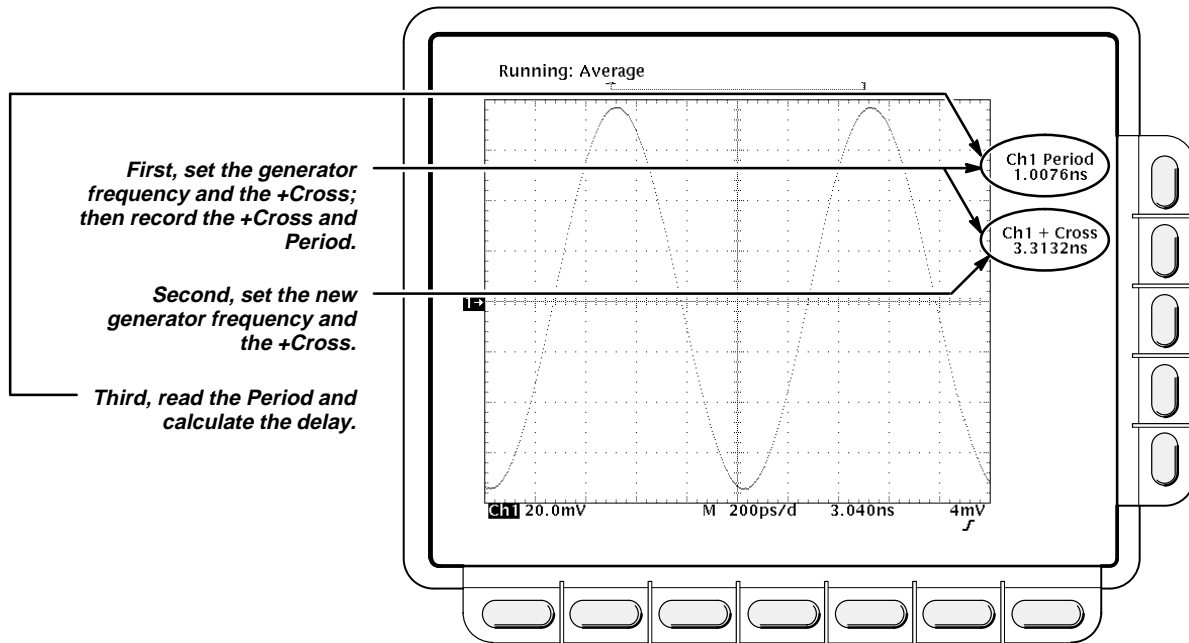


Figure 1-17: Measurement of Accuracy — Single Channel Delta Time Measurement at 10 ps

- Record the **+Cross** and **Period** readouts for later use.
  - Set the generator frequency to 990.000 MHz.
- b. *Set positive cross level:*
- Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep a. If you can adjust to the same **+Cross** readout, skip to substep c.
  - Press **SET LEVEL TO 50%**.
  - Record the **+Cross** and **Period** readouts for later use.
  - Set the generator frequency to 1.000 GHz.
  - Adjust the Trigger **LEVEL** for the same **+Cross** readout as you recorded in substep b.
- c. *Check single channel delta-time measurement accuracy at 10 ps against limits:*
- Press **CLEAR MENU**.
  - Read the **Period** readout.
  - Subtract the **Period** readout from the period you recorded either in substep 3a or substep 3b.
  - CHECK that the difference in periods is within 8 ps to 12 ps.

5. Confirm measurements are within limits for accuracies at 100 ns:

a. Display the test signal:

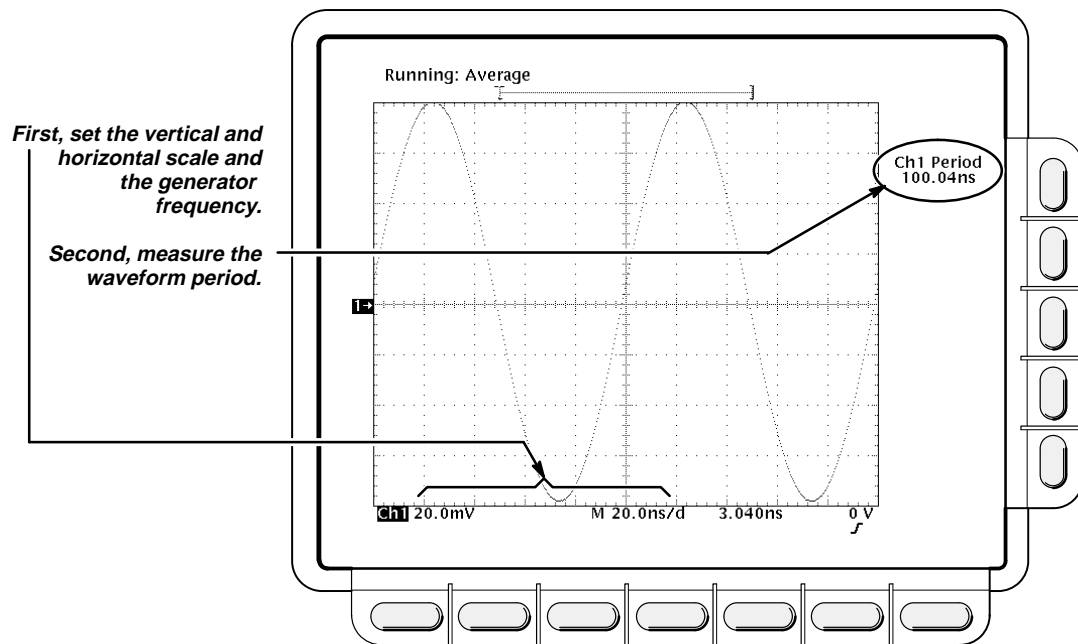


Figure 1-18: Measurement of Accuracy — Single Channel Delta Time Measurement at 100 ns

- Set the generator frequency to 10 MHz.
  - Set the horizontal **SCALE** to 20.0 ns.
  - Press **SET LEVEL TO 50%**.
- b. Check single channel delta-time measurement accuracy at 100 ns against limits:
- Press **MEASURE**.
  - Press the main-menu button **Remove Measrmt**; then press the side-menu button **Measurement 2**.
  - Press **CLEAR MENU**.
  - CHECK that the Period readout is within 99.885 ns to 100.115 ns.
6. Check all channels: Repeat steps 1c through step 5 for all channels. Move the SMA cable to the input connector that corresponds to the channel to be confirmed. Press **WAVEFORM OFF**. Press the front panel button that corresponds to the channel to be confirmed.
7. Disconnect the hookup: Disconnect the cables, adapters, and divider from the generator output at the input connector of the channel last confirmed.

## Trigger System Checks

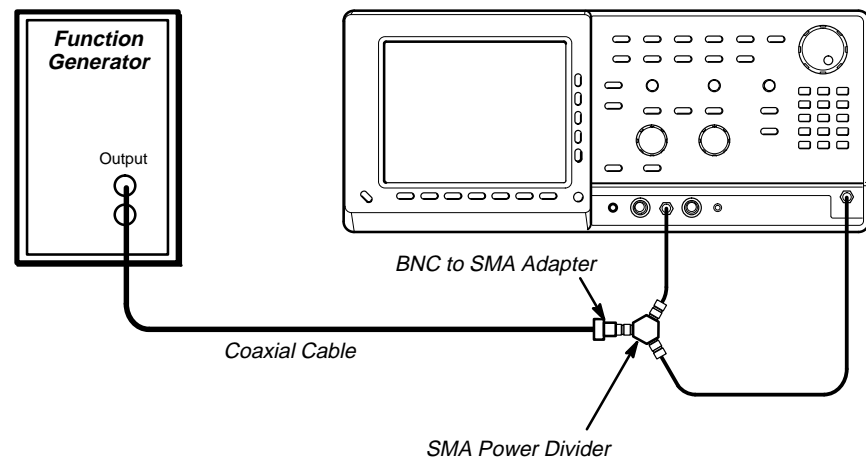
These procedures check those characteristics that relate to the trigger system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification*.

### Check Accuracy, Trigger-Level

**Equipment Required:** One function generator (Item 13), one BNC to SMA adapter (Item 8), one precision coaxial cable (Item 2), 50  $\Omega$  power divider (Item 12), and two SMA cables (Item 3).

**Prerequisites:** The oscilloscope must meet the prerequisites listed on page 1-11.

**Procedure:**



**Figure 1-19: Initial Test Hookup**

1. *Install the test hookup and preset the instrument controls:*
  - a. *Hook up the test-signal source:*
    - Set the output of a function generator to 1 volt.
    - Connect the output of a function generator through a 50  $\Omega$  precision coaxial cable, a BNC to SMA adapter, a 50  $\Omega$  power divider and two SMA cables, to the **CH 1** and **EXT TRIGGER INPUT**.
    - Set the generator for a 10 kHz ramp.
  - 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 trigger system is within limits for Trigger-level/Threshold accuracy:*

a. *Display the test signal:*

- Set the Horizontal **SCALE** to 10 us.
- Press **MEASURE**.
- Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
- Press the main-menu button **Select Measurement for Ch x**.
- 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**.
- Adjust the generator amplitude for a **Pk-Pk** readout of 900 mV.
- Press the main-menu button **Remove Measrmt**; then press the side-menu button **Remove Measurement 1**.



b. *Measure the test signal:*

- Turn the Horizontal **POSITION** control to position the start of the waveform one division from the left side of the graticule.
- Press **TRIGGER MENU**; then press the main-menu button **Level**. Press **400**, **SHIFT, m**, and then **ENTER** on the keypad.
- Press **VERTICAL MENU**; then press the main-menu button **offset**. Press the **400**, **SHIFT, m**, and then **ENTER** on the keypad.
- Set the Horizontal **SCALE** to 10  $\mu$ s.
- Press **CURSOR**.
- Press the main-menu button **Function**; then press the side-menu button **H Bars**. Rotate the general purpose knob to align the active cursor with the start of the waveform (see Figure 1-20).
- Press **CLEAR MENU**.

c. *Check against limits:*

- CHECK that the **@ Cursor** readout is 310 mV to 490 mV.
- Press **TRIGGER MENU**; then press the main-menu button **Level**. Press the **–400**, **SHIFT, m**, and then **ENTER** on the keypad.
- Press **VERTICAL MENU**; then press the main-menu button **offset**. Press the **–400**, **SHIFT, m**, and then **ENTER** on the keypad.

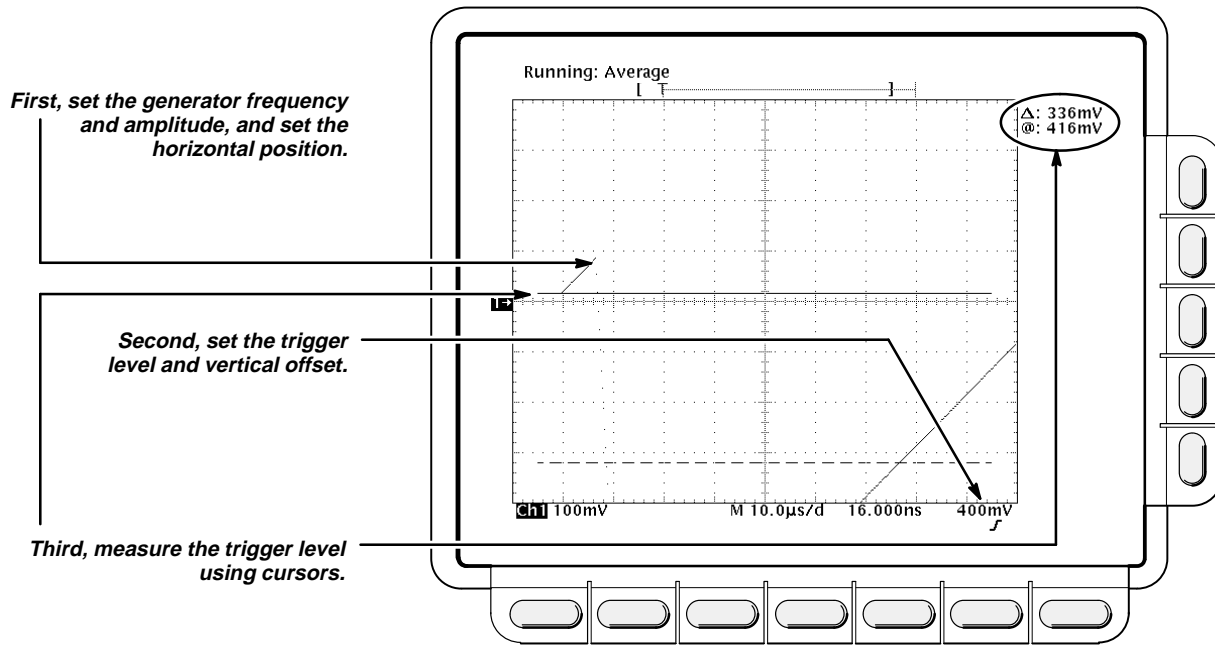


Figure 1-20: Measurement of Trigger-Level Accuracy

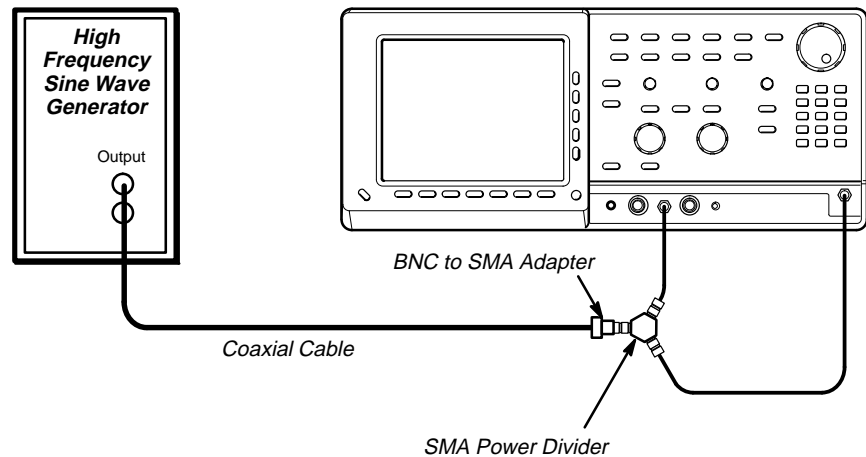
- Press **CURSOR**; then rotate the general purpose knob to align the active cursor with the start of the waveform.
  - CHECK that the **@ Cursor** readout is  $-310\text{ mV}$  to  $-490\text{ mV}$ .
3. *If your oscilloscope has a delay line confirm each input channel trigger source:* Press **TRIGGER MENU**; then press the main-menu button **Source**. Now press the side-menu button that corresponds to the input channel trigger source you wish to confirm. Repeat substeps 2b and c for all input channel trigger sources.
  4. *Disconnect the hookup:*
    - a. *First set the output of the generator to 0 volts.*
    - b. Then disconnect the cables and adapters from the generator output at the input connectors of channel last confirmed and the **EXT TRIGGER INPUT**.

## Sensitivity, Trigger, External, CH 1, and CH 2

**Equipment Required:** One high-frequency leveled sine-wave generator (Item 15), one N to BNC adapter (Item 11), one precision coaxial cable (Item 2), two 50  $\Omega$  SMA cables (Item 3), one BNC to SMA adapter (Item 8), and one 50  $\Omega$  power divider (Item 12).

**Prerequisites:** See page 1-11.

**Procedure:**



**Figure 1-21: Initial Test Hookup**

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. *Hook up the test-signal source:*
    - Connect the signal output of a high-frequency sine wave generator to an N to BNC adapter and a BNC to SMA adapter through a precision coaxial cable; then connect the adapter to a power divider.
    - Connect one output of the power divider to **CH 1** through an SMA cable.
    - Connect the other output of the power divider through a second SMA cable to the **EXT TRIGGER INPUT**. See Figure 1-21.
  - c. *Modify the initialized front-panel control settings:*
    - Set the horizontal **SCALE** for the **M** (main) time base to 200 ns.



- Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
  - Press the main-menu button **Source**; then press the side-menu button for the source being confirmed.
  - Press **MEASURE**.
  - Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
  - Press the main-menu button **Select Measurement for Ch x**.
  - 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 **HORIZONTAL MENU**; then press the main-menu button **Time Base**.
  - Press the side-menu button **Main Only**.
  - Press **SHIFT**; then press **ACQUIRE MENU**. Now press the main-menu button **Mode**; then the side-menu button **Average 16**.
  - Press **CLEAR MENU**.
2. *Confirm Main trigger system is within sensitivity limits: Only perform this step if your oscilloscope contains delay lines (it *does not* contain Option 1D).*
- a. *Display the test signal:*
    - Set the generator frequency to 10 MHz.
    - Set the generator amplitude so that the oscilloscope amplitude readout indicates the amplitude is 80 mV. (Readout may fluctuate around 80 mV.)
  - 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 lit.
    - Press **SET LEVEL TO 50%**.
    - Press **TRIGGER MENU**; then press the main-menu button **Slope**. CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. (Use the side menu to switch between trigger slopes; use the **TRIGGER LEVEL** knob to stabilize the trigger if required.)

- c. *Confirm trigger sensitivity at 200 MHz:* Repeat substeps a and b with the generator frequency set to 200 MHz and the horizontal **SCALE** set to 2 ns.
  - d. *Confirm trigger sensitivity at 1 GHz:* Repeat substeps 2a and 2b with the generator frequency set to 1 GHz, the horizontal **SCALE** set to 1 ns, and the generator amplitude set to 200 mV (as read on the oscilloscope amplitude readout). Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step.
3. *Confirm all channels:* Repeat steps 1c through step 2 for all channels. Move the SMA cable to the input connector that corresponds to the channel to be confirmed. Press WAVEFORM OFF. Press the front panel button that corresponds to the channel to be confirmed. Only perform this step if your oscilloscope contains delay lines (it *does not* contain Option 1D).

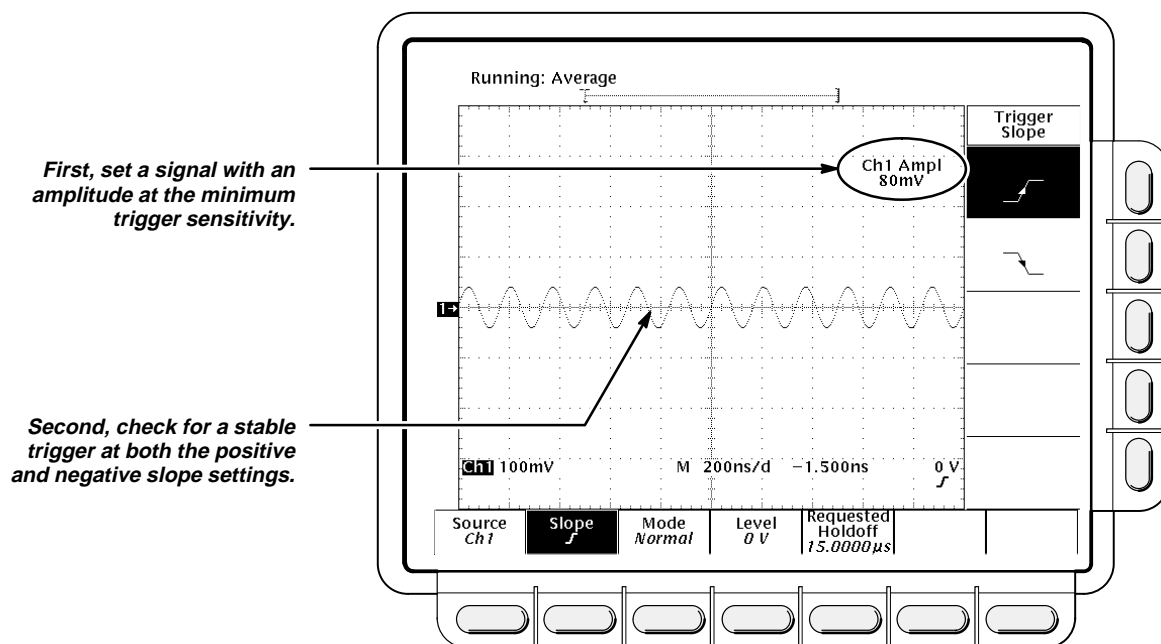


Figure 1-22: Measurement of Trigger Sensitivity

4. *Confirm the External Trigger input:*
  - a. *Display the test signal:*
    - Set the generator frequency to 10 MHz.
    - Set the horizontal **SCALE** for the **M** (main) time base to 200 ns.
    - Set the generator amplitude so that the oscilloscope **CH 1 Amplitude** readout indicates the amplitude is 40 mV. (Readout may fluctuate around 40 mV.)

- b. *Check for external trigger source for stable triggering at limits:* Do the following in the order listed.
    - Use the definition for a stable trigger from step 2.
    - Press **TRIGGER MENU**; then press the main-menu button **Source**.
    - Press the side-menu button **External Trigger**.
    - 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.
  - c. Repeat substep b with the generator frequency set to 200 MHz, the horizontal **SCALE** set to 5 ns, and the generator amplitude set to 40 mV (as read on the oscilloscope amplitude readout).
  - d. Repeat substep b with the generator frequency set to 2 GHz, the horizontal **SCALE** set to 500 ps, and the generator amplitude set to 200 mV (as read on the oscilloscope amplitude readout). Leave the Main trigger system triggered on the positive slope of the waveform before proceeding to the next check.
5. *Disconnect the hookup:* Disconnect the cables, attenuator, adapter, and power divider from the generator output at the input connectors of the oscilloscope.

## Check Trigger Delay Jitter and Random Noise

**Equipment Required:** One high-frequency sine-wave generator (Item 15), an N to BNC adapter (Item 11), a precision coaxial cable (Item 2), two 50  $\Omega$  SMA cables (Item 3), one 50  $\Omega$  power divider (Item 12), and one BNC to SMA adapter (Item 8).

**Prerequisites:** See page 1-11.

### Procedure:

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**.
    - If your oscilloscope has delay lines (standard instrument), set the vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D), set the vertical **SCALE** to 1 mV.
2. Confirm input channels are within limits: Do the following substeps – test CH 1 first, skipping substep a since CH 1 is already setup to be checked from step 1.

- a. *Select an unchecked channel:*
- Press **RUN/STOP**.
  - Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front panel button for the channel you wish to confirm.
  - If your oscilloscope has delay lines (standard instrument), set the vertical **SCALE** to 2 mV. If your oscilloscope does not have delay lines (Option 1D), set the vertical **SCALE** to 1 mV.
- b. *Initialize measurement:*
- Press the front-panel button that corresponds to the channel you are to confirm.
  - Press **SHIFT**; then **ACQUIRE MENU**.
  - Press the main-menu button **Mode**; then press the side-menu button **Normal**.
  - Press **WAVEFORM**.
  - Press the main-menu button **Save Waveform**; then press the side-menu button **To Ref 1**.
  - Press **SHIFT**; then **ACQUIRE MENU**.
  - Press the main-menu button **Mode**; then press the side-menu button **Average**. Press **64**, on the keypad; then press **ENTER**.
  - Press **WAVEFORM**.
  - Press the main-menu button **Save Waveform**; then press the side-menu button **To Ref 2**.
- c. *Initialize waveform math:*
- Press **MATH REF**.
  - Press the main-menu button **Math 2**; then press the side-menu button **Change Math Waveform Definition**.
  - Press the main-menu button **Dual Wfm Math**.
  - Press the side-menu button **Set 1st Source to**; then, using the general purpose knob, set the source to **Ref 1**.
  - Press the side-menu button **Set Operator to**; then, using the general purpose knob, set the operator to **–**.
  - Press the side-menu button **Set 2nd Source to**; then, using the general purpose knob, set the source to **Ref 2**.
  - Press the side-menu button **OK Create Math Wfm**.
- d. *Confirm that random noise is within limits: Do the following substeps.*
- Press **MEASURE**.
  - Press the main-menu button **Select Measurement**.



- Press the side-menu button **more** until the menu label **RMS** appears in the side menu (its icon is shown at the left). Press the side-menu button **RMS**.
- Press **CLEAR MENU**.
- If your oscilloscope has delay lines (standard instrument), CHECK that the **M2 RMS** readout on screen is  $\leq 1.2$  mV. If your oscilloscope does not have delay lines (Option 1D), CHECK that the **M2 RMS** readout on screen is  $\leq 600$   $\mu$ V. See Figure 1-23
- Record the random noise for later use:

$$\text{Random noise} = \text{M2 RMS Readout}$$

- Press **MATH REF**; then press **WAVEFORM OFF**.

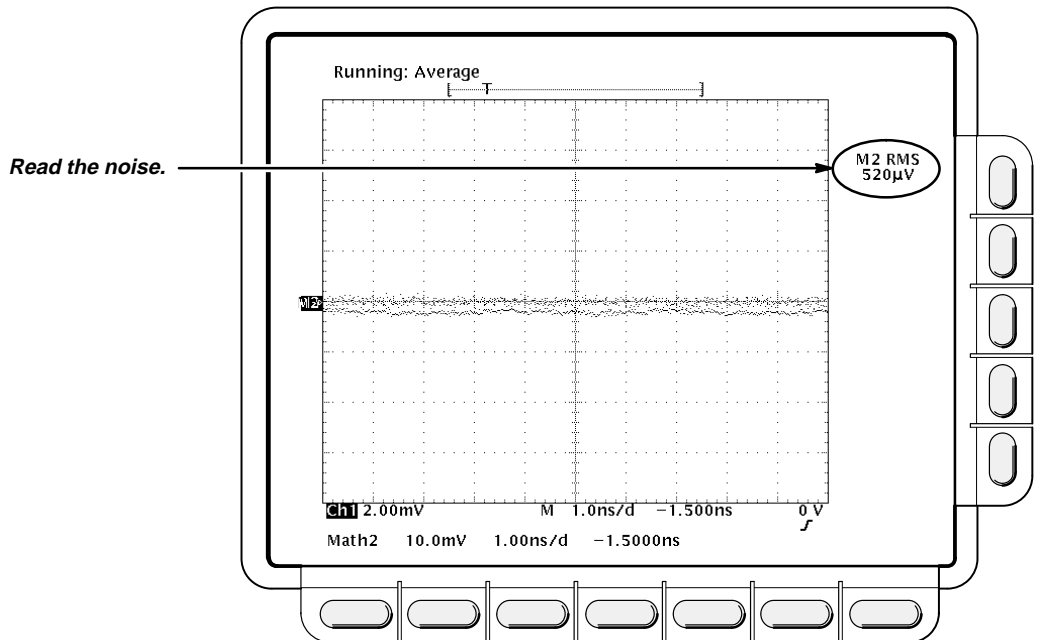


Figure 1-23: Measurement of Random Noise Accuracy



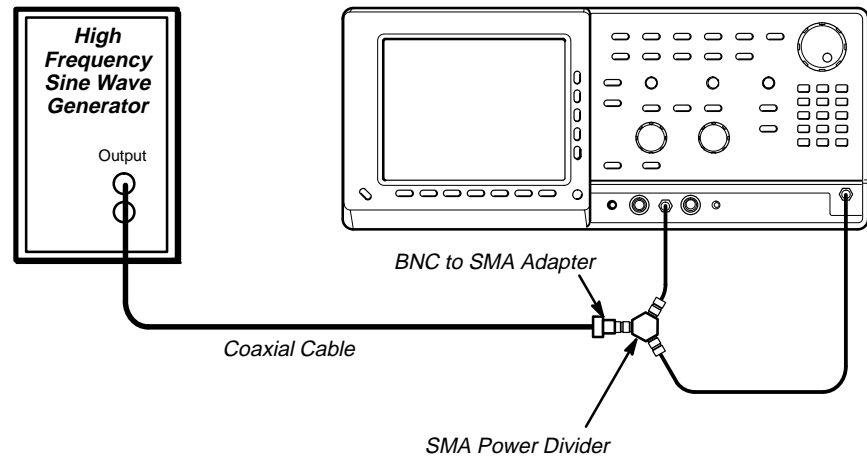


Figure 1-24: Initial Test Hookup

- e. *Hook up the test-signal source:* Connect through an N to BNC adapter, a precision coaxial cable, a BNC to SMA adapter, a 50  $\Omega$  power divider, and two SMA cables, the sine wave generator to the input of the channel you are to confirm and the **EXT TRIGGER INPUT**. Set the output of the generator to 666.666 MHz.
- f. *Modify the front-panel control settings:*
  - Press **SHIFT**; then **ACQUIRE MENU**.
  - Press the main-menu button **Mode**; then press the side-menu button **Normal**.
  - Set the vertical **SCALE** to 50 mV.
  - Set the horizontal **SCALE** of the Main time base to 200 ps.
  - Press **TRIGGER MENU**; then press the main-menu button **Mode**. Now press the side-menu button **Normal**.
  - Press **SET LEVEL TO 50%**.
  - Press **MEASURE**; then press the main-menu button **Select Measrmt for Chx**.
  - Press the side-menu button **–more–**, until **Pk-Pk** appears in the side menu. Press **Pk-Pk**.
  - Press **CLEAR MENU**.
  - Adjust the generator amplitude for an **Pk-Pk** readout of 239 mV. See Figure 1-25.
  - Press **MEASURE**.
  - Press the main-menu button **Remove Measrmt**; then press the side-menu buttons **Measurement 1**.
  - Press the main-menu button **Select Measrmt for CHx**.





- Press the side-menu button **more**, until **Mean** appears in the side menu. Press **Mean**.
- Press the side-menu button **more**, until **RMS** appears in the side menu. Press **RMS**.

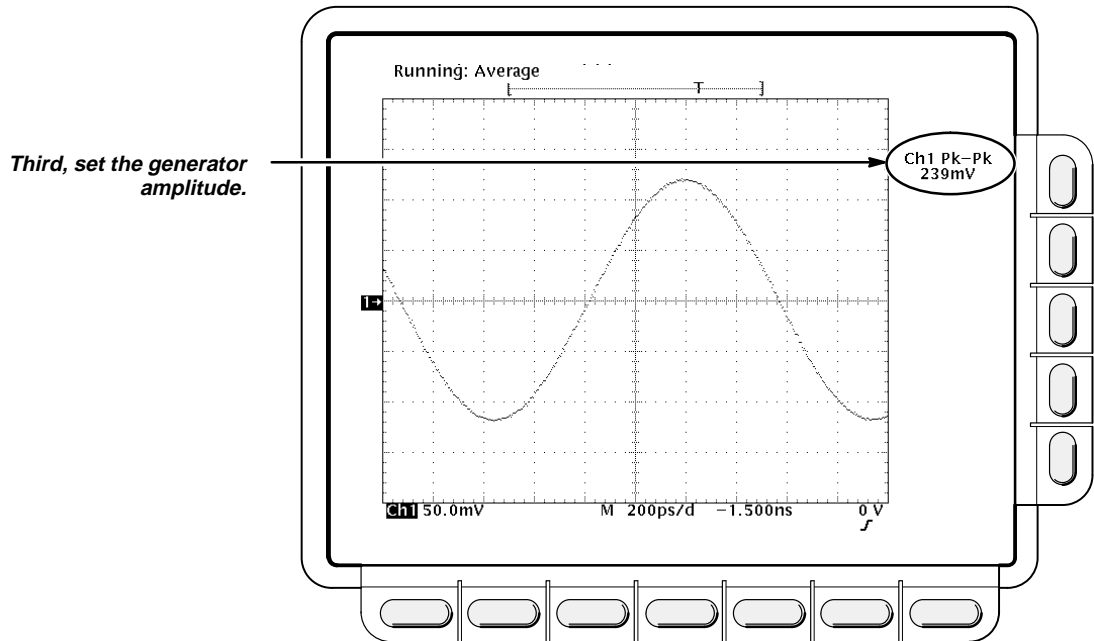


Figure 1-25: Trigger Delay Jitter Level Setting

- g. *Measure the channel noise:*
- Press **TRIGGER MENU**.
  - Press the main-menu button **Level**. Use the keypad to set the level to 0 V (press **0**, then **ENTER**, on the keypad).
  - Press **HORIZONTAL MENU**.
  - Press the main-menu button **Time Base Position**; using the general purpose knob, slowly adjust the time base position a small amount until the displayed waveform starts at 0 V (at the left center of the screen). See Figure 1-26.
  - Press the main-menu button **Fine Scale**. Press **0**, on the keypad; then press **ENTER**.
  - Press the main-menu button **Time Base Position**; using the general purpose knob, slowly adjust the time base position a small amount until the mean readout is as close to 0 V as possible.

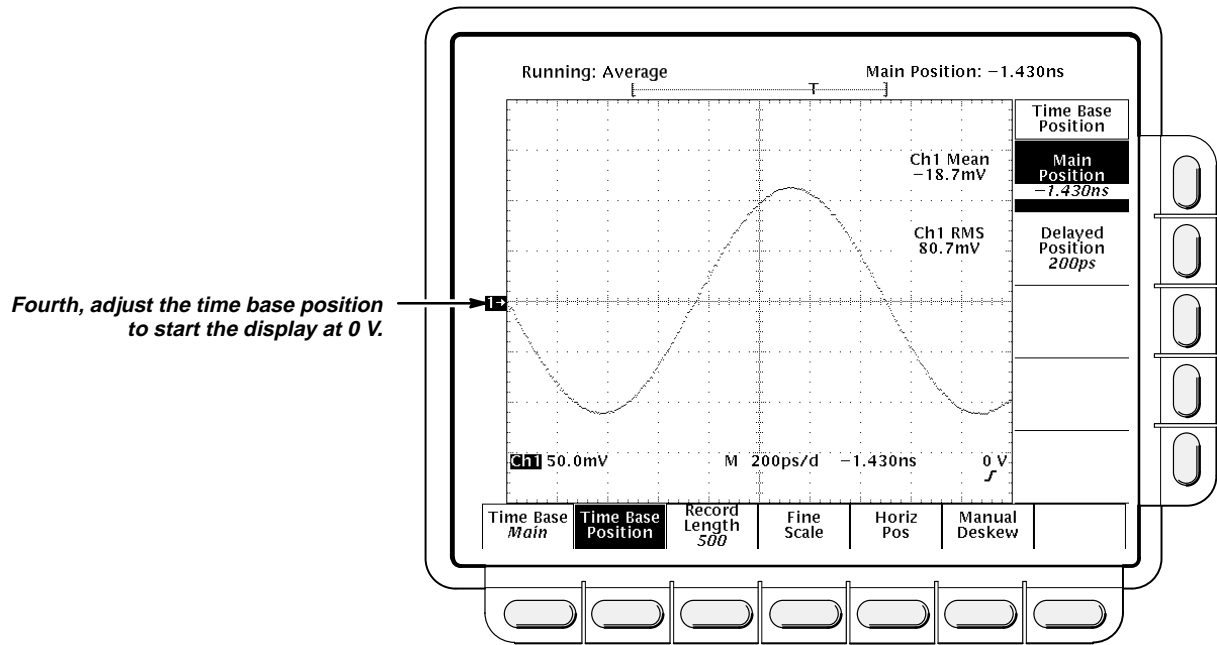


Figure 1-26: Trigger Delay Jitter Time Base Position

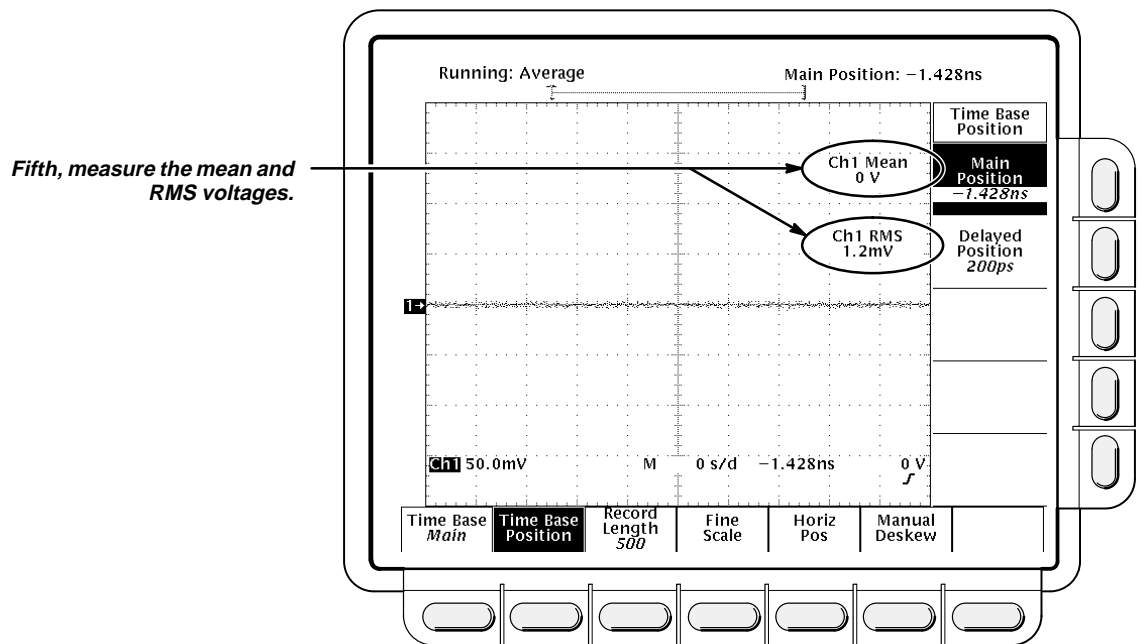


Figure 1-27: Trigger Delay Jitter Channel Noise

h. Calculate the channel noise:

- Press **RUN/STOP**.
- Read the mean and RMS voltages from the readout display. See Figure 1-27.
- Calculate the noise and save the result for future use:

$$\text{Channel noise} = \sqrt{(\text{RMS Readout in mV})^2 - (\text{Mean Readout in mV})^2}$$

i. Calculate the vertical noise due to jitter: Use the channel noise calculated in substep h and the random noise from substep d to calculate the vertical noise due to jitter.

$$\text{Vertical noise due to jitter} = \sqrt{(\text{channel noise})^2 - (\text{Random noise})^2}$$

j. Calculate the time jitter: Use the vertical noise due to jitter calculated in step i and the slew rate to calculate the time jitter.

$$\text{Time jitter} = \frac{\text{Vertical noise due to jitter}}{0.5 \frac{\text{mV}}{\text{ps}}}$$

**Example:**

The formula for time jitter is:

$$\text{Time jitter} = \frac{\text{Vertical noise due to jitter}}{\text{Slew rate}}$$

where:  $\text{Slew rate} = 2 \Pi f \left( \frac{Pk-Pk}{2} \right)$

or for our procedure:

$$\text{Slew rate} = 2 \Pi 666.666 \text{ MHz} \left( \frac{239 \text{ mV}}{2} \right) = 0.5 \frac{\text{mV}}{\text{ps}}$$

$$\text{Time jitter} = \frac{\text{Vertical noise due to jitter}}{0.5 \frac{\text{mV}}{\text{ps}}}$$

- CHECK that the calculated time jitter is < 3 ps.

k. Calculate the 200 ns time jitter:

- Press **RUN/STOP**.
- Use the keypad to set the time base position to 200 ns (press **200**, **SHIFT**, **n**, and then **ENTER**, on the keypad).

- Using the general purpose knob, slowly adjust the time base position a small amount until the displayed waveform starts at 0 V (at the left center of the screen) and the mean readout is as close to 0 V as possible. See Figure 1-27.
- Press **RUN/STOP**.
- Read the mean and RMS voltages from the readout display. See Figure 1-27.
- Calculate the jitter using the mean and RMS voltages from the readout and the random noise from substep d (**M2 RMS** value):

$$\text{Channel noise at 200 ns} = \sqrt{(\text{RMS Readout at 200 ns in mV})^2 - (\text{Mean Readout at 200 ns in mV})^2}$$

$$\text{Vertical noise due to jitter at 200 ns} = \sqrt{(\text{Channel noise at 200 ns in mV})^2 - (\text{Random noise in mV})^2}$$

$$\begin{aligned} \text{Time jitter at 200 ns} &= \frac{\text{Noise due jitter at 200ns}}{\text{Slew rate}} \leq 3 \text{ ps} + 30 \text{ ppm} \times 200 \text{ ns} \leq 9 \text{ ps} \\ &= \frac{\text{Noise due jitter at 200 ns}}{0.5 \frac{\text{mV}}{\text{ps}}} \leq 3 \text{ ps} + 30 \text{ ppm} \times 200 \text{ ns} \leq 9 \text{ ps} \end{aligned}$$

- CHECK that the calculated jitter is  $\leq 9$  ps.
3. *Test all channels:* Repeat step 2 for all input channels.
  4. *Disconnect the hookup:* Disconnect the cables, divider, attenuator, and adapter from the generator output at the oscilloscope input connectors.







# Specifications

**Replace this page with the tab  
divider of the same name.**







# Appendix B: Specification



# Product Description

This subsection begins with a general description of the traits of TDS 800 Digitizing Oscilloscopes. Three subsections follow, one for each of three classes of traits: *nominal traits*, *warranted characteristics*, and *typical characteristics*.

---

## General

Tektronix TDS 800 Digitizing Oscilloscopes are portable, two-channel instruments suitable for use in a variety of test and measurement applications and systems. Key features include:

## General Product Description

- 6 GHz with delay line or 8 GHz with Option 1D
- Pretrigger view (not available with Option 1D)
- Two-channel acquisition (You can use and display all channels simultaneously)
- Two 14-bit digitizers
- Up to 15,000-point record length per channel
- Full GPIB software programmability
- Complete measurement and documentation ability
- Intuitive graphical icon operation blended with the familiarity of traditional horizontal and vertical knobs
- On-line help at the touch of a button
- Specialized display modes, such as variable persistence, gray scaling, and waveform averaging

---

## User Interface

This digitizing oscilloscope uses a combination of front-panel buttons, knobs, and on-screen menus to control its many functions. The front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Within each group, any function likely to get adjusted often, such as vertical positioning, or the time base setting, is set directly by its own front-panel knob.

### Menus

Those functions for which control settings are usually changed less often, such as vertical coupling and horizontal mode, are set indirectly. That is, pressing one (sometimes two) front-panel button, such as vertical menu, displays a menu of functions at the bottom of the screen related to that button. (For the button **VERTICAL MENU**, the menu displayed contains functions such as offset, fine scale, etc.) Using the buttons below this *main* menu

to select a function, such as **Offset**, displays a *side menu* **Appendix B Specifications** function, such as set to 0 volts, at the right side of the screen. Use the buttons to the right of the menu to select a setting, such as **Set to 0 V**.

## Indicators

Several on-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale and trigger level. There are also readouts to display the results of measurements made using cursors or using the automatic parameter extraction feature (called measure) and readouts to display the status of the instrument.

## General Purpose Knob

Using menus you can assign the general purpose knob to adjust a selected parameter function. The method employed is the same as for *selecting* a function, except the final selection in the side menu causes the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the fine gain setting for a channel.

## 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 rising edge trigger, falling edge trigger, and intensified. Such icons allow you to more readily determine status or the available settings.




---

## Signal Acquisition System

The signal acquisition system provides two vertical channels with calibrated vertical scale factors from 2 mV to 200 mV per division (1 mV to 100 mV per division with Option 1D). The acquisition system can acquire all channels simultaneously. Each channel can be independently offset.

Besides the input 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 live waveform in a reference memory.)

---

Appendix B: Specification  
**Horizontal System**

There are three horizontal display modes: main only, main intensified, and delayed only. You can select among various horizontal record length settings (see Table 2-1).

**Table 2-1: Record Length Versus Divisions per Record**

<b>Record Length</b>	<b>Divisions per Record (50 Points/Division)</b>
15000	300 divisions
5000	100 divisions
2500	50 divisions
1000	20 divisions
500	10 divisions

Both the delayed only display and the intensified zone on the main intensified display may be delayed by time with respect to the trigger.

You can independently deskew each channel to compensate for differences in external cable and probe delays.

---

**Trigger System**

The oscilloscope can be triggered from three sources:

- **CH 1 or CH 2:** A trigger signal picked from either of the two input channels. This trigger source has a bandwidth of 1 GHz (not available with Option 1D).
- **External Input:** An external trigger input, which has a bandwidth of 2 GHz.
- **Internal Clock:** An internal rate generator, which can be programmed from the front panel or the GPIB to rates from 10 Hz to 500 kHz.

In addition, programmable trigger holdoff allows synchronizing on a repetitive pulse burst.

---

**On-Board User Assistance**

Two features that help you set up this digitizing oscilloscope to make your measurements are help and autoset.

**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, the oscilloscope displays an introduction to help.

## Autoset

## Appendix B: Specification

Autoset automatically sets up the digitizing oscilloscope for a viewable display based on the input signal.

---

## Measurement Assistance

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

### Cursor

Three types of cursors are provided for making parametric measurements on the displayed waveforms. Voltage can be measured between the positions of H Bar (horizontal) cursors and time can be measured between V Bar (vertical) cursors. These are delta measurements; that is, measurements based on the difference between two cursors. Paired cursors measure both vertical parameters and horizontal parameters simultaneously.

Both V Bar and H Bar cursors can also be used to make absolute measurements — measurements relative to a defined level or event. In the case of the H Bars, either cursor can be selected to read out its voltage with respect to any channel's ground reference level; in the case of the V Bars, its time with respect to the trigger point (event) of the acquisition.

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

### Measure

Measure can automatically extract parameters from the signal input to the digitizing oscilloscope. You may display any four out of the more than 20 available parameters to the screen. The displayed parameters are extracted continuously and the results updated on-screen as the digitizing oscilloscope continues to acquire waveforms.

You can also pop up a display (a snapshot) of almost all the automated measurements. Snapshot can execute all the single waveform measurements available on the selected waveform once and display the results.

### 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 and I/O

You may save acquired waveforms in any of four nonvolatile REF (reference) memories. 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. Assignment can be made to save any of the four channels to any REF memory or to move a stored reference from one REF memory to another. Reference waveforms may also be written into a REF memory location by way of the GPIB interface.

The digitizing 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.

Another standard feature is hardcopy. This feature allows you to output waveforms and other on-screen information to a variety of graphic printers and plotters from the digitizing oscilloscope front panel, providing hard copies without requiring you to put the digitizing oscilloscope into a system-controller environment. The hard copies obtained are WYSIWYG (What-You-See-Is-What-You-Get), based on the display at the time hardcopy is invoked.

---

## Display

TDS 800 Digitizing Oscilloscopes offer flexible display options. You can customize the following attributes of your display:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence
- Display format: XY or YT and graticule type

### Zoom

This digitizing oscilloscope also provides an easy way to focus in on those waveform features you wish to examine up close. By invoking zoom, you can magnify the waveform parameter using the vertical and horizontal controls to expand (or contract) and position it for viewing.





**Product Description**

**Appendix B: Specification**



## Nominal Traits

This subsection contains a collection of tables that list the various *nominal traits* that describe TDS 800 Digitizing Oscilloscopes. Included are electrical and mechanical traits.

Nominal traits are described using simple statements of fact such as “Two” for the trait “Input Channels, Number of,” rather than in terms of limits that are performance requirements.

**Table 2-2: Nominal Traits — Signal Acquisition System**

Name	Description									
Digitizers, Number of	Two									
Digitized Bits, Number of	14 bits <sup>1</sup>									
Input Channels, Number of	Two									
Input Coupling	DC									
Input Connector Type	SMA									
Input Impedance	50 Ω nominal									
Ranges, Sensitivity	1 mV/div – 100 mV/div for Option 1D 2 mV/div – 200 mV/div for the delay line version of the TDS 820									
Ranges, Offset, All Channels	<table border="0" style="width: 100%;"> <tr> <td style="width: 30%; text-align: center;">⌵</td> <td style="width: 40%; text-align: center;">1D</td> <td style="width: 30%;"></td> </tr> <tr> <td style="text-align: center;">⌵</td> <td></td> <td style="text-align: right;">of</td> </tr> <tr> <td></td> <td style="text-align: center;">the TDS 820</td> <td></td> </tr> </table>	⌵	1D		⌵		of		the TDS 820	
⌵	1D									
⌵		of								
	the TDS 820									
Range, Position	⌵ divisions									

<sup>1</sup>The number of digitization levels (DLs) is approximately 13,100. In instruments with delay lines, each DL is equal to approximately 150 μV at all vertical scale settings. Without delay lines (Option 1D), each DL is equal to approximately 75 μV.

## Nominal Traits

Appendix B: Specification **Table 2-3: Nominal Traits — Time Base System**

Name	Description
Sample Acquire Rate	0 to 50 ksamples per second <sup>1</sup>
Range, Seconds per Division	20 ps per division to 2 ms per division in a 1–2–5 sequence. Settable in calibrated 5 ps per division increments through the keypad.
Range, Time Base Position	Main Time base $\geq 16$ ns to 20 ms Delayed Time Base $\geq 16$ ns to 20 ms, but never less than the main time base position
Record Length	500 points, 1000 points, 2500 points, 5000 points, or 15000 points
Rate Generator, Internal Programmable	10 Hz to 500 kHz
Deskew Resolution, Between Channel	Adjustable in 1 ps steps
Deskew Range, Between Channel	0 to 10 ns
Holdoff Range	15 $\mu$ s to 2 s

<sup>1</sup>The sample acquire rate is less than or equal to the slower of the trigger rate or the reciprocal of the trigger holdoff time.

**Table 2-4: Nominal Traits — Triggering System**

Name	Description									
Trigger Sources	External (DC Coupled) Internal rate generator Channel 1 or 2 DC coupled (for the delay line version of the TDS 820 only)									
Ranges, Trigger Level	<table border="0"> <thead> <tr> <th>Source</th> <th>Range</th> <th></th> </tr> </thead> <tbody> <tr> <td>External Trigger</td> <td><math>\pm</math> V</td> <td></td> </tr> <tr> <td>CH 1 or CH 2 Trigger</td> <td><math>\pm</math> TDS 820 only)</td> <td>the</td> </tr> </tbody> </table>	Source	Range		External Trigger	$\pm$ V		CH 1 or CH 2 Trigger	$\pm$ TDS 820 only)	the
Source	Range									
External Trigger	$\pm$ V									
CH 1 or CH 2 Trigger	$\pm$ TDS 820 only)	the								
Resolution, Trigger Level	<table border="0"> <thead> <tr> <th>Source</th> <th>Range</th> </tr> </thead> <tbody> <tr> <td>External Trigger</td> <td>0.5 mV increments</td> </tr> <tr> <td>CH 1 or CH 2 Trigger</td> <td>2 mV increments (for the delay line version of the TDS 820 only)</td> </tr> </tbody> </table>	Source	Range	External Trigger	0.5 mV increments	CH 1 or CH 2 Trigger	2 mV increments (for the delay line version of the TDS 820 only)			
Source	Range									
External Trigger	0.5 mV increments									
CH 1 or CH 2 Trigger	2 mV increments (for the delay line version of the TDS 820 only)									
Internal Clock Out	Square wave out into 50 $\Omega$ : –0.175 V to 0.100 V low level 0.850 V to 1.100 V high level									
1 MHz Clock Out	Square wave out into 50 $\Omega$ : –0.350 V to –0.200 V low level 0.200 V to 0.350 V high level									

Table 2-5: Nominal Traits — Display System

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Name	Description
Video Display Resolution	640 pixels horizontally by 480 pixels vertically in a display area of 5.2 inches horizontally by 3.9 inches vertically
Waveform Display Graticule	401 × 501 pixels for single, 8 × 10 division graticule with 1 cm by 1 cm square divisions
Waveform Display Gray Scale	Sixteen levels in infinite-persistence and variable persistence display styles

Table 2-6: Nominal Traits — GPIB Interface, Output Ports, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE Std 488.1-1987 and IEEE Std 488.2-1987
Fuse Rating	Either of two fuses <sup>1</sup> may be used: a 0.25" × 1.25" (UL 198.6, 3AG): 6 A FAST, 250 V, or a 5 mm × 20 mm, (IEC 127): 5 A (T), 250 V.

<sup>1</sup>Each fuse type requires its own fuse cap.

## Nominal Traits

### Appendix B: Specification

**Table 2-7: Nominal Traits — Mechanical**

<b>Name</b>	<b>Description</b>
Cooling Method	Forced-air circulation with no air filter
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	Digitizing Oscilloscope without delay lines 13.2 kg (29 lbs), with front cover. 23.2 kg (51 lbs), when packaged for domestic shipment. Delay line version of the TDS 820 13.6 kg (30 lbs), with front cover. 23.6 kg (52 lbs), when packaged for domestic shipment. Rackmount conversion kit 2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), when kit is package for domestic shipping.
Overall Dimensions	Standard Digitizing Oscilloscopes Height: 236 mm (9.3 in), when feet and accessories pouch are installed. 193 mm (7.6 in), without the accessories pouch installed. Width: 445 mm (17.5 in), with handle. Depth: 432 mm (17.0 in), with front cover installed. Rackmount Digitizing Oscilloscopes Height: 178 mm (7.0 in). Width: 483 mm (19.0 in). Depth: 558.8 mm (22.0 in).



## Warranted Characteristics

This subsection lists the various *warranted characteristics* that describe TDS 800 Digitizing Oscilloscopes. Included are electrical and environmental characteristics.

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

### NOTE

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

As stated above, this subsection lists only warranted characteristics. A list of *typical characteristics* starts on page 2-19.

## Performance Conditions

## Performance Conditions

The electrical characteristics found in these tables of warranted characteristics apply when the oscilloscope has been adjusted at an ambient temperature between +20° C and +30° C after a warm-up period of at least 20 minutes, is operating at an ambient temperature between 0° C and +50° C (unless otherwise noted), and the user compensation has been initiated. Ambient temperature should not vary more than 2° C during the measurement, unless otherwise noted.

**Table 2-8: Warranted Characteristics — Signal Acquisition System**

<b>Name</b>	<b>Description</b>
Input Voltage, Maximum Operating	2 Vlt net offset range, 1.0 V peak-to-peak 2 Vlt net offset <sup>1</sup> range, 2.0 V peak-to-peak for the delay line version of the TDS 820
Range, Dynamic	1 V peak-to-peak AC 2 V peak-to-peak AC for the delay line version of the TDS 820
<b>Input Resistance</b>	50 Ω 2 Ω 50 Ω 2 Ω for the delay line version of the TDS 820

Warranted Characteristics

Appendix B: ~~Table 2-8~~ **Table 2-8: Warranted Characteristics — Signal Acquisition System (Cont.)**

Name	Description								
Accuracy, DC Gain	$\pm 0.7\%$ $\pm 0.005\%$ $(T_{amb} - T_{adj})$ (after user vertical compensation) at 0 to 50° C $\pm 0.7\%$ $\pm 0.015\%$ $(T_{amb} - T_{adj})$ (after user vertical compensation) at 0 to 50° C for the delay line version of the TDS 820 $T_{adj}$ is the ambient temperature at which offset gain was adjusted.								
Nonlinearity, DC	<b>Integral</b> $< \pm 0.1\%$ vertical compensation) <b>Differential</b> $< 1$ DL (improves with averaging)								
<b>Accuracy, DC Voltage Measurement, Averaged</b>	<table border="0"> <thead> <tr> <th data-bbox="651 632 899 655">Measurement Type</th> <th data-bbox="1068 632 1232 655">DC Accuracy</th> </tr> </thead> <tbody> <tr> <td data-bbox="651 674 964 697">Average of <math>\geq 16</math> waveforms</td> <td></td> </tr> <tr> <td data-bbox="651 743 997 766">Single point relative to ground</td> <td data-bbox="1068 743 1463 827"> <math>\pm 0.1\%</math> <math>\times</math> (reading – Net Offset<sup>1</sup>) <math>\pm 0.1\%</math> Nonlinearity <math>\pm 0.1\%</math> Offset Accuracy                 </td> </tr> <tr> <td data-bbox="651 842 813 865">Delta voltage</td> <td data-bbox="1068 842 1463 894">                     DC Gain Accuracy <math>\times</math> Reading + 2 <math>\times</math> Integral DC Nonlinearity                 </td> </tr> </tbody> </table>	Measurement Type	DC Accuracy	Average of $\geq 16$ waveforms		Single point relative to ground	$\pm 0.1\%$ $\times$ (reading – Net Offset <sup>1</sup> ) $\pm 0.1\%$ Nonlinearity $\pm 0.1\%$ Offset Accuracy	Delta voltage	DC Gain Accuracy $\times$ Reading + 2 $\times$ Integral DC Nonlinearity
Measurement Type	DC Accuracy								
Average of $\geq 16$ waveforms									
Single point relative to ground	$\pm 0.1\%$ $\times$ (reading – Net Offset <sup>1</sup> ) $\pm 0.1\%$ Nonlinearity $\pm 0.1\%$ Offset Accuracy								
Delta voltage	DC Gain Accuracy $\times$ Reading + 2 $\times$ Integral DC Nonlinearity								
<b>Rise Time<sup>2</sup></b>	43.8 ps maximum; 57.8 $\pm 0.1\%$ °C $(T_{amb} - 25^\circ\text{C})$ maximum for the delay line version of the TDS 820								
<b>Accuracy, Net Offset</b>	$\pm 0.1\%$ $\pm 0.1\%$ °C $(T_{amb} - T_{adj})$ (offset – position $\times$ Volts per division) +2 mV + $(T_{amb} - T_c)(0.1 \text{ mV}/^\circ\text{C})$ (after vertical calibration) $\pm 0.1\%$ $\pm 0.1\%$ °C $(T_{amb} - T_{adj})$ (offset – position $\times$ Volts per division) +4 mV + $(T_{amb} - T_c)(0.2 \text{ mV}/^\circ\text{C})$ (after vertical calibration) for the delay line version of the TDS 820 $T_{adj}$ is the ambient temperature at which offset gain was adjusted. $T_{amb}$ is the ambient temperature. $T_c$ is the ambient temperature when a vertical compensation was performed. Net Offset <sup>1</sup> is the nominal voltage level at the center of the A/D converter dynamic range. Offset Accuracy is the accuracy of this voltage level. Net offset gain is calibrated against an external precision voltage reference, at an ambient temperature between 20° C and 30° C. Stability of net offset gain depends on the voltage reference internal to the A/D converter. The 40 parts per million (ppm) temperature coefficient of the voltage reference is included in the accuracy specification. Net Offset balance is compensated during the user initiated vertical calibration procedure.								
Cross Talk (Channel Isolation)	$\leq 0.2\%$ ( $< 500 \mu\text{V}$ ) when any other channel is driven by 067–1338–00 step generator (250 mV amplitude)								
<b>Random Noise</b>	$\leq 600 \mu\text{V}_{\text{RMS}}$ $\leq 1.2 \text{ mV}_{\text{RMS}}$ for the delay line version of the TDS 820								

<sup>1</sup>Net Offset = Offset – (Position  $\times$  Volts per Division). Net Offset is the voltage level at the center of the A-D converter’s dynamic range. Offset Accuracy is the accuracy of this Voltage level.

<sup>2</sup>Measured using an 067-1338-00 reference calibration step generator. Rise time is calculated using SR500. Appendix B: Specification

Table 2-9: Warranted Characteristics — Time Base System

Name	Description	
Accuracy, Delta Time Measurement, Single Channel	Time Interval ( $T_i$ )	Measurement Accuracy
	$\geq 1$ ns	$0.1\% \times$ measured time intervals +15 ps. For intervals <1 ns interpolate between cardinal time interval points.
	100 ps <sup>1</sup>	5 ps
	10 ps <sup>1</sup>	2 ps

**Accuracy, Delta Time Measurement, Between Channels**

$$30 \text{ ps} + 0.1\%(\text{measured delta time} + \text{first channel deskew} - \text{second channel deskew}) + 30 \text{ ps}(\text{smaller of remainder between } \frac{\text{first channel deskew} - \text{second channel deskew}}{3.2768 \text{ ns}} \text{ and } \frac{\text{first channel deskew} - \text{second channel deskew} + 1.6384 \text{ ns}}{3.2768 \text{ ns}})$$

Example: 1) First channel deskew = second channel deskew = 0 ps  
Measured delta time = 10 ns

$$\text{Accuracy} = 30 \text{ ps} + 0.001 \times 10 \text{ ns} = 40 \text{ ps}$$

2) First channel deskew = 0 ps; second channel deskew = 1.5 ns  
Measured delta time = 10 ns

$$\text{Accuracy} = 30 \text{ ps} + 0.001(10 \text{ ns} + 1.5 \text{ ns}) + 30 \text{ ps} \times 0.457 = 20 + 11.5 + 13.7 = 55.2 \text{ ps}$$

<sup>1</sup>For  $\Delta$  time intervals <500 ps measured at (time per division X the number of divisions)  $\leq$ 500 ps.



Appendix B: Specifications **Table 2-10: Warranted Characteristics — Triggering System**

Name	Description
<b>Sensitivity, Trigger</b>	<b>Trigger Source</b> <b>Sensitivity</b> External            40 mV peak-to-peak from DC to 200 MHz, linearly increasing to 200 mV peak-to-peak at 2 GHz
	CH 1 and CH 2    60 mV peak-to-peak from DC to 625 MHz, linearly increasing to 150 mV peak-to-peak at 1.0 GHz for the delay line version of the TDS 820
<b>Jitter, Trigger Delay</b>	3 ps rms + 30 parts per million (ppm) of the selected delay
<b>Accuracy, Trigger Level</b>	<b>Trigger Source</b> <b>Accuracy</b> External $0.10 \times \text{level} + 0.05 \text{ V}$
	CH 1 and CH 2 $0.10 \times \text{level} + 0.05 \text{ V}$ for the delay line version of the TDS 820

**Table 2-11: Warranted Characteristics — Power Requirements**

Name	Description
Source Voltage	90 to 250 VAC <sub>RMS</sub> , continuous range
Source Frequency	47 Hz to 63 Hz
Power Consumption	≤185 W (450 VA)

**Table 2-12: Warranted Characteristics — Environmental and Reliability**

Name	Description
Atmospherics	Temperature: 0° C to +50° C, operating; -40° C to +75° C, non-operating Relative humidity: 0 to 95%, at or below +40° C; 0 to 75%, from +41° C to 50° C Altitude: To 15,000 ft. (4570 m), operating; to 40,000 ft. (12190 m), non-operating
Dynamics	Random vibration: 0.31 g <sub>RMS</sub> , from 5 to 500 Hz, 10 minutes each axis, operating 2.46 g <sub>RMS</sub> , from 5 to 500 Hz, 10 minutes each axis, non-operating

Table 2-12: Warranted Characteristics — Environmental and Reliability (Cont.)

Name	Description
Emissions	Meets or exceeds the requirements of the following standards: MIL-STD-461C CE-03, part 4, curve #1, RE-02, part 7 VDE 0871, Category B FCC Rules and Regulations, Part 15, Subpart J, Class A
Electrostatic Discharge	Up to 8 kV with no change to control settings or impairment of normal operation Up to 15 kV with no damage that prevents recovery of normal operation

**Warranted Characteristics**

**Appendix B: Specification**

## Typical Characteristics

This subsection contains tables that list the various *typical characteristics* that describe TDS 800 Digitizing Oscilloscopes.

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

This subsection lists only typical characteristics. A list of warranted characteristics starts on page 2-13.

**Table 2-13: Typical Characteristics — Signal Acquisition System**

Name	Description															
Input Voltage, Absolute Maximum	Ⓛ Volts maximum Ⓛ Volts maximum for the delay line version of the TDS 820															
Bandwidth, Analog <sup>1</sup>	8 GHz 6 GHz for the delay line version of the TDS 820															
Strobe Kickout	Less than $0.6 \times$ (input signal – net offset) Less than $0.3 \times$ (input signal – net offset) for the delay line version of the TDS 820 In both cases the dominant impulse lasts less than 150 ps.															
VSWR, Input	$\leq 1.1:1$ from DC to 6 GHz $\leq 1.3:1$ from 6 GHz to 8 GHz $\leq 1.3:1$ from DC to 6 GHz for the delay line version of the TDS 820															
Crosstalk, Sine or Square Wave Input	$\geq 1000:1$ from DC to 8 GHz $\geq 150:1$ at $V_{in} \leq 200$ mV p-p (for the delay line version of the TDS 820), less for larger input signals															
Step Response Aberrations, Full Bandwidth	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 35%;"><b>With delay line (for the delay line version of the TDS 820)</b></th> <th style="text-align: left; width: 30%;"><b>Without delay line</b></th> <th style="width: 35%;"></th> </tr> </thead> <tbody> <tr> <td>+3% to –2% <math>\leq 300</math> ps</td> <td>+6% to –3% <math>\leq 500</math> ps</td> <td></td> </tr> <tr> <td>Ⓛ ns</td> <td>Ⓛ ns</td> <td></td> </tr> <tr> <td>Ⓛ ns</td> <td>Ⓛ ns</td> <td></td> </tr> <tr> <td></td> <td>Less than: Ⓛ ps</td> <td>before step</td> </tr> </tbody> </table> <p>Measured using 067–1338–00 reference flat calibration step generator.</p>	<b>With delay line (for the delay line version of the TDS 820)</b>	<b>Without delay line</b>		+3% to –2% $\leq 300$ ps	+6% to –3% $\leq 500$ ps		Ⓛ ns	Ⓛ ns		Ⓛ ns	Ⓛ ns			Less than: Ⓛ ps	before step
<b>With delay line (for the delay line version of the TDS 820)</b>	<b>Without delay line</b>															
+3% to –2% $\leq 300$ ps	+6% to –3% $\leq 500$ ps															
Ⓛ ns	Ⓛ ns															
Ⓛ ns	Ⓛ ns															
	Less than: Ⓛ ps	before step														

## Typical Characteristics

### Appendix B: Specifications **Table 2-13: Typical Characteristics — Signal Acquisition System**

Name	Description
Random Noise	300 $\mu\text{V}_{\text{RMS}}$ 600 $\mu\text{V}_{\text{RMS}}$ for the delay line version of the TDS 820

<sup>1</sup>Bandwidth is calculated from measured rise time using the following formula:

### **Table 2-14: Typical Characteristics — Time Base System**

Name	Description
View Time, Pretrigger	1.5 ns for the delay line version of the TDS 820

### **Table 2-15: Typical Characteristics — Triggering System**

Name	Description
Pulse Width, Minimum Trigger	<b>External</b> 0.25 ns <b>CH 1 and CH 2</b> 0.5 ns for the delay line version of the TDS 820 only

### **Table 2-16: Typical Characteristics — Data Handling**

Name	Description
Retention Time, Nonvolatile Memory <sup>1,2</sup>	$\geq 5$ years

<sup>1</sup>The time that reference waveforms, stored setups, and calibration constants are retained when there is no power to the oscilloscope.

<sup>2</sup>Small lithium-thionyl-chloride batteries internal to the memory ICs maintain the data. 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.

