Performance Verification

Tektronix

TDS6000 Series
Digital Real-Time Oscilloscope

Part of 071-7021-00 June 25, 2003

This document applies to firmware version 1.00 and above.

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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Performance Verification

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

- To rapidly confirm that the oscilloscope functions and was adjusted properly, just do the brief procedures under *Self Tests*, which begin on page 4–5.

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

- To further check functionality, first do the *Self Tests* just mentioned; then do the brief procedures under *Functional Tests* that begin on page 4–6.

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

- If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 4–17, after doing the *Functional* and *Self Tests* mentioned above.

  Advantages: These procedures add direct checking of the warranted specifications that are marked with the ✓ symbol. These procedures require specific test equipment. (See *Table 4–1: Test equipment* on page 4–18).

If you are not familiar with operating this oscilloscope, read the oscilloscope reference or user manuals or explore the online help.

Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

  1. First Step
     a. First Substep
        - First Subpart
        - Second Subpart

     b. Second Substep
  2. Second Step

- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it, as in the example step below:

  Initialize the oscilloscope: Push the front-panel **DEFAULT SETUP** button.

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

- The term “toolbar” refers to a row of buttons at the top of the display. The term “menu bar” refers to a row of menus at the top of the display. You can switch between toolbar and menu bar operating modes by pushing the button near the top right corner of the display. See Figure 4–1.

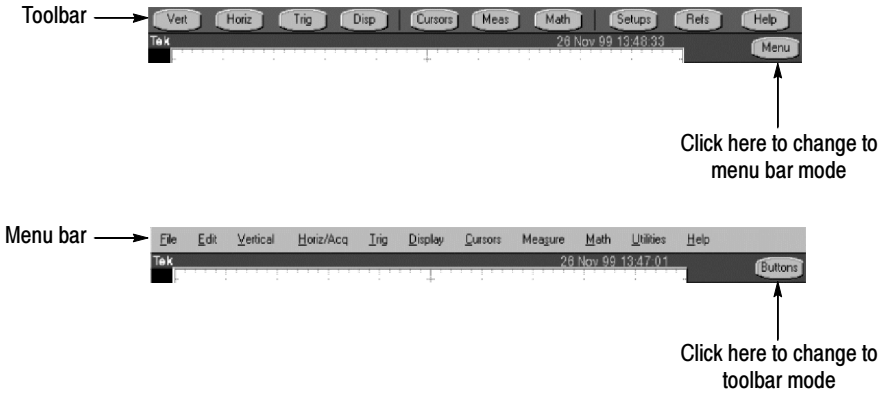


Figure 4- 1: Toolbar and menu bar

- The procedures assume you have connected a mouse to the oscilloscope so you can click on the screen controls. If you have not connected a mouse, you can use the touch screen to operate all the screen controls.

Brief Procedures

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

The *Functional Tests* utilize the probe-compensation output at the front panel as a test-signal source for further verifying that the oscilloscope functions properly. A BNC cable and a BNC-to-SMA adaptor or a TCA-BNC adapter are required to do these test procedures.

Self Tests

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

Verify Internal Adjustment, Self Compensation, and Diagnostics

Equipment required	None
Prerequisites	Power on the oscilloscope and allow a 20 minute warm-up before doing this procedure.

1. *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.
   a. *Display the System diagnostics menu:*
      - If the oscilloscope is in toolbar mode, click the **MENU** button to put the oscilloscope into menu bar mode.
      - Pull down the **Utilities** menu and select **Instrument Diagnostics. . .** . This displays the diagnostics control window.
   b. *Run the System Diagnostics:*
      - First disconnect any input signals from all four channels.
      - Click the **Run** button in the diagnostics control window.
   c. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification may take several minutes. When the verification is finished, the resulting status will appear in the diagnostics control window.

***NOTE**. If diagnostic error message 531 is displayed, re-run signal-path compensation.*

d. *Verify that no failures are found and reported on-screen.* All tests should pass.

e. *Run the signal-path compensation routine:*

- Pull down the **Utilities** menu and select **Instrument Calibration. . .** . This displays the instrument calibration control window.
- If required because the oscilloscope is in service mode, select the **Signal Path** button under Calibration Area.
- Click the **Calibrate** button to start the routine.

f. *Wait:* Signal-path compensation may take five to fifteen minutes to run.

g. *Confirm signal-path compensation returns passed status:* Verify that the word ***Pass*** appears in the instrument calibration control window.

2. *Return to regular service:* Click the **Close** button to exit the instrument calibration control window.

Functional Tests

The purpose of these procedures is to confirm that the oscilloscope functions properly. The only equipment required is a P7240 probe, a probe calibration and deskew fixture, a BNC cable, BNC-to-SMA adapter or TCA-BNC adapter, and, to check the file system, a 3.5 inch, 1.44 Mbyte, formatted floppy disk.

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

Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on the 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 4–17.*

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

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

Verify All Input Channels

Equipment required	One P7240 probe (TDS6404) or P7260 probe (TDS6604) One probe calibration and deskew fixture, Tektronix part number 067-0405-02 (TDS6404) or 067-0484-00 (TDS6604) One BNC cable, Tektronix part number 012-0076-00 or the cable 012-0208-00
Prerequisites	None

1. *Initialize the oscilloscope:* Push the front-panel **DEFAULT SETUP** button.
2. *Hook up the signal source:* Connect one end of the BNC cable to the PROBE COMPENSATION output connector in the oscilloscope. Connect the remaining end of the BNC cable to the GAIN CAL SIG connector of the fixture as shown in Figure 4–2 (TDS6604) on page 4–8 or Figure 4–3 (TDS6404) on page 4–9.
3. Install a P7240 (TDS6404) or TDS7260 (TDS6604) probe in the channel input you want to test (beginning with CH 1).
4. Connect the probe tip to the GAIN CAL pins on the fixture as shown in Figure 4–2 (TDS6604) on page 4–8 or Figure 4–3 (TDS6404) on page 4–9.

NOTE*. If a P7240 or P7260 probe is not available, connect the probe compensation output to the channel input using a BNC cable and adapters.*

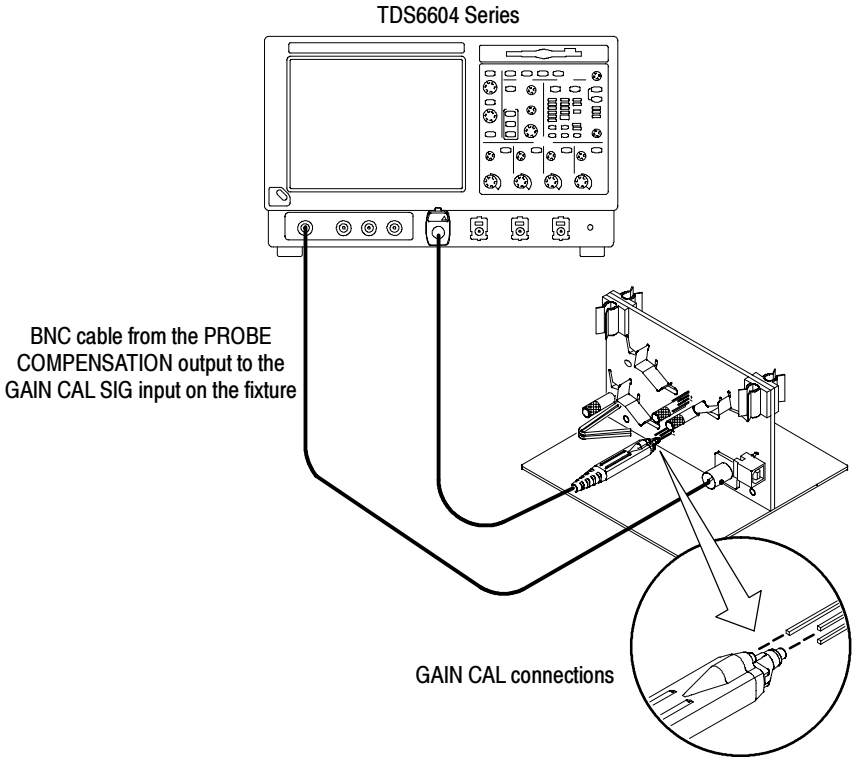


Figure 4- 2: Universal test hookup for functional tests - CH 1 shown

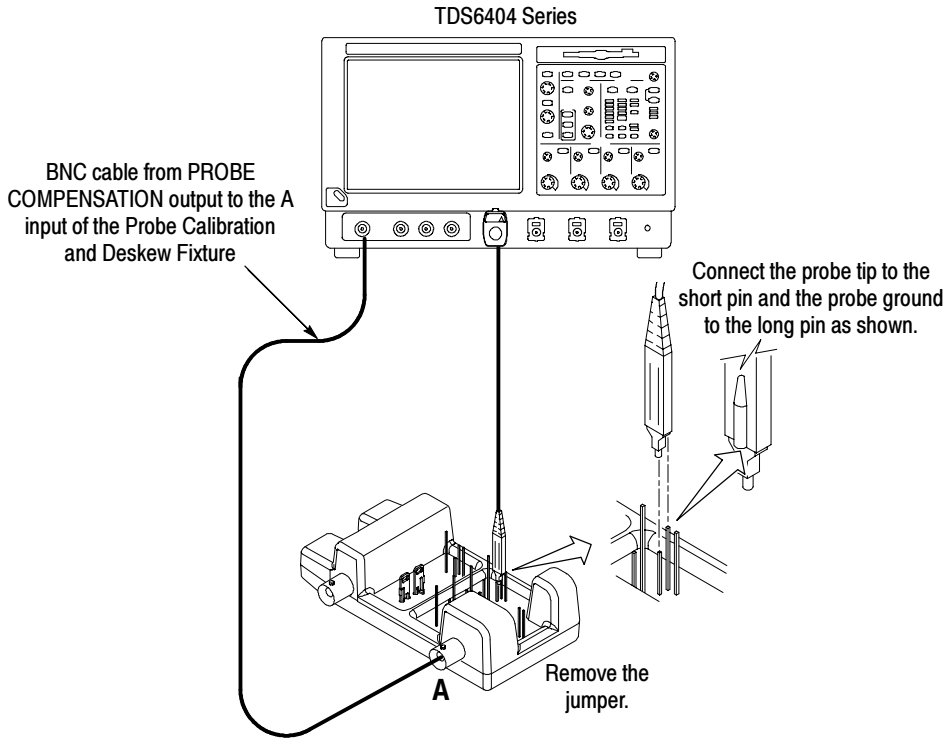


Figure 4- 3: Universal test hookup for functional tests - CH 1 shown

5. *Turn off all channels:* If any of the front-panel channel buttons are lighted, push those buttons to turn off the displayed channels. See Figure 4–4.

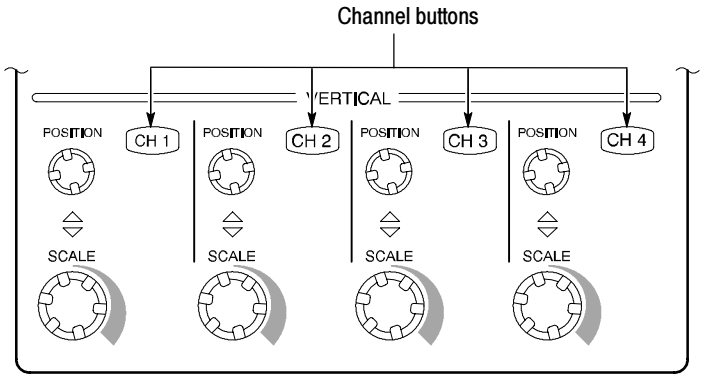


Figure 4- 4: Channel button location

6. *Select the channel to test:* Push the channel button for the channel that you are currently testing. The button lights, and the channel display comes on.

7. *Set up the oscilloscope:*

   - Push the front panel **AUTOSET** button. This sets the horizontal and vertical scale and vertical offset for a usable display and sets the trigger source to the channel that you are testing.
   - Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Confirm that the Ch1 Offset is about **1.6 V** (0.0 V if not using a P7240 or P7260 probe).

8. *Verify that the channel is operational:* Confirm that the following statements are true.

   - For TDS6604: The vertical scale readout for the channel under test shows a setting of about 500 mV, and a square-wave probe-compensation signal about 1 division (0.5 divisions if not using a probe) in amplitude (about 460 mV [240 mV if not using a P7260 probe]) is on the screen.
   - For TDS6404: The vertical scale readout for the channel under test shows a setting of about 200 mV (500 mV if not using a P7240 probe), and a square wave probe-compensation signal about 2.2 divisions (0.5 divisions if not using a probe) in amplitude (about 448 mV [240 mV if not using a P7240 probe]) is on the screen.
   - The front-panel vertical **POSITION** knob (for the channel that you are testing) moves the signal up and down the screen when rotated.
   - Turning the vertical **SCALE** knob counterclockwise (for the channel you are testing) decreases the amplitude of the waveform on-screen, turning the knob clockwise increases the amplitude, and returning the knob to 100 mV (500 mV if not using a probe) returns the amplitude to about 4.5 divisions (0.5 divisions if not using a probe).

9. *Verify that the channel acquires in all acquisition modes:* Pull down the Horiz/Acq menu to select **Horizontal/Acquisition Setup. . .** . Click the **Acquisition** tab in the control window that displays. Click each of the six acquisition modes and confirm that the following statements are true.

   - Sample mode displays an actively acquiring waveform on-screen. (Note that there is a small amount of noise present on the square wave).
   - Peak Detect mode displays an actively acquiring waveform on the screen with the noise present in Sample mode "peak detected."
   - Hi Res mode displays an actively acquiring waveform on the screen with the noise that was present in Sample mode reduced.
   - Average mode displays an actively acquiring waveform on the screen with the noise reduced.

- Envelope mode displays an actively acquiring waveform on the screen with the noise displayed.
- Waveform Database or WfmDB mode displays an actively acquiring and displays a waveform that is the accumulation of several acquisitions.

10. *Test all channels:* Repeat steps 2 through 9 until all four input channels are verified.

11. *Remove the test hookup:* Disconnect the BNC cable, fixture, and the probe from the channel input and the probe compensation output.

Verify the Time Base

Equipment required	One BNC cable, such as Tektronix part number 012-0076-00 One TCA-BNC adapter
Prerequisites	None

1. *Initialize the oscilloscope:* Push the front-panel **DEFAULT SETUP** button.

2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4–5.

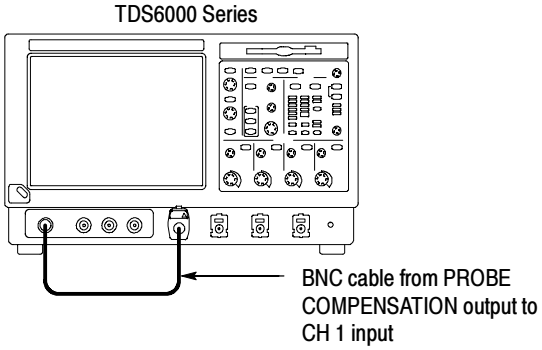


Figure 4- 5: Setup for time base test

3. *Set up the oscilloscope:* Push the front panel **AUTOSET** button.

4. Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Adjust the Ch1 Offset to approximately **0.8 V** using the multipurpose knob.

5. Set the **Vertical SCALE** to **100 mV** per division.

6. *Set the time base:* Set the horizontal **SCALE** to **200 µs/div**. The time-base readout is displayed at the bottom of the graticule.

7. *Verify that the time base operates:* Confirm the following statements.

- One period of the square-wave probe-compensation signal is about five horizontal divisions on-screen for the 200 µs/div horizontal scale setting.
- Rotating the horizontal **SCALE** knob clockwise expands the waveform on the screen (more horizontal divisions per waveform period), counterclockwise rotation contracts it, and returning the horizontal scale to 200 µs/div returns the period to about five divisions.
- The horizontal **POSITION** knob positions the signal left and right on the screen when rotated.

8. *Verify horizontal delay:*

a. *Center a rising edge on screen:*

- Set the horizontal **POSITION** knob so that the rising edge where the waveform is triggered is lined up with the center horizontal graticule.
- Change the horizontal **SCALE** to **20 µs/div**. The rising edge of the waveform should remain near the center graticule and the falling edge should be off screen.

b. *Turn on and set horizontal delay:*

- Pull down the Horiz/Acq menu to select **Horizontal/Acquisition Setup. . .** .
- Click the **Horizontal** tab in the control window that displays.
- Click the **Delay Mode** button to turn delay on.
- Double click the **Horiz Delay** control in the control window to display the pop-up keypad. Click the keypad buttons to set the horizontal delay to **500 µs**, and then click the **ENTER** key.

c. *Verify the waveform:* Verify that a falling edge of the waveform is within a few divisions of center screen.

d. *Adjust the horizontal delay:* Rotate the upper multipurpose knob to change the horizontal delay setting. Verify that the falling edge shifts horizontally. Rotate the front-panel horizontal **POSITION** knob. Verify that this knob has the same effect (it also adjusts delay, but only when delay mode is on).

e. *Verify the delay toggle function:*

- Rotate the front-panel horizontal **POSITION** knob to center the falling edge horizontally on the screen.

- Change the horizontal **SCALE** to **40 ns/div**. The falling edge of the waveform should remain near the center graticule. If not, readjust the delay setting to center the falling edge.
- Push the front-panel **DELAY** button several times to toggle delay off and on and back off again. Verify that the display switches quickly between two different points in time (the rising and falling edges of this signal).

9. *Remove the test hookup:* Disconnect the BNC cable from the channel input and the probe compensation output.

Verify the A (Main) and B (Delayed) Trigger Systems

Equipment required	One BNC cable, such as Tektronix part number 012-0076-00 One TCA-BNC adapter
Prerequisites	None

1. *Initialize the oscilloscope:* Push the front-panel **DEFAULT SETUP** button.
2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4-6.

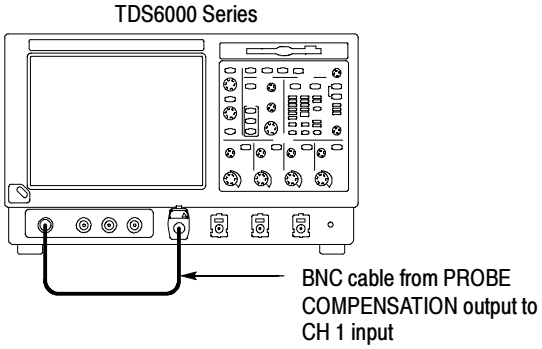


Figure 4-6: Setup for trigger test

3. *Set up the oscilloscope:* Push the front-panel **AUTOSET** button.
4. Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Adjust the Ch1 Offset to approximately **0.8 V** using the multipurpose knob.
5. Set the **Vertical SCALE** to **100 mV** per division.

6. *Verify that the main trigger system operates:* Confirm that the following statements are true:

   - The trigger level readout for the A (main) trigger system changes with the trigger-LEVEL knob.
   - The trigger-LEVEL knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal untriggered).
   - Pushing the front-panel trigger LEVEL knob sets the trigger level to the 50% amplitude point of the signal and triggers the signal that you just left untriggered. (Leave the signal triggered.)

7. *Verify that the delayed trigger system operates:*

   a. *Set up the delayed trigger:*

      - Pull down the **Trig** menu and select **A — B Trigger Sequence. . .** . This displays the A→B Sequence tab of the trigger setup control window.
      - Click the **Trig After Time** button under A Then B.
      - Click the **B Trig Level** control in the control window.

   b. *Confirm that the following statements are tru*e:

      - The trigger-level readout for the B trigger system changes as you turn the lower multipurpose knob.
      - As you rotate the lower multipurpose knob, the square-wave probe-compensation signal can become triggered and untriggered. (Leave the signal triggered.)

   c. *Verify the delayed trigger counter:*

      - Double click the **Trig Delay** control to pop up a numeric keypad for that control.
      - Click the keypad to enter a trigger delay time of 1 second and then click **Enter**.
      - Verify that the trigger READY indicator on the front panel flashes about once every second as the waveform is updated on-screen.

8. *Remove the test hookup:* Disconnect the BNC cable from the channel input and the probe compensation output.

Verify the File System

Equipment required	One BNC cable, such as Tektronix part number 012-0076-00 One TCA-BNC adapter One 1.44 Mbyte, 3.5 inch DOS-compatible formatted disk.
Prerequisites	None

1. *Initialize the oscilloscope:* Push the front-panel **DEFAULT SETUP** button.
2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4–7.

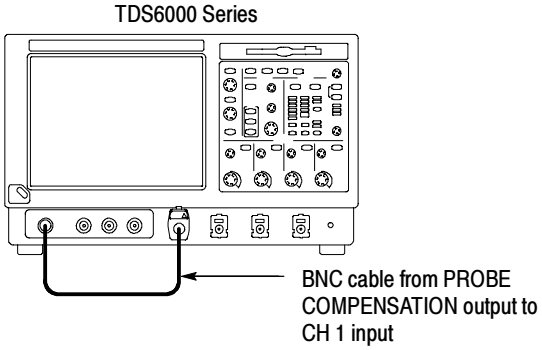


Figure 4- 7: Setup for the file system test

3. *Insert the test disk:* Insert the floppy disk in the floppy disk drive at the top left of the front panel.
4. *Set up the oscilloscope:* Push the front panel **AUTOSET** button.
5. Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Adjust the Ch1 Offset to approximately **0.8 V** using the multipurpose knob.
6. Set the **Vertical SCALE** to **100 mV** per division.
7. *Set the time base:* Set the horizontal **SCALE** to **1 ms/div**. The time-base readout is displayed at the bottom of the graticule.
8. *Save the settings:*
   a. Pull down the **File** menu to select **Instrument Setup**. . . . This displays the instrument setups control window.
   b. Click the **Save** button under Save settings to file in the control window. This displays a familiar Windows dialog box for choosing a destination directory naming the file.

c. In the Save Instrument Setups As dialog box, select the **$3^1/_2$ Floppy (A:)** icon in the Save in: drop-down list to set the save destination to the floppy disk.

d. Note the default file name, and then click the **Save** button to save the setup to the default file name.

9. *Change the settings again:* Set the horizontal **SCALE** to **200 µs/div**.

10. *Verify the file system works:*

a. Click the **Recall Setups** tab in the control window.

b. Click the **Recall** button under Recall settings from file in the control window. This displays a familiar Windows dialog box for locating the settings file that you want to recall.

c. In the Recall Save Instrument Setups From dialog box, select the **$3^1/_2$ Floppy (A:)** icon in the Look in: drop-down list.

d. Locate and then double click in the dialog box on the setup file that you previously stored.

e. Verify that the oscilloscope retrieved the saved setup from the disk. Do this by noticing that the horizontal SCALE is again 1 ms and the waveform shows ten cycles just as it did when you saved the setup.

11. *Remove the test hookup:*

a. Disconnect the BNC cable and adapter from the channel input and the probe compensation output.

b. Remove the floppy disk from the floppy disk drive.

Performance Tests

This section contains a collection of manual procedures for checking that the TDS6000 Series oscilloscope performs as warranted.

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

STOP*. These procedures extend the confidence level provided by the basic procedures described on page 4–5. The basic procedures should be done first, then these procedures performed if desired.*

Prerequisites

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

- The cabinet must be installed on the oscilloscope.
- You must have performed and passed the procedures under *Self Tests,* found on page 4–5, and those under *Functional Tests,* found on page 4–6.
- A signal-path compensation must have been done within the recommended calibration interval and at a temperature within ±5 °C of the present operating temperature. A signal-path compensation must have been done at an ambient humidity within 25% of the current ambient humidity and after having been at that humidity for at least 4 hours.
- The oscilloscope must have been last adjusted at an ambient temperature between +20 °C and +30 °C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature as listed in Table 1–11. (The warm-up requirement is usually met in the course of meeting the Self Tests and Functional Tests prerequisites listed above).

Equipment Required

Procedures starting on page 4–28, use external, traceable signal sources to directly check warranted characteristics. Table 4–1 lists the required equipment.

Table 4-1: Test equipment

Item number and description	Minimum requirements	Example	Purpose
1. Attenuator,10X (two required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Signal Attenuation
2. Attenuator, 5X	Ratio: 5X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0060-02	Signal Attenuation
3. Terminator, 50 Ω (three required)	Impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal Termination for Channel Delay Test
4. Cable, Precision 50 Ω Coaxial (three required)	50 Ω, 36 in, male-to-male BNC connectors	Tektronix part number 012-0482-00	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. Probe, 10X	P7240 probe (TDS6404) P7260 probe (TDS6604)	Tektronix part number P7240 Tektronix part number P7260	Signal Interconnection
8. Floppy disk	3.5 inch 1.44 Mbyte, DOS-compatible floppy disk	Standard IBM PC-compatible disk	Checking File System Basic Functionality
9. Generator, DC Calibration	Variable amplitude to ±7 V; accuracy to 0.1%	Wavetek 9500[1]	Checking DC Offset, Gain, Measurement Accuracy, and Maximum Input Voltage
10. Generator, Calibration	500 mV square wave calibrator amplitude; accuracy to 0.25%	Wavetek 9500[1]	To check accuracy of Signal Out
11. Timer-counter	25 MHz, 1 s gate	Advantest R5360	Checking long-term sample rate and delay time accuracy
12. Generator, Sine-Wave[3]	5 kHz to at least 6 GHz. Variable amplitude from 60 mV to 2 V_{p-p} into 50 Ω. Frequency error <2.0%	Rohde & Schwarz SMT06 with options 01 and 02	Checking Analog Bandwidth, Trigger Sensitivity, Sample-rate, External Clock, and Delay-Time Accuracy
13. Meter, Level and Power Sensor	Frequency range: 10 MHz to the oscilloscope bandwidth. Amplitude range: 6 mV_{p-p} to 2 V_{p-p}	Rohde & Schwarz NRVS and NRV-Z402	Checking Analog Bandwidth and Trigger Sensitivity
14. Splitter, Power	Frequency range: DC to 4 GHz. Tracking: >2.0%	Tektronix part number 015-0565-00	Checking Analog Bandwidth
15. Adapter (four required)	Male N-to-female BNC	Tektronix part number 103-0045-00	Checking Analog Bandwidth

Table 4-1: Test equipment (Cont.)

Item number and description	Minimum requirements	Example	Purpose
16. Adapter	Female N-to-male BNC	Tektronix part number 103-0058-00	Checking Analog Bandwidth
17. Adapter (three required)	SMA female-to-female	Tektronix part number 015-1012-00	Checking the delay between channels
18. Adapter (three required)	SMA male-to-female BNC	Tektronix part number 015-1018-00	Checking the delay between channels
19. Adapter (four required)	SMA male-to-BNC female	TCA-BNC or TCA-SMA and SMA male-to-BNC female adapter (Tektronix part number 015-0554-00 or 015-1018-00)	Signal interconnection
20. Pulse Generator	2 MHz, ≤150 ps rise time, 5 V out	Fluke 9500[1,2]	Used to Test Delta Time Measurement Accuracy
21. Cable, Coaxial (two required)	50 Ω, 20 in, male-to-male SMA connectors	Tektronix part number 174-1427-00	Used to Test Delta Time Measurement Accuracy
22. Adapter	SMA "T", male to 2 SMA female	Tektronix part number 015-1016-00	Used to Test Delta Time Measurement Accuracy
23. Adapter	SMA female to BNC male	Tektronix part number 015-0572-00	Used to Test Delta Time Measurement Accuracy
24. Adapter	BNC male to female elbow	Tektronix part number 103-0031-00	Used to Test Delta Time Measurement Accuracy
25. Terminator	Short circuit, SMA connector	Tektronix part number 015-1021-00	Used to Test Delta Time Measurement Accuracy
26. Attenuator, 2X	Ratio: 2X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0069-02	Used to Test Delta Time Measurement Accuracy
27. Digital Multimeter	Ohms: <60 Ohms	Keithley 2000	Checking input impedance

1 Fluke 9500 with option 100 and an output head (9520, 9530, or 9550) appropriate for the bandwidth of the oscilloscope being tested.

2 For Delta Time Measurement Accuracy, use a Fluke 9500 or a pulse generator with a rise time as shown in Table 4-7 on page 4-61.

3 On Instruments with a bandwidth ≤3 GHz, items 12, 13, and 14 may be replaced with a Fluke 9500 with option 100 and a 9559 output head.

TDS6000 Test Records

Photocopy the following table and use it to record the performance test results for your TDS6000 Digital Storage Oscilloscope.

TDS6000 Test Record

Clock recovery frequency range		Pass	_____	_____	N/A
Instrument Serial Number: _____			Certificate Number: _____		
Temperature: _____			RH %: _____		
Date of Calibration: _____			Technician: _____		
TDS6000 performance test		**Minimum**	**Incoming**	**Outgoing**	**Maximum**
DC voltage measurement accuracy (averaged)					
CH1	50 mV Vert scale setting, -5 Div position setting, +0.5 V offset	+ 883.50 mV	_____	_____	+ 916.50 mV
CH1	50 mV Vert scale setting, +5 Div position setting, -0.5 V offset	- 916.50 V	_____	_____	- 883.50 mV
CH1	100 mV Vert scale setting, -5 Div position setting, +5 V offset	+ 5.45 V	_____	_____	+ 5.55 V
CH1	100 mV Vert scale setting, +5 Div position setting, -5 V offset	- 5.55 V	_____	_____	- 5.45 V
CH1	1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset	+ 4.20 V	_____	_____	+ 4.80 V
CH1	1.0 V Vert scale setting, +5 Div position setting, -2.5 V offset	- 4.80 V	_____	_____	- 4.20 V
CH2	50 mV Vert scale setting, -5 Div position setting, +0.5 V offset	+ 883.50 mV	_____	_____	+ 916.50 mV
CH2	50 mV Vert scale setting, +5 Div position setting, -0.5 V offset	- 916.50 V	_____	_____	- 883.50 mV
CH2	100 mV Vert scale setting, -5 Div position setting, +5 V offset	+ 5.45 V	_____	_____	+ 5.55 V
CH2	100 mV Vert scale setting, +5 Div position setting, -5 V offset	- 5.55 V	_____	_____	- 5.45 V
CH2	1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset	+ 4.20 V	_____	_____	+ 4.80 V
CH2	1.0 V Vert scale setting, +5 Div position setting, -2.5 V offset	- 4.80 V	_____	_____	- 4.20 V

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test		Minimum	Incoming	Outgoing	Maximum
CH3	50 mV Vert scale setting, -5 Div position setting, +0.5 V offset	+ 883.50 mV	_____	_____	+ 916.50 mV
CH3	50 mV Vert scale setting, +5 Div position setting, -0.5 V offset	- 916.50 V	_____	_____	- 883.50 mV
CH3	100 mV Vert scale setting, -5 Div position setting, +5 V offset	+ 5.45 V	_____	_____	+ 5.55 V
CH3	100 mV Vert scale setting, +5 Div position setting, -5 V offset	- 5.55 V	_____	_____	- 5.45 V
CH3	1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset	+ 4.20 V	_____	_____	+ 4.80 V
CH3	1.0 V Vert scale setting, +5 Div position setting, -2.5 V offset	- 4.80 V	_____	_____	- 4.20 V
CH4	50 mV Vert scale setting, -5 Div position setting, +0.5 V offset	+ 883.50 mV	_____	_____	+ 916.50 mV
CH4	50 mV Vert scale setting, +5 Div position setting, -0.5 V offset	- 916.50 V	_____	_____	- 883.50 mV
CH4	100 mV Vert scale setting, -5 Div position setting, +5 V offset	+ 5.45 V	_____	_____	+ 5.55 V
CH4	100 mV Vert scale setting, +5 Div position setting, -5 V offset	- 5.55 V	_____	_____	- 5.45 V
CH4	1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset	+ 4.20 V	_____	_____	+ 4.80 V
CH4	1.0 V Vert scale setting, +5 Div position setting, -2.5 V offset	- 4.80 V	_____	_____	- 4.20 V

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test		Minimum	Incoming	Outgoing	Maximum
Offset accuracy					
CH1	50 mV Vert scale setting, +0.5 V offset 0 V offset -0.5 V offset	 + 491.75 mV - 6.5 mV - 508.25 mV	 _____ _____ _____	 _____ _____ _____	 + 508.25 mV + 6.5 mV - 491.75 mV
CH1	100 mV Vert scale setting, +5 V offset 0 V offset -5 V offset	 + 4.9575 V - 25 mV - 5.0425 V	 _____ _____ _____	 _____ _____ _____	 + 5.0425 V + 25 mV - 4.9575 V
CH1	500 mV Vert scale setting, +5 V offset 0 V offset -5 V offset	 + 4.9175 V - 65 mV - 5.0825 V	 _____ _____ _____	 _____ _____ _____	 + 5.0825 V + 65 mV - 4.9175 V
CH1	1.0 V Vert scale setting, +2.5 V offset 0 V offset -2.5 V offset	 + 2.37625 V - 115 mV - 2.62375 V	 _____ _____ _____	 _____ _____ _____	 + 2.62375 V + 115 mV - 2.37625 V
CH2	50 mV Vert scale setting, +0.5 V offset 0 V offset -0.5 V offset	 + 491.75 mV - 6.5 mV - 508.25 mV	 _____ _____ _____	 _____ _____ _____	 + 508.25 mV + 6.5 mV - 491.75 mV
CH2	100 mV Vert scale setting, +5 V offset 0 V offset -5 V offset	 + 4.9575 V - 25 mV - 5.0425 V	 _____ _____ _____	 _____ _____ _____	 + 5.0425 V + 25 mV - 4.9575 V
CH2	500 mV Vert scale setting, +5 V offset 0 V offset -5 V offset	 + 4.9175 V - 65 mV - 5.0825 V	 _____ _____ _____	 _____ _____ _____	 + 5.0825 V + 65 mV - 4.9175 V
CH2	1.0 V Vert scale setting, +2.5 V offset 0 V offset -2.5 V offset	 + 2.37625 V - 115 mV - 2.62375 V	 _____ _____ _____	 _____ _____ _____	 + 2.62375 V + 115 mV - 2.37625 V

TDS6000 Test Record (cont.)

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

TDS6000 performance test		Minimum	Incoming	Outgoing	Maximum
CH3	50 mV Vert scale setting,				
	+0.5 V offset	+ 491.75 mV	_____	_____	+ 508.25 mV
	0 V offset	- 6.5 mV	_____	_____	+ 6.5 mV
	-0.5 V offset	- 508.25 mV	_____	_____	- 491.75 mV
CH3	100 mV Vert scale setting,				
	+5 V offset	+ 4.9575 V	_____	_____	+ 5.0425 V
	0 V offset	- 25 mV	_____	_____	+ 25 mV
	-5 V offset	- 5.0425 V	_____	_____	- 4.9575 V
CH3	500 mV Vert scale setting,				
	+5 V offset	+ 4.9175 V	_____	_____	+ 5.0825 V
	0 V offset	- 65 mV	_____	_____	+ 65 mV
	-5 V offset	- 5.0825 V	_____	_____	- 4.9175 V
CH3	1.0 V Vert scale setting,				
	+2.5 V offset	+ 2.37625 V	_____	_____	+ 2.62375 V
	0 V offset	- 115 mV	_____	_____	+ 115 mV
	-2.5 V offset	- 2.62375 V	_____	_____	- 2.37625 V
CH4	50 mV Vert scale setting,				
	+0.5 V offset	+ 491.75 mV	_____	_____	+ 508.25 mV
	0 V offset	- 6.5 mV	_____	_____	+ 6.5 mV
	-0.5 V offset	- 508.25 mV	_____	_____	- 491.75 mV
CH4	100 mV Vert scale setting,				
	+5 V offset	+ 4.9575 V	_____	_____	+ 5.0425 V
	0 V offset	- 25 mV	_____	_____	+ 25 mV
	-5 V offset	- 5.0425 V	_____	_____	- 4.9575 V
CH4	500 mV Vert scale setting,				
	+5 V offset	+ 4.9175 V	_____	_____	+ 5.0825 V
	0 V offset	- 65 mV	_____	_____	+ 65 mV
	-5 V offset	- 5.0825 V	_____	_____	- 4.9175 V
CH4	1.0 V Vert scale setting,				
	+2.5 V offset	+ 2.37625 V	_____	_____	+ 2.62375 V
	0 V offset	- 115 mV	_____	_____	+ 115 mV
	-2.5 V offset	- 2.62375 V	_____	_____	- 2.37625 V

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test		Minimum	Incoming	Outgoing	Maximum
Analog bandwidth					
CH1	1 V	3.535 V	_____	_____	N/A
	500 mV	2.12 V	_____	_____	N/A
	200 mV	848 mV	_____	_____	N/A
	100 mV	424 mV	_____	_____	N/A
	50 mV	212 mV	_____	_____	N/A
	20 mV	84.8 mV	_____	_____	N/A
	10 mV	42.4 mV	_____	_____	N/A
CH2	1 V	3.535 V	_____	_____	N/A
	500 mV	2.12 V	_____	_____	N/A
	200 mV	848 V	_____	_____	N/A
	100 mV	424 mV	_____	_____	N/A
	50 mV	212 mV	_____	_____	N/A
	20 mV	84.8 mV	_____	_____	N/A
	10 mV	42.4 mV	_____	_____	N/A
CH3	1 V	3.535 V	_____	_____	N/A
	500 mV	2.12 V	_____	_____	N/A
	200 mV	848 V	_____	_____	N/A
	100 mV	424 mV	_____	_____	N/A
	50 mV	212 mV	_____	_____	N/A
	20 mV	84.8 mV	_____	_____	N/A
	10 mV	42.4 mV	_____	_____	N/A
CH4	1 V	3.535 V	_____	_____	N/A
	500 mV	2.12 V	_____	_____	N/A
	200 mV	848 V	_____	_____	N/A
	100 mV	424 mV	_____	_____	N/A
	50 mV	212 mV	_____	_____	N/A
	20 mV	84.8 mV	_____	_____	N/A
	10 mV	42.4 mV	_____	_____	N/A

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test	Minimum	Incoming	Outgoing	Maximum
Delay between channels	N/A	_____	_____	30 ps
Channel isolation 1.5 GHz				
100 mV				
CH 1	N/A	_____	_____	0.125 divisions
CH 2	N/A	_____	_____	0.125 divisions
CH 3	N/A	_____	_____	0.125 divisions
CH 4	N/A	_____	_____	0.125 divisions
50 mV				
CH 1	N/A	_____	_____	0.125 divisions
CH 2	N/A	_____	_____	0.125 divisions
CH 3	N/A	_____	_____	0.125 divisions
CH 4	N/A	_____	_____	0.125 divisions
10 mV				
CH 1	N/A	_____	_____	0.125 divisions
CH 2	N/A	_____	_____	0.125 divisions
CH 3	N/A	_____	_____	0.125 divisions
CH 4	N/A	_____	_____	0.125 divisions
full bandwidth				
100 mV				
CH 1	N/A	_____	_____	0.5 divisions
CH 2	N/A	_____	_____	0.5 divisions
CH 3	N/A	_____	_____	0.5 divisions
CH 4	N/A	_____	_____	0.5 divisions
50 mV				
CH 1	N/A	_____	_____	0.5 divisions
CH 2	N/A	_____	_____	0.5 divisions
CH 3	N/A	_____	_____	0.5 divisions
CH 4	N/A	_____	_____	0.5 divisions
10 mV				
CH 1	N/A	_____	_____	0.5 divisions
CH 2	N/A	_____	_____	0.5 divisions
CH 3	N/A	_____	_____	0.5 divisions
CH 4	N/A	_____	_____	0.5 divisions
Input impedance				
CH1 10 mV	48.75 Ω	_____	_____	51.25 Ω
CH1 100 mV	48.75 Ω	_____	_____	51.25 Ω
CH2 10 mV	48.75 Ω	_____	_____	51.25 Ω
CH2 100 mV	48.75 Ω	_____	_____	51.25 Ω
CH3 10 mV	48.75 Ω	_____	_____	51.25 Ω
CH3 100 mV	48.75 Ω	_____	_____	51.25 Ω
CH4 10 mV	48.75 Ω	_____	_____	51.25 Ω
CH4 100 mV	48.75 Ω	_____	_____	51.25 Ω

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test		Minimum	Incoming	Outgoing	Maximum
Time base system					
Long term sample rate, delay time, and internal reference accuracy		9999.975 kHz	_____	_____	10000.025 kHz
Delta time measurement	Ch 1	N/A	_____	_____	≤ 0.015 ns
	Ch 2	N/A	_____	_____	≤ 0.015 ns
	Ch 3	N/A	_____	_____	≤ 0.015 ns
	Ch 4	N/A	_____	_____	≤ 0.015 ns
Trigger system accuracy					
Time accuracy for pulse, glitch, timeout, and Width, Hor. scale ≤ 1 μs					
	Lower Limit	3.5 ns	_____	_____	6.5 ns
	Upper Limit	3.5 ns	_____	_____	6.5 ns
Time accuracy for pulse, glitch, timeout, and width, Hor. scale > 1 μs					
	Lower Limit	1.9 μs	_____	_____	2.1 μs
	Upper Limit	1.9 μs	_____	_____	2.1 μs
Probe compensation output signal					
Frequency		950 Hz	_____	_____	1.050 kHz
Voltage (difference)		160 mV	_____	_____	240 mV

TDS6000 Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

TDS6000 performance test	Minimum	Incoming	Outgoing	Maximum
Serial trigger (Option ST only)				
Baud rate limits				
Serial word recognizer				
Signal path 0, Pattern matching 1		_____	_____	
Trigger 1 UI before 0	Pass	_____	_____	N/A
Trigger on 0	Pass	_____	_____	N/A
Trigger 1 UI after 0	Pass	_____	_____	N/A
Signal path 1, Pattern matching 1		_____	_____	
Trigger 1 UI before 1	Pass	_____	_____	N/A
Trigger on 1	Pass	_____	_____	N/A
Trigger 1 UI after 1	Pass	_____	_____	N/A
Pattern matching 0		_____	_____	
Position 1	Pass	_____	_____	N/A
Position 2	Pass	_____	_____	N/A
Position 3	Pass	_____	_____	N/A
Position 4	Pass	_____	_____	N/A
Position 5	Pass	_____	_____	N/A
Position 6	Pass	_____	_____	N/A
Position 7	Pass	_____	_____	N/A
Position 8	Pass	_____	_____	N/A
Position 9	Pass	_____	_____	N/A
Position 10	Pass	_____	_____	N/A
Position 11	Pass	_____	_____	N/A
Position 12	Pass	_____	_____	N/A
Position 13	Pass	_____	_____	N/A
Position 14	Pass	_____	_____	N/A
Position 15	Pass	_____	_____	N/A
Position 16	Pass	_____	_____	N/A
Position 17	Pass	_____	_____	N/A
Position 18	Pass	_____	_____	N/A
Position 19	Pass	_____	_____	N/A
Position 20	Pass	_____	_____	N/A
Position 21	Pass	_____	_____	N/A
Position 22	Pass	_____	_____	N/A
Position 23	Pass	_____	_____	N/A
Position 24	Pass	_____	_____	N/A
Position 25	Pass	_____	_____	N/A
Position 26	Pass	_____	_____	N/A
Position 27	Pass	_____	_____	N/A
Position 28	Pass	_____	_____	N/A
Position 29	Pass	_____	_____	N/A
Position 30	Pass	_____	_____	N/A
Position 31	Pass	_____	_____	N/A
Position 32	Pass	_____	_____	N/A
Clock recovery frequency range	Pass	_____	_____	N/A

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 *Specifications.* Refer to Table 4–1 on page 4–18 for test equipment specifications.

Check DC Voltage Measurement Accuracy

Equipment required	Two dual-banana connectors (Item 5) One BNC T connector (Item 6) One DC calibration generator (Item 9) One SMA male-to-female BNC adapter (Item 19) Two precision 50 Ω coaxial cables (Item 4)
Prerequisites	The oscilloscope must meet the prerequisites listed on page 4–17

WARNING. *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC and sense outputs or grounds.*

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

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

   - Set the output of a DC calibration generator to off or 0 volts.
   - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4–8.
   - Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through an adapter. See Figure 4–8.

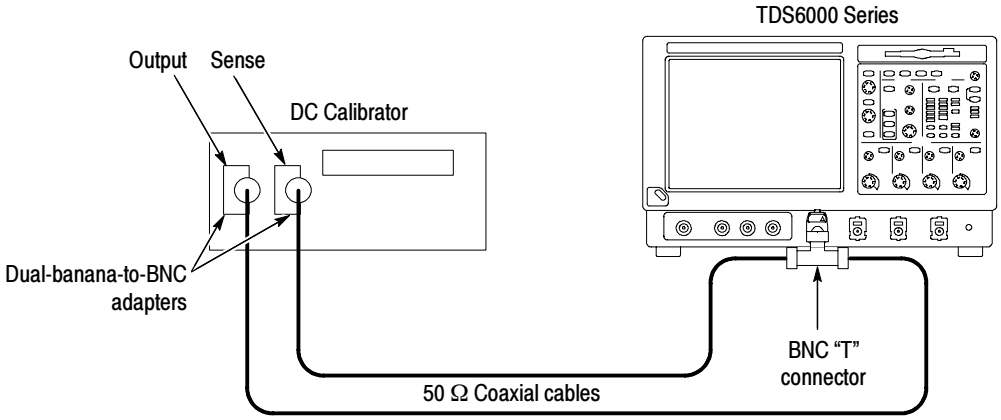


Figure 4- 8: Initial test hookup

b. *Initialize the oscilloscope:* Press **DEFAULT SETUP**.

c. *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for DC accuracy at maximum offset and position:* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1*.

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

b. *Turn on the measurement Mean for the channel:*

- From the tool bar, touch **MEAS** and select the **Ampl** tab, then touch **Mean** to measure the mean of the current channel.
- Press **Close**.

c. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4–2 that is not yet checked. (Start with the first setting listed).

Table 4-2: DC Voltage measurement accuracy

Scale setting	Position setting (Divs)	Offset setting[1]	Generator setting	Accuracy limits
50 mV	-5	+0.5 V	+900 mV	+883.50 mV to +916.50 mV
	+5	-0.5 V	-900 mV	-916.50 mV to -883.50 mV
100 mV	-5	+5 V	+5.5 V	+5.45 V to 5.55 V
	+5	-5 V	-5.5 V	-5.55 V to -5.45 V
1 V	-5	+2.5 V	+4.5 V	+4.20 V to 4.80 V
	+5	-2.5 V	-4.5 V	-4.80 V to -4.20 V

[1] **Set as precisely as the instrument's offset resolution permits.**

d. *Display the test signal:*

- From the tool bar touch **VERT** and touch **Position**.
- Use the keypad to set vertical position to -5 divisions (press **CLR**, **5**, **-**, and then **ENTER**, on the keypad). The baseline level will move off screen.
- Touch **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level will remain off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check has failed for the current vertical scale setting of the current channel).

e. *Measure the test signal:* Press **Close**. Read the measurement results at the **Mean** measurement readout. See Figure 4–9.

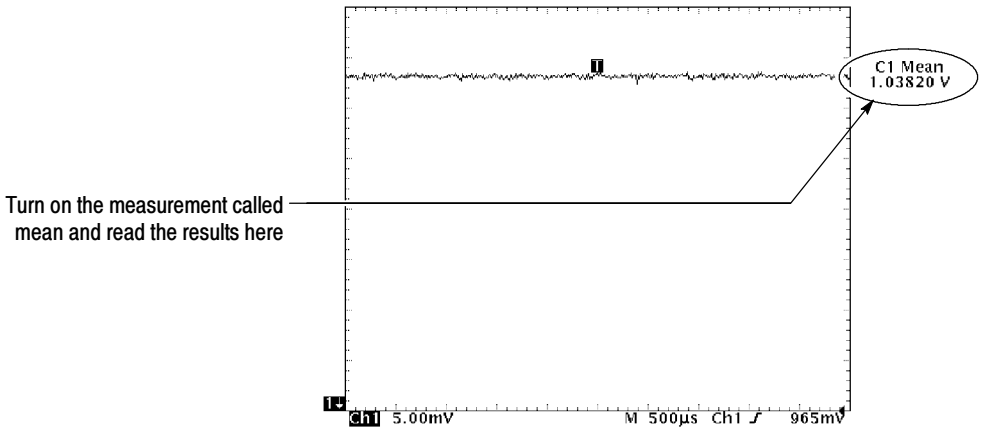


Figure 4- 9: Measurement of DC accuracy at maximum offset and position

f. *Check against limits:*

- CHECK that the readout for the measurement **Mean** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings. Enter value on test record.
- Repeat substep d, reversing the polarity of the position, offset, and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/ generator settings. Enter value on test record.
- Repeat substeps c through f until all vertical scale settings, listed in Table 4–2, are checked for the channel under test.

g. *Test all channels:* Repeat substeps a through f for all four channels.

3. *Disconnect the hookup:*

a. *Set the generator output to 0 V.*

b. Disconnect the cable and adapter from the generator output and the input connector of the channel last tested.

Check Offset Accuracy

Equipment required	Two dual-banana connectors (Item 5) One BNC T connector (Item 6) One DC calibration generator (Item 9) One SMA male-to-female BNC adapter (Item 19) Two precision 50 Ω coaxial cables (Item 4)
Prerequisites	The oscilloscope must meet the prerequisites listed on page 4-17

WARNING. *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC and sense outputs or grounds.*

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

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

   - Set the output of a DC calibration generator to off or 0 volts.
   - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-10.
   - Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through an adapter. See Figure 4-10.

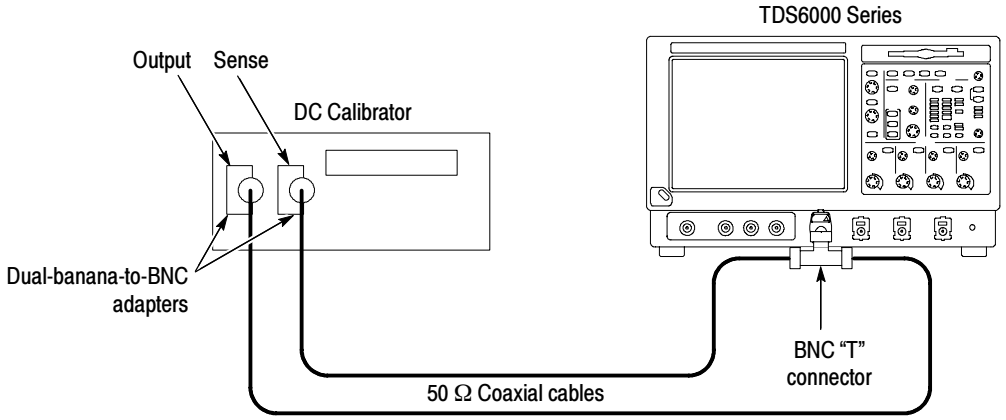


Figure 4- 10: Initial test hookup

b. *Initialize the oscilloscope:* Press **DEFAULT SETUP**.

c. *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for DC accuracy at maximum offset and position:* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1*.

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

b. *Turn on the measurement Mean for the channel:*

- From the tool bar, touch **MEAS** and select the **Ampl** tab, then touch **Mean** to measure the mean of the current channel.
- Press **Close**.

c. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4–3 that is not yet checked. (Start with the first setting listed).

Table 4-3: Offset accuracy

Scale setting	Position setting (Divs)	Offset setting[1]	Generator setting	Accuracy limits
50 mV	0	+0.5 V	+500 mV	+491.75 mV to +508.25 mV
		0 V	0.0 mV	-6.5 mV to +6.5 mV
		-0.5 V	-500 mV	-508.25 mV to -491.75 mV
100 mV	0	+5 V	+5.0 V	+4.9575 V to +5.0425 V
		0 V	0.0 V	-25 mV to +25 mV
		-5 V	-5.0 V	-5.0425 V to -4.9575 V
500 mV	0	+5 V	+5.0 V	+4.9175 V to +5.0825 V
		0 V	0.0 V	-65 mV to +65 mV
		-5 V	-5.0 V	-5.0825 V to -4.9175 V
1 V	0	+2.5 V	+2.5 V	+2.37625 V to +2.62375 V
		0 V	0.0 V	-115 mV to +115 mV
		-2.5 V	-2.5 V	-2.62375 V to -2.37625 V

[1] **Set as precisely as the instrument's offset resolution permits.**

d. *Display the test signal:*

- From the tool bar touch **VERT** and then touch **Position**.
- Use the keypad to set vertical position to 0.0 divisions (press **CLR** and then **ENTER**, on the keypad).
- Touch **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level may move off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the offset accuracy check has failed for the current vertical scale setting of the current channel).

e. *Measure the test signal:* Press **Close**. Read the measurement results at the **Mean** measurement readout. See Figure 4–11.

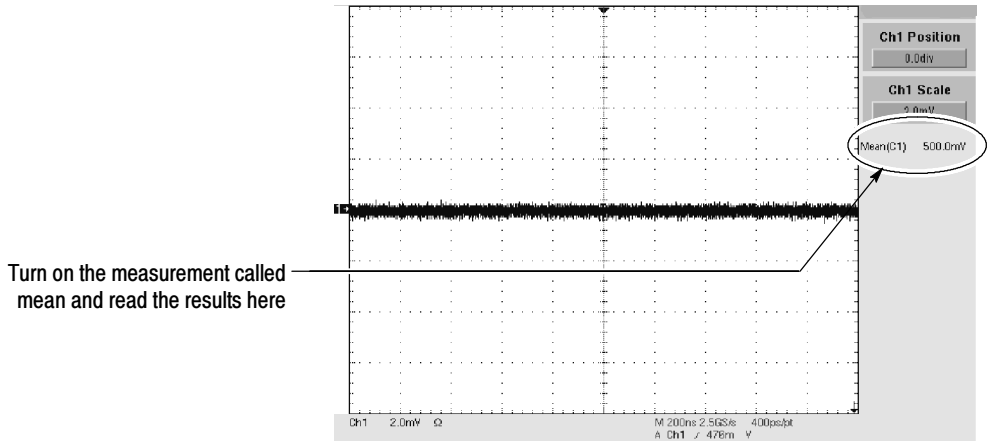


Figure 4- 11: Measurement of offset accuracy

f. *Check against limits:*

- CHECK that the readout for the measurement **Mean** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings. Enter value on test record.
- Repeat substep d, using the zero offset and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/ generator settings. Enter value on test record.
- Repeat substep d, using the negative-polarity offset and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/ generator settings. Enter value on test record.
- Repeat substeps c through f until all vertical scale settings, listed in Table 4–3, are checked for the channel under test.

g. *Test all channels:* Repeat substeps a through f for all four channels.

3. *Disconnect the hookup:*

a. *Set the generator output to 0 V.*

b. Disconnect the cable and adapter from the generator output and the input connector of the channel last tested.

Check Maximum Input Voltage

Equipment required	Two dual-banana connectors (Item 5) One BNC T connector (Item 6) One 10X attenuator (Item 1) One DC calibration generator (Item 9) One SMA male-to-female BNC adapter (Item 19) Two precision 50 Ω coaxial cables (Item 4)
Prerequisites	The oscilloscope must meet the prerequisites listed on page 4-17

WARNING. *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC and sense outputs or grounds.*

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

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

      - Set the output of a DC calibration generator to off or 0 volts.
      - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-12.
      - Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through a 10X attenuator and an adapter. See Figure 4-12.

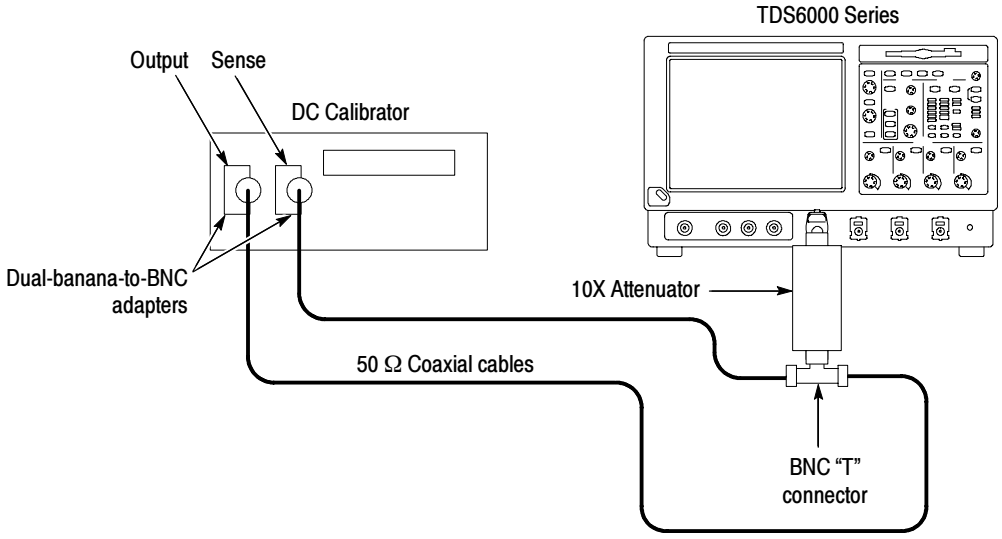


Figure 4- 12: Initial test hookup

b. *Initialize the oscilloscope:* Press **DEFAULT SETUP**.

c. *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for maximum input voltage:* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1.*

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

b. *Turn on the measurement High for the channel:*

- From the tool bar, touch **MEAS** and select the **Ampl** tab, then touch **High** to measure the high of the current channel.

- Press **Close**.

c. *Set the vertical scale:*

- Set the vertical **SCALE** to one of the settings listed in Table 4–4 that is not yet checked. (Start with the first setting listed).
- From the tool bar touch **VERT** and touch **Position**.
- Use the keypad to set vertical position to –3 divisions (press **CLR**, **3**, **-**, and then **ENTER**, on the keypad).
- Set the Coupling to **DC**.
- Touch **Offset**.
- Use the keypad to set vertical offset to 0 V.
- Press **Close**.

Table 4-4: Maximum input voltage limit

Scale setting	Position setting (Divs)	Offset setting	Generator setting	Readout with 10X attenuator	Limits (without 10X attenuator)
50 mV	-3	0 V	+1 V	+100 mV	Coupling in CH readout stays Ω
			+3 V	+300 mV	Coupling changes to ground
1 V	-3	0 V	+5 V	+500 mV	Coupling in CH readout stays Ω
			+10 V	+1.0 V	Coupling changes to ground

d. *Display the test signal:* Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made, or set the generator for the readout indicated in the table for the vertical scale, position, and offset settings you have made. See Figure 4–13.

***NOTE**. When setting the Wavetek to output 10 V, use the following procedure:*
*Press the **Aux** button*
Press the fourth soft key down (Selects the pulse with an exclamation point)
Set the amplitude to 10 V
*Press the **->|** key to select the pulse energy*
Set the energy to 50J
*Press the Output **On** key*
*Press the **Trig Pulse** soft key to trigger the pulse (this will generate a 10 V pulse with 25 seconds duration).*

Use the normal DC output for the 1 V, 3 V, and 5 V generator settings.

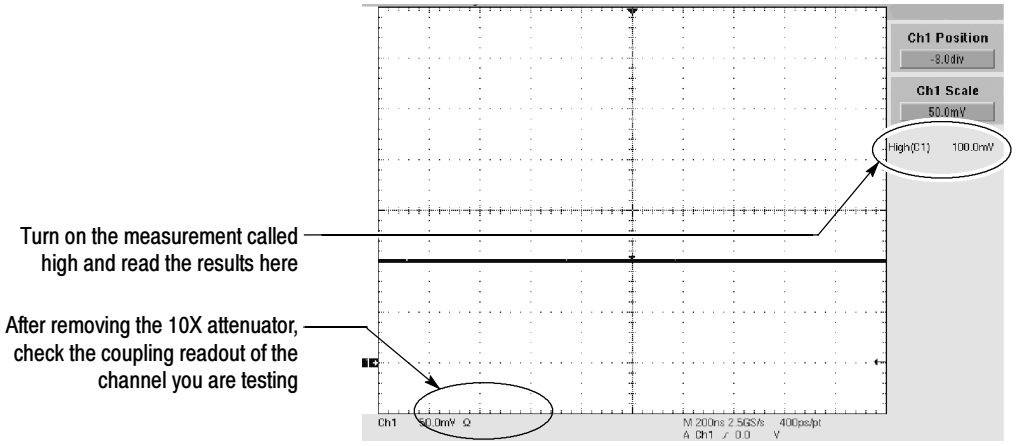


Figure 4- 13: Check of maximum input voltage

e. *Check an unchecked generator setting against limits:*

- Remove the 10X attenuator.
- Connect the generator signal directly to the oscilloscope.
- CHECK that the coupling readout on screen for the selected channel is as listed for the current vertical scale and position/offset/generator settings.
- Reinstall the 10X attenuator.

f. *Check the next generator setting:* Repeat substeps d and e, using the new generator setting as is listed in the table.

g. *Check the remaining vertical scale settings:* Repeat substeps c through f until all vertical scale settings, listed in Table 4–4, are checked for the channel under test.

h. *Test all channels:* Repeat substeps a through g for all vertical channels.

3. *Disconnect the hookup:*

a. *Set the generator output to 0 V.*

b. Disconnect the cable, attenuator, and adapter from the generator output and the input connector of the channel last tested.

Check Analog Bandwidth

Equipment required	One sine wave generator (Item 12) One level meter and power sensor (Item 13) One power divider (Item 14) One female N to male BNC adapter (Item 16) Four male N to female BNC adapters (Item 15) Two 50 Ω precision cables (Item 4) Attenuators (Items 1 and 2) One SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

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

a. *Initialize the oscilloscope:*

- Press **DEFAULT SETUP**.

b. *Modify the default settings:*

- Turn the horizontal **SCALE** knob to 200 ns.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab. Set the acquisition mode as follows:

  TDS6604: Touch **Sample**.

  TDS6404: Touch **Average** and set the number of averages to **16**.
- Set the sampling mode as follows:

  TDS6604: Touch the **Interpolated Real Time IT** button.

  TDS6404: Touch the **Equivalent Time ET** button.
- From the tool bar, touch **MEAS**. Touch Setup **Ref Levs**; then touch the Determine Base, Top Form **Min-Max** button.

***NOTE**. The sine wave generator output amplitude must be leveled to within 0.35 db of the reference frequency (10 MHz) through the bandwidth frequency listed in Table 4–5 on page 4–42. The 0.35 db requirement is necessary to ensure a bandwidth that meets Tektronix specifications.*

You can perform bandwidth PV using an unleveled sine wave generator (with amplitude error > 0.35 db). Under these conditions, the bandwidth PV is subject to the flatness errors associated with the generator used.

Refer to the Sine Wave Generator Leveling Procedure *on page 4–89 if your sine wave generator does not have automatic output amplitude leveling.*

c. *Hook up the test-signal source:* Connect the sine wave output of a leveled sine wave generator to **CH 1**. Set the output of the generator to a reference frequency of 50 MHz or less. See Figure 4–14.

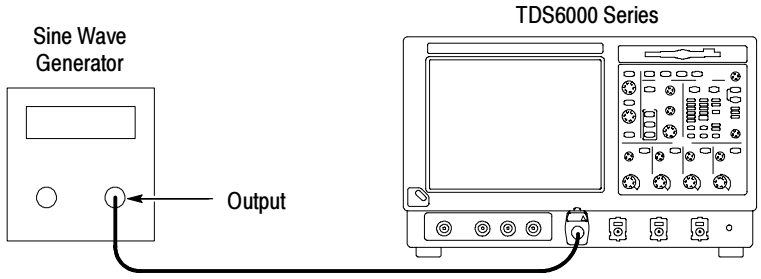


Figure 4- 14: Initial test hookup

2. *Confirm the input channels are within limits for analog bandwidth:* Do the following substeps — test CH 1 first, *skipping substeps* a *and b since CH 1 is already set up for testing from step 1.*

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove all previous measurements.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- Move the leveled output of the sine wave generator to the channel you selected.

b. *Match the trigger source to the channel selected:* Press the Trigger **SOURCE** button until the source that corresponds to the channel you are to confirm is on.

c. *Set the vertical scale:* Set the vertical **SCALE** that corresponds to the channel you are to confirm to one of the settings listed in Table 4–5 not yet checked. (Start with the 100 mV setting).

d. *Set the triggering coupling:* Touch the Coupling **DC** button.

Table 4-5: Analog bandwidth

Vertical scale	Reference amplitude (6 divisions)	Horizontal scale	Test frequency		Limits
			TDS6404	TDS6604	-3 dB Limits
10 mV	60 mV	1 ns	4 GHz	6 GHz	≥42.4 mV
20 mV	120 mV	1 ns	4 GHz	6 GHz	≥84.8 mV
50 mV	300 mV	1 ns	4 GHz	6 GHz	≥212 mV
100 mV	600 mV	1 ns	4 GHz	6 GHz	≥424 mV
200 mV	1.2 V	1 ns	4 GHz	6 GHz	≥848 mV
500 mV	3 V[1]	1 ns	4 GHz	6 GHz	≥2.12 V[1]
1 V	5 V[1]	1 ns	4 GHz	6 GHz	≥3.535 V[1]

[1] **If your generator cannot output the required amplitude, determine its maximum output at the Test frequency, and use this for the reference amplitude. The -3 db limit can be calculated as: 0.707 × reference amplitude.**

e. *Display the test signal:* Do the following subparts to first display the reference signal and then the test signal.

- From the button bar touch **MEAS**; then select the **Time** tab.
- Touch the **Freq** button to measure the frequency of the current channel.
- Select the **Ampl** tab. Touch the **Pk-Pk** button.
- Touch **Close** button.
- Set the generator output so the CHx Pk-Pk readout equals the reference amplitude in Table 4–5 that corresponds to the vertical scale set in substep c.

- Set the trigger as follows:

  TDS6604: Touch the Source **Line** button.

  TDS6404: Press the front-panel **PUSH TO SET 50%** as necessary to trigger a stable display. At full bandwidth, you may also want to make small, manual adjustments to the trigger level. You can use the **Trigger LEVEL** knob to do this.

f. *Measure the test signal:*

- Set the frequency of the generator, as shown on screen, to the test frequency in Table 4–5 that corresponds to the vertical scale set in substep c. See Figure 4–15.
- Set the horizontal **SCALE** to the horizontal scale setting in Table 4–5 that corresponds to the vertical scale set in substep c. Press **PUSH TO SET 50%** as necessary to trigger the signal.
- Read the results at the CHx Pk-Pk readout, which will automatically measure the amplitude of the test signal. See Figure 4–15.

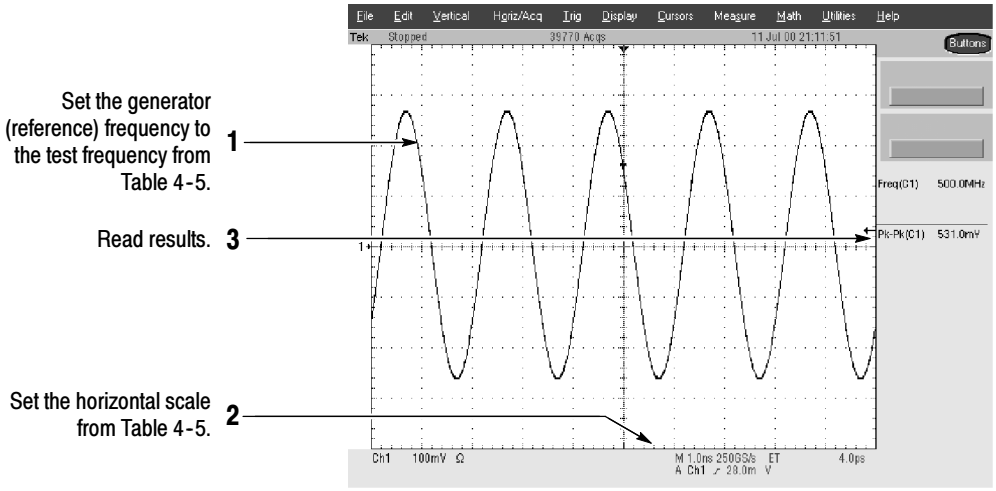


Figure 4-15: Measurement of analog bandwidth

g. *Check against limits:*

- CHECK that the **Pk-Pk** readout on screen is within the limits listed in Table 4–5 for the current vertical scale setting.
- Enter voltage on the test record.
- When finished checking, set the horizontal **SCALE** back to the 40 ns setting.

STOP*. Checking each channel's bandwidth at all vertical scale settings is time consuming and unnecessary. You may skip checking the remaining vertical scale settings in Table 4–5 (that is, skip the following substep, h) if this oscilloscope has performed as follows:*

- Passed the 100 mV vertical scale setting just checked in this procedure.
- Passed the *Verify Internal Adjustment, Self Compensation, and Diagnostics* procedure found under *Self Tests,* on page 4–5.

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

h. *Check remaining vertical scale settings against limits (optional):*

- If desired, finish checking the remaining vertical scale settings for the channel under test by repeating substeps c through g for each of the remaining scale settings listed in Table 4–5 for the channel under test.
- When doing substep e, skip the subparts that turn on the CHx Pk-Pk measurement until you check a new channel.
- Before doing substep f, touch the **Clear** button to remove the previous channel measurements.
- Install/remove attenuators between the generator leveled output and the channel input as needed to obtain the six division reference signals listed in the table.
- When finished bandwidth checks for a particular channel, clear all measurements for that channel.

i. *Test all channels:* Repeat substeps a through g for all four channels.

3. *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last tested.

Check Delay Between Channels

Equipment required	One sine wave generator (Item 12) Three precision 50 Ω coaxial cables (Item 4) One power divider (Item 14) 3 SMA female to female adapter connector (Item 17) 3 SMA male-to-female BNC adapter connector (Item 18) Two SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

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

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

   a. *Initialize the front panel:* Press the **DEFAULT SETUP** button.

   b. *Modify the initialized front-panel control settings:*

   - Do *not* adjust the vertical position of any channel during this procedure.
   - Set the horizontal **SCALE** to 500 ps.
   - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
   - Touch **Average** and set the number of averages to **16**.

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

   - Connect the sine wave output of a sine wave generator to a 50 Ω precision coaxial cable followed by a power divider.
   - Connect the power divider to both **CH 1** and **CH 2**. See Figure 4-16.

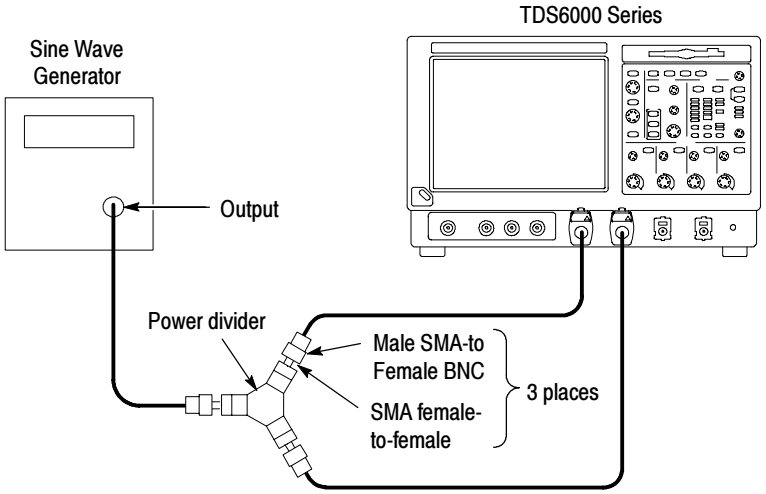


Figure 4-16: Initial test hookup

2. *Confirm all four channels are within limits for channel delay:*

   a. *Set up the generator:* Set the generator frequency to 500 MHz and the amplitude for six to eight divisions in CH 1.

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

   b. The horizontal **SCALE** should already be set to 500 ps. Now set it to 125 ps.

   c. *Save a CH 2 waveform:* Press the **CH 2** Vertical button. From the button bar, touch the **Refs** button and select the **Ref 2** tab. Touch the Save Wfm to Ref2 **Save** button.

   d. *Save CH 3 waveform:*

   - Move the power divider from **CH 2** to **CH 3**, so that **CH 1** and **CH 3** are driven. Press the Vertical **CH 2** and **CH 3** buttons. Select the **Ref 3** tab and touch the Ch Channel **3** button. Touch the Save Wfm to Ref3 **Save** button.

   e. *Display all test signals:*

   - Press the **CH 3** Vertical button to remove CH 3 from the display.
   - Display the live waveform. Move the power divider from **CH 3** to **CH 4**, so that CH 1 and CH 4 are driven. Press the Vertical **CH 4** button to display. See Figure 4–17 on page 4–47.

- Display the reference waveforms. To do this, touch the Ref 3 Display **Off** button to toggle it to On and display the reference. Select the **Ref 2** tab and touch the Display **Off** button to toggle it to On. You may notice their overlapping waveform handle icons. See Figure 4–17 on page 4–47.

f. *Measure the test signal:*

- Locate the time reference points for these waveforms. Do this by first identifying the point where the rising edge of the left-most waveform crosses the center horizontal graticule line. Next, note the corresponding *time reference point* for the right-most waveform. See Figure 4–17 on page 4–47.
- Press **CURSORS** and select the **V Bars** Cursors Type.
- Touch the **Close** button.

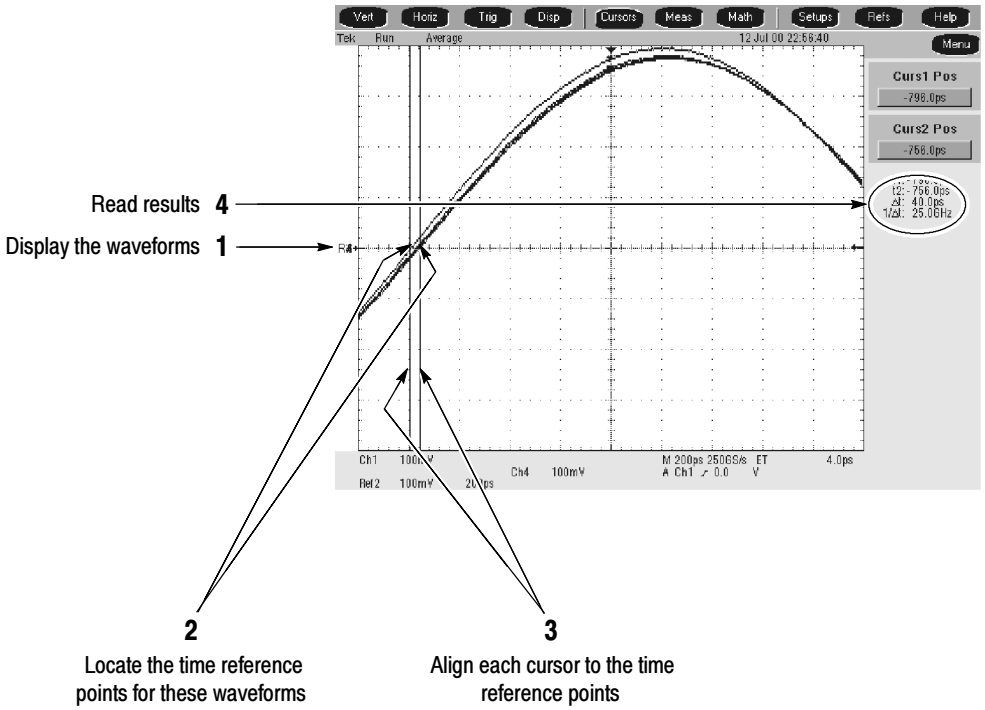


Figure 4-17: Measurement of channel delay

g. *Check against limits:* Use the cursors to measure the skew from CH 1 to CH 2, CH 1 to CH 3, and CH 1 to CH 4. Write down these three numbers in the first measurement column of Table 4–6. Note that these numbers may be either positive or negative.

h. Move the power divider on CH 1 to CH 2. Move the power divider on CH 4 to CH 1.

***NOTE**. To eliminate errors caused by cables and adapters, the measurements are repeated and averaged after swapping channel position of cables.*

i. Repeat the procedure from step 2.c through 2.e.

j. Again use the cursors to measure the skew from CH 1 to CH 2, CH 1 to CH 3, and CH 1 to CH 4. Write down these numbers in the second measurement column of Table 4–6. Note that these numbers may be either positive or negative.

k. Add the first CH 1 to CH 2 skew measurement to the second CH 1 to CH 2 skew measurement and divide the result by 2. Use Table 4–6.

l. Add the first CH 1 to CH 3 skew measurement to the second CH 1 to CH 3 skew measurement and divide the result by 2. Use Table 4–6.

m. Add the first CH 1 to CH 4 skew measurement to the second CH 1 to CH 4 skew measurement and divide the result by 2. Use Table 4–6.

n. Check against limits: CHECK that the largest of the three results from steps k, l, and m is between –30 ps and + 30 ps.

o. Enter the time on the test record.

Table 4-6: Delay between channels worksheet

Coupling	First measurement	Second measurement	Add first and second measurements	Divide sum by 2
CH 1 to CH 2 skew				
CH 1 to CH 3 skew				
CH 1 to CH 4 skew				

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

Check Channel Isolation (Crosstalk)

Equipment required	One leveled sine-wave generator (Item 12) One 2X attenuator (Item 26) Four TCA-BNC adapters (Item 19) Three 50 Ω terminators (Item 3) One 50 Ω, precision coaxial cable (Item 4)
Prerequisites	See page 4-17

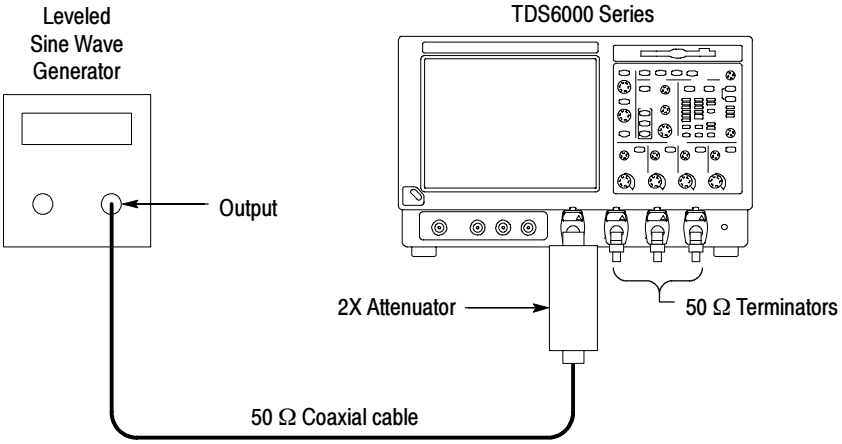


Figure 4-18: Initial test hookup

1. *Install the test hookup and preset the instrument controls:*
   - **a.** *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.
   - **b.** *Modify the initialized control settings:*
     - Turn on all vertical channels (press the Vertical button of any off channels: CH 1, CH 2, CH 3, and CH 4).
     - Set the Horizontal SCALE to **1.25 ns**.
     - Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **100 mV**.
     - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
     - Touch **Average** and set the number of averages to **16**.
     - Touch the **Equivalent Time ET** button.
     - From the button bar, touch **MEAS**.
     - Touch the Source Channel **1** button.

- Select the **Ampl** tab; then touch the **Amplitude** button.
- Touch **Close**.
- Set the Trigger SOURCE to **CH 1**.
- Press **PUSH TO SET 50%**.

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

- Connect, through a 50 Ω precision coaxial cable, a 2X attenuator, and a TCA-BNC adapter, the output of the generator to **CH 1** (see Figure 4–18).
- Connect TCA-BNC adapters to the CH 2, CH 3, and CH 4 inputs.
- Connect 50 Ω terminators to the adapters on the CH 2, CH 3, and CH 4 inputs.

2. *Display the test signal:*

- Set the generator to output a 1.5 GHz sine wave. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. Readout may fluctuate around 500 mV.
- Remove the 2X attenuator.

3. Confirm the input channels are within limits for channel isolation:

a. Check — Amplitude of each trace other than CH 1 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

b. Move the signal to the **CH 2** input connector, change the Trigger SOURCE to **CH 2**, and move the 50 Ω terminator to the CH 1 input.

c. Check — Amplitude of each trace other than CH 2 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

d. Move the signal to the **CH 3** input connector, change the Trigger SOURCE to **CH 3**, and move the 50 Ω terminator to the CH 2 input.

e. Check — Amplitude of each trace other than CH 3 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

f. Move the signal to the **CH 4** input connector, change the Trigger SOURCE to **CH 4**, and move the 50 Ω terminator to the CH 3 input.

g. Check — Amplitude of each trace other than CH 4 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

h. Select an unchecked vertical SCALE:

- Connect the 2X attenuator to the CH 1 input.
- Move the signal to the CH1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **50 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 250 mV. Readout may fluctuate around 250 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.
- Connect the 2X attenuator to CH 1.
- Move the signal to the CH 1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **10 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 50 mV. Readout may fluctuate around 50 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.

4. *Display the test signal:*

- Connect the 2X attenuator to CH 1.
- Move the signal to the CH 1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **100 mV**.

- Set the Horizontal SCALE to 2 to 5 cycles of the signal.
- Set the generator output at a sine wave of **4 GHz** bandwidth to check your oscilloscope. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. Readout may fluctuate around 500 mV.
- Remove the 2X attenuator.

5. Confirm the input channels are within limits for channel isolation:

a. Check — Amplitude of each trace other than CH 1 is 0.5 division or less (discount trace width). Enter the largest amplitude on the test record.

b. Move the signal to the CH 2 input connector, change the Trigger SOURCE to CH 2, and move the 50 Ω terminator to the CH 1 input.

c. Check — Amplitude of each trace other than CH 2 is 0.5 division or less (discount trace width). Enter the largest amplitude on the test record.

d. Move the signal to the CH 3 input connector, change the Trigger SOURCE to CH 3, and move the 50 Ω terminator to the CH 2 input.

e. Check — Amplitude of each trace other than CH 3 is 0.5 division or less (discount trace width). Enter the largest amplitude on the test record.

f. Move the signal to the CH 4 input connector, change the Trigger SOURCE to CH 4, and move the 50 Ω terminator to the CH 3 input.

g. Check — Amplitude of each trace other than CH 4 is 0.5 division or less (discount trace width). Enter the largest amplitude on the test record.

h. Select an unchecked Vertical SCALE:

- Connect the 2X attenuator to CH 1.
- Move the signal to CH 1, set the Trigger SOURCE to CH 1, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **50 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 250 mV. Readout may fluctuate around 250 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.

- Connect the 2X attenuator to CH 1.
- Move the coaxial cable to CH 1, set the Trigger SOURCE to CH 1, and move the 50 Ω terminator to the CH 4 input.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **10 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 50 mV. Readout may fluctuate around 50 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.

6. *Disconnect the hookup:* Disconnect the cable, terminators, and adapters from the generator output and the input connector of the channel.

Check Input Impedance

Equipment required	One Digital Multimeter (Item 27) One Dual-Banana Connector, (Item 5) One precision 50 Ω coaxial cable (Item 4) One SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

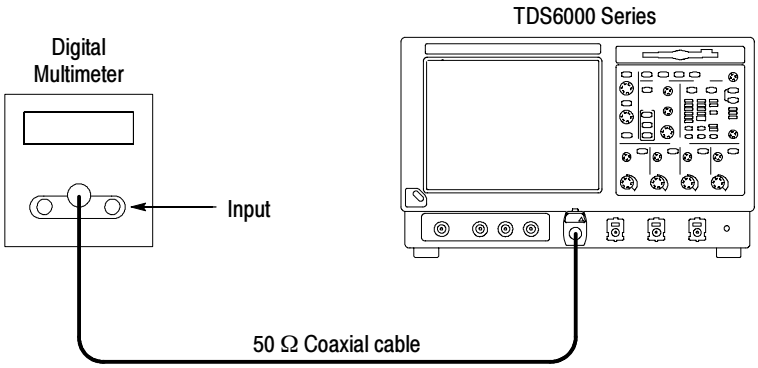


Figure 4-19: Initial test hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the input of the multimeter to **CH 1** through adapters (see Figure 4–19).
   b. Set the Vertical **SCALE** to **10 mV** per division
2. *Check input impedance against limits:*
   a. *Measure the impedance:* Read and record the measured impedance.
   b. Remove the dual banana connector from the digital multimeter (DMM), turn it 180 degrees and reinsert it in the DMM input.
   c. *Measure the impedance:* Read and record the measured impedance.
   d. Add the two measurements and divide the result by 2.
   e. Check — Average of the two measurements is ≥48.75 Ohms and ≤51.25 Ohms. Enter average on the test record.
3. Set the Vertical **SCALE** to **100 mV** per division and repeat step 2.
4. *Repeat steps 2 through 3 for the remaining input channels:*
   a. Move the test setup to an unchecked input channel.
   b. Set the Vertical **SCALE** of the channel to **10 mV** per division.
   c. Repeat steps 2 *through 3*.
5. *Disconnect the hookup:* Disconnect the equipment from the oscilloscope.

Time Base System Checks

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

Check Long-Term Sample Rate and Delay Time Accuracy and Reference

Equipment required	One timer-counter (Item 11) One 50 Ω, precision coaxial cable (Item 4) One SMA male-to-female BNC adapter (Item 19) One sine wave generator (Item 12)
Prerequisites	See page 4-17

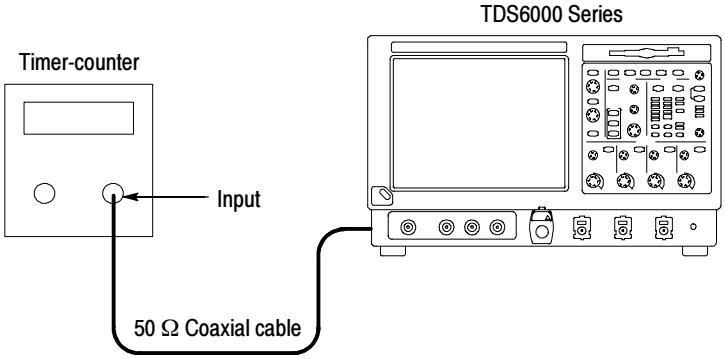


Figure 4-20: Initial test hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the input of the timer-counter to **REF OUT** (see Figure 4-20).
      - Set the timer-counter gate to 1 s.
      - Set the timer-counter to count the reference output.
   b. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.
2. *Confirm the time base is within limits for accuracies:*
   a. *Check long-term sample rate and delay time accuracies against limits:*
      - CHECK that the count on the timer-counter is within limits.
      - Enter the count on the test record.

3. *Confirm reference is within limits for logic levels:*

   a. *Display the test signal:*

      - Move the cable from the timer-counter to the CH 1 input through an adapter.
      - Set the Vertical **SCALE** to 1 V.
      - Use the Vertical **POSITION** knob to center the display on screen.

   b. *Measure logic levels:*

      - From the button bar, touch **MEAS** and select the **Ampl** tab.
      - Touch the **High** and **Low** buttons.
      - Touch the **Close** button.

   c. *Check REF OUT output against limits:* CHECK that the **CH 1 High** readout is ≥1.0 volt and that the **CH 1 Low** readout ≤0.25 volts.

4. *Disconnect the hookup:* Disconnect the cable and adapter from the oscilloscope.

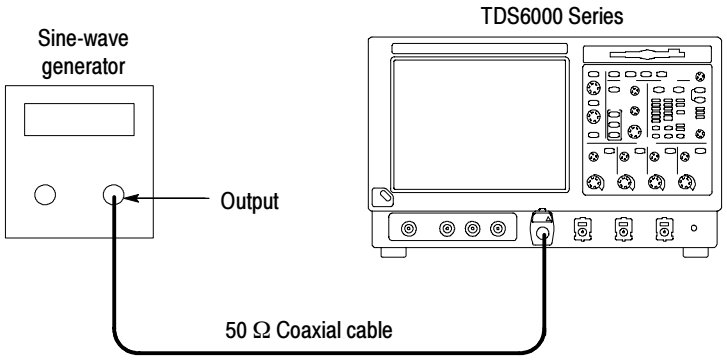


Figure 4- 21: Initial test hookup

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

   a. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.

   b. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the output of the sine wave generator to **CH 1** input through an adapter (see Figure 4–21).

      - From the button bar, touch **MEAS** and select the **Ampl** tab.
      - Touch the **Pk-Pk** button.

- Touch the **Close** button.
- Set the Vertical **SCALE** to 50 mV.
- Set the generator for a 10.0 MHz sine wave.
- Set the generator to output a 4 division signal. Adjust the output until the Pk-Pk readout displays 200 mV.

c. *Set the oscilloscope controls:*

- Move the cable from the **CH 1** input to the rear-panel **Ext Ref** input (see Figure 4–22).
- Touch **Menu** to select menu mode.
- Touch **Utilities** and select **External Signals**.
- Touch the **Internal** button to select the external reference (the button name changes to External).

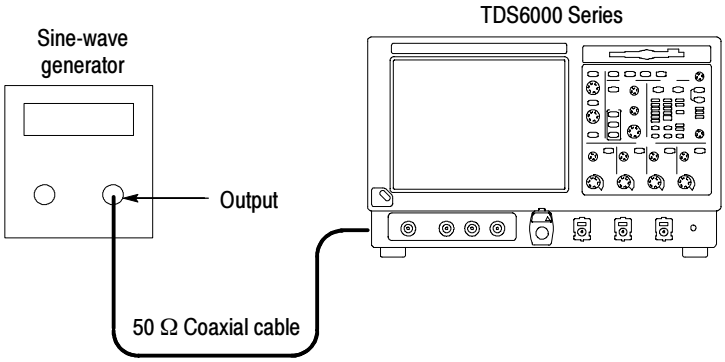


Figure 4- 22: Final test hookup

6. *Confirm external reference:*

a. *Perform a signal path compensation:*

- Touch **Utilities** and select **Instrument Calibration**.
- Touch **Calibrate** and wait for the signal path compensation to finish.

b. *Check the completion status:* If the Status is Fail, refer the instrument to qualified service personnel.

7. *Disconnect the hookup:*

a. Disconnect all test equipment from the oscilloscope.

b. *Set the instrument controls:*

- From menu mode, touch **Utilities** and select **External Signals**.
- Touch the **External** button to select the internal reference (the button name changes to Internal).

c. *Perform a signal path compensation:*

- Touch **Utilities** and select **Instrument Calibration**.
- Touch **Calibrate** and wait for the signal path compensation to finish.

Check Delta Time Measurement Accuracy

Equipment required	One 50 Ω, precision coaxial cable (Item 4) One Connector, BNC "T", male BNC-to-dual female BNC (Item 6) One Pulse Generator, Wavetek 9500 or equivalent (Item 20) Two 50 Ω, coaxial cable, male-to-male SMA connectors (Item 21) One SMA female to BNC male connector (Item 23) One BNC elbow connector (Item 24) One SMA "T", male to two SMA female connectors (Item 22) Two SMA terminator connectors, short circuit, (Item 25) One SMA male-to-female BNC adapter (Item 19) One 2X attenuator, 50 Ω, female BNC-to-male BNC (Item 26)
Prerequisites	See page 4-17

This procedures checks the "sample rate" portion of the Delta Time Measurement Accuracy as listed in *Specifications.* The previous procedure, *Check Accuracy for Long-Term Sample Rate and Delay Time Accuracy and Reference*, see page 4–55, verified the "PPM" portion of the delta time specification.

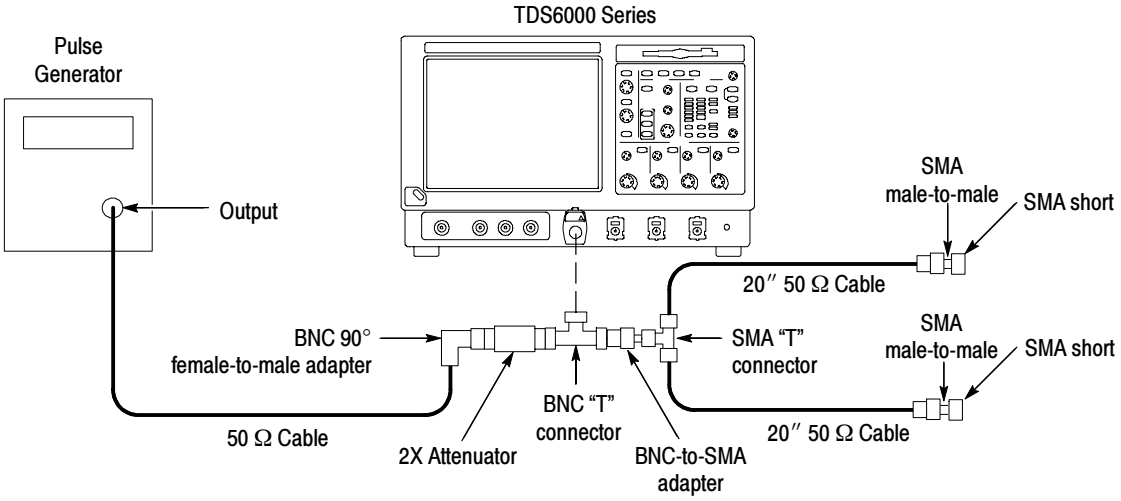


Figure 4-23: Delta time accuracy test hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.

b. *Hook up the pulse generator (see Figure 4–23 on page 4–59):*

- Connect the pulse generator output to a **50 Ω** precision coaxial cable followed by a 90° right-angle female to male BNC adapter, then a **50 Ω** 2X attenuator. The attenuator is connected to one side of the female BNC T connector. The other side of the BNC T is connected to BNC male to SMA adapter. The SMA side is connected to the male side of the SMA T connector. (Keep the distance between the BNC T and SMA T as short as possible). Connect 20 inch **50 Ω** coaxial cables to each female side of the SMA T connector. Connect a female to female SMA adapter to both male coaxial connectors. Connect the SMA short, to the remaining female SMA adapter. Now connect the male BNC T connector to **CH 1**.
- Set the pulse generator output for a positive-going pulse with a rise-time as shown in Table 4–7 on page 4–61 for your oscilloscope, and for the fastest possible rep rate (at least 1 kHz).
- Set the pulse generator output for about 500 mV. (This amplitude can be adjusted later to get a 5-division pulse on screen.)

c. *Modify the initialized front-panel control settings:*

- Press **AUTOSET**. You may see both positive and negative pulses. Adjust the Trigger **LEVEL** knob so the trigger level is about 50% of the rising edge of the positive pulse.
- From the button bar, touch the **Horiz** button and select the **Acquisition** tab. Touch the **Real Time Only RT** button.
- Set the horizontal SCALE to 5 ns/division. The pulse width should be about **6 ns**. The indicated sample rate should be 20 GS/s.
- Adjust pulse amplitude and oscilloscope vertical scale and position as necessary to obtain about **5 divisions** of the **positive** pulse.

***NOTE**. If you have followed the procedure, you should have a 250 mV pulse displayed on screen. Later in this procedure you will set the instrument to measure the pulse width at the 150 mV level.*

If the pulse you supply to the instrument is not a 250 mV pulse, you may need to set the reference level (MidRef) to something other than 150 mV. Set the reference level near the center of the pulse, above any noise, and below any overshoot or ringing on the pulse.

---

d. *Set up for statistics measurements:*

- Re-adjust the Trigger **LEVEL** knob so the trigger level is about 50% of the rising edge of the positive pulse.

- Press **RUN/STOP** button to freeze the display.
- Touch **MEAS** and select the **Time** tab to bring up the Time Measurements menu.
- Touch the **Positive Width** button.
- Touch Setup **Statistics**. Touch the Measurement Statistics **All** button and then touch **Reset** to reset the statistics.
- Touch **Weight n=**. On the keypad press **1000**, then **ENTER**. Touch **Setup**.
- Touch Setup **Ref Levs** and and then touch **Absolute**.
- Touch **MidRef**. Using the keypad or multipurpose knobs, set the mid reference to **150 mV**. Touch **Close**.
- Press the **RUN/STOP** button to start the acquisitions.
- Wait about 30 seconds.
- Press **RUN/STOP** button to freeze the display.
- Record the all statistics values.
- Calculate the difference of the Maximum (M) minus the mean (μ) of the statistics values.
- Calculate the difference of the mean (μ) minus the Minimum (m) of the statistics values.
- Both differences must be less than or equal to the Delta-time accuracy limit shown in Table 4–7 for your oscilloscope.
- Enter the result for delta time on the test record.

Table 4-7: Delta time measurement

Oscilloscope type	Pulse generator rise time range	Delta time accuracy limit
TDS6604	≤150 ps	≤0.015 ns
TDS6404	≤150 ps	≤0.015 ns

e. *Repeat for all other channels:*

- Note the vertical scale setting of the channel just confirmed.
- Press the Vertical channel button for the channel just confirmed to remove the channel from display.

- Touch **MEAS** and the **Clear** to remove the measurement.
- Press the front-panel button that corresponds to the channel you are to confirm.
- Set vertical SCALE to the setting noted in step e, first bullet.
- Press the Trigger Source button to toggle the source to the channel selected.
- Move the test hookup to the channel you selected.
- Press **RUN/STOP** button to start the display.
- Repeat step d.

2. *Disconnect all test equipment from the oscilloscope.*

Trigger System Checks

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

Check Time Accuracy for Pulse, Glitch, Timeout, and Width Triggering

Equipment required	One sine wave generator (Item 12) One 10X attenuator (Item 1) One 50 Ω, precision coaxial cable (Item 4) One SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the instrument:* Press the **DEFAULT SETUP** button.
   b. *Modify the default setup:* Set the horizontal **SCALE** to 10 ns.
   c. *Hook up the test-signal source:* Connect the output of the sine wave generator (Item 12) to CH 1.

      Do this through a 50 Ω precision coaxial cable, followed by a 10X attenuator and adapter. See Figure 4-24.

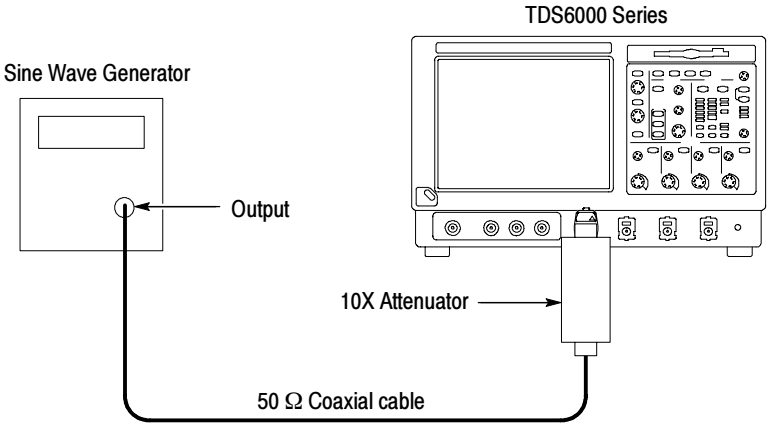


Figure 4-24: Initial test hookup

2. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (time range ≤500 n*s*):*

   a. *Display the test signal:* Set the output of the sine wave generator for a 100 MHz, five-division sine wave on screen. Press **PUSH TO SET 50%**.

   b. *Set the trigger mode:* Press the Trigger **MODE** button to toggle it to **NORMAL**.

   c. *Set upper and lower limits that ensure triggering:* See Figure 4–25.

   - Press the front-panel **ADVANCED** button and select the **A Event** tab; then select width triggering by touching the **Width** button.
   - Touch the **Trig When** button and select **Inside** limits.
   - Touch **Upper Limit** and use the keyboard to set the upper limit to 10 ns: press **10**, then **n**, and **ENTER**.
   - Touch **Lower Limit** and use the keypad to set the lower limit to 2 ns.

   d. *Change limits until triggering stops:*

   - Press **PUSH TO SET 50%**.
   - While doing the following subparts, monitor the display (it will stop acquiring) and the front-panel light **TRIG'D** (it will extinguish) to determine when triggering is lost.
   - Use the multipurpose knob to *increase* the **Lower Limit** readout until triggering is lost.

- CHECK that the **Lower Limit** readout, after the oscilloscope loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
- Enter the time on the test record.
- Use the keypad to return the **Lower Limit** to 2 ns and reestablish triggering.
- Touch **Upper Limit**; then use the multipurpose knob to slowly *decrease* the **Upper Limit** readout until triggering is lost.
- CHECK that the **Upper Limit** readout, after the oscilloscope loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
- Enter the time on the test record.

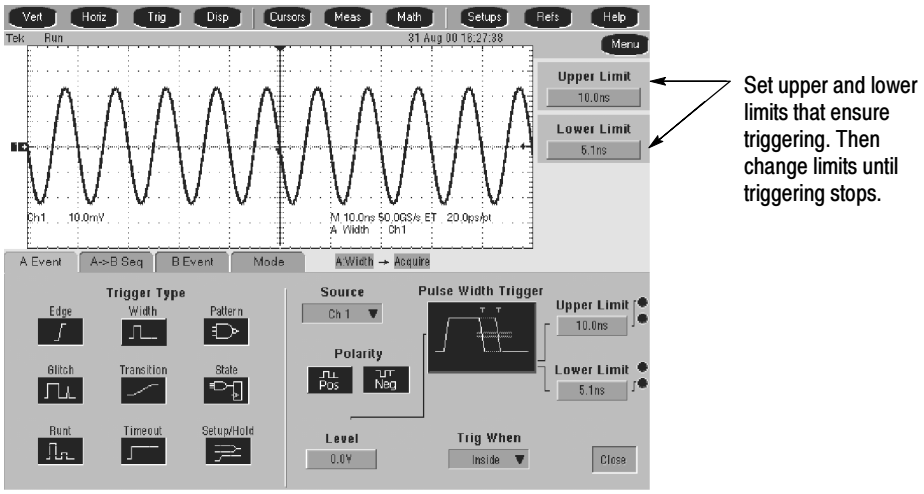


Figure 4- 25: Measurement of time accuracy for pulse and glitch triggering

3. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (time range >520 ns):*

a. *Set upper and lower limits that ensure triggering at 250 kHz:*

- Touch **Upper Limit**. Use the keyboard to set the upper limit to 4 µs.
- Touch **Lower Limit**. Use the keypad to set the lower limit to 500 ns.

b. *Display the test signal:*

- Set the Horizontal **SCALE** to 4 µs.

- Set the output of the sine wave generator for a 250 kHz, five-division sine wave on screen. Set the Vertical **SCALE** to 20 mV (the waveform will overdrive the display).
- Press **PUSH TO SET LEVEL 50%**.

c. *Check against limits:* Do the following subparts in the order listed.

- Use the multipurpose knob to *increase* the **Lower Limit** readout until triggering is lost.
- CHECK that the **Lower Limit** readout, after the oscilloscope stops triggering, is within 1.9 µs to 2.1 µs, inclusive.
- Enter the time on the test record.
- Use the keypad to return the **Lower Limit** to 500 ns and reestablish triggering.
- Touch **Upper Limit**; then use the multipurpose knob to slowly *decrease* the **Upper Limit** readout until triggering stops.
- CHECK that the **Upper Limit** readout, after the oscilloscope loses triggering, is within 1.9 µs to 2.1 µs, inclusive.
- Enter the time on the test record.

4. *Disconnect the hookup:* Disconnect the cable and adapter from the generator output and the input connector of **CH 1**.

Check Sensitivity, Edge Trigger, DC Coupled

Equipment required	One sine wave generator (Item 12) Two precision 50 Ω coaxial cables (Item 4) One 10X attenuator (Item 1) One BNC T connector (Item 6) One SMA male-to-female BNC adapter (Item 19) One 5X attenuator (Item 2) One 50 Ω terminator (Item 3)
Prerequisites	See page 4-17.

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

a. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.

b. *Modify the initialized front-panel control settings:*

- Set the Horizontal **SCALE** to 20 ns.

- Press the Trigger **MODE** button to toggle it to **Normal**.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.
- Touch the **Equivalent Time ET** button.

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

- Connect the signal output of the generator to a BNC T connector. Connect one output of the T connector to **CH 1** through a 50 Ω precision coaxial cable and an adapter. Connect the other output of the T connector to a 50 Ω terminator. Connect the terminator to the **AUX INPUT**. See Figure 4–26.

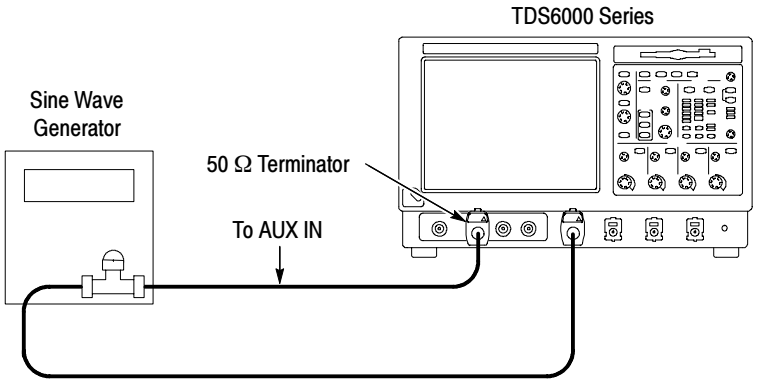


Figure 4-26: Initial test hookup

2. *Confirm the trigger system is within sensitivity limits (50 MHz):*

a. *Display the test signal:*

- Set the generator frequency to 50 MHz.
- From the button bar, touch **MEAS**.
- Touch Setup **Ref Levs**; then touch the **Min-Max** button.
- Touch the **Setup** button and select the **Ampl** tab; then touch the **Amplitude** button.
- Touch **Close**.
- Press **PUSH TO SET 50%**.

- Set the test signal amplitude for about three and a half divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 350 mV. Readout may fluctuate around 350 mV.
- Disconnect the 50 Ω precision coaxial cable at **CH 1** and reconnect it to **CH 1** through a 10X attenuator.

b. *Check the Main trigger system for stable triggering at limits:*

- Read the following definition: A stable trigger is one that is consistent; that is, one that results in a uniform, regular display triggered on the selected slope (positive or negative). This display should *not* have its trigger point switching between opposite slopes, nor should it roll across the screen. At horizontal scale settings of 2 ms/division and faster, **TRIG'D** will remain constantly lighted. It will flash for slower settings.
- Press the Trigger **Slope** button to select the positive slope.
- Adjust the Trigger **LEVEL** knob so that there is a stable trigger. CHECK that the trigger is stable for the test waveform on the positive slope.
- Press the Trigger **Slope** button to select the negative slope. Adjust the Trigger **LEVEL** knob so that there is a stable trigger.
- CHECK that the trigger is stable for the test waveform on the negative slope.
- Leave the trigger system triggered on the positive slope of the waveform before continuing to the next step.

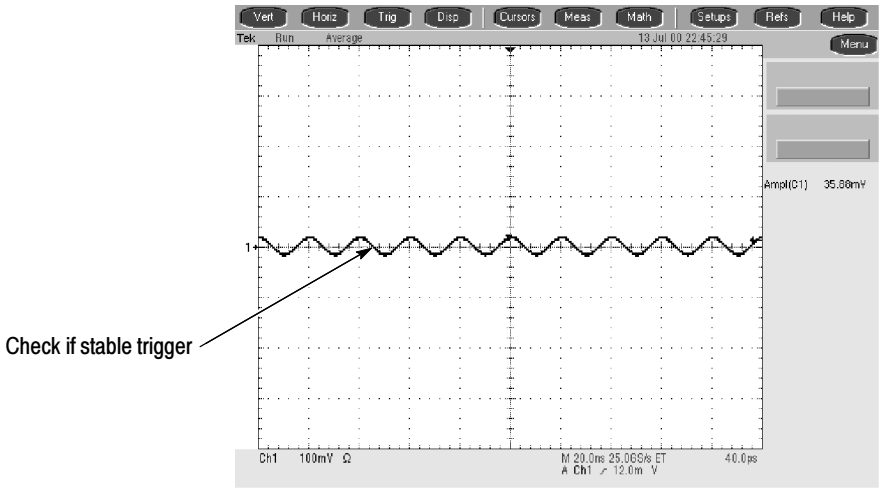


Figure 4- 27: Measurement of trigger sensitivity - 50 MHz results shown

c. *Check Delayed trigger system for stable triggering at limits:* Do the following subparts in the order listed.

- From the button bar select **Trig**. Select the **A->B Seq** tab, and touch the A then B **Trig After Time** button.
- Select the **B Event tab**, and touch the **Set 50%** button.
- CHECK that a stable trigger is obtained for the test waveform for both the positive and negative slopes of the waveform. Use the **TRIGGER LEVEL** knob to stabilize the Main trigger. Touch **B Trig Level** and use the keypad or the multipurpose knob/FINE button to stabilize the Delayed trigger. Touch one of the Slope buttons to switch between trigger slopes. See Figure 4–27 on page 4–68.
- Leave the Delayed trigger system triggered on the positive slope of the waveform before continuing to the next step. Also, return to the main trigger: select the **A->B Seq** tab and touch the A->B Sequence **A Only** button. Then select the **A Event** tab.
- Press **Close**.

3. *Confirm the AUX Trigger input:*

   a. *Display the test signal:*

      - Remove the 10X attenuator and reconnect the cable to **CH 1**.
      - Set the signal amplitude as follows:

TDS6604	**2.5 divisions**
TDS6404	**2.5 divisions**

      - Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is as follows (Readout may fluctuate):

TDS6604	**250 mV**
TDS6404	**250 mV**

   b. *Check the AUX trigger source for stable triggering at limits:* Do the following in the order listed.

      - Use the definition for stable trigger from step 2b.
      - Press the Trigger **SOURCE** button to toggle it to **EXT**.
      - Press **PUSH TO SET 50%**.
      - CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. Press the Trigger **SLOPE** button to switch between trigger slopes. Use the Trigger **LEVEL** knob to stabilize the trigger if required.
      - Leave the trigger system triggered on the positive slope of the waveform before proceeding to the next check.
      - Press the Trigger **SOURCE** button to toggle it to **CH 1**.

4. *Confirm that the trigger system is within sensitivity limits (full bandwidth):*

   a. *Set the Horizontal Scale:* Set the Horizontal **SCALE** to 200 ps.

   b. *Display the test signal:*

      - Set the generator frequency to full bandwidth as follows:

TDS6604	**3 GHz**
TDS6404	**3 GHz**

      - Set the test signal amplitude for about seven divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 750 mV. (Readout may fluctuate around 750 mV).
      - Disconnect the cable at **CH 1** and reconnect it to **CH 1** through a 5X attenuator. Check that a stable trigger is obtained.

c. Repeat step 2, substep b for the full bandwidth selected.

d. *Display the test signal:*

- Set the generator frequency to full bandwidth as follows:

TDS6604	**1.5 GHz**
TDS6404	**1.5 GHz**

- Disconnect the 5X attenuator. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. (Readout may fluctuate around 500 mV).
- Disconnect the cable at **CH 1** and reconnect it to **CH 1** through a 5X attenuator. Check that a stable trigger is obtained.

e. Repeat step 2, substep c only, for the full bandwidth selected.

f. *Display the test signal:*

- Set the generator frequency to 500 MHz.
- Set the Horizontal SCALE to 2.5 ns.
- Remove the 5X attenuator and reconnect the cable to **CH 1**.
- Set the generator amplitude on screen as follows:

TDS6604	**4 divisions**
TDS6404	**4 divisions**

- Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is as follows (Readout may fluctuate):

TDS6604	**350 mV**
TDS6404	**350 mV**

g. Repeat step 3, substeps b only, for the full bandwidth selected.

NOTE*. You just checked the trigger sensitivity. If desired, you may repeat steps 1 through 4c for the other channels (CH 2, CH 3, and CH 4).*

5. *Disconnect the hookup:* Disconnect the cables and adapter from AUX IN and the channel last tested.

Output Signal Checks

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

Check Outputs — CH 3 Signal Out and Aux Trigger Out

Equipment required	Two precision 50 Ω coaxial cables (Item 4) One calibration generator (Item 10) Two SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17. Also, the oscilloscope must have passed *Check DC Voltage Measurement Accuracy* on page 4-28.

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

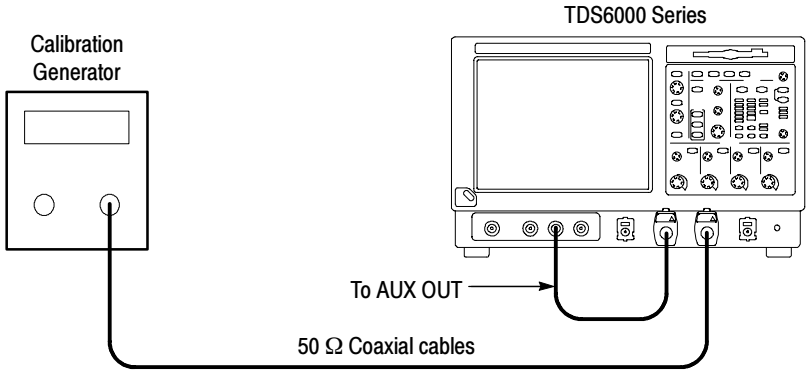


Figure 4-28: Initial test hookup

a. *Hook up test-signal source 1 (See Figure 4-28):*

- Connect the standard amplitude output of a calibration generator through a 50 Ω precision coaxial cable to **CH 3** through an adapter.
- Set the calibration generator to output a 0.500 V square wave.

b. *Hook up test-signal source 2:* Connect the **Aux Out** to **CH 2** through a 50 Ω precision cable and an adapter.

c. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.

d. *Modify the initialized front-panel control settings:*

- Press the Vertical **CH 1** button to toggle it off.
- Press the Vertical **CH 3** button to display that channel.

- Push Trigger **Source** to toggle the source to **CH 3**.
- Set the Horizontal **SCALE** to 200 µs.
- If necessary, adjust the calibration generator output for 5 divisions of amplitude.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **64**.
- Touch the **Close** button.

2. *Confirm AUX OUT is within limits for logic levels:*

a. *Display the test signal:*

- Press the Vertical **CH 3** button to turn off CH 3.
- Press the Vertical **CH 2** button to display that channel.
- Set the Vertical **SCALE** to 500 mV.
- Use the Vertical **POSITION** knob to center the display on screen.

b. *Measure logic levels:*

- From the button bar, touch **MEAS** and select the **Ampl** tab.
- Touch the **High** and **Low** buttons.
- Touch the **Close** button.

c. *Check AUX OUT output against limits:* CHECK that the **CH 2 High** readout is ≥1.0 volt and that the **CH 2 Low** readout ≤0.25 volts. See Figure 4–29.

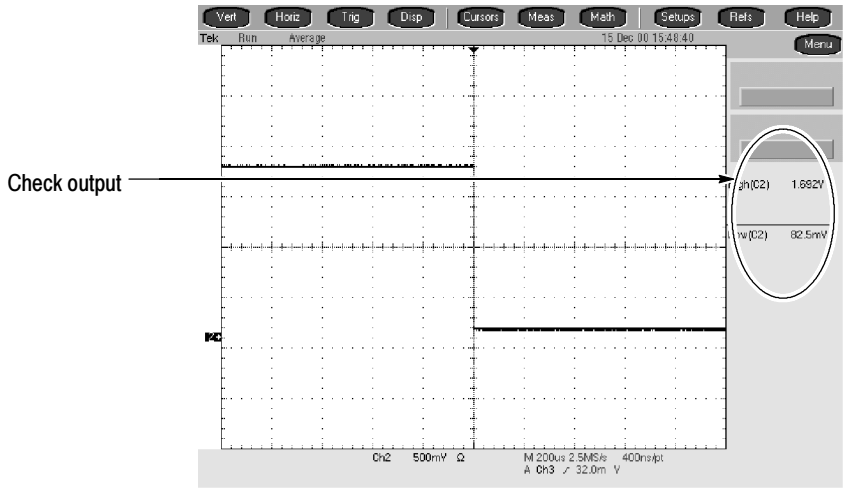


Figure 4- 29: Measurement of trigger out limits

3. *Confirm SIGNAL OUT is within limits for gain:*

   a. *Measure gain:*

      - Move the precision 50 Ω cable from the **AUX OUT** BNC to the **SIGNAL OUT** BNC.
      - Set Vertical **SCALE** to 50 mV.
      - Press **PUSH TO SET 50%**.
      - From the button bar, touch **MEAS** and select the **Ampl** tab.
      - Touch the **Pk-Pk** button.
      - Touch **Close**.

   b. *Check against limits:* CHECK that the readout **CH 2 Pk-Pk** is between 40 mV and 60 mV, inclusive.

4. *Confirm SIGNAL OUT is within limits for offset:*

      - Disconnect the cable from the CH 3 input.
      - From the button bar, touch **MEAS** and select the **Ampl** tab.
      - Touch the **Low** button.
      - Touch **Close**.

   a. *Check against limits:* CHECK that the Low reading is between –100 mV and –170 mV, inclusive.

5. *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

Check Probe Compensation Output

Equipment required	Two dual-banana connectors (Item 6) One BNC T connector (Item 7) Two precision 50 Ω coaxial cables (Item 4) One DC calibration generator (Item 9) One SMA-to-BNC adapter (Item 19)
Prerequisites	See page 4-17. Also, the oscilloscope must have passed *Check Accuracy For Long-Term Sample Rate and Delay Time Accuracy and Reference* on page 4-55.

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

   a. *Hook up test-signal:*

   - Connect one of the 50 Ω cables to **CH 1** through an adapter. See Figure 4-30.
   - Connect the other end of the cable just installed to the **PROBE COMPENSATION** output. See Figure 4-30.

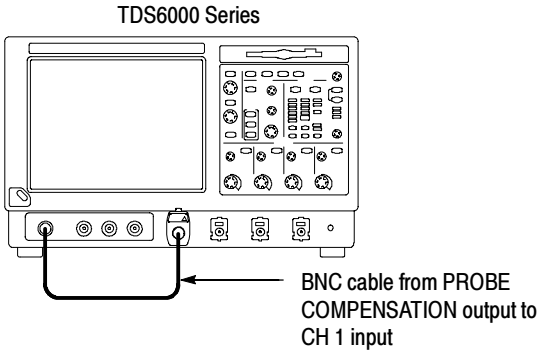


Figure 4-30: Initial test hookup

   b. *Initialize the oscilloscope:* Press the **DEFAULT SETUP** button.

   c. *Modify the initialized front-panel control settings:*

   - Set the **Vertical SCALE** to 100 mV.
   - Touch the **Vert** button and then touch **Offset**. Adjust the Ch1 Offset to 0.8 V using the multipurpose knob.

- Set the Horizontal **SCALE** to 200 µs.
- Press **PUSH TO SET 50%**.
- Use the Vertical **POSITION** knob to center the display on screen.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **128**.

2. *Confirm that the Probe Compensator signal is within limits for frequency:*

a. *Measure the frequency of the probe compensation signal:*

- From the button bar, touch **MEAS** and select the **Time** tab.
- Touch the **Freq** button.

b. *Check against limits:*

- CHECK that the **CH 1 Freq** readout is within 950 Hz to 1.050 kHz, inclusive. See Figure 4–31.
- Enter the frequency on the test record.
- Touch **Clear** to remove the measurement.

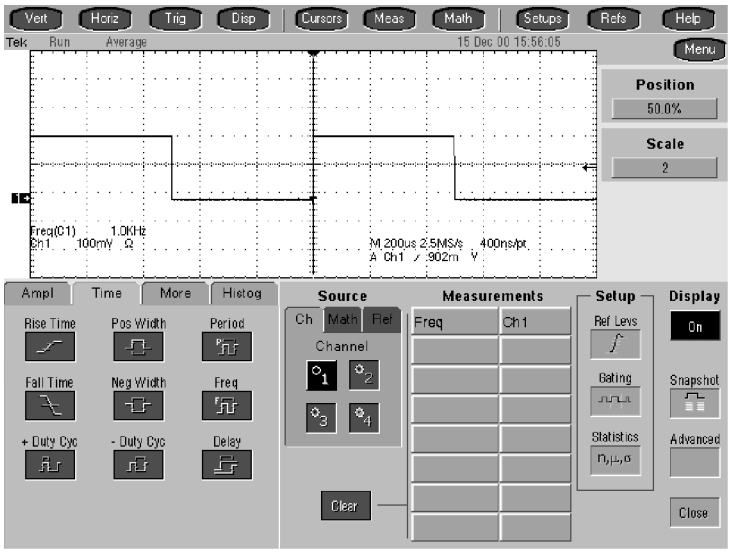


Figure 4-31: Measurement of probe compensator frequency

c. *Save the probe compensation signal in reference memory:*

- Touch **Refs**; then select the **Ref 1** tab.

- Touch the Save Wfm to Ref1 **Save** button to save the probe compensation signal in reference 1.
- Disconnect the cable from **CH 1** and the probe compensation connector.
- Touch the **Display** button to toggle it to on to displayed the stored signal.

d. *Hook up the DC standard source:*

- Set the output of a DC calibration generator to off or 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4–32.
- Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through a TCA-BNC or BNC-to-SMA adapter. See Figure 4–32.

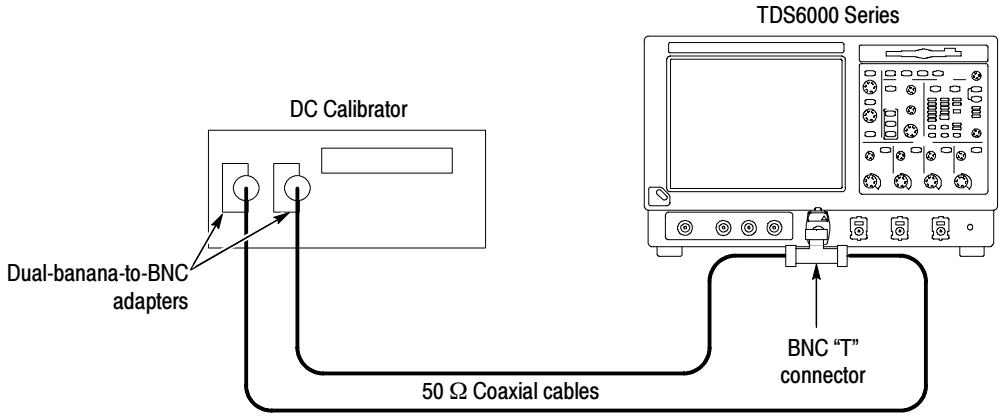


Figure 4- 32: Subsequent test hookup

e. *Measure amplitude of the probe compensation signal:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16** using the keypad or the multipurpose knob.
- Adjust the output of the DC calibration generator until it precisely overlaps the top (upper) level of the stored probe compensation signal. (This value will be near 1.0 V).

- Record the setting of the DC generator.
- Adjust the output of the DC calibration generator until it precisely overlaps the base (lower) level of the stored probe compensation signal. (This value will be near 800 mV).
- Record the setting of the DC generator.

f. Press **Close** to remove the menus from the display. See Figure 4–33.

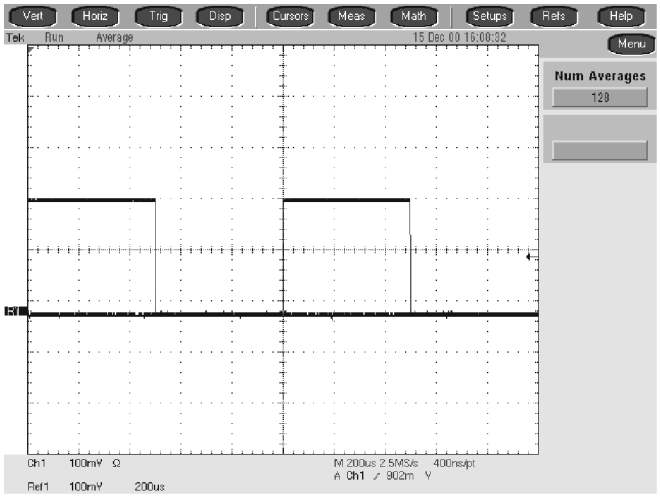


Figure 4- 33: Measurement of probe compensator amplitude

g. *Check against limits:*

- Subtract the value just obtained (base level) from that obtained previously (top level).
- CHECK that the difference obtained is within 160 mV to 240 mV, inclusive.
- Enter voltage difference on test record.

3. *Disconnect the hookup:* Disconnect the cable and adapter from **CH 1**.

Serial Trigger Checks (Option ST Only)

These procedures check those characteristics that relate to the serial trigger system and are listed as checked in *Specifications.*

Check Serial Trigger Baud Rate Limits and Word Recognizer Position Accuracy

Equipment required	One precision 50 Ω coaxial cables (Item 4) One sine-wave generator (Item 12) One TCA-BNC or TCA-SMA adapter (item 19)
Prerequisites	See page 4-17. Also, the oscilloscope must have passed *Check DC Voltage Measurement Accuracy* on page 4-28.

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

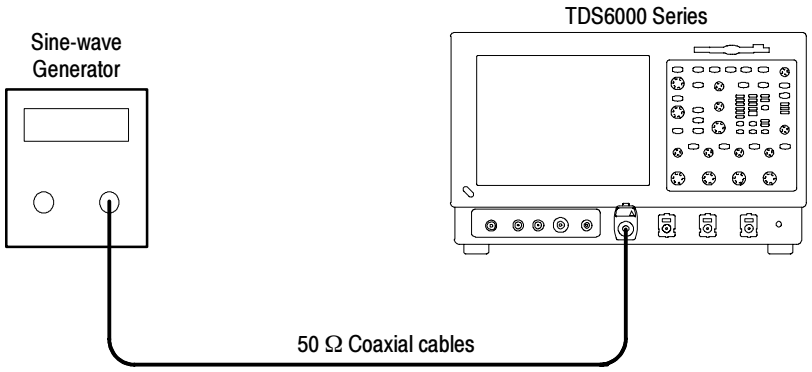


Figure 4-34: Initial test hookup

a. *Hook Up the test-signal source (see Figure 4-34):*

- Connect the sine wave output of the sine-wave generator through a 50 Ω precision coaxial cable to CH 1 through an adapter.
- Set the sine-wave generator to output a 433 MHz sine wave.

b. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

c. Modify the initialized front-panel control settings:

- Set the vertical **SCALE** to 50 mV per division.
- Set the horizontal **SCALE** to 2.5 ns per division.
- Adjust the sine-wave generator output for 4 divisions of amplitude centered on the display.
- Adjust the trigger **LEVEL** to trigger at 25% (-1 division) on the sine wave.

Table 4-8: Serial pattern data

Serial pattern data	Trigger location
DB6D B6DB$_{16}$	One UI before the 0
B6DB 6DB6$_{16}$	At the 0
6DB6 DB6D$_{16}$	One UI after the 0

2. *Verify that the signal path can do isolated 0 and pattern matching circuits can do isolated 1:*

   a. From the button bar, touch **Cursors** and then the **Setup** button.

   b. Set the Tracking Mode to **Tracking**.

   c. Touch the **Close** button.

   d. Adjust the cursors until the Δt readout equals 800 ps (one unit interval). Center the cursors around the center graticule line (see Figure 4–35).

   e. From the button bar, touch **Trig** and select the **A Event** tab.

   f. Touch the **Serial** Trigger Type button and then set the Standard to **GB Ethernet**.

   g. Touch the **Editor** button.

   h. Set the Format to **Hex** and then touch the **Clear** button.

   i. Enter data into the Serial Pattern Data field for one of the settings in Table 4–8 that is not yet checked. (Start with the first setting listed.)

   j. Touch **Apply**.

   k. Verify that the instrument triggers one Unit Interval (UI, one baud divided by the bit period) before the 0 in the input signal (see Figure 4–35). Enter pass or fail in the test record.

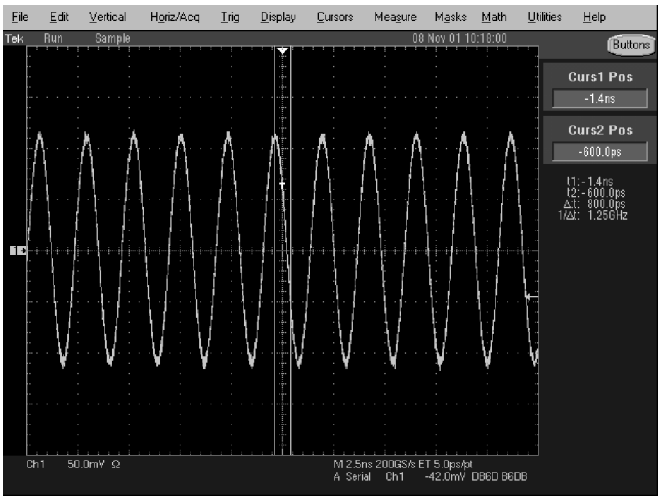
   l. Touch the **Clear** button.

   m. Enter data into Serial Pattern Data field for the next setting in Table 4–8 that is not yet checked.

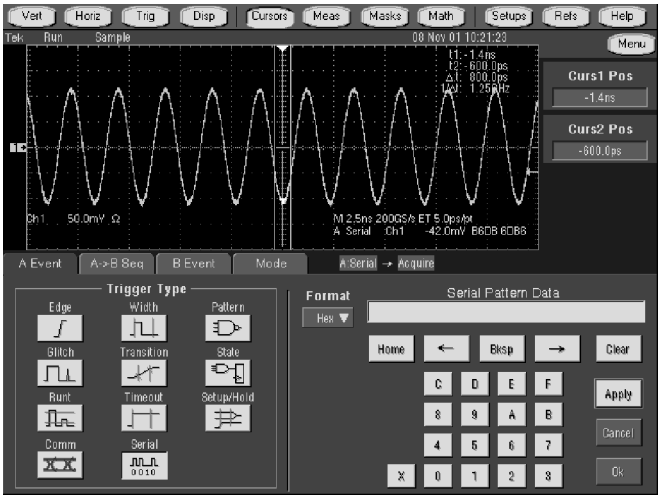
   n. Touch **Apply**.

   o. Verify that the instrument triggers at the 0 in the input signal (see Figure 4–35). Enter pass or fail in the test record.

Triggered 1 UI before a 0



Triggered on a 0



Triggered 1 UI after a 0

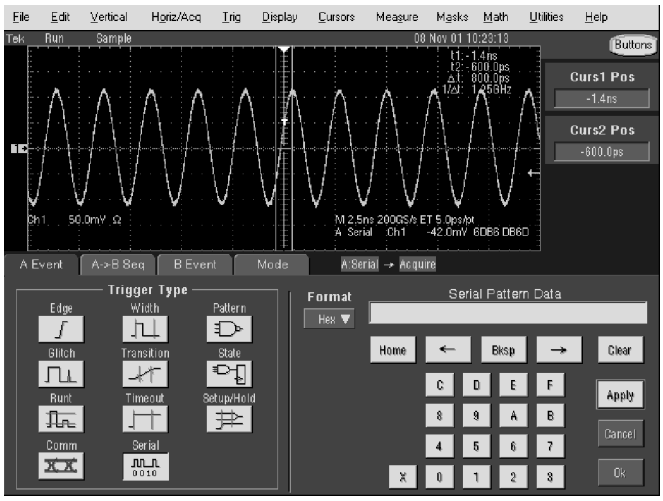


Figure 4- 35: Isolated 0 triggering

p. Touch the **Clear** button.

q. Enter data into Serial Pattern Data field for the next setting in Table 4–8 that is not yet checked.

r. Touch **Apply**.

s. Verify that the instrument triggers one Unit Interval (UI) after the 0 in the input signal (see Figure 4–35). Enter pass or fail in the test record.

Table 4-9: Word recognizer data

Serial pattern data	Trigger location
2492 4924_{16}	One UI before the 1
4924 9249_{16}	At the 1
9249 2492_{16}	One UI after the 1

3. *Verify that the serial path and pattern matching circuits can do isolated 1s:*

a. Adjust the trigger **LEVEL** to trigger at 75% (+1 division) on the sine wave.

b. Touch the **Clear** button.

c. Enter data into the Serial Pattern Data field for one of the settings in Table 4–9 that is not yet checked. (Start with the first setting listed.)

d. Touch **Apply**.

e. Verify that the instrument triggers one Unit Interval (UI) before the 1 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

f. Touch the **Clear** button.

g. Enter data into the Serial Pattern Data field for the next setting in Table 4–9 that is not yet checked.

h. Touch **Apply**.

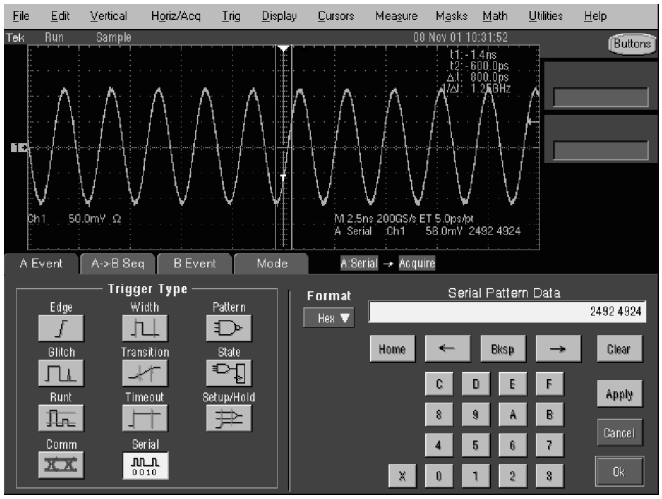
i. Verify that the instrument triggers at the 1 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

j. Touch the **Clear** button.

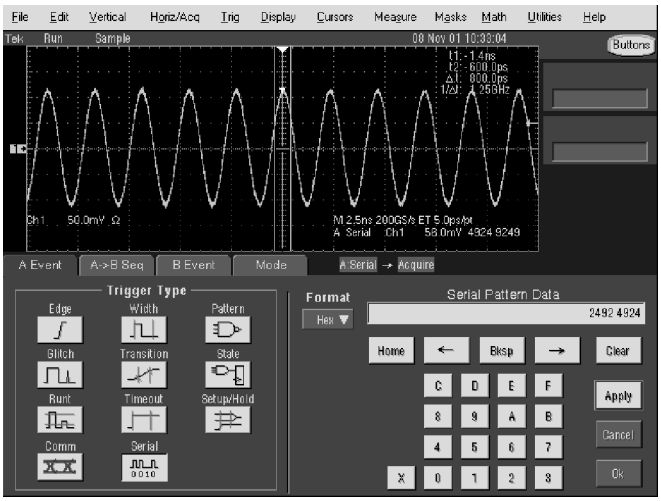
k. Enter data into the Serial Pattern Data field for the next setting in Table 4–9 that is not yet checked.

l. Touch **Apply**.

Triggered 1 UI before a 1



Triggered on a 1



Triggered 1 UI after a 1

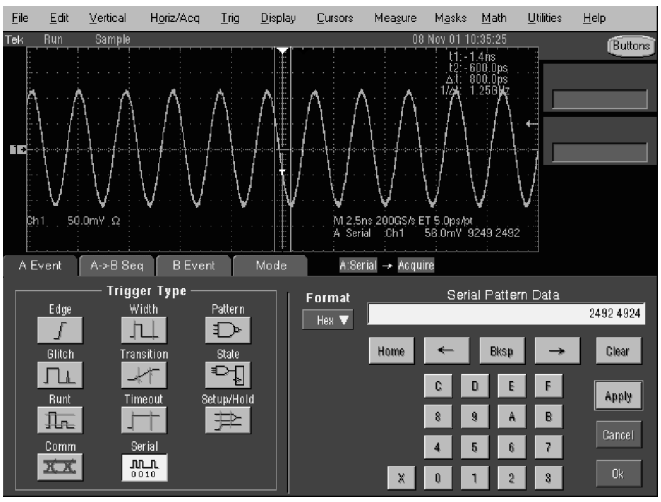


Figure 4- 36: Isolated 1 triggering

m. Verify that the instrument triggers one Unit Interval (UI) after the 1 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

4. *Verify that the pattern matching circuits can do isolated 0:*

a. Adjust the trigger **LEVEL** to trigger at 75% (+1 division) on the sine wave.

b. Set the Format to **Binary** and then touch the **Clear** button.

c. Set the Serial Pattern Data pattern bits to XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXX1_2.

d. Touch **Apply**.

e. Verify that the instrument triggers on a 1 (see Figure 4–37). Enter pass or fail in the test record.

f. Touch the **Clear** button.

g. Set all Serial Pattern Data bits to X except for the nth bit, where n is the step number.

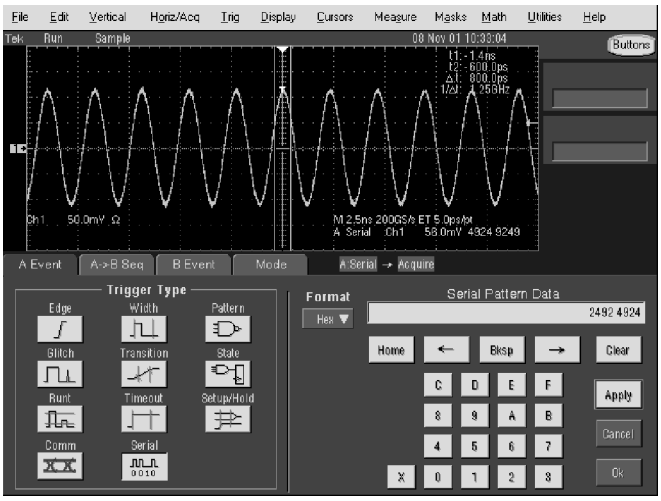
h. Touch **Apply**.

i. Verify that the trigger occurs (n modulo 3) clock cycles after the 1 (see Figure 4–37). Enter pass or fail in the test record.

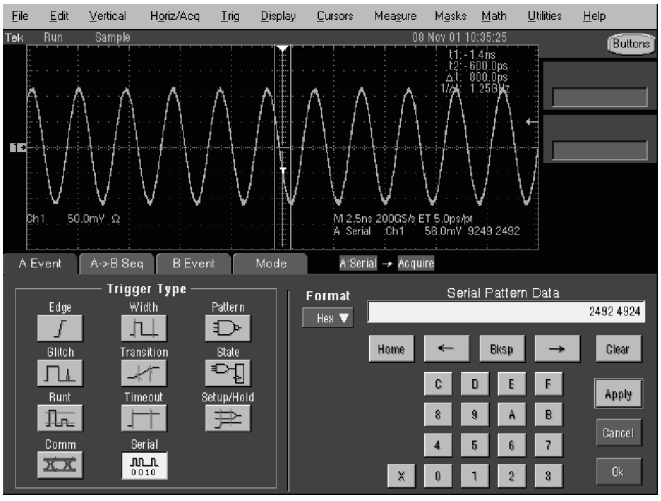
j. Repeat steps g through i until all 32 bits of the Serial Pattern Data have contained a 1.

5. *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

Triggering on a 1. Step 1, 4, 7, 10, . . .



Triggering 1 clock cycle after a 1. Step 2, 5, 8, 11, . . .



Triggering 2 clock cycles after a 1. Step 3, 6, 9, 12, . . .

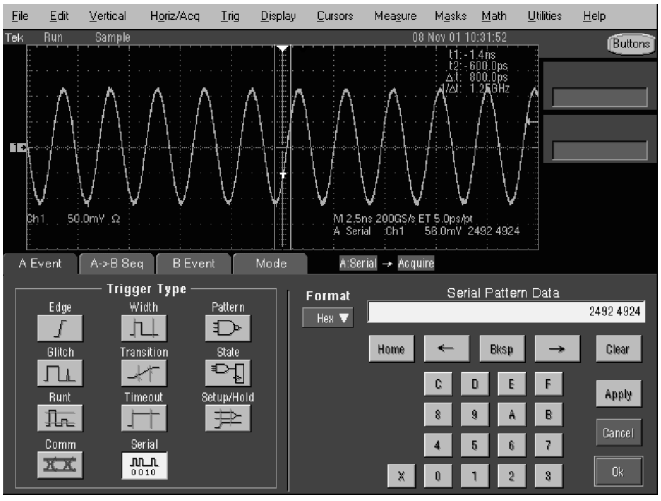


Figure 4- 37: N modulo 3 triggering

Check Serial Trigger Clock Recovery Range

Equipment required	One precision 50 Ω coaxial cables (Item 4) One sine wave generator (Item 12) One TCA-BNC or TCA-SMA adapter (item 19)
Prerequisites	See page 4-17. Also, the oscilloscope must have passed *Check DC Voltage Measurement Accuracy* on page 4-28.

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

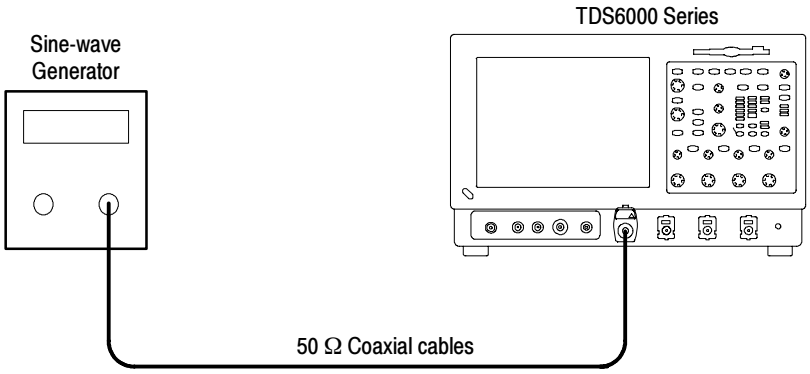


Figure 4-38: Initial test hookup

a. *Hook up test-signal source 1 (See Figure 4-38):*

- Connect the sine wave output of the sine wave generator through a 50 Ω precision coaxial cable to CH 1 through an adapter.
- Set the sine-wave generator to output a 1250 MHz sine wave.

b. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

c. *Modify the initialized front-panel control settings:*

- Press the Vertical **SCALE** to 50 mV per division.
- Set the horizontal **SCALE** to 500 ps per division.
- From the button bar, touch the **Disp** button.
- Touch the Display Style to **Dots**.
- Touch the Display Persistence to **Variable**, and set the Persist Time to **3.0 s**.
- Touch the **Close** button.
- Adjust the sine-wave generator output for 8 divisions of amplitude.

- From the button bar, touch **Trig** and select the **A Event** tab.
- Touch the **Comm** button. Set **Source** to Ch1, **Type** to R Clk, and **Coding** to NRZ.

2. *Verify the clock recovery at frequency:*

   a. From the button bar, touch **Trig** and select the **A Event** tab.

   b. Set the sine-wave generator to output one of the input frequencies in Table 4–10 (on page 4–86) that is not yet checked. (Start with the first setting listed.)

   c. Set the instrument Bit Rate to the Recovered clock Baud rate listed in the table for the current input frequency.

NOTE*. The instrument will attempt to acquire lock once. If the input data is disrupted, removed, or heavily distorted, the instrument may not acquire lock or may loose lock. If the recovered clock is not locked to the incoming data, the waveform display will not be stable (see Figure 4–39). Once the input data is available, press the PUSH SET TO 50% knob to force the instrument to acquire lock again.*

   d. Press **PUSH TO SET 50%**.

NOTE*. As the input frequency is lowered, adjust the Horizontal SCALE to maintain about 3 to 5 eyes across the display.*

   e. Verify that lock is acquired as in Figure 4–39.

   f. Repeat substeps b through d for each input frequency listed in Table 4–10 (on page 4–86).

   g. If all tests pass, enter passed in the test record.

3. *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

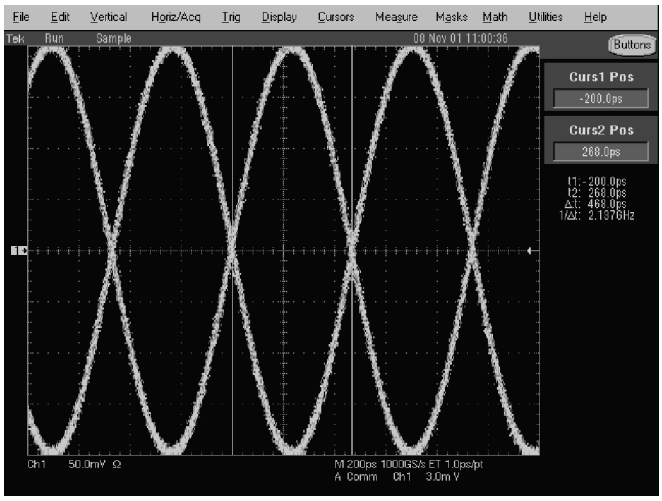
Table 4–10: Clock recovery input frequencies and baud rates

Input frequency	Recovered clock Baud rate
1250 MHz	2500 Mbaud
625 MHz	2500 Mbaud
625 MHz	2375 Mbaud
594 MHz	2500 Mbaud

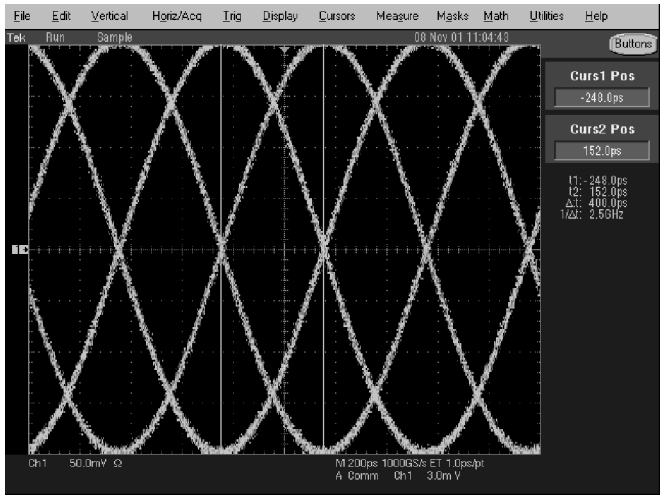
Table 4-10: Clock recovery input frequencies and baud rates (Cont.)

Input frequency	Recovered clock Baud rate
477.5 MHz	1950 Mbaud
462.5 MHz	1850 Mbaud
462.5 MHz	1757 Mbaud
439 MHz	1850 Mbaud
312.5 MHz	1250 Mbaud
310 MHz	1240 Mbaud
155 MHz	620 Mbaud
155 MHz	579 Mbaud
147 MHz	620 Mbaud
109 MHz,	462 Mbaud
115 MHz	439 Mbaud
77.5 MHz	310 Mbaud
39 MHz	156 Mbaud
19.5 MHz	78 Mbaud
9.75 MHz	39 Mbaud
4.875 MHz	19.5 Mbaud
2.438 MHz	9.75 Mbaud
1.219 MHz	4.876 Mbaud
609.5 kHz	2.438 Mbaud
304.8 kHz	1.219 Mbaud

Recovered clock locked (1250 MHz)



Recovered clock locked (625 MHz through 304.8 kHz)



A possible display with the recovered clock not locked

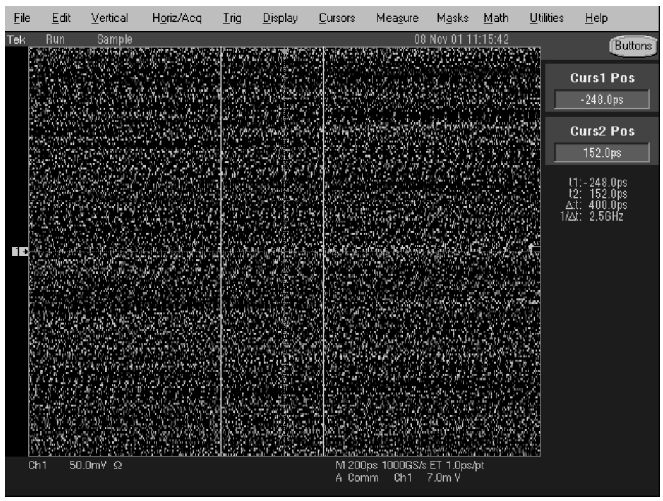


Figure 4- 39: Clock recovery

Sine Wave Generator Leveling Procedure

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

Equipment required	Sine wave generator (Item 12) Level meter and power sensor (Item 13) Power divider (Item 14) Two male N to female BNC adapters (Item 15) One precision coaxial cable (Item 4) One or two SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

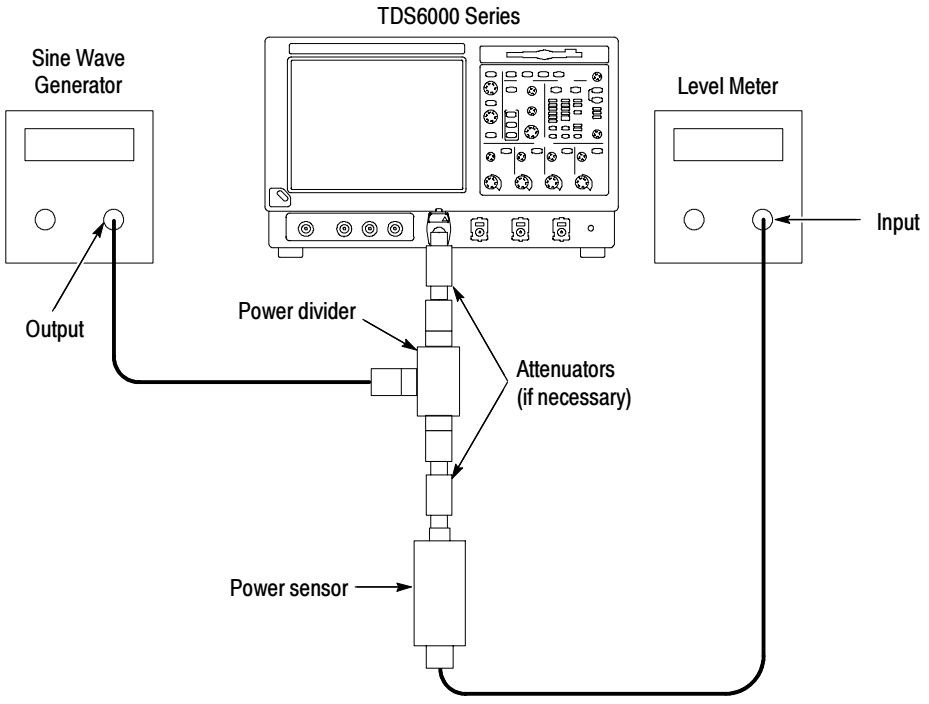


Figure 4-40: Sine wave generator leveling equipment setup

1. *Install the test hookup:* Connect the equipment as shown in Figure 4-40.

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

Equipment required	Sine wave generator (Item 12) Level meter and power sensor (Item 13) Two male N to female BNC adapters (Item 15) Two precision coaxial cables (Item 4) One or two SMA male-to-female BNC adapter (Item 19)
Prerequisites	See page 4-17

1. *Install the test hookup:* Connect the equipment as shown in Figure 4–41 (start with the sine wave generator connected to the oscilloscope).
2. *Set the Generator:*
   - Set the sine wave generator to a reference frequency of 10 MHz.
   - Adjust the sine wave generator amplitude to the required number of divisions as measured by the oscilloscope.

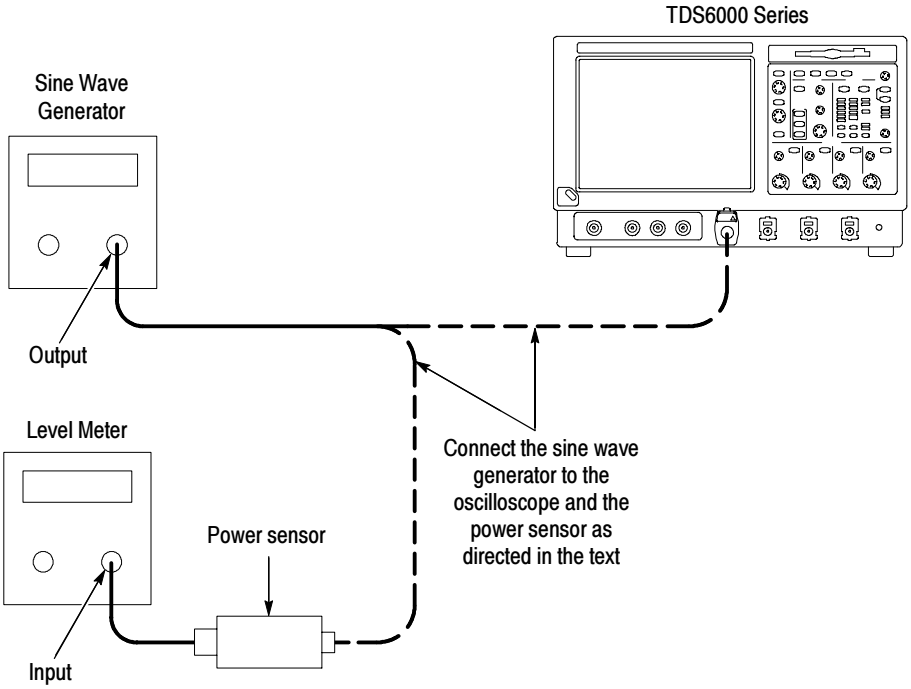


Figure 4-41: Equipment setup for maximum amplitude

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