Tektronix®

# TBS2000B Series Oscilloscopes

## Specification and Performance Verification

077-1538-00

Tektronix®

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## Specification and Performance Verification

**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.

Supports Product Firmware V1.0 and above

www.tek.com
077-1538-00

## Contacting Tektronix

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- Worldwide, visit *www.tek.com* to find contacts in your area.

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# Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

## Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

**To avoid electric shock.** Do not touch exposed connections.

**Do not service alone.** Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

**Disconnect power.** To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

**Use care when servicing with power on.** Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

**Verify safety after repair.** Always recheck ground continuity and mains dielectric strength after performing a repair.

## Terms in the manual

These terms may appear in this manual:

***WARNING.*** *Warning statements identify conditions or practices that could result in injury or loss of life.*

***CAUTION.*** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

# Preface

This manual contains specification and performance verification information for the TBS2000B Series Digital Storage Oscilloscopes.

# Specifications

This chapter contains specifications for the instrument. All specifications are guaranteed unless noted as "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in Performance Verification.

All specifications apply to all models unless noted otherwise. To meet specifications, two conditions must first be met:

- The instrument must have been operating continuously for twenty minutes within the specified operating temperature range.
- You must perform the Signal Path Compensation (SPC) operation described in ... If the operating temperature changes by more than 10 °C (18 °F), you must perform the SPC operation again.

## Model overview

| | TBS2072B | TBS2102B | TBS2074B | TBS2104B | TBS2202B | TBS2204B |
|---|---|---|---|---|---|---|
| Analog channels | 2 | 2 | 4 | 4 | 2 | 4 |
| Bandwidth | 70 MHz | 100 MHz | 70 MHz | 100 MHz | 200 MHz | 200 MHz |
| Sample rate | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s |
| Record length | 5 M points | 5 M points | 5 M points | 5 M points | 5 M points | 5 M points |

## Vertical system analog channels

| | |
|---|---|
| **Hardware bandwidth limits** | 20 MHz |
| **Input coupling** | DC or AC |
| **Input impedance** | 1 MΩ ± 1 %, 13 pF ± 1.5 pF |
| **Sensitivity range** | 2 mV/Div to 5 V/Div in 1-2-5 sequence with probe attenuation set to 1X. |
| **Vertical resolution** | 8 bits |
| **Maximum input voltage** | 300 V RMS; derate above 4 MHz to 6 V RMS at 200 MHz.<br>Based upon sinusoidal or DC input signal. Maximum viewable signal while DC coupled is ±100 V offset ± 5 V/div at 4 divisions, or 120 V. AC coupling allows measuring signals on a DC level up to 300V. For non-sinusoidal waveforms, peak value must be less than 450 V. Excursion above 300 V should be less than 100 ms duration. RMS signal level must be limited to 300 V. If these values are exceeded, damage to the instrument may result. |
| **Number of digitized bits** | 8 bits |
| **Acquisition modes** | Sample, Peak Detect, Average, Roll, and Hi-Res |

**Math modes**

| | |
|---|---|
| **All units:** | Ch 1 - Ch 2 |
| | Ch 2 - Ch 1 |
| | Ch 1 + Ch 2 |
| | Ch 1 X Ch 2 |
| | FFT |
| **4 channel units:** | Ch 3 - Ch 4 |
| | Ch 3 + Ch 4 |
| | Ch 4 - Ch 3 |
| | Ch 3 X Ch 4 |

**DC balance** ± (1 mV +0.1 div)

**DC gain accuracy** ± 2% 5 mV/div through 5 V/div, derated at 0.05%/ °C above 30 °C.

± 3% 2 mV/div

**DC voltage measurement accuracy average mode**

| | |
|---|---|
| **Average of ≥ 16 waveforms** | ±((DC Gain Accuracy) X \|reading - (offset - position)\| + Offset Accuracy + 0.11 div + 1 mV) |
| **Delta Volts between any two averages of ≥16 waveforms acquired with the same oscilloscope setup and ambient conditions** | ±(DC Gain Accuracy X \|reading\| + 0.08 div + 1.4 mV) |

**Vertical position range** ± 5 divisions

**Vertical offset ranges**

| Volts/Div setting | Offset range, 1 MΩ |
|---|---|
| 2 mV/Div to 63 mV/Div | ± 1 V |
| 64 mV/div to 999 mV/div | ± 10 V |
| 1 V/div to 10 V/div | ± 100 V |

**Vertical offset accuracy** ± (0.01 X |offset - position | + DC Balance)

**Analog bandwidth, DC coupled**

| | |
|---|---|
| **200 MHz models:** | DC to >200 MHz |
| **100 MHz models:** | DC to ≥100 MHz |
| **70 MHz models:** | DC to ≥70 MHz |

**Upper-Frequency limit, 20 MHz bandwidth limited** ≥ 20 MHz ± 20%

Because the digital triggering system uses data that has been BW limited, all Trigger functions on the BW limited analog channel are affected. Each channel is separately limited, allowing different bandwidths on different channels of the same instrument.

| | |
|---|---|
| **Lower-Frequency limit, AC coupled, typical** | <10 Hz<br>≤1 Hz when 10X, passive probes are used. |
| **Rise time, typical** | 2.5 ns for 200 MHz Models.<br>4 ns for 100 MHz Models.<br>5.5 ns for 70 MHz Models. |
| **Common mode rejection ratio (CMRR), typical** | 100:1 at 60 Hz, reducing to 10:1 with 50 MHz sine wave with equal Volts/Div and Coupling settings on each channel. |
| **Crosstalk (channel isolation)** | All Models:<br>>100:1 with sine wave at rated bandwidth of instrument and with equal V/div settings on each channel. |

## Horizontal system analog channels

**Sample rate**

TBS207x, TBS210x: 500 MS/s, 1 GS/s, and 2 GS/s on all channels.

### Sample rate for time/div versus record length

| Time/Div | Real Time Sampling Rate = 1 GS/s | | | | | | |
|---|---|---|---|---|---|---|---|
| | RL= 1 k | RL= 2 k | RL= 20 k | RL= 200 k | RL= 2 M | RL= 5 M | RL= AUTO |
| 1 ns | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s | 2 GS/s | 2GS/s |
| 2 ns | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 4 ns | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 10 ns | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 20 ns | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 40 ns | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 100 ns | 500 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 200 ns | 250 MS/s | 500 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 400 ns | 125 MS/s | 250 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 1 µs | 62.4 MS/s | 125 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 2 µs | 31.2 MS/s | 62.5 MS/s | 500 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 4 µs | 15.6 MS/s | 31.2 MS/s | 250 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 10 µs | 6.25 MS/s | 12.5 MS/s | 125 MS/s | 1 GS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 20 µs | 3.12 MS/s | 6.25 MS/s | 62.5 MS/s | 500 MS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 40 µs | 1.56 MS/s | 3.12 MS/s | 31.2 MS/s | 250 MS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 100 µs | 624 kS/s | 1.25 MS/s | 12.5 MS/s | 125 MS/s | 1 GS/s | 1 GS/s | 1 GS/s |
| 200 µs | 312 kS/s | 625 kS/s | 6.25 MS/s | 62.5 MS/s | 500 MS/s | 1 GS/s | 1 GS/s |
| 400 µs | 156 kS/s | 312 kS/s | 3.12 MS/s | 31.2 MS/s | 250 MS/s | 500 MS/s | 500 MS/s |
| 1 ms | 62.4 kS/s | 125 kS/s | 1.25 MS/s | 12.5 MS/s | 125 MS/s | 250 MS/s | 250 MS/s |
| 2 ms | 31.2 kS/s | 62.5 kS/s | 625 kS/s | 6.25 MS/s | 62.5 MS/s | 125 MS/s | 125 MS/s |

| Time/Div | Real Time Sampling Rate = 1 GS/s | | | | | | |
|---|---|---|---|---|---|---|---|
| | RL= 1 k | RL= 2 k | RL= 20 k | RL= 200 k | RL= 2 M | RL= 5 M | RL= AUTO |
| 4 ms | 15.6 kS/s | 31.2 kS/s | 312 kS/s | 3.12 MS/s | 31.2 MS/s | 62.5 MS/s | 62.5 MS/s |
| 10 ms | 6.25 kS/s | 12.5 kS/s | 125 kS/s | 1.25 MS/s | 12.5 MS/s | 31.2 MS/s | 31.2 MS/s |
| 20 ms | 3.12 kS/s | 6.25 kS/s | 62.5 kS/s | 625 kS/s | 6.25 MS/s | 12.5 MS/s | 12.5 MS/s |
| 40 ms | 1.56 kS/s | 3.12 kS/s | 31.2 kS/s | 312 kS/s | 3.12 MS/s | 6.25 MS/s | 6.25 MS/s |
| 100 ms | 624 S/s | 1.25 kS/s | 12.5 kS/s | 125 kS/s | 1.25 MS/s | 3.12 MS/s | 3.12 MS/s |
| 200 ms | 312 S/s | 625 S/s | 6.25 kS/s | 62.5 kS/s | 625 kS/s | 1.25 MS/s | 1.25 MS/s |
| 400 ms | 156 S/s | 312 S/s | 3.12 kS/s | 31.2 kS/s | 312 kS/s | 625 kS/s | 625 kS/s |
| 1 s | 62.4 S/s | 125 S/s | 1.25 kS/s | 12.5 kS/s | 125 kS/s | 312 kS/s | 312 kS/s |
| 2 s | 31.2 S/s | 62.5 S/s | 625 S/s | 6.25 kS/s | 62.5 kS/s | 125 kS/s | 125 kS/s |
| 4 s | 15.6 S/s | 31.2 S/s | 312 S/s | 3.25 kS/s | 31.2 kS/s | 62.5 kS/s | 62.5 kS/s |
| 10 s | 6.25 S/s | 12.5 S/s | 125 S/s | 1.25 kS/s | 12.5 kS/s | 31.2 kS/s | 31.2 kS/s |
| 20 s | 3.12 S/s | 6.25 S/s | 62.5 S/s | 625 S/s | 6.25 kS/s | 12.5 kS/s | 12.5 kS/s |
| 40 s | 1.56 S/s | 3.12 S/s | 31.2 S/s | 312 S/s | 3.12 kS/s | 6.25 kS/s | 6.25 kS/s |
| 100 s | 666 mS/s | 1.25 S/s | 12.5 S/s | 125 S/s | 1.25 kS/s | 3.12 kS/s | 3.12 kS/s |

**Waveform interpolation**

Only (sin x)/x interpolation is provided.

Waveform interpolation is activated for sweep speeds of 40 ns/div and faster

**Record length**

5 M, 2 M, 200 k, 20 k, 2 k, 1 k samples per record, user selectable or in the AUTO mode automatically select the shortest record length which supports the highest sample rate available for the Time/Div settings.

**Seconds division range**

TBS207x, TBS210x, TBS220x: 2 ns/div to 100 sec/div in a 1-2-4 sequence

**Deskew range**

Analog channels only:

TBS207x, TBS210x, TBS220x: ±100 ns with 2 ns resolution

**Long term sample rate and horizontal position time accuracy**

± 25 x $10^{-6}$ over any ≥ 1 ms interval.

**Delta time measurement accuracy**

The limits are given in the following table for signals having amplitude ≥ 7 divisions, slew rate at the measurement points of ≥ 2.0 divisions/ns, and acquired at ≥ 10 mV/Div:

| Condition | Time Measurement Accuracy |
|---|---|
| Single shot, full bandwidth selected | ± (1 Sample Interval + 25 X $10^{-6}$ X \|reading\| + 0.6 ns) |
| > 16 averages, full bandwidth selected | ± (1 Sample Interval + 25 X $10^{-6}$ X \|reading\| + 0.4 ns) |

# Trigger system

**Trigger types**

Edge, Pulse Width, Runt, and Bus.

**Trigger source**

Analog channels and AC Line

**Trigger coupling analog channels**

DC, Noise Reject, High Freq Reject, Low Freq Reject.

**Line trigger characteristics**

Line Trigger mode provides a source to synchronize the trigger with the AC line input.

Matches the AC power Source Voltage and Source Frequency listed in the Power Supply System section.

**Sensitivity, edge–type trigger, DC coupled**

| Trigger Source | Sensitivity |
|---|---|
| Analog inputs | 0.4 division from DC to 50 MHz |
| | 0.6 divisions >50 MHz to 100 MHz |
| | 0.8 divisions >100 MHz to 200 MHz |
| Analog inputs | 0.4 division from DC to 50 MHz |
| | 0.6 divisions >50 MHz to 100 MHz |

**Edge–Type trigger sensitivity, not DC coupled, typical**

| Trigger Coupling | Typical Sensitivity |
|---|---|
| HF reject | Same as DC Coupled limits from DC to 85 kHz. Attenuates signals above 85 kHz. |
| LF reject | 1.2 times the DC Coupled limits for frequencies above 65 kHz. Attenuates signals below 65 kHz. |
| Noise reject | 2.5 times the DC Coupled limits. |

**Trigger level ranges**

Input channels: ± 4.90 divisions from center screen

**Trigger level accuracy, DC coupled, typical**

±0.2 div for signals within ±4 divisions from center screen, having rise and fall times of ≥20 ns.

**Lowest frequency for successful operation of Set Level to 50% function.**

50 Hz. Using a 10 X probe will not affect the operation of this function.

**Pulse–Type runt trigger sensitivity, typical**

0.75 divisions, from DC to max bandwidth.

**Pulse–Type trigger width sensitivity, typical**

3.5 ns.

**Pulse–Type trigger, minimum pulse rearm time**

| Pulse Class | Minimum Pulse Width | Minimum Rearm Time |
|---|---|---|
| Runt | 2 ns | 2 ns |
| Width | 2 ns | 2 ns |
| Rise/Fall Time | 2 ns | 2 ns |

**Time range for pulse width or runt triggering**

2 ns to 8 s

| | |
|---|---|
| **Time accuracy for pulse width triggering** | ± 2 ns. |
| **Trigger frequency counter** | Provides the user a higher accuracy means of identifying the frequency of trigger signals. Since averaging takes place over a longer time span, the number of stable digits is improved over the Automatic Measurement of the same type. |
| **Resolution** | 6 digits |
| **Accuracy, typical** | ±25 x $10^{-6}$ including all reference errors and ±1 count errors. |
| **Frequency range, typical** | AC coupled, 10 Hz minimum to rated bandwidth |
| **Signal source** | Edge selected trigger source only.<br>Frequency counter measures the selected trigger source at all times in edge mode, including when the oscilloscope acquisition is halted due to changes in run status, or acquisition of a single shot event has completed. Counts all edges of sufficient amplitude. |

## Input/Output ports

| | |
|---|---|
| **TekVPI interface** | The probe interface allows installing, powering, compensating and controlling a wide range of probes offering a variety of features. |
| **Total probe power, typical** | TBS2xx4: 24 W, derated at 0.3 W/ °C above 30 °C<br>TBS2xx2: 12 W |
| **Ethernet interface** | One 10/100M BaseT port |
| **Wi-Fi interface** | Available as an optional USB dongle, supports 802.11 b/g/n. |
| **GPIB interface** | Available as an optional accessory that connects to USB Device and USB Host Ports, TEK-488 GPIB to USB Adapter. Control interface is incorporated in the instrument UI. |
| **USB interface** | 2 High Speed 2.0 Host and 1 High Speed Device connector are standard in all models. |
| **Probe compensator** | Front-panel pins |
| **Output voltage and frequency, typical** | 5 V amplitude ± 10% square wave, 1 kHz ± 10%. |
| **Aux Out** | HIGH to LOW transition indicates the trigger occurred. |

## Data storage

| | |
|---|---|
| **Nonvolatile memory retention time, typical** | No time limit for Front Panel Settings, saved waveforms, setups, and calibration constants. |
| **Real-Time clock** | A programmable clock providing time in years, months, days, hours, minutes, and seconds. |

## Display system

| | |
|---|---|
| **Display type** | 9 inch (228 mm) wide format liquid crystal TFT color display. |
| **Display resolution** | 800 horizontal by 480 vertical displayed pixels (WVGA). |
| **Waveform styles** | Vectors, Variable Persistence, and Infinite Persistence. |
| **Graticules** | Grid, None. |
| **Format** | YT and XY. |

## Power source

| | |
|---|---|
| **Power consumption** | 30 W typical, 80 W max at 85 to 275 $V_{AC}$ input. |
| **Power source voltage** | Full range: 100 to 240 $V_{AC}$ RMS ±10%, Installation Category II (Covers range of 90 to 264 $V_{AC}$) |
| **Source frequency** | 45 Hz to 65 Hz over entire source voltage range.<br>360 Hz to 440 Hz, 100 to 132 $V_{AC}$ RMS source voltage |

# Physical characteristics

**Weight**

| | |
|---|---|
| **TBS2xx2:** | 2.62 kg (5.8 lbs.), standalone instrument. |
| | 5.1 kg (11.2 lbs.), when packaged for domestic shipment. |
| **TBS2xx4:** | 4.17 kg (9.2 lbs.), stand-alone instrument. |
| | 7 kg (15.4 lbs.), when packaged for domestic shipment. |

**Dimensions**

| | |
|---|---|
| **TBS2xx2:** | Height: 174.9 mm (6.89 in) |
| | Width: 372.4 mm (14.66 in) |
| | Depth: 103.3 mm (4.07 in) |
| **TBS2xx4:** | Height: 201.5mm (7.93 in) |
| | Width: 412.8 mm (16.25 in) |
| | Depth: 128.1 mm (5.04 in) |

| | |
|---|---|
| **Cooling method** | TBS2xx4: Forced air flow, with fan. |
| | TBS2xx2: Convection air flow, no fan. |
| **Cooling clearance** | 50 mm (2 in) required on left side and rear of instrument. |

# EMC environment and safety

**Temperature**

| | |
|---|---|
| **Operating:** | 0 °C to +50 °C, with 5 °C/minute maximum gradient, noncondensing, up to 3000 m altitude. Instrument will be in specification after a 10 minute settling time and performance of SPC |
| **Nonoperating:** | -40 °C to +71 °C, with 5 °C/minute maximum gradient. |

**Humidity**

| | |
|---|---|
| **Operating:** | 5% to 95% relative humidity (% RH) at up to +30 °C, |
| | 5% to 60% RH above +30 °C up to +50 °C, noncondensing. |
| **Nonoperating:** | 5% to 95% RH (Relative Humidity) at up to +30 °C, |
| | 5% to 60% RH above +30 °C up to +60 °C, noncondensing. |

**Altitude**

| | |
|---|---|
| **Operating:** | Up to 3,000 meters (9,842 feet). |
| **Non-Operating:** | Up to 12,000 meters (39,370 feet). |
| | Altitude is limited by possible damage to LCD at higher altitudes. This damage is independent of operation. |

# Performance verification

## Required equipment

### Table 2: Performance verification

| Description | Minimum requirements | Examples |
|---|---|---|
| DC voltage source | 17.5 mV to 7 V, ±0.5% accuracy | Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250)<br>Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option (Option 5500A-SC) |
| Leveled sine wave Generator | 50 kHz and 200 MHz, ±3% amplitude accuracy | |
| Time mark generator | 10 ms period, ±10 ppm accuracy | |
| 50Ω BNC cable | BNC male to BNC male, ≈ 1 m (36 in) long | Tektronix part number 012-0482-XX |
| 50Ω BNC cable | BNC male to BNC male, ≈ 25 cm (10 in) long | Tektronix part number 012-0208-XX |
| 50 Ω feed through termination | BNC male and female connectors | Tektronix part number 011-0049-XX |
| Dual banana to BNC adapter | Banana plugs to BNC female | Tektronix part number 103-0090-XX |
| BNC T adapter | BNC male to dual BNC female connectors | Tektronix part number 103-0030-XX |
| Splitter, power | Frequency range: DC to 4 GHz. Tracking: >2.0% | Tektronix part number 015-0565-XX |
| Adapter (four required) | Male N-to-female BNC | Tektronix part number 103-045-XX |
| Adapter | Female N-to-male BNC | Tektronix part number 103-0058-XX |
| Leads, 3 black | Stacking banana plug patch cord, ≈ 45 cm (18 in) long | Pomona #B-18-0 |
| Leads, 2 red | Stacking banana plug patch cord, ≈ 45 cm (18 in) long | Pomona #B-18-2 |

## Test record

### Table 3: Test record

| | |
|---|---|
| **Instrument Serial Number:**<br>**Temperature:**<br>**Date of Calibration:** | **Certificate Number:**<br>**RH %:**<br>**Technician:** |

| Instrument performance test | Passed | Failed |
|---|---|---|
| Self test | | |
| Signal path compensation (SPC) | | |

### Table 4: DC balance

| Channel | Coupling | Low limit | Test result | High limit |
|---|---|---|---|---|
| Channel 1 | DC | -21 mV | | 21 mV |
| Channel 2 | DC | -21 mV | | 21 mV |
| Channel 3 [1] | DC | -21 mV | | 21 mV |
| Channel 4 | DC | -21 mV | | 21 mV |

### Table 5: Bandwidth

| Channel | Low limit | Test result | High limit |
|---|---|---|---|
| Channel 1 | 2.12 mV | | -- -- |
| Channel 2 | 2.12 mV | | -- -- |
| Channel 3 | 2.12 mV | | -- -- |
| Channel 3 | 2.12 mV | | -- -- |

### Table 6: Vertical position range

| Channel | V/div setting | Trace position | Offset | DC Voltage source | Pass/Fail |
|---|---|---|---|---|---|
| Channel 1 | 200 mV/div | Top | -0.8 V | -1.8 V | |
| | | Bottom | +0.8 V | +1.8 V | |
| | 5 V/div | Top | –20 V | -45 V | |
| | | Bottom | +20 V | +45 V | |
| Channel 2 | 200 mV/div | Top | -0.8 V | -1.8 V | |
| | | Bottom | +0.8 V | +1.8 V | |
| | 5 V/div | Top | –20 V | -45 V | |
| | | Bottom | +20 V | +45 V | |
| Channel 3 | 200 mV/div | Top | -0.8 V | -1.8 V | |
| | | Bottom | +0.8 V | +1.8 V | |
| | 5 V/div | Top | –20 V | -45 V | |
| | | Bottom | +20 V | +45 V | |
| Channel 4 | 200 mV/div | Top | -0.8 V | -1.8 V | |
| | | Bottom | +0.8 V | +1.8 V | |
| | 5 V/div | Top | –20 V | -45 V | |
| | | Bottom | +20 V | +45 V | |

### Table 7: Sample rate and delay time accuracy

| Instrument performance test | Low limit | Test result | High limit |
|---|---|---|---|
| Sample Rate and Delay Time Accuracy | -2.5 divs | | +2.5 divs |

[1] Channels 3 and 4 are only on four channel instruments

# Performance verification procedures

***NOTE.***

*If your instrument firmware version is v1.02, it should be updated before performing the performance verification procedures. Download the latest firmware from www.tek.com/software.*

The following three conditions must be met prior to performing these procedures:

- The instrument must have been operating continuously for twenty (20) minutes in an environment that meets the operating range specifications for temperature and humidity.
- You must perform a signal path compensation (SPC) before beginning these procedures. If the operating temperature changes by more than 10 °C (18 °F), you must perform the signal path compensation again.
- You must connect the instrument and the test equipment to the same AC power circuit. Connect the instrument and test instruments into a common power strip if you are unsure of the AC power circuit distribution. Connecting the instrument and test instruments into separate AC power circuits can result in offset voltages between the equipment, which can invalidate the performance verification procedure.

The time required to complete the entire procedure is approximately one hour.

***WARNING.*** *Some procedures use hazardous voltages. To prevent electrical shock, always set voltage source outputs to 0 V before making or changing any interconnections.*

# Self test

This procedure uses internal routines to verify that the instrument functions and passes its internal self tests. No test equipment or hookups are required. Start the self test with these steps:

1. Disconnect all probes and cables from the instrument inputs.
2. Push the front-panel Default Setup button to set the instrument to the factory default settings.
3. Push the Utility menu button.
4. Push the Utility Page bezel button, the Diagnostics bezel button, the Self Test bezel button, and turn Multipurpose knob a to select Loop Times.
5. Push the Multipurpose knob a to select Loop Times, and turn the Multipurpose knob a to select Loop 1 Times.
6. Push the Multipurpose knob a to set the Loop Times to 1.
7. Turn Multipurpose knob a to select Run Self Test, and push the Multipurpose knob a to start the self tests.
8. Wait while the self test runs. When the self test completes, a dialog box displays the results of the self test.
9. Push the Menu Off button to clear the dialog box and Self Test menu.

## Signal path compensation (SPC)

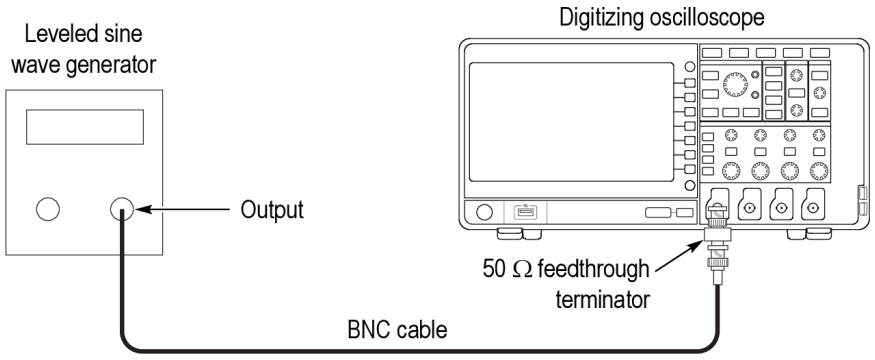
This process corrects for DC inaccuracies caused by temperature variations and/or long term drift.

1. Remove all input signals (probes and cables) from channel inputs. Input signals with AC components adversely affect SPC.
2. Push the front-panel Utility button, and then push the Utility Page bezel button.
3. Push the Calibration bezel button.
4. Turn the Multipurpose button a to select Signal Path, and then push Multipurpose knob a to select Calibration Signal Path.
5. Push the Compensate Signal Paths bezel button.
6. Wait while the Signal Path Compensation runs. On completion a dialog box informs you whether the Compensation completed successfully or not.
7. Push the Menu Off button to clear the dialog box and Self Test menu.

## Check bandwidth

This test checks the bandwidth of all input channels.

1. Connect the output of the leveled sine wave generator (for example, Fluke 9500) to the channel 1 input as shown:



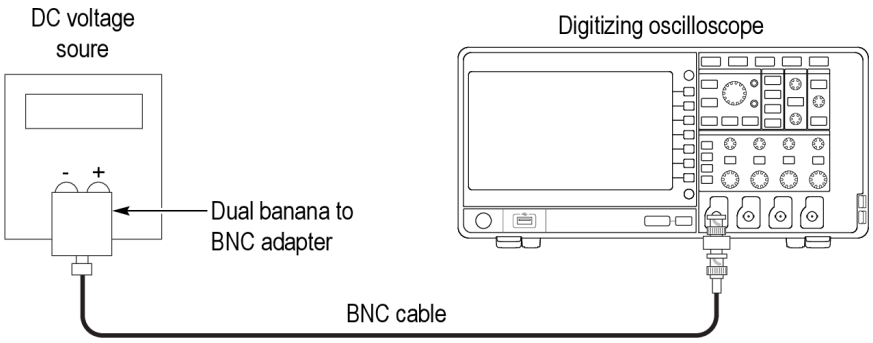

2. Push the front-panel Default Setup button to set the instrument to the factory default settings.
3. Push the front-panel Trigger Menu button.
4. Push the Coupling bezel button, and then use the Multipurpose knob to select and then set Noise Reject (DC Low Sensitivity).
5. Push the front-panel Trigger Menu button.
6. Push the Source bezel button and use Multipurpose knob a to select the channel being tested as the trigger source.
7. Push the Menu Off button, so you can see the screen.
8. Push the channel button (1, 2, 3, or 4) for the channel that you want to check.
9. Push the Probe Setup bezel button, and then use the Multipurpose knob to select Set to 1 X.
10. Push the front-panel Measure button, and then push the bezel button for the channel you are testing.
11. Use Multipurpose knob a to select the Peak-to-peak measurement.
12. Turn the Vertical Scale knob to set the vertical scale to 500 mV/div.
13. Turn the Horizontal Scale knob to 400 µs/div.
14. Set the leveled sine wave generator frequency to 1 kHz.

15. Set the leveled sine wave generator output level so the peak-to-peak measurement is between 2.98 V and 3.02 V.
16. Set the leveled sine wave generator frequency to:
    - **200 MHz** if you are checking a TBS2204B or TBS2202B
    - **100 MHz** if you are checking a TBS2104B or TBS2102B
    - **70 MHz** if you are checking a TBS2074B or TBS2072B
17. Use the Horizontal Scale knob to set the instrument to 10 ns/div.
18. Check that the peak-to-peak measurement is =2.12 V. Enter this measurement in the test record.
19. Move the input cable to the next channel to be tested.
20. Repeat steps GUID-C8E20AC6-5015-4C13-A984-E619E0D9E185#GUID-28944CD6-04DD-4505-BA70-A0390EE7942A through GUID-C8E20AC6-5015-4C13-A984-E619E0D9E185#GUID-C8E20AC6-5015-4C13-A984-E619E0D9E185/STEP-BANDWIDTH-END for all input channels.

## Check vertical offset accuracy

This test checks the offset range for each channel.

1. Connect the instrument to a DC voltage source to run this test. If using the Fluke calibrator as the DC voltage source, connect the calibrator head to the instrument channel to test.



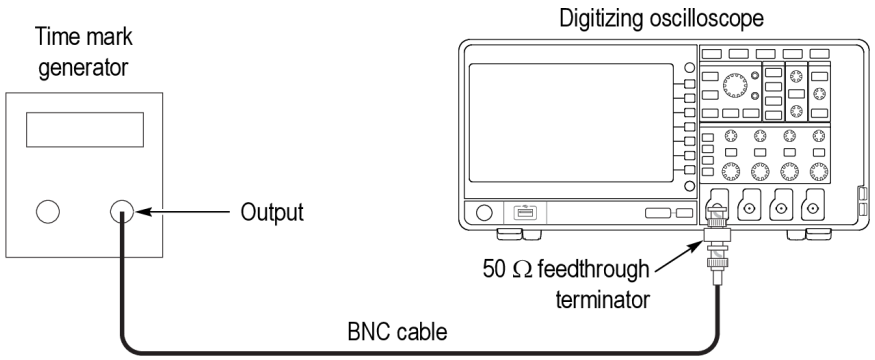

2. Push the front-panel Default Setup button to set the instrument to the factory default settings.
3. Push the channel button (1, 2, 3, or 4) for the channel that you want to check.
4. Push the Probe Setup button, and then use the Multipurpose knob to select Set to 1 X.
5. Use the Vertical Scale knob to set the instrument to 200 mV/div.
6. Use the Vertical Position knob to place the trace at the bottom of the display (-5 divisions).
7. Press the Offset bezel button and use the Multipurpose knob to set the Offset to +0.8 V.
8. Set the DC Voltage source to +1.8 V.
9. Check that the vertical trace is now within 0.2 divisions of the Zero volt line. Record Pass or Fail in the test record.
10. Set the DC Voltage source to 0 V.
11. Push the Offset bezel button and use the Multipurpose knob to select Set to 0V.
12. Use the Vertical Position knob to place the trace at the top of the display (+5 divisions).
13. Press the Offset bezel button and use the Multipurpose knob to set the Offset to –0.8 V.
14. Set the DC Voltage source to –1.8 V.

15. Check that the vertical trace is now within 0.2 divisions of the Zero volt line. Record Pass or Fail in the test record.
16. Set the DC Voltage source to 0 V.
17. Push the Offset bezel button and use the Multipurpose knob to select Set to 0V.
18. Use the Vertical Scale knob to set the instrument to 5 V/div.
19. Use the Vertical Position knob to place the trace at the bottom of the display (-5 divisions).
20. Press the Offset bezel button and use the Multipurpose knob to set the Offset to +20.00 V.
21. Set the DC Voltage source to +45 V.
22. Check that the vertical trace is now within 0.2 divisions of the Zero volt line. Record Pass or Fail in the test record.
23. Push the Offset bezel button and use the Multipurpose knob to select Set to 0V.
24. Use the Vertical Position knob to place the trace at the top of the display (+5 divisions).
25. Press the Offset bezel button and use the Multipurpose knob to set the Offset to –20.00 V.
26. Set the DC Voltage source to –45 V.
27. Check that the vertical trace is now within 0.2 divisions of the Zero volt line. Record Pass or Fail in the test record.
28. Set the DC Voltage source to 0 V.
29. Push the Offset bezel button and use the Multipurpose knob to select Set to 0V.
30. Move the DC Voltage source cable to the next channel to be tested.
31. Push the channel button (1, 2, 3, or 4) for the next channel to check.
32. Repeat steps 4 through 31 for each of the remaining channels.

## Check sample rate and horizontal position time accuracy

This test checks the sample rate and horizontal position time accuracy (time base).

1. Connect the output of the time mark generator to the channel 1 input using a 50 Ω cable and 50 Ω feed through terminator.




2. Set the time mark generator period to **1 ms**. Use a time mark waveform with a fast rising edge.
3. Push the front-panel Default Setup button to set the instrument to the factory default settings.
4. Push the channel 1 button.
5. Push the Probe Setup bezel button, and then use the Multipurpose knob to select Set to 1 X.
6. Set the Vertical SCALE to 500 mV/div.
7. Set the Horizontal SCALE to 1 ms/div.

8. If adjustable, set the time mark generator amplitude to approximately 1 Vp-p
9. Push the Trigger Level knob, to set the trigger level to 50%.
10. Adjust the Vertical POSITION knob to center the time mark signal vertically on the screen.
11. If necessary, adjust the Horizontal POSITION knob to move the trigger location to the center of the screen (50%).
12. Turn the Horizontal POSITION knob counterclockwise to set the delay to close to 1 ms.
13. Set the Horizontal Scale to 10 ns/div.
14. If necessary, turn the Horizontal Position knob to set the delay to exactly 1.0000 ms.
15. Compare the rising edge of the marker with the center horizontal graticule line. The rising edge should cross the 0 V center within ±2.5 divisions (±25 ns) of the center graticule line. Enter the deviation in the test record.

***NOTE.*** *One division of displacement from graticule center corresponds to a 10 ppm time base error.*

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