MSO4000B and DPO4000B Series
Digital Phosphor Oscilloscopes
Specifications and Performance Verification

Technical Reference

077-0509-01

Tektronix

MSO4000B and DPO4000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification

Technical Reference

Revision A

This document supports firmware version 1.00 and above for both MSO4000B Series instruments and DPO4000B Series instruments.

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.

www.tektronix.com

077-0509-01

Tektronix

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Connect and disconnect properly. De-energize the circuit under test before connecting or disconnecting the current probe.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Connect the probe reference lead to earth ground only.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in This Manual

These terms may appear in this manual:

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

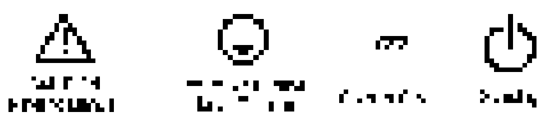
CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



Specifications

This chapter contains specifications for the MSO4000B and the DPO4000B series oscilloscopes. 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 MSO4000B and DPO4000B models unless noted otherwise. To meet specifications, two conditions must first be met:

- The oscilloscope must have been operating continuously for twenty minutes within the specified operating temperature range. (See Table 11 on page 23.)
- You must perform the Signal Path Compensation (SPC) operation described in step 2 of the *Self Test* before evaluating specifications. (See page 53, *Self Test*.) If the operating temperature changes by more than 10 °C (18 °F), you must perform the SPC operation again.

Model	Bandwidth	Analog Channels	Sample Rate (1 ch)	Sample Rate (2 ch)	Sample Rate (4 ch)	Record Length (1 ch)	Record Length (2 ch)	Record Length (4 ch)
MSO4000B models:								
MSO4104B	1 GHz	4	5 GS/s	5 GS/s	5 GS/s	20M	20M	20M
MSO4104B-L	1 GHz	4	5 GS/s	5 GS/s	2.5 GS/s	5M	5M	5M
MSO4102B	1 GHz	2	5 GS/s	5 GS/s	–	20M	20M	–
MSO4102B-L	1 GHz	2	5 GS/s	2.5 GS/s	–	5M	5M	–
MSO4054B	500 MHz	4	2.5 GS/s	2.5 GS/s	2.5 GS/s	20M	20M	20M
MSO4034B	350 MHz	4	2.5 GS/s	2.5 GS/s	2.5 GS/s	20M	20M	20M
DPO4000B models:								
DPO4104B	1 GHz	4	5 GS/s	5 GS/s	5 GS/s	20M	20M	20M
DPO4104B-L	1 GHz	4	5 GS/s	5 GS/s	2.5 GS/s	5M	5M	5M
DPO4102B	1 GHz	2	5 GS/s	5 GS/s	–	20M	20M	–
DPO4102B-L	1 GHz	2	5 GS/s	2.5 GS/s	–	5M	5M	–
DPO4054B	500 MHz	4	2.5 GS/s	2.5 GS/s	2.5 GS/s	20M	20M	20M
DPO4034B	350 MHz	4	2.5 GS/s	2.5 GS/s	2.5 GS/s	20M	20M	20M

Analog Channel Input and Vertical Specifications

The following table shows the analog channel input and vertical specifications for the MSO4000B Series and the DPO4000B Series oscilloscopes.

Table 1: Analog channel input and vertical specifications

Characteristic	Description		
Number of input channels	4 analog channels, digitized simultaneously		
Input coupling	DC or AC		
Input resistance selection	1 MΩ or 50 Ω 250 kΩ selectable for performance verification only.		
Input impedance, DC coupled	1 MΩ	1 MΩ ±1%	
	50 Ω	50 Ω ±1%	
		MSO4104B, DPO4104B, MSO4104B-L DPO4104B-L MSO4102B-L DPO4102B-L MSO4102B DPO4102B	VSWR ≤1.5:1 from DC to 1 GHz, typical
		MSO4054B, DPO4054B	VSWR ≤1.5:1 from DC to 500 MHz, typical
		MSO4034B, DPO4034B	VSWR ≤1.5:1 from DC to 350 MHz, typical
Input Capacitance, 1 MΩ DC coupled	13 pF ± 2 pF		
Maximum input voltage	1 MΩ	300 V_{RMS} at the BNC with peaks ≤±425 V Installation Category II For <100 mV/div, derate at 20 dB/decade above 100 kHz to 30 V_{RMS} at 1 MHz, 10 dB/decade above 1 MHz For ≥100 mV/div, derate at 20 dB/decade above 3 MHz to 30 V_{RMS} at 30 MHz, 10 dB/decade above 30 MHz Maximum peak input voltage at the BNC, ±425 V	
	50 Ω	5 V_{RMS} with peaks ≤±20 V (Duty Factor ≤ 6.25%) Overvoltage trip is intended to protect against overloads that might damage termination resistors. A sufficiently large impulse might cause damage regardless of the overvoltage protection circuitry because of the finite time required to detect and respond.	
DC Balance	0.1 div with the input DC 50 Ω coupled and 50 Ω terminated 0.2 div at 1 mV/div with the input DC 50 Ω coupled and 50 Ω terminated 0.2 div with the input DC 1 MΩ coupled and 50 Ω terminated		

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description			
Number of digitized bits	8 bits Displayed vertically with 25 digitization levels (DL) per division, 10.24 divisions dynamic range. "DL" is the abbreviation for "digitization level." A DL is the smallest voltage level change that can be resolved by an 8-bit A-D Converter. This value is also known as the least significant bit (LSB).			
Sensitivity range (coarse)	*1 MΩ*	1 mV/div to 10 V/div in a 1-2-5 sequence		
	50 Ω	1 mV/div to 1 V/div in a 1-2-5 sequence		
Sensitivity range (fine)	*1 MΩ*	1 mV/div to 5 V/div	<–50% to >+50% of selected setting	
		10 V/div	<–50% to 0%	
		Allows continuous adjustment from 1 mV/div to 10 V/div		
	50 Ω	1 mV/div to 500 mV/div	<–50% to >+50% of selected setting	
		1 V/div	<–50% to 0%	
		Allows continuous adjustment from 1 mV/div to 1 V/div		
Sensitivity resolution (fine), typical	≤1% of current setting			
DC gain accuracy	*For 50 Ω, 1 MΩ, TPP0500, and TPP1000 path:* ±1.5%, derated at 0.100%/°C above 30 °C ±2.0%, derated at 0.100%/°C above 30 °C, 1 mV/Div setting ±3.0% variable gain, derated at 0.100%/°C above 30 °C			
Offset ranges, minimum	*Volts/div setting*		*Offset range*	
			1 MΩ input	50 Ω input
	1 mV/div to 50 mV/div		±1 V	±1 V
	50.5 mV/div to 99.5 mV/div		±0.5 V	±0.5 V
	100 mV/div to 500 mV/div		±10 V	±10 V
	505 mV/div to 995 mV/div		±5 V	±5 V
	1 V/div to 5 V/div		±100 V	±5 V
	5.05 V/div to 10 V/div		±50 V	Not applicable
	For 50 Ω path, 1 V/div is the maximum vertical setting. The input signal cannot exceed Max Input Voltage for the 50 Ω input path. Refer to the Max Input Voltage specification for more information.			
Position range	±5 divisions			
Offset accuracy	±[0.005 × | offset – position | + DC Balance] Both the position and constant offset term must be converted to volts by multiplying by the appropriate volts/div term.			

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description	
Number of Waveforms for Average Acquisition Mode	2 to 512 waveforms Default of 16 waveforms	
DC voltage measurement accuracy Average acquisition mode	Measurement type	DC Accuracy (in Volts)
	Average of ≥ 16 waveforms	±[DC Gain Accuracy × | reading – (offset - position) | + offset accuracy + 0.1 division] Refer to DC Gain Accuracy for temperature derating information.
	Delta Volts between any two averages of ≥16 waveforms acquired with the same oscilloscope setup and ambient conditions	±[DC gain accuracy × | reading | + 0.05 div] Refer to DC Gain Accuracy for temperature derating information.
	Offset, position, and the constant offset term must be converted to volts by multiplying by the appropriate volts/div term. The basic accuracy specification applies directly to any sample and to the following measurements: High, Low, Max, Min, Mean, Cycle Mean, RMS, and Cycle RMS. The delta volt accuracy specification applies to subtractive calculations involving two of these measurements. The delta volts (difference voltage) accuracy specification applies directly to the following measurements: Positive Overshoot, Negative Overshoot, Pk-Pk, and Amplitude.	
DC voltage measurement accuracy Sample acquisition mode, typical	*Measurement type*	*DC Accuracy (in volts)*
	Any sample	±[DC gain accuracy × | reading – (offset – position) | + Offset Accuracy + 0.15 div + 0.6 mV] Refer to DC Gain Accuracy for temperature derating information.
	Delta volts between any two samples acquired with the same oscilloscope setup and ambient conditions	±[DC gain accuracy × | reading | + 0.15 div + 1.2 mV] Refer to DC Gain Accuracy for temperature derating information.
	Offset, position, and the constant offset term must be converted to volts by multiplying by the appropriate volts/div term.	
Analog bandwidth selections	20 MHz, 250 MHz, and Full	

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description		
Analog bandwidth, 50 Ω, DC coupled	These limits are for ambient temperature of ≤30°C and the bandwidth selection set to FULL. Reduce the upper bandwidth frequency by 1% for each °C above 30°C		
	Instrument	*Volts/Div setting*	*Bandwidth*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	5 mV/div — 1 V/div	DC to 1.00 GHz
		2 mV/div — 4.98 mV/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
	MSO4054B DPO4054B	5 mV/div — 1 V/div	DC to 500 MHz
		2 mV/div — 4.98 mV/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
	MSO4034B DPO4034B	2 mV/div — 1 V/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
Analog bandwidth, 1 MΩ, DC coupled	These limits are for ambient temperature of ≤30°C and the bandwidth selection set to FULL. Reduce the upper bandwidth frequency by 1% for each °C above 30°C		
	Instrument	*Volts/Div setting*	*Bandwidth*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	5 mV/div — 10 V/div	DC to 500 MHz
		2 mV/div — 4.98 mV/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
	MSO4054B, typical DPO4054B, typical	5 mV/div — 10 V/div	DC to 500 MHz
		2 mV/div — 4.98 mV/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
	MSO4034B, typical DPO4034B, typical	5 mV/div — 10 V/div	DC to 350 MHz
		2 mV/div — 4.98 mV/div	DC to 350 MHz
		1 mV/div — 1.99 mV/div	DC to 175 MHz
	The MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models have separate 50 Ω and 1 MΩ analog paths, so they must be tested at 50 Ω and 1 MΩ. All other models have only one analog path, so they are fully tested with the 50 Ω termination.		

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description		
Analog bandwidth with TPP0500 or TPP1000 probe, typical	These limits are for ambient temperature of ≤30°C and the bandwidth selection set to FULL. Reduce the upper bandwidth frequency by 1% for each °C above 30°C		
	Instrument	*Volts/Div setting*	*Bandwidth*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	50 mV/div — 100 V/div	DC to 1 GHz (TPP1000 probe) DC to 500 MHz (TPP0500 probe)
		20 mV/div — 49.8 mV/div	DC to 350 MHz
		10 mV/div — 19.9 mV/div	DC to 175 MHz
	MSO4054B, DPO4054B	50 mV/div — 100 V/div	DC to 500 MHz
		20 mV/div — 49.8 mV/div	DC to 350 MHz
		10 mV/div — 19.9 mV/div	DC to 175 MHz
	MSO4034B, DPO4034B	50 mV/div — 100 V/div	DC to 350 MHz
		20 mV/div — 49.8 mV/div	DC to 350 MHz
		10 mV/div — 19.9 mV/div	DC to 175 MHz
Lower frequency limit, AC coupled, typical	< 10 Hz when AC, 1 MΩ coupled The AC coupled lower frequency limits are reduced by a factor of 10 when 10X passive probes are used.		
Upper frequency limit, 250 MHz bandwidth limited, typical	250 MHz, ±20%		
Upper frequency limit, 20 MHz bandwidth limited, typical	20 MHz, ±20%		

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description			
Calculated rise time at 0.350/BW = t_r, typical	The formula is calculated by measuring -3 dB bandwidth of the oscilloscope. The formula accounts for the rise time contribution of the oscilloscope independent of the rise time of the signal source.			
	Instrument	*50 Ω 1 mV/div to 1.99 mV/div*	*50 Ω 2 mV/div to 4.99 mV/div*	*50 Ω 5 mV/div to 1 V/div*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	2 ns	1 ns	350 ps
	MSO4054B, DPO4054B	2 ns	1 ns	700 ps
	MSO4034B, DPO4034B	2 ns	1 ns	1 ns
	Instrument	*TPP1000 probe 10 mV/div to 19.9 mV/div*	*TPP1000 probe 20 mV/div to 49.8 mV/div*	*TPP1000 probe 50 mV/div to 10 mV/div*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	2 ns	1 ns	350 ps
	MSO4054B, DPO4054B	2 ns	1 ns	700 ps
	MSO4034B, DPO4034B	2 ns	1 ns	1 ns
	Instrument	*TPP0500 probe 10 mV/div to 19.9 mV/div*	*TPP0500 probe 20 mV/div to 49.8 mV/div*	*TPP0500 probe 50 mV/div to 10 V/div*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	2 ns	1 ns	700 ps
	MSO4054B, DPO4054B	2 ns	1 ns	700 ps
	MSO4034B, DPO4034B	2 ns	1 ns	1 ns

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description			
Peak Detect or Envelope mode pulse response, typical	*Instrument (Sample Rate Maximum)*		*Minimum pulse width*	
	MSO4104B, DPO4104B, MSO4104B-L DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B		>800 ps	
	MSO4054B, DPO4054B MSO4034B, DPO4034B		>1.6 ns	
Random Noise, Sample Acquisition Mode	*Instrument*	*Bandwidth limit*	*RMS noise (mV)*	
			1 M Ω	*50 Ω*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	Full Bandwidth	≤ (300 µV + 8.0% of Volts/div setting)	≤ (75 µV + 6.0% of Volts/div setting)
		250 MHz bandwidth	≤ (100 µV + 5.0% of Volts/div setting)	≤ (50 µV + 4.0% of Volts/div setting)
		20 MHz bandwidth	≤ (100 µV + 5.0% of Volts/div setting)	≤ (50 µV + 4.0% of Volts/div setting)
	MSO4054B, DPO4054B	Full Bandwidth	≤ (130 µV + 8.0% of Volts/div setting)	≤ (130 µV + 8.0% of Volts/div setting)
		250 MHz bandwidth	≤ (100 µV + 6.0% of Volts/div setting)	≤ (100 µV + 6.0% of Volts/div setting)
		20 MHz bandwidth	≤ (100 µV + 4.0% of Volts/div setting)	≤ (100 µV + 4.0% of Volts/div setting)
	MSO4034B, DPO4034B	Full Bandwidth	≤ (130 µV + 8.0% of Volts/div setting)	≤ (130 µV + 8.0% of Volts/div setting)
		250 MHz bandwidth	≤ (100 µV + 6.0% of Volts/div setting)	≤ (100 µV + 6.0% of Volts/div setting)
		20 MHz bandwidth	≤ (100 µV + 4.0% of Volts/div setting)	≤ (100 µV + 4.0% of Volts/div setting)
Delay between channels, full bandwidth, typical	≤100 ps between any two channels with input impedance set to 50 Ω, DC coupling, with equal volts/division setting or above 10 mV/div All settings in the instrument can be manually time aligned using the Probe Deskew function from –125 ns to +125 ns with a resolution of 20 ps			
Deskew range	–125 ns to +125 ns with a resolution of 20 ps			
Crosstalk (channel isolation), typical	≥100:1 at ≤100 MHz and ≥30:1 at >100 MHz up to the rated bandwidth for any two channels having equal Volts/Div settings			
TekVPI Interface	The probe interface allows installing, powering, compensating, and controlling a wide range of probes offering a variety of features. The interface is available on all front panel inputs including Aux In. Aux In only provides 1 MΩ input impedance and does not offer 50 Ω as the other input channels do.			
Total probe power	Five Tek VPI-compliant probe interfaces (one per channel) 50 W maximum internal probe power			

Table 1: Analog channel input and vertical specifications (cont.)

Characteristic	Description		
Probe power per channel	*Voltage*	*Max Amperage*	*Voltage Tolerance*
	5 V	50 mA (250 mW)	±5%
	12 V	2 A (24 W)	±10%

Horizontal and Acquisition System Specifications

The following table shows the horizontal and acquisitions system specifications for the MSO4000B Series and the DPO4000B Series oscilloscopes.

Table 2: Horizontal and acquisition system specifications

Characteristic	Description			
Sample-rate range	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	5 GS/s — 2.5 S/s		
	MSO4054B, DPO4054B, MSO4034B, DPO4034B	2.5 GS/s —2.5 S/s		
Record Length Range	Non-L models: 20 M, 10 M, 5 M, 1 M, 100 k, 10 k, 1 k L models: 5 M, 1 M, 100 k, 10 k, 1 k			
Seconds/Division range	*Instrument*	*1 k*	*10 k*	*100 k – 20 M*
	MSO4104B, DPO4104B,MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	400 ps – 40 s	400 ps – 400 s	400 ps – 1.00 ks
	MSO4054B, DPO4054B, MSO4034B, DPO4034B	1 ns – 40 s	1 ns – 400 s	1 ns – 1.00 ks
Maximum triggered acquisition rate	> 50,000 wfm/s			
Aperture Uncertainty	≤(3 ps + 0.1 ppm × record duration)$_{RMS}$, for records having ≤1 minute duration			
Long-term sample rate and delay time accuracy	±5 ppm over any ≥1 ms time interval			

Table 2: Horizontal and acquisition system specifications (cont.)

Characteristic	Description
Delta-time measurement accuracy	The formula to calculate the delta-time measurement accuracy (DTA) for a given instrument setting and input signal is given in the following table. (See Table 3.) The formula assumes insignificant signal content above Nyquist and insignificant error due to aliasing. The abbreviations used in the formula are as follows: SR_1 = slew rate around 1st point in measurement (1st edge) SR_2 = slew rate around 2nd point in measurement (2nd edge) N =input-referred noise (V_{RMS}) (Refer to *Random Noise* and *Sample Acquisition Mode* specifications.) TBA = time base accuracy (5 ppm) (Refer to *Long-term Sample Rate* and *Delay Time Accuracy* specifications.) t_p = delta-time measurement duration (sec) RD = (record length)/(sample rate) t_{sr} = 1/(sample rate) assume edge shape that results from Gaussian filter response
	The term under the square-root sign is the stability and is due to TIE (Time Interval Error). The errors due to this term occur throughout a single-shot measurement. The second term is due to both the absolute center-frequency accuracy and the center-frequency stability of the time base and varies between multiple single-shot measurements over the observation interval (the amount of time from the first single-shot measurement to the final single-shot measurement).

Table 3: Delta-Time measurement accuracy formula

The terms used in these formulas are defined under *Delta-time measurement accuracy*, in the preceding table. (See Table 2.)

$$DTA_{pk-pk} =$$

$$\pm 5 \times \sqrt{2\left[\frac{N}{SR_1}\right]^2 + 2\left[\frac{N}{SR_2}\right]^2 + (3ps + 1 \times 10^{-7} \times RD)^2} + 2t_{sr} + TBA \times t_p$$

$$DTA_{rms} =$$

$$\sqrt{2\left[\frac{N}{SR_1}\right]^2 + 2\left[\frac{N}{SR_2}\right]^2 + (3ps + 1 \times 10^{-7} \times RD)^2 + \left(\frac{2 \times t_{sr}}{\sqrt{12}}\right)^2} + TBA \times t_p$$

Trigger Specifications

The following table shows the trigger specifications for the MSO4000B Series and the DPO4000B Series oscilloscopes.

Table 4: Trigger specifications

Characteristic	Description	
Aux In (External) trigger input impedance, typical	1 M Ω ±1% in parallel with 13 pF ±2 pF	
Aux In (External) trigger maximum input voltage	The maximum input voltage at the BNC 300 V_{RMS} Installation Category II Derate at 20 dB/decade above 3 MHz to 30 V_{RMS} at 30 MHz, 10 dB/decade above 30 MHz.	
Aux In (External) trigger bandwidth, typical	250 MHz ±20%	
Trigger bandwidth, Edge, typical	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	1 GHz
	MSO4054B, DPO4054B	500 MHz
	MSO4034B, DPO4034B	350 MHz
Trigger bandwidth, Pulse and Logic, typical	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	1 GHz
	MSO4054B, DPO4054B	500 MHz
	MSO4034B, DPO4034B	350 MHz

Table 4: Trigger specifications (cont.)

Characteristic	Description		
Edge-type trigger sensitivity, DC coupled, typical	Models	*Trigger Source*	*Sensitivity*
	MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, DPO4102B	Any input channel	50 Ω path: 0.40 div from DC to 50 MHz, increasing to 1 div at oscilloscope bandwidth
	MSO4054B, DPO4054B MSO4034B, DPO4034B	Any input channel	50 Ω path: 1 mV/div to 4.98 mV/div – 0.75 div from DC to 50 MHz, increasing to 1.3 div at oscilloscope bandwidth. ≥5 mV/div – 0.40 div from DC to 50 MHz, increasing to 1 div at oscilloscope bandwidth.
	All models	Any input channel	1 MΩ path: 1 mV/div to 4.98 mV/div – 0.75 div from DC to 50 MHz, increasing to 1.3 div at oscilloscope bandwidth. ≥5 mV/div – 0.40 div from DC to 50 MHz, increasing to 1 div at oscilloscope bandwidth.
	All models	Aux in (External)	200 mV from DC to 50 MHz, increasing to 500 mV at 250 MHz
	All models	Line	Fixed
Trigger jitter, typical	≤10 ps_{RMS} for edge-type trigger ≤100 ps_{RMS} for non edge-type trigger modes		
Edge-type trigger sensitivity, not DC coupled, typical	*Trigger Coupling*	*Typical Sensitivity*	
	AC Coupling	1 div for frequencies above 45 Hz. Attenuates signals below 45 Hz.	
	NOISE REJ	2.5 times the DC-coupled limits	
	HF REJ	1.0 times the DC-coupled limits from DC to 50 kHz. Attenuates signals above 50 kHz	
	LF REJ	1.5 times the DC-coupled limits for frequencies above 50 kHz. Attenuates signals below 50 kHz	
Video-type trigger formats and field rates	Triggers from negative sync composite video, field 1 or field 2 for interlaced systems, on any field, specific line, or any line for interlaced or non-interlaced systems. Supported systems include NTSC, PAL, and SECAM.		
Video-type trigger sensitivity, typical	*Delayed and main trigger*		
	Source	*Sensitivity*	
	Any input channel	0.6 to 2.5 divisions of video sync tip	
	Aux In (External)	Video not supported through Aux In (External) input	

Table 4: Trigger specifications (cont.)

<table>
<tr><th>Characteristic</th><th>Description</th></tr>
<tr><td>Lowest frequency for successful operation of "Set Level to 50%" function, typical</td><td>45 Hz</td></tr>
<tr><td>Logic-type or logic qualified trigger or events-delay sensitivities, DC coupled, typical</td><td>1.0 division from DC to maximum bandwidth</td></tr>
<tr><td>Pulse-type runt trigger sensitivities, typical</td><td>1.0 division from DC to maximum bandwidth</td></tr>
<tr><td>Pulse-type trigger width and glitch sensitivities, typical</td><td>1.0 division</td></tr>
<tr><td>Logic-type triggering, minimum logic or rearm time, typical</td><td>For all vertical settings, the minimums are:
<table>
<tr><td>Trigger type</td><td>Pulse width</td><td>Re-arm time</td><td>Time between channels</td></tr>
<tr><td>Logic</td><td>Not applicable</td><td>2 ns</td><td>1 ns</td></tr>
<tr><td>Time Qualified Logic</td><td>4 ns</td><td>2 ns</td><td>1 ns</td></tr>
</table>
For logic, time between channels refers to the length of time a logic state derived from more than one channel must exist to be recognized. For events, the time is the minimum time between a main and delayed event that will be recognized if more than one channel is used.</td></tr>
<tr><td>Minimum clock pulse widths for setup/hold time violation trigger, typical</td><td>For all vertical settings, the minimums are:
<table>
<tr><td>Clock active</td><td>Clock inactive</td></tr>
<tr><td>User hold time + 2.5 ns</td><td>2 ns</td></tr>
</table>
An active pulse width is the width of the clock pulse from its active edge (as defined in the Clock Edge lower-bezel menu item) to its inactive edge. An inactive pulse width is the width of the pulse from its inactive edge to its active edge.
The User hold time is the number selected by the user.</td></tr>
<tr><td>Setup/hold violation trigger, setup and hold time ranges</td><td>
<table>
<tr><td>Feature</td><td>Min</td><td>Max</td></tr>
<tr><td>Setup time</td><td>–0.5 ns</td><td>1.0 ms</td></tr>
<tr><td>Hold time</td><td>1 ns</td><td>1.0 ms</td></tr>
<tr><td>Setup + Hold time</td><td>0.5 ns</td><td>2.0 ms</td></tr>
</table>
Input coupling on clock and data channels must be the same.
For Setup time, positive numbers mean a data transition before the clock.
For Hold time, positive numbers mean a data transition after the clock edge.
Setup + Hold time is the algebraic sum of the Setup Time and Hold Time that you programmed.</td></tr>
</table>

Table 4: Trigger specifications (cont.)

Pulse type trigger, minimum pulse, rearm time, transition time	*Pulse class*	*Minimum pulse width*	*Minimum rearm time*
	Glitch	4 ns	2 ns + 5% of glitch width setting
	Runt	4 ns	2 ns
	Time-qualified runt	4 ns	8.5 ns + 5% of width setting
	Width	4 ns	2 ns + 5% of width upper limit setting
	Slew rate (transition time)	4 ns	8.5 ns + 5% of delta time setting
	For the trigger class width and the trigger class runt, the pulse width refers to the width of the pulse being measured. The rearm time refers to the time between pulses. For the trigger class slew rate, the pulse width refers to the delta time being measured. The rearm time refers to the time it takes the signal to cross the two trigger thresholds again.		
Transition time trigger, delta time range	4 ns to 8 s		
Time range for glitch, pulse width, timeout, time-qualified runt, or time-qualified window triggering	4 ns to 8 s		
Time Accuracy for Pulse, Glitch, Timeout, or Width Triggering	*Time Range*	*Accuracy*	
	1 ns to 500 ns	±(20% of setting + 0.5 ns)	
	520 ns to 1 s	±(0.01% of setting + 100 ns)	
B trigger after events, minimum pulse width and maximum event frequency, typical	4 ns, 500 MHz		
B trigger, minimum time between arm and trigger, typical	4 ns For trigger after time, this is the time between the end of the time period and the B trigger event. For trigger after events, this is the time between the last A trigger event and the first B trigger event.		
B trigger after time, time range	4 ns to 8 seconds		
B trigger after events, event range	1 to 4,000,000		
Trigger level ranges	*Source*		*Range*
	Any input channel		±8 divisions from center of screen ±8 divisions from 0 V when vertical LF reject trigger coupling is selected
	Aux In (External)		±8 V
	Line		Not applicable
	Line trigger level is fixed at about 50% of the line voltage. This specification applies to logic and pulse thresholds.		

Table 4: Trigger specifications (cont.)

Trigger level accuracy, DC coupled, typical	For signals having rise and fall times ≥10 ns.	
	Source	*Range*
	Any input channel	±0.20 div
	Aux In (External)	±(10% of setting + 25 mV)
	Line	Not applicable
Trigger holdoff range	20 ns minimum to 8 s maximum	
Maximum serial trigger bits	128 bits	
Standard serial bus interface triggering		
I^{2}C	**Address Triggering:** 7 and 10 bit user specified address, as well as General Call, START byte, HS-mode, EEPROM, and CBUS **Data Trigger:** 1 to 5 bytes of user specified data **Trigger On:** Start, Repeated Start, Stop, Missing Ack, Address, Data, or Address and Data **Maximum Data Rate:** 10 Mbps	
SPI	**Data Trigger:** 1 to 16 bytes of user-specified data **Trigger On:** SS Active, MOSI, MISO, or MOSI & MISO **Maximum Data Rate:** 50 Mbps	
CAN	**Data Trigger:** 1 to 8 bytes of user-specified data, including qualifiers of equal to (=), not equal to (<>), less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=) **Trigger On:** Start of Frame, Type of Frame, Identifier, Data, Identifier and Data, End of Frame, Missing Ack, or Bit Stuffing Errors **Frame Type:** Data, Remote, Error, Overload **Identifier:** Standard (11 bit) and Extended (29 bit) identifiers **Maximum Data Rate:** 1 Mbps	
LIN	**Identifier Trigger:** 6 bits of user-specified data, equal to (=) **Data Trigger:** 1 to 8 bytes of user-specified data, including qualifiers of equal to (=), not equal to (<>), less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), inside range, or outside range **Error:** Sync, Identifier Parity, Checksum **Trigger On:** Sync, Identifier, Data, Identifier & Data, Wakeup Frame, Sleep Frame, or Error **Maximum Data Rate:** 100 kbps	

Table 4: Trigger specifications (cont.)

FlexRay	**Indicator bits**: Normal Frame, Payload Frame, Null Frame, Sync Frame, Startup Frame **Identifier Trigger**: 11 bits of user-specified data, equal to (=), not equal to (<>), less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), Inside Range, or Outside Range **Cycle Count Trigger**: 6 bits of user-specified data, equal to (=) **Header Fields Trigger**: 40 bits of user-specified data comprising Indicator Bits, Identifier, Payload Length, Header CRC, Cycle Count, or equal to (=) **Data Trigger:** 1 to 16 Bytes of user-specified data, with 0 to 253, or "don't care" bytes of data offset, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), Inside Range, Outside Range **End Of Frame:** User-chosen types Static, Dynamic (DTS), and All **Error:** Header CRC, Trailer CRC, Null Frame-static, Null Frame-dynamic, Sync Frame, Startup Frame **Trigger On:** Start of Frame, Indicator Bits, Identifier, Cycle Count, Header Fields, Data, Identifier & Data, End of Frame, or Error **Maximum Data Rate:** 100 Mbps
I^{2}S	**Data Trigger:** 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), inside range, outside range **Trigger on:** Word Select, Data **Maximum Data Rate:** 12.5 Mbps
Left Justified	**Data Trigger:** 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), inside range, outside range **Trigger on:** Word Select, Data **Maximum Data Rate:** 12.5 Mbps
Right Justified	**Data Trigger:** 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), inside range, outside range **Trigger on:** Word Select, Data **Maximum Data Rate:** 12.5 Mbps
TDM	**Data Trigger:** 32 bits of user-specified data in a channel 0-7, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), inside range, outside range **Trigger on:** Frame Sync, Data **Maximum Data Rate:** 25 Mbps
RS-232	**Bit Rate:** 50 bps to 10 Mbps **Data Bits:** 7, 8, or 9 **Parity:** None, Odd, or Even **Trigger on:** Tx Start bit, Rx Start bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, Rx Parity Error **End of Packet:** 00 (NUL), OA (LF), OD (CR), 20 (SP), FF
MIL-STD-1553	**Trigger on:** Sync, Word Type, Parity Error

Table 4: Trigger specifications (cont.)

USB	**Data Rates Supported:** HS: 480 Mbps, Full: 12 Mbps, Low: 1.5 Mbps **Trigger On:** Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error ***NOTE.*** *HIGH SPEED support available only on MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models.*
Ethernet	**Bit Rate:** 10BASE-T, 10 Mbps; 100BASE-TX, 100 Mbps **Trigger On:** Start Frame Delimiter (SFD), MAC Address, MAC Length/Type, IP Header, TCP Header, TCP/IPv4/MAC Client Data, End of Packet, Idle, FCS (CRC) Error, MAC Q-Tag control Information.

Digital Acquisition Specifications, MSO4000B Series

The following table shows the digital acquisition specifications for the MSO4000B Series oscilloscopes.

Table 5: Digital acquisition specifications, MSO4000B Series

Characteristic	Description
Threshold voltage range	-40 V to +40 V
Digital channel timing resolution	2 ns main memory, 60.6 ps for MagniVu memory
Logic threshold accuracy	±(100 mV + 3% of threshold setting after calibration) Requires valid SPC, as described in step 2 of the *Self Test*. (See page 53, *Self Test*.)
Minimum detectable pulse width, typical	1 ns Using MagniVu memory. Requires the use of 342-1140-00 ground clip on each channel.

P6616 Digital Probe Specifications

The following table shows the P6616 Digital Probe specifications.

Table 6: P6616 digital probe specifications

Characteristic	Description
Number of channels	16 digital inputs
Input resistance, typical	100 kΩ to ground
Input capacitance, typical	3.0 pF Measured at the podlet input. Requires the use of 342-1140-00 ground clip on each channel
Minimum input signal swing, typical	400 mV_{p-p} Requires the use of 342-1140-00 ground clip on each channel
Maximum input signal swing, typical	30 V_{p-p} for $f_{in} \leq$ 200 MHz (centered around the DC threshold voltage) at the P6616 probe tip. 10 V_{p-p} for f_{in} >200 MHz (centered around the DC threshold voltage) at the P6616 probe tip. Failure to meet this input signal requirement will compromise the AC performance of the digital channel. It might also damage the input circuitry. See the Absolute maximum input voltage specification.
Maximum Input Toggle Rate	500 MHz Maximum frequency sine wave input (at the minimum signal swing amplitude) that can accurately be reproduced as a logic square wave. Requires the use of a 342-1140-00 ground clip on each channel. Higher toggle rates can be achieved with higher amplitudes.
Absolute maximum input, typical	±42 V peak at the P6616 input (not at the instrument input) Probe input voltages beyond this limit could permanently damage the instrument and the P6616 probe.
Channel-to-channel skew, typical	200 ps Digital channel to digital channel only. This is the propagation path skew and ignores skew contributions due to threshold inaccuracies (see Threshold accuracy) and sample binning (see Digital channel timing resolution). Factory calibration/deskew is required to achieve this number.

Display Specifications

The following table shows the display specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 7: Display specifications

Characteristic	Description
Display type	Display area: 210.4 mm (8.28 in) (H) x 157.8 mm (6.21 in) (V), 264 mm (10.4 in) diagonal, 6-bit RGB full color, XGA (1024 x 768) TFT liquid crystal display (LCD).
Display resolution	1024 X 768 XGA display resolution
Luminance, typical	400 cd/m^2
Waveform display color scale	The TFT display can support up to 262,144 colors. A subset of these colors are used for the oscilloscope display, all of which are fixed colors and not changeable by the user.

Input/Output Port Specifications

The following table shows the input/output port specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 8: Input/Output port specifications

<table>
<tr><th>Characteristic</th><th>Description</th></tr>
<tr><td>Ethernet interface</td><td>Standard on all models: 10/100/1000 Mbps</td></tr>
<tr><td>GPIB interface</td><td>Available as an optional accessory (TEK-USB-488 GPIB to USB Adapter), which connects to the USB Device and USB Host port.
The control interface is incorporated into the instrument user interface.</td></tr>
<tr><td>Video signal output</td><td>A15-pin D-sub VGA connector.</td></tr>
<tr><td>USB interface</td><td>4 USB host connectors (2.0 HS), two on the instrument front and two on the rear.
1 USB device connector (2.0 HS), on the instrument rear panel.
All are standard on all models.</td></tr>
<tr><td>Probe compensator output voltage and frequency, typical</td><td>Output Voltage
Default: 0-2.5 V amplitude ± 2% (Source Impedance of 1KΩ)
TPPXX00 Cal Mode: 0-2.5 V amplitude ± 5% (Source Impedance of ≤25Ω)
Frequency
1 kHz ± 25%</td></tr>
<tr><td>Auxiliary output (AUX OUT)
Main Trigger or
Reference Clock or
Event</td><td>You can set the auxiliary output (the rear-panel AUX OUT port) to Main Trigger or Reference Clock or Event by pushing the Utility front-panel button and turning Multipurpose knob a to select Ext. Signals. Then push the bottom-menu AUX OUT button and the desired side-menu button.
Main Trigger: A HIGH to LOW transition indicates that the trigger occurred.
Reference Clock: Outputs the 10 MHz oscilloscope reference clock.
Event: Outputs a pulse when a certain event happens, such as a mask-limit event.
<table>
<tr><td colspan="2">Trigger output logic levels</td></tr>
<tr><td>Characteristic</td><td>Limits</td></tr>
<tr><td>Vout (HI)</td><td>≥2.5 V open circuit
≥1.0 V into a 50 Ω load to ground</td></tr>
<tr><td>Vout (LO)</td><td>≤0.7 V into a load of ≤4 mA
≤0.25 V into a 50 Ω load to ground</td></tr>
</table></td></tr>
<tr><td>External Reference nominal input frequency</td><td>10 MHz
You must select either the internal reference (default) or 10 MHz external.</td></tr>
<tr><td>External Reference input frequency variation tolerance, typical</td><td>9.9 MHz to 10.1 MHz
You must run SPC, described in step 2 of the Self Test, whenever the external reference is more than 0.2% (2000 ppm) different than the nominal reference frequency or reference at which SPC was last run. (See page 53, Self Test.) The time base changes in correspondence to the fluctuations in the external reference.</td></tr>
<tr><td>External Reference input sensitivity, typical</td><td>1.5 V_{p-p} for input frequencies between 9.9 MHz and 10.1 MHz</td></tr>
</table>

Table 8: Input/Output port specifications (cont.)

Characteristic	Description
External Reference input maximum input signal	7 V_{p-p}
External Reference input impedance, typical	Rin = 1.5 kΩ ±20% in parallel with 15 pF ±5 pF at 10 MHz

Data Storage Specifications

The following table shows the data storage specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 9: Data storage specifications

Characteristic	Description
Nonvolatile memory retention time, typical	No time limit for front-panel settings, saved waveforms, setups, and calibration constants. 5 M, 10 M, and 20 M records saved as Reference waveforms are not saved in the nonvolatile memory and they will not be saved across a power cycle.
Real-time clock	A programmable clock providing time in years, months, days, hours, minutes, and seconds

Power Source Specifications

The following table shows the power source specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 10: Power source specifications

Characteristic	Description
Source voltage	100 V to 240 V ±10%
Source frequency	(85 to 264 V) 45 Hz to 66 Hz (100 V to 132 V) 360 Hz to 440 Hz
Fuse rating	T6.3AH, 250 VAC The fuse cannot be replaced by the user.

Environmental Specifications

The following table shows the environmental specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 11: Environmental specifications

Characteristic	Description
Temperature	Operating: 0 °C to +50 °C (32 °F to +122 °F) Nonoperating: -20 °C to +60 °C (-4 °F to +140 °F)
Humidity	Operating: High: 40 °C to 50 °C (104 °F to 122 °F), 10% to 60% relative humidity Low: 0 °C to 40 °C (32 °F to 104 °F), 10% to 90% relative humidity Nonoperating: High: 40 °C to 60 °C (104 °F to 140 °F), 5% to 60% relative humidity Low: 0 °C to 40 °C (32 °F to 104 °F), 5% to 90% relative humidity,
Altitude	Operating: 3,000 m (9,843 ft) Nonoperating: 9,144 m (30,000 ft)
Pollution Degree	Pollution Degree 2, indoor use only

Mechanical Specifications

The following table shows the mechanical specifications for the MSO4000B Series and DPO4000B Series oscilloscopes.

Table 12: Mechanical specifications

Characteristic	Description
Dimensions	*Benchtop configuration (oscilloscope only)* Requirements that follow are nominal and unboxed Height: 9.0 in (229 mm) feet folded in, handle folded down 9.8 in (249 mm) feet folded out, handle folded down 11.5 in (292 mm) feet folded in, handle folded up 12.3 in (312 mm) feet folded out, handled folded up Width: 17.3 in (439 mm) from handle hub to handle hub Depth: 5.8 in (147 mm) from back of feet to front of knobs 6.1 in (155 mm) from back of feet to front of front cover 9.8 in (249 mm) from handle to front of knobs (handle folded to backside of unit) Box Dimensions: Height: 15.7 in (399 mm) Width: 15.6 in (396 mm) Length: 22.2 in (564 mm) *Rackmount configuration* Requirements that follow are nominal and unboxed (5U rack sizes): Height: 8.6 in (218 mm) Width: 19.2 in (488 mm), from outside of handle to outside of handle Depth: 15.1 in (384 mm), from outside of handle to back of slide
Weight	*Benchtop configuration (oscilloscope only)* Requirements that follow are nominal: 11.0 lbs (5.0 kg), stand-alone instrument, without front cover. 18.8 lbs (8.5 kg), instrument with rackmount, without front cover 23.6 lbs (10.7 kg), when packaged for domestic shipment (without rackmount)
Clearance Requirements	0 mm (0 in), top 0 in (0 mm), bottom, on feet, with flip stands down 2 in (50.8 mm), left side (facing the front of the instrument) 0 in (0 mm), right side (facing the front of the instrument) 2 in (50.8 mm), rear (where the power cord is plugged in)

Performance Verification

This chapter contains performance verification procedures for the specifications marked with the symbol. The following equipment, or a suitable equivalent, is required to complete these procedures.

Table 13: Required equipment

Description	Minimum requirements	Examples
DC voltage source	3 mV to 4 V, ±0.1% accuracy	Fluke 9500 Oscilloscope Calibrator with a 9510 Output Module
Leveled sine wave generator	50 kHz to 1000 MHz, ±4% amplitude accuracy	
Time mark generator	80 ms period, ±1 ppm accuracy, rise time < 50 ns	
Logic Probe	Low capacitance digital probe, 16 channels.	P6616 probe; standard accessory shipped with MSO4000B Series oscilloscopes.
BNC-to-0.1 inch pin adapter to connect the logic probe to the signal source.	BNC-to-0.1 inch pin adapter; female BNC to 2x16 .01 inch pin headers.	Tektronix adapter part number 679-6240-00; to connect the Fluke 9500 to the P6616 probe.
Digital Multimeter (DMM)	0.1% accuracy or better	
One 50 Ω terminator	Impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-02
One 50 Ω BNC cable	Male-to-male connectors	Tektronix part number 012-0057-01

You might need additional cables and adapters, depending on the actual test equipment you use.

These procedures cover all MSO4000B and DPO4000B models. Please disregard checks that do not apply to the specific model you are testing.

Print the test record on the following pages and use it to record the performance test results for your oscilloscope.

NOTE. *Completion of the performance verification procedure does not update the stored time and date of the latest successful adjustment. The date and time are updated only when the adjustment procedures in the service manual are successfully completed.*

The performance verification procedures verify the performance of your instrument. They do not adjust your instrument. If your instrument fails any of the performance verification tests, you should perform the factory adjustment procedures as described in the *Tektronix MSO4000B and DPO4000B Series Service Manual*. This manual is available at www.tektronix.com/manuals.

Test Record

Model	Serial	Procedure performed by	Date

Test	Passed	Failed
Self Test		

Input Impedance

Performance checks	Vertical scale	Low limit	Test result	High limit
All models for channels 1 and 2				
Channel 1 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
	1 V/div	990 kΩ		1.01 MΩ
Channel 1 Input Impedance, 250 kΩ	100 mV/div	245 kΩ		255 kΩ
Channel 1 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Channel 2 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
	1 V/div	990 kΩ		1.01 MΩ
Channel 2 Input Impedance, 250 kΩ	100 mV/div	245 kΩ		255 kΩ
Channel 2 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
All four-channel models for channels 3 and 4 (MSO4XX4B, MSO4XX4B-L, DPO4XX4B, DPO4XX4B-L)				
Channel 3 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
	1 V/div	990 kΩ		1.01 MΩ
Channel 3 Input Impedance, 250 kΩ	100 mV/div	245 kΩ		255 kΩ
Channel 3 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Channel 4 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
	1 V/div	990 kΩ		1.01 MΩ
Channel 4 Input Impedance, 250 kΩ	100 mV/div	245 kΩ		255 kΩ

Input Impedance

Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 4, Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Aux In Input Impedance, 250 kΩ	100 mV/div	245 kΩ		255 kΩ

DC Balance

All models for channels 1 and 2

Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 1 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.2 mV		0.2 mV
	5 mV/div	-0.5 mV		0.5 mV
	10 mV/div	-1 mV		1 mV
	20 mV/div	-2 mV		2 mV
	49.8 mV/div	-4.98 mV		4.98 mV
	50 mV/div	-5 mV		5 mV
	100 mV/div	-10 mV		10 mV
	200 mV/div	-20 mV		20 mV
	500 mV/div	-50 mV		50 mV
	1 V/div	-100 mV		100 mV
Channel 1 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.4 mV		0.4 mV
	5 mV/div	-1 mV		1 mV
	10 mV/div	-2 mV		2 mV
	20 mV/div	-4 mV		4 mV
	100 mV/div	-20 mV		20 mV
	500 mV/div	-100 mV		100 mV
	1 V/div	-200 mV		200 mV
	10 V/div	-2 V		2 V
Channel 1 DC Balance, 50 Ω, 250 MHz BW	20 mV/div	-2 mV		2 mV
Channel 1 DC Balance, 1 MΩ, 250 MHz BW	20 mV/div	-4 mV		4 mV
Channel 1 DC Balance, 50 Ω, Full BW	20 mV/div	-2 mV		2 mV
Channel 1 DC Balance, 1 MΩ, Full BW	20 mV/div	-4 mV		4 mV

DC Balance

All models for channels 1 and 2

Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 2 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.2 mV		0.2 mV
	5 mV/div	-0.5 mV		0.5 mV
	10 mV/div	-1 mV		1 mV
	20 mV/div	-2 mV		2 mV
	49.8 mV/div	-4.98 mV		4.98 mV
	50 mV/div	-5 mV		5 mV
	100 mV/div	-10 mV		10 mV
	200 mV/div	-20 mV		20 mV
	500 mV/div	-50 mV		50 mV
	1 V/div	-100 mV		100 mV
Channel 2 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.4 mV		0.4 mV
	5 mV/div	-1 mV		1 mV
	10 mV/div	-2 mV		2 mV
	20 mV/div	-4 mV		4 mV
	100 mV/div	-20 mV		20 mV
	500 mV/div	-100 mV		100 mV
	1 V/div	-200 mV		200 mV
	10 V/div	-2 V		2 V
Channel 2 DC Balance, 50 Ω, 250 MHz BW	20 mV/div	-2 mV		2 mV
Channel 2 DC Balance, 1 MΩ, 250 MHz BW	20 mV/div	-4 mV		4 mV
Channel 2 DC Balance, 50 Ω, Full BW	20 mV/div	-2 mV		2 mV
Channel 2 DC Balance, 1 MΩ, Full BW	20 mV/div	-4 mV		4 mV

DC Balance

All four-channel models for channels 3 and 4

Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 3 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.2 mV		0.2 mV
	5 mV/div	-0.5 mV		0.5 mV
	10 mV/div	-1 mV		1 mV
	20 mV/div	-2 mV		2 mV
	49.8 mV/div	-4.98 mV		4.98 mV
	50 mV/div	-5 mV		5 mV
	100 mV/div	-10 mV		10 mV
	200 mV/div	-20 mV		20 mV
	500 mV/div	-50 mV		50 mV
	1 V/div	-100 mV		100 mV
Channel 3 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.4 mV		0.4 mV
	5 mV/div	-1 mV		1 mV
	10 mV/div	-2 mV		2 mV
	20 mV/div	-4 mV		4 mV
	100 mV/div	-20 mV		20 mV
	500 mV/div	-100 mV		100 mV
	1 V/div	-200 mV		200 mV
	10 V/div	-2 V		2 V
Channel 3 DC Balance, 50 Ω, 250 MHz BW	20 mV/div	-2 mV		2 mV
Channel 3 DC Balance, 1 MΩ, 250 MHz BW	20 mV/div	-4 mV		4 mV
Channel 3 DC Balance, 50 Ω, Full BW	20 mV/div	-2 mV		2 mV
Channel 3 DC Balance, 1 MΩ, Full BW	20 mV/div	-4 mV		4 mV

DC Balance
All four-channel models for channels 3 and 4

Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 4 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.2 mV		0.2 mV
	5 mV/div	-0.5 mV		0.5 mV
	10 mV/div	-1 mV		1 mV
	20 mV/div	-2 mV		2 mV
	49.8 mV/div	-4.98 mV		4.98 mV
	50 mV/div	-5 mV		5 mV
	100 mV/div	-10 mV		10 mV
	200 mV/div	-20 mV		20 mV
	500 mV/div	-50 mV		50 mV
	1 V/div	-100 mV		100 mV
Channel 4 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	-0.2 mV		0.2 mV
	2 mV/div	-0.4 mV		0.4 mV
	5 mV/div	-1 mV		1 mV
	10 mV/div	-2 mV		2 mV
	20 mV/div	-4 mV		4 mV
	100 mV/div	-20 mV		20 mV
	500 mV/div	-100 mV		100 mV
	1 V/div	-200 mV		200 mV
	10 V/div	-2 V		2 V
Channel 4 DC Balance, 50 Ω, 250 MHz BW	20 mV/div	-2 mV		2 mV
Channel 4 DC Balance, 1 MΩ, 250 MHz BW	20 mV/div	-4 mV		4 mV
Channel 4 DC Balance, 50 Ω, Full BW	20 mV/div	-2 mV		2 mV
Channel 4 DC Balance, 1 MΩ, Full BW	20 mV/div	-4 mV		4 mV

DC Gain Accuracy (50 Ω)
All 1 GHz models for channels 1 and 2
(MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)

Performance checks	Bandwidth	Vertical scale	Low limit	Test result	High limit
Channel 1 DC Gain Accuracy, 0 V offset, 0 V vertical position, 50 Ω	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		49.8 mV/div	-3.0%		3.0%
		50 mV/div	-1.5%		1.5%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	Full	20 mV/div	-1.5%		1.5%
Channel 2 DC Gain Accuracy, 0 V offset, 0 V vertical position, 50 Ω	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		49.8 mV/div	-3.0%		3.0%
		50 mV/div	-1.5%		1.5%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	Full	20 mV/div	-1.5%		1.5%

DC Gain Accuracy (50 Ω)
All four-channel, 1 GHz models for channels 3 and 4
(MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L)

Performance checks	Bandwidth	Vertical scale	Low limit	Test result	High limit
Channel 3 DC Gain Accuracy, 0 V offset, 0 V vertical position, 50 Ω	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		49.8 mV/div	-3.0%		3.0%
		50 mV/div	-1.5%		1.5%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	Full	20 mV/div	-1.5%		1.5%
Channel 4 DC Gain Accuracy, 0 V offset, 0 V vertical position, 50 Ω	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		49.8 mV/div	-3.0%		3.0%
		50 mV/div	-1.5%		1.5%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	Full	20 mV/div	-1.5%		1.5%

DC Gain Accuracy (1 MΩ)
All models for channels 1 and 2

Performance checks	Bandwidth	Vertical scale	Low limit	Test result	High limit
Channel 1 DC Gain Accuracy, 0 V offset, 0 V vertical position, 1 MΩ	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		50 mV/div	-1.5%		1.5%
		63.5 mV/div	-3.0%		3.0%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
		5 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	FULL	20 mV/div	-1.5%		1.5%
Channel 2 DC Gain Accuracy, 0 V offset, 0 V vertical position, 1 MΩ	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		50 mV/div	-1.5%		1.5%
		63.5 mV/div	-3.0%		3.0%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
		5 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	FULL	20 mV/div	-1.5%		1.5%

DC Gain Accuracy (1 MΩ)
All four-channel models for channels 3 and 4

Performance checks	Bandwidth	Vertical scale	Low limit	Test result	High limit
Channel 3 DC Gain Accuracy, 0 V offset, 0 V vertical position, 1 MΩ	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		50 mV/div	-1.5%		1.5%
		63.5 mV/div	-3.0%		3.0%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
		5 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	FULL	20 mV/div	-1.5%		1.5%
Channel 4 DC Gain Accuracy, 0 V offset, 0 V vertical position, 1 MΩ	20 MHz	1 mV/div	-2.0%		2.0%
		2 mV/div	-1.5%		1.5%
		5 mV/div	-1.5%		1.5%
		10 mV/div	-1.5%		1.5%
		20 mV/div	-1.5%		1.5%
		50 mV/div	-1.5%		1.5%
		63.5 mV/div	-3.0%		3.0%
		100 mV/div	-1.5%		1.5%
		200 mV/div	-1.5%		1.5%
		500 mV/div	-1.5%		1.5%
		1 V/div	-1.5%		1.5%
		5 V/div	-1.5%		1.5%
	250 MHz	20 mV/div	-1.5%		1.5%
	FULL	20 mV/div	-1.5%		1.5%

DC Offset Accuracy
All models for channels 1 and 2, except as noted below

Performance checks	Vertical scale	Vertical offset [1]	Low limit	Test result	High limit
Channel 1 DC Offset Accuracy, 20 MHz BW, 50 Ω 1 GHz models only [2]	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	5.0 V	4.965 V		5.035 V
	100 mV/div	-5.0 V	-5.035 V		-4.965 V
Channel 1 DC Offset Accuracy, 20 MHz BW, 1 MΩ All models	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	9.0 V	8.935 V		9.065 V
	100 mV/div	- 9.0V	-9.065 V		-8.935 V
	500 mV/div	9.0 V	8.855 V		9.145 V
	500 mV/div	- 9.0V	-9.145 V		-8.855 V
	1.01 V/div	99.5 V	98.80 V		100.2 V
	1.01 V/div	-99.5 V	-100.2 V		-98.80 V
	5 V/div	99.5 V	98.00 V		101.0 V
	5 V/div	-99.5 V	-101.0 V		-98.00 V
Channel 2 DC Offset Accuracy, 20 MHz BW, 50 Ω 1 GHz models only [2]	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	5.0 V	4.965 V		5.035 V
	100 mV/div	-5.0 V	-5.035 V		-4.965 V
Channel 2 DC Offset Accuracy, 20 MHz BW, 1 MΩ All models	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	9.0 V	8.935 V		9.065 V
	100 mV/div	-9.0 V	-9.065 V		-8.935 V
	500 mV/div	9.0 V	8.855 V		9.145 V
	500 mV/div	- 9.0V	-9.145 V		-8.855 V
	1.01 V/div	99.5 V	98.80 V		100.2 V
	1.01 V/div	-99.5 V	-100.2 V		-98.80 V
	5 V/div	99.5 V	98.00 V		101.0 V
	5 V/div	-99.5 V	-101.0 V		-98.00 V

1 Use this value for both the calibrator output and the oscilloscope offset setting.

2 Due to system architecture differences between MSO/DPO4000B oscilloscope models, if the bandwidth of your model is less than 1 GHz, do not use the 50 Ω termination setting on the oscilloscope to test offset accuracy. In order to test offset accuracy at the 50 Ω termination setting for models less than 1 GHz, instead use the 1 MΩ termination setting only. For 1 GHz models, test the DC offset accuracy at both the 50 Ω termination setting and the 1 M Ω termination setting.

DC Offset Accuracy

All four-channel models for channels 3 and 4, except as noted below

Performance checks	Vertical scale	Vertical offset [1]	Low limit	Test result	High limit
Channel 3 DC Offset Accuracy, 20 MHz BW, 50 Ω All four-channel 1 GHz models [2]	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	5.0 V	4.965 V		5.035 V
	100 mV/div	-5.0 V	-5.035 V		-4.965 V
Channel 3 DC Offset Accuracy, 20 MHz BW, 1 MΩ All four-channel models	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	9.0 V	8.935 V		9.065 V
	100 mV/div	-9.0 V	-9.065 V		-8.935 V
	500 mV/div	9.0 V	8.855 V		9.145 V
	500 mV/div	- 9.0V	-9.145 V		-8.855 V
	1.01 V/div	99.5 V	98.80 V		100.2 V
	1.01 V/div	-99.5 V	-100.2 V		-98.80 V
	5 V/div	99.5 V	98.00 V		101.0 V
	5 V/div	-99.5 V	-101.0 V		-98.00 V
Channel 4 DC Offset Accuracy, 20 MHz BW, 50 Ω All four-channel 1 GHz models [2]	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	5.0 V	4.965 V		5.035 V
	100 mV/div	-5.0 V	-5.035 V		-4.965 V
Channel 4 DC Offset Accuracy, 20 MHz BW, 1 MΩ All four-channel models	1 mV/div	900 mV	895.3 mV		904.7 mV
	1 mV/div	-900 mV	-904.7 mV		-895.3 mV
	100 mV/div	9.0 V	8.935 V		9.065 V
	100 mV/div	-9.0 V	-9.065 V		-8.935 V
	500 mV/div	9.0 V	8.855 V		9.145 V
	500 mV/div	- 9.0V	-9.145 V		-8.855 V
	1.01 V/div	99.5 V	98.80 V		100.2 V
	1.01 V/div	-99.5 V	-100.2 V		-98.80 V
	5 V/div	99.5 V	98.00 V		101.0 V
	5 V/div	-99.5 V	-101.0 V		-98.00 V

1 Use this value for both the calibrator output and the oscilloscope offset setting.

2 Due to system architecture differences between MSO/DPO4000B oscilloscope models, if the bandwidth of your model is less than 1 GHz, do not use the 50 Ω termination setting on the oscilloscope to test offset accuracy. In order to test offset accuracy at the 50 Ω termination setting for models less than 1 GHz, instead use the 1 MΩ termination setting only. For 1 GHz models, test the DC offset accuracy at both the 50 Ω termination setting and the 1 M Ω termination setting.

Sample Rate and Delay Time Accuracy

Performance checks	Low limit	Test result	High limit
	-1 divisions		+1 divisions

Analog Bandwidth

Performance checks

Bandwidth at Channel	Impedance	Vertical scale	Horizontal scale	V_{in-pp}	V_{bw-pp}	Limit	Test result Gain = V_{bw-pp}/V_{in-pp}
All Models							
Channel 1	50 Ω	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)							
Channel 1	1 MΩ	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	

Analog Bandwidth

Performance checks

Bandwidth at Channel	Impedance	Vertical scale	Horizontal scale	V_{in-pp}	V_{bw-pp}	Limit	Test result Gain = V_{bw-pp}/V_{in-pp}
All Models							
Channel 2	50 Ω	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)							
Channel 2	1 MΩ	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	

Analog Bandwidth

Performance checks

Bandwidth at Channel	Impedance	Vertical scale	Horizontal scale	V_{in-pp}	V_{bw-pp}	Limit	Test result Gain = V_{bw-pp}/V_{in-pp}
All four-channel models for channels 3 and 4							
Channel 3	50 Ω	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	
All four-channel and 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, and DPO4104B-L)							
Channel 3	1 MΩ	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	

Analog Bandwidth

Performance checks

Bandwidth at Channel	Impedance	Vertical scale	Horizontal scale	V_{in-pp}	V_{bw-pp}	Limit	Test result Gain = V_{bw-pp}/V_{in-pp}
All four-channel models							
Channel 4	50 Ω	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	
All four-channel and 1 GHz models (MMSO4104B, DPO4104B, MSO4104B-L, and DPO4104B-L)							
Channel 4	1 MΩ	1 mV/div	4 ns/div (175 MHz)			≥ 0.707	
		2 mV/div	2 ns/div (350 MHz)			≥ 0.707	
		5 mV/div	1 ns/div (Full BW)			≥ 0.707	
		10 mV/div	1 ns/div (Full BW)			≥ 0.707	
		50 mV/div	1 ns/div (Full BW)			≥ 0.707	
		100 mV/div	1 ns/div (Full BW)			≥ 0.707	
		1 V/div	1 ns/div (Full BW)			≥ 0.707	

Random Noise, Sample Acquisition Mode

Performance checks		Vertical sensitivity = 100 mV/div			
		1 MΩ		50 Ω	
	Bandwidth	Test result (mV)	High limit (mV)	Test result (mV)	High limit (mV)
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)					
Channel 1	Full		8.30		6.08
	250 MHz limit		5.10		4.05
	20 MHz limit		5.10		4.05
Channel 2	Full		8.30		6.08
	250 MHz limit		5.10		4.05
	20 MHz limit		5.10		4.05
All four-channel and 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, and DPO4104B-L)					
Channel 3	Full		8.30		6.08
	250 MHz limit		5.10		4.05
	20 MHz limit		5.10		4.05
Channel 4	Full		8.30		6.08
	250 MHz limit		5.10		4.05
	20 MHz limit		5.10		4.05
All <1 GHz models (MSO4054B, DPO4054B, MSO4032B, DPO4034B)					
Channel 1	Full		8.13		8.13
	250 MHz limit		6.10		6.10
	20 MHz limit		4.10		4.10
Channel 2	Full		8.13		8.13
	250 MHz limit		6.10		6.10
	20 MHz limit		4.10		4.10
Channel 3	Full		8.13		8.13
	250 MHz limit		6.10		6.10
	20 MHz limit		4.10		4.10
Channel 4	Full		8.13		8.13
	250 MHz limit		6.10		6.10
	20 MHz limit		4.10		4.10

Delta Time Measurement Accuracy

Performance checks			
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)			
Channel 1			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
MSO/DPO V/Div	**Source V_{pp}**	**Test result**	**High limit**
5 mV	40 mV		118 ps
100 mV	800 mV		117 ps
500 mV	4 V		117 ps
1 V	4 V		122 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		464 ps
5 mV	40 mV		276 ps
100 mV	800 mV		234 ps
500 mV	4 V		232 ps
1 V	4 V		417 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		4.50 ns
5 mV	40 mV		2.52 ns
100 mV	800 mV		2.05 ns
500 mV	4 V		2.03 ns
1 V	4 V		4.01 ns
MSO/DPO = 4 μs/Div, Source freq = 240 kHz			
1 mV	8 mV		45.0 ns
5 mV	40 mV		25.2 ns
100 mV	800 mV		20.5 ns
500 mV	4 V		20.3 ns
1 V	4 V		40.1 ns
MSO/DPO = 40 μs/Div, Source freq = 24 kHz			
1 mV	8 mV		450 ns
5 mV	40 mV		252 ns
100 mV	800 mV		205 ns
500 mV	4 V		203 ns
1 V	4 V		401 ns
MSO/DPO = 400 μs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		4.50 μs
5 mV	40 mV		2.52 μs
100 mV	800 mV		2.05 μs
500 mV	4 V		2.03 μs
1 V	4 V		4.01 μs

Delta Time Measurement Accuracy

MSO/DPO V/Div	Source V_{pp}	Test result	High limit
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)			
Channel 2			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
5 mV	40 mV		118 ps
100 mV	800 mV		117 ps
500 mV	4 V		117 ps
1 V	4 V		122 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		464 ps
5 mV	40 mV		276 ps
100 mV	800 mV		234 ps
500 mV	4 V		232 ps
1 V	4 V		417 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		4.50 ns
5 mV	40 mV		2.52 ns
100 mV	800 mV		2.05 ns
500 mV	4 V		2.03 ns
1 V	4 V		4.01 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		45.0 ns
5 mV	40 mV		25.2 ns
100 mV	800 mV		20.5 ns
500 mV	4 V		20.3 ns
1 V	4 V		40.1 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		450 ns
5 mV	40 mV		252 ns
100 mV	800 mV		205 ns
500 mV	4 V		203 ns
1 V	4 V		401 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		4.50 µs
5 mV	40 mV		2.52 µs
100 mV	800 mV		2.05 µs
500 mV	4 V		2.03 µs
1 V	4 V		4.01 µs

Delta Time Measurement Accuracy

All four-channel and 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L)			
Channel 3			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
MSO/DPO V/Div	**Source V_{pp}**	**Test result**	**High limit**
5 mV	40 mV		118 ps
100 mV	800 mV		117 ps
500 mV	4 V		117 ps
1 V	4 V		122 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		464 ps
5 mV	40 mV		276 ps
100 mV	800 mV		234 ps
500 mV	4 V		232 ps
1 V	4 V		417 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		4.50 ns
5 mV	40 mV		2.52 ns
100 mV	800 mV		2.05 ns
500 mV	4 V		2.03 ns
1 V	4 V		4.01 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		45.0 ns
5 mV	40 mV		25.2 ns
100 mV	800 mV		20.5 ns
500 mV	4 V		20.3 ns
1 V	4 V		40.1 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		450 ns
5 mV	40 mV		252 ns
100 mV	800 mV		205 ns
500 mV	4 V		203 ns
1 V	4 V		401 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		4.50 µs
5 mV	40 mV		2.52 µs
100 mV	800 mV		2.05 µs
500 mV	4 V		2.03 µs
1 V	4 V		4.01 µs

Delta Time Measurement Accuracy

MSO/DPO V/Div	Source V_{pp}	Test result	High limit
All four-channel and 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, and DPO4104B-L)			
Channel 4			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
5 mV	40 mV		118 ps
100 mV	800 mV		117 ps
500 mV	4 V		117 ps
1 V	4 V		122 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		464 ps
5 mV	40 mV		276 ps
100 mV	800 mV		234 ps
500 mV	4 V		232 ps
1 V	4 V		417 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		4.50 ns
5 mV	40 mV		2.52 ns
100 mV	800 mV		2.05 ns
500 mV	4 V		2.03 ns
1 V	4 V		4.01 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		45.0 ns
5 mV	40 mV		25.2 ns
100 mV	800 mV		20.5 ns
500 mV	4 V		20.3 ns
1 V	4 V		40.1 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		450 ns
5 mV	40 mV		252 ns
100 mV	800 mV		205 ns
500 mV	4 V		203 ns
1 V	4 V		401 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		4.50 µs
5 mV	40 mV		2.52 µs
100 mV	800 mV		2.05 µs
500 mV	4 V		2.03 µs
1 V	4 V		4.01 µs

Delta Time Measurement Accuracy

MSO/DPO V/Div	Source V_{pp}	Test result	High limit
All <1 GHz models (MSO4054B, DPO4054B, MSO4034B, DPO4034B)			
Channel 1			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
5 mV	40 mV		234 ps
100 mV	800 mV		233 ps
500 mV	4 V		233 ps
1 V	4 V		237 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		736 ps
5 mV	40 mV		423 ps
100 mV	800 mV		357 ps
500 mV	4 V		354 ps
1 V	4 V		581 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		6.99 ns
5 mV	40 mV		3.54 ns
100 mV	800 mV		2.73 ns
500 mV	4 V		2.69 ns
1 V	4 V		5.34 ns
MSO/DPO = 4 μs/Div, Source freq = 240 kHz			
1 mV	8 mV		69.9 ns
5 mV	40 mV		35.4 ns
100 mV	800 mV		27.3 ns
500 mV	4 V		26.9 ns
1 V	4 V		53.4 ns
MSO/DPO = 40 μs/Div, Source freq = 24 kHz			
1 mV	8 mV		699 ns
5 mV	40 mV		354 ns
100 mV	800 mV		273 ns
500 mV	4 V		269 ns
1 V	4 V		534 ns
MSO/DPO = 400 μs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		6.99 μs
5 mV	40 mV		3.54 μs
100 mV	800 mV		2.73 μs
500 mV	4 V		2.69 μs
1 V	4 V		5.34 μs

Delta Time Measurement Accuracy

All <1 GHz models (MSO4054B, DPO4054B, MSO4034B, DPO4034B)

Channel 2

MSO/DPO V/Div	Source V_{pp}	Test result	High limit
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
5 mV	40 mV		234 ps
100 mV	800 mV		233 ps
500 mV	4 V		233 ps
1 V	4 V		237 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		736 ps
5 mV	40 mV		423 ps
100 mV	800 mV		357 ps
500 mV	4 V		354 ps
1 V	4 V		581 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		6.99 ns
5 mV	40 mV		3.54 ns
100 mV	800 mV		2.73 ns
500 mV	4 V		2.69 ns
1 V	4 V		5.34 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		69.9 ns
5 mV	40 mV		35.4 ns
100 mV	800 mV		27.3 ns
500 mV	4 V		26.9 ns
1 V	4 V		53.4 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		699 ns
5 mV	40 mV		354 ns
100 mV	800 mV		273 ns
500 mV	4 V		269 ns
1 V	4 V		534 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		6.99 µs
5 mV	40 mV		3.54 µs
100 mV	800 mV		2.73 µs
500 mV	4 V		2.69 µs
1 V	4 V		5.34 µs

Delta Time Measurement Accuracy

MSO/DPO V/Div	Source V_{pp}	Test result	High limit
All four-channel and <1 GHz models (MSO4054B, DPO4054B, MSO4034B, DPO4034B)			
Channel 3			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
5 mV	40 mV		234 ps
100 mV	800 mV		233 ps
500 mV	4 V		233 ps
1 V	4 V		237 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		736 ps
5 mV	40 mV		423 ps
100 mV	800 mV		357 ps
500 mV	4 V		354 ps
1 V	4 V		581 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		6.99 ns
5 mV	40 mV		3.54 ns
100 mV	800 mV		2.73 ns
500 mV	4 V		2.69 ns
1 V	4 V		5.34 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		69.9 ns
5 mV	40 mV		35.4 ns
100 mV	800 mV		27.3 ns
500 mV	4 V		26.9 ns
1 V	4 V		53.4 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		699 ns
5 mV	40 mV		354 ns
100 mV	800 mV		273 ns
500 mV	4 V		269 ns
1 V	4 V		534 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		6.99 µs
5 mV	40 mV		3.54 µs
100 mV	800 mV		2.73 µs
500 mV	4 V		2.69 µs
1 V	4 V		5.34 µs

Delta Time Measurement Accuracy

All four-channel and <1 GHz models (MSO4054B, DPO4054B, MSO4034B, DPO4034B)			
Channel 4			
MSO/DPO = 4 ns/Div, Source freq = 240 MHz			
MSO/DPO V/Div	**Source V_{pp}**	**Test result**	**High limit**
5 mV	40 mV		234 ps
100 mV	800 mV		233 ps
500 mV	4 V		233 ps
1 V	4 V		237 ps
MSO/DPO = 40 ns/Div, Source freq = 24 MHz			
1 mV	8 mV		736 ps
5 mV	40 mV		423 ps
100 mV	800 mV		357 ps
500 mV	4 V		354 ps
1 V	4 V		581 ps
MSO/DPO = 400 ns/Div, Source freq = 2.4 MHz			
1 mV	8 mV		6.99 ns
5 mV	40 mV		3.54 ns
100 mV	800 mV		2.73 ns
500 mV	4 V		2.69 ns
1 V	4 V		5.34 ns
MSO/DPO = 4 µs/Div, Source freq = 240 kHz			
1 mV	8 mV		69.9 ns
5 mV	40 mV		35.4 ns
100 mV	800 mV		27.3 ns
500 mV	4 V		26.9 ns
1 V	4 V		53.4 ns
MSO/DPO = 40 µs/Div, Source freq = 24 kHz			
1 mV	8 mV		699 ns
5 mV	40 mV		354 ns
100 mV	800 mV		273 ns
500 mV	4 V		269 ns
1 V	4 V		534 ns
MSO/DPO = 400 µs/Div, Source freq = 2.4 kHz			
1 mV	8 mV		6.99 µs
5 mV	40 mV		3.54 µs
100 mV	800 mV		2.73 µs
500 mV	4 V		2.69 µs
1 V	4 V		5.34 µs

Digital Threshold Accuracy, MSO4000B series only

Performance checks:

Digital channel	Threshold	V_{slow}	V_{shigh}	Low limit	Test result	High limit
D0	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D1	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D2	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D3	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D4	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D5	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D6	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D7	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D8	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D9	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D10	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D11	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D12	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D13	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D14	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D15	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V

Trigger Out (AUX OUT)

Performance checks		Low limit	Test result	High limit
Trigger Output	High 1 MΩ	≥ 2.5 V		–
	Low 1 MΩ	–		≤ 0.7 V
Trigger Output	High 50 Ω	≥ 1.0 V		–
	Low 50 Ω	–		≤ 0.25 V

Performance Verification Procedures

The Performance Verification Procedures consist of a self test and several check steps, which check the instrument's performance to specifications. The following three conditions must be met before performing these procedures:

1. The oscilloscope must have been operating continuously for twenty (20) minutes in an environment that meets the operating range specifications for temperature and humidity.
2. You must perform the Signal Path Compensation (SPC) operation described in step 2 of the *Self Test* before evaluating specifications. (See page 53, *Self Test*.) If the operating temperature changes by more than 10 °C (18 °F), you must perform the SPC operation again.
3. You must connect the oscilloscope and the test equipment to the same AC power circuit. Connect the oscilloscope and test instruments to a common power strip if you are unsure of the AC power circuit distribution. Connecting the oscilloscope and test instruments to 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

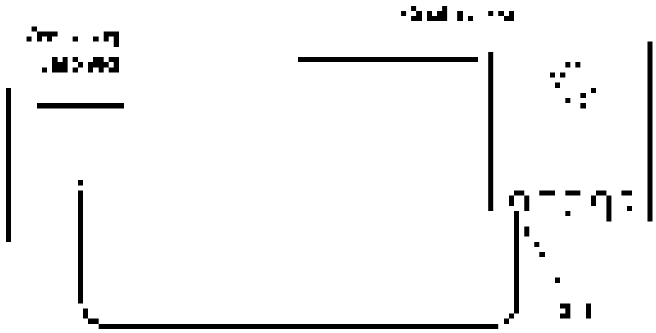
This procedure uses internal routines to verify that the oscilloscope functions and passes its internal self tests. No test equipment or hookups are required.

1. *Run the System Diagnostics (may take several minutes):*
   - **a.** Disconnect everything from the oscilloscope inputs.
   - **b.** Push the front-panel **Default Setup** button.
   - **c.** Push the **Utility** menu button.
   - **d.** Push the **Utility Page** lower-bezel button.
   - **e.** Turn the **Multipurpose a** knob to select **Self Test**.
   - **f.** Push the **Self Test** lower-bezel button. The Loop X Times side-bezel menu will be set to **Loop 1 Times**.
   - **g.** Push the **OK Run Self Test** side-bezel button.
   - **h.** Wait. The internal diagnostics perform an exhaustive verification of proper instrument function. This verification may take several minutes.
   - **i.** Verify that the status of all tests on the readout is **Pass**.
   - **j.** Push the **Menu Off** button twice to clear the dialog box and Self Test menu.
2. *Run the signal path compensation routine (may take 5 to 15 minutes):*
   - **a.** Push the front-panel **Default Setup** button.
   - **b.** Push the **Utility** menu button.
   - **c.** Push the **Utility Page** lower-bezel button.
   - **d.** Turn the **Multipurpose a** knob to select **Calibration**.
   - **e.** Push the **Signal Path** lower-bezel button.
   - **f.** Push the **OK-Compensate Signal Paths** side bezel button.
   - **g.** When the signal path compensation is complete, push the **Menu Off** button twice to clear the dialog box and Self Test menu.
   - **h.** Check the lower-bezel **Signal Path** button to verify that the status is **Pass**.

Check Input Impedance (Resistance)

This test checks the Input Impedance.

1. Connect the output of the oscilloscope calibrator (for example, Fluke 9500) to the oscilloscope channel 1 input, as shown below.



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

2. Push the front-panel **Default Setup** button.
3. *Set the impedance to 1 MΩ as follows:*
   a. Push the channel 1 button.
   b. Set the **Termination** (input impedance) to **1 MΩ**.
4. Set the Vertical **Scale** to **10 mV/division**.
5. Measure the input resistance of the oscilloscope with the calibrator. Record this value in the test record.
6. Repeat steps 4 and 5 for each vertical scale setting in the test record.
7. *Repeat the tests at 250 kΩ as follows:*
   a. Set the calibrator impedance to 1 MΩ.
   b. Push the **Utility** front-panel button.
   c. Push the **Utility Page** lower-bezel button.
   d. Turn the Multipurpose **a** knob to select **Self Test**.
   e. Push the **250 kΩ Impedance Verification** lower-bezel button to set the oscilloscope input impedance to **250 kΩ**.
   f. Push the channel **1** side-bezel button to enable channel 1.

g. Set the Vertical **Scale** to 100 **mV/division**.

h. Measure the input resistance of the oscilloscope with the calibrator. Record this value in the test record.

8. *Repeat the tests at 50 Ω as follows:*

a. Set the calibrator impedance to 50 Ω.

b. Set the **Termination** (input impedance) to **50 Ω**.

c. Repeat steps 4 through d.

9. *Repeat the procedure for all remaining channels as follows:*

a. Push the front-panel channel button to deselect the channel that you already tested.

b. Connect the calibrator to the input for the next channel to be tested.

c. Starting from step 3, repeat the procedure for each channel.

Check DC Balance

This test checks the DC balance. You do not need to connect any equipment (other than a 50Ω terminator) to the oscilloscope to perform this check.

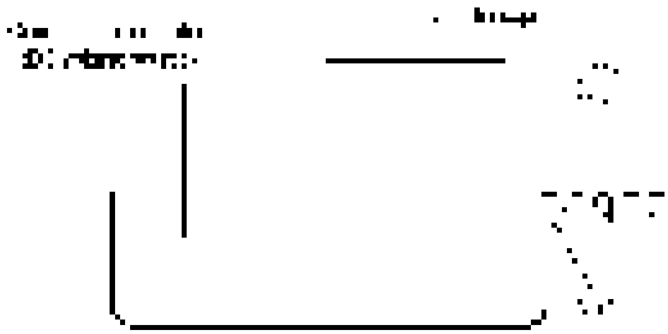
1. Attach a 50 Ω terminator to the oscilloscope channel 1 input.
2. Push the front-panel **Default Setup** button.
3. *Set the input impedance to 50 Ω as follows:*
   a. Push the channel 1 button.
   b. Set the **Termination** (input impedance) to **50 Ω**.
4. Set the bandwidth to 20 MHz:
   a. Push the lower-bezel **Bandwidth** button.
   b. Push the side-bezel button for **20 MHz**.
5. Set the Horizontal **Scale** to **1 ms** per division.
6. *Set the Acquisition mode to Average as follows:*
   a. Push the front-panel **Acquire** button.
   b. Push the **Average** side bezel button.
   c. Ensure that the number of averages is **16**.
7. *Set the trigger source to AC line as follows:*
   a. Push the Trigger **Menu** front-panel button.
   b. Select the **AC Line** trigger source with the **Multipurpose a** knob.
8. Set the Vertical **Scale** to **1 mV** per division.
9. *Select the mean measurement (if not already selected) as follows:*
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Push the **Add Measurement** lower bezel button.
   c. Use the **Multipurpose b** knob to select the **Mean** measurement.
   d. Push the **OK Add Measurement** side-bezel button.
   e. View the **Mean** measurement value in the display.
10. Enter the mean value as the test result in the test record.
11. Repeat steps 8 through 10 for each vertical scale setting in the test record.
12. Push the channel 1 button and then repeat steps 4 thorough 11 for each bandwidth setting.

13. *Repeat the tests at 1 MΩ impedance as follows:*
    a. Push the front-panel channel 1 button.
    b. Set the **Termination** (input impedance) to **1M Ω**.
    c. Repeat steps 4 through 12.
14. *Repeat the procedure for all remaining channels as follows:*
    a. Deselect the channel that you already tested.
    b. Move the 50 Ω terminator to the next channel input to be tested.
    c. Starting from step 3, repeat the procedure for each channel.

Check DC Gain Accuracy

This test checks the DC gain accuracy.

1. Connect the oscilloscope to a DC voltage source. If using the Fluke 9500 calibrator, connect the calibrator head to the oscilloscope channel to test.



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

2. Push the front-panel **Default Setup** button. The Termination (input impedance) is set to 1 MΩ and channel 1 input is selected.

NOTE. 50 Ω termination testing (steps 4 through 11) is required only for MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models.

1 MΩ termination testing (step 14) is required for all models.

3. For MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models, perform steps 4 through 14. For other models, go to step 14 now.
4. *Select 50 Ω input impedance as follows:*
   a. Set the calibrator to 50 Ω output impedance.
   b. Push the channel 1 button.
   c. Set the **Termination** (input impedance) to **50 Ω**.
5. *Set the bandwidth to 20 MHz as follows:*
   a. Push the lower-bezel **Bandwidth** button.
   b. Push the **20 MHz** side-bezel button to select the bandwidth.

6. *Set the Acquisition mode to Average as follows:*
   a. Push the front-panel **Acquire** button.
   b. Push the **Mode** lower-bezel button (if it is not already selected), and then push the **Average** side bezel button.
   c. Ensure that the number of averages is **16**.
7. *Select the Mean measurement as follows:*
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Push the **Add Measurement** lower-bezel button (if it is not already selected).
   c. Use the **Multipurpose b** knob to select the **Mean** measurement.
   d. Push the **OK Add Measurement** side-bezel button.
8. *Set the trigger source to AC line as follows:*
   a. Push the Trigger **Menu** button on the front panel.
   b. Push the **Source** lower-bezel button.
   c. Turn the **Multipurpose a** knob to select the **AC Line** as the trigger source.
9. Set the Vertical **Scale** to **1 mV/division**.
10. *Record the negative-measured and positive-measured mean readings in the worksheet as follows:*
    a. Set the DC Voltage Source to $V_{negative}$.
    b. Push the front-panel Wave Inspector **Measure** button.
    c. Push the **More** lower-bezel button.
    d. Push **Reset Statistics** in the side-bezel menu.
    e. Enter the mean reading in the worksheet as $V_{negative\text{-}measured}$. (See Table 14.)
    f. Set the DC Voltage Source to $V_{positive\text{-}measured}$
    g. Push **Reset Statistics** in the side-bezel menu again.
    h. Enter the mean reading in the worksheet as $V_{positive\text{-}measured}$

Table 14: Gain expected worksheet

Termination	Vertical Scale	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative-measured}$	$V_{positive-measured}$	V_{diff}	DC Gain Accuracy
All 1 GHz models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)								
50Ω	1 mV/div	9 mV	-4.5 mV	+4.5 mV				
	2 mV/div	18 mV	-9 mV	+9 mV				
	5 mV	45 mV	-22.5 mV	+22.5 mV				
	10 mV	90 mV	-45 mV	+45 mV				
	20 mV	180 mV	-90 mV	+90 mV				
	49.8 mV	448.2 mV	-224.1 mV	+224.1 mV				
	50 mV	450 mV	-225 mV	+225 mV				
	100 mV	900 mV	-450 mV	+450 mV				
	200 mV	1800 mV	-900 mV	+900 mV				
	500 mV	4900 mV	-2450 mV	+2450 mV				
	1 V	9000 mV	-4500 mV	+4500 mV				
All Models								
1MΩ	1 mV/div	9 mV	-4.5 mV	+4.5 mV				
	2 mV/div	18 mV	-9 mV	+9 mV				
	5 mV	45 mV	-22.5 mV	+22.5 mV				
	10 mV	90 mV	-45 mV	+45 mV				
	20 mV	180 mV	-90 mV	+90 mV				
	50 mV	450 mV	-225 mV	+225 mV				
	63.5 mV	571.5 mV	-285.75 mV	+285.75 mV				
	100 mV	900 mV	-450 mV	+450 mV				
	200 mV	1800 mV	-900 mV	+900 mV				
	500 mV	4900 mV	-2450 mV	+2450 mV				
	1 V	9000 mV	-4500 mV	+4500 mV				
	5 V	45 V	-22.5 V	+22.5 V				

11. Record Gain Accuracy:

a. Calculate V_{diff} as follows:

$$V_{diff} = |\, V_{negative\text{-}measured} - V_{positive\text{-}measured} \,|$$

b. Enter V_{diff} in the worksheet. (See Table 14.)

c. Calculate *Gain Accuracy* as follows:

$$Gain\ Accuracy = ((V_{diff} - V_{diffExpected})/\ V_{diffExpected}) \geq 100\%$$

d. Enter *Gain Accuracy* in the worksheet and in the test record.

12. Repeat steps 9 through 11 for each vertical scale setting in the test record.

13. *Repeat the procedure for all remaining channels as follows:*

a. Push the front-panel button to deselect the channel that you have already tested.

b. Move the DC voltage source connection to the next channel input to be tested.

c. Starting from step 9, repeat the procedure for each channel.

NOTE. *1 MΩ testing is required for all models.*

14. *For all models, repeat tests at 1 MΩ impedance as follows:*

a. Set the calibrator to 1 MΩ output.

b. Push the front-panel channel 1 button.

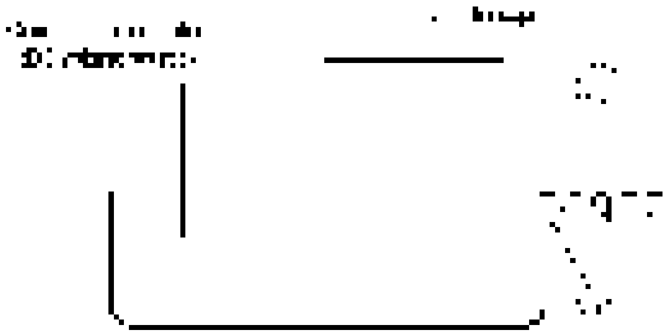
c. Set the **Termination** to **1 MΩ**.

d. Repeat steps 9 through 13.

Check Offset Accuracy

This test checks the offset accuracy.

1. Connect the oscilloscope to a DC voltage source. If you are using the Fluke 9500 calibrator as the DC voltage source, connect the calibrator head to the oscilloscope channel 1.



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

2. Push the front-panel **Default Setup** button.
3. *Set the Acquisition mode to Average as follows:*
   a. Push the front-panel **Acquire** button.
   b. Push the **Mode** lower-bezel button (if not already selected).
   c. Push the **Average** side bezel button.
   d. Ensure that the **number of averages** is set to **16**.
4. *Set the trigger source to AC line as follows:*
   a. Push the Trigger **Menu** front-panel button.
   b. Push the **Source** lower-bezel button.
   c. Turn the **Multipurpose a** knob to select the **AC Line** as the trigger source.
5. Set the Horizontal **Scale** to **1.00 ms** per division.
6. *Set the Bandwidth to 20 MHz as follows:*
   a. Push the channel 1 button.
   b. Push the lower-bezel **Bandwidth** button.
   c. Push the side-bezel button to set the bandwidth to **20 MHz**.

7. *Check that the vertical position is set to 0 divs as follows:*

   a. Push the lower-bezel **More** button to select **Position**.

   b. In the side-bezel button, check that the **Vertical Position** is set to **0 divs**.

   c. If it is not 0 divs, turn the Vertical **Position** knob to set the position to 0.

8. *If you are testing a < 1 GHz model (MSO/DPO4034B or MSO/DPO4054B), go to step 14. Otherwise, select the 50 Ω impedance as follows:*

   a. Set the calibrator to 50 Ω output impedance (50 Ω source impedance).

   b. Push the channel 1 button.

   c. Set the **Termination** to **50 Ω**.

9. Set the vertical **Scale** to **1 mV** per division.

10. *Set the offset as follows:*

    a. Set the calibrator to 900 mV vertical offset.

    b. Push the lower-bezel **More** button to select **Offset**.

    c. Use the **Multipurpose a** knob to set the **Vertical Offset** to **900 mV**, as shown in the test record.

11. *Select the Mean measurement (if not already selected) as follows:*

    a. Push the front-panel Wave Inspector **Measure** button.

    b. Push the **Add Measurement** lower-bezel button.

    c. Use the **Multipurpose b** knob to select the **Mean** measurement.

    d. Push the **OK Add Measurement** side-bezel button.

12. View the mean value in the measurement pane at the bottom of the display and enter it as the test result in the test record.

13. Repeat step 12 for each vertical scale and offset setting combination shown in the test record.

14. *Repeat the tests at 1 MΩ impedance as follows:*

    a. Change the calibrator impedance to 1 MΩ.

    b. Push the front-panel channel 1 button.

c. Set the **Termination** (input impedance) to **1 MΩ**.

d. Repeat steps 9 through 13.

15. *Repeat the procedure for all remaining channels as follows:*

a. Push the front-panel button to deselect the channel that you have already tested.

b. Move the DC voltage source connection to the next channel input to be tested.

c. Starting from step 6, repeat the procedure for each channel.

Check Analog Bandwidth

This test checks the bandwidth at 50 Ω and 1 M Ω for each channel.

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

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

2. Push the front-panel **Default Setup** button.
3. *Select 50 Ω impedance as follows:*
   a. Set the calibrator to 50 Ω output impedance and to generate a sine wave.
   b. Push the front-panel channel 1 button.
   c. Set the **Termination** (input impedance) to **50 Ω**.
4. *Set the Acquisition mode to Sample as follows:*
   a. Push the front-panel **Acquire** button.
   b. Push the **Mode** lower-bezel button (if not already selected).
   c. Push the **Sample** side bezel button.
5. Set the Vertical **Scale** to **1 mV** per division.
6. Adjust the signal source to at least 8 vertical divisions at the selected vertical scale with a set frequency of 50 kHz. For example, at 5 mV/div, use a ≥40 mV_{p-p} signal, at 2 mV/div, use a ≥16 mV_{p-p} signal, and at 1 mV/div, use a ≥8 mV_{p-p} signal. Use a sine wave for the signal source.
7. Set the Horizontal **Scale** to **10 µs** per division.
8. Record the peak-to-peak measurement:
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Use the **Multipurpose b** knob to select the **Peak-to-Peak** measurement.

c. Push the **OK Add Measurement** side-bezel button.

d. This will provide a mean $V_{p\text{-}p}$ of the signal. Call this value $\mathbf{V}_{in\text{-}pp}$.

e. Enter this value in the test record.

9. Set the Horizontal **Scale** to **4 ns** per division.

10. Adjust the signal source to the maximum bandwidth frequency for the bandwidth and model desired, as shown in the following worksheet.

11. *Record the peak-to-peak measurement as follows:*

a. View the mean $V_{p\text{-}p}$ of the signal. Call this value $\mathbf{V}_{bw\text{-}pp}$.

b. Enter this value in the test record.

***NOTE.** For more information on the contents of this worksheet, refer to the bandwidth specifications.* *(See Table 1 on page 2.)*

Table 15: Maximum bandwidth frequency worksheet

All 1 GHz Models (MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B)

Impedance	Vertical Scale	Maximum bandwidth
50 Ω	5 mV/div — 1 V/div	1 GHz
	2 mV/div — 4.98 mV/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz
1 MΩ	5 mV/div — 1 V/div	500 MHz [1]
	2 mV/div — 4.98 mV/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz
All 500 MHz models (MSO4054B, DPO4054B)		
50 Ω	5 mV/div — 1 V/div	500 MHz
	2 mV/div — 4.98 mV/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz

Table 15: Maximum bandwidth frequency worksheet (cont.)

All 500 MHz models (MSO4054B, DPO4054B)		
1 MΩ	5 mV/div — 1 V/div	500 MHz
	2 mV/div — 4.98 mV/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz
All 350 MHz models (MSO4034B, DPO4034B)		
50 Ω	2 mV/div — 1 V/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz
1 MΩ	5 mV/div — 1 V/div	350 MHz
	2 mV/div — 4.98 mV/div	350 MHz
	1 mV/div — 1.99 mV/div	175 MHz

[1] For MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models bandwidth verification, use 500 MHz, rather than 1 GHz, on the 5 mV/div vertical scale.

13. Use the values of $V_{bw\text{-}pp}$ and $V_{in\text{-}pp}$ that you entered in the test record to calculate the *Gain* at bandwidth with the following equation:

    $Gain = V_{bw\text{-}pp} / V_{in\text{-}pp}$

    To pass the performance measurement test, Gain should be ≥ 0.707. Enter *Gain* in the test record.

14. Repeat steps 5 through 13 for all combinations of Vertical Scale and Horizontal Scale settings listed in the test record.

15. *For MSO4104B, DPO4104B, MSO4104B-L, DPO4104B-L, MSO4102B-L, DPO4102B-L, MSO4102B, and DPO4102B models only, repeat the tests at 1 MΩ impedance as follows:*

    a. Change the calibrator impedance to 1 MΩ.

    b. Push the front-panel channel 1 button.

    c. Set the **Termination** (input impedance) to **1 MΩ**.

    d. Repeat steps 5 through 14.

16. *Repeat the procedure for all remaining channels as follows:*

    a. Push the front-panel button to deselect the channel that you have already tested.

    b. Move the calibrator connection to the next channel input to be tested.

    c. Starting from step 3, repeat the procedure for each input channel.

Check Random Noise, Sample Acquisition Mode

This test checks random noise. You do not need to connect any test equipment to the oscilloscope for this test.

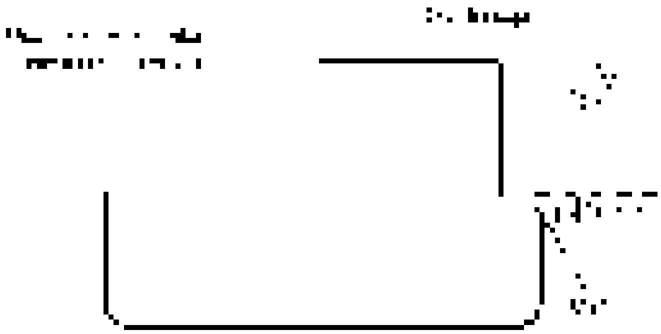
1. Disconnect everything from the oscilloscope inputs.
2. Push the front-panel **Default Setup** button.
3. *Set Gating to Off as follows:*
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Push the bottom-bezel **More** button to select **Gating**.
   c. Push the side-bezel **Off (Full Record)** button.
4. *Select the RMS measurement as follows:*
   a. Push the bottom-bezel **Add Measurement** button.
   b. Use the **Multipurpose b** knob to select the **RMS** measurement.
   c. Push the side-bezel **OK Add Measurement** button.
5. *Reset statistics as follows:*
   a. Push the bottom-bezel **More** button to select **Statistics**.
   b. Push the side-bezel **Reset Statistics** button.
6. Read and make a note of the RMS Mean value. This is the Sampled Mean Value (SMV).
7. *Set the Acquisition mode to Average as follows:*
   a. Push the front-panel **Acquire** button.
   b. Push the bottom-bezel **Mode** button to display the Acquisition Mode menu (if it is not already selected).
   c. Push the side-bezel **Average** button.
   d. Ensure that the **number of averages** is set to **16**.
8. *Reset statistics as follows:*
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Push the bottom-bezel **More** button to select **Statistics** (if it is not already selected).
   c. Push the side-bezel **Reset Statistics** button.
9. Read and make a note of the RMS Mean value. This is the Averaged Mean Value (AMV).
10. Calculate the RMS noise (RMS noise = SMV – AMV), and enter the calculated RMS noise in the test record.

11. *Set the Acquisition mode to Sample as follows:*
    a. Push the front-panel **Acquire** button.
    b. Push the **Mode** lower-bezel button (if it is not already selected).
    c. Push the **Sample** side bezel button.
12. *Repeat the tests at 50 Ω as follows:*
    a. Push the front-panel channel 1 button.
    b. Set the **Termination** (input impedance) to **50 Ω**.
    c. Push the front-panel Wave Inspector **Measure** button, and repeat steps 5 through 11.
13. *Repeat the tests at 250 MHz bandwidth as follows:*
    a. Push the front-panel channel 1 button.
    b. Set the **Termination** (input impedance) to **1 MΩ**.
    c. Push the bottom-bezel **Bandwidth** button.
    d. Push the side-bezel **250 MHz** button.
    e. Push the front-panel Waveform Inspector **Measure** button.
    f. Repeat steps 5 through 12.
14. *Repeat the tests at 20 MHz bandwidth as follows:*
    a. Push the front-panel channel 1 button.
    b. Set the **Termination** (input impedance) to **1 MΩ**.
    c. Push the bottom-bezel **Bandwidth** button.
    d. Push the side-bezel **20 MHz** button.
    e. Push the front-panel Waveform Inspector **Measure** button.
    f. Repeat steps 5 through 12.
15. *Repeat the procedure for all remaining channels as follows:*
    a. Push the front-panel button to deselect the channel that you have already tested.
    b. Starting from step 3, repeat the procedure for each input channel.

Check Sample Rate and Delay Time Accuracy

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

1. Connect the output of a time mark generator to the oscilloscope channel 1 input using a 50 Ω cable, as shown in the following illustration.



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

2. Set the time mark generator period to **80 ms**. Use a time mark waveform with a fast rising edge.
3. Push the front-panel **Default Setup** button.
4. *Set the impedance to 50 Ω as follows:*
   a. Push the front-panel channel 1 button.
   b. Set the **Termination** to **50 Ω**.
5. If it is adjustable, set the time mark amplitude to approximately **1** $\mathbf{V_{p\text{-}p}}$.
6. Set the Vertical **Scale** to **500 mV** per division.
7. Set the Horizontal **Scale** to **20 ms** per division.
8. Adjust the Vertical **Position** knob to center the time mark signal on the screen.
9. Adjust the Trigger **Level** as necessary for a triggered display.
10. Adjust the Horizontal **Position** to move the trigger location to the center of the screen (50%).
11. *Set the delay to 80 ms as follows:*
    a. Push the front-panel **Acquire** button.
    b. Push the lower-bezel **Delay** button to turn delay on (if it is not already on).
    c. Turn the Horizontal **Position** knob clockwise to set the delay to exactly **80 ms**.

12. Set the Horizontal **Scale** to **400 ns/div**.

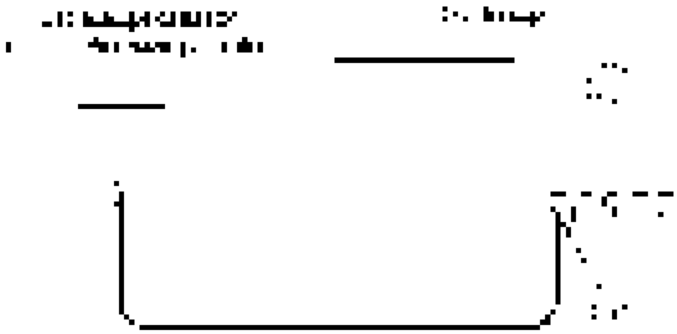
13. Compare the rising edge of the marker with the center horizontal graticule line. The rising edge should be within ±1 divisions of center graticule. Enter the deviation in the test record.

NOTE. *One division of displacement from graticule center corresponds to a 5 ppm time base error.*

Check Delta Time Measurement Accuracy

This test checks the Delta-time measurement accuracy (DTA) for a given instrument setting and input signal.

Connect a 50 Ω coaxial cable from the signal source to the oscilloscope channel 1, as shown in the following illustration.



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

2. Push the oscilloscope front-panel **Default Setup** button.
3. *Select 50 Ω impedance as follows:*
   a. Set the sine wave generator output impedance to 50 Ω.
   b. Push the channel 1 button to display the channel 1 menu.
   c. Set the **Termination** (input impedance) to **50 Ω**.
4. *Set the trigger source to channel 1 as follows:*
   a. Push the Trigger **Menu** button.
   b. Push the **Source** lower-bezel button (if not already selected).
   c. Use the **Multipurpose a** button to select channel 1 (if not already selected).
5. *Set the Mean & St Dev Samples to 100 as follows:*
   a. Push the Wave Inspector **Measure** button.
   b. Push the bottom-bezel **Add Measurement** button.
   c. Use the **Multipurpose b** knob to select the **Burst Width** measurement.
   d. Push the side-bezel **OK Add Measurement** button.

e. Push the bottom-bezel **More** button to select **Statistics**.

f. Use the **Multipurpose a** knob to set the **Mean & Std Dev Samples** to **100**, as shown in the side menu.

6. Set the signal source to 240 MHz and 40 mV as shown in the test record.

NOTE. *To provide consistent results, set the signal source frequency such that the zero crossing does not occur at the beginning or end of the record.*

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7. Set the Horizontal **Scale** to **4 ns** per division.
8. Set the Vertical **Scale** to **5 mV** per division.
9. *Record the Std Dev value as follows:*
   a. Push the side-bezel **Reset Statistics** button.
   b. Push the **Menu Off** button to remove the side-bezel menu.
   c. Wait five or 10 seconds for the oscilloscope to acquire all of the samples.
   d. Verify that the **Std Dev** is less than the upper limit shown in the test record.
   e. Enter the reading in the test record.
10. Repeat steps 6 through 9 for each setting combination shown in the test record.
11. *Repeat the procedure for all remaining channels as follows:*
    a. Push the front-panel button to deselect the channel that you have already tested.
    b. Connect the signal source to the input for the next channel to be tested.
    c. Repeat the procedure from step 3 until all channels have been tested.

Check Digital Threshold Accuracy (MSO4000B Only)

For the MSO4000B series only, this test checks the threshold accuracy of the digital channels. This procedure applies to digital channels D0 through D15, and to channel threshold values of 0 V and +4 V.

1. Connect the P6616 digital probe to the MSO4000B Series instrument, as shown in the following illustration:
   a. Connect the DC voltage source to the digital channel D0.
   b. If you are using the Fluke 9500 calibrator as the DC voltage source, connect the calibrator head to the digital channel D0, using the BNC-to-0.1 inch pin adapter listed in the Required Equipment table. (See Table 13 on page 25.)
   c. Connect channel D0 to both the corresponding signal pin and to a ground pin on the adapter.

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

2. *Turn on the digital channels as follows:*
   a. Push the front-panel **D15-D0** button.
   b. Push the **D15-D0 On/Off** lower-bezel button.
   c. Push the **Turn On D7 - D0** and the **Turn On D15 - D8** side-bezel buttons to turn these channels On.
   d. Ensure that the side-bezel **Display** selection is **On**.
   e. The instrument will display the 16 digital channels.
3. *Set the channel threshold to 0 V as follows:*
   a. Push the **Thresholds** lower-bezel button (if not already selected).
   b. Turn the **Multipurpose a** knob to select channel **D0**.
   c. Turn the **Multipurpose b** knob and set the value to **0.00 V** (0 V/div), using the coarse and fine settings of the knob as necessary to set the exact value.
4. Push the **Menu Off** button and then set the Horizontal **Scale** to **4µs** per division.
5. *Set the Trigger source as follows:*
   a. Push the front-panel Trigger **Menu** button.
   b. Push the **Source** lower-bezel button (if not already selected).
   c. Turn the **Multipurpose a** knob to select channel D0.

6. Set the DC voltage source (Vs) to -400 mV. Wait 3 seconds. Check the logic level of the channel D0 signal display. If it is at a static logic high, change the DC voltage source Vs to -500 mV.

7. Increment Vs by +10 mV. Wait 3 seconds and check the logic level of the channel D0 signal display. If it is a static logic high, record the Vs value as in the 0 V row of the test record.

   If the signal level is a logic low or is alternating between high and low, repeat this step (increment Vs by 10 mV, wait 3 seconds, and check for a static logic high) until a value for $\mathbf{V_{s-}}$ is found.

8. Click the lower-bezel **Slope** button to change the slope to **Falling**.

9. Set the DC voltage source (Vs) to +400 mV. Wait 3 seconds. Check the logic level of the channel D0 signal display.

   If it is at a static logic low, change the DC voltage source Vs to +500 mV.

10. Reduce Vs by -10 mV. Wait 3 seconds and check the logic level of the channel D0 signal display. If it is a static logic low, record the Vs value as $\mathbf{V_{s+}}$ in the 0 V row of the test record.

    If the signal level is a logic high or is alternating between high and low, repeat this step (decrement Vs by 10 mV, wait 3 seconds, and check for a static logic low) until a value for $\mathbf{V_{s+}}$ is found.

11. Find the average using this formula: $V_{sAvg} = (V_{s-} + V_{s+})/2$. Record the average as the test result in the test record.

    Compare the test result to the limits. If the result is between the limits, continue with the procedure to test the channel at the +4 V threshold value.

12. *Set the channel threshold to +4 V as follows:*

    a. Push the front-panel **D15-D0** button.

    b. Push the **Thresholds** lower-bezel button.

    c. Turn the **Multipurpose a** knob to select channel **D0**.

    d. Push the **Fine** front-panel button to turn off the fine adjustment.

    e. Turn the **Multipurpose b** knob and set the value near **4.00 V** (4 V/div).

    f. Push the **Fine** button to turn the fine adjustment on again.

    g. Turn the **Multipurpose b** knob and set the value to exactly **4.00 V** (4 V/div).

13. Set the DC voltage source (Vs) to +4.4 V. Wait 3 seconds. Check the logic level of the channel D0 signal display.

14. Decrement Vs by -10 mV. Wait 3 seconds and check the logic level of the channel D0 signal display. If it is a static logic low, record the Vs value as $\mathbf{V_{s+}}$ in the 4 V row of the test record.

If the signal level is a logic high or is alternating between high and low, repeat this step (decrement Vs by 10 mV, wait 3 seconds, and check for a static logic low) until a value for $\mathbf{V_{s+}}$ is found.

15. Push the front-panel **Trigger Menu** button.

16. Click the lower-bezel **Slope** button to change the slope to **Rising**.

17. Set the DC voltage source (Vs) to +3.6 V. Wait 3 seconds. Check the logic level of the channel D0 signal display.

If the signal level is a static logic high, change the DC voltage source Vs to +3.5 V.

18. Increment Vs by +10 mV. Wait 3 seconds and check the logic level of the channel D0 signal display. If it is a static logic high, record the Vs value as $\mathbf{V_{s-}}$ in the 4 V row of the test record.

If the signal level is a logic low or is alternating between high and low, repeat this step (increment Vs by 10 mV, wait 3 seconds, and check for a static logic high) until a value for $\mathbf{V_{s-}}$ is found.

19. Find the average using this formula: $V_{sAvg} = (V_{s-} + V_{s+})/2$. Record the average as the test result in the test record.

Compare the test result to the limits. If the result is between the limits, the channel passes the test.

20. *Repeat the procedure for all remaining digital channels as follows:*

a. Push the D15–D0 button.

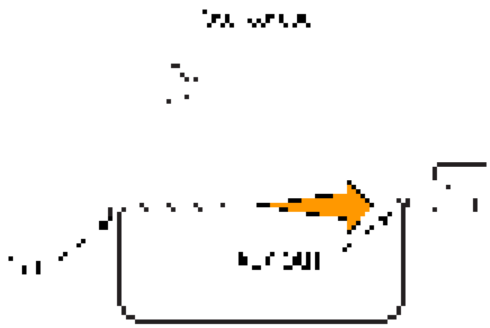
b. Move the DC voltage source connection, including the ground lead, to the next digital channel to be tested.

c. Starting from step 3, repeat the procedure until all 16 digital channels have been tested.

Check Trigger Out

This test checks the main trigger output.

1. Connect the rear-panel **AUX OUT** port to the channel 1 input using a 50 Ω cable, as shown in the following illustration.



2. Push the front-panel **Default Setup** button. This sets **AUX OUT** to **Main Trigger**.
3. Set the Vertical **Scale** to **1 V** per division.
4. *Record the Low and High measurements at 1 MΩ as follows:*
   a. Push the front-panel Wave Inspector **Measure** button.
   b. Push the **Add Measurement** lower-bezel button.
   c. Use the **Multipurpose b** knob to select the **Low** measurement.
   d. Push the **OK Add Measurement** side bezel button.
   e. Enter the Low measurement reading in the test record.
   f. Use the **Multipurpose b** knob to select the **High** measurement.
   g. Push the **OK Add Measurement** side bezel button.
   h. Enter the High measurement reading in the test record.
5. *Record the Low and High measurements at 50 Ω as follows:*
   a. Push the front-panel channel 1 button.
   b. Set the **Termination** (input impedance) to **50 Ω**.
   c. Repeat step 4.

This completes the performance verification procedures.