

# TDS7000 Series

## Characteristics

### Vertical System

	TDS7054	TDS7104	TDS7154	TDS7254	TDS7404
Input Channels	4	4	4	4	4
Analog Bandwidth (-3 dB)	500 MHz	1 GHz	1.5 GHz	2.5 GHz	4 GHz
Calculated Rise Time 10 mV/div to 1 V/div	800 ps	400 ps	240 ps	160 ps	100 ps

### Vertical System (continued)

	TDS7054/TDS7104	TDS7154/TDS7254/TDS7404
Hardware Bandwidth Limits	250 MHz or 20 MHz	Requires TCA-1 MEG
Input Coupling	AC, DC, Gnd	DC, Gnd
Input Impedance	1 M $\Omega$ $\pm$ 0.5% or 50 $\Omega$ $\pm$ 1%	50 $\Omega$ $\pm$ 2.5%
Input Sensitivity, 1 M $\Omega$	1 mV/div to 10 V/div	--
Input Sensitivity, 50 $\Omega$	1 mV/div to 1 V/div	2 mV/div to 1 V/div
Vertical Resolution	8-Bit (>11-Bit with averaging)	8-Bit (>11-Bit with averaging)
Max Input Voltage, 1 M $\Omega$	$\pm$ 150 V CAT I Derate at 20 dB/decade to 9 V <sub>RMS</sub> above 200 kHz	--
Max Input Voltage, 50 $\Omega$	5 V <sub>RMS</sub> , with peaks less than $\pm$ 30 Volts	Determined by TekConnect™ Accessory
DC Gain Accuracy	1%	$\pm$ (2% + (2% * offset))
Offset Range	1 mV/div to 100 mV/div: $\pm$ 1 V	2 mV to 50 mV/div: $\pm$ 0.5 V
	101 mV/div to 1 V/div: $\pm$ 10 V	50.5 mV to 99.5 mV: $\pm$ 0.25 V
	1.01 V/div to 10 V/div: $\pm$ 100 V	100 mV to 500 mV: $\pm$ 5 V
		505 mV to 1 V/div: $\pm$ 2.5 V
Channel-to-channel Isolation Any Two Channels at Equal Vertical Scale Settings	$\geq$ 100:1 at 100 MHz and $\geq$ 30:1 at the Rated Bandwidth	$\geq$ 100:1 at <2.5 GHz and $\geq$ 40:1 at 4 GHz

Typical system bandwidth of TDS7404 with P7240: 4 GHz.

Typical system bandwidth of TDS7404 with P7330: 3.5 GHz.

### Time Base System

	TDS7054/TDS7104	TDS7154/TDS7254/TDS7404
Time Base Range	200 ps/div to 40 s/div	50 ps to 10 s/div
Time Base Delay Time Range	16 ns to 250 s	
Channel-to-channel Deskew Range	$\pm$ 25 ns	
Delta Time Measurement Accuracy	((0.06/sample rate) + (15 ppm * reading)) RMS	((0.06/sample rate) + (2.5 ppm * reading)) RMS
Trigger Jitter (RMS)	8 ps <sub>RMS</sub> (typical)	6 ps <sub>RMS</sub> (typical)
Long Term Sample Rate and Delay Time Accuracy	$\pm$ 15 ppm over $\geq$ 1 ms interval	2.5 ppm over any $\geq$ 100 ms interval

### Acquisition System

	TDS7054	TDS7104	TDS7154/TDS7254/TDS7404
<b>Real-time Sample Rates</b>			
1 channel (max)	5 GS/s	10 GS/s	20 GS/s
2 channels (max)	5 GS/s	5 GS/s	10 GS/s
3-4 channels (max)	2.5 GS/s	2.5 GS/s	5 GS/s
Equivalent Time Sample Rate (max)	250 GS/s	250 GS/s	1 TS/s
Maximum Record Length per Channel with Standard Memory	2 M (1-CH.), 1 M (2-CH.), 500 k (4-CH.)		
with Memory Opt. 2M	8 M (1-CH.), 4 M (2-CH.), 2 M (4-CH.)		
with Memory Opt. 3M	16 M (1-CH.), 8 M (2-CH.), 4 M (4-CH.)		
with Memory Opt. 4M			32 M (1-CH.), 16 M (2-CH.), 8 M (4-CH.)

**Maximum Duration at Highest Real-time Resolution (1-CH)**

	TDS7054	TDS7104	TDS7154/TDS7254/TDS7404
Time Resolution (Single-shot)	200 ps (5 GS/s)	100 ps (10 GS/s)	50 ps (20 GS/s)
Max Duration with Standard Memory	400 $\mu$ s	200 $\mu$ s	100 $\mu$ s
Max Duration with Opt. 2M	1.6 ms	800 $\mu$ s	400 $\mu$ s
Max Duration with Opt. 3M	3.2 ms	1.6 ms	800 $\mu$ s
Max Duration with Opt. 4M			1.6 ms

**Acquisition Modes**

	TDS7054/TDS7104	TDS7154/TDS7254/TDS7404
FastAcq Acquisition	FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events	
Maximum FastAcq Waveform Capture Rate	>200,000 wfms/sec	>400,000 wfms/sec
Waveform Database (requires Option SM)	Accumulate Waveform Database providing three-dimensional array of amplitude, time and counts	
Sample	Acquire sampled values	
Peak Detect	Captures narrow glitches at all real-time sampling rates	
Minimum Peak Detect Pulse Width	$\leq$ 1 ns	400 ps
Averaging	From 2 to 10,000 waveforms included in average	
Envelope	From 2 to $2 \times 10^9$ waveforms included in min-max envelope	
Hi-Res	Real-time boxcar averaging reduces random noise and increases resolution	
FastFrame™ Acquisition	Acquisition memory divided into segments; maximum trigger rate >160,000 waveforms per second. Time of arrival recorded with each event	

**Trigger System**

	TDS7054	TDS7104	TDS7154/TDS7254/TDS7404
<b>Sensitivity</b>			
Internal DC Coupled	0.35 div DC to 50 MHz increasing to 1 div at 500 MHz	0.35 div DC to 50 MHz increasing to 1 div at 1 GHz	0.35 div DC to 50 MHz increasing to 1.5 div at 3 GHz TDS7404: 2.7 div at 4 GHz (typical)
External (Auxiliary Input)	400 mV from DC to 50 MHz increasing to 750 mV at 100 MHz	250mV from DC to 50 MHz increasing to 500mV at 100 MHz	250mV from DC to 50 MHz increasing to 350mV at 500 MHz
Main Trigger	Auto, Normal and Single		

Modes			
Trigger Sequences	Main, Delayed by Time, Delayed by Events. All sequences can include separate horizontal delay after the trigger event to position the acquisition window in time		
<b>Trigger Characteristics</b>			
Standard Trigger Types	Edge, Glitch, Runt, Width, Transition Time, Timeout, Pattern, State, Setup/Hold		
Communications-related Triggers (requires Option SM)	Support for AMI, HDB3, BnZS, CMI, MLT3 and NRZ encoded communications signals. Select among isolated positive or negative one, zero pulse form or eye patterns as applicable to standard.		
Serial Pattern Trigger (requires Option ST)			32-Bit serial word recognizer, bits specified in binary (high, low, don't care) or hex format. Trigger on NRZ-encoded data up to 1.25 GBaud.
<b>Trigger Level Range</b>			
Internal	±12 divisions from center of screen		
External (Auxiliary In)	±8 V		
Line	fixed at 0 V		
Trigger Coupling	DC, AC (attenuates <60 Hz), HF Rej (attenuates >30 kHz), LF Rej (attenuates <80 kHz), Noise Reject (reduces sensitivity)		
Trigger Holdoff Range	250 ns minimum to 12 s maximum		

### Trigger Modes

**Edge** - Positive or negative slope on any channel or front panel auxiliary input. Coupling includes DC, AC, noise reject, HF reject and LF reject.

**Glitch** - Trigger on or reject glitches of positive, negative or either polarity. Minimum glitch width is 1.0 ns with 200 ps resolution.

**Width** - Trigger on width of positive or negative pulse either within or out of selectable time limits (1 ns to 1 s).

**Runt** - Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Optional time qualification.

**Timeout** - Trigger on an event which remains high, low or either, for a specified time period, selectable from 1 ns to 1 s with 200 ps resolution.

**Transition** - Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative or either.

**Setup/Hold** - Trigger on violations of both setup time and hold time between clock and data present on any two input channels.

**Pattern** - Trigger when pattern goes false or stays true for specified period of time. Pattern (AND, OR, NAND, NOR) specified for four input channels defined as HIGH, LOW or Don't Care.

**State** - Any logical pattern of channels (1, 2, 3) clocked by edge on channel 4. Trigger on rising or falling clock edge.

**Trigger Delay by Time** - 16 ns to 250 seconds.

**Trigger Delay by Events** - 1 to 10,000,000 Events.

### Waveform Measurements

**Amplitude** - Amplitude, High, Low, Maximum, Minimum, Peak to Peak, Mean, Cycle Mean, RMS, Cycle RMS, Positive Overshoot, Negative Overshoot.

**Time** - Rise time, Fall time, Positive Width, Negative Width, Positive Duty Cycle, Negative Duty Cycle, Period, Frequency, Delay.

**Combination** - Area, Cycle Area, Phase, Burst Width.

**Histogram-related** - Waveform count, Hits in box, Peak hits, Median, Maximum, Minimum, Peak to Peak, Mean ( $\mu$ ), Standard Deviation ( $\sigma$ ),  $\mu+1\sigma$ ,  $\mu+2\sigma$ ,  $\mu+3\sigma$ .

## Waveform Processing/Math

**Algebraic Expressions** - Define extensive algebraic expressions including waveforms, scalars and results of parametric measurements e.g. (Integral (CH.1-Mean(CH.1))\*1.414).

**Arithmetic** - Add, subtract, multiply, divide waveforms and scalars.

**Relational** - Boolean result of comparison >, <, >=, <=, ==, !=.

**Calculus** - Integrate, differentiate.

**Frequency Domain Functions** - Spectral magnitude and phase, real and imaginary spectra.

**Vertical Units** - Magnitude: Linear, dB, dBm; Phase: Degrees, radians.

**Window Functions** - Rectangular, Hamming, Hanning, Kaiser-Bessel, Blackman-Harris, Gaussian, Flattop2, Tek Exponential.

**Waveform Definition** - As arbitrary math expression.

## Display Characteristics

**Display Type** - Liquid crystal active-matrix color display.

**Display Size** - Width: 211.2 mm (8.32 in.);

Height: 158.4 mm (6.24 in.);

Diagonal: 264 mm (10.4 in.).

**Display Resolution** - 640 horizontal x 480 vertical pixels.

**Waveform Styles** - Vectors, Dots, Variable Persistence, Infinite Persistence.

## Computer System and Peripherals

**CPU** - Intel Celeron processor, 850 MHz.

**PC System Memory** - 512 MB.

**Hard Disk Drive** - Rear-panel, removable hard disk drive, 20 GB capacity.

**Floppy Disk Drive** - Front-panel 3.5 in floppy disk drive, 1.44 MB capacity.

**CD-R/W Drive** - Rear-panel CD-R/W drive with CD creation software application.

**Mouse** - Logitech thumb wheel model included, USB interface.

**Keyboard** - Order 118-9402-00 for small keyboard (fits in pouch); PS-2 interface. Order 119-6297-00 for full-size keyboard; USB interface and hub.

## Input/Output Ports

**Probe Compensator Output** - Front panel BNC connector, requires Probe Cal-Deskew Fixture (included) for probe attachment. Amplitude 200 mV  $\pm 20\%$  into a  $\geq 50 \Omega$  load, frequency 1 kHz  $\pm 5\%$ .

**Analog Signal Output Amplitude** - Front-panel BNC connector, provides a buffered version of the signal that is attached to the Ch 3 input when Ch 3 is selected as trigger source. 20 mV/div  $\pm 20\%$  into a 1 M $\Omega$  load, 10 mV/div  $\pm 20\%$  into a 50  $\Omega$  load.

**Analog Signal Output Bandwidth, Typical** - TDS7054, TDS7104: 100 MHz into a 50  $\Omega$  load.

TDS7154/TDS7254/TDS7404: 1 GHz into a 50  $\Omega$  load.

**External Time Base Reference In** - Rear-panel BNC connector, time base system can phase-lock to external 10 MHz reference.

**Time Base Reference Out** - Rear-panel BNC connector, accepts TTL-compatible output of internal 10 MHz reference oscillator.

**Auxiliary Output Levels** - Front-panel BNC connector, provides a TTL-compatible, polarity switchable pulse when the oscilloscope triggers.

**Parallel Port** - IEEE 1284, DB-25 connector.

**Audio Ports** - Miniature phone jacks for stereo microphone input and stereo line output.

**USB Port** - Allows connection or disconnection of USB keyboard and/or mouse while oscilloscope power is on.

**Keyboard Port** - PS-2 compatible.

**Mouse Port** - PS-2 compatible.

**LAN Port** - RJ-45 connector, supports 10Base-T and 100Base-T.

**Serial Port** - DB-9 COM1 port.

**SVGA Video Port** - DB-15 female connector; connect a second monitor to use dual-monitor display mode.

Supports basic requirements of PC99 specifications.

**GPIO Port** - IEEE 488.2 standard.

**Scope VGA Video Port** - DB-15 female connector, 31.6 kHz sync, EIA RS-343A compliant, connect to show the oscilloscope display, including live waveforms on an external monitor or projector.

## Power Source

**Power** - 100 to 240 V<sub>RMS</sub>, ±10%, 50/60 Hz; 115 V<sub>RMS</sub> ±10%, 400 Hz; CAT II, <300 W (450 VA).

## Physical Characteristics Benchtop Configuration

Dimensions	mm	in.
Height	277	10.9
Width	455	17.9
Depth	425	16.75
Weight	kg	lbs.
Net	18	39
Shipping	37	80

## Physical Characteristics Rackmount Configuration

Dimensions	mm	in.
Height	277	10.5
Width	502	19.75
Depth	486	19.125
Weight	kg	lbs.
Net	19	41
Kit	5.6	12.25

## Mechanical

### Cooling - Required Clearance

	mm	in.
Top	0 or >76	0 or >3
Bottom	0	0
Left side	76	3
Right side	76	3
Front	0	0
Rear	0	0

## Environmental

### Temperature

**Operating** - 0 °C to +50 °C, excluding floppy disk and CD-R/W drives; +10 °C to +45 °C, including floppy disk and CD-ROM drives.

**Nonoperating** - -22 °C to +60 °C.

### Humidity

**Operating** - 20% to 80% relative humidity with a maximum wet bulb temperature of +29 °C at or below +50 °C, noncondensing. Upper limit derated to 25% relative humidity at +50 °C.

**Nonoperating** - With no diskette in floppy disk drive. 5% to 90% relative humidity with a maximum wet bulb temperature of +29 °C at or below +60 °C, noncondensing. Upper limit derated to 20% relative humidity at +60 °C.

### Altitude

**Operating** - 10,000 ft. (3,048 m).

**Nonoperating** - 40,000 ft. (12,190 m).

### Random Vibration

**Operating** - 0.000125 G<sup>2</sup>/Hz from 5 to 350 Hz, -3 dB/octave from 350 to 500 Hz, 0.0000876 G<sup>2</sup>/Hz at 500 Hz. Overall level of 0.24 G<sub>RMS</sub>.

**Nonoperating** - 0.0175 G<sup>2</sup>/Hz from 5 to 100 Hz, -3 dB/octave from 100 to 200 Hz, 0.00875 G<sup>2</sup>/Hz from 200 to 350 Hz, -3 dB/octave from 350 to 500 Hz, 0.006132 G<sup>2</sup>/Hz at 500 Hz. Overall level of 2.28 G<sub>RMS</sub>.

**Electromagnetic Compatibility** - 89/336/EEC.

**Safety** - UL 3111-1, CSA1010.1, EN61010-1, IEC 61010-1.