

Digital Phosphor Oscilloscopes

TDS700D



Characteristics

TDS700D Series Electrical Characteristics

	TDS794D*5	TDS784D	TDS754D*5	TDS724D*5
Bandwidth	2 GHz*4	1 GHz*1	500 MHz*2	500 MHz*2
# Channels	4	4	4	2 + 2 aux.
# Samplers	4	4	4	2
Max Real-time Sample Rate				
1 channel	4 GS/s	4 GS/s	2 GS/s	2 GS/s
2 channels	2 GS/s	2 GS/s	2 GS/s	1 GS/s
3-4 channels	1 GS/s	1 GS/s	1 GS/s	NA
Equivalent-time sample rate	250 GS/s max.	250 GS/s max.	100 GS/s max.	100 GS/s max.
Maximum Record Length				
1 channel	50 K (Opt. 1M: 500 K, Opt. 2M: 8 M)	50 K (Opt. 1M: 500 K, Opt. 2M: 8 M)	50 K (Opt. 1M: 500 K, Opt. 2M: 8 M)	50 K (Opt. 1M: 250 K, Opt. 2M: 4 M)
2 channels	50 K (Opt. 1M: 250 K, Opt. 2M: 4 M)	50 K (Opt. 1M: 250 K, Opt. 2M: 4 M)	50 K (Opt. 1M: 250 K, Opt. 2M: 4 M)	50 K (Opt. 1M: 130 K, Opt. 2M: 2 M)
3-4 channels	50 K (Opt. 1M: 130 K, Opt. 2M: 2 M)	50 K (Opt. 1M: 130 K, Opt. 2M: 2 M)	50 K (Opt. 1M: 130 K, Opt. 2M: 2 M)	NA
Max sample rate window*3	2 ms	2 ms	4 ms	4 ms
Display	NuColor™ Display	NuColor Display	NuColor Display	NuColor Display

*1 In 50 Ohm mode: 5 mV/div: 750 MHz, 2 mV/div: 600 MHz, 1 mV/div: 500 MHz. Reduce the upper bandwidth frequencies by 5 MHz for each degree C above 30°C.

*2 In 50 Ohm mode: 1 mV/div: 450 MHz. Reduce the upper bandwidth frequencies by 2.5 MHz for each degree C above 30°C.

*3 Single-channel operating at full sample rate and maximum record length (Opt. 2M).

*4 Reduce the upper bandwidth frequency by 20 MHz for each degree C above 30°C.

*5 This product is discontinued.

TDS700D Series Vertical System

	TDS794D*5	TDS784D	TDS754D*5	TDS724D*5
Sensitivity	10 mV/div to 1 V/div (50 Ohm mode)	1 mV/div to 10 V/div (1 megaohm mode), 1 mV/div to 1 V/div (50 Ohm mode)	1 mV/div to 10 V/div (1 megaohm mode), 1 mV/div to 1 V/div (50 Ohm mode)	1 mV/div to 10 V/div (1 megaohm mode), 1 mV/div to 1 V/div (50 Ohm mode)
DC gain accuracy	± 1.0% (0.7% typical)	± 1.0% (±0.7% typical)	± 1.0% (±0.7% typical)	± 1.0% (±0.7% typical)
Effective bits (typical)	5.0 (2 GHz @ 4 GS/s), 9.7 with hi-res (1 MHz @ 10 MS/s)	5.5 (1 GHz @ 4 GS/s), 9.7 with hi-res (1 MHz @ 10 MS/s)	6.8 (500 MHz @ 2 GS/s), 9.7 with hi-res (1 MHz @ 10 MS/s)	6.8 (490 MHz @ 2 GS/s), 9.7 with hi-res (1 MHz @ 10 MS/s)
Vertical resolution	8 Bits (256 levels on 10.25 divisions), > 11 Bits with averaging, > 13 Bits typical with hi-res (TDS794D*5, TDS784D), > 12 Bits typical with hi-res (TDS754D*5, TDS724D*5)			
Position range	± 5 divisions	± 5 divisions	± 5 divisions	± 5 divisions
Offset range	± 1 V from 1 mV to 100 mV/div, ± 10 V from 101 mV to 1 V/div, ± 100 V from 1.01 V to 10 V/div (TDS784D, TDS754D*5, TDS724D*5)			
	± 0.5 V from 10 mV to 50 mV/div, ± 0.25 V from 50.5 mV to 99.5 mV/div, ± 5 V from 100 mV to 500 mV/div, ± 2.5 V from 505 mV to 1 V/div (TDS794D*5)			
Analog bandwidth selections	Full only	20 MHz, 250 MHz, full	20 MHz, 250 MHz, full	20 MHz, 250 MHz, full
Input coupling	DC, GND	AC, DC, GND	AC, DC, GND	AC, DC, GND

Input impedance selections	1 megaohm in parallel with 10 pF or 50 Ohm (AC and DC coupling) (TDS784D, TDS754D*5, TDS724D*5) 50 Ohm only (DC coupling only) (TDS794D*5 only)			
AC-coupled low frequency limit	N/A	≤ 10 Hz when AC 1 megaohm coupled. ≤ 200 kHz when AC 50 Ohm coupled.	≤ 10 Hz when AC 1 megaohm coupled. ≤ 200 kHz when AC 50 Ohm coupled.	≤ 10 Hz when AC 1 megaohm coupled. ≤ 200 kHz when AC 50 Ohm coupled.
Channel isolation	> 100:1 at 100 MHz and > 30:1 at the rated bandwidth			
Max. input voltage	5 V _{RMS} , with peaks ≤ ± 20 Volts	300 V CAT II ± 400 V (peak). Derate at 20 dB/decade	300 V CAT II ± 400 V (peak). Derate at 20 dB/decade	300 V CAT II ± 400 V (peak). Derate at 20 dB/decade
		above 1 MHz, 1 megaohm or GND coupled.	above 1 MHz, 1 megaohm or GND coupled.	above 1 MHz, 1 megaohm or GND coupled.

TDS700D Series Timebase System

	TDS794D*5	TDS784D	TDS754D*5/TDS724D*5
Time bases	Main, delayed	Main, delayed	Main, delayed
Time base range	200 ps to 10 s/div	200 ps to 10 s/div	500 ps to 10 s/div
Time base accuracy	± 25 ppm (over any interval ≥ 1 ms)		
Delta time measurement accuracy	± (0.15/sample rate) + (25 ppm x [reading])		
Trigger jitter	7 ps (typical)	7 ps (typical)	8 ps (typical)
Pre-trigger position	0% to 100% of any record		
Delay between channels	≤ 50 ps (any 2 channels with equal V/div and coupling)		

Acquisition Modes

DPO - Captures and displays complex waveforms, random events and subtle patterns in actual signal behavior. By acquiring up to 100 M points/sec TDS794D*5, TDS784D, TDS754D*5 (50 M points/sec; TDS724D*5) DPOs are able to provide 3 dimensions of signal information, in real-time; amplitude, time, and the distribution of amplitude over time. The DPX™ Waveform Imaging Processor automatically selects record lengths between 500 and 500,000 points and sample rate up to 1 GS/s, based on horizontal

time base setting, to optimize displayed sample density.

Peak Detect - High frequency and random glitch capture. Captures glitches of 1 ns using acquisition hardware at all real-time sampling rates.

Sample - Sample data only.

Envelope - Max/min values acquired over one or more acquisitions.

Average - Waveform data from 2 to 10,000 (selectable) is averaged.

Hi-res - Vertical resolution improvement and noise reduction on low-frequency signal (e.g. 12 Bits typical).

FastFrame™ Time Stamp - Acquisition memory size segmentable with trigger rate up to 80,000 per second from 50 to 5,000 points per frame (independent of the number of channels).

Single Sequence - Use RUN/STOP button to capture a single triggered acquisition at a time, which may be automatically saved to NVRAM with AutoSave.

Trigger System

Triggers - Main and delayed.

Main Trigger Modes - Auto, normal, single.

Delayed Trigger - Delayed by time, events or events and time.

Time Delay Range - 16 ns to 250 s.

Events Delay Range - 1 to 9,999,999 events.

External Rear Input - ≥ 1.5 kW; Max input voltage is ± 20 V (DC + peak AC).

Trigger Types

EDGE (main and delayed) -

Conventional level-driven trigger. Positive or negative slope on any channel or rear panel auxiliary input. Coupling selections: DC, AC, noise reject, HF reject, LF reject.

LOGIC (main) -

PATTERN: Specifies a logical combination (AND, OR, NAND, NOR) of the four input channels (high, low, don't care). Trigger when pattern stays true or false for a specified time.

STATE: Any logical pattern of channels 1, 2, and 3 (AUX1 on 2-CH products) plus a clock edge on channel 4 (AUX2 on 2-CH products). Triggerable on rising or falling clock edge.

SETUP/HOLD: Trigger on violations of both setup time and hold time between clock and data which are on two input channels.

PULSE (main) -

GLITCH: Trigger on or reject glitches of positive, negative, or either polarity. Minimum glitch width is 1.0 ns (typical) 2 ns (warranted) with 200 ps resolution.

RUNT: Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again.

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

SLEW RATE: Trigger on pulse edge rates that are either faster or slower than a set rate. Edges can be rising, falling or either.

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.

COMM (optional) -

AMI: Trigger on standard communications signals (including DS1, DS1A, DS1C, DS2, DS3, E1, E2, E3, STS-1 or a custom bit rate). Select between "isolated ones" (positive or negative) and eye diagrams.

CMI: Trigger on standard communications signals (including STS-3, STM1E, DS4NA, E4 or a custom bit rate). Select between positive or negative one pulses, zero pulses and eye diagrams.

NRZ: Trigger on standard communications signals (including OC1/STM0, OC3/STM1, OC12/STM4, E5, FC133, FC266, FC531, FC1063, FDDI HALT, 143 Mb/s serial digital composite video, 270 Mb/s serial digital component video or a custom bit rate). Select between an eye diagram, rising or falling edges or any of eight 3-Bit serial patterns.

VIDEO (optional) -

Trigger on a particular line of individual, odd/even or all fields.

Trigger on a specific pixel of a line by using the video trigger with delay by events. Choose positive or negative horizontal sync polarity.

525/NTSC: Choose monochrome or color (studio-quality NTSC) sync formats.

625/PAL: Choose color or monochrome (studio-quality PAL) sync formats.

HDTV: Choose from 1125/60, 1050/60, 1250/50 and 787.5/60 HDTV formats.

Measurement System

Automatic Waveform Measurements -

Period, frequency, +width, -width, rise time, fall time, +duty cycle, -duty cycle, delay, phase, burst width, high, low, max. min, peak to peak, amplitude, +overshoot, -overshoot, mean, cycle mean, RMS, cycle RMS, area, cycle area, extinction ratio (ratio, dB, %) and mean optical power. Continuous update of up to four measurements

on any combination of waveforms.

Measurement Statistics - Display minimum and maximum or mean and standard deviation on any displayed single-waveform measurements.

Thresholds - Settable in percentage or voltage.

Gating - Any region of the waveform may be isolated for measurement using vertical bars.

Snapshot - Performs all measurements on any one waveform showing results from one instant in time.

Cursor Measurements - Absolute, Delta: Volts, time, frequency and NTSC IRE and line number (with video trigger option).

Cursor Types - Horizontal bars (volts), vertical bars (time); operated independently or in tracking mode.

Waveform Processing

Waveform Functions - $\text{Sin}(x)/x$ or linear interpolation, average, envelope.

Advanced Waveform Functions - FFT, integration, differentiation.

Arithmetic Operators - Add, subtract, multiply, divide, invert.

Autoset - Single-button, automatic setup on selected input signal for vertical, horizontal and trigger systems. Also automatically normalizes signals to standard masks when used with the mask testing option.

Waveform Limit Testing - Compares incoming or math waveform to a reference waveform's upper and lower limits.

Waveform Histograms - Both vertical and horizontal histograms, with periodically updated measurements, allow statistical distributions to be analyzed over any region of the signal. For histograms on DPO acquisitions, both live and stored, the specified region can be repositioned and will update to reflect the underlying 3 dimensional data base, in both YT and XY modes (32 Bits in shallow mode, 64 Bits in deep mode).

Mask Testing (optional) - In addition to the standard communication masks in the instrument, the masks can be edited on the screen. Together with automatic waveform scaling, the mask tests give rapid verification of a digital bit stream's conformance to pulse templates and eye pattern masks. For optical conformance

testing, the internal Fibre Channel and SONET/SDH optical reference receiver filters provide convenient test setup which is compliant to industry standards.

Zoom Characteristics

The zoom feature allows waveforms to be expanded or compressed in both vertical and horizontal axes. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. When used with Hi-res or Average acquisition modes, Zoom provides an effective vertical dynamic range of 1,000 divisions or 100 screens. Zoom features not available on DPO operations.

Dual Window Zoom - Dual graticules simultaneously show selected and zoomed waveforms. Up to two zoom boxes show areas on the selected trace that are being magnified, and the two magnified areas can be overlapped for quick comparison. Color of zoomed trace matches selected trace.

Display Characteristics

Waveform Style - Dots, vectors, variable persistence from 32 ms to 10 s, infinite persistence and intensified samples.

Color - Standard palettes and user-definable color for waveforms, text, graticules and cursors. Measurement text and cursor colors matched to waveform. Waveform collision areas highlighted with different color. Statistical waveform distribution shown with color grading through variable persistence.

Color Grading - With variable persistence selected, historical timing information is represented by temperature or spectral color scheme providing "Z-axis" information about rapidly-changing waveforms.

Graticules - Full, grid, cross-hair, frame, NTSC and PAL (with video trigger option).

Format - YT and XY (and XYZ and dual XY in DPO operation).

Type - 7 in. diagonal, NuColor™ liquid crystal full color shutter display, 256 color levels.

Resolution - 640 horizontal by 480 vertical displayed pixels (VGA).

Computer Interface

GPIB (IEEE-488.2) Programmability - Full talk/listen modes. Control of all modes, settings, and measurements.

Hardcopy

Printer - Phaser 740N/740P, HP Thinkjet, Deskjet, Laserjet, Epson, Interleaf, PostScript, TIFF, PCX, BMP, DPU411/412, RLE.

Plotter - HPGL.

Data - MathCad, spreadsheet formats.

Interface - GPIB standard.

Hardcopy Interface - Centronics and RS-232 (talk only).

Storage

Non-volatile Waveform Storage - 4 full 50 K records (Opt. 1M or 2M: 4 full 130 K records, 2 full 250 K records or 1 compressed 500 K record) (TDS794D*⁵, TDS784D, TDS754D*⁵); 2 full 50 K records (Opt. 1M or 2M: 2 full 130 K records or 1 full 250 K record) (TDS724D*⁵).

Non-volatile Storage for Setups - 10 front panel setups.

Floppy Disk Drive - Store reference waveforms, setups and image files on 3.5 in. 1.44 MB or 720 K MS DOS-format floppy disk.

Iomega Zip and Zip Plus Drive Compatible - Compatible for waveform and front panel setup file transfer to Iomega Zip and Zip Plus Drives.

Power Requirements

Line Voltage Range - 100 to 240 V_{RMS}.

Line Frequency - 45 to 440 Hz.

Power Consumption - 350 W max.

Environmental and Safety

Temperature -

Operating: +4 to +50°C (floppy not used), +10 to +50°C (floppy in use).

Nonoperating: -22 to +60°C.

Humidity -

Operating: To 80% RH at $\leq 32^\circ\text{C}$. Derates to 30% RH at +45°C.

Nonoperating: To 90% RH at $\leq 40^\circ\text{C}$. Derates to 30% RH at +60°C.

Altitude -

Operating: 15,000 ft. (hard disk not used), 10,000 ft. (hard disk in use).

Nonoperating: 40,000 ft.

Electromagnetic Compatibility - 89/336/EEC.

Safety - UL3111-1, CSA1010.1, EN61010-1, IEC61010-1.

Physical Characteristics

Dimensions	mm	in.
Height with feet	193	7.6
Height without feet	178	7
Width with handle	445	17.5
Depth with front cover installed	434	17.1
Weight	kg	lbs.
Net approximately	14.1	31
Shipping Weight approximately	25.4	56