

# Specifications

This section begins with a general description of the traits of the TDS 684A and 7XXA Digitizing Oscilloscopes. Three sections follow, one for each of three classes of traits: *nominal traits*, *warranted characteristics*, and *typical characteristics*.

## Product Description

The TDS 684A and 7XXA Digitizing Oscilloscopes are portable, four-channel instruments suitable for use in a variety of test and measurement applications and systems. Table 2–1 lists key features.

**Table 2–1: Key Features of the TDS 684A and 7XXA Oscilloscopes**

Feature	TDS 684A	TDS 7XXA
Digitizing rate, maximum	5 GS/s on each channel simultaneously	TDS 744A: 2 GS/s TDS 784A: 4 GS/s
Analog bandwidth	1 GHz	TDS 744A: 500 MHz TDS 784A: 1 GHz
Channels	Four, each with 8-bit resolution	
Record lengths, maximum	15,000 samples	50,000 samples (500,000 with option 1M)
Acquisition modes	Sample, envelope, and average	Sample, envelope, average, high-resolution, and peak-detect
Trigger modes	Include: edge, logic, and pulse. Video trigger, with option 05, modes include: NTSC, SECAM, PAL, HDTV, and FlexFormat.	
Display	Color for distinguishing among waveforms, measurements, and associated text	
Storage	1.44 Mbyte, 3.5 inch, DOS 3.3-or-later floppy disk. NVRAM storage for saving waveforms, hardcopies, and setups	
I/O	Full GPIB programmability. Hardcopy output using GPIB, RS-232, or Centronics ports	

# Warranted Characteristics

This section lists the various *warranted characteristics* that describe the TDS 684A and 7XXA Digitizing Oscilloscopes. Electrical and environmental characteristics are included.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

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**NOTE.** *In these tables, those warranted characteristics that are checked in the procedure Performance Verification appear in **boldface type** under the column Name.*

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As stated above, this section lists only warranted characteristics. A list of *typical characteristics* starts on page 2–21.

## Performance Conditions

The performance limits in this specification are valid with these conditions:

- The oscilloscope must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The oscilloscope must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The oscilloscope must have had a warm-up period of at least 20 minutes.
- The oscilloscope must have had its signal-path-compensation routine last executed after at least a 20 minute warm-up period at an ambient temperature within  $\pm 5^{\circ}$  C of the current ambient temperature.

**Table 2–10: Warranted Characteristics — Signal Acquisition System**

Name	Description			
Accuracy, DC Gain	TDS 684A: $\pm 1.5\%$ for all sensitivities from 2 mV/div to 10 V/div $\pm 2.0\%$ at 1 mV/div sensitivity  TDS 7XXA: $\pm 1\%$ for all sensitivities from 1 mV/div to 10 V/div with offset from 0 V to $\pm 100\text{V}$			
Accuracy, Offset	Volts/Div Setting	TDS 684A Offset Accuracy	TDS 744A Offset Accuracy	TDS 784A Offset Accuracy
	1 mV/div – 100 mV/div	$\pm((0.2\% \times   \text{Net Offset}^1  ) + 1.5 \text{ mV} + (0.6 \text{ div} \times \text{V/div}))$	$\pm((0.2\% \times   \text{Net Offset}^1  ) + 1.5 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$	$\pm((0.2\% \times   \text{Net Offset}^1  ) + 1.5 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$
	101 mV/div – 1 V/div	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 15 \text{ mV} + (0.6 \text{ div} \times \text{V/div}))$	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 15 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 15 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$
	1.01 V/div – 10 V/div	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 150 \text{ mV} + (0.6 \text{ div} \times \text{V/div}))$	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 150 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$	$\pm((0.25\% \times   \text{Net Offset}^1  ) + 150 \text{ mV} + (0.1 \text{ div} \times \text{V/div setting}))$
Analog Bandwidth, DC-50 $\Omega$ Coupled and Bandwidth selection is FULL	Volts/Div	684A Bandwidth <sup>2</sup>	744A Bandwidth <sup>2</sup>	784A Bandwidth <sup>2</sup>
	10 mV/div – 1 V/div	DC – 1 GHz	DC – 500 MHz	DC – 1 GHz
	5 mV/div – 9.95 mV/div	DC – 750 MHz	DC – 500 MHz	DC – 750 MHz
	2 mV/div – 4.98 mV/div	DC – 600 MHz	DC – 500 MHz	DC – 600 MHz
	1 mV/div – 1.99 mV/div	DC – 500 MHz	DC – 450 MHz	DC – 500 MHz
Analog Bandwidth, DC-50 $\Omega$ Coupled with P6245 Probe and Bandwidth selection is FULL	Volts/Div as Read Out on Screen	684A Bandwidth <sup>2</sup>	744A Bandwidth <sup>2</sup>	784A Bandwidth <sup>2</sup>
	10 mV/div – 100 V/div	(Not Applicable)	(Not Applicable)	(Not Applicable)
	100 mV/div – 10 V/div	DC – 1 GHz	DC – 500 MHz	DC – 1 GHz
	50 mV/div – 99.5 mV/div	DC – 750 MHz	DC – 500 MHz	DC – 750 MHz
	20 mV/div – 49.8 mV/div	DC – 600 MHz	DC – 500 MHz	DC – 600 MHz
	10 mV/div – 19.9 mV/div	DC – 500 MHz	DC – 450 MHz	DC – 500 MHz

**Table 2–10: Warranted Characteristics — Signal Acquisition System (Cont.)**

Name	Description			
<b>Analog Bandwidth, DC-1M <math>\Omega</math> Coupled with P6139A Probe and Bandwidth selection is FULL</b>	<b>Volts/Div as Read Out on Screen</b>	<b>684A Bandwidth<sup>2</sup></b>	<b>744A Bandwidth<sup>2</sup></b>	<b>784A Bandwidth<sup>2</sup></b>
	10 mV/div – 100 V/div	500 MHz	500 MHz	500 MHz
	100 mV/div – 10 V/div	500 MHz	500 MHz	500 MHz
	50 mV/div – 99.5 mV/div	500 MHz	500 MHz	500 MHz
	20 mV/div – 49.8 mV/div	500 MHz	500 MHz	500 MHz
	10 mV/div – 19.9 mV/div	400 MHz	450 MHz	500 MHz
Crosstalk (Channel Isolation)	$\geq 100:1$ at 100 MHz and $\geq 30:1$ at the rated bandwidth for any two channels having equal Volts/Div settings			
<b>Delay Between Channels, Full Bandwidth</b>	TDS 684A: $\leq 100$ ps for any two channels with equal Volts/Div and Coupling settings TDS 744A/784A: $\leq 50$ ps for any two channels with equal Volts/Div and Coupling settings			
Input Impedance, DC-1 M $\Omega$ Coupled	1 M $\Omega$ $\pm 0.5\%$ in parallel with 10 pF $\pm 3$ pF			
Input Impedance, DC-50 $\Omega$ Coupled	50 $\Omega$ $\pm 1\%$ with VSWR $\leq 1.3:1$ from DC – 500 MHz, $\leq 1.5:1$ from 500 MHz – 1 GHz			
Input Voltage, Maximum, DC-1 M $\Omega$ , AC-1 M $\Omega$ , or GND Coupled	$\pm 400$ V (DC + peak AC); derate at 20 dB/decade above 1 MHz			
Input Voltage, Maximum, DC-50 $\Omega$ or AC-50 $\Omega$ Coupled	5 V <sub>RMS</sub> , with peaks $\leq \pm 30$ V			
Lower Frequency Limit, AC Coupled	TDS 684A: $\leq 10$ Hz when AC-1 M $\Omega$ Coupled; $\leq 200$ kHz when AC-50 $\Omega$ Coupled <sup>3</sup>			

<sup>1</sup> **Net Offset = Offset – (Position  $\times$  Volts/Div).** Net Offset is the nominal voltage level at the oscilloscope input that corresponds to the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

<sup>2</sup> The limits given are for the ambient temperature range of 0°C to +30°C. Reduce the upper bandwidth frequencies by 5 MHz for the TDS 684A or by 2.5 MHz for the TDS 7XXA for each °C above +30°C.

<sup>3</sup> The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X passive probes are used.

**Table 2–11: Warranted Characteristics — Time Base System**

Name	Description
<b>Accuracy, Long Term Sample Rate and Delay Time</b>	TDS 684A: $\pm 100$ ppm over any $\geq 1$ ms interval TDS 7XXA: $\pm 25$ ppm over any $\geq 1$ ms interval

Table 2–12: Warranted Characteristics — Triggering System

Name	Description	
Sensitivity, Edge-Type Trigger, Coupling set to "DC" <sup>1</sup>	Trigger Source	Sensitivity
	Any Channel	TDS 684A: 0.35 division from DC to 50 MHz, increasing to 1 division at 1 GHz TDS 7XXA: 0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz for the TDS 744A or to 1 division at 1 GHz for the TDS 784A
	Auxiliary	TDS 684A or 784A: 250 mV from DC to 50 MHz, increasing to 500 mV at 100 Mhz TDS 744A: 400 mV from DC to 50 MHz, increasing to 750 mV at 100 Mhz
Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering	Time Range	Accuracy
	1 ns to 1 $\mu$ s	$\pm$ (20% of setting + 0.5 ns)
	1.02 $\mu$ s to 1 s	$\pm$ (100 ns + 0.01% of Setting)
Input Signal Sync Amplitude for Stable Triggering, NTSC and PAL modes (Option 05 Video Trigger)	Field selection "Odd", "Even", or "All": 0.6 division to 4 divisions	
	Field selection "Numeric": 1 division to 4 divisions (NTSC mode)	
Jitter (Option 05 Video Trigger)	60 ns <sub>p-p</sub> on NTSC or PAL signal	

<sup>1</sup> The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

Table 2–13: Warranted Characteristics — Output Ports, Probe Compensator, and Power Requirements

Name	Description	
Logic Levels, Main- and Delayed-Trigger Outputs	Characteristic	Limits
	Vout (HI)	$\geq 2.5$ V open circuit; $\geq 1.0$ V into a 50 $\Omega$ load to ground
	Vout (LO)	$\leq 0.7$ V into a load of $\leq 4$ mA; $\leq 0.25$ V into a 50 $\Omega$ load to ground
Output Voltage and Frequency, Probe Compensator	Characteristic	Limits
	Output Voltage	0.5 V (base-top) $\pm 1\%$ into a $\geq 50$ $\Omega$ load
	Frequency	1 kHz $\pm 5\%$
Output Voltage, Signal Out (CH 3 <sup>1</sup> )	For TDS 684A: 20 mV/division $\pm 20\%$ into a 1 M $\Omega$ load; 10 mV/division $\pm 20\%$ into a 50 $\Omega$ load For TDS 7XXA: 22 mV/division $\pm 20\%$ into a 1 M $\Omega$ load; 11 mV/division $\pm 20\%$ into a 50 $\Omega$ load	
Source Voltage	90 to 250 VAC <sub>RMS</sub> , continuous range	
Source Frequency	45 Hz to 440 Hz	

**Table 2–13: Warranted Characteristics — Output Ports, Probe Compensator, and Power Requirements (Cont.)**

Name	Description
Power Consumption	≤300 W (450 VA)

<sup>1</sup> CH 3 signal out is present at the rear panel if CH 3 is selected as the trigger source for the main and/or delayed trigger systems. It is not available when a channel other than CH3 is the source for the Video Trigger when Option 05 is installed.

**Table 2–14: Warranted Characteristics — Environmental**

Name	Description
Atmospherics	<p>Temperature (no diskette in floppy drive):</p> <p>TDS 684A: Operating: +4° C to +45° C</p> <p>TDS 7XXA: Operating: +4° C to +50° C</p> <p>Nonoperating: –22° C to +60° C</p> <p>Relative humidity (no diskette in floppy drive):</p> <p>Operating: 20% to 80%, at or below +32° C, upper limit derates to 30% relative humidity at +45° C</p> <p>Nonoperating: 5% to 90%, at or below +41° C, upper limit derates to 30% relative humidity at 60° C</p> <p>Altitude:</p> <p>To 4570 m (15,000 ft.), operating</p> <p>To 12190 m (40,000 ft.), nonoperating</p>
Dynamics	<p>Random vibration (floppy diskette not installed):</p> <p>0.31 g rms, from 5 to 500 Hz, 10 minutes each axis, operating</p> <p>3.07 g rms, from 5 to 500 Hz, 10 minutes each axis, nonoperating</p>
Emissions <sup>1, 2</sup>	<p>Meets or exceeds the requirements of the following standards:</p> <p>Vfg. 243/1991 Amended per Vfg. 46/1992</p> <p>FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A</p> <p>European Community Requirements</p> <p>EN 55011 Class A Radiated Emissions</p> <p>EN 55011 Class A Conducted Emissions</p> <p>EN 50081–1</p> <p>EN60555–2 Power Line Harmonic Emissions</p>

**Table 2–14: Warranted Characteristics — Environmental (Cont.)**

Name	Description
Susceptibility <sup>1, 2</sup>	<p>Meets or exceeds the EMC requirements of the following standards:</p> <p>EN 50082–1 European Community Requirements</p> <p>IEC 801-2 Electrostatic Discharge</p> <p>IEC 801-3 Radiated Susceptibility</p> <p>IEC 801-4 Fast Transients</p> <p>IEC 801-5 AC Surge</p>
Third Party Certification	<p>Conforms to and is certified where appropriate to:</p> <p>UL 1244</p> <p>CSA–C22.2 No. 231</p>

<sup>1</sup> VGA output cable needs to be terminated, if connected at all, for the Instrument to meet these standards. The test will pass with LCOM part # CTL3VGAMM–5.

<sup>2</sup> The GPIB cable connected to the instrument for certain of the emissions tests must be "low EMI" having a high-quality outer shield connected through a low impedance to both connector housings. Acceptable cables are Tektronix part numbers 012-0991-00, -01, -02, and -03. In order to maintain the EMI performance conforming to the above regulations, the following cables, or their equivalent, should be used: a shielded Centronics cable, 3 meters in length, part number 012-1214-00, and a shielded RS-232 cable, 2.7 meters in length, CA part number 0294-9.