Appendix B: Specification

This section describes and lists the traits of the TDS 600 Digitizing Oscilloscopes. Three sets of tables follow, one set for each of three classes of traits: *nominal traits, warranted characteristics,* and *typical characteristics*.

General

The Tektronix TDS 600 Digitizing Oscilloscopes are portable, four-channel instruments suitable for use in a variety of test and measurement applications and systems. Key differences between the two models are as follows:

- The TDS 640 supplies four full-featured channels. The TDS 620 supplies four full-featured channels for use with two samplers.
- The TDS 640 has four input channels labeled CH 1, CH 2, CH 3, and CH 4. The TDS 620 has four input channels labeled CH 1, CH 2, AUX 1, and AUX 2.
- The TDS 640 has a maximum sample rate of 2 GSamples/second, on all four channels simultaneously. The TDS 620 has a maximum sample rate of 2 GSamples/second, on any two channels simultaneously.

Key features they have in common are as follows:

- A record length of 2,000 samples and 8-bit vertical resolution.
- An analog bandwidth of 500 MHz.
- Extensive triggering capabilities such as edge, logic, and pulse.
- Limit testing and template generation capability.
- Full programmability and printer/plotter output.
- Advanced functions such as continuously-updated measurements.
- Specialized display modes, such as infinite and variable persistence.
- A unique graphical user interface (GUI), an on-board help mode, and a logical front-panel layout which combine to deliver a new standard in usability.

User Interface

These oscilloscopes use a combination of front-panel buttons, knobs, and on-screen menus to control their many functions. Front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Any function likely to get adjusted often, such as vertical positioning or the time base setting, is set directly by its own front-panel knob. Functions which are changed less often, such as vertical coupling and horizontal mode, are set indirectly using selected menus.

Menus

Pressing one (sometimes two) front-panel button(s), such as vertical menu, displays a *main* menu of related functions, such as coupling, bandwidth, etc., at the bottom of the screen. Pressing a main-menu button, such as coupling, displays a *side* menu of settings for that function, such as AC, DC, or GND (ground) coupling, at the right side of the screen. Pressing a side-menu button selects a setting such as DC.

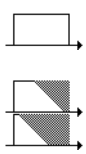
Indicators

On-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale and trigger level. Some readouts use the cursors or the automatic parameter extraction feature (called measure) to display the results of measurements or the status of the instrument.

General Purpose Knob

The general purpose knob can be assigned to adjust a selected parameter function and can quickly change parameters by toggling the **SHIFT** button. Use the same method as for *selecting* a function, except the final selection in the side menu assigns the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the setting for a channels fine gain.

GUI



The user interface also makes use of a Graphical User Interface, or GUI, to make setting functions and interpreting the display more intuitive. Some menus and status are displayed using iconic representations of function settings such as those shown here for full, 100 MHz, and 20 MHz bandwidth. Such icons allow you to more readily determine status or the available settings.

Signal Acquisition System

TDS 620

The signal acquisition system of the TDS 620 Digitizing Oscilloscope provides four full-featured vertical channels, CH 1, CH 2, AUX 1 and AUX 2, with calibrated vertical scale factors from 1 mV to 10 V per division. Any two of the four channels can be acquired simultaneously.

TDS 640

The signal acquisition system of the TDS 640 Digitizing Oscilloscope provides four full-featured vertical channels, CH 1, CH 2, CH 3, and CH 4 with calibrated vertical scale factors from 1 mV to 10 V per division. All four channels can be acquired simultaneously.

Both Models

Each of the four channels can be displayed, vertically positioned, and offset, can have their bandwidth limited (100 MHz or 20 MHz) and their vertical coupling specified. Fine gain can also be adjusted.

Besides the four channels, up to three math waveforms and four reference waveforms are available for display. (A math waveform results when you specify dual waveform operations, such as add, on any two channels; a reference waveform results when you save a live waveform in a reference memory.)

Horizontal System

There are three horizontal display modes: main only, main intensified, and delayed only. You can select among various horizontal record length settings (see Table A-7).

Table A-7: Record Length versus Divisions per Record

Record Length	Divisions per Record (50 Samples/Division)
2000	40 divs
1000	20 divs
500	10 divs

Both the delayed only display and the intensified zone on the main intensified display, may be delayed by time with respect to the main trigger. Both can be set to display immediately after the delay (delayed runs after main mode); the delayed display can also be set to display at the first valid trigger after the delay (delayed-triggerable mode).

The delayed display (or the intensified zone) may also be delayed by a selected number of events. In such a case, the events source is the delayed-trigger source. For any events signal, the delayed-trigger system conditions the signal by determining the source, coupling, etc., of that signal.

Trigger System

The triggering system is comprised of three types of signals for triggering the signal acquisition system:

- **Edge** (main- and delayed-trigger systems): This familiar type of triggering is fully configurable for source, slope, coupling, mode (auto or normal), and holdoff.

- **Logic** (main-trigger system): This type of triggering can be based on pattern (asynchronous) or state (synchronous). In either case, logic triggering is configurable for sources, for boolean operators to apply to those sources, for logic pattern or state on which to trigger, for mode (auto or normal), and for holdoff. Time-qualified logic triggering may be selected in pattern mode.
- **Pulse** (main-trigger system): Pulse triggering is configurable for triggering on runt or glitch pulses, or on pulse widths or periods inside or outside limits that you specify. It is also configurable for source, polarity, mode, and holdoff.

You can choose where the trigger point is located within the acquired waveform record by selecting the amount of pretrigger data displayed. Presets of 20%, 50%, and 80% of pretrigger data can be selected in the horizontal menu, or the general purpose knob can be assigned to set pretrigger data to any value within the 20% to 80% limits.

Acquisition Control

You can specify the mode and manner in which signals are acquired and processed, depending on your measurement requirements:

- You can select the mode for interpolation of points sampled on non-repetitive signals (linear or sin(x)/x). This can increase the apparent sample rate on the waveform when maximum real-time rates are reached.
- Sample, envelope, and average modes can be used to acquire signals.
- The acquisition can be set to stop after a single acquisition (or sequence of acquisitions if acquiring in average or envelope modes), or after a limit condition has been met.

On-Board User Assistance

Using the help and autoset features help you set up this oscilloscope to make your measurements.

Help

Help displays operational information about any front-panel control. When help mode is in effect, manipulating any front-panel control causes the oscilloscope to display information about that control. When help is first invoked, an introduction to help is displayed on screen.

Autoset

Autoset automatically sets up the oscilloscope for a viewable display based on the input signal.

Measurement Assistance

The cursor and measure features can help you quickly make measurements, once you are set up to make measurements.

Cursor

Three types of cursors are provided for making parametric measurements on the displayed waveforms. Horizontal bar cursors (H Bar) measure vertical parameters (typically volts). Vertical bar cursors (V Bar) measure horizontal parameters (typically time or frequency). Paired cursors measure both amplitude and time simultaneously. These are delta measurements; that is, measurements based on the difference between two cursors.

Both H Bar and V Bar cursors can also be used to make absolute measurements. These measurements are relative to a defined level or event. For the H Bars, either cursor can be selected to read out its voltage with respect to any channels ground reference level. For the V Bars, it's time with respect to the trigger point (event) of the acquisition and the cursors can control the portion of the waveform on which automatic measurements are made.

For time measurements, units can be either seconds or Hertz (for 1/time).

Measure

Measure can automatically extract parameters from the signal input to the oscilloscope. Any four out of the more than 20 parameters available can be displayed to the screen. The displayed parameters are extracted continuously and the results updated on-screen as the oscilloscope continues to acquire waveforms.

Digital Signal Processing (DSP)

Tektronix' proprietary digital signal processor, (DSP) is an important component of the multiprocessor architecture of these oscilloscopes. This dedicated processor supports advanced analysis of waveforms when doing such compute-intensive tasks as interpolation, waveform math, and signal averaging. It also teams with a custom display system to deliver specialized display modes. (See *Display*, later in this description.)

Storage and I/O

Acquired waveforms can be saved in any of four nonvolatile reference (REF) memories. Any or all of the saved waveforms can be displayed for comparison with waveforms currently being acquired.

You can choose the source and destination of waveforms to be saved. You can assign any of the four channels to any REF memory, or to move a stored reference from one REF memory to another. Reference waveforms can also be written into a REF memory location via the GPIB interface.

The oscilloscope is fully controllable and capable of sending and receiving waveforms over the GPIB interface (IEEE Std 488.1-1987/IEEE Std 488.2-1987 standard). This feature makes the instrument ideal for making automated measurements in a production or research and development environment that calls for repetitive data taking. Fault detection features, such as self-compensation and self-diagnostic, are built into the oscilloscope to aid in servicing. These features are also accessible using commands sent from a GPIB controller.

Hardcopy is another standard feature. This feature allows you to output waveforms and other on-screen information to a variety of graphic printers and plotters from the oscilloscope front panel. It provides hardcopies, in a variety of popular output formats, such as TIFF, PCX, BMP, and EPS mono or color, without requiring you to put the oscilloscope into a system-controller environment. The hardcopies obtained are based on what is displayed on-screen at the time hardcopy is invoked, and can be stamped with date and time and spooled to a queue for printing at a later time.

Display

The TDS 600 Digitizing Oscilloscopes offer flexible display options. You can customize the following attributes of your display:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence.
- Display format: XY or YT and graticule type.
- Interpolation mode: linear or sin(x)/x.

Zoom

The zoom feature provides an easy way to focus in on those waveform features you wish to examine up close. By invoking zoom, you can expand or compress the waveform parameter using the vertical and horizontal knobs to control the displayed size and position for viewing.

Nominal Traits

This subsection lists the *nominal traits* that describe the TDS 600 Digitizing Oscilloscopes. (Traits that differ according to model or apply only to one model are preceded by the appropriate model number, TDS 620 or TDS 640, in the tables.) Electrical and mechanical traits are included.

Nominal traits are described using simple statements of fact such as "identical" for the trait "Input Channels, Number of," rather than in terms of limits that are performance requirements.

Table A-8: Nominal Traits — Signal Acquisition System

Name	Description	
Bandwidth Selections	20 MHz, 100 MHz, and FULL (500 MHz)	
TDS 620: Samplers, Number of	Two, simultaneous	
TDS 640: Samplers, Number of	Four, simultaneous	
Digitized Bits, Number of	8 bits[1]	
TDS 620: Input Channels, Number of	Four, all identical, called CH 1, CH 2, AUX 1, and AUX 2[2]	
TDS 640: Input Channels, Number of	Four, all identical, called CH 1, CH 2, CH 3, and CH 4[2]	
Input Coupling	DC, AC, or GND	
Input Impedance Selections	1 MΩ or 50 Ω	
Ranges, Offset	**Volts/Div Setting**	**Offset Range**
	1 mV/div–99.5 mV/div	¿ V
	100 mV/div–995 mV/div	¿ V
	1 V/div–10 V/div	¿ V
Range, Position	¿ divisions	
TDS 620: Range, Sensitivity, CH 1, CH 2, AUX 1, and AUX 2	1 mV/div to 10 V/div[3]	
TDS 640: Range, Sensitivity, CH 1, CH 2, CH 3, and CH 4	1 mV/div to 10 V/div[3]	

[1]Displayed vertically with 25 digitization levels (DLs) per division and 10.24 divisions dynamic range with zoom off. A DL is the smallest voltage level change that can be resolved by the 8-bit A-D Converter, with the input scaled to the volts/division setting of the channel used. Expressed as a voltage, a DL is equal to 1/25 of a division times the volts/division setting.

[2]The input characteristics (*Input Coupling, Input Impedance Selections, etc.*) apply to all channels except where otherwise specified.

[3]The sensitivity ranges from 1 mV/div to 10 V/div in a 1–2–5 sequence of coarse settings. Between a pair of adjacent coarse settings, the sensitivity can be finely adjusted. The resolution of such a fine adjustment is 1% of the more sensitive of the pair. For example, between 50 mV/div and 100 mV/div, the volts/division can be set with 0.5 mV resolution.

Table A-9: Nominal Traits — Time Base System

Name	Description
TDS 620: Range, Sample–Rate[1,3]	10 Samples/sec to 2 GSamples/sec on two channels simultaneously
TDS 640: Range, Sample–Rate[1,3]	10 Samples/sec to 2 GSamples/sec on four channels simultaneously
Range, Interpolated Waveform Rate[2,3]	5 GSamples/sec to 100 GSamples/sec (200 ps/Sample to 10 ps/Sample)
Range, Seconds/Division	500 ps/div to 5 s/div
Range, Time Base Delay Time	16 ns to 250 seconds
Record Length	500 samples, 1000 samples, 2000 samples

[1]The range of real-time rates, expressed in samples/second, at which a digitizer samples signals at its inputs and stores the samples in memory to produce a record of time-sequential samples.

[2]The range of waveform rates for interpolated waveform records.

[3]The Waveform Rate (WR) is the equivalent sample rate of a waveform record. For a waveform record acquired by real-time sampling of a single acquisition, the waveform rate is the same as the real-time sample rate; for a waveform created by interpolation of real-time samples from a single acquisition, the waveform rate is faster than the real time sample rate. For both cases, the waveform rate is 1/(Waveform Interval) for the waveform record, where the waveform interval (WI) is the time between the samples in the waveform record.

Table A-10: Nominal Traits — Triggering System

Name	Description	
Range, Delayed Trigger Time Delay	16 ns to 250 seconds	
Range, Events Delay	2 to 10,000,000	
Range (Time) for Pulse-Glitch or Pulse-Width Triggering	2 ns to 1 s	
Ranges, Trigger Level or Threshold	**Source**	**Range**
	Any Channel	¿ screen
	Auxiliary	¿ V
	Line	¿ V

Table A-11: Nominal Traits — Display System

Name	Description
Video Display Resolution	640 pixels horizontally by 480 pixels vertically in a display area of 5.2 inches horizontally by 3.9 inches vertically
Waveform Display Graticule	Single Graticule: 401 × 501 pixels for single, 8 ×10 divisions, where divisions are 1 cm by 1 cm
Waveform Display Grey Scale	Sixteen levels in infinite-persistence and variable-persistence display styles

Table A-12: Nominal Traits —Interfaces, Output Ports, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE Std 488.1-1987 and IEEE Std 488.2-1987
Interface, RS-232 (Option 13 only)	RS-232 interface complies with EIA/TIA 574
Interface, Centronics (Option 13 only)	Centronics interface complies with Centronics interface standard C332-44 Feb 1977, REV A
Logic Polarity for Main- and Delayed-Trigger Outputs	Negative TRUE. High to low transition indicates the trigger occurred
Fuse Rating	Either of two fuses[1] may be used: a .25″ × 1.25″ (UL 198.6, 3AG): 6 A FAST, 250 V, or a 5 mm × 20 mm, (IEC 127): 5 A (T), 250 V

[1]Each fuse type requires its own fuse cap.

Table A-13: Nominal Traits — Mechanical

Name	Description
Cooling Method	Forced-air circulation with no air filter
Construction Material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass laminate. Cabinet is aluminum and is clad in Tektronix Blue vinyl material.
Finish Type	Tektronix Blue vinyl-clad aluminum cabinet

Table A-13: Nominal Traits — Mechanical (Cont.)

Name	Description
Weight	Standard Digitizing Oscilloscope 12.3 kg (27 lbs), with front cover. 20.0 kg (44 lbs), when packaged for domestic shipment Rackmount Digitizing Oscilloscope 12.3 kg (27 lbs) plus weight of rackmount parts, for the rackmounted Digitizing Oscilloscope (Option 1R). 20.5 kg (45 lbs), when the rackmounted Digitizing Oscilloscope is packaged for domestic shipment Rackmount conversion kit 2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), parts plus package for domestic shipping
Overall Dimensions	Standard Digitizing Oscilloscope Height:193 mm (7.6 in), with the feet installed Width: 445 mm (17.5 in), with handle Depth: 434 mm (17.1 in), with front cover installed Rackmount Digitizing Oscilloscope Height: 178 mm (7.0 in) Width: 483 mm (19.0 in) Depth: 558.8 mm (22.0 in)

Warranted Characteristics

This subsection lists the *warranted characteristics* that describe the TDS 600 Digitizing Oscilloscopes. (Characteristics that differ according to model or apply only to one model are preceded by the appropriate model number, TDS 620 or TDS 640.) Electrical and environmental characteristics are included.

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

NOTE

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

Performance Conditions

The electrical characteristics found in these warranted characteristics apply when the oscilloscope has been adjusted at an ambient temperature between +20°C and +30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0°C and +50°C (unless otherwise noted).

Table A-14: Warranted Characteristics — Signal Acquisition System

Name	Description	
Accuracy, DC Gain[3]	¿ .5%. At 1 mV/div ± 2.0%	
Accuracy, DC Voltage Measurement, Averaged[3]	**Measurement Type**	**DC Accuracy**
	Average of ≥16 waveforms	¿ DC Gain × | Reading – Net Offset[1]| + Offset Accuracy + 0.06 div)
	Delta volts between any two averages of ≥16 waveforms[2]	¿ DC Gain × |Reading| + 0.1 div + 0.3 mV)
Accuracy, Offset[3]	**Volts/Div Setting**	**Offset Accuracy**
	1 mV/div – 99.5 mV/div	¿ × |Net Offset[1]| + 1.5 mV + 0.6 div)
	100 mV/div – 995 mV/div	¿ × |Net Offset[1]| + 15 mV + 0.6 div)
	1 V/div – 10 V/div	¿ × |Net Offset[1]| + 150 mV + 0.6 div)

[1]Net Offset = Offset – (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this Voltage level.

[2]The samples must be acquired under the same setup and ambient conditions.

[3]To ensure the most accurate measurements possible, run an SPC calibration first. When using the TDS 620 and/or TDS 640 Digitizing Oscilloscope at a Volts/Div setting of ≤5 mV/div, an SPC calibration should be run once per week to ensure that instrument performance levels meet specifications.

Table A-14: Warranted Characteristics — Signal Acquisition System (Cont.)

Name	Description	
Analog Bandwidth, DC-50 Ω Coupled, or DC-1 MΩ Coupled with P6139A Probe	**Volts/Div**	**Bandwidth[4]**
	5 mV/div – 10 V/div	DC – 500 MHz
	2 mV/div – 4.98 mV/div	DC – 300 MHz
	1 mV/div – 1.99 mV/div	DC – 200 MHz
Cross Talk (Channel Isolation)	≥100:1 at 100 MHz and ≥30:1 at the rated bandwidth for the channels sensitivity setting, for any two channels having equal volts/division settings	
Delay Between Channels, Full Bandwidth	≤250 ps for any two channels with equal volts/division and coupling settings	
Input Impedance, DC-1 MΩ Coupled	1 MΩ [illegible] [illegible] pF	
Input Impedance, DC-50 Ω Coupled	50 Ω [illegible] ≤1.3:1 from DC – 500 MHz	
Input Voltage, Maximum, DC-1 MΩ, AC-1 MΩ, or GND Coupled	[illegible] MHz	
Input Voltage, Maximum, DC-50 Ω or AC-50 Ω Coupled	5 V rms, with peaks ≤[illegible] V	
Lower Frequency Limit, AC Coupled	≤10 Hz when AC–1 MΩ Coupled; ≤200 kHz when AC-50 Ω Coupled[5]	

[4]The limits given are for the ambient temperature range of 0°C to +30°C. Reduce the upper bandwidth frequencies by 2.5 MHz for each °C above +30°C.

[5]The AC Coupled Lower Frequency Limits are reduced by a factor of 10, when 10X passive probes are used.

Table A-15: Warranted Characteristics — Time Base System

Name	Description	
Accuracy, Long Term Sample Rate and Delay Time	[illegible] 00 ppm over any ≥1 ms interval	
Accuracy, Delta Time Measurement	**Conditions**	**Time Measurement Accuracy[1,2]**
	Single Shot, Sample Mode, 100 MHz Bandwidth selected	[illegible] (1 WI + 100 ppm × |Reading| + 500 ps)
	Single Shot, Sample Mode, 20 MHz Bandwidth selected	[illegible] (1 WI + 100 ppm × |Reading| + 1.3 ns)
	Repetitive, ≥ 8 Averages, Full Bandwidth selected	[illegible] (1 WI + 100 ppm × |Reading| + 200 ps)

[1]For input signals ≥ 5 divisions in amplitude and a slew rate of ≥ 2.0 divisions/ns at the delta time measurement points. Signal must have been acquired at a volts/division setting of ≥ 5 mV/division.

[2]The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range or Interpolated Waveform Rates* in Table A-9, on page A-14.

Table A-16: Warranted Characteristics — Triggering System

Name	Description		
Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering	**Time Range**	**Accuracy**	
	2 ns to 1 µs	¿ × | Setting | + 0.5 ns)	
	1.02 µs to 1 s	¿ × | Setting |)	
Accuracy, Trigger Level or Threshold, DC Coupled[2]	**Trigger Source**	**Accuracy**	
	Any Channel	¿ × | Setting – Net Offset[1]| + 0.2 div × Volts/div Setting + Offset Accuracy)	
	Auxiliary	¿ × | Setting | + 8% of p-p signal + 100 mV)	
Sensitivity, Edge-Type Trigger, DC Coupled[3]	**Trigger Source**	**Sensitivity**	
	Any Channel	0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz	
	Auxiliary	0.25 volts from DC to 50 MHz	
Width, Minimum Pulse and Rearm, for Pulse-Type Triggering	**Pulse Class**	**Minimum Pulse Width**	**Minimum Rearm Width**
	Glitch	2 ns	2 ns + 5% of Glitch Width Setting
	Runt	2.5 ns	2.5 ns
	Width	2 ns	2 ns + 5% of Width Upper Limit Setting

[1]Net Offset = Offset – (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

[2]Valid for signals having rise and fall times ≥ 20 ns.

[3]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 A-17: Warranted Characteristics — Output Ports, Probe Compensator, and Power Requirements

Name	Description	
Logic Levels, Main- and Delayed-Trigger Outputs	**Characteristic**	**Limits**
	Vout (HI)	≥2.5 V open circuit; ≥1.0 V into a 50 Ω load to ground
	Vout (LO)	≤0.7 V into a load of ≤4 mA; ≤0.25 V into a 50 Ω load to ground
Output Voltage and Frequency, Probe Compensator	**Characteristic**	**Limits**
	Voltage	0.5 V (base-top) ¿ ≥ 50 Ω load
	Frequency	1 kHz ¿
Output Voltage, Signal Out[1]	20 mV/division ¿ into a 1 MΩ load; 10 mV/division ¿ 50 Ω load	
Source Voltage	90 to 250 VAC rms, continuous range	
Source Frequency	47 Hz to 63 Hz	
Power Consumption	≤300 W (450 VA)	

[1]CH 3 (AUX 1 for TDS 620) signal out is only present at the rear panel if CH 3 (AUX 1) is selected as the trigger source for the main and/or delayed trigger systems.

Table A-18: Warranted Characteristics — Environmental

Name	Description
Atmospherics	Temperature: 0°C to +50°C, operating; –40°C to +75°C, non-operating Relative humidity: 0 to 95%, at or below +40°C; 0 to 75%, from +41°C to 50°C Altitude: To 15,000 ft. (4570 m), operating; to 40,000 ft. (12,190 m), non-operating
Dynamics	Random vibration: 0.31 g rms, from 5 to 500 Hz, 10 minutes each axis, operating; 3.04 g rms, from 5 to 500 Hz, 10 minutes each axis, non-operating
Emissions	Meets or exceeds the EMC requirements of the following standards: MIL-STD-461C CE-03, part 4, curve #1, RE-02, part 7 VDE 0871, Category B FCC Rules and Regulations, Part 15, Subpart B, Class A
User-Misuse Simulation	Electrostatic Discharge Susceptibility: Up to 8 kV with no change to control settings or impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation by the user

Typical Characteristics

This subsection lists the *typical characteristics* which describe the TDS 600 Digitizing Oscilloscopes. (Characteristics that differ according to model or apply only to one model are preceded by the appropriate model number, TDS 620 or TDS 640, in the tables.)

Typical characteristics are described in terms of typical or average performance. Typical characteristics are *not* warranted.

Table A-19: Typical Characteristics — Signal Acquisition System

Name	Description				
Accuracy, DC Voltage Measurement, Not Averaged	**Measurement Type**		**DC Accuracy**		
	Any Sample		±(1.5% × | Reading – Net Offset[1] | + Offset Accuracy + 0.13 div + 0.6 mV)		
	Delta Volts between any two samples[2]		±(1.5% × | Reading | + 0.26 div + 1.2 mV)		
Frequency Limit, Upper, 100 MHz Bandwidth Limited	100 MHz				
Frequency Limit, Upper, 20 MHz Bandwidth Limited	20 MHz				
Calculated Rise Time[3]	**Volts/Div Setting**		**Calculated Rise Time[3]**		
	5 mV/div–10 V/div		800 ps		
	2 mV/div–4.98 mV/div		1.3 ns		
	1 mV/div–1.99 mV/div		2.0 ns		
Step Response Settling Errors	**Volts/Div Setting**	**± Step Response**	**Settling Error (%)[4] at**		
			20 ns	**100 ns**	**20 ms**
	1 mV/div – 99.5 mV/div	≤2 V	≤0.5	≤0.2	≤0.1
	100 mV/div – 995 mV/div	≤20 V	≤1.0	≤0.5	≤0.2
	1 V/div – 10 V/div	≤200 V	≤1.0	≤0.5	≤0.2

[1]Net Offset = Offset – (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

[2]The samples must be acquired under the same setup and ambient conditions.

[3]The numbers given are valid 0°C to +30°C and will increase as the temperature increases due to the degradation in bandwidth. Rise time is calculated from the bandwidth. It is defined by the following formula:

$$Rise\ \ Time\ \ (ns) = \frac{400}{BW\ \ (MHz)}$$

Note that if you measure rise time, you must take into account the rise time of the test equipment (signal source, etc.) that you use to provide the test signal. That is, the measured rise time (RT_m) is determined by the instrument rise time (RT_i) and the rise time of the test signal source (RTgen) according to the following formula:

$$RT_m{}^2 = RT_i{}^2 + RT_{gen}{}^2$$

[4]The values given are the maximum absolute difference between the value at the end of a specified time interval after the mid-level crossing of the step, and the value one second after the mid-level crossing of the step, expressed as a percentage of the step amplitude.

Table A-20: Typical Characteristics — Triggering System

Name	Description	
Input, Auxiliary Trigger	The input resistance is ≥1.5 kΩ; the maximum safe input voltage is ¿ AC).	
Error, Trigger Position, Edge Triggering	**Acquisition Mode**	**Trigger-Position Error[1,2]**
	Sample, Average	¿ WI + 1 ns)
	Envelope	¿ ns)
Holdoff, Variable, Main Trigger	Minimum: For any horizontal scale setting, the *minimum* holdoff for a 1x or 5x setting is 10 times that setting, but is never shorter than 1 μs or longer than 5 s. The *minimum* holdoff for a 2.5x setting is 8 times that setting. Maximum: For any horizontal scale setting, the *maximum* holdoff is at least 2 times the minimum holdoff for that setting, but is never longer than 10 times the minimum holdoff for that setting.	
Lowest Frequency for Successful Operation of “Set Level to 50%” Function	50 Hz	
Sensitivity, Edge-Type Trigger, Not DC Coupled[3]	**Trigger Source**	**Typical Signal Level for Stable Triggering**
	AC	Same as the DC-coupled limits for frequencies above 60 Hz. Attenuates signals below 60 Hz.
	Noise Reject	Three and one-half times the DC-coupled limits.
	High Frequency Reject	One and one-half times the DC-coupled limits from DC to 30 kHz. Attenuates signals above 30 kHz.
	Low Frequency Reject	One and one-half times the DC-coupled limits for frequencies above 80 kHz. Attenuates signals below 80 kHz.

[1]The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of ≥ 2 division/ns.

[2]The waveform interval (WI) is the time between the samples in the waveform record. Also, see the footnote for the characteristics *Sample Rate Range or Interpolated Waveform Rates* in Table A-9, on page A-14.

[3]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 A-20: Typical Characteristics — Triggering System (Cont.)

Name	Description
Sensitivities, Logic-Type Trigger/Pulse Trigger/Events Delay, DC Coupled[4]	1.0 division, from DC to 100 MHz with a minimum slew rate of 25 divs/μs at the trigger level or the threshold crossing.
Sensitivities, Pulse-Type Runt Trigger[5]	1.0 division, from DC to 200 MHz with a minimum slew rate of 25 divs/μs at the trigger level or the threshold crossing.
Sensitivities, Pulse-Type Trigger Width and Glitch[6]	1.0 division, with a minimum slew rate of 25 divs/μs at the trigger level or the threshold crossing. For <5 nsec pulse width or rearm time, 2 divisions are required.
Width, Minimum Pulse and Rearm, for Logic-Type Triggering or Events Delay[7]	5 ns

[4]The minimum signal levels required for stable logic or pulse triggering of an acquisition, or for stable counting of a DC-coupled, events-delay signal. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

[5]The minimum signal levels required for stable runt pulse triggering of an acquisition. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

[6]The minimum signal levels required for stable pulse width or glitch triggering of an acquisition. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

[7]The minimum pulse width and rearm width required for logic-type triggering or events delaying to occur.

Table A-21: Typical Characteristics — Data Handling and Reliability

Name	Description
Time, Data-Retention, Nonvolatile Memory[1,2]	5 years

[1]The times that reference waveforms, stored setups, and calibration constants are retained when there is no power to the oscilloscope.

[2]Data is maintained by small lithium-thionyl-chloride batteries internal to the memory ICs. The amount of lithium is so small in these ICs that they can typically be safely disposed of with ordinary garbage in a sanitary landfill.