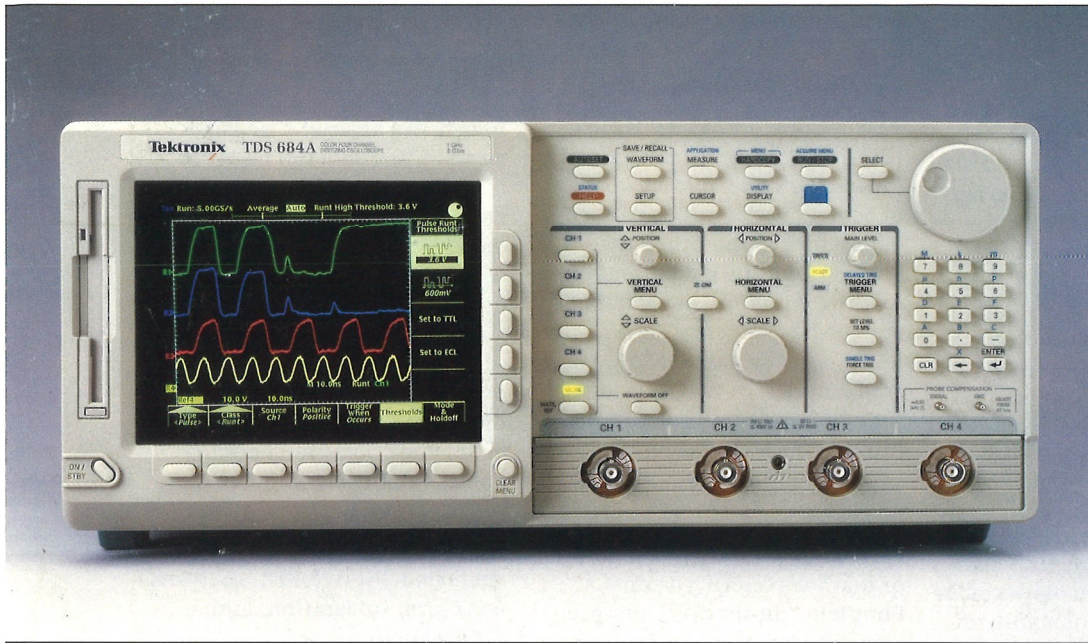# Tektronix

TDS 684A
1 GHz Digital Real-Time Oscilloscope

5 GS/s sampling on four channels combined with powerful logic, runt, slew rate, setup/hold time violation and pulse width triggering makes the TDS 684A ideal for design and debug of today's higher speed digital systems. The TDS 684A has a high-resolution color monitor and 3.5" floppy disk drive. Full bandwidth low-loading probes optimized for SMD probing are available as an option. A powerful HDTV video trigger option is also available.

1 GHz bandwidth	**Tek TriStar™ (DSP) processor for fast waveform processing and live measurement updates**
5 GS/s sample rate on four channels	
4 input channels	
Slew rate, setup & hold, pulse width, 2 ns glitch, runt, pattern and state triggering	**Advanced signal processing functions**
1 mV/div -10 V/div sensitivity	**Waveform pass/ fail testing**
Infinite and variable persistence with color grading	**25 automatic measurements**
	Full GPIB programmability
15,000 point record length per channel	**Desktop publishing outputs**
8-bit vertical resolution	**HDTV Video trigger option**
High resolution color monitor	**1 GHz, 1 pF, 1 MΩ probe option**
3.5" DOS floppy disk drive	**VGA output**
1.5% vertical accuracy	**3 year warranty**

The TDS 684A is the world's first 1 GHz Digital Real-Time (DRT) oscilloscope. It was developed to keep up with the high-bandwidth single-shot needs of today's digital system designs and advanced research.

Like the other members of the TDS Series, the TDS 684A has a well-rounded combination of high-fidelity acquisition, advanced triggering, high-speed signal processing, graphical user interface, sophisticated documentation capabilities, and complementary probing.

High-fidelity acquisition

The TDS 684A is able to provide DRT (Digital Real Time) acquisition because its 5 GS/s sample rate is five times the bandwidth. This makes it possible to accurately display 1 GHz single-shot events and make timing measurements with better than 50 ps accuracy. With DRT acquisition, it is no longer necessary to use repetitive sampling techniques to attain full bandwidth performance.

Moreover, TDS 684A's powerful DRT acquisition comes without compromise. The TDS 684A also provides wide dynamic range, flat response, 8-bit vertical resolution, fast overdrive recovery, calibrated DC offset, 1 mV/div sensitivity, and internal calibration.

Powerful and flexible triggering

The TDS 684A introduces two new trigger types to help debug digital system designs. The Setup & Hold Time Violation trigger captures flip-flop timing problems, and the Slew Rate trigger catches pulse edge rates that are either faster or slower than desired. The TDS 684A also has a full complement of extended triggering functions including Pulse Width, four-input Logic State and Pattern, Glitch, and Runt. A powerful video trigger, available as an option, provides individual field and line triggering on all popular formats including HDTV. Icons illustrate functions to facilitate learning and operation of these advanced trigger types.

Multiprocessor architecture

The TDS 684A uses three microprocessors, including a Tek TriStar™ digital signal processor and a powerful proprietary display processor, to provide the power for waveform math, high-speed averaging, automatic limit testing, live measurements, and variable persistence display.

Easy-to-learn and easy-to-use

Extensive user interface design has made the TDS family of products truly intuitive. They share a familiar front panel layout with dedicated vertical, horizontal and trigger controls. A graphical user interface with icons helps facilitate understanding and use of TDS advanced capabilities. The TDS 684A's color monitor enables the user to rapidly distinguish multiple waveforms and measurements. On-line help provides a convenient built-in reference manual.

Sophisticated documentation

The TDS 684A provides several ways to easily document waveform data. Screen displays can be saved in a number of standard desktop publishing formats to the internal 3.5" DOS format floppy disk drive which can be transferred to a PC for import into word processing applications. Hardcopies can be made directly to monochrome or color printers connected to either the GPIB, RS-232, or Centronics ports. Waveforms saved to disk can even be translated to raw data in spreadsheet or ASCII format with the available CNVRTWFM utility software.

Complementary probing solution

The optional P6245 1 GHz active probe was designed specifically for the TDS 684A. It is capable of achieving the full 1 GHz scope bandwidth at the probe tip while providing exceptional low loading with 1 pF capacitance and 1 MΩ resistance. The P6245's revolutionary low-mass compact design makes it ideal for hands-free probing of fine pitch surface mount devices.

Unique and advanced performance features include:

Limit testing. Compares incoming or math waveforms against a template "on-the-fly," stopping acquisition, saving to floppy disk, or automatically printing the waveform whenever it violates the template. Templates can be easily created on-board by specifying waveform tolerances or down-loaded over the GPIB or floppy disk and saved in non-volatile waveform memories or on floppy disk.

Color-graded variable persistence. TDS 684A provides historical information by color grading samples as they are acquired over time.

Twenty five automatic measurements. Eliminate the need for division counting and manual cursor setup measurements. Icons in the measurement menu clearly illustrate what each measurement does. In addition, measurement "gating" allows the user to select a specific part of a waveform for measurement. Live measurements make it easy to see the effects of changing circuit conditions.

Advanced signal processing. The TDS 684A provides waveform analysis with live FFT analysis, waveform integration, and differentiation.
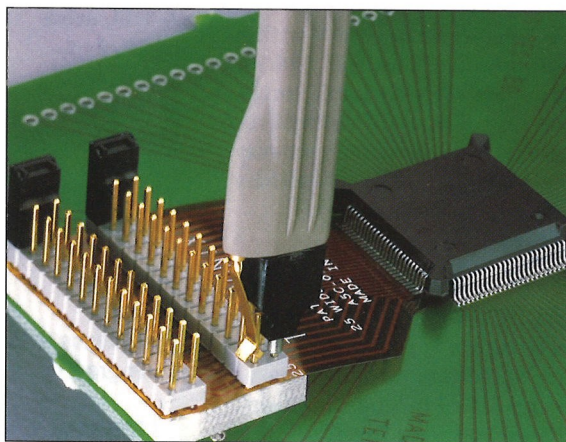
The optional P6245 probe allows for hands-free probing of fine line surface mount devices. Its 1 GHz, 1 pF, 1 MΩ performance makes it an excellent match for the TDS 684A.
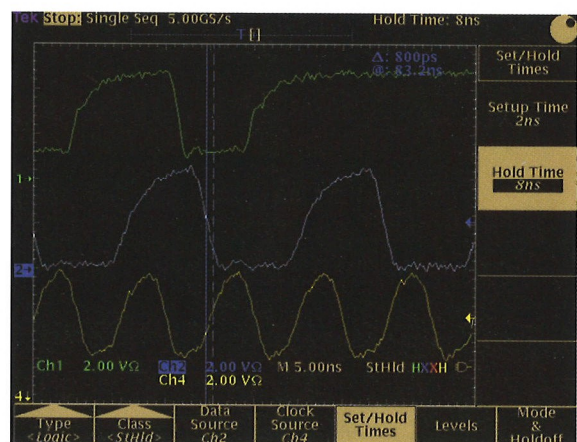
Setup & Hold Time Violation trigger quickly captures timing problems in high-speed digital systems. The color display makes complex signals easy to read.

TDS 684A Electrical Characteristics

Bandwidth — 1 GHz[1].

Channels — 4.

Samplers — 4.

Maximum Sample Rate — 5 GS/s.

Sensitivity — 1 mV to 10 V/div.

Position Range — ±5 divisions.

Offset —
±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.

Vertical System

DC Gain Accuracy — ±1.5%.

Vertical Resolution — 8 bits (256 levels over 10.24 vertical divisions).

Analog Bandwidth Selections — 20 MHz, 250 MHz, and full.

Input Coupling — AC, DC or GND.

Input Impedance Selections — 1 MΩ in parallel with 10 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage — ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 MΩ or GND coupled.

Channel Isolation — >100:1 at 100 MHz and >30:1 at the rated bandwidth for any two channels having equal Volts/div settings.

AC Coupled Low Frequency Limit — ≤ 10 Hz when AC 1 MΩ coupled. ≤ 200 kHz when AC 50 Ω coupled.

Time Base System

Time Bases — Main, Delayed.

Time/Division Range — 200 ps to 10 s/div. 4 ps to 200 s/div. with fit-to-screen or zoom.

Time Base Accuracy — ±100 ppm over any interval ≥ 1 ms.

Record Length — 500 to 15,000 pts.

Pre-Trigger Position — 0% to 90% of record.

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.

PULSE (main) —

WIDTH — Trigger on width of positive or negative pulse either within or not within selectable time limits. Time limits settable from 2 ns to 1 s.

GLITCH — Trigger on (or reject) glitches of positive, negative or either polarity. Minimum glitch width is 2.0 ns, 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. Can be time qualified.

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

LOGIC (main) —

PATTERN — Specifies a logical combination (AND, OR, NAND, NOR) of the four input channels (Hi, Lo, Don't Care). Trigger when pattern stays True or False for user specified time.

STATE — Any logical pattern of channels 1, 2 and 3 plus clock edge on channel 4. Triggerable on positive or negative clock edge.

SETUP & HOLD — Trigger on violations of both setup time and hold time between clock and data which are on separate input channels.

Video (Optional) NTSC, PAL, HDTV, FlexFormat™ — Trigger on a particular line of individual, odd/even, or all fields. Trigger on a specific pixel of a line by using video trigger with delay by events. Choose horizontal sync polarity. Choose from popular HDTV formats (1125/60, 1050/60, 1250/50, 787.5/60) or use FlexFormat™ for other HDTV-type formats by defining frame rep rate, number of lines and fields, and sync timing structure.

Triggering System

Triggers — Main, 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 10,000,000 events.

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

Display

Waveform Style — Dots, vectors, variable persistence selectable from 250 ms to 10 S, infinite persistence, and intensified samples.

Color — Standard palettes and user definable colors 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.

Fit to Screen — Entire acquisition memory displayed on screen.

[1] 50 Ω; 1 mV/div: 500 MHz, 2 mV/div: 600 MHz, 5 mV/div: 900 MHz. Reduce the upper bandwidth frequencies by 5 MHz for each °C above 30°C.

Zoom

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 Average acquisition mode, Zoom provides an effective vertical dynamic range of 1000 divisions.

Measurement System

Automatic waveform measurements —

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty cycle	– Duty cycle
+ Overshoot	– Overshoot
Propagation delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	

Continuous update of up to four measurements on any combination of waveforms.

Thresholds — Settable in percentage or voltage.

Gated — Any region of the record may be isolated for measurement.

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

Cursor Measurements — Absolute, Delta; Volts, Time, Frequency. NTSC IRE and Line Number with video trigger option.

Time Measurement Accuracy — <50 ps typical.

Cursor Types — Horizontal bars (volts); Vertical bars (time); operated independently or in tracking mode.

Waveform Processing

Waveform Functions — Interpolate (selectable between sin(x)/x or linear), Average, Envelope.

Advanced Waveform Functions — FFT, Integration, Differentiation.

Arithmetic Operators — Add, Subtract, Multiply, Divide, Invert.

Autosetup — Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

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

Computer Interface

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

Hardcopy

Printer — HPThinkjet, Epson, Interleaf, Deskjet, Laserjet, PostScript, TIFF, PCX, BMP (Microsoft Windows), DPU 411/412, RLE.

Plotter — HPGL.

Interface — GPIB, Centronics, and RS-232.

Storage

Waveforms — Four 15,000 point records.

Setups — 10 front panel setups.

Floppy Drive — Store reference waveforms, setups, and image files on 3.5" 1.44 MByte or 720 KByte DOS format floppy disk.

CRT

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

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

Power Requirements

Line Voltage Range — 90 to 250 V RMS.

Line Frequency — 45 - 440 Hz.

Power Consumption — 300 Watts max.

Environmental and Safety

Temperature —
Operating —
+4°C to +45°C (floppy not used).
+10°C to +45°C (floppy in use).
Nonoperating — –22°C to +60°C.

Humidity—
Operating (floppy not used) —
To 80% RH at ≤32°C.
Derates to 30% RH at +45°C.

Operating (floppy in use) —
To 80% RH at ≤32°C.
Derates to 30% RH at +45°C.

Nonoperating —
To 90% RH at ≤40°C.
Derates to 30% RH at +60°C.

Altitude —
Operating — 15,000 ft.
Nonoperating — 40,000 ft.

Electromagnetic Compatibility — Meets or exceeds Vfg. 243/1991 amended per Vfg. 46/1992; FCC 47 CFR, Part 15, Subpart B, Class A; EN 50081-1; and EN 50082-1.

Safety — Listed UL 1244; CSA – C22 No. 23; Tektronix self-certification to comply with IEC 348 recommendations.
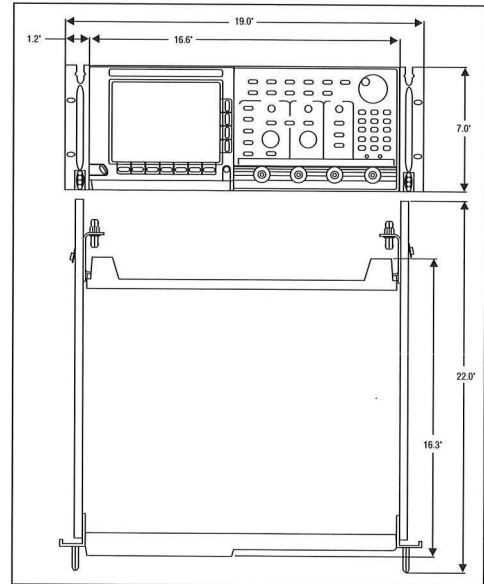
Physical Characteristics

Weight —
Net — Approximately 14.1 kg (31 lb).
Shipping — Approximately 25.4 kg (56 lb).

Dimensions —
Height — 193 mm (7.6 in.) with feet;
178 mm (7.0 in.) without feet.
Width — 445 mm (17.5 in.) with handle.
Depth — 432 mm (17.0 in) with front
cover installed.

Ordering Information

TDS 684A
Digitizing
Oscilloscope

Standard Accessories

070-8999-00 — Reference Manual.

070-8991-00 — User Manual.

070-8709-04 — Programmer Manual.

200-3696-00 — Front Cover.

161-0230-01 — U.S. Power Cord.

Instrument Options

Option 05 — Add Video Trigger; NTSC,
PAL, HDTV, FlexFormat™.

Option 1K — K420 scope cart without
power strip.

Option 1R — Rack Mount.

Option 2P — Tektronix Phaser 200e
thermal wax transfer color printer.

Option 9C — NIST and MIL-STD-45662A
Calibration Certificate.

Option 24 — Add 4 ea P6245 1 GHz active
probes.

Option 26 — Add 4 ea P6139A 500 MHz
passive probes.

Option M2 — Extends warranty coverage
through the first five years of product
ownership

Option M3 — Extends warranty coverage
through the first five years of product
ownership and provides 4 ea calibrations;
one each in years two, three, four, and five.

Option M8 — Provides 4 each calibrations;
one each in years two, three, four, and five.

Probes

P6139A — 500 MHz Passive Probe.

P6204 — 1 GHz FET Probe.

P6205 — 750 MHz FET Probe.

P6245 — 1 GHz FET Probe.

P6408 — TTL Logic Probe.

P6563AS — 4 SMD Probes.

P6711 — 500 nm to 950 nm optical
converter.

P6713 — 1100 nm to 1700 nm optical
converter.

P6009A — High Voltage Probe.

AM 503S — DC/AC Current Probe System*.

Recommended Accessories

016-0909-01 — Soft-sided Carrying Case.

016-1135-00 — Hard-sided Transit Case.

Software

S45F030 — EZ TEST Program Generator.

S3FT400 — WaveWriter; AWG and
waveform creation.

S3FT001 — Tek TMS; Test Management
System.

S3FG910 — Labwindows.

Cables

012-1298-00 — RS232.

012-1250-00 — Centronics.

012-0991-01 — GPIB (1 meter).

012-0991-00 — GPIB (2 meters).

International Power Options

Option A1 — Universal Euro. 220 V, 50 Hz.

Option A2 — UK 240 V, 50 Hz.

Option A3 — Australian 240 V, 50 Hz.

Option A4 — North American 240 V, 60 Hz.

Option A5 — Switzerland 220 V, 50 Hz.

*International power options required on instruments and selected accessories for
operation outside U.S.
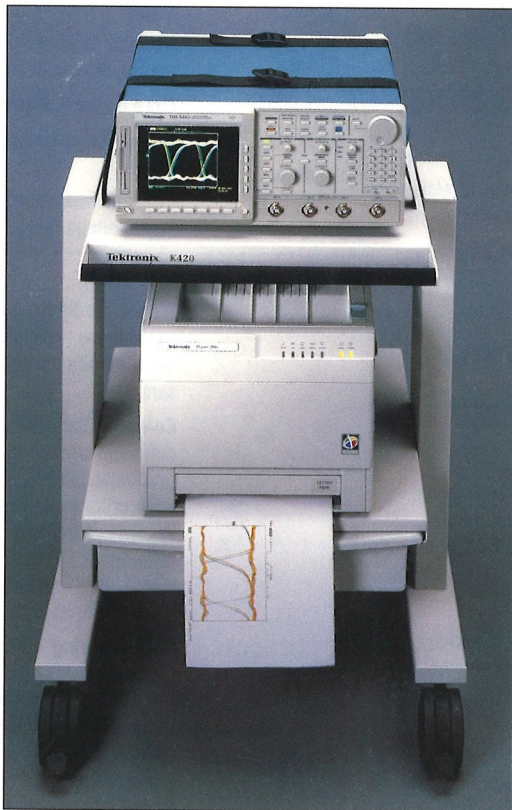
Warranty Information

Three years warranty, covering all labor
and parts, including CRT, but excluding
probes.

The TDS Family of Digitizing Oscilloscopes

In addition to the TDS 500A and TDS 600A Series, the Tektronix TDS family of digitizing oscilloscopes includes the:

- TDS 400 Series with two or four channels at 100 MS/s and 150 MHz to 350 MHz bandwidth for electronic and electro-mechanical design applications.

- TDS 820 with 8 GHz bandwidth and 0.4 ps timing resolution for cost effective device characterization and telecommunications installation and manufacturing applications.

Choose from a broad selection of accessories including the Phaser 200e color printer and the K420 cart.

3/94 FLG4914/DG 25M   55W-10065-0

Tektronix