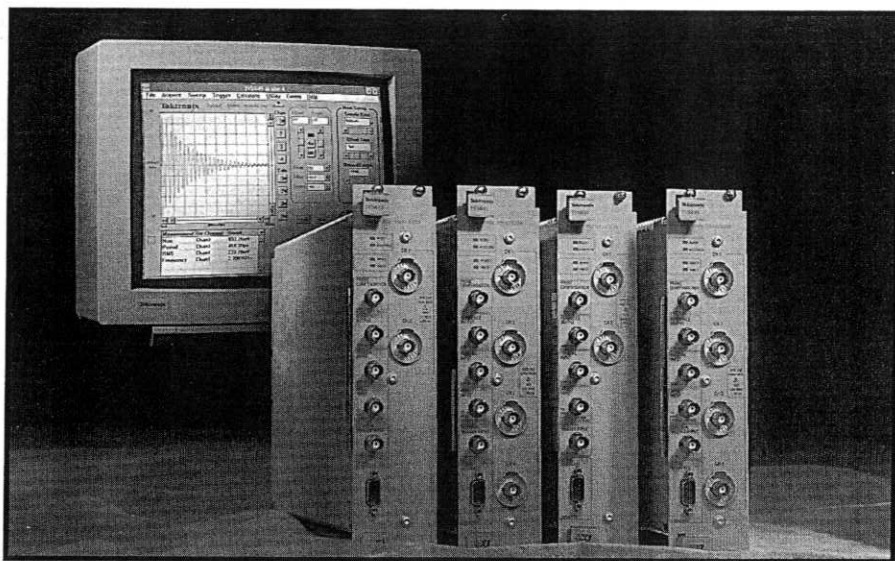# VXI Waveform Analyzers
TVS621A • TVS625A • TVS641A • TVS645A

⭐ Features

- 1 GHz or 250MHz Bandwidth
- 5 GS/s or 1 GS/s Sample Rate
- 2 or 4 Channels
- 15 K Record Length
- Peak Detect Acquisition Mode
- Integrated DSP
- Extensive Processing and Measurement System
- Waveform Template Test
- Measurement Limit Testing
- Zoned Waveform Measurements
- FFT and Digital Filtering (high-, low-, band-pass and band reject)
- SCPI Message Based
- Fast Data Channel
- VXI*plug&play* WIN, WIN95 & WINNT Frameworks

Ⓐ Applications

- High Performance ATE Systems
- Analog and Mixed-signal Testing
- Template/Mask Compliance Testing
- Device Characterization
- Multi-channel Data Collection
- Research in High Speed Phenomena

See Tektronix on the World Wide Web:
http://www.tek.com

CE

For product detail, request a VXI CD-ROM Catalog by completing the business reply card in the back of this catalog.

TVS600A Series of Waveform Analyzers.

TVS600A Series Waveform Analyzers

HIGH PERFORMANCE INSTRUMENTS

The TVS600A-series combines leading edge digital oscilloscope technology with extensive processing and analysis capabilities, all in a compact VXI instrument. The modules readily address mixed signal test applications as well as rigorous characterization and research requirements. Built-in DSP and a rich portfolio of waveform processing and analysis functions rapidly reduce raw data to answers. Onboard waveform template and mask testing efficiently evaluates entire waveforms for compliance. Measurement limit testing may also be performed within the instrument directing the system controller with simple pass-fail indications.

Individual instruments may be selected by bandwidth and channel count while overall analysis functions and command set remain common. Thus, users may establish a core test resource that easily adapts to future requirements for greater speed or higher channel density.

SIGNAL ACQUISITION SYSTEM

Digital Real-Time™ acquisition technology delivers simultaneous single-shot capture on four channels at rates up to 5 GS/s. Input features include 1 GHz bandwidth, sensitivity from 10 mV to 100 V full scale, 50 Ω or 1 MΩ impedance and TEKPROBE® BNC Interfaces to support passive, active, differential voltage and current probes as well as O/E converters.

Single-shot acquisition can be used for transient events or minimum capture time. Signal averaging can be applied to reduce noise on repetitive signals.

Peak detect mode recognizes events as narrow as 1ns anywhere within the sample interval and records their occurrence even at very low sample rates. This can be used to efficiently detect high frequency events while observing long time windows.

Auto-advance mode captures a sequence of transient events into discrete memory segments. The trigger time of each event is recorded and measurements can be made automatically across all events. This technique can be used to rapidly accumulate an ensemble of waveforms, extract several measurements (e.g., amplitude, risetime, width) and report their statistics (min, max, mean, st. dev.) while retaining individual trace data.

SOPHISTICATED TIMEBASE & TRIGGERS

The trigger and timebase systems provide sophisticated control over waveform acquisition. The TVS600A contain both main and delayed timebases. Acquisition can be held off by time delay from main, by counting events or a combination. This can maximize throughput by selectively digitizing only the portion of signal necessary. The trig-to-trig time measurement function returns the time between main- and delayed-timebase triggers providing a fast, accurate time measurement function.

VXI Waveform Analyzers
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The TVS600A includes the sophisticated logic trigger system found in Tektronix high performance oscilloscopes. Pulse width, slew rate and edge-to-edge timing can be used to discriminate events for triggering. Logic states and patterns may also be designated. This system can efficiently detect missing pulses, runt pulses, glitches, setup or hold time violations and other anomalous events at hardware speeds.

EXTENSIVE PROCESSING & ANALYSIS

TVS600A waveform analyzers include on-board DSP, a sophisticated calculation expression system and an extensive function library to efficiently perform waveform processing and analysis.

Signal processing functions include waveform arithmetic, digital filtering and FFT. Arithmetic may be used to produce a power trace from voltage and current inputs or subtract a live trace from a stored reference. Digital low-pass, high-pass, band-pass or band reject filtering with user-specified frequencies and attenuations is included. This can dramatically improve the signal-to-noise ratio and increase measurement resolution and stability. Windowing functions and the FFT provide transformation to the frequency domain for spectral analysis.

MEASUREMENT & CALCULATION SYSTEM

Over thirty measurement functions can be applied to reduce waveforms to scalar results. Measurements may be limited to specific regions allowing complex waveforms to be acquired once, followed by several measurements on different regions.

Calculation expressions may include both waveform data and measured values, facilitating complex analysis. For example, the mean value of a trace can be measured and subtracted prior to integrating the trace and measuring the resulting maximum value. This flexibility improves test throughput by allowing substantial data reduction within the instrument and without system controller interaction.

MEASUREMENT LIMIT COMPARISON

Further efficiency may be gained through on-board comparison to limits. Measurement functions can be tested against limits and reduced to a true/false indication. Results of several comparisons can be logically combined. For example, indicate TRUE if width is <1us or >5us, OR if amplitude is <4.9 V or >5.1 V.
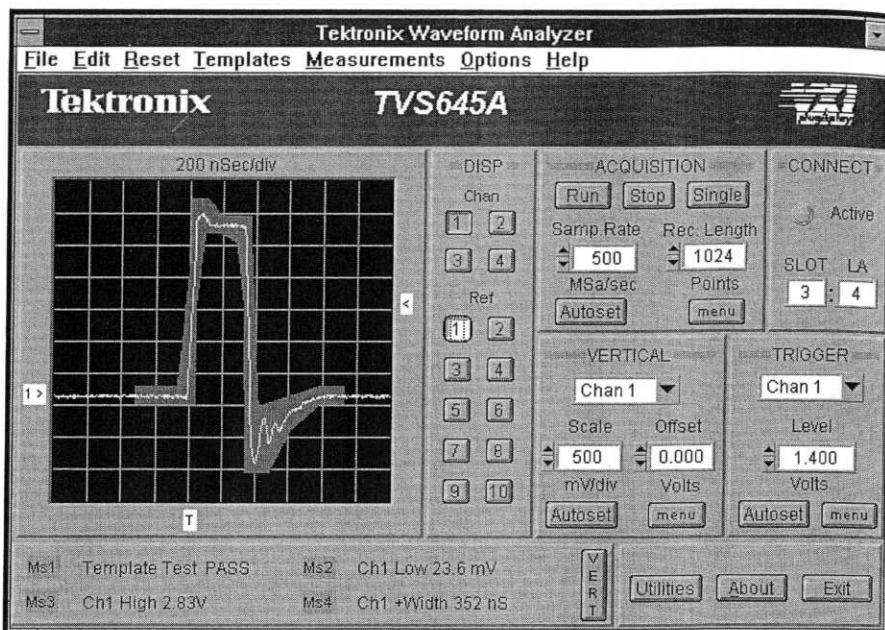
VXIplug&play soft front panel application for WIN, WIN95, WINNT frameworks.

TEMPLATE & MASK TESTING

Entire waveforms can be tested against reference templates or masks. Templates consist of a max/min pair for each trace point to be tested while masks contain one or more two-dimensional regions of interest. The calculation system can be used to measure and rescale live traces or templates prior to comparison and time-alignment may also be accomplished within the instrument. Template and mask violations can be qualified on number of points out (in) or consecutive points out (in) to provide noise immunity. The user may also apply signal averaging, smoothing or digital filtering to improve the signal-to-noise ratio prior to comparison, maximizing test stability.

SYSTEM-CAPABLE INSTRUMENT

Several event-reporting and instrument synchronization features offer advantages to the VXI system-builder. The calculation system can report logical results of its testing by asserting Service Request (SRQ), initiating a VXI Event, issuing a trigger on the VXI backplane or reporting status in response to a query. Conversely, TTL or ECL trigger events can be used to arm and trigger the module.

The TVS600A command set is an extension of SCPI and includes enhancements such as Fast Data Channel protocol for high speed waveform transfers.

VXIplug&play INSTRUMENTATION

The TVS600A-series is fully compliant with the VXIplug&play WIN, WIN95 and WINNT frameworks. The hierarchical instrument driver provides access to all features of the instrument while grouping functions for ease of integration. Both 16-Bit and 32-Bit versions of the driver are included.

The soft front panel application provides a familiar interface for most commonly used instrument features. Autoset functions within the instrument and soft front panel simplify setup with new signals. Readout for up to four measurements is included and limit testing may be enabled for each. Waveform templates can be extracted from "golden waveforms" or downloaded. Templates can be adjusted prior to testing and failure criteria specified such as consecutive points outside.

VXI Waveform Analyzers
TVS621A • TVS625A • TVS641A • TVS645A

Characteristics

VERTICAL

Input Channels – Single-ended TEKPROBE® BNC Interfaces supporting Active, Passive, and Optical Probes. Multichannel acquisitions are acquired simultaneously.
TVS645A: 4 acquisition channels
TVS641A: 4 acquisition channels
TVS625A: 2 acquisition channels
TVS621A: 2 acquisition channels

Bandwidth – DC coupled.

TVS645A and TVS625A:

Full Scale Input	Bandwidth
100 mV to 10 V	DC to 1 GHz
50 mV to 99.5 mV	DC to 750 MHz
20 mV to 49.8 mV	DC to 600 MHz
10 mV to 19.9 mV	DC to 500 MHz
10.1 V to 100 V	DC to 500 MHz

TVS641A and TVS621A:

Full Scale Input	Bandwidth
10 mV to 100 V	DC to 250 MHz

Input Ranges – 10 mV to 100 V full scale in 1400 steps.

Vertical Resolution – 8 bits (256 digitized levels) Resolution can be increased with averaging or signal processing.

Input DC Gain Accuracy – ±1.5% for input ranges ≥ 20 mV full scale. ±2% for input ranges < 20 mV full scale.

Offset Range:

Full Scale Input	Offset Range
10 mV to 1 V	±1 V
1.01 V to 10 V	±10 V
10.1 V to 100 V	±100 V

Offset Accuracy

10 mV to 1 V	±(0.2% x |offset setting| + 1.5 mV +0.6% x full scale)
1.01 mV to 10 V	±(0.2% x |offset setting| + 15 mV +0.6% x full scale)
10.1 V to 100 V	±(0.2% x |offset setting| + 150 mV +0.6% x full scale)

Input Impedance – 1MΩ – 50 Ω Switchable.

Input Coupling – DC, AC, or Off.

Input Noise Filter – Full, 250 MHz, and 20 MHz Bandwidth user selectable.

Delay Between Channels (at same input range and coupling) – ≤100 ps.

Fiducial Input – ≤2.5 ns rise time superimposed on channel 1 acquisition, for time aligning multiple acquisition units. AC coupled signal path. Highpass time constant 5 ns, attenuates signal below 100 MHz.

SAMPLE RATE

Maximum Single-shot
TVS645A: 4 channels @ 5 GS/s
TVS641A: 4 channels @ 1 GS/s
TVS625A: 2 channels @ 5 GS/s
TVS621A: 2 channels @ 1 GS/s

Real Time Acquisitions – From "Maximum Single-shot Sample Rate" to 5 samples per second in a 1, 2.5, 5 selection sequence.

Record Length Maximum –
TVS645A: 4 channels to 15 K
TVS641A: 4 channels to 15 K
TVS625A: 2 channels to 15 K
TVS621A: 2 channels to 15 K

30,000 points per channel for samples rates of 10 MS/s to 5 S/s.

Record Length Range – 256 points to maximum in sequence of 256, 512, 1024, 2048, 4096, 8192, 15000.

Internal Time Base Reference – 10 MHz ±100 ppm.

External Time Base – 10 MHz over the VXI backplane CLK10 line.

Pre & Post Trigger Acquisition – Pre-trigger: (capture of data prior to the trigger event) 0% to ≈ 100% of record length.
Post-trigger: (capture of data after the trigger event) 0 seconds to 250 seconds.

Acquisition Modes – Normal, Average, Envelope, Auto-advance, Peak detect (>1ns).

Auto-advance Acquisition – 1087 records of 256 points to 34 records of 15 K points. Each record is Time Stamped to 125 ns resolution.

TRIGGERING

Sources – Internal (any channel), external, or VXI TTL and ECL trigger bus.

Types – Edge (main and delayed); Pulse (Width, Glitch, Runt, Slew Rate, Time Out); Logic (Pattern, State, and Setup & Hold Time Violation); Delay by Time – 16 ns to 250 secs; Delay by Events – 1 to 10,000,000 events with a maximum rate of 250 MHz.

Modes – Normal, Single, or Auto.

Range Internal – ±100% of Full Scale Input Range settable in steps of 0.1%.

Range External – ±1 V settable in steps of 6 mV.

Sinewave Sensitivity Internal – 3.5% Full Scale DC to 50 MHz increasing to 10% Full Scale at 1 GHz.

Sinewave Sensitivity External – 0.25 V DC to 50 MHz increasing to 1 V at 1 GHz.

Trigger Coupling –
Internal: DC, AC, LF Reject, HF Reject, and Noise Reject. External: DC – 50 Ω.

Trigger Slope – positive or negative.

Pulse Triggering –
Width: Trigger event time either in or out (user selected) of user specified time window. Glitch: Trigger event either greater than or less than (user selected) of user specified time window. Minimum Trigger Event Width: 1 ns. Rearm Latency: 2 ns + 5% of setting. Range: 1 ns to 1 sec.

Arm Input – Internal, External, or from the VXI TTL or ECL trigger bus. External (front panel connector) is TTL compatible and arms on switch closure to ground or 0 V level. 1 KΩ pull-up to +5 V provided.

OTHER FRONT PANEL CONNECTORS

Probe Compensation – Allows adjusting passive probes for use with 1 MΩ input impedance.

Reference Output – Allows verifying accuracy of internal amplitude and time sources.

Serial Interface – RS-232C DTE Interface provides an alternative computer interface for instrument control and waveform data transfer.

Performance Assurance –
Auto-Cal with user verifiable references.

Tested to IEEE-1057 Standard for Digitizing Waveform Recorders.

3 year product warranty.

Environmentally rugged.

ENVIRONMENTAL, PHYSICAL, AND SAFETY

VXI – "C" size, 2 slots wide.

Temperature – Operating: 0°C to +50°C.

Humidity – Operating: 95% relative (non-condensing) ≤ 30°C. 45% relative to +50°C.

Vibration – Operating: Mil-T-28800E Type III Class 5.

Shock – Nonoperating – 60 g, 11 ms, half-sine, 3 shocks per side.

Altitude – Operating: to 4.6 km (15,000 ft.).

Airflow – 6.6 l/s at 0.073 mm H₂O for 10°C rise.

Current Requirements –

	TVS600A	TVS62XA	TVS64XA
+12 V		1.0 A	1.3 A
+5 V		8.0 A	11.0 A
−2 V		0 A	0 A
−5.2 V		2.7 A	4.6 A
−12 V		0.8 A	1.0 A

VXI Waveform Analyzers
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Maximum Power – 106.5 W.

EMC –
EMC performance in VXI mainframe dependent with testing for the TVS600A Series tested in a Tektronix VX1410 mainframe.

Emissions (complies with) – Enclosure: EN55011 Class A for radiated emissions; AC Mains: EN60555-2 for power line harmonics EN55011 Class A for conducted emissions.

Immunity – Complies with EN50082-1 (IEC 801-3).

Immunity ESD – Complies with EN50082-1 (IEC 801-2).

Immunity Fast Transient – Complies with EN50082-1 (IEC 801-4).

Compliance – Complies with FCC CFR 47, Part 15 Subpart B, Class A.

Safety – Complies with UL 3111-1, CAN/CSA 22.2 no. 1010.1, and IEC 1010-1. Low voltage directive 73/23/EEC amendment 2 and EN61010 –1:1993.

COMMAND SET
Message Based – SCPI (Standard Commands for Programmable Instruments).

Fast Data Channel for waveform and measurement transfers.

10 complete instrument settings stored in the instrument (battery backed-up).

Low level (binary) settings query and return.

Instrument status signaling (e.g., operation complete, triggered, waveform data available) using the VXI TTL and ECL trigger bus.

Waveform Processing & Analysis –
Extensive waveform measurements extract time, amplitude and distortion characteristics of signals, including:

Min	Rise
Max	Fall
Low	+Width
High	–Width
Mid	Period
Mean	Frequency
Amplitude	+Duty Cycle
Peak-to-Peak	–Duty Cycle
Gain	Phase
Preshoot	Delay
Overshoot	Center of pulse
RMS	Cross
Std Dev	PCross
Area	Ncross
Cycle Area	Cycle RMS
Pos Area	Trig-Trig Time
Pos Cyc Area	Cycle Mean

Waveform Mathematics and Processing Include–

Add	Segment
Subtract	Window
Multiply	FFT
Divide	Digital Filter
Integrate	Smooth
Differentiate	Statistics
Abs Value	

Calculation Expressions –
Waveform math, transformations, filtering and measurements may be intermixed in algebraic expressions to act on acquired and reference waveform data.

"RMS (SMOoth (CHAN1 * CHAN2))"

Built-in limit testing returns true/false indication after comparison.

MEAN(CHAN1 OUTside 4.8..5.2)|
PWIDth(CHAN2 OUTside 2us..4us)

Segments of waveforms can be analyzed using start/stop measurement zone expressions or processed using the segmentation function.

"FFT(SEGMENT(CHAN1, 1us, 1024))"

The extensive calculation and measurement system simplifies test development and ensures accurate, reliable testing.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TVS645A
4 Channels, 1 GHz, 5 GS/s, 15 K Waveform Analyzer.

TVS641A
4 Channels, 250 MHz, 1 GS/s, 15 K Waveform Analyzer.

TVS625A
2 Channels, 1 GHz, 5 GS/s, 15 K Waveform Analyzer.

TVS621A
2 channels, 250 MHz, 1 GS/s, 15 K Waveform Analyzer.

Each includes: User Manual, Quick Reference Guide, and VXI*plug&play* WIN, WIN95 and WINNT Framework software.

MEASUREMENT SERVICE OPTIONS
Opt. C3 – Three years of Calibration Services.
Opt. C5 – Five years of Calibration Services.
Opt. D3 – Test Data for Opt. C3.
Opt. D5 – Test Data for Opt. C5.
Opt. R5 – Repair warranty extended to cover five years.

PROBES (See page 438).
The TVS600A Series products include TEKPROBE® BNC Interfaces compatible with a wide range of passive, active and differential voltage probes, current probes, O/E converters and electrical communication adapters. Please refer to the Accessories section of this catalog for more information.

See Tektronix on the World Wide Web:
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