Automated Video Measurement Set

VM6000 Data Sheet

- Complete 1 GHz Bandwidth, 4-channel DPO Functionality
- Large 12.1 in. XGA Touch Screen Display
- GPIB Remote Control
- LAN Connectivity
- CD-R/W Drive (DVD Read-only)
- Pinpoint™ Triggering
- Technology-specific Software Options for Jitter and Timing Measurements, Power Measurements, Serial Data, Ethernet, and USB 2.0 Compliance Testing

Applications

- Design Validation
- Standards Compliance Testing
- Quality Control
- Installation and Troubleshooting
- Automated Manufacturing Test
- Off-air Video Systems Test

The VM6000 automates video testing of consumer HDTV and PC graphics devices such as digital set-top boxes, multimedia PCs, graphics cards, and video semiconductors. It addresses the needs of engineers developing and deploying the next generation of video devices for the digitally connected home. Unrivalled performance in terms of speed, accuracy, and reliability has made the VM6000 the choice of industry leaders for design validation, quality control, and ATE applications.

Unlike conventional instruments, the VM6000 integrates acquisition hardware, optimized video measurement algorithms, test signal files, and accessories into a cohesive test system solution. Product verification activities that previously took hours or days to complete can now be completed in seconds or minutes. Offering near plug-and-play video measurement capability, even unskilled operators can reliably assess video output signal quality. The conformance of signals to specifications is reported with obvious pass or fail results, with signal distortions clearly identified for further analysis.
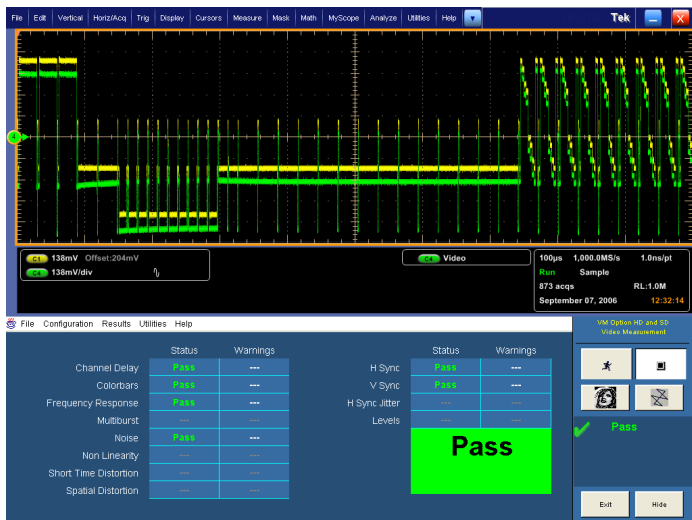
Features & Benefits

- Automates Test of Consumer HDTV Video Devices
- Automates VESA Compliance Test for PC Graphics Devices
- Automates Testing of Multimedia PC
- Fast, Accurate, and Reliable Video Measurements
- Comprehensive Component Analog Video Signal Analysis
- SDTV, HDTV, and RGBHV Component Analog Format Support
- Picture, Vector, and Waveform Displays
- Companion Test Signal Packages
- Time-saving Test Utilities
- Pass/Fail Limit Testing
- Automatic Report Generator
- Video Measurement Accessories

Tektronix®

Summary Pass/Fail Test Results Display.

Signal Format Configuration Menu (Option SD and HD).

The VM6000 stands alone as the only automatic video analyzer capable of supporting SD, HDTV, and PC graphics signal formats. Offering a full 1 GHz bandwidth, and 5 GS/s sample rate, the VM6000 is well suited to the demands of measuring high-resolution HDTV and high-frequency PC graphics video signals. Traditional DTV formats from 480i through 1080p and either RGB or YPbPr color space are supported in Options SD and HD. Option VGA supports common analog RGBHV signal resolutions from 640×480p though 2048×1536p, and pervasive refresh rates from 60 Hz through 120 Hz.

The ultimate solution for component analog video signal analysis, the VM6000 delivers comprehensive characterization of video fidelity, signal quality, and standards compliance. With available options, the instrument automatically assesses conformance of video signals to applicable EIA-770.x, SMPTE-274M, 296M, and VESA VSIS standards. Traditional "TV" signal fidelity is evaluated utilizing industry-accepted parameters, making 150 individual measurements automatically in less than 20 seconds. PC graphics signal fidelity is assessed using comprehensive RGB video and HV Sync measurement parameters made in accordance with VSIS test procedures. Preloaded reference and limit files enable go/no-go evaluation to applicable DMT, CVT, or GTF timing standards.

As an integrated signal analyzer, the VM6000 can be reliably deployed as a stand-alone QA station in manufacturing. Unlike modular test systems, extensive programming, complicated system debugging, or costly test engineering support is not required with the VM6000. Integrated pass/fail limit testing and documentation utilities link distributed design, supply, and manufacturing organizations with standardized test capability. Product quality is enhanced because accurate test results can be reliably generated,

easily replicated, and readily communicated across a global engineering, manufacturing, or sales organization.

These unique capabilities enable in-depth signal analysis, speed product development, and ensure new designs comply with applicable standards. Fast, accurate, and objective video measurements enable manufacturers to ensure that HDTV or PC graphics video signal quality is up to the challenge of today's high-performance displays, as well as providing clear differentiation between input signal and display device impairments.

Easy to Configure and Operate

The VM6000 offers intuitive Windows-based configuration and measurement menus for easy operation and minimal training. A 12.1 in. (307 mm) color display provides a bright, clear, and crisp display of waveforms and measurement results. Users can easily navigate through logically arranged menus and make selections using radio buttons with a mouse or touch screen.

Complicated instrument setups, algorithm selection, programming, and other undesirable aspects of making video measurements are eliminated with the VM6000. Configuration is as simple as selecting the Auto Format function or individually selecting the video format manually and then selecting the measurement parameters from an on-screen menu, eliminating complicated instrument setups, tedious manual measurements, and time-consuming results correlation. These test configuration settings can be readily saved, recalled, or copied, further simplifying test of multiformat video devices. Users wanting to make manual measurements can exit the automated measurement application and then access a full-featured oscilloscope.

Supports SD, HDTV, and RGBHV Component Analog Video Formats

The VM6000 can be flexibly configured to support any combination of component analog SDTV, HDTV, and RGBHV video formats with the available options. Broad format support enables automated test of digital set-top boxes, video semiconductors, DVD players, PC graphics cards, and other consumer video devices.

User-defined Format allows users to test nonstandard formats by entering custom timing parameters, allowing support of unique formats and future undefined formats.

Format Support

Option	Signal Format	Vertical Refresh Frequency	Color Space			Sync Options	
			RGB	YPbPr	Y/G	Composite Sync on CH4	Separate H&V
SD	480i	59.94/60 Hz	X	X	X	X	X
	576i	50 Hz	X	X	X	X	X
	480p	59.94/60 Hz	X	X	X	X	X
	576p	50 Hz	X	X	X	X	X
HD	720p	30/50/59.94/60 Hz	X	X	X	X	X
	1080i	50/59.94/60 Hz	X	X	X	X	X
	1080p	24/50/59.94/60 Hz	X	X	X	X	X
	Other nonstandard HD formats supported by User-defined Format menu. User-defined Format supports nonstandard SD formats, if SD is enabled.		X	X	X	X	X
VGA	640×480p	60, 72, 75, 85, 100, 120 Hz	X	X	X	X	X
	800×600p	60, 72, 75, 85, 100, 120 Hz	X				X
	1024×768p	60, 72, 75, 85, 100, 120 Hz	X	X	X	X	X
	1280×1024p	60, 70, 75, 85, 100, 120 Hz	X				X
	1600×1024p	60, 70, 75, 76, 85, 100 Hz	X	X	X	X	X
	1920×1080p	50, 60, 75, 85, 100 Hz	X				X
	1920×1200p	60, 75, 76, 85, 100 Hz	X				X
	1920×1440p	60, 75, 85 Hz	X				X
	2048×1536p	60, 75, 85 Hz	X				X
	2048×2048p	60 Hz	X				X
	Other progressive RGBHV formats and vertical frequencies supported by User-defined Format.		X				X

Note: Sync combiner (012-1664-xx) supports "Separate H&V" operation.

Bandwidth and Sample Rates Suitable for HDTV and High-resolution PC Graphics Signals

The VM6000 utilizes a digital phosphor oscilloscope platform as the basis for signal acquisition and analysis. Utilizing proven, high-speed measurement architecture, Tektronix surpasses the limitations of current video analyzers to address the evolving needs of the video industry. The VM6000 offers over 1 GHz of bandwidth and 5 GS/s maximum real-time sample rates for all 4 measurement channels – easily assessing the frequency response of 60 MHz HDTV signals or transient response of 350 MHz PCF VESA signals. The high sample rates and low noise floor of the instrument enable noise measurement accuracy that was previously impossible on HDTV signals. A typical rise time of 225 ps and superior time-base performance are sufficient to make critical sync and rise-time measurements as required by EIA-770 and SMPTE 274 M and VESA. Standard 10 M (4 CH) record length and high sample rates deliver measurement results with minimal time lag.

H Sync Measurement Results (Option VGA)

Comprehensive Component Analog Video Signal Analysis

The VM6000 incorporates an extensive set of automated video measurements that deliver comprehensive characterization of the fidelity and conformance of component analog signals. Approximately 150 individual measurements completely characterize video signal amplitudes, timing, and noise distortions into parameter categories that are easily understood, facilitating troubleshooting and design optimization. Enabled by such broad and thorough signal analysis, the VM6000 is able to identify relevant video signal impairments, verify compliance with applicable standards, and ensure operability with connected displays.

VM6000 Automated Measurements

Measurement Parameters	
TV Signals **Options SD and HD**	**PC Graphics Signals** **Option VGA**
Color Bars Levels (1-8 Pedestals)	Color Bars Luma Levels*1
HV Sync H Sync Jitter	HV Timing*1 HV Sync*1 H Sync Jitter*1
Noise	Noise Injection Ratio*1
Nonlinearity	Integral and Differential Linearity, Monotonicity*1
Interchannel Timing	Channel-Channel Mismatch Channel-Channel Skew*1
Transient Response, K2T	Video Transient Response
Multiburst	—
Frequency Response	—
—	Resolution*1
Spatial Distortion	—

*1 VESA parameters.

Measurement parameters have been appropriately selected for testing TV signals (Options SD and HD) and PC graphics signals (Option VGA). These parameters vary by application because of differences in hardware technology, signal attributes, applicable standards, and historical test methodology. TV test measurements are based on the de facto industry standard VM700T and have been adapted to assess distortions unique to digital devices and HDTV signals. The PC graphics measurement set delivers fully automated VESA compliance testing and video measurements, as well as reporting other parameters commonly utilized to characterize PC graphics device performance.

Multiburst Measurement Results Display (Option SD and HD).

Fast, Accurate, and Reliable Automated Video Measurements

The VM6000 is differentiated from conventional oscilloscopes, waveform monitors, or modular instruments by its automated video measurements. Automated measurements deliver benefits in terms of speed, accuracy, and repeatability with ease of use that almost obsoletes manual approaches, and even user-developed programs. Automating signal configuration, signal acquisition, and data analysis enables robust and reliable operation, impervious to signal variations. The VM6000 applies optimized video measurement algorithms and extended data processing to deliver accuracy and reliability that outperforms even the most skilled expert user.

Auto Format Detect – Simplifies operation by automatically detecting the format applied to the instrument. Allows multiple formats to be tested automatically in sequence without the need for user intervention.

Auto Configuration – By selecting the applicable format and desired measurements from the configuration menu, the VM6000 automatically configures gain, offset, and time scale based on the nominal signal values expected. Variations from nominal values are accommodated with Auto Range capabilities.

Auto Range – The Auto Range feature enhances accuracy and enables automated measurement of signals that vary from nominal levels. This feature automatically optimizes gain and offset based on the signal conditions when they deviate from nominal, enabling the instrument to consistently present the best results possible.

Automatic Special Position – The VM6000's automatic special position function ensures that automated measurements are robust to temporal signal distortions, alternate test signals, and alternate output display modes. Always active, this feature identifies appropriate test signal events and sets measurement cursor locations optimally to ensure consistent and meaningful test results. Measurement location selections made by the VM6000 can be analyzed or documented with the selectable feature included in the report generator.

Auto Mode – Auto mode enables users to instruct the instrument to make one, selected, or all automated video measurements with a single a run command. While functioning in Auto mode, the instrument automatically selects the appropriate test signal line, utilizes preset measurement configurations and averaging selected by the user, and completes each measurement. Auto mode also includes multiline measurements capability, enabling users to measure selected parameters on many or all lines in a frame with a single run command.

Measurement Cursors (Special Position) – Options SD and HD address requirement for custom signal analysis by enabling users to input customized measurement locations for the Frequency Response, Levels, and Noise measurement parameters. For frequency response measurements, users can select either timing-location input or frequency input to make response measurements anywhere within the supported video bandwidth utilizing a standard sweep signal. Input locations can be further toggled within YPbPr signals to accommodate either 4:2:2 or 4:4:4 video. This enables detailed analysis of roll-off, frequency distortion, identification of spurs, and aliasing anywhere across the useful frequency spectrum. Cursors for the Levels parameter enable flexible, automated measurement of 3 channel levels for 1-8 individual pedestals on a line, such as can be found with ARIB signals, MacBeth Charts, or other noncolor bar signals. Noise special position cursors allow temporal windowing for noise measurements, enabling noise measurements on signals such as color bars, staircases, or camera test charts.

Frequency Response Measurement Input Selections (Option SD and HD).

V Sync Display (Option SD and HD).
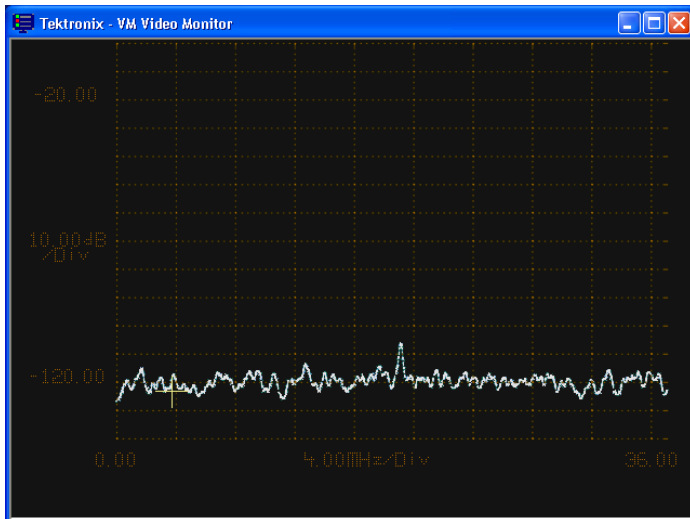
Noise Spectrum Display (Option SD and HD).

H Sync Jitter and Wander Display (Option SD and HD).

New Measurements on V3.X – Options for SD and HD on V3.X offer the three new measurements. The V Sync measurement will support the complete video timing measurement along with the H Sync measurement. The H Sync Jitter measurement measures the RMS Jitter, Frequency Offset, and Frequency Drift Rate for wander measurements that support IEEE 1521-2003. The user-definable demarcation frequency and probability/jitter readout help to search for the root cause during debugging. The spatial distortion measurement measures the size of the video image and detects if any offset or cropping has occurred to the image. This is useful for design engineers to ensure that their video processing is not deforming the picture. This is also good for verifying video aspect ratio mixes such as letterbox or side-panel modes.
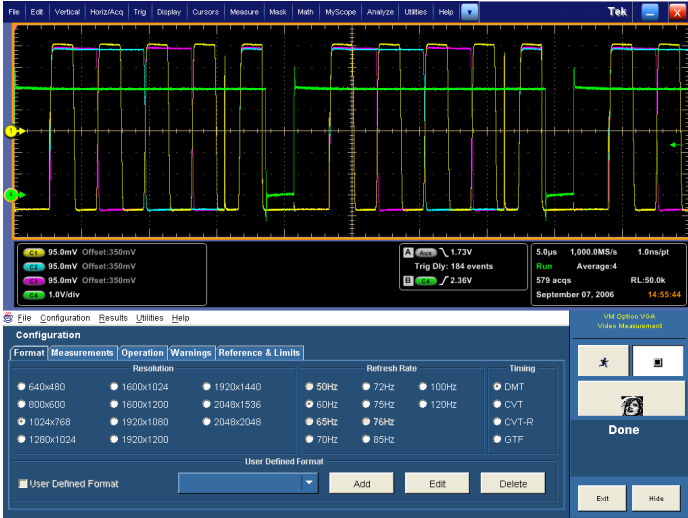

Spatial Distortion Display (Option SD and HD).

Format Configuration Menu (Option VGA).

Measurement Selection Menu (Option VGA).

## Automated VESA Compliance Testing for Analog RGBHV Signal Formats (Option VGA)

The emergence of IP broadcast video and convergence of traditional "TV" and "PC" video entertainment devices have resulted in PCs evolving into media gateways to the digitally connected home. As a result, assessing the fidelity and conformance of analog RGBHV signals has become more important to engineers involved in the design and manufacturing of PC graphics devices. This challenge has been further complicated by the emergence of digital interfaces, proliferation of supported output modes, and the persistence of analog RGBHV interfaces on PC graphics cards.

Tektronix addresses these industry test requirements with the VM6000 Option VGA, the first and only "VM" class solution for PC graphics signals and devices. Option VGA automates signal analysis and mandatory VESA standards compliance testing, speeding design validation testing that is typically performed during the release or modification of PC graphics hardware, software, or integration of complete video systems.

Option VGA supports pervasive analog RGBHV signal formats typically communicated through VGA, DVI-I, or DVI-A interfaces. Automated measurement is possible for 10 standard signal resolutions spanning from 640×480p (VGA) through 2048×2048p (QXGA), at selected vertical refresh frequencies from 60 to 120 Hz. A user-defined format configuration utility enables users to easily create, edit, or recall custom modes and seamlessly access the full test automation of the VM6000 instrument.

Approximately 150 video measurements can be performed for each supported mode, delivering a comprehensive assessment of RGB video fidelity, HV Sync quality, and format conformance. Parameters and test methods are based on industry standard (VESA) test procedures, enabling
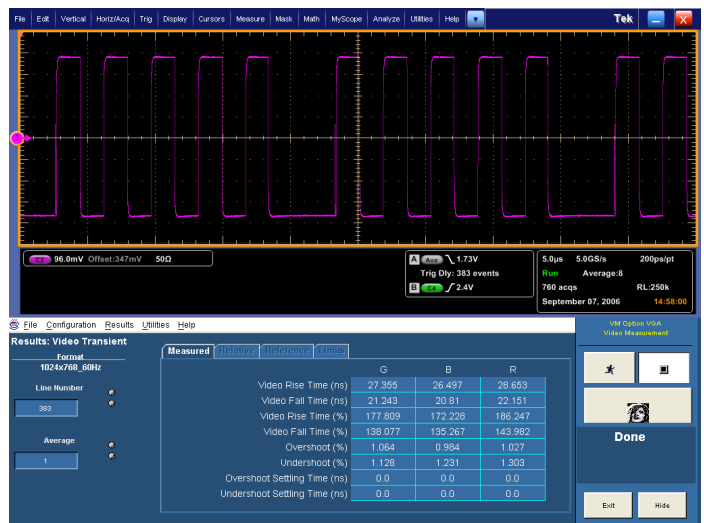
RGB Transient Response Measurement Results (Option VGA).

easy comparison against the requirements of the Video Signal Standard (VSIS) and applicable DMT, GTF, or CVT timing standards. Convenient averaging and configuration controls deliver the flexibility to perform either speedy or precise measurements in accordance with VESA sampling requirements. A full suite of comprehensive RGBHV video parameters can be measured in less than 5 minutes. Preloaded signal reference data and tolerance limit files simplify results analysis, eliminating laborious spreadsheet entry and computation. Test results, and even waveform screen captures can be quickly documented with reports that can be automatically generated, printed, and saved.

An innovative set of PC graphics matrix test signals have been created to enable comprehensive signal characterization for the full range of supported formats. These signals, working in conjunction with a remote controlled measurement interface unit, enable fully automated testing with a single run command. The included measurement interface unit provides connectivity, signal termination, automated switching, and variable loads for sync voltage tests. This approach eliminates the need for expensive FET probes, and delivers optimized accuracy for both DC amplitude and high-frequency timing measurements.

All the necessary elements for compliance or QC testing are integrated into a cohesive solution that delivers easily understood pass or fail test results. Comprehensive parametric signal analysis isolates product performance deficiencies, enables design optimization, and ensures interoperability of connected display devices. With Option VGA, even unskilled operators can make reliable and repeatable assessments of VESA standards compliance. Extensive video knowledge, oscilloscope skills, complicated programming, or system integration skills are no longer required to assess analog RGBHV signal integrity.

Companion Test Signal Packages

Option SS includes a specific companion test signal package to speed and simplify testing of supported signal formats. This package has been developed to enable comprehensive parametric analysis of signal fidelity without the inconvenience of switching test signals. The test signal package eliminates potential video measurement set operability issues and minimize uncertainties regarding the quality of the input signal

Because DTV has resulted in a proliferation in video source content and signal formats, test signals are provided in a variety of pervasive formats to enable easy generation and extended format testing. Since encoded test signals may contain artifacts that detract from measuring the analog signal fidelity, the matrix test signal is also provided in MPEG-2/H.264 encoded Elementary and ATSC Transport Streams. To ensure the encoded signal is accurate, Tektronix has prequalified the matrix test signal for each native video format.

Option SS Signal Sources Package (020-2769-xx):
File and Signal Formats of Test Signal Packages

Parts Number	Description	Formats
020-2770-xx	Signal Sources DVD	480i, 576i
020-2771-xx[2]	Standard Definition Elementary Streams	480i, 480p, 576i, 576p
020-2772-xx	Advanced Definition Elementary Streams	720P, 1080i, 1080p
020-2773-xx[3]	ATSC Transport Streams	480i, 480p, 720P, 1080i, 1080p
020-2774-xx[4, 5, 6]	Baseband Test Signals	525i, 525p, 625i, 625p, 720p, 1080i, 1080p,
020-2775-xx[7]	PC Bitmap Graphics	620×480, 800×600, 1024×768, 1280×1024, 1600×1024, 1600×1200, 1920×1080, 1920×1200, 1920×1440, 2048×1536, 2048×2048
020-2776-xx[8]	H.264 SD and HD Streams	480i, 480p, 576i, 576p, 720p, 1080i, 1080p

[2] 480i, 480p ES Stream provided by 704×480, 720×480 resolution.

[3] ATSC Transport Stream provided for 480i, 480p, 720p/30, 720p/60, 1080i/60, 1080p/24, and 1080p/59.94 formats.
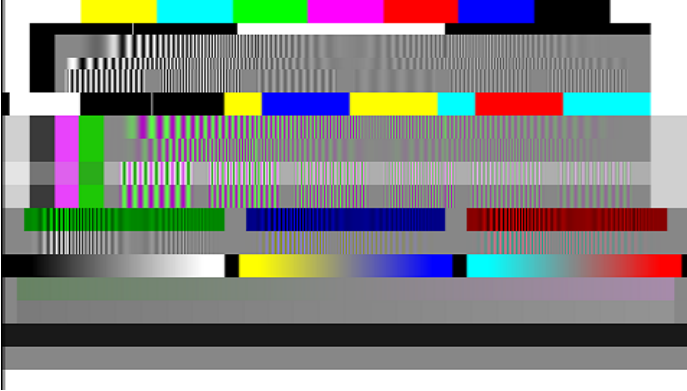
[4] Requires TG700 and appropriate module (AVG7, AWVG7, DVG7, and/or HDVG7).

[5] SDI signal generation not supported for 525P, 576p format.

[6] TG700 DNL files not provided for 1080p/50 and 1080p/60 formats.

[7] Includes PC Matrix and Full Field VESA signals.

[8] Main profile / Level 3 for 480i, 580p, 576i, and 576P. Main profile / Level 4 for 720P, 1080i, and 1080P.

HDTV Matrix Test Signal in 16×9 Aspect Ratio.

HDTV Matrix Test Signal

A specific matrix test signal has been created to enable efficient and comprehensive test of component analog video signal fidelity. The matrix signal includes a range of test signals on different lines to enable video testing without the inconvenience of switching full field signals, and contents have been customized to exercise the full bandwidth capability of each format. One signal can be flexibly utilized for both RGB and YPbPr color spaces, thereby minimizing test signal proliferation.

The HDTV matrix test signal is supplied in a variety of file and signal formats to enable convenient and comprehensive test of set-top boxes and other consumer video devices. High-quality encoded ATSC Transport Stream and compressed Elementary Stream files are supplied for easy playout on a Tektronix MPEG player such as the RTX100B, RTX130B, or MTX100B.

PC Graphics Matrix Test Signal

VESA compliance and certification testing requires that several different types of test signals be applied to the device under test. Option VGA

PC Graphics Matrix Test Signal (Option VGA).

includes test signal files for these patterns, in both full field and matrix forms for the full range of supported image resolutions. Test signal files are provided in .bmp and .png file formats.

VESA compliance and certification testing requires that several different types of test signals be applied to the device under test. Option VGA includes test signal files for these patterns, in both full field and matrix forms for the full range of supported image resolutions. Test signal files are provided in .bmp and .png file formats. The .png files are beneficial because they enable HV timing measurements to be made without the border artifacts potentially introduced by bitmap files.
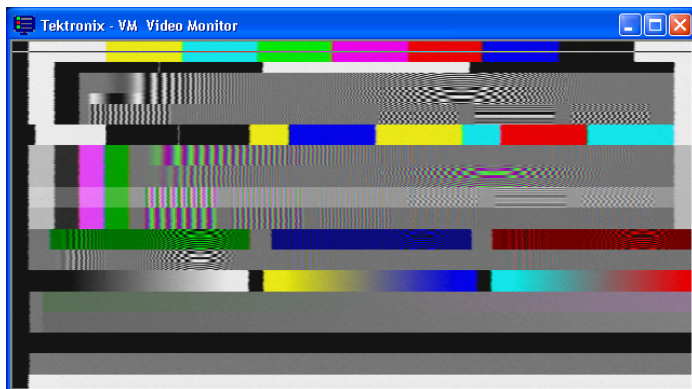
Picture Mode.

Vector Display.

Picture, Vector, and Waveform Displays

Picture and Vector displays can be initiated with a single button press and deliver "at a glance" confidence checking that simplifies signal identification, troubleshooting, and color conversion accuracy. Waveforms are simultaneously displayed with parametric test results to enable visualization of signal impairments.

By selecting Picture mode, a full-color picture display is rendered on the screen from the connected subsampled and down-converted signals to the available picture area and resolution. Pictures appear in an appropriate 16×9 or 4×3 aspect ratio by default; however users can resize, move, or minimize the window as needed. Picture mode incorporates a user-enabled bright line select feature to facilitate test configuration. Live or full motion video signals can also be viewed at vertical refresh rates of 1-2 fps.

The Vector display, available with Option SD and HD, displays the waveform with targets for 75% or 100% color bars and accommodates either 601 or 709 colorimetry targets. Graticule targets and color space can be selected automatically or manually.

Waveforms for all channels are simultaneously viewable in different colors, and displays can be zoomed both vertically and temporally for detailed examination and analysis. Users can selectively expand the waveform to the full display size by minimizing the measurement application.
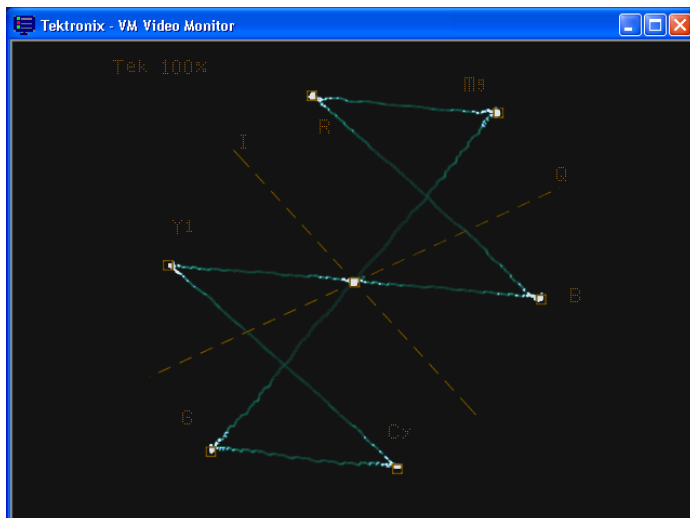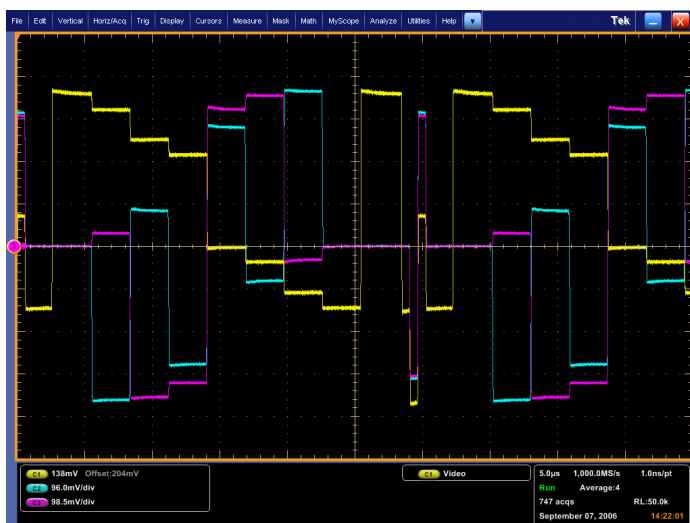
Full-screen Waveform Display.

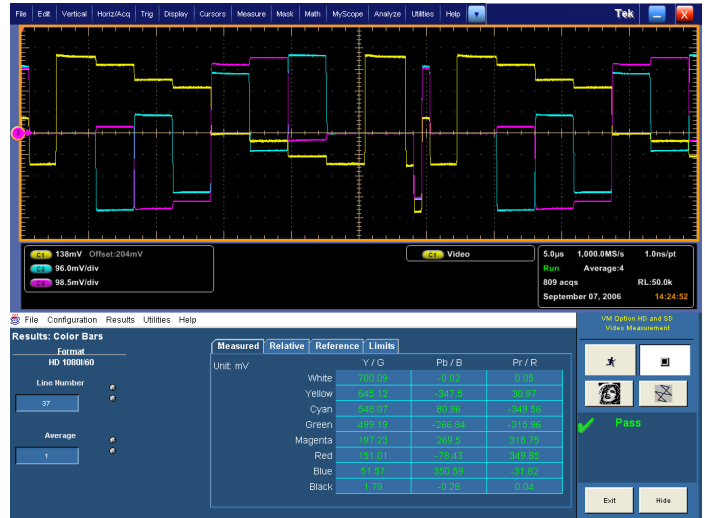Summary Test Results Display with Pass/Fail Indication.

Color Bar Relative Results Display with Limit Testing enabled.

Time-saving Test Utilities and Results Displays

The VM6000 offers a powerful combination of test utilities and custom displays to make HDTV video testing faster, more robust, more convenient, and more accurate. These utilities supplement basic automated measurement capabilities to deliver performance and value unmatched by any other solution. Combined with the extended documentation utilities, these powerful automated measurement utilities and features ensure that the VM6000 meets the demands of all application areas. Research and Development, Quality Control, and Production Test personnel can tailor the instrument settings to meet their particular needs for robust acquisition, speed, or accuracy. By automating measurement functions, video professionals are ensured that automatic measurements are robust, accurate, repeatable, and completely objective.

Summary Test Results Display

For the ultimate in test progress and reporting, the VM6000 incorporates a summary test results display screen. This display shows pass or fail conditions and the progress of the video signal measurements without

having to delve into complicated individual test results. Each of the selected test parameters, measurement progress, pass or fail result per parameter, and test errors, if any, are displayed. Upon completion an overall green or red measurement result flag is displayed. Simply click on the pass/fail measurement to directly access the measurement results. This allows the user to quickly go to the failed test results.

Integrated Pass/Fail Limit Testing

The VM6000 incorporates user-selectable pass/fail limit testing. Acceptability of individual parameters or an entire DUT (Device Under Test) can be assessed without browsing hundreds of individual numerical results. Suitable for use in stand-alone applications, there is a PF (Pass/Fail) summary screen that shows the progress and PF result of individual measurements and an overall DUT PF result based on the selected parameters and user-selected limits. When PF limit testing is enabled, numerical measurement results for failed parameters are displayed in an intuitive red color and passed parameters are displayed in green for easy identification of acceptable/unacceptable or nonconforming signal conditions.
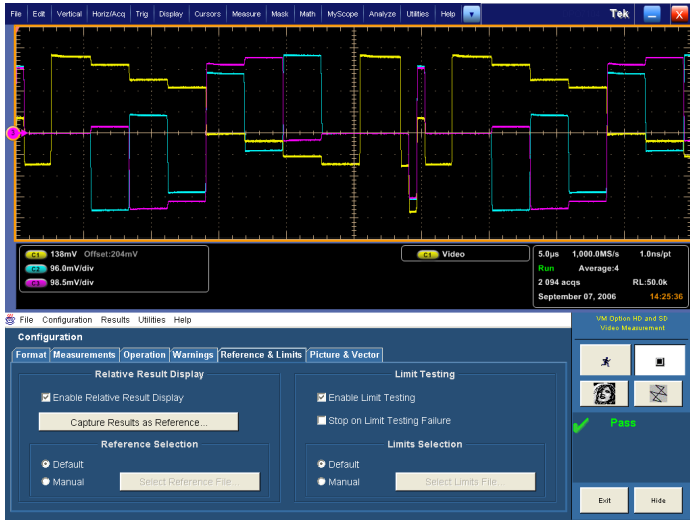
Reference and Limit Test Configuration Menu.

RTF Format

CSV Format

VM6000 Test Report.

Preloaded and User-definable Reference and Limit Files

Tektronix supplies a set of default reference and limit files for the supported video formats to provide "out of the box" test functionality. Option SD and HD have been preloaded with SMPTE/EIA standard reference values and Tektronix-recommended tolerance limit files. Option VGA has been preloaded with VESA reference and tolerance limit values based on the applicable timing standards. The signal reference data boosts test productivity by minimizing the need to access separate standards or quality documents. Files can be edited with other spreadsheet programs to specify customized target values, conformance limits, or go/no-go manufacturing process limits. Reference and limit files can be auto-selected by format (default), manually specified, or loaded automatically using preset configuration files (.vmset).

Flexible Results Displays

To simplify test results analysis, the VM6000 features tabular results menus. Within each parameter group, users can easily browse measurement results, deviation from reference, nominal (reference) value, and max/min tolerance limits for pass and fail. Reference information and calculations necessary to analyze and understand test results are logically organized, and readily available. With limit testing enabled, nonconforming test results are highlighted in red, readily highlighting signal distortions for further analysis.

Save and Recall Measurement Configurations

Measurement configuration settings can be stored, instantaneously recalled, or easily copied to other instruments. Factory default settings can also be recalled, if necessary. Reference and limit files are associated with configuration files, and are automatically pulled in with a recall configuration command. This feature speeds and simplifies device testing with multiple

display output formats, as users can configure, store, and recall a setup for each individual format.

Reference Capture Utility

The output of a "golden" DUT or reference test signal generator can be conveniently captured and stored as a reference file. This utility enables current measurement results to be readily compared with other measurement results utilizing the tabular results display screens in the results menus.

Automatic Report Generator

A report generator utility speeds test documentation by creating an organized, video measurement report with the touch of a single button. Test results, configuration settings, and signal reference data details are summarized in the VM6000 test report. Reports created in .pdf and .rtf formats are organized and suitable for inclusion in certification test results. The option to insert an embedded waveform screen in .rtf format provides the detail of the results to the reviewers. For data analysis, reports can be output in the form of a .csv file, easily imported into spreadsheet programs.
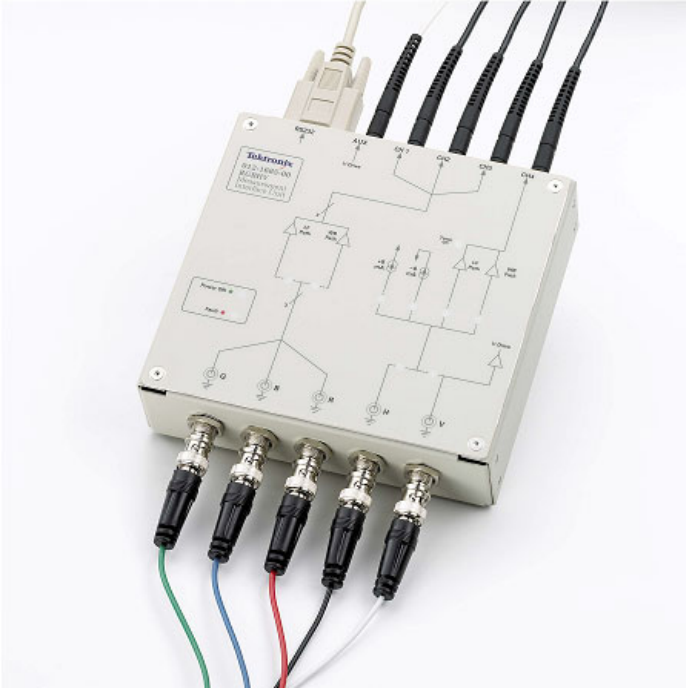
Option VGA – Analog RGBHV Measurement Interface Unit (MIU).

Oscilloscope Measurement Menu.

Video Measurement Accessories

For convenience and enhanced test performance, the VM6000 includes a logical set of complementary video measurement accessories that simplify connection, termination, and measurement. Custom-designed sync pick-off and sync combiner accessories simplify measurement of TV signals. Option VGA includes a custom Measurement Interface Unit (MIU) that has been engineered to enable precision, VESA compliant, and fully automated measurement for 5-channel analog RGBHV signals. The MIU provides

termination, signal switching, and a current source/sink, eliminating the need for expensive FET probes or manual switching of cables during testing.

Addressing stringent requirements for measurement accuracy, the MIU incorporates an innovative dual input path for RGB and HV channels in order to deliver optimized accuracy for both DC amplitude measurement and high-frequency timing measurements. Utilizing RS-232 control, the VM6000 automatically selects either low-frequency or wideband mode as required by the parameter being measured. Incorporating a full 1 GHz of bandwidth, with optimized return loss in wideband mode, the MIU delivers unmatched speed, accuracy, and convenience in testing PC graphics signals.

Sync Load Testing

Per VESA standards, H and V Sync voltages must be measured under V1 and V0 conditions with ±8 mA current loads to ensure adequate power is available to handle impedance variations that may occur with connected displays. Option VGA automates this test by providing loads within the remote control MIU.

Standard GPIB Remote Control and LAN Connectivity

A fast and reliable GPIB port compliant to IEEE 488.2 is standard on the instrument with selectable controller or talk/listener modes. A fully documented oscilloscope GPIB remote command set and simplified video command set enable all of the instrument capabilities accessible through the user interface to be automated through GPIB remote control.

Network connectivity is provided with a LAN port supporting 10BASE-T and 100BASE-T. This enables video test reports or data stored on the hard drive to be accessed through the network. TekVISA™ is functional for LAN remote control of the oscilloscope commands.

Complete Oscilloscope Functionality

Recognizing the need for flexibility, Tektronix has integrated the complete DPO7104 functionality into the VM6000. Manual video measurements are enabled with comprehensive analog HDTV/EDTV triggering for emerging standards like 1080i, 1080p, 720p, and 480p as well as standard video triggering on any line within a field, all lines, all fields, or odd or even fields for NTSC, SECAM, and PAL video signals. In addition, IRE and mV graticules can be selected for easier measurements and visual inspection. Complete functionality of the DPO7104 oscilloscope and optional application software packages extend the capabilities and value of the VM6000 platform. Oscilloscope functionality and specifications are detailed in the DPO7104 or appropriate application software data sheet(s).

Performance You Can Count On

Depend on Tektronix to provide you with performance you can count on. In addition to industry-leading service and support, this product comes backed by a one-year warranty as standard.

Characteristics*9

Video Measurement Specifications

Options SD and HD Video Measurements

Characteristic	Description	VM5000HD, VM5000, TDS5054, TDS5054B, TDS5104, TDS5104B		VM6000, DPO7054, DPO7104, DPO7254, DPO7354	
		Absolute	**Relative to Reference**	**Absolute**	**Relative to Reference**
Amplitude Measurements					
Color Bars, Levels	(Typical)	±3 mV ±0.8% of reading	±4 mV	±3 mV ±0.5% of reading	±4 mV
Noise					
Unweighted	32 Average	±1 dB (–20 dB to –60 dB) ±2 dB (–60 dB to –70 dB)	—	±1 dB (–20 dB to –60 dB) ±2 dB (–60 dB to 70 dB and to 30 MHz) ±2.5 dB (–60 dB to –70 dB and to 60 MHz)	—
Weighted	64 Average	±1 dB (–20 dB to –60 dB) ±2 dB (–60 dB to –70 dB)	—	±1 dB (–20 dB to –70 dB)	—
Frequency Response					
Flag Amplitude	Multiburst (Typical)	±3 mV ±0.8% of reading	±4 mV	±3 mV ±0.5% of reading	±4 mV
Frequency Response	—	±0.5 dB (1 MHz to 10 MHz, typical) ±0.75 dB (10 MHz to 30 MHz, typical)	—	±0.4 dB (1 MHz to 30 MHz, typical)	±0.3 dB (1 MHz to 30 MHz)
Frequency Readout	—	±0.5%	±0.7% (Typical)	±0.5%	±0.7% (Typical)
Linearity					
Nonlinearity	(Typical)	±3%	±0.3%	±3%	±0.3%
Transient					
Rise and Fall	(Typical)	±5 ns (SD) ±2 ns (HD)	±3.5 ns (SD) ±2 ns (HD)	±6.2 ns (SD, DPO7354) ±2 ns (HD, DPO7354) ±6.2 ns (SD, DPO7254) ±2 ns (HD, DPO7254) ±5.3 ns (SD, DPO7104, VM6000) ±2 ns (HD, DPO7104, VM6000) ±4.4 ns (SD, DPO7054) ±2 ns (HD, DPO7054)	±4.5 ns (SD, DPO7354) ±2 ns (HD, DPO7354) ±4.5 ns (SD, DPO7254) ±2 ns (HD, DPO7254) ±3.8 ns (SD, DPO7104, VM6000) ±2 ns (HD, DPO7104, VM6000) ±3.2 ns (SD, DPO7054) ±2 ns (HD, DPO7054)
K2T	(Typical)	±1%	—	±1%	—

Characteristic	Description	VM5000HD, VM5000, TDS5054, TDS5054B, TDS5104, TDS5104B		VM6000, DPO7054, DPO7104, DPO7254, DPO7354	
		Absolute	Relative to Reference	Absolute	Relative to Reference
Sync					
Amplitude	(Typical)	±3 mV ±0.8% of reading	±4 mV	±3 mV ±0.5% of reading	±4 mV
Timing	—	±1 ns	—	±1 ns	—
Rise and Fall Time*[10]	(Typical)	±2 ns (SDi) ±1 ns (SDp) ±1 ns (HD)	±2 ns (SDi) ±1 ns (SDp) ±1 ns (HD)	±3.5 ns (SDi, DPO7354) ±3.5 ns (SDi, DPO7254) ±3.0 ns (SDi, DPO7104, VM6000) ±2.5 ns (SDi, DPO7054) ±3.5 ns (SDp, DPO7354) ±3.5 ns (SDp, DPO7254) ±3.0 ns (SDp, DPO7104, VM6000) ±2.5 ns (SDp, DPO7054) ±2 ns (HD)	±2.6 ns (SDi, DPO7354) ±2.6 ns (SDi, DPO7254) ±2.2 ns (SDi, DPO7104, VM6000) ±2 ns (SDi, DPO7054) ±2.6 ns (SDp, DPO7354) ±2.6 ns (SDp, DPO7254) ±2.2 ns (SDp, DPO7104, VM6000) ±2 ns (SD,p DPO7054) ±2 ns (HD)
Jitter	—	±5 ns (RMS) ±15 ns (Peak) (Min 62.5 Hz, VM5000HD/TDS5104) ±5 ns (RMS) ±15 ns (Peak) (Min 25 Hz, VM5000/TDS5104B)	—	±5 ns (RMS) ±15 ns (Peak) (RL: 40 MS, Min 10 Hz) ±5 ns (RMS) ±15 ns (Peak) (RL: 200 MS, Min 2 Hz)	—
Frequency Drift*[11]	—	±40 ppm Hz/s (480i, Min 0.65 Hz, VM5000HD/TDS5104) ±40 ppm Hz/s (480i, Min 0.32 Hz, VM5000/TDS5104B)	—	±40 ppm Hz/s (RL: 40 MS, Min 0.25 Hz) ±40 ppm Hz/s (RL: 200 MS, Min 0.05 Hz)	—
Frequency Offset*[11]	—	±15 ppm Hz (480i, Min 0.65 Hz, VM5000HD/TDS5104) ±15 ppm Hz (480i, Min 0.32 Hz, VM5000/TDS5104B)	—	±15 ppm Hz (RL: 40 MS, Min 0.25 Hz) ±15 ppm Hz (RL: 200 MS, Min 0.05 Hz)	—

Characteristic	Description	VM5000HD, VM5000, TDS5054, TDS5054B, TDS5104, TDS5104B		VM6000, DPO7054, DPO7104, DPO7254, DPO7354	
		Absolute	Relative to Reference	Absolute	Relative to Reference
Channel Delay					
Measurement Range	—	±35 ns	—	±35 ns	—
Accuracy	—	±5 ns	±500 ps (SD) ±300 ps (HD)	±2 ns	±500 ps (SD) ±300 ps (HD)
Spatial Distortion	(Typical, with the compressed Matrix Test signal)	—	—	—	—
V Cropping, First Active Line, Last Active Line	—	±1 lines	—	±1 lines	—
V Scaling	—	±1%	—	±1%	—
V Offset	—	±1 lines	—	±1 lines	—
H Cropping	—	±6 pixels of the smaller pattern (VM5000HD, TDS5054, TDS5104) ±3 pixels of the smaller pattern (VM5000, TDS5054B, TDS5104B)	—	±1 pixel of the smaller pattern	—
H Start, H End	—	±6 pixels of the smaller pattern (VM5000HD, TDS5054, TDS5104) ±3 pixels of the smaller pattern (VM5000, TDS5054B, TDS5104B)	—	±1 pixel of the smaller pattern	—
H Scaling	—	±1%	—	±1%	—
H Offset	—	±6 pixels of the smaller pattern (VM5000HD, TDS5054, TDS5104) ±3 pixels of the smaller pattern (VM5000, TDS5054B, TDS5104B)	—	±1 pixel of the smaller pattern	—

*9 For VM6000 Instrument Characteristics, please refer to the DPO7104 data sheet.

*10 SDi = SD Interlace, SDp = SD Progressive.

*11 RL = Record Length.

Option VGA Video Measurements*[12]

Characteristic	Description	VM5000HD, VM5000, TDS5104, TDS5104B	VM6000, DPO7104	DPO7254	DPO7354
Amplitude Measurements					
Luma Level, Max and Min	VESA 6.1 (typical)	±5 mV ±0.9% of reading	±5 mV ±0.6% of reading	±5 mV ±0.6% of reading	±5 mV ±0.6% of reading
Color Bars	Channel voltage levels measured relative to back porch (typical)	±3 mV ±0.9% of reading	±3 mV ±0.6% of reading	±3 mV ±0.6% of reading	±3 mV ±0.6% of reading
CH-CH Mismatch (mV)	32-step staircase signal. VESA 6.5 channel voltage levels measured relative to back porch (typical)	±5 mV ±1.3% of reading	±5 mV ±0.9% of reading	±5 mV ±0.9% of reading	±5 mV ±0.9% of reading
CH-CH Mismatch (%)		±0.7% ± (1.3%)×(Luma Level / Max Luma Level); Maximum of ±2.0%	±0.7% ± (0.9%)×(Luma Level / Max Luma Level); Maximum of ±1.6%	±0.7% ± (0.9%)×(Luma Level / Max Luma Level); Maximum of ±1.6%	±0.7% ± (0.9%)×(Luma Level / Max Luma Level); Maximum of ±1.6%
HV Sync Logic "0" and "1"	VESA 7.1 (P-P sync amplitude) = (logic 1 voltage) – (logic 0 voltage) (typical)	±[8 mV ± (0.01) × (P-P sync amplitude)] ±0.8% of reading	±[8 mV ± (0.01) × (P-P sync amplitude)] ±0.5% of reading	±[8 mV ± (0.01) × (P-P sync amplitude)] ±0.5% of reading	±[8 mV ± (0.01) × (P-P sync amplitude)] ±0.5% of reading
Linearity, Resolution, Monotonicity					
Integral Linearity (%)	VESA 6.4. Requires step response compliant to VESA limits for overshoot/undershoot, amplitude and settle time	±1.0% (typical)	±1.0% (typical)	±1.5% (typical)	±1.5% (typical)
Differential Linearity	(Typical)	±0.25 LSB (8 bit) ±0.5 LSB (10 bit)	±0.25 LSB (8 bit) ±0.5 LSB (10 bit)	±0.5 LSB (8 bit) ±1.0 LSB (10 bit)	±0.5 LSB (8 bit) ±1.0 LSB (10 bit)
RGB Video Monotonicity	Monotonicity checks every step on the ramp to ensure signal is always rising (typical)	±0.25 LSB (8 bit) ±0.5 LSB (10 bit)	±0.25 LSB (8 bit) ±0.5 LSB (10 bit)	±0.5 LSB (8 bit) ±1.0 LSB (10 bit)	±0.5 LSB (8 bit) ±1.0 LSB (10 bit)
Resolution Measurement Range	Resolution measured in bits	5 to 10 bits	5 to 10 bits	5 to 10 bits	5 to 10 bits
HV Sync Monotonic Rise and Fall	Checks sync for always-rising and always-falling characteristic. Requires VESA-compliant amplitude, noise, rise, and fall	Detects monotony as small as 1% of P-P sync amplitude (typical)	Detects monotony as small as 1% of P-P sync amplitude (typical)	Detects monotony as small as 2% of P-P sync amplitude (typical)	Detects monotony as small as 2% of P-P sync amplitude (typical)
Noise					
Noise (mV) Measurement Range 8-15 mV	Measurement of RGB noise on constant pedestal, 0 to 700 mV. Output in mV$_{p-p}$, dB below 700 mV, VESA Sec 6.6. Displayed value corrected for instrument noise. Specification applies with 500 MHz bandwidth filter and 10 averages selected	±5.25 mV	±5.25 mV	±5.25 mV	±5.25 mV
Noise (mV) Measurement Range 15-25 mV		The lesser of ±7 mV or ±35%	The lesser of ±7 mV or ±35%	The lesser of ±7 mV or ±35%	The lesser of ±7 mV or ±35%
Noise Injection Ratio (%) Measurement Range 1.1% to 2.1%		±0.75%	±0.75%	±0.75%	±0.75%
Noise Injection Ratio (%) Measurement Range 2.1% to 3.6%		±1%	±1%	±1%	±1%
Timing					
Channel Skew Measurement Range ±35 ns	Alternate implementation of VESA 6.7; Any two channels	±500 ps	±550 ps	±600 ps	±600 ps
H Timing (ns) – Front and Back Porch, Left and Right Border, Addressable Video	—	360 ps ±15 ppm × Reading	360 ps ±2.5 ppm × Reading	360 ps ±2.5 ppm × Reading	360 ps ±2.5 ppm × Reading
H Sync Period, H and V Sync Pulse Width (ns)	—	80 ps ±15 ppm × Reading	80 ps ±2.5 ppm × Reading	80 ps ±2.5 ppm × Reading	80 ps ±2.5 ppm × Reading
V Sync Period (µs)	Readout (precision) is 1 µs	20 ns ±15 ppm × Reading	20 ns ±2.5 ppm × Reading	20 ns ±2.5 ppm × Reading	20 ns ±2.5 ppm × Reading
V Timing (Lines) – Front and Back Porch, Top and Bottom Border, Addressable Lines	Readout (precision) is 1 line. Functions within ±10 lines of VESA reference value	—	—	—	—

Characteristic	Description	VM5000HD, VM5000, TDS5104, TDS5104B	VM6000, DPO7104	DPO7254	DPO7354
Frequency					
H and V Sync, Pixel Clock Frequency	—	±0.01% of reading	±0.01% of reading	±0.01% of reading	±0.01% of reading
Transient Response					
Video Rise and Fall Time Measurement Range >1.3 ns	VESA 6.8 (typical)	±5.0% of reading	±5.0% of reading	±5.0% of reading	±5.0% of reading
Video Rise and Fall Time Measurement Range 800 ps to 1.3 ns		±10% of reading	±10% of reading	±10% of reading	±10% of reading
Video Rise and Fall Time Measurement Range 450 ps to 800 ps	Video Transient Response: Utilizes course grille, VESA Section 6.2, 6.3, 6.8. Displayed results corrected for RGB measurement system bandwidth limitations (typical)	±20% of reading	±20% of reading	±20% of reading	±20% of reading
RGB System Rise Time	(Typical)	350 ps	350 ps	225 ps	210 ps
Sync Rise and Fall Time Measurement Range >5 ns	VESA Section 7.1-7.4. Displayed results corrected for H/V measurement system bandwidth limitations (typical)	±5.0%	±5.0%	±5.0%	±5.0%
Sync Rise and Fall Time Measurement Range 2 ns to 5 ns	(Typical)	±11%	±11%	±11%	±11%
RGB and HV Sync Overshoot and Undershoot Amplitude %, Settle Time: 0-1 ns	(Typical)	±2% of reading	±2% of reading	±2% of reading	±2% of reading
RGB and HV Sync Overshoot and Undershoot Amplitude %, Settle Time: 1-10 ns	(Typical)	±1% of reading	±1% of reading	±1% of reading	±1% of reading
RGB and HV Sync Overshoot and Undershoot Settling Time, Amplitude >5%	VESA 6.3 (typical)	±T rise	±T rise	±T rise	±T rise
Jitter					
H Sync Jitter (ns)	VESA 7.5. Requires VESA compliant amplitude, noise, rise, and fall characteristics	100 ps ±15 ppm × H Sync period	100 ps ±2.5 ppm × H Sync period	100 ps ±2.5 ppm × H Sync period	100 ps ±2.5 ppm × H Sync period
H Sync Jitter (% of Pixel Clock Period) Measurement Range: <200 MHz PCF		<4%	<3%	<3%	<3%
H Sync Jitter (% of Pixel Clock Period) Measurement Range: 200 to 400 MHz PCF		<7.5%	<5%	<5%	<5%

*12 Specifications apply with use of Measurement Interface Unit (MIU).

Hardware Accessory Specifications

RGBHV Measurement Interface Unit (MIU)

Characteristic	Specification Wideband Mode	Specification Precision LF Mode	Reference Information
DC Gain			
RGB Channels	0.1 ±3% (typical)	1.0 ±0.002%	VM6000 automatically compensates for Wideband mode gain
HV Channels	0.01 ±5% (typical)	1.0 ±0.002%	—
DC Termination			
RGB Channels	75 Ω nominal	75 Ω ±0.3%	—
HV Channels	2.2 kΩ ±3%	2.2 kΩ ±1.5%	—
Bandwidth			
RGB Channels	<3 dB down at 1,500 MHz	DC to 10 MHz (typical)	—
HV Channels	<3 dB down at 320 MHz	DC to 10 MHz (typical)	—
RGB Channels Input Return Loss			
1 MHz to 100 MHz	>27 dB	—	27 dB RL is equivalent to ±7.5 Ω variation from 75 Ω
100 MHz to 250 MHz	>21 dB	—	21 dB RL is equivalent to ±15 Ω variation from 75 Ω
HV Channels Input Capacitance	3 pF (typical)	—	—
Current Source Loads (HV channels)	—	+8 mA ±2.5% −8 mA ±2.5%	Current sources provide loads for V0H and V0L testing of HV Sync signals

HDTV Matrix

Test Signal Details

Signal	Format	Signal Details
Color Bars	All	100% Color Bars with 100% White
Multiburst	720p, 1080i, and 1080p	5, 10, 15, 20, 25, 30 MHz for Y, G, B, R 2.5, 5, 7.5, 10, 12.5, 15 MHz for Pb and Pr
	480p and 576p	2, 4, 6, 8, 10, 12 MHz for Y, G, B, R 1, 2, 3, 4, 5, 6 MHz for Pb and Pr
	480i and 576i	1, 2, 3, 4, 5, 6 MHz for Y, G, B, R 0.5, 1, 1.5, 2, 2.5, 3 MHz for Pb and Pr
Sweep	720p, 1080i, and 1080p	5 to 35 MHz for Y, G, B, R 2.5 to 15 MHz for Pb and Pr
	480p and 576p	2 to 12 MHz for Y, G, B, R 1 to 6 MHz for Pb and Pr
	480i and 576i	0.5 to 6 MHz for Y, G, B, R 0.5 to 3 MHz for Pb and Pr
Sweep Parade	All	Windowed Areas (Chirp)
Flat Field – Black	All	Near Black – 7.5 mV
Flat Field – Gray	All	Gray – 350 mV on RGB
Flat Field – White	All	White – 700 mV on RGB
Valid Ramp	All	Ramp 0 to 700 mV on RGB
Shallow Ramp	All YPbPr	Ramp 350 mV ±35 mV on Y, G, B, R Ramp 0 mV ±35 mV on Pb and Pr
Pulse and Bar	YPbPr and RGB	2T Pulse Response with equivalent bar rise and bar fall. Pb and Pr are twice the duration of Y, G, B, R

General

Display Characteristics

Characteristic	Description
Display Type	Liquid-crystal active-matrix color display
Display Size	Diagonal: 307.3 mm (12.1 in.)
Display Resolution	XGA 1024 (H) × 768 (V) pixels
Waveform Styles	Vectors, Dots, Variable Persistence, Infinite Persistence
Color Palettes	Normal, Green, Gray, Temperature, Spectral, and User Defined
Display Format	YT, XY

Computer System and Peripherals

Characteristic	Description
Operating System	Windows XP
CPU	Intel Pentium 4, 3.4 GHz processor
PC System Memory	2 GB
Hard Disk Drive	Rear-panel, removable hard disk drive, 80 GB capacity
CD-R/W Drive	Front-panel CD-R/W drive with CD-creation software application
DVD Drive	Read only
Mouse	Optical wheel mouse, USB interface
Printer (Optional)	Thermal printer; fits in accessories pouch provided with instrument
Keyboard	119-7083-xx for small keyboard (fits in pouch); USB interface and hub

Input/Output Ports

Characteristic	Description
Front Panel	
Video Input	Front-panel BNC connectors (3) for 3-wire CAV. A fourth BNC for separate composite sync or H Sync input on RGBHV signals. A fifth BNC (auxiliary input) for V Sync on RGBHV signals. Trigger level range is adjustable from +8 V to –8 V. The maximum input voltage is ±20 V (DC + peak AC) and input resistance is ≥1.5 kΩ
Probe Compensator Output	Front-panel pins Amplitude: 1 V ±20% into a ≥50 Ω load; 500 mV from base to top into a 50 Ω load Frequency: 1 kHz ±5%
USB 2.0 Port	One front-panel and four side-panel mounted USB 2.0 connectors
Aux Trigger Input	TekVPI interface; ±5 V (50 Ω); 150 V CAT I, derate at 20 dB/decade to 9 V_{RMS} above 200 kHz (1 MΩ)
Side Panel	
Parallel Port	IEEE 1284, DB-25 connector
Audio Ports	Miniature phone jacks for stereo microphone input and stereo line output
Keyboard Port	PS-2 compatible
Mouse Port	PS-2 compatible
LAN Port	RJ-45 connector, supports 10BASE-T, 100BASE-T, and Gigabit Ethernet
Serial Port	DB-9 COM1 port
VGA Video Port	DB-15 female connector; connect a second monitor to use dual-monitor display mode. Supports basic requirements of PC99 specifications
Oscilloscope VGA Video Port	DB-15 female connector, 31.6 kHz sync, EIA RS-343A compliant, connect to show the oscilloscope display, including live waveforms on an external monitor or projector
Rear Panel	
Power	90 to 264 V_{RMS}, ±10%, 47 to 63 Hz; CAT II, <400 VA
Analog Signal Output	BNC connector provides a buffered version of the signal that is attached to the CH3 input when CH3 is selected as trigger source
Amplitude	50 mV/div ±20% into a 1 MΩ load 25 mV/div ±20% into a 50 Ω load
Bandwidth	100 MHz into a 50 Ω load
External Time Base Reference In	BNC connector, time-base system can phase-lock to external 10 MHz reference
Time Base Reference Out	BNC connector accepts TTL-compatible output of internal 10 MHz reference oscillator
Aux Trigger Output	BNC connector provides a TTL-compatible, polarity switchable pulse when the oscilloscope triggers
GPIB Port	IEEE 488.2 standard

Physical Characteristics

Benchtop Configuration

Dimension	mm	in.
Height	292	11.48
Width	451	17.75
Depth	265	10.44
Weight	**kg**	**lb.**
Net	15	32
Shipping	28.9	63.75

Rackmount Configuration

Dimension	mm	in.
Height	323	12.25
Width	479	18.85
Depth (from rackmounting ear to back of instrument)	231.75	9.12
Weight	**kg**	**lb.**
Net	17.4	37.5
Kit	2.5	5.5

Mechanical

Cooling – Required Clearance

Dimension	mm	in.
Top	0	0
Bottom	0	0
Left side	0	0
Right side	76	3
Front	0	0
Rear	0	0

Environmental

Characteristic	Description
Temperature	
Operating	+10 °C to +45 °C
Nonoperating	–40 °C to +71 °C
Humidity	
Operating	5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 °C at or below +50 °C, noncondensing. Upper limit derated to 45% RH above +30 °C up to +50 °C
Nonoperating	5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 °C at or below +60 °C, noncondensing. Upper limit derated to 45% RH above +30 °C up to +50 °C
Altitude	
Operating	10,000 ft. (3,048 m)
Nonoperating	40,000 ft. (12,190 m)
Random Vibration	
Operating	0.000125 G^2/Hz from 5 to 350 Hz
	–3 dB/octave from 350 to 500 Hz
	0.0000876 G^2/Hz at 500 Hz
	Overall level of 0.27 G_{RMS}
Nonoperating	0.0175 G^2/Hz from 5 to 100 Hz
	–3 dB/octave from 100 to 200 Hz
	0.00875 G^2/Hz from 200 to 350 Hz
	–3 dB/octave from 350 to 500 Hz
	0.006132 G^2/Hz at 500 Hz
	Overall level of 2.28 G_{RMS}
Regulatory	
Electromagnetic Compatibility	93/68/EEC; EN61326:1997 +A1 1998+A2:2000
Certifications	UL 3111-1, CSA1010.1, ISO11469,EN61010-1, IEC 61010-1

Ordering Information

VM6000

Item/Option	Order Number / Description
Automatic Video Measurement Set	1 GHz Digital Phosphor Oscilloscope, accessory pouch, front cover, mouse, quick-start user manual (071-173x-xx), Probe calibration and deskew fixture (067-0405-xx), DPO7000 Series product software CD-ROM, optional applications software CD-ROM, performance verification procedure PDF file, GPIB programmer's reference (on product software CD-ROM), calibration certificate documenting NIST traceability, Z 540-1 compliance and ISO9001, power cord, one-year warranty. **Note**: Please specify language and power cord options when ordering.
Video Measurement Accessory Kit (VM)	
Sync Pick-off Accessory	012-1680-xx
75 Ω BNC Termination (Qty. 4)	011-0102-xx
BNC T's (Qty. 4)	103-0030-xx
TPA-BNC Adapter, Sync Combiner	012-1664-xx
VM6000 User Manual	071-2103-xx
VM6000 Product Software CD-ROM	020-2767-xx
VM6000 Programmer's Manual	071-2104-xx
Note: Requires at least one of Option SD, HD, or VGA with each new instrument ordered.	
Note: User to specify quick-start user manual language, and power plug when ordering.	
Opt. HD	Option key enabling HD format support
TPA-BNC Adapter	013-0355-xx
Opt. SD	Option key enabling SD format support
TPA-BNC Adapter	013-0355-xx
Opt. VGA	Option key enabling VGA option
RGBHV Measurement Interface Unit	012-1685-xx
TPA-BNC Adapter (Qty. 4)	013-0355-xx
Opt. SS	
Signal Sources Package (Single instrument license)	020-2769-xx

VM6UP

Item/Option	Order Number / Description
Video Measurement Accessory Kit (VM)	**Note**: User to specify quick-start user manual language, and power plug when ordering.
VM Series User Manual	071-2103-xx
VM Series Product Software CD-ROM	020-2767-xx
Option VM	
Sync Pick-off Accessory	012-1680-xx
75 Ω BNC Termination (Qty. 4)	011-0102-xx
BNC T's (Qty. 4)	103-0030-xx
Sync Combiner	012-1664-xx
Option HD	Option key enabling HD format support
Sync Pick-off Accessory	012-1680-xx
TPA-BNC Adapter	010-0753-xx
Option SD	Option key enabling SD format support
Sync Pick-off Accessory	012-1680-xx
TPA-BNC Adapter	010-0753-xx
Option VGA	Option key enabling VGA option
RGBHV Measurement Interface Unit	012-1685-xx
TPA-BNC Adapter (Qty. 4)	010-0753-xx
Option SS	
Signal Sources Package (Single instrument license)	020-2769-xx

Options

VM6000 Instrument Options

Option	Description
Video Measurement	
Opt. SD*13	SD component analog video measurements and format support
Opt. HD*13	HD component analog video measurements and format support
Opt. VGA*13	RGBHV Video Measurements and VESA Compliance Tests
Opt. SS	Signal sources
Record Length	
Opt. 2RL	80 MS max 20 MS/CH
Opt. 5RL	200 MS max 50 MS/CH
Hardware	
Opt. 2SR	Double maximum real-time sample rate: 40 GS/s (1 channel) 20 GS/s (2 channels) 10 GS/s (3 or 4 channels)
Opt. 1P	Thermal printer in the porch
Software	LSA, JE3, ET3*14,JA3, USB*15, MTM, PWR

*13 At least one of Option SD, HD, or VGA is mandatory for each VM6000 instrument.

*14 Requires Ethernet Test Fixture.

*15 Requires TDSUSBF (USB Test Fixture), supports USB 2.0 low-speed and full-speed compliance testing.

User Manual Options

Option	Description
Opt. L0	English Manual
Opt. L1	French Manual
Opt. L3	German Manual
Opt. L5	Japanese Manual
Opt. L7	Simple Chinese Manual
Opt. L8	Standard Chinese Manual
Opt. L9	Korean Manual
Opt. L10	Russian Manual

Power Plug Options

Option	Description
Opt. A0	North America power cord
Opt. A1	Universal European Union power cord
Opt. A2	UK power cord
Opt. A3	Australia power cord
Opt. A5	Switzerland power cord
Opt. A6	Japan power cord
Opt. A10	China power cord
Opt. A11	India power cord
Opt. A99	No power cord

Service Options

Option	Description
Opt. CA1	Single Calibration or Functional Verification
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R3	Repair Service 3 Years
Opt. R5	Repair Service 5 Years
VM6UP IF	Upgrade Installation Service

Recommended Accessories

Probes

Probe	Description
TAP2500	2.5 GHz TekVPI™ active single-ended probe
TAP1500	1.5 GHz TekVPI active single-ended probe
P6158	3 GHz, 20X low-C probe
P6247*16	1 GHz differential probe
P6243*16	1 GHz active probe
P6245*16	1.5 GHz active probe
P6248*16	1.5 GHz differential probe
P5050	500 MHz, 10X passive probe
P6246	400 MHz differential probe
P6101B	1X passive probe 15 MHz
TCPA300/TCPA400*16	Series current measurement systems
P5200/P5205/P5210*16	High-voltage differential probes
P5100/P6015A*16	High-voltage probes
TCP0030	100 MHz TekVPI AC/DC 30 A current probe

*16 Probe requires TPA-BNC adapter.

Cables

Cable	Order Number
VGA to 5X BNC cable, 6 in.	174-5147-xx
VGA to 5X BNC cable, 1 m	174-5126-xx
GPIB Cable (1 m)	012-0991-xx
GPIB Cable (2 m)	012-0991-xx
RS-232 Cable	012-1298-xx or 012-1692-xx
Centronics Cable	012-1214-xx

Accessories

Accessory	Order Number
Signal Sources on DVD	020-2770-xx
Standard Definition Elementary Streams on CD-ROM	020-2771-xx
Advanced Definition Elementary Streams on CD-ROM	020-2772-xx
ATSC Transport Streams on CD-ROM	020-2773-xx
Baseband Test Signals on CD-ROM	020-2774-xx
PC Bitmap Graphics on CD-ROM	020-2775-xx
H.264 SD and HD Streams on CD-ROM	020-2776-xx
BNC Elbow	103-0031-xx
75 Ω BNC Termination	011-0102-xx
BNC T	103-0030-xx
Mini Keyboard (USB interface)	119-7083-xx
Service Manual	071-1740-xx
Transit Case	016-1522-xx
Video Display Clamp Order	013-0278-xx
Rackmount Kit	016-1965-xx
Oscilloscope Cart	K420

Software

WSTRO – WaveStar™ waveform capture and documentation software.

Test Fixtures

Fixture	Order Number
Sync Pick-off Accessory	012-1680-xx
Sync Combiner Accessory	012-1664-xx
RGBHV Measurement Interface Unit	012-1685-xx
TDSUSBF	Test fixture for use with Opt. USB
Power Deskew Fixture	067-1478-xx
Ethernet Test Fixture	Order through Crescent Heart Software (http://www.c-h-s.com)

Adapters

Adapter	Order Number
TPA-BNC	TekVPI to BNC adapter
AMT75	1 GHz 75 Ω adapter
P6701B	Optical/Electrical converter (Multi Mode)
P6703B	Optical/Electrical converter (Single Mode)

Instrument Upgrades

To upgrade your VM6000, order options as noted – VM6UP with Options SD, HD, VGA, SS, RL02, RL05, RL25, ET3, USB, MTM, PWR, JA3, JE3, LSA, CP2, J2, HT3.
To upgrade other Tektronix oscilloscopes, please consult the following table for platform requirements, mandatory options, functionality, and option availability.

Product	Upgrade Kit	Option				
		VM	**SD**	**HD**	**VGA**	**SS[19]**
DPO7054[20, 21]	VM6UP	X[17]	X	X	NA	X
DPO7104[20, 21]		X[17]	X	X	X	X
DPO7254[20, 21]		X[17]	X	X	X	X
DPO7354[20, 21]		X[17]	X	X	X	X
VM6000		NA[18]	X	X	X	X

NA = Not Available

[17] Option VM is a mandatory option for all DPO oscilloscope upgrades (VM6UP), but it is not needed on purchasing 2nd upgrade kit for the unit which has same serial number.

[18] Option VM is default enabled/included with VM6000. Not required for upgrade kits.

[19] Requires the indication of the serial number of the unit.

[20] The other upgrade kit than Option VM, SD, HD, VGA, SS for DPO7054, DPO7104, DPO7254, and DPO7354 is provided from the DPO7UP kit.

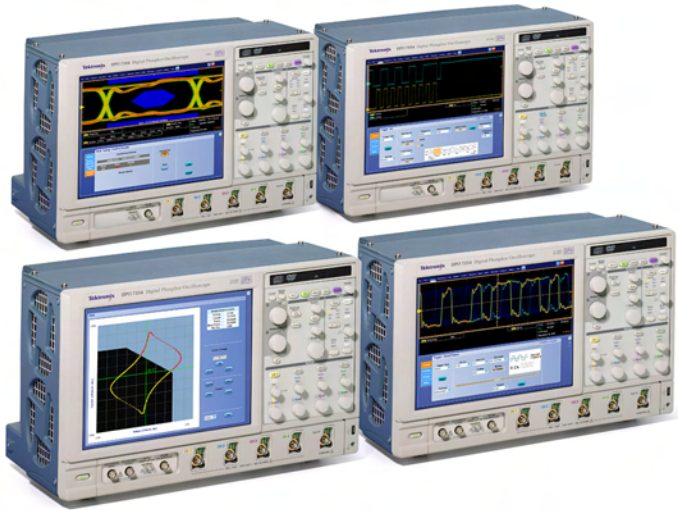[21] The application for DPO7000 needs V4.0.0, or above.

CE

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

GPIB
IEEE-488

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Digital Phosphor Oscilloscopes

DPO7000 Series Data Sheet

Features & Benefits

- 3.5 GHz Bandwidth Model for Serial and Digital Applications
- 2.5 GHz, 1 GHz, and 500 MHz Bandwidth Models for All Applications
- Up to 40 GS/s Real-time Sample Rate on One Channel and up to 10 GS/s on All Four Channels
- Up to 500 Megasamples Record Length with MultiView Zoom™ Feature for Quick Navigation
- >250,000 wfms/s Maximum Waveform Capture Rate
- Up to 310,000 Waveforms per Second with FastFrame™ Segmented Memory Acquisition Mode
- User-selectable Bandwidth Limit Filters for Better Low-frequency Measurement Accuracy
- MyScope® Custom Windows and Right Mouse Click Menus for Exceptional Efficiency

- Event Search and Mark to Find Specific Events in the Entire Waveform
- Pinpoint® Triggering provides the Most Flexible and Highest Performance Triggering, with Over 1400 Combinations to Address Virtually Any Triggering Situation.
- 12.1″ XGA Display with Touch Screen
- Communications Mask Testing
- Clock Recovery from Serial Data Streams
- 64-bit NRZ Serial Pattern Trigger for Isolation of Pattern-dependent Effects up to 1.25 Gb/s
- Low-speed Serial Protocol Triggering and Decode (I^2C, SPI, RS-232, CAN, LIN, and FlexRay)
- Technology-specific Software Solutions provide Built-in Domain Expertise for MIPI® D-PHY, Ethernet, USB 2.0 Compliance Testing, Jitter, Timing, Eye Diagram, Power, DDR Memory Bus Analysis, CAN, LIN, and FlexRay Network Design
- OpenChoice® Software with Microsoft Windows XP OS enables Built-in Networking and Extended Analysis

Applications

- Signal Integrity, Jitter, and Timing Analysis
- Verification, Debug, and Characterization of Sophisticated Designs
- Debugging and Compliance Testing of Serial Data Streams for Telecom and Datacom Industry Standards
- Low-speed Serial Bus Design (I^2C, SPI, RS-232, CAN, LIN, and FlexRay)
- Investigation of Transient Phenomena
- Power Measurements and Analysis
- Spectral Analysis

Tektronix®

Unmatched Performance for Greater Insight Into Your Design to Get Your Work Done Faster

The DPO7000 Series are the new generation of real-time digital phosphor oscilloscopes and are the industry's best solution to the challenging signal integrity issues faced by designers verifying, characterizing, debugging, and testing sophisticated electronic designs.

The family features exceptional performance in signal acquisition and analysis, operational simplicity, and unmatched debugging tools to accelerate your day-to-day tasks. The largest screen in the industry and the intuitive user interface provide easy access to the maximum amount of information.

Unmatched Acquisition Performance

Signal Fidelity of Tektronix Oscilloscopes Ensures Confidence in Your Measurement Results

- High sample rate on all models, on all channels, to capture more signal details (transients, imperfections, fast edges)
    - 40 GS/s on one channel on the 2.5 GHz and 3.5 GHz models
    - Option 2SR to double the maximum real-time sample rate for the 1 GHz model

- High bandwidth up to 3.5 GHz, matched across 2, 3, or 4 channels and enabled by Tektronix proprietary DSP enhancement. The user-selectable DSP filter on each channel provides magnitude and phase correction plus extension to 3.5 GHz for more accurate signal fidelity for complex measurements. The DSP filter on each channel can also be switched off to take advantage of true 2.5 GHz analog bandwidth for applications needing the highest available raw data capture.

- The DPO7000 Series oscilloscopes include as a standard feature a series of user-selectable bandwidth limit filters. These filters preserve the instrument's bandwidth roll-off characteristics, flatness, and phase linearity within the new frequency range, thereby reducing the effects of out-of-band noise on measurements. Now, designers can purchase one instrument for their highest bandwidth needs and easily optimize it to handle lower-frequency measurements as well.

- Very low jitter noise floor and vertical accuracy for very accurate measurements

- Long acquisition to provide more resolution and longer time sequence
    - Standard 10 million data points per channel on the DPO7000 Series
    - Optional up to 500 million total data points on 2.5 GHz and 3.5 GHz models
    - Optional up to 250 million total data points on the 500 MHz and 1 GHz models
    - Easily manage this deep record length, provide detailed comparison and analysis of multiple waveform segments with the MultiView Zoom™ feature. Automatically scroll through deep records visually, or create a math expression to instantly highlight differences

- Highest-performance probing solutions for differential and single-ended voltage signals as well as current measurement, because accurate design verification depends on high-bandwidth access to critical signals and high-fidelity signal capture

User-selectable bandwidth limiting choices.
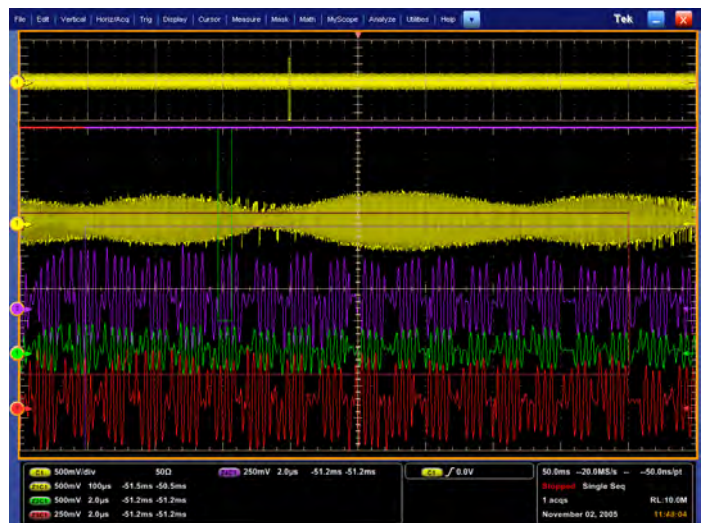
Zoom in on four areas of interest simultaneously to compare them.
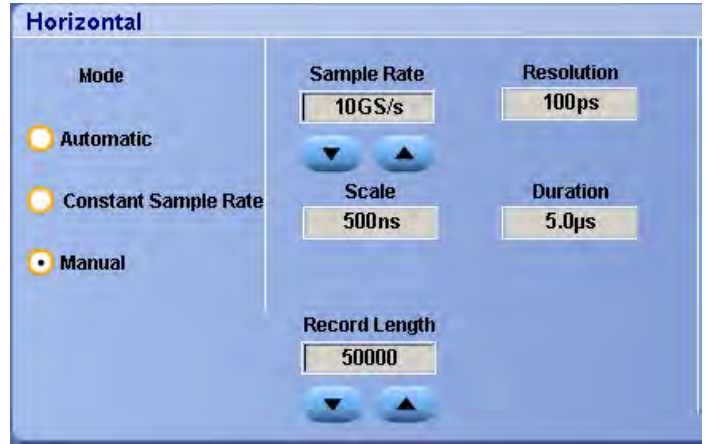
Unmatched Versatility

Get the Most of Your Oscilloscope by Fully Controlling its Waveform Acquisition and Display Parameters

You have the choice of three horizontal time base modes of operation. If you are simply doing signal exploration and want to interact with a lively signal, you will use the *Automatic* or interactive default mode that provides you with the liveliest display update rate. If you want a precise measurement and the highest real-time sample rate that will give you the most measurement accuracy, then the *Constant Sample Rate* mode is for you. It will maintain the highest sample rate and provide the best real-time resolution. The last mode is called the *Manual* mode because it ensures direct and independent control of the sample rate and record length.

With the MyScope® Feature, Create Your Own Control Windows with Only the Controls, Features, and Capabilities that You Care About

Easily create your own personalized "toolbox" of oscilloscope features in a matter of minutes using a simple, visual, drag-and-drop process.

Tektronix active probes achieve high-speed signal acquisition and measurement fidelity.

Once created, these custom control windows are easily accessed through a dedicated MyScope button and menu selection on the oscilloscope button/menu bar, just like any other control window. You can make an unlimited number of custom control windows, enabling each person who uses the oscilloscope in a shared environment to have their own unique control window. MyScope control windows will benefit all oscilloscope users, eliminating the ramp-up time that many face when returning to the lab after not using an oscilloscope for a while, and enables the power user to be far more efficient. Everything you need is found in one control window rather than having to constantly navigate through menu after menu to repeat similar tasks.

3 modes of operation of the horizontal time base.
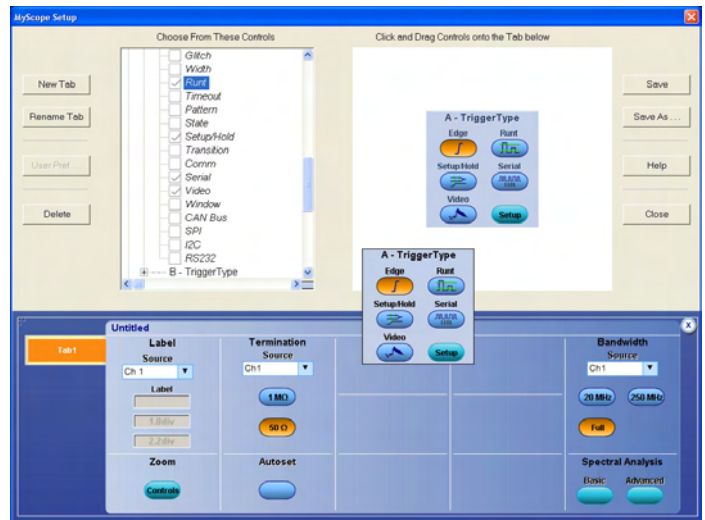
Drag and drop menu items of interest to create the MyScope control window.
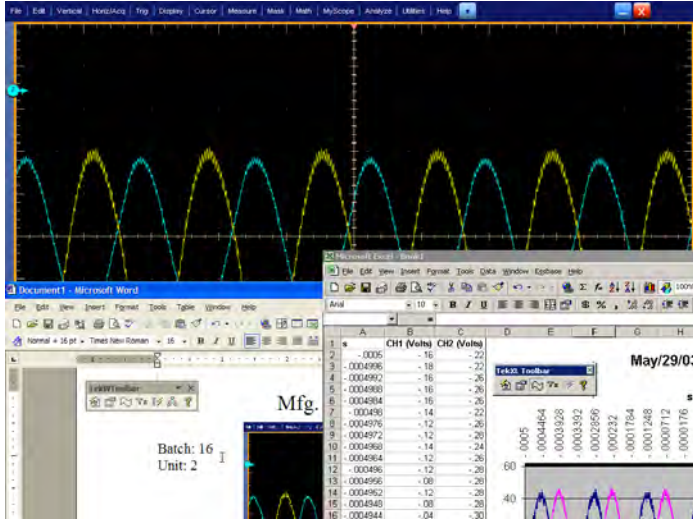
Capture data into Microsoft Excel using the unique Excel toolbar, and create custom reports using the Word toolbar.

Maximize the probability of capturing elusive glitches and other infrequent events with FastAcq acquisition mode.

With OpenChoice® Software, Customize Your Test and Measurement System with Familiar Analysis Tools

The analysis and networking features of OpenChoice software add flexibility to Windows XP Tektronix oscilloscopes: The Windows XP Remote Desktop functionality enables remote monitoring of the instrument over the internet. Using the fast embedded bus, waveform data can be moved directly from acquisition to analysis applications on the Windows desktop at much faster speeds than conventional GPIB transfers. Implementation by Tektronix of industry-standard protocols, such as TekVISA™ interface and ActiveX controls, are included for using and enhancing Windows applications for data analysis and documentation. Support for the DPO7000 Series is also available with NI LabVIEW SignalExpress™ Tektronix Edition. IVI-COM instrument drivers are included to enable easy communication with the oscilloscope using GPIB, serial data, and LAN connections from programs running on the instrument or an external PC. Or, use the Software Developer's Kit (SDK) to help create custom software to automate multistep processes in waveform collection and analysis with Visual BASIC, C, C++, MATLAB, LabVIEW, LabWindows/CVI, and other common Application Development Environments (ADE). Integration of the oscilloscope with external PCs and non-Windows hosts is also supported by the DPO7000 Series software solutions. In addition, the OpenChoice architecture provides a comprehensive software infrastructure for faster, more versatile operations. Data transfer programs, such as the Excel or Word toolbar, are used to simplify analysis and documentation on the Windows desktop or on an external PC.
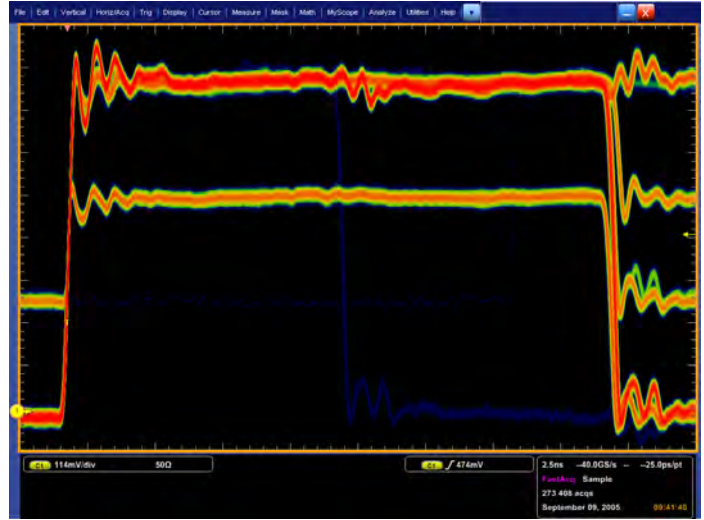
Accelerate the Debug of Complex Electrical Designs

FastAcq Acquisition Mode Expedites Debugging by Clearly Showing Imperfections

More than just color grading, FastAcq enabled by Tektronix proprietary DPX® acquisition technology captures signals up to more than 250,000 waveforms per second on all 4 channels simultaneously, dramatically increasing the probability of discovering infrequent fault events. And with a simple turn of the intensity knob you can clearly see "a world others don't see," because frequency of occurrence is color coded. Some oscilloscope vendors claim high waveform capture rates for short bursts of time, but only the DPO7000 Series, enabled by DPX technology, can deliver these fast waveform capture rates on a sustained basis – saving minutes, hours, or even days by quickly revealing the nature of faults so sophisticated trigger modes can be applied to isolate them.
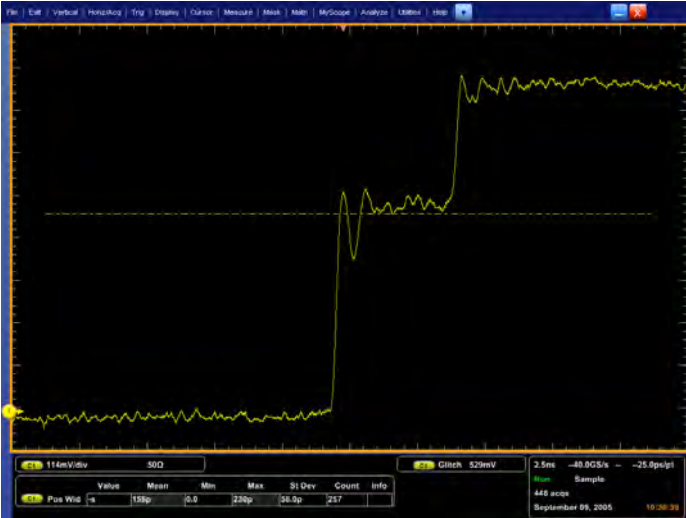
Isolate glitches down to 200 ps wide.

Easily trigger on a specific I²C address.

Isolate Setup and Hold violations down to 360 ps.

The Ability to Trigger an Oscilloscope on Events of Interest is Paramount in Complex Signal Debug and Validation

Whether you're trying to find a system error or need to isolate a section of a complex signal for further analysis, like a DDR Read or Write burst, Tektronix Pinpoint® triggering provides the solution. The Pinpoint trigger system uses Silicon Germanium (SiGe) technology to provide trigger sensitivity of up to the bandwidth of the instrument, and allows selection of most trigger types on both A and B trigger circuits. It can capture very narrow glitches with very little trigger jitter. Other trigger systems offer

multiple trigger types only on a single event (A event), with delayed trigger (B event) selection limited to edge-type triggering and often do not provide a way to reset the trigger sequence if the B event doesn't occur. But Pinpoint triggering provides a full suite of advance trigger types on both A and B triggers with Reset triggering to begin the trigger sequence again after a specified time, state, or transition so that even events in the most complex signals can be captured. Other oscilloscopes typically offer less than 20 trigger combinations; Pinpoint triggering offers over 1400 combinations, all at full performance.

With Enhanced Triggering, you can choose to compensate for the difference in time there is between the trigger path and the display path and eliminate virtually any trigger jitter at the trigger point. In this mode, the trigger point can be used as a measurement reference.

Trigger on the Most Relevant Bit Sequence of the Industry-standard Serial Bus

I²C (Inter-Integrated Circuit) triggering is a standard feature and includes Start Condition, Missing Acknowledge, Restart, Data Read, Address, and/or Data Frame, in a 10 bit or 7 bit format with a specific selection to choose whether or not to include the R/W bit.

SPI (Serial Peripheral Interface) triggering is a standard feature and includes triggering on a data pattern within a user-definable frame.

RS-232 triggering is a standard feature.

CAN (Controller Area Network) triggering is an optional feature (Opt. LSA) and includes synchronization to the Start or End of a CAN frame on any CAN high or CAN low signal, triggering on Type of Frame (Data, Remote, Overload), Identifier, Data, Missing Acknowledge, and Bit Stuffing error.
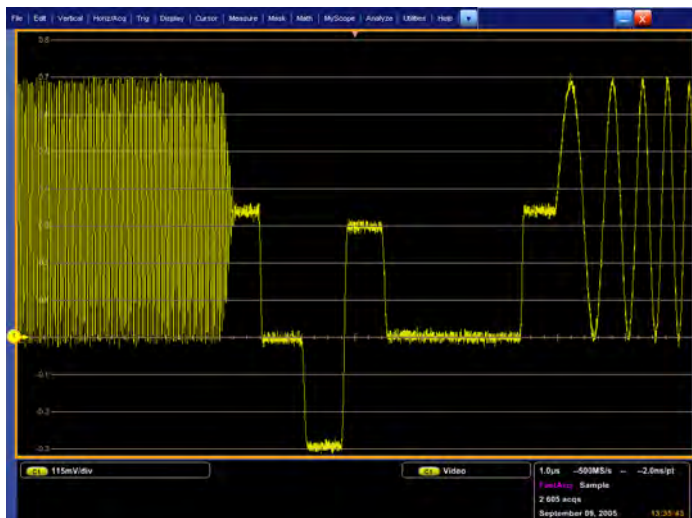
Triggering on an analog HDTV tri-level sync signal and examining horizontal blanking interval.

Serial pattern triggering to debug pattern-dependent issues.

Analog HDTV/EDTV Triggering for emerging standards like 1080i, 1080p, 720p, and 480p as well as standard video triggering on any line within a field, all lines, all fields, odd or even fields for NTSC, SECAM, and PAL video signals. In addition, IRE and mV graticules can be selected for easier measurements and visual inspection. This is a standard feature.

Serial Pattern Triggering for NRZ serial data streams with built-in clock recovery (available on models DPO7254 and DPO7354 only) to debug serial architectures. The instrument can recover the clock signal, identify the transitions, and decode characters and other protocol data. With the combination of the Serial Trigger and Protocol Decode software, you can see the captured bit sequences decoded into their words for convenient analysis (for 8b/10b and other encoded serial data streams), or you can set the desired encoded words for the serial pattern trigger to capture. This serial trigger option covers NRZ serial standards up to 1.25 Gb/s.

Pattern Lock Triggering adds a new dimension to NRZ serial pattern triggering by enabling the oscilloscope to take synchronized acquisitions

of a long serial test pattern with outstanding time base accuracy. Pattern lock triggering can be used to remove random jitter from long serial data patterns. Effects of specific bit transitions can be investigated, and averaging can be used with mask testing. This feature is included as part of Option PTM on the DPO7254 and 7354 models.

Unmatched Usability

The TekVPI™ probe interface provides versatility and ease of use enabled by intelligent bidirectional oscilloscope-to-probe communication.

The DPO7000 Series are fast-responding instruments and contain a comprehensive suite of features such as a touch screen, shallow menu structures, intuitive graphical icons, knob-per-channel vertical controls, support for right mouse clicks, mouse wheel improvements, saving of waveforms and measurements available in Preview mode, and Export/Save/Recall menu improvements.

An integrated toolset for digital design and troubleshooting.

Basic spectral UI control window.

Interoperability with Logic Analyzers for Digital Design and Debug

The Tektronix Integrated View (iView™) data display enables digital designers to solve signal integrity challenges and effectively debug and verify their systems more quickly and easily. This integration allows designers to view time-correlated digital and analog data in the same display window, and isolate the analog characteristics of the digital signals that are causing systems failures. No user calibration is required. And, once set up, the iView feature is completely automated.

More Insight into Your Complex Electrical Design for Characterization and Compliance Testing

The DPO7000 Series oscilloscopes offer the industry's most comprehensive set of analysis and compliance tools, such as a simple math expression, waveform mask testing, a pass/fail compliance test, event searching, event marking, or a custom application that you develop yourself.

A Wide Range of Built-in Advanced Waveform Analysis Tools

Waveform cursors make it easy to measure trace-to-trace timing characteristics, while cursors that link between YT and XY display modes make it easy to investigate phase relationships and Safe Operating Area violations. Select from 53 automatic measurements using a graphical palette that logically organizes measurements into Amplitude, Time, Combination, Histogram, and Communications categories. Gather further insight into your measurement results with statistical data such as mean, min, max, standard deviation, and population.

Define and apply math expressions to waveform data for on-screen results in terms that you can use. Access common waveform math functions with the touch of a button. Or, for advanced applications, create algebraic expressions consisting of live waveforms, reference waveforms, math functions, measurement values, scalars, and user-adjustable variables with an easy-to-use calculator-style editor.

FFT – To analyze your signal in the spectral domain, use the basic spectral (provides you with the best parameter), or use advanced spectral with the manual time base horizontal mode (to directly control the frequency span, center frequency, and resolution bandwidth).

Filtering – Enhance your ability to isolate or remove some important component of your signal (noise or specific harmonics of the signal) by creating your own filters, or using the filters provided as standard with the instrument.

Advanced Analysis, Jitter, Timing, and Eye Diagram Measurements

Accelerating the research of specific events in an acquired waveform.

Advanced Analysis, Jitter, Timing, and Eye Diagram Measurements

Tight timing margins associated with today's serial buses demand stable, low-jitter designs. DPO7000 models include an Essentials version of the DPOJET software package that extends the oscilloscope's measurement capabilities by making measurements over contiguous clock and data cycles in a single-shot real-time acquisition. DPOJET Essentials adds multiple measurements, including Time Interval Error, Phase Noise, Skew, Setup and Hold timing, Duty Cycle, Period, Positive/Negative Width, and others, and provides the ability to measure key jitter and timing parameters to help characterize possible system timing issues. Analysis tools such as plots for time trends and histograms quickly show how timing parameters change over time, like frequency drift, PLL startup transients, or a circuit's response to power supply changes. Spectrum analysis quickly shows the precise frequency and amplitude of jitter and modulation sources.

Further analysis can be added with DPOJET Advanced (Option DJA) that offers extended capabilities, providing a complete suite of analysis tools for insight into jitter and timing as well as other signal quality issues. To the basic jitter and timing measurements described above, DJA adds advanced tools such as Rj/Dj separation, eye diagram masks, and Pass/Fail limits for conformance testing. DPOJET Advanced is the measurement framework that underlies several other Tektronix standards-specific compliance test packages for applications such as DDR memory and USB.

Advanced Event Search and Mark – Event Search and Mark will relieve the user from the tedious task of examining data by highlighting important events, skipping the unimportant ones, and enhancing the comprehension of event relationships. You can navigate between the events of interest effortlessly. Basic event (edge only) search and mark plus support for more advanced event types like transition, setup and hold, or logic pattern are available.

Waveform Limit Testing – This feature consists of comparing an acquired waveform to boundaries. These boundaries are defined by the user to specify a tolerance band around a reference waveform. If any part of the acquired waveform falls outside of the limit, the software returns a failure message and the location of the failure is shown on the waveform.

Communications Mask Testing (Opt. MTM) – This feature provides a complete portfolio of masks for verifying compliance to serial communications standards. It supports 156 Standard Masks:

- ITU-T (64 Kb/s to 155 Mb/s)
- ANSI T1.102 (1.544 Mb/s to 155 Mb/s)
- Ethernet IEEE 902.3, ANSI X3.263 (125 Mb/s to 1.25 Gb/s)
- Sonet/SDH (51.84 Mb/s to 622 Mb/s)
- Fibre Channel (133 Mb/s to 2.125 Gb/s)
- USB (12 Mb/s to 480 Mb/s)
- IEEE 1394 (491.5 Mb/s to 1.966 Gb/s)
- RapidI/O (up to 2 Gb/s)
- OIF Standards (1.244 Gb/s)
- Video (143.18 Mb/s to 1.485 Gb/s)
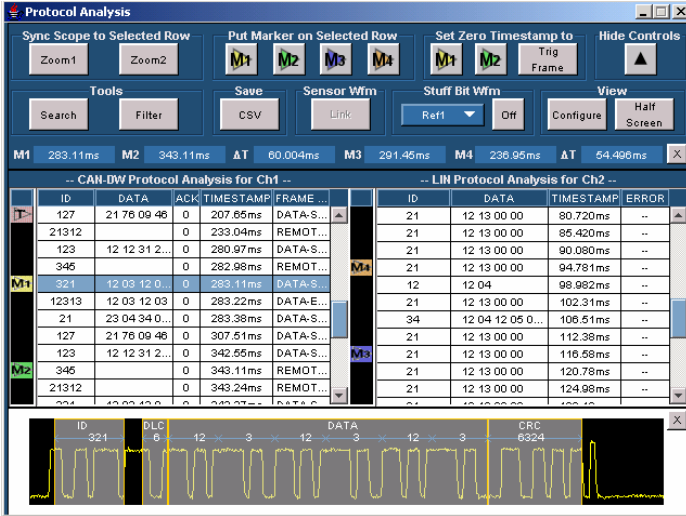
CAN and LIN Timing and Protocol Decode

Ethernet Compliance Testing

Power Measurement and Analysis

USB Compliance Testing
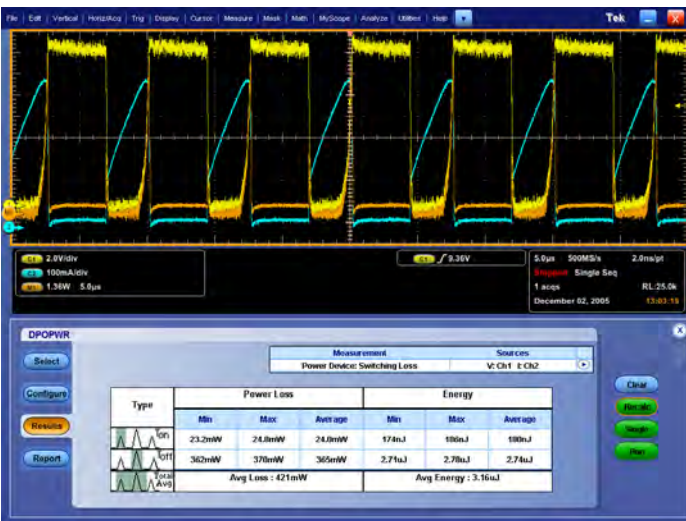
CAN and LIN Timing and Protocol Decode Software (Opt. LSA) – When you need to ensure seamless and reliable operation of a CAN or LIN network, this option enables CAN bus triggering and provides the solution to measure oscillator tolerance, propagation delay, and simultaneously decode CAN and LIN messages, with the protocol leveraging the trigger capabilities. The optional ATM-1 module adds LIN and advanced CAN triggering.

Power Measurement and Analysis (Opt. PWR) – Analyze power dissipation in power supply switching devices and magnetic components, and generate detailed reports in customizable formats. The Hi-Res acquisition mode delivers greater than 8 bits of vertical resolution on single-shot or repetitive signals at bandwidth up to 125 MHz. The powerful and flexible measurements, math, and math-on-math capabilities make it an ideal solution for performing power measurements, such as voltage, current, instantaneous power, and energy, for power device designers. The TekVPI™ interface provides smart communication between the oscilloscope and the probe. TekVPI probe interface also provides more power to the probe interface, allowing direct connection of current probes to the front of the oscilloscope.
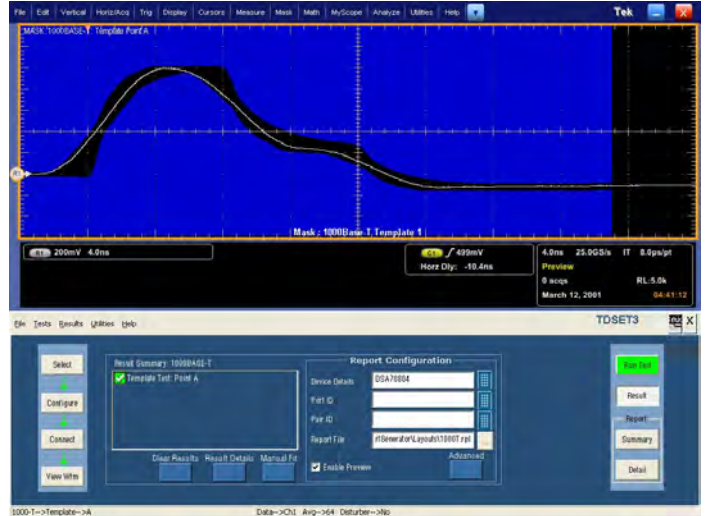
Ethernet Compliance Testing (Opt. ET3) – Receive full physical layer support for Ethernet variants 10BASE-T, 100BASE-TX, and 1000BASE-T with the comprehensive, integrated Tektronix Ethernet tool set. Analog verification, automated compliance software, and device characterization solutions are all included.

USB Compliance Testing (Opt. USB) – Provides compliance testing for USB 2.0 signals. A DPO7254 or DPO7354 is required for compliance testing of high-speed (480 Mb/s) USB signals.

DDR Memory Bus Analysis
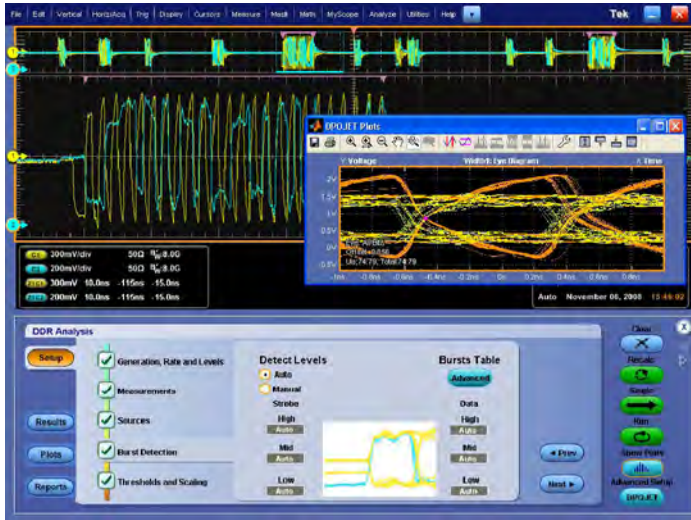
UWB WiMedia Analysis and Measurements

Optional MIPI® D-PHY Characterization and Compliance Testing

DDR Memory Bus Analysis (Opt. DDRA) – Automatically identify DDR1, LP-DDR1 DDR2, DDR3, and GDDR3 Reads and Writes and make JEDEC conformance measurements with pass/fail results on all edges in every Read and Write burst. DDRA also provides capabilities for measurements of 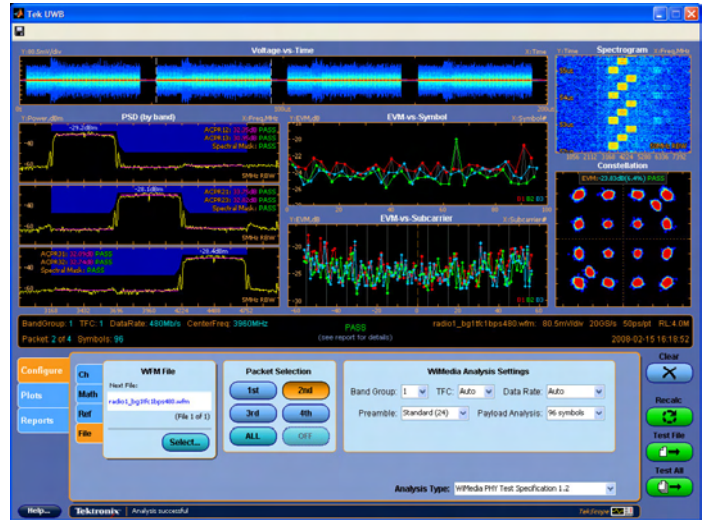clock, address, and control signals. In addition to enabling conformance testing, DDRA with DPOJET is the fastest way to debug complex memory signaling issues.

MIPI® D-PHY Characterization and Compliance Testing (Opt. D-PHY) – Verify to the D-PHY specification, rapidly characterize and discover sources of jitter and signal integrity concerns. Perform high-speed data-clock timing measurements, along with other electrical characteristics in high-speed or low-power modes. This option is available on the DPO7254 and DPO7354 models.

Ultra-Wideband Spectral Analysis (Opt. UWB) and Ultra-Wideband Spectral Analysis Essentials (Opt. UWBE) – UWBE: Ultra-Wideband microwave, optical, and electrical signals require more real-time bandwidth than is possible with spectrum analyzer based solutions. Spectral Analysis and Digital Down Conversion of RF data is fast and easy and the down-converted frequency span of interest may be exported for further analysis in tools such as RSAVu and MATLAB.

UWB goes beyond the Essentials version and adds: WiMedia PHY 1.2 analysis with automatic packet, TFC, and data rate detection, support for all band groups, and Time Frequency Codes and data rates. Rapid visualization, debug, and report generation of the Spectrograms, Power Spectral Density, QPSK/DCM Constellations, EVM-vs-Symbol, EVM-vs-Subcarrier, Common-Phase-Error-vs-Symbol, and Voltage-vs-Time plots and complete measurements are captured and documented for each test condition.

SignalVu™ Vector Signal Analysis (Opt. SVE, SVP, SVM) – Easily validate wideband designs and characterize wideband spectral events. By combining the signal analysis engine of the RSA6100A Real-Time Spectrum Analyzer with that of the industry's widest-bandwidth digital oscilloscopes, you can now evaluate complex signals up to 20 GHz without the need of an external down converter. You get the functionality of a vector signal analyzer, a spectrum analyzer, and the powerful trigger capabilities of a digital oscilloscope – all in a single package. Whether your design validation needs include wideband radar, high data-rate satellite links, or frequency-hopping communications, SignalVu™ vector signal analysis software can speed your time-to-insight by showing you time-variant behavior of these wideband signals.
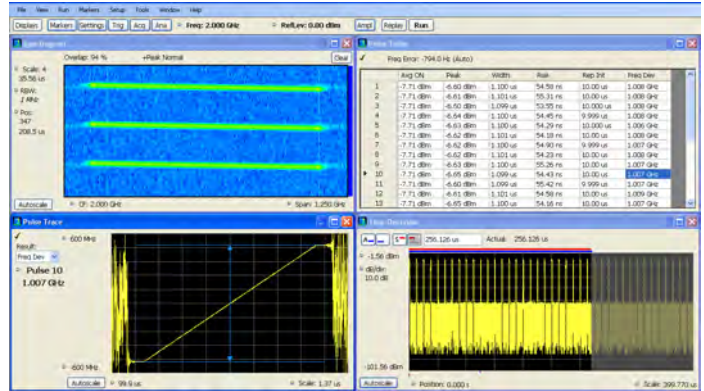
SignalVu™ enables detailed analysis in multiple domains.

Floating Licenses

Floating licenses offer an alternative method to manage your Tektronix asset. Floating licenses allow license-key enabled options to be easily moved among all your DPO/DSA70000B, MSO70000, and DPO7000 Tektronix oscilloscopes. Floating licenses are available for many license-key enabled options. To order a floating version of an option license add "DPOFL-" prefix to the option name. (e.g. DPOFL-ET3)

Check www.tek.com/products/oscilloscopes/floatinglicenses for additional information about floating license options.

Characteristics

Vertical System

Characteristic	DPO7054	DPO7104	DPO7254	DPO7354
Input Channels			4	
Bandwidth (DSP Bandwidth Enhance)	500 MHz	1 GHz	2.5 GHz	3.5 GHz[*1]
Rise Time (DSP Bandwidth Enhance)	460 ps	300 ps	160 ps	115 ps
Hardware Analog Bandwidth (–3 dB)	500 MHz	1 GHz	2.5 GHz	2.5 GHz
Rise Time 10% to 90% (Typical)	460 ps	300 ps	160 ps	145 ps
Rise Time 20% to 80% (Typical)	310 ps	200 ps	100 ps	95 ps
DC Gain Accuracy	±1% with offset/position set to 0			
Bandwidth Limits	Depending on instrument model: 3.0 GHz, 2.5 GHz, 2 GHz, 1 GHz, 500 MHz, 250 MHz, and 20 MHz			
Input Coupling	AC, DC, GND			
Input Impedance (Software selectable)	1 MΩ ±1% with 13 pF ±2 pF or 50 Ω ±1%			
Input Sensitivity	1 MΩ: 1 mV/div to 10 V/div 50 Ω: 1 mV/div to 1 V/div			
Vertical Resolution	8 bit (>11 bit with Hi Res)			
Max Input Voltage, 1 MΩ	±150 V CAT I, derate at 20 dB/decade to 9 V_{RMS} above 200 kHz			
Max Input Voltage, 50 Ω	5 V_{RMS}, with peaks less than ±24 V			
Position Range	±5 divisions			
Offset Range	1 mV/div to 50 mV/div: ±1 V 50.5 mV/div to 99.5 mV/div: ±(1.5 V – 10 divisions) 100 mV/div to 500 mV/div: ±10 V 505 mV/div to 995 mV/div: ±(15 V – 10 divisions) 1 V/div to 5 V/div: ±100 V 5.05 V/div to 10 V/div: ±(150 V – 10 divisions)			
Offset Accuracy	1 mV/div to 9.95 mV/div: ±0.2% (offset value-position) ±0.1 div ±1.5 mV 10 mV/div to 99.5 mV/div: ±0.35% (offset value-position) ±0.1 div ±1.5 mV 100 mV/div to 1 V/div: ±0.35% (offset value-position) ±0.1 div ±15 mV 1.01 V/div to 10 V/div: ±0.25% (offset value-position) ±0.1 div ±150 mV			
Delay between any Two Channels (Typical)	≤100 ps (50 Ω, DC coupling and equal V/div at or above 10 mV/div)			
Channel-to-Channel Isolation (Any two channels at equal Vertical Scale settings) (Typical)	≥100:1 at ≤100 MHz; ≥30:1 between 100 MHz and 2.5 GHz > 20:1 between 2.5 and 3.5 GHz			

*1 3 GHz for sine wave of more than 4 div amplitude (typically).

Time Base System

Characteristic	DPO7054	DPO7104	DPO7254 / DPO7354
Time Base Range	50 ps/div to 1000 s/div	50 ps/div to 1000 s/div	25 ps/div to 1000 s/div
with Opt. 2SR	—	25 ps/div to 1000 s/div	—
Time Resolution (in ET/IT mode)	500 fs	500 fs	250 fs
with Opt. 2SR	—	250 fs	—
Time Base Delay Time Range	5 ns to 250 s		
Channel-to-Channel Deskew	Range ±75 ns		
Delta Time Measurement Accuracy	((0.06 / sample rate) + (2.5 ppm × Reading)) RMS		
Trigger Jitter (RMS)	1.5 ps_{RMS} (typical) with enhanced triggering OFF <100 fs_{RMS} with enhanced triggering ON		
Jitter Noise Floor	<1 ps_{RMS} (<2 ps peak) for record duration <10 µs (typical) <2.5 ps_{RMS} for record duration <30 ms <65 parts/trillion for record durations <10 s		
Time Base Accuracy	±2.5 ppm + Aging <1 ppm per year		

Acquisition System

Characteristic	DPO7054	DPO7104	DPO7254 / DPO7354
Real-time Sample Rates			
1 Channel (Max)	20 GS/s	20 GS/s	40 GS/s
with Opt. 2SR	—	40 GS/s	—
2 Channels (Max)	10 GS/s	10 GS/s	20 GS/s
with Opt. 2SR	—	20 GS/s	—
3-4 Channels (Max)	5 GS/s	5 GS/s	10 GS/s
with Opt. 2SR	—	10 GS/s	—
Equivalent Time Sample Rate (Max)	4 TS/s (for repetitive signals)		
Maximum Record Length per Channel			
Standard Configuration	50 M (1-CH), 25 M (2-CH), 12.5 M (4-CH)		
Record Length Opt. 2RL	125 M (1-CH), 50 M (2-CH), 25 M (4-CH)		
Record Length Opt. 5RL	250 M (1-CH), 125 M (2-CH), 50 M (4-CH)		
Record Length Opt. 10RL	—	—	500 M (1-CH) 250 M (2-CH) 125 M (4-CH)

Maximum Duration at Highest Real-time Resolution (1-CH)

Characteristic	DPO7054	DPO7104	DPO7254 / DPO7354
Resolution	50 ps (20 GS/s)	50 ps (20 GS/s)	25 ps (40 GS/s)
with Opt. 2SR	—	25 ps (40 GS/s)	—
Max Duration with Standard Record Length and Sample Rate	2 ms	2 ms	1 ms
with Opt. 2SR	—	1 ms	—
Max Duration with Opt. 2RL	4 ms	4 ms	2 ms
with Opt. 2SR	—	2 ms	—
Max Duration with Opt. 5RL	10 ms	10 ms	5 ms
with Opt. 2SR	—	5 ms	—
Max Duration with Opt. 10RL	—	—	10 ms

Acquisition Modes

Mode	DPO7054 / DPO7104 / DPO7254 / DPO7354
FastAcq Acquisition Mode	FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events
Maximum FastAcq Waveform Capture Rate	>250,000 wfms/s on all 4 channels simultaneously
Waveform Database	Accumulate waveform database providing three-dimensional array of amplitude, time, and counts
Sample	Acquire sampled values
Peak Detect	Captures narrow glitches at all real-time sampling rates: 1/sample rate at ≤10 GS/s
Averaging	From 2 to 10,000 waveforms included in average
Envelope	From 1 to 2×10^9 waveforms included in min-max envelope
Hi-Res	Real-time boxcar averaging reduces random noise and increases resolution
FastFrame™ Acquisition	Acquisition memory divided into segments; maximum trigger rate >310,000 waveforms per second. Time of arrival recorded with each event. Frame finder tool helps to visually identify transients
Roll Mode	Scrolls sequential waveform points across the display in a right-to-left rolling motion. Up to 10 MS/s with a maximum record length of 40 M

Pinpoint® Trigger System

Characteristic	DPO7054 / DPO7104 / DPO7254 / DPO7354
Sensitivity	
Internal DC Coupled	0.7 div DC to 50 MHz increasing to 1.2 div at rated analog bandwidth (typical); 2.5 div at 3.5 GHz with DSP bandwidth enhance
External (Auxiliary Input) 1 MΩ	250 mV from DC to 50 MHz increasing to 350 mV at 250 MHz (typical)
Trigger Characteristics	
A Event and Delayed B Event Trigger Types	Edge, Glitch, Runt, Width, Transition Time, Time-out, Pattern, State, Setup/Hold, Window – all except Edge, Pattern, and State can be Logic State qualified by up to two channels
Low-speed Serial Protocol Trigger Type (A event only)	I^2C, SPI, and RS-232 (standard). CAN bus available as Opt. LSA. Trigger on address, data, and special handshaking states and other conditions
Main Trigger Modes	Auto, Normal, and Single
Enhanced Triggering	User-selectable; it corrects the difference in timing between the trigger path and the acquired data path (it supports all Pinpoint trigger types on both A and B events except pattern trigger and not available in FastAcq)
Trigger Sequences	Main, Delayed by Time, Delayed by Events, Reset by Time, Reset by State, Reset by Transition. All sequences can include separate horizontal delay after the trigger event to position the acquisition window in time
Communications-related Triggers	Requires Opt. MTM. Support for AMI, HDB3, BnZS, CMI, MLT3, and NRZ encoded communications signals. Select among isolated positive or negative one, zero pulse form, or eye patterns as applicable to the standard
Serial Pattern Trigger	On DPO7254 or DPO7354 only, and requires Opt. PTM. Up to 64 bit serial word recognizer, bits specified in binary (high, low, don't care) or hex format. Trigger on NRZ-encoded data up to 1.25 Gb/s
Video-type Trigger Formats and Field Rates	Triggers from negative sync composite video, field 1, or field 2 for interlaced systems, any field, specific line, or any line for interlaced or noninterlaced systems. Supported systems include NTSC, PAL, SECAM, and HDTV 1080/24sF, 1080p/25, 1080i/50, 1080i/60, 1080p/24, 720p/60, 480p/60
Clock Recovery System	On DPO7254 or DPO7354 only and requires Opt. PTM or MTM
Clock Recovery Phase Locked Loop Bandwidth	Fixed at FBaud/500
Frequency Range	1.5 MBaud to 1.25 GBaud
Clock Recovery Jitter (RMS)	20 ps_{RMS} + 1.25% Unit Interval RMS for PRBS data patterns. 20 ps_{RMS} + 1.25% Unit Interval RMS for repeating "0011" data pattern.
Tracking/Acquisition Range	±5% of requested baud (typical)
Minimum Signal Amplitude Needed for Clock Recovery	1 div_{p-p} up to 1.25 GBaud (typical)
Trigger Level Range Internal	±12 divisions from center of screen
Aux Trigger	TekVPI interface; ±5 V (50 Ω); 150 V CAT I, derate at 20 dB/decade to 9 V_{RMS} above 200 kHz (1 MΩ)
Line	Fixed at 0 V trigger level
Trigger Coupling	DC, AC (attenuates <60 Hz), HF Rej (attenuates >30 kHz), LF Rej (attenuates <80 kHz), Noise Reject (reduces sensitivity)
Trigger Holdoff Range	250 ns min to 12 s max

Trigger Modes

Mode	Description
Edge	Positive or negative slope on any channel or front-panel auxiliary input. Coupling includes DC, AC, noise reject, HF reject, and LF reject
Glitch	Trigger on or reject glitches of positive, negative, or either polarity. Minimum glitch width is down to 170 ps (typical) with rearm time of 250 ps (for DPO7254 or DPO7354)
Width	Trigger on width of positive or negative pulse either within or out of selectable time limits (down to 225 ps)
Runt	Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Event can be time or logic qualified
Time-out	Trigger on an event which remains high, low, or either, for a specified time period. Selectable from 300 ps
Transition	Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either
Setup/Hold	Trigger on violations of both setup time and hold time between clock and data present on any two input channels
Pattern	Trigger when pattern goes false or stays true for specified period of time. Pattern (AND, OR, NAND, NOR) specified for four input channels defined as high, low, or don't care
State	Any logical pattern of channels (1, 2, 3) clocked by edge on channel 4. Trigger on rising or falling clock edge
Window	Trigger on an event that enters or exits a window defined by two user-adjustable thresholds. Event can be time or logic qualified
Trigger Delay by Time	5 ns to 250 s
Trigger Delay by Events	1 to 10,000,000 events
Comm	Provided as part of Opt. MTM. Support for AMI, HDB3, BnZS, CMI, MLT3, and NRZ encoded signals
I2C, SPI, and RS-232	Protocol trigger on DPO7054, DPO7154, DPO7254, or DPO7354
CAN	Basic protocol trigger on DPO7054, DPO7154, DPO7254, or DPO7354 as part of Opt. LSA. Optional ATM-1 module adds LIN and advanced CAN triggering
Serial Pattern (Option PTM)	Captures serial data stream with built-in clock recovery for NRZ standards up to 1.25 Gb/s. Extended with pattern lock triggering to capture repeated acquisitions of long serial test patterns

Search and Mark Events

Event	Description
Basic	Mark any events and document waveforms. Search positive, negative slopes or both on any channels. Event table summarizes all found events. All events are time stamped in reference to trigger position. Users can choose to stop acquisitions when an event is found
Advanced	Search glitches or runts, as well as transition rate, pulse width, setup and hold, time-out, window violations, or find any logic or state pattern on any number of channels. Search DDR Read or Write bursts with Opt. DDRA

Waveform Measurements

Measurement	Description
Automatic Measurements	53, of which 8 can be displayed on-screen at any one time; measurement statistics, user-definable reference levels, measurement within gates isolating the specific occurrence within an acquisition to take measurements on
Amplitude Related	Amplitude, High, Low, Maximum, Minimum, Peak-to-Peak, Mean, Cycle Mean, RMS, Cycle RMS, Positive Overshoot, Negative Overshoot
Time Related	Rise Time, Fall Time, Positive Width, Negative Width, Positive Duty Cycle, Negative Duty Cycle, Period, Frequency, Delay
Combination	Area, Cycle Area, Phase, Burst Width
Histogram Related	Waveform Count, Hits in Box, Peak Hits, Median, Maximum, Minimum, Peak-to-Peak, Mean (μ), Standard Deviation (sigma), μ+1sigma, μ+2sigma, μ+3sigma
Eye-pattern Related	Extinction Ratio (absolute, %, dB), Eye Height, Eye Width, Eye Top, Eye Base, Crossing %, Jitter (p-p, RMS, 6sigma), Noise (p-p, RMS), Signal/Noise Ratio, Cycle Distortion, Q-Factor

Waveform Processing/Math

Characteristic	Description
Arithmetic	Add, Subtract, Multiply, Divide Waveforms and Scalars
Algebraic Expressions	Define extensive algebraic expressions including Waveforms, Scalars, User-adjustable Variables, and Results of Parametric Measurements e.g. (Integral (CH1 – Mean(CH1)) × 1.414 × VAR1)
Math Functions	Average, Invert, Integrate, Differentiate, Square Root, Exponential, Log_{10}, Log_e, Abs, Ceiling, Floor, Min, Max, Sin, Cos, Tan, ASin, ACos, ATan, Sinh, Cosh, Tanh
Math Waveforms	4
Relational	Boolean result of comparison $>$, $<$, $\geq$, $\leq$, $==$, $!=$
Frequency Domain Functions	Spectral Magnitude and Phase, Real and Imaginary Spectra
Vertical Units	Magnitude: Linear, dB, dBm Phase: Degrees, radians, group delay IRE and mV units
Window Functions	Rectangular, Hamming, Hanning, Kaiser-Bessel, Blackman-Harris, Gaussian, Flattop2, Tek Exponential
Waveform Definition	As an arbitrary math expression
Filtering Functions	User-definable filters. Users specify a filter containing the coefficients of the filter. Filter files provided
Mask Function	A function that generates a Waveform Database pixmap from a sample waveform. Sample count can be defined

Display Characteristics

Characteristic	Description
Display Type	Liquid-crystal active-matrix color display
Display Size	Diagonal: 307.3 mm (12.1 in.)
Display Resolution	XGA 1240 horizontal × 768 vertical pixels
Waveform Styles	Vectors, Dots, Variable Persistence, Infinite Persistence
Color Palettes	Normal, Green, Gray, Temperature, Spectral, and User Defined
Display Format	YT, XY

Computer System and Peripherals

Characteristic	Description
Operating System	Windows XP
CPU	Intel Pentium 4, 3.4 GHz processor
PC System Memory	2 GB
Hard Disk Drive	Rear-panel, removable hard disk drive, 80 GB capacity
CD/DVD Drive	Front-panel CD-R/W, DVD-R drive
Mouse	Optical wheel mouse, USB interface

Input/Output Ports

Port	Description
Front Panel	
Probe Compensator Output	Front-panel pins. Amplitude 1 V ±20% into a ≥50 Ω load; 500 mV from base to top into a 50 Ω load, frequency 1 kHz ±5%
Recovered Clock (for DPO7254 or DPO7354 only)	BNC connector, ≤1.25 Gb/s, Output swing ≥130 mV$_{p-p}$ into 50 Ω. Requires Option MTM to enable
Recovered Data (for DPO7254 or DPO7354 only)	BNC connector, ≤1.25 Gb/s, Output swing 200 mV into 50 Ω. Requires Option MTM to enable
USB 2.0 Port	One USB 2.0 host connector
Aux Trigger Input	See trigger specification
Side Panel	
Parallel Port	IEEE 1284, DB-25 connector
Audio Ports	Miniature phone jacks
Keyboard Port	PS-2 compatible
Mouse Port	PS-2 compatible
USB Ports	Four USB 2.0 host connectors
LAN Port	RJ-45 connector, supports 10BASE-T, 100BASE-T, and Gigabit Ethernet
Serial Port	DB-9 COM1 port
VGA Video Port	DB-15 female connector; connect a second monitor to use dual-monitor display mode. Supports basic requirements of PC99 specifications
Oscilloscope VGA Video Port	DB-15 female connector, 31.6 kHz sync, EIA RS-343A compliant, connect to show the oscilloscope display, including live waveforms on an external monitor or projector
Rear Panel	
Power	100 to 240 V$_{RMS}$ ±10%, 47 to 63 Hz, <550 W 115 V$_{RMS}$ ±10%, 360 to 440 Hz CAT I, <500 VA
Analog Signal Output	BNC connector provides a buffered version of the signal that is attached to the CH3 input
Amplitude	50 mV/div ±20% into a 1 MΩ load, 25 mV/div ±20% into a 50 Ω load
Bandwidth	100 MHz into a 50 Ω load
External Time Base Reference In	BNC connector, time base system can phase lock to external 10 MHz reference
Aux Out (Software switchable)	
Time base reference out	BNC connector, provides TTL-compatible output of internal 10 MHz reference oscillator
Trigger output	BNC connector provides a TTL-compatible, polarity switchable pulse when the oscilloscope triggers
GPIB Port	IEEE 488.2 standard

Physical Characteristics

Benchtop Configuration

Dimension	mm	in.
Height	292	11.48
Width	451	17.75
Depth	265	10.44

Weight	kg	lb.
Net	15	32
Shipping	28.9	63.75

Rackmount Configuration

Dimension	mm	in.
Height	331	12.25
Width	479	18.85
Depth (from rackmounting ear to back of instrument)	231.75	9.12

Weight	kg	lb.
Net	17.4	37.5
Rackmount Kit	2.5	5.5

Mechanical

Cooling – Required Clearance

Dimension	mm	in.
Top	0	0
Bottom	0	0
Left Side	76	3
Right Side	0	0
Front	0	0
Rear	0	0

Environmental

Characteristic	Description
Temperature	
Operating	0 °C to +50 °C, excluding CD-R/W drive; +10 °C to +45 °C, including CD-R/W drive
Nonoperating	−40 °C to +71 °C
Humidity	
Operating	5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 °C at or below +50 °C, noncondensing. Upper limit derated to 45% RH above +30 °C up to +50 °C
Nonoperating	5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 °C at or below +60 °C, noncondensing. Upper limit derated to 45% RH above +30 °C up to +50 °C
Altitude	
Operating	10,000 ft. (3,048 m)
Nonoperating	40,000 ft. (12,190 m)
Random Vibration	
Operating	0.000125 G^2/Hz from 5 to 350 Hz, −3 dB/octave from 350 to 500 Hz, 0.0000876 G^2/Hz at 500 Hz. Overall level of 0.27 G_{RMS}
Nonoperating	0.0175 G^2/Hz from 5 to 100 Hz, −3 dB/octave from 100 to 200 Hz, 0.00875 G^2/Hz from 200 to 350 Hz, −3 dB/octave from 350 to 500 Hz, 0.006132 G^2/Hz at 500 Hz. Overall level of 2.28 G_{RMS}
Regulatory	
Electromagnetic Compatibility	93/68/EEC; EN61326:1997 +A1 1998+A2:2000
Certifications	UL 3111-1, CSA1010.1, ISO11469, EN61010-1, IEC 61010-1

Ordering Information

DPO7000 Series

Product	Description
DPO7054	500 MHz Digital Phosphor Oscilloscope
DPO7104	1 GHz Digital Phosphor Oscilloscope
DPO7254	2.5 GHz Digital Phosphor Oscilloscope
DPO7354	3.5 GHz Digital Phosphor Oscilloscope for Serial and Digital applications

All Models Include: Accessory pouch, front cover, mouse, (4) P6139B 500 MHz, 10x passive probes, quick-start user manual (071-173x-xx), DPO7000 Series product software media, DPO7000 Series operating system restoration media, optional applications software media, performance verification procedure PDF file, GPIB programmer's reference (on product software media), calibration certificate documenting NIST traceability, Z 540-1 compliance and ISO9001, power cord, one-year warranty.
Note: User to specify quick-start user manual language, and power plug when ordering.
(Probes and accessories are not included in the oscilloscope warranty. Refer to the data sheet for each probe for its unique warranty and calibration terms.)

Options

Instrument Options

Option	Description
Record Length Options	
Opt. 2RL	125 MS max, 25 MS/Ch
Opt. 5RL	250 MS max, 50 MS/Ch

Option	Description
DPO7254/DPO7354 Only	
Opt. 10RL[5]	500 MS max, 125 MS/Ch
DPO7104 Only	
Opt. 2SR[2]	Double the maximum real-time sample rate to 40 GS/s (1 channel), 20 GS/s (2 channels), 10 GS/s (3 or 4 channels)
Software Options	
Opt. DDRA[9]	DDR Memory Bus Analysis
Opt. DJA	DPOJET Jitter and Eye Diagram Analysis – Advanced
Opt. ET3[3]	TDSET3 Ethernet Compliance Test Software
Opt. HEAC[11]	HEAC Compliance Test Software
Opt. LSA	Low-speed Serial Analysis includes CAN Trigger, and CAN/LIN Decode and Analysis
Opt. MTM	Mask Testing for Serial Communication Standards (up to 1.5 Gb/s). Includes hardware clock recovery on DPO7254/DPO7354
Opt. PWR	DPOPWR Power Measurement and Analysis Software
Opt. SVE	SignalVu™ Essentials – Vector Signal Analysis Software
Opt. SVM[10]	General-purpose Modulation Analysis. Requires Opt. SVE
Opt. SVP[10]	Advanced Signal Analysis (including pulse measurements). Requires Opt. SVE
Opt. SVT[10]	Frequency and Phase Settling Time Measurements. Requires Opt. SVE
Opt. TEKEXP	TekExpress Automation Framework
Opt. USB[4]	USB 2.0 Compliance Test Software
DPO7254/DPO7354 Only	
Opt. D-PHY[5, 9]	MIPI® D-PHY Essentials – Characterization and Compliance test solution
Opt. PTM[5]	8b/10b protocol decoding and NRZ serial pattern triggering. Includes hardware clock recovery up to 1.25 Gb/s and pattern lock triggering
Opt. RTE[5]	RT-Eye® Serial data compliance and analysis software
Opt. UWB[5]	Ultra-Wideband Spectral Analysis Software. Includes WiMedia compliance tests
Opt. UWBE[5]	Ultra-Wideband Spectral Analysis Essentials. Does not include WiMedia compliance tests
DPO7354 Only	
Opt. DVI[8]	Digital Visual Interface compliance test software
XGBT[8, 11]	10GBASE-T Automation Solution
Bundle Options	
Opt. PS1	Power Bundle option includes TPA-BNC adapter, probe calibration and deskew fixture 067-1686-xx, P5205, TCP0030, and Opt. PWR

Floating licenses offer an alternative method to manage your Tektronix asset. Floating licenses allow license-key enabled options to be easily moved among all your DPO/DSA70000B, MSO70000, and DPO7000 Tektronix oscilloscopes. Floating licenses are available for many license-key enabled options. To order a floating version of an option license add "DPOFL-" prefix to the option name. (e.g. DPOFL-ET3)
Check www.tek.com/products/oscilloscopes/floatinglicenses for additional information about floating license options.

[2] DPO7104 only.

[3] Requires Ethernet Test Fixture TF-GBE-ATP or TF-GBE-BTP.

[4] Requires TDSUSBF (USB Test Fixture). Greater than 2 GHz bandwidth required for high-speed USB.

[5] DPO7254 or DPO7354 only.

[8] DPO7354 only.

[9] Requires Opt. DJA.

[10] Requires Opt. SVE or SVEM.

[11] Requires Opt. TEKEXP.

User Manual Options

Option	Description
Opt. L0	English manual
Opt. L1	French manual
Opt. L3	German manual
Opt. L5	Japanese manual
Opt. L7	Simple Chinese manual
Opt. L8	Standard Chinese manual
Opt. L9	Korean manual
Opt. L10	Russian manual

Power Plug Options

Option	Description
Opt. A0	North America
Opt. A1	Universal European Union
Opt. A2	UK
Opt. A3	Australia
Opt. A5	Switzerland
Opt. A6	Japan
Opt. A10	China
Opt. A11	India
Opt. A99	No power cord

Service Options

(Probes and accessories are not included in the oscilloscope warranty. Refer to the data sheet for each probe for its unique warranty and calibration terms.)

Option	Description
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. G3	Complete Care 3 Years (includes loaner, scheduled calibration and more)
Opt. G5	Complete Care 5 Years (includes loaner, scheduled calibration and more)
Opt. R3	Repair Service 3 Years
Opt. R5	Repair Service 5 Years

Recommended Accessories

Probes

Probe	Description
TCP0150	20 MHz TekVPI™ AC/DC 150 A current probe
TCP202[6]	DC coupled current probe
TDP0500	500 MHz TekVPI high-voltage differential probe
TDP1000	1 GHz TekVPI high-voltage differential probe
TDP1500	1.5 GHz TekVPI high-voltage differential probe
TDP3500	3.5 GHz TekVPI high-voltage differential probe
TAP3500	3.5 GHz TekVPI active single-ended probe
TAP2500	2.5 GHz TekVPI active single-ended probe
TAP1500	1.5 GHz TekVPI active single-ended probe
TCP0030	>120 MHz TekVPI AC/DC 30 A current probe
TPA-BNC	TekProbe-BNC Level 2 to TekVPI adapter
P6139B	500 MHz, passive probe (four included with each model)
P6158	3 GHz, 20x low C probe
P6247[6]	1 GHz differential probe
P6243[6]	1 GHz active probe
P6245[6]	1.5 GHz active probe
P6248[6]	1.5 GHz differential probe
P6251[6]	1 GHz high-voltage differential probe
P6330[6]	3 GHz differential probe
P6246[6]	400 MHz differential probe
P6101B	1x passive probe 15 MHz
TCPA300/TCPA400[6]	Series current measurement systems
P5200/P5205/P5210[6]	High-voltage differential probes
P5100/P6015A	High-voltage probes

[6] Probe requires TPA-BNC adapter.

Cables

Cable	Description
GPIB Cable (1 m)	Order 012-0991-01
GPIB Cable (2 m)	Order 012-0991-00
Centronics Cable	Order 012-1214-xx

Accessories

Accessory	Description
Mini Keyboard (USB interface)	Order 119-7083-xx (fits in accessory pouch)
Keyboard (USB interface)	Full-size keyboard with 4 port USB hub. Order 119-6633-00
Transit Case	Order 016-1970-xx
Rackmount Kit	Order 016-1985-xx
Front Hard-drive Option for Rackmount Kit	Order 016-1979-xx
Removable HD Spare	Order 065-0744-xx
Oscilloscope Cart	Order K420 (requires 407-5192-xx bracket set)
WSTRO	WaveStar™ Windows application for remote access

Test Fixtures

Fixture	Description
TDSUSBF	Test fixture for use with Opt. USB
Probe Calibration/Power Deskew Fixture	Order 067-1686-xx
TF-GBE-ATP	1000/100/10BASE-T Advanced Ethernet Test Package, includes test fixture, RJ-45 interconnect cable, and 1000BASE-T jitter test channel cable
TF-GBE-BTP	1000/100/10BASE-T Basic Ethernet Test Package, includes test fixture and RJ-45 interconnect cable
ATM-1	Advanced CAN and LIN triggering module

Adapters

Adapter	Description
P6701B[6]	Optical/Electrical converter (Multi Mode)
P6703B[6]	Optical/Electrical converter (Single Mode)

[6] Probe requires TPA-BNC adapter.

Optional Software

Software	Description
PDU-R	Prodigy RS-232/UART decode application
PDI-R	Prodigy I^{2}C decode application
PDS-R	Prodigy SPI decode application
PDF-R	Prodigy FlexRay decode application
SIGEXPTE	NI LabVIEW SignalExpress™ Tektronix Edition Software (Full Version)

Instrument Upgrades

To upgrade your DPO7000 Series oscilloscope, order DPO7UP with option as noted:

Option	Description
To upgrade record length:	
RL02	From Standard Configuration to Opt. 2RL Configuration
RL05	From Standard Configuration to Opt. 5RL Configuration
RL010[5]	On DPO7254 or DPO7354 from Standard Configuration to Opt. 10RL Configuration
RL25	From Opt. 2RL Configuration to Opt. 5RL Configuration
RL210[5]	On DPO7254 or DPO7354 from Opt. 2RL Configuration to Opt. 10RL Configuration
RL510[5]	On DPO7254 or DPO7354 from Opt. 5RL Configuration to Opt. 10RL Configuration
To upgrade DPO7000 Series with:	
ASM[12]	Advanced Search and Mark
CP2[7]	TDSCPM2 ANSI/ITU Telecom pulse compliance testing software
D-PHY[5, 9]	MIPI® D-PHY Essentials
DDRA[9]	Opt. DDRA
DJAM	Opt. DJA
DJEM[12]	DPOJET Jitter and Eye Diagram Analysis – Essentials
DVI[8]	Opt. DVI
ET3[3]	Opt. ET3
J2	TDSDDM2 disk drive analysis software
LSA	Opt. LSA
LT[12]	Waveform Limit Test
MTM	Opt. MTM
PTM[5]	To upgrade DPO7254 or DPO7354 with Opt. PTM
PWR	Opt. PWR
RTE[5]	Opt. RTE or TDSRT eye software
SVEM	Opt. SVE
SVM[10]	Opt. SVM
SVP[10]	Opt. SVP
SVT[10]	Opt. SVT
USB[4]	Opt. USB
UWB[5]	Opt. UWB
UWBE[5]	Opt. UWBE

[3] Requires Ethernet Test Fixture TF-GBE-ATP or TF-GBE-BTP.

[4] Requires TDSUSBF (USB Test Fixture). Greater than 2 GHz bandwidth required for high-speed USB.

[5] DPO7254 or DPO7354 only.

[7] Requires Opt. MTM.

[8] DPO7354 only.

[9] Requires Opt. DJA.

[10] Requires Opt. SVE or SVEM.

[12] Included as standard feature on units with serial number above B070000 and C010100.

CE

ISO 9001

Product(s) are manufactured in ISO registered facilities.

Data Sheet

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit **www.tektronix.com**

28 Oct 2010   4MW-19046-19

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