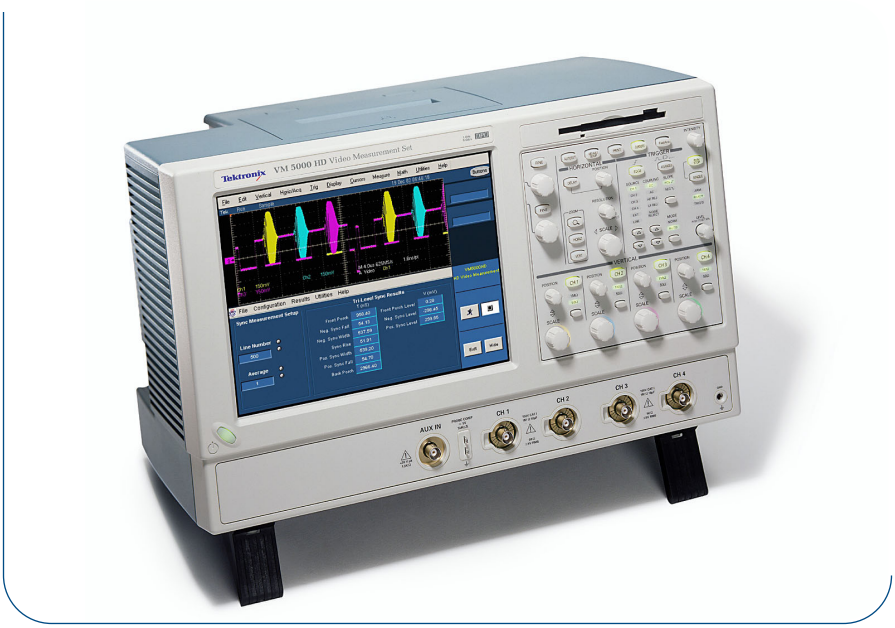
Automated Video Measurement Set

VM5000HD



The VM5000HD automates a variety of component analog video measurements utilized to verify the integrity and quality of HDTV video signals. It automatically assesses conformance of selected video signal parameters to applicable EIA-770-3, SMPTE 274M, and 296M standards. It also automates measurement of other industry-standard video parameters used to quantify the performance of digital set-top boxes or other consumer video reception and playout devices with component analog interfaces.

By integrating automated measurement algorithms and a high-speed, wide-bandwidth signal acquisition platform into one instrument, Tektronix offers a reliable means to make fast, objective, and accurate video measurements. 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 HDTV video output signal quality.

Automated Sync Amplitude and Timing Measurement Results.

As a fully integrated video analyzer, the VM5000HD offers simple configuration menu settings that can be readily recalled or copied, eliminating complicated instrument set-ups, tedious manual measurements, and time-consuming results correlation. Product quality is enhanced because accurate HDTV test results can be reliably generated, easily replicated with other VM5000HD instruments, and readily communicated across a global engineering, supply, or sales organization.

Features & Benefits

Fast, Accurate and Repeatable Video Measurements

Fully Automated, Comprehensive Component Analog Video Measurements

Supports HDTV, Progressive, and PC Format Component Analog Video (YPbPr and RGB)

Acquisition Bandwidth and High Sample Rates for HDTV Signals

Powerful Automated Measurement Features and Utilities

Companion Test Signal Files for Convenient Generation

Standard GPIB and LAN Remote Control Capability

Extensive Documentation Capabilities

Video Measurement Accessories

Complete Oscilloscope Functionality

Applications

Research and Development

Compliance and Certification Testing

Quality/Audit Testing

Automated Production Test

Off-air Video Systems Testing

Tektronix
Enabling Innovation

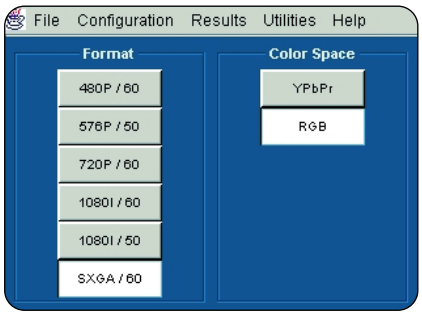
Targeted to meet the needs of video professionals developing, testing, and manufacturing the next generation of digital television reception and play-out devices, the instrument incorporates the power, features, and functionality needed in R&D, QA, and Production Test applications. It enables manufacturers to ensure that HDTV 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

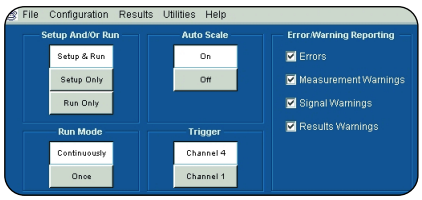
The VM5000HD offers intuitive Windows-based configuration and measurement menus for easy operation with minimal training time. A 10.4 in (264 mm) color display provides a bright, clear, and crisp display of waveforms and measurement results. Users can easily navigate through logically arranged menus, and make selections via radio buttons. For VM700T users that have grown accustomed to operating their instrument via touch screen, an optional touch screen is available. For users who may want to adjust the line number while viewing measurement results, a control to change these is provided conveniently in each individual results page.

Complicated instrument set-ups, algorithm selection, programming and other undesirable aspects of making manual measurements on video signals are eliminated with the VM5000HD. Configuration is as simple as selecting the video format and measurement parameters from an on-screen menu. Users wanting to make manual measurements can utilize the automated set-up capability, exit the automated measurement application and then access a full-featured oscilloscope.

With an intuitive UI, extensive measurement automation, and recallable configuration settings, making reliable and accurate HDTV video measurements is easy for even minimally-trained personnel.



▶ *Format Configuration Menu.*



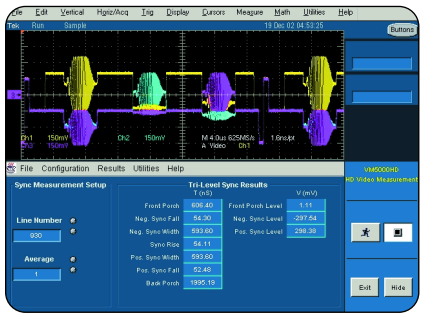
▶ *Operation Configuration Menu.*

▶ Formats Supported

Signal Format	Vertical Frequency	RGB	YPbPr	Sync on CH 4	Sync on CH 1
480p	59.94/60 Hz	X	X	X	X
576p	50 Hz	X	X	X	X
720p	59.94/60 Hz	X	X	X	X
1080i	50/59.94/60 Hz	X	X	X	X
SXGA (1280x1024)	60 Hz	X		X	

Supports HDTV, Progressive, and PC Format Component Analog Video

The VM5000HD has been engineered to support the test needs of devices being deployed by digital cable, direct-to-home satellite and terrestrial broadcast networks, as well as other consumer devices. The instrument supports the most pervasive HDTV and Progressive scan component analog video formats. Recognizing that typical PC video device formats are converging with TV formats, Tektronix has also included some PC video format support to enable test of VGA interfaces. The DTV video measurement capabilities of the VM5000HD supplement the standard definition composite and component capabilities of the VM700T to enable comprehensive video format support for modern devices.



▶ *Tri-level Sync Measurement Results.*

Bandwidth and Sample Rates Suitable for HDTV Signals

The VM5000HD utilizes a digital phosphor oscilloscope platform as the basis for signal acquisition and analysis. This technology provides unmatched insight into signal behavior by displaying, storing and analyzing complex signals in real time using three dimensions of signal information: amplitude, time and distribution of amplitude over time. Enabled by Tektronix proprietary DPX™ acquisition technology, the VM5000HD delivers fast waveform capture rates to handle the demands of HDTV video measurements. This acquisition technology is suited equally well to the analysis of high-resolution computer format video signals typically transmitted via VGA interfaces.

HDTV demands bandwidth and sample rates beyond the capability of current automated video analyzers. Utilizing proven, high speed, measurement architecture, Tektronix surpasses the limitations of current video analyzers to address the evolving needs of the video industry. The VM5000HD offers over 1 GHz of bandwidth and 1.25 GS/s maximum real-time sample rates to easily meet stringent HDTV measurement demands – easily assessing frequency response for signals up to and beyond 30 MHz. The high sample rates and low noise floor of the instrument enable noise measurement accuracy that was previously impossible on HDTV signals. A rise time of 400 ps and superior time-base performance are sufficient to make critical rise time measurements as required by EIA-770c and SMPTE 274M. The maximum record length of 2 MB per channel, combined with high sample rates, delivers measurement results with minimal time lag.

Comprehensive Component Analog Measurement Set

The VM5000HD incorporates a comprehensive set of automated video measurements that enable a thorough and effective assessment of component analog signal performance. This set of measurements has been selected to identify common component signal impairments, ensure operability with connected display devices, and reliably assess the video parameters known to correlate with video signal fidelity.

Most of the component analog video measurements made by the VM5000HD are the same parameters used to assess standard definition component signals. These video parameters, popularized by the “de-facto” reference standard Tektronix VM700T, have been accepted by video equipment designers and broadcast professionals worldwide. Other measurements and configuration settings have been developed to address common impairments and distortions unique to digital set-top boxes and HDTV signals.

The instrument incorporates measurement algorithms and automation software that have been specifically designed to fully employ the high-speed signal acquisition capabilities of the hardware platform. This integration provides key benefits in terms of speed, accuracy, and measurement robustness that are unmatched by manual measurements or even conventional measurement routines.

VM5000HD Automated Video Measurements

- Automated Video Measurements:
  - Sync Amplitude and Timing
  - Color Bars (Levels)
  - Noise
  - Frequency Response
  - Non-Linearity
  - Inter-channel Timing

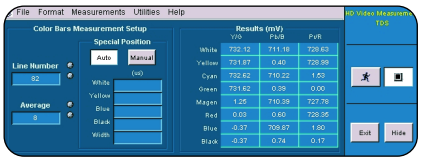
Sync Amplitude and Timing

The VM5000HD automates the sync amplitude and timing measurements specified in SMPTE 296M, 274M, and EIA-770-3. Automated sync test capability, convenient line select feature, and pervasive DTV format support enable quick and convenient verification that digital device outputs conform to applicable standards and work with HDTV displays. All sync measurement results are displayed simultaneously along with the waveform display for comprehensive sync compliance assessment and visualization.

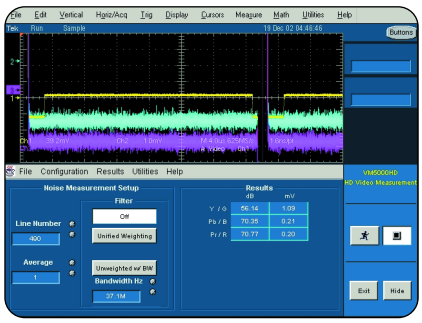
Sync voltages are automatically measured for Negative Sync, Front Porch, and Positive Sync (Tri-level Sync only). Sync timing results are measured and reported automatically for Front Porch, Back Porch, Sync Rise Time, Positive Sync Width (Tri-level only), Positive Sync Fall Time (Tri-level only), Negative Sync Width, and Negative Sync Fall Time.

Automated Video Measurement Set

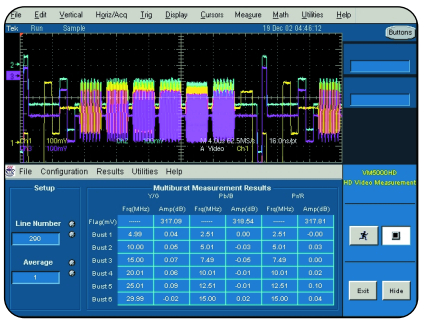
▶ VM5000HD



▶ *Color Bar Measurement Results.*



▶ *Noise Measurement Results with Flat Field Signal.*



▶ *Frequency Response Measurement Results with Multiburst Signal.*

Color Bars (Levels)

One of the most basic measurements utilized to assess video signal quality is the color bar or levels measurement. In component analog video there are twenty-four individual color bar levels that must be measured to ensure that video outputs have acceptable brightness, contrast, and color fidelity. The color bar measurement algorithm identifies and measures only color bar signals, automatically displaying all 24 values for the selected line. User selected averaging provides the flexibility to reduce the impact of temporal variations on level measurements and to address different application requirements.

Noise

Because noise is an important parameter of HDTV video signal quality, the VM5000HD offers noise measurement capability in dB and mV. Weighted and un-weighted measurements are possible and a variety of applicable cut-off filter settings are provided. The noise measurement functions with any flat field signal. The matrix test provided with the test signal package includes three different flat fields, enabling comprehensive assessment of noise at different amplitude levels. Automated noise measurement software, working in concert with auto-ranging capability, enable precision noise measurements on both noisy and very quiet lines.

The low noise floor and high-speed signal acquisition of the VM5000HD enable measurements to –70 dB using the 37 MHz bandwidth cut-off filter, and even better for lower bandwidth signal formats such as 480p.

Frequency Response

Generating high quality HDTV video on modern high performance displays demands that video reception and play-out devices have adequate bandwidth and excellent frequency response. To assess frequency response over the broad range of frequency content within HDTV signals, the measurement utilizes a multiburst signal. The instrument will recognize and measure a wide range of standard multiburst signals to assess frequency response; however, the optional test signal set incorporates a signal with frequency packets spanning from 5 to 30 MHz for the 1080i format.

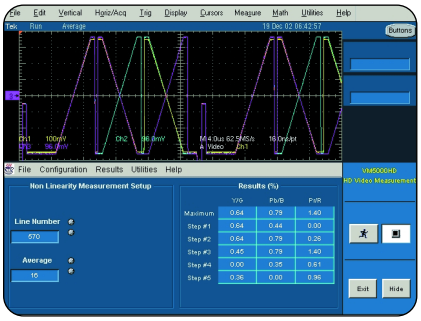
With this signal, Tektronix enables comprehensive assessment of these critical parameters with an automated frequency response measurement that reports flag amplitudes, packet amplitude loss, and packet frequencies. Packet frequency is also measured and displayed in order to identify up-converted content, the use of alternate test signals or to capture distortions introduced as a result of format conversion.

Complementing the automated frequency response measurement, and to accommodate more detailed investigation at frequencies other than those contained in the multiburst signal, Tektronix has included a sweep signal in the matrix test signal. Manual or semi-automated measurements of the sweep signal can be easily measured utilizing the oscilloscope functionality of the instrument and intuitive measurement cursors.

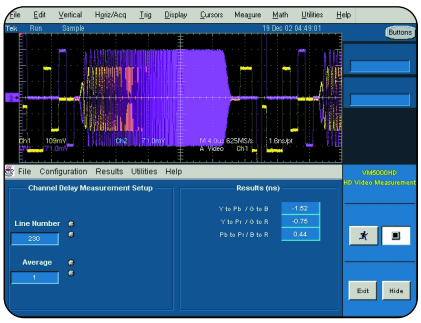
Non-linearity

Linearity is another video parameter that is critical to HDTV and component analog signal fidelity. To instantly assess this critical signal parameter, non-linearity is measured and reported utilizing a valid ramp signal. While the valid ramp signal contained in the optional matrix test signal delivers the fastest test results, the robust measurement algorithms of the VM5000HD can recognize and automatically measure steps or full ramp signals, with the full ramp delivering the most accurate measurement.

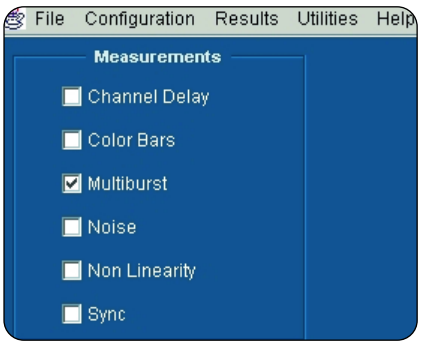
To clarify at what levels signal outputs deviate from optimal linearity, non-linearity of five different averaged segments are reported, complementing the summary measurement result. Channel matching between RGB or YPbPr channels is facilitated through both simultaneous 3-channel waveform display and a logical measurement results table layout.



▶ *Non-linearity Measurement Results with Valid Ramp Test Signal.*



▶ *Channel Delay Measurement Results.*



▶ *Auto Mode Measurement Selection Menu.*

Inter-channel Timing

In order to prevent distortion of component analog video, it is necessary that signals on the different channels arrive with minimal timing discrepancy. The VM5000HD enables assessment of this parameter utilizing a multiburst signal, selected for its obvious temporal transitions that enable the most accurate measurement possible. The powerful measurement algorithm works for a wide variety of test signals including live, or off-air signals that have sufficient correlated edges, regardless of polarity. Measurement results are displayed only if the signal is qualified. Automated measurement enables users to quickly and easily ascertain the magnitude and direction of channel delay errors. By utilizing different frequencies of signal content, channel delay variations at different frequencies can be also assessed.

Powerful Automated Measurement Features and Utilities

The VM5000HD offers a powerful combination of automated measurement features and utilities to make HDTV video test faster, more robust, more convenient and more accurate. These utilities supplement the basic automated measurement capabilities to meet the needs of video professionals in a wide range of application areas and deliver performance and value unmatched by any other solution.

Save and Recall Measurement Configurations

The instrument incorporates the capability to easily save, recall or recall factory default measurement configurations. Configuration settings can be stored, instantaneously recalled or easily copied to other instruments for proliferation of reliable test capability. This ability enables seamless replication of complete measurement capability to globally distributed development, supply or customer locations. It also accelerates and simplifies the test of devices with multiple display output formats, as users can configure, store and recall a set-up for each individual format. The capability eliminates time-consuming correlation exercises as well as perceived quality issues that can stem from measurement hardware, algorithm and configuration differences of other systems.

Auto Mode

Complementing the VM5000HD's ability to make an individual measurement automatically, the instrument incorporates an Auto Mode. Auto Mode enables users to instruct the instrument to make one, selected or all automated video measurements for a particular format on a run command. While functioning in Auto Mode, the instrument automatically selects the appropriate test signal line, utilizes pre-set measurement configurations and averaging selected by the user and completes each measurement.

Automatic Special Position

The VM5000HD incorporates an automatic special position function to ensure that automated measurement capabilities are robust to signal distortions and results are accurate and repeatable. This feature, always active, identifies the appropriate test signal events and sets measurement cursor locations optimally to ensure consistent, accurate and meaningful test results. This function also makes the automated measurements more robust and flexible to handle temporal distortions, or alternate output display modes such as aspect ratio adjustments.

Test signals are identified and tracked during averaging so that in the event a signal changes dramatically during the course of a measurement, the optional signal change report is made. This is useful for identifying intermittent problems with digital encoder equipped video devices.

▶ Test Signal Files: File and Signal Formats of Test Signal

Test Signal Format	16x9	4x3	Bitmap File	TG700	ATSC Compressed MPEG Stream	Elementary Stream	DVD
480p/59.94	X	X		X*[2]	X	X	X*[1]
576p/50	X	X		X*[2]		X	X*[1]
720p/59.94	X			X*[3]	X	X	
1080i/50	X			X*[3]			
1080i/59.94	X			X*[3]	X	X	
SXGA 1280x1024/60		X	X				

*[1] DVDs are 480i and 576i.

*[2] Requires AVG7 module.

*[3] Requires AWVG7 module.

Auto Range Feature

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 and enables the instrument to consistently present the best measurement possible. During a measurement run, the last successful setting for a measurement is also re-used for successful measurements to maintain accuracy in environments where signal levels remain constant. Users can disable the feature if measurement speed is more important than optimized accuracy, or if nominal signal conditions can be assumed.

Combined with the extended documentation utilities, these powerful automated measurement utilities and features ensure that the VM5000HD meets the demands of all application areas. R&D, 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.

Complete Package of Companion Test Signal Files

Specific test signals have been developed to work in concert with the video measurement capabilities of the VM5000HD and to provide comprehensive parametric test of component analog signals. These test signals have been developed to eliminate operability issues and questions regarding the quality of the input test signal.

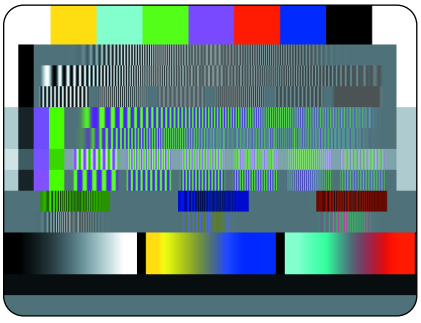
Because the DTV era has resulted in a proliferation of both video content and signal formats, test signals are provided in a variety of pervasive formats to enable easy generation and extended format testing. Since encoded test signals may contain artifacts that detract from measuring the analog signal fidelity, the matrix test signal is also provided as an MPEG-2 encoded stream. To ensure the encoded signal is accurate, Tektronix has pre-qualified the matrix test signal for each native video format.

Test Signal File and Signal Formats

The 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. A high quality encoded ATSC test stream file is supplied and is suitable for easy playout on a Tektronix MPEG player such as the MTX100, AD953-II or AD991. Test signal files are also provided for Tektronix baseband generators, as well as DVD players and PC peripherals.

▶ Matrix Test Signal Components and Signal Details

Signal	Format	Signal Details
Color Bars	All	100% Color Bars with 100% White
Multiburst	1080i and 720p YPbPr	5, 10, 15, 20, 25, 30 MHz for Y 2.5, 5, 7.5, 10,12.5, 15 MHz Pb and Pr
	SXGA and 1080i and 720p RGB	5, 10, 15, 20, 25, 30 MHz for RGB
	480p and 576p YPbPr	2, 4, 6, 8, 10, 12 MHz for Y 1, 2, 3, 4, 5, 6 MHz Pb and Pr
	480p and 576p RGB	2, 4, 6, 8, 10, 12 MHz for RGB
Sweep	All YPbPr	5 to 35 MHz for Y 2.5 to 15 MHz for Pb and Pr
	All RGB	5 to 35 MHz
Sweep Parade	YPbPr and RGB	Windowed Areas (Chirp)
Flat Field – Black	YPbPr and RGB	Near Black – 7.5 mV
Flat Field – Gray	YPbPr and RGB	Gray – 350 mV on RGB
Flat Field – White	YPbPr and RGB	White – 700 mV on RGB
Valid Ramp	All	Ramp 0 to 700 mV on RGB



▶ *HDTV Matrix Test Signal in 16x9 Aspect Ratio.*

HDTV Matrix Test Signal

A specific matrix test signal has been created to enable efficient test of HDTV, Progressive Scan, and PC format video-enabled devices. The matrix test signal includes a range of test signals on different lines to enable video test without the time delay or inconvenience of switching full field signals. The signal has been specifically created to conform to both RGB and YPbPr color spaces, minimizing test signal proliferation and enabling the test of devices that incorporate multiple output colorimetry. Devices with signal reformatting (1080i to 720p or 480p for example) or multiple output resolutions can be fully tested with the available combinations of test signals and supported measurement formats.

Standard GPIB and LAN Remote Control Capabilities

Comprehensive remote control capabilities are standard on the VM5000HD enabling network remote control or high-speed automated testing of video devices. GPIB and LAN ports, simplified video measurement GPIB commands, and complete GPIB remote control documentation provide for convenient and simple remote control.

GPIB Remote Control

A fast and reliable GPIB Port compliant to IEEE 488.2 is standard on the instrument along with a fully documented GPIB remote command set. As GPIB remote control is most important for manufacturing test environments, the instrument incorporates a Front Panel Lockout command to prevent operator tampering and lost downtime. To further enhance production test suitability, the instrument is offered with an optional rackmount.

Simplified GPIB Video Measurement Command Set

The VM5000HD offers a simplified GPIB video measurement command set to complement the complete oscilloscope GPIB command set. With a simple remote command, the automated video measurement capabilities of the VM5000HD can be controlled and accessed under GPIB remote control. These commands simplify integration of the instrument into functional test stations and simplify program development for component qualification or pilot production testing in R&D.

Network Connectivity

Network connectivity is provided with a LAN port supporting 10Base-T and 100Base-T. The intuitive operator UI, test results, reports and waveform captures can be easily accessed from remote locations. The complete automated video measurement capabilities of the instrument can be accessed and controlled from a network-connected PC anywhere in the world.

Extended Documentation Capability

The VM5000HD offers extensive documentation utilities to provide convenient, organized and detailed reporting of measurement results. PC functionality embedded in the instrument and Windows 2000 operating system deliver the ultimate in data and results file portability. Users can output test results at any time, or utilize the automated reporting function that makes all applicable measurements with the set configuration and then automatically saves the results to a report file. Users can also select the output format that meets their immediate needs.

VM5000HD Video Measurements Results Report

January 21, 2003 10:08 AM

Format: 1080I/60 Color Space: RGB

Channel Delay
Line = 130 Average = 1

GtoB	4.92 ns	GtoR	5.60 ns	BtoR	0.71 ns

Color Bars
Line = 50 Average = 1

Color	G Level (mV)	B Level (mV)	R Level (mV)
White	695.72	695.70	696.07
Yellow	697.24	0.99	696.92
Cyan	697.40	695.88	0.39
Green	697.56	1.11	0.04
Magenta	1.65	695.63	696.18
Red	0.38	1.07	697.09
Blue	-0.35	696.00	0.51
Black	-0.52	1.26	-0.23

Multiburst
Line = 180 Average = 1

Channel	G		B		R	
Burst	Frq (MHz)	Amp (dB)	Frq (MHz)	Amp (dB)	Frq (MHz)	Amp (dB)
Flag(mV)	-------	694.78	-------	696.69	-------	697.04
Burst 1	5.01	-0.00	5.01	0.01	5.01	0.00
Burst 2	10.01	-0.01	10.01	0.00	10.01	0.01
Burst 3	15.00	-0.01	15.00	0.06	15.00	0.03
Burst 4	19.99	-0.05	19.99	0.05	19.99	0.06
Burst 5	25.00	-0.00	25.00	0.11	25.00	0.04
Burst 6	30.00	-0.15	30.00	-0.03	30.00	-0.07

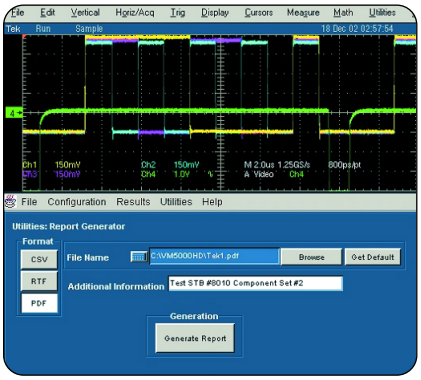
Noise
Line = 490 Average = 1
Filter Mode = Unweighted, Bandwidth Selection = 37.1 MHz

G	78.59 dB	0.08 mV
B	77.23 dB	0.09 mV
R	77.82 dB	0.08 mV

▶ *Automated Video Measurement Results Report.*

An automatic video measurements report generator is included with the instrument. This feature automatically generates a well-formatted, customer presentable report that is saved as a .pdf or .rtf file. It can be initiated on command or automatically upon completion of the selected measurements with the given measurement configuration settings.

Video format, configuration settings and measurement results details are summarized in an organized manner suitable for inclusion in certification and compliance test reports. User information entry fields are provided at the top of the report for logical organization and enhanced report presentation.



▶ *Results Report Configuration and Measurement Menu.*

▶ *Oscilloscope Measurement Menu.*

For video measurement data analysis, results can be output in the form of a .csv file, a format easily exported for spreadsheet analysis. Waveform Captures, and Waveform Captures with Measurement Results, can be stored as either .jpeg or .bmp files.

The floppy disk drive and CD-RW drive enable report files or screen captures to be quickly and easily transported between locations. Alternatively, users can connect the VM5000HD directly to a network and access results data directly from their office PC. A printer port and extensive set of printer drivers enable immediate hardcopy output of measurement results to a connected printer.

Video Measurement Accessories

In order to provide convenient, out-of-the-box measurement capability, necessary video accessories are included with the instrument.Three precision 75 Ω terminations are standard. A custom VGA-to-BNC interface with H/V-to-composite sync converter cable is provided to enable measurement of typical computer video interface signals.This accessory provides true "plug-and-play" test capability for VGA video interfaces. Because video signals also may need to be measured at the board level, the VM5000HD accommodates a wide variety of optional oscilloscope probes including the P5050, most ideal for measuring video signals.

Complete Oscilloscope Functionality

Recognizing that video test professionals require the convenience of a fully automated video analyzer and the flexibility to make manual measurements, Tektronix has incorporated complete oscilloscope functionality into the VM5000HD. The oscilloscope functionality is fully integrated into the VM5000HD package, and users can seamlessly switch back and forth between automated measurements and manual operation of the oscilloscope. For additional information on oscilloscope functionality, please consult the TDS5104 oscilloscope datasheet.

Video Design and Development Capabilities

Tektronix exclusive DPX acquisition technology sets the VM5000HD apart from other instruments, enabling the capture of up to 100,000 waveforms per seconds for a live, analog-like display. The VM5000HD also supports a wide variety of video standards with dedicated triggers including NTSC, PAL, SECAM and analog HDTV. In addition, IRE and mV graticules can be selected for easier measurements and visual inspection.

Non-standard video signals can be measured utilizing the complete menu of flexible triggering options. For making advanced measurements on standard signals, the video measurement application can be used to configure the oscilloscope for measurement prior to utilizing the oscilloscope functionality.

Open Windows Architecture

The VM5000HD combines an automated video measurement set, a high performance oscilloscope and a PC in one self-contained unit. With DPX acquisition technology, an open Windows desktop, and application programming interfaces (API) for Windows and UNIX, this product provides exceptionally fast data acquisition, analysis and network accessibility. By using the embedded PCI bus, waveform data can be moved directly from acquisition to analysis applications on the Windows desktop at much faster speeds than conventional GPIB transfers.

Integration of the instrument with external PCs and non-Windows hosts is also supported by the VM5000HD software solutions. Plug-and-play drivers are included to enable easy communication with the oscilloscope using GPIB, Serial, and LAN connections from LabVIEW and LabWindows programs running on external PCs. UNIX applications, and other LAN resources, can connect directly using the VXI 11.2 server included on the VM5000HD.

▶ Characteristics

▶ Video Measurement Specifications

Characteristic	Description	
Color Bar Measurement Accuracy	±2 mV ±1.5% of reading	Measurement of all 8 bar levels, displayed in absolute (mV) values. YPbPr or RGB formats
Noise Measurement	**Range and Accuracy**	
Unweighted	–20 to –60 dB ±1 dB (30 MHz measurement bandwidth)	Noise measurement bandwidth selectable, 200 KHz to 250 MHz. Trigger on CH 4 required for measurements below –60 dB (30 MHz BW)
	–60 to –70 dB ±2 dB (30 MHz measurement bandwidth)	
Weighted	–20 to –70 dB ±2 dB	Unified Weighting Filter. Trigger on CH 4 required for measurements below –60 dB
Noise Floor	<–76 dB, 30 MHz noise bandwidth	Typically <–80 dB, 30 MHz noise bandwidth
Multiburst Measurement	**Accuracy**	
Flag Amplitude	±2 mV ±1.5% of reading	
1 MHz to 10 MHz Packets	±0.5 dB	Measurement relative to reference flag amplitude
10 to 30 MHz Packets	±0.75 dB	
Frequency Readout	±0.75 dB	Multiburst packet frequency is measured and displayed
Non-linearity Measurement Accuracy	±1.5%	Non-linearity measurement using a ramp test signal. Incremental linearity reported over five equally spaced intervals, as well as an overall linearity figure for each channel
Sync Measurement	**Accuracy**	
Sync Amplitude	±2 mV ±1.5% of reading	Blanking interval measurements, including sync amplitude, width and rise time
Sync Timing	±5 ns	
Rise Time and Fall Time	±5 ns	
Channel Delay	CH 1 to CH 2, CH 1 to CH 3, CH 2 to CH 3; readouts in ns	
	Range	Accuracy
Measurement	±35 ns	±5 ns
Delay Match Error	Less than 1 ns	Any two channels

Display Characteristics

Display Type – Liquid crystal active-matrix color display.

Display Size – 211.2 mm (W) x 158.4 mm (H), 264 mm (10.4 in) diagonal.

Display Resolution – 640 horizontal x 480 vertical pixels.

Waveform Styles – Vectors, Dots, Intensified Samples, Variable Persistence, Infinite Persistence.

Computer System and Peripherals

CPU – Intel Celeron Processor, 1.2 GHz.

PC System Memory – 256 MB.

Hard Disk Drive – ≥20 GB capacity.

Floppy Disk Drive – Front panel 3.5 in floppy disk drive, 1.44 MB capacity.

CD-RW Drive – Side panel CD-RW drive.

Mouse – Logitech thumb wheel model included, USB interface.

Keyboard – Order 119-6633-00 (USB interface).

Input/Output Ports

Video Input – Front panel BNC connector (3) for 3-wire CAV. A fourth BNC for separate composite sync input.

GPIB Port – IEEE 488.2 standard.

Parallel Port – IEEE 1284, DB-25 connector.

USB Port – Allows connection or disconnection of USB keyboard and/or mouse while oscilloscope power is on.

Keyboard and Mouse Ports – PS-2 compatible.

LAN Port – RJ-45 connector, supports 10Base-T and 100Base-T.

Serial Port – DB-9 COM1 port.

Power Source

Power – 100 to 240 V_{RMS} ±10%, 47 to 63 Hz; CAT II, < 220 W.

Physical Characteristics

BENCHTOP CONFIGURATION

Dimensions	mm	in.
Height	285	11.2
Width	447	17.6
Depth	288	11.35
Weight	**kg**	**lbs.**
Net	10.55	23.25
Shipping	25	55

RACKMOUNT CONFIGURATION

Dimensions	mm	in.
Height	267	10.5
Width	483	19
Depth	288	11.35
Weight	**kg**	**lbs.**
Net	11.8	26
Kit	5	11

Cooling

REQUIRED CLEARANCE FOR BENCHTOP CONFIGURATION

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

Environmental

Temperature –
Operating: +5 ºC to +45 ºC.
Nonoperating: –20 ºC to +60 ºC without diskette in floppy drive.

Humidity –
Operating: 20% to 80% relative humidity with a maximum wet bulb temperature of +29 ºC at or below +50 ºC, noncondensing. Upper limit derated to 25% relative humidity at +50 ºC.

Nonoperating: With no diskette in floppy disk drive. 5% to 90% relative humidity with a maximum wet bulb temperature of +29 ºC at or below +60 ºC, noncondensing. Upper limit derated to 20% relative humidity at +60 ºC.

Altitude –
Operating: 10,000 ft. (3,048 m).
Nonoperating: 40,000 ft. (12,190 m).

Random Vibration –
Operating: –0.1 G_{RMS} from 5 to 500 Hz, 10 minutes each axis, 3-axes, 30 minutes total.
Nonoperating: 2.0 G_{RMS} from 5 to 500 Hz, 10 minutes each axis, 3-axes, 30 minutes total.

Electromagnetic Compatibility – 89/336/EEC.

Safety – UL 3111-1, CSA-22.2 No. 1010.1, EN61010-1, IEC61010-1/A2.

▶ Ordering Information

VM5000HD

Automated Video Measurement Set

Includes: Instrument, Front Cover (200-4651-xx), Mouse (119-6298-xx), Keyboard (USB Interface) (119-6633-xx), Quick Reference, GPIB Programmer's reference, VM5000HD Product Software CD-ROM, VM5000HD Operating System Restoration CD-ROM, Test Signal files on CD-ROM and DVD, Terminations (Qty 3), Oscilloscope Analysis and Connectivity Made Easy (071-1046-xx), VGA to BNC Adapter Cord (H/V to Composite Sync Combiner), Performance Verification Procedure PDF file, Calibration Certificate Documenting NIST Traceability, Z540-1 Compliance and ISO9001 Registration, Power Cord. Please specify power plug and manual version when ordering.

Options

Opt. 18 – Touch Screen.

Opt. 1R – Rackmount Kit.

Opt. SS – Complete Package of Companion Test Signals.

Power Plug Options

Opt. A0 – US Plug, 115 V, 60 Hz.

Opt. A1 – Euro Plug, 220 V, 50 Hz.

Opt. A2 – UK Plug, 240 V, 50 Hz.

Opt. A3 – Australian Plug, 240 V, 50 Hz.

Opt. A4 – N. American Plug, 240 V, 50 Hz.

Opt. A5 – Swiss Plug, 220 V, 50 Hz.

Opt. A10 – China Plug, 50 Hz.

Opt. A99 – No Power Cord.

Service

Opt. C3 – Calibration Service 3 Years.

Opt. C5 – Calibration Service 5 Years.

Opt. D1 – Calibration Data Report.

Opt. D3 – Calibration Data Report 3 Years (requires Option C3).

Opt. D5 – Calibration Data Report 5 Years (requires Option C5).

Opt. R3 – Repair Service 3 Years.

Opt. R5 – Repair Service 5 Years.

Recommended Accessories

P5050 500 MHz, 10x Passive Probe (Qty 1) – Order TDS5UP 53.

Service Manual – Order 071-1004-00.

Transit Case – Order 016-1522-00.

Video Display Clamp – Order 013-0278-00.

Cables

GPIB Cable (1m) – Order 012-0991-01.

GPIB Cable (2m) – Order 012-0991-00.

Centronics Cable – Order 012-1250-00.

Automated Video Measurement Set

▶ VM5000HD

Contact Tektronix:

ASEAN / Australasia / Pakistan (65) 6356 3900

Austria +43 2236 8092 262

Belgium +32 (2) 715 89 70

Brazil & South America 55 (11) 3741-8360

Canada 1 (800) 661-5625

Central Europe & Greece +43 2236 8092 301

Denmark +45 44 850 700

Finland +358 (9) 4783 400

France & North Africa +33 (0) 1 69 86 80 34

Germany +49 (221) 94 77 400

Hong Kong (852) 2585-6688

India (91) 80-2275577

Italy +39 (02) 25086 1

Japan 81 (3) 3448-3010

Mexico, Central America & Caribbean 52 (55) 56666-333

The Netherlands +31 (0) 23 569 5555

Norway +47 22 07 07 00

People's Republic of China 86 (10) 6235 1230

Poland +48 (0) 22 521 53 40

Republic of Korea 82 (2) 528-5299

Russia, CIS & The Baltics +358 (9) 4783 400

South Africa +27 11 254 8360

Spain +34 (91) 372 6055

Sweden +46 8 477 6503/4

Taiwan 886 (2) 2722-9622

United Kingdom & Eire +44 (0) 1344 392400

USA 1 (800) 426-2200

USA (Export Sales) 1 (503) 627-1916

For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

Updated 20 September 2002

Our most up-to-date product information is available at:
www.tektronix.com

02/03 HB/XBS 25W-16520-0

Tektronix
Enabling Innovation