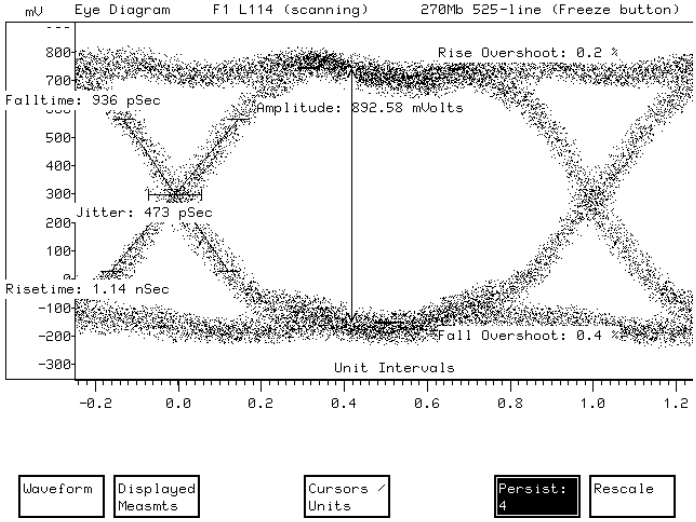
Serial Digital Video Measurement Set

VM700T Option 1S/2S Data Sheet



Features & Benefits

- Automatic Analysis of 270 Mb Component, 143 Mb Composite, and 360 Mb Component Serial Digital Video Signals
- Continuous Real-time Format Analyzer with Event Logging and Frame Capture
- Serial Data Transport Interface (SDTI) Analysis Standard
- Eye Diagram Display with Automatic Limit Violation Detection
- Jitter Measurements with Wideband Spectral Analysis
- Ancillary Data Analyzer with Full Frame Data Distribution Display
- Conformance Testing to SMPTE 259M and 305M
- AES and Embedded Digital Audio Measurements
- Parade, Stacked, and Overlay Displays with Interpolated Waveforms
- SMPTE RP-165 Digital Error Detection and Reporting
- Picture Mode with Relative to Reference Capability
- Relative to Reference Modes
- Longitudinal Time Code Input for Time Stamping Error Events
- Video Wander Measurement

Applications

- Automated Manufacturing Test of Serial Digital Video Equipment
- Unattended Monitoring of Serial Digital Video Signals from Studios, STLs, Earth Stations, and Transmitters
- Equipment Installation and Maintenance
- SDI Interoperability Troubleshooting
- SDTI Interoperability Troubleshooting

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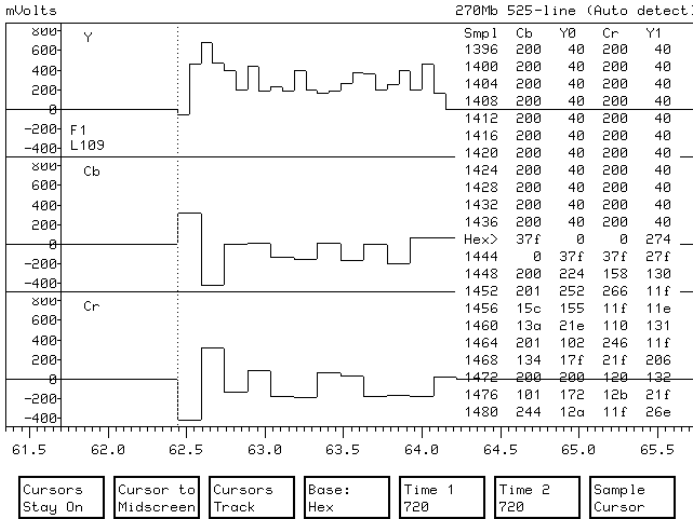


Serial Digital Options

Options 1S and 2S are VM700T, VMTB, and VMUPG upgrade options that add a state-of-the-art serial digital video acquisition and analyzer module to a VM700T, Turbo version VM700A, or standard VM700A video measurement set, providing the capability to display, capture, and analyze the 270 Mb and 360 Mb 525 line and 625 line serial component and 143 Mb 525 line serial composite digital video signal with unprecedented ease and accuracy. Now, for the first time, comprehensive analysis of analog video signals and serial digital video signals is possible in a single package that is the recognized leader in automatic video measurement sets worldwide. The features built into the VM700T/A Series SDI analyzer module are the result of years of experience with professional television organizations and in the designing and manufacture of advanced waveform/vector monitors and automatic analyzers for the serial digital video operating environment.

Ease of Use

The VM700T/A Serial Digital Video Measurement option benefits from the proven display technology and user interface that won a technical Emmy for excellence. All SDI (Serial Digital Interface) measurement functionality was designed with the highest degree of automation possible. The seasoned professional video equipment manufacturer to the first-time SDI design engineer will find the VM700T/A SDI analyzer option innovative, accurate, fast, and above all easy to use.

Many Capabilities

The VM700T/A Serial Digital Video Analyzer module installs directly into a VM700T or Turbo version VM700A. I/O connections are accessible on the instrument rear panel and include two SDI inputs, a re-clocked SDI output (switches with the active SDI input), an AES digital audio input, a Longitudinal Time Code input for time stamping logged error files, and a loopthrough analog black-burst input for timing reference. SDI measurement applications can be selected through the instrument front panel, touch-panel interface, or RS-232-C or GPIB remote control drivers. Simple to complex SDI measurement functions can be created directly from the VM700T touch-panel interface. Functions can be enabled manually, automatically using the system's internal clock, or by remote control. Users who need to create and distribute VM700T SDI measurement functions to additional VM700Ts will appreciate the FTP interface that allows file transfers.

SDTI (SMPTE 305M) Serial Data Transport Interface Analysis

SMPTE 305M specifies a Serial Data Transport Stream that can be used to transport packetized data within a studio/production center environment. The data packets and synchronizing signals are compatible with ANSI/SMPTE 259M and can therefore pass through existing plant routing equipment. The growing use of SDTI to transfer digital video at faster-than-real-time rates with none of the compression artifacts found in MPEG provides tremendous potential to post/production applications. The VM700T Ancillary Data Analyzer application can automatically detect the presence of the SDTI signal as well as decode the SDTI Header data information for quick proofs of the SDTI transport layer. Line number, line number CRC, code and AAI, Destination address, Source address, Block type, CRC flag, data extension flag, reserved data, and Header CRC are all decoded and clearly displayed.

Eye Diagram

A fundamental requirement of any serial digital video measurement set is the ability to verify the electrical characteristics of the SDI transport layer. The VM700T SDI option allows comprehensive analysis of the serial digital transport layer with a high-resolution, equivalent time sampled Eye Pattern Diagram. The Eye Pattern application allows direct observation and verification of the analog characteristics of the serial data signal while simultaneously providing full automatic measurements of all critical signal parameters. Signal level, rise and fall time, rise and fall overshoot, Jitter, and DC offset of the serial data stream are continuously measured and plotted on the VM700T/A crisp, high-resolution CRT display. All Eye parameter measurements are continuously compared against user-programmable limits providing instant notification of an out-of-tolerance condition. An additional Eye monitoring display allows quick visual indications as well as logging of all out-of-limit errors. For a more detailed analysis of the Eye Diagram, voltage and timing cursors are available allowing for direct manual measurements. Selection of 10 Hz and 1 kHz filters, equalizer on-off, an automatic cable length meter, and the ability to select or deselect specific portions of the Eye Waveform for display complete this application.

SDI Jitter Testing

Jitter in the serial digital signal can occur as it is processed by distribution amplifiers, routing switchers, and other digital processing equipment that operate directly on the signal exclusively in its serial form. The VM700T SDI Jitter application provides analysis of SDI Jitter in multiple ways. Peak-to-peak alignment and timing Jitter of the SDI transport layer are continuously measured and displayed in either UI (Unit Intervals) or time. As recommended by SMPTE practices, 1 Hz and 1 kHz selectable clock recovery bandwidths are available. Isolation of Jitter sources is the first step in diagnosis and elimination. Therefore, the VM700T SDI analyzer includes a Jitter spectrum display with over 100 times the spectral range of any competitive device for detailed analysis and identification of all Jitter frequency components. Additionally, a unique Jitter waveform display provides the means to identify line- or frame-correlated Jitter. Cursors are provided to allow precise measurement of Jitter events in both frequency and time. An extremely useful relative to reference mode is also provided allowing up to two Jitter measurement references to be stored internally and used for difference measurements with one of the two SDI inputs.

Real-time Format Monitor

Monitoring for SDI format violations helps ensure trouble-free communication between serial digital devices. Random errors in timing signal placement or other types of data errors, for example, can mean trouble in a data recovery circuit. The VM700T SDI format analyzer provides the continuous, real-time format monitoring capability required to quickly diagnose those hard-to-find format errors in the serial digital signal. A wide range of individual checks are performed with error conditions quickly identified in a highly visible, easy-to-read monitoring display. Monitoring checks include loss of signal; loss of lock; video line; blanking and field length errors; EAV/SAV misplacement; ancillary data errors; audio ancillary data errors; illegal luminance and chrominance values with selectable search areas; 8/10 bit validation; RP-165 validation; errored seconds with time counter; event logging; frame capture on user-definable events and pattern search provide a total validation of the SDI signal format.

Ancillary Data Analyzer

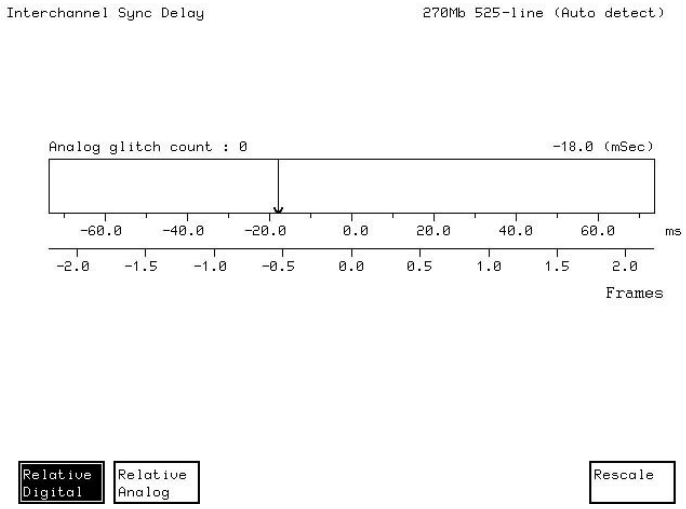
Once problems are identified by the Real-time Format Monitor, the Ancillary Data Analyzer can be automatically enabled to provide a more detailed level of analysis and diagnosis capability. The primary display of the Ancillary Data Analyzer provides a complete analysis of all data, including field, line and sample number, data type, data values, and interpretation of data value. Data errors are immediately sensed, logged, and indicated in easy-to-see "bright up" boxes. A "Find Errors" window scans forwards or backwards in the display buffer, locating and providing a detailed text interpretation of all data errors. A "Find Data Pattern" search mode can be programmed to automatically search and locate specific data patterns as opposed to time-intensive manual searches. The Ancillary Data Analyzer may also be optimized to display only specific data types, for example AES Audio packets or EDH data, ensuring the display remains simple and easy to interpret. To help debug buffer overflow problems in audio devices, the Ancillary Data Distribution Analyzer provides real-time verification of the ancillary data distribution pattern within a video frame.

SDI Waveform Mode

The SDI Waveform mode further extends the capabilities of the VM700T SDI option by providing a real-time display and analysis of the decoded video waveform. Overlay, Parade, and Stacked waveform displays of individual video lines in equivalent analog form allow complete evaluation of the video signal, including the ancillary data region, in a traditional manner. Setup of digital sources is now as easy as if they were analog. Waveforms can be displayed in either "Bar" style, similar in look and feel to a logic analyzer display, or with interpolation, providing a smoother analog look and feel. The "Bar" display style is useful when using the user-selectable sample cursors to provide readouts of video sample values. Samples may be displayed in 8 bit or 10 bit mode in Hex, Binary, or Decimal number base. Timing cursors may be used to determine the exact timing of any two points on the video waveform. The interpolated waveform mode is extremely useful for evaluating the analog characteristics of the component digital signal. Pulse shape, frequency response, insertion gain, rise and fall times, and interchannel timing of the decoded signal can be quickly assessed.

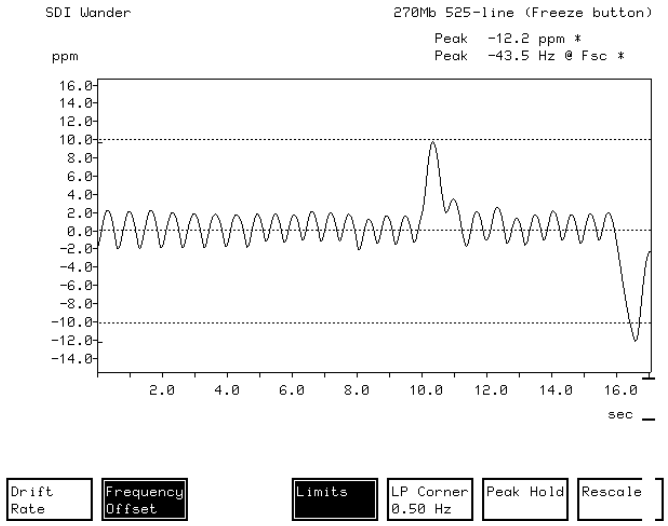
SDI Lightning Display

Pressing the VM700T front-panel Vector button selects the Tektronix-patented Lightning Display. The Lightning Display helps operators quickly set up color-difference component recorders using only the color bar test signal.



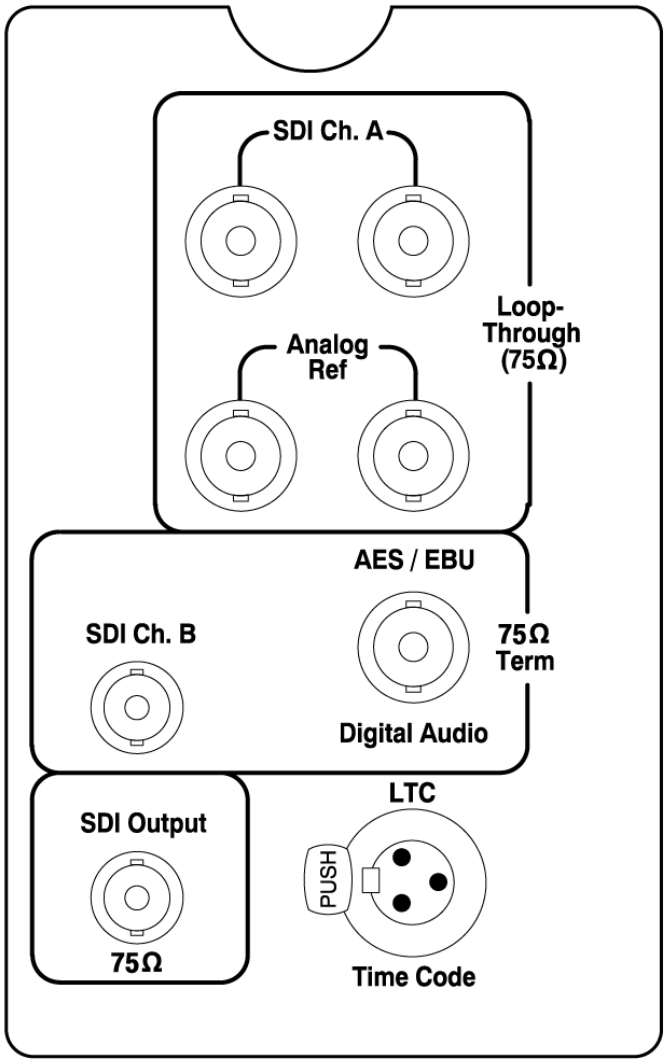
Interchannel Timing

The Interchannel Timing application is designed to quickly measure time delay between two SDI sources or between one SDI source and the analog black-burst reference input. Timing measurements are made in real-time and in-service without special test signals. An easy-to-read auto-scaling display indicates time delay in time or video frames.



SDI Wander

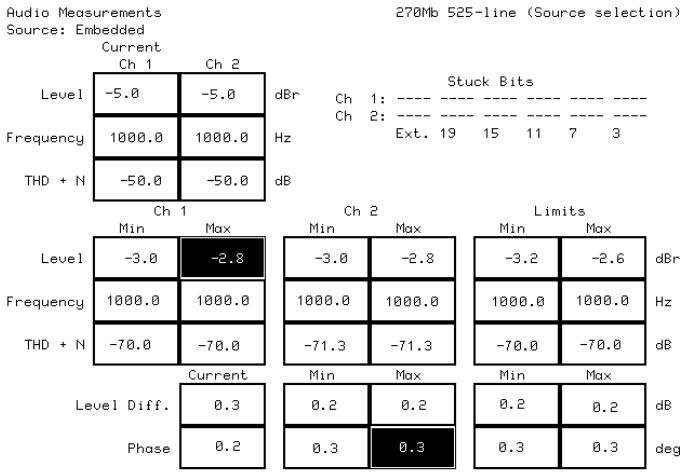
Video sync timing "wander" is a common problem with video that has been transported over a digital distribution network. Subtle shifts in picture hue or, in extreme cases, temporary picture unlock, can result if variations in the horizontal sync frequency timing are not held to within acceptable limits. The VM700T SDI Wander application provides a simple and efficient method for the verification of SDI frequency timing stability for contribution-quality video applications. No special test signals are required. Absolute frequency offset and frequency drift rate measurements are made directly on the SDI signal. Accurate frequency measurements to within 100 ppb can be made. Display limit markers indicate peak frequency offset in ppm and Hz at Fsc over the past 17 seconds. Frequency drift rate measurements are reported in ppm/s and Hz/s at Fsc.



Rear-panel I/O Diagram.

Digital Audio Measurements

The VM700T SDI analyzer option includes a digital audio measurement application. Audio level, audio frequency, total harmonic distortion plus noise, level difference, and interchannel phase of the AES digital audio or embedded digital audio signal can be measured. An easy-to-read display automatically updates all audio measurement results, clearly indicating violations of user-programmable limits and audio bit activity. For precise error documentation, logging mode may be enabled with Linear Time Code time-stamping capability. For a more detailed analysis of the digital audio signal, the Audio Format Analyzer may be selected. The Audio Format Analyzer provides a waveform display of two digital audio channels, in addition to analysis of audio channel status, decoding of user data bits, identification of parity errors, code violations, and invalid samples.



Picture Mode

Picture mode allows a quick, visual verification of the SDI signal source. A bright-up line select feature helps finding any desired video line for testing. Additionally, a relative-to-reference mode is included that displays the differences between the active picture and a stored picture, including differences outside the active video region.

Characteristics

Input Specifications

Channel A

Physical – 2 BNCs (loopthrough).

Electrical –
Input Impedance: 75 Ω.
Return Loss:
≥25 dB from 1 - 360 MHz, channels on or off, power on.
≥15 dB from 1 - 360 MHz, channels on or off, power off.
Insertion Loss: ≥0.2 dB from 1 to 360 MHz.

Channel B

Physical – 1 BNC (terminated).

Electrical –
Input Impedance: 75 Ω.
Return Loss:
≥25 dB from 1 - 360 MHz, channels on or off, power on.
≥15 dB from 1 - 360 MHz, channels on or off, power off.

Channels A and B

Signal –
Format: 143 Mb, 270 Mb, and 360 Mb Serial Digital Video per SMPTE 259.
Clock Tolerance: ±20 ppm.
Launch Amplitude: 800 mV ±20% OR.
Cable Loss: 19 dB loss at 135 MHz wrt 800 mV_{p-p} launch amplitude.

SDI Out

Physical – 1 BNC.

Electrical –
Input Impedance: 75 Ω.
Return Loss:
≥25 dB from 1 - 360 MHz, channels on or off, power on.
≥15 dB from 1 - 360 MHz, channels on or off, power off.

Signal –
Format: 143, 270, Serial Digital Video per SMPTE 259.
Clock Tolerance: No worse than selected input signal.

Analog Black-burst

Physical – 2 BNCs (loopthrough).

Electrical –
Input Impedance: 75 Ω.
Return Loss: ≥30 dB from 1 - 6 MHz, power on or off.

Signal –
Format: 525/625 line analog composite video.
Input Amplitude: ±6 dB wrt. 1 V_{p-p} video.

AES In

Physical – 1 BNC.

Electrical –
Input Impedance: 75 Ω internally terminated.
Return Loss: ≥15 dB from 0.1 - 6 MHz, power on or off.

Signal – Format: 41 kHz, 44 kHz, and 48 kHz AES3 digital stereo audio per SMPTE 276.

LTC

Physical – 1 Mini-XLR.

Electrical – Input Impedance: 20 kΩ internally terminated.

Signal –
Format: Longitudinal time.
Code per IEC pub. 461.
Speed Range: 0.5x to 5x real time.

Measurement Performance

Eye Diagram

Amplitude Measurements – (AC coupled) (averaged)
Range: 80 mV to 1.0 V.
Amplitude Accuracy: ±5% at 800 mV_{p-p}.

Rise-time Measurements –
Accuracy: ±100 ps for signals with rise times of 400 ps-1.5 ns.
Aberrations: <10%, 800 mV_{p-p} step.

Timing Measurements –
Cursor Accuracy: 0.1 ppm ±20 ps.
Resolution: ±40 ps.

Jitter High-pass Filtering – 10 Hz ,1 kHz.

Jitter Measurement

Demodulated Waveform – Bandwidth: 10 Hz to 10 MHz.

Range (P-P) – 2 UI (4 ns at 270 Mb), 50 Hz to 10 MHz, 5 UI at 10 Hz linearly decreasing to 2 UI at 50 Hz.

Accuracy (RMS) – 10% measured on sinusoidal Jitter freq 10 Hz to 10 MHz.

Numeric Resolution – 20 ps.

Jitter High-pass Filtering – 10 Hz, 1 kHz.

SDI Wander Measurement

Nominal Input Freq. – 143 Mb, 270 Mb, and 360 Mb.

Tolerance – ±3%.

Frequency Offset Accuracy – ±0.1 ppm.

Drift Rate Accuracy – ±5 ppb/s.

SDI Interchannel Timing

Digital to SDI Analog Ref Input –
Accuracy: 400 ns.
Maximum delay: 1 frame (digital always assumed to be behind analog).

Digital to Digital – (SDI channel A input to SDI channel B input)
Accuracy: ±1 sample.
Maximum delay: 1 frame.

Ordering Information

Opt. 1S and 2S Ordering Instructions

To order a new VM700T with Serial Digital Video measurement capability order a VM700T with Opt. 1S.
Note: As a minimum, all new VM700Ts must be ordered with either or both analog Opt. 01 (NTSC) or Opt. 11 (PAL) installed.

To upgrade an existing VM700T (serial numbers B020100 and above) to Serial Digital Video measurement capability order a VMUPG Opt. 1S.

To upgrade an existing VM700T (serial numbers below B020100) and any Turbo version VM700A to Serial Digital Video measurement capability, order a VMUPG Opt. 2S.

CE

ISO 9001

Product(s) are manufactured in ISO registered facilities.

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