

# Multiformat, multistandard waveform monitor

## WFM7200 Datasheet



This video/audio/data monitor and analyzer all-in-one platform provides flexible options and field installable upgrades to monitor a diverse variety of video and audio formats. Support for video formats includes 3G-SDI, Dual Link, HD-SDI and composite analog. Support for audio formats includes Dolby E, Dolby Digital Plus, Dolby Digital, AES/EBU, embedded audio and analog audio.

### Key features

- Multiformat, multistandard video monitoring
  - Standard auto-detection of HD/SD-SDI and multiple Dual Link video formats
  - Composite analog (PAL/NTSC) video support (Option CPS)
  - Simultaneous monitoring (Option SIM) allows monitoring of 2 HD/SD-SDI inputs or 1 HD/SD-SDI input and 1 CPS input. Option 3G is required for 3G-SDI format support
  - Multiple Input Mode allows monitoring of 2 to 4 SDI inputs simultaneously (4-input mode requires Option 2SDI)
  - Upgradeable to 3G-SDI (Level A and Level B) format support (Option 3G)
- Comprehensive audio monitoring (Option AD or DPE)
  - Up to 16-channel audio monitoring for embedded audio
  - Multichannel Surround Sound<sup>1</sup> display and flexible Lissajous display with audio level readouts
  - Audio Loudness monitoring to ITU-R BS.1770-3 with audio trigger start/stop functions via GPI (Option AD or DPE)
  - Support for analog, digital, and embedded audio (Option AD)
  - Dolby Digital (AC-3), Dolby Digital Plus, and Dolby E (Option DPE)
  - Comprehensive Dolby metadata decode and display (Option DPE)
  - Dolby E Guard Band meter with user-defined limits (Option DPE)
- Unmatched display versatility
  - FlexVu™, the most flexible four-tile display, suited for various application needs to increase productivity
  - Tektronix-patented Diamond and Arrowhead displays for gamut monitoring
  - Tektronix-patented Timing and Lightning displays
  - New Tektronix-patented Spearhead display and Luma Qualified Vector (LQV™) display facilitate precise color adjustment for post-production applications (Option PROD)
- Stereoscopic 3D video displays for camera alignment and production/post-production applications (Option S3D)
- HDR graticules and HDR zebra overlay for HDR content creation (Option PROD)
- Black picture and Tektronix-patented frozen picture detection
- Advanced ANC data monitoring
  - CEA708/608 Closed Caption monitoring; Teletext (WST), SMPTE2031, OP47, and ARIB B.37 subtitle monitoring
  - Detect and decode ANC data including AFD, WSS, Video Index, TSID, V-Chip, Broadcast Flag/CGMS-A, VITC, LTC, and ANC TC ARIB STD-B35/B37/B39, TR-B22, and TR-B23 support
- In-depth digital data analysis helps quickly resolve difficult content quality and reliability issues (Option DAT)
- Standard and user-definable Safe Area Graticules facilitate editing and format conversion tasks, reducing the need for rework
- Active Format Description (AFD) detection, decode, and automatically adjusted graticule in Picture display enable easy identification of aspect-ratio related issues

<sup>1</sup> Audio Surround Sound Display licensed from RTW (RTW GmbH & Co. KG).

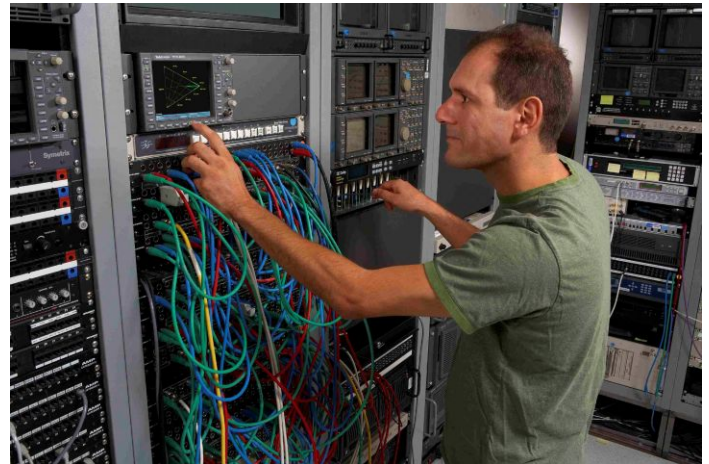
- Superior physical layer signal measurement
  - High-performance real-time eye pattern display, jitter measurements, and patented cable length measurement (Option PHY3)
  - Most comprehensive eye pattern measurements including eye amplitude, rise/fall time, and overshoot/undershoot measurements as well as Tektronix jitter waveform display (Option PHY3)
- Unmatched usability
  - CaptureVu<sup>®</sup> advanced video frame data capture simplifies troubleshooting and equipment setup
  - 32 instrument presets for quick recall of commonly used configurations tailored to engineers or operators
  - Front-panel USB port enables easy transfer of presets, captured video frame data, screenshots, and error log
  - Front-panel headphone port enables quick verification of selected audio pair
  - Intuitive menu structure and context-sensitive help
  - Extensive alarms, status reporting, and error logging
  - Bright, crisp, high-resolution LED backlight display
  - SNMP and Ethernet remote interface capabilities and GPI control facilitate centralized monitoring and control

### Applications

- Monitoring and compliance checking in content distribution and broadcast transmission
- Quality control in content production and post-production
- Equipment/system qualification and troubleshooting for installation and maintenance of content creation and distribution facilities
- Post-production edit suite and color correction monitoring

### WFM7200 waveform monitor

The monitoring and measurement capabilities of this instrument provide a comprehensive suite of options and configurations to suit a variety of applications. For monitoring applications Tektronix-patented gamut displays simplify color adjustments for camera balancing and color correction applications. Get information about the signal at a glance from the audio session and video session displays that assist in ensuring quality control of the image.



Multiformat support grows with your needs

Tektronix provides an extensive audio toolset for monitoring analog, digital AES/EBU, and digital embedded within Option AD. Up to 16 channels of embedded audio can be monitored for bar levels, which allows the operator to quickly check audio signal levels. Lissajous, Surround Sound<sup>1</sup>, and correlation meters show the interaction of the audio channels. For Dolby Digital (AC-3), Dolby Digital Plus, and Dolby E, Option DPE adds the additional functionality to decode the Dolby stream with a comprehensive Dolby metadata decode and status display. To ensure Dolby E synchronization the guard band meter easily shows the start of the Dolby frame in relation to the video signal with user-defined limits.

Loudness is a critical audio measurement to make for each produced program and throughout the distribution chain. The instrument includes a Loudness meter as part of Option AD or DPE, with short and infinite audio loudness measurements to ITU-R BS.1770-3 standard. Preset configurations are defined to meet ATSC A/85, EBU R128, and ARIB TR-B32 to suit the specific requirements of these standards. For detailed analysis of loudness a graphical plot provides a Loudness Session that can store up to 30 hours of data and can be downloaded for inclusion in documentation using a network connection or USB device.

A variety of ancillary data is now carried within the SDI signal, and the ANC data toolset of the instrument can help monitor and troubleshoot problems within the signal chain. The Aux Data Status display provides a summary of critical ANC data such as closed captioning / subtitling, AFD, and time code. The ANC Data Inspector allows the user to quickly verify the presence of ANC data within the signal and the Datalist display allows inspection of the data line by line, sample by sample.

For measurement of the physical layer, the instrument includes high-precision eye and jitter displays that provide automated measurements of amplitude, rise/fall times, overshoot/undershoot, and timing or alignment jitter. The measurement functions of the instrument also include options for AV Delay and Stereoscopic 3D monitoring, making this instrument an ideal choice for monitoring and measurement applications.

- Video monitoring standards and formats
  - Standard definition SDI – standard
  - High definition SDI – standard
  - Dual Link (4:2:2, 4:4:4, alpha channel, 10 bit, 12 bit) – standard
  - Composite analog video – Option CPS
  - 3G-SDI (Level A and Level B) – Option 3G
  - Multiple input mode, four SDI inputs – Option 2SDI
  
- HDR content creation
  - HDR graticules - Option PROD
  - HDR zebra overlay - Option PROD
  - Graticule range selection (Narrow 64d-940d, Full 0d-1019d) - Option PROD
  
- Color gamut monitoring
  - Arrowhead display – standard
  - Diamond and Split Diamond displays – standard
  - Spearhead display – Option PROD
  - Luma Qualified Vector (LQV™) – Option PROD
  
- Audio monitoring standards and formats
  - Analog, digital AES/EBU, digital embedded – Option AD
  - Analog and digital including Dolby Digital, Dolby Digital Plus, and Dolby E – Option DPE
  
- Measurement and analysis
  - Automated eye pattern and jitter measurements – Option PHY3
  - Color bar and pathological signal generation – Option GEN
  - Digital data analysis – Option DAT
  - ANC Data Inspector – Option DAT
  - Simultaneous input monitoring – Option SIM
  - Stereoscopic 3D monitoring – Option S3D
  - Audio/Video delay measurement – Option AVD

## See and Solve™ with Tektronix displays

Tektronix See and Solve™ displays simplify video monitoring tasks such as calibration, error detection, and content correction allowing users to detect errors at a glance and troubleshoot them efficiently. Specialized Session and Status displays provide summarized yet comprehensive reports of conditions and measurements of content parameters.

The screenshot shows the FlexVu™ interface with several key sections:

- Active Log:** A table listing error events with columns for Source, Error Status, Filter, Timecode, and Time. It shows multiple instances of 'Detected Dolby Format (Dolby E 20-bit)' and 'Audio Session Load'.
- Alarm Status:** A table with columns for Alarm, Alarm Status, and Additional Information. It lists various alarms like 'HW Fault', 'SDI Input Missing', 'SDI Input Signal Lock', etc., with their respective statuses.
- Audio Session:** A detailed table showing signal loss and channel levels for Dolby A, Dolby-LR, Dolby-CLife, Dolby-LaRa, and Dolby-LaRc. It includes metrics like Clip, Over, Lead, and Noise.
- Video Session:** A summary of video parameters including Input (SDI Input 1A), Signal (RGB), Effective resolution (Auto 1080i 60), and various error counts like Line Length Err, Line Number Err, and SAV Place Err.
- Statistics:** A table showing error rates for RGB Gamut Error, Chroma Gamut Error, Luma Gamut Error, Y Chroma CRC Error, C Chroma CRC Error, Y Anc Checksum Error, and C Anc Checksum Error.
- Bottom Panel:** Shows the current session (1080i 50), input (SDI Input 1A), and the Tektronix logo.

A variety of Session and Status displays can be viewed at a glance with FlexVu™

The powerful Error Log is configurable by a variety of alarm conditions such as black and frozen frame detection and provides detailed reports for up to 10,000 events that can be downloaded using a web browser or saved through a front-panel connection to a USB flash drive. Alarms can also activate ground closures and SNMP traps, simplifying centralized monitoring of multiple programs and allowing the operator to be alerted to problems within the transmission chain.

The FlexVu™ four-tile display provides maximum flexibility to increase your productivity. Unlike instruments with predetermined view combinations or limited choices, FlexVu™ lets you create a multi-view display tailored to your specific needs and work practices. Each tile can be configured to enable easy signal analysis such as multiple alarm and status screens, different Safe Area Graticules and cursors on each tile, and more.

Tektronix displays offer the sharpest CRT-like trace quality for clear waveform and vector monitoring without pixelation distortions. The familiar video waveform display can show SD, HD, or 3G-SDI (with Option 3G) signals in RGB, YPbPr, YRGB, or composite formats. Signal components can be displayed in either Parade or Overlay mode. For composite analog video, NTSC and PAL signals can be displayed with luma, chroma, and luma+chroma filtering.

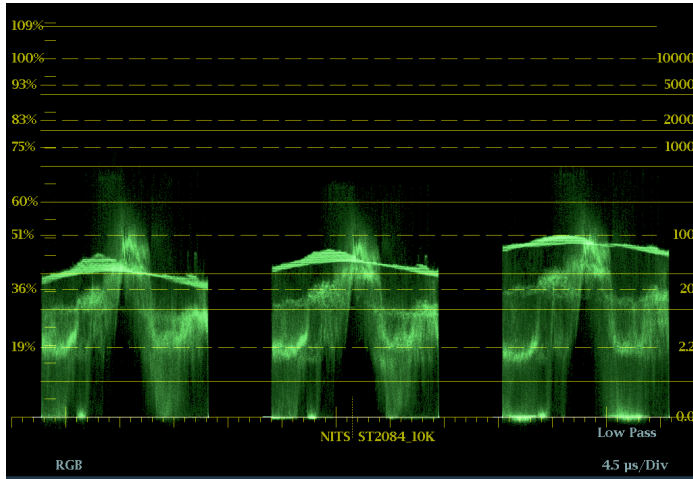
The Vector display offers user-selectable graticules, color targets (75% or 100%), and color axis.

### HDR tool set for content creators

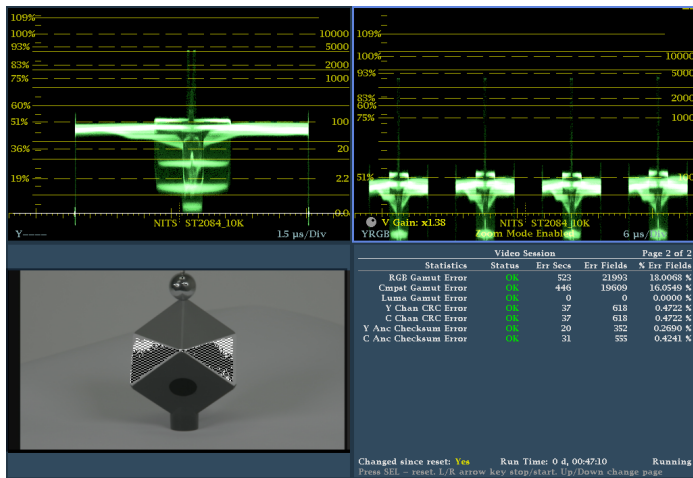
The WFM7200 monitor offers an HDR tool set (Option PROD) for assisting camera operators and editors adjust their content to the correct levels. HDR graticules are available for Hybrid Log Gamma (HLG), SMPTE ST 2084 PQ and Camera log (S-Log1, S-Log2, S-Log3, C Log, Log C, BT.709). ST 2084 HDR is available in Narrow (64d-940d) for 1K, 2K, 4K, 5K and 10K or Full (4d-1019d) for 1K and 10K. Reflectance, Nits, Stops and Code Value are available in HDR modes.

Camera operators can use the graticule lines at 2%, 18% or 90% Reflectance to properly setup camera exposure with a camera test chart of 2% black, 18% gray and 90% white.

Color editors in post-production can use the Specular highlight magnification feature to quickly balance the color in specular highlights and ensure the detail in the objects with specular highlights. The magnification is called Zoom Mode for 1K and 10K ST.2084 HDR. Amplitude cursors allow users to set the cursor at a specific level to make the scene have the desired look. HDR zebra highlighting in the Picture display allows users to verify the location and the size of the specular highlights.



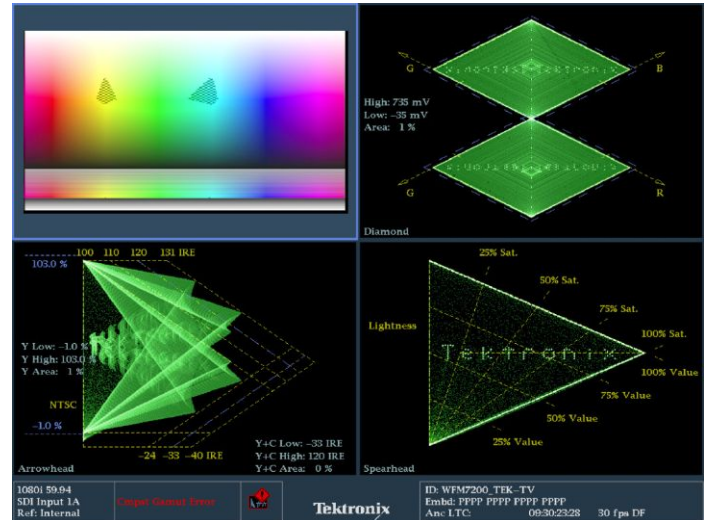
Waveform display showing HDR graticule (ST2084 10K Narrow with Nits scale)



HDR graticule, HDR Zoom Mode and HDR zebra highlighting in four-tile display

### Color correction tool set for editors and colorists

The Tektronix-patented Diamond, Split Diamond, and Arrowhead gamut displays simplify the process of verifying gamut compliance.



Tektronix-patented Diamond, Spearhead, and Arrowhead gamut displays, along with the Picture Bright-up display

The Diamond and Split Diamond displays help easily identify and correct RGB gamut errors in digital video signals. The Arrowhead display saves time in verifying composite gamut compliance for digital video signals. These various trace displays can be displayed in either ITU-R BT.709 or ITU-R BT.2020 color space.

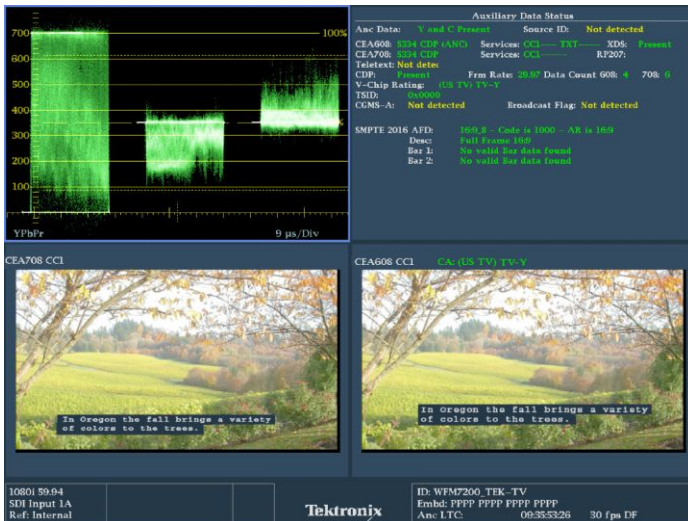
User-selectable gamut thresholds let you tailor these displays and the associated gamut alarms to your particular compliance standards. You can also select bright-up conditions to easily see the location of gamut errors in the picture display. Flexible Safe Area Graticules within the picture display allow for quick placement of graphics, titles, or logos. Using FlexVu™, users can see two or more pictures with different graticules.

The instrument also features optional advanced color gamut monitoring capabilities including the Tektronix-patented Luma Qualified Vector (LQV™) display and Spearhead display (Option PROD) which, when used in conjunction with Tektronix proprietary Diamond and Split Diamond gamut displays, provide the most comprehensive color gamut monitoring tools available for precise color gamut adjustments.

The combination of FlexVu™ and variety of gamut displays allow the instrument to be customized for your individual application to meet your needs. Additionally, simple presets can be set up and quickly recalled allowing the user to rapidly switch from one configuration to another.

## Content QA and distribution chain

The instrument can be configured to alarm on a variety of errors within the video and audio signal. Errors that occur within the program material can be logged against time code, allowing an operator to quickly investigate problems within the material. This can save time in evaluating quality assurance issues within content and provide documentation of the list of errors within the material that can be downloaded from the instrument using a network connection or USB device.



Simultaneous decode of CEA708 and CEA608 captions within multiple picture displays

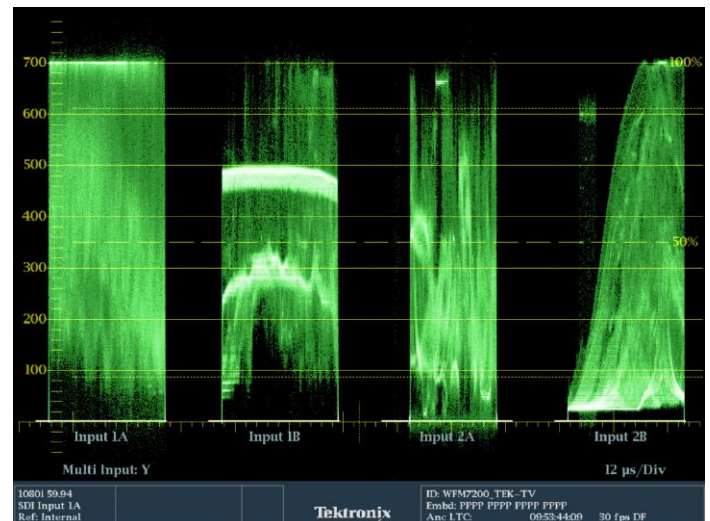
The picture display provides detection and decode of CEA708/608 Closed Caption. Using multiple picture displays, the instrument can decode CEA708 and CEA608 simultaneously, allowing verification of the presence and decoding of this critical metadata within one pass of the material.

Teletext subtitle pages can also be decoded in either 625 formats or using OP47 ancillary data. Flexible Safe Area Graticules allow for quick placement of graphics, titles, or logos. Using FlexVu™, users can see two or more pictures with different graticules.

Black and frozen frame detection can provide indication when the signal is lost during transmission and provide an alert of the alarm visually within the video session or error log displays. Alternatively, a ground closure or SNMP trigger can also be used to alert the operator to a problem.

## Camera balance application

Within a studio or on-location within a truck it is important that all the cameras are matched to ensure the look of the production from camera to camera, scene to scene. With the Multiple Input mode, the instrument can be used to monitor up to four SDI inputs simultaneously when in Full Screen mode (4-input mode requires Option 2SDI). This type of display is ideal for camera balance applications where the user wishes to check the video level across multiple inputs to ensure consistency of the cameras' output. This Multiple Input mode is available within Waveform, Vector, Lighting, Diamond, Arrowhead, and Spearhead (with Option PROD) display modes, allowing for the comparison of video inputs across a wide variety of these displays. The instrument can also be set to either BT.709 or BT.2020 colorimetry for all of these display modes.



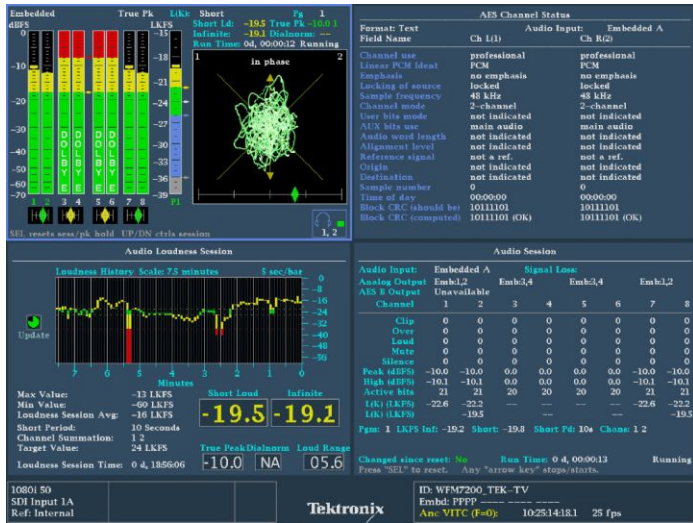
Multiple Input mode display of four SDI inputs with input labels for each signal

## Complete monitoring tool set for optimum sound quality

The instrument provides high-quality digital filtering and oversampling to insure precise, reliable, and repeatable audio measurements. For easy monitoring, the WFM audio options provide format auto-detection and flexible mapping of audio inputs to analog or digital audio outputs for connection to external devices.

The Audio display provides a variety of display configurations for audio level and phase monitoring. Up to 16 channels of embedded audio levels can be monitored with a variety of scales and ballistics configured by the user. For AES and embedded audio, eight audio channels can be monitored for audio level with phase correlation meters. The Bars display provides indicators for faults, audio levels with direct level readouts, and Dolby format information.

A Lissajous display can be enabled for a selected channel pair and provides an X-Y plot of the audio signals. The flexible Lissajous display allows the selection of any two audio channels. The Surround Sound<sup>1</sup> display provides intuitive graphical representation of channel interaction in a system.



Audio monitoring with Lissajous display, Channel Status information, Loudness Session, and Audio Session

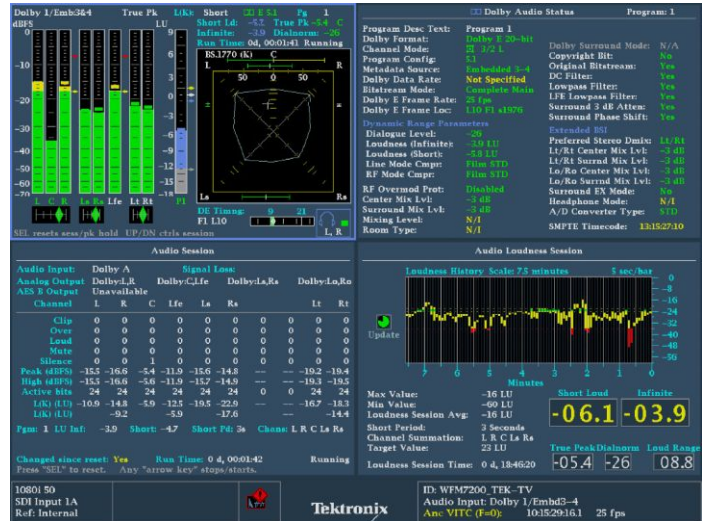
Loudness monitoring is becoming a critical part of audio monitoring of the program to ensure consistent audio loudness levels between programs and commercials. Loudness measurements are made to ITU-R BS.1770-3. A Loudness meter is available within the Audio display that provides Short and Infinite Loudness measurements. Within the configuration menu there are simple Loudness presets for the various standards such as ATSC A/85 2013 (1770-3), EBU R128 2014, ARIB TR-B32, Free TV OP59, and Brazil Ord 354.

The Loudness session display graphically plots Loudness measurements over time, from 90 seconds to 30 hours. The Loudness measurements can be downloaded through the network or saved to USB for further analysis. To help simplify monitoring, the Audio Loudness session can be started, stopped or reset using GPI or Timecode.

Specialized audio displays provide deeper inspection of the signal and make the instrument the most comprehensive waveform and audio monitor available. The Audio Session displays summarize levels, faults, and number of active bits for each channel. These instruments also feature Audio Control Packet Data and Channel Status displays.

## Dolby audio monitoring

With Option DPE, the instrument supports decoding of Dolby Digital (AC-3), Dolby Digital Plus, and Dolby E, providing decoding of up to 10 audio bar level meters along with correlation meters of the Dolby data stream. The decoded Dolby stream can be flexibly mapped to the analog or digital audio outputs.

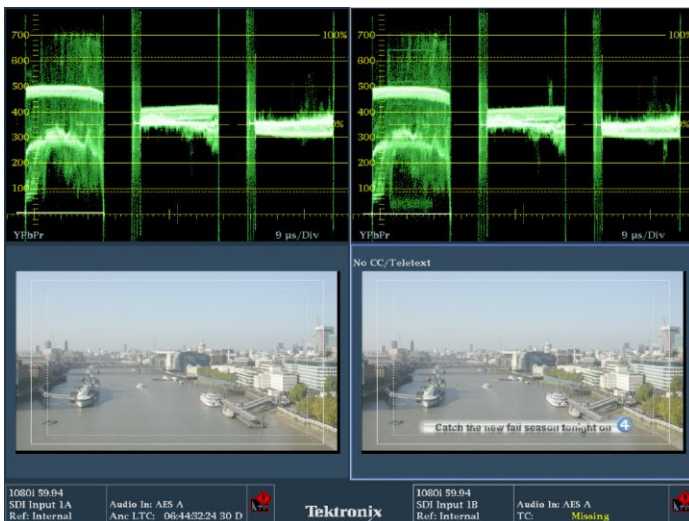


Dolby Audio Monitoring with Surround Sound display, Dolby Status, Audio Session, and Loudness Session displays

The Dolby Status display (Option DPE) gives an in-depth view of integrated or VANC metadata and comparisons of the Dialnorm value to Loudness measurements. Dolby E requires frame synchronization to the video signal and the guard band measurement provides a direct readout in terms of field and line location of the Dolby frame sequence. User-configurable thresholds for the Dolby E guard band timing measurement (Option DPE) are available as well as Dolby E guard band timing and trigger alarms based on their specific guard band parameters.

## Full-featured Simultaneous Input Monitoring (SIM) boosts versatility

The Simultaneous Input Monitoring (Option SIM) capability takes multiformat monitoring to a new level. This capability helps operational staff quickly determine if a video quality problem existed in the input signal or arose in their facility. It enables engineering staff to quickly detect, diagnose, and resolve technical problems introduced in a piece of video equipment by comparing the input and output signals at each point in the chain. This feature is also especially helpful when checking for transparency during format conversion.



Simultaneous Input mode comparing incoming and outgoing signals

FlexVu™ enables flexible and intuitive configuration of displays from two monitored inputs. The user can display simultaneous fault detection, status reporting, alarm generation, and error logging. SIM is ideal for transmission monitoring of simultaneous HD and SD programs. It is also ideal for monitoring stereoscopic 3D content in production and post-production applications by simultaneously monitoring the Left Eye image and the Right Eye image.

SyncVu™ is used in conjunction with SIM mode for 3D applications when input A is used for the Left Eye and input B is used for the Right Eye. When SyncVu™ is enabled, the Left and Right Tile displays are synchronized, so that if a picture tile is selected for Tile 1, Tile 2 automatically displays a picture tile in exactly the same mode as Tile 1. This enables the user to quickly configure the instrument identically for Left and Right Eye 3D monitoring.

The CaptureVu® feature allows users to capture, store, and download the data of a video frame to recreate displays and compare the live signal to captured data for easy troubleshooting of intermittent errors or for analyzing fault conditions at remote sites.

## 3D stereoscopic monitoring

The 3D stereoscopic monitoring and displays are available with Option S3D. A 3D image is comprised of a Left Eye and Right Eye image to be fed as two separate HD-SDI signals or combined within a 3G Level B format. Alternatively, the 3D signal can be carried in a single HD-SDI signal as a Side by Side or Top/Bottom image for the left and right images. A variety of different 3D monitoring modes are available within the instrument to assist the user in determining the difference between the Left Eye and Right Eye views. From this disparity difference between the two left and right images, the depth of an object within the image can be determined.



Simultaneous 3D display of Left Eye and Right Eye signals with Difference Map and Overlay picture displays

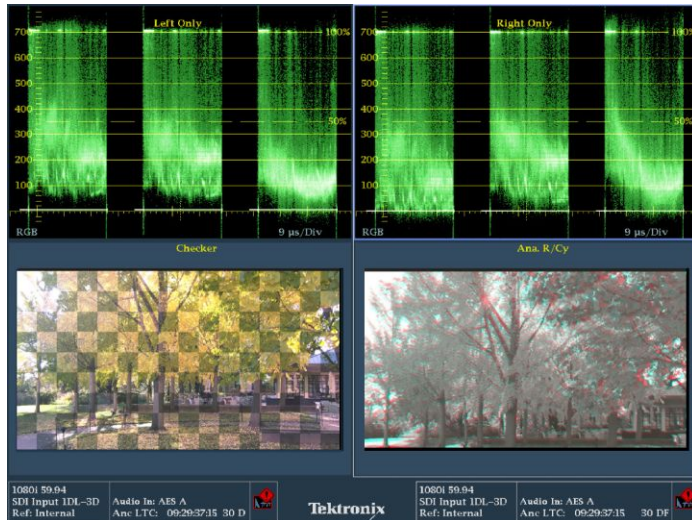
For monitoring purposes a variety of displays can be set up within the Picture mode:

- Difference Map display
- Red/Cyan Anaglyph display
- Green/Magenta Anaglyph display
- Checkerboard display

These modes help the user compare the disparity between the left and right images and can assist in interpreting the depth of the objects within the image.

### 3D stereoscopic measurement

For measurement of the depth of an object within the image (Option S3D) a Disparity Grid can be overlaid over the picture with a horizontal disparity between 1 to 15% of screen width and a vertical disparity of 50%, 25%, or 10% that can be selected by the user. The horizontal and vertical position controls allow the Disparity Grid to be moved around within the picture display to gauge the depth of objects within the image.

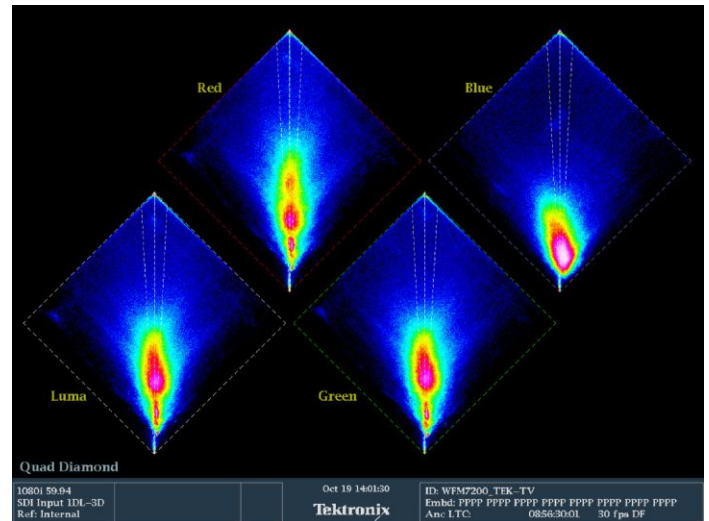


3D Left and Right Eye RGB waveform displays with a Checkerboard, and Red/Cyan Anaglyph picture displays

A set of Disparity Cursors are also available for precise measurement of horizontal disparity of an object between the Left and Right Eye images. Readout is given of the pixel difference between the cursors and the percentage of disparity of an object.

### Quad Diamond display for 3D alignment

The new Tektronix-patented Quad Diamond display (Option S3D) simplifies stereoscopic camera alignment by viewing a disparity histogram of the left and right signal from a signal level of 0 to 100% vertically for each of the components: Luma, Red, Green, and Blue. If the two cameras are well balanced the trace will form a vertical trace for each of the diamonds. A deviation in the trace indicates an imbalance between the left and right eye images that should be corrected using the various camera controls until the trace becomes vertical. This display can also be used in post-production for aiding the editor and perform color correction on the left and right images.



Quad Diamond display of Left and Right Eye Disparity for Luma, Red, Green, and Blue components



## Superior data analysis capabilities for engineers and operators

The ANC Data Inspector (Option DAT) provides an industry-leading solution to help broadcasters easily and accurately ensure that all required VANC data is present and correctly configured through an intuitive ANC data display.

**ANC Data Inspector**

Name	DID/SDID	Presence	Status	Location
S299-1 Aud Grp 2	E6/-	Present	OK	Field F1 / Line 22
S299-1 Aud Grp 1	E7/-	Present	OK	Field F1 / Line 22
S299-1 Ctrl Grp 1	E3/-	Present	OK	Field F1 / Line 9
S299-1 Ctrl Grp 2	E2/-	Present	OK	Field F1 / Line 9
S2016-3 AFD-Bar	41/05	Present	OK	Field F1 / Line 10
S334-1 CDP(708B)	61/01	Present	OK	Field F1 / Line 9

**Detail View Mode: Watch List** Time Elapsed Since Last Reset: 0 d, 00:07:28

Format: SMPTE 334M CDP (708B) Presence: Present

DID: 61 (161) Type: 2 Field: 1 Line: 9 Sample: --

SDID: 1 (101) DC: 82 (152) Link: -- Stream: Y

Exp/Act Chksum: 1b4 / 1b4 Error: OK

000		296	269	152	14f	173	22e	20f	272	114	1fd	180	180	2fc	180	180	2fa
016		200	200	2fa	200	200	2fa	200	200	2fa	200	200	2fa	200	200	2fa	200
032		200	2fa	200	200	2fa	200	200	2fa	200	200	2fa	200	200	2fa	200	200
048		2fa	200	200	2fa	200	200	2fa	200	200	2fa	200	200	2fa	200	200	2fa
064		200	200	2fa	200	200	173	1c1	1e0	265	16e	167	27e	23f	2ff	274	22e
080		20f	102														
096																	
112																	

1080i 59.94 SDI Input 1A Ref: Internal Tektronix ID: WFM7200\_TEK-TV Embd: PFFF PFFF TC:

ANC Data Inspector and CaptureVu provide detailed content analysis

In contrast to other solutions, the ANC Data Inspector enables operators to easily and quickly ensure that the VANC data is present and free of errors. When errors are detected, engineers are quickly guided to a more detailed view of the data packet content for further analysis.

With FlexVu™, each picture display tile can display different CEA708/608 Closed Caption and individual Teletext subtitles. Teletext subtitle pages can be decoded in either WST or OP47 format.

The Auxiliary Data Status display (standard on the instrument) provides summary information on Active Format Description (AFD) per SMPTE 2016, Video Index Aspect Ratio, Wide Screen Signaling (WSS), V-Chip, TSID, CGMS-A, Broadcast Flag, CEA708/608 Closed Caption, Teletext, and Time Code information.

**Auxiliary Data Status**

Anc Data: Y and C Present Source ID: Not detected

CEA608: S334 CDP (ANC) Services: CCI --- TXT --- XDS: Not detected

CEA708: S334 CDP Services: CCI --- RP207: ---

Teletext: Not detected

CDP: Present Frn Rate: 29.97 Data Count 608: 4 708: 0

V-Chip Rating: Not detected

TSID: Not detected

CGMS-A: Not detected Broadcast Flag: Not detected

SMPTE 2016 AFD: 16:9.8 -- Code is 1000 -- AR is 16:9

Desc: Full Frame 16:9

Bar 1: No valid Bar data found

Bar 2: No valid Bar data found

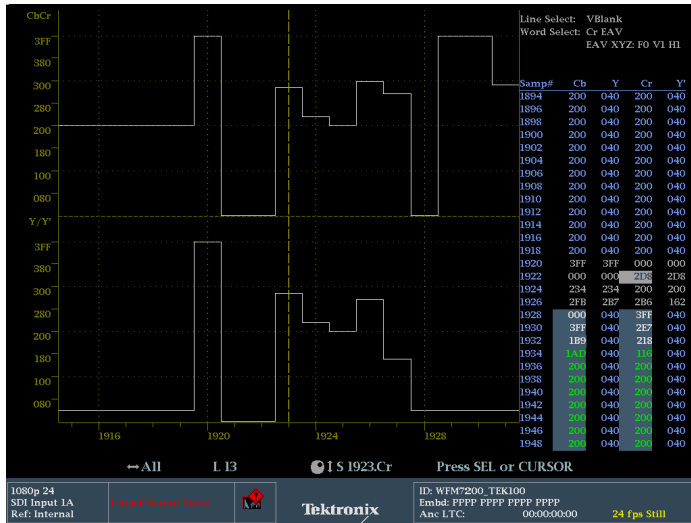
1080i 59.94 SDI Input 1A Ref: Internal Tektronix ID: WFM7200\_TEK-TV Embd: PFFF PFFF TC:

Monitoring of ancillary data (Closed Caption, Time Code, and AFD) using Aux Data Status

Today there is a wide array of metadata that provides information to a variety of equipment through the processing chain. Monitoring of this metadata is critical to ensure that the processing equipment correctly handles the signal. For instance, correct format of the AFD ensures that the aspect ratio on the display is correctly formatted and the automated AFD graticule is available for the Picture display along with the binary data and text description for easy monitoring.

The instrument can also monitor Dolby metadata embedded in the Vertical Ancillary (VANC) data space per SMPTE 2020.

The Datalist display (Option DAT) provides detailed information on the actual data values in HD/SD-SDI and 3G-SDI (with Option 3G) input signals. Users can easily use this display to locate protocol errors in the input signals.



Datalist display provides detailed pixel-by-pixel information

The right side of the display shows the data values in hexadecimal, decimal, or binary format and uses the following color coding for easy identification of data types and errors:

- Green – Active video data
- Blue – Data in horizontal or vertical blanking intervals
- White – EAV, SAV, and other reserved words
- Yellow – Data outside nominally allowed values
- Red – Data with illegal values
- Gold - Switch line
- Blue Background - Ancillary Data Packet

The left side of the display shows un-interpolated digital values plotted against sample numbers as a digital waveform. You can configure this unique display in either Video mode or Data mode.

In Video mode, the display shows the Y, Cb, Cr values aligned temporally, but offset vertically. Like the waveform display, you can configure the display to show one, two, or all three components.

Data values with a blue background represents Ancillary data with indication of DID, SDID/DBN, DC, UDW and Checksum.

## Physical layer measurements

The instrument offers comprehensive physical-layer signal measurements for engineers when Option PHY3 is installed.

The HD/SD-SDI eye pattern display, jitter measurements, and cable length measurements provide essential analysis of the physical layer. An easy-to-interpret gauge provides direct readout of jitter measurements for timing or alignment jitter with various user-selectable jitter filters from 10 Hz to 100 kHz within the eye display. Users can configure timing jitter and alignment jitter readouts to be displayed simultaneously to effectively isolate the sources of jitter.

The SDI Status display summarizes key signal parameters such as signal strength, cable loss, and Tektronix-patented estimated cable length measurements. With Option 3G, the instrument is also capable of displaying 3G physical layer measurements, allowing the instrument to support your future requirements.



Eye and Jitter display along with automated measurements of physical layer parameters

With FlexVu™, users can simultaneously display timing jitter and alignment jitter values, cable parameter measurements, and display different eye patterns to help quickly diagnose and resolve problems related to SDI timing jitter or cable attenuation. The Infinite Persistence mode of the waveform monitor can also be used to more easily view the eye opening of the physical layer signal.

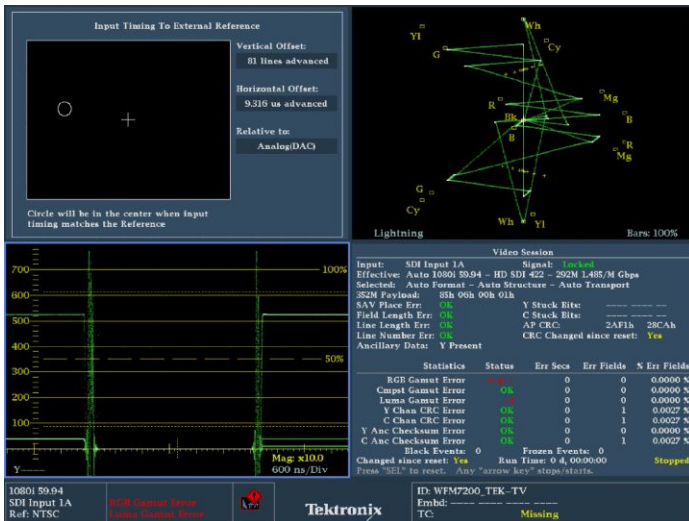
In addition, with Option PHY3 the instrument can also perform automated eye amplitude, automated rise/fall time, automated overshoot/undershoot measurements, and provide a jitter waveform display to view jitter related to line and field rates. All these capabilities help broadcasters and network operators detect and diagnose signal quality problems quickly and efficiently.

Option GEN provides a simple test signal generator output that creates 100% Color Bars, 75% Color Bars, and Pathological Test signals for a variety of video formats that can be used to verify signal path.

## Facility timing made easy

Audio/Video synchronization is an important challenge in the processing of video signals. With Option AVD, the instrument displays the A/V delay on a graphical bar indicator. The measurement readout gives facility engineers the necessary tools to ensure system integrity and facilitate A/V delay compliance. This feature provides out-of-service measurement of A/V delay for analog or digital audio and video formats. A TG8000 or SPG8000 is required to generate the SDI signal which contains the audio and video sequence that can be distributed through the system and measured by the instrument.

The Tektronix-patented Timing display makes facility timing easy through a simple graphical representation which shows the relative timing of the input signal and the reference signal (or a saved offset reference) on an X-Y axis. The Lightning display shows luma and chroma amplitudes and helps users verify component timing using a color bar signal. The Tektronix-patented Bowtie display (standard on the instrument) complements the timing measurement capability of the Lightning display. Using a special Bowtie test signal in component format, this display helps make precise and accurate measurements of inter-channel amplitude and timing. The SCH Phase display helps quickly verify this critical timing parameter of composite analog video signals.



Timing and Lightning displays simplify timing tasks

## Formats

### Video input and external reference formats supported

This instrument performs automatic detection of a wide range of signal formats and accept a wide variety of external references. The instrument automatically detects the signal format and establish the appropriate settings for the various displays.

		External reference inputs											
		Bi-level sync		Tri-level 720p			Tri-level 1080p		Tri-level 1080i			Tri-level 1080 SF	
Input signal		NTSC	PAL	50 Hz	59.94 Hz	60 Hz	23.98 Hz	24 Hz	50 Hz	59.94 Hz	60 Hz	23.98 Hz	24 Hz
Analog	NTSC	x											
	PAL		x										
SD	59.94i	x			x					x			
	50i		x	x					x				
HD	60p					x		x			x		x
	60i					x		x			x		x
	59.94p	x			x					x			
	59.94i	x			x					x			
	50p		x	x					x				
	50i		x	x					x				
	30p					x					x		
	30psF					x					x		
	29.97p	x			x					x			
	29.97psF	x			x					x			
	25p		x	x					x				
	25psF		x	x					x				
	24p					x		x			x		x
	24psF					x		x			x		x
	23.98p	x			x		x			x		x	
23.98psF	x			x		x			x		x		

### Supported SDI formats

Link	Format	Sample structure		Bits	Frame/field rates
SD-SDI (525i)	720×486	4:2:2	YCbCr	10b	59.94i
SD-SDI (625i)	720×576	4:2:2	YCbCr	10b	50i
HD-SDI	1920×1080	4:2:2	YCbCr	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	2048×1080	4:2:2	YCbCr	10b	23.98/24/25/29.97/30p and psF
	1280×720	4:2:2	YCbCr	10b	50/59.94/60p, 23.98/24/25/29.97/30p and psF

Link	Format	Sample structure	Bits	Frame/field rates	
Dual Link HD-SDI	1920×1080	4:2:2	YCbCr	10b	50/59.94/60p
	1920×1080	4:4:4	YCbCr	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4:4	YCbCrA	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	GBR	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4:4	GBRA	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	YCbCr	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	GBR	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:2:2	YCbCr	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:2:2:4	YCbCrA	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	2048×1080	4:2:2	YCbCr	10b	47.95/48/50/59.94/60p
	2048×1080	4:4:4	YCbCr	10b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	GBR	10b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	YCbCr	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	GBR	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	XYZ	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:2:2	YCbCr	12b	23.98/24/25/29.97/30p and psF
3G-SDI Level A (Option 3G)	1920×1080	4:2:2	YCbCr	10b	50/59.94/60p
	2048×1080	4:2:2	YCbCr	10b	47.95/48/50/59.94/60p
	1920×1080	4:4:4	GBR	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	GBR	10b	23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	GBR	12b	50/59.94/60i, 23.98/24/25/29.97/30p
	2048×1080	4:4:4	GBR	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	XYZ	12b	24/25/30p and psF
3G-SDI Level B (Option 3G)	1920×1080	4:2:2	YCbCr	10b	50/59.94/60p
	1920×1080	4:4:4	YCbCr	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4:4	YCbCrA	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	GBR	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4:4	GBRA	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	YCbCr	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:4:4	GBR	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:2:2	YCbCr	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	1920×1080	4:2:2:4	YCbCrA	12b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	2048×1080	4:2:2	YCbCr	10b	47.95/48/50/59.94/60p
	2048×1080	4:4:4	YCbCr	10b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	GBR	10b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	YCbCr	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	GBR	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:4:4	XYZ	12b	23.98/24/25/29.97/30p and psF
	2048×1080	4:2:2	YCbCr	12b	23.98/24/25/29.97/30p and psF
	2× 1080 HD	4:2:2	YCbCr	10b	50/59.94/60i, 23.98/24/25/29.97/30p and psF
	2× 720 HD	4:2:2	YCbCr	10b	50/59.94/60p, 23.98/24/25/29.97/30p

## Specifications

All specifications apply to all models unless noted otherwise.

### Composite video interface (Option CPS)

<b>Formats supported</b>	NTSC, NTSC no setup, PAL
<b>Inputs</b>	Two, only one active at a time
<b>Input type</b>	Passive loopthrough BNC, 75 $\Omega$ compensated
<b>Input dynamic range</b>	$\pm 6$ dB (typical)
<b>Maximum operating amplitude</b>	-1.8 V to +2.2 V, DC + peak AC (typical)
<b>Absolute maximum input voltage</b>	-6.0 V to +6.0 V, DC + peak AC
<b>DC input impedance</b>	20 k $\Omega$ , nominal
<b>Return loss</b>	>40 dB to 6 MHz, power on (typical) >40 dB to 10 MHz (typical) >46 dB to 6 MHz (typical) 35 dB, power off (standard amplitude video)
<b>Crosstalk between channels</b>	>60 dB to 6 MHz (typical)
<b>Loopthrough isolation</b>	>70 dB to 6 MHz (typical)
<b>DC offset with restore off</b>	<20 mV (typical)
<b>DC restore</b>	50 Hz and 60 Hz
<b>Attenuation</b>	Fast mode >95% attenuation Slow mode <10% attenuation
<b>Slow mode</b>	<10% peaking Typical peaking 8% at 50 Hz and 60 Hz
<b>Lock range</b>	$\pm 50$ ppm remains locked

### External reference

<b>Input type</b>	Passive loopthrough BNC, 75 $\Omega$ compensated
<b>DC input impedance</b>	15 k $\Omega$ (typical)
<b>Return loss</b>	>40 dB to 6 MHz (typical) >35 dB to 30 MHz (typical)

**User interface**

Display	1024 (H) × 768 (V) pixels LCD
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**Monitor display output characteristics**

Signal format (XGA DVI-I output)	1024×768, 60 Hz vertical rate
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**Serial digital waveform vertical characteristics****Vertical measurement accuracy**

At X1	±0.5%
At X5	±0.2% of 700 mV full-scale mode

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Gain	X1, X2, X5, and X10
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**Frequency response characteristics****HD**

Luminance channel (Y)	50 kHz to 30 MHz ±0.5%
Chrominance channels (Pb, Pr)	50 kHz to 15 MHz ±0.5%

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**SD**

Luminance channel (Y)	50 kHz to 5.75 MHz ±0.5%
Chrominance channels (Pb, Pr)	50 kHz to 2.75 MHz ±0.5%

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**Analog composite waveform vertical characteristics (Option CPS)**

Vertical measurement accuracy	±1% all gain settings
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Gain	X1, X2, X5, and X10
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Frequency response	Flat to 5.75 MHz, ±1%
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**Waveform horizontal sweep characteristics**

Sweep timing accuracy	±0.5%, all rates, fully digital system
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Sweep linearity	0.2% of time displayed on screen, fully digital system
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**Vector characteristics**

Vector amplitude accuracy	±2%
Vector phase accuracy	±2°

**Audio characteristics (optional capability)**

Level meter resolution	0.056 dB steps at 30 dB scale, from full scale to -20 dBFS
User selectable scales	
Analog	dBu, din, nordic, VU, IEEE PPM, BBC scale, and user definable
Digital	dBFS, din, nordic, VU, IEEE PPM, BBC scale, and user definable
Meter ballistics	Selectable from true peak, PPM type 1, PPM type 2, and Extended Vu
Defined/programmable level detection	Mute, clip, user-programmable silence, over

**Digital audio characteristics (Option DPE and AD)**

Inputs	Two sets with 8 channels each, 32-192 kHz, 24 bit; meets requirements of AES 3-ID and SMPTE 276M-1995
Characteristics	BNC, 75 Ω terminated, unbalanced, 0.2 V <sub>p-p</sub> to 2 V <sub>p-p</sub>
Return loss	>25 dB relative to 75 Ω from 0.1 to 6 MHz (typical)
Outputs	Up to 8 channels, AES 3-ID output, 48 kHz 20 bit for SD embedded, 48 kHz 24 bit for HD embedded, 48 kHz 24 bit for analog to AES. For AES to AES loopthrough, output format equals input format. Meets requirements of SMPTE 276M-1995 (AES 3-ID). For decoded Dolby Digital, output is 24 bits at a rate of 32, 44.1, or 48 kHz for any one decoded pair. For decoded Dolby E, the output is 24 bits at 48 kHz or 47.952 kHz for up to four pairs.
Characteristics	BNC, 75 Ω terminated, unbalanced, 0.9 V <sub>p-p</sub> to 1.1 V <sub>p-p</sub> into 75 Ω
Return loss (typical)	>25 dB relative to 75 Ω from 0.1 to 6 MHz
Jitter (typical)	3.5 ns, peak, with 700 Hz high-pass filter per AES specification
Level meter accuracy over frequency	+0.1 dB from 20 Hz to 20 kHz 0 to -40 dBFS, sine wave Peak ballistic mode (except for within 5 Hz of some submultiples of the sampling frequency)

**Analog audio characteristics (Option DPE and AD)**

Inputs	Two sets of six channels each
Characteristics	Balanced, unterminated through to rear panel connector
Outputs	8 channels
Characteristics	Balanced, unterminated through the rear-panel connector
Output level, balanced	+24 dBu ±0.5 dB
Crosstalk	<90 dB
Input impedance	24 k (typical)
Digital input to analog output gain accuracy over frequency	±0.5 dB, 20 hz to 20 kHz, -40 dBFS, 20 or 24 bit inputs



**Analog audio characteristics (Option DPE and AD)**

Analog input to analog output gain accuracy over frequency +0.8 dB, 20 Hz to 20 kHz, 24 dBu to -16 dBu

Output impedance 50  $\Omega$  nominal

**Power characteristics**

Power consumption 110 W, maximum

Voltage range 100 to 240 VAC  $\pm$ 10%; 50/60 Hz

**Physical characteristics****Dimensions**

Height 133 mm (5.25 in.)

Width 213 mm (8.375 in.)

Depth 464 mm (18.25 in.)

Weight (net) 3.9 kg (8.5 lb.)

**Capabilities by optional configuration**

Video formats and inputs	Capability	Availability
	HD-SDI / Dual Link / SD-SDI	Standard
3G-SDI (Level A and Level B)	Option 3G	
4 SDI Input Monitoring	Option 2SDI	
Composite PAL/NTSC	Option CPS	

Audio formats and inputs	Capability	Availability
	Embedded and AES digital audio	Option AD or DPE
Analog Audio	Option AD or DPE	
Dolby E / Dolby Digital Plus / Dolby Digital	Option DPE	

Physical layer measurement	Capability	Availability
	Jitter measurements	Option PHY3
Eye pattern display	Option PHY3	
Eye pattern auto measurements	Option PHY3	
Pathological signal generation	Option GEN	

Other advanced capabilities	Capability	Availability
	HDR tool set (HDR graticules, HDR Zebra overlay)	Option PROD
Advanced color gamut (Spearhead / LQV)	Option PROD	
Simultaneous Input Monitoring (SIM)	Option SIM	
3D video monitoring	Option S3D	
ANC Data Inspector	Option DAT	
Digital data analysis	Option DAT	
Out-of-service AV delay measurement	Option AVD	



## Ordering information

### Models

<b>WFM7200</b>	SDI waveform monitor, 2 SDI inputs (auto-detection of SDI format); base unit includes HD-SDI, SD-SDI, Dual Link signal formats; Option 3G required for 3G-SDI support
<b>WFM720UP</b>	This field upgrade allows you to upgrade your existing WFM7200 with any of the available WFM7200 options

### Options

#### WFM7200 and WFM720UP options

<b>2SDI</b>	<p>Adds additional SDI module (in slot 2) to support up to 4 SDI inputs within multi-mode displays (3G-SDI, HD-SDI, and SD-SDI support on the same inputs – auto detect).</p> <p>Option 3G required for 3G-SDI support.</p> <p>This option cannot be installed on an instrument with option CPS installed.</p>
<b>3G</b>	Adds support for 3G-SDI signal formats (Level A and Level B). (Upgrades are available by a software option key.)
<b>AD</b>	Adds analog audio monitoring (2 sets of 6-channel analog audio inputs and 8-channel analog audio outputs) plus 16 channels, embedded or AES/EBU digital audio support (8 channels at a time), including loudness monitoring.
<b>AVD</b>	Adds support for out-of-service A/V delay measurement. Option AD or DPE required.
<b>CPS</b>	<p>Adds support for composite analog video monitoring; 2 composite analog inputs; passive loopthrough.</p> <p>This option cannot be installed on an instrument with option 2SDI installed.</p>
<b>DAT</b>	Add advanced 3G / Dual-Link / HD / SD-SDI data analyzer and ancillary data analyzer (Datalist and ANC data Inspector). Option 3G required for 3G-SDI support.
<b>DPE</b>	Adds option AD capabilities (analog and digital audio – embedded or external AES) plus support for decoding and monitoring Dolby E, Dolby D, and Dolby Digital Plus including loudness monitoring.
<b>GEN</b>	Adds 3G/HD/SD-SDI color bar and pathological signal generation capability. Option 3G required for 3G-SDI signal generation capability.
<b>PHY3</b>	Physical layer measurement package (includes automated measurement of 3G/HD/SD eye pattern parameters, jitter, and cable parameters; jitter waveform display). Option 3G required for 3G-SDI physical layer measurements.
<b>PROD</b>	Advanced gamut monitoring package (Spearhead Gamut display and Luma Qualified Vector display) and HDR tool set (HDR graticules, HDR Zebra overlay).
<b>S3D</b>	Add monitoring support for stereoscopic 3D video (including Simultaneous Input Monitoring capability).
<b>SIM</b>	Add simultaneous monitoring of two 3G/HD/SD-SDI inputs or one 3G/HD/SD-SDI input and one CPS input. Option 3G required for 3G-SDI format support.
<b>62</b>	Analog audio breakout cable, 6 feet, male 62-pin connectors to 8 XLR male output connectors and 12 XLR female input connectors.

**Power plug options**

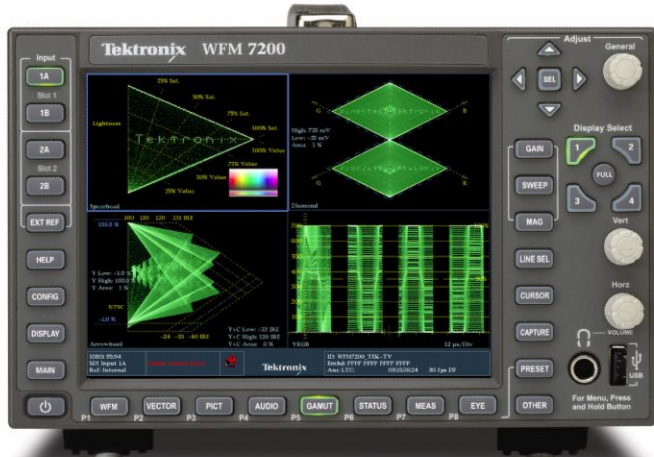
Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

**Service options**

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 (including warranty)
Opt. R3DW	Repair Service Coverage 3 Years (includes product warranty period). 3-year period starts at time of instrument purchase
Opt. R5	Repair Service 5 Years (including warranty)
Opt. R5DW	Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrument purchase

**Optional accessories**

WFM7F02	Portable cabinet includes handle, feet, tilt bail, and front-panel cover
WFMRACK-NN	Dual rack cabinet, New-New
WFMRACK-ON	Dual rack cabinet, Old-New
WFM50F06	Filler blank panel for WFMRACK



WFM7200 front panel



WFM7200 rear panel



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

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**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.tek.com](http://www.tek.com).

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