Multi-format, Multi-standard Waveform Monitors

▶ WFM700HD · WFM700A · WFM700M

▶ **Features & Benefits**

Field-upgradeable, Modular Platform Accommodates SD and HD Digital Component Video per ITU-R BT.601 and SMPTE 292M – Single Product for Both Standards

Exclusive Diamond, Split Diamond and Arrowhead Displays Offer Unique Insight Into Gamut Compliance

Multi-mode Display Improves Efficiency by Letting You View a Wide Variety of Displays Simultaneously

Fully Digital Processing for Accuracy, Repeatability, Stability and Reduced Cost of Ownership

Comprehensive Error Detection, Reporting and Logging Offer Powerful Support for Content QA and Service-level Verification

Configurable Alarms with User-adjustable Thresholds to Select Level of Monitoring Suited to Application

Available HD/SD Eye Pattern and Jitter Display Supports Facility Transition to HD (M Module only)

Available Digital Audio Monitoring Verifies Compliance of Video and Audio in One Instrument, Conserving Space and Lowering Expenses (Requires Purchase of Additional Module)

TFT Color LCD Display, with Touchscreen Control, Provides a Unique, Flexible User Interface with Intuitive, Status-at-a-Glance Operation

Remote Interface for Access and Control from Any Location, Improves Operational Efficiency

▶ **Applications**

Quality Control in the Production and Post-production of HD/SD Digital Video Content

Monitoring and Compliance Checking in the Distribution and Broadcast of HD/SD Digital Video

Video Equipment Qualification and Troubleshooting in the Installation and Maintenance of HD/SD Digital Video Facilities and Systems
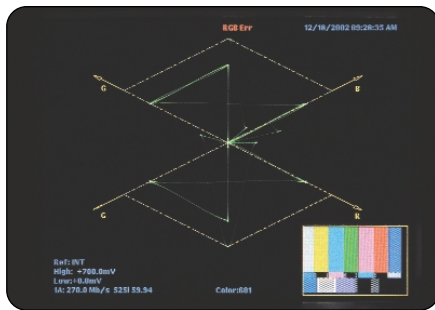
The WFM700 Series of Multi-format Waveform Monitors offers the monitoring capabilities needed in the production, post-production, distribution and transmission of high-definition (HD) and standard-definition (SD) digital video content.

For mixed HD/SD environments, the multi-format **WFM700A** gives you the tools you need to perform operational monitoring tasks like checking signal validity and content quality, setting levels, and verifying signal paths. The **WFM700HD** offers an HD-only version of these same capabilities. The **WFM700M** offers all the capabilities of the WFM700A plus the digital analysis capabilities important in the design, installation and maintenance of digital video systems, including eye diagram,

jitter and data measurements for both HD and SD formats. With available digital audio monitoring support, you can expand the capabilities of any WFM700 configuration to monitor both digital video and audio in a single instrument. These products combine the best of traditional waveform monitors with the measurement accuracy, repeatability, and stability achievable with fully digital technology. Their modular design lets you purchase the capability you need now and add capabilities later as your requirements change. Backed by Tektronix innovation, service, and support, these modular, multi-format, fully digital waveform monitors lower your cost of ownership while offering powerful tools for monitoring digital video and audio signals.
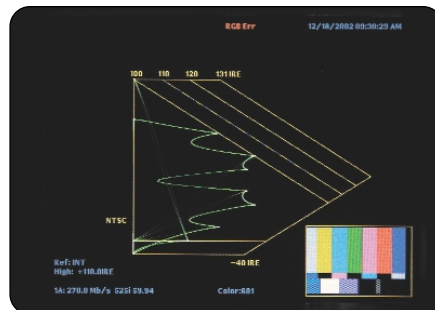
Tektronix

Enabling Innovation

Multi-format, Multi-standard Waveform Monitors

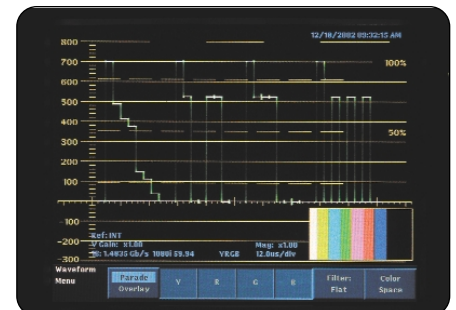▶ WFM700HD • WFM700A • WFM700M

▶ *WFM700 Diamond display.*

▶ *WFM700 Arrowhead display.*

▶ *WFM700 YRGB Waveform display in parade mode.*

▶ *WFM700 Lightning display.*

Tektronix-exclusive Color Gamut Monitoring

Problems with production and operational equipment can introduce illegal colors in the digital video signal, i.e., colors that fall outside established gamut limits. Every member of the WFM700 Series has the following Tektronix patented gamut monitoring displays:

▶ Diamond and Split Diamond – monitoring for component gamut compliance

▶ Arrowhead – monitoring for composite gamut compliance

With these specialized displays you can significantly reduce the time and effort needed to perform this critical quality control task.
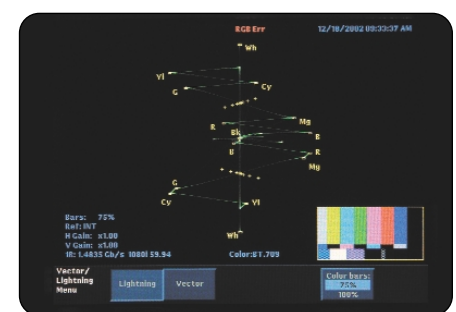
Familiar Waveform Monitoring Displays and Controls

All WFM700 models offer familiar waveform displays. You can view digital video signal components in either an RGB, YRGB, YP_bP_r color space, displayed in parade or overlay mode.

In addition to these digital waveform displays, the WFM700 products can also display a familiar composite representation of an SDI digital signal.

Every WFM700 model offers a rich set of familiar waveform display controls including:

▶ 1-line, 2-line, 1-field, and 2-field sweep selections

▶ Line and field selects

▶ Flat and low-pass filtering

▶ 1x, 5x, 10x and variable gain settings

▶ 0% and 7.5% setup levels in the composite waveform representation

▶ Offset and aligned chroma settings in YP_bP_r color space

▶ Horizontal magnification

Tradition and Innovation in Monitoring Color Amplitude and Timing

Complementing these full-featured waveform displays, every WFM700 product offers two specialized displays for monitoring the color information in digital video signals.

▶ The traditional Vector display for monitoring P_bP_r color amplitude

▶ The Tektronix-patented Lightning display for monitoring luma and chroma amplitudes and interchannel timing

Automatic Detection of a Wide Range of Signal Formats

All WFM700 models have two terminating inputs for serial digital signals in either SMPTE 292M format (WFM700 HD, WFM700A, and WFM700M) or SMPTE 259M format (WFM700A and WFM700M). The following table shows the supported signal formats:

Standard	Physical Interface	Image Format	Field/Frame Rate 60 Hz	Field/Frame Rate 59.94 Hz	Field/Frame Rate 50 Hz	Field/Frame Rate 30 Hz	Field/Frame Rate 29.97 Hz	Field/Frame Rate 25 Hz	Field/Frame Rate 24 Hz	Field/Frame Rate 23.98 Hz
274M	292M	1920x 1080i	X (D-292)	X (E-292)	X (F-292)					
274M	292M	1920x 1080p				X (G-292)	X (H-292)	X (I-292)	X (J-292)	X (K-292)
274M	292M	1920x 1080sF				X	X	X	X	X
240M/ 260M	292M	1920x 1035i	X (A-292)	X (B-292)						
296M	292M	1280x 720p		X (M-292)					X	X
ITU-R BT.601[*1]	259M	720x 576i (625)			X (C-259)					
ITU-R BT.601	259M	720x 483i (525)		X (C-259)						

[*1] ITU-R BT.601 defines sampling for SD serial digital video per SMPTE 259M and ITU-R BT.656.

The monitor will automatically detect the signal format and establish the appropriate settings for the various displays.

All models accept an external reference signal for synchronization.

Timing Reference, Line Number and Ancillary Data Monitoring

Every WFM700 Series product can detect information contained in the horizontal and vertical synchronization intervals in the digital video, including:

▶ Detecting Start-of-Active-Video (SAV) and End-of-Active-Video (EAV)

▶ Error detection and reporting per SMPTE RP165 for standard definition and SMPTE 292M for high definition

▶ Detecting the presence or absence of close caption information embedded in accordance with the EIA 608 and EIA 708 standards

▶ Displaying Ancillary Time Code and VITC timecode values

"Status-at-a-Glance" Video Session Display

In addition to detecting a wide range of video signal characteristics, the WFM700 waveform monitors offer valuable status and error reporting capabilities, like the unique Video Session display. This display summarizes a variety of statistics relevant to video content health and standards compliance, including:

▶ Signal format and colorimetry

▶ Stuck bits indicator

▶ Presence or absence of ancillary data, including embedded audio, closed caption data, or time-codes

▶ Presence or absence of color gamut errors

▶ CRC values

▶ Errored seconds, errored fields, and % errored fields statistics

User-adjustable Alarms and Event Logging

Further enhancing the capability available with the Video Session display, all WFM700 Series instruments can report and log a wide range of alarm conditions, including:

▶ Input signal or external reference signal missing or format mismatch

▶ Color gamut errors

▶ Ancillary data present/absent errors, parity errors, or checksum errors

▶ CRC and EDH errors, code word violations, or field and line length errors

▶ EAV / SAV missing or mismatch with line number

▶ SAV placement error

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Every WFM700 model maintains an event log with each entry stamped with the time-of-day when the waveform monitor logged the event. You can also configure event logging to time stamp events with a VITC value.

Convenient User Interface Features and Display Modes

WFM700 waveform monitors offer many convenient user interface features and display modes, including:

▶ An integrated thin-film LCD color display with touch screen

▶ Full screen and thumbnail picture display

▶ Multi-mode display capability that lets you flexibly combine two displays into a single, split-screen view

▶ Freeze mode for comparing live signals against a stored reference

▶ Electronic graticules and digital cursors

▶ Up to 42 stored presets

▶ Print screen capability, context sensitive on-line help, and complete instrument diagnostics

Powerful Digital Video Waveform Measurement Available

For making highly precise inter-channel amplitude and timing measurements, every WFM700 model offers the familiar Bowtie display. The

▶ *WFM700 Video Session display for SMPTE 292M (HD) signal.*

WFM700M offers more comprehensive measurement capability, adding the following displays to those offered on the WFM700A and WFM700HD:

▶ Data display

▶ Eye pattern display

▶ Jitter display

Digital Audio Monitoring Available on All Models

All members of the WFM700 Series detect and report the presence or absence of embedded audio channels. You can add more extensive capability for monitoring AES/EBU digital audio channels by including Option DG in your order for any WFM700 Series waveform monitor. You can add this audio monitoring capability to a previously purchased WFM700 model by ordering the WFM7DG field upgrade.


▶ *WFM700 Event Log.*

WFM700 Series digital audio monitoring and measurement features include:

▶ Monitoring of up to 8 embedded digital audio channels

▶ 4 AES/EBU audio inputs/outputs for monitoring up to 8 non-embedded audio channels, or producing up to 8 channels of de-embedded audio output

▶ Support for multi-channel digital audio in Dolby 5.1 and 7.1 formats

▶ Audio Level Bar display of 2, 4, 6, or 8 audio channels with true peak, PPM, and Extended VU meter ballistics and selectable scaling

▶ Single-axis Phase Correlation Meter showing the phase relationship between signals on an audio channel pair

▶ Lissajous display showing the phase relationship between the selected channel pair, with X/Y or Sound Stage (L/R) axis orientation and automatic gain control
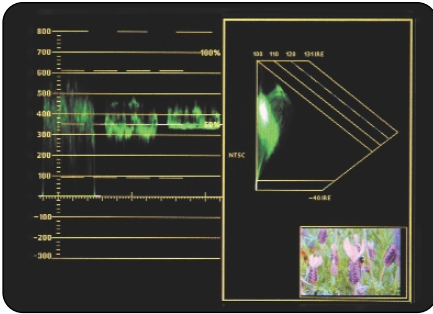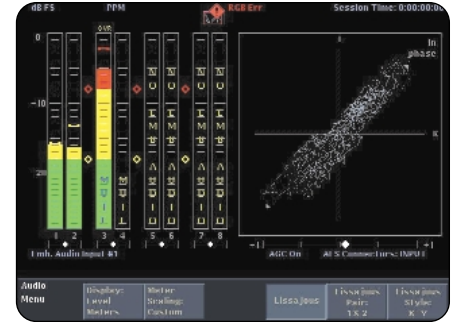
▶ *WFM700 Multi-mode display.*
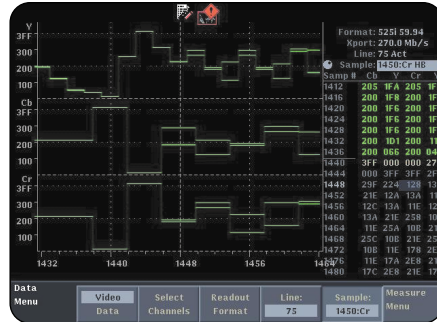
▶ *WFM700 Data display.*

▶ *WFM700 Audio monitoring displays with Level Bars, Phase Correlation Meter, and Lissajous display.*

The audio monitoring module supports the embedded and AES/EBU formats shown in the following table:

Audio Standard	Physical Interface	Sampling Frequency	
		48.0 kHz	44.1 kHz
AES3-1992 (r1997)	AES-3id-2001	X	X
AES3-1992 (r1997)	SMPTE 259M	X	
AES3-1992 (r1997)	SMPTE 292M	X	

Complementing these standard displays, the Channel Status display decodes the information in the Channel Status block defined in AES3-1992 (r1997) for both consumer-grade and professional-grade audio.

Audio monitoring support adds several alarm conditions to the list of video alarms described earlier, including detection of:

▶ Audio CRC errors

▶ Clip, mute, over, and silence conditions

▶ Audio parity errors

▶ Embedded audio absence and AES audio unlock

Like the session display used to monitor video signals, all WFM700 models with audio monitoring capability offer an Audio Session screen that lets you quickly check the health of any digital audio channels and track key audio signal parameters. Key fields include:

▶ Highest true peak, highest uninterpolated peak, and highest bar reading

▶ Sample rate and active bits

▶ The number of clips, mutes, overs, and silences

▶ Invalid samples

▶ Detected receiver errors

Multiple Inputs/Outputs for Easy System Integration

In addition to the inputs and outputs described earlier, every WFM700 model has the following connections:

▶ VGA output for viewing the LCD display on a detached VGA monitor

▶ Analog component video picture monitor outputs

▶ VGA picture monitor output that follows the component picture monitor output for viewing the picture on an inexpensive VGA display

▶ Looping inputs for bi-level and tri-level sync

▶ One switched SDI output that follows the selected input

▶ An SD SDI picture monitor output

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Network Access and Control

The WFM700 Series offers two forms of remote access and control:

▶ A 9-pin remote control port reports alarm conditions and lets you control the monitor by selecting one of seven available instrument presets

▶ A network remote control interface lets you view the WFM700 displays using a standard Web-browser over an Ethernet-based network

Designed to Accommodate Change

All WFM700 models share a common platform and can accept additional modules. The WFM700 Series design also supports feature and performance enhancements via software you can download and install in the instrument through the Ethernet connector.

▶ Characteristics

Serial Digital Video Interface
Video Inputs – 2 per card – only one active at a time.

Input Type – 75 Ω BNC, internally terminated.

Launch Amplitude Accommodation – 800 mV ±10% for full specification. 800 mV ±30% up to 20 dB cable attenuation.

Jitter Tolerance – 0.4 UI$_{p-p}$ typical above 2 MHz.

Return Loss – 15 dB to 1.5 GHz.

Isolation Between Inputs – >45 dB to 1 GHz.

Switched Serial Video Output
Format – 1.485 Gbps or 270 Mbps repeat of selected input.

Output Level – 800 mV$_{p-p}$ ±5% into 75 Ω load.

Return Loss – 15 dB to 1.5 GHz.

Output Type – 75 Ω BNC.

External Reference
Sync Format –
NTSC, PAL, 1080i 59.94 Hz, 1080i 60 Hz, 720p 59.94 Hz, 1080p 23.98 Hz, 1080p 24 Hz.

Input Type – 75 Ω BNC passive loop.

Return Loss – 40 dB to 30 MHz.

Hum – Operates with 500 mV$_{p-p}$.

Signal/Noise – Operates to 25 dB.

Serial SD Only Monitor Output
Content – Follows Active Input With Brightups – SD only digital version of RGB/Y′P′bP′r analog pix monitor output on Ref board.

Rate – 270 Mbps.

Signal Level – 800 mV ±5% into 75 Ω.

Return Loss – 20 dB, 5 MHz to 270 MHz.

Output Type – 75 Ω BNC.

Picture Monitor Outputs
Signal Format, BNC Outputs – Y, P′b, P′r with sync on Y, RGB with sync on all, HD and SD. HD sync is tri-level.

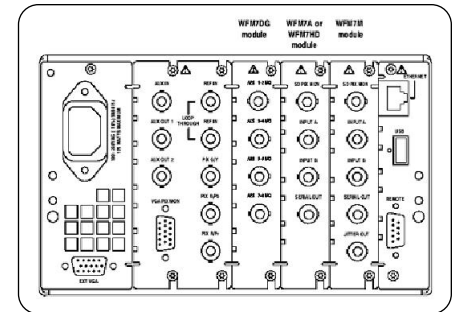**Signal Format, VGA DSUB Outputs –** Same signal as on BNC outputs, also have TTL H and V drive.

Impedance – 75 Ω unbalanced.

Active Video Accuracy – 700 mV ±5%$_{p-p}$ (Y′P′bP′r mode).

Black (Blanking) Output Level – 0 mV ±25 mV for HD and SD.

Frequency Response, SD – Y, G, B and R ±5% to 5.5 MHz.

Frequency Response, HD – Y, G, B and R ±8% to 30 MHz.

▶ *WFM700 Back Panel with two video input modules and an audio input module installed.*

AES Audio Interface
Audio Inputs – 4 inputs, 8 audio channels, meets Requirements of AES-3id-2001.

Input Type – 75 Ω BNC, internally terminated, unbalanced.

Input Amplitude Range – 0.2 V to 2 V peak-to-peak.

Input Sample Rate – 32 k to 96 k samples/sec.

Input Lock Range – >±5%, typical.

Input Return Loss – Better than 25 dB from 0.1 to 6 MHz.

Audio Outputs – Up to 8 audio channels from Embedded Audio only.

Output Format – 48 kHz, 20-Bit, meets requirements of SMPTE 276M-1995 (AES-3id-2001).

Output Amplitude Range – 0.9 V to 1.1 V peak-to-peak into 75 Ω.

Output Sample Rate – Locked to embedded sample rate (nominally 48 kHz).

Output Jitter – Meets AES3-1997.

Output Return Loss – Better than 25 dB 0.1 to 6 MHz.

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Waveform Vertical Deflection

Vertical Measurement Accuracy Using Graticule or Cursor –
At 1x, ±0.5% of 700 mV full scale.
At 5x, ±0.2% of 700 mV full scale.
At 10x, ±0.1% of 700 mV full scale.

Gain – 1x, 5x, 10x, variable.

Variable Gain Range – 0.25x to 14x.

Frequency Response, HD[*1] –
Luminance channel (Y): 50 kHz to 30 MHz ±0.5%.
Chrominance Channels (P′b, P′r): 50 kHz to 15 MHz ±0.5%.

[*1] For monochrome signals, R, G and B bandwidths equal Y bandwidth.

Waveform Horizontal Deflection

Sweep Accuracy – ±0.5%, all rates, fully digital system.

Sweep Linearity – 0.2% of time displayed on screen, fully digital system.

Rates – 1, 2, 3, 4 line or field, depending on mode.

Line Select – Selected line in 1 line, selected first line in 2 line or parade.

Eye Pattern Display

Type – Equivalent time sampler.

Signal Bandwidth – 50 kHz to 2.5 GHz at –3 dB point.

Timebase Jitter (**Note:** in 1 kHz high pass filter) **–**
(HD) – 70 ps typical.
(SD) – 150 ps typical.

Eye Clock Bandwidth Accuracy –
Actual –3 dB point within 10% of nominal.

Display Modes, SD –
Overlay: Overlays all bits to form each eye opening.
10 Eye: Displays eye relative to the parallel clock and line sync.

Display Modes, HD –
Overlay: Overlays all bits to form each eye opening.
20 Eye: Displays eye relative to the parallel clock and line sync.

Jitter Display

Type – Demodulated recovered clock per SMPTE RP184.

Digital Readout –
Accuracy: <0.05 UI + 10%, typical, of reading for jitter frequencies from three times high-pass filter selection to 1 MHz.

Note: High-pass filter selection is set in Jitter Waveform Mode.

Jitter Waveform Gain Error – <0.1 UI + 10%, typical, of reading for jitter frequencies from three times high-pass filter selection to 1 MHz.

Jitter Waveform High-pass Filter Selection – 10 Hz, 1 kHz, 10 kHz, 100 kHz.

Jitter Output – 100 mV/UI, ±10% into 75 Ω load.

Jitter Frequency Response – –3dB at 5 MHz (typical).

RGB Gamut Error Detection

Detection Level –
High Limit, +630 mV to +756 mV in 1 mV steps.
Low Limit, –50 mV to +35 mV in 1 mV steps.

Arrowhead (NTSC/PAL Composite Gamut Limit Display Mode)

Detection Level –
Accuracy, ±7 mV.
High Limit (NTSC-derived formats), 90 IRE to 135 IRE in 1 IRE steps.
High Limit (PAL-derived formats), 630 mV to 950 mV in 1 mV steps.

Audio Level Meter

Level Meter Resolution –
0.05 dB steps at 10 dB scale, from full scale to –40 dB FS.
0.25 dB steps at 0 to –70 dB scale, for signals above –40 dB FS.

Level Meter Accuracy –
0.2 dB from 20 Hz to 20 kHz with 0 to –40 dBFS sine-wave input. PPM Ballistic mode except within 7 Hz of some submultiples of the 192 kHz oversampling frequency. For example:
13.714 kHz ± 7 Hz – 0.22 dB.
16.0 kHz ± 7 Hz – 0.30 dB.
19.2 kHz ± 7 Hz – 0.43 dB (worst case).

General Specifications

Power

Mains Voltage Range – 100 to 240 VAC ±10%.

Mains Frequency – 50 or 60 Hz.

Power Consumption (typical) –
≤100 W with 1 Video Input Module.
≤125 W with 2 Video Input Modules.
150 W max.

VGA O/P – This connector allows the front panel display to be replicated on a remote VGA monitor.

Ethernet Connector – Allows the instrument to be connected to a 10/100Base-T Ethernet circuit for remote control and firmware update.

Environmental

Temperature –
0 ºC to +40 ºC (operating).
–20 ºC to +60 ºC (nonoperating).

Humidity – 20% to 80% RH at up to 40 ºC, noncondensing (operating).

Altitude –
To 3,000 m (operating).
To 12,192 m (nonoperating).

Safety

Designed and tested for compliance with:
ANSI/ISA s82.02.01, Can/CSA C22.2 No. 1010.1, IEC 61010-1, UL 3111-1, 93/68/EEC and EN 61010-1.

EMI

Tested for compliance with:

▶ FCC, CFR Title 47, part 15, Subpart B, Class A

▶ EN 55103-1/2, Class B emissions

▶ European EMC directive, video standard

Physical Characteristics

Dimensions	mm	in.
Height	133.4	5.25
Width	215.9	8.5
Depth	460.4	18.125
Weights	**kg**	**lbs.**
Net	5.5	12.125
Shipping (approx.)	9.6	21.164

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▶ Ordering Information

Following models complete with one video input module (two video inputs).

Instruments

WFM700HD

SMPTE 292M Serial Digital Waveform Monitor.

WFM700A

ITU-R BT.601 and SMPTE 292M Serial Digital Waveform Monitor.

WFM700M

ITU-R BT.601 and SMPTE 292M Serial Digital Waveform Monitor with additional video measurements.

Optional Modules

Options installed and tested at time of manufacture. Maximum of two video modules and one audio module in an instrument.

Option 2HD – Serial digital monitoring module for SMPTE 292M.

Option 2A – Serial digital monitoring module for ITU-R BT.601 and SMPTE 292M.

Option 2M – Serial digital measurement module for ITU-R BT.601 and SMPTE 292M.

Option DG – AES/EBU digital audio monitoring module.

Power Plug Options

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. A5 – Swiss Plug, 220 V, 50 Hz.

Opt. AC – China Plug, 50 Hz.

Service

Opt. C3 – Calibration Service 3 Years.

Opt. D1 – Calibration Data Report.

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

Opt. R3 – Repair Service 3 Years.

Field Upgrade Kits

Shipped as a kit and installed in the field. Maximum of two video modules and one audio module in an instrument.

WFM7HD – Serial digital monitoring module for SMPTE 292M.

WFM7A – Serial digital monitoring module for ITU-R BT.601 and SMPTE 292M.

WFM7M – Serial digital measurement module for ITU-R BT.601 and SMPTE 292M.

WFM7DG – AES/EBU digital audio monitoring module.

Opt. IF – Upgrade Installation Service.

Optional Accessories

WFM7F02 – Portable cabinet includes handle, feet, tilt bail and front panel cover.

WFM7F03 – Plain cabinet.

WFM7F05 Opt. ON or Opt. NN – Dual rackmount for 1700 Series, WFM601 Series, WFM700 Series, 760A and 764.

071-0951-00 – Service Manual for WFM700 Series products (WFM700HD, WFM700A and WFM700M).

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

Products are manufactured in ISO registered facilities. CE ISO 9001

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