

Standard Definition Waveform Monitors

WFM601A • WFM601E • WFM601M Data Sheet



WFM601A/WFM601E/WFM601M Series Serial Digital Component Monitors mounted in accessory 1700F02 Portable Cases.

Features & Benefits

- Two 270 MB Serial Component Loopthrough Inputs
- Real-time CRT Display Suitable for Live Monitoring
- Waveform Parade and Overlay Displays
- Waveform Display in RGB or Y-Pb-Pr Levels
- Bright Line Select Display
- Component Vector Display
- Tektronix Lightning, Bowtie, and Diamond Displays
- Picture Display of Y Channel
- Identification of Embedded Audio Channels
- RGB or Y-Pb-Pr Analog Picture Monitor Outputs
- Switched 270 MB Serial Component Picture Monitor Output
- Waveform Cursors and Markers
- SMPTE RP-165 Digital Error Detection and Reporting

- Tektronix Arrowhead Display of NTSC/PAL Gamut Limit
- Nine User Front-panel Presets
- Environmental, Safety, and EMI Certified
- Three-year Tektronix Warranty
- CE Marking

Applications

WFM601A

- Video Monitoring for Graphics Workstation, Telecine, or Camera Setup Operators

WFM601E

- Evaluation of Digital Transport Layer in Operating Centers

WFM601M

- Data Analysis for Installation and Maintenance

Serial Component Monitors

WFM601A/WFM601E/WFM601M monitors are self-contained, half-rack wide, waveform/vector monitors for the 270 MB serial component operating environment. They share a common design philosophy but are specialized for different applications.

The WFM601A is an operational monitor providing the signal monitoring features useful to the graphics workstation, telecine, or camera setup operator.

The WFM601E extends the WFM601 platform to provide a more comprehensive evaluation of the digital transport layer and is used in digital production and master control operating centers.

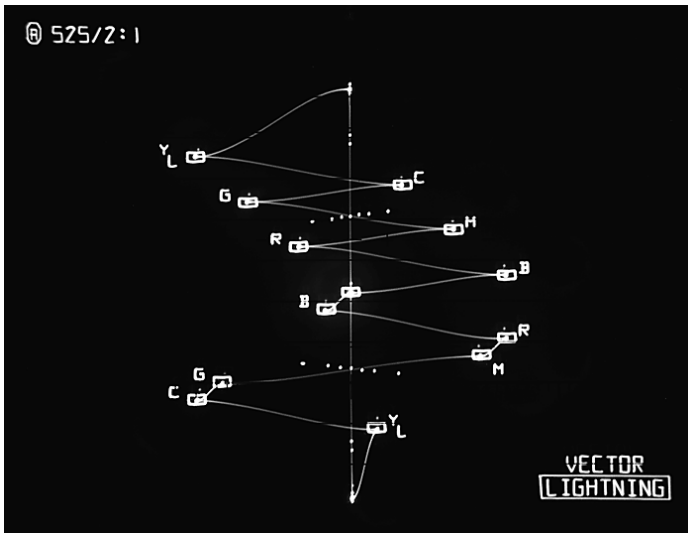
The WFM601M offers all of the video features of the WFM601A and WFM601E, and provides data analysis capabilities for the installation and maintenance engineer.



Digital signal is decoded for analog display in native Y-Pb-Pr format.



RGB format may be selected for camera, telecine, or color graphics applications.



Tektronix Lightning display allows quick setup of color-difference format recorders.

WFM601A Serial Component Waveform/Vector Monitor

The WFM601A monitors 270 MB serial component data signals which may be connected directly through two high-quality passive loopthrough inputs. This allows monitoring of the digital signal path without adapters or other add-on devices. The selected input data is evaluated for correct format and status, and the equivalent analog video signal is displayed in a traditional form allowing accurate monitoring and adjustment of source or processing equipment.

WFM601A/WFM601E/WFM601M monitors offer the conventional analog displays familiar to Tektronix component signal monitor users. Digital

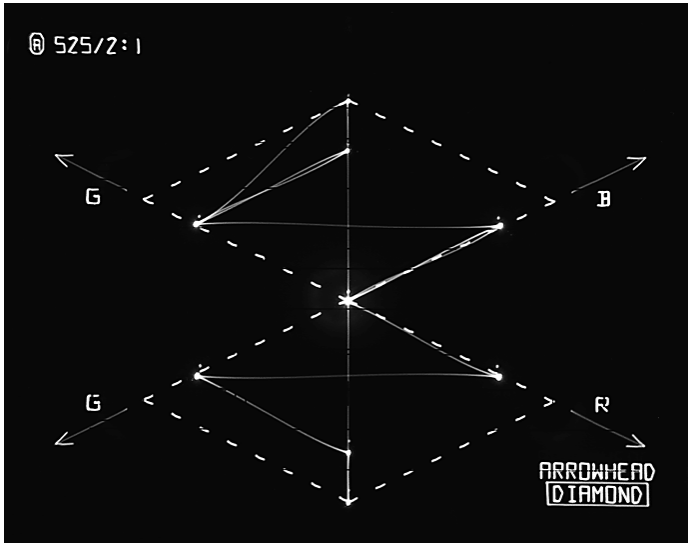
monitoring is as familiar and as useful as viewing an analog component signal.

Operating adjustments and measurements are made to the same signal parameters. Setup of digital sources is as easy as if they were analog.

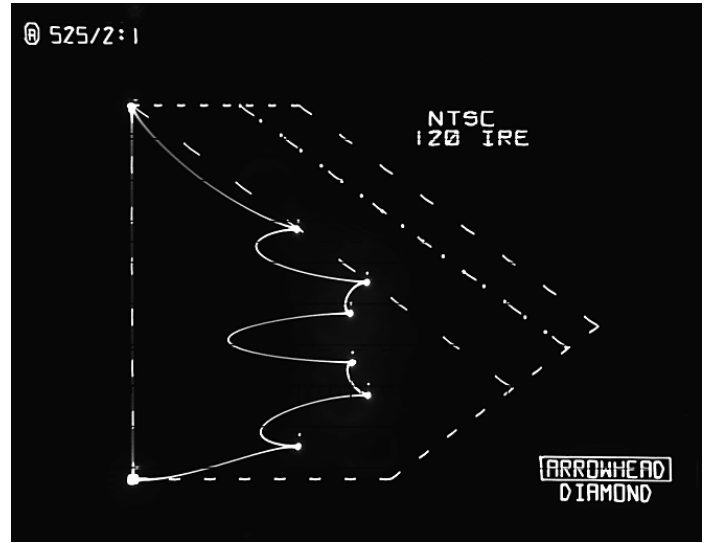
In addition to waveform overlay and parade displays of the three component channels, WFM601 Series monitors feature three Tektronix-patented displays. The Lightning display helps operators quickly set up color-difference component recorders using the standard color bar test signal. Using the Diamond display, color graphics operators can easily determine whether creative effects are reproducible in legal RGB color space, and will be warned that values outside the diamonds may cause recording, transmission, or reproduction errors. An important feature in the WFM601A, WFM601E, and WFM601M is the Tektronix Arrowhead display of video signal composite domain gamut limits. This display clearly illustrates how the component video signal will translate into a luminance + color subcarrier signal to be transmitted as an amplitude-modulated NTSC or PAL signal. The creative operator can use this display to assure intended color and luminance values can be maintained through a composite transmission system.

All models include analog outputs for an RGB or Y'P'bP'r component picture monitor. A switched digital output is also provided for the all-digital plant.

The WFM601A is an operator's monitor, for use by a person responsible for the look and continuity of the television picture. It instills confidence that creative adjustments can be made without violating transmission standards, thus assuring trouble-free distribution throughout a facility. The WFM601A is the only model of the series featuring an analog audio Lissajous display.



Tektronix Diamond display indicates legal RGB color space.



Arrowhead display indicates that colors will be legal in subsequent composite formats, without use of a composite encoder.

WFM601E Serial Component Monitor with Eye Pattern

The WFM601E extends the series platform to provide comprehensive evaluation of the digital transport layer. It allows observation of the analog characteristics (Eye Pattern and signal level) and digital compatibility (format and range checking) of the serial data stream. The WFM601E includes all video features of the WFM601A and adds an analog waveform display of the incoming data signal.

WFM601E Features Include:

- All video features of the WFM601A
- Eye Pattern view of the incoming data signal
- Eye Pattern timing cursors with selectable jitter display, including high-pass filtering
- Eye Pattern voltage cursors to indicate amplitude of the incoming data signal
- Cable length readout, calibrated in meters
- Received signal power readout
- Source signal level meter, independent of cable length
- Extended format checking and data error detection
- Display of field check sums for fixed pattern testing

The WFM601E's wide bandwidth Eye Pattern display is an amplitude vs. time view of the 270 MB data signal's analog transmission path. It displays peak jitter and amplitude errors and, because it is looking at the actual signal path, provides a useful indication of any reflections due to impedance irregularities. The Eye Pattern is displayed at video sweep rates to provide correlation with the video signal, and a word-correlated mode may be selected by more experienced users to observe pattern-dependent crosstalk. Digital signal amplitude and jitter is measured in accordance with SMPTE-compliant high-pass filtering, assisted by time and voltage cursors.

A serial signal level meter, calibrated in meters of equivalent coaxial cable, provides a check to determine how close a system may be running to one important failure point. The voltage level of the data signal at its source is indicated, independent of cable length, to avoid potential equalization errors.

Format checking and reporting are expanded in the WFM601E. Format violations are sensed and clearly reported, and when the EDH signal is present, digital errors in the active picture or full field are reported. A CRC checksum is provided for manufacturing environments where it is common to use fixed pattern test signals to confirm the data integrity of signal processing products. The CRC is calculated for each field of video and displayed on the error screen. If the test signal CRC is known, this allows a data integrity check to be made, allowing limited error checking when EDH is not present in the incoming signal. ANC data identification includes any embedded audio channels present. Format checking provides confidence that checked parameters meet industry requirements for subsequent data recovery.



The WFM601M identifies co-sited data values in each channel.

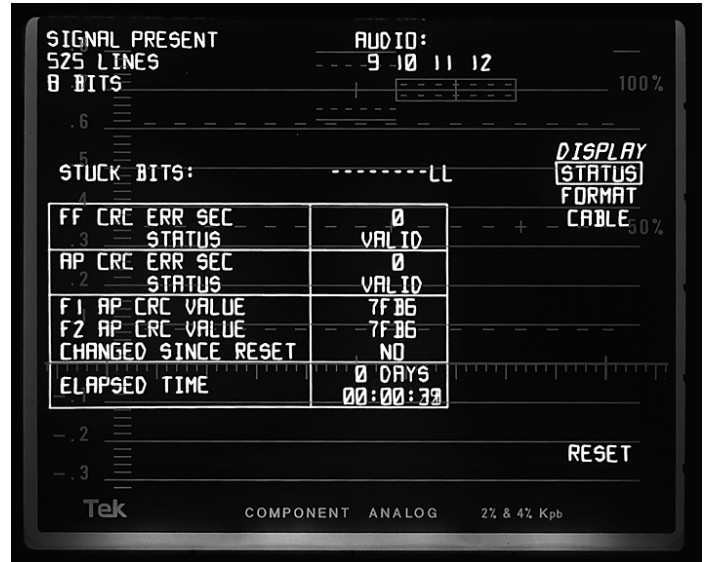
WFM601M Serial Component Measurement Set

The WFM601M is a measurement-quality serial component monitor with all features of the WFM601E. The WFM601M features additional digital analysis capabilities important to those involved in the design, installation, and maintenance of 270 MB component digital systems.

WFM601M features include:

- All video features of the WFM601E
- Logic analyzer data word listing for detailed pixel analysis
- Field/Line/Word cursors on waveform and picture monitor with data value display
- Jitter demodulator with numeric jitter readout and video-correlated jitter waveform display
- Calibrated component analog signal outputs
- Recovered clock output to reference external test equipment

The logic analyzer data word listing allows evaluation of signals to determine conformance to standards. The Cb-Y-Cr-Y' multiplex is clearly delineated providing a comprehensive look at data which makes up the serial digital signal. Field/Line/Word cursors on the waveform and external

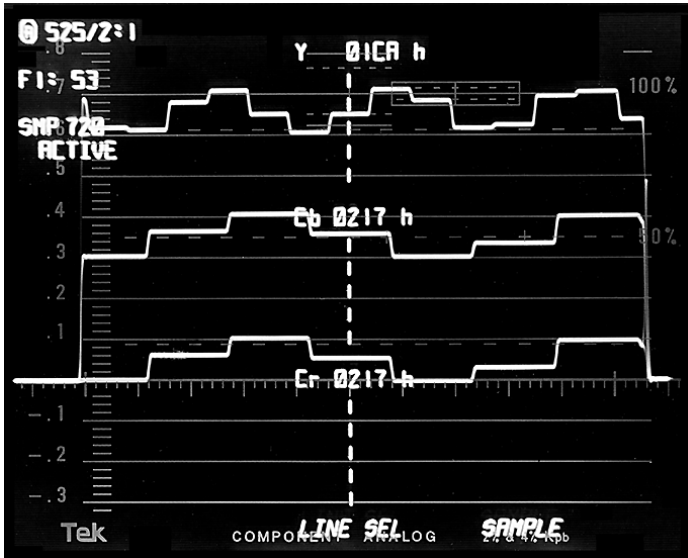


The WFM601M and WFM601E provide a comprehensive view of signal status.



WFM601M wideband data display identifies word values in multiplexed data stream.

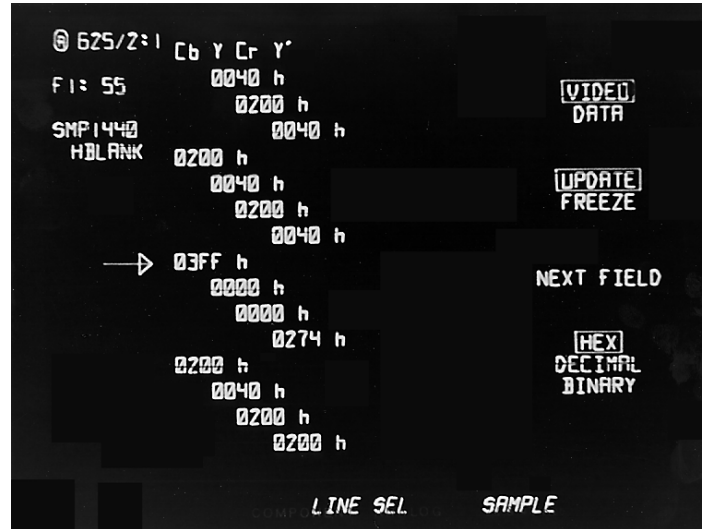
picture monitor give intuitive operator access to the data values and a clear presentation of equivalent analog voltage levels.



WFM601M wideband video display identifies word values in each component channel.

A new jitter demodulator with numeric jitter readout provides a documentable value along with a new display relating jitter to time in the video field or line. A jitter demodulator output is included for further analysis using an audio frequency spectrum analyzer, TDS Series oscilloscope, or VM700T Option 40.

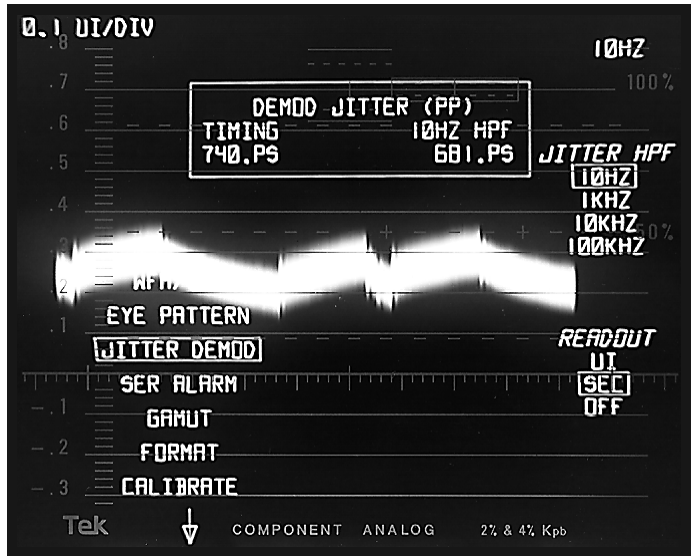
Measurement-grade component analog signal outputs offer a precision video source for measurement of the analog signal represented by the



Data values may be listed in Hex, Decimal, or Binary (WFM601M).

data channel. The WFM601M's analog outputs accurately represent the data signal in terms of amplitude, frequency response, and interchannel timing. When combined with a VM700T Option 30, the WFM601M allows comprehensive evaluation of a component video signal from analog to data to analog.

Equipment and system designers will appreciate the WFM601M's recovered clock output. This signal provides a reference clock, AFC'd using known time constants, to external test equipment.



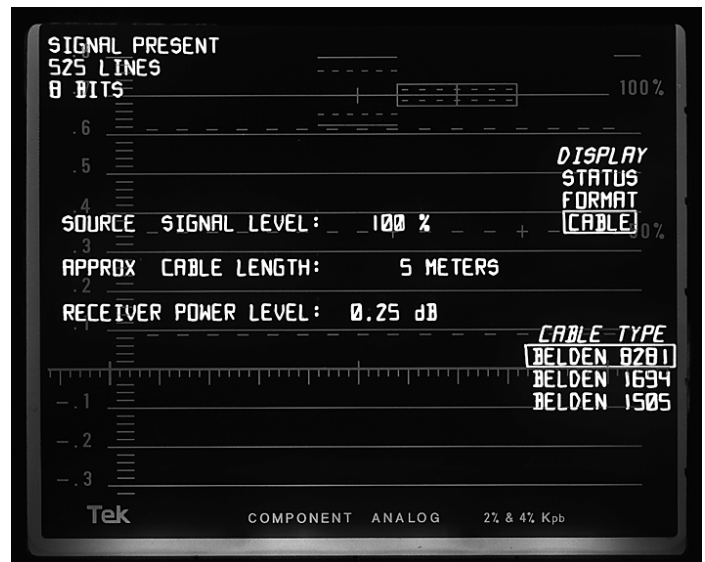
Serial data jitter may be evaluated in real time at video rates, using industry-recognized techniques (WFM601M only).

Digital Monitors for Specific Applications

The WFM601A features real-time monitoring to allow creative adjustment of a camera or graphics work station to provide a standardized video program source. This monitor is used at each operating position to provide traditional waveform, vector and signal gamut monitoring, and digital error checking to assure generation of standards-compliant contribution video.

The WFM601E adds Eye Pattern for a view of the analog signal path transporting the data signal. It is focused toward master control and editing applications where signals are routed and combined into programs.

The WFM601M adds comprehensive data analysis features for the design, installation, and maintenance of digital equipment and systems.



The WFM601E and WFM601M provide a display of important data signal analog parameters.

Data jitter, signal level, and word value displays provide the tools to maintain standardized serial component signals throughout a plant and the WFM601M's precision analog outputs allow measurement to the accuracy of the best analog measurement sets.

WFM601 Series serial component monitors from Tektronix each provide an efficient set of features for a specific application. Every model is economically priced, yet provides an appropriate set of features to make the checks and measurements to assure maximum performance of your television facility.

Characteristics

Serial Digital Interface

Format – 270 Mb/s component. Complies with SMPTE 259M and CCIR656.

Input Type – Passive loopthrough, 75 Ω compensated.

Return Loss – ≥ 25 dB, 1 to 270 MHz power on.

Insertion Loss – $\leq 1.5\%$.

Transmission Bandwidth – 50 kHz to 300 MHz ± 1.0 dB.

Loopthrough Isolation – ≥ 50 dB to 300 MHz.

Serial Receiver Equalization Range – Proper operation with coaxial cable up to 19 dB loss at 135 MHz.

Serial Video Diagnostics

Video Error Detection – Active picture and full field rate resolution. Complies with SMPTE RP165. Sets error flag output through rear-panel REMOTE connector.

Alarm –

Front-panel alarm lamp, and in some cases an on-screen readout, warns that one of the following serial signal video format errors has occurred:

- SAV placed incorrectly.
- Line length error.
- Field length error.
- Reserved values used improperly.
- ANC data checksum error.
- ANC data parity error.
- ANC data placement error.
- Absence of serial video signal.

On-screen Diagnostics –

WFM601A, WFM601E and WFM601M:

- Operating line/field rate.
- Serial video presence.
- EDH checksum presence.
- FF CRC errored seconds.
- AP CRC errored seconds.
- EDH flag errored seconds.
- GAMUT errored seconds.
- Identifies the presence of up to 16 channels of AES/EBU embedded audio.
- Reports absence of serial video signal.

WFM601E and WFM601M only:

- Identifies the presence of ancillary data (other than audio and EDH) and indicates if a checksum error has occurred.

External Reference

Input – Analog composite video or black burst.

Return Loss – ≥ 40 dB to 6 MHz.

Waveform Vertical Deflection

Deflection Factor – $\leq 2\%$.

Variable Gain Range – $+12$ dB to -6 dB.

Frequency Response –

Luminance channel (Y), to 5.0 MHz $\leq 2\%$.

Color difference (P'b and P'r), to 2.5 MHz $\leq 2\%$.

Transient Response – $\leq 1\%$.

Voltage Cursor Accuracy – $\pm 0.5\%$, 20 - 30 °C.

Field Rate Tilt – $\leq 1\%$.

Line Rate Tilt – $\leq 1\%$.

Waveform Horizontal Deflection

Sweep Timing Accuracy –

1 line, 5 μ S/div, mag 0.2 μ S/div, $\pm 1\%$.

2 line, 10 μ S/div, mag 1.0 μ S/div, $\pm 1\%$.

1 field, displays 1 full field.

2 field, displays 2 full fields, and data between them.

Sweep Linearity – $\pm 1\%$ center 10 divisions of sweep.

Timing Cursor Accuracy – $\pm 0.5\%$ at 25 °C.

Horizontal Position Range – Any portion of the synchronized sweep may be positioned on-screen in all sweep modes.

Calibrator

Waveform Squarewave –

Amplitude: 700 mV $\pm 1.0\%$.

Frequency: 100 kHz $\pm 0.1\%$.

Analog Audio Mode (WFM601A only)

Input – DC-coupled differential.

Full-scale Selection – 0, 4, 8, 12 dBm full scale, menu selected.

Full-scale Accuracy – ± 0.5 dB at 1 kHz.

Maximum Input Voltage – ± 8 V peak.

Bandwidth – -3 dB, ≥ 500 kHz.

X and Y Input Phase Matching – $\leq 1^\circ$ at 20 kHz.

Input Impedance – 20 k Ω nominal.

Component Vector Mode

Vertical Bandwidth – ≥ 1.0 MHz ± 100 kHz.

Horizontal to Vertical Match – $\leq 2^\circ$ at 500 kHz or 2 MHz.

Vertical Gain Accuracy – $\pm 1\%$.

Horizontal Gain Accuracy – $\pm 1\%$.

Electronic Graticule Accuracy – $\pm 1\%$.

Display to Graticule Registration – ≤ 0.25 box.

Vector Display –

P'b displayed on horizontal axis.

P'r on vertical axis.

Lightning, Diamond, and Arrowhead Modes

Vertical Gain Accuracy – $\pm 2\%$.
Electronic Graticule Display – Y is displayed vertically.
Lightning Mode –
P'b is displayed horizontally on top half of the display.
P'r is displayed horizontally on bottom half of the display.

Diamond Mode –
Green plotted vs. blue on top half of the display.
Green plotted vs. red on bottom half of the display.

Arrowhead Mode – Luminance displayed vertically, black clamped bottom left.
Equivalent subcarrier amplitude displayed horizontally, zero clamped left. Graticule displays 75% color bar, transmitter zero carrier, and 100% color bar limits. Adjustable gamut alarm.

Bowtie Mode

Common Mode Rejection Ratio – ≥ 34 dB at 2.5 MHz.
Accuracy – $\pm 3\%$.
Interchannel Timing Match – ± 2.0 nS.
Electronic Graticule Display –
Y'P'b displayed on the left half of the display.
Y'P'r displayed on the right half of the display.

Transcoded Analog Outputs

Signal Formats – GBR or Y'P'bP'r.
Sync Amplitude Accuracy – 300 mV $\pm 10\%$.
Analog Output Impedance – Nominally 75 Ω .
Active Video Accuracy (Y'P'bP'r) – 700 mV $\pm 3\%$ (WFM601M $\pm 1\%$).

The Following Analog Output Parameters Are Specified for the WFM601M Only:

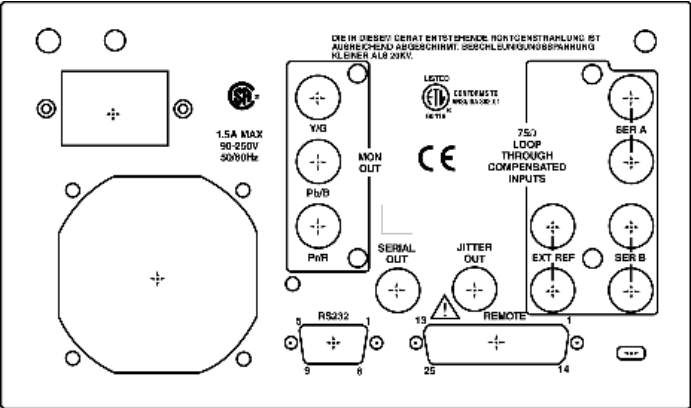
Frequency Response –
Y to 5.75 MHz: $\leq 1\%$.
P'b and P'r to 2.75 MHz: $\leq 1\%$.
Nonlinearity – $\leq 0.5\%$.
Group Delay Error –
Y at 5.75 MHz: ≤ 5 nS.
P'b and P'r at 2.75 MHz: ≤ 10 nS.
Interchannel Timing Match – Y'P'b and Y'P'r ± 5 nS.
Sync to Video Timing –
525 line rate: 9.037 μ S ± 50 nS.
625 line rate: 9.777 μ S ± 50 nS.
Return Loss – 50 kHz to 5 MHz ≥ 40 dB.

Power Source

Mains Voltage Range – 90 to 250 V.
Mains Frequency – 50 or 60 Hz.
Power Consumption – < 75 W.

CRT Display

Viewing Area – 80 $\times$ 100 mm.
Accelerating Potential – Nominally 13.75 kV.
Trace Rotation Range – $> \pm 1^\circ$ from horizontal.
Graticule – Internal waveform graticule with variable illumination.



WFM601A/WFM601E/WFM601M rear panel. Jitter Out connector is active only in the WFM601M.

Environmental

Operating Temperature – 0 to 40 °C (+32 to +104 °F).
Storage Temperature – -40 to +75 °C (-40 to +167 °F).
Operating Altitude – To 2,000 m (6,561 ft.).
Storage Altitude – To 15 km (49,213 ft.).
Vibration – Mil-T-28800D, Para 1.2.2, class 3.
Mechanical Shock – Nonoperating, 50 g, 1/2 sine, 3 shocks/surface, 18 total.
Transportation – Qualified under NSTA Test Procedure 1A, Category II (24 in. drop).
Humidity – 95% noncondensing up to 5 days.
Pollution Degree – Degree 2, IEC61010-1.

Safety

Designed and Tested for Compliance with – ANSI/ISA S82.01, CAN/CSA C22.2 No. 1010.1, IEC61010-1, UL3111-1, 93/68/EEC.

EMI

Tested for Compliance with – 47 CFR Chapter 1 (FCC Rules) Part 15, Class A, EN50081-1, EN50082-1.
Must be installed in Tektronix 1700F00, 1700F02, or WFM7F05 cabinet to qualify for EMI certification.

Physical Characteristics

Dimension	mm	in.
Height	133.4	5.25
Width	215.9	8.50
Depth	460.4	18.125
Weight	kg	lb.
Net	3.8	8.4
Shipping	7.2	15.9

Ordering Information

WFM601A

Serial Component Monitor.

WFM601E

Serial Component Monitor with Eye Pattern.

WFM601M

Serial Component Measurement Set.

All Include: WFM601 Series instruments are supplied with an instruction manual, power cable, spare graticule lamps, spare fuse, and spare air filters. White (P4) phosphor is standard. To meet safety and EMI listing requirements order a cabinet or rackmount from the Optional Accessories list. Please specify power plug when ordering.

Note: Portable Cabinet optional.

Power Plug Options

Opt. A0 – US Plug, 115 V, 60 Hz.

Opt. A1 – Euro Plug, 220 V, 50 Hz.

Opt. A2 – UK Plug, 240 V, 50 Hz.

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

Opt. A5 – Swiss Plug, 220 V, 50 Hz.

WFM601A/WFM601E/WFM601M

Service Manual – Order 070-9836-xx.

Plain Cabinet, no Handle or Feet – Order 1700F00.

Portable Cabinet with Handle, Feet, Tilt Bail, and Front-panel Cover – Order 1700F02.

Dual Rackmount Cabinet – Order WFM7F05 Opt. OO.

Blank Panel for Unused Half of Dual Rackmount – Order 1700F06.

Drawer for Unused Half of Dual Rackmount – Order 1700F07.

Wideband 75 Ω Termination – Order 011-0163-xx.

Service

Opt. C3 – Calibration Service 3 Years.

Opt. C5 – Calibration Service 5 Years.

Opt. D1 – Calibration Data Report.

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

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

Opt. R5 – Repair Service 5 Years.



Product(s) are manufactured in ISO registered facilities.

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