Technical Reference

Tektronix

WFM6100, WFM7000, and WFM7100 Waveform Monitors Specifications and Performance Verification

071-1897-01

This document applies to firmware version 1.2.X.

www.tektronix.com

Audio Surround Sound display courtesy of Radio-Technische Werkstaetten GmbH & Co. KG (RTW) of Cologne, Germany.

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For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty 2

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

***WARNING.** Warning statements identify conditions or practices that could result in injury or loss of life.*

***CAUTION.** Caution statements identify conditions or practices that could result in damage to this product or other property.*

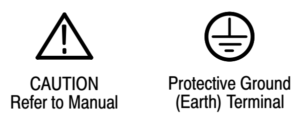
Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:



Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

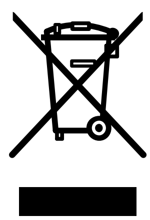
Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Mercury Notification. This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, the Electronics Industries Alliance (www.eiae.org) for disposal or recycling information.

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead, cadmium, mercury, and hexavalent chromium.

Preface

This reference document provides technical information about using the WFM6100, WFM7000, and WFM7100 Series multi-format waveform monitors.

Related User Documents

The following related user documents are available:

- *WFM6100, WFM7000, and WFM7100 Waveform Monitors Release Notes* (Tektronix part number 071-1895-XX). This document describes any known problems or behaviors that you might encounter while using the waveform monitor.
- *WFM6100, WFM7000, and WFM7100 Waveform Monitors Quick Start User Manual* (Tektronix part numbers: English, 020-2705-XX; Japanese 020-2706-XX; Simplified Chinese, 020-2707-XX). This document is a printed Quick Start User Manual and contains the basic operating information for the instrument. Included in the manual is a CD-ROM containing PDFs of the user documents.
- *WFM6100, WFM7000, and WFM7100 Waveform Monitors User Technical Reference* (Tektronix part number 071-1894-XX). This document contains the detailed operating information for the instrument.
- *WFM6100, WFM7000, and WFM7100 Waveform Monitors Specifications and Performance Verification Technical Reference* (Tektronix part number 071-1897-XX). This document contains the complete published specifications for the instrument and the performance verification procedure.
- *WFM6100, WFM7000, and WFM7100 Waveform Monitors Service Manual* (Tektronix part number 071-1896-XX). This document provides servicing information for the waveform monitor and is intended for qualified service personnel only.

Related Reference Documents

The following related reference documents are available at the Tektronix, Inc. Web site (www.tektronix.com):

- *Preventing Illegal Colors*. This application note describes how the Diamond, Arrowhead, and Lightning displays can be used to help prevent the undesired impact of color gamut violations and to simplify the assessment of proper gamut compliance.
- *Understanding Colors and Gamut*. This poster provides a large visual display of how the Diamond, Arrowhead, and Lightning displays can be used to help prevent the undesired impact of color gamut violations.
- *A Guide to Standard and High Definition Digital Video Measurements*. This book is a primer for understanding the basics for making standard and high-definition, digital-video measurements.
- *Analog and Digital Audio Monitoring.* This application note describes how to monitor analog and digital audio signals. Also discussed are specific differences in the methods used to monitor analog audio versus digital audio, and how to plan the transition from monitoring analog audio to monitoring digital audio.
- *Audio Monitoring.* This application note describes balanced and unbalanced audio signals, and explains the physical and electrical characteristics and the specific strength and weaknesses of the different digital audio signal formats.
- *Monitoring Surround Sound Audio*. This application note describes the basics of 5.1-channel surround sound audio and how to use the Surround Sound display to visualize key audio-level and phase relationships in this audio format.

Specifications

Specifications

The following tables list the specifications for the Tektronix WFM6100, WFM7000, and WFM7100 Waveform Monitors. Items listed in the Performance Requirement column are generally quantitative, and can be tested by the *Performance Verification* procedure in Section 2 of this manual. Items listed in the Reference Information column are useful operating parameters that have typical values; information in this column is not guaranteed.

The specifications listed in the Electrical Specifications portion of these tables apply over an ambient temperature range of +0 °C to +40 °C. The rated accuracies are valid when the instrument is calibrated in an ambient temperature range of +20 °C to +30 °C.

Electrical Specifications

Table 1–1: SDI Input Waveform Vertical Characteristics

Characteristic	Performance requirement	Reference information
Vertical Measurement Accuracy		Using graticule or cursor. Measure in YPbPr mode.
1X	± 0.5% of 700 mV full scale mode	
5X	± 0.2% of 700 mV full scale mode	
Gain	X1, X2, X5, and X10	
Variable Gain Range, Typical		0.25X to 1.8X, typical (variable gain multiplied by fixed gain to get total gain).
Frequency Response – HD		
Luminance Channel (Y)	50 kHz to 30 MHz, ± 0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 15 MHz, ± 0.5%	
Frequency Response – SD		
Luminance Channel (Y)	50 kHz to 5.75 MHz, ± 0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 2.75 MHz, ± 0.5%	
YPbPr to RGB Conversion Accuracy		0.1%, nominal

Table 1–1: SDI Input Waveform Vertical Characteristics (Cont.)

Characteristic	Performance requirement	Reference information
Step Response, Typical Preshoot		Sine-squared bars
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Overshoot		
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Ringing		
SD		≤ 0.8% peak-peak (2T5 bar)
HD		≤ 0.8% peak-peak (2T30 bar) Most of the error seen on the display comes from the inherent ringing in the digital data. The response of the monitor is close to the theoretical limit of a perfect sinx/x reconstruction filter.
Pulse Response, Typical Baseline Ringing		Blackman pulse
SD		≤ 0.6% peak-peak (2T5)
HD		≤ 0.7% peak-peak (2T30) Pulse-to-bar ratio 0.995:1 to 1.005:1 on appropriate Sine Squared or Blackman 2T pulse. A sine-squared pulse near Nyquist is not band-limited and so inherently has ringing much larger than the waveform monitor filter. A three term Blackman pulse with the same HAD has much less inherent ringing, so it is a better choice for most testing. See *Digital to Analog Conversion, Data and Filter Requirements*, SMPTE Journal Mar 1995, Vol. 104, Fibush, Baker, Penny.
Tilt, Typical Field Rate		0.1%
Line Rate		0.1%
Off Screen Recovery, Typical		0.1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen at any gain setting.

Table 1–2: Composite Analog Input Waveform Vertical Characteristics

Characteristic	Performance requirement	Reference information
Vertical Measurement Accuracy		Measured using cursors or graticules
1X	± 1%	
5X	± 1%	
Gain		X1, X2, X5, and X10
Variable Gain Range, Nominal		0.25X to 1.8X
Frequency Response	Flat to 5.75 MHz, ± 1%	
Delay Variation over Frequency	± 10 ns to 5.75 MHz	Typically ± 2.5 ns
Transient Response on Sine Squared 2T4 Pulse		Pulse to bar ratio 0.99:1 to 1.01:1
Preshoot	≤ 1%	
Overshoot	≤ 1%	
Ringing	≤ 1%	
Field Rate Tilt	< 0.5%	With DC Restore Fast or Off
Line Rate Tilt	< 0.5%	With DC Restore Fast or Off
Off Screen Recovery		≤ 0.5% variation in baseline of a Chroma modulated pulse when positioned anywhere on screen. Signal must meet specification for Video Maximum Operating Amplitude. Any gain setting.
SNR		60 dB_{RMS} minimum, relative to 700 mv for PAL or 714 mv for NTSC.

Table 1–3: Composite Analog Inputs A and B Physical Layer

Characteristic	Performance requirement	Reference information
Formats Supported		NTSC, NTSC no setup, and PAL, I, B, D, G, H. Complies with RS170A & ITU-R BT.471 Manual or auto detect of input standard
Internal Reference		Proper horizontal and vertical synchronization with a composite signal of appropriate line and field rate
Input Dynamic Range, Typical		± 6 dB range

Table 1–3: Composite Analog Inputs A and B Physical Layer (Cont.)

Characteristic	Performance requirement	Reference information
Video Maximum Operating Amplitudewith Clamp Off (DC Coupled), Typical		–1.8 V to +2.2 V (all inputs) DC + peak AC
Maximum Absolute Video Input Voltage		–6.0 V to +6.0 V (DC + peak AC)
Input Type		Passive loop-through 75 Ω compensated
DC Input Impedance		20 kΩ
Return Loss	≥ 40 dB to 6 MHz with power on	Typically > 46 dB to 6 MHz, > 40 dB to 10 MHz. Typically 35 dB with power off for standard amplitude video
Video Input Crosstalk Between Channels		≥ 60 dB to 6 MHz
Loop through Isolation		≥ 70 dB to 6 MHz
DC Offset with Restore Off, Typical		≤ 20 mV Measured in full screen mode at X5 Gain
DC Restore Modes		Fast, Slow and Off modes Slow has a typical bandwidth of 10 Hz Fast has a typical bandwidth of 500 Hz
DC Restore Offset Error		≤ 2 mV Registration between back porch and 0 V graticule
DC Offset Between Inputs With Restore Off		≤ 7 mV
DC Restore 50 Hz and 60 Hz Attenuation		
Fast Mode	> 95% attenuation	
Slow Mode	< 10% attenuation, < 10% peaking	
Blanking Shift with 10% to 90% APL Change		≤ 1 IRE (7 mV PAL)
Blanking Shift with Presence and Absence of Burst		≤ 1 IRE (7 mV PAL), Typically 0 mV
Lock Range		± 50 ppm, remains locked Vector typically OK to ± 80 ppm. waveform display typically locked to ± 200 ppm
Lock in Presence of Hum		700 mV_{p-p}, on full amplitued 100% color bar signal, remains locked
Lock in Presence of White Noise		Signal/Noise ratio of 32 dB, 5 MHz bandwidth on black burst, remains locked
Color Framing		Correct color framing detected for signals having < 45 SCH phase error with burst present

Table 1–4: Waveform Sweep (Horizontal) Deflection

Characteristic	Performance requirement	Reference information
Sweep		
Accuracy	± 0.5%, all rates	Fully digital system
Linearity	0.2% of time displayed on screen	Fully digital system
Timing Cursor Delta Readout Accuracy, Typical		± 0.5% of sweep time displayed on screen
Rates		1, 2, 3, or 4 line, or field depending on mode
Line Select		Selected line in 1 Line Selected first line in 2 Line

Table 1–5: Eye Pattern Display

Characteristic	Performance requirement	Reference information
Type		Equivalent Time Sampler
Formats		SD and HD, as shown in Table 1–47
Signal Bandwidth	100 MHz to 2.5 GHz at –3 dB point	
Time Base Jitter, Typical		
SD		60 ps_{p-p} in 1 kHz high-pass filter mode
HD		20 ps_{p-p} in 1 kHz high-pass filter mode
Eye Clock Bandwidth Settings		Clock bandwidth can be set to 10 Hz, 100 Hz, 1000 Hz, 10 kHz, or 100 kHz high pass filter
Eye Clock Bandwidth Accuracy		Actual –3 dB frequency within 10% of nominal
Jitter Attenuation Error		
HD		
10 Hz High Pass Filter		Within 0.3 UI + 10% for jitter frequencies above five times bandwidth selection
100 Hz to 100 kHz High Pass Filter		Within 0.05 UI + 10% for jitter frequencies above five times bandwidth selection
SD All High Pass Filter settings		Within 0.05 UI + 10% for jitter frequencies above five times bandwidth selection

Table 1–5: Eye Pattern Display (Cont.)

Characteristic	Performance requirement	Reference information
Display Modes		
SD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter
10 Eye		Displays eye relative to the parallel clock. Useful for observing jitter correlated to word clock
HD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter
20 Eye		Displays eye relative to the parallel clock. Useful for observing jitter correlated to word clock
Vertical Scale Accuracy	800 mV ±5% with an 800 mV_{p-p} input signal	
Horizontal Scale Accuracy		Indicated time per division ±1%, fully digital system
Eye Derived Measurements		
Rise Time / Fall Time, Typical		± 20ps Measurements only valid on a clean signal. Excess jitter, overshoot, or other aberrations will reduce the accuracy. Limited by inherent rise time of eye display
Amplitude, Typical		± 10 mV Measurements only valid on a clean signal. Excess jitter, overshoot, or other aberrations will reduce the accuracy. Limited by inherent rise time of eye display
Equalized Eye Display		Shows eye from input after it has gone through equalizer Allows limited use of eye at long cable length. Equalizer adds some jitter. Can bypass equalizer at short cable lengths to overcome this effect
Equalized Eye Amplitude, Typical		600 mv ±80mv Amplitude of equalized eye is not related to input amplitude. This waveform is from the digital output of the equalizer. It is intentionally displayed at a smaller size to reduce the chance of it being confused with the input eye

Table 1–6: Jitter Display

Characteristic	Performance requirement	Reference information
Type		Displays numerical and graphical readouts of peak-to-peak jitter. Jitter derived from demodulated recovered clock as described in SMPTE RP192 2003. If Opt. PHY is installed, then Jitter Waveform can also be displayed
High-Pass Filter Settings		Can be set to 10 Hz, 1 kHz, 10 kHz, or 100 kHz High pass filter has type-3 response for low frequency rejection of 60 dB/decade below the filter setting. High pass filter also applies to digital readout, jitter waveform and Eye diagram display, but not the reference clock output. There are two independent Jitter demodulators which may be configured with different loop bandwidths. One is applied to the upper two tiles of the display, and the other applies to the lower two tiles
High-Pass Filter Attenuation Accuracy		Frequency at which response is -3dB is within 10% of nominal High-Pass Frequency Response also applies to readout and jitter waveform
High-End Frequency Response, Typical		-3 dB at > 5 MHz Applies to digital readout, jitter waveform, and reference clock output

Table 1–6: Jitter Display (Cont.)

Characteristic	Performance requirement	Reference information
Maximum Jitter		Applies to digital readout, jitter waveform, and Reference Clock output
Maximum is a function of jitter frequency and standard:		Maximum jitter is limited by measurement range at low frequencies, and by jitter tolerance of serial receiver at high frequencies
10 Hz to 30 kHz, HD		20 UI_{p-p}
10 Hz to 40 kHz, SD		10 UI_{p-p}
30 kHz to 1 MHz, HD		Declines to 0.35 UI at 1 MHz
50 kHz to 1 MHz, SD		Declines to 0.35 UI at 1 MHz
>1 MHz, HD		0.35 UI
1 MHz to 4 MHz, SD		0.35 UI
>4 MHz, SD		0.25 UI
Minimum (noise floor) is a function of bandwidth selection:		Applies to jitter waveform
10 Hz, HD		200 ps typical
100 Hz, 1 kHz, 10 kHz, 100 kHz, HD		40 ps typical
All HPF settings, SD		250 ps typical
Digital Readout Type		Displays peak to peak value of jitter detected over the measurement period, as defined by selected high–pass filter setting. Indicates timing jitter or alignment jitter if appropriate
Digital Readout		
Accuracy, Typical		For jitter frequencies from 5 times bandwidth selection to 4 MHz
10 Hz, HD		<0.3 UI + 10% of reading
100 Hz, 1 kHz, 10 kHz, 100 kHz, HD		<0.05 UI + 10% of reading
All HPF settings, SD		<0.05 UI + 10% of reading
Resolution		0.01 UI
Jitter Waveform		
Gain Error, Typical		For jitter frequencies from 5 times bandwidth selection to 4 MHz Error for jitter frequencies between HPF setting and 5x HPF setting due to loop peaking: max of 1.5 dB
10 Hz, HD		<0.4 UI + 10% of reading

Table 1–6: Jitter Display (Cont.)

Characteristic	Performance requirement	Reference information
100 Hz, 1 kHz, 10 kHz, 100 kHz, HD		<0.1 UI + 10% of reading
All HPF settings, SD		<0.1 UI + 10% of reading
Scale		
Horizontal Modes		1 Line, 2 Line, 1 Field, 2 Field
Vertical Modes		1 UI / div, 0.2 UI / div, 0.1 UI / div
Reference Clock Output, Typical		1 V p-p into 75 Ω load SD frequency = 27 MHz HD frequency = 74.25 or 74.17852 MHz
Jitter Measurement Time		0.5 Sec Approximately 5,000,000 independent samples

Table 1–7: Component Vector Mode

Characteristic	Performance requirement	Reference information
Vertical Bandwidth, Typical		
SD		800 kHz
HD		3.4 MHz
Vertical Gain Accuracy	± 0.5%	Fully digital system
Horizontal Gain Accuracy	± 0.5%	Fully digital system
Display to Graticule Registration	0.5%	Fully digital system limited by sample resolution
Vector Display		P_B is displayed on horizontal axis and P_R is displayed on vertical axis

Table 1–8: Waveform Mode Filter Characteristics

Characteristic	Performance requirement	Reference information
Low Pass Filter Gain		
SD, component only		1 ± 0.1% relative to flat gain
HD, component only		1 ± 0.1% relative to flat gain

Table 1–8: Waveform Mode Filter Characteristics (Cont.)

Characteristic	Performance requirement	Reference information
Low Pass Filter Frequency Response		
SD, component only	≤ 3 dB attenuation at 800 kHz ≥ 32 dB attenuation at 3 MHz Filter meets IEEE STD-205	
HD, component only	≤ 3 dB attenuation at 4.5 MHz ≥ 25 dB attenuation above 15 MHz, Noise bandwidth is approximately 8 MHz Stopband null at 18 MHz	
Luma Filter Gain, composite only	1 ± 0.1% relative to flat gain at 50 kHz	
Luma Filter Frequency Response, composite only	≤ 3 dB attenuation at 800 kHz 32 dB attenuation at F_{SC} Same as SD serial component low pass filter	
Chroma Filter Gain, composite only	1 ± 0.1% relative to flat gain	
Chroma Filter Response, composite only	3 dB bandwidth 1 MHz ± 0.2 MHz F_{SC} autoselected based on input standard, implemented digitally, centered on F_{SC}	
Chroma Filter Attenuation at 2x F_{SC}, composite only	≥ 25 dB Implemented digitally. Typically 28 dB for NTSC, 53 dB for PAL	

Table 1–9: SDI Lightning and Diamond Modes

Characteristic	Performance requirement	Reference information
Vertical Gain Accuracy	± 0.5%	Fully digital system
Electronic Graticule Display		
Diamond		RGB deflection axis indicated. Upper and lower halves are separated, to see negative signals
Lightning		Displays signal components as follows: Y vertically Pb horizontally on top half of display P_r horizontally on bottom half of display
Detection Level		
High Limit	+630 mV to +756 mV in 1 mV steps	
Low Limit	–50 mV to +35 mV in 1 mV steps	

Table 1–9: SDI Lightning and Diamond Modes (Cont.)

Characteristic	Performance requirement	Reference information
Detection Level Accuracy	± 3.5 mV	
Diamond Area Threshold Range		0% to 10%

Table 1–10: Data Mode

Characteristic	Performance requirement	Reference information
Digital Waveform		Non-interpolated waveform display. Cursor identifies selected sample value (hex, decimal, binary). Cursor inserted on picture monitor output shows selected line
Digital List		Sequential list of sample values in table format. Cursor identifies selected sample
Display Format		HEX, DEC, BIN

Table 1–11: Composite Vector Mode

Characteristic	Performance requirement	Reference information
Displayed Horizontal and Vertical Gain Accuracy		
X1 Gain	± 1%	
X5 Gain	± 1%	
Display to Graticule Registration	Centered in target, +0.5 box diameter With the color bar black/white display dot centered in target. Boxes are 2% targets	
Vector Display		B–Y is displayed on horizontal axis and R–Y is displayed on vertical axis
Bandwidth, Typical		360 kHz
Horizontal to Vertical Bandwidth Matching	< 0.5° at 500 kHz and 2 MHz	
Composite Vector Dot Reference		Shows “true” zero subcarrier reference
R–Y B–Y Axis Orthogonality. Typical		± 0.1°, implemented digitally

Table 1–12: Arrowhead mode (NTSC/PAL composite limit display)

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy	± 1%, 100 IRE (700 mV), and 131 IRE (900 mV)	(PAL values in parenthesis)
Composite Limit Cursor Accuracy	± 1.0% at 100 IRE, 110 IRE, 120 IRE, and 131 IRE (700 and 950 mV)	(PAL values in parenthesis)
	± 1.0% at –24 IRE, –33 IRE, and –40 IRE (–230 and 300 mV)	(PAL values in parenthesis)
Detection Level, nominal		Adjustable thresholds, 1% steps
Composite Limit Detection Level Accuracy	Detection Level = ± 7 mV of cursor level	Upper detection level can be set to 100, 110, 120 or 131 IRE (700 mV or 950 mV PAL)
		Lower detection level can be set to –24, –33, and –40 IRE (–230 mV or –300 mV PAL)
Composite Limit Area Threshold Range		0% to 10%
Luma Limit Detection Range		
High		90 to 108%, 0.5% steps
Low		+5 to –6%, 0.5% steps
Luma Limit Detection Level Accuracy		Detection level = ± 7 mV of cursor level, nominal
Luma Limit Area Threshold Range		0% to 10%

Table 1–13: Bowtie mode

Characteristic	Performance requirement	Reference information
Common Mode Rejection Ratio		
SD	≥ 34 dB at 2.5 MHz	
HD	≥ 34 dB at 5 MHz	
Interchannel Timing Match	± 0.5 ns	
Functional Description		Displays Y minus Pr and Y minus Pb signals. Requires bowtie signal to be useful. Null in center indicates the channels are time aligned

Table 1–14: Timing Display

Characteristic	Performance requirement	Reference information
Input Timing Relative to External Reference		Display of Vertical and Horizontal timing offset graphically and numerically. One clock cycle resolution Patented proprietary display. Display Timing difference between input and Ref at rear panel or relative to an offset saved by the user
Timing Display Zero Definition		For vertical timing, conforms to SMPTE 168-2002 For horizontal timing, zero delay analog signals have coincident syncs. For digital signals, timing is such that if converted to analog by a WFM601A, then the resultant analog signal is conincident with the reference Timing zero is equivalent to nominal zero delay on TG700. Also agrees with signal that shows minimal shift on the waveform display when going from internal to external Vertical timing, according to SMPTE 168, specifies that the lines with the start of the broad pulses are aligned
Operation with input and reference being different formats		Compatible with any combination listed in Tables 1-44, 1-45, and 1-46. In cases where there are multiple ways to interpret the phase relationship, multiple indicators of the phase will be shown. The numeric display will follow the smallest phase offset

Table 1–15: Picture Mode

Characteristic	Performance requirement	Reference information
Format (XGA)		Allows viewing picture in all formats In SD formats, full screen picture occupies the central portion of the XGA raster area. For tile mode, the image is downsampled to fit the 512 x 350 size In HD formats, picture is downsampled to fit in 1024 x 768 size (512 x 350 in 4–tile mode) In Low Frame Rate formats, frames are repeated as needed to achieve XGA frame rate; similar to 3:2 pulldown on some frame rates
Pix Border On/Off		Allows user to mask or show the inactive portions of the raster such as ANC area for digital and sync for analog. When the border is on, the image is scaled to correct the aspect ratio. When the border is off, the image is either mapped pixel to pixel (full screen SD), or minimally deci-mated to reduce the atrifacts
Synchronization		Picture mode always uses internal timing; it is not affected by external sync
Aspect Ratio		Allows choice of 16:9 or 4:3 for SD, to support widescreen

Table 1–16: Signal Level / Cable Length Detector

Characteristic	Performance requirement	Reference information
Cable Length Measurement Error	15 m ± 10% for cable types listed at end of table	Requires clean SD signal with rise time <1 ns for full accuracy. Excessive ringing or slower rise time may appear as increased cable length
Cable Length Measurement Resolution		2 meters, nominal
Cable Length Measurement Range, Typical		Cable loss range of 0 to 30 dB at $^1/_2$ serial bit rate Typically runs to 40 dB, but with reduced accuracy Equivalent to 0 to 300 m Belden 8281 for SD, 0 to 120 m Belden 8281 for HD

Table 1–16: Signal Level / Cable Length Detector (Cont.)

Characteristic	Performance requirement	Reference information
Launch Amplitude Measurement Accuracy, Typical		± 40 mV at 800 mV level, 0 to 100 m Belden 8281 cable
Launch Amplitude Measurement Resolution, Typical		10 mV
Launch Amplitude Measurement Dynamic Range, Typical		± 50% from 800 mV
Cable Types		Belden 1694A/1505A/8281/1855A Canare L-5CFB Image 1000
Cable loss measurement		Displays loss around 160 MHz minus loss around 18 MHz

Table 1–17: Data error detection (EDH / Status, Under STATUS Button)

Characteristic	Performance requirement	Reference information
Data Integrity		
SD	Active picture and full field. Field rate resolution Complies with SMPTE RP165	Uses CRC check-word system. System is known as EDH (Error Detection and Handling) in industry literature Error icon asserted for 1 second after any error
HD	Field rate Resolution, separate reporting for errors in Y or Color Difference data streams	Error icon asserted for 1 second after any error

Table 1–18: ANC Data and ARIB

Characteristic	Performance requirement	Reference information
Displays		Detects ANC data in SDI streams, displays data from user specified DID and SDID. Displays Audio Control Packet. Decodes data for ARIB types B39, B37, B35, TR-B22, and TR-B23.
Alarms		Allows Alarms to be set for : ANC Parity ANC Checksum B39 Absence B37 Absence B35 Absence TR-B22 Absence TR-B23 Absence

Table 1–19: Audio Bar Displays

Characteristic	Performance requirement	Reference information
Modes		The user may configure the response dynamics (ballistics), reference levels, peak hold, offset, and scale of the meters to suit the monitoring needs of the particular installation or situation
Channel Mode		Any 10 channels configured into 5 pairs with phase correlation meters between pairs; analog audio inputs have a 6 channel maximum
Surround Mode		Left, Right, Center Lfe, Left surround, Right surround meters, and an extra channel pair. Phase correlation meters between L–R, L–C, C–R, Ls-Rs, L-Ls, R-Rs and the extra pair In Dolby mode, the bar configuration is automatically set by metadata
Audio Sources		Monitoring the signal levels and stereo phase of AES/EBU digital audio, digital audio embedded in serial digital video, and Analog Audio inputs Digital Audio (direct and embedded) may be PCM, Dolby digital, or Dolby E
Level Meter Resolution		0.056 dB steps at 30 dB scale, from full scale to –20 dB FS XGA Full Screen mode = 510 steps XGA 4-tile mode = 255 steps VGA Full or 4-tile mode = 260 steps

Table 1–19: Audio Bar Displays (Cont.)

Characteristic	Performance requirement	Reference information
Correlation Meter Speed		User selectable 1 to 20. Factory default is set to 8. Speed 1 averages over 0.04 sec. Speed 2 averages over 0.04 sec. Speed 3 averages over 0.08 sec. Speed 4 averages over 0.12 sec. Speed 5 averages over 0.28 sec. Speed 6 averages over 0.52 sec. Speed 7 averages over 1.0 sec. Speed 8 averages over 1.5 sec. Speed 9 averages over 2.0 sec. Speed 10 averages over 2.5 sec. Speed 11 averages over 3.0 sec. Speed 12 averages over 3.5 sec. Speed 13 averages over 4.0 sec. Speed 14 averages over 4.5 sec. Speed 15 averages over 5.0 sec. Speed 16 averages over 5.5 sec. Speed 17 averages over 6.0 sec. Speed 18 averages over 6.5 sec. Speed 19 averages over 7.0 sec. Speed 20 averages over 7.5 sec. The Phase Correlation Meter Speed setting determines how quickly the meter reacts to changes in phase relationship. The meter reading is actually an average of correlation over time, and this setting determines how many samples are used to calculate the average. The instrument uses the fewest samples when this setting is 1, and the meter reacts almost instantaneously. The instrument uses the most samples when the setting is 20, and the meter reacts much more slowly. Experiment to find the setting that best fits your application
Metering Ballistic Types		Selectable from true peak, PPM Type 1, PPM Type 2, and Extended VU
Peak Program Meter (PPM) Ballistic Response		PPM Type I (IEC Type I, essentially the same as DIN 45406 and Nordic N-9) PPM Type II (IEC Type II, the same as IEEE std. 152–1991) PPM Type I has a slightly faster attack time and a faster return time, 1.7 seconds to fall 20 dB as opposed to 2.8 seconds for Type II

Table 1–19: Audio Bar Displays (Cont.)

Characteristic	Performance requirement	Reference information
True Peak Ballistic Response		PPM Type II decay characteristics, no attack delay, factory default ballistic
Extended VU Ballistic Response		VU meter as defined in IEEE 152–1991, but with an extended dB-linear scale. The meter bars also contain true peak indicators when VU is selected
Peak Hold		True peak indicator remains at the most recent peak for a user selectable time of 1 to 10 seconds
Clip Indication Delay Count		Consecutive FS samples for Clip Indication, user selectable Off or 1 to 100. Factory default is set to 1. A setting of 0 is equivalent to “Off”
Mute Indication Delay Count		Consecutive “0” samples for Mute Indication, user selectable Off or 1 to 100. Factory default is set to 10. A setting of 0 is equivalent to “Off”
Clip/Mute Error Readout Hold Time		1 to 30 seconds, user selectable. Factory Default set to 2
Silence Indication Threshold		Audio level below which the signal will be considered “silent” Used to trigger on-screen indication and alarms
Silence Indication Delay		Off or 1 to 60 seconds, user selectable Indication and alarm will not be asserted until signal stays below the silence threshold for this number of consecutive seconds. Factory default is set to 10. A setting of 0 is equivalent to “Off”
Over Indication Threshold		Audio level above which the signal will be considered “over” Used to trigger on-screen indication and alarms
Over Indication Delay		Off or 1 to 30 seconds, user selectable Indication and alarm will not be asserted until signal stays above the Over Indication Threshold for this number of consecutive seconds. Factory default is set to 2. A setting of 0 is equivalent to “Off”

Table 1–19: Audio Bar Displays (Cont.)

Characteristic	Performance requirement	Reference information
Adjustable Peak Program Level		Peak Program level is the level, relative to digital full scale, that the user chooses as the maximum desired level for monitored programs. The meter bars change to red above Peak Program level
Digital	Range 0 to –30 dBFS	
Analog	Range 24 to –6 dBu	
Adjustable Test Level		Test level is the level, relative to digital full scale, that the user chooses as the test or "line up" level for monitored programs. The meter bars change to yellow between the Test and Peak Program levels
Digital	Range 0 to –30 dBFS	
Analog	Range 24 to –6 dBu	
Set 0 dB Mark	Selections are 0 dBFS or 0 dBu, Peak Program Level (dB), or Test Level (dB)	Use this item to number the meter scale relative to Digital Full scale with digital sources, or relative to 0 dBu with analog sources, or to one of the two user-adjustable levels. When the zero mark is set to either Peak Program or Test level, the scale units are dBr, relative to the 0 dB level; units above the selected 0 dB mark are positive, while units below it are negative
Analog Audio Scale Types		Selection of DIN, Nordic, or PPM preset the scale, test, and reference levels to match these defined meter types

Table 1–20: Audio Bar and Lissajous/Surround Display

Characteristic	Performance requirement	Reference information
Description		In combination with Bar mode (see Table 1–19) can have Lissajous or Surround Display in one tile
Automatic Gain Control (AGC)	Lissajous gain control may be on or off	AGC time constant: 0.5 second to expand display after a 0 to –40 dB level transition, 0.05 second to reduce gain after a –40 to 0 dB level transition

Table 1–20: Audio Bar and Lissajous/Surround Display (Cont.)

Characteristic	Performance requirement	Reference information
Manual Scaling		When AGC is off, level at perimeter of display follows Peak Program Level on Bar display
Surround Display Frequency Weighting Filter		Frequency weighting can be A-weighting or Linear (Flat Response) as described in IEC 651 Dominant sound indicator can be turned on and off

Table 1–21: AES Audio Inputs [1]

Characteristic	Performance requirement	Reference information
Inputs		2 sets with 8 channels each, 32–192 kHz, 24 bit, meets requirements of AES-3ID and SMPTE 276M-1995
Input Connector		BNC, terminated, unbalanced
Input Impedance		75 Ω
Input Return Loss	>25 dB relative to 75 Ω, from 0.1 to 6 MHz	Typically better than 30 dB to 24 MHz Input A has passive terminations, so they are the same with power on or off. Input B has active terminations that go to a higher impedance with the power off
Input Amplitude Range		0.1 V to 2 V peak-to-peak
Input Sample Rate	32k to 192k samples/sec	
Input Lock Frequency Range		> ± 5%. If input sample rate changes more than 5%, then the instrument may search again for a new lock point. Typically stays locked to 12.5%
Level Meter Accuracy Over Frequency	±0.1 dB from 20 Hz to 20 kHz with 0 to –40 dBFS sine wave input, Peak Ballistic mode. Within 5 Hz of some submultiples of the sampling frequency it may be attenuated additionally, as shown below. Sampling frequency refers to the 192 kHz upsampled data used for the bar ballistics For example: $1/12^{th}$ of rate –0.30 dB (16 kHz ± 5 Hz) $1/16^{th}$ of rate –0.17 dB (12 kHz ± 5 Hz) $1/20^{th}$ of rate –0.11 dB (9.6 kHz ± 5 Hz)	May not display full amplitude on fast transients due to sampled nature of digital signal

Table 1–21: AES Audio Inputs [1] (Cont.)

Characteristic	Performance requirement	Reference information
Audio Levels		Bars display signals up to 0 dBFS Must not exceed maximum power specification on analog outputs. Configure output attenuation if necessary

1 **The AES B connectors can be configured for input or output functionality.**

Table 1–22: AES Audio Outputs (alternate function on second set of inputs) [1]

Characteristic	Performance requirement	Reference information
Source		AES Line B outputs can be sourced from embedded, AES line A inputs (active loopthrough) or analog inputs If either Dolby option is installed, then the source may also be a repeat of the encoded Dolby stream, or decoded AES from a Dolby input. See the Dolby spec section for limitations
Number of Outputs		Up to 8 channels
Output Format		AES 3-ID Output, 48 kHz, 20 bit for embedded; 48 kHz, 24 bit for analog to AES. For AES to AES loogthrough, 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 48KHz. For decoded Dolby E the output is 24 bits at 48KHz, or 47.952KHz
Output Connector		BNC, terminated, unbalanced
Output Impedance		75 Ω
Output Return Loss	>25 dB relative to 75 Ω from 0.1 to 6 MHz	Typically better than 30 dB to 24 Mhz Tested in input mode
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) for embedded source, to AES incoming rate for AES source, and to 48 kHz for analog source

Table 1–22: AES Audio Outputs (alternate function on second set of inputs) [1] (Cont.)

Characteristic	Performance requirement	Reference information
Output Jitter, Typical		3.5 ns peak with 700 Hz high pass filter per AES specification AES3 rev. 1997 specification is 4.1 ns peak for 48 kHz audio
Rise and Fall Time, Typical		37 ns from 10% to 90% as per AES3 for 48 kHz sampling <12 ns for 96 kHz and 192 kHz sampling
Analog input to AES output levels, Typical		Analog input of +24 dBu translates to 0 dBFS digital signal Accuracy governed by analog input accuracy spec

[1] **The AES B connectors can be configured for input or output functionality.**

Table 1–23: Embedded Audio Extraction

Characteristic	Performance requirement	Reference information
Embedded Audio Formatting		24-bit Embedded audio is not supported (no AUX bits are extracted), only 20 most significant bits will be extracted. Supports SMPTE 272M Operation Level B only (48 kHz audio sampling rate synchronized with video)
SD		Extract 20-bit audio formatted according to SMPTE 272M
HD		Extract 20 or 24 bit audio formatting according to SMPTE299M
Channel Numbering		Channel numbers per SMPTE 272M (1 through 16) will be correctly shown on all displays
Audio Rates		No support for SMPTE 272M levels C through J
Number of Channels Monitored for Presence		16 channels are monitored for presence
Maximum Number of Channels Monitored for Activity		Monitoring done by audio board only. Can only monitor channels set up for display
Audio levels		Bars display signals up to 0 dBFS Must not exceed maximum power specification on analog outputs. Configure output attenuation if necessary

Table 1–24: Analog Audio Inputs

Characteristic	Performance requirement	Reference information
Number of Channels		Provides up to two sets of six channels of professional balanced differential inputs for each video input, 12 channels total
Input Connector		Balanced, unterminated via rear panel connector Use 62 pin, 3 row, DSUB connector, only 2 rows of 42 pins are connected
Level Meter Accuracy over Frequency	±0.3 dB from 20 Hz to 20 kHz, 24 dBu to –16 dBu sine wave input, Peak Ballistic mode. Within 5 Hz of some submultiples of the sampling frequency it may be attenuated additionally, as shown below. Sampling frequency refers to the 192 kHz upsampled data used for the bar ballistics. For example: 1/12th of rate –0.30 dB (16 kHz ±5 Hz) 1/16th of rate –0.17 dB (12 kHz ±5 Hz) 1/20th of rate –0.11 dB (9.6 kHz ±5 Hz)	
Cross Talk, Typical		≤ –90 dB from 20 Hz to 20 kHz, inputs driven from < 600 Ω source impedance Defined as the displayed bar level in any channel that results from a full scale signal on a different input pair than that input
Maximum Input Levels	+ 24 dBu ±0.3 dBu (see Level Meter Accuracy over Frequency above)	Must not exceed maximum power specification on analog outputs. Configure output attenuation if necessary
Resolution Sampling		24 bits at 48 kHz
Input Impedance		24 kΩ
Off Isolation		≤ –90 dB, from 20 Hz to 20 kHz. Unused input driven from < 600 Ω source impedance Defined as the displayed bar level that results from a full scale signal on any pair of the unused input
Analog Input to Digital Output Distortion (THD+N), Typical		<0.03% from full scale to –30 dBFS , 20 Hz to 20 kHz

Table 1–25: Analog Audio Outputs

Characteristic	Performance requirement	Reference information
Audio Modes		*Balanced*: provides a full-scale output of 24 dBu and is designed for professional balanced applications *Unbalanced*: Designed to drive the unbalanced inputs of consumer amplifiers, in which case the negative output pin must be grounded
Audio Sources		The channels routed to the line outputs may include: Embedded audio source, AES audio source, Analog audio source, and Decoded Dolby
Number of Channels		Provides up to eight channels
Output Connections		Balanced, unterminated via rear panel connector 62 pin, 3 row, DSUB connector, but only 2 rows of 42 pins are connected Ground negative output to support unbalanced mode
Maximum Output Levels	+ 24 dBu ±0.5 dBu	When one output is grounded to achieve unbalanced mode, the outher output will be driven to a larger amplitude. You can reduce the level by adding attenuation in the Audio Settings menu. Do not exceed the maximum rated output power in either mode
Input to Output Gain		0 dB to –120 dB in 0.5 dB steps
Digital Input to Analog Output Gain Accuracy over Frequency	± 0.5 dB, 20 Hz to 20 kHz, 0 to –40 dBFS, 20 or 24 bit input	
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 Ω Intended to drive ≥600 Ω load. Drivers are capable of driving a minimum load impedance of 300 Ω but may overheat. DO NOT exceed maximum rated output power
Digital Input to Analog Output Distortion (THD + N)		≤–0.01% from full scale to –20 dBFS, 20 Hz to 20 kHz
Analog Input to Analog Output Distortion (THD + N)		≤–0.02% from full scale to –20 dBFS, 20 Hz to 20 kHz

Table 1–25: Analog Audio Outputs (Cont.)

Characteristic	Performance requirement	Reference information
Digital Input to Analog Output Crosstalk, Typical		<–90 dB, 20 Hz to 20 kHz, 24 dBu or 0 dBFS input <–100 dB, 20 Hz to 2 kHz, 24 dBu or 0 dBFS input Defined as cross talk within a pair
Output Power Capability, Typical		Capable of continously driving a –10 dBFS sinewave into 600 Ω or –13 dB into 300 Ω This is 25 mW RMS in the load per output pair. Live audio may reach full voltage level as long as the duty cycle is such that the RMS power is less than 25 mW averaged over any 10 second period. If an overtemp condition is detected, the output attenuation may be increased automatically to prevent damage
Meter Level to Headphone Output Gain		0 dB to –63 dB in 0.5 dB steps relative to maximum output level
Digital Input to Headphone Output Gain Accuracy over Frequency	± 0.1 dB, 20 Hz to 20 kHz, 0 to –40 dBFS	
Digital Input to Headphone Output Distortion (THD + N), Typical		±0.05% from full scale to –10 dBFS, 20 Hz to 20 kHz, into 32 Ω <0.2% at full scale into 32 Ω <2% at full scale into 16 Ω
Headphone Output Power Capability		Capable of continuously driving a 6.25 dBu sinewave into 32 Ω or 16 Ω

Table 1–26: Dolby Digital (AC–3) Compressed Audio Monitoring (Opt. DD)

Characteristic	Performance requirement	Reference information
Compressed Audio Input Format		Decodes audio and metadata from Dolby data stream transported through AES or 48 kHz embedded audio source. Supports 32–bit professional and consumer modes on stream zero only
Decoded Audio Outputs		A single, selectable, Dolby Digital decoded channel pair may be output on AES B 1–2 and Analog Outputs 1 & 2 Limited to a single channel pair and line compression mode only, by license requirements

Table 1–26: Dolby Digital (AC–3) Compressed Audio Monitoring (Opt. DD) (Cont.)

Characteristic	Performance requirement	Reference information
Dolby Audio Status Display		Displays basic Dolby D status and bit stream meta-data
Alarms		See Tables 1-48 through 1-54 for added error indicators

Table 1–27: Dolby E and Extended Dolby Digital (AC–3) Compressed Audio Monitoring (Opt. DDE)

Characteristic	Performance requirement	Reference information
Compressed Audio Input Format		Decodes audio and metadata from Dolby data stream transported through AES or 48 kHz embedded audio source, streams 0 through 7. Supports 16-bit professional mode on Channel 1 or 2
Decoded Audio Outputs		Up to eight decoded channels including all surround sound channels plus down mix may be output on AES B or Analog Outputs
Dolby Audio Status Display		Displays extensive Dolby D and Dolby E status and bit stream meta-data
Alarms		See Tables 1-48 through 1-54 for added error indicators

Table 1–28: Picture Monitor Outputs (VGA Pix Mon)

Characteristic	Performance requirement	Reference information
Signal Format VGA DSUB Outputs		Y, Pb, Pr with sync on Y, RGB with sync on all, HD and SD. HD sync is tri-level, also have TTL H and V drive. Component mode only available for SDI input mode Does not support 720p 30, 720p 29.97, 720p 25, 720p 24 or 720p 23.98 formats No H and V sync outputs when sourcing 1080p sf 23.98 or 24, just tri-level sync on Green/Y
DAC Resolution		10 bit
Impedance, Typical		75 Ω unbalanced
Active Video Accuracy	700 mV ±5% peak-peak (Y-Pb-Pr mode)	
Black (blanking) Output Level	0 mV ±50 mV for HD and SD	

Table 1–28: Picture Monitor Outputs (VGA Pix Mon) (Cont.)

Characteristic	Performance requirement	Reference information
Frequency Response, Typical		Measure with a VM5000 and use "normal" VGA to BNC cable (such as Allied 796-9640)
SD		±5% to 5.5 MHz, Y, G, B, and R
HD		±8% to 30 MHz, Y, G, B, and R
Non-Linearity, Typical		≤1.5%
Rise and Fall Time, Typical		
SD		250 ns for Y, R, G, B 500 ns for Pb, Pr
HD		35 ns for Y, R, G, B 70 ns for Pb, Pr
Overshoot and Undershoot, Typical		1%
K Factor, Typical		1%
Interchannel Timing Match, Typical		
SD		Y-to-Pb and Y-to-Pr ±5.0 ns
HD		Y-to-Pb and Y-to-Pr ±4.0 ns
Sync Amplitude Accuracy, Typical		
SD		–300 mV
HD		300 mV on positive and negative excursions
Signal to Noise Ratio, Typical		
SD		70 dB to 5.5 MHz 58 dB to 100 MHz RMS noise on quiet line, relative to 700 mV
HD		58 dB to 30 MHz 55 dB to 250 MHz RMS noise relative to 700 mV
Return Loss on BNCs		>20 db to 30 MHz
Transcoder Accuracy		9 bit
Composite Mode		When using composite input only. Sourced on Green channel of connector
Composite Amplitude, Typical		1 V ±5% including sync and 100% white video
Composite Offset, Typical		±100 mV
Composite mode SNR,Typical		60 dB RMS to 700 mV with 20 MHz BW

Table 1–29: LCD display

Characteristic	Performance requirement	Reference information
Display Area		
Horizontal		13 cm
Vertical		10 cm
Resolution		1024 (H) x 768 (V) pixels
Color Palette		6 bits per component. LSB is dithered to improve picture
Pixel Defects	≤ 6 bad pixels	

Table 1–30: External XGA Output (EXT DISPLAY)

Characteristic	Performance requirement	Reference information
Content		Identical to front-panel LCD display
Output Levels		0.7 V or 1 V for RGB signals, selectable. Fixed 5 V for H and V sync signals
Resolution		1024 (H) x 768 (V) pixels
Color Palette		6 bits per component
Connector Pin Assignments		Pin 1: R Pin 6: GND Pin 11: NC Pin 2: G Pin 7: GND Pin 12: NC Pin 3: B Pin 8: GND Pin 13: HSync Pin 4: NC Pin 9: NC Pin 14: VSync Pin 5: GND Pin 10: NC Pin 15: NC

Table 1–31: LTC Time Code Input / Ground Closures

Characteristic	Performance requirement	Reference information
LTC Input Connector		Balanced, unterminated via rear-panel GC remote connector. See Table 1–38 for connector pinout
LTC Input Impedance		Greater than 10 kΩ
LTC Signal Characteristics		Longtitudinal Time Code per IEC Publication 461
LTC Signal Amplitude Range, Typical		0.2 V_{p-p} to 5.0 V_{p-p}, balanced differential or single-ended

Table 1–31: LTC Time Code Input / Ground Closures (Cont.)

Characteristic	Performance requirement	Reference information
Ground Closure Input Signaling (Preset Selection)		TTL thresholds, 5 V maximum input, –0.5 V minimum input. Pull low to assert Has internal 10 kΩ pull-up to 5 V on each input
Ground Closure Output Characteristics		One open collector output Pulled up by 10 kΩ resistor in series with a diode to +5 V. Pull down current is limited by 10 Ω resistor. Maximum current allowed is 100 mA

Table 1–32: VITC Decoding

Characteristic	Performance requirement	Reference information
Sources		Composite input A or B, SDI input A or B No embedded time-code extraction

Table 1–33: Serial Digital Video Interface (Input A, Input B)

Characteristic	Performance requirement	Reference information
Video Inputs		Two inputs; only one input active at a time
Format		Each input compatible with SMPTE 292M/BTA-S004A and 270 Mb/s SMPTE 259M
Input Type		75 Ω BNC, internally terminated
Cable Loss Accommodation	With 1/SQRT(f) characteristic at ½ of serial rate.	
SD	0 to 30 dB attenuation	Equivalent to approximately 300 m of Belden 8281 at 270 Mb/s
HD	0 to 20 dB attenuation	Equivalent to approximately 80 m of Belden 8281 at 1.485 Gb/s. Typical performance to 110 m
Launch Amplitude Accommodation, Typical		
For Full Specification		800 mV ± 10%
Up to 20 dB Cable Loss		800 mV ± 30%

Table 1–33: Serial Digital Video Interface (Input A, Input B) (Cont.)

Characteristic	Performance requirement	Reference information
Jitter Tolerance, Typical		0.35 UI_{p-p} above 2 MHz. Increases proportional to 1/f below 2 MHz
Return Loss	> 15 dB to 1.5 GHz	
Isolation Between Inputs	> 45 dB to 1 GHz	
Time Base Range		≥ ± 50 ppm

Table 1–34: Serial Video Output (Serial Out/SDI PixMon)

Characteristic	Performance requirement	Reference information
Format		1.485 Gb/s, 1.4835 Gb/s, or 270 Mb/s repeat of selected input
Content – Follows Active Input With Brightups		Selectable as loop output of active input, or Digital version of RGB/YPbPr analog pix monitor output. Gamut and/or line select brightups optionally displayable Gamut error brightups appear one line below error
Output Level	800 mV, ± 10% into 75 Ω load	
Rise and Fall Time, Typical		
SD		400 ps minimum, 800 ps maximum, 20% to 80%
HD		220 ps maximum, 20% to 80%
Return Loss	15 dB to 1.5 GHz	

Table 1–35: External Reference

Characteristic	Performance requirement	Reference information
Input Type		Passive loop-through, 75 Ω compensated
Operational		Locks to analog bi-level and tri-level signals of formats listed in Tables 1–44 through 1–46. Reference must have a frame rate compatible with input. WFM mode and Line Select derive timing from the external sync information Picture mode and Data mode do not use timing from the external reference
Analog Sync Format	PAL 1080i 60 Hz 720p 59.94 Hz NTSC 1080i 59.94 Hz 1080p 23.98 Hz 1080p 24 Hz 720p 50 720p 60 1080i 50 1080sf 23.98 1080sf 24	
Input Signal Level, Typical		–6 dB to +6 dB
DC Input Impedance		20 kΩ
Maximum Operating Input Voltage, Typical		± 5 V DC
Absolute Maximum Input Voltage, Typical		± 5 V DC
Inband Input Impedance, Typical		≥ 15 kΩ
Return Loss. Typical		> 40 dB to 6 MHz > 29 dB to 30 MHz
Hum Tolerance, Typical		Operates with 500 mV_{p-p} at 50 or 60 Hz
Signal/Noise Tolerance, Typical		Operates to 25 dB

Table 1–36: Ethernet

Characteristic	Performance requirement	Reference information
IP Address Mode		Supports manual and DHCP
SNMP		For instrument control and feedback of status. Complies with SNMP version 2
Connector Type		RJ-45 LAN connector supporting 10/100 Base-T

Table 1–37: USB

Characteristic	Performance requirement	Reference information
Type		Host
Speed		Complies with USB 1.1 and USB 2.0 full speed specification Full speed operation in accordance with USB 2.0 spec is 12 Mb/s.

Table 1–38: Remote Port

Characteristic	Performance requirement	Reference information
Alarm Output		
Type		Open collector. Has weak pull-up with a diode to +5 V
Connector Pin Assignments		Pin # Signal 1 Out; GND 2 In; Time Code Positive (LTC input) 3 In; Time Code Negative (LTC input) 4 Out; GND 5 Out; Ground Closure Output 6 In; Preset Recall A1 7 In; Preset Recall A2 8 In; Preset Recall A3 9 In; Preset Recall A4

Table 1–39: Power Source

Characteristic	Performance requirement	Reference information
Electrical Rating	100 – 240 VAC ±10%, 50/60 Hz 115 Watts max.	
Supply Connection		Detachable cord set
Power Consumption, Typical		50 to 110 VA at 110 or 240 VAC

Table 1–39: Power Source (Cont.)

Characteristic	Performance requirement	Reference information
Surge, Typical		7.5 Amps at 90 V 10 Amps at 240 V
Fuse Rating		T3.5, 250 V Not operator replaceable. Refer servicing to qualified service personnel

Table 1–40: Miscellaneous

Characteristic	Performance requirement	Reference information
Real-time Clock Battery Life		>10 year

Physical Specifications

Table 1–41: Physical Characteristics

Characteristic	Standard
Dimensions	
Height	5 1/4 inches (133.4 millimeters)
Width	8 1/2 inches (215.9 millimeters)
Depth	18 1/8 inches (460.4 millimeters)
Weight	
Net	12 pounds (5.5 kilograms)
Shipping	21 pounds (9.6 kilograms), approximate

Table 1–42: Environmental Performance

Category	Standards or description
Temperature	
Operating	0 °C to +40 °C
Non Operating	–20 °C to +60 °C
Humidity	
Operating	20% to 80% relative humidity (% RH) at up to +40 °C, non-condensing
Non Operating	5% to 90% RH (relative humidity) at up to +60 °C, non-condensing
Altitude	
Operating	Up to 9,842 feet (3,000 meters)
Non Operating	Up to 40,000 feet (12,192 meters)
Cooling	Variable Fan. Forced air circulation with no air filter.
Required Clearances	Do not block the bezel or rear panel vent holes, or more than half the vent holes on the sides

Certifications and Compliances

Table 1–43: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity – EMC	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EN 55103 — Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.[2] Environment — E2 – commercial and light industrial Part 1 Emission EN 55022 — Class B radiated and conducted emissions EN 55103-1, Annex A — Radiated magnetic field emissions EN 55103-1, Annex B — Inrush current; I peak = 2.19 amps EN-55103-1, Annex E — Conducted emissions, signal/control ports Part 2 Immunity IEC 61000-4-2 — Electrostatic discharge immunity IEC 61000-4-3 — RF electromagnetic field immunity IEC 61000-4-4 — Electrical fast transient / burst immunity IEC 61000-4-5 — Power line surge immunity IEC 61000-4-6 — Conducted RF Immunity IEC 61000-4-11 — Voltage dips and interruptions immunity Peak Inrush Current: 3.1 Amps EN 55103-2, Annex A — Radiated magnetic field immunity EN 55103-2, Annex B — Balanced ports common mode immunity EN 61000-3-2 — AC power line harmonic emissions
Australia / New Zealand Declaration of Conformity – EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s): AS/NZS 2064.1/2 — Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Exempt from FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
EC Declaration of Conformity – Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN61010-1:2001 — Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL61010-1:2004 — Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 61010-1:2004 — Safety requirements for electrical equipment for measurement, control, and laboratory use.

[2] **Must use high-quality shielded cables to ensure compliance.**

Table 1–43: Certifications and compliances (cont.)

Category	Standards or description	
Additional Compliance	IEC61010-1:2001	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	ISA S82.02.01:1999	Safety standard for electrical and electronic test, measuring, controlling, and related equipment.
Installation (Overvoltage) Category Descriptions	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:	
	CAT III	Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.
	CAT II	Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment.
Overvoltage Category	CAT II	
Pollution Degree Descriptions	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.
Pollution Degree	Pollution Degree 2	
Equipment type	Test and Measurement	
Safety Class	Class I	

Supported Input Formats and Allowed References

An X in Tables 1−44 through 1−46 indicates that that combination is supported and verified. Other combinations within each of these tables may work, but are unverified and only supported on a best effort basis.

Operation with an input from one of these three tables and a reference from another table is not supported (for example, a 1080i 50 input will not work with a 1080i 60 reference). Such mismatches may be reported on the display, and/or the display will “roll” due to the inherent incompatibility between the standards.

Table 1–44: 25 Hz and 50 Hz Frame and Field rates

Input Format	Reference Format					
	PAL	720p 25	720p 50	1080p 25	1080sf 25	1080i 50
720p 25 Hz [3]	X		X			X
720p 50 Hz [3]	X		X			X
1080p 25 Hz [3]	X		X			X
1080sf 25 Hz [3]	X		X			X
1080i 50 Hz [3]	X		X			X
576i 50 Hz (625) [4]	X		X			X
PAL 50 Hz [5]	X					

Table 1–45: 59.94 Hz, 23.98 Hz, and 29.97 Hz Frame and Field rates

Input Format	Reference Format								
	NTSC	720p 23.98	720p 29.97	720p 59.94	1080p 23.98	1080sf 23.98	1080p 29.97	1080sf 29.97	1080i 59.94
720p 23.98 Hz [3]	X			X	X	X			X
720p 29.97 Hz [3]	X			X					X
720p 59.94 Hz [3]	X			X	X	X			X
1080p 23.98 Hz [3]	X			X	X	X			X
1080sf 23.98 Hz [3]	X			X	X	X			X
1080p 29.97 Hz [3]	X			X					X
1080sf 29.97 Hz [3]	X			X					X
1035i 59.94 Hz [3]	X			X					X
1080i 59.94 Hz [3]	X			X					X
483i 59.94 Hz (525) [4]	X			X					X
NTSC 59.94 Hz [5]	X								

[3] **WFM7000 and WFM7100 Opt. HD only.**

[4] **WFM7100 Opt. SD and WFM6100 Opt SD only.**

[5] **Opt. CPS only.**

Table 1–46: 24 Hz, 30 Hz, and 60 Hz Frame and Field rates

Input Format	Reference Format							
	720p 24	720p 30	720p 60	1080p 24	1080sf 24	1080p 30	1080sf 30	1080i 60
720p 24 [3]			X	X	X			X
720p 30 [3]			X					X
720p 60 [3]			X	X	X			X
1080p 24 [3]			X	X	X			X
1080sf 24 [3]			X	X	X			X
1080p 30 [3]			X					X
1080sf 30 [3]			X					X
1035i 60 Hz [4]			X	X	X			X
1080i 60 Hz [5]			X	X	X			X

3 **WFM7000 and WFM7100 Opt. HD only.**

4 **WFM7100 Opt. SD or WFM6100 Opt SD only.**

5 **Opt. CPS only.**

Table 1–47: Supported Digital Standards

Standard	Image Format	Field/Frame Rate							
		60 Hz	59.94	50	30 Hz	29.97	25	24	23.98
274M	1920x1080i	X (D292)	X (E292)	X (F292)					
	1920x1080p				X (G292)	X (H292)	X (I292)	X (J292)	X (K292)
	1920x1080sF				X	X	X	X	X
295M (1250/50)	1920x1080i	Not Supported							
240M / 260M	1920x1035i	X (A292)	X (B292)						
296M	1280X720p	X (L292)	X (M292)	X	X	X	X	X	X
ITU-R BT.601	720X576i (625)			X (C259)					
	720X483i (525)		X (C259)						
293M	720X480p	Not Supported							

Alarms

The following tables list the alarms that may be set for the waveform monitors.

Table 1–48: Common Alarms (WFM6100, WFM7000, WFM7100)

Alarm	Description
HW Fault	Indicates a system fault occurred. May require service
SDI Input Missing	Indicates that no signal is detected on the selected SDI input
SDI Input Signal Lock	Indicates unable to lock to selected SDI input signal
Reference Missing	Indicates that no signal is detected on the Ref input when REF EXT is selected
Ref Lock	Indicates unable to lock to the Ref input signal when REF EXT is selected
Ref Fmt Mismatch	Indicates that the signal format detected on Ref input differs from the configured External Ref format
RGB Gamut Error	Indicates that the selected video input signal contains colors that violate the configured Diamond gamut thresholds
Composite Gamut Error	Indicates that the selected video input signal contains colors that violate the configured Arrowhead gamut thresholds
Luma Gamut Error	Indicates that the selected video input signal contains luminance levels that violate the configured Luma gamut thresholds
Video Fmt Change	Indicates that a change occurred in the format of the selected video input signal
Video Fmt Mismatch	Indicates that the signal format detected on the selected video input differs from the configured Input Format or that the format detected differs from that indicated by the signal's SMPTE 352 payload identifier
Vid/Ref Mismatch	Indicates that the Ref signal format is not compatible with the Input signal format. See Tables 1-44, 1-45, and 1-46, Supported Input Formats and Allowed References
Line Length Error	Indicates that the length of a video line differs from that expected for the detected video format
Field Length Error	Indicates that the length of a video field differs from that expected for the detected video format
EAV Place Error	Indicates that the location of the EAV timing reference signal differs from that expected for the detected video format.
SAV Place Error	Indicates that the location of the SAV timing reference signal differs from that expected for the detected video format
Timecode Vitc Missing	Indicates that a break or discontinuity in the VITC has occurred
Timecode Vitc Invalid	Indicates that the VITC was lost for one frame but has reappeared
Timecode Ltc Missing	Indicates that a break or discontinuity in the LTC has occurred
Timecode Ltc Invalid	Indicates that the LTC was lost for one frame but has reappeared
Timecode Anc Missing	Indicates that a break or discontinuity in the ANC timecode has occurred
Timecode Anc Invalid	Indicates that the ANC timecode was lost for one frame but has reappeared
Closed Caption Missing	Indicates that the configured Closed Caption Transport stream or streams are not present in the selected video input signal

Table 1–48: Common Alarms (WFM6100, WFM7000, WFM7100) (Cont.)

Alarm	Description
CC Service(s) Missing	Indicates that one or more configured EIA 608 Required Services is not present in the closed caption data stream
EIA608 Caption Error	Indicates a data error in an EIA608 data stream, excluding Extended Data Services and EIA708 Caption Data Packet errors
V-Chip Presence Error	Indicates that no content advisory packet has been detected in the selected video input signal for at least 4 seconds
V-Chip Format Error	Indicates that a content advisory packet contained illegal data or was formatted incorrectly
Extended Data Services Error	Indicates a data error in Extended Data Services of an EIA608 data stream
Caption Data Packet Error	Indicates a Caption Data Payload error in the EIA708 stream carrying EIA608 data
Line 21 presence Error	Indicates no VBI caption signal was found on the configured Line and Timing of the selected video input signal
ANC CC Presence Error	Indicates no caption ancillary data (SMPTE334M) was found in the selected video input signal
TSID Missing	Indicates no Transmission Signal Identifier was found in the selected video input signal
TSID Format Error	Indicates detected Transmission Signal Identifier is not an allowed value

Table 1–49: HD Specific Alarms (WFM7100, WFM7000 Opt. HD)

Alarm	Description
Video Not HD	Indicates that the selected SDI video input signal is not an HD format
Line Number Error	Indicates that the encoded line number differs from the counted line number
Y Chan CRC Error	Indicates that the encoded CRC for a line's Y (luminance) samples differs from the calculated CRC
C Chan CRC Error	Indicates that the encoded CRC for a line's C (chrominance) samples differs from the calculated CRC
Y Anc Checksum Error	Indicates that the encoded checksum in a Y (luminance) ancillary data packet differs from the calculated checksum
C Anc Checksum Error	Indicates that the encoded checksum in a C (chrominance) ancillary data packet differs from the calculated checksum

Table 1–50: SD Specific Alarms (WFM6100, WFM7000, WFM7100 Opt. SD)

Alarm	Description
AP CRC Error	Indicates that encoded AP (active picture) CRC differs from the calculated CRC
FF CRC Error	Indicates that encoded FF (full field) CRC differs from the calculated CRC
EDH Error	Indicates that EDH (error detection and handling) has detected an error

Table 1–51: Composite Specific Alarms (Opt. CPS)

Alarm	Description
Cmpst Input Missing	Indicates that no signal is detected on the selected composite video input
Cmpst Lock	Indicates unable to lock to the selected composite video input

Table 1–52: Audio Alarms (Opts. DS and AD Only)

Alarm	Description
Over	Indicates that the signal has exceeded the level specified by the Over Level setting for the period of time specified by the Duration for Over setting.
Silence	Indicates that the signal has fallen below the level specified by the Silence Level setting for the period of time specified by the Duration for Silence setting.
Clip	Indicates that the number of consecutive, full-scale digital audio samples monitored has exceeded the value specified by the Number of Samples for Clip setting.
Mute	Indicates that the number of consecutive, “0” digital audio samples monitored has exceeded the Number of Samples for Mute setting.
AES Unlocked	Indicates unlocked condition of an AES input
CRC Error	Indicates that the AES channel status CRC as calculated by the instrument does not agree with the CRC embedded in the channel status bytes
V Bit	Indicates that the Validity bit is set high for one or more AES audio samples. In the AES/EBU standard, a set validity bit indicates that the sample is not suitable for conversion to audio
AES Parity	Indicates incorrect parity in one or more AES audio samples
AES Sync Error	Indicates a timing error of greater than 25% of an audio frame between the monitored AES input and the selected AES reference input
Emb. Audio Presence	Indicates that no embedded audio stream is detected in the selected SDI input
(Embedded) Checksum	Indicates that the checksum present in the embedded audio stream does not match the calculated checksum
(Embedded) Parity	Indicates incorrect parity in one or more embedded audio samples
Emb. Group Sample Phase	Indicates embedded audio streams are not time-aligned due to asynchronous audio or data error

Table 1–53: Additional Audio Alarms (Opt. DD Only)

Alarm	Description
Dolby Format	Indicates Dolby audio Format is not as expected

Table 1–54: Additional Audio Alarms (Opt. DDE Only)

Alarm	Description
Dolby E /Video Frame Rate Error	Indicates that the Dolby E stream frame rate is not the same as the video frame rate

Performance Verification

Performance Verification

This section contains a collection of manual procedures for verifying that the waveform monitor products perform as warranted:

- WFM7100 models and their options
- WFM7000 models and their options
- WFM6100 models and their options

The procedures are arranged in two basic sections: *Incoming Inspection Procedures* and *Performance Verification Procedures*. The tests in this chapter make up an extensive confirmation of performance and functionality when the following requirement is met:

- The waveform monitor must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature as listed in Table 1−42.

Test Records

Use the tables on the following pages to record the measured performance or Pass/Fail status for each step of the specified test procedure. In cases where a measurement is made in different units than specified in the manual, the actual measured values that correspond to the specification limits are shown in parentheses.

Test Record – Function Tests

WFM6100, WFM7000, and WFM7100 Waveform Monitor Functional Test Record

Instrument Serial Number: __________ Certificate Number: __________

Temperature: __________ RH %: __________

Date of Calibration: __________ Technician: __________

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
Basic Turn On and Self Test			
Front Panel LEDs			
POST			
Front Panel Test			
LCD Pixel and Touch Screen Defects			
LCD Color Palette and Advanced Diagnostics Test			
LCD Color Palette Test			
Advanced Diagnostics			
Touch Panel Registration Test			
Fan Test			
SDI Bit Integrity			
External Reference			
NTSC Lock			
Ref Missing			
Composite Input (Option CPS only)			
CMPST A, WFM with NTSC			
CMPST A, Vector with NTSC			
CMPST A, Picture with NTSC			
CMPST B, WFM with NTSC			
CMPST B, Vector with NTSC			
CMPST B, Picture with NTSC			

WFM6100, WFM7000, and WFM7100 Waveform Monitor Functional Test Record (cont.)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
Analog Audio Input (Options AD, DD, & DDE only)			
Analog Audio input A ports 1–6 display bar			
Analog Audio input B ports 1-6 display bar			
Analog Audio Output (Options AD, DD, & DDE only)			
Digital Audio Input (Options AD, DS, DD, & DDE only)			
AES Audio input A to Display Bar			
AES Audio input B to Display Bar			
Embedded Audio to Display Bar			
Embedded Audio to Lissajous Display			
Digital Audio Output (Options AD, DS, DD, & DDE only)			
AES B 1-2 Audio Output			
AES B 3-4 Audio Output			
AES B 5-6 Audio Output			
AES B 7-8 Audio Output			
Dolby Decode (Options DD, & DDE only)			
LTC Decode			
Ground Closure Remote			
Remote Input – Activate Preset			
Remote Output – Ground Closure			
Ethernet Functionality			

Test Record – All Instruments

If you are testing a WFM6100 or a WFM7000 without Opt HD, skip the HD-only entries in the record. Complete the other entries, which are common to all models.

WFM6100, WFM7000, and WFM7100 Waveform Monitor Video Performance Test Record

Instrument Serial Number: ____________________ Certificate Number: ____________________

Temperature: ____________________ RH %: ____________________

Date of Calibration: ____________________ Technician: ____________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
HD SDI Input Level Low and High (HD only)				
Input A, Low Level				90% (720 mV)
Input A, High Level	110% (880 mV)			
Input B, Low Level				90% (720 mV)
Input B, High Level	110% (880 mV)			
EDH and HD SDI Input Equalization Range (HD only)				
EDH	Pass			
Input A	20 dB			
Input B	20 dB			
HD SDI Loop Through Isolation (HD only)	Pass			
HD PixMon Frequency Response	–0.92 dB (–10%)			+0.82 dB (+10%)
HD SDI Return Loss, A and B Inputs (HD only)				
Input A	–15 dB			
Input B	–15 dB			
HD Cable Meter (HD only)				
SDI A Input (Short Cable)	0 m			17 m
SDI A Input (Long Cable)	76 m			127 m
SDI B Input (Short Cable)	0 m			17 m
SDI B Input (Long Cable)	76 m			127 m
HD Jitter Noise Floor and Bounce (HD only)				
Jitter Noise Floor	Pass			
10 second 10 Hz Jitter Bounce	Pass			

WFM6100, WFM7000, and WFM7100 Waveform Monitor Video Performance Test Record (cont.)

Instrument Serial Number: ______________ Certificate Number: ______________
Temperature: ______________ RH %: ______________
Date of Calibration: ______________ Technician: ______________

Performance Test	Minimum	Incoming	Outgoing	Maximum
HD Jitter Readout Accuracy (HD only)				
Jitter Trace	Pass			
Jitter Readout	Pass			
External Reference Return Loss				
To 6 MHz	–40 dB			
To 30 MHz	–29 dB			
External Reference Formats supported: Bi-Level	Pass			
External Reference Lock Range	–50 ppm			50 ppm
External Reference Formats supported: Tri-Level	Pass			
External Reference Lock in Presence of Hum: Bi-Level	Pass			
LTC Decoding Functionality	Pass			
External Reference Lock in Presence of Hum: Tri-Level	Pass			
Recovered Sine Wave	Pass			
Eye Gain				
SDI A Input	760 mV			840 mV
SDI B Input	760 mV			840 mV
Reference Clock Amplitude and Frequency				
Clock Amplitude	Pass			
Clock Frequency	Pass			
Eye Signal Bandwidth				
SDI A 2.5 GHz Response				
SDI A Minimum Response				
SDI B 2.5 GHz Response				
SDI B Minimum Response				

Test Record – Tests for SD-Equipped Instruments Only

SD-equipped instruments include *all* WFM6100 and WFM7100 instruments and all *Option SD-equipped* WFM7000 instruments.

WFM7100 Waveform Monitor Video Performance Test Record (Option SD only)

Instrument Serial Number: ______________________ Certificate Number: ______________________
Temperature: ______________________ RH %: ______________________
Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
SD SDI Input Level Low and High				
Input A, Low Level				720 mV
Input A, High Level	880 mV			
Input B, Low Level				720 mV
Input B, High Level	880 mV			
SD SDI Input Equalization Range and EDH				
EDH	Pass			
Input A	30 dB			
Input B	30 dB			
SD PixMon Multiburst Frequency Response	–0.92 dB (–10%)			+0.82 dB (+10%)
Analog Pixmon Gain and Offset				
YPbPr	Pass			
RGB	Pass			
Composite	Pass			
SD SDI Serial Output Amplitude	760 mV			840 mV
SD SDI Return Loss				
Input A	–25 dB			
Input B	–25 dB			
SD VITC Decoding Functionality	Pass			
SD Cable Meter				
SDI A Input (Short Cable)	0 m			17 m
SDI A Input (Long Cable)	76 m			127 m
SDI B Input (Short Cable)	0 m			17 m
SDI B Input (Long Cable)	76 m			127 m
SD Equalized Eye Gain	Pass			
SD Jitter Noise Floor and Bounce				
Jitter Noise Floor	Pass			

WFM7100 Waveform Monitor Video Performance Test Record (Option SD only) (cont.)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
SD Jitter Readout Accuracy				
Jitter Trace	Pass			
Jitter Readout	Pass			
Jitter Vibration	Pass			

Test Record – Option CPS only

WFM7100 Waveform Monitor Video Performance Test Record (Options CPS only)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
Composite Analog Frequency Response	99% (7 mV)			101% (–7 mV)
Composite Analog Delay Variation Over Frequency (Group Delay)	–10ns (–7.1 mV)			+10ns (7.1 mV)
Composite Analog Pulse to Bar Ratio	99% (–7 mV)			101% (7 mV)
Composite Analog Field Rate Tilt	–0.5% (–3.5 mV)			+0.5% (+3.5 mV)
Composite Analog Line Rate Tilt	–0.5% (–3.5 mV)			+0.5% (+3.5 mV)
Composite Analog Input Return Loss, A and B Inputs				
Input A	–40 dB			
Input B	–40 dB			
Composite Analog Input DC Offset with Restore Off	–10 mV			10 mV
Composite Analog Input Clamp Off Check	Pass/Fail			
Composite Analog Input DC Restore Hum Attenuation				
DC Restore Off	Pass			
Fast Mode	5% (35 mV)			 (0mV)
Slow Mode	90% (643 mV)			110% (785 mV)
Composite Analog Vertical Measurement Accuracy	707.71 mV			722.01 mV
External Reference Lock Range	–50 ppm			50 ppm
VITC Decoding Functionality	Pass			

Test Record – Options AD, DD, and DDE only

WFM7100 Waveform Monitor Audio Options AD, DD, and DDE only Test Record

Instrument Serial Number: ____________________ Certificate Number: ____________________

Temperature: ____________________ RH %: ____________________

Date of Calibration: ____________________ Technician: ____________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Return Loss				
AES A 1–2 In	–25 dB			
AES A 3–4 In	–25 dB			
AES A 5–6 In	–25 dB			
AES A 7–8 In	–25 dB			
AES B 1–2 I/O	–25 dB			
AES B 3–4 I/O	–25 dB			
AES B 5–6 I/O	–25 dB			
AES B 7–8 I/O	–25 dB			
AES Audio Input Sample Rate				
AES A 1–2 In (96 kHz)	pass			
AES A 3–4 In (96 kHz)	pass			
AES A 5–6 In (96 kHz)	pass			
AES A 7–8 In (96 kHz)	pass			
AES A 1–2 In (35 kHz)	pass			
AES A 3–4 In (35 kHz)	pass			
AES A 5–6 In (35 kHz)	pass			
AES A 7–8 In (35 kHz)	pass			
AES Audio Output Amplitude				
AES B 1–2 I/O	0.9 v			1.1 v
AES B 3–4 I/O	0.9 v			1.1 v
AES B 5–6 I/O	0.9 v			1.1 v
AES B 7–8 I/O	0.9 v			1.1 v
AES Audio Output Jitter				
AES B 1–2 I/O	Pass			
AES B 3–4 I/O	Pass			
AES B 5–6 I/O	Pass			
AES B 7–8 I/O	Pass			
AES Audio Level Meter Accuracy Over Frequency				
AES A 1 In (100 Hz)	Pass			

WFM7100 Waveform Monitor Audio Options AD, DD, and DDE only Test Record (cont.)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES A 2 In (100 Hz)	Pass			
AES A 3 In (100 Hz)	Pass			
AES A 4 In (100 Hz)	Pass			
AES A 5 In (100 Hz)	Pass			
AES A 6 In (100 Hz)	Pass			
AES A 7 In (100 Hz)	Pass			
AES A 8 In (100 Hz)	Pass			
AES A 1 In (1 kHz)	Pass			
AES A 2 In (1 kHz)	Pass			
AES A 3 In (1 kHz)	Pass			
AES A 4 In (1 kHz)	Pass			
AES A 5 In (1 kHz)	Pass			
AES A 6 In (1 kHz)	Pass			
AES A 7 In (1 kHz)	Pass			
AES A 8 In (1 kHz)	Pass			
AES A 1 In (19 kHz)	Pass			
AES A 2 In (19 kHz)	Pass			
AES A 3 In (19 kHz)	Pass			
AES A 4 In (19 kHz)	Pass			
AES A 5 In (19 kHz)	Pass			
AES A 6 In (19 kHz)	Pass			
AES A 7 In (19 kHz)	Pass			
AES A 8 In (19 kHz)	Pass			

WFM7100 Waveform Monitor Audio Options AD, DD, and DDE only Test Record (cont.)

Instrument Serial Number: ______________ Certificate Number: ______________
Temperature: ______________ RH %: ______________
Date of Calibration: ______________ Technician: ______________

Performance Test	Minimum	Incoming	Outgoing	Maximum
Headphone level accuracy over frequency				
Left (100 Hz)	–0.75 dBu			1.25 dBu
Right (100 Hz)	–0.75 dBu			1.25 dBu
Left (1 kHz)	–0.75 dBu			1.25 dBu
Right (1 kHz)	–0.75 dBu			1.25 dBu
Left (19 kHz)	–0.75 dBu			1.25 dBu
Right (19 kHz)	–0.75 dBu			1.25 dBu
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input A1 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A2 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A3 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A4 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A5 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A6 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input A1 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A2 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A3 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A4 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A5 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A6 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input A1 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input A2 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input A3 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input A4 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input A5 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input A6 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B1 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input B2 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input B3 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input B4 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input B5 (100 Hz)	17.5 dBu			18.5 dBu
Analog Input B6 (100 Hz)	17.5 dBu			18.5 dBu

WFM7100 Waveform Monitor Audio Options AD, DD, and DDE only Test Record (cont.)

Instrument Serial Number: ______________ Certificate Number: ______________
Temperature: ______________ RH %: ______________
Date of Calibration: ______________ Technician: ______________

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input B1 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B2 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B3 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B4 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B5 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B6 (1 kHz)	17.5 dBu			18.5 dBu
Analog Input B1 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B2 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B3 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B4 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B5 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input B6 (19 kHz)	17.5 dBu			18.5 dBu
Digital Input to Analog Output Gain Accuracy Over Frequency				
Analog Output 1 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 2 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 3 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 4 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 5 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 6 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 7 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 8 (100 Hz)	17.5 dBu			18.5 dBu
Analog Output 1 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 2 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 3 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 4 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 5 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 6 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 7 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 8 (1 kHz)	17.5 dBu			18.5 dBu
Analog Output 1 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 2 (19 kHz)	17.5 dBu			18.5 dBu

WFM7100 Waveform Monitor Audio Options AD, DD, and DDE only Test Record (cont.)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Output 3 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 4 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 5 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 6 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 7 (19 kHz)	17.5 dBu			18.5 dBu
Analog Output 8 (19 kHz)	17.5 dBu			18.5 dBu
Analog Input to Analog Output Gain Accuracy Over Frequency				
Analog Output 1 (100 Hz)	Pass			
Analog Output 2 (100 Hz)	Pass			
Analog Output 3 (100 Hz)	Pass			
Analog Output 4 (100 Hz)	Pass			
Analog Output 5 (100 Hz)	Pass			
Analog Output 6 (100 Hz)	Pass			
Analog Output 7 (100 Hz)	Pass			
Analog Output 8 (100 Hz)	Pass			
Analog Output 1 (1 kHz)	Pass			
Analog Output 2 (1 kHz)	Pass			
Analog Output 3 (1 kHz)	Pass			
Analog Output 4 (1 kHz)	Pass			
Analog Output 5 (1 kHz)	Pass			
Analog Output 6 (1 kHz)	Pass			
Analog Output 7 (1 kHz)	Pass			
Analog Output 8 (1 kHz)	Pass			
Analog Output 1 (19 kHz)	Pass			
Analog Output 2 (19 kHz)	Pass			
Analog Output 3 (19 kHz)	Pass			
Analog Output 4 (19 kHz)	Pass			
Analog Output 5 (19 kHz)	Pass			
Analog Output 6 (19 kHz)	Pass			
Analog Output 7 (19 kHz)	Pass			
Analog Output 8 (19 kHz)	Pass			

Test Record – Option DS only

WFM7100 Waveform Monitor Audio Option DS only Test Record

Instrument Serial Number: ____________ Certificate Number: ____________
Temperature: ____________ RH %: ____________
Date of Calibration: ____________ Technician: ____________

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Return Loss				
AES A 1–2 In	–25 dB			
AES A 3–4 In	–25 dB			
AES A 5–6 In	–25 dB			
AES A 7–8 In	–25 dB			
AES B 1–2 I/O	–25 dB			
AES B 3–4 I/O	–25 dB			
AES B 5–6 I/O	–25 dB			
AES B 7–8 I/O	–25 dB			
AES Audio Input Sample Rate				
AES A 1–2 In (96 kHz)	Pass			
AES A 3–4 In (96 kHz)	Pass			
AES A 5–6 In (96 kHz)	Pass			
AES A 7–8 In (96 kHz)	Pass			
AES B 1–2 I/O (96 kHz)	Pass			
AES B 3–4 I/O (96 kHz)	Pass			
AES B 5–6 I/O (96 kHz)	Pass			
AES B 7–8 I/O (96 kHz)	Pass			
AES A 1–2 In (35 kHz)	Pass			
AES A 3–4 In (35 kHz)	Pass			
AES A 5–6 In (35 kHz)	Pass			
AES A 7–8 In (35 kHz)	Pass			
AES B 1–2 I/O (35 kHz)	Pass			
AES B 3–4 I/O (35 kHz)	Pass			
AES B 5–6 I/O (35 kHz)	Pass			
AES B 7–8 I/O (35 kHz)	Pass			
AES Audio Output Amplitude				
AES B 1–2 I/O	0.9 v			1.1 v
AES B 3–4 I/O	0.9 v			1.1 v
AES B 5–6 I/O	0.9 v			1.1 v

WFM7100 Waveform Monitor Audio Option DS only Test Record (cont.)

Instrument Serial Number: ______________ Certificate Number: ______________

Temperature: ______________ RH %: ______________

Date of Calibration: ______________ Technician: ______________

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES B 7-8 I/O	0.9 v			1.1 v
AES Audio Output Jitter				
AES B 1-2 I/O	Pass			
AES B 3-4 I/O	Pass			
AES B 5-6 I/O	Pass			
AES B 7-8 I/O	Pass			
AES Audio Level Meter Accuracy Over Frequency				
AES A 1 In (100 Hz)	Pass			
AES A 2 In (100 Hz)	Pass			
AES A 3 In (100 Hz)	Pass			
AES A 4 In (100 Hz)	Pass			
AES A 5 In (100 Hz)	Pass			
AES A 6 In (100 Hz)	Pass			
AES A 7 In (100 Hz)	Pass			
AES A 8 In (100 Hz)	Pass			
AES A 1 In (1 kHz)	Pass			
AES A 2 In (1 kHz)	Pass			
AES A 3 In (1 kHz)	Pass			
AES A 4 In (1 kHz)	Pass			
AES A 5 In (1 kHz)	Pass			
AES A 6 In (1 kHz)	Pass			
AES A 7 In (1 kHz)	Pass			
AES A 8 In (1 kHz)	Pass			
AES A 1 In (19 kHz)	Pass			
AES A 2 In (19 kHz)	Pass			
AES A 3 In (19 kHz)	Pass			
AES A 4 In (19 kHz)	Pass			
AES A 5 In (19 kHz)	Pass			
AES A 6 In (19 kHz)	Pass			
AES A 7 In (19 kHz)	Pass			
AES A 8 In (19 kHz)	Pass			

WFM7100 Waveform Monitor Audio Option DS only Test Record (cont.)

Instrument Serial Number: ______________________ Certificate Number: ______________________

Temperature: ______________________ RH %: ______________________

Date of Calibration: ______________________ Technician: ______________________

Performance Test	Minimum	Incoming	Outgoing	Maximum
Headphone level accuracy over frequency				
Left (100 Hz)	−0.75 dBu			1.25 dBu
Right (100 Hz)	−0.75 dBu			1.25 dBu
Left (1 kHz)	−0.75 dBu			1.25 dBu
Right (1 kHz)	−0.75 dBu			1.25 dBu
Left (19 kHz)	−0.75 dBu			1.25 dBu
Right (19 kHz)	−0.75 dBu			1.25 dBu

Incoming Inspection

This section contains functional/operational checks appropriate to an incoming inspection.

The waveform monitor must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature as listed in Table 1−42 on page 1−34.

Use the following procedures to check the basic functionality of WFM6100, WFM7000, and WFM7100 Waveform Monitors. The checks are arranged by model and option so that you can choose the sections that are appropriate for your instrument. The last two sections are for less critical waveform monitor features: the ground closure and Ethernet ports. You need only test these if you intend to use them. In general, you should test in the order presented, since later tests might depend on items checked in the earlier tests.

Required Equipment

The following equipment is required to perform the incoming inspection procedure.

Table 2–1: Required Test Equipment

Test Equipment	Requirements	Example
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
75 Ω coaxial cables (3 required)	General purpose digital video Male-to-male BNC connectors 1 or 2 meters long	Belden 8281. Tektronix part numbers 012-0159-00 or 012-0159-01
75 Ω Terminator for Analog Video	Male connector, Precision	Tektronix part number 011-0102-03
Analog audio breakout cable (required for Audio Options AD, DD, DDE only)	DB62 to XLR I/O	Tektronix part number 012-1688-00
Dolby bit-stream generator	Generate Dolby Digital, Dolby E and PCM bit streams at 48 kHz. AES3ID-1995/SMPTE 276M output (75 Ω BNC)	Dolby Laboratories DM100 Bitstream Analyzer. (Options DD and DDE only.)

Table 2–1: Required Test Equipment (Cont.)

Test Equipment	Requirements	Example
SDI serial digital video test generator, with embedded audio and composite signal source	NTSC Black	Tektronix TG2000 with BG1 and additional modules indicated in the next three rows
	1080i 59.94 HD signals required for WFM7100 or WFM7000 with Option HD: 100% color bars 10-bit shallow ramp SDI Matrix Split Field Pathological Signal 100% sweep	HDVG1 module for TG2000 (Embedded audio needed for audio options AD, DS, DD, DDE)
	525/270 SD signals required for WFM6100, WFM7100 or WFM7000 with Option SD: 100% color bars 10-bit shallow ramp SDI Matrix Split Field Pathological Signal 100% sweep	DVG1 module for TG2000 (Embedded audio needed for audio options AD, DS, DD, DDE)
	Composite signals required for Option CPS: NTSC SMPTE bars	AVG1 module for TG2000
AES Audio Signal Generator	48 kHz, 24 bit word length signals	Rohde & Schwarz UPL06, Tektronix AM700 and AM70.
AES Audio Signal Analyzer		Rohde & Schwarz UPL06, Tektronix AM700.
Analog Audio Signal Generator		Rohde & Schwarz UPL06, Tektronix AM700 and AM70.
Waveform Monitor	Used to test SDI Pixmon output	Tektronix WFM7100 or WFM700
Video Test Signals	SDI 525 10-bit shallow ramp SDI 525 100% sweep NTSC black NTSC SMPTE bars	Provided by Tektronix TG2000 as specified above
LTC generator		Horita TRG–50 or Adrienne AEC–Box–28
Voltmeter		Fluke 87 or equivalent
15-pin Dsub male connector and cable	Used to mate with the ground closure port	See Figure 2–2 on page 2–53 for wiring diagram of cable
Computer and ethernet cable	Used to test Ethernet connection	Generic equipment

Incoming Inspection Tests

Basic Turn On and Self Test

1. Connect an XGA monitor to the **EXT DISPLAY** connector on the rear of the waveform monitor.
2. Connect the AC line cord to the rear of the instrument and to a 100 to 240 VAC source. There is no power switch on the waveform monitor, so the instrument will turn on as soon as you apply power.
3. Look at the front panel immediately after you apply power. The **PICTURE**, **PRESETS**, and **IN/OUT** buttons should be lit. The other front-panel buttons will light one at a time, in sequence. Verify that all buttons do light. The sequence will repeat until the Boot Loader process completes (approximately 30 seconds).
4. Record pass or fail in the test record for Front Panel LEDs.
5. After about 50 seconds, the Power on diagnostic page should appear on the XGA monitor.
6. Verify that all self tests pass. Any failures will be shown in red. The results of the power-on diagnostics are erased from the screen, but you can view the results by selecting **MAIN > Config > Diagnostics> Diagnostics Log**.
7. After the diagnostics are finished, the instrument state will be restored. When the progress indicator in the upper middle part of the screen is finished, the instrument has finished initializing.
8. Record Pass or Fail for the POST in the test record.
9. If it is still open, close the Diagnostics Log.

Reset to Factory Presets

1. Follow these steps to reset the waveform monitor to the Factory Presets:

   a. Press the **Presets** button.

   b. Press the **Settings** soft key.

   c. Press the **Recall Preset** soft key.

   d. Press the **Factory** soft key.

Front Panel Test

1. Set the waveform monitor to the Factory Presets (See above). Wait for the process to complete as indicated by the progress indicator. Record Pass or Fail in the test record.

2. Connect an SDI color bars signal to the SDI A input. Use a signal type appropriate to the unit under test:

   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 color bars from HDVG1
   - WFM6100, WFM7100, or WFM7000 with Option SD:
     525/270 color bars from DVG1

3. Set the waveform tile to full screen:

   a. Touch the waveform tile to select it.

   b. Press the **DISPLAY** button to make the waveform the full screen display.

4. Touch the **V Gain** touchable readout on the display, and then use the GENERAL knob to adjust the gain. Verify that the gain does change.

5. Press the **SELECT** button, and verify that the **H Mag** touchable readout is now selected.

6. Press all the other buttons, and check that the display and/or soft keys change for each one.

7. Press the **WFM** button.

8. Turn the **HORIZONTAL** and **VERTICAL** knobs and verify the waveform moves appropriately.

9. Record Pass or Fail for Buttons and Knobs in the test record.

LCD Pixel and Touch Screen Defects

1. Set the waveform monitor for an all white screen:

   a. Press the **MAIN** button.

   b. Touch the **Config** soft key, then the **Diagnostics** soft key.

   c. Touch the **Monitor & Display** soft key.

   d. Touch the **Display Panel Solid White** soft key.

2. Count any pixels stuck low (not white).

3. While the screen is all white, inspect for visible defects in the touch panel that exceed the limits in Table 2−2 (page 2−23).

***NOTE**. Inspection should be done from 18” away from the display, under normal room lighting. Loose dust on the front of the screen does not constitute a defect*

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4. Touch the screen to cancel the all white screen.

5. Set the waveform monitor for an all black screen:

   a. Touch the **Display Panel Solid Black** soft key.

6. Count any pixels stuck high (not black).

7. Touch the screen to cancel the all black screen.

8. Check that the total number of pixels counted in steps 2 and 6 is less than six.

Table 2–2: Touch Panel Visual Defects

Defect Type[1]	Allowable Defect		
Circular Defect [2]	>0.020″	None	
	0.015″ to 0.020″	Maximum of two allowed within a 2″ circle	
Black Defect (opaque)	>0.005″	None	
Linear Defect (Scratches)	>0.004″ width	None	
	0.003″ to 0.004″wide	Max length 0.500″	Min separation 0.250″
	0.0021″ to 0.0030″wide	Max length 1.000″	Min separation 0.150″
	0.0010″ to 0.0020″wide	Max length 1.500″	Min separation 0.050″
Stains, discolorations, streaks, scuffs	Allowed if they fade when backlit		

[1] **Defects should be visible from 18″ under normal lighting. If you have to hold it closer or use special lighting to see the defect, it is not a rejectable defect.**

[2] **For irregular defects, use (LengthxWidth)/2.**

9. Record pass or fail for Pixel and Touch Screen in the test record.

10. Touch the **Close Monitor & Display** soft key.

LCD Color Palette and Advanced Diagnostics Test

1. Continuing from the previous test, access Advanced Diagnostics:

   a. Touch the **Run Advanced** soft key.

   b. Touch the **Run** soft key.

LCD Color Palette.

2. Verify the LCD Color Palette by observing the white and red ramps at the top of the screen, and the green and blue ramps at the bottom of the screen:

- The topmost ramp is white. It should vary smoothly from black on the left side of the screen to white on the right side of the screen.
- The ramp just below the white ramp is red. It should vary smoothly from black on the left side of the screen to bright red on the right side of the screen.
- The bottom ramp is blue. It should vary smoothly from black on the left side of the screen to bright blue on the right side of the screen.
- The ramp just above the blue ramp is green. It should vary smoothly from black on the left side of the screen to bright green on the right side of the screen.

For each of these ramps it is normal to have some discrete steps in the brightness. The width of these steps should not exceed 0.1 inches. Some very fine lines may be visible in the ramps. This is normal.

3. Record Pass or Fail in the test record for the LCD Color Palette test.

Advanced Diagnostics.

4. Verify the following frequencies and pulse widths, shown in the diagnostics display, are within the limits listed in Table 2−3.

Table 2–3: Diagnostics Limits

Readout	Nominal	Min	Max
VGA Clock Frequency	64.4475 MHz	64.4375 MHz	64.4575 MHz
QDR Clock Frequency	25.1750 MHz	25.1650 MHz	25.1850 MHz
SD Eye Frequency	36.0204 MHz	35.9844 MHz	36.0564 MHz
HD Eye Frequency [3]	59.3700 MHz	59.3106 MHz	59.4924 MHz
Audio PLL 1 Frequency	12.2880 MHz	12.2780 MHz	12.2980 MHz
Audio PLL 2 Frequency	12.2880 MHz	12.2780 MHz	12.2980 MHz
Hsync PW	20.6 μs	20.4 μs	20.8 μs
Vsync PW	19074.9 μs	18974.9 μs	19174.9 μs
Lissajous Frequency	61.4400 MHz	61.3900 MHz	61.4900 MHz

[3] **For WFM6100 this will display 0.000 MHz.**

5. Verify that all the tests in the middle section of the screen have a green Pass status.

6. Press the **SELECT** button to reboot the unit in normal operation. It may take some time before the button press has any effect. You may cycle the power instead.

7. Record Pass or Fail for Advanced Diagnostics in the test record.

Touch Panel Registration Test

1. Set the waveform monitor to the Factory Presets (See Page 2−21).

2. Using a stylus, touch the screen at the intersection of the four tiles, and determine which tile is selected by the touch. A touch that is $\geq {}^{1}/_{8}''$ inside of a tile should select that tile.

3. Record pass or fail for Touch Panel Registration in the test record.

Fan Test

You should be able to hear the fans and feel air coming out the back of the instrument. At low temperatures the fans will turn slowly and be very quiet. Record Pass or Fail for Fan Test in the test record.

SDI Input – Check Output Validity and Bit Integrity

1. Connect an SDI 10-bit shallow-ramp signal to the SDI A input. Use a signal type appropriate to the unit under test:

   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 10-bit shallow ramp matrix from HDVG1

   - WFM6100, WFM7100, or WFM7000 with Option SD:
     525/270 10-bit shallow ramp matrix from DVG1

2. Set the waveform monitor to the Factory Presets (see Page 2−21).

3. Touch the **Overlay/Parade** soft key to select the Parade mode.

4. Turn off the Pb waveform:

   a. Touch the **Components** soft key.

   b. Touch the **Pb** soft key, so there is not a check mark in the box.

   c. Touch the **Close Components** soft key.

5. Press the **MAG/GAIN** button, and touch the **Fixed Gain x10.00** soft key.

6. Press the **DISPLAY** button to expand the waveform tile to full screen:

7. Set the SDI OUT for PixMon instead of Loopout:

   a. Press the **IN/OUT** button.

   b. Touch the **Settings** soft key.

   c. Touch the **Outputs** soft key.

   d. Touch the **SDI PixMon/SDI Loopout** soft key to select PixMon.

8. Connect the waveform monitor SDI OUT to a second, known good, waveform monitor SDI A input.
9. Repeat steps 2 through 5 for the second waveform monitor.
10. Perform steps 11 through 15, on both the DUT (to check the Serial Input), and the second waveform monitor (to check the DUT Serial Output)
11. Position the waveform on the DUT so that you can check the ramps.
12. Check a major division of both ramps in the signals. Check for 11 to 13 even vertical steps over a major division (10 mV). The steps should always step upward in a monotonic ramp. Check that there are no EDH errors (SD) or CRC errors (HD) on the second waveform monitor.
13. Return both waveform monitors to normal gain:
    a. Press the **MAG/GAIN** button.
    b. Touch the **Fixed Gain x1.00** soft key.
14. Change the input signal to a 100% sweep.
15. Verify the sine waves are uniform and do not have steps. Also verify the amplitude is 700 mV. Check that there are no EDH errors (SD) or CRC errors (HD) on the second waveform monitor.
16. If desired, move the input to input B, select input B from the front panel, and repeat steps 5 through 15.
17. Record Pass or Fail for SDI Bit Integrity in the test record.
18. Disconnect the second waveform monitor.

External Reference

1. Set the waveform monitor to the Factory Presets (See Page 2−21).
2. Connect an SDI 10-bit shallow-ramp signal to the SDI A input. Use a signal type appropriate to the unit under test:
   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 10-bit shallow ramp from HDVG1
   - WFM6100, WFM7100, or WFM7000 with Option SD:
     525/270 10-bit shallow ramp from DVG1
3. Apply an NTSC signal to the External Reference input from the Analog Signal Generator. Install a termination on the loopthrough.
4. Select Ext Ref:
    a. Press the **IN/OUT** button.

   b. touch the **Int Ref/Ext Ref** soft key to select Ext Ref.

5. The status bar in the upper left-hand corner of the display should display Ref: NTSC.
6. Set the upper right tile to a 1 Field waveform display:
   a. Touch within the upper right tile.
   b. Press the **WFM** button.
   c. Touch the **Sweep** soft key.
   d. Touch the **1 Field** soft key.
7. Verify that both WFM tiles are stable.
8. Record Pass or Fail for NTSC Lock in the test record.
9. Remove the NTSC signal from the reference input.
10. Both WFM tiles should "unlock" and scroll.
11. The status bar in the upper left-hand corner of the display should display Ref: Ext. Missing in red text.
12. Record Pass or Fail for Ref Missing in the test record.

Composite Input (Option CPS Only)

1. Set the waveform monitor to the factory presets (See Page 2−21).
2. Apply an NTSC SMPTE color bar signal from the TG2000 AVG1 module to the Composite A input (CMPST A). Install a termination on the loop through.
3. Select the CMPST A input:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
4. Observe the WFM display in tile 1, the signal should be aligned with the zero graticule.

***NOTE**. Recalling the factory presets does not set the vertical position to zero. You may need to adjust the **Vertical** control to set the vertical position to zero.*

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5. Record Pass or Fail for WFM with NTSC in the test record.
6. Observe the Vector in tile 2, the burst should be aligned with the burst marker that extends to the left of the vector center.

7. Record Pass or Fail for Vector with NTSC in the test record.
8. Observe the picture in tile 3. It should be stable and show the color bar signal.
9. Record Pass or Fail for Picture with NTSC in the test record.
10. If desired, move the input to input B and repeat steps 3 – 8.

Analog Audio Input (Option AD, DD, and DDE only)

1. Set the waveform monitor to the factory presets (See Page 2−21).
2. If the audio tile is not present, select a tile and push the **AUDIO** button.
3. Set the analog audio generator to output a 1 kHz, 18 dBu sine wave.
4. Set the waveform monitor for the audio Analog A input:
   a. Touch within the audio tile.
   b. Press the **Audio Input** soft key.
   c. Press the **Analog A** soft key.
5. Using the audio breakout cable or equivalent, connect the first Line A input pair to the analog audio generator and verify that the output level of the generator is indicated on the audio bars with an 18 dBu signal.
6. Repeat step 5 for the second and third line A input pair.
7. Record Pass or Fail for Analog Audio input A ports in the test record.
8. Repeat Step 4 and select the Analog B Audio Input.
9. Repeat step 5 for all three Line B input pairs.
10. Record Pass or Fail for Analog Audio input B ports in the test record.

Analog Audio Output (Option AD, DD, & DDE only)

1. Set the waveform monitor to the factory presets (See Page 2−21).
2. If the audio tile is not present, select a tile and press the **AUDIO** button.
3. Set the waveform monitor for the audio Analog A input:
   a. Touch within the Audio frame.
   b. Press the **Audio Input** soft key.
   c. Press the **Analog A** soft key.
4. Using the audio breakout cable or equivalent, connect the first Line A input pair to the analog audio generator and verify that the output level of the generator is indicated on the audio bars with an 18 dBu signal.

5. Set the Audio Attenuation to 0 dB:

   a. Touch the **Audio Settings** soft key.

   b. Touch the **Attenuate Aud Out** soft key.

   c. Use the **GENERAL** knob to set the attenuation to 0 dB.

6. While still in the Audio Settings submenu, set the Analog Output Bar Map so that Bars 1,2 are the source for all of the Analog Outputs:

   a. Touch the **Audio Inputs and Outputs** soft key.

   b. In the Select Audio I/O Type to configure area, make sure that the **Analog A** soft key is selected.

   c. Touch the **Audio Output Mapping** soft key.

   d. Touch the **Map Analog Outputs** soft key if it isn't already selected.

   e. Touch the **Bars 1,2** soft key in the Audio Source section.

   f. Touch the **Analog 1,2**; **Analog 3,4**; **Analog 5,6**; and **Analog 7,8** soft keys on the Analog Outputs row. Each of these soft keys should say [Bars 1,2] on the Audio Source row when this is done.

   g. Touch the **Exit Audio Output** soft key, and then the **Exit Audio InOut** soft key.

   h. Press the **DISPLAY** button to make the Audio tile the full screen display.

7. Connect the first analog output pair on the breakout cable to the second line A input pair.

8. Verify on the level meter bars that the second set of bars is within 1 dB of the first set of bars.

9. Connect the second analog output pair on the breakout cable to the second line A input pair.

10. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.

11. Connect the third analog output pair on the breakout cable to the second line A input pair.

12. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.

13. Connect the fourth analog output pair on the breakout cable to the second line A input pair.

14. Verify, on the level-meter bars, that the second set of bars is within 1 dB of the first set of bars.
15. Record Pass or Fail in the test record.

Digital Audio Input (Options DG, DS, AD, DD, & DDE only)

1. Set the waveform monitor to the factory presets (see Page 2−21).
2. If the audio tile is not present, select a tile and push the **AUDIO** button.
3. Set the digital audio generator to output a 1 kHz, −6 dBFS sine wave.
4. Set the input source to AES A:
   a. Touch the **Audio Input** soft key.
   b. Touch the **AES A** soft key.
5. Connect the unbalanced output of the digital audio generator to the AES A 1-2 input.
6. Verify that the first set of level meter bars indicates –6 dBFS.
7. Repeat steps 5 and 6 for AES A 3-4, AES A 5-6, and AES A 7-8.
8. Record Pass or Fail for AES A in the test record.
9. Set the Audio Input to AES B:
   a. Touch the **Audio Input** soft key.
   b. Touch the **AES B** soft key.
10. Configure AES B as an input:
    a. Touch the **Audio Settings** soft key.
    b. Touch the **Audio Inputs and Outputs** soft key.
    c. Touch the **AES B** soft key, and make sure that it is set as an Input.
    d. Touch the **Exit Audio InOut** soft key, and then the **Close Audio Settings** soft key.
11. Connect the output of the digital audio generator to the AES B 1-2 input.
12. Verify that the first set of level meter bars indicates −6 dBFS.
13. Record Pass or Fail for AES B in the test record.
14. Repeat steps 11 and 12 for AES B 3-4, AES B 5-6, and AES B 7-8.

15. Set the SDI generator for a signal type appropriate to the unit under test:

    - WFM7100 or WFM7000 with Option HD:
      1080i 59.94 color bars from HDVG1
    - WFM6100, WFM7100, or WFM7000 with Option SD:
      525/270 color bars from DVG1

16. Set the SDI generator for embedded audio in 2 groups starting with group 1, and then access and set its audio channels:

    a. On the generator, press Modules, and then select the appropriate module icon, HDVG1 or DVG1.

    b. Press Test Signals, and select Module Parameters.

    c. Select Audio, and set the audio channels as follows:

       i. Channel 1: 50 Hz, −35 dB

       ii. Channel 2: 100 Hz, −30 dB

       iii. Channel 3: 150 Hz, −25 dB

       iv. Channel 4: 200 Hz, −20 dB

       v. Channel 5: 250 Hz, −15 dB

       vi. Channel 6: 300 Hz, −10 dB

       vii. Channel 7: 400 Hz, −5 dB

       viii. Channel 8: 500 Hz, 0 dB

17. Connect the output of the SDI signal generator with embedded audio to the SDI A input.

18. Touch the **Audio Input** soft key, then touch the **Embedded** soft key.

19. Verify that the level meter bars have a stair step pattern from –35 dB on channel 1 to 0 dB on channel 8.

***NOTE**. If level-meter bars indicate that audio is not present, set the TG2000 module number of groups to 2 even if it appears to be set already.*

20. Record Pass or Fail for Embedded to Display in the test record.

21. Bring up the phase display and set the phase pair to 1 & 2:

    a. Touch the **Aux Display** soft key.

    b. Touch the **Phase** soft key.

c. Touch the **Phase Pair** soft key.

d. Touch the **Bars 1,2** soft key.

22. Go through the other phase pairs (3 & 4, 5 & 6, 7 & 8) and verify that the phase display changes in each one.

23. Record Pass or Fail for Embedded to Lissajous in the test record.

Digital Audio Output (Options DG, DS, AD, DD, & DDE only)

1. Set the waveform monitor to the factory presets (See Page 2−21).

2. If the audio tile is not present, select a tile and push the **AUDIO** button.

3. If you have just finished testing the Digital Audio Inputs, proceed to step 4, otherwise do steps 15-19 of the Digital Audio Input test.

4. Set the AES B connector to be an input:

   a. Touch the **Audio Settings** soft key, then the **Audio Inputs and Outputs** soft key.

   b. Touch the **AES B** soft key, then touch the **AES−B Input/AES−B Output** soft key to configure the port as an Output.

   c. Touch the **Exit Audio InOut** soft key, then the **Close Audio Settings** soft key.

5. Connect the AES B 1-2 output to the Audio Signal Analyzer input.

6. Verify on the analyzer that the signal levels are at –35 dB for the left channel and –30 dB for the right.

7. Connect the AES B 3-4 output to the Audio Signal Analyzer input.

8. Verify on the analyzer that the signal levels are at –25 dB for the left channel and –20 dB for the right.

9. Connect the AES B 5-6 output to the Audio Signal Analyzer input.

10. Verify on the analyzer that the signal levels are at –15 dB for the left channel and –10 dB for the right.

11. Connect the AES B 7-8 output to the Audio Signal Analyzer input.

12. Verify on the analyzer that the signal levels are at –5 dB for the left channel and 0 dB for the right.

13. Record Pass or Fail for each output in the test record.

Dolby Decode (Options DD & DDE only)

1. Set the waveform monitor to the factory presets (See Page 2−21).

2. If the audio tile is not present, select a tile and push the **AUDIO** button.

3. Set the Audio Input to AES A:

a. Touch the **Audio Input** soft key.

b. Touch the **AES A** soft key.

4. Set the Dolby generator for a Dolby D output using the following steps:

a. Press Gen to display the Gen Stream Sel message.

b. Press Up/Down buttons to select a Dolby D stream as indicated by the leading “D” in the bit stream name.

c. Press Enter to activate the selected signal.

5. Use a 75 Ω cable to connect the Digital Output of the Dolby generator to the AES A1-2 In BNC.

6. Check for the “DOLBY D” message in bars 1 and 2 of the Audio display.

7. Set the Audio Input to Dolby 1:

a. Touch the **Audio Input** soft key.

b. Touch the **Dolby 1** soft key. (Factory preset configured Dolby 1 to decode Dolby from the AES A1−2 input.)

8. Check that the audio display shows the decoded Dolby signal.

9. Check that the Dolby program type shown in the top line of the audio display, for example “D 3/2 L”, agrees with the Dolby generator setting.

10. Change the Dolby generator to a Dolby E output:

a. Press Up/Down buttons to select a Dolby E stream as indicated by the leading “E” in the bit stream name.

b. Press Enter to activate the selected signal.

11. If option DDE is present, check that the audio display shows the decoded Dolby signal and that the Dolby program type shown in the top line of the audio display, for example “E 2+2”, agrees with the Dolby generator setting.

12. If option DDE is not present, check for the “DOLBY E” message in bars 1 and 2 of the Audio display.

13. Record Pass or Fail for Dolby Decode in the test record.

LTC Decode and Waveform Test

1. Set the waveform monitor to the factory presets (See Page 2–21).
2. You will need a custom cable for this step (see Figure 2–2 on page 2–53).
   a. Solder wires to each of the pins of a male db9 connector, and strip the insulation back approximately 1/4 inch on each of the wires.
   b. Make a shielded coaxial cable with a male RCA connector on one end. On the other end, connect the center coaxial conductor to pin 2 of the male db9 connector and the outer (shield) conductor to pin 1 of the male db9 connector.

***NOTE**. This is the same cable used to check Ground Closure functionality (see Page 2–34).*

3. Connect the RCA connector on the custom cable to the output of the Timecode generator. Connect the custom cable 9-pin connector to the REMOTE connector on the waveform monitor rear panel.
4. Set the waveform monitor timecode source to LTC:
   a. Press the **IN/OUT** button.
   b. WFM6100 Opt CPS only:
      - Touch the **Analog Input A** soft key, and then the **Settings** soft key.
      - Touch the **Analog Submenu** soft key, and then skip to step e.
   c. Touch the **Settings** soft key.
   d. Touch the **Digital SubMenu** soft key.
   e. Touch the **Timecode** soft key, then the **LTC** soft key.
   f. Touch the **Close Digital** soft key, then the **Close Settings** soft key.
5. Verify that the Decoded LTC is displayed in the upper right corner of the display, and is changing as expected. (It may be necessary to reset the LTC generator using the mode switch.)
6. Record Pass or Fail for LTC Decode in the test record.

Ground Closure Remote

1. Connect an SDI color bars signal to the SDI A input. Use a signal type appropriate to the unit under test:
   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 color bars from HDVG1

- WFM6100, WFM7100, or WFM7000 with Option SD:
  525/270 color bars from DVG1

2. You will need a custom cable for this step (see Figure 2−2 on page 2−53).

NOTE. *This is the same cable used to check LTC functionality on Page 2−34.*

   a. Solder wires to pins 1, 2, 5, 6, 7, 8, and 9 of a male db9 connector, and strip the insulation back approximately 1/4 inch on each of the wires.

   b. Make a shielded coaxial cable with a male RCA connector on one end. On the other end, connect the center coax conductor to pin 2 of the male db9 connector and the outer (shield) conductor to pin 1 of the male db9 connector.

3. Connect the DSUB connector to the REMOTE connector on the waveform monitor.

Test Preset Recall.

4. Set the waveform monitor to the factory presets (see page 2−21).

5. Set the waveform monitor to display a picture in tile 1 and a waveform in the the remaining tiles:

   a. Touch within tile 1.

   b. Press the **PICTURE** button.

   c. Touch within tile 2 and press the **WFM** button.

   d. Touch within tile 3 and press the **WFM** button.

   e. Touch within tile 4 and press the **WFM** button.

6. Save the current settings as a preset:

   a. Press the **PRESETS** button.

   b. Touch the **Settings** soft key.

   c. Touch the **Save Preset** soft key.

   d. Save the preset as Preset A1, or as indicated in steps 7 to 9.

   e. Touch the **No** soft key in the Question dialog box.

7. Repeat steps 5 and 6 to create a preset with picture in tile 2 and waveform in tiles 1, 3, and 4. Save as Preset A2

8. Repeat steps 5 and 6 to create a preset with picture in tile 3 and waveform in tiles 1, 2, and 4.Save as Preset A3

9. Repeat steps 5 and 6 to create a preset with picture in tile 4 and waveform in tiles 1, 2, and 3. Save as Preset A4

10. Set the waveform monitor to the factory presets (See Page 2–21).

11. Short pins 1 and 6 together on the remote cable.

12. Preset A1 should be restored so that a picture is displayed in tile 1. It may take several seconds for the display to change.

13. Short pins 1 and 7 together on the remote cable.

14. Preset A2 should be restored so that a picture is displayed in tile 2. It may take several seconds for the display to change.

15. Short pins 1 and 8 together on the remote cable.

16. Preset A3 should be restored so that a picture is displayed in tile3. It may take several seconds for the display to change.

17. Short pins 1 and 9 together on the remote cable.

18. Preset A4 should be restored so that a picture is displayed in tile 4. It may take several seconds for the display to change.

19. Record Pass or Fail for Activate Preset in the test record.

Test Ground Closure Out

20. Connect a voltmeter or oscilloscope to monitor pin 5 of the DSUB connector.

21. Verify the voltage is greater than 4.5 V. This indicates the output is not asserted.

22. Set the SDI Input alarm:

    a. Press the **MAIN** button.

    b. Touch the **Config** soft key, then the **Alarm Setup** soft key.

    c. Touch the **SDI Input** soft key.

    d. Touch the box in the GC (Ground Closure) column of the SDI Input Missing row. A check mark should appear in the box. This instructs the waveform monitor to assert the ground closure if the SDI input is not present.

    e. Touch the **Save and Close** soft key.

23. The voltmeter should read >4.5 V on pin 5.
24. Remove the input signal from SDI A connector on the rear panel to assert ground closure.
25. The voltmeter should now read a low voltage, below 0.5 V.
26. Record Pass or Fail for Ground Closure in the test record.

Ethernet Test

1. Connect an Ethernet cable from the rear of the unit to a computer with a Web browser.
2. Set the waveform monitor to the factory presets (See Page 2−21).
3. Verify the IP address assigned to the waveform monitor:
   a. Press the **MAIN** button.
   b. Touch the **Config** soft key, then the **Utilities** soft key.
   c. Touch the **Communications** soft key.
   d. Verify that the Config Mode is set to Manual.
   e. Touch the **Network Setup** soft key.
   f. Ensure that the IP address is compatible with your computer network. It may be necessary to change the IP address.
   g. Once the IP address is correct, touch the OK soft key, and then the Close Communications soft key.
4. Open a Web browser on the computer.
5. From the computer, enter the IP address of the waveform monitor into the Web browser address line (for example, http://192.182.256.23).
6. You should see a Web page titled "Tektronix WFM6100/WFM7100 Remote Interface" or something similar. This means that the Ethernet function is working.
7. Record Pass or Fail for Ethernet Functionality in the test record.

Video and General Performance Verification Procedures

This performance verification includes procedures that verify standard and option-equipped instruments.

Required Equipment

Table 2–4: Required Test Equipment (Video and General Performance)

Test Equipment	Requirements	Example
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
SDI serial digital video test generator with embedded audio and composite signal source	NTSC Black	Tektronix TG2000 with BG1 and additional modules indicated below:
	1080i 59.94 HD signals required for WFM7100: ■ 75% and 100% color bars ■ SDI Matrix Split Field Pathological Signal ■ SDI Equalizer ■ VM5000 Matrix	HDVG1 module for TG2000 (Embedded audio needed for audio options DA, DG, AD, DS, DD, DDE)
	HD signal with adjustable SDI amplitude required for WFM7100	HDST1 module for TG2000
	1080i 59.94 analog tri-level sync required for WFM7100	AWVG1 module for TG2000
	525/270 SD signals required for WFM7100 Option SD and WFM6100: ■ 75% and 100% color bars ■ SDI Matrix Pathological Signal ■ SDI Equalizer ■ Adjustable SDI amplitude ■ VM5000 Matrix	DVG1 with option S1 module for TG2000 (Embedded audio needed for audio options DA, DG, AD, DS, DD, DDE)
	Composite signals required for Option CPS: ■ NTSC 0% flat field ■ NTSC 100% color bars	AVG1 module for TG2000
	Precision calibration signals for Option CPS and for Eye Gain test [1]	Tektronix part number 067-0465-00 (AVC1) module for TG2000 [2]

Table 2–4: Required Test Equipment (Video and General Performance) (Cont.)

Test Equipment	Requirements	Example
HD Cable-clone cable simulator	Simulate 10 to 150 meters of 8281 equivalent in 10 m steps	Faraday FFC Kit
SD Cable-clone cable simulator (Required for the WFM6100. Required for WFM7100 Option SD only)	Simulate 0 to 400 meters of 8281 equivalent in 25 meters steps.	Faraday SC75A800B-G
75 Ω coaxial cables (3 required)	General purpose digital video Male-to-male BNC connectors 1 or 2 meters long	Belden 8281 Tektronix part numbers 012-0159-00 or 012-0159-01
75 Ω Terminator for Analog Video	Male connector, precision	Tektronix part number 011-0102-03
75 Ω term for SDI signal. (2)	Male, wideband	Tektronix part number 011-0163-00
75 Ω Network Analyzer or Spectrum Analyzer with Tracking Generator and Return Loss Bridge	Measure return loss. 60 dB range to 10 MHz, 40 dB range to 300 MHz. 75 Ω test port; 50 Ω input and output test ports	Agilent 8712 75 Ω Tektronix 2712 Wide Band Engineering A57TUC with male 75 Ω BNC test port
Video Measurement Set	Measure 1080i/60 RGB Multiburst PIXMON output	Tektronix VM5000
Sync pickoff adapter		Tektronix part number 012-1680-00
Test oscilloscope	>2 GHz bandwidth with 75 Ω input	Tektronix TDS7404B with TCA75 adapter
75 Ω calibration kit		Maury 8580A 75 Ω BNC
VITC Generator (Required for Options CPS and SD only)		Horita VG-50 or Adrienne AEC-Box-28
LTC generator		Horita TG-50 or Adrienne AEC-Box-28
NTSC to SDI Converter (Required for Option SD only)		Grass Valley 8960DEC or AJA model D5D
RCA to 15 pin header custom cable	Shown in Figure 2-2. 15-pin male Dsub connector, Tektronix part number 131-1164-00, RCA plug Allied 932-1098, and wire	

Table 2–4: Required Test Equipment (Video and General Performance) (Cont.)

Test Equipment	Requirements	Example
Square Wave generator	10 kHz, 5 V output, 50 ohm output impedance	Tegam/Tektronix FG5010
VGA to 5x BNC adapter cable	15 pin VGA connector input, 5 BNC connector outputs	Tektronix part number 174-5126-00
1 to 2 VDC voltage source (Required for Option CPS only)	1.5 V battery or power supply	
BNC to retractable hook tip (Required for Option CPS only)		Tektronix part number 013-0076-01
BNC barrel connector		

1 The required custom signals are provided on the User Documents CD. These signals are also provided for an AVG1 module, if an 067-0465-00 (AVC1) is not available. Download the PVCustomSignals.zip file, unzip it, and install the signals on your TG2000.

2 Note that the 067-0465-00 (AVC1) is not available outside of Tektronix. Other equipment can be substituted but it might not have sufficient accuracy to guarantee the specifications. For hum insertion, a general-purpose sine wave generator can be used to terminate and drive back into the video signal through appropriate impedance matching.

Basic Setup

Use the following setup for all tests unless otherwise specified.

1. Connect the power cord to the rear of the waveform monitor.
2. Connect an XGA monitor to rear of instrument.
3. Connect the power cord to the AC mains and allow at least 20 minutes for the waveform monitor to warm up before beginning any procedures.

Instrument Tests

The following procedures apply to all base instruments except where labeled for specific models. Do all tests except those that exclude your model.

HD SDI Input Level Low and High (WFM7000, WFM7100 only)

This test uses the serial output with adjustable level to verify that the waveform monitor can accept serial signals of various amplitudes.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect a 75 Ω cable from a TG2000 HDVG1 output (Output 2) to the HDST1 video input.
3. Connect a 75 Ω cable from the HDST1 STRESS output to the SDI A input on the waveform monitor.
4. On the TG2000 HDVG1, set the output to the SDI Matrix signal.

5. You should see a stable picture and waveform on the waveform monitor display. The status screen should display OK for Y Chan CRC, C Chan CRC, Y Anc Checksum, and C Anc Checksum errors.

6. Set the Status tile to full screen:

   a. Touch within the Status tile to select it.

   b. Press the **DISPLAY** button to make the Status tile the full screen display.

7. On the TG2000 HDST1, adjust the serial amplitude downward to find the lowest level that does not generate any CRC errors in a 10 second period.

8. Record the HDST1 Amplitude Level in the test record.

9. Increase the HDST1 Amplitude Level to 130 %.

10. If any EDH errors are generated, reduce the amplitude until no errors are generated for a 10 second period.

11. Record the HDST1 Amplitude Level in the test record.

12. Move the input cable from the SDI A input to the SDI B input.

13. Repeat steps 7 through 11 for the SDI B input.

14. Record this level in the test record.

EDH and HD SDI Input Equalization Range (WFM7000, WFM7100 only)

This test uses a cable clone to simulate cable. This verifies that the waveform monitor can receive signals that have passed through long cables.

EDH

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the TG2000 HDVG1 output to the TG2000 HDST1 input.

3. Connect the TG2000 HDST1 output to the waveform monitor SDI A input.

4. Set the waveform monitor to display a Video Session status screen:

   a. Touch within tile 4 to activate that tile.

   b. Press **STATUS** to display the status screen in tile 4.

   c. Touch the **Video Session** soft key, and then touch the **Hide Menu** soft key to remove the menu soft keys.

5. Select the 1080i59.94 “SDI Equalizer Test” signal from the TG2000 HDVG1.

6. Set the TG2000 HDST1 SDI parameters for a 1.0 error rate.

7. Check that the Y Chan and C Chan CRC Error readouts, Err Seconds column, shown in the Video Session display, are incrementing at a rate of one per second.

8. Record Pass or Fail in the test record.

Cable Length Accommodation

9. Connect a cable from an output of the TG2000 HDVG1 to the 80 m section of the HD Cable clone.

10. Use a second cable to connect the other port of the cable clone section to the SDI A connector on the waveform monitor.

11. On the TG2000 HDVG1, set the output to the SDI Matrix signal.

12. You should see a stable picture and waveform on the waveform monitor display. All the CRC parameters on the Status screen should read Valid.

13. Connect additional sections of the HD Cable Clone into the signal path to find the longest length of "cable" that does not generate any CRC errors in a 10-second period.

14. Add the HD Cable Clone section lengths to get the total length in meters of Belden 8281 cable. Divide by 4 to calculate the attenuation in dB at 750 MHz.

15. Record the value in the test record.

16. Repeat the test using SDI B input on the waveform monitor.

17. Record this level in the test record.

HD SDI Loop-through Isolation (WFM7000, WFM7100 only)

This test looks for crosstalk between the two SDI inputs. One input is driven by a signal straight from the generator; the second input is driven through the cable clone, which simulates a long cable. The two sources are set to different rates to allow transitions of the serial signal to hit all possible phases. If the isolation is sufficient, the crosstalk will not introduce errors.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Touch within tile 4, then press the **STATUS** button.

3. Touch the **Video Session** soft key.

4. Connect a cable to any output on the TG2000 HDVG1.

5. Connect the other end of the cable to the 80 m section of the HD Cable clone.

6. Connect a second cable to the other port of the cable clone section.
7. Connect a cable from the cable clone to the SDI A input connector.
8. Connect an output from the DVG1 to the SDI B input connector.
9. Set the signal driving the SDI B input to 100% color bars.
10. Set the time base on the second signal to 1 ppm high.
11. Verify that there are no CRC errors on the SDI A input.
12. Record a Pass or Fail as appropriate in the test record.
13. Disconnect the test setup.

HD Pixmon Multiburst Frequency Response (WFM7000, WFM7100 only)

This test uses a VM5000 to test the frequency response at the Pixmon output.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the TG2000 HDVG1 output to the waveform monitor SDI A input.
3. Select the VM5000 Matrix (1080i 59.94) test signal from the HDVG1. This signal is provided on the User Documents CD.
4. Set the waveform monitor to Digital Input A:
   a. Press the **IN/OUT** button.
   b. Touch the **Digital Input A** soft key.
5. Set the HD Alg PixMon to RGB:
   a. Touch the **Settings** soft key.
   b. Touch the **Outputs** soft key.
   c. Touch the **HD Alg PixMon** soft key.
   d. Touch the **RGB** soft key.
6. Connect the waveform monitor PIXMON output to the VM5000, as described in the VM5000 manual or online help.
7. Start the VM5000 HD and SD application, and set the number of Averages to 4.
8. On the Format tab, select 1080i/60, RGB.
9. On the Measurement tab, select Multiburst and clear any other measurement selections.
10. Run the measurement.

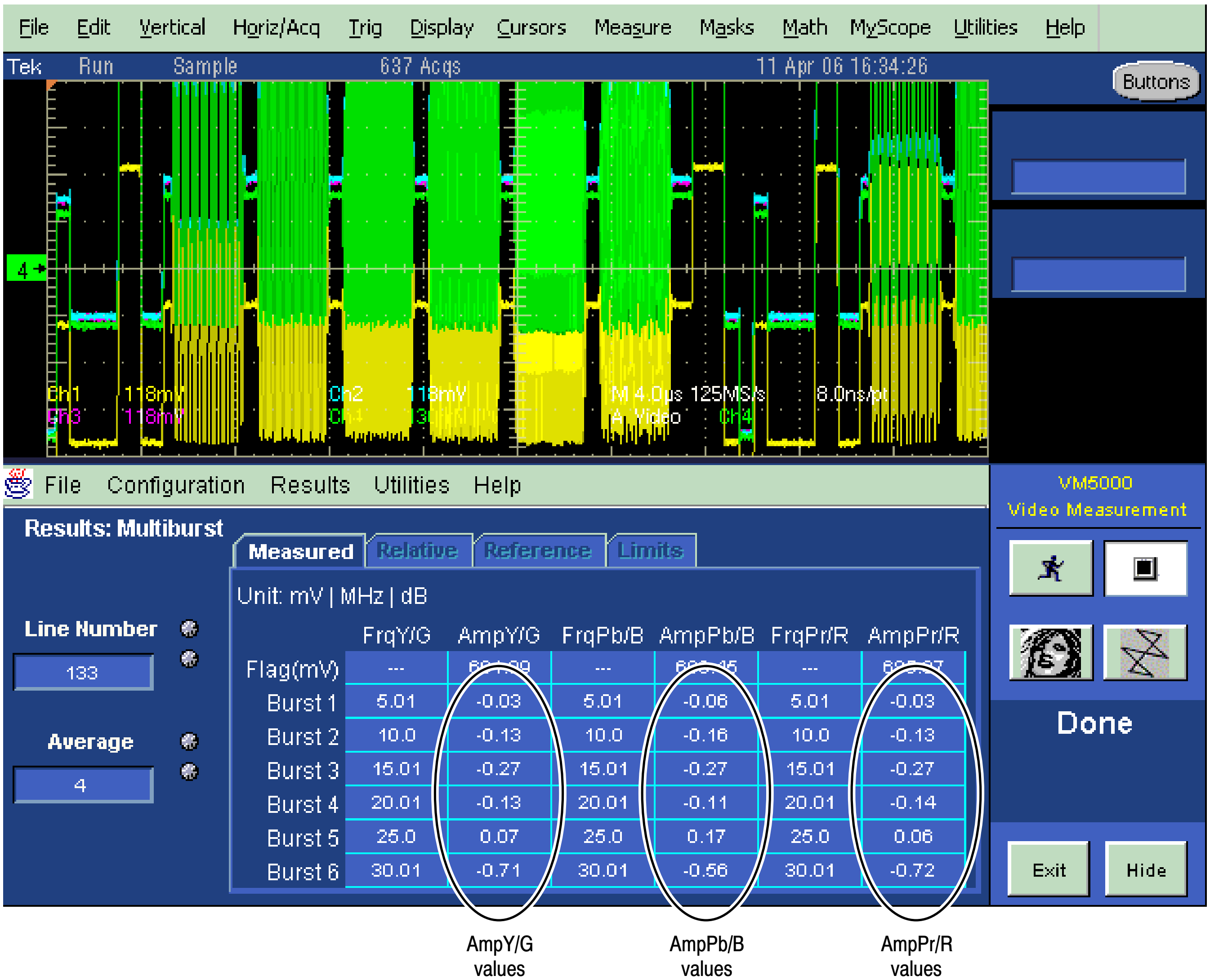

Figure 2–1: VM5000 HD Frequency Response display

11. Check that the Burst dB values in the AmpY/G, AmpPb/B, and AmpPr/R columns are between −0.92 dB (−10%) and +0.82 dB (+10%).

12. Record Pass or Fail in the test record.

HD SDI Return Loss, A and B Inputs (WFM7000, WFM7100 only)

This test uses a network analyzer to check the reflections from the input. You can also use the Spectrum Analyzer, tracking generator, and return loss bridge to make this measurement.

1. Turn on the network analyzer and set it for return loss (the S11 measurement).
2. Set the frequency range for approximately 300 kHz to 2 GHz.
3. Use the calibration kit and calibrate the network analyzer with one of the BNC cables attached.
4. Connect the calibrated end of the cable to the SDI A input of the waveform monitor.
5. Measure the return loss from 300 kHz to 1.5 GHz. Record the lowest return loss value (the biggest reflection) over the frequency range in the test record.
6. Repeat steps 4 and 5 for the SDI B input.

HD Cable Meter (WFM7100 Option Eye/Phy only)

This test uses a short (1−2 m) length of Belden 8281 cable and a long (100 m) length of Belden 8281 cable to check the Cable Meter. A cable clone may be used instead of the long cable.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Select the SDI Status display:
   a. Press the **MAIN** button.
   b. Touch the **SDI Status** soft key.
3. Using the short cable, connect a color bar signal from the HDVG1 to the SDI A input on the waveform monitor.
4. Check that the cable length reading is between 0 m and 17 m.
5. Record the results in the test record.
6. Using the long cable, or the cable clone set to 100 m, connect a color bar signal from the HDVG1 to the SDI A input on the waveform monitor.
7. Check that the cable length reading is between 76 m and 127 m.
8. Record the results in the test record.
9. Repeat steps 3 through 8 for the SDI B input.

HD Jitter Noise Floor (WFM7100 Option Eye/Phy only)

This test checks the jitter noise floor of the waveform monitor. Since some jitter may be introduced by the signal source, you may need to characterize the TG2000 output jitter with an oscilloscope. Most HDVG1 generators have an output noise floor in the 80 ps range.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the TG2000 HDVG1 output to the HDST1 input, and connect the HDST1 STRESS output to the SDI A input on the waveform monitor.
3. Reset the HDST1 to default on all SDI parameters.
4. Select the 1080i 59.95 75% color bar signal from the HDVG1.
5. Press the **IN/OUT** button and touch the **Digital Input A** soft key.
6. Set the WFM tile to full screen:
   a. Touch within the WFM tile to select it.
   b. Press the **DISPLAY** button to make the WFM tile the full screen display.
7. Set the waveform monitor to the jitter display:
   a. Press the **MAIN** button.
   b. Touch the **Jitter** soft key, in the Eye/Phy column.
8. Set the jitter high pass filter to 100 Hz:
   a. Touch the **Jitter HPF** soft key.
   b. Touch the **100 Hz** soft key.
9. Set the vertical gain to x10:
   a. Press the **MAG/GAIN** button.
   b. Touch the **Fixed Gain x10** soft key.
10. Using the graticule or the cursors, measure the jitter amplitude.
11. Check that the jitter amplitude is approximately 80 ps (0.119 UI), depending on the TG2000 output jitter.
12. Touch within the Jitter display to restore the Jitter soft keys.

10 second 10 Hz jitter bounce

13. Set the jitter high pass filter to 10 Hz:
    a. Touch the **Jitter HPF** soft key.

   b. Touch the **10 Hz** soft key.

14. Watch the display for at least 10 seconds. The trace may jump occasionally.
15. Check that any trace jump is ≤ 200 ps (0.297 UI).

HD Jitter Readout Accuracy (WFM7100 Option Eye/Phy only)

1. Press the **DISPLAY** button to return to the 4-tile display.
2. Set the upper left tile to the Eye display:
   a. Touch within the upper left tile to select it.
   b. Press the **MAIN** button.
   c. Touch the **Eye** soft key, in the Eye/Phy column.
3. Set the upper right tile to be the Jitter display:
   a. Touch within the upper right tile to select it.
   b. Press the **MAIN** button.
   c. Touch the **Jitter** soft key, in the Eye/Phy column.
4. Touch the **H Mag** touchable readout in the Jitter display, and use the **GENERAL** knob to set the H magnification to x50.
5. Touch the **Jitter HPF** soft key, and then the **100 Hz** soft key.
6. Set the Jitter display to show 2 Fields:
   a. Touch the **Sweep [1 Line]** soft key.
   b. Touch the **2 Fields** soft key.
7. Adjust the HDST1 module as follows:
   a. Set the jitter (LF) frequency to 9950 Hz.
   b. Slowly increase the jitter (LF) amplitude while watching the Eye display.

      As the jitter amplitude increases, the transitions start to get wider and fill in the space between the transitions. As the jitter amplitude approaches one UI, the space between transitions disappears (the eye display will begin to close).

      At one UI of jitter, the eye diagram will have ‘closed’, and a darkening, or shadow, on an eye trace will appear out of the smeared background. Continue increasing the jitter until another shadow of an eye appears. You now have 2 UIs of jitter.

Continue increasing jitter to 3 UIs. Don’t adjust for 3 UIs on the generator; adjust instead for the sharpest narrow eye shadow on the Trebuchet display which indicates that the applied jitter is precisely 3UI. This may not be 3 UI on the generator, since the HDST1 module may be as accurate.

8. The jitter display should show a stationary sine-wave 3 UI in height. Check the sine portion of the jitter trace, ignoring the small random noise component, with the graticule marks and the cursors to see that it is 3 UI ±10% (between 2.7 UI and 3.3 UI).
9. Record Pass or Fail for the Jitter Trace functional test on the test record.
10. Check that the jitter readout shows the jitter to be between 2.65 UI and 3.35 UI.
11. Record Pass or Fail for the Jitter Readout functional test on the test record.

Jitter Vibration (Option Eye/Phy only)

This test shows if there is undue sensitivity to vibration.

1. Set the instrument on a flat surface, with the top cover in place.
2. Connect an SD or HD signal, as appropriate, to the SDI A input.
3. Select a jitter display.
4. Drop a BNC barrel connector onto the middle of the top cover, from a height of 2 in. (5 cm) while watching the jitter display.
5. Check that the jitter display does not jump more than 0.4 UI.

External Reference Return Loss

This test uses a network analyzer to check the reflections from the input. You can also use the spectrum analyzer, tracking generator, and return loss bridge to make this measurement.

1. Turn on the network analyzer and set it for return loss, the S11 measurement.
2. Set the frequency range for approximately 300 kHz to 35 MHz.
3. Use the calibration kit and calibrate the network analyzer with one of the BNC cables attached.
4. Connect the calibrated end of the cable to one of the Reference inputs on the waveform monitor.
5. Terminate the other Reference connector with the precision termination.
6. Measure the return loss from 300 kHz to 6 MHz. Record the lowest return loss value (the biggest reflection) over the frequency range in the test record.

7. Replace the precision termination with the wideband termination.

8. Measure the return loss from 300 kHz to 30 MHz. Record the lowest return loss value (the biggest reflection) over the frequency range in the test record.

External Reference Formats Supported: Bi-Level

Check that DUT can reference to NTSC and PAL while viewing digital signals.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Press the **IN/OUT** button and touch the **Int Ref/Ext Ref** soft key to select the external reference mode.

3. Connect an SDI color-bars signal to the SDI A input. Use a signal type appropriate to the unit under test:

   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 color bars from HDVG1

   - WFM6100, WFM7100, or WFM7000 with Option SD:
     525/270 color bars from DVG1

4. Apply an NTSC 0% Flat Field signal from the AVG1 output to the Reference input of the waveform monitor. Terminate the other Reference input with a precision termination.

5. Check that the upper-left corner of the waveform monitor display shows the proper standard for the reference.

6. Check that the Waveform and Vector displays are locked.

7. Log either Pass or fail in the test record.

8. Leave test setup as is for the next test.

External Reference Lock Range

Vary the time base of the reference to measure lock range.

1. Adjust the AVG1 time base offset to –50 ppm. Verify that the readout in the upper-left corner of the waveform monitor display does not indicate an unlocked signal. It is normal for the system to momentarily lose lock when the time base is changed.

***NOTE**. The waveform display will not be stable because the SDI time base is not in sync with the reference.*

---

2. Increase the negative time base offset until the waveform monitor cannot sustain lock. Record the maximum offset capability in the test record.

3. Repeat steps 1 and 2, but use positive offsets to test the positive end of the lock range.

4. Reset the AVG1 Module parameters to remove the timebase offset.

External Reference Formats Supported: Tri-Levels (WFM7000 and WFM7100)

Check that DUT can reference to NTSC and PAL while viewing digital signals.

1. Disconnect the AVG1 signal from the Reference input, and connect a 1080i 59.94 Tri-Level Sync signal from the AWVG1.

2. Check that the upper-left corner of the waveform monitor display shows the proper standard for the reference.

3. Check that the Waveform and Vector displays are locked.

4. Log either Pass or Fail in the test record.

5. Disconnect the 1080i 59.94 Tri-Level Sync signal from the reference input.

External Reference Lock in Presence of Hum, Bi-Level

Apply a 0 dB hum signal to the Reference and verify that the waveform monitor still locks correctly.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the TG2000 black burst signal to the video input of the AVC1. Route the video output of the AVC1 (not the precision video output) to one of the waveform monitor REF inputs. Terminate the other REF input.

3. Connect either a digital or composite signal from the TG2000 to the waveform monitor and select the appropriate input to display the signal.

   Note. For instruments without Option CPS you must use a digital signal. For Option CPS instruments, you can use an analog signal for more sensitivity to external reference performance.

4. Set the AVC1 for 0 dB of 60 cycle hum.

5. Press the **IN/OUT** button and touch the **Int Ref/Ext Ref** soft key to select the external reference mode.

6. Check that the signal is locked and the WFM and VECTOR displays are stable.

7. Record Pass or Fail in the test record.

External Reference Lock in Presence of Hum, Tri-Level (WFM7000 and WFM7100 only)

Apply a 0 dB hum signal to the Reference and verify the waveform monitor still locks correctly.

1. Disconnect the black-burst signal from the AVC1 input, and apply a 1080i 59.94, Tri-Level Sync signal from the AWVG1 instead.
2. Set the AVC1 for −0 dB of 60 Hz hum.
3. Check that the signal is locked and the WFM and VECTOR displays are stable.
4. Record Pass or Fail in the test record.
5. Disconnect the AVC1.

Recovered Sine-wave Fidelity (WFM6100 and WFM7100 Option Eye/Phy only)

This test checks that the SD or HD recovered clock signal has no fidelity issues (such as stuck bits), after it has been filtered into a sine-wave and digitized.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect an SD signal to the waveform monitor.
3. Turn on the Recovered Sine-wave function:
   - **a.** Press the **MAIN** button.
   - **b.** Touch the **Config** soft key, and then the **Diagnostics** soft key.
   - **c.** Touch the **Calibration** soft key, and then the **Eye** soft key.
   - **d.** Touch the **Tests** soft key, and read the Cal Eye Test Instructions. Touch **OK**, and the **Show Rcvrd Clock Sine On** soft key, to put a check mark in the box.
   - **e.** Touch the **Close Calib Eye Tests** soft key.
4. Check to see that the sine-wave is smooth and undistorted. There should be one cycle displayed.
5. Use the **GENERAL** knob to adjust the vertical gain to x10.
6. Check the waveform. There should be no discontinuities or jagged edges. Use the **VERTICAL** knob to view the entire waveform.
7. Repeat steps 4 through 6 for HD (if supported).

8. Turn off the Recovered Sine-wave function:

   a. Touch the **Show Rcvrd Clock Sine On** soft key, to remove the check mark from the box.

   b. Close all the menu levels.

9. Record Pass or Fail in the test record.

LTC Decoding Functionality

Apply an LTC signal and verify it is correctly decoded.

An LTC is input through the 9-pin REMOTE connector on the rear panel. To input an LTC signal, you need to construct a cable as shown in Figure 2−2. This cable has seven wires from the Remote connector, with two of them also connected to an RCA connector. Pin 2 of the Remote connector is connected to the center pin of the RCA connector, and pin 3 is connected to the shield of the RCA connector.

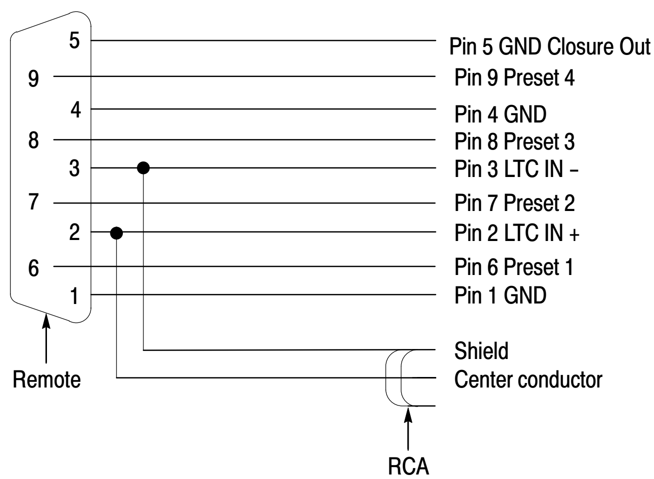

Figure 2–2: Wiring diagram for LTC input/Ground Closure cable

***NOTE**. Apply a signal to only one connector at a time.*

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the RCA connector on the custom cable to the output of the Timecode generator. Connect the custom cable 9-pin connector to the REMOTE connector on the waveform monitor rear panel.

3. Set the timecode source to LTC:

   a. Press the **IN/OUT** button.

b. WFM6100 Opt CPS only:

- Touch the **Analog Input A** soft key, and then the **Settings** soft key.
- Touch the **Analog Submenu** soft key, and then skip to part e of this step.

c. Touch the **Settings** soft key.

d. Touch the **Digital SubMenu** soft key.

e. Touch the **Timecode** soft key, and then the **LTC** soft key.

f. Touch the **Close Digital** soft key, and then the **Close Settings** soft key.

4. If using a Horita TRG50 LTC generator, set the switches to:

V−Size:	LRG
V−Pos:	TOP
Mode:	GEN
Data:	TC

5. It may be necessary to reset the LTC generator via the mode switch. Momentarily move the Mode switch to SET, and back to GEN.

6. Verify that the Decoded LTC is displayed in the upper right corner of the display.

7. Record Pass or Fail in the test record.

Eye Gain (Option EYE/PHY only)

This test uses an 800 mV, 1 MHz square wave to check the Eye Gain. This requires a 1 MHz square wave signal from the TG2000 AVC1 module. This signal is provided on the User Documents CD. Use a precision cable to connect the AVC1 to the waveform monitor.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Set the waveform monitor to Bandwidth test mode:

a. Press the **MAIN** button.

b. Touch the **Config** soft key, and then the **Diagnostics** soft key.

c. Touch the **Calibration** soft key, and then the **Eye** soft key.

d. Touch the **Tests** soft key, and then **OK** on the Calibration: Eye Tests Instructions dialog.

e. Touch the **Bandwidth Test On** soft key, to put a check mark in the box.

f. Close all the menu levels.

3. Connect the AVC1 Precision Video output to the SDI A input on the waveform monitor, and then select the 1 MHz squarewave signal.
4. **Opt. PHY only −** Check that the digital amplitude reading is between 750 mV and 850 mV.
5. Using the cursors and graticule lines, check that the waveform is between 760 mV and 840 mV. Record this level in the test record.
6. Repeat steps 3 through 5 for the SDI B input.
7. Turn off the Bandwidth Test mode:
   a. Press the **MAIN** button.
   b. Touch the **Config** soft key, and then the **Diagnostics** soft key.
   c. Touch the **Calibration** soft key, and then the **Eye** soft key.
   d. Touch the **Tests** soft key, and then **OK** on the Calibration: Eye Tests Instructions dialog.
   e. Touch the **Bandwidth Test On** soft key to remove the check mark from the box.
   f. Close all the menu levels.

Reference Clock Amplitude and Frequency (WFM6100, WFM7100 Option EYE/PHY only)

This test uses an oscilloscope to verify the reference clock output.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect an SD or HD signal, as appropriate, to the waveform monitor SDI A input.
3. Verify that the display shows the signal.
4. Connect one of the CLOCK OUT BNCs to the test oscilloscope, using a 75 Ω cable. The test oscilloscope must have a 75 Ω input.
5. Check that the amplitude of the CLOCK OUT signal is between 0.8 V_{p-p} and 1.2 V_{p-p}.
6. Record Pass or Fail for the Clock Amplitude functional test on the test record.
7. Check that the frequency of the CLOCK OUT signal is 27 MHz ±5% (SD); 74.25 MHz (or 74.17582 MHz) ±5% (HD).
8. Record Pass or Fail for the Clock Frequency functional test on the test record.

Eye Signal Bandwidth (WFM6100, WFM7100 Option EYE/PHY only)

***NOTE**. The level accuracy of the RF generator and the frequency response of the cable and matching pad directly affect this check. To accurately verify this specification with the recommended equipment, the combination of generator, pad, and cable must be characterized as described in* Signal Source Characterization for Eye Signal Bandwidth*, on page 2−85.*

1. Assemble the signal source set-up as characterized in Signal Source Characterization for Eye Signal Bandwidth Verification (see page 2−85).

2. Set the RF generator frequency to 100 MHz.

3. Set the RF generator level as indicated in the characterization table, Table 2−6, on page 2−85.

4. Connect the signal source output to the waveform monitor SDI A input.

5. Press the **IN/OUT** button, and then touch the **Digital Input A** soft key.

6. Check that the RF generator's RF output is on, with no modulation.

7. Press the **DISPLAY** button, and then touch the **1View #1** soft key, to make tile 1 full screen.

8. Press the **MAIN** button, and then touch the **Eye** soft key, in the Eye/Phy column.

9. Touch the **3 Eyes/10 Eyes** soft key to select a 10 Eyes display.

10. Select the Bandwidth Test:

- **a.** Press the **MAIN** button.
- **b.** Touch the **Config** soft key, and then the **Diagnostics** soft key.
- **c.** Touch the **Calibration** soft key, and the **Eye** soft key, and the **Tests** soft key.
- **d.** Read the test description and touch **OK** on the test description window.
- **e.** Touch the **Bandwidth Test On** soft key, to put a check mark in the box.

11. Close all of the soft key menus, leaving the Bandwidth Test On.

12. Use the cursors to measure the waveform amplitude, and note this as the reference amplitude. (If Opt. PHY is installed, the Eye Amplitude readout may be used instead of the cursors.)

13. Set the RF generator frequency to 2.5 GHz.

14. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2−85.
15. Measure the 2.5 GHz waveform amplitude using cursors. (If Opt. PHY is present, the Eye amplitude readout value may be used in place of the cursor measurement.)
16. Calculate the 2.5 GHz response as follows:

$$Response = 20 \times \log\left(\frac{2.5\ GHz\ Amplitude}{Reference\ Amplitude}\right)$$

    This value must be greater (more positive) than −3 dB.

17. Record the 2.5 GHz response in the test record.
18. Set the RF Generator to 100 MHz.
19. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2−85.
20. While observing the waveform, increase the RF generator frequency in 10 MHz steps to 2.5 GHz. Find the frequency that results in the minimum waveform amplitude.
21. Set the RF generator level to the nearest corresponding setting from the Characterization Table on page 2−85.
22. If the waveform amplitude falls below that measured in step 12, calculate the response in dB, as follows:

$$Response = 20 \times \log\left(\frac{Smallest\ Amplitude}{Reference\ Amplitude}\right)$$

    Record this result in the test record as “minimum response”. This value must be greater (more positive) than –3.0 dB.

23. Move the signal source output to the SDI B input.
24. Press the **IN/OUT** button, and touch the **Digital Input B** soft key.
25. Set the RF Generator to 100 MHz.
26. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2−85.
27. Repeat steps 12 through 22 for the Digital B input.
28. Deactivate the Bandwidth Test:

  a. Press the **MAIN** button.
  b. Touch the **Config** soft key, and then the **Diagnostics** soft key.
  c. Touch the **Calibration** soft key, the **Eye** soft key, and the **Tests** soft key.
  d. Read and touch OK on the test description window.
  e. Touch the **Bandwidth Test On** soft key, to remove the check mark from the box.

29. Close all of the soft key menus.

Tests for SD-Equipped Instruments Only

***STOP**. Do the tests in this section only for waveform monitors that support standard definition signals:*

- *All WFM6100 and WFM7100 Waveform monitors*
- *Only WFM7000 Waveform monitors that are equipped with Option SD*

SD SDI Input Level Low and High

This test uses the serial output with adjustable level to verify that the waveform monitor can accept serial signals of various amplitudes.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect a cable to the Opt S1 output of the TG2000 DVG1. The Opt S1 output is typically the second BNC from the top of that module.
3. Connect the other end of the cable to the SDI A input connector on the waveform monitor.
4. On the TG2000 DVG1, set the output to the SDI Matrix signal.
5. You should see a stable picture and waveform on the waveform monitor display. The status screen should display OK for all the EDH parameters.
6. On the TG2000, adjust the serial amplitude downward to find the lowest level that does not generate any EDH errors in a 10 second period.
7. Record the DVG1 amplitude level in the test record.
8. Increase the serial amplitude to 115%.
9. If any EDH errors are generated, reduce the amplitude until no errors are generated for a 10 second period.
10. Record the DVG1 amplitude level in the test record.
11. Repeat the steps 6 to 10, using the SDI B input on the waveform monitor.

SD SDI Input Equalization Range and EDH

This test uses a cable clone to simulate a long cable. This verifies that the waveform monitor can receive signals that have passed through long cables.

1. Set the waveform monitor to the factory presets (see page 2−21).

EDH

2. Connect the TG2000 DVG1 Normal output (not the Opt S1 output) to the Cable Clone input. Typically the Normal output is the top BNC on the DVG1 module.
3. Connect the Cable Clone output to the waveform monitor SDI A input.
4. Set the waveform monitor to display a Video Session status screen:
   a. Touch within tile 4 to activate that tile.
   b. Press the **STATUS** button.
   c. Touch the **Video Session** soft key, and then touch the **Hide Menu** soft key to remove the menu soft keys.
5. Select the 525 270 “SDI Equalizer Test” signal from the TG2000 DVG1.
6. Set all switches on the Cable Clone to the ‘out’ position.
7. While watching the EDH Error display Statistics column on the Video Session screen, rapidly toggle the +1 switch on the Cable Clone between the out and the in position until errors are observed.
8. The EDH Error display on the Video Session screen should indicate an EDH Error on at least one of the switch transitions.
9. Record Pass or Fail in the test record.

Cable Length Accommodation

10. Set the cable clone for minimum cable length (all switches to the “out” position.)
11. On the TG2000 DVG1, set the output to the SDI Matrix signal.
12. You should see a stable picture and waveform on the waveform monitor display. All the EDH parameters on the Video Session Status screen should read OK.
13. Adjust the cable clone to find the longest length of “cable” that does not generate any EDH errors in a 10 second period.
14. Divide the length of Belden 8281 cable by 10 to calculate the attenuation in dB at 135 MHz.
15. Record the value in the test record.
16. Repeat the test using SDI B input on the waveform monitor.
17. Record this level in the test record.

SD Pixmon Multiburst Frequency Response

This test uses a VM5000 to test the frequency response at the Pixmon output.

1. Set the waveform monitor to the factory presets (see page 2–21).

2. Connect the TG2000 DVG1 output to the waveform monitor SDI A input.

3. Select the VM5000 Matrix (525 59.94) test signal from the DVG1.

4. Set the waveform monitor to Digital Input A:

- **a.** Press the **IN/OUT** button.
- **b.** Touch the **Digital Input A** soft key.

5. Set the SD Alg PixMon to RGB:

- **a.** Touch the **Settings** soft key, and then the **Outputs** soft key.
- **b.** Touch the **SD Alg PixMon** soft key, and then the **RGB** soft key.

6. Connect the waveform monitor PIXMON output to the VM5000, as described in the VM5000 manual.

7. Start the VM5000 HD and SD application, and set the number of Averages to 4.

8. Set the format to 480i/60, RGB.

9. Set the Measurement to Multiburst.

10. Run the measurement.

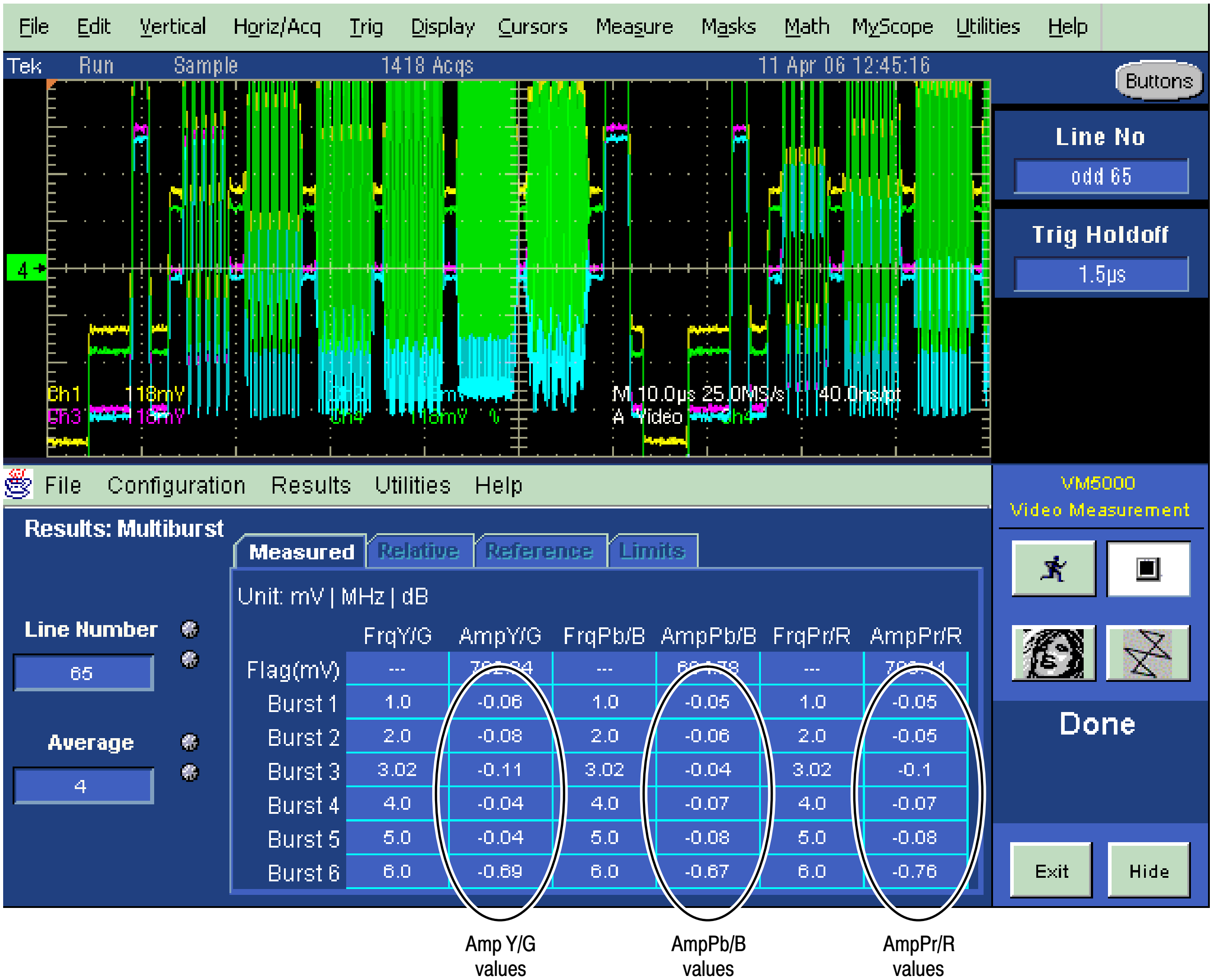

Figure 2–3: VM5000 SD Frequency Response display

11. Check that the Burst dB values in the AmpY/G, AmpPb/B, and AmpPr/R columns are between −0.92 dB (−10%) and +0.82 dB (+10%).
12. Record the results in the test record.

Analog Pixmon Gain and Offset

This test uses an oscilloscope to check the active video gain and black (blanking) levels at the Pixmon output, for the YPbPr, RGB, and Composite modes.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the TG2000 DVG1 output to the waveform monitor SDI A input.
3. Select a 525 270 MB/s 100% color bar signal from the TG2000 DVG1.
4. Connect a VGA to 5x BNC adapter cable to the waveform monitor PIX MON output.

YPbPr

5. Set the SD Alg PixMon to YPbPr:
   a. Press the **IN/OUT** button.
   b. Touch the **Settings** soft key, and then the **Outputs** soft key.
   c. Touch the **SD Alg PixMon** soft key, and then the **YPbPr** soft key.
6. Set the test oscilloscope to view the waveform. The following oscilloscope settings normally provide a usable display:

Vertical Scale	100 mV/div
Vertical Position	–3.5 div
Horizontal Scale	5 us/div
Horizontal Trigger Position	50%
Trigger Slope	Rising edge
Trigger Level	500 mV

7. Connect the Y/G channel of the VGA to 5x BNC adapter cable to the test oscilloscope.
8. Check that the Y waveform is 1 V_{p-p} ±5%, from sync tip to white level (first color bar).
9. Check that the blanking (black) level is 0 mV ±50 mV.
10. Connect the Pb/B channel of the VGA to 5x BNC adapter cable to the test oscilloscope.
11. Check that the Pb waveform is 700 mV_{p-p} ±5%, from the blanking (black) level to the top of the waveform.
12. Check that the blanking (black) level is 0 mV ±50 mV.
13. Connect the Pr/R channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

14. Check that the Pr waveform is 700 mV_{p-p} ±5%, from the blanking (black) level to the top of the waveform.

15. Check that the blanking (black) level is 0 mV ±50 mV.

16. Record Pass or Fail in the test record.

RGB

17. Set the SD Alg PixMon to RGB:

- **a.** Touch the **SD Alg PixMon** soft key.
- **b.** Touch the **RGB** soft key.

18. Connect the Y/G channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

19. Check that the G waveform is 1 V_{p-p} ±5%, from sync tip to white level.

20. Check that the blanking (black) level is 0 mV ±50 mV.

21. Connect the Pb/B channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

22. Check that the B waveform is 700 mV_{p-p} ±5%, from the blanking (black) level to the top of the waveform.

23. Check that the blanking (black) level is 0 mV ±50 mV.

24. Connect the Pr/R channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

25. Check that the R waveform is 700 mV_{p-p} ±5%, from the blanking (black) level to the top of the waveform.

26. Check that the blanking (black) level is 0 mV ±50 mV.

27. Record Pass or Fail in the test record.

Composite

28. Connect the TG2000 AVG1 output to the waveform monitor CMPST A input, and terminate the loopthrough in 75 Ω.

29. Select an NTSC 100% Color Bar from the AVG1.

30. Set the PixMon output to Composite:

- **a.** Touch the **Cmpst PixMon On** soft key, to put a check mark in the box.
- **b.** Close all soft key menus.

c. Touch the **Analog Input A** soft key.

31. Connect the Y/G channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

32. Check that the G waveform is 1 V_{p-p} ±5%, from sync tip to white.

33. Check that the blanking (black) level is 0 mV ±100 mV.

34. Record Pass or Fail in the test record.

SD Serial Output Amplitude

This test verifies that the Serial Output is within specifications.

1. Connect the TG2000 DVG1 output to the SDI A input on the waveform monitor.

2. Set the DVG1 to provide a 525 270 Mb/s 100% color bar signal.

3. Set the waveform monitor to display Digital Input A:

   a. Press the **IN/OUT** button.

   b. Touch the **Digital Input A** soft key.

4. Connect the waveform monitor SDI OUT to the oscilloscope CH 1 input. Make sure that the TCA75 is installed in CH 1.

5. Set the oscilloscope for the measurement, as shown in Table 2−5.

Table 2–5: Oscilloscope Settings for Serial Output Amplitude

Ch 1 Vertical	200 mV/Div
Horizontal	1.0 ns/Div
Trigger Mode Source Pulse Width Upper Limit Lower Limit Trigger Type Trigger if Width Polarity	 CH 1 Inside 10.0 s 30.0 ns Width Occurs Pos
Acquisition Mode	FastAcq

6. Set the oscilloscope cursor 1 to the top of the displayed waveform.

Figure 2-4: Trigger polarity positive

7. Change the oscilloscope trigger polarity to Neg.
8. Set the oscilloscope cursor 2 to the bottom of the displayed waveform. See Figure 2−5.
9. Record the amplitude (ΔV) in the test record.

Figure 2-5: Trigger polarity negative

SD SDI Return Loss, A and B Inputs (Option SD only)

This test uses a network analyzer to check the reflections from the input. You can also use the Spectrum Analyzer, tracking generator, and return loss bridge to make this measurement.

1. Turn on the network analyzer and set it for return loss (the S11 measurement).
2. Set the frequency range for approximately 300 kHz to 500 MHz.
3. Use the calibration kit and calibrate the network analyzer with one of the BNC cables attached.
4. Connect the calibrated end of the cable to the SDI input A of the waveform monitor.
5. Measure the return loss from 300 kHz to 270 MHz. Record the lowest return loss value (the biggest reflection) over the frequency range in the test record.
6. Repeat steps 4 through 5 for SDI B input.

SD VITC Decoding Functionality (Option SD only)

Apply an SDI signal, that was converted from an NTSC signal, with VITC and verify the VITC is correctly decoded.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Route the NTSC signal from the AVG1 to the VITC encoder.
3. Connect the output of the VITC encoder to the NTSC to SDI converter.
4. Connect the SDI from the converter the SDI A input of the DUT.
5. Set the waveform monitor for VITC timecode:
   a. Press the **IN/OUT** button.
   b. Touch the **Settings** soft key, and then the **Digital Submenu** soft key.
   c. Touch the **Timecode** soft key, and then the **VITC** soft key.
   d. Touch the **Close Digital** soft key, and then the **Close Settings** soft key.
6. Verify that a decoded VITC is displayed in the upper-right corner of the waveform monitor display.
7. Verify the VITC is correct and record Pass or Fail in the test record.

SD Cable Meter (WFM6100, WFM7100 Options SD and EYE/PHY only)

This test uses a short (1−2 m) length of Belden 8281 cable and a long (100 m) length of Belden 8281 cable to check the Cable Meter. A cable clone may be used instead of the long cable.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Select the SDI Status display:
   a. Press the **MAIN** button.
   b. Touch the **SDI Status** soft key.
3. Using the short cable, connect a color bar signal from the DVG1 to the SDI A input on the waveform monitor.
4. Check that the cable length reading is between 0 m and 17 m.
5. Record the results in the test record.
6. Using the long cable, or the cable clone set to 100 m, connect a color bar signal from the DVG1 to the SDI A input on the waveform monitor.
7. Check that the cable length reading is between 76 m and 127 m.
8. Record the results in the test record.
9. Repeat steps 3 through 8 for the SDI B input.

SD Equalized Eye Gain (WFM6100, WFM7100 Options SD and EYE/PHY only)

This test checks the amplitude of an internally generated eye signal.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the DVG1 to the waveform monitor SDI A input.
3. Select the Equalized Eye signal:
   a. Push the **MEASURE** button.
   b. Touch the **Eye** soft key.
   c. Touch the **Eye Type** soft key.
   d. Touch the **Equalized Eye** soft key.
4. Using the graticule, check that the waveform is 600 mV ±80 mV.
5. Record Pass or Fail in the test record.

SD Jitter Noise Floor (WFM6100, WFM7100 Options SD and EYE/PHY only)

This test checks the jitter noise floor of the waveform monitor. Since some jitter may be introduced by the signal source, you may need to characterize the TG2000 output jitter with an oscilloscope. Most DVG1 generators have an output noise floor in the 200 ps range.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the TG2000 DVG1 upper (Clean) output to the SDI A input on the waveform monitor.
3. Select the 525 75% color bar signal from the DVG1.
4. Press the **IN/OUT** button and touch the **Digital Input A** soft key.
5. Set the WFM tile to full screen:
   a. Touch within the WFM tile to select it.
   b. Press the **DISPLAY** button to make the waverform monitor tile full screen.
6. Set the waveform monitor to the jitter display:
   a. Press the **MAIN** button.
   b. Touch the **Jitter** soft key, in the Eye/Phy column.

7. Set the jitter high pass filter to 100 Hz:
   a. Touch the **Jitter HPF** soft key.
   b. Touch the **100 Hz** soft key.
8. Set the vertical gain to x10:
   a. Press the **MAG/GAIN** button.
   b. Touch the **Fixed Gain x10** soft key.
9. Verify that the jitter trace is displayed and stable.
10. Using the graticule or the cursors, measure the jitter amplitude.
11. Check that the jitter amplitude is approximately 250 ps (0.068 UI), depending on the TG2000 output jitter.
12. Record Pass or Fail in the test record.
13. Touch within the Jitter display to restore the Jitter soft keys.

SD Jitter Readout Accuracy (WFM6100, WFM7100 Options SD and EYE/PHY only)

1. Set the waveform monitor to a four−tile display:
   a. Press the **DISPLAY** button.
   b. Touch the **4 Views** soft key.
2. Disconnect the TG2000 DVG1 Clean output from the waveform monitor, and connect the TG2000 DVG1 Opt S1 output (typically the 2nd output) to the SDI A input.
3. Set the upper left tile to the Eye display:
   a. Touch within the upper left tile to select it.
   b. Press the **MAIN** button.
   c. Touch the **Eye** soft key, in the Eye/Phy column.
4. Set the upper right tile to the Jitter display:
   a. Touch within the upper right tile to select it.
   b. Press the **MAIN** button.
   c. Touch the **Jitter** soft key, in the Eye/Phy column.
5. Touch the **H Mag** touchable readout in the Jitter display, and use the **GENERAL** knob to set the H magnification to x10.

6. Touch the **Jitter HPF** soft key, and then the **100 Hz** soft key.
7. Adjust the DVG1 (Opt. S1) module as follows:
   a. Select a 525i 59.94 color bar signal.
   b. Set the jitter frequency to 9950 Hz.
   c. Slowly increase the jitter amplitude while watching the Eye display.

      As the jitter amplitude increases, the transitions start to get wider and fill in the space between the transitions. As the jitter amplitude approaches one UI, the space between transitions disappears (the eye display will begin to close).

      At one UI of jitter (about 3.7 ns) the eye diagram will have 'closed', and a darkening, or shadow, on an eye trace will appear out of the smeared background. Continue increasing the jitter until another shadow of an eye appears. You now have 2 UIs of jitter (about 7.4 ns).

      Continue increasing jitter to 3 UIs. The TG2K display will read close to 11.1 ns, but do not adjust according to the TG2000 display. Adjust instead for the sharpest narrow eye shadow on the Trebuchet display which indicates the applied jitter is precisely 3 UI. This may not be 11.1 ns on the generator, since the DVG1 module may not be as accurate.
8. The jitter display should show a stationary sine-wave 3 UI in height. Check the sine portion of the jitter trace, ignoring the small random noise component, with the graticule marks and the cursors to see that it is 3 UI ±10% (between 2.7 UI and 3.3 UI).
9. Record Pass or Fail for the Jitter Trace functional test on the test record.
10. Check that the waveform monitor jitter readout shows the jitter to be between 2.65 UI and 3.35 UI. (Reading = actual ±10% ±0.05.)
11. Record Pass or Fail for the Jitter Readout functional test on the test record.

Jitter Vibration (WFM6100, WFM7100 Option EYE/PHY only)

This test shows if there is undue sensitivity to vibration.

1. Set the instrument on a flat surface, with the top cover in place.
2. Connect an SD or HD signal, as appropriate, to the SDI A input.
3. Select a jitter display.
4. Set V Gain to x10.
5. Drop a BNC barrel connector onto the middle of the top cover, from a height of 5 cm (2 in.) while watching the jitter display.

6. Check that the jitter display does not jump more than 0.4 UI.
7. Record Pass or Fail for Jitter Vibration on the test record.

Tests for Option-CPS Equipped Instruments Only

Composite Analog Frequency Response (Option CPS only)

Use Cursors to measure the reference, and the largest and smallest packets on a multi-burst signal. The greatest deviation from reference is the frequency response.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for 700 mV Multiburst. This signal is provided on the User Documents CD.
4. Select the Composite A input:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
5. Adjust cursors to be near the top and zero portions of the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.
6. Press the **MAG/GAIN** button and touch the **Fixed Gain x5.00** soft key.
7. Adjust the lower cursor to align with the bottom of the reference step of the waveform.
8. Touch the **Fixed Gain x1.00** soft key, and adjust the vertical position to move the top of the waveform to the 0 IRE graticule. The second cursor should also be near the zero graticule mark.
9. Touch the **Fixed Gain x5.00** soft key and adjust the upper cursor to align with the top of the reference step of the waveform.
10. Check the cursor delta readout of the magnitude of the reference step. Note this number. It should be near 98 IRE.
11. Next, adjust the upper cursor to align with the top of the largest packet of the waveform.
12. Touch the **Fixed Gain x1.00** soft key and adjust the vertical position to move the baseline of the waveform to the 0 IRE graticule. The other cursor should also be near the zero graticule mark.

13. Touch the **Fixed Gain x5.00** soft key, and adjust the lower cursor to align with the bottom of the largest packet of the waveform.

14. Note the cursor delta value for the amplitude of the largest packet.

15. Adjust the lower cursor to align with the bottom of the smallest packet of the waveform.

16. Touch the **Fixed Gain x1.00** soft key, and adjust the vertical position to align the top of the waveform to the 0 IRE graticule.

17. Touch the **Fixed Gain x5.00** soft key, and adjust the upper cursor to align with the top of the smallest packet of the waveform.

18. Note the cursor delta value for the amplitude of the smallest packet.

19. In the test record, record the deviation from reference that has the largest magnitude, either largest – reference or smallest – reference.

Adjust. If the Frequency Response is outside the specification, touch the **CONFIG** soft key, the **Diagnostics** soft key, the **Calibration** soft key, the **Composite** soft key, **OK** in the description box, and touch the **Freq Resp** soft key. Then follow the on-screen instructions to adjust the response. Follow the instructions at the bottom of the screen to Save and Exit calibration mode. Afterwards, repeat the above test for Analog Frequency Response and record the new value in the test record.

Composite Analog Delay Variation Over Frequency (Group Delay) (Option CPS only)

Use a 5.75 MHz 5T multi-pulse signal and cursors to measure group delay. This signal is provided on the User Documents CD.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.

3. Set the precision generator for 5.75 MHz multi-pulse. This is a custom test signal with more packets for better coverage.

4. Select the Composite A input:

   a. Press the **IN/OUT** button.

   b. Touch the **Analog Input A** soft key.

   c. Touch within the WFM tile to select it.

   d. Press the **DISPLAY** button to make the WFM tile the full screen display.

5. Turn on the cursor controls:
   a. Touch the **Cursors** soft key.
   b. Touch the **Show Volt** soft key to put a check mark in the box.
   c. Touch the **Close Cursors** soft key.
6. Adjust the cursors to be near the zero portions of the waveform. Touch the **V1** or **V2** touchable readouts in the WFM tile, and then use the **GENERAL** knob to adjust them.
7. Press the **MAG/GAIN** button, then touch the **Fixed Gain x10.00** soft key.
8. Use the cursors to measure the peak-to-peak deviation in the baseline of the multipulse packets. Touch the **V1** or **V2** touchable readouts in the WFM tile, and then use the **GENERAL** knob to adjust them.
9. The peak-to-peak deviation of the baseline is 0.1% per ns. For example, for a 10 ns deviation on a 100 IRE signal yields a deviation of 1 IRE. Record the measured value in the test record.

Composite Analog Pulse to Bar Ratio (Option CPS only)

Apply a pulse and bar signal and use cursors to measure the difference between the two.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for a 2T Pulse and Bar.
4. Select the Composite A input:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
5. Turn on the cursor controls:
   a. Touch the **Cursors** soft key.
   b. Touch the **Show Volt** soft key to put a check mark in the box.
   c. Touch the **Close Cursors** soft key.

6. Adjust the cursors to be near the top portions of the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.
7. Use the **VERTICAL** position knob to move the top of the waveform to the zero graticule.
8. Press the **MAG/GAIN** button, then touch the **Fixed Gain x10.00** soft key.
9. Place one cursor on the top of the “Bar.” Touch the **V1** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust it.
10. Use the **HORIZONTAL** position knob to put the “pulse” on the dotted line at the center of the screen.
11. Press **Vert Gain/Horiz Mag** soft key to select Horizontal magnification, and touch the **Fixed Mag x50** soft key to expand the pulse horizontally.
12. Position the second cursor on the top of the pulse. Touch the **V2** touchable readout in the WFM tile and use the **GENERAL** knob to adjust it.
13. Record the cursor delta in the test record.

Composite Analog Field Rate Tilt (Option CPS only)

Apply a field rate square wave and use cursors to measure the tilt.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for Field Square Wave.
4. Select the Composite A input:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
5. Turn on the cursor controls:
   a. Touch the **Cursors** soft key.
   b. Touch the **Show Volt** soft key to put a check mark in the box.
   c. Touch the **Close Cursors** soft key.

6. Adjust the cursors to be near the top of the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.
7. Use the **VERTICAL** position knob to move the top of the waveform to the zero graticule.
8. Press the **MAG/GAIN** button, and touch the **Fixed Gain x5.00** soft key.
9. Press the **LINE SEL** button, then touch the **All Fields** soft key.
10. Use the **GENERAL** knob to set the line select to a line number between 72 and 202.
11. Use cursors to measure the tilt in the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.
12. Record the value in the test record.

Composite Analog Line Rate tilt (Option CPS only)

Apply a field rate square wave and use cursors to measure the tilt.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for 100% Flat Field.
4. Select the Composite A input and set the WFM tile to full screen:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
5. Turn on the cursor controls:
   a. Touch the **Cursors** soft key.
   b. Touch the **Show Volt** soft key to put a check mark in the box.
   c. Touch the **Close Cursors** soft key.
6. Adjust cursors to be near the top of the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.

7. Use the **VERTICAL** position knob to move the top of the waveform to the zero graticule.

8. Press the **MAG/GAIN** button, then touch the **Fixed Gain x5.00** soft key.

9. Use the cursors to measure the tilt in the waveform, excluding the first and last 5 μs of the bar.

10. Record the value in the test record.

Composite Analog Input Return Loss Input A & B (Option CPS only)

This test uses a network analyzer to check the reflections from the input. You can also use the Spectrum Analyzer, tracking generator, and return loss bridge to make this measurement.

1. Turn on the network analyzer and set it for return loss, the S11 measurement.

2. Set the frequency range for approximately 300 kHz to 10 MHz.

3. Calibrate the network analyzer, with one of the BNC cables attached, using the 75 Ω calibration kit.

4. Connect the calibrated end of the cable to one of the CMPST A input connectors and terminate the other connector.

5. Measure the return loss from 300 kHz to 6 MHz. Record the lowest return loss value (biggest reflection) over the frequency range in the test record.

6. Repeat steps 4 and 5 for the CMPST B input.

Composite Analog Input DC Offset Restore Off (Option CPS only)

Measure the displayed offset when the input is not driven and DC Restore is off.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Apply an NTSC signal from the AVG1 output to the CMPST A input of the waveform monitor. Terminate the other CMPST A input with a precision termination.

3. Terminate one side of the Composite B input with a precision termination.

4. Switch DC Restore off:

   a. Press the **IN/OUT** button.

   b. Touch the **Settings** soft key, and then the **Analog Submenu** soft key.

   c. Touch the **DC Restore** soft key, and then touch the **Off** soft key.

   d. Touch the **Close Analog** soft key, and then the **Close Settings** soft key.

5. Select the Composite A input and set the WFM tile to full screen:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
6. Select the Composite B input:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input B** soft key.
7. Press the **MAG/GAIN** button, then touch the **Fixed Gain x5.00** soft key.
8. Touch the display to enable the WFM soft keys.
9. Turn on the cursor controls:
   a. Touch the **Cursors** soft key, and then touch the **Show Volt** soft key to put a check mark in the box.
   b. Touch the **Close Cursors** soft key**.**
10. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
11. Connect the NTSC signal from the AVG1 output to the Composite B input.
12. Select the Composite A input:
    a. Press the **IN/OUT** button.
    b. Touch the **Analog Input A** soft key.
13. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
14. Record the larger of the two waveform offset values in the test record.

Adjust. If the Offset is outside the specification, select MAIN > Config > Diagnostics> Calibration > Composite and follow the on-screen instructions to automatically adjust the offset. Follow the instructions at the bottom of the screen to Save and Exit calibration mode. Afterwards, repeat the above test for and record the new value in the test record.

Composite Analog Input Clamp Off Check (Option CPS only)

Apply a small DC voltage and verify it is not clamped to zero.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Disconnect all cables and terminators from the Composite inputs.
3. Connect a cable from a CMPST A input connector to the retractable hook clip.
4. Switch DC Restore off:
   a. Press the **IN/OUT** button.
   b. Touch the **Settings** soft key, and then the **Analog Submenu** soft key.
   c. Touch the **DC Restore** soft key, and then touch the **Off** soft key.
   d. Touch the **Close Analog** soft key, and then the **Close Settings** soft key.
5. Select the Composite A input and set the WFM tile to full screen:
   a. Press the **IN/OUT** button.
   b. Touch the **Analog Input A** soft key.
   c. Touch within the WFM tile to select it.
   d. Press the **DISPLAY** button to make the WFM tile the full screen display.
6. Press the **MAG/GAIN** button.
7. Touch the **Vert Var Gain Enable** soft key if there is not a check in the box, then use the **GENERAL** knob to reduce the gain to 0.5X.
8. Hold the hook tips on a battery (D, C, or AA), red to positive, black to negative.
9. Verify that the waveform is offset up by about 1.5 volts and is not being clamped to ground.
10. Record Pass or Fail in the test record.

Composite Analog Input DC Restore Hum Attenuation (Option CPS only)

Apply hum, then measure the attenuation with clamp in all three modes.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. Connect an NTSC color bar signal to the video input of the AVC1. Route the video output of the AVC1 (not the precision video output) to the CMPST A input of the waveform monitor, and terminate the loopthrough in 75 Ω.

3. Set the WFM tile to full screen:

   a. Touch within the WFM tile to select it.

   b. Press the **DISPLAY** button to make the WFM tile the full screen display.

4. Set the AVC1 for 0 dB of 60 Hz hum.

5. Touch the **Sweep** soft key, and then touch the **2 Fields** soft key.

6. Select input and switch DC Restore off:

   a. Press the **IN/OUT** button, and then touch the **Analog Input A** soft key.

   b. Touch the **Settings** soft key, and then the **Analog Submenu** soft key.

   c. Touch the **DC Restore** soft key, and then touch the **Off** soft key.

   d. Touch the **Close Analog** soft key, and then touch the **Close Settings** soft key.

7. Touch within the WFM tile to bring up its soft keys.

8. Turn on the cursor controls:

   a. Touch the **Cursors** soft key.

   b. Touch the **Show Volt** soft key to put a check mark in the box.

   c. Touch the **Close Cursors** soft key**.**

9. Measure the peak-to-peak hum with the cursors. Touch the **V1** or **V2** touchable readout in the WFM tile, then use the **GENERAL** knob to adjust them. The measurement should be about 100 IRE. Record Pass or Fail in the test record.

10. Switch DC Restore to Fast:

    a. Press the **IN/OUT** button.

    b. Touch the **Settings** soft key, and then the **Analog Submenu** soft key.

    c. Touch the **DC Restore** soft key, and then touch the **Fast** soft key.

    d. Touch the **Close Analog** soft key, and then the **Close Settings** soft key..

11. Touch the **V Gain** touchable readout, and then use the **GENERAL** knob to adjust the gain to X10.

12. Measure the peak-to-peak hum with the cursors. Touch the **V1** or **V2** touchable readout in the WFM tile and use the **GENERAL** knob to adjust them. It should be less than 5% of the measurement in step 9 (less than $\approx$5 IRE).

13. Record the value in the test record.

14. Press the **MAG/GAIN** button, and then touch the **Fixed Gain x1** soft key.

15. Switch DC Restore to Slow:

a. Press the **IN/OUT** button, touch the **Settings** soft key, and then touch the **Analog Submenu** soft key.

b. Touch the **DC Restore** soft key, and then touch the **Slow** soft key.

c. Touch the **Close Analog** soft key, and then the **Close Settings** soft key.

16. Measure the peak-to-peak hum with the cursors. Touch the **V1** or **V2** touchable readout in the WFM tile and use the **GENERAL** knob to adjust them. It should be between 90% and 110% of the measurement in step 9.

17. Record the value in the test record.

Composite Analog Vertical Measurement Accuracy (Option CPS only)

Use 100% white and cursors to measure gain.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.

3. Set the Precision generator for a 100% Flat Field.

4. Select the Composite A input and set the WFM tile to full screen:

a. Press the **IN/OUT** button.

b. Touch the **Analog Input A** soft key.

c. Touch within the WFM tile to select it.

d. Press the **DISPLAY** button to make the WFM tile the full screen display.

5. Adjust the cursors to be near the top and zero portions of the waveform. Touch the **V1** or **V2** touchable readout in the WFM tile, and use the **GENERAL** knob to adjust them.

6. Press the **MAG/GAIN** button and touch the **Fixed Gain x5.00** soft key.

7. Adjust the lower cursor to be right on the backporch of the waveform.

8. Touch the **Fixed Gain x1.00** soft key, and adjust the vertical position to locate the top of the waveform at the 0 mV graticule. The second cursor should also be near the zero graticule.

9. Touch the **Fixed Gain x1.00** soft key and adjust the upper cursor to be centered on the top of the waveform.

10. Cursor delta displays the magnitude of the waveform. It should be within 1% of nominal 714.86 mV. Record the amplitude in the test record.

External Reference Lock Range (Option CPS only)

Vary the time base of the reference to measure lock range.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Connect the TG2000 AVG1 to one of the CMPST A inputs, and loop the other CMPST A input to the Ref input. Terminate the other side of the Reference loop through.

3. Select the Composite A input:

   a. Press the **IN/OUT** button.

   b. Touch the **Analog Input A** soft key.

4. Press the **IN/OUT** button and touch the **Int Ref/Ext Ref** soft key to select Ext Ref.

5. Adjust the AVG1 time base offset to –50 ppm. Confirm the VECTOR and WFM displays are stable and that the readout in the upper-left corner of the display does not indicate an unlocked signal. (It is normal for the system to momentarily lose lock when the time base is changed.)

6. Increase the negative time base offset until the system cannot sustain lock. Record the maximum offset capability in the test record.

7. Repeat steps 5 and 6 for positive time base offsets.

VITC Decoding Functionality (Option CPS only)

Apply an NTSC signal with VITC and verify the VITC is correctly decoded.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. Route the NTSC signal from the AVG1 to the VITC encoder.

3. Connect the output of the VITC encoder to one of the CMPST A input connectors and terminate the other connector.

4. Select the Composite A input and set the WFM tile to full screen:

   a. Press the **IN/OUT** button.

   b. Touch the **Analog Input A** soft key.

   c. Touch within the WFM tile to select it.

   d. Press the **DISPLAY** button to make the WFM tile the full screen display.

5. Set the timecode source to VITC:

   a. Press the **IN/OUT** button.

   b. Touch the **Settings** soft key.

   c. Touch the **Analog SubMenu** soft key.

   d. Touch the **Timecode** soft key, and then the **VITC** soft key.

   e. Touch the **Close Analog** soft key, and then the **Close Settings** soft key.

6. Verify that Decoded VITC is displayed in the upper-right corner of the waveform monitor display.

7. Verify that the VITC is correct and record Pass or Fail in the test record.

Signal Source Characterization for Eye Signal Bandwidth

Measuring eye signal bandwidth requires a 75 Ω RF sine wave signal source that can be connected to the 75 Ω BNC input, and is either characterized or automatically leveled. The results of characterization must be applied at each measurement frequency, either by adjusting the generator level setting, or by applying a correction to the amplitude reading from the unit under test.

The method described here uses a 50 Ω generator, 50 to 75 Ω min loss pad, and appropriate adapters and cables to connect to the 75 Ω female BNC input of the unit under test. The exact sequence of adapters, min-loss pad, and cables is not critical as long as correct impedance is maintained in each section, and as long as the complete setup is used exactly as characterized when measuring Eye bandwidth.

The absolute signal level should be chosen to give between 750 and 850 $mV_{p\text{-}p}$ at the reference frequency, as viewed on the unit under test when in Eye BW check mode. With a setup consisting of a 50 Ω generator, a 5.7 dB min loss pad and appropriate adapters and cables, a base generator setting of 6.3 dBm normally gives this result.

Characterization Process

Characterize the test setup as follows to give a table of level setting vs frequency setting for the signal source, resulting in constant signal level at the connection point to the unit under test.

1. Connect the generator and the required converter, adapters, and cables to the wideband power detector.
2. Set the generator to the reference frequency, 50 MHz, and the base level, typically 6.3 dBm.
3. Enter '50 MHz' into the power meter, so it applies the appropriate internal correction.
4. Record the measured power level as the reference level, in Table 2−6.
5. For each frequency listed in Table 2−6, adjust the generator level for a reading closest to the reference level from step 4. Be sure to enter the frequency into the power meter at each step so that it applies the appropriate internal correction.

Table 2–6: Generator Characterization

Frequency setting (MHz)	Level setting	Frequency setting (MHz)	Level setting
100 (Reference Level)	6.3 dBm[3]	1600	
200		1700	

Table 2-6: (Cont.)Generator Characterization

Frequency setting (MHz)	Level setting	Frequency setting (MHz)	Level setting
300		1800	
400		1900	
500		2000	
600		2100	
700		2200	
800		2300	
900		2400	
1000		2500	
1100		2600	
1200		2700	
1300		2800	
1400		2900	
1500		3000	

[3] 6.3 dBm is a typical level, and may be different depending on your setup.

Audio Performance Verification Procedures

Required Equipment

Table 2–7: Required Test Equipment (Audio)

Test Equipment	Requirements	Example
SDI serial digital video test generator with embedded audio	Generates the following signals:	Tektronix TG2000 with the following modules:
	WFM7100/WFM7000 with option HD: 1080i 59.94 100% color bars with two or more groups of embedded audio	HDVG1 module for TG2000
	WFM7100/WFM7000 with Option SD and WFM6100: 525/270 100% color bars with two or more groups of embedded audio	DVG1 module for TG2000
Sine wave generator	Capable of 0.8 V_{p-p} at 6 MHz into a 50 Ω load	Rohde & Schwarz SMT03 Opt. SM-B2
Test Oscilloscope	Amplitude measurements of a 6 Mhz sine wave	Tektronix TDS7404B
Analog/Digital audio generator/analyzer	35 kHz to 96 kHz sample rate range, jitter measurement per AES-3 (1997)	Rohde & Schwarz UPL06 Opt B22, B29
Precision 75 Ω-to-50 Ω adapter	1.5% impedance and attenuation accuracy	Tektronix AMT75
75 Ω coaxial cables (2 required)	General purpose digital video Male-to-male BNC connectors 3' long	Belden 8281
50 Ω coaxial cables (2 required)	Male-to-male BNC connectors 36 inches long	Tektronix part number 012-0482-00
Return loss bridge	75 Ω test port 50 Ω input and output ports	Wide Band Engineering A57TUC with male 75 Ω BNC test port
75 Ω terminator	Male connector	Tektronix part number: 011-0055-02
Audio test cable	1/4 inch phono to 2 XLR	Sound Professionals SP-XLRM-MINI-1 with adapter SP-PHONE-MINI-ST
Audio breakout cable	DB62 to XLR I/O required for Audio Options AD, DD, and DDE	Tektronix part number 012-1688-00

Table 2–7: Required Test Equipment (Audio) (Cont.)

Test Equipment	Requirements	Example
Calculator	Logarithmic function	
Dolby (R) digital audio generator	Generates Dolby D and Dolby E bit streams. Required for Options DD, and DDE.	Dolby Laboratories DM100

The following tests verify that the Audio module for the WFM6100, WFM7000, and WFM7100 waveform monitors meets the warranted characteristics listed in the Specifications chapter. Characteristics with typical specifications (not warranted) are also checked with pass / fail criteria.

Tests for Waveform Monitors Equipped with Audio Options

The tests in this section apply to instruments with Audio options installed. The tests will note when tests or their steps apply only to specific audio options; otherwise, they apply to all the audio options.

AES Return Loss

This test verifies the return loss of the AES Inputs and Outputs. It uses a return loss bridge and compares the reflected amplitude between an open circuit and when terminated by the port under test.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. If the audio tile is not present, push the AUDIO button.
3. Install the 50 Ω N-to-BNC adapter on the sine wave generator output.
4. Connect the sine wave generator output to the input of the return loss bridge using a 50 Ω cable.
5. Connect the output of the return loss bridge to the 50 Ω input of the test oscilloscope using a 50 Ω cable. Do not connect the test port of the bridge at this time.
6. Set the sine wave generator as follows:
   - Frequency 6 MHz
   - Phase Modulation OFF
   - Frequency Modulation OFF

- Output Power +2.0 dBm (0.8 V p-p)
- RF Output ON

7. Adjust the test oscilloscope to obtain a stable display of the 6 MHz sinewave from the sinewave generator. The following oscilloscope settings normally provide a usable display:

- Vertical Scale 50 mV
- Horizontal Scale 100 ns/div
- Bandwidth Limit On

8. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the reference level.

***NOTE**. The reference level should be between 150 mV and 200 mV. Adjust the output level of the sine wave generator if necessary to obtain the correct output level.*

9. Select the AES A input:

a. Touch the **Audio Input** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)

b. Touch the **AES A** soft key.

10. Connect the test port of the Return Loss Bridge directly to the AES A 1-2 In connector. Do not use any cables or adapters.

11. Set the vertical scale on the test oscilloscope to 1 mV/div, and measure the amplitude of the signal on the test oscilloscope. Note this as the Reflection level.

12. Calculate the return loss with the formula below using the measured values from steps 8 and 11.

$$\mathit{Input\ Return\ Loss} = 20 \times \log\left(\frac{\mathit{Reference}}{\mathit{Reflection}}\right)$$

13. Check that the calculated return loss is >25 dB and record it in the test record.

14. Move the return loss bridge to each of the remaining AES A In connectors and repeat steps 10 through 13.

15. Select the AES B input:

a. Touch the **Audio Settings** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)

b. Touch the **Audio Inputs and Outputs** soft key.

c. Touch the **AES B [Input]** soft key.

d. Touch the **Exit Audio InOut** soft key.

e. Touch the **Close Audio Settings** soft key.

16. Repeat steps 10 through 14 for the AES B I/O BNCs.

17. Disconnect the test setup.

AES Sample Rate Range

This test verifies that each AES input locks to an input signal.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are listed in the test record as pass / fail.

1. Set the waveform monitor to the factory presets (see page 2−21).

2. If the audio tile is not present push the AUDIO button.

3. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1−2 In BNC connector using a 75 Ω cable.

4. Set the digital audio generator as follows:

- Frequency — 1 kHz
- Output Level — −20 dB FS Audio Tone
- Sample Frequency — 96 kHz
- Unbalanced V_{p-p} — 1.000 V (Carrier Level)

5. Select the AES A input:

a. Touch the **Audio Input** soft key. (If the Audio menu soft keys are not displayed, touch within the Audio tile first.)

b. Touch the **AES A** soft key.

6. Set the audio tile to full screen:

a. Touch within the audio tile to select it.

b. Press the **DISPLAY** button to make the audio tile the full screen display.

7. Check for an indication of –20 dB FS and no error messages in the corresponding bars, and record Pass or Fail in the test record.

8. Move the audio generator output to each of the remaining AES A In connectors and repeat step 7 for each connector.

9. Set the digital audio generator as follows:

   - Sample Frequency 35 kHz

10. Check for an indication of –20 dB FS and no error messages in the corresponding bars, and record Pass or Fail in the test record.

11. Move the audio generator output to each of the remaining AES A In connectors and repeat step 10 for each connector.

12. Disconnect the test setup.

AES Output Amplitude

This test verifies the amplitude of each AES output.

Performance Requirement. The AES output amplitude test verifies performance characteristics and is listed in the test record.

1. Set the waveform monitor to the factory presets (see page 2−21). This sets AUDIO INPUT to FOLLOW VIDEO, Embedded.

2. If the audio tile is not present, push the **AUDIO** button.

3. Select the AES B output:

   a. Touch the **Audio Settings** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)

   b. Touch the **Audio Inputs and Outputs** soft key.

   c. Touch the **AES B** soft key.

   d. If the AES B soft key says [Input] on the second line, touch the **AES−B Input/AES−B Output** soft key, to make it say [Output].

   e. Touch the **Exit Audio InOut** soft key.

   f. Touch the **Close Audio Settings** soft key.

4. Connect an SDI 100% color bars signal to the SDI A input. Use a signal type appropriate to the unit under test:

- WFM7100 or WFM7000 with Option HD:
  1080i 59.94 color bars from HDVG1
- WFM6100, WFM7100, or WFM7000 with Option SD:
  525/270 color bars from DVG1

5. Set the generator for embedded audio in 2 groups starting with group 1. Audio settings in the TG2000 are accessed as follows:

a. Press Modules.

b. Select the appropriate module icon, HDVG1 or DVG1.

c. Press Test Signals.

d. Select Module Parameters.

e. Select Embedded Audio, and make sure Audio is on.

6. Check that "PPPP PPPP −−−− −−−−" is displayed in the upper right area of the status bar, indicating the presence of two groups of embedded audio.

***NOTE**. If the status bar indicates that embedded audio is not present, set the number of groups to 2 for the TG2000 module, even if it appears to be set to 2 already.*

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7. Connect the AES B 1−2 I/O output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω−to−50 Ω adapter on the input of the test oscilloscope if necessary.

8. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

- Vertical Scale — 200 mV/div
- Horizontal Scale — 100 ns/div
- Horizontal Trigger Position — 30%
- Trigger Slope — Rising edge
- Trigger Level — 0 mV

9. Check that the amplitude of the waveform displayed on the oscilloscope is between 0.9 V and 1.1 V and record the value in the test record.

10. Move the cable to each of the remaining AES B I/O connectors and repeat step 9.

11. Disconnect the test setup.

AES Output Jitter

This test measures jitter at each AES output.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are listed in the test record as pass / fail.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. If the audio tile is not present push the **AUDIO** button.
3. Select the AES B output:
   a. Touch the **Audio Settings** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)
   b. Touch the **Audio Inputs and Outputs** soft key.
   c. Touch the **AES B** soft key.
   d. If the AES B soft key says [Input] on the second line, touch the AES-B Input/AES-B Output soft key, to make it say [Output].
   e. Touch the **Exit Audio InOu**t soft key.
   f. Touch the **Close Audio Settings** soft key.
4. Connect an SDI color-bars signal to the SDI A input. Use a signal type appropriate to the unit under test:
   - WFM7100 or WFM7000 with Option HD:
     1080i 59.94 color bars from HDVG1
   - WFM6100, WFM7100, or WFM7000 with Option SD:
     525/270 color bars from DVG1
5. Set the generator for embedded audio in 2 groups starting with group 1. Audio settings in the TG2000 are accessed as follows:
   a. Press Modules.
   b. Select the appropriate module icon, HDVG1 or DVG1.
   c. Press Test Signals.
   d. Select Module Parameters.
   e. Select Embedded Audio, and make sure Audio is on.
6. Check that “PPPP PPPP −−−− −−−−“ is displayed in the upper right area of the status bar, indicating presence of two groups of embedded audio.

***NOTE**. If status bar indicates that embedded audio is not present, set the number of groups to 2 for the TG2000 module, even if it appears to be set to 2 already.*

7. Connect the AES B 1−2 I/O connector to the digital audio analyzer unbalanced (UNBAL) input using a 75 Ω cable.

8. Set the audio analyzer for measurement of jitter per AES3−1992 (or 1997). To configure the R&S UPL06 Opt B22, B29 for jitter measurement:

a. Press ANLR to display and configure the analyzer screen.

b. Use the up/down arrow keys, keypad, and SELECT button to set the parameters in the ANALYZER panel as follows:

INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	UNBAL (BNC)
Jitter Ref	48.0 (PLL)
START COND	AUTO
Delay	0.0000s
INPUT/PHAS	OFF
FREQ/PHAS	OFF
FUNCTION –	PEAK & S/N
Meas Mode	PK abs
Intv Time	0.5000s
Unit	s
Reference	GEN TRACK
Filter	JITTER wtd
SPEAKER –	OFF

9. Allow the jitter reading to settle for a few seconds.

10. Check for a typical Jitter Peak absolute reading of less than 3.5 ns over an interval of at least 5 seconds, and record Pass or Fail in the test record.

11. Move the cable to each of the remaining AES B I/O connectors and repeat steps 9 and 10 for each AES B I/O connector.

12. Disconnect the test setup.

AES Audio Level Meter Accuracy Over Frequency

This test measures AES level meter accuracy over the audio frequency range.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are listed in the test record as pass / fail.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. If the audio tile is not present, push the **AUDIO** button.
3. Set the digital audio generator as follows:
   - Sample Frequency 48 kHz
   - Output Level −6 dB FS Audio Tone
   - Frequency 100 Hz
4. Select the AES A input:
   a. Touch the **Audio Input [Follows Video]** soft key.
   b. Touch the **AES A** soft key.
5. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1−2 In connector using a 75 Ω cable.
6. Check for an indication of –6 dB FS ±0.2 dB in the corresponding bars and record Pass or Fail in the test record.
7. Move the audio generator output to each of the remaining AES A In connectors and repeat step 6 for each connector.
8. Set the digital audio generator as follows:
   - Sample Frequency 48 kHz
   - Output Level −6 dB FS Audio Tone
   - Frequency 1 kHz
9. Repeat steps 5 through 7.
10. Set the digital audio generator as follows:
    - Sample Frequency 48 kHz
    - Output Level −6 dB FS Audio Tone
    - Frequency 19 kHz
11. Repeat steps 5 through 7.
12. Disconnect the test setup.

Headphone Output Level

This test measures the output level accuracy of the headphones.

Performance Requirement.. This test verifies performance characteristics and is listed in the test record.

1. Set the waveform monitor to the factory presets (see page 2−21).
2. If the audio tile is not present, push the **AUDIO** button.
3. Set the digital audio generator as follows:
   - Sample Frequency 48 kHz
   - Output Level −6 dB FS Sine
   - Frequency 100 Hz
4. Set the parameters in the ANALYZER panel as follows:

INSTRUMENT	ANLG 22 kHz
Min Freq	10 Hz
Ref Imped	100000 Ω
Channel	1
Ch1 Coupl	AC
Ch1 Input	BAL
Ch1 Imped	200 kΩ
Ch1 Common	FLOAT
Ch1 Range	AUTO
START COND	AUTO
Delay	0.0000 s
INPUT DISP	OFF
FUNCTION	RMS & S/N
S/N Sequ	OFF
Meas Time	AUTO
Unit Ch1	DBu
Reference	VALUE: 1.0000 V
Sweep Mode	NORMAL
Notch (Gain)	OFF
Filter	OFF
Filter	OFF
Filter	OFF

5. Touch the **Audio Input** soft key, then the **AES A** soft key.
6. Connect the digital audio generator unbalanced (UNBAL) output to the waveform monitor AES A IN 1−2 connector, using a 75 Ω cable.
7. Verify that the numbers 1,2 are visible under the headphone icon, in the audio tile. You may need to touch the **Hide Menu** soft key, if the Audio tile is in the bottom row.
8. Set the headphone output volume:
   a. Press the **In/Out** button.
   b. Touch the **Settings** soft key.
   c. Touch the **Outputs** soft key.
   d. Touch the **Headphone Volume** soft key.
   e. Use the **General** knob to set the Headphone Volume to 100%.
9. Connect the 1/4″ male phono connector from the headphone test cable to the waveform monitor headphone jack.
10. Connect the XLR corresponding to the ‘Left’ channel to the analyzer balanced (BAL) analog input.
11. Check for 0.25 dBu ±1 dB RMS on the analog analyzer. Record the result in the test record.
12. Connect the XLR corresponding to the ‘Right’ channel to the analyzer balanced (BAL) analog input.
13. Check for 0.25 dBu ±1 dB RMS on the analog analyzer. Record the result in the test record.
14. Set the digital audio generator as follows:
    - Sample Frequency 48 kHz
    - Output Level −6 dB FS Audio Tone
    - Frequency 1 kHz
15. Repeat steps 9 through 12.
16. Set the digital audio generator as follows:
    - Sample Frequency 48 kHz
    - Output Level −6 dB FS Audio Tone
    - Frequency 19 kHz
17. Repeat steps 9 through 12.

Additional Tests for Instruments equipped with Options AD, DD, and DDE

Analog Audio Level Meter Accuracy Over Frequency

This test measures the Analog Input Level Meter Accuracy over the audio frequency range.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Set the waveform monitor to the factory presets (see page 2−21), and push the **AUDIO** button.
2. Set the audio tile to full screen:
   a. Touch within the audio tile to select it.
   b. Press the **DISPLAY** button to make the audio tile the full screen display.
3. Select the Analog A input:
   a. Touch the **Audio Input** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)
   b. Touch the **Analog A** soft key.
4. Install the audio breakout cable to the Analog Audio I/O connector.
5. Connect the generator balanced (BAL) analog output to the Input A1 XLR connector of the breakout cable.
6. Set the audio generator as follows:
   - Channel 2=1
   - Frequency 100 Hz
   - Output Level 18 dBu audio tone
   - Output Impedance 10 Ω
7. Check for an indication of 18 dBu ±0.5dB in the corresponding bar and record the value in the test record.
8. Change analog audio generator Frequency to 1 kHz.
9. Check for an indication of 18 dBu ±0.5dB in the corresponding bar and record the value in the test record.
10. Change analog audio generator Frequency to 19 kHz.
11. Check for an indication of 18 dBu ±0.5dB in the corresponding bar, and record the value in the test record.

12. Repeat steps 6 through 11 for each of the other five Input A XLR connectors in the breakout cable.

13. Select the Analog B input:

    a. Touch the **Audio Input** soft key. (If the Audio menu buttons are not displayed, touch within the Audio tile first.)

    b. Touch the **Analog B** soft key.

14. Repeat steps 5 through 12 for the Input B XLR connectors on the audio breakout cable.

    If any of the Analog A Inputs failed to meet the specification, (or even if they are off by more than a few tenths of a dB) an input adjustment can be performed.

15. To perform an analog input adjust, follow steps 16 through 20; otherwise skip to step 21.

16. Set the analog audio generator as follows:

    - Frequency 1 kHz
    - Output Level 18 dBu Audio Tone
    - Output Impedance 10 Ω

17. Connect the generator balanced (BAL) analog output to the Analog A input that requires adjustment.

18. Access the Calibration routine:

    a. Press the **MAIN** button.

    b. Touch the **Config** soft key.

    c. Touch the **Diagnostics** soft key.

    d. Touch the **Calibration** soft key.

    e. Touch the **Analog Audio** soft key.

    f. Touch the soft key for the Analog Audio Channel to adjust.

    g. Touch the **Start** soft key.

    h. After the calibration process finishes, touch **Exit** to leave the calibration screen. Then touch within the Audio tile to restore the Audio soft keys.

19. Check for an indication of –18 dBu in the newly adjusted audio bar.

20. If multiple inputs require adjustment, repeat steps 17 through 19 for each input.

21. Disconnect the test setup.

Digital Input to Analog Output Gain Accuracy Over Frequency

This test measures the Analog Output level meter accuracy over the audio frequency range, when using an AES or embedded input as the audio source.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Set the waveform monitor to the factory presets (see page 2−21). If the audio tile is not present, push the **AUDIO** button.

2. Set the generator to Digital.

3. Set the Audio Output Attenuation to 0 dB:

   a. Touch the **Audio Settings** soft key.

   b. Touch the **Attenuate Aud Out** soft key.

   c. Use the **GENERAL** knob to set the attenuation to 0 dB.

4. Map Bar 1,2 to all Analog Audio Outputs:

   a. Touch the **Audio Inputs and Outputs** soft key.

   b. Touch the **AES A** soft key.

   c. Touch the **Audio Output Mapping** soft key.

   d. Touch the **Map Analog Output** soft key.

   e. Touch the **Bars 1,2** soft key.

   f. Touch the **Analog 1,2**; **Analog 3,4**; **Analog 5,6**; and **Analog 7,8** soft keys.

   g. Touch the **Exit Audio Output** soft key, then the **Exit Audio InOut** soft key.

   h. Touch the **Close Audio Settings** soft key.

5. Set the audio Input to AES A:

   a. Touch the **Audio Input** soft key.

   b. Touch the **AES A** soft key.

6. Install the audio breakout cable on the Analog Audio I/O connector.

7. Set the analog audio analyzer to measure RMS level in dBu, and for an input impedance of 200 kΩ. This is done on the Rohde & Schwarz UPL06 as follows:

a. Press ANLR to display and configure the ANALYZER panel.

b. Set the parameters in the ANALYZER panel as follows:

INSTRUMENT	ANLG 22 kHz
Min Freq	10 Hz
Ref Imped	100000 Ω
Channel	1
Ch1 Coupl	AC
Ch1 Input	BAL
Ch1 Imped	200 kΩ
Ch1 Common	FLOAT
Ch1 Range	AUTO
START COND	AUTO
Delay	0.0000 s
INPUT DISP	OFF
FUNCTION	RMS & S/N
S/N Sequ	OFF
Meas Time	AUTO
Unit Ch1	DBu
Unit Ch2	DBu
Reference	VALUE: 1.0000 V
Notch (Gain)	OFF
Filter	OFF
Filter	OFF
Filter	OFF

8. Connect the Rohde & Schwarz UPL06 Opt B22, B29 digital generator unbalanced (UNBAL) output to the AES A 1−2 In BNC using a 75 Ω cable.

9. Set the digital audio generator for a −6 dBFs, 100 Hz audio tone at 48 kHz sample rate. This is done on the Rohde & Schwarz UPL06 as follows:

a. Press GEN to display and configure the GENERATOR panel.

b. Set the parameters in the GENERATOR panel as follows:

INSTRUMENT	DIGITAL
Channel	2 = 1
Unbal Out	AUDIO OUT

Cable Sim	OFF
Sync To	GEN CLK
Sample Freq	48 kHz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Audio Bits	24
Unbal Vpp	1.0000 V
Bal Vpp	4.0000 V
Max Volt	1.0000 FS
Ref Freq	1000.0 Hz
Ref Volt	1.0000 FS
PROTOCOL	STATIC
Ch Stat. L	FILE + CRC
Filename	R&S_AES3.PGC
Ch Stat. R	EQUAL L
AUX GEN	OFF
FUNCTION –	SINE
Frq Offset	OFF
DC Offset	OFF
Dither	OFF
Equalizer	OFF
SWEEP CTRL	OFF
FREQUENCY	100.0 Hz
VOLTAGE	0.5000 FS

10. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.

11. Check for an indication of 18 dBu ±0.5dB on the analog analyzer and record the result in the test record.

12. Change the digital audio generator FREQUENCY to 1000 Hz.

13. Check for an indication of 18 dBu ±0.5dB on the analog analyzer and record the result in the test record.

14. Change the digital audio generator FREQUENCY to 19000 Hz.

15. Check for an indication of 18 dBu ±0.5dB on the analog analyzer and record the result in the test record.

16. Repeat steps 8 through 15 for each of the other Output XLR connectors.

17. Disconnect the test setup.

Analog Input to Analog Output Gain Accuracy Over Frequency

This test measures the Analog Audio Output level accuracy over the audio frequency range, when using an Analog Input as the audio source.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are listed in the test record as pass / fail.

1. Set the waveform monitor to the factory presets (see page 2−21). If the audio tile is not present, push the **AUDIO** button.
2. Set the Audio Output Attenuation to 0 dB:
   a. Touch the **Audio Setting**s soft key.
   b. Touch the **Attenuate Aud Out** soft key.
   c. Use the **GENERAL** knob to set the attenuation to 0 dB.
3. Map Bar 1,2 to all Analog Audio Outputs:
   a. Touch the **Audio Inputs and Outputs** soft key.
   b. Touch the **Analog A** soft key.
   c. Touch the **Audio Output Mapping** soft key.
   d. Touch the **Map Analog Outputs** soft key.
   e. Touch the **Bars 1,2** soft key.
   f. Touch the **Analog 1,2**; **Analog 3,4**; **Analog 5,6**; and **Analog 7,8** soft keys.
   g. Touch the **Exit Audio Output** soft key, then the **Exit Audio InOut** soft key.
   h. Touch the **Close Audio Settings** soft key.
4. Set the Audio Input to Analog Audio A:
   a. Touch the **Audio Input** soft key.
   b. Touch the **Analog A** soft key.
5. Set the analog audio generator as follows:
   - Frequency 100 Hz
   - Output Level 18 dBu
   - Output Impedance 10 Ω
6. Connect the audio break out cable to the Analog Audio I/O connector.

7. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
8. Check for an indication of 18 dBu in the corresponding bar.
9. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
10. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer, and record Pass or Fail in the test record.
11. Repeat step 10 for Output 3, Output 5 and Output 7.
12. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
13. Check for an indication of 18 dBu in the corresponding bar.
14. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
15. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer, and record Pass or Fail in the test record.
16. Repeat step 15 for Output 4, Output 6, and Output 8.
17. Set the analog audio generator as follows:
    - Frequency 1 kHz
    - Output Level 18 dBu
    - Output Impedance 10 Ω
18. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
19. Check for an indication 18 dbu in the corresponding bar.
20. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
21. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer and record Pass or Fail the result in the test record.
22. Repeat step 21 for Output 3, Output 5, and Output 7.
23. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
24. Check for an indication of 18 dBu in the corresponding bar.

25. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.

26. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer and record Pass or Fail in the test record.

27. Repeat step 26 for Output 4, Output 6, and Output 8.

28. Set the analog audio generator as follows:

- Frequency 19 kHz
- Output Level 18 dBu Audio Tone
- Output Impedance 10 Ω

29. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.

30. Check for an indication of 18 dbu in the corresponding bar.

31. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.

32. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer and record Pass or Fail in the test record.

33. Repeat step 32 for Output 3, Output 5, and Output 7.

34. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.

35. Check for an indication of 18 dbu in the corresponding bar.

36. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.

37. Check for an RMS indication of 18 dBu ±1.0 dB on the analog analyzer, and record Pass or Fail in the test record.

38. Repeat step 37 for Output 4, Output 6, and Output 8.

The completes the Performance Verification procedures.