

# Technical Reference



## **WFM6120, WFM7020, and WFM7120 Waveform Monitors Specifications and Performance Verification 071-2226-00**

This document applies to firmware version 3.0.X.

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- Worldwide, visit [www.tektronix.com](http://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.

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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:



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

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

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**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:



CAUTION  
Refer to Manual



Protective Ground  
(Earth) Terminal

# 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](http://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](http://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 WFM6120, WFM7020, and WFM7120 Series multi-format waveform monitors.

## Related User Documents

The following related user documents are available:

- *WFM6120, WFM7020, and WFM7120 Waveform Monitors Release Notes* (Tektronix part number 071-2230-XX). This document describes any known problems or behaviors that you might encounter while using the waveform monitor.
- *WFM6120, WFM7020, and WFM7120 Waveform Monitors Quick Start User Manual* (Tektronix part numbers: English, 020-2868-XX; Japanese 020-2869-XX; Simplified Chinese, 020-2870-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.
- *WFM6120, WFM7020, and WFM7120 Waveform Monitors User Technical Reference* (Tektronix part number 071-2228-XX). This document contains the detailed operating information for the instrument.
- *WFM6120, WFM7020, and WFM7120 Waveform Monitors Service Manual* (Tektronix part number 071-2227-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](http://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 WFM6120, WFM7020, and WFM7120 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%	50 kHz to 60 MHz for 1080P 60/59/50 dual link formats.
Chrominance Channels (Pb, Pr)	50 kHz to 15 MHz, ± 0.5%	50 kHz to 30 MHz for 1080P 60/59/50 dual link formats.
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		Sine-squared bars
Preshoot		
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 $\sin x/x$ reconstruction filter.
Pulse Response, Typical		Blackman pulse
Baseline Ringing		
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 <i>Digital to Analog Conversion, Data and Filter Requirements</i> , 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	$\pm 1\%$	
5X	$\pm 1\%$	
Gain		X1, X2, X5, and X10
Variable Gain Range, Nominal		0.25X to 1.8X
Frequency Response	Flat to 5.75 MHz, $\pm 1\%$	
Delay Variation over Frequency	$\pm 10$ ns to 5.75 MHz	Typically $\pm 2.5$ ns
Transient Response on Sine Squared 2T4 Pulse		Pulse to bar ratio 0.99:1 to 1.01:1
Preshoot	$\leq 1\%$	
Overshoot	$\leq 1\%$	
Ringing	$\leq 1\%$	
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		$\leq 0.5\%$ 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 <sub>RMS</sub> 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		$\pm 6$ dB range

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

Characteristic	Performance requirement	Reference information
Video Maximum Operating Amplitude with 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 $\Omega$ compensated
DC Input Impedance		20 k $\Omega$
Return Loss	$\geq 40$ 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		$\geq 60$ dB to 6 MHz
Loop through Isolation		$\geq 70$ dB to 6 MHz
DC Offset with Restore Off, Typical		$\leq 20$ 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		$\leq 2$ mV Registration between back porch and 0 V graticule
DC Offset Between Inputs With Restore Off		$\leq 7$ 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		$\leq 1$ IRE (7 mV PAL)
Blanking Shift with Presence and Absence of Burst		$\leq 1$ IRE (7 mV PAL), Typically 0 mV
Lock Range		$\pm 50$ ppm, remains locked Vector typically OK to $\pm 80$ ppm. waveform display typically locked to $\pm 200$ ppm
Lock in Presence of Hum		700 mV <sub>p-p</sub> , on full amplitude 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	$\pm 0.5\%$ , all rates	Line sweeps for 1080P 60/59/50 dual link formats are shown with image scanning time scale. In these formats, each link operates at $\frac{1}{2}$ the image scanning rate, so link time scale is twice the indicated time per division.
Linearity	0.2% of time displayed on screen	Fully digital system
Timing Cursor Delta Readout Accuracy, Typical		$\pm 0.5\%$ of sweep time displayed on screen
Rates		1, 2, 3, or 4 line, or field depending on mode
Line Select		In 2-line sweep, the selected line is the first displayed line.

**Table 1-5: Eye Pattern Display**

Characteristic	Performance requirement	Reference information
Type		Equivalent Time Sampler
Formats		SD and HD, as shown in Table NO TAG
Signal Bandwidth	100 MHz to 2.5 GHz at -3 dB point	
Time Base Jitter, Typical		
SD		60 ps <sub>p-p</sub> in 1 kHz high-pass filter mode
HD		20 ps <sub>p-p</sub> 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 $\pm 5\%$ with an 800 mV <sub>p-p</sub> input signal	
Horizontal Scale Accuracy		Indicated time per division $\pm 1\%$ , fully digital system
Eye Derived Measurements		
Rise Time / Fall Time, Typical		$\pm 20$ ps 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		$\pm 10$ 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 $\pm 80$ mv  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 <sub>p-p</sub>
10 Hz to 40 kHz, SD		10 UI <sub>p-p</sub>
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 $\Omega$ 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 (6.8 MHz for 1080P 60/59/50 dual link formats)
Vertical Gain Accuracy	$\pm 0.5\%$	Fully digital system
Horizontal Gain Accuracy	$\pm 0.5\%$	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		$1 \pm 0.1\%$ relative to flat gain
HD, component only		$1 \pm 0.1\%$ 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	$\leq 3$ dB attenuation at 800 kHz $\geq 32$ dB attenuation at 3 MHz Filter meets IEEE STD-205	
HD, component only	$\leq 3$ dB attenuation at 4.5 MHz $\geq 25$ dB attenuation above 15 MHz, Noise bandwidth is approximately 8 MHz Stopband null at 18 MHz	For 1080P 60/59/50 dual link formats: $\leq 3$ dB attenuation at 9 MHz $\geq 25$ dB attenuation above 30 MHz
Luma Filter Gain, composite only	$1 \pm 0.1\%$ relative to flat gain at 50 kHz	
Luma Filter Frequency Response, composite only	$\leq 3$ dB attenuation at 800 kHz 32 dB attenuation at $F_{SC}$ Same as SD serial component low pass filter	
Chroma Filter Gain, composite only	$1 \pm 0.1\%$ relative to flat gain	
Chroma Filter Response, composite only	3 dB bandwidth $1 \text{ MHz} \pm 0.2 \text{ MHz}$ $F_{SC}$ autoselected based on input standard, implemented digitally, centered on $F_{SC}$	
Chroma Filter Attenuation at $2x F_{SC}$ , composite only	$\geq 25$ 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	$\pm 0.5\%$	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 Pr 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	$\pm 3.5$ 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	$\pm 1\%$	
X5 Gain	$\pm 1\%$	
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	$< 0.5^\circ$ at 500 kHz and 2 MHz	
Composite Vector Dot Reference		Shows "true" zero subcarrier reference
R-Y B-Y Axis Orthogonality, Typical		$\pm 0.1^\circ$ , implemented digitally

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

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy	$\pm 1\%$ , 100 IRE (700 mV), and 131 IRE (900 mV)	(PAL values in parenthesis)
Composite Limit Cursor Accuracy	$\pm 1.0\%$ at 100 IRE, 110 IRE, 120 IRE, and 131 IRE (700 and 950 mV)	(PAL values in parenthesis)
	$\pm 1.0\%$ 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 = $\pm 7$ 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 = $\pm 7$ 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	$\geq 34$ dB at 2.5 MHz	
	HD	$\geq 34$ dB at 5 MHz	
Interchannel Timing Match	$\pm 0.5$ 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		<p>Display of Vertical and Horizontal timing offset graphically and numerically. One clock cycle resolution</p> <p>Patented proprietary display. Display Timing difference between input and Ref at rear panel or relative to an offset saved by the user</p>
Timing Display Zero Definition		<p>For vertical timing, conforms to SMPTE 168-2002</p> <p>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 coincident with the reference</p> <p>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</p> <p>Vertical timing, according to SMPTE 168, specifies that the lines with the start of the broad pulses are aligned</p>
Operation with input and reference being different formats		<p>Compatible with any combination listed in Tables 1-45, 1-46, and 1-47. 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</p>
Link B to Link A		<p>Display of dual link timing skew. Uncertainty of <math>\pm 1.5</math> clocks or 20 ns.</p>
Input Timing Reference to Other Input		<p>For Simultaneous inputs, allows selection of other channel as reference.</p>



**Table 1-15: Picture Mode**

Characteristic	Performance requirement	Reference information
Format (XGA)		<p>Allows viewing picture in all formats</p> <p>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</p> <p>In HD formats, picture is downsampled to fit in 1024 x 768 size (512 x 350 in 4-tile mode). In 1080P 60/59/50 dual link formats, picture is formed by averaging two lines, one from each link, then downsampling as required for display</p> <p>In Low Frame Rate formats, frames are repeated as needed to achieve XGA frame rate; similar to 3:2 pulldown on some frame rates</p>
Pix Border On/Off		<p>Allows user to mask or show the inactive portions of the raster such as ANC area for digital and sync for analog.</p> <p>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 decimated to reduce the artifacts</p>
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 $\pm$ 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

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

Characteristic	Performance requirement	Reference information
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
Launch Amplitude Measurement Accuracy, Typical		$\pm 40$ 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		$\pm 50\%$ 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**

<b>Characteristic</b>	<b>Performance requirement</b>	<b>Reference information</b>
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
Dual Audio Display Mode		For Simultaneous inputs, Dual Audio Displays are available. A total of 8 bars may be allocated between the two displays. Dolby decoding may be enabled for either display, but not for both
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		<p>User selectable 1 to 20. Factory default is set to 8.</p> <p>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.</p> <p>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</p>
Metering Ballistic Types		Selectable from true peak, PPM Type 1, PPM Type 2, and Extended VU
Peak Program Meter (PPM) Ballistic Response		<p>PPM Type I (IEC Type I, essentially the same as DIN 45406 and Nordic N-9)</p> <p>PPM Type II (IEC Type II, the same as IEEE std. 152-1991)</p> <p>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</p>

**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: AV Delay display (Option AVD)**

Characteristic	Performance requirement	Reference information
Audio Video Delay measurement		Displays the delay of embedded audio relative to SDI video. Shows delay in milliseconds and in fields. Requires SDI signal from TG700 in AV Timing mode.
Measurement Range		At least -2 to +2 seconds: a negative reading indicates audio is advanced with respect to video; a positive reading indicates it is delayed. Range depends on the repetition rate of the test signal. Specification applies for TG700 AV Timing mode, which has a nominal 5 second repetition rate.
Measurement Accuracy	+/- 1/2 video field.	

**Table 1-22: AES Audio Inputs <sup>1</sup>**

Characteristic	Performance requirement	Reference information
Inputs		2 sets with 8 channels each, 32-192 kHz, 24 bit, meets requirements of AES-31D and SMPTE 276M-1995
Input Connector		BNC, terminated, unbalanced
Input Impedance		75 $\Omega$



**Table 1-22: AES Audio Inputs <sup>1</sup> (Cont.)**

Characteristic	Performance requirement	Reference information
Input Return Loss	>25 dB relative to 75 $\Omega$ , 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		> $\pm$ 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	$\pm$ 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 <sup>th</sup> of rate -0.30 dB (16 kHz $\pm$ 5 Hz) 1/16 <sup>th</sup> of rate -0.17 dB (12 kHz $\pm$ 5 Hz) 1/20 <sup>th</sup> of rate -0.11 dB (9.6 kHz $\pm$ 5 Hz)	May not display full amplitude on fast transients due to sampled nature of digital signal
Audio Levels		Bars display signals up to 0 dBFS  Must not exceed maximum power specification on analog outputs. Configure output attenuation if necessary

<sup>1</sup> The AES B connectors can be configured for input or output functionality.

**Table 1-23: AES Audio Outputs (alternate function on second set of inputs) <sup>1</sup>**

Characteristic	Performance requirement	Reference information
Source		AES Line B outputs can be sourced from embedded, AES line A inputs (active loophrough) 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

**Table 1-23: AES Audio Outputs (alternate function on second set of inputs) <sup>1</sup> (Cont.)**

Characteristic	Performance requirement	Reference information
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 $\Omega$
Output Return Loss	>25 dB relative to 75 $\Omega$ 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 $\Omega$	
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
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

<sup>1</sup> The AES B connectors can be configured for input or output functionality.

**Table 1-24: 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. With Simultaneous inputs or dual link formats, 16 channels of each selected SDI input 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 1-25: 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

**Table 1-25: Analog Audio Inputs (Cont.)**

Characteristic	Performance requirement	Reference information
Level Meter Accuracy over Frequency	<p><math>\pm 0.3</math> 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:</p> <p>1/12<sup>th</sup> of rate -0.30 dB (16 kHz <math>\pm</math>5 Hz)  1/16<sup>th</sup> of rate -0.17 dB (12 kHz <math>\pm</math>5 Hz)  1/20<sup>th</sup> of rate -0.11 dB (9.6 kHz <math>\pm</math>5 Hz)</p>	
Cross Talk, Typical		<p><math>\leq -90</math> dB from 20 Hz to 20 kHz, inputs driven from <math>&lt; 600 \Omega</math> source impedance</p> <p>Defined as the displayed bar level in any channel that results from a full scale signal on a different input pair than that input</p>
Maximum Input Levels	+ 24 dBu $\pm 0.3$ 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 k $\Omega$
Off Isolation		<p><math>\leq -90</math> dB, from 20 Hz to 20 kHz. Unused input driven from <math>&lt; 600 \Omega</math> source impedance</p> <p>Defined as the displayed bar level that results from a full scale signal on any pair of the unused input</p>
Analog Input to Digital Output Distortion (THD+N), Typical		$< 0.03\%$ from full scale to -30 dBFS, 20 Hz to 20 kHz

Table 1-26: Analog Audio Outputs

Characteristic	Performance requirement	Reference information
Audio Modes		<p><i>Balanced</i>: provides a full-scale output of 24 dBu and is designed for professional balanced applications</p> <p><i>Unbalanced</i>: Designed to drive the unbalanced inputs of consumer amplifiers, in which case the negative output pin must be grounded</p>
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		<p>Balanced, unterminated via rear panel connector</p> <p>62 pin, 3 row, DSUB connector, but only 2 rows of 42 pins are connected</p> <p>Ground negative output to support unbalanced mode</p>
Maximum Output Levels	+ 24 dBu $\pm$ 0.5 dBu	When one output is grounded to achieve unbalanced mode, the other 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	$\pm$ 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	$\pm$ 0.8 dB, 20 Hz to 20 kHz, 24 dBu to -16 dBu	
Output Impedance		<p>50 <math>\Omega</math></p> <p>Intended to drive <math>\geq</math>600 <math>\Omega</math> load. Drivers are capable of driving a minimum load impedance of 300 <math>\Omega</math> but may overheat. DO NOT exceed maximum rated output power</p>
Digital Input to Analog Output Distortion (THD + N)		$\leq$ -0.01% from full scale to -20 dBFS, 20 Hz to 20 kHz
Analog Input to Analog Output Distortion (THD + N)		$\leq$ -0.02% from full scale to -20 dBFS, 20 Hz to 20 kHz

**Table 1-26: 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 continuously driving a -10 dBFS sinewave into 600 $\Omega$ or -13 dB into 300 $\Omega$  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	$\pm 0.1$ dB, 20 Hz to 20 kHz, 0 to -40 dBFS	
Digital Input to Headphone Output Distortion (THD + N), Typical		$\pm 0.05\%$ from full scale to -10 dBFS, 20 Hz to 20 kHz, into 32 $\Omega$  <0.2% at full scale into 32 $\Omega$  <2% at full scale into 16 $\Omega$
Headphone Output Power Capability		Capable of continuously driving a 6.25 dBu sinewave into 32 $\Omega$ or 16 $\Omega$

**Table 1-27: 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. 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 1-27: Dolby Digital (AC-3) Compressed Audio Monitoring (Opt. DDE) (Cont.)**

Characteristic	Performance requirement	Reference information
Dolby Audio Status Display		Displays basic Dolby D status and bit stream meta-data
Alarms		See Tables 1-49 through 1-55 for added error indicators

**Table 1-28: 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 1-49 through 1-55 for added error indicators

**Table 1-29: 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. With 1080P 60/59/50 dual link formats, combined links are down-converted to the related 1080i format. 4:4:4 dual link formats are down-converted to 4:2:2  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 $\Omega$ unbalanced

**Table 1-29: Picture Monitor Outputs (VGA Pix Mon) (Cont.)**

Characteristic	Performance requirement	Reference information
Active Video Accuracy	700 mV $\pm$ 5% peak-peak (Y-Pb-Pr mode)	
Black (blanking) Output Level	0 mV $\pm$ 50 mV for HD and SD	
Frequency Response, Typical		Measure with a VM5000 and use "normal" VGA to BNC cable (such as Allied 796-9640)
SD		$\pm$ 5% to 5.5 MHz, Y, G, B, and R
HD		$\pm$ 8% to 30 MHz, Y, G, B, and R
Non-Linearity, Typical		$\leq$ 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 $\pm$ 5.0 ns
HD		Y-to-Pb and Y-to-Pr $\pm$ 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 $\pm$ 5% including sync and 100% white video
Composite Offset, Typical		$\pm$ 100 mV
Composite mode SNR, Typical		60 dB RMS to 700 mV with 20 MHz BW



**Table 1-30: 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 1-31: 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 1-32: LTC Time Code Input / Ground Closures**

Characteristic	Performance requirement	Reference information
LTC Input Connector		Balanced, unterminated via rear-panel GC remote connector. See Table 1-39 for connector pinout
LTC Input Impedance		Greater than 10 k $\Omega$
LTC Signal Characteristics		Longitudinal Time Code per IEC Publication 461
LTC Signal Amplitude Range, Typical		0.2 V <sub>p-p</sub> to 5.0 V <sub>p-p</sub> , balanced differential or single-ended

**Table 1-32: LTC Time Code Input / Ground Closures (Cont.)**

Characteristic	Performance requirement	Reference information
Ground Closure Input Signaling (Preset Selection)		<p>TTL thresholds, 5 V maximum input, -0.5 V minimum input. Pull low to assert</p> <p>Has internal 10 k<math>\Omega</math> pull-up to 5 V on each input</p> <p>Direct or encoded inputs must be asserted and stable for at least 150 ms to be recognized reliably. Inputs that are stable for 75 ms or less will never be recognized</p> <p>Inputs are sampled every 16.6 ms. Five consecutive samples must all have the same code for the code to be accepted. It is possible to pulse the codes synchronously with the sampling process and trick the system. Users are encouraged to work within the intent of the specification to insure reliable operation</p>
Ground Closure Output Characteristics		<p>One open collector output</p> <p>Pulled up by 10 k<math>\Omega</math> resistor in series with a diode to +5 V. Pull down current is limited by 10 <math>\Omega</math> resistor. Maximum current allowed is 100 mA</p>

**Table 1-33: VITC Decoding**

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

**Table 1-34: 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 $\Omega$ BNC, internally terminated

**Table 1-34: Serial Digital Video Interface (Input A, Input B) (Cont.)**

Characteristic	Performance requirement	Reference information
Cable Loss Accommodation	With 1/SQRT(f) characteristic at 1/2 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%
Jitter Tolerance, Typical		0.35 UI <sub>p-p</sub> 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 1-35: Serial Video Output (Serial Out/SDI PixMon)**

Characteristic	Performance requirement	Reference information
Format		<p>1.485 Gb/s, 1.4835 Gb/s, or 270 Mb/s same as selected input. With Simultaneous inputs, configurable to be Channel 1 or Channel 2</p> <p>With 1080P 60/59/50 dual link formats, combined links are down-converted to the related 1080i 4:2:2 single link format</p> <p>With other dual link formats, combined links are down-converted to the related 4:2:2 10-bit single link format</p>
Content - Follows Active Input With Brightups		<p>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. For dual link formats, Pix Mon may be configured to display picture from link A alone, link B alone, or links A and B combined</p> <p>Gamut error brightups appear one line below error</p>
Output Level	800 mV, $\pm$ 10% into 75 $\Omega$ 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 1-36: External Reference**

Characteristic	Performance requirement	Reference information
Input Type		Passive loop-through, 75 $\Omega$ compensated
Operational		Locks to analog bi-level and tri-level signals of formats listed in Tables 1-45 through 1-47. 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  With Simultaneous inputs, External Reference settings apply to both channels
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 k $\Omega$
Maximum Operating Input Voltage, Typical		$\pm$ 5 V DC
Absolute Maximum Input Voltage, Typical		$\pm$ 5 V DC
Inband Input Impedance, Typical		$\geq$ 15 k $\Omega$
Return Loss, Typical		> 40 dB to 6 MHz > 29 dB to 30 MHz
Hum Tolerance, Typical		Operates with 500 mV <sub>p-p</sub> at 50 or 60 Hz
Signal/Noise Tolerance, Typical		Operates to 25 dB

**Table 1-37: 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 1-38: 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 1-39: 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		<table border="1"> <thead> <tr> <th>Pin #</th> <th>Signal</th> </tr> </thead> <tbody> <tr><td>1</td><td>Out; GND</td></tr> <tr><td>2</td><td>In; Time Code Positive (LTC input)</td></tr> <tr><td>3</td><td>In; Time Code Negative (LTC input)</td></tr> <tr><td>4</td><td>Out; GND</td></tr> <tr><td>5</td><td>Out; Ground Closure Output</td></tr> <tr><td>6</td><td>In; Preset Recall A1</td></tr> <tr><td>7</td><td>In; Preset Recall A2</td></tr> <tr><td>8</td><td>In; Preset Recall A3</td></tr> <tr><td>9</td><td>In; Preset Recall A4</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Hex</th> <th>Binary Pins 9,8,7,6</th> <th>Direct mode selection</th> <th>Encoded mode selection</th> </tr> </thead> <tbody> <tr><td>F</td><td>1111</td><td>none</td><td>none</td></tr> <tr><td>E</td><td>1110</td><td>Preset 1</td><td>CPS B</td></tr> <tr><td>D</td><td>1101</td><td>Preset 2</td><td>CPS A</td></tr> <tr><td>C</td><td>1100</td><td></td><td>SDI B</td></tr> <tr><td>B</td><td>1011</td><td>Preset 3</td><td>SDI A</td></tr> <tr><td>A</td><td>1010</td><td></td><td>Channel B</td></tr> <tr><td>9</td><td>1001</td><td></td><td>Channel A</td></tr> <tr><td>8</td><td>1000</td><td></td><td>Preset 8</td></tr> <tr><td>7</td><td>0111</td><td>Preset 4</td><td>Preset 7</td></tr> <tr><td>6</td><td>0110</td><td></td><td>Preset 6</td></tr> <tr><td>5</td><td>0101</td><td></td><td>Preset 5</td></tr> <tr><td>4</td><td>0100</td><td></td><td>Preset 4</td></tr> <tr><td>3</td><td>0011</td><td></td><td>Preset 3</td></tr> <tr><td>2</td><td>0010</td><td></td><td>Preset 2</td></tr> <tr><td>1</td><td>0001</td><td></td><td>Preset 1</td></tr> <tr><td>0</td><td>0000</td><td></td><td>unused</td></tr> </tbody> </table>	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	Hex	Binary Pins 9,8,7,6	Direct mode selection	Encoded mode selection	F	1111	none	none	E	1110	Preset 1	CPS B	D	1101	Preset 2	CPS A	C	1100		SDI B	B	1011	Preset 3	SDI A	A	1010		Channel B	9	1001		Channel A	8	1000		Preset 8	7	0111	Preset 4	Preset 7	6	0110		Preset 6	5	0101		Preset 5	4	0100		Preset 4	3	0011		Preset 3	2	0010		Preset 2	1	0001		Preset 1	0	0000		unused
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8	1000		Preset 8																																																																																							
7	0111	Preset 4	Preset 7																																																																																							
6	0110		Preset 6																																																																																							
5	0101		Preset 5																																																																																							
4	0100		Preset 4																																																																																							
3	0011		Preset 3																																																																																							
2	0010		Preset 2																																																																																							
1	0001		Preset 1																																																																																							
0	0000		unused																																																																																							

**Table 1-40: Power Source**

Characteristic	Performance requirement	Reference information
Electrical Rating	100 - 240 VAC $\pm$ 10%, 50/60 Hz 115 Watts max.	
Supply Connection		Detachable cord set
Power Consumption, Typical		50 to 110 VA at 110 or 240 VAC
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 1-41: Miscellaneous**

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



## Physical Specifications

**Table 1-42: 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 1-43: 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 1-44: Certifications and compliances**

Category	Standards or description
EC Declaration of Conformity - EMC	<p>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:</p> <p>EN 55103                      Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.<sup>2</sup></p> <p>Environment                      E2 - commercial and light industrial</p> <p>Part 1 Emission</p> <p>EN 55022                      Class B radiated and conducted emissions</p> <p>EN 55103-1, Annex A              Radiated magnetic field emissions</p> <p>EN 55103-1, Annex B              Inrush current; I peak = 3.1 amps</p> <p>Part 2 Immunity</p> <p>IEC 61000-4-2                      Electrostatic discharge immunity</p> <p>IEC 61000-4-3                      RF electromagnetic field immunity</p> <p>IEC 61000-4-4                      Electrical fast transient / burst immunity</p> <p>IEC 61000-4-5                      Power line surge immunity</p> <p>IEC 61000-4-6                      Conducted RF Immunity</p> <p>IEC 61000-4-11                      Voltage dips and interruptions immunity</p> <p>EN 55103-2, Annex A              Radiated magnetic field immunity</p> <p>EN 61000-3-2                      AC power line harmonic emissions</p>
Australia / New Zealand Declaration of Conformity - EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <p>AS/NZS 2064.1/2                      Industrial, Scientific, and Medical Equipment: 1992</p>
FCC Compliance	Exempt from FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
EC Declaration of Conformity - Low Voltage	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC, amended by 93/68/EEC</p> <p>EN61010-1:2001                      Safety requirements for electrical equipment for measurement control and laboratory use.</p>
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.

<sup>2</sup> **Must use high-quality shielded cables to ensure compliance.**

**Table 1-44: Certifications and compliances (cont.)**

<b>Category</b>	<b>Standards or description</b>
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 1-45 through 1-47 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 1-45: 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 <sup>3</sup>	X		X			X
720p 50 Hz <sup>3</sup>	X		X			X
1080p 25 Hz <sup>3,4</sup>	X		X			X
1080sf 25 Hz <sup>3,4</sup>	X		X			X
1080i 50 Hz <sup>3,4</sup>	X		X			X
576i 50 Hz (625)	X		X			X
PAL 50 Hz <sup>4</sup>	X					

**Table 1-46: 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 <sup>3</sup>	X			X	X	X			X
720p 29.97 Hz <sup>3</sup>	X			X					X
720p 59.94 Hz <sup>3</sup>	X			X	X	X			X
1080p 23.98 Hz <sup>3,4</sup>	X			X	X	X			X
1080sf 23.98 Hz <sup>3,4</sup>	X			X	X	X			X
1080p 29.97 Hz <sup>3,4</sup>	X			X					X
1080sf 29.97 Hz <sup>3,4</sup>	X			X					X

Table 1-46: 59.94 Hz, 23.98 Hz, and 29.97 Hz Frame and Field rates (Cont.)

Input 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
1035i 59.94 Hz <sup>3</sup>	X			X					X
1080i 59.94 Hz <sup>3,4</sup>	X			X					X
483i 59.94 Hz (525)	X			X					X
NTSC 59.94 Hz <sup>5</sup>	X								

<sup>3</sup> WFM7020 and WFM7120 Opt. HD only.

<sup>4</sup> Includes support dual-link standards with option DL.

<sup>5</sup> Opt. CPS only.

Table 1-47: 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 <sup>3</sup>			X	X	X			X
720p 30 <sup>3</sup>			X					X
720p 60 <sup>3</sup>			X	X	X			X
1080p 24 <sup>3,4</sup>			X	X	X			X
1080sf 24 <sup>3,4</sup>			X	X	X			X
1080p 30 <sup>3,4</sup>			X					X
1080sf 30 <sup>3,4</sup>			X					X
1035i 60 Hz <sup>3</sup>			X	X	X			X
1080i 60 Hz <sup>3,4</sup>			X	X	X			X

<sup>3</sup> WFM7020 and WFM7120 Opt. HD only.

<sup>4</sup> Includes support dual-link standards with option DL.

**Table 1-48: Supported Standards**

Image Standard	System Nomenclature	Interface Standard	Signal Type	Image system number for indicated field/frame rate								
				60	59.94	50	30	29.97	25	24	23.98	
274M	1920 x 1080/P	372M (dual link)	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>	1	2	3						
	1920 x 1080/P, PsF		10-bit 4:4:4(:4) R'G'B' (A)				7	8	9	10	11	
			12-bit 4:4:4 R'G'B'				7	8	9	10	11	
			10-bit 4:4:4(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)				7	8	9	10	11	
			12-bit 4:4:4 Y'C <sub>B</sub> C <sub>R</sub>				7	8	9	10	11	
			12-bit 4:2:2(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)				7	8	9	10	11	
	292M	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>				7	8	9	10	11		
	1920 x 1080/I	372M (dual link)	10-bit 4:4:4(:4) R'G'B' (A)	4	5	6						
			12-bit 4:4:4 R'G'B'	4	5	6						
			10-bit 4:4:4(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)	4	5	6						
			12-bit 4:4:4 Y'C <sub>B</sub> C <sub>R</sub>	4	5	6						
			12-bit 4:2:2(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)	4	5	6						
		292M	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>	4	5	6						
	2048 x 1080/P, PsF	372M- proposed	10-bit 4:4:4(:4) R'G'B' (A)				X	X	X	X	X	
			12-bit 4:4:4 R'G'B'				X	X	X	X	X	
10-bit 4:4:4(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)						X	X	X	X	X		
12-bit 4:4:4 Y'C <sub>B</sub> C <sub>R</sub>						X	X	X	X	X		
12-bit 4:2:2(:4) Y'C <sub>B</sub> C <sub>R</sub> (A)						X	X	X	X	X		
295M (1250/50)	1920 x 1080/I, P		Not supported									

**Table 1-48: Supported Standards (Cont.)**

Image Standard	System Nomenclature	Interface Standard	Signal Type	Image system number for indicated field/frame rate								
240M 260M	1920 x 1035/I	292M	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>	X	X							
296M		292M	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>	1	2	3	4	5	6	7	8	
ITU-R BT.601	720 x 576/I (625)	292M	4:2:2 Y'C <sub>B</sub> C <sub>R</sub>			X						
	720 x 483/I (525)		4:2:2 Y'C <sub>B</sub> C <sub>R</sub>		X							
293M	720 x 480/P	Not supported										

## Alarms

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

**Table 1-49: Common Alarms**

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 1-45, 1-46, and 1-47, Supported Input Formats and Allowed References

**Table 1-49: Common Alarms (Cont.)**

<b>Alarm</b>	<b>Description</b>
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
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 1-50: HD Specific Alarms (WFM7120, WFM7020 Opt. HD)**

<b>Alarm</b>	<b>Description</b>
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



**Table 1-50: HD Specific Alarms (WFM7120, WFM7020 Opt. HD) (Cont.)**

Alarm	Description
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 1-51: SD Specific Alarms**

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 1-52: 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 1-53: 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

**Table 1-53: Audio Alarms (Opts. DS and AD Only) (Cont.)**

<b>Alarm</b>	<b>Description</b>
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 1-54: Additional Audio Alarms (Opt. DDE Only)**

<b>Alarm</b>	<b>Description</b>
Dolby Format	Indicates Dolby audio Format is not as expected

**Table 1-55: Additional Audio Alarms (Opt. DDE Only)**

<b>Alarm</b>	<b>Description</b>
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 following waveform monitor products perform as warranted:

- WFM7120 models and their options
- WFM7020 models and their options
- WFM6120 models and their options

This chapter is divided into two sections: *Incoming Inspection Procedures* and *Performance Verification Procedures*. The test procedures in this chapter provide for an extensive confirmation of performance and functionality.

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**NOTE.** *Before performing any of the procedures and tests in this manual, 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 1-43.*

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# 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

### WFM6120, WFM7020, and WFM7120 Waveform Monitor Functional Test Record

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

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
<b>Basic Turn On and Self Test</b>			
Front Panel LEDs			
POST			
<b>Front Panel Test</b>			
LCD Pixel and Defects			
<b>LCD Color Palette and Advanced Diagnostics Test</b>			
LCD Color Palette Test			
Advanced Diagnostics			
<b>Fan Test</b>			
SDI Bit Integrity			
<b>External Reference</b>			
NTSC Lock			
Ref Missing			
<b>EYE (Options EYE and PHY only)</b>			
Eye Waveform			
Jitter Waveform			
<b>Composite Input (Option CPS only)</b>			
CMPST A, WFM with NTSC			
CMPST A, Vector with NTSC			
CMPST A, Picture with NTSC			
CMPST B, WFM with NTSC			

**WFM6120, WFM7020, and WFM7120 Waveform Monitor Functional Test Record (cont.)**

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

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
CMPST B, Vector with NTSC			
CMPST B, Picture with NTSC			
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 Waveform and Decode			
LTC Waveform			
LTC Decode			
Ground Closure Remote			
Remote Input – Activate Preset			
Remote Output – Ground Closure			
Ethernet Functionality			
Simultaneous Input Operation (Option SIM only)			
Dual Link Format (Option DL only)			
A/V Delay (Option AVD only)			



## Test Record - All Instruments

If you are testing a WFM6120 or a WFM7000 without Opt HD, skip the HD-only entries in the record. Complete the other entries, which are common to all models.

### WFM6120, WFM7000, and WFM7120 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			

**WFM6120, WFM7000, and WFM7120 Waveform Monitor Video Performance Test Record (cont.)**

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
<b>HD Jitter Readout Accuracy (HD only)</b>				
Jitter Trace	Pass			
Jitter Readout	Pass			
<b>External Reference Return Loss</b>				
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
<b>Reference Clock Amplitude and Frequency</b>				
Clock Amplitude	Pass			
Clock Frequency	Pass			
<b>Eye Signal Bandwidth</b>				
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* WFM6120 and WFM7120 instruments and all *Option SD-equipped* WFM7000 instruments.

### WFM7120 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
<b>SD SDI Input Level Low and High</b>				
Input A, Low Level				720 mV
Input A, High Level	880 mV			
Input B, Low Level				720 mV
Input B, High Level	880 mV			
<b>SD SDI Input Equalization Range and EDH</b>				
EDH	Pass			
Input A	30 dB			
Input B	30 dB			
SD PixMon Multiburst Frequency Response	-0.92 dB (-10%)			+0.82 dB (+10%)
<b>Analog Pixmon Gain and Offset</b>				
YPbPr	Pass			
RGB	Pass			
Composite	Pass			
SD SDI Serial Output Amplitude	760 mV			840 mV
<b>SD SDI Return Loss</b>				
Input A	-25 dB			
Input B	-25 dB			
SD VITC Decoding Functionality	Pass			
<b>SD Cable Meter</b>				
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			
<b>SD Jitter Noise Floor and Bounce</b>				
Jitter Noise Floor	Pass			

**WFM7120 Waveform Monitor Video Performance Test Record (Option SD only) (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
SD Jitter Readout Accuracy				
Jitter Trace	Pass			
Jitter Readout	Pass			
Jitter Vibration	Pass			

## Test Record - Option CPS only

### WFM7120 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	(0mV)			5% (35 mV)
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 and DDE only

### WFM7120 Waveform Monitor Audio Options AD and DDE only Test Record

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
<b>AES Audio Return Loss</b>				
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			
<b>AES Audio Input Sample Rate</b>				
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			
<b>AES Audio Output Amplitude</b>				
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
<b>AES Audio Output Jitter</b>				
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			
<b>AES Audio Level Meter Accuracy Over Frequency</b>				
AES A 1 In (100 Hz)	Pass			

**WFM7120 Waveform Monitor Audio Options AD and DDE only Test Record (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
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			

**WFM7120 Waveform Monitor Audio Options AD and DDE only Test Record (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
<b>Headphone level accuracy over frequency</b>				
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
<b>Analog Audio Level Meter Accuracy Over Frequency</b>				
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



**WFM7120 Waveform Monitor Audio Options AD and DDE only Test Record (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
<b>Analog Audio Level Meter Accuracy Over Frequency</b>				
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
<b>Digital Input to Analog Output Gain Accuracy Over Frequency</b>				
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

**WFM7120 Waveform Monitor Audio Options AD and DDE only Test Record (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
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
<b>Analog Input to Analog Output Gain Accuracy Over Frequency</b>				
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

### WFM7120 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
<b>AES Audio Return Loss</b>				
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			
<b>AES Audio Input Sample Rate</b>				
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			
<b>AES Audio Output Amplitude</b>				
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

**WFM7120 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			

**WFM7120 Waveform Monitor Audio Option DS only Test Record (cont.)**

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

<b>Performance Test</b>	<b>Minimum</b>	<b>Incoming</b>	<b>Outgoing</b>	<b>Maximum</b>
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 1-43 on page 1-39.

Use the following procedures to check the basic functionality of WFM6120, WFM7020, and WFM7120 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 $\Omega$ 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 $\Omega$ Terminator for Analog Video	Male connector, Precision	Tektronix part number 011-0102-03
Analog audio breakout cable (required for Audio Options AD and 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 $\Omega$ BNC)	Dolby Laboratories DM100 Bitstream Analyzer. (Option DDE only.)

**Table 2-1: Required Test Equipment (Cont.)**

<b>Test Equipment</b>	<b>Requirements</b>	<b>Example</b>
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 WFM7120 or WFM7020 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, DDE)
	525/270 SD signals required: 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, DDE)
	Composite signals required for Option CPS: NTSC SMPTE bars	AVG1 module for TG2000
	Dual link signals required for Options DL and SIM	TG700 with HDVG7 and DVG7 modules; or TG2000 with HDVG1 and DVG1 modules
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 WFM7120 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 1-2 on page 2-55 for wiring diagram of cable
Computer and ethernet cable	Used to test Ethernet connection	Generic equipment
Dual Link Generator		Tektronix TG700



## 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 **MAG**, **LINE SEL**, and **CURSOR** 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 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 **CONFIG > Utilities > View Diagnostics Log > SEL**.
7. After the diagnostics are finished, the instrument state is restored. When the progress indicator in the status bar 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, exit the Diagnostics Log.

### Restore the Factory Presets

1. Follow these steps to reset the waveform monitor to the Factory Presets:
  - a. Press and hold the **PRESET** button.
  - b. Select **Recall Preset > Recall Factory Preset**.
  - c. Press the **SEL** button.

### 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 a 525/270 color bar signal from DVG1 to the SDI A input
3. Press **FULL** to set the active tile to full screen.
4. Turn the **HORIZONTAL** and **VERTICAL** knobs and verify the waveform moves appropriately.

5. Press **HELP** to display the online help.
6. Press each of the front panel buttons.

Each button should flash as you press it. Most buttons will bring up help text related to that button in the right pane of the help screen. Some buttons, such as the presets, all bring up the same information, so you may need to alternate between preset buttons and another button to see the text change. The navigation keys (the four arrow keys and the SEL key) do not bring up help text. They are used to navigate the help panes and content.

7. Press the right arrow key until the Help Contents pane in the upper-left corner is highlighted.
8. Turn the **GENERAL** knob and verify the selector box moves up and down the list of topics.
9. Press **HELP** to exit help.
10. Record Pass or Fail for Buttons and Knobs in the test record.

#### **LCD Pixel Defects**

1. Set the waveform monitor to display a white screen:
  - a. Press the **CONFIG** button.
  - b. Select **Utilities > Screen Solid Color > Select Color > White**
  - c. Press the **SEL** button.
2. Count any pixels stuck low (not white).
3. While the screen is all white, inspect for visible defects that exceed the limits in Table 2-2 (page 2-23).

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**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. Press the **SEL** button to cancel the white screen.
5. Set the waveform monitor for an all black screen:
  - a. Select **Utilities > Screen Solid Color > Select Color > Black**
  - b. Press the **SEL** button.
6. Count any pixels stuck high (not black).
7. Press the **SEL** button to cancel the black screen.
8. Check that the total number of pixels counted in steps 2 and 6 is less than six.

**Table 2-2: LCD Visual Defects**

<b>Defect Type<sup>1</sup></b>	<b>Allowable Defect</b>		
Circular Defect <sup>2</sup>	>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		

<sup>1</sup> 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.

<sup>2</sup> For irregular defects, use (LengthxWidth)/2.

9. Record pass or fail for Pixel Defect in the test record.

10. Press the **CONFIG** button to close the configuration menu.

### **LCD Color Palette and Advanced Diagnostics Test**

1. Run the Advanced Diagnostics:
  - a. Press the **CONFIG** button.
  - b. Select **Utilities > Run Advanced Diags**
  - c. Press the **SEL** button.
  - d. Select **Continue** in the Advanced Diagnostics message window.
  - e. Press the **SEL** button.

#### **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 <sup>1</sup>	36.0204 MHz	35.9844 MHz	36.0564 MHz
HD Eye Frequency <sup>1,2</sup>	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 <sup>3</sup>	61.4400 MHz	61.3900 MHz	61.4900 MHz

<sup>1</sup> Options EYE and PHY only.

<sup>2</sup> For WFM6120 this will display 0.000 MHz.

<sup>3</sup> Options AD and DDE only.

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

6. Press the **SEL** button to reboot the unit in normal operation. It may take some time before the button press has any effect. You can cycle the power instead.
7. Record Pass or Fail for Advanced Diagnostics 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 options installed on the unit under test:
  - Option HD: 1080 59.94i 10-bit shallow ramp matrix from HDVG1
  - 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. Set the display style to Parade:
  - a. Press and hold the **WFM** button to display the waveform menu.
  - b. Select **Display Style**.
  - c. Use the **SEL** button to select **Parade**.
  - d. Press the **WFM** button.
4. Turn off the Pb waveform:
  - a. Press and hold the **WFM** button to display the waveform menu.
  - b. Select **Pb**.
  - c. Use the **SEL** button to select **Off**.
  - d. Press the **WFM** button.
5. Set the display vertical gain:
  - a. Press and hold the **GAIN** button to display the gain menu.
  - b. Select **Gain Settings**.
  - c. Use the arrow keys to select **x10**.
  - d. Press the **GAIN** button once to close the Gain menu. The **GAIN** button should remain lit.
6. Press the **FULL** button to expand the waveform tile to full screen:

7. Connect the waveform monitor SDI OUT to a second, known good, waveform monitor SDI A input.
8. Repeat steps 2 through 5 for the second waveform monitor.
9. Perform steps 10 through 14, on both the DUT (to check the Serial Input), and the second waveform monitor (to check the DUT Serial Output)
10. Position the waveform so that you can check the ramps.
11. 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. On the second waveform monitor, check that there are no EDH errors (SD). If relevant, check that there are no CRC errors (HD) by pressing and holding the **STATUS** button and selecting **Video Session**.
12. Press the **GAIN** button on both waveform monitors so that the button is no longer lit, to return the instruments to x1 gain.
13. Change the input signal to a 100% sweep.
14. 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.
15. If you want, move the signal input to input B by pressing the **CONFIG** button and then selecting **Outputs > SDI Output > Loopout B**. Repeat steps 5 through 14.
16. Record Pass or Fail for SDI Bit Integrity in the test record.
17. Disconnect the second waveform monitor.

### External Reference

1. Restore the Factory Preset (See Page 2-21).
2. Connect a signal to an input. Use a signal type appropriate to the options installed on the unit under test, such as:
  - Option HD: SDI input; 1080 59.94i 10-bit shallow ramp from HDVG1
  - Option SD: SDI input; 525/270 10-bit shallow ramp from DVG1
  - Option CPS: CMPST input; NTSC or PAL color bars from AVC1
3. Apply an NTSC signal to the External Reference input from the Analog Signal Generator. Install a termination on the loopthrough.
4. Press **EXT REF** on the instrument front panel.
5. The status bar in the lower left-hand corner of the display should display Ref: NTSC.

6. Press the Display Select **4** button, then the **WFM** button, and then the **SWEEP** button.
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 lower left-hand corner of the display should display Ref: Ext. Missing.
12. Record Pass or Fail for Ref Missing in the test record.

**Eye  
(Options EYE and PHY  
Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Connect a signal to the SDI A input. Use a signal type appropriate to the options installed on the unit under test, such as:
  - Option HD: 1080 59.04i color bars from HDVG1
  - Option SD: 525/270 color bars from DVG1
3. Press the **EYE** button.
4. Check for the presence of a stable eye diagram in tile 1. (The actual wave shape depends on the generator signal.)
5. Record Pass or Fail for Eye Waveform in the test record.
6. Proceed to the next step if option PHY is present. Otherwise, this test is complete.
7. Set the Eye waveform display to jitter display:
  - a. Press and hold the **EYE** button to display the Eye waveform menu.
  - b. Select **Display Type > Jitter Display > Jitter Display**.
8. Check for a flat line wave shape. (The residual jitter level depends on the quality of the generator signal.)
9. Record Pass or Fail for Jitter Waveform in the test record.

**Composite Input  
(Option CPS Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Apply an NTSC SMPTE color bar signal from the TG2000 AVC1 module to the Composite A input (CMPST A). Install a termination on the loop through.

3. Press Input **C** to select the CMPST A input.
4. Observe the WFM display in tile 1, the signal should be aligned with the zero graticule.

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**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  
(Options AD and DDE  
Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Set the analog audio generator to output a 1 kHz, 18 dBu sine wave.
3. Press and hold the **Display Select** button **4** button to display the Audio pop-up menu.
4. In the Audio Input submenu, select **Analog Input > Analog A.**
5. Press the **AUDIO** button briefly to dismiss the menu.
6. Using the audio breakout cable or equivalent, connect the analog audio generator to the first Line A input pair and verify that the output level of the generator signal is 18 dBu, as indicated on the audio bars.
7. Repeat step 6 for the second and third line A input pair.
8. Record Pass or Fail in the test record.
9. Press and hold the **Display Select** button **4** button to display the **AUDIO** pop-up menu.
10. In the Audio Input submenu, select **Analog Input > Analog B.**
11. Press the **AUDIO** button briefly to dismiss the menu
12. Repeat step 6 for all three Line B input pairs.



13. Record Pass or Fail in the test record.

**Analog Audio Output  
(Options AD and DDE  
Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Press and hold the **Display Select** button **4** button to display the AUDIO pop-up menu.
3. In the Audio Input submenu, select **Analog Input > Analog A**.
4. Press the **AUDIO** button briefly to dismiss the menu
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 18 dBu, as indicated on the audio bars.
6. Press **CONFIG** to display the **CONFIG** menu.
7. Select **Audio Inputs/Outputs > Atten Analog Out**
8. Press **SEL** and use the GENERAL knob to adjust the value to 0db, then press SEL again to set the value.
9. While still in the Audio Inputs/Outputs submenu, select **Analog A > Analog Output Map**.
10. Press **SEL** to display the Analog Output to Analog “A” Bar Map.
11. Put an X in the first bar pair row for Analog Outputs 1&2, 3&4, 5&6, and 7&8.
12. Press **CONFIG** to exit the CONFIG menu.
13. Connect the first 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. Connect the second analog output pair on the breakout cable to the second line A input pair.
16. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.
17. Connect the third analog output pair on the breakout cable to the second line A input pair.
18. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.

19. For Option AD, skip to step 22.
20. Connect the fourth analog output pair on the breakout cable to the second line A input pair.
21. Verify, on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.
22. Record Pass or Fail in the test record.

**Digital Audio Input  
(Options AD, DS, and DDE  
Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Set the digital audio generator to output a 1 kHz, -6 dBFS sine wave.
3. Press and hold the **Display Select** button **4** to display the AUDIO pop-up menu.
4. Select **Audio Input > AES A**.
5. Connect the unbalanced output of the digital audio generator to the AES A 1-2 input.
6. Press the **AUDIO** button to dismiss the menu.
7. Verify that the first set of level meter bars indicates -6 dBFS.
8. Repeat steps 5 and 7 for AES A 3-4, AES A 5-6, and AES A 7-8.
9. Record Pass or Fail for AES A in the test record.
10. Press and hold the **Display Select** **4** button to display the AUDIO pop-up menu.
11. Select **Audio Input > AES B**.
12. Press the **AUDIO** button to dismiss the menu.
13. Connect the output of the digital audio generator to the AES B 1-2 input.
14. Verify that the first set of level meter bars indicates -6 dBFS.
15. Repeat steps 13 and 14 for AES B 3-4, AES B 5-6, and AES B 7-8.
16. Record Pass or Fail for AES B in the test record.
17. Set the SDI generator for a signal type appropriate to the unit under test:
  - a. Option HD: 1080 59.94i color bars from HDVG1
  - b. Option SD: 525/270 color bars from DVG1

18. Set the SDI generator for embedded audio in 2 groups starting with group 1, and then access and set its audio channels:
  - a. 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:
    - Channel 1: 50 Hz, -35 dB
    - Channel 2: 100 Hz, -30 dB
    - Channel 3: 150 Hz, -25 dB
    - Channel 4: 200 Hz, -20 dB
    - Channel 5: 250 Hz, -15 dB
    - Channel 6: 300 Hz, -10 dB
    - Channel 7: 400 Hz, -5 dB
    - Channel 8: 500 Hz, 0 dB
19. Connect the output of the SDI signal generator with embedded audio to the A SDI input.
20. Press and hold the **Display Select** button **4** to display the AUDIO pop-up menu.
21. Select **Audio Input > Embedded**.
22. Press the **AUDIO** button.
23. 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.

---

24. Record Pass or Fail for Embedded Display in the test record.
25. Press and hold the **Display Select** button **4** to display the AUDIO pop-up menu.
26. Select **Phase Pair > 1 & 2**.
27. Go through the other phase pairs (3 & 4, 5 & 6, 7 & 8) and verify that the phase display changes in each one.

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

**Digital Audio Output  
(Options DS, AD, and DDE  
Only)**

1. Restore the Factory Preset (See Page 2-21).
2. If you have just finished testing the Digital Audio Inputs, proceed to step 3, otherwise do steps 18-23 of the Digital Audio Input test.
3. Press **CONFIG** to display the configuration menu.
4. Select **Audio Inputs/Outputs > AES B Config Port As > Output**.
5. Briefly press the **CONFIG** button to close the menu.
6. Connect the AES B 1-2 output to the Audio Signal Analyzer input.
7. Verify on the analyzer that the signal levels are at  $-35$  dBFS for the left channel and  $-30$  dBFS for the right.
8. Connect the AES B 3-4 output to the Audio Signal Analyzer input.
9. Verify on the analyzer that the signal levels are at  $-25$  dBFS for the left channel and  $-20$  dBFS for the right.
10. Connect the AES B 5-6 output to the Audio Signal Analyzer input.
11. Verify on the analyzer that the signal levels are at  $-15$  dBFS for the left channel and  $-10$  dBFS for the right.
12. Connect the AES B 7-8 output to the Audio Signal Analyzer input.
13. Verify on the analyzer that the signal levels are at  $-5$  dBFS for the left channel and  $0$  dBFS for the right.
14. Record Pass or Fail for each output in the test record.

**Dolby Decode  
(Option DDE Only)**

1. Restore the Factory Preset (See Page 2-21).
2. Press and hold **Display Select** button **4** to display the AUDIO pop-up menu.
3. Select **Audio Input > AES A**.
4. Press the **Display Select** button **4** again to dismiss the pop-up.
5. Set the Dolby generator for a Dolby D output using the following steps:
  - a. Press Gen to display the Gen Stream Sel message



### **LTC Waveform and Decode Test**

1. Restore the Factory Preset (See Page 2-21).
2. You will need a custom cable for this step (see Figure 1-2 on page 2-55).
  - 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. Select any NTSC signal for the AVC1.
5. Connect the TG2000 AVC1 composite output to the video input of the Timecode generator.
6. Connect a 525/270 color bar signal from DVG1 to the SDI A input.
7. Press **CONFIG**.
8. Select **Aux Data Settings > Timecode Display if present > LTC**.
9. Press the **OTHER** button to display the LTC waveform.
10. Press the **CONFIG** button to close the menu.
11. The LTC waveform should be displayed in the active tile. The amplitude will depend on the source. The sync packet should remain at a constant horizontal location on the sweep.
12. Record Pass or Fail for the LTC waveform in the test record.
13. In the lower-right corner of the screen, the time from the LTC input should be shown. It may be necessary to reset the LTC generator by using the reset switch.
14. Record Pass or Fail for LTC Decode in the test record.

### **Ground Closure Remote**

1. Connect a 525/270 color bar signal to the SDI A input.
2. You will need a custom cable for this step (see Figure 1-2 on page 2-55).

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**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. Restore the Factory Preset (See Page 2-21).

---

**NOTE.** This test overwrites presets A1 through A4. Save any existing presets to USB flash memory before doing this procedure.

---

5. Set the waveform monitor to display a picture in tile 1 and a waveform in the the remaining tiles:
  - a. Press the **Display Select** button **1** button and then press the **PICT** button.
  - b. Press the **Display Select** button **2** and then press the **WFM** button.
  - c. Press the **Display Select** button **3** and then press the **WFM** button.
  - d. Press the **Display Select** button **4** and then press the **WFM** button.
6. Save the current settings as preset A1:
  - a. Press and hold the **PRESET** button to display the Preset Menu.
  - b. Select **Save Preset > Select Group A > Save A1**.
  - c. Save the preset as Preset **A1**.
  - d. Briefly press the **PRESET** button to close the Preset menu.
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 tile 3. 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.
20. Restore saved presets from the USB flash memory device (if saved before this procedure).

#### **Test Ground Closure Out**

21. Connect a voltmeter or oscilloscope to monitor pin 5 of the DSUB connector.
22. Verify the voltage is greater than 4.5 V. This indicates the output is not asserted.
23. Connect a 525/270 color bar signal from DVG1 to the SDI A input.
24. Restore the Factory Preset (See Page 2-21).
25. On a 15-pin, male DSUB connector, solder wires or strip back insulation to gain access to pins 2, 5, and 9.
26. Connect the DSUB connector to the ground closure remote connector on the waveform monitor.
27. Press the **CONFIG** button to display the CONFIG menu.
28. Select **Alarms > SDI Input**, then press the **SEL** button



29. Use the arrow keys to move the selection highlighting to the **Ground Closure** column of the **SDI Input Missing** row, and then press **SEL** to put an X in the box. This instructs the waveform rasterizer to assert the ground closure if the input is not present.
30. The voltmeter should read about 4.7 V on pin 9.
31. Remove the input signal from the SDI connector on the rear panel to assert ground closure.
32. The voltmeter should now read a low voltage, below 0.5 V.
33. 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. The computer must have a Web browser installed.
2. Restore the Factory Preset (See Page 2-21).
3. Press the **CONFIG** button to display the Configuration menu.
4. Select **Network Settings > IP Configure Mode**.
5. Verify that the IP Config Mode is set to **Manual**.
6. Select **Network Settings > IP Address**.
7. Set the IP Address to be compatible with the computer:
  - a. Use the left/right arrow keys to move the highlight to each box in the address.
  - b. Use the up/down arrow keys to change the number in each box as required.
  - c. To accept your changes, move the highlight to the Accept box and press **SEL**.
8. Open a Web browser on the computer.
9. From the computer, enter the IP address of the waveform monitor into the Web browser address line (for example, <http://192.182.256.23>).
10. You should see a Web page titled “Tektronix WFM6120/WFM7120 Remote Interface” or something similar. This means that the Ethernet function is working.
11. Record Pass or Fail for Ethernet Functionality in the test record.

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**NOTE.** *While in Simultaneous Input mode, certain displays can be displayed either on the left or on the right, but not both at the same time.*

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**Simultaneous Input  
Operation Test  
(Option SIM Only)**

1. Connect the TG700 dual link generator HDVG7 module link A output to the instrument SDI A input. Restore the Factory Preset (See Page 2-21).
2. Connect the DVG7 module link B output to the instrument SDI B input.
3. Perform the following steps to set the DVG7 module format and the HDVG7 module to 1080 59.94i YCbCr+A 4:4:4 10 bits:
  - a. Press **MODULE** until **HDVG7** appears.
  - b. Press **FORMAT** until **1080 59.94i** appears and then press **ENTER**.
  - c. Press **CANCEL**.
  - d. Press the up/down arrows until **SAMPLE STRUCTURE/DEPTH** appears.
  - e. Press the left/right arrows until **YCbCr+A 4:4:4** appears.
  - f. Press the **ENTER** button.
  - g. Press **COLOR BAR** and then press the right arrow button until **100% Color Bars** appears.
  - h. Press **MODULE** until **DVG7** appears.
  - i. Press the up/down arrows until **STATUS** appears.
  - j. Press **FORMAT** until **525-270** appears and then press **ENTER**.
  - k. Press **CANCEL**. You should see **SMPTE Color Bars** on the generator display.
4. Restore the Factory Preset (See Page 2-21).
5. Press the **CONFIG** button.
6. Select **Input Mode > Simultaneous**.
7. Press **Display Select** button **1** to select tile 1.
8. Press the **INPUT** button that corresponds to one of the two connected signals.
9. Press **Display Select** button **2** to select tile 2.
10. Press the **INPUT** button that corresponds to the other connected signal.
11. Check that the left two tiles (tiles 1 and 3) show the signal selected for tile 1, and that the right two tiles (tiles 2 and 4) show the signal selected for tile 2.

12. Check that the left portion of the Status Bar displays the status of the signal driving tiles 1 and 3, and the right portion of the Status Bar displays the status of the signal driving tiles 2 and 4.
13. Enter pass or fail in the test record.

**Dual Link Format  
Verification Test  
(Option DL Only)**

1. Check that the dual link generator is still set up the same as in the previous test.
2. Restore the Factory Preset (See Page 2-21).
3. Press **Display Select** button **2** to select tile 2.
4. Press and hold the **STATUS** button and use the arrow buttons to select **Display Type** and then **Video Session**.
5. Press **Display Select** button **4** to select tile 4.
6. Press and hold the **VECTOR** button to open the Vector menu.
7. Select **Display Type > Lightning**.
8. Press **Display Select** button **4** briefly to dismiss the menu.
9. Verify the following are true in the specified tile or area:
  - Tile 1: YPbPrA parade waveform displayed
  - Tile 2: Format Auto 1080 59.94i-YCbCrA 4444 10 bit
  - Tile 3: Color bars picture displayed
  - Tile 4: Endpoints of lightening display land within targets
  - Status Bar: SDI Input DL-AB is displayed
10. On the TG700, check that HDVG7 is displayed, and then press **SMPTE 1080 59-9UI GBR 4:4:4 12 bits**, and then press **ENTER**.
11. Verify the following are true for the specified tile or area:
  - Tile 1: YPbPr parade waveform displayed and automatically converted from RGB input signal
  - Tile 2: Format (gives some indication of RGB)
  - Tile 3: Color bars picture displayed
  - Tile 4: Endpoints of lightening display land within targets
12. Record pass or fail in the test record.

**A/V Delay Test  
(Option AVD Only)**

1. Connect an SDI video signal from a SIGNAL output of the DVG7 to the SDI A input of the WFM instrument.
2. Set the signal generator for AV Timing Mode as follows:
  - Press the **MODULE** button until **TG700:PRESET** appears and then press **ENTER**.
  - Press **<** to display **Factory Default**, then press **ENTER**.
  - Press **MODULE** until DVG7 appears.
  - Press **^** until **VIDEO** appears and then press **ENTER**.
  - Press **^** until **AV Timing Mode** appears.
  - Press **>** to select **ON** and then press **ENTER**.
  - Press **CANCEL** to return to the previous menu.
  - Press **^** until **AUDIO (EMBEDDED)** appears.
  - Press **<** until **GROUP 1** appears and then press **ENTER**.
  - Press **>** until **STATUS: ENABLED** appears and then press **ENTER**.
3. On the WFM instrument, restore the Factory Preset (See Page 2-21).
4. Press and hold the **MEAS** button to display the Measure menu.
5. Select **Display Type > AV Delay**.
6. Press the **<** navigation button to return to the previous menu level and then set **AV Delay Enable** to **On**.
7. Briefly press the **MEAS** button to dismiss the menu.
8. Check that the AV Delay readout is green and that it indicates less than .005 s. The number in the Fields readout will depend on the video standard in use.
9. Enter Pass or Fail 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 WFM7120: <ul style="list-style-type: none"> <li>■ 75% and 100% color bars</li> <li>■ SDI Matrix Split Field Pathological Signal</li> <li>■ SDI Equalizer</li> <li>■ VM5000 Matrix</li> </ul>	HDVG1 module for TG2000 (Embedded audio needed for audio options DG, AD, DS, DDE)
	HD signal with adjustable SDI amplitude required for WFM7120	HDST1 module for TG2000
	1080i 59.94 analog tri-level sync required for WFM7120	AWVG1 module for TG2000
	525/270 SD signals required: <ul style="list-style-type: none"> <li>■ 75% and 100% color bars</li> <li>■ SDI Matrix Pathological Signal</li> <li>■ SDI Equalizer</li> <li>■ Adjustable SDI amplitude</li> <li>■ VM5000 Matrix</li> </ul>	DVG1 with option S1 module for TG2000 (Embedded audio needed for audio options DG, AD, DS, DDE)
	Composite signals required for Option CPS: <ul style="list-style-type: none"> <li>■ NTSC 0% flat field</li> <li>■ NTSC 100% color bars</li> </ul>	AVG1 module for TG2000
Precision calibration signals for Option CPS and for Eye Gain test <sup>1</sup>	Tektronix part number 067-0465-00 (AVC1) module for TG2000 <sup>2</sup>	

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

<b>Test Equipment</b>	<b>Requirements</b>	<b>Example</b>
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	Simulate 0 to 400 meters of 8281 equivalent in 25 meters steps.	Faraday SC75A800B-G
75 $\Omega$ 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 $\Omega$ Terminator for Analog Video	Male connector, precision	Tektronix part number 011-0102-03
75 $\Omega$ term for SDI signal. (2)	Male, wideband	Tektronix part number 011-0163-00
75 $\Omega$ 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 $\Omega$ test port; 50 $\Omega$ input and output test ports	Agilent 8712 75 $\Omega$  Tektronix 2712  Wide Band Engineering A57TUC with male 75 $\Omega$ 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 $\Omega$ input	Tektronix TDS7404B with TCA75 adapter
75 $\Omega$ calibration kit		Maury 8580A 75 $\Omega$ BNC
VITC Generator		Horita VG-50 or Adrienne AEC-Box-28
LTC Generator		Horita TG-50 or Adrienne AEC-Box-28
NTSC to SDI Converter		Grass Valley 8960DEC or AJA model D5D
RCA to 15 pin header custom cable	Shown in Figure 1-2. 15-pin male Dsub connector, Tektronix part number 131-1164-00, RCA plug Allied 932-1098, and wire	
VGA to 5x BNC adapter cable	15 pin VGA connector input, 5 BNC connector outputs	Tektronix part number 174-5126-00

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

Test Equipment	Requirements	Example
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		

<sup>1</sup> 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.

<sup>2</sup> 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  
(Option HD 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  $\Omega$  cable from a TG2000 HDVG1 output (Output 2) to the HDST1 video input.
3. Connect a 75  $\Omega$  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. Select a tile, press and hold the **STATUS** button, and select **Video Session** to display the status screen. The status screen should display OK for Y Chan CRC, C Chan CRC, Y Anc Checksum, and C Anc Checksum errors.

6. Press the **STATUS** button to close the menu.
7. Press **FULL** to display the status screen full tile.
8. 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.
9. Record the HDST1 Amplitude Level in the test record.
10. Increase the HDST1 Amplitude Level to 130 %.
11. If any EDH errors are generated, reduce the amplitude until no errors are generated for a 10 second period.
12. Record the HDST1 Amplitude Level in the test record.
13. Move the input cable from the SDI A input to the SDI B input.
14. Repeat steps 8 through 12 for the SDI B input.
15. Record this level in the test record.

**EDH and HD SDI Input  
Equalization Range  
(Option HD 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. If you do not have the video status screen displayed, press and hold the **STATUS** button, select Video Session, and press the **FULL** button to display the tile full screen.
5. Press the **STATUS** button to close the menu.
6. Select the 1080i59.94 “SDI Equalizer Test” signal from the TG2000 HDVG1.
7. Set the TG2000 HDST1 SDI parameters for a 1.0 error rate.
8. 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.
9. Record Pass or Fail in the test record.



**Cable Length Accommodation**

10. Connect a cable from an output of the TG2000 HDVG1 to the 80 m section of the HD Cable clone.
11. Use a second cable to connect the other port of the cable clone section to the SDI A connector on the waveform monitor.
12. On the TG2000 HDVG1, set the output to the SDI Matrix signal.
13. Press the numbered **Display Select** button for the tile that shows a WFM display.
14. Press the **FULL** button.
15. You should see a stable picture and waveform on the waveform monitor display.
16. Press **FULL** again to return to the 4-tile view.
17. You should see that all of the CRC parameters on the Status screen read Valid.
18. 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.
19. 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.
20. Record the value in the test record.
21. Repeat the test using SDI B input on the waveform monitor.
22. Record this level in the test record.

**HD SDI Loop-through Isolation (Option HD 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. If you do not have the video status screen displayed, press the **DISPLAY SELECT 4** button, press and hold the **STATUS** button, and select Video Session.
3. Press the **STATUS** button to close the menu.

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  
(Option HD 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 Documentation CD.
4. Press **CONFIG > Output > HD Alg PixMon > RGB**.
5. Connect the waveform monitor PIXMON output to the VM5000, as described in the VM5000 manual or online help.
6. Start the VM5000 HD and SD application and set the number of Averages to 4.
7. On the Format tab, select 1080i/60, RGB.
8. On the Measurement tab, select Multiburst and clear any other measurement selections.
9. Run the measurement.

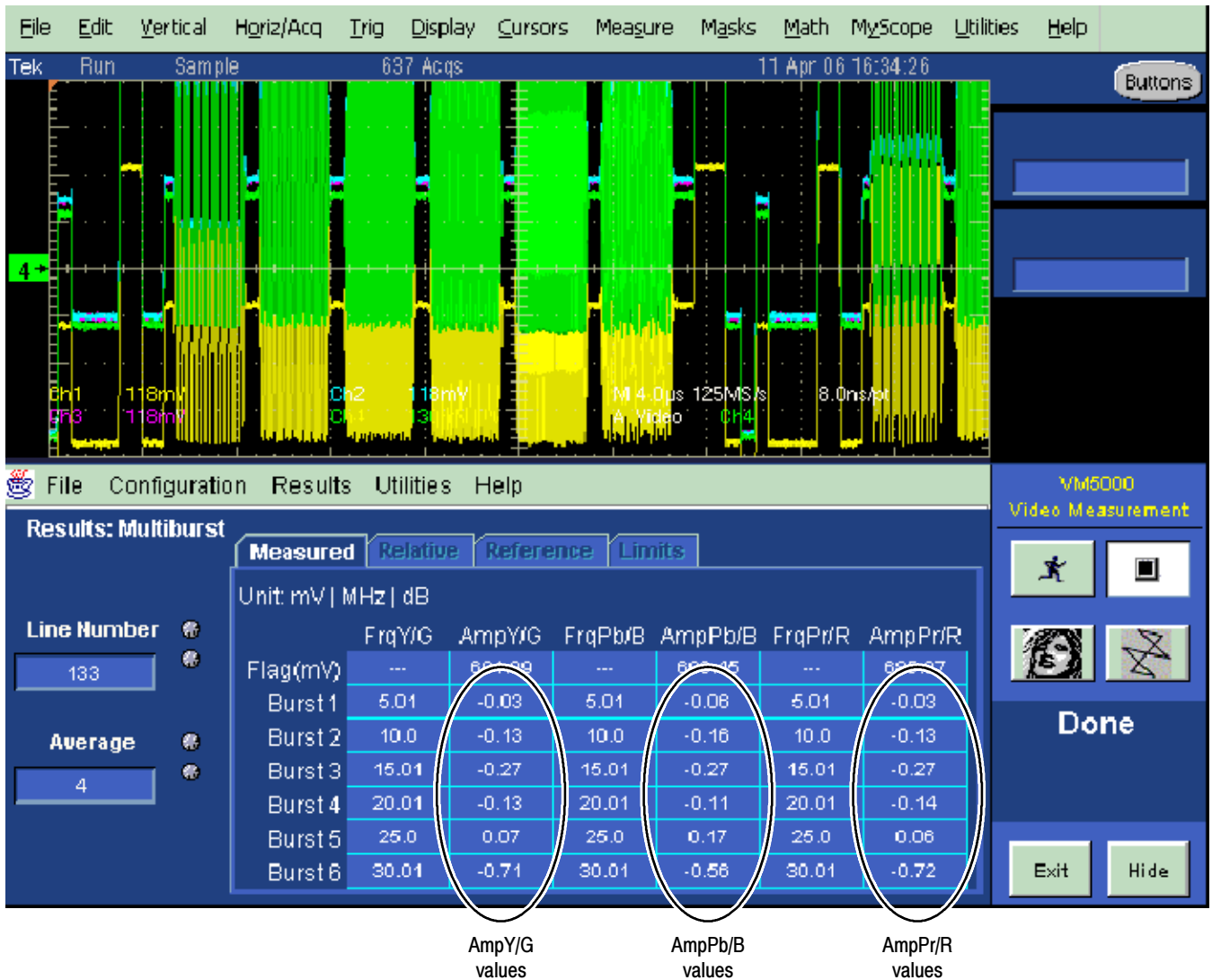


Figure 1-1: VM5000 HD Frequency Response display

10. 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%).
11. Record Pass or Fail in the test record.

**HD SDI Return Loss,  
A and B Inputs  
(Option HD 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  
(WFM7120  
Option EYE or 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. Press and hold the **STATUS** button and select SDI Status.
3. Press the **STATUS** button to close the menu.
4. Using the short cable, connect a color bar signal from the HDVG1 to the SDI A input on the waveform monitor.
5. Check that the cable length reading is between 0 m and 17 m.
6. Record the results in the test record.
7. 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.
8. Check that the cable length reading is between 76 m and 127 m.
9. Record the results in the test record.
10. Repeat steps 4 through 9 for the SDI B input.

**HD Jitter Noise Floor  
(WFM7120  
Option EYE or 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 **Input A** button.
6. Press the **FULL** button to set the WFM tile to full screen.
7. Set the waveform monitor to the jitter display:
  - a. Press and hold the **EYE** button.
  - b. Select **Display Type** and then **Jitter Display**.
8. Set the jitter high pass filter to 100 Hz:
  - a. In the **EYE** menu, select **Jitter1 HP Filter**.
  - b. Select **100 Hz**.
9. Set the vertical gain to x10:
  - a. Press and hold the **GAIN** button.
  - b. Select **Gain Settings** and then **x10**.
  - c. Press the **GAIN** button to remove the pop-up menu.
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. Record Pass or Fail in the test record.

**10 second 10 Hz jitter bounce**

13. Set the jitter high pass filter to 10 Hz:
  - a. Press and hold the **EYE** button, and select **Jitter1 HP Filter**.
  - b. Select **10 Hz**.

14. Watch the display for at least 10 seconds. The trace may jump occasionally.
15. Check that any trace jump is  $\leq 200$  ps (0.297 UI).
16. Record Pass or Fail in the test record.

**HD Jitter Readout  
Accuracy  
(WFM7120  
Option EYE or PHY only)**

1. Press the **FULL** button to return to the 4-tile display.
2. Set the upper left tile to the Eye display:
  - a. Press the **DISPLAY SELECT 1** button.
  - b. Press and hold the **EYE** button.
  - c. Select **Display Type** and then **Eye Display**.
3. Set the upper right tile to be the Jitter display:
  - a. Press the **DISPLAY SELECT 2** button.
  - b. Press and hold the **EYE** button.
  - c. Select **Display Type** and then **Jitter Display**.
4. Press and hold the **MAG** button, and select x50 magnification.
5. Press and hold the **EYE** button, select **Jitter1 HP Filter**, and then select **100 Hz**.
6. Press and hold the **SWEEP** button and select **2 Field** to show two fields in the Jitter display.
7. Press the **SWEEP** button to close the menu.
8. 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 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.

9. 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  $\pm 10\%$  (between 2.7 UI and 3.3 UI).
10. Record Pass or Fail for the Jitter Trace functional test on the test record.
11. Check that the jitter readout shows the jitter to be between 2.65 UI and 3.35 UI.
12. Record Pass or Fail for the Jitter Readout functional test on the test record.
13. Reset the generator.

### **HD Jitter Vibration (Option EYE or 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 HD signal 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 the unit under test 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 **EXT REF** button 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 options installed on the unit under test:
  - HD: 1080 59.94i color bars from HDVG1
  - 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 lower-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  
(WFM7020 and WFM7120)**

Check that the unit under test 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 lower-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.

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**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.

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4. Set the AVC1 for 0 dB of 60 cycle hum.
5. Press the **EXT REF** button 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  
(WFM7020 and WFM7120  
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  
(WFM6120 and WFM7120  
Option EYE and 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.

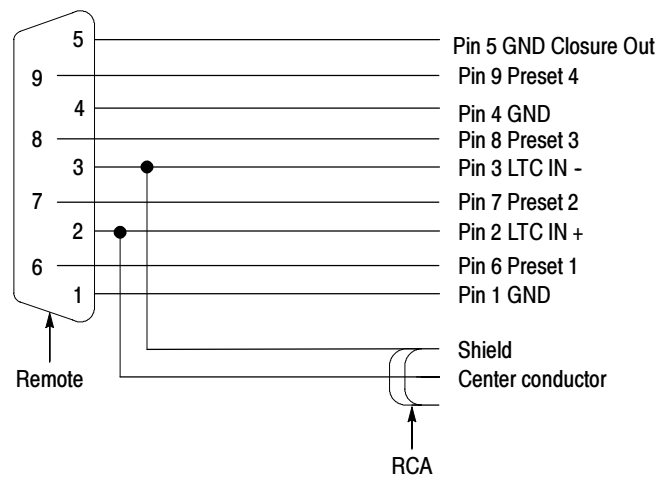
1. Set the waveform monitor to the factory presets (see page 2-21).
2. Connect an SD signal to the waveform monitor.
3. Turn on the Recovered Sine-wave function:
  - a. Press the **CONFIG** button.
  - b. Select **Utilities, Calibration**, and then press the **SEL** button.
  - c. Use the down arrow key to scroll through the Calibration status screen and select **Eye Recovered Clock Test**.
  - d. Press the **SEL** button to start the calibration.
4. Check to see that the sine-wave is smooth and undistorted. There should be one cycle displayed.
5. Press the **Display Select 1** button to activate the upper-left tile.
6. Press the **FULL** button.
7. Press and hold the **GAIN** button, select **VAR Gain**, and set the **Gain Setting** to **x5**.
8. Press the **GAIN** button to dismiss the pop-up menu and use the **GENERAL** knob to adjust the vertical gain to **x10.0**.
9. Check the waveform. There should be no discontinuities or jagged edges. Use the **VERTICAL** knob to view the entire waveform.
10. Repeat steps 4 through 9 for HD (if supported).

11. When the process is complete, press **CONFIG** and select **Utilities > Calibration**. Navigate to **Eye Recovered Clock Test** and select **Off**.
12. Close all menus.
13. 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 1-2. 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 1-2: 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. WFM6120 Opt CPS only: Select **Audio Inputs/Outputs** and then **Analog Input A**. Proceed to step 3b.

b. Press the **CONFIG** button, select **Aux Data Settings > Timecode Display if present > LTC**.

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 lower right corner of the display.

7. Record Pass or Fail in the test record.

**Eye Gain**  
**(Option EYE or 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 Documentation 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 **CONFIG** button.

b. Select **Utilities, Calibration**, and then press the **SEL** button.

c. Use the down arrow key to scroll through the Calibration status screen and select **SDI Deserializer Mode**.

d. Press the **SEL** button to start the calibration.

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. **Option PHY only:** Check that the digital amplitude reading is between 760 mV and 840 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. When the calibration process is complete, press the **STATUS** button and select **Save** or **Save and Exit** to exit calibration.

8. Close all the menus.

**Reference Clock  
Amplitude and Frequency  
(WFM6120, WFM7120  
Option EYE or 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  $\Omega$  cable. The test oscilloscope must have a 75  $\Omega$  input.
5. Check that the amplitude of the CLOCK OUT signal is between 0.8 V<sub>p-p</sub> and 1.2 V<sub>p-p</sub>.
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  $\pm 5\%$  (SD); 74.25 MHz (or 74.17582 MHz)  $\pm 5\%$  (HD).
8. Record Pass or Fail for the Clock Frequency functional test on the test record.

**Eye Signal Bandwidth  
(WFM6120, WFM7120  
Option EYE or PHY only)**

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**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 2-84.*

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1. Assemble the signal source set-up as characterized in Signal Source Characterization for Eye Signal Bandwidth Verification (see page 2-84).
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 2-84.
4. Connect the signal source output to the waveform monitor SDI A input.
5. Press the Input A button.
6. Check that the RF generator's RF output is on, with no modulation.
7. Press the **Display Select 1** button and then the **EYE** button.
8. Press the **FULL** button.

9. Press the **SWEEP** button to see the **10 Eye** readout on the display screen.
10. Select the Bandwidth Test:
  - a. Press the **CONFIG** button.
  - b. Select **Utilities, Calibration**, and then press the **SEL** button.
  - c. Use the down arrow key to scroll through the Calibration status screen and select **SDI Deserializer Mode**.
  - d. Press the **SEL** button to start the calibration.
11. Use the cursors to measure the waveform amplitude, and note this as the reference amplitude. (If Option PHY is installed, the Eye Amplitude readout may be used instead of the cursors.)
12. Set the RF generator frequency to 2.5 GHz.
13. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2-84.
14. 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.)
15. Calculate the 2.5 GHz response as follows:

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

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

16. Record the 2.5 GHz response in the test record.
17. Set the RF Generator to 100 MHz.
18. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2-84.
19. 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.
20. Set the RF generator level to the nearest corresponding setting from the Characterization Table on page 2-84.
21. If the waveform amplitude falls below that measured in step 11, 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.

22. Move the signal source output to the SDI B input.
23. Press the Input **B** button.
24. Set the RF Generator to 100 MHz.
25. Set the RF generator output level to the corresponding setting shown in the Characterization Table on page 2-84.
26. Repeat steps 11 through 21 for the Digital B input.
27. When the process is complete, press **CONFIG** and select **Utilities > Calibration**. Select **Save** or **Save and Exit** to exit the bandwidth calibration.

## Tests for SD-Equipped Instruments Only

### **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. Press the **Display Select 4** button and then press the **FULL** button.
6. You should see a stable picture and waveform on the waveform monitor display.
7. Press the **FULL** button again to return to the 4-tile display view.
8. Press and hold the **STATUS** button and select **Display Type > Video Session**.
9. In the Status Display, you should see OK for all the EDH parameters.
10. 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.
11. Record the DVG1 amplitude level in the test record.
12. Increase the serial amplitude to 115%.
13. If any EDH errors are generated, reduce the amplitude until no errors are generated for a 10 second period.
14. Record the DVG1 amplitude level in the test record.
15. Repeat the steps 10 to 14, 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. Press **Display Select 4** to activate that tile.
  - b. Press and hold the **STATUS** button.
  - c. Select **Display Type** and then **Video Session**.
  - d. Press the **STATUS** button to dismiss the menu.
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. Press Input A.
5. Set the SD Alg PixMon to RGB:
  - a. Press the **CONFIG** button.
  - b. Select **Outputs, SD Anlg PixMon**, and then **RGB**.
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 1-3: 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 **CONFIG** button.
  - b. Select **Outputs, SD Anlg PixMon,** and then **YPbPr.**
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  $1 V_{p-p} \pm 5\%$ , from sync tip to white level (first color bar).
9. Check that the blanking (black) level is  $0 mV \pm 50 mV$ .
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  $700 mV_{p-p} \pm 5\%$ , from the blanking (black) level to the top of the waveform.
12. Check that the blanking (black) level is  $0 mV \pm 50 mV$ .
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  $700 \text{ mV}_{\text{p-p}} \pm 5\%$ , from the blanking (black) level to the top of the waveform.
15. Check that the blanking (black) level is  $0 \text{ mV} \pm 50 \text{ mV}$ .
16. Record Pass or Fail in the test record.

### **RGB**

17. Set the SD Alg PixMon to RGB by selecting **RGB** from the Outputs menu.
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  $1 \text{ V}_{\text{p-p}} \pm 5\%$ , from sync tip to white level.
20. Check that the blanking (black) level is  $0 \text{ mV} \pm 50 \text{ mV}$ .
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  $700 \text{ mV}_{\text{p-p}} \pm 5\%$ , from the blanking (black) level to the top of the waveform.
23. Check that the blanking (black) level is  $0 \text{ mV} \pm 50 \text{ mV}$ .
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  $700 \text{ mV}_{\text{p-p}} \pm 5\%$ , from the blanking (black) level to the top of the waveform.
26. Check that the blanking (black) level is  $0 \text{ mV} \pm 50 \text{ mV}$ .
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  $75 \Omega$ .
29. Select an NTSC 100% Color Bar from the AVG1.
30. Select **Composite PixMon** from the **Outputs** menu.
31. Press the right arrow key to highlight **On**.
32. Press the Input **C** button.
33. Connect the Y/G channel of the VGA to 5x BNC adapter cable to the test oscilloscope.

- 34. Check that the G waveform is  $1 V_{p-p} \pm 5\%$ , from sync tip to white.
- 35. Check that the blanking (black) level is  $0 mV \pm 100 mV$ .
- 36. Record Pass or Fail in the test record.

**SD Serial Output Amplitude**

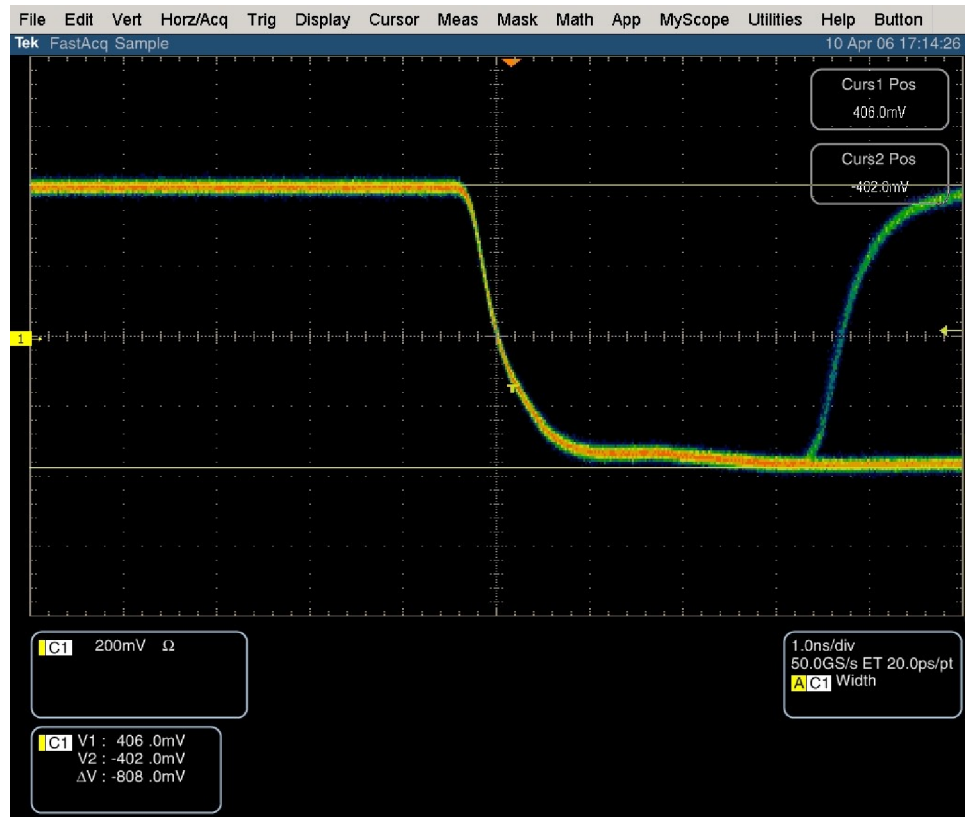
This test verifies that the Serial Output is within specifications.

- 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. Press the Input A button.
- 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**

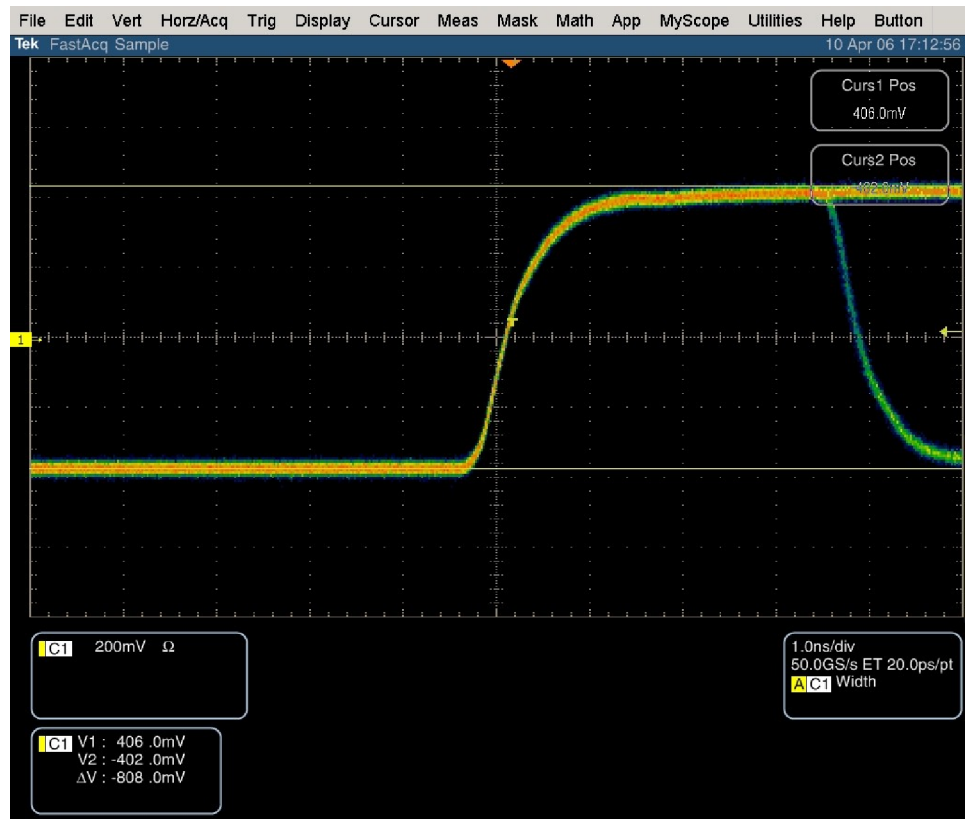
Ch 1 Vertical	200 mV/Div
Horizontal	1.0 ns/Div
Trigger Mode	
Source	CH 1
Pulse Width	Inside
Upper Limit	10.0 s
Lower Limit	30.0 ns
Trigger Type	Width
Trigger if Width	Occurs
Polarity	Pos
Acquisition Mode	FastAcq

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



**Figure 1-4: 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 1-5.
9. Record the amplitude ( $\Delta V$ ) in the test record.



**Figure 1-5: Trigger polarity negative**

### SD SDI Return Loss, A and B Inputs

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**

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 **CONFIG** button.
  - b. Select **AUX Data Settings**.
  - c. Select **Timecode Display Channel** and then **VITC**.
  - d. Press **CONFIG** to remove the menu.
6. Verify that a decoded VITC is displayed in the lower-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  
(WFM6120, WFM7120  
Options 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 and hold the **STATUS** button.
  - b. Select **Display Type** and then **SDI Status**.
  - c. Press the **STATUS** button again to close the menu.
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  
(WFM6120, WFM7120  
Options 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. Press the **EYE** button.
4. Select the Equalized Eye signal:
  - a. Press the **CONFIG** button.
  - b. Select **Physical Layer Settings** and then **Eye Display Mode**.
  - c. Press the right arrow key to select **Equalized**.
  - d. Press the **CONFIG** button to close the configuration menu
5. Using the graticule, check that the waveform is 600 mV  $\pm$ 80 mV.
6. Record Pass or Fail in the test record.

**SD Jitter Noise Floor  
(WFM6120, WFM7120  
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 Input A button.
5. Press the **Display Select** button for the WFM display and press **FULL** to set the WFM tile to full screen.
6. Set the waveform monitor to the jitter display:
  - a. Press and hold the **EYE** button.
  - b. Select **Display Type** and then **Jitter Display**.

7. Set the jitter high pass filter to 100 Hz:
  - a. Select **Jitter1 HP Filter** from the Eye menu.
  - b. Select **100 Hz**.
8. Set the vertical gain to x10:
  - a. Press and hold the **GAIN** button.
  - b. Select **Gain Settings** and then select **x10**.
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.

**SD Jitter Readout  
Accuracy  
(WFM6120, WFM7120  
Option EYE/PHY only)**

1. Set the waveform monitor to a four-tile display by pressing the **FULL** button.
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. Press the **Display Select 1** button.
  - b. Press and hold the **EYE** button.
  - c. Select **Display Type** and then **Eye Display**.
4. Set the upper right tile to the Jitter display:
  - a. Press the **Display Select 2** button.
  - b. Press and hold the **EYE** button.
  - c. Select **Display Type** and then **Jitter Display**.
5. Press and hold the **MAG** button, select **Gain Setting**, and then select **x10** to set the horizontal magnification.
6. Press and hold the **EYE** button, select **Jitter1 HP Filter**, and then select **100 Hz**.

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  $\pm 10\%$  (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  $\pm 10\% \pm 0.05$ .)
11. Record Pass or Fail for the Jitter Readout functional test on the test record.
12. Reset the generator.

**SD Jitter Vibration  
(WFM6120, WFM7120  
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 signal to the SDI A input.
3. Select a jitter display.
4. Press the **GAIN** button, select **VAR Gain** and press the right arrow to highlight **Enable**. Press the **GAIN** button again to close the menu and then use the **GENERAL** knob to set the vertical gain to **x4**.

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 Documentation CD.
4. Press the Input **C** button.
5. Press the **FULL** button to make the WFM tile the full screen.
6. Adjust cursors to be near the top and zero portions of the waveform. Press the **CURSORS** button and use the **GENERAL** knob to adjust the **Volt1** or **Volt2** readouts. Use the arrow keys to select between them.
7. Press and hold the **GAIN** button, select **Gain Settings** and then **x5**.
8. Press the **GAIN** button to close the menu.
9. Adjust the lower cursor to align with the bottom of the reference step of the waveform.
10. Use the **Vert** knob to move the top of the waveform to the 0 IRE graticule. The second cursor should also be near the zero graticule mark.
11. Use the **General** knob to adjust the upper cursor to align with the top of the reference step of the waveform.
12. Check the cursor delta readout of the magnitude of the reference step. Note this number. It should be near 98 IRE.
13. Next, adjust the upper cursor to align with the top of the largest packet of the waveform.
14. Use the vertical knob to move the baseline of the waveform to the 0 IRE graticule. The other cursor should also be near the zero graticule mark.
15. Use the horizontal knob to adjust the lower cursor to align with the bottom of the largest packet of the waveform.
16. Note the cursor delta value for the amplitude of the largest packet.
17. Adjust the lower cursor to align with the bottom of the smallest packet of the waveform.

18. Use the vertical knob to adjust the vertical position to align the top of the waveform to the 0 IRE graticule.
19. Use the horizontal knob to adjust the upper cursor to align with the top of the smallest packet of the waveform.
20. Note the cursor delta value for the amplitude of the smallest packet.
21. 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, press the **CONFIG** button, select **Calibration**, and then press the **SEL** button. Use the down arrow to navigate to **Composite Freq Peak**, and 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. Press the Input C button to select the Composite A input.
5. Press the **FULL** button to make the WFM tile the full screen display.

6. Press the **CURSORS** button to turn on the cursor controls.
7. Use the arrow keys to navigate to Volt1 and Volt2. Adjust the cursors to be near the zero portions of the waveform using the **GENERAL** knob.
8. Press and hold the **GAIN** button, select **Gain Settings**, and then select **x10**.
9. Press the **GAIN** button to close the menu.
10. Use the cursors to measure the peak-to-peak deviation in the baseline of the multipulse packets. Use the arrow keys to navigate between **Volt1** and **Volt2** and use the **GENERAL** knob to adjust them.
11. 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. Press the Input **C** button to select the Composite A input.
5. Press the **FULL** button to make the WFM tile the full screen display.
6. Press the **CURSORS** button to turn on the cursor controls.
7. Use the arrow keys to navigate between **Volt1** and **Volt2** and adjust the cursors to be near the top portions of the waveform. Use the **GENERAL** knob to adjust them.
8. Use the vertical knob to move the top of the waveform to the zero graticule.
9. Press and hold the **GAIN** button, select **Gain Settings**, and then **x10**.
10. Press the **GAIN** button to close the menu.
11. Place one cursor on the top of the “Bar.” Use the **GENERAL** knob to adjust **Volt1** in the WFM tile.
12. Use the horizontal knob to put the “pulse” on the dotted line at the center of the screen.
13. Press and hold the **MAG** button and select **x50** to expand the pulse horizontally.



14. Press the **MAG** button to close the menu.
15. Position the second cursor on the top of the pulse. Select **Volt2** using the arrow keys and use the **GENERAL** knob to adjust it.
16. 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. Press the Input **C** button to select the Composite A input.
5. Press the **FULL** button to make the WFM tile the full screen display.
6. Press the **CURSORS** button to turn on the cursor controls.
7. Use the arrow keys to select **Volt1** and **Volt2** and adjust the cursors to be near the top of the waveform using the **GENERAL** knob.
8. Use the vertical knob to move the top of the waveform to the zero graticule.
9. Press and hold the **GAIN** button, select Gain Settings, and then select **x5**.
10. Press the **GAIN** button to close the menu.
11. Press the **LINE SEL** button use the left and right arrow keys to select **ALL**.
12. Use the **GENERAL** knob to set the line select to a line number between 72 and 202.
13. Use the arrow keys to select **Volt1** and **Volt2** and use cursors to measure the tilt in the waveform using the **GENERAL** knob to adjust them.
14. 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. Press the Input **C** button to select the Composite A input.

5. Press the **FULL** button to make the WFM tile the full screen display.
6. Press the **CURSORS** button to turn on the cursor controls.
7. Use the arrow keys to select **Volt1** or **Volt2** and adjust cursors to be near the top of the waveform using the **GENERAL** knob.
8. Use the **VERTICAL** position knob to move the top of the waveform to the zero graticule.
9. Press and hold the **GAIN** button, select **Gain Settings**, and then select **x5**.
10. Press the **GAIN** button to close the menu.
11. Use the cursors to measure the tilt in the waveform, excluding the first and last 5  $\mu\text{s}$  of the bar.
12. 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  $\Omega$  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. (Press the Input **D** button to select Composite B)

**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 **CONFIG** button.
  - b. Select **Composite Input, DC Restore**, and then select **Off**.
5. Press the **Input C** button to select the Composite A input
6. Press the **FULL** button to make the WFM tile the full screen display.
7. Press the **Input D** button to select the Composite B input.
8. Press and hold the **GAIN** button, select **Gain Settings**, and then select **x5**.
9. Press the **GAIN** button to close the menu.
10. Press the **CURSORS** button to turn on the cursor controls.
11. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
12. Connect the NTSC signal from the AVG1 output to the Composite B input.
13. Press the **Input C** button to select the Composite A input.
14. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
15. Record the larger of the two waveform offset values in the test record.

**Adjust.** If the Offset is outside the specification, press the **CONFIG** button, select **Calibration**, and then press the **SEL** button. Use the down arrow to navigate to **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 **CONFIG** button.
  - b. Select **Composite Input, DC Restore**, and then select **Off**.
5. Press the Input **C** button to select the Composite A input.
6. Press the **FULL** button to make the WFM tile the full screen display.
7. Press and hold the **GAIN** button.
8. Select **VAR Gain** and press the right arrow key to select **Enable**. Use the **GENERAL** knob to reduce the gain to 0.5X.
9. Press the **GAIN** button to close the menu.
10. Hold the hook tips on a battery (D, C, or AA), red to positive, black to negative.
11. Verify that the waveform is offset up by about 1.5 volts and is not being clamped to ground.
12. 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  $\Omega$ .
3. Press the Input **C** button.
4. Press the **FULL** button to make the WFM tile the full screen display.
5. Set the AVC1 for 0 dB of 60 Hz hum.
6. Press and hold the **SWEEP** button and select **2F**. If you cannot get 2 field, make sure the display style is set to Overlay (press and hold the WFM button and select Overlay).
7. Select input and switch DC Restore off:

- a. Press the **CONFIG** button.
  - b. Select **Composite Input, DC Restore**, and then select **Off**.
  - c. Press the **CONFIG** button to close the menu.
8. Press the **CURSORS** button to turn on the cursor controls.
9. Use the arrow keys to select **Volt1** or **Volt2** and measure the peak-to-peak hum with the cursors. 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 **CONFIG** button.
  - b. Select **Composite Input, DC Restore**, and then select **Fast**.
11. Press and hold the **GAIN** button, select **GAIN Settings** and then **x10**. Then select **VAR Gain**, press the right arrow key to highlight **Enable**, and use the **GENERAL** knob to adjust the gain to **x4.00**.
12. Use the arrow keys to select **Volt1** or **Volt2** and measure the peak-to-peak hum with the cursors. Use the **GENERAL** knob to adjust them. The measurement 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 and hold the **GAIN** button, select **VAR Gain**, press the right arrow key to highlight **Enable**, and use the **GENERAL** knob to adjust the gain to **x1.25**.
15. Switch DC Restore to Slow:
  - a. Press the **CONFIG** button.
  - b. Select **Composite Input, DC Restore**, and then select **Slow**.
16. Measure the peak-to-peak hum with the cursors. Touch the **Volt1** or **Volt2** 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. Press the Input **C** button to select the Composite A input.
5. Press the **FULL** button to make the WFM tile the full screen display.
6. Press the **CURSOR** button.
7. Use the arrow keys to select **Volt1** or **Volt2**. Use the **GENERAL** knob to adjust the cursors to be near the top and zero portions of the waveform.
8. Press and hold the **GAIN** button, select **Gain Settings**, and then select **x5**.
9. Position the lower cursor on to the backporch of the waveform.
10. Select **Gain Settings** and then **x2** 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.
11. Position the upper cursor to be centered on the top of the waveform.
12. 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. Press the Input **C** button to select the Composite A input.
4. Press the **EXT REF** button to activate external reference mode.
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. Press the **Input C** button to select the Composite A input.
5. Press the **FULL** button to make the WFM tile the full screen display.
6. Set the timecode source to VITC:
  - a. Press the **CONFIG** button.
  - b. Select **Aux Data Settings**.
  - c. Select **Timecode Display**.
  - d. Select **VITC**.
7. Verify that Decoded VITC is displayed in the lower-right corner of the waveform monitor display.
8. 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  $75\ \Omega$  RF sine wave signal source that can be connected to the  $75\ \Omega$  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  $50\ \Omega$  generator,  $50$  to  $75\ \Omega$  min loss pad, and appropriate adapters and cables to connect to the  $75\ \Omega$  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  $850\ \text{mV}_{\text{p-p}}$  at the reference frequency, as viewed on the unit under test when in Eye BW check mode. With a setup consisting of a  $50\ \Omega$  generator, a  $5.7\ \text{dB}$  min loss pad and appropriate adapters and cables, a base generator setting of  $6.3\ \text{dBm}$  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,  $100\ \text{MHz}$ , and the base level, typically  $6.3\ \text{dBm}$ .
3. Enter '100 MHz' into the power meter, to apply 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)	$6.3\ \text{dBm}^3$	1600	
200		1700	



**Table 2- 6: (Cont.)Generator Characterization**

<b>Frequency setting (MHz)</b>	<b>Level setting</b>	<b>Frequency setting (MHz)</b>	<b>Level setting</b>
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	

<sup>3</sup> 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:
	WFM7120/WFM7020 with option HD: 1080i 59.94 100% color bars with two or more groups of embedded audio	HDVG1 module for TG2000
	All instruments with SD: 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 <sub>p-p</sub> 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 and DDE	Tektronix part number 012-1688-00



- 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.

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**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.*

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9. Select the AES A input:
- a. Press the **CONFIG** button and select **Audio Inputs/Outputs**.
  - b. Select **AES A**.
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.

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

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. From the **CONFIG > Audio Inputs/Outputs** menu, select **AES B**.
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 display is not selected, press the **AUDIO** button.
3. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1-2 In BNC connector using a 75  $\Omega$  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. Press and hold the **AUDIO** button, select Audio Input, and then select **AES A**.
  - b. Press the **AUDIO** button to close the menu.
6. Press the **FULL** 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 selected, press the Display Select **4** button.
3. Select the AES B output:
  - a. Press the **CONFIG** button.
  - b. Select **Audio Inputs/Output**, then select **AES B**.
  - c. Select **Configure port as** and press the right arrow key to highlight **Output**.
  - d. Press the **CONFIG** button to close the menu.
4. Connect an SDI 100% color bars signal to the SDI A input. Use a signal type appropriate to the unit under test:
  - Option HD:  
1080i 59.94 color bars from HDVG1
  - 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 lower right area of the status bar, indicating the presence of two groups of embedded audio.





- Option HD:  
1080i 59.94 color bars from HDVG1
  - 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  $\Omega$  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 selected, press the Display Select **4** 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. Press and hold the **AUDIO** button, select **Audio Input**, and then select **AES A**.
  - b. Press the **AUDIO** button to close the menu.
5. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1-2 In connector using a 75  $\Omega$  cable.
6. Check for an indication of -6 dB FS  $\pm 0.2$  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 selected, press the Display Select 4 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 $\Omega$
Channel	1
Ch1 Coupl	AC
Ch1 Input	BAL
Ch1 Imped	200 k $\Omega$
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. Press and hold the **AUDIO** button, select **Audio Input**, and then select **AES A**.
6. Press the **AUDIO** button to close the menu.
7. Connect the digital audio generator unbalanced (UNBAL) output to the waveform monitor AES A IN 1-2 connector, using a 75  $\Omega$  cable.
8. Verify that the numbers 1,2 are visible under the headphone icon, in the audio tile.
9. Set the headphone output volume to maximum by turning the **Horz** (VOLUME) knob clockwise.
10. Connect the 1/4" male phono connector from the headphone test cable to the waveform monitor headphone jack.
11. Connect the XLR corresponding to the 'Left' channel to the analyzer balanced (BAL) analog input.
12. Check for 0.25 dBu  $\pm$ 1 dB RMS on the analog analyzer. Record the result in the test record.
13. Connect the XLR corresponding to the 'Right' channel to the analyzer balanced (BAL) analog input.
14. Check for 0.25 dBu  $\pm$ 1 dB RMS on the analog analyzer. Record the result in the test record.
15. Set the digital audio generator as follows:
  - Sample Frequency                      48 kHz

- Output Level                                -6 dB FS Audio Tone
  - Frequency                                    1 kHz
16. Repeat steps 9 through 12.
17. Set the digital audio generator as follows:
- Sample Frequency                        48 kHz
  - Output Level                                -6 dB FS Audio Tone
  - Frequency                                    19 kHz
18. Repeat steps 9 through 12.

## Additional Tests for Instruments equipped with Options AD 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 press the Display Select **4** button.
2. Press the **FULL** button to make the audio tile the full screen display.
3. Select the Analog A input:
  - a. Press and hold the **AUDIO** button, select **Audio Input**, and then select **Analog A**.
  - b. Press the **AUDIO** button to close the menu.
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  $\Omega$

7. Check for an indication of 18 dBu  $\pm$ 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  $\pm$ 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  $\pm$ 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. Press and hold the **AUDIO** button, select **Audio Input**, and then select **Analog B**.
- b. Press the **AUDIO** button to close the menu.

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 $\Omega$       |

17. Connect the generator balanced (BAL) analog output to the Analog A input that requires adjustment.

18. Access the Calibration routine by pressing the **CONFIG** button, selecting **Utilities**, and then **Calibration**.

- a. Press the **SEL** button.
- b. Use the down arrow key to navigate to **Analog Audio Channel**.
- c. After the calibration process finishes, follow the directions on the screen and press the **STATUS** button to save and exit Calibration.

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 selected, press the Display Select **4** button.
2. Set the generator to Digital.
3. Set the Audio Output Attenuation to 0 dB:
  - a. Press and hold the **AUDIO** button.
  - b. Select **Analog Out Atten.**
  - c. Press the right arrow button to select the attenuation setting.
  - d. Use the **GENERAL** knob to set the attenuation to **0 dB**.
  - e. Press the **AUDIO** button to close the menu.
4. Map Bar 1,2 to all Analog Audio Outputs:
  - a. Press the **CONFIG** button.
  - b. Select **Audio Inputs/Outputs**.
  - c. Select **AES A**, **Analog Output Map**, and then press the **SEL** button.
  - d. Use the arrow keys to navigate to the **Analog 1,2**; **Analog 3,4**; **Analog 5,6**; and **Analog 7,8** boxes across from **Bars 1,2**.
  - e. Press the **SEL** key to place a check mark in those boxes.
  - f. When finished, navigate to the **Return** box and press the **SEL** button to exit the mapping menu.
5. Set the audio Input to AES A:
  - a. Press and hold the **AUDIO** button, select **Audio Input**, and then select **AES A**.
  - b. Press the **AUDIO** button to close the menu.

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 k $\Omega$ . 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 $\Omega$
Channel	1
Ch1 Coupl	AC
Ch1 Input	BAL
Ch1 Imped	200 k $\Omega$
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  $\Omega$  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  $\pm$ 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  $\pm$ 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  $\pm$ 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 selected, press the Display Select **4** button.
2. Set the Audio Output Attenuation to 0 dB:
  - a. Press and hold the **AUDIO** button.
  - b. Select **Analog Out Atten**, and press the SEL button.
  - c. Use the **GENERAL** knob to set the attenuation to 0 dB.
  - d. Press the **AUDIO** button to close the menu.
3. Map Bar 1,2 to all Analog Audio Outputs:
  - a. Press the **CONFIG** button.
  - b. Select **Audio Inputs/Outputs**.
  - c. Select **AES A, Analog Output Map**, and then press the SEL button.
  - d. Use the arrow keys to navigate to the **Analog 1,2; Analog 3,4; Analog 5,6; and Analog 7,8** boxes across from **Bars 1,2**.
  - e. Press the SEL key to place a check mark in those boxes.
  - f. When finished, navigate to the **Return** box and press the SEL button to exit the mapping menu.

4. Set the Audio Input to Analog Audio A:
  - a. Press and hold the **Audio** button.
  - b. Select **Audio Inputs/Outputs**, then select **Analog A**
  - c. Press the **Audio** button to close the menu.
5. Set the analog audio generator as follows:

■ Frequency	100 Hz
■ Output Level	18 dBu
■ Output Impedance	10 $\Omega$
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  $\pm 1.0$  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  $\pm 1.0$  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 $\Omega$
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  $\pm 1.0$  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  $\pm 1.0$  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  $\Omega$
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  $\pm 1.0$  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  $\pm$ 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.

This completes the Performance Verification procedures.

