

**WVR6020, WVR7020, WVR7120,
WVR6100 Opt. MB, WVR7000 Opt. MB,
and WVR7100 Opt. MB
Waveform Rasterizers
Specifications and Performance Verification
Technical Reference**



077-0083-02

Tektronix

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Technical Reference**

This document applies to firmware version 5.0.X and above.

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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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.

Power Disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

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

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

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

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

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

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

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.

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



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



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

Symbols and 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.

The following symbol(s) may appear on the product:



CAUTION
Refer to Manual



Protective Ground
(Earth) Terminal

Preface

This manual contains specifications and performance verification procedures for the WVR6020, WVR7020, and WVR7120 Waveform Rasterizers.

Related Documents

The following related user documents are also available for this product:

- *WVR6020, WVR7020, and WVR7120 Waveform Rasterizers Quick Start User Manual*. This document provides detailed operating information.
- *Waveform Monitor and Rasterizer User Technical Reference*. This document provides supplemental operating information.
- *WVR6020, WVR7020, and WVR7120 Waveform Rasterizers Release Notes*. This document describes problems or behaviors that you might encounter while using the waveform rasterizer. This document is provided as a standard accessory when you order a new instrument. If you upgrade your instrument firmware from the Tektronix Web site, an updated version of this document is provided.

Specifications

This chapter contains specifications for the Tektronix WVR6020, WVR7020, and WVR7120 waveform rasterizers. Items listed in the Performance Requirement column are generally quantitative, and are either tested by the *Performance Verification* procedure or are guaranteed by design.

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 +50 °C. The rated accuracies are valid when the instrument is calibrated in an ambient temperature range of +20 °C to +30 °C and has been operating continuously for at least 20 minutes within this range.

The characteristics are divided into the following sections:

- Common Characteristics
- High Definition (HD) Characteristics
- Standard Definition (SD) Characteristics
- Options Characteristics

Common Characteristics

The characteristics in this section are common to the WVR6020, WVR7020, and WVR7120 Waveform Rasterizers.

Table 1: SDI input waveform vertical characteristics

Characteristic	Performance requirement	Reference information	
Displayed Vertical Gain Accuracy		YPbPr signal from a digital signal generator as measured in YPbPr mode. Limited by display resolution, measured by Graticules or Cursors. Applies to all three channels.	
	At X1		± 0.5%
	At X5		± 0.2%
Variable Gain Range	0.25X to 10X		
Line Rate Tilt	< 0.1%, guaranteed by digital design.		
Off Screen Recovery	< 0.1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen. X1, X5, or with any variable gain setting.		
RGB Transcoder Accuracy	± 0.1%		
Bit Integrity	Accurately shows both 8 and 10 bit signals.		

Table 2: SDI >Composite mode filter characteristics

Characteristic	Performance requirement	Reference information
Luma Filter Gain	1 + 0.1% relative to Flat (no filter) gain.	
Luma Filter Response	< 3 dB attenuation at 800 KHz. > 32 dB attenuation at F _{sc} .	Filter meets STD-205.
Chroma Filter Response	Selecting Chroma filter switches off displayed luma.	

Table 3: Waveform sweep (horizontal) characteristics

Characteristic	Performance requirement	Reference information
Sweep Timing Accuracy	± 0.1%	All Sweep and Mag modes, limited by display resolution, measured using Graticules or Cursors. Guaranteed by digital design. Input time base within + 10 PPM. Line sweeps for 1080P 60/59/50 dual link formats are shown with image scanning time scale. In these formats, each link operates at 1/2 the image scanning rate, so link time scale is twice the indicated time per division.
Sweep Linearity	± 0.1%	Guaranteed by digital design.
Sweep Rates	1, 2, 3 or 4 line; field; or 2 fields (depending on mode).	Some rates only available in parade modes. 1 Field sweep displays one full field, including field rate sync. 2 Field sweep displays two full fields and the field rate sync between them.
Sweep Rates, Mag	Mag occurs around center of sweep.	Two line and two field Mag modes optimized to display blanking intervals. Mag from 8X to 50X for line sweeps, depending on format and mode. Mag is 20X for field sweeps.
Horizontal Position Range	Any portion of the synchronized sweep can be positioned on screen in all sweep modes. Any portion of the sweep can be set to the middle of the screen in non-magnified mode.	

Table 4: Component vector mode characteristics

Characteristic	Performance requirement	Reference information
Vector Display	P _B is displayed on the horizontal axis and P _R is displayed on the vertical axis.	

Table 4: Component vector mode characteristics (cont.)

Characteristic	Performance requirement	Reference information
Vector Position	Graticules and waveform move together with position controls. Range sufficient to put any bar target in center of screen at all gains.	
Variable Gain	Variable affects waveform amplitude relative to graticules.	
Displayed Horizontal and Vertical Gain Accuracy	X1 Gain $\pm 0.5\%$ X5 Gain $\pm 0.2\%$	Limited by display resolution, measured using Graticules or Cursors.
Display to Graticule Registration	Centered in target, ± 0.25 box diameter at 1x gain, (plus-min) 0.1 box diameter at 5X gain. Graticules expand when in x5 mode.	Boxes are 2% targets.
Bandwidth, typical	SD	800 kHz
	HD	4.5 MHz (9 MHz for 1080P 60/59/50 dual link formats)
Lightning Display	Y is displayed vertically. P_B is displayed horizontally on top half of display. P_R is displayed horizontally on bottom half of display.	
Lightning Timing mark delay values	Deviation of the G/Mg transition from center indicates chroma-luma delay. Deflection calibrated for color bars with 200 ns luma rise time, and 400 ns chroma rise time.	If the transition bends in toward black, the color-difference signal is delayed with respect to luma. If the transition bends out toward white, the color difference signal is leading the luma signal.
SD		
1 st tic mark from center	20 ns	
2 nd tic mark	40 ns	
3 rd tic mark	74 ns (1 luma sample)	
4 th tic mark	148 ns (1 chroma sample)	
HD (1080P 60/59/50)		
1 st tic mark from center	2 ns (1 ns)	
2 nd tic mark	5 ns (2.5 ns)	
3 rd tic mark	13.5 ns (6.75 ns) 1 luma sample	
4 th tic mark	27 ns (13.5 ns) 1 chroma sample	

Table 5: Diamond (RGB gamut) display characteristics

Characteristic	Performance requirement	Reference information
Displayed Horizontal and Vertical Gain Accuracy	$\pm 0.5\%$, 1x and 5x gain.	Limited by display resolution.

Table 5: Diamond (RGB gamut) display characteristics (cont.)

Characteristic	Performance requirement	Reference information
Diamond	GBR Deflection axis indicated.	
Detection Level	Adjustable thresholds, 1% resolution.	Default is nominally 103% of legal RGB.
Upper	630 mV to 756 mV.	Upper detection level: 721 mV.
Lower	-70 mV to +35 mV.	Lower Detection level: -21 mV
Detection Level Accuracy	± 5 mV	
Colorimetry	Defined in CCIR601 for SD. Defined in ITU 709-2 and SMPTE 240M for HD.	

Table 6: Arrowhead display (SDI > Composite mode) characteristics

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy (PAL values in parentheses)	± 1%, 100 IRE (700 mV) and 131 IRE (900 mV).	
Composite Limit Cursor Accuracy (PAL values in parentheses)	± 1% at 100, 110, 120, 131 IRE (700 and 950 mV).	
Detection Level	Adjustable thresholds, 1% steps.	
Composite Limit Detection Level Accuracy (PAL values in parentheses)	Detection level = ± 7mV of cursor level. Detection level can be set to 100, 110, 120, or 131 IRE (700 or 950 mV PAL).	

Table 7: Picture display mode characteristics

Characteristic	Performance requirement	Reference information
Modes	Color only, internally referenced with 60 Hz vertical refresh.	
Full Screen Modes	Under scan image with and without blanking displayed.	
Tiled Modes	Decimated with correct aspect ratio.	
Safe Area Graticule, standards-based	Displays safe action and safe title area graticules per SMPTE RP218, ARIB TR-B4 V1.1, and ITU.	
Safe Area Graticule, custom		
Height and width adjustment range	0% to 100%.	Displays safe action and safe title area graticules with user-adjustable height, width vertical offset and horizontal offset.
Offset adjustment range	-50% to 50%.	
Adjustment resolution	1%	
EIA608 (Closed Caption) Signal Types		

Table 7: Picture display mode characteristics (cont.)

Characteristic	Performance requirement	Reference information
Option HD	EIA608 ancillary data in HD. EIA608 in EIA708 ancillary data in HD.	Capability added by options is in addition to base unit capability.
SD	EIA608 line 21 on 525/270 SD. EIA608 ancillary data in SD. EIA608 in EIA708 ancillary data in SD.	
Option CPS	EIA608 line 21 on composite analog.	
EIA608 Data Types Displayed		
Required Services	CC Channels 1-4 Text Channels 1-4	
XDS Data	Current Program Content Advisory (VCHIP) Transmission Signal Identifier (TSID)	
Closed Caption		
EIA608 line 21 line selection range		Lines 5 through 25, manual or automatic mode.
EIA608 line 21 decoding timing range (typical)		
Normal setting	9.7 ms to 11.3 μ s	Normal setting exceeds requirements of EIA608 decoder specification by 60%. Early and late settings provided to allow decoding of even more extreme signals.
Early setting	8.9 ms to 10.5 μ s	
Late setting	10.3 ms to 11.8 μ s	

Table 8: Timing display characteristics

Characteristic	Performance requirement	Reference information
Input timing relative to External Reference	Display of V & H timing offset graphically and numerically. One clock cycle resolution.	Patented proprietary display.
Timing Display Zero Definition	Vertical timing conforms to SMPTE168-2002.	Timing zero is equivalent to nominal zero delay on TG700. Also agrees with signal that shows minimal shift on the waveform display when go from internal to external.
Link B to Link A		Display of dual link timing skew. Uncertainty of ± 1.5 clocks or 20 ns.
Input Timing Reference to Other Input		For Simultaneous inputs, allows selection of other channel as reference.

Table 9: LTC display characteristics

Characteristic	Performance requirement	Reference information
LTC Waveform	Displays voltage versus time waveform of LTC input.	Timing derived from currently selected video timing. AC coupled only. Graticule with volts and audio dBu scale.
LTC Waveform Vertical Accuracy, typical	$\pm 5\%$	
LTC Waveform DC Offset, typical	± 100 mV	
LTC Waveform Time Base, typical	3 ms/division for NTSC, 4ms/div for PAL.	Runs in 2 field sweep mode only, triggered by field one to allow verifying audio to video synchronization.
Operating Input Voltage Range, typical	13.6 V _{p-p} if driven differentially, 6.5 V _{p-p} on either input if driven single-ended.	AC coupled so always displayed symmetrically about center. Waveform will shift up or down if overdriven.
Maximum absolute input voltage range		± 12 V on both inputs.

Table 10: External reference characteristics

Characteristic	Performance requirement	Reference information
Formats supported	(See page 33, <i>Signal Input-to-Reference Compatibility Tables</i> .)	In Ext Ref mode, waveform display and line select function derive timing from the Reference input. Reference must have a frame rate compatible with the input as listed in the <i>Signal Input-to-Reference Compatibility Tables</i> . Picture mode does not use timing from the Reference input. With Simultaneous inputs, External Reference settings apply to both channels.
Input Dynamic Range, typical	+ 6 dB range	
Absolute Maximum Input Voltage	± 8.5 V DC plus peak AC	
Input Type	Passive loop through 75 Ω compensated	
DC Input Impedance	20 k Ω	
Return Loss, typical		Typically > 46 dB to 6 MHz with power on or off. Typically > 40 dB to 30 MHz with power on. Typically > 35 dB to 30 MHz with power off. Loop through terminated in 75 Ω , power on or off.
Timing Shift with 10 to 90% APL Change, typical	< 0.5 ns	
Timing Shift with Hum, typical	< 20 ns with 0 dB hum on WFM mode, 2 degrees on Vector mode.	
Lock Range	± 50 ppm, remains locked.	
Lock in Presence of Hum		

Table 10: External reference characteristics (cont.)

Characteristic	Performance requirement	Reference information
Bi-level sync	Remains locked with $< 1.0 V_{p-p}$ on 0 dB signal.	
Tri-level sync	Remains locked with $< 0.5 V_{p-p}$ on 0 dB signal.	
Lock in Presence of White Noise	Remains locked on black burst with Signal/Noise ratio of 32 dB, 5 MHz bandwidth.	
Color Framing	Correct color framing detected for composite signals with burst present and having $< 45^\circ$ SCH Phase error.	Also applies to internal mode.

Table 11: Miscellaneous measurements and display characteristics

Characteristic	Performance requirement	Reference information
352M Payload	Displays the payload type as indicated by SMPTE 352M ancillary data.	Shown in the Video Session display.
Ancillary Data	Identifies the presence of ancillary data (other than EDH).	Shown in the Video Session display.
SDI Video Format	Indicates SDI video format listed in the section. (See page 33.)	Shown in the Video Session display.
Stuck Bits	Displays the state of unchanging bits in the SDI data stream.	Shown in the Video Session display.
Gamut Error Statistics	Displays errored seconds and fields, and percentage of fields with errors for RGB, Composite and Luma Gamut errors. (See Table 21 on page 12.)	Shown in the Video Session display.
Closed Caption Type	Indicates closed caption types detected.	Shown in the Auxiliary Data Status display.
V-Chip Rating	Displays the Content Advisory Rating from the selected EIA608 data stream.	Shown in the Auxiliary Data Status display.
CC Services	Lists the Closed Caption Services present in the selected EIA608 data stream.	Shown in the Auxiliary Data Status display.
Transmission Signal Identifier	Displays the TSID present in the selected EIA608 data stream.	Shown in the Auxiliary Data Status display.

Table 12: Timecode characteristics

Characteristic	Performance requirement	Reference information
Display	Onscreen readout from the selected timecode type and source appears in the status bar and in the Error Log.	
VITC signal type	Vertical Interval Time Code as defined by SMPTE 12M.	

Table 12: Timecode characteristics (cont.)

Characteristic	Performance requirement	Reference information
LTC signal type	Linear Time Code as defined by SMPTE 12M.	
ANC TC signal type	Ancillary Data Timecode was defined by SMPTE RP 188-1999.	
Supported Time Code Signal Types and Sources		
Option HD	LTC from Remote connector. ANC TC from HD.	
SD (WVR7020, WVR7120)	VITC from 525/270 SDI. ANC TC from SD.	
SD (WVR6020)	VITC from 525/270 SDI. LTC from Remote connector. ANC TC from SD.	
Option CPS	VITC from composite.	

Table 13: General characteristics

Characteristic	Performance requirement	Reference information
Presets	5 user presets and a Factory default.	
Real Time Clock	Time set by user, used for log time stamps.	
Field Upgradeable SW and FPGA	All code except for boot flash can be upgraded.	
Battery life and retention time, typical	10 years for normal operation, 5 years worst case.	Battery not drained while instrument is off, drain higher at elevated temperature.
Low light illumination, typical	"Off" leds optionally driven at user selected level from 1 to 10%.	
Preset Parameters	Covers all parameters except configure/utilities menu items.	
Line Select Function	Any one tile may be in line select for waveform, vector, arrowhead, diamond, or lightning.	
Line Select Bright-up	Selected line is indicated with a cursor in picture and field sweeps.	Picture cursor can be disabled.
Line Select Range	Any line, numbered according to appropriate standard, frame and color frame structure.	Fields greater than 1 display the line number in the field and the line number in the frame or color frame.
Acoustic Noise Level, typical	Front 40, rear 39, side 38 dB(A) for standing location at 25 °C ambient. Front 41, rear 45, side 38 dB(A) for sitting location at 25 °C ambient.	Measured as per ISO7779. Unit placed on desk, measured in operator location. Fan speed and noise increase at higher temperature.

Table 14: Program error alarms

Characteristic	Performance requirement	Reference information
Alarm Coverage	Alarms only reported on selected input. (See Table 45 on page 30.)	
Alarm Log Depth	10,000 alarm entries.	Volatile
Alarm Log Time stamping	Time of Day, and Selectable LTC, VITC, or ATC (Ancillary Time Code).	
Alarm Notification	All alarms may be configured to be reported to any or all of the following: XGA display Icon or Text, Beeper, SNMP, Ground Closure Alarm Output, Web based User Interface, Alarm Log.	

Table 15: Ethernet

Characteristic	Performance requirement	Reference information
SNMP	For instrument control & feedback of status. Complies with SNMP version 2.	
IP Address Mode	Supports manual and DHCP.	
Connector	RJ-45 LAN connector supporting 10/100 BaseT.	The 10/100Base-T Ethernet port connector arrangements: The RJ-45 connector has built in LEDs. The Green LED indicates an active connection. The Yellow LED indicates speed. ON = 100, OFF = 10.

Table 16: XGA picture monitor output characteristics

Characteristic	Performance requirement	Reference information
Amplitude, typical	Can switch between 1 V and 0.7 V.	
Resolution	1024 x 768 with 16 colors.	

Table 17: Ground closure remote / LTC time code input characteristics

Characteristic	Performance requirement	Reference information
LTC Input Connector	Balanced, unterminated through rear panel GC remote connector.	
LTC Input Impedance	Greater than 10 k Ω .	
LTC Signal Characteristics	Linear Time Code per IEC Publication 461.	
LTC Signal Amplitude Range, typical	0.2 V _{p-p} to 5.0 V _{p-p} balanced differential or single-ended.	

Table 17: Ground closure remote / LTC time code input characteristics (cont.)

Characteristic	Performance requirement	Reference information			
Ground Closure Input signaling	TTL thresholds, 5 V max input, -0.5 V min input. Pull low to assert.	Has internal 10 kΩ pull-up to 5 V on each input. 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.			
		<i>Hex</i>	<i>Binary Pins</i> 15, 14, 13, 5	<i>Direct mode selection</i>	<i>Encoded mode selection</i>
		F	1111	none	No action
		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		
		7	0111	Preset 4	
		6	0110		Factory Preset
		5	0101		Preset 5
		4	0100		Preset 4
		3	0011		Preset 3
		2	0010		Preset 2
		1	0001		Preset 1
		0	0000		unused
Ground Closure Output characteristics	Open collector output, 30 V maximum, 100 mA maximum, 300 mW maximum.				

Table 18: Power supply characteristics

Characteristic	Performance requirement	Reference information
Electrical Rating, typical	100-240 VAC ±10%, 50/60 Hz, 100 watts maximum.	Continuous range from 90 to 264 VAC.
Supply Type	Single phase	
Supply Connection, typical	Detachable cord set with lock.	
Power Consumption, typical	< 90 VA (50 watts).	
Fuse	Primary fuse value 3.15 AH (20 mm x 5 mm).	Not operator replaceable. Please refer to qualified personnel.

Table 19: Physical characteristics

Characteristic	Performance requirement	Reference information
Dimensions, typical		Fits 19 inch rack, 1 RU high. Comes with rack slides installed on chassis.
Height	1.72 inches (43.7 millimeters).	
Width	19 inches (482.6 millimeters) measured at front trim.	
Depth	20.25 inches (514.4 millimeters) including rack handles and BNCs.	
Weight, typical		
Net	8 pounds 12 oz (4.0 kilograms).	
Shipping	15.7 pounds (7.2 kilograms) approximate.	

Table 20: Environmental characteristics

Characteristic	Performance requirement	Reference information
Temperature, typical		Exceeds Mil-PRF-28800F for a class 5 product.
Operating	0 to +50 °C.	
Non-operating	-40 to +75 °C.	
Altitude, typical		Exceeds Mil-PRF-28800F for a class 5 product.
Operating	3,000 meters (10,000 ft)	
Non-operating	12,000 meters (40,000 ft).	
Humidity, typical		Do not operate with visible moisture on the circuit boards. Exceeds Mil-PRF-28800F Class 3.
Operating	5% to 95% relative humidity (% RH) at up to +30 °C, derated linearly to 45% maximum relative humidity (%RH) at +50 °C, non-condensing.	
Non-operating	5% to 95% relative humidity (% RH) at up to +30 °C, derated linearly to 45% maximum relative humidity (%RH) at +60 °C, non-condensing. Warm-up period of 20 minutes is required after extended exposure to non-operating upper limits.	
Vibration, typical		Meets Mil-PRF-28800F Class 3.
Operating	Tektronix Class 5 Random Vibration Operating Test: For Laboratory / Benchtop Products.	

Table 20: Environmental characteristics (cont.)

Characteristic	Performance requirement	Reference information
Power Spectral Density	0.00015 g ² /Hz from 5 to 350 Hz. -3 dB/octave from 350 to 500 Hz. 0.000105 g ² /Hz at 500 Hz. Overall level of 0.27 g _{RMS} , 10 minutes per axis.	
Non-operating	Tektronix Class 5 Random Vibration Non-operating Test: For Laboratory / Benchtop Products.	
Power Spectral Density	0.0175 g ² /Hz from 5 to 100 Hz. -3 dB/octave from 100 to 200 Hz. 0.00875 g ² /Hz from 200 to 350 Hz. -3 dB/octave from 350 to 500 Hz. 0.006132 g ² /Hz at 500 Hz. Overall level of 2.28 g _{RMS} , 10 minutes per axis.	
Mechanical Shock, typical		
Non-operating	30 g 1/2 sine, 11 ms duration, 3 shocks per surface (18 total).	Meets Mil-PRF-28800F Class 3.
Transportation, typical		TEK Std 062-9537-00. Meets International Safe Transit Association Test Procedure 1A, April 1996, Category II for Vibration, Impact (24 inch drop), and Compression.

High Definition (HD) Characteristics

The characteristics in this section only apply to instruments with Option HD.

Table 21: HD waveform vertical characteristics, SDI inputs A and B

Characteristic	Performance requirement	Reference information
Frequency Response		
Luminance channel (Y) to 30 MHz (to 60 MHz for 1080P 60/59/50 dual link formats)	± 0.5%	RGB Monochrome identical to Y channel.
Color difference channels (P _B & P _R) to 15 MHz (to 30 MHz for 1080P 60/59/50 dual link formats)	± 0.5%	
Transient Response	Pulse-to-bar ratio 0.99:1 to 1.01:1 on appropriate Sine-Squared or Blackman 2T pulse.	

Table 21: HD waveform vertical characteristics, SDI inputs A and B (cont.)

Characteristic	Performance requirement	Reference information
Pre-shoot, Over-shoot, Sine-Squared Bars: 2T30 bar	$\leq 0.5\%$ peak	
Ringing: Sine-Squared Bars: 2T30	$\leq 0.8\%$ $p-p$	
Low Pass Filter Frequency Response	≤ 3 dB attenuation at 4 MHz. ≥ 25 dB attenuation at 15 MHz.	Response provides conventional noise reduction. For 1080P 60/59/50 dual link formats: ≤ 3 dB attenuation at 9 MHz ≥ 25 dB attenuation above 30 MHz

Table 22: HD physical characteristics, SDI A and B inputs

Characteristic	Performance requirement	Reference information
Formats Supported	1485/1483 Mbit/s component. (See page 33, <i>Signal Input-to-Reference Compatibility Tables</i> .)	Auto detect of input standard
Input Level	800 mV _{p-p} $\pm 10\%$ Input voltages outside this range may cause reduced receiver performance.	
Input Type	Passive loop through 75 Ω compensated.	
Return Loss, typical		
Power on		≥ 15 dB 1-1500 MHz
Power off		≥ 10 dB 1-1500 MHz
Insertion Loss (Loop Through)		≤ 4 dB to 1500 MHz
Loop Through Isolation		≥ 5 dB to 1 GHz
Serial Receiver Equalization Range	Proper operation with up to 20.0 dB loss at 750 MHz using coaxial cable having loss characteristics of $1/\sqrt{F}$ 800 mV launch amplitude per SMPTE 292M.	Equivalent to approximately 80 meters of Belden 8281. Typically operates to 130 meters.
Jitter Tolerance	0.35 UI _{p-p} above 1 MHz. 5 UI _{p-p} at 10 kHz.	
Input Timebase Range	1485 Mbit/s ± 50 ppm, or 1483.51 Mbit/s (plus-min) 50ppm.	Many functions continue to operate over a much wider range, typically 10,000 ppm.

Table 23: Miscellaneous measurements and displays

Characteristic	Performance requirement	Reference information
Errors and Alarms	(See Table 46 on page 31.)	
Error Statistics	Displays errored seconds and fields, and percentage of fields with errors for Y and C CRC Errors and Y and C Anc Checksum errors.	Shown in Video Session display.

Standard Definition (SD) Characteristics

The characteristics in this section are common to the WVR6020, WVR7020, and WVR7120 Waveform Rasterizers.

Table 24: SD waveform vertical characteristics, SDI inputs A and B

Characteristic	Performance requirement	Reference information
Frequency Response		RGB Monochrome identical to Y channel.
Luminance channel (Y)	5.75 MHz \pm 0.5%	
Color difference channels (P _B & P _R)	2.75 MHz \pm 0.5%	
Transient Response		
Pre-shoot, Over-shoot (Sine-Squared Bars)	2T5 bar \leq 0.3% peak	
Ringing (Sine-Squared Bars)	2T5 \leq 0.8% _{p-p}	
Pulse-to-bar ratio	0.99:1 to 1.01:1 on appropriate Sine-Squared or Blackman 2T pulse.	
Low Pass Filter Frequency Response, SDI Component Only	\leq 3 dB attenuation at 800 kHz. \geq 32 dB attenuation at 3 MHz.	Response meets STD-05.

Table 25: SD physical characteristics, SDI inputs A and B

Characteristic	Performance requirement	Reference information
Formats Supported	270 Mbit/s component. (See page 33, <i>Signal Input-to-Reference Compatibility Tables</i> .)	Auto detect of input standard.
Input Level	800 mV _{p-p} \pm 10% Input voltages outside this range may cause reduced receiver performance.	
Input Type	Passive loop through 75 Ω compensated.	
Return Loss, typical		
Power on		\geq 25 dB 1-270 MHz
Power off		\geq 15 dB 1-270 MHz
Insertion Loss (Loop Through)		\leq 2 dB to 270MHz
Loop Through Isolation		\geq 50 dB to 300 MHz
Serial Receiver Equalization Range	Proper operation with up to 23.0 dB loss at 135 MHz using coaxial cable having loss characteristics of $1/\sqrt{F}$ 800 mV launch amplitude per SMPTE 292M.	Typically 275 meters using Belden 8281 coaxial cable.
Jitter Tolerance	0.4 UI _{p-p} above 1 MHz. 5 UI _{p-p} at 10 kHz.	
Input Timebase Range	270Mbit/s \pm 50ppm	Many functions continue to operate to much wider range, typically 10,000 ppm.

Table 26: Miscellaneous measurements and displays

Characteristic	Performance requirement	Reference information
Errors and Alarms	(See Table 46.)	
EDH Error Statistics	Displays errored seconds and fields, and percentage of fields with errors for Active Picture CRC, Full Field CRC, and EDH Error conditions.	

Option Characteristics

The characteristics in this section are option-specific and apply to instruments equipped with the specified option.

Video Option CPS Option CPS (Analog Composite) is available for the WVR6020, WVR7020, and WVR7120. The following tables list the the characteristics specific to Option CPS.

Table 27: Composite analog waveform vertical characteristics (Option CPS)

Characteristic	Performance requirement	Reference information
Displayed Vertical Measurement Accuracy	$\pm 1\%$ all gain settings.	Measured using cursors.
Frequency Response	Flat to 5.75 MHz $\pm 1\%$. Typically +0.4% to 5.75 MHz.	
Delay Variation over Frequency	"10 ns to 5.75 MHz".	Typically $< \pm 2.0$ ns.
Transient Response on sine squared 2T4 pulse		
Pulse-to-Bar Ratio	0.99:1 to 1.01:1	
Pre-shoot	$\leq 1\%$	
Overshoot	$\leq 1\%$	
Ringing	$\leq 1\%$	
Luma Filter Gain	$1 \pm 0.1\%$ relative to flat gain at 50 kHz.	
Luma Filter Response	< 3 dB attenuation at 800 KHz. > 32 dB attenuation at FSC.	Filter meets STD-205.
Chroma Filter Gain	$1 \pm 1.0\%$, relative to flat gain.	
Chroma Filter Response	3 dB bandwidth 3.3 MHz for PAL, 2.4 MHz for NTSC ± 0.3 MHz.	F _{sc} auto selected based on input standard, Implemented digitally, may not be centered on Fsc.
Chroma Filter Attenuation at 2X FSC, Composite only	≥ 25 dB	Implemented Digitally, Typically 28 dB for NTSC, 53 dB for PAL.
Field Rate Tilt	$< 0.5\%$ with DC restore Fast or Off.	

Table 27: Composite analog waveform vertical characteristics (Option CPS) (cont.)

Characteristic	Performance requirement	Reference information
Line Rate Tilt	< 0.5%	
Off Screen Recovery	≤ 0.5% variation in baseline of a Chroma modulated pulse when positioned anywhere on screen. X1, X5, or any variable gain setting.	

Table 28: Composite analog physical characteristics; composite input characteristics (Option CPS)

Characteristic	Performance requirement	Reference information
Formats supported	NTSC, NTSC no setup, and PAL, I, B, D, G, H Complies with RS170A & ITU-R BT.471.	Manual or auto detect of input standard.
Internal Reference	Proper horizontal and vertical synchronization with a composite signal of appropriate line and field rate.	
Input Dynamic Range (typical)	± 6 dB range	
Video Maximum Operating Amplitude (typical)	-1.8 V to +2.2 V, (all inputs) DC + peak AC.	
Maximum Absolute Video Input Voltage	-6.0 V to +6.0 V (DC + peak AC).	
Input Type	Passive loop through 75 Ω compensated	
DC Input Impedance	20 kΩ	
Return Loss, typical		Typically > 46 dB to 6 MHz; > 40 dB to 10 MHz. Typically 35 dB with power off for standard amplitude video.
Video Input Cross-talk Between Channels	≥60 dB to 6 MHz.	
Loop through Isolation	≥70 dB to 6 MHz.	
DC Offset with Restore Off (typical)	≤10 mV	Measured in full screen mode at x5 vertical gain.
DC Restore Modes	Fast, Slow, and Off modes.	Slow has a typical bandwidth of 10 Hz, Fast has a typical bandwidth of 500 Hz.
DC Restore Offset Error	<2 mV	Registration between back porch and 0 V graticule.
DC Offset between Inputs with restore off (typical)	<7 mV	
DC Restore 50 and 60 Hz Attenuation		
Fast Mode	>95% attenuation	

Table 28: Composite analog physical characteristics; composite input characteristics (Option CPS) (cont.)

Characteristic	Performance requirement	Reference information
Slow Mode	<10% attenuation, <10% peaking. Slow mode typical peaking 8% at 50 and 60 Hz.	
Blanking Shift with 10 to 90% APL Change	≤1 IRE (7 mV PAL)	
Blanking Shift with Presence and Absence of Burst	≤1 IRE (7 mV PAL). Typically 0 mV.	
Lock Range	“50 ppm, remains locked”.	Vector typically OK to ± 80ppm. WFM display typically locked to (plus-min) 200ppm.
Lock in Presence of Hum	± 1.0 V _{p-p} , on 0 dB 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.	
Clamp Range (typical)	Signals with back porch within ± 1V range.	Clamp can keep signal in this range displayed at correct position on screen. Signals outside this range may be displayed offset upward or downward.

Table 29: Alarms (Option CPS)

Characteristic	Performance requirement	Reference information
Errors and Alarms	(See Table 47 on page 31.)	

Table 30: Picture display mode characteristics (Option CPS)

Characteristic	Performance requirement	Reference information
Composite Decoder	Adaptive Comb	

Table 31: Composite vector mode characteristics (Option CPS)

Characteristic	Performance requirement	Reference information
Displayed Horizontal and Vertical Gain Accuracy	1% for X1 Gain or X5 Gain.	
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)	500 kHz	
Horizontal to Vertical Bandwidth Matching	< 0.5° at 500 kHz and 2 MHz.	

Table 31: Composite vector mode characteristics (Option CPS) (cont.)

Characteristic	Performance requirement	Reference information
Composite Vector Dot Reference	Shows true zero subcarrier reference.	
DG/DP Graticule	Includes markings for measurement of differential gain and differential phase.	

Video Option EYE Option EYE and PHY is available for the WVR7120 only. The following tables list the the characteristics specific to Option EYE and PHY.

Table 32: Eye Diagram Display characteristics

Characteristic	Performance requirement	Reference information
Type		Equivalent Time Sampler.
Formats		(See page 33, <i>Signal Input-to-Reference Compatibility Tables</i> .)
Signal Bandwidth		
WVR7120	50 kHz to 2.0 GHz at –3 dB point.	
WVR6020	50 kHz to 600 MHz at –3 dB point.	
Time Base Jitter, typical		–
HD		35 ps p-p in 1 kHz HPF mode.
SD	–	80 ps p-p in 1 kHz HPF mode.
Eye Clock		
Bandwidth Settings		Clock bandwidth can be set to 10 Hz, 100 Hz, 1 kHz, 10 kHz, or 100 kHz High-Pass filter (HPF).
Bandwidth Accuracy	Actual –3dB frequency within 10% of nominal.	
Jitter Attenuation Error		Displays jitter at frequencies from selected high-Pass filter (HPF) corner up to limit inherent in the serial bit rate.
HD at 10 Hz HPF	Within 0.3 UI + 10% for jitter frequencies above 5x the bandwidth selection.	Error for jitter frequencies between HPF setting and 5x HPF setting due to loop peaking, max of 1.5 dB.
HD at 100 Hz to 100 KHz HPF SD at All HPF Settings	Within 0.05 UI + 10% for jitter frequencies above 5x the bandwidth selection.	Error for jitter frequencies between HPF setting and 5x HPF setting due to loop peaking, max of 1.5 dB.
Display Modes		
Overlay (HD and SD)		Overlays all bits to form each eye opening; useful for observing peak jitter.
20 Eye (HD) 10 Eye (SD)		Displays eye relative to the parallel clock; useful for observing jitter correlated to word clock.
Scale Accuracy		

Table 32: Eye Diagram Display characteristics (cont.)

Characteristic	Performance requirement	Reference information
Vertical	800 mV \pm 5% with an 800 mV _{p-p} input.	
Horizontal		Indicated time per division \pm 1%.
Eye Derived Measurements (Option PHY)		Option measurements include: Eye Amplitude, Eye Risetime, Eye Falltime, and Eye Risetime – Falltime.
Eye Amplitude Measurement Accuracy, typical		\pm 10 mV relative to cursor measurement on displayed eye. Measurements are valid on a clean signal only. Excess jitter, overshoot or other aberrations will reduce the accuracy. Absolute accuracy is limited by Vertical Scale Accuracy.
Eye Risetime / Falltime Measurement Accuracy, typical		\pm 20 ps relative to cursor measurement on displayed eye. Measurements are valid on a clean signal only. Excess jitter, overshoot or other aberrations will reduce the accuracy. Absolute accuracy is limited by the inherent rise time of the 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.

Table 33: Jitter Display characteristics (Option PHY)

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. Option PHY adds Jitter Waveform display.
High Pass Filter		

Table 33: Jitter Display characteristics (Option PHY) (cont.)

Characteristic	Performance requirement	Reference information
Settings		Selectable 10 Hz, 100 Hz, 1 kHz, 10 kHz, or 100 kHz high Pass filter applied to demodulated jitter before peak detection. High-Pass filter has type-3 response for low-frequency rejection of 60 dB/decade below the filter setting. High-Pass filter applies to jitter readout, jitter waveform and Eye diagram display. Two independent jitter demodulators 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.
Attenuation Accuracy	Actual -3 dB frequency within 10% of nominal.	High-Pass frequency response applies to jitter readout, jitter waveform and Eye diagram display.
High-End Frequency Response, typical		-3 dB at >5 MHz. Applies to jitter readout and jitter waveform.
Maximum Jitter, typical		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.
HD		20 UI at 30 kHz; 0.35 UI above 1 MHz
SD		10 UI at 40 kHz; 0.35 UI from 1 MHz to 4 MHz; 0.25 UI above 4 MHz
Jitter Noise Floor, typical		Applies to jitter waveform.
HD at 10 Hz HPF		200 ps
HD at 100 Hz to 100 KHz HPF		40 ps
SD at All HPF Settings		250 ps
Digital Readout		
Type		Displays peak-to-peak value of jitter over the measurement interval, as defined by the High Pass Filter setting.
Accuracy, typical		Error for jitter frequencies between HPF setting and 5x HPF setting due to loop peaking, maximum of 1.5 dB.
HD at 10 Hz HPF		Within 0.3 UI + 10% of reading for jitter frequencies from 5x bandwidth selection to 4 MHz.
HD at 100 Hz to 100 kHz HPF		Within 0.05 UI + 10% of reading for jitter frequencies from 5x bandwidth selection to 4 MHz.
SD at All HPF Settings		

Table 33: Jitter Display characteristics (Option PHY) (cont.)

Characteristic	Performance requirement	Reference information
Resolution		0.01 UI
Jitter Waveform		
Amplitude Error, typical		Error for jitter frequencies between HPF setting and 5x HPF setting due to loop peaking, maximum of 1.5 dB.
HD at 10 Hz HPF		Within 0.4 UI + 10% of reading for jitter frequencies from 5x bandwidth selection to 4 MHz.
HD at 100 Hz to 100 kHz HPF SD at All HPF Settings		Within 0.1 UI + 10% of reading for jitter frequencies from 5x bandwidth selection to 4 MHz.
Scale		
Horizontal		1 Line, 2 Line, 1 Field, and 2 Field modes.
Vertical		1 UI/div, 0.2 UI/div, and variable 0.1 UI/div to 2.5 UI/div.
Jitter Measurement Time		0.5 s Approximately 10,000,000 independent samples.

Table 34: Signal level and cable length detector characteristics

Characteristic	Performance requirement	Reference information
Source Level Detector		
Measurement Accuracy, typical		40 mV at 800 mV level, 0 to 100 m Belden 8281 cable.
Measurement Resolution, typical		10 mV
Measurement Dynamic Range, typical		± 50% from 800 mV.
Cable Length Detector		
Measurement Error	15 m 10% of the reading for the cable type.	Requires clean SD signal with rise time less than 1 ns for full accuracy. Excessive ringing or slower rise time may appear as increased cable length.
Measurement Resolution		2 m
Measurement Range, typical		Cable loss range of 0 to 40 dB at ½ serial bit rate. Equivalent to: <ul style="list-style-type: none"> ■ HD: 0 to 120 m Belden 8281 ■ SD: 0 to 400 m Belden 8281

Table 34: Signal level and cable length detector characteristics (cont.)

Characteristic	Performance requirement	Reference information
Cable Loss Measurement		Displays loss near 160 MHz minus loss near 18 MHz. Not a function of the selected cable type. You can set alarm threshold without knowing the cable type if you characterize the receiver.
Cable Types		
United States		SD/HD Belden 1505A, 1506A, 1694A, 1695A, 1855A, and 8281.
Japan		Canare L-5CFB
Europe		Image 1000

Audio Option AD Option AD (Digital/Analog Audio) is available for the WVR6020, WVR7020, and WVR7120. The following tables list the the characteristics specific to Option AD.

Table 35: Audio bar displays (Option AD)

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. Each pair has a phase correlation meter.	
Pair Mode	Any 4 channel pairs with phase correlation meters.	
Surround Mode	Left, Right, Center, Low-frequency-effects, Left-surround, Right-surround meters, and an extra channel pair. Phase correlation meters between the two left- right-pairs and the extra pair.	
Audio Sources	Selected from AES A inputs, AES B inputs embedded audio.	
Level Meter Resolution	0.056 dB steps at 30 dB scale, for from full scale to -20 dB FS. 0.20 dB Steps at 0 to -70 dB scale, for signals above -20 dB FS, Tiled display.	

Table 35: Audio bar displays (Option AD) (cont.)

Characteristic	Performance requirement	Reference information
Correlation Meter Speed	User selectable 1 to 20. Factory default set to 8.	Speed 1 averages over 0.0167 s Speed 2 averages over 0.0333 s Speed 3 averages over 0.0667 s Speed 4 averages over 0.133 s Speed 5 averages over 0.267 s Speed 6 averages over 0.533 s Speed 7 averages over 1.0 s Speed 8 averages over 1.5 s Speed 9 averages over 2.0 s Speed 10 averages over 2.5 s Speed 11 averages over 3.0 s Speed 12 averages over 3.5 s Speed 13 averages over 4.0 s Speed 14 averages over 4.5 s Speed 15 averages over 5.0 s Speed 16 averages over 5.5 s Speed 17 averages over 6.0 s Speed 18 averages over 6.5 s Speed 19 averages over 7.0 s Speed 20 averages over 7.5 s
Metering Ballistics	Selectable from true peak, PPM type 1, PPM Type 2, and Extended VU.	
Peak Program Meter (PPM)	PPM Type I (IEC Type I, essentially the same as DIN 45406 and Nordic N-9). PPM Type II (IEC Type II, the same as IEEE Std 152-1991).	PPM Type I has a slightly faster attack time and a faster return time, 1.7 seconds to fall 20 dB as opposed to 2.8 seconds for Type II.
True Peak	PPM decay characteristics, no attack delay.	Factory Default ballistic.
Extended VU	A VU meter as defined in IEEE 152-1991, but with an extended dB-linear scale.	
Peak Hold	Indicated peaks held for user selected time. Adjustable from 1 to 10 seconds.	
Clip Indication Delay Count (not analog)	Consecutive FS samples for Clip Indication, user selectable Off or 1 to 100. Factory default set to 1 "0" is off.	
Mute Indication Delay Count (not analog)	Consecutive "0" samples for Mute Indication, user selectable, Off or 1 to 100. Factory default set to 10 "0" is 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.	

Table 35: Audio bar displays (Option AD) (cont.)

Characteristic	Performance requirement	Reference information
Silence Indication Delay	Off or 1 to 60 seconds, user selectable. Indication and alarm will not be asserted until threshold has been exceeded for this number of consecutive seconds. Factory default set to 10. "0" is 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 selected. Indication and alarm will not be asserted until threshold has been exceeded for this number of consecutive seconds. Factory default set to 2. "0" is off.	
Adjustable Peak Program level (dBFS)	Range 0 to -30.	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.
Adjustable Test Level (dBFS)	Range 0 to -30.	Test level is the level relative to digital full scale that you choose as the test or "line up" level for your system. The meter bars change to yellow between the Test and Peak Program levels.
Set 0 dB Mark	Select dBFS, Peak Program level, or Test level.	Use this item to number the meter scale relative to Digital Full scale 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.

Table 36: Audio bar and aux displays (Option AD)

Characteristic	Performance requirement	Reference information
Phase Display AGC	AGC (automatic gain control) may be configured on or off.	AGC time constant: 0.5 sec to expand display after a 0 to -40 level transition, 0.05 sec to reduce gain after a -40 to 0 dB level transition.
Phase Display Manual Scaling	When AGC is off, level at perimeter of display follows Program Level on Bar display.	
Phase Display Source Selection	Provides independent selection of any two channels of the selected audio input.	

Table 36: Audio bar and aux displays (Option AD) (cont.)

Characteristic	Performance requirement	Reference information
Surround Display	Provides a dynamic graphic display of multi-channel surround sound with integrated indicators for levels, correlations and dominant location. Provided with permission of RTW RADIO-TECHNISCHE WERKSTAETTEN GmbH & Co.).	
Surround Dominance Indicator	Selectable on or off.	
Surround Sound Filter	Selectable Linear (RMS) or A-Weighted. A-Weighting filter conforms to IEC651 Type 0.	

Table 37: Audio text displays (Option AD)

Characteristic	Performance requirement	Reference information
Session Log	List of significant audio events with time stamps. Depending on input, may include clips, mutes, silence, over.	

Table 38: AES audio inputs (Option AD)

Characteristic	Performance requirement	Reference information
Inputs	2 sets with 8 Channels each, 32, 44.1, 48, and 96 kHz, 24-bit, Meets Requirements of AES 3-ID and SMPTE 276M-1995.	
Input Connector	BNC, terminated, unbalanced.	
Input Impedance	75 Ω	
Return loss, typical		Typically better than 30 dB to 12 MHz. Input A has Passive terms that are the same with power on or off. Input B has active terms that go to a higher impedance with the power off.
Input Amplitude Range (typical)	0.2 V to 2 V _{p-p} .	
Input Sample rate	32k, 44.1k, 48k, and 96k samples/second	
Input Lock Range (typical)	Greater than $\pm 5\%$ of nominal sample rate.	After exceeding 5%, the instrument may search again for a new lock point. Typically stays locked to 12.5%.
Level Meter Accuracy over Frequency (typical)	0.2 dB from 20 Hz to 20 kHz 0 to -40 dBFS sine wave, peak Ballistic mode.	
Audio Levels	Bars display signals up to 0 dBFS.	

Table 39: AES audio outputs (Option AD)

Characteristic	Performance requirement	Reference information
Sources	AES A or embedded. Any audio source may be configured to drive AES B outputs but the outputs must be driven from the currently selected source.	
Number of Outputs	Up to 8 Channels.	
Output Format	Meets Requirements of SMPTE 276M-1995 (AES 3-ID).	
Output Connector	BNC, terminated, unbalanced.	
Output Impedance	75 Ω	
Return loss, typical		Typically better than 30 dB to 12 MHz. Tested in input mode.
Output Amplitude Range	0.9 V to 1.1 V _{p-p} into 75 Ω .	
Output Sample Rate	Depends on source.	
AES A	Output sample rate is same as the corresponding AES A input sample rate.	
Analog (requires option AD or higher)	Output sample rate is 48 kHz.	
Embedded	Output sample rate is 48 kHz locked to embedded audio sample rate.	
Output Jitter (typical)	< 3.5 ns peak with 700 Hz high Pass as per AES specification.	AES3 rev 1997 spec is 4.1 ns peak for 48 kHz audio.
Rise and Fall Time (typical)	37 ns 10% to 90% as per SMPTE 276M.	

Table 40: Embedded audio extraction and monitoring on status bar (Option AD)

Characteristic	Performance requirement	Reference information
Embedded Audio Detection	Identifies the presence or absence of up to 16 channels of Embedded digital audio. With Simultaneous inputs or dual link formats, 16 channels of each selected SDI input are monitored for presence.	
Embedded Audio Formatting		For SD, 24-bit Embedded audio is not supported (no AUX bits are extracted) only 20 most significant bits are extracted.
SD	Extracts 20-bit audio formatted according to SMPTE 272M operation Levels A and B (48 kHz audio sampling rate synchronized with video).	
HD	Extracts 24-bit audio formatted according to SMPTE 299M preferred implementation (48 kHz audio sampling rate synchronized with video).	

Table 40: Embedded audio extraction and monitoring on status bar (Option AD) (cont.)

Characteristic	Performance requirement	Reference information
Channel Numbering	Channel numbers per SMPTE 272M and SMPTE 299M (1 through 16) will be correctly shown on all displays.	
Audio Levels	Bars display signals up to 0 dBFS.	Must not exceed maximum power specification on analog outputs. Configure output attenuation if necessary.

Table 41: Analog audio inputs (Option AD)

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 through rear panel connector.	
Level Meter Accuracy over Frequency	± 0.5 dB from 20 Hz to 20kHz 0 to -40 dBFS sine wave, Peak Ballistic mode.	
Cross Talk (typical)	≤ -80 dB, typically ≤ -90 dB from 20 Hz to 20 kHz, inputs driven from $<600 \Omega$ source impedance.	Defined as the displayed bar level in any channel that results from a full scale signal on a different input pair in that input.
Maximum Input Levels	+24 dBu	Must not exceed max power specification on analog outputs. Configure output attenuation if necessary.
Sampling Resolution	24 bits at 48 kHz.	
Input Impedance (typical)	24 k Ω , balanced.	Unbalanced input impedance is typically 18 k Ω .
Off Isolation (typical)	≤ -80 dB, from 20 Hz to 20 kHz. Unused input terminated by $<600 \Omega$ source impedance.	

Table 42: Analog audio outputs (Option AD)

Characteristic	Performance requirement	Reference information
Audio Modes	Balanced: Provide a full-scale output of 24 dBu. This mode is intended for professional balanced applications. Unbalanced: Intended to drive the unbalanced inputs of consumer amplifiers, in which case one side of the line must be grounded.	Outputs are to drive line level inputs. Not intended to drive speakers directly.

Table 42: Analog audio outputs (Option AD) (cont.)

Characteristic	Performance requirement	Reference information
Audio Sources	The channels routed to the line outputs may include: Embedded audio source AES audio source Analog audio source	
Number of Channels	Provides up to eight channels.	
Output Connections	Balanced, unterminated through rear panel connector.	
Maximum Output Levels		
Balanced	+24 dBu ± 0.5 dB	When grounding one output to achieve unbalanced mode, the other output will be driven to a larger amplitude. You may reduce the level by adding attenuation in the configuration menu. Do not exceed maximum rated power in either mode.
Unbalanced	+10 dBV ± 0.5 dB	
Input to Output Gain	0 dB to –120 dB in 0.5 dB steps.	
Digital Input to Analog Output Gain Accuracy over frequency	± 0.5 dB, 20 Hz to 20 kHz, 0 to –40 dBFS, 20 or 24 bit input.	
Analog Input to Analog Output Gain Accuracy over frequency	± 1 dB, 20Hz to 20 kHz, 24 dBu to –16 dBu.	
Output Impedance (typical)	50 Ω , balanced.	Intended to drive a high impedance load. Drivers are capable of driving a minimum load impedance of 300 Ω but may overheat. Do not exceed the maximum rated power.
Digital Input to Analog Output Distortion (THD+N) (typical)	≤ 0.02% from full scale to –30 dBFS, 20 Hz to 20 kHz.	
Analog Input to Analog Output Distortion (THD+N) (typical)	< 0.05% from full scale to –30 dBFS, 20 Hz to 20 kHz.	
Analog or Digital Input to Analog Output Cross-talk (typical)	< –82 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.	
Output Power Capability (typical)	Capable of continuously driving a –10 dBFS sine wave into 600 Ω or –13 dB into 300 Ω .	This is 25 mW RMS in the load per output pair. Live audio may reach full voltage level as long as duty cycle is such that the RMS power is less than 25 mW averaged over any 10 second period. Exceeding this limit at high ambient temperature may cause the output circuit to overheat and damage the instrument.

Audio Option DDE Option DDE (Extended Dolby Digital Audio) is available for the WVR7120 only. The following table lists the the characteristics specific to Option DDE.

Option DDE additionally includes all the functions and characteristics of Option AD.

Table 43: Dolby E and extended Dolby Digital (AC-3) compressed audio monitoring (Option DDE)

Characteristic	Performance requirement	Reference information
Compressed Audio Input Format	Decodes audio and metadata from Dolby data stream transported via AES or 48 kHz embedded audio source.	Supports 32-bit professional and consumer modes as well as 16-bit professional mode on Channel 1 or Channel 2, stream 0 through 7.
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 metadata.	
Alarms	(See Table 49.)	

Table 44: 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	$\pm 1/2$ video field.	
Alarms	(See Table 49.)	

Alarms

The tables in this section provide a list of all the WVR6020, WVR7020, and WVR7120 alarms.

Table 45: Common alarms (WVR6020, WVR7020, and WVR7120)

Alarm	Indication
HW Fault	A system fault occurred. May require service.
SDI Input Missing	No signal is detected on the selected SDI input.
SDI Input Signal Lock	Unable to lock to selected SDI input signal.
Reference Missing	No signal is detected on the Ref input when REF EXT is selected.
Ref Lock	Unable to lock to the Ref input signal when REF EXT is selected.
Ref Fmt Mismatch	The signal format detected on Ref input differs from the configured External Ref format.
RGB Gamut Error	The selected video input signal contains colors that violate the configured Diamond gamut thresholds.
Composite Gamut Error	The selected video input signal contains colors that violate the configured Arrowhead gamut thresholds.
Luma Gamut Error	The selected video input signal contains luminance levels that violate the configured Luma gamut thresholds.
Video Fmt Change	A change occurred in the format of the selected video input signal.
Video Fmt Mismatch	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	The Ref signal format is not compatible with the Input signal format. (See page 33, <i>Signal Input-to-Reference Compatibility Tables</i> .)
Line Length Error	The length of a video line differs from that expected for the detected video format.
Field Length Error	The length of a video field differs from that expected for the detected video format.
EAV Place Error	The location of the EAV timing reference signal differs from that expected for the detected video format.
SAV Place Error	The location of the SAV timing reference signal differs from that expected for the detected video format.
Timecode Vitc Missing	A break or discontinuity in the VITC has occurred.
Timecode Vitc Invalid	The VITC was lost for one frame but has reappeared.
Timecode Ltc Missing	A break or discontinuity in the LTC has occurred.
Timecode Ltc Invalid	The LTC was lost for one frame but has reappeared.
Timecode Anc Missing	A break or discontinuity in the ANC timecode has occurred.
Timecode Anc Invalid	The ANC timecode was lost for one frame but has reappeared.
Closed Caption Missing	The configured Closed Caption Transport stream or streams are not present in the selected video input signal.
CC Service(s) Missing	One or more configured EIA 608 Required Services is not present in the closed caption data stream.

Table 45: Common alarms (WVR6020, WVR7020, and WVR7120) (cont.)

Alarm	Indication
EIA608 Caption Error	A data error in an EIA608 data stream, excluding Extended Data Services and EIA708 Caption Data Packet errors.
V-Chip Presence Error	No content advisory packet has been detected in the selected video input signal for at least 4 seconds.
V-Chip Format Error	A content advisory packet contained illegal data or was formatted incorrectly.
Extended Data Services Error	A data error in Extended Data Services of an EIA608 data stream.
Caption Data Packet Error	A Caption Data Payload error in the EIA708 stream carrying EIA608 data.
Line 21 presence Error	No VBI caption signal was found on the configured Line and Timing of the selected video input signal.
ANC CC Presence Error	No caption ancillary data (SMPTE334M) was found in the selected video input signal.
TSID Missing	No Transmission Signal Identifier was found in the selected video input signal.
TSID Format Error	Detected Transmission Signal Identifier is not an allowed value.
AP CRC Error	Encoded AP (active picture) CRC differs from the calculated CRC.
FF CRC Error	Encoded FF (full field) CRC differs from the calculated CRC.
EDH Error	EDH (error detection and handling) has detected an error.

Table 46: HD specific alarms added with Option HD

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

Table 47: Composite specific alarms added with Option CPS

Alarm	Indication
Cmpst Input Missing	No signal is detected on the selected composite video input.
Cmpst Lock	Unable to lock to the selected composite video input

Table 48: Audio alarms added with Option AD

Alarm	Indication
Over	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	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.

Table 48: Audio alarms added with Option AD (cont.)

Alarm	Indication
Clip	The number of consecutive, full-scale digital audio samples monitored has exceeded the value specified by the #Samples for Clip setting.
Mute	The number of consecutive, "0" digital audio samples monitored has exceeded the #Samples for Mute setting.
AES Unlocked	Unlocked condition of an AES input.
CRC Error	The AES channel status CRC as calculated by the instrument does not agree with the CRC embedded in the channel status bytes.
V Bit	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	Incorrect parity in one or more AES audio samples.
AES Sync Error	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	No embedded audio stream is detected in the selected SDI input.
(Embedded) Checksum	The checksum present in the embedded audio stream does not match the calculated checksum.
(Embedded) Parity	Incorrect parity in one or more embedded audio samples.
Emb. Group Sample Phase	Embedded audio streams are not time-aligned due to asynchronous audio or data error.

Table 49: Audio alarms added with Option DDE

Alarm	Indication
Dolby Format	Dolby audio format differs from the configured Dolby Format Expected.
Dolby E /Video Frame Rate Error	The Dolby E stream frame rate is not the same as the video frame rate.

Signal Input-to-Reference Compatibility Tables

The following tables list the signal input and reference formats that are supported by the instrument. An X indicates supported input and reference combinations. Blank cells in the tables indicate untested combinations.

Table 50: 59.94, 29.97, 23.98 Hz input and reference format combinations

Input Format	Reference Format								
	NTSC	720p			1080p	1080sf	1080p	1080sf	1080i
		23.98	29.97	59.94	23.98	23.98	29.97	29.97	59.94
720p, 23.98 Hz ³	X		X	X	X			X	
720p, 29.97 Hz ³	X		X					X	
720p, 59.94 Hz ³	X		X	X	X			X	
1080p, 23.98 Hz ^{3 4}	X		X	X	X			X	
1080sf, 23.98 Hz ^{3 4}	X		X	X	X			X	
1080p, 29.97 Hz ^{3 4}	X		X					X	
1080sf, 29.97 Hz ^{3 4}	X		X					X	
1035i, 59.94 Hz ³	X		X					X	
1080i, 59.94 Hz ^{3 4}	X		X					X	
483i, 59.94 Hz (525) ²	X		X					X	
NTSC 59.94 Hz ¹	X								

¹ Available with Option CPS.

² Available with all instruments (SD).

³ Available with WVR7020 and WVR7120.

⁴ Includes dual-link standards with Option DL.

Table 51: 60, 30, 24 Hz input and reference format combinations

Input Format	Reference Format							
	720p			1080p	1080sf	1080p	1080sf	1080i
	24	30	60	24	24	30	30	60
720p, 24 Hz ¹			X	X	X			X
720p, 30 Hz ¹			X					X
720p, 60 Hz ¹			X	X	X			X
1080p, 24 Hz ^{1 2}			X	X	X			X

Table 51: 60, 30, 24 Hz input and reference format combinations (cont.)

Input Format	Reference Format							
	720p			1080p	1080sf	1080p	1080sf	1080i
	24	30	60	24	24	30	30	60
1080sf, 24 Hz ^{1 2}			X	X	X			X
1080p, 30 Hz ^{1 2}			X					X
1080sf, 30 Hz ^{1 2}			X					X
1035i, 60 Hz ¹			X	X	X			X
1080i, 60 Hz ^{1 2}			X	X	X			X

¹ Available with WVR7020 and WVR7120.

² Includes dual-link standards with Option DL.

Table 52: 50, 25 Hz input and reference format combinations

Input Format	Reference Format					
	PAL	720p		1080p	1080sf	1080i
		25	50	25	25	50
720p, 25 Hz ³	X		X			X
720p, 50 Hz ³	X		X			X
1080p, 25 Hz ^{3 4}	X		X			X
1080sf, 25 Hz ^{3 4}	X		X			X
1080i, 50 Hz ^{3 4}	X		X			X
576i, 50 Hz (625) ²	X		X			X
¹ PAL 50 Hz	X					

¹ Available with Option CPS.

² Available with all instruments (SD).

³ Available with WVR7020 and WVR7120.

⁴ Includes dual-link standards with Option DL.

Table 53: Supported Standards

Image	System	Interface	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 _B C _R '	1	2	3					
			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 _B C _R ' (A)				7	8	9	10	11
			12-bit 4:4:4 Y'C _B C _R '				7	8	9	10	11
	1920 x 1080/I	372M (dual link)	4:2:2 Y'C _B C _R '				7	8	9	10	11
			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 _B C _R ' (A)	4	5	6					
			12-bit 4:4:4 Y'C _B C _R '	4	5	6					
274M	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 _B C _R ' (A)				X	X	X	X	X
			12-bit 4:4:4 Y'C _B C _R '				X	X	X	X	X
			12-bit 4:2:2(:4) Y'C _B C _R ' (A)				X	X	X	X	X
295M (1250/50)	1920 x 1080/I, P			Not supported							
240M 260M	1920 x 1035/I	292M	4:2:2 Y'C _B C _R '	X	X						
296M		292M	4:2:2 Y'C _B C _R '	1	2	3	4	5	6	7	8

Table 53: Supported Standards (cont.)

Image	System	Interface	Signal Type	Image system number for indicated field/frame rate							
				60	59.94	50	30	29.97	25	24	23.98
ITU-R BT.601	720 x 576/I (625)	292M	4:2:2 Y'C _B C _R '			X					
	720 x 483/I (525)	292M	4:2:2 Y'C _B C _R '		X						
293M	720 x 480/P			Not supported							

Performance Verification

This section contains a collection of manual procedures for verifying that the WVR6020, WVR7020, and WVR7120 waveform rasterizer products perform as warranted. The procedures will note to which instruments and options they apply.

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

NOTE. *The waveform rasterizer must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature as listed. (See Table 20 on page 11.)*

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.

Functional Test Record (All Instruments)

Use the following tables to record the results from the functional test.

Table 54: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Functional Test Record

Instrument Serial Number:		Certificate Number:	
Temperature:		RH %:	
Date of Calibration:		Technician:	
Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
Basic Turn On and Self Test			
Front Panel LEDs			
POST			
Front Panel Test			
Factory Preset			
Buttons and Knobs			
XGA and Advanced Diagnostics Test			
Color Palette Test			
XGA DAC			
Advanced Diagnostics			
Fan Test			
SDI Bit Integrity			
External Reference			
NTSC Lock			
Ref Missing			
Eye Waveform (Option EYE or PHY)			
Jitter Waveform (Option PHY)			
Composite Input (Option CPS)			
CMPST A, WFM with NTSC			

Table 54: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Functional Test Record (cont.)

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
CMPST A, Vector with NTSC			
CMPST A, Picture with NTSC			
CMPST B, WFM with NTSC			
CMPST B, Vector with NTSC			
CMPST B, Picture with NTSC			
Analog Audio Input (Options AD and DDE)			
Analog Audio input A ports 1-6 display bar			
Analog Audio input B ports 1-6 display bar			
Analog Audio Output (Options AD and DDE)			
Digital Audio Input (Options DG, AD, DS, and DDE)			
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 DG, AD, DS, and DDE)			
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 (Option DDE only)			
LTC Decode and Waveform Test			
LTC Waveform Presence			
LTC Decode			
Ground Closure Remote			
Remote Input - Activate Preset 1			

Table 54: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Functional Test Record (cont.)

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
Remote Output - Ground Closure			
Ethernet Functionality			
Simultaneous Input (Option SIM)			
Dual Link (Option DL)			
Audio/Video Delay (Option AVD)			

Video Performance Test Record (All Instruments)

Use the following table to record the results from the video performance test. If you are testing a WVR6020, skip WVR7020/WVR7120-only entries in the record, but complete the other entries, which are common to both models.

Table 55: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer 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 (WVR7020 / WVR7120 with Option HD)				
Input A, Low Level				720
Input A, High Level	880			
Input B, Low Level				720
Input B, High Level	880			
HD SDI Input Equalization Range (WVR7020 / WVR7120 with Option HD)				
Input A	20 dB			
Input B	20 dB			
HD SDI Loop Through Isolation (WVR7020 / WVR7120 with Option HD)	Pass			

Table 56: Eye Performance Test Record (WVR7120 with option EYE or PHY)

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
HD Cable Meter (WVR7120 with Option HD)				
Approx Cable Length (0 m), SDIA	0 m			17 m
Approx Cable Length (100 m), SDIA	76 m			127 m
Approx Cable Length (0 m), SDIB	0 m			17 m
Approx Cable Length (100 m), SDIB	76 m			127 m
HD Jitter Tests (WVR7120 with Option HD)				
HD Jitter Readout Noise	Pass			
HD Jitter Waveform Noise (WVR7120 Option PHY)	Pass			
HD 10 second Jitter Bounce	Pass			
HD Jitter Readout Accuracy	Pass			
HD Jitter Waveform Accuracy (WVR7120 option PHY)	Pass			
HD Jitter Vibration	Pass			
HD Recovered Sine Wave Fidelity	Pass			
Eye Gain, SDI A	760 mV			840 mV
Eye Gain, SDI B	760 mV			840 mV
Eye Signal Bandwidth	-3 dB			
High frequency response				
Eye Minimum Response SDI A	-3 dB			

Table 56: Eye Performance Test Record (WVR7120 with option EYE or PHY (cont.))

Performance Test	Minimum	Incoming	Outgoing	Maximum
Eye Minimum Response, SDI B	-3 dB			
Eye 50 kHz Response, SDI A	-3 dB			
Eye 50 kHz Response, SDI B	-3 dB			
Equalized Eye Gain	Pass			

SD Video Performance Test Record (All Instruments)

Use the following table to record the results from the SD video performance test.

Table 57: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Video Performance Test Record

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
SD SDI Input Level Low and High				
Input A, Low Level				720
Input A, High Level	880			
Input B, Low Level				720
Input B, High Level	880			
SD SDI Input Equalization Range				
Input A	23 dB			
Input B	23 dB			
SD SDI VITC Decoding Functionality	Pass			

Table 58: SD Eye Performance Test Record (WVR7120 with Options EYE or PHY)

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
SD Cable Meter (0 m), SDIA	0 m			17 m

Table 58: SD Eye Performance Test Record (WVR7120 with Options EYE or PHY) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
SD Cable Meter (100 m), SDIA	76 m			127 m
SD Cable Meter (0 m), SDIB	0 m			17 m
SD Cable Meter (100 m), SDIB	76 m			127 m
SD Jitter Readout Noise	Pass			
SD Jitter Waveform Noise (option PHY)	Pass			
SD 10 second Jitter Bounce	Pass			
SD Jitter Readout Accuracy	Pass			
SD Jitter Waveform Accuracy (option PHY)	Pass			
SD Recovered Sine Wave Fidelity	Pass			

Video Performance Test Record (Option CPS)

Use the following table to record the results from the video performance test for instruments with Option CPS installed.

Table 59: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Video Performance Test Record (Option CPS)

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
Composite Analog Vertical Measurement Accuracy	99% (707.71mv)			101% (722mv)
Composite Analog Frequency Response	99% (-7mv)			101% (7mv)

Table 59: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Video Performance Test Record (Option CPS) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
Composite Analog Delay Variation Over Frequency (Group Delay)	-10ns (-7.1mv)			+10ns (7.1mv)
Composite Analog Pulse to Bar Ratio	99% (-7mv)			101% (7mv)
Composite Analog Field Rate Tilt	-0.5% (-3.5mv)			+0.5% (+3.5mv)
Composite Analog Line Rate Tilt	-0.5% (-3.5mv)			+0.5% (+3.5mv)
Composite Analog Input DC Offset with Restore Off	-10mv			10mv
Composite Analog Input Clamp Off Check	Pass/Fail			
Composite Analog Input DC Restore Hum Attenuation				
Fast Mode	(0mv)			5% (35mv)
Slow Mode	90% (643mv)			110% (785mv)
External Reference Lock Range	-50ppm			50ppm
VITC Decoding Functionality	Pass			

Audio Performance Test Record (Options AD and DDE)

Use the following table to record the results from the audio performance test for instruments with Options AD or DDE installed.

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE)

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Input Sample Rate				
AES A 1-2 In (96 kHz)	Pass			

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
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 (44.1 kHz)	Pass			
AES A 3-4 In (44.1 kHz)	Pass			
AES A 5-6 In (44.1 kHz)	Pass			
AES A 7-8 In (44.1 kHz)	Pass			
AES B 1-2 I/O (44.1 kHz)	Pass			
AES B 3-4 I/O (44.1 kHz)	Pass			
AES B 5-6 I/O (44.1 kHz)	Pass			
AES B 7-8 I/O (44.1 kHz)	Pass			
AES Audio Output Amplitude				
AES B 1-2 I/O	0.9 V			1.1v
AES B 3-4 I/O	0.9 V			1.1v
AES B 5-6 I/O	0.9 V			1.1v
AES B 7-8 I/O	0.9 V			1.1v
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			

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
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			

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
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			
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input A1 (100 Hz)	17.5dBu			18.5dBu
Analog Input A2 (100 Hz)	17.5dBu			18.5dBu
Analog Input A3 (100 Hz)	17.5dBu			18.5dBu
Analog Input A4 (100 Hz)	17.5dBu			18.5dBu
Analog Input A5 (100 Hz)	17.5dBu			18.5dBu
Analog Input A6 (100 Hz)	17.5dBu			18.5dBu
Analog Input A1 (1 kHz)	17.5dBu			18.5dBu
Analog Input A2 (1 kHz)	17.5dBu			18.5dBu
Analog Input A3 (1 kHz)	17.5dBu			18.5dBu
Analog Input A4 (1 kHz)	17.5dBu			18.5dBu
Analog Input A5 (1 kHz)	17.5dBu			18.5dBu
Analog Input A6 (1 kHz)	17.5dBu			18.5dBu
Analog Input A1 (19 kHz)	17.5dBu			18.5dBu
Analog Input A2 (19 kHz)	17.5dBu			18.5dBu
Analog Input A3 (19 kHz)	17.5dBu			18.5dBu

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Input A4 (19 kHz)	17.5dBu			18.5dBu
Analog Input A5 (19 kHz)	17.5dBu			18.5dBu
Analog Input A6 (19 kHz)	17.5dBu			18.5dBu
Analog Input B1 (100 Hz)	17.5dBu			18.5dBu
Analog Input B2 (100 Hz)	17.5dBu			18.5dBu
Analog Input B3 (100 Hz)	17.5dBu			18.5dBu
Analog Input B4 (100 Hz)	17.5dBu			18.5dBu
Analog Input B5 (100 Hz)	17.5dBu			18.5dBu
Analog Input B6 (100 Hz)	17.5dBu			18.5dBu
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input B1 (1 kHz)	17.5dBu			18.5dBu
Analog Input B2 (1 kHz)	17.5dBu			18.5dBu
Analog Input B3 (1 kHz)	17.5dBu			18.5dBu
Analog Input B4 (1 kHz)	17.5dBu			18.5dBu
Analog Input B5 (1 kHz)	17.5dBu			18.5dBu
Analog Input B6 (1 kHz)	17.5dBu			18.5dBu
Analog Input B1 (19 kHz)	17.5dBu			18.5dBu
Analog Input B2 (19 kHz)	17.5dBu			18.5dBu
Analog Input B3 (19 kHz)	17.5dBu			18.5dBu
Analog Input B4 (19 kHz)	17.5dBu			18.5dBu
Analog Input B5 (19 kHz)	17.5dBu			18.5dBu

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

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

Table 60: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options AD and DDE) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Output 4 (19 kHz)	17.5dBu			18.5dBu
Analog Output 5 (19 kHz)	17.5dBu			18.5dBu
Analog Output 6 (19 kHz)	17.5dBu			18.5dBu
Analog Output 7 (100 Hz)	17.5dBu			18.5dBu
Analog Output 8 (100 Hz) ¹	17.5dBu			18.5dBu

¹ Does not apply to Option DA. Option DA provides six analog outputs

Audio Performance Test Record (Options DG and DS)

Use the following table to record the results from the audio performance test for instruments with Options DG or DS installed.

Table 61: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options DG and DS)

Instrument Serial Number:		Certificate Number:		
Temperature:		RH %:		
Date of Calibration:		Technician:		
Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Input Sample Rate				
AES A 1-2 In (96 kHz)	Pass			
AES A 3-4 In (96 kHz)	Pass			
AES A 5-6 In (96 kHz)	Pass			
AES A 7-8 In (96 kHz)	Pass			
AES B 1-2 I/O (96 kHz)	Pass			
AES B 3-4 I/O (96 kHz)	Pass			
AES B 5-6 I/O (96 kHz)	Pass			
AES B 7-8 I/O (96 kHz)	Pass			

Table 61: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options DG and DS) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES A 1-2 In (44.1 kHz)	Pass			
AES A 3-4 In (44.1 kHz)	Pass			
AES A 5-6 In (44.1 kHz)	Pass			
AES A 7-8 In (44.1 kHz)	Pass			
AES B 1-2 I/O (44.1 kHz)	Pass			
AES B 3-4 I/O (44.1 kHz)	Pass			
AES B 5-6 I/O (44.1 kHz)	Pass			
AES B 7-8 I/O (44.1 kHz)	Pass			
AES Audio Output Amplitude				
AES B 1-2 I/O	0.9v			1.1v
AES B 3-4 I/O	0.9v			1.1v
AES B 5-6 I/O	0.9v			1.1v
AES B 7-8 I/O	0.9v			1.1v
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			

Table 61: WVR6020 / WVR7020 / WVR7120 Waveform Rasterizer Audio Performance Test Record (Options DG and DS) (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
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			

Incoming Inspection

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

The waveform rasterizer 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 the table. (See Table 20 on page 11.)

Use the following procedures to check the basic functionality of WVR6020, WVR7020, and WVR7120 Waveform Rasterizers. 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 rasterizer 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 procedures.

Table 62: Required test equipment for incoming inspection

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

Table 62: Required test equipment for incoming inspection (cont.)

Test equipment	Requirements	Example
SDI serial digital video test generator, with embedded audio and composite signal source	NTSC Black	Tektronix TG2000 with BG1 and additional modules indicated below.
	1080i 59.94 HD signals required for 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 for option SD: 100% color bars 10-bit shallow ramp SDI Matrix Split Field Pathological Signal 100% sweep	DVG1 module for TG2000 (Embedded audio needed for audio options AD, DS, DDE)
	Composite signals required for Option CPS: NTSC SMPTE bars	AVG1 module for TG2000
	Dual Link	TG700 with HDLG7 module
	AV Delay	TG700 with DVG7 module
	AES Audio Signal Generator	48kHz, 24 bit word length signals
AES Audio Signal Analyzer		Rohde & Schwarz UPL06, Tektronix AM700.
Analog Audio Signal Generator		Rohde & Schwarz UPL06, Tektronix AM700 and AM70.
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 TG-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 on page 82.)
Computer and ethernet cable	Used to test Ethernet connection	Generic equipment

Basic Turn On and Self Test

1. Connect a XGA monitor to the connector on the rear of the waveform rasterizer.
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 rasterizer, so the instrument will turn on as soon as you apply power.
3. Look at the front panel immediately after you apply power. All the buttons should be lit, the text above the three knobs should also be lit, and the FAULT indicator should be lit.
4. After a couple of seconds, the lights in the buttons and text will turn off.
5. After about 15 seconds, the FAULT light should turn off. Record Pass or Fail in the test record.
6. Also after about 15 seconds, the Power on diagnostic page should appear on the XGA monitor.
7. Verify that the instrument Passes all self tests. Any failures are 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**.
8. After the diagnostics are finished, the instrument state will be restored. When the progress indicator in the middle-right part of the screen is finished, the instrument has finished initializing.
9. Record Pass or Fail for the POST in the test record.

Front Panel Test

1. Press the **FACTORY** button to restore the factory preset. 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. Attach a loopthrough terminator.
4. Press the **FULL** button to set the active tile to full screen.
5. Turn the **HORIZONTAL** and **VERTICAL** knobs and verify the waveform moves appropriately.
6. Press **HELP** to display the online help.
7. 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.

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

XGA and Extended Diagnostics Test

1. Press **CONFIG** to display the **CONFIG** menu.
2. Select **Utilities**.
3. Select **CPU Color Palette Check** and then press **SEL**.
4. Verify that 16 distinct colors are displayed. This tests the XGA data path from the CPU.
5. Record Pass or Fail in the test record for Color Palette Test.
6. Select **Run Advanced Diags**, and then press **SEL**.
7. Use the right-arrow key to highlight the Continue box and then press **SEL** to run the test.
8. Verify the XGA DAC is working by looking at the White and Red ramps at the top of the screen, and at the Green and Blue ramps at the bottom of the screen. They should not have steps but should instead have a smooth transition from dark to light.

9. Record Pass or Fail for XGA DAC in the test record.
10. Verify that the following frequencies are within 10 kHz of the nominal values listed below and that the following widths are within 0.1 μ s of the nominal values listed below:
 - a. QDR Clock = 25.175 MHz
 - b. VGA clock = 65.000 MHz
 - c. Audio PLL1 = 12.288 MHz
 - d. Audio PLL2 = 12.288 MHz
 - e. Hsync PW = 2.2 μ s
 - f. Vsync PW = 62.0 μ s
 - g. Lissajous 1 Frequency = 61.4388 MHz (audio option only)
 - h. Lissajous 2 Frequency = 0.0000 MHz (audio option only)
11. Verify that all the tests in the middle section of the screen have a green Pass status.
12. Verify that the bus bit activity tests (labeled Channel A, Processor Video, and Composite Video (if option installed), and appearing at the bottom of the screen) are as follows:
 - a. All three tests show both a red and a green bar in each bit location.
 - b. The Processors Video test shows 8 bits from the CPU, a space, then Hsync, a space, Vsync, a space and then the blank line. It is normal for the V sync bit to blink occasionally.
13. Press **SEL** or cycle the power to reboot the unit.
14. Record Pass or Fail for Advanced Diagnostics in the test record.

Fan Test

If the fault light in the lower left corner of the front panel is not on (Red), then the fans are running. You should also be able to hear them 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 Bit Integrity

1. Connect the appropriate signal to the SDI A input:
 - a. With Option HD: 1080i 59.94 10-bit shallow ramp signal from HDVG1
 - b. All other options: 525/270 10-bit shallow ramp signal from DVG1
2. Terminate the SDI A loopthrough.
3. Press the **FACTORY** button to restore the factory preset.
4. Press and hold the **WFM** button to bring up the WFM pop-up menu.
5. Use the arrow keys to select the **Pb** waveform and turn it off. Leave all others as is.
6. Press the WFM button to close the menu.
7. Press the **5X** gain button.
8. Press the **VAR** gain button and then use the **GENERAL** knob to increase the gain to **10X**.
9. Press the **FULL** button to expand the tile to full screen. Position the waveform so that you can check the ramps.
10. 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.
11. Press the **VAR** button to switch variable gain off and press **1X** to return to normal gain.
12. Change the input signal to a 100% sweep.
13. Verify the sine waves are uniform and do not have steps. Also verify that the amplitude is 700 mV.
14. Move the input signal to input B, terminate the SDI B loopthrough, select input B from the front panel, and repeat steps 7 through 13.
15. Record Pass or Fail for SDI Bit Integrity in the test record.

External Reference

1. Press the **FACTORY** button to restore the factory preset.
2. Connect a 525/270 10-bit shallow ramp signal from a DVG1 module to the SDI A input of the unit under test.
3. Terminate the loopthrough.
4. Apply an NTSC signal to the External Reference input from the Analog Signal Generator. Install a termination on the loopthrough.
5. Press the **EXT REF** button on the instrument front panel.
6. The status bar in the lower left-hand corner of the display should display Ref: NTSC.
7. Press the **DISPLAY SELECT 4** button, then **WFM**, and then **FIELD**.
8. Verify that both WFM tiles are stable.
9. Record Pass or Fail for NTSC Lock in the test record.
10. Remove the NTSC signal from the reference input.
11. Both WFM tiles should "unlock" and scroll.
12. The status bar in the lower left-hand corner of the display should display Ref: Ext. Missing.
13. Record Pass or Fail for Ref Missing in the test record.

Eye (Options EYE and PHY)

1. Press the **FACTORY** button to restore factory preset.
2. Connect a 525/270 color bars signal from DVG1 to the SDI A input of the unit under test.
3. Terminate the loopthrough.
4. Press and hold the **EYE** button (if no EYE button is present, press and hold **MEAS** to call up the Eye menu).
5. If the Eye display is not showing, select **Display Type > Eye Display** from the submenu.
6. Check for the presence of a stable eye diagram in tile 1. (Actual wave shape depends strongly on the generator.)
7. Record Pass or Fail for Eye Waveform in the test record.
8. Proceed to the next step if option PHY is present. Otherwise, this test is complete.
9. Press and hold the **DISPLAY SELECT 1** button to display the EYE menu.
10. Select **Display Type > Jitter Display** and check for a flat line wave shape. (Residual jitter level depends strongly on the generator.)
11. Record Pass or Fail for Jitter Waveform in the test record.

Composite Input (Option CPS)

1. Press the **FACTORY** button to restore the factory preset.
2. Apply an NTSC SMPTE color bar signal from the TG2000 AVG1 module to the Composite A input. Install a termination on the loop through.
3. Select the **CMPST A** input from the front panel.
4. Observe the WFM in tile 1, the signal should be aligned with the zero graticule.
5. Record Pass or Fail 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 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 in the test record.
10. If desired, move the input and termination to input B and repeat steps 3 - 8.

Analog Audio Input (Option AD & DDE)

1. Press the **FACTORY** button to restore the factory preset.
2. Set the analog audio generator to output a 1 kHz, 18dBu sine wave.
3. Press and hold the **DISPLAY SELECT 4** button to display the **AUDIO** pop-up menu.
4. Select **Audio Input > Analog A**.
5. Press the **AUDIO** button briefly to dismiss the menu.
6. Using the audio breakout cable or equivalent, connect the first Line A input pair to the analog audio generator and verify that the output level of the generator is indicated on the audio bars with an 18 dBu signal.
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 **Audio** button to display the **AUDIO** menu and select **Audio Input > Analog B**.
10. Press the **AUDIO** button again to dismiss the menu.
11. Repeat step 6 for all three Line B input pairs.
12. Record Pass or Fail in the test record.

**Analog Audio Output
(Option AD & DDE)**

1. Press the **FACTORY** button to restore the factory preset.
2. Press and hold the **DISPLAY SELECT 4** button to display the **AUDIO** pop-up menu.
3. Select **Audio Input > Analog A**.
4. Press the **AUDIO** button to close 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 indicated on the audio bars with an 18 dBu signal.
6. Press the **CONFIG** button to display the **CONFIG** menu.
7. In the Audio Inputs/Outputs submenu, set Attenuate Audio Output to 0 dB (press **SEL** and use the **GENERAL** knob to adjust the value, then press **SEL** again when you have set the value).
8. While in the Audio Inputs/Outputs submenu, select **Analog A > Analog Output Map**.
9. Press the **SEL** button to display the Analog Output to Analog "A" Bar Map.
10. Put an X in the first bar pair position for Analog Outputs 1&2, 3&4, 5&6, and 7&8.
11. Press the **CONFIG** button to exit the **CONFIG** menu.
12. Connect the first analog output pair on the breakout cable to the second line A input pair.
13. Verify on the level meter bars that the second set of bars is within 1 dB of the first set of bars.
14. Connect the second analog output pair on the breakout cable to the second line A input pair.
15. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.
16. Connect the third analog output pair on the breakout cable to the second line A input pair.
17. Verify on the level meter bars, that the second set of bars is within 1 dB of the first set of bars.
18. Connect the fourth analog output pair on the breakout cable to the second line A input pair.
19. Verify, on the level-meter bars, that the second set of bars is within 1 dB of the first set of bars.
20. Record Pass or Fail in the test record.

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

1. Press the **FACTORY** button to restore the factory preset.
2. Set the digital audio generator to output a 1 kHz, –6 dBFS sine wave.
3. Press and hold the **DISPLAY SELECT 4** button to display the **AUDIO** pop-up menu.
4. Select **Audio Input > AES A**.
5. Press the **AUDIO** button to close the menu.
6. Connect the unbalanced output of the digital audio generator to the AES A 1-2 input.
7. Verify that the first set of level meter bars indicates –6 dBFS.
8. Repeat steps 6 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. Connect the output of the digital audio generator to the AES B 1-2 input.
13. Press the **AUDIO** button.
14. Verify that the first set of level meter bars indicates –6 dBFS.
15. Repeat steps 12 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 525/270 color bars signal from a 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 DVG1.
 - b. Press Test Signals, and select Module Parameters
 - c. Select Audio, and set the audio channels as follows:

Channel	Value
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 4** button to display the AUDIO pop-up menu.
21. Select **Audio Input > Embedded**.
22. Press the **AUDIO** button to dismiss the menu.
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 **AUDIO** button.
26. Select **Phase Pair 1 & 2**.
27. Press the **Audio** button to close the menu.
28. Verify that the phase display changes as appropriate.
29. Repeat steps 25 through 27 for phase pairs 3 & 4, 5 & 6, and 7 & 8, and verify that the phase display changes in each one.
30. Record Pass or Fail for Embedded to Lissajous in the test record.

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

1. Press **FACTORY** to restore the factory preset.
2. If you have just finished testing the Digital Audio Inputs, proceed to next step, otherwise do steps 17-23 of the Digital Audio Input test.
3. Press the **CONFIG** button to display the **CONFIG** menu.
4. Select **Audio Inputs/Outputs > AES B > Output**.
5. 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 dB for the left channel and -30 dB 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 dB for the left channel and -20 dB 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 dB for the left channel and -10 dB 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 dB for the left channel and 0 dB for the right.
14. Record Pass or Fail for each output in the test record.

Dolby Decode (Option DDE)

1. Press the **FACTORY** button to restore the factory preset.
2. Press and hold the **DISPLAY SELECT 4** button to display the **AUDIO** pop-up menu.
3. Select **Audio Input > AES A**.
4. Press the **Display Select 4** button 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.
 - b. Press the **Up/Down** buttons to select a Dolby D stream as indicated by the leading "D" in the bit stream name.
 - c. Press **Enter** to activate the selected signal.
6. Connect the Digital Output of the Dolby generator to the **AES A1-2 In BNC** with a 75 Ω cable.
7. Check for the "DOLBY D" message in bars 1 and 2 of the Audio display.
8. Press and hold the **DISPLAY SELECT 4** button to display the **AUDIO** pop-up menu.
9. In the **Audio Input** submenu, select **Dolby 2**. (Factory preset configured **Dolby 2** to decode Dolby from the **AES A1-2** input.)
10. Press the **DISPLAY SELECT 4** button again to dismiss the pop-up.
11. Check that the audio display shows the decoded Dolby signal.
12. Check that the Dolby program type shown in the top line of the audio display, for example "D 3/2 L", agrees with the Dolby generator setting.
13. Change the Dolby generator to a Dolby E output:
 - a. Press the **Up/Down** buttons to select a Dolby E stream as indicated by the leading "E" in the bit stream name.
 - b. Press **Enter** to activate the selected signal.
14. If option DDE is present, check that the audio display shows the decoded Dolby signal and that the Dolby program type shown in the top line of the audio display, for example "E 2+2", agrees with the Dolby generator setting.
15. If option DDE is not present, check for the "DOLBY E" message in bars 1 and 2 of the Audio display.
16. Record Pass or Fail for Dolby Decode in the test record.

LTC Decode and Waveform Test

1. Press **FACTORY** to restore the factory preset.
2. Connect the LTC generator to pins 7 and 8 of the remote connector. This will require making a custom cable assembly. (See Figure 1.)
3. Select any NTSC signal for the AVG1.
4. Connect the TG2000 AVG1 composite output to the video input of the Timecode generator.
5. Connect a 525/270 color bar signal from DVG1 to the SDI A input.
6. Press **CONFIG**.
7. In the Aux Data Settings submenu, set the Timecode Display to **LTC**.
8. 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.
9. Record Pass or Fail for the LTC waveform in the test record.
10. In the lower-right corner of the screen, the time from the LTC input should be shown.
11. Press the generator GEN switch to SET. The numbers should change.
12. Record Pass or Fail for LTC Decode in the test record.

Ground Closure Remote

1. Connect a **525/270 color bar** signal from DVG1 to the SDI A input.
2. Press **FACTORY** to restore the factory preset.
3. Press **PICT** to display a picture in tile 1.
4. Press and hold the PRESET 1 button until the message Preset #1 was saved is displayed in the active tile. You will need to hold the button for 1 to 2 seconds.

Test Preset Recall.

5. Press **FACTORY** again.
6. On a 15-pin, male DSUB connector, solder wires or strip back insulation to gain access to pins 2, 5, and 9.
7. Connect the DSUB connector to the ground closure remote connector on the waveform rasterizer.
8. Short pins 2 and 5 together on the remote cable.
9. Preset 1 should be restored so that a picture is displayed in tile 1.
10. Record Pass or Fail for Activate Preset in the test record.

Test Ground Closure Out.

11. Connect the voltmeter to pins 2 and 9 of the DSUB connector.
12. Verify the voltage is about 4.7 V. This indicates the output is not asserted.
13. Press **CONFIG** to display the CONFIG menu.
14. Select **ALARMS > SDI Input**, then press the **SEL** button.
15. Use the arrow keys to get to the top-right corner of the **Input** error check box, and then press **SEL** to put an X in the box for the Ground Closure column and the SDI Input Missing row. This instructs the waveform rasterizer to assert the ground closure if the input is not present.
16. The voltmeter should read about 4.7 V on pin 9.
17. Remove the input signal from the SDI connector on the rear panel to assert ground closure.
18. The voltmeter should now read a low voltage, below 0.5 V.
19. Record Pass or Fail for Ground Closure in the test record.

Ethernet Test

1. Connect an Ethernet cable from the rear of the unit to a computer with a Web browser.
2. Press **FACTORY** to restore the factory preset.
3. Press the **CONFIG** button to display the Configuration menu.
4. Select **Network Settings > IP Configure Mode**.
5. Verify the IP Config Mode is set to **Manual**.
6. Select **Network Settings > IP Address**.
7. Use the left/right arrow keys to move the highlight to each box in the address. Use the up/down arrow keys to change the number in each box as required. Set the IP Address to be compatible with the computer.
8. To accept your changes, move the highlight to the Accept box and press **SEL**.
9. From the computer, enter the IP address of the waveform rasterizer into the Web browser address line (for example, http://192.182.256.23).
10. You should see a Web page that lists several options for accessing the waveform rasterizer from the PC. If this happens, then the Ethernet function is working.
11. Record Pass or Fail for Ethernet in the test record.

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.*

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

1. Set up a signal generator with an HDVG1 module and a DVG1 module. Connect an output from the HDVG1 module to the SDI A input on the instrument under test.
2. Connect an output from the DVG1 module to the SDI B input on the instrument under test.
3. Connect the loopthrough terminators on the instrument.
4. Set the HDVG1 module format to 1080 59.94i 100% color bars.
5. Set the DVG1 module format to 525-270.
6. Press **FACTORY** to restore factory settings.
7. Press **CONFIG**, select **Input Mode**, and then select **Simultaneous**.
8. Press **CONFIG** again to remove the menu.
9. Press **DISPLAY SELECT** button **2** to select tile 2.
10. Press the **WFM** button to select the waveform display in tile 2.
11. Press **DISPLAY SELECT** button **4** to select tile 4.
12. Press the **PICT** button to select the picture display.
13. Check that the left two tiles (tiles 1 and 3) show the signal from the SDI A input. Check that the right two tiles (tiles 2 and 4) show the signal from the SDI B input.
14. Check that the left portion of the Status Bar displays the status of the SDI A signal input, and that the right portion of the Status Bar displays the status of the SDI B signal input.
15. Enter Pass or fail in the test record.

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

1. Set up a dual link signal generator with an HDLG7 module. Connect the Link A output on the module to the SDI A input on the instrument, and the Link B output on the module to the SDI B input on the instrument.
2. Connect the loophrough terminators on the instrument.
3. Perform the following steps to set the HDLG7 module format to 1080 59.94i:
 - a. On the signal generator, press the **FORMAT** button until 1080 59.94i appears, and then press the **ENTER** button.
 - b. Press the **CANCEL** button.
 - c. Press the up/down arrows until Sample Structure/Depth appears.
 - d. Press the left/right arrows until YCbCr+A 4:4:4 10 bits appears.
 - e. Press the **ENTER** button.
 - f. Press the **COLOR BAR** button until 75% color bars appears.
4. Press the **FACTORY** button on the instrument under test to restore factory settings.
5. Press **DISPLAY SELECT 2** to select tile 2.
6. Press and hold the **STATUS** button.
7. Select **Display Type > Video Session**.
8. Press **DISPLAY SELECT 4** to select tile 4.
9. Press and hold the **VECT** button to display the Vector map and the Vector menu.
10. Select **Display Type > Lightning**.
11. Press the **VECTOR** button to close the menu.

12. Verify that the following are true in the specified tile or area:

Setting	Display
Tile 1	YPbPrA parade waveform displayed
Tile 2	Format indicates Auto 1080i 59.94-YCbCrA 4444 10 bit
Tile 3	Color bars picture displayed
Tile 4	Endpoints of Lightning display land within targets
Status Bar	SDI Input DL-AB is displayed

13. On the signal generator, check that HDVG7 is displayed and then press the down arrow button to select Sample Structure/Depth. Next, press the right arrow button to change the HDVG7 color space from YPbPr to GBR 4:4:4 10 bit.

14. Press the **ENTER** button.

15. Verify the following are true for the specified tile or area:

Setting	Display
Tile 1	YPbPr parade waveform displayed and automatically converted from RGB input signal
Tile 2	Format indicates GBR 4:4:4 10 bit
Tile 3	Color bars picture displayed
Tile 4	Endpoints of Lightning display land within targets

16. Record Pass or fail in the test record.

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

1. Connect an SDI video signal from a SIGNAL output of the DVG7 to the SDI A input of the WVR instrument. Terminate the loop-through.
2. Set the signal generator for AV Timing Mode as follows:
 - a. Press the **MODULE** button until **TG700:PRESET** appears and then press **ENTER**.
 - b. Press < to display **Factory Default**, and then press **ENTER**.
 - c. Press **MODULE** until the module type you are using appears.
 - d. Press **U** until **VIDEO** appears and then press **ENTER**.
 - e. Press **U** until **AV Timing Mode** appears.
 - f. Press > to select **ON** and then press **ENTER**.
 - g. Press **CANCEL** to return to the previous menu.
 - h. Press **U** until **AUDIO (EMBEDDED)** appears.
 - i. Press < until **GROUP 1** appears and then press **ENTER**.
 - j. Press > until **STATUS: ENABLED** appears and then press **ENTER**.
3. On the WVR instrument, press the **FACTORY** button to restore factory settings.
4. Press and hold the **MEAS** button.
5. Select **Display Type > AV Delay**.
6. Press the < navigation key to return to the previous menu level.
7. Set **AV Delay Enable to On**.
8. Press the **MEAS** button to close the menu.
9. Check that the AV Delay readout is green and that it indicates less than 0.005 s. The number in the Fields readout will depend on the video standard in use.
10. Enter Pass or fail in the test record.

Video and General Performance Verification

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

Required Equipment

Table 63: Required test equipment for performance verification

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 HD capable instruments:	HDVG1 module for TG2000 (Embedded audio needed for audio options DG, AD, DS, DDE)
	<ul style="list-style-type: none"> ■ 100% color bars ■ 10-bit shallow ramp ■ SDI Matrix Split Field Pathological Signal ■ 100% sweep 	
	HD signal with adjustable SDI amplitude required for HD capable instruments	HDST1 module for TG2000
	1080i 59.94 analog tri-level sync required for HD capable instruments	AWVG1 module for TG2000
	5225/270 SD signals required SD capable instruments:	DVG1 with option S1 module for TG2000 (Embedded audio needed for audio options DG, AD, DS, DDE)
<ul style="list-style-type: none"> ■ 100% color bars ■ 10-bit shallow ramp ■ SDI Matrix Pathological Signal ■ 100% sweep ■ Adjustable SDI amplitude 		
Composite signals required for CPS capable instruments: NTSC SMPTE bars	AVG1 module for TG2000	
Precision calibration signals for CPS capable instruments	AVC1 module for TG2000 ¹	
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 meter steps.	Faraday SC75A800B-G

Table 63: Required test equipment for performance verification (cont.)

Test equipment	Requirements	Example
75 Ω coaxial cables (3 required)	General purpose digital video Male-to-male BNC connectors 1 or 2 meters long	Belden 8281. Tektronix part number: 012-0159-00 or 012-0159-01
75 Ω terminator for Analog Video	Male connector, Precision	Tektronix part number: 011-0102-03
75 Ω terminator for SDI signal (2)	Male, wideband	Tektronix part number: 011-0163-00
75 Ω network analyzer or Spectrum Analyzer with Tracking Generator	75 Ω test port; 50 Ω input and output test ports	Agilent 8712 75 Ω Tektronix 2712 Wide Band Engineering A57TUC with male 75 Ω BNC test port
75 Ω calibration kit		Maury 8580A 75 Ω BNC
VITC Generator (Required for SD and Option CPS)		Horita VG-50 or Adrienne AEC-Box-28
LTC generator		Horita TG-50 or Adrienne AEC-Box-28
NTSC to SDI Converter (Required for SD)		Grass Valley 8960DEC or AJA model D5D
RCA and BNC to 15 pin header custom cable	Cable description: <ul style="list-style-type: none"> ■ 15-pin male Dsub connector; Tektronix part number 131-1164-00 ■ BNC; Tektronix part number 131-5647-00 ■ RCA plug; Allied 932-1098 ■ Wire (See Figure 1.) 	
Square Wave generator	10 kHz, 5 V output, 50 Ω output impedance	Tektronix FG5010
1 to 2 VDC voltage source (Required for Option CPS)	1.5 V battery or power supply	
BNC to retractable hook tip (Required for Option CPS)		Tektronix part number: 013-0076-01
RF Generator (Required for Option EYE or PHY)	50 kHz to 2.5 GHz sinewave for checking eye signal bandwidth	Rhode & Schwarz SMT03
RF Power Meter with 75 Ω head	50 MHz to 2 GHz Used to characterize RF generator for checking eye signal bandwidth	Agilent E4418B Power Meter with 8483A Power Sensor
Wideband 50 Ω to 75 Ω matching pad	0 to 2.5 GHz, N connectors, 75 Ω N-to-BNC adapter	Rhode & Schwarz RAM

¹ Note that the 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.

Initial Setup Use the following initial setup for all tests unless otherwise specified.

1. Connect the power cord to the rear of the waveform rasterizer.
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 rasterizer to warm up before beginning any procedures.

Signal Source Characterization for Eye Signal Bandwidth

Verifying eye signal bandwidth requires a 75 Ω RF sine wave signal that can be connected to the 75 (Ω) BNC input, and is either characterized or automatically leveled. (See page 90.). The results of characterization must be applied at each measurement frequency, either by adjusting the generator level setting, or by applying a correction to the amplitude reading from the unit under test.

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

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

Characterization Process

Characterize the test setup as follows to give a table of level setting versus 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 MHz, and the base level, typically 6.3 dBm.
3. Enter "100 MHz" into the power meter, so it applies the appropriate internal correction.
4. Record the measured power level as the reference level. (See Table 64.)
5. For each frequency listed, adjust the generator level for a reading closest to the reference level from previous step. Be sure to enter the frequency into the power meter at each step so that it applies the appropriate internal correction. Record each generator level setting in the following table.

Table 64: Generator characterization

Frequency setting (MHz)	Level setting	Frequency setting (MHz)	Level setting
100 (Reference Level)	6.3 dBm †	1600	
200		1700	
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	

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

Instrument Tests

The following procedures apply to all base instruments except where labeled Option HD. If you are testing an instrument with SD only, skip Option HD procedures, but do the others.

NOTE. Instruments with serial number B029999 and below do not have a front-panel EYE button. If Option EYE has been installed on these instruments, access the Eye and Jitter displays by pressing the MEAS button.

HD SDI Input Level Low and High (Option HD)

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

1. Press FACTORY, and then press the DISPLAY SELECT 4 button.
2. Press and hold STATUS to display the pop-up menu, and then select Video Session.
3. Connect a cable from an TG2000 HDVG1 output to the HDST1 video input. Press STATUS again to remove the pop-up menu.
4. Connect a cable from the HDST1 STRESS output to one of the SDI Input A connectors on the waveform rasterizer.
5. Terminate the other SDI Input A connector.
6. On the TG2000 HDVG1, set the output to the SDI Matrix signal.
7. You should see a stable picture and waveform on the waveform rasterizer display. The status screen should display OK for Y Chan CRC, C Chan CRC, Y Anc Checksum and C Anc Checksum errors.
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. Repeat the test using SDI Input B on the waveform rasterizer.
14. Record the HDST1 Amplitude Level in the test record.

HD SDI Input Equalization Range (Option HD)

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

1. Press **FACTORY**, and then press the **DISPLAY SELECT 4** button.
2. Press **STATUS** to display the status screen in tile 4.
3. Press and hold **STATUS** to display the pop-up menu, and then select **Video Session**. Press **STATUS** again to remove the pop-up menu.
4. Connect a cable to an output from 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 the other end of the second cable to either of the **SDI Input A** connectors on the waveform rasterizer.
8. Terminate the other **SDI Input A** connector.
9. On the **TG2000 HDVG1**, set the output to the **SDI Matrix** signal.
10. You should see a stable picture and waveform on the waveform rasterizer display. All the **CRC** parameters on the **Status** screen should read **Valid**.
11. 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.
12. 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**.
13. Record the value in the test record.
14. Repeat the test using **SDI Input B** on the waveform rasterizer.
15. Record this level in the test record.

HD SDI Loop-through Isolation (Option HD)

This test looks for cross-talk 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 cross-talk will not introduce errors.

1. Press **FACTORY**, and then press the **DISPLAY SELECT 4** button.
2. Press **STATUS** to display the status screen in tile 4.
3. Press and hold **STATUS** to display the pop-up menu, and then select **Video Session**.
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 one of the **SDI Input A** connectors.
8. Terminate the other **SDI Input A** connector.
9. Connect an output from the **DVG1** to one of the **SDI Input B** connectors.
10. Terminate the other **SDI Input B** connector.
11. Set the signal driving **SDI Input B** to 100% color bars.
12. Set the time base on the second signal to 1 ppm high.
13. Verify that there are no **CRC** errors on the **SDI A** input.
14. Record a **Pass** or **fail** as appropriate in the test record.
15. Disconnect the test setup.

**External Reference
Formats Supported:
Bi-Level**

Check that the device under test can reference to **NTSC** and **PAL** while viewing digital signals.

1. Press **FACTORY** on the waveform rasterizer.
2. Press **EXT** to enable external reference mode.
3. Connect a **525/270** color bars signal from the **DVG1** module to the **SDI A** input of the unit under test and terminate the **SDI loop-through** connector.
4. Apply an **NTSC** black signal from the **AVG1** output to the **Reference** input of the waveform rasterizer. Terminate the other **Reference** input with a precision termination.
5. Check that the lower-left corner of the waveform rasterizer 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 lower-left corner of the waveform rasterizer 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 rasterizer cannot sustain lock. Record the maximum offset capability in the log table.
3. Reset AVG1 Module parameters to remove the timebase offset.
4. Repeat steps 1 and 2, but use positive offsets to test the positive end of the lock range.

External Reference Formats Supported: Tri-Levels (Option HD)

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

1. Disconnect the NTSC black signal from the Reference input, and apply a 1080i 59.94 Tri-Level Sync signal from the AWVG1.
2. Check that the lower-left corner of the waveform rasterizer 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.

External Reference Lock in Presence of Hum, Bi-Level

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

1. Press FACTORY on the waveform rasterizer.
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 rasterizer Ref inputs. Terminate the other Ref input connector.
3. Connect either a digital or composite signal from the TG2000 to the waveform rasterizer and select the appropriate input to display the signal.

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

4. Set the AVC1 for 0 dB of 60 cycle hum.
5. Press EXT on the waveform rasterizer to set the reference to external.
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 (Option HD)

Apply a 0 dB hum signal to the Reference and verify the waveform rasterizer 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 -3 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.

LTC Decoding Functionality

Apply an LTC signal and verify it is correctly decoded.

An LTC is input through the 15-pin Remote connector on the rear panel. To input an LTC signal, you need to construct a cable as shown in the following figure. This cable has four wires from the Remote connector, two to an RCA connector and two to a BNC. Pin 7 of the Remote connector is connected to the center pin of the RCA connector, and pin 6 is connected to the shield of the RCA connector. Pin 8 of the Remote connector is connected to the center pin of the BNC and pin 6 goes to the shield of the BNC.

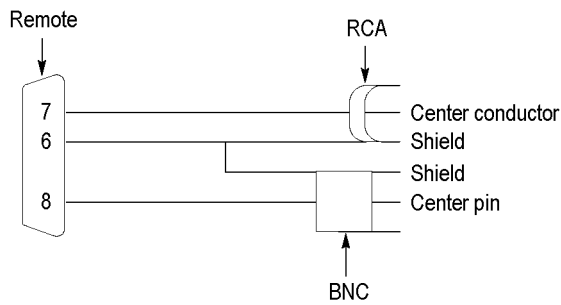


Figure 1: Wiring diagram for LTC input cable

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

1. Press FACTORY on the waveform rasterizer.
2. Connect the RCA connector on the custom cable to the output of the Timecode generator. Connect the 15-pin connector on the custom cable to the remote connector on the rear of the waveform rasterizer.
3. Press CONFIG to display the Configuration menu. Select "Aux Display Settings, Timecode Display if present," and then select LTC from the submenu.
4. Press OTHER on the front panel to display the LTC waveform.
5. Verify that decoded LTC is displayed in the lower right corner of the display.
6. It may be necessary to reset the LTC generator through the mode switch.
7. Record Pass or fail in the test record.

LTC Waveform Accuracy

Apply a square wave to the LTC input and use variable gain to normalize the display height. The variable gain factor indicates the input gain error.

1. Press FACTORY on the waveform rasterizer.
2. Connect the RCA connector from the custom cable to the output of the Timecode generator. Connect the 15-pin connector on the custom cable to the REMOTE connector on the rear of the waveform rasterizer.
3. Unplug the LTC generator so it is turned off. It needs to stay connected to the DUT to terminate the input.
4. Connect the 10 kHz square wave source to the BNC on the remote cable. Set the square wave amplitude to 5 V. If necessary, use an oscilloscope to verify that the amplitude is accurate.
5. Press OTHER on the waveform rasterizer front panel to display the LTC waveform.
6. Press FULL to change the waveform rasterizer display to full-screen mode.
7. Press VAR to activate the variable gain function.
8. Adjust the gain and vertical position until the displayed waveform is five divisions high.

The variable gain readout indicates the error in the input circuit. A gain of 1.03 indicates the input gain error is -3% . Record the gain error in the test record.

HD Cable Meter (Option HD and EYE or PHY)

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

1. Press FACTORY.
2. Press and hold STATUS, and then select Display Type > SDI Status.
3. Using the short cable, connect an HDVG1 output to the waveform rasterizer SDI A input. Terminate the other SDI A connector with a 75 Ω SDI terminator.
4. Set the HDVG1 to generate a 1080i 59.94 75% Color Bars signal.
5. Check that the cable length reading is between 0 m and 17 m.
6. Record the result in the test record.
7. Replace the short cable with the long one, or set the cable clone to 100 m.
8. Check that the cable length reading is between 76 m and 127 m.
9. Record the result in the test record.
10. If any cable length reading is outside the specification, perform the following adjustment procedure. Perform both the Short HD and Long HD steps for any input (SDI A or SDI B) that was found to be outside the specification.

NOTE. Be sure to use a generator with SDI output set as close as possible to 800 mV, since the Cable Meter adjustment establishes the Source Level as well as the Approx Cable (cable length) calibration.

11. Press CONFIG, select Utilities > Calibration, and then press SEL to start the calibration process.
12. Using the up and down arrow buttons, navigate to the Cable Meter calibration cases, press SEL to start, and follow the on-screen instructions.
13. Repeat steps 3 through 10 for the SDI B input and record the new results in the test record.

**HD Jitter Noise Floor
(Option HD and EYE or
PHY)**

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

1. Press FACTORY.
2. Connect the TG2000 HDVG1 output to the HDST1 input, and connect the HDST1 STRESS output to the rasterizer SDI A input. Terminate the loophrough connector on the rasterizer.
3. Reset the HDST1 to default on all SDI parameters.
4. Set the HDVG1 to generate a 1080i 59.94 100% Color Bars signal.

5. Press EYE. (If there is no EYE button, press and hold MEAS, and then select Display Type > Eye Display.)
6. Press and hold the DISPLAY SELECT 1 button to display the pop-up menu.
7. Select Jitter1 HP Filter > 100 Hz.
8. Check that the jitter readout indicates approximately 90 ps (0.13 UI), depending on TG2000 output jitter.
9. Enter Pass or Fail in the test record for HD Jitter Readout Noise.
10. If the HD Jitter Noise Floor is outside the specification, perform HD CDR Center and HD CDR Null calibration as described below. Adjustments for frame rates such as 59.94 and 29.97 Hz are indicated as "1/M"; frame rates such as 60, 50, and 30 Hz have no "1/M" indication.
 - a. Press CONFIG, select Utilities > Calibration and press SEL to access the Calibration menu.
 - b. Using left and right arrow buttons, navigate to the appropriate Eye HD CDR Center calibration case, press SEL to start, and follow the on-screen instructions.
 - c. Navigate to the appropriate Eye HD CDR Null calibration case press SEL to start, and follow the on-screen instructions. Be sure to use the SDI PLL Test pathological signal for this adjustment.
 - d. Restart the HD Jitter Noise Floor test, and then record the new values in the test record.
11. Proceed to the next step if option PHY is present. Otherwise skip to step 20.
12. Press FULL.
13. Press <, and then select Display Type > Jitter Display.
14. Press <, and then select Jitter1 HP Filter > 100 Hz.
15. Press the DISPLAY SELECT 1 button briefly to close the menu.
16. Press 5X GAIN.
17. Measure the amplitude of the jitter waveform using the graticule or cursors.
18. Check that the jitter amplitude is approximately 90 ps (0.13 UI), depending on the TG2000 output jitter.
19. Enter Pass or Fail in the test record for HD Jitter Waveform Noise.

10 second 10 Hz Jitter Bounce.

20. Press and hold the DISPLAY SELECT 1 button, and then select Jitter1 HP Filter > 10 Hz.
21. Watch the display for at least 10 seconds. The jitter amplitude may jump occasionally.
22. Check that any jump is less than 200 ps (0.297 UI).
23. Enter Pass or Fail in the test record for HD 10 second Jitter Bounce.
24. Turn Cursors OFF.

HD Jitter Readout Accuracy (Option HD and EYE or PHY)

This test checks for jitter readout accuracy.

1. Connect the HDVG1, HDST1 and rasterizer as described in the previous check, *HD Jitter Noise Floor*. (See page 84.)
2. Press the DISPLAY SELECT 1 button to select tile 1.
3. Press GAIN 1X button.
4. Press and hold EYE (or MEAS if no EYE button), and then select Display Type > Eye Display.
5. Press the left arrow key and then select Jitter1 HP Filter > 100 Hz.
6. If the jitter readout is not displayed, press the left arrow key and then select Jitter Meter > Meter & Readout.
7. Adjust the HDST1 module SDI parameters as follows:
 - a. Set the Jitter (LF) Freq to 9950 Hz.
 - b. Set the Jitter (LF) Ampl to 3.00 UI.
8. Check that the jitter readout is between 2.65 UI and 3.35 UI.
9. Record Pass or fail in the test record for the HD Jitter Readout Accuracy.

HD Jitter Waveform Accuracy (Option HD and PHY)

This test checks for jitter waveform accuracy.

1. Connect the HDVG1, HDST1, and rasterizer as described in *HD Jitter Noise Floor*.

(See page 84.)
2. Set tile 2 for Jitter display as follows:
 - a. Press the DISPLAY SELECT 2 button.
 - b. Press and hold EYE (or MEAS if there is no EYE button), and then select Display Type > Jitter Display.
 - c. Press the DISPLAY SELECT 2 button to close the menu.
 - d. Press MAG and FIELD for a sweep rate of 150 us/div.
3. Adjust the HDST1 module SDI parameters as follows:
 - a. Set the jitter (LF) frequency to 9950 Hz and set the jitter (LF) amplitude to 0 UI.
 - 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 will 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.
 - c. Continue increasing the jitter until another shadow of an eye appears. You now have 2 UIs of jitter.
 - d. Continue increasing jitter to 3 UIs. Do not adjust for 3 UIs on the generator; adjust instead for the sharpest narrow eye shadow on the rasterizer display which indicates the applied jitter is precisely 3UI. This may not be 3 UI on the generator because you are setting it for 3 UI added jitter instead of 3 UI total jitter.
4. The jitter display should show a nearly 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).
5. Record Pass or fail in the test record for the HD Jitter Waveform Accuracy.
6. Turn Cursors OFF.
7. Reset the generator.

Jitter Vibration (Option EYE or PHY)

This test shows if there is excessive sensitivity to vibration.

1. Disconnect the HDST1 and set the instrument on a flat surface, with the top cover in place.
2. Connect an HDVG1 output to WVR SDI A input.
3. Terminate the other SDI A connector with a 75 Ω SDI terminator.
4. Set the HDVG1 to generate a 1080i 59.94 100% Color Bars signal.
5. Press the left arrow key and then select Jitter1 HP Filter > 100 Hz.
6. If the jitter readout is not displayed, press the left arrow key and then select Jitter Meter > Meter & Readout.
7. Place a sheet of paper on the top cover to protect the surface, and then drop a BNC barrel connector onto the middle of the top cover from a height of 5 cm (2 inches) while watching the jitter readout.
8. Check that the jitter readout does not jump more than 0.4 UI.
9. Enter Pass or Fail in the test record.

HD Recovered Sine-wave Fidelity (Options EYE or PHY)

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

1. Press FACTORY.
2. Connect an HDVG1 output to the SDI A input. Set the HDVG1 to generate a 1080i 59.94 100% Color Bars signal.
3. Terminate the other SDI A connector with a 75 Ω SDI terminator.
4. Press CONFIG, and then select Utilities > Calibration. Press SEL to start calibration.
5. Press the up and down arrow keys to navigate to the end of the list of Calibration Cases, highlighting Eye Recovered Clock Test. Press SEL to begin this test.
6. Press the DISPLAY SELECT 1 button, and then press FULL to view the sine wave. Check that it is smooth and undistorted. There should be one cycle displayed.
7. Press GAIN 5X and VAR. Use the GENERAL knob to adjust the gain to x10.
8. Check the waveform. There should be no discontinuities or jagged edges. Use the VERTICAL knob to view the entire waveform.
9. Record Pass or fail in the test record.
10. Press the DISPLAY SELECT 4 button to return to the Calibration menu.
11. Press and hold STATUS, and then select Exit to exit calibration mode.

**Eye Gain (Option SD or HD
and EYE or PHY)**

This test uses an 800 mV, 1 MHz square wave to check the Eye Gain. This requires a 1 MHz square wave signal, provided by Tektronix, from the TG2000 AVC1 module.

1. Press FACTORY.
2. Press CONFIG, and then select Utilities > Calibration. Press SEL to start calibration.
3. Connect the AVG1 output to the SDI A input on the waveform monitor, and select the 1 MHz square wave signal.
4. Terminate the other SDI A connector with a 75 Ω SDI terminator. (The accuracy of this check depends directly on the accuracy of this terminator.)
5. Press the up or down arrow key if necessary to navigate the Eye Gain Adjust SDI A calibration case. (The number and ordering of calibration cases varies with installed options. If an Audio option is installed, press the up or down arrow key repeatedly to move to the second page.)
6. Press SEL to begin this test.
7. Press the DISPLAY SELECT 1 button.
8. Position the display or use cursors to measure the waveform amplitude. Check that the amplitude is between 760 mV and 840 mV.
9. Record this level in the test record for Eye Gain.
10. If the Eye Gain is outside the specification, perform the following adjustment procedure:
 - a. Press the DISPLAY SELECT 4 button to return to the Calibration menu.
 - b. Use the General knob or up and down arrow buttons to adjust the displayed amplitude of the eye waveform until it is 800 mV.
 - c. Press and hold STATUS, and then select Exit to exit calibration mode.
 - d. Repeat the Eye Gain test from step 1 and record the new values in the test record for Eye Gain.
11. Record this level in the test record.
12. **Option PHY only.** Check that the Eye Amplitude readout in tile 2 is between 760 mV and 840 mV.
13. Repeat steps 3 through 12 for the SDI B input.
14. Press the DISPLAY SELECT 4 button to return to the Calibration menu.
15. Press and hold STATUS, and then select Exit. Press SEL to exit the Calibration menu without saving.

**Eye Signal Bandwidth
(Options EYE or PHY)**

This test verifies the eye signal bandwidth.

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 Spurge Characterization for Eye Signal bandwidth.(See page 75, Signal Source Characterization for Eye Signal Bandwidth.).*

1. Assemble the signal source setup as characterized in Signal Source Characterization for Eye Signal Bandwidth Verification.(See page 75, *Signal Source Characterization for Eye Signal Bandwidth.*)
2. Set the RF generator frequency to 100 MHz.
3. Set the RF generator level. (See Table 64.)
4. Connect the signal source output to the SDI A input and terminate the connector with a 75 Ω terminator.
5. Press SDI A.
6. Check that the RF generator's RF output is on, with no modulation.
7. Press CONFIG, and then select Utilities > Calibration. Press SEL to start calibration.
8. Press the up arrow key to navigate the Eye Bandwidth Test calibration case.
9. Press SEL to begin this test.
10. Press the DISPLAY SELECT 1 button, and then press CURSOR to enable cursor measurement of the waveform shown in tile 1.
11. Use the cursors to measure the waveform amplitude, and note this as the reference amplitude. (If Option PHY is present, the Eye Amplitude readout in tile 2 may be used instead of the cursors.)
12. Set the RF generator frequency to 2.0 GHz (600 MHz for WVR6020).
13. Set the RF generator output level to the corresponding setting. (See Table 64.)
14. Measure the waveform amplitude using cursors. (If Opt. PHY is present, the Eye Amplitude readout in tile 2 may be used in place of the cursor measurement.)
15. Calculate the high frequency response as follows: Response = 20 x log (high frequency Amplitude / Reference Amplitude).
This value must be greater (more positive) than -3 dB.
16. Record the high frequency response in the test record.
17. Set the RF Generator to 100 MHz.

18. Set the RF generator output level to the corresponding setting. (See Table 64.)
19. While observing the waveform, increase the RF generator frequency in 10 MHz steps 2.0 GHz (600 MHz for WVR6020). Find the frequency that results in the minimum waveform amplitude.
20. Set the RF generator level to the nearest corresponding setting. (See Table 64.)
21. If the waveform amplitude falls below that measured in step 11, calculate the response in dB, as follows:
$$\text{Response} = 20 \times \log \left(\frac{\text{Smallest Amplitude}}{\text{Reference Amplitude}} \right)$$

Record this result in the test record as "minimum response". This value must be greater (more positive) than -3.0 dB.
22. Set the RF generator frequency to 50 kHz.
23. Set the RF generator level to the level of the lowest frequency characterization point. (See Table 64.)
24. Use the cursors to measure the 50 kHz waveform amplitude. (If Option PHY is present, the Eye Amplitude readout in tile 2 may be used in place of the cursor measurement.)
25. Calculate the 50 kHz response as follows: $\text{Response} = 20 \times \log \left(\frac{50 \text{ kHz Amplitude}}{\text{Reference Amplitude}} \right)$
This value must be greater (more positive) than -3 dB.
26. Record the 50 kHz response in the test record.
27. Move the signal source output to the SDI B input.
28. Press SDI B.
29. Set the RF Generator to 100 MHz.
30. Set the RF generator output level to the corresponding setting. (See Table 64 on page 76.)
31. Repeat steps 12 through 26 for the Digital B input.
32. Press the DISPLAY SELECT 4 button to return to the Calibration menu.
33. Press and hold STATUS, and then select Exit to exit calibration mode.

**Equalized Eye Gain
(Options EYE or PHY)**

This test checks for the presence of an internally generated eye signal.

1. Press FACTORY.
2. **HD only:** Connect an HDVG1 output to the SDI A input and terminate the loopthrough connectors. Set the HDVG1 to generate a 1080 59.94i 100% Color Bars signal.
3. **SD only:** Connect a DVG1 output to the SDI A input and terminate the loopthrough connectors. Set the DVG1 to generate a 525-270 75% Color Bars signal.
4. Press the EYE button (or MEAS if no EYE button) to get the Eye display.
5. Press CONFIG, and then select Physical Layer Settings > Eye Display Mode > Equalized.
6. Using the graticule, check that the waveform amplitude is between 400 mV and 650 mV.
7. Record Pass or fail in the test record.

SD Video Tests

NOTE. Do the tests in this section only for waveform rasterizers that support standard definition signals.

SD SDI Input Level Low and High

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

1. Press FACTORY.
2. Press the DISPLAY SELECT 4 button.
3. Press and hold STATUS to display the pop-up menu and select Video Session. Then press STATUS again to close the pop-up menu.
4. 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.
5. Connect the other end of the cable to one of the SDI Input A connectors on the waveform rasterizer.
6. Terminate the other SDI Input A connector.
7. On the TG2000 DVG1, set the output to the SDI Matrix signal.
8. You should see a stable picture and waveform on the waveform rasterizer display. The status screen should display Valid for all the EDH parameters.
9. 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.
10. Record this level in the test record.
11. Increase the serial amplitude to 115%.
12. If any EDH errors are generated, reduce the amplitude until no errors are generated for a 10 second period.
13. Record this level in the test record.
14. Repeat the test using SDI Input B on the waveform rasterizer.
15. Record this level in the test record.

SD SDI Input Equalization Range

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

1. Press FACTORY.
2. Press the DISPLAY SELECT 4 button.
3. Press STATUS to display the status screen in tile 4.
4. Press and hold STATUS to display the pop-up menu, and then select Video Session. Press the STATUS button again to dismiss the pop-up menu.
5. Connect a cable to the Normal output from the TG2000 DVG (not the Opt S1 output). Typically the Normal output is the top BNC on the DVG1 module.
6. Connect the other end of the cable to the Faraday Cable clone.
7. Connect a second cable to the other port of the cable clone.
8. Connect the other end of the second cable to either of the SDI Input A connectors on the waveform rasterizer.
9. Terminate the other SDI Input A connector.
10. Set the cable clone for minimum cable length, that is, 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 rasterizer display. All the EDH parameters on the Status screen should read Valid.
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 Input B on the waveform rasterizer.
17. Record this level in the test record.

**SD VITC Decoding
Functionality**

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

1. Press **FACTORY** on the waveform rasterizer.
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 to one of the SDI Input A input of the DUT and terminate the other side of the loop through.
5. Press the **CONFIG** button, and then select **AuxData Setting > TimeCode Display if present > VITC**.
6. Press **CONFIG** again to exit the menu.
7. Verify that a decoded VITC is displayed in the lower-right corner of the waveform rasterizer display.
8. Verify the VITC is correct and record **Pass** or **fail** in the test record.

**SD Cable Meter (Options
EYE or PHY)**

This test uses a short (1 to 2 meters) 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. Press FACTORY.
2. Press and hold STATUS, and then select Display Type > SDI Status.
3. Using the short cable, connect a DVG1 output to the WVR SDI A input. Terminate the other SDI A connector with a 75 Ω SDI terminator.
4. Set the DVG1 to generate a 525-270 100% Color Bars signal.
5. Check that the cable length reading is between 0 m and 17 m.
6. Record the result in the test record.
7. Replace the short cable with the long one, or set the cable clone to 100 m.
8. Check that the cable length reading is between 76 m and 127 m.
9. Record the result in the test record.
10. If any cable length reading is outside the specification, perform the following adjustment procedure. Perform both the Short SD and Long SD steps for any input (SDI A or SDI B) that was found to be outside the specification.

NOTE. Be sure to use a generator with SDI output set as close as possible to 800 mV, because the Cable Meter adjustment establishes the Source Level as well as the Approx Cable (cable length) calibration.

11. Press CONFIG, select Utilities > Calibration, and then press SEL to start the calibration process.
12. Using up and down arrow buttons, navigate to the Cable Meter calibration cases, press SEL to start, and follow the on-screen instructions.
13. Repeat steps 2 through 10 for the SDI B input and record the new results in the test record.

SD Jitter Noise Floor (Options EYE or PHY)

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 modules have an output noise floor in the 200 ps range.

1. Press FACTORY.
2. Connect the DVG1 upper output to SDI A input and terminate the loophrough connector.
3. Set the DVG1 to generate a 525-270 100% Color Bars signal.
4. Press and hold the EYE button. (If there is no EYE button, press and hold MEAS, and then select Display Type > Jitter Display.)
5. Press the left arrow key and then select Jitter1 HP Filter > 100 Hz.
6. Check that the jitter readout indicates approximately 250 ps (0.07 UI), depending on TG2000 output jitter.
7. Enter Pass or Fail in the test record for SD Jitter Readout Noise.
8. Proceed to the next step if option PHY is present. Otherwise skip to step 18.
9. Press FULL.
10. Press the left arrow key and then select Display Type > Jitter Display.
11. Press the left arrow key and then select Jitter1 HP Filter > 100 Hz.
12. Press the DISPLAY SELECT 1 button briefly to close the menu.
13. Press 5X GAIN.
14. Measure the amplitude of the jitter waveform using the graticule or cursors.
15. Using the graticule or the cursors, measure the jitter amplitude.
16. Check that the jitter amplitude is approximately 250 ps (0.07 UI), depending on the TG2000 output jitter.
17. Enter Pass or Fail in the test record for SD Jitter Waveform Noise.
- 10 second 10 Hz Jitter Bounce.**
18. Press and hold the DISPLAY SELECT 1 button, and then select Jitter1 HP Filter > 10 Hz.
19. Watch the display for at least 10 seconds. The jitter amplitude may jump occasionally.
20. Check that any jump is less than 300 ps (0.08 UI).
21. Enter Pass or Fail in the test record for SD 10 second Jitter Bounce.

SD Jitter Readout Accuracy (Options EYE or PHY)

This test checks the SD jitter readout accuracy.

1. Connect the DVG1 Option S1 output (typically the second output) to the SDI A input and terminate the loopthrough connector.
2. Set the DVG1 to generate a 525-270 100% Color Bars signal.
3. Press the left arrow key and then select Display Type > Eye Display.
4. Press the left arrow key and then select Jitter1 HP Filter > 100 Hz.
5. If the jitter readout is not displayed, press the left arrow key, and then select Jitter Meter > Meter & Readout.
6. Adjust the DVG1 SDI module parameters as follows:
 - a. Set the Jitter Freq to 9950 Hz.
 - b. Set the Jitter Ampl to 11.1 ns (3.00 UI).
7. Check that the jitter readout is between 2.65 UI and 3.35 UI.
8. Record Pass or fail in the test record for SD Jitter Readout Accuracy.
9. Reset the generator.

SD Jitter Waveform Accuracy (Option PHY)

This test checks the SD jitter waveform accuracy.

1. Press the FULL button to return the display to 4-tile mode.
2. Set tile 2 for Jitter display as follows:
 - a. Press the DISPLAY SELECT 2 button.
 - b. Press and hold EYE (or MEAS if no EYE button), and then select Display Type > Jitter Display.
 - c. Press MAG and FIELD for a sweep rate of 150 us/div.
3. Adjust the DVG1 SDI module parameters as follows:
 - a. Set the jitter frequency to 9950 Hz.
 - b. 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 will 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.
 - c. Continue increasing the jitter until another shadow of an eye appears. You now have 2 UIs of jitter.
 - d. Continue increasing jitter to 3 UIs. Do not adjust for 3 UIs on the generator; adjust instead for the sharpest narrow eye shadow on the rasterizer display, which indicates that the applied jitter is precisely 3UI. This may not be 3 UI on the generator because you are setting it for 3 UI added jitter instead of 3 UI total jitter.
4. The jitter display should show a nearly 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).
5. Record Pass or Fail in the test record for SD Jitter Waveform Accuracy.

SD Recovered Sine-wave Fidelity (Options EYE or PHY)

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

1. Press **FACTORY**.
2. Connect a **DVG1** output to the **SDI A** input. Set the **DVG1** to generate a 525-270 100% Color Bars signal.
3. Terminate the other **SDI A** connector with a 75 Ω **SDI** terminator.
4. Press **CONFIG**, and then select **Utilities > Calibration**. Press **SEL** to start calibration.
5. Press the up or down arrow key to navigate to the end of the list of **Calibration Cases**, highlighting **Eye Recovered Clock Test**. Press **SEL** to begin this test.
6. Press the **DISPLAY SELECT 1** button and then press **FULL** to view the sine wave. Check that it is smooth and undistorted. There should be one cycle displayed.
7. Press **GAIN 5X** and **VAR**. Use the **GENERAL** knob to adjust the gain to x10.
8. Check the waveform. There should be no discontinuities or jagged edges. Use the **VERTICAL** knob to view the entire waveform.
9. Record **Pass** or **fail** in the test record.
10. Press the **DISPLAY SELECT 4** button to return to the **Calibration** menu.
11. Press and hold **STATUS**, and then select **Exit**. Press **SEL** to exit the **Calibration** menu without saving.

Composite Analog (Option CPS) Video Tests

Composite Analog Frequency Response (Option CPS)

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. Press **FACTORY** on the waveform rasterizer.
2. Press **CONFIG**, select **Graticules** and set **Cmpst Waveform Graticule Units** to **mV**.
3. Connect the precision video generator to one of the **Composite A** input connectors and terminate the other connector with the precision terminator.
4. Set the precision generator for **700 mV Multiburst**. The top packet must be **5.75 MHz**.
5. Press the **CMPST A**, **CURSOR** and **FULL** buttons.
6. Adjust cursors to be near the top and zero portions of the waveform.
7. Press **5X**, adjust the lower cursor to align with the bottom of the reference step of the waveform.
8. Press **1X**, and adjust the vertical position to move the top of the waveform to the **0 mV** graticule. The second cursor should also be near the zero graticule mark.
9. Press **5X** and adjust the upper cursor to align with the top of the reference step of the waveform.
10. Check the cursor delta readout of the magnitude of the reference step. Note this number. It should be near **700 mV**.
11. Next, adjust the upper cursor to align with the top of the largest packet of the waveform.
12. Press **1X** and adjust the vertical position to move the baseline of the waveform to the **0 mV** graticule. The other cursor should also be near the zero graticule mark.
13. Press **5X** and adjust the lower cursor to align with the bottom of the largest packet of the waveform.
14. Note the cursor delta value for the amplitude of the largest packet.
15. Adjust the lower cursor to align with the bottom of the smallest packet of the waveform.
16. Press **1X**, and adjust the vertical position to align the top of the waveform to the **0 mV** graticule.
17. Press **5X** and adjust the upper cursor to align with the top of the smallest packet of the waveform.
18. Note the cursor delta value for the amplitude of the largest packet.

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

Adjust. If the Frequency Response is outside the specification, press the CONFIG, select Utilities, and then select Calibration and 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)**

Use 5.75 MHz 5T multi-pulse signal and cursors to measure group delay.

1. Press FACTORY on the waveform rasterizer.
2. Press CONFIG, select Graticules and set Cmpst Waveform Graticule Units to mV.
3. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
4. Set the precision generator for 5.75 MHz multiburst. This is a custom test signal with more packets for better coverage.
5. Press the CMPST A, CURSOR and FULL buttons.
6. Adjust the cursors to be near the zero portions of the waveform.
7. Press 5X and VAR. Use the GENERAL knob to increase the gain to 10X.
8. Use the cursors to measure the peak-to-peak deviation in the baseline of the multipulse packets.
9. The peak-to-peak deviation of the baseline is 0.1% per ns. For example, for a 10 ns deviation on a 714 mV signal yields a deviation 7.1 mV. Record the measured value in the test record.

Composite Analog Pulse to Bar Ratio (Option CPS)

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

1. Press FACTORY.
2. Press CONFIG, select Graticules and set Cmpst Waveform Graticule Units to mV.
3. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
4. Set the precision generator for a 2T Pulse and Bar.
5. Press the CMPST A, CURSOR and FULL buttons.
6. Adjust the cursors to be near the top portions of the waveform.
7. Use the VERTICAL position knob to move the top of the waveform to the zero graticule.
8. Press 5x and VAR. Use the GENERAL knob to increase the gain to 10X.
9. Place one cursor on the top of the "Bar".
10. Use the HORIZONTAL position knob to put the "pulse" on the dotted line at the center of the screen.
11. Press MAG to expand the pulse horizontally.
12. Position the second cursor on the top of the pulse.
13. Record the cursor delta in the test record.

**Composite Analog Field
Rate Tilt (Option CPS)**

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

1. Press FACTORY.
2. Press CONFIG, select Graticules and set Cmpst Waveform Graticule Units to mV.
3. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
4. Set the precision generator for Field Square Wave.
5. Press the CMPST A button, then the CURSOR button, and then the FULL button.
6. Adjust cursors to be near the top of the waveform.
7. Use the vertical position knob to move the top of the waveform to the zero graticule.
8. Press the 5x gain button and the FIELD button.
9. Use cursors to measure the tilt in the waveform.
10. Record the value in the test record.

**Composite Analog Line
Rate tilt (Option CPS)**

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

1. Press FACTORY.
2. Press CONFIG, select Graticules, and then set Cmpst Waveform Graticule Units to mV.
3. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
4. Set the precision generator for 100% Flat Field.
5. Press the CMPST A, CURSOR, and FULL buttons.
6. Adjust the cursors to be near the top of the waveform.
7. Use the VERTICAL position knob to move the top of the waveform to the zero graticule.
8. Press 5X.
9. Use the cursors to measure the tilt in the waveform, excluding the first and last 5 μ s of the bar.
10. Record the value in the test record.

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

Measure the displayed offset when the input is undriven and DC Restore is off.

1. Press FACTORY.
2. Apply an NTSC signal from the AVG1 output to the Composite A input of the waveform rasterizer. Terminate the other Composite A input with a precision termination.
3. Terminate one side of the Composite B input with a precision termination.
4. Switch off DC Restore by selecting CONFIG > Composite Input > DC Restore > Off.
5. Press CMPST A, and allow the waveform rasterizer to recognize and lock to the input signal.
6. Press CMPST B, CURSOR, and FULL.
7. Press 5X.
8. Push and hold WFM, select Center Waveform from the pop-up menu, and then press SELECT.
9. Press WFM again to remove the pop-up menu.
10. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
11. Connect the NTSC signal from the AVG1 output to the Composite B input.
12. Press CMPST A.
13. Set the cursor to the center of the flat-line waveform. Note the waveform offset indicated by the cursor readout.
14. Record the larger of the two waveform offset values in the test record.
15. Perform the following steps if the Offset is outside the specification:
 - a. Select CONFIG > Utilities > Calibration and follow the on-screen instructions to automatically adjust the offset.
 - b. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.
 - c. Afterwards, repeat steps 1-14 above and record the new value in the test record.

**Composite Analog Input
Clamp Off Check (Option
CPS)**

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

1. Press FACTORY.
2. Disconnect all terminators from the Composite inputs.
3. Connect a cable from a Composite A connector to the retractable hook clip.
4. Select CONFIG > Composite Input > DC Restore > Off.
5. Press CMPST A and FULL.
6. Press VAR and then use the GENERAL knob to reduce the gain to 0.5X
7. Hold the hook tips on the battery, red to positive, black to negative.
8. Verify that the waveform is offset up about 1.5 volts and is not being clamped to ground.
9. Record Pass or fail in the test record.

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

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

1. Press FACTORY.
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 Composite A input of the waveform rasterizer. Terminate the other connector with a precision terminator.
3. Set the AVC1 for 0 dB of 60 Hz hum.
4. Press the CMPST A button and then the FULL button.
5. Press FIELD twice to get a 2-field sweep (if you cannot get 2-field, make sure the display style is set to Overlay).
6. Select CONFIG > Composite Input > DC Restore > Off.
7. Press CURSOR and measure the peak-to-peak hum with the cursors. The measurement should be about 714 mV.
8. Select CONFIG > Composite Input > DC Restore > Fast.
9. Press the CONFIG button to dismiss the pop-up menu.
10. Measure the peak-to-peak hum with the cursors. It should be less than 5% of the measurement in step 7.
11. Record the value in the test record.
12. Select CONFIG > Composite Input > DC Restore > Slow.
13. Press the CONFIG button to dismiss the pop-up menu.
14. Measure the peak-to-peak hum with the cursors. It should be between 90% and 110% of the measurement in step 7.
15. Record the value in the test record.

**Composite Analog Vertical
Measurement Accuracy
(Option CPS)**

Use 100% white and cursors to measure gain.

1. Press FACTORY on the waveform rasterizer.
2. Press CONFIG, select Graticules, and set Cmpst Waveform Graticule Units to mV.
3. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
4. Set the Precision generator for a 100% Flat Field.
5. Press the CMPST A, CURSOR and FULL buttons.
6. Adjust the cursors to be near the top and zero portions of the waveform.
7. Press the 5X gain button. Adjust the lower cursor to be right on the backporch of the waveform.
8. Press 1X, and adjust the vertical position to locate the top of the waveform at the 0 mV graticule. The second cursor should also be near the zero graticule.
9. Press 5X and adjust the upper cursor to be centered on the top of the waveform.
10. Cursor delta displays the magnitude of the waveform. It should be within 1% of nominal 714.86 mV. Record the amplitude in the test record.
11. Perform the following steps if the Amplitude is outside the specification:
 - a. Press CONFIG, select Utilities, and then select Calibration and follow the on-screen instructions to adjust the gain.
 - b. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.
 - c. Afterwards, repeat steps 1-10 above for Analog Vertical Gain Accuracy and record the new value in the test record.

**External Reference Lock
Range (Option CPS)**

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

1. Press **FACTORY** on the waveform rasterizer.
2. Connect the TG2000 AVG1 to Composite A and loop through to the Ref input. Terminate the other side of the Reference loop through.
3. Press **Cmpst A** to select the Composite A input.
4. Press **EXT** to set the reference to external.
5. Adjust the AVG1 time base offset to -50 ppm. Confirm that the **VECTOR** and **WFM** displays are stable and that the readout in the lower-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)**

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

1. Press **FACTORY** on the waveform rasterizer.
2. Route the NTSC signal from the AVG1 to the VITC encoder.
3. Connect the output of the VITC encoder to one of the Composite A input connectors and terminate the other connector.
4. Select **CMPST A** on the front panel.
5. Press the **CONFIG** button and then select **Aux Data Setting > TimeCode Display if present > VITC**.
6. Press **CONFIG** again to exit the menu.
7. Verify that **Decoded VITC** is displayed in the lower-right corner of the waveform rasterizer display.
8. Verify that the VITC is correct and record **Pass** or **fail** in the test record.

Audio Performance Verification

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

Required Equipment

Table 65: Required audio test equipment

Test equipment	Requirements	Example
SDI serial digital video test generator with embedded audio	Generates signals listed below.	Tektronix TG2000 with modules indicated below.
	Option HD: 1080i 59.94 100% color bars with two or more groups of embedded audio	HDVG1 module for TG2000
	525/270 100% color bars with two or more groups of embedded audio	DVG1 module for TG2000
Sine wave generator	Capable of 0.8 Vp-p at 6 MHz into a 50 Ω load	Rohde & Schwarz SMT03 Opt. SM-B2
Test oscilloscope	Amplitude measurements of a 6 MHz sine wave	Tektronix TDS7404B
Analog/Digital audio generator/analyzer	35 kHz to 96 kHz sample rate range, jitter measurement per AES-3 (1997)	Rohde & Schwarz UPL06 Opt B22, B29
Precision 75 Ω -to-50 Ω adapter	1.5% impedance and attenuation accuracy	Tektronix AMT75
75 Ω coaxial cables (2 required)	General purpose digital video Male-to-male BNC connectors 3' long	Belden 8281
50 Ω coaxial cables (2 required)	Male-to-male BNC connectors 36 inches long	Tektronix part number: 012-0482-00
75 Ω Terminator	Male connector	Tektronix part number: 011-0055-02
Audio breakout cable	DB62 to XLR I/O required for Audio Options AD, DD, DDE	Tektronix part number: 012-1688-00
	DB37 to XLR I/O required for Audio Option DA	Tektronix part number: 012-1658-01
Calculator	Logarithmic function	
Dolby (R) digital audio generator	Generates Dolby D and Dolby E bit streams. Required for Options DD, and DDE.	Dolby Laboratories DM100

AES Audio Tests

The following tests verify that the Audio module for the WVR7020 and WVR7120 waveform rasterizers meets the warranted characteristics listed in the Specifications chapter. Characteristics with typical specifications (not warranted) are also checked with Pass / fail criteria.

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. Press FACTORY.
2. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1-2 In BNC connector using a 75 Ω cable.
3. Set the digital audio generator as follows:

Control or Setting	Value
Frequency	1 kHz
Output Level	-20 dB FS Audio Tone
Sample Frequency	96 kHz
Unbalanced V _{p-p}	1.000 V (Carrier Level)

4. Press and hold the DISPLAY SELECT 4 button to display the Audio pop-up menu.
5. In the Audio Input submenu, select AES A.
6. Press the Display Select 4 button to dismiss the Audio menu.
7. Check for an indication of -20 dB FS and no error messages in the corresponding bars, and record the Pass/fail result in the test record.
8. Move the audio generator output to each of the remaining AES A In connectors and repeat previous step for each connector.
9. Set the Sample Frequency on the digital audio generator to 44.1 kHz.
10. Check for an indication of -20 dB FS and no error messages in the corresponding bars, and record the Pass/fail result in the test record.
11. Move the audio generator output to each of the remaining AES A In connectors and repeat previous step 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. Press FACTORY (sets AUDIO INPUT to FOLLOW VIDEO, Embedded).
2. Select CONFIG to display the CONFIG menu.
3. From the Audio Inputs/Outputs submenu, select AES B > Config Port as: > Output.
4. Press CONFIG again to remove the CONFIG menu.

NOTE. For Options AD and DG, the AES B Outputs will be available only if Embedded is selected as the current audio input source.

5. Connect a 525/270 color bars signal from the DVG1 module to the SDI A input of the instrument under test and terminate the SDI loop-through connector.
6. Set the generator for embedded audio in 2 groups starting with group. 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.
7. Check that "PPPP PPPP — —" is displayed in the bottom 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 appears to be set to 2 already.

8. Connect the AES B 1-2 I/O output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
9. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Control or Setting	Value
Vertical Scale	200 mV/div
Horizontal Scale	100 ns/div

Control or Setting	Value
Horizontal Trigger Position	30%
Trigger Slope	Rising edge
Trigger Level	0 mV

- 10.** Check that the amplitude of the waveform displayed on the oscilloscope is between 0.9 V and 1.1 V and record the value in the test record.
- 11.** Move the cable to each of the remaining AES B I/O connectors and repeat previous step.
- 12.** Disconnect the test setup.

AES Output Jitter This test measures jitter at each AES output.

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

1. Press the FACTORY button to restore the factory preset.
2. Press the CONFIG button to bring up the CONFIG menu.
3. In the Audio Inputs/Outputs submenu, select AES B and from the submenu select Config Port as: Output.
4. Press CONFIG again to close the CONFIG menu.
5. Connect a 525/270 color bars signal from the DVG1 module to the SDI A input of the instrument under test and terminate the SDI loop-through connector.
6. Set the generator for embedded audio in 2 groups starting with group. 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.
7. Check that "PPPP PPPP — —" is displayed in the bottom 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 appears to be set to 2 already.*

8. Connect the AES B 1-2 I/O connector to the digital audio analyzer unbalanced (UNBAL) input using a 75 Ω cable.
9. 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

Instrument	Digital
FUNCTION -	PEAK & S/N
Meas Mode	PK abs
Intv Time	0.5000s
Unit	s
Reference	GEN TRACK
Filter	JITTER wtd
SPEAKER -	OFF

10. Allow the jitter reading to settle for a few seconds.
11. Check for a typical Jitter Peak absolute reading of less than 3.5 ns over an interval of at least 5 seconds, and record the Pass/fail result in the test record.
12. Move the cable to each of the remaining AES B I/O connectors and repeat steps 10 and 11 for each AES B I/O connector.
13. 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. Press FACTORY.
2. Set the digital audio generator as follows:

Control or Setting	Value
Sample Frequency	48 kHz
Output Level	-6 dB FS Audio Tone
Frequency	100 Hz

3. Press and hold the DISPLAY SELECT 4 button to display the Audio pop-up menu.
4. In the Audio Input submenu, select AES A.
5. Press the Display Select 4 button to dismiss the Audio menu.
6. Connect the digital audio generator unbalanced (UNBAL) output to the AES A 1-2 In connector using a 75 Ω cable.
7. Check for an indication of -6 dB FS 0.2 dB in the corresponding bars and record the Pass/fail result 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:

Control or Setting	Value
Sample Frequency	48 kHz
Output Level	-6 dB FS Audio Tone
Frequency	1 kHz

10. Repeat steps 6 through 8.
11. Set the digital audio generator as follows:

Control or Setting	Value
Frequency	19 kHz
Output Level	-6 dB FS Audio Tone
Sample Frequency	48 kHz

12. Repeat steps 6 through 8.
13. Disconnect the test setup.

Audio Tests (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. Press FACTORY.
2. Press and hold the DISPLAY SELECT 4 button to display the pop-up menu.
3. In the Audio Input submenu, select Analog A.
4. Remove the audio tile pop-up by pressing AUDIO.
5. Install the analog breakout cable to the Analog Audio I/O connector.
6. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
7. Set the analog audio generator as follows:

Control or Setting	Value
Frequency	100 Hz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

8. Check for an indication of 18 dBu \pm 0.5dB in the corresponding bar and record the value in the test record.
9. Change analog audio generator Frequency to 1 kHz.
10. Check for an indication of 18 dBu \pm 0.5dB in the corresponding bar and record the value in the test record.
11. Change analog audio generator Frequency to 19 kHz.
12. Check for an indication of 18 dBu \pm 0.5dB in the corresponding bar, and record the value in the test record.
13. Repeat steps 7 through 12 for each of the other five Input A XLR connectors in the breakout cable.
14. Press and hold the DISPLAY SELECT 4 button to display the pop-up menu.
15. In the Audio Input submenu, select Analog B.
16. Press the AUDIO button to remove of the pop-up menu.
17. Repeat steps 6 through 13 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.

18. To perform an analog input adjust, do the following steps, otherwise skip to step 28.
19. Set the analog audio generator as follows:

Control or Setting	Value
Frequency	1 kHz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

20. Connect the generator balanced (BAL) analog output to the Analog A input that requires adjustment.
21. Press CONFIG to display the CONFIG menu.
22. In the Utilities submenu, select Calibration.
23. Push the right or left arrow key until the desired Analog Input channel is highlighted and push the select key to perform an adjustment.
24. Press and hold the DISPLAY SELECT 4 button to display the pop-up menu.
25. Select Exit to leave the Calibration screen.
26. Check for an indication of -18 dBu in the newly adjusted audio bar.
27. If multiple inputs require adjustment, repeat steps 20 through 26 for each input.
28. 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. Press FACTORY.
2. Press CONFIG to display the CONFIG menu.
3. In the Audio Inputs/Outputs submenu, select Attenuate Audio Out and set the attenuation to 0 dB.
4. Also in the Audio Inputs/Outputs submenu, select AES A > Analog Out Map.

NOTE. For the step that follows, note that Option DA does not have outputs Analog 7 & 8, so you can only set the other inputs listed in the step when checking Option DA-equipped instruments.

5. In the Analog Output Map, put an X in the Bar 1, 2 position for outputs Analog 1 & 2, Analog 3 & 4, Analog 5 & 6, and Analog 7 & 8.
6. Press CONFIG again to remove the CONFIG menu.
7. Press and hold the DISPLAY SELECT 4 button to display the pop-up menu.
8. In the Audio Input submenu, select AES A.
9. Press AUDIO to remove the audio tile pop-up.
10. Install the audio breakout cable on the Analog Audio I/O connector.
11. Set the analog audio analyzer to measure RMS level in dBu, and for an input impedance of 200 k Ω . This is done on the R&S UPL06 as follows:
 - a. Press ANLR to display and configure the ANALYZER panel.
 - b. Use the up/down arrow keys, keypad, and SELECT button to set the parameters in the ANALYZER panel as follows:

Instrument	ANLG 22 kHz
Min Freq	10 Hz
Ref Imped	100000 Ω
Channel	1
Ch1 Coupl	AC
Ch1 Input	BAL
Ch1 Imped	200 k Ω
Ch1 Common	FLOAT
Ch1 Range	AUTO
START COND	AUTO
Delay	0.0000 s
INPUT DISP	OFF
FUNCTION	RMS & S/N

Instrument	ANLG 22 kHz
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

12. Connect the R&S UPL06 Opt B22, B29 digital generator unbalanced (UNBAL) output to the AES A 1-2 In BNC using a 75 Ω cable.
13. Set the digital audio generator for a -6dBfs, 100 Hz audio tone at 48 kHz sample rate. This is done on the R&S UPL06 as follows:
 - a. Press GEN to display and configure the GENERATOR panel.
 - b. Use the up/down arrow keys, keypad, and SELECT button to 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

Instrument	Digital
FUNCTION -	SINE
Frq Offset	OFF
DC Offset	OFF
Dither	OFF
Equalizer	OFF
SWEEP CTRL	OFF
FREQUENCY	100.0 Hz
VOLTAGE	0.5000 FS

14. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
15. Check for an indication of 18 dBu \pm 0.5dB on the analog analyzer and record the result in the test record.
16. Change the digital audio generator FREQUENCY to 1000 Hz.
17. Check for an indication of 18 dBu \pm 0.5dB on the analog analyzer and record the result in the test record.
18. Change the digital audio generator FREQUENCY to 19000 Hz.
19. Check for an indication of 18 dBu \pm 0.5dB on the analog analyzer and record the result in the test record.
20. Repeat steps 12 through 19 for each of the other Output XLR connectors.
21. 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. Press FACTORY.
2. Press CONFIG to display the CONFIG menu.
3. In the Audio Inputs/Outputs submenu, select Attenuate Audio Output and set the attenuation to 0 dB.
4. Also in the Audio Inputs/Outputs submenu, select Analog A > Analog Out Map.

NOTE. For the step that follows, note that Option DA does not have outputs Analog 7 & 8, so you can only set the other inputs listed in the step when checking Option DA-equipped instruments.

5. In the Analog Output Map, put an X in the Bar 1, 2 position for outputs Analog 1 & 2, Analog 3 & 4, Analog 5 & 6, and Analog 7 & 8.
6. Press CONFIG again to remove the CONFIG menu.
7. Press and hold the DISPLAY SELECT 4 button to display the pop-up menu.
8. In the Audio Input submenu, select Analog A.
9. Exit out of the audio tile pop-up by pressing the AUDIO button.
10. Set the analog audio generator as follows:

Control or Setting	Value
Frequency	100 Hz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

11. Connect the analog audio break out cable to the Analog Audio I/O connector.
12. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
13. Check for an indication of 18 dBu in the corresponding bar.
14. Connect the Output 1 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 the Pass/fail result in the test record.
16. Repeat the previous step for Output 3 and Output 5. Repeat also for Output 7, except when checking Option DA-equipped instruments.
17. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
18. Check for an indication of 18 dbu in the corresponding bar.
19. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
20. Check for an RMS indication of 18 dBu \pm 1.0 dB on the analog analyzer, and record the Pass/fail result in the test record.
21. Repeat the previous step for Output 4 and Output 6. Repeat also for Output 8, except when checking Option DA-equipped instruments.
22. Set the analog audio generator as follows:

Control or Setting	Value
Frequency	1 kHz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

23. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
24. Check for an indication of 18 dbu in the corresponding bar.
25. Connect the Output 1 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
26. Check for an RMS indication of 18 dBu \pm 1.0dB on the analog analyzer and record Pass/fail the result in the test record.
27. Repeat the previous step for Output 3 and Output 5.
28. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable. Press CONFIG to display the CONFIG menu.
29. Check for an indication of 18 dBu in the corresponding bar.
30. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.
31. Check for an RMS indication of 18 dBu \pm 1.0dB on the analog analyzer and record the Pass/fail result in the test record.
32. Repeat the previous step for Output 4 and Output 6. Repeat also for Output 8, except when checking Option DA-equipped instruments.
33. Set the analog audio generator as follows:

Control or Setting	Value
Frequency	19 kHz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

34. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
35. Check for an indication of 18 dbu in the corresponding bar.
36. Connect the Output 1 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 the Pass/fail result in the test record.
38. Repeat the previous step for Output 3 and Output 5. Repeat also for Output 7, except when checking Option DA-equipped instruments.
39. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable. Press CONFIG to display the CONFIG menu.
40. Check for an indication of 18 dbu in the corresponding bar.
41. Connect the Output 2 XLR of the breakout cable to the analyzer balanced (BAL) analog input.

- 42.** Check for an RMS indication of $18 \text{ dBu} \pm 1.0 \text{ dB}$ on the analog analyzer, and record the Pass/fail result in the test record.
- 43.** Repeat the previous step for Output 4 and Output 6. Repeat also for Output 8, except when checking Option DA-equipped instruments.

This completes the Performance Verification procedures.