

Service Manual



WVR610A & WVR611A Waveform Rasterizers

071-1243-01

This document applies to firmware version 1.1X 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.

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

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.

Powering Off. The power cord provides Mains disconnect.

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

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

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

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

Symbols and Terms

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



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



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

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

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

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

CAUTION indicates a hazard to property including the product.

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



Service Safety Summary

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

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

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

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

To avoid electric shock, do not touch exposed connections.

Preface

This is the service manual for the WVR610A & WVR611A Waveform Rasterizers.

Read this preface to learn how this manual is structured, what conventions it uses, and where you can find other information related to servicing these products.

Manual Structure

This manual is divided into chapters, which are made up of related subordinate topics. These topics can be cross referenced as sections.

Be sure to read the introductions to all procedures. These introductions provide important information needed to do the service correctly, safely, and efficiently.

Manual Conventions

This manual uses certain conventions that you should become familiar with before attempting service.

Module The term module refers to a collection of items that are replaceable as a unit. A module may contain electrical and mechanical assemblies, circuit boards, and interconnecting cables.

Replaceable Parts This manual refers to any field-replaceable assembly or mechanical part by its name or generically as a replaceable part. In general, a replaceable part is any circuit board or assembly that is listed in the *Replaceable Mechanical Parts* in Chapter 10.

Safety Symbols and terms related to safety appear in the *General Safety Summary* found at the beginning of this manual.

Be sure to read both the General Safety Summary and Service Safety Summary before performing any service to this instrument.

Related Documents

The following related user documents are available:

- *WVR610A & WVR611A Waveform Rasterizers User Manual*. This document provides detailed operating information.
- *WVR610A & WVR611A 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, Inc. website, an updated version of this document is provided.

Related Reference Documents

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

- *Preventing Illegal Colors*. This application note describes how the Diamond, Arrowhead, and Lightning displays on the waveform monitor can be used to help prevent the undesired impact of color gamut violations and to simplify the assessment of proper gamut compliance.
- *Understanding Colors and Gamut*. This poster provides a large visual display of how the Diamond, Arrowhead, and Lightning displays on the waveform monitor can be used to help prevent the undesired impact of color gamut violations.
- *A Guide to Standard and High Definition Digital Measurements*. This book is a primer for understanding the basics for making standard and high-definition, digital-video measurements.

Contacting Tektronix

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* **This phone number is toll free in North America. After office hours, please leave a voice mail message.**
Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.



Specifications

Specifications

The tables in this appendix list the specifications for the Tektronix WVR610A & WVR611A Waveform Rasterizers. Items listed in the Performance Requirement column are generally quantitative, and are either tested by the *Performance Verification* procedure in the Service Manual 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.

Electrical Specifications

Table 1-1: SDI Input waveform vertical characteristics

Characteristic	Performance requirement	Reference information
Displayed Vertical Gain Accuracy	At X1, $\pm 0.5\%$ Gain of 700 mV full scale mode At X5, $\pm 0.2\%$ Gain of 700 mV full scale mode	YPbPr signal from a 4:2:2 digital signal generator as measure in YPbPr mode. Limited by display resolution, measured using Graticules or Cursors. Any one of the three channels.
Variable Gain Range, Typical	0.25X to 10X	
Frequency Response		
Luminance Channel (Y)	to 5.75 MHz, $\pm 0.5\%$	RGB monochrome identical to Y channel.
Chrominance Channels (Pb, Pr)	to 2.75 MHz, $\pm 0.5\%$	
Transient Response		
Preshoot	$\leq 0.3\%$ peak (2T5 bar)	Pulse-to-bar ration 0.99:1 to 1.01:1 on appropriate Sine-squared or Blackman 2T pulse.
Overshoot	$\leq 0.3\%$ peak (2T5 bar)	
Sine-Squared Bars	$\leq 0.3\%$ peak (2T5 bar)	
Ringing		
Sine-Squared Bars	$\leq 0.8\%$ peak-peak (2T5 bar)	
Tilt, Typical		
Field Rate	$< 0.1\%$	

Table 1-1: SDI Input waveform vertical characteristics (Cont.)

Characteristic	Performance requirement	Reference information
Line Rate	< 0.1%	
Off Screen Recovery, Typical	< 0.1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen	X1, X5 or any variable gain setting
RGB Transcoder Accuracy		± 0.1%
Bit Integrity		Accurately shows both 8 and 10-bit signals

Table 1-2: Serial digital video (SDI inputs A and B) interface physical layer characteristics

Characteristic	Performance requirement	Reference information
Formats Supported		270 Mb/s component. Complies with SMPTE 259M and CCIR 656.
Input Level	800 mV peak-to-peak ± 10%	Input voltages outside this range may cause reduced receiver performance.
Input Type		Passive loopthrough 75 Ω, compensated
Return Loss	≥ 25 dB from 1 to 270 MHz, power on ≥ 15 dB from 1 to 270 MHz, power off	
Insertion Loss (Loopthrough)		≤ 1.2 dB to 270 MHz Checked indirectly via return loss and equalization range
Loopthrough Isolation	≥ 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 a $1/\sqrt{F}$ loss characteristics. 800 mV launch amplitude per SMPTE 259M.	230 meters using Belden 8281 coaxial cable, typically 300 meters
Input Time Base Range	270 Mbits/s ± 50ppm	Many functions continue to operate to a wider range, typically 1000 ppm.

Table 1-3: Composite analog input waveform vertical characteristics

Characteristic	Performance requirement	Reference information
Displayed Vertical Gain Accuracy	± 1% all Gain settings	Measured using graticules
Variable Gain Range, Typical	0.25X to 10.0X	
Frequency Response	flat to 5.75 MHz, ± 1%	

Table 1-3: Composite analog input waveform vertical characteristics (Cont.)

Characteristic	Performance requirement	Reference information
Delay Variation over Frequency	± 10 ns to 5.75 MHz	
Transient Response		Measured using Sine-squared 2T4 pulse and bar
Pulse-to-Bar Ratio	0.99:1 to 1.01:1	
Pre-shoot	$\leq 1\%$	
Overshoot	$\leq 1\%$	
Ringing	$\leq 1\%$	
Tilt, Typical		
Field Rate	$< 0.5\%$	
Line Rate	$< 0.5\%$	
Off Screen Recovery, Typical		$< 0.5\%$ variation in baseline of a Chroma modulated pulse when positioned anywhere on screen X1, X5 or any variable gain setting

Table 1-4: Composite analog inputs A and B physical layer characteristics

Characteristic	Performance requirement	Reference information
Formats Supported	NTSC, NTSC no setup, and PAL, I, B, Q, G. Complies with RS170A and 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
Video Maximum Operating Amplitude, typical		-1.8 V to +2.2 V DC + peak AC (all inputs)
Maximum Absolute Video Input Amplitude		-8.5 V to +8.5 V DC + peak AC
Input Type	Passive loopthrough 75 Ω , compensated	
DC Input Impedance		20 k Ω
Return Loss	≥ 40 dB to 6 MHz, power on	Typically > 46 dB to 6 MHz, power on, > 35 dB to 6 MHz, power off for standard amplitude video
Video Input Cross-talk Between Channels		≥ 60 dB to 6 MHz
Loopthrough Isolation		≥ 70 dB to 6 MHz

Table 1-4: Composite analog inputs A and B physical layer characteristics (Cont.)

Characteristic	Performance requirement	Reference information
DC Offset with Restore Off		≤ 20 mV typical, 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	≤ 7 mV	
DC Restore 50 and 60 Hz Attenuation, typical	Fast Mode > 95% attenuation Slow Mode < 10% attenuation Off Mode	
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 3 mV
Lock Range	± 50 ppm	Remains locked
Lock in Presence of Hum		± 1 V peak-to-peak 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 and burst is present	
Error Reporting		Should report CPU-readable error conditions, for example, no input present, unlocked, etc.
Clamp Range		Can correct signals with backporch within 1 V of ground.
Sync AFC Speed		User selectable setting of Fast or Slow response to line rate variations. Typical bandwidth of 600 Hz (Fast) and 10 kHz (Slow)

Table 1-5: External reference characteristics

Characteristic	Performance requirement	Reference information
Formats Supported	NTSC and PAL complies with RS170A and ITU-R BT.471.	Proper horizontal and vertical synchronization with a composite signal of appropriate line field rate.
Input Dynamic Range, Typical		± 6 dB
Absolute Maximum Input Voltage, Nominal		± 8.5 V DC plus Peak AC
Input Type		Passive loophrough 75Ω , compensated
DC Input Impedance, Nominal	20 k Ω	
Return Loss	≥ 40 dB to 6 MHz, power on	Typically > 46 dB to 6 MHz, power on, > 35 dB to 6 MHz, power off for standard amplitude video
Timing Shift with 10 to 90% APL Change	≤ 0.5 ns	
Timing Shift with Hum	≤ 20 ns with 0 dB hum	
Lock Range	± 50 ppm, remains locked	
Lock in Presence of Hum		± 1.0 V peak-to-peak, 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 $< 45^\circ$ SCH Phase Error and burst is present	
Error Reporting		Should report CPU-readable error conditions, for example, no input present, unlocked, etc.
Zero Timing Offset	For correctly timed input, should see minimal shift on the WFM display between internal and external mode.	For vertical timing, conforms to SMPTE168 - 2002. That is, the lines with the start of the broad pulses are aligned. For Horizontal timing, zero delay analog signals have coincident syncs. For digital signals timing is such that if convert to analog via a WFM601a then resultant analog signal is coincident with the reference.
Sync AFC Speed		User selectable setting of Fast or Slow response to line rate variations. Typical bandwidth of 600 Hz (Fast) and 10 kHz (Slow)

Table 1-6: Waveform sweep (horizontal) characteristics

Characteristic	Performance requirement	Reference information
Sweep Timing Accuracy	$\pm 0.1\%$	All Sweep and Mag modes, limited by display resolution, measured using graticules or cursors. Guaranteed by digital design. Input time base within ± 10 PPM.
Sweep Linearity	$\pm 0.1\%$	Guaranteed by digital design.
Sweep Rates, Normal		
1 Line	5 $\mu\text{s}/\text{division}$	Numbers shown for overlay, parade modes are scaled appropriately.
2 Line	10 $\mu\text{s}/\text{division}$	
1 Field	1.5 ms/division for 60 Hz signals, 2 ms/division for 50 Hz signals	
2 Field	3 ms/division for 60 Hz signals, 4 ms/division for 50 Hz signals	
Sweep Rates, Mag		
1 Line	0.2 $\mu\text{s}/\text{division}$	Mag occurs around center of sweep 2 line and 2 field Mag modes optimized to display blanking intervals.
2 Line	1 $\mu\text{s}/\text{division}$	
3 Line	1 $\mu\text{s}/\text{division}$	
4 Line	1 $\mu\text{s}/\text{division}$	
1 Field	75 $\mu\text{s}/\text{division}$ for 60 Hz signals, 100 $\mu\text{s}/\text{division}$ for 50 Hz signals	
2 Field	150 $\mu\text{s}/\text{division}$ for 60 Hz signals, 200 $\mu\text{s}/\text{division}$ for 50 Hz signals	
3 Field	75 $\mu\text{s}/\text{division}$ for 60 Hz signals, 300 $\mu\text{s}/\text{division}$ for 50 Hz signals	
4 Field	150 $\mu\text{s}/\text{division}$ for 60 Hz signals, 400 $\mu\text{s}/\text{division}$ for 50 Hz signals	
Horizontal Position Range, Nominal		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-mag mode.

Table 1-7: Waveform mode filter characteristics

Characteristic	Performance requirement	Reference information
Low Pass Filter Gain, Component Only	$1 \pm 0.1\%$ relative to flat gain	
Low Pass Filter Frequency Response, Component Only	≤ 3 dB attenuation at 800 kHz ≥ 32 dB attenuation at 3 MHz	Filter meets STD-205.
Luma Filter Gain, Composite Only	$1 \pm 0.1\%$ relative to flat gain at 50 kHz	
Luma Filter Response, Composite Only	≤ 3 dB attenuation at 800 kHz ≥ 40 dB attenuation at F_{sc}	Same as component low pass filter. Filter meets STD-205.
Chroma Filter Gain, Composite Only		$1 \pm 0.1\%$ relative to flat gain.
Chroma Filter Response, Composite Only	3 dB bandwidth is $1 \text{ MHz} \pm 0.2 \text{ MHz}$.	Centered on f_{sc} . Implemented digitally.
Chroma Filter Attenuation at $2X F_{sc}$, Composite Only	≥ 25 dB	Typically 28 dB for NTSC, 53 dB for PAL

Table 1-8: Component vector mode

Characteristic	Performance requirement	Reference information
Vector Display	P_B is displayed on horizontal axis and P_R is displayed on vertical axis.	
Vector Position Behavior	Graticules and waveform move together with position controls. Range sufficient to put any bar target in center of screen at all gains.	
Variable Gain Behavior	Variable affect 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.
Display to Graticule Registration	Centered in target, ± 0.25 box diameter at 1X gain, ± 0.1 box diameter at 5X gain.	Boxes are 2% targets.
Bandwidth, typical		800 kHz, meets STD-205.

Table 1-9: Composite vector mode characteristics

Characteristic	Performance requirement	Reference information
Displayed Horizontal and Vertical Gain Accuracy	X1 Gain $\pm 1\%$ X5 Gain $\pm 1\%$	
Display to Graticule Registration	Centered in target, ± 0.5 box diameter with the color bar black/white display dot centered in target.	Boxes are 2% targets.
Vector Display		B-Y is displayed on horizontal axis and R-Y is displayed on vertical axis
Horizontal to Vertical Bandwidth Matching		$< 2^\circ$ at 500 kHz and 2 MHz
Composite Vector Dot Reference		Shows "true" zero subcarrier reference
R-Y B-Y Axis Orthogonality		0.1° . Implemented digitally.
Bandwidth, typical		500 kHz

Table 1-10: Lightning and Diamond modes display

Characteristic	Performance requirement	Reference information
Displayed Horizontal and Vertical Gain Accuracy	Gain $\pm 0.5\%$	Limited by display resolution, measured using graticules.
Diamond	GBR Deflection axis indicated.	
Lightning	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 Marks		As deflected from center, the 1st tic mark is an error of 20 ns, 2nd tic mark is 40 ns, 3rd tic mark is 74 ns (1 luma sample) and 4th tic mark is 148 ns (1 chroma sample). 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.

Table 1-11: RGB gamut error indication (Diamond displays)

Characteristic	Performance requirement	Reference information
Detection Level	Adjustable thresholds: Upper: 650 to 756 mV Lower: -70 to +35 mV Default is nominally 103% of legal RGB Upper: 721 mV Lower: -21 mV	
Detection Level Accuracy	± 5 mV	
Colorimetry		According to CCIR601.

Table 1-12: Arrowhead mode (NTSC/PAL composite limit display of component input mode)

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy (PAL values in parenthesis)	$\pm 1\%$, 100 IRE (700 mV) and 131 IRE (900 mV)	
Composite Limit Cursor Accuracy (PAL values in parenthesis)	2% at 100, 110, 120, and 131 IRE (700 and 900 mV) 2% at -24, -33, and -40 IRE (-230 and -300 mV)	
Detection Level	Adjustable thresholds, 1% steps.	Out of limit signals are displayed as Red on the out-of-limit portion of the Arrowhead display.
Composite Limit Detection Level Accuracy (PAL values in parenthesis)		Detection level ± 7 mV, 90 to 135% in 1% steps Upper Detection level can be set to 100, 110, 120, or 131 IRE (700 or 950 mV PAL)
Luma Limits		High 90 to 108% Low +5 to -6% 0.5% steps Default is nominally 103% and -1%.
Luma Limit Detection Level Accuracy		Detection level = ± 7 mV of cursor level

Table 1-13: Program error alarms and “Background Measurement Alarms”

Characteristic	Performance requirement	Reference information
Alarm Coverage		Alarms only reported on active input
Alarm Log Depth		10,000 Alarm entries. Data is volatile; it is lost on power down.
Alarm Log Time Stamping	Time of day and selectable LTC or VITC.	
Alarm Notification		All alarms can 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.
SDI Alarms		
EDH Error	Active picture and full field. Field rate resolution.	Uses CRC system. System is known as EDH (Error Detection and Handling) in industry literature. Complies with SMPTE RP 165.
Signal Loss	Reports absence of video signal for the currently selected input.	
RGB and Composite Gamut Errors		User adjustable thresholds. Alarm point may also be displayed in picture mode via bright-up near the location of the error.
Audio Alarms		
Audio Level Alarms		Warns that an audio channel is at mute, clip, silence, or over after a user-definable period of time. Mute and Clip are defined as minimum and maximum digital codes. Silence and Over are levels that can be set by the user.
Audio Error		Warns that an Audio CRC Error has occurred. Does not apply to analog audio inputs.
Audio Unlocked		Warns that an Audio AES clock is not present or out of frequency range.
Composite Video Alarms		
Signal Loss Alarm		Reports absence of video signal for the currently selected input and External Reference if it is enabled.
LTC and VITC		Warns that a break or discontinuity has occurred.

Table 1-14: Miscellaneous measurements and displays

Characteristic	Performance requirement	Reference information
Embedded Audio		Identifies the presence of up to 16 channels of embedded digital audio. Alarms are triggered for lack of presence, checksum errors, buffer full/empty, or parity errors on up to 8 channels
EDH Error Statistics		Displays asynchronous errored seconds. Active picture and full field statistics are separately compiled.
SDI Video Format		Indicates whether the signal is 525 lines or 625 lines.
Composite Video Format		Indicates whether the signal is NTSC or PAL. "Forced Format" mode overrides.
VITC		On screen readout of the VITC of the selected video input. Also displayed in the error logging information. Complies with SMPTE 12M.
LTC		On screen readout of the LTC on GC Remote Connector. Also displayed in the error logging information. Complies with SMPTE 12M.

Table 1-15: Picture display mode

Characteristic	Performance requirement	Reference information
Modes		Color Only, internally referenced with 60 Hz refresh.
Full-screen Mode	Under scan image with and without blanking displayed	Close to 1 pixel per input sample but interpolated as needed to get correct aspect ratio. Composite picture with blanking displayed does not show sync and burst but does show vertical interval signals such as VITS, teletext and closed caption.

Table 1-16: Measure display

Characteristic	Performance requirement	Reference information
Input Timing Relative to External Reference		Display of Vertical and Horizontal timing offset.
Timing Display Zero Definition (When <i>Relative to</i> : is set to <i>Rear Panel</i> .)		<p>For vertical timing conform to SMPTE168 - 2002.</p> <p>For Horizontal timing, zero delay analog signals have coincident syncs. For digital signals, timing is such that if converted to analog via a WFM601a then the resultant analog signal is coincident with the reference.</p> <p>Timing zero is equivalent to nominal zero delay on TG700. Also agrees with timing that has minimal shift on the waveform display when going from internal to external.</p> <p>Vertical timing as per SMPTE168 specifies that the first lines that contain broad pulses are aligned.</p>

Table 1-17: Other display

Characteristic	Performance requirement	Reference information
LTC Waveform	Displays voltage versus time waveform of LTC input.	Timing derived from currently selected video timing. Mutually exclusive to Stair Step mode.
LTC Waveform Vertical Accuracy, Typical		± 5%
LTC Waveform DC Offset, Typical		± 100 mV
LTC Waveform Time Base, Typical		<p>3 ms/division for NTSC, 4 ms/div for PAL</p> <p>Runs in 2-field sweep mode only, triggered by field one to allow verifying audio to video synchronization.</p>

Table 1-18: Audio bar displays

Characteristic	Performance requirement	Reference information
Modes		User can configure the response dynamics (ballistics), reference levels, peak hold, offset, and scale of the meters to suite the monitoring needs of their installation or situation. Each pair has a phase correlation meter.
8 Channel		Any four channel pairs with phase correlation meters. Only six channels active with analog audio input.
Surround		Left, Right, Center, Lfe, 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		Monitors the signal levels and stereo phase of AES/EBU digital audio, digital audio embedded in serial digital video and analog audio inputs.
Level Meter Resolution		0.056 dB steps on 30 dB scale, from full scale to -20 dB FS. 0.20 dB steps on 0 to -70 dB scale, for signals above -240 dB FS, tiled display.
Correlation Meter Speed	User selectable from 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.

Table 1-18: Audio bar displays (Cont.)

Characteristic	Performance requirement	Reference information
Peak Program Meter PPM Type 1		Equivalent to IEC 60268-10 Type I, DIN 45406, and Nordic N-9
PPM Type 2		Equivalent to IEEE Std. 152-1991 and IEC 60268-10 Type II
True Peak		PPM decay characteristics, no attack delay. Shows actual signal peaks regardless of duration. This is the factory default ballistic.
Extended VU		A VU meter as defined in IEEE Std. 152-1991 but an extended dB-linear scale.
Peak Hold	Hold adjustable from 1 to 10 seconds, default is 2 seconds.	Indicated Peaks held for selected time.
Clip Indication Delay Count		Consecutive FS samples for Clip indication, user selectable Off or 1 to 100. Factory default set to 1.
Mute Indication Delay Count		Consecutive "0" samples for Mute indication, user selectable Off or 1 to 100. Factory default set to 10.
Clip/Mute Hold Time		User selectable from 1 to 30 seconds. Factory default set to 2.
Silence Indication Threshold		Audio level below which the signal is considered "silent". Used to trigger on-screen indication and alarms.
Silence Indication Delay		Off or 1 to 60 seconds selectable. Indication and alarm will not be asserted until threshold has been exceeded for the set number of seconds. Factory default is set to 10.
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 selectable. Indication and alarm will not be asserted until threshold has been exceeded for the set number of seconds. Factory default is set to 10.

Table 1-18: Audio bar displays (Cont.)

Characteristic	Performance requirement	Reference information
Adjustable Peak Program Level (dBFS)		Range: 0 to -30 dB. Peak program level is the level (relative to digital full scale) that you choose as the maximum desired level for monitored programs. The meter bars change to red between the Peak program level.
Adjustable Test Level (dBFS)		Range: 0 to -30 dB. 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	Selectable from Top of Scale, Peak Program Level, or Test Level.	Use this item to number the meter scale relative to top of 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 1-19: Audio bar and lissajous displays

Characteristic	Performance requirement	Reference information
Description		In combination with Bar mode can have Lissajous in one tile.
Automatic Gain Control	Gain control can be 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.
Manual Scaling		When AGC is off, level at perimeter of display follows Program level on Bar display.

Table 1-20: Audio text displays

Characteristic	Performance requirement	Reference information
Session Log (audio and video)		List of Significant audio events with time stamps. Depending on input may include Clips, mutes, Silence, over.

Table 1-21: AES audio inputs

Characteristic	Performance requirement	Reference information
Inputs		2 sets with 8 channels each, 24-bit. Meets requirements of AES 3-ID.
Input Connector		BNC, terminated, unbalanced.
Input Impedance		75Ω
Return Loss		> 25 dB relative to 75Ω, from 0.1 to 6 MHz, typically better than 25 dB to 12 MHz. Input A has passive terms and so 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		0.2 V to 2 V peak-to-peak
Input Sample Rate		32 kHz, 44.1 kHz, 48 kHz, and 96 kHz
Input Lock Range		> ± 5%. This means that exceeding 5%, the instrument may search again for a new lock point. Typically stays locked to 12.5%

Table 1-21: AES audio inputs (Cont.)

Characteristic	Performance requirement	Reference information
Level Meter Accuracy over Frequency	<p>0.2 dB from 20 Hz to 20 kHz 0 to -40 dBFS sine-wave, Peak Ballistic mode. Except for within 5 Hz of some submultiples of the sampling frequency for 32, 44.1 and 48 kHz input. 96 kHz inputs follows the 48 kHz exceptions since it is not upsampled. For example:</p> <p>1/7th of rate -0.25 dB (for 48 kHz this is 6.857 kHz + 5 Hz)</p> <p>1/6th of rate -0.3 dB (for 48 kHz this is 8 kHz + 5 Hz)</p> <p>1/5th of rate -0.5 dB (for 48 kHz this is 9.6 kHz + 5 Hz)</p> <p>1/4th of rate -0.7 dB (for 48 kHz this is 12 kHz + 5 Hz)</p> <p>2/7th of rate -0.25 dB (for 48 kHz this is 13.714 kHz + 5 Hz)</p> <p>1/3rd of rate -1.3 dB (for 48 kHz this is 16 kHz + 5 Hz)</p> <p>4/10th of rate -0.5 dB (for 48 kHz this is 19.2 kHz + 5 Hz)</p>	Worst case examples are shown, other rates with minor exceptions exist. Note that all exceptions are above 6 kHz so on impact accuracy on harmonics of normal audio content.
Audio Levels	Bars display signals up to 0 dBFS.	Must not exceed max power specification on analog outputs. Configure output attenuation if necessary.

Table 1-22: AES audio outputs

Characteristic	Performance requirement	Reference information
Source		From embedded audio only.
Number of Outputs		Up to 8 channels
Output Format		Stereo Output, 48 kHz, 20 bit, Meets requirements of SMPTE 276M-1995 (AES 3-ID)
Output Connector		BNC, terminated, unbalanced.
Output Impedance		75Ω

Table 1-22: AES audio outputs (Cont.)

Characteristic	Performance requirement	Reference information
Return Loss		> 25 dB relative to 75Ω, from 0.1 to 6 MHz. Tested in Input mode.
Output Amplitude Range		0.9 V to 1.1 V peak-to-peak into 75Ω
Output Sample Rate		Locked to embedded sample rate (nominally 48 kHz).
Output Jitter, Typical		3.5 ns with 700 Hz high pass as per AES specification AES3 rev 1997 specification is 4.1 ns for 48 kHz audio.
Rise and Fall Times, Typical		37 ns 10 to 90% as per AES3

Table 1-23: Embedded audio extraction and monitoring on status bar

Characteristic	Performance requirement	Reference information
Embedded Audio Formatting		Extract 20-bit audio formatted according to SMPTE 272M. 24-bit embedded audio is not supported (no AUX bits are extracted) only the 20 most significant bits will be extracted. Supports SMPTE 272M Operation Level B only (48 kHz audio sampling rate synchronized with video).
Channel Numbering		Channel number per SMPTE 272M (1 through 16) will be correctly shown on all displays.
ANC Data Extraction		Only audio data is extracted, other ANC data is ignored.
Number of Channels Monitored for Presence		16 channels are monitored for presence.
Audio Levels	Bars display signals up to 0dBFS.	Must not exceed max power specification on analog outputs. Configure output attenuation if necessary.

Table 1-24: Analog audio inputs

Characteristic	Performance requirement	Reference information
Number of Channels		Provides up to two sets of six channels of professional, balanced, differential inputs, 12 channels total.
Input Connector		Balanced, unterminated connector on rear panel. Use 37 pin, 2 row, DSUB connector.
Level Meter Accuracy over Frequency	0.5 dB from 20 Hz to 20 kHz 0 to -40 dBFS sine-wave, Peak Ballistic mode. Except for within 5 Hz of some submultiples of the sampling frequency for 32, 44.1 and 48 kHz input. 96 kHz inputs follows the 48 kHz exceptions since it is not upsampled. For example: 1/7th of rate -0.75 dB (for 48 kHz this is 6.857 kHz + 5 Hz) 1/6th of rate -0.8 dB (for 48 kHz this is 8 kHz + 5 Hz) 1/5th of rate -1.0 dB (for 48 kHz this is 9.6 kHz + 5 Hz) 1/4th of rate -1.2 dB (for 48 kHz this is 12 kHz + 5 Hz) 2/7th of rate -0.75 dB (for 48 kHz this is 13.714 kHz + 5 Hz) 1/3rd of rate -1.8 dB (for 48 kHz this is 16 kHz + 5 Hz) 4/10th of rate -1.0 dB (for 48 kHz this is 19.2 kHz + 5 Hz)	Worst case examples are shown, other rates with minor exceptions exist. Note that all exceptions are above 6 kHz so on impact accuracy on harmonics of normal audio content.
Cross Talk		≤ 80 dB, typically ≤ 100 dB from 20 Hz to 20 kHz. 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 referenced to level Meter Accuracy over Frequency above.	Must not exceed max power specification on analog outputs. Configure output attenuation if necessary.
Resolution Sampling, Nominal		24 bits at 48 kHz

Table 1-24: Analog audio inputs (Cont.)

Characteristic	Performance requirement	Reference information
Maximum Input Levels, Typical		35 kΩ
Off Isolation		<p>≤ 80 dB, from 20Hz to 20 kHz. Unused input driven from <600 ohm source impedance</p> <p>Defined as the displayed bar level that results from a Full scale signal on any pair of the unused input.</p>

Table 1-25: Analog audio outputs

Characteristic	Performance requirement	Reference information
Audio Modes		<p>Balanced: Provide a full-scale output of 24 dBu and is intended for professional balanced applications.</p> <p>Unbalanced: Intended to drive the unbalanced inputs of consumer amplifiers in which case one side of the line must be grounded.</p>
Audio Sources		<p>The channels routed to the line outputs can include:</p> <p>Embedded audio source</p> <p>AES audio source</p> <p>Analog audio source</p>
Number of Channels		Provides up to 6 channels.
Output Connections		<p>Balanced, unterminated connector located on rear panel.</p> <p>Use 37 pin, 2 row, DSUB connector. Ground negative output to support unbalanced mode.</p>

Table 1-25: Analog audio outputs (Cont.)

Characteristic	Performance requirement	Reference information
Maximum Output Levels		Balanced: +24 dBu \pm 0.5 dB Unbalanced: -10 dBV \pm 0.5 dB When grounding one output to achieve unbalanced mode, the other output will be driven to a larger amplitude. You can reduce the output level by adjusting attenuation in the Configuration menu. Do not exceed maximum rated power for either mode.
Input to Output Gain		0 dB to -120 dB in 0.5 dB steps.
Digital Input to Analog Output Gain Accuracy Over Frequency	\pm 0.5 dB, 20 Hz to 20 kHz, 0 to -40 dBFS, 20 or 24 bit input.	
Analog Input to Analog Output Gain Accuracy Over Frequency	\pm 1 dB, 20 Hz to 20 kHz, 24 dBu to -16 dBu	
Output Impedance, Nominal		50 Ω Intended to drive 600 Ω load. Drivers are capable of driving a minimum load impedance of 300 Ω but may overheat. Do not exceed maximum rated 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 Crosstalk, 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 output level is equivalent is 25 mW RMS in the load per output pair. Live audio may reach full voltage level as long as the duty cycle is such that the RMS power is less than 25 mW averaged over any 10 second period. Exceeding this limit at high ambient temperature may cause the output circuit to overheat and damage the instrument.

Table 1-26: Ground closure Remote/LTC input

Characteristic	Performance requirement	Reference information
LTC Input Connector		Balanced, unterminated via rear panel GC remote connector.
LTC Input Impedance		> 10 k Ω
LTC Signal Characteristics		Longitudinal Time Code per IEC Publication 461.
LTC Signal Amplitude Range		0.2 to 5.0 Vp-p balanced differential or single-ended
Ground Closure Input Signaling		TTL thresholds, 5 V maximum input, -0.5 V minimum input. Pull low to assert. Instrument has an internal 10 k Ω pull-up resistor on each input.
Ground Closure Output Characteristics		Open collector output, 30 V maximum, 100 mA maximum, 300 mW maximum.

Table 1-27: Ethernet characteristics

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

Table 1-28: XGA Picture monitor output

Characteristic	Performance requirement	Reference information
Amplitude		Can switch between 1 V and 0.7 V.
Resolution		1024 x 768. Timings are typical.

Table 1-29: General characteristics

Characteristic	Performance requirement	Reference information
Presets		Five user presets and a factory default preset.
Real Time Clock		Time settable by user, used for logging time stamps.
Field Upgradable Software and FPGA		All code except for boot flash can be upgraded.
Battery Life and Retention Time		5 years worst case, 10 years typical.
Low Light Illumination		“OFF” LEDs optionally illuminated at user selectable level from 1 to 10%.
Preset Parameters		All instrument settings except those under CONFIG > Utilities are saved as part of the Preset.
System Log		Stores diagnostic messages, accessed from CONFIG menu.
Line Select Function		Any one tile can be in line select for waveform, vector, arrowhead, diamond, or lightning.
Cursor Styles		Cursor style - Voltage, Time or Voltage + Time. Available in Waveform Display only. Independent cursors can be in multiple tiles of WFM display.
Cursor Range		Cursors can be placed on any portion of the valid Waveform range.
Line Select Bright-up		Selected line appears as a bright line on picture and in WFM displays set to Field Sweep. Can be disabled in CONFIG > Graticules > Picture Line Select Cursor and Field Sweep Select Cursor.
Line Select Range		Any line in SDI-525 (1 to 525), SDI-625 (1 to 625), NTSC (1 to 1050), PAL (1 to 2500). Fields greater than 1 display the line number in the field and the line number in the frame or color frame.

Table 1-29: General characteristics (Cont.)

Characteristic	Performance requirement	Reference information
Acoustic Noise Level, Typical		<p>Front 33 dB(A), Rear 35 dB(A), Side 31 dB(A) for standing location at 25 °C ambient</p> <p>Front 34 dB(A), Rear 36 dB(A), Side 32 dB(A) for sitting location at 25 °C ambient</p> <p>Measured as per ISO7779. Unit placed on desk, measure in operator location. Fan speed and noise increase at higher temperature.</p>
Freeze Mode		<p>Global and Tile by tile freeze modes.</p> <p>The frozen trace is displayed in a different color than the live trace. All display modes can be frozen; Configuration or other menus cannot be frozen.</p>
Freeze Display Modes		<p>Each tile can be independently set to display frozen only, live only, or live overlaid with frozen. Note that the Overlay mode is not supported for Status displays, the Timing Display or Audio level bars.</p>

Table 1-30: Power supply

Characteristic	Performance requirement	Reference information
Electrical Rating	100 - 240 VAC ± 10%, 50/60 Hz, 100 W maximum	Continuous range from 90 - 264 VAC.
Supply Type		Single phase.
Supply Connection		Detachable cord set with lock.
Power Consumption, Typical		< 90 VA (50 Watts)
Fuse	UL/IEC127 F3.15A H, 250 VAC (5 x 20 mm)	Not operator replaceable.

Physical Specifications

Table 1-31: Physical characteristics

Characteristic	Standard
Dimensions	
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	
Net	8.75 pounds (4 kilograms)
Shipping	15.7 pounds (7.2 kilograms) approximate

Table 1-32: Environmental performance

Category	Standards or description
Temperature	Operating: 0 to +50 °C Non-operating: -40 to +75 °C
Humidity	Proper operation from 5% to 93% Relative Humidity. Do not operate with visible moisture on the circuit boards. Exceeds Mil-PRF-28800F for a class 5 product.
Vibration	Tektronix Class 5 Random Vibration Operating Test: For Laboratory / Benchtop Products (instrument meets brief operational performance checks at these levels): Power Spectral Density of: 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 GRMS, 10 minutes per axis. Tektronix Class 5 Random Vibration Non-operating Test: For Laboratory / Benchtop Products: Power Spectral Density of: 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 GRMS, 10 minutes per axis. Meets Mil-PRF-28800F for a Class 3 product.
Mechanical Shock	Non-operating: 50 g, halfsine, 11 ms duration, 3 shocks per surface (18 total).

Table 1-32: Environmental performance (Cont.)

Category	Standards or description
Transportation	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.
Altitude	Operating: Up to 3000 meters (10,000 feet). Non-operating: Up to 12,192 meters (40,000 feet).

Certifications and Compliances

Table 1-33: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity - EMC	<p>Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <p>EN 55103 Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.¹</p> <p>Environment E2 - commercial and light industrial</p> <p>Part 1 Emission</p> <p>EN 55022 Class B radiated and conducted emissions</p> <p>EN 55103-1, Annex A Radiated magnetic field emissions</p> <p>EN 55103-1, Annex B Inrush current; I peak = 4.82 amps</p> <p>EN-55103-1, Annex E Conducted emissions, signal/control ports</p> <p>Part 2 Immunity</p> <p>IEC 61000-4-2 Electrostatic discharge immunity</p> <p>IEC 61000-4-3 RF electromagnetic field immunity</p> <p>IEC 61000-4-4 Electrical fast transient / burst immunity</p> <p>IEC 61000-4-5 Power line surge immunity</p> <p>IEC 61000-4-6 Conducted RF Immunity</p> <p>IEC 61000-4-11 Voltage dips and interruptions immunity</p> <p>EN 55103-2, Annex A Radiated magnetic field immunity</p> <p>EN 55103-2, Annex B Balanced ports common mode immunity</p> <p>EN 61000-3-2 AC power line harmonic emissions</p>
Australia / New Zealand Declaration of Conformity - EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <p>AS/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992</p>
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
EC Declaration of Conformity - Low Voltage	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC, amended by 93/68/EEC</p> <p>EN 61010-1/A2:1995 Safety requirements for electrical equipment for measurement control and laboratory use.</p>
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1 Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

¹ Use only high-quality shielded cables.

Table 1-33: Certifications and compliances (cont.)

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



Operating Information

Operating Basics

This chapter provides basic operating information for the WVR610A & WVR611A Waveform Rasterizers.

Overview

The WVR610A & WVR611A use a flexible, tiled display. The waveform rasterizer can display four tiles at one time. Each tile can display a different measurement, effectively creating four independent instruments. See Figure 2-1. To enable the tiles to function independently, most of the controls only affect one tile at a time. The tile that is currently being controlled is considered the *active* tile and it is indicated on the display by a light-blue outline around the tile. The active tile is indicated on the front panel by the lit display select button on the left side of the front panel.



Figure 2-1: A display with all four tiles visible

The waveform rasterizer can also display one tile at a time. If, for example, you want to display just the Waveform tile to make a rise time measurement, you can press the FULL button to display a tile in full-screen mode. See Figure 2-2.

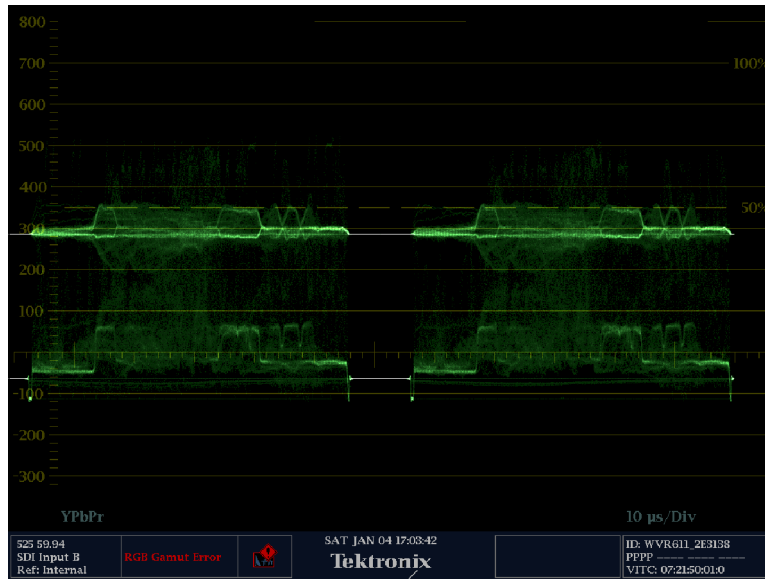


Figure 2-2: A tile in full-screen mode

The waveform rasterizer can display measurements in multiple tiles simultaneously. See Figures 2-3 and 2-4. For example, you can display all four Status screens at one time. The only measurement that cannot be displayed in more than one tile is the Audio measurement. It can be displayed in only one tile at a time.



Figure 2-3: A display with multiple Status screens

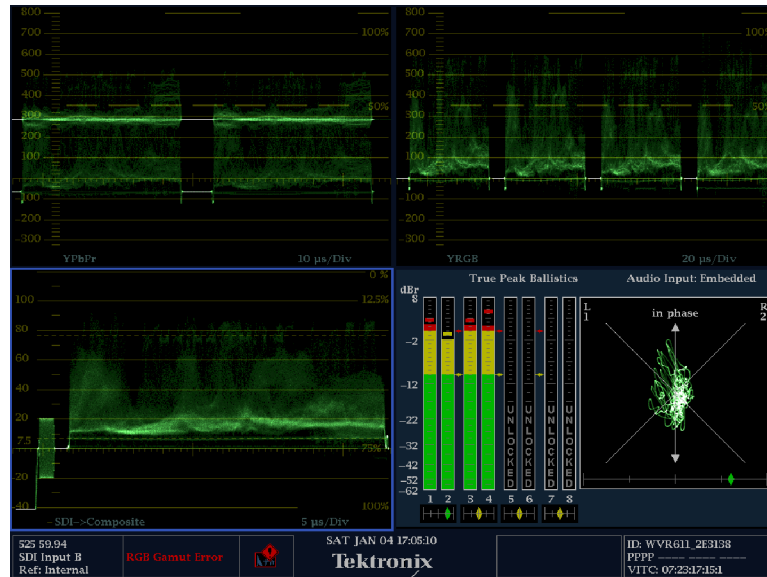


Figure 2-4: A display with multiple WFM displays

Three Levels of Control

You control the waveform rasterizer on three levels:

- Frequently-changed settings
- Tile-specific settings
- Instrument-wide settings

Frequently changed settings. The front-panel buttons control the most commonly changed parameters, such as which measurement appears in each tile. The knobs are used to adjust levels and make selections.

Tile-specific settings. Pop-up menus control parameters that are specific to the tile in which they are displayed. The pop-up menu control less frequently changed parameters such as the waveform display mode (for example, changing the waveform display mode from RGB to YPbPr). To display a pop-up menu, press and hold the desired **MEASURE SELECT** or **DISPLAY SELECT** button for about a second.

Instrument-wide settings. The parameters in the Configuration menu are instrument-wide settings. The configuration menu controls settings that are changed only occasionally, such as changing waveform color or setting the network address.

Range of Controls

Some controls are global and affect all tiles, while other controls only affect the active tile. Generally speaking, if a control is configured by front-panel buttons or by a pop-up menu, then it is tile specific. Configuration selections are usually global. Exceptions are the Input buttons, and all audio features, both of which are global.

Front-Panel Controls

The following sections describe the front panel controls of the WVR610A & WVR611A.

Tile Settings

Each tile maintains its own settings independent of the other tiles, including GAIN and SWEEP, and display type among others. For instance, when you switch a tile to a different measurement, the GAIN and SWEEP settings will be changed to what they were the last time the selected measurement was displayed in the tile.

Display type is also independent for each tile. You could set Tile 1 to display the Video Session STATUS screen and set Tile 2 to display the Error Log STATUS screen. Suppose you then change Tile 1 to a WFM display and Tile 2 to a GAMUT display. If you then change Tile 1 back to a STATUS display, it will display the Video Session screen, which is what it was set to before you changed it to the WFM display. Likewise, if you change Tile 2 back to STATUS, it will display the Error Log screen.

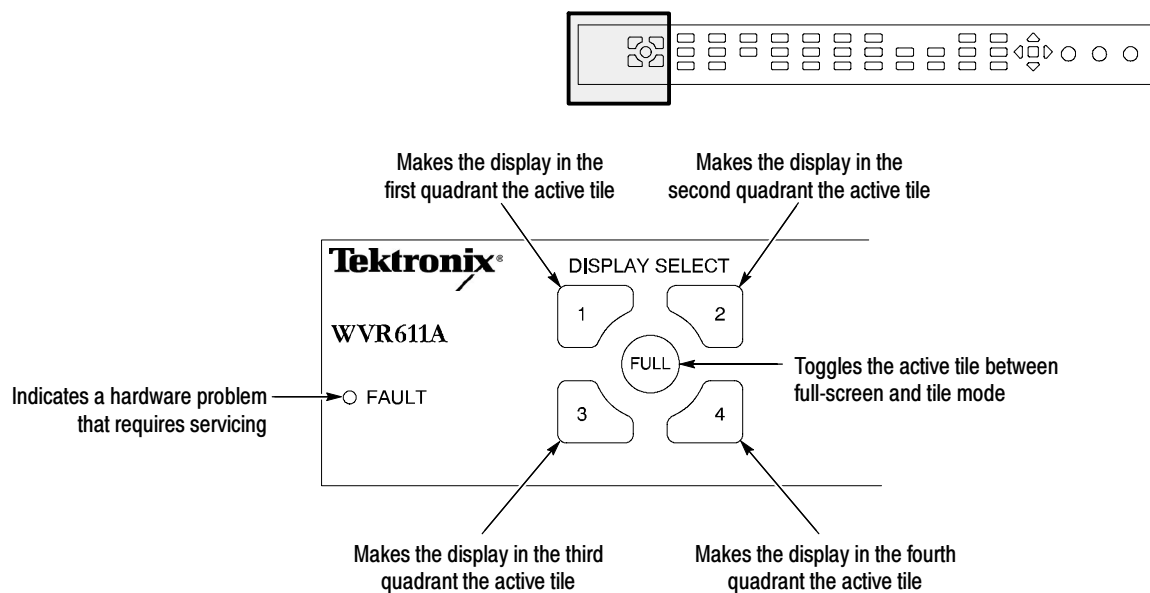


Figure 2-5: Display select buttons and fault indicator

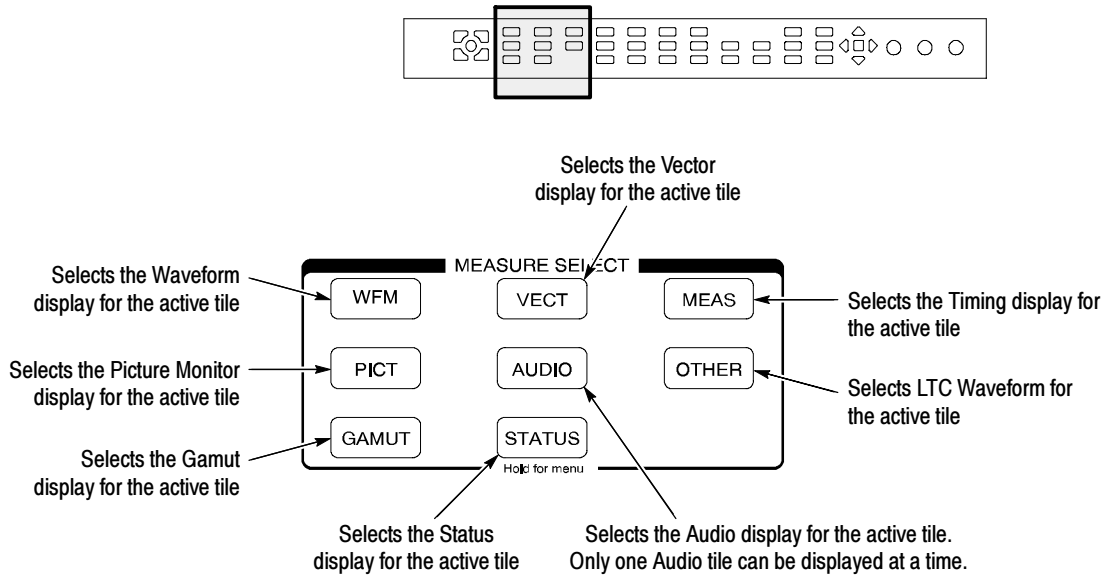


Figure 2-6: Measure select buttons

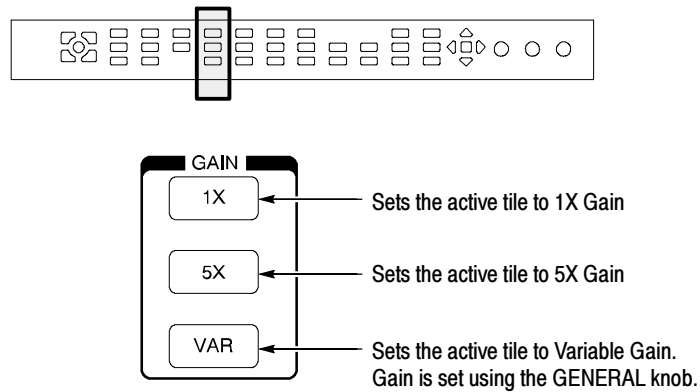


Figure 2-7: Gain buttons

NOTE. The Gain controls are not enabled for all measurements.

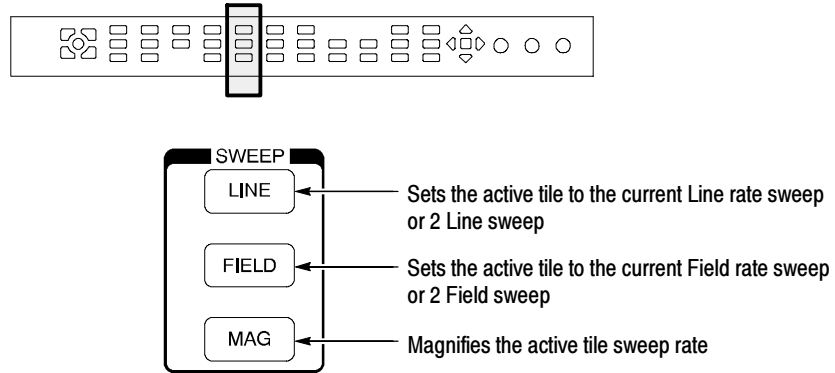


Figure 2-8: Sweep buttons

NOTE. The Sweep controls are not enabled for all measurements.

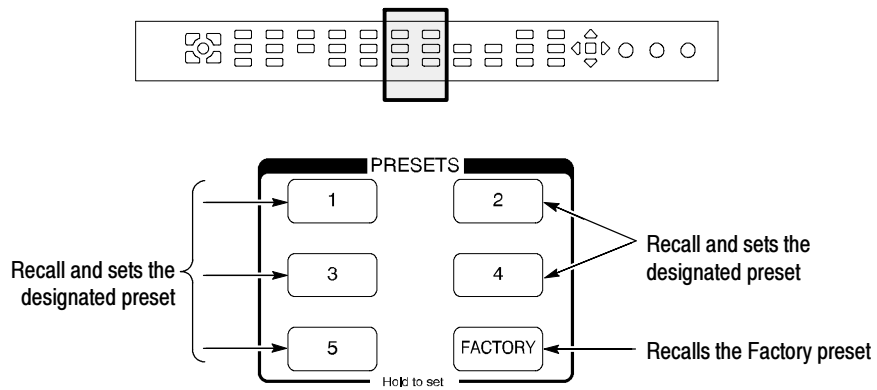


Figure 2-9: Presets buttons

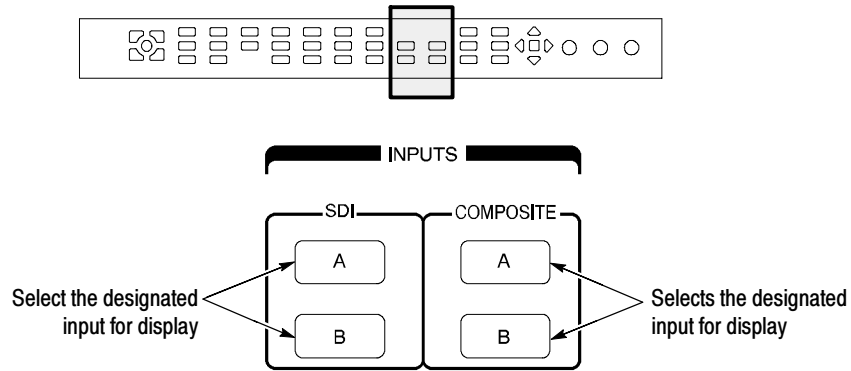


Figure 2-10: Input select buttons

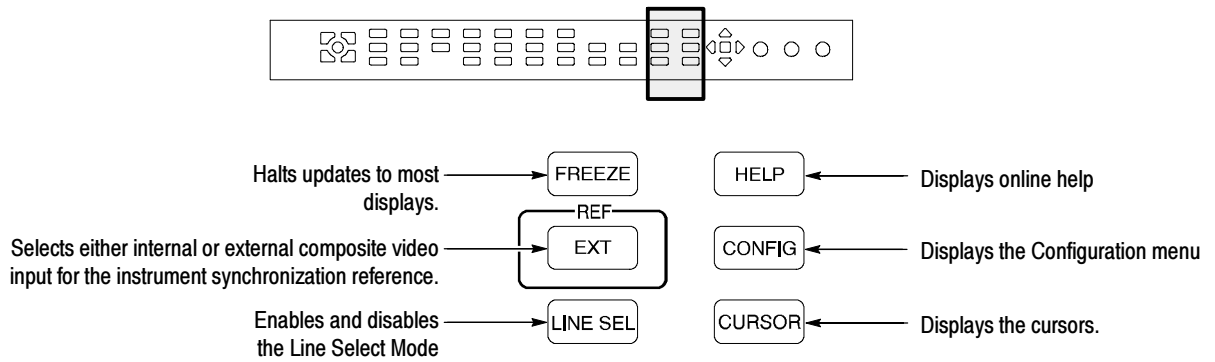


Figure 2-11: General function buttons

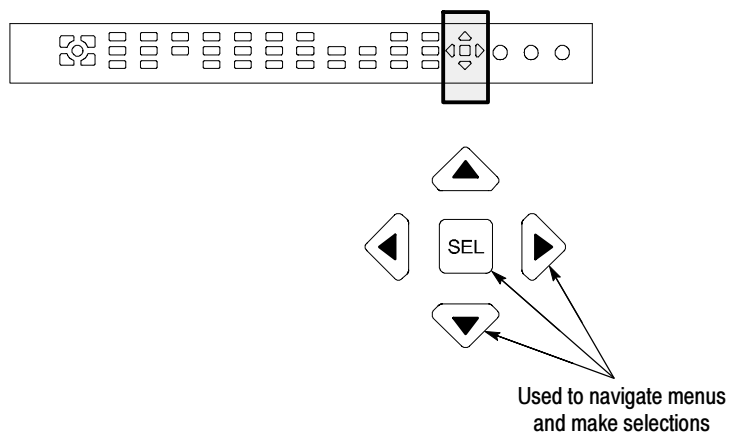


Figure 2-12: Arrow keys and SEL button

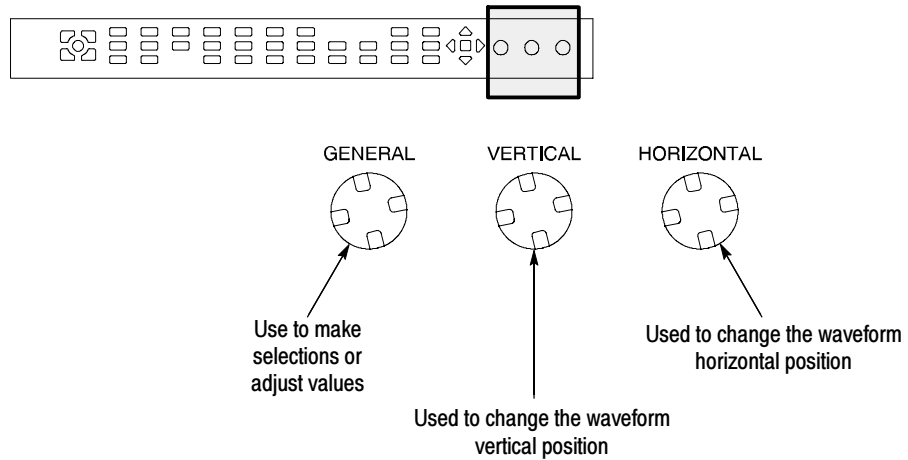


Figure 2- 13: Control knobs

Pop-Up Menus

Pop-up menus appear in the active tile. In general, they control only settings specific to the active tile. For example, the pop-up menu for the Waveform display enables you to specify the Display Mode. See Figure 2-14.

To display a pop-up menu:

- Press and hold the desired **MEASURE SELECT** or **DISPLAY SELECT** button for about a second.

The pop-up menu will appear, unless it is not appropriate for the current setting of the waveform rasterizer (for example, trying to display the Gamut menu when viewing a composite input signal).

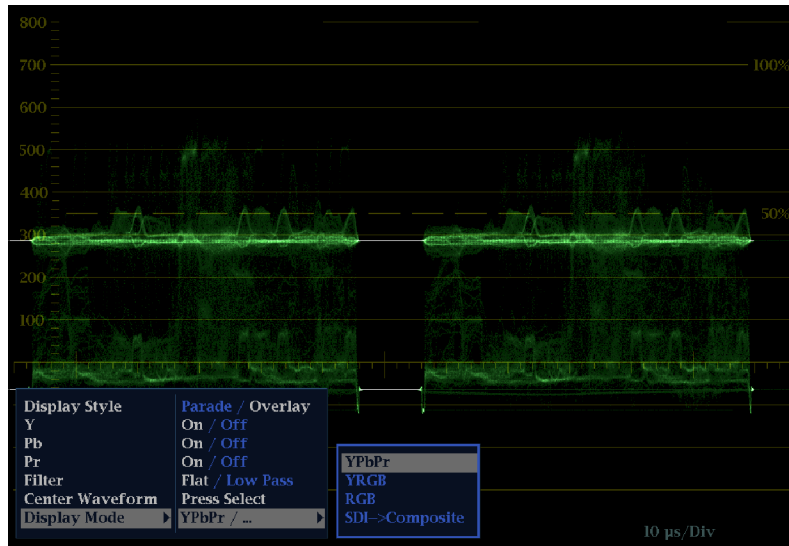


Figure 2-14: The WFM pop-up menu with display mode set to YPbPr

The selections in a pop-up menu can change depending on settings. For example, in Figure 2-14 Y, Pb, and Pr are in the menu when the display mode is set to YPbPr. But the menu changes when the display mode is set to RGB. See Figure 2-15.

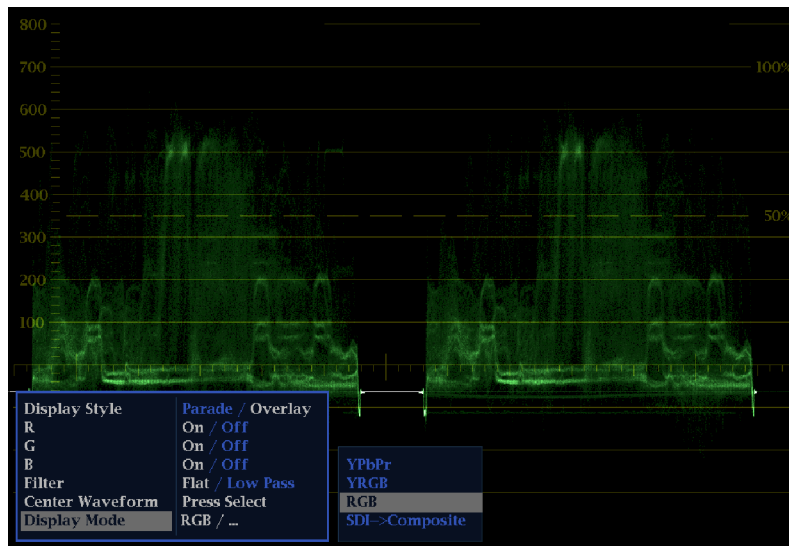


Figure 2-15: The WFM pop-up menu display mode set to RGB

Configuration Menu

The Configuration menu is used to change the settings of the waveform rasterizer that are changed only occasionally or settings that are not specific to a tile, such as printer settings.

To display the Configuration menu:

- Press the **CONFIG** button.

The Configuration menu is displayed on the top or bottom half of the screen opposite the active tile. See Figure 2-16.

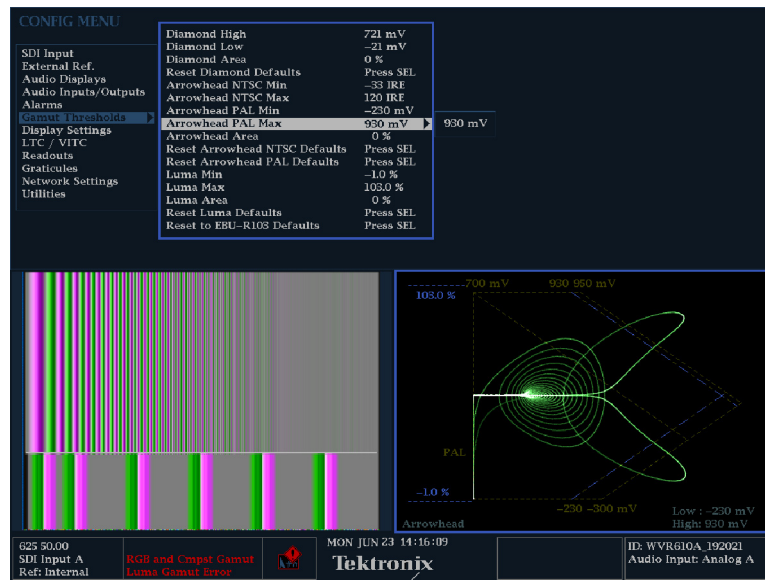


Figure 2- 16: The configuration menu

Status Bar

The Status Bar appears at the bottom of the waveform rasterizer display. The Status Bar provides a number of text and icon elements to give you an easily viewed guide to the status of the instrument and the monitored signal. Table 2-1

describes the elements of the Status Bar and Table 2-2 describes the icons that can appear in the Status Bar.

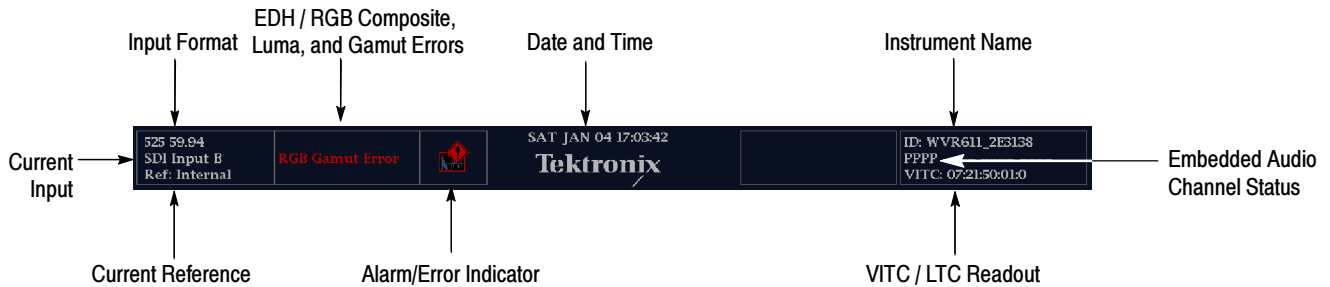







Figure 2-17: Elements of the status bar

Table 2-1: Status bar element descriptions

Display element	Description
Input Format	Text indicating the format of the signal on the selected input, or whether signal is missing or unlocked
EDH Error	A one-line area that is visible if EDH errors are present.
RGB Gamut Error ¹	A one-line area that is visible if RGB gamut errors are present.
Composite Gamut Error ¹	A one-line area that is visible if Composite gamut (Arrowhead) errors are present.
Luma Errors	A one-line area that is visible if Luma errors are present.
Date and Time	Readout of the date and time (set in CONFIG > Utilities).
Instrument Name	Name assigned to the waveform rasterizer in the CONFIG > Utilities menu.
Audio Channel Status	A 16-character string indicating embedded audio channel status. Each character shows the status of a specific channel: - for not present and P for present
VITC/LTC readout	A readout showing the selected time format.
Alarm/Error Indicator	An icon visible when alarms when are occurring.
Current Reference	Text indicating the source of the current reference. Possible references are: Ext., Internal. Also indicates format and whether the reference is missing or unlocked.
Current Input	Text indicating the selected input. Possible inputs are: SDI A, SDI B, Cmpst A, Cmpst B (depending on installed options). Also indicates if the current input is not in Auto mode and is unlocked.

¹ Because RGB and Composite Gamut messages appear on the same line in the display, if both RGB and Composite Gamut errors are present at the same time, the message “RGB and Cmpst Gamut” will appear.

Table 2-2: Status bar icons

Icon	Description
	Warning - Appears when an alarm or error has been triggered.
	Alarms Muted - Appears when the alarms have been muted from the STATUS pop-up menu.
	Remote Access - Appears when the waveform rasterizer is accessed from the network. For example, when the sending commands to the waveform rasterizer from the remote interface.
	Alarms Disabled - This text appears in the Status Bar when Alarms have been disabled from the Configuration menu.
	Freeze Active - Appears when the tiles have been frozen.

Waveform Display

The Waveform (WFM) display is the familiar voltage versus time display used to view a waveform. You can view the input signal in line or field sweep. You can choose which SDI signal elements are displayed (RGB, YRGB, or YPbPr), and you can apply filters to the signal. You can also display an SDI input as though it were a composite signal. Figure 2-18 identifies the elements of the Waveform display and Table 2-3 describes the meaning of the elements of the Waveform display.

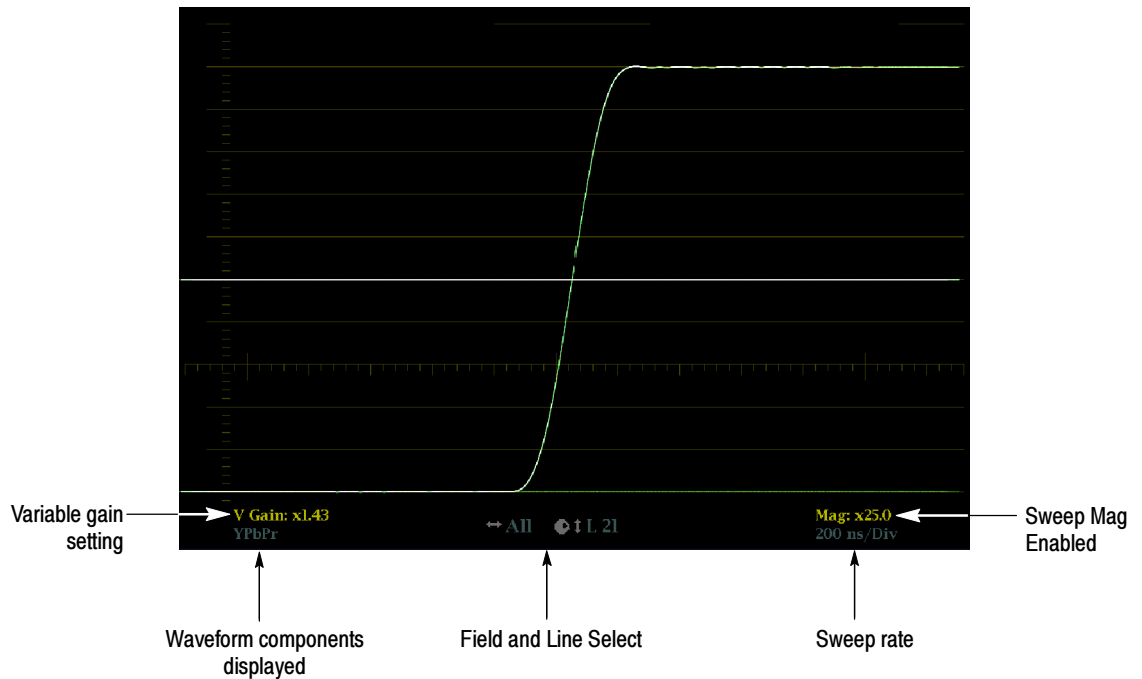


Figure 2- 18: Waveform display elements

Table 2- 3: Waveform display element descriptions

Display element	Description
Gain Setting	A text string indicating the gain setting. Possible readouts are V Gain: x5 , and V Gain: 1.50 . When the Gain is set to a value other than 1, it will appear in a bright yellow color. The gain setting is not displayed when it is X1.
Waveform components displayed	A text string showing the current waveform color space components displayed. Non-displayed components are indicated by dashes: --.
Field and Line Select	A readout displaying the currently selected field and line.
Sweep rate	A readout showing the current sweep rate in a tile.
Sweep rate, Mag	A readout showing when the Mag button is pressed; if pressed, Mag is displayed next to the sweep rate in yellow text.

Vector Display

The Vector display provides two display types: Vector and the Tektronix proprietary Lightning display (SDI signals only). The **Vector** display shows a plot of the R-Y signal on one axis and the B-Y signal on the other. It is useful for looking at hue and saturation of the colors, but does not show luminance information. The **Lightning** display shows the same color signals as in vector,

but they are plotted versus luminance. One color difference signal in the top half and the other in the bottom. Lightning is useful for checking chroma and luma gain, and for checking chroma to luma delay via the timing marks that show errors in the green to magenta transition on a color bar signal.

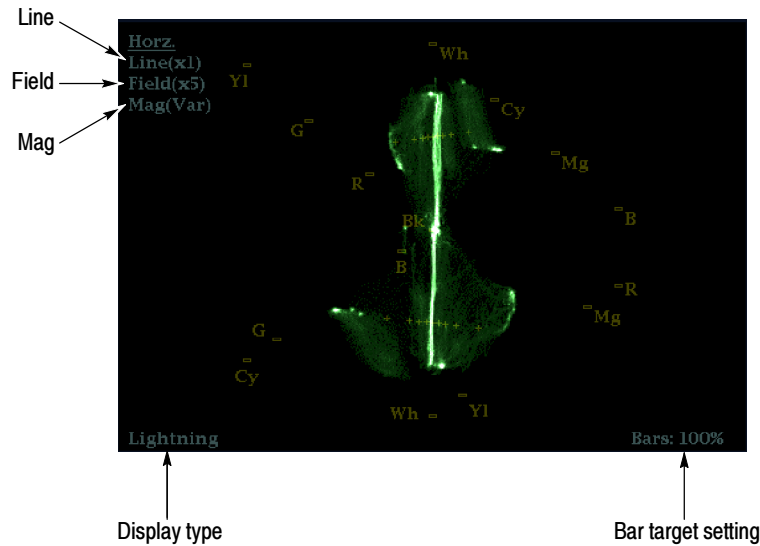


Figure 2- 19: Vector display elements

Table 2- 4: Vector/Lightning display element descriptions

Display element	Description
Line	Pressing the LINE button sets the horizontal gain to 1X.
Field	Pressing the FIELD button sets the horizontal gain to 5X.
Mag	Pressing the MAG buttons enables you to adjust the horizontal gain using the GENERAL knob.
Display type	The selected display, either Lightning or Vector.
Bar target setting	The bar target setting, either 75% or 100%.
Phase	Appears in Composite Vector display only.

Measure Display

Pressing the MEAS button displays a Tektronix proprietary display that greatly simplifies measuring the timing difference between two signals as the timing is corrected. Using the Tektronix Timing display enables you to easily compare and correct the timing between two digital signals.

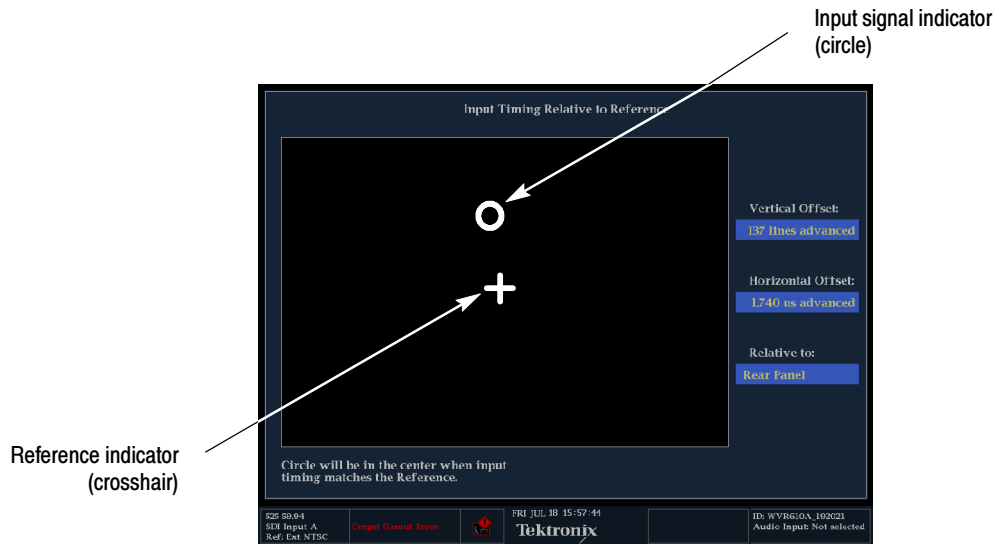


Figure 2-20: Timing display

Table 2-5: Timing display element descriptions

Display element	Description
Input signal indicator	A circle representing timing of input signal relative to the reference.
Reference indicator	A crosshair indicator representing the reference signal.
Vertical Offset	The timing difference between the reference and input signal.
Horizontal Offset	The timing difference between the reference and input signal.
Relative to	Indicates the chosen zero point for the timing display. The default is <i>Rear Panel</i> . In this mode, the offset is zero when the input and reference are at the same timing at the rear panel of the waveform rasterizer. The other setting is <i>Saved Offset</i> . In this mode, you can save the timing from one signal, and then display the timing relative to that saved offset.

Picture Display

The Picture display lets you see the picture generated by the video signal. You can choose to display the picture with or without a Picture Frame. See Figure 2-21. The Picture Frame function allows you to display or hide elements of the video signal outside the active video. With Picture Frame switched On, only the active video portion of the signal is displayed. With Picture Frame switched Off, elements of the signal outside the active video are visible. When the picture frame is off, you can see user data, embedded audio and elements in the vertical interval.

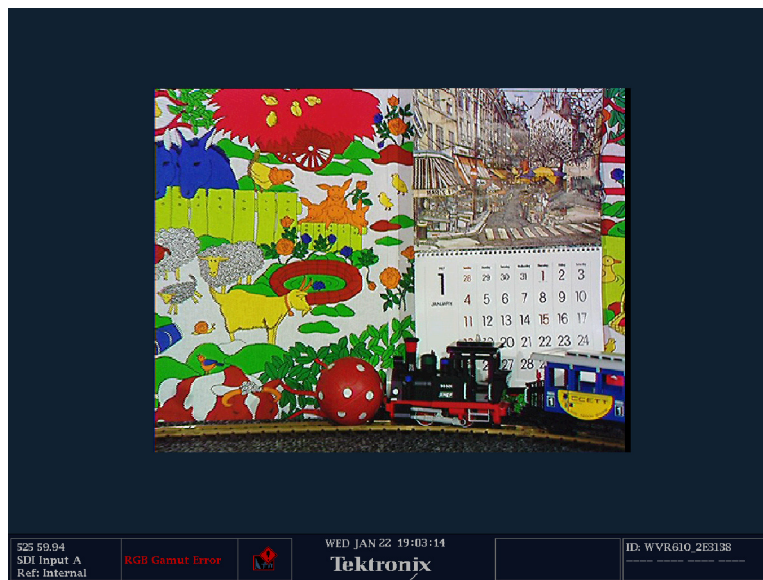


Figure 2-21: Picture display

NOTE. In tile mode, 525 line pictures are cropped by 12 lines. Six at the top and six at the bottom. This is done as part of the aspect ratio correction. In full-screen mode there is no cropping.

Pictures are decimated horizontally or vertically to achieve the correct 4 x 3 aspect ratio on a square pixel computer monitor. This decimation may cause some artifacts. This behavior may be evident on a sweep signal on 525 mode.

Audio Display

The Audio display provides level meters and a phase display for monitoring audio signals. The Audio display always shows the level meters and correlation

meters. When you choose to display the phase plot (also known as Lissajous), the left portion of the Audio tile displays the level meters and the right portion the Phase display. See Figure 2-22.

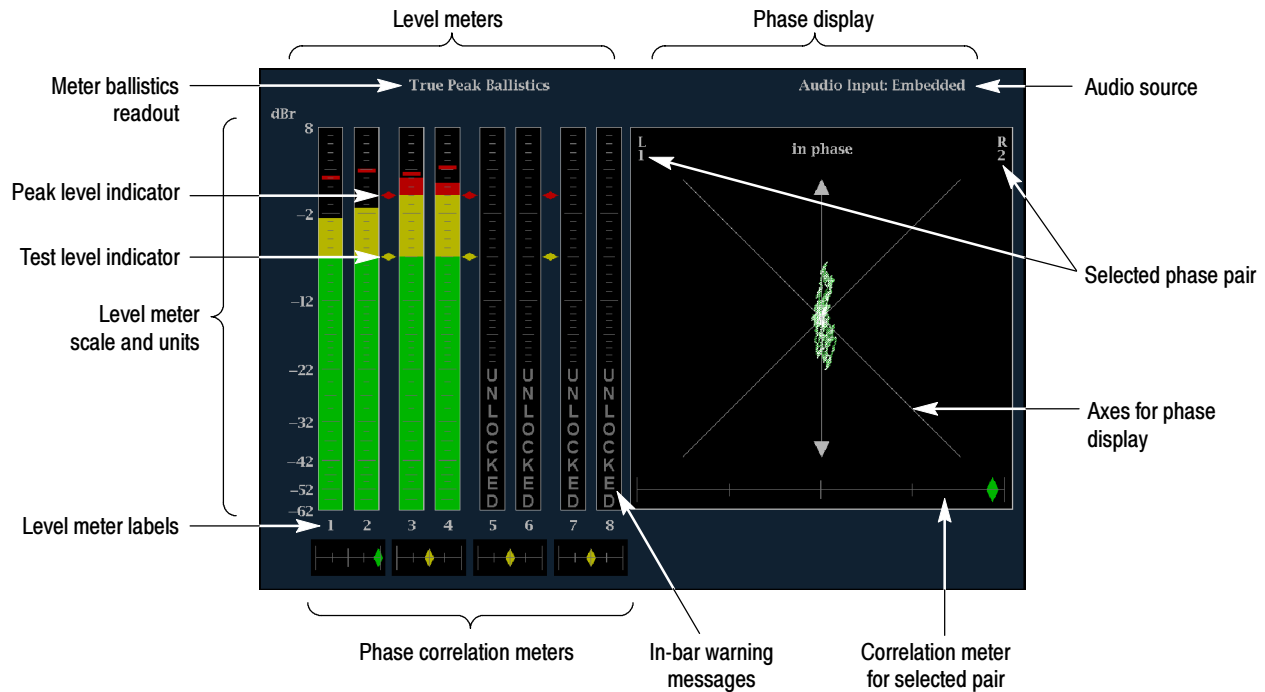


Figure 2-22: Audio display with phase display

Table 2-6: Audio display element descriptions

Display element	Description
Level meters	Indicate the amplitude of selected audio channels.
Phase display	Plot of one channel versus the other in a pair.
Audio source	The selected audio input.
Level meter labels	Identifies the signal in each meter bar.
Level meter ballistics readouts	Displays the selected dynamic response characteristic.
Axes for phase display	Shows the orientation of the two audio signals.
Phase correlation meters	Displays phase correlation between the two channels of each appropriate pair. Located under the bars for the same channels. Duplicated under the Phase display. Has configurable response time.
Test level and Peak Program Level Indicators	Diamond-shaped markers between the level bars that indicate the configurable limits set up for the display. Above the Test level the bar displays in a yellow color. Above the Peak level the bar displays in a Red color. Test level is also known as Reference level or Line-up level.
Level Meter Scale and units	By default, the zero dB mark is at digital full scale, and units are in dB relative to full scale (dBFS). You may also set the 0 dB mark to either the Peak Program level or the Test level.

Above-bar Warning Messages

The WVR610A & WVR611A display warning messages above the level meter bars. The warning messages that can appear above the bars are shown below.

CLIP. The number of consecutive samples is at or exceeds the # Samples for Clip setting.

OVER. The signal has been at or above the specified Over Level for a time exceeding the Duration for Over setting.

In-bar Warning Messages

The WVR610A & WVR611A display warning messages within the level meter bars. The warning messages that can appear are shown below in order of priority.

UNLOCKED. The instrument is not locked to an incoming signal on the indicated input channel. Data cannot be decoded and all data and other errors are ignored. This means that if an AES input is selected, nothing recognizable is present on the input, or if embedded audio is selected, the VIDEO input is unrecognizable.

AES PARITY. The incoming subframe does not have even parity as specified by the digital audio standards. The data sample is unreliable and is ignored. The level meters and Lissajous display treat the sample as a zero sample.

AES CRC ERROR. The CRC code in the AES channel status packet is incorrect. Sometimes the CRC code is set to zero, indicating that the signal is missing; when this is the case, this message is not displayed.

MUTE. The number of consecutive all-zero samples is at or exceed the # Samples for Mute setting.

SILENCE. The signal has been at or below the specified Silence Level for a time exceeding the Duration for Silence setting.

DISABLED. Disabled can appear for three reasons:

- Analog audio is selected as the bar source, this causes bars 7 and 8 to say DISABLED since there are only 6 analog inputs.
- Embedded audio is selected as the bar source when Composite video is selected as the video input. Since there is no embedded audio in composite, all of the bars will say DISABLED.
- If the currently selected audio source's Bar to Input Map does not have all of the bars mapped to inputs, any bars that are unmapped will say DISABLED.

AES V BIT. Indicates that the Validity bit is set high for one or more data samples. In the AES/EBU standard, a set validity bit indicates that the sample is not suitable for conversion to audio. By default, the level meter bars and Lissajous display treat the affected samples as zero samples.

Other Display

The Other display is used to display an LTC waveform when one is present. This enables you to check the LTC amplitude, noise and the the timecode is locked to the video. The display has two vertical scales, one in Volts and the other in dBu.

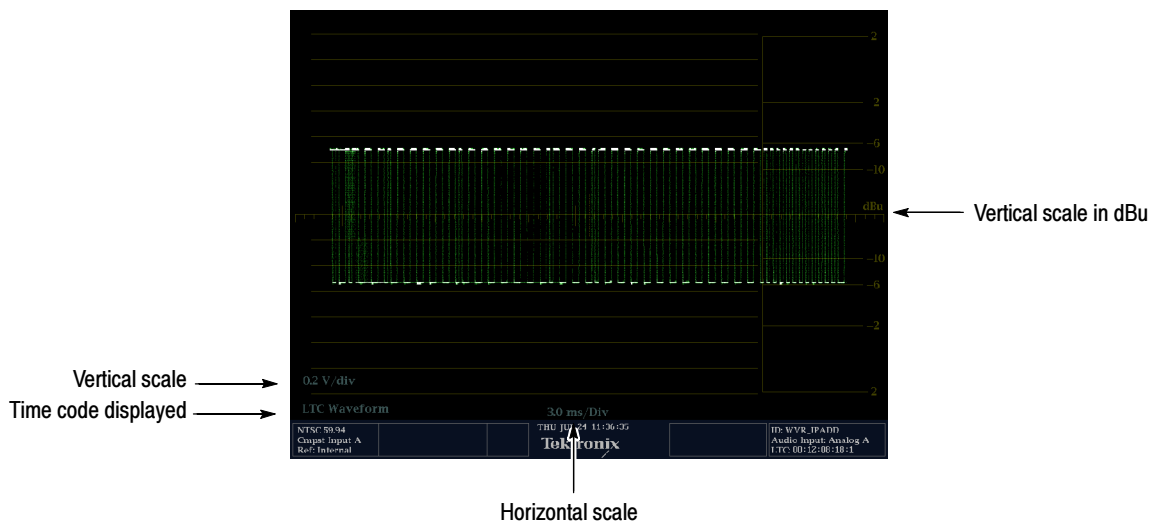


Figure 2-23: Other display elements

Table 2-7: Other display element descriptions

Display element	Description
Vertical scale	Text indicating vertical scale
Time code displayed	Indicates that the LTC is being displayed
Horizontal scale	Text indicating the horizontal scale
Vertical scale in dBu	Alternate graticule with vertical scale in dBu

Gamut Display

The Gamut display provides three proprietary Tektronix displays to enable you to easily and quickly check the gamut of an SDI signal. You can choose from the

Arrowhead, Diamond and Split Diamond displays. The Arrowhead display provides NTSC and PAL composite gamut information directly from the SDI signal. The Diamond and Split Diamond display provide a reliable method of detecting invalid colors.

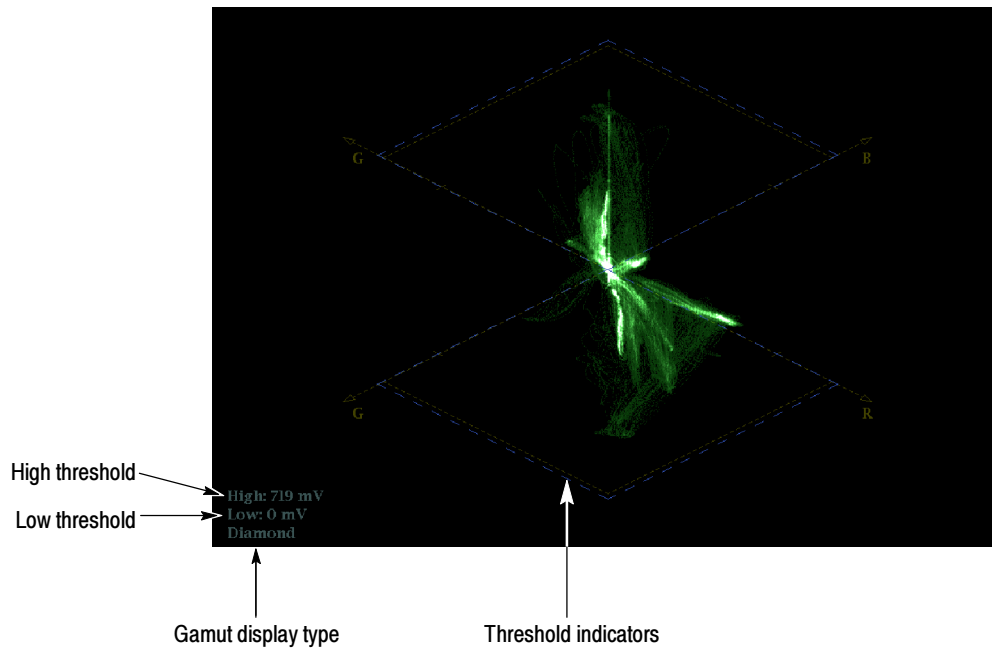


Figure 2-24: Gamut display elements

Table 2-8: Waveform display element descriptions

Display element	Description
High threshold	Text showing the currently specified high threshold (Diamond High or Arrowhead Max).
Low threshold	Text showing the currently specified low threshold (Diamond Low).
Gamut display type	The selected Gamut display type: Diamond, Split Diamond, or Arrowhead.
Threshold indicators	Blue dashed lines indicating the threshold settings.

Status Display

The Status display provides several views of signal status. Status displays are text displays that show signal status in a variety of ways. You can view current alarms and errors (those occurring now and within the last few seconds), a history of errors and alarms (up to 10,000 entries), video error statistics or audio error statistics. You can display a different Status display type in all four tiles at once. See Figure 2-25.

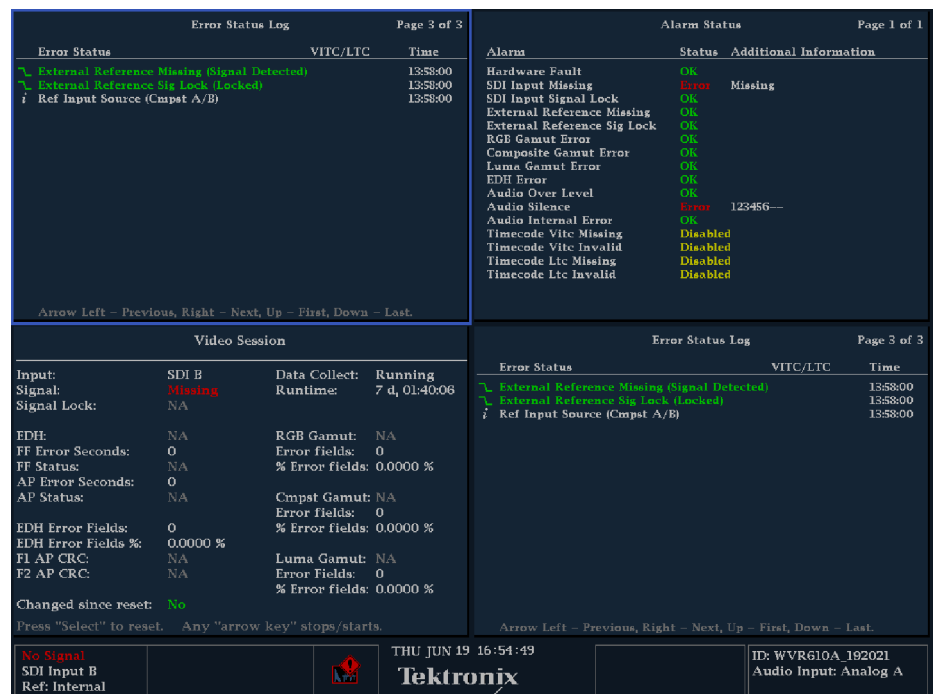


Figure 2-25: A STATUS display in all four tiles

For detailed information on the elements of the various Status displays, see *Configuring Alarms and Viewing Status* in the *WVR610A & WVR611A Waveform Rasterizers User Manual*.

Navigating Menus

Both the pop-up menus and the Configuration menu contain multiple panes of information. To change settings in a menu, you must navigate or traverse to the desired pane of the menu. See Figure 2-26.

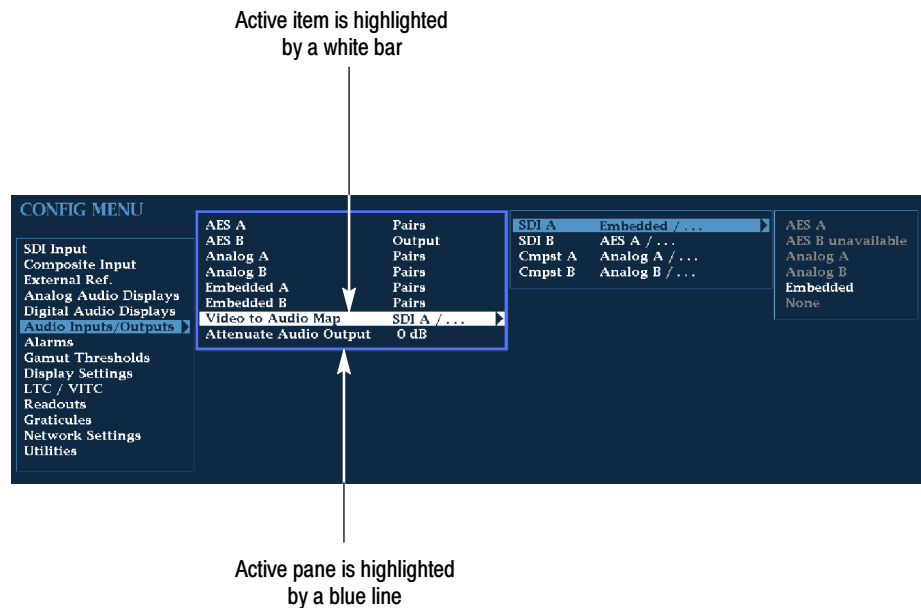


Figure 2-26: Panes in a menu

Only one pane of the menu is active at a time, this pane is indicated by a blue highlight ring. In Figure 2-26, the highlight appears around the middle pane.

To change a setting, you must highlight the desired setting. To move the highlight between panes in a menu, use the arrow keys or the **SEL** button.

To navigate in a menu:

1. Use the up/down-arrow keys or the **GENERAL** knob to select the desired item within a pane.
2. Press the right-arrow key to access the next pane. Repeat if necessary.
3. Use the right-arrow key or the **SEL** button to change the value of the selection.
4. If the knob icon appears next to a selection, you use the **GENERAL** knob to change that selection. See Figure 2-27. You can also use the up and down-arrow keys, but the knob is usually faster.

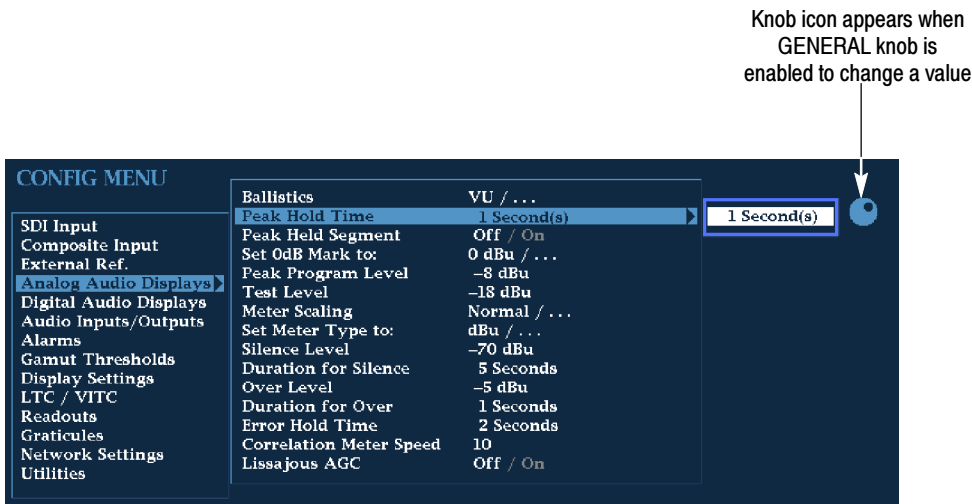


Figure 2-27: Knob icon

5. Press the left-arrow key to move the highlight back to a previous pane.
6. Press any other button to exit the menu.

Setting the Active Tile

Normally, there are four displays on the screen. Each display or quadrant is called a tile. The tiles are numbered 1, 2, 3, and 4, corresponding to the numbered Display Select front-panel buttons. See Figure 2-28.

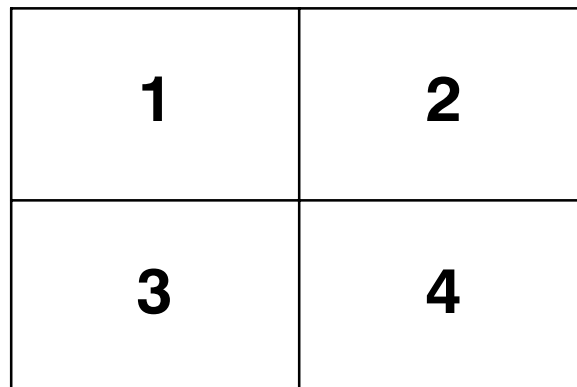
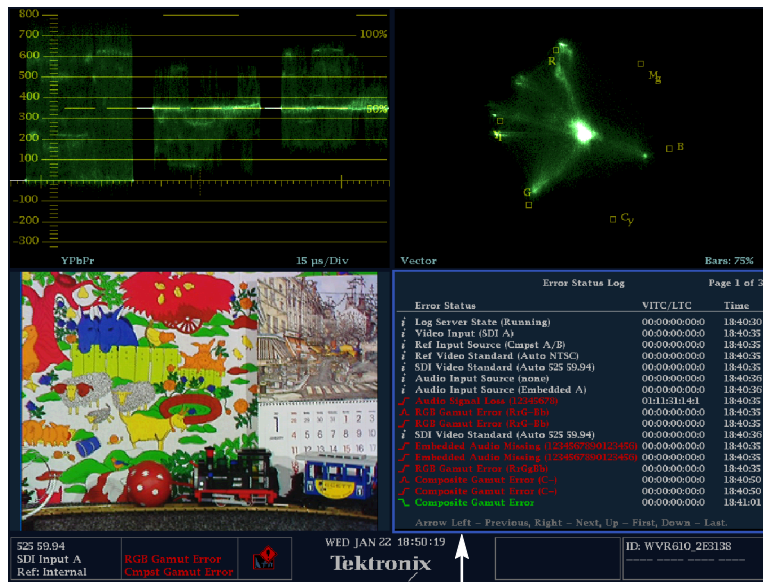


Figure 2-28: Tile positions in the display

One of the four tiles is defined as the *active tile*. The active tile is indicated by the lit Display Select button on the front panel and by the light blue highlight around the tile in the display (see Figure 2-29). Most changes to the instrument state affect the active tile. For example, changing a Vector display to an Audio display changes only the active tile.



Highlight indicates active tile

Figure 2-29: Identifying the active tile

To change the active tile:

- Press the numbered Display Select button of the tile you wish to make the active tile. See Figure 2-30.

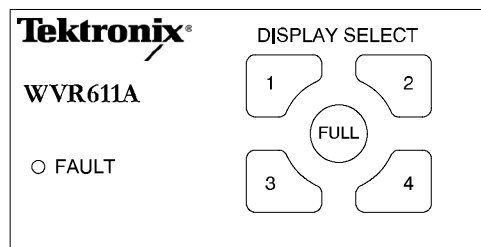


Figure 2-30: Press a numbered button to set the active tile

Displaying a Tile in Full-screen Mode

The waveform rasterizer can display four tiles at once or just one tile. When just one tile is displayed, it occupies the full screen. See Figure 2-31.

To display a tile in full-screen mode:

1. If necessary, press the numbered Display Select button for the tile you want displayed in full-screen mode to make it the active tile.
2. Press the **FULL** button.

When the display is in full-screen mode, press **FULL** again to return to Tile mode.

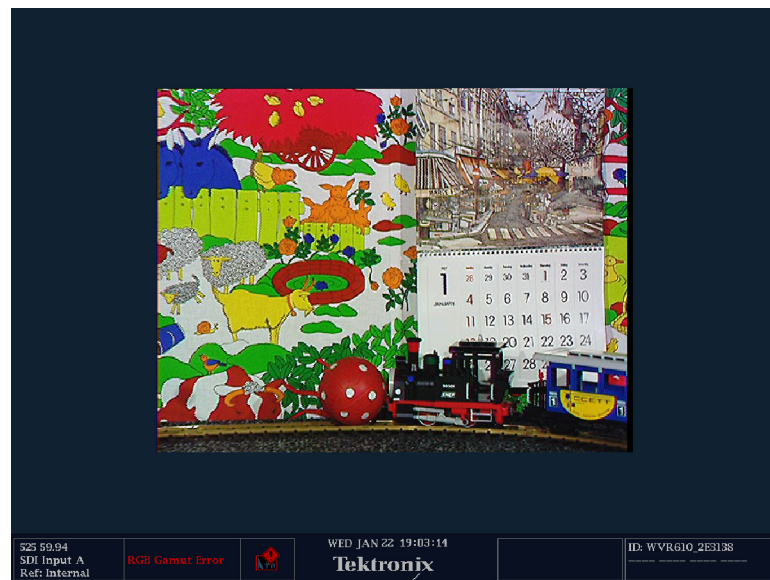


Figure 2-31: Full-screen mode

While in the full-screen mode, if you press another DISPLAY SELECT button, the waveform rasterizer will display the contents of the selected tile in full-screen mode.

Selecting a Measurement for the Active Tile

To select a measurement for the Active tile:

- Press the button for the measurement you want displayed in the active tile.

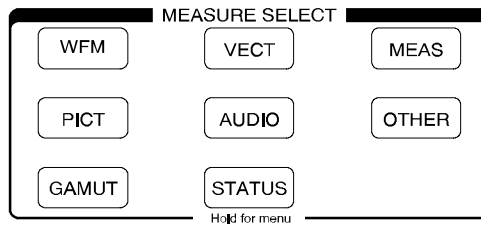


Figure 2-32: Measure select buttons

Most measurement selections can be displayed multiple times. For example, you can display a Waveform measurement in two tiles, one with 1X gain and one with 5X gain. Or you can display multiple STATUS screens all at the same time. The exception is the AUDIO measurement; only one instance of the AUDIO tile can be displayed at a time.

Using Online Help

The WVR610A & WVR611A online help is a quick reference to instrument operation. The online help is context sensitive, and the topic displayed depends on what is displayed in the active tile when the online help is selected. See Figure 2-33.

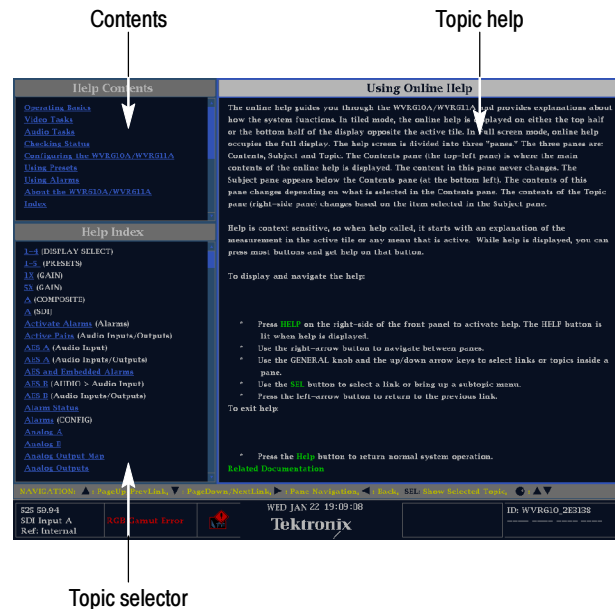


Figure 2-33: The three sections of the online help

The online help contains three panes: Contents, Topic Selector, and Topic Help. The Contents pane displays the major help topics available, including an index. The choices in the Contents pane are always the same.

The choices in the Topic Selector pane change depending on the major topic chosen in the Contents pane. The choices in the Topic Selector are subtopics related to the major help topic selected in Contents. When Index is selected in Contents, the Topic Selector pane lists all the index entries.

The Topic Help pane displays the help for the subtopic selected in the Topic Selector or for a button pressed while help is displayed. The Topic Help section can also contain links to other topics within help. See Figure 2-33.

The online help is context sensitive. For example, if you press a button when the online help is displayed, the online help will display the Topic Help for the button you press. Additionally, if you have a pop-up menu displayed and select a setting in the pop-up menu and press HELP, the online help displays the topic help for the item selected in the pop-up menu.

To display the online help:

- Press **HELP** on the right side of the front panel.

To navigate the online help:

- Press the right-arrow key to move the selection highlight to the next pane.
- Use the **GENERAL** knob and the up / down arrow keys to select a topic you wish to display.
- Press **SEL** to display a selected topic.
- To follow a link within topic help, highlight the link using the **GENERAL** knob or the up / down arrow keys, then press **SEL**.
- Press the left-arrow key to go back to the previous link.

To exit the online help:

- Press **HELP**.

Rear Panel Connections

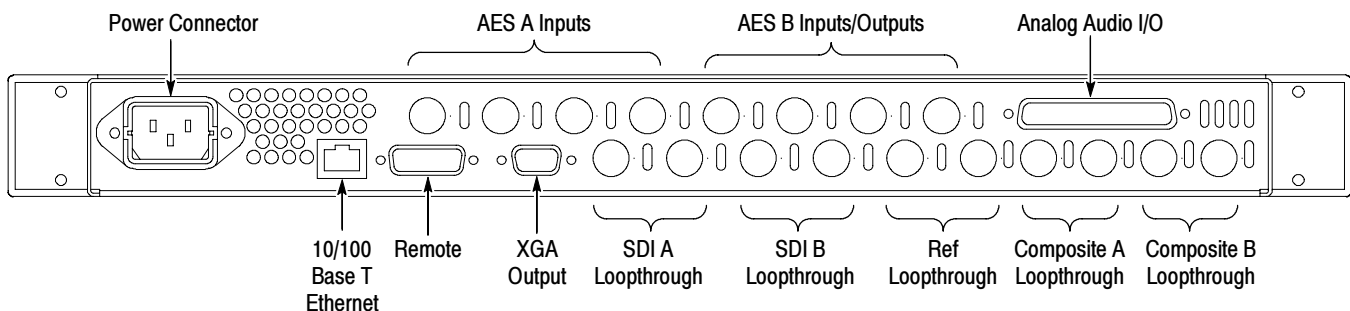


Figure 2-34: Rear-panel connectors

Power Connector

The waveform rasterizer is designed to operate from a single-phase power source with one current-carrying conductor at or near earth-ground (the neutral conductor). Only the line conductor is fused for over-current protection. The fuse is internal. Systems that have both current-carrying conductors live with respect to ground (such as phase-to-phase in multiphase systems) are not recommended as power sources. The power source frequency is 50 or 60 Hz. The operating voltage range is continuous from 100 to 240 VAC.

Video Input Connectors

There are two SDI and two Composite (WVR611A only) loop-through connectors on the rear panel.

SDI A Loop-through. A passive loop-through component serial digital input, compensated for 75 Ω .

SDI B Loop-through. A passive loop-through component serial digital input, compensated for 75 Ω .

Composite A Loop-through. A passive loop-through composite analog input, compensated for 75 Ω . (WVR611A only)

Composite B Loop-through. A passive loop-through composite analog input, compensated for 75 Ω . (WVR611A only)

Ref Loop-through. A passive loop-through synchronization input, compensated for 75 Ω . The input signal can be analog black burst or analog composite video.

AES A/B Connectors

The BNC connectors labeled AES A /AES B support AES audio inputs (based on the audio option installed). The AES B connectors can be configured to output embedded audio from the Configuration menu. See Table 2-9.

Table 2-9: AES Connectors

Connector	Input /output	Channel supported
AES A 1-2 In	Input	AES channels 1 and 2
AES A 3-4 In	Input	AES channels 3 and 4
AES A 5-6 In	Input	AES channels 5 and 6
AES A 7-8 In	Input	AES channels 7 and 8
AES B 1-2 I/O	Input / Output	AES channels 1 and 2, or when configured from the Configuration menu, AES output of embedded audio channels
AES B 3-4 I/O	Input / Output	AES channels 3 and 4, or when configured from the Configuration menu, AES output of embedded audio channels
AES B 5-6 I/O	Input / Output	AES channels 5 and 6, or when configured from the Configuration menu, AES output of embedded audio channels
AES B 7-8 I/O	Input / Output	AES channels 7 and 8, or when configured from the Configuration menu, AES output of embedded audio channels

Analog Input/Output Connector

The Analog I/O connector is used to input and output analog signals. The Analog I/O connector is a 37-pin, D-subminiature connector. Table 2-10 lists the function of each pin in the connector.

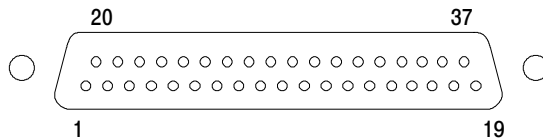


Figure 2-35: Analog I/O connector pin diagram



CAUTION. Use care when connecting the Analog Audio Output. Refer to Table 1-25 in Specifications, to ensure Audio Load and Output Power meet specifications. Exceeding Analog Audio Output Power may result in damage to the instrument.

Table 2-10: Analog I/O connector pin-out

Pin	Pin name	Description
1	ANALOG_INPUT_LP0_A	Balanced differential analog audio input: Left, positive, Pair 0, Line A
2	ANALOG_INPUT_LP0_B	Balanced differential analog audio input: Left, positive, Pair 0, Line B
3	ANALOG_INPUT_RP0_A	Balanced differential analog audio input: Right, positive, Pair 0, Line A
4	ANALOG_INPUT_RP0_B	Balanced differential analog audio input: Right, positive, Pair 0, Line B
5	ANALOG_INPUT_LP1_A	Balanced differential analog audio input: Left, positive, Pair 1, Line A
6	ANALOG_INPUT_LP1_B	Balanced differential analog audio input: Left, positive, Pair 1, Line B
7	ANALOG_INPUT_RP1_A	Balanced differential analog audio input: Right, positive, Pair 1, Line A
8	ANALOG_INPUT_RP1_B	Balanced differential analog audio input: Right, positive, Pair 1, Line B
9	ANALOG_INPUT_LP2_A	Balanced differential analog audio input: Left, positive, Pair 2, Line A
10	ANALOG_INPUT_LP2_B	Balanced differential analog audio input: Left, positive, Pair 2, Line B
11	ANALOG_INPUT_RP2_A	Balanced differential analog audio input: Right, positive, Pair 2, Line A
12	ANALOG_INPUT_RP2_B	Balanced differential analog audio input: Right, positive, Pair 2, Line B
13	GND	
14	ANA_OUT_LN0	Balanced differential analog audio output: Left, negative, Pair 0
15	ANA_OUT_RN0	Balanced differential analog audio output: Right, negative, Pair 0
16	ANA_OUT_LN1	Balanced differential analog audio output: Left, negative, Pair 1
17	ANA_OUT_RN1	Balanced differential analog audio output: Right, negative, Pair 1
18	ANA_OUT_LN2	Balanced differential analog audio output: Left, negative, Pair 2
19	ANA_OUT_RN2	Balanced differential analog audio output: Right, negative, Pair 2
20	ANALOG_INPUT_LN0_A	Balanced differential analog audio input: Left, negative, Pair 0, Line A

Table 2-10: Analog I/O connector pin-out (Cont.)

Pin	Pin name	Description
21	ANALOG_INPUT_LN0_B	Balanced differential analog audio input: Left, negative, Pair 0, Line B
22	ANALOG_INPUT_RN0_A	Balanced differential analog audio input: Right, negative, Pair 0, Line A
23	ANALOG_INPUT_RN0_B	Balanced differential analog audio input: Right, negative, Pair 0, Line B
24	ANALOG_INPUT_LN1_A	Balanced differential analog audio input: Left, negative, Pair 1, Line A
25	ANALOG_INPUT_LN1_B	Balanced differential analog audio input: Left, negative, Pair 1, Line B
26	ANALOG_INPUT_RN1_A	Balanced differential analog audio input: Right, negative, Pair 1, Line A
27	ANALOG_INPUT_RN1_B	Balanced differential analog audio input: Right, negative, Pair 1, Line B
28	ANALOG_INPUT_LN2_A	Balanced differential analog audio input: Left, negative, Pair 2, Line A
29	ANALOG_INPUT_LN2_B	Balanced differential analog audio input: Left, negative, Pair 2, Line B
30	ANALOG_INPUT_RN2_A	Balanced differential analog audio input: Right, negative, Pair 2, Line A
31	ANALOG_INPUT_RN2_B	Balanced differential analog audio input: Right, negative, Pair 2, Line B
32	ANA_OUT_LP0	Balanced differential analog audio output: Left, positive, Pair 0
33	ANA_OUT_RP0	Balanced differential analog audio output: Right, positive, Pair 0
34	ANA_OUT_LP1	Balanced differential analog audio output: Left, positive, Pair 1
35	ANA_OUT_RP1	Balanced differential analog audio output: Right, positive, Pair 1
36	ANA_OUT_LP2	Balanced differential analog audio output: Left, positive, Pair 2
37	ANA_OUT_RP2	Balanced differential analog audio output: Right, positive, Pair 2

The previous table identifies the Analog input/output connectors by left/right pairs. The waveform rasterizer interface and the optional audio breakout cable identifies the signals as a series of numbers from 1 to 6. Table 2-11 maps the left/right pairs to the analog input number used in the interface and on the breakout cable.

Table 2-11: Channel pair to analog input mapping

Pair label	Analog input
L0	1
R0	2
L1	3
R1	4
L2	5
R2	6

Connecting Signals. When connecting audio signals to the Analog Input connectors, you can use either balanced or unbalanced signals. If you connect unbalanced signals to the inputs, you do not have to ground the unused lead (grounding the unused lead can reduce noise).

When connecting the Analog Output connectors, you can connect them as balanced or unbalanced. However, if you connect the balanced outputs to an unbalanced input, you must ground the unused lead. You can ground either lead.

NOTE. Note that grounding the unused lead does not attenuate the output but it does halve the clipping level. Therefore, you must attenuate the output by at least 6 dB to avoid clipping. The output signal level in unbalanced mode is double the signal level in balanced mode.

Units that have both analog and digital capability can have AES or embedded inputs converted to analog and then routed to the six balanced outputs.

XGA Output Connector

This is the display output. The display resolution is 1024 x 768, in 16 colors. The output is compatible with standard analog PC monitors, either CRT or LCD-based. The REMOTE connector is a 15-pin D-type connector with socket contacts. See Figure 2-36.

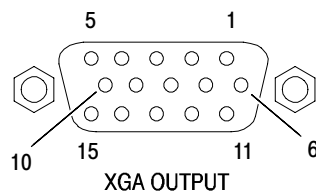


Figure 2-36: XGA output connector pin diagram

Table 2-12: XGA connector pin-out

Pin	Description	Notes
1	Red Video	
2	Green Video	
3	Blue Video	
4	Not connected	
5	Ground	
6	Red Ground	
7	Green Ground	

Table 2-12: XGA connector pin-out (Cont.)

Pin	Description	Notes
8	Blue Ground	
9	+5 V	For monitor EEPROM
10	Not Connected	
11	Not Connected	
12	ID Bit	Supports I ² C polling
13	Horizontal Sync	
14	Vertical Sync	
15	ID Clock	

Ground Closure

The REMOTE connector interface uses ground closures for remote control and indicating to external equipment when alarms have occurred. The input of LTC is through the REMOTE connector. The REMOTE connector is a 15-pin D-type connector with socket contacts. See Figure 2-37 and Table 2-13.

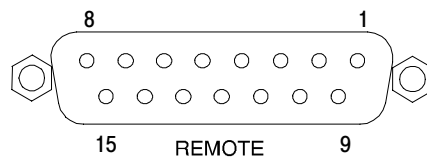


Figure 2-37: REMOTE connector pin diagram

Table 2-13: REMOTE connector pin-out

Pin	Description	Direction	Notes
1	Reserved for future use	--	
2	GND		
3	Reserved for future use	--	
4	Reserved for future use	--	
5	Preset 1	IN	Recall Preset 1
6	GND		
7	+Time Code	IN	LTC (longitudinal time code) input.
8	-Time Code	IN	

Table 2- 13: REMOTE connector pin-out (Cont.)

Pin	Description	Direction	Notes
9	Output	OUT	This line goes to ground when asserted. It is asserted when an alarm occurs, if enabled.
10	Reserved for future use	--	
11	Reserved for future use	--	
12	Reserved for future use	--	
13	Preset 2	IN	Recall front-panel presets. Asserting one of the Preset signals causes the associated front-panel preset to be applied to the waveform rasterizer. Assert a pin by connecting it to ground.
14	Preset 3	IN	
15	Preset 4	IN	

Ethernet Connector

The waveform rasterizer provides a 10/100 BaseT Ethernet interface. The Ethernet connector is a standard RJ-45 connector. See Figure 2-38.

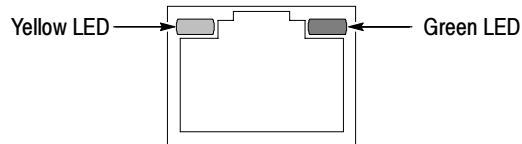


Figure 2- 38: RJ-45 Ethernet connector

The connector includes two LEDs for indicating status. See Table 2-14.

Table 2- 14: Ethernet connector LEDs

LED color	Meaning
Green	Connection is active
Yellow	ON = 100 Mb transmission rate OFF = 10 Mb transmission rate

Table 2-15 provides a pin-out for the RJ-45 connector.

Table 2-15: Ethernet connector pin-out

Pin	Pin name	Description
1	TX_D1+	Transceive Data+
2	TX_D1-	Transceive Data-
3	RX_D2+	Receive Data+
4	BI_D3+	Bi-directional Data+
5	BI_D3-	Bi-directional Data-
6	RX_D2-	Receive Data-
7	BI_D4+	Bi-directional Data+
8	BI_D4-	Bi-directional Data-

Changing Instrument Settings

Use the Configuration menu to adjust instrument settings that are not specific to a tile. The Configuration menu settings are instrument settings that you will generally set when you first install the waveform rasterizer, and then change only occasionally afterward.

SDI Input Settings

The SDI Input settings specify how SDI inputs are displayed. See Table 2-16.

To change the SDI Input settings:

1. Press **CONFIG** to display the Configuration menu.
2. Select **SDI Input** to display the submenu.
3. Press the right-arrow key to change the menu focus to the **SDI Input** submenu.
4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-16: SDI input settings

Setting	Choices / Range
Input Format	Auto / 525 / 625
Strip EAV/SAV/ANC	On / Off
Chroma	Offset / Align
NTSC Setup	0% / 7.5%

Input Format

Specifies the format of the input signal. **Auto** allows the input to automatically detect the input format, or it can be configured to run only in 525 or 625 line mode. The manual mode (525 or 625) may be useful for signals with errors.

Strip EAV/SAV/ANC

Determines whether the EAV and SAV timing references or the ancillary data, such as audio, are visible in the Waveform display. Since these data values are not band limited, they usually ring when displayed through the video waveform filters.

Chroma Determines the vertical position of the color difference signals. If you select **Align**, the chroma zero levels are aligned with the luminance zero level. The color difference signals will extend below luma, but Gain will expand around the zero levels. If you select **Offset** a 350 mV positive offset is added to the PbPr channels. This does not affect the transcoded RGB display or the picture monitor output signal.

NTSC Setup Specifies how the SDI->Composite and Arrowhead display will be setup.

Composite Input Settings

The Composite Input settings specify how composite inputs are displayed. See Table 2-17.

To change the Composite Input settings:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Composite Input**.
3. Use the navigation keys to change the menu focus to the submenu.
4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-17: Composite input settings

Setting	Choices / Range
Input Format	Auto / NTSC / PAL
Sync AFC Speed	Fast / Slow
DC Restore	Fast / Slow / Off
NTSC Setup	On / Off
PAL Vector	Normal / V+

Input Format Specifies the format of the input composite signal. In **Auto**, the waveform rasterizer automatically detects the correct format. This setting is useful when you occasionally changes the input format. If you always monitor the same signal format, you can specify **NTSC** or **PAL**.

- Sync AFC Speed** The Sync AFC Speed sets the ability of the loop to follow changes in the external reference signal. “Fast” can track signals with more line rate variation. “Slow” has lower jitter.
- DC Restore** Applies a voltage to the signal to keep one point on the waveform at a fixed DC level. This makes taking measurements easier when the DC level of the waveform shifts due to changes in signal content. Setting choices are Fast, Slow, and Off.
- Select **Off** when you wish to see the DC offset in the signal. Off cancels the operation of the DC Restore circuitry.
 - Select **Slow** when you wish to remove DC offset from the signal but you still want to see hum.
 - Select **Fast** when you want to remove the effects of hum and offset from the signal.
- NTSC Setup** The NTSC Setup setting optimizes the operation of the WVR610A & WVR611A for NTSC signals with and without set up. For example, this setting changes the scaling of the vector bar targets.
- PAL Vector** When V+ is chosen, the phase reference of the -V lines is inverted, then shown as an overlay on the +V lines to provide a comparison display.

External Reference Setting

The External Reference setting specifies the allowed formats of the signal on the EXT REF IN connector. See Table 2-18.

To change the External Reference settings:

1. Press **CONFIG** to display the Configuration menu.
2. Use the **GENERAL** knob or the up/down arrow keys to select **External Ref**.
3. Use the navigation keys to change the menu focus to the External Ref submenu.
4. Select the Lock to Standard setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2- 18: External reference settings

Setting	Choices
Lock to Standard	Auto / NTSC / PAL
Sync AFC Speed	Fast / Slow

Lock to Standard Sets the external reference format. In **Auto**, the waveform rasterizer automatically detects the correct format. This setting is useful when you occasionally change the input format for the external reference signal. If you always use the same external reference signal format, you can specify **NTSC** or **PAL**.

Sync AFC Speed The Sync AFC Speed sets the ability of the loop to follow changes in the external reference signal. “Fast” can track signals with more line rate variation. “Slow” has lower jitter.

NOTE. When using an SDI input with an external reference, an input signal time-base variation outside the specified range may be shown as a reference unlock on the status bar and error logs.

Analog Audio Displays Settings

The Audio Display submenu provides access to parameters that control meter ballistics, various meter characteristics such as Peak Hold Time, the number of consecutive samples required to trigger various alarms, and other settings. Table 2-19 lists the settings for audio displays.

To change the audio display settings:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Analog Audio Displays**. Use the right-key to change to menu focus to the Analog Audio Displays submenu.
3. Select the desired setting and change the setting as desired.
4. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-19: Analog Audio display settings

Setting	Values
Ballistics	True Peak / PPM Type 1 / PPM Type 2 / VU Default: True Peak
Peak Hold Time	Range: 0 to 10 seconds Default: 2 seconds
Peak Hold Segment	On / Off Default: On
Set 0dB Mark To:	Top of Scale / Peak Program Level / Test Level Default: Test Level
Peak Program Level	24 to -6 dBu Default: 10 dBu
Test Level	24 to -6 dBu Default: 0 dBu
Meter Scaling	Normal (Default) Custom Height: 10 to 90 dB (Default: 70 dB) Custom Offset: -20 to 0 dB (Default: 0 dB) Graticule Step Size: 3 to 10 dB (Default: 10 dB)
Set Meter Type to:	dBu / DIN (IEC Type 1) / VU / Nordic (IEC Type IIb) / IEEE PPM
Silence Level	Range: -16 to -46 dBu Default: -26 dB
Duration for Silence	Range: 0 to 60 seconds Default: 10 seconds
Over Level	Range: 24 to -6 dB Default: 10 dB
Duration for Over	Range: 0 to 30 seconds Default: 1 second
Error Hold Time	Range: 0 to 30 seconds Default: 2 seconds

Table 2- 19: Analog Audio display settings (Cont.)

Setting	Values
Correlation Meter Speed	Range: 1 to 30 Default: 8
Lissajous AGC	On / Off Default: On

Ballistics Specifies the response characteristics of the level meters. Choices are True Peak, PPM (Peak Program Meter) Type 1 and Type 2, and VU.

- **True Peak** - Show actual signal peaks regardless of their duration. Rise times are essentially instantaneous. Fall time is like PPM Type 2, and requires 2.8 seconds to fall 20 dB. The in-bar peak indicator will persist at the peak level for the “Peak Hold Time”. When True Peak ballistics are selected, the display designation is **True Peak Ballistics**.
- **PPM Type 1**- Response equivalent to IEC Type I (essentially the same as DIN 45406 and Nordic N-9). The PPM Type 1 has a slightly faster attack time and a faster return time than Type 2, requiring 1.7 seconds to fall 20 dB as opposed to 2.8 seconds for Type II. When PPM Type 1 ballistics are selected, the display designation is **PPM Type 1 Ballistics**.
- **PPM Type 2**-Response equivalent to IEC Type II (the same as defined in IEEE Std 152-1991). The PPM Type 2 has a slightly slower attack time and a slower return time than Type 1, requiring 2.8 seconds to fall 20 dB as opposed to 1.7 seconds for Type 1. When PPM Type 2 ballistics are selected, the display designation is **PPM Type 2 Ballistics**.
- **VU** - A VU meter as defined by IEEE Std. 152-1991, but with an extended dB-linear scale. The meter bars will also contain true peak indicators when VU is selected. The display designation of this setting is **VU Ballistics**.

Peak Hold Time Specifies the number of seconds that the True Peak Indicator remains at the most recent peak level.

Peak Hold Segment Switches the Peak Hold Indicator on or off.

Set 0 dB Mark To Numbers the meter scale relative to Top of 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.

Peak Program Level Sets the maximum desired level for monitored programs. The meter bars change to red above the Peak Program Level.

Test Level Sets as the test or “line up” level for your system. The meter bars change to yellow between the Test and Peak Program Levels.

Meter Scaling Sets the scaling for the level meters. Meter scaling can be set to Normal or customized by setting up to three parameters: Custom Height, Custom Offset and Graticule Size. At the Normal setting, the meter scale is set to a 70 dB range, with the actual values at the top and bottom of the meter depending on the setting for *Set 0dB Mark to:*. When you select one of the custom parameters, all are enabled. When using Custom Height, the range of the meters can be set from 10 - 90 dB. When using Custom Offset, you are setting the location of a “window” on the bar, where the size of the window is set by the Custom Height setting. The Custom Offset setting, in effect, moves the window up and down the range of the level meter. The Graticule Size setting specifies the difference in dB between graticule tic marks. The difference between tic marks can be set from 3 dB to 10 dB, except for VU which is set at 3 dB.

Set Meter Type to: Sets parameters defining meter characteristics to conform with audio meter types standardized in the industry. The characteristics of each meter type are shown in Table 2-20.

Table 2-20: Characteristics of meter types

Meter Type	Ballistic	0 dB Mark	Test	PPL	Scale Height	Scale Offset	Scale Step
dBu	PPM Type II	Test	0 dBu	10 dBu	70 dB	0 dB	10 dB
DIN (IEC Type 1)	PPM Type I	PPL	-3 dBu (-9 dBr)	6 dBu (0 dBr)	55 dB	13 dB	5 dB
VU	VU	Test	0 dBu	0 dBu	24 dB	21 dB	1 dB
Nordic (IEC Type IIb)	PPM Type II	Test	0 dBu	6 dBu	54 dB	12 dB	6 dB
IEEE PPM	PPM Type II	PPL	0 dBu (-8 dBr)	8 dBu (0 dBr)	32 dB	8 dB	4 dB

Silence Level Sets the audio level below which the signal is considered silent. This value is used to trigger an on-screen indicator and alarms.

Duration for Silence Specifies how long the audio level must be below the *Silence Level* before an alarm is triggered. Setting the duration to “0” seconds disables the alarm.

Over Level	Specifies the audio level above which the signal is considered “over”. This setting is used to trigger on-screen indicators and alarms.
Duration for Over	Specifies how long the audio level must be above the <i>Over Level</i> before an alarm will be triggered.
Error Hold Time	Specifies the length of time the in-bar error messages are displayed after the error has been removed.
Correlation Meter Speed	Determines how quickly the meter reacts to changes in phase relationship. The meter reading is actually an average of correlation over time and this setting determines how many samples are used to calculate the average. Lower settings result in a faster meter response. Experiment to find the setting that best fits your needs. The default setting is 8, which is 1.5 seconds.
Lissajous AGC	When On, allows the Lissajous or Phase display to change gain and keep the display well scaled. When Off, puts the display in fixed gain mode with the Peak Program level at the perimeter of the active area.

NOTE. *The audio pop-up menu allows selection of input and allows the optional phase display to be added to the audio tile.*

Digital Audio Displays Settings

The Digital Audio Display submenu provides access to parameters that control meter ballistics, various meter characteristics such as Peak Hold Time, the number of consecutive samples required to trigger various alarms, and other settings. Table 2-19 lists the settings for audio displays.

To change the audio display settings:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Digital Audio Displays**. Use the right-key to change to menu focus to the Digital Audio Displays submenu.
3. Select the desired setting and change the setting as desired.
4. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-21: Digital Audio display settings

Setting	Values
Ballistics	True Peak / PPM Type 1 / PPM Type 2 / VU Default: True Peak
Peak Hold Time	Range: 0 to 10 seconds Default: 2 seconds
Peak Hold Segment	On / Off Default: On
Set 0dB Mark To:	Top of Scale / Peak Program Level / Test Level Default: Peak Program Level
Peak Program Level	0 to -30 dBFS Default: -8 dB
Test Level	0 to -30 dBFS Default: -18 dB
Meter Scaling	Normal (Default) Custom Height: 10 to 90 dB (Default: 70 dB) Custom Offset: -20 to 0 dB (Default: 0 dB) Graticule Step Size: 3 to 10 dB (Default: 10 dB)
# Samples for Clip	Range: 0 to 100 Default: 1
# Sample for Mute	Range: 0 to 100 Default: 10 consecutive
Silence Level	Range: -70 to -40 dBFS Default: -60 dB
Duration for Silence	Range: 0 to 60 seconds Default: 10 seconds
Over Level	Range: -20 to 0 dBFS Default: -8 dB
Duration for Over	Range: 0 to 30 seconds Default: 1 second
Error Hold Time	Range: 0 to 30 seconds Default: 2 seconds

Table 2-21: Digital Audio display settings (Cont.)

Setting	Values
Correlation Meter Speed	Range: 1 to 30 Default: 8
Lissajous AGC	On / Off Default: On

Ballistics Specifies the response characteristics of the level meters. Choices are True Peak, PPM (Peak Program Meter) Type 1 and Type 2, and VU.

- **True Peak** - Show actual signal peaks regardless of their duration. Rise times are essentially instantaneous. Fall time is like PPM Type 2, and requires 2.8 seconds to fall 20 dB. The in-bar peak indicator will persist at the peak level for the “Peak Hold Time”. When True Peak ballistics are selected, the display designation is **True Peak Ballistics**.
- **PPM Type 1**- Response equivalent to IEC Type I (essentially the same as DIN 45406 and Nordic N-9). The PPM Type 1 has a slightly faster attack time and a faster return time than Type 2, requiring 1.7 seconds to fall 20 dB as opposed to 2.8 seconds for Type II. When PPM Type 1 ballistics are selected, the display designation is **PPM Type 1 Ballistics**.
- **PPM Type 2**-Response equivalent to IEC Type II (the same as defined in IEEE Std 152-1991). The PPM Type 2 has a slightly slower attack time and a slower return time than Type 1, requiring 2.8 seconds to fall 20 dB as opposed to 1.7 seconds for Type 1. When PPM Type 2 ballistics are selected, the display designation is **PPM Type 2 Ballistics**.
- **VU** - A VU meter as defined by IEEE Std. 152-1991, but with an extended dB-linear scale. The meter bars will also contain true peak indicators when VU is selected. The display designation of this setting is **VU Ballistics**.

Peak Hold Time Specifies the number of seconds that the True Peak Indicator remains at the most recent peak level.

Peak Hold Segment Switches the Peak Hold Indicator on or off.

Set 0 dB Mark To Numbers the meter scale relative to Top of 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.

Peak Program Level	Sets the maximum desired level for monitored programs relative to digital full scale. The meter bars change to red above the Peak Program Level.
Test Level	Sets as the test or “line up” level for your system relative to digital full scale. The meter bars change to yellow between the Test and Peak Program Levels.
Meter Scaling	Sets the scaling for the level meters. Meter scaling can be set to Normal or customized by setting up to three parameters: Custom Height, Custom Offset and Graticule Size. At the Normal setting, the meter scale is set to a 70 dB range, with the actual values at the top and bottom of the meter depending on the setting for <i>Set 0dB Mark to:</i> . When you select one of the custom settings, all are enabled. When using Custom Height, the range of the meters can be set from 10 - 90 dB. When using Custom Offset, you are setting the location of a “window” on the bar, where the size of the window is set by the Custom Height setting. The Custom Offset setting, in effect, moves the window up and down the range of the level meter. The Graticule Size setting specifies the difference in dB between graticule tic marks. The difference between tic marks can be set from 3 to 10 dB.
# Samples for Clip	Specifies the number of consecutive Full Scale samples that must occur for a clip indication to appear. Setting the number of samples to “0” disables the alarm.
# Samples for Mute	Specifies the number of consecutive “0” samples that must occur for a mute indication to appear. Setting the number of samples to “0” disables the alarm.
Silence Level	Sets the audio level below which the signal is considered silent. This value is used to trigger an on-screen indicator and alarms.
Duration for Silence	Specifies how long the audio level must be below the <i>Silence Level</i> before an alarm is triggered. Setting the duration to “0” seconds disables the alarm.
Over Level	Specifies the audio level above which the signal is considered “over”. This setting is used to trigger on-screen indicators and alarms.
Duration for Over	Specifies how long the audio level must be above the <i>Over Level</i> before an alarm will be triggered.
Error Hold Time	Specifies the length of time the in-bar error messages are displayed after the error has been removed.

Ignore Validity Bit Determines how the waveform rasterizer reacts to a high (value 1) validity bit in the input data. In AES3-1992 digital audio, a high validity bit indicates that the sample word is not suitable for conversion to audio. When this setting is set to the factory default of **Off**, the waveform rasterizer will ignore any sample accompanied by a high validity bit, display a “V BIT” flag on the meter display and report invalid samples on the session report. When set to **On**, invalid sample reporting will be turned Off, and the waveform rasterizer will treat all samples as valid.

Correlation Meter Speed Determines how quickly the meter reacts to changes in phase relationship. The meter reading is actually an average of correlation over time and this setting determines how many samples are used to calculate the average. Lower settings result in a faster meter response. Experiment to find the setting that best fits your needs. The default setting is 8, which is 1.5 seconds.

Lissajous AGC When On, allows the Lissajous or Phase display to change gain and keep the display well scaled. When Off, puts the display in fixed gain mode with the Peak Program level at the perimeter of the active area.

NOTE. *The audio pop-up menu allows selection of input and allows the optional phase display to be added to the audio tile.*

Audio Inputs/Outputs

There are three CONFIG submenus for audio: **Analog Audio Displays**, **Digital Audio Displays**, and **Audio Inputs / Outputs**. Audio Inputs/Outputs controls which audio input is active. Audio inputs and outputs must be configured before they can be used. Analog Audio Displays and Digital Audio Displays control general audio configuration settings for parameters such as meter ballistics. See *Analog Audio Displays Settings* on page 2-40 and *Digital Audio Displays Settings* on page 2-44.

Control of which audio input is active is located in the AUDIO pop-up menu.

To set up audio inputs/outputs, first each input group should be configured. Then if desired, a “Video to Audio Map” can be defined so that as you change video inputs the audio source you want will be selected automatically. Finally, any desired “Analog Audio Out Mapping” can be configured.

For units with digital audio capability, there are four AES pair inputs in the “A” bank and four in the “B” bank. Four pairs of audio signals can also be extracted (de-embedded) from the active serial video input. The “B” input bank can be

configured as an output for the extracted audio. When in this mode the B input bank is not available as an input source.

For units with analog audio capability, there are six balanced inputs in the “A” bank and six in the “B” bank. There are also six balanced outputs.

Units that have both analog and digital capability can convert AES or embedded inputs to analog and route to the six balanced outputs.

Audio Inputs/Outputs Parameters

Table 2-22 lists the configuration options for the audio inputs and outputs.

Table 2-22: Audio Inputs and Outputs

Input	First choice	Second choice
AES A	Bar Format	Pairs / Surround
	Input to Bar Map	
	Analog Out Map	
AES B	Config Port As	Input / Output
	Bar Format	Pairs / Surround
	Input to Bar Map	
Analog A	Bar Format	Pairs / Surround
	Input to Bar Map	
	Analog Out Map	
Analog B	Bar Format	Pairs / Surround
	Input to Bar Map	
	Analog Out Map	
Embedded A	Bar Format	Pairs / Surround
	Input to Bar Map	
	Analog Out Map	
Embedded B	Bar Format	Pairs / Surround
	Input to Bar Map	
	Analog Out Map	
Video to Audio Mapping	SDI A	AES A /AES B / Analog A / Analog B / Embedded / None
	SDI B	AES A /AES B / Analog A / Analog B / Embedded / None
	Cmpst A	AES A /AES B / Analog A / Analog B / None

Table 2-22: Audio Inputs and Outputs (Cont.)

Input	First choice	Second choice
	Cmpst B	AES A /AES B / Analog A / Analog B / None
Attenuate Audio Output	Press SEL to change	

AES A/B, Analog A/B, Embedded A/B

These selections enable you to specify the parameters that affect the audio inputs.

Bar Format. Specifies the format used for the bars (level meters) in the Audio display. When Pairs is selected, the bars are labeled with numbers, 1-8. When Surround is selected, the bars are labeled with surround channel designators: L (left), C (center), R (right), Ls (left-surround), Rs (right-surround), Lfe (low-frequency effects), Lo (Left total for stereo equivalent), and Ro (Right total for stereo equivalent). Note that the Lo and Ro channels are inputs, they are not derived from the other channels. See Figure 2-39.

Input to Bar Map. Enables you to map the AES pair inputs to the desired level bar in the Audio tile. Press **SEL** to display the input to bar mapping window. See Figure 2-39. Use the checkboxes (press the arrow-keys to move the selection and press **SEL** to mark a checkbox) to specify which audio input source is displayed in which bar in the Audio window. Note that the labels for the bars change depending on the Bar Format setting. See Figure 2-39



Bar labels when Bar Format is set to Pairs

Bar labels when Bar Format is set to Surround

Figure 2-39: Mapping inputs to bars

Analog Out Map. Enables you to route audio inputs to the analog audio outputs by specifying which level meter bar is mapped to which analog output. See Figure 2-40.

Analog Output to AES "A" Bar Map			
Output Bar	Analog Output 0	Analog Output 1	Analog Output 2
L	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ls	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Lfe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ro	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>


Select here  returns to the Config Menu

Figure 2-40: Analog out map

Video to Audio Mapping

Associates each of the video inputs with any one of the available audio inputs. For example, if you are select the SDI A video input, you can choose to associate the AES A audio input with it.

Configuring Audio Inputs

To set up an audio input:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Audio Inputs/Outputs** to display the submenu.
3. Select the input to be configured. See Figure 2-41.

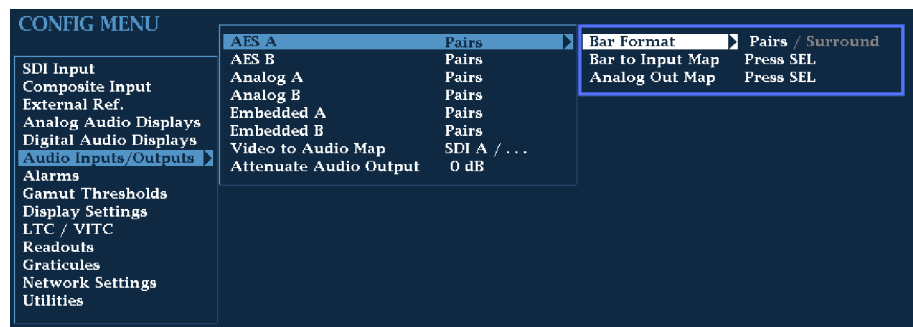


Figure 2-41: Configuring audio inputs

4. For the selected input, select from **Surround** for 5.1 or 7.1 type display or **Pairs** for a stereo, plus SAP and discrete channels type installation.
5. For that input select **Input Bar Map** and specify which input pair should be displayed in each bar pair. See Figure 2-42.

Bar to AES "A" Input Map					
Input Bar	Allow Alarm	AES A0	AES A1	AES A2	AES A3
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Select here returns to the Config Menu

Figure 2- 42: Bar to input mapping

6. In the input bar map selector box, you can also select which inputs will be capable of generating alarms.
7. Finally, select the Output Map to specify which input be routed to each analog output. See Figure 2-43.

Analog Output to AES "A" Bar Map			
Output Bar	Analog Output 0	Analog Output 1	Analog Output 2
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Select here returns to the Config Menu

Figure 2- 43: Mapping analog output

8. Repeat for other audio inputs as needed for your application.

Configure Video to Audio Mapping

To set up the mapping for Audio follows Video Mode:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Video to Audio Map** to display the submenu.
3. Select a video input, then select the audio input that you want to be active when this video input is active. See Figure 2-44.

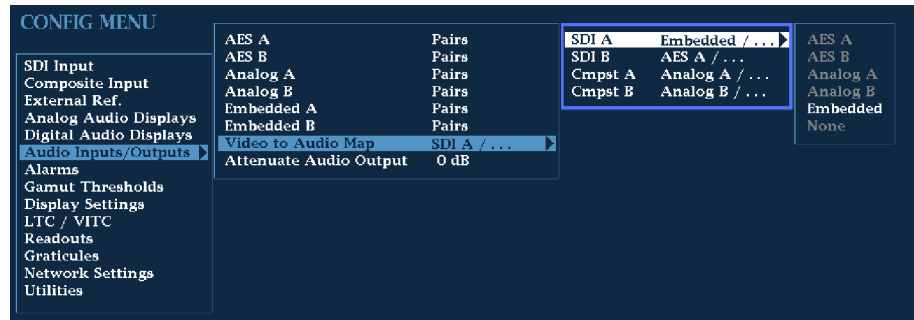


Figure 2- 44: Video to audio mapping

4. Repeat for the other video inputs as needed for your application.

Attenuate Audio Output

The Attenuate Audio Output function enables you to attenuate the audio output signal from 0–120 dB. This function is useful if you are connecting unbalanced audio outputs to balanced inputs or you need to adjust the signal level (volume) of the output signal.



CAUTION. Output Attenuation is necessary when the input audio is abnormally high (that is, greater than -10 dBFS on average or the RMS level exceeds $+14$ dBu). Exceeding these levels for lengthy periods could result in damage to the instrument. Please refer to Specifications, Table 1–25 on page 1–20 for further details.

Setting Up AES B Connectors as Outputs

The AES B connectors can be configured as inputs or outputs. When configured as outputs, the only signal that can be the source to output is the audio that has been de-embedded from the SDI input. The de-embedding is always done from the active input, so if you switch SDI inputs, the audio source will change, and if select a composite input, then the AES B outputs will go silent.

The AES B outputs follow the currently active de-embedded channels as displayed in the audio level bars. So if bar pairs 1,2 and 3,4 are the only ones active, then AES B connectors 1,2 and 3,4 will be the only pairs active as well.

Only one BNC may source the audio from a given de-embedded channel. If the same de-embedded channel is displayed on multiple bar pairs, then only the BNC corresponding to the lowest numbered bar pair will be active.

To set up the AES B connectors as outputs:

1. Press **CONFIG** to display the Configuration menu.

2. Select **Audio Inputs/Outputs**.
3. Select **AES B** from the submenu.
4. Select **Config Port As:**.
5. Press **SEL** to select **Output**. See Figure 2-45.

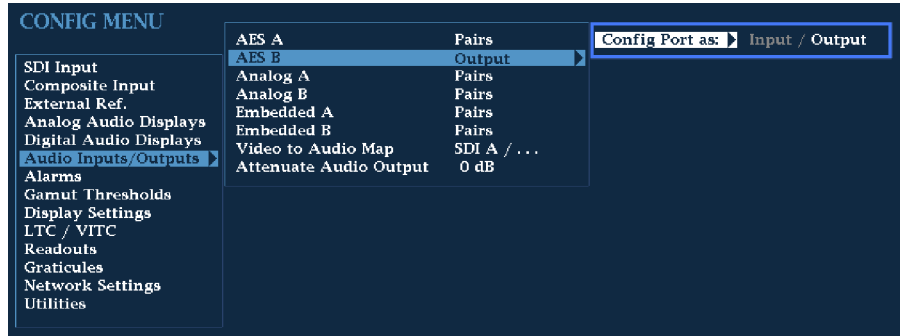


Figure 2- 45: Configuring AES B as an output

6. Press **CONFIG** to remove the Configuration menu.

NOTE. If AES B will be used as an output, do not bother to set it up as an input and do not select it in the Audio follows Video mode.

If AES B is used to output de-embedded audio, the first BNC will have the signal displayed in the first pair of bars. The second BNC will have the signal displayed in the second set of bars and so on. This mapping is not configurable.

Gamut Thresholds Menu

The **Gamut Thresholds** menu enables you to specify the signal levels at which errors and alarms are triggered. See Table 2-23.

To change the **Gamut Threshold** settings:

1. Press **CONFIG** until the menu appears.
2. Use the **GENERAL** knob or the up/down arrow keys to select **Gamut Thresholds**.
3. Use the navigation keys to change the menu focus to the Gamut Thresholds submenu.

4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-23: Gamut thresholds

Setting	Choices / Range
Diamond High	Range: 630 mV - 756 mV Default: 721 mV
Diamond Low	Range: -50 mV - +35 mV Default: -21 mV
Diamond Area	Range: 0 - 10% Default: 1%
Reset Diamond Defaults	Press SEL to reset
Arrowhead NTSC Min	Range: -50 - -10 IRE Default: -24 IRE
Arrowhead NTSC Max	Range: 90 - 120 IRE Default: 120 IRE
Arrowhead PAL Min	Range: -400 mV - -100 mV Default: -230 mV
Arrowhead PAL Max	Range: 630 mV - 950 mV Default: 930 mV
Arrowhead Area	Range: 0 - 10% Default: 1%
Reset Arrowhead NTSC Defaults	Press SEL to reset
Reset Arrowhead PAL Defaults	Press SEL to reset
Luma Min	Range: -6 - +5% Default: -3%
Luma Max	Range: 90 - 108% Default: 103%
Luma Area	Range: 0 - 10% Default: 1%
Reset Luma Defaults	Press SEL to reset
Reset to EBU-R103 Defaults	Press SEL to reset

Diamond High	Sets the level above which RGB components are considered too large and out of gamut.
Diamond Low	Specifies that signals below this level on a Diamond display will trigger an error/alarm.
Diamond Area	Specifies the percentage of the total image pixels (up to 10%) that can be outside the current gamut limits, yet not be reported as a gamut error.
Reset Diamond Defaults	Resets the gamut thresholds for Diamond displays to the factory default.
Arrowhead NTSC Min	Specifies that signals below this level on an Arrowhead NTSC display will trigger an error or alarm.
Arrowhead NTSC Max	Specifies that signals above this level on an Arrowhead NTSC display will trigger an error or alarm.
Arrowhead PAL Min	Specifies that signals below this level on an Arrowhead PAL display will trigger an error or alarm.
Arrowhead PAL Max	Specifies that signals above this level on an Arrowhead PAL display will trigger an error or alarm.
Arrowhead Area	Specifies the percentage of the total image pixels (up to 10%) that can be outside the current gamut limits, yet not be reported as a gamut error.
Reset Arrowhead NTSC Defaults	Resets level to factory default for Arrowhead NTSC display.
Reset Arrowhead PAL Defaults	Resets level to factory default for Arrowhead PAL display.
Luma Min	Specifies that signals below this level on an Arrowhead display will trigger an error or alarm.
Luma Max	Specifies that signals above this level on an Arrowhead display will trigger an error or alarm.
Luma Area	Specifies the percentage of the total image pixels (up to 10%) that can be outside the current Luma limits, yet not be reported as a Luma error.

Reset Luma Defaults Resets level to factory default.

Reset to EBU-R103 Defaults Resets the Gamut and Luma Limit thresholds to the values recommended in the EBU R103-2000 specification.

Table 2-24: EBU-R103 recommended limits for Gamut and Luma

Threshold	Recommended setting
Diamond High	735 mV (105%)
Diamond Low	-35 mV (-5%)
Diamond Area	1%
Luma Min	-1%
Luma Max	103%
Luma Area	1%

Display Settings Menu

The Display Settings menu allows you to specify various display colors, intensities, and modes for the VGA display. See Table 2-25.

To change the **Display Settings**:

1. Press **CONFIG** to display the Configuration menu.
2. Use the **GENERAL** knob or the up/down arrow keys to select **Display Settings**.
3. Use the right-arrow key to change the menu focus to the submenu.
4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-25: Display settings

Setting	Choices / Range
Readout Intensity	0 - 100% Default: 50%
Readout Color	Gold / Blue / Red
Waveform Intensity	-50 - +50 Default: 0

Table 2-25: Display settings (Cont.)

Setting	Choices / Range
Waveform Color	White / Green
Graticule Intensity	0 - 100% Default: 50%
Graticule Color	Gold / Blue / Red
Picture Brightness	20 - 100%
Picture Refresh Mode	Interlace / CRT / LCD
VGA Output	0-1.0v / 0-0.7v
Picture Brightup on RGB Gamut Error	On / Off
Picture Brightup on Cmpst Gamut Error	On / Off
Picture Brightup on Luma Gamut Error	On / Off
Panel Backlight	On / Off
Panel Backlight Intensity	1 - 10

Readout Intensity Sets the display intensity of on-screen readouts.

Readout Color Sets the color of the on-screen readouts.

Waveform Intensity Sets the display intensity of the waveform. You can set this to higher values to better see low incidence signals, but it may saturate more frequent signals.

Waveform Color Sets the color of the waveform. When set to green, you can see a wider range of signals since high incidence signals will be displayed in white while most signals will be displayed in green.

Graticule Intensity Sets the display intensity of the graticule.

Graticule Color Sets the color of the graticule.

Picture Brightness Sets the brightness of the picture display.

Picture Refresh Mode The Picture Refresh Mode allows you to optimize the picture mode display for different types of monitors and applications. The three possible values for this configuration item are:

Interlace. Interlace mode runs the picture very close to how it would run on a standard video monitor. Each field is displayed for that field's normal time. This is useful if you want to see the picture with a minimum of processing.

CRT. CRT mode holds the previous field at reduced intensity to make the picture be more uniform and brighter. While this introduces minor motion artifacts it greatly reduces flicker.

LCD. LCD mode holds all of the previous field along with the current field. This introduces some motion artifacts but is necessary to prevent problems on most LCD monitors and projectors. This mode also increases the brightness significantly.

The default mode is **CRT**. If you change to other modes, you may need to adjust the Picture Brightness configuration parameter to optimize the image.

VGA Output Sets the voltage output level for the VGA display.

Picture Brightup on RGB Gamut Error Specifies whether or not the picture display shows a cross-hatch pattern on areas of the picture where RGB gamut errors occur.

Picture Brightup on Cmpst Gamut Error Specifies whether or not the picture display shows a cross-hatch pattern on areas of the picture where composite gamut errors occur.

Picture Brightup on Luma Gamut Error Specifies whether or not the picture display shows a cross-hatch pattern on areas of the picture where luma gamut errors occur.

NOTE. *The gamut bright-ups on the picture may be difficult to see on signals with luminance in the mid range. An example of such a case is the cyan bar in a 75% color bar signal. This does not happen often at normal gamut threshold values. The gamut errors reported on screen and in the log will not be affected and will report errors in all signals accurately.*

Panel Backlight The Panel Backlight setting enables you to illuminate the front-panel buttons that are not selected (the illumination setting for selected buttons cannot be changed). There are two controls for the front-panel backlight. One control turns the backlight on and off (Panel Backlight) and the other control sets the intensity or brightness of the backlight (Panel Backlight Intensity).

Panel Backlight Intensity Sets the intensity of the front-panel button backlight. This feature is especially useful in low-light situations so you can see buttons that are not selected.

Freeze Affects Specifies the scope of the Freeze operation. If All Tiles is selected, pressing FREEZE captures an image in all the tiles simultaneously. If Active Tile is selected, pressing FREEZE captures an image only in the active tile.

LTC / VITC Menu

The **LTC / VITC** menu enables you to specify which time code is used for logging and whether or not it is displayed in the Status Bar. See Table 2-26.

Table 2-26: LTC / VITC settings

Setting	Description	Choices / Range
Display if Present	Specifies which time code is used for logging and displayed in the Status bar readout	VITC / LTC / Off

Readouts Menu

The **Readouts** menu enables you to turn various display readouts on or off. See Table 2-27.

To change the **Readouts** settings:

1. Press and hold the **CONFIG** button until the menu appears.
2. Use the **GENERAL** knob or the up/down arrow keys to select **Readouts**.
3. Use the navigation keys to change the menu focus to the Readouts submenu.
4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-27: Readout settings

Setting	Choices / Range
Waveform	On / Off
Vector	On / Off

Table 2-27: Readout settings (Cont.)

Setting	Choices / Range
Picture	On / Off
Gamut	On / Off

Waveform Specifies whether or not readouts are visible in the Waveform display.

Vector Specifies whether or not readouts appear in the Vector display.

Picture Specifies whether or not readouts appear in the Picture display.

Gamut Specifies whether or not readouts appear in the Gamut display.

Graticules Menu

The Graticules submenu enables you to specify the graticule display style associated with different displays based on the input signal. See Table 2-28.

Table 2-28: Graticule settings

Setting	Choices / Range
SDI Vector I/Q Axis	On / Off
Cmpst Waveform Graticule Units	Auto / mV
Picture Line Select Cursor	On / Off
Field Sweep Line Select Cursor	On / Off

SDI Vector I/Q Axis Turns the display of the I/Q axis in the Vector display on or off for SDI input signals.

Cmpst Waveform Graticule Units Sets the Waveform display graticule units for Composite input signals.

Picture Line Select Cursor Displays a cursor in the PICTURE display that tracks the selected line when any tile has LINE SEL mode turned on. This feature enables you to see which line in the picture is displayed in the tile in LINE SEL mode.

**Field Sweep Line Select
Cursor**

Displays a cursor in a field or 2-field WFM display that tracks the selected line in another tile which has LINE SEL mode turned on. Thus enabling you to see which line in the field is displayed in the tile in LINE SEL mode.

Network Settings

This menu allows you to set IP addresses and change what methods of network control are active.

Table 2-29: Network settings

Setting	Choices / Range
IP Config Mode	Manual / DHCP
IP Address	xxx.xxx.xxx.xxx
Subnet Mask	xxx.xxx.xxx.xxx
Gateway Address	xxx.xxx.xxx.xxx
View MAC Address	xx:xx:xx:xx:xx:xx
Instrument Name	15-character alphanumeric string
SNMP Enable	Off / On
SNMP Public Community	15-character alphanumeric string
SNMP Private Community	15-character alphanumeric string
SNMP Trap Enable	Off / On
SNMP Trap Address 1	xxx.xxx.xxx.xxx
SNMP Trap Address 2	xxx.xxx.xxx.xxx
SNMP Trap Address 3	xxx.xxx.xxx.xxx
SNMP Trap Address 4	xxx.xxx.xxx.xxx
Web Enable	Off / On

IP Config Mode

Specifies how the WVR610A & WVR611A network address is determined. Network addresses can be assigned either automatically or manually. If your network uses DHCP (Dynamic Host Configuration Protocol) to assign addresses, then the address will be assigned dynamically to the WVR610A & WVR611A. If your network does not use DHCP, you will have to manually enter the address for the WVR610A & WVR611A. To get an address, talk to your LAN administrator.

To set the IP Config Mode:

1. Press **CONFIG** to display the Configuration menu.

2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **IP Config Mode**.
4. Press **SEL** to set the mode to **Manual** or **DHCP** as required.
5. If the IP Config Mode is set to Manual, set the IP Address.
6. Press **CONFIG** to remove the Configuration menu.

IP Address

The IP (Internet Protocol) address is the network address of the WVR610A & WVR611A. If you plan to use your WVR610A & WVR611A on a network (for example, for using the web interface), you may need to set this address depending on how your network assigns addresses. If your network does not use automatic address allocation (DHCP), you will need to set this address. To get an address, talk to your LAN administrator.

To set the IP Address:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Verify the **IP Config Mode** is set to **Manual**.
4. Select **IP Address** and press the right-arrow key to change the menu focus to the submenu. See Figure 2-46.

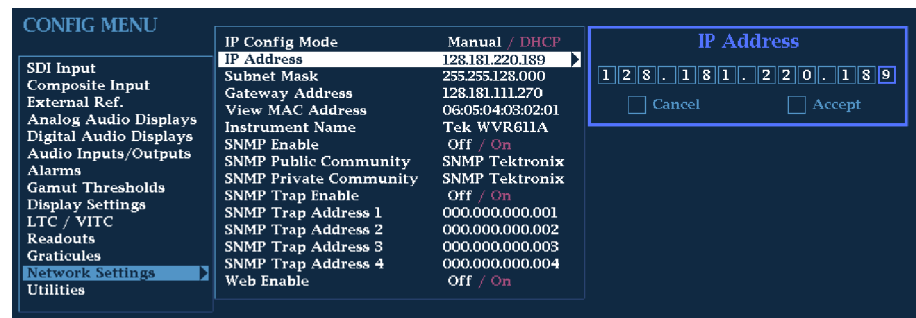


Figure 2-46: Setting IP address

5. 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.
6. Work your way through each box in the address, setting the number as required.
7. To accept your changes, move the highlight to the **Accept** box and press **SEL**.
8. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.

Subnet Mask

The Subnet Mask is part of the network address of the WVR610A & WVR611A. If you plan to use your WVR610A & WVR611A on a network (for example, for using the web interface), you may need to set this parameter depending on how your network assigns addresses. If your network does not use automatic address allocation (DHCP), you will need to set this parameter. To get the correct subnet mask, talk to your LAN administrator.

To set the Subnet Mask:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Verify the **IP Config Mode** is set to **Manual**.
4. Select **Subnet Mask** and press the right-arrow key to change the menu focus to the submenu.
5. To change the Subnet Mask, select the **Change** box using the left/right arrow keys. Once **Change** is selected, use the up/down arrow keys to scroll through the list of available masks. See Figure 2-47.

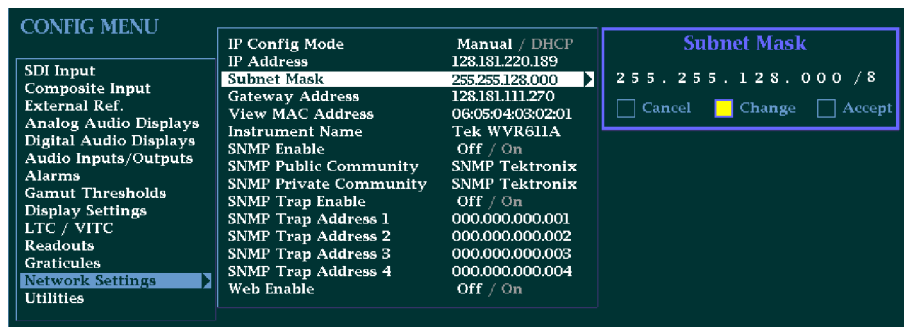


Figure 2-47: Setting subnet mask

6. After you have selected the correct Subnet Mask, use the right-arrow key to select **Accept**. Once **Accept** is highlighted, press **SEL** to accept the change.
7. If you decide not to change the Subnet Mask, move the highlight to the **Cancel** box and press **SEL**.

Gateway Address

The Gateway Address is the network address of a node that serves as an entrance to another network. To find out what the Gateway address is for your network, talk to your LAN administrator.

To set the Gateway Address:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **Gateway Address** and press the right-arrow key to change the menu focus to the submenu.
4. 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.
5. Work your way through each box in the address, setting the number as required.
6. To accept your changes, move the highlight to the **Accept** box and press **SEL**.
7. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.

View MAC Address

The **View MAC Address** parameter allows you to see the MAC (Media Access Control) address assigned to the instrument. This is a unique address used to identify the instrument.

To view the MAC address:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow to change the menu focus to the submenu.
3. Read the MAC address at the right of **View MAC Address**.

Instrument Name

The WVR610A & WVR611A allows you to name the instrument for identification across a network. The instrument name is a 15-character string made up of alphanumeric text. The available characters are 0-9, a-z, A-Z, - , _ , and blank.

To change the instrument name:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Utilities** and press the right-arrow key to change the menu focus to the submenu.
3. Select **Instrument Name** and press the right-arrow key to change the menu focus to the submenu.
4. Use the left/right arrow keys to move the highlight to each box. Use the up/down arrow keys to change the character in each box as required. Press **SEL** to toggle between uppercase and lowercase characters.

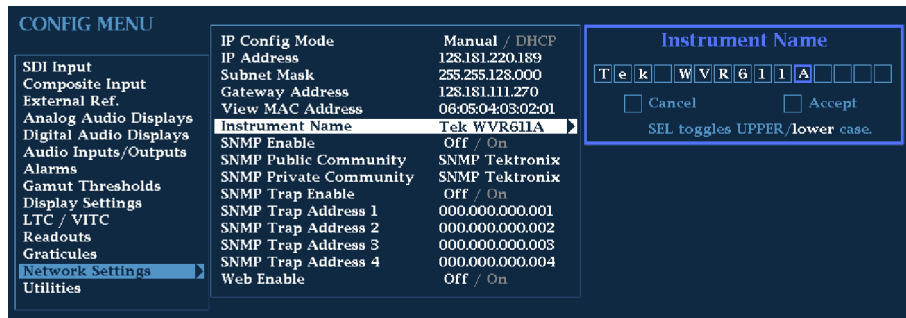


Figure 2- 48: Setting the instrument name

5. To accept the name you have entered, move the highlight to the **Accept** box and press **SEL**.
6. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.

SNMP Enable

This setting enables you to allow or deny remote control access to the waveform rasterizer over a network. You can still access the waveform rasterizer using the Web Interface when SNMP Enable is Off, but you will not be able to view or change instrument settings using the waveform rasterizer MIB commands.

To set the SNMP Enable mode:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **SNMP Enable**.
4. Press **SEL** to change the setting.

5. After changing the setting, press **CONFIG** to remove the Configuration menu.

SNMP Public Community

This setting specifies the string that SNMP commands must include to have read-only access.

To set the SNMP Public Community string:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **SNMP Public Community** and press the right-arrow key to change the menu focus to the submenu.
4. Use the left/right arrow keys to move the highlight to each box. Use the up/down arrow keys to change the character in each box as required. Press **SEL** to toggle between uppercase and lowercase characters.

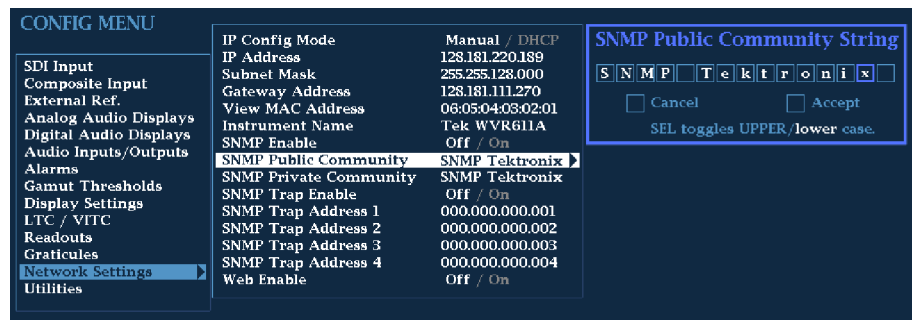


Figure 2-49: Setting the SNMP public community string

5. To accept the name you have entered, move the highlight to the **Accept** box and press **SEL**.
6. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.
7. After changing the setting, press **CONFIG** to remove the Configuration menu.

SNMP Private Community

This setting specifies the string that SNMP commands must include to have read/write access.

To set the SNMP Public Community string:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **SNMP Private Community** and press the right-arrow key to change the menu focus to the submenu.
4. Use the left/right arrow keys to move the highlight to each box. Use the up/down arrow keys to change the character in each box as required. Press **SEL** to toggle between uppercase and lowercase characters.

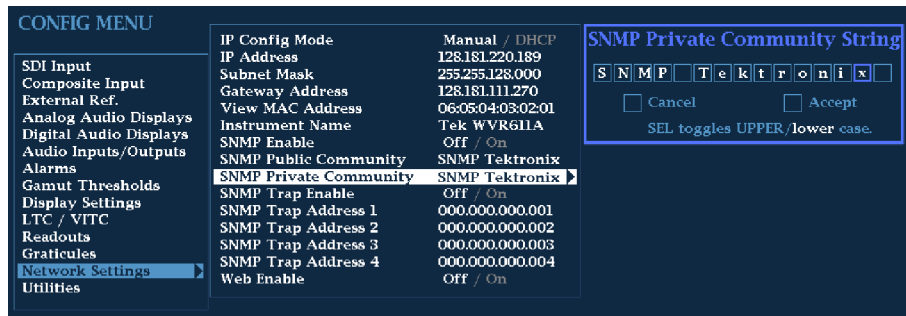


Figure 2- 50: Setting the SNMP private community string

5. To accept the name you have entered, move the highlight to the **Accept** box and press **SEL**.
6. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.
7. After changing the setting, press **CONFIG** to remove the Configuration menu.

SNMP Trap Enable

This setting allows you to turn on or off the capability of the waveform rasterizer to generate SNMP traps.

To set the SNMP Trap Enable mode:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **SNMP Trap Enable**.
4. Press **SEL** to change the setting.

5. After changing the setting, press **CONFIG** to remove the Configuration menu.

SNMP Trap Address 1-4

This setting allows you to set IP addresses to which SNMP traps are sent.

To set the SNMP Trap Addresses:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select the desired **SNMP Trap Address** (1 through 4) and press the right-arrow key to change the menu focus to the submenu.
4. Use the left/right arrow keys to move the highlight to each box. Use the up/down arrow keys to change the number in each box as required. See Figure 2-51.

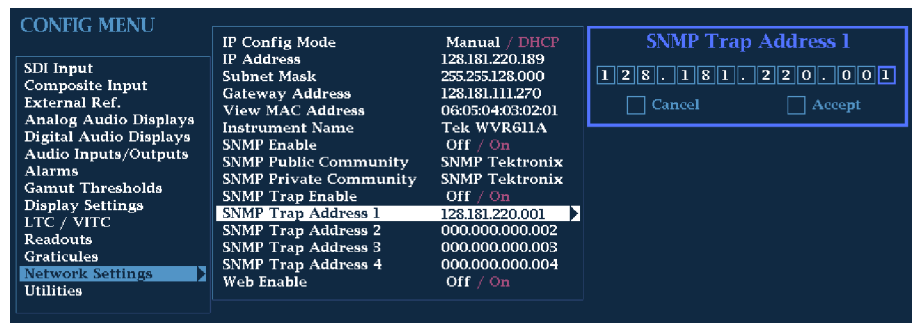


Figure 2-51: Setting the SNMP trap address

5. To accept the address you have entered, move the highlight to the **Accept** box and press **SEL**.
6. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.
7. After setting the address, press **CONFIG** to remove the Configuration menu.

Web Enable

This setting allows you to allow or deny web browser access to the waveform rasterizer.

To set the Web Enable setting:

1. Press **CONFIG** to display the Configuration menu.

2. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
3. Select **Web Enable**.
4. Press **SEL** to change the setting.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Utilities Menu

The Utilities submenu provides settings for several non-measurement related waveform rasterizer parameters. See Table 2-30.

To change the **Utilities** settings:

1. Press and hold the **CONFIG** button until the menu appears.
2. Use the **GENERAL** knob or the up/down arrow keys to select **Utility**.
3. Use the navigation keys to change the menu focus to the Utility submenu.
4. Select the desired setting and change the setting as needed.
5. After changing the setting, press **CONFIG** to remove the Configuration menu.

Table 2-30: Utilities settings

Setting	Choices / Range
View HW / SW Version	View Only
Set Clock	Time : Date
CPU Color Palette	View Only
System Upgrade	Press SEL
Calibration	Press SEL to Start
Run Power Up Diags	Press SEL
Run Advanced Diags	Press SEL
View Diagnostic Log	Press SEL
Diag Log Mode	Circular / Stop when full

View HW/SW Version

This settings lists the version number for several hardware and software subsystems.

To view the list of hardware and software versions:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Utilities** and press the right-arrow to change the menu focus to the submenu.
3. Select **View HW/SW Version**. The version numbers will appear in the submenu listing to the right. See Figure 2-52.

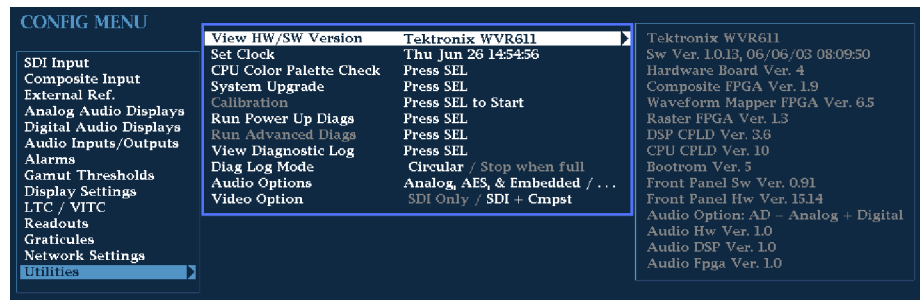


Figure 2-52: Viewing hw/sw version numbers

Set Clock

This setting allows you to set the real-time clock in the waveform rasterizer.

To set the clock:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Utilities** and press the right-arrow key to change the menu focus to the submenu.
3. Select **Set Clock** and press the right-arrow key to change the menu focus to the submenu.
4. Use the left/right arrow keys to move the highlight to each box in the time and date fields. Use the up/down arrow keys to change the value in each box as required.

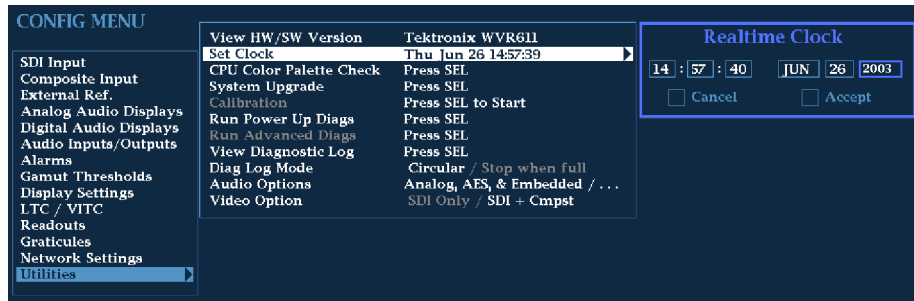


Figure 2- 53: Setting the internal clock

5. Work your way through each box in the time and date fields, setting the value as required.
6. To accept your changes, move the highlight to the **Accept** box and press **SEL**.
7. If you wish to cancel the changes you have made, move the highlight to the **Cancel** box and press **SEL**.

CPU Color Palette Check

This setting in the Config menu enables a service technician to easily verify that the display color circuitry is operating correctly.

To display the CPU Color Palette:

1. Press **CONFIG** to display the Config menu.
2. Select **Utilities** and press the right-arrow key to change the menu focus to the submenu.
3. Select **CPU Color Palette Check**.
4. Press **SEL** to display the color palette. See Figure 2-54.
5. Press **CONFIG** to remove the Config menu.

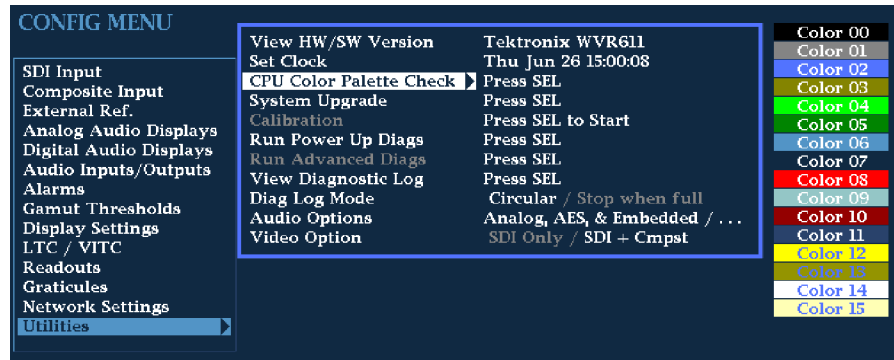


Figure 2-54: CPU color palette

System Upgrade

The **System Upgrade** selection is used to upgrade the system software of the WVR610A & WVR611A. The upgrade is performed access an Ethernet network using a PC to transfer the new software to the WVR610A & WVR611A. For the procedure to upgrade the system firmware, refer to *Upgrading the Waveform Rasterizer Firmware* on page 2-79.

Calibration

This menu selection is used during the Performance Verification and adjustment process. You must use the correct, properly calibrated equipment to achieve specified performance characteristics. Refer to the *Composite Analog Vertical Measurement Accuracy* (WVR611A only), *Composite Analog Frequency Response* (WVR611A only), *Composite Analog Input DC Offset Restore Off* (WVR611A only), and *Analog Audio Level Meter Accuracy Over Frequency* (Options AN and DA only) procedures in *Performance Verification* for the adjustment procedures.

Run Power Up Diags

The waveform rasterizer provides diagnostic routines that you can run if you believe your instrument is not behaving correctly. You can run two levels of diagnostics. The Power Up Diags are the diagnostic routines that are run when power is applied to the waveform rasterizer. The Advanced Diags is a more thorough set of diagnostics that you can run if the waveform rasterizer passes the Power Up Diags but you believe there is still a problem with the waveform rasterizer.

To run the power-up diagnostics:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Utilities** and press the right-arrow to change the menu focus to the submenu.
3. Select **Run Power Up Diags**. Press **SEL** to display the Power-up Diagnostics screen.

- To run the diagnostics, use the right-arrow key to select **Run Diagnostics**. Press **SEL** to start. See Figure 2-55.

NOTE. False alarm error entries may be recorded in the log file while running diagnostics. Examine the log time stamps to see which errors are not significant, or clear the log files after running diagnostics.



Figure 2-55: Power-up diagnostics passed

- To exit the Power-up Diagnostics screen, use the right-arrow key to select **Exit** and press **SEL**.

If your waveform rasterizer does not pass the power-up diagnostics, see the *WVR610A & WVR611A Waveform Rasterizers Service Manual* for information on troubleshooting. If you wish to return the waveform rasterizer to Tektronix for servicing, see page xvii for information on how to contact Tektronix.

Run Advanced Diags

If your waveform rasterizer passes the power-up diagnostics but you still feel it may not be operating properly, you can run the Advanced Diagnostics. Note that the waveform rasterizer must be rebooted to run the Advanced Diagnostics.

To run the Advanced Diagnostics:

- Press **CONFIG** to display the Configuration menu.

2. Select **Utilities** and press the right-arrow to change the menu focus to the submenu.
3. Select **Run Advanced Diags**. Press **SEL** to begin the Advanced Diagnostics. This displays the screen show in Figure 2-56.

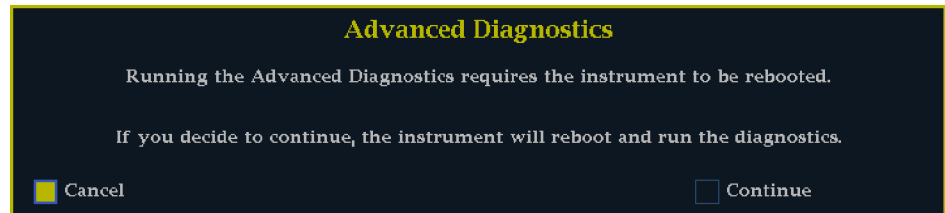


Figure 2-56: Advanced diagnostics dialog box

4. To continue with the Advanced Diagnostics, use the right-arrow key to select **Continue** and press **SEL**.

After the Advanced Diagnostics have been completed, you will see a screen that lists a series of tests and other values. The display will indicate that the tests either Passed or Failed.

NOTE. *False alarm error entries may be recorded in the log file while running diagnostics. Examine the log time stamps to see which errors are not significant, or clear the log files after running diagnostics.*

If the waveform rasterizer does not pass the Advanced Diagnostics, see *Troubleshooting* on page 6-5 for information on troubleshooting. If you wish to return the waveform rasterizer to Tektronix for servicing, see page xvii for information on how to contact Tektronix.

Viewing the Diagnostic Log

You can display the results of previous diagnostics runs if they have been saved.

To display the diagnostic log:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Utilities** and press the right-arrow to change the menu focus to the submenu.
3. Select **View Diagnostic Log**. Press **SEL** to display the log. This displays a screen similar to Figure 2-57.



Figure 2-57: Diagnostics log

The Diagnostic Log can contain many pages of information depending on how long it has been since the log was erased and how many times diagnostics have been run.

To view different pages in the Diagnostic Log:

- Use the right-arrow key to select the page you wish to view. Press **SEL** to view the selected page.

You can view the first page, last page, previous page or the next page. The number of pages in the diagnostics log is shown at the top-right corner of the diagnostics log screen.

Table 2-31 describes the contents of the columns that appear in the diagnostics log.

Table 2-31: Diagnostic log contents

Column heading	Description
Status	Either Pass or Fail.
Diagnostic	The name of the diagnostic routine.
Additional Information	Details about the diagnostic routine; entries are: NPass - Number of passes NTotal - Number of times the routine was run

To erase all the entries in the Diagnostic Log:

1. Use the right-arrow key to select **Erase** at the bottom of the diagnostics log screen.
2. Press **SEL** to erase the contents of the diagnostics log.

Setting the Diag Log Mode

The Diagnostics Log can contain only a limited number of entries. You can specify how the waveform rasterizer deals with a full diagnostics log by setting the **Diag Log Mode** in the Config menu. The choices for Diag Log Mode are:

- **Circular** - When set to Circular, the diagnostics log starts overwriting the oldest entries in the log once it is full. In Circular mode, the diagnostics log will add entries indefinitely.
- **Stop when full** - When set to Stop when full, the waveform rasterizer stops adding entries to the diagnostics log when it is full.

To set the Diag Log mode:

1. Press **CONFIG** to display the CONFIG menu.
2. Select **Utilities** from the menu.
3. Press the right-arrow key to change the menu focus to the submenu.
4. Press **Diag Log Mode** from the submenu.
5. Press **SEL** to change the setting between **Circular** and **Stop when full**.
6. Press **CONFIG** to remove the menu.

Updating the Waveform Rasterizer Firmware

System Upgrade (CONFIG> Utilities > System Upgrade) is used to upgrade the system software of the WVR610A & WVR611A. The upgrade is performed across an Ethernet network using a PC to transfer the new software to the WVR610A & WVR611A.

The firmware upgrade process involves the following steps:

- Downloading the firmware package ZIP-file from the Tektronix website.
- Initiating the update mode on the waveform rasterizer.
- Unzipping the firmware package and using the enclosed data-transfer utility to send the new firmware data to the instrument you are upgrading.
- Verifying the operation of the instrument after the firmware upgrade.

PC System Requirements

Before you download the WVR610A & WVR611A firmware-upgrade package, verify that your PC meets these requirements.

The data-transfer utility for upgrading the WVR610A & WVR611A runs on the following PC systems:

- Windows 98
- Windows NT 4.0
- Windows 2000
- Windows ME systems
- Windows XP

Additionally, your PC requires the following minimum system-requirements to load and operate the data-transfer utility used to upgrade the waveform rasterizer:

- Winsock 2.0
- Ethernet interface
- 10 MB of free disk space

Firmware Package Download

You can download the latest version of the WVR610A & WVR611A firmware from the Tektronix website at the following URL:

http://www.tek.com/Measurement/video_audio

From there, follow the links to *Software & Drivers*, and then to *Video Test* to locate the waveform rasterizer firmware-upgrade package.

When you download the upgrade package, you will receive a self-extracting ZIP file containing the following files:

- transfer.exe (data-transfer utility program)
- firmware.pkg (waveform rasterizer firmware-upgrade data file)
- readme.txt (release notes)

Preparing for the System Upgrade

Once you have downloaded a system upgrade package, unzip the file. Next, write down the network address of the waveform rasterizer you plan to upgrade.

Installing the Firmware

To install new firmware in a waveform rasterizer:

1. On the waveform rasterizer, press **CONFIG** to display the Config menu.
2. Select **Utilities** and press the right-arrow key to change the menu focus to the submenu.
3. Select **System Upgrade** and press **SEL**. This displays the System Software Upgrade window. See Figure 2-58.

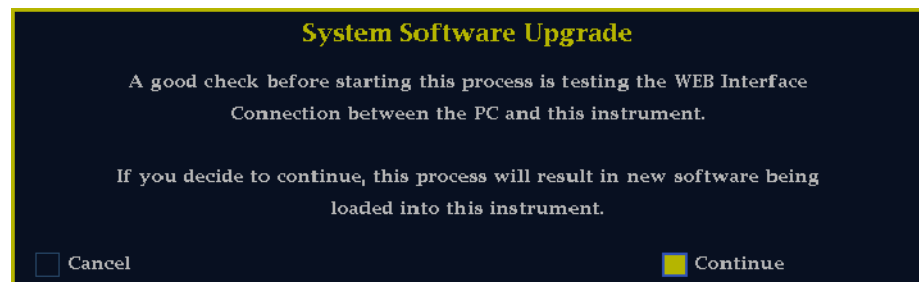


Figure 2-58: Select continue to begin the firmware upgrade process

4. To continue with the upgrade, press the right-arrow key to select **Continue** and press **SEL**.

NOTE. You can also place the waveform rasterizer into the upgrade mode by pressing the **FULL** button while applying power to the instrument.

This places the waveform rasterizer into the upgrade mode. The monitor display will go to black and the DISPLAY SELECT keys will flash in sequence. If the instrument is in DHCP mode, the arrow keys will also flash.

NOTE. If the waveform rasterizer is in DHCP mode, wait until the arrow keys stop flashing before proceeding.

If you don't recall the IP address of the waveform rasterizer, you can temporarily set the IP address to the default value (192.168.1.1) once it is in upgrade mode by pressing **SEL**. After the upgrade is completed, the original IP address will be restored.

5. On the PC, double-click the **transfer.exe** file to launch the transfer program. This displays the window shown in Figure 2-59.

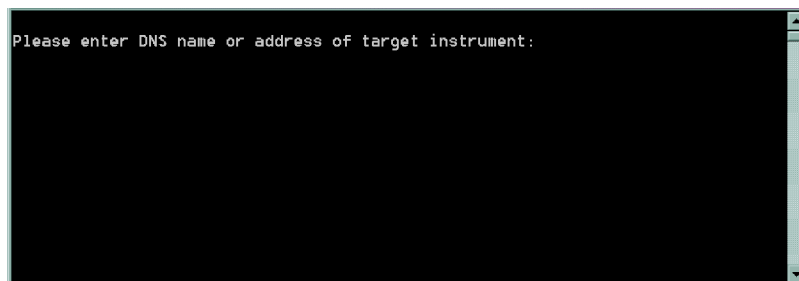


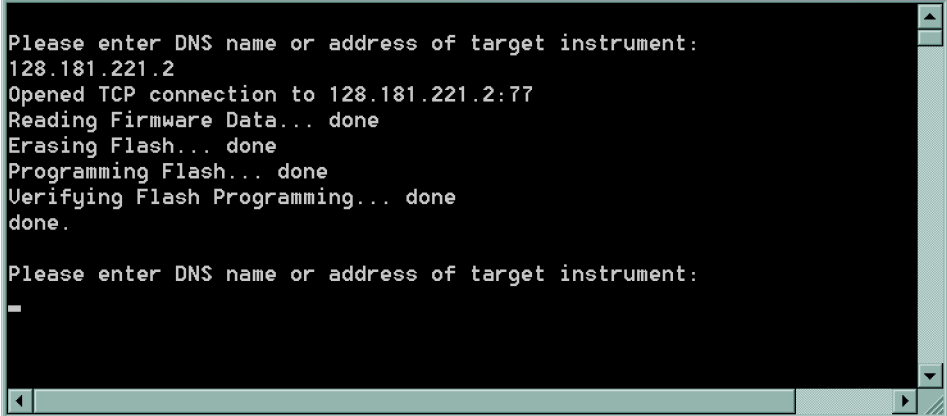
Figure 2-59: Transfer utility window

6. Type the network address (for example: 198.181.221.123) or DNS name of the waveform rasterizer you wish to update, and then press Enter. This starts the firmware upgrade process.

To stop the firmware update, you can press any MEASURE button on the front-panel of the waveform rasterizer before the transfer utility begins erasing the flash ROM. Once the words **Erasing Flash...** appear in the transfer utility window, you cannot stop the update.

As the firmware upgrade begins, the buttons on the waveform rasterizer will stop flashing. Next, buttons on the waveform rasterizer will illuminate to indicate the progress of the software upgrade.

- As each stage completes, the following buttons illuminate in sequence WFM, VECT, MEAS, and 1X.
 - While each stage progresses, the middle row of buttons (PICT, AUDIO, OTHER, 5X and so forth) illuminates.
 - When CONFIG illuminates, the stage in process has completed.
7. The transfer utility displays **done** when the software upgrade completes. See Figure 2-60.



```
Please enter DNS name or address of target instrument:
128.181.221.2
Opened TCP connection to 128.181.221.2:77
Reading Firmware Data... done
Erasing Flash... done
Programming Flash... done
Verifying Flash Programming... done
done.
Please enter DNS name or address of target instrument:
_
```

Figure 2-60: Done appears when the software upgrade completes

When the software upgrade completes, the waveform rasterizer will reboot.

8. To update another waveform rasterizer, begin at step 1 and skip step 5. If you won't be updating another waveform rasterizer, press **Enter** to exit the transfer utility.

Upgrading Multiple Instruments

You can upgrade several instruments in in one session, one at a time. To do this, use the Windows Command Prompt. Enter the following line in a Command Prompt window (substituting the addresses of your machines):

```
transfer.exe 192.181.115.1 192.181.115.2 192.181.115.3
```

Separate the addresses with a space.

Alternatively, you can use file redirection to input the IP addresses to the transfer.exe utility. To do this, create a text file containing a carriage-return delimited list of IP addresses or DNS names for the instruments to be updated. If you created a text file named HOSTS.TXT, you would enter the following command to update a group of instruments:

```
transfer.exe < HOSTS.TXT
```

Verifying the Upgrade

After you have completed the firmware upgrade, the instrument will reboot and come up in an operational mode.

NOTE. *When you perform a firmware upgrade, the Readme.txt file that is included with the firmware-upgrade package will document whether all of the current Configuration menu and instrument-mode settings are preserved.*

To verify the functional performance of your instrument, perform the procedures located in *Performance Verification* beginning on page 4-1.



Theory of Operation

Theory of Operation

The WVR610A & WVR611A Waveform Rasterizers have serial digital and optional analog composite inputs. Optionally, they can also have analog only, digital only, or digital and analog audio capability. All models use an external XGA monitor for the display. This section covers the full capability, so some portions may not apply to a model with fewer features.

This theory of operation is mainly based on the *High-level signal flow block diagram* (on the foldout page in Section 8). When necessary, other block diagrams may also be referenced.

The upper portion of the block diagram covers functions on the main board. The lower section covers those of the audio board. The primary functions on the main board are:

1. Serial Digital Input
2. Composite input
3. Reference Input
4. Digital Waveform Processing Engine
5. Rasterizing Engine
6. Recursion and Picture processing Engine
7. Control Processor and it's associated peripherals
8. Front Panel
9. LTC and VITC decoder

The primary functions on the audio board are:

1. Processing
2. Inputs
3. Outputs

There are also miscellaneous circuits such as the fans and their thermal control system, and the "Fault" bus. These are covered in the *High-level fault and fan block diagram* on the foldout page in Section 8.

Power Distribution is not shown in the block diagram but is covered at the end of this section.

Serial Digital Input

The serial digital signal inputs are passive loop-throughs, so they must be terminated to operate properly. The two inputs go through a 2-to-1 multiplexer and are then applied to the cable equalizer and the rest of the serial-to-parallel conversion circuit. The output of this section is parallel data and a 27 MHz clock.

Composite Input

The Composite input also has passive loop-through capability. If unterminated, the signal appears twice as large as it should. The two sets of inputs go through a 2-to-1 multiplexer; then the selected signal can be clamped, if selected by the user. After the clamp, the signal is filtered and then applied to an A-to-D converter to generate a 12-bit parallel signal. There is also a sync separator to generate timing information and a picture decoder. The output of the picture decoder is very similar to the parallel data from the serial digital input. The sync from the input is passed on the WFM FPGA where the processing is done in the digital domain including the sub-carrier regeneration and demodulation.

Reference Input

The Reference input is a passive loopthrough similar to that of the Composite input. The buffered signal is clamped and then digitized to generate a 10-bit stream. A simple, sync separator is used to generate timing information which is sent to the waveform processing FPGA. As on the composite input, the sync from the reference is passed on to the WFM FPGA where the processing is done in the digital domain.

Digital Waveform Processing Engine

The parallel data streams from all three video inputs are applied to the waveform processing FPGA. This block up-samples, interpolates, demodulates and otherwise processes the data to generate the signals needed to create the displays.

Rasterizing Engine

Inside the same FPGA as the waveform processing is the Rasterizer engine. This block builds up the variable intensity images in the fast static RAM. For each pixel of the display, the intensity is incremented every time the waveform hits that coordinate. This results in a display that is bright where the signal is most of the time and dim where it has only passed only once or a few times. For any

given frame, the intensity map is built up in one memory chip and read out of the other. The functions are swapped on the next field.

Recursion and Picture Processing Engine

The output of the rasterizer feeds the picture and recursive processing engine in the second large FPGA. This engine adds the previous frame to the present frame to reduce flicker and improve brightness. It also converts the picture and waveform signals from the input rate of 50 or 59.94 Hz to 60 Hz frame rate to work with the XGA monitor. The picture and waveform data are combined with the graphics and audio bar information from the control processor, then output to the XGA DAC to drive the external monitor. Note that the parallel data from the serial digital input, and the parallel stream from the composite decoder bypass the waveform processing engine and connect directly to this FPGA to provide the picture functionality.

Control Processor

The control processor is in charge of all the operational modes in the instrument, and it draws the audio bars. The control processor communicates with the front panel through RS232 signaling. It uses either parallel or the I2C bus for control of most other the internal devices. A few parts communicate through other bus types like JTAG or SPI. Audio data is input to the control processor via the 8 bit HPI bus.

The control processor interfaces to the Ethernet through a dual rate switch. This allows the network connection to run at 10 or 100 MB/s.

Front Panel

The front panel contains a small processor that communicates to the control processor through RS232 signaling. Power, ground, fault and a programming signal to allow the front panel processor flash code to be updated are also included in the interface.

LTC and VITC Decoder

LTC and VITC signals are routed to the decoder chip. The control processor reads the time values from the decoder chip. If selected by the user, the decoded time values can be displayed on the XGA monitor and used to time stamp alarm log entries.

LTC inputs come from the remote connector. The LTC signal is also applied to an A/D converter and then input to the waveform processing FPGA to create the LTC waveform display.

The VITC input can come from three sources. The analog composite signal from the output of the 2-to-1 multiplexer can be routed to the LTC decoder. Alternatively the reference signal can be routed to the LTC input, although this function is not supported in version 1.0.4 software. Finally, the SDI input can be output from the recursion and picture processing FPGA to a simple encoder. This encoder converts the signal to analog composite that is then routed to the decoder chip. This digital-to-analog path is only useful for digital signals that have analog-type VITC on them. This circuit will not correctly process other forms of digital VITC.

Audio Option Board

The audio option (if installed) resides on the upper “mezzanine” board. There are three versions of audio option: “AN” is Analog only, “DG” is Digital only, and “DA” which supports both Analog and Digital.

Audio Processing

All three audio versions have the same basic processing engine. This uses an FPGA to up-sample the data if needed, and two DSP chips whose main function is to calculate the peak values for the selected meter ballistics (response characteristics).

The audio data has two paths to the display. On one path, peak values are sent to the control processor which then plots the bar displays. On the second path, one pair of raw data samples is sent to the waveform processing engine which interpolates and plots it to generate the lissajous display.

Audio Inputs

Depending on the installed option, there are up to three basic audio input paths: AES, analog, and embedded. AES inputs are accepted at various rates, the input decoder extracts the clock from the input stream. For rates of 48 kHz or below, the FPGA up-samples the data by a factor of two to improve the accuracy of the bar processing in the Audio DSP chips. A 96 kHz rate AES signal is not up-sampled.

Analog inputs are digitized at 48 kHz and then go through the same up-sampling by the FPGA and processing by the DSP chips as the AES inputs.

The embedded audio path starts at the waveform processing engine. First the audio samples are extracted from the serial digital video data using a 12.288 MHz oscillator and sent to the audio board. At the audio board, the streams are multiplexed into the AES decoders and then follow the same path as the AES data. The user can choose to have the de-embedded audio output on the AES B port.

Audio Outputs

There are two audio outputs, analog and AES. Both outputs always follow the source that is currently selected for the audio bar display. The analog outputs can come from any input. The selected signal output from the FPGA, is converted from digital to analog and then sent as a balanced output to the 37-pin rear panel connector.

The AES outputs are only available when the input is embedded. In this case, the AES B connectors can be configured as outputs, and the embedded is sent out on the AES B connectors.

Fault and Fan Block Diagram

There are two circuits not shown on the signal flow block diagram, the Fan control and the bus that drives the front-panel “Fault” LED. Refer to the *High-level fault and fan block diagram* (on the foldout page in Section 8) while reading the associated paragraphs below.

The fan circuit senses the temperature to set the fan speed. Each fan has a tachometer output to indicate fan speed so the circuit can run the fans at low speed without stalling. The slower of the two fans controls a power supply that provides the voltage for both fans. If a fan is not turning, the circuit senses the stall and asserts the fault line and a line to the control processor so the event can be entered in the diagnostic log.

The front panel “Fault” LED is driven by a line accessible by most of the instrument. The concept is to provide fault information independent of the control processor, since it may not always be working. If any circuit detects a fault, it pulls the fault line low. This line is what is called a “wire-or” because any circuit can assert it by pulling it low. Circuits are also expected to assert a local LED when asserting the fault line. Because of this local LED, a technician should be able to look inside the box and see a red LED near the site of the fault. Faults are usually also sent independently to the control processor.

For details about the circuits that can assert the fault light and their associated local LEDs, refer to the *Troubleshooting* on page 6-5.

Power Supply and Distribution

The power supply for the WVR610A & WVR611A has a universal AC input that enables it to accommodate 100 to 264 VAC without any user range switching. The output is 5 V DC, which is then converted to all the other necessary supply voltages by circuits at the point of usage.

The Primary supply 5 V output has fuses on the main board. The location of these fuses is shown on the diagrams in the troubleshooting section.

The secondary supplies and their tolerances are specified in the troubleshooting section. The location of the supply test points is shown in Diagrams section.



Performance Verification

Performance Verification

This section contains a collection of manual procedures for checking that the WVR610A & WVR611A Waveform Rasterizers perform as warranted.

The procedures are arranged in two basic sections: *Incoming Inspection Procedures* and *Performance Verification Procedures*. They check all the characteristics that are designated as checked in *Specifications*.

The tests in this chapter comprise an extensive confirmation of performance and functionality when the following requirement is met:

- 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 Table 1-32 .

Use the tables on the follow 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.

WVR610A & WVR611A 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			
Composite Input			
CMPST A, WFM with NTSC			
CMPST A, Vector with NTSC			
CMPST A, Picture with NTSC			
CMPST B, WFM with NTSC			
CMPST B, Vector with NTSC			
CMPST B, Picture with NTSC			
Analog Audio Input			
Analog Audio input A ports 1 -6 display bar			
Analog Audio input B ports 1 -6 display bar			
Analog Audio Output			
Digital Audio Input			
AES Audio input A to Display Bar			
AES Audio input B to Display Bar			
Embedded Audio to Display Bar			
Embedded Audio to Lissajous Display			

WVR610A & WVR611A Waveform Rasterizer Functional Test Record (cont.)

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

Functional Test (Incoming Inspection)	Incoming	Outgoing	Comments
Digital Audio Output			
AES B 1-2 Audio Output			
AES B 3-4 Audio Output			
AES B 5-6 Audio Output			
AES B 7-8 Audio Output			
LTC Decode and Waveform Test			
LTC Waveform Presence			
LTC Decode			
Ground Closure Remote			
Remote Input – Activate Preset 1			
Remote Output – Ground Closure			
Ethernet Functionality			

WVR611A Waveform Rasterizer Video Performance Test Record

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
SDI Input Level Low and High				
Low Level				720
High Level	880			
SDI Serial Receiver Equalization Range	23 dB			
SDI Loop Through Isolation	Pass			
SDI Return Loss, A and B Inputs				
Input A	25 dB			
Input B	25 dB			
External Reference Return Loss	-40 dB			
External Reference Formats supported – NTSC and PAL	Pass			
External Reference Lock Range	-50ppm			50ppm
External Reference Lock in Presence of Hum	Pass			
VITC Decoding Functionality	Pass			
LTC Decoding Functionality	Pass			
LTC Waveform Accuracy	-8%			8%
Composite Analog Displayed Vertical Measurement Accuracy	99% (707.71mv)			101% (722mv)
Composite Analog Frequency Response	99% (7mv)			101% (-7mv)
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 Return Loss, A and B Inputs				
Input A	-40 dB			
Input B	-40 dB			

WVR611A Waveform Rasterizer Video Performance Test Record (cont.)

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Composite Analog Input DC Offset with Restore Off	-20mv			20mv
Composite Analog Input Clamp Off Check	Pass/Fail			
Composite Analog Input DC Restore Hum Attenuation				
Fast Mode	95% (35mv)			(0mv)
Slow Mode	90% (643mv)			110% (785mv)

WVR610A Waveform Rasterizer Video Performance Test Record

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
SDI Input Level Low and High				
SDI Input low level				720
SDI Input high level	880			
SDI Serial Receiver Equalization Range	23 dB			
SDI Loop Through Isolation	Pass			
SDI Return Loss, A and B Inputs				
Input A	25 dB			
Input B	25 dB			
External Reference Return Loss	-40 dB			
External Reference Formats supported – NTSC and PAL	Pass			
External Reference Lock Range	-50ppm			50ppm
External Reference Lock in Presence of Hum	Pass			
VITC Decoding Functionality	Pass			
LTC Decoding Functionality	Pass			
LTC Waveform Accuracy	-8%			8%

WVR610A & WVR611A Waveform Rasterizer Audio Option DA Test Record

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Return Loss				
AES A 1-2 In	-25 dB			
AES A 3-4 In	-25 dB			
AES A 5-6 In	-25 dB			
AES A 7-8 In	-25 dB			
AES B 1-2 I/O	-25 dB			
AES B 3-4 I/O	-25 dB			
AES B 5-6 I/O	-25 dB			
AES B 7-8 I/O	-25 dB			
AES Audio Input Sample Rate				
AES A 1-2 In (96 kHz)	pass			
AES A 3-4 In (96 kHz)	pass			
AES A 5-6 In (96 kHz)	pass			
AES A 7-8 In (96 kHz)	pass			
AES B 1-2 I/O (96 kHz)	pass			
AES B 3-4 I/O (96 kHz)	pass			
AES B 5-6 I/O (96 kHz)	pass			
AES B 7-8 I/O (96 kHz)	pass			
AES A 1-2 In (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

WVR610A & WVR611A Waveform Rasterizer Audio Option DA Test Record (cont.)

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

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

WVR610A & WVR611A Waveform Rasterizer Audio Option DA Test Record (cont.)

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input A1 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A1 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A1 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B1 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B2 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input B1 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B2 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (1 kHz)	-6.5dB FS			-5.5dB FS

WVR610A & WVR611A Waveform Rasterizer Audio Option DA Test Record (cont.)

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Input B1 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B2 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (19 kHz)	-6.5dB FS			-5.5dB FS
Digital Input to Analog Output Gain Accuracy Over Frequency				
Analog Output 1 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 2 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 3 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 4 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 5 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 6 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Output 1 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 2 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 3 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 4 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 5 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 6 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 1 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 2 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 3 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 4 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 5 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Output 6 (19 kHz)	-6.5dB FS			-5.5dB FS

WVR610A & WVR611A Waveform Rasterizer Audio Option DG Test Record

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
AES Audio Return Loss				
AES A 1-2 In	-25 dB			
AES A 3-4 In	-25 dB			
AES A 5-6 In	-25 dB			
AES A 7-8 In	-25 dB			
AES B 1-2 I/O	-25 dB			
AES B 3-4 I/O	-25 dB			
AES B 5-6 I/O	-25 dB			
AES B 7-8 I/O	-25 dB			
AES Audio Input Sample Rate				
AES A 1-2 In (96 kHz)	pass			
AES A 3-4 In (96 kHz)	pass			
AES A 5-6 In (96 kHz)	pass			
AES A 7-8 In (96 kHz)	pass			
AES B 1-2 I/O (96 kHz)	pass			
AES B 3-4 I/O (96 kHz)	pass			
AES B 5-6 I/O (96 kHz)	pass			
AES B 7-8 I/O (96 kHz)	pass			
AES A 1-2 In (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

WVR610A & WVR611A Waveform Rasterizer Audio Option DG Test Record (cont.)

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

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

WVR610A & WVR611A Waveform Rasterizer Audio Option AN Test Record

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Audio Level Meter Accuracy Over Frequency				
Analog Input A1 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input A1 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A1 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A2 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A3 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A4 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A5 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input A6 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B1 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B2 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (100 Hz)	-6.5dB FS			-5.5dB FS
Analog Input B1 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B2 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (1 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B1 (19 kHz)	-6.5dB FS			-5.5dB FS

WVR610A & WVR611A Waveform Rasterizer Audio Option AN Test Record (cont.)

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

Performance Test	Minimum	Incoming	Outgoing	Maximum
Analog Input B2 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B3 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B4 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B5 (19 kHz)	-6.5dB FS			-5.5dB FS
Analog Input B6 (19 kHz)	-6.5dB FS			-5.5dB FS

Analog Input to Analog Output Gain Accuracy Over Frequency

Output 1 (100 Hz)	Pass			
Output 2 (100 Hz)	Pass			
Output 3 (100 Hz)	Pass			
Output 4 (100 Hz)	Pass			
Output 5 (100 Hz)	Pass			
Output 6 (100 Hz)	Pass			
Output 1 (1 kHz)	Pass			
Output 2 (1 kHz)	Pass			
Output 3 (1 kHz)	Pass			
Output 4 (1 kHz)	Pass			
Output 5 (1 kHz)	Pass			
Output 6 (1 kHz)	Pass			
Output 1 (19 kHz)	Pass			
Output 2 (19 kHz)	Pass			
Output 3 (19 kHz)	Pass			
Output 4 (19 kHz)	Pass			
Output 5 (19 kHz)	Pass			
Output 6 (19 kHz)	Pass			

Incoming Inspection Procedures

Use the following procedures to check the basic functionality of a WVR610A or WVR611A waveform rasterizer. 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 procedure.

Table 4-1: Required Test Equipment

Test Equipment	Requirements	Example	Instrument	
			WVR610A	WVR611A
XGA Monitor	Computer monitor capable of 1024 x 768 x 60Hz scan rate		✓	✓
75 Ω coaxial cables (3 required)	General purpose digital video Male-to-male BNC connectors 1 or 2 meters long	Belden 8281. Tek 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		Tektronix part number 012-1658-01		
SD serial digital video test signal generator with embedded audio and composite signal source	525-format 100% color bars SDI Matrix Split Field Pathological Signal, 270Mbit/sec 525 or 625 standard	Tektronix TG2000 with BG1, AVG1, and DVG1 (AVG1 only needed for WVR611 units, embedded audio only needed for Audio Option DA and DG).	✓	✓
AES Audio Signal Generator	48kHz, 24 bit word length signals	Rohde & Schwarz UPL06, Tektronix AM700 and AM70.	✓	✓
AES Audio Signal Analyzer		Rohde & Schwarz UPL06, Tektronix AM700.	✓	✓
Analog Audio Signal Generator		Rohde & Schwarz UPL06, Tektronix AM700 and AM70.	✓	✓
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	✓	✓

Table 4- 1: Required Test Equipment (Cont.)

Test Equipment	Requirements	Example	Instrument	
			WVR610A	WVR611A
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		✓	✓
Computer and ethernet cable	User to test Ethernet connection		✓	✓

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 all self tests pass. Any failures will be shown in red. The results of the power-on diagnostics are erased from the screen, but you can view them 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 lower-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 **FACTORY** 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 the DVG1 output to the **SDI A** input. Terminate the SDI loop-through.
3. Press **FULL** to set the active tile to full screen.
4. Press **HELP** to display the online help.
5. Press all the other buttons.

Each one should flash as you press it. Most buttons should bring up help text for 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 **HELP** and navigation keys (the four arrow keys and the **SEL** key) do not bring up help text since they are used to traverse the help panes and content.

6. Press the right arrow key until the **Help Contents** pane in the upper-left corner is highlighted.
7. Turn the **GENERAL** knob and verify the selector box moves up and down the list.
8. Press **HELP** to exit help.
9. Turn the **HORIZONTAL** and **VERTICAL** knobs and verify the waveform moves appropriately.
10. 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** and then press **SEL**.
3. Select **CPU Color Palette Test** 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 the following frequencies are within 10 kHz of the nominal value listed below:
 - a. SDI Clock = 27.000 MHz
 - b. VGA clock = 64.000 MHz
 - c. Audio PLL = 12.288 MHz
 - d. Analog Pix = 27.000 MHz (WVR611A only)
 - e. Hsync rate : Width = 19 : 3 μ s
 - f. Vsync rate : Width = 16737 : 64 μ s
 - g. Lissajous Frequencies – Liss[0,1] = 19.8 MHz-20.1 MHz (only if audio option installed)
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 (SDI PIX and VGA PIX) at the bottom of the screen show both a red and a green bar in each bit location. The VGA PIX line (XGA bus) should show 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 re-boot the unit in normal operation.
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. Apply a 10-bit 525 shallow ramp to the SDI A port. Install a termination on the other side of the loop through.
2. Press **FACTORY** to restore the factory preset.
3. Press and hold **WFM** to bring up the WFM pop-up menu.
4. Use the arrow keys to select the Pr and Pb waveforms and turn them off.
5. Press the **5X** gain button.

6. Press the **VAR** gain button and then use the GENERAL knob to increase the gain to 10X.
7. Press **FULL** to expand the tile to full screen.
8. Count the steps in the waveform. There should be 11 to 13 even vertical steps in each major division (10 mV). The steps should always step upward in a monotonic ramp.
9. Press **VAR** to switch variable gain off and press **1X** to return to normal gain.
10. Change the input signal to a 100% sweep.
11. Verify the sine waves are uniform and do not have steps. Also verify the amplitude is 700 mV.
12. If desired, move the input and termination to input B, select input B from the front panel and repeat steps 5 through 11.
13. Record Pass or Fail for SDI Bit Integrity in the test record.

External Reference

1. Press **FACTORY** to restore the factory preset.
2. Apply a 525 SDI signal to SDI A from the TG2000 DVG1 module. Install a termination on the loopthrough.
3. Apply an NTSC signal to the External Reference Port from the TG2000 BG1 module. Install a termination on the loopthrough.
4. Select **EXT REF** on the waveform rasterizer front panel.
5. The status bar in the lower left-hand corner of the display should display **Ref: Ext NTSC**.
6. Press the display select **4** button, then **WFM**, then **FIELD**.
7. Verify that both WFM tiles are stable.
8. Record Pass or Fail for NTSC Lock in the test record.
9. Remove the NTSC signal from the reference input.
10. Both WFM tiles should “unlock” and scroll.
11. The status bar in the lower left-hand corner of the display should display **Ref: Ext. Missing**.
12. Record Pass or Fail for Ref Missing in the test record.

Composite Input

1. Press **FACTORY** to restore the factory preset.
2. Apply an NTSC SMPTE bar signal from the TG2000 AVG1 module to the Composite A port. 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

1. Press **FACTORY** 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 button **4** to display the AUDIO pop-up menu.
4. In the Audio Input submenu, select **Analog A**.
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 a -6 dBFS signal.
6. Repeat step 5 for the second and third line A input pair.
7. Record Pass or Fail in the test record.
8. Bring up the AUDIO pop-up menu again and select **Analog B** in the Audio Input submenu.
9. Repeat step 5 for all three Line B input pairs.
10. Record Pass or Fail in the test record.

Analog Audio Output

1. Press **FACTORY** to restore the factory preset.
2. Press and hold the display select button **4** to display the AUDIO pop-up menu.

3. In the Audio Input submenu, select **Analog A**.
4. Using the audio breakout cable or equivalent, connect the first Line A input pair to the analog audio generator and verify that the output level of the generator is indicated on the audio bars with a -6 dBFS signal.
5. Press **CONFIG** to display the CONFIG menu.
6. 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).
7. While in the **Audio Inputs/Outputs** submenu, select **Analog A** and from the submenu select **Analog Out Map**. Press **SEL** to display the **Analog Output to Analog "A" Bar Map**.
8. Put an **X** in the first bar pair position for Analog Output 0, Analog Output 1, and Analog Output 2.
9. Press **CONFIG** to exit the CONFIG menu.
10. Connect the first analog output pair on the breakout cable to the second line A input pair.
11. Verify on the level meter bars that the second set of bars is within 1 dB of the first set of bars.
12. Connect the second 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 third 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. Record Pass or Fail in the test record.

Digital Audio Input

1. Press **FACTORY** to restore the factory preset.
2. Set the digital audio generator to output a 1 kHz, -6 dBFS sine wave.
3. Press and hold **4** to display the AUDIO pop-up menu.
4. In the **Audio Input** submenu, select **AES A**.
5. Connect the output of the digital audio generator to the AES A 1-2 input.
6. Verify that the first set of level meter bars indicates -6 dBFS.

7. Repeat steps 5 and 6 for AES A 3-4, AES A 5-6, and AES A 7-8.
8. Record Pass or Fail for AES A in the test record.
9. Press and hold **4** to display the AUDIO pop-up menu.
10. In the Audio Input submenu, select **AES B** (make sure it is configured as an input in the CONFIG menu).
11. Connect the output of the digital audio generator to the AES B 1-2 input.
12. Verify that the first set of level meter bars indicates -6 dBFS.
13. Record Pass or Fail for AES B in the test record.
14. Repeat steps 11 and 12 for AES B 3-4, AES B 5-6, and AES B 7-8.
15. Set the SD signal generator for the following signal output:
 - a. 525 format color bars
 - b. Embedded audio: 2 groups starting with group 1
 - c. Set the audio channels as follows:
 - i. Channel 1: 50 Hz, -35 dB
 - ii. Channel 2: 100 Hz, -30 dB
 - iii. Channel 3: 150 Hz, -25 dB
 - iv. Channel 4: 200 Hz, -20 dB
 - v. Channel 5: 250 Hz, -15 dB
 - vi. Channel 6: 300 Hz, -10 dB
 - vii. Channel 7: 400 Hz, -5 dB
 - viii. Channel 8: 500 Hz, 0 dB
16. Connect the output of the SD signal generator with embedded audio to the port A SDI input.
17. Press and hold **4** to display the AUDIO pop-up menu.
18. In the Audio Input submenu, select **Embedded**.
19. Verify that the level meter bars have a stair step pattern from -35 dB on channel 1 to 0 dB on channel 8.
20. Record Pass or Fail for Embedded Display in the test record.
21. Bring up the audio tile pop-up and set the phase pair to 1 & 2.

22. Go through the other phase pairs (3 & 4, 5 & 6, 7 & 8) and verify that the phase display changes in each one.
23. Record Pass or Fail for Embedded to Lissajous in the test record.

Digital Audio Output

1. Press **FACTORY** to restore the factory preset.
2. If you have just finished testing the Digital Audio Inputs, proceed to step 3, otherwise do steps 15-19 of the Digital Audio Input test.
3. Press **CONFIG** to display the CONFIG menu.
4. Select **Audio Inputs/Outputs**.
5. Under the AES B submenu, configure the port as an **Output**.
6. Press **CONFIG** to close the menu.
7. Connect the AES B 1-2 output to the Audio Signal Analyzer input.
8. Verify on the analyzer that the signal levels are at -35 dB for the left channel and -30 dB for the right.
9. Connect the AES B 3-4 output to the Audio Signal Analyzer input.
10. Verify on the analyzer that the signal levels are at -25 dB for the left channel and -20 dB for the right.
11. Connect the AES B 5-6 output to the Audio Signal Analyzer input.
12. Verify on the analyzer that the signal levels are at -15 dB for the left channel and -10 dB for the right.
13. Connect the AES B 7-8 output to the Audio Signal Analyzer input.
14. Verify on the analyzer that the signal levels are at -5 dB for the left channel and 0 dB for the right.
15. Record Pass or Fail for each output 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.
3. Connect the TG2000 DVG1 SDI output to the SDI A input. Terminate the loopthrough.
4. Connect the TG2000 composite output to the video input of the Timecode generator.
5. Select any NTSC signal for the AVG1.

6. Select any 525 signal for the DVG1.
7. Press **CONFIG** and select **LTC/VITC**.
8. Use the navigation keys to set the timecode source to be **LTC**.
9. Press **Other** to display the LTC waveform.
10. 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.
11. Record Pass or Fail for the LTC waveform in the test record.
12. In the lower-right corner of the screen, the time from the LTC input should be shown.
13. Record Pass or Fail for LTC Decode in the test record.

Ground Closure Remote

1. Connect an SDI signal to SDI input A and terminate the loopthrough.
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.
5. Press **FACTORY** again.
6. On a 15-pin 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 tile1.
10. Record Pass or Fail for Activate Preset in the test record.
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. Select **Alarms** and then select **SDI Input**.
14. Use the arrow keys to get to the top right corner of the SDI Input error check box, and 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 SDI input is not present.

15. The voltmeter should still read about 4.7 V on pin 9.
16. Remove the input signal from SDI A connector on the rear panel.
17. The voltmeter should now read a low voltage, below 0.5 V.
18. 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 **CONFIG** to display the Configuration menu.
4. Select **Network Settings** and press the right-arrow key to change the menu focus to the submenu.
5. Verify the **IP Config Mode** is set to **Manual**.
6. Select **IP Address** and press the right-arrow key to change the menu focus to the submenu.
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. Configure the **IP Config Mode** and **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.

Video and General Performance Verification Procedures

This section applies to both the WVR610A & WVR611A. The first portion is applicable for both, the later portion is only needed for the WVR611A model. Some “common” tests are done differently for the two models. These exception cases are indicated as being only for one model or the other.

Required Software Version

To perform the procedures in this section your waveform rasterizer must be running software version 1.XXX or higher. The performance verification requires the use of cursors to make some measurements. Cursors were not available in earlier versions of the software. You can download a firmware upgrade from the Tektronix web site, www.tektronix.com.

Table 4-2: Required Test Equipment

Test Equipment	Requirements	Example	Instrument	
			WVR610A	WVR611A
XGA Monitor	Computer monitor capable of 1024 x 768 x 60Hz scan rate		✓	✓
SD serial digital video test signal generator	525-format 100% color bars SDI Matrix Split Field Pathological Signal, 270Mbit/sec 525 or 625 standard	Tektronix TG2000 with two DVG1 modules. One must have Opt S1 for variable SDI amplitude	✓	✓
NTSC and PAL analog generator	100% bars and Black	Tektronix TG2000 with AVG1 module	✓	✓
NTSC and PAL precision calibration source	100% white, 100% multi-burst, Calibrated Multi-pulse	Tektronix TG2000 AVC1 ¹ Calibration module. Includes special cable.		✓
NTSC and PAL calibrated Hum insertion	Insert 0 dB hum (714mv) on the video signal.	Tektronix TG2000 AVC1 ¹ Calibration module	✓	✓
“Cable Clone” cable simulator	Simulate 0 to 400 meters of 8281 equivalent in 25 meters steps.	Faraday SC75A800B-G	✓	✓
75 Ω coaxial cables (3 required)	General purpose digital video Male-to-male BNC connectors 1 or 2 meters long	Belden 8281. Tektronix part numbers 012-0159-00 or 012-0159-01	✓	✓
75 Ω Terminator for Analog Video	Male connector, Precision	Tektronix part number: 011-0102-03	✓	✓
75 Ω term for SDI signal. (2)	Male, wideband	Tektronix part number 011-0163-00	✓	✓

Table 4-2: Required Test Equipment (Cont.)

Test Equipment	Requirements	Example	WVR610A	WVR611A
75 Ω network analyzer or Spectrum Analyzer with Tracking Generator and Return Loss Bridge	Measure return loss. 60 dB range to 10 MHz, 40 dB range to 300 MHz. 75 Ω test port; 50 Ω input and output test ports	Agilent 8712 75 ohm Tektronix 2712 Wide Band Engineering A57TUC with male 75 Ω BNC test port	✓	✓
75 Ω calibration kit		Maury 8580A 75 Ω BNC	✓	✓
VITC Generator		Horita VG-50 or Adrienne AEC-Box-28	✓	✓
LTC generator		Horita TG-50 or Adrienne AEC-Box-28	✓	✓
NTSC to SDI Converter		Grass Valley 8960DEC or AJA model D5D	✓	✓
RCA and BNC to 15 pin header custom cable	As shown in Figure 4-1. 15-pin male Dsub connector, Tektronix part number 131-1164-00. BNC Tektronix part number 131-5647-00 and RCA plug Allied 932-1098, wire		✓	✓
Square Wave generator	10 kHz, 5 V output, 50 ohm output impedance	Tektronix FG5010	✓	✓
1 to 2 VDC voltage source	1.5 V battery or power supply			✓
BNC to retractable hook tip		Tektronix part number 013-0076-01		✓

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.

Basic Setup

Use the following 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 5 minutes for the waveform rasterizer to warm up before beginning any procedures.

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 **4** in the Display Select section.
3. Press and hold **STATUS** to display the pop-up menu and select **Video Session**.
4. Connect a cable to the Opt S1 output of the TG2000 DVG. The Opt S1 output is typically the second BNC from the top of that module.
5. Connect the other end of the cable from the TG2000 DVG 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.

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 **4** in the Display Select section.
3. Press **STATUS** to display the status screen in tile 4.
4. Press and hold **STATUS** to display the pop-up menu and select **Video Session**.
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 be **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.

SDI Loop Through Isolation

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** on the waveform rasterizer.
2. Press **4** in the Display Select section.
3. Press **STATUS** to display the status screen in tile 4.
4. Press and hold **STATUS** to display the pop-up menu and select **Video Session**.
5. Connect a cable to the Normal output on 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. Set the cable clone to 225 meters cable equivalent. Connect a cable from the cable clone to one of the SDI Input A connectors.
8. Connect the second DVG1 to one of the SDI Input B connectors.
9. Set the signal driving SDI Input B to 100% color bars.
10. Set the time base on the second signal to 1 ppm high.

11. Verify that there are no EDH errors on the SDI A input.
12. Record a pass or fail as appropriate in the test record.

SDI Return Loss, A and B Inputs

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

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

External Reference Return Loss

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

1. Turn on the network analyzer and set it for Return loss, the S11 measurement.
2. Set the frequency range for approximately 300 kHz to 10 MHz.
3. Use the calibration kit and calibrate the network analyzer with one of the BNC cables attached.
4. Connect the calibrated end of the cable to one of the Reference inputs on the waveform rasterizer.
5. Terminate the other Reference connector.
6. Measure the Return loss from 300 kHz to 6 MHz. Record the lowest return loss value (the biggest reflection) over the frequency range in the test record.

**External Reference
Formats Supported:
NTSC & PAL**

Check that DUT 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. Apply a 525 100% bar digital signal from the TG2000 DVG1 to one of the SDI Input A connectors. Terminate the other SDI Input A 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. Repeat steps 3 through 6 with a 625 SDI signal and a PAL reference.
8. Log either Pass or fail in the test record.

**External Reference Lock
Range (WVR610A Version)**

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

1. Press **FACTORY** on the waveform rasterizer.
2. Connect the TG2000 AVG1 output to one of the Reference inputs. Terminate the other Reference input connector.
3. Connect the DVG1 to one of the SDI Input A connectors and terminate the other SDI Input A input connector.
4. Press **EXT** to enable external reference mode.
5. 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.*

6. Increase the negative time base offset until the waveform rasterizer cannot sustain lock. Record the maximum offset capability in the log table.
7. Repeat steps 5 and 6 for positive time base offsets.

External Reference Lock Range (WVR611A Version)

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 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.

External Reference Lock in Presence of Hum

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. For a WVR610A you must use a digital signal; for a WVR611A 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.

VITC Decoding Functionality (WVR610A Version)

Apply an SDI signal, that was converted from an NTSC signal, with VITC and verify 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 **CONFIG** to display the Configuration menu. Select **LTC/VITC** from the submenu and then select **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 of fail in the test record.

VITC Decoding Functionality (WVR611A Version)

Apply an NTSC signal with VITC and verify 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 **CONFIG** to display the Configuration menu. Select **LTC/VITC** from the submenu and then select **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 of 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 Figure 4-1. 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.

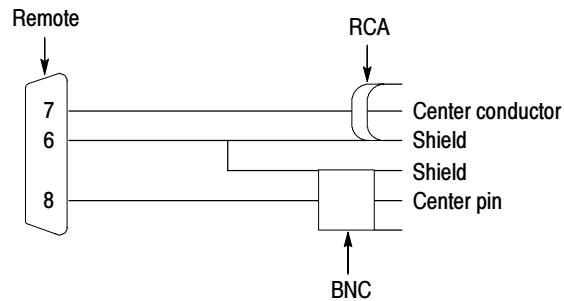


Figure 4- 1: Wiring diagram for LTC input cable

NOTE. Apply a signal to only once 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 **LTC/VITC** from the submenu and then select **LTC**.
4. Press **OTHER** on the front panel to display the LTC waveform.
5. Verify that **Decoded LTC** should be displayed in the lower right corner of the display.
6. It may be necessary to reset the LTC generator via 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 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.

This completes the tests for the WVR610A. The following tests are for the WVR611A only.

Composite Analog Vertical Measurement Accuracy

Use 100% white and cursors to measure gain.

1. Press **FACTORY** on the waveform rasterizer.
2. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
3. Set the Precision generator for NTSC 100% white bar.
4. Press the **CMPST A**, **CURSOR** and **FULL** buttons.
5. Adjust the cursors to be near the top and zero portions of the waveform.
6. Press the **5X** gain button. Adjust the lower cursor to be right on the backporch of the waveform.
7. 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.
8. Press **5X** and adjust the upper cursor to be centered on the top of the waveform.
9. 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.

Adjust. If the Amplitude is outside the specification, press **CONFIG**, select **Utilities**, then select **Calibration** and follow the on-screen instructions to adjust the gain. Follow the instructions at the bottom of the screen to Save and Exit calibration mode. Afterwards, repeat the above test for Analog Vertical Gain Accuracy and record the new value in the test record.

Composite Analog Frequency Response

Use cursors to measure the largest and smallest packets on a multi-burst signal. The difference is the frequency response variation.

1. Press **FACTORY** on the waveform rasterizer.
2. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for NTSC 100% multiburst. The top packet must be 5.75 MHz.
4. Press the **CMPST A**, **CURSOR** and **FULL** buttons.
5. Adjust cursors to be near the top and zero portions of the waveform.
6. Press **5X**, adjust the lower cursor to line up with the largest packet of the waveform.
7. Press **1X**, and adjust the vertical position to move the top of the waveform to be at the 0 mV graticule. The second cursor should also be near the zero graticule mark.
8. Press **5X** and adjust the upper cursor to line up with the top of the largest packet of the waveform.
9. Check the cursor delta display of the magnitude of the waveform. Note this number. It should be near 700 mV.
10. Adjust the cursor to line up with the top of the smallest packet.
11. Press **1X** and adjust the vertical position to move the baseline of the waveform to be at the 0 mV graticule. The other cursor should also be near the zero graticule mark.
12. Press **5X** and adjust the lower cursor to line up with the smallest packet of the waveform.
13. Note the cursor delta value.
14. Subtract the magnitude of the smallest packet as seen in step 13 from the largest as measured in step 9. This difference is the frequency response.
15. Record the difference in the test record.

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

Use special 12.5T NTSC multi-pulse signal and cursors to measure group delay.

1. Press **FACTORY** on the waveform rasterizer.
2. Connect the precision video generator to one of the Composite A input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for special 12.5T multiburst. This is a custom test signal with more packets for better coverage.
4. Press the **CMPST A**, **CURSOR** and **FULL** buttons.
5. Adjust the cursors to be near the zero portions of the waveform.
6. Press **5X** and **VAR**. Use the **GENERAL** knob to increase the gain to 10X.
7. Use the cursors to measure the peak-to-peak deviation in the baseline of the multipulse packets.
8. The peak-to-peak deviation of the baseline is 0.1% per ns. So, for a 10 ns deviation on a 714 mV signal, you should measure 7.1 mV. Record the value in the test record.

**Composite Analog Pulse
to Bar Ratio**

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

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

**Composite Analog Field
Rate Tilt**

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

1. Press **FACTORY**.
2. Connect the precision video generator to one of the **Composite A** input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for Field Rate Square Wave.
4. Press the Composite A button and cursor button and the full button.
5. Adjust cursors to be near the top of the waveform.
6. Use the vertical position knob to move the top of the waveform to the zero graticule.
7. Press the 5x gain button and the Field button.
8. Use cursors to measure the tilt in the waveform.
9. Record the value in the test record.

**Composite Analog Line
Rate tilt**

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

1. Press **FACTORY**.
2. Connect the precision video generator to one of the **Composite A** input connectors and terminate the other connector with the precision terminator.
3. Set the precision generator for 100% white.
4. Press the **CMPST A**, **CURS** and **FULL** buttons.
5. Adjust the cursors to be near the top of the waveform.
6. Use the **VERTICAL** position knob to move the top of the waveform to the zero graticule.
7. Press **5X**.
8. Use the cursors to measure the tilt in the waveform, excluding the first and last 5 μ s of the bar.
9. Record the value in the test record.

**Composite Analog Input
Return Loss Input A**

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

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

2. Set the frequency range for approximately 300 kHz to 10 MHz.
3. Calibrate the network analyzer, with one of the BNC cables attached, using the 75 ohm calibration kit.
4. Connect the calibrated end of the cable to one of the **Composite A** input connectors and terminate the other connector.
5. Measure the Return loss from 300 kHz to 6 MHz. Record the lowest return loss value (biggest reflection) over the frequency range in the test record.
6. Repeat steps 4–5 for the **Composite B** input.

Composite Analog Input DC Offset Restore Off

Measure the displayed offset when the input is un-driven and DC Restore is off.

1. Press **FACTORY**.
2. Disconnect all cables from the Composite inputs.
3. Terminate one side of both the **Composite A** and **Composite B** inputs.
4. Switch off DC Restore by selecting **CONFIG > Composite Input > DC Restore > Off**.
5. Press **CMPST A**, **CURSOR**, and **FULL**.
6. Adjust the cursors to be near the bottom of the waveform.
7. Press **5X**.
8. Push and hold **WFM**, select **Center Waveform** from the pop-up menu, then press **SELECT**.
9. Measure the waveform offset using the voltage cursor.
10. Press **CMPST B**.
11. Measure the waveform offset using the voltage cursor.
12. Record the larger of the two values in the test record.

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

**Composite Analog Input
Clamp Off Check**

Apply a small DC voltage and verify 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**

Apply hum, 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.
3. Set the AVC1 for 0 dB of 60 cycle hum.
4. Press **FIELD** twice to get a 2-field sweep.
5. Select **CONFIG > Composite Input > DC Restore > Off**.
6. Press **CURSOR** and measure the peak-to-peak hum with the cursors. The measurement should be about 714 mV.
7. Select **CONFIG > Composite Input > DC Restore > Fast**.
8. Measure the peak-to-peak hum with the cursors. It should be less than 5% of the measurement in step 6.
9. Record the value in the test record.
10. Select **CONFIG > Composite Input > DC Restore > Slow**.
11. Measure the peak-to-peak hum with the cursors. It should be between 90% and 110% of the measurement in step 6.
12. Record the value in the test record.

Audio Performance Verification Procedures

Table 4-3: Required Audio Test Equipment

Test Equipment	Requirements	Example	Audio Option		
			AN	DG	AD
SD serial digital video test signal generator	525-format 100% color bars w/ embedded audio	Tektronix TG2000 with DVG1 module		✓	✓
Sine wave generator	Capable of 0.8 V _{p-p} at 6 MHz into a 50 Ω load	Rohde & Schwarz SMT03 Opt. SM-B2		✓	✓
Test Oscilloscope	Amplitude measurements of a 6Mhz sine wave	Tektronix TDS794		✓	✓
Analog/Digital audio generator/analyzer	35 kHz to 96 kHz sample rate range, jitter measurement per AES-3 (1997)	Rohde & Schwarz UPL06 Opt B22, B29	✓	✓	✓
Precision 75 Ω-to-50 Ω adapter	1.5% impedance and attenuation accuracy	Tektronix AMT75		✓	✓
75 Ω coaxial cables (2 required)	General purpose digital video Male-to-male BNC connectors 3' long	Belden 8281		✓	✓
50 Ω coaxial cables (2 required)	Male-to-male BNC connectors 36 inches long	Tektronix part number: 012-0482-00		✓	✓
Return loss bridge	75 Ω test port 50 Ω input and output ports	Wide Band Engineering A57TUC with male 75 Ω BNC test port		✓	✓
75 Ω Terminator	Male connector	Tektronix part number: 011-0055-02		✓	✓
Analog Audio Breakout Cable	DB37 to XLR I/O	Tektronix part number: 012-1658-01	✓		✓
Calculator	Logarithmic function			✓	✓

The following tests verify that the Audio module for the WVR610A & WVR611A 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 Return Loss (Option DG or DA only)

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

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

1. Press **FACTORY**.
2. Install the 50 Ω N-to-BNC adapter on the sine wave generator output.
3. Connect the sine wave generator output to the input port of the Return Loss Bridge using a 50 Ω cable.
4. Connect the output of the Return Loss Bridge to the 50 Ω input of the test oscilloscope using a 50 Ω cable. Do not connect the test port of the Bridge at this time.
5. Set the sine wave generator as follows:
 - Frequency 6 MHz
 - Phase Modulation OFF
 - Frequency Modulation OFF
 - Output Power +2.0 dBm (0.8 V p-p)
 - RF Output ON
6. Adjust the test oscilloscope to obtain a stable display of the 6 MHz sinewave from the sinewave generator. The following oscilloscope settings normally provide a usable display.
 - Vertical Scale 50 mV
 - Horizontal Scale 100 ns/div
 - Bandwidth Limit On
7. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the reference level.

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

8. Press and hold the display select button **4** to display the AUDIO pop-up menu.

- Sample Frequency 96 kHz
 - Unbalanced V_{p-p} 1.000 V (Carrier Level)
4. Press and hold **4** to display the AUDIO pop-up menu.
 5. In the Audio Input submenu, select **AES A**.
 6. 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.
 7. Move the audio generator output to each of the remaining AES A In connectors and repeat step 6 for each connector.
 8. Set the digital audio generator as follows:
 - Sample Frequency 44.1 kHz
 9. 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.
 10. Move the audio generator output to each of the remaining AES A In connectors and repeat step 9 for each connector.
 11. Disconnect the test setup.

AES Output Amplitude (Option DG and DA Only)

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**.
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. The AES B Outputs will be available only if Embedded is selected as the current audio input source.

5. Connect the SD video generator to one of the **SDI A Loophrough** connectors using a 75Ω cable.
6. Connect a 75Ω terminator to the other **SDI A Loophrough** connector.
7. Set the SD video generator for a 525-format 100% color bars signal.

8. Set the SD video generator for 2 groups of embedded audio, starting with group 1.
9. 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.
10. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

■ Vertical Scale	200 mV/div
■ Horizontal Scale	100 ns/div
■ Horizontal Trigger Position	30%
■ Trigger Slope	Rising edge
■ Trigger Level	0 mV
11. 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.
12. Move the cable to each of the remaining AES B I/O connectors and repeat step 11 for each AES I/O connector.
13. Disconnect the test setup.

AES Output Jitter (Options DG and DA Only)

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 the SD video generator to one of the **SDI A Loophrough** connectors using a 75 Ω cable.
6. Connect a 75 Ω terminator to the other **SDI A Loophrough** connector.
7. Set the SD video generator for a 525-format 100% color bars signal.
8. Set the SD video generator for 2 groups of embedded audio, starting with group 1.

9. Connect the **AES B 1-2 I/O** connector to the digital audio analyzer unbalanced (UNBAL) input using a 75 Ω cable.
10. Set the audio analyzer for measurement of jitter per AES3-1992 (or 1997).
11. Allow the jitter reading to settle for a few seconds.
12. 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.
13. Move the cable to each of the remaining AES B I/O connectors and repeat steps 9 through 12 for each AES B I/O connector.
14. Disconnect the test setup.

AES Audio Level Meter Accuracy Over Frequency (Options DG and DA Only)

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:
 - Frequency 100 Hz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
3. Press and hold **4** to display the AUDIO pop-up menu.
4. In the **Audio Input** submenu, select **AES A**.
5. Connect the digital audio generator unbalanced (UNBAL) output to the **AES A 1-2 In** connector using a 75 Ω cable.
6. Check for an indication of -6 dB FS ± 0.2 dB in the corresponding bars and record the pass/fail result in the test record.
7. Move the audio generator output to each of the remaining **AES A In** connectors and repeat step 6 for each connector.
8. Set the digital audio generator as follows:
 - Frequency 1 kHz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
9. Repeat steps 5 through 7.

10. Set the digital audio generator as follows:
 - Frequency 19 kHz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
11. Repeat steps 5 through 7.
12. Disconnect the test setup.

Analog Audio Level Meter Accuracy Over Frequency (Options AN and DA Only)

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 **4** to display the AUDIO pop-up menu.
3. In the **Audio Input** submenu, select **Analog A**.
4. Remove the audio tile pop-up by pressing **AUDIO**.
5. Set the analog audio generator as follows:
 - Frequency 100 Hz
 - Output Level 18 dBu Audio Tone
 - Output Impedance 10 Ω
6. Connect the analog audio break out cable to the **Analog Audio I/O** connector.
7. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable
8. Check for an indication of -6 dB FS ± 0.5 dB in the corresponding bar, and record the value in the test record.
9. Repeat step 8 for the other five Input A XLR connectors.
10. Set the analog audio generator as follows:
 - Frequency 1 kHz
 - Output Level 18 dBu Audio Tone
 - Output Impedance 10 Ω

11. Repeat steps 7 through 9.
12. Set the analog audio generator as follows:
 - Frequency 19 kHz
 - Output Level 18 dBu Audio Tone
 - Output Impedance 10 Ω
13. Repeat steps 7 through 9.
14. Press and hold **4** to display the AUDIO 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 5 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, follow steps 20 through 27, otherwise skip to step 28.
19. Set the analog audio generator as follows:
 - 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 **4** to display the **Calibration** pop-up menu.
25. Select **Exit** to leave the calibration screen.
26. Check for an indication of –6 dB FS 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
(Option DA Only)**

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 Output** and set the attenuation to **0 dB**.
4. Also in the **Audio Inputs/Outputs** submenu, select **AES A > Analog Out Map**.
5. In the Analog Output Map screen, put an **X** in the **Bar 1,2** position for **Analog Output 0**, **Analog Output 1** and **Analog Output 2**.
6. Press **CONFIG** again to remove the Config menu.
7. Press and hold **4** to display the AUDIO pop-up menu.
8. In the Audio Input submenu, select **AES A**.
9. Press **AUDIO** to remove the audio tile pop-up.
10. Set the digital audio generator as follows:
 - Frequency 100 Hz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
11. Set the analog audio analyzer as follows:
 - Input Impedance 200 k Ω
12. Connect the digital audio generator unbalanced (UNBAL) output to the **AES A 1-2 In** BNC using a 75 Ω cable.
13. Connect the analog audio break out cable to the **Analog Audio I/O** connector.
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 ± 0.5 dB on the analog analyzer, and record the result in the test record.
16. Repeat step 15 for the other five Output XLR connectors.
17. Set the digital audio generator as follows:
 - Frequency 1 kHz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
18. Repeat steps 14 through 16.
19. Set the digital audio generator as follows:
 - Frequency 19 kHz
 - Output Level -6 dB FS Audio Tone
 - Sample Frequency 48 kHz
20. Repeat steps 14 through 16.
21. Disconnect the test setup.

Analog Input to Analog Output Gain Accuracy Over Frequency (Option AN Only)

This test measures the Analog Audio Output level meter 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**.
5. In the Analog Output Map screen, put an **X** in the **Bar 1,2** position for **Analog Output 0**, **Analog Output 1** and **Analog Output 2**.
6. Press **CONFIG** again to remove the Config menu.
7. Press and hold **4** to display the AUDIO 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:
 - 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 -6 dB FS 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 ± 1.0 dB on the analog analyzer, and record the pass/fail result in the test record.
16. Repeat step 15 for Output 3 and Output 5.
17. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
18. Check for an indication of -6 dB FS 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 ± 1.0 dB on the analog analyzer, and record the pass/fail result in the test record.
21. Repeat step 20 for Output 4 and Output 6.
22. Set the analog audio generator as follows:
 - 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 -6 dB FS 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 step 26 for Output 3 and Output 5.
28. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
29. Check for an indication of -6 dB FS 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 step 31 for Output 4 and Output 6.
33. Set the analog audio generator as follows:
 - Frequency 19 kHz
 - Output Level 18 dBu Audio Tone
 - Output Impedance 20 Ω
34. Connect the generator balanced (BAL) analog output to the Input A1 XLR of the breakout cable.
35. Check for an indication of -6 dB FS 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 step 37 for Output 3 and Output 5
39. Connect the generator balanced (BAL) analog output to the Input A2 XLR of the breakout cable.
40. Check for an indication of -6 dB FS 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 dBu \pm 1.0 dB on the analog analyzer, and record the pass/fail result in the test record.
43. Repeat step 42 for Output 4 and Output 6.

The completes the Performance Verification procedures.



Adjustment Procedures

Adjustments

The waveform rasterizer does not normally require any adjustments. The adjustments which can be made should only be made while performing a Performance Verification. Refer to the *Composite Analog Vertical Measurement Accuracy* (WVR611A only), *Composite Analog Frequency Response* (WVR611A only), *Composite Analog Input DC Offset Restore Off* (WVR611A only), and *Analog Audio Level Meter Accuracy Over Frequency* (Options AN and DA only) procedures in *Performance Verification* for the adjustment procedures.



Maintenance

General Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the waveform rasterizer. The following subsections are included:

- *Preventing ESD* — General information on preventing damage by electrostatic discharge.
- *Inspection and Cleaning* — Information and procedures for inspecting and cleaning the waveform rasterizer.
- *Troubleshooting* — Information for isolating and troubleshooting failed modules. Included are instructions for operating the waveform rasterizer diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- *Repackaging Instructions* — Information on returning a waveform rasterizer for service.

Preventing ESD

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual and the ESD information below.



CAUTION. *Static discharge can damage any semiconductor component in the waveform rasterizer.*

When performing any service that requires internal access to the waveform rasterizer, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.

6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the waveform rasterizer. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent waveform rasterizer malfunction and enhance its reliability.

Preventive maintenance consists of visually inspecting and cleaning the waveform rasterizer and using general care when operating it.

How often maintenance should be performed depends on the severity of the environment in which the waveform rasterizer is used. A proper time to perform preventive maintenance is just before any waveform rasterizer adjustment.

General Care

The cabinet helps keep dust out of the waveform rasterizer and should normally be in place when operating the waveform rasterizer.

Interior Cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.



WARNING. Before performing any procedure that follows, power down the instrument and disconnect it from line voltage.

Exterior Cleaning

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the chassis that may damage the chassis.



CAUTION. Avoid the use of chemical cleaning agents that might damage the plastics used in the waveform rasterizer. Use only deionized water when cleaning the front-panel buttons. Use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Inspection — Exterior. Inspect the outside of the waveform rasterizer for damage, wear, and missing parts, using Table 6-1 as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the waveform rasterizer.

Table 6-1: External inspection check list

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware	Repair or replace defective module
Front-panel knobs	Missing, damaged, or loose knobs	Repair or replace missing or defective knobs
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Repair or replace defective modules. Clear or wash out dirt
Rackmount slides	Correct operation	Repair or replace defective module
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors	Repair or replace damaged or missing items, frayed cables, and defective modules

Inspection — Interior. To access the inside of the waveform rasterizer for inspection and cleaning, you will need to remove the top cover.

Inspect the internal portions of the waveform rasterizer for damage and wear, using Table 6-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, check Table 6-2 in Section 5 to see if it is necessary to adjust the waveform rasterizer.



CAUTION. To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the waveform rasterizer.

Table 6-2: Internal inspection check list

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure — Interior. To clean the waveform rasterizer interior, perform the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

STOP. *If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.*

3. If steps 1 and 2 do not remove all the dust or dirt, the waveform rasterizer may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 6.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Dry all parts with low-pressure, deionized air.

Lubrication. There is no periodic lubrication required for the waveform rasterizer.

Troubleshooting

The procedures in this section will help you trace the root cause of a problem back to one of the replaceable parts. In general, this is a board-level replacement but there are a few components on some boards that are replaceable.



WARNING. Before performing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary found at the beginning of this manual.

To prevent possible injury to service personnel or damage to electrical components, please read Preventing ESD on page 6-1.

Getting Started

This procedure consists of two main sections; the first section contains the *Symptoms and Causes* table, and the second section contains a set of *Detailed Troubleshooting Procedures*. The table lists common problems and should help you identify the problem or it may direct you to one of the detailed troubleshooting procedures in the second section. If you do not find your instrument's problem in the table, or if no specific problem was reported by the user, then follow the steps in the *Unknown Problem* section in the Symptoms and Causes table.

To properly test a waveform rasterizer you must have a known good XGA monitor and appropriate signal sources. Depending on what portion of the instrument you are testing, this might include Composite video, Serial Digital Video, Analog Audio, or Digital Audio. In some cases, you may also need receivers or an oscilloscope to check outputs.

Table 6-3: Required Test Equipment

Test Equipment	Requirements	Example
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
SD serial digital video test signal generator with embedded audio and composite signal source	525-format 100% color bars SDI Matrix Split Field Pathological Signal, 270 Mbit/sec 525 or 625 standard	Tektronix TG2000 with BG1, AVG1, and DVG1 (AVG1 only needed for WVR611A units, embedded audio only needed for Audio Option DA and DG).
AES Audio Signal Generator	48 kHz, 24 bit word length signals	Rohde & Schwarz UPL06, Tektronix AM700 and AM70.
Analog Audio Signal Generator		Rohde & Schwarz UPL06, Tektronix AM700 and AM70.

Table 6-3: Required Test Equipment (Cont.)

Test Equipment	Requirements	Example
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
Voltmeter		Fluke 87 or equivalent
Oscilloscope	Video trigger capability	Tektronix TDS3000B Series

Table 6-4: Symptoms and causes

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
No LEDs lit and XGA output not working	Perform general checks Perform primary power supply checks Perform secondary power supply checks Replace main circuit board
Fault Light on after 15 sec boot up	Check error status page for more information Check diagnostic log for more information Perform fault LED problem isolation
Inconsistent or partial hardware failures	Perform primary power supply checks Perform secondary power supply checks Replace main circuit board
Fails any of these Power On Self Tests (POST): TIMECODE_DECODER_COMM SDI_GENNUM_COM SDI_CPLD_COMM SDI_ENCODER_COMM COMP_FPGA_COMM RASTER_FPGA_PROG RASTER_FPGA_COMM VGA_CLK_INIT WFM_FPGA_PROG WFM_FPGA_COMM COMP_VIP_COMM	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Replace the main board

Table 6-4: Symptoms and causes (Cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
If Fails any of these POST: AUDIO_SELF_TEST	Review messages in diagnostic log. If unit also fails other tests as well, then suspect main board and perform the Primary and Secondary Power supply tests. If only this test fails, then perform "Audio POST Failure" procedure to isolate the problem to main or audio board.
Diagnostic log shows Fail on any of these Advanced Diagnostics: ADV_DIAG_PWROK ADV_DIAG_RDBUS ADV_DIAG_DCMRST ADV_DIAG_QDR0 ADV_DIAG_QDR1 ADV_DIAG_RAS ADV_DIAG_SDRAM0 ADV_DIAG_SDRAM1 ADV_DIAG_SDRAM2 ADV_DIAG_AUX ADV_DIAG_GENNUM ADV_DIAG_ALL	Perform primary power supply checks Perform secondary power supply checks Replace the main board.
Diagnostic log shows Fail on any of these Advanced Diagnostics: ADV_DIAG_LSS	Review messages in diagnostic log. If the waveform rasterizer also fails other tests as well, then suspect main board and perform the primary and secondary power supply tests. If only this test fails, then perform <i>Isolating Advanced Diagnostic Lissajous Errors</i> procedure to isolate the problem to main or audio board.

Table 6-4: Symptoms and causes (Cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Failures while running the advanced diagnostics: <ul style="list-style-type: none"> ■ PLD Data Bus ■ PLD Address Bus ■ Power Supply ■ RCD Data Bus ■ RCD Address Bus ■ DCM Reset ■ QDR RAM 1 ■ QDR RAM 2 ■ Raster Data Bus Output ■ Raster Data Bus Input ■ SDRAM 0 Data Bus ■ SDRAM 0 Address Bus ■ SDRAM 1 Data Bus ■ SDRAM 1 Address Bus ■ SDRAM 2 Data Bus ■ SDRAM 2 Address Bus ■ RD_DP_AUX Bus ■ SDI Processor R/W 	<ul style="list-style-type: none"> ■ Perform secondary power supply checks ■ Replace main board
Failures while running the advanced diagnostics: <ul style="list-style-type: none"> ■ Liss[0] Frequency ■ Liss[1] Frequency ■ Lissajous [0] Bus ■ Lissajous [1] Bus 	<ul style="list-style-type: none"> ■ Perform <i>Isolating Advanced Diagnostic Lissajous Errors</i> procedure
Log Message: <ul style="list-style-type: none"> ■ Fail AUDIO_DSP_HEARTBEAT 	In the initial release of the software this message can be a false failure if the processor gets too busy. For example, if restoring presets with very different settings. If the audio function works OK, but this message still appears occasionally, then upgrade the software to the current version, clear the log, and bench test to see if the problem persists. If it does, then search for an intermittent problem in the audio board, cables, or main board.

Table 6-4: Symptoms and causes (Cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Functional Test Failures PVD Test Failures	<p>In case of failure on either Functional or the Performance tests, the board at fault is generally obvious. Before replacing a board:</p> <ol style="list-style-type: none"> 1. Perform the primary and secondary power supply checks. 2. Run the advanced diagnostics and check the diagnostic log for help in isolating the fault. <p>If this does not isolate the problem, then replace the main board if the test is in one of the following areas:</p> <ul style="list-style-type: none"> ■ SDI ■ Composite ■ Ref ■ LTC ■ VITC ■ XGA output ■ Color Palette ■ Remote I/O ■ Ethernet <p>If the problem is in the audio board, perform these tests:</p> <ol style="list-style-type: none"> 1. Isolating Advanced Diagnostic Lissajous errors. 2. Audio POST Failure.
Unknown Problems Often an instrument will come into service with vague or intermittent symptoms. In cases like these, the following set of tests may help find the problem or the marginal condition.	<ol style="list-style-type: none"> 1. Check the diagnostic log. This log records a variety of problems and will enable you to see messages for an error that may not be currently happening. 2. Check the power supplies by performing the Primary and Secondary Supply checks. A marginal supply can lead to intermittent operation if it is near the acceptable threshold. This includes the main supply and the secondary supplies on each board 3. Check the error log. This may give clues about how the unit was operating when the user saw problems. 4. Run the functional test. This will exercise a majority of the functions in the unit and includes the advanced diagnostics. Some parts of the test may not be necessary for all problem areas. 5. If the unit has an audio board, remove it and re-check any problem areas in the video performance. The Audio board can place too much of a load on the supplies if they are marginal. If the performance changes with the audio board removed, then you should perform the primary and secondary power supply checks and look for an excess load on one of the supplies.

Detailed Troubleshooting Procedures

The following tests should be run as indicated in the *Symptom and Causes* table above. The procedures check for specific problems or will help you isolate a

problem to a board. You can run them at any time for informational purposes but if you do not run the procedures in the correct context, then the final recommendation identifying a root cause might be suspect.

List of detailed troubleshooting procedures:

- General Checks
- Fault LED Problem Isolation
- Primary Power Supply Checks
- Secondary Power Supplies Checks
- Front Panel Troubleshooting
- Isolating Audio Problems
- Isolating Advanced Diagnostic Lissajous Errors.

General Checks

1. Check that the power cord is installed.
2. Check that the XGA monitor cable is connected on both ends and that the screws are holding it securely.
3. Check that all internal cables are correctly connected and seated.
4. Check for any discolored or burned components.

Fault LED Problem Isolation

The waveform rasterizer has a red **FAULT** LED on the front panel. This indicator lights up when specific types of problems occur in the instrument. The **FAULT** LED is different from the error icon on the XGA display, which indicates a problem with the signals. It is normal for the **FAULT** LED to be lit for 10 to 15 seconds during boot up.

The fault system is simple and does not require the processor be running to indicate faults. However, the fault system does not cover everything and does not give full details about the nature of the fault. Note that some problems that are covered by the **FAULT** LED are also reported to the diagnostic log.

If the instrument runs sufficiently to access the **CONFIG** menu, then check the diagnostic log for messages about the cause of the fault. Skip directly to that portion of this section if such information is available.

All subsystems that assert the **FAULT** LED also assert a local, red LED to indicate the area that generated the fault. Thus, whenever the instrument fault line is asserted, you need only remove the top cover and look for the red LEDs inside to find the location of the fault. Table 6-5 list the circuits that can assert faults and identifies the LEDs associated with the circuit. See Figure 8-1 on page 8-1, Figure 8-2 on page 8-2, Figure 8-3 on page 8-3, and Figure 8-4 on

page 8-4 for the location of the LEDs on the circuit boards. There are also duplicates of the instrument FAULT LED and the audio fault LED on the main board (DS940 and DS840.)

Table 6-5: Circuits that can assert faults

Circuit Area	Local LED
Fans	DS681, DS670
DSP	DS550
Audio	DS360, DS0460, DS940 on main
Front Panel	DS252 (between preset 1, 2)
CPU	DS830

Fan Failures. One possible source of an asserted FAULT LED is a fan failure.

If the right-side fan fails, then LED DS681 will be lit.

If the left-side fan fails, the LED DS670 will be lit.

A third fan circuit is set up on the board but is not currently used.

The fan failure is sensed through tachometer feedback, thus a fault will be asserted if the fan is not connected, stalled, or if the tachometer feedback line is not working correctly.

If one fan fails, the control circuit will increase the voltage and the other fan will be driven at full speed.

If neither fan is spinning, then check the dedicated switching supply that drives them.

If both fans are spinning, but one is showing a fault, swap the fans. If the problem moves with the fan, then replace the defective fan. If the fault does not track the swap, then there is a problem on the main board.

The normal voltage to drive the fans (pin 1) varies from about 6 V to 13.5 V in response to temperature and fan speed.

DSP. The following conditions can assert the FAULT LED from the DSP circuitry:

- Over temperature 3.3 V supply
- Over temperature 1.8 V supply
- Over temperature 1.5 V supply

If any of these are in fault condition, the front-panel FAULT light will be lit and the local, red LED DS550 will be lit. Over temperature faults are reported in the diagnostic log – so you can look there to see if the DSP is asserting the line and which supply is the root cause.

If the system is not running, then check the voltage on the 1.5 V, 1.8 V and 3.3 V supplies. If these are good, then check the temperature of the regulators U490, U590, and U690. If they are hot, then they are overloaded or defective; replace the main board.

Additionally, there are LEDs on the “Power Good” lines from each of the DSP secondary supplies. These are in a row with the 5 V and 2.5 V indicators. If the supply has fallen out of regulation, then the Power Good LED will not be lit. *These errors may be added to the set of conditions that OR into the Fault line in a later SW release. **If these aren't used now, we shouldn't mention them.***

Audio. The audio fault LED is DS360 on the component side and DS0460 on the back of the audio board. (The back side of the board faces up when it is installed in the instrument.)

If the audio board is asserting the fault line, but the rest of the instrument is working correctly, then replace the audio board.

The audio processor asserts the fault light after a POST (power on self test) failure.

The POST does the following:

- Reads all of the AES decoder internal registers and verifies that what is read is correct
- Reads all of the D/A internal registers and verifies that what was read is correct
- Performs an active-bit test on the A/D output clocks
- Checks the serial EEPROM to see which of the analog inputs have been calibrated
- The main CPU asserts the fault line if the DSP heartbeat fails. This condition will be shown in the diagnostic log.

Front Panel. The front panel local fault LED is DS252 (behind the PRESETS buttons near the top of board). The LED that shows through the panel is DS890.

If the Front panel asserts the Fault line, then replace the front panel board.

The front-panel processor asserts the fault indicator for about 1 second during reset. If it does not finish initializing and running internal diagnostics, then the

fault LED will remain lit. If the front-panel processor detects a fault in the diagnostics, then it will leave the fault asserted after it finishes.

The internal tests are:

- **RAM Test** - Entire RAM is tested. If this test fails, the ROM Test is skipped.
- **ROM Test** - The front-panel processor calculates the checksum of the program stored in flash and compares it with the stored checksum.

CPU. The CPU fault LED is DS830. The CPU section also has DS940, which is a duplicate of the FAULT LED, and DS840, which is a duplicate of the audio fault light.

The CPU can detect that the fault line is asserted. If the user has configured the alarm section to monitor hardware faults, then alarms will be generated and / or logged as set by the user. Since the CPU has access to many of the individual error flags, some of these are displayed on the diagnostic log.

The CPU can also assert the fault line for some failures during initialization and power on self test (POST).

If the CPU is asserting the fault line, then replace the main board.

Primary Power Supply Tests

This section describes methods for verifying the proper operation of the waveform rasterizer primary power supply.



CAUTION. *Some parts of this test require removing the insulating safety shield. To avoid personal injury, be careful not to contact the circuitry while the shield is removed. Be sure to replace the shield as soon as possible to prevent injury.*

The main power supply accepts 100 to 264 VAC and outputs 5 VDC. The output voltage at the supply must be between 4.9 and 5.3 V for correct operation. On the main board, the common 5 V supply must be between 4.80 and 5.25 V.

If the voltage at the output of the supply is not correct, check the input voltage. If the input voltage is in the correct range, then replace the power supply.

If the supply output voltage is zero, then check the input circuit. The voltage should be the same at the line cord, at the input to the power supply, and on both ends of the fuse on the input to the supply. If the input voltage is correct while the output is not, replace the supply. If the input voltage is not correct replace the element in the chain that is not passing the AC input.

If the power supply output is correct, also check the four fuses in the 5 V system near the main board power connector J581 (see Figure 8-1). All should have 5 V on both sides. If not, replace the fuse.

Secondary Power Supply Tests

There are multiple secondary supplies that are derived from the main 5 V supply. Be sure all four 5 V fuses are good (as noted in *Primary Power Supply Tests*) before checking the secondary supplies.

First, check the digital secondary supplies as shown in Table 6-6. Each supply has an LED and a test point, as shown in Figure 8-1 on page 8-1. The test points are located “under” the edge of the Audio board, if it is installed. You can remove the audio board if desired, but it is usually possible to probe the test points with the board in place. Also, removing the audio board load may change the power supply voltages. If any supplies are out of range, replace the main board.

Table 6-6: Digital secondary supplies

Nominal (+V)	Allowed Range (+V)	Measure at
1.5	1.4 to 1.6	TP430
1.8	1.7 to 1.9	TP431
2.5	2.4 to 2.6	TP432
2.7	2.6 to 2.8	TP433
3.3	3.3 to 3.55	TP530
5.0	4.75 to 5.25	TP531
12	11.4 to 12.7	TP532

After you have checked the Digital Secondary Supplies, check the Analog supplies as shown in Table 6-7. These have LEDs and test points as shown in Figure 8-1 on page 8-1. If any voltages are out of tolerance, replace the main board.

Table 6-7: Analog supplies

Nominal (V)	Allowed range (V)	Measure at
+8	+7.65 to 8.4	TP170
-8	-8.65 to -7.7	TP171
-5	-5.2 to -4.8	TP172
+5 “good”	+4.75 to 5.25	TP173

Check the Audio supplies on the Audio Board as shown in Table 6-8, (if an Audio Board is installed). The test points are available, with the board installed, at the location specified in Figure 8-3 on page 8-3.

Table 6-8: Audio secondary supplies

Supply Name	Range	Measured at	Notes
5VD	4.6 to 5.4	TP902	
3.3VD	3.2 to 3.6	TP806	
2.5VD	2.3 to 2.7	TP804	
1.6V	1.5 to 1.7	TP801	
6VA	5.9 to 6.9	TP805	
-5VA2	-4.5 to -5.5	TP200	Not present in analog only version Opt AN
5VA2	4.8 to 5.2	TP802	Not present in analog only version Opt AN
-5VA	-4.5 to -5.5	TP800	Not present in digital only version Opt DG
5VA	4.8 to 5.2	TP900	Not present in digital only version Opt DG
-15V	-14.5 to 15.5	TP803	Not present in digital only version Opt DG
+15V	14.5 to 15.5	TP901	Not present in digital only version Opt DG

Front Panel Troubleshooting

If the instrument has a reasonable display on the screen, but the front panel does not work, follow this procedure:

1. Do the LEDs turn on for 2 to 3 seconds at power up? If not, check the 5 V fuse, F580, on the main board and check the cable from the main board to the front panel. If there is power to the front panel and the LEDs do not turn on at power up, then replace the front panel board.
2. After power up, do most of the LEDs turn on and stay on? If not, proceed to step 3. Otherwise probe J390, pin 6 and pin 7 on the main board. Pin 6 should be TTL high (about 3.3 V) and pin 7 should be low (RS232 level, about -7 V). If not, suspect the main board. Otherwise probe pin 6 and 7 of J670 on the front panel board. If they are high and low, respectively, suspect the front panel, otherwise replace the cable.
3. When you press buttons on the front panel, do LEDs DS971 and DS972 on the main board flash? These LEDs monitor the transmit and receive lines on the main board side of the RS232 transceiver. If they flash, then go to step 5.
4. If DS971 is not flashing, then check pin 3 of J390 on the main board. When you press a key, you should see pulses about a 15 V high and 100 to 300 μ s long. If not, suspect the front panel board.
5. If pin 3 of J390 is toggling and DS971 is not, then the RS232 receiver on the main board is not working. Replace the main board.

6. If both DS971 and DS972 are flashing, then check pin 5 on main board connector J390. When a front panel button is pressed, the front panel sends a message to the main board via pin 3. The CPU on the main board responds via pin 5 and this instructs the front panel to change which LEDs on the front panel are illuminated. Pin 5 should have a burst of pulses with about 15 V signal swing and a basic pulse width of about 100 μ s. If there is no response from the CPU on pin 5 of main board connector J390, then the RS232 transmitter is bad; replace the main board.
7. If both the DS971 and DS972 LEDs are flashing and the signals at the main board connector are also good but the operation of the front panel is not correct, check the cable between the two boards. This can be done by probing pin 5 on J670 of the front panel board. As in step 5, it should have a burst of pulses about 15 V high and 100 μ s long after a button press. If the signal is bad, suspect the cable. If the signal is good, replace the front panel board.
8. If some buttons work, but others do not, then the front panel or the elastomeric key pads are bad. Disassemble the front panel assembly and use a small piece of wire or foil to emulate the carbon pad on the switch mat. If this registers as a switch closure then replace the elastomeric key pad. Otherwise replace the front panel board.
9. If some front panel button LEDs work and others do not, then the problem must be in the front panel board. These LEDs have the anodes connected to +5 V and the cathodes connected to a resistor driven by a logic gate. Probe the voltage on the LED. If the LED is bad replace it, otherwise replace the front panel board.
10. The FAULT LED should be lit at power up for about 10 seconds. It should also be lit if either fan is stopped. If it is not lit at power up or when a fan is stopped, then check the voltage on the LED. The cathode connects to a 332 ohm resistor tied to ground and the anode connects to the output of a logic gate. If the voltage looks correct, then replace the LED, otherwise replace the front panel board.
11. If the buttons and LEDs work but knobs do not work, then replace the front panel.
12. If the buttons and LEDs work but the beeper does not sound, then replace the front panel board.

Audio POST Failure

It is sometimes difficult to isolate the root cause of audio problems. Most audio problems are due to faults on the audio board, but the audio board communicates with the main board, so in some cases the problem may be there as well. This test isolates an audio POST failure to either the audio board, main board, or the cable between.

If there is an audio POST failure indicated by either the Power-Up Diagnostics or the fault LEDs on the audio board (DS360 or DS0460), perform the following procedure to narrow the problem to either the audio board or the main board.

1. Prepare a test oscilloscope with the following settings:
 - Horizontal Scale 5.00 μ s/div
 - Vertical Scale 2.00 V/div
2. If the Power-Up Diagnostics screen reports **Audio DSP Self Test – 10**.
 - a. Check the FPGA programmed indicator (DS0430 on the audio board). If this LED is off, proceed to step c; otherwise probe pin 34 of connector J750 of the main board during boot-up. If the signal on the pin toggles, replace the main board, otherwise check pin 34 of J400 on the audio board. If signal toggles on pin 34, replace the cable; otherwise replace the audio board.
 - b. Probe pin 33 of J750 on the main board during the boot-up sequence. If the signal does not exhibit a low to high transition, replace the main board. If the signal does toggle, check pin 33 of J400 on the audio board. If the signal doesn't toggle on pin 33, replace the cable.
 - c. Probe pins 31 and 32 of connector J750 during the boot-up sequence. If the signal on either of these pins doesn't toggle, replace the main board. If they do, probe pins 31 and 32 on the audio board. If the signal doesn't toggle on either pin, suspect the cable.
 - d. Probe pin 30 of J400 on the audio board during the boot-up sequence. If the signal does not exhibit a low to high transition, replace the audio board. If it does, check pin 30 of connector J750 on the main board. If the signal on pin 30 doesn't toggle, suspect the cable; if the signal on pin 30 does toggle, suspect the audio board.
3. If the Power-Up Diagnostics screen reports **Audio DSP Self Test – 1**, perform the following procedure:
 - a. Check to see if the audio board is recognized by the main board by pressing **CONFIG** and selecting **Utilities > View HW/SW Version**.
 - b. If there is an audio option listed, suspect the audio board, otherwise proceed to step c.
 - c. Probe pins 3 through 14 on the main board connector J750 and verify that the signals on all pins are toggling. If any signals do not, replace the main board. If they all do, check them again on the audio board J400. If any of the signals do not toggle on the audio board, replace the cable.
 - d. Probe pins 15 and 18 on connector J750 during boot-up and verify that the signals toggle. If they don't, suspect the main board. If they do,

- check them again on the audio board J400. If either of the signals on pins 15 and 18 do not toggle on the audio board, replace the cable.
- e. Probe pin 25 on the audio board connector J400. If the signal does not toggle, replace the audio board; otherwise check it again on the main board connector J750. If the signal on pin 25 does not toggle on the main board, then replace the cable, otherwise replace the main board.
4. If the Power-Up Diagnostics screen reports **Audio DSP Self Test – 2**, perform the following procedure:
 - a. Check to see if the audio board is recognized by the main board by pressing **CONFIG** and selecting **Utilities > View HW/SW Version**.
 - b. If there is an audio option listed, suspect the audio board, otherwise proceed to step c.
 - c. Probe pins 3 through 14 on the main board connector J750 and verify that the signals on all pins are toggling. If any of the signals on pins 3 through 14 do not toggle, replace the main board. If they all do, check them again on the audio board J400. If any of the signals on the pins do not toggle on the audio board, replace the cable.
 - d. Probe pins 15 and 20 on connector J750 during boot-up and verify that the signals on the pins toggle. If they don't, suspect the main board. If the signals do toggle, check them again on the audio board J400. If any of the signals on the pins do not toggle on the audio board, replace the cable.
 - e. Probe pin 27 on the audio board connector J400. If the signal on the pin does not toggle, replace the audio board, otherwise check it again on the main board connector J750. If the signal on pin 27 does not toggle on the main board, then replace the cable, otherwise replace the main board.
 5. If the Power-Up Diagnostics screen reports **Audio DSP Self Test – X**, where X is any other number, replace the audio board.

Isolating Advanced Diagnostic Lissajous Errors

The advanced diagnostics test the lissajous data path between the audio and main boards. A failure in this data path can be due to problem on either board. Perform the following tests to isolate the problem to one board or the other.

1. If the advanced diagnostics detect an error in the lissajous circuitry, then it will display a failure in the following categories:
 - **Liss[0] Frequency** : should be between 19.8 MHz and 20.1 MHz
 - **Liss[1] Frequency** : should be between 19.8 MHz and 20.1 MHz
 - **Lissajous[0] Bus** : pass/fail

- **Lissajous[1] Bus** : pass/fail
2. If there are any failures, prepare a test oscilloscope with the following settings:
 - Vertical Scale 2.00 V/div
 - Horizontal Scale 200 ns/div
 3. If there is Liss[0] Frequency failure:
 - a. Put the scope probe on pin 22 of connector J940 on the audio board. Verify the signal is $\approx 3 V_{p-p}$ and is a continuous 50% duty-cycle square wave.
 - b. If the signal looks bad at J940, the audio board most likely has a failure, otherwise continue to step c.
 - c. With the scope probe, verify the signal at J650 pin 22 of the main board. If it is bad, suspect the cable, otherwise replace the main board.
 4. If there is a Liss[1] Frequency failure:
 - a. Put the scope probe on pin 30 of connector J940 on the audio board. Verify the signal is $\approx 3 V_{p-p}$ and is a continuous 50% duty cycle square wave.
 - b. If the signal looks bad at J940, the audio board most likely has a failure, otherwise continue to step c.
 - c. With the scope probe, verify the signal at J650 pin 30 of the main board. If it is bad here suspect the cable; otherwise replace the main board.
 5. If there is a Lissajous[0] Bus failure:
 - a. Put the scope probe on connector J940 pin 21 of the audio board and verify the signal is $\approx 3 V_{p-p}$ and toggles low at regular intervals.
 - b. If the signal on pin 21 looks OK, put the scope probe on pin 23. Pin 23 is the data line and the signal will have a somewhat random look depending on the audio source. Just verify that the signal is toggling and is $\approx 3 V_{p-p}$.
 - c. If either signal looks bad at J940, the audio board most likely has a failure, otherwise continue to step d .
 - d. With the scope probe, check the signal at pin 21 of J650 on the main board. Verify the signal is $\approx 3 V_{p-p}$ and toggles low at regular intervals.
 - e. If the signal on pin 21 looks OK, put the scope probe on pin 23. Pin 23 is the data line and the signal will have a somewhat random look

Repackaging Instructions

This section contains the information needed to repack the waveform rasterizer for shipment or storage.

Packaging

When repacking the instrument for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging. Refer to *Contacting Tektronix* on page xvii for the mailing address, the email address, and phone number.

Seal the shipping carton with an industrial stapler or strapping tape.

Shipping to the Service Center

Contact the Service Center to get an RMA (return material authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number.
- The owner's address.
- Name and phone number of a contact person.
- Type and serial number of the instrument.
- Reason for returning.
- A complete description of the service required.

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.



Options

Options and Accessories

Options

The waveform rasterizer can be ordered with options to support analog audio, digital audio, or both analog and digital audio.

Audio Options

Three audio options are available:

- **Option AN.** Two groups of three pairs of analog inputs, one group of three pairs of analog outputs.
- **Option DG.** Four pairs of AES/EBU inputs and four pairs of bi-directional AES/EBU outputs selected from eight embedded pairs.
- **Option DA.** Both analog and digital capabilities installed.

Service Options

The following service options are available for the WVR610A & WVR611A:

- **Option R3.** Extends the instrument warranty to 3 years.
- **Option R5.** Extends the instrument warranty to 5 years.
- **Option C3.** Provides calibration services for 3 years.
- **Option C5.** Provides calibration services for 5 years.
- **Option D3.** Provides test data for 3 years.
- **Option D5.** Provides test data for 5 years.

Standard Accessories

The following accessories are shipped with each waveform monitor:

Documents

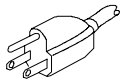
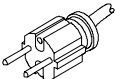
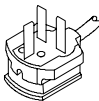

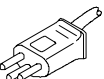
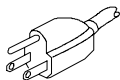

The following documents are standard accessories:

- *WVR610A & WVR611A Waveform Rasterizers User Manual*, Tektronix part number 071-1199-XX.
- *WVR610A & WVR611A Waveform Rasterizers Release Notes*, Tektronix part number 061-4260-XX.

Power Cords

All WVR610A & WVR611A Waveform Rasterizers are shipped with one of the following power cord options. Power cords for use in North America are UL listed and CSA certified. Cords for use in areas other than North America are approved by at least one authority acceptable in the country to which the product is shipped.

Table 7-1: Power cord identification

Plug configuration	Normal usage	Option number
	North America 120 V	Standard
	Universal Euro	A1
	United Kingdom	A2
	Australia	A3
	Switzerland	A5
	Japan	A6
	China	AC

Optional Accessories

The following items are optional accessories:

- *WVR610A & WVR611A Waveform Rasterizers Service Manual*, Tektronix part number 071-1243-XX.
- Analog/Audio Breakout Cable Assembly, Tektronix part number 012-1658-01.



Diagrams

Diagrams

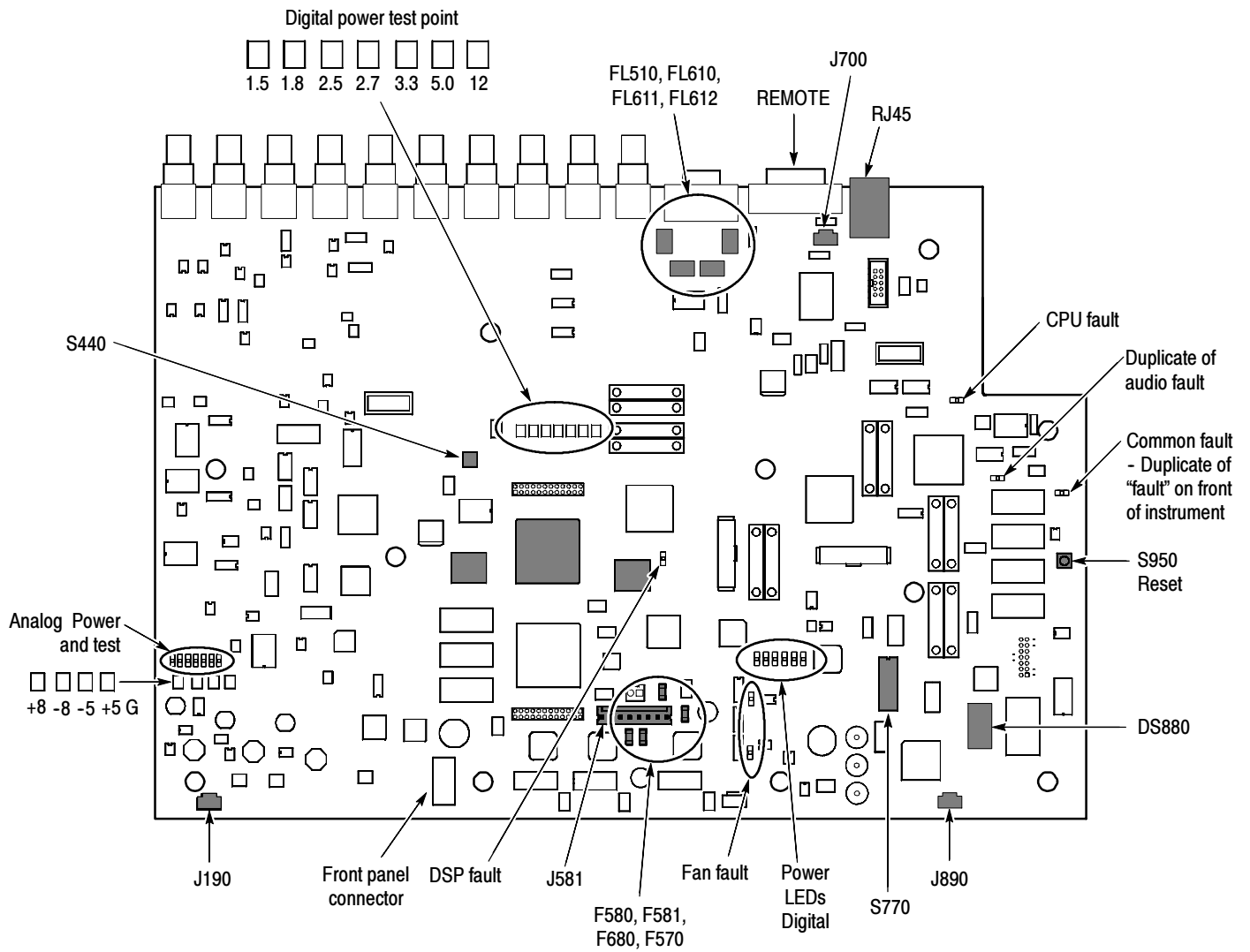


Figure 8-1: Main board indicator LED, connector, and test point locations

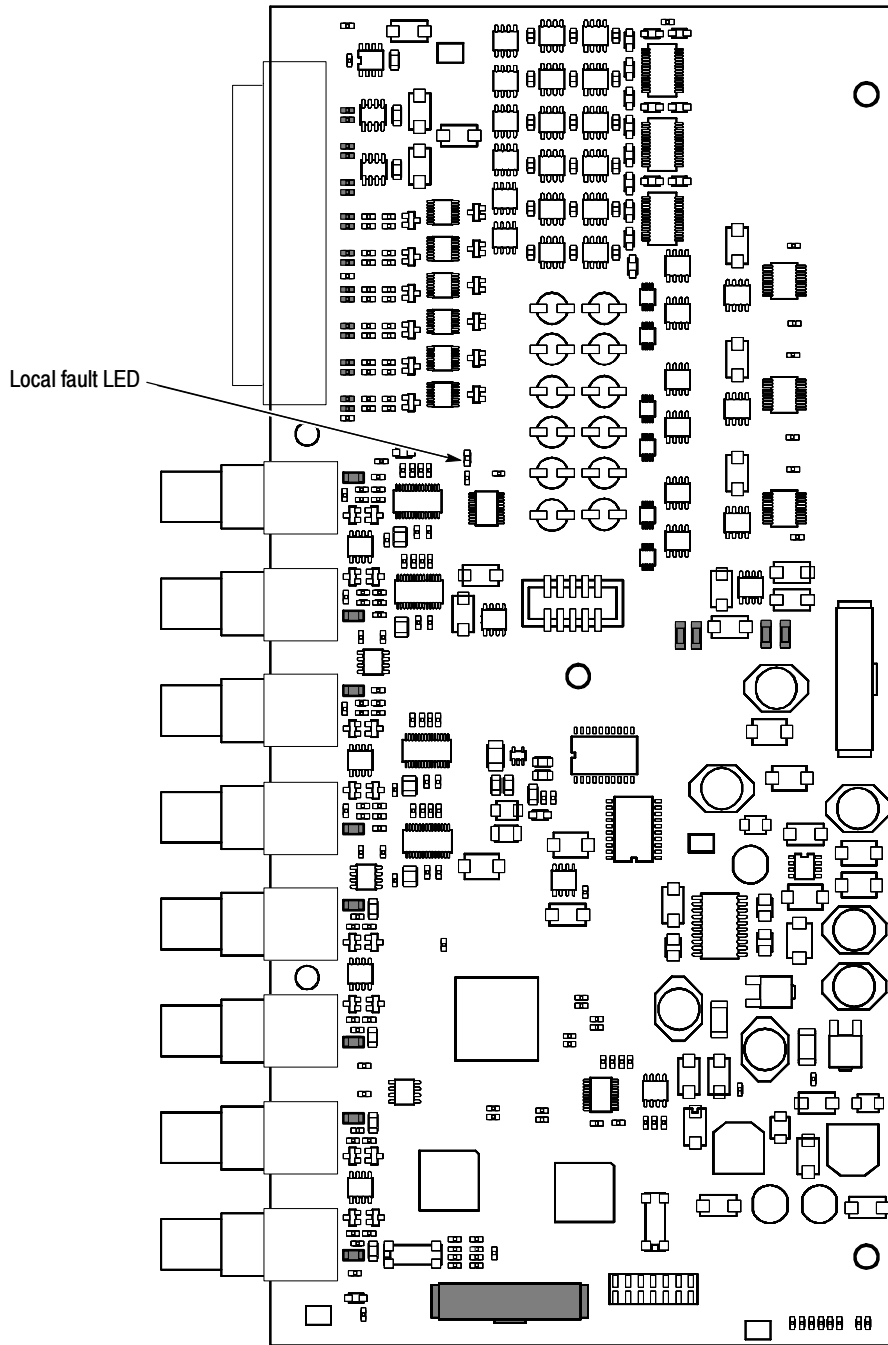


Figure 8-2: Audio board component side indicator LED, location

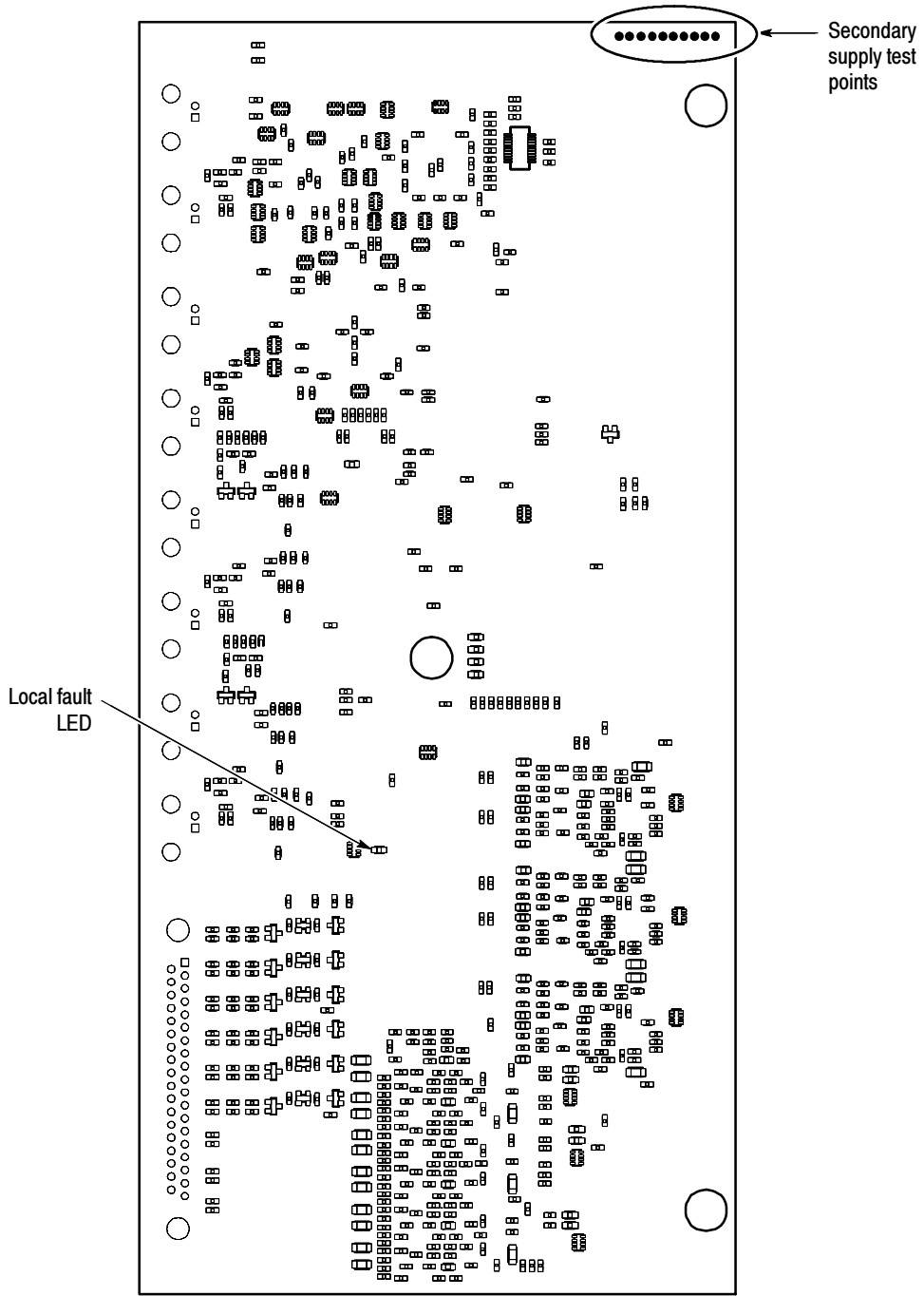


Figure 8-3: Audio board back side indicator LED and test point locations

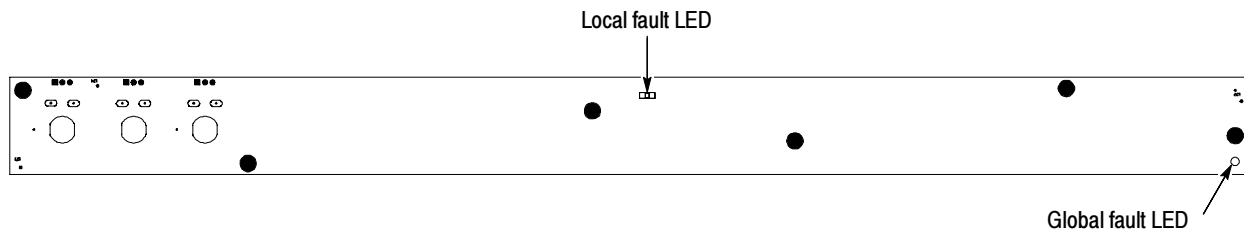


Figure 8- 4: Front panel board indicator LED locations (viewed from back side)

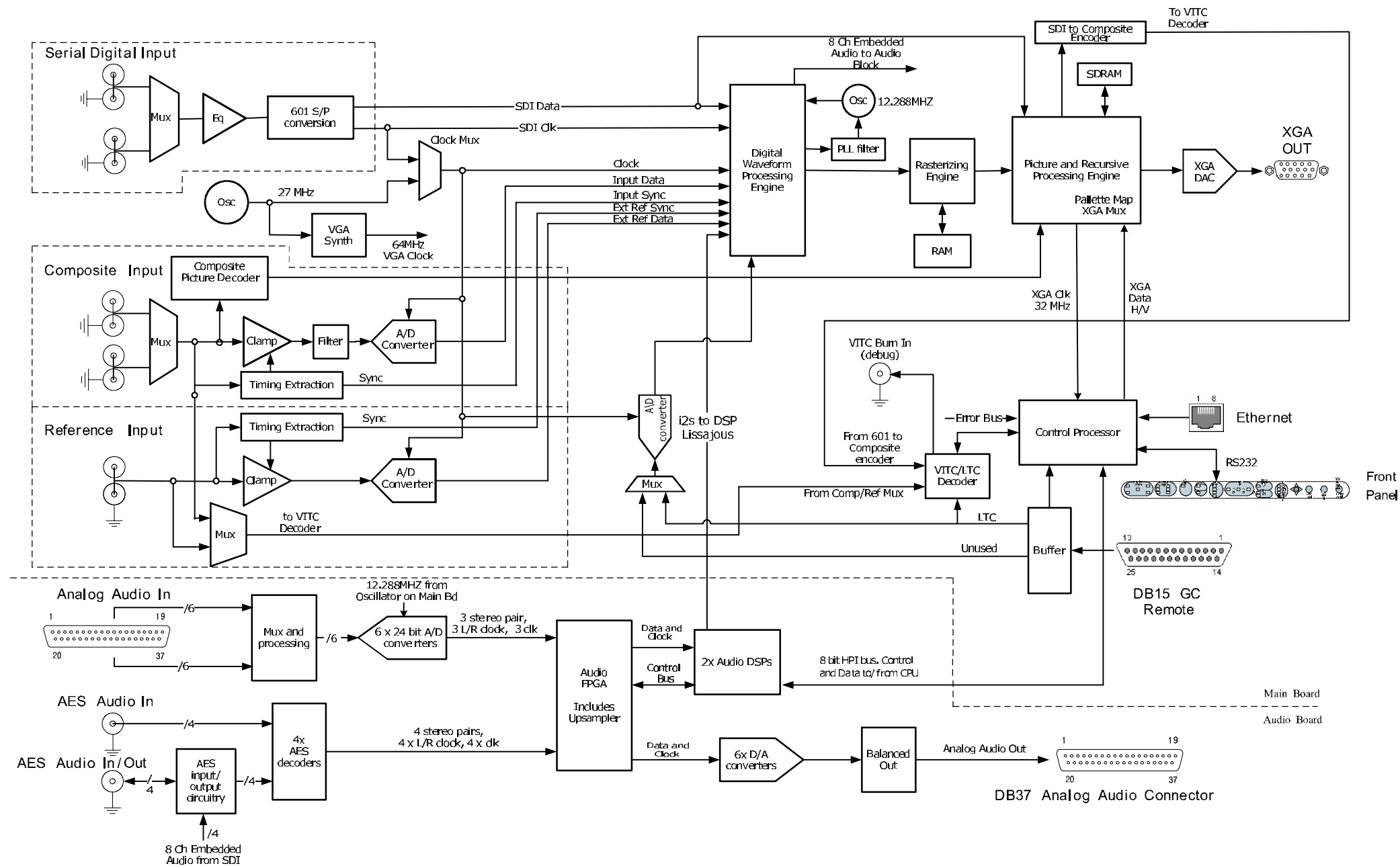


Figure 8-5: High-level signal flow block diagram

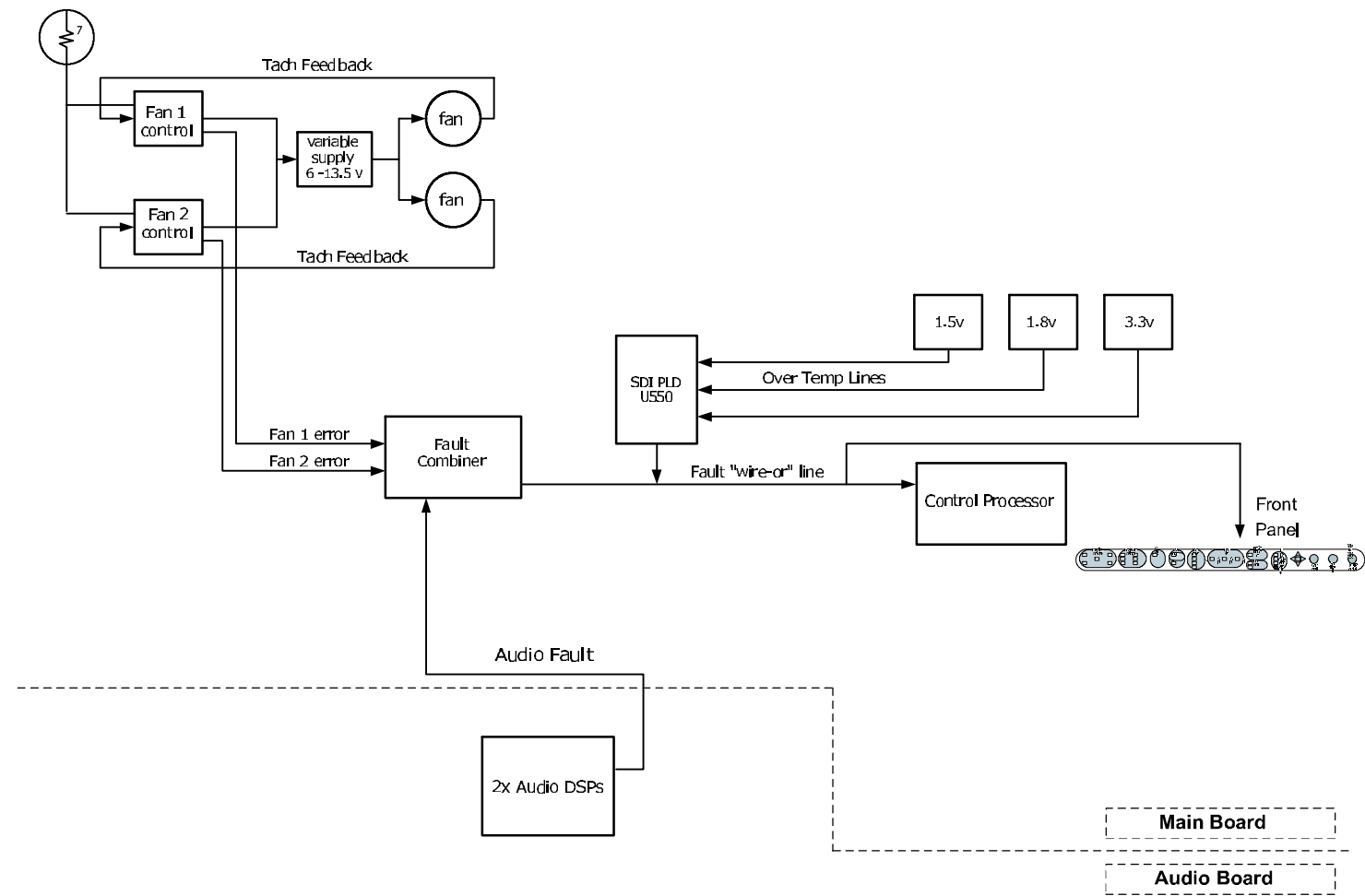


Figure 8-6: High-level fault and fan block diagram



Replaceable Electrical Parts

Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in Section 10, *Mechanical Parts List*. Refer to that section for part numbers when using this manual. In general, circuit boards are exchanged when faulty, though there are a few individual components that can be replaced.



Replaceable Mechanical Parts

Replaceable Parts

This section contains a list of the replaceable modules for the WVR610A & WVR611A Waveform Rasterizers. Use this list to identify and order replacement parts. Note that not all parts listed in this section are present on every model. The parts present will depend on the model and options installed.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: www.tektronix.com.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for the WVR610A & WVR611A Waveform Rasterizers. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entry indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. code	This indicates the code of the actual manufacturer of the part.
8	Mfr. part number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations Abbreviations conform to American National Standard ANSI Y1.1-1972.

Mfr. Code to Manufacturer Cross Index The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
	KINGBRIGHT ELECTRONIC CO. LTD.	P.O.BOX 1~336 Chung Ho City Taipei	Taipei, TAIWAN ROC TW
	SANYO Electronic Components	1-1,Sanyo-cho	Daito City Osaka, JP 574-8534
	TENSOLITE COMPANY	3000 COLUMBIA HOUSE BLVD~SUITE 120	VANCOUVER, WA US 98661
	KINGBRIGHT ELECTRONIC CO. LTD.	P.O.BOX 1~336 Chung Ho City Taipei	Taipei, TAIWAN ROC TW
	TENSOLITE COMPANY	3000 COLUMBIA HOUSE BLVD~SUITE 120	VANCOUVER, WA US 98661
00779	TYCO ELECTRONICS CORPORATION	CUSTOMER SERVICE DEPT~PO BOX 3608	HARRISBURG, PA 17105-3608
02660	AMPHENOL CORP	720 SHERMAN AVE	HAMDEN, CT 06514-6514
06090	RAYCHEM CORP	300 CONSTITUTION DR	MENLO PARK, CA 94025-1111
060D9	TENSOLITE COMPANY	PRECISION HARNESS AND ASSEMBLY~3000 COLUMBIA HOUSE BLVD~#120	VANCOUVER, WA 98661
06666	GENERAL DEVICES	PO BOX 39100	INDIANAPOLIS, IN 46239
07263	FAIRCHILD SEMICONDUCTOR CORPORATION	CORPORATE HEADQUARTERS~333 WESTERN AVENUE	SOUTH PORTLAND, ME 04106-1705
09353	C & K COMPONENTS CORP	57 STANLEY AVE	WATERTOWN, MA 02172-4802
0GV52	SCHAFFNER EMC INC	9-B FADEM ROAD	SPRINGFIELD, NJ 07081
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214-4657
0KB05	NORTH STAR NAMEPLATE INC	LABEL PRODUCTS, 5750 NE MOORE COURT	HILLSBORO, OR 97124-6474
13103	THERMALLOY INC	2021 W. VALLEY VIEW LN~PO BOX 810839	DALLAS, TX 75381-5381
13509	AMPHENOL CORP	INTERCONNECTION PRODUCTS~20 VALLEY STREET	ENDICOTT, NY 13760
18796	MURATA ELECTRONICS N AMERICA	1900 WEST COLLEGE AVE.	STATE COLLEGE, PA 16801-2723
1AW87	LEWIS SCREW CO.	4300 SOUTH RACINE AVENUE	CHICAGO, IL 60609
1LT13	ARTESYN TECHNOLOGY	7575 MARKET PLACE DR	EDEN PRAIRIE, MN 55344
22670	GM NAMEPLATE INCORPORATED	2040 15TH AVE WEST	SEATTLE, WA 98119-2783
24931	FCI USA INC	RF/COAXIAL DIV~2100 EARLYWOOD DR~PO BOX 547	FRANKLIN, IN 46131
26364	COMPONENTS CORPORATION	6 KINSEY PLACE	DENVILLE, NJ 07834
2K262	BOYD CORPORATION	6136 NE 87TH AVENUE	PORTLAND, OR 97220
31918	ITT SWITCH PRODUCTS	8081 WALLACE RD	EDEN PRAIRIE, MN 55344-8798
32997	BOURNS INC	TRIMPOT DIVISION~1200 COLUMBIA AVE	RIVERSIDE, CA 92507-2114
50434	AGILENT TECHNOLOGIES	SEMICONDUCTOR PRODUCTS~370 W TRIMBLE ROAD	SAN JOSE, CA 95131-1008
51406	MURATA ELECTRONICS N. AMERICA INC.	2200 LAKE PARK DR	SMYRNA, GA 30080-7604
55322	SAMTEC INC	810 PROGRESS BLVD~PO BOX 1147	NEW ALBANY, IN 47150-1147
55566	RAF ELECTRONIC HARDWARE INC	95 SILVERMINE ROAD	SEYMOUR, CT 06483
74594	COMPONENT RESOURCES INC	BUSSMAN PARTS~C/O CASEY LAKEY~14525 SW WALKER ROAD	BEAVERTON, OR 97006
74868	AMPHENOL CORP	RF/MICROWAVE OPERATIONS~1 KENNEDY AVE	DANBURY, CT 06810-5803
75915	LITTELFUSE INC	800 E NORTHWEST HWY	DES PLAINES, IL 60016-3049
78189	SHAKEPROOF	DIVISION OF ILLINOIS TOOL WORK~ST. CHARLES ROAD	ELGIN, IL 60120
7M294	CARLYLE INC	6801 SOUTH 180TH STREET	TUKWILA, WA 98188
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR~PO BOX 500	BEAVERTON, OR 97077-0001
80126	PACIFIC ELECTRICCORD CO	747 WEST REDONDO BEACH~PO BOX 10	GARDENA, CA 90247-4203
81073	GRAYHILL INC	561 HILLGROVE AVE~PO BOX 10373	LAGRANGE, IL 60525
93907	CAMCAR DIV OF TEXTRON INC	ATTN: ALICIA SANFORD~516 18TH AVE	ROCKFORD, IL 611045181
S4091	SANYO DENKI	468 AMAPOLA AVE	TORRANCE, CA 90501
TK0588	UNIVERSAL PRECISION PRODUCT	1775 NW CORNELIUS PASS RD	HILLSBORO, OR 97124
TK0941	APPLIED INDUSTRIAL TECHNOLOGIES	5041 NW FRONT AVE	PORTLAND, OR 97210-1702

Manufacturers cross index (Cont.)

Mfr. code	Manufacturer	Address	City, state, zip code
TK0EM	MOLEX ELECTRONICS	FARNHAM ROAD~BORDON	HAMPSHIRE, ENGLAND
TK0JO	USD WIRE	19,21,LORONG USAHAJAYA 4, KAW,PER- IND,USAHAJAYA,MUKIM 14	PENANG, MY 11900
TK1898	AMPHENOL FIBER OPTICS	925 116TH AVE N.E., SUITE 247~P.O. BOX 726	BELLEVUE, WA 98004
TK1943	NEILSEN MANUFACTURING INC	3501 PORTLAND RD NE	SALEM, OR 97303
TK2006	CONTACT GMBH	C/O TEK HOLLAND N.V.-PO BOX 526	HEERENVEEN 8440 AM, 60
TK2058	TDK CORPORATION OF AMERICA	1600 FEEHANVILLE DRIVE	MOUNT PROSPECT, IL 60056
TK6565	WRICO STAMPING CO	1310 N HOBSON STREET	GILBERT, AZ 85233-1207

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-1-1	211-0734-00			16	SCREW,MACH; 6-32 X 0.250,FLH100,STL,CDPL,T-10 TORX	93907	6-32 X .250, T1
10-1-2	200-4779-00			1	COVER; TOP,0.050 AL	TK6565	200-4779-00
10-1-3	671-5611-00			1	CKT BD ASSY; MAIN,389-3416-00 WVR611A	80009	671-5611-00
10-1-3	671-5611-01		B010999	1	CKT BD ASSY; MAIN,389-3416-00 WVR611A	80009	671-5611-01
10-1-3	671-5611-02	B011000		1	CKT BD ASSY; MAIN,389-3416-00 WVR611A	80009	671-5611-01
10-1-3	671-5616-00			1	CKT BD ASSY; MAIN,W /O COMPOSITE,389-3422-00 WVR610A	80009	671-5616-00
10-1-3	671-5616-01		B010999	1	CKT BD ASSY; MAIN,W /O COMPOSITE,389-3422-00 WVR610A	80009	671-5616-01
10-1-3	671-5616-02	B011000		1	CKT BD ASSY; MAIN,W /O COMPOSITE,389-3422-00 WVR610A	80009	671-5616-01
10-1-4	146-0116-00			1	BATTERY, DRY; 3.0V,850MAH,LITHIUM,0.57X1 INCHES		CR14250SE-SP1-1
10-1-5	131-4046-00			1	CONN,DSUB; PCB/PNL,;FEMALE,RTANG,15 POS,0.318 MLG X 0.125 TAIL,4-40 THD INSERTS,BD RETENTION	02660	617C015SAJ120
10-1-6	131-5450-00			1	CONN,DSUB; PCB,HIGH DENSITY;FEMALE,RTANG,15 POS,0.078 CTR,0.350 MLG X 0.125 TAIL,BD RETENTION	TK0EM	89263-6042
10-1-7	214-3903-00			6	SCREW,JACK; 4-40 X 0.312 LONG,0.188 H HEX HEAD STAND OFF,4-40 INT THD, X 0.312 THD EXT 4-40	55566	4750-3-12 (+LOCK-WASHER)
					<i>Note: Quantity varies with instrument and audio option.</i>		
10-1-8	131-4131-00			1	CONN,PLUG,ELEC; MALE W/LOCKING ADPTR,EXT MTG	80126	B-0778
10-1-9	211-0410-00			2	SCR,ASSEM WSHR; 4-40 X 0.437,PNH,STL,T-10 TORX	0KB01	ORDER BY DESCR
10-1-10	119-0420-00			1	FILTER,RFI; LINE FILTER;6A,250VAC,DC-400HZ,LEAKAGE CURRENT 2UA AT 220V/55HZ;FN9223B-6/06	0GV52	FN9223B-6/06
10-1-11	351-0104-03			1	SL SECT,DWR EXT; 12.625 L,W/O HARDWARE	06666	C-720-3
10-1-12	212-0158-00			8	SCREW,MACHINE; 8-32 X 0.375,PNH,STL,CDPL,T-20 TORX	0KB01	ORDER BY DESCR
10-1-13	351-0751-01			1	TRK,SL OUT SECT; STATIONARY & INTERMEDIATE	06666	CC3442-99-0006
10-1-14	211-0721-00			4	SCREW,MACHINE; 6-32 X 0.375,PNH,STL,CDPL,T-15 TORX	0KB01	ORDER BY DESCR
10-1-15	119-6801-00			1	POWER SUPPLY; 110W,AC-DC,5VDC 22A OUT,90-264VAC 47-63HZ IN,PFC,6.5 X 3 X 1.26 IN, UL, CSA, VDE	1LT13	NLP110-9605
10-1-16	311-2570-00			3	DIGITAL CONTACTING ENCODER; PCB MOUNT, .354 DIA HOLE,1.0 L X .25 DIA SHAFT, NO DETENTS	32997	ECW1J-B32-SEO/05 8
10-1-17	210-1039-00			6	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST	78189	1224-02
10-1-18	671-5382-00			1	CKT BD ASSY; FRONT PANEL,TESTED,389-3257-00 WIRED	80009	671-5382-00
10-1-19	366-0816-01			3	KNOB; SILVER GRAY, 0.420OD, 0.520H, PC/ABS BAYBLEND FR110,F PANEL	TK0JO	
					<i>Note: 260-2774-XX is used on both the WVR610A and WVR611A. To use this part on the WVR610A, you must cut off the two buttons provided for the CMPST inputs.</i>		
10-1-20	260-2774-00			1	SWITCH,KEYPAD;ELASTOMERIC,F PANEL,PUSHBUTTON	22670	260-2774-00
10-1-21	354-0025-00			1	RING,RETAINING; EXTERNAL,U/O 0.187 DIA SFT	TK0941	555-18MI
10-1-22	213-0216-00			1	THUMBSCREW; 10-32 X 0.85,0.375 OD HD,SST W/SLOT	0KB01	213-0216-00
10-1-23	367-0530-00			2	HANDLE,BOW; AL,1.0 X 1.25,STAIN FINISH	74594	367-0530-00

Replaceable parts list (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-1-24	101-0160-00			1	TRIM RING; FRONT,19.000 X 1.718 X 0.345,PC/ABS	TK1943	101-0160-00
10-1-25	441-2295-00			1	CHASSIS,FRONT; 0.050 AL	TK6565	441-2295-00
10-1-26 10-2-26	210-0457-00			7	NUT,PL,ASSEM WA; 6-32 X 0.312,STL CD PL,W/LOCKWASHER	0KB01	ORDER BY DESCR
10-1-27	150-5009-00			1	DIODE,OPTO; LED;HI-EFFIC RED,626NM,3.4MCD AT 10MA;HLMP-6305-021,YOKE LEAD BEND,12MM	50434	HLMP-6305-L0021
10-1-28	211-0410-00			6	SCR,ASSEM WSHR; 4-40 X 0.437,PNH,STL,CDPL,T-10 TORX	93907	829-07510-024
10-1-29	150-0277-00			46	LT EMITTING DIO;GREEN, 570 NM, 1206, REVERSE MOUNT		APTD3216MGCK-01
10-1-30	441-2293-00			1	CHASSIS; MAIN,0.050 AL	TK1943	441-2293-00
10-1-31	211-0722-00			15	SCREW,MACH; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR	93907	B80-32265-000
10-1-32	337-4298-00			1	SHIELD; POWER SUPPLY,0.020 POLYCARBONATE	2K262	337-4298-00
10-1-33	211-1161-00			8	SCREW,MACH; 4-40 X 1.500,PAN HEAD,T-10 TORX,ZINC PL	1AW87	211-1161-00
10-1-34	119-6617-00			2	FAN ASSY; DC, 12V;0.045A,4100 RPM,5 CFM,20DBA, 40MM X 40MM X 28MM;6 IN,3 LEAD, W/CONN & HSING	S4091	
10-1-35	407-4916-00			1	BRACKET ASSEMBLY,FAN; 0.050 AL	TK6565	
10-2-36	174-4770-00			1	CA ASSY,SP; PWR,BR;10.250 L;18 AWG;CONN HDR 1 X 8 AND CONN HDR 1 X 1 2;PWR SUPPLY TO MAIN BD		174-4770-00
10-2-37	174-4769-00			1	CA ASSY,SP; HV,BR,15.00 L & 4.00 L;CONN EACH END;LINE FILTER TO PWR SUPPLY		174-4769-00
10-2-38	260-5012-00	B010100	B011000	1	SWITCH,DIP; SPST,SLIDE,DIP,4 POSITION,GOLD OVER NICKEL,0.4VA @ 20VDC,0.05 HALF PITCH;TD04H0SK1,SMD	09353	TDA04H0SK1
10-2-39	134-0272-00			12	PLUG,BUTTON; 0.5 HOLE DIA,8 PRONG,SST	0KB01	NS-48152
					<i>Note: Quantity varies with instrument and audio option.</i>		
10-2-40	131-7270-00			10	CONN,RF PLUG; BNC,PCB,PNL MNT,FEMALE,RTANG,75 OHM, 0.510 H X 0.169 TAIL,ZINC DIE CAST HOUSING	74868	31-71042
					<i>Note: Quantity varies with instrument model.</i>		
10-2-41	210-1039-00			10	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST	78189	1224-02
					<i>Note: Quantity varies with instrument model.</i>		
10-2-42	220-0497-00			10	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS CD PL	0KB01	220-0497-00
					<i>Note: Quantity varies with instrument model.</i>		
10-2-43	214-5022-00			1	HEAT SINK,SEMIC; IC,BGA;30MM X 30MM X 20MM H,FINNED,CAST ALUMINUM,BLACK ANODIZED,1.7 DEG	TK6530	UB30-20B
10-2-44	131-6885-00			2	CONN,HDR; SMD,SYS50;MALE,STR,2 X 20,0.05 X 0.1 CTR,0.480H,SHRD/4,CTR PLZ,LATCHING,30 GOLD	00779	147377-4
10-2-45	119-5067-00			4	FILTER,RFI; EMI, COMMON MODE CHOKE COIL; 2LINES, 200 OHM IMP, 20- 300MHZ, 50V, 0.5A; 8 PIN SMD	TK2058	ZJYS51R5-4PT
10-2-46	131-7257-00			1	CONN,JACK; PCB/PNL,RJ45,CAT5,W/LEDS YELLOW & GREEN,FEMALE,RTANG,8 POS,0.1 CTR,0.528 H X 0.138 TAIL	TK1898	RJMG-6312-71-01
10-2-47	260-5015-00			1	SWITCH,PUSH;SPST,TACT;50MA,50V,MOMENTARY,SILVER CONTACTS;KSC221G,GULLWING SMD	31918	KSC221GB

Replaceable parts list (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-2-48	131-3572-00			1	CONN,HDR: PCB,MALE,STR,2 X 7,0.1 CTR,0.385 H X 0.120 TAIL,SHRD/4 SIDES,CTR PLZ,30 GOLD,0.150 END DIM	00779	103309-2
10-2-49	260-5000-00			1	SWITCH,SLIDE; SPST;DIP8 POSITION,GOLD OVER NICKEL,3A,2PF,SEALED;90HBW08S,44MM	81073	90HBW08P
10-2-50	150-1022-00			1	DISPLAY,OPTO; ,LED;RED,660NM,7SEG,0.3 INCH DISPLAY,125UCD PER SEGMENT AT10MA,COMMON ANODE	07263	MAN72A
10-2-51	159-5010-00			4	FUSE,SMD; 7A,125V,FAST BLOW,0.1 X 0.1X 0.24;UL REG	75915	451007
10-2-52				1	FUSE; UL/IEC127, F3.15A H, 250VAC (5 x 20 mm)	1LT13	ORDER BY DESC
10-2-53	159-5003-00			1	FUSE,THRM,CHIP; SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,30V MAX (MAIN)	06090	SMD100-2
10-2-54	131-6187-00			1	CONN,HDR PWR; PCB,MALE,STR,1 X 8,0.156 CTR,0.450 MLG X 0.125 TAIL,PLZ WALL,TIN	00779	640445-8
10-2-55	131-7244-00			2	CONN,HDR; SMD,MALE,STR,2 X 5,0.100 CTR,0.350 H,0.165 MLG,SHRD/4 SIDES,MIL PLZ,30 GOLD (ONE ON MAIN BOARD, ONE ON FRONT PANEL)	55322	ASP-22260-05
10-2-56	131-5457-00			3	CONN,HDR; PCB,;MALE,STR,1 X 3,0.10 CTR,0.535 H X 0.130 TAIL,SHRD/4 SIDES,CTR PLZ,LATCHING,BD RETENTION	00779	103908-2
10-2-57	214-4965-00			2	HEAT SINK,SEMIC; IC,DIP08.3/PLCC28;0.400" W X 0.400" H X 0.400" L,FINNED,ALUMINUM,BLACK ANODIZED	13103	17991B X 0.400
10-2-58	174-4771-00			1	CA ASSY,SP; IDC,RIBBON,10.00 L,DOUBLE ENDED,FE-MALE,2 X 5 POS;F/P BD TO MAIN BD		174-4771-00
10-2-59	200-4800-00			1	COVER,MINI; 2X FEX-440	TK6565	200-4800-00
					<i>Note: Not present in instruments with option AN or DA</i>		
10-1-60	335-0893-00			1	MARKER IDENT, FRONT PANEL LABEL,1.31 X 16.46,0.010 POLYCARBONATE,W/ADHESIVE BACK; WVR611A	0KB05	335-0893-00
10-1-60	335-0894-00			1	MARKER IDENT, FRONT PANEL LABEL,1.31 X 16.46,0.010 POLYCARBONATE,W/ADHESIVE BACK; WVR610A	0KB05	335-0894-00
10-7-1	012-1658-00		B011455	1	CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT; WVR610A	060D9	012165800
10-7-1	012-1658-00		B011955	1	CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT; WVR811A	060D9	012165800
	012-1658-01	B011456		1	CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT; WVR610A	060D9	012165801
	012-1658-01	B011956		1	CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT; WVR611A	060D9	012165801
					<i>Note: Optional Accessory</i>		
					OPTION AN - START		
10-3-1	671-5598-00			1	CKT BD ASSY; ANALOG AUDIO,389-3255-00, OPT AN	80009	671559800
	671-5598-01		B011455	1	CKT BD ASSY; ANALOG AUDIO,389-3255-00, OPT AN WVR610A	80009	671559801
	671-5598-01		B011955	1	CKT BD ASSY; ANALOG AUDIO,389-3255-00, OPT AN WVR611A	80009	671559801
	671-5598-02	B011456		1	CKT BD ASSY; ANALOG AUDIO,389-3255-00, OPT AN WVR610A	80009	671559802
	671-5598-02	B011956		1	CKT BD ASSY; ANALOG AUDIO,389-3255-00, OPT AN WVR611A	80009	671559802

Replaceable parts list (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-3-5	174-4281-00			2	CA ASSY.SP; FLAT RIBBON, IDC, 30 AWG, 6.100L, 40 POS	060D9	174-4281-00
10-3-6	129-1570-00			3	POST, SPACER; 1.385 X 0.250 X 0.375 DEEP	TK0588	129-1570-00
10-5-3, 10-6-1	276-5014-00			36	EMI SUPPRESSION; FERRITE BEAD; 60 OHMS@100MHZ, I _{MAX} =500MA, DCR<0.10 OHM	51406	BLM18PG600SN1
10-5-2	131-4364-00			1	CONN, DSUB; PCB/PNL, FEMALE, RTANG, 37 POS, 0.112 CTR, 0.318 MLG X 0.125 TAIL, BD RETENTION	02660	617-C-037-SAJ-120
10-5-4	276-5015-00			4	EMI SUPPRESSION; FERRITE BEAD; 75 OHMS@100MHZ, I _{MAX} =3.0 A, DCR<0.025 OHM	51406	BLM41P750SPT
10-5-5	131-6885-00			2	CONN, HDR; SMD, SYS50; MALE, STR, 2 X 20, 0.05 X 0.1 CTR, 0.480H, SHRD/4, CTR PLZ, LATCHING, 30 GOLD	00779	147377-4
10-7-2	200-4804-00			1	COVER; SHIELD, ELEC CONN, 37 POS DSUB, ZINC	13509	17-1657-37
10-7-3	131-0422-00			1	CONN, DSUB; SLDR CUP/PNL, MALE, STR, 37 POS, 0.112 CTR, 0.186 H X 0.126 TAIL, 0.125 DIA THRU MTG OPTION AN - END OPTION DG - START	TK2006	11-2960
10-3-1	671-5599-00			1	CKT BD ASSY; DIGITAL, TESTED, 389-3255-00, OPT DG	80009	671559900
	671-5599-01		B011455	1	CKT BD ASSY; DIGITAL, TESTED, 389-3255-00, OPT DG WVR610A	80009	671559901
	671-5599-01		B011955	1	CKT BD ASSY; DIGITAL, TESTED, 389-3255-00, OPT DG WVR611A	80009	671559901
	671-5599-02	B011456		1	CKT BD ASSY; DIGITAL, TESTED, 389-3255-00, OPT DG WVR610A	80009	671559902
	671-5599-02	B011956		1	CKT BD ASSY; DIGITAL, TESTED, 389-3255-00, OPT DG WVR611A	80009	671559902
10-3-2	131-7270-00			8	CONN, RF PLUG; BNC, PCB, PNL MNT, FEMALE, RTANG, 75 OHM, 0.510 H X 0.169 TAIL, ZINC DIE CAST HOUSING	74868	31-71042
10-3-3	220-0497-00			8	NUT, PLAIN, HEX; 0.5-28 X 0.562 HEX, BRS CD PL	0KB01	220-0497-00
10-3-4	210-1039-00			8	WASHER, LOCK; 0.521 ID, INT, 0.025 THK, SST	78189	1224-02
10-3-5	174-4281-00			2	CA ASSY.SP; FLAT RIBBON, IDC, 30 AWG, 6.100L, 40 POS	060D9	174-4281-00
10-3-6	129-1570-00			3	POST, SPACER; 1.385 X 0.250 X 0.375 DEEP	TK0588	129-1570-00
10-5-1	276-5002-00			8	EMI, SUPPRESSION; FERRITE BEAD; 70 OHMS@100MHZ, I _{MAX} =200 MA, DCR<0.5 OHM; CHIP, 1206	18796	BLM31A700SPT
10-5-5	131-6885-00			2	CONN, HDR; SMD, SYS50; MALE, STR, 2 X 20, 0.05 X 0.1 CTR, 0.480H, SHRD/4, CTR PLZ, LATCHING, 30 GOLD OPTION DG - END OPTION DA - START	00779	147377-4
10-3-1	671-5378-00			1	CKT BD ASSY; OPT AES/ANALOG AUDIO, 389-3255-00	80009	671537800

Replaceable parts list (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description	Mfr. code	Mfr. part number
	671-5378-01		B011455	1	CKT BD ASSY; OPTIONAL AES/ANALOG AUDIO WVR610A	80009	671537801
	671-5378-01		B011955	1	CKT BD ASSY; OPTIONAL AES/ANALOG AUDIO WVR611A	80009	671537801
	671-5378-02	B011456		1	CKT BD ASSY; OPTIONAL AES/ANALOG AUDIO WVR610A	80009	671537802
	671-5378-02	B011956		1	CKT BD ASSY; OPTIONAL AES/ANALOG AUDIO WVR611A	80009	671537802
10-3-2	131-7270-00			8	CONN,RF PLUG; BNC,PCB,PNL MNT,FEMALE,RTANG,75 OHM, 0.510 H X 0.169 TAIL, ZINC DIE CAST HOUSING	74868	31-71042
10-3-3	220-0497-00			8	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS CD PL	0KB01	220-0497-00
10-3-4	210-1039-00			8	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST	78189	1224-02
10-3-5	174-4281-00			2	CA ASSY.SP; FLAT RIBBON,IDC,30 AWG,6.100L,40 POS	060D9	174-4281-00
10-3-6	129-1570-00			3	POST,SPACER; 1.385 X 0.250 X 0.375 DEEP	TK0588	129-1570-00
10-5-1	276-5002-00			8	EMI,SUPPRESSION; FERRITE BEAD;70 OHMS@100MHZ,IMAX=200 MA,DCR<0.5 OHM;CHIP,1206	51406	BLM18PG600SN1
10-5-2	131-4364-00			1	CONN,DSUB; PCB/PNL,FEMALE,RTANG,37 POS,0.112 CTR,0.318 MLG X 0.125 TAIL,BD RETENTION	02660	617-C-037-SAJ-120
10-5-3	276-5014-00			36	EMI SUPPRESSION; FERRITE BEAD;60 OHMS@100MHZ,IMAX=500MA,DCR<0.10 OHM	51406	BLM18PG600SN1
10-5-4	276-5015-00			4	EMI SUPPRESSION; FERRITE BEAD;75 OHMS@100MHZ,IMAX=3.0 A,DCR<0.025 OHM	51406	BLM41P750SPT
10-5-5	131-6885-00			2	CONN,HDR; SMD,SYS50;MALE,STR,2 X 20,0.05 X 0.1 CTR,0.480H,SHRD/4,CTR PLZ,LATCHING,30 GOLD	00779	147377-4
10-7-2	200-4804-00			1	COVER; SHIELD,ELEC CONN,37 POS DSUB,ZINC	13509	17-1657-37
10-7-3	131-0422-00			1	CONN,DSUB; SLDR CUP/PNL;MALE,STR,37 POS,0.112 CTR,0.186 H X 0.126 TAIL,0.125 DIA THRU MTG OPTION DA - END	TK2006	11-2960

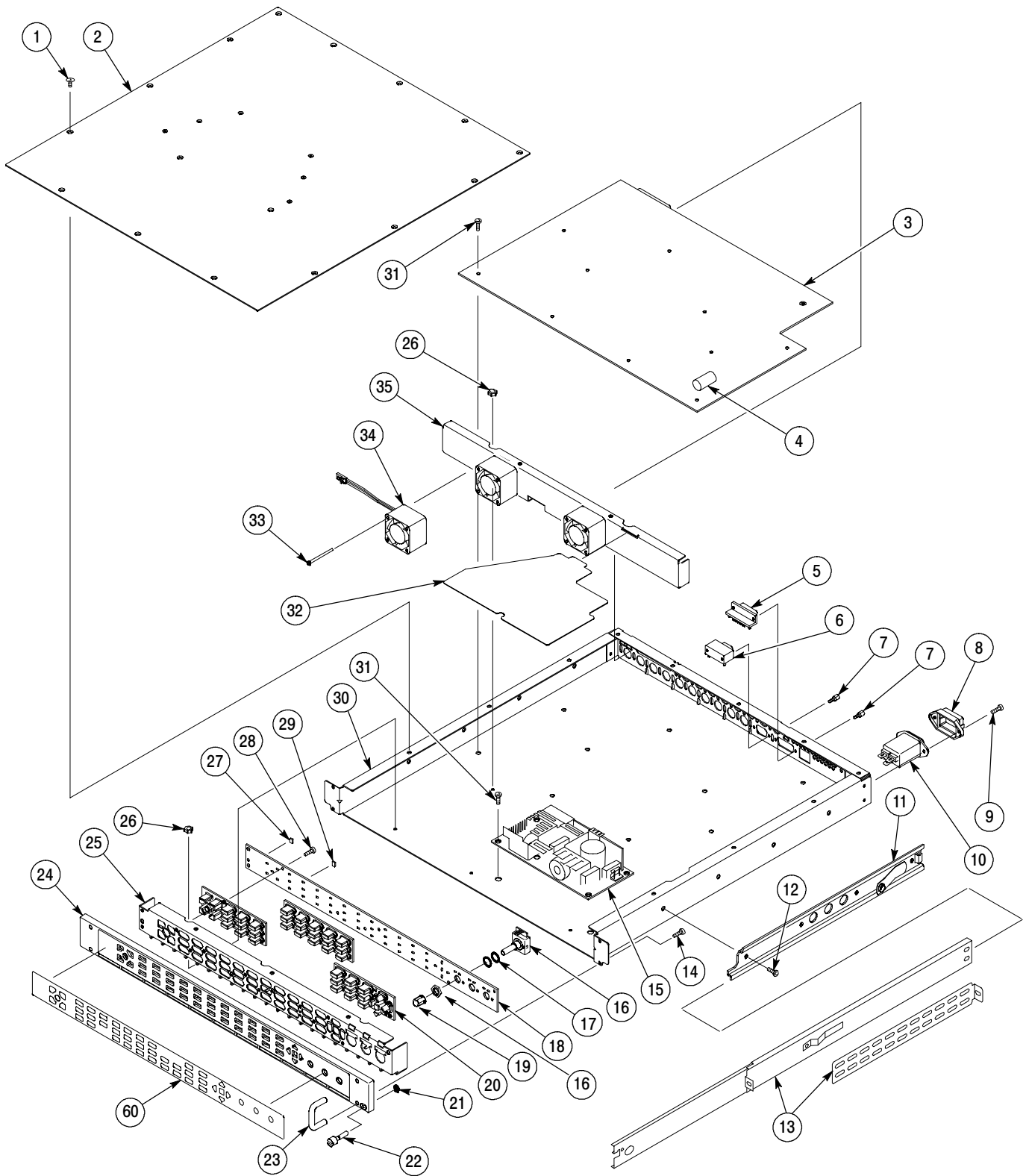


Figure 10-1: Replaceable mechanical parts

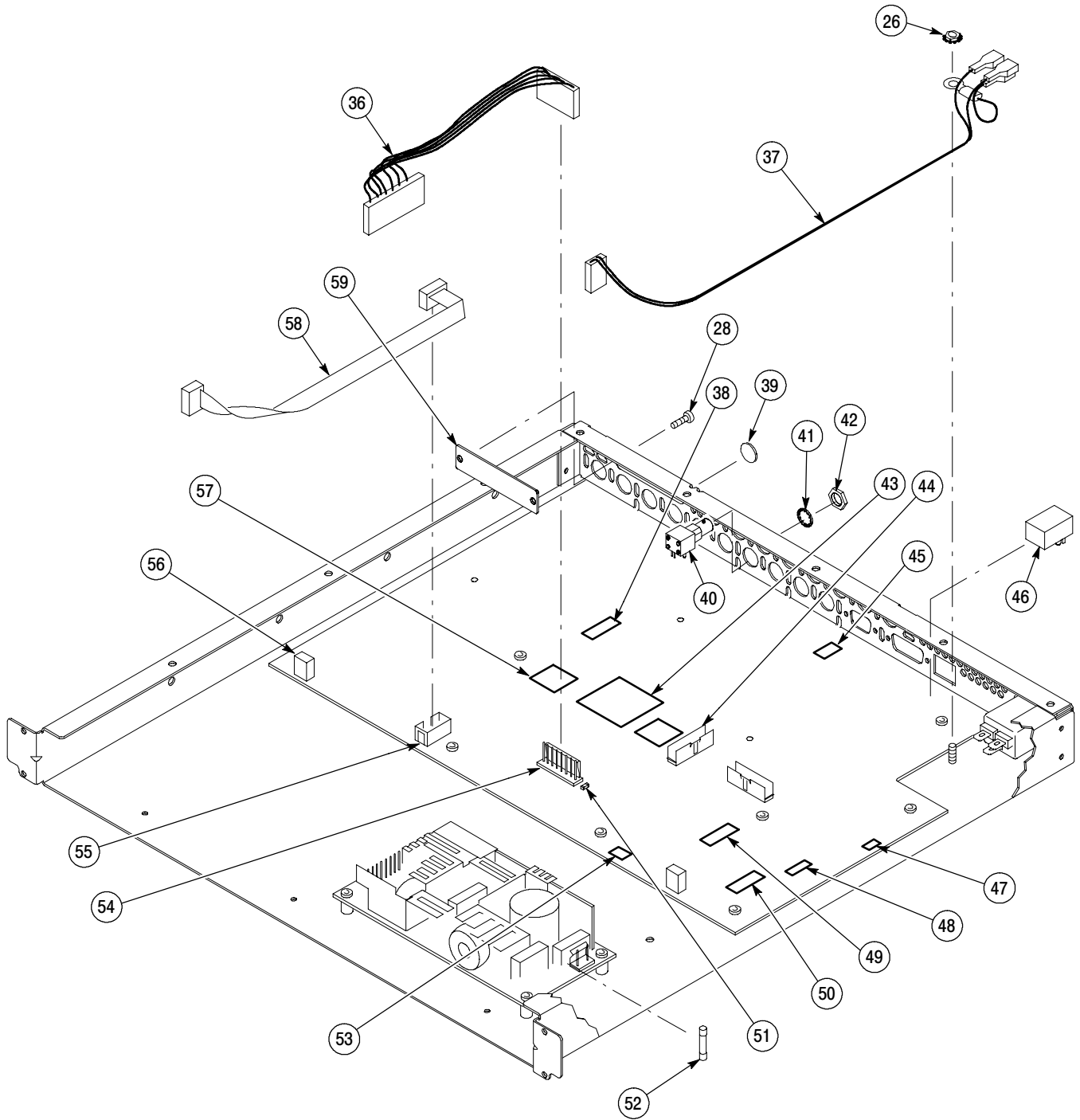


Figure 10-2: Replaceable cables, connectors, and mechanical parts

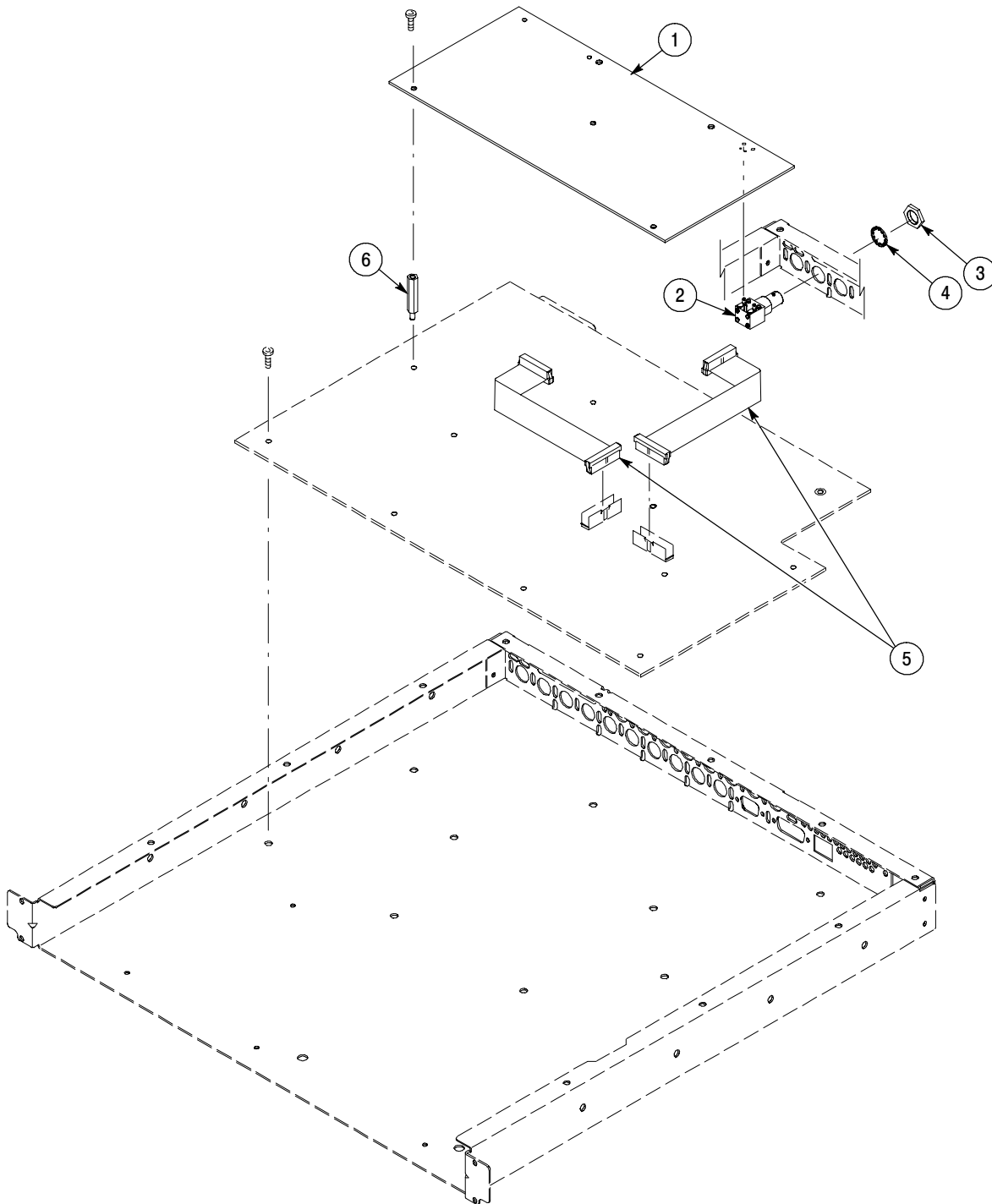


Figure 10-3: Audio option boards and connectors

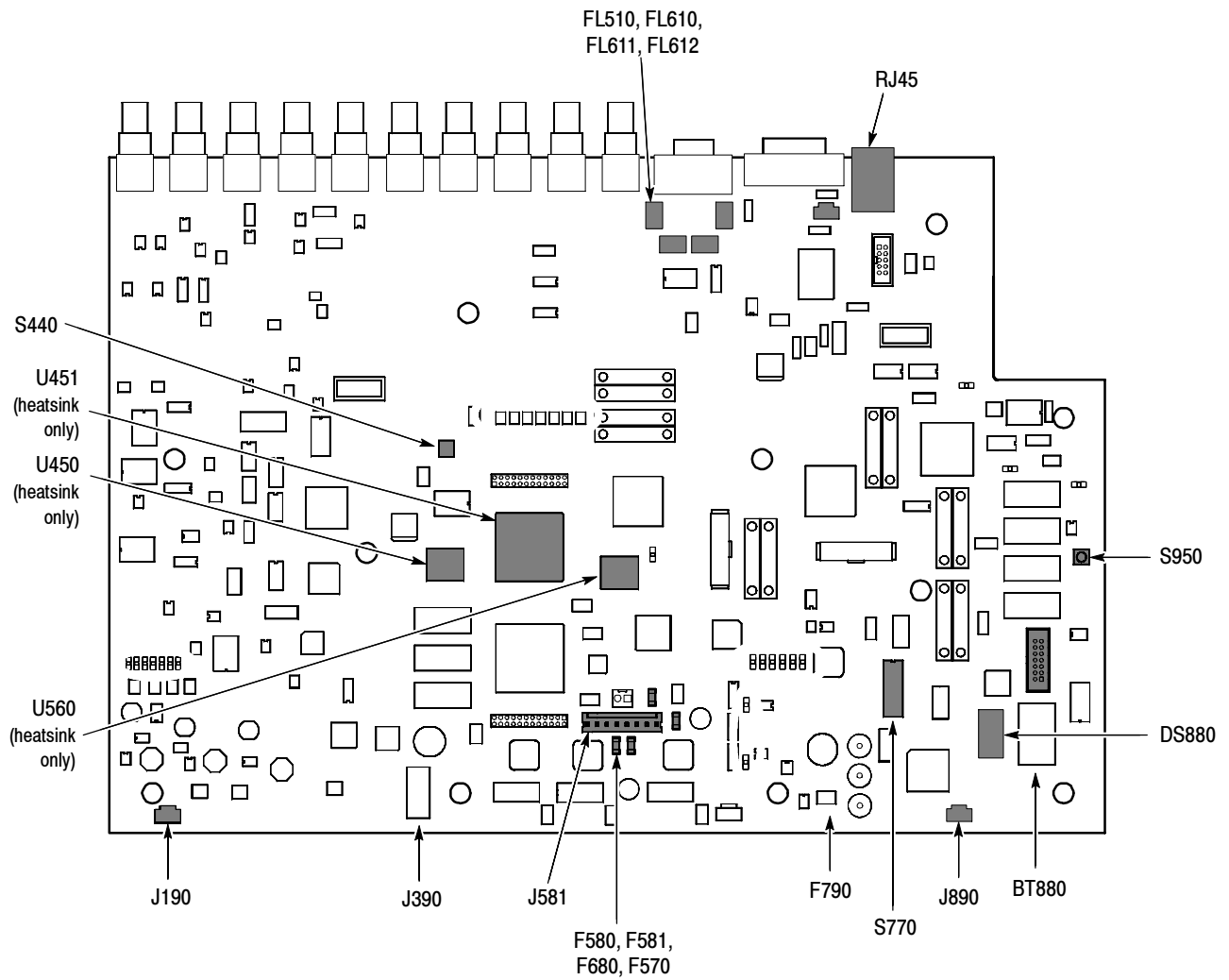


Figure 10-4: Main board replaceable components and connectors

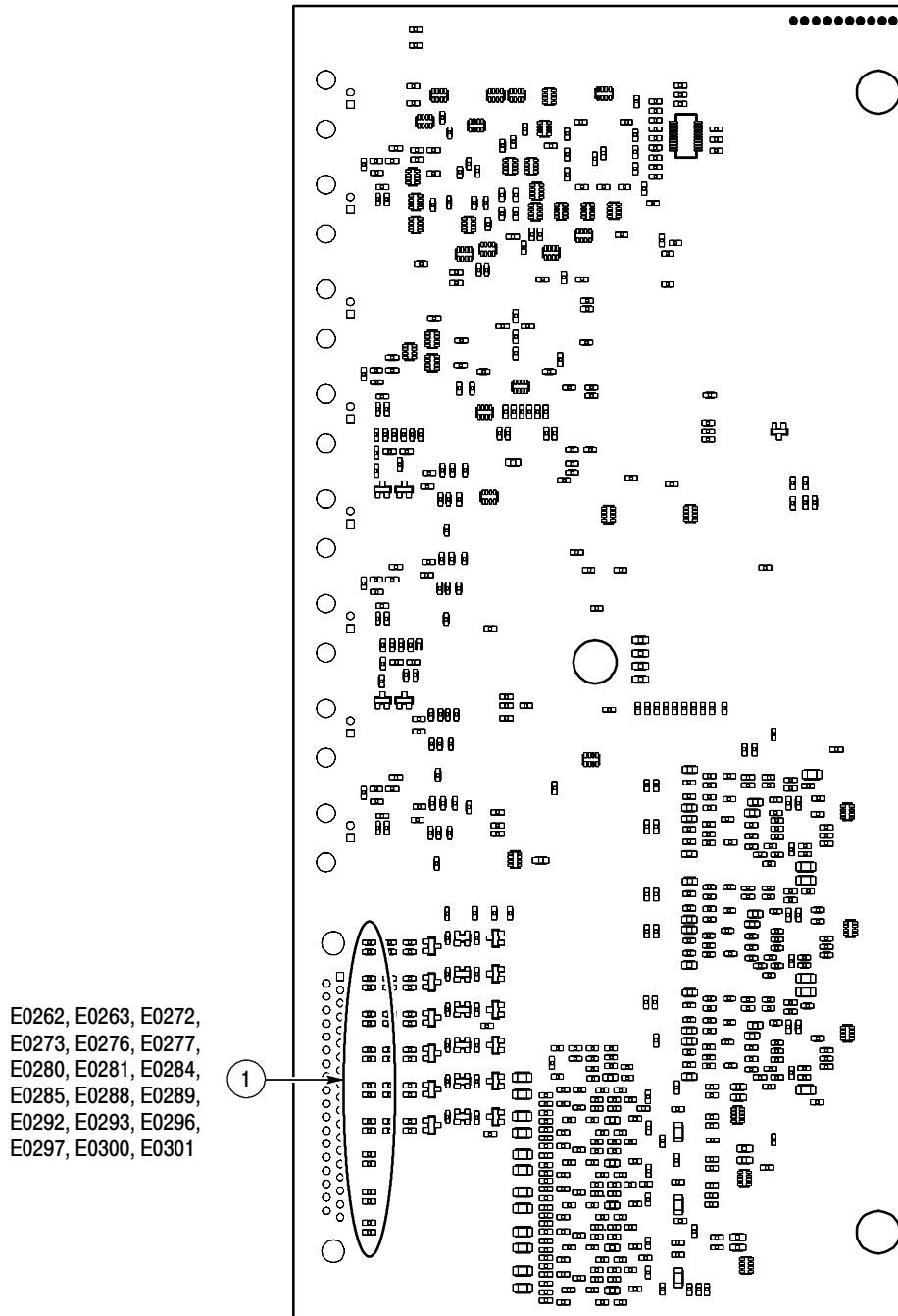


Figure 10-6: Audio board back-side components

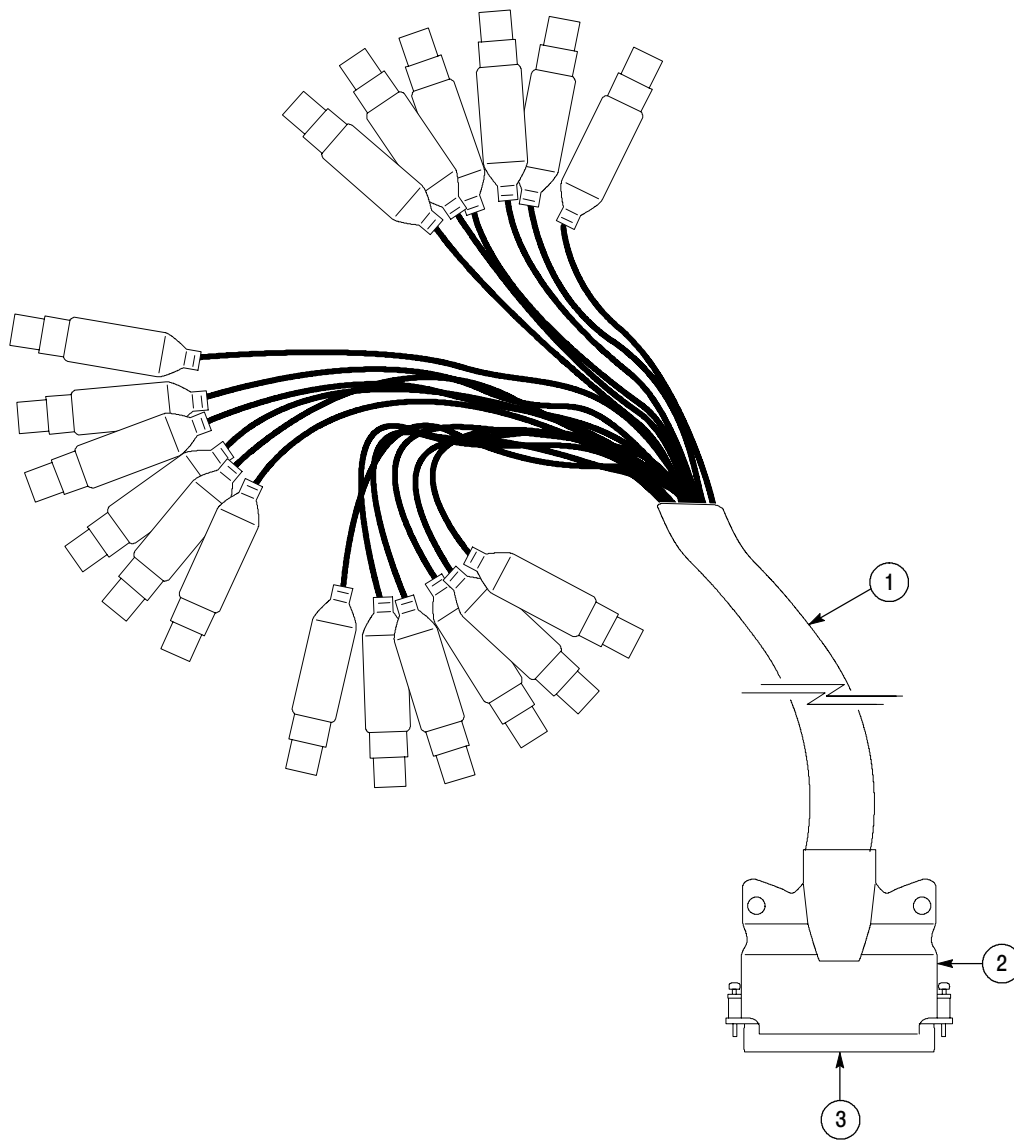


Figure 10-7: Analog audio breakout cable assembly