



**AWG-HD
HDMI test fixture
Specifications and Performance Verification
Technical Reference**

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Contacting Tektronix

Tektronix, Inc.
14150 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

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

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

Table of Contents

Important safety information	iii
General safety summary	iii
Service safety summary	v
Terms in this manual	v
Symbols and terms on the product	v
Preface	vi
Related documents available on www.tek.com	vi
Specifications	1
System characteristics	2
Physical characteristics	2
Power characteristics	2
Environmental performance	3
Performance verification	4
Prerequisites	4
Required equipment	4
Frequency response	5
Minimum skew between \pm	6
Max/Min voltage swing	8
Test record	9

Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page v, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

This product shall be used in accordance with local and national codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

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.

Do not use the provided power cord for other products.

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, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

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 operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Use the product in its temperature rating. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product.



WARNING. *The product is heavy. To reduce the risk of personal injury or damage to the device get help when lifting or carrying the product.*



WARNING. *The product is heavy. Use a two-person lift or a mechanical aid.*

Use only the Tektronix rackmount hardware specified for this product.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

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 product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

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.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:



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



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

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

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



Preface

The Tektronix AWG-HD is an HDMI fixture for sink (Rx) testing with programmable delay and amplitude. This document provides the electrical, mechanical, and environmental specifications for this product, as well as the procedures for performance verification.

Related documents available on www.tek.com

- AWG-HD Programmer Manual
- TekExpress® FRL Solution Application Help (Available from the TekScope menu in the TekExpress application and as a downloadable PDF at www.tek.com.)
- AWGSYNC01 Safety and Installation Manual
- AWG70000 Series Help (Available from the AWG70000 Series instrument Help menu and as a downloadable PDF at www.tek.com.)
- AWG-HD Specifications and Performance Verification Technical Reference
- TekExpress® eARC Solution Application Help (Available from the TekScope menu in the TekExpress application and as a downloadable PDF at www.tek.com.)

Specifications

All specifications are guaranteed unless labeled Typical. Typical specifications are provided for your convenience.

NOTE. *Warranted characteristics that are checked in the Performance Verification are marked with a ✓ symbol.*

The performance limits in this specification are valid within the following conditions:

- Software version installed on the AWG-HD is 2.2 or greater.
- Operate the instrument in an environment that meets the temperature, altitude, and humidity characteristics listed in these specifications.

System characteristics

Frequency response ✓	+1 dB to -2.5 dB, 0 to 8 GHz +1 dB to -5 dB, 0 to 18 GHz	Test frequency response tolerance and amplitude flatness.
Min skew between \pm ✓	± 250 ps	Minimum intra-pair skew achievable for a single channel.
Typical skew between \pm, typical	± 300 ps	Typical intra-pair skew achievable for a single channel.
Max voltage swing ✓	$1.5 V_{pk-pk}$ min	Maximum voltage swing (amplitude).
Min voltage swing ✓	$80 mV_{pk-pk}$ max	Minimum voltage swing (amplitude).
DC gain, typical	0 to 3.5 V	Voltage range that each channel can operate under typical HDMI configuration.
DC offset accuracy, typical	$< \pm 100$ mV	The DC accuracy of the offset of the system.
Input/Output impedance	$50 \pm 5 \Omega$	The resistance at each input and output.
Number of outputs	8, all identical	Located on the front panel.
Number of inputs	8, all identical	Located on the front panel.
Connector type	SMA	Located on the front panel.

Physical characteristics

Weight	11.34 kg (25 lbs)
Dimensions	
Height	88.9 mm (3.5 in)
Width	425.45 mm (16.75 in)
Depth	190.5 mm (7.5 in)

Power characteristics

Power supply	100 - 240 VAC 50/60 Hz
Power consumption	< 120 W

Environmental performance

Temperature	
Operating	+10 °C to +30 °C (+50 °F to +86 °F)
Nonoperating	-10 °C to +50 °C (14 °F to +122 °F)
Humidity	
Operating	5% to 90% RH (relative humidity) up to + 30 °C (+86 °F), non-condensing
Nonoperating	5% to 45% RH above +30 °C to +50 °C (+86 °F to 122 °F), non-condensing
Altitude	
Operating	3000 meters (9842.5 feet)
Nonoperating	12000 meters (39370 feet)

Performance verification

NOTE. The performance verification procedure is not a calibration procedure. The performance verification procedure only verifies that your instrument meets key specifications.

Prerequisites

The tests in this section make up a confirmation of performance and functionality when the following requirements are met:

- Operate the instrument in an environment that meets the temperature, altitude, and humidity characteristics listed in the specifications.
- The instrument must be completely assembled and covers installed per factory specification.

Required equipment

These procedures use external, traceable signal sources to directly check warranted characteristics. The following table lists the equipment required for this procedure.

Item	Qty	Model example	Test
Real-time oscilloscope, ≥ 23 GHz BW	1	Tektronix DPO72304SX or other SX model ≥ 23 GHz BW	All EXCEPT Frequency Response
Signal generator, max freq > 18 GHz, low phase noise	1	Anritsu MG3694B	All
Power splitter	1	Anritsu K241C	All EXCEPT Frequency Response
Power meter	1	Rhode and Schwartz NRV-Z1 head (10M – 18GHz) with the URV35 base power meter	Frequency Response
Cable, SMA (low loss, phase stable)	5	Tektronix 0130-314-00	All
Torque wrench	1	8 in-lbs	All

NOTE. Make sure that any adaptor and cable you use is specified to operate at the frequency range of the test you are performing. Connector frequency ranges:

SMA: DC to 18 GHz typical, up to 26.5 GHz for certain SMA cable/connectors.

Frequency response

This test verifies the frequency response of the unit to verify it can operate at the expected frequency range. Tests will need to be run at every channel of the unit, both positive and negative legs. It is measured by inputting a sinusoidal wave into the input of the device, sweeping across frequency while measuring the amplitude at the output with a power meter to check for amplitude flatness relative to a reference frequency of 100 MHz.

Signal Generator input setup

1. Connect the signal generator RF OUT to the AWG-HD CH1- IN with a SMA cable.
2. Set the amplitude to 0 dBm.
3. Set the generator to output a sine wave.

Output to power meter setup

1. Connect the power meter input to the AWG-HD CH1+ Out with a SMA cable.

NOTE. *The DUT is a pass-through that inverts the input signal, so anything plugged in to a positive IN channel will come out of the negative OUT channel and vice versa.*

Test

1. Launch TekVISA and establish communication with the AWG-HD unit.
2. Send the OUTPUT ENABLE command to the AWG-HD to turn the output on.
3. Set the signal generator as follows. Ensure the path (generator, cables, power meter) is characterized for accurate results.
 - Frequency: 100 MHz
 - Amplitude: 0 dBm
4. Turn on the output of the signal generator.
5. Send the ZERO command to the AWG-HD so that all channels have the same delay.
6. Record the amplitude (dBm) reading of the power meter.

This will be used as your reference at 100 MHz. All future readings will be measured in reference to this value to check the frequency response.

7. On the signal generator, increment the frequency by 100 MHz and then measure the amplitude again.

8. Continue incrementing in 100 MHz steps up to 18 GHz. Measure and record the amplitude for each step in the test record.
9. Once finished, repeat the test with each of the following input configurations and record the results in the test record:
 - Input: CH1+IN, Output: CH1–OUT
 - Input: CH2 +IN, Output: CH2 –OUT
 - Input: CH2 –IN, Output: CH2 +OUT
 - Input: CH3 + IN, Output: CH3 –OUT
 - Input: CH3 –IN, Output: CH3 +OUT
 - Input: CH4 +IN, Output: CH4 –OUT
 - Input: CH4 –IN, Output: CH4 +OUT

Minimum skew between \pm

This test verifies the maximum intra-pair skew attainable between the positive and negative leg of each channel. The minimum requirement for this is ± 250 ps. To test this, the DUT delay must be centered and the value entered will be the maximum skew.

Signal Generator input setup

1. Connect a SMA cable to the signal generator RF OUT.
2. Connect a power splitter to the other end of that SMA cable.
3. Connect 2 SMA cables, one to each output, of the power splitter.
4. Connect the ends of the SMA cables from the splitter to the AWG-HD CH1 +IN and CH1 –IN.
5. Set the amplitude to 0 dBm.
6. Set the frequency to 2.112 GHz.
7. Set the generator to output a sine wave.

Output to oscilloscope setup

1. Connect CH1 of the oscilloscope to CH1 +OUT of the AWG-HD.
2. Connect CH2 of the oscilloscope to CH1 –OUT of the AWG-HD.

Test

1. Launch TekVISA and establish communication with the AWG-HD unit.
2. Send the OUTPUT ENABLE command to the AWG-HD to turn the output on.

3. Set the signal generator as follows. Ensure the path (generator, cables, power meter) is characterized for accurate results.
 - Frequency: 2.112 GHz
 - Amplitude: 0 dBm
4. Turn on the output of the signal generator.
5. Set volts/div to full scale and the sampling rate to 50 GS/s on the oscilloscope.
6. Add a Delay measurement between CH1 and CH2 on the oscilloscope.
7. Determine if you need to calibrate the horizontal delay for the first measurement as follows:
 - a. Find the first edge trigger point of the acquisition.
 - b. Look at the first and second edge trigger points and check that the cursors are at the same 50% point for both channels. If they are, proceed to step 8. If not, proceed to step 7 c.
 - c. Add a horizontal delay to the start of the acquisition if the trigger points are misaligned.
8. Average >100000 acquisitions and note the skew (rounded to half a ps).
9. Send the STEP command to the AWG-HD on CH:1 with the value of the skew previously measured.
10. Increase the frequency on the signal generator to 4.112 GHz.
11. Run another acquisition on the oscilloscope.
12. Record the skew and send the STEP command to the AWG-HD on the corresponding channel with the value of the skew (rounded to half a ps). Wait 1 second, clear, and then run another acquisition on the oscilloscope.
13. If centered (<2 ps skew), send a DEL query on the corresponding channel. The returned number is the minimum skew between \pm .
14. Record the results in the test record.
15. Perform this test on the other three channels of the AWG-HD. Make sure to change the commands sent to the AWG-HD to the channel being measured. For example, when measuring CH2, use the CH:2 DEL command.
16. Record the results in the test record.

Max/Min voltage swing

This test verifies the maximum and minimum voltage swing attainable by the device.

Signal Generator input setup

1. Connect a SMA cable to the signal generator RF OUT.
2. Connect a power splitter to the other end of that SMA cable.
3. Connect 2 SMA cables, one to each output, of the power splitter.
4. Connect the ends of the SMA cables from the splitter to the AWG-HD CH1 +IN and CH1 –IN.
5. Set the amplitude to 500 mV.
6. Set the frequency to 6.112 GHz.
7. Set the generator to output a sine wave.

Output to oscilloscope setup

1. Connect CH1 of the oscilloscope to CH1 +OUT of the AWG-HD.
2. Connect CH2 of the oscilloscope to CH1 –OUT of the AWG-HD.

Test

1. Launch TekVISA and establish communication with the AWG-HD unit.
2. Send the OUTPUT ENABLE command to the AWG-HD to turn the output on.
3. Send the ZERO command to the AWG-HD so that all channels have the same delay.
4. Set the signal generator as follows. Ensure the path (generator, cables, power meter) is characterized for accurate results.
 - Frequency: 6.112 GHz
 - Amplitude: 500 mV
5. Turn on the output of the signal generator.
6. Set Volts/div to full scale and the sampling rate to 50 GS/s on the oscilloscope.
7. Add an amplitude measurement for the waveforms for each channel in order to calculate the maximum voltage swing.
8. Add the two amplitudes and record the result in the test record. This is the maximum voltage swing. Record this value in the test record.
9. To measure the minimum voltage swing, set the amplitude of the signal generator to 35 mV.
10. Add the two amplitudes and record the result in the test record. This is the minimum voltage swing. Record this value in the test record.
11. Repeat this procedure on CH2, CH3, and CH4.

Test record

Use the attached spreadsheet to record test results for all of the tests provided in this document. To access the spreadsheet, view and then download the attachment in this PDF.