AWG70001A and AWG70002A Arbitrary Waveform Generators and AWGSYNC01 Synchronization Hub Specifications and Performance Verification

Technical Reference

077-0780-03

Tektronix

AWG70001A and AWG70002A Arbitrary Waveform Generators and AWGSYNC01 Synchronization Hub Specifications and Performance Verification

Technical Reference

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 before performing service.

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077-0780-03

Tektronix

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- Worldwide, visit www.tektronix.com to find contacts in your area.

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General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

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

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

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

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

Do not operate without covers. Do not operate this product with covers or panels removed.

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

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

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

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

Terms in this manual

These terms may appear in this manual:

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

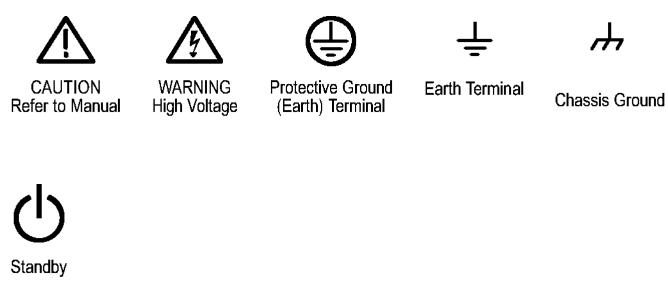
CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and terms on the product

These terms may appear on the product:

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

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



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 manual contains specifications and performance verification procedures for the AWG70000A Series Arbitrary Waveform Generators and the AWGSYNC01 Synchronization Hub.

Related documents

The following user documents are also available for this product:

- *AWG70000A Series Safety and Installation Manual*. This document provides safety information and how to install the instrument.
- *AWGSYNC01 Safety and Installation Manual*. This document provides safety information and how to install the instrument.
- *AWG70000A Series Arbitrary Waveform Generators Service Manual*. This is a PDF-only manual that provides module-level service information. It can be downloaded from the Tektronix Web site.

Specifications

Specifications

This section contains the specifications for the AWG70000A series Arbitrary Waveform Generators and the AWGSYNC01 Synchronization Hub. The generators are covered together in the first part, followed by the separate AWGSYNC01 information.

All specifications are typical unless noted as warranted. Warranted specifications that are marked with the ✓ symbol are checked in this manual.

Performance conditions

To meet specifications, the following conditions must be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must be operating within the environmental limits. (See Table 1-32 on page 1-21.)
- The instrument must be powered from a source that meets the specifications. (See Table 1-30 on page 1-18.)
- The instrument must have been operating continuously for at least 20 minutes within the specified operating temperature range.

Electrical specifications

Table 1-1: Run mode

Characteristics	Description
Continuous mode	An arbitrary waveform is output continuously.
Triggered mode	An arbitrary waveform is output only once when a trigger signal is applied. After the waveform is output, the instrument waits for the next trigger signal.
Triggered continuous mode	An arbitrary waveform is output continuously after a trigger signal is applied.

Table 1-2: Arbitrary waveform

Characteristics	Description
Waveform memory	
AWG70001A	
Standard	2,000,000,000 points
With Option 01	8,000,000,000 points when ≤25 GS/s 16,000,000,000 points when >25 GS/s
AWG70002A	
Standard	2,000,000,000 points
With Option 01	8,000,000,000 points
Minimum waveform size	
AWG70001A	1 point in continuous run mode 4800 points in triggered run modes
AWG70002A	1 point in continuous run mode 2400 points in triggered run modes
Waveform granularity	
AWG70001A	1 point in continuous run mode 2 points in triggered run modes
AWG70002A	1 point in continuous run mode 1 point in triggered run modes
Waveform interleaving	Interleaving is performed without zeroing
AWG70001A	Non-interleaved when ≤25 GS/s, interleaved when >25 GS/s
AWG70002A	Non-interleaved at all sample rates
DAC resolution	8-bit, 9-bit, or 10-bit

Table 1-3: Sample clock generator

Characteristics	Description
Instrument / Option	Sampling rate control range
AWG70001A Option 150	1.49 kS/s to 50 GS/s
AWG70002A Option 225	1.49 kS/s to 25 GS/s
AWG70002A Option 216	1.49 kS/s to 16 GS/s
AWG70002A Option 208	1.49 kS/s to 8 GS/s
Resolution	With jitter reduction: 3 digits Without jitter reduction: 8 digits
Phase adjustment	Used to manually align the outputs with other generators or instruments.
Range	-10,800° to +10,800°
Resolution	1°

Table 1-4: Analog output

Characteristics	Description
Connector type	Aeroflex/Weinschel Planar Crown Universal Connector System with SMA female adapter
Number of outputs	AWG70001A: 1 AWG70002A: 2
Type of outputs	(+) and (–) complementary output
ON/OFF control	Independent control for each analog output complementary pair
Output impedance	50 Ω
VSWR	
AWG70001A	DC to 5 GHz = 1.32:1 5 GHz to 10 GHz = 1.52:1 10 GHz to 20 GHz = 1.73:1
AWG70002A	DC to 5 GHz = 1.61:1 5 GHz to 10 GHz = 1.61:1
Amplitude	Independent control for each channel
Range	0.25 V_{p-p} to 0.5 V_{p-p} into 50 Ω single-ended 0.5 V_{p-p} to 1.0 V_{p-p} into 100 Ω differential
Resolution	1 mV
✓ DC accuracy (warranted)	±(2% of amplitude + 1 mV)
Amplitude flatness	Flatness is measured as the deviation from the ideal sin(x)/x response curve of the DAC at the specified sample rate. The response is mathematically removed from the measured data.
AWG70001A	+1.8 dB to –1.8 dB up to 10 GHz +1.8 dB to –3 dB from 10 GHz to 15 GHz
AWG70002A	+0.8 dB to –1.5 dB up to 10 GHz

Table 1-4: Analog output (cont.)

Characteristics	Description
Sin(x)/x bandwidth	The sin(x)/x bandwidth can be solved for using the following equation: 20 * log (sin(x)/x) = -3 For interleaved waveforms: x = 2π * fout ÷ fsample For non-interleaved waveforms: x = π * fout ÷ fsample fsample = sample rate fout = sin(x)/x bandwidth
AWG70001A	≤ 25 GS/s (non-interleaved): 11.1 GHz * fsample ÷ 25 GS/s > 25 GS/s (interleaved): 11.1 GHz * fsample ÷ 50 GS/s
AWG70002A	11.1 GHz * fsample ÷ 25 GS/s
Analog bandwidth	Analog bandwidth is measured with the ideal sin(x)/x response curve of the DAC mathematically removed from the measured data.
AWG70001A	15 GHz at 50 GS/s
AWG70002A	13.5 GHz at 25 GS/s
Rise/fall time	When operating in interleaved mode, rising and falling edges are created using two sample points. As a result, the rise/fall time is dependent on the sample rate.
AWG70001A	≤ 25 GS/s: < 23 ps at 30 GS/s: < 42 ps at 40 GS/s: < 32 ps at 50 GS/s: < 27 ps
AWG70002A	< 22 ps
Aberrations	$<18\%_{p-p}$ for the first 100 ps following the step transition with 100% reference at 1 ns, for an ambient temperature range of 20 ºC to 30 ºC
Skew between (+) and (-) outputs	< 5 ps

Table 1-4: Analog output (cont.)

Characteristics	Description	
Harmonic distortion	Measured with a balun.	
AWG70001A and AWG70002A		
Operating at 25 GS/s	Output Frequency	2nd harmonic
	<2 GHz	< –60 dBc
	2 GHz – 6 GHz	< –50 dBc
	>6 GHz	< –42 dBc
		3rd harmonic
	<1 GHz:	< –60 dBc
	1 GHz – 2 GHz	< –50 dBc
	>2 GHz	< –40 dBc
AWG70002A		
Operating at 8 GS/s	Output Frequency	2nd harmonic
	<1 GHz	< –60 dBc
	1 GHz – 3.2 GHz	< –55 dBc
		3rd harmonic
	<1 GHz:	< -60 dBc
	1 GHz – 3.2 GHz	< –50 dBc
Operating at 16 GS/s		2nd harmonic
	<1 GHz	< –60 dBc
	1 GHz – 4 GHz	< –55 dBc
	>4 GHz	< –50 dBc
		3rd harmonic
	<1 GHz:	< –60 dBc
	1 GHz – 2 GHz	< –50 dBc
	>2 GHz	< –40 dBc
SFDR	(See Table 1-5.) (See Table 1-6.) (See Table 1-7.) (See Table 1-8.)	
ENOB		
AWG70001A	4.6 bits at 14.990 GHz. All noise and distortion DC - 20 GHz	
AWG70002A	5.6 bits at 9.990 GHz. All noise and distortion DC - 12.5 GHz	
Phase noise with jitter reduction	(See Table 1-9.) (See Table 1-10.) (See Table 1-11.) (See Table 1-12.)	

Table 1-4: Analog output (cont.)

Characteristics	Description
Phase noise without jitter reduction	(See Table 1-13.) (See Table 1-14.) (See Table 1-15.) (See Table 1-16.)
Random jitter on clock pattern	0.25 ps rms Using 0101.. clock pattern, amplitude = 0.5 V_{p-p}
Total jitter on random pattern	10 ps_{p-p} Using PRBS pattern, amplitude = 0.5 V_{p-p}, measured at Bit Error Rate of $1e^{-12}$
Interleave adjustment (AWG70001A only)	
Phase adjustment range	-180° to +180°
Phase adjustment resolution	1°
Amplitude matching range	±10% of amplitude setting
Inter-channel skew control (AWG70002A only)	
Range	–100 ps to +100 ps
Resolution	1 ps
Accuracy	±5 ps

Table 1-5: SFDR, AWG70001A & AWG70002A operating at 25 GS/s [1]

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
100 MHz	DC – 1 GHz	–80 dBc	DC – 10 GHz	–72 dBc
DC – 500 MHz	DC – 500 MHz	–70 dBc	DC – 1.5 GHz	–66 dBc
DC – 1 GHz	DC – 1 GHz	–63 dBc	DC – 3 GHz	–63 dBc
DC – 2 GHz	DC – 2 GHz	–62 dBc	DC – 6 GHz	–60 dBc
DC – 3 GHz	DC – 3 GHz	–60 dBc	DC – 6 GHz	–52 dBc
DC – 5 GHz	DC – 5 GHz	–52 dBc	DC – 6 GHz	–52 dBc
5 – 6 GHz	5 – 6 GHz	–52 dBc	3 – 9 GHz	–40 dBc
6 – 7 GHz	6 – 7 GHz	–42 dBc	4 – 10 GHz	–42 dBc

Table 1-5: SFDR, AWG70001A & AWG70002A operating at 25 GS/s [1] (cont.)

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
7 – 8 GHz	7 – 8 GHz	–55 dBc	6 – 12.5 GHz	–50 dBc
8 – 10 GHz	8 – 10 GHz	–50 dBc	6 – 12.5 GHz	–50 dBc

1 Measured with a balun, excluding harmonics.

Table 1-6: SFDR, AWG70001A operating at 50 GS/s [1]

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
100 MHz	DC – 1 GHz	–80 dBc	DC – 10 GHz	–72 dBc
DC – 500 MHz	DC – 500 MHz	–70 dBc	DC – 1.5 GHz	–66 dBc
DC – 1 GHz	DC – 1 GHz	–63 dBc	DC – 3 GHz	–63 dBc
DC – 2 GHz	DC –2 GHz	–62 dBc	DC – 6 GHz	–60 dBc
DC – 3 GHz	DC –3 GHz	–60 dBc	DC – 6 GHz	–52 dBc
DC – 5 GHz	DC – 5 GHz	–52 dBc	DC – 6 GHz	–52 dBc
5 – 6 GHz	5 – 6 GHz	–52 dBc	3 – 9 GHz	–40 dBc
6 – 7 GHz	6 – 7 GHz	–42 dBc	4 – 10 GHz	–42 dBc
7 – 8 GHz	7 – 8 GHz	–60 dBc	6 – 12.5 GHz	–52 dBc
8 – 10 GHz	8 – 10 GHz	–50 dBc	6 – 12.5 GHz	–52 dBc
10 – 12 GHz	10 – 12 GHz	–53 dBc	6 – 12.5 GHz	–50 dBc
12 – 13 GHz	12 – 13 GHz	–22 dBc	10 – 15 GHz	–22 dBc
13 – 14 GHz	13 – 14 GHz	–54 dBc	11 – 16 GHz	–20 dBc
14 – 16 GHz	14 – 16 GHz	–46 dBc	13 – 18 GHz	–38 dBc
16 – 18.5 GHz	16 – 18.5 GHz	–42 dBc	14 – 20 GHz	–30 dBc
18.5 – 20 GHz	18.5 – 20 GHz	–28 dBc	16 – 20 GHz	–24 dBc

1 Measured with a balun, excluding harmonics.

Table 1-7: SFDR, AWG70002A operating at 8 GS/s [1]

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
100 MHz	DC – 1 GHz	–80 dBc	DC – 3 GHz	–72 dBc
0 – 500 MHz	DC – 500 MHz	–68 dBc	DC – 1.5 GHz	–66 dBc
DC – 1 GHz	DC – 1 GHz	–63 dBc	DC – 3 GHz	–63 dBc
DC – 2 GHz	DC – 2 GHz	–60 dBc	DC – 4 GHz	–60 dBc

Table 1-7: SFDR, AWG70002A operating at 8 GS/s [1] (cont.)

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
DC – 2.6 GHz	DC –2.6 GHz	–55 dBc	DC – 4 GHz	–52 dBc
DC – 3.2 GHz	DC – 3.2 GHz	–47 dBc	DC – 4 GHz	–47 dBc

1 Measured with a balun, excluding harmonics.

Table 1-8: SFDR, AWG70002A operating at 16 GS/s [1]

Analog channel output frequency	In band performance measured across	Specification	Adjacent band performance measured across	Specification
100 MHz	DC – 1 GHz	–80 dBc	DC – 3 GHz	–72 dBc
0 – 500 MHz	DC – 500 MHz	–68 dBc	DC – 1.5 GHz	–66 dBc
DC – 1 GHz	DC – 1 GHz	–62 dBc	DC – 3 GHz	–63 dBc
DC – 2 GHz	DC – 2 GHz	–60 dBc	DC – 6 GHz	–58 dBc
DC – 3.5 GHz	DC –3.5 GHz	–57 dBc	DC – 8 GHz	–40 dBc
3.5 – 4.5 GHz	3.5 – 4.5 GHz	–42 dBc	DC – 8 GHz	–42 dBc
4.5 – 6.4 GHz	4.5 – 6.4 GHz	–52 dBc	DC – 8 GHz	–42 dBc

1 Measured with a balun, excluding harmonics.

Table 1-9: Phase noise with jitter reduction, AWG70001A operating at 50 GS/s

	Analog output frequency			
Offset	**100 MHz**	**1 GHz**	**10 GHz**	**16 GHz**
100 Hz	–116 dBc/Hz	–94 dBc/Hz	–75 dBc/Hz	–70 dBc/Hz
1 kHz	–134 dBc/Hz	–116 dBc/Hz	–95 dBc/Hz	–91 dBc/Hz
10 kHz	–136 dBc/Hz	–119 dBc/Hz	–101 dBc/Hz	–96 dBc/Hz
100 kHz	–138 dBc/Hz	–118 dBc/Hz	–99 dBc/Hz	–96 dBc/Hz
1 MHz	–150 dBc/Hz	–132 dBc/Hz	–112 dBc/Hz	–108 dBc/Hz
10 MHz	–156 dBc/Hz	–157 dBc/Hz	–138 dBc/Hz	–130 dBc/Hz

Table 1-10: Phase noise with jitter reduction, AWG70001A & AWG70002A operating at 25 GS/s

	Analog output frequency		
Offset	**100 MHz**	**1 GHz**	**10 GHz**
100 Hz	–115 dBc/Hz	–95 dBc/Hz	–76 dBc/Hz
1 kHz	–134 dBc/Hz	–115 dBc/Hz	–86 dBc/Hz
10 kHz	–138 dBc/Hz	–121 dBc/Hz	–102 dBc/Hz
100 kHz	–138 dBc/Hz	–118 dBc/Hz	–100 dBc/Hz
1 MHz	–150 dBc/Hz	–132 dBc/Hz	–113 dBc/Hz
10 MHz	–155 dBc/Hz	–157 dBc/Hz	–138 dBc/Hz

Table 1-11: Phase noise with jitter reduction, AWG70002A operating at 8 GS/s

	Analog output frequency			
Offset	100 MHz	1 GHz	2 GHz	3 GHz
100 Hz	–110 dBc/Hz	–89 dBc/Hz	–83 dBc/Hz	–80 dBc/Hz
1 kHz	–127 dBc / Hz	–109 dBc / Hz	–102 dBc / Hz	–99 dBc / Hz
10 kHz	–134 dBc/Hz	–115 dBc/Hz	–108 dBc/Hz	–107 dBc/Hz
100 kHz	–134 dBc/Hz	–113 dBc/Hz	–106 dBc/Hz	–104 dBc/Hz
1 MHz	–142 dBc/Hz	–121 dBc/Hz	–114 dBc/Hz	–112 dBc/Hz
10 MHz	–154 dBc/Hz	–149 dBc/Hz	–144 dBc/Hz	–141 dBc/Hz

Table 1-12: Phase noise with jitter reduction, AWG70002A operating at 16 GS/s

	Analog output frequency				
Offset	100 MHz	1 GHz	2 GHz	3 GHz	4 GHz
100 Hz	–112 dBc/Hz	–90 dBc/Hz	–87 dBc/Hz	–82 dBc/Hz	–80 dBc/Hz
1 kHz	–128 dBc / Hz	–109 dBc / Hz	–103 dBc / Hz	–99 dBc / Hz	–97 dBc / Hz
10 kHz	–134 dBc/Hz	–116 dBc/Hz	–110 dBc/Hz	–106 dBc/Hz	–104 dBc/Hz
100 kHz	–133 dBc/Hz	–113 dBc/Hz	–108 dBc/Hz	–104 dBc/Hz	–101 dBc/Hz
1 MHz	–141 dBc/Hz	–122 dBc/Hz	–116 dBc/Hz	–113 dBc/Hz	–110 dBc/Hz
10 MHz	–154 dBc/Hz	–150 dBc/Hz	–147 dBc/Hz	–143 dBc/Hz	–140 dBc/Hz

Table 1-13: Phase noise without jitter reduction, AWG70001A operating at 49.998998 GS/s

	Analog output frequency			
Offset	100 MHz	1 GHz	10 GHz	16 GHz
100 Hz	–110 dBc/Hz	–89 dBc/Hz	–69 dBc/Hz	–67 dBc/Hz
1 kHz	–125 dBc/Hz	–105 dBc/Hz	–84 dBc/Hz	–82 dBc/Hz
10 kHz	–130 dBc/Hz	–110 dBc/Hz	–94 dBc/Hz	–89 dBc/Hz
100 kHz	–126 dBc/Hz	–106 dBc/Hz	–89 dBc/Hz	–85 dBc/Hz
1 MHz	–139 dBc/Hz	–119 dBc/Hz	–104 dBc/Hz	–100 dBc/Hz
10 MHz	–145 dBc/Hz	–128 dBc/Hz	–111 dBc/Hz	–106 dBc/Hz

Table 1-14: Phase noise without jitter reduction, AWG70001A & AWG70002A operating at 24.998998 GS/s

	Analog output frequency		
Offset	100 MHz	1 GHz	10 GHz
100 Hz	–104 dBc/Hz	–92 dBc/Hz	–74 dBc/Hz
1 kHz	–124 dBc/Hz	–105 dBc/Hz	–83 dBc/Hz
10 kHz	–130 dBc/Hz	–111 dBc/Hz	–93 dBc/Hz
100 kHz	–126 dBc/Hz	–106 dBc/Hz	–89 dBc/Hz
1 MHz	–131 dBc/Hz	–122 dBc/Hz	–104 dBc/Hz
10 MHz	–142 dBc/Hz	–129 dBc/Hz	–109 dBc/Hz

Table 1-15: Phase noise without jitter reduction, AWG70002A operating at 7.998997998 GS/s

	Analog output frequency			
Offset	**100 MHz**	**1 GHz**	**2 GHz**	**3 GHz**
100 Hz	–107 dBc/Hz	–88 dBc/Hz	–83 dBc/Hz	–79 dBc/Hz
1 kHz	–120 dBc/Hz	–99 dBc/Hz	–92 dBc/Hz	–90 dBc/Hz
10 kHz	–126 dBc/Hz	–107 dBc/Hz	–100 dBc/Hz	–98 dBc/Hz
100 kHz	–125 dBc/Hz	–105 dBc/Hz	–98 dBc/Hz	–96 dBc/Hz
1 MHz	–131 dBc/Hz	–110 dBc/Hz	–103 dBc/Hz	–102 dBc/Hz
10 MHz	–141 dBc/Hz	–121 dBc/Hz	–113 dBc/Hz	–112 dBc/Hz

Table 1-16: Phase noise without jitter reduction, AWG70002A operating at 15.998997998 GS/s

	Analog output frequency				
Offset	**100 MHz**	**1 GHz**	**2 GHz**	**3 GHz**	**4 GHz**
100 Hz	–106 dBc/Hz	–88 dBc/Hz	–84 dBc/Hz	–79 dBc/Hz	–75 dBc/Hz
1 kHz	–120 dBc/Hz	–101 dBc/Hz	–94 dBc/Hz	–90 dBc/Hz	–87 dBc/Hz
10 kHz	–126 dBc/Hz	–107 dBc/Hz	–102 dBc/Hz	–98 dBc/Hz	–96 dBc/Hz
100 kHz	–125 dBc/Hz	–106 dBc/Hz	–100 dBc/Hz	–96 dBc/Hz	–94 dBc/Hz
1 MHz	–135 dBc/Hz	–115 dBc/Hz	–109 dBc/Hz	–106 dBc/Hz	–103 dBc/Hz
10 MHz	–141 dBc/Hz	–121 dBc/Hz	–115 dBc/Hz	–112 dBc/Hz	–109 dBc/Hz

Table 1-17: AC analog output (AWG70001A, Option AC)

Characteristics	Description
Connector type	Aeroflex/Weinschel Planar Crown Universal Connector System with SMA female adapter
Number of outputs	1
Type of output	Single-ended output
Output impedance	50 Ω
Frequency range	
No filter	10 MHz to 18 GHz
Low Pass	10 MHz to 11.5 GHz
Band Pass	10 GHz to 14.5 GHz 13 GHz to 18 GHz

Table 1-17: AC analog output (AWG70001A, Option AC) (cont.)

Characteristics	Description
Amplitude Range	For a CW signal at specified frequencies in each path. Each path is calibrated at a single frequency (see Amplitude Accuracy). For signals at different frequencies, the range is shifted and the actual output power will be offset from the requested power. The specifications for the no filter path at 13 GHz and the band pass path at 18 GHz reflect the capability at those frequencies, not the accuracy.
No filter	25 dBm to –70 dBm at 1 GHz 18 dBm to –77 dBm at 13 GHz
Low Pass	25 dBm to –70 dBm at 1 GHz
Band Pass	
10 GHz to 14.5 GHz	18 dBm to –77 dBm at 11 GHz
13 GHz to 18 GHz	20 dBm to –90 dBm at 14 GHz 18 dBm to –90 dBm at 18 GHz
Amplitude resolution	0.01 dB
Amplitude accuracy	The AWG does not include a leveling loop. Signal amplitude accuracy is only specified for a CW signal at the calibration frequency. Signals at different frequencies can have a different amplitude. Modulated or multi-tone signals often have significantly lower amplitude. Calibration is done with a small signal to keep the amplifier in a linear range. When playing out full amplitude signals at high levels the amplifiers can be driven into compression and the output amplitude will not match the requested level and the signal can be distorted.
No filter	
16 °C to 26 °C	± 0.5 dB at 1 GHz
0 °C to 50 °C	± 1.5 dB at 1 GHz
Low Pass	
16 °C to 26 °C	± 0.5 dB at 1 GHz
0 °C to 50 °C	± 1.5 dB at 1 GHz
Band Pass (10 GHz to 14.5 GHz)	
16 °C to 26 °C	± 1.5 dB at 11 GHz
0 °C to 50 °C	± 3.0 dB at 11 GHz
Band Pass (13 GHz to 18 GHz)	
16 °C to 26 °C	± 1.5 dB at 14 GHz
0 °C to 50 °C	± 3.5 dB at 14 GHz
Amplitude flatness	Specifications include the sin(x)/x roll off of the DAC at 50 GS/s.
No filter	
10 MHz to 10 GHz	± 3 dB
10 MHz to 13 GHz	± 4 dB
Low Pass	
10 MHz to 10 GHz	± 3 dB

Table 1-17: AC analog output (AWG70001A, Option AC) (cont.)

Characteristics	Description	
Band Pass		
10 GHz to 14.5 GHz	± 3.5 dB	
13 GHz to 18 GHz	± 4.5 dB	
Harmonic distortion	Measured with a balun.	
Operating at 50 GS/s	Output Frequency	2nd harmonic
No filter	<1 GHz	< –34 dBc
	1 GHz to 4 GHz	< –30 dBc
	>4 GHz	< –28 dBc
	Output Frequency	3rd harmonic
	<1 GHz	< –50 dBc
	1 GHz to 4 GHz	< –45 dBc
	>4 GHz	< –33 dBc
Amplifier 1 dB compression	AWG70001A operating at 50 GS/s	
	Output Frequency	Value
No filter	1 GHz	> 25 dBm
	13 GHz	> 22 dBm
Low Pass	1 GHz	> 25 dBm
Band Pass (10 to 14.5 GHz)	11 GHz	> 22 dBm
Band Pass (13 to 18 GHz)	14 GHz	> 22 dBm
	18 GHz	> 20 dBm
Switching time	The time required for the attenuators and amplifiers to settle to the specified output amplitude after an amplitude change. 20 ms	

Table 1-18: Marker output

Characteristics	Description
Connector type	SMA on front panel
Number of outputs	AWG70001A: 2 AWG70002A: 4
Type of output	(+) and (–) complementary output
ON/OFF Control	Independent control for each marker
Output impedance	50 Ω
Output voltage	Independent control for each marker. Output voltage into RLOAD [Ω] to GND is approximately (2 * RLOAD / (50 + RLOAD)) times of voltage setting.
Amplitude range	0.5 V_{p-p} to 1.4 V_{p-p} into 50 Ω
Amplitude resolution	10 mV
Offset range	1.4 V – (amplitude ÷ 2) to –1.4 V + (amplitude ÷ 2) into 50 Ω

Table 1-18: Marker output (cont.)

Characteristics	Description
Offset resolution	10 mV
✓ DC accuracy (warranted)	±(10% of |output high or low setting| + 50 mV) into 50 Ω
External termination voltage range	–2.8 V to +2.8 V
Rise/fall time	< 35 ps (20% to 80% of swing) when High = 1.0 V, Low = 0 V
Output current	±28 mA maximum, assuming 1.4 V into 50 Ω load.
Delay from analog	AWG70001A: 180 ps ±25 ps AWG70001A Option AC: –380 ps ±25 ps AWG70002A: 755 ps ±25 ps
Variable delay control	Independent control for each marker
Range	0 to 100 ps
Resolution	1 ps
Accuracy	±15 ps
Skew between (+) and (-) outputs	< 12 ps
Skew between M1 and M2	< 15 ps
Random jitter on clock pattern	0.4 ps rms (using 0101.. clock pattern) with Hi = 0.25 V, Low = –0.25 V
Total jitter on random pattern	20 ps_{p-p} Using PRBS15 pattern, with Hi = 0.25 V, Low = –0.25 V Measured at Bit Error Rate = $1e^{-12}$
Aberrations	< ±33% p-p for the first 100 ps following the step transition with 100% reference at 1 ns, for an ambient temperature range of 20 ºC to 30 ºC.
Minimum pulse width	80 ps A marker output can change logic states on any sample point. However it must remain in a given logic state long enough to satisfy the minimum pulse width specification.

Table 1-19: Clock output

Characteristics	Description
	The external clock output is a copy of an internal clock generator that is used to create the DAC sample clock. This clock always operates in the octave range specified below. It is multiplied and divided to create the effective DAC sampling rate.
Connector type	SMA on rear panel
Output impedance	50 Ω AC coupled
Output amplitude	+5 dBm to +10 dBm
Frequency range	6.25 GHz to 12.5 GHz

Table 1-19: Clock output (cont.)

Characteristics	Description
Frequency resolution	
Internal and fixed reference clock operation	With jitter reduction: 50 MHz Without jitter reduction: 100 MHz ÷ 2^{20}
External variable reference clock operation:	With jitter reduction: Fref ÷ R Without jitter reduction: Fref ÷ R ÷ 2^{20} Fref = reference clock frequency R = 4 when 140 MHz < Fref ≤ 240 MHz R = 2 when 70 MHz < Fref ≤ 140 MHz R = 1 when 35 MHz ≤ Fref ≤ 70 MHz

Table 1-20: Clock input

Characteristics	Description
	The external clock input can be used to create the DAC sample clock. This clock must always operate in the octave range specified below. It is multiplied and divided to create the actual DAC sample clock.
Connector type	SMA on rear panel
Input impedance	50 Ω(AC coupled)
Input amplitude	0 dBm to +10 dBm
Frequency range	6.25 GHz to 12.5 GHz Acceptable frequency drift while the instrument is operating is ±0.1%.

Table 1-21: Trigger input

Characteristics	Description
Number of inputs	2
Connector	SMA on rear panel
Input impedance	1 kΩ or 50 Ω selectable
Polarity	Positive or negative selectable
Input voltage range	
1 kΩ selected	–10 V to 10 V
50 Ω selected	< 5 V_{RMS}
Input voltage minimum amplitude	0.5 V_{p-p} minimum
Threshold control	
Range	–5.0 V to 5.0 V
Resolution	0.1 V
Accuracy	± (5% of |setting| + 0.1 V)

Table 1-21: Trigger input (cont.)

Characteristics	Description
Minimum pulse width	
1 kΩ selected	20 ns
50 Ω selected	20 ns
Trigger delay to analog output	Asynchronous trigger mode: 32,480 / (2 * fclk) ±20 ns Synchronous trigger mode: 30,880 / (2 * fclk) ±20 ns fclk is the frequency of the DAC sampling clock The DAC sampling clock frequency is displayed on the clock settings tab when the external clock output is enabled.
Trigger hold off	8320/fclk ±20 ns fclk is the frequency of the DAC sampling clock Trigger hold off is the amount of delay required at the end of a waveform before another trigger pulse can be processed.
Trigger asynchronous jitter	The asynchronous jitter performance is directly proportional the frequency of the DAC sampling clock. The DAC sampling clock frequency is displayed on the clock settings tab when the external clock output is enabled.
1 kΩ selected	130 ps_{p-p}, 26 ps_{rms} for 6.25 GHz DAC sampling clock 90 ps_{p-p}, 17 ps_{rms} for 12.5 GHz DAC sampling clock
50 Ω selected	105 ps_{p-p}, 24 ps_{rms}s for 6.25 GHz DAC sampling clock 70 ps_{p-p}, 14 ps_{rms} for 12.5 GHz DAC sampling clock
Trigger synchronous jitter	Clock In = 12.5 GHz: 300 fs_{rms}, 4.2 ps RJ_{p-p} BER@10-12 Variable Reference In = 156.25 MHz: 400 fs_{rms}s, 5.6 ps RJ_{p-p} BER@10-12 Fixed Reference In = 10 MHz: 1.7 ps rms, 23.8 ps RJ_{p-p} BER@10-12 Sample rate = 25 GS/s Trigger input impedance = 50 Ω

Table 1-22: Reference clock input

Characteristics	Description
Connector type	SMA on rear panel
Input impedance	50 Ω (AC coupled)
Input amplitude	–5 dBm to +5 dBm
Frequency range	10 MHz ±100 ppm
Variable frequency range	35 MHz to 240 MHz. Acceptable frequency drift while the instrument is operating is ± 0.1%.

Table 1-23: Sync clock output

Characteristics	Description
Connector type	SMA on rear panel
Output impedance	50 Ω (AC coupled)

Table 1-23: Sync clock output (cont.)

Characteristics	Description
Output amplitude	1.0 ± 0.15 V_{pp} into 50 Ω
Frequency	Clock output ÷ 80

Table 1-24: Sequencer

Characteristics	Description
Maximum number of steps	16,383
Waveform repeat	Selectable: Infinity Variable from 1 to 1,048,576

Table 1-25: Pattern Jump In connector

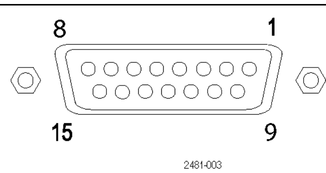
Characteristics	Description	
Connector type	15-pin D-sub female connector on rear panel	
Input signal pin assignment		
	Pin assignments	
	1	GND
	2	Data bit 0, input
	3	Data bit 1, input
	4	Data bit 2, input
	5	Data bit 3, input
	6	GND
	7	Strobe, input
	8	GND
	9	GND
	10	Data bit 4, input
	11	Data bit 5, input
	12	Data bit 6, input
	13	Data bit 7, input
	14	GND
	15	GND
Input levels	3.3 V LVCMOS 5 V TTL compliant	
Input impedance	1 kΩ resistor pull down to GND	

Table 1-25: Pattern Jump In connector (cont.)

Characteristics	Description
Number of jump destinations	256
Strobe	
Polarity	Data is clocked in on negative edge
Minimum pulse width	64 ns
Setup and hold	Setup: 5 ns Hold: 5 ns
Latency to analog output	102,125/fclk +20 ns ± 20 ns The DAC sampling clock frequency is displayed on the clock settings tab when the external clock output is enabled.
Holdoff time	>18 µs Strobe hold off is the amount of delay required at the end of a waveform before another strobe pulse can be processed.

Table 1-26: Flag out connectors

Characteristics	Description
Connector type	SMB on rear panel
Number of Outputs	AWG70001A: 4 AWG70002A: 8
Output Impedance	50 Ω
Output Amplitude	High: 3.3 V into 50 Ω to GND Low: 0 V
Maximum Toggle Frequency	<11 MHz It will track the sequencer step rate
Analog to flag delay Repeatability	If Waveform Length/240 = integer, then ≤ 200 ps If Waveform Length/240 = Noninteger, then ≤ 120/sampling clock
Analog to Flag Output delay	-291.5/(sample_clock_rate *2) + 9.76ns ± 5 ns

Table 1-27: 10 MHz reference clock output

Characteristics	Description
Connector type	SMA on rear panel
Output impedance	50 Ω (AC coupled)
Amplitude	+4 dBm ±2 dBm
✓ Frequency (warranted)	10 MHz ± (1 ppm + aging). Sine wave output
Aging	Within ±1 ppm/year

Table 1-28: CPU module and peripheral devices

Characteristics	Description
CPU	SN B020000 and above: Intel core I7-4700EQ, 4 core, 2.4 GHz, 6M cache SN B019999 and below: Intel core 2 duo processor
Memory	SN B020000 and above: 16 GB (2 x 8 GB), DDR3-1600 or faster SODIMM SN B019999 and below: 4 GB (2 x 2 GB), DDR2-800 or faster SODIMM
Hard disk drive	Solid state, ≥500 GB, removable
USB 2.0	2 ports, front panel, type A connector. The front USB ports can be enabled/disabled as a group. 4 ports, rear panel, type A connector. The rear USB ports can be enabled/disabled as a group.
LAN	RJ-45 LAN connector supporting 10 base-T, 100 base-T, and Gigabit Ethernet on rear panel
ESATA	1 port on rear panel, 1.5 Gbps. Instrument must be powered down to make connection.
Video output	1 VGA port on rear panel
GPIB	Available as an optional accessory that connects to the USB Device and USB Host ports with the TEK-USB-488 GPIB to USB Adapter The control interface is incorporated into the instrument user interface.

Table 1-29: Display

Characteristics	Description
Display area	132 mm X 99 mm (5.2 in X 3.9 in, 6.5 in diagonal)
Resolution	1024 X 768 pixels
Touch screen	Built-in touch screen

Table 1-30: Power supply

Characteristics	Description
Source voltage and frequency	
Rating voltage	100 V_{AC} to 240 V_{AC}
Frequency range	50 Hz to 60 Hz
Power consumption	<500 W

⚠ ***WARNING.*** *To reduce the risk of fire and shock, ensure that the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.*

Mechanical characteristics

Table 1-31: Mechanical characteristics

Characteristics	Description
Net weight	
AWG70001A and AWG70002A	
Without package	37.0 lb (16.8 kg)
With package	49.4 lb (22.4 kg)
AWG70001A with option AC	
Without package	38.56 lb (17.49 kg)
With package	50.96 lb (23.12 kg)
Dimensions, overall	
Height	153.6 mm (6.05 in)
Width	460.5 mm (18.13 in)
Length	603.5 mm (23.76 in)
Cooling method	Forced-air circulation with no air filter
Cooling clearance	
Top	0 in
Bottom	0 in
Left side	50 mm (2 in)
Right side	50 mm (2 in)
Rear	0 in

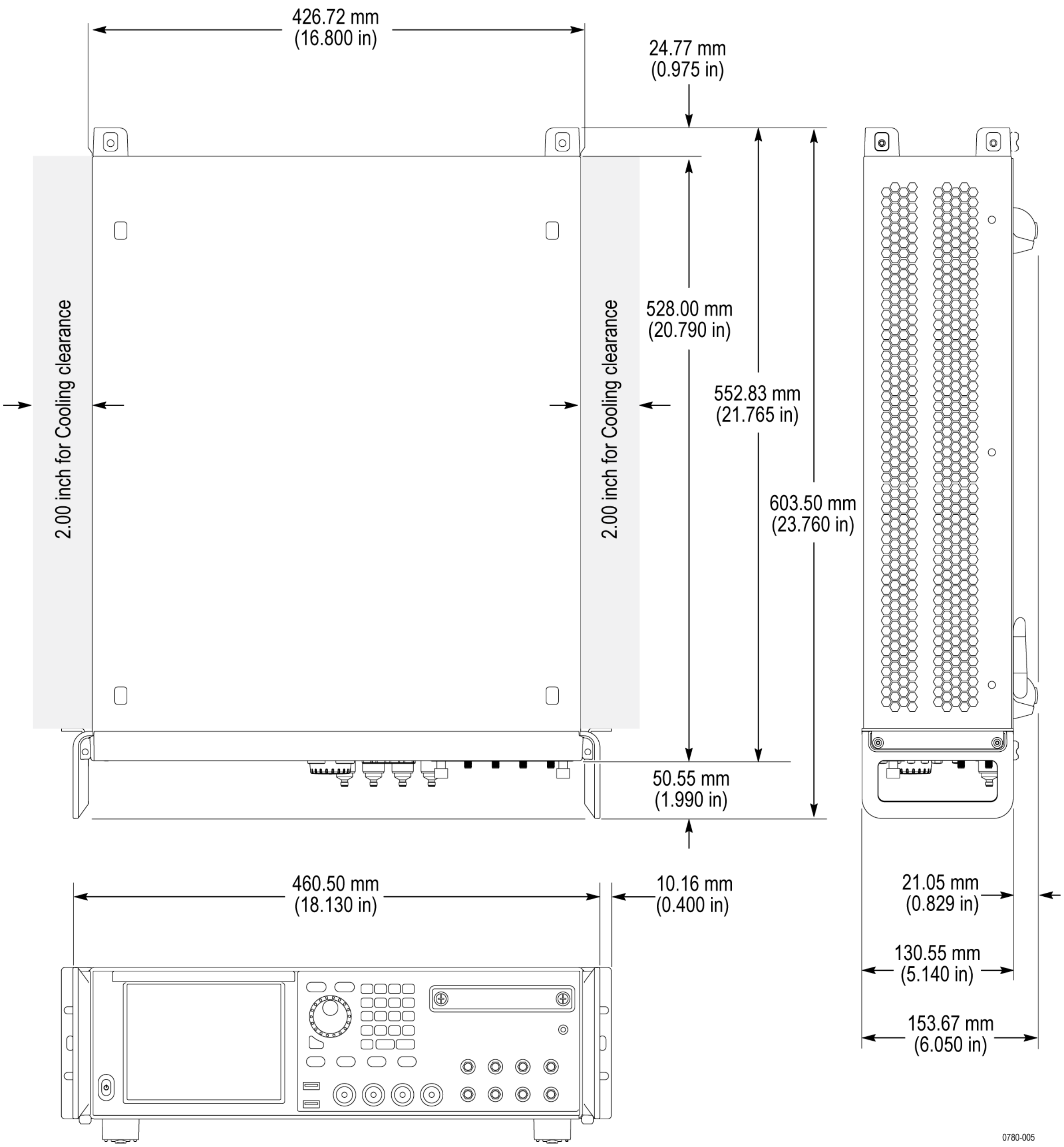


Figure 1-1: Dimensions and minimum cooling clearances

Environmental characteristics

Table 1-32: Environmental characteristics

Characteristics	Description
Temperature	
Operating	0 °C to +50 °C (+32 °F to 122 °F)
Nonoperating	–20 °C to +60 °C (-4 °F to 140 °F) with 30 °C/hour (86 °F/hour) maximum gradient, with no media installed in disc drives
Relative humidity	
Operating	5% to 90% relative humidity at up to +30 °C (+86 °F) 5% to 45% relative humidity above +30 °C (+86 °F) up to +50 °C (122 °F) noncondensing
Nonoperating	5% to 90% relative humidity at up to 30 °C 5% to 45% relative humidity above +30 °C (+86 °F) up to +60 °C (140 °F) noncondensing
Altitude	
Operating	Up to 3,000 m (approximately 10,000 feet) Maximum operating temperature decreases 1 °C (34 °F) each 300 m (984 ft) above 1.5 km (4921 ft)
Nonoperating	Up to 12,000 m (approximately 40,000 feet)

AWGSYNC01

Electrical specifications

Table 1-33: Electrical specifications

Characteristic	Description
System	
Number of AWG70001A or AWG70002A instruments supported	4 All instruments must be the same model
Output to Output Skew (typical)	±10 ps
Repeatability (typical)	≤5 ps
Random Jitter on Clock Pattern (typical)	0.315 ps rms
Total Jitter on Random Pattern (typical)	13 ps_{p-p}
Calibration	
Connector	SMA at the Front Panel
Number of inputs	4
Input Impedance	50 Ω
Clock	
Clock Output	The external clock output is a copy of an external input clock into the sync hub. This output is used to drive the external clock input of the AWG.
Number of Outputs	4
Connector	SMA on rear-panel
Output Impedance	50 Ω AC coupled
Output Amplitude (typical)	+5 dBm to +10 dBm
Frequency Range	6.25 GHz to 12.5 GHz
Clock Input	The external clock input is used to create the DAC sample clock. This clock must always operate in the octave range specified below.
Connector	SMA on rear-panel
Input Impedance	50 Ω AC coupled

Table 1-33: Electrical specifications (cont.)

Characteristic	Description
Input Amplitude (typical)	+5 dBm to +10 dBm
Frequency Range (typical)	6.25 GHz to 12.5 GHz
Sync Clock Output	
Connector	SMA on rear-panel
Output Impedance	50 Ω AC coupled
Output Amplitude (typical)	1.0 ±0.15 V_{p-p} into 50 Ω
Frequency	Clock Output ÷ 80
Trigger Input	
Number of Inputs	2
Slope / Polarity	Positive or negative selectable
Connector	SMA on rear-panel
Input Impedance	1 k Ω or 50 Ω selectable
Input Voltage Range	When 1 k is selected: –10 V to +10 V When 50 Ω is selected: <5 V_{RMS}
Input Minimum Amplitude (typical)	0.5 V_{p-p}
Threshold Range	–5.0 V to +5.0 V
Threshold Resolution	0.1 V
Threshold Accuracy (typical)	±5% of setting + 0.1 V
Trigger Minimum Pulse Width (typical)	When 1 kΩ is selected: 20 ns When 50 Ω is selected: 20 ns
Trigger Delay to Analog Output (typical)	Synchronous trigger mode: 30,800 / (2 * sampling clock) + 20 ns ±20 ns
Trigger Asynchronous Jitter (typical)	80 / sampling clock frequency
Trigger Synchronous Jitter (typical)	Clock In = 12.5 GHz: 300 fs rms, 4.2 ps RJ_{p-p} BER@10-12 Variable Reference In = 156.25 MHz: 400 fs rms, 5.6 ps RJ_{p-p} BER@10-12 Fixed Reference In = 10 MHz: 1.7 ps rms, 23.8 ps RJ_{p-p} BER@10-12 Sample rate = 25 GS/s Trigger input impedance = 50

Table 1-33: Electrical specifications (cont.)

Characteristic	Description
Pattern Jump Input	
Connector	15-pin DSUB on rear-panel
Pin Assignments	Pin, Signal 1 GND 2 Jump Bit 0 Input 3 Jump Bit 1 Input 4 Jump Bit 2 Input 5 Jump Bit 3 Input 6 GND 7 Strobe Input 8 GND 9 GND 10 Jump Bit 4 Input 11 Jump Bit 5 Input 12 Jump Bit 6 Input 13 Jump Bit 7 Input 14 GND 15 GND
Input Impedance	1 kΩ pull-up to 5 V
Input Levels	3.3 V LVCMOS, 5 V TTL compliant
Number of Destinations	256
Strobe Polarity	Negative
Strobe Minimum Pulse Width (typical)	64 ns
Strobe Setup and Hold (typical)	Setup: 5 ns Hold: 5 ns
Latency to Analog Output (typical)	102,125 / sampling clock +20 ns ± 20 ns
Holdoff Time	>18 μs
Sync Port	
Number of ports	4
Function	Proprietary interface for connecting to the AWG SYNC hub. Enables synchronized clocking and triggering of multiple AWG instruments.
Connector	62-pin Samtec EI8-031-S-D-RA on the rear panel

Table 1-34: Power supply

Characteristic	Description
Power	
Power Supply AC Line Input	100 – 240 VAC, 50 / 60 Hz
Power Consumption	110 W
Safety	U.S. Nationally Recognized Testing Laboratory (NRTL) Listing UL61010-1 Standard for Electrical Measuring and Test Equipment or ANSI/ISA S82.02.01 Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment Canadian Certification CAN/CSA C22.2 No. 61010.1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use European Union Compliance Low Voltage Directive 73/23/EEC EN61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Additional Compliance IEC61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Mechanical characteristics

Table 1-35: Mechanical characteristics

Characteristic	Description
Dimensions	
Main body	Height: 1.75" Width: 16.80" Depth: 20.79"
Overall with feet & handles	Height: 1.75" Width: 18.13" Depth: 23.76"
Net Weight	Instrument: 11.2 lbs Instrument with packaging: 20.0 lbs
Cooling Clearance	Top: 0" Bottom: 0" Sides: 0" Rear: 2"

Performance verification

Performance verification procedures

Two types of performance verification procedures can be performed on the instrument: *Brief Procedures* and *Performance Tests*. You may not need to perform all of these procedures, depending on what you want to accomplish.

- To rapidly confirm that the instrument functions and was adjusted properly, perform *Diagnostics* and *Calibration*.

Advantages: These procedures are quick to do and require no external equipment or signal sources. These procedures perform extensive functional and accuracy testing to provide high confidence that the instrument will perform properly.

- To further check functionality, first perform Diagnostics and Calibration, and then perform *Functional Test*.

Advantages: The procedure requires minimal additional time to perform, and requires minimal equipment. The procedure can be used when the instrument is first received.

- If more extensive confirmation of performance is desired, complete the self tests and functional test, and then do the *Performance Tests*.

Advantages: These procedures add direct checking of warranted specifications. These procedures require specific test equipment. (See page 2-21, *Required equipment*.)

If you are not familiar with operating this instrument, refer to the online help or the user information supplied with the instrument.

Input and output options

The instrument has two USB ports on the front panel, and four USB ports on the rear panel. (See Figure 2-1.) These ports can be used for an external mouse and/or keyboard. Additionally, an external video display can be connected to the VGA display port on the rear panel.

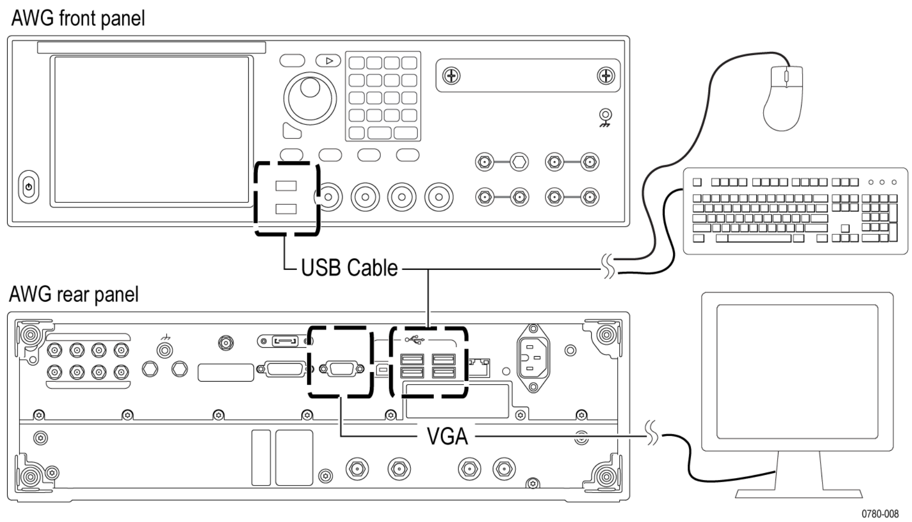
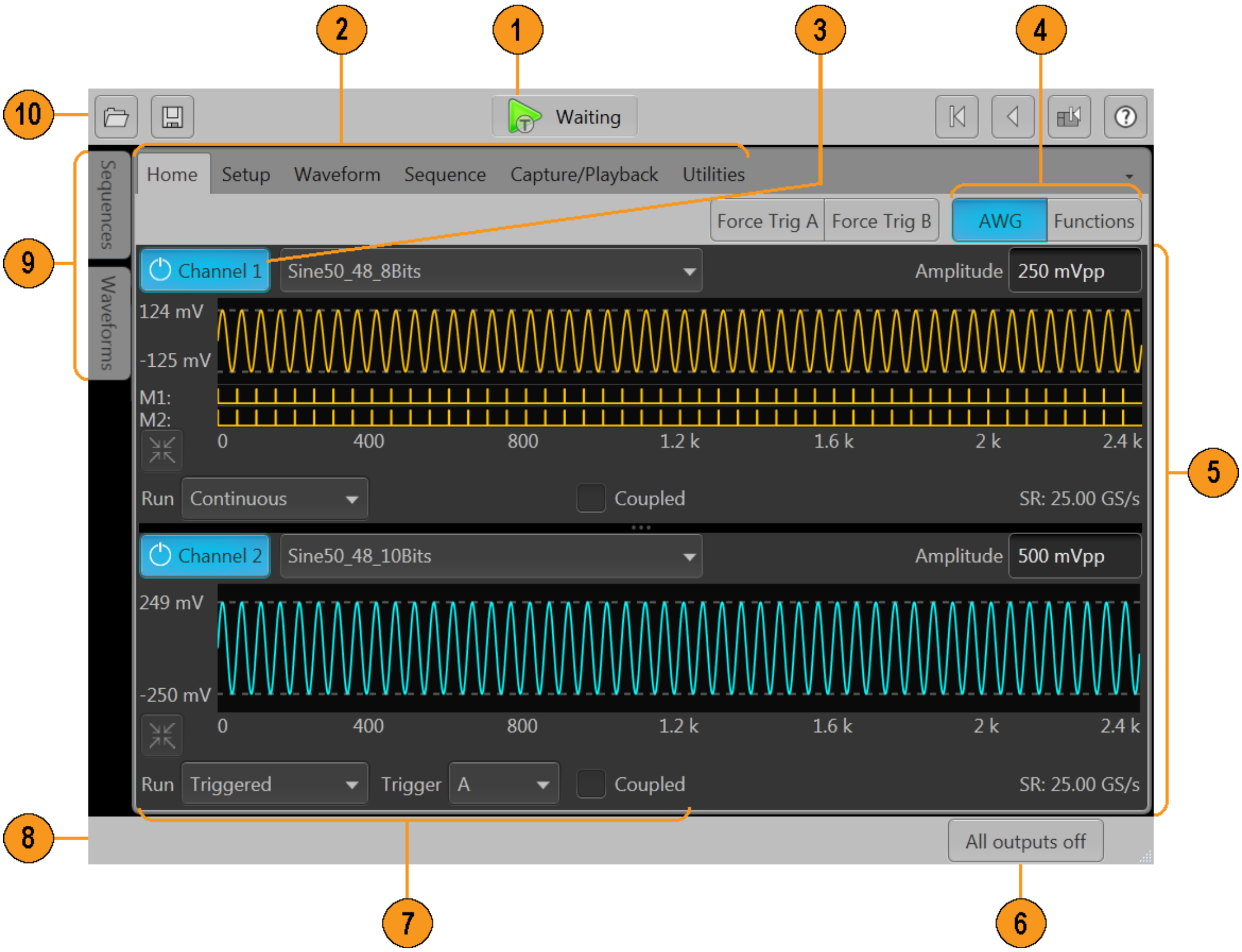


Figure 2-1: Peripheral connections

Instrument interface overview

The instrument interface is briefly described on the following pages to help you perform the tests and to navigate to the files needed to complete the procedures.

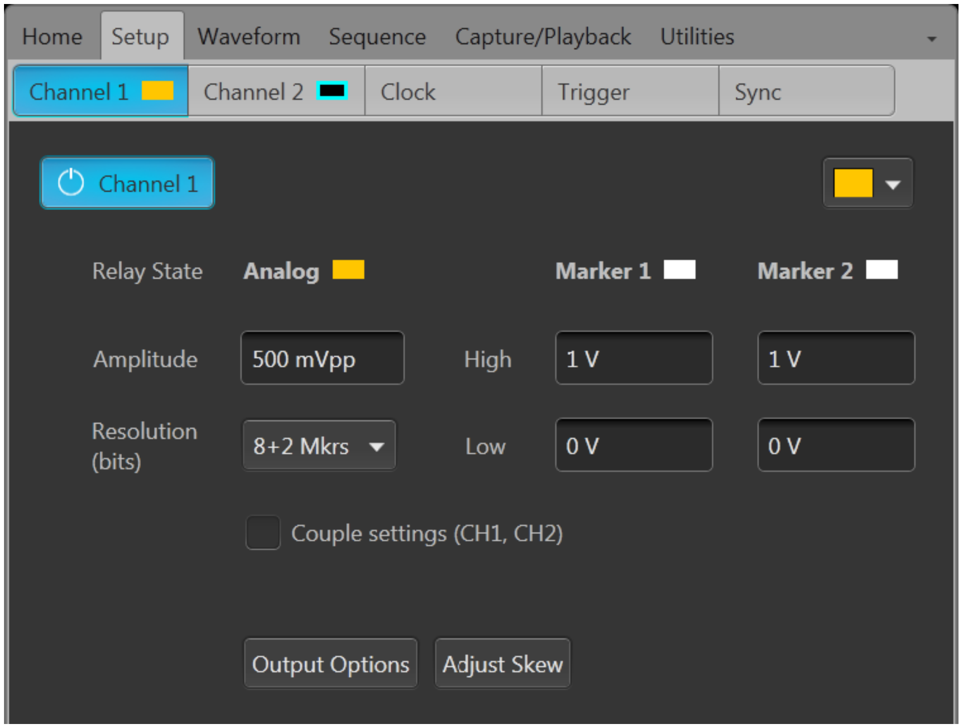


Screen element	Description
1. Play/Stop button	Starts and stops waveform play out. The Play button icon changes to indicate the waveform play out status.
2. Work space tabs	The work space tabs provides access to all of the instrument functions. ■ Home returns the work space area to the channel plot display. ■ Setup displays the setup controls for channel, clock, triggers, and system synchronization using the AWBSYNC01. ■ Waveform displays the waveform editor controls to create and edit waveforms. ■ Sequence displays the workspace area to create waveform sequences (Option 03). ■ Capture/Playback displays the workspace area to import baseband I/Q data files (captured from an instrument such as a spectrum analyzer or oscilloscope) and compile them into a waveform for playout. ■ Utilities displays controls for system information (including diagnostics and calibration), preferences, help and support. Utilities are global instrument settings that are maintained in non-volatile memory.
3. Channel enable	Enables the channel output. Internally connects the channel and marker output connectors to the instrument. The All Outputs Off feature overrides the channel enable control.
4. Mode selection	Switches the instrument mode between AWG (arbitrary waveform generator) and Functions (function generator).
5. Work space	The work space area view changes depending on the selected work space tab.
6. All outputs off	The All Outputs Off button provides a quick disconnect of the analog outputs and marker outputs, whether those outputs are enabled or not. (All Outputs Off overrides the output enable controls.) The outputs are electrically disconnected. When the All Outputs Off is disabled, the channel and marker outputs return to their defined state.
7. Trigger controls	The trigger controls provide access to the trigger settings. ■ Run Mode to set the trigger type ■ Trigger source for external triggering ■ Couple the trigger settings for two channel instruments
8. Status bar	The status bar displays various user messages and status indicators.

Screen element	Description
9. Waveforms and sequences	Contains all waveforms and sequences available for playout. Touch and hold (or right-mouse click) a waveform or sequence name to display menu selections to manage the lists. Sequencing requires Option 03.
10. Toolbar	Tools are used to: ■ Open files (setup files, waveform files, sequence files). ■ Save the current setup. ■ Reset to the default setup. ■ Restore the most recently used setup. ■ Reset to the default window layout. ■ Display the instrument help.

Typical output control screen

The screen shot below shows the controls that display when you are setting up a typical output waveform. In this example, the Channel 1 Analog output parameters are displayed.



Brief procedures

There are three procedures in this section that provide a quick way to confirm basic functionality and proper adjustment:

- *Diagnostics*
- *Calibration*
- *Functional Test*

Diagnostics

The following steps run the internal routines that confirm basic functionality and proper adjustment.

Equipment	Prerequisites
None	None

1. Disconnect all the cables from the output channels.
2. From the **File and Utilities** tab, select **System**.
3. Click the **Diagnostics & Calibration** button and then select **Diagnostics**.

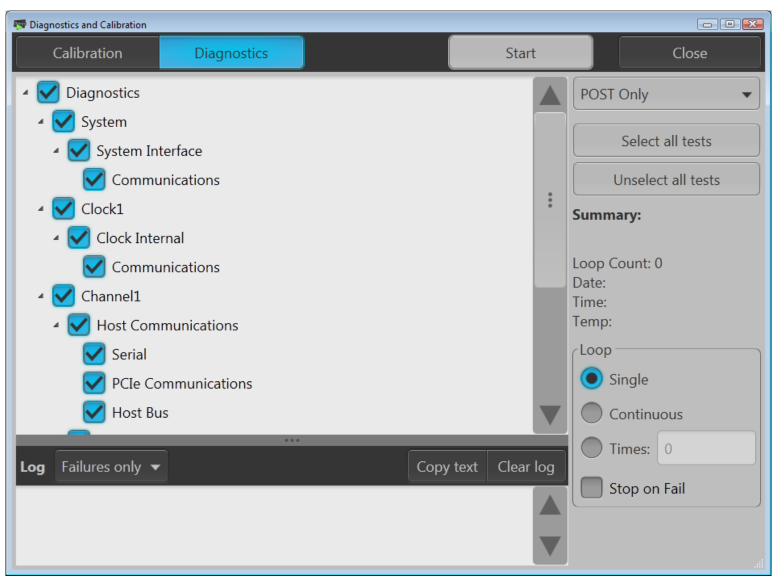


Figure 2-2: Diagnostics dialog box

4. In the Diagnostics dialog box, confirm that all the check boxes are selected. If they are not all selected, click the **Select all tests** button.

5. Click the **Start** button to execute the diagnostics.

   The internal diagnostics perform an exhaustive verification of proper instrument function. This verification may take several minutes. When the verification is completed, the resulting status will appear in the dialog box.

6. Verify that **Pass** appears as Status in the dialog box when the diagnostics complete.

7. Click the **Close** button.

Calibration

Equipment	Prerequisites
None	Power on the instrument and allow a 20 minute warm-up before doing this procedure.

1. From the **File and Utilities** tab, select **System**.

2. Click the **Diagnostics & Calibration** button and then select **Calibration**.

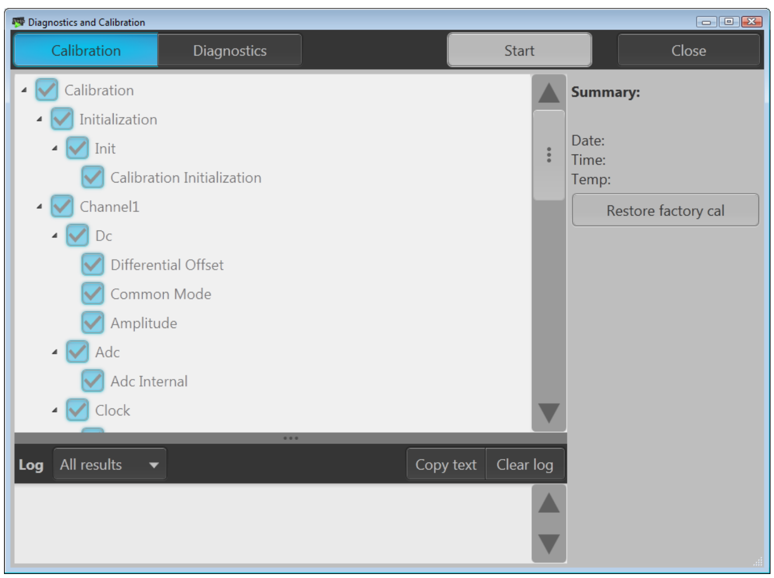


Figure 2-3: Calibration dialog box

3. Click the **Start** button to start the routine.

4. Verify that **Pass** appears in the Summary column for all items when the calibration completes.

5. Click the **Close** button.

Functional test

The purpose of the procedure is to confirm that the instrument functions properly. The required equipment is listed below.

Table 2-1: Required equipment for the functional test

Item	Qty.	Minimum requirements	Recommended equipment
Oscilloscope	1 ea.	Bandwidth: 4 GHz or higher 4 channels	Tektronix DPO70404C
Function generator	1 ea.	1 kHz, square wave, 5 V_{p-p} output	Tektronix AFG3021C
Signal analyzer (required for Option AC only)	1 ea.	Bandwidth: 14 GHz or higher	Tektronix RSA5126B
Adapter	3 ea	TekConnect oscilloscope input to SMA input	Tektronix TCA-SMA
50 Ω SMA cable	3 ea.	DC to 20 GHz	Tensolite 1-3636-465-5236
50 Ω SMA termination	3 ea.	DC to 18 GHz	Tektronix part number 015-1022-01 (one is supplied with the AWG70001A, two with the AWG70002A).
50 Ω BNC cable	1 ea.	Male connectors both ends	Tektronix part number 012-0057-01
SMA-BNC adapter	3 ea.	SMA female to BNC male connector	Tektronix part number 015-0572-00
Planar Crown RF Input Connector – 7005A-1 SMA Female (required for Option AC only)	1 ea.	Planar Crown RF Input Connector – Type N to SMA Female For use with Tektronix RSA5126B signal analyzer	Tektronix part number 131-8689-00

Test waveforms

The following table lists the test waveforms that are used for the functional test. These are included on the instrument hard drive at: **C:\Program Files\Tektronix\AWG70000\Samples\PV**.

Table 2-2: Test waveforms

Waveform name	Purpose
PV_Square.wfmx	For the triggered output functional test For the analog and marker functional test

Checking the analog and marker outputs

Required equipment	Prerequisites
Oscilloscope	None
Three TCA-SMA adapters	
Three 50 Ω SMA cables	
Three 50 Ω SMA terminations	

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use a 50 Ω SMA cable and a TCA-SMA adapter to connect the CH 1 + connector on the instrument to channel 1 of the oscilloscope.
3. Use a 50 Ω SMA cable and a TCA-SMA adapter to connect the CH 1 Markers M1 + connector on the instrument to channel 2 of the oscilloscope.
4. Use a 50 Ω SMA cable and a TCA-SMA adapter to connect the CH 1 Markers M2 + connector on the instrument to channel 3 of the oscilloscope.
5. Use a 50 Ω SMA termination to terminate the CH 1 – connector on the instrument.
6. Use a 50 Ω SMA termination to terminate the CH 1 Markers M1 – connector on the instrument.
7. Use the 50 Ω SMA termination to terminate the CH 1 Markers M2 – connector on the instrument.

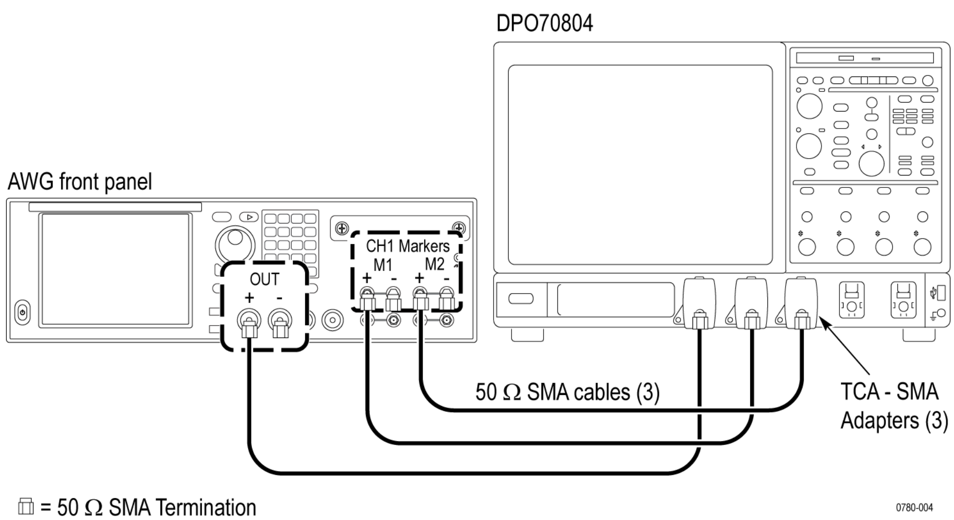
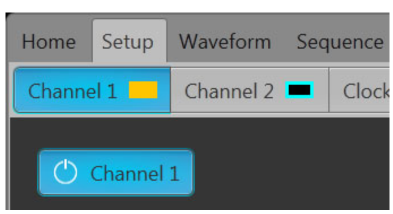


Figure 2-4: Equipment connections for checking the analog and marker outputs

8. Set the oscilloscope as follows:
   a. Vertical scale: 200 mV/div (CH 1), 1 V/div (CH 2 and CH 3)
   b. Horizontal scale: 20 ns/div
   c. Input coupling: DC
   d. Input impedance: 50 Ω
   e. CH 1 position: +2 div (if necessary)
   f. CH 2 position: –1 div (if necessary)
   g. CH 3 position: –3 div (if necessary)
   h. Trigger source: CH1
   i. Trigger level: 0 mV
   j. Trigger slope: Positive
   k. Trigger mode: Auto
9. Press the **Home** button on the instrument, or click the **Home** tab on the display.
10. Click the **Reset to default setup** button in the toolbar.
11. On the instrument, load the **PV_Square.wfmx** waveform as an output waveform. Follow the steps below:
    a. In the Waveform List window, click **Open Waveform** and navigate to **C:\Program Files\Tektronix\AWG70000\Samples\PV**.
    b. Select **Open File**.
    c. In the Waveform List window, select (drag and drop) the **PV_Square.wfmx** waveform on to the work space.
12. In the Setup tab, under Resolution, check **8+2 Mkrs**.
13. Click the **Enable outputs** button.



14. Click the **Play** button on-screen or on the instrument.
15. Press the **All Outputs** button on the instrument to output the waveform.
16. Check that the Channel 1, Marker 1, and Marker 2 waveforms are properly displayed on the oscilloscope screen. (See Figure 2-5.)

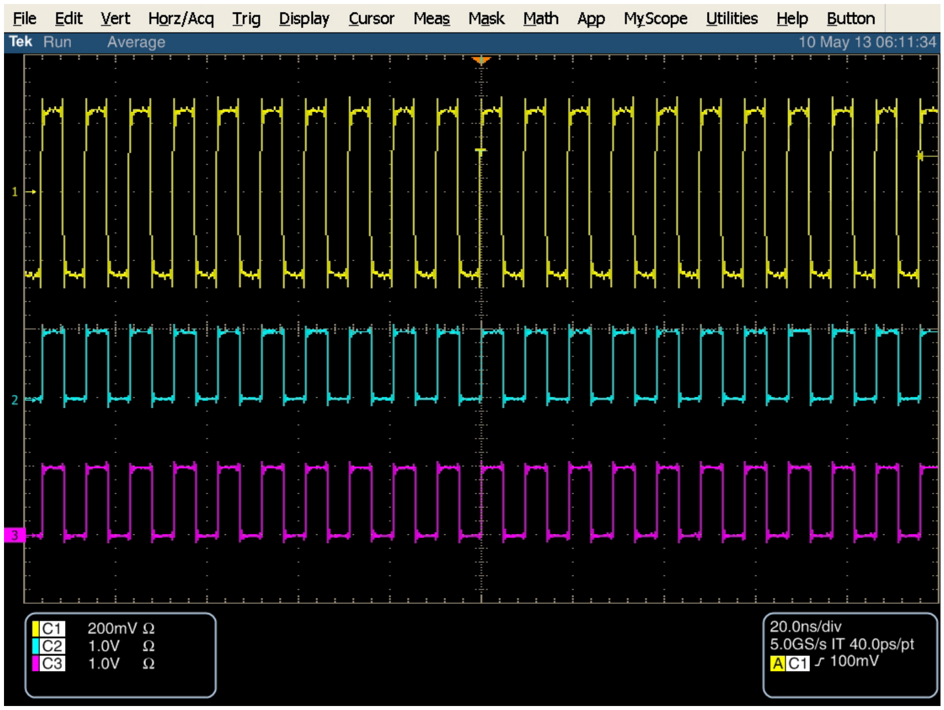


Figure 2-5: Output waveform from the channel, marker 1, and marker 2 connectors

17. Press the **All Outputs** button again to disable the channel 1 output.

18. If you are testing an AWG70002A, repeat the test for the Channel 2, Marker 1, and Marker 2 outputs.

19. Disconnect the test setup.

Checking the AC output (AWG70001A with option AC)

Required equipment	Prerequisites
Signal analyzer	None
One Planar Crown RF Input Connector – 7005A-1 SMA Female	
One 50 Ω SMA cable	
Two 50 Ω SMA terminations	

1. Press the **All Outputs** button on the instrument to turn off all the outputs.
2. Click the **Reset to default setup** button in the toolbar.
3. Use a 50 Ω SMA cable to connect the AC connector on the instrument to the RF input of the signal analyzer.

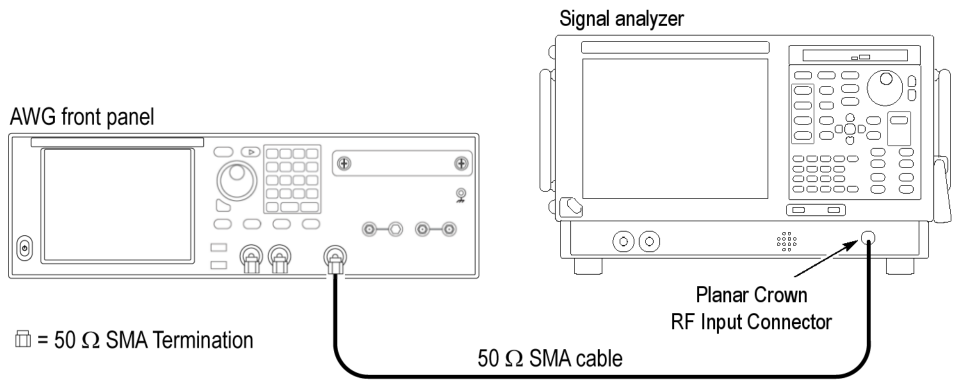


Figure 2-6: Equipment connections for checking the AC output

4. Create three test waveforms.

   a. Set the instrument to its default settings.

   b. Click the **Waveform** tab on the display.

   c. Set the Function to Sine

   d. Check the Advanced Options box

NOTE. *Checking Advanced Options prevents the instrument from changing the Sampling Rate while adjusting the Frequency of the generated waveform. The Sampling Rate should be at the default setting of 50 GS/s.*

---

   e. Set the Frequency to 1 GHz

   f. Click Compile Settings

   g. In the Name field, change the name to Waveform_1 GHz

   h. Click Compile

   i. Set the Frequency to 11 GHz

   j. Click Compile Settings

   k. In the Name field, change the name to Waveform_11 GHz

   l. Click Compile

   m. Set the Frequency to 14 GHz

   n. Click Compile Settings

   o. In the Name field, change the name to Waveform_14 GHz

   p. Click Compile

5. Set the spectrum analyzer as follows:

   a. Press the Preset button to set the analyzer to its default settings

   b. Display the Spectrum measurement

   c. Set Center Frequency to 1 GHz

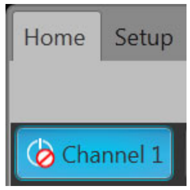
6. Click the **Setup** tab on the display.

   a. Change the Output Path to AC

   b. Set Filter to None

7. Press the **Home** button on the instrument, or click the **Home** tab on the display.

8. Click the **Channel 1** button to enable the output.



9. In the Waveform List window, select (drag and drop) the **Waveform_1 GHz** waveform on to the work space.

10. Press the **Play** button, or click Play on the display.

11. Press the **All outputs off** button to *enable* the outputs.

12. Check that the Channel 1 waveform is properly displayed on the signal analyzer screen. (See Figure 2-8.)

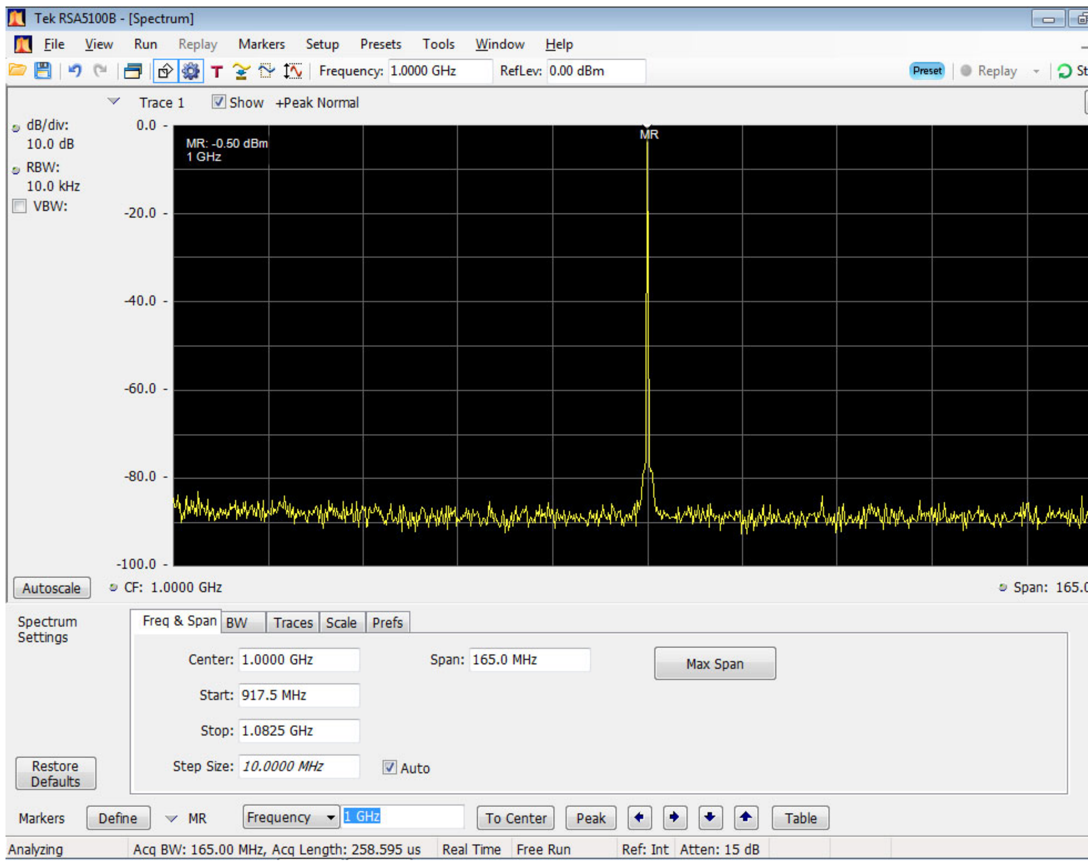


Figure 2-7: 1 GHz output waveform – no filter

13. Press the **All Outputs** button to *disable* the outputs.

14. Click the **Setup** tab on the display.

   a. Set Filter to Low Pass

15. Press the **All outputs off** button to *enable* the outputs.

16. Check that the Channel 1 waveform is properly displayed on the signal analyzer screen. (See Figure 2-8.)

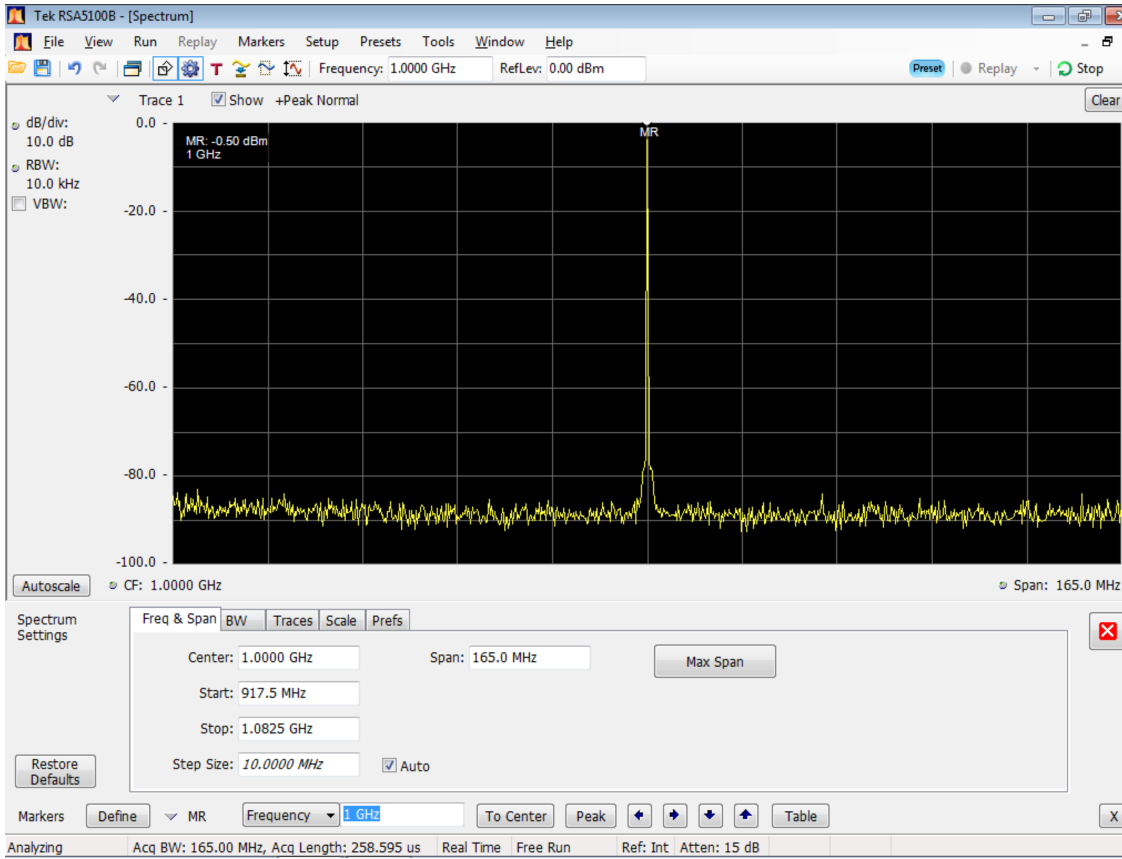


Figure 2-8: 1 GHz output waveform – Filter set to Low Pass

17. Press the **All Outputs** button to *disable* the outputs.

18. Click the **Setup** tab on the display.

- **a.** Set Filter to Band Pass
- **b.** Set Range to 10–14.5GHz

19. Press the **Home** button, or click the **Home** tab on the display.

20. In the Waveform List window, select (drag and drop) the **Waveform_11 GHz** waveform on to the work space.

21. Press the **All outputs off** button to *enable* the outputs.

22. Check that the Channel 1 waveform is properly displayed on the signal analyzer screen. (See Figure 2-9.)

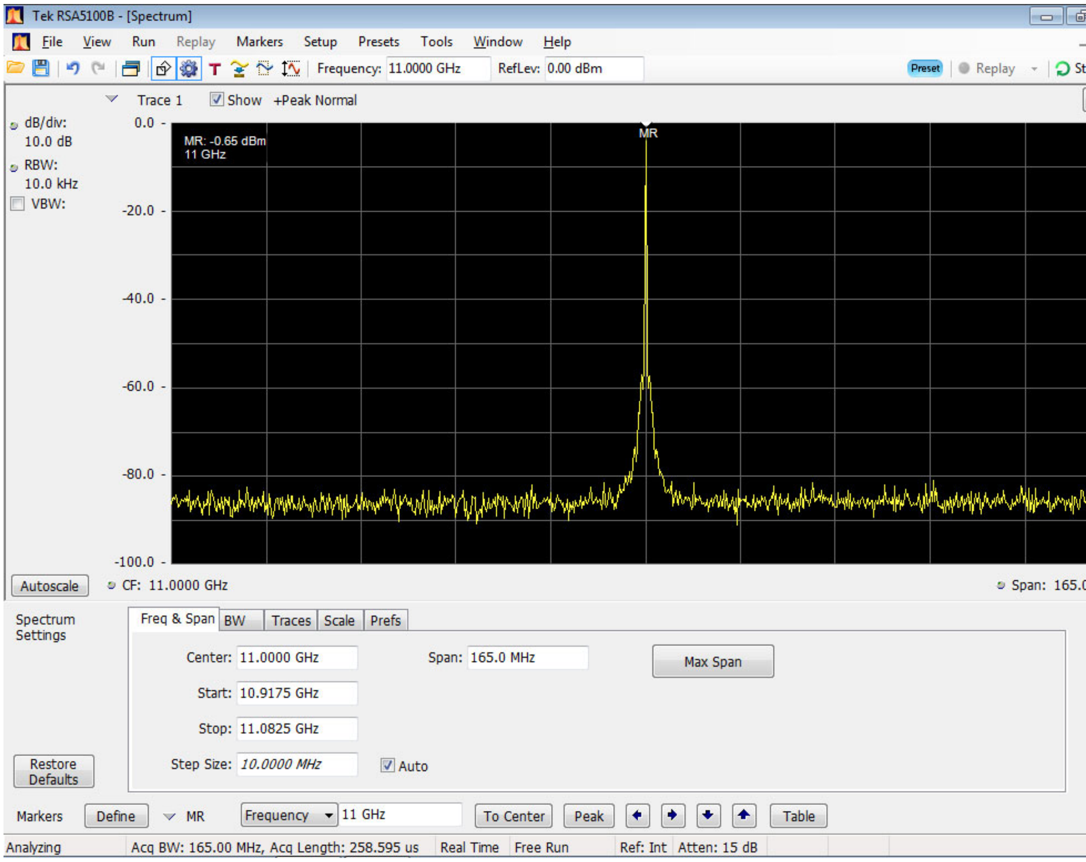


Figure 2-9: 11 GHz output waveform

23. Press the **All Outputs** button to *disable* the outputs.

24. Click the **Setup** tab on the display.

   a. Set Range to 13–18GHz

25. Press the **Home** button, or click the **Home** tab on the display.

26. In the Waveform List window, select (drag and drop) the **Waveform_14 GHz** waveform on to the work space.

27. Press the **All outputs off** button to *enable* the outputs.

28. Check that the Channel 1 waveform is properly displayed on the signal analyzer screen. (See Figure 2-10.)

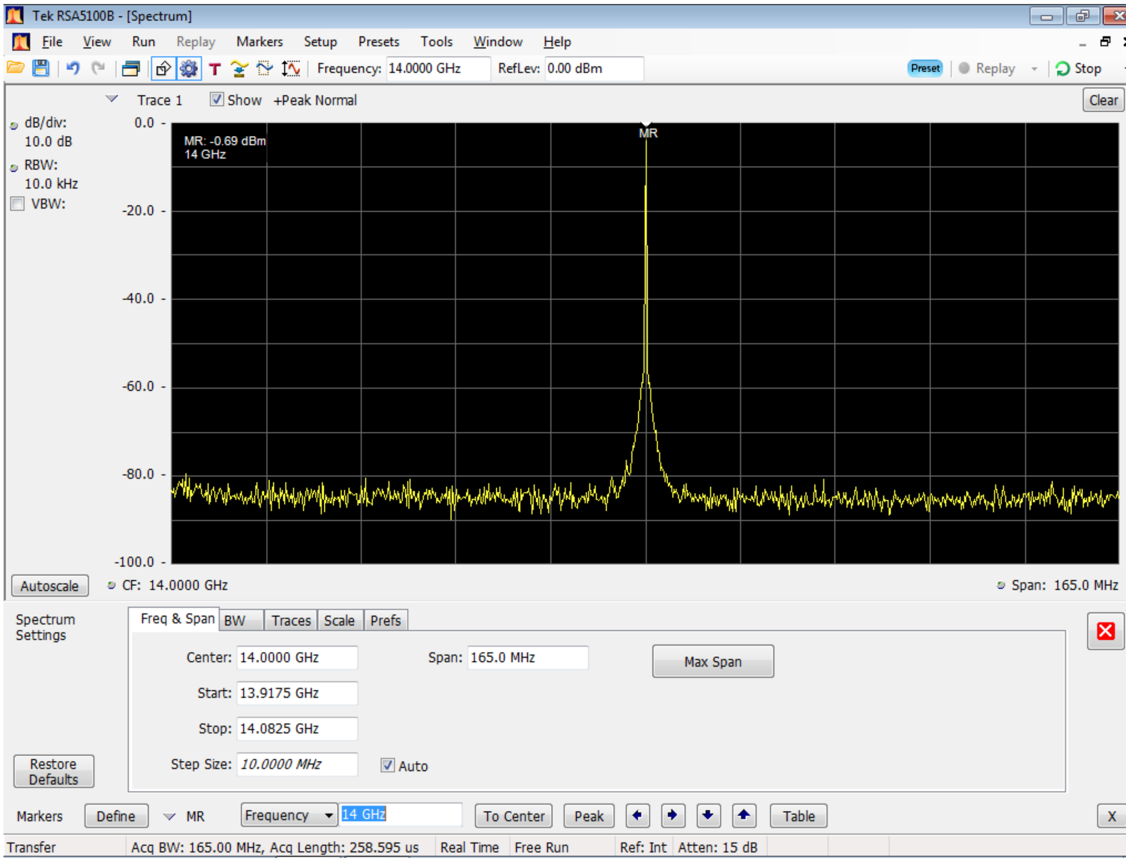


Figure 2-10: 14 GHz output waveform

29. Press the **All Outputs** button to *disable* the outputs.

30. Disconnect the test setup.

Checking the triggered outputs

Required equipment	Prerequisites
Oscilloscope	None
Function Generator (AFG3021C or equivalent)	
One TCA-SMA adapter	
Two 50 Ω SMA cables	
One SMA female to BNC male adapter	

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.

2. Connect a BNC to SMA adapter to the output of the function generator.

3. Connect an SMA cable between the output of the function generator and the Trigger A input on the rear of the AWG.

4. Connect a TCA-BNC adapter on the input channel of the oscilloscope.

5. Connect an SMA cable between the output of the AWG and the TCA-BNC adapter on the oscilloscope.

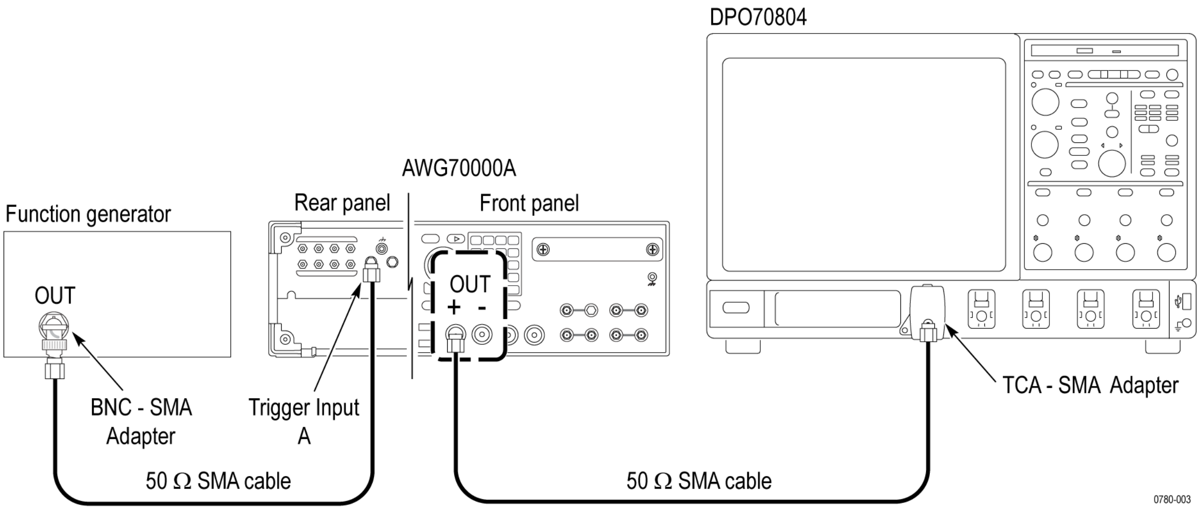


Figure 2-11: Equipment connection for checking the triggered outputs

6. Set the oscilloscope as follows:
   a. Vertical scale: 200 mV/div
   b. Horizontal scale: 20 ns/div
   c. Trigger source: CH1
   d. Trigger level: 100 mV

7. Press the **Home** button on the instrument, or click the Home tab on the display.

8. Click the **Reset to default setup** button in the toolbar.
9. Set the function generator output to square wave, 1 kHz, 5 V_{p-p}.
10. Turn on the output of the function generator.
11. On the instrument, load the **PV_Square.wfmx** waveform as an output waveform. Follow the steps below:
    a. In the Waveform List window, click **Open Waveform** and navigate to **C:\Program Files\Tektronix\AWG70000\Samples\PV**.
    b. Select **Open File**.
    c. In the Waveform List window, select (drag and drop) the **PV_Square.wfmx** waveform on the work space area.
12. In the Run tab on the bottom of the screen, select **Triggered**, and set the Trigger Input to **A**.
13. Click the **CH1 Enable** button.
14. In the Setup tab, click **Trigger**, and set the trigger level to 1.0 V, Rising, 50 Ω.
15. Click the **Play** button on-screen or on the instrument.
16. Press the **All Outputs** button on the instrument to output the waveform.
17. Verify that the output is displayed on the AWG work space.
18. Verify that the output is displayed on the oscilloscope.
19. Repeat the test for the Trigger B input: Move the cable from the Trigger A input to the Trigger B input, and then under the Run tab, set the trigger input to **B**.
20. Verify that the Trigger B output is displayed on the AWG work space.
21. Verify that the output is displayed on the oscilloscope.
22. Disconnect the test setup.

Performance tests

This section contains performance verification procedures for the specifications listed below.

- 10 MHz reference frequency accuracy
- Analog amplitude accuracy
- Marker high and low level accuracy

Prerequisites

The tests in this section comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the instrument.
- You must have performed and passed the procedure *Diagnostics* and *Calibration*, and the procedure *Functional Tests*.
- The instrument must have been last adjusted at an ambient temperature between +20 °C and +30 °C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperatures between +10 °C and +40 °C.

Required equipment

The following table lists the test equipment required to perform the performance verification procedures. The table identifies examples of recommended equipment and lists the required precision where applicable. If you substitute other test equipment for the listed examples, the equipment must meet or exceed the listed tolerances.

Table 2-3: Required equipment for performance tests

Item	Qty.	Minimum requirements	Recommended equipment
Frequency counter	1 ea.	Frequency accuracy: within ± 0.01 ppm	Tektronix MCA3040
Digital multimeter	1 ea.	DC accuracy: within ± 0.01%	Keithley 2000 DMM or Tektronix DMM4040/4050
Adapter	3 ea	TekConnect oscilloscope input to SMA input	Tektronix TCA-SMA
50 Ω SMA cable	3 ea.	DC to 20 GHz	Tensolite 1-3636-465-5236
50 Ω SMA termination	3 ea.	DC to 18 GHz	Tektronix part number 015-1022-01 (one is supplied with the AWG70001A, two with the AWG70002A.)
50 Ω BNC termination	1 ea.	DC to 1 GHz, feedthrough	Tektronix part number 011-0049-02

Table 2-3: Required equipment for performance tests (cont.)

Item	Qty.	Minimum requirements	Recommended equipment
50 Ω BNC cable	1 ea.	Male connectors both ends	Tektronix part number 012-0057-01
SMA-BNC adapter	3 ea.	SMA female to BNC male connector	Tektronix part number 015-0572-00
SMA-BNC adapter	1 ea.	SMA male to BNC female connector	Tektronix part number 015-0554-00
BNC-dual banana adapter	1 ea.	BNC to dual banana plugs	Tektronix part number 103-0090-00

Test waveforms

The following table lists the test waveforms that are used for the performance verification procedures. These are included on the instrument hard drive at: **C:\Program Files\Tektronix\AWG70000\Samples\PV**.

Table 2-4: Performance test waveforms

Waveform name	Purpose
PV_DC_Minus.wfmx	For checking the analog amplitude accuracy and the marker high and low level accuracy
PV_DC_Plus.wfmx	

Test record

Photocopy the test record and use it to record the performance test results. (See page 2-35, *Test record*.)

10 MHz reference frequency accuracy

Required equipment	Prerequisites
Frequency counter	(See page 2-21, *Prerequisites*.)
SMA female-to-BNC male adapter	
50 Ω SMA cable	

1. Connect the 10 MHz Reference Output on the back of the instrument to the A input of the frequency counter, using the 50 Ω SMA cable and SMA-BNC adapter.

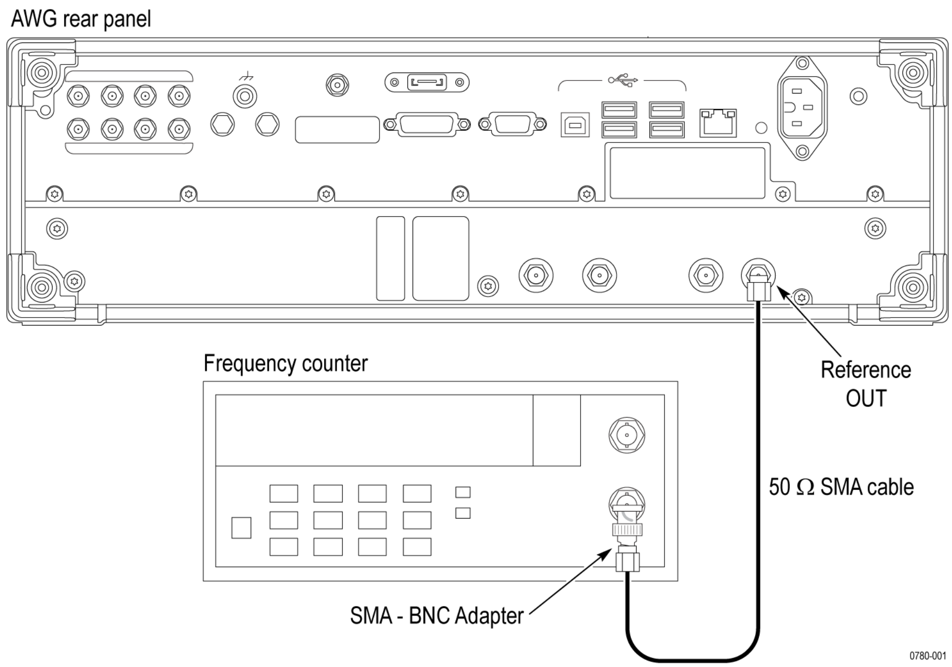


Figure 2-12: Equipment connection for verifying the 10 MHz reference frequency accuracy

2. On the frequency counter, press the Meas and the Freq buttons.

3. Verify that the frequency counter reading falls within the range of 9.99999 MHz to 10.00001 MHz (±1 ppm).

4. Disconnect the test setup.

Analog amplitude accuracy

NOTE. *If checking an AWG70001A instrument with Option AC, ensure that Channel 1 is set to Direct Mode in the Setup tab to enable the analog + and – complimentary outputs.*

Required equipment	Prerequisites
Digital multimeter	(See page 2-21, *Prerequisites*.)
BNC-dual banana adapter	
50 Ω BNC termination	
SMA female-BNC male adapter	
50 Ω SMA termination	

Measure the termination resistance. Before verifying the analog amplitude accuracy, you need to measure the resistance of the 50 Ω BNC termination.

1. Connect the BNC-dual banana adapter and 50 Ω BNC termination to the HI and LO inputs on the digital multimeter.

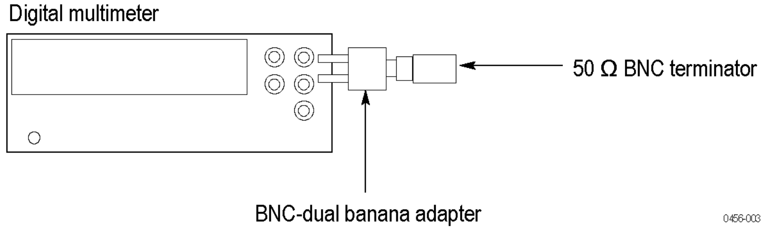


Figure 2-13: Equipment connection for measuring the termination resistance

2. Set the digital multimeter to the **Ω 2 wires** mode.
3. Measure the resistance and note the value as **Term_R**.
4. Set the digital multimeter to the **DCV** mode.

NOTE. *Lead resistance is not included in the measurement results when using four wire ohms. The accuracy is higher especially for small resistances. Use a four wire method if necessary.*

Check the analog amplitude accuracy.

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Connect an SMA-BNC adapter to the 50 Ω BNC termination on the digital multimeter.

3. Use the 50 Ω SMA cable to connect the CH 1 + connector on the instrument to the HI and LO inputs on the digital multimeter.
4. Use the 50 Ω SMA termination to terminate the CH 1 – connector on the instrument.

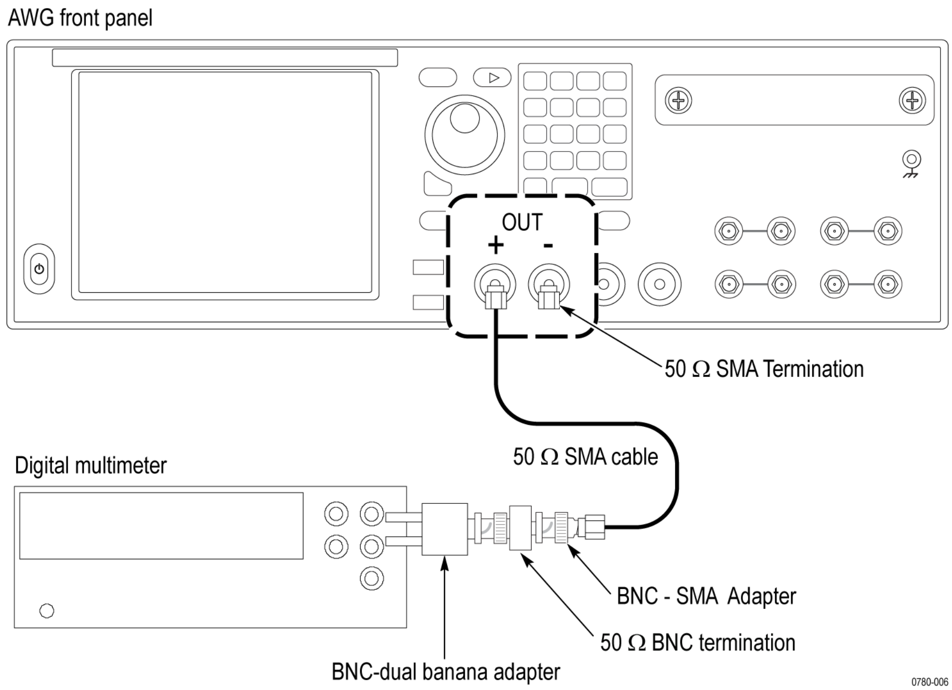


Figure 2-14: Equipment connection for checking the analog amplitude accuracy

5. Press the **Home** button on the instrument, or click the Home tab on the display.
6. Click the **Reset to default setup** button in the Setup Shortcuts tab.
7. On the instrument, load the **PV_DC_Plus.wfmx** waveform as an output waveform:
   a. Select **Open Waveform**.
   b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG70000\Samples\PV** folder, and then select the **PV_DC_Plus.wfmx** file. The **Waveform List** window appears.
   c. In the window, drag and drop the **PV_DC_Plus.wfmx** waveform on the work space.
8. From the Setup tab, click the Channel 1 button.
9. Set the amplitude of the instrument as shown in the first row of the table:

Table 2-5: Analog amplitude accuracy

Model	Amplitude settings	Accuracy limits
AWG70000A Series	250 mV_{p-p}	244 mV to 256 mV
	375 mV_{p-p}	367 mV to 383 mV
	500 mV_{p-p}	489 mV to 511 mV

10. Press the Ch 1 **Enable** button on the instrument to enable the channel 1 output.
11. Press the **Play** button on the instrument to output the signal.
12. Press the **All Outputs On/Off** button on the instrument to output the waveform.
13. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_1**.
14. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    V_high = [(Term_R + 50) / (2 Term_R)] Measured_voltage_1

    Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3 in the *Measure the termination resistance* procedure. (See page 2-24, *Measure the termination resistance*.)
15. In the **Waveform List** window, select the **PV_DC_Minus.wfmx** waveform on the **User Defined** tab.
16. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_2**.
17. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    V_low = [(Term_R + 50) / (2 Term_R)] Measured_voltage_2

    Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3 in the *Measure the termination resistance* procedure. (See page 2-24, *Measure the termination resistance*.)
18. Verify that the voltage difference |(V_high-V_low)| falls within the limits given in the table. (See Table 2-5 on page 2-26.)
19. Repeat steps 9 through 18 for each amplitude setting in the table. (See Table 2-5 on page 2-26.)
20. Move the SMA-BNC adapter from the CH 1 + connector to the CH 1 – connector and move the 50 Ω SMA termination from the CH 1 – connector to the CH 1 + connector.
21. Repeat steps 9 through 19.
22. If you are testing a AWG70002A, repeat steps 9 through 21 for the Channel 2 output.

23. Press the **All Outputs On/Off** button to turn off all the outputs.
24. Disconnect the test setup.

Analog AC amplitude accuracy (Option AC only)

This procedure is only for AWG70001A instruments with Option AC.

Required equipment	Prerequisites
Digital multimeter	(See page 2-21, *Prerequisites*.)
BNC-dual banana adapter	
50 Ω BNC termination	
SMA female-BNC male adapter	
50 Ω SMA termination	

Measure the termination resistance. Before verifying the analog amplitude accuracy, you need to measure the resistance of the 50 Ω BNC termination.

1. Connect the BNC-dual banana adapter and 50 Ω BNC termination to the HI and LO inputs on the digital multimeter.

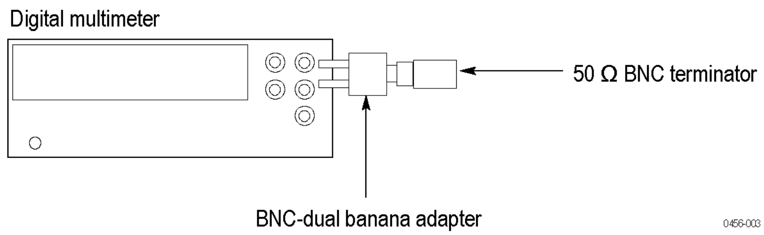


Figure 2-15: Equipment connection for measuring the termination resistance

2. Set the digital multimeter to the **Ω 2 wires** mode.
3. Measure the resistance and note the value as **Term_R**.
4. Set the digital multimeter to the **DCV** mode.

NOTE. *Lead resistance is not included in the measurement results when using four wire ohms. The accuracy is higher especially for small resistances. Use a four wire method if necessary.*

Check the analog AC amplitude accuracy.

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Select the **Setup** tab and set the channel output mode to **AC**.
3. Connect an SMA-BNC adapter to the 50 Ω BNC termination on the digital multimeter.
4. Use the 50 Ω SMA cable to connect the AC connector on the instrument to the HI and LO inputs on the digital multimeter.

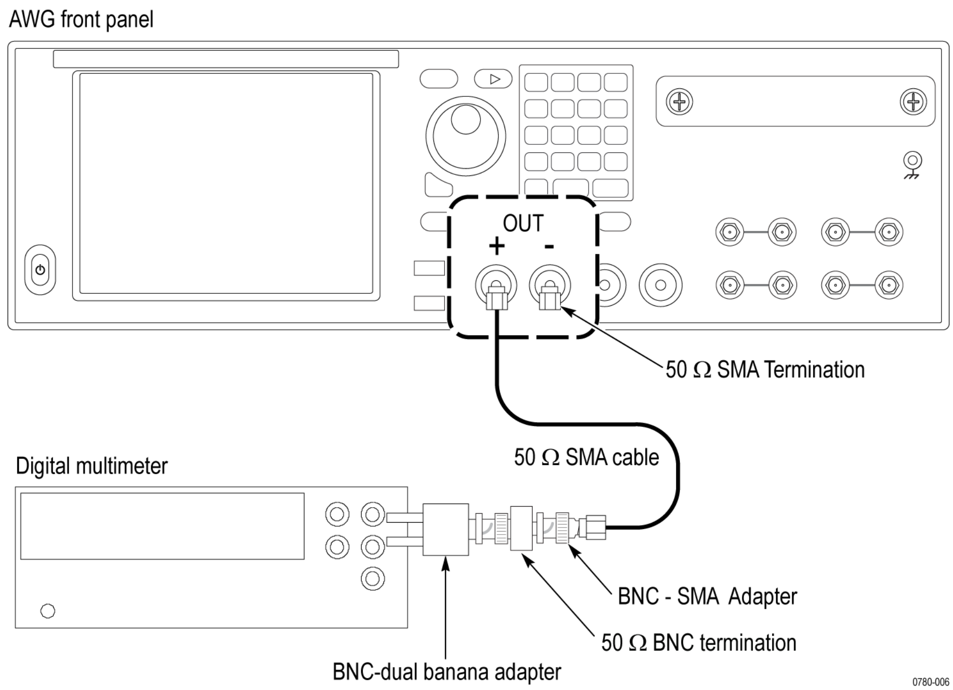


Figure 2-16: Equipment connection for checking the analog amplitude accuracy

5. Press the **Home** button on the instrument, or click the Home tab on the display.
6. Click the **Reset to default setup** button in the toolbar.
7. On the instrument, load the **PV_DC_Plus.wfmx** waveform as an output waveform:
   a. Select **Open Waveform**.
   b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG70000\Samples\PV** folder, and then select the **PV_DC_Plus.wfmx** file. The **Waveform List** window appears.
   c. In the window, drag and drop the **PV_DC_Plus.wfmx** waveform on the work space.
8. Set the amplitude of the instrument as shown in the first row of the table:

Table 2-6: AC analog amplitude accuracy

Model	Amplitude settings	Accuracy limits
AWG70000A series	250 mV_{p-p}	244 mV to 256 mV
	375 mV_{p-p}	367 mV to 383 mV
	500 mV_{p-p}	489 mV to 511 mV

9. Press the Ch 1 **Enable** button on the instrument to enable the channel 1 output.
10. Press the **Play** button on the instrument to output the signal.

11. Press the **All Outputs On/Off** button on the instrument to output the waveform.
12. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_1**.
13. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    V_high = [(Term_R + 50) / (2 Term_R)] Measured_voltage_1

    Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3 in the *Measure the termination resistance* procedure. (See page 2-28, *Measure the termination resistance*.)
14. In the **Waveform List** window, select the **PV_DC_Minus.wfmx** waveform on the **User Defined** tab.
15. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_2**.
16. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    V_low = [(Term_R + 50) / (2 Term_R)] Measured_voltage_2

    Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3 in the *Measure the termination resistance* procedure. (See page 2-28, *Measure the termination resistance*.)
17. Verify that the voltage difference |(V_high-V_low)| falls within the limits given in the table. (See Table 2-6 on page 2-29.)
18. Repeat steps 8 through 17 for each amplitude setting in the table. (See Table 2-6 on page 2-29.)
19. Press the **All Outputs On/Off** button to turn off all the outputs.
20. Disconnect the test setup.

Marker high and low level accuracy

Required equipment	Prerequisites
Digital multimeter	(See page 2-21, *Prerequisites*.)
BNC-dual banana adapter	
50 Ω BNC cable	
50 Ω BNC termination	
SMA male-BNC female adapter	
50 Ω SMA termination	

+ Marker high level accuracy

1. Perform the *Measure the termination resistance* procedure. (See page 2-24, *Measure the termination resistance*.)
2. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
3. Use the 50 Ω SMA cable, SMA-BNC adapter, 50 Ω BNC termination, and BNC-Banana adapter to connect the CH 1 Markers M1 + connector on the instrument to the HI and LO inputs on the digital multimeter.
4. Use the 50 Ω SMA termination to terminate the CH 1 Markers M1 – connector on the instrument.

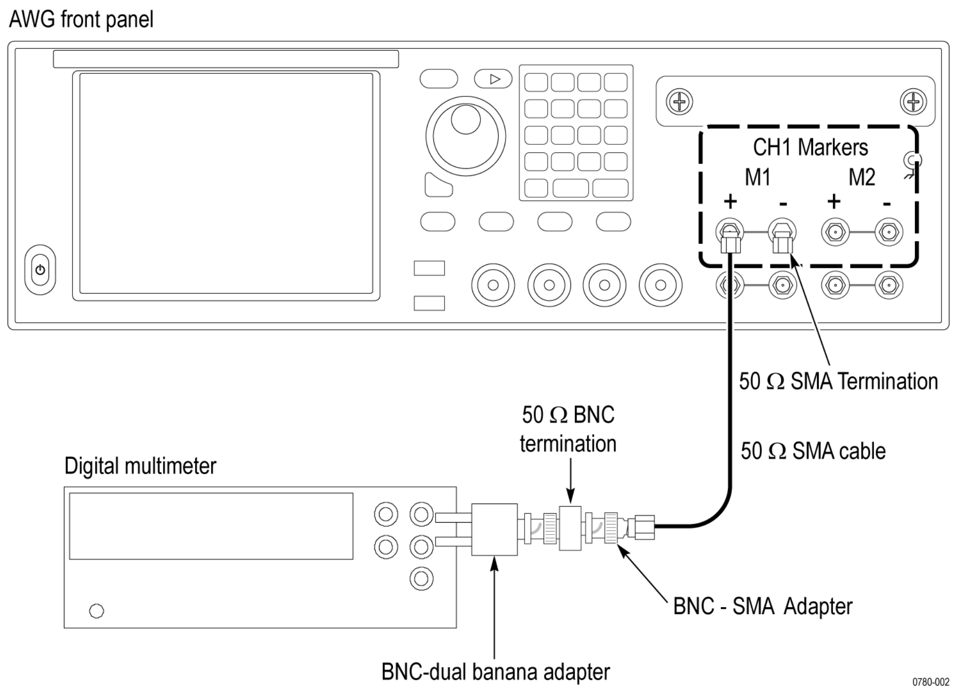


Figure 2-17: Equipment connection for verifying the marker high and low level accuracy

NOTE. *This test uses the .wfmx files that are used in the previous test (Analog Amplitude Accuracy). If you did not perform that test, use step 7 in the procedure to load the files, and then proceed with the following steps to activate the 8+2 markers.*

5. In the **Waveform List** window, select (drag and drop) the **PV_DC_Plus.wfmx** waveform to the work space.
6. Press the **Home** button on the instrument, or click the **Home** tab on the display.
   a. Click on the **Setup** tab.
   b. From the drop-down list under Resolution (bits), select **8+2 Mkrs**.
7. Click the CH 1 **Enable** button on the instrument to enable the channel 1 output.
8. Press the **All Outputs** button on the instrument to output the waveform.
9. Make the instrument High Level setting shown in the first row of the following table:

Table 2-7: Marker high level accuracy

High level settings	Accuracy limits
+ 1.4 V	1.185 V to 1.615 V
0.0 V	–75 mV to +75 mV
–0.9 V	–1.065 V to –0.735 V

10. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_1**.
11. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    Marker_High = (Term_R + 50) / (2 Term_R) Measured_voltage_1

    Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3 in the *Measure the termination resistance* procedure. (See page 2-24, *Measure the termination resistance*.)
12. Verify that the marker High level falls within the limits given in the table. (See Table 2-7.)
13. Repeat steps 9 through 12 for the remaining 2 rows in the table. (See Table 2-7.)

+ Marker low level accuracy

14. In the **Waveform List** window, select (drag and drop) the **PV_DC_Minus.wfmx** waveform to the work space.
15. Click the Ch 1 **Enable** button on the instrument to enable the channel 1 output.
16. Press the **All Outputs On/Off** button on the instrument to output the waveform.
17. Make the instrument Low Level setting shown in the first row of the table shown below.

Table 2-8: Marker low level accuracy

Low level settings	Accuracy limits
+ 0.9 V	0.735 V to 1.065 V
0.0 V	–75 mV to +75 mV
–1.4 V	–1.615 V to –1.185 V

18. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_2**.
19. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

    Marker_Low = (Term_R + 50) / (2 Term_R) Measured_voltage_2
20. Verify that the marker Low level falls within the limits given in the table. (See Table 2-8.)
21. Repeat steps 17 through 20 for the remaining 2 rows in the table. (See Table 2-8.)
22. Press the **All Outputs On/Off** button to disable the channel 1 output.

– Marker high level accuracy

23. Move the SMA-BNC adapter from the CH 1 Markers M1 + connector to the CH 1 Markers M1 – connector and move the 50 Ω SMA termination from the CH 1 Markers M1 – connector to the CH 1 Markers M1 + connector.

NOTE. *The files that are used in the – markers tests are the same as used in the + markers tests, but in opposite: When testing the Markers M1 – output, the marker high level accuracy is tested using the **PV_DC_Minus.wfmx** file, and then the marker low level accuracy is tested using the **PV_DC_Plus.wfmx** file.*

24. Using the **PV_DC_Minus.wfmx** file that is present on the workspace, repeat steps 7 through 13 to complete the high level accuracy test for the M1 – Marker output.

– Marker low level accuracy

The marker low level accuracy is tested using the **PV_DC_Plus.wfmx** file.

25. In the **Waveform List** window, select (drag and drop) the **PV_DC_Plus.wfmx** waveform to the work space.

26. Repeat steps 15 through 20 to complete the low level accuracy test for the M1 – Marker output.

CH 1 Markers M2 + and M2 – accuracy

27. Repeat steps 7 through 26 for CH 1 Markers M2 + and M2 – outputs.

AWG70002A marker accuracy

28. If you are testing an AWG70002A, repeat the marker test (steps 7 through 27) for the Channel 2 marker outputs.

29. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.

30. Disconnect the test setup.

Test record

Photocopy this page and the next two pages, and use them to record the performance test results for your instrument.

AWG70000A series performance test record

Instrument Model:					
Instrument Serial Number:		Certificate Number:			
Temperature:		RH %:			
Date of Calibration:		Technician:			
Performance Test		**Minimum**	**Incoming**	**Outgoing**	**Maximum**
10 MHz Reference Frequency Accuracy		9.99999 MHz			10.00001 MHz
Analog Amplitude Accuracy					
AWG70001A, AWG70002A					
Ch 1 +	Amplitude				
	250 mV_{p-p}	244 mV			256 mV
	375 mV_{p-p}	367 mV			383 mV
	500 mV_{p-p}	489 mV			511 mV
Ch 1 –	Amplitude				
	250 mV_{p-p}	244 mV			256 mV
	375 mV_{p-p}	367 mV			383 mV
	500 mV_{p-p}	489 mV			511 mV
AWG70002A					
Ch 2 +	Amplitude				
	250 mV_{p-p}	244 mV			256 mV
	375 mV_{p-p}	367 mV			383 mV
	500 mV_{p-p}	489 mV			511 mV
Ch 2 –	Amplitude				
	250 mV_{p-p}	244 mV			256 mV
	375 mV_{p-p}	367 mV			383 mV
	500 mV_{p-p}	489 mV			511 mV
Marker High and Low Level Accuracy					
AWG70001A, AWG70002A					

Performance Test			Minimum	Incoming	Outgoing	Maximum
	Ch 1 Marker	M1 +				
		High level	1.185 V			1.615 V
			–75 mV			+75 mV
			–1.065 V			–0.735 V
		Low level	0.735 V			1.065 V
			–75 mV			+75 mV
			–1.615 V			–1.185 V
		M1 –				
		High level	1.185 V			1.615 V
			–75 mV			+75 mV
			–1.065 V			–0.735 V
		Low level	0.735 V			1.065 V
			–75 mV			+75 mV
			–1.615 V			–1.185 V
		M2 +				
		High level	1.185 V			1.615 V
			–75 mV			+75 mV
			–1.065 V			–0.735 V
		Low level	0.735 V			1.065 V
			–75 mV			+75 mV
			–1.615 V			–1.185 V
		M2 –				
		High level	1.185 V			1.615 V
			–75 mV			+75 mV
			–1.065 V			–0.735 V
		Low level	0.735 V			1.065 V
			–75 mV			+75 mV
			–1.615 V			–1.185 V

Marker High and Low Level Accuracy

AWG70002A

Performance Test		Minimum	Incoming	Outgoing	Maximum
Ch 2 Markers	M1 +				
	High level	1.185 V			1.615 V
		–75 mV			+75 mV
		–1.065 V			–0.735 V
	Low level	0.735 V			1.065 V
		–75 mV			+75 mV
		–1.615 V			–1.185 V
	M1 –				
	High level	1.185 V			1.615 V
		–75 mV			+75 mV
		–1.065 V			–0.735 V
	Low level	0.735 V			1.065 V
		–75 mV			+75 mV
		–1.615 V			–1.185 V
	M2 +				
	High level	1.185 V			1.615 V
		–75 mV			+75 mV
		–1.065 V			–0.735 V
	Low level	0.735 V			1.065 V
		–75 mV			+75 mV
		–1.615 V			–1.185 V
	M2 –				
	High level	1.185 V			1.615 V
		–75 mV			+75 mV
		–1.065 V			–0.735 V
	Low level	0.735 V			1.065 V
		–75 mV			+75 mV
		–1.615 V			–1.185 V