

**AWG5000C Series
Arbitrary Waveform Generators
Specifications and Performance Verification
Technical Reference**

www.tektronix.com



077-0455-01

Tektronix

Copyright © Tektronix. All rights reserved. Licensed software products are owned by Tektronix or its subsidiaries or suppliers, and are protected by national copyright laws and international treaty provisions.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specifications and price change privileges reserved.

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

TekLink is a trademark of Tektronix, Inc.

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.tektronix.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

[W2 – 15AUG04]

Table of Contents

General Safety Summary	iv
Service Safety Summary.....	vi
Preface	vii
Related Documents	vii
Specifications	1
Performance Conditions	1
Electrical Specifications.....	2
Mechanical (Physical) Characteristics.....	12
Environmental Characteristics	13
Performance Verification Procedures.....	15
Brief Procedures	15
Diagnostics	15
Self Calibration	17
Functional Test	17
Performance Tests	22
Prerequisites	22
Required Equipment.....	23
Test Record	25
10 MHz Reference Frequency Accuracy.....	34
Analog Offset Accuracy	34
Analog Amplitude Accuracy	38
Analog Harmonic Distortion	40
Analog Non-Harmonic Spurious Signal.....	42
Analog Phase Noise	43
Marker High and Low Level Accuracy	46
Marker Output Delay Accuracy.....	48
DC Output Voltage Accuracy	51

List of Figures

Figure 1: Diagnostics dialog box	16
Figure 2: Calibration dialog box	17
Figure 3: Equipment connections for checking the analog and marker outputs	18
Figure 4: Output waveform from the Analog, Mkr 1, and Mkr 2 outputs	19
Figure 5: Equipment connection for checking the digital data outputs	20
Figure 6: Output waveform from the Digital Data Out connector	21
Figure 7: Equipment connection for verifying the 10 MHz reference frequency accuracy	34
Figure 8: Equipment connection for measuring the termination resistance	35
Figure 9: Equipment connection for verifying the analog offset accuracy	36
Figure 10: Equipment connections for verifying the analog harmonic distortion	40
Figure 11: Equipment connections for verifying the non-harmonic spurious signal	42
Figure 12: Equipment connections for verifying the analog phase noise	44
Figure 13: Example of the analog phase noise measurement	45
Figure 14: Equipment connection for verifying the marker high and low level accuracy	46
Figure 15: Equipment connections for verifying the marker output delay accuracy	49
Figure 16: Equipment connection for verifying the DC output voltage accuracy	51

List of Tables

Table 1: Run mode	2
Table 2: Arbitrary waveform	2
Table 3: Clock generator	3
Table 4: Trigger generator	3
Table 5: Inter-channel skew control	3
Table 6: Waveform rotation control for analog output	4
Table 7: Analog output	4
Table 8: Marker output	6
Table 9: Digital data output (Option 03 only)	7
Table 10: Trigger and gate input	7
Table 11: Event input	8
Table 12: Reference clock input	8
Table 13: Oscillator (External clock) input	9
Table 14: Add input	9
Table 15: DC output	9
Table 16: Oscillator output	9
Table 17: Dynamic Jump In for Option 09 Only	10
Table 18: 10 MHz clock output	11
Table 19: TekLink port	11
Table 20: CPU module and peripheral devices	11
Table 21: Display	11
Table 22: Power supply	12
Table 23: Mechanical characteristics	12
Table 24: Environmental characteristics	13
Table 25: Required equipment	23
Table 26: Test waveforms	24
Table 27: Analog offset accuracy	36
Table 28: Analog amplitude accuracy	38
Table 29: Analog harmonic distortion	41
Table 30: Analog non-harmonic spurious signal	43
Table 31: Analog phase noise	44
Table 32: Marker High and Low level accuracy	47
Table 33: DC output voltage accuracy	51

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:



Standby

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 AWG5000C Series Arbitrary Waveform Generators.

Related Documents

The following user documents are also available for this product:

- *AWG5000 and AWG7000 Series Arbitrary Waveform Generators Quick Start User Manual*. This document describes the functions and use of the instrument.
- *AWG5000 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

This section contains the specifications for the instruments.

All specifications are guaranteed unless noted as (*Typical*). Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in this manual.

Performance Conditions

To meet specifications, following conditions must be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C (68 °F and 86 °F)
- The instrument must be operating within the environmental limits. (See Table 24 on page 13.)
- The instrument must be powered from a source that meets the specifications. (See Table 22 on page 12.)
- The instrument must have been operating continuously for at least 20 minutes within the specified operating temperature range.

Electrical Specifications

Table 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.
Gated mode	An arbitrary waveform is output only when a gate signal is asserted. The waveform output is repeated while the gate signal stays asserted. When the gate signal is deasserted, the waveform output stops immediately.
Sequence mode	Standard: Sequence switching with wait trigger Option 08: Fast sequence switching

Table 2: Arbitrary waveform

Characteristics	Description
Waveform length	
Without Option 01	1 to 16,200,000 points
With Option 01	1 to 32,400,000 points
Hardware limitation	250 points minimum
Waveform granularity	1 point
DAC resolution	14 bits
Number of waveforms	Up to 32,000 waveforms (predefined waveforms are not included.)
Sequence length	1 to 8,000 steps
Sequence controls	
Without Option 08	Repeat count, Wait-for-Trigger (On only), Go-to-N, and Jump are available
Option 08	Repeat count, Wait-for-Trigger (On or Off), Go-to-N, and Jump are available
Repeat count	1 to 65,536 or infinite (all channels operate the same sequence)
Jump timing	Synchronous or Asynchronous selectable
Sequence switching time (<i>Typical</i>)	
AWG5012C, AWG5014C	2.1 ns
AWG5002C	4.2 ns

Table 3: Clock generator

Characteristics	Description
Sampling rate control	
Range	
AWG5002C	10.0000 MS/s to 0.6000 GS/s
AWG5012C, AWG5014C	10.0000 MS/s to 1.2000 GS/s
Resolution	8 digits
✓ Internal clock frequency	Within $\pm$ (1 ppm + aging)
Internal clock frequency accuracy (Typical)	Aging: within $\pm$ 1 ppm/year
✓ Reference oscillator accuracy	Within $\pm$ (1 ppm + aging)
Reference oscillator accuracy aging (Typical)	Aging: within $\pm$ 1 ppm/year

Table 4: Trigger generator

Characteristics	Description
Trigger rate	
Range	1.0 μ s to 10.0 s
Resolution	0.1 μ s minimum
Accuracy	Same as the reference oscillator

Table 5: Inter-channel skew control

Characteristics	Description
Skew control	
Range	-5 ns to +5 ns
Resolution	5 ps
Skew accuracy (Typical) ¹	$\pm$ (10% of effective skew setting +150 ps)

¹ Effective skew setting is the absolute value of the difference between the skew setting on channels.

Table 6: Waveform rotation control for analog output

Characteristics	Description
Phase control	
Range	CVR Gain stability is $\pm 0.1\%$ if measured within 25° of the temperature at factory calibration
Resolution	CVR Gain linearity is $\pm 0.2\%$. Perform an automatic sweep and take voltage measurements at every DAC value.
Time control	
Range	$-1/2$ period to $+1/2$ period of waveform
Resolution	1 ps
Point control	
Range	-50% to $+50\%$ of waveform
Resolution	0.001 points

Table 7: Analog output

Characteristics	Description
Connector type	BNC on front panel
Type of output	(+) and (–) complementary output
Output impedance	50 Ω
Amplitude controls	
Range	
Normal mode	20 mV to 4.5 V _{p-p}
Direct output mode	20 mV to 0.6 V _{p-p}
Resolution	1 mV
Offset controls	
Range	
Normal mode	-2.25 V to $+2.25$ V
Direct output mode	N/A
Resolution	1 mV
✓ Amplitude accuracy	DC accuracy: within $\pm$ (2% of amplitude + 2 mV) at offset = 0V
✓ Offset accuracy	DC accuracy: within $\pm$ (2% of offset + 15 mV) at minimum amplitude
Bandwidth (Typical)	
Normal mode	250 MHz (at -3 dB), when amplitude = 2.0 V _{p-p} , offset=0 V
Direct output mode	370 MHz (at -3 dB), when amplitude = 0.6 V _{p-p}
Rise/fall time (Typical)	
Normal mode	1.4 ns (10% to 90%), when amplitude = 2.0 V _{p-p} , offset = 0 V
Direct output mode	0.95 ns (10% to 90%), when amplitude = 0.6 V _{p-p}
Overshoot (Typical)	< 10%, when amplitude = 2.0 V _{p-p}

Table 7: Analog output (cont.)

Characteristics	Description
Ringing (<i>Typical</i>)	
Normal mode	850 mV _{p-p} , when amplitude = 4.5 V _{p-p} , filter = Through 175 mV _{p-p} , when amplitude = 2.0 V _{p-p} , filter = Through
Direct output mode	65 mV _{p-p} , when amplitude = 0.6 V _{p-p}
Low pass filter	
Normal mode	20 MHz, 100 MHz, Through (Bessel type)
Direct output mode	N/A
Delay from marker (<i>Typical</i>)	
	Direct output delay +19.0 ns: low pass = 20 MHz Direct output delay +5.3 ns: low pass = 100 MHz Direct output delay +1.5 ns: low pass = Through -1.5 ns to +0.4 ns: direct output mode (when amplitude = 0.6 V _{p-p} , offset = 0 V)
ON/OFF control	
	Output relay is available for each channel. A control is common to the complementary output.
✓ Harmonic distortion	Measured with 32-point sine waveform, defined up to 5 th harmonics.
AWG5012C, AWG5014C Normal mode	< -40 dBc, when amplitude = 2.0 V _{p-p} , offset = 0 V, clock = 1.2 GS/s, signal = 37.5 MHz
AWG5002C, Normal mode	< -49 dBc, when amplitude = 0.6 V _{p-p} , offset = 0 V, clock = 1.2 GS/s, signal = 37.5 MHz
AWG5012C, AWG5014C Direct output mode	< -46 dBc, when amplitude = 2.0 V _{p-p} , offset = 0 V, clock = 600 MS/s, signal = 18.75 MHz
AWG5002C, Direct output mode	< -55 dBc, when amplitude = 0.6 V _{p-p} , offset = 0 V, clock = 600 MS/s, signal = 18.75 MHz
✓ Non-harmonic spurious	Amplitude = 2.0 V _{p-p} , offset = 0 V, measured with 32-point sine waveform, measurement range is DC to sampling_frequency ÷ 2
AWG5012C, AWG5014C	< -60 dBc, DC to 600 MHz, when clock = 1.2 GS/s, signal = 37.5 MHz
AWG5002C	< -60 dBc, DC to 300 MHz, when clock = 600 MS/s, signal = 18.75 MHz
SFDR (<i>Typical</i>)	
AWG5012C, AWG5014C	50 dBc, when clock = 1.2 GS/s, signal = 37.5 MHz (Normal output mode, amplitude = 2.0 V _{p-p} , offset = 0 V, measured with 32-point sine waveform, measurement range is DC to sampling_frequency ÷ 2 including harmonics)
AWG5002C, AWG5012C, AWG5014C	56 dBc, when clock = 600 MS/s, signal = 18.75 MHz (Normal output mode, amplitude = 2.0 V _{p-p} , offset = 0 V, measured with 32-point sine waveform, measurement range is DC to sampling_frequency ÷ 2 including harmonics)
Normal mode Amplitude = 0.6 V _{p-p}	-60 dBc, when signal = 10 MHz -80 dBc, when signal = 1 MHz (Clock = 600 MS/s, offset = 0 V, measured with 60 and 600 points/cycle sine waveform, measurement range is DC to 300 MHz)

Table 7: Analog output (cont.)

Characteristics	Description
Direct output mode Amplitude = 0.6 V _{p-p}	-64 dBc, when signal = 10 MHz -80 dBc, when signal = 1 MHz (Clock = 600 MS/s, offset = 0 V, measured with 60 and 600 points/cycle sine waveform, measurement range is DC to 300 MHz)
✓ Phase noise	Amplitude = 2.0 V _{p-p} , offset = 0 V, measured with 32-point sine waveform
AWG5012C, AWG5014C	< -85 dBc/Hz at 10 kHz offset, when clock = 1.2 GS/s, signal = 37.5 MHz
AWG5002C	< -85 dBc/Hz at 10 kHz offset, when clock = 600 MS/s, signal = 18.75 MHz
Skew between (+) and (-) output (Typical)	< 200 ps

Table 8: Marker output

Characteristics	Description
Connector type	BNC on front panel
Number of outputs	Marker 1 and Marker 2 are available for each channel.
Type of output	Single-ended output
Output impedance	50 Ω
Level controls	Output voltage into RLOAD(Ω) to GND is approximately $(2 \times \text{RLOAD} \div (50 + \text{RLOAD})) \times \text{voltage setting}$
Voltage window	-1.0 V to +2.7 V into 50 Ω
Amplitude	0.1 V _{p-p} to +3.7 V _{p-p} maximum into 50 Ω
Resolution	0.01 V
✓ Level accuracy	DC accuracy: $\pm (10\% \text{ of } \text{setting} + 120 \text{ mV})$ into 50 Ω
Output current	$\pm 54 \text{ mA}$ maximum
Variable delay control	Available for Marker 1 and Marker 2
Range	0 to 1000 ps
Resolution	50 ps
✓ Variable delay accuracy	$\pm (5\% \text{ of } \text{setting} + 250 \text{ ps})$
Rise/fall time (Typical)	300 ps (20% to 80% of swing), when Hi = 1.0 V, Low = 0 V
Skew between Marker-1 and Marker-2 output (Typical)	< 1000 ps
Skew between (+) and (-) output (Typical)	< 100 ps
Random jitter on clock pattern (Typical)	5 ps _{RMS} (by 0101... clock pattern), when Hi = 1.0 V, Low = 0 V
Total jitter on random pattern (Typical)	150 ps _{p-p} (using PN15 pattern, when High = 1.0 V, Low = 0 V), measured at bit error rate = $1\text{e-}12$

Table 9: Digital data output (Option 03 only)

Characteristics	Description
Connector type	SMB on rear panel
Number of outputs	28 (14-bit output on channel 1 and channel 2)
Type of output	Single-ended
Output impedance	50 Ω
Level controls	Output voltage into RLOAD(Ω) to GND is approximately $(2 \times \text{RLOAD} \div (50 + \text{RLOAD})) \times \text{voltage setting}$
Voltage window	-1.0 V to +2.7 V into 50 Ω
Amplitude	0.1 V _{p-p} to +3.7 V _{p-p} into 50 Ω
Resolution	0.01 V
Level accuracy	DC accuracy: $\pm (10\% \text{ of } \text{setting} + 120 \text{ mV})$ into 50 Ω
Output current	$\pm 54 \text{ mA}$ maximum
Rise/fall time (<i>Typical</i>)	300 ps (20% to 80%, when Hi = 1.0 V, Low = 0 V)
Skew between outputs (<i>Typical</i>)	< 400 ps between 14-bit outputs

Table 10: Trigger and gate input

Characteristics	Description
Connector type	BNC on front panel
Input impedance	1 k Ω or 50 Ω selectable
Polarity	Positive or negative selectable
Input voltage range	
When 1 k Ω selected	-10 V to 10 V
When 50 Ω selected	< 5 V _{RMS}
Threshold control	
Level	-5.0 V to 5.0 V
Resolution	0.1 V
Accuracy (<i>Typical</i>)	$\pm (5\% \text{ of } \text{setting} + 0.1 \text{ V})$
Input voltage swing (<i>Typical</i>)	0.5 V _{p-p} minimum
Minimum pulse width	
Triggered mode	20 ns
Gated mode	1024 $\times$ sampling period + 10 ns
Trigger delay to analog output (<i>Typical</i>)	48 $\times$ sampling period + 500 ns
Trigger hold off time (<i>Typical</i>)	160 $\times$ sampling period – 200 ns When hardware sequencer is used
Gate delay to analog output (<i>Typical</i>)	240 $\times$ sampling period + 500 ns
Trigger jitter (<i>Typical</i>)	2.0 ns to 4.5 ns

Table 11: Event input

Characteristics	Description
Connector type	BNC on front panel
Input impedance	1 k Ω or 50 Ω selectable
Polarity	Positive or negative selectable
Input voltage range	
When 1 k Ω selected	–10 V to 10 V
When 50 Ω selected	< 5 V _{RMS}
Threshold control	
Level	–5.0 V to 5.0 V
Resolution	0.1 V
Accuracy (<i>Typical</i>)	$\pm$ (5% of setting + 0.1 V)
Input voltage swing (<i>Typical</i>)	0.5 V _{p-p} minimum
Minimum pulse width	20 ns
Delay to analog output (<i>Typical</i>)	200 $\times$ sampling period + 500 ns When asynchronous jump
Hold off time (<i>Typical</i>)	260 $\times$ sampling period + 300 ns

Table 12: Reference clock input

Characteristics	Description
Connector type	BNC on rear panel
Input impedance	50 Ω (AC coupled)
Input voltage swing	0.2 V _{p-p} to 3 V _{p-p}
Fixed mode input frequency	10 MHz, 20 MHz, and 100 MHz within $\pm$ 0.5%
Variable mode input frequency range	10 MHz to 600 MHz Frequency should be stable Acceptable frequency drift while the instrument is operating: $\pm$ 0.5%
Variable mode multiplier rate	The rate value is limited by sampling rate range.
AWG5012C, AWG5014C	1 to 240
AWG5002C	1 to 120

Table 13: Oscillator (External clock) input

Characteristics	Description
Connector type	BNC on rear panel
Input impedance	50 Ω (AC coupled)
Frequency range	600 MHz to 1200 MHz Frequency should be stable. Acceptable frequency drift while running is $\pm 0.5\%$.
Input voltage swing	0.2 V to 0.8 V _{p-p}
Divider	
AWG5012C, AWG5014C	1/1, 1/2, 1/4, 1/8, ... ,1/32
AWG5002C	1/2, 1/4, 1/8, ... ,1/32

Table 14: Add input

Characteristics	Description
Connector type	BNC on the rear panel, for each channel
Input impedance	50 Ω (DC coupled)
DC gain (<i>Typical</i>)	1
Bandwidth (<i>Typical</i>)	DC to 100 MHz, at -3 dB, when amplitude is 1 V _{p-p}
Input voltage range	± 1.0 V

Table 15: DC output

Characteristics	Description
Connector type	2 x 4 pin header, 2.54 mm pitch (female) on front panel
Number of outputs	4
Output voltage control	
Range	-3.0 V to $+5.0$ V
Resolution	10 mV
Control	Independent for each output
✓ Output voltage accuracy	$\pm (3\% \text{ of } \text{setting} + 120 \text{ mV})$ into High-Z load
Output current	± 100 mA maximum
Output impedance (<i>Typical</i>)	1 Ω

Table 16: Oscillator output

Characteristics	Description
Connector type	BNC on rear panel
Output impedance	50 Ω (AC coupled)
Output frequency range	600 MHz to 1200 MHz
Output voltage swing (<i>Typical</i>)	0.4 V _{p-p} into 50 Ω

Table 17: Dynamic Jump In for Option 09 Only

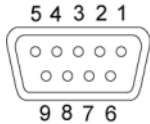
Characteristics	Description
Function	Allows fast switching during table jump and subsequence
Connector type	9-pin D-sub female to converter box (Tektronix part number, 850-0108-xx) through the TekLink connector
Input signal & pin assignment	
<i>Pin</i>	<i>Signal and direction</i>
1	Strobe, input
2	Event bit 3, input
3	Event bit 2, input
4	Event bit 1, input
5	Event bit 0, input
6	GND
7	GND
8	GND
9	GND
Input levels	TTL
Input voltage range	0 V to +5 V
High-level input voltage	2 V to 5 V
Low-level input voltage	0 V to +0.8 V
Input impedance	Pull up to 4.5 V by 2.2 k Ω resistor
Output connector type	40-pin TekLink connector with TekLink cable
Output levels	LVDS
Strobe	Must Strobe jump destination
Number of dynamic jump destinations	16 Maximum sequence indices The flag that decides whether or not the event input pattern is valid can be set to each of the patterns.
Minimum strobe width	64 ns
Latency to Analog Output (<i>Typical</i>)	From D-sub connector on TTL-to-LVDS converter to Analog output when asynchronous jump is selected Maximum 650 ns at 1.2 GS/s Maximum 1300 ns at 650 MS/s
Hold-off time (<i>Typical</i>)	Maximum of 500 sample clock cycles When asynchronous jump is selected

Table 18: 10 MHz clock output

Characteristics	Description
Connector type	BNC on rear panel
Output impedance	50 Ω (AC coupled)
Amplitude (<i>Typical</i>)	1.2 V _{p-p} into 50 Ω 2.4 V _{p-p} into 1 M Ω

Table 19: TekLink port

Characteristics	Description
Function	Provides a TekLink interface that complies with Tektronix TekLink 2.0 specification The instrument operates in slave mode only.
Connector type	40-pin connector on rear panel

Table 20: CPU module and peripheral devices

Characteristics	Description
CPU	Intel core duo processor
Memory	4 GB DDR2-800 or faster
Hard disk drive	≥160 GB, usable area is about 90%
Optical disk drive	CD-RW/DVD drive, writing software not included
USB 2.0	6 (2 x front, 4 x rear)
LAN	RJ-45 LAN connector supporting 10 base-T, 100 base-T, and Gigabit Ethernet on rear panel
ESATA	External ESATA at ≥ 1.5Gbps
Video output	DV/I connector
GPIO	IEEE 488.2 standard interface, 24 pins
PS2 keyboard connector	6 pins, mini-DIN
PS2 mouse connector	6 pins, mini-DIN
Serial ports	Two RS-232C, D-sub, 9 pins

Table 21: Display

Characteristics	Description
Size	210 mm X 158 mm (8.28 in X 6.22 in)
Resolution	1024 X 768 pixels
Touch screen	Built-in touch screen

Table 22: Power supply

Characteristics	Description
Source voltage and frequency	
Rating voltage	100 V _{AC} to 240 V _{AC}
Frequency range	47 Hz to 63 Hz
Power consumption	560 W
	The maximum power consumed by the fully-optioned instrument
Surge current	30 A peak (25 °C) for ≤ 5 line cycles, after product has been turned off for at least 30 s.

Mechanical (Physical) Characteristics

Table 23: Mechanical characteristics

Characteristics	Description
Net weight (<i>Typical</i>)	
Without package	Approximately 19.5 kg (42.9 lb)
With package	Approximately 28.5 kg (62.8 lb)
Dimensions, overall	
Height	245 mm (9.6 in)
Width	465 mm (18.3 in)
Length	500 mm (19.7 in)
Dimensions, with packaging	
Height	635 mm (25 in)
Width	665 mm (26.2 in)
Length	500 mm (19.7 in)
Cooling method	Forced-air circulation with no air filter
Clearance	
Top and bottom	20 mm (0.8 in)
Bottom	20 mm (0.8 in)
Left side	150 mm (6 in)
Right side	150 mm (6 in)
Rear	75 mm (3.0 in)

Environmental Characteristics

Table 24: Environmental characteristics

Characteristics	Description
Temperature	
Operating	+10 °C to +40 °C (+50 °F to 104 °F) with 15 °C/hour (59 °F/hour) maximum gradient, noncondensing derated 1.0 °C (34 °F) per 300 m (984 ft) above 1500 m (4921 ft) altitude
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 +40 °C (104 °F) noncondensing, and as limited by a maximum wet-bulb temperature +29 °C (84.2 °F) (derates relative humidity to 45% relative humidity at +40 °C (104 °F))
Nonoperating	5% to 90% relative humidity at up to +30 °C (+86 °F) 5% to 45% relative humidity above +30 °C (+86 °F) up to +40 °C (104 °F) noncondensing, and as limited by a maximum wet-bulb temperature +29 °C (84.2 °F) (derates relative humidity to 11% relative humidity at +40 °C (104 °F))
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)

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 *Self 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 *Self 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 23, *Required Equipment*.)

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

Brief Procedures

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

- *Diagnostics*
- *Self 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. Select **System > Diagnostics**.

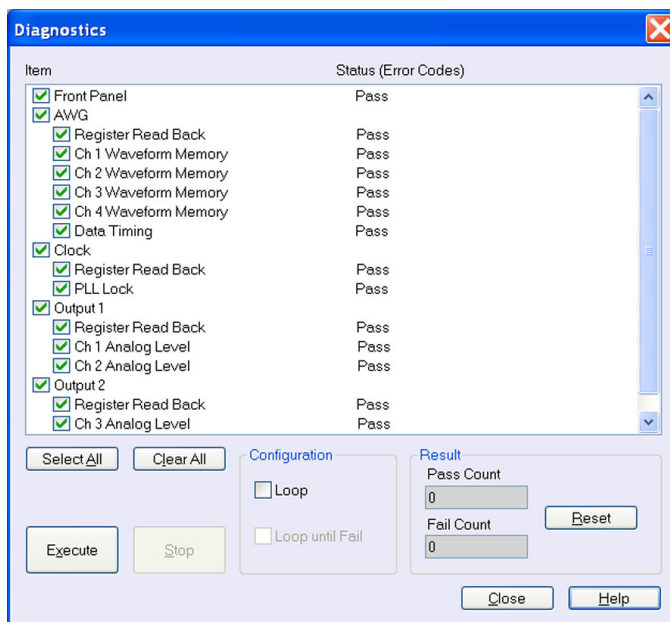


Figure 1: Diagnostics dialog box

3. In the Diagnostics dialog box, confirm that all the check boxes are selected. If they are not all selected, click the **Select All** button.
4. Click the **Execute** 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.
5. Verify that **Pass** appears as Status in the dialog box when the diagnostics complete.
6. Click the **Close** button.

Self Calibration

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

1. Select **System > Calibration**.

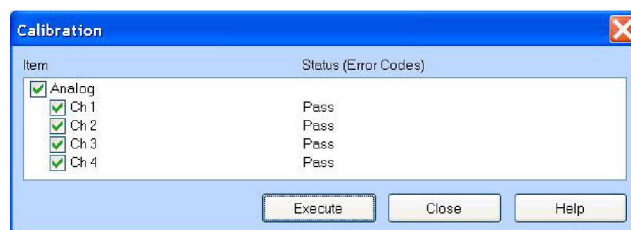


Figure 2: Calibration dialog box

2. Click the **Execute** button to start the routine.
3. Verify that **Pass** appears in the status column for all items when the calibration completes.
4. Click the **Close** button.

Functional Test

The purpose of the procedure is to confirm that the instrument functions properly. The required equipment is three 50 Ω BNC cables, an oscilloscope, and a 50 Ω SMB-BNC cable (Option 03 only).

Checking the Analog and Marker Outputs

Required equipment	Prerequisites
Oscilloscope (DPO7054 or equivalent)	None
Three 50 Ω BNC cables	

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use a 50 Ω BNC cable to connect the Channel 1 Analog connector on the instrument to the CH1 connector on the oscilloscope.
3. Use a 50 Ω BNC cable to connect the Channel 1 Mkr 1 connector on the instrument to the CH2 connector on the oscilloscope.
4. Use the 50 Ω BNC cable to connect the Channel 1 Mkr 2 connector on the instrument to the CH3 connector on the oscilloscope.

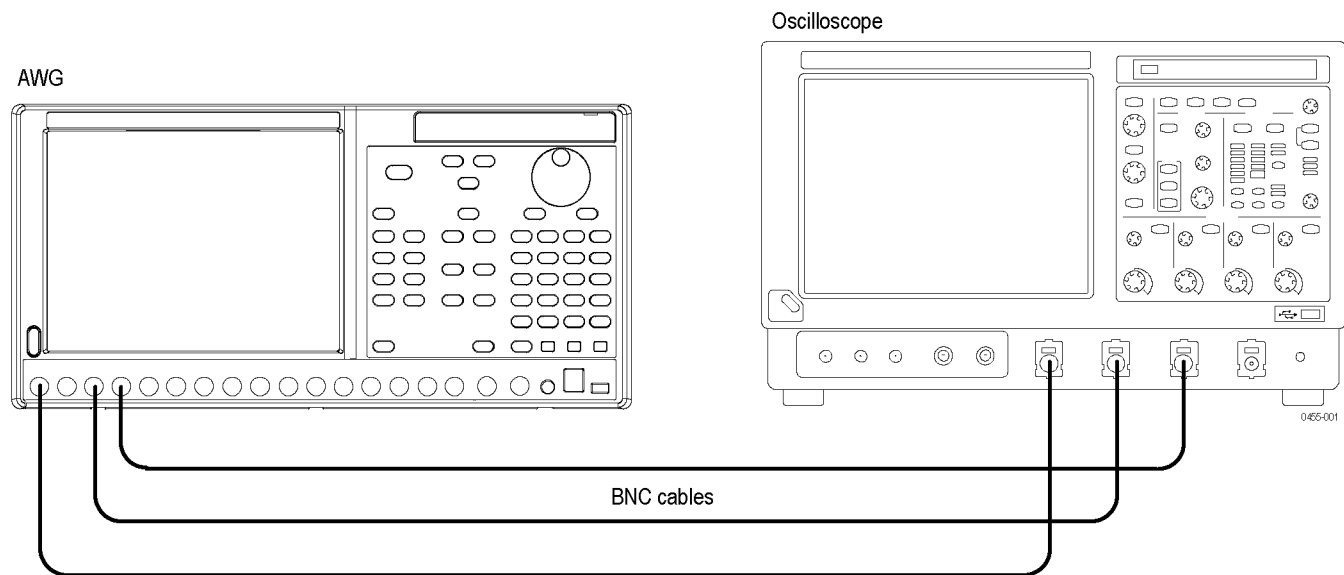


Figure 3: Equipment connections for checking the analog and marker outputs

5. Set the oscilloscope as follows:
 - a. Vertical scale: 1 V/div (CH1, CH2, and CH3)
 - b. Horizontal scale: 200 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
6. Press the **Factory Default** button on the instrument.
7. Press the **Ch1 Select** button on the instrument.

8. On the instrument, load the **sine_mk1_mk2** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **sine_mk1_mk2** waveform on the **User Defined** tab.

NOTE. If your instrument is an AWG5002C a warning message is displayed when you open the pv_awg5000.awg file. Ignore the message and press the OK button.

9. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
10. Press the **Run** button on the instrument to output the waveform.
11. Check that the Channel 1 Analog, Mkr 1, and Mkr 2 waveforms are properly displayed on the oscilloscope screen.

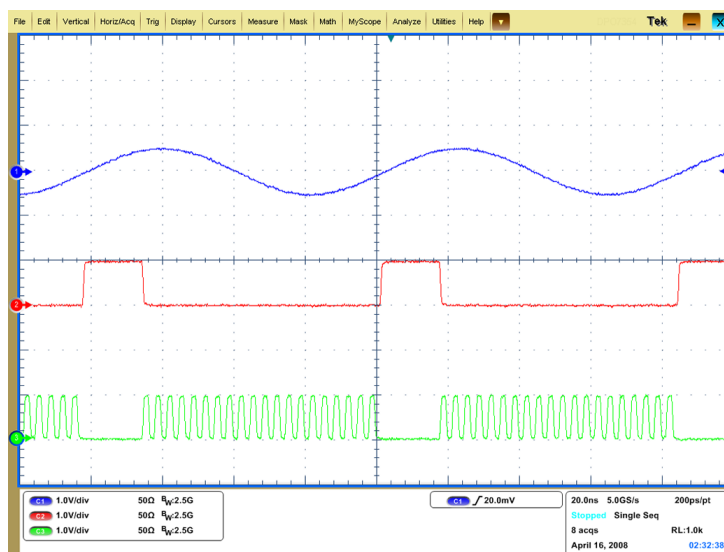


Figure 4: Output waveform from the Analog, Mkr 1, and Mkr 2 outputs

12. Press the **Ch 1 On** button again to disable the channel 1 output.
13. Repeat the test for the Channel 2 Analog, Mkr 1, and Mkr 2 outputs.
14. For the AWG5014C Repeat the test for the Channel 3 and Channel 4 Analog, Mkr 1, and Mkr 2 outputs.

Checking the Digital Data Outputs (Option 03 Only)

Required equipment

Oscilloscope (DPO7054 or equivalent)
 50 Ω BNC cable
 50 Ω SMB-BNC cable (Tektronix part number 174-5104-00)

Prerequisites

None

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use the 50 Ω SMB-BNC cable and 50 Ω BNC cable to connect the Ch 1 Digital Data Out 0 connector on the instrument rear panel to the CH1 connector on the oscilloscope.

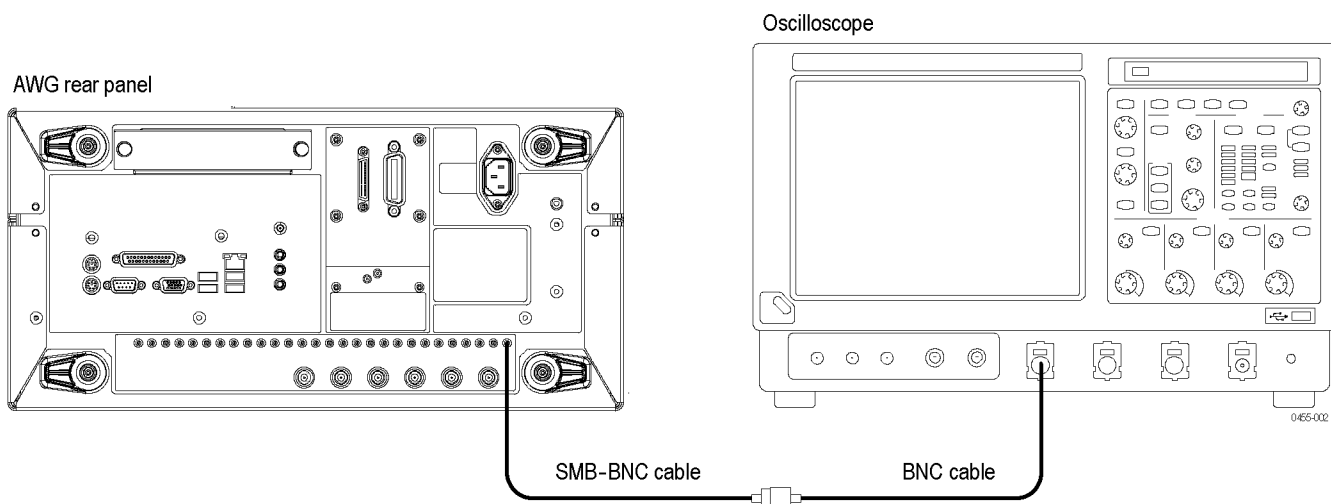


Figure 5: Equipment connection for checking the digital data outputs

3. Set the oscilloscope as follows:
 - a. Vertical scale: 500 mV/div
 - b. Horizontal scale: 200 ns/div
 - c. Input coupling: DC
 - d. Input impedance: 50 Ω
 - e. Trigger source: CH1
 - f. Trigger level: 500 mV
 - g. Trigger slope: Positive
 - h. Trigger mode: Auto
4. Press the **Factory Default** button on the instrument.
5. Press the **Ch1 Select** button on the instrument.

6. On the instrument, load the **square1** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **square1** waveform on the **User Defined** tab.
7. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
8. Press the **Run** button on the instrument to output the waveform.
9. Check that the square wave is properly displayed on the oscilloscope screen. (See Figure 6.)

NOTE. *If your instrument has firmware version 2.0 or earlier, the amplitude of the displayed waveform is different from the waveform shown in the following figure.*

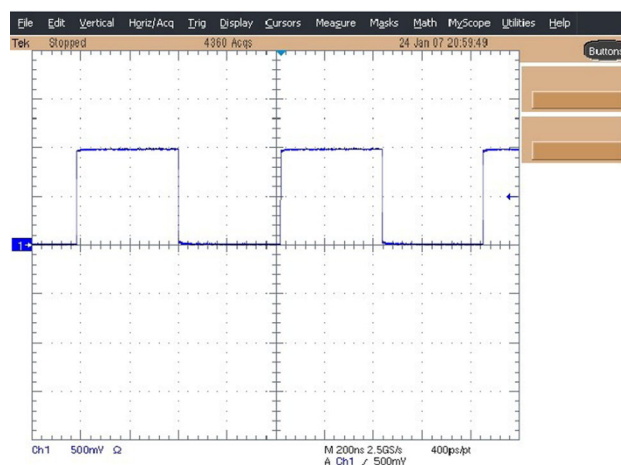


Figure 6: Output waveform from the Digital Data Out connector

10. Move the SMB-BNC cable from the Ch 1 Digital Data Out 0 connector to the Ch 1 Digital Data Out 1 connector and repeat the previous step.
11. Repeat step 10 for the remaining digital data outputs (Ch 1 Digital Data Out 2 to Ch 1 Digital Data Out 13).
12. Press the **Ch 1 On** button again to disable the channel 1 output.
13. Repeat the test for all the Ch 2 Digital Data outputs.

Performance Tests

This section contains performance verification procedures for the specifications marked with the ✓ symbol.

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 *Self 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 all of the performance verification procedure. 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 25: Required equipment

Item	Qty.	Minimum requirements	Recommended equipment
Oscilloscope	1 ea.	Bandwidth: 500 MHz or higher 4 channels	Tektronix DPO7054
Frequency counter	1 ea.	Frequency accuracy: within ± 0.01 ppm	Agilent Technologies 53181A
Sampling oscilloscope	1 ea.	Bandwidth: 20 GHz or higher 2 channels	Tektronix CSA8200 with 80E03
Spectrum analyzer	1 ea.	Bandwidth: DC to 8 GHz	Tektronix RSA3308B
Digital multimeter	1 ea.	DC accuracy: within $\pm 0.01\%$	Keithley 2000 DMM or Agilent Technologies 34410A
50 Ω BNC cable	2 ea.	DC to 2 GHz	Tektronix part number 012-0057-01
50 Ω BNC termination	1 ea.	DC to 1 GHz, feedthrough	Tektronix part number 011-0049-02
BNC-SMA adapter	2 ea.	BNC female to SMA male connectors	Tektronix part number 015-0554-00
BNC-N adapter	1 ea.	BNC female to N male connectors	Tektronix part number 103-0045-00
BNC-dual banana adapter	1 ea.	BNC to dual banana plugs	Tektronix part number 103-0090-00
DC output lead set	1 ea.	8-pin twisted pair, 24 inch	Tektronix part number 012-1697-00 (supplied with the AWG)

Test Waveforms

The following table lists the test waveforms that are used for the performance verification procedures and functional test. These are included in the pv_awg5000.awg file on the C: drive.

Table 26: Test waveforms

No.	Waveform name	Purpose
1	dc_minus	For checking the analog amplitude accuracy
2	dc_plus	For checking the analog amplitude accuracy
3	dc_zero	For checking the analog offset accuracy
4	marker_hi	For checking the marker high level accuracy
5	marker_low	For checking the marker low level accuracy
6	sine32	For checking analog harmonic distortion, analog non-harmonic spurious signal, and analog phase noise
7	sine_mk1_mk2	For the functional test
8	square1	For checking the marker output delay accuracy test

NOTE. *If your instrument is an AWG5002C, a warning message is displayed when you open the pv_awg5000.awg file. Ignore the message and press the OK button.*

Test Record

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

AWG5000C 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		9.99998 MHz			10.00002 MHz
Analog Offset Accuracy					
Ch 1	Offset	Output mode			
	+2.25 V	Direct D/A out: Off	2190 mV		2310 mV
	+1 V	Direct D/A out: Off	965 mV		1035 mV
	0.0 V	Direct D/A out: Off	–15 mV		+15 mV
	–1 V	Direct D/A out: Off	–1035 mV		–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV		–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV		+15 mV
/Ch 1	Offset	Output mode			
	+2.25 V	Direct D/A out: Off	2190 mV		2310 mV
	+1 V	Direct D/A out: Off	965 mV		1035 mV
	0.0 V	Direct D/A out: Off	–15 mV		+15 mV
	–1 V	Direct D/A out: Off	–1035 mV		–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV		–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV		+15 mV
Ch 2	Offset	Output mode			
	+2.25 V	Direct D/A out: Off	2190 mV		2310 mV
	+1 V	Direct D/A out: Off	965 mV		1035 mV
	0.0 V	Direct D/A out: Off	–15 mV		+15 mV
	–1 V	Direct D/A out: Off	–1035 mV		–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV		–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV		+15 mV

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
/Ch 2	Offset	Output mode				
	+2.25 V	Direct D/A out: Off	2190 mV			2310 mV
	+1 V	Direct D/A out: Off	965 mV			1035 mV
	0.0 V	Direct D/A out: Off	–15 mV			+15 mV
	–1 V	Direct D/A out: Off	–1035 mV			–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV			–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV			+15 mV
Ch 3	Offset	Output mode				
	+2.25 V	Direct D/A out: Off	2190 mV			2310 mV
	+1 V	Direct D/A out: Off	965 mV			1035 mV
	0.0 V	Direct D/A out: Off	–15 mV			+15 mV
	–1 V	Direct D/A out: Off	–1035 mV			–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV			–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV			+15 mV
/Ch 3	Offset	Output mode				
	+2.25 V	Direct D/A out: Off	2190 mV			2310 mV
	+1 V	Direct D/A out: Off	965 mV			1035 mV
	0.0 V	Direct D/A out: Off	–15 mV			+15 mV
	–1 V	Direct D/A out: Off	–1035 mV			–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV			–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV			+15 mV
Ch 4	Offset	Output mode				
	+2.25 V	Direct D/A out: Off	2190 mV			2310 mV
	+1 V	Direct D/A out: Off	965 mV			1035 mV
	0.0 V	Direct D/A out: Off	–15 mV			+15 mV
	–1 V	Direct D/A out: Off	–1035 mV			–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV			–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV			+15 mV
/Ch 4	Offset	Output mode				
	+2.25 V	Direct D/A out: Off	2190 mV			2310 mV
	+1 V	Direct D/A out: Off	965 mV			1035 mV
	0.0 V	Direct D/A out: Off	–15 mV			+15 mV
	–1 V	Direct D/A out: Off	–1035 mV			–965 mV
	–2.25 V	Direct D/A out: Off	–2310 mV			–2190 mV
	N/A (0V)	Direct D/A out: On	–15 mV			+15 mV

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Analog Amplitude Accuracy</i>						
Ch1	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
/Ch1	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
Ch2	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
/Ch2	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
Ch3	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
/Ch3	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A/out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A/out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A/out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
Ch4	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
/Ch4	Amplitude	Output mode				
	20 mV _{p-p}	Direct D/A out: Off	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: Off	194 mV			206 mV
	500 mV _{p-p}	Direct D/A out: Off	488 mV			512 mV
	1.0 V _{p-p}	Direct D/A out: Off	0.978 V			1.022 V
	2.0 V _{p-p}	Direct D/A out: Off	1.958 V			2.042 V
	4.5 V _{p-p}	Direct D/A out: Off	4.408 V			4.592 V
	20 mV _{p-p}	Direct D/A out: On	17.6 mV			22.4 mV
	200 mV _{p-p}	Direct D/A out: On	194 mV			206 mV
	600 mV _{p-p}	Direct D/A out: On	586 mV			614 mV
<i>Analog Harmonic Distortion (AWG501xC)</i>						
Ch 1	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–40 dBc
	0.6 V	Direct D/A out: On	none			–49 dBc
Ch 2	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–40 dBc
	0.6 V	Direct D/A out: On	none			–49 dBc
Ch 3	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–40 dBc
	0.6 V	Direct D/A out: On	none			–49 dBc
Ch 4	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–40 dBc
	0.6 V	Direct D/A out: On	none			–49 dBc

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Analog Harmonic Distortion (AWG5002C)</i>						
Ch 1	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–46 dBc
	0.6 V	Direct D/A out: On	none			–55 dBc
Ch 2	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–46 dBc
	0.6 V	Direct D/A out: On	none			–55 dBc
Ch 3	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–46 dBc
	0.6 V	Direct D/A out: On	none			–55 dBc
Ch 4	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–46 dBc
	0.6 V	Direct D/A out: On	none			–55 dBc
<i>Analog Non-Harmonic Spurious</i>						
Ch1	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–60 dBc
Ch 2	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–60 dBc
Ch 3	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–60 dBc
Ch 4	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–60 dBc
<i>Analog Phase Noise (at 10 kHz offset)</i>						
Ch 1	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–85 dBc/Hz
Ch 2	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–85 dBc/Hz
Ch 3	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–85 dBc/Hz
Ch 4	Amplitude	Output mode				
	2.0 V	Direct D/A out: Off	none			–85 dBc/Hz

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Marker High and Low Level Accuracy</i>						
Ch 1	Mkr 1	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV
	Mkr 2	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV
Ch 2	Mkr 1	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
Ch 2	Mkr 2	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV
Ch 3	Mkr 1	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV
Ch 3	Mkr 2	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-1.0 V	-1220 mV			-780 mV
Ch 4	Mkr 1	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	-120 mV			+120 mV
		-0.9 V	-1.11 V			-0.69 V

AWG5000C performance test record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
Ch 4		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	−120 mV			+120 mV
		−1.0 V	−1220 mV			−780 mV
Ch 4	Mkr 2	High level setting				
		+2.7 V	2.31 V			3.09 V
		+1.0 V	780 mV			1220 mV
		0.0 V	−120 mV			+120 mV
		−0.9 V	−1.11 V			−0.69 V
		Low level setting				
		+2.6 V	2.22 V			2.98 V
		+1.0 V	780 mV			1220 mV
		0.0 V	−120 mV			+120 mV
		−1.0 V	−1220 mV			−780 mV
Marker Output Delay Accuracy						
Ch 1	Mkr 1		700 ps			1300 ps
	Mkr 2		700 ps			1300 ps
Ch 2	Mkr 1		700 ps			1300 ps
	Mkr 2		700 ps			1300 ps
Ch 3	Mkr 1		700 ps			1300 ps
	Mkr 2		700 ps			1300 ps
Ch 4	Mkr 1		700 ps			1300 ps
	Mkr 2		700 ps			1300 ps
DC Output Accuracy						
DC output						
+5 V			4.73 V			5.27 V
+3 V			2.79 V			3.21 V
0.0 V			−120 mV			+120 mV
−3 V			−3.21 V			−2.79 V

10 MHz Reference Frequency Accuracy

Required equipment	Prerequisites
Frequency counter	(See page 22, <i>Prerequisites</i> .)
50 Ω BNC cable	

1. Use the 50 Ω BNC cable to connect the 10 MHz Reference Output connector on the instrument to the frequency counter CH1 input.

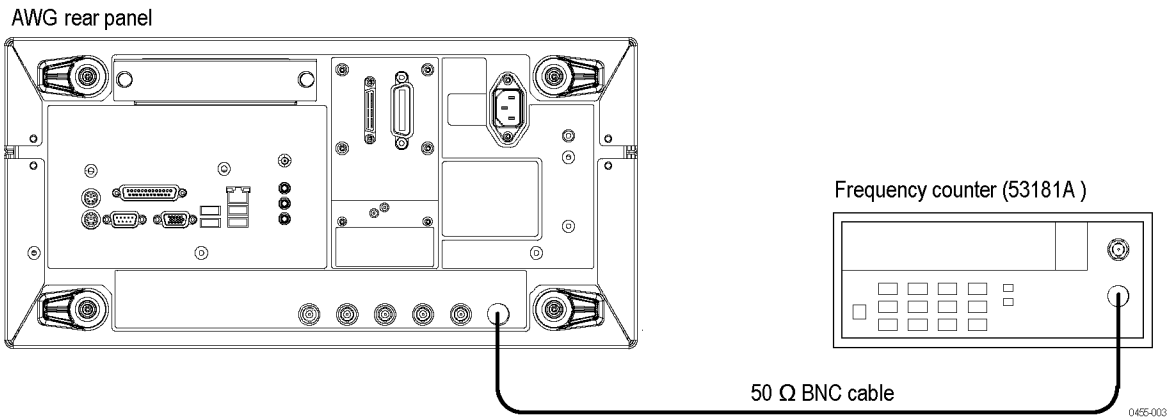


Figure 7: Equipment connection for verifying the 10 MHz reference frequency accuracy

2. Set the frequency counter as follows:
 - a. MEASURE: Frequency1, Gate Time: 0.10 s
 - b. CHANNEL1: Coupling: AC, Impedance: 50 Ω
3. Press the **Factory Default** button on the instrument.
4. Verify that the frequency counter reading falls within the range of 9.99998 MHz to 10.00002 MHz (± 2 ppm).
5. Disconnect the test setup.

Analog Offset Accuracy

Required equipment	Prerequisites
Digital multimeter	(See page 22, <i>Prerequisites</i> .)
50 Ω BNC cable	
50 Ω BNC termination	
BNC-dual banana adapter	

Measuring the Termination Resistance

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

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

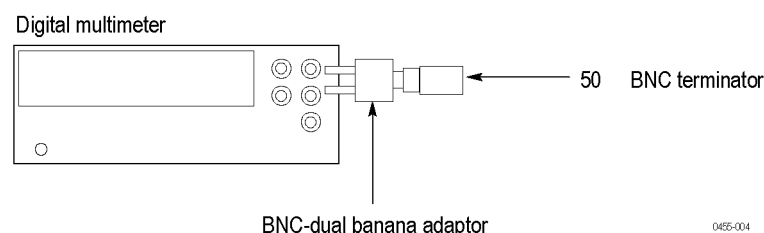


Figure 8: Equipment connection for measuring the termination resistance

2. Set the digital multimeter to the **W 2 wires** mode.
3. Measure the resistance and note the value as **Term_R**.
4. Set the digital multimeter to the **VDC** mode.
5. Disconnect the test setup.

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.

Verifying the Analog Offset Accuracy

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use the 50 Ω BNC cable, 50 Ω BNC termination, and BNC-dual banana adaptor to connect the Channel 1 Analog connector on the instrument to the HI and LO inputs on the digital multimeter.

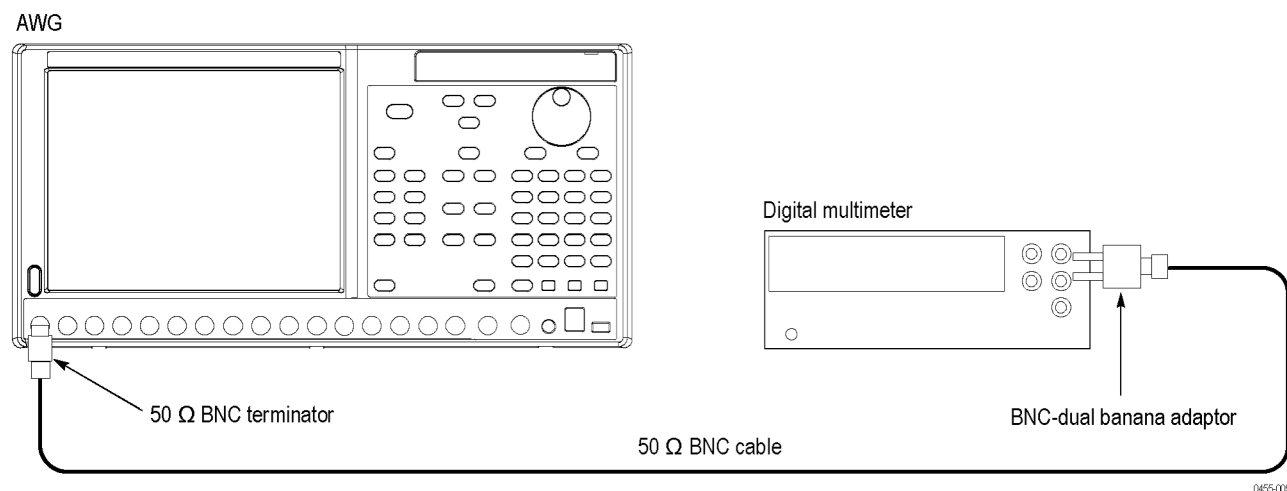


Figure 9: Equipment connection for verifying the analog offset accuracy

3. Press the **Factory Default** button on the instrument.
4. Press the **Ch1 Select** button on the instrument.
5. On the instrument, load the **dc_zero** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **dc_zero** waveform on the **User Defined** tab.
6. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
7. Press the **Run** button on the instrument to output the waveform.
8. Set the offset of the instrument to the level shown in the first row of the following table:

Table 27: Analog offset accuracy

Offset settings	Output mode settings	Accuracy limits
+2.25 V	Direct D/A out: Off	2190 mV to 2310 mV
1 V	Direct D/A out: Off	965 mV to 1035 mV
0.0 V	Direct D/A out: Off	–15 mV to +15 mV
–1 V	Direct D/A out: Off	–1035 mV to –965 mV
–2.25 V	Direct D/A out: Off	–2310 mV to –2190 mV
N/A (0 V)	Direct D/A out: On	–15 mV to + 15 mV

9. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage**.

10. Use the following formula to compensate the voltage for the 50 Ω BNC termination:

$$\text{Voltage} = [(\text{Term_R} + 50) / (2 \times \text{Term_R})] \times \text{Measured_voltage}$$

Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3. (See page 35, *Measuring the Termination Resistance*.)

11. Verify that the calculated value falls within the limits given in the table. (See Table 27.)
12. Repeat steps 8 through 11 for each offset setting in the table. (See Table 27.)
13. Move the BNC termination from the Channel 1 Analog connector to the Channel 1 Analog connector.
14. Repeat steps 8 through 12.
15. Repeat steps 6 through 14 for the Channel 2 output.
16. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 outputs.
17. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
18. Disconnect the test setup.

Analog Amplitude Accuracy

Required equipment	Prerequisites
Digital multimeter	(See page 22, <i>Prerequisites</i> .)
50 Ω BNC cable	
50 Ω BNC termination	
BNC-dual banana adapter	

1. Perform *Measuring the Termination Resistance*. (See page 35.)
2. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
3. Use the 50 Ω BNC cable, 50 Ω BNC termination, and BNC-dual banana adapter to connect the Channel 1 Analog connector on the instrument to the HI and LO inputs on the digital multimeter. (See Figure 9.)
4. Press the **Factory Default** button on the instrument.
5. Press the **Ch 1 Select** button on the instrument.
6. On the instrument, load the **dc_plus** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **dc_plus** waveform on the **User Defined** tab.
7. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
8. Press the **Run** button on the instrument to output the waveform.
9. Set the amplitude and output mode of the instrument as shown in the first row of the table. (See Table 28.)

Table 28: Analog amplitude accuracy

Amplitude settings	Output mode settings	Accuracy limits
20 mV _{p-p}	Direct D/A out: Off	17.6 mV to 22.4 mV
200 mV _{p-p}	Direct D/A out: Off	194 mV to 206 mV
500 mV _{p-p}	Direct D/A out: Off	488 mV to 512 mV
1.0 V _{p-p}	Direct D/A out: Off	0.978 V to 1.022 V
2.0 V _{p-p}	Direct D/A out: Off	1.958 V to 2.042 V
4.5 V _{p-p}	Direct D/A out: Off	4.408 V to 4.592 V
20 mV _{p-p}	Direct D/A out: On	17.6 mV to 22.4 mV
200 mV _{p-p}	Direct D/A out: On	194 mV to 206 mV
600 mV _{p-p}	Direct D/A out: On	586 mV to 614 mV

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:
$$V_high = [(Term_R + 50) / (2 \times Term_R)] \times Measured_voltage_1$$

Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3. (See page 35.)
12. In the **Waveform List** window, select the **dc_minus** waveform on the **User Defined** tab.
13. Measure the output voltage on the digital multimeter and note the value as **Measured_voltage_2**.
14. Use the following formula to compensate the voltage for the 50 Ω BNC termination:
$$V_low = [(Term_R + 50) / (2 \times Term_R)] \times Measured_voltage_2$$

Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3. (See page 35.)
15. Verify that the voltage difference $|(V_high - V_low)|$ falls within the limits given in the table. (See Table 28.)
16. Repeat steps 9 through 15 for each amplitude setting in the table. (See Table 28.)
17. Move the BNC termination from the Channel 1 Analog connector to the Channel 1 Analog connector.

18. Repeat steps 9 through 16.
19. Repeat steps 7 through 18 for the Channel 2 output.
20. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 outputs.
21. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
22. Disconnect the test setup.

Analog Harmonic Distortion

Required equipment

Spectrum analyzer

50 Ω BNC cable

BNC-N adaptor

Prerequisites

(See page 22, *Prerequisites*.)

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use the 50 Ω BNC cable and BNC-N adaptor to connect the Channel 1 Analog connector on the instrument to the INPUT connector on the spectrum analyzer.

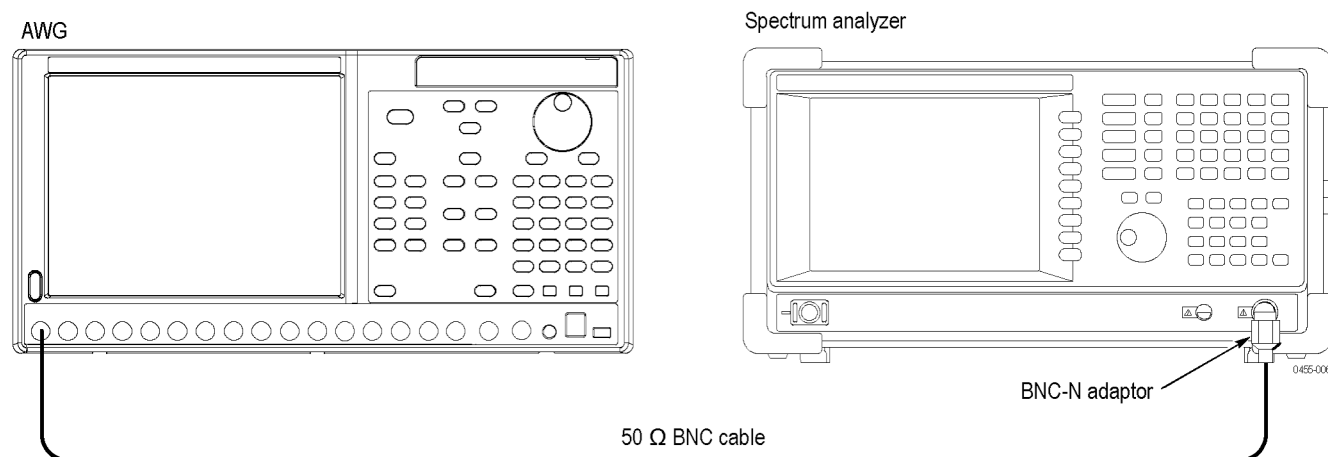


Figure 10: Equipment connections for verifying the analog harmonic distortion

3. Set the spectrum analyzer as follows:
 - a. Center frequency: 100 MHz
 - b. Span: 200 MHz
 - c. RBW: 20 kHz
4. Press the **Factory Default** button on the instrument.
5. Press the **Ch 1 Select** button on the instrument.

6. On the instrument, load the **sine_32** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **sine_32** waveform on the **User Defined** tab.
7. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
8. Press the **Run** button on the instrument to output the waveform.
9. Make the settings shown in the first row (or corresponding row for your instrument) of the following table:

Table 29: Analog harmonic distortion

AWG5000C model and settings				Measurement frequency (MHz)				Accuracy limit
Model	Output mode	Amplitude	Sampling rate (output frequency)	2nd	3rd	4th	5th	Nth reference
AWG501C	Direct D/A out: Off	2.0 V _{p-p}	1.2 GS/s (37.5 MHz)	75	112.5	150	187.5	-40 dBc
	Direct D/A out: On	0.6 V _{p-p}						-49 dBc
AWG5002C	Direct D/A out: Off	2.0 V _{p-p}	600 MS/s (18.75 MHz)	37.5	56.25	75	93.75	-46 dBc
	Direct D/A out: On	0.6 V _{p-p}						-55 dBc

10. Use the delta measurement function of the spectrum analyzer to measure harmonic distortion of each measurement frequency.
11. Verify that the harmonic distortion falls within the limits given in the table. (See Table 29.)
12. Repeat steps 9 through 11 for each setting in the table. (See Table 29.)
13. Move the 50 Ω BNC cable from Channel 1 Analog connector to the Channel 2 Analog connector.
14. Repeat steps 7 through 12 for the Channel 2 output.
15. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 outputs.
16. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
17. Disconnect the test setup.

Analog Non-Harmonic Spurious Signal

Required equipment

Spectrum analyzer

50 Ω BNC cable

BNC-N adaptor

Prerequisites

(See page 22, *Prerequisites*.)

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use the 50 Ω BNC cable and BNC-N adaptor to connect the Channel 1 Analog connector on the instrument to the INPUT connector on the spectrum analyzer.

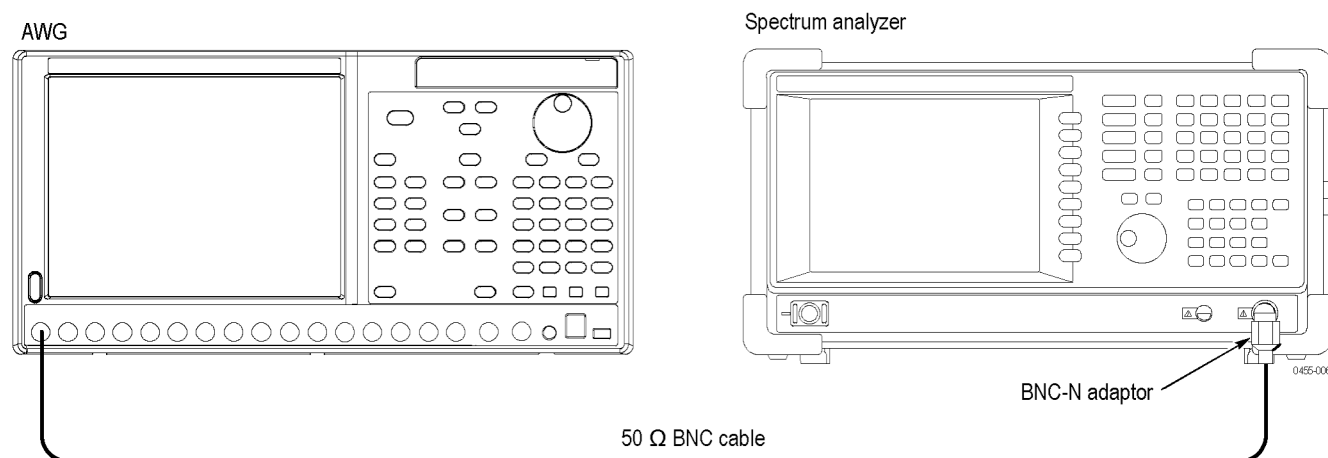


Figure 11: Equipment connections for verifying the non-harmonic spurious signal

3. Press the **Factory Default** button on the instrument.
4. Press the **Ch1 Select** button on the instrument.
5. On the instrument, load the **sine_32** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **sine_32** waveform on the **User Defined** tab.
6. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
7. Press the **Run** button on the instrument to output the waveform.

8. Make the instrument and spectrum analyzer settings shown in the first row or the second row of the following table:

Table 30: Analog non-harmonic spurious signal

AWG5000BC model and settings				Spectrum analyzer settings			
Model	Output mode	Amplitude	Sampling rate (output frequency)	Center frequency	Span	RBW	Accuracy limit
AWG501xC	Direct D/A out: Off	2.0 V _{p-p}	1.2 GS/s (37.5 MHz)	400 MHz	800 MHz	20 kHz	–60 dBc
AWG5002C	Direct D/A out: Off	2.0 V _{p-p}	600 MS/s (18.75 MHz)	200 MHz	400 MHz	20 kHz	–60 dBc

9. Use the spectrum analyzer to measure non-harmonic spurious signal of the Analog output over a frequency range of DC to 600 MHz (for the AWG5002C, DC to 300 MHz). For example, note the reference level of the fundamental waveform, and then measure each spurious.
10. Verify that the non-harmonic spurious signal falls within the limits given in the table. (See Table 30.)
11. Move the 50 Ω BNC cable from the Channel 1 Analog connector to the Channel 2 Analog connector.
12. Repeat steps 6 through 10 for the Channel 2 output.
13. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 outputs.
14. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
15. Disconnect the test setup.

Analog Phase Noise

Required equipment	Prerequisites
Spectrum analyzer	(See page 22, <i>Prerequisites</i> .)
50 Ω BNC cable	
BNC-N adapter	

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use the 50 Ω BNC cable and BNC-N adapter to connect the Channel 1 Analog connector on the instrument to the INPUT connector on the spectrum analyzer.

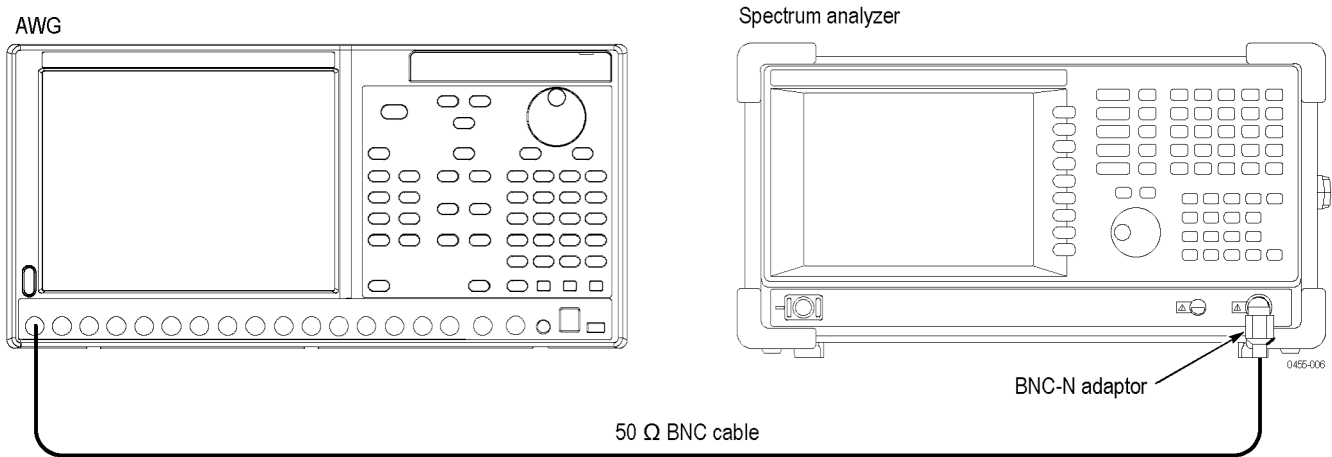


Figure 12: Equipment connections for verifying the analog phase noise

3. Press the **Factory Default** button on the instrument.
4. On the instrument, load the **sine_32** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select (drag and drop) the **sine_32** waveform on the **User Defined** tab.
5. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
6. Press the **Run** button on the instrument to output the waveform.
7. Make the instrument and spectrum analyzer settings shown in the first row (or the second row for your instrument) of the table. (See Table 31.)
8. Use the spectrum analyzer to measure phase noise of the Analog output.
9. Verify that the analog phase noise at 10 kHz offset falls within the limits given in the following table:

Table 31: Analog phase noise

AWG5000C model and settings				Spectrum analyzer settings			
Model	Output mode	Amplitude	Sampling rate	Center frequency	Span	RBW	Accuracy Limit at 10 kHz offset
AWG501xC	Direct D/A out: Off	2.0 V _{p-p}	1.2 GS/s	37.5 MHz	50 kHz	100 Hz	–85 dBc/Hz
AWG5002C	Direct D/A out: Off	2.0 V _{p-p}	600 MS/s	18.75 MHz	50 kHz	100 Hz	–85 dBc/Hz

10. Move the 50 Ω BNC cable from the Channel 1 Analog connector to the Channel 2 Analog connector.
11. Repeat steps 5 through 9 for the Channel 2 output.
12. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 outputs.
13. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
14. Disconnect the test setup.

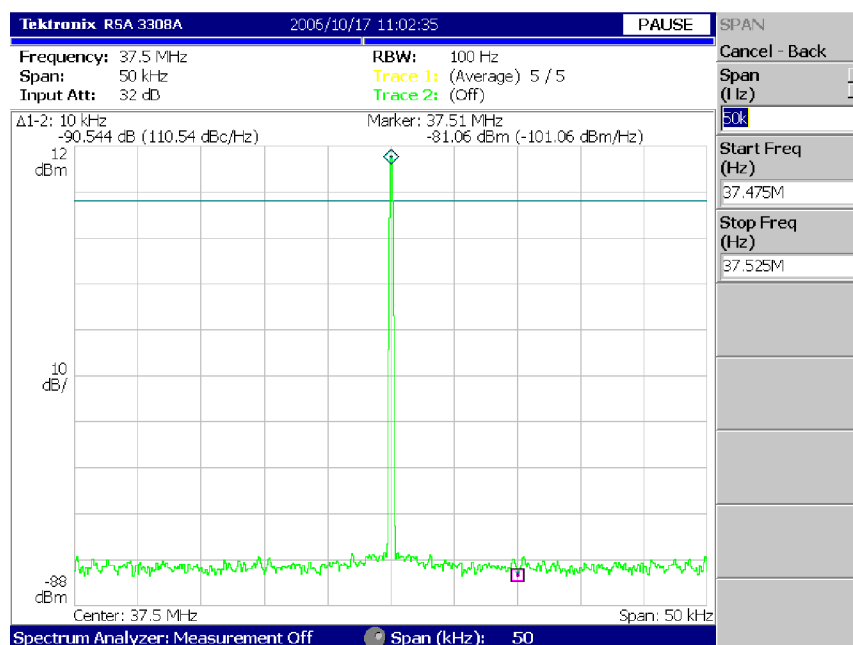


Figure 13: Example of the analog phase noise measurement

Marker High and Low Level Accuracy

Required equipment

Digital multimeter
50 Ω BNC cable
50 Ω BNC termination
BNC-dual banana adapter

Prerequisites

(See page 22, *Prerequisites*.)

1. Perform *Measuring the Termination Resistance*. (See page 35.)
2. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
3. Use the 50 Ω BNC cable, 50 Ω BNC termination, and BNC-dual banana adapter to connect the Channel 1 Mkr 1 connector on the instrument to the HI and LO inputs on the digital multimeter.

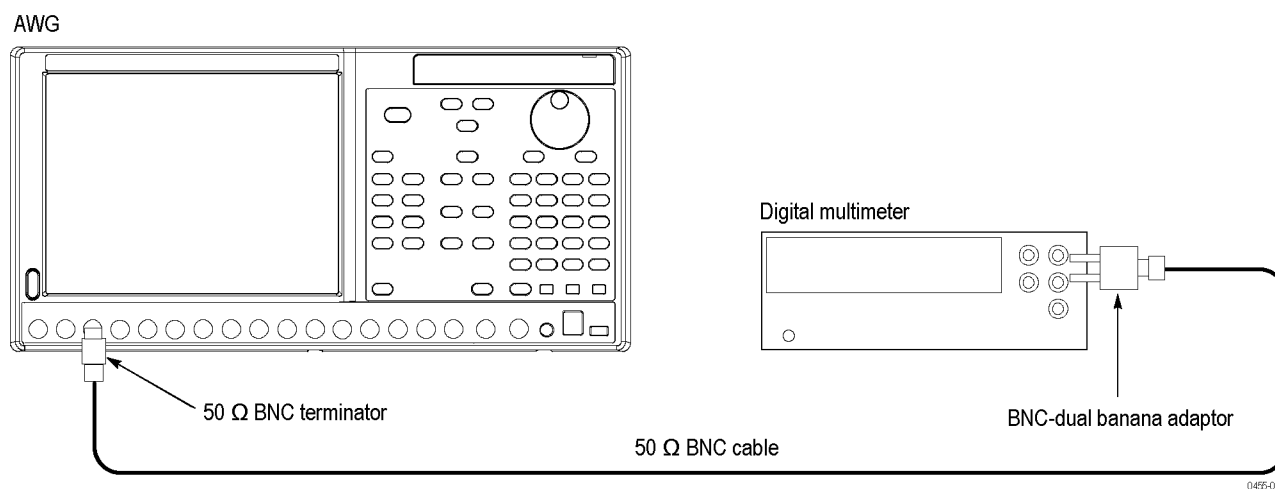


Figure 14: Equipment connection for verifying the marker high and low level accuracy

4. Press the **Factory Default** button on the instrument.
5. Press the **Ch1 Select** button on the instrument.
6. On the instrument, load the **marker_hi** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select the **marker_hi** waveform on the **User Defined** tab.
7. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
8. Press the **Run** 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 32: Marker High and Low level accuracy

High level settings	Accuracy limits
+2.7 V	2.31 V to 3.09 V
+1.0 V	780 mV to 1220 mV
0.0 V	–120 mV to +120 mV
–0.9 V	–1.11 V to 0.69 V
Low level settings	Accuracy limits
+2.6 V	2.22 V to 2.98 V
+1.0 V	780 mV to 1220 mV
0.0 V	–120 mV to +120 mV
–1.0 V	–1220 mV to –780 mV

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:

$$\text{Marker_High} = (\text{Term_R} + 50) / (2 \text{ Term_R}) \text{ Measured_voltage_1}$$

Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3. (See page 35.)

12. Verify that the marker High level falls within the limits given in the table. (See Table 32.)
13. Repeat steps 9 through 12 for each row in the table. (See Table 32.)
14. In the **Waveform List** window, select the **marker_low** waveform on the **User Defined** tab.
15. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
16. Press the **Run** button on the instrument to output the waveform.
17. Make the instrument Low Level setting shown in the first row of the table.
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:
- $$\text{Marker_Low} = (\text{Term_R} + 50) / (2 \text{ Term_R}) \text{ Measured_voltage_2}$$
- Where Term_R is the resistance of the 50 Ω BNC termination measured in step 3. (See page 35.)
20. Verify that the marker Low level falls within the limits given in the table.

21. Repeat steps 17 through 20 for each row in the table.
22. Press the **Ch 1 On** button to disable the channel 1 output.
23. Move the BNC termination from the Channel 1 Mkr 1 connector to the Channel 1 Mkr 2 connector.
24. Repeat steps 7 through 21.
25. Move the 50 Ω BNC termination from Channel 1 Mkr 2 connector to the Channel 2 Mkr 1 connector.
26. Repeat steps 7 through 24 for the Channel 2 marker outputs.
27. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 marker outputs.
28. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
29. Disconnect the test setup.

Marker Output Delay Accuracy

Required equipment	Prerequisites
Sampling oscilloscope	(See page 22, <i>Prerequisites</i> .)
Two 50 Ω BNC cable	
Two BNC-SMA adapters	

1. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
2. Use a 50 Ω BNC cable and BNC-SMA adapter to connect the Channel 1 Mkr 1 connector on the instrument to the CH1 connector on the sampling oscilloscope.
3. Use the 50 Ω BNC cable and BNC-SMA adapter to connect the Channel 1 Mkr 2 connector on the instrument to the TRIGGER DIRECT connector on the sampling oscilloscope.

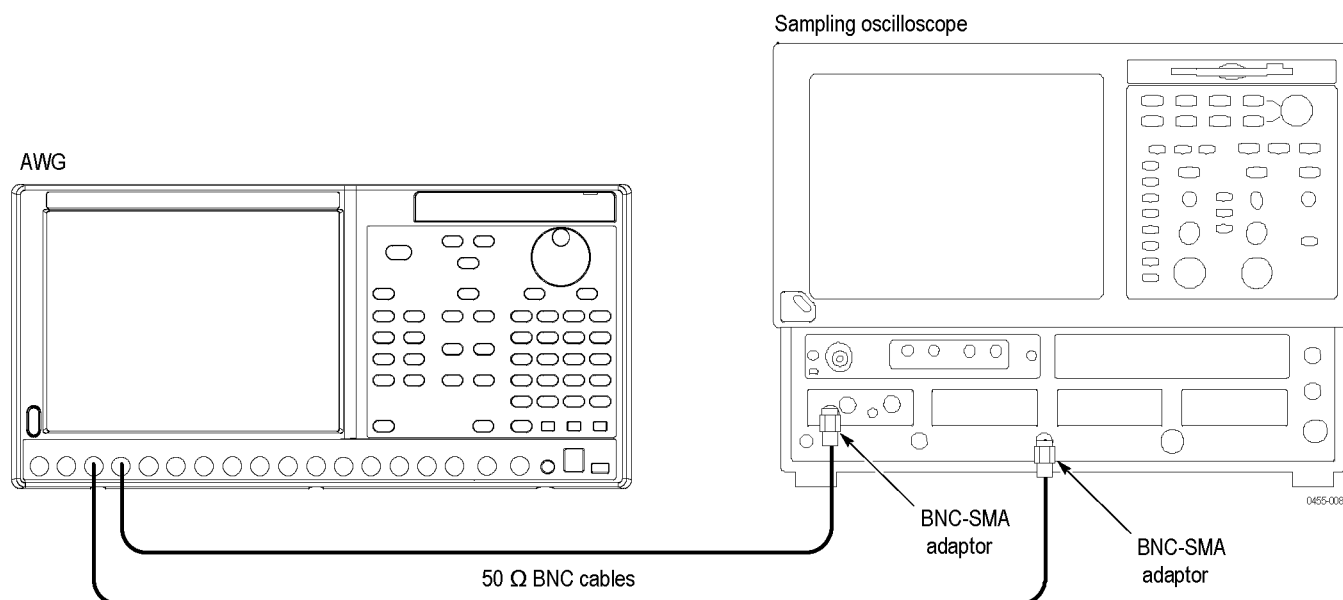


Figure 15: Equipment connections for verifying the marker output delay accuracy

4. Set the sampling oscilloscope as follows:
 - a. Vertical scale: 250 mV/div
 - b. Horizontal scale: 500 ps/div
 - c. Trigger source: External Direct
 - d. Trigger level: 150 mV (or Set to 50%)
 - e. Trigger slope: positive
 - f. Measure: Pulse measurement > Pulse Time > Delay
5. Press the **Factory Default** button on the instrument.
6. On the instrument, load the **square1** waveform as an output waveform.
 - a. Select **File > Open File**.
 - b. In the dialog box, navigate to the **C:\Program Files\Tektronix\AWG\System\PV** directory, and then select the **pv_awg5000.awg** file. The **Waveform List** window appears.
 - c. In the window, select the **square1** waveform on the **User Defined** tab.
7. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
8. Press the **Run** button on the instrument to output the waveform.
9. On the oscilloscope, store the channel 1 waveform to **Ref 1** as a reference waveform.
10. On the instrument, set the **Marker 1** delay value to **1.00 ns**.

11. Use the oscilloscope to measure the delay time between the Ref 1 waveform and channel 1 waveform at the 50% level.
12. Verify that the delay time is within the range of 700 ps to 1300 ps.
13. Press the **Ch 1 On** button on the instrument to disable the channel 1 output.
14. Move the 50 Ω BNC cable from the Channel 1 Mkr 1 connector to the Channel 1 Mkr 2 connector and from Channel 1 Mkr 2 connector to the Channel Mkr 1 connector.
15. Press the **Ch 1 On** button on the instrument to enable the channel 1 output.
16. On the oscilloscope, store the channel 1 waveform to **Ref 1** as a reference waveform.
17. On the instrument, set the **Marker 2** delay value to **1.00 ns**.
18. Repeat steps 11 and 12.
19. Repeat steps 7 through 18 for the Channel 2 markers.
20. *For the AWG5014C:* Repeat the test for the Channel 3 and Channel 4 marker outputs.
21. Press the **All Outputs On/Off** button on the instrument to turn off all the outputs.
22. Disconnect the test setup.

DC Output Voltage Accuracy

Required equipment

Digital multimeter

DC output lead set

Test leads (provided with the digital multimeter)

Prerequisites

(See page 22, *Prerequisites*.)

1. Use the test leads to connect the HI and LO inputs on the digital multimeter.
2. Use the DC output lead set to connect the DC Output connector on the instrument.

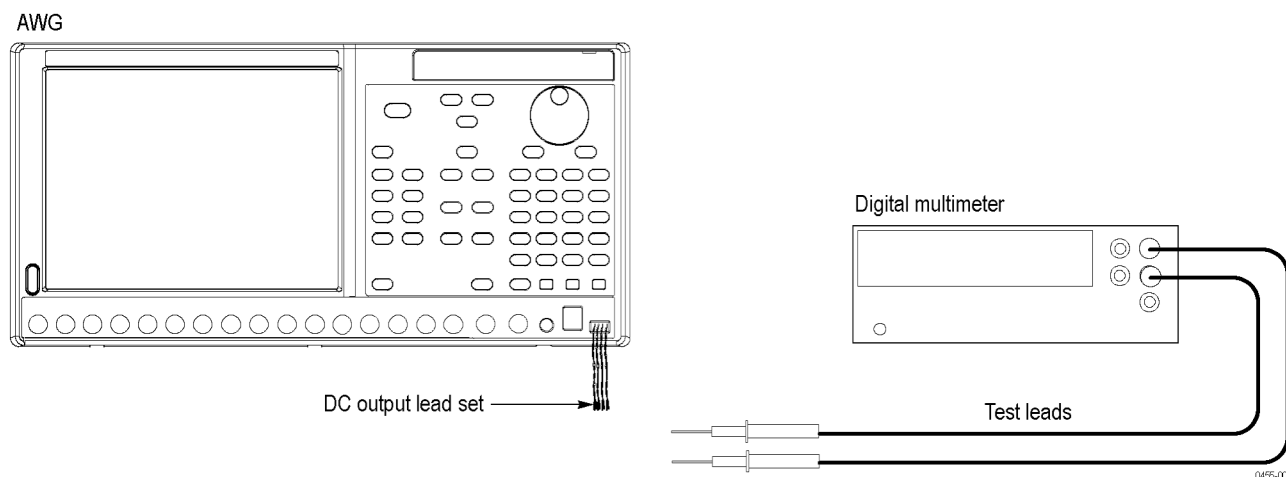


Figure 16: Equipment connection for verifying the DC output voltage accuracy

3. Set the digital multimeter to the **VDC** mode.
4. On the instrument, select the **DC Outputs** tab in the **Settings** window.
5. On the DC Output tab, set the DC 1, DC 2, DC 3, and DC 4 levels to the setting shown in the first row of the following table:

Table 33: DC output voltage accuracy

DC output settings	Accuracy limits
+5 V	4.73 V to 5.27 V
+3 V	2.79 V to 3.21 V
0.0 V	-120 mV to +120 mV
-3 V	-3.21 V to -2.79 V

6. On the DC Outputs tab, select the **DC Output** check box to enable the DC output. The DC Output LED on the front panel lights.
7. Attach the black test lead to the connector lead from DC1 GND.

- 8.** Attach the red test lead to the connector lead from DC1.
 - 9.** Verify that the DC output level falls within the limits given in the table.
(See Table 33.)
 - 10.** Repeat steps 8 and 9 for DC 2, DC 3, and DC 4.
 - 11.** Repeat steps 5 through 10 for each row in the table. (See Table 33.)
- This completes the performance verification.