# AWG5000C Series
# Arbitrary Waveform Generators
# Specifications and Performance Verification

## Technical Reference

077-0455-03

Tektronix

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# Arbitrary Waveform Generators
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www.tektronix.com

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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.

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[W2 – 15AUG04]

# Table of Contents

# List of Figures

# List of Tables

# 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.*

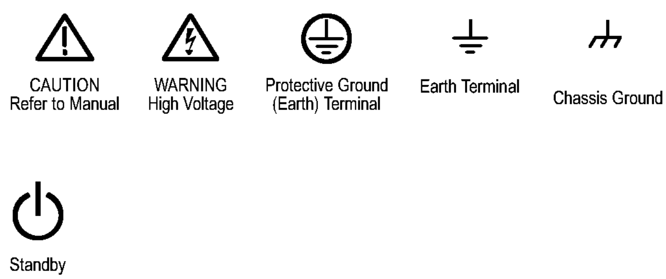
***CAUTION.** Caution statements identify conditions or practices that could result in damage to this product or other property.*

## 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 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 de-asserted, the waveform output stops immediately. |
| Sequence mode | Standard: Sequence switching with wait trigger<br>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 (*Typical*) | |
| 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 ± (1 ppm + aging) |
| Internal clock frequency accuracy (*Typical*) | Aging: within ± 1 ppm/year |
| ✓ Reference oscillator accuracy | Within ± (1 ppm + aging) |
| Reference oscillator accuracy aging (*Typical*) | Aging: within ± 1 ppm/year |

### Table 4: Trigger generator

| Characteristics | Description |
|---|---|
| Trigger rate | |
| Range | 1.0 µs to 10.0 s |
| Resolution | 0.1 µs 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] | ±(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 ±0.1% if measured within 25° of the temperature at factory calibration |
| Resolution | CVR Gain linearity is ±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 ± (2% of amplitude + 2 mV) at offset = 0 V |
| ✓ Offset accuracy | DC accuracy: within ± (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 (*Typical*) | |
| Normal mode | 850 $mV_{p-p}$, when amplitude = 4.5 $V_{p-p}$, filter = Through<br>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 (*Typical*) | Direct output delay +19.0 ns: low pass = 20 MHz<br>Direct output delay +5.3 ns: low pass = 100 MHz<br>Direct output delay +1.5 ns: low pass = Through<br>–1.5 ns to +0.4 ns: direct output mode<br>(when amplitude = 0.6 $V_{p-p}$, offset = 0 V) |
| ON/OFF control | Output relay is available for each channel. The 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 (*Typical*) | |
| AWG5012C, AWG5014C | 50 dBc, when clock = 1.2 GS/s, signal = 37.5 MHz<br>(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<br>(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<br>Amplitude = 0.6 $V_{p-p}$ | -60 dBc, when signal = 10 MHz<br>-80 dBc, when signal = 1 MHz<br>(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<br>-80 dBc, when signal = 1 MHz<br>(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 × RLOAD ÷ (50 + RLOAD)) × 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: ± (10% of \|setting\| + 120 mV) into 50 Ω |
| Output current | ± 54 mA maximum |
| Variable delay control | Available for Marker 1 and Marker 2 |
| Range | 0 to 1000 ps |
| Resolution | 50 ps |
| ✓ Variable delay accuracy | ± (5% of \|setting\| + 250 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 H i= 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 = $1e^{-12}$ |

### 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 × RLOAD ÷ (50 + RLOAD)) × 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: ± (10% of \|setting\| + 120 mV) into 50 Ω |
| Output current | ± 54 mA maximum |
| Rise/fall time (*Typical*) | 300 ps (20% to 80%, when Hi = 1.0 V, Low = 0 V) |
| Skew between outputs (*Typical*) | < 400 ps between 14-bit outputs |

### Table 10: Trigger and gate input

| Characteristics | Description |
|---|---|
| Connector type | BNC on front panel |
| Input impedance | 1 kΩ or 50 Ω selectable |
| Polarity | Positive or negative selectable |
| Input voltage range | |
| When 1 kΩ 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 (*Typical*) | ± (5% of \|setting\| + 0.1 V) |
| Input voltage swing (*Typical*) | 0.5 $V_{p-p}$ minimum |
| Minimum pulse width | |
| Triggered mode | 20 ns |
| Gated mode | 1024 × sampling period + 10 ns |
| Trigger delay to analog output (*Typical*) | 48 × sampling period + 500 ns |
| Trigger hold off time (*Typical*) | 160 × sampling period – 200 ns<br>When hardware sequencer is used |
| Gate delay to analog output (*Typical*) | 240 × sampling period + 500 ns |
| Trigger jitter (*Typical*) | 2.0 ns to 4.5 ns |

### Table 11: Event input

| Characteristics | Description |
|---|---|
| Connector type | BNC on front panel |
| Input impedance | 1 kΩ or 50 Ω selectable |
| Polarity | Positive or negative selectable |
| Input voltage range | |
| When 1 kΩ 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 (*Typical*) | ± (5% of \|setting\| + 0.1 V) |
| Input voltage swing (*Typical*) | 0.5 $V_{p-p}$ minimum |
| Minimum pulse width | 20 ns |
| Delay to analog output (*Typical*) | 200 × sampling period + 500 ns<br>When asynchronous jump |
| Hold off time (*Typical*) | 260 × 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 ± 0.5% |
| Variable mode input frequency range | 10 MHz to 600 MHz<br>Frequency should be stable<br>Acceptable frequency drift while the instrument is operating: ± 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<br>Frequency should be stable.<br>Acceptable frequency drift while running is ±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 (*Typical*) | 1 |
| Bandwidth (*Typical*) | DC to 100 MHz, at –3 dB, when amplitude is 1 $V_{p-p}$ |
| Input voltage range | ± 1.0 V |

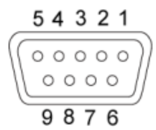
### Table 15: DC output

| 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 | ± (3% of \|setting\| + 120 mV) into High-Z load |
| Output current | ±100 mA maximum |
| Output impedance (*Typical*) | 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 (*Typical*) | 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 |   |
| *Pin* | *Signal and direction* |
| 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 kΩ 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<br>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 (*Typical*) | From D-sub connector on TTL-to-LVDS converter to Analog output when asynchronous jump is selected<br>Maximum 650 ns at 1.2 GS/s<br>Maximum 1300 ns at 650 MS/s |
| Hold-off time (*Typical*) | Maximum of 500 sample clock cycles<br>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 (*Typical*) | 1.2 $V_{p-p}$ into 50 Ω<br>2.4 $V_{p-p}$ into 1 MΩ |

### Table 19: TekLink port

| Characteristics | Description |
|---|---|
| Function | Provides a TekLink interface that complies with Tektronix TekLink 2.0 specification<br>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 |
| Solid state hard disk drive | ≥300 GB, usable area is about 90% |
| Hard disk drive | ≥1 TB, 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 ≥ 1.5 Gbps |
| Video output | DV/I connector |
| GPIB | 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<br>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 (*Typical*) | |
| 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)<br>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)<br>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)<br>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**.

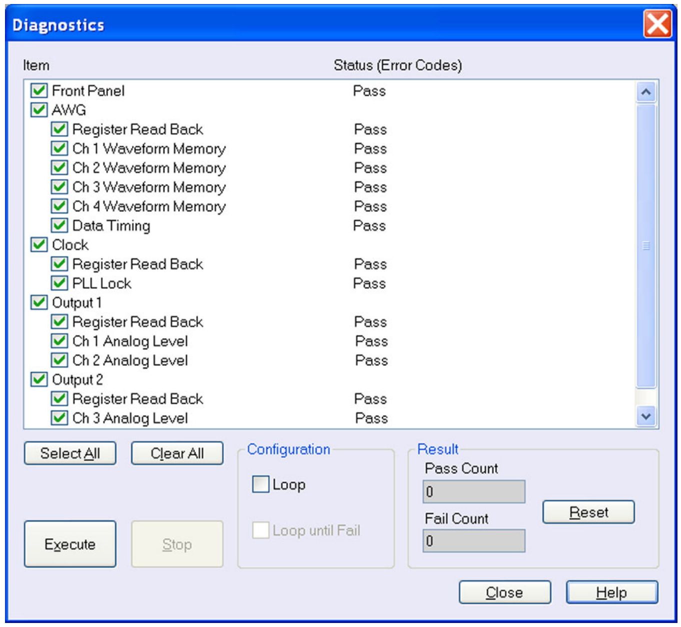



**Figure 1: Diagnostics dialog box**

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**.

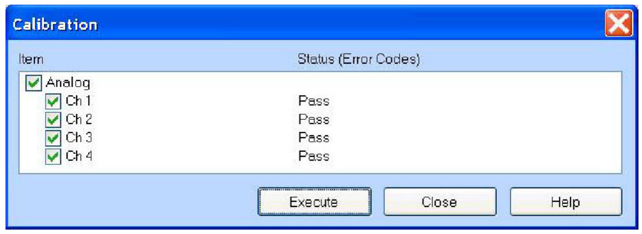



**Figure 2: Calibration dialog box**

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.

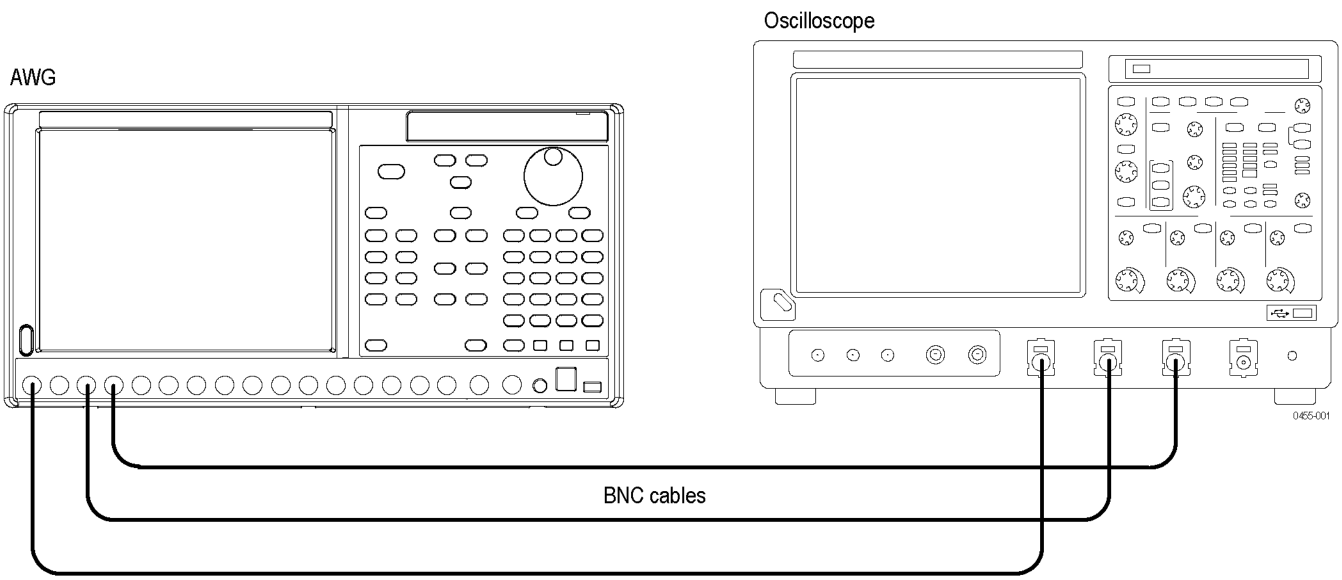



**Figure 3: Equipment connections for checking the analog and marker outputs**

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.

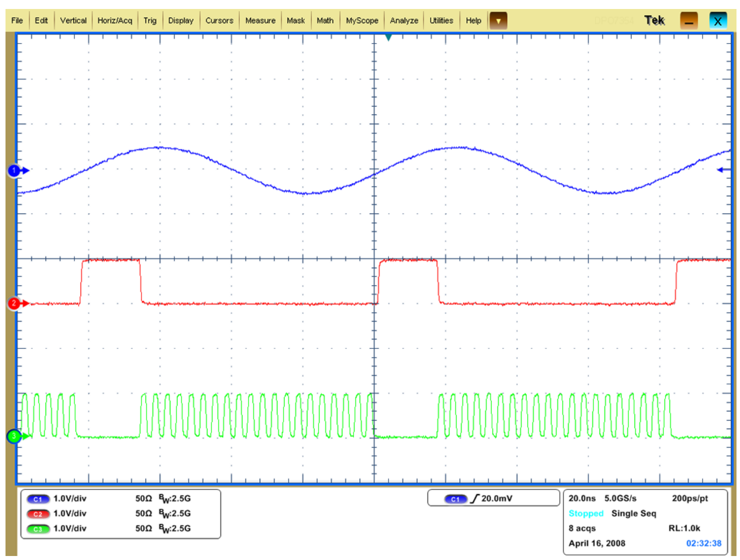



**Figure 4: Output waveform from the Analog, Mkr 1, and Mkr 2 outputs**

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 | Prerequisites |
|---|---|
| Oscilloscope (DPO7054 or equivalent) | None |
| 50 Ω BNC cable | |
| 50 Ω SMB-BNC cable (Tektronix part number 174-5104-00) | |

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.

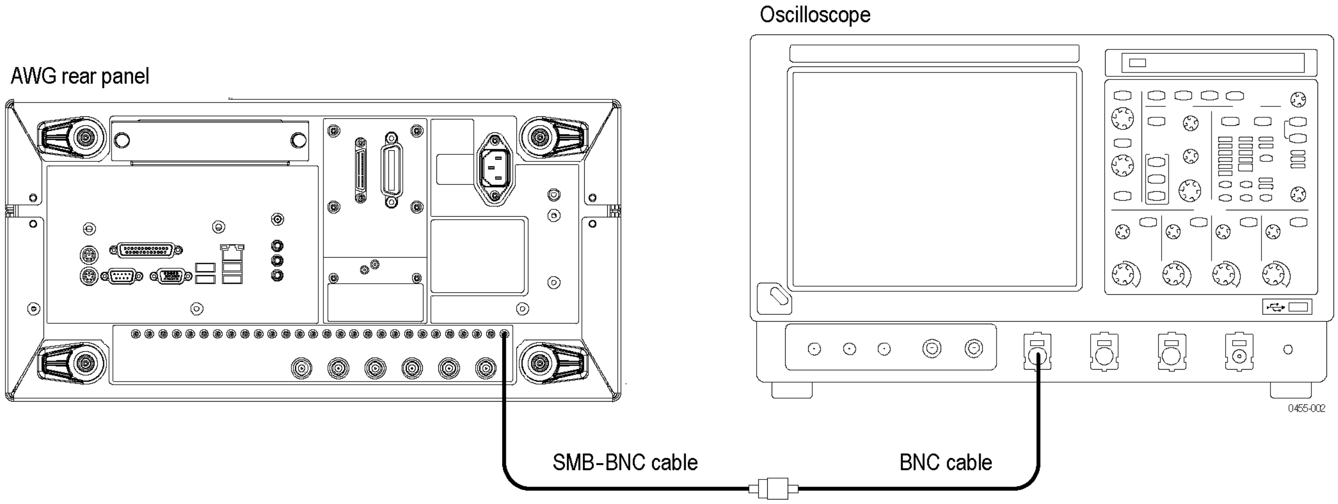



Figure 5: Equipment connection for checking the digital data outputs

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.*

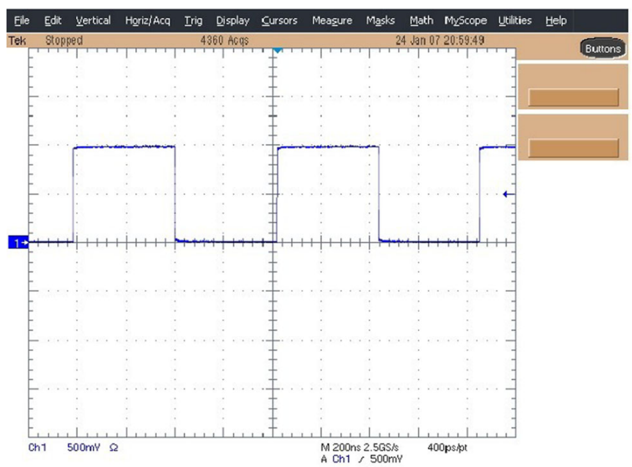



**Figure 6: Output waveform from the Digital Data Out connector**

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<br>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<br>2 channels | Tektronix DSA8200 with 80E03 |
| Spectrum analyzer | 1 ea. | Bandwidth: DC to 8 GHz | Tektronix RSA3308B |
| Digital multimeter | 1 ea. | DC accuracy: within ± 0.01% | Keithley 2000 DMM<br>or<br>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<br>(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 (0 V) | 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 (0 V) | 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 (0 V) | 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 (0 V) | 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 (0 V) | 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 (0 V) | 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 (0 V) | 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 (0 V) | Direct D/A out: On | –15 mV | | | +15 mV |

### AWG5000C performance test record (cont.)

| Performance Test | | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|---|
| *Analog Amplitude Accuracy* | | | | | | |
| 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 |
| *Analog Harmonic Distortion (AWG501xC)* | | | | | | |
| 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 |
|---|---|---|---|---|---|---|
| *Analog Harmonic Distortion (AWG5002C)* | | | | | | |
| 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 |
| *Analog Non-Harmonic Spurious* | | | | | | |
| 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 |
| *Analog Phase Noise (at 10 kHz offset)* | | | | | | |
| 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 |
|---|---|---|---|---|---|---|
| *Marker High and Low Level Accuracy* | | | | | | |
| 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 |
| Ch 1 | 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, *Prerequisites*.) |
| 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.

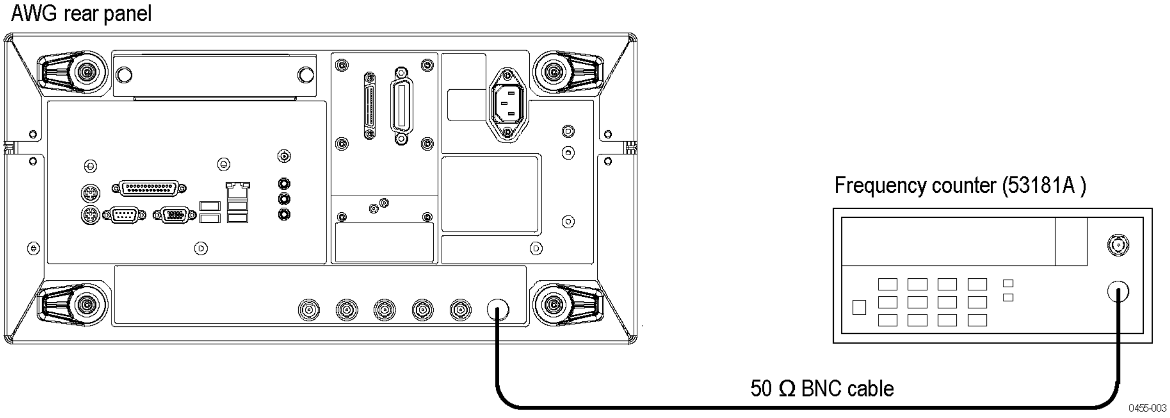



**Figure 7: Equipment connection for verifying the 10 MHz reference frequency accuracy**

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, *Prerequisites*.) |
| 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 50Ω BNC termination.

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

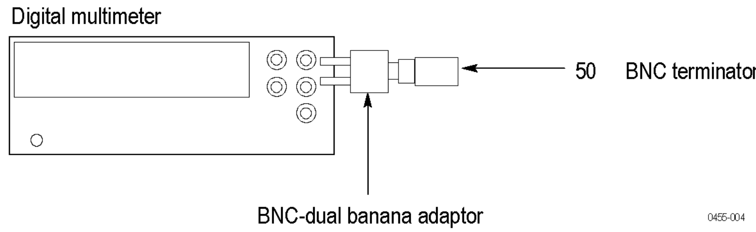



**Figure 8: Equipment connection for measuring the termination resistance**

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 adapter to connect the Channel 1 Analog connector on the instrument to the HI and LO inputs on the digital multimeter.

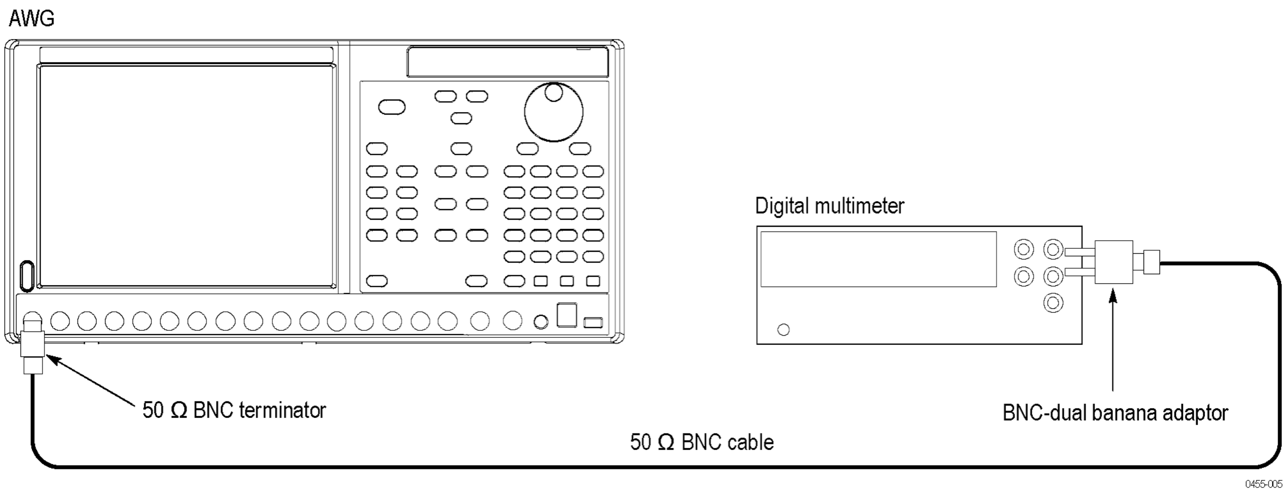



**Figure 9: Equipment connection for verifying the analog offset accuracy**

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:

    Voltage = [(Term_R + 50) /(2 × Term_R)] × 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 $\overline{\text{Analog}}$ connector.

14. Repeat steps 8 through 12.

15. Repeat steps 5 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, *Prerequisites*.) |
| 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 × Term_R)] ×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 × Term_R)] × 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 $\overline{\text{Analog}}$ connector.

18. Repeat steps 9 through 16.

19. Repeat steps 6 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 | Prerequisites |
|---|---|
| Spectrum analyzer | (See page 22, *Prerequisites*.) |
| 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.

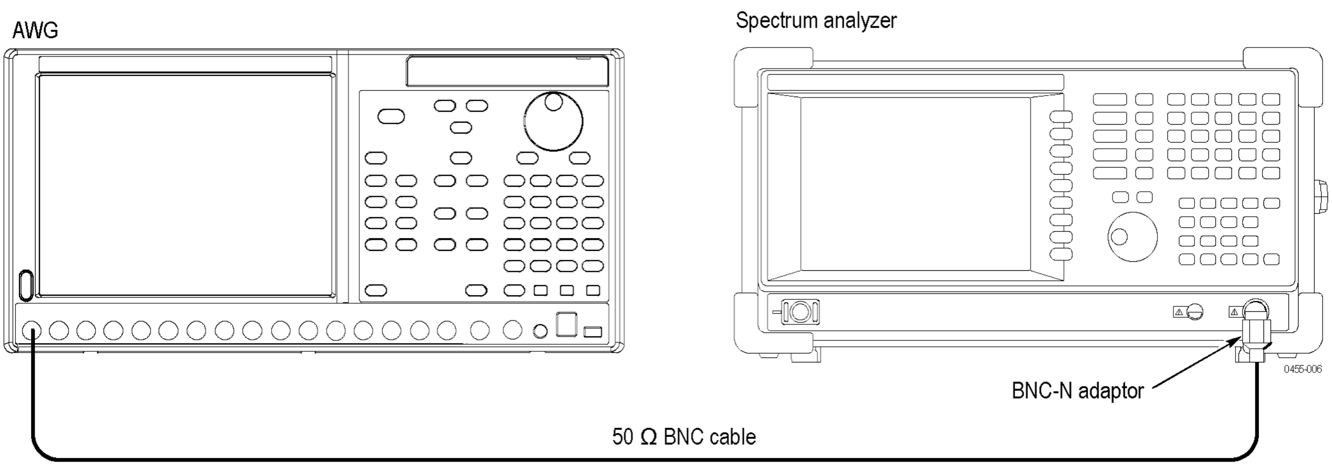



**Figure 10: Equipment connections for verifying the analog harmonic distortion**

3. Set the spectrum analyzer as follows:

   a. Center frequency: 100 MHz

   b. Span: 200 MHz

   c. RBW: 20 kHz

   d. Amplitude: +20 dBm

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** |
| AWG5012C | 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 |
| AWG5014C | 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 6 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 | Prerequisites |
|---|---|
| Spectrum analyzer | (See page 22, *Prerequisites*.) |
| 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.

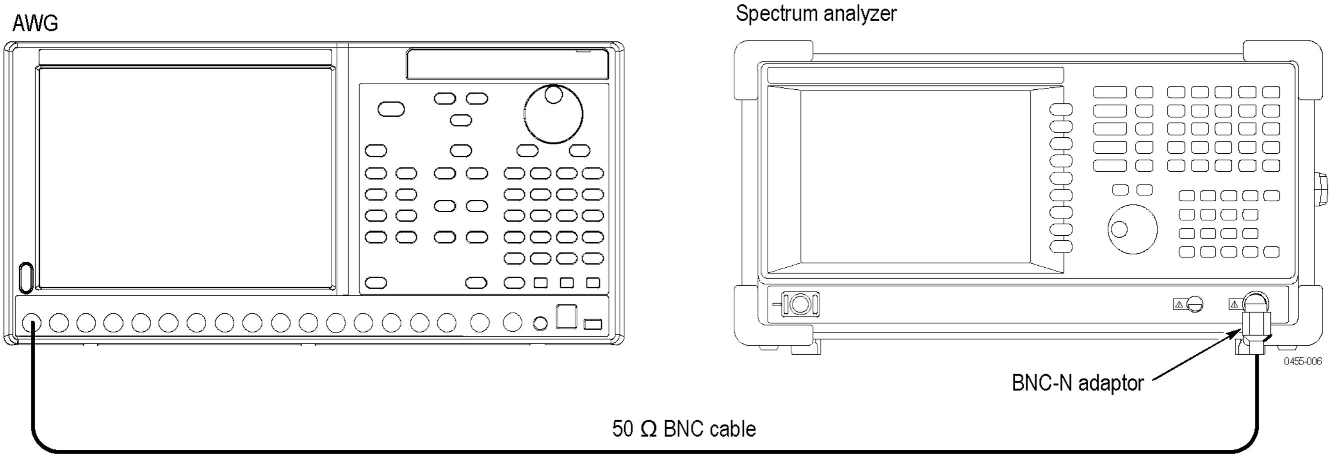



**Figure 11: Equipment connections for verifying the non-harmonic spurious signal**

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**

| AWG5000C model and settings | | | | Spectrum analyzer settings | | | |
|---|---|---|---|---|---|---|---|
| **Model** | **Output mode** | **Amplitude** | **Sampling rate (output frequency)** | **Center frequency** | **Span** | **RBW** | **Accuracy limit** |
| AWG5012C<br>AWG5014C | 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 5 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, *Prerequisites*.) |
| 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.

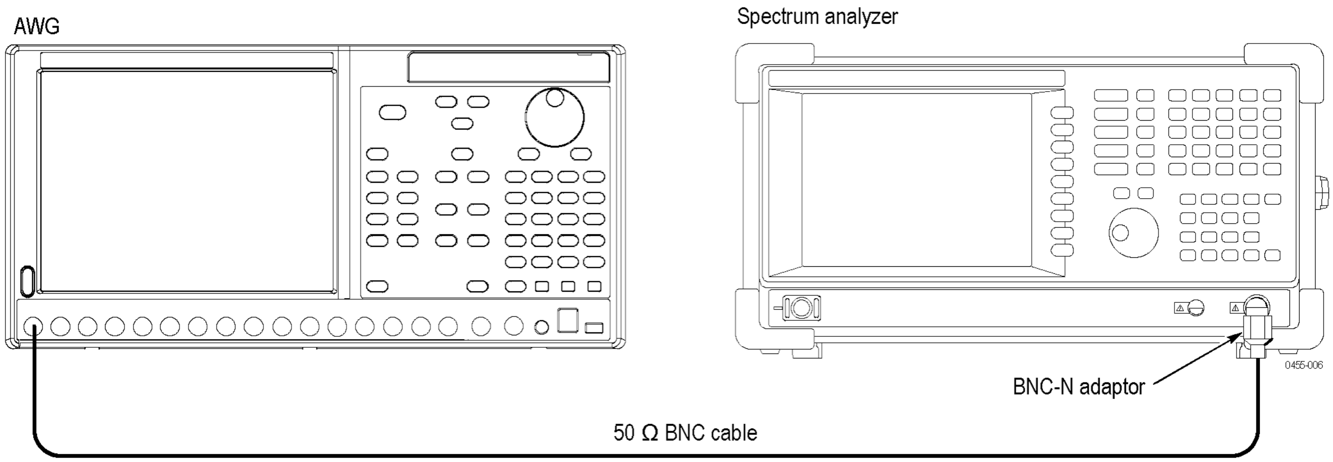



**Figure 12: Equipment connections for verifying the analog phase noise**

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** |
| AWG5012C<br>AWG5014C | 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 4 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.

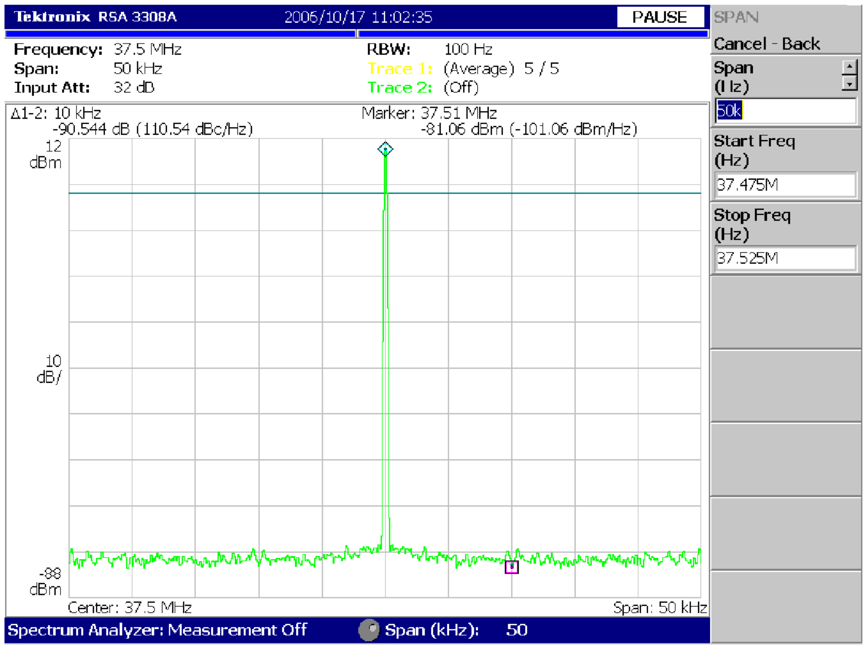



**Figure 13: Example of the analog phase noise measurement**

## Marker High and Low Level Accuracy

| Required equipment | Prerequisites |
|---|---|
| Digital multimeter | (See page 22, *Prerequisites*.) |
| 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 Mkr 1 connector on the instrument to the HI and LO inputs on the digital multimeter.

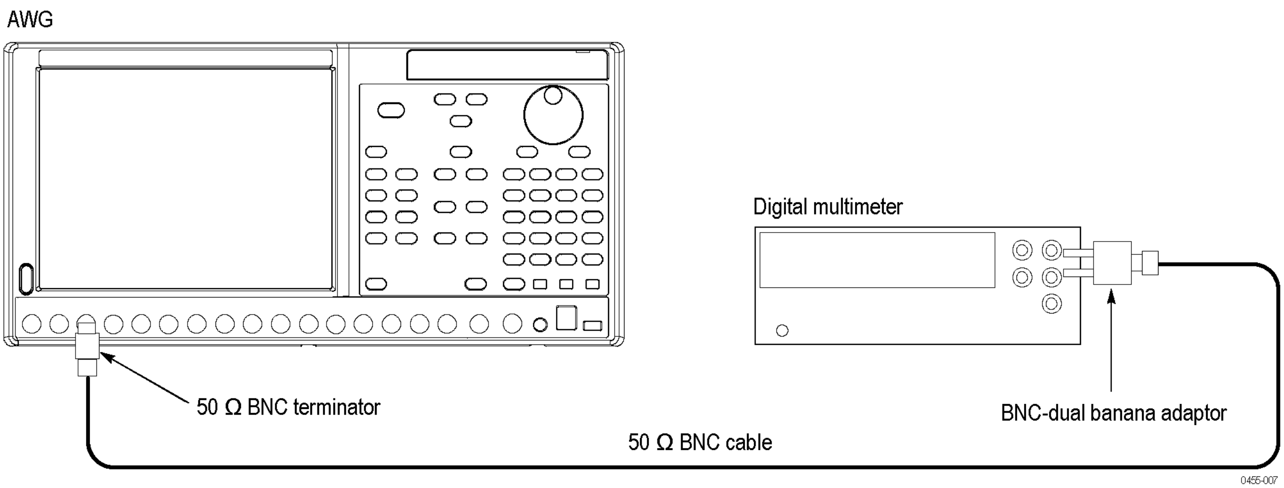



Figure 14: Equipment connection for verifying the marker high and low level accuracy

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:

    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. (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:

    Marker_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. (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 6 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, *Prerequisites*.) |
| 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.

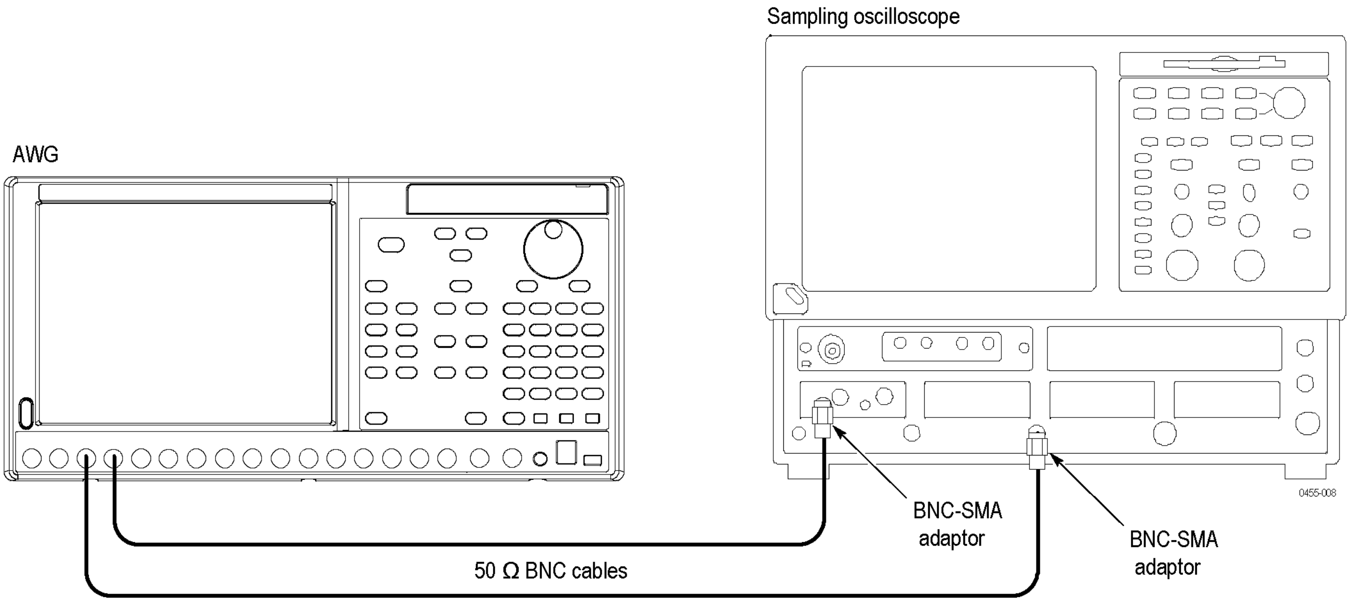



**Figure 15: Equipment connections for verifying the marker output delay accuracy**

4. Set the sampling oscilloscope as follows:

   a. Vertical scale: 100 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 6 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 | Prerequisites |
|---|---|
| Digital multimeter | (See page 22, *Prerequisites*.) |
| DC output lead set | |
| Test leads (provided with the digital multimeter) | |

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.

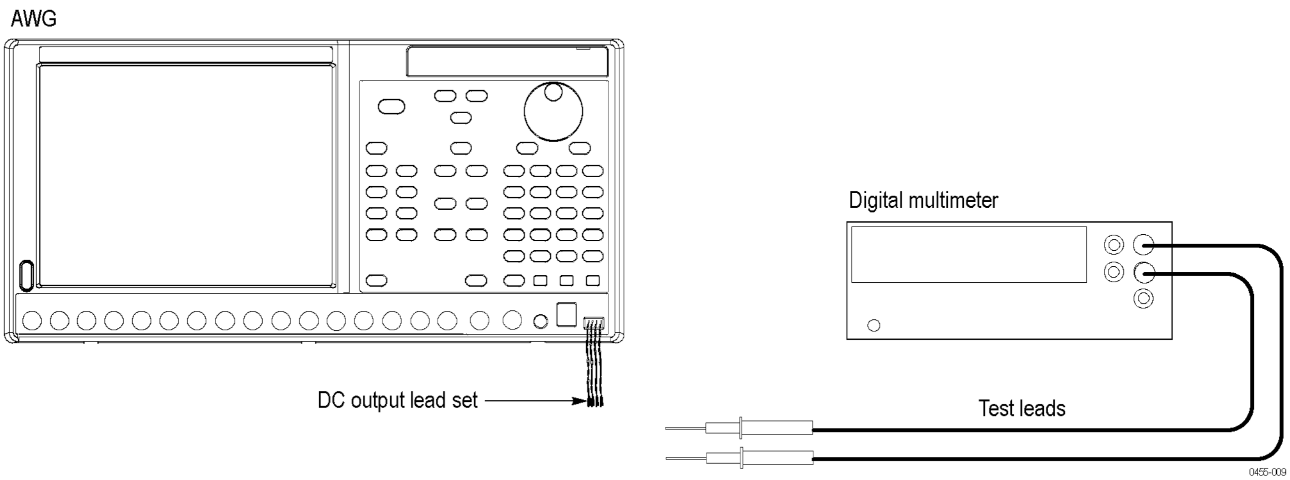



**Figure 16: Equipment connection for verifying the DC output voltage accuracy**

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.