The AWG710 Arbitrary Waveform Generator
Delivers World-class Signal Fidelity at 4.0 GS/s to Solve Ever-increasing Measurement Challenges

The AWG710 combines world-class signal fidelity with ultra high-speed mixed signal simulation, a powerful sequencing capability and graphical user interface with flexible waveform editor, to solve the toughest measurement challenges in the disk drive, communications and semiconductor design/test industries.

**Standard Waveforms for Communications**

- **ITU-T**
  - STM1E, E5 CEPT, E4, E3, E2, E1
- **T1.302**
  - STS-3, STS-1, DS4NA, DS3, DS2, DS1/1C/1A
- **Fibre Channel**
  - FC1063E, FC531E, FC266E, FC133E
- **SDH/SONET**
- **Other**
  - D2, D1, FDD-1, 100Base-TX, Gigabit Ethernet

**Features & Benefits**

- 4.0 GS/s Sample Rate
  - Simulates Real-world Signals Up To 2.0 GHz
- 2 Markers With 16 ps RMS Jitter
  - Deliver Ultra-stable Timing to the Device-under-test (DUT)
- 16 M or 32 M Point Record Length Provide Longer Serial or Rotational Media Data Streams
- 8-bit Vertical Resolution for Precise Signal Replication
- Analog Bandwidth to 2 GHz (Option 02, Calculated Based on Rise Time) Provides the Highest Signal Fidelity of All High-speed AWGs
- EZ Function Generator Mode
  - Allows Quick Creation and Edit of Sine, Square, Triangle, Ramp, Pulse and DC Waveforms
- Waveform Quick Editor
  - with 300 fs Edge Timing Resolution Delivers Output Edge Control with Near Real-time Precision
- Real-time Sequencing
  - Creates Infinite Waveform Loops, Jumps, Patterns and Conditional Branches
- GPIB and LAN (10/100Base-T) Interfaces

**Applications**

- **Disk Drive Read/Write Design and Test**
- **Communications Design and Test**
  - Arbitrary IF Baseband Signals
  - Standard Waveforms for Communications
- **Pulse Generation**
  - High-speed, Low-jitter Data and Clock Source
- **Mixed Signal Design and Test**
  - Real-world Simulations
    - Corruption and Enhancement of Ideal Waveforms
    - Timing and Amplitude Signal Impairments
    - Waveforms Imported from MathCad, MATLAB, Excel and Others
Arbitrary Waveform Generator

Characteristics

Arbitrary Waveforms

Waveform Length – 960 to 16,200,000 points (or 32,400,000 points, option 01) in multiples of four.
Sequence Length – 1 to 8,000 steps.
Sequence Repeat Counter – 1 to 65,536 or infinite.

Function Generator Waveforms

Operation Mode – Continuous mode only.
Waveform Shape – Sine, Triangle, Square, Ramp, Pulse or DC.
Frequency – 1.000 Hz to 400.0 MHz.
Amplitude – Range: 0.020 Vp-p to 2 Vp-p into 50 Ω. Resolution: 1 mV.
Offset – Range: –0.500 V to +0.500 V into 50 Ω. Resolution: 1 mV.
DC Level – DC waveform only. Range: –0.500 V to +0.500 V into 50 Ω. Resolution: 1 mV.
Polarity – Normal, Invert.
Duty Cycle – Range: 0.1% to 99.9%, Pulse waveform only. Resolution: 1 µs to 10.0 s. Resolution: 3 digits, 0.1 µs minimum. Accuracy: ±0.1%.

Clock Generator

Sampling Frequency – 50.000000 kHz to 4.0000000 GHz.
Resolution – 8 digits.
Internal Clock – Accuracy: ±1 ppm.
Phase Noise – (data clock is 1/4th of the output sample rate)
At 1 GS/s, 10 kHz offset: -80 dBc/Hz.
At 1 GS/s, 100 kHz offset: -100 dBc/Hz.

Operating Modes

Continuous – Waveform is iteratively output. If a sequence is defined, the sequence order and repeat functions are applied.
Triggered – Waveform is output only once when an external, internal, GPIB, LAN or manual trigger is received.
Gated – Waveform begins output when gate is true and resets to beginning when false.
Enhanced – Waveform is output as defined by the sequence.

Internal Trigger Generator

Internal Trigger Rate – Range: 1.0 µs to 10.0 s. Resolution: 3 digits, 0.1 µs minimum. Accuracy: ±0.1%.

Main Output

Output Signal – Complementary, CH1 and channel inverse.
Digital to Analog Converter – Resolution: 8-bits.
Differential Non-linearity: ±1/2-LSB.
Integral Non-linearity: ±1-LSB.
Output Connector – Front Panel SMA.

Normal Out*1

Amplitude –
Output Voltage: -1.5 V to +1.5 V into 50 Ω.
Amplitude: 20 mV to 2.0 V into 50 Ω.
Resolution: 1 mV.
DC Accuracy: ±(2.0% of Amplitude + 2 mV) at offset = 0 V.
Offset –
Range: -0.500 V to +0.500 V into 50 Ω.
Resolution: 1 mV.
Accuracy: ±1.5% of offset ±10 mV at 20 mV amplitude.
Pulse Response – (-1 and 1 waveform data, 0 V offset, through filter at 1 Vp-p, clock 1 GS/s):
 Rise Time: (10% to 90%): ≤480 ps.
 Fall Time: (10% to 90%): ≤480 ps.
Aberrations: At 1.0 Vp-p,
Amplitude: ±6%.
Flatness: (after 20 ns from rise/fall edge) ±3%.
Sine Wave Characteristics (4.0 GS/s clock, 32 waveform points, 125 MHz signal frequency. 1.0 V amplitude, 0 V offset, through filter) –
Harmonics: ≤-40 dBc, DC to 1000 MHz.
Noise: ≤-50 dBc, DC to 1000 MHz.
Phase Noise: ≤-85 dBc/Hz at 10 kHz offset.

Filter*1

Type – 20, 50, 100, 200 MHz Bessel low-pass.
Rise Time (10% to 90%) – 20 MHz, 17 ns; 50 MHz, 7.0 ns; 100 MHz, 3.7 ns; 200 MHz, 2.0 ns.
Group Delay – 20 MHz, 18 ns; 50 MHz, 8 ns; 100 MHz, 4.7 ns; 200 MHz, 3 ns.

Direct D/A Out*1

Amplitude – 20 mVp-p to 1.0 Vp-p into 50 Ω.
Resolution – 1 mV.
DC Accuracy – ±(2% of Amplitude + 2 mV).
Offset – no function.
DC Offset Accuracy – 0 V ±10 mV at 20 mV amplitude (waveform data = 0).
Pulse Response (-1 and 1 waveform data, at 0.5 Vp-p) –
 Rise Time (10% to 90%): ≤280 ps.
 Fall Time (10% to 90%): ≤280 ps.
Output Impedance – 50 Ω.

*1 Option 02 eliminates the ability to switch between normal and direct D/A out, as well as filter and offset control.
Extended Bandwidth Output (Option 02)
Amplitude – 500 m\(V_p\) to 1.0 \(V_p\) into 50 \(\Omega\).
Resolution – 1 mV.
DC Offset Accuracy – ±2.0% of amplitude + 2 mV.
Offset – No function.
Filter – No function.
DC Offset Accuracy – 0 V ±10 mV (waveform data = 0).
Pulse Response – ±1 and 1 waveform data, at 1.0 \(V_p\).
Rise Time – (10% to 90%): ≤175 ps.
Fall Time – (10% to 90%): ≤175 ps.
Output Impedance – 50 \(\Omega\).

Amplitude – 500 m\(V_p\) to 1.0 \(V_p\) into 50 \(\Omega\).
Resolution – 1 mV.
DC Accuracy – ±(2.0% of amplitude + 2 mV).
Offset – No function.
Filter – No function.
DC Offset Accuracy – 0 V ±10 mV (waveform data = 0).
Pulse Response – ±1 and 1 waveform data, at 1.0 \(V_p\).
Rise Time – (10% to 90%): ≤175 ps.
Fall Time – (10% to 90%): ≤175 ps.
Output Impedance – 50 \(\Omega\).

Auxiliary Outputs
Marker
Number – 2 (complementary).
Level –
Hi/Lo: –1.1 V to 3.0 V into 50 \(\Omega\) (Max. 2.5 \(V_p\)).
Amplitude: 2.5 \(V_p\) max. into 50 \(\Omega\).
Resolution – 0.05 V.
DC Accuracy – Within ±0.1 V ±5% of setting into 50 \(\Omega\).
Rise/Fall Time (20% to 80%) – 150 ps
Period Jitter –
At 4 GS/s: 1.6 \(ps_{p-p}\).
At 2 GS/s: 1.9 \(ps_{p-p}\).
At 1 GS/s: 2.5 \(ps_{p-p}\).
Cycle-to-Cycle Jitter –
At 4 GS/s: 4.8 \(ps_{p-p}\).
At 2 GS/s: 3.7 \(ps_{p-p}\).
At 1 GS/s: 3.1 \(ps_{p-p}\).
Connector – Rear-panel BNC.

Trigger In
Impedance: 1 k\(\Omega\) or 50 \(\Omega\).
Polarity: POS or NEG.
Connector: Rear-panel BNC.
Input Voltage Range –
1 k\(\Omega\): ±10 V.
50 \(\Omega\): ±5 V.
Threshold –
Level: ±10 V.
Resolution: 0.1 V.
Accuracy: ±5% of level + 0.1 V.
Trigger Mode –
Minimum Pulse Width: 10 ns, 0.2 V amplitude.
Trigger Holdoff: ≥109.5 clocks + 500 ns.
Delay to Analog Out: 211.5 clocks + 17 ns (Normal Output, Filter “Through”).
Gate Mode –
Minimum Pulse Width (0.2 V amplitude): 1152 clocks + 10 ns.
Gate Hold Off: ≤1920 clocks + 20 ns.
Delay to Analog Out: 1355 to 1499.5 clocks + 9 ns (Normal Output, Filter “Through”).
Event Trigger Input –
Number of Events: 4-bits.
Input Signals: 4 event bits, strobe.
Threshold: TTL level.
Maximum Input: 0 V to +5 V (DC + peak AC).
Impedance 1 k\(\Omega\), pull-up to +3.3 V.
Connector: Rear-panel 9-Pin D-sub.

10 MHz Reference Clockout
Amplitude – 1.2 \(V_p\) into 50 \(\Omega\). Max 2.5 \(V_p\) open.
Impedance – 50 \(\Omega\), AC coupling.
Connector – Rear-panel BNC.

1/4 Clock Out
Level – ECL 100 K compatible.
Period Jitter –
At 4 GS/s: 2.6 \(ps_{p-p}\).
At 2 GS/s: 2.4 \(ps_{p-p}\).
At 1 GS/s: 1.9 \(ps_{p-p}\).
Cycle-to-Cycle Jitter –
At 4 GS/s: 4.8 \(ps_{p-p}\).
At 2 GS/s: 3.7 \(ps_{p-p}\).
At 1 GS/s: 3.1 \(ps_{p-p}\).
Connector – Rear-panel BNC.

Enhanced Mode –
Minimum Pulse Width: 320 clocks + 10 ns.
Event Hold Off: ≤896 clocks + 20 ns.
Delay to Analog Out (jump timing: Async):
Strobe: ON, 1627.5 clocks + 7 ns.
Strobe: OFF, 1883.5 clocks + 5 ns.
Event Input to Strobe Input:
Setup Time: 192 clocks + 10 ns.
Hold Time: 192 clocks + 10 ns.
Reference 10 MHz Clock IN –
Input Voltage Range: 0.2 V to 3.0 \(V_p\), ±10 V maximum.
Impedance: 50 \(\Omega\), AC coupled.
Frequency Range: 10 MHz ±0.1 MHz.
Connector: Rear-panel BNC.

General Characteristics
Display – Color TFT LCD.
Display Area – Horizontal: 13.06 cm (5.14 in.), Vertical: 9.70 cm (3.81 in.)
Resolution – 640x480.

Data Storage
Internal Hard Disk – 10.0 GB.
Flash Disk – 256 MB.
Floppy Disk – 3.5”, 1.44 MB.

Environment
Temperature –
Operating: 10 °C to +40 °C.
Nonoperating: -20 °C to +60 °C.
Humidity –
Operating: 20% to 80%.
Nonoperating: 5% to 90%.
Altitude (Hard Disk Restriction)–
Operating: Up to 3,000 m (10,000 ft.).
Nonoperating: Up to 12,000 m (40,000 ft.).
Random Vibration –
Operating: 0.27 GRMS, 5 Hz to 500 Hz, 10 minutes.
Nonoperating: 2.28 GRMS, 5 Hz to 500 Hz, 10 minutes.
Shock – Nonoperating: 294 m/s² (30 G), half-sine, 11 ms duration (three times each axis, in each direction, 18 total).

Safety – UL 3111-1, CSA C22.2 No. 1010.1, EN61010-1, IEC61010-1.
Arbitrary Waveform Generator

AWG710

Power Supply
Rating – 100 to 240 VAC.
Range – 90 to 250 VAC.
Maximum Power and Current – 220 VA and 5 A.
Frequency – 48 to 63 Hz.

Physical Characteristics
Dimensions mm in.
Height 193 7.60
Width 433 17.05
Depth 508 20.00
Weight kg lbs.
Without package 14.1 31.10
With package 24.5 54.00

Interfaces – GPIB, Ethernet: 10/100Base-T, RJ-45.
PC Keyboard – 6-Pin mini-DIN, rear.

Ordering Information
AWG 7 1 0
4.0 GS/s, 8-bit, 16 M point, single-channel arbitrary waveform generator.
Includes: User manual (070-A828-00), programmer’s manual (070-A829-00), GPIB programming examples (062-A258-00), sample waveform library disk (062-A271-00), performance verification (062-A273-00), Certificate of Calibration (no charge), Arb-Link software utility (062-A270-00), 50 Ω SMA male terminators (2) (015-1022-01), power cable.
Please specify power plug when ordering.

Options
Opt. 01 – 32 M points waveform memory.
Opt. 02 – Extends analog bandwidth to 2 GHz (calculated based on rise time).
Opt. 10 – Flash disk and standby switch (alternative for standard hard disk drive).
Opt. 1R – Rackmount.

Service
Opt. D3 – Calibration Data Report 3 years (with Option C3).

Recommended Accessories
Protective Cover – Order 200-3696-01.

Power Cord Options
Opt. AC – China plug, 50 Hz.

Software
Arb-Link – (062-A270-01) PC-based waveform creation utility.

Warranty
One year parts and labor.