Arbitrary Waveform Generator

▶ AWG710B

▶ Features & Benefits

4.2 GS/s Sample Rate Simulates Real-world Signals Up To 2.1 GHz

2 Markers With 2.0 ps$_{RMS}$ (at 4.2 GS/s, Typical) Jitter Deliver Stable Timing to the Device-Under-Test (DUT)

32.4M (32,400,000) or 64.8M (64,800,000) Point Record Length Provide Longer Data Streams

Analog Bandwidth to 2 GHz (Option 02, Calculated Based on Rise Time) Provides the Highest Signal Fidelity of All High-speed AWGs

Direct External Clock Input Allows Jittered and Non-jittered Signals for High-speed Data Stream Timing Margin Test Up to 4.2 Gb/s

Synchronous Operation Mode Supports Two AWG710B Outputs (2: Analog, 4: Marker) Synchronization for High Data Rate Wireless and Data Communication Test and Optical Write Channel Strategy Signal Test

Waveform Quick Editor with 300 fs Edge Timing Resolution Delivers Output Edge Control with Near Real-time Precision

Allows Two-signal Mix Function Digitally to Support Disk Drive Noise Performance Test and Pre/De-emphasis Serial Data Communication Test

Real-time Sequencing Creates Infinite Waveform Loops, Jumps, Patterns and Conditional Branches
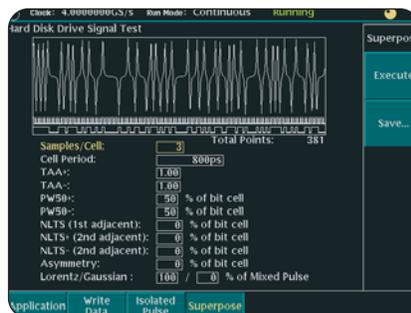
The AWG710B Arbitrary Waveform Generator Delivers World-class Signal Fidelity at 4.2 GS/s to Solve Ever-increasing Measurement Challenges
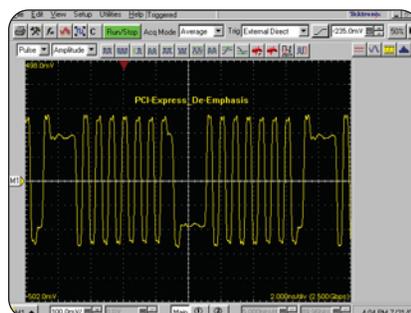
The AWG710B Arbitrary Waveform Generator Delivers World-class Signal Fidelity at 4.2 GS/s to Solve Ever-increasing Measurement Challenges. New two box synchronous operation function supports 2 ch 4.2 GS/s solution.

The AWG710B 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.

The built-in signal applications enable you to easily create standard waveforms for disk drive read channels, communications up to 4.2 Gb/s such as ITU-T, TI.102, Fibre Channel and SDH/SONET also various semiconductor applications.

▶ *Disk drive read channel application.*

▶ *2.5 Gbps PCI express de-emphasis signal.*

▶ Applications

Disk Drive Read/Write Design and Test

Communications Design and Test

Arbitrary IF and IQ Base-band 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

Tektronix
Enabling Innovation

Arbitrary Waveform Generator

▶ AWG710B

▶ Characteristics

Arbitrary Waveforms

Waveform Length – 960 to 32,400,000 points (or 64,800,000 points, Option 01) in multiples of four.

Sequence Length – 1 to 8,000 steps.

Sequence Repeat Counter – 1 to 65,536 or infinite.

Run Modes

Gated mode, Event Jump, and Software Jump are disabled in the synchronous operation.

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.

Extended Operation

Function Generator

Waveform Shape – Sine, Triangle, Square, Ramp, Pulse, or DC.

Frequency – 1.000 Hz to 400.0 MHz.

Amplitude –
Range: 0.020 V_{p-p} to 2 V_{p-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:
    1.000 Hz to 4.000 MHz: 0.1% step.
    4.001 MHz to 20.00 MHz: 0.5% step.
    20.01 MHz to 40.00 MHz: 1% step.
    40.01 MHz to 80.00 MHz: 2% step.
    80.01 MHz to 100.0 MHz: 2.5% step.
    100.1 MHz to 160.00 MHz: 4% step.
    160.1 MHz to 200.0 MHz: 5% step.
    200.1 MHz to 400.0 MHz: 10% step.

Marker Out –
Marker1 Pulse Width:
    Hi Lo: 20%/80% of Period.
Marker2 Pulse Width:
    Hi/Lo: 50%/50% of Period, except 100.1 MHz to 160.0 MHz.
    Hi/Lo: 52%/48% of Period, at 100.1 MHz to 160.0 MHz.
Marker Level:
    Hi Level: 1 V into 50 Ω.
    Lo Level: 0 V into 50 Ω.

Waveform Mixing Operation – Supports two-signals mixed output digitally.

Synchronous Operation – Supports to synchronize two AWG710B signals output by two boxes.

NOTE: This operation is executed by Sync master and Sync slave operation combination.

Sync Master Operation – Set one AWG710B as a master box.

Sync Slave Operation – Set another AWG710B as a slave box.

Clock Generator

Sampling Frequency – 50.000000 kS/s to 4.2000000 GS/s.

Resolution – 8 digits.

Internal Clock – Accuracy: ±1 ppm.

Phase Noise – (VCO out)
    At 4.2 GS/s, 10 kHz offset: −65 dBc/Hz.
    At 4.2 GS/s, 100 kHz offset: −96 dBc/Hz.

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 V_{p-p}, clock 1 GS/s) using 20 GHz BW oscilloscope.
Rise Time: (10 to 90%): ≤480 ps.
Fall Time: (10 to 90%): ≤480 ps.
Aberrations: ±10% (at 1.0 V_{p-p} amplitude).
Flatness: ±5% (after 20 ns from rise/fall edge).

Sine Wave Characteristics –
(4.2 GS/s clock, 32 waveform points, 131.25 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 mV_{p-p} to 1.0 V_{p-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 V_{p-p}) –
Rise Time (10% to 90%): ≤280 ps.
Fall Time (10% to 90%): ≤280 ps.

Output Impedance – 50 Ω.

Extended Bandwidth Output (Option 02)

Amplitude – 500 mV_{p-p} to 1.0 V_{p-p} into 50 Ω

Resolution – 1 mV.

DC Accuracy – ±(2.0% of amplitude + 2 mV).

Offset – No function.

DC Offset Accuracy – 0 V ±10 mV at 500 mV Amplitude (waveform data = 0).

Pulse Response – (−1 and 1 waveform data, at 1.0 V_{p-p}).

Rise Time – (10% to 90%): ≤175 ps.

Fall Time – (10% to 90%): ≤175 ps.

Output Impedance – 50 Ω.

Auxiliary Outputs

Marker

Number – 2 (complementary).

Level –
High Level: −1.00 V to 2.45 V into 50 Ω to GND.
Low Level: −2.00 V to 2.40 V into 50 Ω to GND.
Amplitude: 0.05 V_{p-p} to 1.25 V_{p-p} max. into 50 Ω to GND.

[1] Option 02 eliminates the ability to switch between normal and direct D/A out, as well as filter and offset control.

Resolution – 0.05 V.

DC Accuracy –
Within ±0.1 V ±5% of setting into 50 Ω.
Maximum Output Current: ±80 mA.

Rise/Fall Time (20% to 80%) – <130 ps into
50 Ω to GND (1.0 V_{p-p}, Hi +1.0 V, Lo 0 V).

Period Jitter (Typical) – by1010 clock pattern.
At 4.2 GS/s 2.0 ps_{RMS}, 15 ps peak to peak.
At 2.1 GS/s 2.0 ps_{RMS}, 15 ps peak to peak.
At 1.05 GS/s 2.0 ps_{RMS}, 15 ps peak to peak.

Cycle-to-Cycle Jitter (Typical) – by1010 clock
pattern.
At 4.2 GS/s 3.4 ps_{RMS}, 25 ps peak to peak.
At 2.1 GS/s 3.4 ps_{RMS}, 25 ps peak to peak.
At 1.05 GS/s 3.7 ps_{RMS}, 26 ps peak to peak.

Marker Skew – <20 ps (typical).

**Delay (Between analog output and marker
output) –**
(Marker Level: 1 V_{p-p} (Hi + 1V/Lo 0 V), Analog
Output: At 1 V_{p-p}.)
Normal Output: 2.4 ns (Offset 0 V, Filter = "Through.")
Direct Output: –1 ns.

Connector – Front-panel SMA.

VCO Out
Amplitude –
CML, AC coupling, 0.4 V_{p-p} into 50 Ω to GND.
Impedance: 50 Ω, AC coupling.

Connector – Rear-panel SMA.

10 MHz Reference Clock Out
Amplitude – 1.2 V_{p-p} into 50 Ω. Max 2.5 V_{p-p} open.

Impedance – 50 Ω, AC coupling.

Connector – Rear-panel BNC.

C Out 1 and 2
For 2 boxes synchronous usage.
Connector: SMA, Rear.
Output Signal Style: Complementary.

T Out 1 and 2
For 2 boxes synchronous usage.
Connector: SMA, Rear.
Output Signal Style: Complementary.

Auxiliary Inputs

Trigger In
Trigger Mode – Minimum Pulse Width: 10 ns,
0.2 V amplitude.

Impedance – 1 kΩ or 50 Ω.

Polarity – POS or NEG.

Connector – Rear-panel BNC.

Input Voltage Range –
1 kΩ: ±10 V.
50 Ω: ±5 V.

Threshold –
Level: –5.0 V to 5.0 V.
Resolution: 0.1 V.

Trigger Mode – Minimum Pulse Width: 10 ns,
0.2 V amplitude.

Trigger Hold-off –
One Box Operation: ≤109.5 clocks + 500 ns.
Two Boxes Synchronous Operation: ≤109.5 clocks
+ 700 ns.
Delay to Analog Out: 275.5 clocks + 17 ns (Normal
Output, Filter "Through").

Gate Mode – (for one box operation).
Minimum Pulse Width (0.2 V amplitude):
1152 clocks + 10 ns.
Gate Hold Off: ≤1920 clocks + 20 ns.
Delay to Analog Out: 1355 to 1563.5 clocks + 9 ns
(Normal Output, Filter "Through").

Event Input – (for one box operation).
Number of Events: 7-bits.
Input Signals: 7 event bits, strobe.
Threshold: TTL level.
Maximum Input: 0 V to +5 V (DC + peak AC).
Impedance 1 kΩ, pull-up to +3.3 V.
Connector: Rear-panel 9-Pin D-sub.

Enhanced Mode –
Minimum Pulse Width: 320 clocks + 10 ns.
Event Hold Off: ≤ 896 clocks + 20 ns.
Delay to Analog Out (Jump timing: Async, Output
Norm, Filter Through):
    Strobe: ON, 1691.5 clocks + 10 ns.
    Strobe: OFF, 1947.5 clocks + 6 ns.
Event Input to Strobe Input:
Setup Time: 192 clocks + 10 ns.
    Hold Time: 192 clocks + 10 ns.

External Clock IN
Input Voltage Range – 0.4 V_{p-p} to 2.0 V_{p-p}.

Impedance – 50 Ω, AC coupled.

Frequency Range – 125 MHz to 4.2 GHz

Note: Need >10 mV/ns signal slew rate.

Connector – Rear-panel SMA.

Reference 10 MHz Clock IN
Input Voltage Range – 0.2 V_{p-p} to 3.0 V_{p-p},
±10 V maximum.

Impedance – 50 Ω, AC coupled.

Frequency Range – 10 MHz ±0.1 MHz.

Connector – Rear-panel BNC.

C IN
For 2 boxes synchronous usage.
Connector: SMA, Rear.
Input Signal Style: Complementary.

T IN
For 2 boxes synchronous usage.
Connector: SMA, Rear.
Input Signal Style: Complementary.

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 – ≥20.0 GB.

Flash Disk – 256 MB (Option 10).

Floppy Disk – 3.5 inch, 1.44 MB.

Environment
Temperature –
Operating: 10 ºC to +40 ºC.
Nonoperating: –20 ºC to +60 ºC.

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: 2.65 m/s^2_{RMS} (0.27 G_{RMS}, 5 Hz to 500 Hz,
10 minutes.
Nonoperating: 22.36 m/s^2_{RMS} (2.28 G_{RMS}, 5 Hz to
500 Hz, 10 minutes.

Shock – Nonoperating: 294 m/s^2 (30 G), half-sine,
11 ms duration (three times each axis, in each
direction, 18 total).

EMC Compliance – EC Council Directive
89/336/EEC (EC-92), AS/NZS2064-1/ 2.

Safety – UL 61010B-1, CSA C22.2 No. 1010.1,
EN61010-1 second edition.

Power Supply
Rating – 100 to 240 VAC.

Range – 90 to 250 VAC.

Maximum Power and Current – 240 VA and 5 A.

Frequency – 48 to 63 Hz.

Physical Characteristics

Dimensions	mm	in
Height	193	7.6
With Option 11	232	9.1
Width	434	17.1
Depth	508	20
Weight	**kg**	**lb**
Without Package	14.1	31.1
With Option 11	16.1	35.7
With Package	24.5	54
With Option 11	27.5	61.1

Interfaces – GPIB, Ethernet: 10/100Base-T, RJ-45.

PC Keyboard – 6-Pin mini-DIN, rear.

Arbitrary Waveform Generator

► AWG710B

► Ordering Information

AWG710B

4.2 GS/s, 8-bit, 32 M point, single-channel arbitrary waveform generator.

Includes: User manual, Programmer's manual, Floppy disk: sample waveform library (063-A3740-00), performance verification (063-3721-00), Sample Program (062-A258-50), Certificate of Calibration, power cable. 50 Ω SMA Terminator 2 ea (015-1022-01).

Please specify power plug when ordering.

Options

Opt. 01 – 64 M points waveform memory.

Opt. 02 – Extends analog bandwidth to 2 GHz (calculated based on rise time).

Opt. 10[*2] – Flash disk and standby switch (alternative for standard hard disk drive).

Note: Option 10 is for ATE and system usage needing 7x24 hour operation. Also adds capability to power on/off by rear panel main switch.

Opt. 11[*2]– Removable Hard Drive.

Opt. 1R– Rackmount kit.

Service

Opt. C3 – Calibration service 3 years.

Opt. C5 – Calibration service 5 years.

Opt. D1 – Calibration data report.

Opt. D3 – Calibration data report 3 years (with option C3).

Opt. D5 – Calibration data report 5 years (with option C5).

Opt. R3 – Repair service 3 years.

Opt. R5 – Repair service 5 years.

[*2]Options 10 and 11 are mutually exclusive.

Recommended Accessories

Service Manual – 071-1417-xx.

Protective Cover – 200-3696-01.

Power Plug Options

Opt. A0 – North America Power.

Opt. A1 – Universal EURO Power.

Opt. A2 – United Kingdom Power.

Opt. A3 – Australia Power.

Opt. A5 – Switzerland Power.

Opt. A6 – Japan Power.

Opt. A10 – China Power.

Opt. A99 – No Power Cord or AC Adapter.

Language Option

Opt. L0 – English (User, Programmer).

Opt. L5 – Japanese (User, Programmer).

Warranty

One year parts and labor.

Our most up-to-date product information is available at:
www.tektronix.com

04/04   HB/WWW   76W-14865-3

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