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Arbitrary Waveform Generator

▶ AWG710B

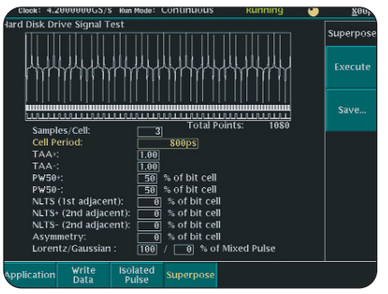


The AWG710B Arbitrary Waveform Generator Delivers World-class Signal Fidelity at 4.2 GS/s to Solve Ever-increasing Measurement Challenges

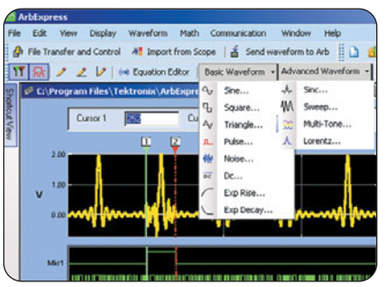
New two-box synchronous operation function supports 2 ch 4.2 GS/s solution.

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. Also included is AXW100 ArbExpress™ waveform creation and editing software. This software allows for easy waveform import from oscilloscopes or basic, advanced, and math waveform creation and edit capabilities.



▶ *Disk drive read channel application.*



▶ *AXW100 ArbExpress Software.*

▶ Features & Benefits

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

Two Markers With 2.0 ps_{RMS} (at 4.2 GS/s Typical) Jitter Deliver Stable Timing to the Device-under-Test (DUT)

32.4 M (32,400,000) or 64.8 M (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

▶ 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

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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 – One to 8,000 steps.
Sequence Repeat Counter – One 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 synchronization of two AWGxxx boxes allowing two synchronized signal outputs.
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 4.2GS/s, 10 kHz offset: –65 dBc/Hz.
At 4.2GS/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 – Into 50 Ω.
Amplitude Range: 20 mV to 2.0 V peak-to-peak.
Resolution: 1 mV.
DC Accuracy: ±(2.0% of Amplitude + 2 mV) at offset = 0 V.
Offset – Into 50 Ω.
Range of Signal Center: ±0.500V
(Rails of –1.5V, +1.5V).
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.
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 0V), 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.

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

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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.

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

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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), AXW100 ArbExpress™ Software Utility CD (063-3763-00), Certificate of Calibration, power cable. 50 Ω SMA Terminator two each (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 – Rack Mount 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.

Recommended Accessories

Service Manual – 071-1417-xx.

Protective Cover – 200-3696-01.

Spare Removable Hard Disk Kit – 650-4644-00 (Opt. 11 must be installed).

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.

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

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