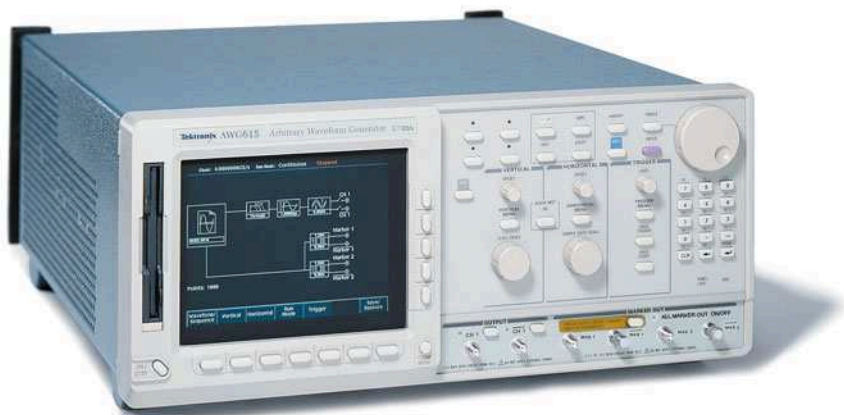


Arbitrary Waveform Generator

▶ AWG615



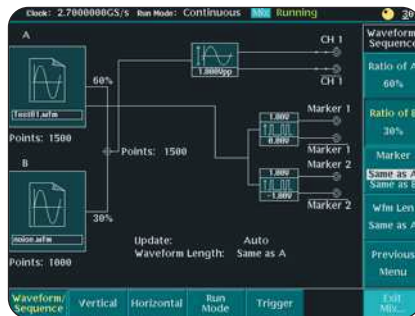
▶ AWG615.

The AWG615 Arbitrary Waveform Generator Delivers World-class Signal Fidelity at 2.7 GS/s to Solve Ever-increasing Measurement Challenges

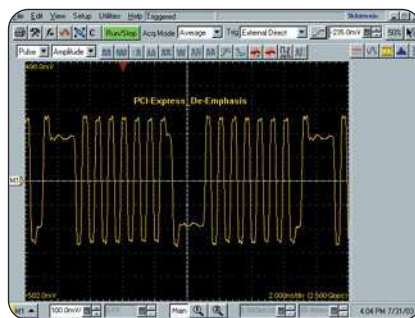
New two box synchronous operation function supports 2 ch 2.7 GS/s solution.

The AWG615 combines world-class signal fidelity with 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 2.7 Gb/s such as ITU-T, TI.102, Fibre Channel and SDH/SONET also various semiconductor applications.



▶ Waveform Mixing Function.



▶ 2.5 Gbps PCI express de-emphasis signal.

▶ Features & Benefits

2.7 GS/s Sample Rate
Simulates Real-world Signals
Up To 1.35 GHz

2 Markers With 2.1 ps_{RMS}
(@2.7 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 2.7 Gb/s

Synchronous Operation
Mode Supports Two AWG615
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 400 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

COMPUTING

COMMUNICATIONS

VIDEO

Arbitrary Waveform Generator

▶ AWG615

▶ 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 270.0 MHz.

Amplitude –

Range: $0.020 V_{p-p}$ to $2 V_{p-p}$ into 50Ω .
Resolution: 1 mV.

Offset –

Range: $-0.500 V$ to $+0.500 V$ into 50Ω .
Resolution: 1 mV.

DC Level –

DC waveform only.
Range: $-0.500 V$ to $+0.500 V$ into 50Ω .
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 270.0 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: 1V into 50Ω .
Lo Level: 0V into 50Ω .

Waveform mixing operation – Supports two-signals mixed output digitally.

Synchronous operation – Supports to synchronize two AWG615 signals output by two boxes.

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

Sync master operation – Set one AWG615 as a master box.

Sync slave operation – Set another AWG615 as a slave box.

Clock Generator

Sampling Frequency – 50.000000 kS/s to 2.7000000 GS/s.

Resolution – 8 digits.

Internal Clock – Accuracy: ± 1 ppm.

Phase Noise –

(VCO out)
At 2.7 GS/s, 10 kHz offset: -58 dBc/Hz.
At 2.7 GS/s, 100 kHz offset: -93 dBc/Hz.

Internal Trigger Generator

Internal Trigger Rate –

Range: 1.0 μ s to 10.0 s.
Resolution: 3 digits, 0.1 μ s minimum.
Accuracy: $\pm 0.1\%$.

Main Output

Output Signal – Complementary; CH1 and channel inverse.

Digital to Analog Converter –

Resolution: 8-bits.
Differential Non-linearity: $\pm 1/2$ -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 50Ω .
Amplitude: 20 mV to 2.0 V into 50Ω .
Resolution: 1 mV.
DC Accuracy: $\pm(2.0\%$ of Amplitude + 2 mV) at offset = 0 V.

Offset –

Range: $-0.500 V$ to $+0.500 V$ into 50Ω .
Resolution: 1 mV.
Accuracy: $\pm 1.5\%$ 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: $\pm 10\%$ (at $1.0 V_{p-p}$ amplitude).
Flatness: $\pm 5\%$ (after 20 ns from rise/fall edge).

Sine Wave Characteristics –

(2.7 GS/s clock, 32 waveform points, 84.375 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 50Ω .

Resolution – 1 mV.

DC Accuracy – $\pm(2\%$ 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 – 50Ω .

*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 – $500 mV_{p-p}$ to $1.0 V_{p-p}$ into 50Ω .

Resolution – 1 mV.

DC Accuracy – $\pm(2.0\%$ 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 – 50Ω .

Auxiliary Outputs

Marker

Number – 2 (complementary).

Level –

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

Resolution – 0.05 V.

DC Accuracy –

Within $\pm 0.1 V \pm 5\%$ of setting into 50Ω .
Maximum Output current: ± 80 mA.

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

Period Jitter (Typical) –

by 1010 clock pattern
At 2.7 GS/s 2.1 ps_{RMS}, 15 ps peak to peak.
At 1.35 GS/s 2.1 ps_{RMS}, 15 ps peak to peak.
At 0.675 GS/s 2.0 ps_{RMS}, 14 ps peak to peak.

Cycle-to-Cycle Jitter (Typical) –

by 1010 clock pattern.
At 2.7 GS/s 3.6 ps_{RMS}, 26 ps peak to peak.
At 1.35 GS/s 3.6 ps_{RMS}, 26 ps peak to peak.
At 0.675 GS/s 3.3 ps_{RMS}, 23 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 OV), 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 2.7 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 °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: 2.65 m/s²_{RMS} (0.27 G_{RMS}, 5 Hz to 500 Hz, 10 minutes).
Nonoperating: 22.36 m/s²_{RMS} (2.28 G_{RMS}, 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).

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
Width	434	17.1
Depth	508	20
Weight	kg	lb.
Without package	14.1	31.1
With package	24.5	54

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

PC Keyboard – 6-Pin mini-DIN, rear.

Arbitrary Waveform Generator

▶ AWG615

▶ Ordering Information

AWG615

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

Includes: User manual, Programmer's manual, Floppy disk: sample waveform library (063-3779-00), performance verification (063-3780-00), Sample Program (062-A258-50), Certificate of Calibration, power cable. 50 Ω SMA Terminator 2 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 – 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. 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 – 071-1516-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.

Contact Tektronix:

ASEAN / Australasia / Pakistan (65) 6356 3900

Austria +43 2236 8092 262

Belgium +32 (2) 715 89 70

Brazil & South America 55 (11) 3741-8360

Canada 1 (800) 661-5625

Central Europe & Greece +43 2236 8092 301

Denmark +45 44 850 700

Finland +358 (9) 4783 400

France & North Africa +33 (0) 1 69 86 80 34

Germany +49 (221) 94 77 400

Hong Kong (852) 2585-6688

India (91) 80-22275577

Italy +39 (02) 25086 1

Japan 81 (3) 6714-3010

Mexico, Central America & Caribbean 52 (55) 56666-333

The Netherlands +31 (0) 23 569 5555

Norway +47 22 07 07 00

People's Republic of China 86 (10) 6235 1230

Poland +48 (0) 22 521 53 40

Republic of Korea 82 (2) 528-5299

Russia, CIS & The Baltics +358 (9) 4783 400

South Africa +27 11 254 8360

Spain +34 (91) 372 6055

Sweden +46 8 477 6503/4

Taiwan 886 (2) 2722-9622

United Kingdom & Eire +44 (0) 1344 392400

USA 1 (800) 426-2200

USA (Export Sales) 1 (503) 627-1916

For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

Last Update March 01, 2004

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

Product(s) are manufactured
in ISO registered facilities.



Copyright © 2004, Tektronix, Inc. All rights reserved. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX and TEK are registered trademarks of Tektronix, Inc. All other trade names referenced are the service marks, trademarks or registered trademarks of their respective companies.

04/04 HB/SFI

76W-12991-2