

Arbitrary Waveform Generator

▶ AWG610



▶ AWG610.

AWG610 Combines High Performance with Ease-of-Use to Tackle Your Challenges in Data Storage Characterization and Communications Physical Layer Testing

The AWG610 delivers 2.6 GS/s sample rate to test high-speed devices and subsystems, and 8 M points record length for long signal simulations. Its 8-bit vertical resolution

provides precise signal replication, while its 400 fs resolution edge shift control allows greater timing precision.

▶ [Need Title]

ITU-T	T1.102	Fibre Channel	SDH/Sonet	Other
STM1E	STS-3	FC1063E	OC48/STM16	D2
E5 CEPT	STS-1	FC531E	OC36	D1
E4	DS4NA	FC266E	OC24	FDD-1
E3	DS3	FC133E	OC18	100Base-TX
E2	DS2		OC12/STM4	Gigabit Ethernet
E1	DS1/1C/1A		OC3/STM1	
			OC1/STM0	

▶ Features & Benefits

2.6 GS/s Sample Rate to Test High-speed Devices and Subsystem

1 Analog and 2 Digital Output Markers to Produce Complex Mixed Analog and Digital Signals

8 M Point Record Length for Long Signal Playtimes

8-bit Vertical Resolution for Precise Signal Replication

Analog Bandwidth to Over 800 MHz

EZ Function Generator Mode Allows Quick Creation and Edit of Sine, Square, Triangle, Ramp, Pulse and DC Waveforms

Waveform Quick Editor with up to 400 fs Edge Timing Resolution Delivers Output Edge Control with Greater Timing Precision

Real-time Sequencing Creates Infinite Waveform Loops, Jumps, Patterns and Conditional Branches

Built-in Read Channel and Data Pattern Editing Capability

GPIB and LAN (10Base-T) Interfaces

Built-in Hard Drive for Mass Data Storage

▶ Applications

Disk Drive Read/Write Design and Test

- Head
- Pre-amplifier
- Read/Write
- Servo Test

Communications Design and Test

- Standard Waveforms for Communications

Pulse Generation

- Duty Cycle Ranges from 0% to 100% for NRZ Data
- Testing Clock/Gating Width Variations

Mixed Signal Design and Test

Real-world Simulations

- Corruption and Enhancement of Ideal Waveforms
- Timing and Amplitude Signal Impairments
- Jitter Profiles
- Waveforms Imported from GPIB, Floppy Disk, 10Base-T Ethernet, DSO or DPO

COMPUTING

COMMUNICATIONS

VIDEO

Arbitrary Waveform Generator

▶ AWG610

▶ Characteristics

Arbitrary Waveforms

Waveform Length – 512 to 8,100,032 points in multiples of eight.

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 260.0 MHz.

Amplitude –

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

Offset –

Range: $-1.000 V$ to $+1.000 V$ into 50Ω .
Resolution: 1 mV.

DC Level –

DC waveform only.
Range: $-1.000 V$ to $+1.000 V$ into 50Ω .
Resolution: 1 mV.

Polarity – Normal, Invert.

Duty Cycle –

Range: 0.1% to 99.9%, Pulse waveform only.
Resolution:

- 1.000 Hz to 2.600 MHz: 0.1% step.
- 2.601 MHz to 13.00 MHz: 0.5% step.
- 13.01 MHz to 26.00 MHz: 1% step.
- 26.01 MHz to 52.00 MHz: 2% step.
- 52.01 MHz to 65.00 MHz: 2.5% step.
- 65.01 MHz to 104.00 MHz: 4% step.
- 104.1 MHz to 130.0 MHz: 5% step.
- 130.1 MHz to 260.0 MHz: 10% step.

Marker Out –

Marker1 Pulse Width:

Hi/Lo: 20%/80% of Period.

Marker2 Pulse Width:

Hi/Lo: 50%/50% of Period, except 65.01 MHz to 104.0 MHz.

Hi/Lo: 52%/48% of Period, at 65.01 MHz to 104.0 MHz.

Marker Level:

Hi Level: 2V into 50Ω .

Lo Level: 0V into 50Ω .

Clock Generator

Sampling Frequency – 50.000000 kHz to 2.60000000 GHz.

Resolution – 8 digits.

Internal Clock – Accuracy: ± 1 ppm.

Phase Noise – (data clock is 1/4th of the output sample rate).

At 650 MHz, 10 kHz offset: -80 dBc/Hz.

At 650 MHz, 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 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: $\pm 1/2$ -Bit.
Integral non-linearity: ± 1 -Bit.

Output Connector – Front Panel SMA.

Normal Out

Amplitude –

Output Voltage: $-2.0 V$ to $+2.0 V$ into 50Ω .

Amplitude: 20 mV to 2.0 V into 50Ω .

Resolution: 1 mV.

DC Accuracy: $\pm(1.5\%$ of Amplitude + 2 mV) at offset = 0 V.

Offset –

Range: $-1.000 V$ to $+1.000 V$ into 50Ω .

Resolution: 1 mV.

Accuracy: $\pm(1\%$ of offset + 10 mV) at amplitude = 20 mV.

Pulse Response (–1 and 1 waveform data, 0 V Offset, Through Filter at 1 V_{p-p}) –

Rise Time (10 to 90%): ≤ 750 ps.

Fall Time (10 to 90%): ≤ 750 ps.

Aberations (at 1000 MHz): At 1.0 V_{p-p}

Amplitude: $\pm 10\%$.

Flatness (after 20 ns from rise/fall edge): $\pm 3\%$.

Sine Wave Characteristics (2.6 GS/s Clock,

32 Waveform Points, 81.25 MHz Signal

Frequency, 0.5 V Amplitude, 0 V Offset,

Through Filter) –

Harmonics: ≤ -40 dBc, DC to 800 MHz.

Noise: ≤ -50 dBc, DC to 800 MHz.

Phase noise: ≤ -85 dBc/Hz at 10 kHz offset.

Filter

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, 3.5 ns; 200 MHz, 1.75 ns.

Delay from Trigger –

20 MHz, 50 ns + 22 clocks; 50 MHz, 40 ns + 22 clocks; 100 MHz, 35 ns + 22 clocks; 200 MHz, 33 ns + 22 clocks; through 30 ns + 22 clocks.

Direct D/A Out

Amplitude

Output Voltage – $-0.5 V$ to $+0.5 V$ into 50Ω .

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

(waveform data = 0).

Pulse Response (–1 and 1 waveform data,

at 0.5 V_{p-p}) –

Rise Time (10 to 90%): ≤ 400 ps.

Fall Time (10 to 90%): ≤ 400 ps.

Output Impedance – 50Ω .

Auxiliary Outputs

Marker

Number – 2 (complementary).

Level –

Hi/Lo: 1.1 V to 3.0 V into 50Ω (Max. 2.5 V_{p-p}).

$-2.2 V$ to 6.0 V into $1 M\Omega$. (Max. 5 V_{p-p}).

Resolution – 0.05 V.

Accuracy – Within $\pm 0.1 V$ +5% of setting.

Rise/Fall Time (20 to 80%) – 150 ps ($2 V_{p-p}$,

Hi +1 V, Lo $-1 V$) into 50Ω .

Variable Delay –

Range: 0 ns to +1.5 ns.

Accuracy: -30% to $+10\%$ at 1.5 ms setting.

Resolution: 100 ps.

Marker Skew: 70 ps (typical).

Connector – Front-panel SMA.

10 MHz Reference Clockout –

Amplitude: $\geq 1 V_{p-p}$ into 50Ω . Max 3 V_{p-p} open.

Impedance: 50Ω , AC coupling.

Connector: Rear-panel BNC.

1/4 Clock Out –

Level: ECL 100 K compatible.

Connector: Rear-panel BNC.

Trigger In –

Impedance: 1 k Ω or 50Ω .

Polarity: POS or NEG.

Input Voltage Range –

1 k Ω : $\pm 10 V$.

50Ω : $\pm 5 V$.

Threshold –

Level: –5.0 V to 5.0 V.
Resolution: 0.1 V.
Accuracy: ±(5% of level + 0.1 V).
Pulse Width (0.2 V amplitude): 10 ns minimum.
Trigger Holdoff: ≥576 clocks + 450 ns.
Delay to Marker: 28 ns + 22 clocks.
Delay to Analog Out: (typical).
(filter through).
30 ns + 22 clocks (trigger).
30 ns + 880 clocks (gate).
Connector: Rear-panel BNC.

Event Trig Input –

Number of Events: 4 Bits.
Input Signals: 4 event bits, strobe.
Threshold: TTL level.
Pulse Width: 128 clocks minimum.
Maximum Input: 0 V to +5 V (DC + peak AC).
Delay to Analog Out: 850 clocks +20 ns (ASYN mode).
Impedance 2.2 kΩ, pull-up to +5 V.
Connector: Rear-panel 9-Pin D-sub.

Reference 10 MHz Clock IN –

Input Voltage Range: 0.2 V 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.

General Characteristics

Display

Area – 13.2 cm (5.2 in.) horizontal by 9.9 cm (3.9 in.) vertical.

Resolution – 640 horizontal by 480 vertical pixels.

Data Storage

Internal Hard Disk Drive – 3.0 GB (standard).

Floppy Disk Drive – 3.5 in., 1.44 MB.

Option 10 –

Flash Disk replaces HDD, 78 MB. (Opt. 10 is best suited for ATE and system usage requiring 7x24 hour operation.)

Environmental, EMC, Safety

Temperature –

Operating: 10 °C to +40 °C.
Nonoperating: –20 °C to +60 °C.

Humidity –

Operating: 20 to 80%, noncondensing.
Nonoperating: 5 to 90%, noncondensing.

Altitude –

Operating: Up to 4,500 m. (15,000 ft.). Maximum operating temperature decreases 1 °C per 300 m above 1.5 km.
Nonoperating: Up to 15,000 m (50,000 ft.).

Vibration (Test Limits) –

Operating: 0.27 G_{RMS} from 5 to 500 Hz, 10 minutes.
Nonoperating: 2.28 G_{RMS} from 5 to 500 Hz, 10 minutes.

Shock (Test Limits) –

Nonoperating: 294 m/s² (30 G), half-sine, 11 ms duration.

EMC Compliance –

EN50081-1, EN50082-1.
AS/NZS 20641/2.

Safety – UL3111-1, CSA1010.1, EN61010-1, IEC61010-1.

Power

Source Power –

Line Voltage Range: 100 to 240 VAC.
Line Frequency: 48 to 63 Hz.

Power Consumption – 600 W at 8 A.

Physical Characteristics

Dimensions	mm	in.
Height	193	7.6
Width	422	16.6
Depth	560	22.0
Weight	kg	lbs.
Net	17	37.5

Other

Programmable Interface –

GPIB: 24-Pin IEEE488.1 connector.
 Ethernet: 10Base-T, RJ-45 connector.
 Keyboard Connector: 6-Pin mini-DIN connector.

▶ Ordering Information

AWG610

2.6 GS/s, Single-channel arbitrary waveform generator.

Includes: User manual (071-0554-05), programmer manual (071-0555-01), GPIB programming examples disk (063-3216-01), sample waveform library disk (063-3217-00), performance verification disk (063-3218-00), power cable, fuse (159-0407-00).

Please specify power plug when ordering.

Recommended Accessories

Service Manual – Order 071-0556-02.

Protective Cover – Order 200-3696-01.

AC Current Probe (Transformer) – 1 GHz:
Order CT1.

AC Current Probe (Transformer)– 200 MHz:
Order CT2.

AC Current Probe (Transformer)– 2 GHz:
Order CT6.

GPIB Cable – Order 012-0991-01.

50 Ω BNC Cable – Order 012-1341-00.

50 Ω BNC Cable – Order 012-1256-00.

50 Ω SMB Cable – Order 012-1458-00.

50 Ω SMB-to-BNC Cable – Order 012-1459-00.

50 Ω BNC Termination – Order 011-0049-01.

50 Ω BNC Power Divider – Order 015-0660-00.

50 Ω SMA Cable (20 inches) – Order 174-1427-00.

50 Ω SMA Cable (1.0 m) – Order 174-1341-00.

50 Ω SMA Cable (60 inches) – Order 174-1428-00.

SMA Precision Cable (1 ns) – Order 015-0562-00.

SMA Precision Cable (2 ns) – Order 015-0560-00.

SMA Precision Cable (5 ns) – Order 015-0561-00.

SMA T Connector – Order 015-1016-00.

50 Ω SMA Termination – Order 015-1022-00.

50 Ω SMA Power Divider – Order 015-1014-00.

SMA(Ma) - BNC(Fe) Connector – Order 015-0554-00.

SMA(Fe) - BNC(Ma) Connector – Order 015-0572-00.

SMA Kit – Order 020-01693-00.

400 MHz BNC Low-pass Filter – Order 015-0659-00.

200 MHz BNC Low-pass Filter – Order 015-0658-00.

100 MHz BNC Low-pass Filter – Order 015-0657-00.

Instrument Cart – Order K420.

Rackmount Conversion Kit – Order 016-1675-01.

Options

Opt. 10 – Flash disk (78 MB) remove HDD and STBY switch. (Opt. 10 is best suited for ATE and system usage requiring 7x24 hour operation.)

Opt. 1R – Rackmount.

Power Plug Options

Opt. A0 – US Plug, 115 V, 60 Hz.

Opt. A1 – Euro Plug, 220V, 50 Hz.

Opt. A2 – UK Plug, 240V, 50 Hz.

Opt. A3 – Australian Plug, 240V, 50 Hz.

Opt. A4 – N. American Plug, 240V, 50 Hz.

Opt. A5 – Swiss Plug, 220V, 50 Hz.

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.

Warranty

One year parts and labor.

Arbitrary Waveform Generator

▶ AWG610

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) 80-2275577

Italy +39 (02) 25086 1

Japan 81 (3) 3448-3010

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

Updated 20 September 2002

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



Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Copyright © 2003, 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.

04/03 HB/SFI

76W-12991-1