AWG400 Series Arbitrary Waveform Generators

▶ AWG400 Series

The AWG400 Series performs a wide range of modulated (I&Q) and mixed signal simulations (analog & digital) for wireless and wired data communication, in addition to semiconductor device characterization.

The AWG400 is ideal for design or manufacturing test engineers who need to replicate marginal and erroneous mixed signal conditions. The only product in its class offering 200 MS/s, 16-Bit vertical resolution, 1, 2 or 3 channel configurations and optional digital outputs (16, 32 or 48), the AWG400 is a superior choice for those who need an additional channel, longer memory or higher vertical resolution. The color display, graphical user interface and stand-alone Microsoft Windows-based waveform creating utility supports quick creation, editing and output of custom or imported waveforms.

Modulation Standards and Display Types

Modulation Types

- BPSK
- QPSK
- OQPSK
- π/4DQPSK
- 8PSK
- 16QAM
- 64QAM
- 256QAM
- User defined

Modulation Displays

- I(t), Q(t)
- R(t), φ(t)
- Eye Diagram I
- Eye Diagram Q
- Vector Diagram
- Constellation
- Magnitude Spectrum
- Phase Spectrum

▶ Features & Benefits

1, 2 or 3 Independent Waveform Channels

16-Bit (1/65536) Vertical Resolution

200 MS/s Sample Rate

Up to 16 M Record Length

Optional 16/32/48-Bit 100 MHz (CMOS) Digital Data Generator for Mixed-signal Device Testing

2, 4 or 6 Digital Marker Outputs

Channel Internal Independent Noise Generator

Independent Channel Skew Control

Independent Channel External Signal ADD-INPUT

External Clock and External Reference Inputs

▶ Applications

Designing, Testing and Deploying

- Quadrature Digitally Modulated I&Q Signals and Displays
- Mixed (Analog/ Digital) Signals
- Stimulus Signals for Imaging Display and Recording Devices (CCD, LCD)
- Enhanced/Corrupted Playback of DSO Captured Signals
- Simulation Waveform Vectors Imported from Mathcad, Matlab, Excel and Others

Network Communications Physical Layer Testing

- ITU-T (E1, E2, E3)
- TI.102 (DS1, DS1A, DS1C)
- Fibre Channel (FCI33E)
- SDH/SONET (OC1/STM0, OC3/STM1)
- D2
- 100Base-TX

Tektronix

Characteristics

AWG400 Product Specification Guide

Arbitrary Waveforms

Waveform Length – 64 to 4,050,000 points (64 to 16,200,000 points with Opt. 01).

Waveform Segment Length – ≥64 points, in multiple of 1.

Sequence Steps – 1 to 8,000 steps (All channels operate the same sequence).

Repeat Counter – 1 to 65,536 or infinite.

Clock Generator

Sample Frequency – 10.00000 kS/s to 200.0000 MS/s.

Resolution Accuracy – 7 digits / ±2 ppm (±0.0002%).

Period Jitter (rms) – 7 ps at 200 MHz (typical).

Cycle Jitter (rms) – 12 ps at 200 MHz (typical).

Main Analog Output

Number of Outputs – AWG430 – 3, AWG420 – 2, AWG410 –1.

Output Style – Complementary (standard), Single-ended (Opt. 05).

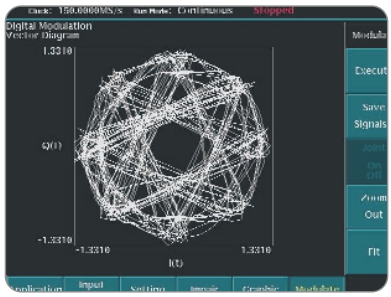
Output Connector / Impedance – BNC front panel (50 Ω).

Vertical Resolution – 16-Bit.

D/A Converter (DNL/INL) – ±3 LSB at 25°C / ±4 LSB at 25°C.

Skew Time Between Channels – ≤±100 ps (Relative to Ch1).

Variable Delay (Range/Resolution/Accuracy) – –2.52 ns to +2.52 ns / 70 ps / ±70 ps at 25°C.



π/4DQPSK vector diagram.

Complementary Output

Amplitude / Range – –2.0 V to + 2.0 V (into 50 Ω) / 20 mV to 2.0 V_{p-p} (into 50 Ω).

Resolution / DC Accuracy – 1 mV / ± (1.5% of setting + 2 mV) (Offset = 0 V).

Step Response (10% – 90%) – (–1 and 1 waveform data, 0 V offset, filter "Through").

Rise Time – ≤4.0 ns.

Fall Time – ≤4.0 ns.

Settling Time – ±3% (after 50 ns from rise/fall edges).

Aberration – ±10% (amplitude >1.0 V), ±7% (amplitude ≤1.0 V).

SFDR – (Signal frequency: 1.0 MHz, amplitude: 1.0 V, offset: 0 V, filter "Through") –74 dB (@ 50 MS/s), –74 dB (@ 100 MS/s), –62 dB (@ 150 MS/s).

Offset

Range/Resolution – –1.00 V to + 1.00 V (into 50 Ω) / 1 mV.

Accuracy – ± (1% of offset + 10 mV) (amplitude = 20 mV, waveform data 0).

Filter

Type – Bessel low pass filter 1 MHz, 5 MHz, 20 MHz, 50 MHz.

Rise Time (10% – 90%) – 350 ns, 70 ns, 18 ns, 7 ns.

Delay From Trigger – 350 ns, 70 ns, 18 ns, 7 ns (group delay).

Direct Output (Standard)

Range / Amplitude – –0.25 V to +0.25 V (into 50 Ω) / 20 mV to 0.5 V (into 50 Ω).

Resolution / DC Accuracy – 1 mV / ± (1.5% of setting + 2 mV).

Step Response (10% – 90%) – (filter "Through").

Rise / Fall Time – ≤3.0 ns / ≤3.0 ns.

Single-ended Output (Option 05)

Range / Amplitude – –5.0 V to +5.0 V (into 50 Ω) / 20 mV to 5.0 V (into 50 Ω).

Resolution / DC Accuracy – 1 mV / ± (1.5% of setting + 2 mV) (Offset = 0 V).

Range / Resolution – –2.500 V to +2.500 V (into 50 Ω) / 1 mV.

Accuracy – ± (1% of offset + 10 mV) (amplitude = 20 mV, waveform data 0).

Step Response (10% – 90%) – (–1 and 1 waveform data, 0 V Offset, Filter "Through").

Rise Time – ≤5.0 ns.

Fall Time – ≤5.0 ns.

Settling Time – ±3% (after 50 ns from rise/fall edges).

Aberration – ±10% (amplitude >1.0 V), ±7% (amplitude >1.0 V).

SFDR – (Signal frequency: 1.0 MHz, amplitude: 1.0 V, offset: 0 V, filter "Through") –72 dB (at 50 Ms/s), –70 dB (at 100 Ms/s), –60 dB (at 150 Ms/s).

Filter

Type – Bessel low pass filter 1 MHz, 5 MHz, 20 MHz, 50 MHz.

Rise Time (10% – 90%) – 350 ns, 70 ns, 18 ns, 7 ns.

Delay From Trigger – 350 ns, 70 ns, 18 ns, 7 ns (Group Delay).

Direct Output (Standard)

Amplitude / Range – –0.25 V to +0.25 V (into 50 Ω) / 20 mV to 0.5 V (into 50 Ω).

Resolution / DC Accuracy / Offset – 1 mV / ± (1.5% of setting + 2 mV).

Step Response (10% – 90%) – Rise/Fall Time ≤3.0 ns / ≤3.0 ns (filter "Through").

Auxiliary Outputs

Marker

Maximum Data Rate – 200 Mb/s.

Number of Outputs –
AWG430: 6.
AWG420: 4.
AWG410: 2 (2 per channel).

Level / Impedance – Hi: ≥2.4 V, Lo: ≤0.1 V (into 50 Ω) LVC541 output driver / 50 Ω.

Rise Time (10% – 90%) – 4 ns maximum.

Output Skew – ≤±100 ps.

Output Connector – BNC rear panel.

Master Clock Out

Level / Impedance – 1 V_{p-p} (into 50 Ω) / 50 Ω.

Frequency / Output Connector – 100 MHz to 200 MHz / BNC rear panel.

Noise (Ch1, Ch2, Ch3 independent)

Range / Resolution – –130 dBm/Hz to –95 dBm/Hz / 1 dBm/Hz.

Accuracy / Type – ± 2.5 dB at (–95 dBm/Hz to –130 dBm/Hz at 10 MHz) / Gaussian.

Flatness – ±2.5 dB (1 MHz to 100 MHz (at –95 dBm/Hz reference 50 MHz).

Output Connector – Part of analog front panel BNC.

Digital Data (output from P4116, Option 03)

Number of Outputs – Ch 1 = 16, Ch 1+2 = 32, Ch 1+2+3 = 48.
Each channel D0-D15 = 16 Bits + clock.

Output Connector – Each channel 34-Pin (header pin connector), P4116 CMOS Pod.

Maximum Data Rate – 10 kb/s to 100 Mb/s.

Level / Impedance – Hi: ≥2.3 V, Lo: ≤0.1 V (into 50 Ω) 74LVC541 output driver / 50 Ω.

Rise Time (10% – 90%) – 3 ns Maximum.

Skew Time – 1 ns (typical) (between clock signals and data).

Data Invalid Time – 4 ns.

10 MHz Reference

Amplitude / Impedance – 1 V_{p-p} (into 50 Ω), 3 V_{p-p} max (into 1 MΩ) / Impedance: 50 Ω AC coupled.

Output Connector – BNC rear panel.

Display Monitor

Format / Connector – VGA / D-sub 9-Pin, rear panel.

Auxiliary External Input

Trigger

Impedance / Polarity – 1 kΩ or 50 Ω / positive or negative.

Input Range / Threshold – 1 kΩ ±10 V or 50 Ω ±5 V / –5.0 V to 5.0 V.

Accuracy / Resolution – ± (5% of setting level + 0.1 V) / 0.1 V.

Minimum Pulse Width / Dead Time – 10 ns (0.2 V @ Amplitude) / ≤65 clock + 200 ns maximum.

Delay to Analog Out – 50 ns + 1 clock.

Connector – BNC rear panel.

Internal Trigger Generator

Range / Resolution / Accuracy – 1.0 µs to 10.0 s / 3 digits, minimum 0.1µs / ±0.1%.

Event In

Number of Events In / Input Signal – 4-Bit / 4 event bits + strobe.

Threshold / Min. Pulse Width – TTL level / ≥100 ns.

Maximum Input Level / Impedance – 0 V to +5 V (DC + peak AC) / 2.2 kΩ, pulled-up to +5 V.

Delay to Analog Out – ≤130 Clock + 400 ns.

Connector – 9-Pin D-sub rear panel.

ADD

Number of ADD In – Ch1, Ch 2, Ch 3 Independent.

Input Range / Impedance – –1 V to 1 V (DC + peak AC) / 50 Ω.

Band Width (–3 dB) / Level Accuracy – ≥50 MHz at 1 V_{p-p} input / ±5%.

Connector – BNC rear panel.

10 MHz Reference

Input Range / Impedance – 0.2 V to 3 V_{p-p}, maximum ±10 V / 50 Ω, AC coupled.

Frequency Range / Connector – 10 MHz ± 0.1 MHz / BNC rear panel.

Master Clock In

Sensitive Voltage / Threshold – ≥ 0.4 V_{p-p} / 0.5 V DC.

Minimum Pulse Width / Maximum Input Voltage – 2 ns / ± 2 V DC.

Frequency Range / Impedance – DC to 200 MHz / 50 Ω.

Connector – BNC rear panel.

Environment / Other

Operation Mode – Continuous, Triggered, Gated, Enhanced.

Display – Color TFT LCD.

Display Area / Resolution – Horizontal: 13.06 cm (5.14 in.), Vertical: 9.70 cm (3.81 in.) / 640x480.

Data Storage

Internal Hard Disk – 10.0 GB.

Flash Disk (Option 10) – 128 MB.

Floppy Disk – 3.5", 1.44 MB.

Environment

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

Humidity – Operating / Nonoperating: 20% to 80% / 5% to 90%.

Altitude – Operating / Nonoperating: Up to 3,000 m (10,000 ft.) / up to 12,000 m (40,000 ft.).

Vibration – Operating / Nonoperating: 0.27 G_{RMS}, 5 Hz to 500 Hz / 2.28 G_{RMS}, 5 Hz to 500 Hz.

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

EMC – EC Council Directive 89 / 336 / EEC (EC-92), AD / NZS 2064.1 / 2.

Safety – UL 3111-1, CSA C22.2 No. 1010.1, EN61010-1.

Power Supply

Rating / Range – 100 to 240 VAC / 90 to 250 VAC.

Maximum Power & Current / Frequency – 400 W & 4 A / 48 to 63 Hz.

Physical Characteristics

AWG410

Dimensions	**mm**	**in.**
Height	193	7.6
Width	433	16.69
Depth	508	20
Weight	**kg**	**lb.**
Net	13.7	30.2
With Packaging	22.3	49.12

AWG420

Dimensions	**mm**	**in.**
Height	193	7.6
Width	433	16.69
Depth	508	20
Weight	**kg**	**lb.**
Net	14.1	31.1
With Packaging	22.3	49.12

AWG430

Dimensions	**mm**	**in.**
Height	193	7.6
Width	433	16.69
Depth	508	20
Weight	**kg**	**lb.**
Net	14.4	31.7
With Packaging	22.3	49.12

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

PC Keyboard – 6-Pin mini-DIN, serial communication port.

Ordering Information

AWG410

200 MS/s, 16-Bit One Channel Arbitrary Waveform Generator.

Includes: User/programmer's manual 070-A809-00, GPIB programming examples 062-A258-00, sample waveform library disk 062-A257-00, performance verification 062-A270-00, Cal. Certificate no charge, Arb-link software utility 062-A270-00, power cable (U.S. 115 V).

AWG420

200 MS/s, 16-Bit Two Channel Arbitrary Waveform Generator.

Includes: User/programmer's manual 070-A809-00, GPIB programming examples 062-A258-00, sample waveform library disk 062-A257-00, performance verification 062-A270-00, Cal. Certificate no charge, Arb-link software utility 062-A270-00, power cable (U.S. 115 V).

AWG430

200 MS/s, 16-Bit Three Channel Arbitrary Waveform Generator.

Includes: User/programmer's manual 070-A809-00, GPIB programming examples 062-A258-00, sample waveform library disk 062-A257-00, performance verification 062-A270-00, Cal. Certificate no charge, Arb-link software utility 062-A270-00, power cable (U.S. 115 V).

Options

Opt. 01 – 16 M point waveform memory.

Opt. 03 – CMOS Digital Data Outputs –16/32/48-Bit (number of digital output bits depends on AWG400 model).

Opt. 05 – Single-ended output (Alternative for standard complementary output).

Opt. 10 – 128 MB 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 – Rackmount.

Service Options

Opt. C3 – Three years of Calibration Services.

Opt. D1 – Calibration data certificate.

Opt. D3 – Test data; requires C3.

Opt. R3 – Repair warranty extended to cover three years.

Recommended Accessories

Service Manual – 070-A811-00.

Power Cord Options

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A12 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

Opt. A99 – No power cable.

Opt. AC – China.

Software

Arb-Link™ – PC-based stand-alone waveform creation utility.

Warranty

One year parts and labor.

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