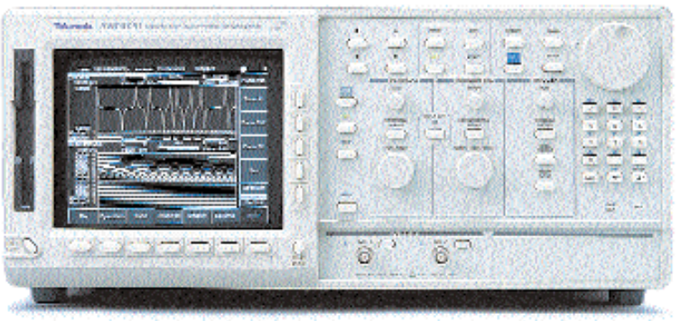
Arbitrary Waveform Generator

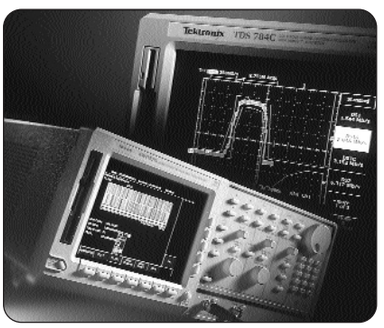
AWG500 Series



AWG520.

AWG500 Series Solves Communications Physical Layer and Media Storage Design and Test Challenges

The AWG500 Series' unique design combines a graphical editing display with powerful output capabilities to simplify the creation of arbitrary and complex waveforms and enable easy on-screen waveform editing. With the AWG500 series' many built-in intuitive and powerful features, you can easily develop and edit custom waveforms. Option 03 adds an independent 10-bit-wide digital data port that can be used in conjunction with marker outputs for data generation up to 12-bits wide at up to 1 GHz (14-bits, AWG520). Direct waveform transfer capability makes the AWG500 Series the perfect complement to selected Tektronix oscilloscopes.



The AWG500 Series can easily generate telecom signals which complement masks from a digital oscilloscope.

Features & Benefits

One or Two Channels with 10-Bit Vertical Resolution

Independent 10-Channel, 1 GHz Digital Data Generation (with Opt. 03)

Built-in Independent Real-time Noise Generation

External Clock Input Permits Jitter Insertion and Synchronization

Supports Direct External Clock and 10 MHz Reference Input

Unique Real-time Sequencing Links Multiple Waveform Files Creating Waveforms of Nearly Infinite Length

Built-in Application Generates Jitter, Data Communication and Disk Drive Waveforms

User Modified Isolation Pulse for Disk Drive Testing

Built-in 3 GB Hard Drive for Mass Data Storage

Optional 78 MB Flash Disk for ATE Applications

Applications

Communications Design and Test:
- Low Frequency Modulated RF with Components Using AM and FM Modulation
- Digital Information Encoding Using FSK, PSK and QAM (Quadrature Modulation) for Cellular, Fax and Modem Communications

Optical Communications Design and Test:
- Reflections, Crosstalk and Ground Bounce Simulation

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

Real-world Simulations:
- Corrupt Ideal Waveforms
- Add Jitter to Waveforms
- EMP/EMI and Other System Noise
- Power Supply Noise and Ripple
- Transducer Simulation

Tektronix
Enabling Innovation

Arbitrary Waveform Generator

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Characteristics

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/Ethernet 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.

Arbitrary Waveforms

Waveform Length – 256 to 4,194,048 points in multiples of four.

Sequence Length – 1 to 8,000 steps. Both CH1 and CH2 operate from the same sequence (AWG520).

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 100.0 MHz.

Amplitude –
Range: 0.020 V_{pp} to 2 V_{pp} into 50 Ω.
Resolution: 1 mV.

Offset –
Range: –1.000 V to +1.000 V into 50 Ω.
Resolution: 1 mV.

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

Phase –
AWG520 only.
Range: –360º to +360º.
Resolution:
- 1.000 Hz to 100.0 kHz: 0.036 º step.
- 100.01 kHz to 1.000 MHz: 0.36 º step.
- 1.001 MHz to 5.000 MHz: 1.8 º step.
- 5.001 MHz to 10.00 MHz: 3.6 º step.
- 10.001 MHz to 20.00 MHz: 7.2 º step.
- 20.001 MHz to 25.00 MHz: 9 º step.
- 25.001 MHz to 40.00 MHz: 14.4 º step.
- 40.001 MHz to 50.00 MHz: 18 º step.
- 50.001 MHz to 100.0 MHz: 36 º step.

Channel Output Summary

Output Type	AWG510	AWG520
Analog	1	2
Complement	1	N/A
Marker	M1, M2	CH1: M1, M2 CH2: M1, M2
Digital (Option 03)	1 Analog, Complement, D0 to D9, M1, M2 (Analog and digital channels can have separate data)	2 Analog (CH2 Analog = D0 to D9, CH1 and CH2 Analog independent.), D0 to D9, 4 Markers

Polarity – Normal, Invert.

Duty Cycle –
Range: 0.1% to 99.9%, Pulse waveform only.
Resolution:
- 1.000 Hz to 1.000 MHz: 0.1% step.
- 1.001 MHz to 5.000 MHz: 0.5% step.
- 5.001 MHz to 10.00 MHz: 1% step.
- 10.01 MHz to 20.00 MHz: 2% step.
- 20.01 MHz to 25.00 MHz: 2.5% step.
- 25.001 MHz to 40.00 MHz: 4% step.
- 40.01 MHz to 50.00 MHz: 5% step.
- 50.01 MHz to 100.00 MHz: 10% step.

Marker Out –
Marker1 Pulse Width: Hi/Lo: 20%/80% of Period.
Marker2 Pulse Width:
- Hi/Lo: 50%/50% of Period, except 5.001 MHz to 8.000 MHz.
- Hi/Lo: 52%/48% of Period, at 5.001 MHz to 8.000 MHz.

Marker Level:
- Hi Level: 2 V into 50 Ω.
- Lo Level: 0V into 50 Ω.

Clock Generator

Sampling Frequency – 50.000000 kHz to 1.0000000 GHz.

Resolution – 8 digits.

Internal Clock –
Accuracy: ±1 ppm.
Phase Noise:
- At 1 GHz, 10 kHz offset: –80 dBc/Hz.
- At 1 GHz, 100 kHz offset: –100 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 –
AWG510: Complementary; CH1 and CH1 (overscore).
AWG520: Single-ended; CH1 and CH2.

DA Converter –
Resolution: 10-Bit.
Differential Non-linearity: ±1 LSB.
Integral Non-linearity: ±1 LSB.

Normal Out –
Pulse Response (–1 and 1 waveform data, 0 V offset, Through filter):
- Rise Time (10 to 90%): Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.5 ns.
- Fall Time (10 to 90%): Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.7 ns.
- Aberrations (at 500 MHz): Amplitude >1.0 V, ±10%; Amplitude ≤1.0 V, ±7%.
- Flatness (after 50 ns from rise/fall edge): ±3%.
- Small signal bandwidth (–3 dB, Amplitude 0.5 V): 300 MHz.

Sinewave Characteristics (1 GS/s clock, 32 waveform points, 31.25 MHz signal frequency, 1.0 V amplitude, 0 V offset, Through filter):
- Harmonics: ≤–50 dBc, DC to 400 MHz.
- Noise: ≤–53 dBc, DC to 400 MHz.
- Phase Noise: ≤–90 dbc/Hz at 10 kHz offset.

Filter:
- Type: 10, 20, 50, 100 MHz Bessel low-pass.
- Rise Time (10 to 90%): 10 MHz, 35 ns; 20 MHz, 17 ns; 50 MHz, 7.0 ns; 100 MHz, 3.5 ns.
- Delay from Trigger: 10 MHz, 77 ns +1 clock; 20 MHz, 57 ns +1 clock; 50 MHz, 45 ns +1 clock; 100 MHz, 42 ns +1 clock; Through, 37 ns +1 clock.

Direct DA Out –
Output Voltage: 0.5 V_{p-p} (with –0.27 V offset) into 50 Ω.
Amplitude Accuracy: 0.5 V_{p-p} ±10%.
DC Offset Accuracy: –0.27 V ±10% (waveform data = 0).
Pulse Response (–1 and 1 waveform data):
- Rise Time (10 to 90%): ≤700 ps.
- Fall Time (10 to 90%): ≤700 ps.

Output Impedance – 50 Ω.

Connector – Front panel BNC.

Auxiliary Outputs

Marker –
Number:
AWG510: 2.
AWG520: 4.
Level:
Hi/Lo: –2.0 V to 2.0 V (0.05 V_{p-p} to 4 V_{p-p}) into 50 Ω; –4.0 V to 4.0 V (0.1 V_{p-p} to 8 V_{p-p}) into 1 MΩ.
Resolution: 0.05 V.
Accuracy: Within ±0.1 V ±5% of setting.
Rise/Fall Time (10 to 90%, typical):
At 1 V_{p-p}, Hi +0.5 V/Lo –0.5 V: 0.5 ns.
At 2 V_{p-p}, Hi +1 V/Lo –1 V: 1.0 ns.
At 4 V_{p-p}, Hi +2 V/Lo –2 V: 2.0 ns.
Variable Delay:
Range: 0 ns to +2 ns.
Resolution: 20 ps.
Marker Skew: 32 ps.
Connector: Rear-panel SMB.

Clock Out –
Level: ECL 100 K compatible.
Connector: Front-panel BNC.

Noise –
Level:
Range: –145 dBm/Hz to -105 dBm/Hz.
Resolution: 1 dB.
Accuracy: ±2.5 dB at 100 MHz.
Flatness: ±2.5 dB, 1 MHz to 300 MHz (referenced to –105 dBm/Hz at 100 MHz).
Type: Gaussian.
Connector: Front-panel BNC.

Digital Data Out (Opt. 03) –
Output Signals: D0 to D9 (10-Bits).
Level:
Hi/Lo: –2.0 V to 2.0 V (0.1 V_{p-p} to 4 V_{p-p}) into 50 Ω; –4.0 V to 4.0 V (0.2 V_{p-p} to 8 V_{p-p}) into 1 MΩ.
Resolution: 0.1 V.
Accuracy: Within ±0.1 V ±5% of setting.
Rise/Fall Time (10 to 90%) typical:
At 1 V_{p-p}, Hi +0.5 V/Lo –0.5 V: 0.5 ns.
At 2 V_{p-p}, Hi +1 V/Lo –1 V: 1.0 ns.
At 4 V_{p-p}, Hi +2 V/Lo –2 V: 2.0 ns.
Skew Between Data: ≤1 ns, 330 ps typical.
Delay:
Data to Marker: 4.4 ns.
Clock to Data: 3.7 ns.
Connector: Rear-panel SMB.

Auxiliary Inputs

Trigger In –
Impedance: 1 kΩ or 50 Ω.
Polarity: POS or NEG.
Input Voltage Range:
1 kΩ: ±10 V.
50 Ω: ±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: 500 ns maximum.
Delay to Marker: 30 ns +1 clock.
Connector: Front-panel BNC.

Event Trig Input –
Number of Events: 4 Bits.
Input Signals: 4 event bits, strobe.
Threshold: TTL level.
Pulse Width: 64 clocks minimum.
Maximum Input: 0 V to +5 V (DC + peak AC).
Delay to Analog Out: ≤384 clock +20 ns.
Impedance 2.2 kΩ, pull-up to +5 V.
Connector: Rear-panel 9-Pin D-sub.

CH1 ADD Input –
Input Voltage Range: –1 V to 1 V (DC + peak AC).
Impedance: 50 Ω.
Bandwidth (–3 dB): DC to 200 MHz at 1 V_{p-p} input.
Amplitude Accuracy: ±5%.
Connector: Front-panel BNC.

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.

External Sample Clock In

Input Voltage Range – 0.25 V_{p-p} to 1 V_{p-p}.

Maximum Input Voltage Range – ±10 V_{max}.

Impedance – 50 Ω, AC coupling.

Frequency Range – 10 MHz to 1 GHz.

Duty Cycle Ratio – 40% to 60%.

Pulse Width – 0.5 ns minimum.

Connector – Rear panel BNC.

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 – 10.0 GB (standard).

Floppy Disk Drive – 3.5 in., 1.44 MB.

Option 10 – Substitute flash disk (78 MB) for HDD, add standby switch. (Opt. 10 is best suited for ATE and system usage requiring 7x24 hour operation.)

Environmental, EMC, Safety

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

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

Shock (test limits) – Nonoperating: 294 m/s^2 (30 G), half-sine, 11 ms duration.

EMC Compliance –
EN50081-1.
EN50082-1.
FCC Part 15, Subchapter B Class A.
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 –
AWG510: 400 W at 5 A (standard).
AWG520: 600 W at 8 A maximum.

Physical Characteristics

Dimensions	mm	in.
Height	178	7.0
Width	422	17.5
Depth	560	25.8
Weight	**kg**	**lbs.**
Net	17	37.5

Warranty – One year parts and labor.

Other

Programmable Interface –
GPIB: 24-Pin IEEE488.1 connector.
Ethernet: 10Base-T, RJ-45 connector.

Keyboard Connector – 6-Pin mini-DIN connector.

Arbitrary Waveform Generator

AWG500 Series

Ordering Information

AWG510

Programmable Single-channel Arbitrary Waveform Generator.

AWG520

Programmable Dual-channel Arbitrary Waveform Generator.

Both Include: User manual (071-0099-00), Programmer manual (071-0100-00), GPIB programming examples disk (063-2982-00), sample waveform library disk (063-2981-00), performance verification disk (063-2983-00), power cord, fuse (159-0239-00). Please specify power plug when ordering.

Recommended Accessories

Service Manual – Order 071-0101-01.

Protective Cover – Order 200-3696-01.

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 011-0049-02.

800 MHz BNC Low-pass Filter – Order 015-0660-00.

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.

Rackmount Conversion Kit – Order 016-1675-01.

Keyboard – IBM-compatible 4-Pin mini DIN connector.

Options

Opt. 03 – CH. 2 10-Bit output up to 1 GHz.

Opt. 10 – Flashdisk (78 MB) and standby switch – removes HDD. (Opt. 10 is best suited for ATE and system usage requiring 7x24 hour operation.)

Opt. 1R – Rackmount.

Power Plug Options

Opt. A0 – North America Power.

Opt. A1 – Universal EURO Power.

Opt. A2 – United Kingdom Power.

Opt. A3 – Australia Power.

Opt. A4 – 240 V, North America Power.

Opt. A5 – Switzerland Power.

Service

Opt. C3 – Calibration Service 3 Years.

Opt. D1 – Calibration Data Report.

Opt. D3 – Calibration Data Report 3 Years (with Option C3).

Opt. R3 – Repair Service 3 Years.

Warranty

One year parts and labor.

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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.

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