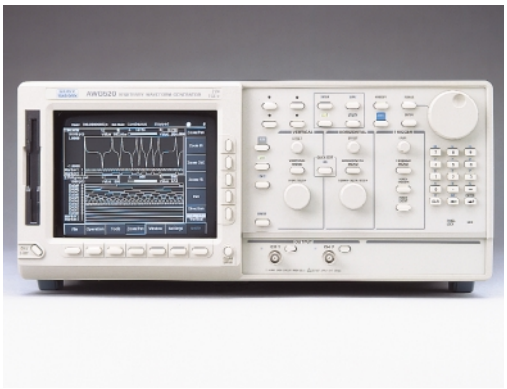
Arbitrary Waveform Generator

AWG 510 • AWG 520



Features and Benefits

External Clock Input Permits Jitter Insertion and Synchronization

One or Two Channels with 10-bit Vertical Resolution

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

Real-time Noise Generation

Supports Direct External Clock and 10 MHz Reference Input

Waveform Transfers from DSO

File Transfers from GPIB, Floppy Disk, or 10Base-T Ethernet

On-Screen Waveform Editing for Ease-of-Use

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

Built-in 3 GB Hard Drive for Mass Data Storage

User Modified Isolation Pulse for Disk Drive Testing

Optional 78 MB Flash Disk for ATE Applications

Applications

Communications Design and Test:
- Low Frequency Modulated RF
- 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

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

As a member of the Tektronix family of arbitrary generators, the AWG 500 Series is a high performance, mixed-signal source. The AWG 500 Series provides 1 GS/s sample clock rate and 4 Mword execution memories.

Its unique design integrates a graphical editing display with the most powerful hardware output capabilities available. This allows on-screen viewing of waveform editing and simplifies "what-if" test scenarios by easily allowing the creation of composite signals.

The AWG 500 uses a graphical user interface to overcome the historical difficulties associated with developing arbitrary and complex waveforms. Several intuitive and powerful techniques are built-in to develop and edit custom waveforms.

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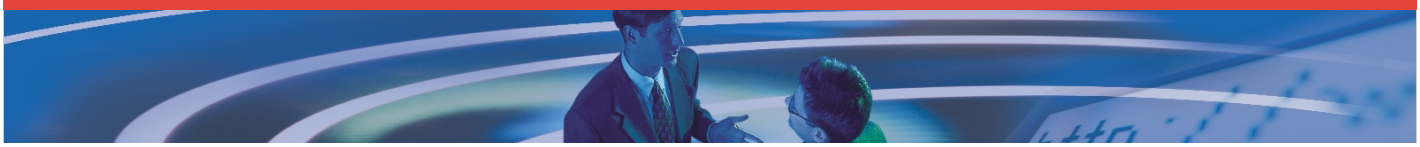

The standard AWG 510 configuration provides up to 2 V output or 4 V into a differential input with the complementary output, each with 10-bits vertical resolution. Option 03 adds an independent 10-bit-wide digital data port which can be used in conjunction with the marker outputs for data generation up to 12-bits wide at up to 1 GHz (14-bits AWG 520).

The standard AWG 520 configuration provides 2 channels. Each channel provides 10-bit vertical resolution with amplitudes up to 2 V_{p-p}.

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 (AWG 520).
Sequence Repeat Counter – 1 to 65,536 or infinite.

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 –
AWG 510: Complementary; CH1 and $\overline{CH1}$.
AWG 520: Single-ended; CH1 and CH2.

DA Converter –
Resolution: 10 bits.
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:
AWG 510: 2.
AWG 520: 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%):
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%):
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.

DATA STORAGE

Internal Hard Disk Drive – 3 GB (standard).
Floppy Disk Drive – 3.5 in., 1.44 MB.
Opt. 10 – Substitute Flash Disk (78 MB) for HDD, add standby switch.

ENVIRONMENTAL, EMC, SAFETY

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

Humidity –
Operating: 20 to 80%, non-condensing.
Nonoperating: 5 to 90%, non-condensing.

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 duration.
Nonoperating: 2.28 g RMS from 5 to 500 Hz, 10 minutes duration.

Shock (test limits) –
Nonoperating: 294 m/s2 (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 –
AWG 510: 400 W at 5 A (standard).
AWG 520: 600 W at 8 A maximum.

Physical Characteristics

Dimensions	mm	in.
Height	178	7.6
Width	422	17.5
Depth	560	25.8
Weight	**kg**	**lb.**
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.

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 Cable (U.S. 115 V), Fuse (159-0239-00).

OPTIONS

Opt. 03 – Ch 2 10-bit output up to 1 GHz.

Opt. 10 – Flashdisk (78 MB) and standby switch – removes HDD.

Opt. 1R – Rack mount.

INTERNATIONAL POWER PLUGS

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

Opt. A2 – UK 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

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.

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

For further information, contact Tektronix:

Worldwide Web: for the most up-to-date product information visit our web site at: www.tektronix.com/Measurement/signal_sources/

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