Arbitrary Waveform Generators

AWG520

Features & Benefits
- Two Channels with 10-Bit Vertical Resolution
- Independent 10-Channel, 1 GHz Digital Data Generation (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 10 GB Hard Drive for Mass Data Storage that Can Optionally Be Made Removable for Secure Applications (using Opt. 11)
- Optional 128 MB Flash Disk for ATE Applications (Opt. 10)
- Replace Standard Function and Sweep Generators in Wide Range of 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

AWG520 Solves Communications Physical Layer and Media Storage Design and Test Challenges

The AWG520’s 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 AWG520’s 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 14-bits wide at up to 1 GHz (14-bits, AWG520). Direct waveform transfer capability makes the AWG520 the perfect complement to selected Tektronix oscilloscopes.

The AWG520 can easily generate telecom signals which complement masks from a digital oscilloscope.

1 Arbitrary Waveform Generators • www.tektronix.com/signal_sources
Arbitrary Waveform Generators

AWG520

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.
- **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 Vp-p to 2 Vp-p 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** – Range: –360° to +360°. Resolution: 1.000 Hz to 100.0 Hz; 0.030° step. 100.01 Hz to 1.000 MHz; 0.36° step. 1.001 MHz to 5.000 MHz; 1.8° step. 5.001 MHz to 10.000 MHz; 3.6° step. 10.001 MHz to 20.000 MHz; 7.2° step. 20.001 MHz to 25.000 MHz; 9° step. 25.001 MHz to 40.000 MHz; 14.4° step. 40.001 MHz to 50.000 MHz; 18° step. 50.001 MHz to 100.0 MHz; 36° step.
- **Polarity** – Normal, Invert.
- **Duty Cycle** – Range: 0.1% to 99.9%, Pulse waveform only. Resolution: 0.1% to 99.9%
- **Aberrations** – Amplitude: ±10%; Accuracy: ±0.1%.

**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.
- **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** – 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, ≤5.0 ns.
  - Fall time (10 to 90%): Amplitude >1.0 V, ≤0.5 ns; Amplitude ≤1.0 V, ≤1.0 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.
- **Noise** – ≤–53 dBc.
- **Phase Noise** – ≤–80 dBc/Hz at 1 kHz offset.

**Filter**

- **Type** – 10, 20, 50, 100 MHz Bessel low-pass.
- **Amplitude** – 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 Vp-p (with –0.27 V offset) into 50 Ω.
- **Amplitude Accuracy** – ±10%.
- **DC Offset Accuracy** – ≤±0.27 V (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.

Channel Output Summary

<table>
<thead>
<tr>
<th>Output Type</th>
<th>AWG520</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog</td>
<td>2</td>
</tr>
<tr>
<td>Complement</td>
<td>N/A</td>
</tr>
<tr>
<td>Marker</td>
<td>CH1: M1, M2, CH2: M1, M2</td>
</tr>
<tr>
<td>Digital (Opt. 03)</td>
<td>2 Analog (CH2 Analog = D9 to D9, CH1 and CH2 Analog independent), D0 to D9, 4 Markers</td>
</tr>
</tbody>
</table>
**Arbitrary Waveform Generators**

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### Auxiliary Outputs

**Marker**
- **Number:** AWG520: 4.
- **Level:**
  - Hi Lo: –2.0 V to 2.0 V (0.05 Vp-p to 4 Vp-p) into 50 Ω.
  - 4.0 V to 4.0 V (0.1 Vp-p to 8 Vp-p) into 1 MΩ.
- **Resolution:** ±0.5 V.
- **Accuracy:** ±0.1 V ±5% of setting.

**Input Voltage Range:**
- **Polarity:** POS or NEG.
- **Impedance:** 1 kΩ.

**Trigger In**
- **Polarity:** POS or NEG.
- **Impedance:** 50 Ω.

**Auxiliary Inputs**
- **Polarity:** POS or NEG.
- **Input Voltage Range:**
  - 1 kΩ: ±10 V.
  - 50 Ω: ±5 V.

**Trigger Out**
- **Level:** ±10 V.
- **Impedance:** 50 Ω.

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### 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 gpeak from 5 to 500 Hz, 10 minutes duration.
- **Nonoperating:** 2.28 gpeak from 5 to 500 Hz, 10 minutes duration.

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

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### Physical Characteristics

**Dimensions**
- **Weight:**
  - **kg:** 17
  - **lbs:** 37.5

**Power Consumption**
- **600 W at 8 A maximum.**

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### Power Consumption

**Source Power**
- **Line Voltage Range:** 100 to 240 VAC.
- **Line Frequency:** 48 to 63 Hz.

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### Warranty

**One year parts and labor.**

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### Keyboard Connector
- **6-Pin mini-DIN connector.**
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Ordering Information

Programmable Dual-channel Arbitrary Waveform Generator.
Includes: User manual (071-0099-00), Programmer manual (071-0100-00), GPIB programming examples disk (063-2982-00), sample waveform laboratory disk (063-2981-00), AXW100 ArbExpress Software Utility CD (063-3763-00), performance verification disk (063-2983-00), power cord, fuse (159-0239-00). Please specify power plug when ordering.

Recommended Accessories

Protective Cover – Order 200-3696-01.
GPIB Cable – Order 012-0991-01.
50 Ω BNC Cable (36-inch) – Order 012-1341-00.
50 Ω BNC Cable (98-inch) – 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.
Spare Removable Hard Disk Kit – Order 650-4643-00 (Opt. 11 must be installed).

Options

Opt. 03 – CH. 2 10-Bit output up to 1 GHz.
Opt. 10 – Flashdisk (128 MB) and standby switch – removes HDD.
Opt. 11 – Removable Hard Disk (exclusive to Option 10 and/or Option 3).
Opt. 1R – Rackmount.

Power Plug Options


Service

Opt. C5 – Calibration Service 5 Years.
Opt. D3 – Calibration Data Report 3 Years (with Option C3).
Opt. D5 – Calibration Data Report 5 Years (with Option C5).

Warranty

One year parts and labor.

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