Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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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.
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 $V_{pp}$.

### 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 6,5536 or infinite.

#### CLOCK GENERATOR

**Sampling Frequency** – 50.000000 kHz to 1,000,000 kHz.

**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 CH1.
- AWG 520: Single-ended; CH1 and CH2.

**DA Converter** –

- **Resolution**: 10 bits.

**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 ≤1.0 V): 300 MHz.

- **Sine Wave Characteristics** (10 MHz clock, 32 waveforms, 0.1 Vp-p, Through filter):
  - **Amplitude Accuracy**: 0.5 $V_{pp}$ ±10%.
  - **Differential Non-Linearity**: ±1 LSB.
  - **Integral Non-Linearity**: ±1 LSB.
  - **Resolution**: 10 bits.

- **DA Converter – AWG 520**: Single-ended; CH1 and CH2.
  - **Level**: Hi/Lo: –2.0 V to 2.0 V (0.05 $V_{pp}$ to 4 $V_{pp}$) into 50 Ω; –4.0 V to 4.0 V (0.1 $V_{pp}$ to 8 $V_{pp}$) into 1 Ω.
  - **Resolution**: 0.05 V.
  - **Accuracy**: Within ±0.1 V ±5% of setting.

- **Rise/Fall Time (10 to 90%)**:
  - At 1 $V_{pp}$, Hi: +0.5 V/Lo: –0.5 V: 0.5 ns.
  - At 2 $V_{pp}$, Hi: +1 V/Lo: –1 V: 1.0 ns.
  - At 4 $V_{pp}$, 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.

#### AUXILIARY OUTPUTS

**Marker** –

- **Number**: AWG 510: 2.
  - AWG 520: 4.
- **Level**:
  - Hi/Lo: –2.0 V to 2.0 V (0.05 $V_{pp}$ to 4 $V_{pp}$) into 50 Ω; –4.0 V to 4.0 V (0.1 $V_{pp}$ to 8 $V_{pp}$) into 1 Ω.
  - **Resolution**: 0.05 V.
  - **Accuracy**: Within ±0.1 V ±5% of setting.

- **Rise/Fall Time (10 to 90%)**:
  - At 1 $V_{pp}$, Hi: +0.5 V/Lo: –0.5 V: 0.5 ns.
  - At 2 $V_{pp}$, Hi: +1 V/Lo: –1 V: 1.0 ns.
  - At 4 $V_{pp}$, 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 GENERATOR

**Sampling Frequency** – 50.000000 kHz to 1,000,000 kHz.

**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%.

**Direct DA Out** –

- **Output Voltage**: 0.5 $V_{pp}$ (with –0.27 V offset) into 50 Ω.
  - **Amplitude Accuracy**: 0.5 $V_{pp}$ ±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.

#### Filter:

- **Type**: 10, 20, 50, 100 MHz Bessel low-pass.
- **Delay from trigger**: 10 MHz, 77 ns + 1 clock; 20 MHz, 37 ns + 1 clock; 50 MHz, 70 ns + 1 clock; 100 MHz, 142 ns + 1 clock; Through, 37 ns + 1 clock.
- **Rise/Fall Time (10 to 90%)**:
  - Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.7 ns.
- **Accuracies**:
  - ±10%; Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.7 ns.

#### Digital Data Out (Opt. 03) –

**Output Signals**: D0 to D9 (10 bits).

- **Level**:
  - Hi/Lo: –2.0 V to 2.0 V (0.1 $V_{pp}$ to 4 $V_{pp}$) into 50 Ω; –4.0 V to 4.0 V (0.2 $V_{pp}$ to 8 $V_{pp}$) into 1 Ω.
  - **Resolution**: 0.1 V.
  - **Accuracy**: Within ±0.1 V ±5% of setting.

- **Rise/Fall Time (10 to 90%)**:
  - At 1 $V_{pp}$, Hi: +0.5 V/Lo: –0.5 V: 0.5 ns.
  - At 2 $V_{pp}$, Hi: +1 V/Lo: –1 V: 1.0 ns.
  - At 4 $V_{pp}$, 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.

#### CONNECTOR

**Output Impedance** – 50 Ω.

**Connector** – Front Panel BNC.

- **Level**: ECL 100 K compatible.
- **Connector**: Rear-panel SMB.

**Data to marker**: 4.4 ns.

**Clock to data**: 3.7 ns.

**Connector**: Rear-panel SMB.
**Characteristics**

### 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 Vp-p input.
- Amplitude Accuracy: ±5%.
- Connector: Front-panel BNC.

**Reference 10 MHz Clock IN**
- Input Voltage Range: 0.2 V to 3.0 Vp-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 Vp-p to 1 Vp-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)**
- Operating: 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 2064.1/2.
- Safety – UL61010-1, 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

<table>
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<th>Dimensions</th>
<th>mm</th>
<th>in.</th>
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<td>Height</td>
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</table>

### 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.
**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.

**INTERNATIONAL POWER PLUGS**

**RECOMMENDED ACCESSORIES**
- 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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