Arbitrary Waveform Generators

AWG7000B Series Data Sheet

Features & Benefits

- 12 GS/s (24 GS/s) and 6 GS/s Models
- 9.6 GHz Effective RF Frequency Output
- 1 or 2 Arbitrary Waveform Outputs
  - Accurate Timing with only 20 ps_{p-p} Total Jitter (at 10^{-12} BER, Typical)
  - 35 ps Tr/Tf (20% to 80%)
  - ±100 ps Range (1 ps Resolution) Interchannel Skew Control
- 2 or 4 Variable-level Marker Outputs
  - Accurate Timing with only 30 ps_{p-p} Total Jitter (at 10^{-12} BER, Typical)
  - 45 ps Tr/Tf (20% to 80%)
  - Up to 300 ps Range (1 ps Resolution) Delay Control
- Vertical Resolution up to 10 bit Available: 10 bit (No Marker Output) or 8 bit (with Two Marker Outputs)
- Up to 64M (64,800,000) Point Record Length provides Longer Data Streams
- Down to 100 fs Resolution Edge Timing Shift Control
- 16,000 Step Sequencing Creates Infinite Waveform Loops, Jumps, and Conditional Branches
- Real-time Sequencing Creates Infinite Waveform Loops, Jumps, and Conditional Branches
- Intuitive User Interface Shortens Test Time
- Integrated PC Supports Network Integration and provides a Built-in DVD, Removable Hard Drive, LAN, and USB Ports

Applications

- High-speed Serial Communications
  - Up to 12 Gb/s Data Rate as a Binary Data Source (2x Oversampling, Interleaved)
  - Up to 8 Gb/s Data Rate as a Universal Direct Synthesis Source (3x Oversampling, Interleaved)
  - 64M Point (Standard) and 128M Point (Optional) Memory Record Length Enables Generation of Longer Waveforms
  - Provides any Profile Multilevel Signals to allow Timing (Jitter) Margin Testing without External Power Combiners
- Wideband RF for Communications and Defense Electronics
  - Wideband Modulated Arbitrary Direct RF Output up to 9.6 GHz
  - Ultra Wideband (UWB) IQ/IF Signal Generation with 2-channel, 12 GS/s, and 10 bit Resolution
  - Direct RF Generation of all WiMedia Band Groups (BG1 to BG6)
- Disk Drive (Magnetic/Optical) Read/Write:
  - Up to 6 Gb/s Data Rate (2 points/cell) or 42 ps Timing Resolution
- Mixed-signal Design and Test:
  - 2-channel Analog plus 4-channel Marker Outputs
- High-speed, Low-jitter Data/Pulse and Clock Source
- Real-world, Ideal, or Distorted Signal Generation – Including all the Glitches, Anomalies, and Impairments
- Playback of Oscilloscope Captured Signals, Including Enhancements such as Adding Predistortion Effects
- Waveform Vectors Imported from Third-party Tools such as MathCAD, MATLAB, Excel, and Others

Tektronix®

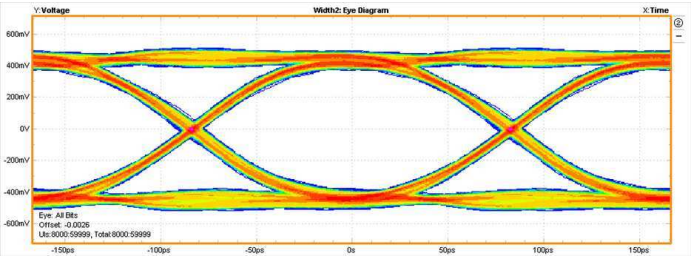


Figure 1: 24 GS/s, 6 Gb/s SATA Gen3 test signal, AWG7122B Option 06.

Industry's Best Mixed-signal Stimulus Solution for Ever-increasing Measurement Challenges

The AWG7000B Series arbitrary waveform generator delivers a unique combination of superior signal stimulus, unrivaled sample rate, bandwidth, and uncompromised usability.

This family offers the industry's best solution to the challenging signal stimulus issues faced by designers verifying, characterizing, and debugging sophisticated electronic designs.

The direct synthesis signal generation enables a variety of signal outputs including multilevel, pre/de-emphasis, jitter (Rj, Pj, ISI, DCD), SSC, and wander elements.

With sample rates from 6 GS/s to 24 GS/s (with up to 10 bit resolution), together with one or two output channels, the toughest signal generation challenges in the high-speed serial communication and wideband RF applications can easily be solved. The open Windows (Windows XP) based instruments deliver ease-of-use and allow unparalleled connectivity with peripherals and compatibility with third-party software.

Application Examples

The need for performance arbitrary waveform generation is broad and spans over a wide array of applications. With the AWG7000B Series, Tektronix' industry-leading arbitrary waveform generators represent a cutting edge benchmark in performance, sample rate, signal fidelity, and timing resolution.

The ability to create, generate, or replicate either ideal, distorted, or "real-life" signals is essential in the design and testing process. Signal generation with controllable rise and fall times, noise or jitter; pre-emphasis, multilevel, and mixed signals; wideband RF, and fast-changing signals are just some of the capabilities of the AWG7000B Series.

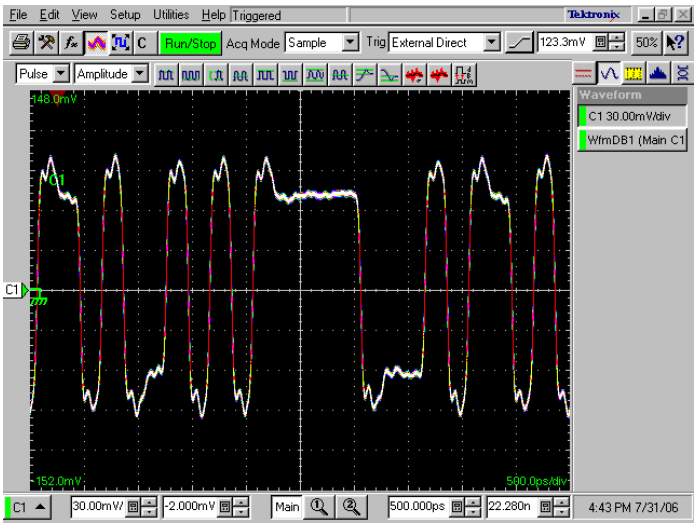


Figure 2: For 5 Gb/s De-emphasis signal output by 20 GS/s.

High-speed Serial Signal Generation

With increasing transmission speeds and to compensate for frequency characteristics of "lossy" media, the technique of pre/de-emphasis is increasingly applied. Serial data standards such as PCI Express and others have also included pre/de-emphasis tests as a requirement to meet the respective compliance test specification.

The basic theory of pre-emphasis is that for any series of bits of the same value, the first bit always has a higher voltage level than the following bits. By doing so, frequency characteristics of transmission lines can be compensated thus the signal fidelity at the receiver side increased.

The AWG7000B Series, with its performance and analog output, enables users to directly generate pre/de-emphasized signals for next-generation serial data standards. It also enables users to generate 3-level signals as required for SATA Out-of-Band (OOB) testing.

The direct generation of such signals provides an increased signal quality and avoids cumbersome signal generation done through multiple channels and a power combiner. See Figure 1 and Figure 2.

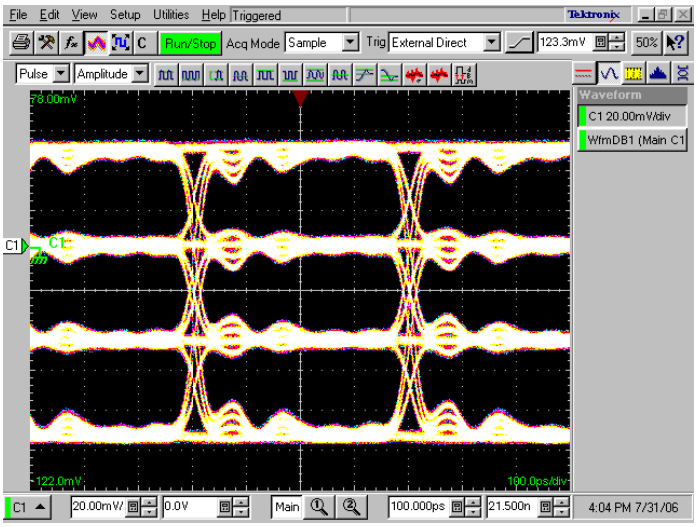


Figure 3: 20 Gb/s 4-PAM signal (5 GS/s; AWG7121B).

Multilevel Signal Generation

The requirements for serial interfaces are continuously increasing. Higher and higher data rates are required, and the performance of cables and circuits is moving closer to their theoretical limits. One technique to increase the data rate without increasing the transition rate is by applying multilevel signals, wherein a signal can assume more than the standard binary 2 levels.

In multilevel signaling one can think of multilevel discrete amplitudes of a signal. This phenomenon is known as Pulse Amplitude Modulation (PAM). A 4-PAM signal, a signal with 4 different amplitudes, increases the data rate by four without increasing the transition rate of the signal. Multilevel signals are not only applied for data transmission. Multilevel memory chips, storing more than a single bit in an individual memory element, are being produced and multilevel coding of data for storage on optical disks is being considered as an efficient way to increase storage capacity.

The AWG7000B Series enables you to test your latest design by generating any kind of mixed or multilevel signal. See Figure 3.

Figure 4: Hard disk read channel signal (5 Gb/s 2 points per cell); AWG7121B with 10 GS/s.

Signal Generation for Storage Device Testing

Increasing capacity requirements for storage devices leads to the development of newer and faster read-and-write strategies for both magnetic and optical mediums. Multilevel coding of data for storage on optical disks is also considered as an efficient way to increase storage capacity.

The AWG7000B Series with its ability to generate an accurate reproduction of the R/W signals, enables users to design, develop, and test the latest storage devices. With sample rates up to 24 GS/s, and the generation of up to 6 signals (2 analog plus 4 Marker) with a clock timing resolution of 100 ps, the AWG7000B Series represents a new benchmark for the storage industry. See Figure 4.

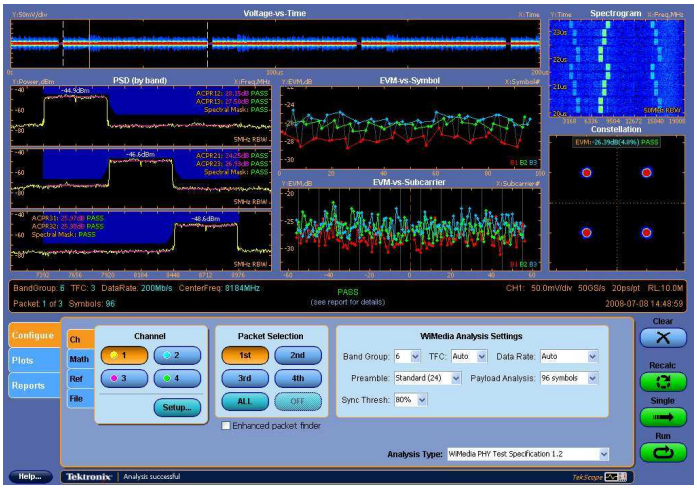
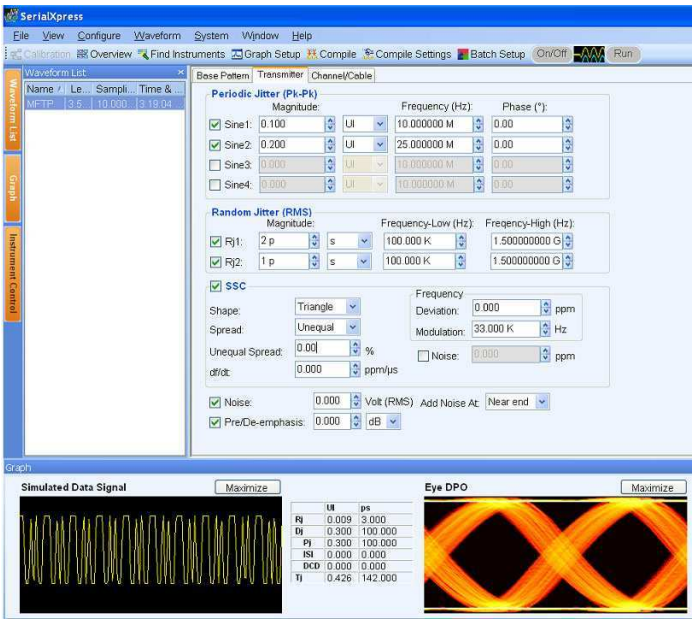


Figure 5: Direct WiMedia signals are easily created with RFXpress and the AWG7122B with Option 06 Interleaving.

Wideband RF Signal Generation

In the RF world, technologies ranging from a wireless mouse to a satellite image require test equipment that can provide enough sample rate and resolution to recreate even the most complex RF behavior. The latest digital RF technologies often exceed the capabilities of current test instruments because of the need to generate the wide-bandwidth and fast-changing signals that are increasingly seen in many wireless applications such as UWB, radar, and others.

The AWG7000B Series enables the direct generation of RF signals, using the D/A converter, up to an effective frequency of 9.6 GHz and with the capability to add real-world signal anomalies. The direct generation of IF or RF signals avoids I/Q degradations and lengthy adjustments associated with traditional methods using I/Q modulators. See Figure 5.

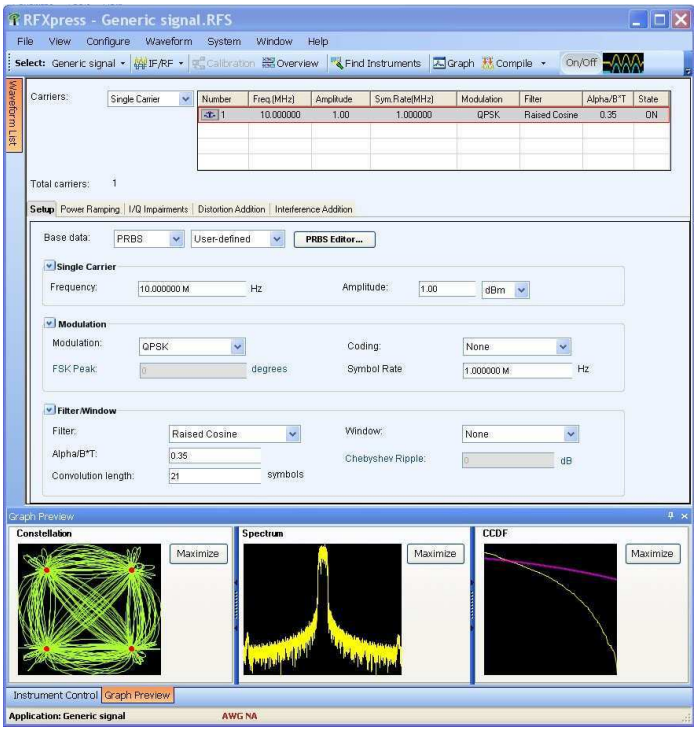


Additional Software Application Tools Extending Waveform Generation

SerialXpress® (SDX100)

SerialXpress enables creation of the exact waveforms required for design validation, margin/characterization, and conformance testing of high-speed serial data receivers. It considerably simplifies signal creation and jitter simulations, thus reducing overall development and test time. In addition to supporting the generation of jitter (Random, Periodic (sinusoidal), ISI, and DCD) SerialXpress also supports SSC, pre-emphasis, and random noise addition, providing users the ability to create combinations of various impairments simultaneously to stress receiver designs.

SSC also supports custom profiles and df/dt for stressing PLL designs. A programmatic interface enables easy integration of SerialXpress into test automation systems.



RFXpress® (RFX100)

RFXpress® is a software package that synthesizes digitally modulated baseband, IF, and RF signals. It takes IQ, IF, and RF signal generation to the next level and fully exploits the wideband signal generation capabilities of Arbitrary Waveform Generators (AWGs). Supporting a wide range of modulation formats, as well as the symbol map functions, the software allows users to define a wide variety of unique modulation and frequency-hopping schemes.

SPARA is an option for RFXpress that provides emulation of RF components from touchstone files. You can cascade multiple touchstone files to emulate a RF chain. The effect of the RF component can also be de-embedded by selecting the Inversion option. This option also adds a provision to characterize a two-port device (DUT). A wizard guides you through a step-by-step process to obtain S21 characteristics (Insertion Loss) of the device in a text format.

The RFXpress calibration feature predistorts the signal to provide flat frequency and linear phase response out of the AWG. Additionally you also have a provision to calibrate the image between fs/2 and fs thus providing a flat response for the undersampled signals.

The UWB-WiMedia signal creation module for RFXpress (see Figure 4), has the capability to digitally synthesize and generate direct RF signals for all the band groups of the UWB spectrum. The latest WiMedia specification defines UWB signals that are communicated over a 1.5 GHz modulation bandwidth, includes complex preamble synchronization sequences, and can operate in both hopping (TFI) and nonhopping (FFI) modes. All six band groups (BG1 to BG6) can be generated in a variety of ways including band hopping in either IQ, IF, or direct RF generation. The conformance mode allows users to generate signals that conform to WiMedia's specifications, while the custom mode enables users to add complex adjustments to the signals for stress and margin testing.

Radar Signal Creation is a software module for RFXpress that gives you the ultimate flexibility in creating pulsed radar waveforms. It gives you the ability to build your own radar pulse suite starting from pulse-to-pulse trains to pulse groups. It supports a variety of modulation schemes including LFM, Barker and Polyphase Codes, User-defined codes, Step FM, Nonlinear FM, User-defined FM, and Custom modulation. It also has the ability to generate pulse trains with staggered PRI to resolve Range and Doppler ambiguity, frequency hopping for Electronic Counter-Counter Measures (ECCM), and pulse-to-pulse amplitude variation to simulate Swerling target models including antenna scan patterns and multipath effects.

Both RFXpress and SerialXpress are powerful, easy-to-use software packages to synthesize high-speed serial data and RF signals respectively for Arbitrary Waveform Generators (AWG). They run as an integral part of the AWG7000B Series arbitrary waveform generators or from an external PC.

For more details on RFXpress and SerialXpress visit www.tektronix.com

Characteristics

Arbitrary Waveforms

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Arbitrary Waveform Output				
Digital-to-Analog Converter				
Resolution	10 bit (no marker output) or 8 bit (2 channel markers available, each channel selectable)			
Number of Outputs	2	1	2	1
Output Type	Differential			
Output Impedance	50 Ω			
Output Connector Type	SMA (front panel)			
Sampling Rate				
(Standard)	10 M to 12 GS/s	10 M to 12 GS/s	10 M to 6 GS/s	
(Option 06)	12 G to 24 GS/s			
Frequency Characteristics				
Effective RF Freq Out (Fmax)	Fmax determined as the lower of “Effective bandwidth (-6 dB)” or “Max sampling rate / 2.5 points per cycle”			
Standard (Typical)	3.5 GHz		2.4 GHz	
Option 02 (Typical)	N/A	4.8 GHz	N/A	
Option 06 (Typical)	9.6 GHz	N/A	N/A	
Effective Freq Switching Time	Minimum frequency switching time (from selected frequencies F_1 to F_2) is determined as ”1 / Fmax”			
Standard (Typical)	170 ns		300 ns	
Option 02 (Typical)	N/A	170 ns	N/A	
Option 06 (Typical)	400 us	N/A	N/A	
Option 08 (Typical)	286 ps		417 ps	
Option 02/08 (Typical)	N/A	208 ps	N/A	
Option 06/08 (Typical)	104 ps	N/A	N/A	
Amplitude Characteristics				
Rise-time Bandwidth (-3 dB)	Bandwidth converted from rise time (0.35/Tr, as gaussian transition) characteristics through analog output and filtering circuitry			
Standard (Typical)	Normal: 750 MHz Direct: 3.5 GHz			
Option 02 (Typical)	N/A	7.5 GHz	N/A	
Option 06 (Typical)	7.5 GHz	N/A	N/A	
Standard Output				
Low Pass Filter	Normal: 50 MHz, 200 MHz (Bessel type) Direct: N/A			
Amplitude				
Range	Normal: 50 mV to 2.0 V_{p-p} Direct: 50 mV to 1.0 V_{p-p}			
Resolution	1 mV			
Accuracy	±(3.0% of amplitude ± 2 mV) at offset = 0 V			
Offset				
Range	Normal: -0.5 V to +0.5 V Direct: N/A			
Resolution	1 mV			
Accuracy	±(2% of offset ± 10 mV) at minimum amplitude			

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Distortion Characteristics				
	12 GS/s clock, 32 waveform points, 375 MHz signal frequency, 1.0 V amplitude		6 GS/s clock, 32 waveform points, 187.5 MHz signal frequency, 1.0 V amplitude	
Harmonic Distortion	Normal: ≤ -35 dBc Direct: ≤ -42 dBc		Normal: ≤ -40 dBc Direct: ≤ -45 dBc	
Nonharmonic Spurious	≤ -50 dBc (DC to 6 GHz)		≤ -50 dBc (DC to 3.0 GHz)	
Spurious Free Dynamic Range	12 GS/s clock, Amplitude: 1 V_{p-p}, Offset: 0 V 10 bit DAC operational mode, DC to 6 GHz		6 GS/s clock, Amplitude: 1 V_{p-p}, Offset: 0 V 10 bit DAC operational mode, DC to 3 GHz	
(Typical)	Normal: 45 dBc Direct: 45 dBc (at 375.0 MHz)		Normal: 51 dBc Direct: 51 dBc (at 187.5 MHz)	
Phase Noise	12 GS/s clock, Amplitude: 1 V_{p-p}, Offset: 0 V Carrier Frequency: 375.0 MHz		6 GS/s clock, Amplitude: 1 V_{p-p}, Offset: 0 V Carrier Frequency: 187.5 MHz	
(Typical)	≤ -90 dBc/Hz at 10 kHz offset		≤ -90 dBc/Hz at 10 kHz offset	
Random Jitter	1010 clock pattern			
RMS (Typical)	Normal: 1.6 ps Direct: 0.9 ps			
Total Jitter	2^{15-1} PN data pattern (at 10^{-12} BER)			
Peak-to-Peak ($_{p-p}$) (Typical)	Normal: 50 ps at 0.5 Gb/s Direct: 30 ps at 6 Gb/s			
Pulse Characteristics				
Pulse Response				
Rise/Fall Time (20 to 80%)	Normal: 350 ps (at 2.0 V_{p-p}) Direct: 75 ps (at 1.0 V_{p-p})			
Timing Skew (Typical)	Less than 20 ps (between each channel (+) Pos and (-) Neg output)			
Delay from Marker Output	Direct: 0.5 ns Normal + 50 MHz: 9.7 ns Normal + 200 MHz: 3.9 ns Normal + Through: 2.1 ns			

Option 02/06 Output

Characteristic	AWG7122B		AWG7121B
	(Interleave mode)	(Noninterleave mode)	
Low Pass Filter		N/A	
Zeroing Control	On or Off	NA	
Amplitude			
Range	Zeroing On: 250 mV_{p-p} to 0.5 V_{p-p}, Zeroing Off: 500 mV_{p-p} to 1.0 V_{p-p}	500 mV to 1.0 V_{p-p}	
Resolution		1 mV	
Accuracy	Zeroing On: Within ±(40% of amplitude + 2 mV) Zeroing Off: Within ±(8% of amplitude + 2 mV)	±(2.0% of amplitude ± 2 mV)	
Offset		NA	
Distortion Characteristics			
	24 GS/s clock, 32 waveform points, 750 MHz signal frequency	12 GS/s clock, 32 waveform points, 375 MHz signal frequency, 1.0 V_{p-p}	
Harmonic Distortion	Zeroing On: ≤ -40 dBc (0.5 V_{p-p}), Zeroing Off: ≤ -40 dBc (1 V_{p-p})	≤ -42 dBc	
Nonharmonic Spurious	Zeroing On: ≤ -45 dBc (0.5 V_{p-p}), Zeroing Off: ≤ -45 dBc (1 V_{p-p}), DC to 6 GHz	≤ -50 dBc, DC to 6 GHz	
Spurious Free Dynamic Range	24 GS/s clock, 10 bit DAC operation mode, DC to 12 GHz	12 GS/s clock, Amplitude: 1 V_{p-p}, 10 bit DAC operational mode, DC to 6 GHz	
(Typical)	Zeroing On: 30 dB, Zeroing Off: 40 dB, (3.0 GHz)	44 dB (at 375 MHz), 48 dB (at 187.5 MHz)	
Phase Noise	24 GS/s clock, 750.0 MHz	12 GS/s clock, Amplitude: 1 V_{p-p} Carrier Frequency: 375.0 MHz	
(Typical)	Zeroing On: ≤ -85 dBc/Hz (0.5 V_{p-p}), Zeroing Off: ≤ -85 dBc/Hz (1 V_{p-p}) at 10 kHz offset	≤ -90 dBc/Hz at 10 kHz offset	
Random Jitter		1010 clock pattern	
RMS (Typical)		0.9 ps	
Total Jitter		2^{15} - 1 PN data pattern (at 10^{-12} BER)	
Peak-to-Peak ($_{p-p}$) (Typical)		20 ps at 2 G to 12 Gb/s	
Pulse Characteristics			
Pulse Response			
Rise/Fall Time (20 to 80%)		35 ps (at 1.0 V_{p-p})	
Timing Skew (Typical)		Less than 12 ps (between each channel (+) Pos and (-) Neg output)	
Delay from Marker Output	0.9 ns	1.2 ns	0.2 ns
Interleave Skew / Level Adjustment	Skew: ±180 degree against sample rate (e.g.: 24 GS/s: 83 ps = 360 degree) with 0.1 degree resolution, Amplitude: 1 mV resolution	NA	
Output Frequency Response		Refer to Figure 6	
	Amplitude relative to 100 MHz, measured by harmonics of pulse waveform. Includes sin(x)/x roll-off, sample rate 24 GS/s	(Amplitude relative to 100 MHz, measured by harmonics of pulse waveform. Includes sin(x)/x roll-off), sample rate 12 GS/s	
	Zeroing On: 500 MHz: -0.5 dB, 1 GHz: -0.5 dB, 2 GHz: -1.0 dB, 3 GHz: -1.5 dB, 4 GHz: -1.9 dB, 5 GHz: -2.7 dB, 6 GHz: -3.5 dB, 7 GHz: -4.0 dB, 8 GHz: -4.5 dB, 9 GHz: -5.7 dB, 10 GHz: -6.8 dB, 11 GHz: -8.0 dB Zeroing Off: 500 MHz: -0.5 dB, 1 GHz: -0.5 dB, 2 GHz: -1.4 dB, 3 GHz: -1.9 dB, 4 GHz: -2.7 dB, 5 GHz: -4.8 dB, 6 GHz: -6.6 dB, 7 GHz: -8.2 dB, 8 GHz: -10.4 dB, 9 GHz: -14.0 dB, 10 GHz: -18.0 dB, 11 GHz: -25.0 dB	500 MHz: -0.5 dB, 1 GHz: -0.5 dB, 2 GHz: -1.4 dB, 3 GHz: -1.9 dB, 4 GHz: -2.7 dB, 5 GHz: -4.8 dB, 6 GHz: -6.6 dB	
Level Flatness (Typical)	±2 dB		±2 dB

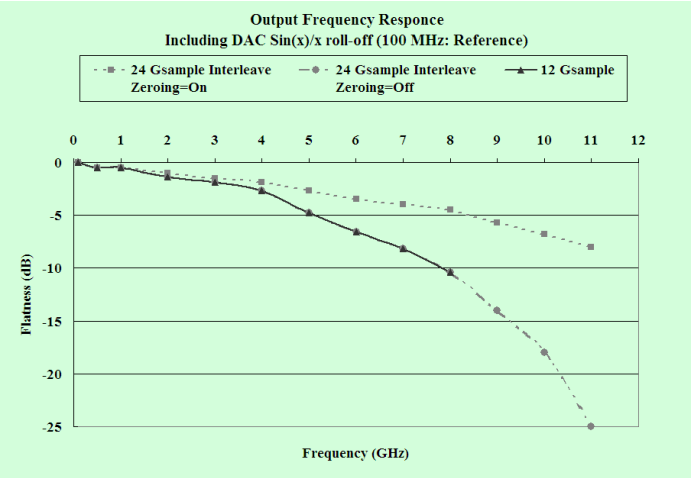


Figure 6: Output Frequency Response Curve.

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Waveform Length	2 to 32,400,000 points (or 2 to 64,800,000 points, Option 01) in multiples of 4 Option 06: Interleave: 2 to 64,800,000 points (or 2 to 129,600,000 points, Option 01) in multiples of 8	2 to 32,400,000 points (or 2 to 64,800,000 points, Option 01) in multiples of 4		
Number of Waveform	1 to 16,000			
Sequence Length	1 to 16,000 steps			
Sequence Repeat Counter	1 to 65,536 or infinite			
Sequence Control	Repeat count, Wait for Trigger, Go-to-N and Jump. The standard model requires “wait for trigger ON” for all sequence step definition, the Option 08 (fast sequence switching) selectable On or Off for each sequence step			
Jump Mode	Synchronous and Asynchronous			
Run 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, LAN, or manual trigger is received			
Gated	Waveform begins output when gate is true and resets to beginning when false			
Sequence	Waveform is output as defined by the sequence			
Sampling Clock				
Resolution	8 digits			
Accuracy	Within ±(1 ppm + Aging), Aging: Within ±1 ppm/year			
Internal Trigger Generator				
Internal Trigger Rate				
Range	1.0 µs to 10.0 s			
Resolution	3 digits, 0.1 µs minimum			
Skew Control between Outputs				
Range	-100 ps to +100 ps	N/A	-100 ps to +100 ps	N/A
Resolution	1 ps	N/A	1 ps	N/A
Skew Accuracy	±(10% of setting + 10 ps)	N/A	±(10% of setting + 10 ps)	N/A
Auxiliary Outputs				
Marker Output				
Number of Outputs	4 (2 per ch)	2	4 (2 per ch)	2
Output Style	Differential			
Output Impedance	50 Ω			
Connector	SMA Front			

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Level (into 50 Ω) (Twice for Hi_Z Input)				
Output Window	-1.4 V to +1.4 V			
Amplitude	0.5 V_{p-p} to 1.4 V_{p-p}			
Resolution	10 mV			
External Termination	-2.8 V to +2.8 V			
Level Accuracy	±(10% of setting + 75 mV)			
Rise/Fall Time (20% to 80%)	45 ps (1.0 V_{p-p}, Hi: +1.0 V, Low: 0 V)			
Marker Timing Skew				
Intra-skew	<13 ps (between each channel (+) Pos and (-) Neg output) (typical)			
In Same Channel	<30 ps (between Marker 1 and Marker 2 output) (typical)			
Delay Control between Markers				
Range	0 to 300 ps			
Resolution	1 ps			
Accuracy	±(5% of setting + 50 ps)			
Random Jitter	1010 clock pattern			
RMS (Typical)	1 ps			
Total Jitter	2^{15} - 1 PN data pattern (at 10^{-12} BER)			
Peak to Peak (p-p): (Typical)	30 ps			
10 MHz Reference Out				
Amplitude	1.2 V_{p-p} into 50 Ω. Max 2.5 V_{p-p} open			
Impedance	50 Ω, AC coupling			
Connector	BNC Rear			
DC Outputs				
Number of Outputs	4: Independently controlled outputs			
Range	-3.0 V to +5.0 V			
Resolution	10 mV			
Output Voltage Accuracy	±(3% of the setting + 120 mV)			
Max Current	±30 mA			
Connector	2 × 4 pin header on front panel			

Auxiliary Inputs

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Trigger / Gate In				
Impedance	1 kΩ or 50 Ω			
Polarity	POS or NEG			
Connector	BNC Front			
Input Voltage Range	1 kΩ: ±10 V 50 Ω: ±5 V			
Threshold				
Level	-5.0 V to 5.0 V			
Resolution	0.1 V			
Trigger to Output Uncertainty				
Asynchronous between Internal/External Clock and Trigger Timing (Typical)	0.7 ns at 10 GS/s 0.8 ns at 9 GS/s 1.0 ns at 6 GS/s			
Synchronize between External Clock and Trigger Timing (Typical)	12 GS/s, x1 clock divider, synchronous trigger mode with specific timing: 50 ps_{p-p}, 10 ps_{RMS}			
Synchronize between External 10 MHz Reference and Trigger Timing (Typical)	12 GS/s setting, synchronous trigger mode with specific timing: 120 ps_{p-p}, 30 ps_{RMS}			
Synchronize between External Variable Reference and Trigger Timing (Typical)	2^N (N: integer) Clock setting of reference, synchronous trigger mode with specific timing: 50 ps_{p-p}, 10 ps_{RMS}			
Trigger Mode				
Minimum Pulse Width	20 ns			
Trigger Hold-off	832 * sampling_period - 100 ns			
Delay to Analog Out	128 * sampling_period + 250 ns			
Gated Mode				
Minimum Pulse Width	1024 * sampling_period + 10 ns			
Delay to Analog Out	640 * sampling_period + 260 ns			
Event Input				
Impedance	1 kΩ or 50 Ω			
Polarity	POS or NEG			
Connector	BNC Front			
Input Voltage Range	1 kΩ: ±10 V 50 Ω: ±5 V			
Threshold Level	-5.0 V to 5.0 V			
Resolution	0.1 V			
Sequence Mode				
Minimum Pulse Width	20 ns			
Event Hold-off	900 * sampling_period + 150 ns			
Delay to Analog Out	1024 * sampling_period + 280 ns (Jump timing: Asynchronous jump)			
External Clock IN				
Input Voltage Swing	+7 to +11 dBm			
Impedance	50 Ω, AC coupled			
Frequency Range	6 GHz to 12 GHz: (acceptable frequency drift is ±0.5%)			
Clock Divider	1/1, 1/2, 1/4……1/256		1/2, 1/4……1/256	
Connector	SMA Rear			
Fixed Reference Clock IN				
Input Voltage Range	0.2 V_{p-p} to 3.0 V_{p-p}			
Impedance	50 Ω, AC coupled			
Frequency Range	10 MHz, 20 MHz, 100 MHz (with ±0.1%)			
Connector	BNC Rear			

Characteristic	AWG7122B	AWG7121B	AWG7062B	AWG7061B
Variable Reference Clock IN				
Input Ranges	5 MHz to 800 MHz (acceptable frequency drift is ±0.1%)			
Input Voltage Range	0.2 V_{p-p} to 3 V_{p-p}			
Impedance	50 Ω, AC coupled			
Multiplier Rate	1 to 2400 (2 to 4800 at interleave)	1 to 2400	1 to 1200	
Connector	BNC Rear			

AWG7000B Series Common Features

Characteristic	Description
Waveform File Import Capability	Tektronix TDS5000/6000, TDS/CSA7000B, TDS/CSA/DSA8000, DPO7000B, DPO/DSA70000B (*.wfm). TDS3000, DPO4000 (*.isf) AWG400s/500s/610/615/710/710B (*.wfm, *.pat, *.seq), AFG3000 (*.tfw), DTG5000s (*.dtg) Text data file (third-party software creation waveform data: MATLAB, MathCad, Excel)
Waveform File Export	Export waveform format by series of AWG400/500/600/700 (*.wfm or *.pat) and text format
S/W Driver for Third-party S/W	IVI-COM driver and MATLAB library
Instrument Control/Data Transfer Ports	
GPIB	Remote control and data transfer. (Conforms to IEEE-Std 488.1, compatible with IEEE 488.2 and SCPI-1999.0)
Ethernet (10/100/1000Base-T)	Remote control and data transfer. (Conforms to IEEE 802.3) RJ-45
TekLink	Proprietary bus for Tektronix product local communication
Computer System and Peripherals	Windows XP Professional, 2 GB SDRAM, 80 GB removable Hard Drive at rear (available front mount kit), CD-RW/DVD drive at front, included USB compact keyboard and mouse
PC I/O Ports	USB 2.0 compliant ports (6 total, 2 front, 4 rear), PS/2 mouse and keyboard connectors (rear panel), RJ-45 Ethernet connector (rear panel) supports 10/100/1000Base-T, XGA out
Display Characteristics	10.4 in., LCD color display with touch screen, 1024 (H) × 768 (V) (XGA)
Mechanical Cooling	
Required Clearance	
Top and Bottom	2 cm (0.8 in.)
Side	15 cm (6 in.)
Rear	7.5 cm (3 in.)
Power Supply	100 to 240 VAC, 47 to 63 Hz
Power Consumption	450 W
Safety	UL61010-1, CAN/CSA-22.2, No.61010-1-04, EN61010-1, IEC61010-1
Emissions	EN 55011 (Class A), IEC61000-3-2, IEC61000-3-3
Immunity	IEC61326, IEC61000-4-2/3/4/5/6/8/11
Regional Certifications	
Europe	EN61326
Australia / New Zealand	AS/NZS 2064

Physical Characteristics

Dimension	mm	in.
Height	245	9.6
Width	465	18.0
Length	500	19.7
Weight (approx.)	**kg**	**lb.**
Net	19	41.9
Net with Package	28	61.7

Environmental Characteristics

Characteristic	Operation	Nonoperation
Temperature	+10 °C to +40 °C	-20 °C to +60 °C
Humidity	5% to 80% relative humidity (% RH) at up to +30 °C, 5% to 45% RH above +30 °C up to +50 °C	5% to 90% relative humidity (% RH) at up to +30 °C, 5% to 45% RH above +30 °C up to +50 °C
Altitude	Up to 3,048 meters (10,000 feet)	Up to 12,192 meters (40,000 feet)
Random Vibration	0.27 G_{RMS}, 5 to 500 Hz, 10 minutes per axis	2.28 G_{RMS}, 5 to 500 Hz, 10 minutes per axis
Sine Vibration	0.33 mm $_{p-p}$ (0.013 $in._{p-p}$) constant displacement, 5 to 55 Hz	—
Mechanical Shock	Half-sine mechanical shocks, 30 g peak amplitude 11 ms duration, 3 drops in each direction of each axis	Half-sine mechanical shocks, 10 g peak amplitude 11 ms duration, 3 drops in each direction of each axis

	AWG7122B/AWG7121B/AWG7062B/AWG7061B		AWG7121B	AWG7122B	
	Standard		Option 02	Option 06 (Including Option 02)	
	Normal Out	Direct Out	High Bandwidth	High Bandwidth without Interleave	High Bandwidth with Interleave, Zeroing Off, (Zeroing On)
Maximum Amplitude	2 V_{p-p}	1 V_{p-p}	1 V_{p-p}	1 V_{p-p}	1 V_{p-p} (0.5 V_{p-p})
Minimum Amplitude	50 mV_{p-p}	50 mV_{p-p}	500 mV_{p-p}	500 mV_{p-p}	500 mV_{p-p} (250 mV_{p-p})
Offset	±500 mV	N/A	N/A	N/A	N/A
Tr/Tf (20 to 80%)	350 ps	75 ps	35 ps	35 ps	35 ps
Output Bandwidth	750 MHz	3.5 GHz	7.5 GHz	7.5 GHz	7.5 GHz

Ordering Information

Arbitrary Waveform Generator

AWG7122B
12.0 GS/s (24 GS/s interleaved), 8/10 bit, 32M point, 2-channel arbitrary waveform generator.

AWG7121B
12.0 GS/s, 8/10 bit, 32M point, 1-channel arbitrary waveform generator.

AWG7062B
6.0 GS/s, 8/10 bit, 32M point, 2-channel arbitrary waveform generator.

AWG7061B
6.0 GS/s, 8/10 bit, 32M point, 1-channel arbitrary waveform generator.

All Models Include: Accessory pouch, front cover, USB mouse, compact USB keyboard, lead set for DC output, stylus for touch screen (2 ea), AWG7000B Series product software CD and instructions, documentation CD with browser, Quick Start User Manual and registration card, Certificate of Calibration, power cable, and 50 Ω SMA terminator (3 ea).
Note: Please specify power cord and language option at time of order.

Instrument Options

Product Options

Option	AWG7122B, AWG7121B, AWG7062B, AWG7061B
Opt. 01	Waveform record length expansion (from 32M point to 64M point)
Opt. 08	Fast sequence switching (requires export control license) ECCN: 3A002
AWG7122B	
Opt. 06	Interleaved output at 24 GS/s (includes Option 02 - High-bandwidth output), (alternative for standard output)
AWG7121B	
Opt. 02	High-bandwidth output (alternative for standard output)

International Power Plugs

Option	Description
Opt. A0	North America
Opt. A1	Universal EURO
Opt. A2	United Kingdom
Opt. A3	Australia
Opt. A5	Switzerland
Opt. A6	Japan
Opt. A10	China
Opt. A11	India
Opt. A99	No power cord or AC adapter

Language Options

Option	Description
Opt. L0	English manual
Opt. L5	Japanese manual
Opt. L7	Simplified Chinese manual
Opt. L8	Traditional Chinese manual
Opt. L10	Russian manual

Application Software

Product	Description
RFX100	General-purpose IQ, IF, and RF signal creation software package
Opt. UWBCF	RFXpress plug-in for UWB-WiMedia IQ, IF, and RF conformance signal creation (requires RFX100 as prerequisite)
Opt. UWBCT	RFXpress plug-in for UWB-WiMedia IQ, IF, and RF custom and conformance signal creation (requires RFX100 as prerequisite and includes Opt. UWBCF)
Opt. RDR	RFXpress plug-in for Radar Signal Creation (requires RFX100 as prerequisite)
Opt. SPARA	S-parameter emulation and DUT characterization (requires RFX100 as prerequisite)
SDX100	Jitter-generation software package (includes USB dongle)
Opt. ISI	S-parameter and ISI creation (requires SDX100 as prerequisite)
Opt. SSC	Spread Spectrum Clock addition option (requires SDX100 as prerequisite)

Service Options

Option	Description
Service Option (for example, AWG7122B Opt. C3)	
Opt. CA1	A single calibration event
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R3	Repair Service 3 Years
Opt. R5	Repair Service 5 Years
Service Post Sales Offering (for example, AWG7122B-CA1)	
CA1	A single calibration event
R3DW	Repair Service Coverage 3 Years
R5DW	Repair Service Coverage 5 Years
R2PW	Repair Service Coverage 2 Years Post Warranty
R1PW	Repair Service Coverage 1 Year Post Warranty

Product Upgrade

Product	Ordering Options		Description
AWG7122B	AWG70BUP	Opt. M12	Waveform Length Expansion 32M point to 64M point
AWG7062B	AWG70BUP	Opt. M02	
AWG7121B	AWG70BUP	Opt. M11	
AWG7061B	AWG70BUP	Opt. M01	
AWG7122B	AWG70BUP	Opt. S48	Upgrade from Standard to Option 08 (fast sequence switching), requires export license
AWG7062B	AWG70BUP	Opt. S38	
AWG7121B	AWG70BUP	Opt. S28	
AWG7061B	AWG70BUP	Opt. S18	

Recommended Accessories

Item	Description	Parts Number
Pin Header		
SMA Cable	102 cm (40 in.)	012-1690-xx
SMB Cable	51 cm (20 in.)	012-1503-xx
Rackmount Kit	Rackmount Kit with instruction	016-1983-xx
Front Removable HDD Bay	Front Removable HDD Bay	016-1979-xx
Replacement Hard Disk for AWG5000/7000 Series	SATA disk assembly (no software installation), instruction sheet	065-0811-xx
Quick Start User Manual	English	071-2481-xx
	Japanese	071-2482-xx
	Simplified Chinese	071-2483-xx
	Traditional Chinese	071-2484-xx
	Russian	071-2485-xx
Service Manual	Service Manual, English	Visit Tektronix website

Warranty

One-year parts and labor.

CE

ISO 9001 Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488 Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit **www.tektronix.com**

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