Tektronix®

Arbitrary Waveform Generators

AWG70000A Series

The industry-leading AWG70000A Series arbitrary waveform generator (AWG) provides you with unparalleled performance at the cutting edge for sample rate, signal fidelity, and waveform memory. In order to engineer the world's most complex data communications systems, the ability to create ideal, distorted and "real life" signals is essential. The AWG70000A Series of AWGs delivers this, giving you the industry's best signal stimulus solution for ever-increasing measurement challenges. With up to 50 GS/s and 10-bit vertical resolution, it offers easy generation of very complex signals and complete control over signal characteristics.

Key performance specifications

- Sample rates up to 50 GS/s
- -80 dBc spurious free dynamic range
- 10 bits vertical resolution
- 16 GSample waveform memory

Key features

- Complete solution for wideband RF signal generation in a single box
  - Direct generation of wideband signals with carriers up to 20 GHz, removing the need for external RF conversion
- Simulate real-world analog effects on high speed digital data streams
  - Model signal impairments up to speeds of 12.5 GBs
- Generate high precision RF signals
  - Spurious Free Dynamic Range performance better than -80 dBc
- Create high speed baseband signals for optical transmission with the vertical resolution to handle higher order complex modulation
  - 10 bits of vertical resolution at a sample rate of 50 GS/s
- Create long waveforms scenarios without building complex sequences
  - Up to 16 GSamples of Waveform Memory plays 320 ms of data at 50 GS/s
- Synchronize multiple units (manually or with the AWG Synchronization Hub) to achieve a multi-channel high speed AWG system
- Fully operational without external PC
  - Built-in display and buttons make it possible to quickly select, edit and play waveforms directly from the front panel of the AWG
- Simulate real-world environments by playing back captured signals
  - Waveforms captured with Oscilloscopes or Real-Time Spectrum Analyzers can be played back, edited or re-sampled on the AWG
- Smooth transition from simulation to the real-world testing environment
  - Waveform vectors imported from third-party tools such as MATLAB

Applications

- Wideband RF/MW for communications and defense electronics
  - Output wideband RF signals up to 20 GHz
- Validation and compliance testing of high speed silicon and communications devices
  - Easily stress test receivers with a wide array of signal impairments
- Coherent optical research
  - Generation of high Baud rate baseband signals with higher order, complex modulation
- Leading edge research in electronics, physics & chemistry
  - High speed, low jitter signal source generates uniquely specified analog signals, fast pulses, data streams and clocks

Seamless transition from simulation to generation

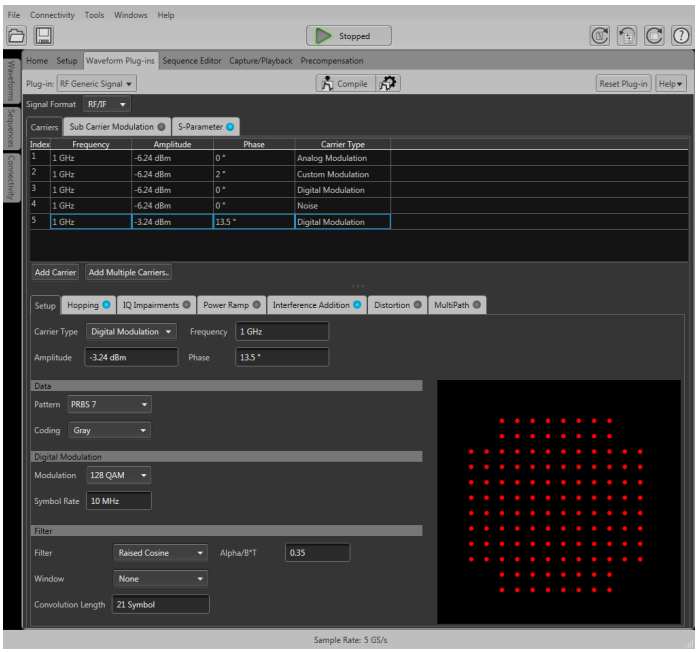
If a waveform can be defined or captured, then the AWG70000A can generate the signal. The creation of the waveform can happen in many ways. Waveform creation plug-ins, which are optimized to work specifically the Tektronix AWG family, provide specific waveform creation capabilities, while 3rd party solutions like MATLAB, Excel, or others, have the flexibility to create any waveform you desire. Waveforms created in any of these packages can be imported and played back in the AWG70000A, seamlessly transitioning from the simulation world to the real world.

Additionally, any signals captured on Tektronix oscilloscopes or Real-Time Spectrum analyzers can be loaded into the AWG70000A and played back. With the use of the built in waveform generation plug-ins, the captured signal can also be modified or changed to meet any specific requirements that may exist.

Wideband RF signal generation

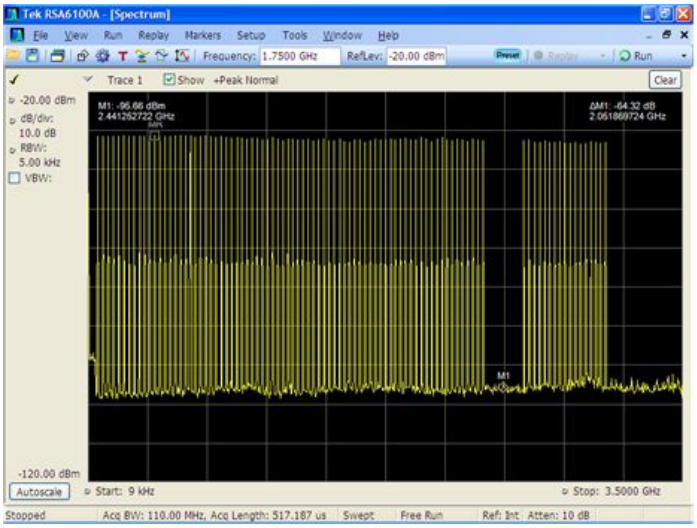
RF signals are becoming more and more complex, making it more difficult to accurately create the signals required for the testing and characterization of RF systems. To address these challenges, RF Generic delivers advanced capabilities to synthesize digitally modulated baseband, IF and RF/microwave signals supporting a wide range of modulation schemes.

The RF Generic, Radar, Multitone, OFDM, and Environment plug-in's easy to use graphical user interfaces integrate seamlessly with the AWG70000A Series user interface or the SourceXpress remote PC application.



The AWG70000A with the RF Generic Plugin allows complex RF Waveform Generation

The latest digital RF technologies often exceed the capabilities of other test instruments because of the need to generate the wide-bandwidth and fast-changing signals that are increasingly seen in many RF applications such as Radar, RF communications, OFDM, and Multi-tone. When used in conjunction with the specific plugin, the AWG70000A Series supports a wide range of modulation formats and simplifies the task of creating complex RF waveforms. The AWG70000A Series instruments provide customers with ways to generate fully modulated baseband, intermediate frequency (IF) signals, or directly generated RF waveforms up to 20 GHz.

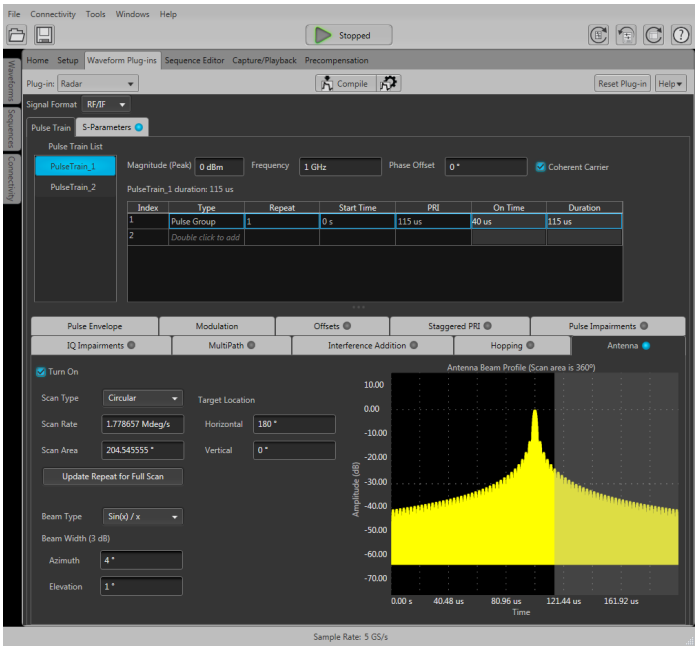


3 GHz wide multi-carrier signal generated on the AWG70000A with over 60 dBC SFDR

Radar signal creation

Generating advanced radar signals often demands exceptional performance from an AWG in terms of sample rate, dynamic range, and memory. The Tektronix AWG70000A Series sets a new industry standard for advanced radar signal generation, by delivering wide modulation bandwidths up to 20 GHz. With a sample rate of up to 50 GS/s the AWG70000A Series can directly generate RF signals never before possible from an AWG. In instances where IQ generation is desired, the AWG70000A offers the ability to oversample the signal, thereby improving signal quality with its outstanding SFDR performance.

The AWG700000A and the Radar plug-in are the perfect solution for creating complex radar signals. Users get the ultimate flexibility in creating custom radar pulse suites. Modulation types such as LFM, Barker and Polyphase Codes, Step FM, and Nonlinear FM are easily created using the AWG, and the flexibility of the plug-in enables the creation of waveforms requiring customer-defined modulation. The combination AWG and Radar plug-in solution 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, clutter, and multipath effects.

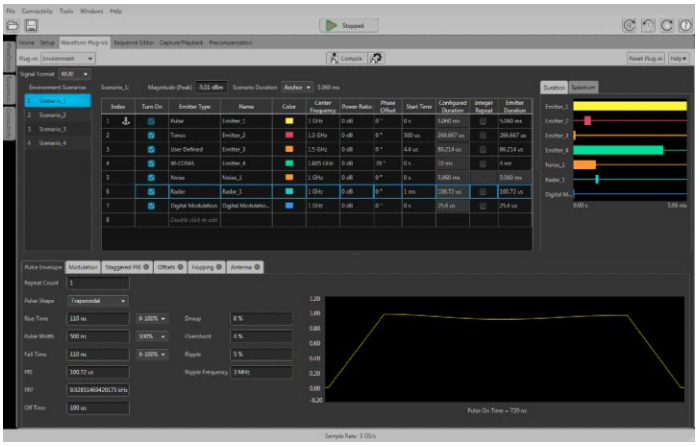


AWG radar pulses created with AWG70000A and Radar plug-in.

Environment signal generation

The mission-critical nature of many radar signals requires that they coexist with standards-based commercial signals sharing the same spectrum without performance degradation. To meet this expectation, a radar designer has to thoroughly test all the corner cases at the design/debug stage. The AWG70000A and the Environment plug-in offers extreme flexibility to define and create these worst-case scenarios.

You can specify up to 50 scenarios to define your environment, including WiMAX, WiFi, GSM, CDMA, W-CDMA, DVB-T, Noise, Bluetooth, LTE, OFDM, Radar and more. This plug-in also allows you to seamlessly import signals from other plug-ins (including Radar, RF Generic etc.), as well as from Matlab® and from Tektronix spectrum analyzers and oscilloscopes, into your environment. You can also configure PHY parameters of your standard-specific signals. You can define the carrier frequency, power, start time, and duration for all the signals in your environment, so you have full control over the way these signals interact/interfere with each other.



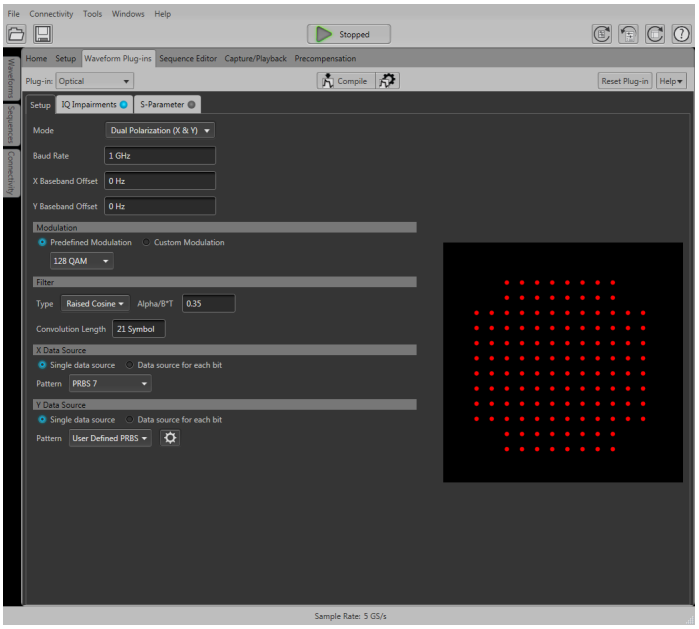
Multiple scenarios with multiple emitters using the Environment plug-in

Coherent optical

Today's high speed and increasingly web driven world is pushing the demand for short and long haul coherent optical development. Phase modulation, high baud rate, high sample rate, bandwidth and resolution are all critical to optical applications. Tektronix understands the challenges and inconsistencies of coherent optical testing and offers a reliable, easy to set up and high performing tool set for optical testing, waveform generation and calibration.

The Tektronix AWG70000A Series Arbitrary Waveform Generator (AWG) can reach sampling rates as high as 50 GSa/s with 10 bits vertical resolution. Such level of performance allows for the direct generation of IQ basebands signals required by modern coherent optical communication systems based on quadrature modulation of an optical carrier with data rates well over 200Gb/s. Multiple AWG70000As can be synchronized (manually or with the AWG Synchronization Hub) to use the max 50 Ga/s on each baseband signal with low EVM and 32 Gbaud performance.

Generating the desired signal is only the first challenge in coherent optical. The quality of the signal, low EVM's and having a clear open eye is crucial. The Optical plug-in, in conjunction with the pre-compensation plug-in, can be used for calibration of the AWG to the device under test and for precompensation of coherent optical signals.



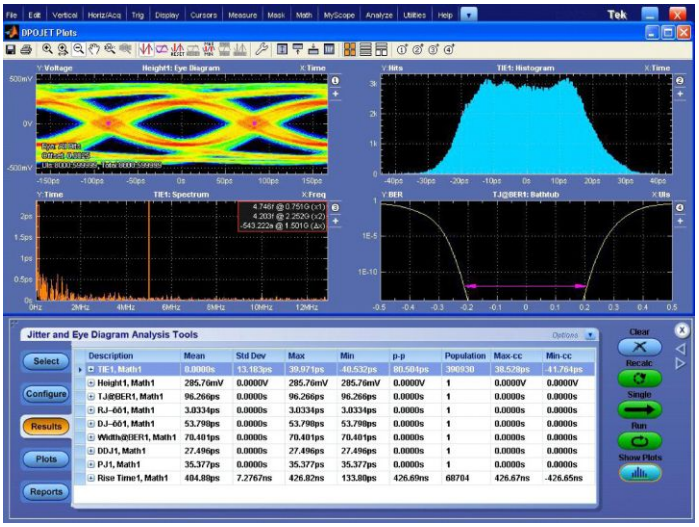
Generic OFDM creation

In today's wireless world, OFDM is becoming the modulation method of choice for transmitting large amounts of digital data over short and medium distances. The need for wide bandwidths and multiple carriers create challenges for engineers who need to create OFDM signals to test their RF receivers. The AWG70000A Series, when coupled with the OFDM plug-in, allows users to configure every part of the OFDM signal definition. Engineers can build signals symbol-by-symbol to create a complete OFDM frame or let the plug-in choose default values for some signal aspects. The combined AWG and OFDM plug-in supports a variety of data coding formats that include Reed Solomon, Convolution, and Scrambling. Users also have the ability to define each subcarrier in the symbol which can be configured independently for type, modulation, and base data. The OFDM plug-in gives visibility into all aspects of the OFDM signal by providing a symbol table that gives a summary of all the carriers in the selected symbol. OFDM packets/ frames can be built by specifying the spacing between the symbols/frames and parts of the OFDM packets can be stressed by adding gated noise.

High-speed serial signal generation

Serial signals are made up entirely of binary data- simple ones and zeros. As clock rates have increased, these simple ones and zeros have begun to look more like analog waveforms because analog events are embedded in the digital data. The zero rise time and the perfectly flat tops of textbook digital signals no longer represent reality. Electronic environments have noise, jitter, crosstalk, distributed reactances, power supply variations, and other shortcomings. Each takes its toll on the signal. A real-world digital "square wave" rarely resembles its theoretical counterpart.

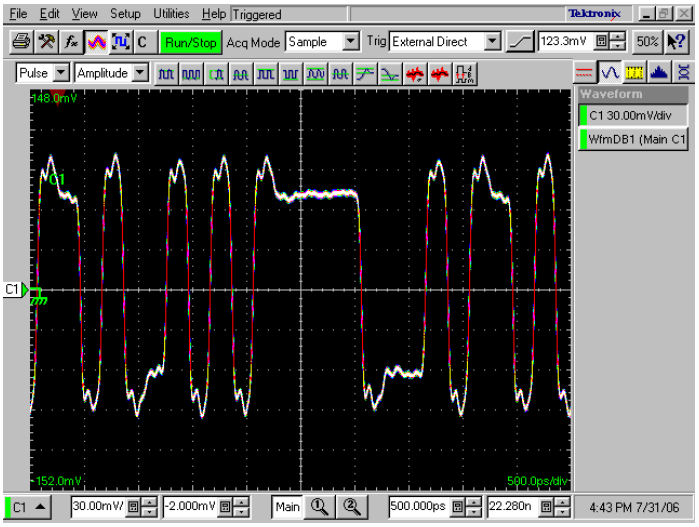
Since the AWG70000A Series is an analog waveform source, it is the perfect single-box solution that is used to create digital data streams and mimic the analog imperfections that occur in real-world environments. The AWG70000A Series uses direct synthesis techniques to allow engineers to create signals that simulate the effects of propagation through a transmission line. Rise times, pulse shapes, delays, and aberrations can all be controlled with the AWG70000A Series instruments. When used in conjunction with the High Speed Serial (HSS) plug-in, engineers are provided control over every aspect of their digital signals reaching speeds of up to 50 Gb/s. This is exactly what is needed for rigorous receiver testing requirements.



Easily create digital data impairments with the AWG70000A and HSS plug-in.

The HSS plug-in allows the AWG70000A Series instruments to create a variety of digital data impairments such as jitter (Random, Periodic, Sinusoidal), noise, pre/de-emphasis, duty cycle distortion, Inter-symbol Interference (ISI), Duty Cycle Distortion (DCD), and Spread Spectrum Clocking (SSC). The transmission environments of both board and cables can be emulated using S-parameter files that can be applied to any waveform. The AWG70000A and the HSS plugin also provides base pattern waveforms for many of today's high-speed serial applications such as SATA, Display Port, SAS, PCI-E, USB, and Fibre Channel.

For high-speed serial applications the AWG70000A Series offers the industry's best solution for addressing challenging signal stimulus issues faced by digital designers who need to verify, characterize, and debug complex digital designs. The file-based architecture uses direct synthesis to create complex data streams and provides users with the simplicity, repeatability, and flexibility required to solve the toughest signal generation challenges in high-speed serial communication applications.



Digital data with de-emphasis added using the AWG70000A and the HSS plug-in.

LXI Class C

Using the LXI Web Interface, you can connect to the AWG70000A Series through a standard web browser by simply entering the AWG's IP address in the address bar of the browser. The web interface enables viewing of instrument status and configuration, as well as status and modification of network settings. All web interaction conforms to the LXI Class C specification.

Performance you can count on

Depend on Tektronix to provide you with performance you can count on. In addition to industry-leading service and support, this product comes backed by a standard one-year warranty.

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Definitions

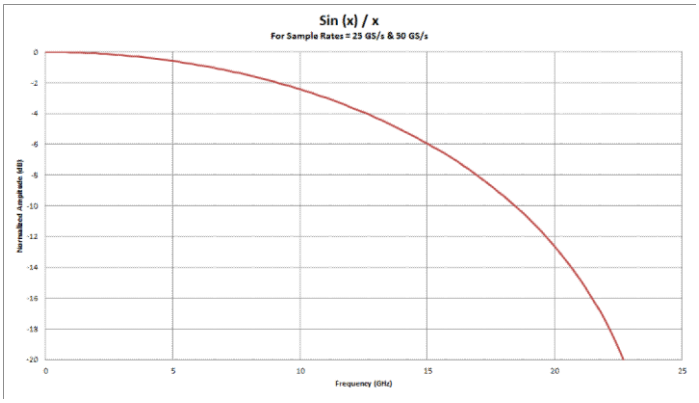
Specifications (not noted) - Product characteristics described in terms of specified performance with tolerance limits which are warranted/guaranteed to the customer. Specifications are checked in the manufacturing process and in the Performance Verification section of the product manual with a direct measurement of the parameter.

Typical (noted) - Product characteristics described in terms of typical performance, but not guaranteed performance. The values given are never warranted, but most units will perform to the level indicated. Typical characteristics are not tested in the manufacturing process or the Performance Verification section of the product manual.

Nominal (noted) - Product characteristics described in terms of being guaranteed by design. Nominal characteristics are non-warranted, so they are not checked in the manufacturing process or the Performance Verification section of the product manual.

Model overview

		AWG70001A	AWG70002A
Digital to analog converter			
	Sample rate (nominal)	1.5 kS/s - 50 GS/s	1.5 kS/s - 25 GS/s
	Resolution (nominal)	10 bit (no markers selected), 9 bit (one marker selected), or 8 bit (two markers selected)	
Sin(x)/x roll-off			
	Sin(x)/x (-3dB)	11.1 GHz	11.1 GHz



Sin x/x rolloff at 25 GS/s and 50 GS/s

Frequency domain characteristics

Effective frequency output	Fmaximum (specified) is determined as "sample rate / oversampling rate" or "SR / 2.5".
AWG70001A	20 GHz
AWG70002A	10 GHz
Output amplitude characteristics	Amplitude levels are measured as singled-ended outputs. Amplitude level will be 3 dBm higher when using differential (both) outputs.
Range (typical)	-8 dBm to -2 dBm
Resolution (typical)	0.35 dB
Accuracy (typical)	0.17 dB
Output flatness	Mathematically corrected for characteristic Sin (x)/x roll-off, uncorrected by external calibration methods.
AWG70001A	±1.8 dB to 10 GHz, +1.8 dB, -3 dB 10 GHz to 15 GHz
AWG70002A	+0.8 dB, -1.5 dB to 10 GHz

Frequency domain characteristics

Analog bandwidth

Measured with a multi-sine waveform with equal amplitude across the band. The Sin(x)/x response is mathematically removed from the measured response before recording the -3 dB crossing.

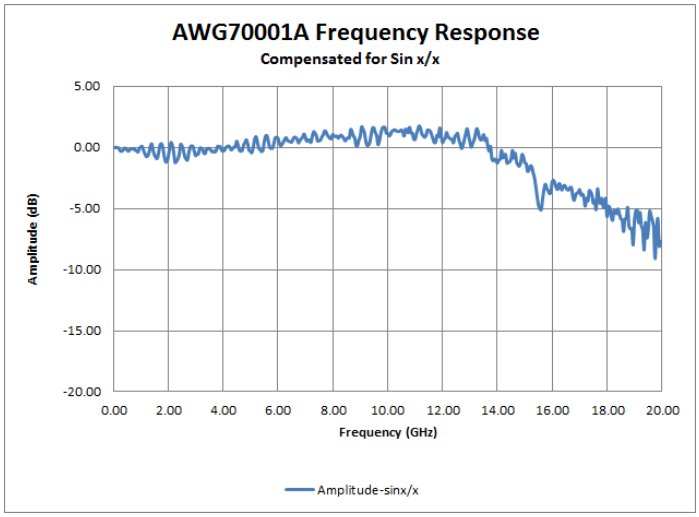
AWG70001A	15 GHz
AWG70002A	13.5 GHz

Output match, SWR (typical)

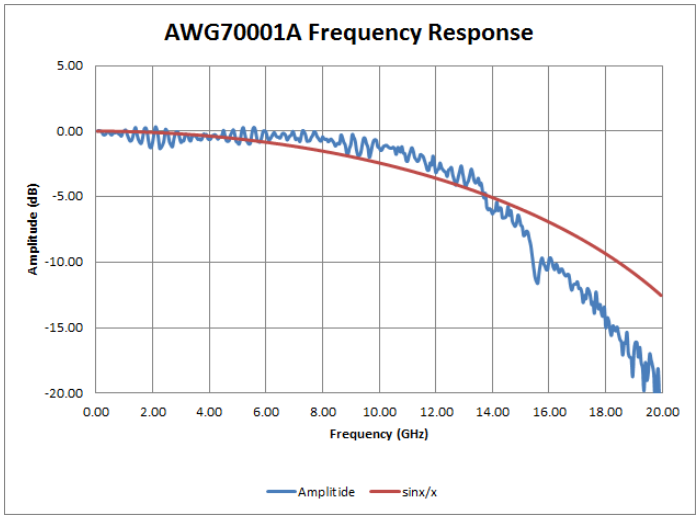
AWG70001A	DC to 5 GHz = 1.32:1
	5 GHz to 10 GHz = 1.52:1
	10 GHz to 20 GHz = 1.73:1
AWG70002A	DC to 5 GHz = 1.61:1
	5 GHz to 10 GHz = 1.61:1

Frequency response

AWG70001A



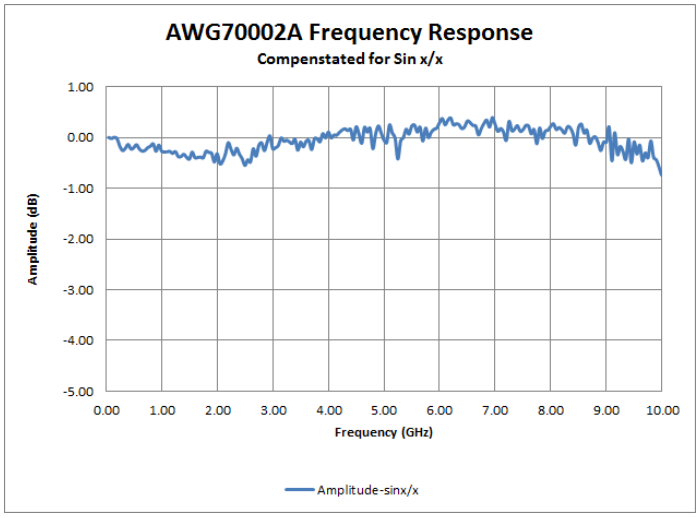
AWG70001A frequency response at 50 GS/s with Sin(x)/x response mathematically removed from measured data



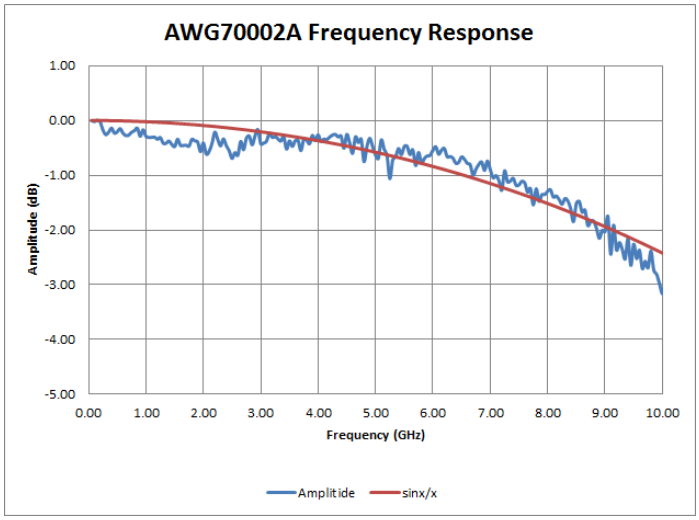
AWG70001A measured frequency response and ideal Sin(x)/x response at 50 GS/s

Frequency domain characteristics

AWG70002A



AWG70002A frequency response at 25 GS/s with Sin(x)/x response mathematically removed from measured data



AWG70002A measured frequency response and ideal Sin(x)/x response at 25 GS/s

Time domain characteristics

Bit rate (nominal)	Bit rate determined as "sample rate / 4 points per cycle", allowing full impairment generation.
AWG70001A	12.5 Gb/s
AWG70002A	6.25 Gb/s
Rise/fall time (typical)	Rise/fall time measured at 20% to 80% levels, related by a factor of 0.75 to the industry standard of 10% to 90% levels.
AWG70001A	Sampling rate ≤ 25 GS/s: < 23 ps
	< 27 ps at 50 GS/s
AWG70002A	< 22 ps
Output amplitude characteristics	Amplitude levels are measured between differential outputs (+) to (-). For single-ended output, the amplitude level will be one-half the specified voltage levels.
Range (typical)	500 mV_{p-p} to 1 V_{p-p}
Resolution (typical)	1.0 mV
Accuracy (typical)	±(2% of amplitude + 1 mV)

Sequencer characteristics

	The sequencer for the AWG70000A is a firmware upgrade that allows the user to run a sequence of waveforms. The sequencer runs independent channels except for the clock.
Maximum repeat count	2^{20} counts (1,048,576 counts)
Maximum sequencing steps	16,383
Subsequencing	Single level depth
Waveform granularity resolution	2 on the single-channel AWG70001A 1 on the two-channel AWG70002A
Minimum waveform length	2400 points on the two-channel AWG70002A 4800 points on the single-channel AWG70001A

Spurious Free Dynamic Range (SFDR) characteristics

Spurious free dynamic range (SFDR) characteristics

Frequency output of AWG [1] [2]

AWG70001A operating at 50 GS/s

	In band performance		Adjacent band performance	
Analog channel output frequency	**Measured across**	**Specification (typical)**	**Measured across**	**Specification (typical)**
100 MHz	DC - 1 GHz	-80 dBc	DC - 10 GHz	-72 dBc
DC - 500 MHz	DC - 500 MHz	-70 dBc	DC - 1.5 GHz	-66 dBc
DC - 1 GHz	DC - 1 GHz	-63 dBc	DC - 3 GHz	-63 dBc
DC - 2 GHz	DC - 2 GHz	-62 dBc	DC - 6 GHz	-60 dBc
DC - 3 GHz	DC - 3 GHz	-60 dBc	DC - 6 GHz	-52 dBc
DC - 5 GHz	DC - 5 GHz	-52 dBc	DC - 6 GHz	-52 dBc
5 GHz - 6 GHz	5 GHz - 6 GHz	-52 dBc	3 GHz - 9 GHz	-40 dBc
6 GHz - 7 GHz	6 GHz - 7 GHz	-42 dBc	4 GHz - 10 GHz	-42 dBc
7 GHz - 8 GHz	7 GHz - 8 GHz	-60 dBc	6 GHz - 12.5 GHz	-52 dBc
8 GHz - 10 GHz	8 GHz - 10 GHz	-50 dBc	6 GHz - 12.5 GHz	-52 dBc
10 GHz - 12 GHz	10 GHz - 12 GHz	-53 dBc	6 GHz - 12.5 GHz	-50 dBc
12 GHz - 13 GHz	12 GHz - 13 GHz	-22 dBc	10 GHz - 15 GHz	-22 dBc
13 GHz - 14 GHz	13 GHz - 14 GHz	-54 dBc	11 GHz - 16 GHz	-20 dBc
14 GHz - 16 GHz	14 GHz - 16 GHz	-46 dBc	13 GHz - 18 GHz	-38 dBc
16 GHz - 18.5 GHz	16 GHz - 18.5 GHz	-42 dBc	14 GHz - 20 GHz	-30 dBc
18.5 GHz - 20 GHz	18.5 GHz - 20 GHz	-28 dBc	16 GHz - 20 GHz	-24 dBc

AWG70001A and AWG70002A operating at 25 GS/s

	In band performance		Adjacent band performance	
Analog channel output frequency	**Measured across**	**Specification (typical)**	**Measured across**	**Specification (typical)**
100 MHz	DC - 1 GHz	-80 dBc	DC - 10 GHz	-72 dBc
0 - 500 MHz	DC - 500 MHz	-70 dBc	DC - 1.5 GHz	-66 dBc
DC - 1 GHz	DC - 1 GHz	-63 dBc	DC - 3 GHz	-63 dBc
DC - 2 GHz	DC - 2 GHz	-62 dBc	DC - 6 GHz	-60 dBc
DC - 3 GHz	DC - 3 GHz	-60 dBc	DC - 6 GHz	-52 dBc
DC - 5 GHz	DC - 5 GHz	-52 dBc	DC - 6 GHz	-52 dBc
5 GHz - 6 GHz	5 GHz - 6 GHz	-52 dBc	3 GHz - 9 GHz	-40 dBc
6 GHz - 7 GHz	6 GHz - 7 GHz	-42 dBc	4 GHz - 10 GHz	-42 dBc
7 GHz - 8 GHz	7 GHz - 8 GHz	-55 dBc	6 GHz - 12.5 GHz	-50 dBc
8 GHz - 10 GHz	8 GHz - 10 GHz	-50 dBc	6 GHz - 12.5 GHz	-50 dBc

1 Measured with Balun at maximum sample rate.

2 SFDR is determined as a function of the directly generated carrier frequency. Harmonics not included.

Spurious Free Dynamic Range (SFDR) characteristics

AWG70002A 8 Gsa/sec

	In band performance		Adjacent band performance	
Analog channel output frequency	**Measured across**	**Specification (typical)**	**Measured across**	**Specification (typical)**
100 MHz	DC - 1 GHz	-80 dBc	DC - 3 GHz	-72 dBc
DC - 500 MHz	DC - 500 MHz	-68 dBc	DC - 1.5 GHz	-66 dBc
DC - 1 GHz	DC - 1 GHz	-63 dBc	DC - 3 GHz	-63 dBc
DC - 2 GHz	DC - 2 GHz	-60 dBc	DC - 4 GHz	-60 dBc
DC - 2.6 GHz	DC - 2.6 GHz	-55 dBc	DC - 4 GHz	-52 dBc
DC - 3.2 GHz	DC - 3.2 GHz	-47 dBc	DC - 4 GHz	-47 dBc

AWG70002A 16 Gsa/sec

	In band performance		Adjacent band performance	
Analog channel output frequency	**Measured across**	**Specification (typical)**	**Measured across**	**Specification (typical)**
100 MHz	DC - 1 GHz	-80 dBc	DC - 3 GHz	-72 dBc
DC - 500 MHz	DC - 500 MHz	-68 dBc	DC - 1.5 GHz	-66 dBc
DC - 1 GHz	DC - 1 GHz	-62 dBc	DC - 3 GHz	-63 dBc
DC - 2 GHz	DC - 2 GHz	-60 dBc	DC - 6 GHz	-58 dBc
DC - 3.5 GHz	DC - 3.5 GHz	-57 dBc	3 GHz - 8 GHz	-40 dBc
3.5 GHz - 4.5 GHz	3.5 GHz - 4.5 GHz	-42 dBc	4 GHz - 8 GHz	-42 dBc
4.5 GHz - 6.4 GHz	4.5 GHz - 6.4 GHz	-52 dBc	6 GHz - 8 GHz	-42 dBc

Output distortion characteristics

Harmonic distortion [3]

Sample rate = 25 GS/s

2nd harmonic, at output frequency

Frequency range	Value
< 2 GHz	< -60 dBc
2 GHz - 6 GHz	< -50 dBc
> 6 GHz	< -42 dBc

3rd harmonic, at output frequency

Frequency range	Value
< 1 GHz	< -60 dBc
1 GHz - 2 GHz	< -50 dBc
> 2 GHz	< -40 dBc

Effective number of bits (ENOB)

AWG70001A

4.6 bits at 14.99 GHz

All noise and distortion DC - 20 GHz

AWG70002A

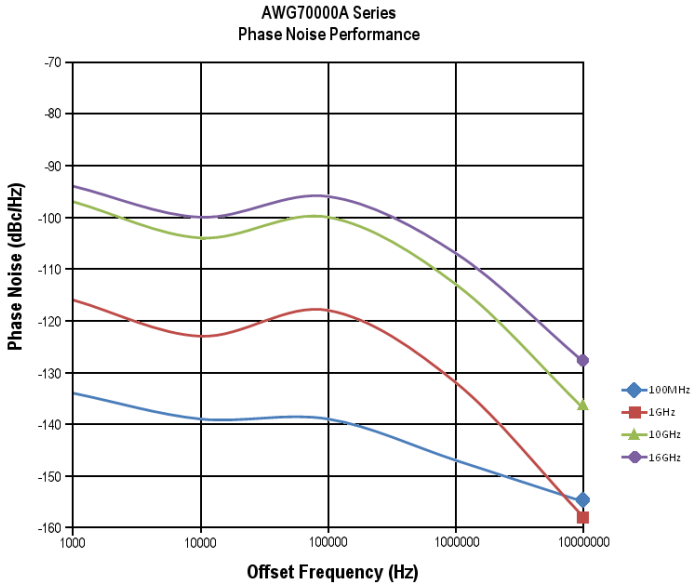
5.6 bits at 9.99 GHz

All noise and distortion DC - 12.5 GHz

3 Measured with Balun at maximum sample rate.

Output distortion characteristics

Phase noise



Phase noise in reduced jitter mode

Jitter

Random jitter (typical)	250 fs RMS
Total jitter (typical)	10 ps_{p-p} at 12.5 Gb/s

Channel timing characteristics

These specifications apply to model AWG70002A only.

Channel to channel skew	±5 ps

Output skew control

Range	-100 to 100 ps
Resolution	500 fs
Accuracy	±5 ps
Intra-channel skew	<5 ps

Hardware characteristics

Number of analog outputs

AWG70001A	1 channel
AWG70002A	2 channels

Output connector	Aeroflex/Weinschel Planar Crown Universal Connector System with SMA female adapter
Output impedance	50 Ω

Waveform length

AWG70001A	Standard: up to 2 GSamples
	With extended memory: up to 16 GSamples
AWG70002A	Standard: up to 2 GSamples
	With extended memory: up to 8 GSamples

Hardware characteristics

Waveform granularity	
Continuous run mode	1 point
Triggered run modes	AWG70001A: 2 points
	AWG70002A: 1 point
Run modes	
Continuous	Waveform is continuously repeated
Triggered	Waveform is output only once after a trigger is received
Triggered Continuous	Waveform is continuously repeated after a trigger is received
Sampling clock	
Resolution	Up to 8 digits
Accuracy	Within ±(1 ppm + Aging), Aging: ±1 ppm per year

Computer outputs

Operating system / peripherals / IO	Windows 7
	16 GB (4 GB for serial numbers B019999 and below)
	≥ 480 GB solid state drive
	Included USB compact keyboard and mouse
	6 USB 3.0/2.0 compliant ports (2 front - USB 2.0) (4 rear - USB 3.0 (USB 2.0 for serial numbers B019999 and below))
	RJ-45 Ethernet connector (rear panel) supports 10/100/1000BASE-T
	VGA video (rear panel) for external monitor
	eSATA (rear panel)
Display characteristics	LED backlit touch screen display, 132 x 99 mm (165 mm diagonal), 1024 × 768 pixels
Waveform file import capability	Import waveform format by series:
	*.AWGX file format created by Tektronix AWG70000A Series
	*.WFMX file format created by Tektronix AWG70000A Series
	*.RFD file format created by Tektronix RFX100 RFXpress Advanced RF/IF/IQ waveform software
	*.SXD file format created by Tektronix SDX100 SerialXpress high-speed serial data signals software
	*.WFM file format created by Tektronix AWG5000 or AWG7000 Series
	*.PAT and *.WFM file formats created by Tektronix AWG400/500/600/700 Series
	*.IQT file format created by Tektronix RSA3000 Series
	*.TIQ file format created by Tektronix RSA6000/5000 Series or MDO4000 Series
	*.WFM or *.ISF file formats created by Tektronix TDS/DPO/MSO/DSA Series
	*.TXT file format created by Tektronix AWG5000 or AWG7000 Series
	*.AWG file created by Tektronix AWG5000 or AWG7000 Series
	*.MAT Matlab file format
	*.SEQX sequence file format created by Tektronix AWG70000A Series
	*.SEQ sequence file format created by Tektronix AWG400, AWG500, or AWG600 Series
Waveform file export capability	*.WFMX file format (Tektronix AWG70000A Series)
	*.TXT file format

Computer outputs

Software driver for third-party applications

IVI-COM driver

IVI-C driver

Instrument control / data transfer

GPIB through USB B device port (requires external adapter TEK-USB-488)

Remote control and data transfer (conforms to IEEE-Std 488.1, compatible with IEEE-Std 488.2 and SCPI-1999.0)

Ethernet

Remote control and data transfer (conforms to IEEE-Std 802.3)

LAN eXtensions for Instrumentation (LXI)

Class LXI Class C Version 1.4

Auxiliary outputs

Markers

Number

AWG70001A: Total of 2

AWG70002A: Total of 4 (2 per channel)

Style

Differential

Connector

SMA (front panel)

Impedance

50 Ω

Level into 50 Ω

Characteristic	Description
Window	-1.4 V to 1.4 V
Amplitude	0.5 V_{p-p} to 1.4 V_{p-p}
Resolution	10 mV
Accuracy	±(10% of setting + 50 mV) into 50 Ω
Rise/fall time (20% - 80%)	<35 ps (High: 1.0 V, Low: 0 V)

Timing skew

Characteristic	Description
Intra-channel (typical)	<12 ps (between each channel (+) Pos and (–) Neg output)
Inter-channel (typical)	<15 ps (between Marker 1 and Marker 2 outputs)

Delay control

Characteristic	Description
Delay from analog output (typical)	AWG70001A: 180 ps ±25 ps AWG70002A: 755 ps ±25 ps
Range	0 to 100 ps
Resolution	1 ps
Accuracy	±15 ps

Jitter

Characteristic	Description
Random RMS (typical)	0.4 ps_{RMS}
Total p-p (typical)	20 ps_{p-p} (Using PRBS15 pattern)

10 MHz reference out

Connector

SMA (rear panel)

Output impedance

50 Ω, AC coupled

Amplitude

+4 dBm ±2 dBm

Frequency

10 MHz ±(1 ppm + aging)

Auxiliary outputs

Flag outputs

Connector	SMB (rear panel)
Number of outputs	AWG70001A: 4 AWG70002A: 8
Impedance	50 Ω
Amplitude	High: 3.3 V into 50 Ω Low: 0 V

Synchronization clock output

Frequency	1/80 of the clock output
Amplitude	1.0 V ±150 mV_{p-p} into 50 Ω
Connector	SMA (rear panel)
Output impedance	50 Ω, AC coupled

External clock output

Connector	SMA (rear-panel)
Output impedance	50 Ω AC coupled
Frequency range	6.25 GHz to 12.5 GHz
Output amplitude	+5 dBm to +10 dBm

Auxiliary inputs

Trigger

Number	2 (A and B)
Polarity	Pos or Neg
Impedance	50 Ω, 1 kΩ
Range	50 Ω: <5 V_{rms} 1 kΩ: ±10 V
Connector	SMA (rear panel)

Threshold

Characteristic	Description
Range	-5.0 V to 5.0 V
Resolution	0.1 V
Accuracy	±(5% +100 mV)

Trigger to output uncertainty

Characteristic	Description
Asynchronous (typical)	±40 ps at maximum sample rate
Synchronous (typical)	External variable reference and synchronous trigger timing: 500 fs_{rms}, 7 ps_{p-p} at BER 10^{-12}
Synchronous (typical)	External 10 MHz reference and synchronous trigger timing: 5 ps_{rms}, 70 ps_{p-p} at BER 10^{-12}

Trigger minimum pulse width	20 ns
Trigger hold-off	8320/fclk ±20 ns where fclk is the frequency of the DAC sampling clock

Reference in

Input amplitude	-5 dBm to +5 dBm
Fixed frequency range	10 MHz, ±10 ppm
Variable frequency range	35 MHz to 250 MHz

Auxiliary inputs

Connector	SMA (rear panel)
Impedance	50 Ω, AC coupled

External Clock in

Connector	SMA (rear panel)
Input impedance	50 Ω, AC coupled
Frequency range	6.25 GHz to 12.5 GHz
Input amplitude	0 dBm to +10 dBm

Physical characteristics

Dimensions

Height	153.6 mm (6.05 in)
Width	460.5 mm (18.13 in)
Depth	603 mm (23.76 in)

Weight

Net weight without packaging	AWG70001A and AWG70002A: 37.0 lb (16.8 kg) AWG70001A with option AC: 38.56 lb (17.49 kg)
Net weight with packaging	AWG70001A and AWG70002A: 49.4 lb (22.4 kg) AWG70001A with option AC: 50.96 lb (23.12 kg)

Cooling clearance

Top	0 in
Bottom	0 in
Left side	50 mm (2 in)
Right side	50 mm (2 in)
Rear	0 in

Power supply

AC line input	100 to 240 V AC, 50/60 Hz
Consumption	500 Watts

EMC, environment, and safety

Temperature

Operating	0 ºC to +50 ºC (+32 ºF to +122 ºF)
Non-operating	-20 ºC to +60 ºC (-4 ºF to +140 ºF)

Humidity

Operating	5% to 90% relative humidity (% RH) at up to 30 °C
	5% to 45% relative humidity above 30 °C up to 50 °C
	Non-condensing
Non-operating	5% to 90% relative humidity (% RH) at up to 30 °C
	5% to 45% relative humidity above 30 °C up to 60 °C
	Non-condensing

EMC, environment, and safety

Altitude

Operating	Up to 3,000 meters (9,843 feet)
	Derate maximum operating temperature by 1 °C per 300 meters above 1500 meters.
Non-operating	Up to 12,000 meters (39,370 feet)

Vibration

Operating	Sine: 0.33 mm p-p (0.013 in p-p) constant displacement, 5 to 55 Hz
	Random: 0.27 G_{RMS} from 5 to 500 Hz, 10 minutes per axis
Nonoperating	Random: 2.28 G_{RMS} from 5 to 500 Hz, 10 minutes per axis

Mechanical shock

Operating	Half-sine mechanical shocks, 30 g peak, 11 ms duration, 3 drops in each direction of each axis

Regulatory

Safety	UL61010-1, CAN/CSA-22.2, No.61010-1, EN61010-1, IEC61010-1
Emissions	EN55011 (Class A), IEC61000-3-2, IEC61000-3-3
Immunity	IEC61326, IEC61000-4-2/3/4/5/6/8/11

Regional certifications

Europe	Australia/New Zealand
EN61326	AS/NZS 2064

Ordering information

AWG 70000 family

AWG70001A	10 bit, 2 GSamples record length, 1-channel arbitrary waveform generator.
	Option 150: 1.5 kS/s to 50 GS/s
AWG70002A	10 bit, 2 GSamples record length, 2-channel arbitrary waveform generator.
	Option 225: 1.5 kS/s to 25 GS/s

Standard accessories [4]

015-1022-xx	One 50 Ω SMA terminator per channel
119-7054-xx	USB mouse
119-7275-xx	Compact USB keyboard
119-8131-xx	Touch screen stylus
071-3110-xx	Installation and safety manual
—	Certificate of calibration
—	Power cord

Warranty

One-year parts and labor

4 Specify power cord and language option at time of order

Options

Product options

Opt. 01	Waveform record length expansion AWG70001A: from 2 GSamples to 16 GSamples AWG70002A: from 2 GSamples to 8 GSamples on both channels
Opt. 03	Adds sequencing
Opt. 150	Adds 50 GS/s sampling rate (AWG70001A only)
Opt. 208	Adds 8 GS/s sampling rate (AWG70002A only)
Opt. 216	Adds 16 GS/s sampling rate (AWG70002A only)
Opt. 225	Adds 25 GS/s sampling rate (AWG70002A only)
Opt. AC	Adds a single-ended AC coupled output connector with additional amplification and attenuation (AWG70001A only)

Power plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Language options

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

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. CA1	Single Calibration or Functional Verification
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. G3	Complete Care 3 Years (includes loaner, scheduled calibration, and more)
Opt. G5	Complete Care 5 Years (includes loaner, scheduled calibration, and more)
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

Post sales service options

CA1	Single calibration or functional verification
R5DW	Repair service coverage 5 years
R2PW	Repair service coverage 2 years post warranty
R1PW	Repair service coverage 1 year post warranty

Rack mount kit

AWGRACK	Rack mount kit for AWG70000A Series

Product upgrades

AWG70001A

AWG701AUP Opt. 01	Increases the waveform record length to 16 Gsamples
AWG701AUP Opt. 03	Adds sequencing
AWG701AUP Opt. SSD-01	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 7 operating system for instruments with serial numbers B019999 and below. This drive can also be used to revert an instrument with the Windows 10 OS to the Windows 7 OS.
AWG701AUP Opt. SSD-02	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 10 operating system for instruments with serial numbers B020000 and above. This drive can also be used to convert an instrument with the Windows 7 OS to the Windows 10 OS.
AWG701AUP Opt. SSD-03	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 10 operating system for instruments with serial numbers B019999 and below. This drive can also be used to convert an instrument with the Windows 7 OS to the Windows 10 OS.

AWG70002A

AWG702AUP Opt. 01	Increases the waveform record length to 8 Gsamples for each channel
AWG702AUP Opt. 03	Adds sequencing
AWG702AUP Opt. 0816	Increases the sampling rate from 8 GS/s to 16 GS/s
AWG702AUP Opt. 0825	Increases the sampling rate from 8 GS/s to 25 GS/s
AWG702AUP Opt. 1625	Increases the sampling rate from 16 GS/s to 25 GS/s
AWG702AUP Opt. SSD-01	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 7 operating system for instruments with serial numbers B019999 and below. This drive can also be used to revert an instrument with the Windows 10 OS to the Windows 7 OS.

AWG702AUP Opt. SSD-02	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 10 operating system for instruments with serial numbers B020000 and above. This drive can also be used to convert an instrument with the Windows 7 OS to the Windows 10 OS.
AWG702AUP Opt. SSD-03	Provides an additional (or replacement) preprogrammed Solid State Drive with the Microsoft Windows 10 operating system for instruments with serial numbers B019999 and below. This drive can also be used to convert an instrument with the Windows 7 OS to the Windows 10 OS.

Plug-ins

Plug-ins increase the capabilities of the arbitrary waveform generators. Various plug-ins are available providing unique types of waveforms or additional compensation. Each plug-in has its own installation file which installs seamlessly into the generators. After installation, it simply becomes a new menu selection. No other configuration is necessary.

Plug-in	Description	Nomenclature	Licensed enhancements
Multitone & Chirp plug-in	Create generate chirps, notches and tones	MTONENL-SS01 MTONEFL-SS01	
PreCompensation plug-in	Create correction coefficients that can be applied on waveforms to get flat frequency and linear phase response	PRECOMNL-SS01 PRECOMFL-SS01	
High Speed Serial plug-in	Create pre-distorted waveforms to test a device's conformance to standards	HSSNL-SS01 HSSFL-SS01 HSSPACKNL-SS01 HSSPACKFL-SS01	S-Parameters and Intersymbol Interference Spread Spectrum Clocking (Licensed enhancements are included with HSSPACK)
RF Generic plug-in	Create digitally modulated signals with multiple carrier groups	RFGENNL-SS01 RFGENFL-SS01	S-Parameters
Optical plug-in	Create waveforms with complex modulation schemes for optical testing	OPTICALNL-SS01 OPTICALFL-SS01	S-Parameters Spread Spectrum Clocking
OFDM plug-in	Create Single or Multiple OFDM based Frames with one or more bursts	OFDMNL-SS01 OFDMFL-SS01	S-Parameters
RADAR plug-in	Create RADAR pulsed waveforms with various modulations and impairments	RADARNL-SS01 RADARFL-SS01	S-Parameters
Environment plug-in	Create real world scenarios for commercial, electronic warfare, and simulations for monitoring and receiver testing	ENVNL-SS01 ENVFL-SS01	
Spread Spectrum Clocking plug-in	Adds SSC capability to the High Speed Serial and Optical plug-ins	SSCFLNL-SS01 SSCFLFL-SS01	
S-Parameters plug-in	Adds S-Parameter capability to the RF Generic, High Speed Serial, Optical, OFDM, and RADAR plug-ins	SPARANL-SS01 SPARAFL-SS01	

Plug-ins require the purchase of a license before they are fully functional.

There are two types of licenses available for each plug-in: node-locked (NL) and floating (FL).

- Node Locked Licenses (NL) provide your own copy of the application on your instrument and are permanently assigned to a product model/serial number.
- Floating Licenses (FL) can be moved between product models.

Recommended accessories

Item	Description	Part number
Synchronization Hub	Enables fast synchronization of multiple AWG70000A series instruments	AWGSYNC01 Synchronization Hub
GPIB to USB Adapter	Enables GPIB control through USB B port	TEK-USB-488
MDC4500-4B	DC amplifier for MIPI applications	MDC4500-4B
Baluns	200 kHz - 17 GHz	Picosecond Pulse Labs 5315A
	300 kHz - 26.5 GHz	Marki BAL-0026
	5 MHz - 20 GHz	Hyperlabs HL9402
Bias Ts	10 kHz - 50 GHz	Picosecond Pulse Labs 5542
	200 kHz - 12 GHz	Mini-Circuits ZX85-12G-S+
Power Splitters	1.5 kHz - 18 GHz	Mini-Circuits ZX10-2-183-S+
	DC-18 GHz	Aeroflex/Weinschel 1515
Amplifiers	2.5 kHz - 10 GHz, 26 dB gain	Picosecond Pulse Labs 5866
	25 kHz - 45 GHz, 16 dB gain	Picosecond Pulse Labs 5882
	0.01 - 20 GHz, 30 dB gain	RF-Lambda RAMP00G20GA
Adapter	SMB female to SMA female	Mouser 565-72979
Programmer manual	Programming commands, English only	Visit Tektronix website

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Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

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.tek.com.

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