

# Arbitrary Waveform Generators

## AWG70000A Series Datasheet



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 GSsample 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 waveform 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

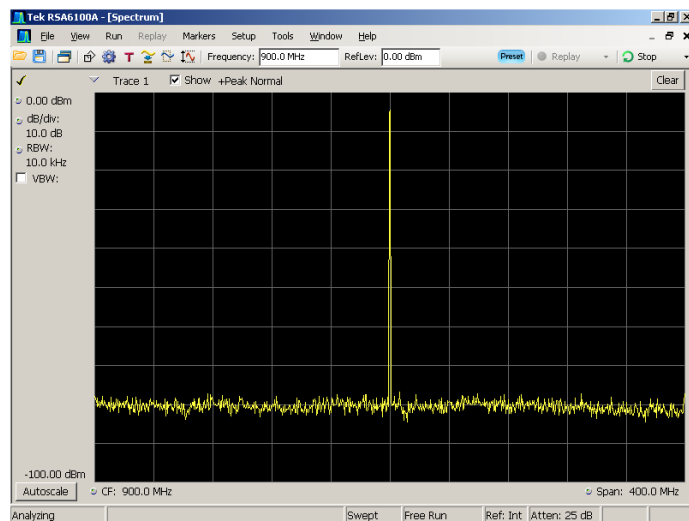
## Seamless transition from simulation to generation

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. Application software like RFXpress and SerialXpress, 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 RFXpress software, the captured signal can also be modified or changed to meet any specific requirements that may exist.

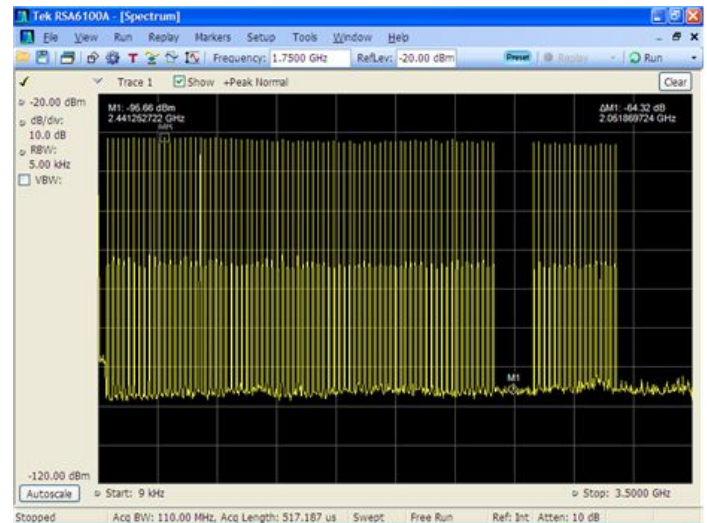
## Wideband RF signal generation

Creating RF signals is becoming more and more complex, making it difficult for RF engineers to accurately create the signals required for conformance and margin testing. When combined with RFXpress, the AWG70000A Series can address these tough design challenges. RFXpress is a software package that digitally synthesizes modulated baseband, IF, and RF signals taking signal generation to new levels by fully exploiting the wideband signal generation capabilities of the AWG70000A Series arbitrary waveform generators (AWGs). Together, the AWG70000A and RFXpress provide engineers with "bandwidth on demand", which is the ability to generate wideband modulated signals anywhere within the 20 GHz frequency range.



The AWG70000A offers outstanding Spurious Free Dynamic Range performance

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 comms, OFDM, and UWB. When used in conjunction with RFXpress, 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 AWG70000A and RFXpress 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 RFXpress enables the creation of waveforms requiring customer-defined modulation. The combination AWG and RFXpress 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.

## Coherent optical

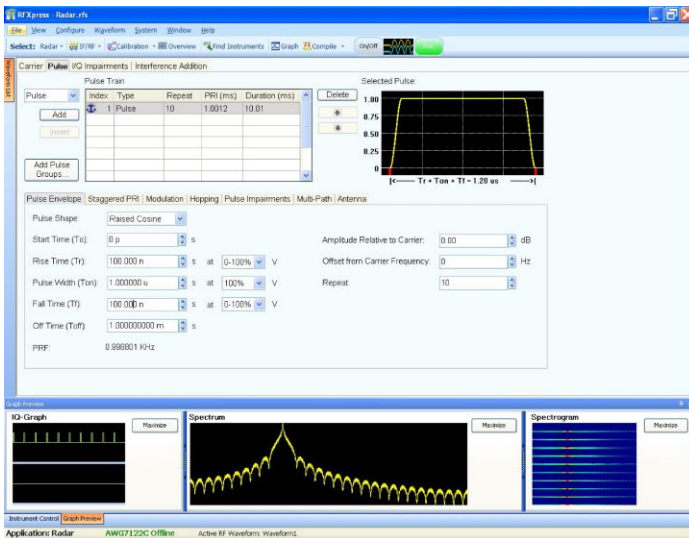
Today's high speed and increasingly web driven world is pushing the demand for short and long haul coherent optical development. Phase modulation, high baud rate, high sample rate, bandwidth and resolution are all critical to optical applications. Tektronix understands the challenges and inconsistencies 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. RFXpress 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 RFXpress, 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 RFXpress software choose default values for some signal aspects. The combined AWG/RFXpress solution 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 RFXpress software 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.



AWG radar pulses created with AWG70000A and RFXpress.

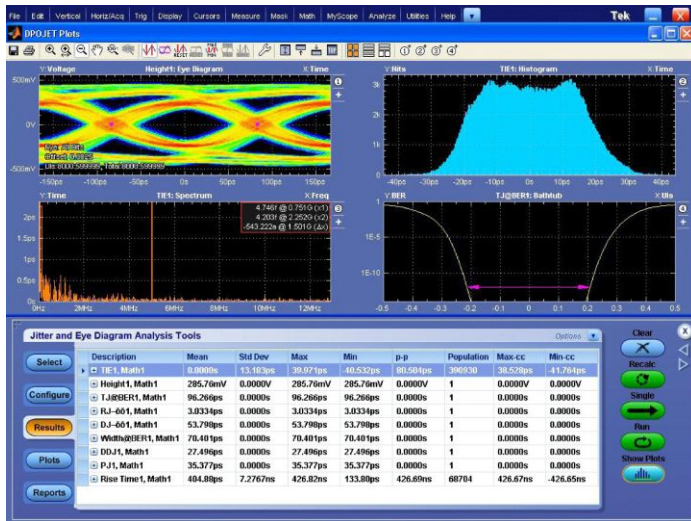
## Environment signal generation

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 RFXpress (with optional Environment plug-in) offers extreme flexibility to define and create these worst-case scenarios.

You can specify up to 25 signals to define your environment, including WiMAX, WiFi, GSM, GSM-EDGE, EGPRS 2A, EGPRS2B, CDMA, W-CDMA, DVB-T, Noise, and CW Radar. This plug-in also allows you to seamlessly import signals from other RFXpress plug-ins (including Radar, Generic Signal, 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.

## High-speed serial signal generation

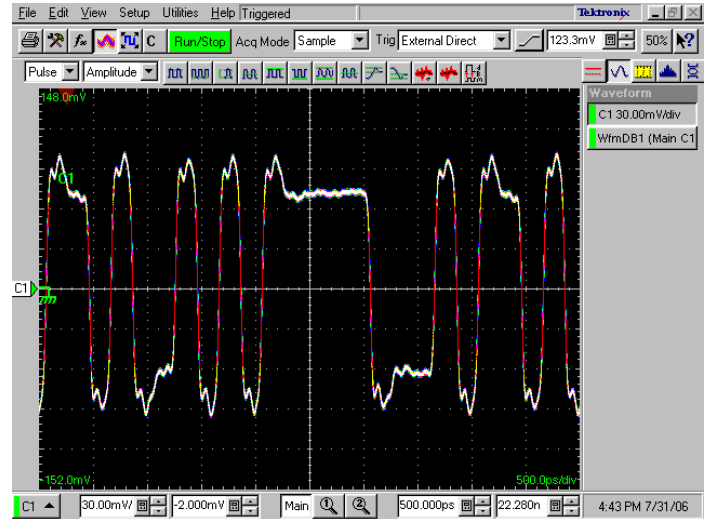
Serial signals are made up entirely of binary data- simple ones and zeros. As clock rates have increased these simple ones and zeros have begun to look more like analog waveforms because analog events are embedded in the digital data. The zero rise time and the perfectly flat tops of textbook digital 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 SerialXpress software package, engineers are provided control over every aspect of their digital signals reaching speeds of up to 12.5 Gb/s. This is exactly what is needed for rigorous receiver testing requirements.



Easily create digital data impairments with the AWG70000A and SerialXpress.

SerialXpress enables 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 touchstone files uploaded into SerialXpress. The AWG70000A and SerialXpress solution 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 SerialXpress.

## 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

## 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.

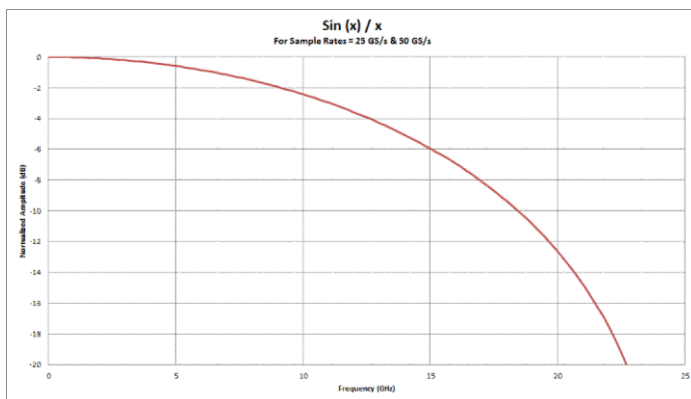
**Typical** (noted) - Product characteristics described in terms of typical performance, but not guaranteed performance. The values given are never warranted, but most units will perform to the level indicated. Typical characteristics are not tested in the manufacturing process or the Performance Verification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

Specifications apply to all models unless noted otherwise.

## 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

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

**Frequency domain characteristics**

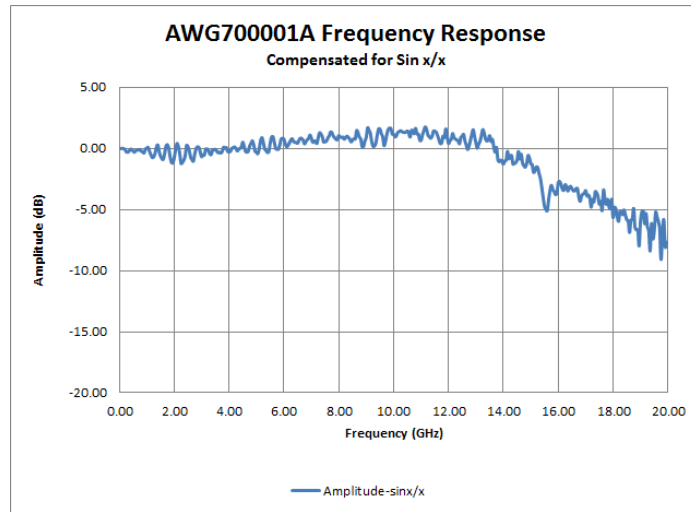
<b>Analog bandwidth</b>	Measured with a multi-sine waveform with equal amplitude across the band. The Sin(x)/x response is mathematically removed from the measured response before recording the -3 dB crossing.
<b>AWG70001A</b>	15 GHz
<b>AWG70002A</b>	13.5 GHz

**Output match, SWR (typical)**

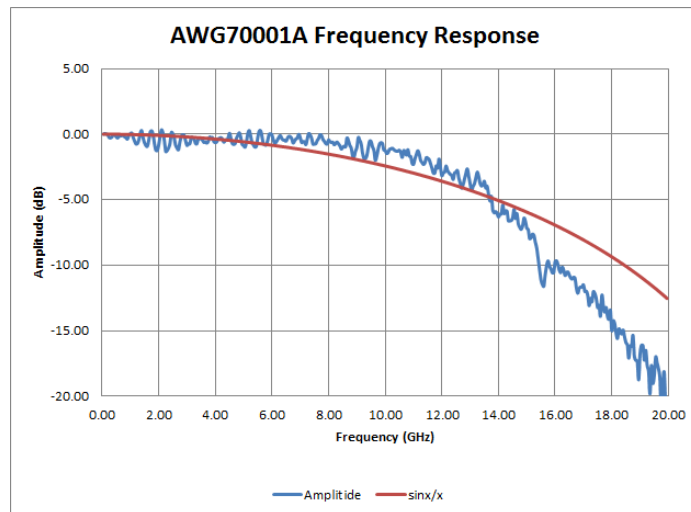
<b>AWG70001A</b>	DC to 5 GHz = 1.32:1 5 GHz to 10 GHz = 1.52:1 10 GHz to 20 GHz = 1.73:1
<b>AWG70002A</b>	DC to 5 GHz = 1.61:1 5 GHz to 10 GHz = 1.61:1

**Frequency response**

**AWG70001A**



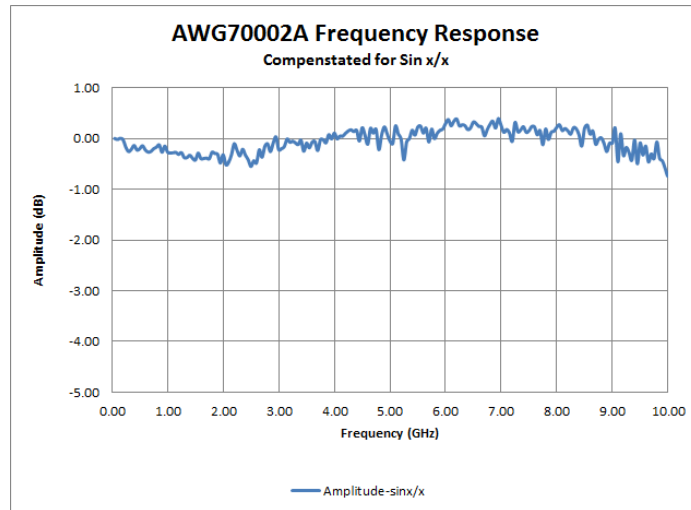
AWG70001A frequency response at 50 GS/s with Sin(x)/x response mathematically removed from measured data



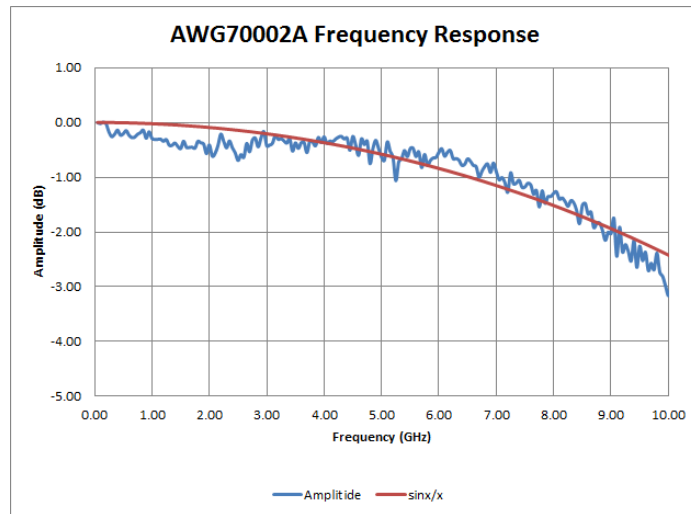
AWG70001A measured frequency response and ideal Sin(x)/x response at 50 GS/s

**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**

<b>Bit rate (nominal)</b>	Bit rate determined as "sample rate / 4 points per cycle", allowing full impairment generation.
<b>AWG70001A</b>	12.5 Gb/s
<b>AWG70002A</b>	6.25 Gb/s
<b>Rise/fall time (typical)</b>	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.
<b>AWG70001A</b>	Sampling rate ≤ 25 GS/s: < 23 ps < 27 ps at 50 GS/s
<b>AWG70002A</b>	< 22 ps
<b>Output amplitude characteristics</b>	Amplitude levels are measured between differential outputs (+) to (-). For single-ended output, the amplitude level will be one-half the specified voltage levels.
<b>Range (typical)</b>	500 mV <sub>p-p</sub> to 1 V <sub>p-p</sub>
<b>Resolution (typical)</b>	1.0 mV
<b>Accuracy (typical)</b>	±(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.

<b>Maximum repeat count</b>	2 <sup>20</sup> counts (1,048,576 counts)
<b>Maximum sequencing steps</b>	16,383
<b>Subsequencing</b>	Single level depth
<b>Waveform granularity resolution</b>	2 on the single-channel AWG70001A 1 on the two-channel AWG70002A
<b>Minimum waveform length</b>	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 <sup>1 2</sup>

**AWG70001A**

	In band performance		Adjacent band performance	
	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

**AWG70002A 8 Gsa/sec**

	In band performance		Adjacent band performance	
	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

<sup>1</sup> Measured with Balun at maximum sample rate.

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



**Spurious Free Dynamic Range (SFDR) characteristics**

**AWG70002A 16 Gsa/sec**

	In band performance		Adjacent band performance	
	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

**AWG70002A**

	In band performance		Adjacent band performance	
	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

**Output distortion characteristics**

**Harmonic distortion<sup>3</sup>**

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**

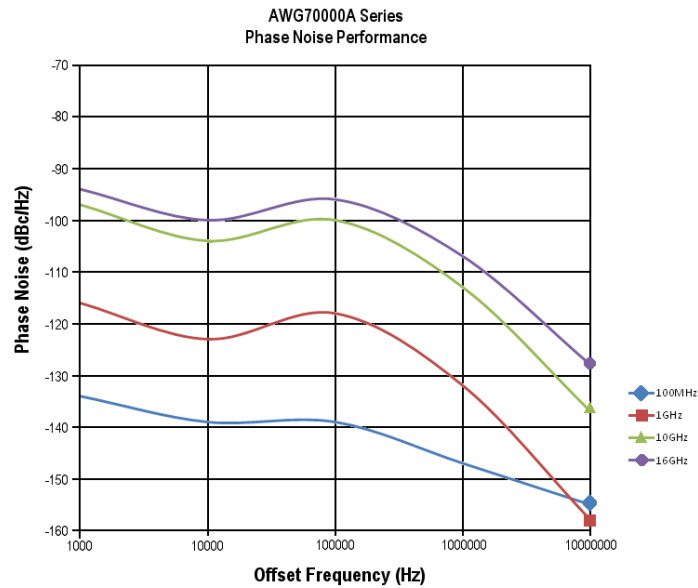
5.6 bits at 9.99 GHz

All noise and distortion DC - 12.5 GHz

<sup>3</sup> 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 <sub>p-p</sub> 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 $\pm(1 \text{ ppm} + \text{Aging})$ , Aging: $\pm 1 \text{ ppm per year}$

## Computer characteristics

Operating system / peripherals / IO	Windows 7 4 GB memory $\geq 480$ GB solid state drive Included USB compact keyboard and mouse USB 2.0 compliant ports (6 total - 2 front, 4 rear) RJ-45 Ethernet connector (rear panel) supports 10/100/1000BASE-T VGA video (rear panel) for external monitor eSATA (rear panel)
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Display characteristics	LED backlit touch screen display, 165 mm (6.5 in.) diagonal, 1024 × 768 XGA
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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
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Waveform file export capability	*.WFMX file format (Tektronix AWG70000A Series) *.TXT file format
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Computer characteristics

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	<table border="1"> <thead> <tr> <th>Characteristic</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Window</td> <td>-1.4 V to 1.4 V</td> </tr> <tr> <td>Amplitude</td> <td>0.5 V<sub>p-p</sub> to 1.4 V<sub>p-p</sub></td> </tr> <tr> <td>Resolution</td> <td>10 mV</td> </tr> <tr> <td>Accuracy</td> <td>±(10% of setting + 50 mV) into 50 Ω</td> </tr> <tr> <td>Rise/fall time (20% - 80%)</td> <td>&lt;35 ps (High: 1.0 V, Low: 0 V)</td> </tr> </tbody> </table>	Characteristic	Description	Window	-1.4 V to 1.4 V	Amplitude	0.5 V <sub>p-p</sub> to 1.4 V <sub>p-p</sub>	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)
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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 $\Omega$
Amplitude	High: 3.3 V into 50 $\Omega$ Low: 0 V

### Synchronization clock output

Frequency	1/80 of the clock output
Amplitude	1.0 V $\pm$ 150 mV <sub>p-p</sub> into 50 $\Omega$
Connector	SMA (rear panel)
Output impedance	50 $\Omega$ , AC coupled

### External clock output

Connector	SMA (rear-panel)
Output impedance	50 $\Omega$ 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 $\Omega$ , 1 k $\Omega$
Range	50 $\Omega$ : <5 V <sub>rms</sub> 1 k $\Omega$ : $\pm$ 10 V
Connector	SMA (rear panel)

Threshold	Characteristic	Description
	Range	-5.0 V to 5.0 V
	Resolution	0.1 V
	Accuracy	$\pm$ (5% +100 mV)

Trigger to output uncertainty	Characteristic	Description
	Asynchronous (typical)	$\pm$ 40 ps at maximum sample rate
	Synchronous (typical)	External variable reference and synchronous trigger timing: 500 fs <sub>rms</sub> , 7 ps <sub>p-p</sub> at BER 10 <sup>-12</sup>
	Synchronous (typical)	External 10 MHz reference and synchronous trigger timing: 5 ps <sub>rms</sub> , 70 ps <sub>p-p</sub> at BER 10 <sup>-12</sup>

Trigger minimum pulse width 20 ns

Trigger hold-off >1.4  $\mu$ s

### Reference in

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

## Auxiliary inputs

<b>Connector</b>	SMA (rear panel)
<b>Impedance</b>	50 $\Omega$ , AC coupled

---

### External Clock in

<b>Connector</b>	SMA (rear panel)
<b>Input impedance</b>	50 $\Omega$ , AC coupled
<b>Frequency range</b>	6.25 GHz to 12.5 GHz
<b>Input amplitude</b>	0 dBm to +10 dBm

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## Physical characteristics

### Dimensions

<b>Height</b>	153.6 mm (6.05 in)
<b>Width</b>	460.5 mm (18.13 in)
<b>Depth</b>	603 mm (23.76 in)

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### Weight

<b>Net weight without packaging</b>	16.8 kg (37.0 lb)
<b>Net weight with packaging</b>	22.4 kg (49.4 lb)

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### Cooling clearance

<b>Top</b>	0 in
<b>Bottom</b>	0 in
<b>Left side</b>	50 mm (2 in)
<b>Right side</b>	50 mm (2 in)
<b>Rear</b>	0 in

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### Power supply

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

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## EMC, environment, and safety

### Temperature

<b>Operating</b>	0 °C to +50 °C (32 °F to +122 °F )
<b>Non-operating</b>	-20 °C to +60 °C (140 °F to +50 °F )

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### Humidity

<b>Operating</b>	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
<b>Non-operating</b>	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

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## EMC, environment, and safety

### Altitude

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

### Vibration

<b>Operating</b>	Sine: 0.33 mm p-p (0.013 in p-p) constant displacement, 5 to 55 Hz Random: 0.27 G <sub>RMS</sub> from 5 to 500 Hz, 10 minutes per axis
<b>Nonoperating</b>	Random: 2.28 G <sub>RMS</sub> from 5 to 500 Hz, 10 minutes per axis

### Mechanical shock

<b>Operating</b>	Half-sine mechanical shocks, 30 g peak, 11 ms duration, 3 drops in each direction of each axis
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### Regulatory

<b>Safety</b>	UL61010-1, CAN/CSA-22.2, No.61010-1, EN61010-1, IEC61010-1
<b>Emissions</b>	EN55011 (Class A), IEC61000-3-2, IEC61000-3-3
<b>Immunity</b>	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

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

### Standard accessories <sup>4</sup>

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

## Warranty

One-year parts and labor

<sup>4</sup> Specify power cord and language option at time of order

## Options

### Product options

<b>Opt. 01</b>	Waveform record length expansion AWG70001A: from 2 GSamples to 16 GSamples AWG70002A: from 2 GSamples to 8 GSamples on both channels
<b>Opt. 03</b>	Adds sequencing
<b>Opt. 150</b>	Adds 50 GS/s sampling rate (AWG70001A only)
<b>Opt. 208</b>	Adds 8 GS/s sampling rate (AWG70002A only)
<b>Opt. 216</b>	Adds 16 GS/s sampling rate (AWG70002A only)
<b>Opt. 225</b>	Adds 25 GS/s sampling rate (AWG70002A only)
<b>Opt. RFX</b>	Adds RFXpress (RFX100) software to the AWG
<b>Opt. RDR</b>	Adds radar signal generation to RFXpress <sup>5</sup>
<b>Opt. SPARA</b>	Adds S-parameter emulation to RFXpress <sup>5</sup>
<b>Opt. OFDM</b>	Adds OFDM signal generation to RFXpress <sup>5</sup>
<b>Opt. UWBCF</b>	Adds UWB-WiMedia conformance signal generation to RFXpress <sup>5</sup>
<b>Opt. UWBCT</b>	Adds UWB-WiMedia custom and conformance signal generation to RFXpress (includes Opt. UWBCF) <sup>5</sup>
<b>Opt. ENV</b>	Adds environment signal generation to RFXpress <sup>5</sup>
<b>Opt. ENV01</b>	Bundling option - Opt. ENV + Opt. RDR <sup>5</sup>
<b>Opt. ENV02</b>	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM <sup>5</sup>
<b>Opt. ENV03</b>	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM + Opt. SPARA <sup>5</sup>
<b>Opt. ENV04</b>	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM + Opt. SPARA + Opt. UWBCT <sup>5</sup>

### Power plug options

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

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<sup>5</sup> Requires Opt. RFX



**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

**Application software**

<b>SDX100</b>	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)
<b>RFX100</b>	Advanced RF/IF/IQ waveform creation and editing software
Opt. RDR	Radar signal generation (requires RFX100 as prerequisite)
Opt. SPARA	S-parameter emulation (requires RFX100 as prerequisite)
Opt. OFDM	OFDM signal generation (requires RFX100 as prerequisite)
Opt. UWBCF	UWB-WiMedia conformance signal generation (requires RFX100 as prerequisite)
Opt. UWBCT	UWB-WiMedia custom and conformance signal generation (requires RFX100 as prerequisite and includes Opt. UWBCF)
Opt. ENV	Environment signal generation (requires RFX100 as prerequisite)
Opt. ENV01	Bundling option - Opt. ENV + Opt. RDR (requires RFX100 as prerequisite)
Opt. ENV02	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM (requires RFX100 as prerequisite)
Opt. ENV02	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM (requires RFX100 as prerequisite)
Opt. ENV03	Bundling option - Opt. ENV + Opt. RDR + Opt. OFDM + Opt. SPARA (requires RFX100 as prerequisite)

## Rack mount kit

**AWGRACK** Rack mount kit for AWG70000A Series

## Product upgrades

### AWG70001A

**AWG701AUP Opt. 01** Increases the waveform record length to 16 G samples  
**AWG701AUP Opt. 03** Adds sequencing  
**AWG701AUP Opt. SSD** Provides an additional (or replacement) preprogrammed solid state drive

### AWG70002A

**AWG702AUP Opt. 01** Increases the waveform record length to 16 G samples  
**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** Provides an additional (or replacement) preprogrammed solid state drive

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



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