

# ARB RIDER AWG-7000

7102(D)/7104(D)  
7202(D)/7204(D)/7204(D)-S  
7172(D)/7174(D)/ 7174(D)-S

## Technical Datasheet

**2 / 4 CHANNELS – ALL IN ONE:  
Function Generator, Arb Generator,  
Pulse Pattern Generator and Digital  
Pattern Generator.**

- 2, 4 Analog Channels
- Up to 20 GS/s
- 14 Bit Vertical Resolution
- Up to 10 GHz output frequency
- < 50ps Rise/fall time
- 100 ps minimum pulse width
- Single ended output with up to 5 V<sub>p-p</sub> into 50 Ω with hardware offset of ±2.5V into 50 Ω. Total Output Voltage Window ±5 V (10 V<sub>p-p</sub>) into 50 Ω
- Differential output with up to 2 V<sub>p-p</sub> into 100 Ω with common mode voltage of ±2 V into 50 Ω
- Up to 9 Gpts Waveform Memory per Channel
- Up to 32 Digital Channels in synchronous with analog Generation
- Multi-Instrument Synchronization: up to 16 analog and 128 digital channels



### Key performance specifications

- **AWG Mode**
  - 14-bit vertical resolution
  - Up to 20 GS/s Variable Clock
  - Up to 10 GHz output frequency
  - < 50ps Rise/fall time
  - 32bit digital channels
  - Up to 9 Gpts Waveform Memory per Channel
  - Single ended amplitude up to 5 V<sub>p-p</sub> into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2 V<sub>p-p</sub> into 100 Ω load with common mode voltage of ±2 V into 50 Ω
- **AFG Mode**
  - 6.5 GHz Sine Waveforms
  - Up to 20 GS/s fixed, 14-bit vertical resolution
  - Single ended amplitude up to 5 V<sub>p-p</sub> into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2 V<sub>p-p</sub> into 100 Ω load with common mode voltage of ±2 V into 50 Ω
  - Improved proprietary DDS based technology
- **Pulse Pattern Generator (PPG) Mode - Optional**
  - Up to 6.5Gbit/s NRZ, RZ and R1 bit stream generation
  - 2,3 or 4 levels pattern
  - 64 point arbitrary shape per transition
  - Programmable duration for any transition
  - Up to 12 Mbit (2 levels) and 6 Msymbols (3 or 4 levels) pattern memory for channel
  - Single ended amplitude up to 5 V<sub>p-p</sub> into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2 V<sub>p-p</sub> into 100 Ω load with common mode voltage of ±2V into 50 Ω

## Features & Benefits

- Sample rate can be programmed in from 1 S/s up to 20 GS/s, with 14-bit vertical resolution, ensures exceptional signal integrity
- Arbitrary waveform memory up to 9 Gpts
- Mixed Signal Generation – 2 or 4 Analog channels with up to 32 synchronized Digital Channels<sup>1</sup> for debugging and validating digital design
- Three operation modes – Simple Rider AFG (DDS AFG mode), True Arb (variable clock Arbitrary AWG mode) and PPG (Pulse/Serial Pattern Generator – Optional).
- Digital outputs provide up to 10 Gb/s data rate in programmable CML standard. CML to LVTTTL adapter is available
- Advanced sequencer with up to 16384 user defined waveforms provides the possibility of generating complex signal scenarios with the most efficient memory usage
- Windows based platform with 7in touch screen, front panel buttons and knob
- Compact form factor, convenient for bench top and fully fit with 3U – 19” rackmount standard
- LAN, USB-TMC and GPIB interfaces for remote control



<sup>1</sup> Digital output channels are available in the 7204,7174 and 7104 model only

# Applications and Area

## Optics & Photonics, RF Wireless

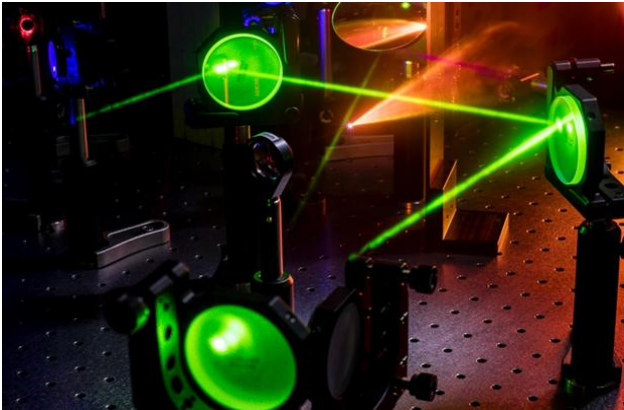


Figure 1: Laser & Photonics

The AWG-7000 is the ideal choice for the frontier of science & technology experiments and cutting-edge challenges like **High Energy Physics, Optical, laser** and **photonics** and RF Wireless Communication.

The AWG-7000 Series instrument can create virtually any signal - analog or digital, ideal or distorted, standard or custom.

You can easily build complex RF/IF/IQ waveform, extremely small width, high amplitude pulses to drive **electro/acousto-optic modulators, pulsed laser diode** or it can be used in quantum optics experiments like manipulating **nitrogen vacancy color center** in diamond.

### Highlights

- Drive electro-optic modulator.
- Modulating and driving laser diode.
- Quantum optics emitters testing.
- RF Wireless Digital modulation

## Quantum Applications



Figure 2: Quantum Encryption

Emerging Quantum technologies like **Quantum Sensing, Quantum Key Distribution** will improve our lives in the next years.

They will be fundamental tools for secure communications and how we measure, navigate, study, explore, see, and interact with the world around us by sensing changes in motion, and electric and magnetic fields.

Recently the investigation of light-matter coupling between ensembles of cold atoms and photons propagating in so-called optical nanofibers, i.e., glass fibers whose diameter is smaller than the optical wavelength.

The special properties of these fibers make them suitable for use as a "**quantum laboratory**".

The AWG-7000 is the perfect tool to face all these new technological challenges, since it allows you to generate pulses with **ultra-fast rise** and fall time, Gaussian shapes, multi-level PAM and PRBS signals, complex pulse trains, pulsed RF signals with impairments that are the key factors for those kind of tests.

## Highlights

- PRBS signals generation.
- QKD and Quantum sensing.
- Cold atoms
- Manipulate nitrogen vacancy color center in diamond.
- Minimum delay between Trigger In Analog Out.
- Up to 16 analog channels and 128 digital channels fully synchronized.
- Built-in sequencer with conditional/unconditional/dynamic jump features, two independent Trigger Inputs, up to 4 Marker outputs.

## Automotive



Figure 3: Automotive

Today's cars are including a lot of highly sophisticated electronic control unit with very sensitive electronic components. As demands go up, next-generation advanced driver-assistance systems (ADAS) require camera and **radar** systems with increasingly high resolution.

Camera, **LIDAR**, Radar and **Ultrasound** devices need higher bandwidth and lower latency networking and complex automotive technologies to come.

Physical layer testing, transmit & receiver testing and channel testing need a high performance and easy-to-use tools to satisfy the latest automotive challenges.

The Arb-Rider 7000 Series combining 20 GS/s with 14-bits vertical resolution, represents the ideal instrument for generating the real-world signals that are necessary to emulate the most demanding testing cases.

## Highlights

- Electrical standards emulation up to 5V.
- Physical layer testing.
- Sensor testing.
- EMI debugging, troubleshooting and testing.

## Advanced Research Applications

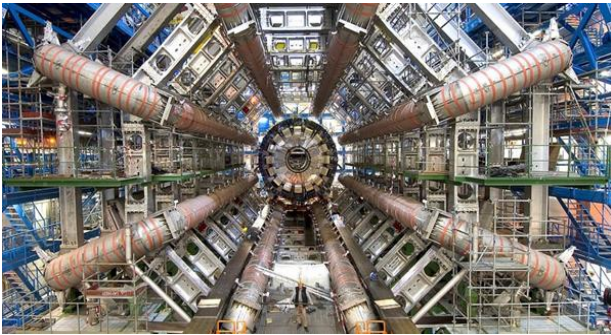


Figure 4: Advanced Research

The AWG-7000 has the best overall product in the market between signal amplitude and bandwidth: you can generate 5Vpp pulses with more than 6.5 GHz of analog bandwidth.

The combination of ultra-fast edge & minimum pulse width generation, excellent dynamic range and easy to use interface perfectly meet the scientists and engineers working on large experiments such as **Accelerators**, **Tokamak** or **synchrotrons** to emulate signals without creating specific test boards.

Pulses may be easily generated for applications such as Pulse Electron Beam or X Ray Sources, Flash X-ray Radiography, Lighting pulse simulators, high Power Microwave modulators.

## Highlights

- Emulation of detectors.
- Emulation of signal sources adding noise.
- Generation/playback of real-world signals.

## Semiconductors Test

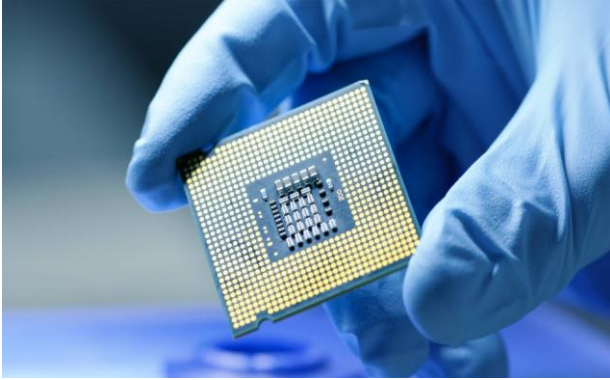


Figure 5: Semiconductors testing

Consumers continually demand better performance in a smaller form factor with reduced power requirements.

This in turn has led to devices with much smaller footprints, much higher data throughput, and lower power requirements. These features enable many of the technologies that consumers take advantage of today such as SATA, USB, and PCI Express.

## Aerospace and Defense



Figure 6: Aerospace & Defense applications

Radar, Lidar and Sonar design and testing perfectly

The AWG-7000 Series allows the testing of these

high-speed devices, since it can provide up to 16 analog output channels with a maximum data rate of 8 Gbps and it can perform PCI-Express Gen. 3 debugging.

Emulation of complex signals generated with inclusion of noise or distortions may become an excellent way to provide Compliance Components Test to help semiconductor engineers.

The fast edges and pulse generation can be used to provide characterization in fast power devices.

## Highlights

- High-speed serial testing.
- Semiconductors characterization.
- High-speed clock generation.
- Frequency response, intermodulation distortion and noise-figure measurements.
- Pulse Pattern generator.

match with the AWG-7000 Series.

Moreover the capability to generate high bandwidth signals can be used on digital modulation systems for Radio Applications or others I/Q signal modulation.

The generation of high-speed signals combined to the advanced sequencer with fast sequence switch feature, allow the emulation of complex real world signal scenarios.

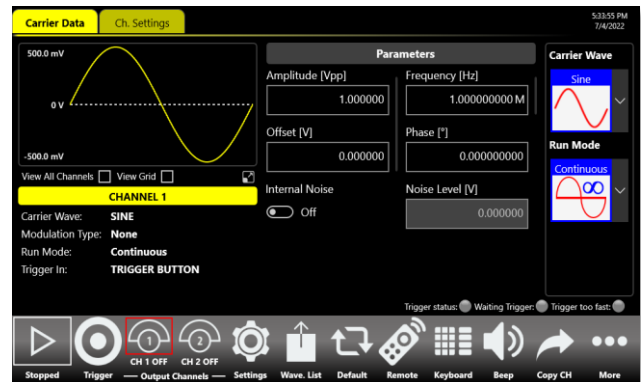
## Highlights

- Radar and Lidar RF modulated signals emulation.
- Electronic Warfare complex scenarios generation.
- Avionics testing

## Simple Rider AFG: Function Generator Mode Interface

**Simple Rider AFG** UI is designed for touch and it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips. All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smart phones: touch features and gestures are available to engineers and scientists to create advanced waveforms or digital patterns in few touches.

- The swipe gesture gives easy access to the output waveform parameters
- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data.
- Time saving shortcuts and intuitive icons simplify the instrument setup.



## Simple Rider TrueArb: AWG Mode Interface

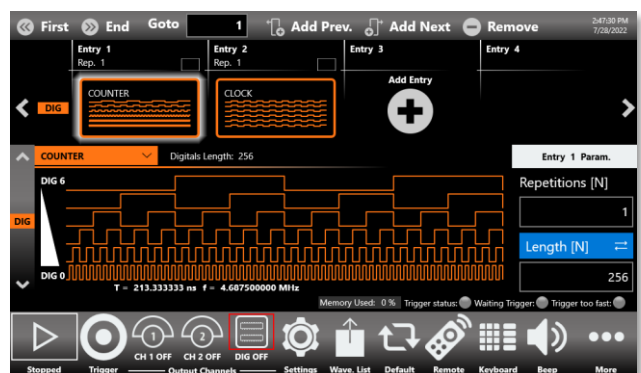
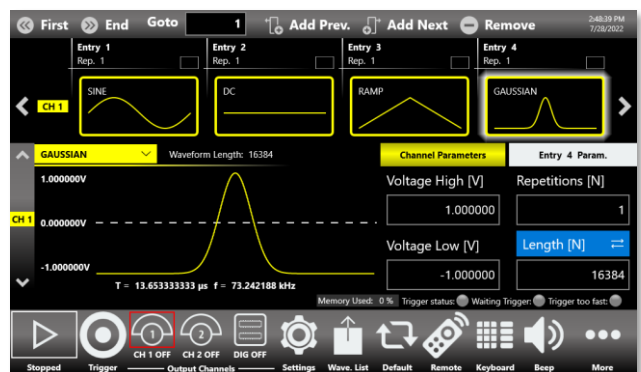
In **Simple Rider True-Arb** interface, the users can define complex waveforms with up to 16,384 sequence entries of analog waveforms and digital patterns, define their execution flow by means of loops, jumps and conditional branches.

Digital output combined and synchronized with analog output signals represent an ideal tool to troubleshoot and validate digital design.

The waveform memory length of up to 9 GSamples on each channel combined with up to 16,384 and up to 4,294,967,294 repetitions, make the Arb-Rider 7202/7204 or the ideal generator for the most demanding technical applications.

Thanks to the intuitive and easy waveform sequencer user interface, the most complex waveform scenarios can be created with just few screen touches.

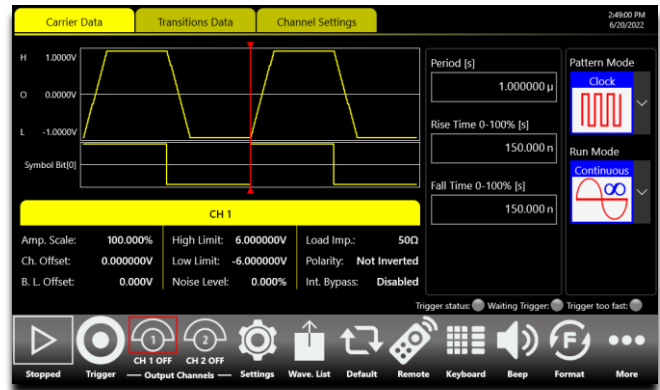
Up to 4 instruments can be synchronized together in order to obtain a 16 analog – 128 digital channel generator. A dedicated synchronization bus guarantees the intra-chassis synchronization. Arb Rider supports the standard Ethernet interface for remote control and easy customized instrument programming.



## Simple Rider PPG: Pulse Pattern Generator (PPG) Mode Interface

The easiest touch screen display interface allows to create patterns scenarios, only in a few screen touches.

In summary the Pulse Pattern Generator provides the capability to generate PRBS patterns and up to 12 MSymbols custom patterns where bit transitions can have arbitrarily user defined shapes. The ARB-RIDER-AWG7000 Pulse Pattern Generator can generate patterns up to 6.5Gbaud.



The software architecture provides the possibility to easily generate the patterns in different generation modality and also gives the opportunity to modulate the patterns with internal or external signals with the purpose to generate also different effects of noise (jitter, ripple, ...).

## Table of Available Models

GS/s	Output	Model	Description
20 GS/s	Single ended	<b>AWG-7202</b>	2 CH – 5Vpp Single ended outputs – Full memory <sup>2</sup>
		<b>AWG-7204</b>	4 CH – 5Vpp Single ended outputs – Full memory
		<b>AWG-7204-S</b>	4 CH – 5Vpp Single ended outputs – Short memory or 2 CH – 5Vpp Single ended outputs – Full memory
	Differential	<b>AWG-7202D</b>	2 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
		<b>AWG-7204D</b>	4 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
		<b>AWG-7204D-S</b>	4 CH – 2Vpp (1Vpp single ended) Differential outputs – Short memory or 2 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
17 GS/s	Single ended	<b>AWG-7172</b>	2 CH – 5Vpp Single ended outputs – Full memory
		<b>AWG-7174</b>	4 CH – 5Vpp Single ended outputs – Full memory
		<b>AWG-7174-S</b>	4 CH – 5Vpp Single ended outputs – Short memory or 2 CH – 5Vpp Single ended outputs – Full memory
	Differential	<b>AWG-7172D</b>	2 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
		<b>AWG-7174D</b>	4 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
		<b>AWG-7174D-S</b>	4 CH – 2Vpp (1Vpp single ended) Differential outputs – Short memory or 2 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
10 GS/s	Single ended	<b>AWG-7102</b>	2 CH – 5Vpp Single ended outputs – Full memory
		<b>AWG-7104</b>	4 CH – 5Vpp Single ended outputs – Full memory
	Differential	<b>AWG-7102D</b>	2 CH – 2Vpp (1Vpp single ended) Differential outputs – Full memory
		<b>AWG-7104D</b>	4 CH – 2Vpp (1Vpp single ended) Differential output – Full memory

<sup>2</sup> Full and Short memory modes affect the available waveform memory. For a detailed description see the “Table 1 Waveform memory vs model and operating mode”

## Options and Accessories

Item	Description
<b>AWG-7202-PAT</b>	O Pulse Pattern Generator (PPG) for AWG-7202(D), 7172(D) or 7102(D)
<b>AWG-7204-PAT</b>	O Pulse Pattern Generator (PPG) for AWG-7204(D), 7174(D) or 7104(D)
<b>AWG-7xx4-8DIG</b>	O AWG-7xx4-8DIG 8CH Dig license for AWG-7204(D), 7174(D) or 7104(D)
<b>AWG-7xx4-16DIG</b>	O AWG-7xx4-16DIG 16CH Dig license for AWG-7204(D), 7174(D) or 7104(D)
<b>AWG-7xx4-32DIG</b>	O AWG-7xx4-32DIG 32CH Dig license for AWG-7204(D), 7174(D) or 7104(D)
<b>AWG-7000-FSS</b>	O AWG-7000 Fast Sequence Switch
<b>AWG-7xx2-WAR</b>	O 3 years warranty extension for AWG-7202(D), 7172(D) or 7102(D)
<b>AWG-7xx4-WAR</b>	O 3 years warranty extension for AWG-7204(D), 7204(D)-S, 7174(D), 7174(D) -S or 7104(D)
<b>RIDER-MINI-SAS-HD</b>	A Mini Sas HD cable for digital probe, 8 Differential signal (available only for 4-channels models with long memory)
<b>RIDER-AWG7K-SYNC</b>	A Synchronization cable for all AWG-7000 models
<b>AT-DTTL8</b>	A LVDS to LVTTTL digital adapter probe (available only for 4-channels models with long memory)
<b>AT-LVDS-SMA8</b>	A CML to SMA digital adapter cable (available only for 4-channels models with long memory)
<b>GP-IB / USB-TMC</b>	A GPIB and USBTMC Ports for Remote Control
<b>RIDER-RACK</b>	A Rackmount kit for Rider instrument system

O = options, A = Accessories





## Memory vs model and operating modes

		Memory per channel (Msamples)							
Channel count	MODEL	FULL RATE mode (20/17Gps max sampling rate)				HALF RATE mode (10Gps max sampling rate)			
		CH1	CH2	CH3	CH4	CH1	CH2	CH3	CH4
20 GS/s and 17 GS/s	2 AWG-7202 AWG-7202D AWG-7172 AWG-7172D	9600	1.17	-	-	4800	4800	-	-
	4 AWG-7204 AWG-7204D AWG-7174 AWG-7174D	9600	9600	0.589	0.589	4800	4800	4800	4800
10 GS/s	2 AWG-7102 AWG-7102D	-	-	-	-	4800	4800	-	-
	4 AWG-7104 AWG-7104D	-	-	-	-	4800	4800	4800	4800



		Memory per channel (Msamples)							
Channel count	MODEL	FULL RATE mode (20/17Gps max sampling rate)				HALF RATE mode (10Gps max sampling rate)			
		CH1	CH2	CH3	CH4	CH1	CH2	CH3	CH4
20 GS/s and 17 GS/s	4 AWG-7204-S AWG-7204D-S AWG-7174-S AWG-7174D-S	SHORT MEMORY mode							
		0.512	0.512	0.512	0.512	-	-	-	-
		FULL MEMORY mode							
		9600	1.17	-	-	4800	4800	-	-

Table 1 Waveform memory vs model and operating modes

All specifications are typical unless noted otherwise. The guaranteed performances are referred to a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 5°C to 40°C and after a 45-minute warm up period. Within ±10°C after auto-calibration

<b>General Specifications</b>		
	<p><b>AWG-7202</b> <b>AWG-7202D</b></p> <p><b>AWG-7172</b> <b>AWG-7172D</b></p> <p><b>AWG-7102</b> <b>AWG-7102D</b></p> 	<p><b>AWG-7204</b> <b>AWG-7204D</b></p> <p><b>AWG-7204S<sup>3</sup></b> <b>AWG-7204D-S<sup>3</sup></b></p> <p><b>AWG-7174</b> <b>AWG-7174D</b></p> <p><b>AWG-7174-S<sup>3</sup></b> <b>AWG-7174D-S<sup>3</sup></b></p> <p><b>AWG-7104</b> <b>AWG-7104D</b></p> 
<b>Operating Mode</b>	AFG Mode - True Arb Mode - PPG Mode (optional)	
<b>Number of Markers and Analog Channels</b>		
Analog channels	2	4
Markers	2	4
	<p><b>AWG-7202</b> <b>AWG-7202D</b></p> <p><b>AWG-7172</b> <b>AWG-7172D</b></p> <p><b>AWG-7102</b> <b>AWG-7102D</b></p> <p><b>AWG-7204-S</b> <b>AWG-7204D-S</b></p> <p><b>AWG-7174-S</b> <b>AWG-7174D-S</b></p> 	<p><b>AWG-7204</b> <b>AWG-7204D</b></p> <p><b>AWG-7174</b> <b>AWG-7174D</b></p> <p><b>AWG-7104</b> <b>AWG-7104D</b></p> 
<b>Number of Digital Channels</b>		
Digital channels	-	32

<sup>3</sup> The AFG Mode has only 2 Channels in -S models.

	<p><b>AWG-7202</b> <b>AWG-7204</b> <b>AWG-7204-S</b></p> <p><b>AWG-7172</b> <b>AWG-7174</b> <b>AWG-7174-S</b></p> <p><b>AWG-7102</b> <b>AWG-7104</b></p> 	<p><b>AWG-7202D</b> <b>AWG-7204D</b> <b>AWG-7204D-SD</b></p> <p><b>AWG-7172D</b> <b>AWG-7174D</b> <b>AWG-7174D-S</b></p> <p><b>AWG-7102D</b> <b>AWG-7104D</b></p> 
<b>Output Channels</b>		
Output type	Single ended DC coupled	Differential DC coupled
Output impedance	Single ended: 50 Ω	Single ended: 50 Ω Differential: 100 Ω
Connectors	SMA on front panel	
<b>DC Amplitude</b>		
Amplitude range	±2.5 V (into 50 Ω)	±0.5 V Se. (into 50 Ω) ±1 V Diff. (into 100 Ω)
Resolution	500μV (nom), 5 digits	100μV (nom), 5 digits
Amplitude accuracy	±(1.5% of  setting  + 15mV) <sup>4</sup>	±(1% of  setting  + 2mV) <sup>4</sup>
<b>DC Baseline Hardware Offset (Common mode offset)</b>		
Resolution	< 4 mV or 4 digits	
Range (50 Ω into 50 Ω)	-2.5 V to +2.5 V	-2 V to +2 V
Range (50 Ω into High Z load)	-2.5 V to +2.5 V	-2 V to +2 V
Accuracy (50 Ω into 50 Ω) (guaranteed)	±(1% of  setting  + 15 mV)	±(1% of  setting  + 5 mV)
<b>AC Accuracy</b> (1 kHz sine wave, 0 V offset, > 5 mV <sub>p-p</sub> amplitude, 50 Ω load)	±2.5% of setting [Vpp] <sup>4</sup>	

<sup>4</sup> The specification is guarantee in the range 0% to 80% of full scale output

## True Arb - Baseband mode specifications

	<b>AWG-7202</b> <b>AWG-7204</b> <b>AWG-7204-S</b> <b>AWG-7172</b> <b>AWG-7174</b> <b>AWG-7174-S</b> <b>AWG-7102</b> <b>AWG-7104</b>	<b>AWG-7202D</b> <b>AWG-7204D</b> <b>AWG-7204D-S</b> <b>AWG-7172D</b> <b>AWG-7174D</b> <b>AWG-7174D-S</b> <b>AWG-7102D</b> <b>AWG-7104D</b>
<b>General specifications</b>		
Operating Modes	Full Rate Mode (Variable clock) Half Rate Mode (Variable clock)	
Sampling Rate <b>AWG-720x(D) / AWG717x(D) Model:</b> <ul style="list-style-type: none"> <li>- Full Rate Mode</li> <li>- Half Rate Mode</li> </ul> <b>AWG-7204(D)-S / AWG7174(D)-S Model:</b> <ul style="list-style-type: none"> <li>- Full Rate and Full Rate SHORT MEMORY Mode</li> <li>- Half Rate Mode</li> </ul> <b>AWG-710x(D) Model:</b>	1 S/s to 20 GS/s <sup>5</sup> (AWG-720x(D)) 1 S/s to 17 GS/s <sup>5</sup> (AWG-717x(D)) 1 S/s to 10 GS/s <sup>5</sup> 1 S/s to 20 GS/s <sup>5</sup> (AWG-7204(D)-S) 1 S/s to 17 GS/s <sup>5</sup> (AWG-7174(D)-S) 1 S/s to 10 GS/s <sup>5</sup> 1 S/s to 10 GS/s <sup>5</sup>	
Sin(x)/x	8.85 GHz @ 20GS/S (AWG-7202(D) / AWG7204(D)-S)) 7.52 GHz @ 17GS/S (AWG-7172(D) / AWG7174(D)-S)) 4.425 GHz @ 10GS/S (AWG-710x / AWG710x(D))	
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced	

<sup>5</sup> The entire Sample Rate interval is not continuous:  $[15.726 \text{ GHz} \div 13.764 \text{ GHz}] / 2^N$  with  $N = 0, 1, 2, 3, \dots, 34$  are forbidden intervals.



Timer		
Range	17.6 ns to 429 ms	
Resolution	± 1 sampling clock cycle	
<b>Analog Channel to Channels skew</b>		
Range	0 to 1.63 us	
Resolution	<b>4CH Model:</b> Skew Resolution: 1 Sampling Clock Cycle (CHx to CHx (x=1,2,3,4) Skew)  FINE Skew Resolution: 100 fs (CH1/CH3 Couple to CH2/CH4 Couple Skew)  <b>2CH Model:</b> 100 fs	
Accuracy	±(1% of setting + 20 ps)	
Initial skew	< 20 ps	
<b>Calculated bandwidth (0.35 / rise or fall time<sub>10-90</sub>)</b>		
- For <b>20</b> or <b>17 GSa/s</b> model:	≥ 5 GHz	≥ 5.8 GHz
- For <b>10 GSa/s</b> model:	≥ 2.6 GHz	≥ 3.25 GHz
<b>Measured 3dB bandwidth (sin(x)/x compensated)</b>		
- For <b>20</b> or <b>17 GSa/s</b> model:	5.8 GHz	-
- For <b>10 GSa/s</b> model:	3 GHz	
<b>Nyquist Bandwidth (Fs/2)</b>		
- For <b>20 GSa/s</b> model:	10 GHz	
- For <b>17 GSa/s</b> model:	8.5 GHz	
- For <b>10 GSa/s</b> model:	5 GHz	
<b>Rise/fall time (1 V<sub>p-p</sub> single-ended 20% to 80%)</b>		
- For <b>20</b> or <b>17 GSa/s</b> model:	≤ 50 ps	≤ 45 ps

<ul style="list-style-type: none"> <li>- For <b>10 GSa/s</b> model:</li> </ul> <b>Rise/fall time</b> (1 $V_{p-p}$ single-ended 10% to 90%)	$\leq 85$ ps	$\leq 77$ ps			
	<ul style="list-style-type: none"> <li>- For <b>20 or 17 GSa/s</b> model:</li> </ul>	$\leq 70$ ps	$\leq 60$ ps		
	<ul style="list-style-type: none"> <li>- For <b>10 GSa/s</b> model:</li> </ul>	$\leq 130$ ps	$\leq 110$ ps		
<b>Overshoot</b> (1 $V_{p-p}$ single-ended)	$<8\%$	$<6\%$			
<b>Random jitter on clock pattern</b> (rms, typical)	$< 2$ ps				
	<b>AWG-7202</b> <b>AWG-7204</b> <b>AWG-7204-S</b> <b>AWG-7172</b> <b>AWG-7174</b> <b>AWG-7174-S</b> <b>AWG-7102</b> <b>AWG-7104</b>				
<b>SFDR</b> <sup>6</sup> (2.5 $V_{p-p}$ single-ended, 20 GSa/s)	Measurement Range 1	dBc	Measurement Range 2	dBc	
DC – 100 Mhz	DC – 10 Ghz	-70			
DC – 500 Mhz	DC – 10 Ghz	-70			
DC – 2 Ghz	DC – 6 Ghz	-70	DC – 10 Ghz	-60	
DC – 3 Ghz	DC – 4 Ghz	-65	DC – 10 Ghz	-55	
DC – 4 Ghz	DC – 5 Ghz	-55	DC – 10 Ghz	-52	
4 Ghz – 5 Ghz	2 Ghz – 5 Ghz	-65	DC – 10 Ghz	-53	
5 Ghz – 6 Ghz	5 Ghz – 10 Ghz	-67	DC – 10 Ghz	-53	
6 Ghz – 7 Ghz	4 Ghz – 10 Ghz	-62	DC – 10 Ghz	-46	
7 Ghz – 8 Ghz	6 Ghz – 10 Ghz	-62	DC – 10 Ghz	-42	

<sup>6</sup> Channel Optimization = High linearity, Flatness Compensation = Off

	<b>AWG-7202D</b> <b>AWG-7204D</b> <b>AWG-7204D-S</b> <b>AWG-7172D</b> <b>AWG-7174D</b> <b>AWG-7174D-S</b> <b>AWG-7102D</b> <b>AWG-7104D</b>			
<b>SFDR<sup>6</sup></b> (0.5 V <sub>p-p</sub> single ended, 20 GSa/s)	Measurement Range 1	dBc	Measurement Range	dBc
DC – 100 Mhz	DC – 2 Ghz	-77	DC – 10 Ghz	-67
DC – 500 Mhz	DC – 2 Ghz	-77	DC – 10 Ghz	-67
DC – 2 Ghz	DC – 6 Ghz	-65	DC – 10 Ghz	-60
DC – 3 Ghz	DC – 4 Ghz	-65	DC – 10 Ghz	-58
DC – 4 Ghz	DC – 6 Ghz	-60	DC – 10 Ghz	-54
4 Ghz – 5 Ghz	2 Ghz – 5 Ghz	-65	DC – 10 Ghz	-53
5 Ghz – 6 Ghz	5 Ghz – 10 Ghz	-70	DC – 10 Ghz	-53
6 Ghz – 7 Ghz	4 Ghz – 10 Ghz	-62	DC – 10 Ghz	-46
7 Ghz – 8 Ghz	6 Ghz – 10 Ghz	-75	DC – 10 Ghz	-42

## AFG Mode Specifications

	<b>AWG-7202</b> <b>AWG-7204</b> <b>AWG-7204-S</b> <b>AWG-7172</b> <b>AWG-7174</b> <b>AWG-7174-S</b> <b>AWG-7102</b> <b>AWG-7104</b>	<b>AWG-7202D</b> <b>AWG-7204D</b> <b>AWG-7204D-S</b> <b>AWG-7172D</b> <b>AWG-7174D</b> <b>AWG-7174D-S</b> <b>AWG-7102D</b> <b>AWG-7104D</b>
<b>General Specifications</b>		
<b>Amplitude</b>		
Range	0 to 5Vpp (into 50 Ω)	0 to 2Vpp Diff. (into 100 Ω) 0 to 1Vpp Se. (into 50 Ω)
Resolution	500μV (nom), 5 digits	100μV (nom), 5 digits
Operating mode	DDS mode	
Standard Waveforms	Sine, Square, Pulse, Ramp, more (Noise, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine	
Run Modes	Continuous, modulation, sweep, burst	
Arbitrary Waveforms	Vertical resolution: 14-bit Waveform length: 16,384 points	
<b>Internal Trigger Timer</b>		
Range	10 ns to 100 s	
Resolution	31.25 ps	
Accuracy	±(0.1% setting + 5 ps)	
<b>Sine Waves</b>		
Max Frequency	6.5 GHz (for 20 Gsps and 17 Gsps models) 3.25 GHz (for 10 Gsps models)	
Frequency Range Sine (50 Ω into 50 Ω)	18 mHz to ≤ 3.5 GHz: 5Vpp 3.5 GHz to ≤ 4.5 GHz: 4Vpp	18 mHz to ≤ 6.5 GHz: 2Vpp Diff.

	4.5 GHz to ≤ 6.5 GHz: 3Vpp	18 mHz to ≤ 6.5 GHz: 1Vpp Se.
Flatness	DC to 6 GHz: ±0.5 dB (1 Vpp, relative to 1 kHz)	DC to 6.5 GHz: ±0.5 dB (1 Vpp diff., relative to 1 kHz)
Harmonic Distortion (1 V <sub>p-p</sub> )	18mHz to ≤ 1MHz < -60dBc 1MHz to ≤ 1GHz < -50dBc 1GHz to ≤ 6.5GHz < -40dBc	-
Total Harmonic Distortion (1 V <sub>p-p</sub> )	10 Hz to 20 kHz < 0.2%	-
Phase Noise (1 V <sub>p-p</sub> , 10 kHz offset)	20 MHz: < -127 dBc/Hz typ. 100 MHz: < -124 dBc/Hz typ. 1 GHz: < -105 dBc/Hz typ.	
<b>Square Waves</b>		
Frequency Range	18 mHz to ≤ 2.5 GHz (for 20 Gsps and 17 Gsps models) 18 mHz to ≤ 1.25 GHz (for 10 Gsps models)	
Rise/fall time (10% to 90%)	120 ps (for 20 Gsps and 17 Gsps models) 240 ps (for 10 Gsps models)	
Rise/fall time (20% to 80%)	90 ps (for 20 Gsps and 17 Gsps models) 180 ps (for 10 Gsps models)	
Overshoot (1 V <sub>p-p</sub> )	<2%	
Jitter (rms)	<2 ps	
<b>Pulse Waves</b>		
Frequency Range	18 mHz to ≤ 2.5 GHz (for 20 Gsps and 17 Gsps models) 18 mHz to ≤ 1.25 GHz (for 10 Gsps models)	
Pulse width	150 ps to (Period – 150 ps) <sup>7</sup> (for 20 Gsps and 17 Gsps models) 300 ps to (Period – 300 ps) <sup>8</sup> (for 10 Gsps models)	

<sup>7</sup> Below 150 ps width ((for 20 Gsps and 17 Gsps models)) or below 300 ps ((for 10 Gsps models)), the pulse amplitude will have some reduction with respect to the set value.

Pulse width Resolution	20 ps or 15 digits	
Pulse duty	0.1% to 99.9% (limitations of pulse width apply)	
Leading/trailing edge transition time (10% to 90%)	120 ps to 1000 s (for 20 Gsps and 17 Gsps models) 240 ps to 1000 s (for 10 Gsps models)	
Leading/trailing edge transition time (20% to 80%)	90 ps to 1000 s (for 20 Gsps and 17 Gsps models) 180 ps to 1000 s (for 10 Gsps models)	
Transition time Resolution	2 ps or 15 digits	
Overshoot (1 $V_{p-p}$ )	< 2%	
Jitter (rms, with rise and fall time $\geq$ 400ps)	<2 ps	
<b>Double Pulse Waves</b>		
Frequency Range ( $V_{pp} =  V_{pp1}  +  V_{pp2} $ )	<p>for 20 Gsps and 17 Gsps models:</p> <p>18 mHz to <math>\leq</math> 1.25 GHz: 10Vpp</p> <p>for 10 Gsps models: 18 mHz to <math>\leq</math> 625 MHz: 10Vpp</p>	<p>for 20 Gsps and 17 Gsps models:</p> <p>18 mHz to <math>\leq</math> 1.25 GHz: 4Vpp Diff. (18 mHz to <math>\leq</math> 1.25 GHz: 2Vpp Se)</p> <p>for 10 Gsps models: 18 mHz to <math>\leq</math> 625 MHz: 4Vpp Diff. (18 mHz to <math>\leq</math> 625 MHz: 2Vpp Se)</p>
Other Pulse Parameters	Same as Pulse Waves	
<b>Ramp Waves</b>		
Frequency Range	18 mHz to 250 MHz (for 20 Gsps and 17 Gsps models) 18 mHz to 125 MHz (for 10 Gsps models)	
Linearity (< 10 kHz, 1 $V_{p-p}$ , 100%)	$\leq$ 0.1%	

Symmetry	0% to 100%	
<b>Other Waves</b>		
Frequency Range		
Exponential Rise, Exponential Decay	18 mHz to 250 MHz (for 20 Gsps and 17 Gsps models) 18 mHz to 125 MHz (for 10 Gsps models)	
Sin(x)/x, Gaussian, Lorentz, Haversine	18 mHz to 500 MHz (for 20 Gsps and 17 Gsps models) 18 mHz to 250 MHz (for 10 Gsps models)	
Additive Noise		
Bandwidth (-3 dB)	4 GHz	
Level	0 V to 2.5 V - abs(carrier max value [V <sub>pk</sub> ])	0 V to 0.5 V Single Ended - abs(carrier max value [V <sub>pk</sub> ]) 0 V to 1 V Differential - abs(carrier max value [V <sub>pk</sub> ])
Resolution	1 mV	
<b>Arbitrary</b>		
Number of Samples	2 to 16384	
Frequency range	1 μHz to 2.5 GHz (for 20 Gsps and 17 Gsps models) 1 μHz to 1.25 GHz (for 10 Gsps models)	
Analog Bandwidth (-3 dB)	2.9 GHz (for 20 Gsps and 17 Gsps models) 1.45 GHz (for 10 Gsps models)	
Rise/fall time (10% to 90%)	120 ps (for 20 Gsps and 17 Gsps models) 240 ps (for 10 Gsps models)	
Rise/fall time (20% to 80%)	90 (for 20 Gsps and 17 Gsps models) 180 ps (for 10 Gsps models)	
Jitter (rms)	< 2 ps	
<b>Frequency Resolution</b>		
Sine, square, pulse, arbitrary, Sin(x)/X	18 mHz or 15 digits 18 mHz or 14 digits	

Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine	
<b>Frequency Accuracy</b> Non-ARB ARB	$\pm 1.0$ ppm of setting $\pm 1.0$ ppm of setting $\pm 1$ $\mu$ Hz
<b>Modulations</b>	
<b>Amplitude Modulation (AM)</b> Carrier waveforms Modulation source Internal modulating waveforms Modulating frequency Depth	Standard waveforms (except Pulse, DC and Noise), ARB Internal or external Sine, Square, Ramp, Noise, ARB Internal: 18 mHz to 80 MHz, External: 1 GHz max. 0.00% to 120.00%
<b>Frequency Modulation (FM)</b> Carrier waveforms Modulation source Internal modulating waveforms Modulating frequency	Standard waveforms (except Pulse, Square, DC and Noise), ARB Internal or external Sine, Square, Ramp, Noise, ARB Internal: 18 mHz to 80 MHz, External: 1 GHz max.
Peak deviation	DC to 6.5 GHz (for 20 Gsps and 17 Gsps models) DC to 3.25 GHz (for 10 Gsps models)
<b>Phase Modulation (PM)</b> Carrier waveforms Modulation source Internal modulating waveforms Modulating frequency Phase deviation range	Standard waveforms (except Pulse, Square, DC and Noise), ARB Internal or external Sine, Square, Ramp, Noise, ARB Internal: 18 mHz to 80 MHz, External: 1 GHz max. 0° to 360°
<b>Frequency Shift Keying (FSK)</b> Carrier waveforms Modulation source Internal modulating waveforms	Standard waveforms (except Pulse, Square, DC and Noise), ARB Internal or external Square

Key rate	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Hop frequency	1 $\mu$ Hz to 6.5 GHz (for 20 Gsps and 17 Gsps models) 1 $\mu$ Hz to 3.25 GHz (for 10 Gsps models)
Number of keys	2
<b>Phase Shift Keying (PSK)</b>	
Carrier waveforms	Standard waveforms (except Pulse, Square, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Square
Key rate	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Hop phase	0° to +360°
Number of keys	2
<b>Pulse Width Modulation (PWM)</b>	
Carrier waveforms	Pulse
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Deviation range	0% to 50% of pulse period
<b>Sweep</b>	
Type	Linear, Logarithmic, staircase, and user defined
Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Sweep time	4ns $\leq$ Rise time + Hold time + Fall time $\leq$ 2000s
Rise/Hold/return times	0 to 2000 s
Rise/hold/return time resolution	1ps or 12 digits
Total sweep time accuracy	$\leq$ 0.4%
Start/stop frequency range	18 MHz to Max Waveform frequency (see Frequency Range for the Specific Waveform)
Trigger source	Internal/External/Manual
<b>Burst</b>	
Waveforms	Standard waveforms (except DC and Noise), ARB
Type	Trigger or gated

Burst count	1 to 4,294,967,295 cycles or Infinite			
	<b>AWG-7202</b> <b>AWG-7204</b> <b>AWG-7204-S</b> <b>AWG-7172</b> <b>AWG-7174</b> <b>AWG-7174-S</b> <b>AWG-7102</b> <b>AWG-7104</b>			
<b>SFDR<sup>6</sup></b> (2.5 V <sub>p-p</sub> single-ended, 20 GSa/s)	Measurement Range 1	dBc	Measurement Range 2	dBc
DC – 100 Mhz	DC – 10 Ghz	-70		
DC – 500 Mhz	DC – 10 Ghz	-70		
DC – 2 Ghz	DC – 6 Ghz	-65	DC – 10 Ghz	-60
DC – 3 Ghz	DC – 4 Ghz	-65	DC – 10 Ghz	-55
DC – 4 Ghz	DC – 5 Ghz	-55	DC – 10 Ghz	-52
4 Ghz – 5 Ghz	2 Ghz – 5 Ghz	-65	DC – 10 Ghz	-53
5 Ghz – 6 Ghz	5 Ghz – 10 Ghz	-67	DC – 10 Ghz	-53

## Pulse Pattern Generator (PPG) Specifications – *Optional*

	<p>AWG-7202 AWG-7202D</p> <p>AWG-7172 AWG-7172D</p> <p>AWG-7102 AWG-7102D</p> <p>AWG-7204S AWG-7204D-S</p> <p>AWG-7174-S AWG-7174D-S</p>	<p>AWG-7204 AWG-7204D</p> <p>AWG-7174 AWG-7174D</p> <p>AWG-7104 AWG-7104D</p>
<p><b>Number of PPG Analog Channels</b></p> <p>PPG Analog channels</p> <p>Marker out</p>	<p>2</p> <p>2</p>	<p>4</p> <p>4</p>
	<p>AWG-7202 AWG-7204</p> <p>AWG-7204-S</p> <p>AWG-7172 AWG-7174</p> <p>AWG-7174-S</p> <p>AWG-7102 AWG-7104</p>	<p>AWG-7202D AWG-7204D</p> <p>AWG-7204D-S</p> <p>AWG-7172D AWG-7174D</p> <p>AWG-7174S-S</p> <p>AWG-7102D AWG-7104D</p>
<b>General Specifications</b>		
<p>Operating mode</p> <p>Pattern types</p> <p>Run Modes</p>	<p>NRZ, RZ or R1 bitstream Pattern generator</p> <p>Clock Pattern, Custom Pattern, PRBS pattern, Go-Through Pattern, Pulse Pattern</p> <p>Continuous, modulation, burst (Triggered, Gated, Continuous triggered)</p>	
<b>Internal Trigger Timer</b>		
<p>Range</p> <p>Resolution</p> <p>Accuracy</p>	<p>10 ns to 100 s</p> <p>31.25 ps</p> <p>±(0.1% setting + 5 ps)</p>	

<b>Transition Specifications</b>	
Transition peculiarity	Arbitrarily user defined transition shapes Programmable duration for any transition
Transitions types	Arbitrary, predefined
Transitions memory length	64 points
Predefined transition Shapes	Sine, Square, Pulse, Ramp_up, Ramp_down, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine
Transition duration [0-100%]	<p>For 20 Gsps and 17 Gsps models: 150ps to Symbol duration for Custom, PRBS and Go-Through pattern</p> <p>150ps to Period/2 for Clock Pattern 150ps to (Period-150ps) for Pulse Pattern</p> <p>For 10 Gsps models: 300ps to Symbol duration for Custom, PRBS and Go-Through pattern</p> <p>300ps to Period/2 for Clock Pattern 300ps to (Period-300ps) for Pulse Pattern</p>
<b>Clock Pattern</b>	
Max clock pattern frequency	3.25 GHz (for 20 Gsps and 17 Gsps models) 1.625 GHz (for 10 Gsps models)
Pattern levels	2 levels
Overshoot (1 V <sub>p-p</sub> )	< 2 %
Jitter (rms)	< 2 ps
<b>Custom Pattern</b>	
Max custom pattern rate	Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models) Up to 3.25 Gbaud (for 10 Gsps models)
Pattern levels	2, 3 or 4 levels



Predefined custom patterns	Zero, one, clock, counter
Pattern memory channel	Up to 12 MBit (2 levels) Up to 6 MSymbols (3 or 4 levels) (For 2 channel and -S models)
	Up to 6 MBit (2 levels) Up to 3 MSymbols (3 or 4 levels) (For 4 channel models)
Pattern length resolution	1 bit
Min pattern length	16 bits
Overshoot (1 V <sub>p-p</sub> )	< 2%
<b>PRBS Pattern</b>	
Max PRBS pattern rate	Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models) Up to 3.25 Gbaud (for 10 Gsps models)
Pattern levels	2 levels
PRBS types	PRBS -7,9,11,15,23,31
Overshoot (1 V <sub>p-p</sub> )	< 2%
<b>Go-Through Pattern</b>	
Max Go-Through pattern rate	Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models) Up to 3.25 Gbaud (for 10 Gsps models)
Pattern levels	2,3 or 4 levels
Max External Pattern Rate	Up to 125 Mbit/s
Overshoot (1 V <sub>p-p</sub> )	< 2%
<b>Pulse Pattern</b>	
Max Pulse pattern frequency	Up to 3.25 GHz (for 20 Gsps and 17 Gsps models) Up to 1.625 GHz (for 10 Gsps models)

Pattern levels	2 Levels
Min Rise/Fall time (0-100%)	150 ps
Min Pulse Width	300 ps
Overshoot (1 $V_{p-p}$ )	< 2%
<b>Pattern Modulation</b>	
<b>Amplitude Modulation (AM)</b>	
Carrier patterns	All types
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Triangular, Ramp_up, Ramp_down, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine, Noise, ARB
Modulating frequency	Internal: 18 mHz to 80 MHz, External: 1 GHz max.
Depth	0.00% to 120.00%
<b>Frequency Modulation (FM)</b>	
Carrier patterns	All types
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Triangular, Ramp_up, Ramp_down, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine, Noise, ARB
Modulating frequency	Internal: 18 mHz to 80 MHz, External: 1 GHz max.
Peak deviation	DC to 6.5 GSymbols/s (for 20 Gsps and 17 Gsps models) DC to 3.25 GSymbols/s (for 10 Gsps models)
<b>Phase Modulation (PM)</b>	
Carrier patterns	All types
Modulation source	Internal or external

Internal modulating waveforms	Sine, Square, Pulse, Ramp_up, Ramp_down, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine, Noise, ARB
Modulating frequency	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Phase deviation range	0° to 360°
<b>Frequency Shift Keying (FSK)</b>	
Carrier patterns	All types
Modulation source	Internal or external
Internal modulating waveforms	Square
Key rate	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Hop Symbol Rate	1uSymbols/s to 6.5 GSymbols/s for Custom and PRBS pattern 18 MHz to 3.25 GHz for Clock pattern (for 20 Gsps and 17 Gsps models)
	1uSymbols/s to 3.25 GSymbols/s for Custom and PRBS pattern 1uHz to 1.625 GHz for Clock pattern (for 10 Gsps models)
Number of keys	2
<b>Phase Shift Keying (PSK)</b>	
Carrier patterns	All types
Modulation source	Internal or external
Internal modulating waveforms	Square
Key rate	Internal: 18 MHz to 80 MHz, External: 1 GHz max.
Hop phase	0° to +360°
Number of keys	2
<b>Burst</b>	
Patterns	All types

Type	Block mode
Burst count	1 to 4,294,967,295 cycles or Infinite

Timing and Clock	
<b>Sampling Rate</b>	
Range <sup>5</sup>	
– For 20 or 17 GSa/s models:	<p><b>Full Rate mode:</b></p> <p>1 S/s to <b>20</b> GS/s for 20GSa/s models  1 S/s to <b>17</b> GS/s for 17GSa/s models</p> <p><b>Half Rate mode:</b></p> <p>1 S/s to <b>10</b> GS/s</p>
– For 10 GSa/s models:	<p>1 S/s to <b>10</b> GS/s</p>
Resolution	64 Hz
Accuracy	± 1.0 ppm
<b>Digital outputs</b> (Optional for AWG7204(D) / AWG7174(D) / AWG7104(D) models only)	
<b>Output Channels</b>	
Connectors	Mini-SAS HD connector on rear panel (custom pin-out)
Number of connectors	4
Number of outputs	32-bits
<b>Output impedance</b>	100 Ω differential
<b>Output type</b>	CML with programmable pk-pk amplitude
<b>Maximum update rate</b>	10 Gbps per channel (AWG7204(D) / AWG7174(D)) 5 Gbps per channel (AWG7104(D))
<b>Memory depth</b>	4.5 Gbit per digital channel

<b>8 bit CML to LVTTTL Converter Probe (Optional AT-DTLL8)</b>	
<b>Output connector</b>	20 position 2.54 mm 2 Row IDC Header
<b>Output type</b>	LVTTTL
<b>Output impedance</b>	50 $\Omega$ nominal
<b>Output voltage</b>	0.8V to 3.8V programmable in group of 8 bits
<b>Maximum Update Rate</b>	125 Mbps@0.8V and 400 Mbps@3.6V
<b>Dimensions</b>	W 52 mm – H 22 mm – D 76 mm
<b>Input Connector</b>	Proprietary standard
<b>Cable Length</b>	1 meter
<b>Cable Type</b>	Proprietary standard
<b>Proprietary Mini SAS HD to SMA cable (Optional) (TBD)</b>	
<b>Output connector</b>	SMA
<b>Output type</b>	CML
<b>Number of SMA</b>	16 (8 differential bits)
<b>Cable type</b>	Proprietary standard
<b>Cable Length</b>	1 meter
<b>Rise/fall time (10% to 90%)</b>	< 300 ps
<b>Jitter (rms)</b>	< 5ps

<b>Auxiliary input and output characteristics</b>	
<b>Sync in/out</b>	
Connector type	QSFP connector on rear panel (custom pinout)
Master to Slave delay (typical)	-
<b>Modulation Input (MOD_IN)</b>	
Connector type	SMA on front panel
Number of connectors	2 (for 2 channel models) 4 (for 4 channel models)
Input impedance	50 $\Omega$
Voltage Window	$\pm 0.5$ V
<b>Marker Output</b>	
Connector type	SMA on front panel
Number of connectors	2 (for 2 channel models) 4 (for 4 channel models)
Output impedance	50 $\Omega$
<b>Output level (into 50 <math>\Omega</math>)</b>	
Voltage Window	-0.5V to 1.65V
Amplitude	100 mVpp to 2.15 Vpp
Resolution	1 mV
Accuracy	$\pm(5\%$ setting + 25 mV)
<b>Switching characteristics</b>	
Max Update Rate (True Arb Mode)	20 Gbps
Max Data Rate (True Arb Mode)	>4 Gbps @ 1Vpp swing
Max Frequency (AFG Mode)	125 MHz (continuous mode)
<b>Rise/fall time (10% to 90%, 2 Vpp)</b>	<150 ps
<b>Jitter (rms)</b>	<10 ps

<b>Marker out to analog channel skew</b>	
Range	True Arb Mode: 0 to 1.368 $\mu$ s AFG Mode: 0 to 8.5 sec. in Contin. Mode, 0 to 1.8 $\mu$ s in Trig. Mode
Resolution	<b>True Arb Mode:</b> 1/64 of DAC sampling period (for 20 Gsps and 17 Gsps models)  1/128 of DAC sampling period (for 10 Gsps models)  <b>AFG Mode:</b> 1.5625 ps
Accuracy	$\pm$ (1% of setting + 50 ps)
Initial skew	< 20 ps
<b>Marker Width</b> Value/Range	<b>True Arb Mode:</b> (Marker Automatic Mode) <b>36</b> sampling clock cycles (Full Rate Mode) <b>18</b> sampling clock cycles (Half Rate Mode)  <b>AFG Mode (Continuous Mode):</b> 50% of waveform period (Automatic Marker Width Mode), 500ps to waveform period – 2,1ns (Manual Marker Width Mode)  AFG Mode (Burst/Sweep Mode): Burst Duration for burst mode, half of sweep duration for Sweep mode
<b>Trigger/Event Inputs</b>	
Connector	SMA on the Front Panel
Number of Trigger Inputs	2 (for 2 channel models) 4 (for 4 channel models)
Input impedance	50 $\Omega$ / 1k $\Omega$
Slope/Polarity	Positive or negative or both

Range	± 3.5 V (50 Ohm input impedance) ± 10 V (1K Ohm input impedance)
Threshold control level	-8 V to 8 V
Threshold control Resolution	10 mV
Threshold control accuracy	± 100 mV
Minimum pulse width (1 V <sub>p-p</sub> )	1 ns
Trigger/gate input to Analog Output delay	<b>Slow (synchronous) trigger</b> AFG mode: < 355 ns (< 380 ns in triggered sweep mode) True Arb mode: <4392 * DAC clock period(ns) + 17.6 ns <b>Fast (asynchronous) trigger</b> AFG mode: < 345 ns (< 370 ns in triggered sweep mode) True Arb mode: <4392 * DAC clock period(ns) + 17.6 ns
Trigger In to output jitter (rms)	AFG mode: < 20 ps True Arb mode: 0.29*DAC clock period
Trigger In programmable delay range	0ps to 2418 ps
Trigger In programmable delay resolution	78ps
Maximum Frequency	AFG: 75 MTps on Rising/Falling Edge, 100 MTps on Both Edges True Arb mode: 1/ (Period of the Analog Waveform + 293 DAC Clock period) MTps = Mega Transitions per second
<b>Reference clock input</b>	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Input voltage range	0.2Vpp to 3.3Vpp
Damage level	Maximum Input voltage: 3.6Vpp Maximum input power: 15 dBm (50 Ω)
Frequency range	5 MHz to 500 MHz
Frequency Resolution	1 Hz

Reference clock output	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	10 MHz TCXO
Initial accuracy @ 25 °C	± 1.0 ppm
Aging	± 1.0 ppm/year
Stability vs. temperature	± 1.0 ppm
Amplitude	1.65 Vpp
Phase Noise @ 10 MHz carrier	-120 dBc/Hz at 100 Hz ; -140 dBc/Hz at 1KHz;-150 dBc/Hz at 10 KHz
External Clock Input	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Frequency <sup>8</sup>	<p><u>True Arb</u>: SampleRate / N where:  N = 8, 16, 32, 64 for every SampleRate <sup>8-9</sup></p> <p><u>AFG</u>: 312.5 MHz, 625 MHz, 1250 MHz or 2500 MHz (selectable)</p>
Input Power Range	+0 dBm to +10 dBm
Damage Level	15 dBm
Sync Clk Out	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	<p>AFG Mode: 20Ghz / N where N=40, 80, 160, ..., 5120</p> <p>AWG Mode: Sampling Rate/N, N=64, 128,..., 8192<sup>9</sup></p>
Amplitude	1Vpp into 50 Ohm

<sup>8</sup>When using the External Clock Input the SampleRate must be in the range 0÷20 GHz, but the entire Sample Rate interval is not continuous (see the corresponding section in the User manual)

<sup>9</sup> For AWG-717x(D) and AWG-7174(D)-S models the max Sampling rate is limited to 17Gps

<b>External Modulation input (AFG only)</b>	
Connector type	SMA on front panel (MOD.IN)
Input impedance	50 $\Omega$
Number of inputs	2 (for 2 channel models) 4 (for 4 channel models)
Bandwidth	1 GHz
Input voltage range	1 Vpp (0,5V to 0.5V)
Vertical resolution	14-bit
<b>Pattern Jump In (optional)</b>	
Connector type	DSUB15
Input signals	DATA[0..7] + Data_Select + Load
Internal Data Width	14 bit, multiplexed using Data_Select
Number of addressable entries	16384
Data Rate	DC to 1 MHz
Input Range	VIL = 0V to 0.8V / VIH= 2V to 3.3V
Impedance	Internal 1k $\Omega$ pull-up resistor to Vcc (3.3V)

<b>Power</b>	
<b>Source Voltage and Frequency</b>	100 to 240 VAC $\pm$ 10% @ 45-66 Hz
<b>Max. power consumption</b>	Max. 300W
<b>Environmental characteristics</b>	
<b>Temperature (operating)</b>	+5 $^{\circ}$ C to +40 $^{\circ}$ C (+41 $^{\circ}$ F to 104 $^{\circ}$ F)
<b>Temperature (non-operating)</b>	-20 $^{\circ}$ C to +60 $^{\circ}$ C (-4 $^{\circ}$ F to 140 $^{\circ}$ F)
<b>Humidity (operating)</b>	5% to 80% relative humidity with a maximum wet bulb temperature of 29 $^{\circ}$ C at or below +40 $^{\circ}$ C, (upper limit de-rates to 20.6% relative humidity at +40 $^{\circ}$ C). Non-condensing.

<b>Humidity (non-operating)</b>	5% to 95% relative humidity with a maximum wet bulb temperature of 40°C at or below +60°C, upper limit de-rates to 29.8% relative humidity at +60°C. Non-condensing.
<b>Altitude (operating)</b>	3,000 meters (9,842 feet) maximum at or below 25°C
<b>Altitude (non-operating)</b>	12,000 meters (39,370 feet) maximum
<b>EMC and safety</b>	CE compliant
<b>Safety</b>	EN61010-1
<b>Main Standards</b>	EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
<b>Immunity</b>	EN 61326-1:2013

<b>System specifications</b>	
<b>Display</b>	7 inch, 1024x600, capacitive touch LCD
<b>Operative System</b>	Windows 10
<b>External Dimensions</b>	W 445 mm – H 135 mm – D 320 mm (3U 19" rackmount)
<b>Weight</b>	Max. 26.45 lbs (12 Kg)
<b>Front panel connectors</b>	CH N OUTPUT (SMA) where N=2,4 depending on the model MOD N INPUT (SMA) where N=2,4 depending on the model MARKER N OUT (SMA) where N=2,4 depending on the model TRG IN N(SMA) where N=2,4 depending on the model  2 USB 3.0 ports
<b>Rear panel connectors</b>	Ref. Clk. IN (SMA) Ref. Clk. Out (SMA) Sync Clk Out (SMA) Ext Clk IN(SMA) Sync IN (QSFP cable) Sync OUT (QSFP cable) Pattern Jump In (DSUB15) (AWG-7000-FSS opt. only) POD X[7..0] where X=A,B,C,D (Customized Mini SAS HD)  External Monitor ports (one or more)  2 USB 2.0 ports or more  4 USB 3.0 ports  Ethernet port (10/100/1000BaseT Ethernet, RJ45 port)  2 PS/2 keyboard and mouse ports  2 DPI ports  1 DVI port
<b>Hard Disk</b>	1 TB SSD or better
<b>Processor</b>	Intel® Pentium Gold G6400 4 GHz (or better)
<b>Processor Memory</b>	32 GB or better