



ACTIVE  
TECHNOLOGIES

# RIDER

Time to **Reinvent** advance signal generation



## ARB Rider 5062(D)/5064(D)/5068(D) *Technical Datasheet*

**2 / 4 / 8 CHANNELS – ALL IN ONE:  
Function Generator, Arb  
Generator, Serial Pattern Generator  
and Digital Pattern Generator.**

- 2, 4 or 8 Analog Channels
- 6.16 GS/s (12.32 GS/s in RF mode)
- 16 Bit Vertical Resolution
- 5 GHz Effective frequency, < 110ps Rise/fall time
- 230ps 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 Ohm
- Differential output with up to 3 V<sub>p-p</sub> into 100 Ω with common mode voltage of ±2 V into 50 Ω
- Up to 4 Gpts Waveform Memory per Channel
- Up to 32 Digital Channels in synchronous with analog Generation
- Multi-Instrument Synchronization: **up to 32 analog and 128 digital channels**

### Key performance specifications

- **AWG Mode**
  - 16-bit vertical resolution
  - 6.16 GS/s Variable Clock (12.32 GS/s in RF mode)
  - 5 GHz Effective frequency, < 110ps Rise/fall time
  - 8bit, 16bit or 32bit digital channels
  - Up to 4 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 3 V<sub>p-p</sub> into 100 Ω load with common mode voltage of ±2 V into 50 Ω
- **AFG Mode**
  - 2 GHz Sine Waveforms
  - 6.16 GS/s fixed, 16-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 3 V<sub>p-p</sub> into 100 Ω load with common mode voltage of ±2 V into 50 Ω
  - Improved proprietary DDS based technology
- **Serial Pattern Generator (SPG) Mode**
  - Up to 1.5Gbit/s NRZ bit stream generation
  - 2,3 or 4 levels pattern
  - 64 point arbitrary shape per transition
  - Programmable duration for any transition
  - Up to 2Mbit (2 levels) or up to 1Msymbols (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 3V<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 to 6.16 GS/s (12.32 GS/s in RF mode), with 16-bit vertical resolution, ensures exceptional signal integrity
- Arbitrary waveform memory up to 4 Gpts for each analog channel
- Mixed Signal Generation – 2, 4 or 8 Analog channels with 8, 16 or 32 synchronized Digital Channels for debugging and validating digital design.
- Three operation modes – Simple Rider AFG (DDS AFG mode), True Arb (variable clock Arbitrary AWG mode) and SPG (Serial Pattern Generator).
- Digital outputs provide up to 1.54 Gb/s data rate in LVDS format. LVDS to LVTTTL adapter is available
- Advance 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

## Applications areas

### Automotive



Today's cars are including a lot of highly sophisticated electronic control unit with very sensitive electronic components. The Arb Rider 5062/5064/5068 combining 6.16 GS/s with 16 vertical resolution, represents an ideal tool for successfully addressing the new testing challenges in automotive.

- EMI debugging, troubleshooting and testing
- Electrical standards emulation up to 5V

### IoT and Ind 4.0 perfect RF Modulator



Arb and Function Riders will be the iconic instrument for this applications. The possibility to emulate complex RF I/Q modulation for simulation and Test vs wireless devices or working on Internet of things of industry 4.0 applications. Each engineer may use the possibility to import waveform to emulate devices under test, impose distortion on waveform (such noise) to test the ability of devices to be compliant to the standards.



**Research Applications**

Research centers and Universities, are key users of Arb Rider generator’s series.

Complex waveform and/or sophisticated Pulses emulation based on variable edges or multilevel could be perfectly created. The combination of fast edge generation, excellent dynamic range and easy to use user interface meet perfectly scientists and engineers working on Quantum Research or on large experiments such Accelerators, Tokamak or synchrotrons to emulate signals without creating specifics test boards.

- Emulation of detectors
- Emulation of signal sources adding noise
- Generation/playback of real-world signals
- Emulation of long PRBS sequences
- Modulating and driving laser diode

**Aerospace and Defense applications**

Electronic warfare signals driven by Radar or

Sonar systems perfectly match with these generators. Large BW Riders can be used on digital modulation systems for Radio Applications or others I/Q signal modulation.

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

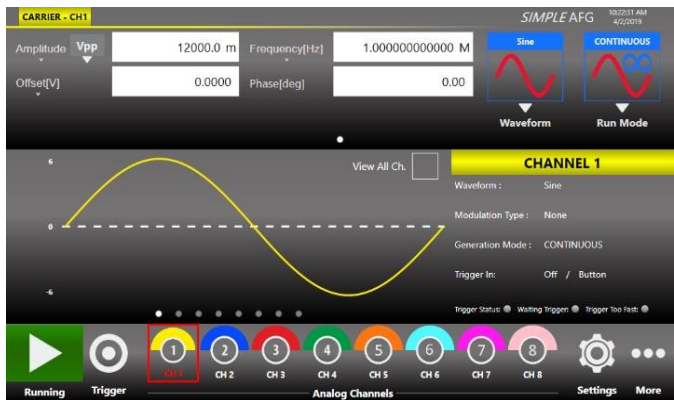
- Frequency response, intermodulation distortion and noise-figure measurements
- Phase Locked Loop (PLL) pull-in and hold range characterization
- Radar base-band signals emulation

**Semiconductors Test**

Emulation of complex signals generated with inclusion of noise or distortions may became an excellent way to provide Compliance Components Test to help semiconductors engineers. The fast edges and pulse generation can be used to provide characterization in fast power devices.

**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.

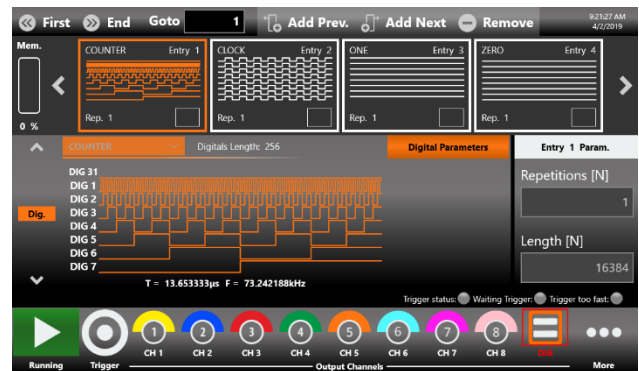
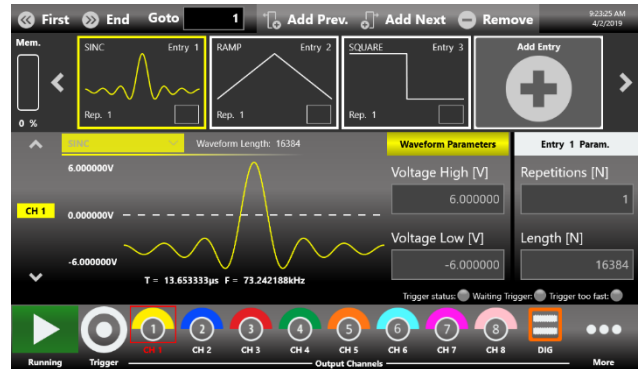
Digital output combined and synchronized with analog output signals represent an ideal tool to troubleshoot and validate digital design.

The waveform memory length of up to 4 GSamples on each channel combined with up to 16,384 and up to 4,294,967,294 repetitions, make the Arb-Rider 5062/5064/5068 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 instrument can be synchronized together in order to obtain a 32 analog – 128 digital channel generator. A dedicated synchronization bus guarantees the intra-chassis synchronization.

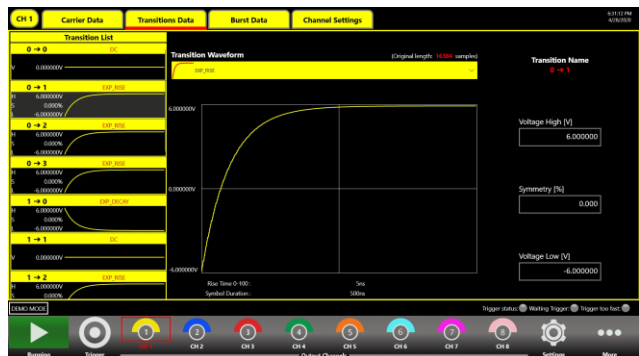
Arb Rider supports the standard Ethernet interface for remote control and easy customized instrument programming.



## Simple Rider SPG: Serial Pattern Generator (SPG) Mode Interface

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

In summary the Data Pattern Generator provides the capability to generate PRBS patterns and up to 2MSymbols custom patterns where bit transitions can have arbitrarily user defined shapes. The ARB-RIDER-AWG5000 Serial Pattern Generator can generate patterns up to 1.5Gbaud.



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, ...).



Document name **AWG-5062/5064/5068 - Technical Specifications**

Last Date Update: 22/02/2021

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  $\pm 10^\circ\text{C}$  after auto-calibration.

General Specifications			
Operating Mode	AFG Mode		
	True Arb Mode		
	SPG Mode		
	AWG-5062 AWG-5062D	AWG-5064 AWG-5064D	AWG-5068 AWG-5068D
<b>Number of Channels</b>			
Analog	2	4	8
Digital	0/8 opt.	0/8/16 opt.	0/8/16/24/32 opt.
Markers	1	2	4
	AWG-5062 AWG-5064 AWG-5068	AWG-5062D AWG-5064D AWG-5068D	
<b>Output Channels</b>			
Output type	Single ended DC coupled	Differential DC coupled	
Output impedance	Single ended: 50 $\Omega$	Single ended: 50 $\Omega$ Differential: 100 $\Omega$	
Connectors	SMA on front panel		
<b>DC Amplitude</b>			
Amplitude range	$\pm 2.5$ V (into 50 $\Omega$ )	$\pm 0.75$ V Se. (into 50 $\Omega$ ) $\pm 1.5$ V Diff. (into 100 $\Omega$ )	
Resolution	100 $\mu\text{V}$ (nom), 5 digits		
Amplitude accuracy (guaranteed)	$\pm(1\%$ of  setting  + 5 mV)	$\pm(0.5\%$ of  setting  + 2 mV)	
<b>DC Baseline Hardware Offset (Common mode offset)</b>			
Resolution	< 4 mV or 4 digits		
Range (50 $\Omega$ into 50 $\Omega$ )	-2.5 V to +2.5 V	-2 V to +2 V	



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Range (50 Ω into High Z load)	-2.5 V to +2.5 V	-4 V to +4 V
Accuracy (50 Ω into 50 Ω) (guaranteed)	± (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) (guaranteed)	± (1% of setting [Vpp] + 5mV)	

True Arb - Baseband mode specifications	AWG-5062 AWG-5064 AWG-5068	AWG-5062D AWG-5064D AWG-5068D
<b>General specifications</b>		
Operating Mode	Variable clock (True Arbitrary) – Baseband mode	
Sample Rate	1 S/s to 6.16 GS/s	
Sin(x)/x	2.72 GHz @ 6.16GS/S,	
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced	
Vertical Resolution	16 bit	
Waveform Length	128M to 2G samples per channel (up to 4G samples optional)	
Waveform Granularity	1 if the entry length is > 416 samples 32 if entry length is ≥ 128 and ≤ 416 samples	
Sequence Length	1 to 16384	
Sequence Repeat Counter	1 to 4294967294 or infinite	
Timer		
Range	20 ns to 1.39 seconds	
Resolution	± 1 sampling clock cycle	
<b>Analog Channel to Channels skew</b>		
Range	0 to 2.63 us	
Resolution	100 fs	
Accuracy	±(1% of setting + 20 ps)	
Initial skew	< 20 ps	
<b>Effective frequency output</b> (Fmax = sample rate / 2.5)	2.46 Ghz	



<b>Calculated bandwidth (0.35 / rise or fall time)</b>	≥ 2 GHz	≥ 2.2 GHz
<b>SFDR @ 100 MHz</b> (Fsa= 6 Gsa/s, measured across DC to Fs/2, excluding fsa - 2*fout and fsa- 3*fout and excluding harmonic)	< -80 dBc	< - 90 dBc
<b>SFDR</b> (Fsa= 6,16 Gsa/s, measured across DC to Fs/2, excluding fsa - 2*fout and fsa- 3*fout and excluding harmonic) <sup>1</sup>	1μHz to ≤ 600MHz: < -80dBc 600MHz to ≤ 1.5GHz: < -75dBc 1.5GHz to ≤ 2GHz: < -65dBc 2GHz to ≤ 3GHz: < -55dBc	1μHz to < 100MHz: < -90dBc 100MHz to ≤ 600MHz: < -82dBc 600MHz to ≤ 1.5GHz: < -75dBc 1.5GHz to ≤ 2GHz: < -70dBc 2GHz to ≤ 3GHz: < -62dBc
<b>Rise/fall time</b> (1 V <sub>p-p</sub> single-ended 10% to 90%)	≤ 175 ps	≤ 155 ps
<b>Rise/fall time</b> (1 V <sub>p-p</sub> single-ended 20% to 80%)	≤ 110 ps	≤ 100 ps
<b>Overshoot</b> (1 V <sub>p-p</sub> single-ended)	<5%	<6%
<b>Random jitter on clock pattern</b> (rms, typical)	< 2 ps	

True Arb - RF Mode specifications	AWG-5062 AWG-5064 AWG-5068	AWG-5062D AWG-5064D AWG-5068D
<b>General specifications</b>		
Operating Mode	Variable clock (True Arbitrary) – RF mode	
Output Sample Rate	8.5 GS/s to 12.32 GS/s	
Sin(x)/x	5.04 Ghz @ 12.32GS/S	
RF Modulation	I/Q quadrature	
RF Carrier count per output channel	Single Carrier (2 components I0,Q0 for channel) Double Carrier (4 components, I0,Q0 and I1,Q1 for channel)	
RF Carrier Frequency range	0 up to 6 GHz	
RF Carrier Frequency resolution	1 mHz	

<sup>1</sup> For AWG-5062/5064/5068 models the SFDR is evaluated @ 2.5Vpp single ended nominal output amplitude. For AWG-5062D/5064D/5068D models the SFDR is evaluated @ 1.5Vpp differential nominal output amplitude provided to the spectrum analyzer through a Minicircuit TC1-1-13M+ balun.



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RF Carrier Phase	Programmable
I/Q Component Data Rate	1/8 of the Output Sample rate
I/Q Component Prescaler	0 to 2 <sup>32</sup>
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced
I/Q Component Vertical Resolution	16 bit
I/Q Component Waveform Length	32M to 500M samples for component (up to 1G samples optional)
I/Q Component Waveform Granularity	1 if the entry length is > 104 samples 8 if entry length is ≥ 32 and ≤ 104 samples
Sequence Length	1 to 16384
Sequence Repeat Counter	1 to 4294967294 or infinite
Timer Range Resolution	20 ns to 1.39 seconds ± 1 Component sampling clock cycle
<b>I/Q Component to Component skew</b> Range Resolution Accuracy Initial skew	0 to [16200 * 8/Output Sampling Clock] s [8/Output Sampling Clock] s ±(1% of setting + 20 ps) < 20 ps
<b>Effective frequency output</b> (Fmax = sample rate / 2.5)	5.04 GHz





AFG Mode Specifications	AWG-5062 AWG-5064 AWG-5068	AWG-5062D AWG-5064D AWG-5068D
<b>General Specifications</b>		
Amplitude		
Range	0 to 5Vpp (into 50 Ω)	0 to 3Vpp Diff. (into 100 Ω) 0 to 1.5Vpp Se. (into 50 Ω)
Resolution	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: 16-bit Waveform length: 16,384 points	
Internal Trigger Timer		
Range	10.4 ns to 88 s	
Resolution	80 ps	
Accuracy	±(0.1% setting + 5 ps)	
<b>Sine Waves</b>		
Frequency Range Sine (50 Ω into 50 Ω) <sup>2</sup>	1 μHz to ≤ 1 GHz: 5Vpp 1 GHz to ≤ 2 GHz: 4Vpp	1 μHz to ≤ 2 GHz: 3Vpp Diff. 1 μHz to ≤ 2 GHz: 1.5Vpp Se.
Flatness	DC to 2 GHz: ±0.5 dB (1 Vpp, relative to 1 kHz)	DC to 2 GHz: ±0.5 dB (1 Vpp diff., relative to 1 kHz)
Harmonic Distortion (1 V <sub>p-p</sub> )	1μHz to ≤ 20kHz < -75dBc 20kHz to ≤ 400MHz < -70dBc 400MHz to ≤ 1GHz < -60dBc 1GHz to ≤ 2GHz < -55dBc	-
Total Harmonic Distortion (1 V <sub>p-p</sub> )	10 Hz to 20 kHz < 0.05%	-

<sup>2</sup> Amplitude doubles on HiZ load



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<p>Spurious (measured across DC to <math>F_s/2</math>)<sup>3</sup></p> <p>Phase Noise (1 <math>V_{p-p}</math>, 10 kHz offset)</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px dotted black; padding: 5px;"> <p>1 <math>\mu</math>Hz to <math>\leq</math> 500MHz: &lt; -75dBc</p> <p>500MHz to <math>\leq</math> 1.5GHz: &lt; -70dBc</p> <p>1.5 GHz to <math>\leq</math> 2 GHz: &lt; -55 dBc</p> </td> <td style="width: 50%; padding: 5px;"> <p>1 <math>\mu</math>Hz to <math>\leq</math> 250MHz: &lt; -85dBc</p> <p>250MHz to <math>\leq</math> 500MHz: &lt; -80dBc</p> <p>500MHz to <math>\leq</math> 1.5 GHz: &lt; -70 dBc</p> <p>1.5 GHz to <math>\leq</math> 2 GHz: &lt; -60 dBc</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>20 MHz: &lt; -127 dBc/Hz typ.</p> <p>100 MHz: &lt; -123 dBc/Hz typ.</p> <p>1 GHz: &lt; -105 dBc/Hz typ.</p> </td> </tr> </table>	<p>1 <math>\mu</math>Hz to <math>\leq</math> 500MHz: &lt; -75dBc</p> <p>500MHz to <math>\leq</math> 1.5GHz: &lt; -70dBc</p> <p>1.5 GHz to <math>\leq</math> 2 GHz: &lt; -55 dBc</p>	<p>1 <math>\mu</math>Hz to <math>\leq</math> 250MHz: &lt; -85dBc</p> <p>250MHz to <math>\leq</math> 500MHz: &lt; -80dBc</p> <p>500MHz to <math>\leq</math> 1.5 GHz: &lt; -70 dBc</p> <p>1.5 GHz to <math>\leq</math> 2 GHz: &lt; -60 dBc</p>	<p>20 MHz: &lt; -127 dBc/Hz typ.</p> <p>100 MHz: &lt; -123 dBc/Hz typ.</p> <p>1 GHz: &lt; -105 dBc/Hz typ.</p>													
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<p><b>Pulse Waves</b></p> <p>Frequency Range</p> <p>Pulse width</p> <p>Pulse width Resolution</p> <p>Pulse duty</p> <p>Leading/trailing edge transition time (10% to 90%)</p> <p>Leading/trailing edge transition time (20% to 80%)</p> <p>Transition time Resolution</p> <p>Overshoot (1 <math>V_{p-p}</math>)</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px dotted black; padding: 5px;"> <p>1 <math>\mu</math>Hz to <math>\leq</math> 770 MHz</p> </td> <td style="width: 50%; padding: 5px;"> <p>1 <math>\mu</math>Hz to <math>\leq</math> 770 MHz</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>500 ps to (Period – 500 ps)<sup>4</sup></p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>20 ps or 15 digits</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>0.1% to 99.9% (limitations of pulse width apply)</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>400 ps to 1000 s</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>300 ps to 1000 s</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>2 ps or 15 digits</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 5px;"> <p>&lt; 2%</p> </td> </tr> </table>	<p>1 <math>\mu</math>Hz to <math>\leq</math> 770 MHz</p>	<p>1 <math>\mu</math>Hz to <math>\leq</math> 770 MHz</p>	<p>500 ps to (Period – 500 ps)<sup>4</sup></p>		<p>20 ps or 15 digits</p>		<p>0.1% to 99.9% (limitations of pulse width apply)</p>		<p>400 ps to 1000 s</p>		<p>300 ps to 1000 s</p>		<p>2 ps or 15 digits</p>		<p>&lt; 2%</p>	
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<sup>3</sup> For AWG-5062/5064/5068 models the spurious are evaluated @ 1Vpp single ended nominal output amplitude. For AWG-5062D/5064D/5068D models the SFDR is evaluated @ 1Vpp differential nominal output amplitude provided to the spectrum analyzer through a Minicircuit TC1-1-13M+ balun.

<sup>4</sup> Below 500 ps width, the pulse amplitude will have some reduction respect to the set value



Jitter (rms, with rise and fall time $\geq 400$ ps)	$<2$ ps		
<b>Double Pulse Waves</b>			
Frequency Range	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px dotted black; padding: 5px;"> <math>1 \mu\text{Hz to } \leq 385 \text{ MHz: } 10V_{pp}</math>            where  <math>V_{pp} =  V_{pp1}  +  V_{pp2} </math> </td> <td style="width: 50%; padding: 5px;"> <math>1 \mu\text{Hz to } \leq 385 \text{ MHz: } 6V_{pp} \text{ Diff.}</math>  <math>(1 \mu\text{Hz to } \leq 385 \text{ MHz: } 3V_{pp} \text{ Se})</math>            where  <math>V_{pp} =  V_{pp1}  +  V_{pp2} </math> </td> </tr> </table>	$1 \mu\text{Hz to } \leq 385 \text{ MHz: } 10V_{pp}$ where $V_{pp} =  V_{pp1}  +  V_{pp2} $	$1 \mu\text{Hz to } \leq 385 \text{ MHz: } 6V_{pp} \text{ Diff.}$ $(1 \mu\text{Hz to } \leq 385 \text{ MHz: } 3V_{pp} \text{ Se})$ where $V_{pp} =  V_{pp1}  +  V_{pp2} $
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Other Pulse Parameters	Same as Pulse Waves		
<b>Ramp Waves</b>			
Frequency Range	1 $\mu\text{Hz}$ to 75 MHz		
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	1 $\mu\text{Hz}$ to 75 MHz		
Sin(x)/x, Gaussian, Lorentz, Haversine	1 $\mu\text{Hz}$ to 150 MHz		
Additive Noise			
Bandwidth (-3 dB)	2 GHz		
Level	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px dotted black; padding: 5px;">           0 V to 2.5 V - abs(carrier max value [<math>V_{pk}</math>])         </td> <td style="width: 50%; padding: 5px;">           0 V to 0.75 V Single Ended - abs(carrier max value [<math>V_{pk}</math>])             0 V to 1.5 V Differential - abs(carrier max value [<math>V_{pk}</math>])         </td> </tr> </table>	0 V to 2.5 V - abs(carrier max value [ $V_{pk}$ ])	0 V to 0.75 V Single Ended - abs(carrier max value [ $V_{pk}$ ])  0 V to 1.5 V Differential - abs(carrier max value [ $V_{pk}$ ])
0 V to 2.5 V - abs(carrier max value [ $V_{pk}$ ])	0 V to 0.75 V Single Ended - abs(carrier max value [ $V_{pk}$ ])  0 V to 1.5 V Differential - abs(carrier max value [ $V_{pk}$ ])		
Resolution	1 mV		
<b>Arbitrary</b>			
Number of Samples	2 to 16384		
Frequency range	1 $\mu\text{Hz}$ to $\leq 770$ MHz		
Analog Bandwidth (-3 dB)			



SPECIFICATIONS
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<p>Rise/fall time (10% to 90%)</p> <p>Rise/fall time (20% to 80%)</p> <p>Jitter (rms)</p>	<p>950 MHz</p> <p>400 ps</p> <p>300 ps</p> <p>&lt; 2 ps</p>
<p><b>Frequency Resolution</b></p> <p>Sine, square, pulse, arbitrary, Sin(x)/X</p> <p>Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine</p>	<p>1 <math>\mu</math>Hz or 15 digits</p> <p>1 <math>\mu</math>Hz or 14 digits</p>
<p><b>Frequency Accuracy</b></p> <p>Non-ARB</p> <p>ARB</p>	<p><math>\pm 2.0</math> ppm of setting   <math>\pm 500</math> ppb of setting (Opt.)</p> <p><math>\pm 2.0</math> ppm of setting <math>\pm 1</math> <math>\mu</math>Hz   <math>\pm 500</math> ppb of setting <math>\pm 1</math> <math>\mu</math>Hz(Opt.)</p>
<b>Modulations</b>	
<p><b>Amplitude Modulation (AM)</b></p> <p>Carrier waveforms</p> <p>Modulation source</p> <p>Internal modulating waveforms</p> <p>Modulating frequency</p> <p>Depth</p>	<p>Standard waveforms (except Pulse, DC and Noise), ARB</p> <p>Internal or external</p> <p>Sine, Square, Ramp, Noise, ARB</p> <p>Internal: 500 <math>\mu</math>Hz to 61 MHz, External: 10 MHz max.</p> <p>0.00% to 120.00%</p>
<p><b>Frequency Modulation (FM)</b></p> <p>Carrier waveforms</p> <p>Modulation source</p> <p>Internal modulating waveforms</p> <p>Modulating frequency</p> <p>Peak deviation</p>	<p>Standard waveforms (except Pulse, DC and Noise), ARB</p> <p>Internal or external</p> <p>Sine, Square, Ramp, Noise, ARB</p> <p>Internal: 500 <math>\mu</math>Hz to 61 MHz, External: 10 MHz max.</p> <p>DC to 2 GHz</p>
<p><b>Phase Modulation (PM)</b></p> <p>Carrier waveforms</p> <p>Modulation source</p> <p>Internal modulating waveforms</p> <p>Modulating frequency</p> <p>Phase deviation range</p>	<p>Standard waveforms (except Pulse, DC and Noise), ARB</p> <p>Internal or external</p> <p>Sine, Square, Ramp, Noise, ARB</p> <p>Internal: 500 <math>\mu</math>Hz to 61 MHz, External: 10 MHz max.</p> <p>0° to 360°</p>





<b>Frequency Shift Keying (FSK)</b> Carrier waveforms Modulation source Internal modulating waveforms Key rate	Standard waveforms (except Pulse, DC and Noise), ARB Internal or external Square Internal: 500 $\mu$ Hz to 61 MHz, External: 10 MHz max.
Hop frequency	1 $\mu$ Hz to 2 GHz
Number of keys	2
<b>Phase Shift Keying (PSK)</b> Carrier waveforms Modulation source Internal modulating waveforms Key rate Hop phase Number of keys	Standard waveforms (except Pulse, DC and Noise), ARB Internal or external Square Internal: 500 $\mu$ Hz to 61 MHz, External: 10 MHz max. $0^\circ$ to $+360^\circ$ 2
<b>Pulse Width Modulation (PWM)</b> Carrier waveforms Modulation source Internal modulating waveforms Modulating frequency Deviation range	Pulse Internal or external Sine, Square, Ramp, Noise, ARB Internal: 500 $\mu$ Hz to 61 MHz, External: 10 MHz max. 0% to 50% of pulse period
<b>Sweep</b> Type Waveforms Sweep time Hold/return times Sweep/hold/return time resolution Total sweep time accuracy Start/stop frequency range Trigger source	Linear, Logarithmic, staircase, and user defined Standard waveforms (except Pulse, DC and Noise), ARB 30 ns to 2000 s 0 to (2000 s – 30 ns) 15 ns or 12 digits $\leq 0.4\%$ Sine: 1 $\mu$ Hz to 2 GHz, Square: 1 $\mu$ Hz to 770 MHz 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

Timing and Clock	
<b>Sampling Rate</b>	
Range	1 S/s to 6.16 GS/s (1 S/s to 12.32 GS/S in RF mode)
Resolution	32 Hz
Accuracy	$\pm 2.0$ ppm   $\pm 500$ ppb (Opt.)
Digital outputs (Optional)	
<b>Output Channels</b>	
Connectors	Mini-SAS HD connector on rear panel (custom pin-out)
Number of connectors	1,2,4
Number of outputs	8-bits,16-bits,32-bits
<b>Output impedance</b>	100 $\Omega$ differential
<b>Output type</b>	LVDS
<b>Rise/fall time (10% to 90%)</b>	< 1 ns
<b>Jitter (rms)</b>	20 ps
<b>Maximum update rate</b>	1.54 Gbps per channel
<b>Memory depth</b>	512M Samples per digital channel (up to 1G optional)



<b>8 bit LVDS 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)</b>	
<b>Output connector</b>	SMA
<b>Output type</b>	LVDS
<b>Number of SMA</b>	16 (8 bits)
<b>Cable type</b>	Proprietary standard
<b>Cable Length</b>	1 meter
<b>Auxiliary input and output characteristics</b>	
<b>Sync in/out</b>	
Connector type Master to Slave delay (typical)	Infiniband 4X connector on rear panel (custom pinout) TBD



<b>Marker Output</b>	
<b>Connector type</b>	SMA on front panel
<b>Number of connectors</b>	1/2/4
<b>Output impedance</b>	50 $\Omega$
<b>Output level (into 50 <math>\Omega</math>)</b> Voltage Window Amplitude Resolution Accuracy	-0.5V to 1.65V 100 mVpp to 2.15 Vpp 1 mV $\pm(5\%$ setting + 25 mV)
<b>Switching characteristics</b> Max Update Rate (True Arb Mode) Max Data Rate (True Arb Mode) Max Frequency (AFG Mode)	6.16 Gbps >4 Gbps @ 1Vpp swing 96.5 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 Resolution Accuracy Initial skew	True Arb Mode:0 to 2.3 $\mu$ s AFG Mode:0 to 11 sec. in Contin. Mode, 0 to 2.3 $\mu$ s in Trig. Mode True Arb Mode:1/64 of DAC sampling period, AFG Mode:5 ps $\pm(1\%$ of setting + 5 ps) < 20 ps
<b>Trigger/Event Inputs</b>	
<b>Connector</b>	SMA on the Front Panel
<b>Number of Trigger Inputs</b>	2 (Trig.in 1, Trig.in 2)
<b>Input impedance</b>	50 $\Omega$ / 1k $\Omega$
<b>Slope/Polarity</b>	Positive or negative or both
<b>Input damage level</b>	< -15 V or > +15 V





Threshold control level	-10 V to 10 V
Resolution	50 mV
Threshold control accuracy	$\pm(10\% \text{ of }  \text{setting}  + 0.2 \text{ V})$
Input voltage swing	0.5 V <sub>p-p</sub> minimum
Minimum pulse width (1 V <sub>p-p</sub> )	3 ns
Trigger/gate input to Analog Output delay	<p><b>Slow (synchronous) trigger</b> AFG mode: &lt; 355 ns (&lt; 405 ns in triggered sweep mode) True Arb mode: &lt;1550 * DAC clock period(ns) + 10 ns</p> <p><b>Fast (asynchronous) trigger</b> AFG mode: &lt; 335 ns (&lt; 385 ns in triggered sweep mode) True Arb mode: &lt;1360 * DAC clock period(ns) + 27 ns</p>
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 2418ps
Trigger In programmable delay resolution	78ps
Maximum Frequency	AFG: 65 MTps on Rising/Falling Edge, 80 MTps on Both Edges True Arb mode: 1/ (Period of the Analog Waveform + 48 DAC Clock period) MTps = Mega Transitions per second
Reference clock input	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Input voltage range	0.2Vpp to 2Vpp
Damage level	Maximum Input voltage: -0.3V to 3.6V Maximum input power: 30 dBm (50 Ω)
Frequency range	5 MHz to 200 MHz
Frequency Resolution	1 Hz
Reference clock output	



Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	10 MHz TCXO   100 MHz VCOCXO (Optional)
Initial accuracy @ 25 °C	± 1.0 ppm   ± 500 ppb (Opt.)
Aging	± 1.0 ppm/year   ± 500 ppb/year (Opt.)
Stability vs. temperature	± 1 ppm   ± 50 ppb(Opt.)
Amplitude	1.65 Vpp
Phase Noise @ 20 MHz carrier	-120 dBc/Hz at 100 Hz ; -140 dBc/Hz at 1KHz;-150 dBc/Hz at 10 KHz
Phase Noise @ 100 MHz carrier(Opt.)	-120 dBc/Hz at 100 Hz ; -145 dBc/Hz at 1KHz;-150 dBc/Hz at 10 KHz
<b>External Clock Input</b>	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Frequency <sup>5</sup>	<u>True Arb</u> : SampleRate / N where: N = 4, 8, 16, 32 for SampleRate = 3.08÷6.16 GHz N = 2, 4, 8, 16, 32 for SampleRate = 3.08÷5.0 GHz <u>AFG</u> : 192.5 MHz, 385 MHz, 770 MHz or 1540 MHz (selectable)
Input Power Range	+0 dBm to +10 dBm
Damage Level	15 dBm
<b>Sync Clk Out</b>	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	AFG Mode: 6.16Ghz / N where N=16, 32, 64, ..., 2048  AWG Mode: 6.16Ghz/16 to 6.16Ghz/4096
Amplitude	1Vpp into 50 Ohm
<b>External Modulation input</b>	
Connector type	SMA on rear panel

<sup>5</sup> When using the External Clock Input the SampleRate must be in the range 3.08÷6.16 GHz



SPECIFICATIONS
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Input impedance	10 K $\Omega$
Number of inputs	1
Bandwidth	10 MHz with 50 MS/s sampling rate
Input voltage range	-1 V to +1 V (except FSK, PSK). FSK, PSK: 0V÷3.3V with 1.65V fixed threshold
Vertical resolution	12-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> <b>Max. power consumption</b>	100 to 240 VAC $\pm 10\%$ @ 45-66 Hz Max. 100W (AWG 5062 /5062D) Max. 200W (AWG 5064 /5064D) Max. 300W (AWG 5068 /5068D)
<b>Environmental characteristics</b>	
<b>Temperature (operating)</b>	+5 °C to +40 °C (+41 °F to 104 °F)
<b>Temperature (non-operating)</b>	-20 °C to +60 °C (-4 °F to 140 °F)
<b>Humidity (operating)</b>	5% to 80% relative humidity with a maximum wet bulb temperature of 29°C at or below +40°C, (upper limit de-rates to 20.6% relative humidity at +40°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



System specifications	
Display	7 inch, 1024x600, capacitive touch LCD
Operative System	Windows 10
External Dimensions	W 445 mm – H 135 mm – D 320 mm (3U 19" rackmount)
Weight	Max. 26.45 lbs (12 Kg)
Front panel connectors	CH N OUTPUT (SMA) where N=2,4,8 depending on the model MARKER N OUT (SMA) where N=1,2,4 depending on the model TRG IN N(SMA) where N =1,2 2 USB 3.0 ports
Rear panel connectors	Ref. Clk. IN (SMA) Ref. Clk. Out (SMA) Ext. Mod. IN (SMA) Sync Clk Out (SMA) Ext Clk IN(SMA) Sync IN (Infiniband 4X) Sync OUT (Infiniband 4X) Pattern Jump In (DSUB15) (AWG-5000-FSS opt. only) POD X[7..0] where X=A,B,C,D depending on the model (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
Hard Disk	1 TB SSD or better
Processor	Intel® Pentium 3.7 GHz (or better)
Processor Memory	32 GB or better