ACTIVE TECHNOLOGIES

ADMESS

RIDER

Time to Reinvent advance signal generation

ARB Rider 4012 / 4014 /4018 Technical Datasheet

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

- 2, 4 or 8 Analog Channels
- 1.2 GS/s 14 Bit Vertical Resolution
- 300 MHz Bandwidth
- Up to 24 V_{p-p} Output Voltage and ±12V HW Baseline Offset
  Total Output Voltage Window ±24V (48 V_{p-p}) into High Impedance
- Up to 128 Mpts Waveform Memory per Channel
- Up to 32 Digital Channels in synchronous with analog Generation
- Simple Rider™ UI: designed for touch AWG/AFG user interfaces.
- Multi-Instrument Synchronization (AWG4018 only): **up to 32 analog** and **128 digital channels**

Key performance specifications

- AFG Mode
  - 300 MHz Sine Waveforms
  - 1.2 GS/s fixed, 14-bit vertical resolution
  - Amplitude up to 12 V_{p-p} into 50 Ω load
  - Programmable hardware offset: ± 6V into 50 Ω
  - Improved DDS based technology

- AWG Mode
  - 1.2 GS/s Variable Clock, 14-bit vertical resolution
  - 8bit,16bit or 32 bit digital channels
  - Up to 128 Mpts Waveform Memory per Channel
  - 318 MHz Calculated Bandwidth
  - Amplitude up to 12 V_{p-p} into 50 Ω load
  - Programmable hardware offset: ± 6V into 50 Ω

Features & Benefits

- Sample rate can be programmed in from 1 S/s to 1.2 GS/s, with 14-bit vertical resolution, ensures exceptional signal integrity
- Arbitrary waveform memory up to 128 Mpts 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.
- Two operation modes – Simple Rider AFG (DDS AFG mode) and True Arb (variable clock Arbitrary AWG mode)
- Digital outputs provide up to 1.2 Gb/s data rate in LVDS format. LVDS to LVTTL 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 interfaces for remote control

Active Technologies

www.activetechnologies.it

SPECIFICATIONS

Applications areas

Automotive

Today's cars are including a lot of highly sophisticated electronic control unit with very sensitive electronic components.
The Arb Rider 4012/4014/4018 combining 1.2 GS/s with 14 vertical resolution, represents an ideal tool for successfully addressing the new testing challenges in automotive.

- CAN, CAN-FD, LIN, Flexray, SENT emulation
- EMI debugging, troubleshooting and testing
- Electrical standards emulation up to 24V
- Power MOSFET circuitry in automotive electronics optimization

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 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

Electronics 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.

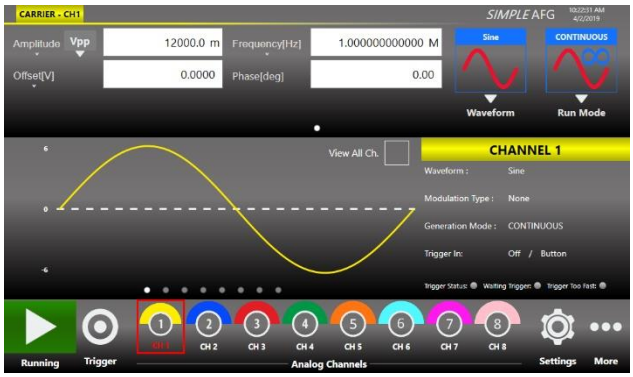
- Frequency response, intermodulation distortion and noise-figure measurements
- Phase Locked Loop (PLL) pull-in and hold range characterization
- Radar base-band signals emulation

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.

- Clock and Sensor signals generation
- MOSFET gate drive amplitude signal emulation
- Power up sequences of IC using the low impedance feature (5 Ω output impedance)

Simple Rider AFG: Function Generator Mode Interface

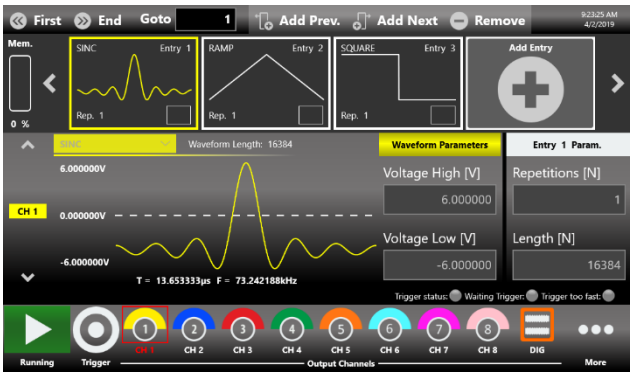


Simple Rider AFG UI is designed for touch and it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips. All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smart phones: touch features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

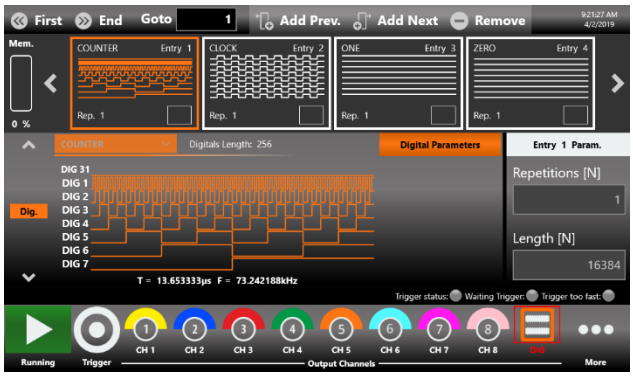
- The swipe gesture gives easy access to the output waveform parameters
- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data.
- Time saving shortcuts and intuitive icons simplify the instrument setup.

Simple Rider TrueArb: AWG and DPG 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 128 MSamples on each channel combined with up to 16,384 and up to 4,294,967,294 repetitions, make the Arb-Rider 4012/4014/4018 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. This feature is available on AWG4018 model only

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

Document name **AWG-4012/4014/4018 - Technical Specifications** Last Date Update: 13/07/2020

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.

General Specifications			
Number of Channels	**AWG - 4012**	**AWG - 4014**	**AWG - 4018**
Analog out Digital out Marker out	2 0/8 optional 1	4 0/8/16 optional 2	8 0/8/16/32 optional 4
Operating Mode	AFG Mode True Arb Mode		
Amplitude			
Range (50 Ω into 50 Ω)[1]	0 to 6Vpp (12 V_{p-p} optional)		
Accuracy (1kHz sine wave, 0V offset, > 5mV_{p-p} amplitude, 50Ω load) (guaranteed)	±(1% of setting [V_{p-p}] + 5 mV)		
Resolution	<0.5 mV_{p-p} or 5 digits		
Output impedance	Single-ended: 50 Ω, Low Impedance: 5 Ω		
Baseline Offset			
Range (50 Ω into 50 Ω) Range (50 Ω into High Z load) Accuracy (50 Ω into 50 Ω) (guaranteed) Resolution	-3 V to +3 V (-6V to +6V opt.) -6 V to +6 V (-12V to +12V opt.) ±(1% of |setting| +5 mV) <4 mV or 4 digits		
DC			
Amplitude range (50 Ω, single-ended) Amplitude accuracy (guaranteed)	-3V to 3V (-6V to 6V opt.) ±(1% of |setting| + 10 mV)		

[1] Amplitude doubles on HiZ load

AFG Mode Specifications	
Output Channels	
Connectors	BNC on front panel
Output type	Single-ended
Output Impedance	50 Ω or 5 Ω (low impedance)
General Specifications	
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
Internal Trigger Timer	
Range	13.3 ns to 100 s
Resolution	104 ps
Accuracy	±(0.1% setting + 5 ps)
Sine Waves	
Frequency Range Sine (50 Ω into 50 Ω)[2]	1 µHz to ≤ 70 MHz: 12V >70 MHz to ≤120 MHz: 9V >120 MHz to ≤180 MHz: 6V >180 MHz to ≤300 MHz: 3V (without **HV opt**. the maximum amplitude is limited to 6 V)
Flatness (1 V_{p-p}, relative to 1 kHz)	DC to 300 MHz: ±0.5 dB
Harmonic Distortion (1 V_{p-p})	1 µHz to ≤ 10 MHz: < -65 dBc > 10 MHz to ≤ 50 MHz: < -55 dBc > 50 MHz to ≤ 100 MHz: < -45 dBc > 100 MHz to ≤ 300 MHz: < -30 dBc
Total Harmonic Distortion (1 V_{p-p})	10 Hz to 20 kHz: < 0.1%

[2] Amplitude doubles on HiZ load

Spurious (1 V_{p-p}) (excluding $f_{Sa} - f_{out}$, $f_{Sa} - 2*f_{out}$)	1 µHz to ≤ 10 MHz: < -60 dBc >10 MHz to ≤ 300 MHz: < -55 dBc
Phase Noise (1 V_{p-p}, 10 kHz offset)	10 MHz: < -120 dBc/Hz typ. 100 MHz: < -115 dBc/Hz typ.
Square Waves	
Frequency Range	1 µHz to ≤ 40 MHz: 12V >40 MHz to ≤80 MHz: 10V >80 MHz to ≤150 MHz: 7V (without **HV opt**. the maximum amplitude is limited to 6 V)
Rise/fall time	2 ns
Overshoot (1 V_{p-p})	< 2%
Jitter (rms)	< 20 ps
Pulse Waves	
Frequency Range	1µHz to ≤ 5 MHz: 12V >5 MHz to ≤60 MHz: 10V >60 MHz to ≤150 MHz: 7V (without **HV opt**. the maximum amplitude is limited to 6 V)
Pulse width	2.5 ns to (Period – 2.5 ns)
Pulse width Resolution	20 ps or 15 digits
Pulse Duty Cycle	0% to 100%, 14 digits (limitations of pulse width apply)
Leading/trailing edge transition time	2 ns to 1000 s
Transition time Resolution	2 ps or 15 digits
Overshoot (1 V_{p-p})	< 2%
Jitter (rms, with rise and fall time ≥ 2ns)	<20 ps
Double Pulse Waves	
Frequency Range	**Without HV option** : 1µHz to ≤ 5 MHz: 12 V_{p-p} >5 MHz to ≤150 MHz: 6 V_{p-p} where $V_{p-p} =\| V_{p-p}\ 1\| + \| V_{p-p}\ 2\|$

	With HV option : 1µHz to ≤ 5 MHz: 24 V_{p-p} >5 MHz to ≤60 MHz: 10 V_{p-p} >60 MHz to ≤150 MHz: 7 V_{p-p} where V_{p-p} =| V_{p-p} 1|+| V_{p-p} 2|
Other Pulse Parameters	Same as Pulse Waves
Ramp Waves	
Frequency Range	1 µHz to 15 MHz
Linearity (< 10 kHz, 1 V_{p-p}, 100%)	≤ 0.1%
Symmetry	0% to 100%
Other Waves	
Frequency Range	
Exponential Rise, Exponential Decay	1 µHz to 15 MHz
Sin(x)/x, Gaussian, Lorentz, Haversine	1 µHz to 30 MHz
Additive Noise	
Bandwidth (-3 dB)	> 200 MHz
Level	0 V to 6 V – | carrier max value [V_{pk}] |
Resolution	1 mV
Arbitrary	
Number of Samples	2 to 16,384
Frequency range	1 µHz to ≤ 150 MHz
Analog Bandwidth (-3 dB)	175 MHz
Rise/fall time	2 ns
Jitter (rms)	< 20 ps
Frequency Resolution	
Sine, square, pulse, arbitrary, Sin(x)/x	1 µHz or 15 digits
Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine	1 µHz or 14 digits
Frequency Accuracy	
Non-ARB	±2.0 x 10^{-6} of setting
ARB	± 2.0 x 10^{-6} of setting ±1 µHz

Modulations	
Amplitude Modulation (AM)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	Internal: 500 µHz to 48 MHz External: 8 MHz maximum
Depth	0.00% to 120.00%
Frequency Modulation (FM)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	Internal: 500 µHz to 48 MHz External: 8 MHz maximum
Peak deviation	DC to 300 MHz
Phase Modulation (PM)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	Internal: 500 µHz to 48 MHz External: 8 MHz maximum
Phase deviation range	0° to 360°
Frequency Shift Keying (FSK)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Square
Key rate	Internal: 500 µHz to 48 MHz, External: 8 MHz maximum
Hop frequency	1 µHz to 300 MHz
Number of keys	2

Phase Shift Keying (PSK)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal or external
Internal modulating waveforms	Square
Key rate	Internal: 500 µHz to 48 MHz, External: 8 MHz maximum
Hop phase	0° to +360°
Number of keys	2
Pulse Width Modulation (PWM)	
Carrier waveforms	Pulse
Modulation source	Internal or external
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	Internal: 500 µHz to 48 MHz External: 8 MHz maximum
Deviation range	0% to 50% of pulse period
Sweep	
Type	Linear, Logarithmic, staircase, and user defined
Waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Sweep time	40 ns to 2000 s
Hold/return times	0 to (2000 s – 40 ns)
Sweep/hold/return time resolution	20 ns or 12 digits
Total sweep time accuracy	≤ 0.4%
Start/stop frequency range	Sine: 1 µHz to 300 MHz, Square: 1 µHz to 150 MHz
Trigger source	Internal (Timer) / External / Manual
Burst	
Waveforms	Standard waveforms (except DC and Noise), ARB
Type	Trigger or gated
Burst count	1 to 4,294,967,295 cycles or Infinite
TrueArb Mode Specifications	
Output Channels	
Connectors	BNC on front panel
Output type	Single-ended

Output Impedance	50 Ω or 5 Ω (low impedance)
General specifications	
Operating Mode	Variable clock (True Arbitrary)
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped,Advanced
Vertical Resolution	14 bit
Waveform Length	16 to 2M samples per channel (AWG401X-2M) 16 to 64M samples per channel (AWG401X-64M) 16 to 128M samples per channel (AWG401X-128M) where X = 2,4 or 8
Waveform Granularity	1 if the entry length is > 384 samples 16 if entry length is ≥ 32 and ≤ 384 samples
Sequence Length	1 to 16384
Sequence Repeat Counter	1 to 4294967294 or infinite
Timer Range	23.52 ns to 7 seconds
Timer Resolution	± 1 sampling clock cycle
Analog Channel to Channels skew	
Range	0 to 3.4 µs
Resolution	≤ 5 ps
Accuracy	±(1% of setting + 20 ps)
Initial skew	< 200 ps
Calculated bandwidth (0.35 / rise or fall time)	≥ 318 MHz
Harmonic distortion (Sine wave 32 points, 1 V_{p-p})	< -60 dBc (@ 1.2 GS/s, 37.5 MHz)
Spurious (Sine wave 32 points, 1 V_{p-p})	< -60 dBc (@ 1.2 GS/s, 37.5 MHz)
SFDR (Sine wave 32 points, 1 V_{p-p})	< -60 dBc (@ 1.2 GS/s, 37.5 MHz)
Rise/fall time (1 V_{p-p} single-ended 10% to 90%)	≤ 1.1 ns
Overshoot (1 V_{p-p} single-ended)	< 2%

Timing and Clock	
Sampling Rate	

Range	1 Sample/s to 1.2 GSample/s
Resolution	16 Hz
Accuracy	± 2.0 x 10^{-6}
Random jitter on clock pattern (rms)	< 10 ps
Digital Outputs (Optional)	
Output Channels	
Connectors	Mini-SAS HD connector on rear panel (Non-standard pin-out)
Number of connectors	1
Number of outputs	8-bits
Output impedance	100 Ω differential
Output type	LVDS
Rise/fall time (10% to 90%)	< 1 ns
Jitter (rms)	20 ps
Maximum update rate	1.2 Gbps
Memory depth	2M samples per channel (AWG401X-2M) 64M samples per channel (AWG401X-64M) 128M samples per channel (AWG401X-128M) where X= 2,4 or 8

8 bit LVDS to LVTTL Converter Probe (Optional AT-DTLL8)	
Output connector	20 position 2.54 mm 2 Row IDC Header
Output type	LVTTL
Output impedance	50 Ω nominal
Output voltage	0.8V to 3.8V programmable in group of 8 bits
Maximum Update Rate	125 Mbps@0.8V and 400 Mbps@3.6V
Dimensions	W 52 mm – H 22 mm – D 76 mm
Input Connector	Proprietary standard
Cable Length	1 meter
Cable Type	Proprietary standard
Proprietary Mini SAS HD to SMA cable (Optional)	
Output connector	SMA
Output type	LVDS
Number of SMA	16 (8 bits)
Cable type	Proprietary standard
Cable Length	1 meter
Auxiliary input and output characteristics	
Marker Output	
Connector type	BNC on front panel
Number of connectors	1, 2 or 4
Output impedance	50 Ω
Output level (into 50 Ω)	
Amplitude	1 V to 2.5 V
Resolution	10 mV
Accuracy	±(2% setting + 10 mV)
Rise/fall time (10% to 90%, 2.5 V_{p-p})	< 700 ps
Jitter (rms)	20 ps

Marker out to analog channel skew	
Range	AFG Mode: 0 to 14s in Continuous Mode 0 to 3 us in Triggered Mode True Arb Mode: 0 to 3µs
Resolution	AFG Mode: 39 ps True Arb Mode: 78 ps,
Accuracy	±(1% of setting + 140 ps)
Initial skew	< 1 ns
Trigger/Gate Input	
Connector type	BNC on the Front Panel
Input impedance	50Ω / 1kΩ
Slope/Polarity	Positive or negative or both
Input damage level	< -15 V or > +15 V
Threshold control level	-10 V to 10 V
Resolution	50 mV
Threshold control accuracy	±(10% of |setting| + 0.2 V)
Input voltage swing	0.5 V_{p-p} minimum
Minimum pulse width (1 V_{p-p})	3 ns
Initial trigger delay to Analog Output	AFG mode: < 360 ns (< 420 ns in triggered sweep mode) True Arb mode: < 240 * DAC clock period + 32 ns
Trigger In to output jitter	AFG mode: < 40 ps True Arb mode: 0.29*DAC clock period
Maximum Frequency	AFG mode: 65 MTps on Rising/Falling Edge 80 MTps on Both Edges True Arb mode: 42.5 MTps where MTps = Mega Transitions per second
Reference Clock Input	
Connector type	SMA on rear panel
Input impedance	50 Ω, AC coupled
Input voltage range	-4 dBm to 11 dBm sine or square wave (Rise time T10-90 <1 ns and Duty Cycle from 40% to 60%)
Damage level	+14 dBm
Frequency range	5 MHz to 100 MHz

Reference Clock Output	
Connector type	SMA on rear panel
Output impedance	50 Ω, AC coupled
Frequency	10 MHz
Accuracy	± 2.0 ppm
Aging	± 1.0 ppm/year
Amplitude	1.65V
Jitter (rms)	< 20 ps
External Modulation Input	
Connector type	SMA on rear panel
Input impedance	>2 MΩ
Number of inputs	1
Bandwidth	8 MHz with 40 MS/s sampling rate
Input voltage range	-0.5V to +0.5V
Vertical resolution	8-bit
Power	
Source Voltage and Frequency	100 to 240 VAC ±10% @ 45-66 Hz
Maximum power consumption	150 W
Environmental characteristics	
Temperature (operating)	+5 °C to +40 °C (+41 °F to 104 °F)
Temperature (non-operating)	-20 °C to +60 °C (-4 °F to 140 °F)
Humidity (operating)	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.
Humidity (non-operating)	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.
Altitude (operating)	3,000 meters (9,842 feet) maximum at or below 25°C
Altitude (non-operating)	12,000 meters (39,370 feet) maximum
EMC and safety	
Compliance	CE compliant
Safety	EN61010-1

Main Standards	EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
Immunity	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	9.5Kg (AWG4012) – 10.3Kg (AWG4014) – 12Kg (AWG4018)
Front panel connectors	CH1 to CH8 OUTPUT (BNC) MARKER OUT 1 to 4 (BNC) TRIGGER IN (BNC)
Rear panel connectors	Ref Clk In (SMA) Ref Clk Out (SMA) Ext Mod In (SMA) External Monitor ports (one or more) DIGITAL POD A[7..0] (AWG 4012 / 4014 / 4018) DIGITAL POD B[7..0] (AWG 4014 / 4018) DIGITAL POD C[7..0] (AWG 4018) DIGITAL POD D[7..0] (AWG 4018) 1 USB 2.0 ports or more Ethernet port (10/100/1000BaseT Ethernet, RJ45 port) 2 PS/2 keyboard and mouse ports
Hard Disk	32 GB SSD or better
Processor	Intel® Celeron J1900, 2 GHz (or better)
Processor Memory	4 GB or better