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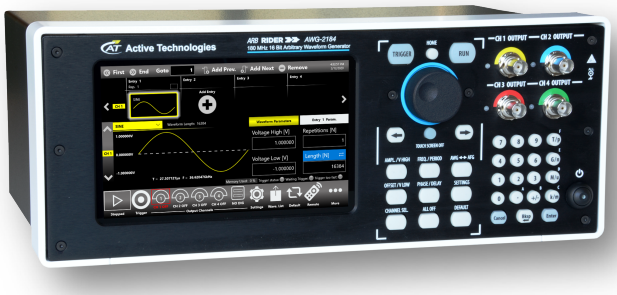
ACTIVE TECHNOLOGIES

RIDER

Time to Reinvent advance signal generation

ARB Rider 2182 / 2184 Technical Datasheet



2–4 CHANNELS / 180 MHz ALL-IN-ONE: Function Generator, Arb Generator and Digital Pattern Generator

- 2 or 4 Analog Channels
- 600 MS/s (1.2 GS/s with x2 interpolation)
- 16-bit Vertical Resolution
- 180 MHz Bandwidth
- Up to 12V_{p-p} into 50Ω load
- Up to 256Mpts Waveform Memory per Channel
- 8 Digital Channels in synchronous with analog Generation
- Simple Rider™ UI: designed for touch AWG/AFG user interfaces.

Key performance specifications

- AFG Mode
  - 180 MHz Sine Waveforms
  - 1.2 GS/s fixed
  - 16-bit vertical resolution
  - Amplitude up to 12V_{p-p} into 50Ω load
  - Improved DDS based technology
- AWG Mode
  - 600 MS/s Variable Clock (1.2 GS/s with x2 Interpolation)
  - 16-bit vertical resolution
  - 8-bit digital channels
  - Up to 256 Mpts Waveform Memory per Channel
  - 160 MHz Calculated Bandwidth
  - Amplitude up to 12V_{p-p} into 50Ω load

Features & Benefits

- Sample rate can be programmed in from 1 S/s to 600 MS/s (1 S/s to 1.2 GS/s with 2x interpolation), with 16-bit vertical resolution, ensuring exceptional signal integrity
- Arbitrary waveform memory up to 256 Mpts for each analog channel
- Mixed Signal Generation – 2 or 4 Analog channels with 8 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 600Mb/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 7” touch screen, front panel buttons and knob
- Compact form factor, convenient for bench top and fully fit with 3U – 10” rackmount standard
- LAN 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 2182 / 2184 combining 600 MS/s (1.2 GS/s with 2x interpolation) with 16 bit 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 12Vp-p
- 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 application. 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

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

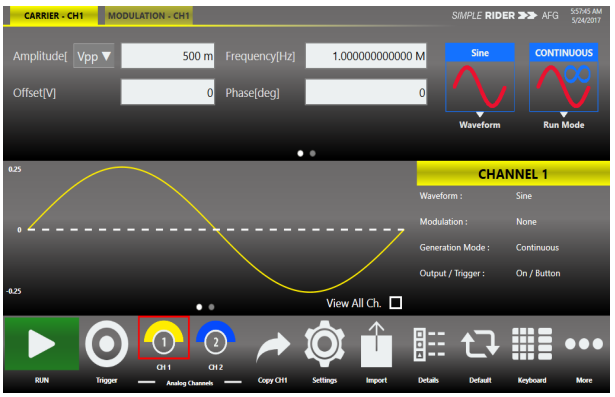
Semiconductors Test

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.

- Clock and Sensor signals generation
- MOSFET gate drive amplitude signal emulation
- Power up sequences of IC using the low (0 Ω) output impedance feature

Simple Rider AFG: Function Generator Mode Interface

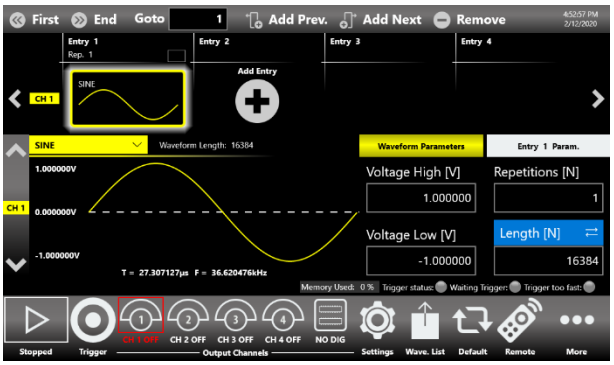
Simple Rider AFG UI is designed for touch and it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips.
All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smart phones: touch features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



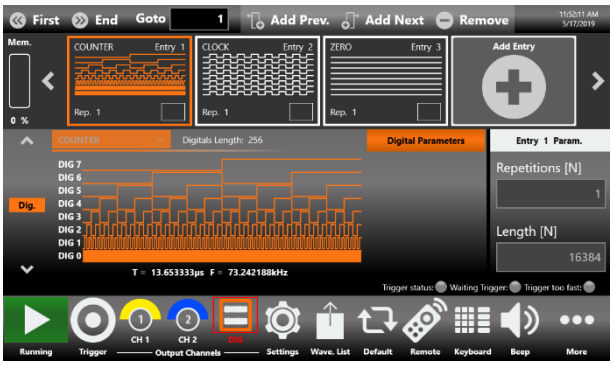
- The swipe gesture gives easy access to the output waveform parameters
- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data
- Time saving shortcuts and intuitive icons simplify the instrument setup

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 256 Mpoints on each channel combined with up to 16,384 and up to 4,294,967,294 repetitions, make the Arb-Rider 2182 / 2184 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.

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

Document name **AWG - 2182 / 2184 - Technical Specifications** Last Date Update: 28/10/2021

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 ±10°C after auto-calibration.
Some specifications on this document refer to the available options and accessories that can be found in the table at the end of this document.

General Specifications		
	AWG-2182	**AWG-2184**
Number of Channels Analog out Digital out Marker out	 2 0/8 – optional 1	 4 0/8 – optional 1
Operating Mode	AFG Mode True Arb Mode	
Amplitude Range (50Ω into 50Ω)[1] Accuracy (1kHz sine wave, 0V offset, >5mV$_{p-p}$ amplitude, 50Ω load) (guaranteed) Resolution Output impedance	 0 to 6Vp-p (12Vp-p optional) ±(1% of setting [Vp-p] + 5mV) <0.5mVp-p or 5 digits Single-ended: 50Ω, Low Impedance: 0Ω	
DC Amplitude range (50Ω into 50Ω)[1] Amplitude accuracy (guaranteed)	 -3V to 3V (-6V to 6V optional) ±(1% of |setting| + 10mV)	
Output attenuator	0dB or 20dB selectable	
AFG Mode Specifications		
Output Channels Connectors Output type	 BNC on front panel Single-ended	

[1] Amplitude doubles into HiZ load

Output Impedance	50Ω or 0Ω (low impedance) programmable
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: 16-bit Waveform length: 16,384 points
Internal Trigger Timer	
Range	13.4ns to 100s
Resolution	104ps
Accuracy	±(0.1% setting + 5ps)
	AWG-2182/2184
Sine Waves	
Frequency Range (50Ω into 50Ω)	1 μHz to ≤ 150 MHz: 6 V_{p-p} >150 MHz to ≤ 180 MHz: 5 V_{p-p} <u>HV option:</u> 1 μHz to ≤ 50 MHz: 12 V_{p-p} >50 MHz to ≤ 60 MHz: 10 V_{p-p} >60 MHz to ≤ 100 MHz: 8 V_{p-p} >100 MHz to ≤ 150 MHz: 6 V_{p-p} >150 MHz to ≤ 180 MHz: 5 V_{p-p}
Max Frequency Value	180 MHz
Flatness (1Vp-p, relative to 1 kHz)	DC to 180 MHz: ±0.5dB

Harmonic Distortion (1Vp-p)	1 µHz to ≤ 20 kHz: <-75dBc >20 kHz to ≤ 1 MHz: <-70dBc >1 MHz to ≤ 10 MHz: <-65dBc >10 MHz to ≤ 50 MHz: <-55dBc >50 MHz to ≤ 120 MHz: <-45dBc >120 MHz to ≤ 180 MHz: <-40dBc
Total Harmonic Distortion (1Vp-p)	10 Hz to 20 kHz: <0.04%
Spurious (1Vp-p) (excluding f_{Sa}-f_{Out}, f_{Sa}-2*f_{Out})	1 µHz to ≤ 10 MHz: <-80dBc >10 MHz to ≤ 180 MHz: <-80dBc + 6dBc/octave
Phase Noise (1Vp-p, 10kHz offset)	10 MHz: < -127dBc/Hz typ 100 MHz: < -115dBc/Hz typ
Square Waves	
Frequency Range	1 µHz to 80 MHz: $6V_{p-p}$ HV option: 1 µHz to ≤ 30 MHz: $12V_{p-p}$ >30 MHz to ≤ 50 MHz: $11V_{p-p}$ >50 MHz to ≤ 70 MHz: $10V_{p-p}$ >70 MHz to ≤ 80 MHz: $9V_{p-p}$
Rise/fall time	4ns
Overshoot ($1V_{p-p}$)	<1%
Jitter (rms)	<2ps

Pulse Waves	
Frequency Range	1 µHz to 80 MHz: 6V_{p-p} HV option: 1 µHz to ≤ 3 MHz: 12V_{p-p} >3 MHz to ≤ 10 MHz: 11V_{p-p} >10 MHz to ≤ 70 MHz: 10V_{p-p} >70 MHz to ≤80 MHz: 9V_{p-p}
Pulse width	5ns to (Period – 5ns)
Pulse width Resolution	20ps or 15 digits
Leading/trailing edge transition time	4ns to 1000s
Transition time Resolution	2ps or 15 digits
Pulse duty	0% to 100% 14 digits (limitations of pulse width apply)
Overshoot (1V_{p-p})	<1%
Jitter (rms, with rise and fall time ≥4ns)	<2ps
Double Pulse Waves	
Frequency Range	1 µHz to ≤ 3 MHz: 12V_{p-p} >3 MHz to ≤ 50 MHz: 6V_{p-p} where V_{p-p} = |V_{p-p}1\| + \|V_{p-p}2\| HV option: 1 µHz to ≤ 3 MHz: 24V_{p-p} >3 MHz to ≤ 10 MHz: 11V_{p-p} >10 MHz to ≤ 50 MHz: 10V_{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 5 MHz
Linearity (<10 kHz, 1V_{p-p}, 100%)	≤0.1%
Symmetry	0% to 100%
Other Waves	
Frequency Range	

Exponential Rise, Exponential Decay	1 µHz to 5 MHz
Sin(x)/x, Gaussian, Lorentz, Haversine	1 µHz to 10 MHz
Additive Noise	
Bandwidth (-3dB)	>200 MHz
Level	0V to 6V – |carrier max value [V_{pk}]|
Resolution	1mV
Arbitrary	
Number of Samples	2 to 16,384
Frequency range	1 µHz to ≤ 80 MHz
Analog Bandwidth (-3 dB)	87.5 MHz
Rise/fall time	4ns
Jitter (rms)	<2ps
Frequency Resolution	
Sine, Square, Pulse, Arbitrary, Sin(x)/s	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
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	500 µHz to 48 MHz
Depth	0.00% to 120.00%
Frequency Modulation (FM)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	500 µHz to 48 MHz
Peak deviation	DC to 180 MHz

Phase Modulation (PM)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	500 µHz to 48 MHz
Phase deviation range	0° to 360°
Frequency Shift Keying (FSK)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal
Internal modulating waveforms	Square
Key rate	500 µHz to 48 MHz
Hop frequency	1 µHz to 180 MHz
Number of keys	2
Phase Shift Keying (PSK)	
Carrier waveforms	Standard waveforms (except Pulse, DC and Noise), ARB
Modulation source	Internal
Internal modulating waveforms	Square
Key rate	500 µHz to 48 MHz
Hop phase	0° to +360°
Number of keys	2
Pulse Width Modulation (PWM)	
Carrier waveforms	Pulse
Modulation source	Internal
Internal modulating waveforms	Sine, Square, Ramp, Noise, ARB
Modulating frequency	500 µHz to 48 MHz
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	40ns to 2000s
Hold/return times	0 to (2000s – 40ns)
Sweep/hold/return time resolution	20ns or 12digits
Total sweep time accuracy	≤0.4%
Start/stop frequency range	Sine: 1 μHz to 180 MHz Square: 1 μHz to 80 MHz
Trigger source	Internal / External / Manual
Burst	
Waveforms	Standard waveforms (except DC and Noise), ARB
Type	Triggered or Gated
Burst count	1 to 4,294,967,295 cycles or Infinite
True Arb mode specifications	
Output Channels	
Connectors	BNC on front panel
Output type	Single-ended DC coupled
Output Impedance	50Ω or 0Ω (low impedance)
General specifications	
Operating Mode	Variable clock (True Arbitrary)
Run Modes	Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced
Vertical Resolution	16 bit
Waveform Length	16 to 2M samples per channel (up to 256M samples optional)
Waveform Granularity	1 if the entry length is >384 samples

	8 if entry length is ≥16 and ≤384 samples
Sequence Length	1 to 16,384
Sequence Repeat Counter	1 to 4,294,967,295 or infinite
Timer	
Range	23.52ns to 7s
Resolution	±1 sampling clock period
Analog Channel to Channels skew	
Range	0 to 6.59 us (depending on internal sampling rate)
Resolution	Channel 1/2 to Channel 3/4: ≤ 5ps, Channel 1/3 to Channel 2/4: 1 DAC sampling period
Accuracy	±(1% of setting + 20ps)
Initial skew	<200 ps
Calculated bandwidth (0.35 / rise or fall time)[2]	≥160 MHz
Harmonic distortion (Sine wave 32 pts, $1V_{p-p}$)	< -62dBc (@ 600MS/s, 18.75 MHz)
Spurious (Sine wave 32 pts, $1V_{p-p}$)	< -80dBc (@ 600MS/s, 18.75 MHz)
SFDR (Sine wave 32 pts, $1V_{p-p,\ including\ Harmonics}$)	< -62dBc (@ 600MS/s, 18.75 MHz)
Rise/fall time ($1V_{p-p}$ single-ended 10% to 90%)[2]	≤2.2ns
Overshoot ($1V_{p-p}$ single-ended)[2]	< 2%
Timing and Clock	
Sampling Rate	
Range	1 S/s to 600 MS/s (1 S/s to 1.2 GS/s with x2 interpolation)
Resolution	16 Hz
Accuracy	±2.0ppm
Random jitter on clock pattern (rms)	<2ps
Digital outputs (Optional)	
Output Channels	

[2] 2x interpolation OFF

Connectors Number of connectors Number of outputs	Mini-SAS HD connector on rear panel (Non-standard pin-out) 1 8 bits
Output impedance	100Ω differential
Output type	LVDS
Rise/fall time (10% to 90%)	<1ns
Jitter (rms)	20ps
Maximum update rate	600 Mbps
Memory depth	2MSamples per digital channel (up to 256MSamples optional)
8 bit LVDS to LVTTL Converter Probe (Optional AT-DTTL8)	
Output connector	20 position 2.54 mm 2 Row IDC Header
Output type	LVTTL
Output impedance	50Ω nominal
Output voltage	0.8V to 3.8V programmable
Maximum Update Rate	125Mbps@0.8V and 400Mbps@3.6V
Dimensions	W 52mm – H 22mm – D 76mm
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		
	AWG-2182	**AWG-2184**
Marker Output		
Connector type	BNC on front panel	BNC on rear panel
Number of connectors	1	
Output impedance	50 Ω	
Output level (into 50 Ω) Amplitude Resolution Accuracy	 1V to 2.5V 10mV ±(2% setting + 10mV)	
Rise/fall time (10% to 90%, 2.5V_{p-p})	<700ps	
Jitter (rms)	20ps	
Marker out to analog channel skew Range Resolution Accuracy Initial skew	 True Arb Mode: 0 to 3μs AFG Mode: 0 to 14s in Continuous Mode 0 to 3μs in Triggered Mode True Arb Mode: 78ps, AFG Mode: 39ps ±(1% of setting + 140 ps) < 1 ns	
Trigger/Gate input		
Connector	BNC on front panel	BNC on rear panel
Input impedance	50Ω / 1kΩ programmable	
Slope/Polarity	Positive or negative or both	

Input damage level	<-15V or >+15V
Threshold control level	-10V to 10V
Resolution	10mv
Threshold control accuracy	±(10% of |setting| + 0.2V)
Input voltage swing	$0.5V_{p-p}$ minimum
Minimum pulse width ($1V_{p-p}$)	3ns
Initial trigger/gate delay to Analog Output	AFG mode: <400 ns (<460 ns in triggered sweep mode) True Arb mode: <131*DAC sampling period + 22.5 ns (<143*DAC sampling period+22.5 ns with 2x interpolation)
Trigger In to output jitter	AFG mode: <45ps True Arb mode: 0.29*DAC sampling 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	50Ω, AC coupled
Input voltage range	-4 dBm to 11dBm sine or square wave (rise time T_{10-90} <1ns and duty cycle from 40% to 60%)
Damage level	+14dBm
Frequency range	5 MHz to 100 MHz
Reference clock output	
Connector type	SMA on rear panel
Output impedance	50Ω, AC coupled
Frequency	10 MHz
Accuracy	$\pm 2.0 \times 10^{-6}$
Aging	$\pm 1.0 \times 10^{-6}$/year
Amplitude	1.65V
Jitter (rms)	<20ps
Power	
Source Voltage and Frequency	100 to 240VAC ±10% @ 45 Hz to 66 Hz

Max. power consumption	100W
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		
	AWG-2182	**AWG-2184**
Display	7”, 1024x600, capacitive touch LCD	
Operative System	Windows 10	
External Dimensions	W 362 mm – H 143 mm – D 258 mm (3U 10” rackmount)	
Weight	6.25 kg	
Front panel connectors	CH1, CH2 OUTPUT (BNC) MARKER OUT (BNC) TRIGGER IN (BNC)	CH1, CH2 OUTPUT (BNC) CH3, CH4 OUTPUT (BNC)
Rear panel connectors		REF CLK IN (SMA)

	REF CLK IN (SMA) REF CLK OUT (SMA) External Monitor ports DIGITAL POD A[7..0] 1 USB 2.0 ports or more Ethernet port (10/100/1000BaseT Ethernet, RJ45 port) 2 PS/2 keyboard and mouse ports	REF CLK OUT (SMA) MARKER OUT (BNC) TRIGGER IN (BNC) External Monitor ports DIGITAL POD A[7..0] 1 USB 2.0 ports or more Ethernet port (10/100/1000BaseT Ethernet, RJ45 port) 2 PS/2 keyboard and mouse ports
Hard Disk	240 GB SSD or better	
Processor	Intel® Celeron J1900, 2 GHz (or better)	
Processor Memory	4 GB or better	

Table of Available Models

Item	Description
AWG-2100-DIG8	8 channel Digital license (Mini SAS cable included)
AWG2182-2M	2ch 600Ms/s AWG 2Ms memory - 180MHz AFG
AWG2182-64M	2ch 600Ms/s AWG 64Ms memory - 180MHz AFG
AWG2182-256M	2ch 600Ms/s AWG 256Ms memory - 180MHz AFG
AWG2184-2M	4ch 600Ms/s AWG 2Ms memory - 180MHz AFG
AWG2184-64M	4ch 600Ms/s AWG 64Ms memory - 180MHz AFG
AWG2184-256M	4ch 600Ms/s AWG 256Ms memory - 180MHz AFG

Table of Available Options and Accessories

Item	Description
Options	
AWG-2182-HV	High voltage output (12Vpp on 50ohm) for AWG2182
AWG-2184-HV	High voltage output (12Vpp on 50ohm) for AWG2184
AWG-2100-DIG8	8 channel Dig license (Mini SAS cable included) for AWG2000
AWG2002-WAR	3 years warranty extension for AWG2182
AWG2004-WAR	3 years warranty extension for AWG2184
Accessories	
AT-DTTL8	LVDS to LVTTL digital adapter probe
AT-LVDS-SMA8	LVDS to SMA digital adapter cable
RIDER-C-RACK	Rackmount kit for Rider C series (AWG2000)
GPIB / USB-TMC	GPIB and USBTMC Ports for Remote Control
SSD-250	Additional 250GB Solid State Disk for RIDER series
SSD-500	Additional 500GB Solid State Disk for RIDER series
SSD-1000	Additional 1TB Solid State Disk for RIDER series