# 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 $V_{p-p}$ into 50 Ω with hardware offset of ±2.5V into 50 Ω. Total Output Voltage Window ±5 V (10 $V_{p-p}$) into 50 Ω**
- **Differential output with up to 2.5 $V_{p-p}$ 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 $V_{p-p}$ into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2.5 $V_{p-p}$ 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 $V_{p-p}$ into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2.5 $V_{p-p}$ 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 $V_{p-p}$ into 50 Ω with hardware offset of ±2.5 V into 50 Ω
  - Differential amplitude up to 2.5$V_{p-p}$ 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[1] 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 LVTTL 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


[1] Digital output channels are available in the 7204 and 7174 model only

# Applications and Area

## Optics & Photonics, RF Wireless

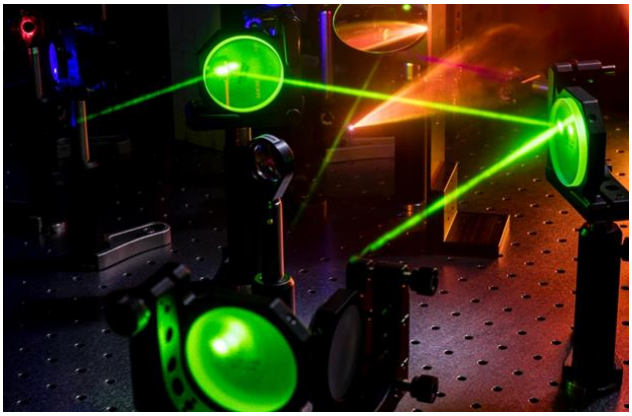


*Figure 1: Laser & Photonics*

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

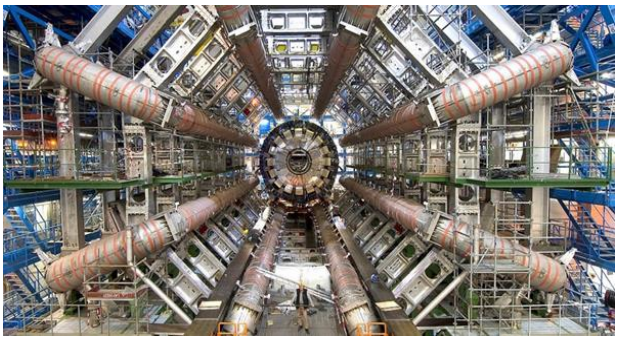


*Figure 4:Advanced Research*

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 **Accelerators**, **Tokamak** or **synchrotrons** to emulate signals without creating specifics test boards.

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 modulato

**Highlights**

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

## Semiconductors Test

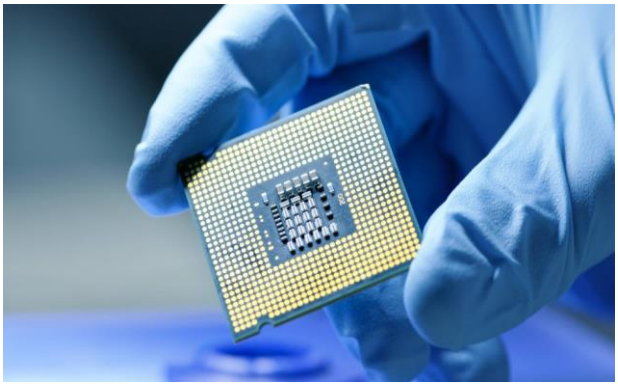


*Figure 5: Semiconductors testing*

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 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.

Highlights

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

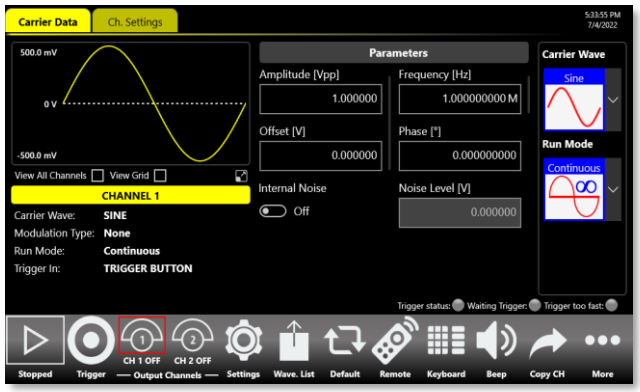
match with the AWG-7000 Series.
Moreover the capability to generate high bandwidth signals can be used on digital modulation systems for Radio Applications or others I/Q signal modulation.
The generation of high-speed signals combined to the advanced sequencer with fast sequence switch feature, allow 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

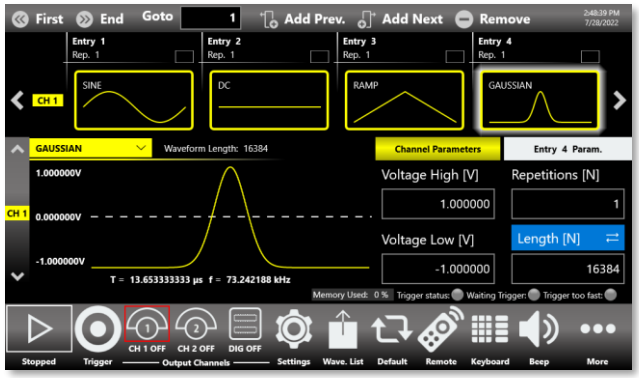
**Simple Rider AFG** UI is designed for touch and it has been developed to put all the capabilities of modern Waveform Generators right at your fingertips. All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smart phones: touch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



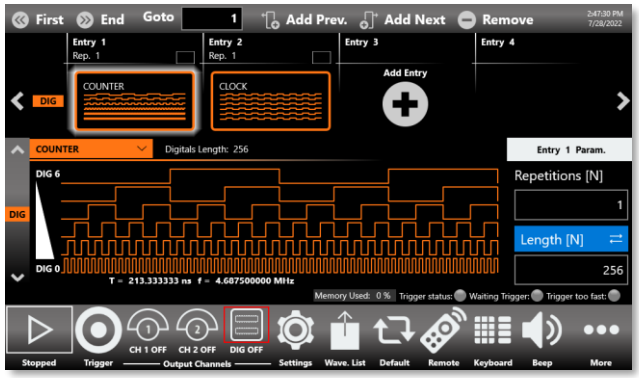

- The swipe gesture gives easy access to the output waveform parameters
- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data.
- Time saving shortcuts and intuitive icons simplify the instrument setup.

# 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.

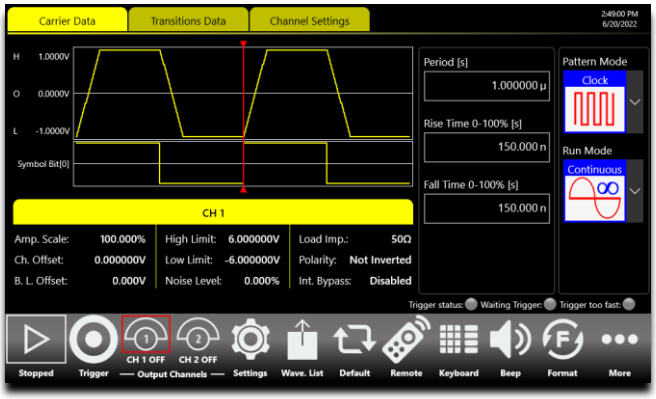



Thanks to the intuitive and easy waveform sequencer user interface, the most complex waveform scenarios can be created with just few screen touches.

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 | **AWG-7202** | 2 CH – 5Vpp Single ended outputs – Full memory[2] |
| | | **AWG-7204** | 4 CH – 5Vpp Single ended outputs – Full memory |
| | | **AWG-7204-S** | 4 CH – 5Vpp Single ended outputs – Short memory or<br>2 CH – 5Vpp Single ended outputs – Full memory |
| | Differential | **AWG-7202D** | 2 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| | | **AWG-7204D** | 4 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| | | **AWG-7204D-S** | 4 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Short memory or<br>2 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| 17 GS/s | Single ended | **AWG-7172** | 2 CH – 5Vpp Single ended outputs – Full memory |
| | | **AWG-7174** | 4 CH – 5Vpp Single ended outputs – Full memory |
| | | **AWG-7174-S** | 4 CH – 5Vpp Single ended outputs – Short memory or<br>2 CH – 5Vpp Single ended outputs – Full memory |
| | Differential | **AWG-7172D** | 2 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| | | **AWG-7174D** | 4 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| | | **AWG-7174D-S** | 4 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Short memory or<br>2 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| 10 GS/s | Single ended | **AWG-7102** | 2 CH – 5Vpp Single ended outputs – Full memory |
| | | **AWG-7104** | 4 CH – 5Vpp Single ended outputs – Full memory |
| | Differential | **AWG-7102D** | 2 CH – 2.5Vpp (1.25Vpp single ended) Differential outputs – Full memory |
| | | **AWG-7104D** | 4 CH – 2.5Vpp (1.25Vpp single ended) Differential output – Full memory |

[2] 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 |
|---|---|---|
| **AWG-7202-PAT** | O | Serial Pattern Generator (SPG) for AWG-7202(D), 7172(D) or 7102(D) |
| **AWG-7204-PAT** | O | Serial Pattern Generator (SPG) for AWG-7204(D), 7174(D) or 7104(D) |
| **AWG-7xx4-8DIG** | O | AWG-7xx4-8DIG 8CH Dig license for AWG-7204(D), 7174(D) or 7104(D) |
| **AWG-7xx4-16DIG** | O | AWG-7xx4-16DIG 16CH Dig license for AWG-7204(D), 7174(D) or 7104(D) |
| **AWG-7xx4-32DIG** | O | AWG-7xx4-32DIG 32CH Dig license for AWG-7204(D), 7174(D) or 7104(D) |
| **AWG-7000-FSS** | O | AWG-7000 Fast Sequence Switch |
| **AWG-7xx2-WAR** | O | 3 years warranty extension for AWG-7202(D), 7172(D) or 7102(D) |
| **AWG-7xx4-WAR** | O | 3 years warranty extension for AWG-7204(D), 7204(D)-S, 7174(D), 7174(D) -S or 7104(D) |
| **RIDER-MINI-SAS-HD** | A | Mini Sas HD cable for digital probe, 8 Differential signal (available only for 4-channels models with long memory) |
| **RIDER-AWG7K-SYNC** | A | Synchronization cable for all AWG-7000 models |
| **AT-DTTL8** | A | LVDS to LVTTL digital adapter probe (available only for 4-channels models with long memory) |
| **AT-LVDS-SMA8** | A | CML to SMA digital adapter cable (available only for 4-channels models with long memory) |
| **GP-IB / USB-TMC** | A | GPIB and USBTMC Ports for Remote Control |
| **RIDER-RACK** | A | Rackmount kit for Rider instrument system |

O = options, A = Accessories

# Memory vs model and operating modes

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

| | Channel count | MODEL | Memory per channel (Msamples) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | FULL RATE mode (20/17Gsps max sampling rate) | | | | HALF RATE mode (10Gsps max sampling rate) | | | |
| | | | CH1 | CH2 | CH3 | CH4 | CH1 | CH2 | CH3 | CH4 |
| 20 GS/s and 17 GS/s | 4 | AWG-7204-S<br>AWG-7204D-S<br>AWG-7174-S<br>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

## General Specifications

| | **AWG-7202**<br>**AWG-7202D**<br>**AWG-7172**<br>**AWG-7172D**<br>**AWG-7102**<br>**AWG-7102D**<br>  | **AWG-7204**<br>**AWG-7204D**<br>**AWG-7204S**<br>**AWG-7204D-S**<br>**AWG-7174**<br>**AWG-7174D**<br>**AWG-7174-S**<br>**AWG-7174D-S**<br>**AWG-7104**<br>**AWG-7104D**<br>  |
|---|---|---|
| **Operating Mode** | AFG Mode - True Arb Mode - SPG Mode (optional) | |
| **Number of Markers and Analog Channels** | | |
| Analog channels | 2 | 4 |
| Markers | 2 | 4 |
| | **AWG-7202**<br>**AWG-7202D**<br>**AWG-7172**<br>**AWG-7172D**<br>**AWG-7102**<br>**AWG-7102D**<br>**AWG-7204-S**<br>**AWG-7204D-S**<br>**AWG-7174-S**<br>**AWG-7174D-S**<br>  | **AWG-7204**<br>**AWG-7204D**<br>**AWG-7174**<br>**AWG-7174D**<br>**AWG-7104**<br>**AWG-7104D**<br>  |
| **Number of Digital Channels** | | |
| Digital channels | - | 32 |

| | AWG-7202<br>AWG-7204<br>AWG-7204-S<br><br>AWG-7172<br>AWG-7174<br>AWG-7174-S<br><br>AWG-7102<br>AWG-7104<br><br>  | AWG-7202D<br>AWG-7204D<br>AWG-7204D-SD<br><br>AWG-7172D<br>AWG-7174D<br>AWG-7174D-S<br><br>AWG-7102D<br>AWG-7104D<br><br>  |
|---|---|---|
| **Output Channels** | | |
| Output type | Single ended DC coupled | Differential DC coupled |
| Output impedance | Single ended: 50 Ω | Single ended: 50 Ω<br>Differential: 100 Ω |
| Connectors | SMA on front panel | |
| **DC Amplitude** | | |
| Amplitude range | ±2.5 V (into 50 Ω) | ±0.625 V Se. (into 50 Ω)<br>±1.25 V Diff. (into 100 Ω) |
| Resolution | 500µV (nom), 5 digits | 100µV (nom), 5 digits |
| Amplitude accuracy | ±(1.5% of \|setting\| + 15mV)[3] | ±(1% of \|setting\| + 2mV)[3] |
| **DC Baseline Hardware Offset (Common mode offset)** | | |
| 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 | -4 V to +4 V |
| Accuracy (50 Ω into 50 Ω) (guaranteed) | ±(1% of \|setting\| + 15 mV) | ±(1% of \|setting\| + 5 mV) |
| **AC Accuracy** (1 kHz sine wave, 0 V offset, > 5 $mV_{p-p}$ amplitude, 50 Ω load) (guaranteed) | ± (1% of setting [Vpp] + 5mV) [3] | |

[3] The specification is guarantee in the range 0% to 80% of full scale output

## True Arb - Baseband mode specifications

| | AWG-7202<br>AWG-7204<br>AWG-7204-S<br>AWG-7172<br>AWG-7174<br>AWG-7174-S<br>AWG-7102<br>AWG-7104 | AWG-7202D<br>AWG-7204D<br>AWG-7204D-S<br>AWG-7172D<br>AWG-7174D<br>AWG-7174D-S<br>AWG-7102D<br>AWG-7104D |
|---|---|---|
| **General specifications** | | |
| Operating Modes | Full Rate Mode (Variable clock)<br>Half Rate Mode (Variable clock) | |
| Sampling Rate<br>***AWG-720x(D) / AWG717x(D)*** Model:<br>– Full Rate Mode | 1 S/s to 20 GS/s[4] (AWG-720x(D))<br>1 S/s to 17 GS/s[4] (AWG-717x(D)) | |
| – Half Rate Mode | 1 S/s to 10 GS/s[4] | |
| ***AWG-7204(D)-S / AWG7174(D)-S*** Model: | 1 S/s to 20 GS/s[4] (AWG-7204(D)-S)<br>1 S/s to 17 GS/s[4] (AWG-7174(D)-S) | |
| ***AWG-710x(D)*** Model: | 1 S/s to 10 GS/s[4] | |
| Sin(x)/x | 8.85 GHz @ 20GS/S (AWG-7202(D) / AWG7204(D)(-S))<br>7.52 GHz @ 17GS/S (AWG-7172(D) / AWG7174(D)(-S))<br>4.425 GHz @ 10GS/S (AWG-710x / AWG710xD) | |
| Run Modes | Continuous, Triggered Continuous, Single/Burst, Stepped, Advanced | |
| Vertical Resolution | 14 bit | |

[4] The entire Sample Rate interval is not continuous (see the corresponding section in the User manual)

| | |
|---|---|
| Max Waveform Memory<br><br>***AWG-720x(D) / AWG717x(D)*** Models:<br>– Full Rate Mode (20 GS/s) | **AWG7202 / AWG7202D and AWG7172 / AWG7172D**:<br>CH1: 9.6 Gsamples; CH2: 1.17 Msamples<br>**AWG7204 / AWG7204D and AWG7174 / AWG7174D**:<br>CH1, CH3: 9.6 Gsamples; CH2, CH4: 589 ksamples |
| – Half Rate Mode (10 GS/s) | 4.8 Gsamples for channel |
| ***AWG-7204(D)-S / AWG7174(D)-S*** Models:<br>– 4 Channel:<br>Full Rate SHORT MEMORY (20 GS/s) | 512 ksamples for every channel |
| – 2 Channel:<br>Full Rate Mode (20 GS/s)<br>Half Rate Mode (10 GS/s) | CH1: 9.6 Gsamples; CH2: 1.17 Msamples<br>4.8 Gsamples for channel |
| ***AWG-710x(D)*** Models: | 4.8 Gsamples for channel |
| Waveform Granularity | For **AWG 720x / 720xD** and **AWG 717x / 717xD:**<br>1 if the entry length is > 8928 samples<br>288 if entry length is ≥ 288 and ≤ 8928 samples<br><br>For AWG **7204-S / 7204D-S:**<br>1 if the entry length is > 512 samples<br>64 if entry length is ≥ 256 and ≤ 512 samples<br><br>For AWG **710x / 710xD:**<br>1 if the entry length is > 4464 samples<br>288 if entry length is ≥ 288 and ≤ 4464 samples |
| Sequence Length | 1 to 16384 |
| Sequence Repeat Counter | 1 to 4294967294 or infinite |
| **Timer** | |

| | | |
|---|---|---|
| Range | 17.6 ns to 429 ms | |
| Resolution | ± 1 sampling clock cycle | |
| **Analog Channel to Channels skew**<br>Range<br>Resolution<br><br><br><br><br>Accuracy<br>Initial skew | <br>0 to 1.63 us<br>**4CH Model**:<br>CHx to CHx (x=1,2,3,4): 1 sampling Clock Cycle<br>CH1/CH2 couple to CH3/CH4 couple: 100 fs<br>**2CH Model**:<br>CHx to CHx (x=1,2): 100 fs<br>±(1% of setting + 20 ps)<br>< 20 ps | |
| **Calculated bandwidth (0.35 / rise or fall time$_{10\text{-}90}$)**<br>– For **20** or **17 GSa/s** model:<br>– For **10 GSa/s** model: | <br>≥ 5 GHz<br>≥ 2.6 GHz | <br>≥ 5.8 GHz<br>≥ 3.25 GHz |
| **Measured 3dB bandwidth (sin(x)/x compensated)**<br>– For **20** or **17 GSa/s** model:<br>– For **10 GSa/s** model: | <br>5.8 GHz<br>3 GHz | <br>- |
| **SFDR @ 100 MHz**[5]<br>Measured across DC to Fs/2 where Fs is:<br>Fs= 20 Gsa/s for AWG-720x(D) models<br>Fs= 17 Gsa/s for AWG-717x(D) models<br>Fs= 10 Gsa/s for AWG-710x(D) models | < - 65 dBc | - |
| **SFDR**<br>Measured across DC to Fs/2 where Fs is:<br>Fs= 20 Gsa/s for AWG-720x(D) models | 18mHz to ≤ 100MHz: < -65dBc | |

[5] Measured excluding Fs - 2*fout and Fs- 3*fout and excluding harmonic. For AWG-7202/7204(-S) models the SFDR is evaluated @ 2.5Vpp single ended nominal output amplitude.

| | | |
|---|---|---|
| Fs= 17 Gsa/s for AWG-717x(D) models<br>Fs= 10 Gsa/s for AWG-710x(D)models | 100MHz to ≤ 500MHz: < -60dBc<br>500MHz to ≤ 5GHz: < -55dBc<br>5GHz to ≤ 10GHz: < -50dBc | - |
| **Rise/fall time (**1 $V_{p-p}$ single-ended 20% to 80%)<br>– For **20** or **17 GSa/s** model:<br>– For **10 GSa/s** model: | <br>≤ 50 ps<br>≤ 85 ps | .<br>≤ 45 ps<br>≤ 77 ps |
| **Rise/fall time (**1 $V_{p-p}$ single-ended 10% to 90%)<br>– For **20** or **17 GSa/s** model:<br>– For **10 GSa/s** model: | <br>≤ 70 ps<br>≤ 130 ps | <br>≤ 60 ps<br>≤ 110 ps |
| **Overshoot** (1 $V_{p-p}$ single-ended) | <8% | <6% |
| **Random jitter on clock pattern** (rms, typical) | < 2 ps | |

# AFG Mode Specifications

| | **AWG-7202<br>AWG-7204<br>AWG-7204-S<br>AWG-7172<br>AWG-7174<br>AWG-7174-S<br>AWG-7102<br>AWG-7104** | **AWG-7202D<br>AWG-7204D<br>AWG-7204D-S<br>AWG-7172D<br>AWG-7174D<br>AWG-7174D-S<br>AWG-7102D<br>AWG-7104D** |
|---|---|---|
| **General Specifications** | | |
| **Amplitude**<br>Range | 0 to 5Vpp (into 50 Ω) | 0 to 2.5Vpp Diff. (into 100 Ω)<br>0 to 1.25Vpp 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<br>Waveform length: 16,384 points | |
| **Internal Trigger Timer**<br>Range<br>Resolution<br>Accuracy | <br>6.5 ns to 100 s<br>31.25 ps<br>±(0.1% setting + 5 ps) | |
| **Sine Waves** | | |
| Max Frequency | 6.5 GHz (for 20 Gsps and 17 Gsps models)<br>3.25 GHz (for 10 Gsps models) | |
| Frequency Range Sine (50 Ω into 50 Ω) | 18 mHz to ≤ 3.5 GHz: 5Vpp<br>3.5 GHz to ≤ 4.5 GHz: 4Vpp<br>4.5 GHz to ≤ 6.5 GHz: 3Vpp | 18 mHz to ≤ 6.5 GHz: 2.5Vpp Diff.<br>18 mHz to ≤ 6.5 GHz: 1.25Vpp Se. |
| Flatness | DC to 6 GHz: ±0.5 dB<br>(1 Vpp, relative to 1 kHz) | DC to 6.5 GHz: ±0.5 dB<br>(1 Vpp diff., relative to 1 kHz) |
| Harmonic Distortion (1 $V_{p-p}$) | 18mHz to ≤ 1MHz < -60dBc<br>1MHz to ≤ 1GHz < -50dBc<br>1GHz to ≤ 6.5GHz < -40dBc | - |
| Total Harmonic Distortion (1 $V_{p-p}$) | 10 Hz to 20 kHz < 0.2% | - |
| Spurious [6]<br>Measured across DC to Fs/2 where Fs is:<br>Fs= 20 Gsa/s for AWG-720x(-D) models<br>Fs= 17 Gsa/s for AWG-717x-D models<br>Fs= 10 Gsa/s for AWG-710x-D models | 18mHz to ≤ 1MHz < -60dBc<br>1MHz to ≤ 1GHz < -50dBc<br>1GHz to ≤ 6.5GHz < -40dBc | - |
| Phase Noise (1 $V_{p-p}$, 10 kHz offset) | 20 MHz: < -127 dBc/Hz typ.<br>100 MHz: < -124 dBc/Hz typ. | |

[6] For Single ended models the spurious are evaluated @ 1Vpp single ended nominal output amplitude.

| | |
|---|---|
| | 1 GHz: < -105 dBc/Hz typ. |
| **Square Waves** | |
| Channels with Square Wave | All Channels (for all models excluding -S models)<br>Only on CH1 and CH2 (for -S models) |
| Frequency Range | 18 mHz to ≤ 2.5 GHz (for 20 Gsps and 17 Gsps models)<br>18 mHz to ≤ 1.25 GHz (for 10 Gsps models) |
| Rise/fall time (10% to 90%)<br><br>Rise/fall time (20% to 80%) | 120 ps (for 20 Gsps and 17 Gsps models)<br>240 ps (for 10 Gsps models)<br><br>90 ps (for 20 Gsps and 17 Gsps models)<br>180 ps (for 10 Gsps models) |
| Overshoot (1 $V_{p-p}$) | <2% |
| Jitter (rms) | <2 ps |
| **Pulse Waves** | |
| Channel with Pulse Wave | All Channels (for all models but -S models)<br>CH1 and CH2 (for -S models) |
| Frequency Range | 18 mHz to ≤ 2.5 GHz (for 20 Gsps and 17 Gsps models)<br>18 mHz to ≤ 1.25 GHz (for 10 Gsps models) |
| Pulse width | 150 ps to (Period – 150 ps)[7]<br>(for 20 Gsps and 17 Gsps models)<br>300 ps to (Period – 300 ps)[7]<br>(for 10 Gsps models) |
| 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<br>(10% to 90%)<br><br>Leading/trailing edge transition time<br>(20% to 80%) | 120 ps to 1000 s (for 20 Gsps and 17 Gsps models)<br><br>240 ps to 1000 s (for 10 Gsps models)<br>90 ps to 1000 s (for 20 Gsps and 17 Gsps models)<br>180 ps to 1000 s (for 10 Gsps models) |

[7] 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.

| | | |
|---|---|---|
| Transition time Resolution | 2 ps or 15 digits | |
| Overshoot (1 $V_{p-p}$) | < 2% | |
| Jitter (rms, with rise and fall time ≥ 400ps) | <2 ps | |
| **Double Pulse Waves** | | |
| Frequency Range<br>(Vpp= \|Vpp1\| + \|Vpp2\|) | for 20 Gsps and 17 Gsps models:<br>18 mHz to ≤ 1.25 GHz: 10Vpp<br>for 10 Gsps models:<br>18 mHz to ≤ 625 MHz: 10Vpp | for 20 Gsps and 17 Gsps models:<br>18 mHz to ≤ 1.25 GHz:<br>5Vpp Diff.<br>(18 mHz to ≤ 1.25 GHz: 2.5Vpp Se)<br>for 10 Gsps models:<br>18 mHz to ≤ 625 MHz: 5Vpp Diff.<br>(18 mHz to ≤ 625 MHz: 2.5Vpp Se) |
| Other Pulse Parameters | Same as Pulse Waves | |
| **Ramp Waves** | | |
| Frequency Range | 18 mHz to 250 MHz (for 20 Gsps and 17 Gsps models)<br>18 mHz to 125 MHz (for 10 Gsps models) | |
| Linearity (< 10 kHz, 1 $V_{p-p}$, 100%) | ≤ 0.1% | |
| Symmetry | 0% to 100% | |
| **Other Waves** | | |
| 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)<br>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 [$V_{pk}$]) | 0 V to 0.625 V Single Ended - abs(carrier max value [$V_{pk}$])<br>0 V to 1.25 V Differential - abs(carrier max value [$V_{pk}$]) |
| Resolution | 1 mV | |
| **Arbitrary** | | |
| Number of Samples | 2 to 16384 | |
| Frequency range | 1 µHz to 2.5 GHz (for 20 Gsps and 17 Gsps models)<br>1 µHz to 1.25 GHz (for 10 Gsps models) | |
| Analog Bandwidth (-3 dB) | 2.9 GHz (for 20 Gsps and 17 Gsps models)<br>1.45 GHz (for 10 Gsps models) | |
| Rise/fall time (10% to 90%) | 120 ps (for 20 Gsps and 17 Gsps models)<br>240 ps (for 10 Gsps models) | |
| Rise/fall time (20% to 80%) | 90 (for 20 Gsps and 17 Gsps models)<br>180 ps (for 10 Gsps models) | |
| Jitter (rms) | < 2 ps | |
| **Frequency Resolution**<br>Sine, square, pulse, arbitrary, Sin(x)/X Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine | 18 mHz or 15 digits<br>18 mHz or 14 digits | |
| **Frequency Accuracy**<br>Non-ARB<br>ARB | ± 2.0 ppm of setting \| ± 500 ppb of setting (Opt.)<br>± 2.0 ppm of setting ±1 µHz \| ± 500 ppb of setting ±1 µHz(Opt.) | |

| 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: 18 mHz to 80 MHz, External: 1 GHz max. |
| Depth | 0.00% to 120.00% |
| **Frequency Modulation (FM)** | |
| Carrier waveforms | Standard waveforms (except Pulse, Square, DC and Noise), ARB |
| 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. |
| Peak deviation | DC to 6.5 GHz (for 20 Gsps and 17 Gsps models)<br>DC to 3.25 GHz (for 10 Gsps models) |
| **Phase Modulation (PM)** | |
| Carrier waveforms | Standard waveforms (except Pulse, Square, DC and Noise), ARB |
| 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. |
| Phase deviation range | 0° to 360° |
| **Frequency Shift Keying (FSK)** | |
| 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 frequency | 1 µHz to 6.5 GHz (for 20 Gsps and 17 Gsps models)<br>1 µHz to 3.25 GHz (for 10 Gsps models) |
| Number of keys | 2 |
| **Phase Shift Keying (PSK)** | |

| | |
|---|---|
| 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 |
| **Pulse Width Modulation (PWM)** | |
| 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 |
| **Sweep** | |
| Type | Linear, Logarithmic, staircase, and user defined |
| Waveforms | Standard waveforms (except Pulse, DC and Noise), ARB |
| Sweep time | 4ns ≤ Rise time + Hold time + Fall time ≤ 2000s |
| Rise/Hold/return times | 0 to 2000 s |
| Rise/hold/return time resolution | 1ps or 12 digits |
| Total sweep time accuracy | ≤ 0.4% |
| Start/stop frequency range | 18 mHz to Max Waveform frequency (see Frequency Range for the Specific Waveform) |
| Trigger source | Internal/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 |

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

| | **AWG-7202<br>AWG-7204<br>AWG-7204-S** | **AWG-7202D<br>AWG-7204D<br>AWG-7204D-S** |
|---|---|---|

| | AWG-7172<br>AWG-7174<br>AWG-7174-S<br>AWG-7102<br>AWG-7104 | AWG-7172D<br>AWG-7174D<br>AWG-7174S-S<br>AWG-7102D<br>AWG-7104D |
|---|---|---|
| **General Specifications** | | |
| Operating mode | NRZ, RZ or R1 bitstream Pattern generator | |
| Pattern types | Clock Pattern, Custom Pattern, PRBS pattern, Go-Through Pattern, Pulse Pattern | |
| Run Modes | Continuous, modulation, burst (Triggered, Gated, Continuous triggered) | |
| **Internal Trigger Timer** | | |
| Range | 6.5 ns to 100 s | |
| Resolution | 31.25 ps | |
| Accuracy | ±(0.1% setting + 5 ps) | |
| **Transition Specifications** | | |
| Tansition peculiarity | Arbitrarily user defined transition shapes<br>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%] | For 20 Gsps and 17 Gsps models:<br>150ps to Symbol duration for Custom, PRBS and Go-Through pattern<br>150ps to Period/2 for Clock Pattern<br>150ps to (Period-150ps) for Pulse Pattern | |

| | |
|---|---|
| | For 10 Gsps models:<br>300ps to Symbol duration for Custom, PRBS and Go-Through pattern<br>300ps to Period/2 for Clock Pattern<br>300ps to (Period-300ps) for Pulse Pattern |
| **Clock Pattern** | |
| Max clock pattern frequency | 3.25 GHz (for 20 Gsps and 17 Gsps models)<br>1.625 GHz (for 10 Gsps models) |
| Pattern levels | 2 levels |
| Overshoot (1 $V_{p-p}$) | < 2 % |
| Jitter (rms) | < 2 ps |
| **Custom Pattern** | |
| Max custom pattern rate | Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models)<br>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)<br>Up to 6 MSymbols (3 or 4 levels)<br>(For 2 channel models)<br><br>Up to 6 MBit (2 levels)<br>Up to 3 MSymbols (3 or 4 levels)<br>(For 4 channel models) |
| Pattern length resolution | 1 bit |
| Min pattern length | 16 bits |
| Overshoot (1 $V_{p-p}$) | < 2% |
| **PRBS Pattern** | |

| | |
|---|---|
| Max PRBS pattern rate | Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models)<br>Up to 3.25 Gbaud (for 10 Gsps models) |
| Pattern levels | 2 levels |
| PRBS types | PRBS -7,9,11,15,23,31 |
| Overshoot (1 $V_{p-p}$) | < 2% |
| **Go-Through Pattern** | |
| Max Go-Through pattern rate | Up to 6.5 Gbaud (for 20 Gsps and 17 Gsps models)<br>Up to 3.25 Gbaud (for 10 Gsps models) |
| Pattern levels | 2,3 or 4 levels |
| Max External Pattern Rate | Up to 1 Gbit/s |
| Overshoot (1 $V_{p-p}$) | < 2% |
| **Pulse Pattern** | |
| Max Pulse pattern frequency | Up to 3.25 GHz (for 20 Gsps and 17 Gsps models)<br>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% |
| **Pattern Modulation** | |
| **Amplitude Modulation (AM)** | |
| 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% |
| **Frequency Modulation (FM)** | |
| 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)<br>DC to 3.25 GSymbols/s (for 10 Gsps models) |
| **Phase Modulation (PM)** | |
| 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° |
| **Frequency Shift Keying (FSK)** | |
| 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. |
| Hope Symbol Rate | |

| | |
|---|---|
| Number of keys | 1uSymbols/s to 6.5 GSymbols/s for Custom and PRBS pattern<br>18 mHz to 3.25 GHz for Clock pattern<br>(for 20 Gsps and 17 Gsps models)<br><br>1uSymbols/s to 3.25 GSymbols/s for Custom and PRBS pattern<br>1uHz to 1.625 GHz for Clock pattern<br>(for 10 Gsps models)<br><br>2 |
| **Phase Shift Keying (PSK)** | |
| 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 |
| **Burst** | |
| Patterns | All types |
| Type | Block mode or Bit mode |
| Burst count | 1 to 4,294,967,295 cycles or Infinite |

| **Timing and Clock** | |
|---|---|
| **Sampling Rate** | |
| Range[4] | |
| – **For 20 or 17 GSa/s models:** | **Full Rate mode:**<br>1 S/s to **20** GS/s for 20GSa/s models<br>1 S/s to **17** GS/s for 17GSa/s models |

| | |
|---|---|
| | **Half Rate mode:**<br>1 S/s to **10** GS/s |
| – **For 10 GSa/s models:** | 1 S/s to **10** GS/s |
| Resolution | 64 Hz |
| Accuracy | ± 2.0 ppm \| ± 500 ppb (Opt.) |
| **Digital outputs**<br>**(Optional for AWG7204(D) / AWG7174(D) / AWG7104(D) models only)** | |
| **Output Channels** | |
| Connectors | Mini-SAS HD connector on rear panel<br>(custom pin-out) |
| Number of connectors | 4 |
| Number of outputs | 32-bits |
| **Output impedance** | 100 Ω differential |
| **Output type** | CML with programmable pk-pk amplitude |
| **Maximum update rate** | 10 Gbps per channel |
| **Memory depth** | 4.5 Gbit per digital channel |
| **8 bit CML 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) (TBD)** |  |
| **Output connector** | SMA |
| **Output type** | CML |
| **Number of SMA** | 16 (8 differential bits) |
| **Cable type** | Proprietary standard |
| **Cable Length** | 1 meter |
| **Rise/fall time (10% to 90%)** | < 300 ps |
| **Jitter (**rms) | < 5ps |

| | |
|---|---|
| **Auxiliary input and output characteristics** | |
| **Sync in/out** | |
| Connector type | QSFP connector on rear panel (custom pinout) |
| Master to Slave delay (typical) | - |
| **Modulation Input (MOD_IN)** | |
| Connector type | SMA on front panel |
| Number of connectors | 2 (for 2 channel models)<br>4 (for 4 channel models) |
| Input impedance | 50 Ω |

| | |
|---|---|
| Voltage Window | ± 1 V |
| **Marker Output** | |
| Connector type | SMA on front panel |
| Number of connectors | 2 (for 2 channel models)<br>4 (for 4 channel models) |
| Output impedance | 50 Ω |
| **Output level (into 50 Ω)** | |
| Voltage Window | -0.5V to 1.65V |
| Amplitude | 100 mVpp to 2.15 Vpp |
| Resolution | 1 mV |
| Accuracy | ±(5% setting + 25 mV) |
| **Switching characteristics** | |
| 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) |
| **Rise/fall time (10% to 90%, 2 Vpp)** | <150 ps |
| **Jitter** (rms) | <10 ps |
| **Marker out to analog channel skew** | |
| Range | True Arb Mode: 0 to 1.368 µs<br>AFG Mode: 0 to 8.5 sec. in Contin. Mode, 0 to 1.8 µs in Trig. Mode |
| Resolution | **True Arb Mode**:<br>1/64 of DAC sampling period<br>(for 20 Gsps and 17 Gsps models)<br>1/128 of DAC sampling period<br>(for 10 Gsps models)<br>**AFG Mode**: 1.5625 ps |
| Accuracy | ±(1% of setting + 50 ps) |
| Initial skew | < 20 ps |

| | |
|---|---|
| **Marker Width**<br>Value/Range | **True Arb Mode**: (Marker Automatic Mode)<br>**36** sampling clock cycles (Full Rate Mode)<br>**18** sampling clock cycles (Half Rate Mode)<br><br>**AFG Mode** (Continuous Mode):<br>50% of waveform period (Automatic Marker Width Mode), 500ps to waveform period – 2,1ns (Manual Marker Width Mode)<br>AFG Mode (Burst/Sweep Mode): Burst Duration or half of sweep duration |
| **Trigger/Event Inputs** | |
| Connector | SMA on the Front Panel |
| Number of Trigger Inputs | 2 (for 2 channel models)<br>4 (for 4 channel models) |
| Input impedance | 50Ω / 1kΩ |
| Slope/Polarity | Positive or negative or both |
| Range | ± 3.5 V (50 Ohm input impedance)<br>± 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 $V_{p-p}$) | 1 ns |
| Trigger/gate input to Analog Output delay | **Slow (synchronous) trigger**<br>AFG mode: < 205 ns (< 240 ns in triggered sweep mode)<br>True Arb mode: <4392 * DAC clock period(ns) + 17.6 ns<br>**Fast (asynchronous) trigger**<br>AFG mode: < 195 ns (< 230 ns in triggered sweep mode)<br>True Arb mode: <4392 * DAC clock period(ns) + 17.6 ns |
| Trigger In to output jitter (rms) | AFG mode: < 20 ps<br>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<br>True Arb mode: 1/ (Period of the Analog Waveform + 293 DAC Clock period)<br>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 3.3Vpp |
| Damage level | Maximum Input voltage: 3.6Vpp<br>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 \| 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 @ 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[8] | True Arb: SampleRate / N where:<br>N = 8, 16, 32, 64 for every SampleRate [8 - 9]<br>AFG: 312.5 MHz, 625 MHz, 1250 MHz or 2500 MHz (selectable) |
| 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 | AFG Mode: 20Ghz / N where N=40, 80, 160, …, 5120<br>AWG Mode: Sampling Rate/N, N=64, 128,.., 8192[9] |
| Amplitude | 1Vpp into 50 Ohm |
| **External Modulation input** (AFG only) | |
| Connector type | SMA on front panel (MOD.IN) |
| Input impedance | 50 Ω |
| Number of inputs | 2 (for 2 channel models)<br>4 (for 4 channel models) |
| Bandwidth | 1 GHz |
| Input voltage range | 1 Vpp (0,5V to 0.5V) |
| Vertical resolution | 14-bit |
| **Pattern Jump In (optional)** | |
| Connector type | DSUB15 |
| Input signals | DATA[0..7] + Data_Select + Load |
| Internal Data Width | 14 bit, multiplexed using Data_Select |

[8]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)
[9] For AWG-717x(D) and AWG-7174(D)-S models the max Sampling rate is limited to 17Gsps

| | |
|---|---|
| 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 1kΩ pull-up resistor to Vcc (3.3V) |

| | |
|---|---|
| **Power** | |
| **Source Voltage and Frequency** | 100 to 240 VAC ±10% @ 45-66 Hz |
| **Max. power consumption** | Max. 250W |
| **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** | 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<br>(3U 19” rackmount) |
| **Weight** | Max. 26.45 lbs (12 Kg) |
| **Front panel connectors** | CH N OUTPUT (SMA) where N=2,4 depending on the model<br>MOD N INPUT (SMA) where N=2,4 depending on the model<br>MARKER N OUT (SMA) where N=2,4 depending on the model<br>TRG IN N(SMA) where N=2,4 depending on the model<br>2 USB 3.0 ports |
| **Rear panel connectors** | Ref. Clk. IN (SMA)<br>Ref. Clk. Out (SMA)<br>Sync Clk Out (SMA)<br>Ext Clk IN(SMA)<br>Sync IN (QSFP cable)<br>Sync OUT (QSFP cable)<br>Pattern Jump In (DSUB15) (AWG-7000-FSS opt. only)<br>POD X[7..0] where X=A,B,C,D (Customized Mini SAS HD)<br>External Monitor ports (one or more)<br>2 USB 2.0 ports or more<br>4 USB 3.0 ports<br>Ethernet port (10/100/1000BaseT Ethernet, RJ45 port)<br>2 PS/2 keyboard and mouse ports<br>2 DPI ports<br>1 DVI port |
| **Hard Disk** | 1 TB SSD or better |
| **Processor** | Intel® Pentium Gold G6400 4 GHz (or better) |
| **Processor Memory** | 32 GB or better |