Arbitrary/Function Generator

AFG1000 Series Datasheet

The AFG1000 Series Arbitrary Function Generator provides a waveform generation tool with the best price performance ratio. It includes two models with dual channels, up to 60 MHz bandwidth and up to 10 V_{p-p} output amplitude. The four run modes, 50 built-in frequently-used waveforms and the built-in 200 MHz frequency counter cover most waveform generation needs in your experiment and test jobs. The 3.95-inch TFT LCD, short-cut buttons, USB interface and PC software provide the most intuitive ways to configure the instrument.

Key performance specifications

- Dual-channel, 25 MHz or 60 MHz sine waveforms, 12.5 MHz or 30 MHz square waveforms
- 14 bits, 125 MS/s or 300 MS/s arbitrary waveforms with 8 k points record length
- Amplitude 1 mV_{p-p} to 10 V_{p-p} into 50 Ω loads

Key features

- Continuous, sweeping, burst, and modulation modes (AM, FM, PM, ASK, FSK, PSK, PWM) covers most requirements for students and other users to get the experiments/test job done
- 64-MByte internal non-volatile memory for arbitrary waveform storage
- Built-in 200 MHz counter with 6-digit resolution offers an easy and precise way of frequency/period/pulse width/duty cycle measurement
- Standard USB host/device for memory expansion and remote control
- Free ArbExpress makes user defined waveforms editing extremely easy through an external USB memory stick
- Standard 5-year warranty

Applications

- Electric and electronics experiments
- Communications experiments
- Sensor simulation
- Functional test

Performance and features

1 µHz to 25 MHz or 60 MHz sine waveform range, with 12-digit or 1 µHz resolution and a ±1 ppm drift high stability time base, provides great signal fidelity in the frequency domain. With 1 mV_{p-p} to 10 V_{p-p} output amplitude range, and 14-bit or 1 mV_{p-p} resolution over the whole frequency range, there is no need to compromise between output amplitude and frequency any more.

Four different run modes cover most use cases with a cost effective solution. 50 most-frequently used standard and arbitrary waveforms are built-in for easy access. Up to 8 K points arbitrary waveforms memory enables users to replicate real world signals captured with a Tektronix oscilloscope or defined with ArbExpress. The built-in 200 MHz and 6-digit resolution frequency counter is an easy and precise way to measure frequencies/periods/pulse widths/duty cycles.

Ease of use

The high-resolution 3.95-inch color TFT display shows relevant settings and parameters in both text and graphic formats, which give users full confidence in their settings, and let them focus on the task at hand. The front panel shortcut buttons and rotary knob make accesses to most frequently used functions and settings with minimum effort and time. The built-in 64-MByte non-volatile memory together with USB stick memory interface, provide unlimited space for user-defined waveform storage.

Software and solutions

The user-defined arbitrary waveforms generated by the free ArbExpress software can easily be loaded on the AFG1000 with a USB memory stick.

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Channels

Number of channels	2

Built-in waveforms

Built-in waveforms	Sine, Square, Pulse, Ramp, Noise, and 45 frequently used arbitrary waveforms

General characteristics

Sine waves

	AFG1022	AFG1062
Range	1 µHz to 25 MHz	1 µHz to 60 MHz
Sine wave in burst mode	2 mHz to 25 MHz	2 mHz to 30 MHz
Effective maximum frequency out	25 MHz	60 MHz
Amplitude flatness (1 V_{p-p}), typical		
<10 MHz	±0.4 dB	±0.4 dB
≥10 MHz and ≤25 MHz	±0.7 dB	
≥10 MHz and ≤60 MHz		±0.9 dB
Harmonic distortion (1 V_{p-p})		
≤10 MHz	< -50 dBc	< -60 dBc
>10 MHz	< -50 dBc	< -47 dBc
Total harmonic distortion	< 0.2% (10 Hz to 20 kHz, 1 V_{p-p})	
Spurious (1 V_{p-p}), typical	< -45 dBc	
Phase noise, typical	1 MHz: < -110 dBc/Hz at 10 kHz offset, 1 V_{p-p}	

Residual clock noise, typical	-57 dBm

Square wave

Range	**AFG1022**	**AFG1062**
	1 µHz to 12.5 MHz	1 µHz to 30 MHz
Rise/fall time, typical	<12 ns	<10 ns
Jitter (rms), typical	<1 ns	<500 ps
Overshoot	<5%	

Ramp wave

Range	**AFG1022**	**AFG1062**
	1 µHz to 1 MHz	1 µHz to 2 MHz
Linearity, typical	≤ 0.1% of peak output at 10% - 90% of amplitude range, at 1 kHz, 1 V_{p-p} , 50% symmetry	
Symmetry	0.0% to 100.0%	

Pulse wave

Range	**AFG1022**	**AFG1062**
	1 µHz to 12.5 MHz	1 µHz to 30 MHz
Pulse width range	40 ns to 999 ks	17 ns to 999 ks
Pulse width resolution	1 ns or 4 digits	
Pulse duty	<1 MHz, 0.1% to 99.9% (limitations of pulse duty width apply)	
	≥1 MHz, 50% fixed	≥1 MHz, 50% fixed

Edge transition time, typical	<12 ns, fixed	<10 ns, fixed
Overshoot, typical	<5%	
Jitter (rms), typical	<1 ns	<500 ps

Noise

Noise bandwidth (-3 dB)	**AFG1022**	**AFG1062**
	25 MHz	50 MHz
Noise type	White Gausian	

DC

Range	**AFG1022**	**AFG1062**
	-5 V to +5 V, 50 Ω load	
	-10 V to + 10 V, open circuit or high Z load	

Arbitrary waveform

Range	**AFG1022**	**AFG1062**
	1 µHz to 10 MHz	1 µHz to 30 MHz
Arbitrary waveform in burst mode	2 mHz to 10 MHz	2 mHz to 30 MHz
Effective analog bandwidth (-3 dB)	30 MHz	60 MHz
Non-volatile memory	64 MByte	
Memory		
Length	2 to 8 K Points	
Sampling rate	125 MS/s	300 MS/s

Vertical resolution	14 bits	
Rise and fall time	< 10 ns	< 8 ns
Jitter (rms), typical	< 6 ns	

Frequency

Resolution	**AFG1022**	**AFG1062**
	1 µHz or 12 digits	
Internal reference stability	±1 ppm at 0 - 40 °C	
Internal reference aging	±1 ppm per year	

Amplitude

Range (50 Ω load)

≤25 MHz	**AFG1022**	**AFG1062**
	1 mV_{p-p} to 10 V_{p-p}	1 mV_{p-p} to 10 V_{p-p}
>25 MHz	-	1 mV_{p-p} to 5 V_{p-p}

Range (Open circuit or high Z load)

≤25 MHz	2 mV_{p-p} to 20 V_{p-p}	2 mV_{p-p} to 20 V_{p-p}
>25 MHz	-	2 mV_{p-p} to 10 V_{p-p}

Accuracy	±(1% of setting +1 mV_{p-p}), (1 kHz sine waveform, 0 V offset)
Resolution	1 mV_{p-p}, 1 mV_{rms} or 4 digits
Units	V_{p-p}, V_{rms}
Output impedance	50 Ω (typical)
Local impedance setting	Selectable: 50 Ω, 1 Ω to 10.000 kΩ, High Z (adjusts displayed amplitude according to selected load impedance)
Isolation	No floating ground, signal ground connected to chassis ground
Signal output protection	Short-circuit tolerance, main output automatically disabled when over current

DC offset

Range	±(5 V_{pk} – Amplitude$_{p-p}$/2), 50 Ω load ±(10 V_{pk} – Amplitude$_{p-p}$/2), open circuit or high Z load
Accuracy	±(1% of |setting| + 1 mV + 0.5% of amplitude (V_{p-p}))
Resolution	1 mV or 4 digits

Modulation

Modulation, sweeping, and burst modes are only available for channel 1 on the AFG1022.

The AFG1062 supports equal strong channels with modulation, sweeping, and burst modes.

Amplitude modulation

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary
Internal AM frequency	2 mHz to 20 kHz
Depth	0.0% to 100.0%

Frequency modulation

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary
Internal modulating frequency	2 mHz to 20 kHz
Frequency deviation	(limited by carrier waveform type)

AFG1022	AFG1062
2 mHz to 12.5 MHz	2 mHz to 30 MHz

Phase modulation

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary
Internal PM frequency	2 mHz to 20 kHz
Phase Deviation	0° to 180°

Amplitude shift keying (AFG1062 only)

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	50% duty cycle square
ASK rate	2 mHz to 100 kHz

Frequency shift keying

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	50% duty cycle square
FSK rate	2 mHz to 100 kHz

Phase shift keying (AFG1062 only)

Carrier waveforms	Sine, square, ramp, arbitrary, except DC and noise
Source	Internal / external
Internal modulating waveforms	50% duty cycle square
PSK rate	2 mHz to 100 kHz

Pulse width modulation (AFG1062 only)

Carrier waveforms	Pulse, ≤1 MHz
Source	Internal / external
Internal modulating waveforms	Sine, square, ramp, arbitrary, except DC and noise
PWM frequency	2 mHz to 20 kHz
Deviation	0.0% to 50.0% of pulse period

Sweeping

Modulation, sweeping, and burst modes are only available for channel 1 on the AFG1022.

The AFG1062 supports equal strong channels with modulation, sweeping, and burst modes.

Carrier waveforms

Carrier waveforms	Sine, square, ramp, arbitrary (AFG1062 only)

Minimum start-stop frequency	1 µHz

Maximum start-stop frequency

	AFG1022	AFG1062
Sine	25 MHz	60 MHz
Square	12.5 MHz	30 MHz
Ramp	1 MHz	2 MHz

Type	Linear, logarithmic

Direction	Up / down
Sweep time	1 ms to 500 s ± 0.1%
Trigger sources	Internal, external, or manual

Burst

Modulation, sweeping, and burst modes are only available for channel 1 on the AFG1022.

The AFG1062 supports equal strong channels with modulation, sweeping, and burst modes.

Waveforms	Sine, square, ramp, pulse, arbitrary except DC and noise
Types	AFG1022: count (1 to 50,000 cycles), infinite, gated AFG1062: count (1 to 1,000,000 cycles), infinite, gated
Start phase	-360° to +360°
Trigger sources	Internal, external, or manual
Internal trigger interval	(40 ns or (cycles x period) to 500 s) ± 1%
Gate source	External trigger

Frequency counter

Function	Frequency, period, positive pulse width, duty cycle
Frequency range	100 mHz to 200 MHz
Frequency resolution	6 digits
Coupling mode	AC, DC

Voltage Range and Sensitivity, DC coupled (non-modulation signal)

100 mHz to 100 MHz	250 mV_{p-p} to 5 V_{p-p} (AC + DC)
100 MHz to 200 MHz	450 mV_{p-p} to 3 V_{p-p} (AC + DC)

Voltage range and sensitivity, AC coupled (non-modulation signal)

1 Hz to 100 MHz	250 mV_{p-p} to 5 V_{p-p}
100 MHz to 200 MHz	450 mV_{p-p} to 4 V_{p-p}

Pulse width and duty cycle measure	1 Hz to 10 MHz
Input impedance	1 M Ω in parallel with 100 pF
High frequency noise restraint (HFR)	On / Off (HFR frequency = 500 kHz)
Sensitivity	Low, middle, or high
Trigger level range	-2.5 V to +2.5 V

Auxiliary inputs and outputs

External modulation input

Input frequency range	DC to 20 kHz
Input voltage range	All except FSK: ±1 V full scale, FSK: 3.3 V logic level
Input impedance	12 kΩ (typical)

External trigger input

Level	TTL-compatible
Slope	Rising or falling (selectable)
Pulse Width	>100 ns

External reference clock input

(Shared with Frequency Counter Input)

Impedance	400 Ω, AC coupled
Requested Input voltage swing	100 mV_{p-p} to 5 V_{p-p}
Locking range	10 MHz ±9 kHz

External reference clock output

Frequency	10 MHz
Impedance	50 Ω, DC coupled
Amplitude	1.6 V_{p-p} into 50 Ω load

Communication interface

USB	Host and device, USB TMC compliance

Display

Display type	3.95-inch

Display resolution	480 by 320
Display colors	65,536

Menu and online help languages

Menu and online help languages	English and Simplified Chinese

Power source

Supply	220-240 VAC, 100-120 VAC, 50/60 Hz, CATII
Consumption	AFG1022: Less than 28 W AFG1062: Less than 35 W
Fuse	110 V: 250 V, F1AL 220 V: 250 V, F0.5AL
Warm-up time	30 minutes (typical)

Physical characteristics

Dimensions (W, H, D)	230 × 110 × 306 mm (9.0 × 4.4 × 12.1 in)
Weight	
Net	3.4 kg (7.5 lbs)
Shipping	4.7 kg (10.3 lbs)

EMC environment and safety

Temperature	
Working	0 ℃ to 40 ℃ (32 °F to 104 °F)
Storage	-20 ℃ to 60 ℃ (-4 °F to 144 °F)
Relative humidity (non-condensing)	Operating: ≤ 80%, +0 °C to +40 °C (+32 °F to +104 °F) Non-operating: 5% to 90%, < +40 °C (+104 °F) Non-operating: 5% to 80%, ≥ +40 °C (+104 °F) to ≤ +60 °C (+140 °F)
Altitude	Operating: up to 3,000 m (9843 ft.) Non-operating: up to 12,000 m (39,370 ft)
Cooling method	Fan cooling

EMC compliance

European Union	EN 61326-1
Australia/NZ	CISPR 11, Class A

Safety compliance

UL 61010-1

CAN/CSA-C22.2 No. 61010-1

EN 61010-1

IEC 61010-1

Ordering information

Models

AFG1022	Arbitrary Function Generator
AFG1062	Arbitrary Function Generator

Instrument options

Power plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years

Probes and accessories are not covered by the warranty and Service Offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

Accessories

Standard Accessories

- AFG1000 Arbitrary/Function Generator Safety and Compliance Instructions; printed document
- AFG1000 Documentation CD containing the following PDF documents:
  - AFG1000 Arbitrary/Function Generators Quick Start User Manual, English
  - AFG1000 Arbitrary/Function Generators Quick Start User Manual, Simplified Chinese
  - AFG1000 Arbitrary/Function Generators Programmer Manual
  - AFG1000 Arbitrary/Function Generators Specifications and Performance Verification Manual
- PDF documents not included on the AFG1000 Documentation CD but available for download from *www.tek.com*.
  - AFG1000 Arbitrary/Function Generators Quick Start User Manual, Russian, (Tektronix part number 077-1135-xx)
  - AFG1000 Arbitrary/Function Generators Quick Start User Manual, Japanese, (Tektronix part number 077-1166-xx)
- Packing list
- Power cord, specified by country
- Certificate of calibration; printed document
- USB cable x 1, Type A to Type B

- BNC cable x 2
- Tektronix Supplemental Information Sheet For the Peoples Republic of China: China RoHs; printed document
- Fuse, cartridge; 5 x 20 mm, 0.5 A, 250 V, time-delay
- Fuse, cartridge; 5 x 20 mm, 1 A, 250 V, time-delay

Warranty

- Five year warranty on parts and labor

Recommended accessories

- 174-4401-xx, USB cable, type A to type B cable – three feet
- 174-5194-xx, USB cable, type A to type B cable – six feet
- 012-1732-xx, BNC cable assembly, 0 to 1 GHz, shielded – three feet
- 159-0568-xx, Fuse, cartridge; 5 x 20 mm, 0.5 A, 250 V, time-delay
- 159-0569-xx, Fuse, cartridge; 5 x 20 mm, 1 A, 250 V, time-delay

Tektronix is ISO 14001:2015 and ISO 9001:2015 certified by DEKRA.

Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

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