

# 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 or 1 M points record length
- Amplitude 1  $mV_{p-p}$  to 10  $V_{p-p}$  into 50  $\Omega$  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

- Compatible with TekSmartLab™ for easy teaching and learning
- Standard 5-year warranty

### Applications

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

### Performance and features

1  $\mu$ Hz to 25 MHz or 60 MHz sine waveform range, with 12-digit or 1  $\mu$ Hz resolution and a  $\pm 1$  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 1 M 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.

As a building block of Tektronix educational solution, the AFG1000 can be embedded into TekSmartLab and enable a cost efficient and effective way of teaching, learning, and lab management.

# Specifications

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

## Channels

Number of channels	2
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## Built-in waveforms

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

### Sine waves

	AFG1022	AFG1062
Range	1 $\mu$ Hz to 25 MHz	1 $\mu$ Hz 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	$\pm 0.4$ dB	$\pm 0.5$ dB
$\geq 10$ MHz and $\leq 25$ MHz	$\pm 0.7$ dB	
$\geq 10$ MHz and $\leq 60$ MHz		$\pm 0.9$ dB
Harmonic distortion (1 $V_{p-p}$ )		
$\leq 10$ 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

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

**General characteristics**

**Ramp wave**

	<b>AFG1022</b>	<b>AFG1062</b>
Range	1 $\mu$ Hz to 1 MHz	1 $\mu$ Hz to 2 MHz
Linearity, typical	$\leq$ 0.1% of peak output at 10% - 90% of amplitude range, at 1 kHz, 1 V <sub>pp</sub> , 50% symmetry	
Symmetry	0.0% to 100.0%	

**Pulse wave**

	<b>AFG1022</b>	<b>AFG1062</b>
Range	1 $\mu$ Hz to 12.5 MHz	1 $\mu$ Hz 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)	
	$\geq$ 1 MHz, 50% fixed	$\geq$ 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**

	<b>AFG1022</b>	<b>AFG1062</b>
Noise bandwidth (-3 dB)	25 MHz	50 MHz
Noise type	White Gaussian	

**DC**

	<b>AFG1022</b>	<b>AFG1062</b>
Range	-5 V to +5 V, 50 $\Omega$ load	
	-10 V to + 10 V, open circuit or high Z load	

**Arbitrary waveform**

	<b>AFG1022</b>	<b>AFG1062</b>
Range	1 $\mu$ Hz to 10 MHz	1 $\mu$ Hz 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 8,192	2 to 1 M-point
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	

**General characteristics**

Frequency

	AFG1022	AFG1062
Resolution	1 $\mu$ Hz or 12 digits	
Internal reference stability	$\pm$ 1 ppm at 0 - 40 °C	
Internal reference aging	$\pm$ 1 ppm per year	

Amplitude

Range (50 $\Omega$ load)	AFG1022	AFG1062
$\leq$ 25 MHz	1 mV <sub>p-p</sub> to 10 V <sub>p-p</sub>	1 mV <sub>p-p</sub> to 10 V <sub>p-p</sub>
>25 MHz	-	1 mV <sub>p-p</sub> to 5 V <sub>p-p</sub>
<b>Range (Open circuit or high Z load)</b>		
$\leq$ 25 MHz	2 mV <sub>p-p</sub> to 20 V <sub>p-p</sub>	2 mV <sub>p-p</sub> to 20 V <sub>p-p</sub>
>25 MHz	-	2 mV <sub>p-p</sub> to 10 V <sub>p-p</sub>
Accuracy	$\pm$ (1% of setting +1 mV <sub>p-p</sub> ), (1 kHz sine waveform, 0 V offset)	
Resolution	1 mV <sub>p-p</sub> , 1 mV <sub>rms</sub> or 4 digits	
Units	V <sub>p-p</sub> , V <sub>rms</sub>	
Output impedance	50 $\Omega$ (typical)	
Local impedance setting	Selectable: 50 $\Omega$ , 1 $\Omega$ to 10.000 k $\Omega$ , 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	$\pm$ (5 V <sub>pk</sub> - Amplitude <sub>p-p</sub> /2), 50 $\Omega$ load $\pm$ (10 V <sub>pk</sub> - Amplitude <sub>p-p</sub> /2), open circuit or high Z load
Accuracy	$\pm$ (1% of  setting  + 1 mV + 0.5% of amplitude (V <sub>p-p</sub> ))
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%

**Modulation**

**Frequency modulation**

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

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

**Phase modulation**

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

**Amplitude shift keying**

	(AFG1062 only)
<b>Carrier waveforms</b>	Sine, square, ramp, arbitrary, except DC and noise
<b>Source</b>	Internal / external
<b>Internal modulating waveforms</b>	50% duty cycle square
<b>ASK rate</b>	2 MHz to 100 kHz

**Frequency shift keying**

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

**Phase shift keying**

	(AFG1062 only)
<b>Carrier waveforms</b>	Sine, square, ramp, arbitrary, except DC and noise
<b>Source</b>	Internal / external
<b>Internal modulating waveforms</b>	50% duty cycle square
<b>PSK rate</b>	2 MHz to 100 kHz

**Pulse width modulation**

	(AFG1062 only)
<b>Carrier waveforms</b>	Pulse, ≤1 MHz
<b>Source</b>	Internal / external
<b>Internal modulating waveforms</b>	Sine, square, ramp, arbitrary, except DC and noise
<b>PWM frequency</b>	2 MHz to 20 kHz
<b>Deviation</b>	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.

<b>Carrier waveforms</b>	Sine, square, ramp, arbitrary (AFG1062 only)	
<b>Minimum start-stop frequency</b>	1 $\mu$ Hz	
<b>Maximum start-stop frequency</b>		
<b>Sine</b>	<b>AFG1022</b>	<b>AFG1062</b>
	25 MHz	60 MHz
<b>Square</b>	12.5 MHz	30 MHz
<b>Ramp</b>	1 MHz	2 MHz
<b>Type</b>	Linear, logarithmic	
<b>Direction</b>	Up / down	
<b>Sweep time</b>	1 ms to 500 s $\pm$ 0.1%	
<b>Trigger sources</b>	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.

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

## Frequency counter

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

## Frequency counter

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

100 mHz to 100 MHz	250 mV <sub>p-p</sub> to 5 V <sub>p-p</sub> (AC + DC)
100 MHz to 200 MHz	450 mV <sub>p-p</sub> to 3 V <sub>p-p</sub> (AC + DC)

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

1 Hz to 100 MHz	250 mV <sub>p-p</sub> to 5 V <sub>p-p</sub>
100 MHz to 200 MHz	450 mV <sub>p-p</sub> to 4 V <sub>p-p</sub>

Pulse width and duty cycle measure 1 Hz to 10 MHz

Input impedance 1 M  $\Omega$  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: $\pm 1$ V full scale, FSK: 3.3 V logic level
Input impedance	12 k $\Omega$ (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 $\Omega$ , AC coupled
Requested Input voltage swing	100 mV <sub>p-p</sub> to 5 V <sub>p-p</sub>
Locking range	10 MHz $\pm 9$ kHz

### External reference clock output

Frequency	10 MHz
Impedance	50 $\Omega$ , DC coupled
Amplitude	1.6 V <sub>p-p</sub> into 50 $\Omega$ load

### Communication interface

USB	Host and device, USB TMC compliance
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## 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, CAT II

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 °C to 40 °C (32 °F to 104 °F)

Storage -20 °C to 60 °C (-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



## EMC environment and safety

### 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](http://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 registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



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



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**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tek.com](http://www.tek.com).

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