Arbitrary Function Generator

AFG1022 Datasheet

- Compact form factor for stacking on other bench instruments to save valuable bench space
- Free ArbExpress makes user defined waveforms editing extremely easy
- Compatible with TekSmartLab™ for easy teaching and learning

Applications

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

The AFG1022 Arbitrary Function Generator provides a waveform generation tool with the best price performance ratio. It includes dual channel, 25 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.

Features and benefits

- Dual-channel, 25 MHz sine wave, and 12.5 MHz square/pulse wave provides a cost effective solution for basic education and other applications
- 125 MS/s sampling rate and 14-bit vertical resolution enable great signal fidelity
- 1 mV_{p-p} to 10 V_{p-p} output amplitude over the whole frequency range
- The intuitive user interface shortens the learning curve for students and other users
- 2 to 8,192-point length of memory for user-defined arbitrary waveforms
- 64-MByte internal non-volatile memory for arbitrary waveform storage
- Standard USB host/device for memory expansion and remote control
- Continuous, sweeping, burst, and modulation modes covers most requirements for students and other users to get the experiments/test job done
- Built-in 200 MHz counter with 6-digit resolution offers an easy and precise way of frequency/period/pulse width/duty cycle measurement
- Menu and online help are in English and Simplified Chinese

Performance and features

1 µHz to 25 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 and four modulation 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 8,192 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

Compatible with ArbExpress, the user-defined arbitrary waveforms generated by the free software can be loaded on the AFG1022 easily with a USB memory stick.

As a building block of Tektronix educational solution, the AFG1022 can be embedded into TekSmartLab and enable a cost efficient and effective way of teaching, learning, and lab management.

Specifications

Channels

Number of channels	2

Built-in waveforms

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

Sine wave

Range	1 µHz to 25 MHz
Sine wave in burst mode	2 mHz to 25 MHz
Effective maximum frequency out	25 MHz
Amplitude flatness (1 V_{p-p})	
<10 MHz	±0.2 dB
10 MHz to 25 MHz	±0.3 dB
Harmonic distortion	< -50 dBc, 1 V_{p-p}, 1 µHz to 25 MHz
Total harmonic distortion	< 0.2% (10 Hz to 20 kHz, 1 V_{p-p})
Spurious	< -45 dBc, 1 V_{p-p}, 1 µHz to 25 MHz
Phase noise	1 MHz: < -110 dBc/Hz at 10 kHz offset, 1 V_{p-p} (typical)
Residual clock noise	-57 dBm (typical)

Square wave

Range	1 µHz to 12.5 MHz
Rise/fall time	< 12 ns
Jitter (rms)	< 1 ns (typical)
Overshoot	<5%

Ramp wave

Range	1 µHz to1 MHz
Linearity	≤ 0.1% of peak output at 10% - 90% of amplitude range, at 1 kHz, 1 V_{p-p}, 50% symmetry (typical)
Symmetry	0.0% to 100.0%

Pulse wave

Range	1 mHz to 12.5 MHz
Pulse width range	40.00 ns to 999,000 s
Pulse width resolution	10 ps or 5 digits
Pulse duty	<1 MHz, 0.001% to 99.999% (limitations of pulse duty width apply) 1 MHz to 12.5 MHz, 50% fixed
Edge transition time	< 12 ns, fixed
Overshoot	< 5% (typical)
Jitter (rms)	< 1 ns (typical)

Noise

Noise bandwidth (-3 dB)	25 MHz
Noise type	White Gausian

DC

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

Arbitrary waveform

Range	1 µHz to 10 MHz
Arbitrary waveform in burst mode	2 mHz to 10 MHz
Effective analog bandwidth (-3 dB)	30 MHz
Non-volatile memory	64 MByte
Memory	
Length	2 to 8,192: 125 MS/s
Sampling rate	125 MS/s
Vertical resolution	14 bits
Rise and fall time	< 10 ns
Jitter (rms)	< 6 ns (typical)

Frequency

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

Amplitude

Range	1 mV_{p-p} to 10 V_{p-p}, 50 Ω load 2 mV_{p-p} to 20 V_{p-p}, open circuit or high Z load
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} – $Amplitude_{pp}$/2), 50 Ω load
	±(10 V_{pk} – $Amplitude_{pp}$/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 [1]

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	2 mHz to 12.5 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°
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

1 Modulation, sweeping, and burst modes are only available in channel 1.

Sweeping [1]

Carrier waveforms	Sine, square, ramp
Minimum start-stop frequency	1 µHz
Maximum start-stop frequency	Sine: 25 MHz Square: 12.5 MHz Ramp: 1 MHz
Type	Linear, logarithmic
Direction	Up / down
Sweep time	1 ms to 500 s ± 0.1%
Trigger sources	Internal, external, or manual

Burst [1]

Waveforms	Sine, square, ramp, pulse, arbitrary except DC and noise
Types	Count (1 to 50,000 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

Frequency counter

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, CAT Ⅱ
Consumption	Less than 28 W
Fuse	110 V: 250 V, F4AL 220 V: 250 V, F2AL
Warm-up time	30 minutes (typical)

Physical characteristics

Dimensions (W, H, D)	235 × 110 × 295 mm (9.2 × 4.33 × 11.61 in)
Weight	
Net	3.4 kg (7.4 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	Operating: ≤ 80%, +0 °C to +40 °C (+32 °F to +104 °F) Non-operating: 5% to 90%, < +40 °C (+104 °F), non-condensing Non-operating: 5% to 80%, ≥ +40 °C (+104 °F) to ≤ +60 °C (+140 °F), non-condensing
Altitude	Operating: up to 3,000 m (9842 ft.) Non-operating: up to 12,000 m (39,368 ft)
Cooling method	Fan cooling
EMC compliance	
European Union	EN 61326-1
Australia/NZ	CISPR 11, Class A
Safety compliance	
EN61010-1	
IEC61010-1	

Ordering information

Models

AFG1022	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
Opt. R5	Repair Service 5 Years (including warranty)
Opt. R5DW	Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrument purchase

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

- AFG1022 Arbitrary/Function Generator Safety and Compliance Instructions; printed document
- AFG1022 Documentation CD containing the following PDF documents:
  - AFG1022 Arbitrary/Function Generators Quick Start User Manual, English
  - AFG1022 Arbitrary/Function Generators Quick Start User Manual, Simplified Chinese
  - AFG1022 Arbitrary/Function Generators Programmer Manual
  - AFG1022 Arbitrary/Function Generators Specifications and Performance Verification Manual
- 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, 2 A, 250 V, time-delay
- Fuse, cartridge; 5 x 20 mm, 4 A, 250 V, time-delay

Warranty

- Three 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
- 159-0107-xx, Fuse, cartridge; 5 x 20 mm, 2 A, 250 V, time-delay
- 159-0397-xx, Fuse, cartridge; 5 x 20 mm, 4 A, 250 V, time-delay

CE

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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