Tektronix®

임의/함수 발생기

AFG1000 시리즈 데이터 시트

AFG1000 시리즈 임의 함수 발생기는 최상의 가격 대비 성능의 파형 생성 도구를 제공합니다. 여기에는 듀얼 채널, 최대 60MHz 대역폭 및 최대 10Vp-p 출력 진폭의 두 가지 모델이 포함됩니다.4 개의 실행 모드, 자주 사용되는 내장 파형 50 개 및 내장 200MHz 주파수 카운터는 실험 및 테스트 작업에서 대부분의 파형 생성 요구를 충족합니다.3.95 인치 TFT LCD, 바로 가기 버튼, USB 인터페이스 및 PC 소프트웨어는 계측기를 구성하는 가장 직관적 인 방법을 제공합니다.

주요 성능 사양

- 듀얼 채널, 25MHz 또는 60MHz 사인 파형, 12.5MHz 또는 30MHz 구형 파형
- 8 k 포인트 또는 1 M 포인트 레코드 길이의 14 비트, 125 MS / s 또는 300 MS / s 임의 파형
- 진폭 1mVp-p ~ 10Vp-p (50Ω 부하)

주요 특징

- 연속, 스위핑, 버스트 및 변조 모드 (AM, FM, PM, ASK, FSK, PSK, PWM)는 학생 및 다른 사용자가 실험 / 테스트 작업을 수행하기 위한 대부분의 요구 사항을 충족합니다.
- 임의 파형 저장을 위한 64MByte 내부 비 휘발성 메모리
- 6 자리 분해능의 내장 200MHz 카운터는 주파수/주기/펄스폭/듀티 사이클 측정을 쉽고 정확하게 제공합니다.
- 메모리 확장 및 원격 제어를 위한 표준 USB 호스트 / 장치
- Free ArbExpress는 외부 USB 메모리 스틱을 통해 사용자 정의 파형 편집을 매우 쉽게 만듭니다.

응용

- **전기 및 전자 실험**
- **통신 실험**
- **센서 시뮬레이션**
- **기능 테스트**

성능 및 특징

12 자리 또는 1μHz 분해능과 ± 1ppm 드리프트의 높은 안정성 시간 기반을 갖춘 1μHz ~ 25MHz 또는 60MHz 사인 파형 범위는 주파수 영역에서 뛰어난 신호 충실도를 제공합니다. 1mVp-p ~ 10Vp-p 출력 진폭 범위와 전체 주파수 범위에서 14 비트 또는 1mVp-p 분해능 으로 더 이상 출력 진폭과 주파수간에 타협 할 필요가 없습니다.

4 가지 실행 모드는 비용 효율적인 솔루션으로 대부분의 사용 사례를 처리합니다. 가장 자주 사용되는 50 개의 표준 및 임의 파형이 내장되어있어 쉽게 액세스 할 수 있습니다. 최대 1M 포인트 임의 파형 메모리를 사용하면 Tektronix 오실로스코프로 캡처 하거나 ArbExpress로 정의한 실제 신호를 복제 할 수 있습니다. 내장 200MHz 및 6 자리 분해능 주파수 카운터는 주파수 /주기/펄스폭/듀티 사이클을 측정하는 쉽고 정확한 방법입니다.

사용하기 쉬움

고해상도 3.95 인치 컬러 TFT 디스플레이는 텍스트 및 그래픽 형식으로 관련 설정 및 매개 변수를 표시하여 사용자가 자신의 설정에 대한 자신감을 갖고 현재 작업에 집중할 수 있습니다. 전면 패널 바로 가기 버튼과 로터리 노브를 사용하면 최소한의 노력과 시간으로 가장 자주 사용하는 기능과 설정에 액세스 할 수 있습니다. USB 스틱 메모리 인터페이스와 함께 내장 된 64MByte 비 휘발성 메모리는 사용자 정의 파형 저장을 위한 무제한 공간을 제공합니다.

소프트웨어 및 솔루션

무료 ArbExpress 소프트웨어로 생성 된 사용자 정의 임의 파형은 USB 메모리 스틱을 사용하여 AFG1000에 쉽게 로드 할 수 있습니다. AFG1000은 Tektronix 교육 솔루션의 빌딩 블록으로 TekSmartLab에 내장되어 비용 효율적이고 효과적인 교육, 학습 및 실험실 관리 방법을 제공합니다.

명세서

별도로 명시되지 않는 한 모든 사양이 보장됩니다. 별도 명시되지 않는 한 모든 사양은 모든 모델에 적용됩니다.

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	±0.5 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

	AFG1022	AFG1062
Range	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%	

General characteristics

Ramp wave

	AFG1022	AFG1062
Range	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

	AFG1022	AFG1062
Range	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

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

DC

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

Arbitrary waveform

	AFG1022	AFG1062
Range	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 8,192	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 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)

	AFG1022	AFG1062
≤25 MHz	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)

	AFG1022	AFG1062
≤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%

Modulation

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	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

Frequency counter

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, 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 ℃ 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

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.
  - 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

CE

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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.

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