

Generadores de funciones/arbitrarios

Arbitrary/Function Generators

AFG 3011/3021B/3022B/3101/3102/3251/3252 / AFG 3011 / 3021B / 3022B / 3101 / 3102 / 3251 / 3252 Data Sheet



Funciones y ventajas

- Formas de onda sinusoidales de 10 MHz, 25 MHz, 100 MHz o 240 MHz
- Formas de onda arbitrarias de 14 bits, 250 MS/s, 1 GS/s o 2 GS/s
- Amplitud de cargas de hasta $20 V_{c-p}$ en 50Ω
- Pantalla de 5,6" para conseguir la máxima confianza en los ajustes y en el aspecto de la forma de onda
- Forma de onda de pulso con tiempos de límites variables
- AM, FM, PM, FSK, PWM
- Barrido y ráfaga
- Modelos de doble canal que permiten ahorrar costos y espacio de banco
- Conector USB en el panel frontal para el almacenamiento de la forma de onda en el dispositivo de memoria
- USB, GPIB y LAN
- Controladores de LabVIEW y LabWindows/IVI-C

Aplicaciones

- Diseño y prueba electrónicos
- Simulación de sensor
- Prueba funcional
- Enseñanza y formación

Descripción del producto

Su rendimiento, versatilidad, funcionamiento intuitivo y accesibilidad económica sin igual hacen que los Generadores de funciones, de forma de onda arbitraria y de pulsos de la serie AFG3000 sean los instrumentos más útiles de la industria.

Versatilidad y rendimiento superior

Los usuarios pueden elegir entre 12 formas de onda estándar distintas. Las formas de onda arbitrarias se pueden generar con una longitud de hasta 128 K con frecuencias de muestreo elevadas. En las formas de onda pulsatorias, el tiempo de los flancos anterior y posterior se puede configurar de manera independiente. Las señales externas se pueden conectar y añadir a la señal de salida. Los modelos de doble canal pueden generar dos señales idénticas o completamente distintas. Todos los instrumentos presentan una base de tiempo altamente estable con sólo una deriva de ± 1 ppm al año.

La interfaz de usuario intuitiva presenta más información a primera vista

Una pantalla grande muestra a primera vista todos los parámetros de forma de onda y gráficos de forma de la onda pertinentes. Eso le permite confiar plenamente en los ajustes de la señal y concentrarse en la tarea que esté llevando a cabo. Las teclas de acceso rápido proporcionan acceso directo a los parámetros y funciones utilizados con frecuencia. Se pueden seleccionar otras teclas según su conveniencia a través de una serie de menús claramente estructurados. Eso reduce el tiempo que se emplea en aprender y en volver a aprender a utilizar el instrumento. El aspecto es idéntico a los Osciloscopios TDS 3000 más populares del mundo.

Incluye el software ArbExpress™ para poder crear fácilmente formas de onda

Con este programa para PC, las formas de onda se pueden importar perfectamente desde cualquier osciloscopio Tektronix o se pueden definir por medio de las funciones estándar, del editor de ecuaciones y de las matemáticas de forma de onda.

Characteristics

AFG3000 Series Characteristics

Characteristic	AFG3011	AFG3021B AFG3022B	AFG3101 AFG3102	AFG3251 AFG3252
Channels	1	1 / 2	1 / 2	1 / 2
Waveforms	Sine, Square, Pulse, Ramp, Triangle, Sin(x)/x, Exponential Rise and Decay, Gaussian, Lorentz, Haversine, DC, Noise			
Sine Wave	1 μ Hz to 10 MHz	1 μ Hz to 25 MHz	1 μ Hz to 100 MHz	1 μ Hz to 240 MHz
Sine wave in Burst Mode	1 μ Hz to 5 MHz	1 μ Hz to 12.5 MHz	1 μ Hz to 50 MHz	1 μ Hz to 120 MHz
Effective maximum frequency out	10 MHz	25 MHz	100 MHz	240 MHz
Amplitude Flatness (1 V_{pp})				
<5 MHz	± 0.15 dB	± 0.15 dB	± 0.15 dB	± 0.15 dB
5 MHz to 10 MHz	± 0.3 dB	—	—	—
5 MHz to 20 MHz	—	± 0.3 dB	± 0.3 dB	± 0.3 dB
20 MHz to 25 MHz	—	± 0.5 dB	± 0.3 dB	± 0.3 dB
25 MHz to 100 MHz	—	—	± 0.5 dB	± 0.5 dB
100 MHz to 200 MHz	—	—	—	± 1.0 dB
200 MHz to 240 MHz	—	—	—	± 2.0 dB
Harmonic Distortion (1 V_{pp})				
10 Hz to 20 kHz	< -60 dBc	< -70 dBc	< -60 dBc	< -60 dBc
20 kHz to 1 MHz	< -55 dBc	< -60 dBc	< -60 dBc	< -60 dBc
1 MHz to 5 MHz	< -45 dBc	< -50 dBc	< -50 dBc	< -50 dBc
5 MHz to 10 MHz	< -45 dBc	< -50 dBc	< -37 dBc	< -37 dBc
10 MHz to 25 MHz	—	< -40 dBc	< -37 dBc	< -37 dBc
>25 MHz	—	—	< -37 dBc	< -30 dBc
THD	<0.2% (10 Hz – 20 kHz, 1 V_{pp})			
Spurious (1 V_{pp})				
10 Hz to 1 MHz	< -60 dBc	< -60 dBc	< -60 dBc	< -50 dBc
1 MHz to 10 MHz	< -50 dBc	—	—	—
1 MHz to 25 MHz	—	< -50 dBc	< -50 dBc	< -47 dBc
>25 MHz	—	—	< -50 dBc + 6 dBc/octave	< -47 dBc + 6 dBc/octave
Phase noise, typical	< -110 dBc/Hz at 10 MHz, 10 kHz offset, 1 V_{pp}	< -110 dBc/Hz at 20 MHz, 10 kHz offset, 1 V_{pp}		
Residual clock noise	-63 dBm	-63 dBm	-57 dBm	-57 dBm
Square Wave	1 μ Hz to 5 MHz	1 μ Hz to 12.5 MHz	1 μ Hz to 50 MHz	1 μ Hz to 120 MHz
Rise/Fall time	≤ 50 ns	≤ 18 ns	≤ 5 ns	≤ 2.5 ns
Jitter (RMS), typical	500 ps	500 ps	200 ps	100 ps
Ramp Wave	1 μ Hz to 100 kHz	1 μ Hz to 250 kHz	1 μ Hz to 1 MHz	1 μ Hz to 2.4 MHz
Linearity, typical	$\leq 0.2\%$ of peak output	$\leq 0.1\%$ of peak output	$\leq 0.15\%$ of peak output	$\leq 0.2\%$ of peak output
Symmetry	0.0% to 100.0%	0.0% to 100.0%	0.0% to 100.0%	0.0% to 100.0%
Pulse Wave	1 MHz to 5 MHz	1 MHz to 12.5 MHz	1 MHz to 50 MHz	1 MHz to 120 MHz
Pulse width	80.00 ns to 999.99 s	30.00 ns to 999.99 s	8.00 ns to 999.99 s	4.00 ns to 999.99 s
Resolution	10 ps or 5 digits			
Pulse duty	0.001% to 99.999% (Limitations of pulse width apply)			
Edge transition time	50 ns to 625 s	18 ns to 625 s	5 ns to 625 s	2.5 ns to 625 s
Resolution	10 ps or 4 digits		10 ps or 4 digits	
Lead delay				
Range	(Continuous Mode): 0 ps to Period (Triggered/Gated Burst Mode): 0 ps to Period – [Pulse Width + 0.8 * (Leading Edge Time + Trailing Edge Time)]			
Resolution	10 ps or 8 digits			
Overshoot, typical	<5%			
Jitter (RMS), typical	500 ps	500 ps	200 ps	100 ps

Characteristic	AFG3011	AFG3021B AFG3022B	AFG3101 AFG3102	AFG3251 AFG3252
Other Waveforms	1 μ Hz to 100 kHz	1 μ Hz to 250 kHz	1 μ Hz to 1 MHz	1 μ Hz to 2.4 MHz
Noise Bandwidth (-3 dB)	10 MHz	25 MHz	100 MHz	240 MHz
Noise type	White Gaussian			
DC (into 50 Ω)	-10 V to +10 V	-5 V to +5 V	-5 V to +5 V	-2.5 V to +2.5 V
Arbitrary Waveforms	1 mHz to 5 MHz	1 mHz to 12.5 MHz	1 mHz to 50 MHz	1 mHz to 120 MHz
Arbitrary waveforms in Burst Mode	1 mHz to 2.5 MHz	1 mHz to 6.25 MHz	1 mHz to 25 MHz	1 mHz to 60 MHz
Effective analog bandwidth (-3 dB)	8 MHz	34 MHz	100 MHz	225 MHz
Nonvolatile memory	4 waveforms	4 waveforms	4 waveforms	4 waveforms
Memory: Sample rate	2 to 128 K: 250 MS/s	2 to 128 K: 250 MS/s	>16 K to 128 K: 250 MS/s 2 to 16 K: 1 GS/s	>16 K to 128 K: 250 MS/s 2 to 16 K: 2 GS/s
Vertical resolution	14 bits	14 bits	14 bits	14 bits
Rise/Fall time	\leq 80 ns	\leq 20 ns	\leq 8 ns	\leq 3 ns
Jitter (RMS)	4 ns	4 ns	1 ns at 1 GS/s 4 ns at 250 MS/s	500 ps at 2 GS/s 4 ns at 250 MS/s
Amplitude, 50 Ω Load	20 mV _{p-p} to 20 V _{p-p}	10 mV _{p-p} to 10 V _{p-p}	20 mV _{p-p} to 10 V _{p-p}	\leq 200 MHz: 50 mV _{p-p} to 5 V _{p-p} >200 MHz: 50 mV _{p-p} to 4 V _{p-p}
Amplitude, Open Circuit	40 mV _{p-p} to 40 V _{p-p}	20 mV _{p-p} to 20 V _{p-p}	40 mV _{p-p} to 20 V _{p-p}	\leq 200 MHz: 100 mV _{p-p} to 10 V _{p-p} >200 MHz: 100 mV _{p-p} to 8 V _{p-p}
Accuracy	\pm (2% of setting +2 mV) (1 kHz sine wave, 0 V offset, >20 mV _{p-p} amplitude)	\pm (1% of setting +1 mV) (1 kHz sine wave, 0 V offset, >10 mV _{p-p} amplitude)		
Resolution	0.1 mV _{p-p} , 0.1 mV _{RMS} , 1 mV, 0.1 dBm or 4 digits			
Units	V _{p-p} , V _{RMS} , dBm (sine wave only)			
Output impedance	50 Ω			
Load impedance setting	Selectable: 50 Ω , 1 Ω to 10.0 k Ω , High Z (Adjusts displayed amplitude according to selected load impedance)			
Isolation	42 V _{pk} maximum to earth			
Short-circuit protection	Signal outputs are robust against permanent shorts against floating ground			
External voltage protection	To protect signal outputs against external voltages use fuse adapter 013-0345-xx			
DC offset range, 50 Ω load	\pm (10 V _{pk} – Amplitude _{pp} /2)	\pm (5 V _{pk} – Amplitude _{pp} /2)	\pm 5 V _{pk} DC	\pm 2.5 V _{pk} DC
DC offset range, open circuit	\pm (20 V _{pk} – Amplitude _{pp} /2)	\pm (10 V _{pk} – Amplitude _{pp} /2)	\pm 10 V _{pk} DC	\pm 5 V _{pk} DC
Accuracy	\pm (2% of setting + 10 mV + 1% of amplitude (V _{p-p}))	\pm (1% of setting + 5 mV + 0.5% of amplitude (V _{p-p}))		
Resolution	1 mV			

Modulation

AM, FM, PM

Characteristic	Description
Carrier Waveforms	All, except Pulse, Noise, and DC
Source	Internal/External
Internal Modulating Waveform	Sine, square, ramp, noise, ARB (AM: maximum waveform length 4,096; FM/PM: maximum waveform length 2,048)
Internal Modulating Frequency	2 mHz to 50.00 kHz
AM Modulation Depth	0.0% to +120.0%
Min FM Peak Deviation	DC
Max FM Peak Deviation	See chart, below

Modulation: Max FM Peak Deviation

Characteristic	AFG3011	AFG3021B AFG3022B	AFG3101 AFG3102	AFG3251 AFG3252
Sine	5 MHz	12.5 MHz	50 MHz	120 MHz
Square	2.5 MHz	6.25 MHz	25 MHz	60 MHz
ARB	2.5 MHz	6.25 MHz	25 MHz	60 MHz
Others	50 kHz	125 kHz	500 kHz	1.2 MHz

PM Phase Deviation – 0.0° to +180.0°

Frequency Shift Keying

Characteristic	Description
Carrier Waveforms	All, except Pulse, Noise, and DC
Source	Internal/External
Internal Modulating Frequency	2 MHz to 1.000 MHz
Number of Keys	2

Pulse Width Modulation

Characteristic	Description
Carrier Waveform	Pulse
Source	Internal/External
Internal Modulating Waveform	Sine, square, ramp, noise, ARB (maximum waveform length 2,048)
Internal Modulating Frequency	2 MHz to 50.00 kHz
Deviation	0% to 50.0% of pulse period

Sweep

Characteristic	Description
Waveforms	All, except Pulse, Noise, and DC
Type	Linear, logarithmic
Sweep Time	1 ms to 300 s
Hold/Return Time	0 ms to 300 s
Max Total Sweep Time	300 s
Resolution	1 ms or 4 digits
Total Sweep Time Accuracy, typical	≤0.4%
Min Start/Stop Frequency	All except ARB: 1 μHz ARB: 1 mHz
Max Start/Stop Frequency	See chart, below

Sweep: Max Start/Stop Frequency

Characteristic	AFG3011	AFG3021B AFG3022B	AFG3101 AFG3102	AFG3251 AFG3252
Sine	10 MHz	25 MHz	100 MHz	240 MHz
Square	5 MHz	12.5 MHz	50 MHz	120 MHz
ARB	5 MHz	12.5 MHz	50 MHz	120 MHz
Others	100 kHz	250 kHz	1 MHz	2.4 MHz

Burst

Characteristic	Description
Waveforms	All, except Noise and DC
Type	Triggered, gated (1 to 1,000,000 cycles or Infinite)
Internal Trigger Rate	1 μs to 500.0 s
Gate and Trigger Sources	Internal, external, remote interface

Auxiliary Inputs

Characteristic	Description
Modulation Inputs Channel 1, Channel 2	
Input range	All except FSK: ±1 V FSK: 3.3 V logic level
Impedance	10 kΩ
Frequency range	DC to 25 kHz (122 kS/s)
External Triggered/Gated Burst Input	
Level	TTL compatible
Impedance	10 kΩ
Pulse width	100 ns minimum
Slope	Positive/Negative, selectable
Trigger delay	0.0 ns to 85.000 s
Resolution	100 ps or 5 digits
Jitter (RMS), typical	Burst: <500 ps (Trigger input to signal output)
10 MHz Reference Input	
Impedance	1 kΩ, AC coupled
Required Input Voltage Swing	100 mV _{p-p} to 5 V _{p-p}
Lock Range	10 MHz ±35 kHz
External Channel 1 Add Input	AFG3101, AFG3102, AFG3251, AFG3252 only
Impedance	50 Ω
Input range	-1 V to +1 V (DC + peak AC)
Bandwidth	DC to 10 MHz (-3 dB) at 1 V _{p-p}

Auxiliary Outputs

Characteristic	Description
Channel 1 Trigger Output	
Level	Positive TTL level pulse into 1 kΩ
Impedance	50 Ω
Jitter (RMS), typical	AFG3011/21B/22B: 500 ps AFG3101/02: 200 ps AFG3251/52: 100 ps
Max Frequency	4.9 MHz (4.9 MHz to 50 MHz: A fraction of the frequency is output; >50 MHz: no signal is output)
10 MHz Reference Out	
Impedance	50 Ω, AC coupled
Amplitude	1.2 V _{p-p} into 50 Ω load

Common Characteristics

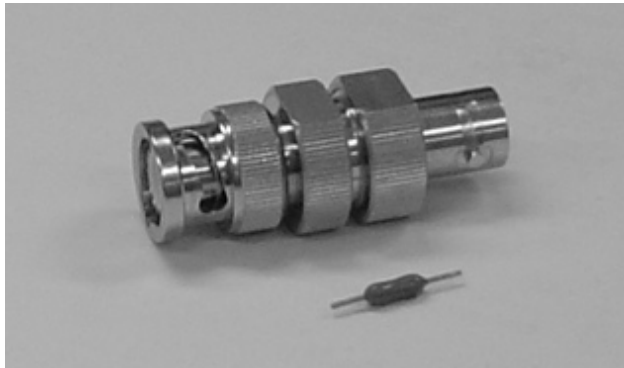
Characteristic	Description
Frequency Setting Resolution	1 μ Hz or 12 digits
Phase (except DC, Noise, Pulse)	
Range	-180° to +180°
Resolution	0.01° (sine), 0.1° (other waveforms)
Internal Noise Add	When activated, output signal amplitude is reduced to 50%
Level	0.0% to 50% of amplitude (V_{pp}) setting
Resolution	1%
Main Output	50 Ω
Effective Frequency Switching Speed	2 ms using remote control (sequencing not available)
Internal Frequency Reference	
Stability	All except ARB: ± 1 ppm, 0 °C to 50 °C ARB: ± 1 ppm ± 1 μ Hz, 0 °C to 50 °C
Aging	± 1 ppm per year
Remote Programming	GPIB, LAN 10BASE-T / 100BASE-TX, USB 1.1 Compatible with SCPI-1999.0 and IEEE 488-2 standards
Configuration times, typical	
	USB LAN GPIB
Function change	95 ms 103 ms 84 ms
Frequency change	2 ms 19 ms 2 ms
Amplitude change	60 ms 67 ms 52 ms
Select user ARB	88 ms 120 ms 100 ms
Data download time for 4000 point waveform data, typical	20 ms 84 ms 42 ms
Power Source	100 to 240 V, 47 to 63 Hz, or 115 V, 360 to 440 Hz
Power Consumption	Less than 120 W
Warm-up Time, typical	20 minutes
Power-on Self Calibration, typical	<16 s
Acoustic Noise, typical	<50 dBA
Display	AFG3021B: 5.6 in. Monochrome LCD All others: 5.6 in. Color LCD
User Interface and Help Language	English, French, German, Japanese, Korean, Simplified and Traditional Chinese, Russian (user selectable)

Physical Characteristics**Benchtop Configuration**

Dimensions	mm	in.
Height	156.3	6.2
Width	329.6	13.0
Depth	168.0	6.6
Weight	kg	lb.
Net	4.5	9.9
Shipping	5.9	12.9

Environmental and Safety Characteristics

Characteristic	Description
Temperature	
Operating	0 °C to +50 °C
Nonoperating	-30 °C to +70 °C
Humidity	
Operating	$\leq +40$ °C: $\leq 80\%$ $> +40$ °C to 50 °C: $\leq 60\%$
Altitude	Up to 10,000 ft./3,000 m
EMC Compliance	
European Union	EN 61326:1997 Class A EN 61000-3-2:2000, and EN 61000-3-3:1995 IEC 61000-4-2:1999, -4-3:2002, -4-4:2004, -4-5:2005, -4-6:2003, -4-11:2004
Australia	EN 61326:1997
Safety	UL 61010-1:2004 CAN/CSA C22.2 No. 61010-1:2004 IEC 61010-1:2001



BNC Fuse Adapter and 0.125 A Fuse

Ordering Information

AFG3011, AFG3021B, AFG3022B, AFG3101, AFG3102, AFG3251, AFG3252

Arbitrary/Function Generator

Includes: Quick-start user manual, power cord, USB cable, CD-ROM with programmer manual, service manual, LabView and IVI drivers, CD-ROM with ArbExpress™ software, and NIST-traceable calibration certificate. Please specify power plug when ordering.

International Power Plugs

Option	Description
Opt. A0	North America power
Opt. A1	Universal EURO power
Opt. A2	United Kingdom power
Opt. A3	Australia power
Opt. A5	Switzerland power
Opt. A6	Japan power
Opt. A10	China power
Opt. A11	India power
Opt. A99	No power cord or AC adapter

Note: Includes front-panel overlay.

Manual Options

Option	Description
Opt. L0	English (071-1631-xx)
Opt. L1	French (071-1632-xx)
Opt. L2	Italian (071-1669-xx)
Opt. L3	German (071-1633-xx)
Opt. L4	Spanish (071-1670-xx)
Opt. L5	Japanese (071-1634-xx)
Opt. L7	Simple Chinese (071-1635-xx)
Opt. L8	Traditional Chinese (071-1636-xx)
Opt. L9	Korean (071-1637-xx)
Opt. L10	Russian (071-1638-xx)
Opt. L99	No manual

Service

Option	Description
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. CA1	Single calibration event or coverage for the designated calibration interval, whichever comes first
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 Years

Warranty

Three-year warranty on parts and labor.

Recommended Accessories

Accessory	Description
Rackmount Kit	RM3100
Fuse adapter, BNC-P to BNC-R	013-0345-xx
Fuse set, 3 pcs, 0.125 A.	159-0454-xx
BNC cable shielded, 3 ft.	012-0482-xx
BNC cable shielded, 9 ft.	012-1256-xx
GPIB cable, double shielded	012-0991-xx



Product(s) are manufactured in ISO registered facilities.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.