

Arbitrary/Function Generators

AFG3021B • AFG3022B • AFG3101 •
AFG3102 • AFG3251 • AFG3252

CHARACTERISTICS

AFG3000 Series Characteristics

Model	AFG3021B / AFG3022B	AFG3101 / AFG3102	AFG3251 / AFG3252
Channels	1 / 2	1 / 2	1 / 2
Waveforms	Sine, Square, Pulse, Ramp, Triangle, Sin (x)/x, Exponential Rise & Decay, Gaussian, Lorentz, Haversine, DC, Noise		
Sine Wave	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 12.5 MHz	1 μ Hz to 50 MHz	1 μ Hz to 120 MHz
Amplitude Flatness (1 V_{p-p})			
<5 MHz	± 0.15 dB	± 0.15 dB	± 0.15 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_{p-p})			
10 Hz to 20 kHz	<-70 dBc	<-60 dBc	<-60 dBc
20 kHz to 1 MHz	<-60 dBc	<-60 dBc	<-60 dBc
1 MHz to 5 MHz	<-50 dBc	<-50 dBc	<-50 dBc
5 MHz to 10 MHz	<-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 _{p-p})		
Spurious (1 V_{p-p})			
10 Hz to 1 MHz	<-60 dBc	<-60 dBc	<-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 20 MHz, 10 kHz offset, 1 V _{p-p}		
Residual Clock Noise	-63 dBm	-57 dBm	-57 dBm
Square Wave	1 μ Hz to 12.5 MHz	1 μ Hz to 50 MHz	1 μ Hz to 120 MHz
Rise/Fall Time	≤ 18 ns	≤ 5 ns	≤ 2.5 ns

Jitter (rms), typical	500 ps	200 ps	100 ps
Ramp Wave	1 μ Hz to 250 kHz	1 μ Hz to 1 MHz	1 μ Hz to 2.4 MHz
Linearity, typical	$\leq 0.1\%$ of peak output	$\leq 0.15\%$ of peak output	$\leq 0.2\%$ of peak output
Symmetry	0.0% to 100.0%.		
Pulse Wave	1 mHz to 12.5 MHz	1 mHz to 50 MHz	1 mHz to 120 MHz
Pulse Width	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	18 ns to 625 s	5 ns to 625 s	2.5 ns to 625 s
Resolution	10 ps or 4 digits		
Lead Delay	Range: 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	200 ps	100 ps
Other Waveforms	1 μ Hz to 250 kHz	1 μ Hz to 1 MHz	1 μ Hz to 2.4 MHz
Noise Bandwidth (-3 dB)	25 MHz	100 MHz	240 MHz
Noise Type	White Gaussian		
DC (into 50 Ω)	-5 V to +5 V	-5 V to +5 V	-2.5 V to +2.5 V
Arbitrary Waveforms	1 mHz to 12.5 MHz	1 mHz to 50 MHz	1 mHz to 120 MHz
Non-volatile memory	4 waveforms	4 waveforms	4 waveforms
Memory: Sample rate	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
Rise Time/Fall Time	≤ 20 ns	≤ 8 ns	≤ 3 ns
Jitter (rms)	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	10 mV _{p-p} to 10 V _{p-p}	20 mV _{p-p} to 10 V _{p-p}	≤ 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	20 mV _{p-p} to 20 V _{p-p}	40 mV _{p-p} to 20 V _{p-p}	≤ 200 MHz: 100 mV _{p-p} to

			10 V _{p-p} >200 MHz: 100 mV _{p-p} to 8 V _{p-p}
Accuracy	±(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, 1Ω to 10.0 kΩ, High Z (adjusts displayed amplitude according to selected load impedance)		
Isolation	42 V 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 013-0345-00		
DC Offset, 50 Ω Load	±5 V _{pk} AC + DC	±5 V _{pk} AC + DC	±2.5 V _{pk} AC + DC
DC Offset, Open Circuit	±10 V _{pk} AC + DC	±10 V _{pk} AC + DC	±5 V _{pk} AC + DC
Accuracy	±(1% of setting + 5 mV + 0.5% of amplitude (V _{p-p}))		
Resolution	1 mV		

Modulation

AM, FM, PM

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

	AFG3021B / AFG3022B	AFG3101 / AFG3102	AFG3251 / AFG3252
Sine	12.5 MHz	50 MHz	120 MHz
Square	6.25 MHz	25 MHz	60 MHz
ARB	5 MHz	25 MHz	60 MHz

Others	100 kHz	500 kHz	2.4 MHz
--------	---------	---------	---------

PM Phase Deviation - 0.0° to +180.0°.

Frequency Shift Keying

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

Carrier Waveform	Pulse
Source	Internal/External
Internal Modulating Waveform	Sine, square, ramp, noise, ARB
Internal Modulating Frequency	2 MHz to 50.00 kHz
Deviation	0% to 50.0% of pulse period

Sweep

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
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

	AFG3021B / AFG3022B	AFG3101 / AFG3102	AFG3251 / AFG3252
Sine	25 MHz	100 MHz	240 MHz
Square	12.5 MHz	50 MHz	120 MHz
ARB	12.5 MHz	50 MHz	120 MHz
Others	200 kHz	1 MHz	5 MHz

Burst

Waveforms	All, except Noise and DC
Type	Triggered, gated (1 to 1,000,000 cycles or Infinite)
Internal Trigger Rate	1.000 ms to 500.0 s
Gate and Trigger Sources	Internal, external, remote interface

Auxiliary Inputs

Modulation Input Channel	
---------------------------------	--

1, Channel 2	
Input Range	All except FSK: ± 1 V FSK: 3.3 V logic level
Impedance	10 k Ω
Frequency Range	DC to 25 kHz (122 KS/s)
External Triggered/Gated Burst Input	
Level	TTL compatible
Impedance	10 k Ω
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 k Ω , AC coupled
Required Input Voltage Swing	100 mV _{p-p} to 5 V _{p-p}
Lock Range	10 MHz \pm 35 kHz
External Channel 1 Add Input	
	AFG3101, AFG3102, AFG3251, AFG3252 only
Impedance	50 Ω
Input Range	-1 V to +1 V (DC + peakAC)
Bandwidth	DC to 10 MHz (-3 dB) at 1 V _{p-p}

Auxiliary Outputs

Channel 1 Trigger Output	
Level	Positive TTL level pulse into 1 k Ω
Impedance	50 Ω
Jitter (rms), typical	AFG3021B/22B: 500 ps AFG3101/02: 200 ps AFG3251/52: 100 ps
10 MHz Reference Out	
	AFG3101, AFG3102, AFG3251, AFG3252 only
Impedance	50 Ω , AC coupled
Amplitude	1.2 V _{p-p} into 50 Ω load

Common Characteristics

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 _{p-p}) setting

Resolution	1%		
Main Output	50 Ω		
Internal Frequency Reference			
Stability	All except ARB: ±1 ppm, 0 °C to 50 °C ARB: ±1 ppm ± 1 μHz, 0 °C to 50 °C		
Aging	±1 ppm per year		
Remote Programming	GPIB, LAN 10BASE-T / 100BASE-TX, USB 1.1		
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" Monochrome LCD		
	All others: 5.6" Color LCD		

Physical Characteristics

Benchtop Configuration

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

Environmental & Safety Characteristics

Temperature	
Operating	0 °C to +50 °C
Nonoperating	-30 °C to +70 °C
Humidity	
Operating	At or below +40 °C: ≤80% >+40 °C to 50 °C: ≤60%
Altitude	Up to 10,000 feet/3,000 m
EMC Compliance	
European Union	EN 61326 Class A

	EN 61000-3-2, and EN 61000-3-3 IEC 61000-4-2, 4-3, 4-4, 4-5, 4-6, 4-11
Australia	AS/NZS 2064
Safety	UL 61010-1:2004 CAN/CSA C22.2 No. 61010-1:2004 IEC 61010-1:2001