Arbitrary/Function Generators

▶ **AFG3011 • AFG3021B • AFG3022B • AFG3101 • AFG3102 • AFG3251 • AFG3252**

Product Description

Unmatched performance, versatility, intuitive operation and affordability make the AFG3000 Series of Function, Arbitrary Waveform and Pulse Generators the most useful instruments in the industry.

Superior Performance and Versatility

Users can choose from 12 different standard waveforms. Arbitrary waveforms can be generated up to 128 K in length at high sampling rates. On pulse waveforms, leading and trailing edge time can be set independently. External signals can be connected and added to the output signal. Dual channel models can generate two identical or completely different signals. All instruments feature a highly stable time base with only ±1 ppm drift per year.

Intuitive User Interface Shows More Information at a Single Glance

A large screen shows all relevant waveform parameters and graphical waveshape at a single glance. This gives full confidence in the signal settings and lets you focus on the task at hand. Shortcut keys provide direct access to frequently used functions and parameters. Others can be selected conveniently through clearly structured menus. This reduces the time needed for learning and relearning how to use the instrument. Look and feel are identical to the world's most popular TDS3000 Oscilloscopes.

ArbExpress® Software Included for Creating Waveforms with Ease

With this PC software waveforms can be seamlessly imported from any Tektronix oscilloscope, or defined by standard functions, equation editor and waveform math.

▶ Features & Benefits

10 MHz, 25 MHz, 100 MHz or 240 MHz sine waveforms

14 bits, 250 MS/s, 1 GS/s, or 2 GS/s arbitrary waveforms

Amplitude up to 20 V_{p-p} into 50 Ω loads

5.6" display for full confidence in settings and waveform shape

Multi-language and intuitive operation saves set-up time

Pulse waveform with variable edge times

AM, FM, PM, FSK, PWM

Sweep and burst

Dual channel models save cost and bench space

USB connector on front panel for waveform storage on memory device

USB, GPIB and LAN

LabVIEW and LabWindows/IVI-C drivers

▶ Applications

Electronic test and design

Sensor simulation

Functional test

Education and training

Tektronix®

▶ Characteristics

▶ AFG3000 Series Characteristics

Model	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 µHz to 10 MHz	1 µHz to 25 MHz	1 µHz to 100 MHz	1 µHz to 240 MHz
Sine Wave in Burst Mode	1 µHz to 5 MHz	1 µHz to 12.5 MHz	1 µHz to 50 MHz	1 µHz to 120 MHz
Effective maximum frequency out	10 MHz	25 MHz	100 MHz	240 MHz
Amplitude Flatness (1 V_{p-p})				
<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_{p-p})				
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_{p-p})			
Spurious (1 V_{p-p})				
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_{p-p}	<–110 dBc/Hz at 20 MHz, 10 kHz offset, 1 V_{p-p}		
Residual Clock Noise	–63 dBm	–63 dBm	–57 dBm	–57 dBm
Square Wave	1 µHz to 5 MHz	1 µHz to 12.5 MHz	1 µHz to 50 MHz	1 µHz 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 µHz to 100 kHz	1 µHz to 250 kHz	1 µHz to 1 MHz	1 µHz to 2.4 MHz
Linearity, typical	≤0.2% of peak output	≤0.1% of peak output	≤0.15% of peak output	≤0.2% of peak output
Symmetry	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

AFG3000 Series Characteristics (continued)

Model	AFG3011	AFG3021B/AFG3022B	AFG3101/AFG3102	AFG3251/AFG3252
Other Waveforms	1 µHz to 100 kHz	1 µHz to 250 kHz	1 µHz to 1 MHz	1 µHz 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
Non-volatile 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 Time/Fall Time	≤80 ns	≤20 ns	≤8 ns	≤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}	≤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}	≤200 MHz: 100 mV_{p-p} to 10 V_{p-p} >200 MHz: 100 mV_{p-p} to 8 V_{p-p}
Accuracy	±(2% of setting +2 mV) (1 kHz sine wave, 0 V offset, >20 mV_{p-p} amplitude)	±(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 Vpk 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 Range, 50 Ω Load	±(10 V_{pk} – $Amplitude_{pp}$/2)	±(5 V_{pk} – $Amplitude_{pp}$/2)	±5 V_{pk} DC	±2.5 V_{pk} DC
DC Offset Range, Open Circuit	±(20 V_{pk} – $Amplitude_{pp}$/2)	±(10 V_{pk} – $Amplitude_{pp}$/2)	±10 V_{pk} DC	±5 V_{pk} DC
Accuracy	±(2% of |setting| + 10 mV + 1% of amplitude (V_{p-p}))	±(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.

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 (maximum waveform length 2,048).
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.
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.

Burst

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.

▶ Modulation: Max FM Peak Deviation

	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 – 0.0º to +180.0º.

▶ Sweep: Max Start/Stop Frequency

	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

▶ Common Characteristics

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

Auxiliary Inputs

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 mVp-p to 5 Vp-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 + peakAC).
Bandwidth – DC to 10 MHz (–3 dB) at 1 Vp-p.

Auxiliary Outputs

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 – AFG3101, AFG3102, AFG3251, AFG3252 only.
Impedance – 50 Ω, AC coupled.
Amplitude – 1.2 Vp-p into 50 Ω load.

▶ Common Characteristics

Frequency Setting Resolution – 1 µHz or 12 digits.
Phase (except DC, Noise, Pulse) –
Range – –180º to +180º.
Resolution – 0.01º (sine), 0.1º (other waveforms).
Internal Noise Add – When activated, output signal amplitude is reduced to 50%.
Level – 0.0% to 50% of amplitude (Vp-p) setting.
Resolution – 1%.
Main Output – 50 Ω.
Effective Frequency Switching Speed – 2 ms via remote control (sequencing not available).
Internal Frequency Reference –
Stability – All except
ARB: ±1 ppm, 0 ºC to 50 ºC.
ARB: ±1 ppm ± 1 µHz, 0 ºC to 50 ºC.
Aging – ±1 ppm per year.
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.
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	lbs.
Net	4.5	9.9
Shipping	5.9	12.9

Environmental and Safety Characteristics

Temperature	
Operating	0 ºC to +50 ºC
Nonoperating	–30 ºC to +70 ºC

Humidity	
Operating	At or below +40 ºC: ≤80% >+40 ºC to 50 ºC: ≤60%
Altitude	Up to 10,000 feet/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

► 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, NIST-traceable calibration certificate. Please specify power plug when ordering.

International Power Plugs

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.

Manual Options

Note: Includes front panel overlay.

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

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 Option C3).

Opt. D5 – Calibration Data Report 5 Years (with Option C5).

Opt. R5 – Repair Service 5 Years.

Warranty

Three year warranty on parts and labor.

Recommended Accessories

Rackmount Kit – RM3100.

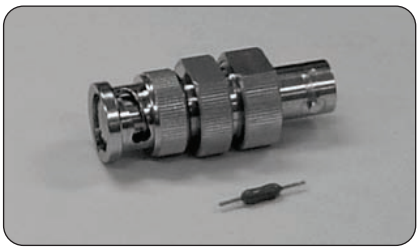
Fuse adapter, BNC-P to BNC-R. – 013-0345-00.

Fuse set, 3 pcs, 0.125 A. – 159-0454-00.

BNC cable shielded, 3 ft. – 012-0482-00.

BNC cable shielded, 9 ft. – 012-1256-00.

GPIB cable, double shielded – 012-0991-00.



► BNC Fuse Adapter and 0.125 A Fuse.

Arbitrary/Function Generators

► AFG3011 • AFG3021B • AFG3022B • AFG3101 • AFG3102 • AFG3251 • AFG3252

Contact Tektronix:

ASEAN / Australasia (65) 6356 3900
Austria +41 52 675 3777
Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium 07 81 60166
Brazil & South America (11) 40669400
Canada 1 (800) 661-5625
Central East Europe, Ukraine and the Baltics +41 52 675 3777
Central Europe & Greece +41 52 675 3777
Denmark +45 80 88 1401
Finland +41 52 675 3777
France +33 (0) 1 69 86 81 81
Germany +49 (221) 94 77 400
Hong Kong (852) 2585-6688
India (91) 80-22275577
Italy +39 (02) 25086 1
Japan 81 (3) 6714-3010
Luxembourg +44 (0) 1344 392400
Mexico, Central America & Caribbean 52 (55) 5424700
Middle East, Asia and North Africa +41 52 675 3777
The Netherlands 090 02 021797
Norway 800 16098
People's Republic of China 86 (10) 6235 1230
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea 82 (2) 6917-5000
Russia & CIS +7 (495) 7484900
South Africa +27 11 206 8360
Spain (+34) 901 988 054
Sweden 020 08 80371
Switzerland +41 52 675 3777
Taiwan 886 (2) 2722-9622
United Kingdom & Eire +44 (0) 1344 392400
USA 1 (800) 426-2200
For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

Updated 12 November 2007

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.tektronix.com**

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.

Copyright © 2008, Tektronix. All rights reserved. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX and TEK are registered trademarks of Tektronix, Inc. All other trade names referenced are the service marks, trademarks or registered trademarks of their respective companies.

03/08 HB/WOW 76W-18656-3

Tektronix®

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Tektronix:

AFG3011 AFG3021B AFG3022B AFG3101 AFG3102 AFG3251 AFG3252