

## AFG-303x & AFG-302x Specifications

The specifications apply when the AFG-303x & AFG-302x is powered on for at least 30 minutes under +20°C~+30°C.

	AFG-3031	AFG-3032	AFG-3021	AFG-3022
Channels	1	2	1	2
<b>Features</b>				
I/O signal ground for the instrument chassis	Isolation			
Connector shells for channel output(s), Sync output, 10MHz REF Input, Mod Input and Mod output are isolated from the instrument's chassis. Maximum allowable voltage on isolated connector shells is $\pm 42$ Vpk. (DC + AC Peak)				
Each of the signal ground of CH1 & CH2	-	Isolated	-	Isolated
Standard Waveforms	Sine, Square, Triangle, Ramp, Pulse, Noise, Harmonic			
<b>Arbitrary Waveforms</b>				
Sample Rate	250 MSa/s			
Repetition Rate	125MHz			
Waveform Length	8M points			
Amplitude Resolution	16 bits			
Non-Volatile Memory	Ten 8M waveforms (1)			
User define Output Section	Any section from 2 to 8M points			
Trigger	Infinite/Manual/External			
Built-in Arbitrary Waveforms	<p>Sine, Square, Ramp, Sinc, Exp Rise, Exp Fall, DC, Pulse, Abstan, Havercosine, Sinever, Absin, Haversine, Stair_down, Abssinehalf, N_pulse, Stair_UD, Ampalt, Negramp, Stair_up, Attalt, Rectpuls1, Stepresp, Diric_even, Roundhalf, Trapezia, Diric_odd, Sawtoot, Tripuls1, Gauspuls1, Sinetra, Dlorentz, Ln, Sqrt, Since, Lorentz, Xsquare, Gauss, Arccos, Arctan, Sech, Arccot, Arctanh, Sinh, Arccsc, Cosh, Tan, Arcsec, Cot, Tanh, Arcsin, Csc, Arcsinh, Sec, Barthannwin, Chebwin, Kaiser, Bartlett, Flattopwin, Triang, Blackman, Hamming, Tukeywin, Bohmanwin, Hann, Cardiac, EOG, EEG, EMG, PLETH, RESP, ECG1, ECG2, ECG3, ECG4, ECG5, ECG6, ECG7, ECG8, ECG9, ECG10, ECG11, ECG12, ECG13, ECG14, ECG15, LFPULSE, TENS1, TENS2, TENS3, IGNITION, SP, VR, TP1, TP2A, TP2B, TP3A, TP3B, TP4, TP5A, TP5B</p> <p>Note: It is required to update the ARB data first prior to enabling both Medical (Cardiac, EOG, EEG, EMG, PLETH, RESP, ECG1, ECG2, ECG3, ECG4, ECG5, ECG6, ECG7, ECG8, ECG9, ECG10, ECG11, ECG12, ECG13, ECG14, ECG15, LFPULSE, TENS1, TENS2, TENS3) and AutoElec (IGNITION, SP, VR, TP1, TP2A, TP2B, TP3A, TP3B, TP4, TP5A, TP5B ) waveforms.</p>			
I Q Waveforms	<p>Source: Random, Fixed Pattern</p> <p>Type: ASK, MSK, FSK, 2FSK, 4FSK, 8FSK, BPSK, QPSK, DQPSK, OQPSK, <math>\pi/4</math> – QPSK, <math>\pi/4</math> – DQPSK, 8PSK, 16APSK, 32APSK, 16QAM, 32QAM, 64QAM</p>			
<b>Frequency Characteristics</b>				
	Sine / Square	1uHz to 30MHz		1uHz to 20MHz
	Pulse	1uHz to 25MHz		1uHz to 20MHz
	Triangle / Ramp	1uHz to 1MHz		

Resolution		1uHz
Accuracy	Stability	±1 ppm 0 to 50°C
		±0.3 ppm 18 to 28°C
	Aging	±1 ppm, per 1 year
	Tolerance	≤ 1 uHz
<b>Output Characteristics (2)</b>		
Amplitude	Range	1 mVpp to 10 Vpp (into 50Ω) 2 mVpp to 20 Vpp (into open-circuit)
		Accuracy
	Resolution	0.1 mV or 4 digits
	Flatness	0.1dB <10 MHz
		0.2 dB 10 MHz to 30 MHz (sinewave relative to 1 kHz/into 50Ω)
	Units	Vpp, Vrms, dBm,
Offset	Range	±5 Vpk ac +dc (into 50Ω) ±10Vpk ac +dc (into open circuit)
		Accuracy
	Waveform Output	Impedance
SYNC Output	Protection	Short-circuit protected Overload relay automatically disables main output
	Ground Isolation	42Vpk max.
	Level	TTL-compatible into>1kΩ
	Impedance	50Ω nominal
<b>Sine wave Characteristics</b>		
Harmonic Distortion(5)	-60 dBc DC~1 MHz, Ampl < 3 Vpp	
	-55 dBc DC~1 MHz, Ampl > 3 Vpp	
	-45 dBc 1MHz~5 MHz, Ampl > 3 Vpp	
	-30 dBc 5MHz~30 MHz, Ampl > 3 Vpp	
Total Harmonic Distortion	< 0.2%+0.1mVrms	
	DC to 20 kHz	
Spurious (non-harmonic)(5)	-60 dBc DC~1 MHz	
	-50 dBc 1MHz~20MHz	
	-50 dBc+ 6 dBc/octave 1MHz~30MHz (AFG-3031/3032 only)	
Phase Noise	< -110dBc/Hz typical,15 kHz offset, fc = 10MHz,	
<b>Square wave Characteristics</b>		
Rise/Fall Time	<8 ns (3)	
Overshoot	< 5%	

Asymmetry(@50% duty)	1% of period+1 ns	
Variable Duty Cycle	20.0% to 80.0%, $\leq$ 25 MHz 40.0% to 60.0%, 25 to 30MHz	20.0% to 80.0% , $\leq$ 20 MHz
Jitter	0.01%+525ps < 2 MHz 0.1%+75ps > 2 MHz	
<b>Ramp Characteristics</b>		
Linearity	< 0.1% of peak output	
Variable Symmetry	0% to 100% (0.1% resolution)	
<b>Pulse Characteristics</b>		
Width	20ns to 999,83ks (Extended mode 0.00ns ~1,000ks(6)) Width - 0.625 * [(Rise Time - 0.6ns) + (Fall Time - 0.6ns)] $\geq$ 0 Period $\geq$ Width+0.625* [(Rise Time-0.6ns)+(Fall Time-0.6ns)]	
Duty setting range	0.017% to 99.983% (Extended mode 0.0000% to 100.0000%(6))	
Period	40ns to 1,000,000s	
Rise Time and Fall Time(7)	9.32 ns to 799.89ks	
Resolution	0.0001%	
Overshoot	<5%	
Jitter	50 ps typical(<10kHz)	
<b>Noise</b>		
Noise Type	Gaussian	
Noise Bandwidth	100MHz equivalent bandwidth	
<b>Harmonic</b>		
Harmonic order	$\leq$ 8	
Harmonic Type	Even, Odd, All, User ; Amplitude and Phase can be set for all harmonics	
<b>AM and AM(DSB-SC) Modulation</b>		
Carrier Waveforms	Sine, Square, Triangle, Ramp, Pulse, Noise ,Arb	
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp	
Modulating Frequency	2 mHz to 20 kHz	
Depth	0% to 120.0%	
Source	Internal / External	
<b>FM</b>		
Carrier Waveforms	Sine, Square, Triangle, Ramp	
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp	
Modulating Frequency	2 mHz to 20 kHz	
Peak Deviation	DC to 30 MHz (1uHz resolution)	DC to 20 MHz (1uHz resolution)
Source	Internal / External	
<b>PM</b>		

Carrier Waveforms	Sine, Triangle, Ramp			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Phase Deviation	0° to 360°, 0.1° resolution			
Modulating Frequency	2 mHz to 20 kHz			
Source	Internal			
<b>PWM</b>				
Carrier Waveforms	Square			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Modulating Frequency	2 mHz to 20 kHz			
Deviation	0% ~ 100.0% of pulse width, 0.1% resolution			
Source	Internal / External			
<b>Additive modulation (Sum)</b>				
Carrier Waveforms	Sine, Triangle, Ramp, Pulse, Noise			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Ratio	0% to 100% of carrier amplitude, 0.01% resolution			
Modulating Frequency	2 mHz to 20 kHz			
Source	Internal / External			
<b>FSK</b>				
Carrier Waveforms	Sine, Square, Triangle, Ramp			
Modulating Waveforms	50% duty cycle square			
Internal Rate	2 mHz to 1 MHz			
Frequency Range	DC to 30 MHz	DC to 30MHz	DC to 20MHz	DC to 20MHz
Source	Internal / External			
<b>PSK</b>				
Carrier Waveforms	Sine, Square, Triangle, Ramp			
Modulating Waveforms	50% duty cycle square			
Internal Rate	2 mHz to 1 MHz			
Frequency Range	DC to 30 MHz	DC to 30MHz	DC to 20MHz	DC to 20MHz
Source	Internal / External			
<b>SWEEP</b>				
Waveforms	Frequency Sweep: Sine, Square, Triangle, Ramp Amplitude Sweep: Sine, Square, Triangle, Ramp, Pulse, Noise, ARB			
Type	Frequency, Amplitude			
Functions	Linear or Logarithmic			
Direction	Up or Down			
Start / Stop Frequency	Any frequency within the waveform's range			
Sweep Time	1 ms to 500 s (1 ms resolution)			
Trigger Mode	Single, External, Internal			
Trigger Source	Internal / External			
<b>BURST</b>				

Waveforms	Sine, Square, Triangle, Ramp, Pulse, Noise	
Frequency	1 uHz to 30 MHz (4)	1uHz to 20MHz
Burst Count	1 to 1,000,000 cycles or Infinite	
Start / Stop Phase	-360.0° to +360.0° (0.1° resolution)	
Internal Period	1 us to 500 s	
Gate Source	External Trigger (pulse waveforms can only be used in gate mode)	
Trigger Source	Single, External or Internal Rate	
Trigger Delay	N-Cycle, Infinite: 0us to 100s (1us resolution)	
<b>External Modulation Input</b>		
Type	AM,AM(DSB-SC) ,FM, PWM ,SUM	
Voltage Range	± 5V full scale	
Input Impedance	10kΩ	
Frequency	DC to 20 kHz	
<b>Modulation Output (AFG-3031/3021 only)</b>		
Type	AM, AM(DSB-SC) ,FM, PM, PWM, SUM, Sweep	
Amplitude Range	≥ 1Vpp	
Impedance	> 10kΩ typical	
<b>External Trigger Input</b>		
Type	For FSK,PSK, Burst, Sweep, N Cycle ARB	
Input Level	TTL Compatibility	
Slope	Rising or Falling (Selectable)	
Pulse Width	> 100 ns	
Input rate	DC to 1 MHz	
Input Impedance	10kΩ,DC coupled	
<b>Latency</b>		
Sweep	< 1 us (typical)	
Burst	<0.55us (typical)	
ARB	<(27.5/sample rate)+274ns	
<b>Jitter</b>		
Sweep	2.5 us	
Burst	1 ns; except pulse,300 ps	
<b>10MHz Reference Output</b>		
Output voltage	1 Vp-p / 50 Ω square wave	
Output Impedance	50 Ω, AC coupled	
Output Frequency	10MHz	
<b>10MHz Reference Input</b>		
Input Voltage	0.5Vpp to 5Vpp	
Input Impedance	1k Ω, unbalanced, AC coupled	
Input Frequency	10MHz ± 10Hz	
Waveform	Sine or Square (50±5% duty)	

Ground Isolation	42Vpk max.		
External-Sync			
Phase Delay (max.)	Series Connection: $39+(N-2)*39 \pm 25nS$ Parallel connection: $(N-1)*6 \pm 25nS$ (where N=number of connected units)		
Maximum number of connected units	Series Connection: 4 Parallel Connection: 6		
Applicable Functions	Sine, Square, Triangle, Pulse, Ramp, Harmonic, MOD, Sweep, Burst		
Store/Recall	10 Groups of Setting Memories		
Interface	GPIB(Optional), LAN, USB		
Display	4.3 inch TFT LCD, 480 × 3 (RGB) × 272		
General Specifications			
Power Source	AC 100~240V , 50~60Hz		
Power Consumption	50VA	85VA	50VA 85VA
Operating Environment	Temperature to satisfy the specification : 18 ~ 28°C		
	Operating temperature : 0 ~ 40°C		
	Relative Humidity:		
	≤ 80%, 0 ~ 40°C		
	≤ 70%, 35 ~ 40°C		
	Installation category : CAT II		
Operating Altitude	2000 meters		
Pollution Degree	IEC 61010 Degree 2, Indoor Use		
Storage Temperature	-10 ~ 70°C, Humidity: ≤70%		
Dimensions (WxHxD)	Bench Top : 265 (W) x 107 (H) x 374 (D)		
Weight	Approx. 4kg		
Safety Designed to	EN61010-1		
EMC Tested to	IEC-61326, EN 55011		
Accessories	Test cable(GTL-110×1 for AFG-3031/AFG-3021, GTL-110×2 for AFG-3032/AFG-3022), User Manual Compact Disk × 1, Quick Start Guide × 1, Power cord × 1		
(1). A total of ten waveforms can be stored. (Every waveform can composed of 8M points maximum.)			
(2). Add 1/10th of output amplitude and offset specification per °C for operation outside of 0°C to 28°C range (1-year specification).			
(3). Edge time decreased at higher frequency.			
(4). Sine and square waveforms above 25 MHz are allowed only with an "Infinite" count.			
(5). Harmonic distortion and Spurious noise at low amplitudes is limited by a -70 dBm floor.			
(6). Loss may occur if the pulse width is beyond the setting range of the normal mode. The pulse may vanish at times.			
(7). Rise time and Fall time should be ≥ 0.01% of period.			