GW INSTEK
Simply Reliable

Tetszőleges kimenőjel funkciógenerátorok, AFG-3000 sorozat

CE | LAN | GPIB | USB | PC Software

FŐBB JELLEMZŐK

- 1 µHz - 20, vagy 30MHz, 20Vpp. 1, vagy 2 csatorna
- Tetszőleges hullámforma 250MSa/s, 16-bit felbontás, 8M memória mélység
- Egymástól elszigetelt csatornák
- Szinkronizált fázis max. 6 egységig és 12 csatornáig
- Harmonikus jelgenerátor
- A kétcsatornás kivitel támogatja a SUM modulációt, csatolást, követést és fázis funkciókat
- A pulzus hullámformák egymástól függetlenül állíthatók
- Beépített AM/FM/PM/FSK/PWM/SUM moduláció, Sweep és Burst funkciók
- USB/LAN/CPIB (opció) vezérlő interfészek

PANEL INTRODUCTION

AFG-3032/3022

1. TFT LCD Panel
2. Number Panel
3. Scroll Knob & Selection Key
4. Power Switch
5. Output Terminals
6. Main Output Switch
7. Function Keys
8. Operation Keys
9. USB Host
10. Trigger & Modulation Input
11. 10MHz REF Input & Output
12. Fan
13. GPIB
14. LAN
15. USB Device

AFG-3031/3021

1. TFT LCD Panel
2. Number Panel
3. Scroll Knob & Selection Key
4. Power Switch
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6. Main Output Switch
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12. Fan
13. GPIB
14. LAN
15. USB Device

The AFG-3000 Series Comes With Four Models. Model Number and Channel (s) are Listed as Follows:

MODEL MAIN FUNCTION	AFG-3031	AFG-3032	AFG-3021	AFG-3022
Frequency Range	1 Hz ~ 30 MHz	1 Hz ~ 30 MHz	1 Hz ~ 20 MHz	1 Hz ~ 20 MHz
Channel	1	2	1	2

GW Instek AFG-3000 Series arbitrary function generators include 20MHz/30MHz single isolated channel and 20MHz/30MHz dual isolated channel models, designed to meet industry, scientific research, and education applications. Not only output channel is earth ground isolation, dual channel models are also independently earth ground isolation, which is suitable for floating circuits (up to ±42V). Without taking grounding reference into consideration, each channel of dual channel models can be operated independently and multi ARB units can output simultaneously. Applications are, for instance, the ignition control or transmission device of automotive electronics. The series features sample rate of 250MSa/s, 16-bit resolution, and 8M point memory depth arbitrary waveform characteristics. Users can rebuild maximum 8M memory depth waveforms through using a GW Instek digital storage oscilloscope with the built-in DSOLink function of the AFG-3000 Series.

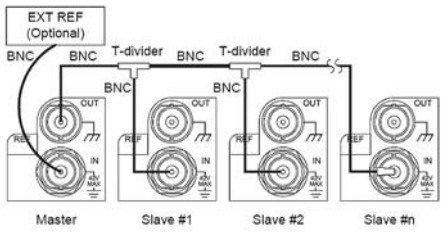
The series supports synchronized phase for multi channel operation and the maximum phase synchronization operation is up to 6 units and 12 channels. 10 MHz atomic clock frequency standard can be input via external signal source to elevate precision for frequency output. The series supports frequency sweep and amplitude sweep that can also integrate functions, including linear/logarithm, one-way (saw tooth)/two-way (triangle) waveforms, continuous/single trigger/gated trigger to meet various application requirements by applying different sweep methods. Frequency sweep tests the frequency response of electronic components such as filter and low frequency amplifier. Amplitude sweep simulates vibration tests (requires a vibration tester), and it also conducts aging tests of various materials and linearity tests of low frequency amplifier.

The main features of the AFG-3000 Series include output amplitude from 1mVpp to 10Vpp (connected with a 50 ohm load); frequency range from 1uHz to 20MHz or 30MHz; 1uHz frequency resolution; and built-in sine, square, pulse, triangle, ramp, DC voltage, harmonic and noise. The waveform width, rise edge time and fall edge time of pulse waveform can be adjusted flexibly. Pulse waveform, with duty cycle from 0.017% to 99.983%, can be applied as trigger signals. Users can conduct arbitrary editing via 65 built-in function waveforms. The series supports AM/FM/PM/FSK/PWM modulation, frequency sweep, amplitude sweep and burst to satisfy industrial application requirements. Dual channel models provide SUM modulation, coupling, tracking, and phase to meet the test requirements of differential signal, phase control and amplifier distortion. Built-in 8th harmonic signal generator simulates harmonic signal of switching power supplies and it also tests EMI power filter characteristics. The AFG-3000 Series provides free arbitrary waveform editing software (AWES) for users to quickly edit waveforms from the built-in diagrams so as to execute measurements.

A. CIRCUIT DESIGN FOR GROUND ISOLATION AMONG OUTPUT/INPUT TERMINAL, INSTRUMENT CHASSIS, AND DUAL CHANNELS

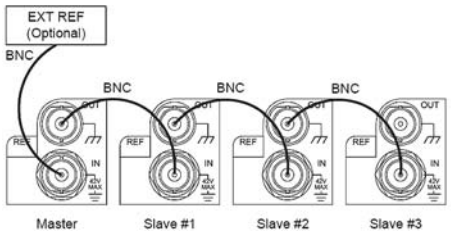
Channel 1, channel 2, reference 10 MHz input, synchronization and modulation input/output connector grounding are isolated from instrument chassis. The output channels of dual channel models are independently isolated. These connectors can sustain maximum isolation voltage up to ±42Vpk (DC+ AC peak value) to earth ground that is ideal for floating circuit tests. Multi units output can be achieved without factoring in grounding reference issue. Applications include ignition controller or transmission devices of automotive electronics. The built-in DC bias voltage of the AFG-3000 Series can be applied on various waveforms. The DC bias voltage is ±5V under 50Ω load. For automotive electronic applications require higher DC bias voltage such as ignition controller or transmission devices, the external power supplies can be used to bring up the DC bias voltage to ±42Vpk (DC+ AC peak value).

B. MULTI CHANNEL SYNCHRONIZED PHASE OPERATION



Method one uses reference frequency output (REF OUT) and reference frequency input (REF IN), 50 ohm BNC cable (RG-58A/U) and T type BNC connector to connect up to 6 units to conduct synchronized phase operation.

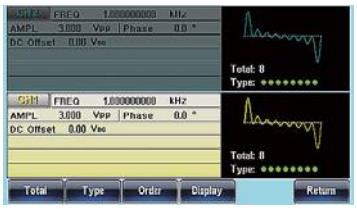
Users can implement multi channel synchronized phase operation up to 6 units and 12 channels (AFG-3032/3022). There are two methods to execute synchronized phase applications. Under different frequency, master unit can synchronize each channel and modulate individual



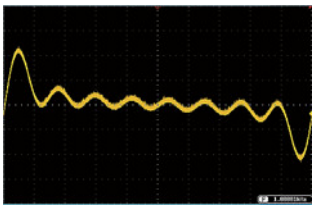
Method two uses reference frequency output (REF OUT) and reference frequency input (REF IN)), 50 ohm BNC cable (RG-58A/U) to connect up to 4 units to conduct synchronized phase operation.

phase. At 10 MHz reference frequency input (REF IN) connector, users can input 10 MHz atomic clock frequency standard via external signal source to enhance precision for frequency output.

C. HARMONIC SIGNAL GENERATOR



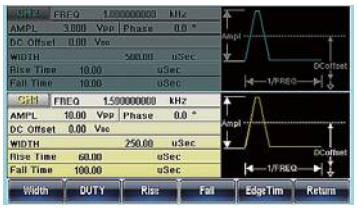
Harmonic Signal Generator



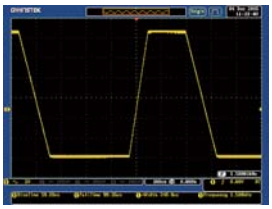
Harmonic Signal

Harmonic signal generator simulates the harmonic signal of switching power supplies and conducts characteristics tests on EMI power filter. Users can set order number and phase for harmonic signals to obtain desired signals. The following diagrams show 8th harmonic signal.

D. PULSE GENERATOR



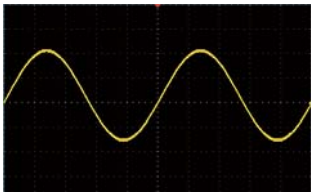
Pulse Generator



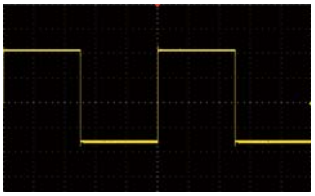
Pulse signal

The output frequency for pulse reaches 25 MHz and its duty cycle is from 0.017% to 99.983%. Users can set pulse width, duty cycle, rise edge time, fall edge time and edge time to support trigger signal. The following diagrams show settings for pulse signal.

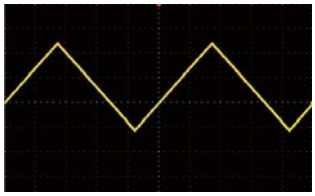
E. VERSATILE OUTPUT WAVEFORM SELECTIONS



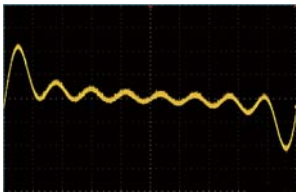
Sine



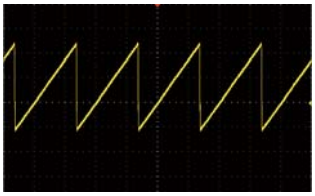
Square



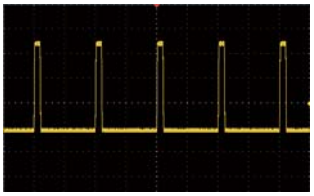
Triangle



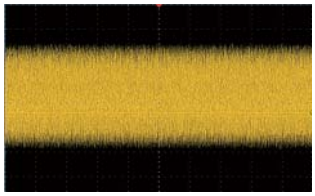
Harmonic



Ramp



Pulse

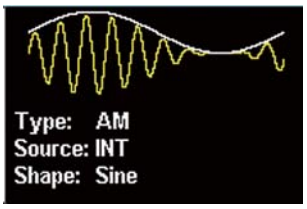


Noise

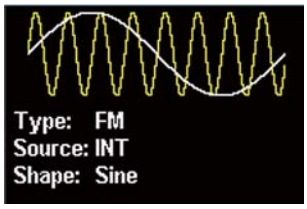
DC Voltage

65 built-in function waveforms include engineering applications, medical electronics, mathematics, and standard waveforms such as sine, square, triangle, ramp, pulse, noise, harmonic, and DC voltage that allow users to easily select desired waveforms. Users can select and edit 65 function waveforms from the arbitrary function.

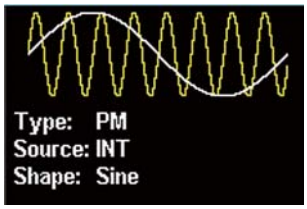
F. MODULATION FUNCTION



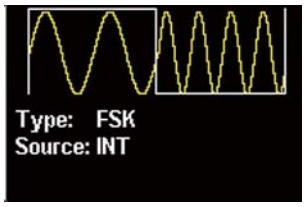
Amplitude Modulation



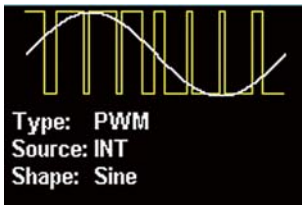
Frequency Modulation



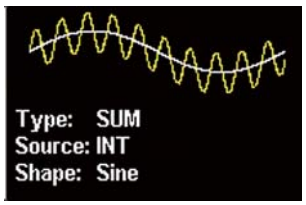
Phase Modulation



Frequency-shift Keying Modulation



Pulse Width Modulation



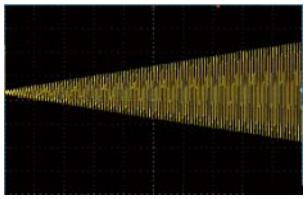
Sum Modulation

The series supports AM, FM, PM, FSK, PWM and SUM modulation. Modulation source can be from inside or outside.

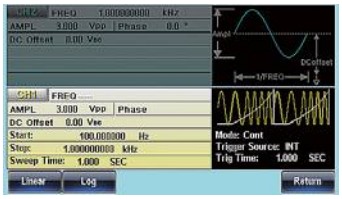
Applications include the baseband of communications systems, motor control and light adjustment, etc.

G. SWEEP FUNCTION

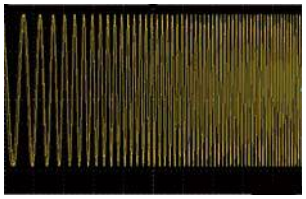
Amplitude Sweep Setting



Amplitude Sweep Signal



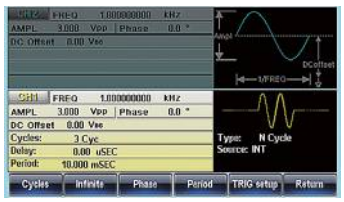
Frequency Sweep Setting



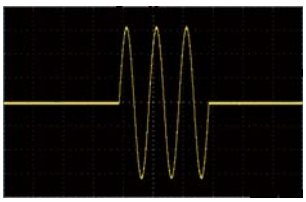
Frequency Sweep Signal

The series supports frequency sweep and amplitude sweep that can also integrate functions, including linear/logarithm, one-way (saw tooth)/two-way (triangle) waveforms, continuous/single trigger/gated trigger to meet various application requirements by different sweep methods. Frequency sweep carries out tests on the frequency response of electronic components such as filter and low frequency amplifier. Amplitude sweep simulates vibration tests (requires a vibration tester), and it also conducts aging tests of various materials and linearity tests of low frequency amplifier.

H. BURST FUNCTION



Burst Setting



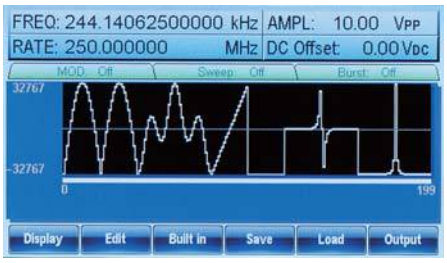
Burst Signal

The series supports N-period or gated trigger. Phase angle, duration time, frequency, waveform infinite can be adjusted to meet non-continuous output applications.

I. FLEXIBLE ARBITRARY WAVEFORM EDITING

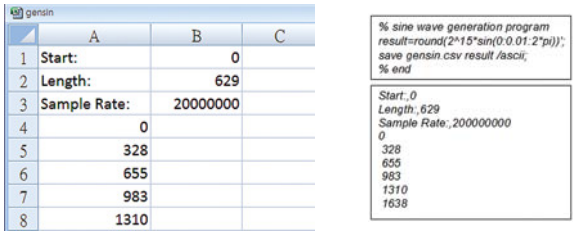
Four methods to obtain arbitrary waveforms

- **Front Panel Operation**



Via single unit's panel, arbitrary waveforms can be selected, edited, stored, recalled, output, triggered from 65 built-in waveforms.

- **CSV file Upload**



	A	B	C
1	Start:	0	
2	Length:	629	
3	Sample Rate:	20000000	
4	0		
5	328		
6	655		
7	983		
8	1310		

```
% sine wave generation program
result=round(2^15*sin(0:0.01:2*pi));
save gensin.csv result /ascii;
% end
```

```
Start:,0
Length:,629
Sample Rate:,200000000
0
328
655
983
1310
1638
```

Supports CSV file

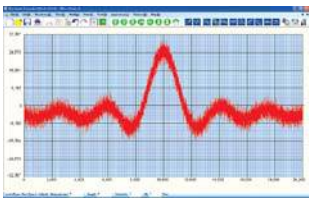
Support CSV file upload produced by MATLAB and Excel.

- **Direct Waveform Reconstruction (DWR)**

Direct Waveform Reconstruction from the DSO

Collocate with GDS series digital oscilloscopes to retrieve waveforms and upload them to arbitrary generator to achieve direct waveform reconstruction.

- **Arbitrary Waveform Editing PC Software**

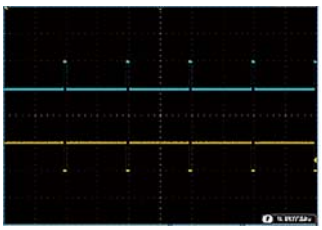


A Sinc Waveform with Gaussian Noise

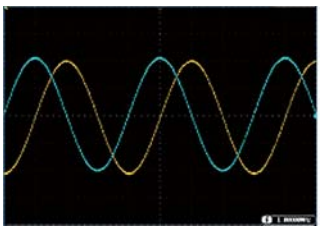
Digital Signal

Use AWES to edit complex waveforms. The software supports waveform mathematical operation. The waveform series includes Uniform Noise, Gaussian Noise, Rayleigh Noise, various digital codes such as non zero code, Manchester and RS-232, etc.

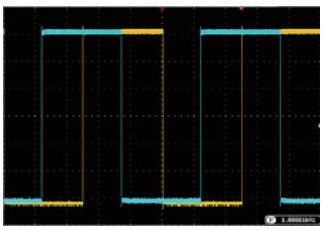
J. CORRELATED FUNCTIONS OF DUAL CHANNEL OUTPUTS



Differential signal



Sine and cosine signal



Square signal phase adjustment

AFG-3032/3022 models support independent channel or correlated channel applications. Four correlated functions are provided including SUM modulation, coupling, tracking, and phase.

* SUM modulation combines two signals and outputs the signal via one single channel. Combining noise and sine waveform to execute speaker's distortion test is one of the applications.
* Coupling function arbitrarily sets ratio and difference for frequency and amplitude between two channels to realize a simultaneous effect for all parameters of dual channel. The example is amplifier using third order interpolation point(IP3) measurement to simulate signal output of two different frequency oscillators.
* Tracking function produces differential signal with same frequency, same amplitude, and 180 degree phase difference.
* Phase function arbitrarily sets phase parameters between two channels such as simulating sine/ cosine/square signal phase adjustment.

SPECIFICATIONS

			AFG-3031	AFG-3032	AFG-3021	AFG-3022
CHANNELS			1	2	1	2
FEATURES	**I/O Signal Ground for the Instrument Chassis**		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 ±42 Vpk. (DC + AC Peak)			
	Each of the Signal Ground of CH1/CH2		—	Isolated	—	Isolated
	Standard Waveforms		Sine, Square, Triangle, Ramp, Pulse, Noise, Harmonic			
ARBITRARY WAVEFORMS	**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 ~ 8M points			
	Trigger		External			
	Built-in Arbitrary Waveforms		Sine, Square, Ramp, Sinc,Pulse, DC, Sin(x)/x, Exponential Rise, Exponential Fall, Negative Ramp, Absatan, Havercosine, Sinever, Abssin, 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, In, Sqrt, Exporise, Lorentz, Xsquare, Expofall, Gauss, Since, 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			
FREQUENCY CHARACTERISTICS	**Sine / Square**		1μHz ~ 30MHz	1μHz ~ 30MHz	1μHz ~ 20MHz	1μHz ~ 20MHz
	Pulse		1μHz ~ 25MHz	1μHz ~ 25MHz	1μHz ~ 20MHz	1μHz ~ 20MHz
	Triangle / Ramp		1μHz ~ 1MHz			
	Resolution		1μHz			
	Accuracy	**Stability**	±1 ppm 0 ~ 50℃ ; ±0.3 ppm 18 ~ 28℃			
		Aging	±1 ppm, per 1 year			
		Tolerance	≦ 1 μHz			
OUTPUT CHARACTERISTICS (2)	**Amplitude**	**Range**	1 mVpp ~ 10 Vpp (into 50Ω); 2 mVpp to 20 Vpp (into open-circuit)			
		Accuracy	± 1% of setting ±1 mVpp (at 1 kHz / into 50Ω without DC offset)			
		Resolution	0.1 mV or 4 digits			
		Flatness	0.1dB <10 MHZ; 0.2 dB 10 MHz ~ 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	1% of setting + 2 mV+ 0.5% of amplitude			
	Waveform Output	**Impedance**	50Ω typical (fixed); > 10MΩ (output disabled)			
		Protection	Short-circuit protected ; Overload relay automatically disables main output			
	SYNC Output	**Level**	TTL-compatible into>1kΩ			
		Impedance	50Ω nominal			
SINE WAVE CHARACTERISTICS	**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 ~ 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)			
	Phase Noise		<-110dBc/Hz typical, 15 kHz offset, fc = 10MHz			
SQUARE WAVE CHARACTERISTICS	**Rise/Fall Time**		<8 ns (3)			
	Overshoot		< 5%			
	Asymmetry		1% of period+1 ns			
	Variable Duty Cycle		20.0%~80.0%, ≦ 25 MHz; 40.0%~60.0% , 25~30MHz		20.0%~80.0% , ≦ 20 MHz	
	Jitter		0.01%+525ps<2 MHz; 0.1%+75ps>2 MHz			
RAMP CHARACTERISTICS	**Linearity**		< 0.1% of peak output			
	Variable Symmetry		0% ~ 100% (0.1% resolution)			
PULSE CHARACTERISTICS	**Pulse Width**		20ns ~ 999,830s; Period ≧ Width-0.625 [(Rise Time-0.6ns)+(Fall Time-0.6ns)]			
	Duty Setting Range		0.017% ~ 99.983%			
	Period		40ns ~ 1,000,000s			
	Rise Time and Fall Time		9.32 ns ~ 799,900s (0.01ns or 3 digit resolution)			
	Resolution		0.0001%			
	Overshoot		<5%			
	Jitter		100 ppm + 50 ps			
HARMONIC	**Harmonic Order**		≦8			
	Harmonic Type		Even, Odd, All, User ; Amplitude and Phase can be set for all harmonics			
AM	**Carrier Waveforms**		Sine, Square, Triangle, Ramp, Pulse, Arb			
	Modulating Waveforms		Sine, Square, Triangle, Up/Dn Ramp			
	Modulating Frequency		2 mHz ~ 20 kHz			
	Depth		0% ~ 120.0%			
	Source		Internal / External			
FM	**Carrier Waveforms**		Sine, Square, Triangle, Ramp			
	Modulating Waveforms		Sine, Square, Triangle, Up/Dn Ramp			
	Modulating Frequency		2 mHz ~ 20 kHz			
	Peak Deviation		DC ~ 30 MHz (1μHz resolution)		DC~20 MHz (1μHz resolution)	
	Source		Internal / External			
PM	**Carrier Waveforms**		Sine, Triangle, Ramp			
	Modulating Waveforms		Sine, Square, Triangle, Up/Dn Ramp			
	Phase Deviation		0°~ 360°, 0.1° resolution			
	Modulating Frequency		2 mHz ~ 20 kHz			
	Source		Internal			
PWM	**Carrier Waveforms**		Square			
	Modulating Waveforms		Sine, Square, Triangle, Up/Dn Ramp			
	Modulating Frequency		2 mHz ~ 20 kHz			
	Deviation		0% ~ 100.0% of pulse width, 0.1% resolution			
	Source		Internal / External			
ADDITIVE MODULATION (SUM)	**Carrier Waveforms**		Sine, Triangle, Ramp, Pulse, Noise			
	Modulating Waveforms		Sine, Square, Triangle, Up/Dn Ramp			
	Ratio		0% ~ 100% of carrier amplitude, 0.01% resolution			
	Modulating Frequency		2 mHz ~ 20 kHz			
	Source		Internal / External			
FSK	**Carrier Waveforms**		Sine, Square, Triangle, Ramp			
	Modulating Waveforms		50% duty cycle square			
	Internal Rate		2 mHz ~ 1 MHz			
	Frequency Range		DC ~ 30 MHz		DC ~ 20 MHz	
	Source		Internal / External			

GW INSTEK
Simply Reliable

Tetszőleges kimenőjel funkciógenerátorok, AFG-3000 sorozat

SPECIFICATIONS

		AFG-3031	AFG-3032	AFG-3021	AFG-3022
SWEEP	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 F / Stop FREQ	Any frequency within the waveform's range			
	Sweep Time	1 ms ~ 500 s (1 ms resolution)			
	Trigger Mode	Single, External, Internal			
	Trigger Source	Internal / External			
BURST	Waveforms	Sine, Square, Triangle, Ramp, Pulse, Noise			
	Frequency	1 μHz ~ 30 MHz (4)	1 μHz ~ 30 MHz (4)	1 μHz ~ 20 MHz	1 μHz ~ 20 MHz
	Burst Count	1 ~ 1,000,000 cycles or Infinite			
	Start / Stop Phase	-360.0°~ +360.0° (0.1° resolution)			
	Internal Period	1 s ~ 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 : 0 s ~ 100s (1us resolution)			
EXTERNAL MODULATION INPUT	Type	AM, FM, PWM			
	Voltage Range	± 5V full scale			
	Input Impedance	10kΩ			
	Frequency	DC ~ 20 kHz			
MODULATION OUTPUT		Yes	—	Yes	—
	Type	AM, FM, PM, PWM, SUM, Sweep			
	Amplitude Range	≧ 1Vpp			
	Impedance	> 10kΩ typical			
EXTERNAL TRIGGER INPUT	Type	For FSK, Burst, Sweep, N Cycle ARB			
	Input Level	TTL Compatibility			
	Slope	Rising or Falling (Selectable)			
	Pulse Width	> 100 ns			
	Input rate	DC ~ 1 MHz			
	Input Impedance	10kΩ,DC coupled			
	Latency	Sweep : < 10 s (typical); Burst : < 100 ns (typical)			
	Jitter	Sweep : 2.5 s ; Burst : 1 ns , except pulse,300 ps			
10MHz REFERENCE OUTPUT	Output Voltage	1 Vp-p / 50 Ω square wave			
	Output Impedance	50 Ω, AC coupled			
	Output Frequency	10MHz			
10MHz REFERENCE INPUT	Input Voltage	0.5Vpp ~ 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) x 39 ±25nS; Parallel connection : (N-1) x 6 ±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 x 3 (RGB) x 272			
GENERAL SPECIFICATIONS	Power Source	AC100 ~ 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 & Weight	265 (W) x 107 (H) x 374 (D)mm, Approx. 4kg			

The specifications apply when the function generator is powered on for at least 30 minutes under +20°C~+30°C. Specifications subject to change without notice. FG-303132GD1BH

Note :
1. A total of ten waveforms can be stored(Every waveform can composed of 8M points maximum)
2. Add 1/10 th of output amplitude and offset specification perC for operation outside of 0C~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

ORDERING INFORMATION

AFG-3031 30MHz Single channel Arbitrary Function Generator
AFG-3032 30MHz Dual channel Arbitrary Function Generator
AFG-3021 20MHz Single channel Arbitrary Function Generator
AFG-3022 20MHz Dual channel Arbitrary Function Generator

ACCESSORIES

Quick Start Guide *1, CD-ROM with AFG software and user manual x 1
GTL-101 BNC-Alligator Test Lead x 1 (only AFG-3031/3021)
GTL-101 BNC-Alligator Test Lead x 2 (only AFG-3032/AFG-3022)

OPTIONAL

Opt.01 GPIB Interface

OPTIONAL ASSESSORIES

GTL-246 USB Type A to Type B cable

FREE DOWNLOAD

PC Software Arbitrary Waveform Editing Software

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