Datasheet

Single & Dual channel Arbitrary Function Generator

Stock No. : Model :
1225620  AFG-30021
1225621  AFG-30022
1225622  AFG-30031
1225623  AFG-30032

FEATURES

• 1 µHz – 20 or 30MHz, 20Vpp. 1 or 2 Channel(s)
• Arbitrary Waveform 250MSa/s, 16-bit Resolution, 8M Memory Depth
• Isolation Channel Circuit Design
• Synchronized Phase Operates up to 6 Units and 12 Channels
• Harmonic Signal Generator
• Dual Channel Models Support SUM Modulation, Coupling, Tracking, and Phase Functions
• Pulse Waveform Parameters Can be Set Independently
• Built-in AM/FM/PM/FSK/PWM/SUM Modulation, Sweep and Burst Functions
• Provide USB/LAN/GPIB (Optional) Instrument Control Interface
The AFG-30000 Series Comes With Four Models. Model Number and Channel(s) are Listed as Follows:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>AFG-30031</th>
<th>AFG-30032</th>
<th>AFG-30021</th>
<th>AFG-30022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>1 μHz – 30 MHz</td>
<td>1 μHz – 30 MHz</td>
<td>1 μHz – 20 MHz</td>
<td>1 μHz – 20 MHz</td>
</tr>
<tr>
<td>Channel</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

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
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 circuits. 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-30000 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).

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. 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.

Users can implement multi channel synchronized phase operation up to 6 units and 12 channels (AFG-30032/30022). There are two methods to execute synchronized phase applications. Under different frequency, master unit can synchronize each channel and modulate individual 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 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

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

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*
- Type: AM
- Source: INT
- Shape: Sine

*Frequency Modulation*
- Type: FM
- Source: INT
- Shape: Sine

*Phase Modulation*
- Type: PM
- Source: INT
- Shape: Sine

*Frequency-shift Keying Modulation*
- Type: FSK
- Source: INT

*Pulse Width Modulation*
- Type: PWM
- Source: INT

*Sum Modulation*
- Type: SUM
- Source: INT

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.

- **Direct Waveform Reconstruction (DWR)**

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

- **CSV file Upload**

  Support CSV file upload produced by MATLAB and Excel.

- **Arbitrary Waveform Editing PC Software**

  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.

### Differential signal

![Differential signal](image1)

### Sine and cosine signal

![Sine and cosine signal](image2)

### Square signal phase adjustment

![Square signal phase adjustment](image3)

II. **CORRELATED FUNCTIONS OF DUAL CHANNEL OUTPUTS**

AFG-30032/30022 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.
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>AFC-30031</th>
<th>AFC-30032</th>
<th>AFC-30021</th>
<th>AFC-30022</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/O Signal Ground for the Instrument Chassis</td>
<td>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)</td>
<td>-</td>
<td>-</td>
<td>Isolated</td>
</tr>
<tr>
<td>Each of the Signal Ground of CH1/CH2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard Waveforms</td>
<td>Sine, Square, Triangle, Ramp, Pulse, Noise, Harmonic</td>
<td>-</td>
<td>-</td>
<td>Isolated</td>
</tr>
<tr>
<td>ARBITRARY WAVEFORMS</td>
<td>Sample Rate: 250 MSa/s</td>
<td>Repetition Rate: 125MHz</td>
<td>Amplitude Resolution: 8M points</td>
<td>Non-Volatile Memory: 16 bits</td>
</tr>
<tr>
<td>Waveform Length</td>
<td>Ten 8WV6M waveforms (1)</td>
<td>Any section from 2 – 8M points</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AM/PM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HARMONIC CHARACTERISTICS</td>
<td>Harmonic Type: Even, Odd, All; User: Amplitude and Phase can be set for all harmonics</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SOURCE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PM CHARACTERISTICS</td>
<td>Linear</td>
<td>Variable Symmetry</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2 mHz ~ 20 kHz</td>
<td>-0.1% of peak output</td>
<td>0% ~ 100% (0.1% resolution)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PULSE CHARACTERISTICS</td>
<td>Duty Setting Range: 0.017% ~ 99.983%</td>
<td>Period: 0° to 360°</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2 mHz ~ 20 kHz</td>
<td>-</td>
<td>0% ~ 100% (0.1% resolution)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SOURCE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FM CHARACTERISTICS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AM</td>
<td>Sine, Square, Triangle, Ramp, Pulse, Noise</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
</tr>
<tr>
<td>SOURCE</td>
<td>Internal</td>
<td>External</td>
<td>Internal</td>
<td>External</td>
</tr>
<tr>
<td>PM SOURCE</td>
<td>Internal</td>
<td>External</td>
<td>Internal</td>
<td>Internal</td>
</tr>
<tr>
<td>PWM CHARACTERISTICS</td>
<td>Square</td>
<td>Square, Square, Triangular, Up/Dn Ramp</td>
<td>Square, Square, Triangular, Up/Dn Ramp</td>
<td>Square</td>
</tr>
<tr>
<td>2 mHz ~ 20 kHz</td>
<td>-</td>
<td>0% ~ 100% (0.1% resolution)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SOURCE</td>
<td>Internal</td>
<td>External</td>
<td>Internal</td>
<td>Internal</td>
</tr>
<tr>
<td>ADDITIVE MODULATION (SUM)</td>
<td>Sine, Square, Triangle, Ramp, Pulse, Noise</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
<td>Sine, Square, Triangle, Up/Dn Ramp</td>
</tr>
<tr>
<td>SOURCE</td>
<td>Internal</td>
<td>External</td>
<td>Internal</td>
<td>External</td>
</tr>
<tr>
<td>FSK CHARACTERISTICS</td>
<td>Sine, Square, Triangle, Ramp</td>
<td>50% duty cycle square</td>
<td>50% duty cycle square</td>
<td>50% duty cycle square</td>
</tr>
<tr>
<td>SOURCE</td>
<td>Internal</td>
<td>External</td>
<td>Internal</td>
<td>External</td>
</tr>
</tbody>
</table>

**CHANNELS**

- **AFG-30031**
- **AFG-30032**
- **AFG-30021**
- **AFG-30022**

**SPECIFICATIONS**

- **Connection Chassis**: From the instrument's chassis. Maximum allowable voltage on isolated connector shells is ±42 Vpk (DC + AC Peak).
- **Connector shells for channel output(s)**: 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**: ±42 Vpk (DC + AC Peak).
- **Isolated Connector Shells**: Connector shells for channel output(s), Sync output, 10MHz REF Input, Mod Input and Mod output are isolated from the instrument's chassis.
- **Isolated**: Connector shells for channel output(s), Sync output, 10MHz REF Input, Mod Input and Mod output are isolated from the instrument's chassis.
### Specifications

| Waveforms | Frequency Sweep : Sine, Square, Triangle, Ramp; Amplitude Sweep : Sine, Square, Triangle, Ramp, Pulse, Noise, ARB
| Direction | Linear or Logarithmic
| 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
| Burst Count | 1 T ~ 1,000,000 cycles or Infinite
| Start / Stop Phase | 360.0 ~ 360.0° (0.1° resolution)
| Internal Period | 1 µs ~ 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 µs – 100s (1µs resolution)

| External Modulation Input Type | AM, FM, PM, PWM
| Voltage Range | ±5V full scale
| Input Impedance | 10kΩ
| Frequency | DC ~ 20 kHz

| MODULATION OUTPUT Type | AM, FM, PM, PWM, SUM, Sweep
| Amplitude Range | ±1Vpp
| Input Impedance | >10kΩ typical
| Frequency | DC ~ 20 kHz

| 10MHz REFERENCE OUTPUT Output Voltage | 1 Vpp / 30 Ω square wave
| Output Impedance | 50 Ω, AC coupled
| Frequency | 10MHz

| 10MHz REFERENCE INPUT Input Voltage | 0.5Vpp – 5VPp
| Input Impedance | 1kΩ, unbalanced, AC coupled
| Input Frequency | 10MHz ± 0.1Hz
| Waveform | Sine or Square (50±5% duty)
| Ground Isolation | 42Vpk max.

| EXTREF-SYNC Phase Delay (max.) | Series Connection : 39s × (N-2) × 39 ±25ns; Parallel Connection : (N-1) × 25ns (where N=number of connected units)
| Maximum Number of Connected Units | Series Connection : 39s / Parallel Connection : 6
| Applicable Functions | Sine, Square, Triangle, Pulse, Ramp, Harmonic, MOD, Sweep, Burst

| General Specifications Power Source | AC100 ~ 240V, 50 / 60Hz
| 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
| Maximum Power | 2000 meters
| Pollution Degree | IEC 61010 Degree 2, Indoor Use
| Storage Temperature | -10 ~ 70°C, Humidity : ≤ 70%

| ORDERING INFORMATION AFG-30031 | 30MHz Single channel Arbitrary Function Generator
| AFG-30032 | 30MHz Dual channel Arbitrary Function Generator
| AFG-30021 | 20MHz Single channel Arbitrary Function Generator
| AFG-30022 | 20MHz Dual channel Arbitrary Function Generator

| OPTICAL Options | Opt.01 GPIB Interface

| OPTIONAL ACCESSORIES | GTL-246 USB Type A to Type B cable

| FREE DOWNLOAD | PC Software Arbitrary Waveform Editing Software

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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.

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Note 1: A total of ten waveforms can be stored (Every waveform can be composed of 8M points maximum)

Note 2: Add 1/10 th of output amplitude and offset specification per C for operation outside of 0 ~ +20°C C range (1 year specification)

Note 3: 3. Edge time decreased at higher frequency

Note 4: Sine and square waveforms above 25 MHz are allowed only with an “Infinite” count

Note 5: Harmonic distortion and Spurious noise at low amplitudes is limited by a -70 dBm floor