

Arbitrary Function Generator

AFG-3021, AFG-3022, AFG-3031 & AFG-3032

QUICK START GUIDE

GW INSTEK PART NO. 82FG-30320M01



ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

February 2016 edition

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Table of Contents

SAFETY INSTRUCTIONS	4
GETTING STARTED	10
Main Features	10
Panel Overview	12
Selecting a Waveform	20
Modulation	23
Sweep	26
Burst	26
ARB	27
Utility Menu	30
AFG-3021, AFG-3022, AFG-3031 & AFG-3032 Specifications	33
EC Declaration of Conformity	40

S SAFETY INSTRUCTIONS

This chapter contains important safety instructions that should be followed when operating and storing the function generator. Read the following before any operation to ensure your safety and to keep the function generator in the best condition.

Safety Symbols

These safety symbols may appear in this manual or on the instrument.



WARNING

Warning: Identifies conditions or practices that could result in injury or loss of life.



CAUTION

Caution: Identifies conditions or practices that could result in damage to the function generator or to other objects or property.



DANGER High Voltage



Attention: Refer to the Manual



Signal ground. Chassis ground



Signal ground. Isolated from other channels and ground.



Do not dispose electronic equipment as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased.

Safety Guidelines

General Guideline







CAUTION

- Do not place heavy objects on the instrument.
- Do not place flammable objects on the instrument.
- Avoid severe impact or rough handling that may damage the function generator.
- Avoid discharges of static electricity on or near the function generator.
- Use only mating connectors, not bare wires, for the terminals.
- The instrument should only be disassembled by a qualified technician.
- Do not apply more than 42Vpk to any input/output ground or to the chassis ground.
- Do not apply voltage to the output terminals to avoid damage to the instrument.
- Do not apply more than $\pm 5V$ to the trigger or MOD input terminals to avoid damage to the instrument.

(Measurement categories) EN 61010-1:2010 specifies the measurement categories and their requirements as follows. The AFG-30XX falls under category II.

- Measurement category IV is for measurement performed at the source of a low-voltage installation.
- Measurement category III is for measurement performed in a building installation.
- Measurement category II is for measurement performed on circuits directly connected to a low voltage installation.
- Measurement category I is for measurements performed on circuits not directly connected to Mains.

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- | | |
|---|---|
| Power Supply | <ul style="list-style-type: none">• AC Input voltage: 100 - 240V AC, 50 - 60Hz. |
|  WARNING | <ul style="list-style-type: none">• Connect the protective grounding conductor of the AC power cord to an earth ground to prevent electric shock. |
-
- | | |
|---|--|
| Fuse | <ul style="list-style-type: none">• Fuse type:
AFG-3032&3022: T1A/250V
AFG-3021&3031: T0.63A/250V |
|  WARNING | <ul style="list-style-type: none">• Only qualified technicians should replace the fuse.• To ensure fire protection, replace the fuse only with the specified type and rating.• Disconnect the power cord and all test leads before replacing the fuse.• Make sure the cause of the fuse blowout is fixed before replacing the fuse. |
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- | | |
|---|--|
| Ground | <ul style="list-style-type: none">• The AFG-30XX is a floating function generator; the AFG-30XXs' common ground is electrically isolated from the chassis ground by a 42Vpk isolation voltage (DC + peak AC). Exceeding 42Vpp may cause damage to the internal circuits. |
|  CAUTION | <ul style="list-style-type: none">• Do not short the chassis ground with CH1(MAIN)'s or CH2's common ground if there is a potential voltage difference between them. Doing so may damage the unit or externally connected equipment.• If there is a potential voltage between CH1's and CH2's common ground, do not short them. Doing so may damage the unit or externally connected equipment. |
-
- | | |
|---|--|
|  WARNING | <ul style="list-style-type: none">• To avoid electric shock ensure that the output voltage and floating voltage does not exceed 42Vpk in total.• Do not touch any exposed connectors when the unit is being operated. |
|---|--|
-

Cleaning the function generator	<ul style="list-style-type: none">• Disconnect the power cord before cleaning the function generator.• Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid into the function generator.• Do not use chemicals containing harsh products such as benzene, toluene, xylene, and acetone.
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Operation Environment	<ul style="list-style-type: none">• Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution (Note below) and avoid strong magnetic fields.• Relative Humidity: < 80%• Altitude: < 2000m• Temperature: 0°C to 40°C <p>(Pollution Degree) EN 61010-1:2010 specifies pollution degrees and their requirements as follows. The function generator falls under degree 2.</p> <p>Pollution refers to “addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity”.</p> <ul style="list-style-type: none">• Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.• Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.• Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.
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Storage environment	<ul style="list-style-type: none">• Location: Indoor• Relative Humidity: < 70%• Temperature: -10°C to 70°C
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Disposal

Do not dispose this instrument as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased. Please make sure discarded electrical waste is properly recycled to reduce environmental impact.

Class A Device**WARNING**

The AFG-30XX function generators are categorized as Class A equipment. Class A equipment is intended for use in an industrial environment. Class A equipment may have potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

Power cord for the United Kingdom

When using the function generator in the United Kingdom, make sure the power cord meets the following safety instructions.

NOTE: This lead/appliance must only be wired by competent persons

 **WARNING: THIS APPLIANCE MUST BE EARTHED**

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

Green/ Yellow:	Earth
Blue:	Neutral
Brown:	Live (Phase)



As the colours of the wires in main leads may not correspond with the coloured marking identified in your plug/appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with either the letter E, the earth symbol \oplus or coloured Green/Green & Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse: refer to the rating information on the equipment and/or user instructions for details. As a guide, a cable of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any exposed wiring from a cable, plug/ connection that is engaged in a live socket is extremely hazardous. If a cable or plug is deemed hazardous, turn off the mains power and remove the cable, any fuses and fuse assemblies. All hazardous wiring must be immediately destroyed and replaced in accordance to the above standard.

GETTING STARTED

The Getting started chapter introduces the function generator's main features, appearance, set up procedure and power-up.

Note: Throughout this document, "AFG-30XX" refers to the AFG-3021, AFG-3022, AFG-3031 & AFG-3032, unless stated otherwise.

Main Features

Model name	Frequency bandwidth	Channels
AFG-3021	20MHz	1 (signal ground chassis isolation)
AFG-3022	20MHz	2 (signal ground chassis isolation and channel isolation)
AFG-3031	30MHz	1 (signal ground chassis isolation)
AFG-3032	30MHz	2 (signal ground chassis isolation and channel isolation)

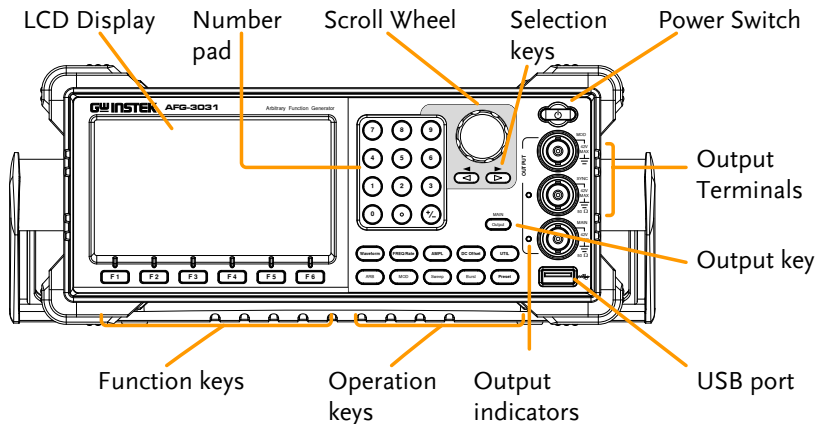
- Performance
- DDS Function Generator series
 - 1 μ Hz high frequency resolution maintained at full range
 - 1ppm frequency stability
 - Full Function Arbitrary Waveform Capability
 - 250 MSa/s sample rate
 - 125 MSa/s repetition rate
 - 8 M-point waveform length
 - 16-bit amplitude resolution

	<ul style="list-style-type: none">-Ten 8 M waveform memories-True waveform output to display-D W R (Direct Waveform Reconstruction) capability-Waveform editing capability sans PC-N Cycle and Infinite output mode selectable
	<ul style="list-style-type: none">• -60dBc low distortion sine wave
Features	<ul style="list-style-type: none">• Sine, Square, Triangle, Pulse, Ramp, Noise, DC standard waveforms• Int/Ext AM, FM, PWM, FSK, PM, SUM modulation• Modulation/sweep signal output• Burst function with internal and external triggers• Store/recall 10 groups of setting memories• Output overload protection• Two channel tracking (AFG-3022/3032 only)• 42Vpk signal ground chassis isolation and 42Vpk channel isolation• Multi-unit synchronized control• DSO Link function to transfer captured waveforms from the DSO to the function generator• Harmonic waveform function• Pulse waveform with configurable rise times & fall times• Frequency and amplitude sweep
Interface	<ul style="list-style-type: none">• Interface: LAN, USB (standard), GPIB (optional)• 4.3 inch color TFT LCD (480 × 272) Graphical User Interface• AWES (Arbitrary Waveform Editing Software) PC software

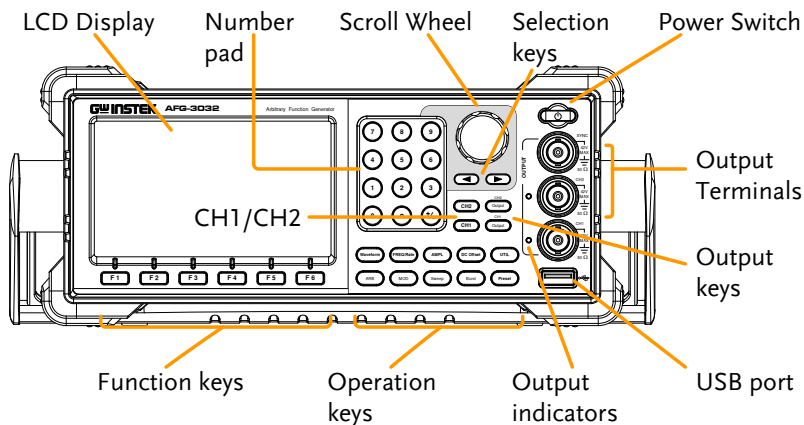
Panel Overview

Front Panel

AFG-3021/3031



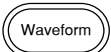
AFG-3022/3032

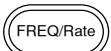



LCD display TFT color LCD display, 480 x 272 resolution.

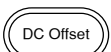
Function keys:
F1~F6  Activates the functions which appear in the bottom of the LCD display.


Operation keys

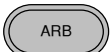
 Waveform is used to select a waveform type.


 The FREQ/Rate key is used to set the frequency or sample rate.

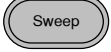
 AMPL sets the waveform amplitude.

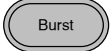
 Sets the DC offset.


 The UTIL key is used to access the save and recall options, set the remote interface (USB, GPIB, LAN), use DSO link (AFG-3021/3031), update and view the firmware version, access the calibration options, output impedance settings (AFG-3021/3031 only), set the language and access the help menu.


 ARB is used to set the arbitrary waveform parameters.


 The MOD, Sweep and Burst keys are used to set the modulation, sweep and burst settings and parameters.





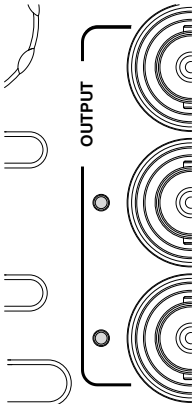


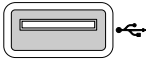
Preset  The preset key is used to recall a preset state.

Main Output (AFG-3021/3031)		The Output key is used to turn on or off the waveform output.
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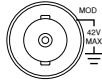
CH1/CH2 Output (AFG-3022/3032)		CH1/CH2 Output key. These keys are used to turn the output on or off for each individual channel.
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CH1/CH2 (AFG-3022/3032)	 	The CH1/CH2 keys are used to access the DSO link function, output impedance settings and phase settings for the AFG-3022 & AFG-3032.
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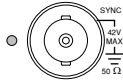
Output indicators		When an Output indicator is green, it indicates that the output is active.
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USB host connector		The USB Host connector is used to save and restore data as well as update the firmware.
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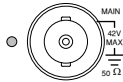
Output terminals
(AFG-3021/3031)



Modulation output terminal for the AM, FM, PWM, PM, SUM or sweep function.



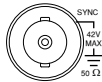
The SYNC output terminal outputs a TTL logic level signal in phase with the zero phase position of the main output. 50Ω output impedance.



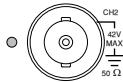
The primary output terminal. 50Ω output impedance.

Note: The MAIN ground has a common ground with the MOD output, SYNC and MOD input terminals. They are also isolated from the chassis ground and the 10MHz REF IN ground by an isolation voltage of 42Vpk.

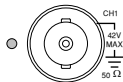
Output terminals
(AFG-3022/3032)



The SYNC output terminal outputs a TTL logic level signal in phase with the zero phase position of the CH1 output. 50Ω output impedance.



CH2 output terminal. 50Ω output impedance.



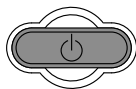
CH1 output terminal. 50Ω output impedance.

Note: The CH1, CH2 and 10MHz REF IN ground are isolated from each other and from the chassis ground by an isolation voltage of 42Vpk.

The CH1 ground has a common ground with the MOD output, SYNC and the CH1 MOD input terminals.

The CH2 ground has a common ground with the CH2 MOD input terminal.

Standby key



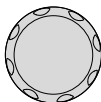
The standby key is used to turn the function generator on (green) or to put the function generator into standby mode (red).

Selection keys

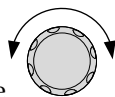


Used to select digits when editing parameters.

Scroll Wheel

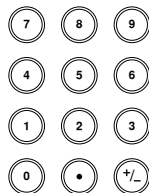


The scroll wheel is used to edit values and parameters.



Decrease Increase

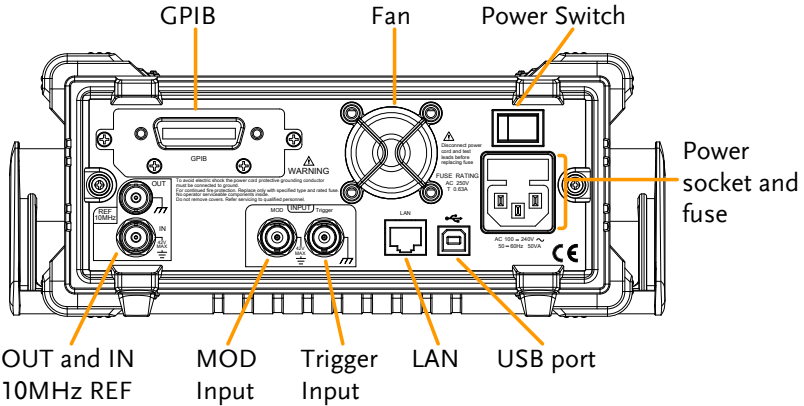
Keypad



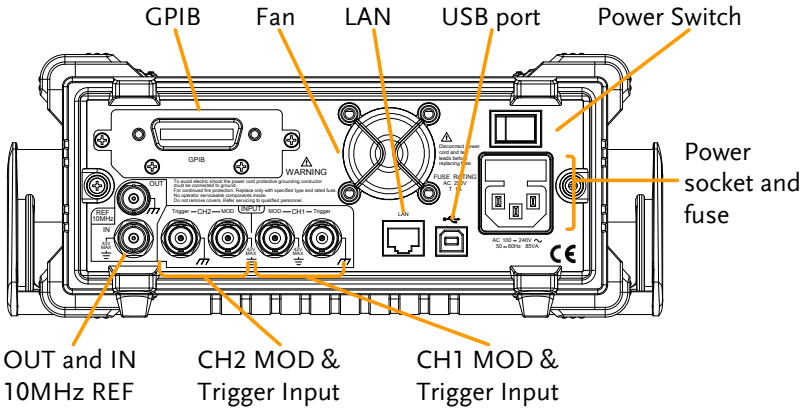
The digital keypad is used to enter values and parameters. The keypad is often used in conjunction with the selection keys and variable knob.

Rear Panel

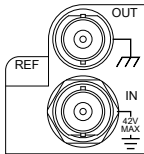
AFG-3021/3031



AFG-3022/3032



10MHz REF OUT

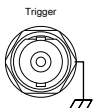


10 MHz reference output.

10MHz REF IN

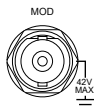
10 MHz reference input. The 10MHz REF IN ground has a 42Vpk isolation from the CH1(MAIN), CH2 and chassis ground.

Trigger Input



External trigger input. Used to receive external trigger signals. For the AFG-3022/3032 there is a separate trigger input for CH1 and CH2.

MOD input



Modulation input terminal. For the AFG-3022/3032 there is a separate modulation input for CH1 and CH2.

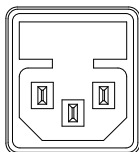
Note: The CH1/CH2 MOD input ground are isolated from each other and from the chassis ground by an isolation voltage of 42Vpk.

The CH1 MOD input shares ground with the CH1 ground.

The CH2 MOD input shares ground with the CH2 ground.

Fan

Power Socket Input and fuse



Power input: 100-240V AC, 50-60Hz.

Fuse:
AFG-3032 & AFG-3022: T1A/250V
AFG-3021 & AFG-3031: T0.63A/250V

Power Switch



Main power switch.

USB B port



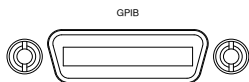
The USB B connector is used to connect the function generator to a PC for remote control.

LAN port



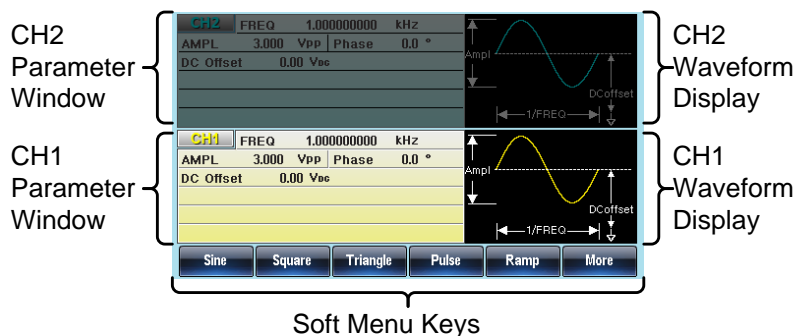
Ethernet port used for remote control (RJ45 connector).

GPIB



24 pin female GPIB connector for PC remote control.

Display



Parameter Windows These windows are used to edit the parameter values for CH1 and CH2.

Waveform Display The Waveform Display is used give an indication of the expected waveform output for each channel.

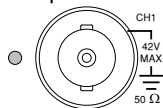
Soft Menu Keys The function keys (F1~F6) below the Soft Menu keys correspond to the soft keys.

Selecting a Waveform

Square Wave

Example: Square wave, 3Vpp, 75% duty, 1 kHz

Output



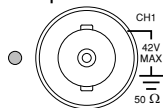
1. Press **Waveform > Square (F2)**.
2. Press **Duty(F1) > 75 > % (F5)**.
3. Press **FREQ/Rate > 1 > kHz (F5)**.
4. Press **AMPL > 3 > VPP (F6)**.
5. Press **Output**.

Input: N/A

Triangle Wave

Example: Triangle wave, 5Vpp, 10kHz

Output



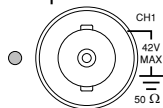
1. Press **Waveform > Triangle (F3)**.
2. Press **FREQ/Rate key > 10 > kHz (F5)**.
3. Press **AMPL > 5 > VPP (F6)**.
4. Press **Output**.

Input: N/A

Sine Wave

Example: Sine wave, 10Vpp, 100kHz

Output



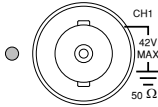
1. Press **Waveform > Sine (F1)**.
2. Press **FREQ/Rate > 100 > kHz (F5)**.
3. Press **AMPL > 10 > VPP (F6)**.
4. Press **Output**.

Input: N/A

Pulse Wave

Example: Pulse wave, 10Vpp, 100kHz, 5us pulse width

Output



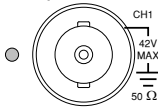
Input: N/A

1. Press **FREQ/Rate** > 100 > kHz (F5).
2. Press **Waveform** > Pulse (F4).
3. Press **Width** (F1) > 5 > uSEC (F3).
4. Press **AMPL** > 10 > VPP (F6).
5. Press **Output**.

Noise Wave

Example: White noise output

Output



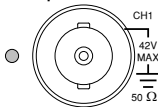
Input: N/A

1. Press **Waveform** > More (F6) > Noise (F1).
2. Press **Output**.

Harmonic Wave

Example: 10kHz harmonic sine wave, odd & even (all) harmonics, up to the 3rd order (2nd(5Vpp), 3rd(2Vpp), 0° phase).

Output



Input: N/A

1. Press **Waveform** > More (F6) > Harmonic (F2).
2. Press **Total** (F1) > 3 > Enter (F1).
3. Press **Type** (F2) > ALL (F3).
4. Press **Order** (F3).
5. Press **Order** (F1) > 2 > Enter (F1).
6. Press **Amp**(F2) > 5 > VPP (F2).
7. Press **Phase**(F3) > 0 > Degree (F1).

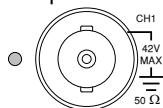
8. Press **Order (F1) > 3 > Enter (F1)**.
9. Press **Amp(F2) > 2 > VPP (F2)**.
10. Press **Phase(F3) > 0 > Degree (F1)**.
11. Press **Output**.

Modulation

AM

Example: AM modulation. 100Hz modulating square wave. 1kHz Sine wave carrier. 80% modulation depth.

Output



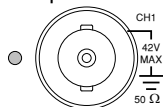
Input: N/A

1. Press **MOD > AM (F1)**.
2. Press **Waveform > Sine (F1)**.
3. Press **Freq/Rate > 1 > kHz (F5)**.
4. Press **MOD > AM (F1) > Shape (F4) > Square (F2)**.
5. Press **MOD > AM (F1) > AM Freq (F3)**.
6. Press **100 > Hz (F2)**.
7. Press **MOD > AM (F1) > Depth (F2)**.
8. Press **80 > % (F1)**.
9. Press **MOD > AM (F1) > Source (F1) > INT (F1)**.
10. Press **Output**.

FM

Example: FM modulation. 100Hz modulating square wave. 1kHz sine wave carrier. 100 Hz frequency deviation. Internal source.

Output



Input: N/A

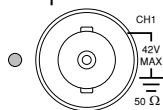
1. Press **MOD > FM (F2)**.
2. Press **Waveform > Sine (F1)**.
3. Press **Freq/Rate > 1 > kHz (F5)**.
4. Press **MOD > FM (F2) > Shape (F4) > Square (F2)**.
5. Press **MOD > FM (F2) > FM Freq (F3)**.
6. Press **100 > Hz (F2)**.
7. Press **MOD > FM (F2) > Freq Dev (F2)**.
8. Press **100 > Hz (F3)**.

9. Press **MOD > FM (F2) > Source (F1) > INT (F1)**.
10. Press **Output**.

FSK Modulation

Example: FSK modulation. 100Hz hop frequency. 1kHz carrier wave. Triangle wave. 10 Hz rate. Internal source.

Output



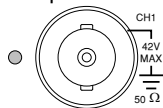
Input: N/A

1. Press **MOD > FSK (F3)**.
2. Press **Waveform > Triangle (F3)**.
3. Press **Freq/Rate > 1 + kHz (F5)**.
4. Press **MOD > FSK (F3) > FSK Rate (F3)**.
5. Press **10 > Hz (F2)**.
6. Press **MOD > FSK (F3) > Hop Freq (F2)**.
7. Press **100 > Hz (F3)**.
8. Press **MOD > FSK (F3) > Source (F1) > INT (F1)**.
9. Press **Output**.

PM

Example: PM modulation. 100Hz phase frequency. Sine wave shape. 180° phase deviation. 1kHz sine wave carrier.

Output



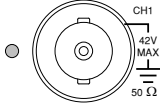
Input: N/A

1. Press **MOD > PM (F4)**.
2. Press **Waveform > Sine (F1)**.
3. Press **Freq/Rate > 1 > kHz (F5)**.
4. Press **MOD > PM (F4) > Shape (F4) > Sine (F1)**.
5. Press **MOD > PM (F4) > PM Freq (F3)**.
6. Press **100 > Hz (F2)**.
7. Press **MOD > PM (F2) > Phase Dev (F2)**.
8. Press **180 > Degree (F1)**.

SUM Modulation

Example: FSK modulation. 100Hz SUM frequency. 50% SUM amplitude. 1kHz carrier sine wave. Triangle wave shape. Internal source.

Output



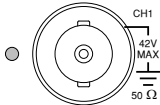
Input: N/A

1. Press **MOD > SUM (F5)**.
2. Press **Waveform > Sine (F1)**.
3. Press **Freq/Rate > 1 + kHz (F5)**.
4. Press **MOD > SUM (F5) > SUM Freq (F3)**.
5. Press **100 > Hz (F2)**.
6. Press **MOD > SUM (F5) > SUM Ampl (F2)**.
7. Press **50 > % (F1)**.
8. Press **MOD > SUM (F5) > Shape (F4) > Triangle (F3)**
9. Press **MOD > SUM (F5) > Source (F1) > INT (F1)**.
10. Press **Output**.

PWM Modulation

Example: PWM modulation. 800Hz carrier wave. 15 kHz modulating sine wave. 50% duty cycle. Internal source.

Output



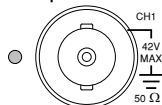
Input: N/A

1. Press **Waveform > Square (F2)**.
2. Press **MOD > PWM (F4)**.
3. Press **FREQ/Rate key > 800 > Hz (F4)**.
4. Press **MOD > PWM (F4) > Shape (F4) > Sine (F1)**.
5. Press **MOD > PWM (F4) > PWM Freq (F3)**.
6. Press **15 > kHz (F3)**.
7. Press **MOD > PWM (F4) > Duty (F2)**.
8. Press **50 > % (F1)**.
9. Press **MOD > PWM (F4) > Source (F1) > INT (F1)**.
10. Press **Output**.

Sweep

Example: Frequency sweep. Start frequency 10mHz, stop frequency 1MHz. Log sweep, 1 second sweep, manual trigger.

Output



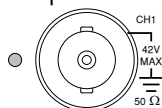
Input: N/A

1. Press **Sweep > Start (F3)**.
2. Press **10 > mHz (F2)**.
3. Press **Sweep > Stop (F4)**.
4. Press **1 > MHz (F5)**.
5. Press **Sweep > Type/MOD (F2) > Functions (F3) > Log (F2)**.
6. Press **Sweep > SWP Time (F5)**.
7. Press **1 > SEC (F2)**.
8. Press **Sweep > TRIG Type (F6) > Manual (F3)**.
9. Press **Output**.
10. Press **Trigger (F1)**.

Burst

Example: Burst mode, N-Cycle (Internally triggered), 1kHz burst frequency, burst count = 5, 10 ms burst period, 0° burst phase, internal trigger, 10 us delay.

Output



Input: N/A

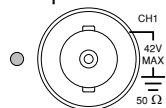
1. Press **FREQ/Rate > 1 > kHz (F5)**.
2. Press **Burst > N Cycle (F1) > Cycles (F1)**.
3. Press **5 > Cyc (F5)**.
4. Press **Burst > N Cycle (F1) > Period (F4)**.
5. Press **10 > msec (F2)**.
6. Press **Burst > N Cycle (F1) > Phase (F3)**.
7. Press **0 > Degree (F5)**.
8. Press **Burst > N Cycle (F1) > TRIG Setup (F5) > INT (F1)**.
9. Press **Burst > N Cycle (F1) > TRIG Setup (F5) > Delay (F4)**.
10. Press **10 > uSEC (F2)**.
11. Press **Output**.

ARB

ARB – Add Built-In Waveform

Example: ARB Mode, exponential rise. Start 0, length 100, scale 32767.

Output

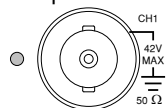


1. Press **ARB > Built in (F3) > Basic (F1) > More (F5) > Exp Rise (F1)**.
2. Press **Start (F1) > 0 > Enter (F5)**.
3. Press **Length (F2) > 100 > Enter (F5)**.
4. Press **Scale (F3), 32767 > Enter (F5) > Done (F4)**.

ARB – Add Built-In Waveform - Pulse

Example: ARB Mode, Pulse. Start 0, Frequency 1kHz, Duty 25%.

Output

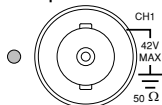


1. Press **ARB > Built in (F3) > Basic (F1) > More (F5) > Pulse (F4)**.
2. Press **Frequency (F1) > 1 > kHz (F5)**.
3. Press **Duty (F2) > 25 > %(F5)**.

ARB - Add Point

Example: ARB Mode, Add point, Address 40, data 30,000.

Output

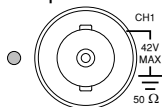


1. Press **ARB** > **Edit (F2)** > **Point (F1)** > **Address (F1)**.
2. Press **40** > **Enter (F5)**.
3. Press **Data (F2)** > **30000** > **Enter (F5)**.

ARB - Add Line

Example: ARB Mode, add line, address: data (10:30, 50:100)

Output

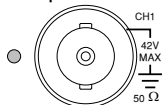


1. Press **ARB** > **Edit (F2)** > **Line (F2)** > **Start ADD (F1)**.
2. Press **10** > **Enter (F5)**.
3. Press **Start Data (F2)** > **30** > **Enter (F5)**.
4. Press **Stop ADD (F3)** > **50** > **Enter (F5)**.
5. Press **Stop Data (F4)** > **100** > **Enter (F5)** > **Done (F5)**.

ARB – Output Section

Example: ARB Mode, output ARB waveform, start 0, length 1000.

Output

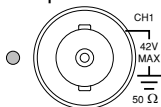


1. Press **ARB** > **Output (F6)**.
2. Press **Start (F1)** > **0** > **Enter (F5)**.
3. Press **Length (F2)** > **1000** > **Enter (F5)**.

ARB – Output N Cycle

Example: ARB Mode, Output N Cycle, Start 0, Length 1000, N Cycle 10.

Output

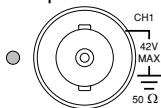


1. Press **ARB > Output (F6)**.
2. Press **Start (F1) > 0 > Enter (F5)**.
3. Press **Length (F2) > 1000 > Enter (F5)**.
4. Press **N Cycle (F4)**.
5. Press **Cycles (F1) > 10 > Enter (F5)**.
6. To trigger the output once:
Press **Trigger (F5)**.

ARB – Output Infinite Cycles

Example: ARB Mode, output N cycle, start 0, length 1000, cycles infinite.

Output



1. Press **ARB > Output (F6)**.
2. Press **Start (F1) > 0 > Enter (F5)**.
3. Press **Length (F2) > 1000 > Enter (F5)**.
4. Press **Infinite (F5)**.

Utility Menu

Save

Example: Save to memory file #5.

1. Press **UTIL > Memory (F1)**.
2. Choose a file using the scroll wheel.
3. Press **Store (F1) > Done (F5)**.

Recall

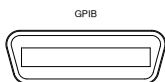
Example: Recall memory file #5.

1. Press **UTIL > Memory (F1)**.
2. Choose a file using the scroll wheel.
3. Press **Recall (F2) > Done (F5)**.

Interface GPIB

Example: GPIB interface, address 10.

GPIB



1. Press **UTIL > Interface (F2) > GPIB (F1) > Address (F1)**.
2. Press **10 > Done (F5)**.

Interface LAN

Example: LAN interface, DHCP IP configuration.

LAN



1. Press **UTIL > Interface (F2) > LAN (F3)**.
2. Press **Config (F2) > DHCP (F1)**.
3. Press **Done (F3)**.

Interface USB

Example: USB interface.

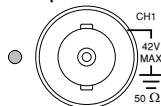


1. Press **UTIL > Interface (F2) > USB (F2)**.

Dual Channel – Frequency Coupling

Example: 1kHz offset coupling. AFG-3022, 3032 only.

Output

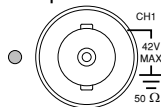


1. Press **UTIL > Dual Ch (F5) > Freq Cpl (F1)**.
2. Press **Offset (F2) > 10 > kHz (F4)**.

Dual Channel – Amplitude Coupling

Example: Amplitude coupling. AFG-3022, 3032 only.

Output

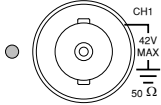


1. Press **UTIL > Dual Ch (F5) > Ampl Cpl (F2)**.
2. Press **ON (F1)**.

Dual Channel – Tracking

Example: Inverted tracking. AFG-3022, 3032 only.

Output



1. Press **UTIL > Dual Ch (F5) > Tracking (F3)**.
2. Press **Inverted (F3)**.

AFG-3021, AFG-3022, AFG-3031 & AFG-3032 Specifications

The specifications apply when the function generator is powered on for at least 30 minutes under +20°C~+30°C.

General Specification	AFG-3021	AFG-3031	AFG-3022	AFG-3032
Channels	1	1	2	2
Instrument Chassis	Isolated	Isolated	Isolated	Isolated
Signal Ground	—	—	Isolated	Isolated
Waveforms				
Standard	Sine, Square, Ramp, Pulse, Noise, Harmonic, DC			
Arbitrary Waveforms				
ARB Function	Built in			
Sample Rate	250 MSa/s			
Repetition Rate	125MHz			
Waveform Length	8M points			
Amplitude Resolution	16 bits			
Non-Volatile Memory	Ten 8M waveforms(1)			
User-defined Output Section	Any section from 2 to 8M points			
Trigger	External			
Built-in Arbitrary	Sine, Square, Ramp, Sinc, Exp Rise, Exp Fall, DC, Pulse, Abstan, Haversine, Sinever, Abssin, Haversine, Stair_down, Absinehalf, 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			

Frequency Characteristics					
Range	Sine	20MHz	20MHz	30MHz	30MHz
	Square	20MHz	20MHz	30MHz	30MHz
	Triangle, Ramp		1MHz		
Resolution			1μHz		
Accuracy	Stability		±1 ppm 0 to 50°C		
			±0.3 ppm 18 to 28°C		
	Aging		±1 ppm, per 1 year		
	Tolerance		≤1 μHz		
Output Characteristics(2)					
Amplitude	Range		1 mVpp to 10 Vpp(into 50Ω)		
			2 mVpp to 20 Vpp(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 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 (open circuit)		
	Accuracy		1% of setting + 2 mV + 0.5% Amplitude		
Waveform	Impedance		50Ω typical (fixed)		
Output			> 10MΩ (output disabled)		
	Protection		Short-circuit protected		
			Overload relay automatically disables main output		
	Ground Isolation		42Vpk max.		
Sync Output	Level		TTL-compatible into>1kΩ		
	Impedance		50Ω nominal		
	Ground Isolation		42Vpk max.		
			(same ground as CH1 output)		
Sine wave Characteristics					
Distortion(5)	Harmonic	-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), 15kHz 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% to 80.0%: ≤ 20 MHz	20.0% to 80.0%: ≤ 25 MHz	20.0% to 80.0%: 20 MHz to 40.0%: 60.0%: 25~ 30MHz	20.0% to 80.0%: 25 MHz to 40.0%: 60.0%: 25~ 30MHz
Jitter	0.01%+525ps < 2 MHz 0.1%+75ps > 2 MHz			

Ramp Characteristics	
Linearity	< 0.1% of peak output
Variable Symmetry	0% to 100% (0.1% resolution)

Pulse Characteristics				
Frequency	1uHz ~ 20MHz	1uHz ~ 25MHz	1uHz ~ 20MHz	1uHz ~ 25MHz
Width	20ns ~ 999.83ks			
	$\text{Width} - 0.625 * [(\text{Rise Time} - 0.6\text{nS}) + (\text{Fall Time} - 0.6\text{nS})] \geq 0$			
	$\text{Period} \geq \text{Width} + 0.625 * [(\text{Rise Time} - 0.6\text{nS}) + (\text{Fall Time} - 0.6\text{nS})]$			
Duty Setting Range	0.017% to 99.983%			
Period	40ns ~ 1000000s			
Rise time and Fall Time	9.32ns ~ 799.9ks			
Resolution	0.0001%			
Overshoot	< 5%			
Jitter	50ps typical (<10kHz)			

Noise	
Noise Type	Gaussian
Noise Bandwidth	100MHz equivalent bandwidth

Harmonic	
Harmonic Order	≤ 8
Harmonic Type	Even, Odd, All, User Amplitude and Phase can be set for all harmonics

AM Modulation				
Carrier Waveforms	Sine, Square, Triangle, Ramp, Pulse, Arb			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Modulating Frequency	2mHz to 20kHz			
Depth	0% to 120.0%			
Source	Internal / External			
FM Modulation				
Carrier Waveforms	Sine, Square, Triangle, Ramp			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Modulating Frequency	2mHz to 20kHz			
Peak Deviation	DC to 30MHz(1 uHz resolution) (DC to 20MHz for AFG-3021/3022)			
Source	Internal / External			
PWM				
Carrier Waveforms	Square			
Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp			
Modulating Frequency	2mHz to 20kHz			
Deviation	0% ~ 100.0% of pulse width, 0.1% resolution			
Source	Internal / External			
FSK				
Carrier Waveforms	Sine, Square, Triangle, Ramp			
Modulating Waveforms	50% duty cycle square			
Internal Rate	2mHz to 100kHz			
Frequency Range	DC to 20MHz	DC to 30MHz	DC to 20MHz	DC to 30MHz
Source	Internal / External			
Additive modulation (Sum)				
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	2mHz to 20kHz
	Source	Internal /External
PM	Carrier Waveforms	Sine, Triangle, Ramp
	Modulating Waveforms	Sine, Square, Triangle, Up/Dn Ramp
	Phase Deviation	0° to 360°, 0.1° resolution
	Setting Range	
	Modulating Frequency	2mHz to 20kHz
	Source	Internal
Sweep	Waveforms	Frequency Sweep: Sine, Square, Triangle, Ramp Amplitude Sweep: Sine, Square, Triangle, Ramp, Pulse, Noise, ARB
	Type	Frequency, Amplitude
	Functions	Linear or Logarithmic
	Directions	Up or Down
	Start/Stop Frequency	Any frequency within the waveform's range
	Sweep Time	1ms to 500s (1ms resolution)
	Hold Time	
	Return Time	
	Trigger Mode	Single, External, Internal
	Trigger Source	Internal/External
Burst	Waveforms	Sine, Square, Triangle, Ramp, Pulse and Noise
	Frequency	1μHz to 20MHz 1μHz to 30MHz(4) 1μHz to 20MHz 1μHz to 30MHz(4)
	Burst Count	1 to 1000000 cycles or Infinite
	Start/Stop Phase	-360.0° to +360.0° (0.1° resolution)
	Internal Period	1us to 500s
	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)
External Modulation Input	Type	AM, FM, PWM, Sum
	Voltage Range	± 5V full scale
	Input Impedance	10kΩ
	Frequency	DC to 20kHz

	Ground Isolation	42Vpk max. (same ground as corresponding channel)
Modulation Output (AFG-3021/3031)		
	Type	AM, FM, PWM, PM, Sum, Sweep
	Amplitude	≥ 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	>100ns
	Input rate	DC to 1MHz
	Input Impedance	10kΩ, DC coupled
Latency	Sweep	<10us (typical)
	Burst	<100ns (typical)
Jitter	Sweep	2.5 us
	Burst	1 ns; except pulse, 300 ps
10 MHz Reference Output		
	Output Voltage	1 Vp-p/50Ω square wave
	Output Impedance	50Ω, AC coupled
	Output Frequency	10MHz
10 MHz Reference Input		
	Input Voltage	0.5Vp-p to 5Vp-p
	Input Impedance	1kΩ, unbalanced, AC coupled
	Max. Allowed	± 10Vdc
	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	AC100 - 240V, 50 - 60Hz
	Power	85 VA for AFG-3032 & AFG-3022
	Consumption	50VA for AFG-3021 & AFG-3031
	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	EN 61010 Degree 2, Indoor Use
	Storage Temperature	-10~70°C, Humidity: ≤70%
Dimensions	Bench Top	265 (W) x 107(H) x 374(D)
	Weight	Approx. 3.5kg
	Safety Designed to	EN 61010-1
	EMC Tested to	EN 61326, EN 55011
	Accessories	Test cable(GTL-110×1 for AFG-3021/3031, GTL-110×2 for AFG-3022/3032), User Manual Compact Disk × 1, Quick Start Guide × 1, Power cord × 1

- (1). A total of ten waveforms can be stored. (Every waveform can be 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” burst count.
- (5). Harmonic distortion and Spurious noise at low amplitudes is limited by a -70 dBm floor.

EC Declaration of Conformity

We

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GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.

No. 69, Lushan Road, Suzhou New District Jiangsu, China

declares that the below mentioned product

AFG-3021, AFG-3031, AFG-3022, AFG-3032

Are herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (2004/108/EC & 2014/30/EU) and Low Voltage Equipment Directive (2006/95/EC & 2014/35/EU). For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Directive, the following standards were applied:

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EN 61326-1 :	Electrical equipment for measurement, control and	
EN 61326-2-1:	laboratory use — EMC requirements (2013)	
Conducted and Radiated Emissions EN 55011:2009+A1:2010	Electrostatic Discharge EN 61000-4-2: 2009	
Current Harmonic EN 61000-3-2:2014	Radiated Immunity EN 61000-4-3:2006+A1:2008+A2:2010	
Voltage Fluctuation EN 61000-3-3:2013	Electrical Fast Transients EN 61000-4-4:2012	
-----	Surge Immunity EN 61000-4-5: 2006	
-----	Conducted Susceptibility EN 61000-4-6: 2014	
-----	Power Frequency Magnetic Field EN 61000-4-8:2010	
-----	Voltage Dips/ Interrupts EN 61000-4-11: 2004	

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Low Voltage Directive 2006/95/EC & 2014/35/EU
Safety Requirements EN 61010-1:2010 (Third Edition) EN 61010-2-030:2010 (First Edition)