Arbitrary Function Generator

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

QUICK START GUIDE

GW INSTEK PART NO. 82FG-30320MF1

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

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The information in this manual was correct at the time of printing. However, Good Will continues to improve its products and therefore reserves the right to change the specifications, equipment, and maintenance procedures at any time without notice.

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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.
- To avoid damage to the instrument, do not apply beyond the range of 0 ~ 5V to the trigger input terminal.
- To avoid damage to the instrument, do not apply beyond the range of -5 ~ +5V to the MOD input terminal.

	(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.
Power Supply ⚠ WARNING	• AC Input voltage: 100 - 240V AC, 50 - 60Hz. • Connect the protective grounding conductor of the AC power cord to an earth ground to prevent electric shock.
Fuse ⚠ WARNING	• Fuse type: AFG-3032&3022: T1A/250V AFG-3021&3031: T0.63A/250V • 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.

Ground ⚠ CAUTION	• 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. • 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	• 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	• 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.
Operation Environment	• 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

	(Pollution Degree) EN 61010-1:2010 specifies pollution degrees and their requirements as follows. The function generator falls under degree 2. Pollution refers to "addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity". • 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.
Storage environment	• Location: Indoor • Relative Humidity: < 70% • Temperature: -10°C to 70°C
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 ⏚ 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 0.75mm^2 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 or 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
- 1μHz 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

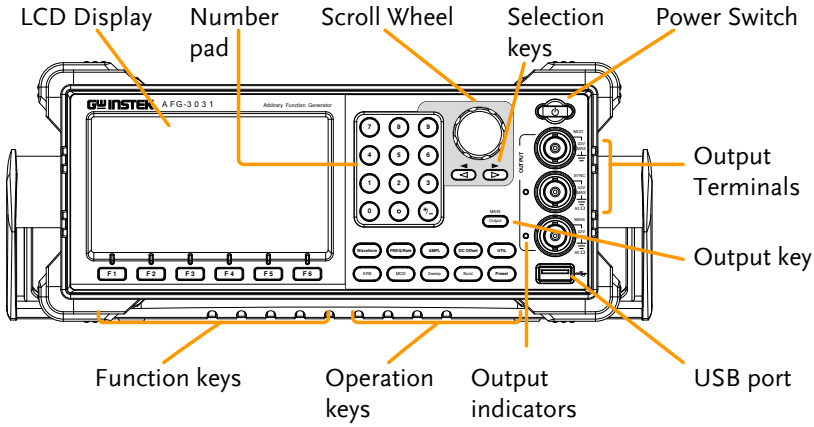
	-Ten 8 M waveform memories -True waveform output to display -D W R (Direct Waveform Reconstruction) capability -Waveform editing capability sans PC -N Cycle and Infinite output mode selectable • -60dBc low distortion sine wave
Features	• Sine, Square, Triangle, Pulse, Ramp, Noise, DC standard waveforms • IQ baseband waveform (AFG-3032/AFG-3022 only) • Int/Ext AM, AM (DSB-SC), FM, PWM, FSK, PM, PSK, 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	• Interface: LAN, USB (standard), GPIB (optional) • 4.3 inch color TFT LCD (480 × 272) Graphical User Interface • AWES (Arbitrary Waveform Editing Software) PC software

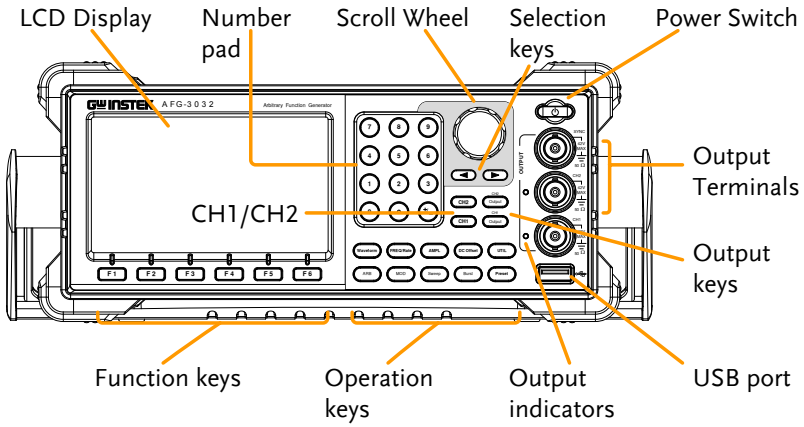
Panel Overview

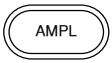
Front Panel

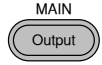
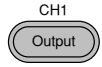
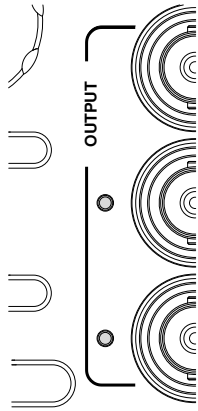
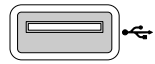
AFG-3021/3031



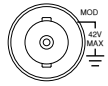
AFG-3022/3032



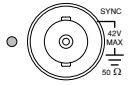
LCD display	TFT color LCD display, 480 x 272 resolution.	
Function keys: F1~F6		Activates the functions which appear in the bottom of the LCD display.
Operation keys		Waveform is used to select a waveform type.
		The FREQ/Rate key is used to set the frequency or sample rate.
		AMPL sets the waveform 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.
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.
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.
Output indicators		When an Output indicator is green, it indicates that the output is active.
USB host connector		The USB Host connector is used to save and restore data as well as update the firmware.

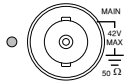
Output terminals (AFG-3021/3031)



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.

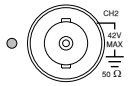


The primary output terminal. 50Ω output impedance.

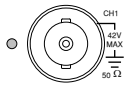
Note: The MAIN ground has a common ground with the MOD output, SYNC and MOD input terminals. They are also isolated from the chassis ground and the 10MHz REF IN ground by an isolation voltage of 42Vpk.

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.

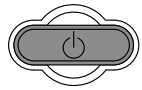
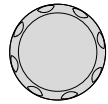
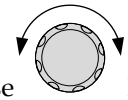
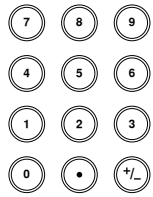


CH1 output terminal. 50Ω output impedance.

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.

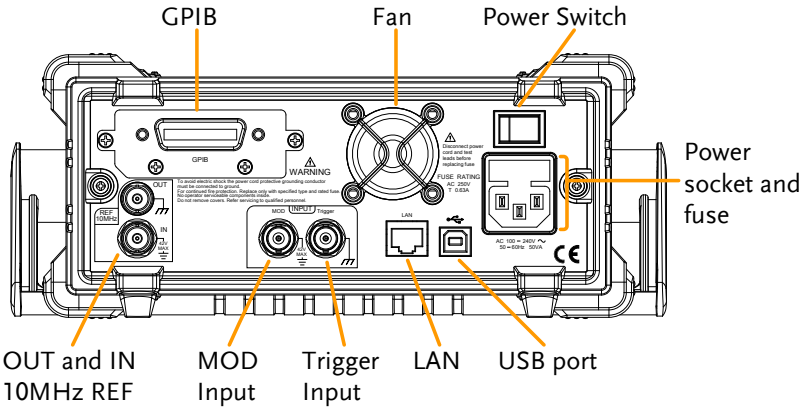
The CH1 ground has a common ground with the MOD output, SYNC and the CH1 MOD input terminals.

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

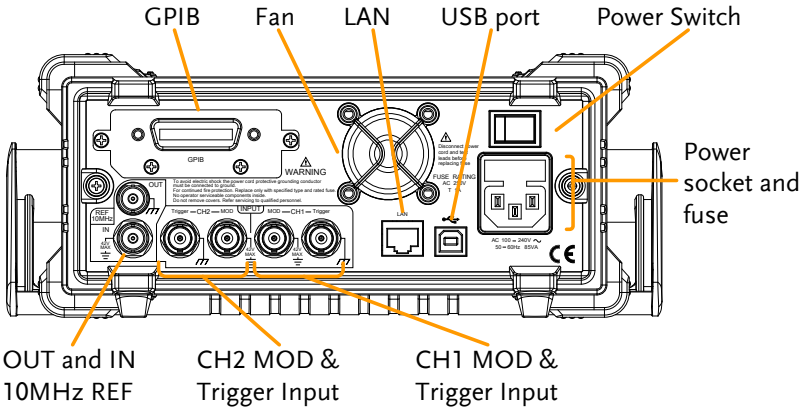
Standby key		The standby key is used to turn the function generator on (green) or to put the function generator into standby mode (red).
Selection keys		Used to select digits when editing parameters.
Scroll Wheel		The scroll wheel is used to edit values and parameters.  Decrease Increase
Keypad		The 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

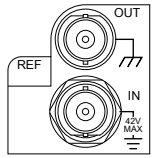
AFG-3021/3031



AFG-3022/3032



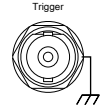
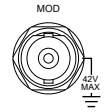
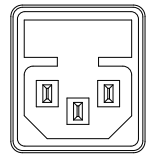
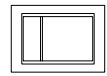
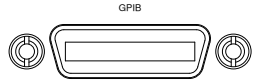
10MHz REF OUT



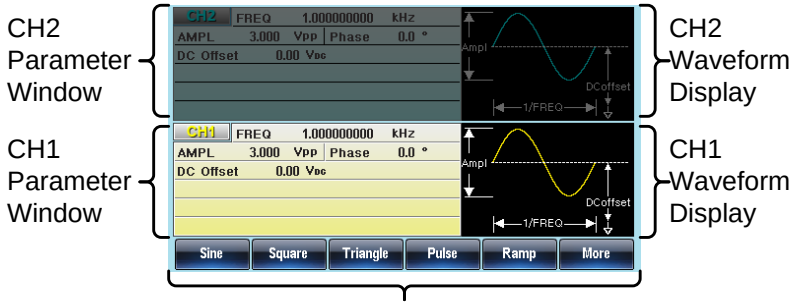
10 MHz reference output.

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



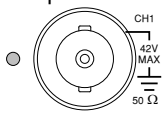
Parameter Windows	These windows are used to edit the parameter values for CH1 and CH2.
Waveform Display	The Waveform Display is used give an indication of the expected waveform output for each channel.
Soft Menu Keys	The function keys (F1~F6) below the Soft Menu keys correspond to the soft keys.

Selecting a Waveform

Square Wave

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

Output



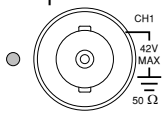
Input: N/A

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**.

Triangle Wave

Example: Triangle wave, 5Vpp, 10kHz

Output



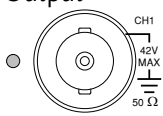
Input: N/A

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

Sine Wave

Example: Sine wave, 10Vpp, 100kHz

Output



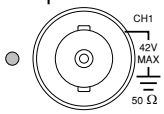
Input: N/A

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

Pulse Wave

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

Output



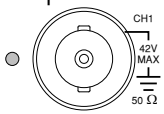
Input: N/A

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



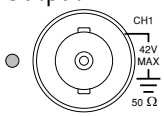
Input: N/A

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).**

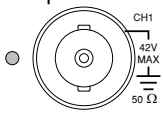
8. Press **Order (F1) > 3 > Enter (F1).**
9. Press **Amp(F2) > 2 > VPP (F2).**
10. Press **Phase(F3) > 0 > Degree (F1).**
11. Press **Output.**

Modulation

AM

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

Output



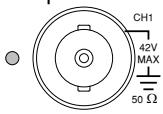
Input: N/A

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

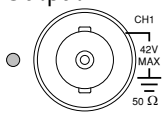
1. Press **MOD > FM (F2).**
2. Press **Waveform > Sine (F1).**
3. Press **Freq/Rate > 1 > kHz (F5).**
4. Press **MOD > FM (F2) > Shape (F4) > Square (F2).**
5. Press **MOD > FM (F2) > FM Freq (F3).**
6. Press **100 > Hz (F2).**

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



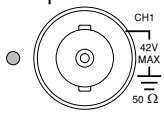
Input: N/A

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

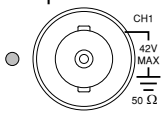
1. Press **MOD > PM (F4).**
2. Press **Waveform > Sine (F1).**
3. Press **Freq/Rate > 1 > kHz (F5).**
4. Press **MOD > PM (F4) > Shape (F4) > Sine (F1).**
5. Press **MOD > PM (F4) > PM Freq (F3).**
6. Press **100 > Hz (F2).**
7. Press **MOD > PM (F2) > Phase Dev (F2).**

8. Press **180 > Degree (F1).**

PSK Modulation

Example: PSK modulation. 100Hz PSK rate. 1kHz carrier wave. 180° PSK phase. Triangle wave. Internal source.

Output



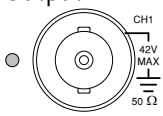
Input: N/A

1. Press **MOD > PSK (F5).**
2. Press **Waveform > Triangle (F3).**
3. Press **Freq/Rate > 1 + kHz (F5).**
4. Press **MOD > PSK (F5) > PSK Rate (F3).**
5. Press **1 + 0 + 0 + Hz (F2).**
6. Press **MOD > PSK (F5) > PSK Phase (F2).**
7. Press **1 + 8 + 0 + Degree (F1).**
8. Press **MOD > PSK (F5) > Source (F1) > INT (F1).**
9. Press **Output.**

SUM Modulation

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

Output



Input: N/A

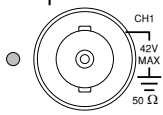
1. Press **MOD > MORE (F6) > SUM (F1).**
2. Press **Waveform > Sine (F1).**
3. Press **Freq/Rate > 1 + kHz (F5).**
4. Press **MOD > MORE (F6) > SUM (F1) > SUM Freq (F3).**
5. Press **100 > Hz (F2).**
6. Press **MOD > MORE (F6) > SUM (F1) > SUM Ampl (F2).**
7. Press **50 > % (F1).**
8. Press **MOD > MORE (F6) > SUM (F1) > Shape (F4) > Triangle (F3)**

9. Press **MOD > MORE (F6) > SUM (F1) > 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



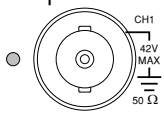
Input: N/A

1. Press **Waveform > Square (F2).**
2. Press **MOD > MORE (F6) > PWM (F2).**
3. Press **FREQ/Rate key > 800 > Hz (F4).**
4. Press **MOD > MORE (F6) > PWM (F2) > Shape (F4) > Sine (F1).**
5. Press **MOD > MORE (F6) > PWM (F2) > PWM Freq (F3).**
6. Press **15 > kHz (F3).**
7. Press **MOD > MORE (F6) > PWM (F2) > Duty (F2).**
8. Press **50 > % (F1).**
9. Press **MOD > MORE (F6) > PWM (F2) > 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

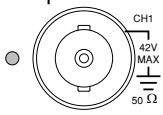
1. Press **Sweep > Start (F3).**
2. Press **10 > mHz (F2).**
3. Press **Sweep > Stop (F4).**
4. Press **1 > MHz (F5).**
5. Press **Sweep > Type/MOD (F2) > Functions (F3) > Log (F2).**

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.**

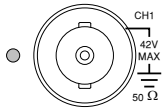
ARB

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).**

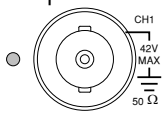


2. Press **Start (F1) > 0 > Enter (F5).**
3. Press **Length (F2) > 100 > Enter (F5).**
4. Press **Scale (F3), 32767 > Enter (F5) > Done (F4).**

ARB – Add Built-In Waveform - Pulse

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

Output

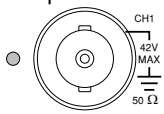


1. Press **ARB > Built in (F3) > Basic (F1) > More (F5) > Pulse (F4).**
2. Press **Frequency (F1) > 1 > kHz (F5).**
3. Press **Duty (F2) > 25 > %(F5).**

ARB - Add Point

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

Output

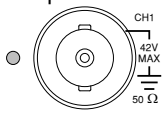


1. Press **ARB > Edit (F2) > Point (F1) > Address (F1).**
2. Press **40 > Enter (F5).**
3. Press **Data (F2) > 30000 > Enter (F5).**

ARB - Add Line

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

Output

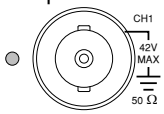


1. Press **ARB > Edit (F2) > Line (F2) > Start ADD (F1).**
2. Press **10 > Enter (F5).**
3. Press **Start Data (F2) > 30 > Enter (F5).**
4. Press **Stop ADD (F3) > 50 > Enter (F5).**
5. Press **Stop Data (F4) > 100 > Enter (F5) > Done (F5).**

ARB – Output Section

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

Output

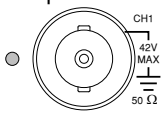


1. Press **ARB > Output (F6).**
2. Press **Start (F1) > 0 > Enter (F5).**
3. Press **Length (F2) > 1000 > Enter (F5).**

ARB – Output N Cycle

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

Output

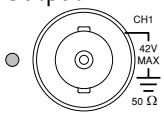


1. Press **ARB > Output (F6).**
2. Press **Start (F1) > 0 > Enter (F5).**
3. Press **Length (F2) > 1000 > Enter (F5).**
4. Press **N Cycle (F4).**
5. Press **Cycles (F1) > 10 > Enter (F5).**
6. To trigger the output once:
   Press **Trigger (F5).**

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).**

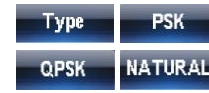
IQ Waveform

Setup

Example: type : QPSK(NATURAL), source: Random, symbol rate: 3.84MHz

1. Press UTIL, IQ (F6).

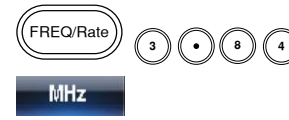
2. Press Type (F1), PSK (F4), QPSK (F2) and NATURAL (F1)



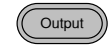
3. Press Return (F6) for several times to back to the main menu.

4. Press Source (F2) and Random (F1).

5. Press FREQ/Rate key, 3 + . + 8 + 4 and MHz (F6)



6. Press Output key on the front panel.



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

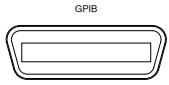
Example: Recall memory file #5.

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.

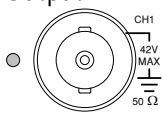
USB B

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

Dual Channel – Frequency Coupling

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

Output

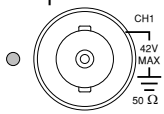


1. Press **UTIL > Dual Ch (F5) > Freq Cpl (F1).**
2. Press **Offset (F2) > 10 > kHz (F4).**

Dual Channel – Amplitude Coupling

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

Output

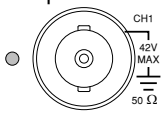


1. Press **UTIL > Dual Ch (F5) > Ampl Cpl (F2).**
2. Press **ON (F1).**

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	Infinite/Manual/External			
	Built-in Arbitrary	Sine, Square, Ramp, Sinc, Exp Rise, Exp Fall, DC, Pulse, Abstan, 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, 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				

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.

IQ Waveforms					
	Source	Random, Fixed Pattern			
	Type	ASK, MSK, FSK, 2FSK, 4FSK, 8FSK, BPSK, QPSK, DQPSK, OQPSK, pi/4 – QPSK, pi/4 – DQPSK, 8PSK, 16APSK, 32APSK, 16QAM, 32QAM, 64QAM			
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 Output	Impedance	50Ω typical (fixed) > 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					
	Harmonic Dstortion(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), 15kHz offset, fc=10MHz			
Square wave Characteristics					
	Rise/Fall Time	<8 ns(3)			
	Overshoot	<5%			
	Asymmetry (@50% duty)	1% of period +1 ns			
	Variable Duty Cycle	20.0% to 80.0%: ≤ 20 MHz	20.0% to 80.0%: ≤ 25 MHz 40.0% to 60.0%: 25~30MHz	20.0% to 80.0%: ≤ 20 MHz	20.0% to 80.0%: ≤ 25 MHz 40.0% to 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 (Extended mode 0.00ns ~ 1,000ks(6)) Width - 0.625 * [(Rise Time - 0.6nS) + (Fall Time - 0.6nS)] ≧ 0 Period ≧ 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 ~ 1000000s			

	Rise time and Fall Time	9.32ns ~ 799.89ks
	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 and AM(DSB-SC) Modulation		
	Carrier Waveforms	Sine, Square, Triangle, Ramp, Pulse, Noise, 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 1MHz			
	Frequency Range	DC to 20MHz	DC to 30MHz	DC to 20MHz	DC to 30MHz
	Source	Internal / External			
PSK					
	Carrier Waveforms	Sine, Square, Triangle, Ramp			
	Modulating Waveforms	50% duty cycle square			
	Internal Rate	2mHz to 1MHz			
	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 Setting Range	0° to 360°, 0.1° resolution			
	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)
	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, AM (DSB-SC), 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, AM (DSB-SC), FM, PWM, PM, Sum, Sweep
	Amplitude	≥ 1Vpp
	Impedance	>10kΩ typical
External Trigger Input		
	Type	For FSK, PSK, 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	<1us (typical)
	Burst	<0.55us (typical)
	ARB	< (27.5/sample rate) + 274ns
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 Input	± 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 ±25nS Parallel connection: (N-1)*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 × 3 (RGB) × 272

General Specifications		
	Power Source	AC100 - 240V, 50 - 60Hz
	Power Consumption	85 VA for AFG-3032 & AFG-3022 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.
(6). Loss may occur if the pulse width is beyond the setting range of the normal mode. The pulse may vanish at times.

Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.

declare that the below mentioned product

Type of Product: Arbitrary Function Generator
Model Number: 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 (2014/30/EU) and Low Voltage Equipment Directive (2014/35/EU).
For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Directive, the following standards were applied:

◎ EMC	
EN 61326-1 : EN 61326-2-1:	Electrical equipment for measurement, control and laboratory use — EMC requirements (2013)
Conducted and Radiated Emissions EN 55011:2009+A1:2010	Electrical Fast Transients EN 61000-4-4:2012
Current Harmonic EN 61000-3-2:2014	Surge Immunity EN 61000-4-5: 2006
Voltage Fluctuation EN 61000-3-3:2013	Conducted Susceptibility EN 61000-4-6: 2014
Electrostatic Discharge EN 61000-4-2: 2009	Power Frequency Magnetic Field EN 61000-4-8:2010
Radiated Immunity EN 61000-4-3:2006+A1:2008+A2:2010	Voltage Dips/ Interrupts EN 61000-4-11: 2004
Low Voltage Equipment Directive 2014/35/EU	
Safety Requirements	EN 61010-1:2010 (Third Edition) EN 61010-2-030:2010 (First Edition)

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