ΛKTΛKOM

User Manual

AWG Series Function/Arbitrary Waveform Generator

AWG-4105/AWG-4110/AWG-4150

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

- **Use proper power line.** Only the special power line of the products approved by the state should be used.

- **Ground the instrument.** This generator is grounded through the protective terra conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to the earth ground. Make sure that the instrument is properly grounded before connecting the input or output terminals.

- **Observe all the ratings of the terminal.** To avoid fire or shock, observe all the ratings and symbols that marked on the instrument. Read the user guide carefully before making connections to the instrument.

- **Do not operate without Covers.** Do not operate the product with covers or panels removed.

- **Avoid circuit or wire exposed.** Do not touch the exposed connections or components when the power is on.

- **Do not operate with suspected failures.** If you suspect there is damage with this product, you should have it inspected by qualified service personnel authorized by **AKTAKOM** before further operations.

- **Provide proper ventilation.**

- **Do not operate in wet/damp conditions.**

- **Do not operate in an explosive atmosphere.**

- **Keep the product's surfaces clean and dry.**

Safety Terms and Symbols

Terms in this guide. These terms may appear in this manual:

Hazardous Voltage | Refer to the Instructions | Protective Earth Ground | Earth Ground

Terms on the product. Terms below may appear on the product:

DANGER : Indicates an injury or hazard that may immediately happen.

WARNING : Indicates an injury or hazard that may not immediately happen.

CAUTION : Indicates that a potential damage to the instrument or other property might occur.

Symbols on the product. Symbols as followed may appear on the product:

WARNING: Warning statements indicate the conditions or practices that could result in injury or loss of life.

CAUTION: Caution statements indicate the conditions or practices that could result in damage to this product or other property.

Introduction of AWG Series

The manual covers the following 3 types of AWG Series Function/Arbitrary Waveform Generators:
AWG-4105/AWG-4110/AWG-4150

AWG Series Function/Arbitrary Waveform Generators adopt the direct digital synthesis (DDS) technology, which can provide stable, high-precision, pure and low distortion signals. Its combination of excellent system features, easiness in usage and versatile functions makes this generator a perfect solution for your job now and in the future.

AWG Series Function/Arbitrary Waveform Generator has a clear and simple front-panel. The user-friendly panel layout and instructions, versatile terminals, direct graph interface, built-in instructions and help system have greatly simplified the operation process, with the help of which, users do not have to spend a great deal of time learning and familiarizing the operation of the generator before they can use it proficiently. The built-in AM, FM, PM, ASK, and FSK modulation functions generate modulated waveforms at ease, without the help of a separate modulating source. USB I/O is a standard accessory, while LAN and GPIB are optional. Remote instructions meet the SCPI specification requirements.

From the characteristics and specifications given below, you will understand how AWG can satisfy your requirements.

- DDS technology provides precise, stable and low distortional output signal.
- 3.5 TFT color LCD display.
- 125MSa/s sampling rate, 14-bit resolution.
- Frequency characteristics:
    Sine: 1uHz to 50 MHz Square:
    1uHz to 25 MHz Ramp: 1uHz
    to 300 kHz Pulse: 500uHz to
    10MHz
    White Noise: 50MHz bandwidth (-3dB)
    Arbitrary: 1uHz to 5MHz
- 5 standard waveforms: Sine, Square, Ramp, Pulse, Noise
- Self-defined arbitrary waveform
- Multiple modulation function, various modulated waveform: AM, FM, PM, ASK, FSK, Sweep and Burst.
- Multiple I/O: external modulation source, external 10 MHz reference input, external trigger source, waveform output, synchronous signal output.
- Support USB storage device. Software updating could also be performed using USB devices.
- Up to 16k sample points of internal waveform depth, which can rebuild or simulate any complex waveform.

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- Remote control is realized using the USB.
- Multiple interfaces: USB host & device, GPIB (IEEE-488) (option) , LAN. (option)
- Support the seamless connection with AKTAKOM Series Digital Oscilloscopes; Can directly read and rebuild the stored waveform in the oscilloscopes.
- 2 languages (English and Chinese) user interface and built-in help system.

Chapter 1   Getting Started

This chapter covers the following topics:

■   General Inspection

■   Handle Adjustment

■   The Front/Rear Panel

■   To Set a Waveform

■   To Set Modulate/Sweep/Burst

■   To Set Output

■   To Use Digital Input

■   To Use Store/Utility/Help Function

General Inspection

When you get a new AWG Series Function/Arbitrary Waveform Generator, you are suggested to take the following steps to inspect the instrument.

1. **Inspect the shipping container for damage.**
    If there are damages in the packing or foam, keep them until the whole machine and the accessories pass the electric and mechanical testing.

2. **Check the accessories.**
    Accessories supplied with the instrument are listed in chapter 6 "Appendix A: Accessories". If the contents are incomplete or damaged, please notify your **AKTAKOM** sales representative.

3. **Inspect the instrument.**
    In case any mechanical damage or defect, or if the instrument does not operate properly or pass performance tests, notify your **AKTAKOM** sales representative. If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as your **AKTAKOM** sales office. Keep the shipping materials for the carrier's inspection. **AKTAKOM** offices will arrange for repair or replacement at **AKTAKOM**'s option without waiting for claim settlement.

Handle Adjustment

To adjust the handle position of AWG Function/Arbitrary Waveform Generator, please grip the handle by the sides and pull it outward. Then, make the handle rotate to the desired position.
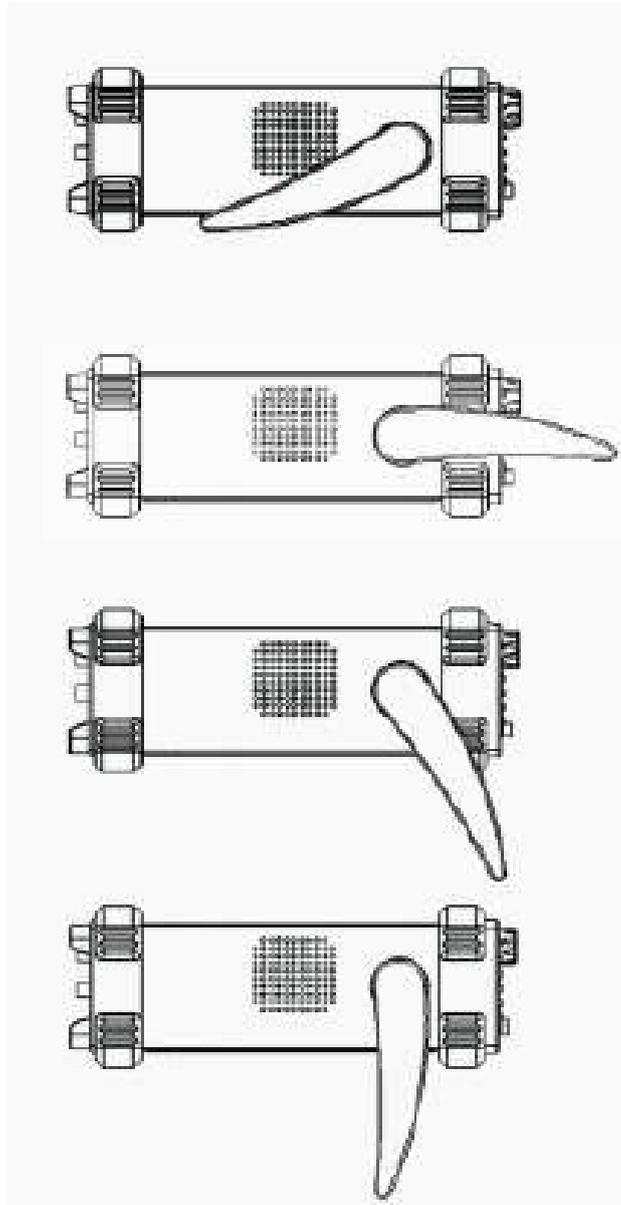
Figure 1-1 Viewing Position and Carrying Position

The Front/Rear Panel

When you get a new AWG Series Function/Arbitrary Waveform Generator, first you need to understand how to operate the front/rear panel correctly. This chapter will make a brief introduction and description for the operation and functions of the front/rear panel.

The AWG Series Function/Arbitrary Waveform Generator has a clear and simple front panel. See Figure 1-2 and Figure 1-3. The front panel has a knob and functional keys. The 5 blue grey buttons on the right side of the screen are menu buttons (named F1 to F5 from up to down) with the help of which, you can enter different functions menu or have direct specific applications. The signal input and output interfaces are set at the front and rear panels which can help generating multiple arbitrary waveforms. The various interfaces can meet the need of the multiple interface communications.
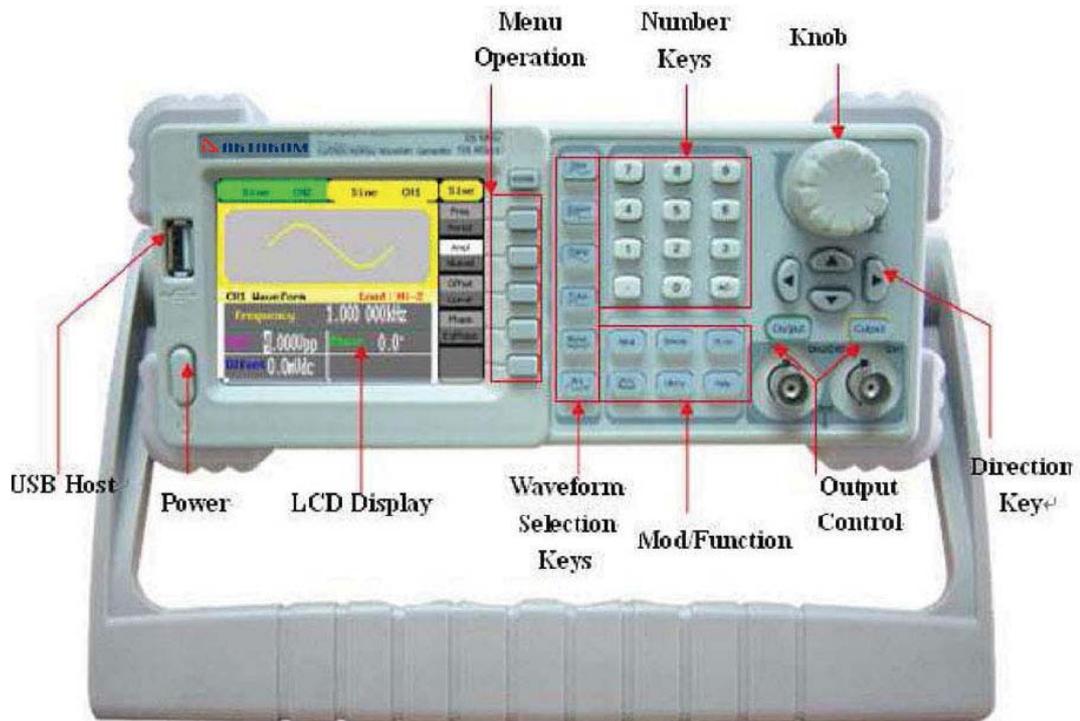

Figure 1-2 Front Panel of AWG Series

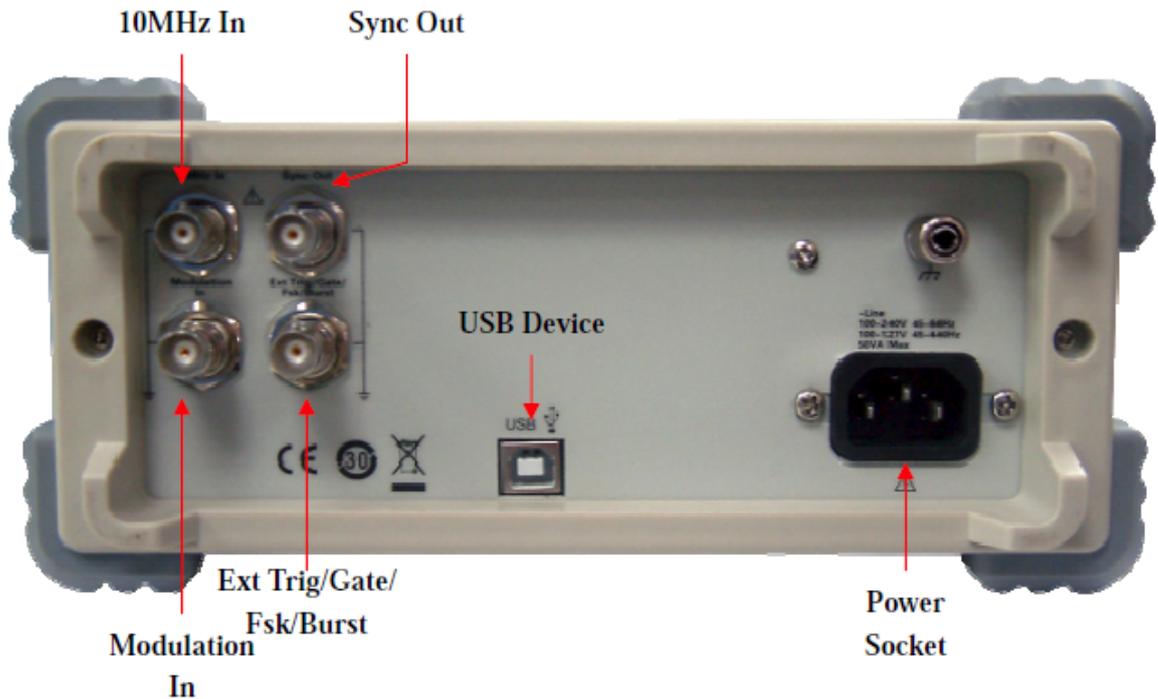Figure 1-3 Front Panel of AWG Series
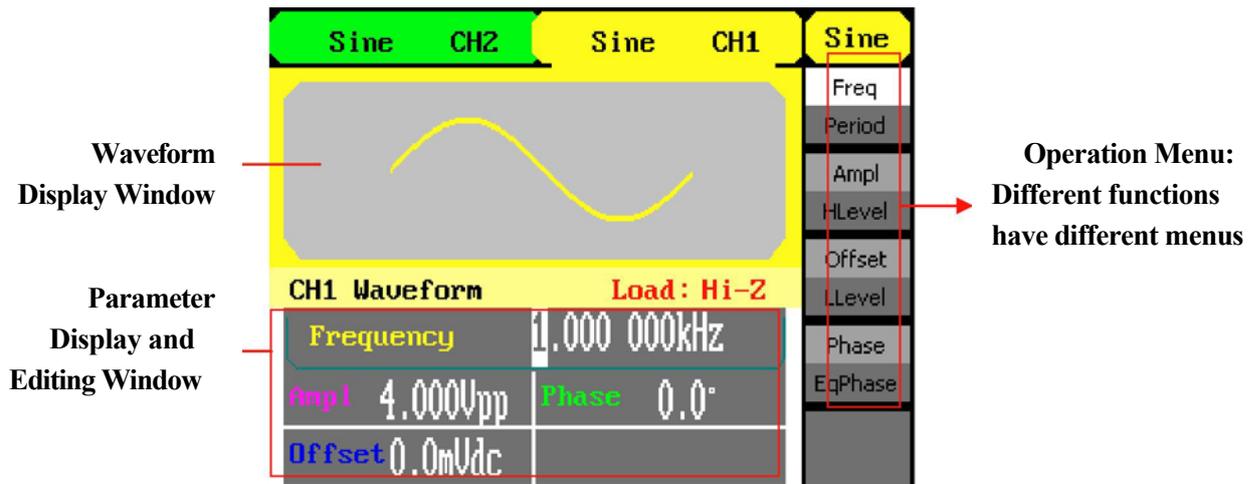

Figure 1-4 Rear Panel of AWG Series

Waveform Display Window

Parameter Display and Editing Window

Operation Menu: Different functions have different menus

Figure 1-5

Display Interface (Sine Wave is the default display signal)

Character definitions in this User Manual:

The signs for buttons in this manual are the same as the panel buttons. Please note that, the signs for the functional buttons on the operation panel are represented by squared words, such as **Sine** , which represents the transparent functional key with Sine on it on the front panel, while the menu buttons are represented by brighten words such as Freq, which means the frequency option in the Sine menu.

⚠️ **Note**: The main Output and Sync Channels are located in the front panel, which only allow signal output. If they are used as signal input channels, they will be burned and lead to instrument malfunction.

To Set a Waveform

On the operation panel, there is a set of buttons with waveform icon. See Figure 1-6. The exercise below will help you familiarize with the waveform selection settings.

Figure 1-6 Waveform Selection Buttons

1. Press Sine   button and the waveform window will display sine waveform. AWG Series Generator can generate sine signal with a frequency from 1μHz to 50MHz. By setting frequency/period, amplitude/high level, offset/low level, sine signal with different parameters can be generated.
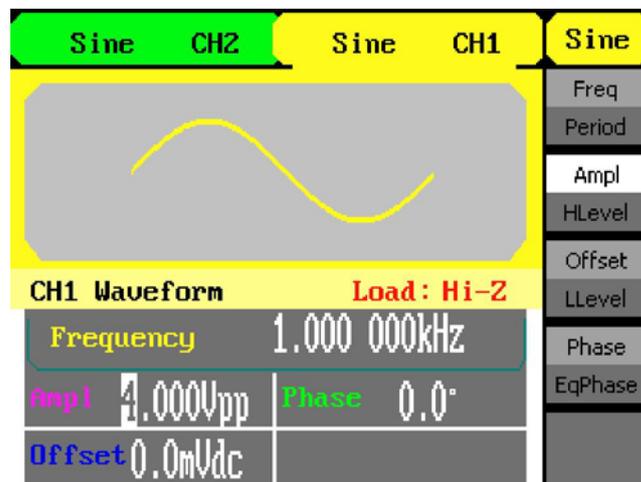

Figure 1-7 Sine Signal Display Interface

As shown in Figure 1-7, the default signal parameters are: 1 kHz frequency, 4.0Vpp amplitude and 0Vdc offset.

2. Press **Square**   button, and the waveform window displays square waveform. AWG Series Generator can generate square signal with a frequency from 1μHz to 25MHz and variable duty cycle.

Figure 1-8 Square Signal Display Interface

As shown in Figure 1-8, the default signal parameters are: 1 kHz frequency, 4.0 Vpp amplitude, 0Vdc offset and 50% duty cycle.

3. Press **Ramp** button, and the waveform window displays ramp waveform. AWG Series Generator can generate ramp signal with a frequency of from 1μHz to 300 kHz and variable symmetry
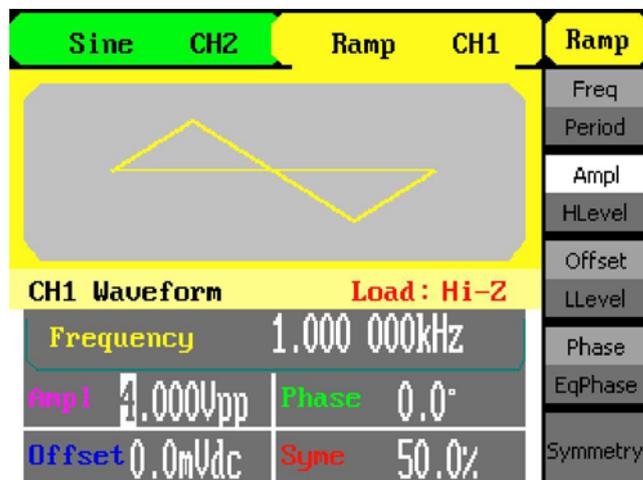

Figure 1-9 Ramp Signal Display Interface

As shown in Figure 1-9, the default signal parameters are: 1kHz frequency, 4.0 Vpp amplitude, 0Vdc offset and 50% symmetry.

4. Press **Pulse** button, and the waveform window displays pulse waveform. AWG Series Generator can generate pulse signal with a frequency from 500μHz to 5 MHz and variable pulse width and delay

.

Figure 1-10 Pulse Signal Display Interface

As shown in Figure 1-10, the default signal parameters are: 1 kHz frequency, 4.0Vpp amplitude, 0Vdc offset, 200μs pulse width.

5. Press **Noise** button, and the waveform window displays noise waveform. AWG Series Generator can generate noise signal with a band width up to 50 MHz.
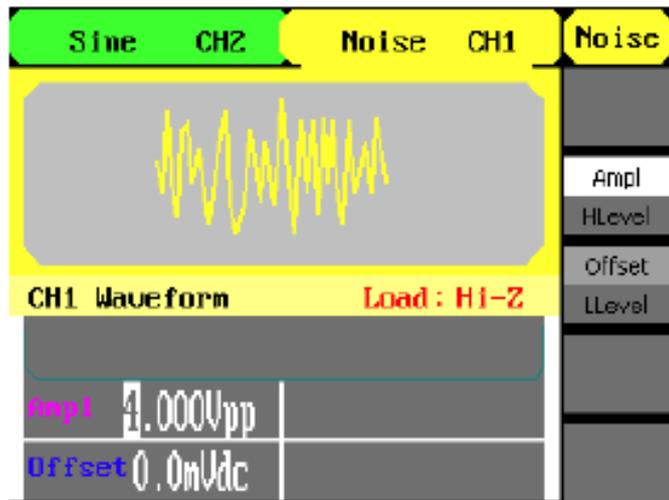

Figure 1-11 Noise Signal Display Interface

As shown in Figure 1-11, the default signal parameters are: 4.0Vpp amplitude and 0Vdc offset.
6. Press **Arb** button, and the waveform window displays arbitrary waveform. AWG Series Generator can generate repeatable arbitrary waveform signals with at most 16K points and 5MHz frequency.
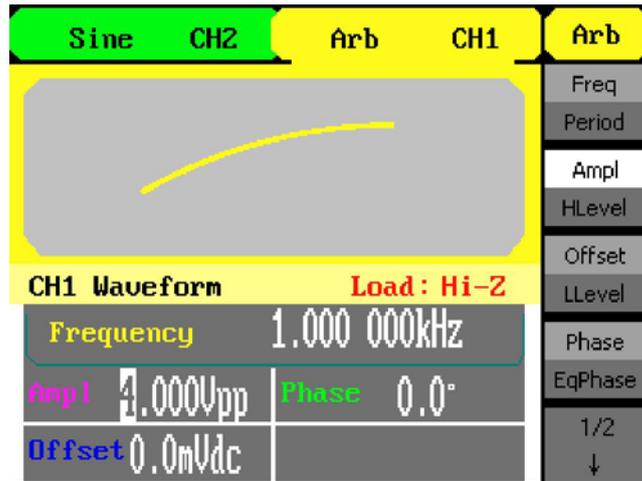
Figure 1-12 Arbitrary waveform Signal Display Interface As shown in
Figure 1-12, the default sine signal parameters are: 1kHz frequency, 4.0 Vpp amplitude and
0mVdc offset.

To Set Modulate/Sweep/Burst

As shown in Figure 1-13, there are three buttons on the front panel, which are used for modulation, sweep and burst settings. The instructions below will help you familiarize with the setting of these functions.

Figure 1-13

Modulate/Sweep/Burst button

1. Press **Mod** button, and the modulated waveforms will be generated. The modulated waveform can be changed by modifying the parameters such as type, internal/external modulation, depth, frequency, waveform, etc. AWG Series can modulate waveform using AM, FM, PM, ASK and FSK. Sine, square, ramp or arbitrary waveforms can be modulated (pulse, noise and DC can not be modulated).
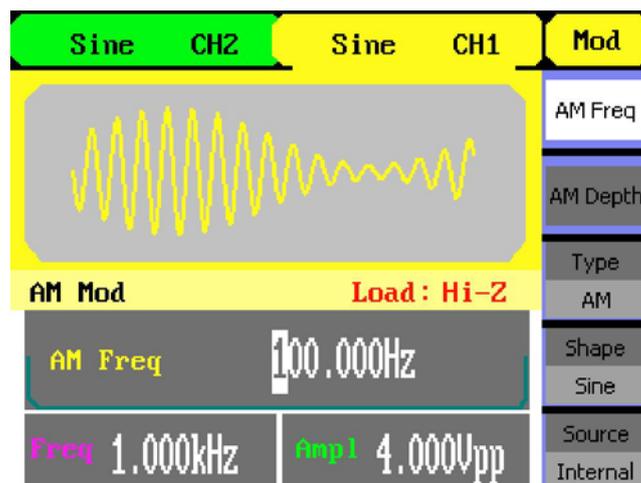

Figure 1-14 Modulated Waveform Display Interface

2. Press **Sweep** button, sine, square, ramp or arbitrary waveform can be swept (pulse, noise and DC can not be swept). In the sweep mode, AWG Series generate signal with variable frequencies.
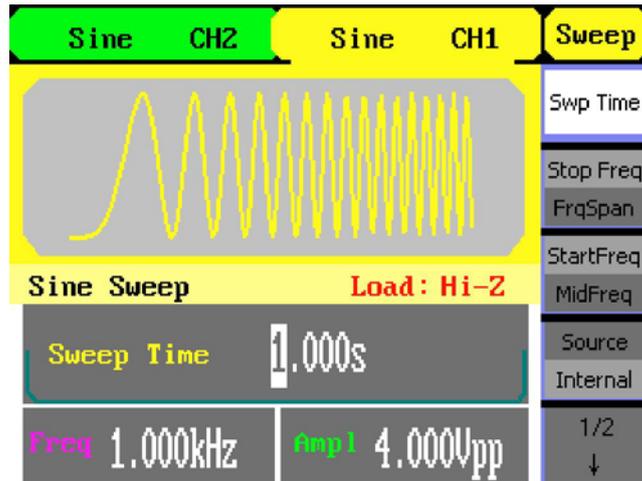
Figure 1-15 Sweep Waveform Display Interface

3. Press **Burst** button, burst for sine, square, ramp, pulse or arbitrary waveform can be generated.
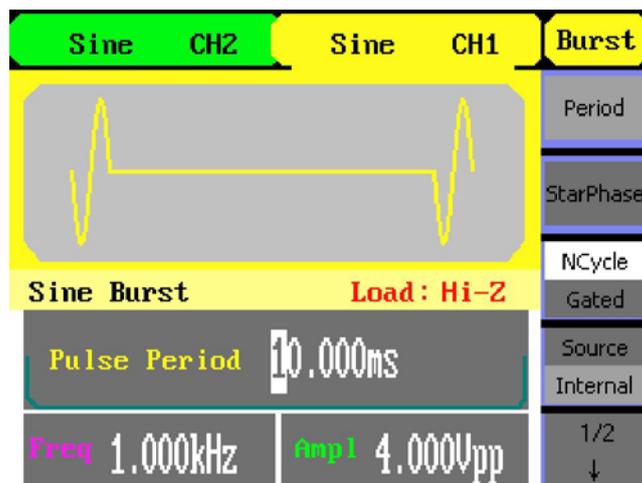
Figure 1-16 Burst Waveform Display Interface

Term Explanation
Burst： Output waveforms with set cycle times. Burst can last for certain times of waveform cycle (N-Cycle Burst) or be controlled by external gated signals (Gated Burst). Burst applies to all kinds of waveforms, but noise can only be used in gated burst. Generally it is called burst function within every signal generator.

To Set Output

As shown in Figure 1-17, there are two buttons on the right side of the operation panel, which are used to output control. The instruction below will help you familiarize with these functions.

Figure 1-17 Output Buttons

Press **Output** button, activate or deactivate the output signal.

To Use Digital Input

As shown in Figure 1-18, there are three sets of buttons on the operation panel, which are direction button, the knob and the keypad. The instruction below will help you familiarize with **the digital input function**.

Figure 1-18 Front Panel Digital Input

1. The up and down keys are used to shift parameters and the left and right keys are used to shift digits.
2. Keypad is used to directly set the parameters value.
3. Knob is used to change a signal digit value whose range is 0~9. Clockwise to increase 1.

To Use Store/Utility/Help Function

As shown in Figure 1-19, there are three buttons on the operation panel, which are used to call the store/recall, utility and help function. The instruction below will help you familiarize with these functions.

Figure 1-19 Store/Recall,
Utility and Help Button

1.   The   **Store/Recall**   button is used to store waveform data and configure information.
2.   The **Utility** button is used to set the auxiliary system function, change the output configure parameters, interface setting, system setting information or perform the instrument self-test and read the calibration information, etc.
3.   The   **Help**   button is used to read the help information.

Chapter 2 Operating Your Generator

Up to now you have got a brief understanding about AWG series with the front/rear panel, every function control area and keys. You should also know how to set your Function/Arbitrary Waveform Generator for your usage. If you are not familiar with these operations, you are suggested to read chapter one "Getting Started" again.

This chapter covers the following topics:

■ Setting Sine Signal   (Sine)

■ Setting Square Signal   (Square)

■ Setting Ramp Signal   (Ramp)

■ Setting Pulse Signal   (Pulse)

■ Setting Noise Signal   (Noise)

■ Setting Arb Signal   (Arb)

■ Output Modulated Signal   (Mod)

■ Output Sweep Signal   (Sweep)

■ Output Burst Signal   (Burst)

■ Store/Recall   (Store/Recall)

■ Utility Setting   (Utility)

■ Help System   (Help)

You are suggested to read this chapter carefully so as to understand AWG Series Generator's versatile waveform setting functions and more operation methods.

To Set Sine Signals

Press **Sine** button to call the sine operation. The sine waveform parameters are set by using the sine operation menu.

The parameters of sine waveforms are: frequency/period, amplitude/high level, offset/low level and phase. Different sine signals are generated by setting these parameters. As is shown in Figure 2-1, in the soft key menu, select Freq. Cursor is located in the frequency parameter area in the parameter display window, and users can set the frequency value here.
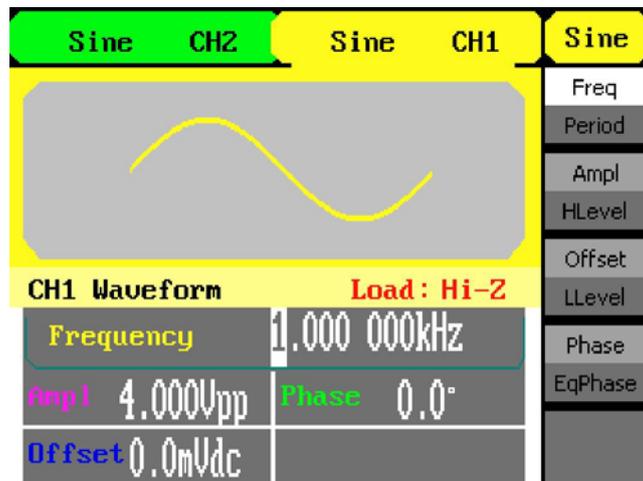

Figure 2-1 Sine Parameter Display Interface

Figure 2-2   Table 2-1 Menu Explanations of Sine Waveform

Function menu	Setting s	Explanations
Freq/ Period		Set the signal frequency or period; The current parameter will switch at a second press.
Ampl/ H Level		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.
Phase/ EqPhase		Set the phase of the signal; The current parameter will switch at a second press.

To Set the Output Frequency/Period

1. Press **Sine** →Freq , to set the frequency parameter.
   The frequency shown on the screen when the instrument is powered is the default value or the set value beforehand. When setting the function, if the current value is valid for the new waveform, it will be used sequentially. If you want to set the period for the waveform, press Freq/Period button again, to switch to the period parameter (The current operation is displayed in inverse color).

2. Input the desired frequency.
   Use the keypad to input the parameter value directly, and press the corresponding button to select the parameter unit. Or you can use the direction button to select the digit you want to edit, and then use the knob to change its value.
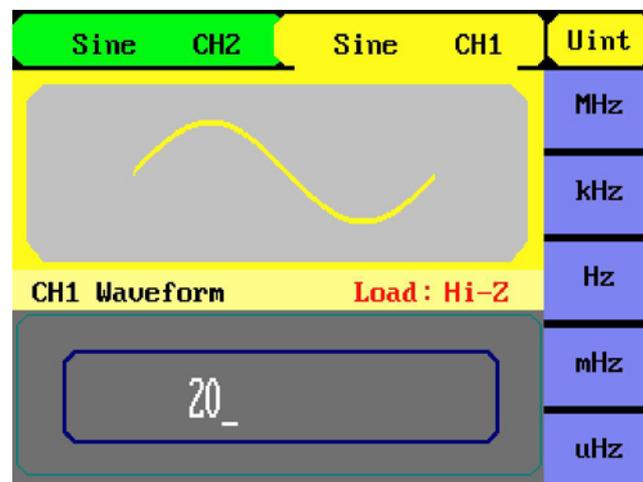

Figure 2-3 Setting the Frequency

Instruction:
When using the keypad to enter the digit, you can use the left direction button to move the cursor backward and delete or change the value of the previous digit.

To Set the Output Amplitude

1. Press **Sine** →Ampl , to set the amplitude.
   The amplitude shown on the screen when the instrument is powered is the default value or
   the set value beforehand. When changing the function, if the current value is valid for the
   new waveform, it will be used sequentially. If you want to set the waveform by high level or
   low level, press the Ampl/HLevel or Offset/LLevel button again, to switch into the high
   level or low level parameter (the current operation is displayed in inverse color).

2. Input the desired Amplitude Use the keypad or the knob to input the desired value, choose
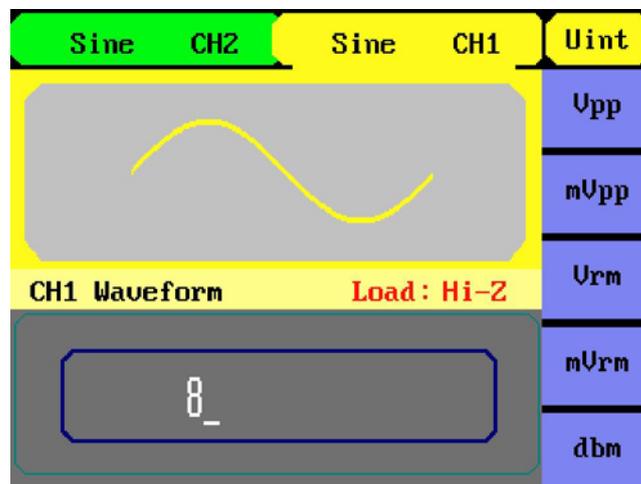   the unit, and press the corresponding button.

Figure 2-4 Setting the Amplitude

To Set the DC Offset

1. Press **Sine** →Offset , to set the offset.
   The offset shown on the screen when the instrument is powered is the default value or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Offset
   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button.
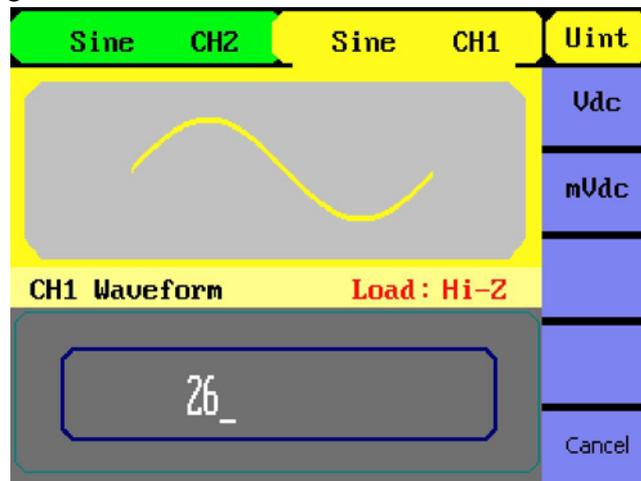

Figure 2-5 Setting the Offset

To Set Square Signals

Press **Square** button to call the Square operation. The square waveform parameters are set by using the Square operation menu.

The parameters of Square waveforms are: frequency/period, amplitude/high level, offset/low level, phase and duty cycle. As is shown in Figure 2-6, in the soft key menu, select Duty. Cursor is located in the duty parameter area in the parameter display window, and users can set the duty value here.
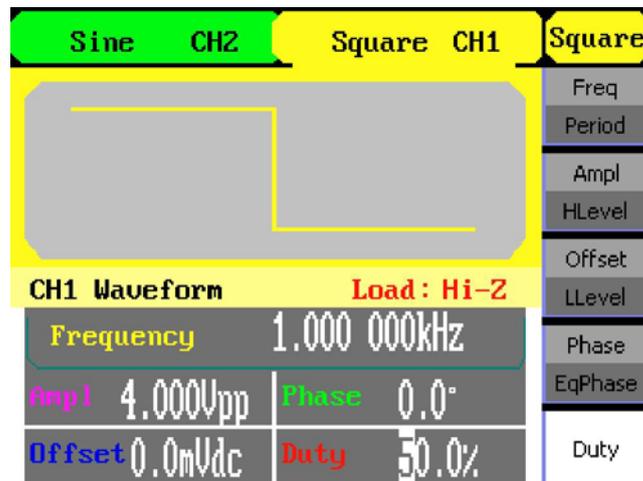
Figure 2-6 Square Parameter Display Interface

Figure 2-7   Table 2-2 Menu Explanations of Square Waveform

Function Menu	Settings	Explanation
Freq/ Period		Set the signal frequency or period; The current parameter will switch at a second press.
Ampl/ HLevel		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.
Phase/ EqPhase		Set the phase of the signal; The current parameter will switch at a second press.
Duty		Set the duty cycle for square waveform.

Term Explanation:	
Duty Cycle: The percentage that the high level takes up the whole period.	
Please Note : for the Frequency	Duty Cycle Value
Below 10MHz:	20% to 80%
From 10MHz to20MHz (included):	40% to 60%
Higher than 20MHz:	50%

To Set the Duty Cycle

1. Press **Square** →Duty , to set the duty cycle.
    The duty cycle shown on the screen when the instrument is powered is the default value or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Duty Cycle
    Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The generator will change the waveform immediately.
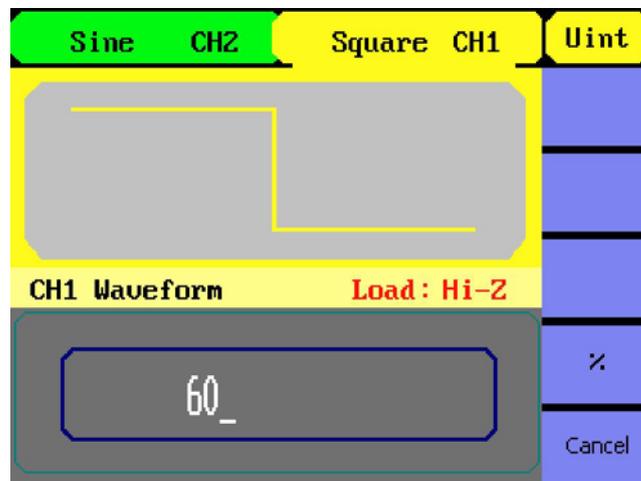

Figure 2-8 Setting the Duty Cycle

To Set Ramp Signals

Press **Ramp** button to call the ramp operation. The ramp waveform parameters are set by using the ramp operation menu.
The parameters for ramp waveforms are: frequency/ period, amplitude/ high level, offset/ low level, phase and symmetry. As is shown in Figure 2-9, in the soft key menu, select Symmetry. Cursor is located in the symmetry parameter area in the parameter display window, and users can set the symmetry value here.
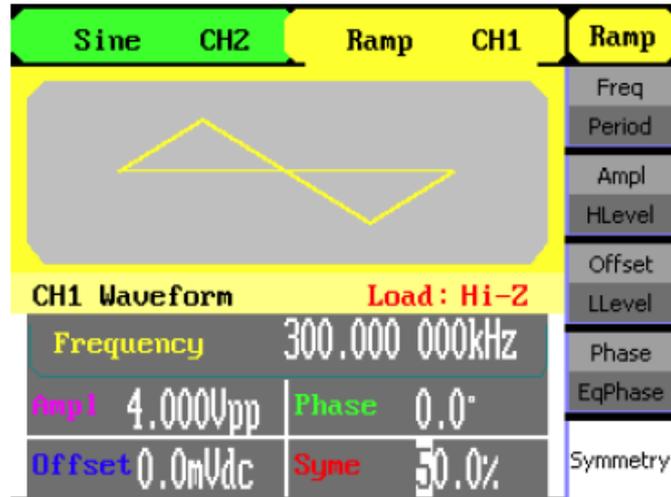

Figure 2-9 Ramp Parameter Display Interface
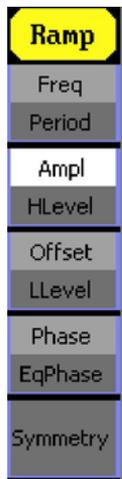
Figure 2-10   Table 2-3 Menu Explanations of Ramp Waveform

Function Menu	Settings	Explanation
Freq/ Period		Set the signal frequency or period; The current parameter will switch at a second press.
Ampl/ HLevel		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.
Phase/ EqPhase		Set the phase of the signal; The current parameter will switch at a second press.
Symmetry		Set the symmetry for ramp waveform.

> **Term Explanation:**
> **Symmetry:** The percentage that the rising period takes up the whole Period.
> **Input Range:** 0~100%.

To Set the Symmetry

1. Press **Ramp** →Symmetry , to set the symmetry.
   The symmetry shown on the screen when the instrument is powered is the default value or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Symmetry
   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The generator will change the waveform immediately.
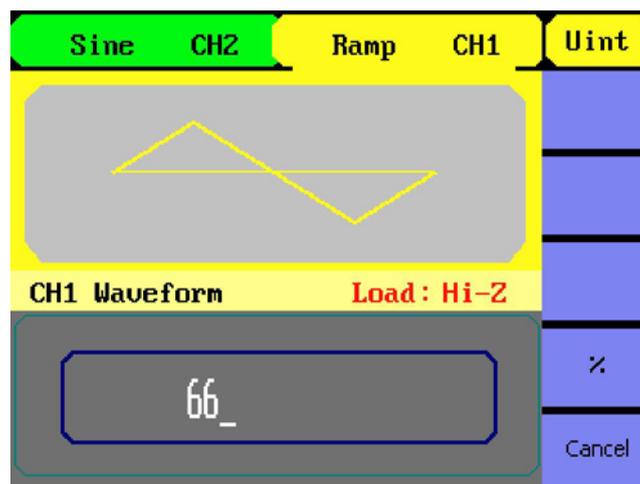
Figure 2-11 Setting the Symmetry

To Set Pulse Signals

Press **Pulse** button to call the pulse operation. The pulse waveform parameters are set by using the pulse operation menu.

The parameters for pulse waveforms are: frequency/period, amplitude/high level, offset/low level, pulse width and delay. As is shown in Figure 2-12, in the soft key menu, select PulWidth. Cursor is located in the pulse width parameter area in the parameter display window, and users can set the pulse width value here.
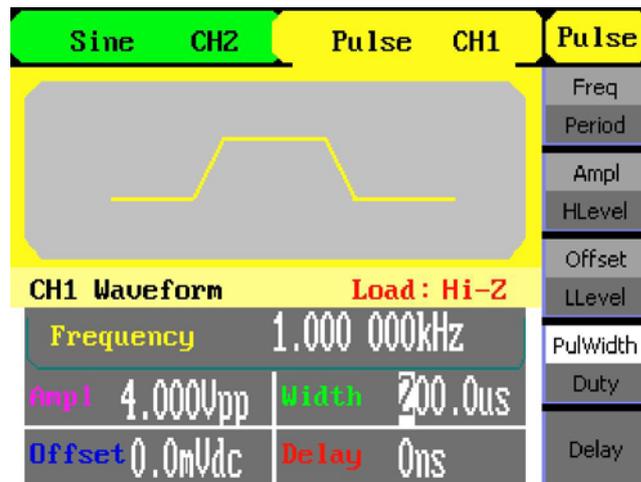
Figure 2-12 Pulse Parameter Display Interface

Figure 2-13   Table 2-4 Menu Explanations of Pulse Waveform

Function Menu	Settings	Explanation
Freq/ Period		Set the signal frequency or period; The current parameter will switch at a second press.
Ampl/ HLevel		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.
PulWidth /Duty		Set the signal pulse width or duty; The current parameter will switch at a second press.
Delay		Setting the delay for pulse waveform.

> **Term Explanation:**
> **Pulse Width:**
> Positive Pulse Width: the time span between thresholds of 50% of the rising edge amplitude to the next 50% of the falling edge amplitude;
> Negative Pulse Width: the time span between thresholds of 50% of the falling edge amplitude to the next 50% of the rising edge amplitude.

To Set the Pulse Width

1. Press **Pluse** →PulWidth , to set the pulse width.
   The pulse width shown on the screen when the instrument is powered is the default value or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Pulse Width
   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The Generator will change the waveform immediately.

Figure 2-14 Setting the Pulse Width

To Set the Delay

1. Press **Pulse** Delay , to set the delay. The delay shown on the screen when the instrument is powered is the default value or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired delay
Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The generator will change the waveform immediately.
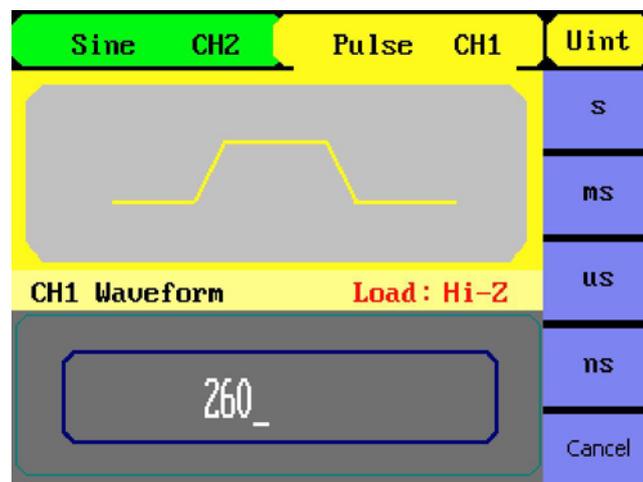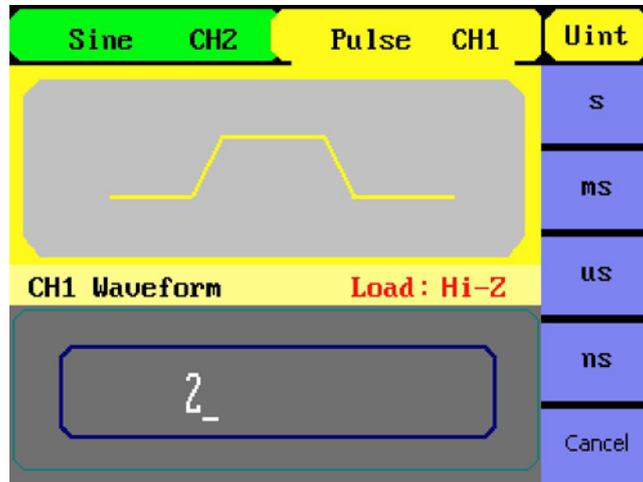

Figure 2-15 Setting the Delay

To Set Noise Signals

Press **Noise** button to call the gaussian white noise operation. The noise waveform parameters are set by using the noise operation menu.

The parameters for noise waveforms are: amplitude/high level and offset/low level. As is shown in Figure 2-16, in the soft key menu, select Offset, Cursor is located in the Offset parameter area in the parameter display window, and users can set the offset value here. Noise is non-regulated signal which has no frequency or period.
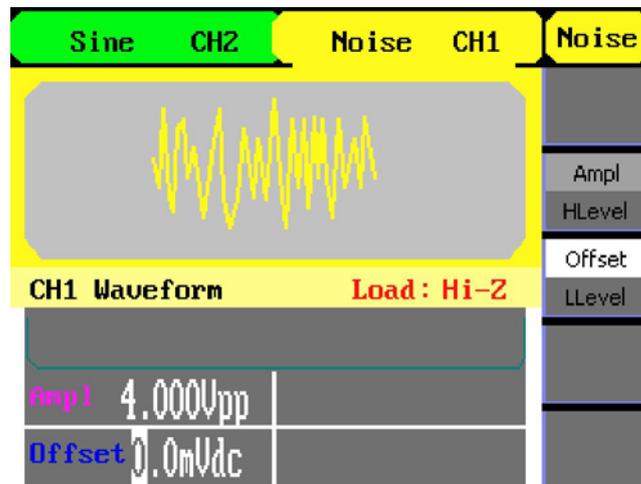

Figure 2-16 Noise Parameter Display Interface

Figure 2-17   Table 2-5 Menu Explanations of Noise Waveform

Function Menu	Settings	Explanation
Ampl/ HLevel		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.

To Set Arbitrary Signals

Press **Arb** button to call the arb operation. The arb waveform parameters are set by using the arb operation menu.

The arb signal consists of two types: the system built-in waveform and the user-definable waveform. The parameters for arb waveforms are: frequency/period, amplitude/high level and offset/ low level and phase.
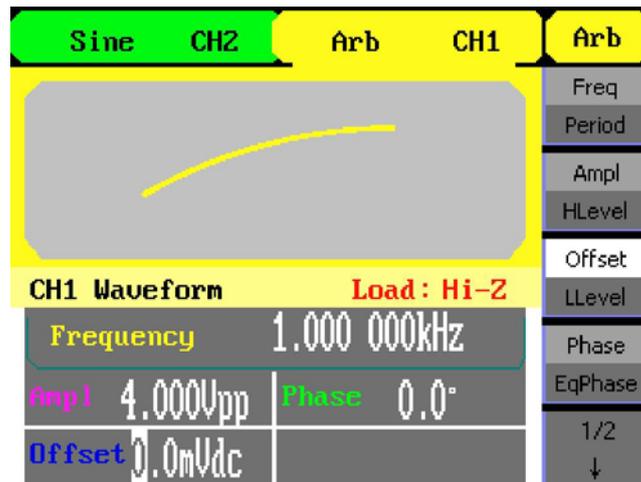
Figure 2-18 Arb Parameter Display Interface

Figure 2-19   Table 2-6 Menu Explanations of Arb Waveform (Page 1/2)

Function Menu	Settings	Explanation
Freq/ Period		Set the signal frequency or period; The current parameter will switch at a second press.
Ampl/ HLevel		Set the signal amplitude or high level; The current parameter will switch at a second press.
Offset/ LLevel		Set the signal offset or low level; The current parameter will switch at a second press.
Phase/ EqPhase		Set the phase of the signal; The current parameter will switch at a second press.

Figure 2-20   Table 2-7 Menu Explanations of Arb Waveform (Page 2/2)

Function Menu	Settings	Explanation
Load Wform		Select the built-in arbitrary signal as output.

To Select the built-in Arbitrary Waveform

There are forty-eight built-in Arbitrary Waveforms and user-definable Arbitrary Waveforms inside the Generator. To select one of them, follow the instructions below:
Press **Arb** →Load Wform, to enter the interface below.

Figure 2-21   Table 2-8 Menu Explanations of Built-in Arbitrary Waveform

Function Menu	Settings	Explanation
Built-In		Select one of the forty-eight built-in arbitrary waveforms (see Table 2-8).
Stored Wforms		Select one of arbitrary waveforms stored in the non-volatile memory.
Cancel		Cancel the current operation, and return to the upper menu. (the followings are the same and will not be explained).

1. To Select the Built-in Waveform

Press **Arb** →Load Wform->Built-In , and enter the following interface.
As is shown in Figure 2-22, there are five kinds of arbitrary waveform。

Figure 2-22   Table 2-9 Menu Explanations of Built-In Arbitrary Waveform

Function Menu	Settings	Explanation
Common		Select common waveform.
Math		Select math waveform.
Project		Select project waveform.
Winfun/ Triangle		Select windows function. /triangle waveform.
Choice		Validate the built-in waveform.

Figure 2-23 Common Built-In Arbitrary Waveform interface

Table 2-10 Menu Explanations of Common Built-In Arbitrary Waveform

Function Menu	Settings	Explanation
StairUp		Select the built-in stair up Waveform.
StairDn		Select the built-in stair down waveform.
StairUD		Select the built-in stair up&down waveform.
P Pulse		Select the built-in positive pulse waveform.
NPulse		Select the built-in negative pulse waveform.
Trapezia		Select the built-in trapezoid waveform.
UpRamp		Select the built-in up ramp waveform.
DnRamp		Select the built-in down ramp waveform.

Figure 2-24 Math Built-In Arbitrary Waveform Interface

Table 2-11 Menu Explanations of Math Built-in Arbitrary Waveform

Function Menu	Settings	Explanation
ExpFall		Select the built-in exponential fall waveform.
ExpRise		Select he built-in exponential rise waveform.
LogFall		Select the built-in logarithmic fall waveform.
LogRise		Select the built-in logarithmic rise waveform.
Sqrt		Select the built-in square root waveform.
Root3		Select the built-in Root3 waveform.
X^2		Select the built-in X^2 waveform.
X^3		Select the built-in X^3 waveform.
Sinc		Select the built-in sinc waveform; Sinc $=$ sin(x)/x.
Gaussian		Select the built-in gaussian Waveform.
Dlorentz		Select the built-in D-lorentz Waveform.
Haversin		Select the built-in haversine Waveform.
Lorentz		Select the built-in lorentz Waveform.
Gauspuls		Select the built-in gaussian-modulated sinusoidal pulse waveform.
Gmonpuls		Select the built-in Gaussian monopulse waveform.
Tripuls		Select the built-in triangle pulse waveform.

Figure 2-25 Project Built-In Arbitrary Waveform interface

Table 2-12 Menu Explanations of Project Built-in Arbitrary Waveform

Function Menu	Settings	Explanation
Cardiac		Select the built-in electrocardiogram (ECG) signal waveform.
Quake		Select the built-in loma prieta earthquake waveform.
Chirp		Select the built-in swept-frequency cosine

		waveform.
TwoTone		Select the built-in two tone signal waveform
SNR		Select the built-in sin wave with white noise waveform.

Hamming	Hanning	Kaiser	Blackman
Gaussian	Triangle	Haris	Bartlett
Tan	Cot	Sec	Csc
Asin	Acos	Atan	ACot

Figure 2-26 Winfun/Triangle Built-In Arbitrary Waveform interface Table 2-13 Menu

Explanations of Winfun/Triangle Built-in Arbitrary Waveform

Function Menu	Settings	Explanation
Hamming		Select the built-in hamming window waveform.
Hanning		Select the built-in hanning window waveform.
Kaiser		Select the built-in kaiser window Waveform.
Blackman		Select the built-in blackman windows waveform.
Gaussian		Select the built-in gaussian window waveform.
Triangle		Select the built-in triangle window waveform.
Hairs		Select the built-in hairs window waveform.
Bartlett		Select the built-in bartlett window waveform.
Tan		Select the built-in tangent waveform.
Cot		Select the built-in cotangent waveform.
Sec		Select the built-in secant waveform.
Csc		Select the built-in cosecant waveform
Asin		Select the built-in inverse sine waveform.
Acos		Select the built-in inverse cosine waveform.
Atan		Select the built-in tangent waveform.
Acot		Select the built-in inverse cotangent waveform.

2. To Select the Stored Waveform

Press **Arb** →Load Wform->Stored Wforms, and enter the following interface.

As is shown in Figure 2-27, use the direction keys or knob to choose the corresponding arbitrary waveform and press Choice.
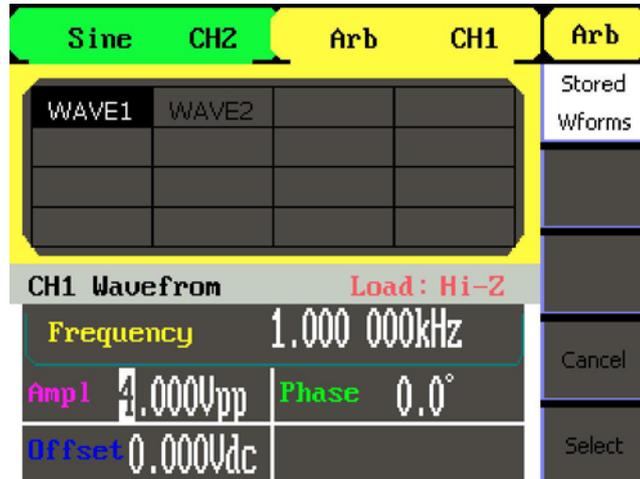

Figure 2-27 Stored Wform Display Interface

To Generate the Modulated Waveform

Use the **Mod** button to generate modulated waveform.AWG Series can generate AM, FM, ASK, FSK and PM modulated waveforms. Modulating parameters vary with the types of the modulation. In AM, users can set the source (internal/external), depth, modulating frequency, modulating waveform and carrier waveform; In FM, users can set the source (internal/external),frequency deviation, modulating waveform and carrier waveform; In ASK, users can set the source (internal/external), modulating waveform and carrier waveform; In FSK, users can set the source (internal/external), frequency range, key frequency, modulating waveform and carrier waveform; In PM, users can set the source (internal/external),phase deviation, modulating frequency, modulating waveform and carrier waveform.

We will cover how to set these parameters in details according to the modulation types.
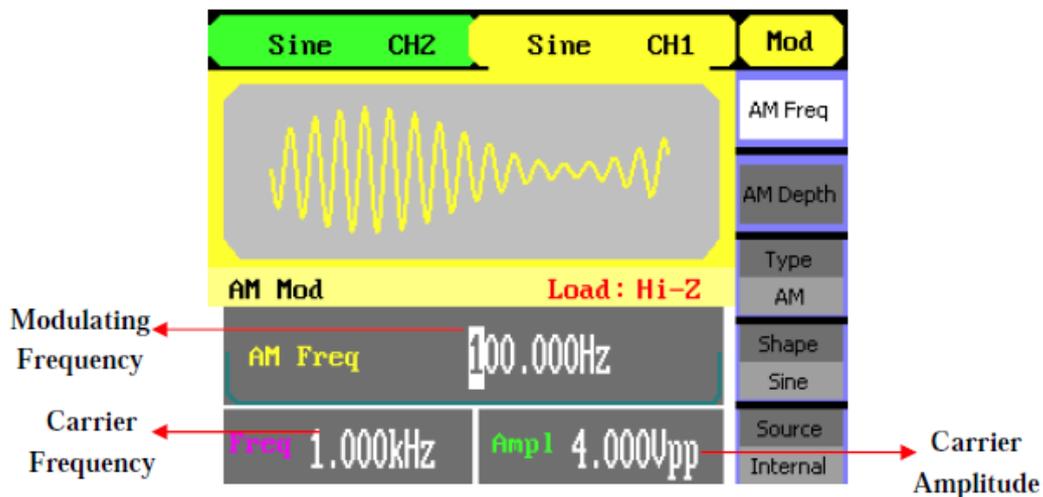

Figure 2-28

The Display Interface of Modulated Waveform Parameter

AM

The modulated waveform consists of two parts: the carrier waveform and the modulating waveform. In AM, the amplitude of the carrier waveform varies with the instantaneous voltage of the modulating waveform. The parameters for the AM are in Table 2-14

Press **Mod** →Type→AM , to enter the following menu.

Figure 2-29

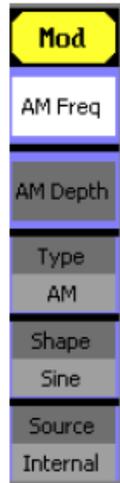Table 2-14 Menu Explanations of the AM Parameters

Function Menu	Settings	Explanation
AM Freq		Set the modulating waveform frequency. Frequency range: 2mHz~20kHz (internal source only).
AM Depth		Set the amplitude range.
Type	AM	amplitude modulation.
Shape	Sine Square Triangle UpRamp DnRamp Noise Arb	Choose the modulating waveform. To change the carrier waveform parameter, press Sine, Square etc.
Source	Internal	The source is internal
	External	The source is external. Use the [Modulation In] connector in the rear panel.

Term Explanation
Modulation Depth
The amplitude range (also called "Percentage Modulation"). Modulation depth varies from 1% to 120%.
•   In the 0% modulation, the output amplitude is the half of the set one.
•   In the 100 **%** modulation,   the output amplitude is the same with the set one.
•   For an external source, the depth of AM is controlled by the voltage level of the connector connected to the [Modulation In]. +6V corresponds to the currently set depth 100%.

FM

The modulated waveform consists of two parts: the carrier waveform and the modulating waveform. In FM, the frequency of the carrier waveform varies with the instantaneous voltage of the modulating waveform. The parameters for the FM are as shown in Figure 2-30.
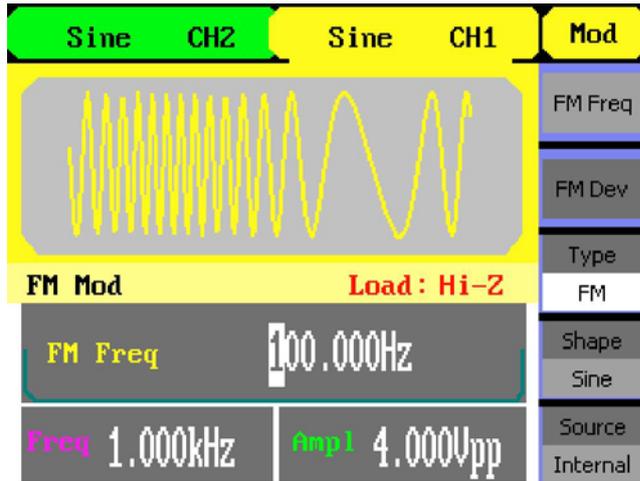
Figure 2-30 Setting Interface of FM Waveform Parameter

Press **Mod** →Type→FM , to enter the following menu.

Figure 2-31   Table 2-15 Menu Explanations of the FM Parameters

Function Menu	Settings	Explanation
FM Freq		Set the modulating waveform frequency. Frequency range 2mHz~20kHz (internal source only).
FM Dev		Set the maximum frequency deviation
Type	FM	Frequency modulation
Shape	Sine Square Triangle UpRamp DnRamp Noise Arb	Choose the modulating waveform. To change the carrier waveform parameter, press Sine, Square etc.
	Internal	The source is internal
Source	External	The source is external. Use the [Modulation In] connector in the rear panel.

ASK

ASK is a form of modulation that represents digital data as variations in the amplitude of a carrier wave. The amplitude of an analog carrier signal varies in accordance with the bit stream(modulating signal)，keeping frequency and phase constant. The parameters for the ASK are as shown in Figure 2-32
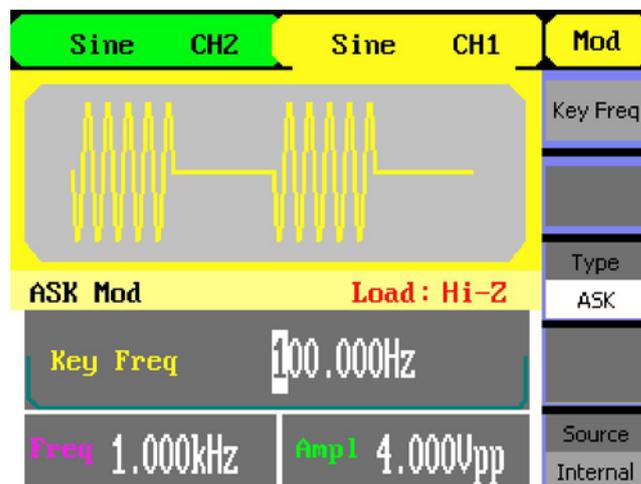

Figure 2-32 Setting Interface of ASK Waveform Parameter

Press **Mod** →Type→ASK , to enter the following menu.

Figure 2-33   Table 2-16 Menu Explanations of the ASK Parameters

Function Menu	Settings	Explanation
Key Freq		Set the frequency at which the output amplitude shifts between the carrier amplitude and zero (internal modulation only): 2mHz~50KHz.
Type	ASK	Amplitude shift keying modulation.
Source	Internal	The source is internal
	External	The source is external, Use the [Ext Trig/Gate/Fsk/Burst] connector in the rear panel.

FSK

The FSK Modulation is a modulation method, the output frequency of which switches between two the pre-set frequencies (carrier waveform frequency and the hop frequency). The frequency at which the output frequency switches is called the key frequency. The key freq is determined by the internal frequency generator or the signal voltage level offered by the Ext Trig/Gate/Fsk/Burst connector in the rear panel:

Figure 2-34 Setting Interface of FSK Waveform Parameter

Press **Mod** →Type→FSK, to enter the following interface.

Figure 2-35   Table 2-17 Menu Explanations of the FSK Parameters

Function Menu	Settings	Explanation
Key Freq		Set the frequency at which the output frequency shifts between the carrier frequency and the hop frequency (internal modulation only): 2mHz~50KHz.
Type	FSK	Frequency shift keying modulation
Hop Freq		Set the hop frequency
Source	Internal	The source is internal.
	External	The source is external. Use the [Ext Trig/Gate/Fsk/Burst] connector in the rear panel.

PM

The modulated waveform consists of two parts: the carrier waveform and the modulating waveform. In PM, the phase of the carrier waveform varies with the instantaneous voltage level of the modulating waveform. The parameters for the PM are as shown in Figure 2-36.
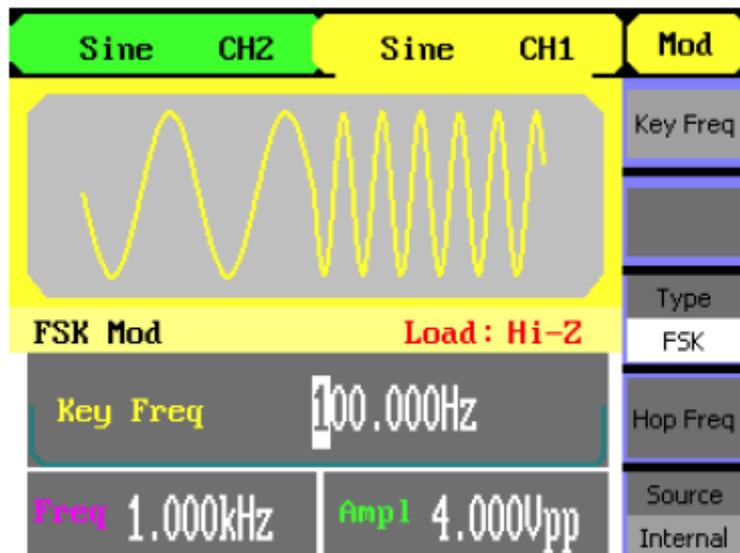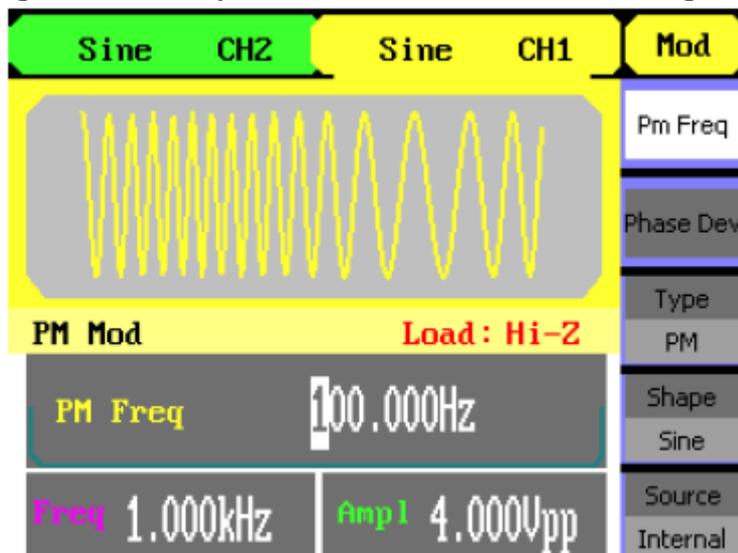
Figure 2-36
The Setting Interface of PM Waveform Parameter

Press **Mod** →Type →PM, enter the following interface.

Figure 2-37   Table 2-18 Menu Explanations of the PM Parameters

Function Menu	Settings	Explanation
PM Freq		Set the modulating waveform frequency. Frequency range: 2mHz~20kHz (internal source only).
Phase Dev		Set the phase deviation between the modulating waveform and the carrier waveform, ranging from 0 °to 360°
Type	PM	Phase modulation
Shape	Sine Square Triangle UpRam DnRam Noise Arb	Choose the modulating waveform. To change the carrier waveform parameter, press Sine, Square etc.
Source	Internal	The source is internal.
	External	The source is external. Use the [Ext Trig/Gate/Fsk/Burst] connector in the rear panel.

To Generate Sweep

In the frequency sweep mode, the function generator "steps" from the start frequency to the stop frequency at the sweep rate you specify. Sweep can be generated by sine, square, ramp or arbitrary waveforms (pulse, noise and DC are not allowed).
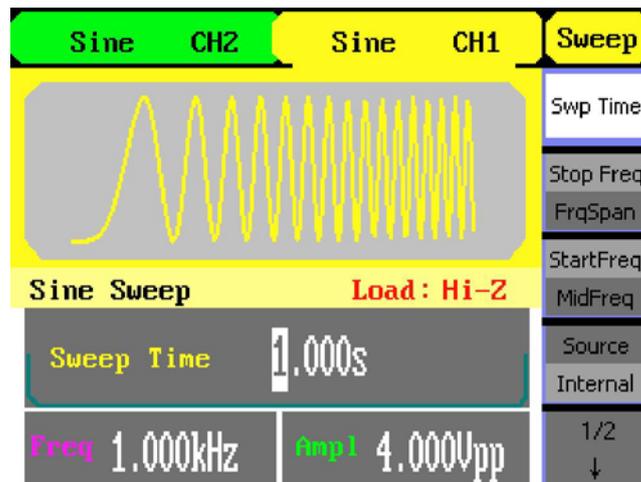
Figure 2-38 Setting Interface of Sweep Waveform Parameter

Press **Sweep** button to enter the following menu. Set the waveform parameters by using the operation menu.

Figure 2-39   Table 2-19 Menu Explanations of Waveform Sweep (Page 1/2)

Function Menu	Settings	Explanation
Swp Time		Set the time span of the sweep in which the frequency changes from the start frequency to stop frequency.
Stop Freq Freq. Span		Set the stop frequency of the sweep; Set the frequency span of the sweep.
Start Freq Mid Freq		Set the start frequency of the sweep; Set the center frequency of the sweep.
Source	Internal	Choose internal source.
	External	Choose external source, use the [Ext Trig/Gate/Fsk/Burst] connector in the rear panel.
	Manual	Set the start and stop time by hand.

Sweep Frequency Setting

Use start freq and stop freq or center freq and freq span to set the range of the frequency. Press the button again to switch between each other.

Figure 2-40

Table 2-20 Menu Explanations of Waveform Sweep (Page 2/2)

Function Menu	Settings	Explanation
Trig Out	Open Off	Set signal triggered at rise edge; Turn off trigger setting.
Linear/ Log		Set the sweep with linear spacing; Set the sweep with logarithmic spacing.
Direct	↑ ↓	Sweep upward; Sweep downward.

To Generate Burst

Burst function can generate versatile waveforms in burst, which can last specific times of waveform cycle(N-Cycle burst), or when external gated signals(gated burst) is applied, any waveform could be used, but noise can only be used in Gated Burst.

Press **Burst** button to enter the following interface. Set the waveform parameters by using the operation menu.

Figure 2-41

Setting Interface of Burst Waveform Parameter

Set the N-Cycle Burst

Press **Burst** →N Cycle , to enter the following interface.

Figure 2-42   Table 2-21 Menu Explanations of the N-Cycle Parameters （Page 1/2）

Function Menu	Settings	Explanation
Period		Set the burst Period
Start Phase		Set the start phase of the burst
N Cycle Gated		Use the N-Cycle mode Use the Gated mode
Source	Internal	Choose internal source
	External	Choose external source, use the [EXT Trig/Gate/Fsk/Burst] connector in the rear panel
	Manual	Choose external source, set the start time by hand

Burst Period

Set the time span between an N-Cycle burst and the next. If necessary the period will increase to allow the specific number of cycles in a burst. Burst Period>Carrier Period × Burst Number

Start Phase

Define the start point in a waveform. The phase varies from 0° to 360°, and the default setting is 0°. For an Arbitrary Waveform, 0° is the first waveform point.

N-Cycle/Gated

N-Cycle has specific number of waveform cycles, and every burst is activated by a trigger event. Gated burst use external source to control burst as when to be activated.

Figure 2-43   Table 2-22 Menu Explanations of the N-Cycle Parameters (Page2/2)

Function Menu	Settings	Explanation
Trig Out	⬆ ⬇ Off	Signal Triggered at Rise Edge Signal Triggered at Fall Edge Turn off Trigger Setting
Cycles/ Infinite		Set the number of the bursts in a N-Cycle Set the number of the bursts in a N-Cycle to be infinite
Delay		Set the delay time before the burst starts

Cycles

Set the number of waveform cycle in an N-Cycle (1 to 50,000 or Infinite).

If you choose Infinite, then a continuous waveform will be generated which will not stop until a trigger event happens.

- If needed, Burst Period will increase to cater to the specific number of cycles.
- For an infinite-cycle burst, external or manual trigger is needed to activate burst.

Delay

Set the time delay between the trigger input and the start of the N-Cycle burst. The minimum delay is 240ns.

Set the Gated Burst

Press **Burst** →Gated , to enter the following interface.

Figure 2-44   Table 2-23 Menu Explanations of the Gated Burst Parameters

Function Menu	Settings	Explanation
NCycle Gated		Set NCycle mode; Set the gated mode.
Polarity	Positive Negative	Set the polarity for the gated Signal.

To Store and Recall

Press **Store/Recall** button to enter the following interface. You can save or recall the state or data documentation inside the generator. The status file and data file on the U Disk are also allowed to rebuild or delete. File names can only be English.

Figure 2-45 Save and Read Interface

Figure 2-46   Table 2-24 Menu Explanations of Save and Recall (Page 1/2)

Function Menu	Settings	Explanation
File Type	State Data All File	The setting of the generator; Arbitrary waveform file; All kinds of files.
Browser	Path Directory File	Shift between the path; Directory and file.
Save		Save the waveform to the appointed place.
Recall		Recall the waveform or setting information in the specific position in the memory.
Delete		Delete the selected file

About the browser

The directory selection shift is done by the direction keys. In the directory mode, pressing the right key will open the lower directory while the left key will fold the directory. Up and down key are used to shift between the directories; in the Path mode, right key stands for the lower

directory, left key upper, up key route, and down key the lowest or the stroll bar between the files.

To Save the Instrument State

Users are allowed to store the instrument state in any of the 10 non-volatile memories. The state storage will "memorize" the selected function (including the arbitrary waveform), frequency, amplitude, DC offset, duty cycle, symmetry, and other modulation parameter used.

To save the instrument state, the procedures are given as followed:
1. Choose the file type to store
   Press **Store/Recall** →Type→State, and choose state as the storage type.
2. Choose the location of the file.
   There are ten positions in the Local(C :), choose anyone of them by rotating the knob.
3. Name the file and save it
   Press Save button, enter the desired name. Press Save to finish.

To Save Data

Users are allowed to store data document in any of the 10 non-volatile memories. If the place is already occupied, new document will cover the old one. The procedures for data storage are given as followed:
1. Choose the file type to store
   Press **Store/Recall** →Type→data, and choose data as the storage type.
2. Choose the location of the file.
   There are ten positions in the Local(C :), choose anyone of them by rotating the knob.
3. Name the file and save
   Press Save button, enter the desired name. Press Save to finish.

To Use USB Storage

As is shown in Figure 2-47, the storage location is divided into: The internal storage Local(C :) and the U Disk storage U Disk (A :). At the left side of the front panel, there is a USB interface. When a USB storage   is connected,   the storage menu will show "Mobile Disk (A:)".

Otherwise, the default location is the internal location Local(C :).

Figure 2-47 To Use the USB Storage

1. Install the Mobile Disk
   Insert the Mobile Disk into the USB interface on the front panel, and the screen will show "Detect a Mobile Disk", and storage menu will show "Mobile Disk (A :)"
2. Choose the Mobile Disk
   Press Browser->Directory, move the cursor with the up or down direction key to select "Mobile Disk (A :)". Press the right key to open the lower directory, use the up and down direction key to choose the file "AWG". Use the right key to open the lower directory, and up and down key to select the file "Workspace". Input the file name and save.
3. Remove the Mobile Disk Remove the Mobile Disk from the interface. The system will inform you "The Mobile Disk is removed", and the "Mobile Disk (A :)" in the storage menu will disappear.

Note: Mobile Disk can only be U Disk; portable hard disk is not supported.

To Save a File

Press **Store/Recall** →Store , to enter the following interface. Enter the desired file name in the "File Name" frame. In the middle of the figure below is the input keypad, used to edit the file name. Use the up and down direction keys and knob to select the desired character; use the left and right direction keys to edit the input file name.
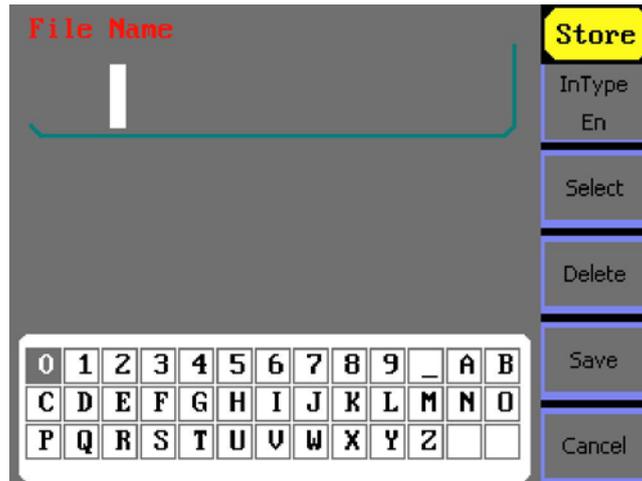
Figure 2-48 File Storage Interface

Figure 2-49   Table 2-25 Menu Explanation of File Storage

Function Menu	Settings	Explanation
Input Type	En	English input.
Select		Select the current character.
Delete		Delete the current character.
Save		Store the file with the current name.

1. **English Input**

The English input interface is as shown in Figure 2-50, to save a file named "NEWFILE", follow the steps below:

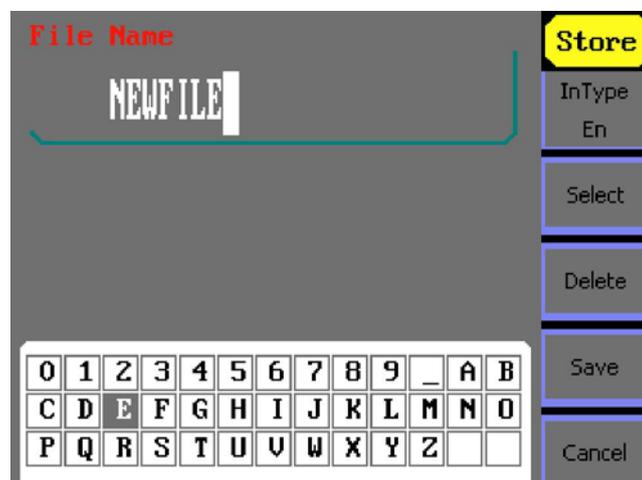Figure 2-50   English Input Interface

(1) Press Input Type->En, to enter the English interface.
(2) Input the file name" NEWFILE".
   Use the Knob to adjust the cursor's horizontal position and the up and down key to adjust the vertical position. Select the Character "N" and press Select. Repeat this until you have inputted "NEWFILE".
(3) Edit the File Name
   When you have entered a wrong character, move the cursor to the wrong character to be deleted and press Delete to remove it. Reenter the file name.
(4) Press Save, to finish and save the file.

To Set the Utility Function

With the **Utility** Function, you can set the parameters of the generator such as: DC On/Off, Sync On/Off, Output Parameter, Interface Parameter, System Setting and Testing Parameter. The DC switch offers the options of DC output or Arbitrary Waveform Output. Sync Switch offers the option to choose the Sync Signal or not. Output Setting provides the parameter setting for Load/Impedance and Normal/Inverse. The System Setting provides the setting for Language, Display, Beep, Screen Guard, Format, Power System Configure and default setting; Test provides   the self-testing and calibration function.

Press **Utility** button, to enter the Utility Menu. Its functions are listed below in Table 2-26

Figure 2-51

Table 2-26 Menu Explanations of Utility System Setting (Page1/2)

Function Menu	Settings	Explanation
DC	On	Set the output waveform to be DC Set the output waveform to be arbitrary.
Copy	On	Copy settings of the source channel to the other's. Set the copy function disabled
Output Setup		Set the output parameter
Count		Frequency counter

Figure 2-52
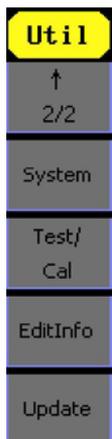
Table 2-27 Menu Explanations of Utility System Setting (Page2/2)

Function Menu	Settings	Explanation
System		Set the system configuration
Test/Cal		Test and calibrate the instrument
Edit Info		Information of the system
Update		Update function

To Set the DC Output

Press **Utility** →DC→On , to enter the following interface. Please note that there is a "Direct Current On" sign at the middle left of the screen.
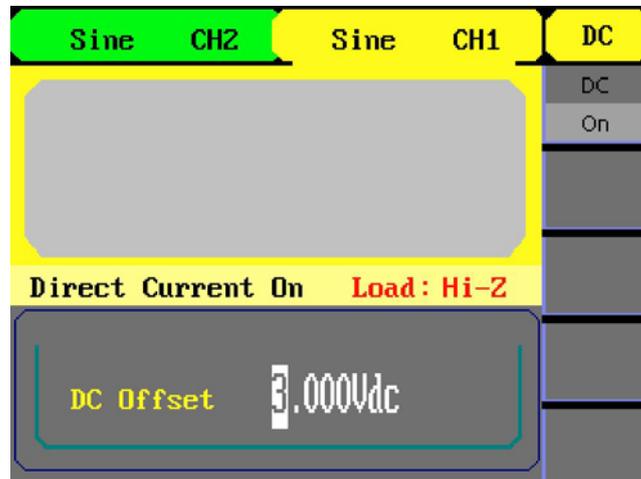

Figure 2-53 DC Setting Interface

DC Offset
Set the DC voltage level.

To Shift into the Arbitrary Waveform Output
1. Press **Utility** →DC→DC Off , to close DC output and return to arbitrary waveform output.
2. Press any functional button, and the waveform output setting turns into the arbitrary waveform output. The DC option is turned off automatically.

To copy the settings

Press **Utility** →Copy→On ,to copy the settings to the other's channel.

To Set Output Parameter

Press **Utility** →Output Setup , to enter the following interface.

Figure 2-54   Table 2-28 Menu Explanations of Output Setting (Page 1/2)

Function Menu	Settings	Explanation
Load High Z		Set the load connected to the Output Connector; Set the load connected to the Output Connector to be HighZ.
Normal Invert		Normal output; Inverse output.
Sync	On Off	Open Sync output; Close Sync output.
Done		Finish operation.

1. To Set the Output Load

For the [Output] Connector on the Front panel, the Generator has a built-in 50Ω series impendence. If the actual load does not match the set one, the displayed amplitude and offset will be incorrect. This function is used to match the displayed voltage with the expected one.

Steps for setting the load:

(1) Press **Utility** →Output Setup→Load , to enter the following interface.
   Please note that the load parameter shown on the right bottom is the default setting when the power is on or the pre-set load value. If the current value is valid for the output, then current value will be used.

(2) Input the desired load value.
   Use the keypad or the knob to enter the desired value and choose the unit, Ω or KΩ, press the corresponding button.
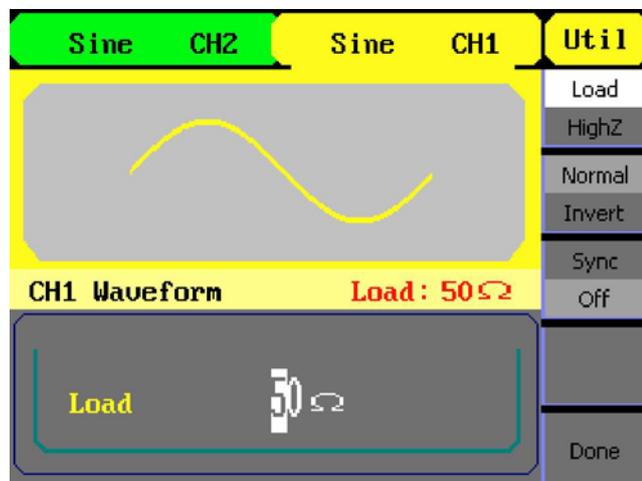
Figure 2-55 Set the Output Load

> **Instruction**
> AWG Series has a fixed 50Ω Series Impendence. No matter what value the set parameter is, if the real load is different from the set one, the displayed voltage will not equal the real voltage.

2. To Set the Invert Waveform

Press **Utility** →Output Setup→Invert, to set the Inverse Waveform Output. When the waveform is inverse, no offset will change.

3. To Set the Sync Output

The generator provides Sync output through the [Sync] connector on the rear panel. All standard output functions (except DC and Noise) have a corresponding Sync signal. For some applications, they can be disabled if users do not want to use it,

- In the default setting, the Sync signal should be connected to the [Sync] connector (activated). When the Sync Signal is disabled, the output voltage of the [Sync] connector is level low.
- In the Inverse Mode, the Waveform that corresponds to the Sync Signal does not inverse.
- The Sync Signal is a Pulse Signal with fixed positive pulse width, which is more than 50ns.
- For non-modulated waveform, the Sync Signal reference is the carrier..
- For internal modulating AM, FM and PM, the Sync signal reference is the modulated signal (not the carrier signal).
- For ASK and FSK, the Sync Signal Reference is the keying Frequency.
- For a Sweep, when the sweep starts, the Sync Signal becomes TTL Level High. The Sync frequency equals the specific Sweep time.
- For the Burst, when the burst starts, the Sync Signal is Level High.
- For the External Gated Burst, the Sync Signal follows the External Gated Signal.

To measure the frequency

AWG Series have included a frequency counter which could measure frequency from 100mHZ to 200MHZ. Press **Utility** →Count, to enter the following interface.

Figure 2-56

Table 2-29 Menu Explanations of Frequency Counter

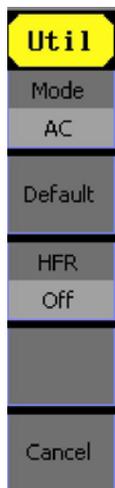| Function Menu	Settings	Explanation
Freq		Measure frequency.
Period		Measure period.
Duty/ TrigLev		Measure duty. Set the trigger level voltage.
PWidth/ NWidth		Measure positive width; Measure negative width.
Setup		Set the count configuration.

Figure 2-57

Table 2-30 Menu Explanations of Setup

Function Menu	Settings	Explanation
Mode	DC AC	Set the coupling mode to DC; Set the coupling mode to AC.
Default		Set count settings to default.
HFR	On Off	Open the high frequency rejection filter. Close the high frequency rejection filter.

To Set the System

Press **Utility** → System , to enter the following interface.

Figure 2-58   Table 2-31 Menu Explanations of System Setup (Page 1/2)

Function Menu	Settings	Explanation
Number format		Set the number format.
Language		
Power On	Default Last	All the settings return to default when powered; All the settings return to the last one. when powered.
Set to Default		Set all the settings to default

Figure 2-59   Table 2-32 Menu Explanations of System Setup (Page 2/2)

Function Menu	Settings	Explanation
Beep	On Off	Open beep; Close beep.
ScrnSvr	1min 5min 15min 30min 1hour 2hour 5hour	Activate the screen saver program. screen saver will be on if no action is taken within the time that you have selected. Press any button the resume.
	Off	Deactivate the screen saver program.
Clock	Internal External	Choose the system clock source.

Key points:
Power On
Choose the configuration setting when the machine is powered.

Two choices are available: the default setting and the latest. Once selected, the setting will be used when the instrument is powered.

Beep
Activate or deactivate the sound when an error occurs from the front panel or the remote interface. Activate or deactivate any sound made by the button or knob on the front panel. The current setting is stored in the non-volatile memory.

1. Set the Format

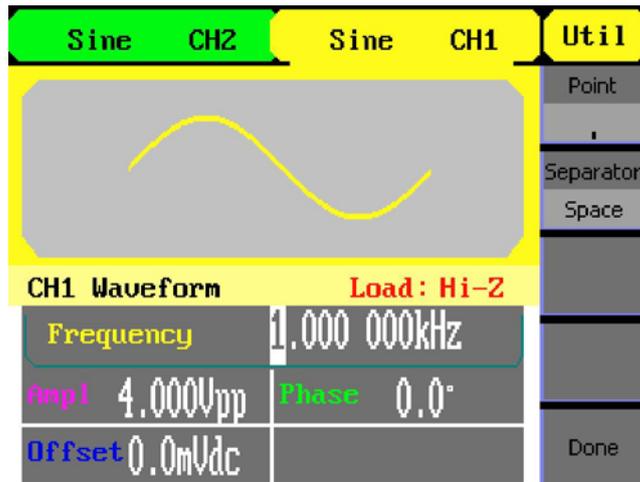Press **Utility** →System→Number Format , to enter the following interface.

Figure 2-60 Set the number Format

Figure 2-61

Table 2-33 Menu Explanations of Setting the Number Format

Function Menu	Settings	Explanation
Point	• ,	Using dot to represent point; Using comma to represent point.
Separator	On Off Space	Enable the Separator; Close the Separator; Use Space to separate.

According to the different choices of the point and the separator, the format can have various forms.

(1) • as point, press Separator->On, the example is as followed:

Figure 2-62 Set Format

(2) , as point, press ->Separator->On, the example is as followed:

Figure 2-63 Set Format

(3) • as point, press Separator->Off, the example is as followed:

Frequency   1.000000kHz

Figure 2-64 Set Format

(4) 𝍏 as point, press Separator->Off, the example is as followed:

Frequency   1,000000kHz

Figure 2-65 Set Format

(5) • as point, press Separator->Space, the example is as followed:

Frequency   1.000 000kHz

Figure 2-66 Set Format

(6) 𝍏 as point, press Separator->Space, the example is as followed:

Frequency   1,000 000kHz

Figure 2-67 Set Format

3. Language Setup

The AWG Series Generator offers two languages (English and Simplified Chinese) for user to choose.
To Select Language, press Utility and then Language to select the language.
The Procedure is as followed:
Press **Utility** →System→Language , to change the language.

4. To Return to Default Setting

Press **Utility** →System→Set to Default , to set the system to the default setting. The default settings
of the system are as followed:

Table 2-34 Factory Default Setting

Output	Default
Function	Sine Wave
Frequency	1kHz
Amplitude/Offset	4Vpp/0Vdc
Phase	0
Terminals	High Z

Modulation	Default
Carrier	1kHz Sine Wave
Modulating	100Hz Sine Wave
AM Depth	100%
FM Deviation	500Hz
Key Freq	100Hz
Key Freq	100Hz
FSK Hop Frequency	1MHz
Phase Deviation	180

Sweep	Default
Start/Stop Frequency	100Hz/1.9kHz
Sweep Time	1S
Trig Out	Off
Mode	Linear
Direction	↑

Burst	Default
Period	10ms
Phase	0°
Count	1 Cycle
Trig	Off

Trigger	Default
Source	Internal

Test/Cal

Press **Utility** →Test/Cal , to enter the following menu.
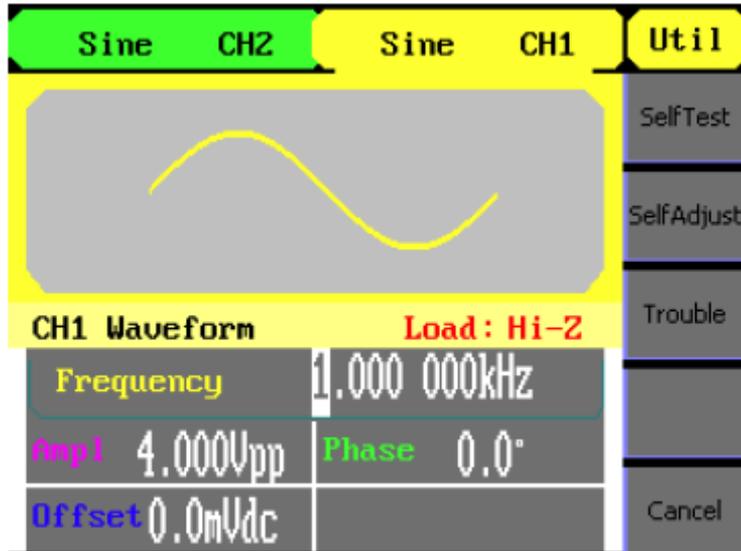

Figure 2-68 Test/Cal function Menu

Figure 2-69

Table 2-35 Menu Explanations of Test Setting

Function Menu	Settings	Explain
Self -Test		Perform system self-test

Figure 2-70   Table 2-36 Menu Explanations of Self Test

Function Menu	Settings	Explain
Scr Test		Run screen test program.
Key Test		Run keyboard test program.
LED Test		Run LED test program.

1.   **Scr Test**

Select Scr Test to enter the screen test interface. The clew words "Press '7' Key to continue, Press '8' Key to exit" is displayed. You could press the "7" for test.
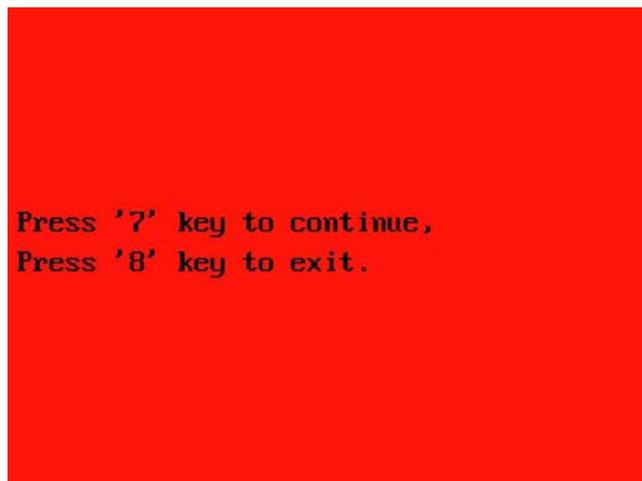
Figure 2-71 Screen Test Interface

2.   **Key Test**

Select "keyboard Test" to enter the keyboard test interface, the on-screen lathy rectangle shapes represent the front panel keys. The shapes with two arrows beside them represent the front panel knobs. Test all keys and knobs and you should also verify that all the backlit buttons illuminate correctly.

- **Note**：
  When you operate, the screen would display the white (color LCD).

- The tested button or knobs corresponding area would display green (color LCD).
- At the bottom of the screen display "Press '8' Key Three Times to exit" information prompt to show that press '8' three times for quitting the test.
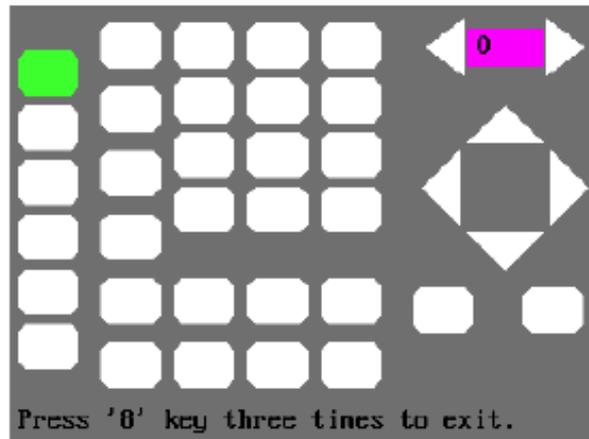
Figure 2-72 Key Test Interface

3. **LED Test**

Select "LED Test" to enter the lighten interface, the on-screen lathy rectangle shapes represent the front panel keys; The shapes with two arrows beside them represent the front panel knobs. The clew words "Press '7' Key to continue, "Press '8' Key to exit" is displayed, You could press the "7" button continuously for testing, when buttons are lighted ,the corresponding area on the screen would display green(color LCD).

Figure 2-73 Led Test Interface

Edit Information

Press the EditInfo option button of the Utility Menu to view the generator's hardware and software configuration.
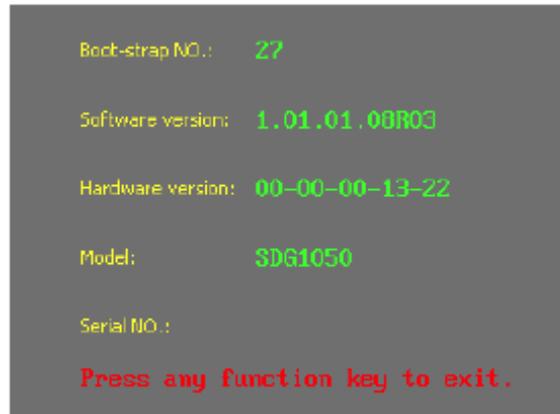
Figure 2-74 Edit Info Interface
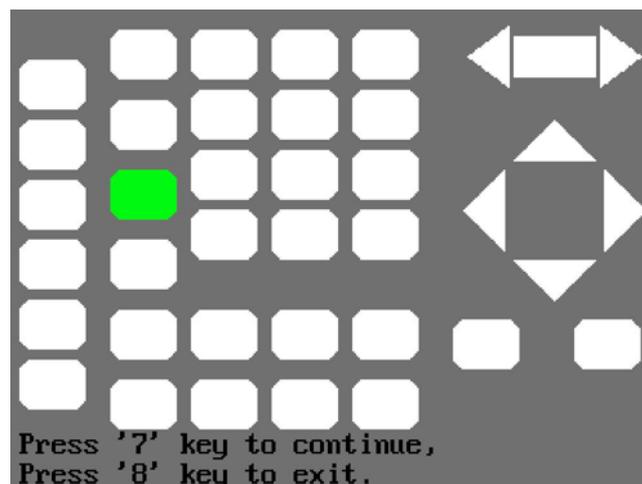
Updating Firmware

■ Using USB flash drive update firmware

The software of the generator can be updated directly via USB flash drive. This process takes about two minutes. Follow the next steps:

1. Insert USB flash drive with firmware procedure to USB host interface on the front panel of the generator
2. Press the **Utility** button to enter the "Utility Menu".
3. Press "Next Page" option button to enter the second page of "Utility Menu".
4. Press the "Update Firmware" option button.
5. Select the update file to update the system software.

Note: Don't cut off the power during product is being updating.

How to Use the Built-in Help System

You can get a particularly help for every button on the front panel by using the built-in help system. Or you can get help about the operation of the front panel buttons with the help list.

Press **Help**   to enter the following interface.

Figure 2-75 Help Menu

Figure 2-76
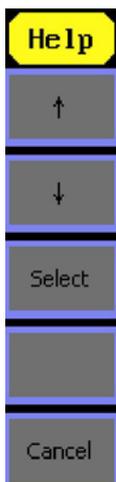
Table 2-37 Help Menu Explanations

Function Menu	Settings	Explanation
↑		Cursor upward to select
↓		Cursor downward to select
Select		Select to read the information

Chapter 3 Application and Examples

To help the user master how to use the Function/ Arbitrary Waveform Generator more efficiently, we will describe some examples in detail. All the examples below use the default setting of the instrument except especial explanations.

This chapter includes the following topics:

Example 1：Generate a Sine Wave

Generate a sine wave with 50kHz frequency, 5Vpp amplitude and 1Vdc offset.

> **Steps:**

• Set the frequency.

1. Press **Sine** → Freq and choose frequency which will display in white color.
2. Input "50" from the keyboard and choose the unit "kHz". The frequency is set to be 50 kHz.

• Set the amplitude.

1. Press Ampl to choose Ampl which will display in white color.
2. Input "5" from the keyboard and choose the unit "Vpp". The amplitude is set to be 5 Vpp.

• Set the Offset.

1. Press Offset to choose Offset which will display in white color
2. Input "1" from the keyboard and choose the unit "Vdc". The offset is set to be 1 Vdc.

When the frequency, amplitude and offset are set, the wave generated is shown in Figure 3-1;
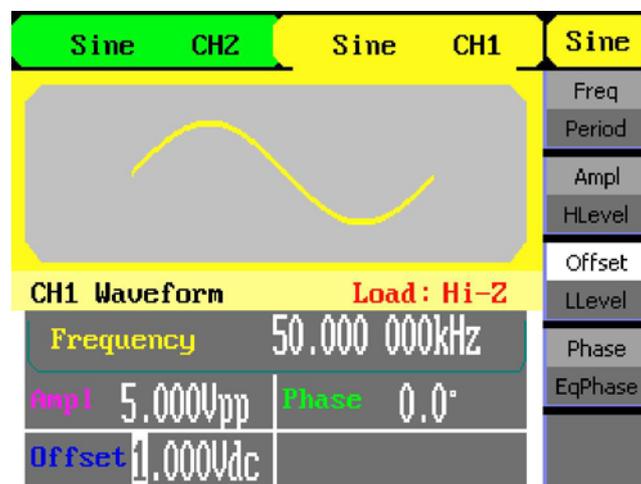
Figure 3-1 Sine Waveform

Example 2：Generate a Square Wave

Generate a square wave with 5 kHz frequency, 2 Vpp amplitude, 0Vdc offset and 30% duty cycle.

> **Steps:**

• Set the frequency.
1. Press **Square** →Freq and choose Frequency which will display in white color.
2. Input "5" from the keyboard and choose the unit "KHz". The frequency is set to be 5 KHz.

• Set the amplitude.

1. Press Ampl to choose Ampl which will display in white color.
2. Input "2" from the keyboard and choose the unit "Vpp". The amplitude is set to be 2 Vpp.

• Set the offset.

1. Press Offset to choose Offset which will display in white color
2. Input "0" from the keyboard and choose the unit "Vdc". The Offset is set to be 0 Vdc.

• Set the duty

1. Press Duty to choose Duty which will display in white color
2. Input "30" from the keyboard and choose the unit "%". The duty is set to be 30%.

When the frequency, amplitude, offset and duty cycle are set, the wave generated is shown in Figure 3-2.
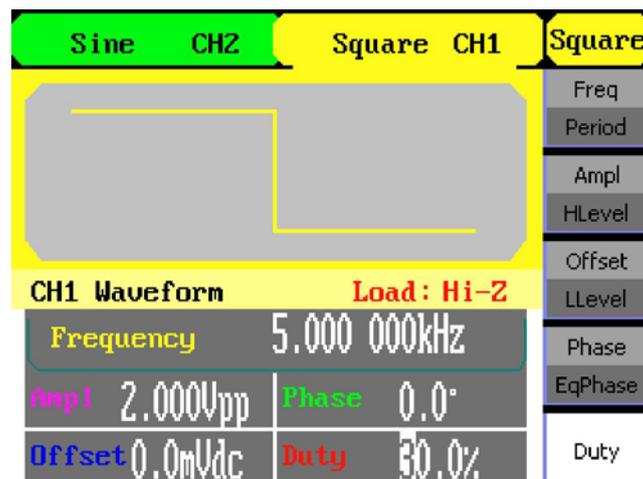
Figure 3-2 Square Waveform

Example 3 : Generate a Ramp Wave

Generate a ramp wave with 10μs period, 100mVpp amplitude, 20mVdc offset , 45°phase and 30% symmetry.

> **Steps:**

- Set the period.

1. Press **Ramp** →Freq and choose Period which will display in white color.
2. Input "10" from the keyboard and choose the unit "us". The period is set to be 10us.

- Set the amplitude.

1. Press Ampl to choose Ampl which will display in white color.
2. Input "100" from the keyboard and choose the unit "mVpp". The amplitude is set to be 100mVpp.

- Set the offset.

1. Press Offset to choose Offset which will display in white color
2. Input "20" from the keyboard and choose the unit "mVdc". The offset is set to be 20mVdc.

- Set the phase

1. Press Phase to choose Phase which will display in white color
2. Input "45" from the keyboard and choose the unit "   ". The phase is set to be 45   .

- Set the symmetry

1. Press Symmetry to choose Symmetry which will display in white color.
2. Input "30" from the keyboard and choose the unit "30%". The symmetry is set to be 30%.

When the period, amplitude, offset, phase and symmetry are set, the wave generated is shown in Figure 3-3:
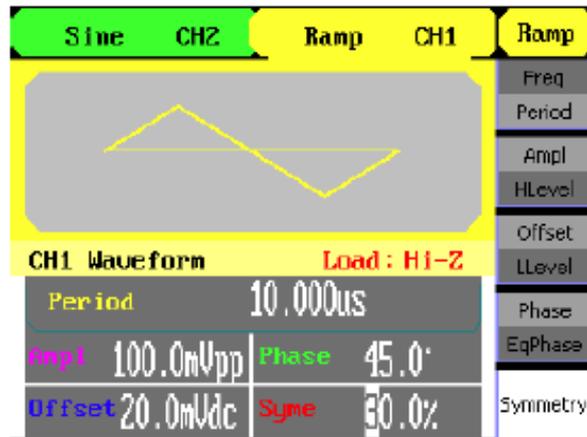
Figure 3-3 Ramp Waveform

Example 4 : Generate a Pulse Wave

Generate a pulse wave with 5 kHz frequency, 5V high level, -1V low level, 40μs pulse width and 20ns delay.

> **Steps:** •

•   Set the frequency.

1.   Press   **Pulse**   → Freq and choose Freq , which will display in white color.
2.   Input "5" from the keyboard and choose the unit "KHz". The frequency is set to be 5 KHz.

•   Set the high level

1.   Press Ampl and choose the HLevel which will display in white color.
2.   Input "5" from the keyboard and choose the unit "V". The high level is set to be 5V.

•   Set the low level

1.   Press Offset and choose the LLevel which will display in white color.
2.   Input "-1" from the keyboard and choose the unit "V". The low level is set to be -1V.

•   Set the pulse width

1.   Press PulWidth and choose PulWidth which will display in white color.
2.   Input "40" from the keyboard and choose the unit "us". The pulse width is set to be 40us.

•   Set the Delay

1.   Press Delay and choose Delay which will display in white color.
2.   Input "20" from the keyboard and choose the unit "ns". The delay is set to be 20ns.

When the frequency high level, low level, pulse width and delay are set, the wave generated is shown in Figure 3-4:

Figure 3-4 Pulse Waveform

Example 5: Generate a Noise Wave

Generate a noise waveform with 50mVpp amplitude and 5mVdc offset.

> **Steps:**

- Set the Amplitude

1. Press   **Noise** → Ampl and choose the Ampl which will display in white color.
2. Input "50" from the keyboard and choose the unit "mVpp". The amplitude is set to be 50 mVpp.

- Set the Offset

1. Press Offset to choose Offset which will display in white color.
2. Input "5" from the keyboard and choose the unit "mVdc". The offset is set to be 10mVdc.

When the amplitude and offset are set, the wave generated is shown in Figure 3-5
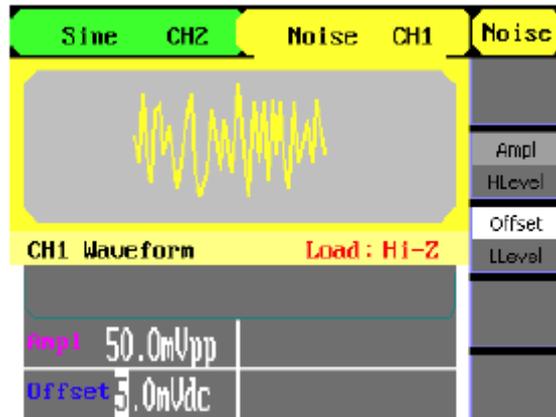
Figure 3-5 Noise Waveform

Example 6: Generate an Arbitrary Wave

Generate an arbitrary waveform (Sinc) with 5MHz frequency, 2Vrms amplitude and 0Vdc offset.

> **Steps:**

- Set the type of the arbitrary waveform.

1. Press **Arb** → (1/2 ↓) → LoadWform, to choose the built-in waveform..
2. Press BuiltIn → Math. There are sixteen math arbitrary waveforms.
3. Choose Sinc, and press Choice to enter Arb Main Menu.

- Set the frequency.

1. Press Freq and choose Frequency which will display in white color.
2. Input "5" from the keyboard and choose the unit "MHz". The frequency is set to be 5MHz.

- Set the amplitude

1. Press Ampl to choose Ampl which will display in white color.
2. Input "2" from the keyboard and choose the unit "Vrms". The amplitude is set to be 2 Vrms.

- Set the offset

1. Press Offset to choose Offset which will display in white color.
2. Input "0" from the keyboard and choose the unit "Vdc". The offset is set to be 0 Vdc.

When the arbitrary waveform's type, frequency, amplitude and offset are set, the wave generated is shown in Figure 3-6:
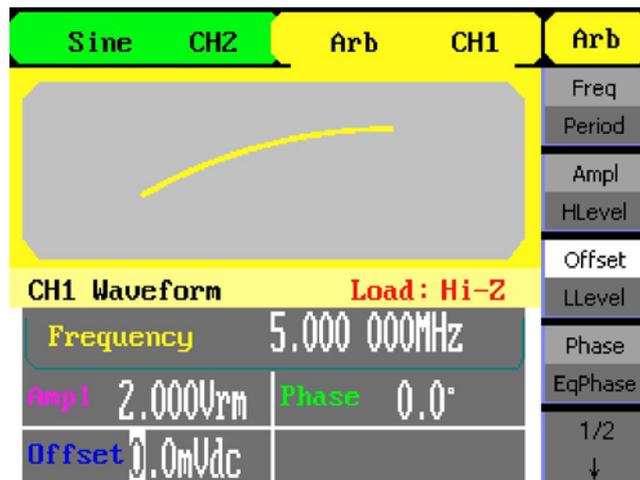
Figure 3-6 Sinc Waveform

Example 7 : Generate a Sweep Linear Wave

Generate a sine sweep waveform whose frequency starts from 100Hz to 10KHz. Use internal trigger mode, linear sweep, and the sweep time is 2s.

> **Steps:**

• Set the sweep function:

Press **Sine** , and choose the sine waveform as the sweep function.
The default setting of the source is internal.

• Set the frequency, amplitude and offset.

1. Press Freq and choose Freq which will display in white color. Input "5" from the keyboard and choose the unit "KHz" to set the frequency 5 kHz.
2. Press Ampl to choose Ampl which will display in white color. Input "5" from the keyboard and choose the unit "Vpp" to set the amplitude 5 Vpp.
3. Press Offset to choose Offset which will display in white color. Input "0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc

• Set the sweep time.

Press **Sweep** → Sweep Time , Input "2" from the keyboard and choose the unit "s" to set sweep time 2s.

• Set the start frequency

Press Start Freq, Input "100" from the keyboard and choose the unit "Hz" to set start freq 100Hz.

• Set the end frequency

Press End Freq, Input "10" from the keyboard and choose the unit "kHz" to set stop freq 10 kHz.

• Set the Sweep Mode

Press (1/2 ↓) → Linear, and choose Linear.

When all parameters above are set, the linear sweep wave generated is shown in Figure 3-7:
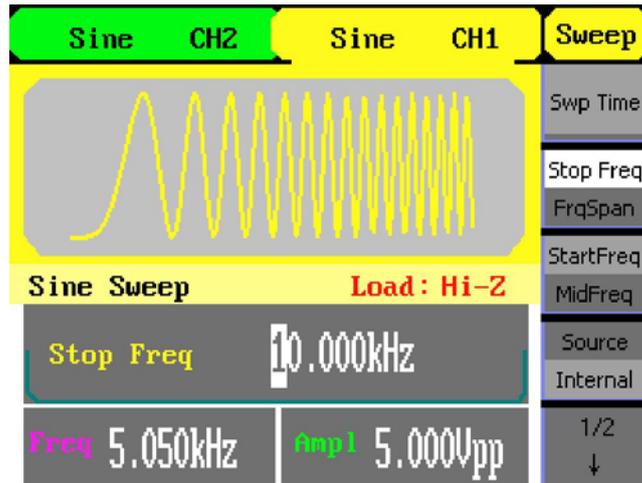
Figure 3-7 Sweep Waveform

Example 8: Generate a Burst Wave

Generate a burst waveform of 5 cycles. The period is 3ms. Use internal trigger and 0 degree phase.

> **Steps:**

- Set the sweep function:

    Press   **Sine** , and choose the sine waveform as the burst function. The default setting of the source is internal.

- Set the frequency, amplitude and offset

1. Press Freq and choose Freq which will display in white color. Input "10" from the keyboard and choose the unit "kHz" to set the frequency 10kHz.
2. Press Ampl to choose Ampl which will display in white color. Input "1" from the keyboard and choose the unit "Vpp" to set the amplitude 1Vpp.
3. Press Offset to choose Offset which will display in white color. Input "0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc

- Set the sweep mode.

    Press **Burst** →N Cycle , choose N Cycle Mode.

- Set the burst period

    Press Period, input "3" from the keyboard and choose the unit "ms" to set the period 3ms.

- Set the start phase

    Press Start Phase, input 3   from the keyboard and choose the unit   to set the start phase 0   .

- Set the burst cycles

    Press (1/2 ↓) → Choose Cycles. Input "5" from the keyboard and choose the unit "Cycle" to set the burst cycle 5.

- Set the delay

    Press Delay, and input "100" from the keyboard and choose the unit "us" to set the

delay 100μs.

When all parameters above are set, the wave generated is shown in 8:
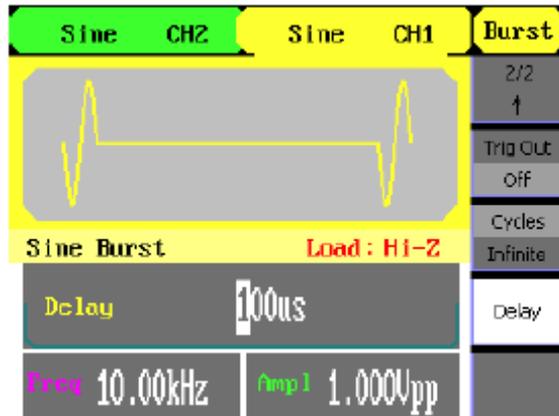
Figure 3-8 Burst Waveform Output

Example 9: Generate an AM Wave

Generate an AM waveform with 80% depth. The carrier is a sine wave with 10 kHz frequency, and the modulating wave is a sine wave with 200Hz frequency.

> **Steps:**

- Set the frequency amplitude and offset of the carrier wave.

1. Press **Sine** , and choose the sine waveform as the carrier wave
2. Press Freq and choose Freq which will display in white color. Input"10" from the keyboard and choose the unit "kHz" to set the frequency 10KHz
3. Press Ampl and choose Ampl which will display in white color. Input"1" from the keyboard and choose the unit "Vpp" to set the amplitude 1Vpp.
4. Press Offset and choose Offset which will display in white color. Input"0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc.

- Set the modulation type AM and parameters.

1. Press **Mod** → Type → AM , choose AM. Please notice that the message shown on the middle left side of the screen is "AM Mod".
2. Press AM Freq, input"200" from the keyboard and choose the unit "Hz" to set the AM freq 200Hz.
3. Press AM Depth, input"80" from the keyboard and choose the unit "%" to set the AM depth 80%.
4. Press Shape →Sine , to choose sine wave as the modulating waveform.

When all parameters above are set, the wave generated is shown in Figure 3-9:
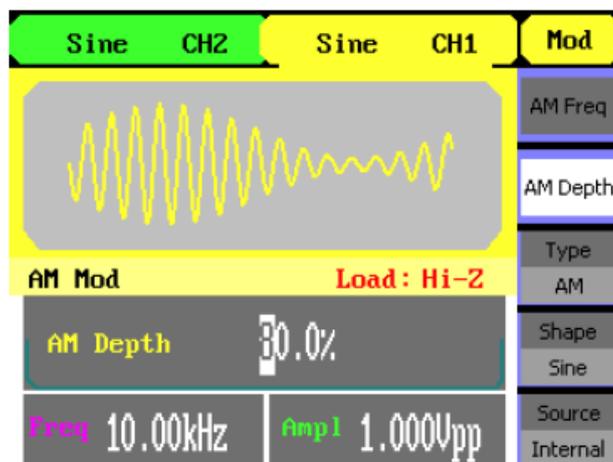
Figure 3-9 AM Waveform

Example 10 : Generate a FM Wave

Generate a FM waveform, the carrier is a sine wave with 10 kHz frequency, and the modulating wave is a sine wave with 1 Hz frequency, 2kHz frequency deviation.

> **Steps:**

- Set the frequency, amplitude and offset of the carrier wave.

1. Press **Sine** , and choose the sine waveform as the carrier wave
2. Press Freq and choose Freq which will display in white color. Input"10" from the keyboard and choose the unit "kHz" to set the frequency 10kHz
3. Press Ampl and choose Ampl which will display in white color. Input"1" from the keyboard and choose the unit "Vpp" to set the amplitude 1Vpp.
4. Press Offset and choose Offset which will display in white color. Input"0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc.

- Set the modulation type FM and parameters.

1. Press **Mod** → Type → FM , choose FM. Please notice that the message shown on the middle left side of the screen is "FM Mod".
2. Press FM Freq , input "1" from the keyboard and choose the unit "Hz" to set the AM Freq 1Hz.
3. Press FM Dev , input "2" from the keyboard and choose the unit "KHz" to set the FM deviation 2KHz.
- Press Shape → Sine , to choose sine wave as the modulating waveform.

When all parameters above are set, the wave generated is shown in Figure 3-10:
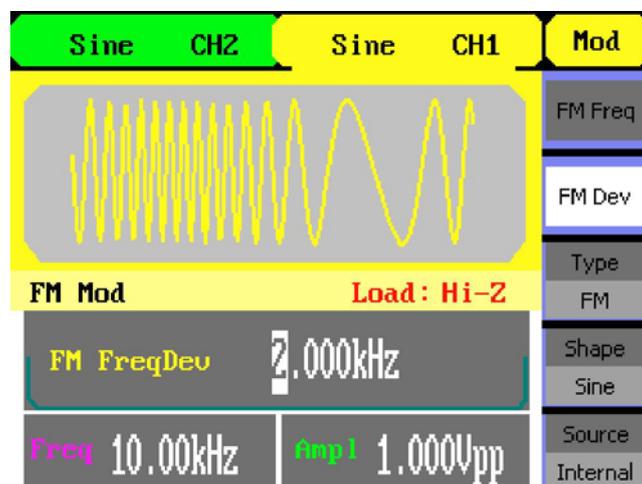
Figure 3-10 FM Waveform

Example 11: Generate a PM Wave

Generate a PM waveform, the carrier is a sine wave with 10 kHz frequency, and the modulating wave is a sine wave with 2 kHz frequency, 90° phase deviation.

> **Steps:**

- Set the frequency, amplitude and offset of the carrier wave.

1. Press   **Sine** , and choose the sine waveform as the carrier wave
2. Press Freq and choose Freq which will display in white color. Input"10" from the keyboard and choose the unit "kHz" to set the frequency 10kHz
3. Press Ampl and choose Ampl which will display in white color. Input"5" from the keyboard and choose the unit "Vpp" to set the amplitude 5Vpp.
4. Press Offset and choose Offset which will display in white color. Input"0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc.

- Set the modulation type PM and parameters.

1. Press   **Mod**   →Type → PM , choose PM. Please notice that the message shown on the middle left side of the screen is "PM Mod".
2. Press PM Freq, input "2" from the keyboard and choose the unit "kHz" to set the PM freq 2 kHz.
3. Press Phase Dev , input "90" from the keyboard and choose the unit " °" to set the phase deviation 90°.
4. Press Shape →Sine , to choose sine wave as the modulating waveform.

When all parameters above are set, the wave generated is shown in Figure 3-11:
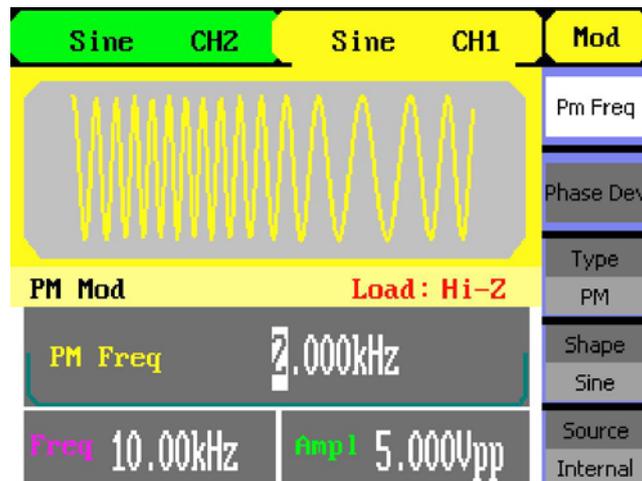
Figure 3-11 PM Waveform

Example 12：Generate a FSK Wave

Generate a FSK waveform with 200Hz key frequency. The carrier is a sine wave with 10kHz frequency, and the hop wave is a sine wave with 500Hz frequency.

> **Steps:**

- Set the frequency, amplitude and offset of the carrier wave.

1. Press **Sine** , and choose the sine waveform as the carrier wave
2. Press Freq and choose Freq which will display in white color. Input"10" from the keyboard and choose the unit "kHz" to set the frequency 10KHz
3. Press Ampl and choose Ampl which will display in white color. Input"5" from the keyboard and choose the unit "Vpp" to set the amplitude 5Vpp.
4. Press Offset and choose Offset which will display in white color. Input"0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc.
- Set the modulation type FSK and parameters.
1. Press **Mod** →Type → FSK , choose FSK. Please notice that the message shown on the middle left side of the screen is "FSK Mod".
2. Press Key Freq, input"200" from the keyboard and choose the unit "Hz" to set the key frequency 200 Hz.
3. Press Hop Freq, input "500" from the keyboard and choose the unit "Hz" to set the hop frequency 500Hz.

When all parameters above are set, the wave generated is shown in Figure 3-12
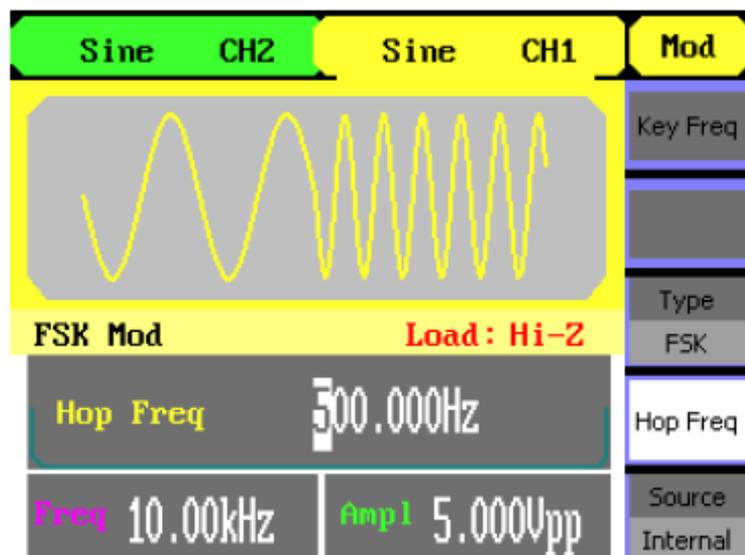
Figure 3-12 FSK Waveform

Example 13 : Generate an ASK Wave

Generate an ASK waveform with 500Hz key frequency. The carrier is a sine wave with 5kHz frequency.

> **Steps:**

- Set the frequency, amplitude and offset of the carrier wave.

1. Press **Sine** , and choose the sine waveform as the carrier wave
2. Press Freq and choose Freq which will display in white color. Input "5" from the keyboard and choose the unit "kHz" to set the frequency 5KHz
3. Press Ampl and choose Ampl which will display in white color. Input "5" from the keyboard and choose the unit "Vpp" to set the amplitude 5Vpp.
4. Press Offset and choose Offset which will display in white color. Input "0" from the keyboard and choose the unit "Vdc" to set the offset 0Vdc.

- Set the modulation type ASK and parameters.

1. Press **Mod** → Type → ASK , choose ASK. Please notice that the message shown on the middle left side of the screen is "ASK Mod".
2. Press Key Freq, input "500" from the keyboard and choose the unit "Hz" to set the key freq 500 Hz.

When all parameters above are set, the wave generated is shown in Figure 3-13:
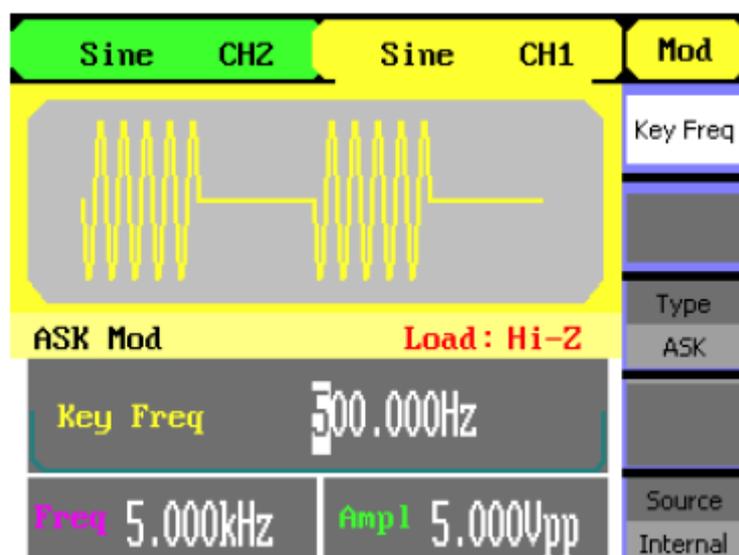
Figure 3-13 ASK Waveform

Chapter 4   Troubleshooting

General Inspecting

After receiving a new AWG Series Function/Arbitrary Waveform Generator, please inspect the instrument as followed:

1. **Inspect the shipping container for damage.**
    Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

2. **Inspect the whole instrument.**
    In case there is any mechanical damage or defect, or the instrument does not operate properly or fails performance tests, notify the **AKTAKOM** sales representative.
    If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as the **AKTAKOM** sales department. Keep the shipping materials for carrier's inspection.

3. **Check the accessories.**
    Accessories supplied with the instrument are listed below. If the contents are incomplete or damaged, notify the **AKTAKOM** sales representative. **Standard Accessories:**
    *   A User Manual
    *   A Certification
    *   A Guaranty Card
    *   A CD(including EasyWave1.0 computer software system)
    *   A Power Cord that fits the standard of destination country
    *   A USB Cable

Troubleshooting

1. After the waveform generator is powered on, the screen remains dark, please do the

following steps:

(1) Check the power cable's connection.

(2) Ensure the power switch is turned on.

(3) After the inspections above, restart the waveform generator..

(4) If the generator still doesn't work after the checking, please connect with **AKTAKOM** company.

2. If there is no signal wave output after setting the parameters, please do as following

steps:

(1) Check whether the BNC cable has connected with output channel or not.

(2) Check whether the output button have been turned on or not.

Chapter 5   Service and Support

Maintain summary

AKTAKOM warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of three years from the date of shipment from an authorized **AKTAKOM** distributor. If a product proves defective within the respective period, **AKTAKOM** will provide repair or replacement as described in the complete warranty statement. To arrange for service or obtain a copy of the complete warranty statement, please contact your nearest **AKTAKOM** sales and service office.

Except as provided in this summary or the applicable warranty statement, **AKTAKOM** makes no warranty of any kind, express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. In no event shall **AKTAKOM** be liable for indirect, special or consequential damages

Chapter 6   Appendix

Appendix A: Accessories

AWG Series Function/ Arbitrary Waveform Generator Accessories:

Standard Accessories:

- A User Manual
- A Certification
- A Guaranty Card
- A CD(including EasyWave1.0 computer software system)
- A Power Cord that fits the standard of destination country
- A USB Cable

Optional Accessories:
- BNC Cable
- GPIB/LAN interface

Appendix B: Specification

Specification

Model	AWG-4105	AWG-4110	AWG-4150
Max. output frequency	5MHz	10MHz	50MHz
Output channels	2		
Sample rate	125 MSa/s		
Arbitrary waveform length	16 kpts		
Frequency resolution	1 μHz		
vertical resolution	14 bits		
Waveform	Sine, Square, Triangular, Pulse, Gaussian Noise. 48 types of arbitrary waveform		
Sine	1μHz ~ 5MHz	1μHz ~ 10MHz	1μHz ~ 50MHz
Square	1μHz ~ 5MHz	1μHz ~ 10MHz	1μHz ~ 25MHz
Pulse	3μHz ~ 5MHz	3ÙJ	'¢'7OJ	"	3μHz ~ 7OJ	"
Ramp/Triangular	1μHz ~ 300mHz	1μHz ~ 300mHz	1μHz ~ 300mHz
Gaussian white noise	5MHz (-3dB)	10MHz (-3dB)	50MHz (-3dB)
Arbitrary waveform	1μHz ~ 5MHz	1μHz ~ 5MHz	1μHz ~ 5MHz
Modulation	AM、FM、PM、FSK、ASK、PWM、Sweep、Burst		
Amplitude range	2 mVpp ~ 10 Vpp (50Ω), 4 mVpp ~ 20 Vpp (high impedance)		
Other functions	Frequency counter: Max. frequency 200MHz		
Standard interface	USB Host & Device		
Optional interfaces	GPIB(IEEE-488), LAN		
Dimension	W x H x D=229mm x 105mm x 281mm		

Attention:

All these specifications apply to the AWG Series Function/Arbitrary Waveform Generator unless otherwise explanation. To satisfy these specifications, the following conditions must be met first:

1. The instrument have been operating continuously for more than 30 minutes within specified operating temperature range (18ºC ~ 28°C).
2. You must perform the Self Cal operation if the operating temperature changes by more than 5℃ .

Note: all specifications are guaranteed except noted "typical value".

Frequency Specification

	AWG-4105	AWG-4110	AWG-4150
Waveform	Sine, Square, Ramp, Triangle, Pulse, Noise, Arb		
Sine	1μHz ~ 5MHz	1μHz ~ 5MHz	1μHz ~ 5MHz
Square	1μHz ~ 5MHz	1μHz ~ 10MHz	1μHz ~ 25MHz
Pulse	1μHz ~ 5MHz	1μHz ~ 5MHz	1μHz ~ 5MHz
Ramp/Triangular	1μHz ~ 300kHz	1μHz ~ 300kHz	1μHz ~ 300kHz
Gaussian white noise	5MHz (-3dB)	10MHz (-3dB)	50MHz (-3dB)
Arbitrary waveform	1μHz ~ 5MHz	1μHz ~ 5MHz	1μHz ~ 5MHz
resolution	1μHz		
Accuracy	Within 90daysv+50 ppm within 1 year +100 ppm 18°C ~ 28°C		
Temperaturecoefficient	<5 ppm/°C		

Sine Wave Spectrum Purity

Harmonic Distortion	CHI		CH2	
	<1 Vpp	>1 Vpp	<1 Vpp	>1 Vpp
DC-1 MHz	-55 dBc	-45 dBc	-55 dBc	-45 dBc
1 MHz - 5 MHz	-55 dBc	-40 dBc	-55 dBc	-40 dBc
5 MHz - 25 MHz	-50 dBc	-35 dBc	-50 dBc	-35 dBc
Total harmonic waveform distortion	DC ~ 20 kHz， 1 Vpp <0.2%			
Spurious signal （non-harmonic）	DC ~ 1 MHz < -70 dBc 1 MHz ~ 10 MHz < -70 dBc + 6 dB/spectrum phase			

Phase noise   10kHz Offset,   -108 dBc / Hz   (typical value)

Square Wave

Rise/fall time (10% ~ 90%, typical value, 1 kHz, 1		< 12 ns
Overshoot		< 5% (typical value, 1kHz, 1 Vpp)
Duty	1 μHz ~ 10 MHz	20% ~ 80%
	10 MHz （exclude） ~ 20 MHz	40% ~ 60%
	20 MHz （exclude） ） ~ 25 MHz	50%
Asymmetric （50% Duty Cycle）		Cycle 1% + 20 ns (typical value, 1 kHz, 1 Vpp)
Jitter		6 ns + cycle 0.1% (typical value, 1 kHz, 1 Vpp)

Ramp Wave	
Linearity	< Peak value output0.1%,　（typical value，1 kHz，1 Vpp，symmetric 100%）
Symmetry	0% to 100%

Pulse Wave Specification

Pulse width	Max. 2000 s ： Min. 20 ns，　Min. resolution 1 ns
Rise/Fall time　（10%-90%，typical value，1 kHz, 1 Vpp）	same as square waveform
Overshoot	< 5%
Jitter	6 ns + cycle 100 ppm

Arbitrary Waveform Specification

Waveform length	16k points	16k points
Vertical resolution	14 bits　（include symbol）	14 bits　（include symbol）
Sample rate	125 MSa/s	125 MSa/s
Min. Rise/Fall time	20ns　（typical value）	20ns　（typical value）
Jitter　（RMS）	6 ns + 30 ppm　（typical	6 ns + 30 ppm　（typical
Storage in non-volatile RAM memory (10 in total）	10 waveforms	10 waveforms

Output Specification

Output	CH 1	CH 2
Amplitude	2 mVpp -10 Vpp (50ohm，<10MHz) 2 mVpp - 5 Vpp (50ohm，>10MHz) 4 mVpp ~ 20 Vpp　（high <10MHz) 4 mVpp - 10 Vpp (high impedance，＞10MHz）	2 mVpp - 3 Vpp　(50ohm) 4 mVpp ~ 6 Vpp　（high impedance）
Vertical resolution （100 kHz sine waveform）	+ (1 %+1 mVpp of setting value)	+ (1%+1 mVpp of setting value）
Amplitude flatness (compared to 100 kHz sine waveform, 5 Vpp)	<100 kHz 0.1 dB	<100 kHz 0.1 dB
	100 kHz ~ 5 MHz 0.15 dB	100 kHz ~ 5 MHz 0.15 dB
	＞5 MHz 0.3 dB	＞5 MHz 0.3 dB

DC Offset		
Range （DC）	5 V （50ohm） 10 V （high impedance）	1.5 V （50ohm） 3 V （high impedance）
Offset accuracy	± （|setting offset value|1%+1 mV）	± （|setting offset value|1%+1 mV）

Waveform Output		
Impedance	50ohm(typical value)	50ohm(typical value)
Protection	short-circuit protection	short-circuit protection

AM Modulation（CH1/CH2）		
Carrier	Sine, Square, Ramp, Arbitrary (except DC)	
Source	Internal/External	
Modulation waveform	Sine, Square, RAMP, Noise, Arbitrary (2 mHz ~ 20 kHz)	
Modulation depth	0% ~ 120%	

FM Modulation（CH1/CH2）		
Carrier	Sine, Square, Triangle, Arbitrary （except DC）	
Source	Internal/External	
Modulation waveform	Sine, Square, RAMP, Triangle, Gaussian Noise, Arbitrary（2 mHz ~ 20 kHz）	
Frequency deviation	AWG-4105	0 ~ 2.5 MHz
	AWG-4110	0 ~ 5 MHz
	AWG-4150	0 ~ 25 MHz

PM Modulation（CH1/CH2）	
Carrier	Sine, Square, Triangle, Arbitrary （except DC）
Source	Internal/External
Modulation waveform	Sine, Square, RAMP, Triangle, Gaussian Noise, Arbitrary（2 mHz ~ 20 kHz）
Deviation	0 ~ 360°

FSK Modulation（CH1/CH2）	
Carrier	Sine, Square, Triangle, Arbitrary（except DC）
Source	Internal/External
Modulation waveform	50% duty square waveform （2 mHz ~ 50 kHz）

ASK Modulation（CH1/CH2）	
Carrier	Sine, Square, Triangle, Arbitrary （except DC）
Source	Internal/External
Modulation waveform	50% duty square waveform（2 mHz ~ 50 kHz）

PWM Modulation（CH1/CH2）	
Frequency	500μHz ~ 20kHz
Source	Internal/External

Modulation waveform	Sine, Square, RAMP, Triangle, Arbitrary (except DC)
External modulation	-6~+6V （ （corresponding modulation depth 0%~100%）

Sweep（CH1/CH2）

Carrier	Sine, Square, RAMP, Triangle, Arbitrary (except DC)
Type	linear/logarithmic
Direction	Up/ down
Sweep time	1 ms ~ 500 s + 0.1%
Trigger source	Manual, external, internal

Burst（CH1/CH2）

Waveform	Sine, Square, RAMP, Pulse, Arbitrary(except DC)
Type	Count (1 ~ 50,000 cycles) ， infinite, Gated
Start/Stop phrase	0° ~ 360°
Internal cycle	1 μs ~ 500 s + 1%
Gated trigger	External trigger
Trigger source	Manual , External or Internal

Rear Panel Connector

External modulation	±6 Vpk= 100% modulation depth 5 kΩ input impedance
External trigger	TTL compatible

The external input voltage can't be over ±6V, otherwise instrument gets damaged.

Trigger Input

Voltage level input	TTL compatible
Slope	Up or down (optional)
Pulse width	> 100 ns
Input impedance	> 10 k, DC coupling
Response time	Sweep:< 500 μs（typical value）
Burst	< 500ns（typical value）

Trigger Output

Voltage level	TTL compatible
Pulse width	> 400 ns （typical value）
Output impedance	50 (typical value)
Max. frequency	1 MHz

SYNC Output

Voltage level	TTL compatible
Pulse width	> 50 ns　　（typical value）
Output impedance	50　　　(typical value)
Max. frequency	2MHz

Frequency Counter

Measurement	Frequency, Cycle, Positive/negative pulse width, duty cycle		
Frequency range	Single Channel: 100 mHz ~ 200 MHz		
Frequency resolution	6 bits/s		
Voltage range and sensitivity(non-modulated signal）			
Auto	1 Hz ~ 200 MHz		200 mVpp ~ 5 Vpp
Manual	DC coupling	DC deviation range	+1.5 VDC
		100 mHz ~ 100 MHz	20m VRMS ~ +5 Vac+dc
		100 MHz ~ 200 MHz	40m VRMS ~ +5 Vac+dc
	AC coupling	1 Hz ~ 100 MHz	50m Vpp ~ +5 Vpp
		100 MHz ~ 200 MHz	100m Vpp ~ +5 Vpp
Pulse width and duty measurement	1 Hz ~ 10 MHz（100 mVpp ~ 10 Vpp）		
Input adjustment	Input impedance		1 MΩ
	Coupling methods		AC, DC
	High-frequency inhibition		High-frequency noise inhibition(HFR)open or close
	Sensitivity		Three levels: low, middle, high
Trigger method	Trigger voltage level range：±3 V　(0.1 **%**~ 100% **)**		
	Resolution：6 mV		
	Adjust trigger voltage level manually/automatically		

General Specification

Display	
Display type	3.5'TFT-LCD
Resolution	320xRGBx240
Contrast（typical value）	350:1
Backlight intensity (typical value)	300cd/m^2
Power	
Voltage	100~240 VAC$_{RMS}$，45~440 Hz，CATII
Consumption	＜30W
Fuse	1A，250V
Environment	
Temperature	Operation：0°C--50°C
	Storage：-20°C--60°C
Cooling method	natural cooling down
Temperature range	Below +35℃：≤90% relative humidity
	+35℃ ~ +50℃：≤60% relative humidity
Altitude	Operation: below 3,000 meters
	Storage: below 15,000 meters
Others	
Dimension	Width：229mm
	Height：105mm
	Depth：281mm
Weight	N.W: 2.8 Kg
	G.W: 4.2 Kg
IP protection	
IP2X	
Calibration Cycle	
1 year	

Appendix C: Daily Maintain and Cleaning

Daily Maintain

Do not store or leave the instrument in where the LCD will be exposed to direct sunlight for long periods of time.

⚠ **CAUTION:** To avoid damage to the instrument, do not expose them to sprays, liquids, or solvents.

Cleaning

If this instrument requires cleaning, disconnect it from all power sources and clean it with a mid detergent and water. Make sure the instrument is completely dry before reconnecting it to a power source.

To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the instrument with a lint-free cloth. Use care to avoid scratching the clear plastic display filter.
2. Use a soft cloth dampened with water to clean the instrument.

⚠ **WARNING:** To avoid damage to the surface of the instrument, do not use any abrasive or chimerical cleaning agents.