User Manual

SDG2000X Series Function/Arbitrary Waveform Generator

UM0202X-E01B

Declaration

General Safety Summary

Carefully read the following safety precautions to avoid any personal injuries or damages to the instrument and any product connected to it. To avoid potential hazards, please use the instrument as specified.

Only the qualified technician can service the instrument.

Avoid fire or personal Injure.

Use proper power line.

Use only the special power line which approved by local state.

Ground the Instrument.

The instrument is grounded through the protective terra conductor of the power line. To avoid electric shock, the ground conductor must be connected to the earth. Make sure the instrument is grounded correctly before connecting its input or output terminals.

Connect the signal wire correctly.

The potential of the signal wire ground is equal to the earth, so do not connect the signal wire to a high voltage. Do not touch the exposed contacts or components.

Observe all terminal ratings.

To avoid fire or electric shock, please observe all ratings and sign instruction on the instrument. Before connecting the instrument, please read the manual carefully to gain more information about the ratings.

Do not operate with suspected failures.

If you suspect that the product is damaged, please let a qualified service personnel check it.

Avoid circuit or wire exposure.

Do not touch exposed contacts or components when the power is on.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep the surface of the instrument clean and dry.

Safety Terms and Symbols

Terms used on the instrument. Terms may appear on the instrument:

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 used on the instrument. Symbols may appear on the instrument:

Hazardous Voltage	Protective Earth Ground	Warning	Chassis Ground	Power Switch

Introduction of SDG2000X

The manual covers the following 3 models of SDG2000X Series Function/Arbitrary Waveform Generators: SDG2042X, SDG2082X and SDG2122X.

SIGLENT's SDG2000X is a series of dual-channel function/arbitrary waveform generators with specifications of up to 120MHz maximum bandwidth, 1.2GSa/s sampling rate and 16-bit vertical resolution. The proprietary TrueArb & EasyPulse techniques help to solve the weaknesses inherent in traditional DDS generators when generating arbitrary, square and pulse waveforms. Using these techniques the SDG2000X provides users with a variety of high fidelity, low jitter signals in order to meet the growing requirements for a multitude of complex applications.

Key Features

◆ Dual-channel, 120MHz maximum bandwidth, 20Vpp maximum output amplitude, high fidelity output with 80dB dynamic range

◆ High-performance sampling system with 1.2GSa/s sampling rate and 16-bit vertical resolution. No detail in your waveforms will be lost

◆ Innovative TrueArb technology, based on a point-by-point architecture, supports any 8pts~8Mpts Arb waveform with a sampling rate in range of 1μSa/s~75MSa/s

◆ Innovative Easy Pulse technology, capable of generating lower jitter Square or Pulse waveforms, brings a wide range and extremely high precision in pulse width and rise/fall times adjustment

◆ Plenty of analog and digital modulation types: AM、DSB-AM、FM、PM、FSK、ASK 、PSK and PWM

◆ Sweep and Burst function

◆ High precision Frequency Counter

◆ Standard interfaces: USB Host, USB Device（USBTMC）, LAN（VXI-11）

Optional interface: GPIB

◆ 4.3" touch screen display for easier operation

Catalogue

1 Quick Start

This chapter covers the following topics:

- Handle Adjustment
- The Front/Rear Panel
- To Set a Waveform
- To Set Modulation/Sweep/Burst
- To Turn On/Off Output
- To Use Digital Input
- To Use Common Function Keys

1.1　Handle Adjustment

To adjust the handle position of SDG2000X, please grip the handle by the sides and pull it outward. Then, make the handle rotate to the desired position.
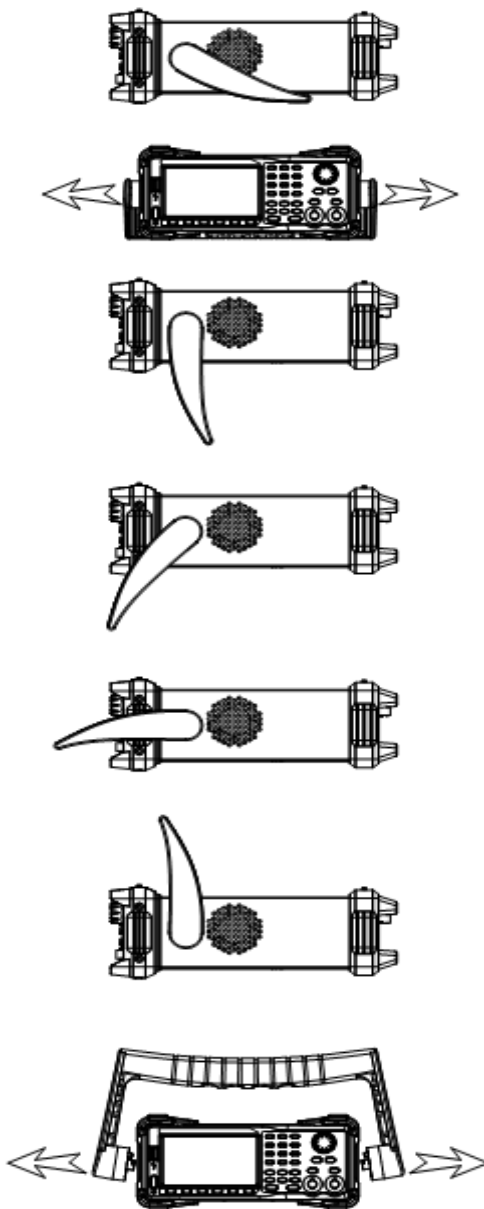
Figure 1-1 Viewing Position and Carrying Position

1.2 The Front/Rear Panel

When you get a new SDG2000X, 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.

Front Panel

SDG2000X has a clear and simple front panel which includes 4.3 inch touch screen, menu softkeys, numeric keyboard, knob, function keys, arrow keys, and channel control area, etc.
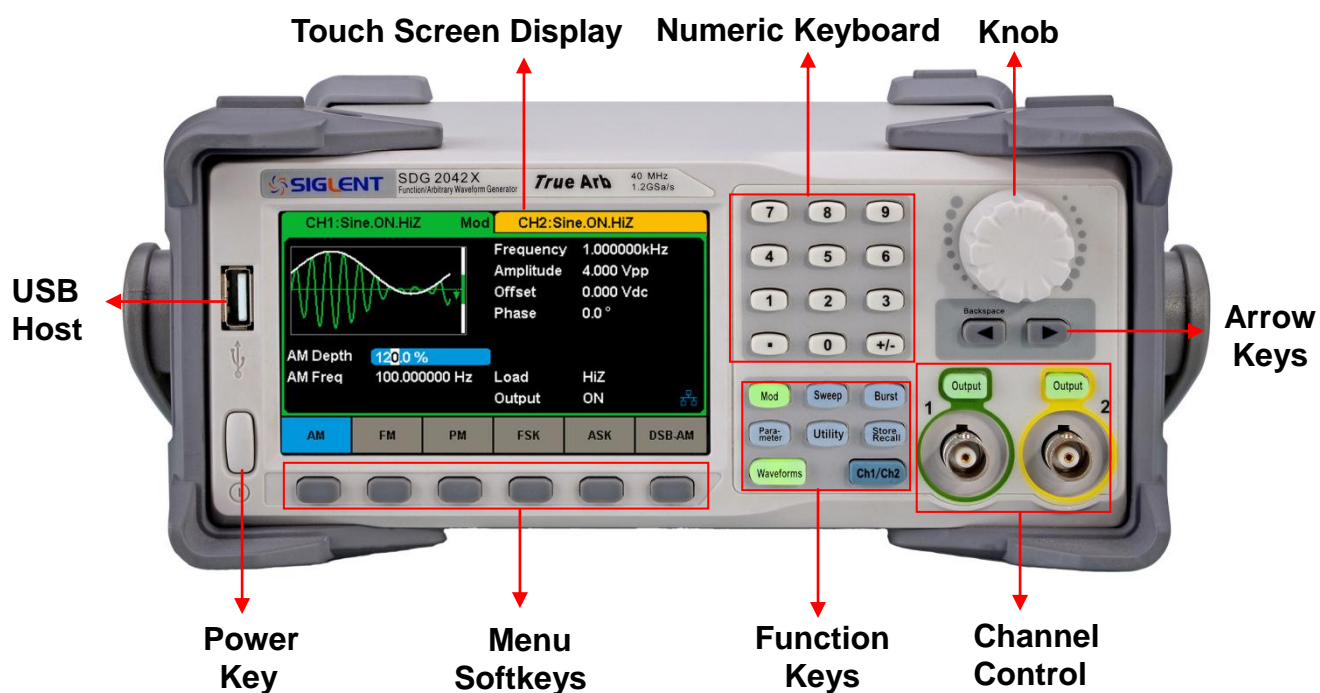
Figure 1-2 Front Panel of SDG2000X

Rear Panel

The rear panel provides multiple interfaces, including Counter, 10MHz In/Out, Aux In/Out, LAN, USB Device, Earth Terminal and AC Power Supply Input.
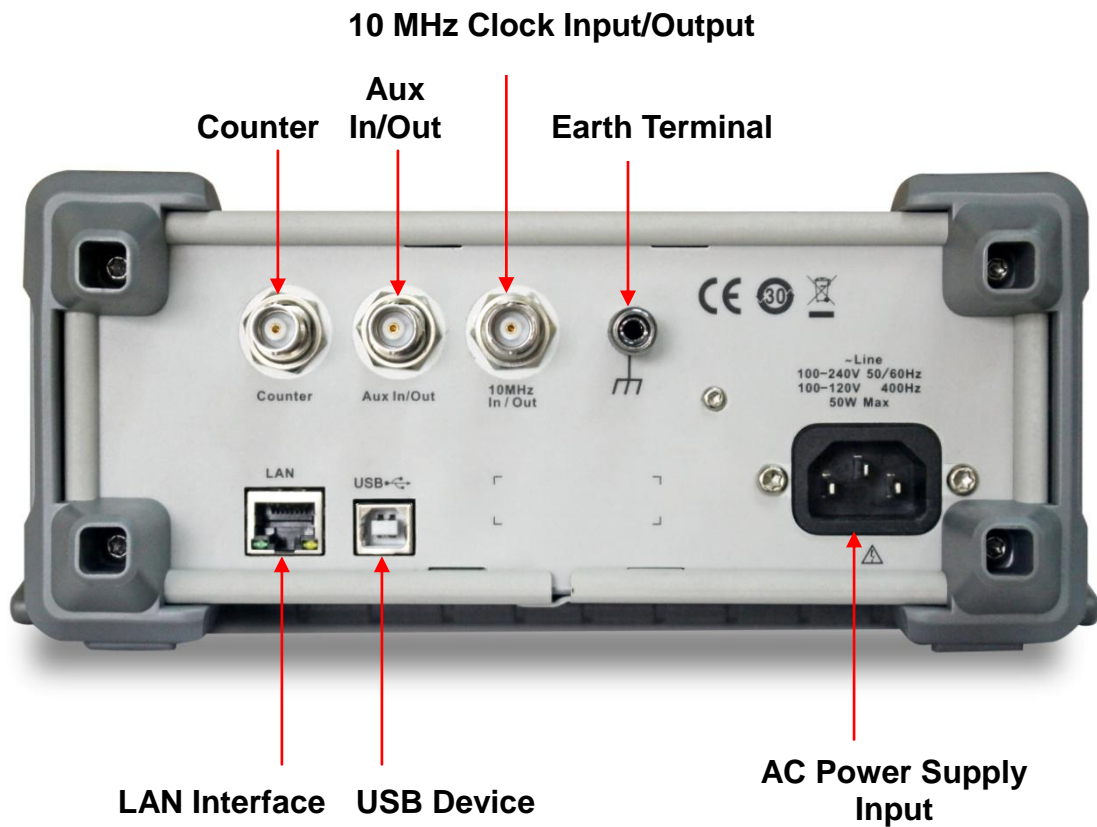
Figure 1-3 Rear Panel of SDG2000X

Touch Screen Display

SDG2000X can only display parameters and waveform of one channel at a time. The picture below shows the interface when CH1 chooses AM modulation of sine waveform. The information displayed may vary depending on the function selected.

The entire screen of the SDG2000X is a touch screen. You can use your figure or touch pen to control the instrument. Most functions and selections can be chosen using the touch screen in a similar manner to the front panel keys and knob.
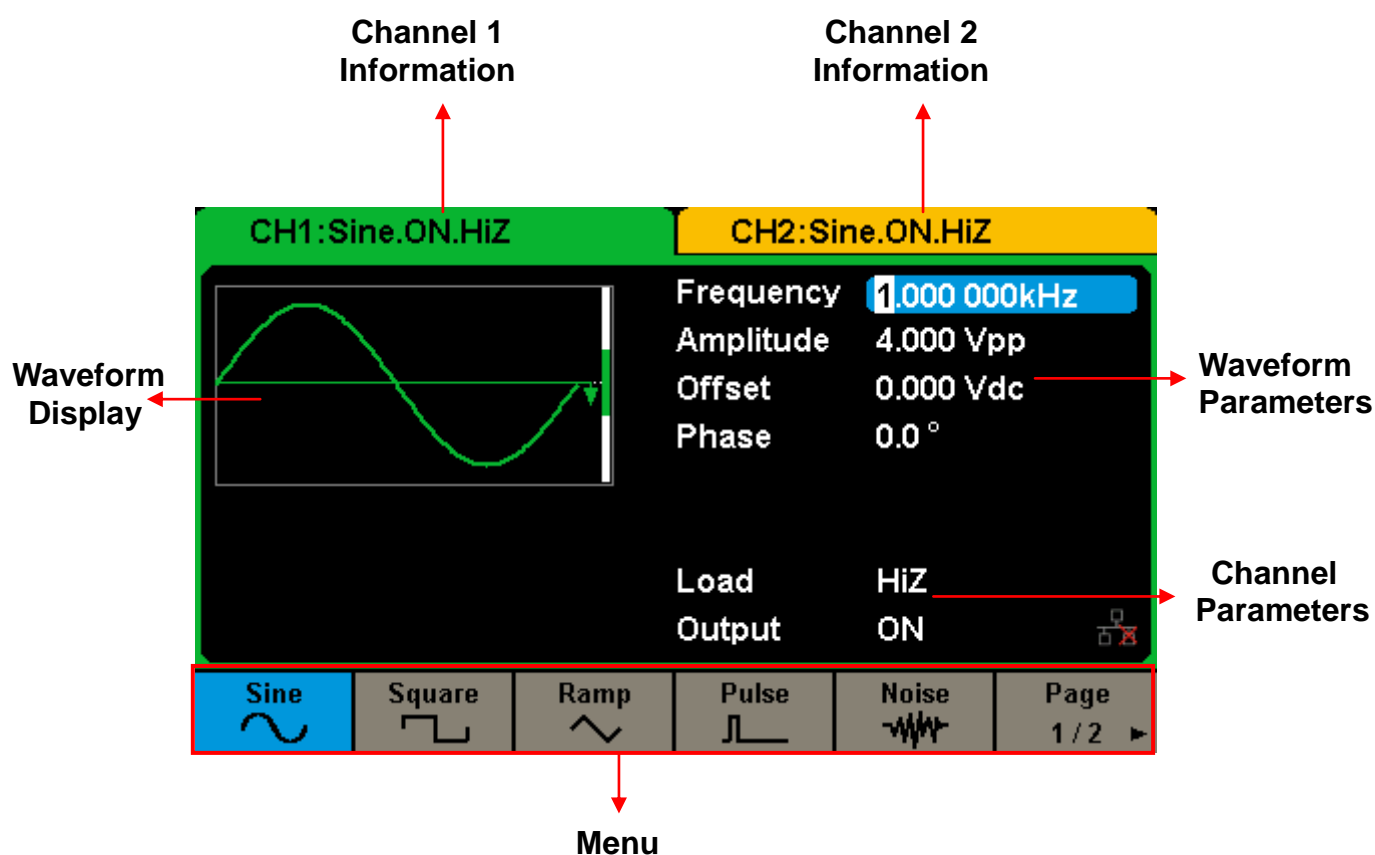
Figure 1-4 Touch Screen Display

1.3   To Set a Waveform

Press Waveforms to enter the menu as Figure 1-5 shows. The exercise below will help you be familiar with the waveform selection settings.
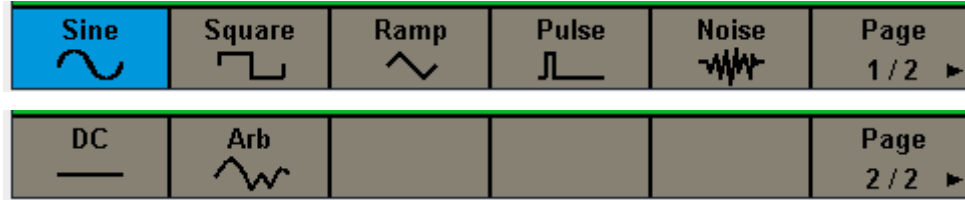
Figure 1-5 Waveform Selections

1. Press Waveforms key and then press Sine softkey. The generator can generate sine signal with frequency from 1μHz to 120MHz. By setting Frequency/Period, Amplitude/High level, Offset/Low level and Phase, a sine signal with different parameters can be generated.
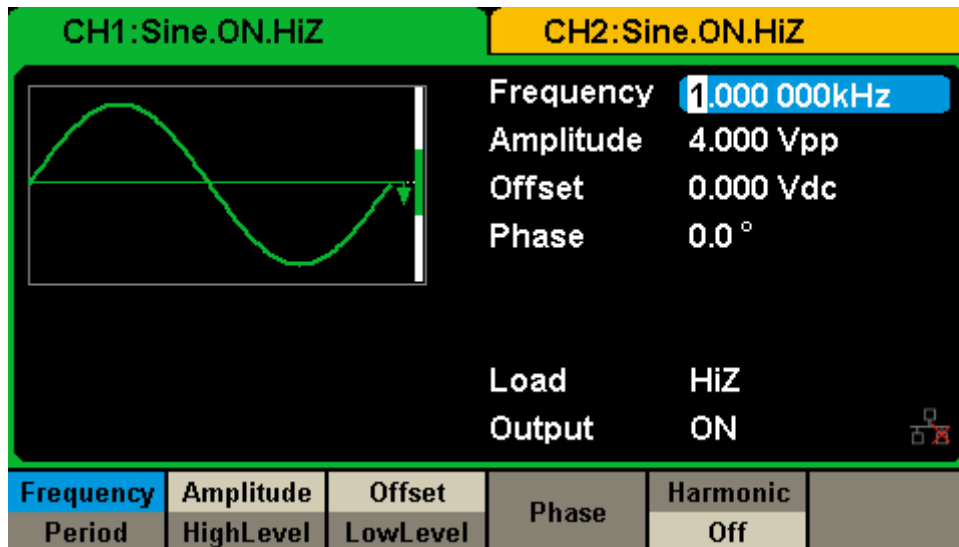
Figure 1-6 Sine Display Interface

2. Press Waveforms key and then press Square softkey. The generator can generate square signal with frequency from 1μHz to 25MHz and variable duty cycle. By setting Frequency/Period, Amplitude/High level, Offset/Low level, Phase and DutyCycle, a square signal with different parameters can be generated.
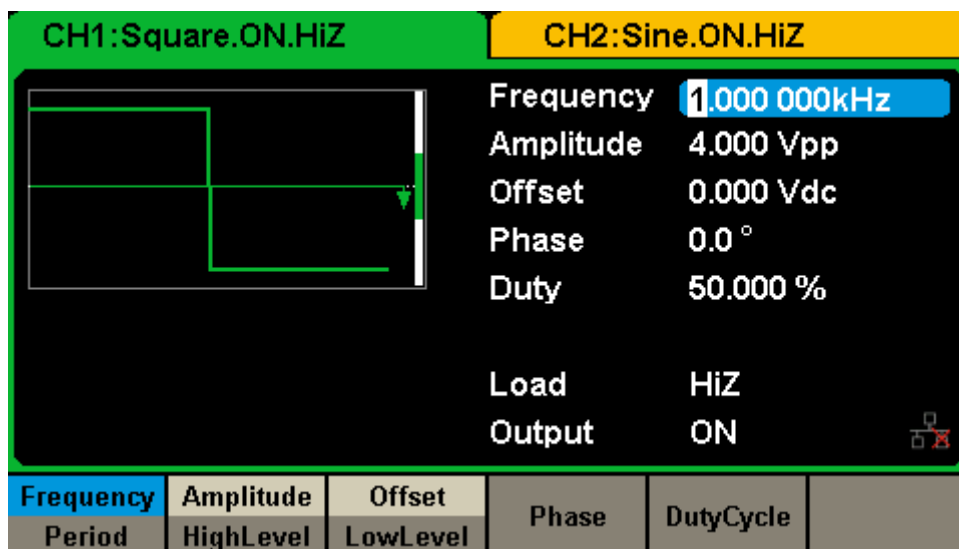
Figure 1-7 Square Display Interface

3. Press Waveforms key and then press Ramp softkey. The generator can generate ramp signal with frequency from 1µHz to 1MHz and variable symmetry. By setting Frequency/Period, Amplitude/High level, Offset/Low level, Phase and Symmetry, a ramp signal with different parameters can be generated.
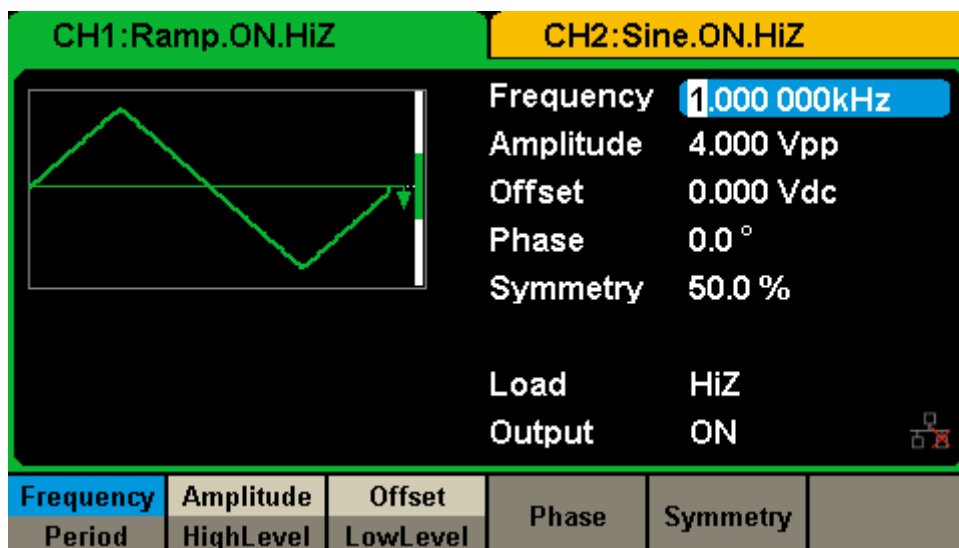
Figure 1-8 Ramp Display Interface

4. Press Waveforms key and then press Pulse softkey. The generator can generate pulse signal with frequency from 1µHz to 25 MHz and variable pulse width and rise/fall time. By setting Frequency/Period, Amplitude/High level, Offset/Low level, PulWidth/Duty, Rise/Fall and Delay,

a pulse signal with different parameters can be generated.
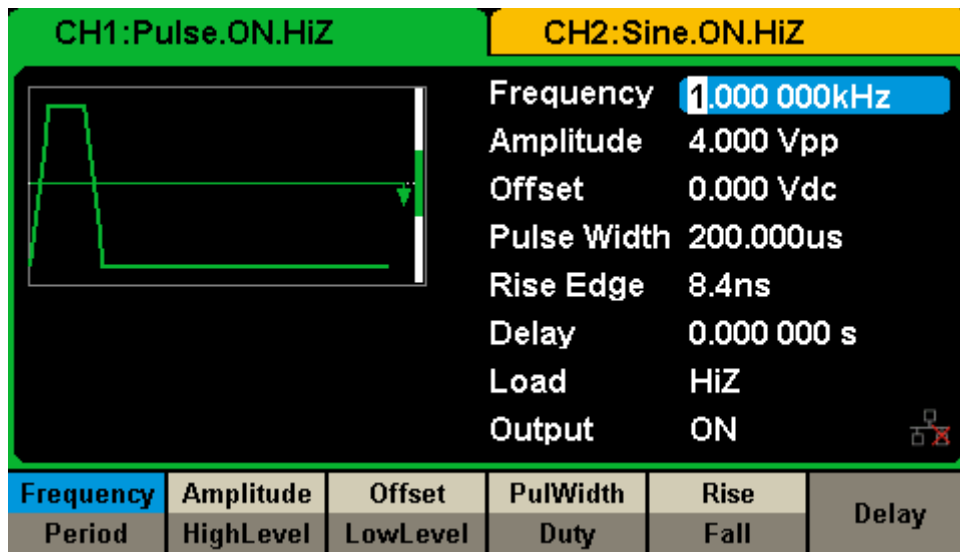
Figure 1-9 Pulse Display Interface

5. Press [Waveforms] key and then press [Noise] softkey. The generator can generate noise with bandwidth from 20MHz to 120MHz. By setting Stdev，Mean and Bandwidth, noise with different parameters can be generated.
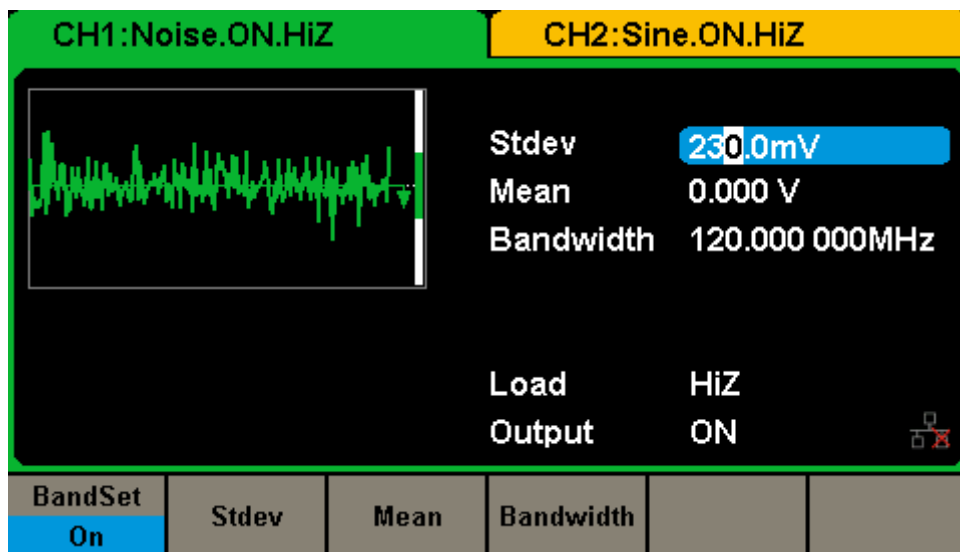
Figure 1-10 Noise Display Interface

6. Press [Waveforms] key and then press Page 1/2, last press the DC softkey. The generator can generate DC signal with level up to ±10V into HighZ load or ±5V into 50Ω load.
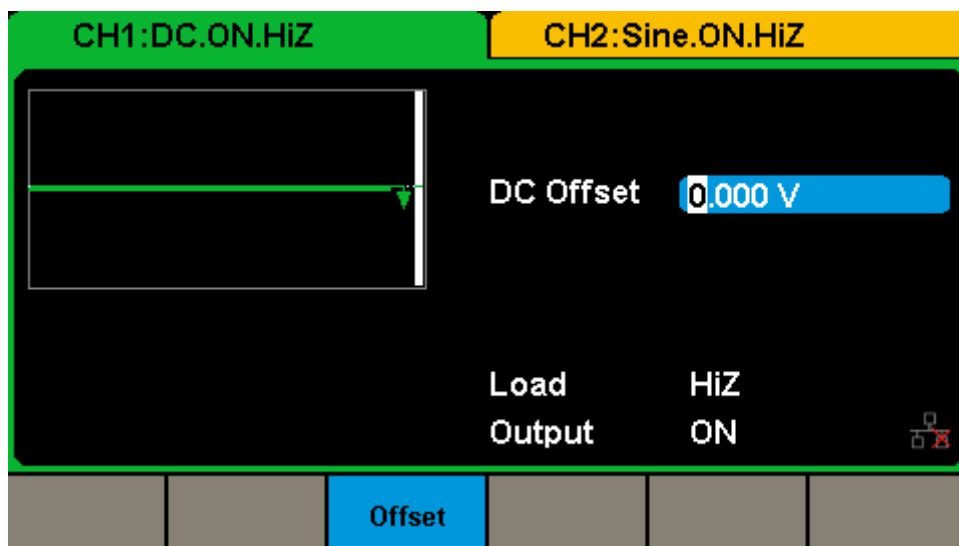
Figure 1-11 DC Display Interface

7. Press Waveforms key and then press Page 1/2, last press the Arb softkey. The generator can generate repeatable arbitrary waveform signals with length from 8 to 8M points and frequency up to 20MHz. By setting Frequency/Period, Amplitude/High level, Offset/Low level, Phase and Arb Mode, an arbitrary signal with different parameters can be generated.
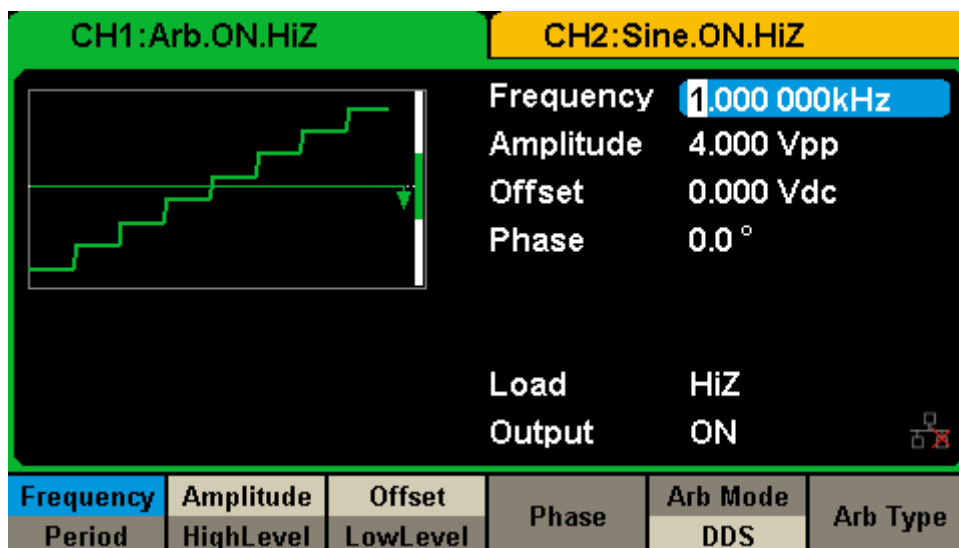
Figure 1-12 Arbitrary Waveform Display Interface

# 1.4   To Set Modulation/Sweep/Burst

As shown in Figure 1-13, there are three keys on the front panel, which are used for modulation, sweep and burst settings. The instructions below will help you be familiar with these functions.
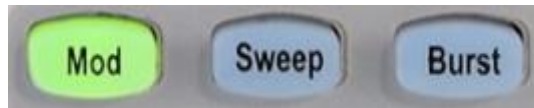
Figure 1-13 Modulate/Sweep/Burst Key

1. Press Mod, the Modulation function will be enabled.

The modulated waveform can be changed by modifying the parameters such as Type, Source, AM Depth, AM Freq, Shape, etc. SDG2000X can modulate waveforms using AM, FM, PM, ASK, FSK, PSK, PWM and DSB-AM, etc. Pulse waveforms can only be modulated using PWM. Noise and DC cannot be modulated.
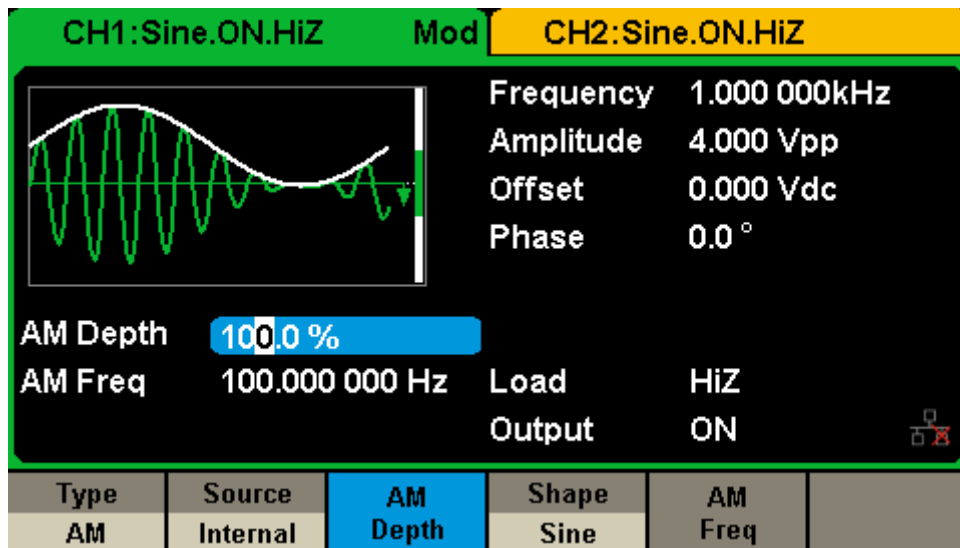
Figure 1-14 Modulation Display Interface

2. Press Sweep, the Sweep function will be enabled.

Sine, square, ramp and arbitrary waveforms support sweep. In sweep mode, SDG2000X can generate signal with variable frequency. The available range of sweep time is from 1ms to 500s. The trigger source could be "Internal", "External" or "Manual".
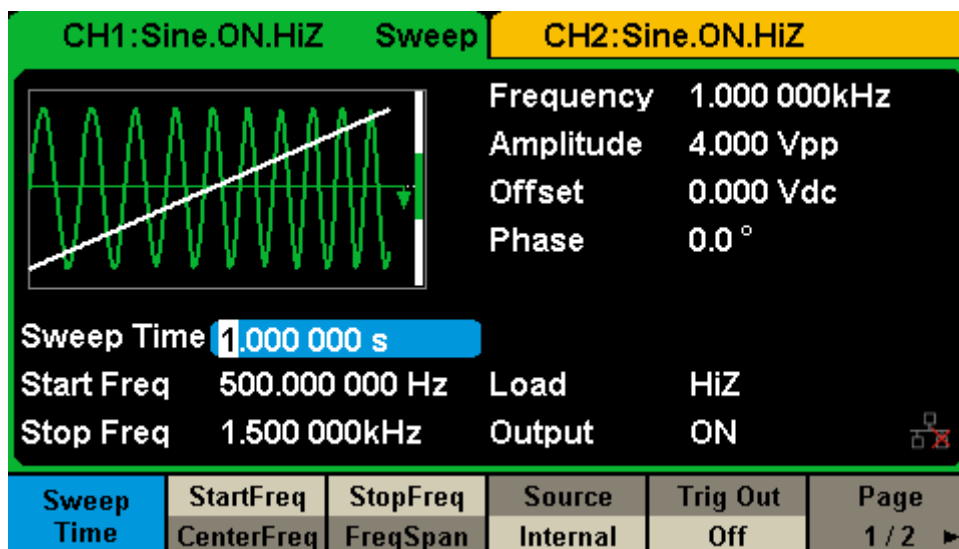
Figure 1-15 Sweep Waveform Display Interface

3. Press Burst, the Burst function will be enabled.

Burst signal for sine, square, ramp, pulse or arbitrary waveforms can be generated. Start Phase ranges from 0° to 360° and Burst Period ranges from 1μs to 1000s.
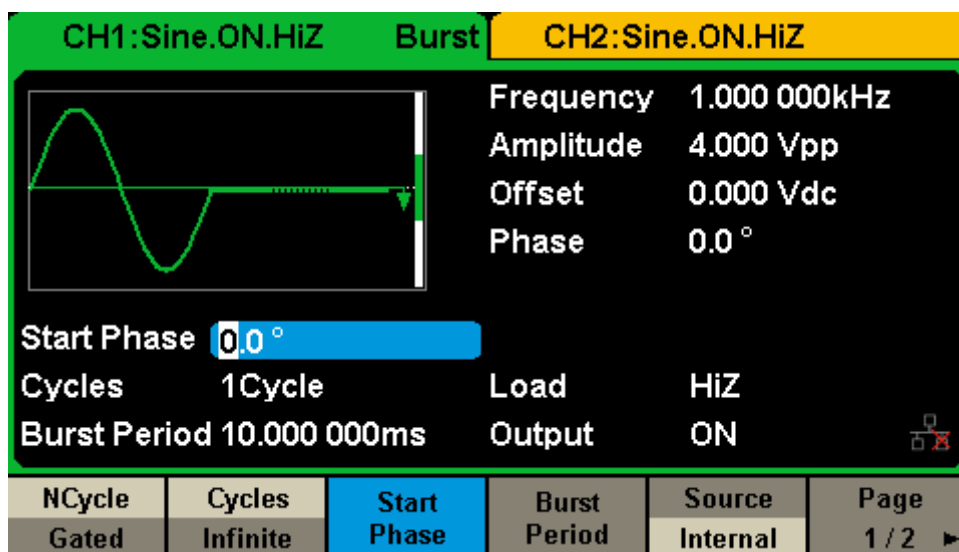
Figure 1-16 Burst Waveform Display Interface

1.5 To Turn On/Off Output

As shown in Figure 1-17, there are two keys on the right side of the operation panel, which are used to control output of the two channels. Choose a channel and press the corresponding Output key, the key backlight will be lighted and the output will be turned on. Press the Output key again, the key backlight will be extinguished and the output will be turned off.

Figure 1-17 Output Keys

1.6 To Use Digital Input

As shown in

Figure 1-18, there are three sets of keys on the front panel, which are arrow keys, knob and numeric keyboard. The instructions below will help you be familiar with the digital input function.

Figure 1-18 Front Panel Digital Input

1. The numeric keyboard is used to set the parameters value.
2. The knob is used to increase (clockwise) or decrease (counterclockwise) the current digit when setting parameters
3. When using knob to set parameters, the arrow keys are used to select the digit to be modified; When using numeric keyboard to set parameters, the left arrow key is used as a Backspace function.

1.7 To Use Common Function Keys

As shown in Figure 1-19, there are five keys on the operation panel, which are called Parameter, Utility, Store/Recall, Waveforms, and Ch1/Ch2. The instructions below will help you be familiar with these functions.

Figure 1-19 Waveforms Utility and Parameter Key

1. The Parameter key makes it convenient for users to set the parameters of basic waveforms directly.
2. The Utility key is used to set the auxiliary system function, such as output configurations, interface setting, system setting information, performing the instrument self-test and reading the calibration information, etc.
3. The Store/Recall key is used to store and recall waveform data and configuration information.
4. The Waveforms key is used to select basic waveforms.
5. The Ch1/Ch2 key is used to switch the currently selected channel between CH1 and CH2. After start-up, CH1 is selected as default. At this point, press the key to select CH2.

2 Front Panel Operations

Up to now, you have got a brief understanding about SDG2000X 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 '**Quick Start**' again.

This chapter covers the following topics:
- To Set Sine Signal
- To Set Square Signal
- To Set Ramp Signal
- To Set Pulse Signal
- To Set Noise Signal
- To Set DC Signal
- To Set Arbitrary Signal
- To Set Harmonic
- To Set Modulation Function
- To Set Sweep Function
- To Set Burst Function
- To Store and Recall
- To Set Utility Function

You are suggested to read this chapter carefully so as to understand SDG2000X's versatile waveform setting functions and more operation methods.

2.1   To Set Sine Signal

Press Waveforms key to call the wave operation and then press the Sine softkey. The sine waveform parameters are set by using the sine operation menu.

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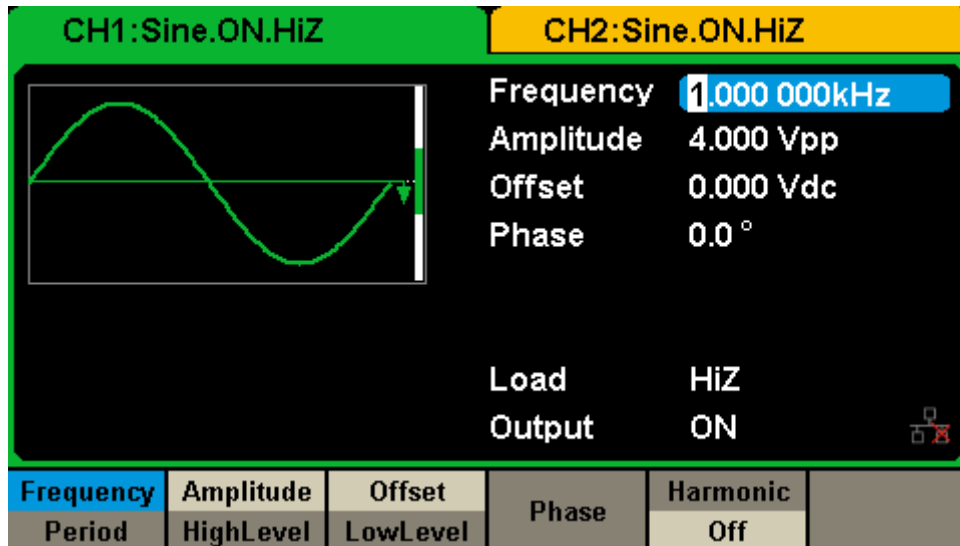
Figure 2-1 Sine Parameters Display Interface

Table2-1 Menu Explanations of Sine Waveform

Function menu	Settings	Explanations
Frequency/ Period		Set the signal frequency or period; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
Phase		Set the phase of the signal.

To Set the Frequency/Period

Frequency is one of the most important parameters of basic waveforms. For different instrument model and waveform, the setting ranges of frequency are different. For detailed information, please refer to "SDG2000X Datasheet". The default frequency is 1kHz.

1. Press Waveforms → Sine → Frequency, to set the frequency parameter. The frequency shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 Frequency/Period key again, to switch to the period parameter (the current operation is displayed in inverse color).

2. Input the desired frequency.
Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.

Figure 2-2 Setting the Frequency

Note:

When using the numeric keyboard to enter the value, you can use the left arrow key to move the cursor backward and delete the value of the previous

digit.

To Set the Amplitude

The amplitude setting range is limited by the "Load" and "Frequency/Period" settings. For detailed information, please refer to "SDG2000X Datasheet".

1.   Press Waveforms → Sine → Amplitude, to set the amplitude.
The amplitude shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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, press the Amplitude/HighLevel key again, to switch into the high level parameter (the current operation is displayed in inverse color).

2.   Input the desired amplitude.
Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
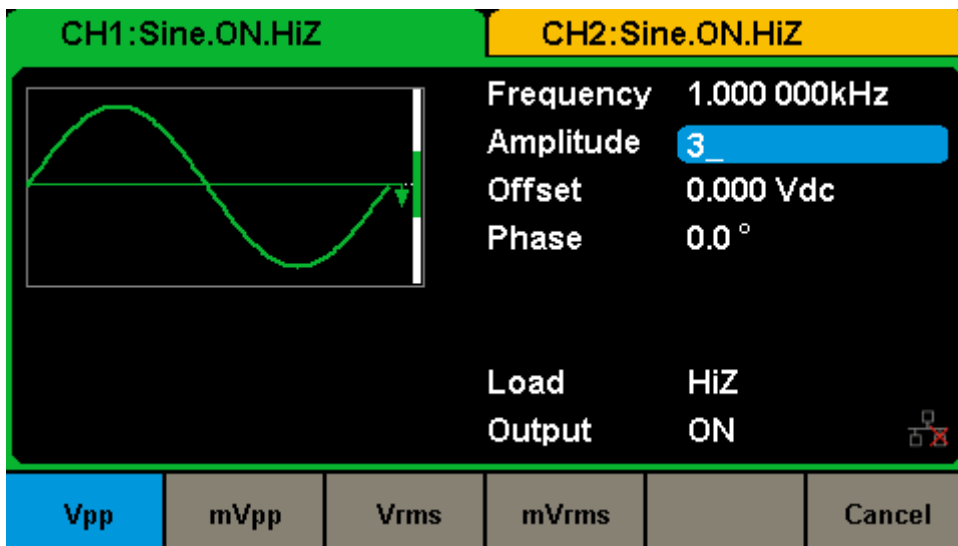
Figure 2-3 Setting the Amplitude

To Set the Offset

The offset setting range is limited by the "Load" and "Amplitude/HighLevel" settings. For detailed information, please refer to "SDG2000X Datasheet". The default value is 0Vdc.

1. Press Waveforms → Sine → Offset, to set the offset.

The offset shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 low level, press the Offset/LowLevel key again, to switch into the low level parameter (the current operation is displayed in inverse color).

2. Input the desired offset.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
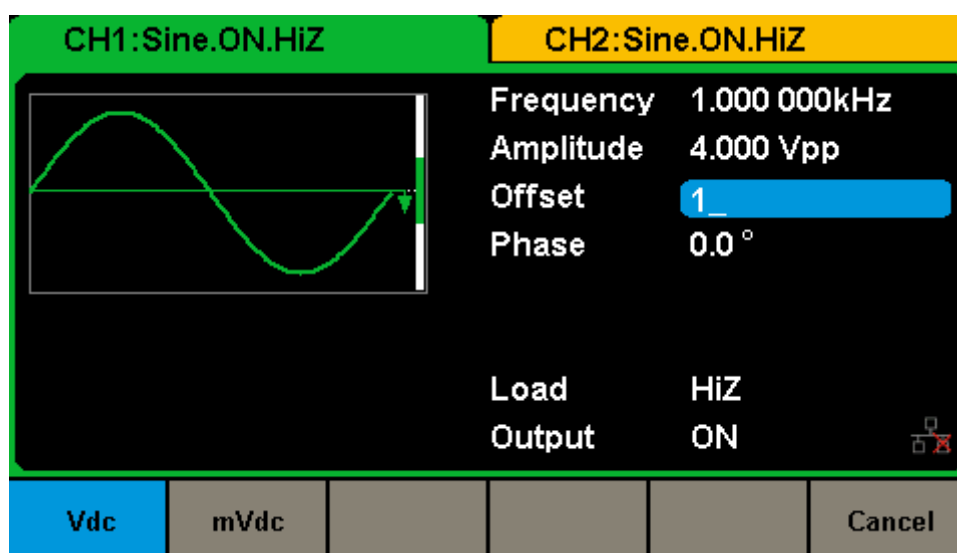
Figure 2-4 Setting the Offset

To Set the Phase

1. Press Waveforms → Sine → Phase, to set the phase.

The Phase shown on the screen when the instrument is powered on is the default value or the set value of last power on. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired phase.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
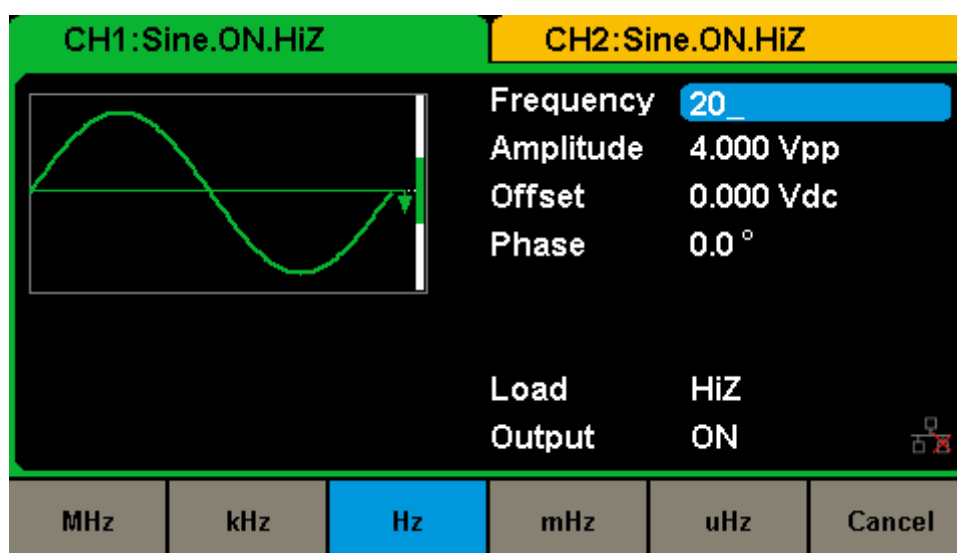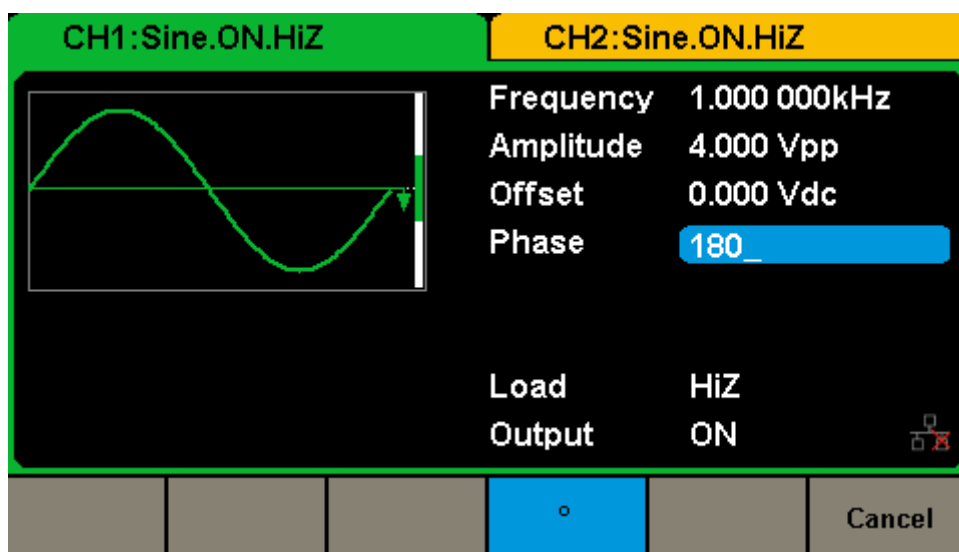

Figure 2-5 Setting the Phase

2.2 To Set Square Signal

Press Waveforms key to call the wave operation, and press the Square softkey. The square waveform parameters are set by using the Square operation menu.

The parameters of square waveforms include frequency/period, amplitude/high level, offset/low level, phase and duty. As shown in Figure 2-6, select DutyCycle. The duty cycle parameter area is highlighted in the parameter display window, and users can set the duty cycle value here.
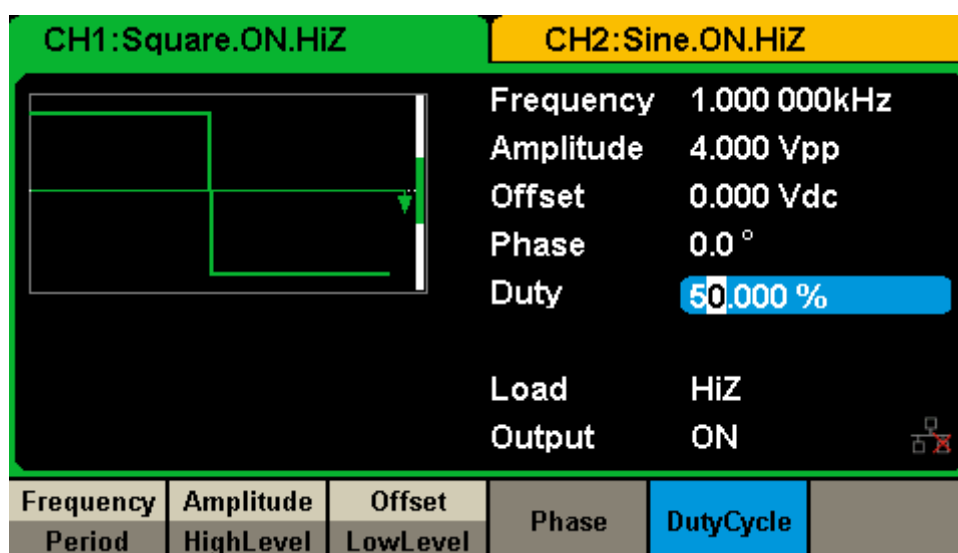
Figure 2-6 Square Parameters Display Interface

Table2-2 Menu Explanations of Square Waveform

Function Menu	Settings	Explanation
Frequency/ Period		Set the signal frequency or period; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
Phase		Set the phase of the signal.
DutyCycle		Set the duty cycle for square waveform.

To Set the Duty Cycle

Duty Cycle: The percentage that the high level takes up the whole period.
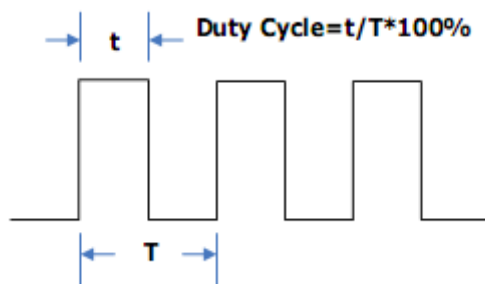
The duty cycle setting range is limited by the "Frequency/Period" setting. For detailed information, please refer to "SDG2000X Datasheet". The default value is 50%.

1． Press Waveforms → Square → DutyCycle, to set the duty cycle.

The duty cycle shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value. The generator will change the waveform immediately.

Figure 2-7 Setting the Duty Cycle

Note:

The methods of setting other parameters of square signal are similar to sine signal.

2.3　　　To Set Ramp Signal

Press Waveforms key to call the wave operation, and press the Ramp softkey. The ramp waveform parameters are set by using the ramp operation menu.

The parameters for ramp waveforms include frequency/period, amplitude/high level, offset/low level, phase and symmetry. As shown in Figure 2-8, in the soft key menu, select Symmetry. The symmetry parameter area is highlighted in the parameter display window, and users can set the symmetry value here.

CH1:Ramp.ON.HiZ			CH2:Sine.ON.HiZ		
			Frequency	1.000 000kHz	
			Amplitude	4.000 Vpp	
			Offset	0.000 Vdc	
			Phase	0.0 °	
			Symmetry	50.0 %	
			Load	HiZ	
			Output	ON	
Frequency Period	Amplitude HighLevel	Offset LowLevel	Phase	Symmetry	
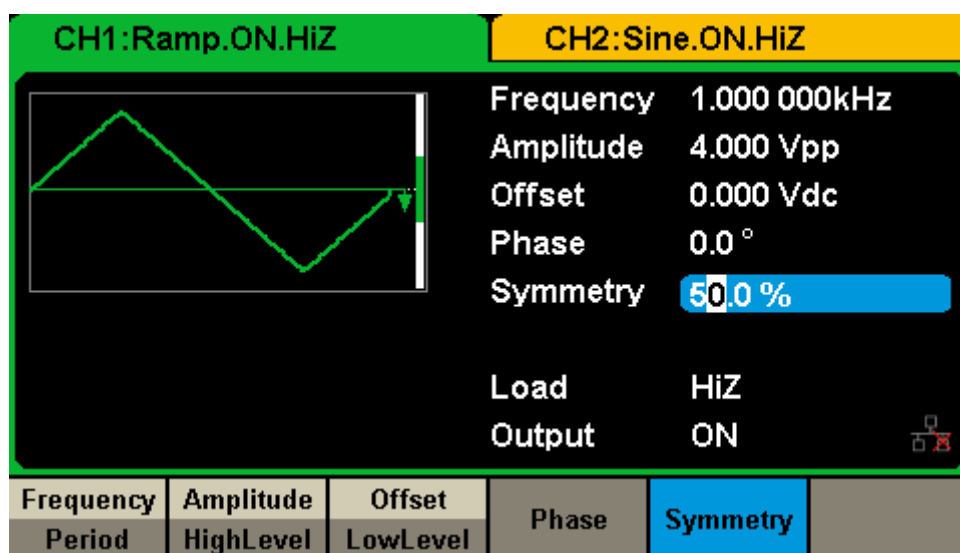
Figure 2-8 Ramp Parameters Display Interface

Table2-3 Menu Explanations of Ramp Waveform

Function Menu	Settings	Explanation
Frequency/ Period		Set the signal frequency or period; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
Phase		Set the phase of the signal.
Symmetry		Set the symmetry for ramp waveform.

To Set the Symmetry

Symmetry: The percentage that the rising period takes up the whole Period.

Input Range: 0~100%

Default Value: 50%
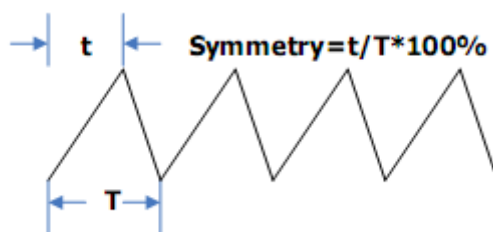
1. Press Waveforms → Ramp → Symmetry, to set the symmetry.

The symmetry shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value. The generator will change the waveform immediately.
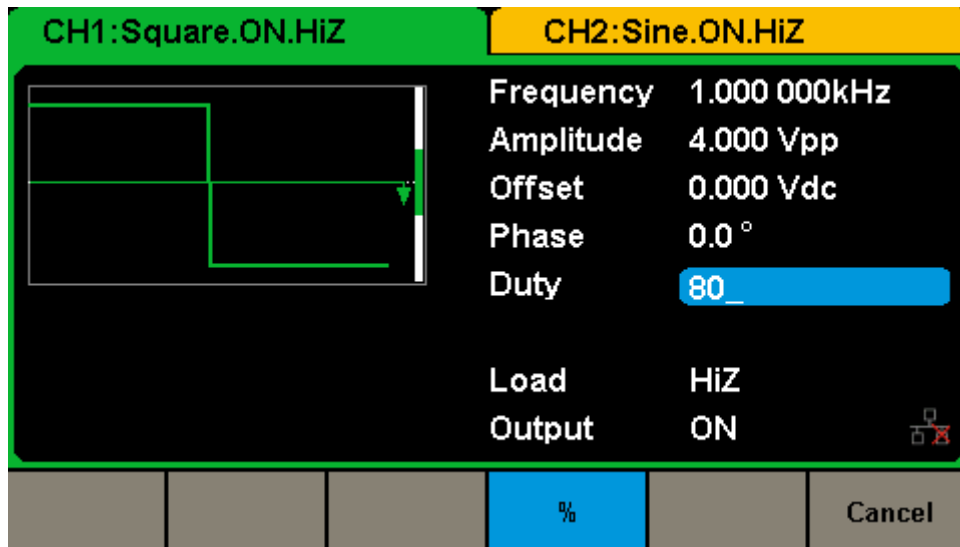

Figure 2-9 Setting the Symmetry

Note:

The methods of setting other parameters of ramp signal are similar to sine signal.

2.4 To Set Pulse Signal

Press Waveforms key to call the wave operation, and press the Pulse softkey. The pulse waveform parameters are set by using the pulse operation menu.

The parameters for pulse waveforms include frequency/period, amplitude/high level, offset/low level, width, rise/fall and delay. As shown in Figure 2-10, in the soft key menu, select PulWidth. The pulse width parameter area is highlighted in the parameter display window, and users can set the pulse width value here.
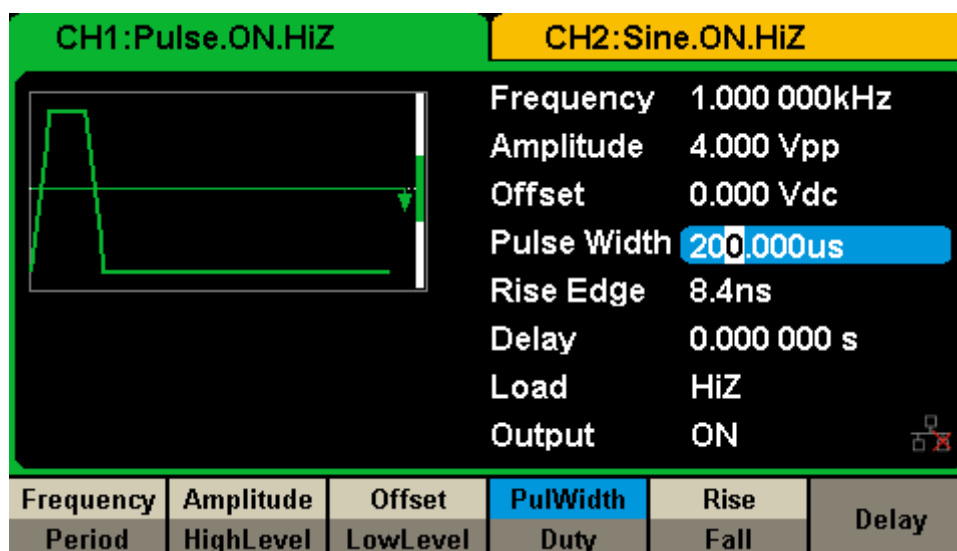
Figure 2-10 Pulse Parameters Display Interface

Table 2-4 Menu Explanations of Pulse Waveform

Function Menu	Settings	Explanation
Frequency/ Period		Set the signal frequency or period; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
PulWidth/ Duty		Set the signal pulse width or duty The current parameter will be switched at a second press.
Rise/ Fall		Setting the rise edge or fall edge for pulse waveform. The current parameter will be switched at a second press.
Delay		Setting the delay for pulse waveform.

To Set the Pulse Width/Duty

Pulse width is defined as the time from the 50% threshold of a rise edge amplitude to the 50% threshold of the next falling edge amplitude (as shown in the figure below). The pulse width setting range is limited by the "Minimum Pulse Width" and "Pulse Period" setting. For detailed information, please refer to "SDG2000X Datasheet". The default value is 200µs.

Pulse duty is defined as the percentage that the pulse width takes up in the whole period. Pulse duty and pulse width are correlative. Once a parameter is changed, the other will be automatically changed.
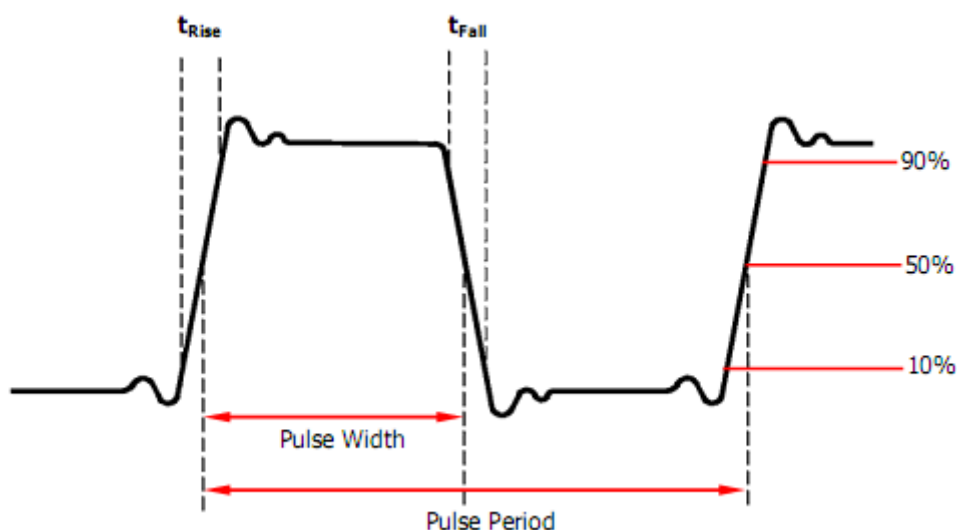
1. Press Waveforms → Pulse → PulWidth, to set the pulse width.
The pulse width shown on the screen when the instrument is powered on is the default value or the set value of last power on. When changing the function, if the current value is valid for the new waveform, it will be used sequentially. If you want to set the waveform by duty, press the PulWidth/Duty key again, to switch into the duty parameter (the current operation is displayed in inverse color).

2. Input the desired Pulse Width.
Use the numeric keyboard to input the parameter value directly, and press the

corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value. The generator will change the waveform immediately.
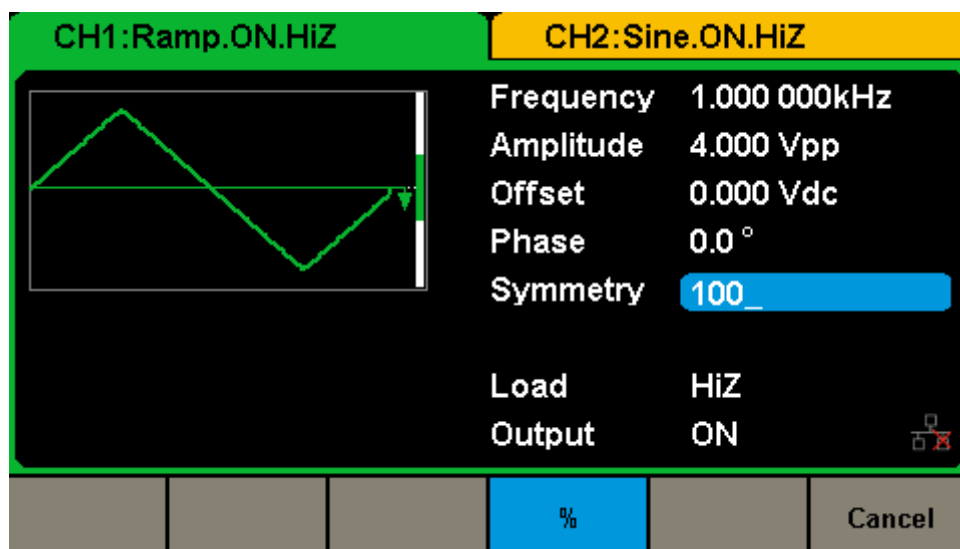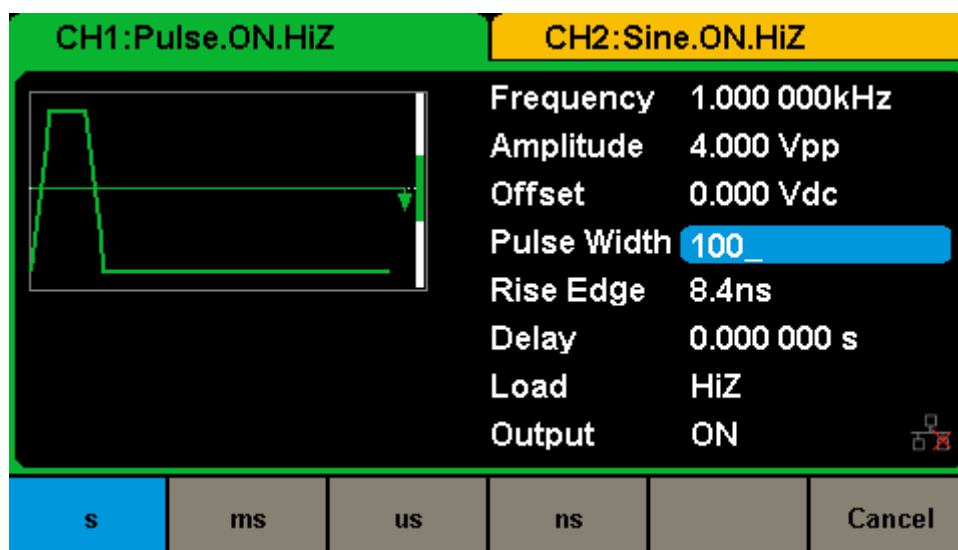

Figure 2-11 Setting the Pulse Width

To Set the Rise/Fall Edge

Rise edge time is defined as the duration of the pulse amplitude rising from 10% to 90% threshold, while fall edge time is defined as duration of the pulse amplitude moving down from 90% to 10% threshold. The setting of rise/fall edge time is limited by the currently specified pulse width limit. Users can set rise edge and fall edge independently.

1.   Press Waveforms → Pulse → Rise to set the rise edge.

The rise edge shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 fall edge, press the Rise/Fall key again, to switch into the fall edge parameter (the current operation is displayed in inverse color).

2. Input the desired rise edge.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value. The generator will change the waveform immediately.
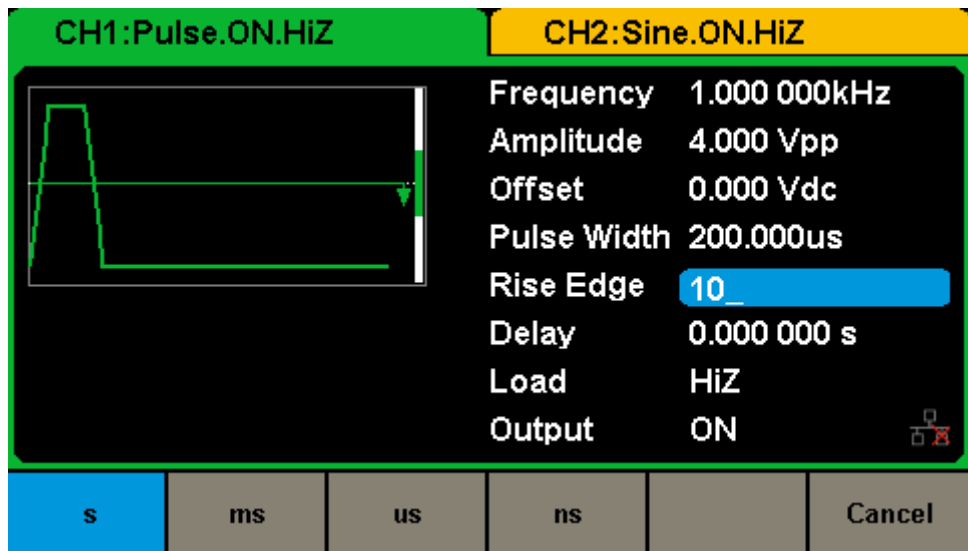
Figure 2-12 Setting the Rise Edge

Note:

The methods of setting other parameters of pulse signal are similar to sine signal.

2.5 To Set Noise Signal

Press Waveforms key to call the wave operation, and press the Noise softkey. The noise parameters are set by using the noise operation menu.

The parameters for noise include stdev, mean and bandwidth. As shown in Figure 2-13, in the soft key menu, select Stdev, The stdev parameter area is highlighted in the parameter display window, and users can set the stdev value here. Noise is non-periodic signal which has no frequency or period.
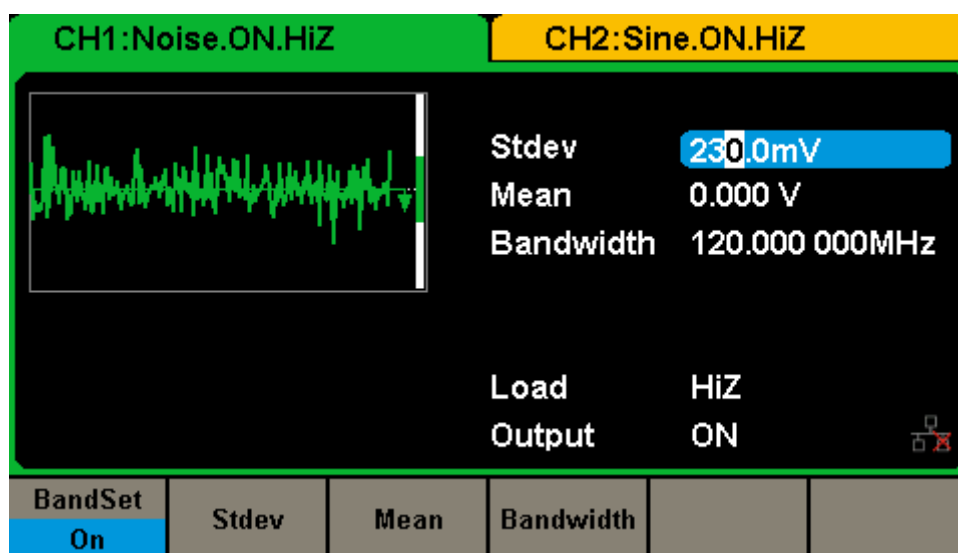
Figure 2-13 Noise Parameters Display Interface

Table 2-5 Menu Explanations of Noise

Function Menu	Settings	Explanation
BandSet		Turn on/off the bandwidth setting.
Stdev		Setting the stdev for noise waveform.
Mean		Setting the mean for noise waveform.
Bandwidth		Setting the bandwidth for noise waveform.

To Set the Stdev

1. Press Waveforms → Noise → Stdev, to set the stdev.

The stdev shown on the screen when the instrument is powered on is the default value or the set value of last power on. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired stdev.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
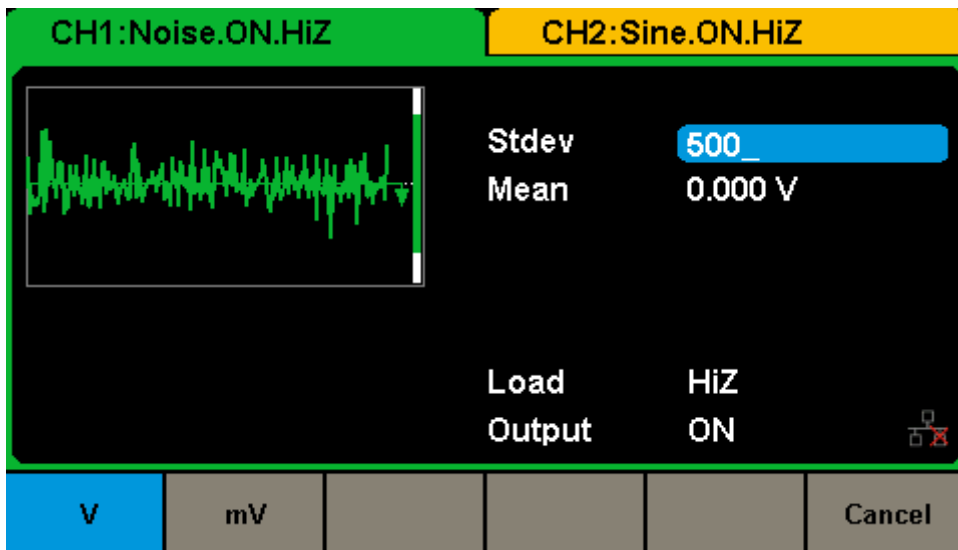
Figure 2-14 Setting the Stdev

To Set the Mean

1. Press Waveforms → Noise → Mean, to set the mean.

The mean shown on the screen when the instrument is powered on is the default value or the set value of last power on. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired mean.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
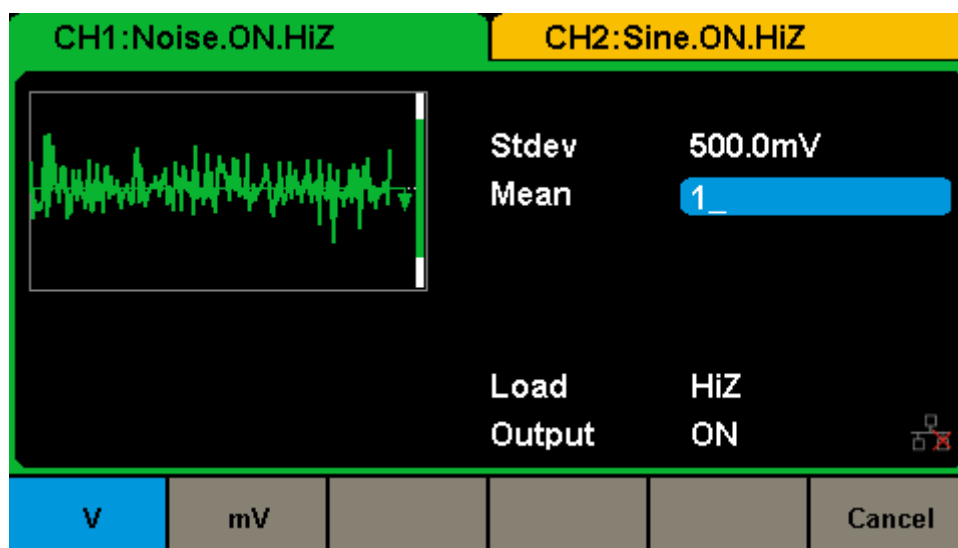
Figure 2-15 Setting the Mean

To Set the Bandwidth

1. Press Waveforms → Noise → BandSet and choose "On" to set the bandwidth.

The bandwidth shown on the screen when the instrument is powered on is the default value or the set value of last power on. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired bandwidth.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
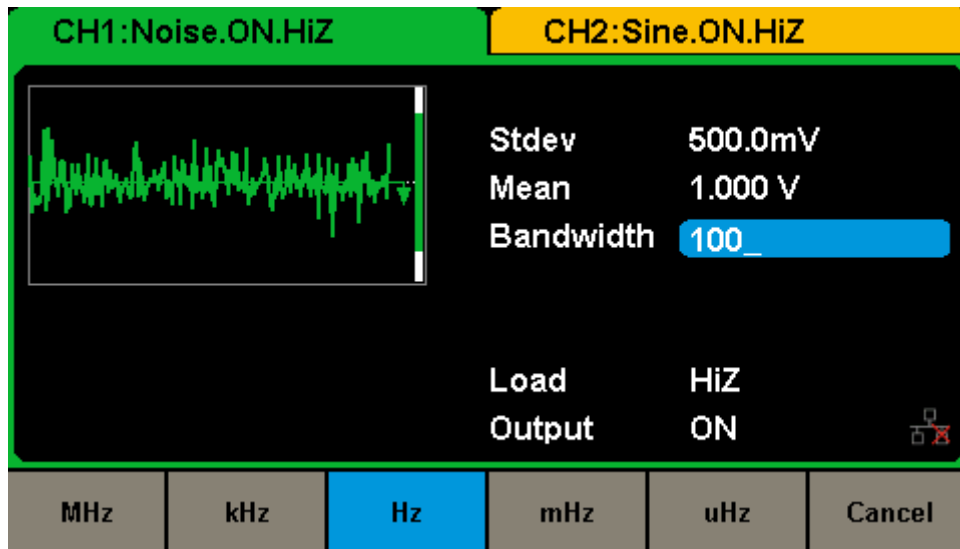
Figure 2-16 Setting the Bandwidth

2.6   To Set DC Signal

Press Waveforms → Page 1/2 → DC, to enter the following interface. Please note that there is an 'offset' parameter at the middle of the screen.
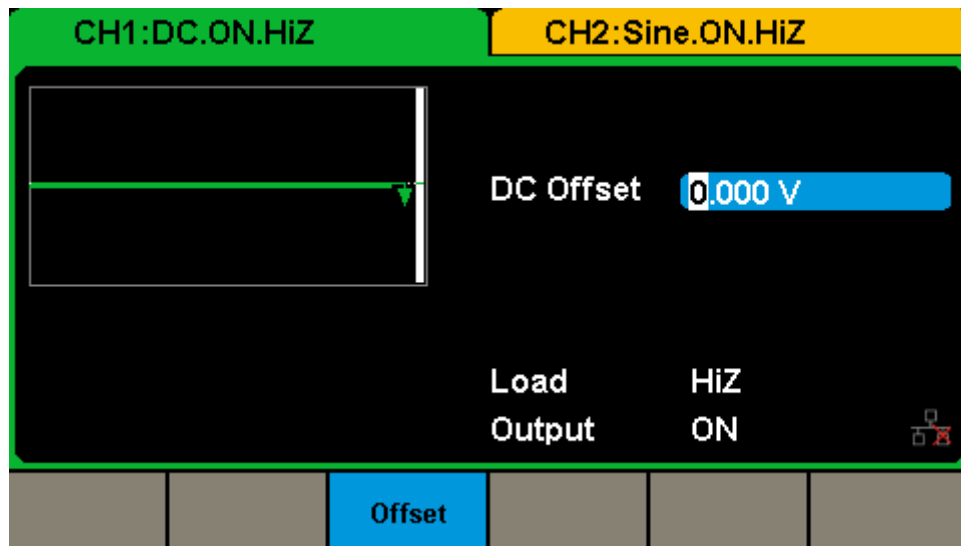
Figure 2-17 DC Setting Interface

Note:

The method of setting offset of DC signal is similar to sine signal.

2.7 To Set Arbitrary Signal

The Arb signal consists of two types: the system built-in waveform and the user-defined waveform. Built-in waveforms are stored in the internal non-volatile memory. It also allows users to edit the arbitrary waveform with 8 to 8M data points, namely 8pts to 8Mpts.

DDS

Choose Waveforms → Page 1/2 → Arb → Arb Mode and select the "DDS" output mode. The parameters include frequency/period, amplitude/high level, offset/low level and phase.
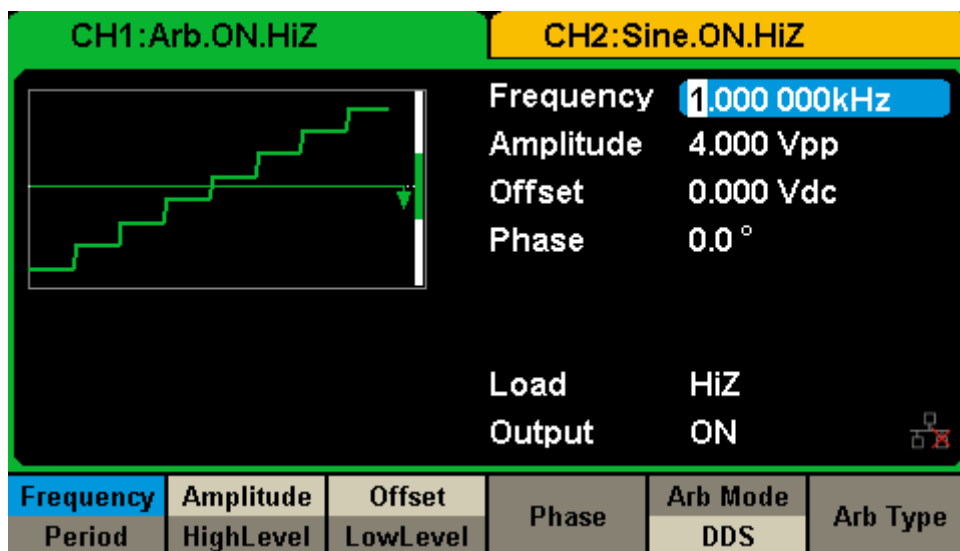
Figure 2-18 Arb Parameters Display Interface (DDS)

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

Function menu	Settings	Explanations
Frequency/ Period		Set the signal frequency or period; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
Phase		Set the phase of the signal.

In DDS output mode, users can set the frequency or period of the arbitrary

waveform. The instrument outputs an arbitrary waveform which is made up of certain points according to the current frequency

TrueArb

Choose Waveforms → Page 1/2 → Arb → Arb Mode and select the "TrueArb" output mode. The parameters include sampling rate/frequency, amplitude/high level, offset/ low level and phase.
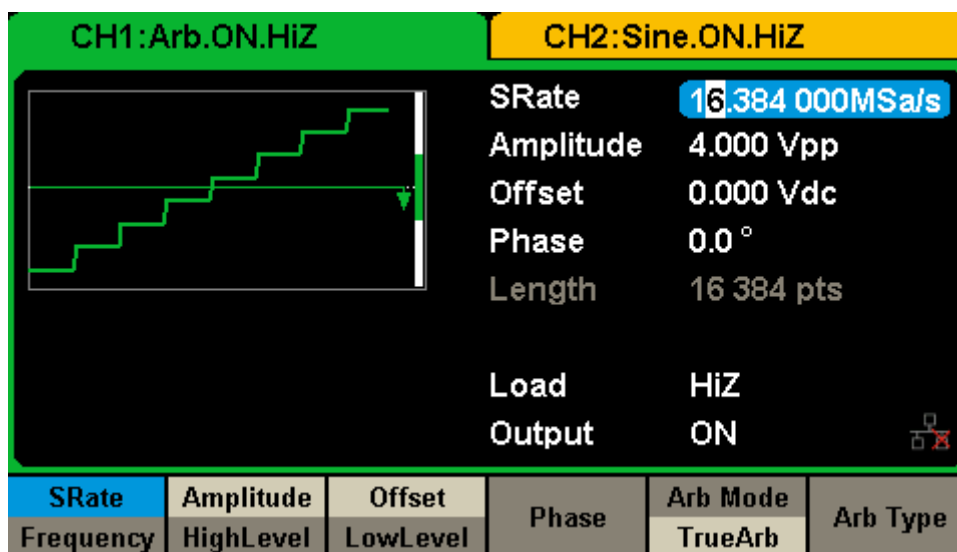
Figure 2-19 Arb Parameters Display Interface (TrueArb)

Table 2-7 Menu Explanations of Arb Waveform (Page 1/2)

Function menu	Settings	Explanations
SRate/ Frequency		Set the signal sampling rate or frequency; The current parameter will be switched at a second press.
Amplitude/ HighLevel		Set the signal amplitude or high level; The current parameter will be switched at a second press.
Offset/ LowLevel		Set the signal offset or low level; The current parameter will be switched at a second press.
Phase		Set the phase of the signal.

In TrueArb output mode, users can set the sampling rate (the output points per second) or frequency of the arbitrary waveform. The instrument outputs an arbitrary waveform point by point according to the current sampling rate.

To Set the Sampling Rate

1. Press Waveforms → Page 1/2 → Arb → TureArb → Srate, to set the sampling rate parameter.

The sampling rate shown on the screen when the instrument is powered on is the default value or the set value of last power on. 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 frequency for the waveform, press SRate/Frequency key again, to switch to the frequency parameter (the current operation is displayed in inverse color).

2. Input the desired sampling rate.

Use the numeric keyboard to input the parameter value directly, and press the corresponding key to select the parameter unit. Or you can use the arrow keys to select the digit you want to edit, and then use the knob to change its value.
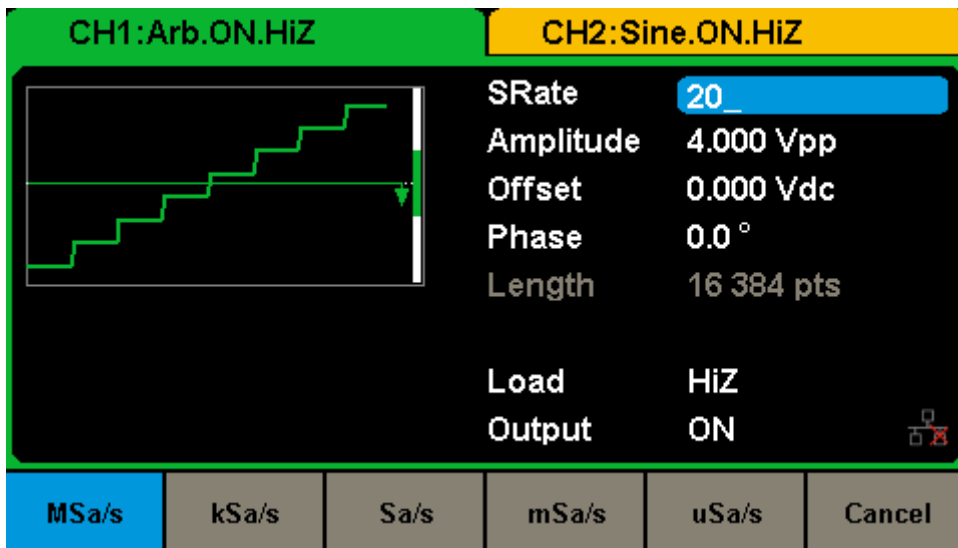

Figure 2-20 Setting the Sampling Rate

Note:

The methods of setting other parameters of arbitrary signal are similar to sine signal.

To select the built-in Arbitrary Waveform

There are plenty of built-in Arbitrary Waveforms and user-defined Arbitrary Waveforms inside the generator. To select one of them, follow the instructions below.

1. To Select the Built-in Waveform

Choose Waveforms → Page 1/2 → Arb → Arb Type → Built-In to enter the following interface, as shown in Figure 2-21.
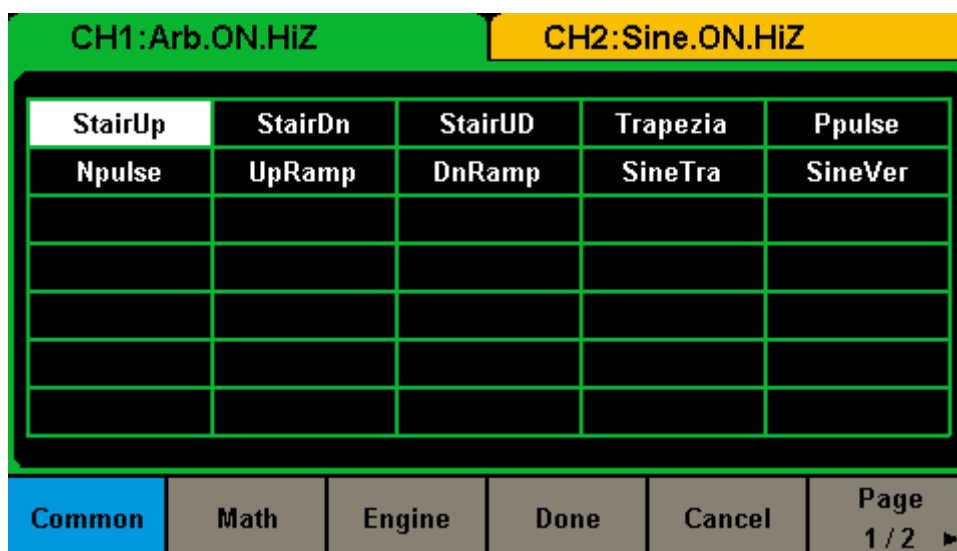
Figure 2-21 Built-in Arbitrary Waveforms

Press Common, Math, Engine, Win/Trigo, Square or Others to switch to the desired category (each category has one or more sub-categories). Press the corresponding menu key to switch to the desired sub-category (the selected sub-category in the sub-category bar is highlighted), then rotate the knob or click the touch screen to choose the desired waveform (the selected waveform is highlighted), finally press Done to recall the corresponding waveform.

Table 2-8 Built-in Waveforms

Item	Sub-item	Waveform	Explanation
Common	Common	StairUp	Stair-up waveform

		StairDn	Stair-down waveform
		StairUD	Stair-up and down waveform
		Trapezia	Trapezia waveform
		Ppulse	Positive pulse
		Npulse	Negative pulse
		UpRamp	UpRamp waveform
		DnRamp	DnRamp waveform
		SineTra	Sine-Tra waveform
		SineVer	Sine-Ver waveform
Math	Math	ExpFall	ExpFall function
		ExpRise	ExpRise function
		LogFall	LogFall function
		LogRise	LogRise function
		Sqrt	Sqrt function
		Root3	Root3 function
		X^2	X^2 function
		X^3	X^3 function
		Airy	Airy function
		Besselj	Bessel I function
		Bessely	Bessel II function
		Dirichlet	Dirichlet function
		Erf	Error function
		Erfc	Complementary error function
		ErfcInv	Inverted complementary error function
		ErfInv	Inverted error function
		Laguerre	4-times Laguerre polynomial
		Legend	5-times Legend polynomial
		Versiera	Versiera
		Sinc	Sinc function
		Gaussian	Gaussian function
		Dlorentz	Dlorentz function
		Haversine	Haversine function
		Lorentz	Lorentz function
		Gauspuls	Gauspuls signal
		Gmonopuls	Gmonopuls signal

		Tripuls	Tripuls signal
		Weibull	Weibull distribution
		LogNormal	LogNormal Gaussian distribution
		Laplace	Laplace distribution
		Maxwell	Maxwell distribution
		Rayleigh	Rayleigh distribution
		Cauchy	Cauchy distribution
Engine	Engine	Cardiac	Cardiac signal
		Quake	Analog quake waveform
		Chirp	Chirp signal
		TwoTone	TwoTone signal
		SNR	SNR signal
		AmpALT	Gain oscillation curve
		AttALT	Attenuation oscillation curve
		RoundHalf	RoundHalf Waveform
		RoundsPM	RoundsPM Waveform
		BlaseiWave	Time-velocity curve of explosive oscillation
		DampedOsc	Time-displacement curve of damped oscillation
		SwingOsc	Kinetic energy – time curve of swing oscillation
		Discharge	Discharge curve of NI-MH battery
		Pahcur	Current waveform of DC brushless motor
		Combin	Combination function
		SCR	SCR firing profile
		TV	TV signal
		Voice	Voice signal
		Surge	Surge signal
		Radar	Analog radar signal
		Ripple	Ripple wave of battery
		Gamma	Gamma signal
		StepResp	Step-response signal
		BandLimited	Bandwidth-limited signal
		CPulse	C-Pulse
		CWPulse	CW pulse
		GateVibr	Gate self-oscillation signal
		LFMPulse	Linear FM pulse

		MCNoise	Mechanical construction noise
Win/Trigo	Window	Hamming	Hamming window
		Hanning	Hanning window
		Kaiser	Kaiser window
		Blackman	Blackman window
		GaussiWin	GaussiWin window
		Triangle	Triangle window (Fejer window)
		BlackmanH	BlackmanH window
		Bartlett-Hann	Bartlett-Hann window
		Bartlett	Bartlett window
		BarthannWin	Modified Bartlett-Hann window
		BohmanWin	BohmanWin window
		ChebWin	ChebWin window
		FlattopWin	Flat top weighted window
		ParzenWin	ParzenWin window
		TaylorWin	TaylorWin window
		TukeyWin	TukeyWin (tapered cosine) window
	Trigo	Tan	Tangent
		Cot	Cotangent
		Sec	Secant
		Csc	Cosecant
		Asin	Arc sine
		Acos	Arc cosine
		Atan	Arc tangent
		ACot	Arc cotangent
		CosH	Hyperbolic cosine
		CosInt	Integral cosine
		Coth	Hyperbolic cotangent
		Csch	Hyperbolic cosecant
		SecH	Hyperbolic secant
		SinH	Hyperbolic sine
		SinInt	Integral sine
		TanH	Hyperbolic tangent
		ACosH	Arc hyperbolic cosine
		ASecH	Arc hyperbolic secant

		ASinH	Arc hyperbolic sine
		ATanH	Arc hyperbolic tangent
		ACsch	Arc hyperbolic cosecant
		ACoth	Arc hyperbolic cotangent
Square	Square 1	SquareDuty01	Square waveform with 1% duty
		SquareDuty02	Square waveform with 2% duty
		SquareDuty04	Square waveform with 4% duty
		SquareDuty06	Square waveform with 6% duty
		SquareDuty08	Square waveform with 8% duty
		SquareDuty10	Square waveform with 10% duty
		SquareDuty12	Square waveform with 12% duty
		SquareDuty14	Square waveform with 14% duty
		SquareDuty16	Square waveform with 16% duty
		SquareDuty18	Square waveform with 18% duty
		SquareDuty20	Square waveform with 20% duty
		SquareDuty22	Square waveform with 22% duty
		SquareDuty24	Square waveform with 24% duty
		SquareDuty26	Square waveform with 26% duty
		SquareDuty28	Square waveform with 28% duty
		SquareDuty30	Square waveform with 30% duty
		SquareDuty32	Square waveform with 32% duty
		SquareDuty34	Square waveform with 34% duty
		SquareDuty36	Square waveform with 36% duty
		SquareDuty38	Square waveform with 38% duty
		SquareDuty40	Square waveform with 40% duty
		SquareDuty42	Square waveform with 42% duty
		SquareDuty44	Square waveform with 44% duty
		SquareDuty46	Square waveform with 46% duty
		SquareDuty48	Square waveform with 48% duty
		SquareDuty50	Square waveform with 50% duty
		SquareDuty52	Square waveform with 52% duty
		SquareDuty54	Square waveform with 54% duty
		SquareDuty56	Square waveform with 56% duty
		SquareDuty58	Square waveform with 58% duty
		SquareDuty60	Square waveform with 60% duty

		SquareDuty62	Square waveform with 62% duty
		SquareDuty64	Square waveform with 64% duty
		SquareDuty66	Square waveform with 66% duty
		SquareDuty68	Square waveform with 68% duty
	Square 2	SquareDuty70	Square waveform with 70% duty
		SquareDuty72	Square waveform with 72% duty
		SquareDuty74	Square waveform with 74% duty
		SquareDuty76	Square waveform with 76% duty
		SquareDuty78	Square waveform with 78% duty
		SquareDuty80	Square waveform with 80% duty
		SquareDuty82	Square waveform with 82% duty
		SquareDuty84	Square waveform with 84% duty
		SquareDuty86	Square waveform with 86% duty
		SquareDuty88	Square waveform with 88% duty
		SquareDuty90	Square waveform with 90% duty
		SquareDuty92	Square waveform with 92% duty
		SquareDuty94	Square waveform with 94% duty
		SquareDuty96	Square waveform with 96% duty
		SquareDuty98	Square waveform with 98% duty
		SquareDuty99	Square waveform with 99% duty
Others	Medical	EOG	Electro-Oculogram
		EEG	Electroencephalogram
		EMG	Electromyogram
		Pulseilogram	Pulseilogram
		ResSpeed	Speed curve of the respiration
		ECG1	Electrocardiogram 1
		ECG2	Electrocardiogram 2
		ECG3	Electrocardiogram 3
		ECG4	Electrocardiogram 4
		ECG5	Electrocardiogram 5
		ECG6	Electrocardiogram 6
		ECG7	Electrocardiogram 7
		ECG8	Electrocardiogram 8
		ECG9	Electrocardiogram 9
		ECG10	Electrocardiogram 10

		ECG11	Electrocardiogram 11
		ECG12	Electrocardiogram 12
		ECG13	Electrocardiogram 13
		ECG14	Electrocardiogram 14
		ECG15	Electrocardiogram 15
		LFPulse	Waveform of the low frequency pulse electrotherapy
		Tens1	Waveform 1 of the nerve stimulation electrotherapy
		Tens2	Waveform 2 of the nerve stimulation electrotherapy
		Tens3	Waveform 3 of the nerve stimulation electrotherapy
	Mod	AM	Sectional sine AM signal
		FM	Sectional sine FM signal
		PFM	Sectional pulse FM signal
		PM	Sectional sine PM signal l
		PWM	Sectional PWM signal
	Filter	Butterworth	Butterworth filter
		Chebyshev1	Chebyshev1 filter
		Chebyshev2	Chebyshev2 filter
	Demo	demo1_375pts	TureArb waveform 1（375 pts）
		demo1_16kpts	TureArb waveform 1（16384 pts）
		demo2_3kpts	TureArb waveform 2（3000 pts）
		demo2_16kpts	TureArb waveform 2（16384 pts）

2. To Select the Stored Waveform

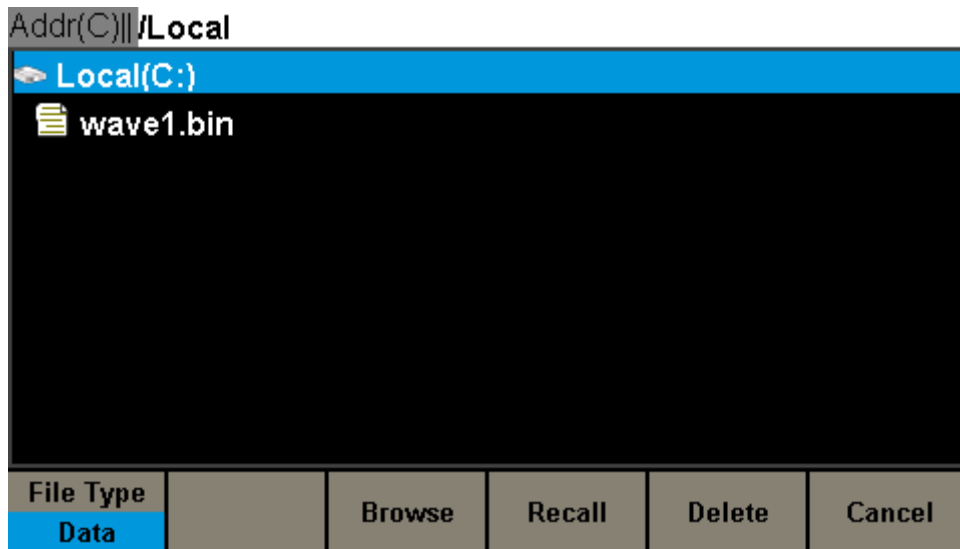Choose Waveforms → Page 1/2 → Arb → Arb Type → Stored Waveforms to enter the following interface, as shown in Figure 2-22.

Figure 2-22 Stored Waveform Display Interface

Rotate the knob or touch the screen to choose the desired waveform. Then press Recall to recall the corresponding waveform.

2.8   To Set Harmonic

SDG2000X can be used as a harmonic generator to output harmonic with specified order, amplitude and phase. According to Fourier transform, periodic time domain waveform is the superposition of a series of sine waveforms as shown in the equation below:

$$f(t) = A_1 \sin(2\pi f_1 t + \varphi_1) + A_2 \sin(2\pi f_2 t + \varphi_2) + A_3 \sin(2\pi f_3 t + \varphi_3) + ...$$

Generally, component with f_1 frequency is called fundamental waveform, f_1 is fundamental waveform frequency, A_1 is fundamental waveform amplitude, φ_1 is fundamental waveform phase. The frequencies of the other components (called harmonic) are all integral multiples of the fundamental waveform. Components whose frequencies are odd multiples of the fundamental waveform frequency are called odd harmonics and components whose frequencies are even multiples of the fundamental waveform frequency are called even harmonics.

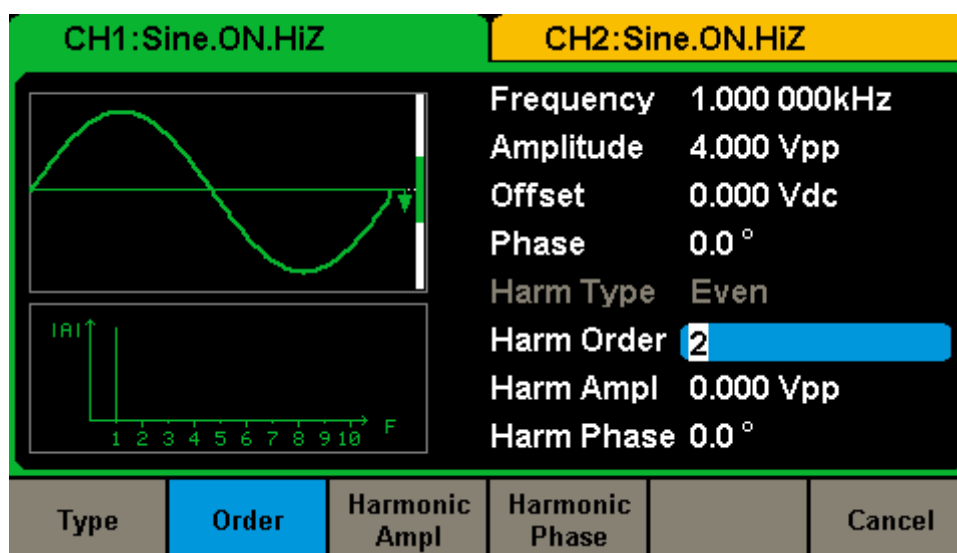Press Waveforms → Sine → Harmonic and choose "On", then press Harmonic Parameter to enter the following interface.

Figure 2-23 Harmonic Interface

Table 2-9 Menu Explanations of Harmonic

Function menu	Settings	Explanations
Type		Set the harmonic type to "odd", "ever" or "all".
Order		Set the order of the harmonic.
Harmonic Ampl		Set the amplitude of the harmonic.
Harmonic Phase		Set the phase of the harmonic.
Cancel		Return to the sine parameters menu.

To Select the Harmonic Type

SDG2000X can output odd harmonic, ever harmonic and user-defined orders of harmonic. After entering the harmonic setting menu, press Type to select the desired harmonic type.

1. Press Even, the instrument will output fundamental waveform and even harmonics.

2. Press Odd, the instrument will output fundamental waveform and odd harmonics.

3. Press All, the instrument will output fundamental waveform and all the user-defined orders of harmonics.

To Set the Harmonic Order

After entering the harmonic setting menu, press Order, the use the numeric keyboard or knob to input the desired value.

● The range is limited by the maximum output frequency of the instrument and current fundamental waveform frequency.

● Range: 2 to maximum output frequency of the instrument ÷ current fundamental waveform frequency

● The maximum is 10.

To Select the Harmonic Amplitude

After entering the harmonic setting menu, press Harmonic Ampl to set the harmonic amplitude of each order.

1. Press Order to select the sequence number of the harmonic to be set.

2. Press Harmonic Ampl to set the amplitude of the harmonic selected. Use the arrow keys and knob to change the value. Or use the numeric keyboard to input the amplitude value and then select the desired unit from the pop-up menu. The units available are Vpp, mVpp and dBc.

To Select the Harmonic Phase

After entering the harmonic setting menu, press Harmonic Phase to set the harmonic phase of each order.

1. Press Order to select the sequence number of the harmonic to be set.

2. Press Harmonic Phase to set the phase of the harmonic selected. Use the arrow keys and knob to change the value. Or use the numeric keyboard to input the phase value and then select the unit °.

2.9 To Set Modulation Function

Use the Mod key to generate modulated waveform. SDG2000X can generate AM, FM, ASK, FSK, PSK, PM, PWM and DSB-AM 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; In DSB-AM, users can set the source (internal/external), modulating frequency, modulating waveform and carrier; In FM, users can set the source (internal/external), modulating frequency, frequency deviation, modulating waveform and carrier; In PM, users can set the source (internal/external), phase deviation, modulating frequency, modulating waveform and carrier; In ASK, users can set the source (internal/external), key frequency and carrier; In FSK, users can set the source (internal/external), key frequency, hop frequency and carrier; In PSK, users can set the source (internal/external), key frequency, polarity and carrier; In PWM, users can set the source (internal/external), modulating frequency, width/duty cycle deviation, modulating waveform and carrier.

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

2.9.1 AM

The modulated waveform consists of two parts: the carrier and the modulating waveform. In AM, the amplitude of the carrier varies with the instantaneous voltage of the modulating waveform.

Press Mod → Type → AM, the parameters of AM modulation are shown in Figure 2-24.
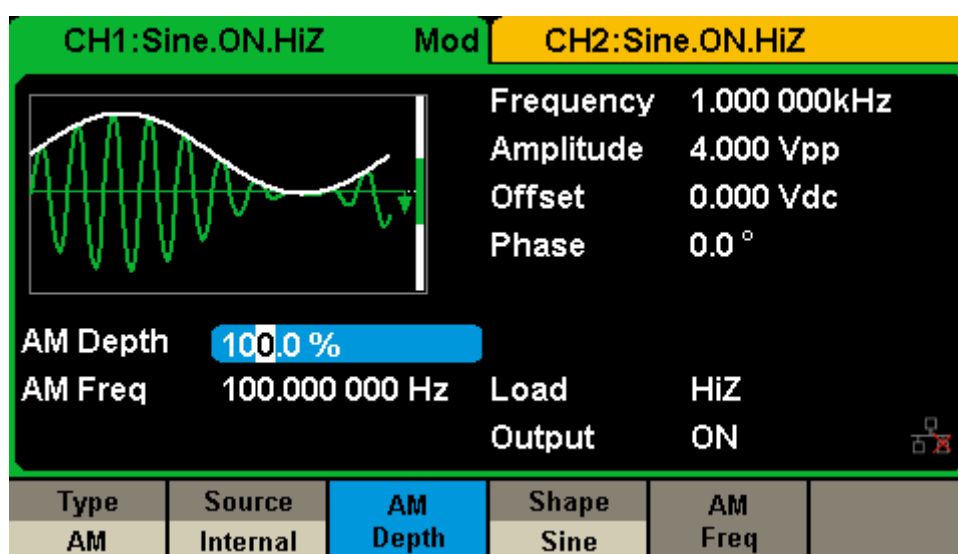
Figure 2-24 Setting Interface of AM Modulation

Table 2-10 Menu Explanations of the AM Parameters

Function Menu	Settings	Explanation
Type	AM	Amplitude modulation
Source	Internal	The source is internal
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
AM Depth		Set the modulation depth.
Shape	Sine	Choose the modulating waveform.
	Square	
	Triangle	
	UpRamp	
	DnRamp	
	Noise	

	Arb	
AM Freq		Set the modulating waveform frequency. Frequency range: 1mHz~1MHz (internal source only).

To Select Modulation Source

SDG2000X can accept modulating signal from internal or external modulation source. Press Mod → AM → Source to select "Internal" or "External" modulation source. The default is "Internal".

1. Internal Source

When internal AM modulation source is selected, press Shape to select Sine, Square, Triangle, UpRamp, DnRamp, Noise or Arb as modulating waveform.

● Square: 50% duty cycle

● Triangle: 50% symmetry

● UpRamp: 100% symmetry

● DnRamp: 0% symmetry

● Arb: the arbitrary waveform selected of the current channel

Note:

Noise can be used as modulating waveform but cannot be used as carrier.

2. External Source

When external AM modulation source is selected, the generator accepts external modulating signal from the [Aux In/Out] connector at the rear panel. At this time, the amplitude of the modulated waveform is controlled by the signal level on the connector. For example, if the modulation depth is set to 100%, the output amplitude will be the maximum when the modulating signal is +6V and the minimum when the modulating signal is -6V.

Key Points:

How to realize a modulation between dual channels? The following example takes the output signal of CH2 as the modulating waveform.

1. Connect the CH2 output terminal to [Aux In/Out] connector at the rear

panel using a dual BNC cable.

2. Select CH1 and press Mod to select the desired modulation type as well as set the corresponding parameters, and then select external modulation source.

3. Select CH2 and select the desired modulating waveform and set the corresponding parameters.

4. Press Output to enable the output of CH1.

To Set Modulation Depth

Modulation depth expressed as a percentage indicates the amplitude variation degree. AM modulation depth varies from 1% to 120%. Press AM Depth to set the parameter.

- In the 0% modulation, the output amplitude is the half of the set one.
- In the 120% 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 on the connector connected to the [Aux In/Out]. ±6V correspond to 100% depth.
- When external modulation source is selected, this menu is hidden.

To Set Modulation Frequency

When internal modulation source is selected, press AM Freq to highlight the parameter, then use the numeric keyboard or arrow keys and knob to input the desired value.

- The modulation frequency ranges from 1mHz to 1MHz.
- When external modulation source is selected, this menu is hidden.

2.9.2 DSB-AM

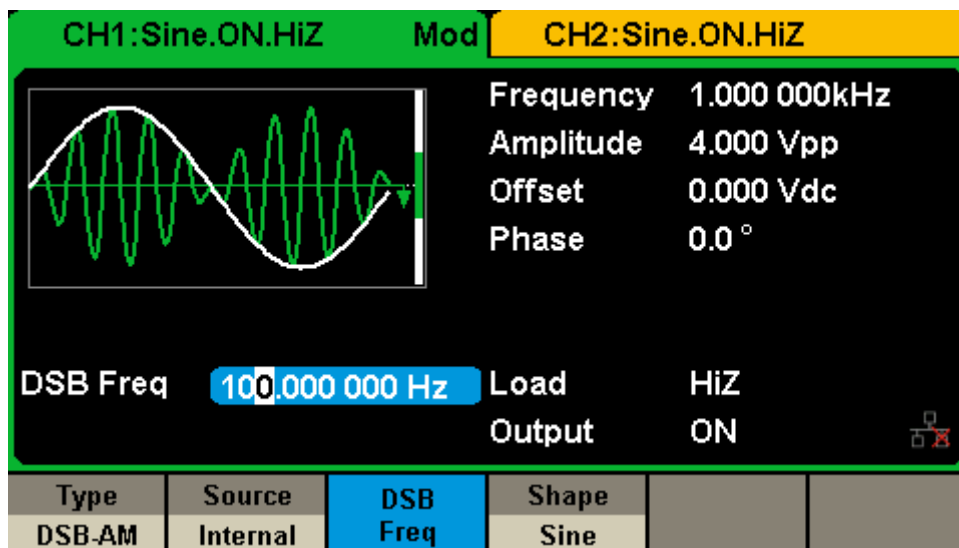Press Mod → Type → DSB-AM. The parameters of DSB-AM modulation are shown in Figure 2-25.

Figure 2-25 Setting Interface of DSB-AM Modulation

Table 2-11 Menu Explanations of the DSB-AM Parameters

Function Menu	Settings	Explanation
Type	DSB-AM	DSB Amplitude modulation.
Source	Internal	The source is internal.
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
DSB Freq		Set the modulating waveform frequency. Frequency range: 1mHz~1MHz (internal source only).
Shape	Sine	Choose the modulating waveform.
	Square	
	Triangle	
	UpRamp	
	DnRamp	
	Noise	
	Arb	

Note:

The methods of setting the parameters of DSB-AM are similar to AM.

2.9.3 FM

The modulated waveform consists of two parts: the carrier and the modulating waveform. In FM, the frequency of the carrier varies with the instantaneous voltage of the modulating waveform.

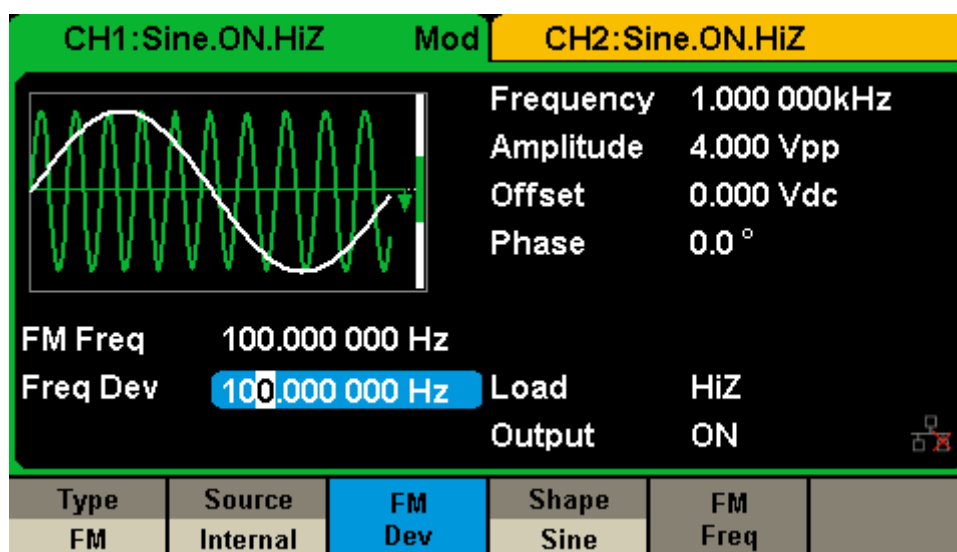Press Mod → Type → FM, the parameters of FM modulation are shown in Figure 2-26.

Figure 2-26 Setting Interface of FM Modulation

Table 2-12 Menu Explanations of the FM Parameters

Function Menu	Settings	Explanation
Type	FM	Frequency modulation
Source	Internal	The source is internal
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Freq Dev		Set the frequency deviation
Shape	Sine	Choose the modulating waveform.
	Square	
	Triangle	
	UpRamp	
	DnRamp	
	Noise	

	Arb	
FM Freq		Set the modulating waveform frequency. Frequency range 1mHz~1MHz (internal source).

To Set Frequency Deviation

Press FM Dev to highlight the parameter, and then use the numeric keyboard or arrow keys and knob to input the desired value.

● The deviation should be equal to or less than the carrier frequency.
● The sum of the deviation and the carrier frequency should be equal to or less than maximum frequency of the selected carrier waveform.

Note:

The methods of setting other parameters of FM are similar to AM.

2.9.4 PM

The modulated waveform consists of two parts: the carrier and the modulating waveform. In PM, the phase of the carrier varies with the instantaneous voltage level of the modulating waveform.

Press $\boxed{\text{Mod}}$ → $\boxed{\text{Type}}$ → $\boxed{\text{PM}}$, the parameters of PM modulation are shown in Figure 2-27.
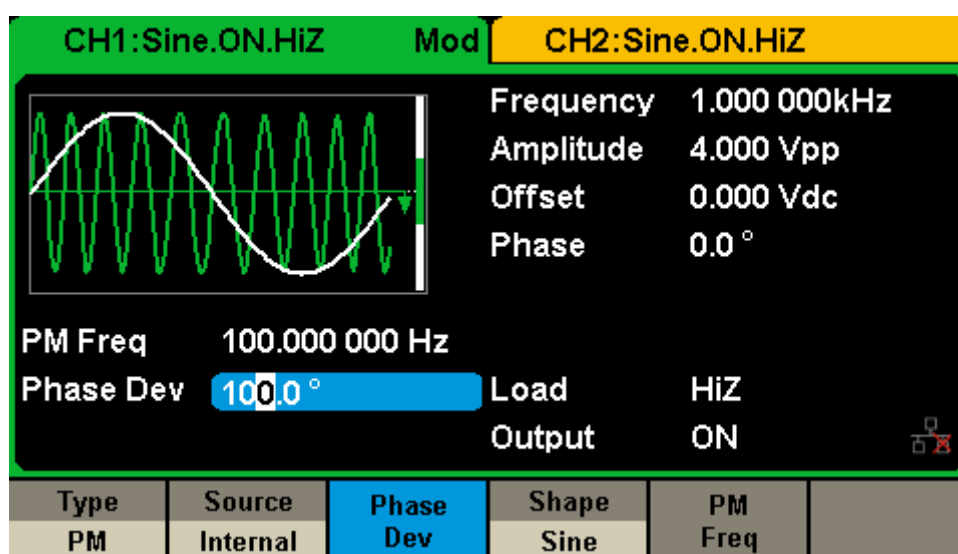

Figure 2-27 Setting Interface of PM Modulation

Table 2-13 Menu Explanations of the PM Parameters

Function Menu	Settings	Explanation
Type	PM	Phase modulation
Source	Internal	The source is internal
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Phase Dev		Phase deviation ranges from 0° ~ 360°.
Shape	Sine	Choose the modulating waveform.
	Square	
	Triangle	
	UpRamp	
	DnRamp	
	Noise	

	Arb	
PM Freq		Set the modulating waveform frequency. Frequency range: 1mHz~1MHz.

To Set Phase Deviation

Press Phase Dev to highlight the parameter, and then use the numeric keyboard or arrow keys and knob to input the desired value.

- Use the numeric keyboard or arrow keys and knob to input the desired value.
- The range of phase deviation is from 0° to 360° and the default value is 100°.

Note:

The methods of setting other parameters of PM are similar to AM.

2.9.5 FSK

The FSK is Frequency Shift Keying, the output frequency of which switches between two preset frequencies (carrier frequency and the hop frequency).

Press Mod → Type → FSK, the parameters of FSK modulation are shown in Figure 2-28.

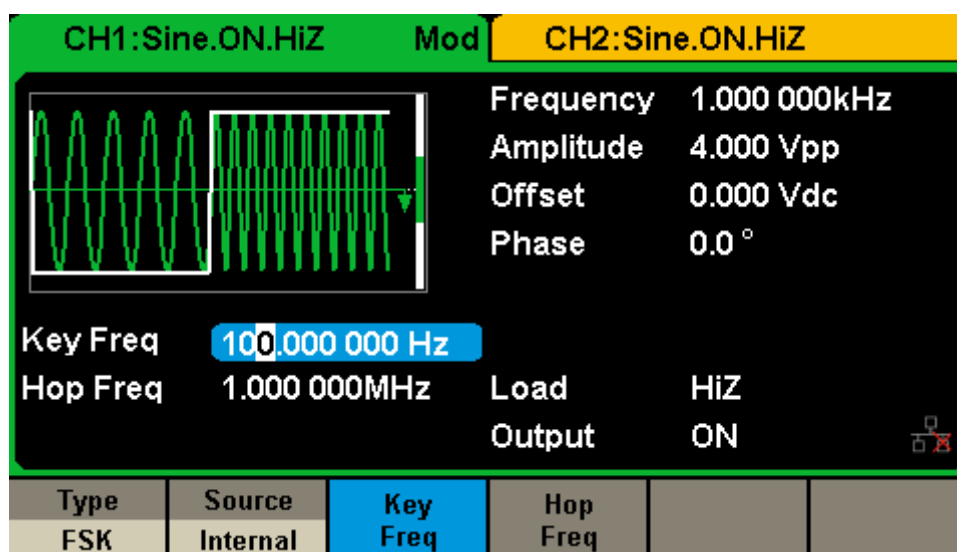Figure 2-28 Setting Interface of FSK Modulation

Table 2-14 Menu Explanations of the FSK Parameters

Function Menu	Settings	Explanation
Type	FSK	Frequency shift keying modulation.
Source	Internal	The source is internal.
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Key Freq		Set the frequency at which the output frequency shifts between the carrier frequency and the hop frequency (internal modulation only): 1mHz~1MHz.
Hop Freq		Set the hop frequency.

To Set Key Frequency

When internal modulation source is selected, press Key Freq to set the rate at which the output frequency shifts between "carrier frequency" and "hop

frequency".

- Use the numeric keyboard or arrow keys and knob to input the desired value.
- The key frequency ranges from 1mHz to 1MHz.
- When external modulation source is selected, this menu is hidden.

To Set Hop Frequency

The range of hop frequency depends on the carrier currently selected. Press Hop Freq to highlight the parameter, and then use the numeric keyboard or arrow keys and knob to input the desired value.

- Sine: 1uHz~120MHz
- Square: 1uHz~25MHz
- Ramp: 1uHz~1MHz
- Arb: 1uHz~20MHz

Note:

The methods of setting other parameters of FSK are similar to AM. In addition, the external modulating signal of FSK must be Square which complies with the CMOS level specification.

2.9.6 ASK

When using ASK (Amplitude Shift Keying), you should configure carrier frequency and key frequency. The key frequency is the shift rate of modulated waveform amplitude.

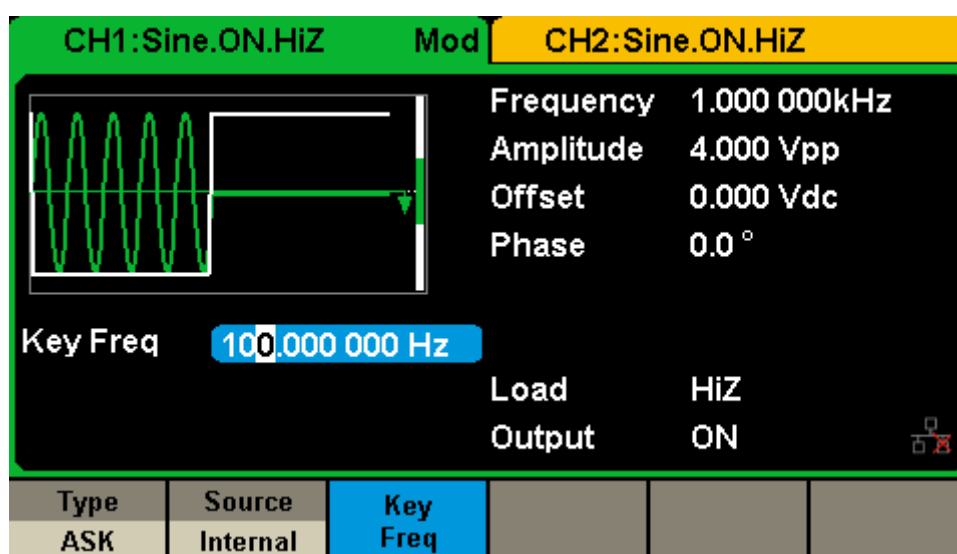Press Mod → Type → ASK, the parameters of ASK modulation are shown in Figure 2-29

Figure 2-29 Setting Interface of ASK Modulation

Table 2-15 Menu Explanations of the ASK Parameters

Function Menu	Settings	Explanation
Type	ASK	Amplitude shift keying modulation.
Source	Internal	The source is internal.
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Key Freq		Set the frequency at which the output amplitude shifts between the carrier amplitude and zero (internal modulation only): 1mHz~1MHz.

Note:

The methods of setting the parameters of ASK are similar to AM. In addition, the external modulating signal of ASK must be Square which complies with the CMOS level specification.

2.9.7 PSK

When using PSK (Phase Shift Keying), you should configure the generator to "shift" its output phase between two preset phase values (carrier phase and modulating phase). The default modulating phase is 180°.

Press Mod → Type → PSK, the parameters of PSK modulation are shown in Figure 2-30.

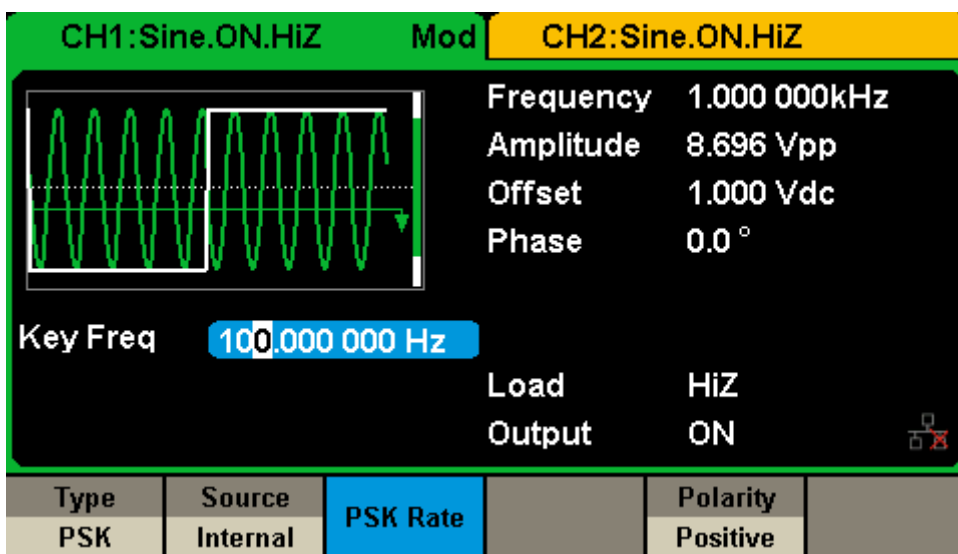Figure 2-30 Setting Interface of PSK Modulation

Table 2-16 Menu Explanations of the PSK Parameters

Function Menu	Settings	Explanation
Type	PSK	Phase shift keying modulation.
Source	Internal	The source is internal.
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Key Freq		Set the frequency at which the output phase shifts between the carrier phase and 180° (internal modulation only): 1mHz~1MHz.
Polarity	Positive	Set the modulating polarity.
	Negative	

Note:

The methods of setting the parameters of PSK are similar to AM. In addition, the external modulating signal of PSK must be Square which complies with the CMOS level specification.

2.9.8 PWM

In PWM (Pulse Width Modulation), the pulse width of pulse varies with the instantaneous voltage of the modulating waveform. The carrier can only be pulse.

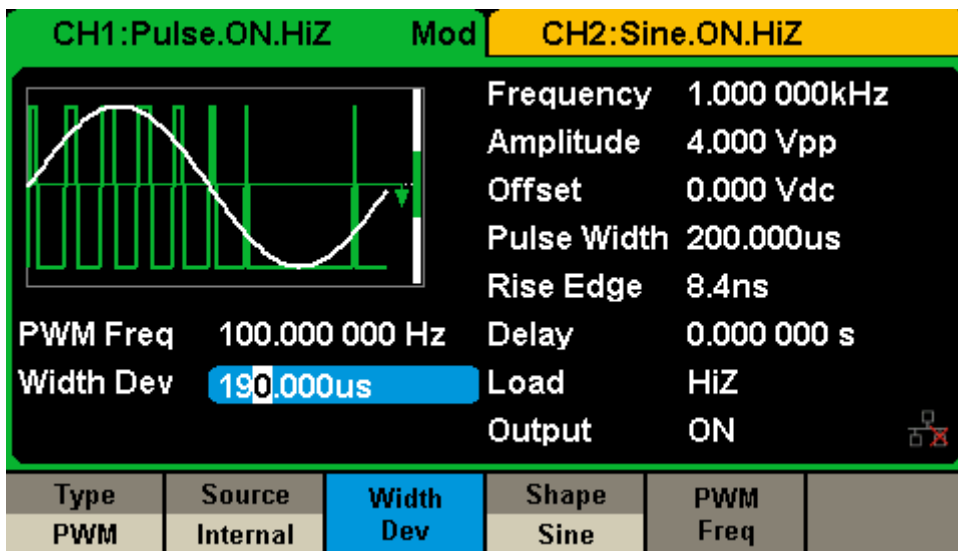Press Waveforms → Pulse → Mod, the parameters of PWM modulation are shown in Figure 2-31.

Figure 2-31 Setting Interface of PWM Modulation

Table 2-17 Menu Explanations of the PWM Parameters

Function Menu	Settings	Explanation
Type	PWM	Pulse width modulation. The carrier is pulse.
Source	Internal	The source is internal.
	External	The source is external. Use the [Aux In/Out] connector at the rear panel.
Width Dev		Set the width deviation.
Duty Dev		Set the duty deviation.
Shape	Sine	Choose the modulating waveform.
	Square	
	Triangle	
	UpRamp	
	DnRamp	

	Noise	
	Arb	
PWM Freq		Set the modulating waveform frequency. Frequency range: 1mHz~1MHz (internal source only).

To Set Pulse Width/Duty Deviation

Width Deviation represents the variation of the modulated waveform pulse width relative to the original pulse width. Press Width Dev to highlight the parameter, and use the numeric keyboard or arrow keys and knob to input the desired value, as shown in the Figure 2-32.
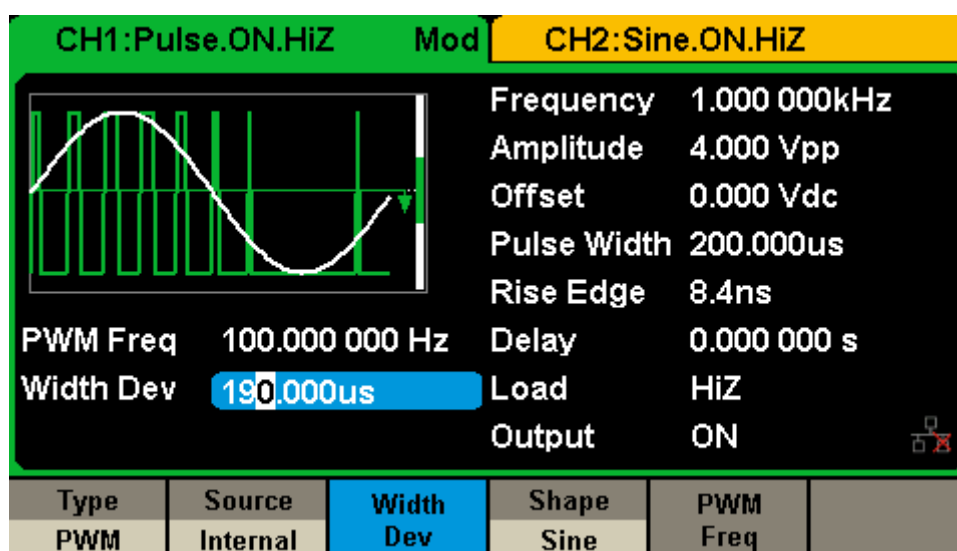

Figure 2-32 Width Deviation Setting Interface

- The width deviation cannot exceed the current pulse width.
- The width deviation is limited by the minimum pulse width and current edge time setting.

Duty Deviation represents the variation (%) of the modulated waveform duty relative to the original duty. Press Duty Dev to highlight the parameter, and then use the numeric keyboard or arrow keys and knob to input the desired value, as shown in the Figure 2-33.
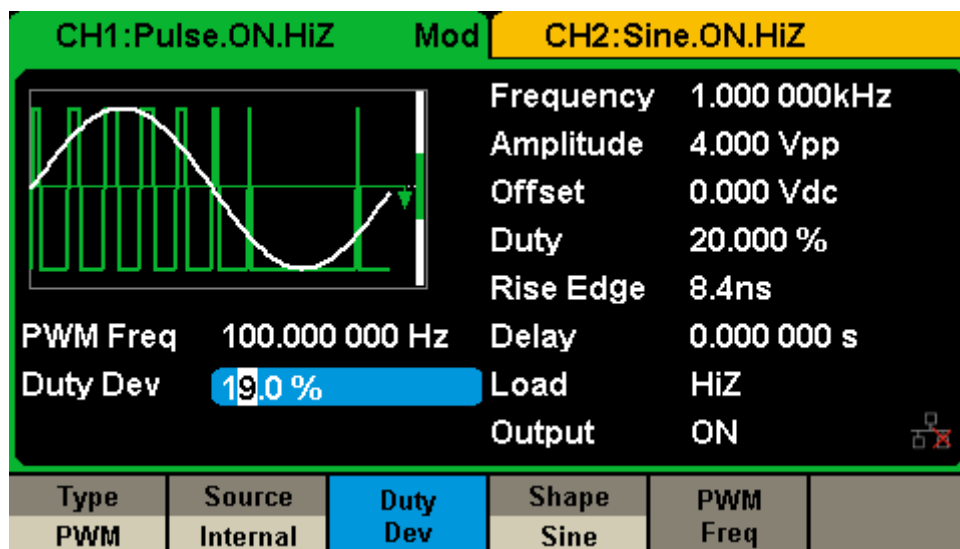
Figure 2-33 Duty Deviation Setting Interface

- The duty deviation cannot exceed the current pulse duty.
- The duty deviation is limited by the minimum duty and current edge time setting.
- Duty deviation and width deviation are correlative. Once a parameter is changed, the other will be automatically changed.

Note:

The methods of setting other parameters of PWM are similar to AM.

2.10   To Set Sweep Function

In the sweep mode, the generator steps from the start frequency to the stop frequency in the sweep time you specify. The waveforms that support sweep include sine, square, ramp and arbitrary.

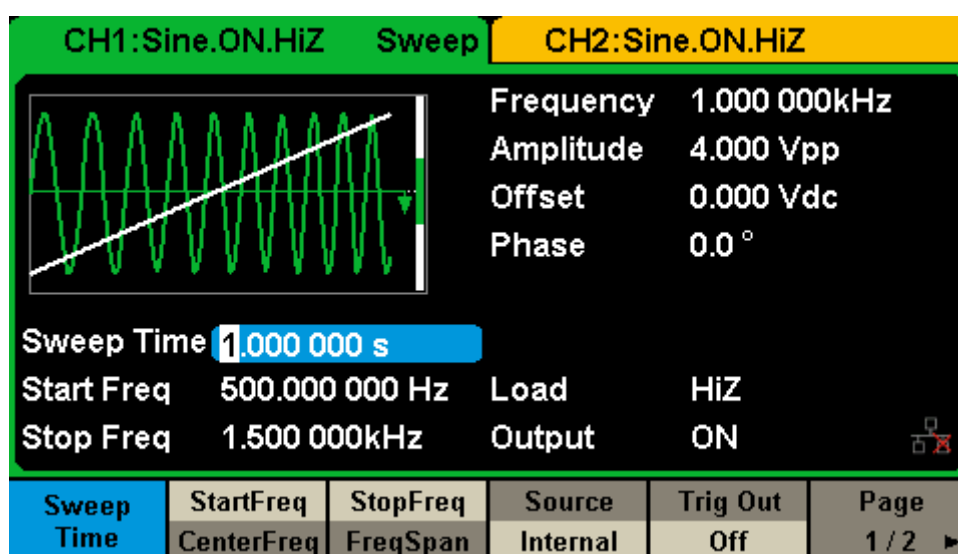Press Sweep key to enter the following menu. Set the waveform parameters by using the operation menu.

Figure 2-34 Setting Interface of Sweep (Page 1/2)

Table 2-18 Menu Explanations of Sweep (Page 1/2)

Function Menu	Settings	Explanation
Sweep time		Set the time span of the sweep in which the frequency changes from the start frequency to stop frequency.
Start Freq Mid Freq		Set the start frequency of the sweep; Set the center frequency of the sweep.
Stop Freq Freq Span		Set the stop frequency of the sweep; Set the frequency span of the sweep.
Source	Internal	Choose internal source as a trigger.
	External	Choose external source as a trigger. Use the [Aux In/Out] connector at the rear panel.
	Manual	Trigger a sweep by manual.
Trig Out	Off	Disable trigger out.
	On	Enable trigger out.

Page 1/2		Enter the next page.

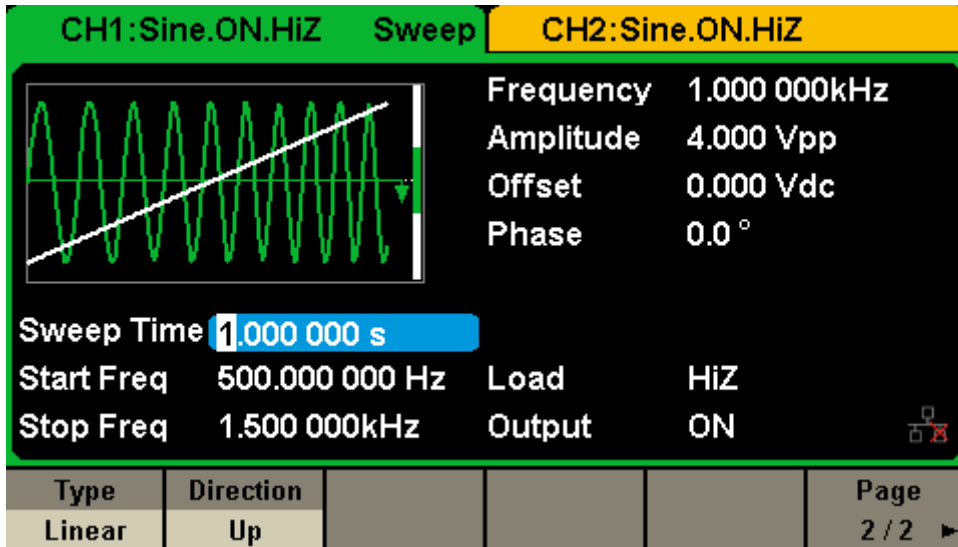Figure 2-35 Setting Interface of Sweep (Page 2/2)

Table 2-19 Menu Explanations of Sweep (Page 2/2)

Function Menu	Settings	Explanation
Type	Linear	Set the sweep with linear profile.
	Log	Set the sweep with logarithmic profile.
Direction	Up	Sweep upward.
	Down	Sweep downward.
Page 2/2		Return to the previous page.

Sweep Frequency

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

Start Frequency and Stop Frequency

Start Frequency and Stop Frequency are the lower and upper limits of the frequency for sweep. Start Frequency ≤ Stop Frequency.

● Choose Direction → Up, the generator will sweep from start frequency to

stop frequency.

● Choose Direction → Down, the generator will sweep from stop frequency to start frequency.

Center Frequency and Frequency Span

Center Frequency = (|Start Frequency + Stop Frequency|)/2

Frequency Span = Stop Frequency – Start Frequency

Sweep Type

SDG2000X provides "Linear" and "Log" sweep profiles and the default is "Linear".

Linear Sweep

In linear sweep, the output frequency of the instrument varies linearly in the way of "several Hertz per second". Choose Sweep → Page 1/2 → Type → Linear, there is a straight line displayed on the waveform on the screen, indicating that the output frequency varies linearly.
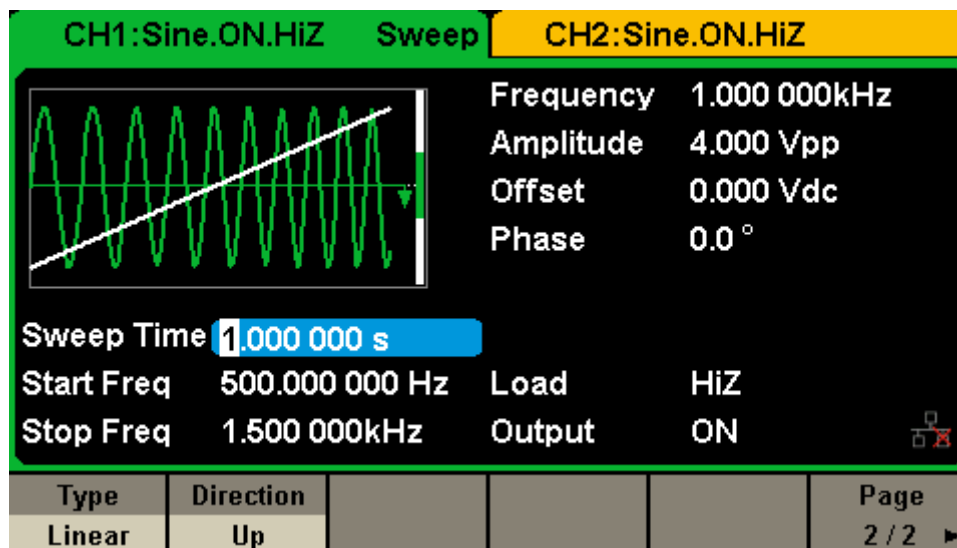

Figure 2-36 Linear Sweep

Log Sweep

In log sweep, the output frequency of the instrument varies in a logarithmic fashion, that is, the output frequency changes in the way of "decade per second". Choose Sweep → Page 1/2 → Type → Log, there is an exponential function curve displayed on the waveform on the screen, indicating that the output frequency changes in a logarithmic mode.
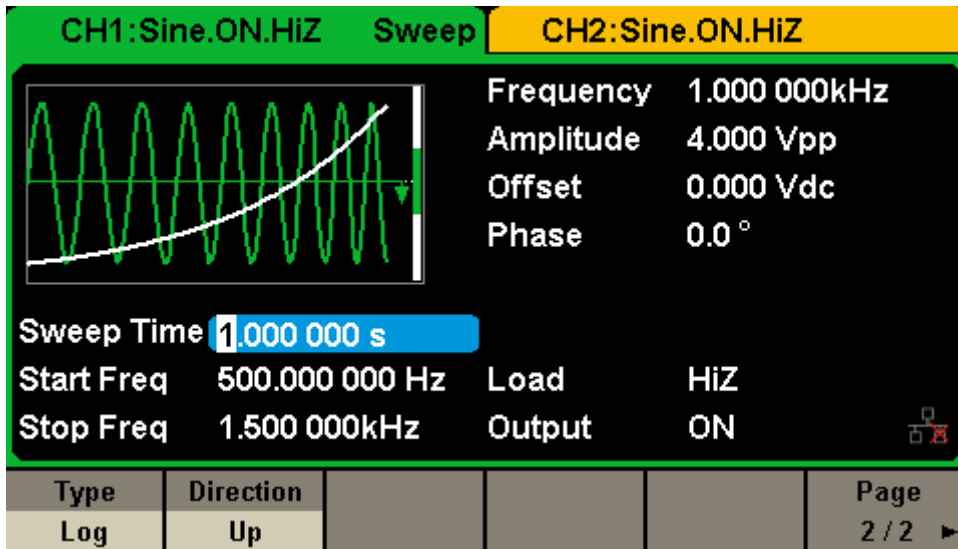

Figure 2-37 Log Sweep

Sweep Trigger Source

The sweep trigger source could be internal, external or manual. The generator will generate a sweep output when a trigger signal is received and then wait for the next trigger source.

1. Internal Trigger

Choose Source → Internal, the generator outputs continuous sweep waveform when internal trigger is selected. The default is "Internal". Choose Trig Out → On, the [Aux In/Out] connector at the rear panel will output the trigger signal.

2. External Trigger

Choose Source → External, the generator accepts the trigger signal inputted from the [Aux In/Out] connector at the rear panel when external trigger is

selected. A sweep will be generated once the connector gets a CMOS pulse with specified polarity. To set the CMOS pulse polarity, choose Edge to select "Up" or "Down".

3. Manual Trigger

Choose Source → Manual, a sweep will be generated from the corresponding channel once you press Trigger softkey when manual trigger is selected. Choose Trig Out → On, the [Aux In/Out] connector at the rear panel will output the trigger signal.

2.11   To Set Burst Function

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

Burst Type

SDG2000X provides three burst types including N-Cycle, Infinite and Gated. The default is N-Cycle.

Table 2-20 Relations among burst type, trigger source and carrier

Burst Type	Trigger Source	Carrier
N-Cycle	Internal/External/ Manual	Sine, Square, Ramp, Pulse, Arbitrary.
Infinite	External/Manual	Sine, Square, Ramp, Pulse, Arbitrary.
Gated	Internal/External	Sine, Square, Ramp, Pulse, Noise, Arbitrary.

N-Cycle

In N-Cycle mode, the generator will output waveform with specified number of cycles after receiving the trigger signal. Waveforms that support N-Cycle burst include sine, square, ramp, pulse and arbitrary.

Press Burst → NCycle → Cycles, and use the numeric keyboard or arrow keys and knob to input the desired cycles. Set the waveform parameters by using the operation menu, as shown in Figure 2-38 and Figure 2-39.
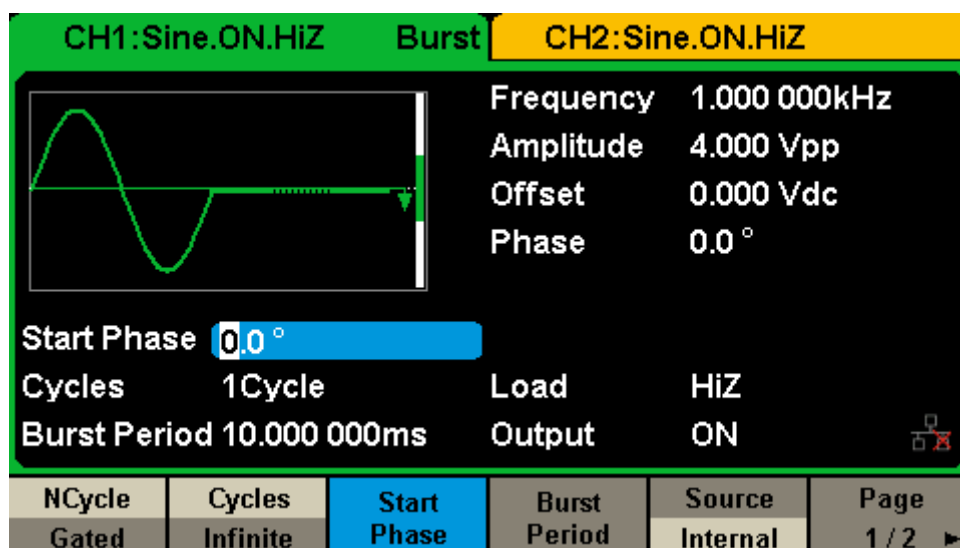
Figure 2-38 N-Cycle Burst Interface (Page 1/2)

Table 2-21 Menu Explanations of the N-Cycle Burst (Page 1/2)

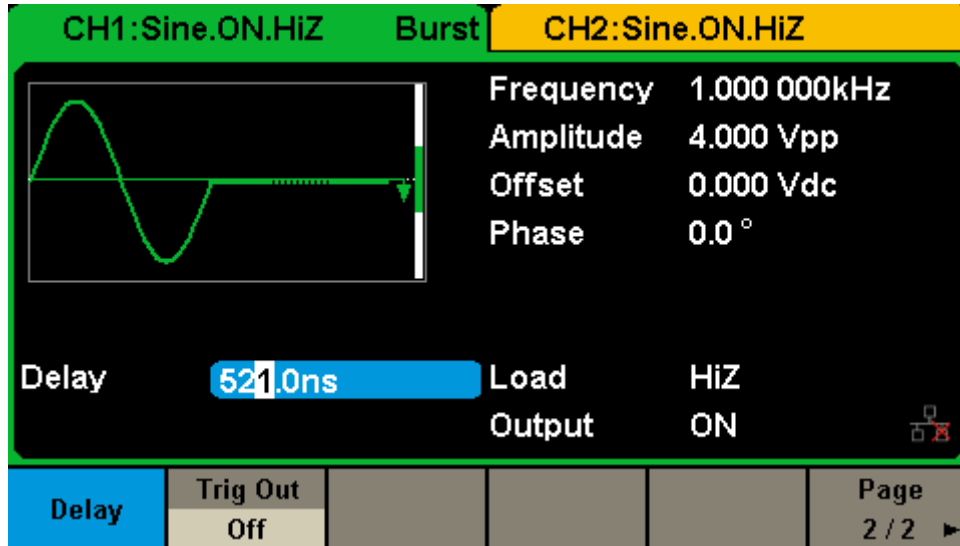| Function Menu	Settings	Explanation
NCycle		Use the N-Cycle mode.
Cycles Infinite		Set the number of the bursts in N-Cycle. Set the number of the bursts in N-Cycle to be infinite.
Start Phase		Set the start phase of the burst.
Burst Period		Set the burst period.
Source	Internal	Choose internal source as a trigger.
	External	Choose external source as a trigger. Use the [Aux In/Out] connector at the rear panel.
	Manual	Trigger a burst by manual.
Page 1/2		Enter the next page.

Figure 2-39 N-Cycle Burst Interface (Page 2/2)

Table 2-22 Menu Explanations of the N-Cycle Burst (Page2/2)

Function Menu	Settings	Explanation
Delay		Set the delay time before the burst starts.
Trig Out	Off	Disable trigger out.
	On	Enable trigger out.
Page 2/2		Return to the previous page.

Infinite

In infinite mode, the cycle number of the waveform is set as an infinite value. The generator outputs a continuous waveform after receiving the trigger signal. Waveforms that support infinite mode include sine, square, ramp, pulse and arbitrary.

Press Burst → NCycle → Infinite, and set the trigger source to "external" or "manual". The screen will display an infinite cycle burst, as shown in Figure 2-40.
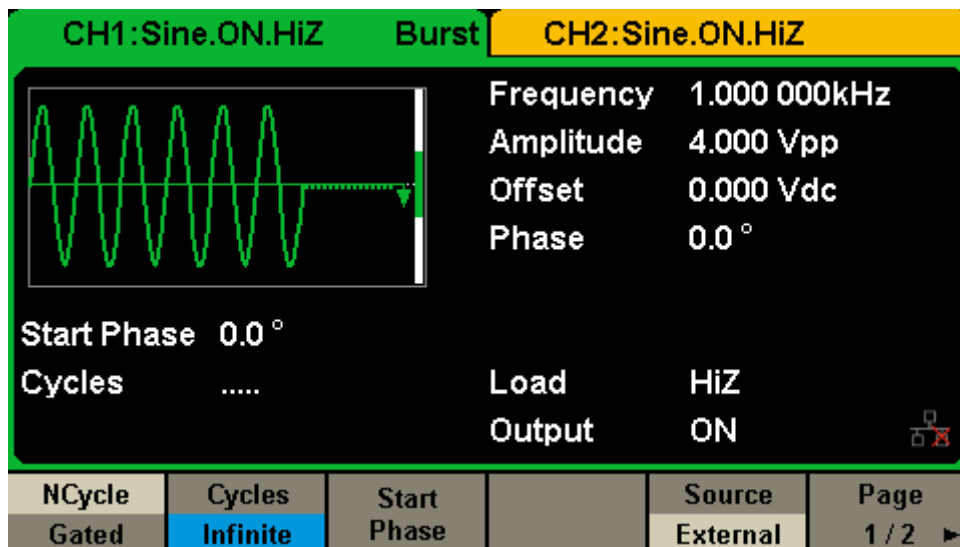
Figure 2-40 Infinite Burst Interface

Gated

In gated mode, the generator controls the waveform output according to the gate signal level. When the gated signal is "true", the generator outputs a continuous waveform. When the gated signal is "false", the generator first completes the output of the current period and then stops. Waveforms that support gated burst include sine, square, ramp, pulse, noise and arbitrary.
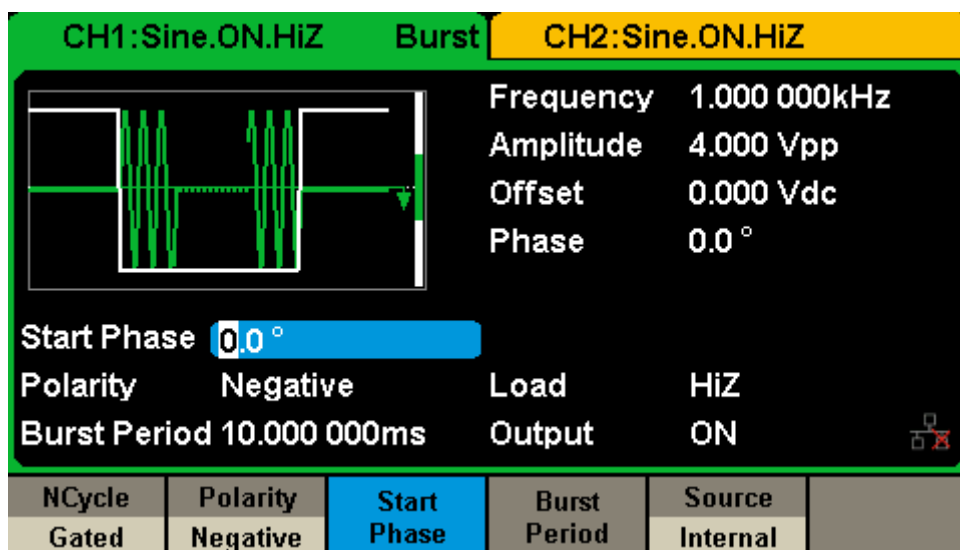
Press Burst → Gated, to enter the following interface.

Figure 2-41 Gated Burst Interface

Table 2-23 Menu Explanations of the Gated Burst

Function Menu	Settings	Explanation
Gated		Use the gated mode.
Polarity	Positive	Set the polarity for the gated signal.
	Negative	
Start Phase		Set the start phase of the burst.
Burst Period		Set the burst Period.
Source	Internal	Choose internal source as a trigger.
	External	Choose external source as a trigger. Use the [Aux In/Out] connector at the rear panel.

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.

Burst Period

Burst Period is only available when the trigger source is internal. It is defined as the time from the start of a burst to the start of the next one. Choose Burst Period, and use the numeric keyboard or arrow keys and knob to input the desired value.

● Burst Period ≥ 0.99µs + carrier period × burst number
● If the current burst period set is too short, the generator will increase this value automatically to allow outputting the specified number of cycles.

Cycles/Infinite

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 once a trigger happens.

Delay

Set the time delay between the trigger input and the start of the N-Cycle burst.

Burst Trigger Source

The burst trigger source could be internal, external or manual. The generator will generate a burst output when a trigger signal is received and then wait for the next trigger source.

1. Internal Trigger

Choose Source → Internal, the generator outputs continuous burst waveform when internal trigger is selected. Choose Trig Out as "Up" or "Down", the [Aux In/Out] connector at the rear panel will output trigger signal with specified edge.

2. External Trigger

Choose Source → External, the generator accepts the trigger signal inputted from the [Aux In/Out] connector at the rear panel when external trigger is selected. A burst will be generated once the connector gets a CMOS pulse with specified polarity. To set the CMOS pulse polarity, choose Edge to select "Up" or "Down".

3. Manual Trigger

Choose Source → Manual, a burst will be generated from the corresponding channel once you press Trigger softkey when manual trigger is selected.

2.12   To Store and Recall

SDG2000X can store the current instrument state and user-defined arbitrary waveform data in internal or external memory and recall them when needed. Press Store/Recall to enter the following interface.
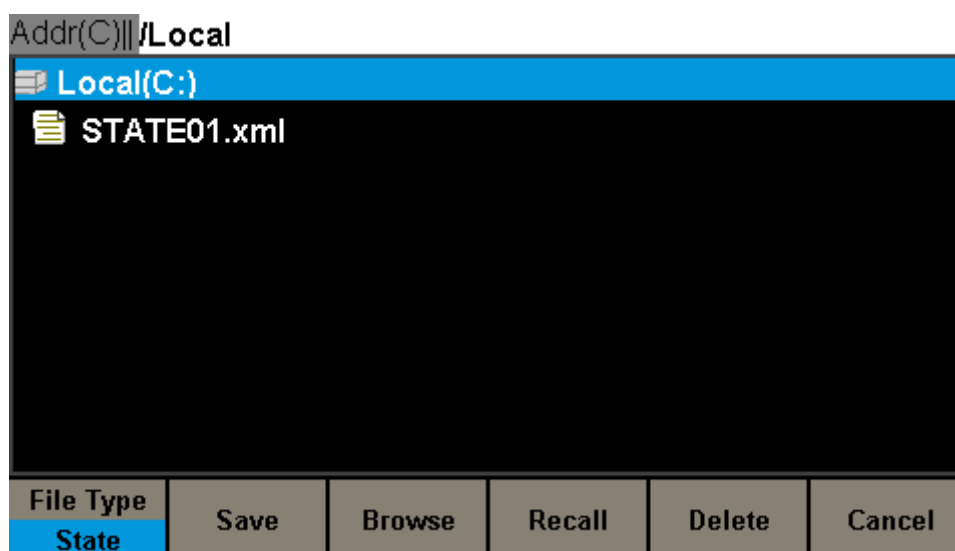

Figure 2-42 Store/Recall Interface

Table 2-24 Menu Explanations of Save and Recall

Function Menu	Settings	Explanation
File Type	State	The setting of the generator;
	Data	Arbitrary waveform file
Browse		View the current directory.
Save		Save the waveform to the specified path.
Recall		Recall the waveform or setting information in the specific position of the memory.
Delete		Delete the selected file.
Cancel		Exit the Store/Recall interface.

2.12.1　Storage System

SDG2000X provides an internal non-volatile memory (C Disk) and a USB Host interface for external memory.

1. Local (C:)

Users can store instrument states and arbitrary waveform files to C Disk.

2. USB Device (0:)

There is a USB Host interface on the left of the front panel, which permits users to store/recall waveforms or update the firmware version by U-Disk. When the generator detects a USB storage device, the screen will show the driver letter "USB Device (0:)" and display a prompt message "USB device connected.", as shown in Figure 2-43. After removing the U-Disk, the screen will display a prompt message "USB device removed." And "USB Device (0:)" in the storage menu will disappear.
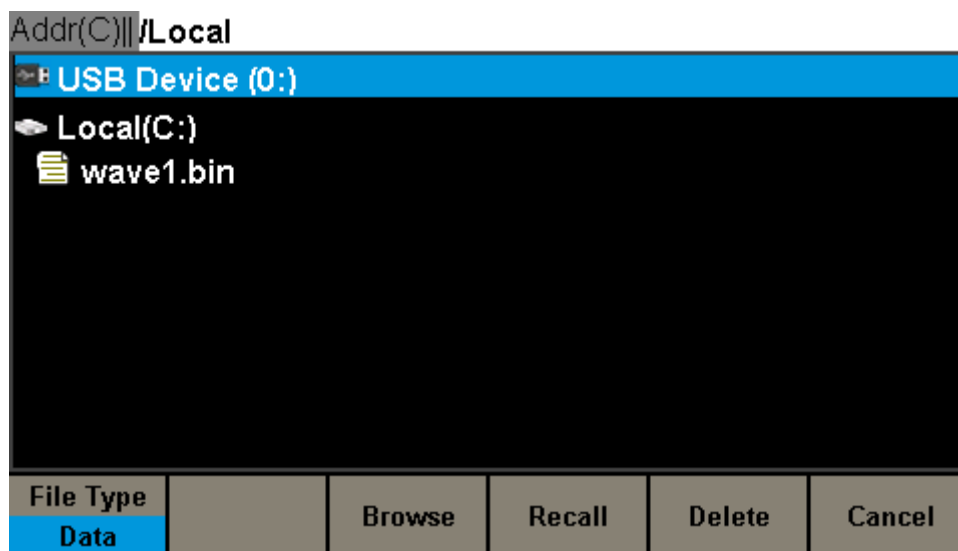

Figure 2-43 Storage System

Note:

SDG2000X can only identify files of which filenames consist of English letters, number and underscore. If other characters are used, the name might be displayed in the store and recall interface abnormally.

Browse

- Use the knob to shift between the directories or click the corresponding location on the screen to choose Local (C:) or USB Device (0:). Choose Browse, press the knob or click the selected folder to open the current directory.
- Use the knob to switch between folder and files under the current directory. Choose Browse, press the knob or click the selected folder to open the subdirectory. Choose <up>, then choose Brower or press the knob to return to the upper level directory.

2.12.2   File Type

Choose Store/Recall → File Type to select the desired file type. Available file types are State File and Data File.

State File

Store the instrument state in internal or external memory in "*.xml" format. The state file stored includes waveform parameters and modulation, sweep, burst parameters of two channels and utility parameters.

Data File

SDG2000X could recall the data files in "*.csv" or "*.dat" format from the external memory and transfer them into "*.bin" format then store them in the internal memory. When it is done, the generator will enter arbitrary waveform interface automatically.

In addition, users can edit arbitrary waveforms by PC software — EasyWave, download them to the internal memory through remote interface and store them (in "*.bin" format) in the internal memory.

2.12.3   File Operation

To Save the Instrument State

Users are allowed to store the instrument state in internal and external memories. The storage will save the selected function (including the basic waveform parameters, modulation parameters and other utility settings used.)

To save the instrument state, the procedures are given as followed:

1.   Choose the file type to store.

Press Store/Recall → File Type → State, and choose state as the storage type.

2.   Choose the location of the file.

Choose a desired location by rotating the knob or clicking the corresponding location on the touch screen.

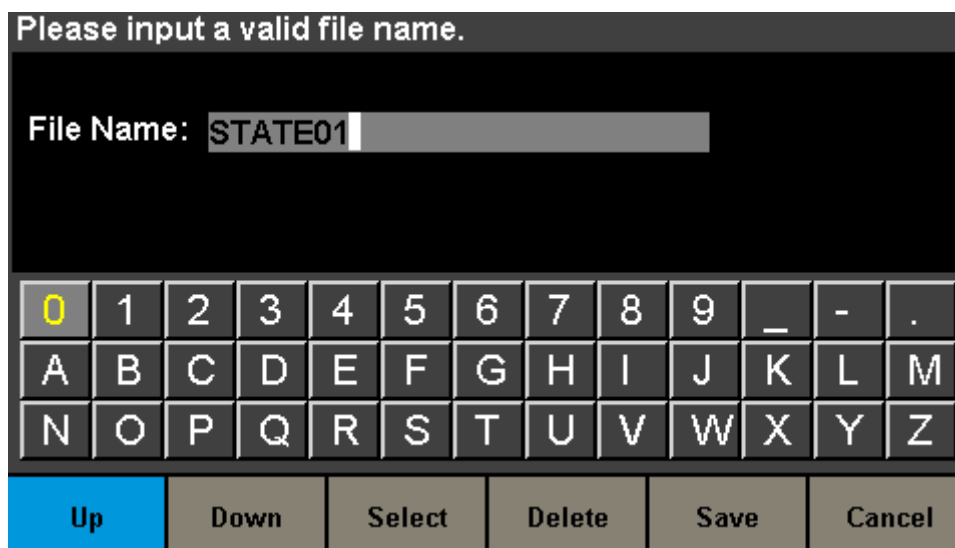**3.   Name the file.**

Press Save, to enter the following interface.

Figure 2-44 Filename Input Interface

Table 2-25 Menu Explanation of File Storage

Function Menu	Settings	Explanation
Up		Cursor upward to select.
Down		Cursor downward to select.
Select		Select the current character.
Delete		Delete the current character.
Save		Store the file with the current name.
Cancel		Return to the store/Recall interface.

Select the character

Users can select the desired character from the virtual soft keyboard by the knob or Up and Down menus. Or touch the location of the character on the screen directly. Then choose Select to display the character selected in the filename area.

Delete the character

Use the left and right arrow keys to move the cursor in the file name. Then choose Delete to delete the corresponding character.

4. Save the file.

After finishing inputting filename, press Save. The generator will save the file under the currently selected directory with the specified filename.

To Recall State File or Data File

To recall the instrument state or arbitrary waveform data, the procedures are given as followed:

1. Choose the file type.

Press Store/Recall → File Type, and choose state or data as the storage type.

2. Choose the file to be recalled.

Rotate the knob or click the touch screen to select the file you want to recall.

3.   Recall the file.

Choose Recall, press the knob or click the location of the file on the screen, the generator will recall the selected file and display corresponding prompt message when the file is read successfully.

To Delete File

To delete the instrument state or arbitrary waveform data, the procedures are given as followed:

1. Choose the file.

Rotate the knob or click the touch screen to select the file you want to delete.

2. Delete the file.

Choose Delete, the generator will display prompt message 'Delete the file?' Then press Done, the generator will delete the currently selected file.

2.13　To Set Utility Function

With the Utility function, you can set the parameters of the generator such as Sync, Interface, System Setting, Self Test and Frequency Counter, etc. Press Utility to enter the utility menu, as shown in Figure 2-45 and Figure 2-46.

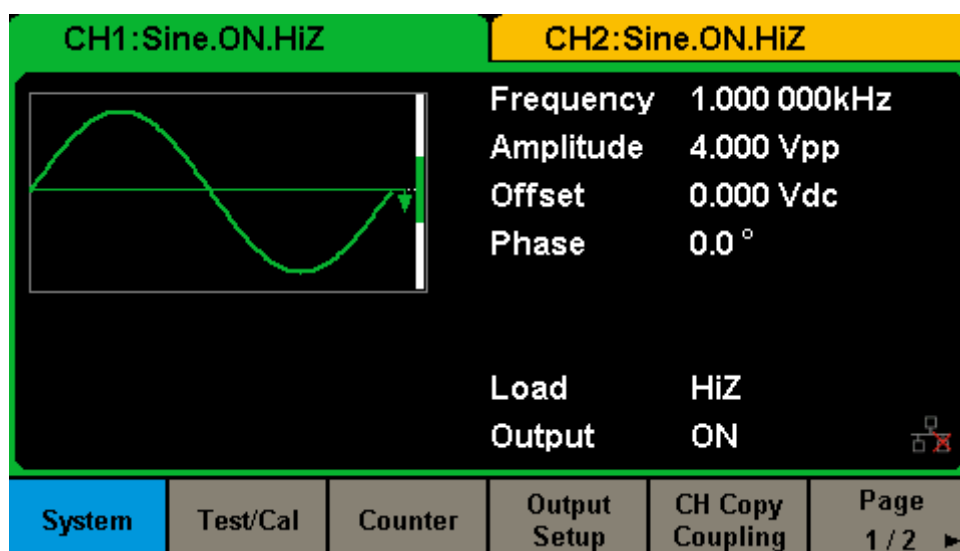Figure 2-45 Utility Setup Interface (Page 1/2)

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

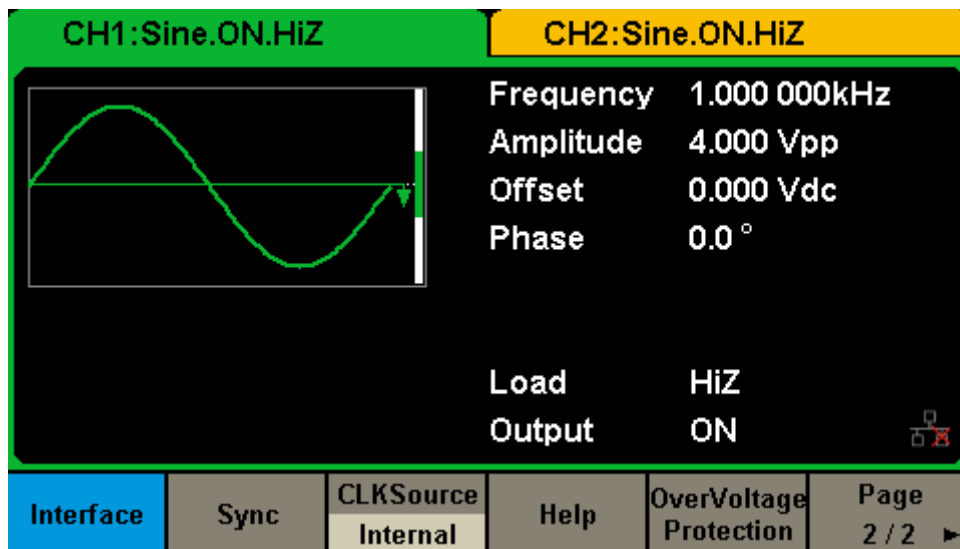| Function Menu	Settings	Explanation
System		Set the system configuration.
Test/Cal		Test and calibrate the instrument.
Counter		Frequency counter setting.
Output Setup		Set the output parameters of CH1 and CH2.
CH Copy Coupling		Set the track, channel coupling or channel copy function.
Page 1/2		Enter the next page.

Figure 2-46 Utility Setup Interface (Page 2/2)

Table 2-27 Menu Explanations of Utility (Page2/2)

Function Menu	Settings	Explanation
Interface		Set the parameters of remote interfaces.
Sync		Set the sync output.
CLKSource	Internal	Choose the system clock source.
	External	
Help		View the help information.
OverVoltage Protection		Turn on/off the overvoltage protection function.
Page 2/2		Return to the previous page.

2.13.1 System Settings

Press Utility → System, to enter the following interface.
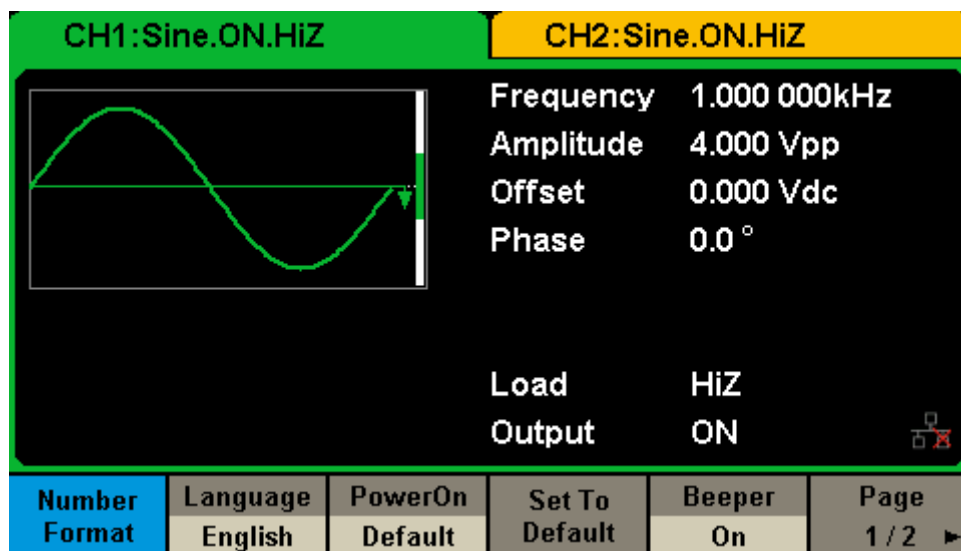
Figure 2-47 System Setup Interface (Page 1/2)

Table 2-28 Menu Explanations of System Setup (Page 1/2)

Function Menu	Settings	Explanation
Number format		Set the number format.
Language	English	Set the language.
	Chinese	
PowerOn	Default	All the settings return to default when power on;
	Last	All the settings return to the setting of last power on.
Set to Default		Set all the settings to default.
Beeper	On	Open the beeper.
	Off	Close the beeper.
Page 1/2		Enter the next page.
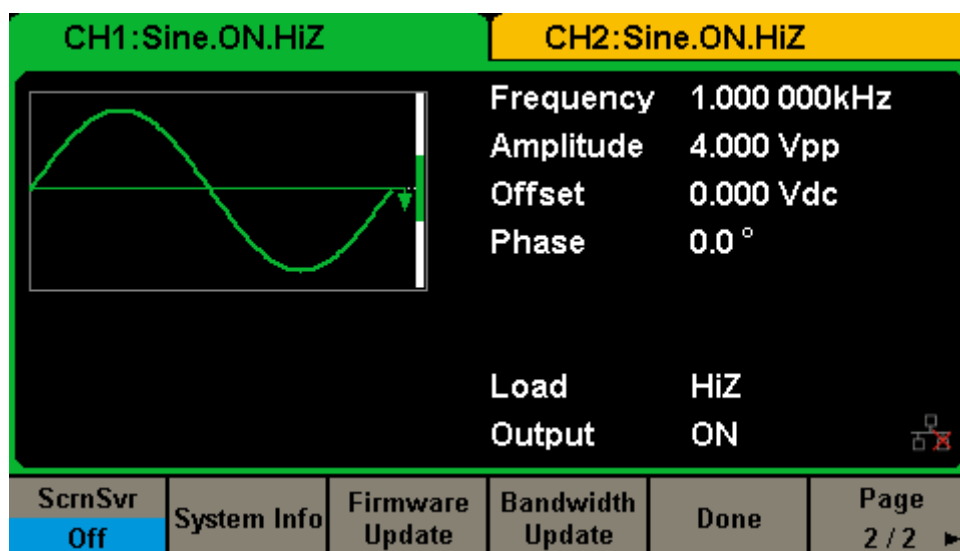
Figure 2-48 System Setup Interface (Page 2/2)

Table 2-29 Menu Explanations of System Setup (Page 2/2)

Function Menu	Settings	Explanation
ScrnSvr	1min	Enable or disable the screen saver.
	5min	
	15min	
	30min	
	1hour	
	2hour	
	5hour	
	Off	Disable the screen saver.
System Info		View the system information
Firmware Update		Update the firmware by the U-disk.
Bandwidth Update		Update the bandwidth of the generator.
Done		Save the current settings and return to the Utility menu.
Page 2/2		Return to the previous page.

1. Set the Number Format

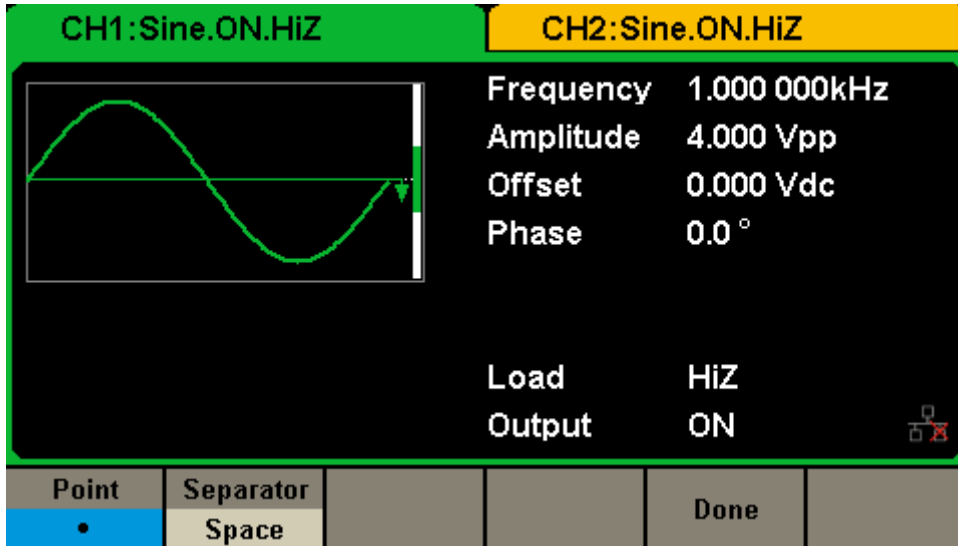Press Utility → System → Number Format, to enter the following interface.

Figure 2-49 Set the Number Format

Table 2-30 Menu Explanations of Setting the Number Format

Function Menu	Settings	Explanation
Point	.	Use dot to represent decimal point;
	,	Use comma to represent decimal point.
Separator	On	Enable the Separator;
	Off	Close the Separator;
	Space	Use Space as the separator.
Done		Save the current settings and return to the System menu.

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

2. Language Setup

The generator offers two languages (English and Simplified Chinese). Press Utility → System → Language, to select the desired language. This setting is stored in non-volatile memory and will not be influenced by the Set To Default operation.
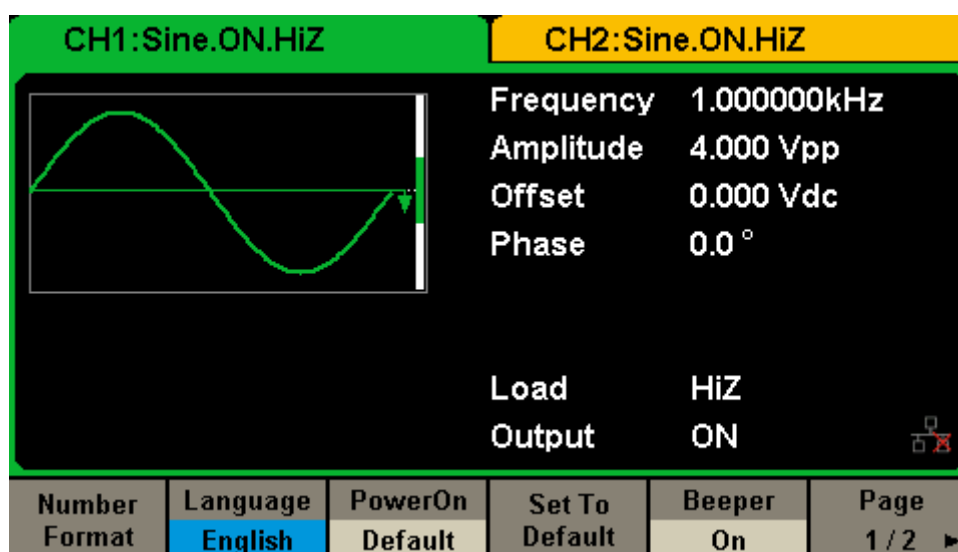
English Interface

Figure 2-50 English Interface
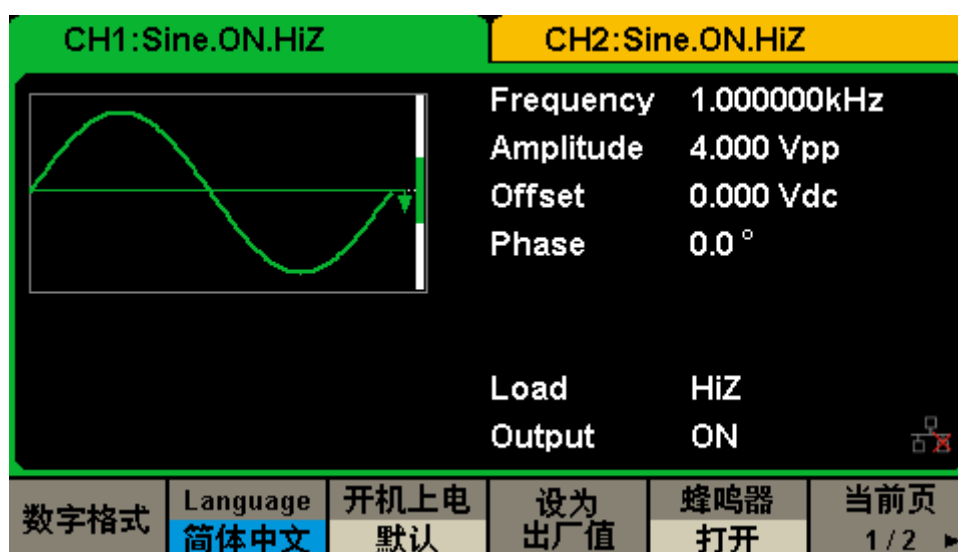
Chinese Interface

Figure 2-51 Chinese Interface

3. Power On

Choose the setting when the generator is powered on. Two choices are available: the default setting and the last. Once selected, the setting will be applied when the instrument is powered on. This setting is stored in non-volatile memory and will not be influenced by the Set To Default operation.

- Last: includes all system parameters and states, except channel output

state.

● Default: denotes the factory defaults except certain parameters (such as Language).

4. Set to Default

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

Table 2-31 Factory Default Setting

Output	Default
Function	Sine Wave
Frequency	1kHz
Amplitude/Offset	4Vpp/0Vdc
Phase	0°
Load	High Z
Modulation	**Default**
Carrier	1kHz Sine Wave
Modulating	100Hz Sine Wave
AM Depth	100％
FM Deviation	100Hz
ASK Key Frequency	100Hz
FSK Key Frequency	1MHz
FSK Hop Frequency	100Hz
PSK Key Frequency	100Hz
PM Phase Deviation	100°
PWM Width Dev	190µs
Sweep	**Default**
Start/Stop Frequency	500Hz/1.5kHz
Sweep Time	1s
Trig Out	Off
Mode	Linear
Direction	↑

Burst	Default
Burst Period	10ms
Start Phase	0°
Cycles	1Cycle
Trig Out	Off
Delay	521ns
Trigger	**Default**
Source	Internal

5. Beeper

Enable or disable the beeper. Press Utility →System → Beeper to select "On" or "Off" and the default is "On".

6. Screen Saver

Enable or disable screen saver. Press Utility → System → Page 1/2 → ScrnSvr to select "On" or "Off" and the default is "Off". Screen saver will be on if no action is taken within the time that you have selected. Click the touch screen or press any key to resume.

7. System Info

Select the System Info option of the utility menu to view the generator's system information, including startup times, software version, hardware version, model and serial number.

Figure 2-52 System Information Interface

8. Updating Firmware

The software of the generator can be updated directly via U-disk. This process takes about two minutes. Follow the steps below:

1. Insert U- disk with firmware update file to USB host interface on the front panel of the generator.
2. Press the Utility key to enter the 'Utility Menu'.
3. Press 'Page 1/2' option key to enter the second page of 'Utility Menu'.
4. Press the 'Firmware Update' option key.
5. Select the update file and choose Recall to update the system software.
6. After updating is finished, restart the generator.

Note:

⚠ Don't cut off the power during the generator is being updated.

9. Updating Bandwidth

If you need to update the bandwidth of the generator, you are suggested to

contact **SIGLENT** to obtain a license and input it in the bandwidth updating interface. Choose Utility → System → Page1/2 → Bandwidth Update to enter the following interface.

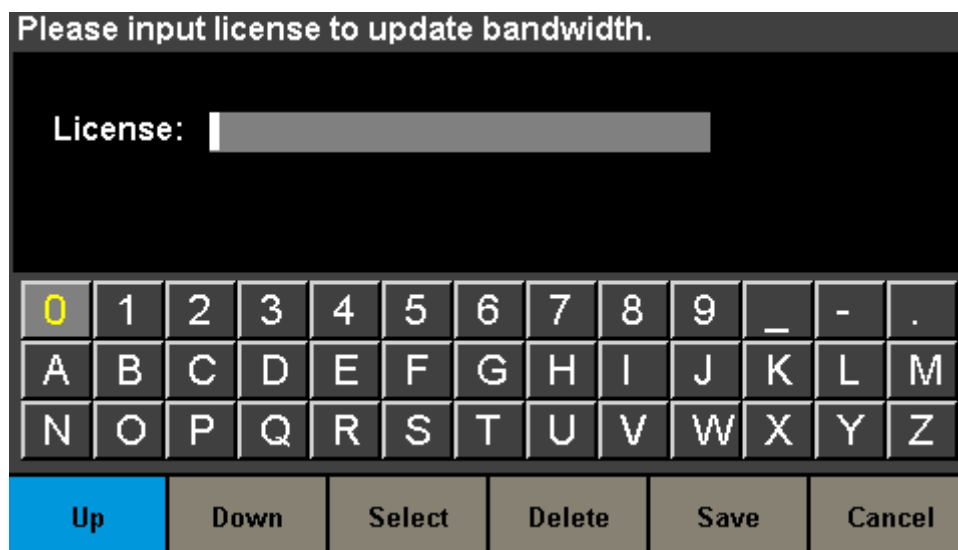Figure 2-53 Bandwidth Updating Interface

Table 2-32 Menu Explanation of File Storage

Function Menu	Settings	Explanation
Up		Cursor upward to select.
Down		Cursor downward to select.
Select		Select the current character from the virtual soft keyboard
Delete		Delete the current character of the license.
Save		Save the license.
Cancel		Return to the Utility menu.

Note:

SDG2000X supports 40MHz, 80MHz and 120 MHz bandwidth for now.

2.13.2　Test/Cal

Choose Utility → Test/Cal, to enter the following interface.
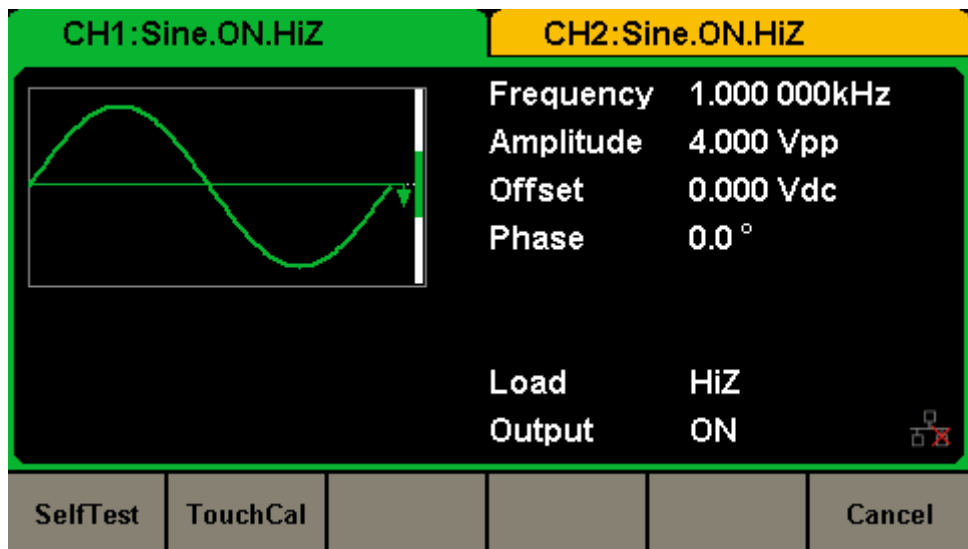
Figure 2-54 Test/Cal function Menu

Table 2-33 Menu Explanations of Test/Cal Setting

Function Menu	Settings	Explain
SelfTest		Perform a system self-test.
TouchCal		Do a touch screen calibration.
Cancel		Return to the Utility menu.

Self Test

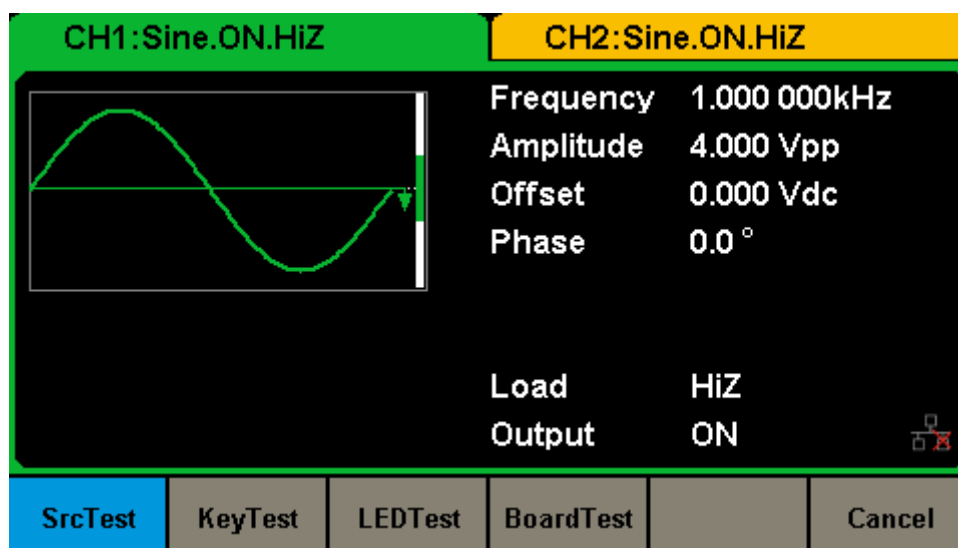Press Utility → Test/Cal → SelfTest, to enter the following menu.

Figure 2-55 Self Test Interface

Table 2-34 Menu Explanations of Self Test

Function Menu	Settings	Explain
ScrTest		Run screen test program.
KeyTest		Run keyboard test program.
LEDTest		Run key indicator lights test program.
BoardTest		Run hardware circuit self-test program.
Cancel		Return to the Test/Cal menu.

1. ScrTest

Select ScrTest to enter the screen test interface. The prompt message 'Please press '7' key to continue, press '8' key to exit.' is displayed. You could press the '7' key for test and observe if there is any serious color deviation, bad pixel or display error.
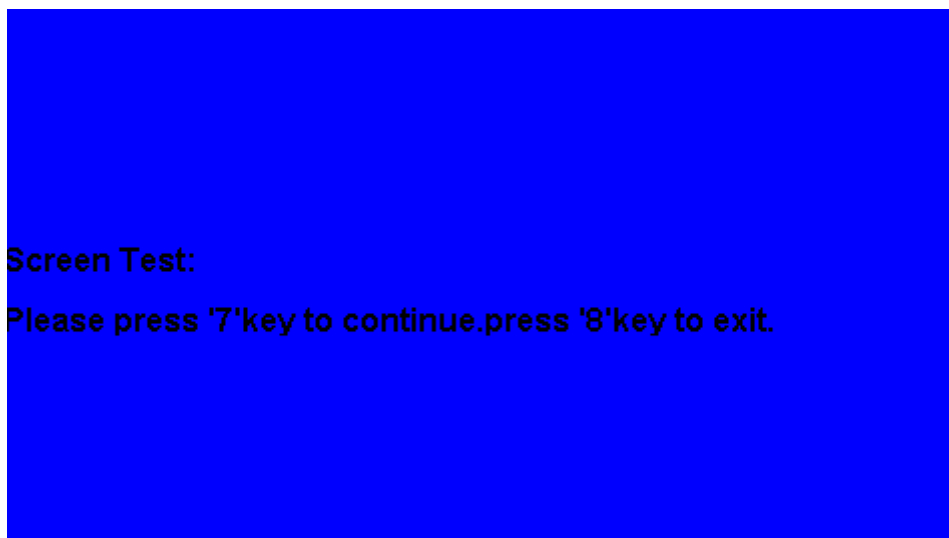
Figure 2-56 Screen Test Interface

2. Key Test

Select KeyTest to enter the keyboard test interface, the on-screen lathy rectangle shapes represent the front panel keys. The round between two arrows represents the knob. Test all keys and knob and you should also verify that all the backlight keys illuminate correctly.
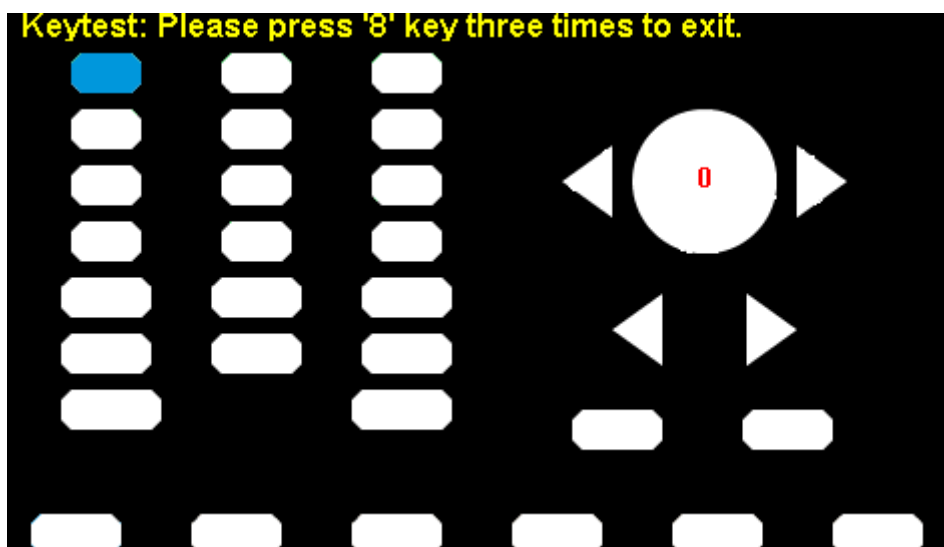

Figure 2-57 Key Test Interface

The corresponding area of tested keys or knob would display in blue color.

The top of the screen displays 'Please press '8' key three times to exit.'

3. LED Test

Select LEDTest to enter the LED test interface, the on-screen lathy rectangle

shapes represent the front panel keys. The prompt message 'Please press '7' Key to continue, press '8' Key to exit.' is displayed. You could press the '7' key continuously for testing, when a key is lighted, the corresponding area on the screen would display in blue color.
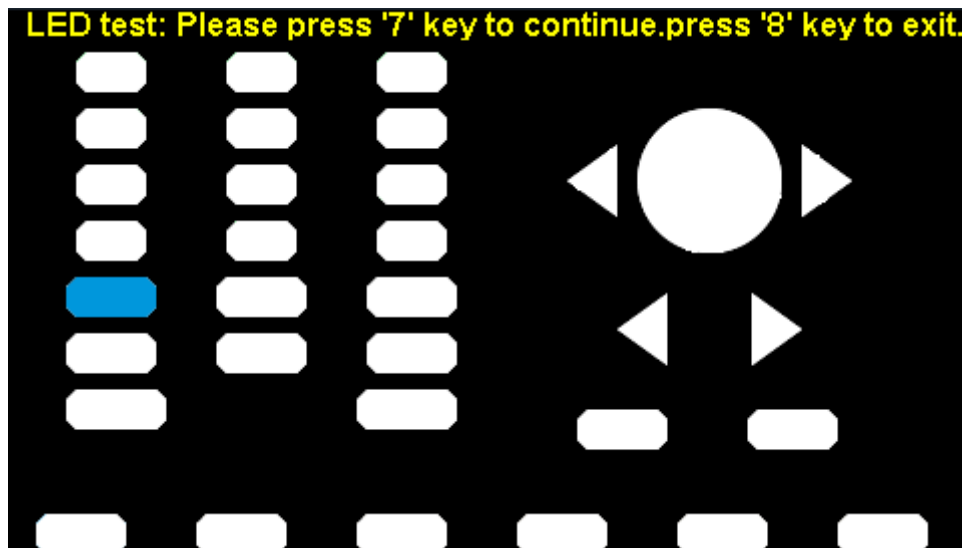

Figure 2-58 LED Test Interface

4. Board Test
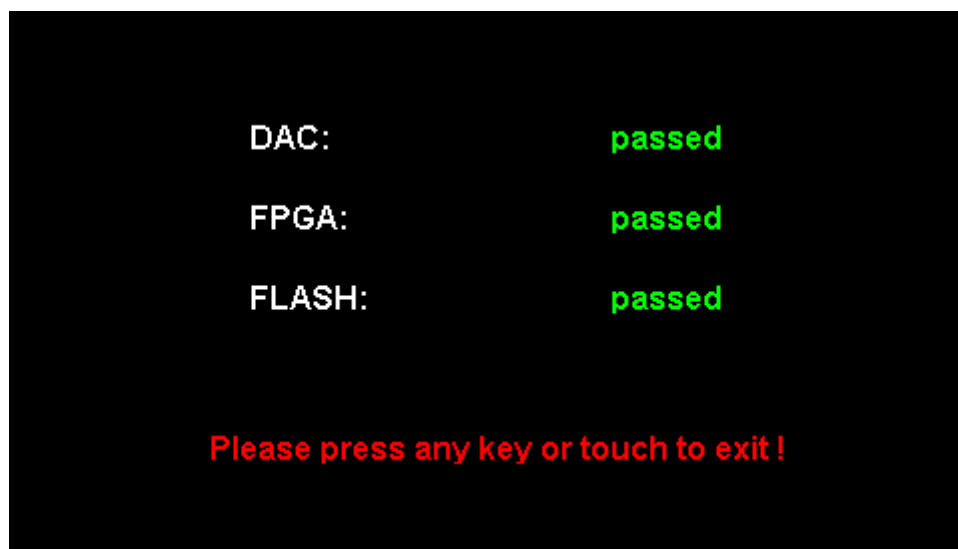
Select BoardTest to enter the following interface.

Figure 2-59 Board Test Interface

Touch Adjust

Use the function regularly to calibrate the touch screen, which makes it more

accurate when the finger or touch pen touches the screen and avoids any misoperation.

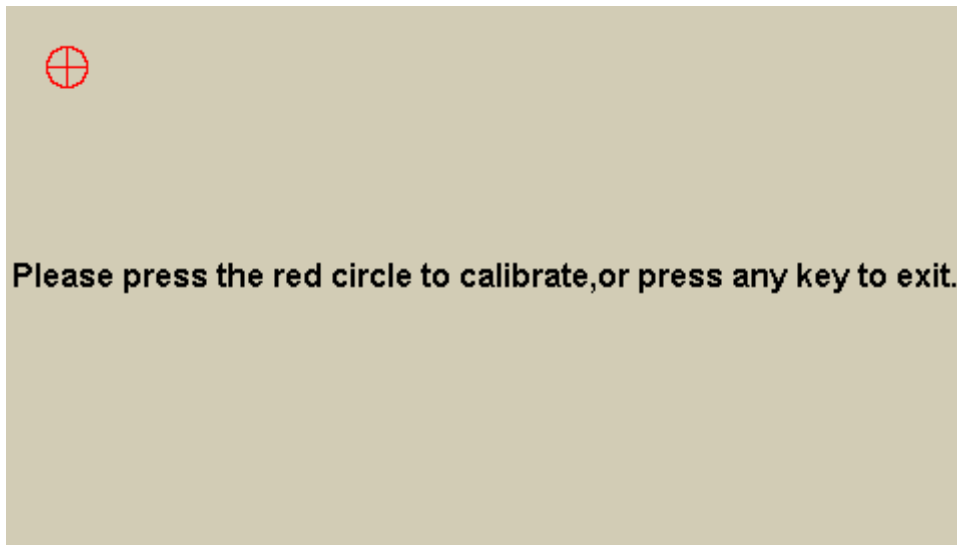Press Utility → Test/Cal → TouchCal, to enter the following interface.

Figure 2-60 Touch Adjust Interface

According to the message, click the red circle on the upper left corner, upper right corner, lower left corner and lower right corner of the screen in sequence. After touch calibration is done, the system will display the following tip. Then press any key or touch the screen to exit the current interface.
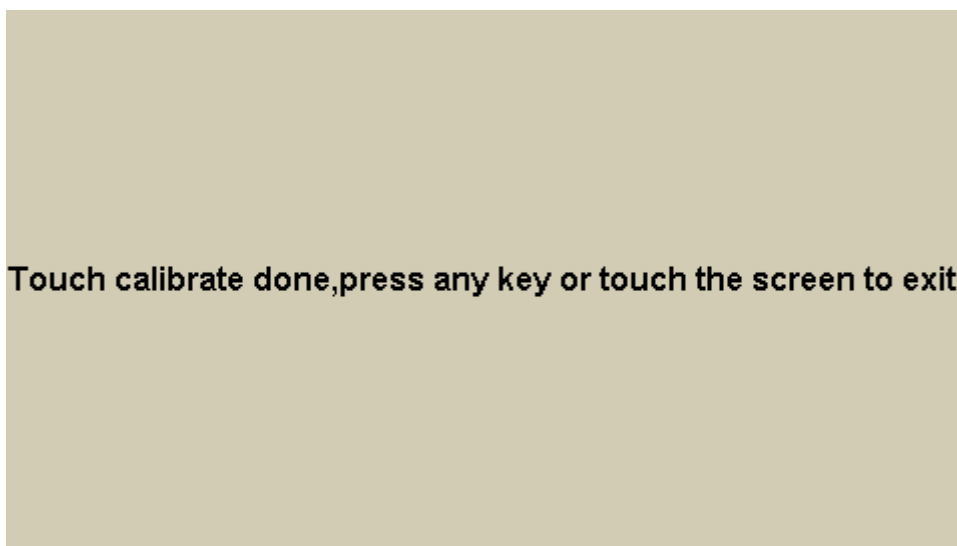

Figure 2-61 Touch Adjust Done

2.13.3   Frequency Counter

SDG2000X provides a frequency counter which could measure frequency from 100mHz to 200MHz. In addition, the dual channels can still output normally when the counter is enabled. Press Utility → Counter, to enter the following interface.
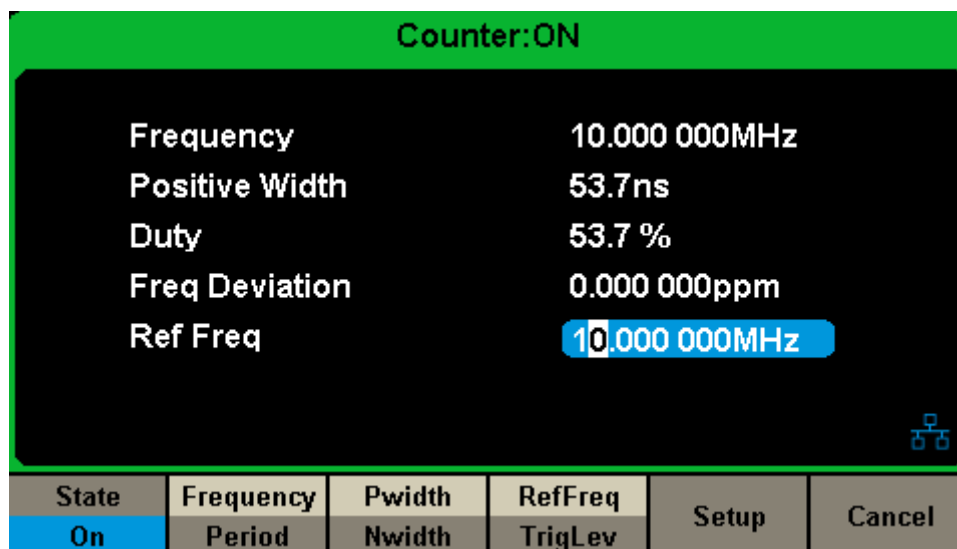

Figure 2-62 Frequency Counter Interface

Table 2-35 Menu Explanations of Frequency Counter

Function Menu	Settings	Explanation
State	Off	Open the counter.
	On	Close the counter.
Frequency		Measured frequency.
Period		Measured period.
PWidth		Measured positive width.
NWidth		Measured negative width.
RefFreq		Set the reference frequency. System will calculate the deviation between the measured frequency and the reference frequency automatically.
TrigLev		Set the trigger level voltage.
Duty		Measured duty.
Setup		Set the counter configuration.
Cancel		Exit the frequency counter interface.
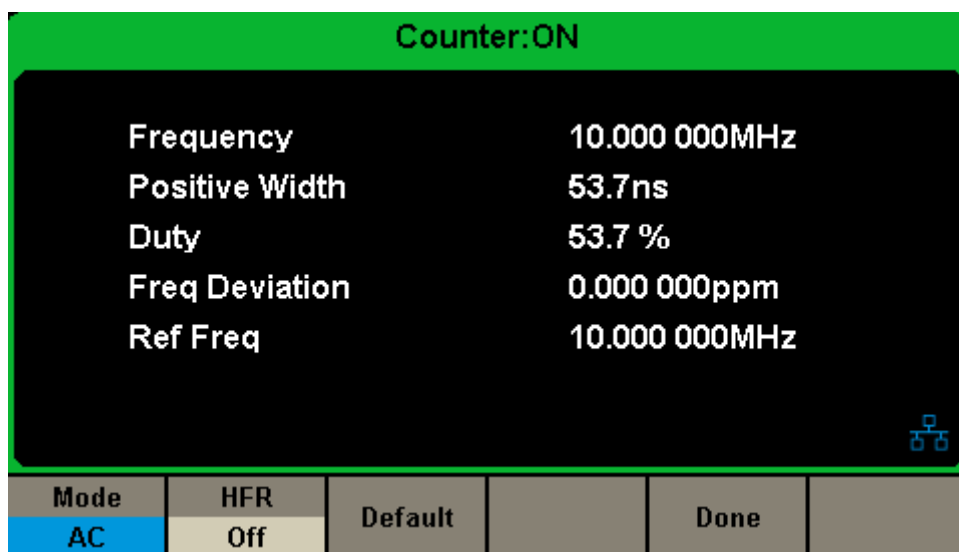
Figure 2-63 Counter Setup Interface

Table 2-36 Menu Explanations of Setup

Function Menu	Settings	Explanation
Mode	DC	Set the coupling mode to DC
	AC	Set the coupling mode to AC
HFR	On	Open the high frequency rejection filter.
	Off	Close the high frequency rejection filter.
Default		Set the frequency counter settings to default.
Done		Save the current settings and return to the previous menu.

1. To Select the Parameters to be measured

The frequency counter of SDG2000X could measure parameters including frequency, period, duty, positive pulse width and negative pulse width.

2. Reference Frequency

The generator is able to calculate the frequency deviation automatically according to the current reference frequency.

3. Trigger Level

Set the trigger level of the measurement system. The system triggers and gets the measurement readings when the input signal reaches the specified trigger

level. The default is 0V and the available range is from -3V to 1.5V. Choose TrigLev and use the numeric keyboard to input the desired value and select the unit (V or mV) from the pop-up menu. Or use the knob and arrow keys to change the parameter value.

4. Coupling Mode

Set the coupling model of the input signal to "AC" or "DC". The default is "AC".

5. HFR

High Frequency Rejection can be used to filter out the high-frequency components and improve the measurement accuracy in low-frequency signal measurement. Press HFR to enable or disable this function. The default is "Off".

● Enable High Frequency Rejection when low-frequency signal with lower than 250kHz frequency is measured to filter out the high-frequency noise interference.

● Disable High Frequency Rejection when high-frequency signal with greater than 250kHz frequency is measured and the maximum input frequency can be 200MHz.

2.13.4   Output

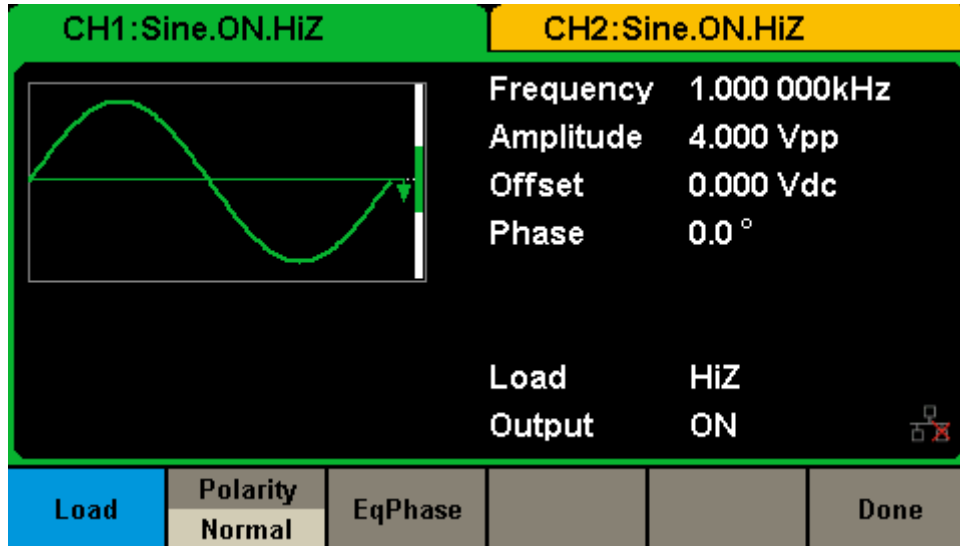Press Utility → Output to enter the following interface.

Figure 2-64 Output Setup Interface

To Set the Output Load

For the [CH1] and [CH2] connector on the front panel, the generator has built-in 50Ω serial impendence. If the actual load does not match the set one, the displayed voltage will not equal the real voltage. This function is used to match the displayed voltage with the expected one.

Steps for setting the load:

Press Utility → Output Setup → Load, to set the output load. The load parameter shown on the down bottom is the default setting when the power is on or the pre-set load value.
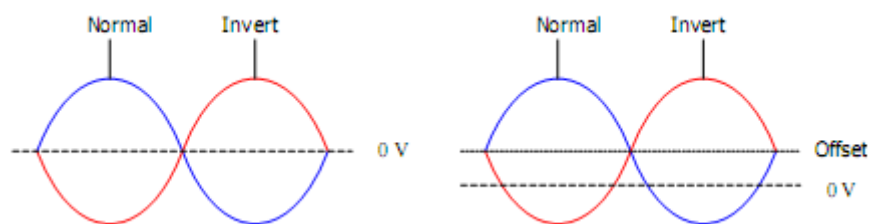
High Impedance: displayed as HiZ;

Load: the default is 50Ω and the range is 50Ω to 100kΩ.

To Set the Output Polarity

Press Utility → Output Setup → Polarity to set the output signal as normal or inverted. Waveforms inversion is relative to the offset voltage, as shown in the following figure.

Note: The Sync signal related to the waveform is not inverted when the waveform is inverted.

To Set EqPhase

Press Utility → Output Setup → EqPhase to align the phases of CH1 and CH2. Choosing the menu will re-configure two channels and enable the generator to output with specified frequency and start phase. For two signals whose frequencies are the same or in multiple, this operation will align their phases.

2.13.5   CH Copy/Coupling

Channel Copy

SDG2000X supports states and waveform copy function between its two channels, namely copies all parameters and states (including the channel output state) and arbitrary waveform data of one channel to the other one.

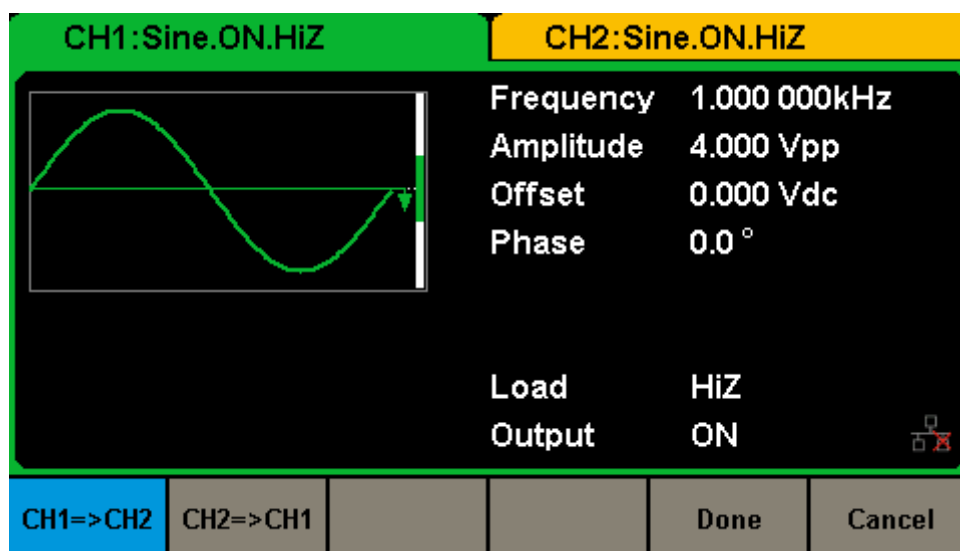Press Utility → CH Copy Coupling → Channel Copy, to enter the following interface.

Figure 2-65 Channel Copy Interface

Table 2-37 Menu Explanations of Channel Copy

Function Menu	Settings	Explanation
CH1=>CH2		Copy all parameters and states of CH1 to CH2.
CH2=>CH1		Copy all parameters and states of CH2 to CH1.
Done		Perform the current selection and return to the Utility menu.
Cancel		Give up the current selection and return to the Utility menu.

Note:

Channel coupling or track function and channel copy function are mutually

exclusive. When channel coupling or track function is enabled, the menu Channel Copy is hidden.

Channel Coupling

SDG2000X supports frequency, amplitude and phase coupling. Users can set the frequency deviation/ratio, amplitude deviation/ratio or phase deviation /ratio of the two channels. When coupling is enabled, CH1 and CH2 are as reference as each other. When the frequency, amplitude or phase of one channel (as the reference) is changed, the corresponding parameter of the other channel will be changed automatically and always keeps the specified frequency deviation/ratio, amplitude deviation/ratio or phase deviation /ratio relative to the base channel.

Press Utility → CH Copy Coupling → Channel Coupling, to enter the following interface.

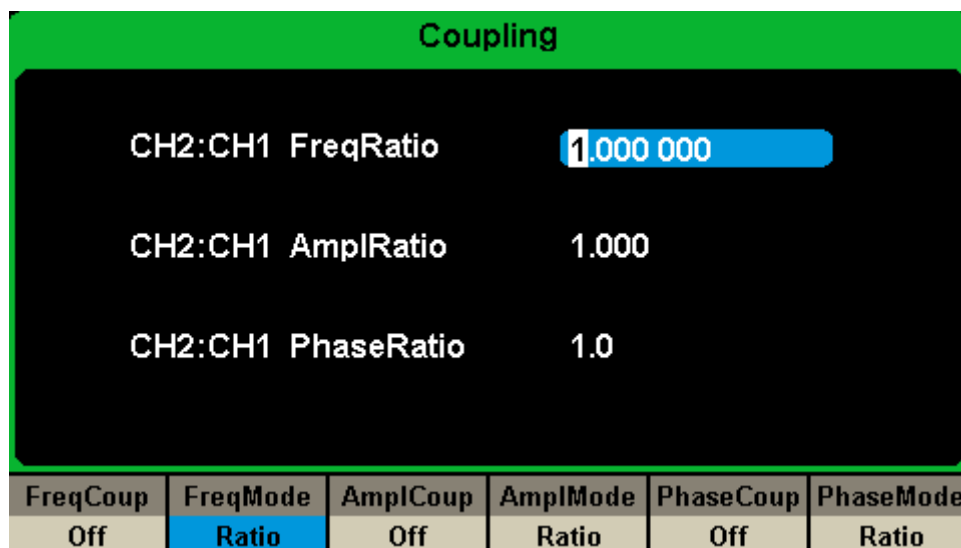Figure 2-66 Channel Coupling Interface

Frequency Coupling

1. To Enable Frequency Coupling Function

Press FreqCoup to turn frequency coupling "On" or "Off". The default is "Off".

2. To Select Frequency Coupling Mode

Press FreqMode to choose "Deviation" or "Ratio", and then use the numeric keyboard or knob and arrow keys to input the desired value.

● Deviation: the frequency deviation between CH1 and CH2. The parameter relations are shown below: $Freq_{CH2}$-$Freq_{CH1}$=FreqDev.

● Ratio: the frequency ratio of CH1 and CH2. The parameter relations are shown below: $Freq_{CH2}$:$Freq_{CH1}$=FreqRatio.

Amplitude Coupling

1. To Enable Amplitude Coupling Function

Press AmplCoup to turn amplitude coupling "On" or "Off". The default is "Off".

2. To Select Amplitude Coupling Mode

Press AmplMode to choose "Deviation" or "Ratio", and then use the numeric keyboard or knob and arrow keys to input the desired value.

● Deviation: the amplitude deviation between CH1 and CH2. The parameter relations are shown below: $Ampl_{CH2}$-$Ampl_{CH1}$=AmplDev.

● Ratio: the amplitude ratio of CH1 and CH2. The parameter relations are shown below: $Ampl_{CH2}$:$Ampl_{CH1}$=AmplRatio.

Phase Coupling

1. To Enable Phase Coupling Function

Press PhaseCoup to turn phase coupling "On" or "Off". The default is "Off".

2. To Select Phase Coupling Mode

Press PhaseMode to choose "Deviation" or "Ratio", and then use the numeric keyboard or knob and arrow keys to input the desired value.

● Deviation: the phase deviation between CH1 and CH2. The parameter relations are shown below: $Phase_{CH2}$-$Phase_{CH1}$=PhaseDev.

● Ratio: the phase ratio of CH1 and CH2. The parameter relations are shown below: $Phase_{CH2}$:$Phase_{CH1}$=PhaseRatio.

Key Points:

1. Channel coupling is only available when both the waveforms of the two channels are basic waveforms including Sine, Square, Ramp and Arbitrary.

2. When the Phase Coupling function is enabled, if the phase of one channel is changed, the phase of the other channel will be changed accordingly. At

this point, aligning phase between the two channels can be realized without executing the Eqphase operation.

3. Channel coupling and channel function are mutually exclusive. When channel coupling is enabled, the menu Channel Copy is hidden.

Channel Track

When the track function is enabled, if the parameters or states of CH1 are changed, the corresponding parameters or states of CH2 will be adjusted to the same values or states automatically. At this point, the dual channels can output the same signal.

Choose Utility → CH Copy Coupling → Track to enable or disable the track function. When the track function is enabled, channel copy and coupling functions are disabled; the user interface is switched to CH1 and can't be switched to CH2, as shown in the following figure.
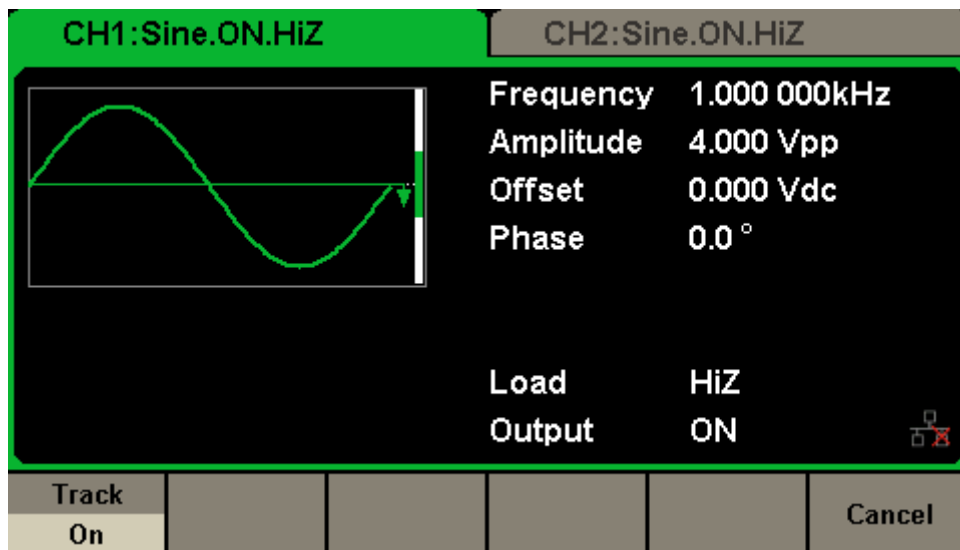

Figure 2-67 Track Interface

2.13.6   Remote Interface

SDG2000X can be controlled remotely via USB, LAN and GPIB (option) interfaces. Users can set the corresponding interface according to their needs.

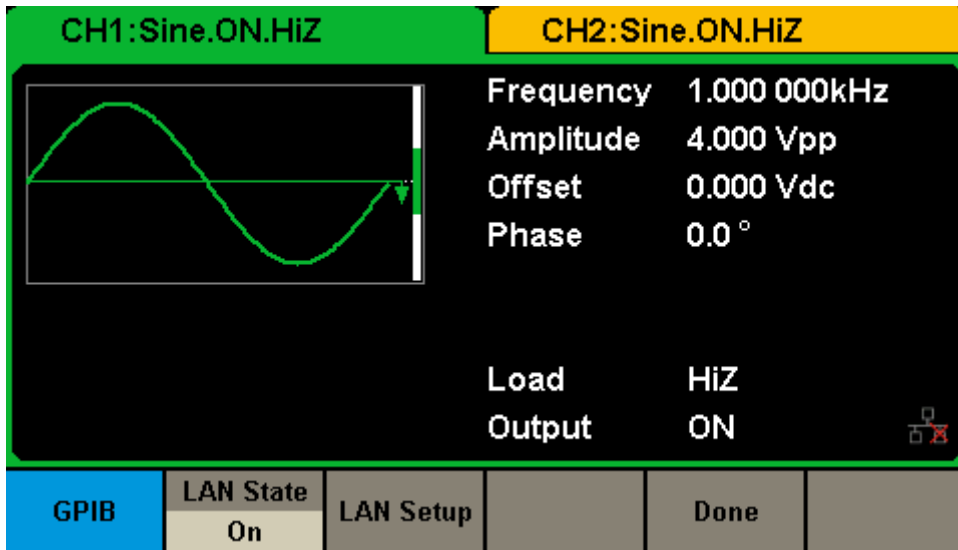Press Utility → Page 1/2 → Interface to open the following menu. You can set LAN parameters or GPIB address.

Figure 2-68 Interface Settings

Table 2-38 Menu Explanations of Interface

Function Menu	Settings	Explanation
GPIB		Set the GPIB address.
LAN State	On	Turn on LAN.
	Off	Turn off LAN.
LAN Setup		Set the IP address, subnet mask and gateway.
Done		Save the current settings and return to the Utility menu.

SDG2000X can be controlled remotely via the following two ways:

1. User-defined programming

Users can program and control the instrument by using the SCPI commands

(Standard Commands for Programmable Instruments). For more information about the commands and programming, please refer to "Remote Control Manual".

2. PC software

Users can use the PC software Measurement & Automation Explorer of NI (National Instruments Corporation) to send commands to control the instrument remotely.

Remote Control via USB

SDG2000X can communicate with PC through USBTMC protocol. You are suggested to do as the following steps.

1. Connect the device.

Connect the USB Device interface at the rear panel of SDG2000X with your PC via a USB cable.

2. Install the USB driver.

NI Visa is recommended.

3. Communicate with PC remotely

Open Measurement & Automation Explorer of NI and choose the corresponding resource name. Then click "Open VISA Test Panel" to turn on the remote command control panel through which you can send commands and read data.

Remote Control via GPIB

Each device connected to GPIB interface must have a unique address. The default value is 18 and it ranges from 1 to 30. The selected address is stored in non-volatile memory.

1. Connect the device.

Connect the generator to your computer using a USB to GPIB adapter (option).

Note:

Please make sure that a GPIB card has been installed to your PC already.

Connect the USB terminal of the USB to GPIB adapter to the USB Host interface at the front panel of the generator and the GPIB terminal to the GPIB card terminal of the PC.

2. Install the driver of GPIB card.

Please install the driver of the GPIB card which has been connected to your PC correctly.

3. Set the GPIB address.

Choose Utility → Page 1/2 → Interface → GPIB to enter the following interface. Users can use the knob, arrow keys or numeric keyboard to change the value and press Done to save the current setting.
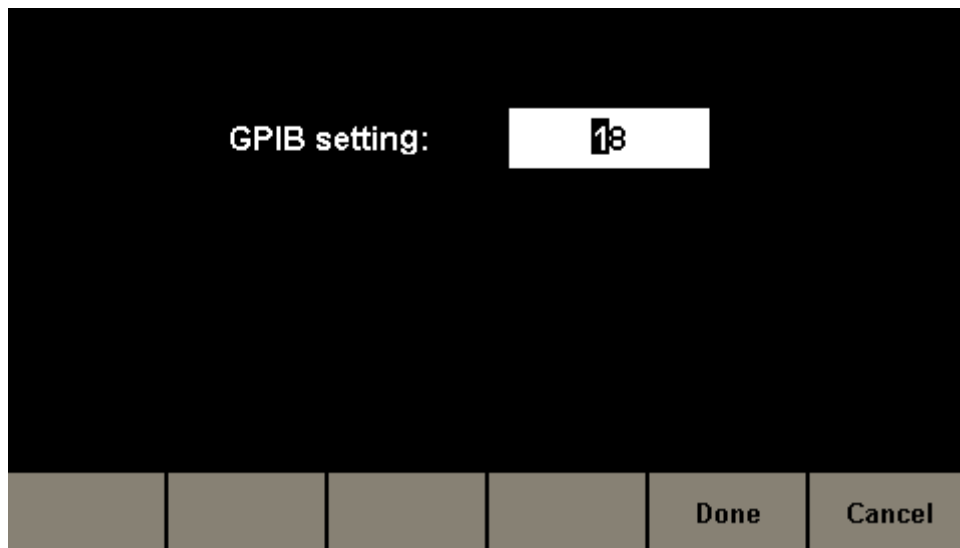

Figure 2-69 GPIB Setting Interface

4. Communicate with PC remotely

Open Measurement & Automation Explorer of NI. After adding the GPIB

device successfully, choose the corresponding resource name. Then click "Open VISA Test Panel" to turn on the remote command control panel through which you can send commands and read data.
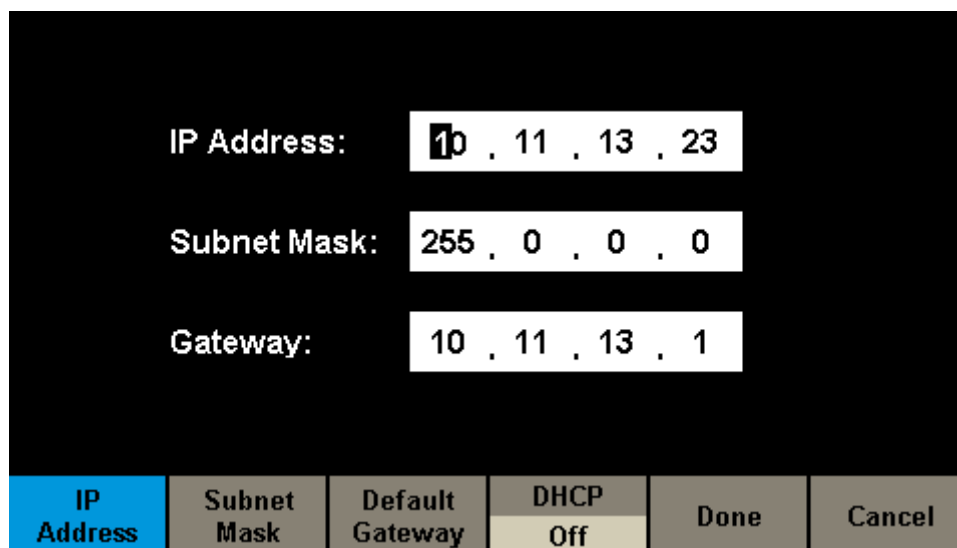
Remote Control via LAN

SDG2000X can communicate with PC through LAN interface. Users can view and modify the LAN parameters.

1. Connect the device.
Connect the generator to your PC or the LAN of your PC using a network cable.

2. Configure network parameters.
Choose Utility → Page 1/2 → Interface → LAN State to turn on LAN. Then choose LAN Setup to enter the following interface.

Figure 2-70 LAN Settings Interface

1) To Set IP Address
The format of IP address is nnn.nnn.nnn.nnn. The first nnn ranges from 1 to 223 and the others range from 0 to 255. You are recommended to acquire an available IP address from your network administrator.

Press IP Address and use the arrow keys and numeric keyboard or knob to enter your desired IP address. The setting is stored in non-volatile memory and will be loaded automatically when the generator is powered on at the next time.

2) To Set Subnet Mask

The format of subnet mask is nnn.nnn.nnn.nnn and each nnn ranges from 0 to 255. You are recommended to acquire an available subnet mask from your network administrator.

Press Subnet Mask and use the arrow keys and numeric keyboard or knob to enter your desired subnet mask. The setting is stored in non-volatile memory and will be loaded automatically when the generator is powered on at the next time.

3) To Set Gateway

The format of gateway is nnn.nnn.nnn.nnn and each nnn ranges from 0 to 255. You are recommended to acquire an available gateway from your network administrator.

Press Gateway and use the arrow keys and numeric keyboard or knob to enter your desired gateway. The setting is stored in non-volatile memory and will be loaded automatically when the generator is powered on at the next time.

Note:
● If the generator is connected to the PC directly, set the IP addresses, subnet masks and gateways for both of the PC and generator. The subnet masks and gateways of PC and generator must be the same and the IP addresses of them must be within the same network segment.
● If the generator is connected to the LAN of your PC, please contact with your network administrator to get an available IP address. For details, refer to the TCP/IP protocol.

4) DHCP Configuration Mode

In DHCP mode, the DHCP server in the current network assigns LAN parameters, e.g. IP address, for the generator. Press DHCP to select "On" or "Off" to turn DHCP mode on or off. The default is "Off".

3. Communicate with PC remotely

Open Measurement & Automation Explorer of NI. After adding the LAN device (VISA TCP/IP Resource…) successfully, choose the corresponding resource name. Then click "Open VISA Test Panel" to turn on the remote command control panel through which you can send commands and read data.

2.13.7   Sync Output

The generator provides Sync output through the [Aux In/Out] connector at the rear panel. When the synchronization is on, the port can output a CMOS signal with the same frequency as basic waveforms (except Noise and DC), arbitrary waveforms, and modulated waveforms (except external modulation).
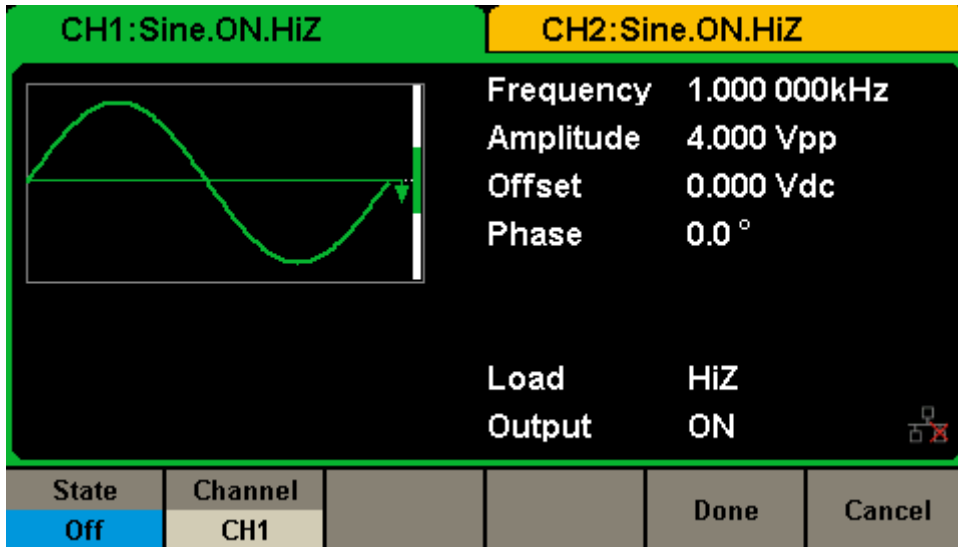

Figure 2-71 Sync Output Interface

Table 2-39 Menu Explanations of Sync Output

Function Menu	Settings	Explanation
State	Off	Close the sync output
	On	Open the sync output
Channel	CH1	Set the sync signal of CH1.
	CH2	Set the sync signal of CH2.
Done		Save the current settings and return to the Utility menu.
Cancel		Give up the current settings and return to the Utility menu.

Sync Signals of Different Waveforms：

Basic Waveform and Arbitrary Waveform

1) When the frequency of the waveform is less than or equal to 1MHz, the sync signal is a Pulse with 500ns pulse width and the same frequency as

the waveform.

2) When the frequency of the waveform is greater than 1MHz, there is no sync signal output.

3) Noise and DC: there is no sync signal output.

Modulated Waveform

1) When internal modulation is selected, the sync signal is a Pulse with 500ns pulse width.

   For AM, FM, PM and PWM, the frequency of the sync signal is the modulating frequency.

   For ASK and FSK, the frequency of the sync signal is the key frequency.

2) When external modulation is selected, there is no sync signal output, for the [Aux In/Out] connector on the rear panel is used to input external modulating signal.

Sweep and Burst Waveform

When Sweep or Burst function is turned on, there is no sync signal output and the Sync menu is hidden.

2.13.8   Clock Source

SDG2000X provides an internal 10MHz clock source. It also can accept external clock source form the [10 MHz In/Out] connector at the rear panel. It can also output clock source from the [10 MHz In/Out] connector for other devices.

Press Utility → Page 1/2 → CLKSource to select "Internal" or "External". If "External" is selected, the instrument will detect whether a valid external clock signal is input from the [10MHz In/Out] connector at the rear panel. If not, the prompt message "No external clock source!" would be displayed and the clock source would be switched to "Internal".

Sync methods for two or more instruments:

● **Synchronization between two instruments**
Connect the [10MHz In/Out] connector of generator A (using internal clock) to the [10MHz In/Out] connector of generator B (using external clock) and set the output frequencies of A and B as a same value to realize synchronization.

● **Synchronization among multiple instruments**
Divide the 10MHz clock source of a generator (using internal clock) into multiple channels, and then connect them to the [10MHz In/Out] connectors of other generators (using External clock), and finally set the output frequencies of all the generators as a same value to realize synchronization.

2.13.9   To Use the Built-in Help System

SDG2000X provides a powerful built-in help system, by which users can view the help information at any time when operating the instrument. Press Utility → Page 1/2 → Help to enter the following interface.

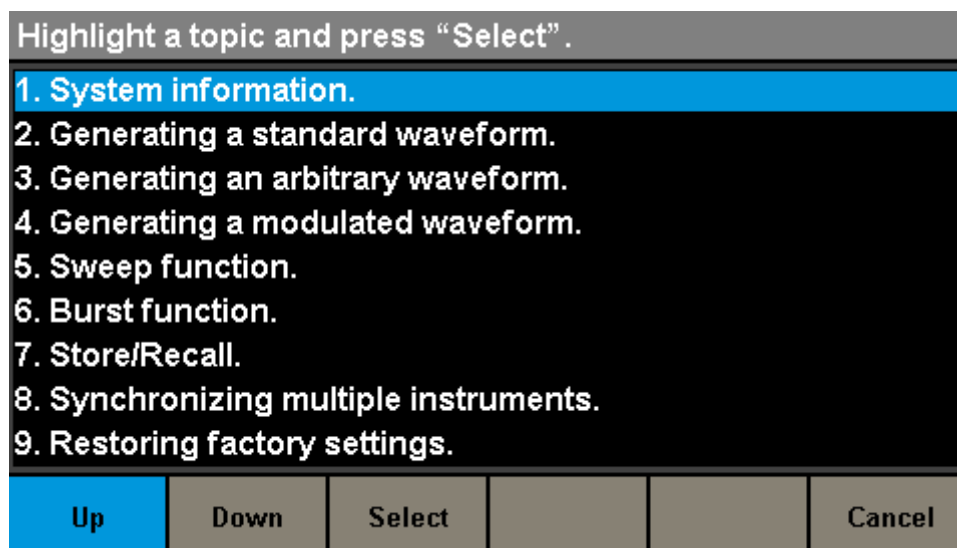Figure 2-72 Help Menu

Table 2-40 Help Menu Explanations

Function Menu	Settings	Explanation
UP		Cursor upward to select.
Down		Cursor downward to select.
Select		Read the currently selected help information.
Cancel		Exit the built-in help system.

There are 10 options of the help list. You can use the knob, operation menus or touch the corresponding location on the screen to select the help information that you want to read.

2.13.10 Overvoltage Protection

Choose Utility → Page 1/2 → OverVoltage Protection to turn on or off the function, as shown in the following figure.
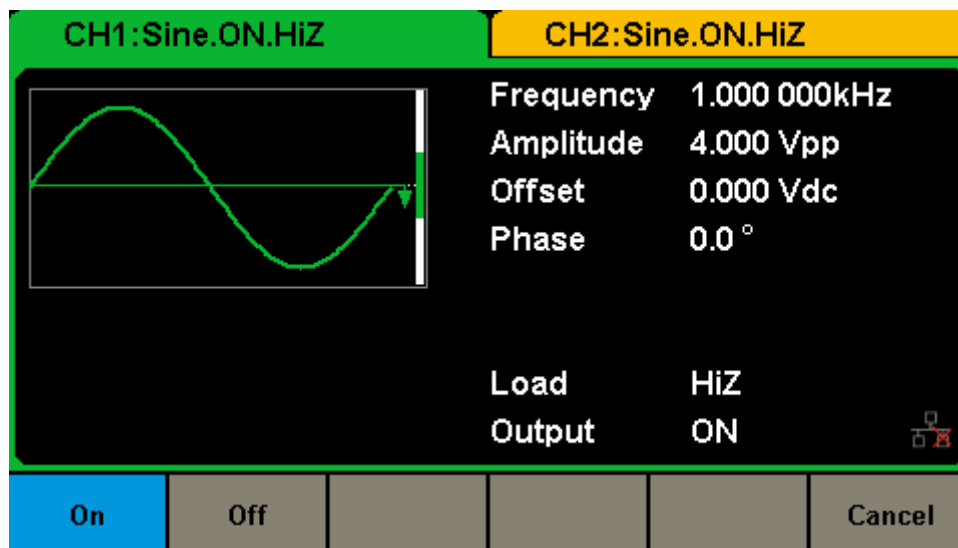

Figure 2-73 Overvoltage Protection Interface

If the state is set to ON, overvoltage protection of CH1 and CH2 will take effect once any of the following conditions is met. When overvoltage protection occurs, a message will be displayed and the output is disabled.

● The absolute value of input voltage is higher than 11V±0.5V when the amplitude of the generator is higher than or equal to 3.2Vpp or the DC offset is higher than or equal to |2VDC|.

● The absolute value of input voltage is higher than 4V±0.5V when the amplitude of the generator is lower than 3.2Vpp or the DC offset is lower than |2VDC|.

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3 Examples

To help the user master how to use SDG2000X more efficiently, we provide 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 Waveform
- Example 2: Generate a Square Waveform
- Example 3: Generate a Ramp Waveform
- Example 4: Generate a Pulse Waveform
- Example 5: Generate a Noise
- Example 6: Generate a DC Waveform
- Example 7: Generate a Linear Sweep Waveform
- Example 8: Generate a Burst Waveform
- Example 9: Generate an AM Modulation Waveform
- Example 10: Generate a FM Modulation Waveform
- Example 11: Generate a PM Modulation   Waveform
- Example 12: Generate a FSK Modulation   Waveform
- Example 13: Generate an ASK Modulation   Waveform
- Example 14: Generate an PSK Modulation   Waveform
- Example 15: Generate a PWM Modulation   Waveform
- Example 16: Generate a DSB-AM Modulation   Waveform

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3.1   Example 1: Generate a Sine Waveform

Generate a sine waveform with 1MHz frequency, 5Vpp amplitude and 1Vdc offset.

➢ **Steps:**
● Set the frequency.
1. Press Waveforms → Sine →Frequency/Period and choose Frequency which will display in blue color.
2. Input '1' from the keyboard and choose the unit 'MHz'. The frequency is set to 1MHz.

● Set the Amplitude.
1. Press Amplitude/HighLevel to choose Amplitude which will display in blue color.
2. Input '5' from the keyboard and choose the unit 'Vpp'. The amplitude is set to 5Vpp.

● Set the Offset.
1. Press Offset/LowLevel to choose Offset which will display in blue color.
2. Input '1' from the keyboard and choose the unit 'Vdc'. The offset is set to 1Vdc.

When the frequency, amplitude and offset are set, the waveform generated is shown in Figure 3-1.
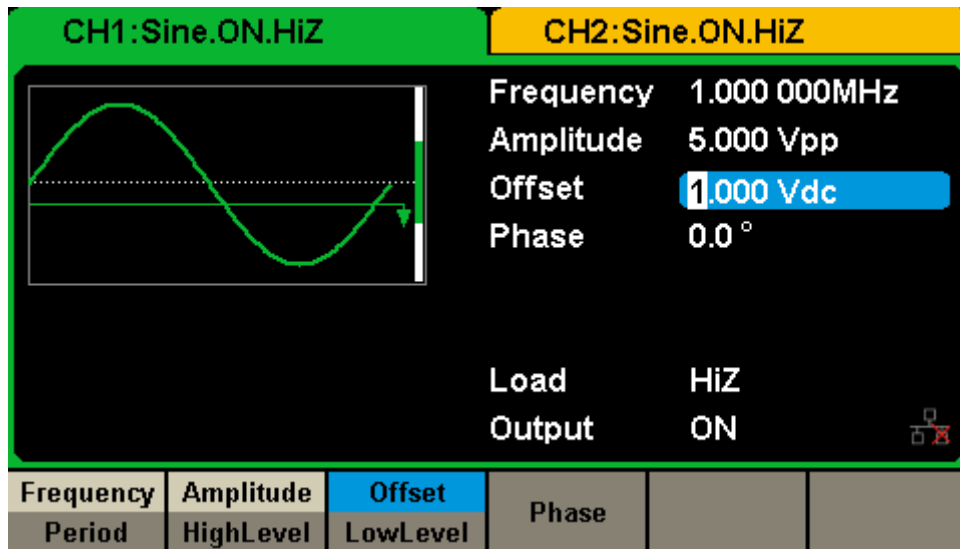
Figure 3-1 Generate a Sine Waveform

3.2　　Example 2: Generate a Square Waveform

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

➢ **Steps:**
● Set the frequency.
1. Press Waveforms → Square → Frequency/Period and choose Frequency which will display in blue color.
2. Input '5' from the keyboard and choose the unit 'kHz'. The frequency is set to 5kHz.

● Set the Amplitude.
1. Press Amplitude/HighLevel to choose Amplitude which will display in blue color.
2. Input '2' from the keyboard and choose the unit 'Vpp'. The amplitude is set to 2Vpp.

● Set the Offset.
1. Press Offset/LowLevel to choose Offset which will display in blue color.
2. Input '0' from the keyboard and choose the unit 'Vdc'. The offset is set to 0Vdc.

● Set the DutyCycle.
1. Press DutyCycle to choose DutyCycle which will display in blue color.
2. Input '30' from the keyboard and choose the unit '%'. The duty is set to 30%.

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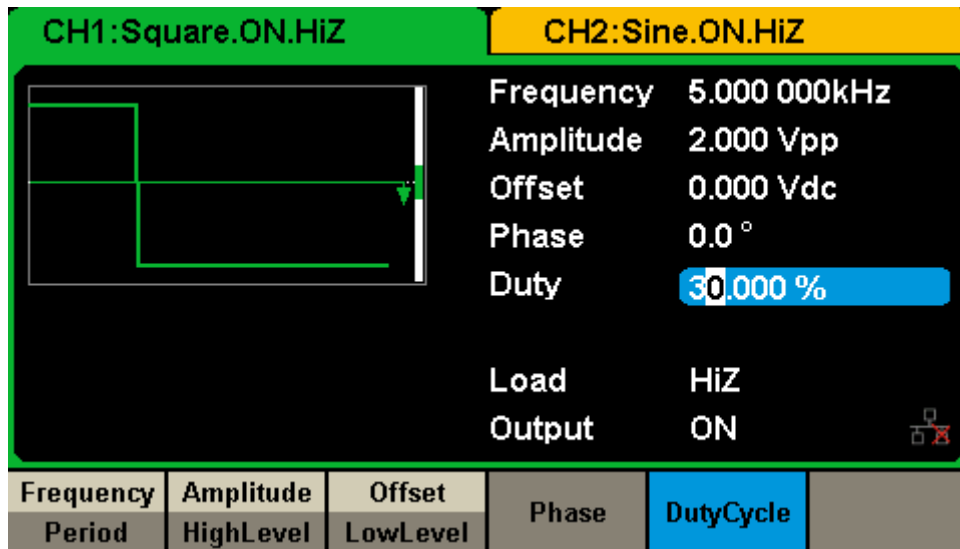
Figure 3-2 Generate a Square Waveform

3.3 Example 3: Generate a Ramp Waveform

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

➢ **Steps:**
● Set the Period.
1. Press Waveforms → Ramp → Frequency/Period and choose Period which will display in blue color.
2. Input '10' from the keyboard and choose the unit 'µs'. The period is set to 10µs.

● Set the Amplitude.
1. Press Amplitude/HighLevel to choose Amplitude which will display in blue color.
2. Input '100' from the keyboard and choose the unit 'mVpp'. The amplitude is set to 100mVpp.

● Set the Offset.
1. Press Offset/LowLevel to choose Offset which will display in blue color.
2. Input '20' from the keyboard and choose the unit 'mVdc'. The offset is set to 20mVdc.

● Set the Phase.
1. Press Phase to choose Phase which will display in blue color.
2. Input '45' from the keyboard and choose the unit '°'. The phase is set to 45°.

● Set the Symmetry.
1. Press Symmetry to choose Symmetry which will display in blue color.
2. Input '30' from the keyboard and choose the unit '30%'. The symmetry is set to 30%.

When the period, amplitude, offset, phase and symmetry are set, the waveform generated is shown in Figure 3-3.
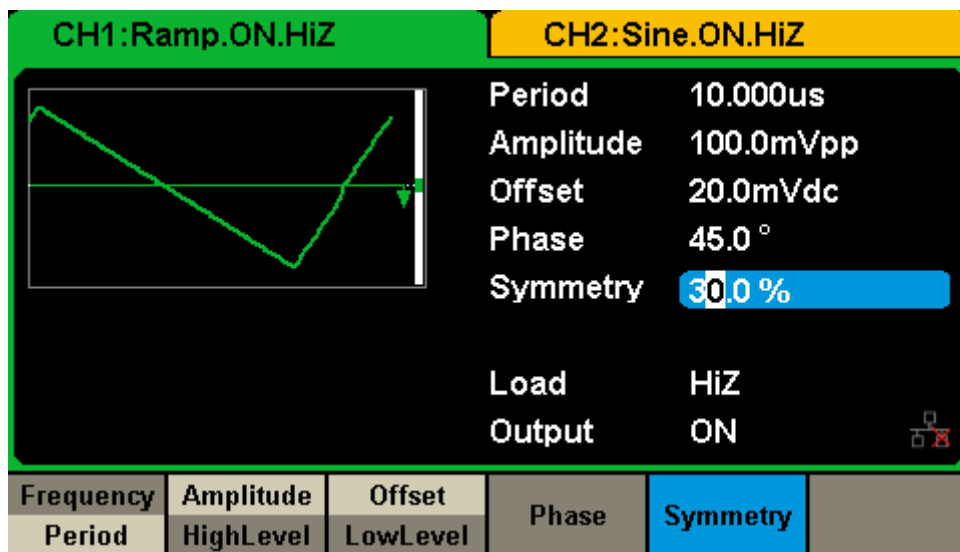

Figure 3-3 Generate a Ramp Waveform

3.4 Example 4: Generate a Pulse Waveform

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

➢ **Steps:**
● Set the Frequency.
1. Press Waveforms → Pulse → Frequency/Period and choose Frequency, which will display in blue color.
2. Input '5' from the keyboard and choose the unit 'kHz'. The frequency is set to 5 kHz.

● Set the HighLevel.
1. Press Amplitude/HighLevel and choose the HighLevel which will display in blue color.
2. Input '5' from the keyboard and choose the unit 'V'. The high level is set to 5V.

● Set the LowLevel.
1. Press Offset/LowLevel and choose the LowLevel which will display in blue color.
2. Input '-1' from the keyboard and choose the unit 'V'. The low level is set to -1V.

● Set the PulWidth.
1. Press PulWidth/Duty and choose PulWidth which will display in blue color.
2. Input '40' from the keyboard and choose the unit 'µs'. The pulse width is set to 40µs.

● Set the Delay.
1. Press Delay to choose Delay which will display in blue color.
2. Input '20' from the keyboard and choose the unit 'ns'. The delay is set to

20ns.

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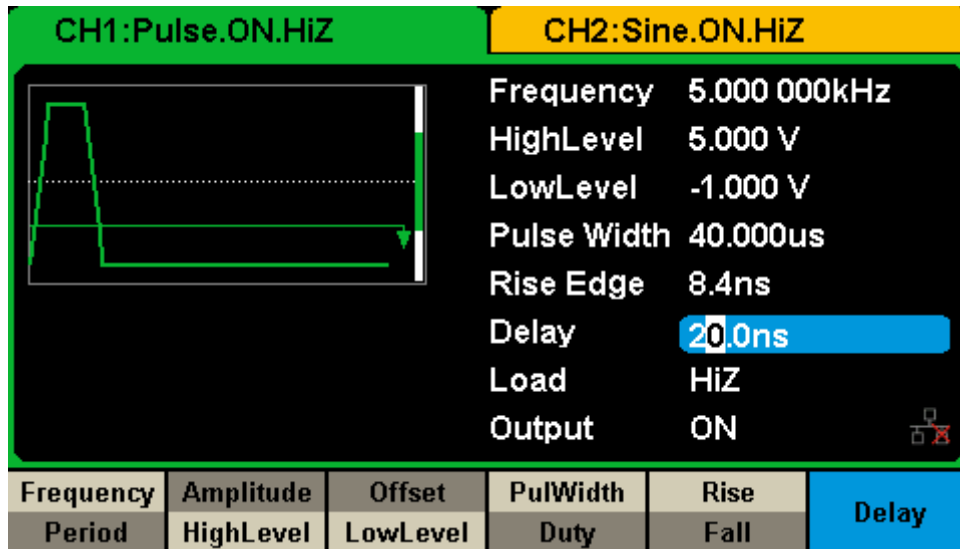

Figure 3-4 Generate a Pulse Waveform

3.5   Example 5: Generate a Noise

Generate a noise with 0.5V stdev and 1 V mean.

➢ **Steps:**

● Set the Stdev.

1. Press Waveforms → Noise → Stdev to choose Stdev which will display in blue color.

2. Input '0.5' from the keyboard and choose the unit 'V'. The stdev is set to 0.5 V.

● Set the Mean.

1. Press Mean to choose Mean which will display in blue color.

2. Input '1' from the keyboard and choose the unit '1'. The mean is set to 1V.

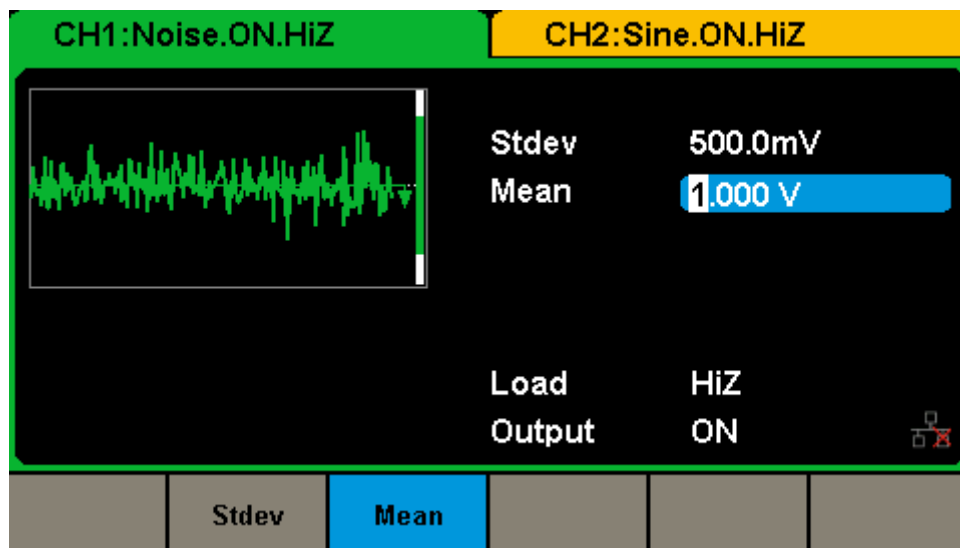When the stdev and mean are set, the noise generated is shown in Figure 3-5.

Figure 3-5 Generate a Noise

3.6   Example 6: Generate a DC Waveform

Generate a DC waveform with 3Vdc offset,

➢ **Steps:**
● Choose the DC waveform.
1. Press Waveforms →Page 1/2→ DC, to choose the DC waveform.

● Set the Offset.
1. Press Offset and choose Offset which will display in blue color.
2. Input '3' from the keyboard and choose the unit 'Vdc'. The DC offset is set
    to 3Vdc.

When the DC offset is set, the waveform generated is shown in Figure 3-6.
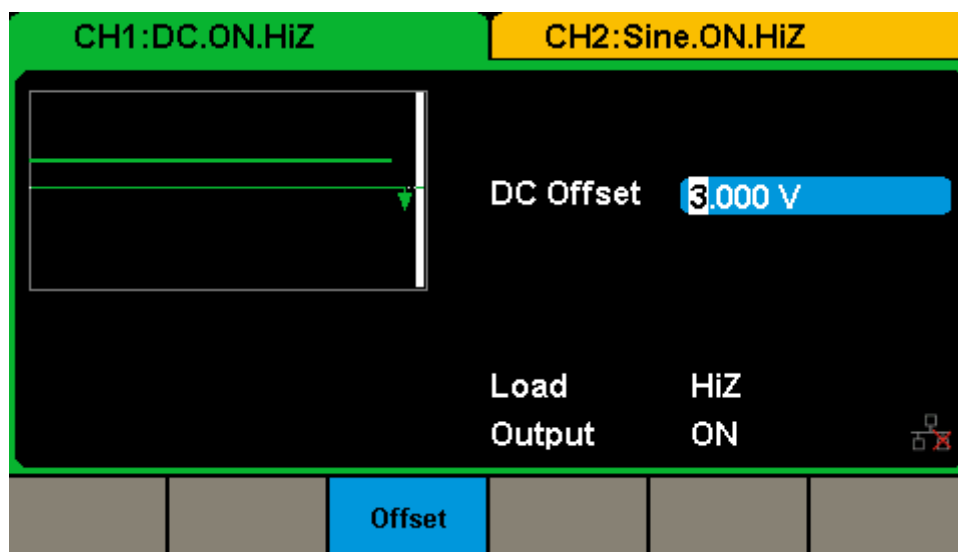
Figure 3-6 Generate a DC Waveform

3.7 Example 7: Generate a Linear Sweep Waveform

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 Waveforms and choose the sine waveform as the sweep function.
 The default setting of the source is internal.

● Set the amplitude and offset.
1. Press Amplitude/HighLevel to choose Amplitude which will display in blue color. Input '5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
2. Press Offset/LowLevel to choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 0Vdc

● Set the sweep time.
 Press Sweep → Page 1/2 → Sweep Time, input '1' from the keyboard and choose the unit 's' to set the sweep time to 1s.

● Set the start frequency.
 Press StartFreq, input '100' from the keyboard and choose the unit 'Hz' to set the start freq to 100Hz.

● Set the stop frequency.
 Press StopFreq, input '10' from the keyboard and choose the unit 'kHz' to set the stop freq to 10kHz.

● Set the sweep profiles.

Press Type and choose Linear.

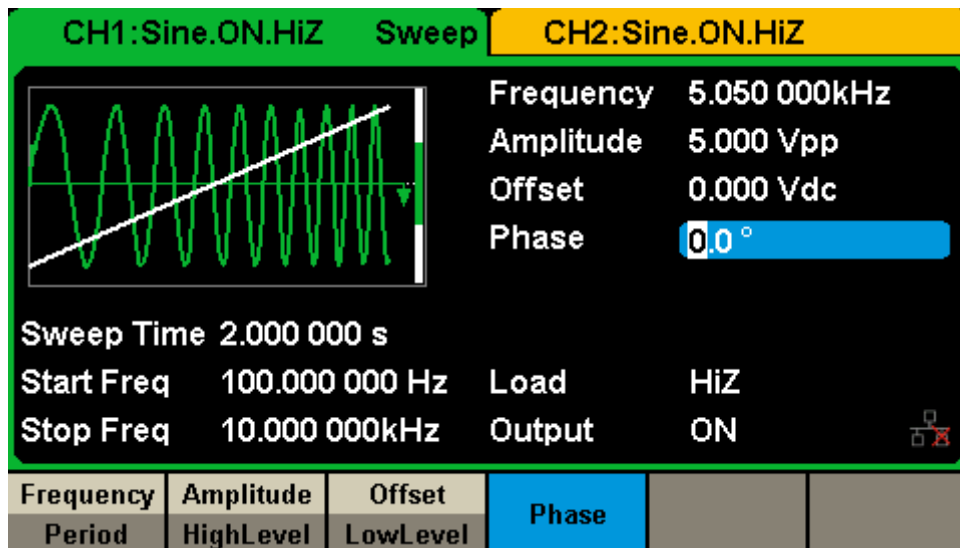When all parameters above are set, the linear sweep waveform generated is shown in Figure 3-7.

Figure 3-7 Generate a Linear Sweep Waveform

3.8   Example 8: Generate a Burst Waveform

Generate a burst waveform with 5 cycles. The burst period is 3ms. Use internal trigger and 0° start phase.

➢ **Steps:**
● Set the burst function.
  Press Waveforms, and choose the sine waveform as the burst function.

● Set the frequency, amplitude and offset.
1. Press Frequency/Period and choose Frequency which will display in blue color. Input '10' from the keyboard and choose the unit 'kHz' to set the frequency to 10kHz.
2. Press Amplitude/HighLevel to choose Amplitude which will display in blue color. Input '4' from the keyboard and choose the unit 'Vpp' to set the amplitude to 4Vpp.
3. Press Offset/LowLevel to choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 0Vdc

● Set the burst mode.
  Press Burst → NCycle, choose N-Cycle Mode. The default setting of the source is internal.

● Set the burst period.
  Press Burst Period, input '3' from the keyboard and choose the unit 'ms' to set the burst period to 3ms.

● Set the start phase.
  Press Start Phase, input '0' from the keyboard and choose the unit '°' to set the start phase to 0°.

● Set the burst cycle.

Press Cycle, Input '5' from the keyboard and choose the unit 'Cycle' to set the burst cycle to 5.

● Set the delay.

Press Page 1/2 to choose Delay, and input '100' from the keyboard and choose the unit 'μs' to set the delay to 100μs.

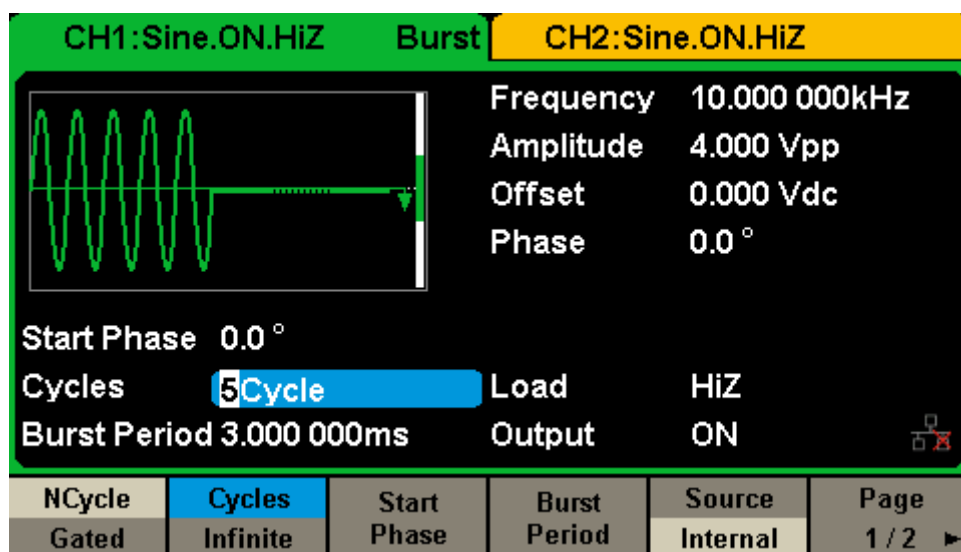When all parameters above are set, the waveform generated is shown in Figure 3-8.

Figure 3-8 Generate a N-Cycle Burst Waveform

3.9 Example 9: Generate an AM Modulation Waveform

Generate an AM modulation waveform with 80% depth. The carrier is a sine wave with 10kHz 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 Waveforms , and choose the sine waveform as the carrier wave
2. Press Frequency/Period and choose Frequency which will display in blue color. Input'10' from the keyboard and choose the unit 'kHz' to set the frequency to 10kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input'1' from the keyboard and choose the unit 'Vpp' to set the amplitude to 1Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input'0' from the keyboard and choose the unit 'Vdc' to set the offset to 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'.
2. Press AM Freq, input'200' from the keyboard and choose the unit 'Hz' to set the AM Freq to 200Hz.
3. Press AM Depth, input '80' from the keyboard and choose the unit '%' to set the AM depth to 80%.
4. Press Shape → Sine, to choose sine wave as the modulating waveform.

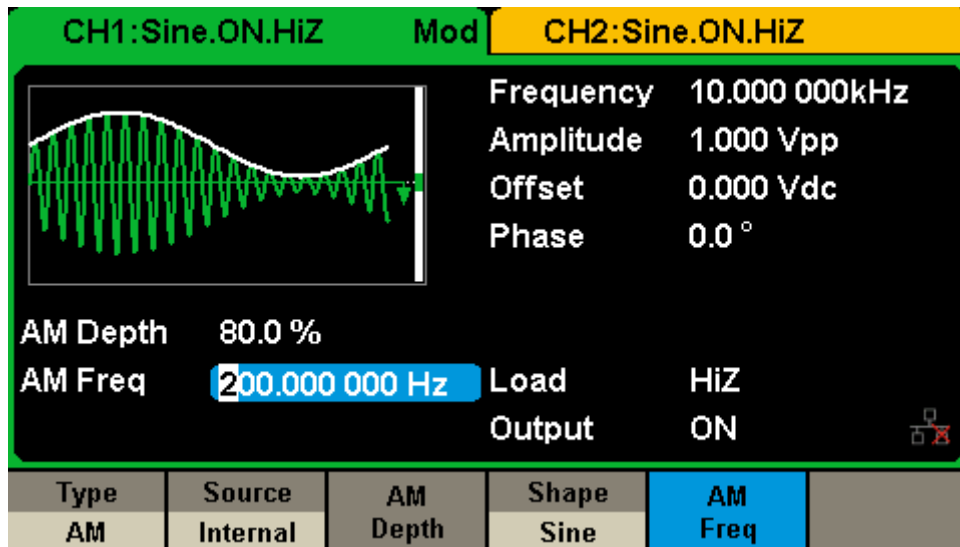When all parameters above are set, the waveform generated is shown in Figure 3-9.

Figure 3-9 Generate an AM Modulation Waveform

3.10 Example 10: Generate a FM Modulation Waveform

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

➢ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms, and choose the sine waveform as the carrier wave.
2. Press Frequency/Period and choose Frequency which will display in blue color. Input'10' from the keyboard and choose the unit 'kHz' to set the frequency to 10kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input'1' from the keyboard and choose the unit 'Vpp' to set the amplitude to 1Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input'0' from the keyboard and choose the unit 'Vdc' to set the offset to 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'.
2. Press FM Freq, input '1' from the keyboard and choose the unit 'Hz' to set the FM Freq to 1Hz.
3. Press FM Dev, input '2' from the keyboard and choose the unit 'kHz' to set the FM deviation to 2kHz.
4. Press Shape →Sine, to choose sine wave as the modulating waveform.

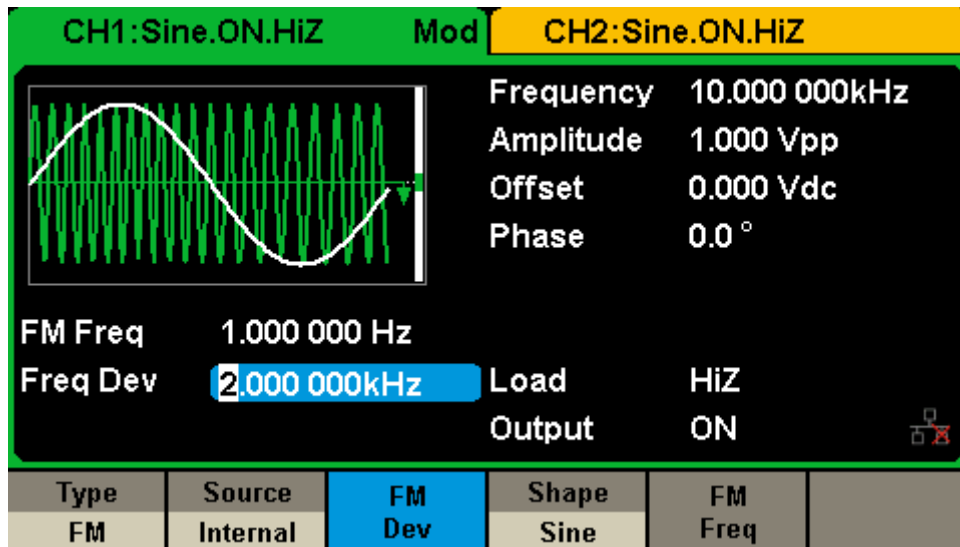When all parameters above are set, the waveform generated is shown in Figure 3-10.

Figure 3-10 Generate a FM Modulation Waveform

3.11 Example 11: Generate a PM Modulation Waveform

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

➢ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms , and choose the sine waveform as the carrier wave.
2. Press Frequency/Period and choose Frequency which will display in blue color. Input'10' from the keyboard and choose the unit 'kHz' to set the frequency to 10kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input'5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input'0' from the keyboard and choose the unit 'Vdc' to set the offset to 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'.
2. Press PM Freq, input '2' from the keyboard and choose the unit 'kHz' to set the PM Freq to 2kHz.
3. Press Phase Dev, input '90' from the keyboard and choose the unit ' °' to set the phase deviation to 90°.
4. Press Shape →Sine, to choose sine wave as the modulating waveform.

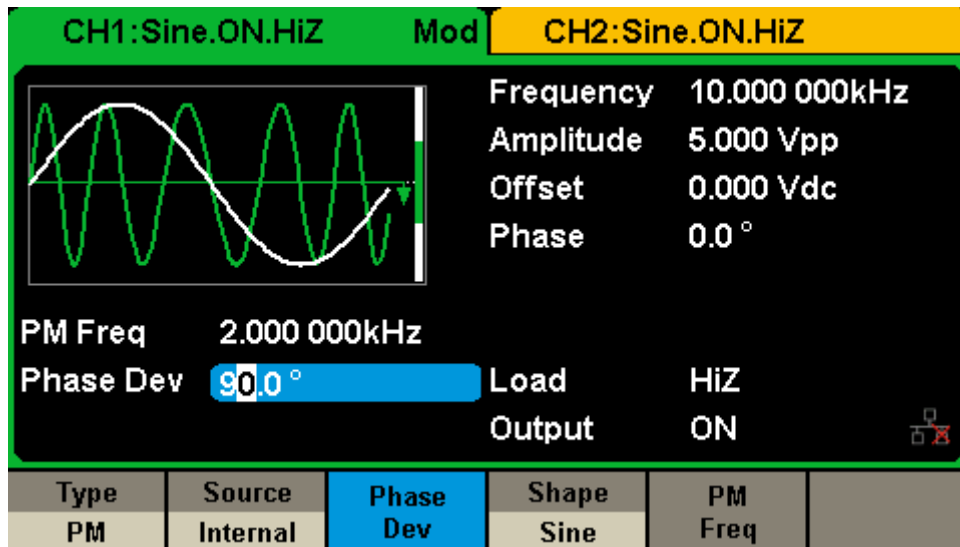When all parameters above are set, the waveform generated is shown in Figure 3-11.

Figure 3-11 Generate a PM Modulation Waveform

3.12 Example 12: Generate a FSK Modulation Waveform

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

➢ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms , and choose the sine waveform as the carrier wave
2. Press Frequency/Period and choose Frequency which will display in blue color. Input'10' from the keyboard and choose the unit 'kHz' to set the frequency to 10kHz.
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input'5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 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'.
2. Press Key Freq, input'200' from the keyboard and choose the unit 'Hz' to set the key frequency to 200 Hz.
3. Press Hop Freq, input '500' from the keyboard and choose the unit 'Hz' to set the hop frequency to 500Hz.

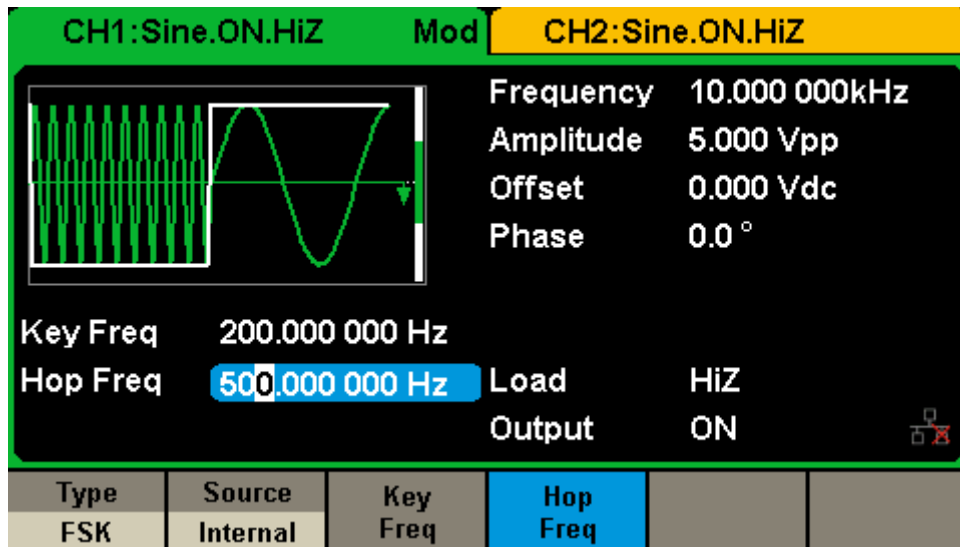When all parameters above are set, the waveform generated is shown in Figure 3-12.

Figure 3-12 Generate a FSK Modulation Waveform

3.13   Example 13: Generate an ASK Modulation Waveform

Generate an ASK modulation 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 Waveforms, and choose the sine waveform as the carrier wave
2. Press Frequency/Period and choose Frequency which will display in blue color. Input '5' from the keyboard and choose the unit 'kHz' to set the frequency to 5kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input '5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 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'.
2. Press Key Freq, input '500' from the keyboard and choose the unit 'Hz' to set the key frequency to 500 Hz.

When all parameters above are set, the waveform generated is shown in
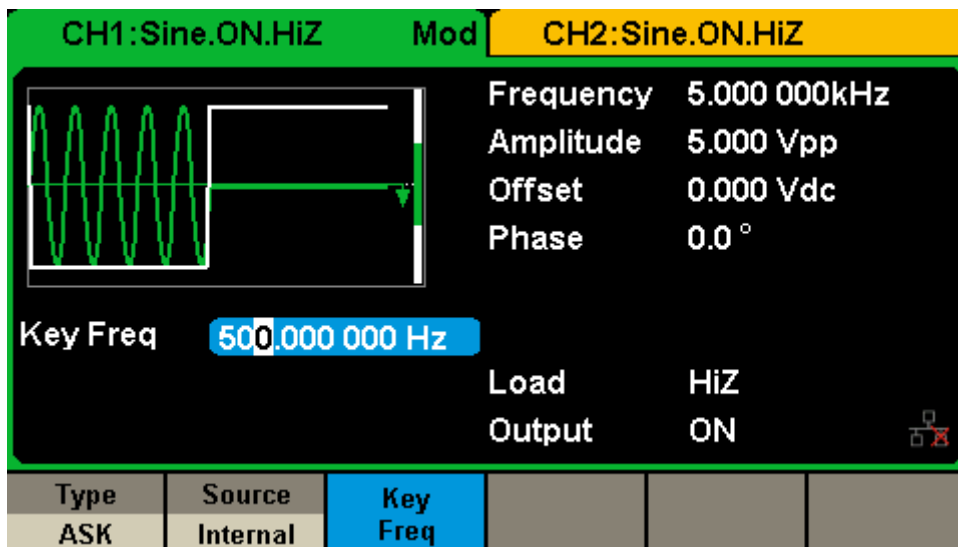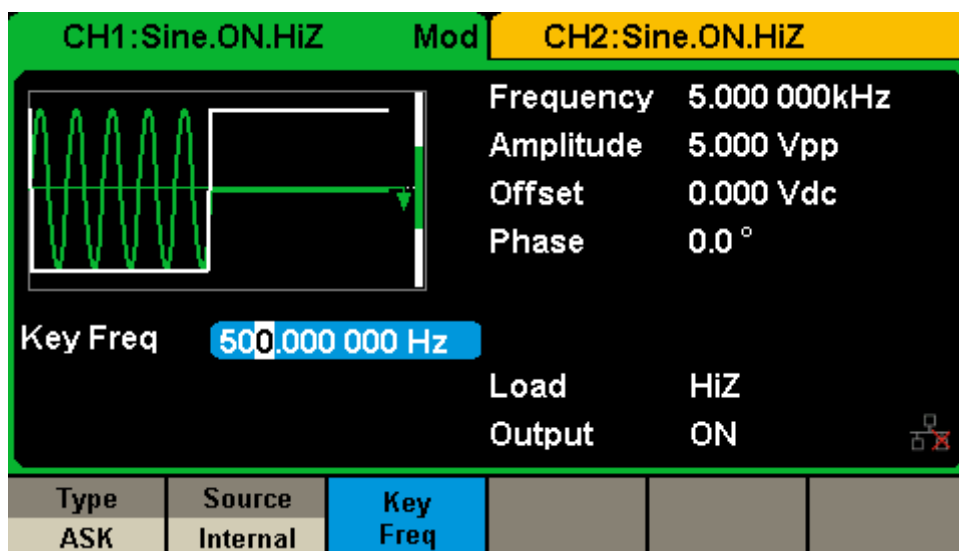
Figure 3-13.

Figure 3-13 Generate an ASK Modulation Waveform

3.14 Example 14: Generate an PSK Modulation Waveform

Generate a PSK modulation waveform with 200Hz key frequency. The carrier is a sine wave with 1kHz frequency.

➤ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms, and choose the sine waveform as the carrier wave
2. Press Frequency/Period and choose Frequency which will display in blue color. Input '1' from the keyboard and choose the unit 'kHz' to set the frequency to 1kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input '5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 0Vdc.

● Set the modulation type PSK and parameters.
1. Press Mod → Type → Page 1/2 → PSK, choose PSK. Please notice that the message shown on the middle left side of the screen is 'PSK'.
2. Press Key Freq, input '200' from the keyboard and choose the unit 'Hz' to set the key frequency to 200 Hz.
3. Press Polarity → Positive.

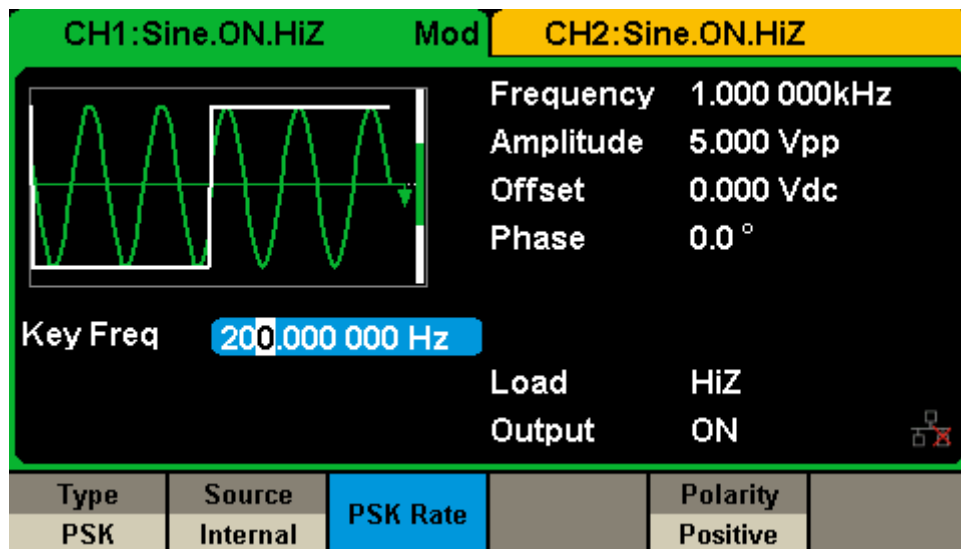When all parameters above are set, the waveform generated is shown in Figure 3-14.

Figure 3-14 Generate a PSK Modulation Waveform

3.15 Example 15: Generate a PWM Modulation Waveform

Generate a PWM modulation waveform with 200Hz key frequency. The carrier is a pulse wave with 5kHz frequency.

➢ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms , and choose the Pulse waveform as the carrier wave
2. Press Frequency/Period and choose Frequency which will display in blue color. Input '5' from the keyboard and choose the unit 'kHz' to set the frequency to 5kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input '5' from the keyboard and choose the unit 'Vpp' to set the amplitude to 5Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 0Vdc.
5. Press PulWidth and choose PulWidth which will display in blue color. Input '40' from the keyboard and choose the unit 'us' to set the PulWidth to 40us

● Set the modulation type PWM and parameters.
1. Press Mod, Please notice that the message shown on the middle left side of the screen is 'PWM '.
2. Press PWM Freq, input '200' from the keyboard and choose the unit 'Hz' to set the PWM Freq to 200Hz.
3. Press Width Dev, input '20' from the keyboard and choose the unit 'us' to set the width deviation to 20us

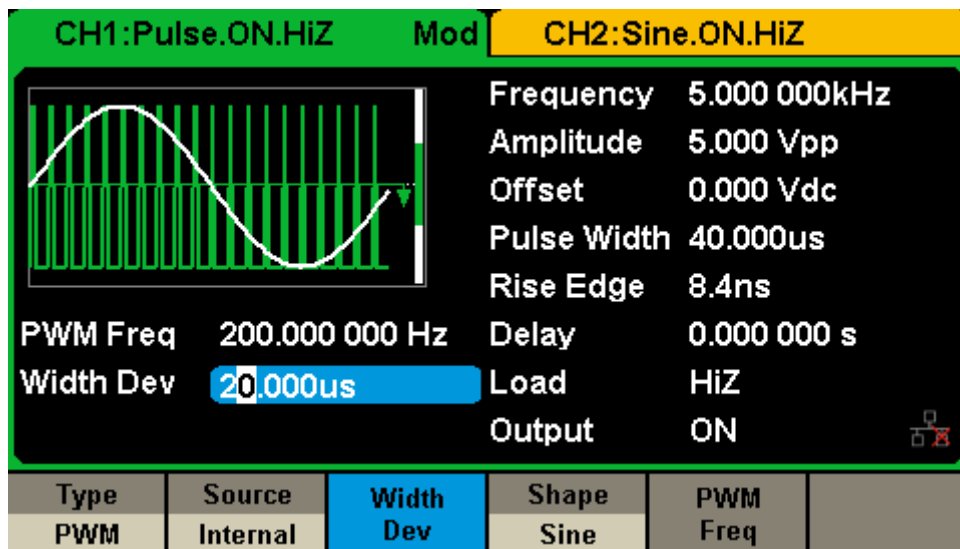When all parameters above are set, the waveform generated is shown in Figure 3-15.

Figure 3-15 Generate a PWM Modulation Waveform

3.16 Example 16: Generate a DSB-AM Modulation Waveform

Generate a DSB-AM modulation waveform with 100Hz modulating frequency. The carrier is a sine wave with 2kHz frequency.

➢ **Steps:**
● Set the frequency, amplitude and offset of the carrier wave.
1. Press Waveforms, and choose the sine waveform as the carrier wave.
2. Press Frequency/Period and choose Frequency which will display in blue color. Input '2' from the keyboard and choose the unit 'kHz' to set the frequency to 2kHz
3. Press Amplitude/HighLevel and choose Amplitude which will display in blue color. Input '4' from the keyboard and choose the unit 'Vpp' to set the amplitude to 4Vpp.
4. Press Offset/LowLevel and choose Offset which will display in blue color. Input '0' from the keyboard and choose the unit 'Vdc' to set the offset to 0Vdc.

● Set the modulation type DSB-AM and parameters.
1. Press Mod → Type → DSB-AM, choose DSB-AM. Please notice that the message shown on the middle left side of the screen is 'DSB-AM '.
2. Press DSB Freq, input '100' from the keyboard and choose the unit 'Hz' to set the DSB Freq to 100Hz.

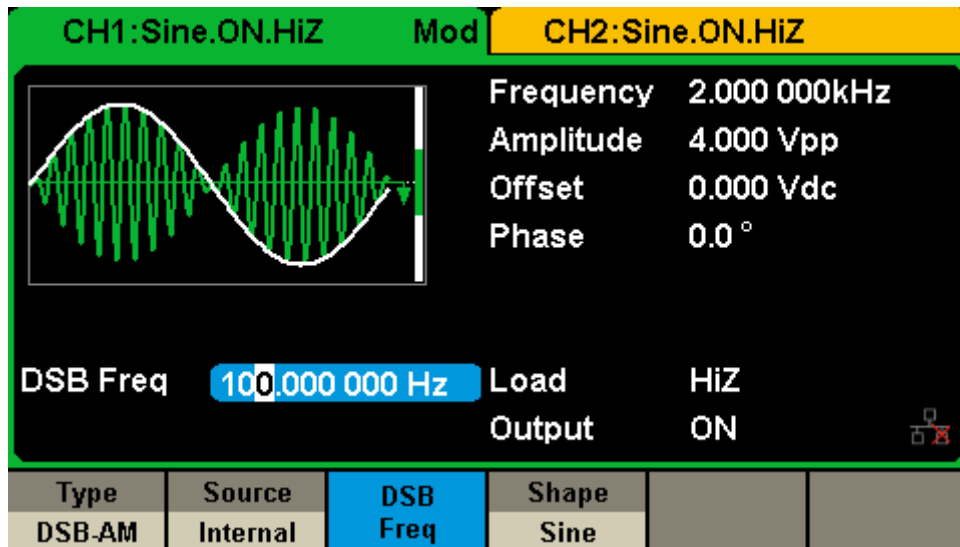When all parameters above are set, the waveform generated is shown in Figure 3-16.

Figure 3-16 Generate a DSB-AM Modulation Waveform

4 Troubleshooting

4.1   General Inspecting

After receiving a new SDG2000X Series Function/Arbitrary 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 in the performance tests, notify the SIGLENT sales representative.

If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as the SIGLENT sales department. Keep the shipping materials for carrier's inspection.

3. **Check the accessories**.

Accessories supplied with the instrument are listed in "**Appendix A**". If the contents are incomplete or damaged, notify the SIGLENT sales representative.

4.2 Troubleshooting

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

(4) If the generator still doesn't work after checking, please contact with SIGLENT.

2. If there is no waveform output after setting the parameters, please do as the following steps:

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

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

(3) If the generator still doesn't work after checking, please contact with SIGLENT.

5 Service and Support

5.1　　Maintain summary

SIGLENT warrants that the products it manufactures and sells will be free from defects in materials and workmanship for three years from the date of shipment from an authorized **SIGLENT** distributor. If a product is proved to be defective within the warranty period, **SIGLENT** 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 **SIGLENT** sales and service office. Except as provided in this summary or the applicable warranty statement, **SIGLENT** makes no warranty of any kind, express or implied, including but not limited to the implied warranties of merchantability and special applicability. In no event shall **SIGLENT** be liable for indirect, special or consequential damages.

5.2   Contact SIGLENT

SIGLENT TECHNOLOGIES CO., LTD

Address: 3/F, NO.4 building, Antongda Industrial Zone, 3rd Liuxian Road, 68th

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6 Appendix

Appendix A: Accessories

SDG2000X Series Function/Arbitrary Waveform Generator Accessories:

Standard Accessories:
- A Quick Start
- A Calibration Report
- A Product Certification
- A CD(including a arbitrary editing software EasyWave)
- A Power Line that fits the standard of the destination country
- A USB Cable
- A BNC Coaxial Cable

Optional Accessories:
- USB-GPIB adapter (IEEE 488.2)
- SPA1010 Power Amplifier
- 20dB Attenuator

Appendix B: Daily Maintain and Cleaning

Daily Maintain

Do not store or leave the instrument in where the touch screen will be exposed to direct sunlight for a long time.

⚠ **CAUTION:** To avoid damage to the instrument, do not expose them to spray, liquid, or solvent.

Cleaning

If the instrument requires cleaning, disconnect it from all power sources and clean it with a mild 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. When cleaning the touch screen, be careful to avoid scratching the transparent plastic protective screen.

2.   Use a soft cloth dampened with water to clean the instrument.

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