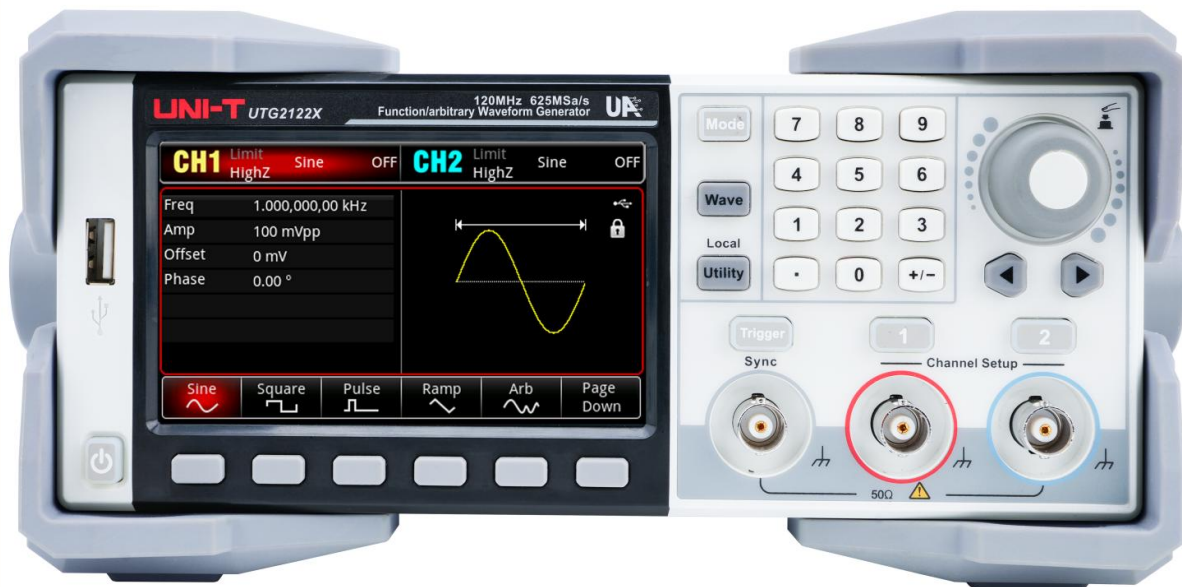


UNI-T[®]

Instruments.uni-trend.com



User's Manual

UTG2000X Series Function/Arbitrary Waveform Generator

V1.1

2024.7

Foreword

Dear Users,

Hello! Thank you for choosing this brand new UNI-T instrument. In order to use this instrument safely and correctly, please read this manual thoroughly, especially the Safety Requirements part. After reading this manual, it is recommended to keep the manual at an easily accessible place, preferably close to the device, for future reference.

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Warranty Service

UNI-T warrants that the product will be free from defects for a three-year period. If the product is re-sold, the warranty period will be from the date of the original purchase from an authorized UNI-T distributor. Probes, other accessories, and fuses are not included in this warranty.

If the product is proved to be defective within the warranty period, UNI-T reserves the rights to either repair the defective product without charging of parts and labor, or exchange the defected product to a working equivalent product. Replacement parts and products may be brand new, or perform at the same specifications as brand new products. All replacement parts, modules, and products become the property of UNI-T.

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This warranty shall not apply to any defects or damages caused by accidental, machine parts' wear and tear, improper use, and improper or lack of maintenance. UNI-T under the provisions of this warranty has no obligation to provide the following services:

- a) Any repair damage caused by the installation, repair, or maintenance of the product by non UNI-T service representatives.
- b) Any repair damage caused by improper use or connection to an incompatible device.
- c) Any damage or malfunction caused by the use of a power source which does not conform to the requirements of this manual.
- d) Any maintenance on altered or integrated products (if such alteration or integration leads to an increase in time or difficulty of product maintenance).

This warranty is written by UNI-T for this product, and it is used to substitute any other express or implied warranties. UNI-T and its distributors do not offer any implied warranties for merchant ability or applicability purposes.

For violation of this guarantee, regardless of whether UNI-T and its distributors are informed that any indirect, special, incidental, or consequential damage may occur, UNI-T and its distributors shall not be responsible for any of the damages.

Chapter 1 User's Guide

This manual is to introduce the safety requirements, installment and the operation of UTG2000X series function/arbitrary generator.

1.1 Inspecting Packaging and List

When you receive the instrument, please make sure to check the packaging and list by the following steps.

- Check packing box and padding material whether is extruded or teased caused by external forces, and further checking the appearance of the instrument. If you have any questions about the product or need consulting services, please contact the distributor or local office.
- Carefully to take out the article and check it with the packing list.

1.2 Safety Requirements

This section contains information and warnings that must be followed to keep the instrument operating under safety conditions. In addition, user should also follow the common safety procedures.

Safety Precautions

Warning	Please follow the following guidelines to avoid possible electric shock and risk to personal safety.
	Users must follow the following conventional safety precautions in operation, service and maintenance of this device. UNI-T will not be liable for any personal safety and property loss caused by the user's failure to follow the following safety precautions. This device is designed for professional users and responsible organizations for measurement purposes.
	Do not use this device in any way not specified by the manufacturer. This device is only for indoor use unless otherwise specified in the product manual.

Safety Statements

Warning	"Warning" indicates the presence of a hazard. It reminds users to pay attention to a certain operation process, operation method or similar. Personal injury or death may occur if the rules in the "Warning" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Warning" statement.
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Caution	“Caution” indicates the presence of a hazard. It reminds users to pay attention to a certain operation process, operation method or similar. Product damage or loss of important data may occur if the rules in the “Caution” statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the “Caution” statement.
Note	“Note” indicates important information. It reminds users to pay attention to procedures, methods and conditions, etc. The contents of the “Note” should be highlighted if necessary.

Safety Sign

	Danger	It indicates possible danger of electric shock, which may cause personal injury or death.
	Warning	It indicates that you should be careful to avoid personal injury or product damage.
	Caution	It indicates possible danger, which may cause damage to this device or other equipment if you fail to follow a certain procedure or condition. If the “Caution” sign is present, all conditions must be met before you proceed to operation.
	Note	It indicates potential problems, which may cause failure of this device if you fail to follow a certain procedure or condition. If the “Note” sign is present, all conditions must be met before this device will function properly.
	AC	Alternating current of device. Please check the region's voltage range.
	DC	Direct current device. Please check the region's voltage range.
	Grounding	Frame and chassis grounding terminal
	Grounding	Protective grounding terminal
	Grounding	Measurement grounding terminal
	OFF	Main power off
	ON	Main power on
	Power Supply	Standby power supply: when the power switch is turned off, this device is not completely disconnected from the AC power supply.
CAT I		Secondary electrical circuit connected to wall sockets through transformers or similar equipment, such as electronic instruments and electronic equipment; electronic equipment with protective measures, and any high-voltage and low-voltage circuits, such as the

		copier in the office.
CAT II		CATII: Primary electrical circuit of the electrical equipment connected to the indoor socket via the power cord, such as mobile tools, home appliances, etc. Household appliances, portable tools (e.g. electric drill), household sockets, sockets more than 10 meters away from CAT III circuit or sockets more than 20 meters away from CAT IV circuit.
CAT III		Primary circuit of large equipment directly connected to the distribution board and circuit between the distribution board and the socket (three-phase distributor circuit includes a single commercial lighting circuit). Fixed equipment, such as multi-phase motor and multi-phase fuse box; lighting equipment and lines inside large buildings; machine tools and power distribution boards at industrial sites (workshops).
CAT IV		Three-phase public power unit and outdoor power supply line equipment. Equipment designed to "initial connection", such as power distribution system of power station, power instrument, front-end overload protection, and any outdoor transmission line.
	Certification	CE indicates a registered trademark of EU
	Certification	UKCA indicates a registered trademark of UK
	Certification	Conforms to UL STD 61010-1, 61010-2-030, Certified to CSA STD C22.2 No. 61010-1, 61010-2-030.
	Waste	Do not place equipment and its accessories in the trash. Items must be properly disposed of in accordance with local regulations.
	EFUP	This environment-friendly use period (EFUP) mark indicates that dangerous or toxic substances will not leak or cause damage within this indicated time period. The environment-friendly use period of this product is 40 years, during which it can be used safely. Upon expiration of this period, it should enter the recycling system.

Safety Requirements

Warning

Preparation before use

Please connect this device to AC power supply with the power cable provided;

The AC input voltage of the line reaches the rated value of this device. See the product manual for specific rated value.

The line voltage switch of this device matches the line voltage;

	The line voltage of the line fuse of this device is correct. It not used for measuring the main circuit,
Check all terminal rated values	Please check all rated values and marking instructions on the product to avoid fire and impact of excessive current. Please consult the product manual for detailed rated values before connection.
Use the power cord properly	You can only use the special power cord for the instrument approved by the local and state standards. Please check whether the insulation layer of the cord is damaged or the cord is exposed, and test whether the cord is conductive. If the cord is damaged, please replace it before using the instrument.
Instrument Grounding	To avoid electric shock, the grounding conductor must be connected to the ground. This product is grounded through the grounding conductor of the power supply. Please be sure to ground this product before it is powered on.
AC power supply	Please use the AC power supply specified for this device. Please use the power cord approved by your country and confirm that the insulation layer is not damaged.
Electrostatic prevention	This device may be damaged by static electricity, so it should be tested in the anti-static area if possible. Before the power cable is connected to this device, the internal and external conductors should be grounded briefly to release static electricity. The protection grade of this device is 4 kV for contact discharge and 8 kV for air discharge.
Measurement accessories	Measurement accessories are of lower class, which are definitely not applicable to main power supply measurement, CAT II, CAT III or CAT IV circuit measurement. Probe subassemblies and accessories within the range of IEC 61010-031 and current sensor within the range of IEC 61010-2-032 can meet its requirements.
Use the input / output port of this device properly	Please use the input / output ports provided by this device in a properly manner. Do not load any input signal at the output port of this device. Do not load any signal that does not reach the rated value at the input port of this device. The probe or other connection accessories should be effectively grounded to avoid product damage or abnormal function. Please refer to the product manual for the rated value of the input / output port of this device.
Power fuse	Please use power fuse of specified specification. If the fuse needs to be replaced, it must be replaced with another one that meets the specified specifications by the maintenance personnel authorized by UNI-T.
Disassembly and cleaning	There are no components available to operators inside. Do not remove the protective cover. Maintenance must be carried out by qualified personnel.
Service	This device should be used indoors in a clean and dry environment with

environment	ambient temperature from 10 °C ~ +40 °C。 Do not use this device in explosive, dusty or humid air.
Do not operate in humid environment	Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.
Do not operate in flammable and explosive environment	Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.
Caution	
Abnormality	If this device may be faulty, please contact the authorized maintenance personnel of UNI-T for testing. Any maintenance, adjustment or parts replacement must be done by the relevant personnel of UNI-T.
Cooling	Do not block the ventilation holes at the side and back of this device; Do not allow any external objects to enter this device via ventilation holes; Please ensure adequate ventilation, and leave a gap of at least 15 cm on both sides, front and back of this device.
Safe transportation	Please transport this device safely to prevent it from sliding, which may damage the buttons, knobs or interfaces on the instrument panel.
Proper ventilation	Poor ventilation will cause the device temperature to rise, thus causing damage to this device. Please keep proper ventilation during use, and regularly check the vents and fans.
Keep clean and dry	Please take actions to avoid dust or moisture in the air affecting the performance of this device. Please keep the product surface clean and dry.
Note	
Calibration	The recommended calibration period is one year. Calibration should only be carried out by qualified personnel.

1.3 Environmental Requirements

This instrument is suitable for the following environment.

- Indoor use
- Pollution degree 2
- Overvoltage category: This product should be connected to a power supply that meets Overvoltage Category II. This is a typical requirement for connecting devices via power cords and plugs.

- In operating: altitude lower than 2000 meters; in non-operating: altitude lower than 15000 meters
- Unless otherwise specified, operating temperature is 10 to +40°C; storage temperature is -20 to +60
- In operating, humidity temperature below to +35°C, ≤90% RH. (Relative humidity)
- In non-operating, humidity temperature +35°C to +40°C, ≤60% RH. (Relative humidity)

There are ventilation opening on the rear panel and side panel of the instrument. So please keep the air flowing through the vents of the instrument housing. To prevent excessive dust from blocking the vents, please clean the instrument housing regularly. The housing is not waterproof, please disconnect the power supply first and then wipe the housing with a dry cloth or a slightly moistened soft cloth.

1.4 Connecting Power Supply

The specification of input AC power.

Voltage Range	Frequency
100-240 VAC (fluctuant ±10 %)	50/60 Hz
100-120 VAC (fluctuant ±10 %)	400 Hz

Please use the attached power lead to connect to the power port.

Connecting to service cable

This instrument is a Class I safety product. The supplied power lead has good performance in terms of case ground. This spectrum analyzer is equipped with a three-prong power cable that meets international safety standards. It provides good case grounding performance for the specification of your country or region.

Please install AC power cable as follow.

- Ensure the power cable is in a good condition.
- Leave enough space for connecting the power cord.
- Plug the attached three-prong power cable into a well-grounded power socket.

1.5 Electrostatic Protection

Electrostatic discharge may cause damage to component. Components can be damaged invisibly by electrostatic discharge during transportation, storage and use.

The following measure can reduce the damage of electrostatic discharge.

- Testing in anti-static area as far as possible.
- Before connecting the power cable to the instrument, inner and outer conductors of the instrument should be briefly grounded to discharge static electricity.
- Ensure all the instruments are properly grounded to prevent the accumulation of static.

1.6 Preparation Work

1. Connect the power supply wire, plug the power socket into the protective grounding socket; adjust the alignment jig according to your view.
2. Press the software switch  on the front panel to boot-up the instrument.

1.7 Remote Control

UTG2000X series function/arbitrary waveform generator supports communication with the computer via USB, LAN interface. User can use SCPI via USB, LAN interface and combined with programming language or NI-VISA to remote control the instrument and operating other programmable instrument which is also supports SCPI.

The detailed information about the installation, remote control mode and the programming, please refer to *UTG2000X Series Programming Manual* at the official website [http:// www.uni-trend.com](http://www.uni-trend.com)

1.8 Help Information

UTG2000X series function/arbitrary waveform generator has built-in help system for each function key and menu control key. Long press any softkey or button to check help information.

Chapter 2 Product Introduction

This product has DDS (direct digital frequency synthesis) function, it can generate high precision and stable waveform output with a resolution as low as 1 μ Hz. It is an economical, high performance, multifunction function/arbitrary waveform generator. It can generate high precision, stable, pure and low distortion signal. UTG2000X series has convenient operation, superior technical indicators and humanized graphics display. A multi-purpose equipment for the needs of learning, testing and improving work efficiency.

2.1 Main Features

- Dual channel with equivalent performance, the maximum output frequency is 120 MHz, the maximum output amplitude is 20 Vpp
- 625 MSa/s sampling rate, 16-bit vertical resolution
- 10 basic waveform output: sine wave, square wave, pulse wave, ramp wave, arbitrary wave, harmonic, expression, pseudo-random code, noise, DC, and DoublePluse
- Maximum frequency of square wave is 50 MHz, low jitter
- Wide dynamic high-precision edge time adjustable pulse wave, the edge time can be fine tuning, with high adjusting resolution and range
- Low harmonic distortion
- Multiple analog and digital modulation function: AM, PM, FM, DSB-AM, ASK, PSK, BPSK, QPSK, FSK, 3FSK, 4FSK, QAM, OSK, PWM, SUM
- Supports sweep frequency and pulse string output
- Arbitrary waveform length within 8 pts ~ 64 Mpts, output low jitter waveform point by point
- Supports channel duplication, follow and superposition
- Arbitrary waveform can be generated by arbitrary waveform editor of upper computer
- 7-digit hardware frequency meter
- Built-in 200 arbitrary waveforms
- USB Host, USB Device, LAN, independent 10 MHz clock source input and output
- Supports SCPI protocol
- 4.3-inch TFT LCD capacitive touch screen

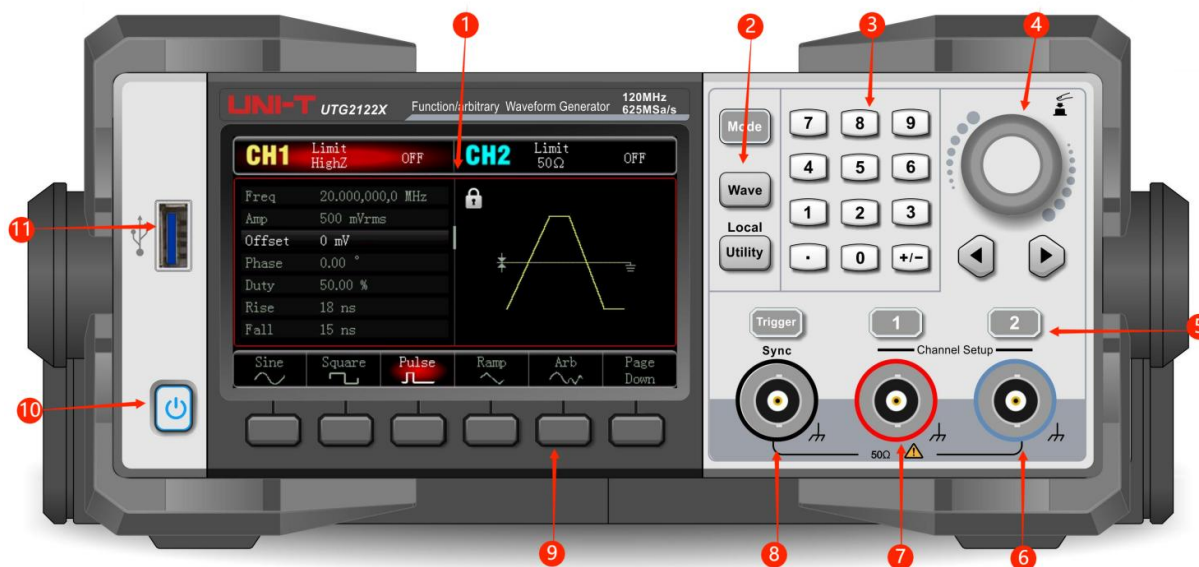
2.2 Output Features

Channel	CH1,CH2
Amplitude Range	1 mVpp ~ 10 Vpp (50 Ω)
Waveform	Sine wave, square wave, pulse wave, ramp wave, arbitrary wave, noise, DC, harmonic, PRBS, expression, DoublePluse
Modulation	AM, FM, PM, ASK, FSK, 3FSK, 4FSK, PSK, BPSK, QPSK, OSK, SUM, DSB-AM, QAM, PWM
Sweep Frequency	Log (logarithm), Line (linearity), Step
Pulse string	N cycle, gate, infinite

2.3 Panel and Key

2.3.1 Front Panel

The product has a front panel of simple, intuitive and easy to use, as shown in the following figure.



1. Display Screen

4.3 inch high resolution TFT color LCD is clearly distinguishes the output status of channel 1 and channel 2, function menu and other important information through different colors. The humanized system interface can make human-computer interaction become easier and improve work efficiency.

2. Function Key

Mode, Wave, Utility key to set the modulation, carrier wave parameter and modulating

parameter and auxiliary function.

3. Numerical Keyboard

Digit key 0-9, decimal point ".", symbolic key "+/-" for input the parameter. The left key is used to backspace and delete the previous bit of the current input.

4. Multifunction rotary knob / Arrow Key

Multifunction rotary knob is used for changing number (rotate clockwise to increase number) or as the arrow key, press the knob to select the function or confirm the setting. When using multifunction rotary knob and arrow key to set the parameter, it is used to switch the digital bits or clear the previous bit or move (to left or right) cursor position.

5. CH1/CH2 Output Control Key

Quickly to switch the current channel display on the screen (The highlighted CH1 info bar indicates the current channel, the parameter list displays the relevant information of CH1, so as to set the waveform parameters of channel 1.) If CH1 is the current channel (CH1 info bar is highlighted), press **CH1** key to quickly turn on/off CH1 output, or press **Utility** key to pop out the bar and then press **CH1 Setting** softkey to set. When channel output is enabled, the indicator light will be illumined, the info bar will display the output mode ("Wave", "Modulate", "Linear" or "Log") and signal will output by output terminal. When **CH1** key or **CH2** key is disabled, the indicator light will be extinguished, the info bar will display "OFF" and turn off the output port.

6. Channel 2

CH2 output interface.

7. Channel 1

CH1 output interface.

8. Sync output interface

When sync output interface of channel is enabled, it acts as an interface for the synchronous output signal of the channel.

9. Menu Softkey

Select or view the contents of the softkey labels (at the bottom of the function screen) and set the parameters with the numeric keypad or multifunction rotary knobs or arrow keys.

10. Power Supply Switch

Press the power supply switch to turn on the instrument, press it again to turn it off.

11. USB Interface

USB interface is used to connect with an external USB storage device. The instrument supports USB FAT32 32G. Through this interface, arbitrary waveform data files saved in

USB can be read or imported. In addition, the system of the instrument can be upgraded through this interface. It can make sure that the program of function/arbitrary waveform generator is the latest released version.

Note

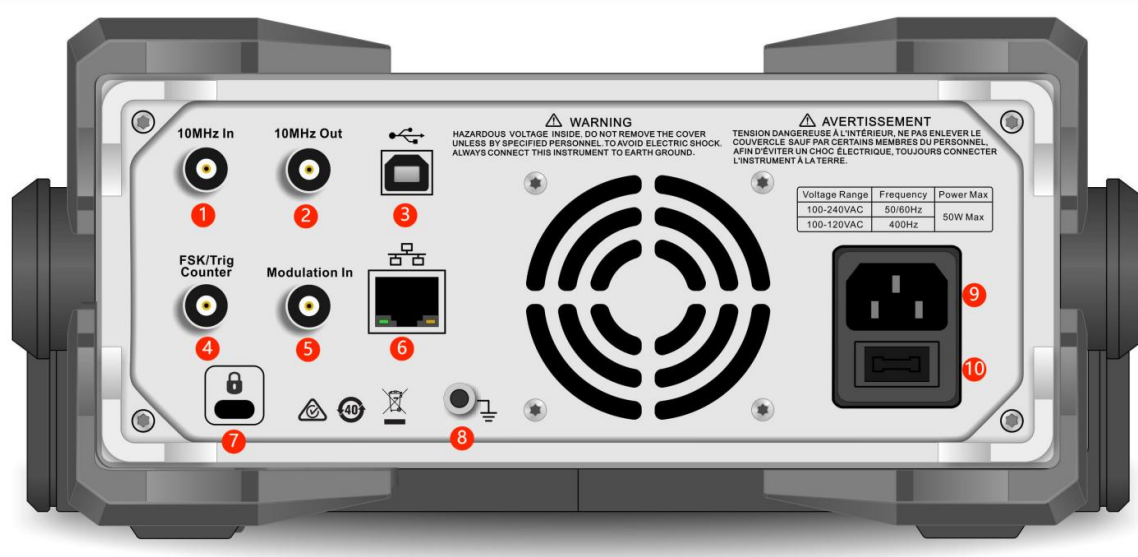
The channel output interface has overvoltage protective function, it will be generated when one of the following condition is met.

The amplitude of the instrument is larger than 4 Vpp, the input voltage is larger than $|\pm 12\text{ V}|$, frequency is less than 10 kHz.

The amplitude of the instrument is less than 4 Vpp, the input voltage is larger than $|\pm 5\text{ V}|$, frequency is less than 10 kHz.

When the overvoltage protective function is enabled, the channel will automatically disconnects the output.

2.3.2 Rear Panel



1. External 10 MHz input interface

Build synchronization between multiple function and arbitrary waveform generator or synchronizing with external 10 MHz clock signal. When the instrument detects a 10 MHz clock signal (input requirement: frequency is 10 MHz, amplitude is TTL), the signal will automatically be the external clock source, an icon **EXT 10M** will displayed at the upper right on the user page. If the external clock source is missing, over limit or not connected, the clock source will automatically switch to the internal and an icon **EXT 10M** will disappear.

2. Internal 10 MHz output interface

Build synchronization between multiple function and arbitrary waveform generator or export the reference frequency with external 10 MHz clock signal.

3. USB Host

This port is used to connect to the upper computer for remote control.

4. FSK/Trig/Counter (external digital modulation/trigger signal/frequency meter/signal output of sweep frequency and pulse string)

In ASK, FSK, PSK, OSK, when the modulation source is external, a modulation signal (TTL) can be imported via the external digital modulation interface. The output amplitude, frequency and phase will be determined by the signal from the external digital modulation interface.

When trigger source of sweep frequency is external, a TTL with specified polarity can be imported via the external digital modulation interface. This pulse signal can enable the sweep frequency.

When the pulse string mode is gate, the trigger source of N cycle and infinite is external, a gate signal can be imported via the external digital modulation interface. This pulse string can export the pulse string with specified number of cycles.

When the trigger source of sweep frequency and pulse string is internal or manual, the trigger source (square wave) can export via the external digital modulation interface. This signal is compatible with TTL.

When use the frequency meter function, a signal (compatible TTL) can export via the external digital modulation interface.

5. Modulation In (external analog modulation input interface)

In AM, FM, PM, DSB-AM, SUM or PWM, when the modulation source is external, a modulation signal can be imported via the external analog modulation input interface. The modulating depth, frequency deviation, phase deviation or duty cycle deviation will be controlled by $\pm 5V$ signal level of the external analog modulation input terminal.

6. LAN interface

The instrument can connect to local area network via this port for remote control.

7. Safety lock (purchase separately)

Lock the oscilloscope at fixed position.

8. Ground terminal

Provides an electrical ground connection for connecting an anti-static wrist strap when moving the instrument or to reduce electrostatic damage (ESD) when connecting DUT.

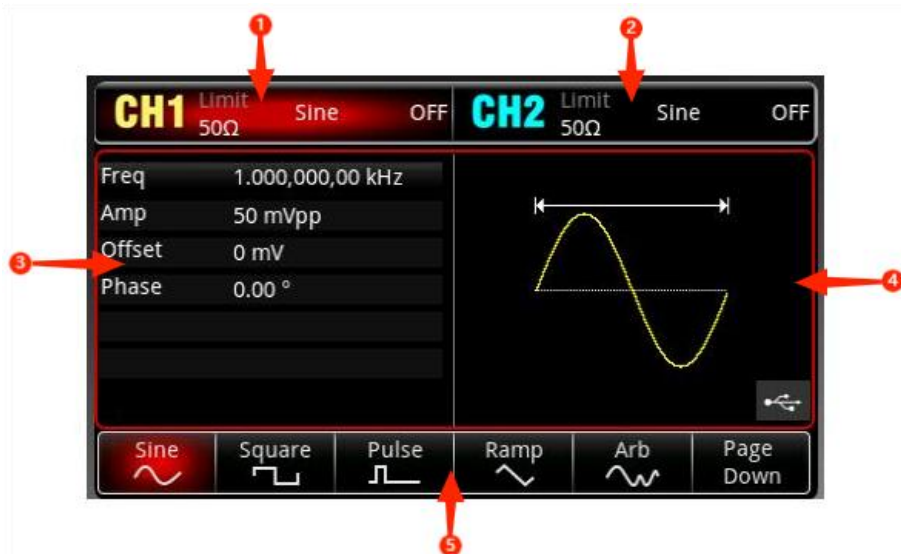
9. AC power input

AC power specification of UTG2000X series, refer to the section of Connecting Power Supply.

10. Main power switch

When the power switch is "I", indicating that the instrument is power on. When the power switch is "O", indicating that the instrument is power off (the power switch on the front panel does not work).

2.3.3 Function Interface



1. CH1 info, the currently selected channel will be highlighted.
"50 Ω" indicates the impedance 50 Ω to be matched at the output port (1 Ω to 999999 Ω, or high impedance, the default is HighZ).
"Sine" (Sine wave) indicates the current mode is sine wave. (In different working modes, it may be "AM ", "N cycle", "Gate", "Linear" or "Log".)
Tap CH1 info label to switch the current channel and turn on the setup menu.
2. CH2 info is the same as CH1.
3. Waveform parameter list: the parameter of the current wave will be displayed in a list format. If an item indicates pure white in the list, then it can be set by the menu softkey, numerical keyboard, arrow keys and multifunction rotary knob. If the bottom color of the current character is the color of the current channel (it is white when the system is being set up), it means that this character enters the editing state and the parameters can be set with the arrow keys or numeric keyboard or multifunction rotary knob.
4. Waveform display area: display the current wave of the channel (it can distinguish the current belongs to which channel by the color or CH1/CH2 info bar, the wave parameter will be displayed in the list at the left side.)
Notes: There is no wave display area when the system is being set up. This area is expanded into a list of parameters.
5. Softkey label: to identify the function menu softkey and the menu operation softkey.

Highlight: It indicates that the right center of the label displays the color of the current channel or the gray when the system is being set up, and the font is pure white.

Chapter 3 Quick Start

3.1 Output Basic Waveform

3.1.1 Output Frequency

Default waveform: a sine wave with frequency 1 kHz, amplitude 100 mV peak-to-peak (connect with 50 Ω port)

The specific steps to change the frequency to 2.5 MHz are as follows.

Press **Wave** → **Sine** → **Freq** key in turn, use the numerical keyboard to enter 2.5 and then select the unit of the parameter to **MHz**.

3.1.2 Output Amplitude

Default waveform: a sine wave with amplitude 100 mV peak-to-peak (connect with 50 Ω port)

The specific steps to change the amplitude to 300 mVpp are as follows.

Press **Wave** → **Sine** → **Amp** key in turn, use the numerical keyboard to enter 300 and then select the unit of the parameter to **mVpp**.

3.1.3 DC Deviation Voltage

The DC deviation voltage is a sine wave of 0 V by default (connect with 50 Ω port).

The specific steps to change the DC deviation voltage to -150 mV are as follows.

Press **Wave** → **Sine** → **Offset** key in turn, use the numerical keyboard to enter -150 and then select the unit of the parameter to **mV**.

Note: This parameter can also be set by multipurpose rotary knob and arrow keys.

3.1.4 Phase

The default phase is 0°.

The specific steps to change the phase to 90° are as follows.

Press the softkey **Phase**, use the numerical keyboard to enter 90 and then select the unit of the parameter to **°**.

3.1.5 Duty Cycle of Pulse Wave

The default frequency of pulse wave is 1 kHz, the duty cycle is 50 % (limited by a minimum pulse width specification of 22 ns)

The specific steps to set duty cycle to 25 % (limited by a minimum pulse width specification of 22 ns) are as follows.

Press **Wave** → **Pluse** → **Duty** key in turn, use the numerical keyboard to enter 25 and then select the unit of the parameter to **%**.

3.1.6 Symmetry of Ramp Wave

The default frequency of pulse wave is 1 kHz.

The specific steps to set the symmetry to 75 are as follows.

Press **Wave** → **Ramp** → **Symmetry** key in turn, use the numerical keyboard to enter 75 and then select the unit of the parameter to **%**.

3.1.7 DC Voltage

The default DC voltage is 0 V.

The specific steps to change the DC voltage to 3 V are as follows.

Press **Wave** → **Page Down** → **DC** key in turn, use the numerical keyboard to enter 3 and then select the unit of the parameter to **V**.

3.1.8 Noise Wave

The default noise wave Gaussian noise with amplitude of 100 mVpp, DC deviation is 0 V.

The specific steps to set Gaussian noise amplitude 300 mVpp, DC deviation 1 V are as follows.

Press **Wave** → **Page Down** → **Noise** → **Amp** key in turn, use the numerical keyboard to enter 300 and then select the unit of the parameter to **mVpp**, press **Phase** key, use the numerical keyboard to enter 1 and then select the unit of the parameter to **V**.

3.1.9 Harmonic Wave

The default frequency of harmonic wave is 1 kHz.

The specific steps to set the total harmonic times to 10 are as follows.

Press **Wave** → **Page Down** → **Harmonic** → **Order** in turn, use the numerical keyboard to enter 10 and then press **Type** key to select **All**.

3.1.10 PRBS

The default frequency of PRBS is 100 bps.

The specific steps to set PN7, edge time to 20 ns are as follows.

Press **Wave** → **Page Down** → **PRBS** → **PNCode** key in turn, select PN7, press **Edge Time** key, use the numerical keyboard to enter 20 and then select the unit of the parameter to **ns**.

3.1.11 Expression

An expression is a combination of numbers, operators, numerical separators (brackets), free

variables, etc. that describes the output waveform in a meaningful arrangement that can result in a numerical value, the basic format is $V_{out} = f(x)$, such as $f(x)$ is $(x-1)*x*(x+1)$.

Since the signal source output is a repetition of the signal over a finite period of time, the variable range in the expression $f(x)$ should be defined, x is defined by **Exp Start** and **Exp End**. The expression has 18 kinds of function mixed operation, press the **Exp Str** key to enter the expression editing menu, press the **Page Down** key to cycle switch between the operator or expression.

The default formula of expression is $\sin(x)$, and the default start value is 0. Take the formula “ $\cos(x)$, the end value is 6.2831852, the frequency is 200 kHz, and the amplitude is 200 mVpp” as an example, the specific steps are as follows.

Press the **Wave** → **Page Down** → **Exp** → **Exp Str** key in sequence, and use the arrow key to clear the expression text box, and select **cos** in expression menu, and select **x** and press the rotary to enter.

Press the **Exp End** key and use the numerical keyboard to enter 6.2831852, and press the **Freq** key and use the numerical keyboard to enter 200, and select the unit to **kHz**, finally, press the **Amp** key and use the numerical keyboard to enter 200, and then select the unit to **mVpp** complete the setting.

3.1.12 DoublePulse

DoublePulse can set the total number of pulses, the width of each pulse, the rising edge, the falling edge, and the gap between each pulse. The default pulse 0 has a width of 30 ns and a gap of 30 ns. Taking pulse 0 with a width of 20 ns and a gap of 15 ns as an example, the specific steps are as follows.

Press the **Wave** → **Page Down** → **Page Down** → **DPulse** → **Page Down** → **PulseSn** key in sequence, use the numerical keyboard to enter 0, and press the **Width** key and use the numerical keyboard to enter 20, and select the unit to **ns**, finally, press the **Gap** key and use the numerical keyboard to enter 15, and then select the unit to **ns** complete the setting.

3.2 Auxiliary Function

The auxiliary function (Utility) can set the frequency meter, system, for CH1 and CH2. The specific functions are shown in the following table.

3.2.1 Channel Setting

Function Menu	Function Sub-menu	Setting	Description
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CH1, CH2 setting	Channel output	OFF, ON	
	Channel reverse	OFF, ON	
	Sync output	CH1, CH2, OFF	
	Load	50 Ω , 70 Ω , high impedance	1 Ω to 1 M Ω
	Amplitude limit	OFF, ON	
	Upper limit of amplitude		To set the upper limit for amplitude output of the channel
	Lower limit of amplitude		To set the lower limit for amplitude output of the channel

Select **Utility** → **CH1 Setting** key in turn (or CH2 Setting) to set the channel.

1. Channel Output

Select the softkey **CH1 Output** to “OFF” or “ON”.

Note: The channel output function can be quickly turn on/off by **CH1**, **CH2** key on the front panel.

2. Channel Reverse

Select the softkey **Inversion** to “OFF” or “ON”.

3. Sync Output

Select the softkey **Sync Output** to “CH1”, “CH2” or “OFF”.

4. Load

Select the softkey **Load** to 1 Ω ~1 M Ω or select it to 50 Ω , 70 Ω or high impedance.

5. Amplitude Limit

It supports amplitude limit output to protect load. Select the softkey **Amp Limit** to “OFF” or “ON”.

6. Upper limit of Amplitude

Select the softkey **Upper** to set the upper limit range of the amplitude.

7. Lower limit of Amplitude

Select the softkey **Lower** to set the lower limit range of the amplitude.

3.2.2 Channel Duplication

Select **Utility** → **CH Copy** key in turn to select the softkey **CH1 Copy** or **CH2 Copy**, which is to copy the parameter of the current channel into other channel.

CH1 Copy: copy CH1 parameter into CH2

CH2 Copy: copy CH2 parameter into CH1

3.2.3 Channel Tracking

The channel tracking function has two types, parameter tracking and channel tracking. The parameter tracking is divided into frequency tracking, amplitude tracking and phase tracking. The setting menu of channel tracking is shown the following table.

Function Menu	Function Sub-menu	Setting	Description
Channel tracking	Channel tracking	OFF, ON	
	Tracking type	Parameter tracking, channel tracking	
	Phase deviation		Turn on the channel tracking to set the phase deviation
	Frequency tracking	OFF, deviation, ratio	Turn on the parameter tracking to select the frequency tracking mode: OFF, deviation, ratio
	Amplitude tracking	OFF, deviation, ratio	Turn on the amplitude tracking to select the frequency tracking mode: OFF, deviation, ratio
	Phase tracking	OFF, deviation, ratio	Turn on the phase tracking to select the frequency tracking mode: OFF, deviation, ratio

Select **Utility** → **CH Follow** key in turn to set the channel tracking function.

1. Channel Tracking

Select the softkey **CH Follow** to “OFF” or “ON”.

2. Tracking Type

Select the softkey **Follow Type** to “parameter tracking” or “channel tracking”.

When the parameter tracking is selected, frequency tracking, amplitude tracking and phase tracking should be set.

When the channel tracking is selected, the phase deviation should be set.

3. Phase Deviation

Select the softkey **PhaseDeviation** in the channel tracking menu, use numerical keyboard to

enter the phase deviation of CH2-CH1. CH1 and CH2 are reference sources to each other. If a parameter of one of the channels (which is the reference source) is changed, the parameter of the other channel will automatically copy the parameter of the reference channel, and only the phase will maintain the specified deviation from the reference channel.

4. Frequency Tracking

The softkey **FreqFollow** can be selected in the channel tracking menu. The frequency tracking mode of CH1 and CH2 can set to ratio, deviation or OFF. CH1 and CH2 are reference sources to each other. If a parameter of one of the channels (which is the reference source) is changed, the frequency of the other channel will be automatically adjusted, and always maintain the specified ration and deviation from the reference channel. Ratio: CH2:CH1; Deviation: CH2-CH1

When the softkey Deviation is selected, use numerical keyboard to enter the deviation value.

When the softkey **Rate** is selected, use numerical keyboard to enter the ratio.

5. Amplitude Tracking

The softkey **AmpFollow** can be selected in the channel tracking menu. The amplitude tracking mode of CH1 and CH2 can set to ratio, deviation or OFF. CH1 and CH2 are reference sources to each other. If a parameter of one of the channels (which is the reference source) is changed, the amplitude of the other channel will be automatically adjusted, and always maintain the specified ration and deviation from the reference channel. Ratio: CH2:CH1; Deviation: CH2-CH1

When the softkey Deviation is selected, use numerical keyboard to enter the deviation value.

When t the softkey **Rate** is selected, use numerical keyboard to enter the ratio.

6. Phase Tracking

The softkey **PhasFollow** can be selected in the channel tracking menu. The phase tracking mode of CH1 and CH2 can set to ratio, deviation or OFF. CH1 and CH2 are reference sources to each other. If a parameter of one of the channels (which is the reference source) is changed, the phase of the other channel will be automatically adjusted, and always maintain the specified ration and deviation from the reference channel. Ratio: CH2:CH1; Deviation: CH2-CH1

When the softkey Deviation is selected, use numerical keyboard to enter the deviation value.

When the softkey **Rate** is selected, use numerical keyboard to enter the ratio.

7. Icon

When the channel tracking is enabled, the tracking icon will appear in the channel parameter list on the top right, as shown in the following figure.



3.2.4 Channel Superposition

Select **Utility** → **CH Add** key in turn to set **CH1 Add** or **CH2 Add**.

Select and enable **CH1 Add**, CH1 will output the waveform of CH1+CH2.

Select and enable **CH2 Add**, CH2 will output the waveform of CH1+CH2.

When CH1 and CH2 is combined, a combined icon will appear on the top right in the parameter list, as shown in the following figure.



3.2.5 Frequency Meter

This function/arbitrary waveform generator can measure the frequency and duty cycle of

compatible TTL signals. The range of measurement frequency is 100 mHz ~ 200 MHz. When use the frequency meter, a compatible TTL signal is imported via the external digital modulation or frequency meter interface (FSK/Trig/Counter).

Select **Utility** → **Counter** key in turn to read the value of signal “frequency”, “period”, “duty cycle”, “positive pulse” or “negative pulse” in the parameter list. If there is no signal input, the parameter list of the frequency meter is always display the last measured value. The frequency meter will only refresh the display when a compatible TTL signal is imported via the external digital modulation or frequency meter interface (FSK/Trig/Counter).

3.2.6 Arbitrary Wave Manager

The user can check the local arbitrary wave, delete user-defined arbitrary wave, export or import the arbitrary wave from external storage device.

1. Check local arbitrary wave

Press **Utility** → **System** → **Arb Manage** → **Wave** → **Local** → **Confirm** → **Other** → **Confirm** key in turn to check all the arbitrary waves in other list.

2. Delete user-defined arbitrary wave

Press **Utility** → **System** → **Arb Manage** → **User** → **Confirm** key in turn to select the arbitrary wave “ABA_1_2.bsv”, and then press the softkey **Delete** to delete it.

3. Delete user-defined arbitrary wave on the current page

Press **Utility** → **System** → **Arb Manage** → **User** → **Confirm** key in turn, and press the softkey **Delete Current Page** to delete the arbitrary wave on the current page.

4. Delete all the user-defined arbitrary waves

Press **Utility** → **System** → **Arb Manage** → **User** → **Confirm** key in turn, and press the softkey **Delete All** to delete all the user-defined arbitrary waves in the current file folder.

5. Export the user-defined arbitrary wave

Press **Utility** → **System** → **Arb Manage** → **User** → **Confirm** key in turn, and select the arbitrary wave “ALT_03.bsv” in other list and then press the softkey **Export** to export it to external storage device.

6. Export all the user-defined arbitrary waves

Press **Utility** → **System** → **Arb Manage** → **User** → **Confirm** key in turn, and then press the softkey **Export All**, the arbitrary wave of the current file folder will export to external storage device.

7. Import the arbitrary wave

Press **Utility** → **System** → **Arb Manage** → **External** → **Confirm** key in turn, and select an

arbitrary wave catalogue, press the rotary knob to open the arbitrary list, and then select the arbitrary wave "ABA_1_2.bsv", press the softkey **Import** to import it to the user catalogue in arbitrary wave manager.

8. Import the arbitrary wave on the current page

Press **Utility** → **System** → **Arb Manage** → **External** → **Confirm** key in turn, and select an arbitrary wave catalogue, press the rotary knob to open the arbitrary list, press the softkey **Import Current Page** to import it to the user catalogue in arbitrary wave manager.

9. Import all the arbitrary waves

10. Press **Utility** → **System** → **Arb Manage** → **External** → **Confirm** key in turn, and select an arbitrary wave catalogue, press the rotary knob to open the arbitrary list, press the softkey **Import All** to import the arbitrary wave in the current file folder to the user catalogue in arbitrary wave manager.

3.2.7 Network Setting

Select **Utility** → **LAN Config** key in turn to enter the network setting page.

1. Access mode

Press the softkey **IP Type** to select manual or automatic.

2. IP address

The format IP address is nnn.nnn.nnn.nnn, the range of the first nnn is 1~223, the range of other three nnn is 0~255. It is recommended that you consult network administrator for an available IP address. Select the softkey **IP**, use the numerical keyboard, rotary knob or arrow key to enter IP address. This setting can be saved to nonvolatile memory. The instrument will automatically load the set IP address when the instrument is rebooted.

3. Subnet mask

The format of subnet mask address is nnn.nnn.nnn.nnn, the range of nnn is 0~255. It is recommended that you consult network administrator for an available subnet mask. Select the softkey **Mask**, use the numerical keyboard, rotary knob or arrow key to enter subnet mask. The instrument will automatically load the set IP address when the instrument is rebooted.

4. Gateway

The format of gateway is nnn.nnn.nnn.nnn, the range of nnn is 0~255. It is recommended that you consult network administrator for an available gateway. Select the softkey **Gateway**, use the numerical keyboard, rotary knob or arrow key to enter gateway. The instrument will automatically load the set IP address when the instrument is rebooted.

5. Physical address

Physical addresses are numbered from 0 and sequentially incremented by 1 each time.

Thus, the physical address space of the memory grows linearly. It is represented as a binary number, an unsigned integer, written in hexadecimal number format.

3.2.8 System

Function Menu	Function Sub-menu	Setting	Description
	Language	English, simplified Chinese, German	
	Phase synchronization	Independent, Sync	
	Sound	OFF/ON	
	Numeric separator	Comma, Space, none	
	Backlight	10 %, 30 %, 50 %, 70 %, 90 %, 100 %	
	Arbitrary wave manager	Local, user, external	
	Screen saver	OFF, 5 minutes, 15 minutes, 30 minutes, 1 hour	
	Default Setting		Restore to the factory setting
	Help		Help Information
	About		Model's name, version and company's website

Select **Utility** → **System** key in turn to enter the system setting page.

Note: As the system has several menus, there are two pages, press the softkey **Next** to turn the page.

1. Language

Press the softkey **Language** to set the system language to simplified Chinese, English or German.

2. Phase Synchronization

Select the softkey **Phase Sync** to select "Independent" or "Sync".

Independent: The output phase of CH1 and CH2 is not related.

Sync: The output phase of CH1 and CH2 is synchronizing.

3. Sound

Turn on/off the beep function, select the softkey **Beep** to select "OFF" or "ON".

4. Numeric Separator

Set the separator for the numerical value between in parameters of channel, press the softkey **NumFormat** to select comma, space or none.

5. Backlight

Set the backlight brightness of screen, press the softkey **BackLight** to select 10 %, 30 %, 50 %, 70 %, 90 % or 100 %.

6. Screen Saver

Press the softkey **ScrnSvr** to select OFF, 5 minutes, 15 minutes, 30 minutes or 1 hour. When there is no arbitrary operation, the instrument enters the screen saver state as the setting time. When **Mode**, **CH1**, **CH2** key turns blinking, press arbitrary key to recover.

7. Default Setting

Restore to the factory setting.

8. Help System

Built-in help system provides help text for key or menu on the front panel. Press the help topic to check help information of front panel operation. Long press any one of soft key or button to check help information, such as press Wave key to check. Press arbitrary key or rotary knob to exit the help. Long press any one of softkey or button to check help information, such as press **Wave** key to check the help information. Press arbitrary key or rotate the rotary knob to exit the help.

9. About

Press the softkey **About** to check the device model, SN, version info and company's website.

Chapter 4 Advanced Application

This chapter is to introduce modulation of AM, FM, PM, ASK, FSK, 3FSK, 4FSK, PSK, BPSK, QPSK, OSK, SUM, DSB-AM, QAM and PWM.

Press **Mode** key to enter modulation mode and the key will light up. Press it again to exit the modulation mode and the key will light off.

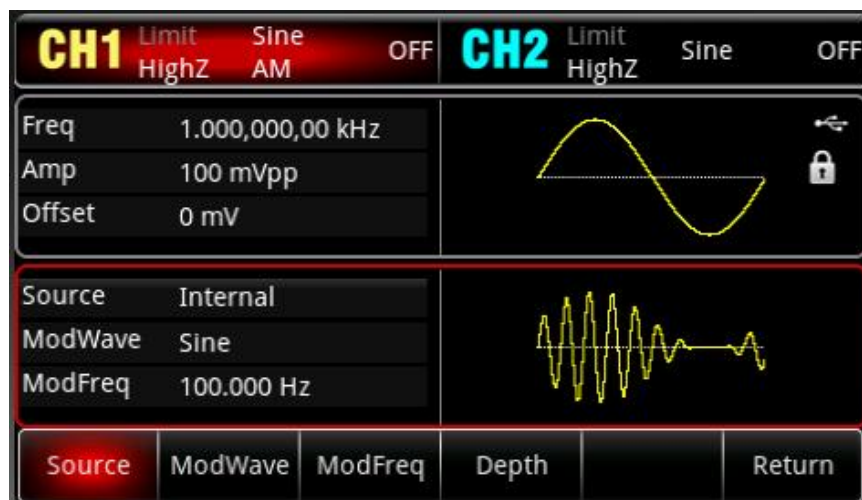
4.1 Modulation Wave Output

4.1.1 Amplitude Modulation (AM)

In AM mode, modulated wave is consist of the carrier wave and the modulation wave. The amplitude of the carrier wave will changed with the amplitude of the modulation wave. The modulation mode of the two channels are independent, user can set the same or different modulation mode for CH1 and CH2.

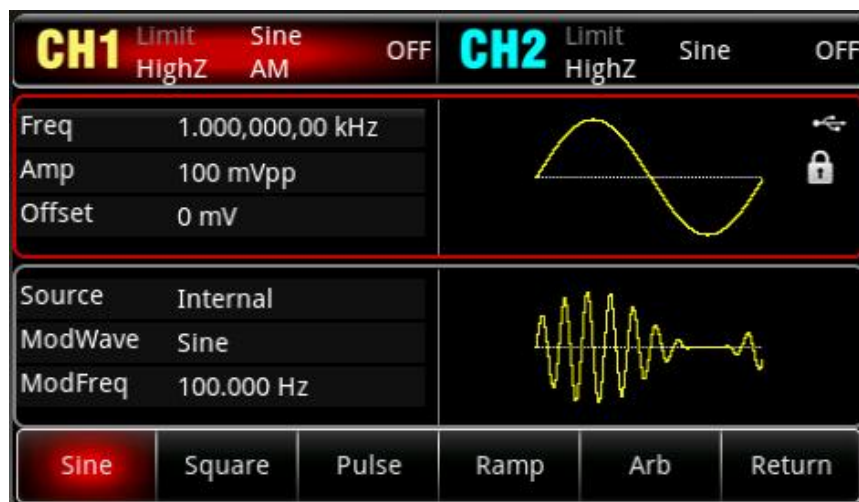
Select AM mode

Press **Mode** → **Mod** → **AM** key in turn to turn on AM mode, the instrument will output the modulated waveform according to the currently modulation wave and the carrier wave.



Select Carrier Wave

The carrier wave can be sine wave, square wave, ramp wave or arbitrary wave. The default is sine wave. After AM mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

The frequency range of the carrier wave can be set differently. The default frequency of the carrier wave is 1 kHz. The frequency of each carrier wave are shown the following table.

Carrier Wave	Frequency					
	UTG2122X		UTG2082X		UTG2062X	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Sine wave	1 μ Hz	120 MHz	1 μ Hz	80 MHz	1 μ Hz	60 MHz
Square wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz
Pulse wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz
Ramp wave	1 μ Hz	5 MHz	1 μ Hz	4 MHz	1 μ Hz	3 MHz
Arbitrary wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz

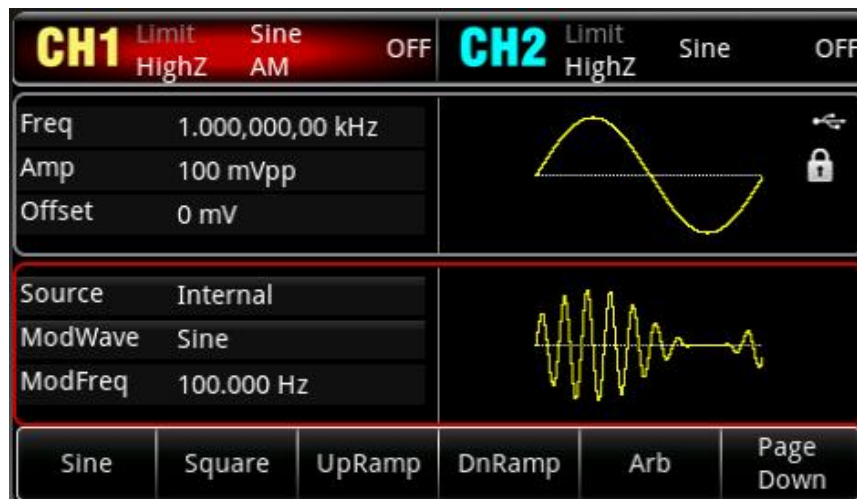
If the frequency of the carrier wave need to be set, please select the carrier wave at first, and then use multifunction rotary knob or press the softkey **ModFreq** to set the frequency, use the numerical keyboard to enter number and select unit softkey to complete the setting.

Select Modulation Wave

If the modulation source of this instrument comes from internal, then the modulation wave can be sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When AM mode is enabled, the default modulation wave is sine wave. The modulation wave can be changed by using multifunction rotary knob or pressing the softkey **ModWave** in AM mode.

- Square wave: Duty cycle is 50 %
- Rising ramp wave: Symmetry is 100 %.

- Falling ramp wave: Symmetry is 0 %.
- Arbitrary wave: The length of arbitrary wave limits at 4 kpts by the method of automatic extracting point when arbitrary wave is the modulation wave.
- Noise Wave: White Gauss noise



Modulation Frequency Setting

The frequency range is 2 mHz ~ 1 MHz (the default is 100 Hz). When AM mode is enabled, the default frequency of the modulation wave is 100 Hz. It can be change by using multifunction rotary knob or pressing the softkey **ModFreq**, and then use the numerical keyboard to enter number and select unit soft key to complete the setting in AM mode.

Modulation Depth Setting

The modulation depth indicates the change of amplitude, which expressed in percentage. AM modulation depth range can be set between 0 %~120 %, the default range is 100 %.

- When the modulation depth is 0 %, it outputs a constant amplitude (a half of the carrier wave amplitude).
- When the modulation depth is 100 %, the output amplitude will change with the modulation waveform.
- When the modulation depth is greater than 100 %, the output amplitude of the instrument will not greater than 10 Vpp (load is 50 Ω.)

It can be change by using multifunction rotary knob or pressing the softkey **Depth**, and then use the numerical keyboard to enter number and select unit soft key to complete the setting in AM mode.

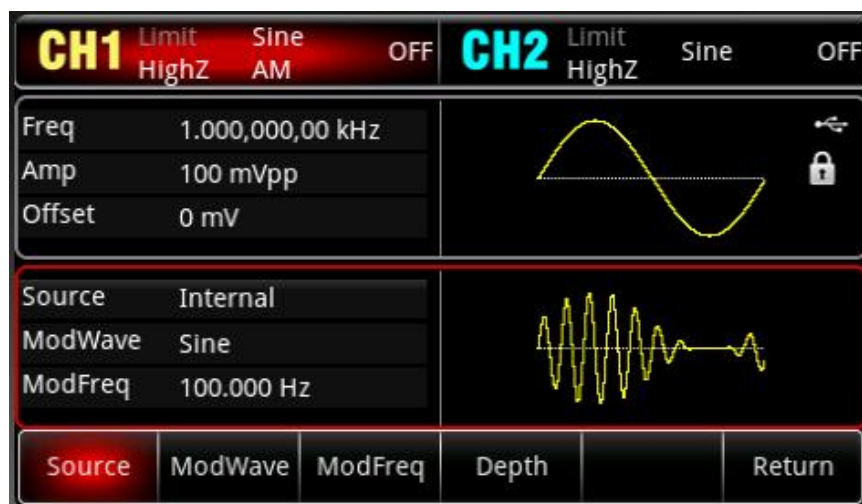
Comprehensive Example

In AM mode, set an internal 200 Hz sine wave as a modulating signal, another square wave

signal with frequency 10 kHz, amplitude 200 mVpp, duty ratio 45 % as the carrier wave and set modulation depth to 80 % at last. The setting steps are as follows.

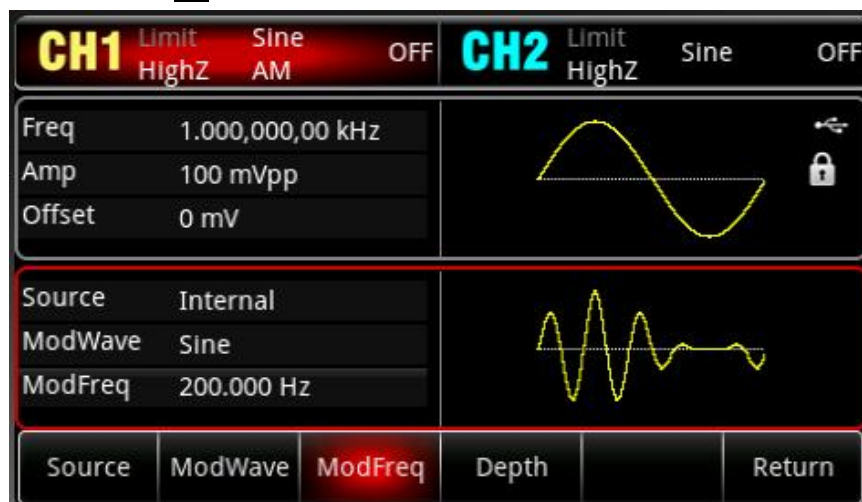
1) Enabling AM mode

Press **Mode** → **ModWave** → **AM** key in turn to turn on AM mode.



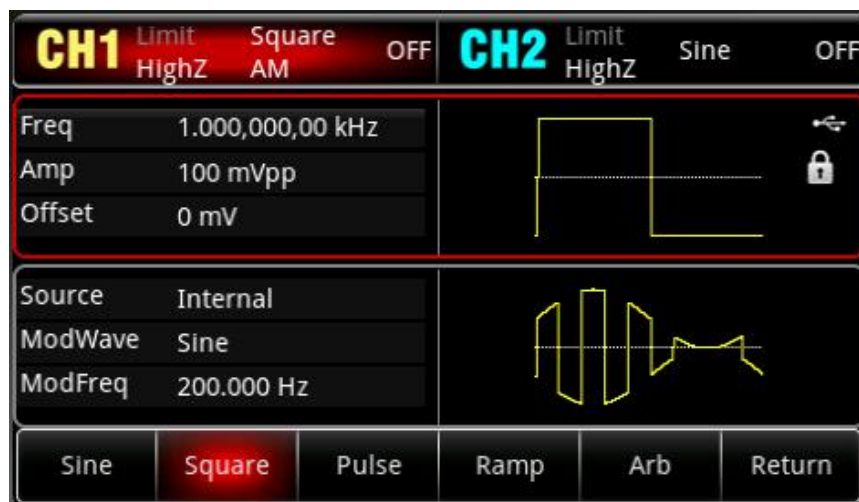
2) Set modulation signal

Base on the step 1, press the softkey **ModFreq** and use the numerical keyboard to enter 200 and then select the unit to **Hz**.



3) Set carrier wave and parameter

Press **Wave** key to enter the carrier wave page and then select square wave as the carrier wave (the default is sine wave).

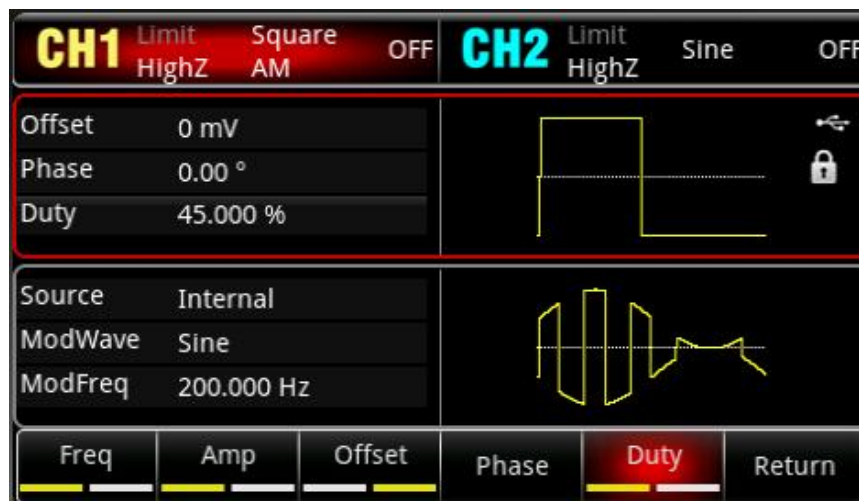


Press the softkey **Freq** to set the frequency, use the numerical keyboard to enter 10 and then select the unit of parameter to **kHz**.

Press the softkey **Amp** soft key to set the amplitude, use the numerical keyboard to enter 200 and then select the unit of parameter to **mVpp**.

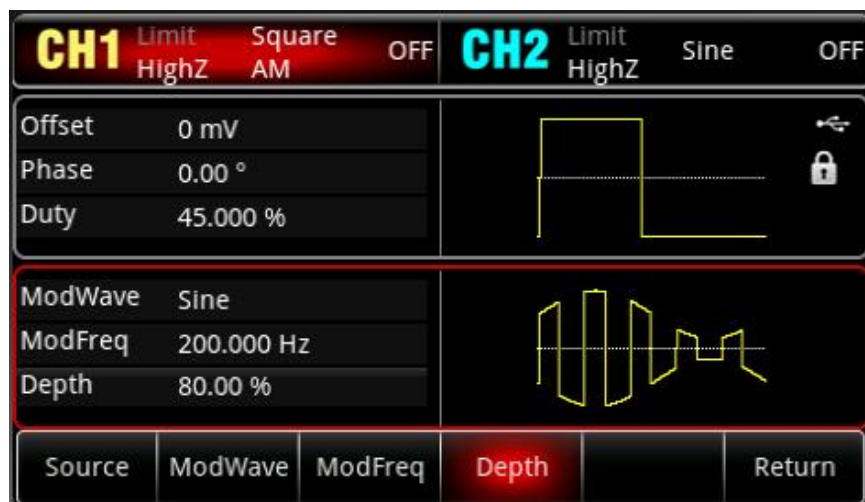
Press the softkey **Duty** soft key to set the duty cycle, use the numerical keyboard to enter 45 and then select the unit of parameter to %.

As shown in the following figure.



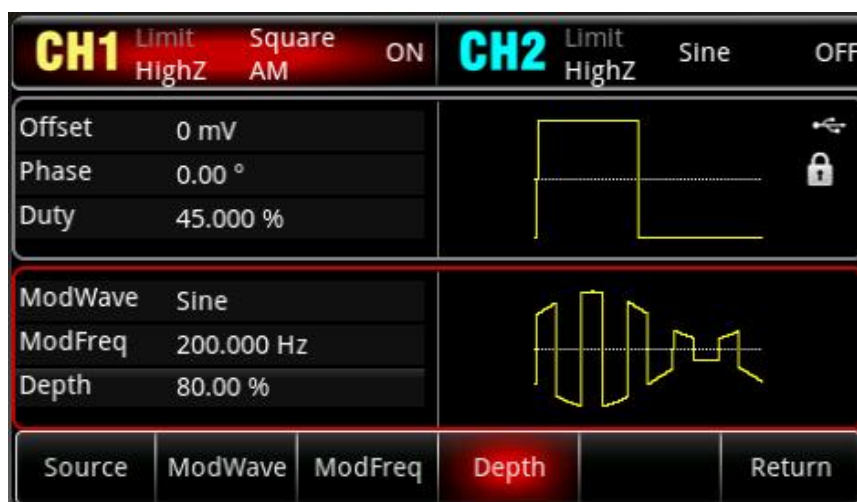
4) Set modulation depth

After the parameter setting of the carrier wave is completed, press **Mode** → **ModWave** → **AM** key in turn to enter AM setting, press the softkey **Depth**, use the numerical keyboard to enter 80 and then select the unit of parameter to %.

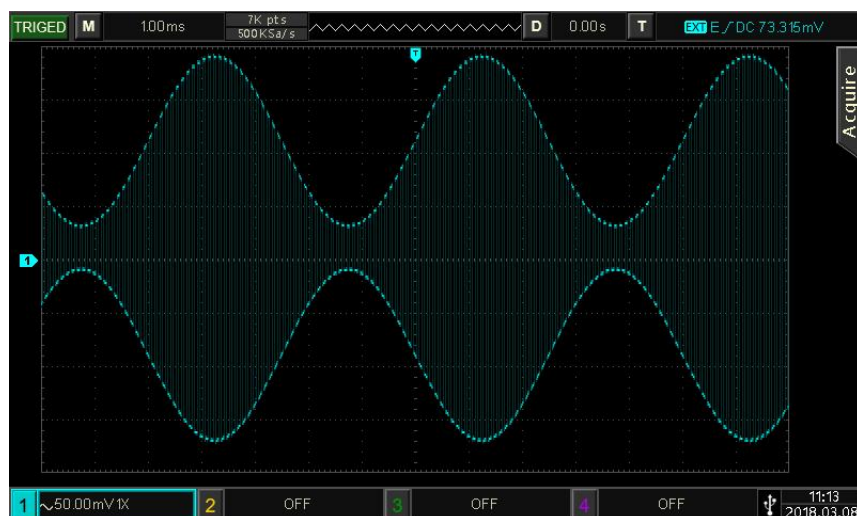


5) Enabling channel output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



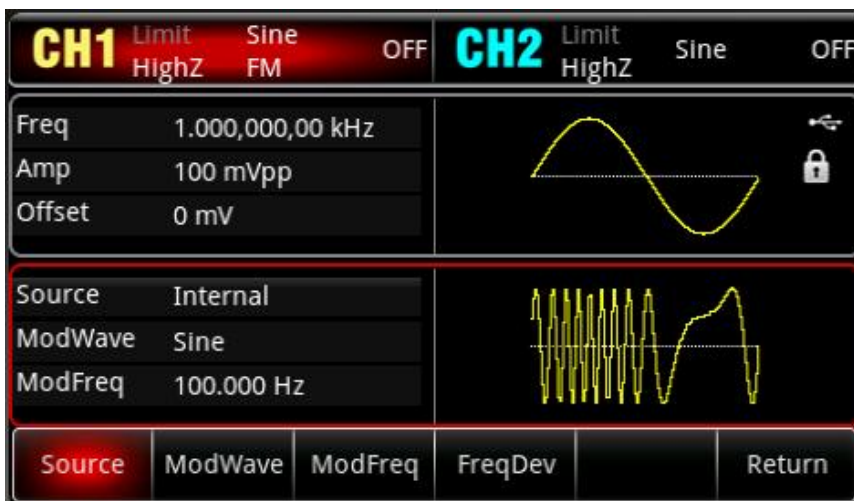
To view the modulation waveform of AM through an oscilloscope as shown in the following figure.



4.1.2 Frequency Modulation (FM)

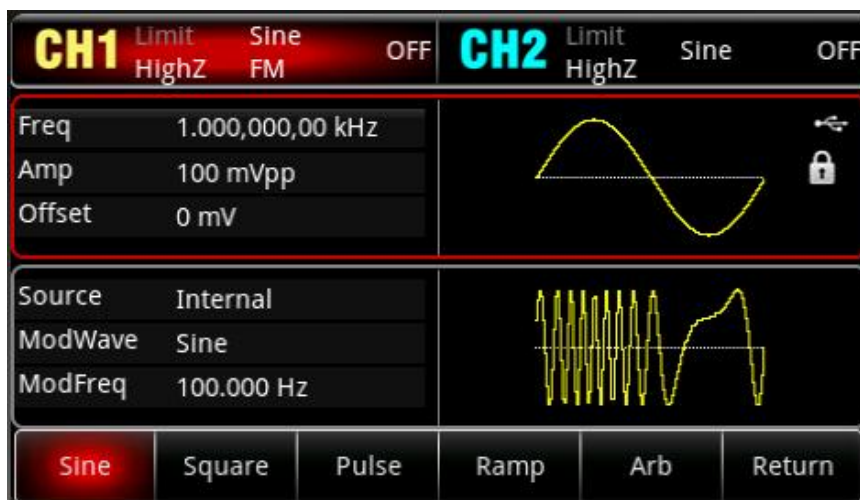
In FM mode, modulated wave is consist of the carrier wave and the modulation wave. The frequency of the carrier wave will changed with the amplitude of the modulation wave.

Press **Mode** → **Mod** → **FM** key in turn to turn on FM mode, the instrument will output the modulated waveform according to the currently modulation wave and the carrier wave.



Select Carrier Wave

The carrier wave can be sine wave, square wave, pulse wave, ramp wave or arbitrary wave. The default is sine wave. After FM mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

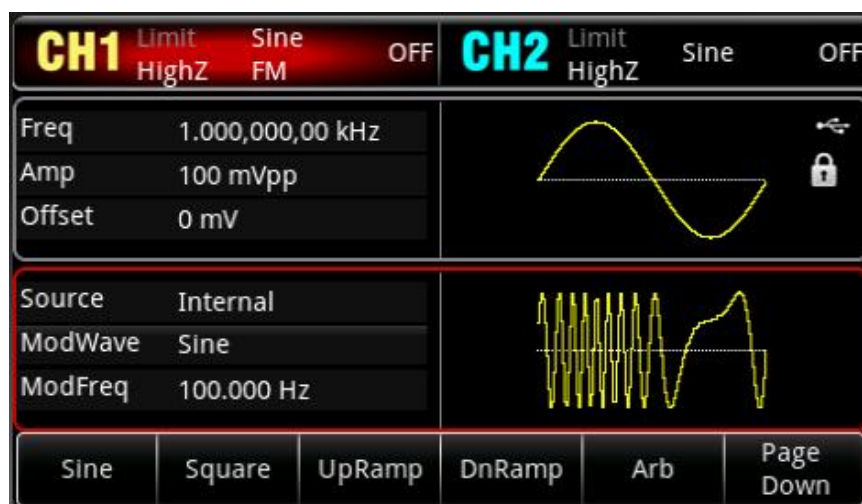
Refer to Carrier Wave Frequency in AM mode.

Select Modulation Wave

If the modulation source of this instrument comes from internal, then the modulation wave can

be sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When FM mode is enabled, the default modulation wave is sine wave. The modulation wave can be changed by using multifunction rotary knob or pressing the softkey **ModWave** in FM mode.

- Square wave: Duty cycle is 50 %
- Rising ramp wave: Symmetry is 100 %.
- Falling ramp wave: Symmetry is 0 %.
- Arbitrary wave: The length of arbitrary wave limits at 4 kpts by the method of automatic extracting point when arbitrary wave is the modulation wave.
- Noise Wave: White Gauss noise



Modulation Frequency Setting

The frequency range is 2 mHz ~ 1 MHz (the default is 100 Hz). When FM mode is enabled, the default frequency of the modulation wave is 100 Hz. It can be change by using multifunction rotary knob or pressing the softkey **ModFreq**, and then use the numerical keyboard to enter number and select unit soft key to complete the setting in FM mode.

Set Frequency Deviation

Frequency deviation indicates the frequency deviation of the wave that has been frequency modulated which relative to the frequency of carrier wave. FM deviation range can set from the minimum DC to a half of the currently maximum carrier wave frequency. The default frequency deviation is 1 kHz. It can be change by pressing the softkey **FreqDev** in FM mode.

- Frequency deviation $\leq$ Carrier wave frequency, if the frequency deviation is greater than the carrier wave frequency, the instrument will automatically limits the deviation to the maximum which allowed by the currently carrier frequency.

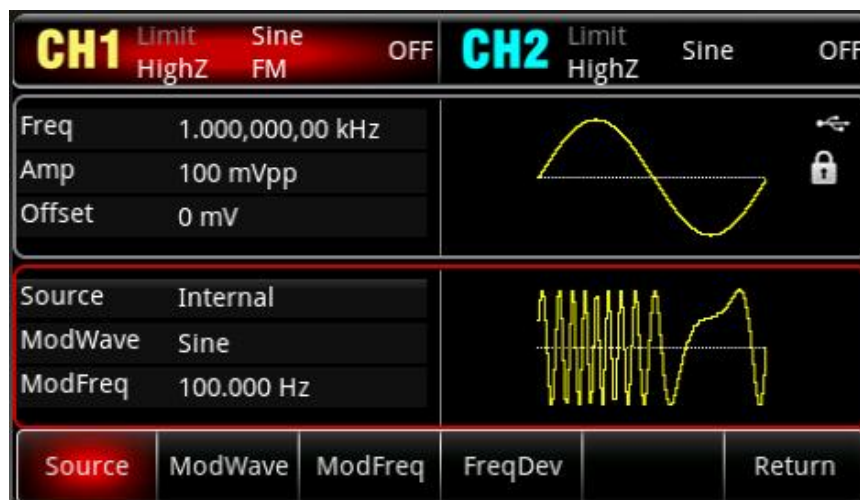
- The sum of the frequency deviation and the carrier wave frequency $\leq$ the maximum of the currently carrier frequency, if the frequency deviation value is invalid, the instrument will automatically limits the deviation to the maximum which allowed by the currently carrier frequency.

Comprehensive Example

In FM mode, set an internal 2 kHz square wave as a modulating signal, another sine wave signal with frequency 10 kHz, amplitude 100 mVpp as the carrier wave and set frequency deviation to 5 kHz at last. The setting steps are as follows.

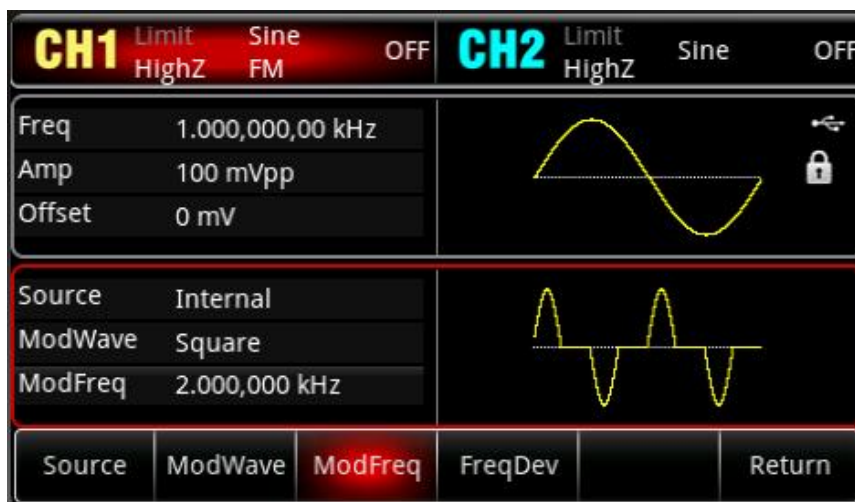
1) Enabling FM Mode

Press **Mode** → **ModWave** → **FM** key in turn to turn on FM mode.



2) Set modulation signal and wave

Base on the step 1, press the softkey **ModWave** to select square wave as the carrier wave, and press the softkey **ModFreq**, use the numerical keyboard to enter 2 and then select the unit to **kHz**.



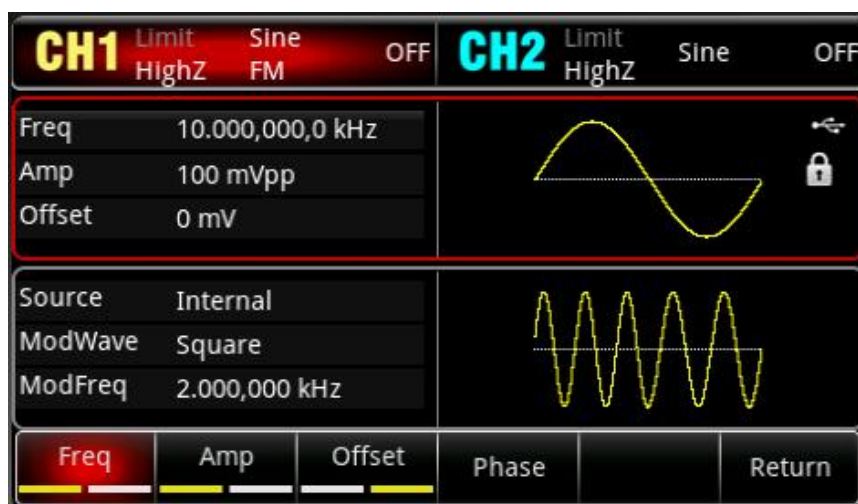
3) Set carrier wave and parameter

Press **Wave** key to enter the carrier wave page and then select square wave as the carrier wave (the default is sine wave).



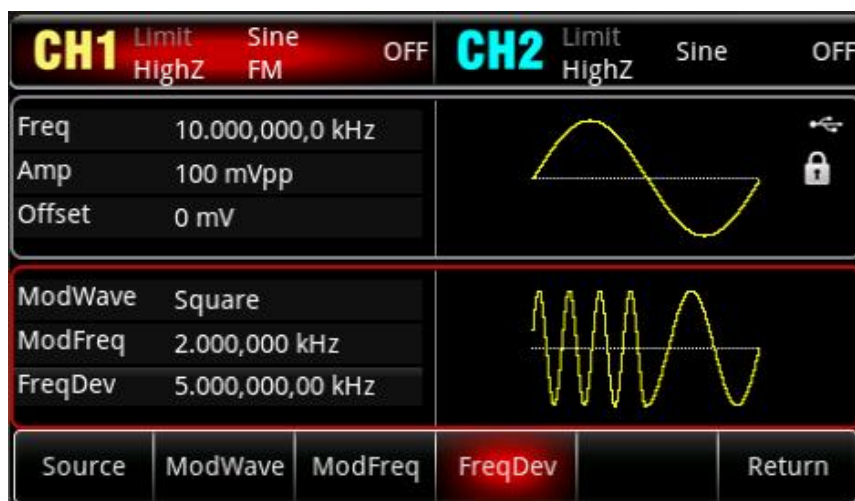
Press the softkey **Freq** to set the frequency, use the numerical keyboard to enter 10 and then select the unit of parameter to **kHz**.

Press the softkey **Amp** to set the amplitude, use the numerical keyboard to enter 100 and then select the unit of parameter to **mV**.



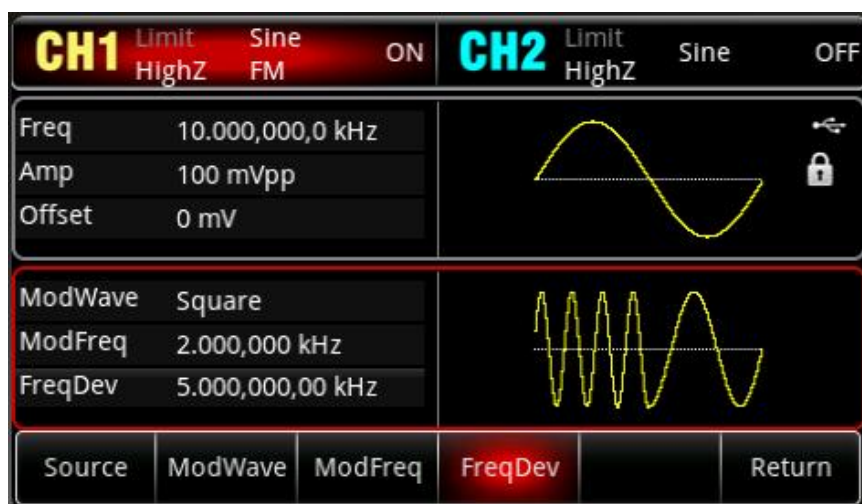
4) Set Frequency deviation

After the parameter setting of the carrier wave is completed, press **Mode** → **ModWave** → **FM** key in turn to enter FM setting, press the softkey **FreqDev**, use the numerical keyboard to enter 5 and then select the unit of parameter to **kHz**.

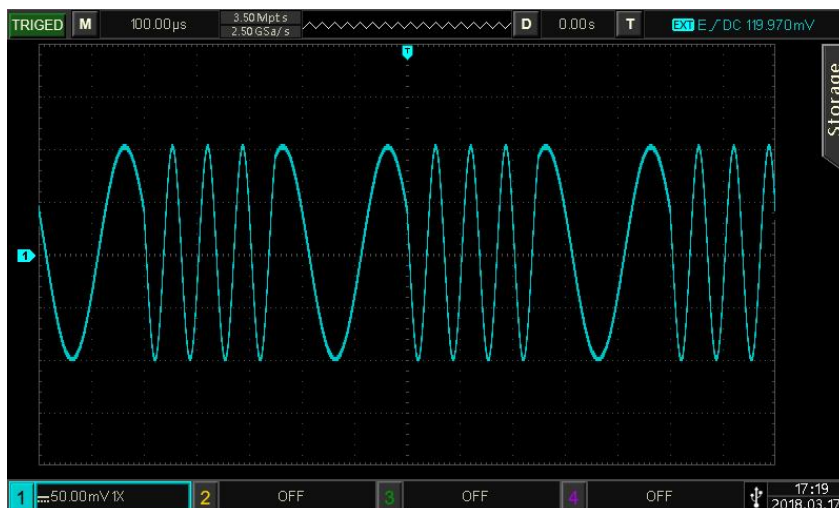


5) Enabling Channel Output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



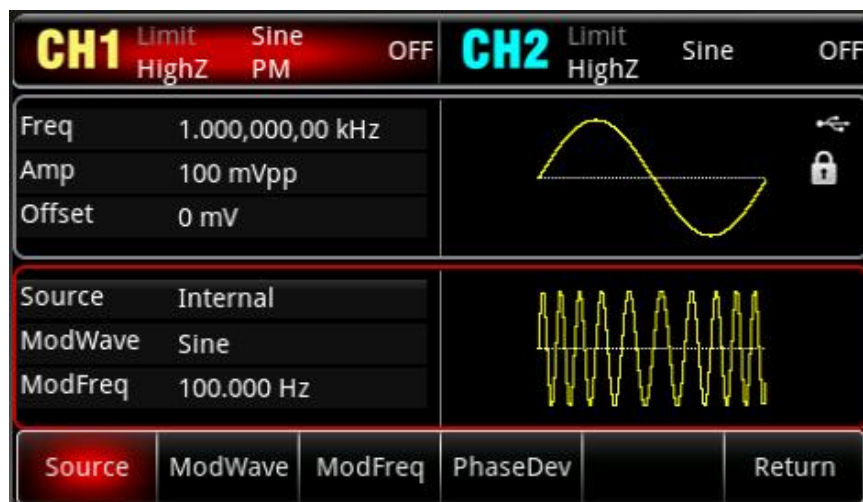
To view the modulation waveform of FM through an oscilloscope as shown in the following figure.



4.1.3 Phase Modulation (PM)

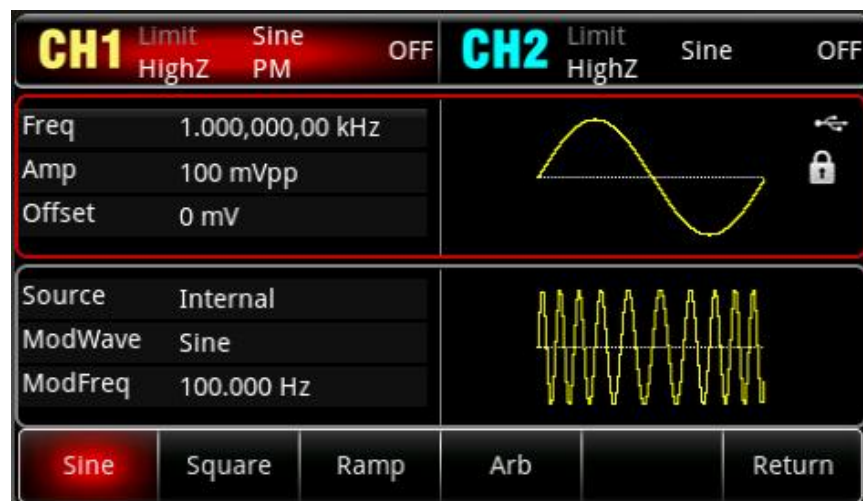
In PM mode, modulated wave is consist of the carrier wave and the modulation wave. The phase of the carrier wave will changed with the amplitude of the modulation wave.

Press **Mode** → **Mod** → **PM** key in turn to turn on PM mode, the instrument will output the modulated waveform according to the currently modulation wave and the carrier wave.



Select Carrier Wave

The carrier wave can be sine wave, square wave, ramp wave or arbitrary wave. The default is sine wave. After PM mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

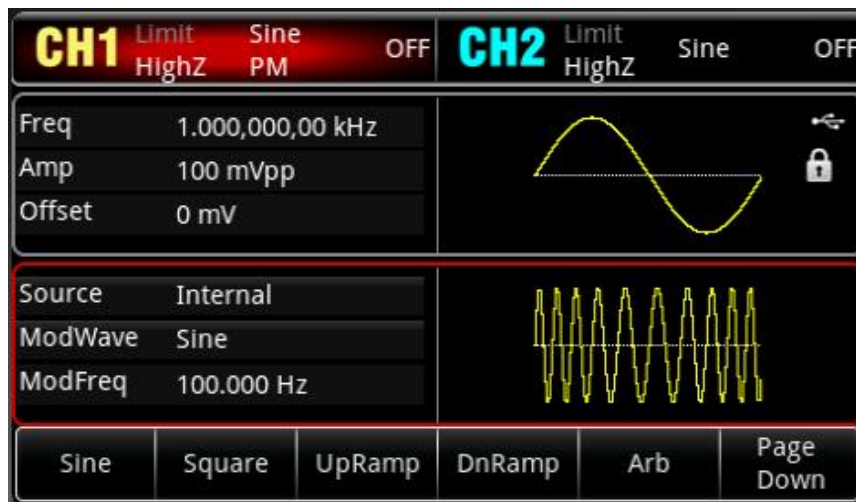
Refer to Carrier Wave Frequency in AM mode.

Select Modulation Wave

If the modulation source of this instrument comes from internal, then the modulation wave can be sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When PM mode is enabled, the default modulation wave is sine wave. The modulation wave can be changed by using multifunction rotary knob or pressing the softkey **ModWave** in PM mode.

- Square wave: Duty cycle is 50 %
- Rising ramp wave: Symmetry is 100 %.
- Falling ramp wave: Symmetry is 0 %.

- Arbitrary wave: The length of arbitrary wave limits at 4 kpts by the method of automatic extracting point when arbitrary wave is the modulation wave.
- Noise Wave: White Gauss noise



Modulation Frequency Setting

The frequency range is 2 mHz ~ 1 MHz (the default is 100 Hz). When PM mode is enabled, the default frequency of the modulation wave is 100 Hz. It can be change by using multifunction rotary knob or pressing the softkey **ModFreq**, and then use the numerical keyboard to enter number and select unit soft key to complete the setting in PM mode.

Phase Deviation Setting

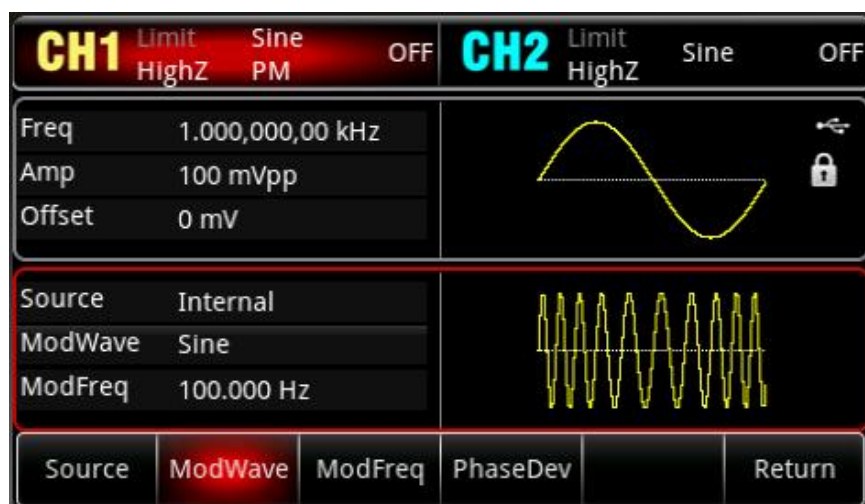
Phase deviation indicates the phase deviation of the wave that has been phase modulated which relative to the phase of carrier wave. PM deviation range can be set to 0° - 360°. The default phase deviation is 180°. It can be change by pressing the softkey **PhaseDev** and arrow keys in PM mode.

Comprehensive Example

In PM mode, set an internal 200 Hz sine wave as a modulating signal, another sine wave signal with frequency 900 Hz, amplitude 100 mVpp as the carrier wave and set phase deviation to 200° at last. The setting steps are as follows.

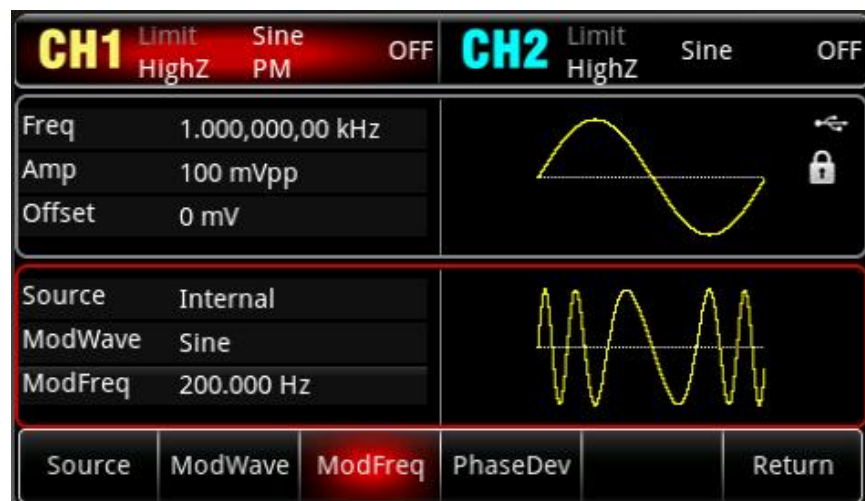
1) Enabling PM Mode

Press **Mode** → **ModWave** → **PM** key in turn to turn on PM mode.



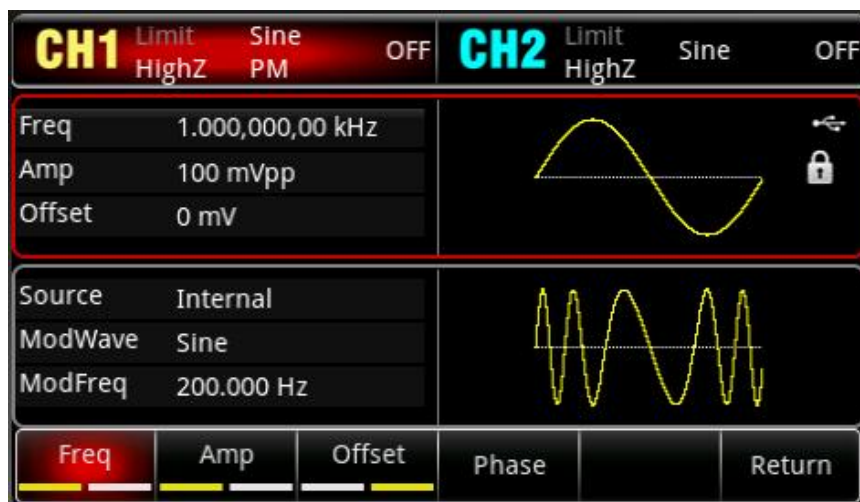
2) Set modulation signal

Base on the step 1, press the softkey **ModFreq** and use the numerical keyboard to enter 200 and then select the unit to **Hz**.



3) Set carrier wave and parameter

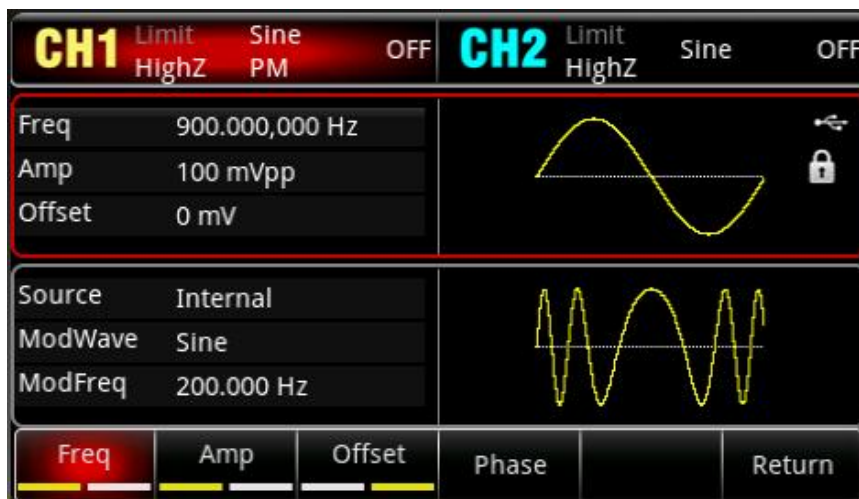
Press **Wave** key to enter the carrier wave page and then select square wave as the carrier wave (the default is sine wave).



Press the softkey **Freq** key to set the frequency, use the numerical keyboard to enter 900 and then select the unit of parameter to **Hz**.

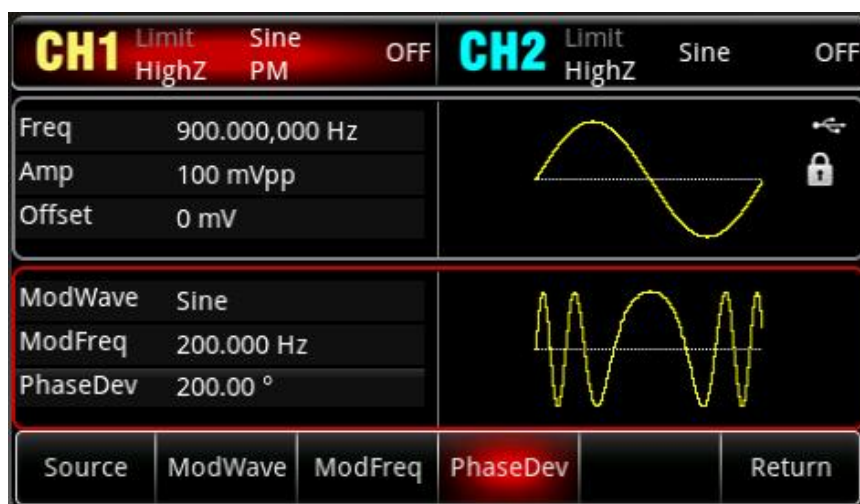
Press the softkey **Amp** to set the amplitude, use the numerical keyboard to enter 100 and then select the unit of parameter to **mVpp**.

As shown in the following figure.



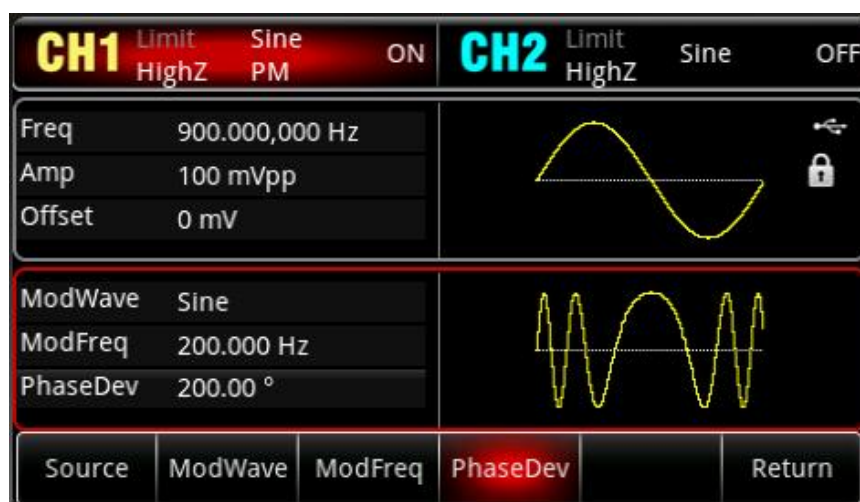
4) Set phase deviation

After the parameter setting of the carrier wave is completed, press **Mode** → **ModWave** → **PM** key in turn to enter AM setting, press the softkey **PhaseDev**, use the numerical keyboard to enter 200 and then select the unit of parameter to **°**.

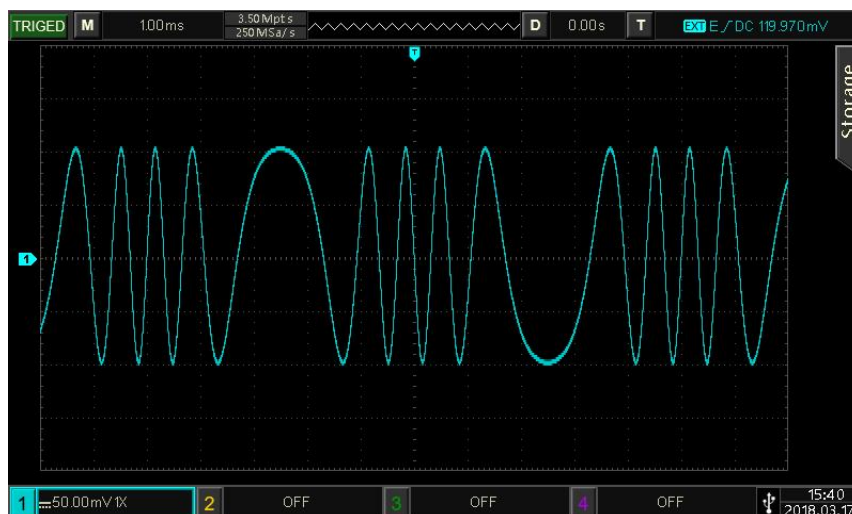


5) Enabling the channel output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



To view the modulation waveform of PM through an oscilloscope as shown in the following figure.

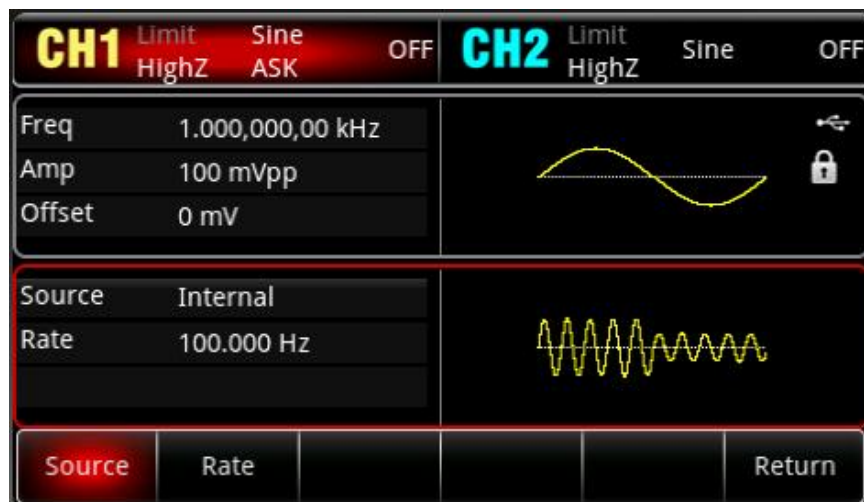


4.1.4 Amplitude Shift Keying (ASK)

In ASK mode, change the amplitude of carrier signal to express the digital signal as “0” or “1”. It outputs the carrier signals with different amplitude according to the logic level of modulation signal. The modulation mode of the two channels are independent, user can set the same or different modulation mode for CH1 and CH2.

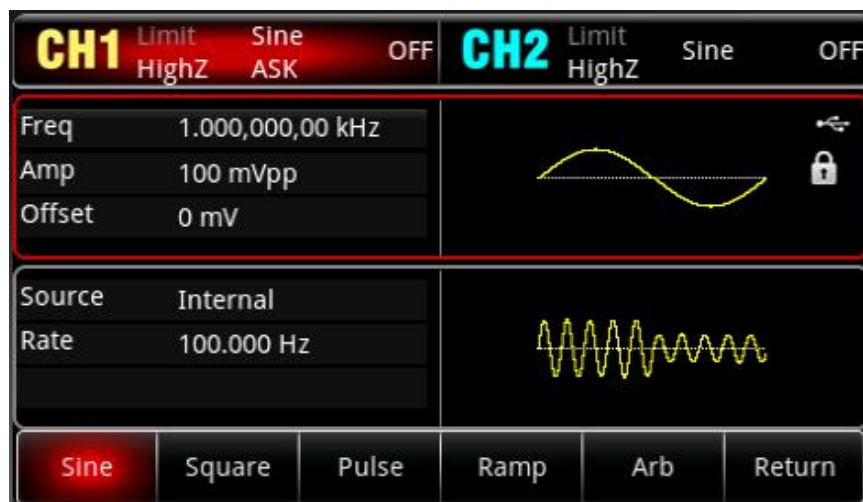
Select ASK

Select **Mode** → **Mod** → **ASK** key in turn to turn on ASK mode, the waveform generator will output the modulated waveform according to the currently ASK rate and the carrier wave.



Select Carrier Wave

Carrier wave of ASK can be sine wave, square wave, pulse wave or arbitrary wave (except DC). The default is sine wave. After ASK mode is selected, press **Wave** key to enter the carrier wave interface.

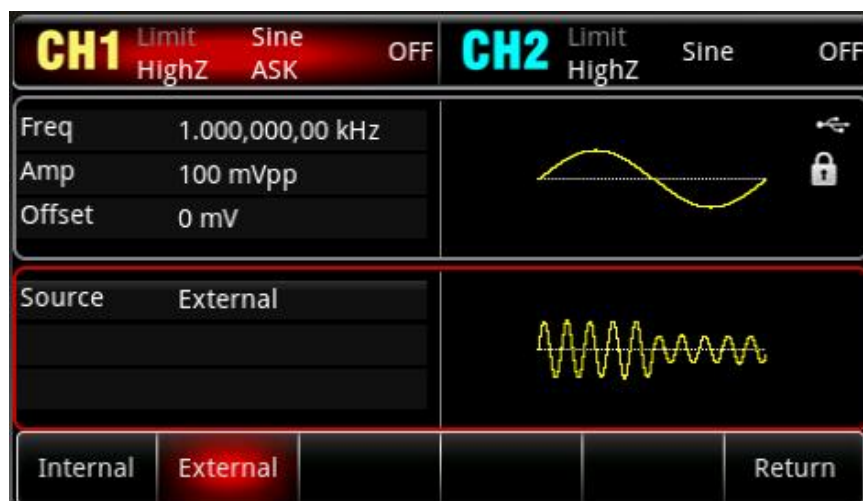


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When ASK mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **External** in turn.



1) Internal Source

When the modulation source is internal, the internal modulation wave is a square sine with duty ratio 50 % (non-adjustable). The frequency between the carrier frequency and the hopping frequency can be specified by adjusting the FSK rate.

2) External Source

When the modulation source is external, the carrier wave will be modulated by the external wave. ASK amplitude output is controlled by logic level on the external digital modulation terminal (FSK/Trig/Counter). For example, it outputs the frequency of carrier wave when the

logic level of external input is low; it outputs the hopping frequency when the logic level of external input is high.

ASK Rate Setting

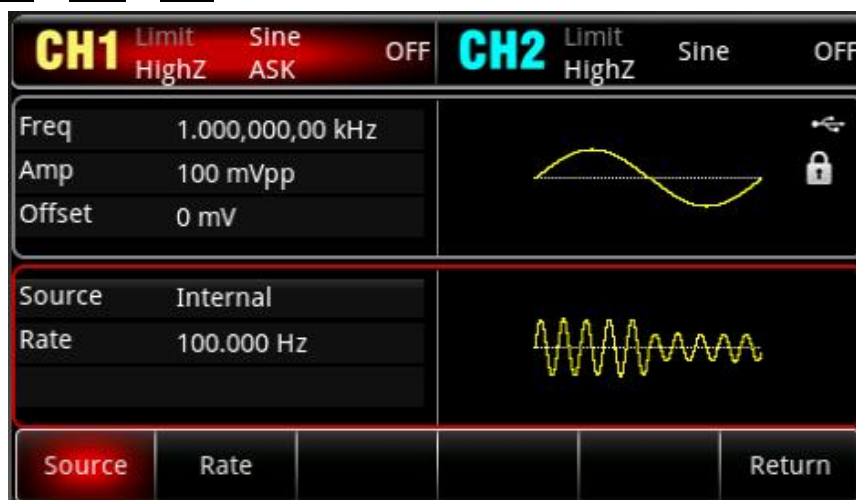
When ASK mode is enabled, it can set ASK rate (2 mHz ~ 100 kHz). The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Rate**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting.

Comprehensive Example

In ASK mode, set a sine wave with 15 kHz, 2 Vpp as the carrier signal, switching the amplitude of carrier frequency based on the frequency of 300 Hz. The setting steps are as follows.

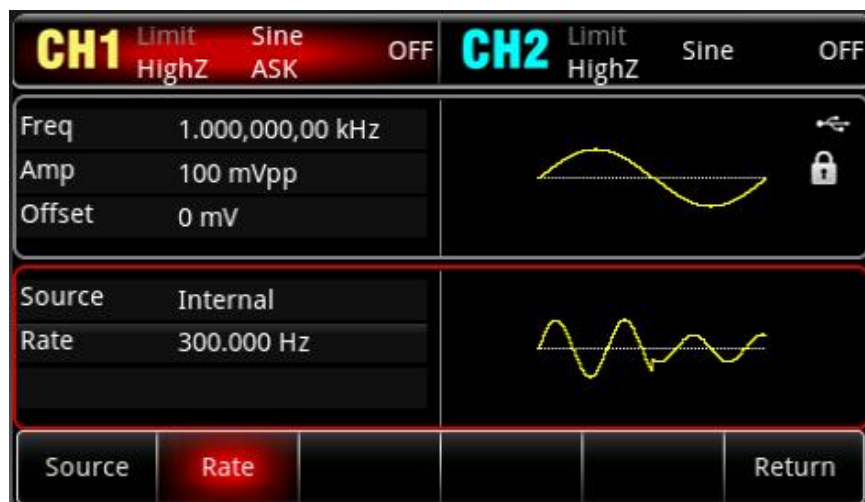
1) Enabling ASK mode

Press **Mode** → **Mod** → **ASK** key in turn to turn on ASK mode.



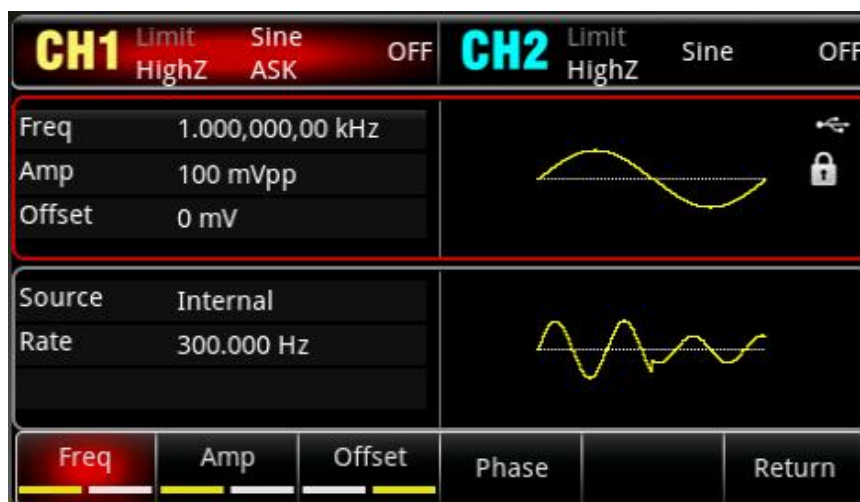
2) Set modulation rate

Press the softkey **Rate** and use the numerical keyboard to enter 300 and then select the unit to **Hz**.



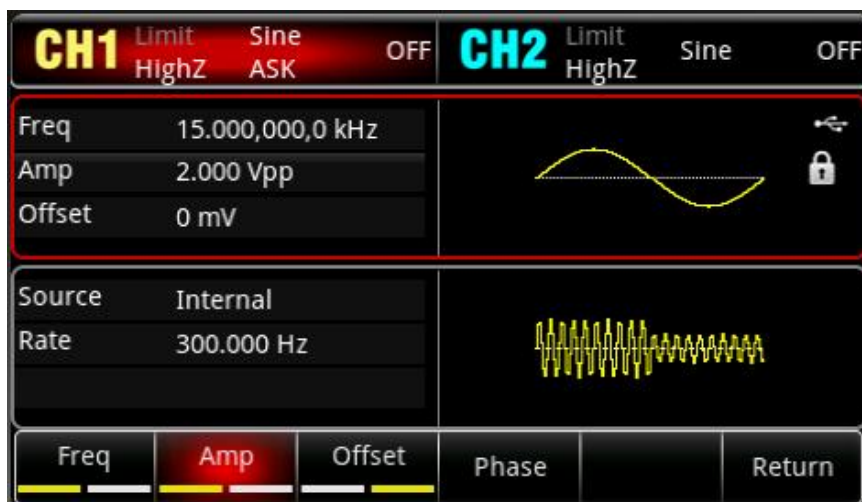
3) Set carrier signal

Press **Wave** key to enter the carrier wave page and then select sine wave as the carrier wave (the default is sine wave).



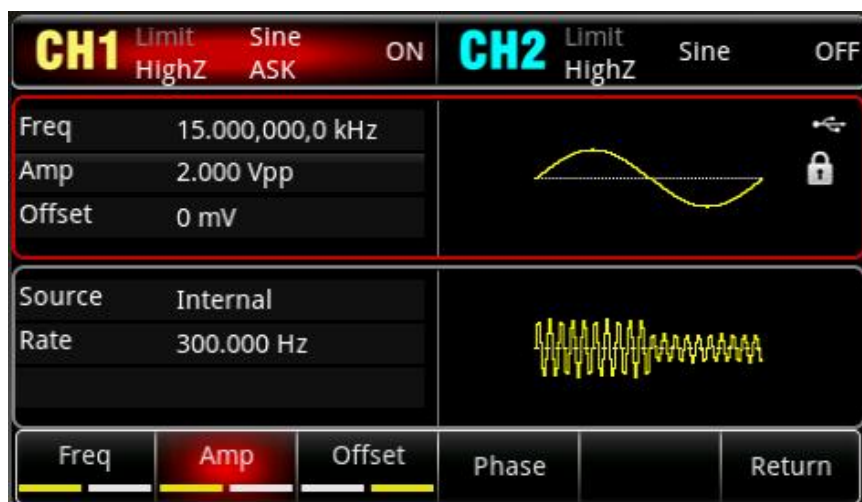
Press the softkey **Freq** key to set the frequency, use the numerical keyboard to enter 15 and then select the unit of parameter to **kHz**.

Press the softkey **Amp** soft key to set the amplitude, use the numerical keyboard to enter 2 and then select the unit of parameter to **Vpp**.

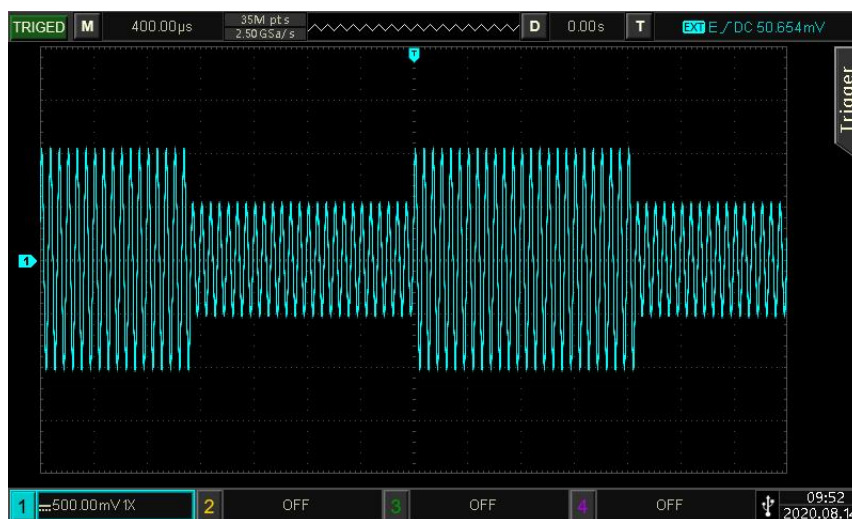


4) Enabling channel output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



To view the modulation waveform of ASK through an oscilloscope as shown in the following figure.

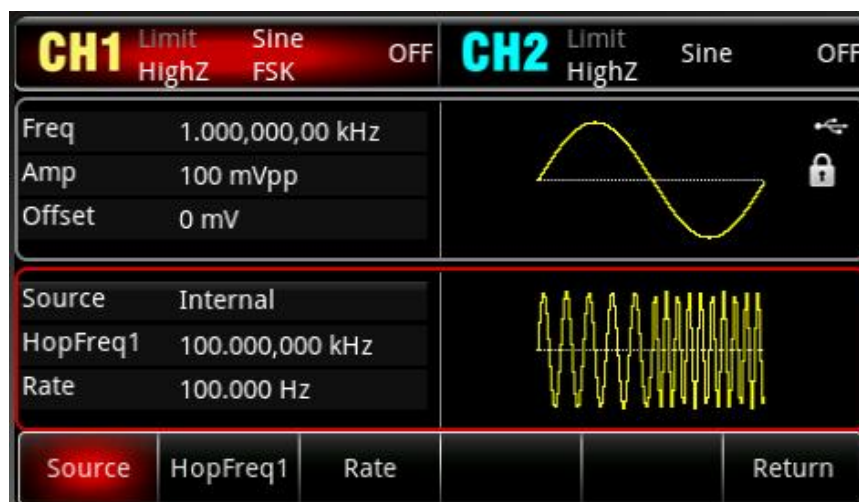


4.1.5 Frequency Shift Keying (FSK)

In FSK mode, it can set the switch rate between the frequency of carrier wave and hopping frequency.

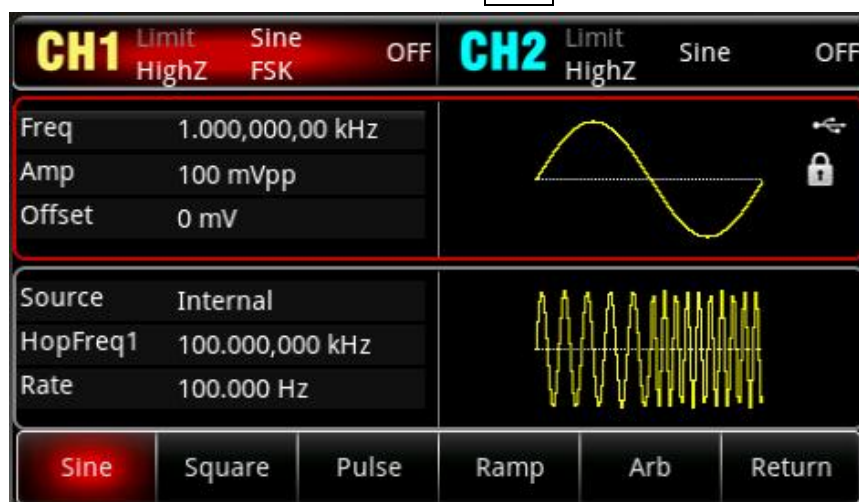
Select FSK

Select **Mode** → **Mod** → **FSK** key in turn to turn on FSK mode, the waveform generator will output the modulated waveform according to the currently setting.



Select Carrier Wave

Carrier wave of ASK can be sine wave, square wave, ramp wave or arbitrary wave. The default is sine wave. After FSK mode is selected, press **Wave** key to enter the carrier wave interface.

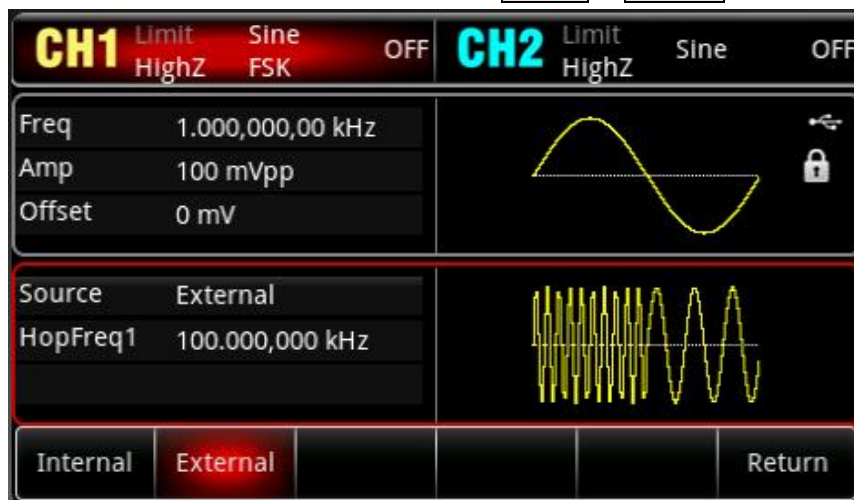


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When FSK mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **External** in turn.



1) Internal Source

When the modulation source is internal, the internal modulation wave is a square sine with duty ratio 50 % (non-adjustable). The frequency between the carrier frequency and the hopping frequency can be specified by adjusting the FSK rate.

2) External Source

When the modulation source is external, the carrier wave will be modulated by the external wave. FSK amplitude output is controlled by logic level on the external digital modulation terminal (FSK/Trig/Counter). For example, it outputs the frequency of carrier wave when the logic level of external input is low; it outputs the hopping frequency when the logic level of external input is high.

Hopping Frequency Setting

When FSK mode is enabled, the default hopping frequency is 100 kHz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **HopFreq1**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting. Hopping frequency range is depends on the carrier wave, the frequency setting of the carrier wave can refer to Carrier Frequency in AM mode.

FSK Rate Setting

When the modulation source is internal, the frequency can be switched between the carrier frequency and the hopping frequency. When FSK mode is enabled, it can set FSK rate (2 mHz ~ 1 MHz). The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys

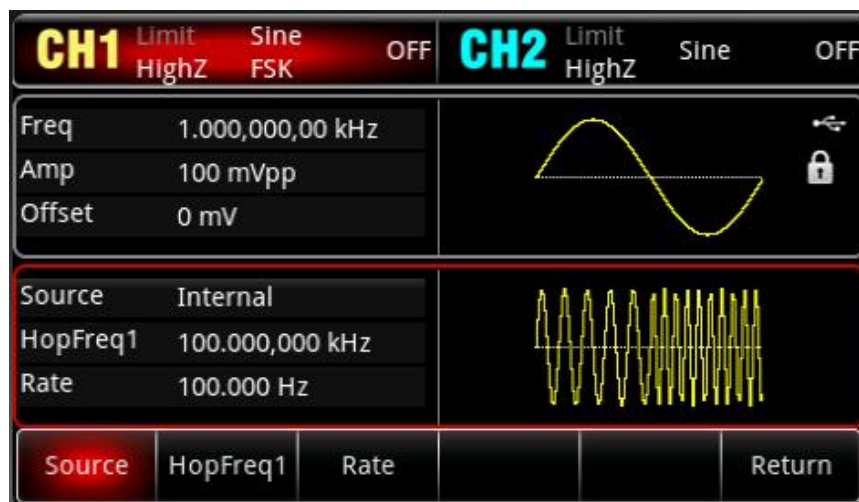
or pressing the softkey **Rate**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting.

Comprehensive Example

In FSK mode, set a sine wave with 2 kHz, 1 Vpp as the carrier signal, the hopping frequency is 800 Hz, switching the carrier frequency and hopping frequency based on the frequency of 200 Hz. The setting steps are as follows.

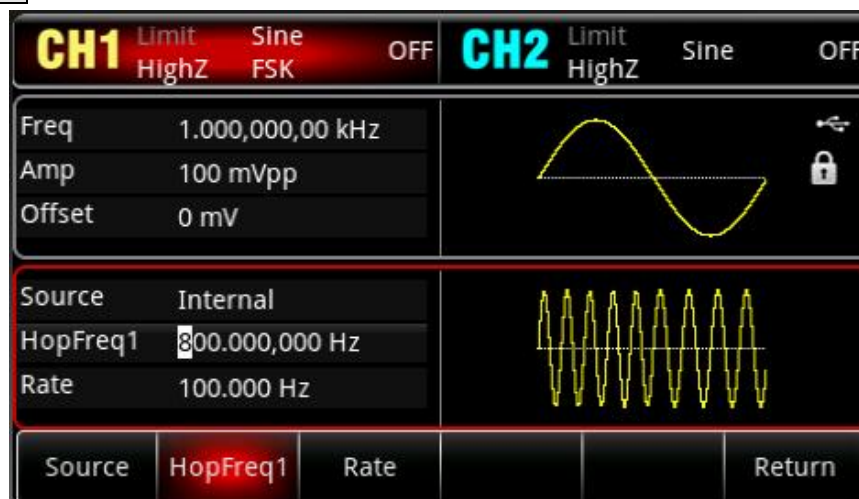
1) Enabling FSK mode

Press **Mode** → **Mod** → **FSK** key in turn to turn on FSK mode.



2) Set modulation rate

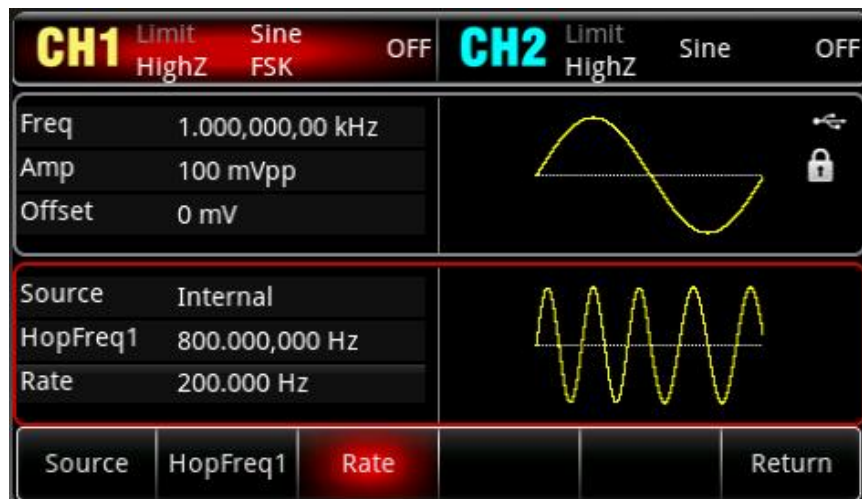
Press the softkey **HopFreq1** and use the numerical keyboard to enter 800 and then select the unit to **Hz**.



3) Set modulation rate

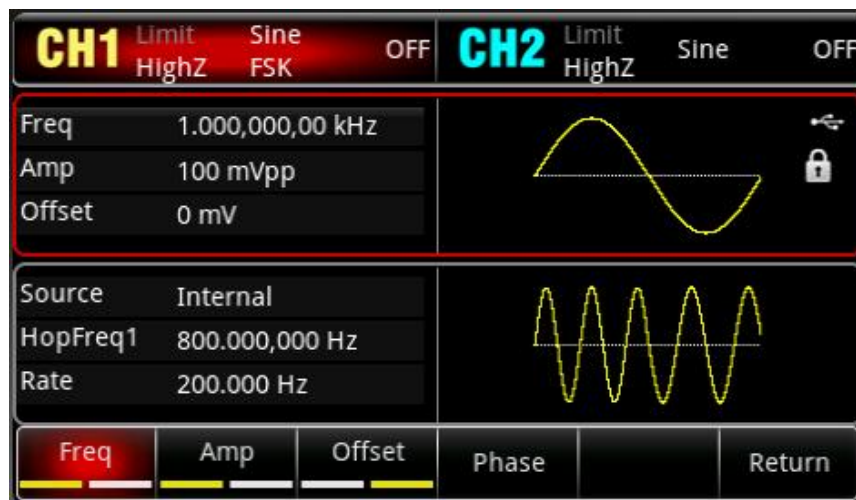
Press the softkey **Rate** and use the numerical keyboard to enter 200 and then select the unit

to **Hz**.



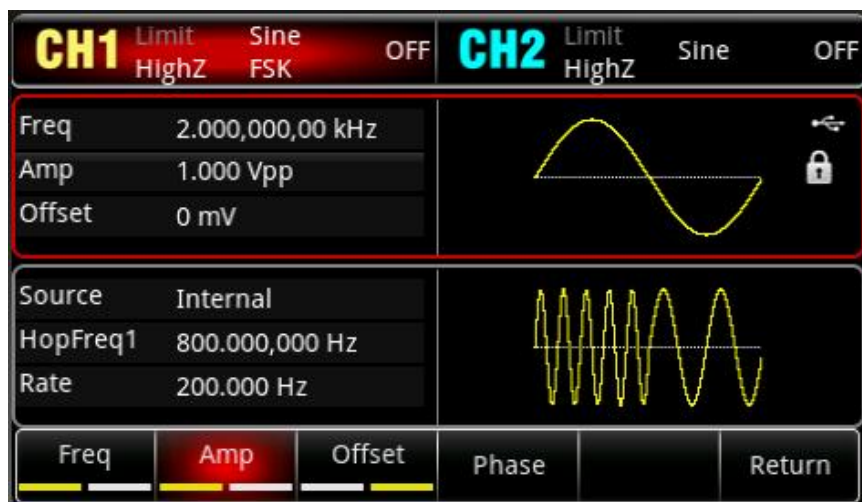
4) Set carrier signal

Press **Wave** key to enter the carrier wave page and then select sine wave as the carrier wave (the default is sine wave).



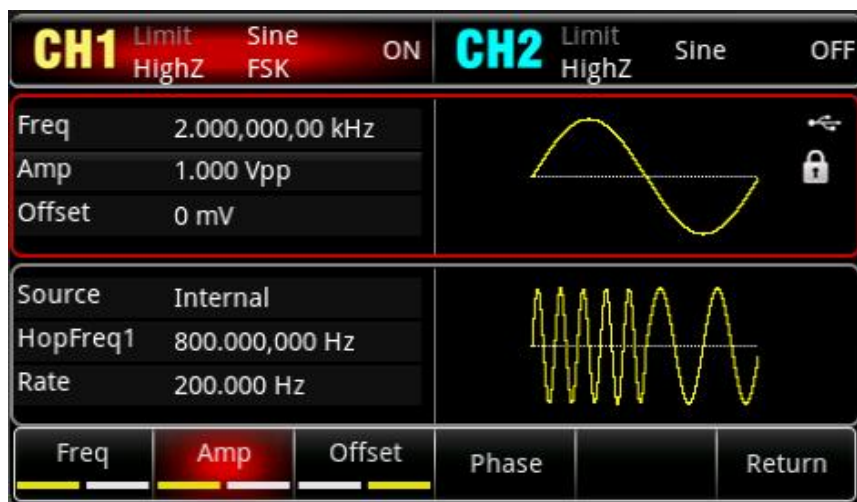
Press the softkey **Freq** to set the frequency, use the numerical keyboard to enter 2 and then select the unit of parameter to **kHz**.

Press the softkey **Amp** to set the amplitude, use the numerical keyboard to enter 1 and then select the unit of parameter to **Vpp**.

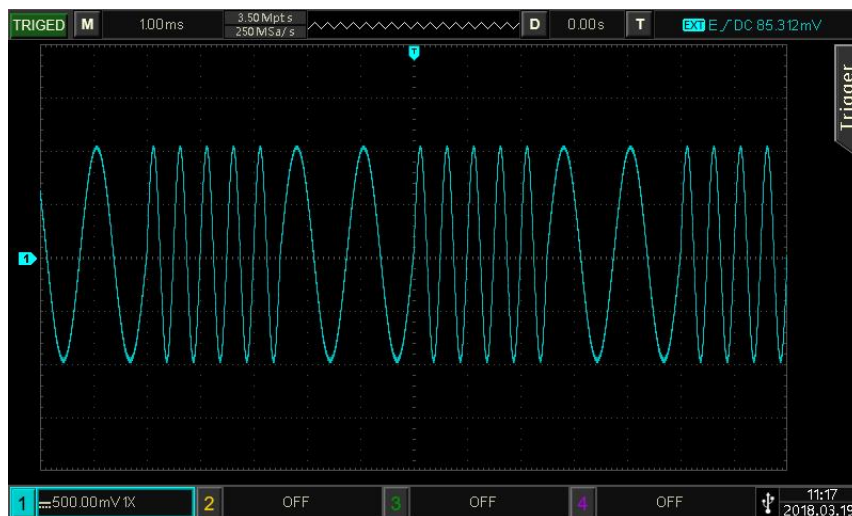


5) Enabling channel output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



To view the modulation waveform of FSK through an oscilloscope as shown in the following figure.

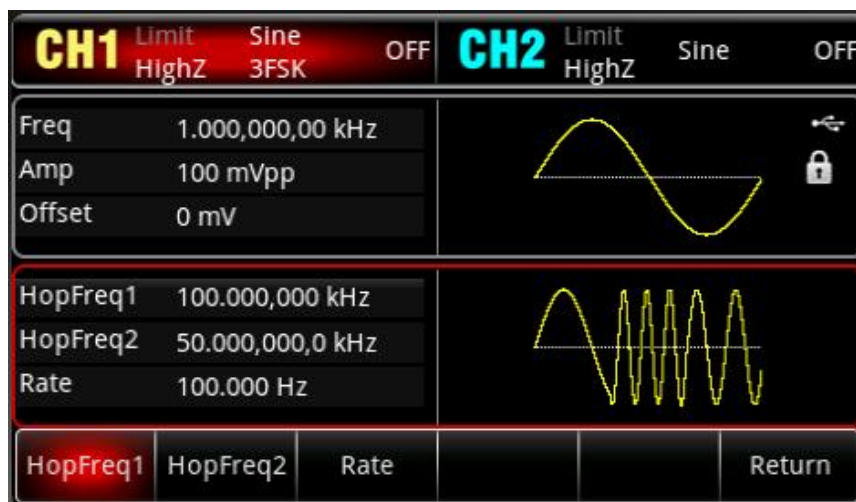


4.1.6 Three Frequency Shift Keying (3FSK)

In 3FSK mode, the function/arbitrary waveform generator can move among three preset frequency (carrier frequency and two hopping frequency) . It outputs the frequency of carrier signal or hopping frequency according to the logic of modulation signal. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

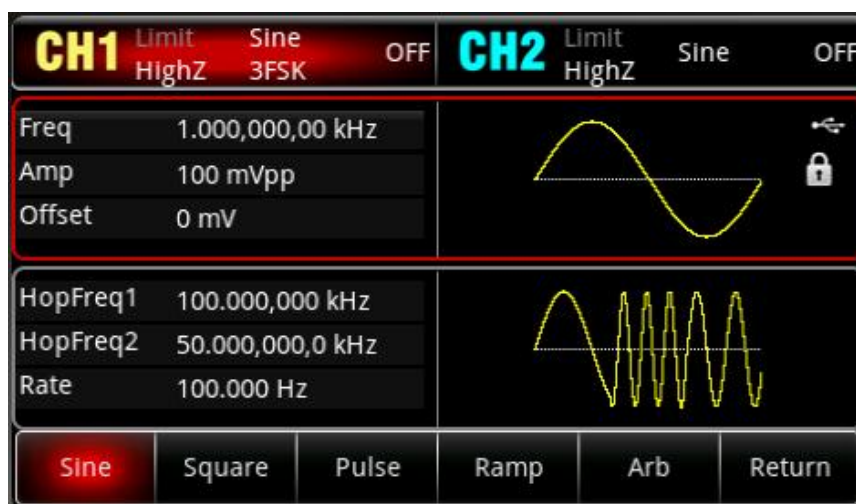
Select 3FSK mode

Press **Mode** → **Mod** → **3FSK** key in turn to turn on 3FSK mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of 3FSK can be sine wave, square wave, ramp wave or arbitrary wave (except DC). The default is sine wave. After 3FSK mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Set Hopping Wave

Use multifunction rotary knob and arrow keys to set the hopping frequency 1 (or hopping frequency 2), or press the softkey **HopFreq1** (or **HopFreq2**), and use the numerical keyboard to enter number and select the unit softkey to complete the setting. Hopping frequency range is depends on the carrier wave, the frequency setting of the carrier wave can refer to Carrier Frequency in AM mode.

3FSK Rate Setting

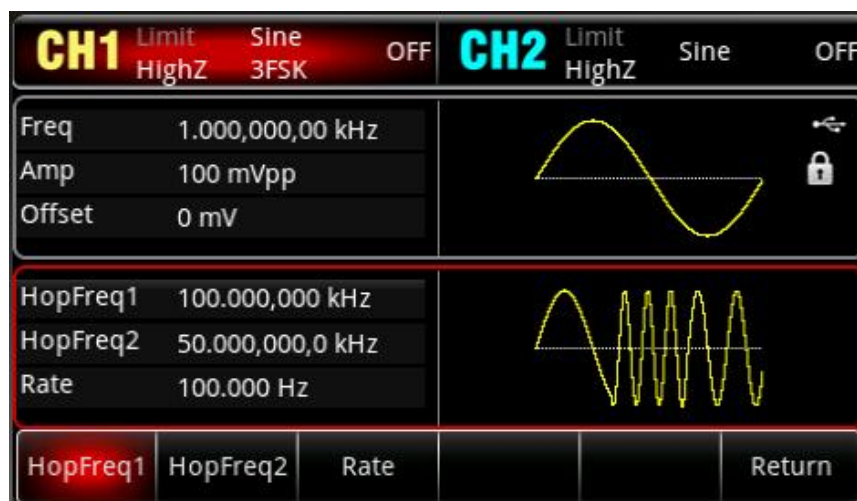
When the modulation source is internal, the frequency can be switched between the carrier frequency and the hopping frequency. When 3FSK mode is enabled, it can set 3FSK rate (2 mHz ~ 1 MHz). The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Rate**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting.

Comprehensive Example

In 3FSK mode, set a sine wave with 2 kHz, 1 Vpp as the carrier signal, set the hopping frequency 1 to 1 kHz, the hopping frequency 2 to 5 kHz, switching the carrier frequency and hopping frequency based on the frequency of 100 Hz. The setting steps are as follows.

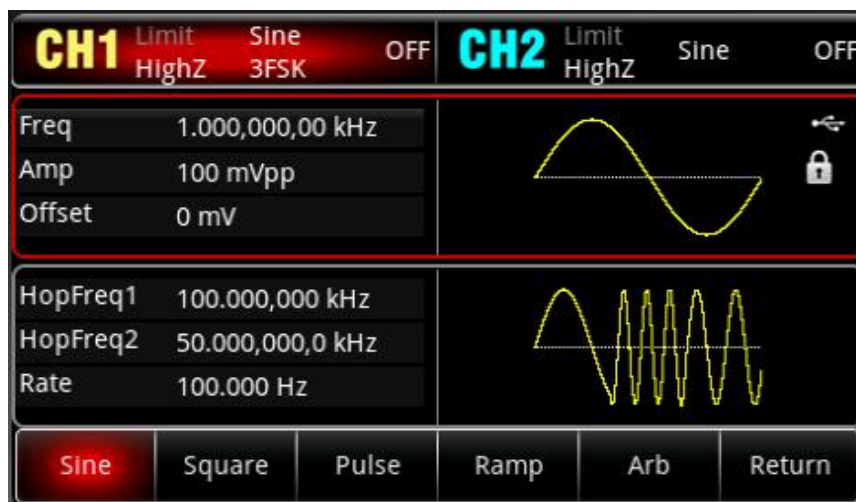
1) Enabling 3FSK mode

Press **Mode** → **Mod** → **3FSK** key in turn to turn on 3FSK mode.



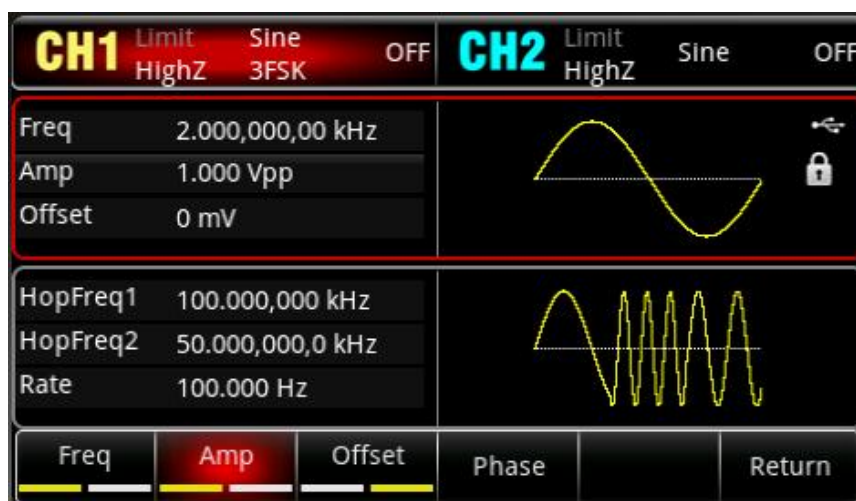
2) Set carrier signal

Press **Wave** key to select the sine wave as the carrier wave (the default is sine wave), so this setting is not necessary to be set.



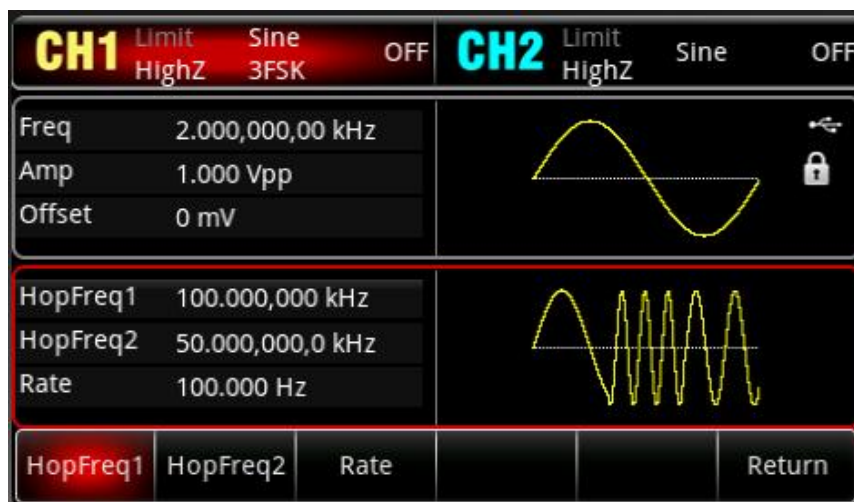
Press the softkey **Freq** to set the frequency, and then use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp** to set the amplitude, and then use the numerical keyboard to enter 1 Vpp.



3) Set hopping frequency and modulation rate

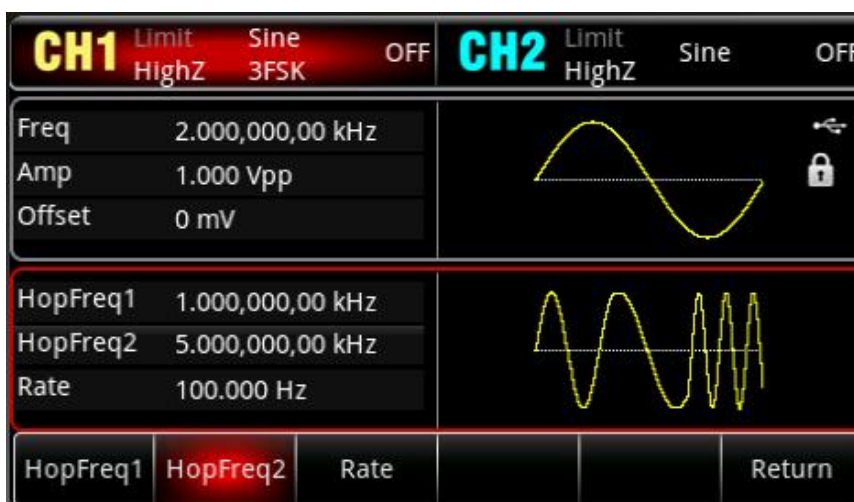
When the carrier signal is set, press **Mode** → **Mod** → **3FSK** key in turn to go back to the following page and then to set modulation parameter.



Press the softkey **Rate**, use the numerical keyboard to enter 100 Hz.

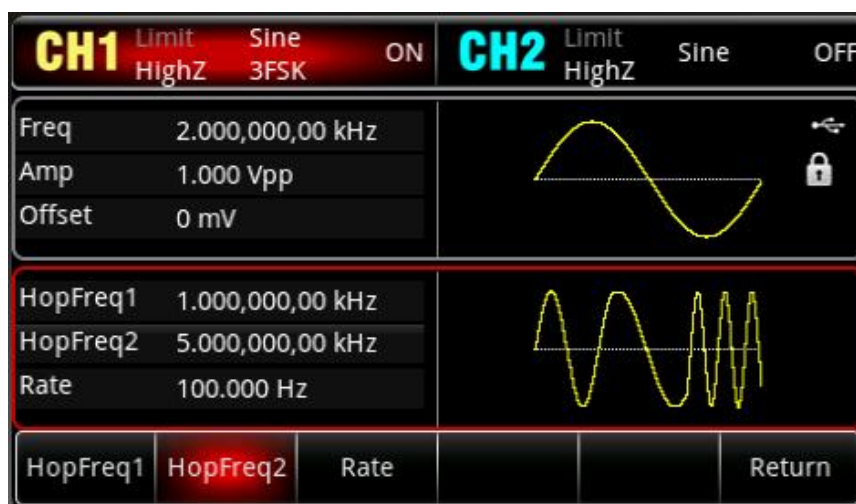
Press the softkey **HopFreq1**, use the numerical keyboard to enter 1 kHz.

Press the softkey **HopFreq2**, use the numerical keyboard to enter 5 kHz.



4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "3FSK" character, which indicates CH1 output is enabled.



To view the modulation wave of 3FSK through an oscilloscope as shown in the following figure.

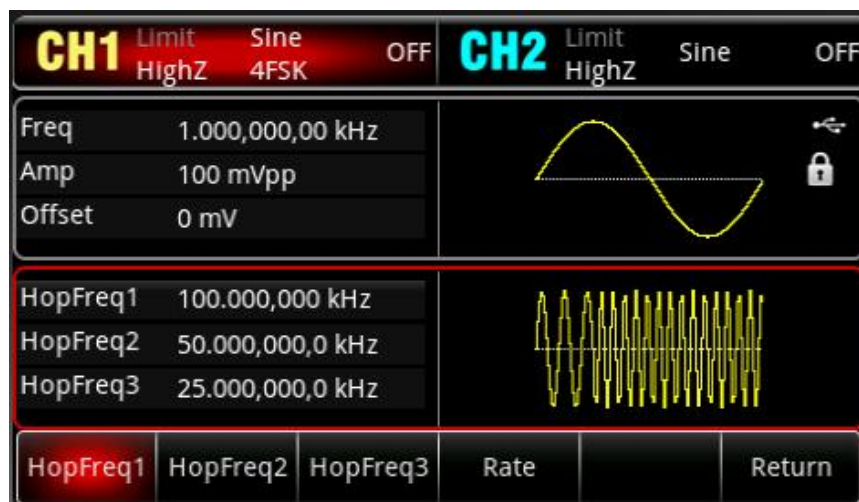


4.1.7 Four Frequency Shift Keying (4FSK)

In 4FSK mode, the function/arbitrary waveform generator can move among four preset frequency (carrier frequency and four hopping frequency) . It outputs the frequency of carrier signal or hopping frequency according to the logic of modulation signal. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

Select 4FSK mode

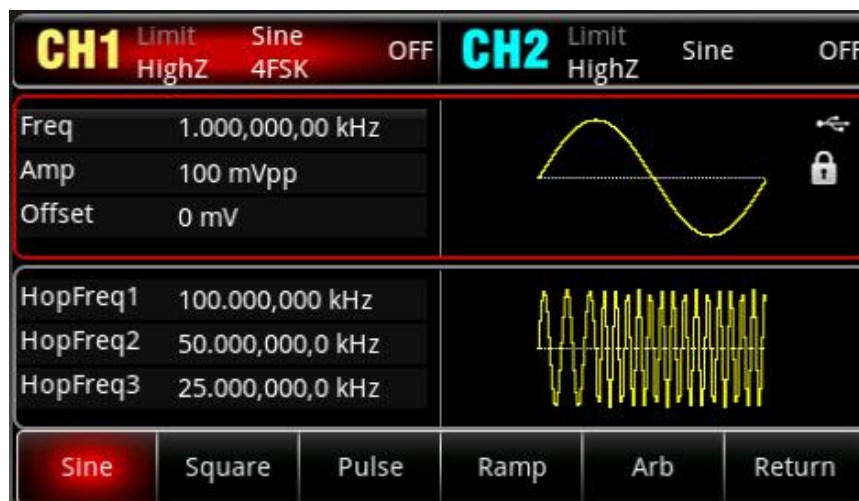
Press **Mode** → **Mod** → **4FSK** key in turn to turn on 4FSK mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of 4FSK can be sine wave, square wave, ramp wave or arbitrary wave (except DC).

The default is sine wave. After 4FSK mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Set Hopping Wave

Use multifunction rotary knob and arrow keys to set the hopping frequency 1 (or hopping frequency 2), or press the softkey **HopFreq1** (**HopFreq2** or **HopFreq3**), and use the numerical keyboard to enter number and select the unit softkey to complete the setting. Hopping frequency range is depends on the carrier wave, the frequency setting of the carrier wave can refer to Carrier Frequency in AM mode.

4FSK Rate Setting

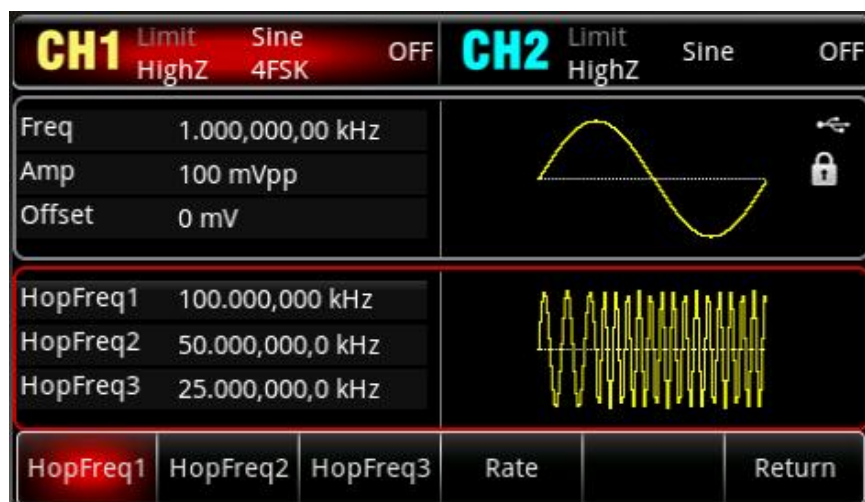
When the modulation source is internal, the frequency can be switched between the carrier frequency and the hopping frequency. When 4FSK mode is enabled, it can set 3FSK rate (2 mHz ~ 1 MHz). The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Rate**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting.

Comprehensive Example

In 4FSK mode, set a sine wave with 500 Hz, 1 Vpp as the carrier signal, set the hopping frequency 1 to 2 kHz, the hopping frequency 2 to 5 kHz, the hopping frequency 3 to 10 kHz, switching the carrier frequency and hopping frequency based on the frequency of 100 Hz. The setting steps are as follows.

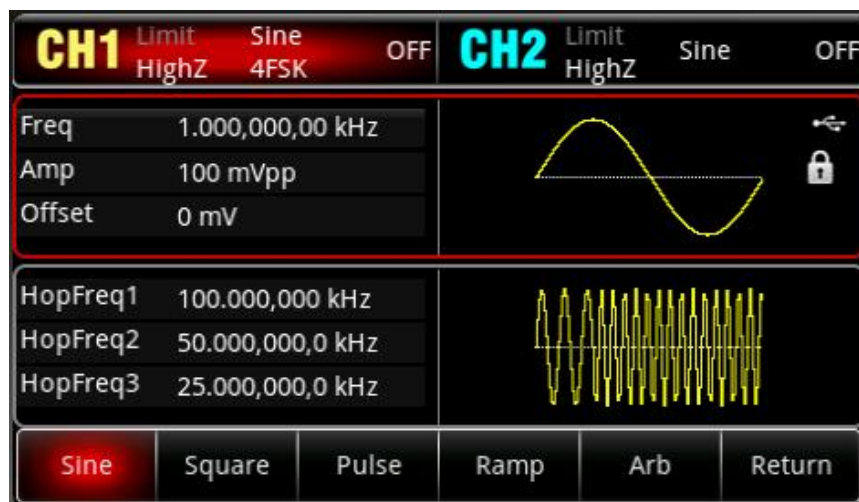
1) Enabling 4FSK mode

Press **Mode** → **Mod** → **4FSK** key in turn to turn on 4FSK mode.



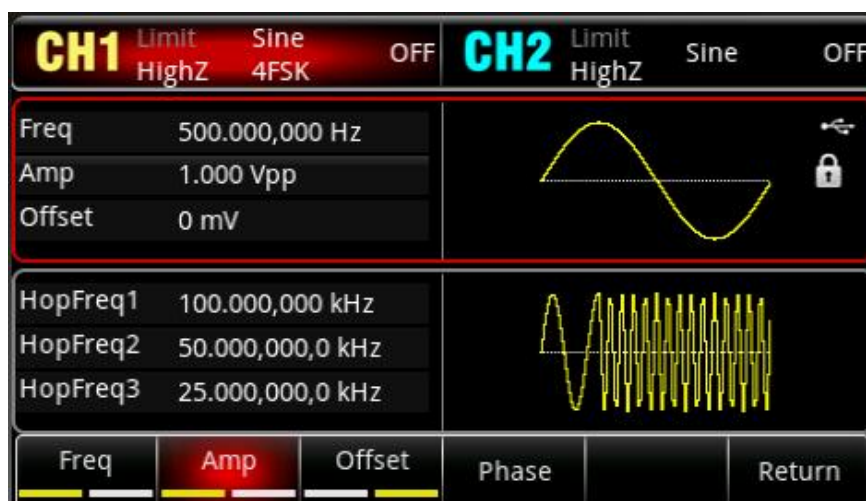
2) Set carrier signal

Press **Wave** key to select the sine wave as the carrier wave (the default is sine wave), so this setting is not necessary to be set.



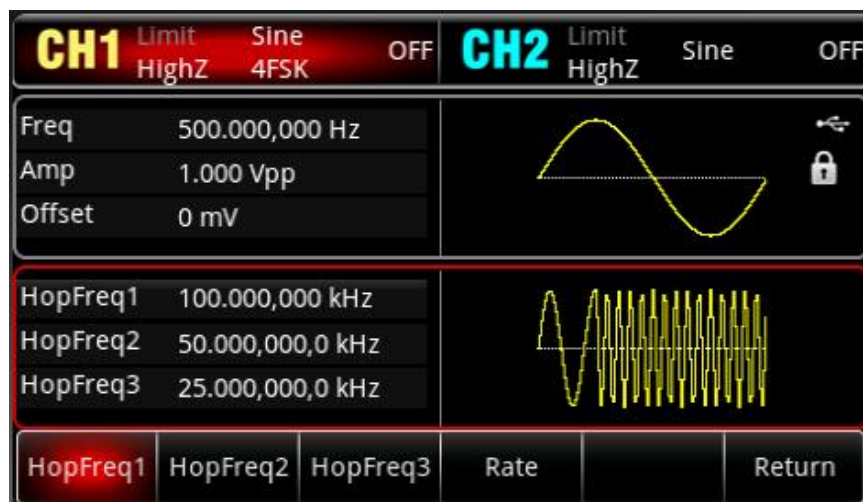
Press the softkey **Freq** to set the frequency, and then use the numerical keyboard to enter 500 Hz.

Press the softkey **Amp** to set the amplitude, and then use the numerical keyboard to enter 1 Vpp.



3) Set hopping frequency and modulation rate

When the carrier signal is set, press **Mode** → **Mod** → **4FSK** in turn to go back to the following page and then to set modulation parameter.

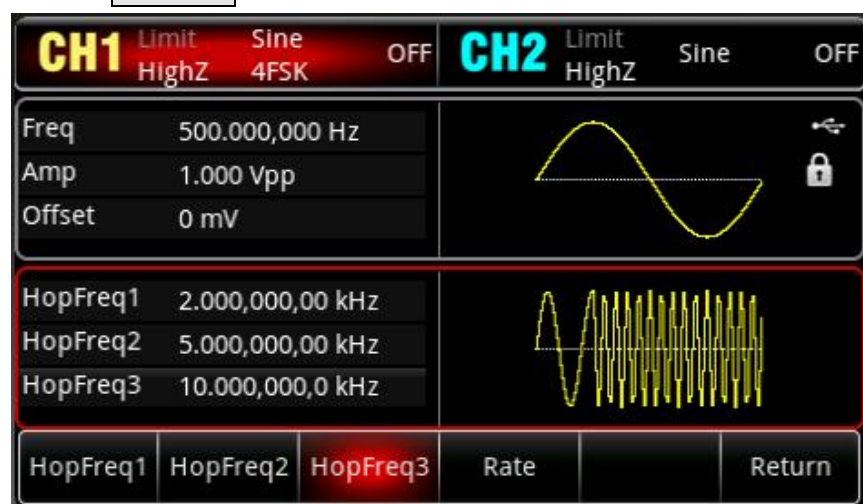


Press the softkey **Rate**, use the numerical keyboard to enter 100 Hz.

Press the softkey **HopFreq1**, use the numerical keyboard to enter 2 kHz.

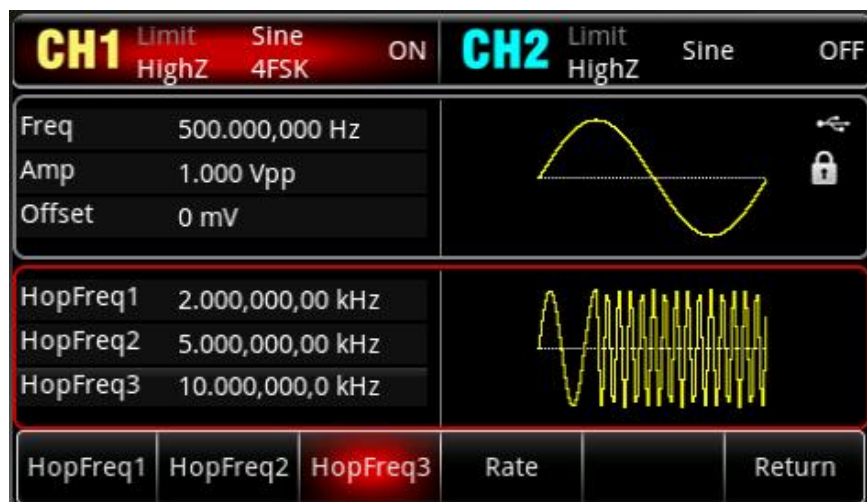
Press the softkey **HopFreq2**, use the numerical keyboard to enter 5 kHz.

Press the softkey **HopFreq3**, use the numerical keyboard to enter 10 kHz.

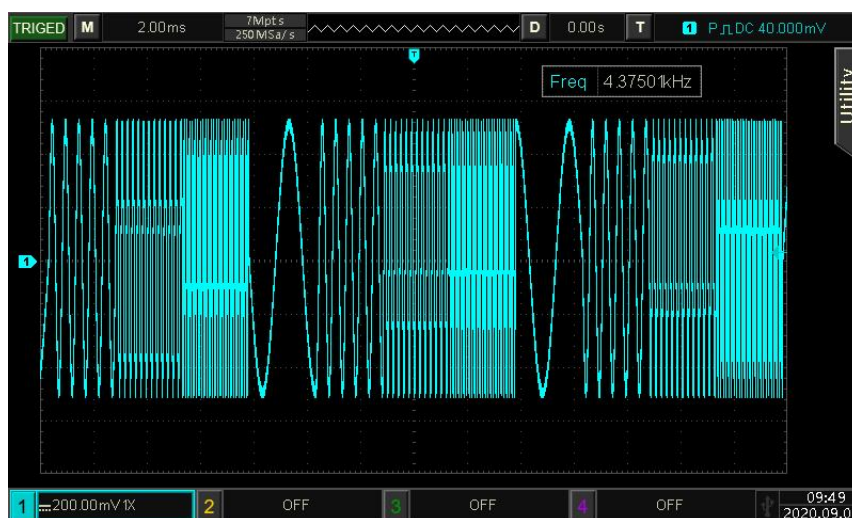


4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "4FSK" character, which indicates CH1 output is enabled.



To view the modulation wave of 4FSK through an oscilloscope as shown in the following figure.

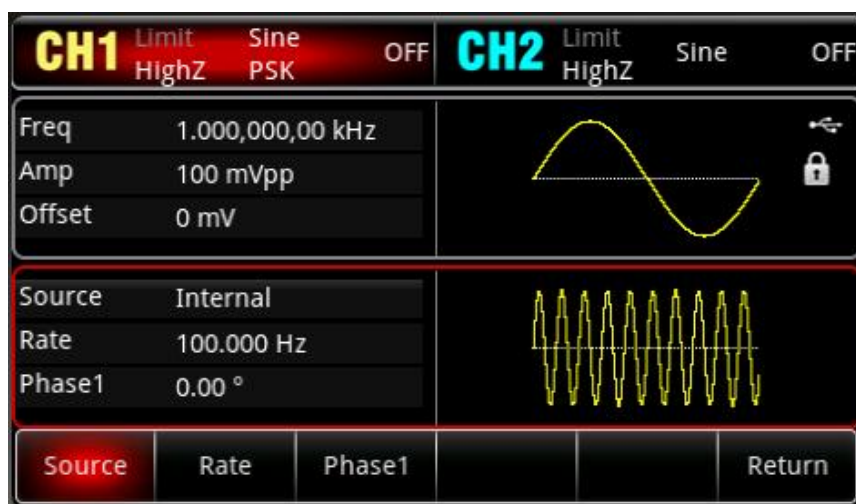


4.1.8 Phase Shift Keying (PSK)

In PSK mode, the function/arbitrary waveform generator can move between two preset phases (carrier phase and modulation phase). It outputs the carrier phase or modulation phase according to the logic level of the modulation signal. The modulation mode of the two channels are independent, user can set the same or different modulation mode for CH1 and CH2.

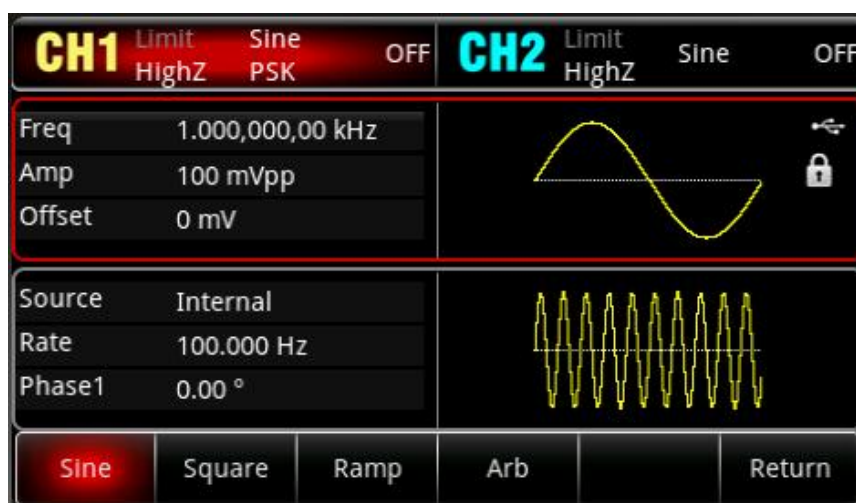
Select PSK Mode

Select **Mode** → **Mod** → **PSK** key in turn to turn on PSK mode, the waveform generator will output the modulated waveform according to the currently PSK rate and the carrier wave.



Select Carrier Wave

Carrier wave of PSK can be sine wave, square wave, ramp wave or arbitrary wave (except DC). The default is sine wave. After PSK mode is selected, press **Wave** key to enter the carrier wave interface.

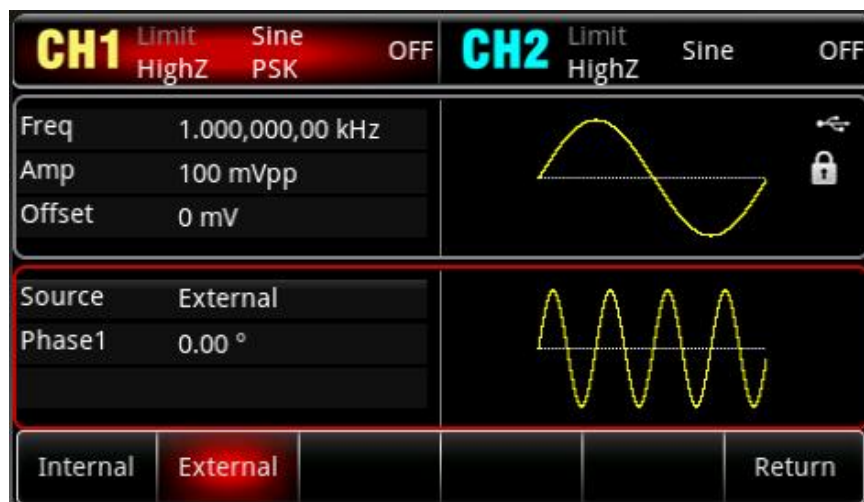


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When PSK mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **External** in turn.



1) Internal Source

When the modulation source is internal, the internal modulation wave is a square sine with duty ratio 50 % (non-adjustable). The frequency between the carrier phase and the modulation phase can be specified by adjusting the PSK rate.

2) External Source

When the modulation source is external, the rate option in the parameter list will be hidden. At this point, the carrier wave will be modulated by the external wave. PSK phase output is controlled by logic level on the external digital modulation terminal (FSK/Trig/Counter). For example, it outputs the carrier phase when the logic level of external input is low; it outputs the modulation phase when the logic level of external input is high.

PSK Rate Setting

When the modulation source is internal, the frequency can be switched between the carrier phase and modulation phase. When PSK mode is enabled, it can set PSK rate (the range is 2 mHz ~ 100 kHz). The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Rate**, and then use the numerical keyboard to enter number and select unit softkey to complete the setting.

Set Modulation Phase

The modulation phase is the phase change of PSK waveform with respect to the carrier phase. The range of PSK phase is $-360^\circ \sim 360^\circ$. The default is 0° . It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Phase1** to complete the setting.

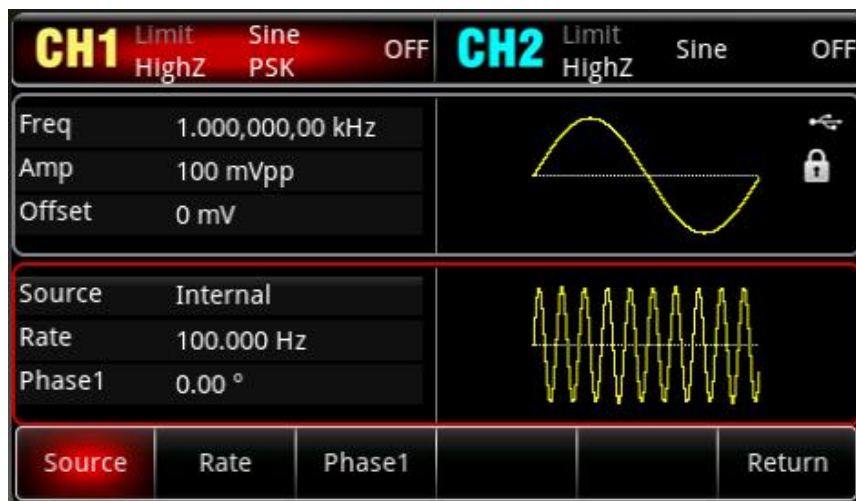
Comprehensive Example

In PSK mode, set a sine wave with 2 kHz, 2 Vpp as the carrier signal, switching the carrier phase

and modulation 180° phase based on the frequency of 1 kHz. The setting steps are as follows.

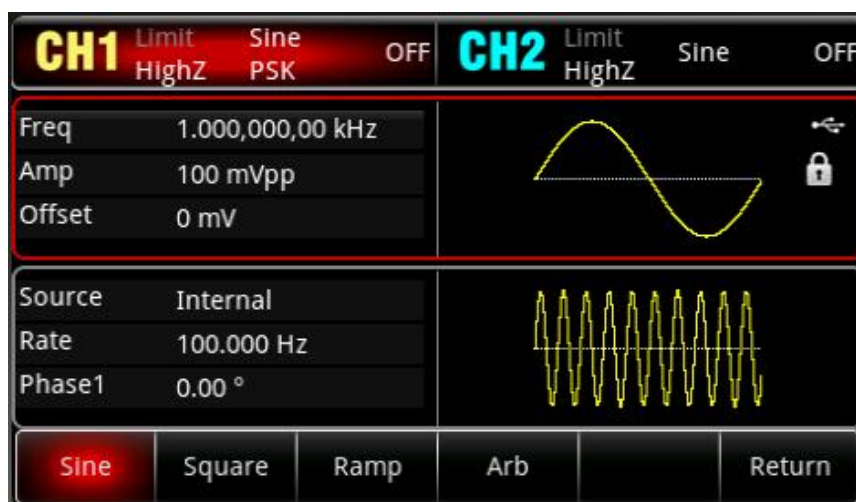
1) Enabling PSK mode

Press **Mode** → **Mod** → **PSK** key in turn to turn on PSK mode.



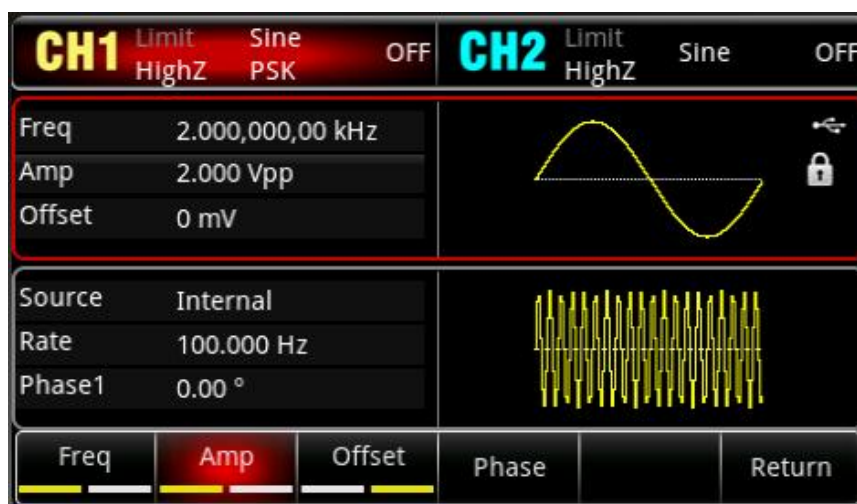
2) Set carrier signal

Press **Wave** key to enter the carrier wave page and then select sine wave as the carrier wave (the default is sine wave).



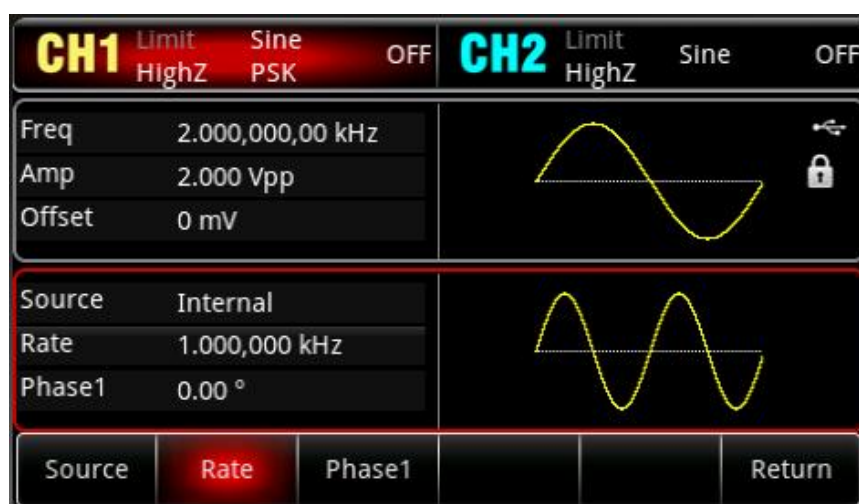
Press the softkey **Freq** to set the frequency, use the numerical keyboard to enter 2 and then select the unit of parameter to **kHz**;

Press the softkey **Amp** to set the amplitude, use the numerical keyboard to enter 2 and then select the unit of parameter to **Vpp**.



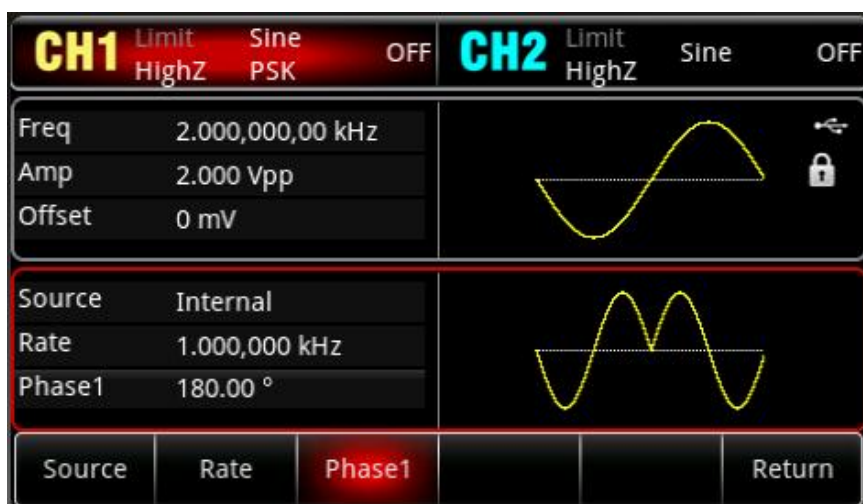
3) Set modulation rate

Press **Wave** key to enter the modulation parameter page, and press the softkey **Rate**, use the numerical keyboard to enter 1 and then select the unit to **kHz**.



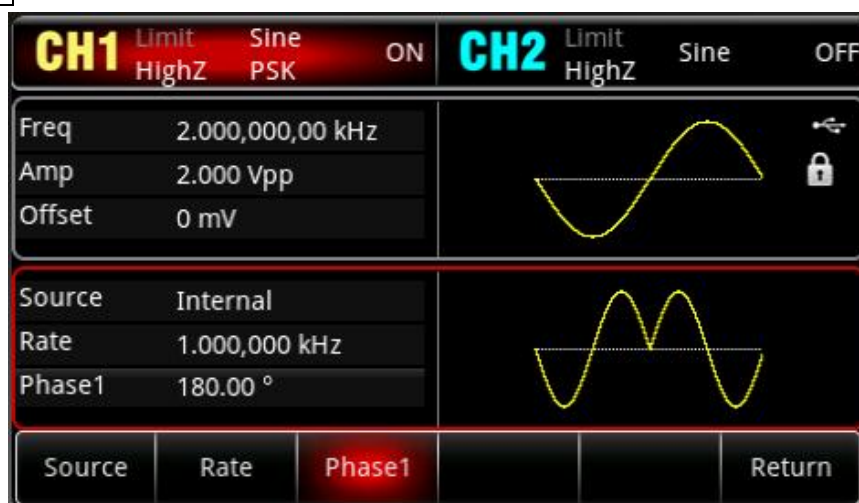
4) Set phase

Press the softkey **Phase1** and use the numerical keyboard to enter 180, and then select the unit to **°**.

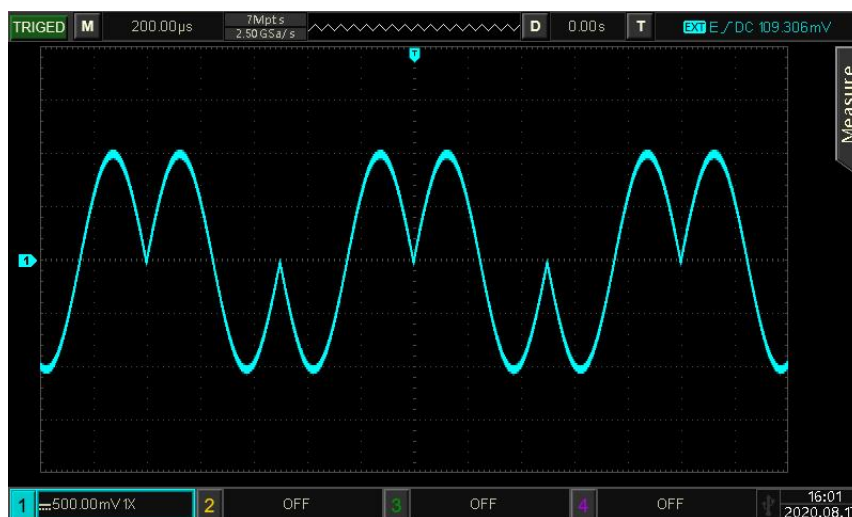


5) Enabling channel output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



To view the modulation waveform of PSK through an oscilloscope as shown in the following figure.

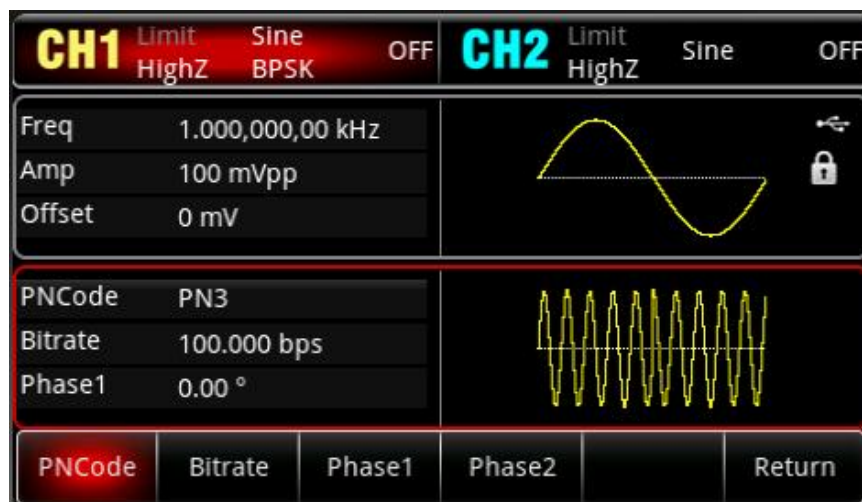


4.1.9 Binary Phase Shift Keying (BPSK)

In BPSK mode, the function/arbitrary waveform generator can move between preset phase (carrier frequency and modulation phase) , it is expressed in 0 and 1. It outputs the carrier phase or modulation phase according to the logic of modulation signal. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

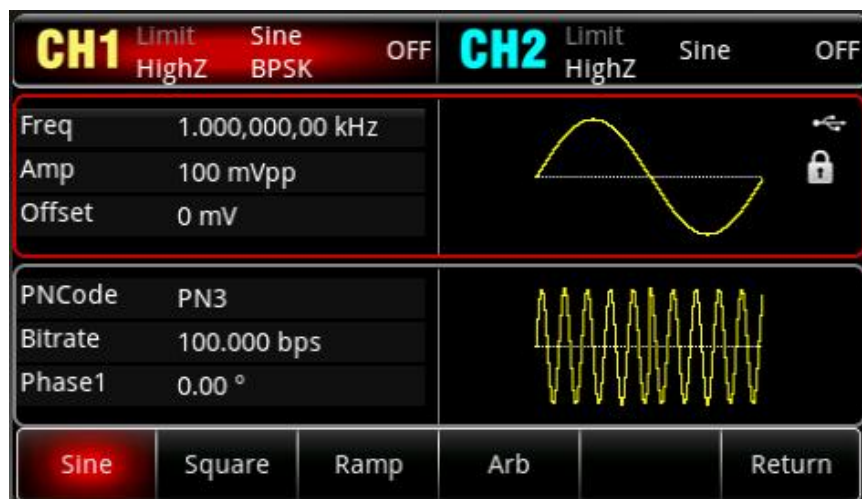
Select BPSK Mode

Press **Mode** → **Mod** → **BPSK** key in turn to turn on BPSK mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of BPSK can be sine wave, square wave, ramp wave or arbitrary wave (except DC). The default is sine wave. After BPSK mode is selected, press **Wave** key to enter the carrier wave interface.

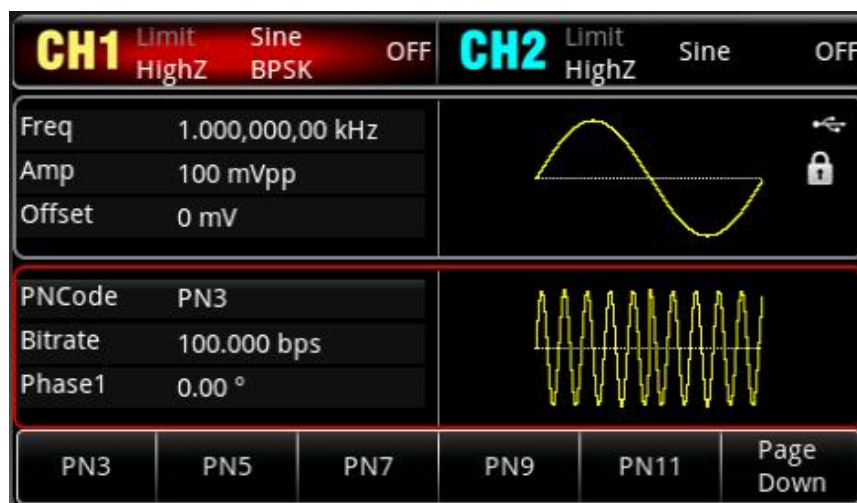


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Symbol

The modulation source of this instrument can select internal. When BPSK mode is enabled, the default symbol is PN3. It can change by using multifunction rotary knob or pressing **PNCode** → **PN3** key in turn.



Bitrate Setting

The frequency between the carrier phase and modulation phase can be set. When BPSK is enabled, the range of BPSK bitrate can set to 2 mbps ~ 1 Mbps. The default is 100 bps. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **BitRate**, and use the numerical keyboard to enter number and then select the unit to complete the setting.

Phase Setting

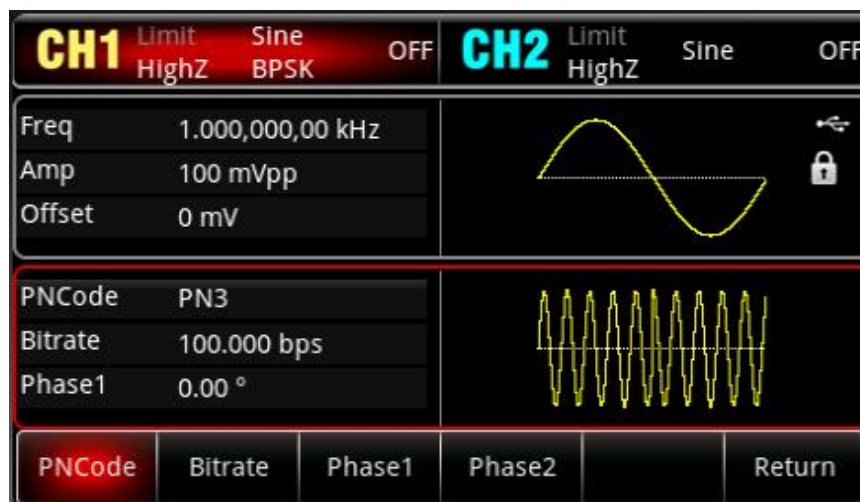
- 1) Phase 1 is the carrier phase, the default phase is 0°. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Phase1**, and use the numerical keyboard to enter number and then select the unit to complete the setting.
- 2) Phase 2 is the modulation phase, which indicates the phase change of BPSK waveform with respect to the carrier phase. The range of BPSK phase is -360° ~ 360°. The setting method is the same as step 1.

Comprehensive Example

In BPSK mode, set a sine wave with 2 kHz, 2 Vpp as the carrier signal, set the phase of carrier phase and modulation start phase to 90° and moving the phase based on the frequency of 1 kbps, set PN to PN15. The setting steps are as follows.

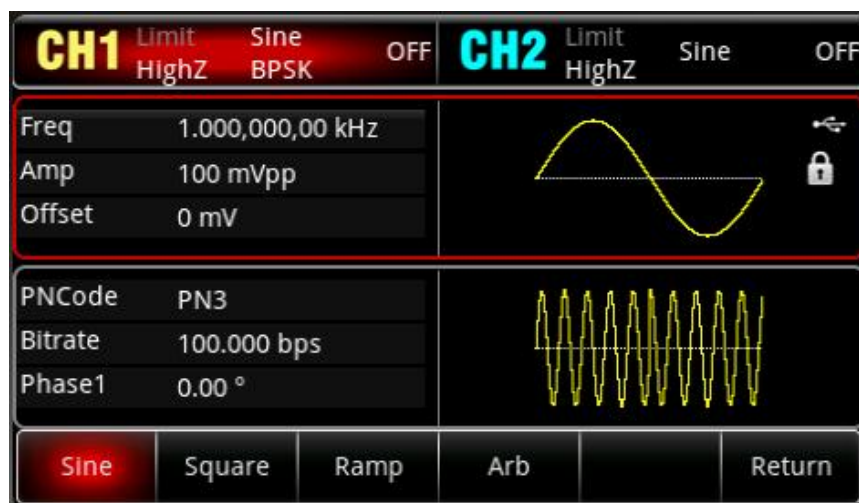
1) Enabling BPSK mode

Press **Mode** → **Mod** → **BPSK** key in turn to turn on BPSK mode.



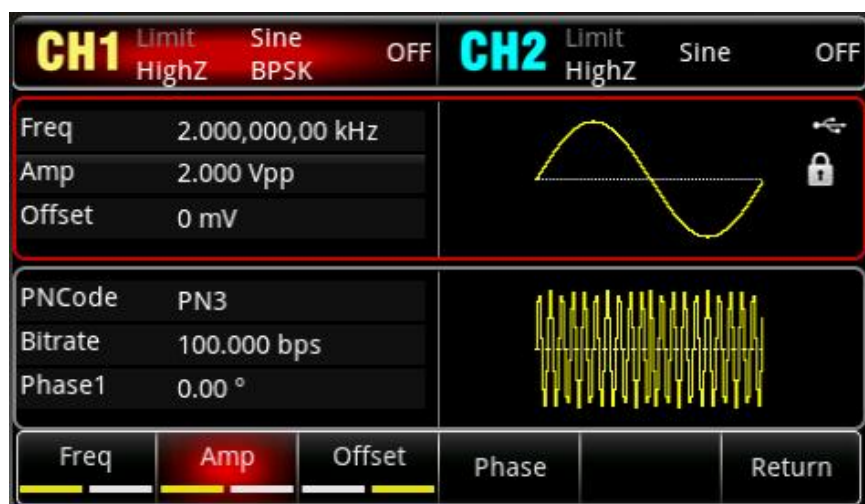
2) Set carrier signal

Press **Wave** key to select sine wave as the carrier wave (the default is sine wave), so this step doesn't need to be changed.



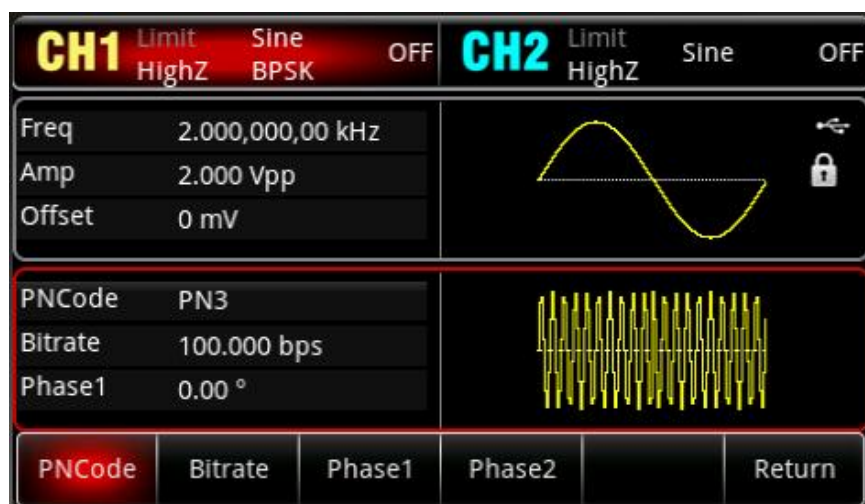
Press the softkey **Freq**, use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp**, use the numerical keyboard to enter 2 Vpp.



3) Set BPSK bitrate and phase

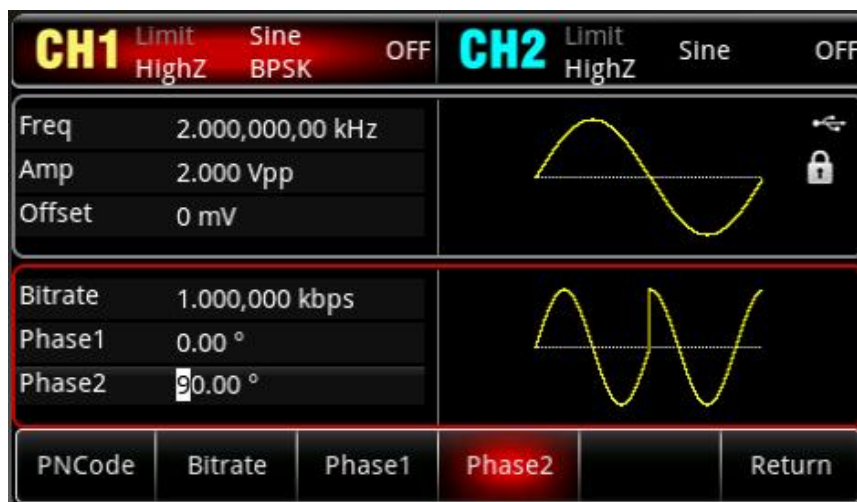
When the carrier signal is set, press **Mode** → **Mod** → **BPSK** key in turn to go back to the following page to set the modulation parameter.



Press the softkey **BitRate**, use the numerical keyboard to enter 1 kbps.

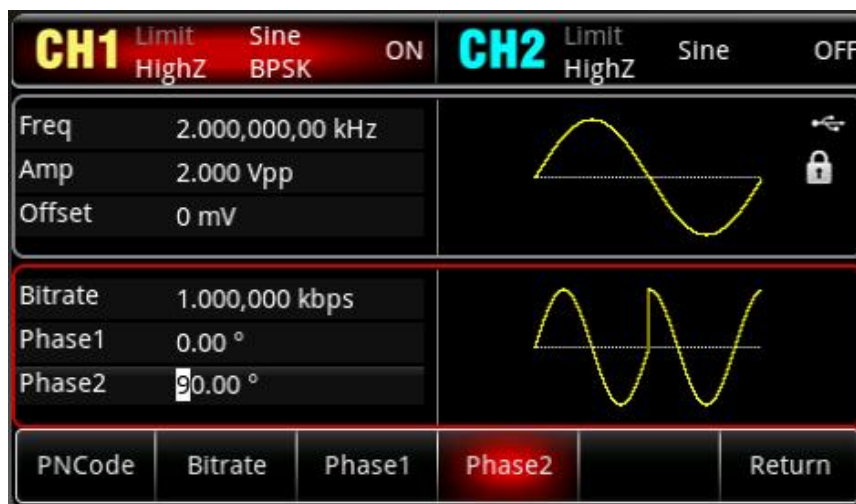
Press the softkey **Phase1** and **Phase2** to change the phase 1 to 0°, phase 2 to 90°.

Press the softkey **PNCode** to pop out the dialog box to select PN15.

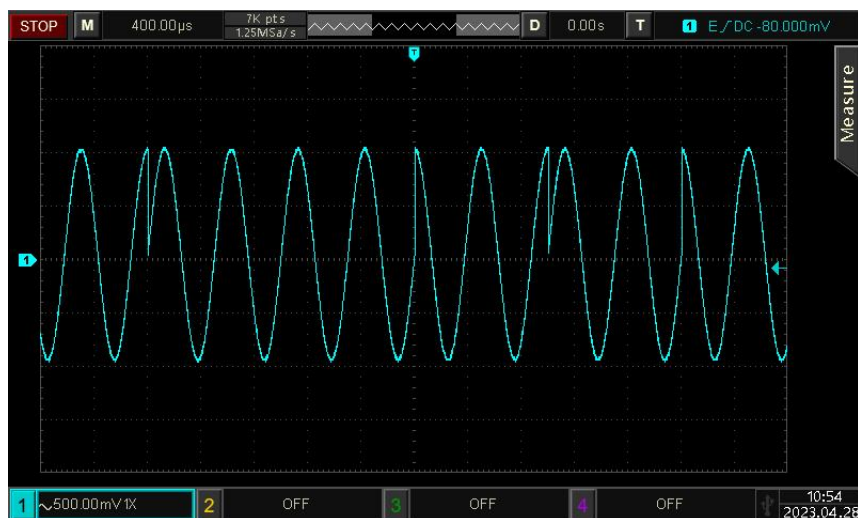


4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "BPSK" character, which indicates CH1 output is enabled.



To view the modulation wave of BPSK through an oscilloscope as shown in the following figure.

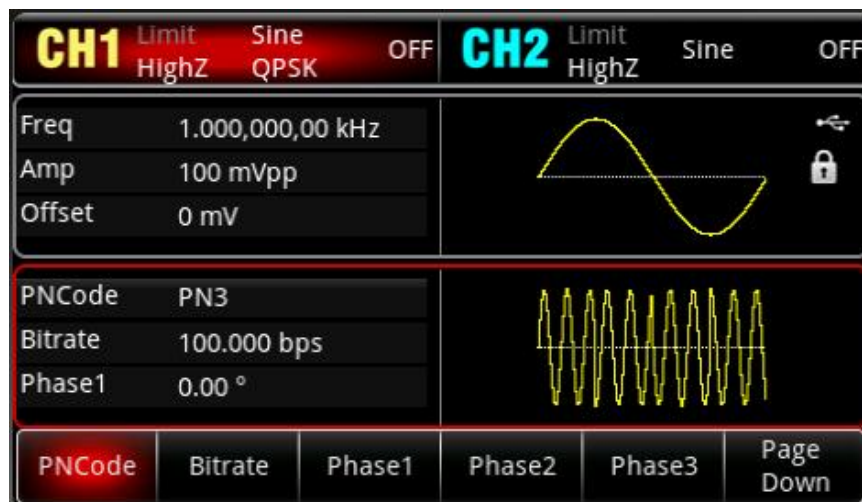


4.1.10 Quadrature Phase Shift Keying (QPSK)

In QPSK mode, the function/arbitrary waveform generator can move among four preset phase (carrier frequency and three modulation phase) . It outputs the carrier phase or modulation phase according to the logic of modulation signal. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

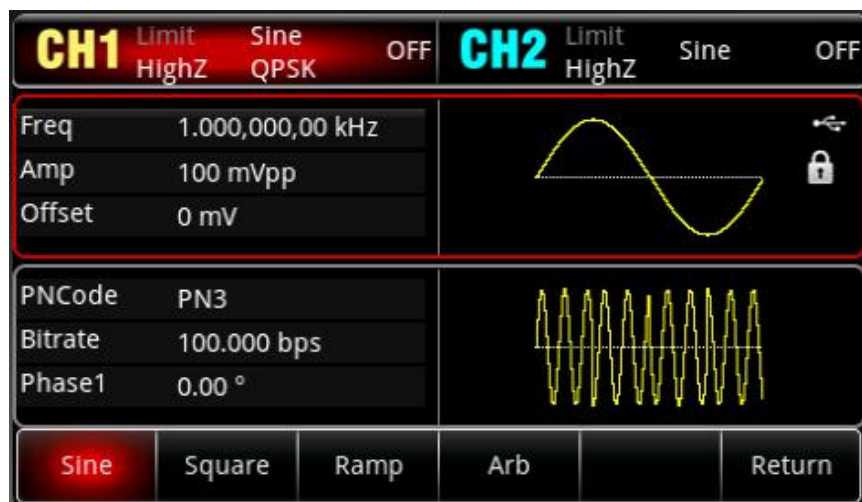
Select QPSK Mode

Press **Mode** → **Mod** → **QPSK** key in turn to turn on QPSK mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of QPSK can be sine wave, square wave, ramp wave or arbitrary wave (except DC). The default is sine wave. After QPSK mode is selected, press **Wave** key to enter the carrier wave interface.



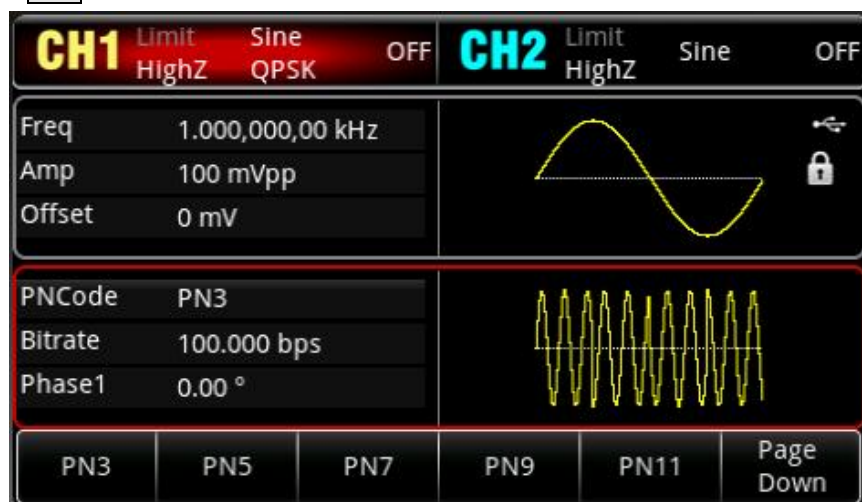
Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Symbol

The modulation source of this instrument can select internal. When QPSK mode is enabled, the default symbol is PN3. It can change by using multifunction rotary knob or pressing the softkey

PNCode → PN3 in turn.



Bitrate Setting

The frequency between the carrier phase and modulation phase can be set. When QPSK is enabled, the range of QPSK bitrate can set to 2 mbps ~ 1 Mbps. The default is 100 bps. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey BitRate, and use the numerical keyboard to enter number and then select the unit to complete the setting.

Phase Setting

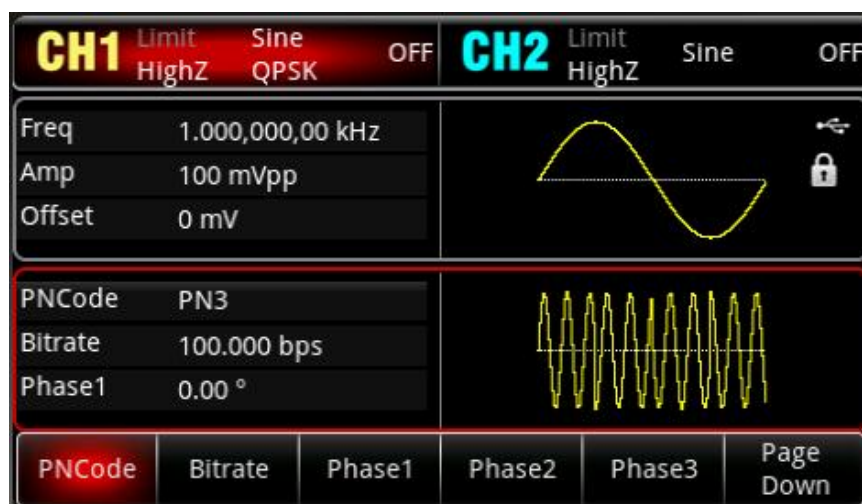
- 1) Phase 1 is the carrier phase, the default phase is 0° . It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Phase1**, and use the numerical keyboard to enter number and then select the unit to complete the setting.
- 2) Phase 2, 3, 4 is the modulation phase, which indicates the phase change of QPSK waveform with respect to the carrier phase. The range of BPSK phase is $-360^\circ \sim 360^\circ$. The modulation frequency can be set by using the multifunction rotary knob and arrow keys or pressing the softkey **Phase2**, **Phase3**, **Phase4**, use the numerical keyboard to enter number and then select the unit to complete the setting.

Comprehensive Example

In QPSK mode, set a sine wave with 2 kHz, 2 Vpp as the carrier signal, set the phase of three carrier phase and modulation start phase to 90° , 180° , 270° and moving the phase based on the frequency of 1 kbps, set PN to PN15. The setting steps are as follows.

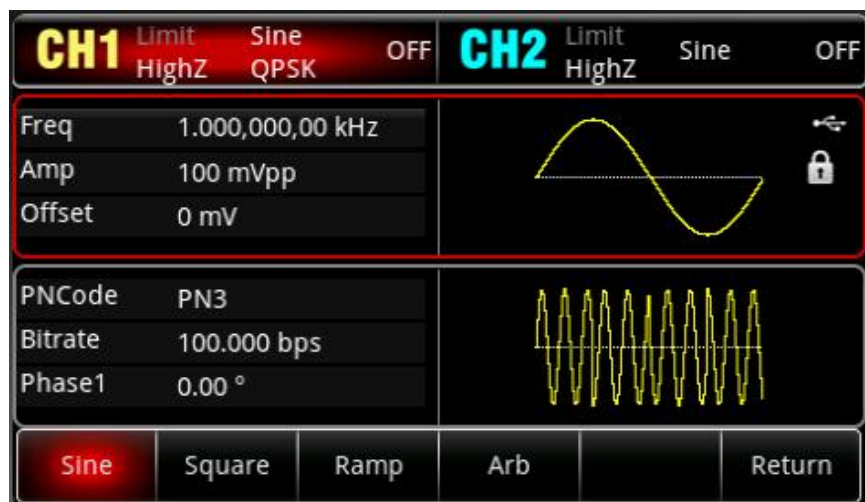
1) Enabling QPSK mode

Press **Mode** → **Mod** → **QPSK** key in turn to turn on QPSK mode.



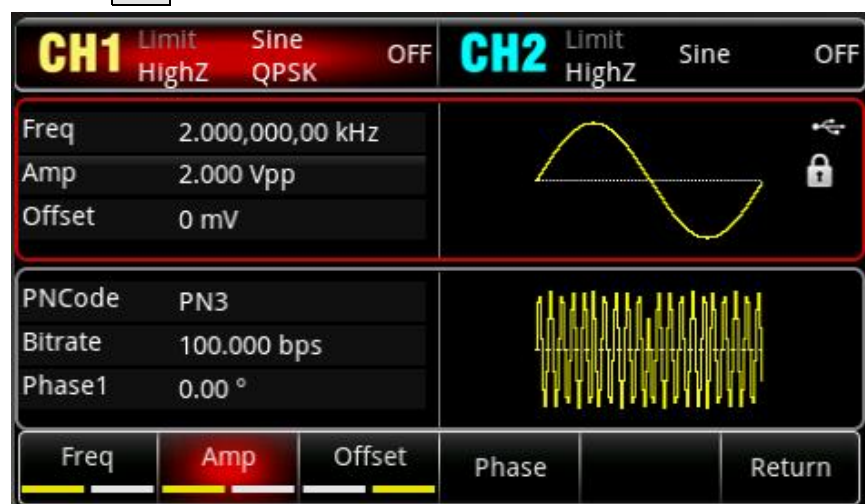
2) Set carrier signal

Press **Wave** key to select sine wave as the carrier wave (the default is sine wave), so this step doesn't need to be changed.



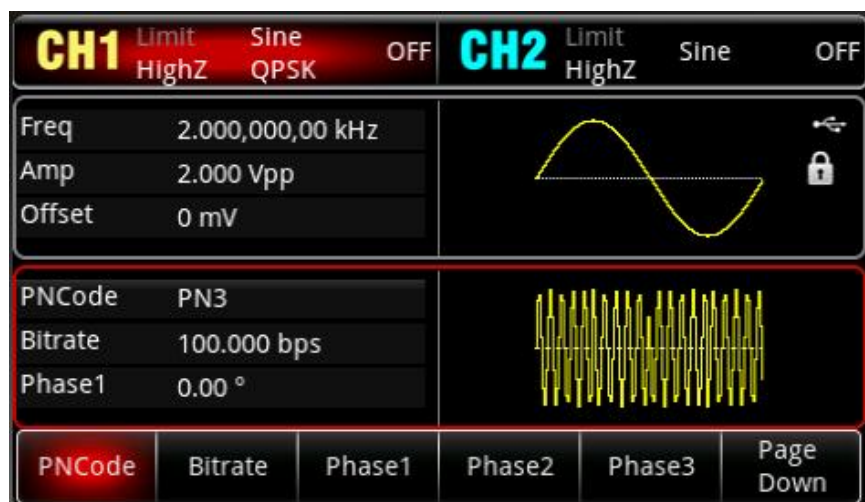
Press the softkey **Freq**, use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp**, use the numerical keyboard to enter 2 Vpp.



3) Set QPSK bitrate and modulation phase

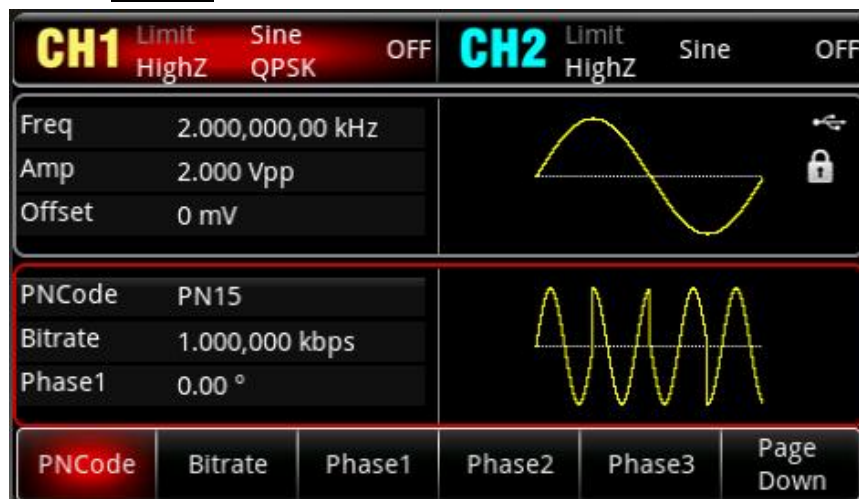
When the carrier signal is set, press **Mode** → **Mod** → **QPSK** key in turn to go back to the following page to set the modulation parameter, as shown in the following figure.



Press the softkey **BitRate**, use the numerical keyboard to enter 1 kbps.

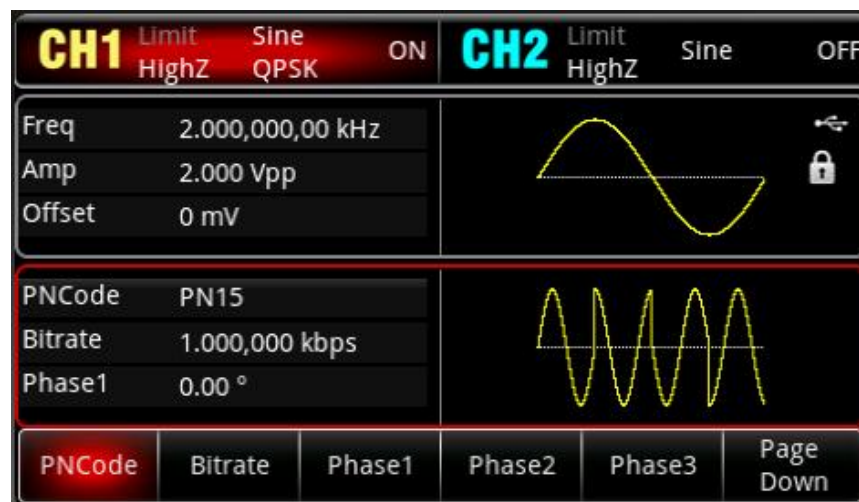
It is not necessary to set the phase, use the default value, phase 1 is 0°, phase 2 is 90°, phase 2 is 180° and phase 4 is 270°.

Press the softkey **PNCode** to pop out the dialog box to select PN15.

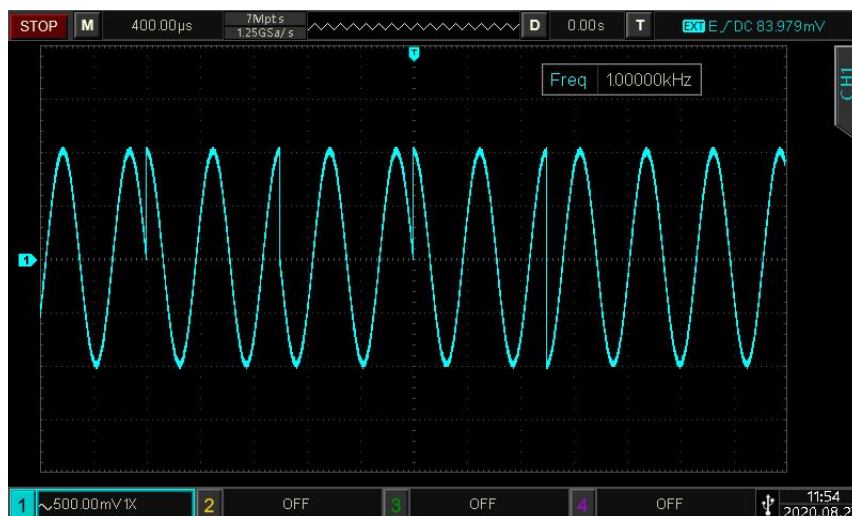


4) Enabling channel output

Press the state of CH1 output to “ON”, or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight “QPSK” character, which indicates CH1 output is enabled.



To view the modulation waveform of QPSK through an oscilloscope as shown in the following figure.



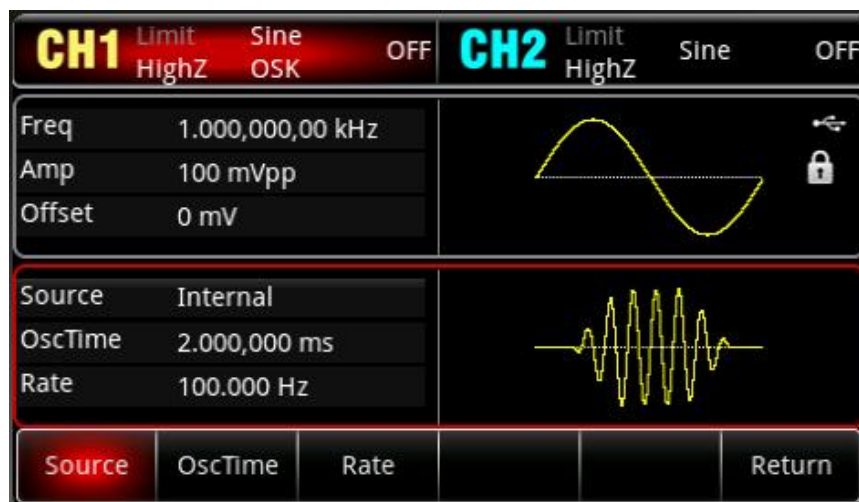
4.1.11 Oscillation Keying (OSK)

In OSK mode, the function/arbitrary waveform generator can output a sine signal of intermittent oscillation.

When the internal crystal oscillator starts to oscillating, the instrument will output the carrier waveform. The output stops when the internal crystal oscillator stops oscillating. The modulation mode of each channels are independent, user can set the same or different modulation mode for each channels.

Select OSK Mode

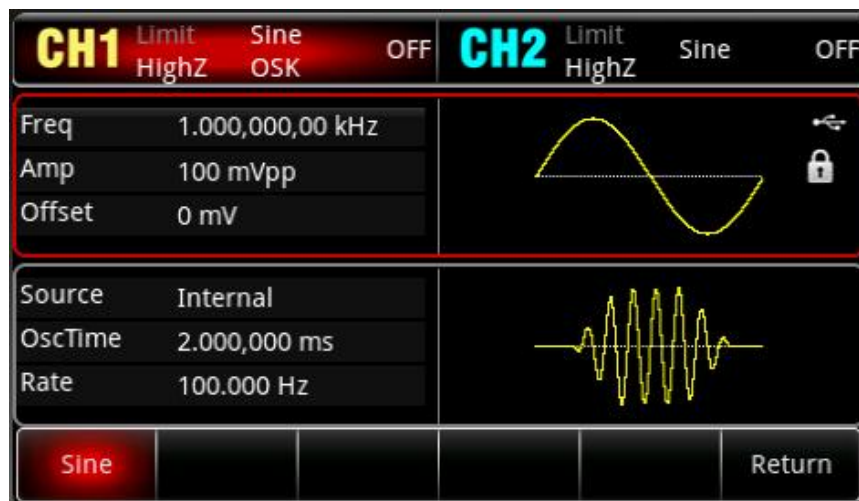
Select **Mode** → **Mod** → **OSK** key in turn to turn on OSK mode, the waveform generator will output the modulated waveform according to the currently PSK rate and the carrier wave.



Select Carrier Wave

Carrier wave of OSK can only can be sine wave. When OSK is selected, the carrier wave will automatically set to sine wave.

Press **Wave** key, the selection only has sine wave.



Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When OSK mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **External** in turn.

1) Internal trigger source

When the modulation source is internal, the modulation wave is sine wave. Set OSK rate to assign the phase relationship of oscillation start and stop.

2) External trigger source

When the modulation source is external, the rate option in the parameter list will be hidden. At this point, the carrier wave will be modulated by the external wave. The OSK phase output is controlled by logic level on the external digital modulation terminal (FSK/Trig/Counter) on the back panel. For example, output the oscillation wave when the external input is low; stop output when the external input is high.

Oscillation Time Setting

Oscillation period is oscillation period of internal crystal oscillator. Set the oscillation time by using multifunction rotary knob and arrow keys or pressing the softkey **OscTime**, use the numerical keyboard to enter number and then select the unit to complete the setting. The range is 5 ns ~ 250 s, the default is 2 ms.

OSK Rate Setting

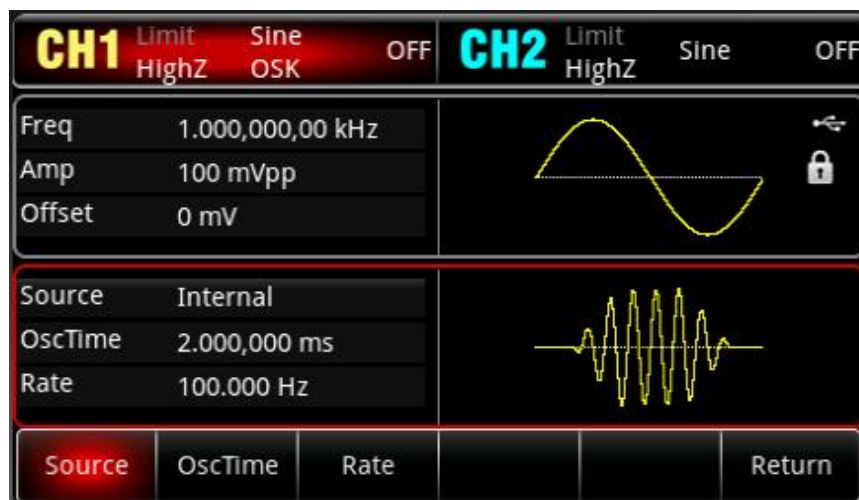
When the modulation source is internal, the frequency between carrier phase and modulation phase can be set. When OSK modulation is enabled, the OSK rate can be set and the range is 2 mHz ~ 1 MHz, the default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Rate**, use the numerical keyboard to enter number and then select the unit to complete the setting.

Comprehensive Example

In OSK mode, set an internal sine wave with 2 kHz, 2 Vpp as a carrier wave, set the rate to 100 Hz and the oscillation period to 1 μ s, the settings steps are as following.

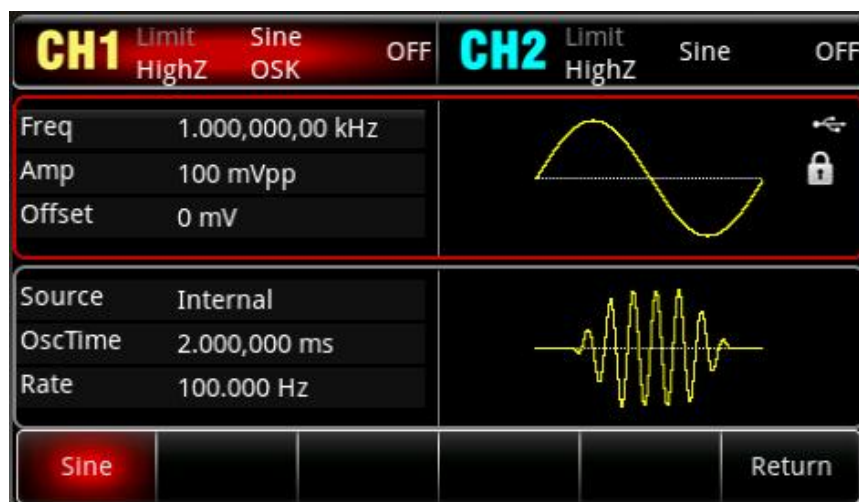
1) Enabling OSK mode

Press **Mode** → **Mod** → **OSK** key in turn to turn on OSK mode.



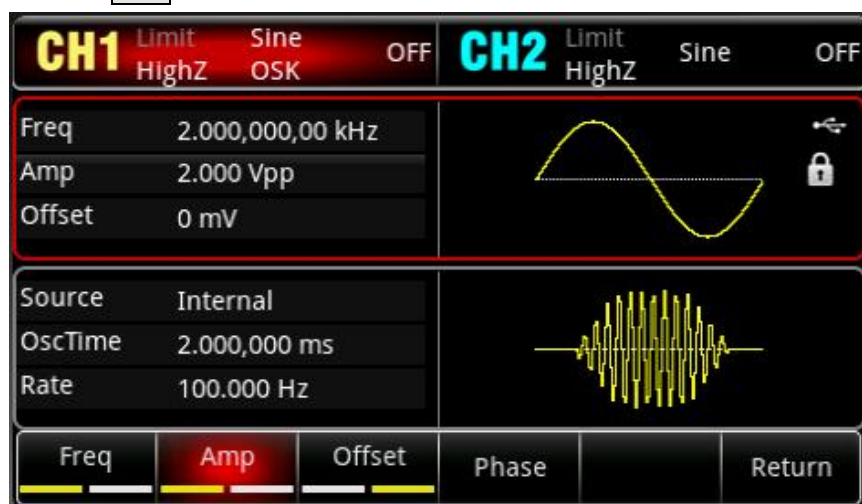
2) Set carrier signal

Press **Wave** key to select sine wave as the carrier wave (the default is sine wave). The carrier signal of OSK can only be sine wave, so this setting doesn't need to be changed.



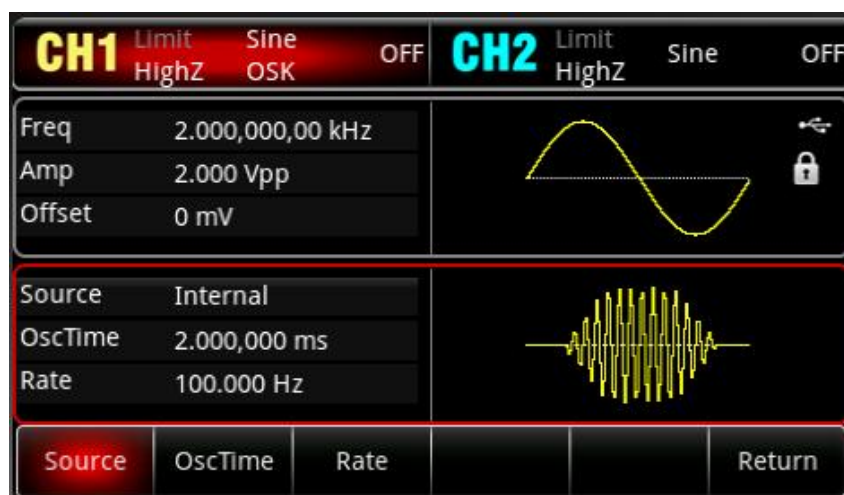
Press the softkey **Freq**, use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp**, use the numerical keyboard to enter 2 Vpp.



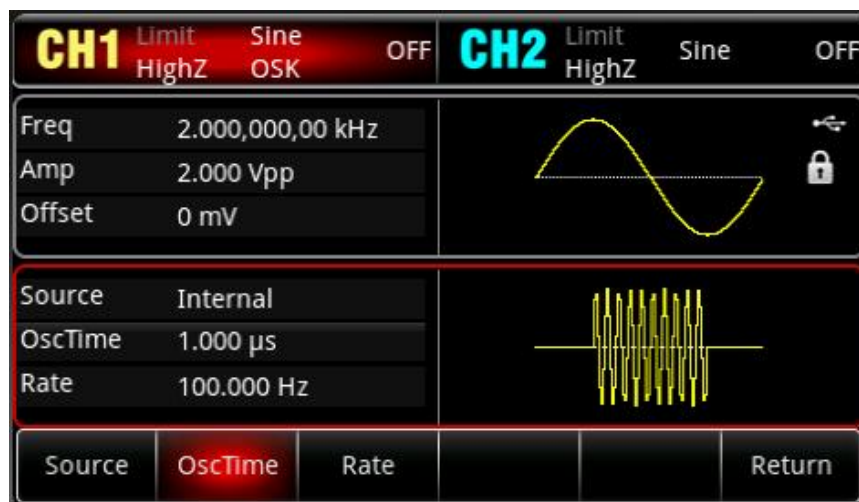
3) Set OSK rate

When the carrier signal is set, press **Mode** → **Mod** → **OSK** key in turn to go back to the following page and then to set modulation parameter.



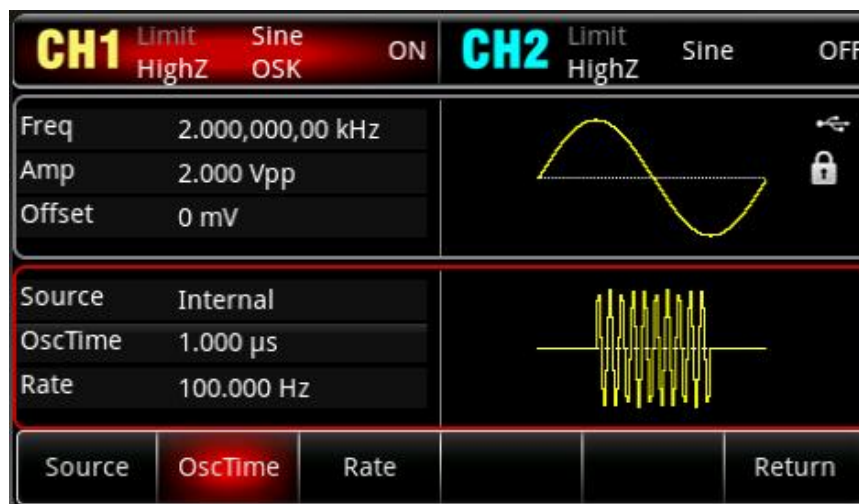
Press the softkey **Rate**, use the numerical keyboard to enter 100 Hz (the default is 100Hz) .

Press the softkey **OscTime**, use the numerical keyboard to enter 1 μs.

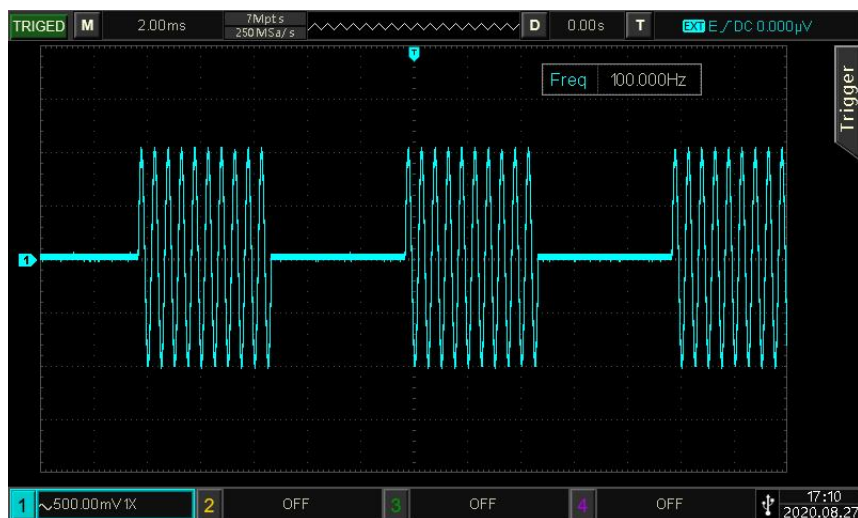


4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "OSK" character, which indicates CH1 output is enabled.



To view the modulation wave of OSK through an oscilloscope as shown in the following figure.

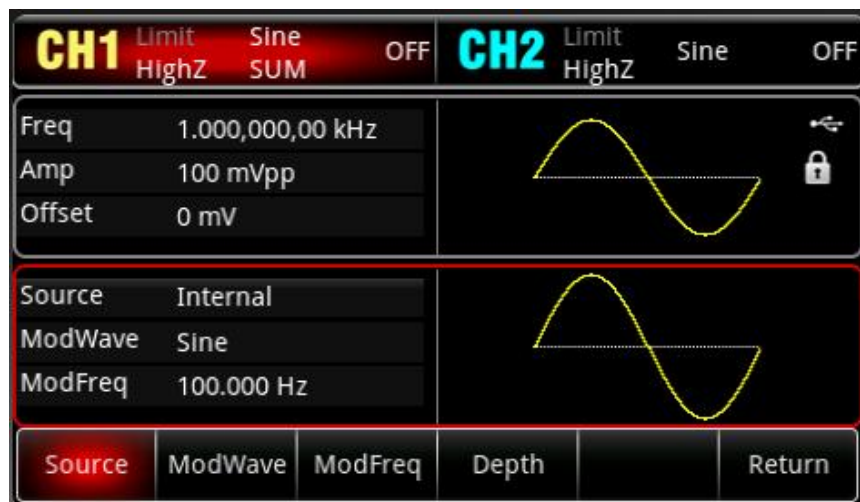


4.1.12 SUM Modulation (SUM)

In SUM mode, the modulated wave is consist of carrier wave and modulation wave. The output waveform is sum of the amplitude of the carrier wave multiply by modulation factor and add the amplitude of the modulation wave multiply by modulation factor. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

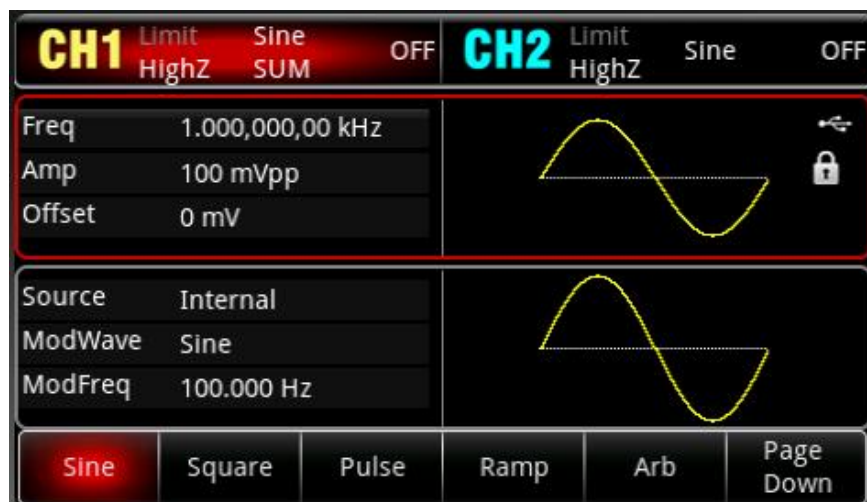
Select SUM Mode

Press **Mode** → **Mod** → **SUM** key in turn to turn on SUM mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of SUM can be sine wave, square wave, ramp wave, noise wave, harmonic wave or arbitrary wave (except DC). The default is sine wave. After SUM mode is selected, press **Wave** key to enter the carrier wave interface.

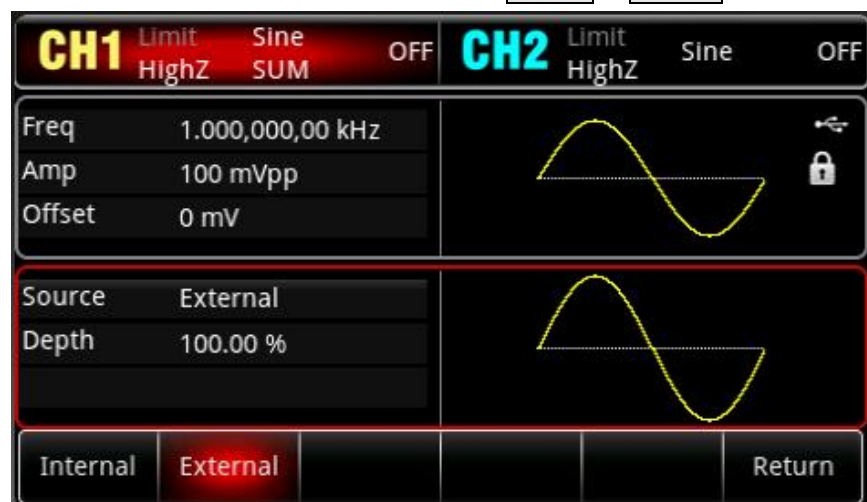


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When SUM mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **Internal** in turn.



1) Internal Source

When the modulation source is internal, the modulation wave can be sine wave, square wave, rising ramp wave, falling ramp wave and noise wave. The default is sine wave. When SUM mode is enabled, the default modulation wave is sine wave. It can be change by using multifunction rotary knob or pressing the softkey **ModWave** → **Sine** in turn.

- Square wave: Duty cycle is 50 %
- Rising ramp wave: Symmetry is 100 %.
- Falling ramp wave: Symmetry is 0 %.

- Arbitrary wave: The length of arbitrary wave limits at 2 kpts by the method of automatic extracting point when arbitrary wave is the modulation wave.
- Noise Wave: White Gauss noise

2) External source

When the modulation source is external, the modulation wave and modulation frequency will be hidden in parameter list. The carrier wave will be modulated by an external wave. SUM modulation depth is controlled by $\pm 5V$ signal level at the external analog modulation input terminal on the rear panel. For example, if the modulation depth is set to 100 %, the output of SUM amplitude is maximum when the external modulation signal is +5V; the output of SUM amplitude is minimum when the external modulation signal is -5V.

Modulation Frequency Setting

When the modulation source is internal, the frequency of modulation wave can be set. The range of modulation frequency is 2 mHz ~ 1 MHz. The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **ModFreq**, use the numerical keyboard and enter number and then select the unit to complete the setting. When the modulation source is external, the modulation wave and modulation frequency will be hidden in parameter list. The carrier wave will be modulated by an external wave. The range of external input modulation signal is 0 Hz ~ 50 kHz.

Modulation Depth Setting

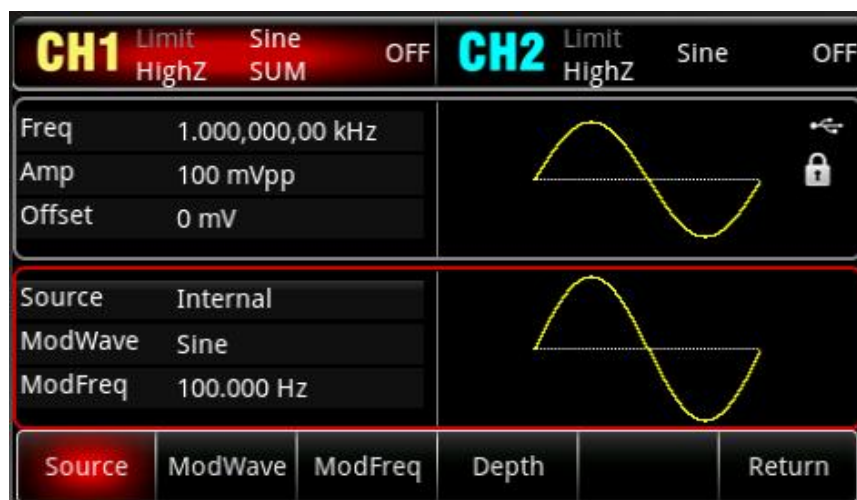
Modulation depth indicates the change of the extent of amplitude, which expressed in percentage. The range of SUM modulation depth is 0 %~100 %, the default range is 100 %. When the modulation depth is 0 %, it outputs the carrier wave. When the modulation depth is 100 %, it outputs the modulation wave. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **ModFreq** key, use the numerical keyboard and enter number to complete the setting. When the modulation source is external, the output amplitude is controlled by ± 5 signal level at the external analog modulation input terminal (Modulation In).

Comprehensive Example

In SUM mode, set a sine wave with 1 kHz from the internal as the modulation signal, and set a square wave with 1 kHz, 200 mVpp, 45 % as the carrier signal, and then set the modulation depth to 80 %. The setting steps are as follows.

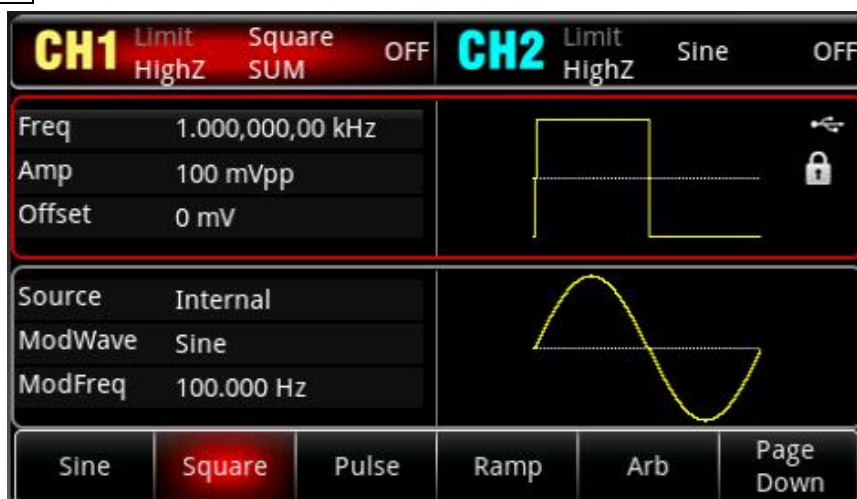
1) Enabling OSK mode

Press **Mode** → **Mod** → **OSK** key in turn to turn on OSK mode.



2) Set carrier signal

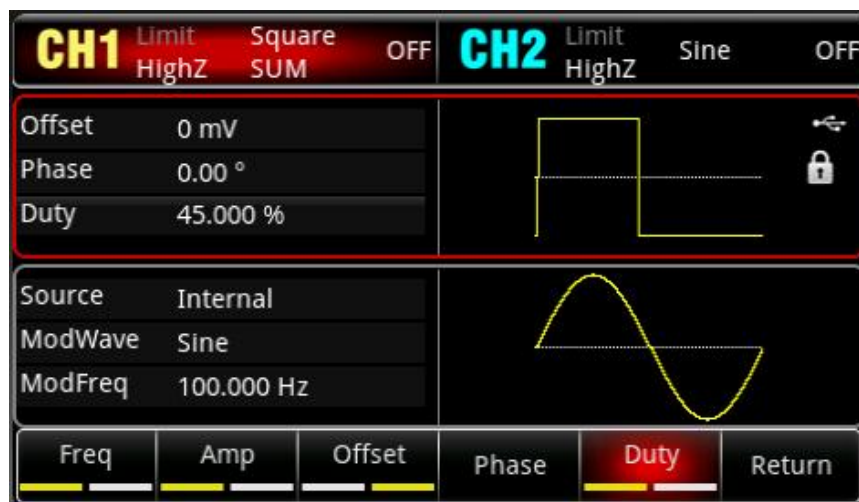
Press **Wave** key to select square wave as the carrier wave (the default is sine wave).



Press the softkey **Freq** to set the frequency, and then use the numerical keyboard to enter 2 kHz.

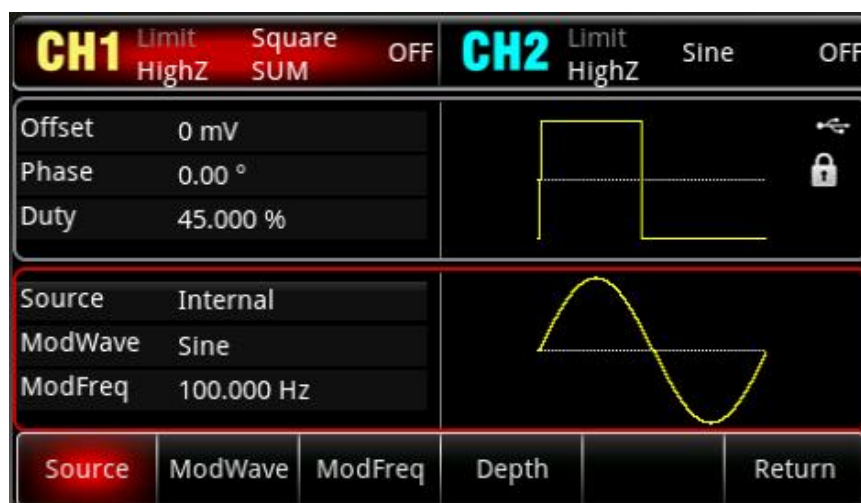
Press the softkey **Amp** to set the amplitude, and then use the numerical keyboard to enter 200 mVpp.

Press the softkey **Duty** to set the duty cycle, and then use the numerical keyboard to enter 45 %.



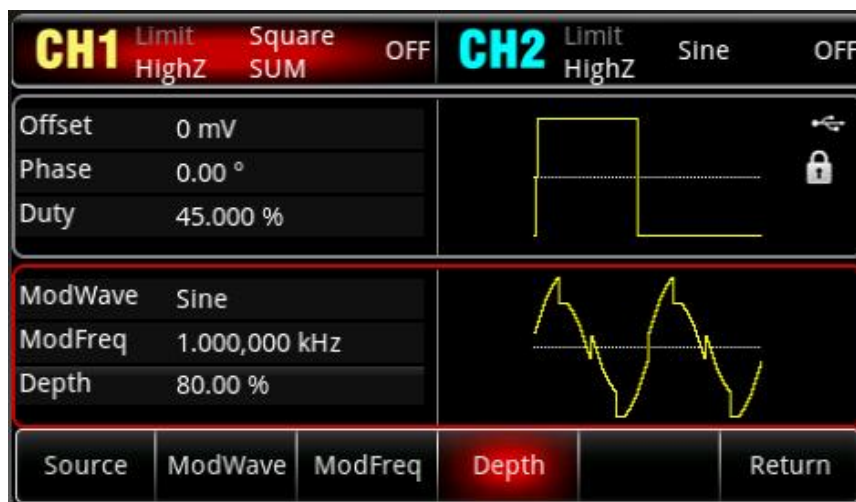
3) Set the modulation frequency and depth

When the carrier signal is set, press **Mode** → **Mod** → **SUM** key in turn to go back to the following page and then to set modulation parameter.



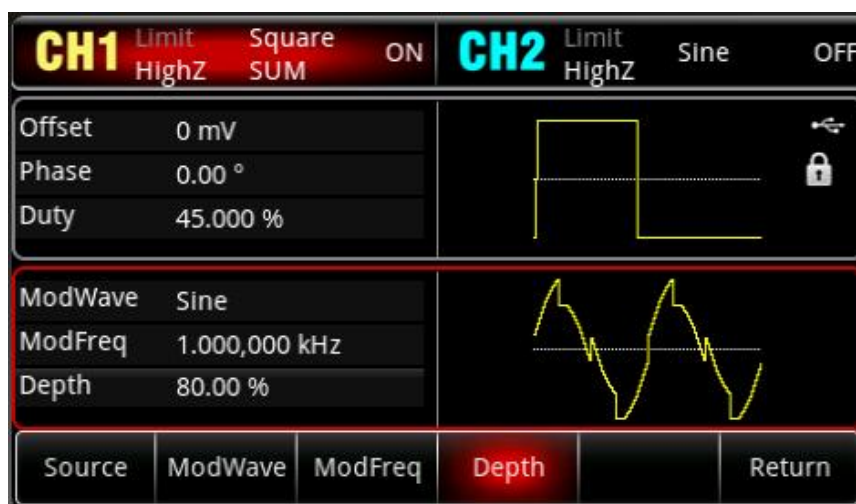
Press the softkey **ModFreq** to set the frequency, and then use the numerical keyboard to enter 1 kHz.

Press the softkey **Depth** to set the amplitude, and then use the numerical keyboard to enter 80 %.

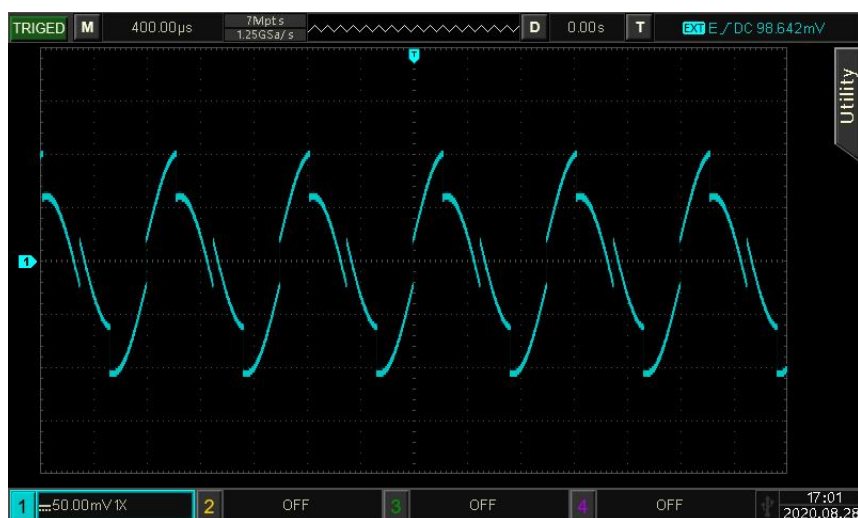


4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "SUM" character, which indicates CH1 output is enabled.



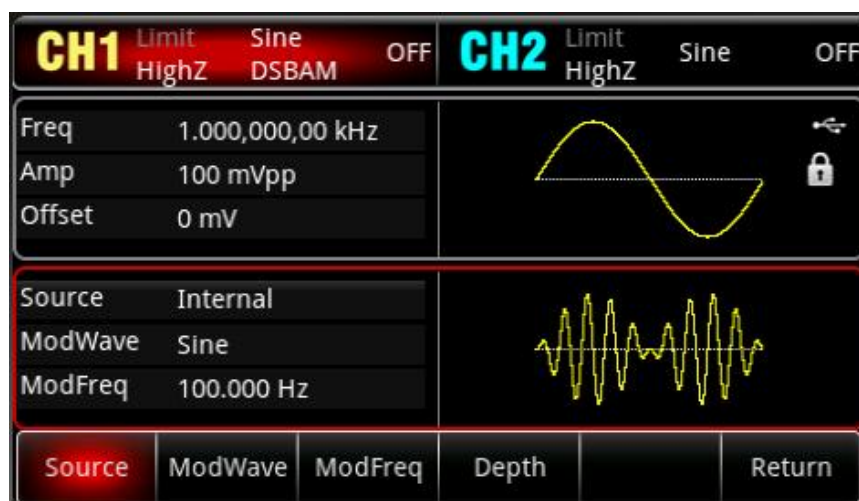
To view the modulation waveform of SUM through an oscilloscope as shown in the following figure.



4.1.13 Double-sideband Amplitude Modulation (DSBAM)

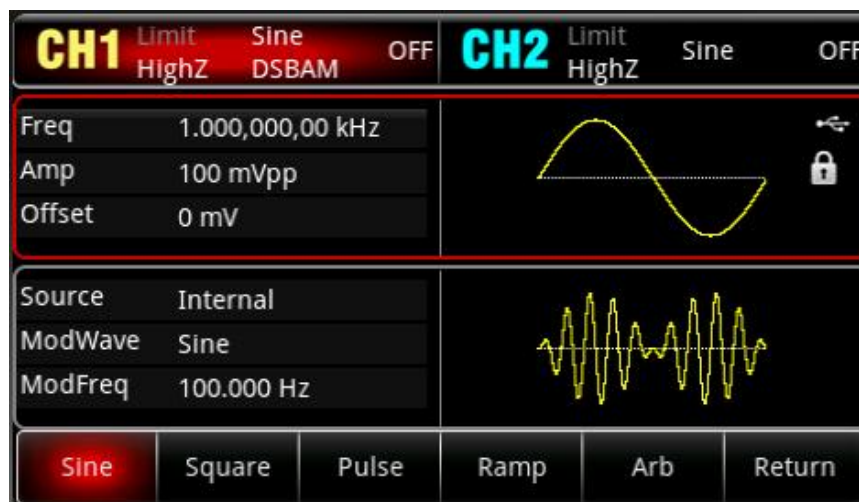
Select DSBAM Mode

Press **Mode** → **Mod** → **DSBAM** key in turn to turn on DSBAM mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of DSBAM can be sine wave, square wave, ramp wave, pulse wave or arbitrary wave (except DC). The default is sine wave. After DSBAM mode is selected, press **Wave** key to enter the carrier wave interface.

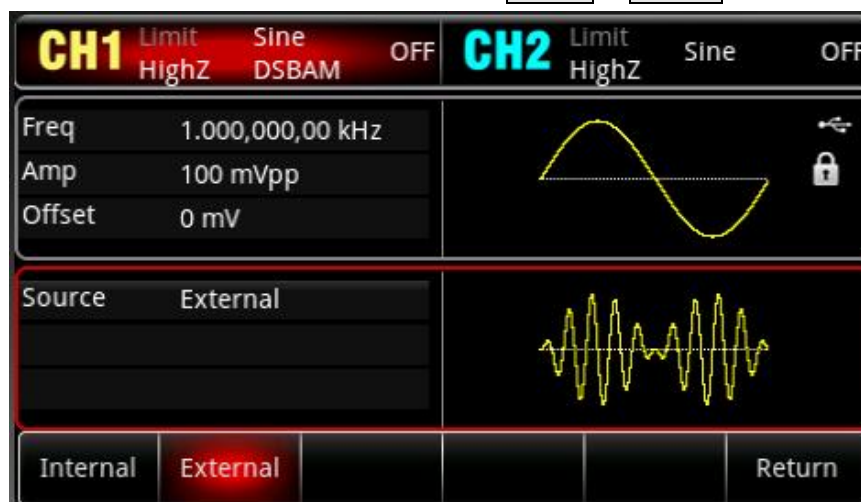


Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Source

The modulation source of this instrument can select internal or external. When DSBAM mode is enabled, the default modulation source is internal. It can switch to external by using multifunction rotary knob or pressing the softkey **Source** → **Internal** in turn.



1) Internal Source

When the modulation source is internal, the modulation wave can be sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When DSBAM mode is enabled, the default modulation wave is sine wave. It can be change by using multifunction rotary knob or pressing the softkey **ModWave** → **Sine** in turn.

- Square wave: Duty cycle is 50 %
- Rising ramp wave: Symmetry is 100 %.
- Falling ramp wave: Symmetry is 0 %.

- Arbitrary wave: The length of arbitrary wave limits at 2 kpts by the method of automatic extracting point when arbitrary wave is the modulation wave.
- Noise Wave: White Gauss noise

2) External source

When the modulation source is external, the modulation wave and modulation frequency will be hidden in parameter list. The carrier wave will be modulated by an external wave. DSBAM modulation depth is controlled by $\pm 5V$ signal level at the external analog modulation input terminal (Modulation In) on the rear panel. For example, if the modulation depth is set to 100 %, the output of DSBAM amplitude is maximum when the external modulation signal is +5V; the output of DSBAM amplitude is minimum when the external modulation signal is -5V.

Modulation Frequency Setting

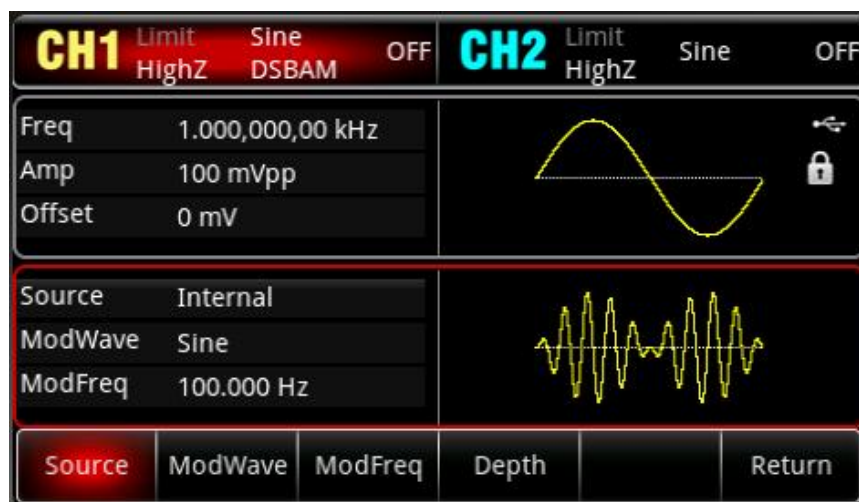
When the modulation source is internal, the frequency of modulation wave can be set. The range of modulation frequency is 2 mHz ~ 1 MHz. The default is 100 Hz. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **ModFreq**, use the numerical keyboard and enter number and then select the unit to complete the setting. When the modulation source is external, the modulation wave and modulation frequency will be hidden in parameter list. The carrier wave will be modulated by an external wave. The range of external input modulation signal is 0 Hz ~ 50 kHz.

Comprehensive Example

In DSBAM mode, set a square wave with 1 kHz from the internal as the modulation signal, and set a sine wave with 2 kHz, 2 Vpp as the carrier signal. The setting steps are as follows.

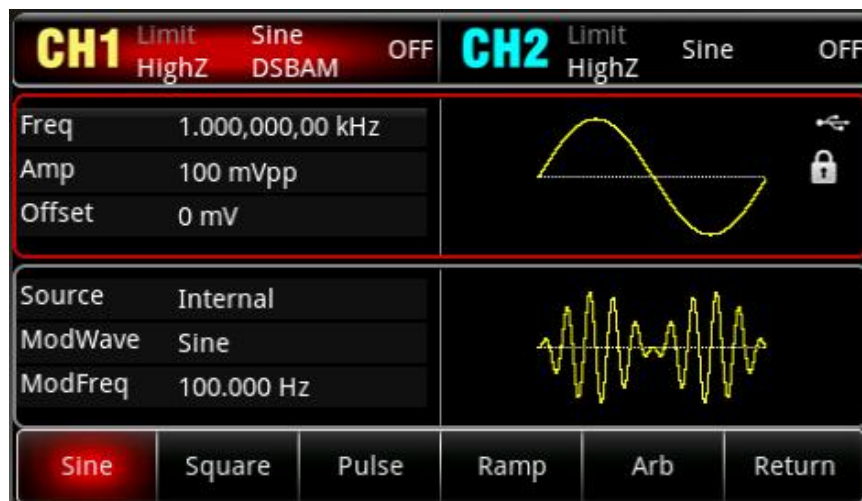
1) Enabling DSBAM mode

Press **Mode** → **Mod** → **DSBAM** key in turn to turn on DSBAM mode.



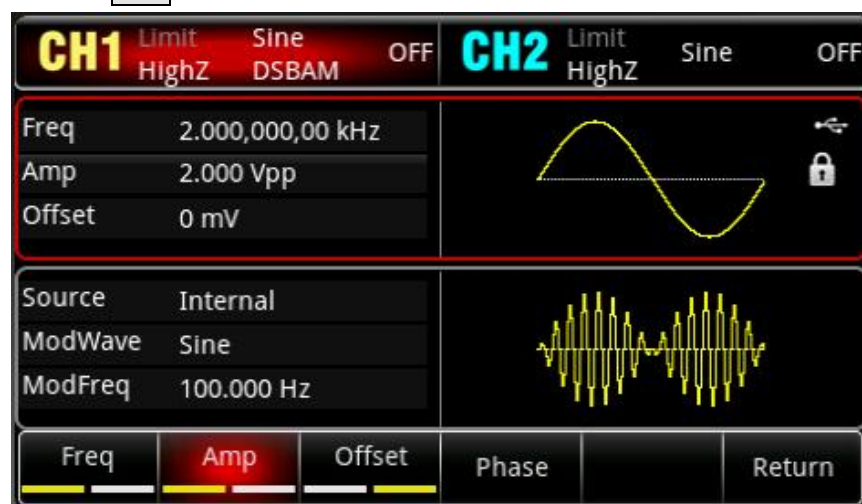
2) Set carrier signal

Press **Wave** key to select sine wave as the carrier wave (the default is sine wave), so this step doesn't need to be changed.



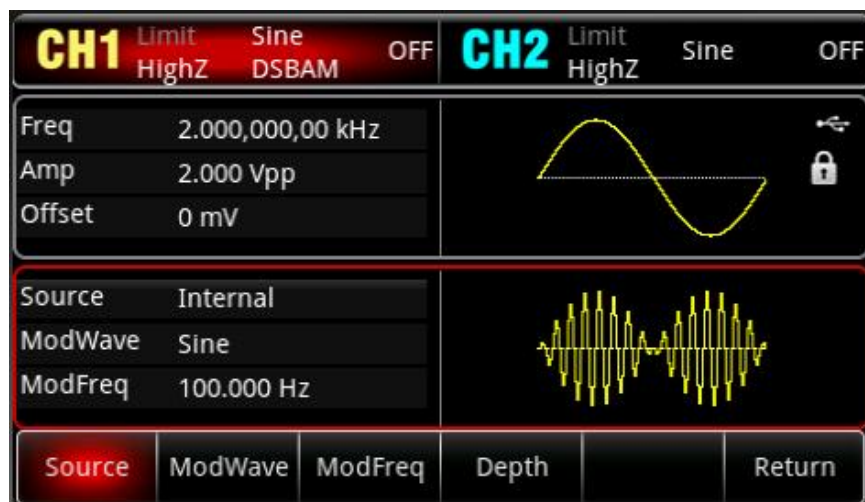
Press the softkey **Freq**, and then use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp**, and then use the numerical keyboard to enter 2 Vpp.



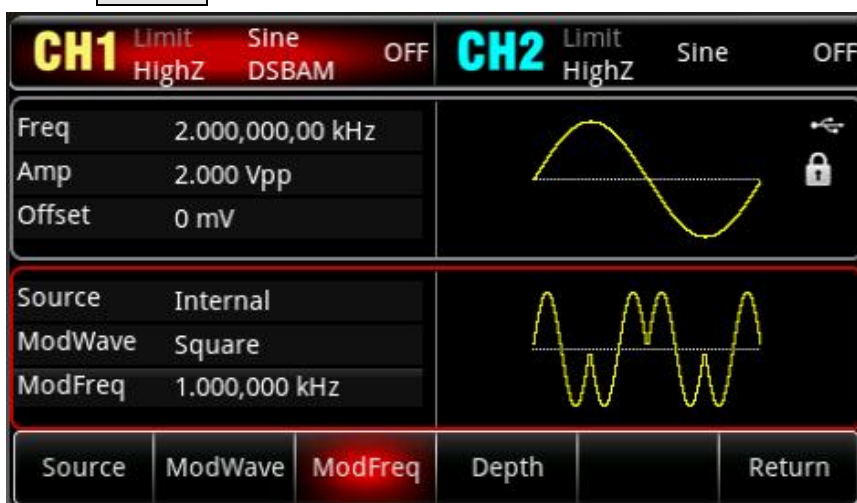
3) Set modulation wave and frequency

When the carrier wave is set, press **Wave** key to go back to the following page to set the modulation parameter.



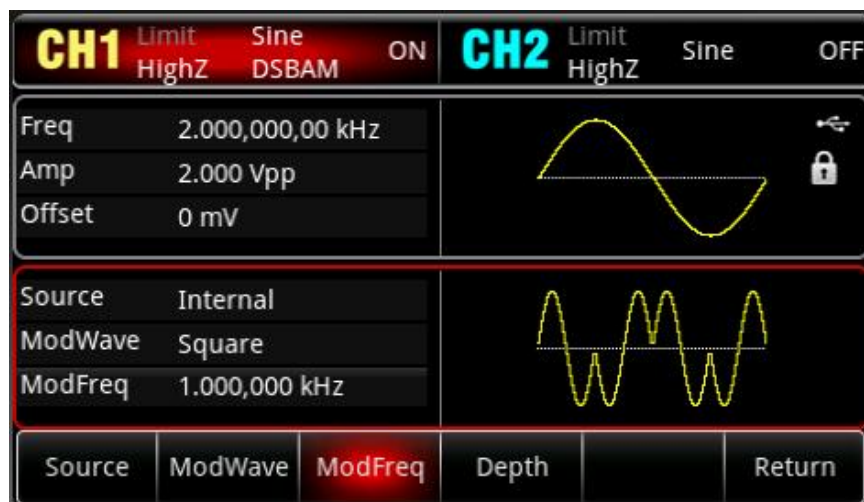
Press the softkey **ModWave** to select square wave.

Press the softkey **ModFreq** and use the numerical keyboard to enter 1 kHz.

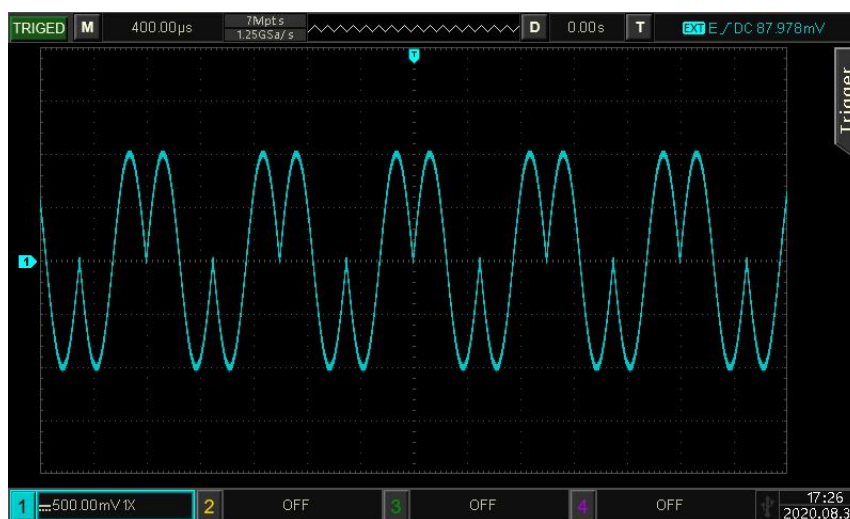


4) Enabling channel output

Press the state of CH1 output to "ON", or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight "DSBAM" character, which indicates CH1 output is enabled.



To view the modulation waveform of DSBAM through an oscilloscope as shown in the following figure.



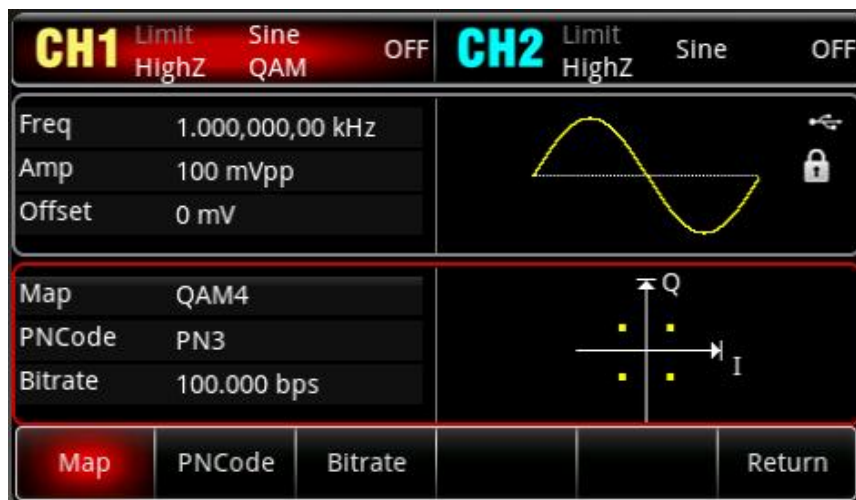
4.1.14 Quadrature Modulation (QAM)

In QAM mode, set two signals of the same frequency but with phase difference 90° (usually represented by Sin and Cos) as the carrier wave, use baseband signal to modulate the carrier wave. UTG2000X function/arbitrary waveform generator can output seven modulation types: QAM4, QAM8, QAM16, QAM32, QAM64, QAM128 and QAM256M. The modulation mode of each channel are independent, user can set the same or different modulation mode for each channels.

Note: It is recommended to use the 10 MHz reference output signal of this instrument as the reference clock input for the demodulation device or input the reference clock of demodulation device as the signal clock. The signal can be accurate demodulation through clock synchronization, which to eliminate the phase difference.

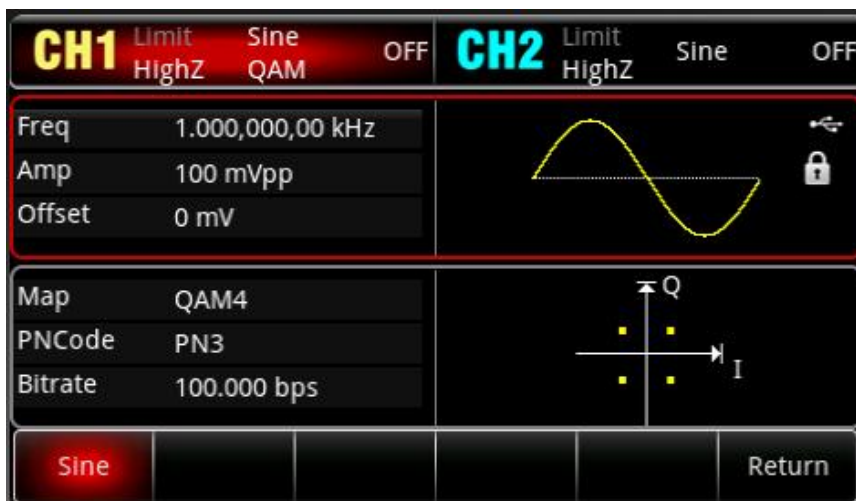
Select QAM Mode

Press **Mode** → **Mod** → **QAM** key in turn to turn on QAM mode, the waveform generator will output the modulated waveform according to the currently settings.



Select Carrier Wave

Carrier wave of QAM can only be sine wave. After QAM mode is selected, press **Wave** key, only sine wave is available in the modulation type on the right.



Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Select Modulation Mode

The modulation mode is the distribution of constellation diagram, it change with the modulation mode. The modulation mode can change by using multifunction rotary knob or pressing the softkey **Map** → **QAM4** key in turn to select QAM4, QAM8, QAM16, QAM32, QAM64, QAM128 or QAM256M.

Select Symbol

When QAM mode is enabled, the default symbol is PN3. It can be change by using multifunction rotary knob or pressing the softkey **PNode** → **PN3** in turn to select PN3, PN5, PN7, PN9, PN11, PN13, PN15, PN17, PN19, PN21, PN23, PN25, PN27, PN29 or PN31.

Bitrate Setting

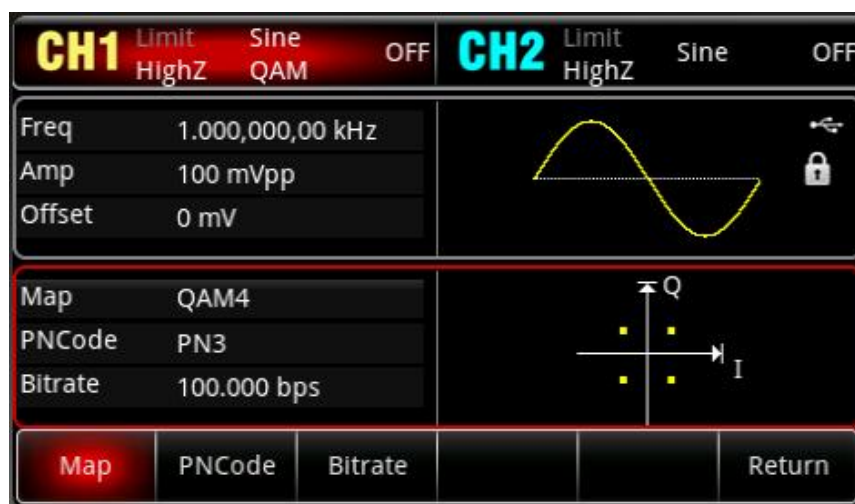
The frequency between the carrier phase and modulation phase can be set. When QAM is enabled, the range of QAM bitrate is 2mbps~1 Mbps. The default is 100 bps. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **BitRate**.

Comprehensive Example

In QAM mode, set a sine wave with 2 kHz, 2 Vpp from the internal as the carrier signal, set the bitrate to 100 bps, the modulation mode to QAM64 and the data source to PN7. The setting steps are as follows.

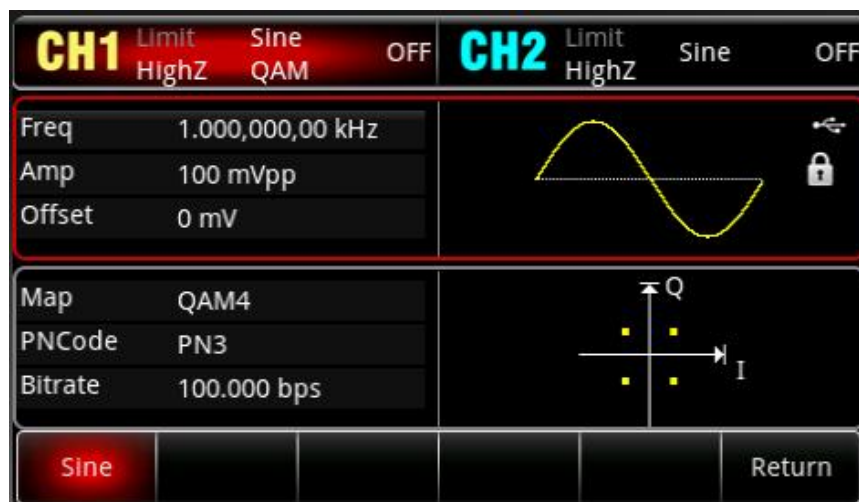
1) Enabling BPSK mode

Press **Mode** → **Mod** → **QAM** key in turn to turn on QAM mode.



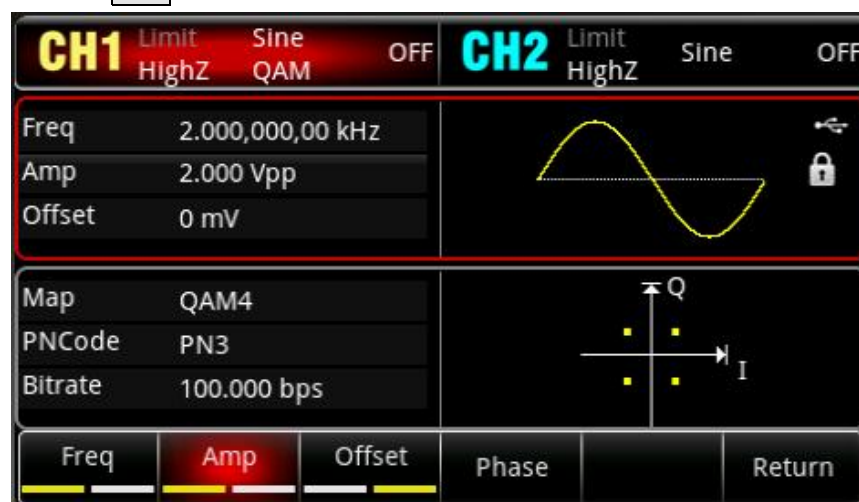
2) Set carrier signal

Press **Wave** key to select sine wave as the carrier wave. The carrier signal of QAM can only be sine wave, so this step doesn't need to be changed.



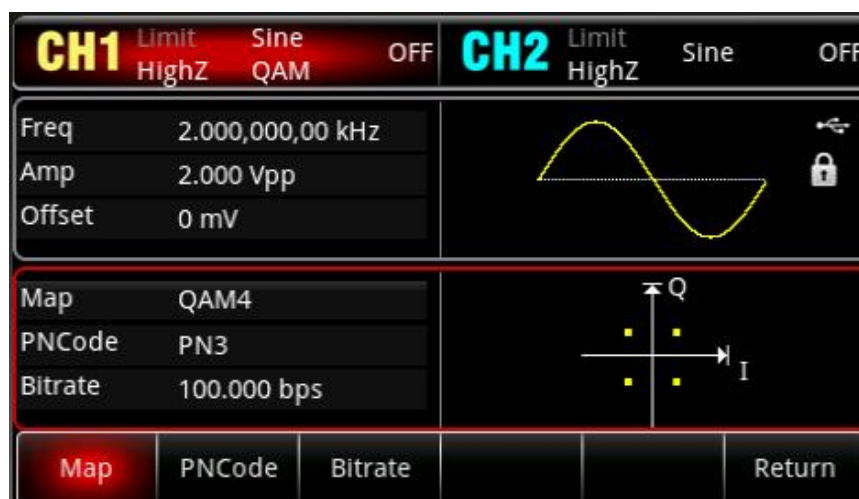
Press the softkey **Freq**, and then use the numerical keyboard to enter 2 kHz.

Press the softkey **Amp**, and then use the numerical keyboard to enter 2 Vpp.



3) Set modulation parameter

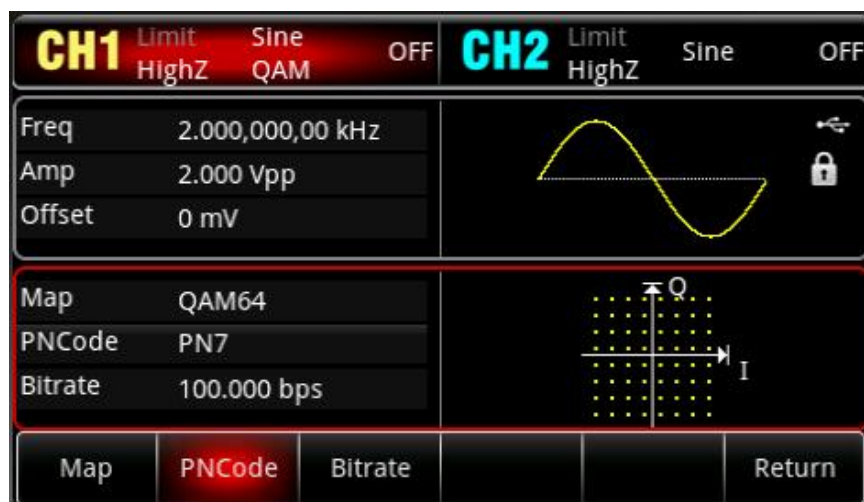
When the carrier signal is set, press **Wave** key to go back to the following page to set the modulation parameter.



Press the softkey **Map** → **QAM4** in turn to select QAM64.

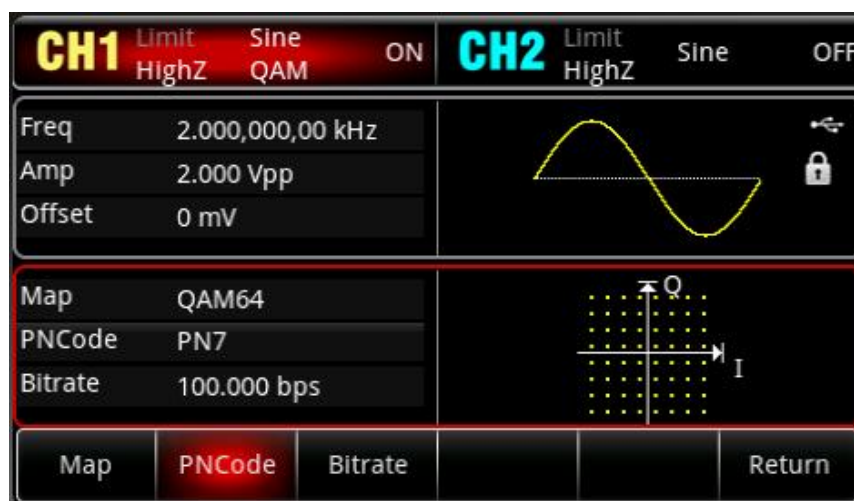
Press the softkey **PNCode** to pop out the dialog box select PN7.

Press the softkey **Bitrate** and then use the numerical keyboard to enter 100 bps (the default is 100 bps).

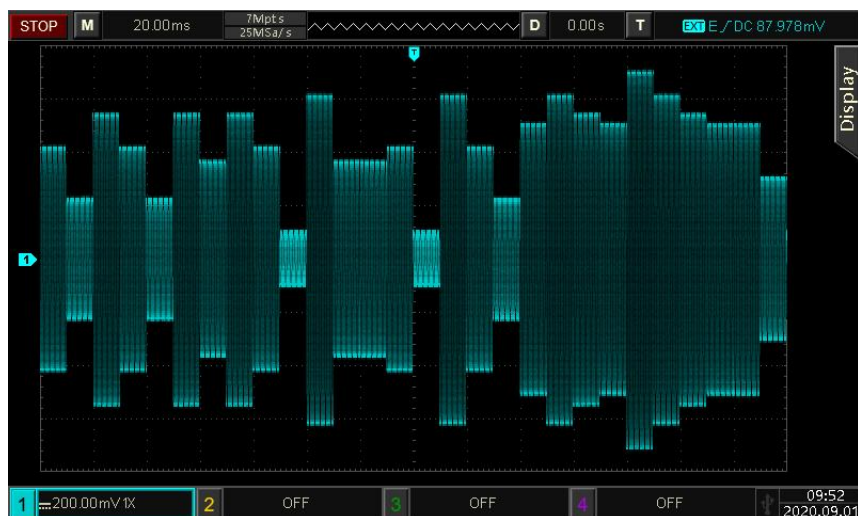


4) Enabling channel output

Press the state of CH1 output to “ON”, or press the quick key CH1 on the front panel to turn on CH1 output, or press the softkey **Utility** → **CH1 Setting** in turn, and then press **CH1 Output** key to enable the channel output. When the channel output is enabled, CH1 key will illuminate and grey CH1 label will change to highlight “QAM” character, which indicates CH1 output is enabled.



To view the modulation waveform of QAM through an oscilloscope as shown in the following figure.

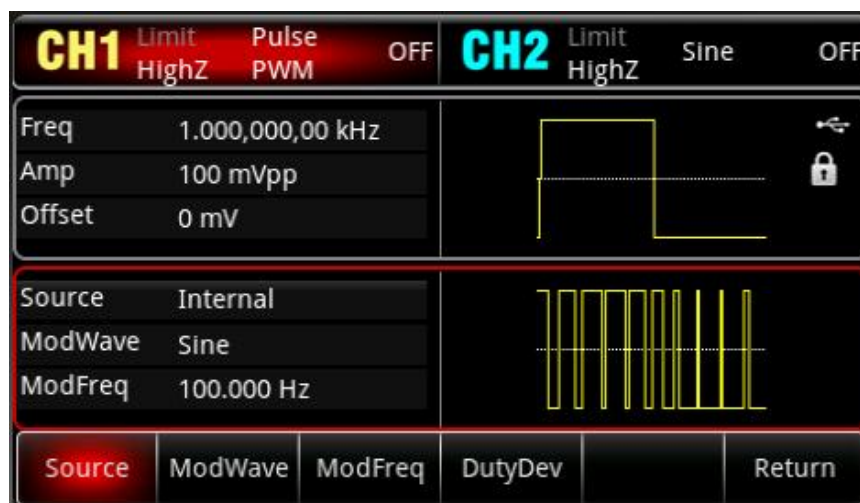


4.1.15 Pulse Width Modulation (PWM)

In PWM mode, the modulated waveform is consist of the carrier wave and the modulation wave. The pulse width of the carrier wave will changed with the amplitude of the modulation wave. The modulation mode of the two channels are independent, user can set the same or different modulation mode for CH1 and CH2.

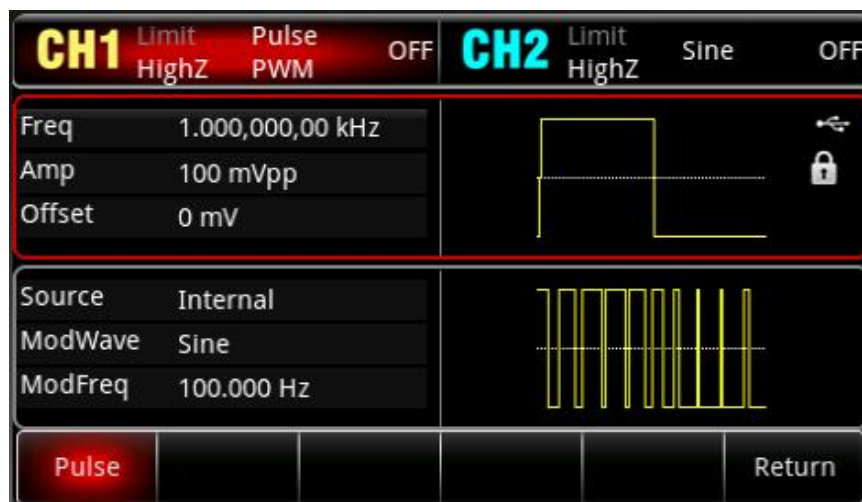
Select PWM Mode

Press **Mode** → **Mod** → **PWM** key in turn to turn on PWM mode, the instrument will output the modulated waveform according to the currently setting.



Select Carrier Wave

The carrier wave of PWM can only be sine wave. After PWM mode is selected, press **Wave** key to enter the carrier wave interface.



Set Carrier Wave Frequency

Refer to Carrier Wave Frequency in AM mode.

Set Modulation Frequency

When PWM mode is enabled, the frequency range of modulation wave is 2 mHz ~ 1 MHz (the default is 100 Hz). It can be change by using multifunction rotary knob or pressing the softkey **ModFreq**, and then use numerical keyboard to enter number and select unit soft key to complete the setting.

Duty Cycle Deviation Setting

The duty cycle deviation indicates the deviation of modulated wave with respect to the currently duty cycle of the carrier wave. The duty cycle range of PWM is 0 % ~ 49.99 %, the default is 49.99 %. It can be change by using multifunction rotary knob or pressing the softkey **DutyDev**.

Note

- Duty cycle deviation is deviation of modulated waveform with respect to the duty ratio of original pulse wave (express in %).
- Duty cycle deviation cannot exceed the duty cycle of the current pulse wave.
- The sum of duty cycle deviation and the duty cycle of the current pulse wave must be $\leq 99.99\%$.
- Duty cycle deviation is limited by the minimum duty cycle of pulse wave and the current edge time.

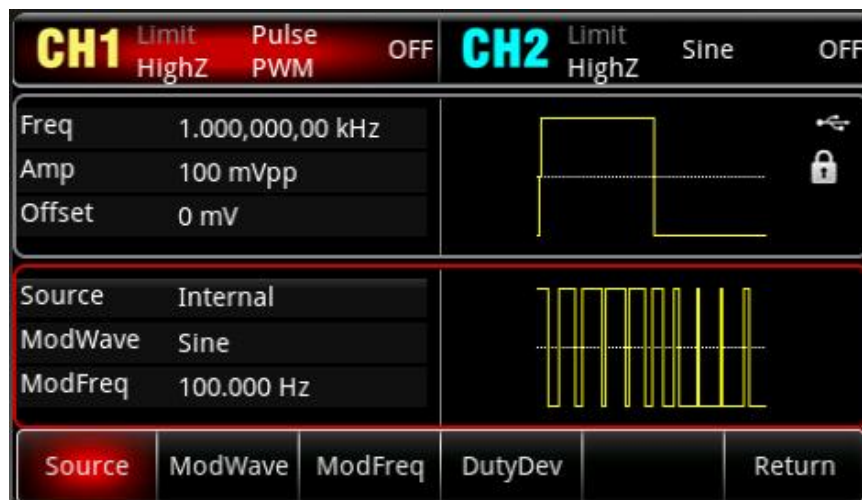
Comprehensive Example

In PWM mode, set a sine wave with 1 kHz sine wave from the internal as the modulating signal and set a pulse wave with frequency of 10 kHz, amplitude of 2 Vpp, duty cycle of 50 % and

rising/falling time of 100 ns, and then set the duty cycle deviation to 40 %. The settings steps as following.

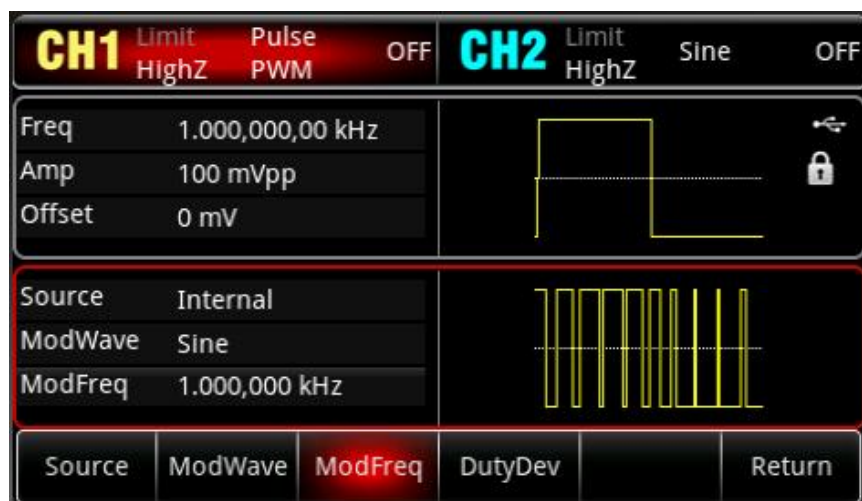
1) Enabling PWM mode

Press **Mode** → **Mod** → **PWM** key in turn to turn on PWM mode.



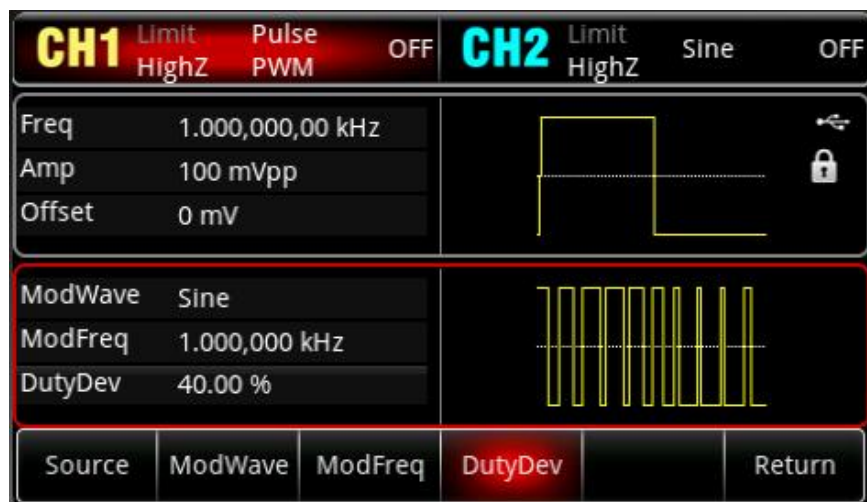
2) Set modulation signal

Press the softkey **ModFreq**, use the numerical keyboard to enter 1 and then select the unit to **kHz**.



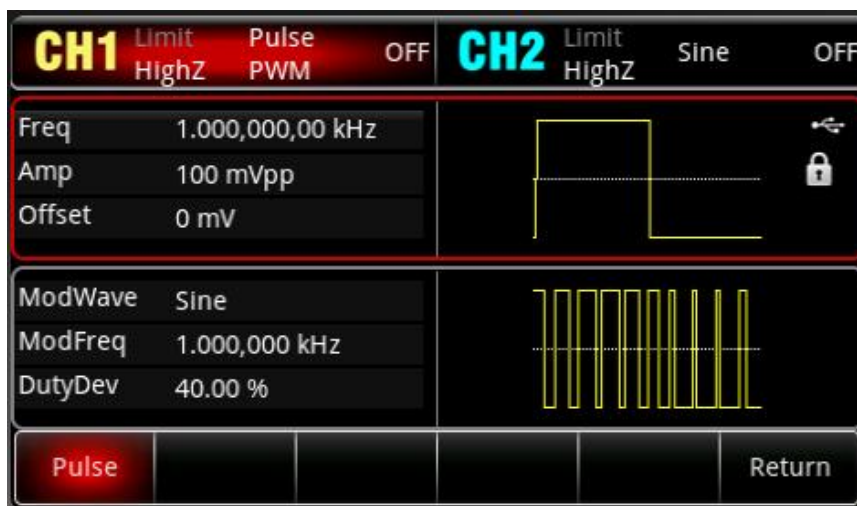
3) Set duty cycle

Press the softkey **DutyDev**, use the numerical keyboard to enter 40 and then select the unit to %.



4) Set carrier wave and parameter

Press **Wave** key to enter the carrier wave page and then select pulse wave as the carrier wave (the default is pulse wave).



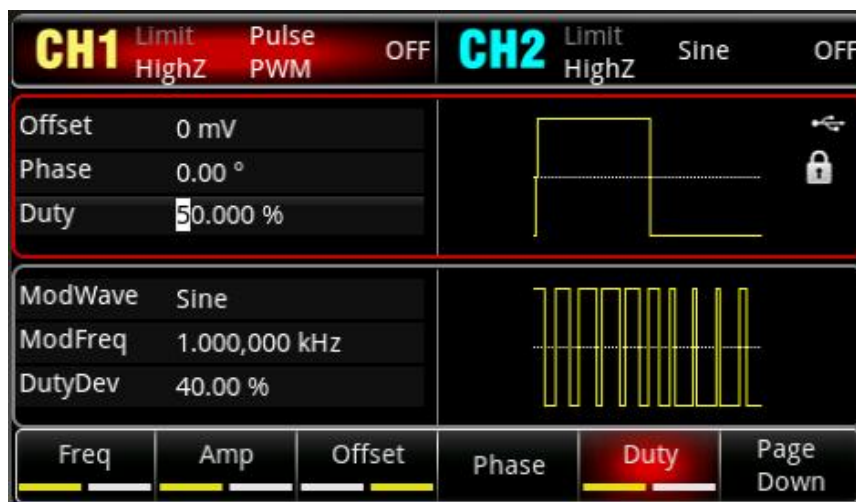
Press the softkey **Freq** to set the frequency, use the numerical keyboard to enter 10 and then select the unit of parameter to **kHz**.

Press the softkey **Amp** to set the amplitude, use the numerical keyboard to enter 2 and then select the unit of parameter to **Vpp**.

Press the softkey **Rise** to set the rising edge, use the numerical keyboard to enter 100 and then select the unit of parameter to **ns**.

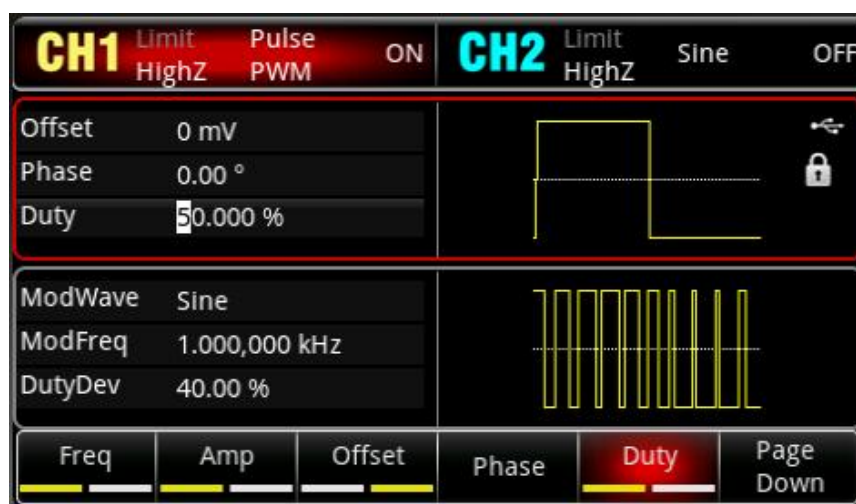
Press the softkey **Fall** to set the falling edge, use the numerical keyboard to enter 100 and then select the unit of parameter to **ns**.

Press the softkey **Duty** to set the duty cycle, use the numerical keyboard to enter 50 and then select the unit of parameter to %.

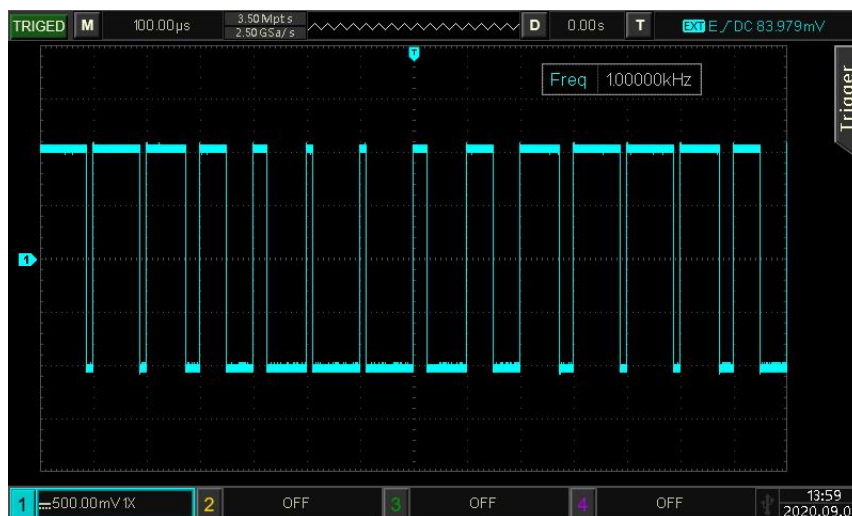


5) Enabling Channel Output

Press **CH1** key, if the key is illuminated which means the channel output is enabled.



To view the modulation waveform of PWM through an oscilloscope as shown in the following figure.



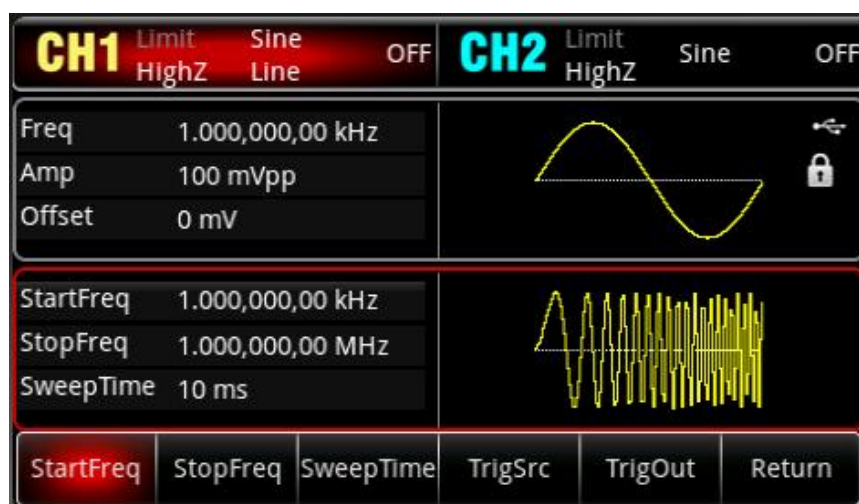
4.2 Sweep Wave Output

In frequency sweep mode, the output frequency of the instrument is change from start frequency to stop frequency in a linear, logarithmic or step way. Sine wave, square wave, ramp wave and arbitrary wave (except DC) can all generate the frequency sweep output.

4.2.1 Sweep Frequency

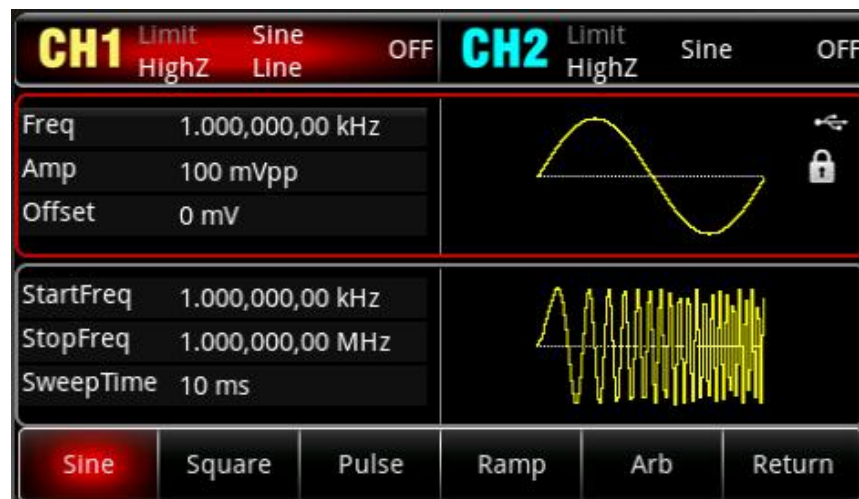
1) Enabling Sweep Frequency Mode

Press **Mode** → **Sweep** → **Line** key in turn to turn on sweep frequency mode, the instrument will output the sweep frequency wave according to the currently setting, as shown in the following figure.



2) Select Sweep Frequency Wave

The sweep frequency wave can be sine wave, square wave, pulse wave, ramp wave or arbitrary wave. The default is sine wave. After frequency sweep mode is selected, press **Wave** key to enter the carrier wave interface.



4.2.2 Start and Stop Frequency

Start frequency and stop frequency is the upper limit and lower limit of frequency for sweep frequency. The function/arbitrary waveform generator is always sweep from the start frequency to the stop frequency and back to the start frequency.

Press **Mode** → **Sweep** → **Line** key in turn to enter the sweep setting interface, use multifunction rotary knob and arrow keys or press the softkey **StartFreq** or **StopFreq**, use the numerical keyboard to enter number and then select the unit to complete the setting.

Note

- When start frequency < stop frequency, DDS function/arbitrary waveform generator sweeps from low frequency to high frequency.
- When start frequency > stop frequency, DDS function/arbitrary waveform generator sweeps from high frequency to low frequency.
- When start frequency = stop frequency, DDS function/arbitrary waveform generator outputs the fixed frequency.

The start frequency is 1 kHz and stop frequency is 20 kHz by default. The range of start and stop frequency is vary with frequency sweep wave, the frequency range for each frequency sweep wave see the table as follows.

Carrier Wave	Frequency					
	UTG2122X		UTG2082X		UTG2062X	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Sine wave	1 μ Hz	120 MHz	1 μ Hz	80 MHz	1 μ Hz	60 MHz
Square wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz
Pulse wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz
Ramp wave	1 μ Hz	5 MHz	1 μ Hz	4 MHz	1 μ Hz	3 MHz
Arbitrary wave	1 μ Hz	50 MHz	1 μ Hz	40 MHz	1 μ Hz	30 MHz

4.2.3 Sweep Frequency Mode

Press the softkey **Sweep** to select linear, logarithmic or step.

Linear: waveform generator outputs frequency in a linear way during sweep frequency mode.

Logarithmic: waveform generator change the output frequency in logarithmic way during sweep frequency mode.

Step: waveform generator use the set step to perform sweep frequency from start frequency to stop frequency.

4.2.4 Sweep Frequency Time

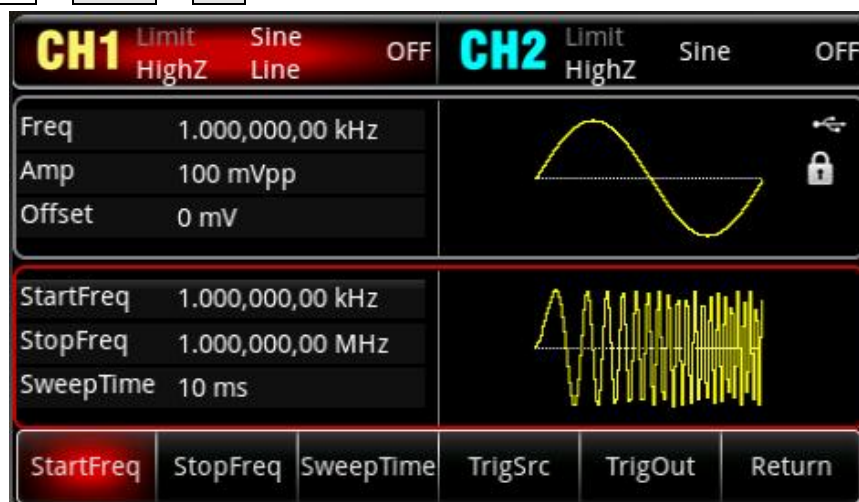
In frequency sweep mode, the frequency sweep time (the range is 1 ms- 500s), the default is 1s. It can be change by pressing the softkey **SweepTime** and use the numerical keyboard to enter number and then select unit to complete the setting.

4.2.5 Comprehensive Example

In frequency sweep mode, set a square wave with amplitude of 1 Vpp, duty cycle of 50 % from the internal as the sweep frequency wave. Sweep frequency mode is set to linear, set the start frequency to 1 kHz, stop frequency to 50 kHz, sweep time to 2 ms, and use the internal source trigger to output the sweep frequency wave. The setting steps are as follows.

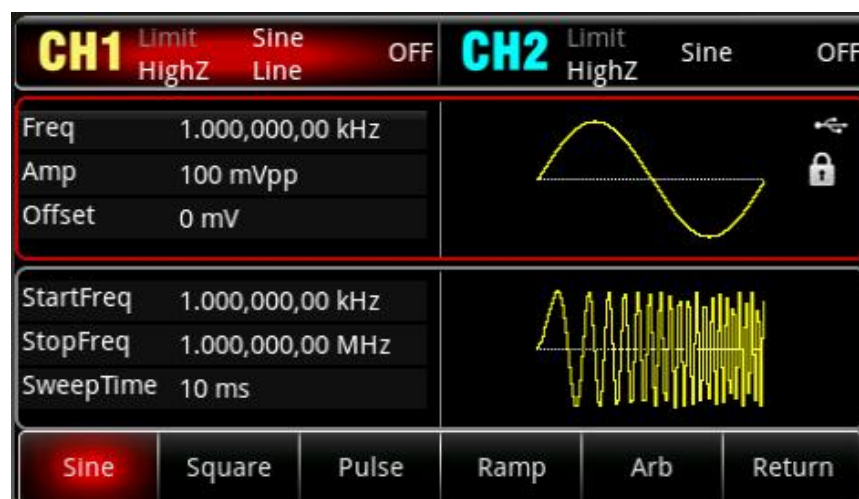
1) Enabling linear sweep Mode

Press **Mode** → **Sweep** → **Line** key in turn to turn on linear sweep mode.



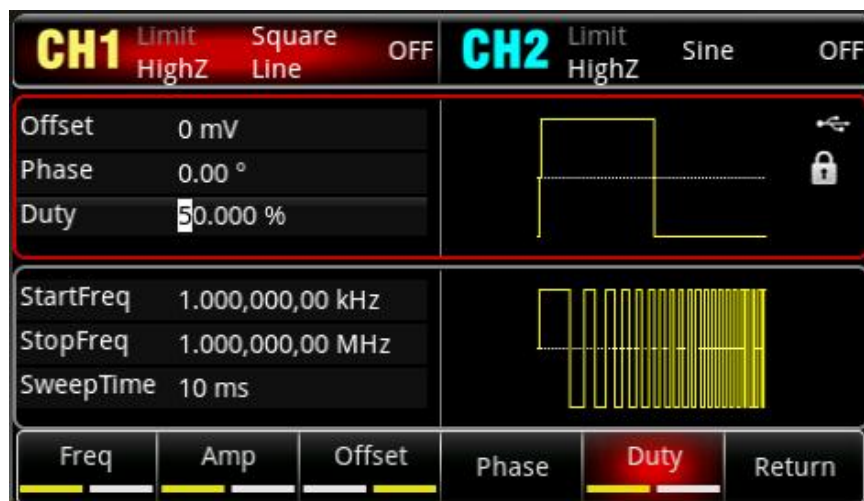
2) Select sweep frequency wave

Press **Wave** key to enter the sweep frequency wave interface and select square wave (the default is sine wave).



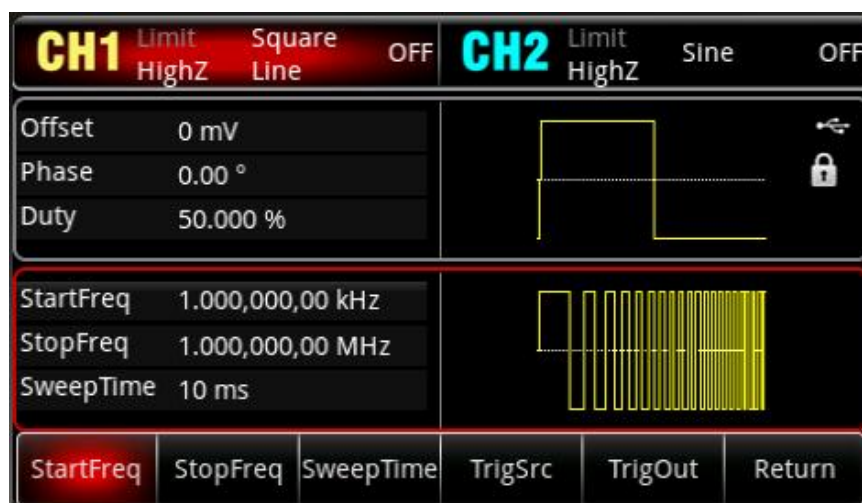
Press the softkey **Amp** to set the amplitude, use the numerical keyboard to input 1 and then select the unit of parameter to **Vpp**.

Press the softkey **Duty** to set the duty cycle, use the numerical keyboard to input 50 and then select the unit of parameter to % (the default duty cycle is 50 %).



3) Set start/stop frequency and sweep time

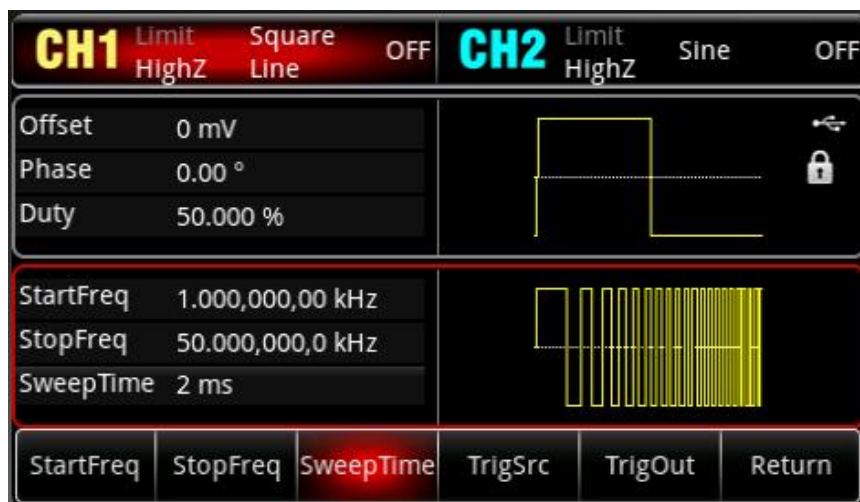
Press **Mode** → **Sweep** → **Line** key in turn to enter linear sweep.



Press the softkey **StartFreq** to set the start frequency, use the numerical keyboard to input 1 and then select the unit of parameter to **kHz**. The default is 1 kHz.

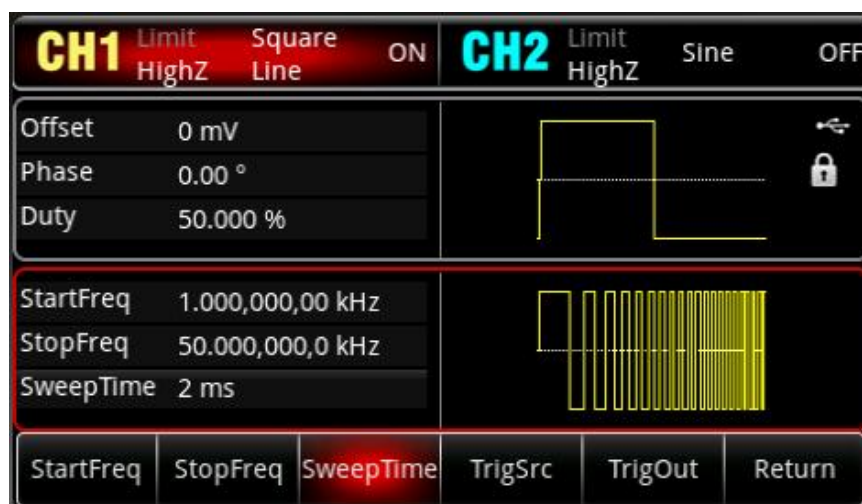
Press the softkey **StopFreq** to set the stop frequency, use numerical keyboard to input 50 and then select the unit of parameter to **kHz**.

Press the softkey **SweepTime** to set the sweep time, use numerical keyboard to input 2 and then select the unit of parameter to **ms**.

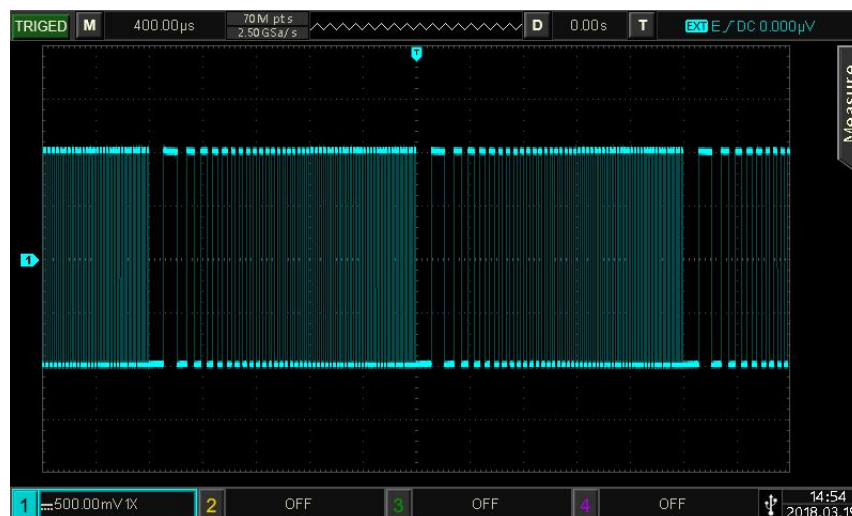


4) Enabling Channel Output

Press **CH1** key, if the indicator light is illuminated which means the channel output is enabled.



To view the modulation waveform of linear sweep through an oscilloscope as shown in the following figure.



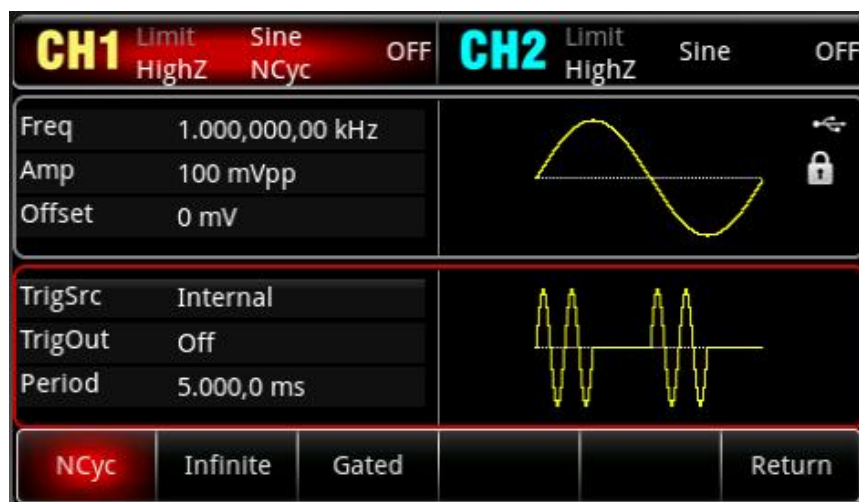
4.3 Pulse String Output

The waveform generator can generate a designated cycle period wave (pulse string). The pulse string output can be controlled by internal trigger or external trigger. It has three trigger output type, N cycle, gate and infinite. Sine wave, square wave, ramp wave, pulse wave, arbitrary wave (except DC) and noise wave (only applicable to gating pulse string) can generate pulse string. And offer N cycle, gating and infinite pulse string. It can generate pulse train for sine wave, square wave, ramp wave, pulse wave, arbitrary wave (except DC) and noise (only applicable to gating pulse train). The modulation mode of the two channel are independent, user can set the same or different modulation mode for CH1 and CH2.

4.3.1 Pulse String

1) Enabling sweep frequency mode

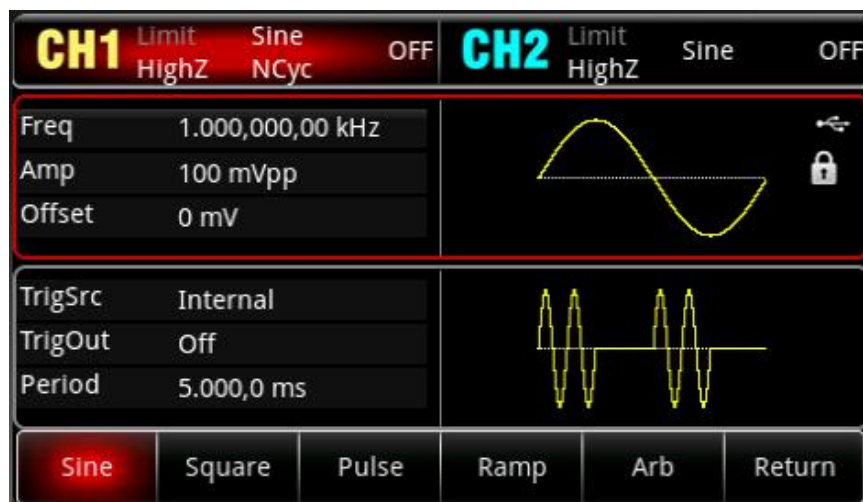
Press **Mode** → **Burst** key in turn to turn on pulse string mode, the instrument will output the pulse string according to the currently setting, as shown in the following figure.



2) Select wave

- N cycle mode supports sine wave, square wave, ramp wave, pulse wave and arbitrary wave (except DC).
- Gating mode supports sine wave, square wave, ramp wave, pulse wave, arbitrary wave (except DC) and noise wave.
- Infinite mode supports sine wave, square wave, ramp wave, pulse wave and arbitrary wave (except DC).

After the pulse string mode is enabled through the above steps, press **Wave** key to enter the carrier wave interface.



3) Set wave frequency

In N cycle and gating mode, wave frequency is defines the signal frequency during pulse string. In N cycle mode, the pulse string is output with the specified number of cycles and wave frequency. In gating mode, the pulse string is output with wave frequency when trigger signal is high level.

Note

Wave frequency is different from pulse string period. Pulse string period is used to specify the interval between pulse strings (only for N cycle mode). The default frequency for each wave is 1 kHz, the setting range refer to Table 4-3.

Table 4-3

Carrier Wave	Frequency					
	UTG2122X		UTG2082X		UTG2062X	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Sine wave	1 μ Hz	120 MHz	1 μ Hz	80MHz	1 μ Hz	60MHz
Square wave	1 μ Hz	50 MHz	1 μ Hz	40MHz	1 μ Hz	30MHz
Pulse wave	1 μ Hz	50 MHz	1 μ Hz	40MHz	1 μ Hz	30MHz
Ramp wave	1 μ Hz	5 MHz	1 μ Hz	4MHz	1 μ Hz	3MHz
Arbitrary wave	1 μ Hz	50 MHz	1 μ Hz	40MHz	1 μ Hz	30MHz

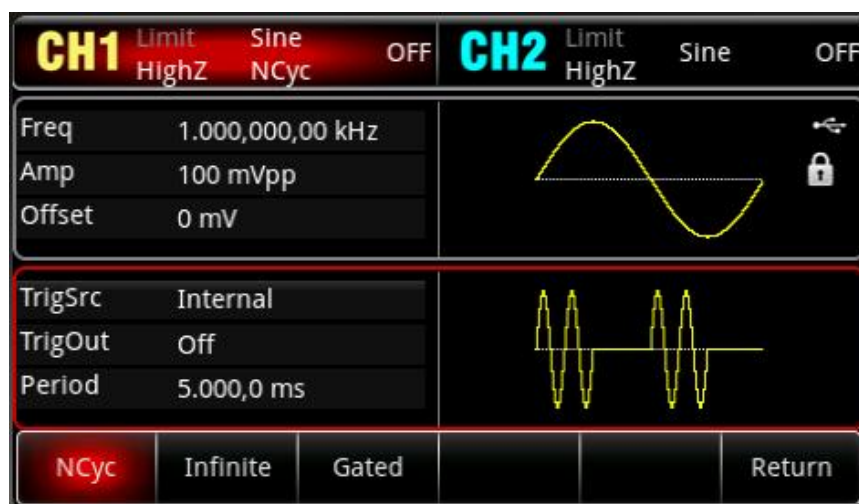
The wave frequency can be set after the weave is selected, use multifunction rotary knob or press the softkey **Freq**, use the numerical keyboard to enter number and select unit to complete the setting.

4.3.2 Pulse String Type

UTG2000X can output three types of pulse train, N cycle, gating and infinite. The default type is N cycle.

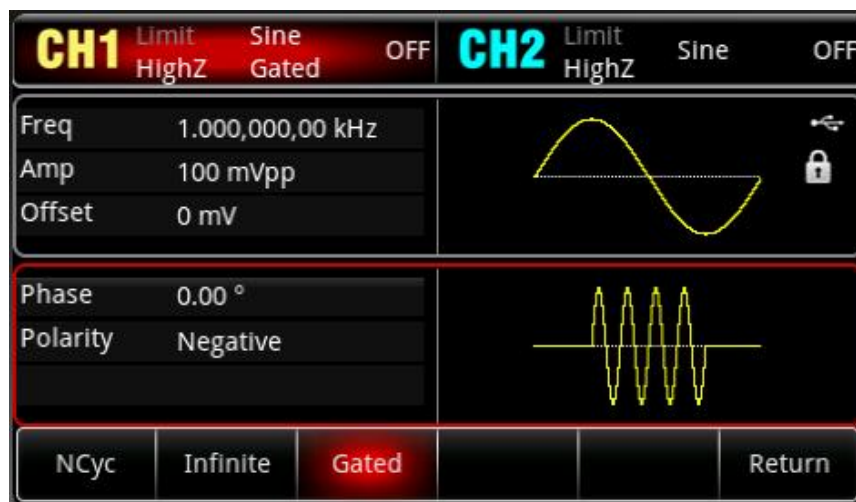
1) N Cycle Mode

Press the softkey **NCyc** to enter N cycle mode, the waveform generator will output a waveform with designated cycle number (pulse string). After a designated number cycle number is exported, the waveform generator will stop and wait for the next trigger. The trigger source of pulse string can be internal or external in this mode. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **TrigSrc** to complete the setting (as shown in the following figure).



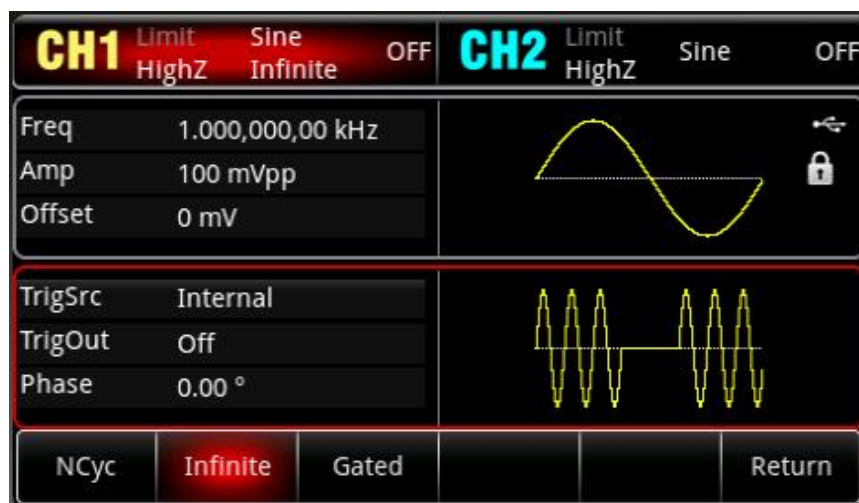
2) Gating Mode

Press the softkey **Gated** to enter gating mode, the trigger source, trigger output, trigger edge, burst (pulse string period) and cycle number options in the parameter list will be automatically hidden. So it can only use the external trigger source, the waveform generator will be triggered by the external digital modulation terminal (FSK/Trig/Counter) on the rear panel. If the polarity is positive and trigger input signal is high level, the waveform generator will output a continuous wave; if the trigger input signal is low, it need to complete the currently wave period at first and then stop it, while start phase of the selected wave should keep at the corresponding level. For noise wave, if gating signal turns to fake, the output will be stop immediately. The polarity can be select by using multifunction rotary knob and arrow keys or pressing the softkey **Polarity** to complete the setting (as shown in the following figure).



3) Infinite Mode

Press the softkey **Infinite** to enter infinite mode, burst period (pulse string period) and cycle number options in the parameter list will be automatically hidden. Infinite pulse string means to set the wave cycle number to infinitely great. The waveform generator will output a continuous wave when receive a trigger signal. The trigger source of pulse string can be internal or external in this mode. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **TrigSrc** to complete the setting (as shown in the following figure).



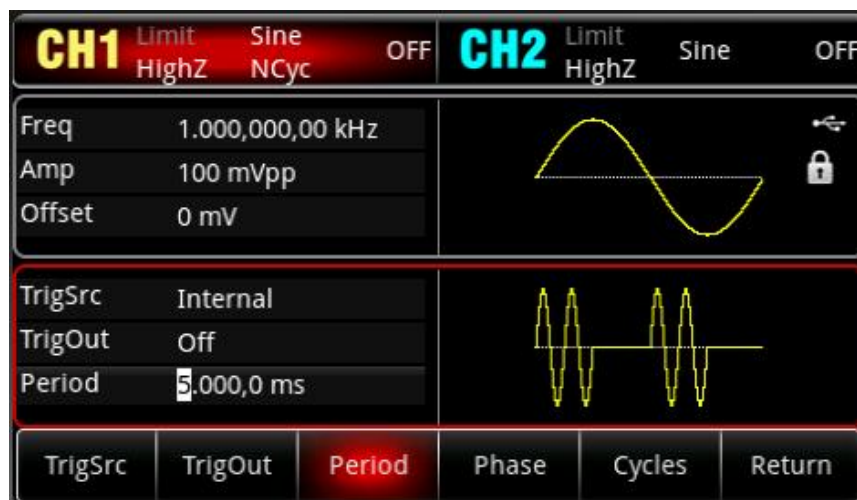
4.3.3 Start Phase of Pulse String

Pulse string phase is phase of the start point for pulse string, it can be set to $-360^{\circ} \sim +360^{\circ}$. The default start phase is 0° . It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Phase** to complete the setting.

- For sine, square, ramp and impulse wave, 0° is the point at which the waveform passes 0 V (or DC deviation value) in forward direction.

- For arbitrary waveform, 0° is the first waveform point which downloaded to the storage.
- Start phase has no effect on the noise wave.

4.3.4 Burst of Pulse String



Burst (pulse string period) is only for N cycle mode, which means the time from one pulse string to the next pulse string. When trigger source is external, burst (pulse string period) option in parameter list will be hidden. The range of burst (pulse string period) is 1μs~500s. The default range is 5 ms. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Period** to complete the setting.

Note

- Burst pulse string period $\geq$ waveform period $\times$ cycle number (number of pulse string). At here, waveform period is the reciprocal of the wave frequency which mentioned in Select Burst
- If burst (pulse string period) is too small, the waveform generator will increase the designated period to allow to output a designated number of cycles.

4.3.5 Cycle Number of Pulse String

In N cycle mode, pulse string counting is used to specify the number of waveform cycle. The range is 1- 50000. The default is 2. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **Cycles** to complete the setting.

Note

- Cycle number $<$ Trigger period $\times$ Wave frequency
- If cycle number exceeds the above limits, the waveform generator increase the pulse string period to adapt the designated pulse string count automatically (but the wave frequency

won't be change).

4.3.6 Trigger Source

The waveform generator will generate a pulse string output when receive a trigger signal and wait next trigger source. The trigger source of pulse string can be internal or external. It can be change by using multifunction rotary knob and arrow keys or pressing the softkey **TrigSrc** to complete the setting in pulse string type interface.

- 1) The pulse string is continuously output at a specified frequency when the trigger source is internal. The frequency of pulse string output is controlled by pulse string period. The waveform generator can output the pulse string with N cycle and infinite type.
- 2) The waveform generator will trigger by the external digital modulation terminal (FSK/Trig/Counter) on the rear panel when the trigger source is external. The waveform generator will output a pulse string upon receiving a TTL pulse with designated polarity. The waveform can output the pulse string with N cycle, gating and infinite type.

4.3.7 Trigger Edge

The external digital modulation terminal (FSK/Trig/Counter) can be used as input terminal (which the trigger source is external) to set rising edge and falling edge. "Rise" indicates that the rising edge of external signal is generated and output a pulse string. "Fall" indicates that the falling edge of external signal is generated and output a pulse string.

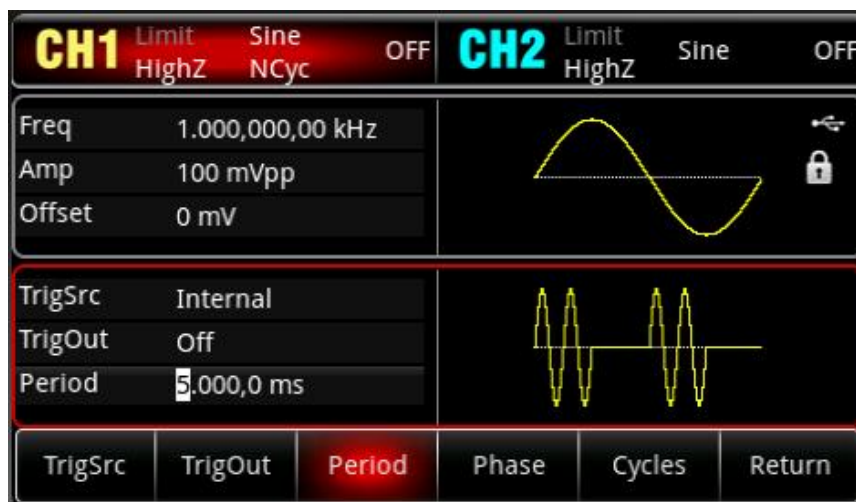
In gating mode, when the polarity in parameter list is positive, then it will output a pulse string when the external signal is high level; when the polarity is negative, then it will output a pulse string the external signal is low level. The default is rising edge. It can be change by using multifunction rotary knob and arrow keys or press the softkey **TrigEdg** → **Fall** (press the softkey **Polarity** → **Negative** in gating mode) to complete the setting in pulse string type interface.

4.3.8 Comprehensive Example

In burst mode, set a sine wave with period of 5 ms, amplitude of 500 mVpp as pulse string wave, set burst mode to N cycle, pulse string period to 15 ms, and then set cycle number to 2. The settings steps are as following.

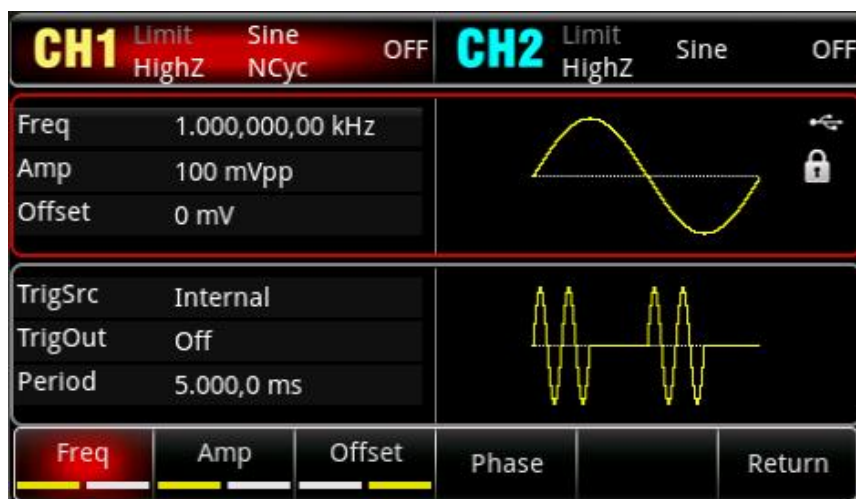
- 1) Enabling Burst Mode

Press **Mode** → **Burst** → **NCyc** key in turn to set burst mode to "N cycle" mode.



2) Select Pulse String Wave

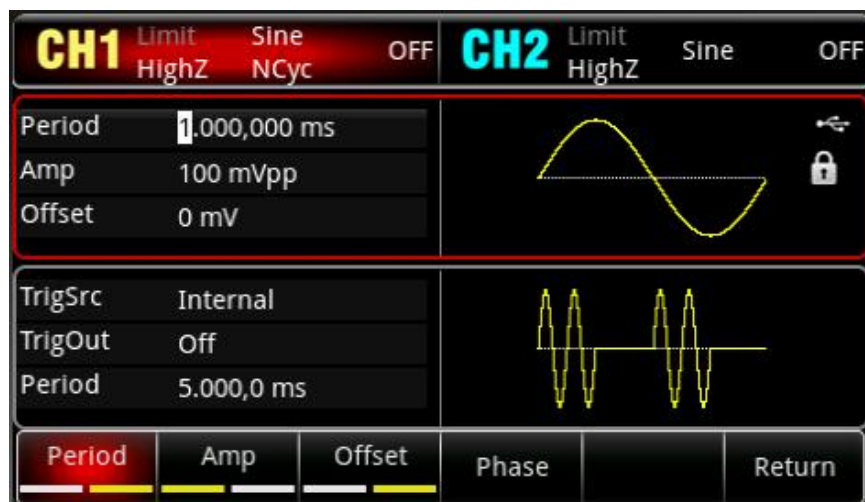
Base on the step 1, press the softkey **Wave** → **Sine** in turn to select the sine wave to be the carrier wave. The default pulse string wave is the sine wave, so this step doesn't need to be change.



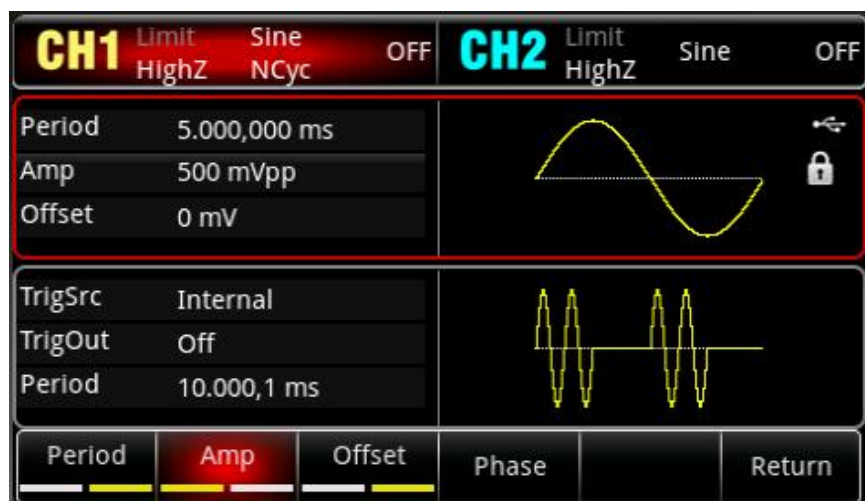
At this point, the amplitude setting can be set by using multifunction rotary knob and arrow keys.

(Notes: If the setting interface displays **Freq**, this means it can only set the frequency parameter, in other words, the frequency and period cannot be converted. If it displays **Period**, then period of 2 ms is corresponding to 500 Hz and their reciprocal relationship is $T=1/f$).

Press the softkey **Freq** → **Period** (the second time press the softkey **Period** is to convert the frequency and period in parameter list), the interface will be put as shown in the following figure.

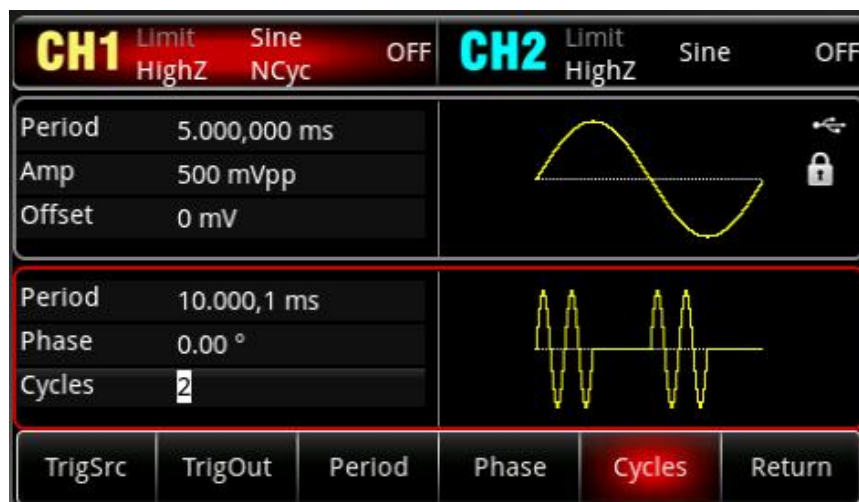


Press the corresponding softkey to set a parameter, to enter the numerical value and then select the unit.

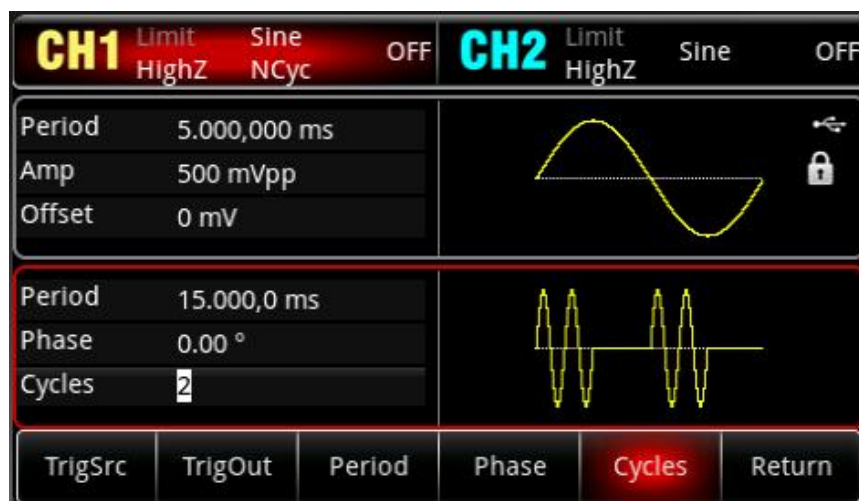


3) Set pulse string period and wave cycle

After pulse string wave and the relevant parameter is selected, press **Mode** → **Burst** → **NCyc** key in turn to go back to the following figure.

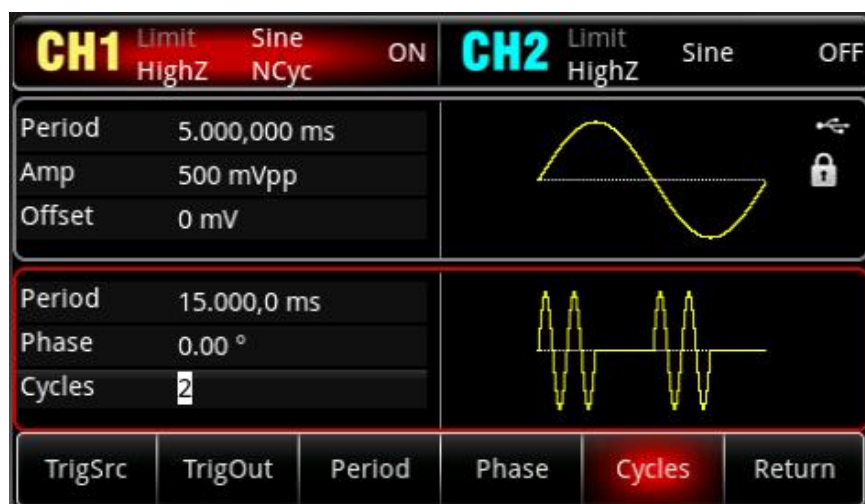


Press the corresponding softkey to set a parameter, to enter numerical value and then select the unit.

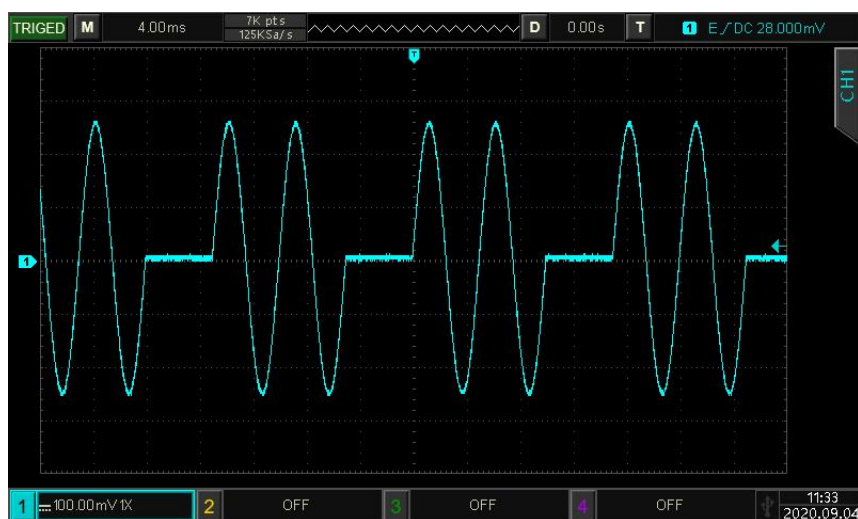


4) Enabling channel output

Press **CH1** key on the front panel to quick turn on CH1 output, or press **Utility** key to pop out the softkey **CH1 Setting** to enable CH1 output. When the channel output is enabled, CH1 key will illuminate and grey "OFF" character on the right CH1 label will change to "N cycle" character in yellow, which indicates CH1 output is enabled.



To view the modulation wave of pulse string through an oscilloscope as shown in the following figure.

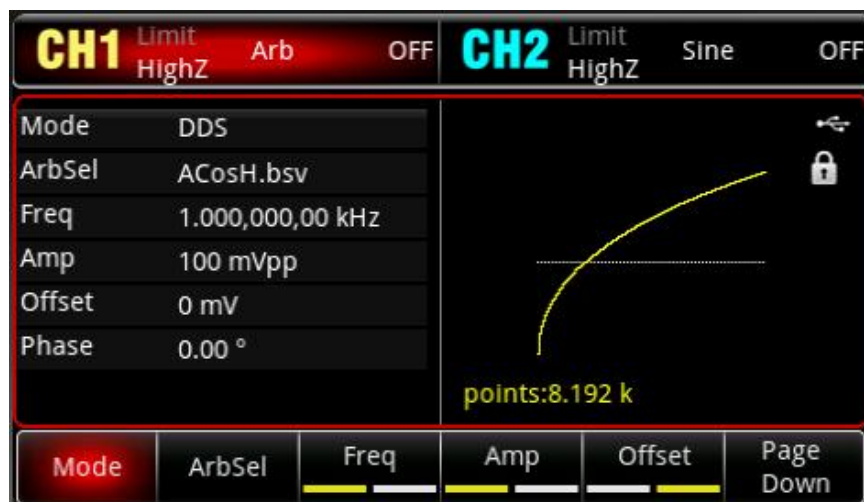


4.4 Arbitrary Wave Output

This product has store more than 200 arbitrary waves, the wave name refer to built-in arbitrary wave table.

4.4.1 Arbitrary Wave Mode

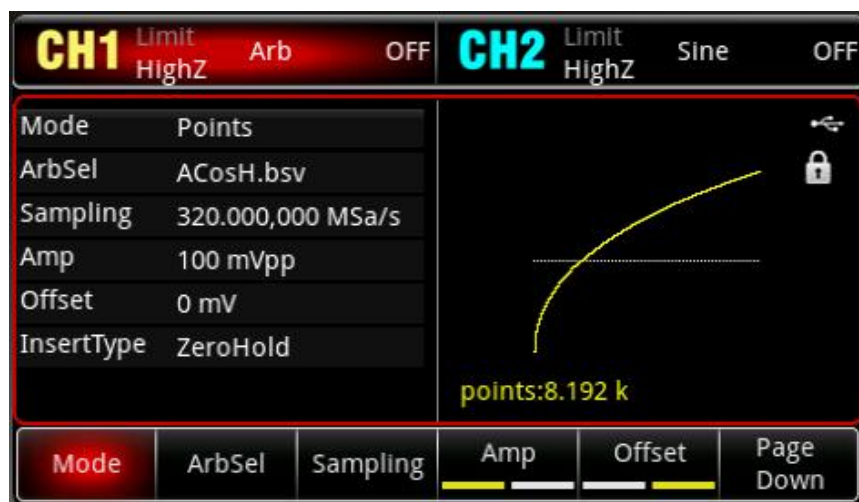
Press **Wave** → **Arb** key in turn to turn on arbitrary wave mode, the waveform generator will output the modulated waveform according to the currently settings.



4.4.2 Point by Point Output/DDS Mode

UTG2000X supports point by point and DDS mode to output the arbitrary wave. In point by point mode, the waveform generator automatically calculates the frequency of output signal (4577.64Hz) according to waveform length (e.g. 65.536k points) and sampling rate. The waveform generator outputs waveform points one by one with this frequency. It can prevent loss of important waveform point.

In DDS mode (the default mode), the waveform generator outputs the arbitrary waveform by automatic interpolation or extracting point with fixed length (8.192 points) and the frequency of parameter list. It can be change by using multifunction knob in arbitrary wave page or press the softkey DDS. The point by point mode as shown in the following figure.



4.4.3 Select Arbitrary Wave

When the arbitrary wave is enabled, user can select built-in arbitrary wave by using multifunction rotary knob and arrow keys or pressing the softkey **ArbSel** to select the arbitrary wave.

Arbitrary wave table: [Appendix B Built-in Arbitrary Wave Table](#)

Chapter 5 Troubleshooting

Possible faults in use of UTG2000X and troubleshooting methods are listed below. Please handle fault as the corresponding steps. If it cannot be fixed, please contact with the distributor or local office and provide the model information (press Utility → System → About key in turn to check the model info).

5.1 No Display (Blank Screen)

If the waveform generator is blank screen when press the power switch on the front panel.

- 1) Inspect whether the power source is properly connected.
- 2) Inspect whether the power button is pressed.
- 3) Restart the instrument.
- 4) If the instrument still can't work, please contact with the distributor or local office for product maintenance service.

5.2 No Waveform Output

The setting is correct but the instrument has no waveform output.

- 1) Inspect whether BNC cable and the output terminal is properly connected.
- 2) Inspect whether CH1, CH2 button is turned on.
- 3) If the instrument still can't work, please contact with the distributor or local office for product maintenance service.

Chapter 6 Service and Support

6.1 Maintenance and Cleaning

(1) General Maintenance

Keep the instrument away from the direct sunlight.

Caution

Keep sprays, liquids and solvents away from the instrument or probe to avoid damaging the instrument or probe.

(2) Cleaning

Check the instrument frequently according to the operating condition. Follow these steps to clean the external surface of the instrument:

- a. Please use a soft cloth to wipe the dust outside the instrument.
- b. When cleaning the LCD screen, please pay attention and protect the transparent LCD screen.
- c. When cleaning the dust screen, use a screwdriver to remove the screws of the dust cover and then remove the dust screen. After cleaning, install the dust screen in sequence.
- d. Please disconnect the power supply, then wipe the instrument with a damp but not dripping soft cloth. Do not use any abrasive chemical cleaning agent on the instrument or probes.

Warning

Please confirm that the instrument is completely dry before use, to avoid electrical shorts or even personal injury caused by moisture.

6.2 Contact Us

If the use of this product has caused any inconvenience, if you in mainland China you can contact UNI-T company directly.

Service support: 8am to 5.30pm (UTC+8), Monday to Friday or via email. Our email address is infosh@uni-trend.com.cn

For product support outside mainland China, please contact your local UNI-T distributor or sales center.

Many UNI-T products have the option of extending the warranty and calibration period, please contact your local UNI-T dealer or sales center.

To obtain the address list of our service centers, please visit our website at URL:

<http://www.uni-trend.com>

Appendix A: Factory Setting

Parameter	Factory Setting
Channel Parameter	
Carrier wave	Sine wave
Output load	High
Sync output	CH1
Channel output	OFF
Channel inverted output	OFF
Amplitude limit	OFF
Upper limit of amplitude	+1 V
Lower limit of amplitude	-1 V
Basic Wave	
Frequency	1 kHz
Amplitude	100 mVpp
DC deviation	0 mV
Start phase	0°
Duty cycle of Square wave	50 %
Symmetry of ramp wave	50 %
Duty cycle of pulse wave	50 %
Rising edge of pulse wave	5 ns
Falling edge pulse wave	5 ns
Arbitrary Wave	
Built-in arbitrary wave	ACosH.bsv
AM (Amplitude Modulation)	
Modulation wave	Sine wave
Modulation frequency	100 Hz
Modulation depth	100 %
FM (Amplitude Frequency)	
Modulation wave	Sine wave
Modulation frequency	100 Hz

Frequency deviation	1 kHz
PM (Phase Modulation)	
Modulation wave	Sine wave
Modulation frequency	100 Hz
Phase deviation	180°
DSB-AM (Double-sideband Amplitude Modulation)	
Modulation source	Internal
Modulation wave	Sine wave
Modulation frequency	100 Hz
Modulation depth	100 %
QAM (Quadrature Modulation)	
IQ map	QAM4
Symbol	PN3
Bitrate	100 bps
ASK (Amplitude Shift Keying)	
Modulation source	Internal
Modulation rate	100 Hz
FSK (Frequency Shift Keying)	
Modulation source	Internal
Rate	100 Hz
Hopping frequency1	100 kHz
3FSK (Three Frequency Shift Keying)	
Modulation source	Internal
Rate	100 Hz
Hopping frequency 1	100 kHz
Hopping frequency 2	50 kHz
4FSK (Four Frequency Shift Keying)	
Modulation source	Internal

Rate	100 Hz
Hopping frequency 1	100 kHz
Hopping frequency 2	50 kHz
Hopping frequency 3	25 kHz
PSK (Phase Shift Keying)	
Modulation source	Internal
Rate	100 Hz
Phase	0°
BPSK (Binary Phase Shift Keying)	
Carrier wave	Sine wave
Symbol	PN3
Phase	0°
Phase 1	90°
Bitrate	100 bps
QPSK (Quadrature Phase Shift Keying)	
Carrier wave	Sine wave
Symbol	PN3
Bitrate	100 bps
Phase 1	0°
Phase 2	90°
Phase 3	180°
Phase 4	270°
OSK (Oscillation Keying)	
Modulation source	Internal
Oscillation time	2 ms
Rate	100 Hz
PWM (Pulse Width Modulation)	
Modulation source	Internal
Modulation wave	Sine wave
Modulation frequency	100 Hz

Duty cycle	49.99 %
SUM (SUM Modulation)	
Modulation source	Internal
Modulation wave	Sine wave
Modulation frequency	100 Hz
Modulation depth	100 %
Sweep Frequency	
Sweep frequency type	Linear
Start frequency	1 kHz
Stop frequency	1 MHz
Sweep frequency time	10 ms
Pulse String	
Trigger source	Internal
Start phase	0°
Polarity	Negative
Burst (pulse string period)	5.000 ms
Cycle number	2
System Parameter	
Sound	
Numeric separator	,
Backlight	100 %
Language	Default

Appendix B: Built-in Arbitrary Wave Table

Type	Name	Description
Common function (15)	AbsSine	Absolute sine wave
	AbsSineHalf	Absolute half-sine wave
	AmpALT	Amplify sine wave
	AttALT	Attenuates sine wave
	Gaussian_monopulse	Gaussian monocycle
	GaussPulse	Gaussian pulse
	NegRamp	Falling ramp
	NPulse	N-Pulse signal
	PPulse	P-Pulse signal
	SineTra	TraSine wave signal
	SineVer	VerSine wave signal
	StairUD	Stair up and down
	StairDn	Stair down
	StairUp	Stair up
	Trapezia	Trapezoid
Engine (25)	BandLimited	Band limited signal
	BlaseiWave	Vibration of blasting “time-vibration velocity” curve
	Butterworth	Butterworth filter
	Chebyshev1	Chebyshev filter I
	Chebyshev2	Chebyshev filter II
	Combin	Combined function
	CPulse	C-Pulse signal
	CWPulse	CW pulse signal
	DampedOsc	Damped oscillation “time-offset” curve
	DualTone	Double audio signal
	Gamma	Gamma signal
	GateVibar	Gate self-oscillation signal
	LFMPulse	Linear FM pulse signal
	MCNoise	Mechanical noise
	Discharge	Ni-MH battery discharge curve

	Pahcur	Brushless DC motor current wave
	Quake	Quake wave
	Radar	Radar signal
	Ripple	Power ripple
	RoundHalf	Half round wave
	RoundsPM	RoundsPM wave
	StepResp	Step response signal
	SwingOsc	Swing oscillation - time curve
	TV	Television signal
	Voice	Voice signal
Maths (27)	Airy	Airy function
	Besselj	Besselj function I
	Besselk	Besselk function
	Bessely	Besselj function II
	Cauchy	Cauchy distribution
	Cubic	Cubic function
	Dirichlet	Dirichlet function
	Erf	Error function
	Erfc	Complementary error function
	ErfcInv	Inverse complementary error function
	ErfInv	Inverse error function
	ExpFall	Exponential falling function
	ExpRise	Exponential rising function
	Gammaln	Natural logarithm of Gamma function
	Gauss	Gaussian distribution (Normal distribution)
	HaverSine	Haversed sine
	Laguerre	Quartic Laguerre polynomial
	Laplace	Laplace distribution
	Legend	Quintic Legendre Polynomials
	Log10	Logarithm function based on 10
	LogNormal	Logarithmic normal distribution
	Lorentz	Lorentzian function
	Maxwell	Maxwell distribution
	Rayleigh	Rayleigh distribution

	Versiera	Versiera
	Weibull	Weibull distribution
	ARB_X2	Square function
SectMod (5)	AM	Sine wave amplitude modulation
	FM	Sine wave frequency modulation
	PFM	Pulse wave modulation
	PM	Sine wave phase modulation
	PWM	Pulse width modulation
Bioelect (6)	Cardiac	Electrocardio signal
	EOG	Electro-oculogram
	EEG	Electroencephalogram
	EMG	Electromyography
	Pulseilogram	Sphygmus curve of common people
	ResSpeed	Expiration rate curve of common people
Medical (4)	LFPulse	Low frequency pulse electrotherapy waveform
	Tens1	Transcutaneous electric nerve stimulation waveform 1
	Tens2	Transcutaneous electric nerve stimulation waveform 2
	Tens3	Transcutaneous electric nerve stimulation waveform 3
Automotive (17)	Ignition	Ignition waveform of automobile internal-combustion engine
	ISO16750-2 SP	Profile map of automobile starting oscillation
	ISO16750-2 Starting1	Automobile starting voltage waveform 1
	ISO16750-2 Starting2	Automobile starting voltage waveform 2
	ISO16750-2 Starting3	Automobile starting voltage waveform 3
	ISO16750-2 Starting4	Automobile starting voltage waveform 4
	ISO16750-2 VR	Operating voltage profile map of automobile under resetting
	ISO7637-2 TP1	Transient phenomena of automobile

		caused by power cut
	ISO7637-2 TP2A	Transient phenomena of automobile caused by inductance in wiring
	ISO7637-2 TP2B	Transient phenomena of automobile caused by turning off start-up changer
	ISO7637-2 TP3A	Transient phenomena of automobile caused by conversion
	ISO7637-2 TP3B	Transient phenomena of automobile caused by conversion
	ISO7637-2 TP4	Working profile map of automobile under start-up
	ISO7637-2 TP5A	Transient phenomena of automobile caused by power cut of battery
	ISO7637-2 TP5B	Transient phenomena of automobile caused by power cut of battery
	SCR	SCR (sintering temperature distribution)
	Surge	Surge signal
Trigonome (21)	CosH	Hyperbolic cosine
	CosInt	Cosine integral
	Cot	Cotangent function
	CotHCon	Concave hyperbolic cotangent
	CotHPro	Convex hyperbolic cotangent
	CscCon	Concave cosine
	CscPro	Convex cosine
	CotH	Hyperbolic cotangent
	CscHCon	Concave hyperbolic cosecant
	CscHPro	Convex hyperbolic cosecant
	RecipCon	Reciprocal of the depression
	RecipPro	Reciprocal of the projection
	SecCon	The secant of the depression
	SecPro	The secant of the projection
	SecH	Hyperbolic secant
	Sinc	Sinc function
	SinH	Cotangent function
	SinInt	Sine integral

	Sqrt	Square root function
	Tan	Tangent function
	TanH	Hyperbolic tangent
AntiTrigonome (16)	ACosH	Arc-cosine function
	ACotCon	Arc- hyperbolic cosine function
	ACotPro	Arc- hyperbolic cosine function
	ACotHCon	Convex arc cotangent function
	ACotHPro	Concave arc- hyperbolic cosine function
	ACscCon	Convex arc- hyperbolic cosine function
	ACscPro	Concave arc cosecant function
	ACscHCon	Convex arc cosecant function
	ACschPro	Concave arc hyperbolic cosecant function
	ASecCon	Convex arc hyperbolic cosecant function
	ASecPro	Concave arc secant function
	ASecH	Convex arc secant function
	ASin	Arc hyperbolic secant function
	ASinH	Arcsin function
	ATan	Arc hyperbolic sine function
	ATanH	Arctan function
Noise (6)	NoiseBlue	Blue noise
	NoiseBrown	Brown noise (red noise)
	NoiseGray	Gray noise
	NoisePink	Pink noise
	NoisePurple	Purple noise
	Noisewhite	White noise
Window function (17)	Bartlett	Bartlett window
	BarthannWin	Amended Bartlett window
	Blackman	Blackman window
	BlackmanH	BlackmanH window
	BohmanWin	Bohman window
	Boxcar	Rectangle window
	ChebWin	Chebyshev window

	GaussWin	Gaussian window
	FlatTopWin	Flat-top window
	Hamming	Hamming window
	Hanning	Hanning window
	Kaiser	Kaiser window
	NuttallWin	The minimum of four Blackman Harris window
	ParzenWin	Parzen window
	TaylorWin	Taylor window
	Triang	Quarter window (Fejer window)
	TukeyWin	Tukey window
Complex Wavelets (7)	Complex Frequency B-spline	Complex Frequency B-spline function
	Complex Gaussian	Complex Gaussian function
	Complex Morlet	Complex Morlet wavelet
	Complex Shannon	Complex Shannon function
	Mexican hat	Mexican hat wavelet
	Meyer	Meyer wavelet
	Morlet	Morlet wavelet
Other (34)	ABA_1_1	
	ABA_1_2	
	ALT_03	
	ALT_04	
	ALT_05	
	AUDIO	
	COIL_2_1	
	COIL_2_2	
	DC_04	
	ECT_1_2	
	EGR_2	
	EGR_3_2	
	EST_03_2	
	IAC_1_1	
	INJ_1_1	
	INJ_2	
	INJ_3	

	INJ_4	
	INJ_5_6	
	INJ_7	
	KS_1_1	
	MAF_1_1	
	MAF_1_2	
	MAF_5_3	
	MAP_1_1	
	MAP_1_2	
	MC_3	
	Mexican hat	Mexican hat wavelet
	O2PROPA1	
	O2PROPA2	
	O2SNAP	
	STAR02_1	
	TPS_1_1	
	TPS_1_2	