

**UNI-T**®

Instruments.uni-trend.com



# UTG9000T Series Function/ Arbitrary Waveform Generator

## User's Manual

2025.7

UNI-T Technologies, Inc.

## Perface

Thank you for purchasing this brand new product. In order to use this product safely and correctly, please read this manual thoroughly, especially the safety notes.

After reading this manual, it is recommended to keep the manual at an easily accessible place, preferably close to the device, for future reference.

## Copyright Information

Copyright is owned by Uni-Trend Technology (China) Limited.

UNI-T products are protected by patent right of China or other counties, including patents that have been obtained or are being applied for.

The company reserves the right to change specification and price of products.

UNI-T reserves all rights. Licensed software products are owned by UNI-T and its subsidiaries or providers, and protected by provisions of national copyright laws and international treaties. Information in this paper will replace information in all data published.

UNI-T is the registered trademark of Uni-Trend Technology (China) Limited.

If the product is proven to be defective during the applicable warranty period, UNI-T can repair the defective product without charging expenses of components and labor, or replace the defective product with equivalent product at its discretion. UNI-T's components, modules and replaced products for warranty may be brand new, or have performance equivalent to that of new products after repair. All replaced components, modules and products will be properties of UNI-T.

The "customers" below are individuals or entities of rights provided in the warranty according to the statement. In order to obtain services promised in the warranty, "customers" must report defects to UNI-T during the applicable warranty period, and make appropriate arrangement for performance of services. Customers should be responsible for packing of defective products and transport them to maintenance center designated by UNI-T, pay freight in advance and provide copy of proof of purchase of the original purchaser. If the product is transported to a place in the country where UNI-T maintenance center is, UNI-T should pay for returning the product to the customer. If the product is transported to any other places, the customer should pay all freight, duties, taxes and any other expenses.

The warranty is inapplicable to any defects, failures or damages caused by accident, normal wear of components, use beyond specified scope or improper use of product, or improper or insufficient maintenance. UNI-T is not obliged to provide the services below as prescribed by the warranty:

- a) Repair damage caused by installation, repair or maintenance of personnel other than service representatives of UNI-T;
- b) Repair damage caused by improper use or connection to incompatible equipment;

- c) Repair any damages or failures caused by using power source not provided by UNI-T;
- d) Repair products that have been changed or integrated with other products (if such change or integration increases time or difficulty of repair).

The warranty is formulated by UNI-T for this product, replacing any other express or implied warranties. UNI-T and its distributors refuse to give any implied warranty for marketability or applicability for special purpose. For violation of the warranty, repair or replacement of defective products is the only and all remedial measure UNI-T provides for customers. No matter whether UNI-T and its distributors are informed of any possible indirect, special, occasional or inevitable damage in advance, they assume no responsibility for such damage.



# UTG9000T Series Function/Arbitrary Waveform Generator

This product has DDS (direct digital frequency synthesis) function, it can present high precision, stable, pure and low distortion signal. Plus, it can also offer wave in high frequency with quick rising edge and falling edge. It is a high-performance, multifunction four channel arbitrary function generator. Capacitive touch screen, superior technical index and humanity graph display design for your better work performance. This product is a multi-purpose generator to meet your current and future testing needs.

## Features

- Standard four channel with separate output channel mode
- Nine carrier waves: sine wave, square wave, ramp wave, pulse wave, harmonic wave, noise, PRBS (pseudo random binary sequence), DC, arbitrary wave
- The maximum sampling rate 2.5GSa/s, the vertical resolution 16bits and 14bits
- Adjustable noise bandwidth
- Sine wave output: 600MHz/500MHz/350MHz, full-band: 1μHz
- Square wave output: 200MHz/160MHz/120MHz, the minimum edge time: within 1.5ns, adjustable duty ratio
- Pulse wave output: 200MHz/160MHz/120MHz, wide dynamic range high precise adjustable rising/falling edge time, adjustable duty ratio
- It can output phase and amplitude, independent and adjustable 2~16 harmonic wave
- The maximum output swing: 20Vpp
- It can output arbitrary wave 8pts ~ 64Mpts, offer point-by-point, over 200 sets non - volatile digital arbitrary wave storage
- It can store 16GB (optional) or 20MB arbitrary file (.bsv and .csv), the instrument status file
- It can read arbitrary wave file (.bsv and .csv) and the instrument file storage in USB
- Abundant modulation types: AM, FM, PM, DSB-AM, QAM, ASK, FSK, 3FSK, 4FSK, PSK, BPSK, QPSK, OSK, PWM, SUM
- Linear sweep, logarithmic sweep, list frequency sweep, stepping frequency sweep
- Offer frequency sweep and burst (pulse string) output
- Digital protocol output: SPI, IIC, UART
- SNR(signal to noise ratio) one-click output

- All channel can be internal/external modulating, internal/external/trigger respectively or at the same time
- Hardware frequency counter: 800MHz, AC/DC current coupling
- Powerful upper-computer software and arbitrary editor
- 10.1 capacitive touch screen, 1280\*800 resolution
- Standard configuration interface: USB Host, USB Device, LAN, independent input and output 10MHz clock source
- Easy-to-use multi-purpose knob and numeric keyboard

# Table of Contents

|   |    |
|---|----|
| Perface .....   | 2  |
| Copyright Information .....                                 | 3  |
| UTG9000T Series Function/Arbitrary Waveform Generator ..... | 5  |
| Chapter 1 User's Guide .....                                | 10 |
| 1.1 Inspecting Packaging and List .....                     | 10 |
| 1.2 Safety Requirements .....                               | 10 |
| 1.3 Environmental Requirements .....                        | 14 |
| 1.4 Connecting Power Supply .....                           | 15 |
| 1.5 Electrostatic Protection .....                          | 15 |
| 1.6 Preparation Work .....                                  | 16 |
| 1.7 Remote Control .....                                    | 16 |
| 1.8 Help Information .....                                  | 16 |
| Chapter 2 Qick Guide .....                                  | 17 |
| 2.1 General Inspection .....                                | 17 |
| 2.1.1 Inspect the Damage of Transportation .....            | 17 |
| 2.1.2 Inspect the Accessories .....                         | 17 |
| 2.1.3 Inspect the Instrument .....                          | 17 |
| 2.2 Introduction of Panels and Keys .....                   | 17 |
| 2.2.1 Front Panel .....                                     | 17 |
| 2.2.2 Back Panel .....                                      | 19 |
| 2.3 Output the Carrier wave .....                           | 22 |
| 2.3.1 Frequency Output Settings .....                       | 23 |
| 2.3.2 Output Amplitude Settings .....                       | 23 |
| 2.3.3 DC Offset Voltage Settings .....                      | 24 |
| 2.3.4 Square Wave Settings .....                            | 24 |
| 2.3.5 Pulse Wave Settings .....                             | 25 |
| 2.3.6 DC Voltage Settings .....                             | 25 |
| 2.3.7 Ramp Wave Settings .....                              | 26 |
| 2.3.8 Noise Wave Settings .....                             | 26 |
| 2.3.9 Harmonic Wave Settings .....                          | 27 |
| 2.3.10 PRBS Wave Settings .....                             | 28 |
| 2.3.11 Noise Superposition Settings .....                   | 28 |
| 2.4 Secondary Function Settings .....                       | 29 |

|           |  |     |
|-----------|--|-----|
| 2.4.1     | Channel Settings .....                               | 29  |
| 2.4.2     | Channel Coupling .....                               | 30  |
| 2.4.3     | Channel Merging .....                                | 33  |
| 2.4.4     | Frequency Counter .....                              | 33  |
| 2.4.5     | System .....   | 34  |
| Chapter 3 | Advanced Applications .....                          | 42  |
| 3.1       | Output Modulation Waveform .....                     | 42  |
| 3.1.1     | AM (Amplitude Modulation) .....                      | 42  |
| 3.1.2     | FM (Frequency Modulation) .....                      | 48  |
| 3.1.3     | PM (Phase Modulation) .....                          | 53  |
| 3.1.4     | ASK (Amplitude Shift Keying) .....                   | 58  |
| 3.1.5     | FSK (Frequency Shift Keying) .....                   | 62  |
| 3.1.6     | 3FSK Modulation (Three Frequency Shift Keying) ..... | 66  |
| 3.1.7     | 4FSK Modulation (Four Frequency Shift Keying) .....  | 70  |
| 3.1.8     | PSK (Phase Shift Keying) .....                       | 73  |
| 3.1.9     | BPSK (Double Phase Shift Keying) .....               | 78  |
| 3.1.10    | QPSK (Quad-Phase Shift Keying) .....                 | 82  |
| 3.1.11    | OSK (Oscillation Keying) .....                       | 86  |
| 3.1.12    | SUM (Sum Modulation) .....                           | 90  |
| 3.1.13    | DSB-AM (Double Side Band Amplitude Modulation) ..... | 94  |
| 3.1.14    | QAM (Quadrature Amplitude Modulation) .....          | 99  |
| 3.1.15    | PWM (Pulse Width Modulation) .....                   | 103 |
| 3.2       | Output Frequency Sweep Waveform .....                | 107 |
| 3.2.1     | Select Frequency Sweep .....                         | 108 |
| 3.2.2     | Starting and stop frequency settings .....           | 108 |
| 3.2.3     | Frequency Sweep Mode .....                           | 109 |
| 3.2.4     | Frequency Sweep Time .....                           | 110 |
| 3.2.5     | Select trigger source .....                          | 110 |
| 3.2.6     | Trigger Output .....                                 | 111 |
| 3.2.7     | Trigger Edge .....                                   | 111 |
| 3.2.8     | Comprehensive example .....                          | 112 |
| 3.3       | Output Burst Waveform .....                          | 114 |
| 3.3.1     | Select Burst .....                                   | 114 |
| 3.3.2     | Burst Type .....                                     | 115 |
| 3.3.3     | Initial Phase of Burst .....                         | 117 |

|                                |   |     |
|--------------------------------|---|-----|
| 3.3.4                          | Burst Period .....                        | 117 |
| 3.3.5                          | Counting of Burst .....                   | 118 |
| 3.3.6                          | Select Trigger Source .....               | 118 |
| 3.3.7                          | Trigger Output .....                      | 118 |
| 3.3.8                          | Trigger Edge .....                        | 119 |
| 3.3.9                          | Comprehensive example .....               | 119 |
| 3.4                            | Output Arbitrary Waveform .....           | 122 |
| 3.4.1                          | Turn on arbitrary waveform mode .....     | 122 |
| 3.4.2                          | Point by point output/ DDS mode .....     | 122 |
| 3.4.3                          | Select Arbitrary Waveform .....           | 123 |
| 3.4.4                          | Create and edit arbitrary waveform .....  | 129 |
| 3.5                            | Output Digital Protocol .....             | 130 |
| 3.5.1                          | SPI Protocol .....                        | 130 |
| 3.5.2                          | IIC Protocol .....                        | 132 |
| 3.5.3                          | UART Protocol .....                       | 134 |
| Chapter 4                      | Troubleshooting .....                     | 137 |
| 4.1                            | No Display on Screen (Blank Screen) ..... | 137 |
| 4.2                            | No Waveform Output .....                  | 137 |
| 4.3                            | Fail to Recognize USB .....               | 137 |
| Chapter 5                      | Service and Support .....                 | 138 |
| 5.1                            | Upgrade Product Program .....             | 138 |
| 5.2                            | Contact US .....                          | 138 |
| Appendix A:                    | Factory Setting .....                     | 139 |
| Appendix B:                    | Maintenance and Cleaning .....            | 143 |
| Limited Warranty and Liability | .....                                     | 144 |

# Chapter 1 User's Guide

This manual includes safety requirements, installment and the operation of UTG100X 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













|                |  |
|----------------|--|
| <b>Warning</b> | <b>Please follow the following guidelines to avoid possible electric shock and risk to personal safety.</b>  |
|                | 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

|                |   |
|----------------|---|
| <b>Warning</b> | "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.   |
| <b>Caution</b> | “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. |
| <b>Note</b>    | “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

|   |                     |  |
|---|---------------------|--|
|    | <b>Danger</b>       | It indicates possible danger of electric shock, which may cause personal injury or death.  |
|    | <b>Warning</b>      | It indicates that you should be careful to avoid personal injury or product damage.  |
|  | <b>Caution</b>      | 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. |
|  | <b>Note</b>         | 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.         |
|  | <b>AC</b>           | Alternating current of device. Please check the region's voltage range.  |
|  | <b>DC</b>           | Direct current device. Please check the region's voltage range.  |
|  | <b>Grounding</b>    | Frame and chassis grounding terminal.  |
|  | <b>Grounding</b>    | Protective grounding terminal.   |
|  | <b>Grounding</b>    | Measurement grounding terminal.  |
|  | <b>OFF</b>          | Main power off.  |
|  | <b>ON</b>           | Main power on.   |
|  | <b>Power Supply</b> | Standby power supply: when the power switch is turned off, this device is not completely disconnected from the AC power supply.  |
| <b>CAT I</b>  |                     | 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.  |
| <b>CAT II</b>   |                      | 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.  |
| <b>CAT III</b>  |                      | 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). |
| <b>CAT IV</b>   |                      | 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.  |
|  | <b>Certification</b> | CE indicates a registered trademark of EU.  |
|  | <b>Certification</b> | UKCA indicates a registered trademark of UK.  |
|  | <b>Certification</b> | ETL indicates a registered trademark of Intertek. It conform to UL STD 61010-1 and 61010-2-030, CSA STD C22.2 No.61010-1 and 61010-2-030.   |
|  | <b>Waste</b>         | Do not place equipment and its accessories in the trash. Items must be properly disposed of in accordance with local regulations.   |
|  | <b>EFUP</b>          | 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

| <b>Warning</b>                |  |
|-------------------------------|--|
| <b>Preparation before use</b> | <p>Please connect this device to AC power supply with the power cable provided;</p> <p>The AC input voltage of the line reaches the rated value of this device. See the product manual for specific rated value.</p> <p>The line voltage switch of this device matches the line voltage;</p> |



|  |   |
|--|---|
|  | The line voltage of the line fuse of this device is correct;<br>It not used for measuring the main circuit.   |
| <b>Check all terminal rated values</b>                     | 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.   |
| <b>Use the power cord properly</b>                         | 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.  |
| <b>Instrument Grounding</b>                                | 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.  |
| <b>AC power supply</b>                                     | 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.  |
| <b>Electrostatic prevention</b>                            | 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.  |
| <b>Measurement accessories</b>                             | 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.  |
| <b>Use the input / output port of this device properly</b> | 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. |
| <b>Power fuse</b>  | 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.  |
| <b>Disassembly and cleaning</b>                            | There are no components available to operators inside. Do not remove the protective cover.  |

|  |   |
|--|---|
|  | Maintenance must be carried out by qualified personnel.   |
| <b>Service environment</b>                                   | This device should be used indoors in a clean and dry environment with ambient temperature from 10 °C ~ +40 °C. Do not use this device in explosive, dusty or humid air.  |
| <b>Do not operate in humid environment</b>                   | Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.  |
| <b>Do not operate in flammable and explosive environment</b> | Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.   |
| <b>Caution</b>   |   |
| <b>Abnormality</b>   | 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.   |
| <b>Cooling</b>   | Do not block the ventilation holes at the side and back of this device;<br>Do not allow any external objects to enter this device via ventilation holes;<br>Please ensure adequate ventilation, and leave a gap of at least 15 cm on both sides, front and back of this device. |
| <b>Safe transportation</b>                                   | Please transport this device safely to prevent it from sliding, which may damage the buttons, knobs or interfaces on the instrument panel.  |
| <b>Proper ventilation</b>                                    | 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.  |
| <b>Keep clean and dry</b>                                    | 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.   |
| <b>Note</b>  |   |
| <b>Calibration</b>   | 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
- 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°C

- In operating, humidity temperature below to +35°C, ≤90% relative humidity;  
In non-operating, humidity temperature +35°C to +40°C, ≤60% 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 |
|-----------------------------|-----------|
| 100-240VAC (fluctuant ±10%) | 50/60Hz   |
| 100-120VAC (fluctuant ±10%) | 400Hz     |

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 instrument 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. Connecting the power supply wire, plug the power socket into the protective grounding socket; According to your view to adjust the alignment jig.
2. Toggle on the power switch on the back panel to operate the instrument. Press the switch  on the front panel, the instrument is boot-up.

## 1.7 Remote Control

UTG9000T series function/arbitrary waveform generator supports communication with the computer via USB interface. User can use SCPI via USB 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 UTG9000T Series Programming Manual at the official website [http:// www.uni-trend.com](http://www.uni-trend.com)

## 1.8 Help Information

UTG9000Tseries function/arbitrary waveform generator has built-in help system for each function key and menu control key.

? Symbol for the help menu, tap this symbol to open the help menu.

## Chapter 2 Quick Guide

### 2.1 General Inspection

Please inspect the instrument as the following steps.

#### 2.1.1 Inspect the Damage of Transportation

If the packing boxes or foamed plastic protection pad is serious damaged, please contact with distributor or the local office.

Due to the damage of transportation, please keep the packaging and notice the relevant transportation department and the distributor, they will replace or maintain the product.

#### 2.1.2 Inspect the Accessories

UTG9000T accessories: power line (apply for the local country/region), one USB, four BNC cable (1 meter) If the accessories are lost or damaged, please contact with the distributor or the local office.

#### 2.1.3 Inspect the Instrument

If the instrument appearance is damaged. It can not operate properly or performance test failure. Please contact with the distributor or the local office.

## 2.2 Introduction of Panels and Keys

### 2.2.1 Front Panel

UTG9000T series function/arbitrary waveform generator front panel is simple, visual and easy to use. See Figure 2-1

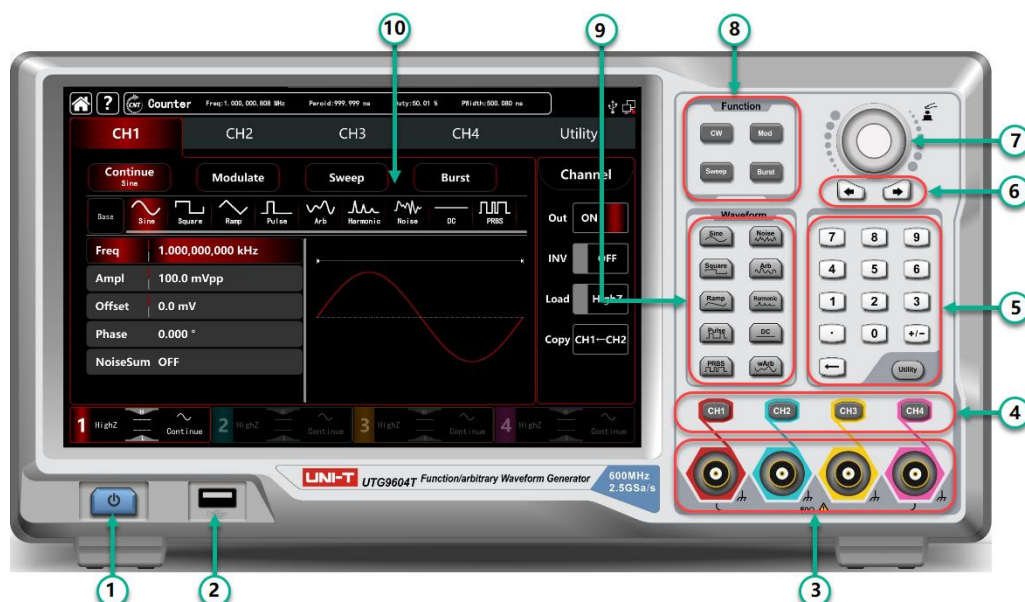



Figure 2-1 Front Panel Structure

## ① ON/OFF

Supply voltage of power source is 100-240VAC (fluctuant  $\pm 10\%$ ), 50/60Hz; 100-120VAC (fluctuant  $\pm 10\%$ ). Connect the instrument to the power source with power line in accessories or other lines up to standard. Toggle on the power switch on the back panel to operate the instrument. Turn ON/OFF:  backlight is on (red) when power supply in normal. Press the key, the backlight is on (green). Afterwards, the screen enters function interface after displaying start-up interface. In order to prevent accidentally touching ON/OFF to turn off the instrument, this switch key needs to press about 1s to turn off the instrument. The backlight of the key and screen are simultaneously off after turning off the instrument.

## ② USB Interface

The instrument supports U disks of FAT32 with maximum capacity of 32G. USB interface can be used to save and read the current status file. USB interface can also be used to upgrade the system program, to ensure that the current program of function/ arbitrary generator is the latest version released by the company.

## ③ Channel Output Terminal Output the signal of the wave.

## ④ Channel Control Terminal

Channel control terminal, which is channel output switch. There are three ways to operating:

- 1) Quick switch the current channel (CH bar is highlight, which means it is the current channel, parameter tab shows CH1 information for the wave parameter settings.) The CH1 can turn on/off the output function of the current channel quickly.
- 2) Tap UTILITY → Channel, turn on the output function.
- 3) Touch the channel setting on the left side of the screen.

Starting output function, the backlight of the CH1 will be light on, the channel tab displays output mode of the current channel (shows “continue”, “modulate” words, etc.), and the channel output terminal export the signal at the same time. Turn off the output function, the backlight of the CH1 will be also light off, the channel tab becomes grey and the channel output terminal closed.

## ⑤ Numeric Key and Utility

The numeric key is used to enter numbers 0~9, decimal point “.”, symbol key “+/-” and delete key. Utility key is used to set multipurpose settings.

## ⑥ Direction Key

The direction key is used to switch number digits or move cursor position (left or right) when using multifunction knob or direction key to set parameter.

## ⑦ Multifunction Knob/Key

The multifunction knob is used to change numbers (clockwise to increase number) or used as a menu key to select or confirm the parameter settings.

## ⑧ Select Output Mode

CW, MOD, SWEEP, BURST tab to control the output of continues, modulate, sweep, burst

## ⑨ Quick Select Wave Types

Quickly select the output wave types to produce the common wave that you need.

⑩ Display Screen

10.1 inch TFT. Different colors to distinguish the status of output, select menu and other important information of CH1, CH2, CH3 and CH4. A friendly-use system is helpful to promote work efficiency.

⑪ Over-voltage Protection

**Caution** The output terminal has over-voltage protection function, the following situation will activate the function,

amplitude **> 4Vpp**, input voltage **> ±12.5V**, frequency **< 10kHz**

amplitude **< 4Vpp**, input voltage **> ±5.0V**, frequency **< 10kHz**

Display screen will pop-out "Over-voltage protection, the output is closed."

## 2.2.2 Back Panel

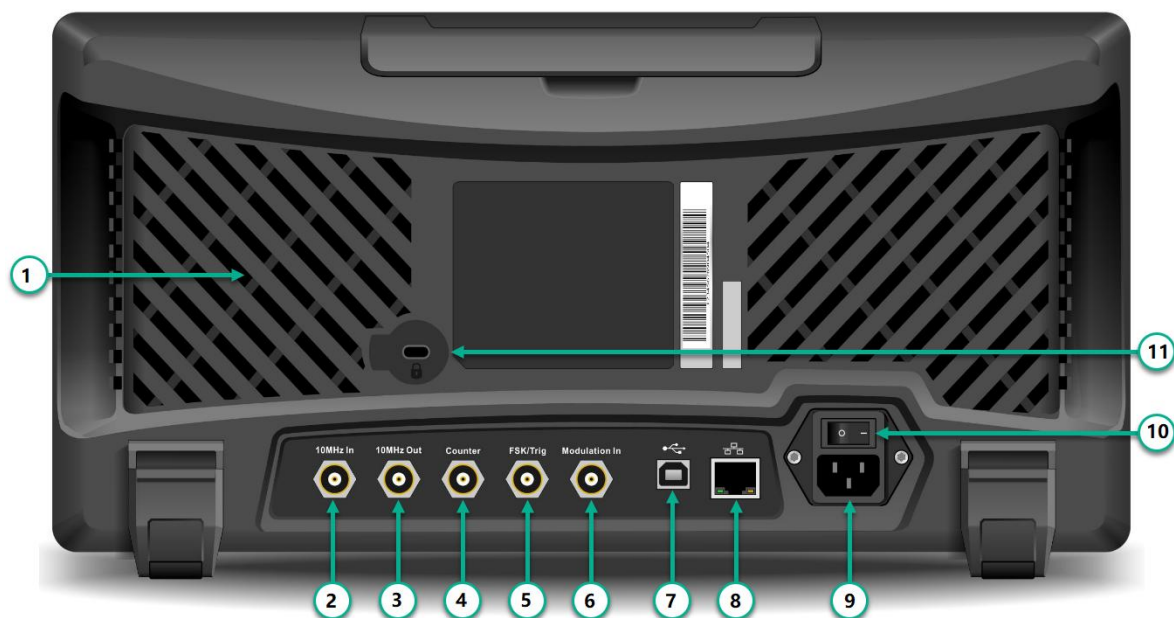


Figure 2-2 Back Front Structure

① Heat Emission Hole

To make sure that the instrument in good heat emission status, don't block off these holes.

② External 10MHz input terminal

Establish synchronization of multiple function/arbitrary waveform generators or synchronization with external 10 MHz clock signal. When clock source of the instrument is external, external 10MHz input terminal receives an external 10MHz clock signal.

③ Internal 10MHz output terminal

Establish synchronous or external clock signal with reference frequency of 10 MHz for multiple function/arbitrary waveform generators. When clock source of the instrument is internal, internal 10MHz output terminal outputs an internal 10MHz clock signal.

④ Frequency Counter Interface

Input signal through the interface when using frequency counter.

⑤ External Digital Modulation Interface

In case of modulation of ASK, FSK, PSK or OSK signal, if modulation source is external, input modulation signal through external digital modulation interface (TTL level). The corresponding output amplitude, frequency and phase are determined by signal level of external digital modulation interface. If trigger source of frequency sweep is external, receive a TTL pulse with designated polarity through external digital modulation interface. This pulse can start scanning. If burst mode is gated. Trigger source of N period and wireless trigger source are external, input gated signal through the external modulation interface. This pulse string can output a designated cycle number of pulse string.

⑥ External Analog Modulation Output Terminal

In case of AM, FM, PM, DSB-AM, SUM or PWM signal, if modulation is external, input signal through external analog modulation. The corresponding modulation of depth, frequency deviation, phase deviation or duty ratio deviation is controlled by  $\pm 5V$  signal level of the external analog modulation input terminal.

⑦ USB Interface

Connect with the upper computer software through USB interface to achieve the control of the instrument by computer.

⑧ LAN Port

The instrument can connect with LAN by LAN port, to achieve remote control.

⑨ AC Power Input Terminal: 100-240VAC (fluctuant  $\pm 10\%$ ), 50/60Hz; 100-120VAC (fluctuant  $\pm 10\%$ ).

⑩ Main Power Switch: Power on in "I" position; Power off in "O" position (The front panel ON/OFF button is unable to use.)

⑪ Case Locker

Open the case locker to activate the function of anti-theft.



### 2.2.3 Touch Screen Display Interface

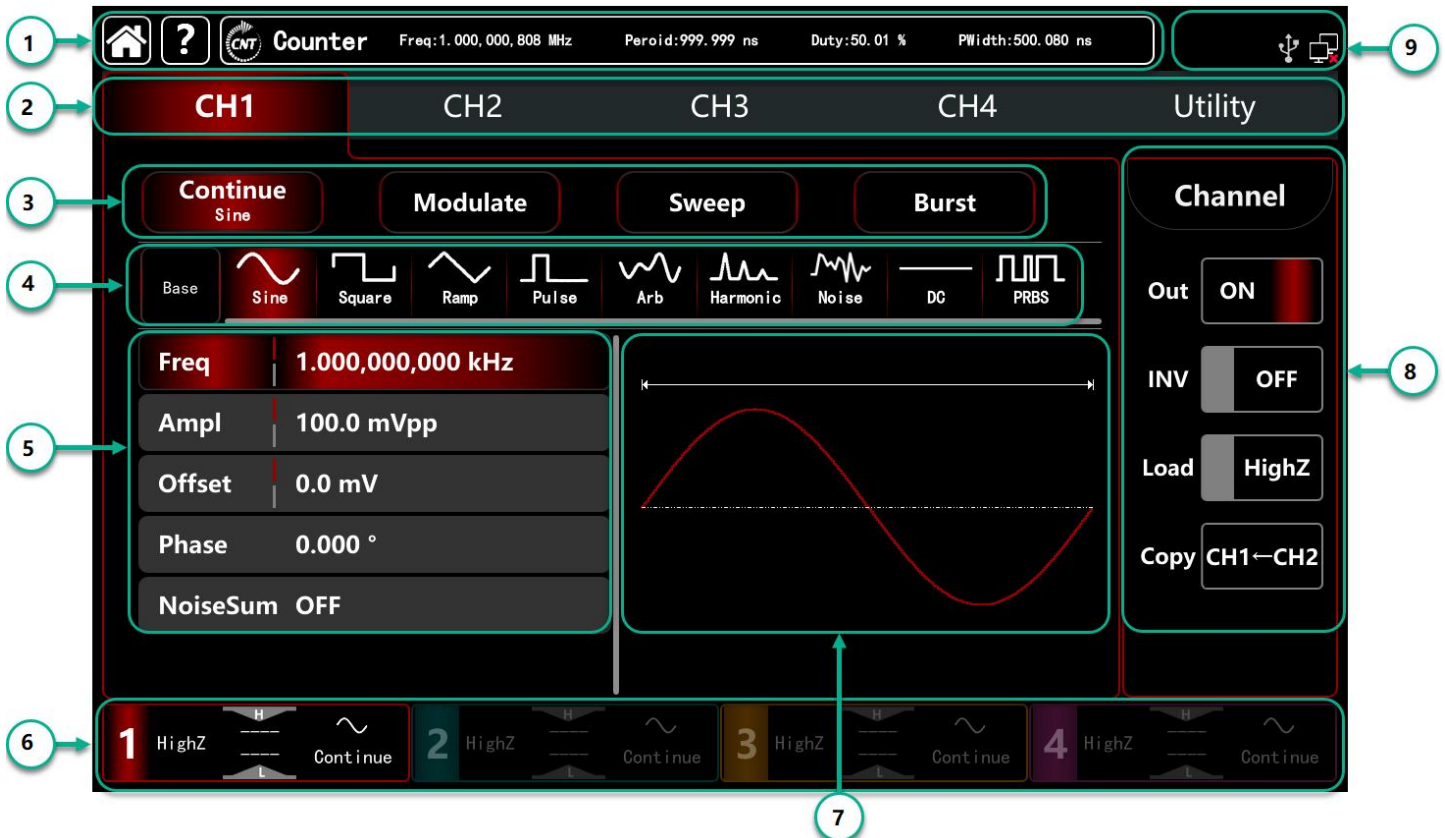


Figure 2-3 Touch Screen Display Interface

UTG9000T is designed with capacitive touch screen, display window multi-panel layout. Menu category position is fixed, reduce the level of interface jumps.

Description:

- ① Home key, Help key, Frequency counter: this area does not change with other interface jumps.
  - 1) : Home symbol, tap this symbol to return to the home page in any other interface.
  - 2) : Help symbol, tap this symbol to open the help menu.
  - 3) : Frequency symbol, tap this symbol to open frequency counter, it presents the test result .
- ② Menu tab: tap CH1, CH2, CH3, CH4 and Utility to make parameter and secondary function settings.  
 Highlight display: Select tab will be highlight with CH color or cyan of the secondary function, words with white color.
- ③ Output Mode: continue, modulate, sweep, burst
- ④ Carrier wave Settings: Nine carrier wave - sine wave, square wave, ramp wave, pulse wave, harmonic wave, noise, PRBS (pseudo random binary sequence), DC, arbitrary wave.
- ⑤ Parameter List: Display the parameter of the current wave in list format, tap parameter list area to enable editing, virtual numeric keyboard pop-out ,see Figure 2-4

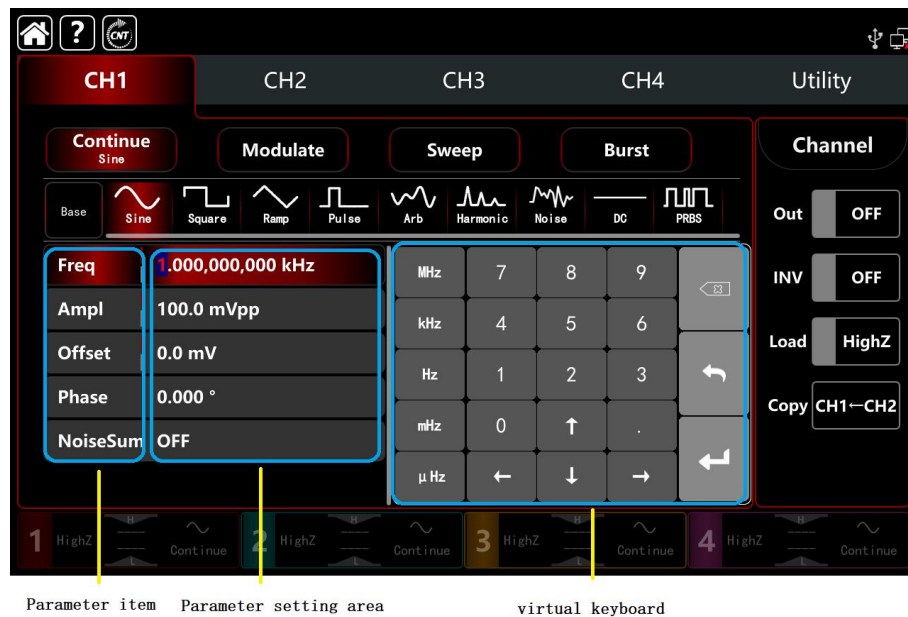



Figure 2-4 Parameter Editing

- ⑥ CH tab: the current channel which chosen will be highlight.
  - 1) “High Z” presents load with high resistance, it can set to be 50Ω.
  - 2)  presents the output wave is sine wave.
  - 3) 3 “Continue” presents the output wave is continue wave, which is output carrier wave only.( Other different mode may presents “carrier wave”, “AM”, “linear” or “N period”)
- ⑦ Wave Display Area: display the current waveform (it can distinguish by color or highlight of the CH tab, parameter list display the current waveform parameters on the left side.)  
Note: There is no waveform display area in Utility page.
- ⑧ CH Status Settings: quick switch the general settings of the current channel. Tap channel tab to switch output on/off to enable the channel output; inverse on/off to enable the inverse waveform; load on/off to enable HighZ or 50Ω to match the resistance of the output terminal; can copy the CH2 settings to CH1
- ⑨ System Settings: display USB connecting status, LAN symbol, external clock, etc.

## 2.3 Output the Carrier wave

UTG9000T series function/arbitrary waveform generator can output the carrier wave by single channel or four channel, including sine wave, square wave, ramp wave, pulse wave, harmonic wave, noise, PRBS (pseudo random binary sequence), DC, arbitrary wave. The instrument output a sine wave frequency 1 kHz, amplitude 100mVpp (default setting) when activating.

This section is to introduce how to set the output of the carrier wave, the contents as following:

- Frequency output settings

- Amplitude output settings
- DC offset voltage settings
- Square wave settings
- Pulse wave settings
- DC voltage settings
- Ramp wave settings
- Noise wave settings
- Harmonic wave settings
- PRBS settings
- Noise superposition settings

### 2.3.1 Frequency Output Settings

The instrument output of a sine wave is frequency 1kHz, amplitude 100mVpp (default setting) when activating the instrument.

The step to set the frequency to 2.5MHz:

- 1) Tap the parameter list area of Frequency tab, pop-out the virtual numeric keyboard to enter 2.5MHz (or rotate the knob and direction key to make the settings.)
- 2) Tap word **Frequency** to step through Frequency/Period

Note: multifunction knob/direction key is also can used to make parameter settings.

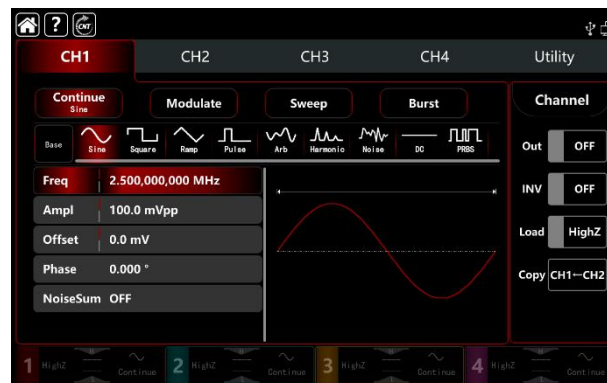


Figure 2-4 Frequency Settings

### 2.3.2 Output Amplitude Settings

The instrument output of a sine wave amplitude is 100mV peak value (default setting) when activating the instrument.

The step to set the amplitude to 300mVpp:

- 1) Tap Amplitude tab, pop-out the virtual numeric keyboard to enter 300mVpp
- 2) Tap word **Amplitude** to step through unit of Vpp, Vrms, dBm

Note: dBm setting only enable when Load is no HighZ mode

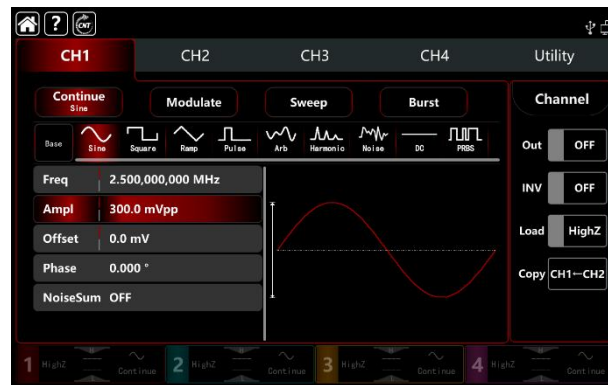


Figure 2-5 Amplitude Settings

### 2.3.3 DC Offset Voltage Settings

The instrument output DC offset voltage of a sine wave amplitude is 0V (default setting) when activating the instrument.

The step to set the DC offset voltage to -150mV:

- 1) Tap **Continue** tab to select **Sine**
- 2) Tap **Offset** tab, pop-out the virtual numeric keyboard to enter -150mV
- 3) Tap word **Offset**, Amplitude and Offset tab becomes High (maximum)/Low (minimum) level.

This method is convenient to set the signal limits of digital applications

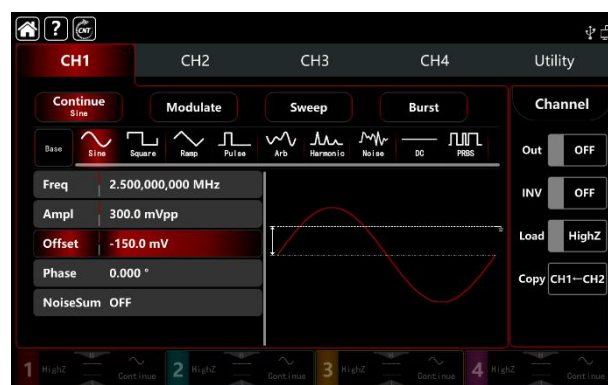


Figure 2-6 DC Offset Voltage Settings

### 2.3.4 Square Wave Settings

The duty ratio of square wave presents the time quantum of the square wave at a high level of each cycling (assuming that the waveform is not inverse.) The duty ratio default value is 50% of the square wave.

The step to set frequency to 1kHz, amplitude 1.5Vpp, DC offset voltage 0V, duty ratio 70%:

- 1) Tap **Continue** tab to select **Square** wave mode, tap Amplitude tab to pop-out virtual numeric keyboard to enter 1.5Vpp.
- 2) Tap **Duty** tab, pop-out virtual numeric keyboard to enter 70%.
- 3) Tap word **Duty** again to step through Duty/PWidth.

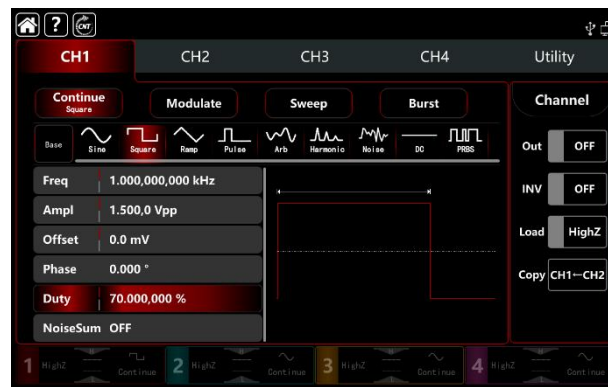


Figure 2-7 Square Settings

### 2.3.5 Pulse Wave Settings

The duty ratio of pulse wave presents the time quantum between with threshold value of rising edge 50% decrease to the next falling edge 50% (assuming that the waveform is not inverse.)

Users can make parameter settings to this instrument, then it can output the adjustable pulse wave with pulse width and edge time. The duty cycle default value is 50% of the pulse wave, rising/falling edge time 1us.

The step to set period 2ms, amplitude 1.5Vpp, DC offset voltage 0V, duty ratio 25 % (limited by the lower pulse wave width 2.4ns), rising/falling edge time 200us:

- 1) Tap **Continue** tab to select **Pulse** wave mode, pop-out numeric keyboard to enter 1.5Vpp.
- 2) Tap **Duty** tab, pop-out the virtual numeric keyboard to enter 25%.
- 3) Tap **REdge** tab, pop-out the virtual numeric keyboard to enter 200us, the same way to set the **FEEdge**.

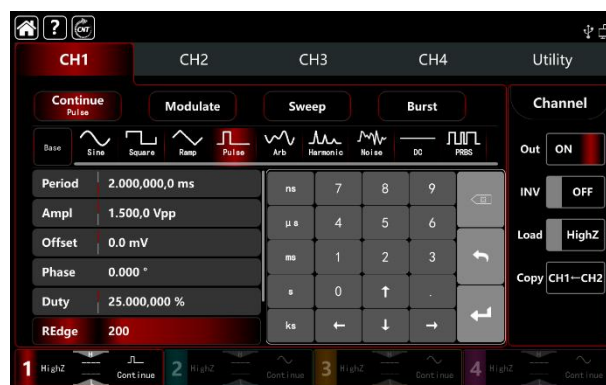


Figure 2-8 Pulse Wave Settings

### 2.3.6 DC Voltage Settings

The default value is 0V of the DC voltage.

The step to set DC offset voltage to 3V:

- 1) Tap **Continue** tab to select **DC** wave mode.
- 2) Tap **Offset** tab, pop-out the virtual numeric keyboard to enter 3V.

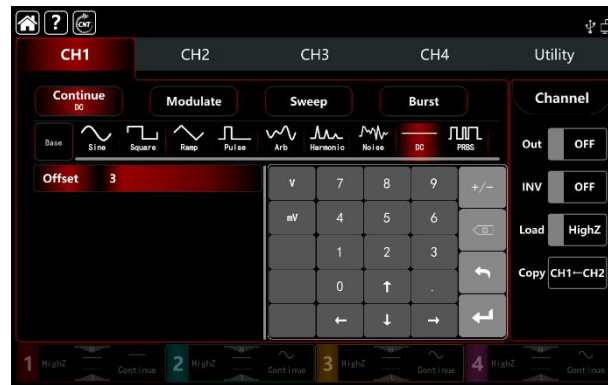


Figure 2-9 DC Settings

### 2.3.7 Ramp Wave Settings

The symmetry presents the ramp slope is the positive of time quantum in each cycling (assuming that the waveform is not inverse.) The default value of the symmetry of ramp wave is 50%.

The step to set frequency 10 kHz, amplitude 2Vpp, DC offset 0V, symmetry 60%:

- 1) Tap **Continue** tab to select **Ramp**, pop-out the virtual numeric keyboard to enter 10kHz.
- 2) Tap **Amplitude** tab, pop-out the virtual numeric keyboard to enter 2Vpp.
- 3) Tap **Symmetry** tab, pop-out numeric keyboard to enter 60%.

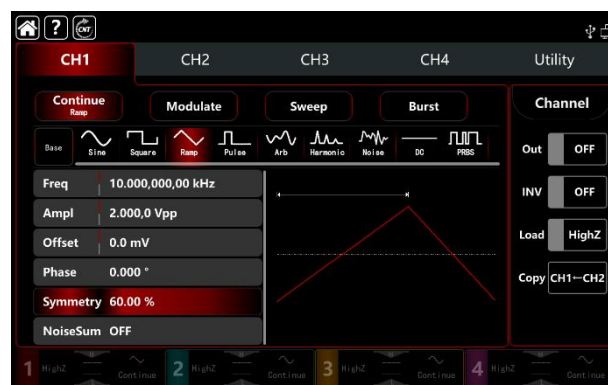


Figure 2-10 Ramp Wave Settings

### 2.3.8 Noise Wave Settings

The default value of amplitude is 100mVpp, DC offset is 0mV (standard gaussian noise). If other wave's amplitude and DC offset function has changed, the default value of noise wave will also be change. So it can only set the amplitude and DC offset in noise wave mode.

The step to set frequency 100MHz, amplitude 300mVpp:

- 1) Tap **Continue** tab to select **Noise** wave mode.
- 2) Tap **Frequency** tab, pop-out the virtual numeric keyboard to enter 100MHz.
- 3) Tap **Amplitude** tab, pop-out the virtual numeric keyboard to enter 300mVpp.

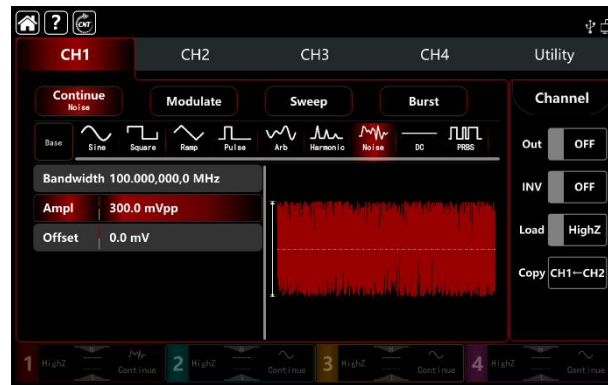


Figure 2-11 Noise Wave Settings

### 2.3.9 Harmonic Wave Settings

UTG9000T function/arbitrary waveform generator can output the designated count, amplitude and phase. According to the Fourier Transform theory, the time domain waveform of period function is the superposition of a series sine wave, it presents:

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

Usually, the component with frequency  $f_1$  is called the carrier wave,  $f_1$  serve as the carrier frequency,  $A_1$  serve as the carrier wave amplitude,  $\varphi_1$  serve as the carrier wave phase. And beyond that, the frequency of other component are integer multiples of the carrier frequency are called harmonic wave. Harmonic whose rated frequency is an odd multiple of the carrier wave frequency is called odd harmonic; harmonic whose rated frequency is an even multiple of the carrier frequency are called even harmonic.

The default frequency is 1kHz, amplitude 100mVpp, DC offset 0mv, phase 0°, harmonic wave type as odd harmonic, the total number of harmonic wave 2 times, the amplitude of harmonic wave 100m, the phase of harmonic wave 0°. The step to set frequency 1MHz, amplitude 5Vpp, DC offset 0mV, phase 0°, harmonic wave types as All, harmonic wave 2 times, the amplitude of harmonic 4Vpp, the phase of harmonic 0°:

- 1) Tap **Continue** tab to select **Harmonic**.
- 2) Tap **Frequency** tab, pop-out the virtual numeric keyboard to enter 1MHz.
- 3) Tap **Amplitude** tab, pop-out the virtual numeric keyboard to enter 5Vpp.
- 4) Tap **Total** number tab, pop-out the virtual numeric keyboard to enter 2.
- 5) Tap **Type** tab to select All.
- 6) Tap **Amplitude** of harmonic wave tab, pop-out the virtual numeric keyboard to enter 4Vpp.



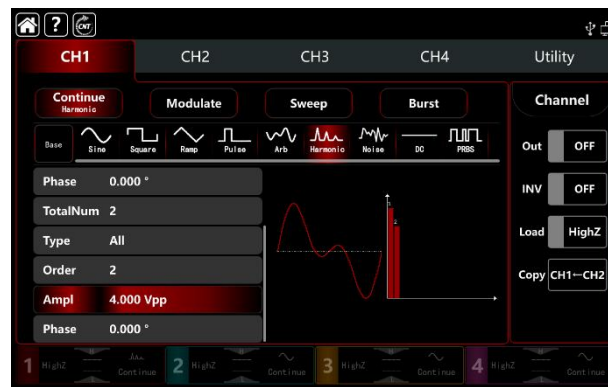


Figure 2-12 Ramp Wave Settings

### 2.3.10 PRBS Wave Settings

The step to set the PRBS wave to bit rate 50kbps, amplitude 4Vpp, code element PN7, and edge time 20ns:

- 1) Tap **Continue** tab to select **PRBS**.
- 2) Tap **Bitrate** tab, pop-out the virtual numeric keyboard to enter 50kbps.
- 3) Tap **Amplitude** tab, pop-out the virtual numeric keyboard to enter 4Vpp.
- 4) Tap **PN** code tab, pop-out the virtual numeric keyboard to enter PN7.

The default edge time is 20ns.

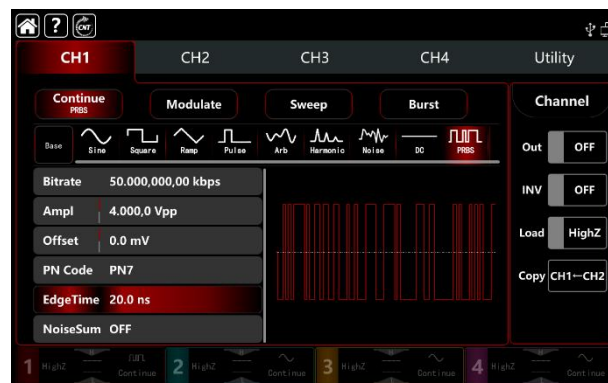


Figure 2-13 PRBS Wave Settings

### 2.3.11 Noise Superposition Settings

UTG9000T function/arbitrary waveform generator can add noise. The SNR is adjustable. The step to set the sine wave of frequency 10kHz, amplitude 2Vpp, DC offset 0V, signal noise ratio 0dB:

- 1) Tap **Continue** tab to select **Sine**.
- 2) Tap **Frequency** tab, pop-out the virtual numeric keyboard to enter 10kHz.
- 3) Tap **Amplitude** tab, pop-out the virtual numeric keyboard to enter 2Vpp.
- 4) Tap **Noise** to turn on.

Note: 1. Different frequency and amplitude will effect the range of SNR. The default noise superposition is 10dB.

2. When the noise superposition is turned on, the amplitude coupling function is not available.



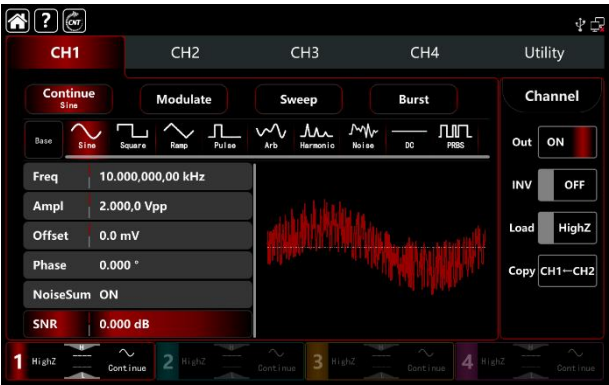


Figure 2-14 Noise Superposition Settings

## 2.4 Secondary Function Settings

Utility can set the settings of the channel, channel coupling, frequency counter, digital protocol, system and internet, detailed description as following,

### 2.4.1 Channel Settings

Table 2-1 CH1/2

| Menu  | Sub-menu        | Setting              | Description                            |
|-------|-----------------|----------------------|--|
| CH1/2 | Output          | ON/OFF               |  |
|       | Inverse         | ON/OFF               |  |
|       | Load            | 50Ω, high resistance | 1Ω~1000kΩ                              |
|       | Amplitude Limit | ON/OFF               |  |
|       | High            |                      | The high limit of the output amplitude |
|       | Output          |                      | The low limit of the output amplitude  |
|       | Inverse         | ON/OFF               |  |
|       | Load            | ON/OFF               |  |

Table 2-2 CH3/4

| Menu  | Sub-menu        | Setting                   | Description                            |
|-------|-----------------|---------------------------|--|
| CH3/4 | Output          | OFF/ON                    |  |
|       | Inverse         | OFF/ON                    |  |
|       | Load            | High resistance (default) | 1Ω~1000kΩ                              |
|       | Amplitude Limit | OFF/ON                    |  |
|       | High            |                           | The high limit of the output amplitude |
|       | Low             |                           | The low limit of the output amplitude  |

Tap **Utility** → **Channel** to make the relevant settings:

1. Output

Tap **Output** to step through ON/OFF. Note: **CH1**, **CH2**, **CH3**, **CH4** key can quick turn on /off the channel output function on the front panel.

2. Inverse

Tap **INV** to step through ON/OFF.

3. Load

Tap **Load** to step select HighZ, 50Ω or to enter number within 1Ω~1000kΩ.

4. Amplitude Limit

This function is order to protect load. Tap **Ampl Limit** to step through ON/OFF.



5. High

Tap **High** to enter the high limit of amplitude.

6. Low

Tap **Low** to enter the high limit of amplitude.

7. Sync Output

Tap **Sync Out** to step through ON/OFF. The sync output of CH1 is the CH3, and the CH2 sync output is corresponding to CH4. When CH1 sync output is turn on, CH3 tab  becomes  ; When CH2 sync output is turn on, CH4 tab becomes

8. Sync Inverse

Tap **Sync-INV** to step through ON/OFF.

## 2.4.2 Channel Coupling

The channel coupling is classified as Frequency Coupling, Amplitude Coupling and Phase Coupling.

The menu settings as following,

Table 2-3 Frequency Coupling

| Menu               | Sub-menu  | Settings           | Description                           |
|--------------------|-----------|--------------------|---------------------------------------|
| Frequency Coupling | Frequency | OFF/ON             |                                       |
|                    | Type      | Ratio, Deviation   |                                       |
|                    | Ratio     | CH2:CH1 or CH4:CH3 | Turn on Ratio to make the setting     |
|                    | Deviation | CH2-CH1 or CH4-CH3 | Turn on Deviation to make the setting |

Table 2-4 Amplitude Coupling

| Menu               | Sub-menu  | Setting            | Description                           |
|--------------------|-----------|--------------------|---------------------------------------|
| Amplitude Coupling | Amplitude | OFF/ON             |                                       |
|                    | Type      | Ratio, Deviation   |                                       |
|                    | Ratio     | CH2:CH1 or CH4:CH3 | Turn on Ratio to make the setting     |
|                    | Deviation | CH2-CH1 or CH4-CH3 | Turn on Deviation to make the setting |

Table 2-5 Phase Coupling

| Menu           | Sub-menu  | Setting            | Description                           |
|----------------|-----------|--------------------|---------------------------------------|
| Phase Coupling | Phase     | OFF/ON             |                                       |
|                | Type      | Ratio, Deviation   |                                       |
|                | Ratio     | CH2:CH1 or CH4:CH3 | Turn on Ratio to make the setting     |
|                | Deviation | CH2-CH1 or CH4-CH3 | Turn on Deviation to make the setting |

Note: 1、 The coupling setting of CH3 to CH4 is the same as CH1 coupling to CH2.

2、 Channel Merge is not available when Amplitude Coupling is on.

Tap **Utility**→**Coupling** to make the relevant settings:

### 1. Frequency Coupling

The frequency coupling mode to set ratio or deviation. CH1 and CH2 are each other's reference sources, change one of the channel's (as the reference source) frequency counter, the other channel will adjustment automatically. And always maintain the specified ratio/deviation of the reference channel.

Ratio: the specific value of CH2 : CH1; Deviation: the difference value of CH2-CH1. The frequency settings to set CH3 coupling to CH4 is the same as CH1 coupling to CH2.

Tap **Freq** to step through OFF/ON.

Tap **Type** to step through Ratio/Deviation.

Ratio type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

Deviation type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

### 2. Amplitude Coupling

The amplitude coupling mode to set ratio or deviation. CH1 and CH2 are each other's reference

sources, change one of the channel's (as the reference source) amplitude, the other channel will adjustment automatically. And always maintain the specified ratio/deviation of the reference channel.

Ratio: the specific value of CH2: CH1; Deviation: the difference value of CH2-CH1. The amplitude settings of CH3 coupling to CH4 is the same as CH1 coupling to CH2.

Tap **Ampl** to step through OFF/ON.

Tap **Type** to step through Ratio/Deviation.

Ratio type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

Deviation type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

### 3. Phase Coupling

The phase coupling mode to set ratio or deviation. CH1 and CH2 are each other's reference sources, change one of the channel's (as the reference source) phase, the other channel will adjustment automatically. And always maintain the specified ratio/deviation of the reference channel.

Ratio: the specific value of CH2: CH1; Deviation: the difference value of CH2-CH1. The phase settings of CH3 coupling to CH4 is the same as CH1 coupling to CH2.

Tap **Phase** to step through OFF/ON.

Tap **Type** to step through Ratio/Deviation.

Ratio type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

Deviation type: tap **CH2:CH1** tab, pop-out the virtual numeric keyboard to enter numbers and tap return key.

### 4. Display Icon

Turn on channel coupling, the coupling icon appears on the right side of the waveform parameters display list in the home page.

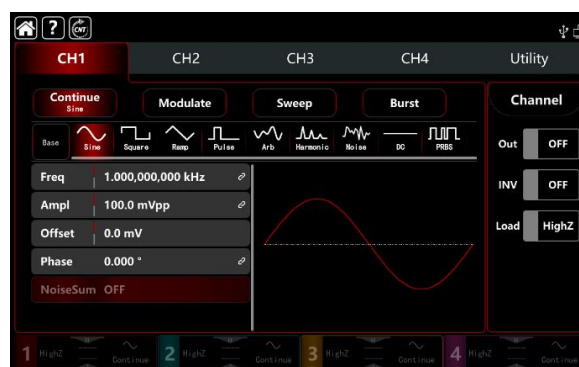


Figure 2-15 Channel Coupling

2.4.3 Channel Merging

Tap **Utility**→**Coupling** to make the relevant settings:

In general, the output terminal of CH1/2 is only export the CH1/2 waveform, turn on channel merging function can output the CH1 and CH2 waveform; the performance of CH3/4 is same as the output terminal of CH1/2.

Tap **CH1 Merge** to step through OFF/CH1+CH2. CH1+CH2 merging interface see Figure 2-16.

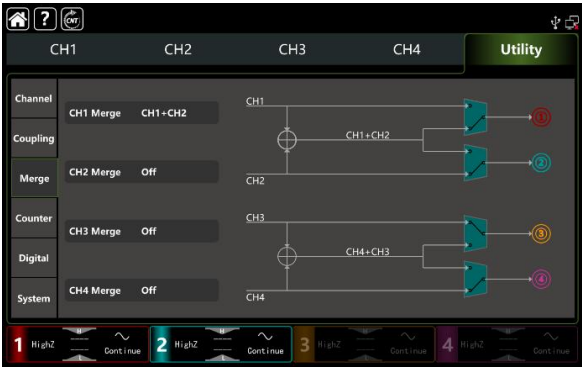


Figure 2-16 Channel Merging

CH1 merging settings is CH1+CH2, waveform interface has the symbol **Merged:CH1 + CH2** display on the left corner of the home page.

Similarly, the channel combination of CH2, CH3, and CH4 is the same as that of CH1.

Note: Amplitude coupling is not available when channel merging is turned on.

2.4.4 Frequency Counter

This function/arbitrary has 8digits/s frequency counter function, testing frequency of range 100mHz~800MHz, frequency counter, measurement range is 100mHz~800MHz, signal voltage width range input. It can measure the external input signal of frequency, period, ratio, positive pulse and negative pulse, etc. And make statistics on the measurement results. The instrument is auto measuring the maximum, minimum, the average value and standard deviation.

Table 2-6 Frequency Counter Settings

| Menu              | Sub-menu              | Setting      | Description  |
|-------------------|-----------------------|--------------|--|
| Frequency counter | Switch                | OFF/ON       |  |
|                   | Coupling              | AC, DC       | To ensure accurate measurement, turn on AC when the input signal frequency is high; turn on DC when the frequency is low |
|                   | Trigger Level         | -2.5V ~ 2.5V |  |
|                   | Sensitivity           | 0%-100%      |  |
|                   | High Frequency Reject | OFF/ON       |  |

Tap **Utility**→**Counter** to make the relevant settings, see Figure 2-17.

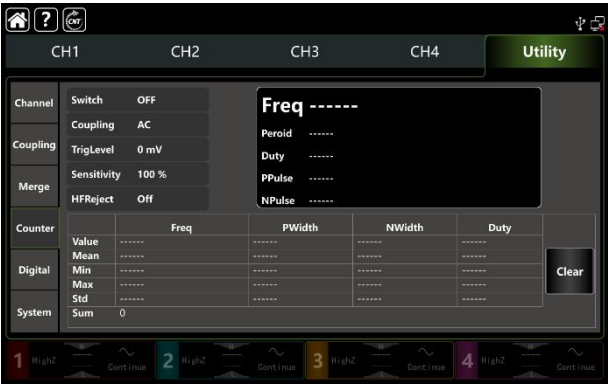


Figure 2-17 Frequency Counter

- 1) Switch
- Tap **Switch** to step through OFF/ON.
- 2) Coupling
- Tap **Coupling** to step through AC/DC. The default option is AC.
- 3) Trigger Level
- Tap **TrigLevel**, pop-out the virtual numeric keyboard to enter numbers and tap return key.The default value is 0V.
- 4) Sensitivity
- Tap **sensitivity**, pop-out the virtual numeric keyboard to enter numbers and tap return key.The default value is 100%.
- 5) High Frequency Reject
- Tap **HFReject** to step through OFF/ON. The default option is OFF
- 6) Clear
- Tap **Clear** to delete all the measured result and restart to calculate.

2.4.5 System

System

Table 2-7 System Settings

| Menu   | Sub-menu     | Setting                                 | Description             |
|--------|--------------|---|-------------------------|
| System | Language     | Chinese, English                        |                         |
|        | Separator    | Comma, Space, None                      |                         |
|        | Beep         | OFF/ON                                  |                         |
|        | Backlight    | 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% |                         |
|        | Screen Saver | OFF,5min,15 min,30 min,60 min           |                         |
|        | Clock Source | Internal, External                      |                         |
|        | Clock Output | OFF/ON                                  |                         |
|        | Power On     | Default, Last, Set1, Se2, Set3, Set4,   | Save as a default state |

|  |             |   |  |
|--|-------------|---|--|
|  |             | Set5  |  |
|  | Phase       | Sync, Independent   | Restore to factory settings or save the settings             |
|  | Manual      | SingleChannel , AllChanel                                   |  |
|  | Switch Mode | Independent , CH1&2 , CH3&4 , CH1&2&3 , CH2&3&4 , CH1&2&3&4 | Sets whether each channel is open or closed at the same time |
|  | Save        |   | Save the preview settings                                    |
|  | Default     |   | Restore default settings                                     |

Tap **Utility** → **System** to make the relevant settings

1. Language

Tap **Language** to step through Chinese/English, this function requires to restart the instrument.

2. Separator

Tap to **Separator** to step through Comma, Space, None, and it is separator between in parameters of channel.

3. Beep

Tap **Beep** to step through OFF/ON to set the sound when tap the key.

4. Backlight

Tap Backlight key to step through the light of screen of “30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%”.



5. Screen Saver

Tap **Screen Saver** to step through OFF/5min, 15min, 30min, and 60min. The instrument will turn off screen display as the screen saver setting, it can be call on by press any keys.

6. Clock Source

Tap **Clock Source** key to step through Internal/External.

Internal: supported clock source of 10MHz.

External: receive the external clock through the terminal of 10MHz In at the back panel (frequency 10MHz, amplitude TTL). If the instrument inspect the terminal has no effect external clock, screen will pop-out a notice “ External clock is invalid.” And display the symbol  on the top right. If the instrument inspect the terminal of external clock is effect, it displays the symbol .

7. Clock Output

Tap **Clock Output** to step through OFF/ON. Turn on the clock output, the terminal of 10MHz Out for other instrument.

**The synchronization approach between the instruments:**

Connect the terminal of 10MHz Out of the first instrument (Clock Output ON) with the terminal of 10MHz In of the other instrument (Clock source External), and set both of them at the same output frequency to implement the sync. Multi-instrument can sync with others as the same steps.

**8. Phase**

Tap **Phase** step through Sync/Independent.

Sync: The start phase of four channels are associated.

Independent: The start phase of channel is independent.

**9. Power On**

Tap **Power On** to step through Default, Last, Set1, Set2, Set3, Set4, and Set5.

Set the start status of the instrument, select the preview settings of save function.

**10. Manual**

Tap **Manual** to step through SingleChannel/ AllChannel.

When trigger source is enabled in Sweep or Burst mode, the SingleChannel function can only work on the current channel. The AllChannel function can work on all the channel at the same time which the channel trigger source is turned on.

**11. Switch Mode**

Tap **Switch Mode** to step through Independent , CH1&2 , CH3&4 , CH1&2&3 , CH2&3&4 , CH1&2&3&4. When independent is selected, the switches of each channel are independent of each other, and the switch of one channel does not affect the other channels (except for channel Sync Out). When CH1&2 is selected, the switch of channel 1 and channel 2 are associated, and when channel 1 is opened or closed, channel 2 will automatically do the same operation, and vice versa, when channel 2 is opened or closed, channel 1 will automatically do the same operation. The other options work the same way.

**12. Save**

Tap **Save** to keep the current settings as the preview settings, it can select to keep into Set1, Set2, Set3, Set4 and Set5.

Default

Tap **Default** to restore the instrument to "Factory settings", pop-out dialog box, and tap it to Cancel/Ok.

**13. About**

Display model name, version information and company address, etc.



## LAN

Table 2-8 LAN Settings

| Menu | Sub-menu   | Setting | Description                          |
|------|------------|---------|--------------------------------------|
|      | DHCP       | OFF/ON  | Turn off to set the following option |
|      | IP address |         |                                      |
|      | Mask       |         |                                      |
|      | Gateway    |         |                                      |
|      | MAC        |         |                                      |

Tap **Utility** → **System** to enter the settings interface (on the right side)

1. DHCP

Tap DHCP to step through OFF/ON.

2. IP Address

IP address format: nnn.nnn.nnn.nnn, the first of nnn range can set to 1~233, the second 0~255.

It is suggest that you inquiry the internet administrator to get an available IP address. Tap **IP** or push the numeric keyboard to enter numbers. This settings will be stored in non-volatile memory, and the instrument will automatically applied on next boot.

3. Mask

Subnet mask format: nnn.nnn.nnn.nnn, nnn range can set to 0~255. It is suggest that you inquiry the internet administrator to get an available subnet mask address. Tap **Mask** or push the numeric keyboard to enter numbers. This settings will be stored in non-volatile memory, and the instrument will automatically applied on next boot.

4. Gateway

Gateway format: nnn.nnn.nnn.nnn, It is suggest that you inquiry the internet administrator to get an available gateway. Tap **Gateway** or push the numeric keyboard to enter numbers. This settings will be stored in non-volatile memory, and the instrument will automatically applied on next boot.

5. MAC

MAC address are numbered from zero and incremented sequentially by one, so the MAC address space of memory increase linearly. It is represented as a binary number, an unsigned integer, and written as a hexadecimal number.

6. Web access and control devices

Access and control the device through the Web address http://IP , where IP is the IPv4 address set by the network, such as:http://192.168.20.210 .

After opening the http://IP address in the browser, enter the Web Username and Web Password set by the LAN to log in to the device. After successful login, the browser can be used for instrument control, execution of SCPI instructions, network Settings and other operations. The device can be remotely controlled using a Web browser on a PC or mobile terminal, which mimics the touch screen/mouse clickable display function, just like a physical instrument, and operates as follows.

(1) Access Local Area Network

The computer and the Function/Arbitrary Waveform Generator are under the same LAN. Check the IP address through the Utility -> System menu of the Function/Arbitrary Waveform Generator, and then the browser accesses Function/Arbitrary Waveform Generator by http://ip port.

### Example

Computer IP: 192.168.20.3

Function/Arbitrary Waveform Generator IP: 192.168.20.210

PC browser using 192.168.20.210 to access Function/Arbitrary Waveform Generator to check the basic information and control parameter of the instrument, such as network setting, password and SCPI, as shown in the following Figure 2-18.

The screenshot shows the UNI-T web interface. At the top, there is a navigation bar with the UNI-T logo and a 'Login' button. Below the navigation bar, there are several tabs: Home, Instrument Control, LAN Config, Password Set, SCPI Command, Service & Support, and Help. The main content area is divided into three sections: Basic Info, LAN Info, and Notice.

| Basic Info       |                    |
|------------------|--------------------|
| Manufacturer     | UNI-T Technologies |
| Model            | UTG9004T           |
| Serial Number    | 40089862250867     |
| Firmware Version | 1.13.1021          |

| LAN Info   |                   |
|------------|-------------------|
| IP Address | 192.168.20.210    |
| Mask       | 255.255.254.0     |
| Gateway    | 192.168.20.1      |
| MAC        | 24-76-25-FF-A1-73 |

| Notice                    |   |
|---------------------------|---|
| Browser Require           | The browser needs to support websocket. It is recommended to use chrome V102.0.5005.115 and above |
| Network Bandwidth Require | ≥100Mbps  |
| Max Connection            | 1   |
| Display Device Require    | 1080p LCD recommended   |

Figure 2-18 Web Basic Information

Log in to check the network and password and SCPI setting of the instrument. For the Username and Password required to log in, see Web Username and Web Password in the LAN Settings. Log in to view and control Function/Arbitrary Waveform Generator, as shown in the following Figure 2-19.

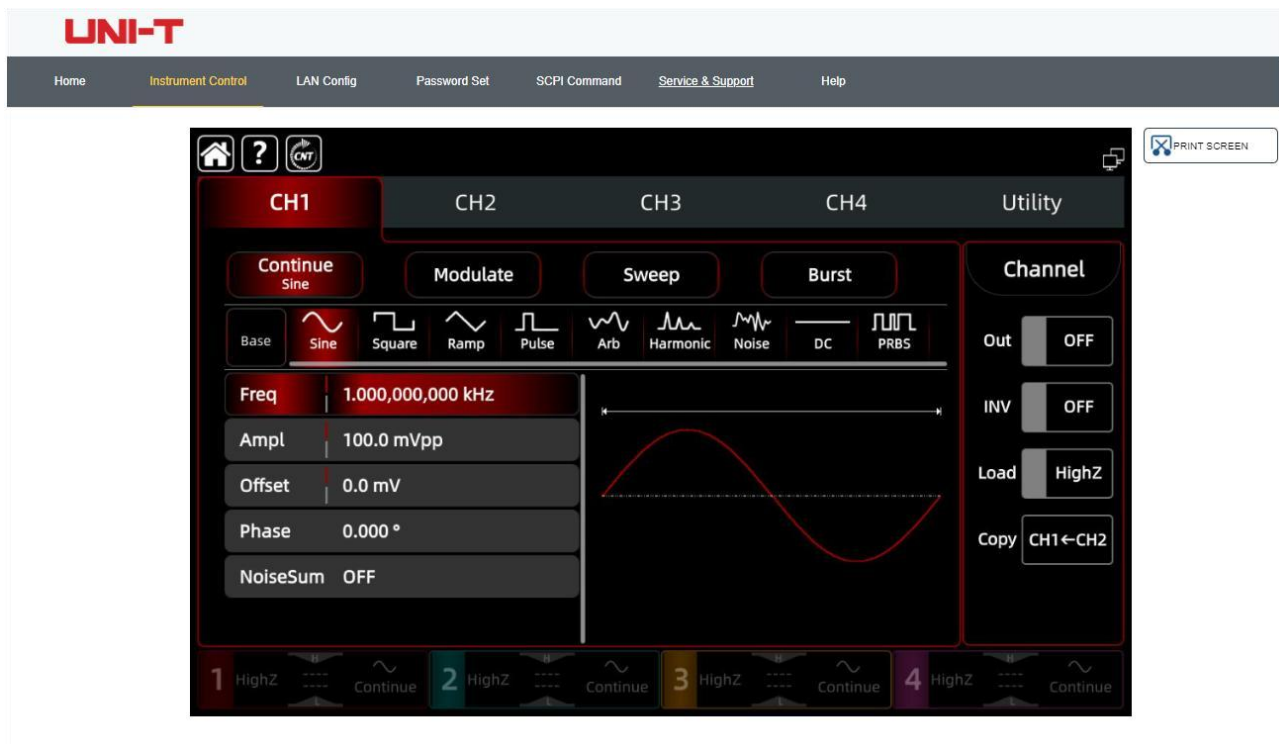


Figure 2-19 Web Control

The operations that can be performed on the touch screen of the physical instrument, such as selecting menu panels, clicking on function keys, entering numbers and characters, dragging marks, etc., can also be performed on this Web page, as well as printing the screen.

## (2) Access Outer Network

- plug the network cable into Function/Arbitrary Waveform Generator and the network can be access internet
- open the frp proxy service on the server
- configure the frp proxy IP and port of Function/Arbitrary Waveform Generator
- the browser can access `http://IP:web_port`, and the access interface is consistent with the above.

### Note

This Function/Arbitrary Waveform Generator uses frp intranet penetration way to achieve external network access. frp version is 0.34.0. This machine with frp-0.34.0 client, it need use with the server, the server needs to open frp server, the client connects to the frp server port is 7000, so the server needs to configure `bind_port = 7000`.

## (3) Network Setting

Modify the network and Frp agent network information of Function/Arbitrary Waveform Generator, as shown in the following Figure 2-20.

UNI-T

Home

Instrument Control

LAN Config

Password Set

SCPI Command

Service & Support

Help

LAN Info

Type

DHCP

| Item    | Value          |
|---------|----------------|
| IP      | 192.168.20.210 |
| Mask    | 255.255.254.0  |
| Gateway | 192.168.20.1   |

Modify LAN Config

Confirm

Frp Proxy Info

| Item      | Value         |
|-----------|---------------|
| Frp IP    | 121.37.220.55 |
| Web Port  | 9000          |
| Pic Port  | 9002          |
| Ctrl Port | 9001          |

Modify Frp Proxy

Query Frp Used Port

Confirm

Figure 2-20 Web Network Setting

(4) Password Setting

Modify Web login password of the Function/Arbitrary Waveform Generator, as shown in the following Figure 2-21, the original password can be viewed under Physical Instruments->Utility->System->LAN Settings.

UNI-T

Home

Instrument Control

LAN Config

Password Set

SCPI Command

Service & Support

Help

Modify Password

| Item                 | Value                    |
|----------------------|--------------------------|
| Old Password         | <input type="password"/> |
| New Password         | <input type="password"/> |
| Confirm New Password | <input type="password"/> |

Confirm

Cancel

Figure 2-21 Web Password Setting

(5) SCPI

Execute the SCPI command, as shown in the following Figure 2-22, enter the command in the SCPI command edit box, click the "Send Command" button, and the execution result will be printed in the report column as below.

UNI-T

Home

Instrument Control

LAN Config

Password Set

SCPI Command

Service & Support

Help

SCPI Command

\*idn?

Send

UNI-T Technologies, UTG9504T, 40089862250867, 1.13.1021

Figure 2-22 SCPI Control

## Chapter 3 Advanced Applications

### 3.1 Output Modulation Waveform

Modulation types: a total of 15 types - AM, FM, PM, DSB-AM, QAM, ASK, FSK, 3FSK, 4FSK, PSK, BPSK, QPSK, OSK, PWM, SUM

UTG9000T can output the modulated waveform from a single channel or multiple channels simultaneously. Waveform is consist of the carrier waveform and the modulated waveform. The carrier wave can be sine, square ramp, arbitrary (except DC) or pulse. The modulated wave can be the internal modulation or the external modulation.

The contents of this section as following:

- AM: Amplitude Modulation
- FM: Frequency Modulation
- PM: Phase Modulation
- ASK: Amplitude Shift Keying
- FSK: Frequency Shift Keying
- 3FSK: Three Frequency Shift Keying
- 4FSK: Four Frequency Shift Keying
- PSK: Phase Shift Keying
- BPSK: Double Phase Shift Keying
- QPSK: Quad-Phase Shift Keying
- SUM: Sum Modulation
- DSB-AM: Double Side Amplitude Modulation
- QAM: Quadrature Amplitude Modulation
- OSK: Oscillation Keying
- PWM: Pulse Width Modulation

Take CH1 as example to introduce these functions.

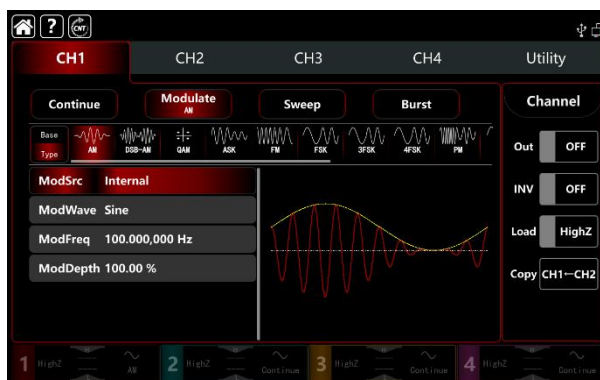
#### 3.1.1 AM (Amplitude Modulation)

AM is consist of the carrier wave and the modulated wave, the amplitude of the carrier wave changed by the amplitude of the modulated wave.

The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

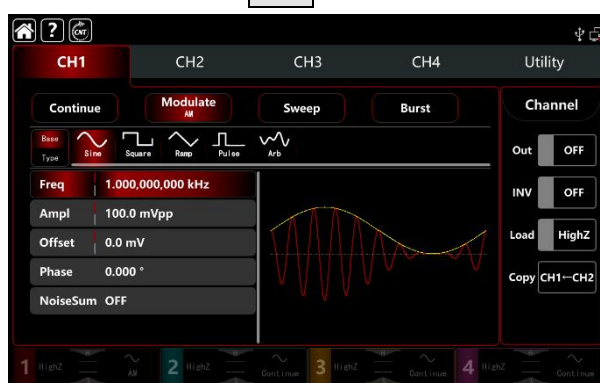
## Select AM Modulation

Tap **CH1** → **Modulate** → **AM** to turn on the AM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



## Select the carrier waveform

The carrier wave of AM: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select AM modulation, tap **Base** to present the carrier waveform on the right side.



## Carrier frequency settings

The frequency range of the carrier wave can set differently, all the default fundamental frequency is 1kHz, see Table 4-1 and Table 4-2 for the frequency settings of the different carrier waveform.

Table 4-1 The carrier wave frequency of CH1 and CH2

| Carrier waveform | Frequency |        |          |        |          |        |
|------------------|-----------|--------|----------|--------|----------|--------|
|                  | UTG9604T  |        | UTG9504T |        | UTG9354T |        |
|                  | MIN       | MAX    | MIN      | MAX    | MIN      | MAX    |
| Sine wave        | 1μHz      | 600MHz | 1μHz     | 500MHz | 1μHz     | 350MHz |
| Square wave      | 1μHz      | 200MHz | 1μHz     | 160MHz | 1μHz     | 120MHz |
| Ramp wave        | 1μHz      | 30MHz  | 1μHz     | 30MHz  | 1μHz     | 20MHz  |
| Pulse wave       | 1μHz      | 200MHz | 1μHz     | 160MHz | 1μHz     | 120MHz |
| Arbitrary wave   | 1μHz      | 100MHz | 1μHz     | 100MHz | 1μHz     | 80MHz  |

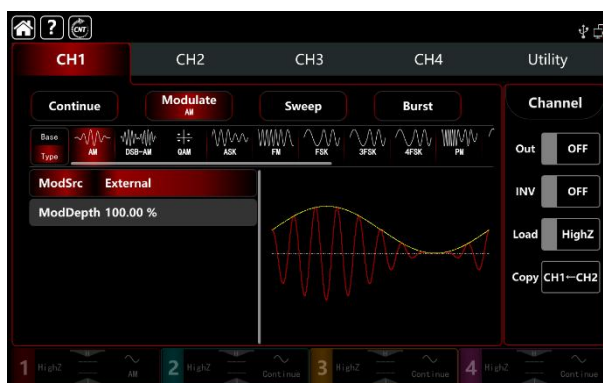
Table 4-2 The carrier wave frequency of CH3 and CH4

| Carrier waveform | Frequency  |        |            |        |            |        |
|------------------|------------|--------|------------|--------|------------|--------|
|                  | UTG9604T   |        | UTG9504T   |        | UTG9354T   |        |
|                  | MIN        | MAX    | MIN        | MAX    | MIN        | MAX    |
| Sine wave        | 1 $\mu$ Hz | 200MHz | 1 $\mu$ Hz | 200MHz | 1 $\mu$ Hz | 160MHz |
| Square wave      | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 50MHz  |
| Ramp wave        | 1 $\mu$ Hz | 10MHz  | 1 $\mu$ Hz | 10MHz  | 1 $\mu$ Hz | 8MHz   |
| Pulse wave       | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 50MHz  |
| Arbitrary wave   | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 60MHz  | 1 $\mu$ Hz | 50MHz  |

Rotate multifunction knob and direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to set the carrier wave frequency.

### Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on AM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in AM modulation setting interface.



#### 1) Internal source

When the modulation source is internal, the modulation waveform can be sine, square, rising ramp, falling ramp arbitrary and noise wave. The default wave is sine wave. When turn on AM modulation, **ModWave** present Sine, rotate multifunction knob or tap word **Sine** tab to select the waveform in modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 2kpts by the method of select point automatically



- Noise wave: white gaussian noise

## 2) External source

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

## Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The input external modulating signal frequency range is between 0Hz~50kHz.

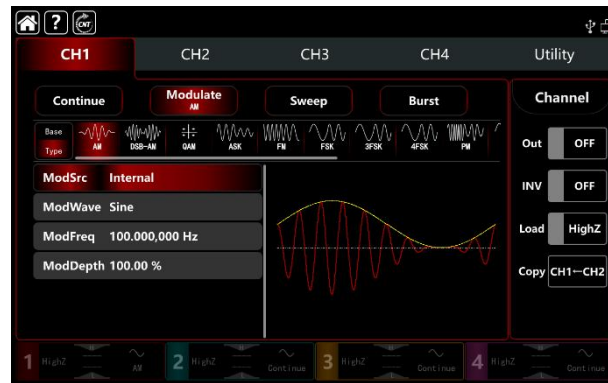
## Modulation depth settings

Modulation depth indicates the change of the extent of amplitude, use percentage to express. AM modulation depth range can set between 0%~120%, the default range is 100%. If the modulation depth is 0%, then output a constant amplitude (the half of the carrier wave amplitude); if the modulation depth is 100%, the output amplitude will change by the modulation waveform. When the modulation depth is greater than 100%, the instrument will not output greater than  $\pm 5V$  peak-to-peak voltage (connect with the terminal of 50 $\Omega$ ). Rotate multifunction knob and direction key or tap **ModDepth** tab to pop-out visual numeric keyboard to enter values. When the modulation source is external, the output amplitude is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel. For example, if set the modulation depth to 100%, the output of AM amplitude is maximum when the external modulation signal is +5V; the output of AM amplitude is minimum when the external modulation signal is -5V.

## Comprehensive example

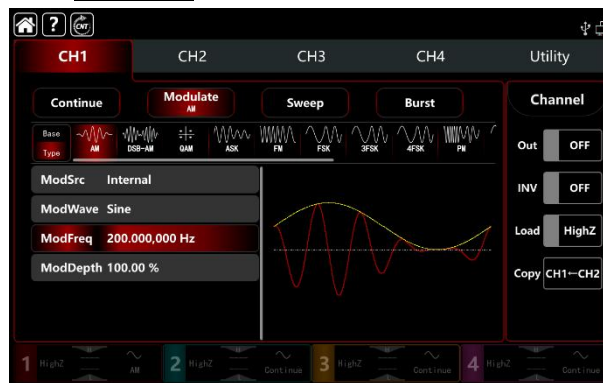
In AM modulation mode, set an internal 200Hz sine wave as a modulating signal, another carrier wave signal with frequency 10kHz, amplitude 200mVpp, duty ratio 45%, and set the modulation depth to 80%, the settings steps as following,

- 1) Turn on AM modulation mode: tap **CH1** → **Modulate** → **AM** accordingly.



## 2) Set the parameter of modulating signal

Base on the step 1) to tap **ModFreq** tab to pop-out visual numeric keyboard to enter 200Hz.



## 3) Set the parameter of the carrier wave signal

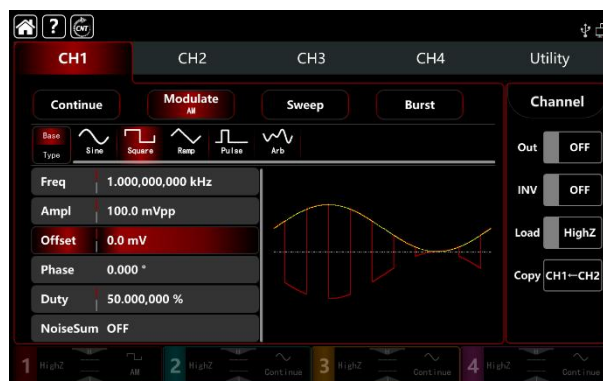
Tap **Base** to select Square as the carrier waveform (the default option is sine wave).

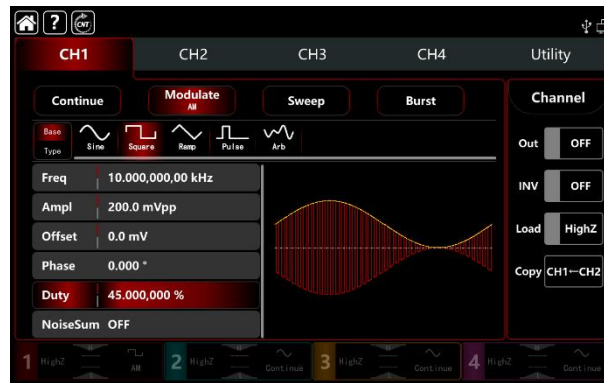
Tap **Freq** tab to pop-out visual numeric keyboard to enter 10kHz.

Tap **Ampl** tab to pop-out visual numeric keyboard to enter 200mVpp.

Tap **Duty** tab to pop-out visual numeric keyboard to enter 45%.

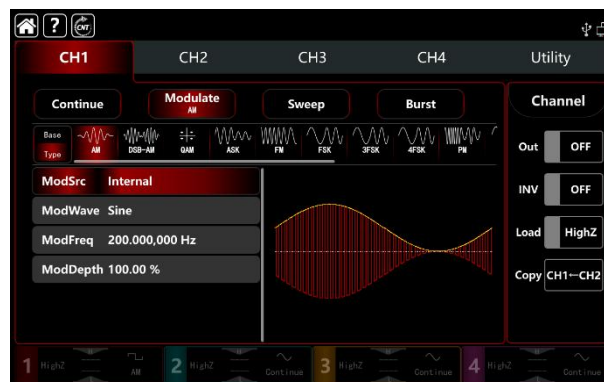
See the Figure as following,



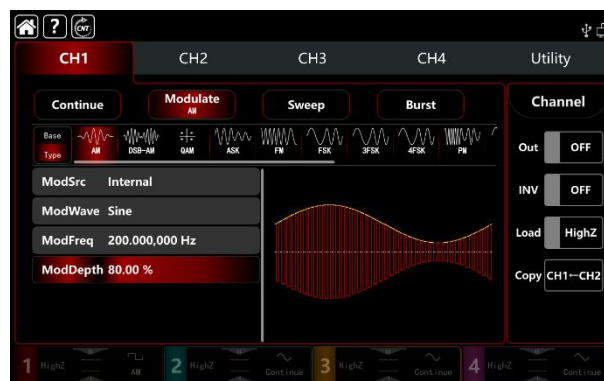


#### 4) Set the modulation depth

After the parameter setting of the carrier wave, tap Type to return to AM modulation interface to set the depth.

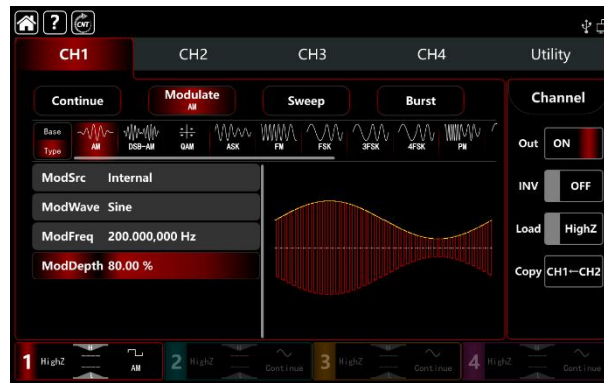


Tap **ModDepth** tab to pop-out visual numeric keyboard to enter 80%.

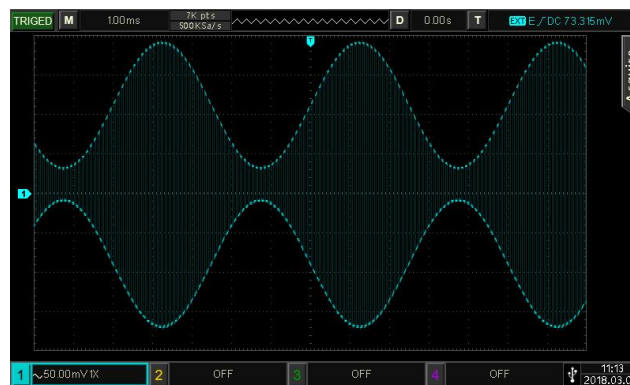


#### 5) Turn on the output channel

Tap channel **Out** to ON or push **CH1** on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility** → **Channel** → **Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the AM modulation waveform viewed through an oscilloscope is shown in the figure below,

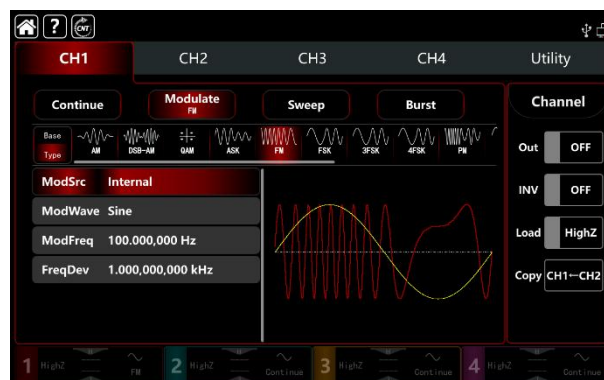


### 3.1.2 FM (Frequency Modulation)

In frequency modulation mode, the modulated waveform consists of the carrier wave and the modulation wave. The carrier wave frequency changes by the modulation wave amplitude. The modulation modes for each channel are independent; it can set the same or different modulation modes to each channel.

#### Select FM modulation

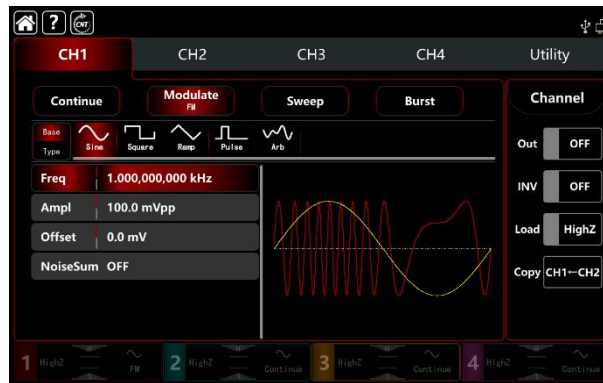
Tap **CH1** → **Modulate** → **FM** to turn on FM modulation; the instrument outputs the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

The carrier wave of AM: sine, square, ramp, pulse and arbitrary wave (except DC), the default option

is sine wave. After select FM modulation, tap **Base** to present the carrier waveform on the right side.

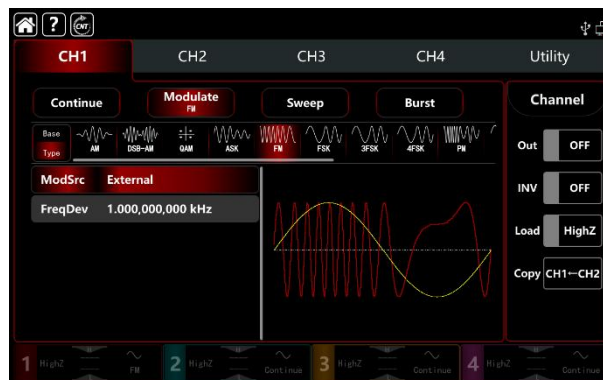


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on FM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in FM modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation waveform can be sine, square, rising ramp, falling ramp arbitrary and noise wave. The default wave is sine wave. When turn on FM modulation, **ModWave** present Sine, rotate multifunction knob or tap word **Sine** to select the waveform in modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 2kpts by the method of select point automatically
- Noise wave: white gaussian noise

## 2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The FM offset is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel. The frequency of the output at the positive signal level is greater than the carrier wave frequency, at the negative signal level is less than the carrier wave frequency, the lower external signal level produces less deviation. For example, if set the frequency deviation to 1kHz, the FM output increased by 1kHz to the current fundamental frequency when the external modulated signal is +5V; the FM output subtracted by 1kHz from the current fundamental frequency when the external modulated signal is -5V.

### Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in FM modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The input external modulating signal frequency range is between 0Hz~50kHz.

### Modulated frequency deviation settings

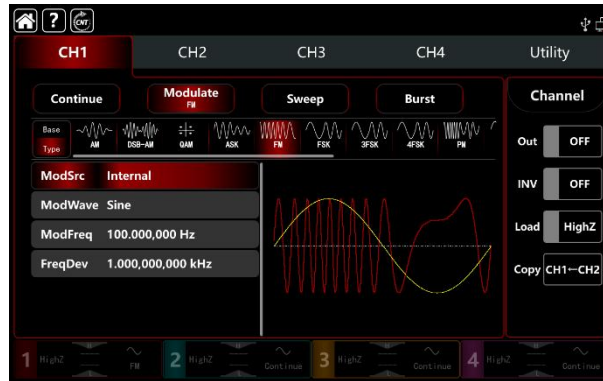
Frequency deviation indicates the frequency deviation changes between in the FM-modulated wave frequency and the carrier wave frequency. FM deviation range can set from 0 $\mu$ Hz to half of the maximum current carrier wave frequency. The default range is 1kHz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

- The frequency deviation must  $\leq$  the carrier wave frequency, if the frequency deviation is greater than fundamental frequency, the function/arbitrary waveform generator automatically limits the deviation to the maximum which allowed by the current fundamental frequency.
- The sum of the frequency deviation and the carrier wave frequency must  $\leq$  the maximum of the current fundamental frequency, if the frequency deviation value is valid, the function/arbitrary waveform generator automatically limits the deviation to the maximum which allowed by the current fundamental frequency.

## Comprehensive example

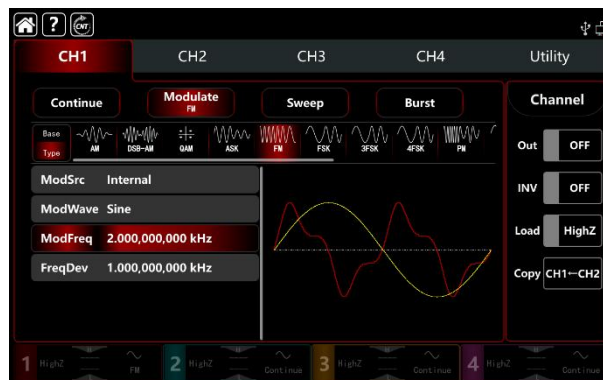
In FM modulation mode, set an internal 2kHz square wave as a modulating signal, another sine wave with frequency 10kHz, amplitude 100mVpp as a carrier wave signal, and set the frequency deviation to 5kHz, the settings steps as following,

- 1) Turn on FM modulation mode: tap **CH1** → **Modulate** → **FM** accordingly.



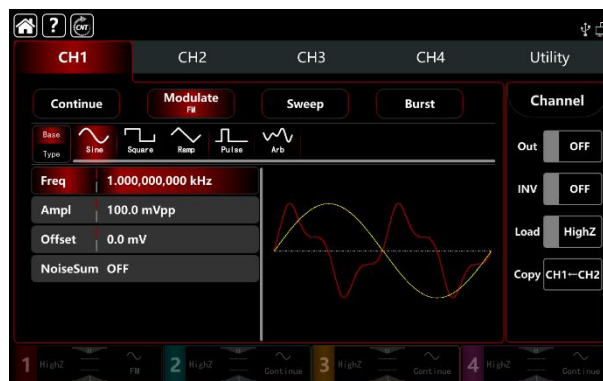
- 2) Set the parameter of modulating signal

Base on the step 1) to tap **ModFreq** tab to pop-out visual numeric keyboard to enter 2kHz.



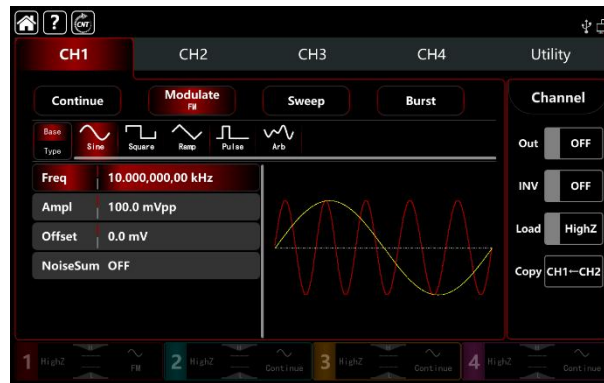
- 3) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



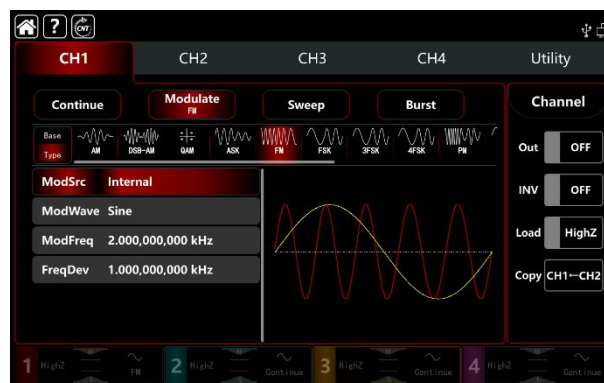
Tap **Freq** to pop-out visual keyboard to enter 10kHz.



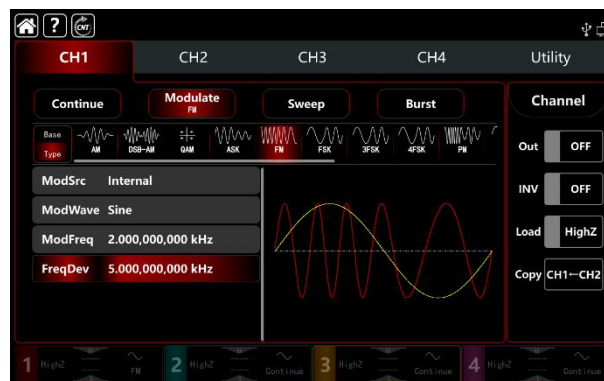


#### 4) Set the frequency deviation

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the frequency deviation.



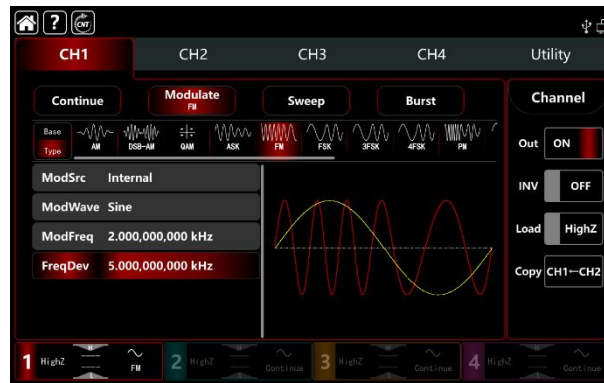
Tap **FreqDev** tab to pop-out visual numeric keyboard to enter 5kHz.



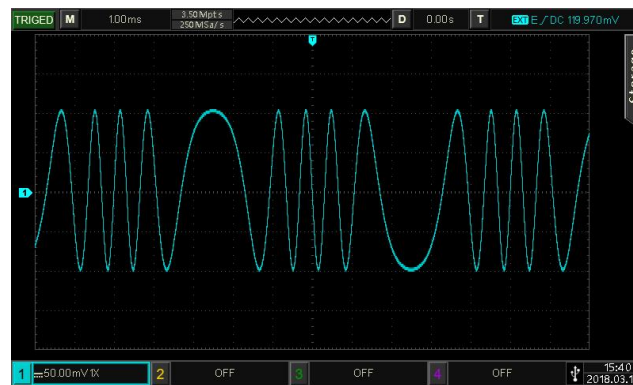
#### 5) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility** → **Channel** → **Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.





The shape of the FM modulation waveform viewed through an oscilloscope is shown in the figure below,

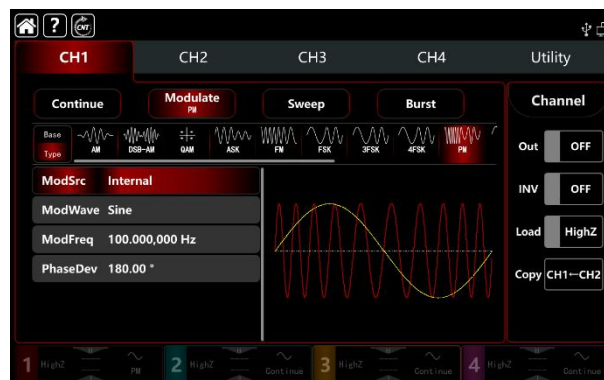


### 3.1.3 PM (Phase Modulation)

PM is consist of the carrier wave and the modulated wave, the phase of the carrier wave will changed by the phase of the modulated wave. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

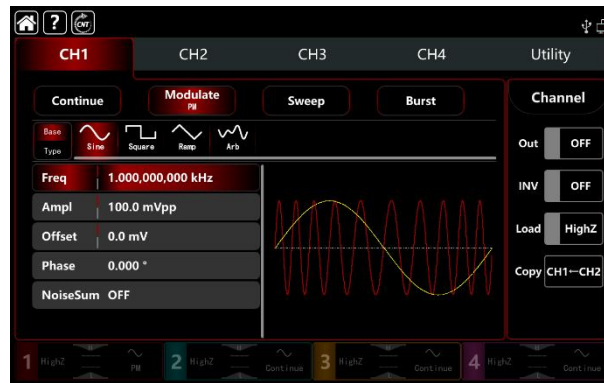
#### Select PM modulation

Tap **CH1** → **Modulate** → **PM** to turn on the AM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

The carrier wave of PM: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select PM modulation, tap **Base** to present the carrier waveform on the right side.

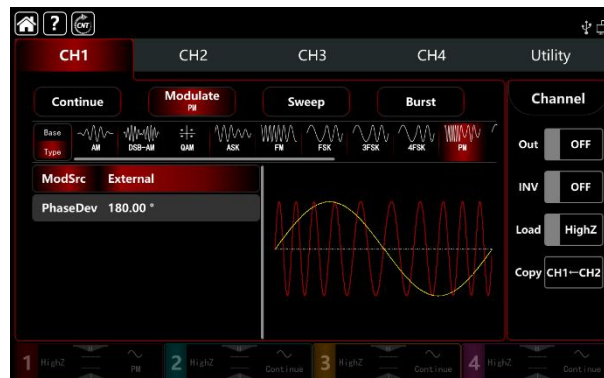


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on FM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in PM modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation waveform can be sine, square, rising ramp, falling ramp arbitrary and noise wave. The default wave is sine wave. When turn on FM modulation, **ModWave** present Sine, rotate multifunction knob or tap word **Sine** to select the waveform in modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 2kpts by the method of select point automatically
- Noise wave: white gaussian noise

### 2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. The PM offset is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel. For example, if set the phase deviation to  $180^\circ$ , that is equal to  $+5V$  of the external modulated signal, the lower external signal level produces less deviation.

### Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between  $1\mu\text{Hz}\sim 2\text{MHz}$ , the default range is  $100\text{Hz}$ . Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in PM modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The input external modulating signal frequency range is between  $0\text{Hz}\sim 50\text{kHz}$ .

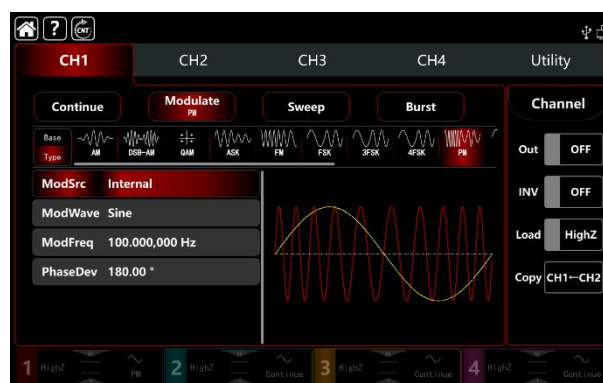
### Modulated phase deviation settings

Phase deviation indicates the phase deviation changes between in the PM-modulated waveform phase and the carrier wave phase. Phase deviation range can set  $0^\circ\sim 360^\circ$ , the default range is  $180^\circ$ . Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

### Comprehensive example

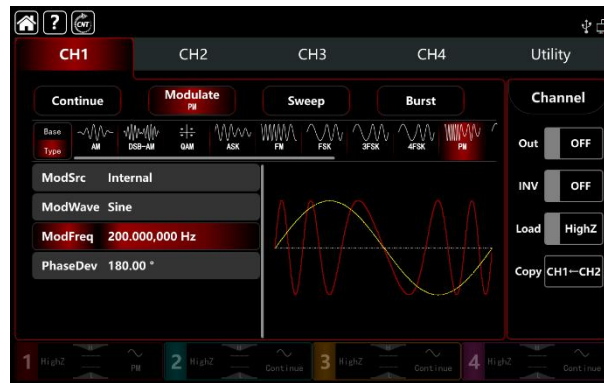
In PM modulation mode, set an internal  $200\text{Hz}$  sine wave as the modulating signal, another sine wave with frequency  $900\text{Hz}$ , amplitude  $100\text{mVpp}$  as the carrier wave signal, and set the phase deviation to  $200^\circ$ , the settings steps as following,

- 1) Turn on PM modulation mode: tap **CH1**  $\rightarrow$  **Modulate**  $\rightarrow$  **FM** accordingly.



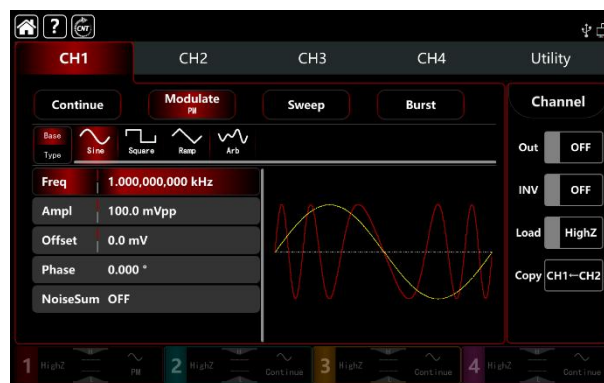
- 2) Set the parameter of modulating signal

Base on the step 1) to tap **ModFreq** tab to pop-out visual numeric keyboard to enter  $200\text{Hz}$ .

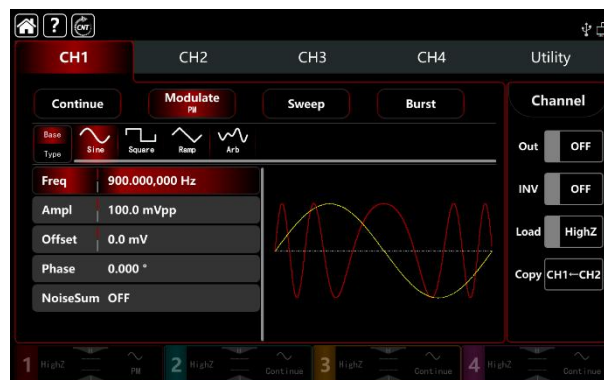


### 3) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.

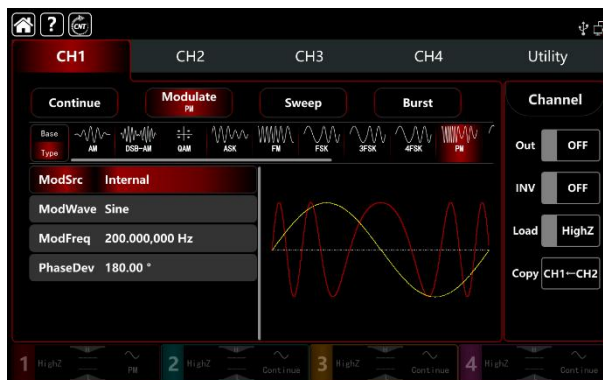


Tap **Freq** to pop-out visual keyboard to enter 900Hz.

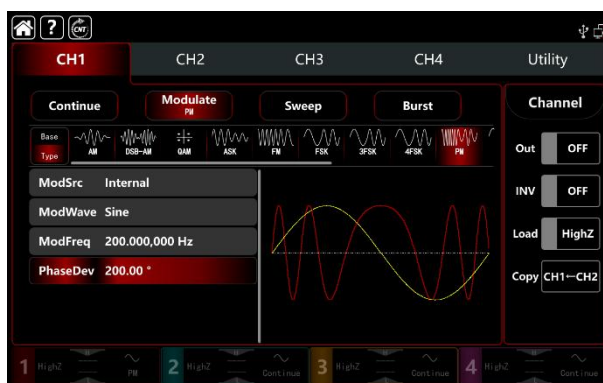


### 4) Set the phase deviation

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the phase deviation.

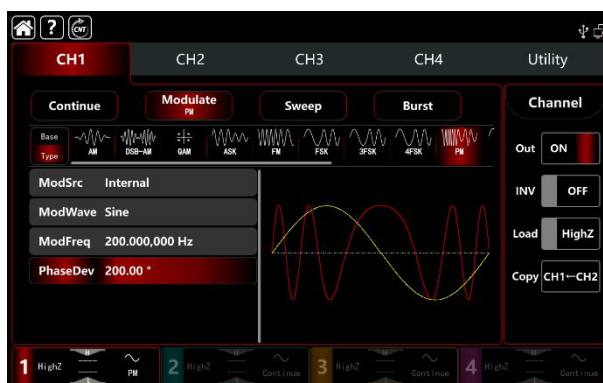


Tap **PhaseDev** tab to pop-out visual numeric keyboard to enter 200°.

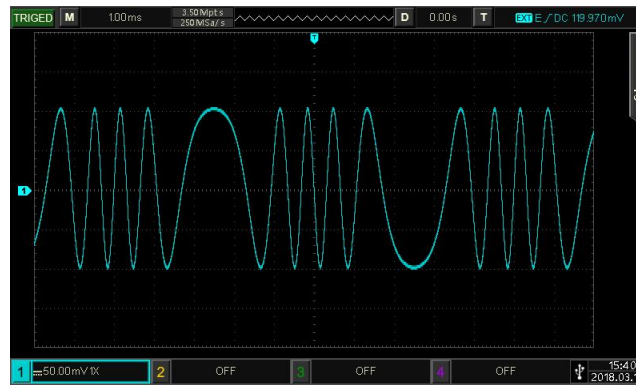


5) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the PM modulation waveform viewed through an oscilloscope is shown in the figure below,

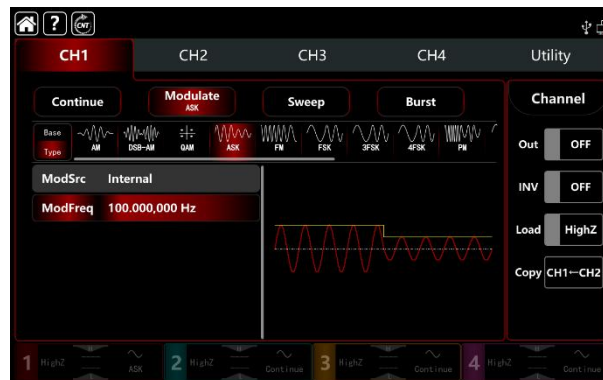


### 3.1.4 ASK (Amplitude Shift Keying)

ASK is a digital amplitude modulation, it expresses digital signals “0” and “1” by changing the amplitude of carrier signal. And according to the logical of modulation signal to output the carrier signals with different amplitude. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

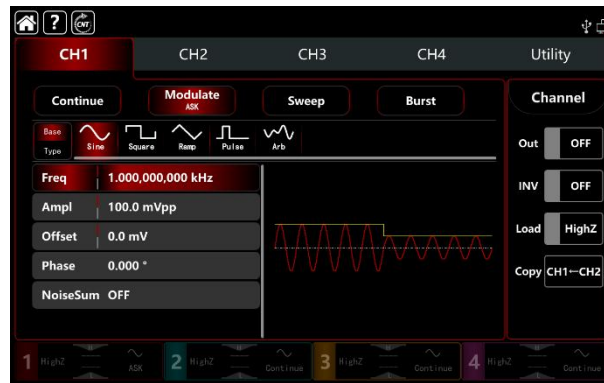
#### Select ASK modulation

Tap **CH1** → **Modulate** → **ASK** to turn on ASK modulation, the instrument output the modulated waveform according to the current setting of the modulation wave frequency and the carrier wave.



#### Select the carrier waveform

The carrier wave of AM: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select ASK modulation, tap **Base** to present the carrier waveform on the right side.

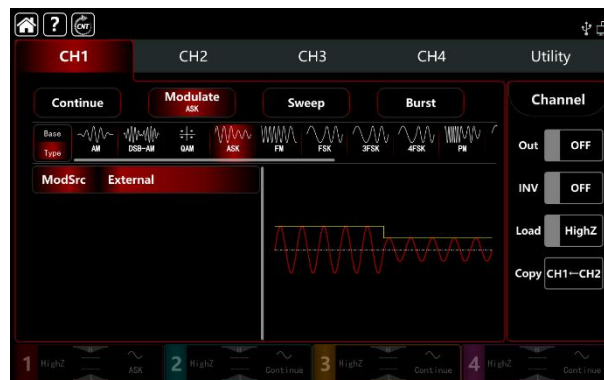


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on FM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in ASK modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation wave is a square sine with duty ratio 50% (built-in and can't adjustable). It can select rate of the modulated wave amplitude by the frequency settings.

### 2) External source

When the modulation source is external, rate will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The ASK amplitude output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel.- For example, output the current carrier amplitude when the external input is low; output amplitude is less than the current carrier amplitude when the external input is high.



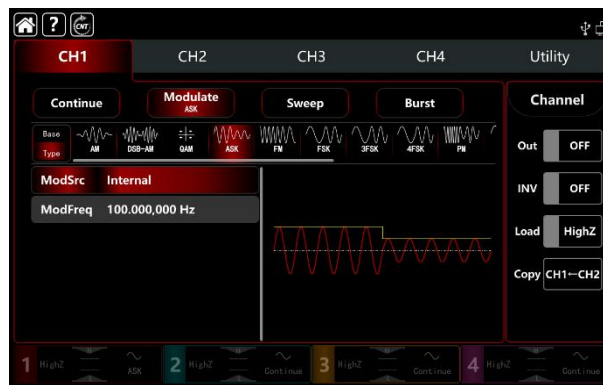
## Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in ASK modulation setting interface.

## Comprehensive example

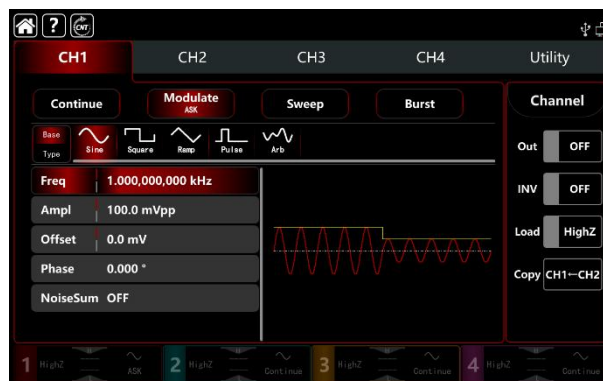
In ASK modulation mode, set an internal logical signal 300Hz as the modulating signal, another sine wave with frequency 15kHz, amplitude 2Vpp as the carrier signal, the settings steps as following, Note: It can only set the frequency of this signal, the frequency is the ASK rate. Logic signal is self-configurable by the instrument.

- 1) Turn on ASK modulation mode: tap **CH1**→**Modulate**→**ASK** accordingly.



- 2) Set the parameter of the carrier wave signal

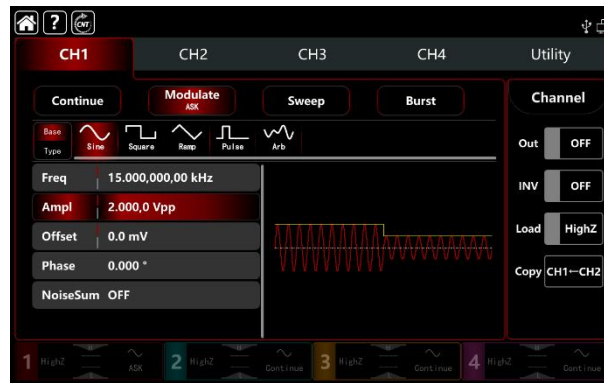
Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



Tap **Freq** to pop-out visual keyboard to enter 15kHz.

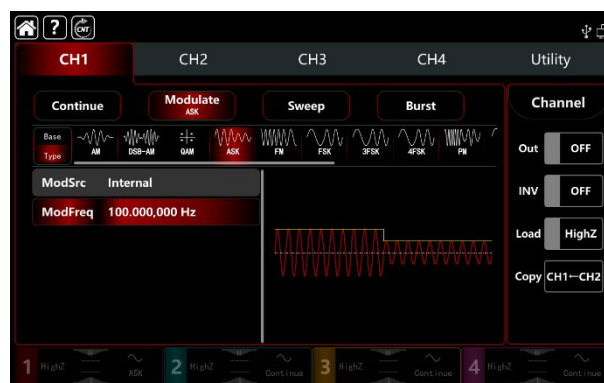
Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.



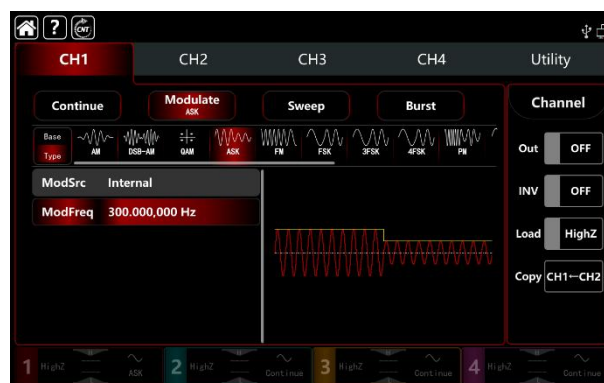


### 3) Set the parameter of the modulating signal

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the frequency.

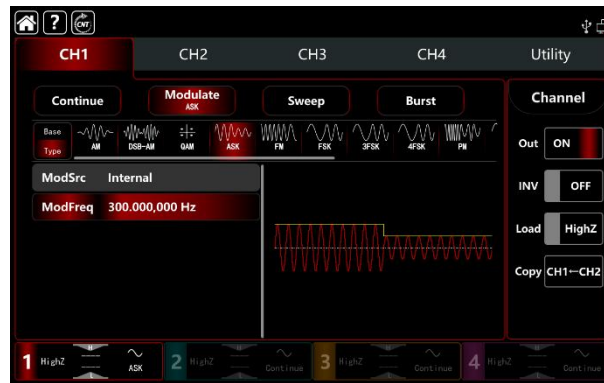


Tap **ModSrc** tab to pop-out visual numeric keyboard to enter 300Hz.

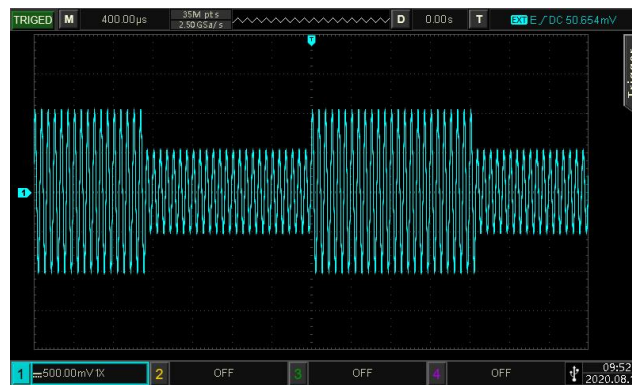


### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the ASK modulation waveform viewed through an oscilloscope is shown in the figure below,

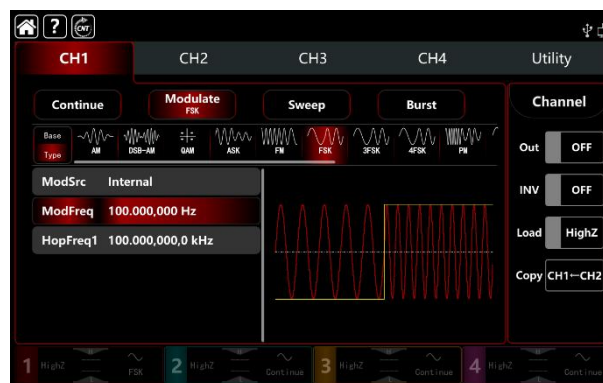


### 3.1.5 FSK (Frequency Shift Keying)

In FSK modulation mode, the function/arbitrary waveform generator can move between in two preset frequencies (carrier frequency and hopping frequency) According to the logical level of the modulating signal to output the carrier frequency or hopping frequency. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

#### Select FSK modulation

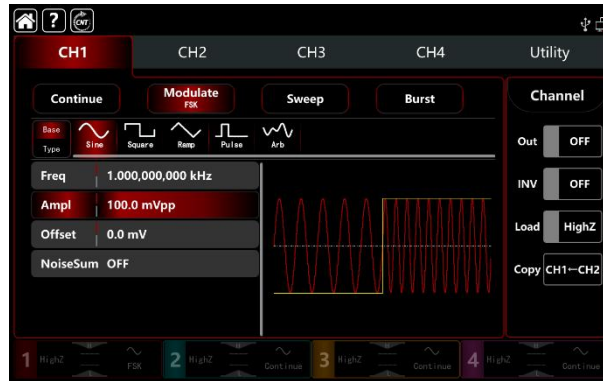
Tap **CH1**→**Modulate**→**FSK** to turn on FSK modulation, the instrument output the modulation waveform according to the current setting.



#### Select the carrier waveform

The carrier wave of FSK: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select FSK modulation, tap **Base** to present the carrier waveform on the right

side.

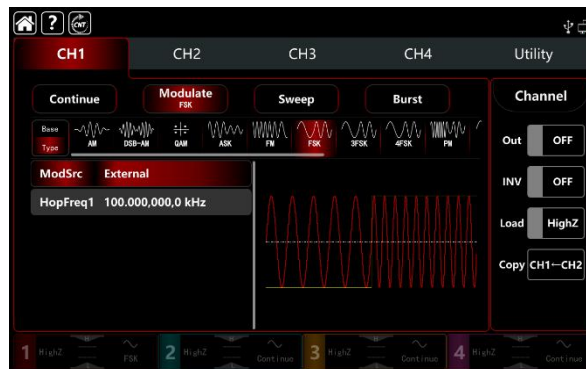


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on FSK modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in FSK modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation wave is a square sine with duty ratio 50% (built-in and can't adjustable). It can select shift frequency between the carrier wave frequency and hopping frequency by the frequency settings.

### 2) External source

When the modulation source is external, rate will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The FSK frequency output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel. For example, output the current carrier frequency when the external input is low; output hopping frequency when the external input is high.

## Hopping frequency settings

The default hopping frequency is 10kHz. Rotate multifunction knob, push direction key or tap **HopFreq1** tab to pop-out visual numeric keyboard to enter values and select unit in FSK modulation setting interface. The range of hopping frequency depends on carrier waveform. Refer to [table 4-1/4-2](#) of AM modulation.

## Modulation waveform frequency settings

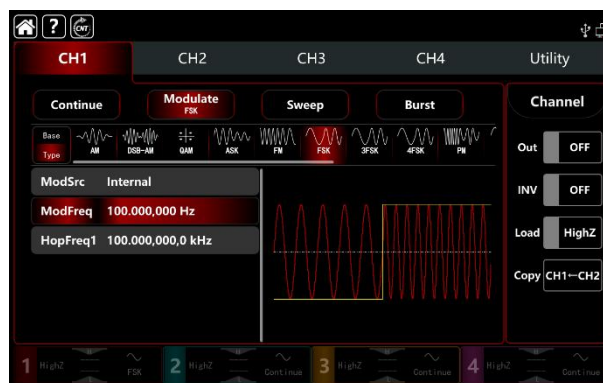
When the modulation source is internal, it can select shift frequency between the carrier wave frequency and hopping frequency. Turn on FSK modulation mode to set the frequency, the range is between 1μHz~2MHz, default 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Comprehensive example

In FSK modulation mode, set an internal 2kHz,1Vpp sine wave as a carrier wave, set the hopping frequency to 800Hz, make the carrier wave and hopping frequency shift between within 200Hz frequency. The settings steps as following,

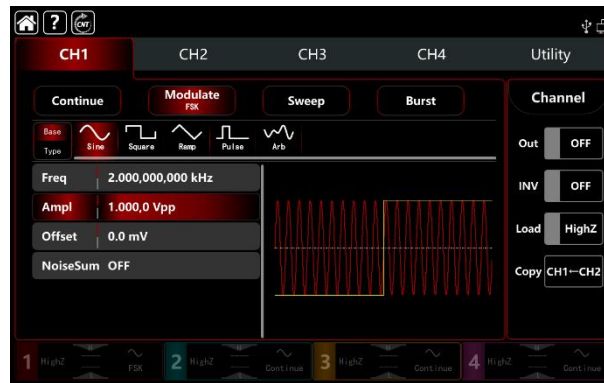
- 1) Turn on FSK modulation mode: tap **CH1**→**Modulate**→**FSK** accordingly.
- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



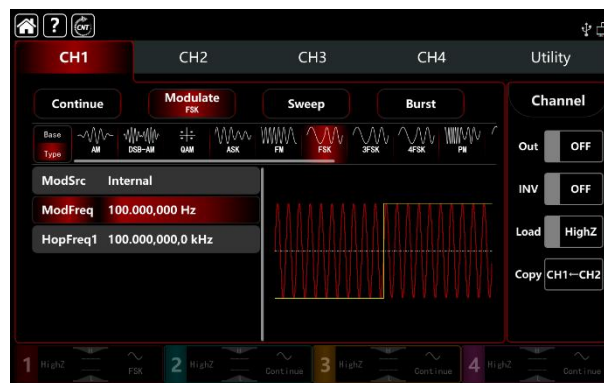
Tap **Freq** to pop-out visual keyboard to enter 2kHz.

Tap **Ampl** to pop-out visual keyboard to enter 1Vpp.



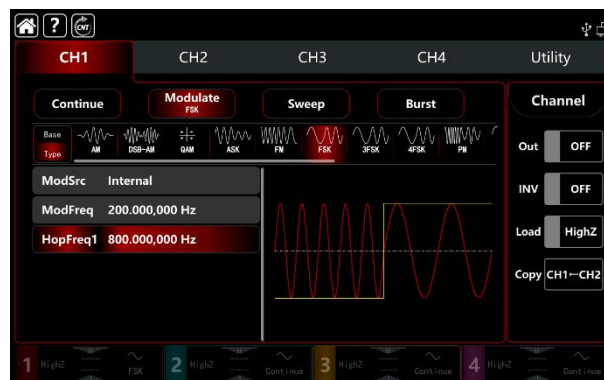
### 3) Set the hopping frequency and the modulating frequency

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the modulating frequency.



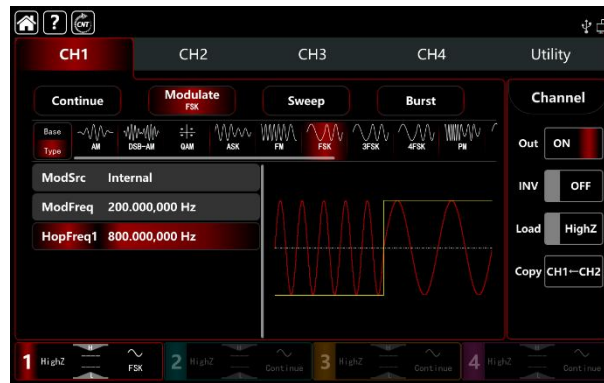
Tap **ModFreq** to pop-out visual keyboard to enter 200Hz.

Tap **HopFreq1** to pop-out visual keyboard to enter 800Hz.

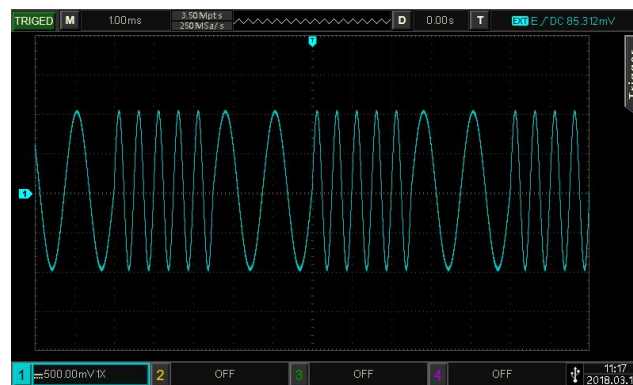


### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the FSK modulation waveform viewed through an oscilloscope is shown in the figure below,

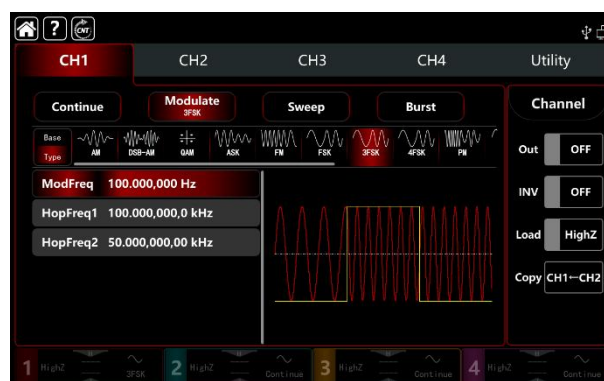


### 3.1.6 3FSK Modulation (Three Frequency Shift Keying)

In three frequency shift keying modulation mode, the function/arbitrary waveform generator can move between among three preset frequencies (carrier frequency and two hopping frequency) According to the logical level of the modulating signal to output the carrier frequency or hopping frequency. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

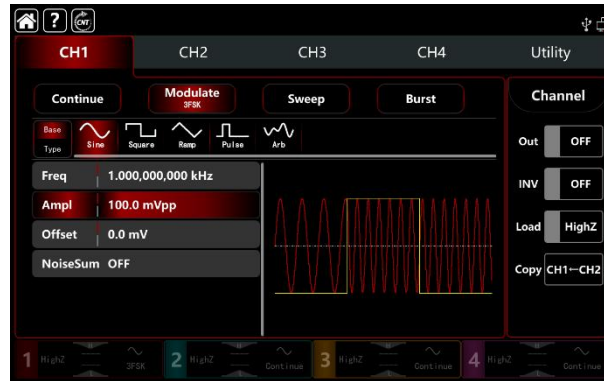
#### Select 3FSK modulation

Tap **CH1** → **Modulate** → **3FSK** to turn on 3FSK modulation, the instrument output the modulation waveform according to the current setting.



## Select the carrier waveform

The carrier wave of 3FSK: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select 3FSK modulation, tap **Base** to present the carrier waveform on the right side.



## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Hopping frequency settings

Rotate multifunction knob, push direction key or tap **HopFreq1** and **HopFreq2** tab to pop-out visual numeric keyboard to enter values and select unit in 3FSK modulation setting interface. The range of hopping frequency depends on carrier waveform. Refer to [table 4-1/4-2](#) of AM modulation.

## Modulation waveform frequency settings

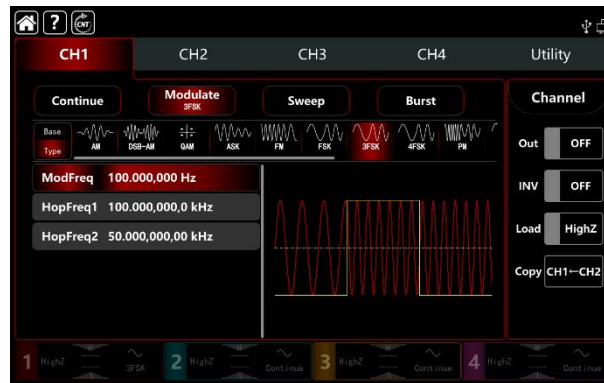
When the modulation source is internal, it can select shift frequency between the carrier wave frequency and hopping frequency. Turn on 3FSK modulation mode to set the frequency, the range is between 1μHz~2MHz, default 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Comprehensive example

In FSK modulation mode, set an internal 2kHz,1Vpp sine wave as a carrier wave, set **HopFreq1** to 1kHz, set **HopFreq2** to 5kHz, make the carrier wave and hopping frequency shift between within 100Hz frequency. The settings steps as following,

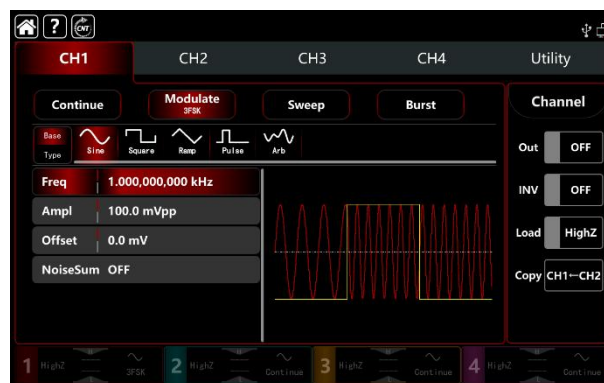
- 1) Turn on FSK modulation mode: tap **CH1** → **Modulate** → **3FSK** accordingly.





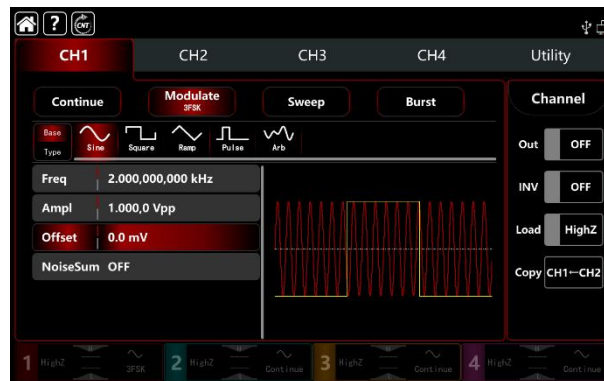
2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



Tap **Freq** to pop-out visual keyboard to enter 2kHz.

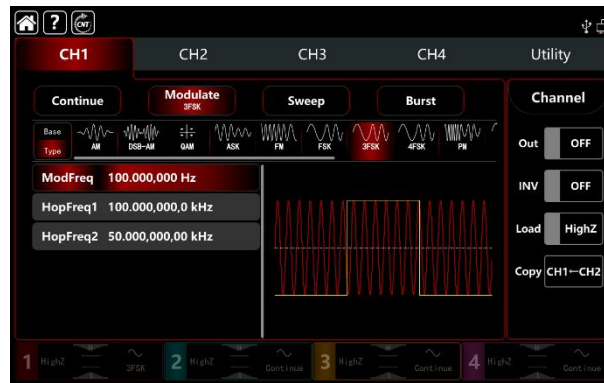
Tap **Ampl** to pop-out visual keyboard to enter 1Vpp.



3) Set the hopping frequency and the modulating frequency

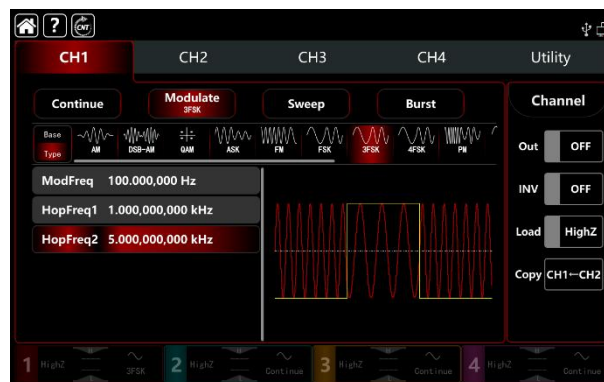
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the modulating frequency.





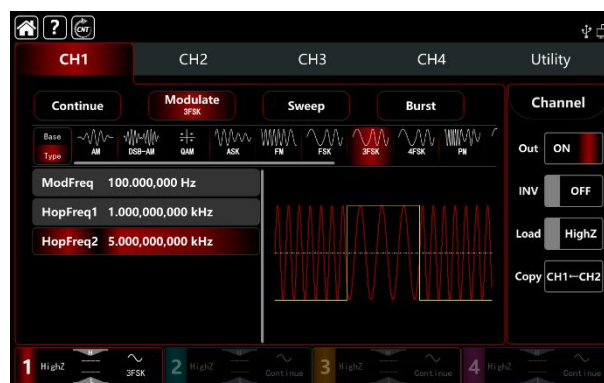
Tap **HopFreq1** to pop-out visual keyboard to enter 1kHz.

Tap **HopFreq2** to pop-out visual keyboard to enter 5kHz.



#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the 3FSK modulation waveform viewed through an oscilloscope is shown in the figure below,

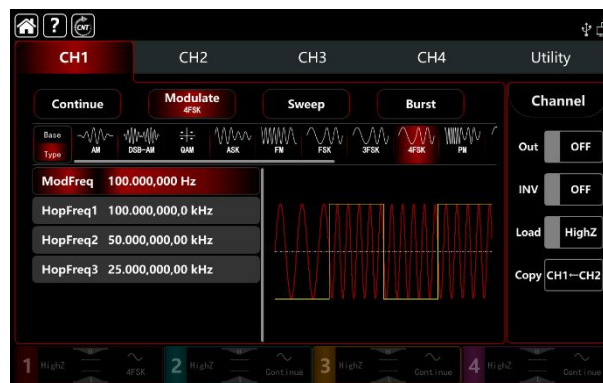


### 3.1.7 4FSK Modulation (Four Frequency Shift Keying)

In three frequency shift keying modulation mode, the function/arbitrary waveform generator can move between among three preset frequencies (carrier frequency and three hopping frequency) According to the logical level of the modulating signal to output the carrier frequency or hopping frequency. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

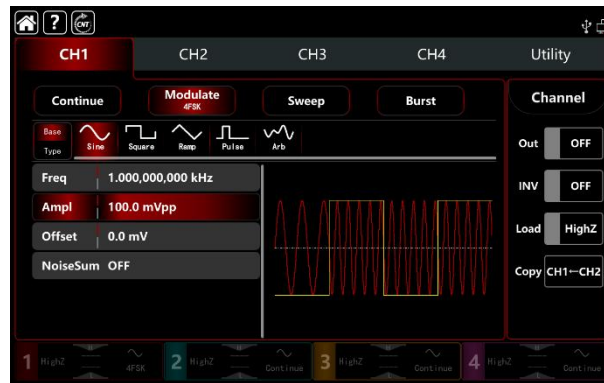
#### Select 4FSK modulation

Tap **CH1** → **Modulat** → **4FSK** to turn on 4FSK modulation, the instrument output the modulation waveform according to the current setting.



#### Select the carrier waveform

The carrier wave of 4FSK: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select FSK modulation, tap **Base** to present the carrier waveform on the right side.



## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Hopping frequency settings

Rotate multifunction knob, push direction key or tap **HopFreq1**, **HopFreq2** and **HopFreq3** tab to pop-out visual numeric keyboard to enter values and select unit in 4FSK modulation setting interface. The range of hopping frequency depends on carrier waveform. Refer to [table 4-1/4-2](#) of AM modulation.

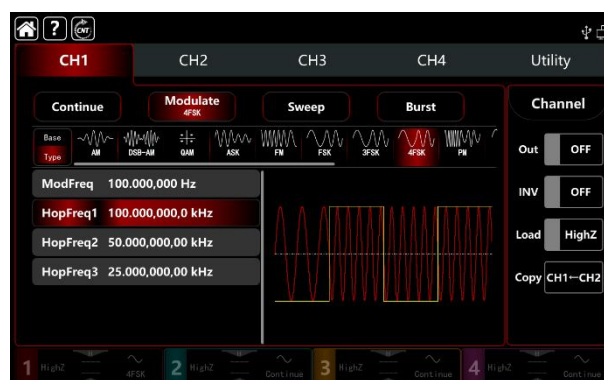
## Modulation waveform frequency settings

When the modulation source is internal, it can select shift frequency between the carrier wave frequency and hopping frequency. Turn on 4FSK modulation mode to set the frequency, the range is between 1μHz~2MHz, default 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Comprehensive example

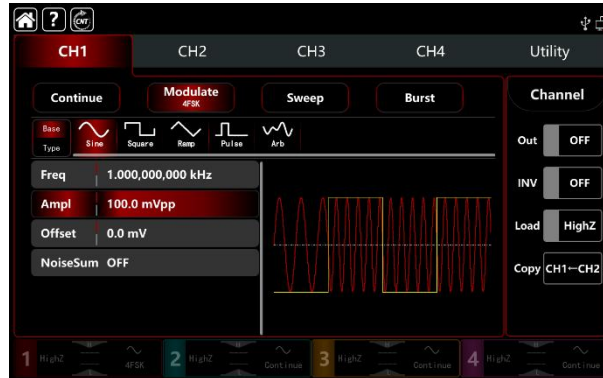
In 4FSK modulation mode, set an internal 500Hz,1Vpp sine wave as a carrier wave, set **HopFreq1** to 2kHz, set **HopFreq2** to 5kHz, set **HopFreq3** to 10kHz, make the carrier wave and hopping frequency shift between within 100Hz frequency. The settings steps as following,

- 1) Turn on FSK modulation mode: tap **CH1**→**Modulate**→**4FSK** accordingly.



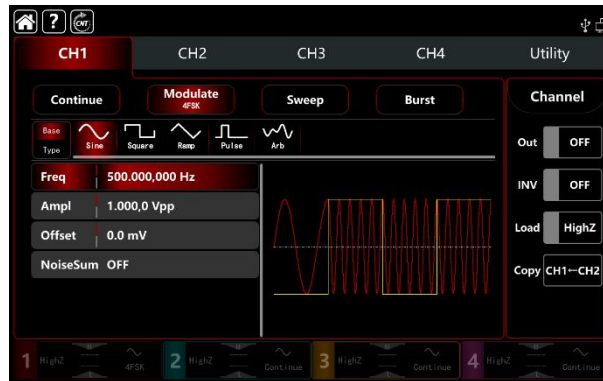
## 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



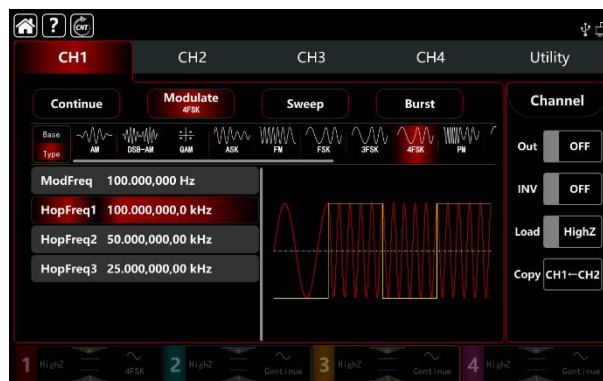
Tap **Freq** to pop-out visual keyboard to enter 500Hz.

Tap **Ampl** to pop-out visual keyboard to enter 1Vpp.



## 3) Set the hopping frequency and the modulating frequency

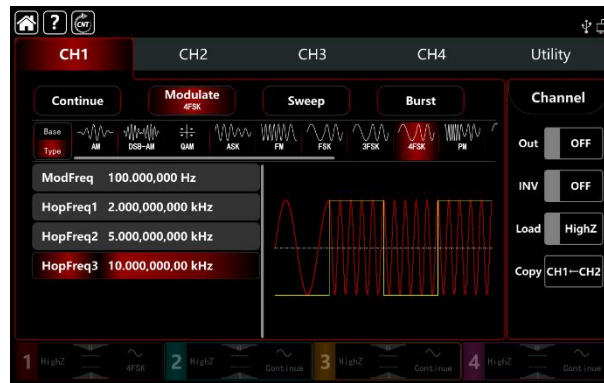
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the modulating frequency.



Tap **HopFreq1** to pop-out visual keyboard to enter 2kHz.

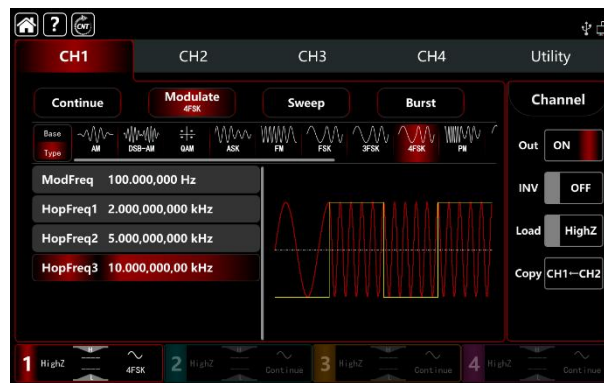
Tap **HopFreq2** to pop-out visual keyboard to enter 5kHz.

Tap **HopFreq3** to pop-out visual keyboard to enter 10kHz.

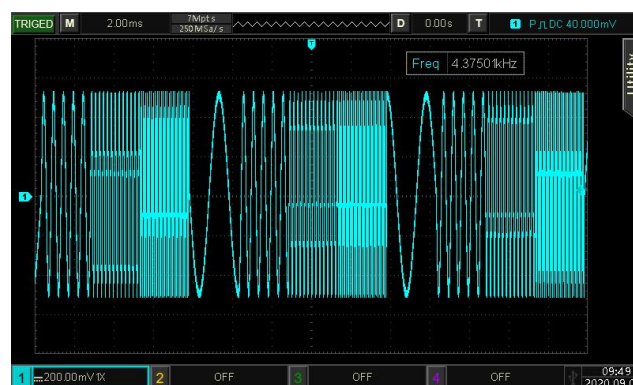


#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the 4FSK modulation waveform viewed through an oscilloscope is shown in the figure below,

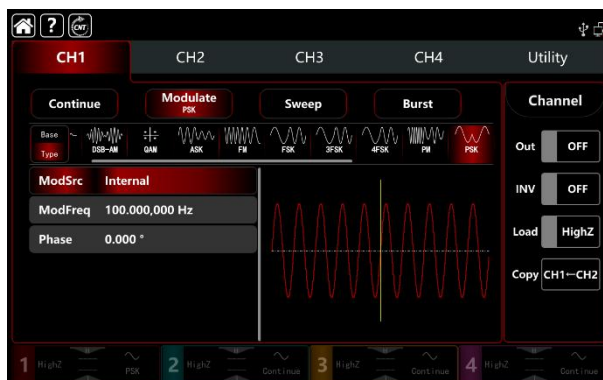


### 3.1.8 PSK (Phase Shift Keying)

In PSK modulation mode, the function/arbitrary waveform generator can move between in two preset phases (carrier phase and hopping phase) According to the logical level of the modulating signal to output the carrier frequency or hopping frequency. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

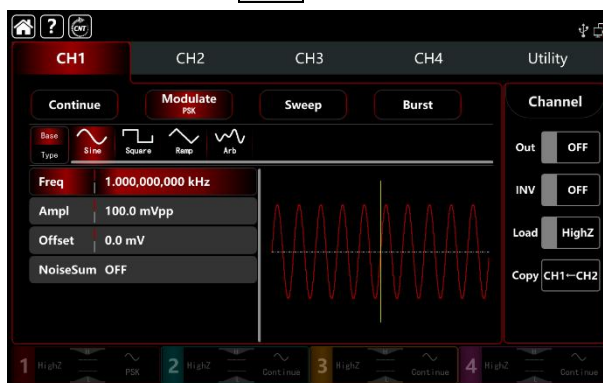
## Select PSK modulation

Tap **CH1** → **Modulate** → **PSK** to turn on PSK modulation, the instrument output the modulated waveform according to the current phase setting (default 0° and can't adjustable) of the modulation wave and the carrier wave.



## Select the carrier waveform

The carrier wave of PSK: sine, square, ramp and arbitrary wave (except DC), the default option is sine wave. After select PSK modulation, tap **Base** to present the carrier waveform on the right side.



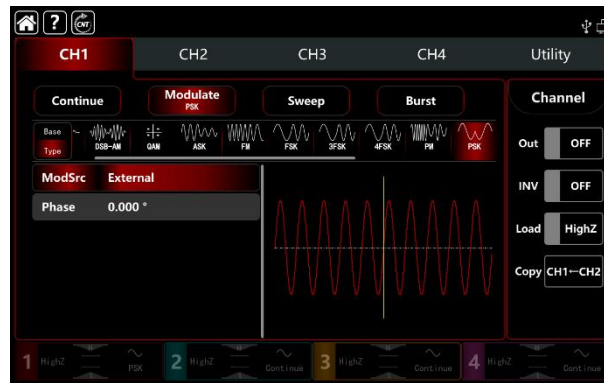
## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on PSK modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in PSK modulation setting interface.





### 1) Internal source

When the modulation source is internal, the modulation wave is a square sine with duty ratio 50% (built-in and can't adjustable). It can select shift frequency between the carrier wave frequency and hopping frequency by the frequency settings.

### 2) External source

When the modulation source is external, rate will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The PSK frequency output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel. For example, output the current carrier phase when the external input is low; output hopping phase when the external input is high.

## Modulation waveform frequency settings

When the modulation source is internal, it can select shift frequency between the carrier wave frequency and hopping frequency. Turn on PSK modulation mode to set the frequency, the range is between 1μHz~2MHz, default 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

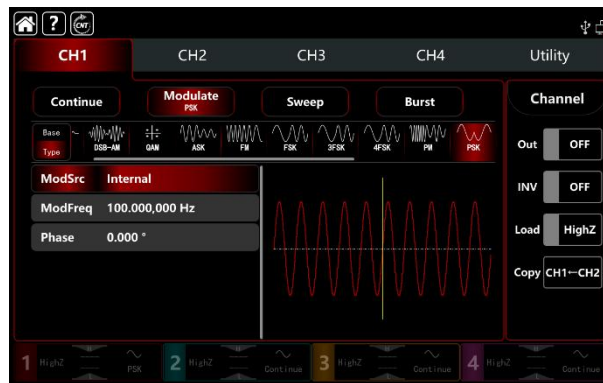
## Modulating phase settings

PSK modulation mode presents the changes between the modulated wave phase and the carrier wave phase. The phase range can set to 0°~360°, the default phase is 180°. Rotate multifunction knob, push direction key or tap **Phase** tab to pop-out visual numeric keyboard to enter values and select unit in PSK modulation setting interface.

## Comprehensive example

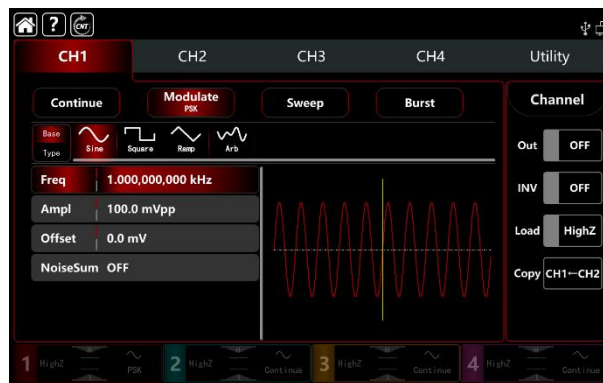
In PSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the frequency 1kHz to shift between the modulating phase 180° and the carrier wave, the settings steps as following,

- 1) Turn on PSK modulation mode: tap **CH1** → **Modulate** → **PSK** accordingly.



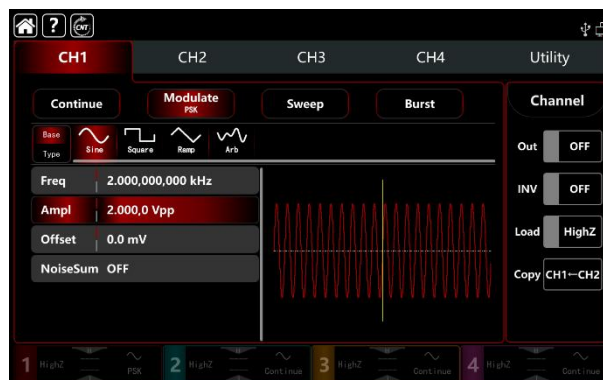
- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



Tap **Freq** to pop-out visual keyboard to enter 2kHz.

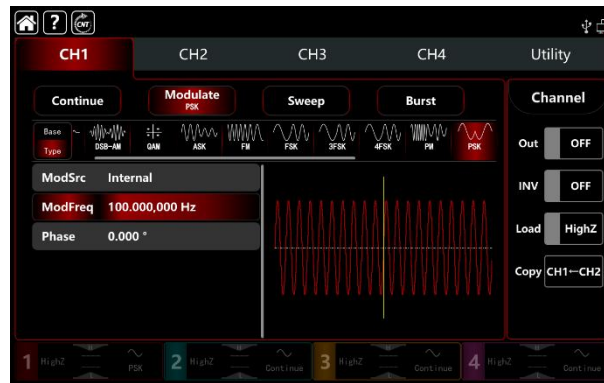
Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.



- 3) Set the modulating frequency and phase

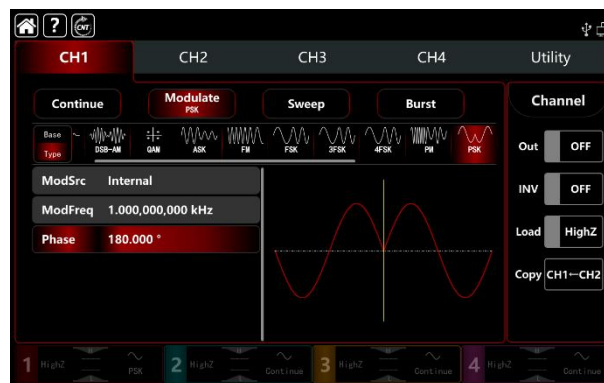
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the modulating frequency and phase.





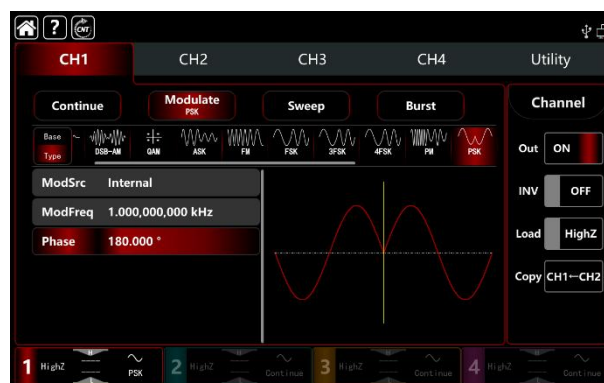
Tap **ModFreq** to pop-out visual keyboard to enter 1kHz.

Tap **Phase** to pop-out visual keyboard to enter 180°.

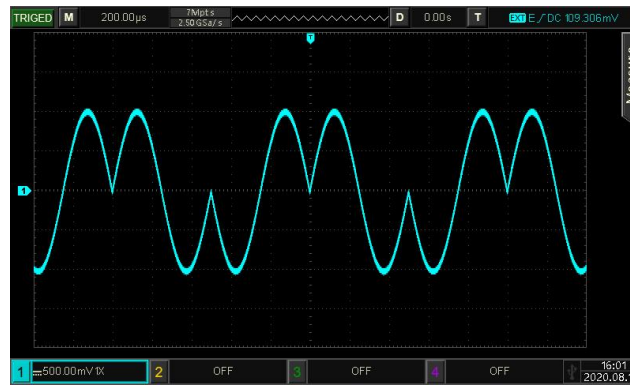


#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the PSK modulation waveform viewed through an oscilloscope is shown in the figure below,

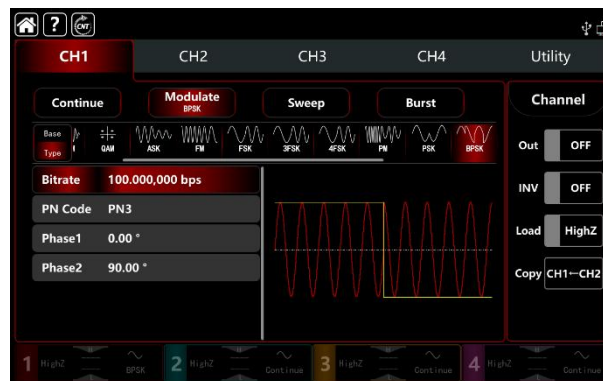


### 3.1.9 BPSK (Double Phase Shift Keying)

In BPSK modulation mode, the function/arbitrary waveform generator can move preset phase between in the carrier phase and the modulating phase, to represent the information of 0 and 1. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

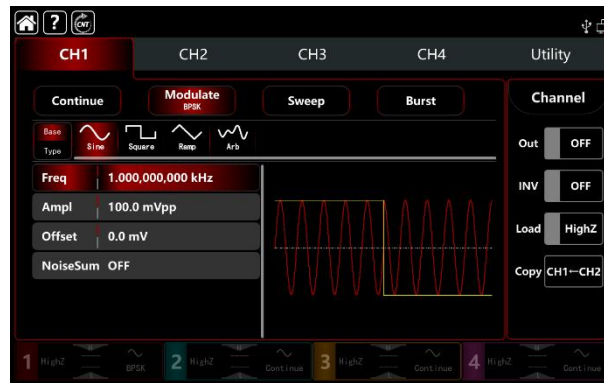
#### Select BPSK modulation

Tap **CH1** → **Modulate** → **BPSK** to turn on BPSK modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

The carrier wave of BPSK: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select BPSK modulation, tap **Base** to present the carrier waveform on the right side.

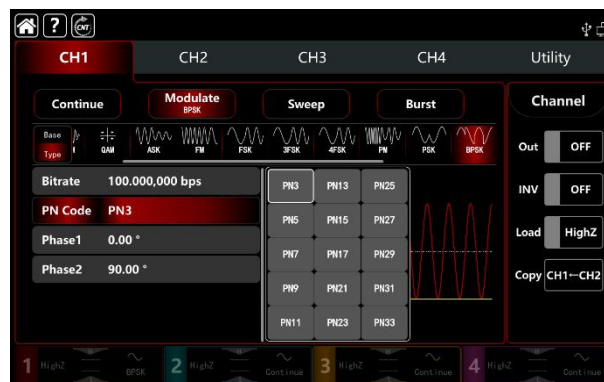


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## The PN code settings

UTG9000T function/arbitrary waveform generator can select the internal source. Turn on BPSK modulation mode, the default PN code is PN3. Rotate multifunction knob or tap **PN Code** → **PN3** to select different PN code.



## BPSK rate settings

In BPSK modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The BPSK bitrate range can set to 1μbps~2Mbps, the default range is 100bps. Rotate multifunction knob, push direction key or tap **Bitrate** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

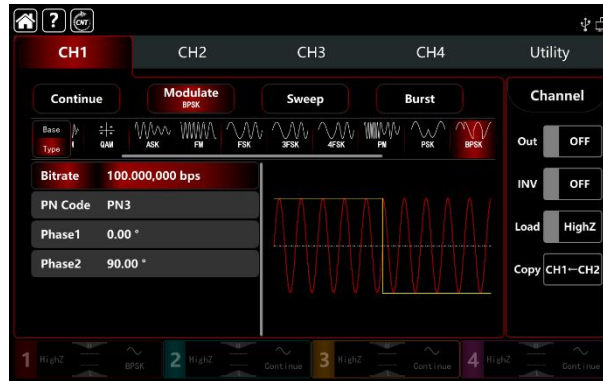
## Phase settings

- 1) Phase1 is the carrier wave phase, the default value is 0°. Rotate multifunction knob, push direction key or tap **Phase1** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.
- 2) Phase1 is the modulating phase, it means the phase changes between the BPSK-modulated wave and the carrier wave phase. The BPSK modulating phase range can set to 0°~360°, the settings steps is the same as Phase1.

## Comprehensive example

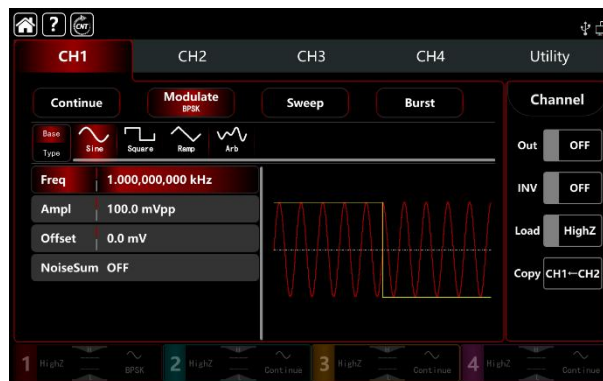
In BPSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the initial phase to 90°, 1kbps shift frequency between in the carrier wave phase and the modulating wave phase, set PN Code to PN15. The settings steps as following,

- 1) Turn on BPSK modulation mode: tap **CH1** → **Modulate** → **BPSK** accordingly.



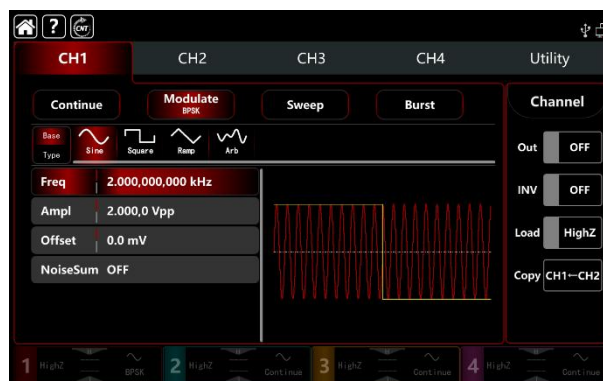
- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



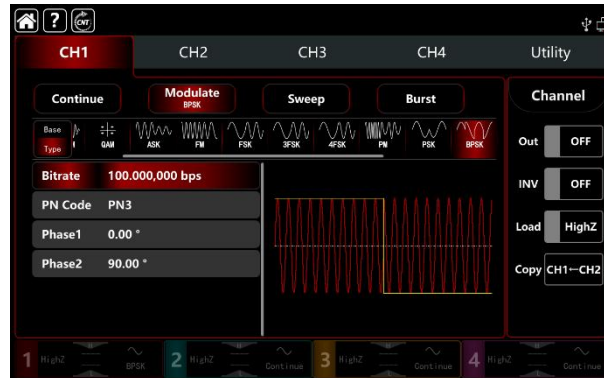
Tap **Freq** to pop-out visual keyboard to enter 2kHz.

Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.



### 3) Set the BPSK bitrate and phase

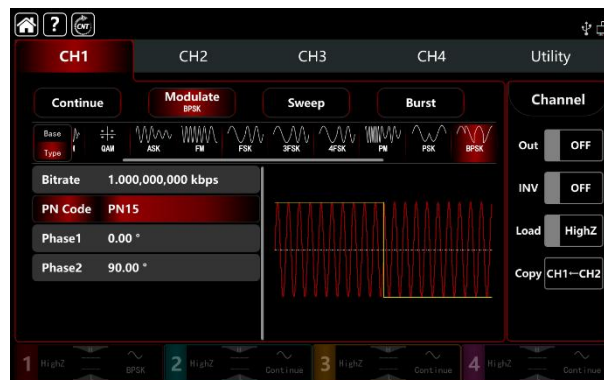
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the BPSK rate and phase.



Tap **Bitrate** to pop-out visual numeric keyboard to enter 1kbps.

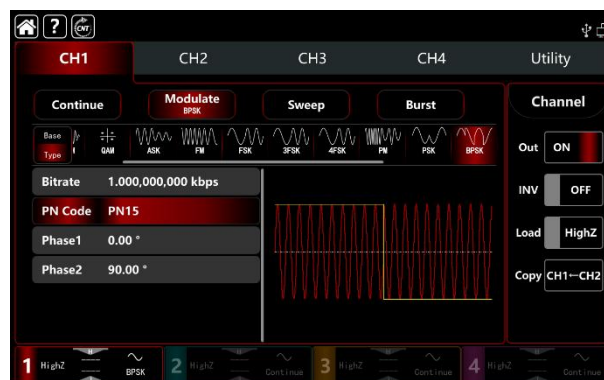
Phase use the default value, phase1: 0°, phase2 : 90°.

Tap **PN Code** PN3 to select PN15.



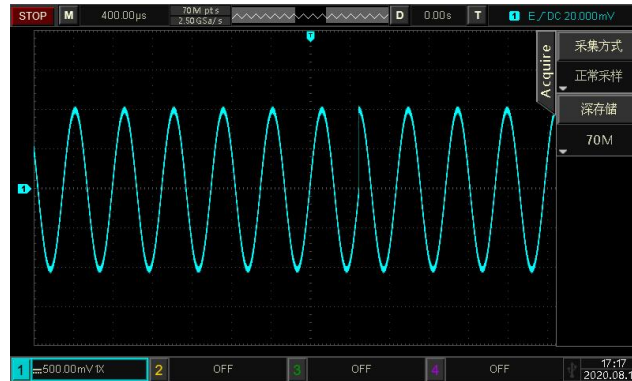
### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the BPSK modulation waveform viewed through an oscilloscope is shown in the

figure below,

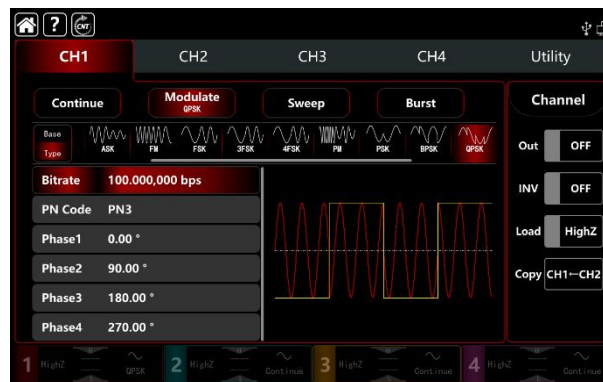


### 3.1.10 QPSK (Quad-Phase Shift Keying)

In QPSK modulation mode, the function/arbitrary waveform generator can move between in four preset phase (carrier phase and three modulating phase) According to the logical level of the modulating signal to output the carrier phase or modulating phase. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

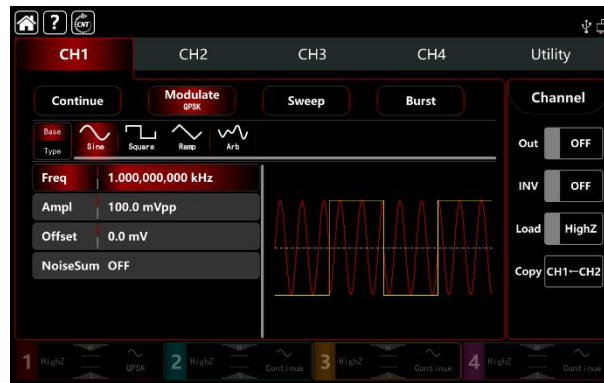
#### Select QPSK modulation

Tap **CH1** → **Modulate** → **QPSK** to turn on FSK modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

The carrier wave of QPSK: sine, square, ramp and arbitrary wave (except DC), the default option is sine wave. After select QPSK modulation, tap **Base** to present the carrier waveform on the right side.

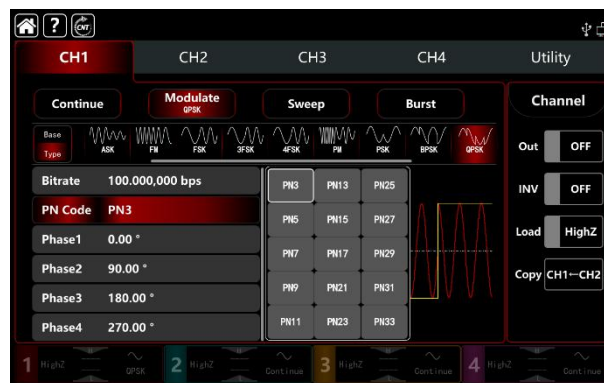


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## The PN code settings

UTG9000T function/arbitrary waveform generator can select the internal source. Turn on QPSK modulation mode, the default PN code is PN3. Rotate multifunction knob or tap **PN Code** → **PN3** to select different PN code.



## QPSK bitrate settings

In QPSK modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The QPSK bitrate range can set to 1μbps~2Mbps, the default range is 100bps. Rotate multifunction knob, push direction key or tap **Bitrate** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Phase settings

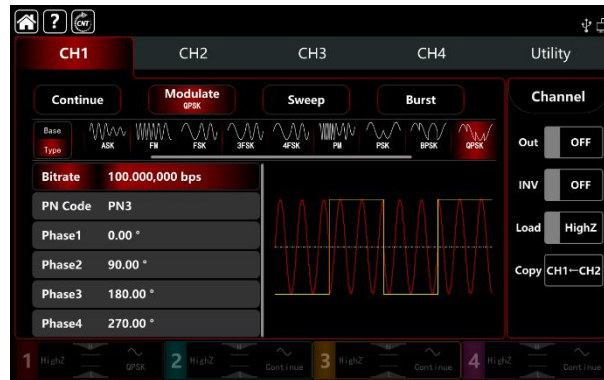
- 1) Phase1 is the carrier wave phase, the default value is 0°.
- 2) Phase2, 3, 4 is the modulating phase, it means the phase changes between the QPSK-modulated wave and the carrier wave phase. The QPSK modulating phase range can set to 0°~360°. Rotate multifunction knob, push direction key or tap **Phase1**, **Phase2**, **Phase3** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.



## Comprehensive example

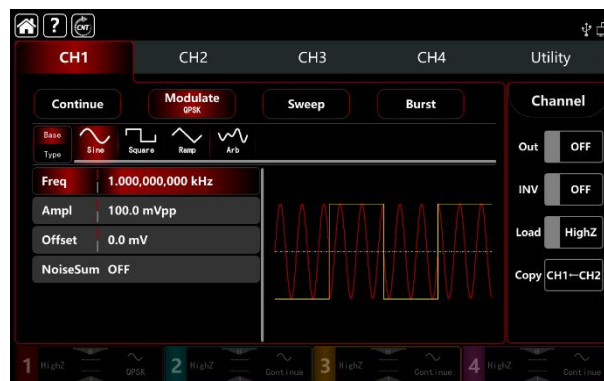
In QPSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the phase of the three fundamental waves and the initial modulation phases be  $90^\circ$ ,  $180^\circ$  and  $270^\circ$  respectively, hopping frequency 1kbps among the phases, select PN code as PN 15, the setting steps as following,

- 1) Turn on QPSK modulation mode: tap **CH1** → **Modulate** → **QPSK** accordingly.



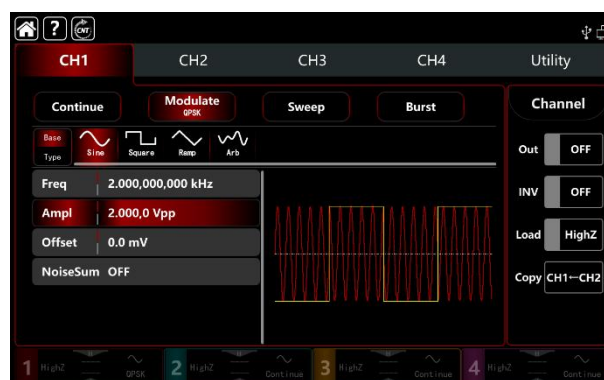
- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



Tap **Freq** to pop-out visual keyboard to enter 2kHz.

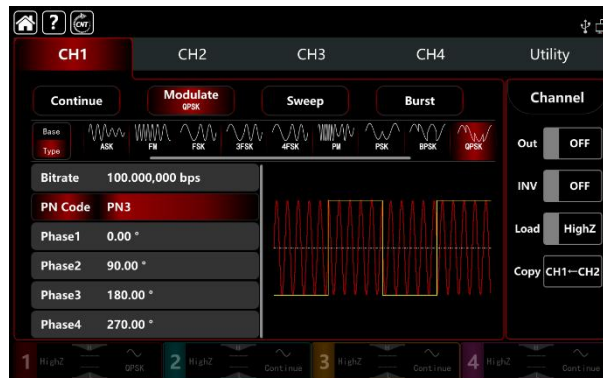
Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.





### 3) Set QPSK bitrate and the modulating phase

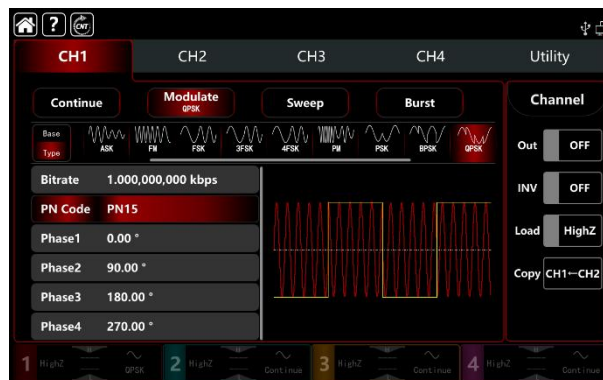
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the QPSK bitrate and phase.



Tap **Bitrate** to pop-out visual numeric keyboard to enter 1kbps.

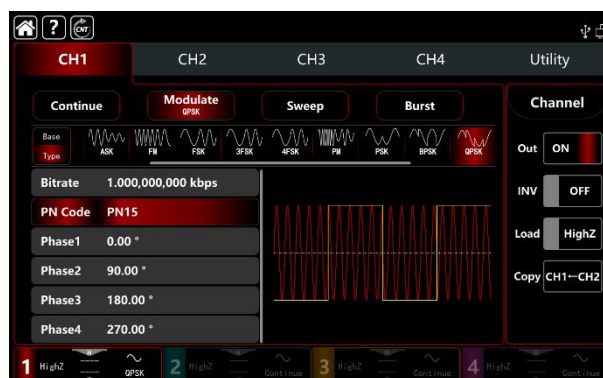
Phase use the default value, phase1: 0°, phase2 : 90°, phase3:180°, phase4:270°.

Tap **PN Code** PN3 to select PN15.

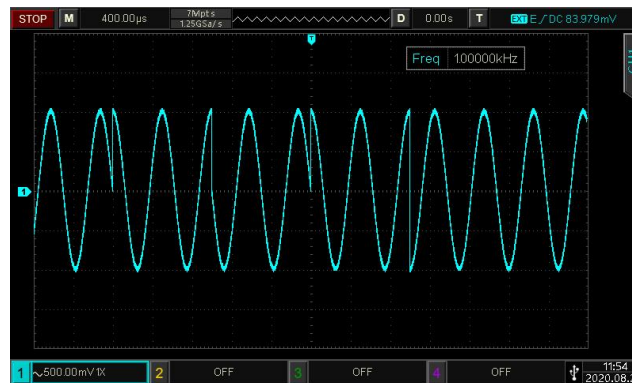


### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the BPSK modulation waveform viewed through an oscilloscope is shown in the figure below,

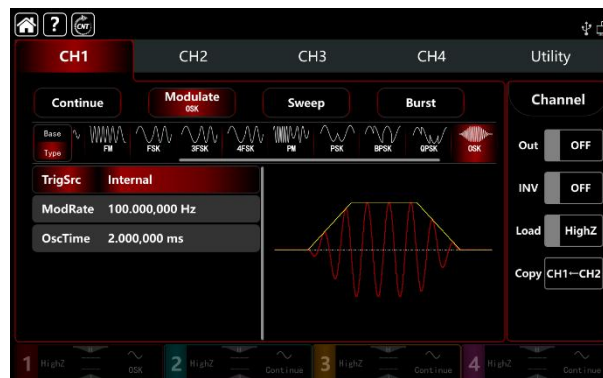


### 3.1.11 OSK (Oscillation Keying)

The function/arbitrary waveform generator can output a sinusoidal signal of intermittent oscillation in OSK. The carrier waveform is output when internal crystal oscillator starts oscillation; output is stopped when internal crystal oscillator stops oscillation. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

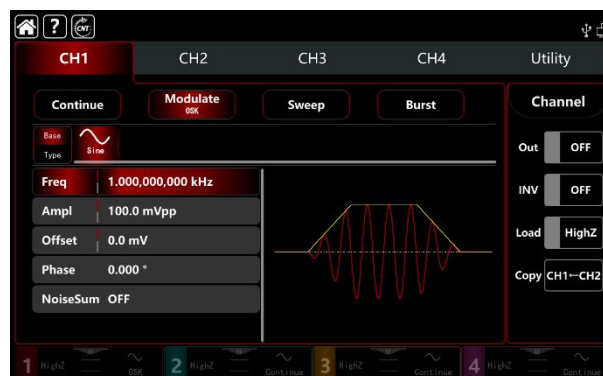
#### Select OSK modulation

Tap **CH1**→**Modulate**→**QSK** to turn on OSK modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

OSK carrier waveform is sine wave.

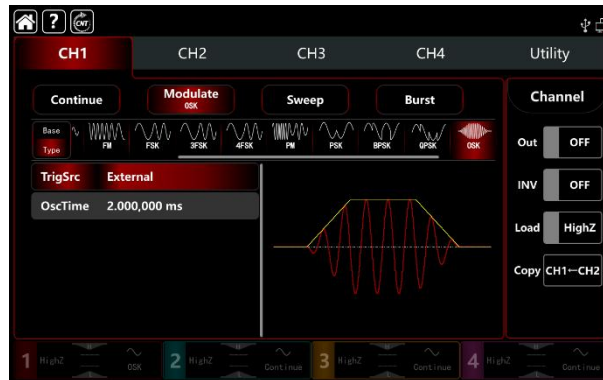


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the trigger source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external of the modulation trigger source. When turn on OSK modulation, the default modulation source is internal. Rotate multifunction knob or tap **TrigSrc** tab to step through internal or external modulation source in OSK modulation setting interface.



### 1) Internal trigger source

When the modulation source is internal, the modulation wave is sine wave. Use OSK rate to control the phase relationship of oscillation starting and stopped.

### 2) External trigger source

When the modulation source is external, rate will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The OSK phase output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel. For example, output the current oscillation wave when the external input is low; stop output when the external input is high.

## Oscillation period settings

Oscillation period is oscillation period of internal crystal oscillator. Rotate multifunction knob, push direction key or tap **OscTime** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. The range is between 1μHz~2MHz, default 2ms.

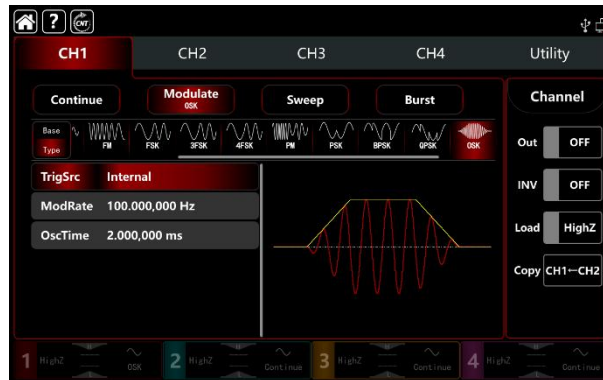
## OSK rate settings

OSK modulation mode presents the changes between the modulated wave phase and the carrier wave phase in internal trigger source. The rate range can set to 1μHz~2MHz, the default rate is 100Hz. Rotate multifunction knob, push direction key or tap **ModRate** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Comprehensive Example

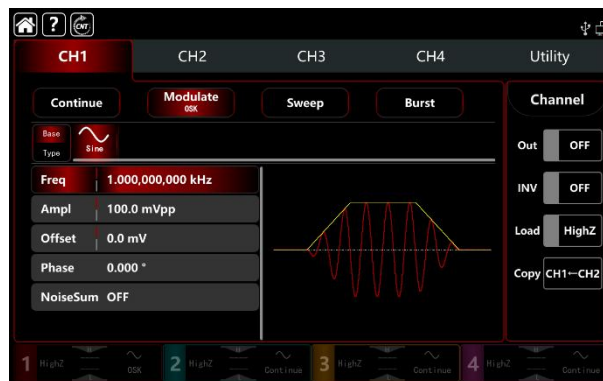
In OSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the frequency 100Hz, oscillation period 1μs, the settings steps as following,

- 1) Turn on OSK modulation mode: tap **CH1** → **Modulate** → **OSK** accordingly.



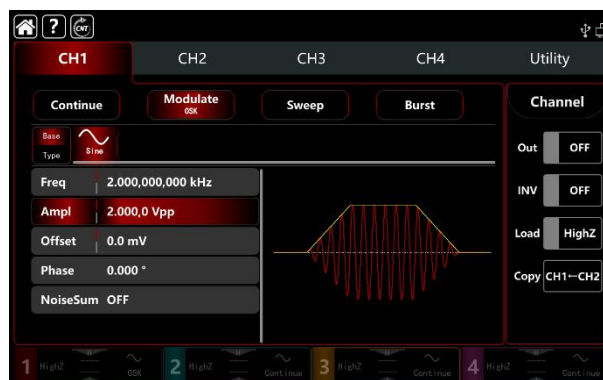
- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



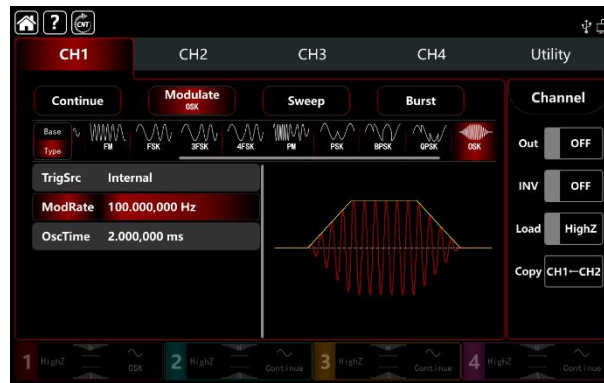
Tap **Freq** to pop-out visual keyboard to enter 2kHz.

Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.



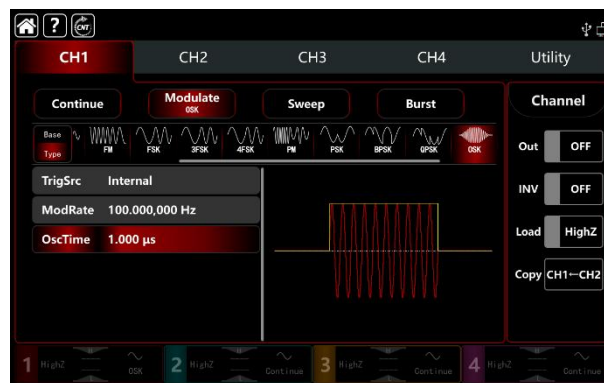
- 3) Set the modulating rate

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the modulating rate.



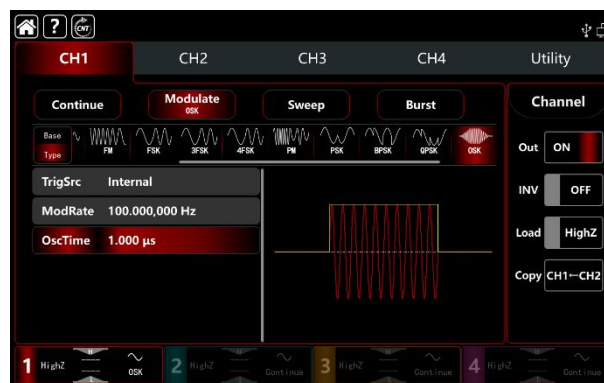
Tap **ModRate** to pop-out visual keyboard to enter 100Hz (the default 100Hz).

Tap **OscTime** to pop-out visual keyboard to enter 1us.

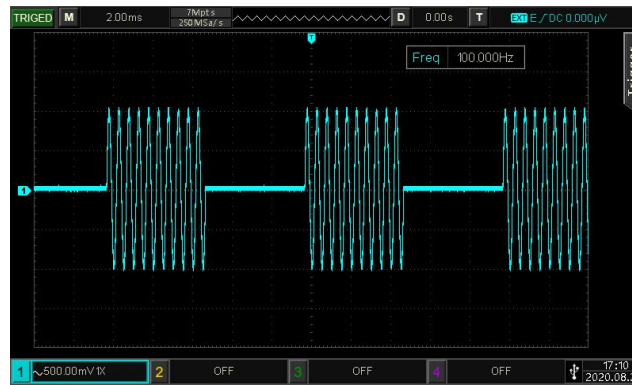


#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the PSK modulation waveform viewed through an oscilloscope is shown in the figure below,

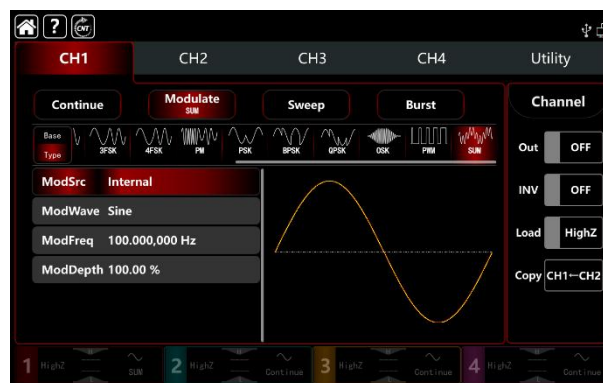


### 3.1.12 SUM (Sum Modulation)

Sum modulation is consist of the carrier wave and the modulated wave. The output waveform is sum of the amplitude of the carrier wave multiply by modulation factor and add the amplitude of the modulated wave multiply by modulation factor. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

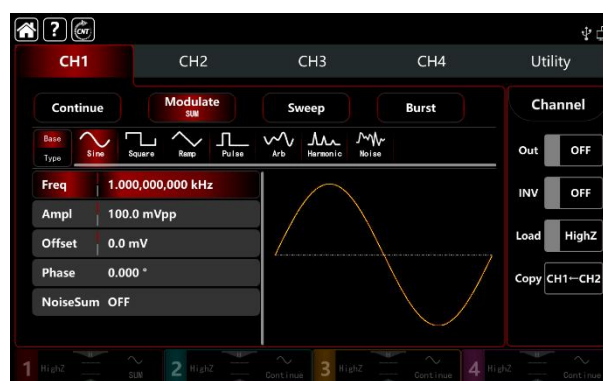
#### Select SUM modulation

Tap **CH1** → **Modulate** → **SUM** to turn on the AM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

The carrier wave of SUM: sine, square, ramp, pulse, harmonic, noise and arbitrary wave (except DC), the default option is sine wave. After select SUM modulation, tap Base to present the carrier waveform on the right side.

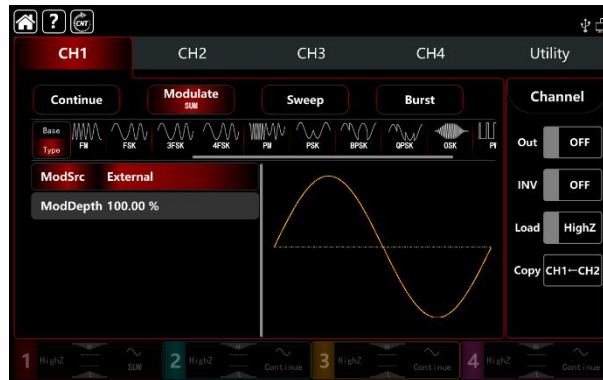


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

### Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on SUM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in SUM modulation setting interface.



### Select the source of modulation

#### 1) Internal source

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on SUM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in AM modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 2kpts by the method of select point automatically
- Noise wave: white gaussian noise

#### 2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The SUM modulation depth is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel. For example, if set the modulation depth 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 waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The input external modulating signal frequency range is between 0Hz~50kHz.

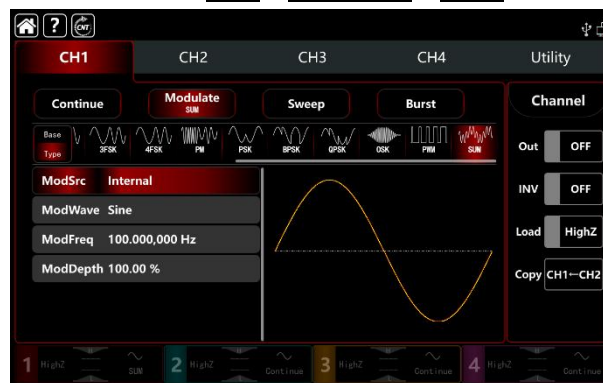
## Modulation depth settings

Modulation depth indicates the change of the extent of amplitude, use percentage to express. SUM modulation depth range can set between 0%~100%, the default range is 100%. If the modulation depth is 0%, then output the carrier wave; if the modulation depth is 100%, output the modulated wave. Rotate multifunction knob and direction key or tap **ModDepth** tab to pop-out visual numeric keyboard to enter values. When the modulation source is external, the output amplitude is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel.

## Comprehensive example

In SUM modulation mode, set an internal 1kHz sine wave as the modulating signal, another square sine with frequency 2kHz, amplitude 200mVpp, duty ratio 45% as the carrier wave signal, and set the modulation depth to 80%, the settings steps as following,

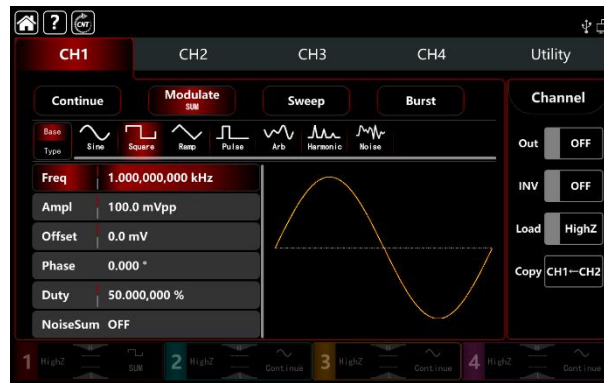
- 1) Turn on SUM modulation mode: tap **CH1**→**Modulate**→**SUM** accordingly.



- 2) Set the parameter of the carrier wave signal

Tap **Base** to select Square as the carrier waveform (the default option is sine wave).

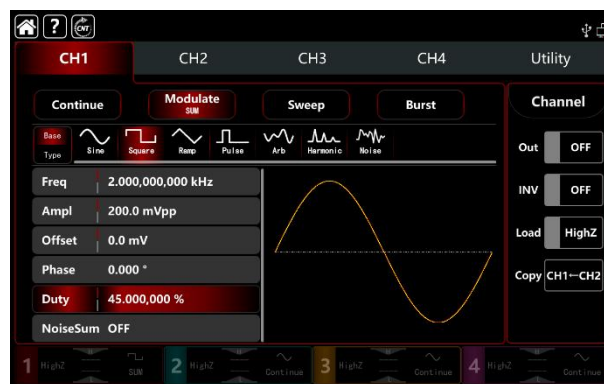




Tap **Freq** tab to pop-out visual numeric keyboard to enter 2kHz.

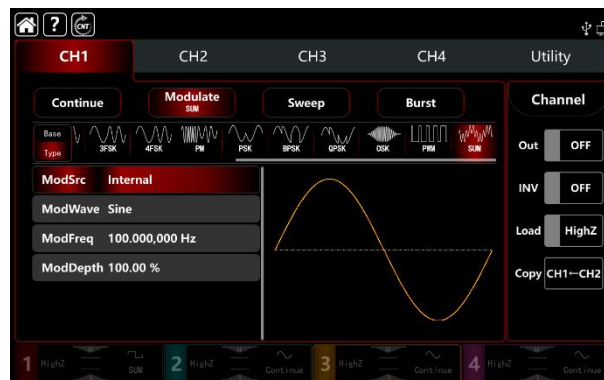
Tap **Ampl** tab to pop-out visual numeric keyboard to enter 200mVpp.

Tap **Duty** tab to pop-out visual numeric keyboard to enter 45%.



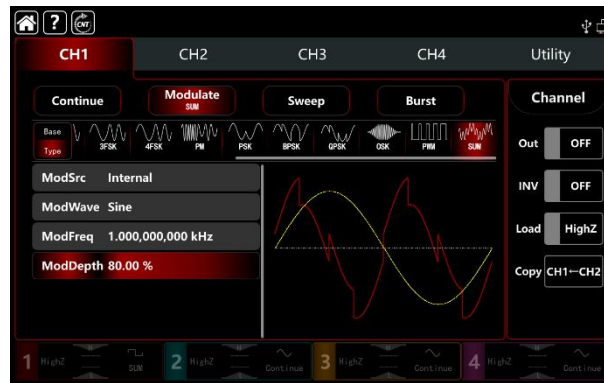
### 3) Set the modulation frequency and depth

After the parameter setting of the carrier wave, tap **Type** to return to SUM modulation interface to set the frequency and depth.



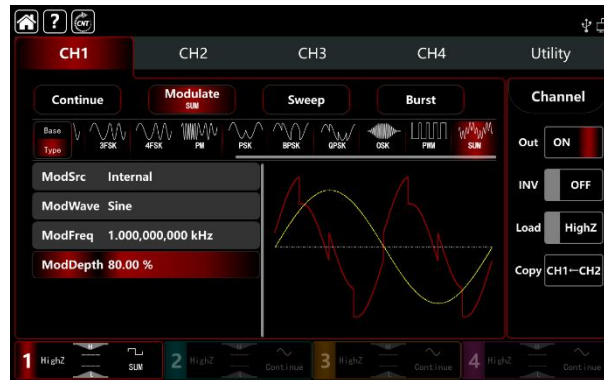
Tap **ModFreq** tab to pop-out visual numeric keyboard to enter 1kHz.

Tap **ModDepth** tab to pop-out visual numeric keyboard to enter 80%.

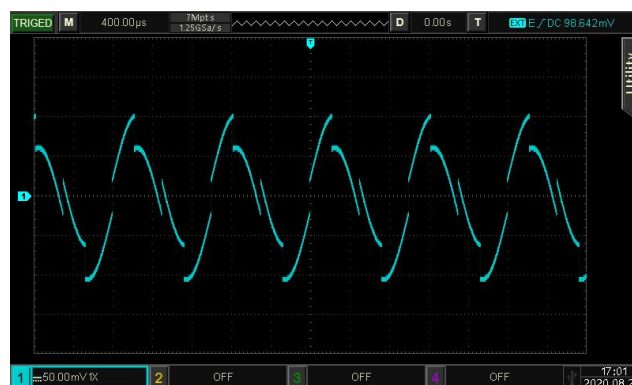


#### 4) Turn on the output channel

Tap channel **Out** to ON or push **CH1** on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



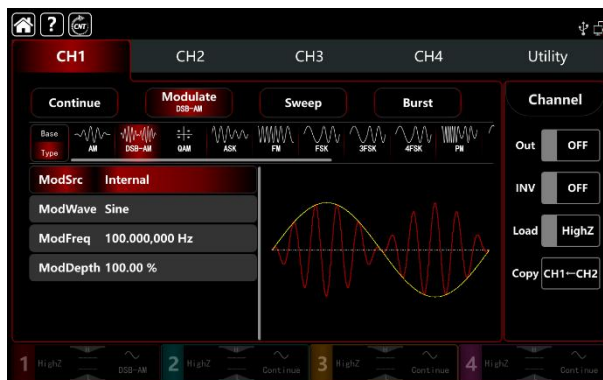
The shape of the AM modulation waveform viewed through an oscilloscope is shown in the figure below,



### 3.1.13 DSB-AM (Double Side Band Amplitude Modulation)

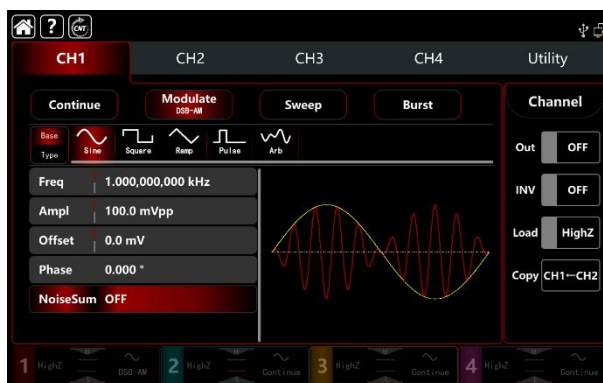
#### Select FM modulation

Tap **CH1**→**Modulate**→**DSB-AM** to turn on DSB-AM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



### Select the carrier waveform

The carrier wave of DSB-AM: sine, square, ramp, pulse and arbitrary wave (except DC), the default option is sine wave. After select DSB-AM modulation, tap **Base** to present the carrier waveform on the right side.

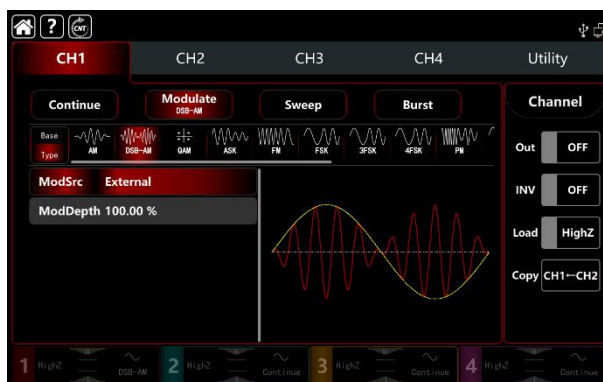


### Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

### Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on DSB-AM modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in DSB-AM modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation waveform can be sine, square, rising ramp, falling ramp arbitrary and noise wave. The default wave is sine wave. When turn on DSB-AM modulation, **ModWave** present Sine, rotate multifunction knob or tap word **Sine** to select the waveform in modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 2kpts by the method of select point automatically
- Noise wave: white gaussian noise

### 2) External source

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

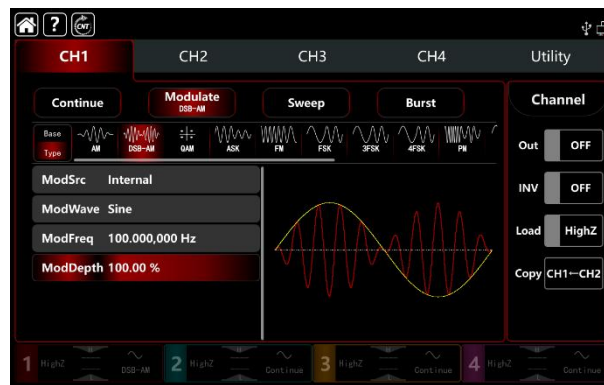
## Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The input external modulating signal frequency range is between 0Hz~50kHz.

## Comprehensive example

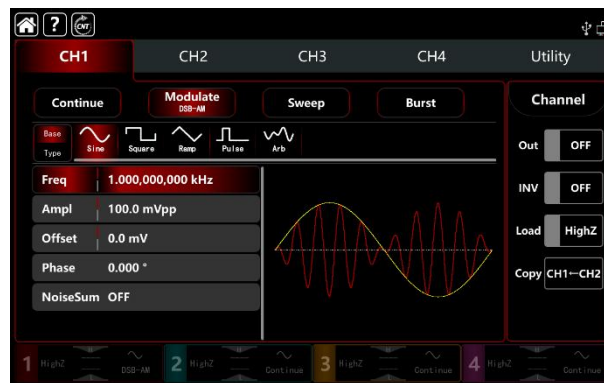
In DSB-AM modulation mode, set an internal 1kHz square wave as a modulating signal, another sine wave signal with frequency 2kHz, amplitude 2Vpp as the carrier wave signal, the settings steps as following,

- 1) Turn on AM modulation mode: tap **CH1** → **Modulate** → **AM** accordingly.



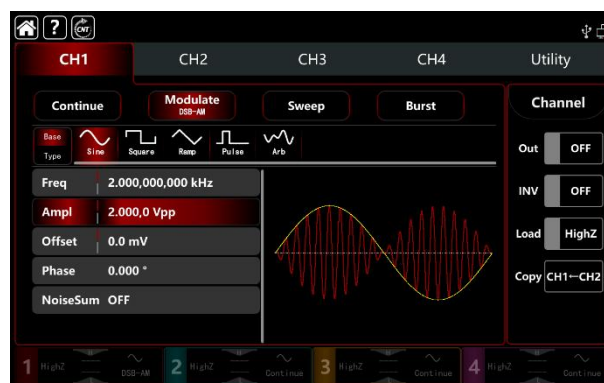
## 2) Set the parameter of the carrier wave signal

Tap **Base** to select Square as the carrier waveform (the default option is sine wave).



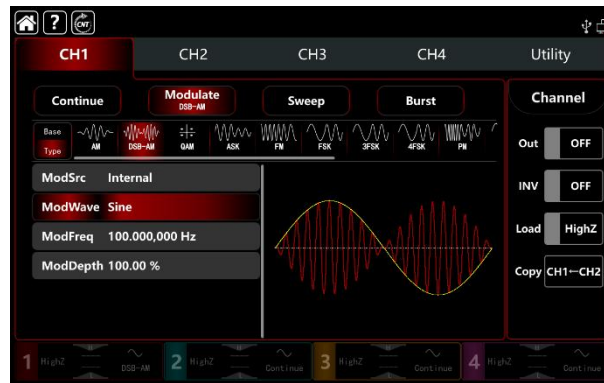
Tap **Freq** tab to pop-out visual numeric keyboard to enter 2kHz.

Tap **Ampl** tab to pop-out visual numeric keyboard to enter 2Vpp.



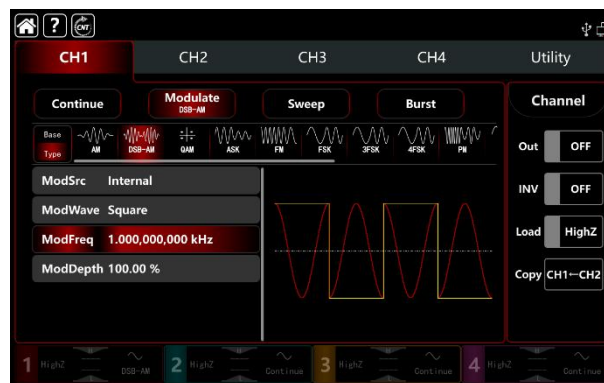
## 3) Set the modulation wave and frequency

After the parameter setting of the carrier wave, tap **Type** to return to DSB-AM modulation interface to set the modulation wave and frequency.



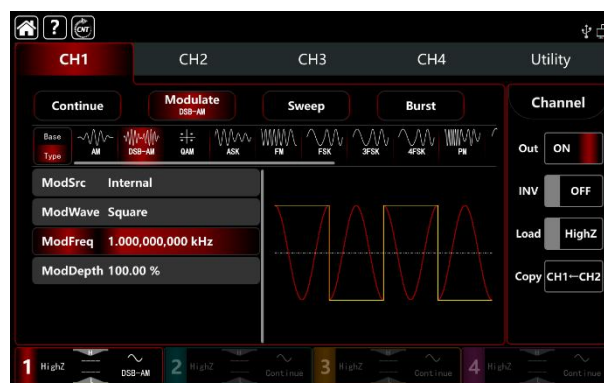
Tap **ModWave** tab to pop-out visual numeric keyboard to select square wave.

Tap **ModFreq** tab to pop-out visual numeric keyboard to enter 1kHz.

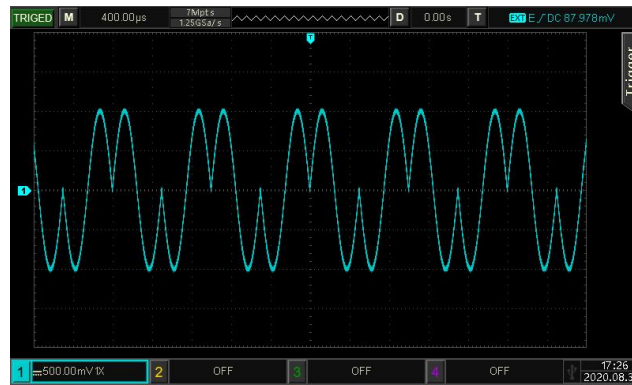


#### 4) Turn on the output channel

Tap channel **Out** to ON or push **CH1** on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the AM modulation waveform viewed through an oscilloscope is shown in the figure below,



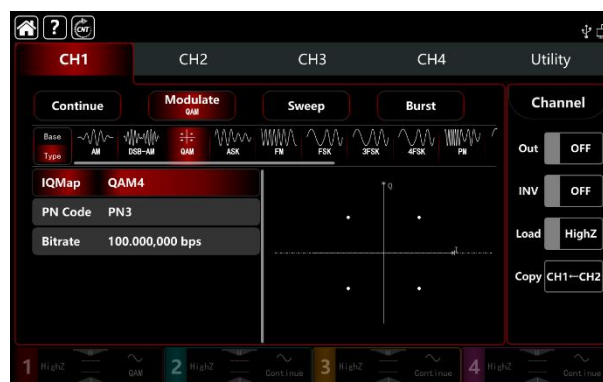
### 3.1.14 QAM (Quadrature Amplitude Modulation)

In quadrature amplitude modulation mode, set two signals of the same frequency but with phase difference  $90^\circ$  (usually represented by Sin and Cos) as the carrier wave, modulating the carrier wave by baseband signal. UTG9000T function/arbitrary waveform generator can output seven modulation types: QAM4, QAM8, QAM16, QAM32, QAM64, QAM128 and QAM256M. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

Note: It is recommended to use the 10MHz reference output signal of this instrument as the input reference clock of the demodulation instrument or input the demodulation instrument reference clock as the signal clock, Accurate the signal demodulation and eliminate the phase deviation by clock sync.

#### Select QAM modulation

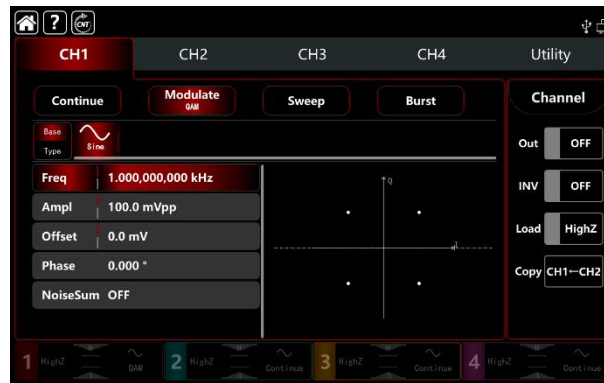
Tap **CH1** → **Modulate** → **QAM** to turn on QAM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

QAM carrier waveform is sine wave. After select QAM modulation, tap **Base** to present the carrier waveform on the right side.





## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Modulation type

The modulation type, which is the division of the constellation changed by the modulation types. Rotate multifunction knob or tap **IQMap**→**QAM4** to step through QAM4, QAM8, QAM16, QAM32, QAM64, QAM128, and QAM256M.

## Select PN code

Turn on QAM modulation mode, the default PN code is PN3. Rotate multifunction knob or tap **PN Code**→**PN3** to step through PN3, PN5, PN7, PN9, PN11, PN13, PN15, PN17, PN21, PN23, PN25, PN27, PN29, PN31, and PN33.

## QAM rate settings

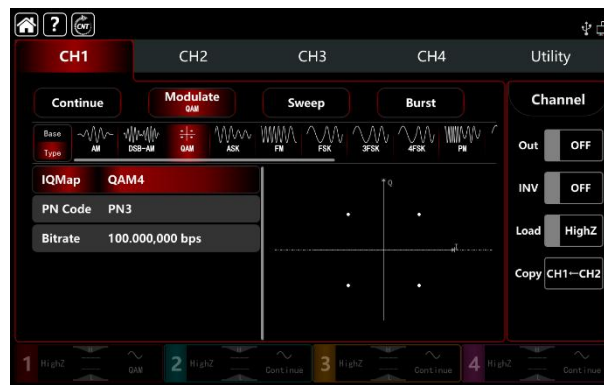
In QAM modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The QAM rate range can set to 1μbps~2Mbps, the default range is 100bps. Rotate multifunction knob, push direction key or tap **Bitrate** tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

## Comprehensive example

In QAM modulation mode, set an internal 2kHz,2Vpp sine wave as a carrier wave, set the rate to 100bps, modulation type QAM64, PN code PN7, The settings steps as following,

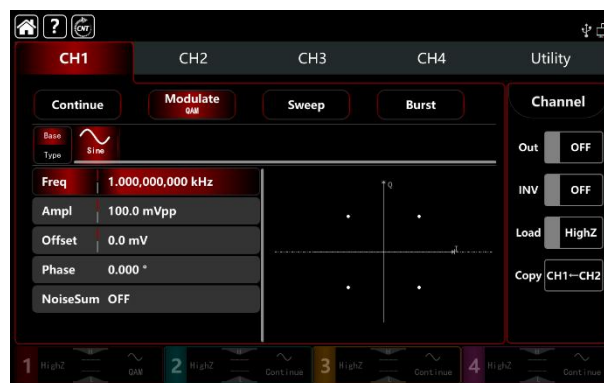
- 1) Turn on BPSK modulation mode: tap **CH1**→**Modulate**→**QAM** accordingly.





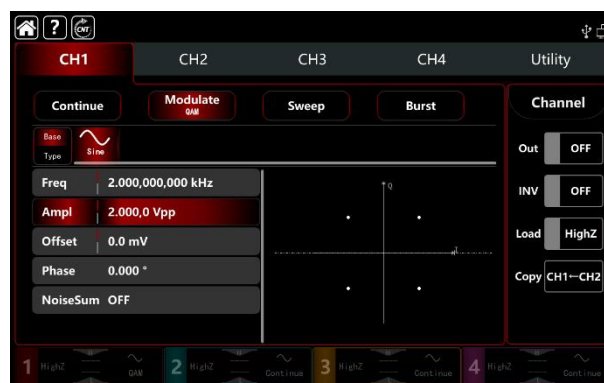
## 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.



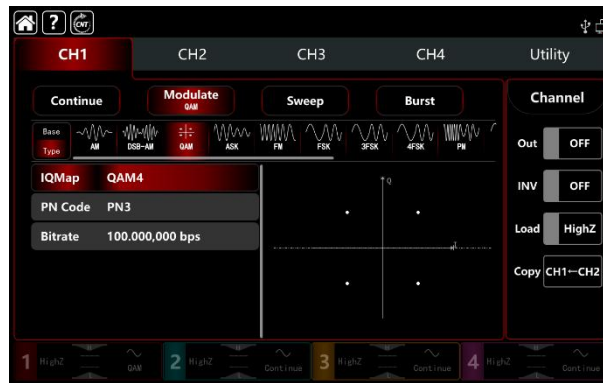
Tap **Freq** to pop-out visual keyboard to enter 2kHz.

Tap **Ampl** to pop-out visual keyboard to enter 2Vpp.



## 3) Set the modulation parameter

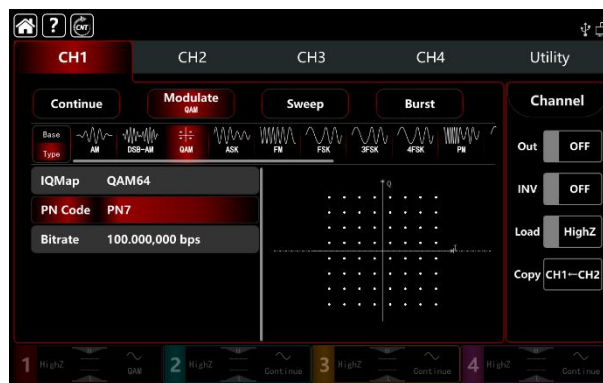
After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set parameter.



Tap **IQMap** → **QAM4** to select QAM64.

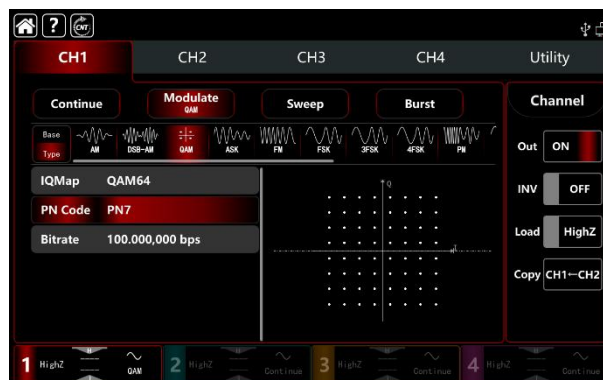
Tap **PN Code** → **PN3** to select PN7.

Tap **Bitrate** to pop-out visual numeric keyboard to enter 100bps (the default 100bps)

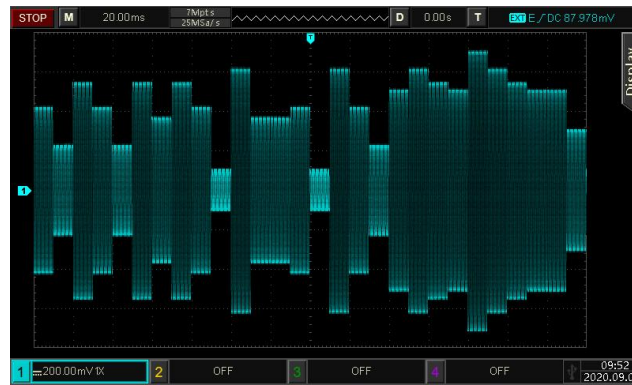


#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility** → **Channel** → **Output** or double-click the channel tab at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab backlight light on indicating that the channel 1 output is turned on.



The shape of the QAM modulation waveform viewed through an oscilloscope is shown in the figure below,

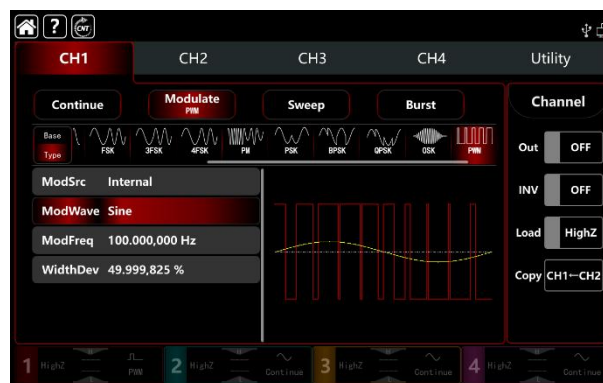


### 3.1.15 PWM (Pulse Width Modulation)

In pulse width modulation mode, the modulated waveform is consist of the carrier wave and the modulation wave. The carrier wave width changed by the modulation wave amplitude. The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

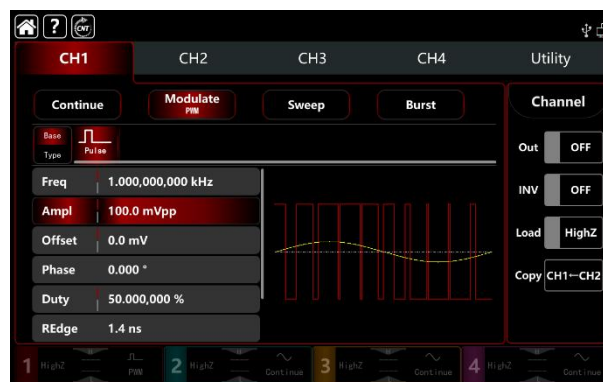
#### Select PWM modulation

Tap **CH1** → **Modulate** → **PWM** to turn on PWM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



#### Select the carrier waveform

PWM carrier waveform can only be pulse wave. After select PWM modulation, tap **Base** to present the carrier waveform on the right side.

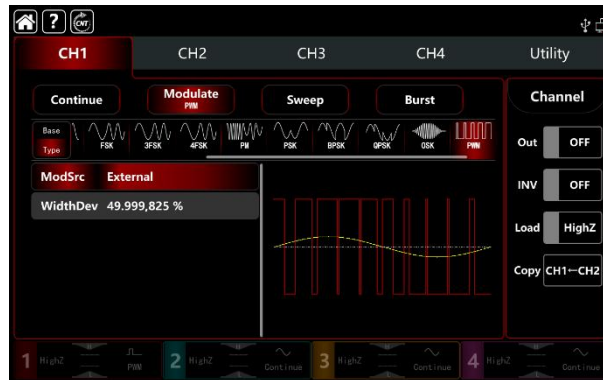


## Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

## Select the source of modulation

UTG9000T function/arbitrary waveform generator can select internal or external modulation source. When turn on PSK modulation, the default modulation source is internal. Rotate multifunction knob or tap **ModSrc** tab to step through internal or external modulation source in PSK modulation setting interface.



### 1) Internal source

When the modulation source is internal, the modulation waveform can be sine, square, rising ramp, falling ramp arbitrary and noise wave. The default wave is sine wave. When turn on PWM modulation, **ModWave** present Sine, rotate multifunction knob or tap word **Sine** to select the waveform in modulation setting interface.

- Square wave: duty ratio 50%
- Rising ramp wave: symmetry 100%
- Falling ramp wave: symmetry 0%
- Arbitrary wave: the length of arbitrary wave limit at 4kpts by the method of select point automatically
- Noise wave: white gaussian noise

### 2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The PWM duty ratio offset is controlled by the  $\pm 5V$  signal level on the external analog modulation input terminal (Modulation In connector) on the back panel. For example, if set the duty ratio offset to 15% when the external modulated signal is +5V, the duty ratio of the carrier wave (pulse wave) increase 15%, the lower external signal level produces less deviation.

## Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1 $\mu$ Hz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap **ModFreq** tab to pop-out visual numeric keyboard to enter values and select unit in FM modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The input external modulating signal frequency range is between 0Hz~50kHz.

## Duty ratio deviation settings

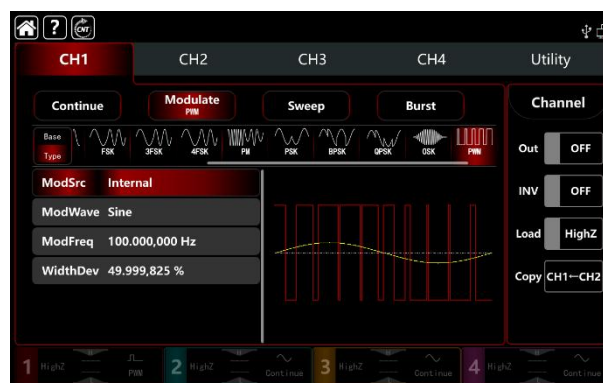
Duty ratio deviation is deviation of modulated waveform from the current carrier duty ratio. The range of PWM can set to 0%~49.999825%, the default is 49.999825%. Rotate multifunction knob, push direction key or tap **DutyDev** tab to pop-out visual numeric keyboard to enter values and select unit in FM modulation setting interface.

- Duty ratio deviation is deviation of modulated waveform from the current carrier duty ratio (express by %).
- Duty ratio deviation can't exceed the duty ratio of the current pulse wave.
- The sum of duty ratio deviation and the current pulse wave must be  $\leq 99.99\%$
- The minimum duty ratio of pulse wave and the current edge time will effect the duty ratio settings.

## Comprehensive example

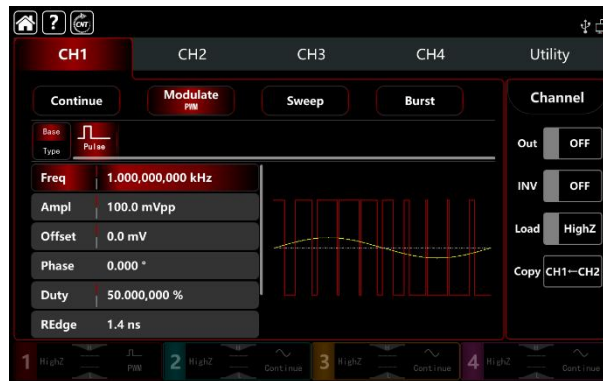
In PWM modulation mode, set an internal 1kHz sine wave as a modulating signal, another pulse wave with frequency 10kHz, amplitude 2Vpp, duty ratio 50%, rising/falling edge time 100ns as a carrier wave signal, and set the frequency duty ratio deviation to 40%, the settings steps as following,

- 1) Turn on FM modulation mode: tap **CH1**→**Modulate**→**FM** accordingly.



- 2) Set the parameter of the carrier wave signal

Tap **Base** to select sine as the carrier wave (the default option is sine), so this step has no change.

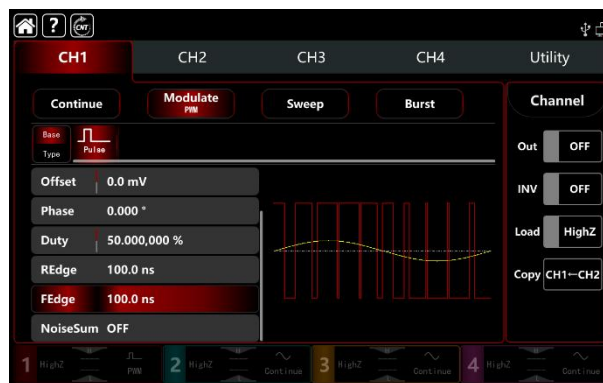


Tap **Freq** to pop-out visual numeric keyboard to enter 10kHz.

Tap **Ampl** to pop-out visual numeric keyboard to enter 2Vp.

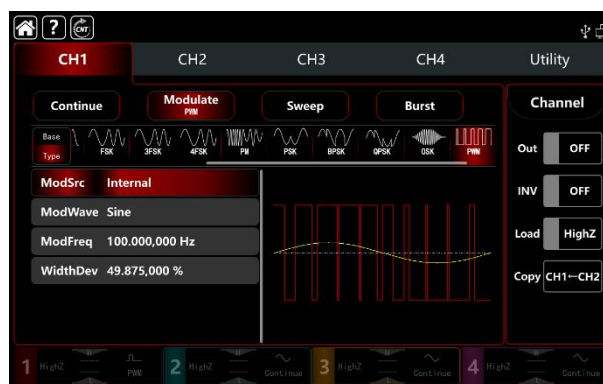
Tap **REdge** to pop-out visual numeric keyboard to enter 100ns.

Tap **FEde** to pop-out visual numeric keyboard to enter 100ns.



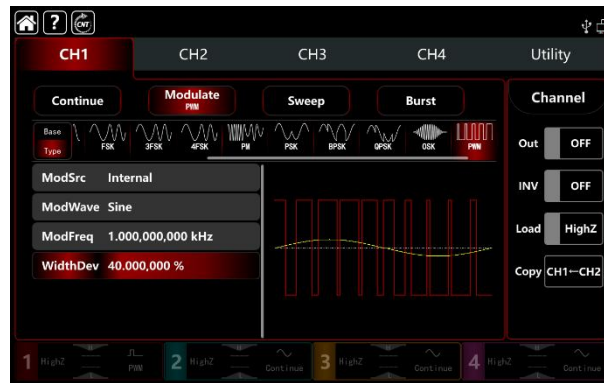
### 3) Set the modulating parameter

After the parameter setting of the carrier wave, tap **Type** to return to modulation interface to set the parameter.



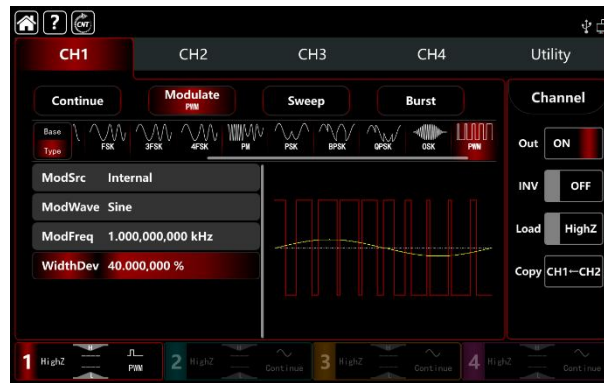
Tap **ModFreq** to pop-out visual numeric keyboard to enter 1kHz.

Tap **DutyDev** to pop-out visual numeric keyboard to enter 40%.

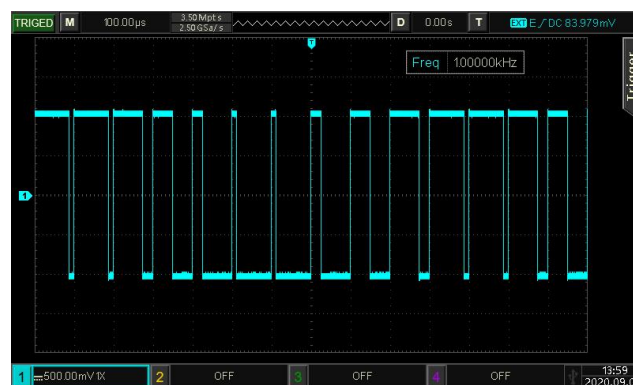


#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab bar at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab bar backlight light on indicating that the channel 1 output is turned on.



The shape of the FM modulation waveform viewed through an oscilloscope is shown in the figure below,



## 3.2 Output Frequency Sweep Waveform

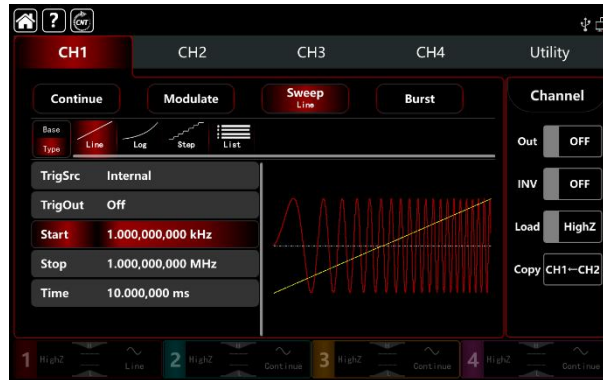
In frequency sweep mode, the function/arbitrary waveform generator can output the frequency from starting to stop by the mode of linear, logarithm, stepping and list sweep in designated sweep time. Trigger source can be internal, external or manual it can generate frequency sweep output for



sine, square, sawtooth ramp and arbitrary wave (except DC). The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

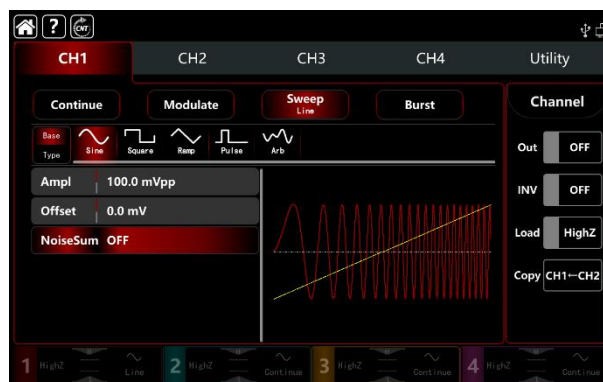
### 3.2.1 Select Frequency Sweep

- 1) Turn on frequency sweep mode: tap **CH1** → **Sweep** accordingly, the instrument output the current frequency sweep waveform.



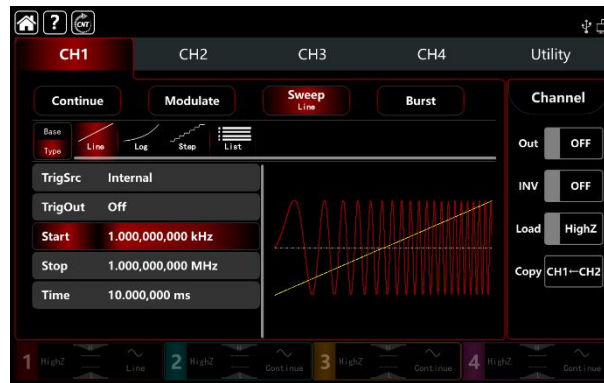
- 2) Select the frequency sweep waveform

Tap Base tap **Base** to present the carrier waveform on the right side. See the interface figure as below,



### 3.2.2 Starting and stop frequency settings

Starting and stop frequency are the upper limit and lower limit of frequency sweep. The function/arbitrary waveform generator is always sweeps from starting frequency to stop frequency. Rotate multifunction knob, push direction key or tap **Start**, **Stop** tab to pop-out visual numeric keyboard to enter values and select unit in sweep modulation setting interface.



- When starting frequency < stop frequency, the function/arbitrary waveform generator sweeps from low to high frequency.
- When starting frequency > stop frequency, the function/arbitrary waveform generator sweeps from high to low frequency.
- When starting frequency = stop frequency, the function/arbitrary waveform generator outputs a constant frequency.
- The synchronous signal of frequency sweep mode is low from starting point to midpoint of frequency sweep time, and high from midpoint to end of frequency sweep time.

By default, starting frequency is 1kHz and stop frequency is 1Mz, but the range of starting and stop frequency can vary with frequency sweep waveform. See the Table 4-1/4-2 Carrier frequency settings of AM.

### 3.2.3 Frequency Sweep Mode

UTG9000T has four frequency sweep mode: linear, logarithm, stepping and list sweep

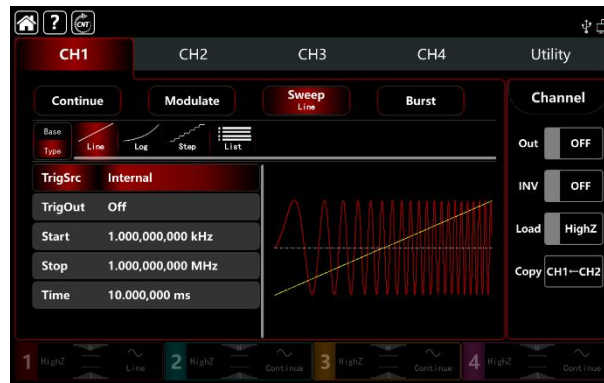
Linear frequency sweep: output frequency in a linear way

Logarithm frequency sweep: output frequency in a logarithm way

Stepping frequency sweep: output frequency in a stepping way

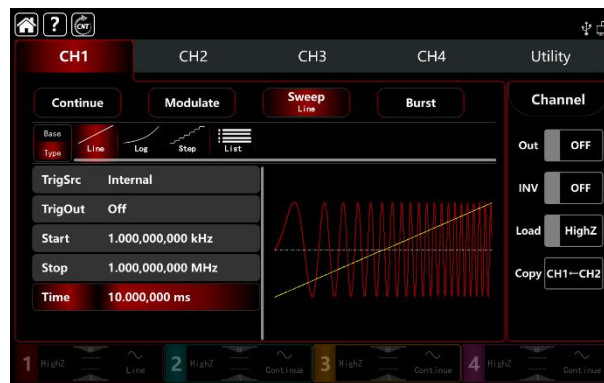
List frequency sweep: output frequency in a list way

Linear frequency sweep mode is default. Tap **Sweep** → **Type** to select **Line**, **Log**, **Step**, and **List** mode.



### 3.2.4 Frequency Sweep Time

The default time from starting to stop frequency is 1s, and time range can set to 1ms~500s. Rotate multifunction knob, tap **Type**→**Time** tab to pop-out visual numeric keyboard to enter values and select unit.

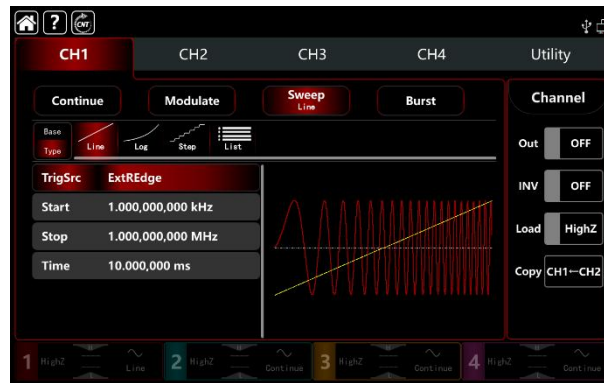


### 3.2.5 Select trigger source

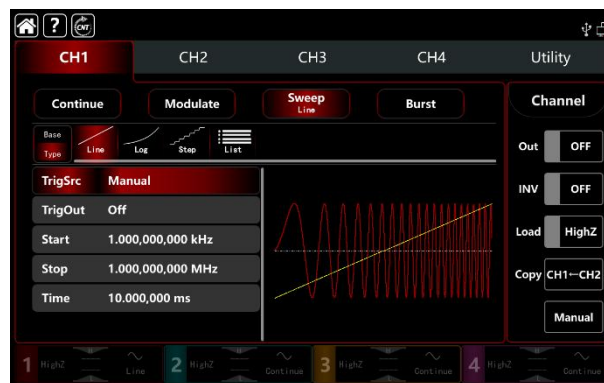
The waveform generator will output a frequency sweep when receive a trigger signal and wait next trigger source. The trigger source of frequency sweep can be internal, external (external rising/falling edge) or manual. Rotate multifunction knob or tap ModSrc to step through Internal, External, ExREdge, ExFEdge, and Manual.

- 1) The waveform generator will output a succession frequency sweep when in internal trigger source. The rate controlled by frequency sweep time.
- 2) The waveform generator will trigger by the external digital modulation terminal (FSK Trig connector) on the back panel when in external source. The waveform generator will start frequency sweep upon receiving a TTL pulse with designated polarity.

Note: In external trigger source, trigger output will be hidden in parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.



- 3) Manual trigger source present in the current channel setting interface on the right side of the screen. Tap **Manual** to output a sweep frequency for each time.



### 3.2.6 Trigger Output

When trigger source is internal or manual, the trigger signal (square wave) can be output through external digital modulation terminal (FSK Trig connector), compatible with TTL level. The default trigger output is OFF. Rotate multifunction knob or tap TrigOut to step through Close, REdge and DEdge.

- Internal trigger source, the waveform generator outputs a square wave with duty ratio of 50% from external digital modulation terminal (FSK Trig connector) when frequency sweep starts. Trigger period depends on designated frequency sweep time.
- Manual trigger source, the waveform generator outputs a pulse wide than 1 $\mu$ s from external digital modulation terminal (FSK Trig connector) when frequency sweep starts.
- External trigger source, trigger output will be hidden in parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.

### 3.2.7 Trigger Edge

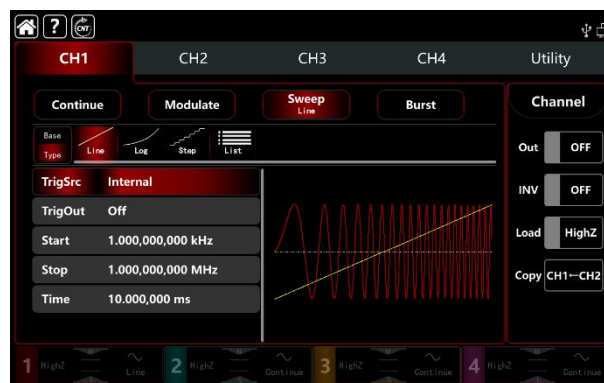
The external digital modulation terminal (FSK Trig connector) can be designated edge as input or output. When the terminal used as input (external trigger source), rising edge means that rising edge of external signal triggers output a frequency sweep; falling edge means that falling edge of

external signal triggers output a frequency sweep. When the terminal used as output (internal trigger or manual trigger source), rising edge represents the rising edge output trigger signal; falling edge represents the falling edge output trigger signal, and the default is rising edge.

### 3.2.8 Comprehensive example

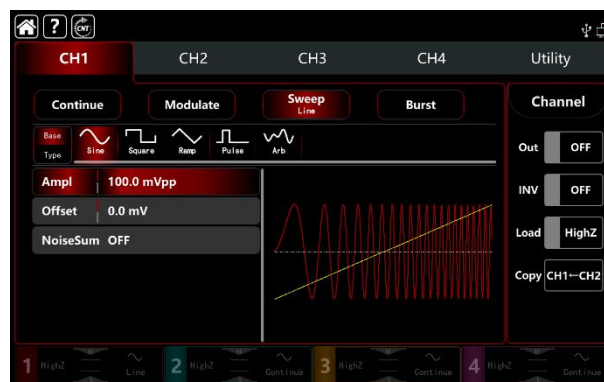
In frequency sweep mode, set a square wave with amplitude 1Vpp, duty ratio 50% as frequency sweep, the frequency sweep type is linear, set the starting frequency to 1kHz, stop frequency 50kHz and frequency sweep time to 2ms, use the internal rising edge trigger source to output frequency sweep. The settings steps as following,

Turn on FM modulation mode: tap **CH1**→**Sweep**→**Linear** accordingly

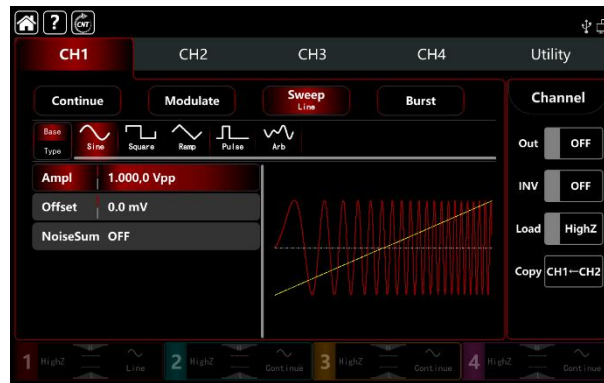


- 1) Set the parameter of the carrier wave signal

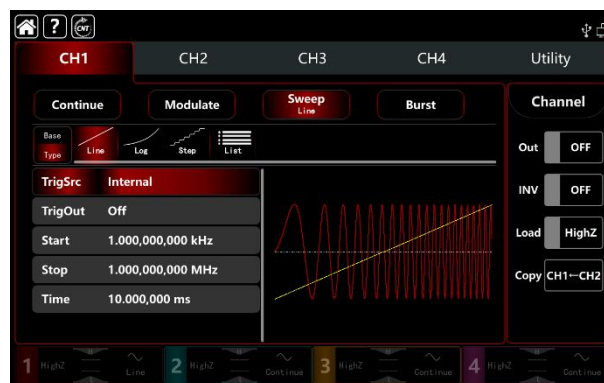
Tap **Base** to select square wave (the default option is sine wave.) See the interface figure as below,



Tap **Ampl** tab to pop-out visual numeric keyboard to enter 1Vpp.



- 2) Set the starting/stop frequency, frequency sweep time, trigger source and edge  
After the parameter setting of the carrier wave, tap **Type** to return to sweep interface to set the frequency sweep parameter.

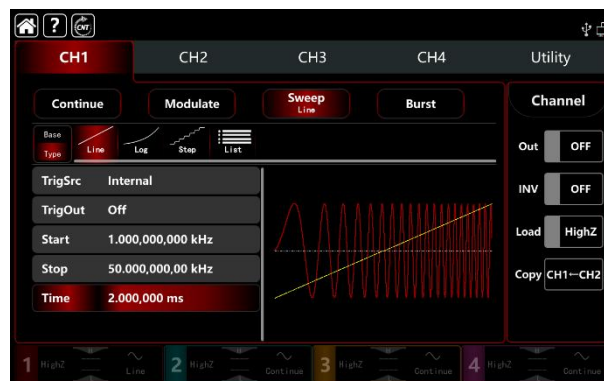


Select Linear as the way of frequency sweep (default).

Tap **Start** tab to pop-out visual numeric keyboard to enter 1kHz.

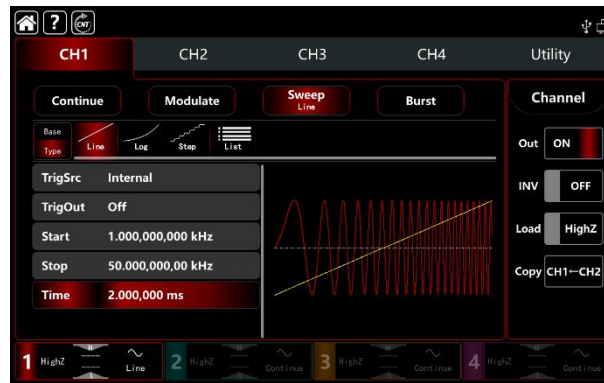
Tap **Stop** tab to pop-out visual numeric keyboard to enter 50kHz.

Tap **DwellTime** tab to pop-out visual numeric keyboard to enter 2ms.

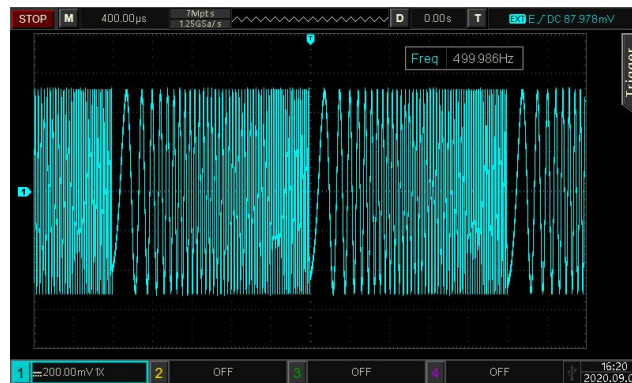


- 3) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility** → **Channel** → **Output** or double-click the channel tab bar at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab bar backlight light on indicating that the channel 1 output is turned on.



The shape of the frequency sweep waveform viewed through an oscilloscope is shown in the figure below,

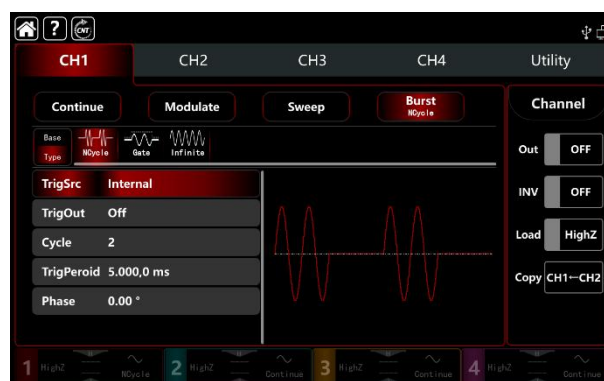


### 3.3 Output Burst Waveform

The waveform generator can output a designated cycle period wave (pulse string). It has three trigger output mode: internal, external and manual. 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 modes for each channel are independent, it can set the same or different modulation modes to each channel.

#### 3.3.1 Select Burst

Turn on Burst mode: tap **CH1** → **Burst** accordingly, the instrument output the modulated pulse string waveform according to the current setting.

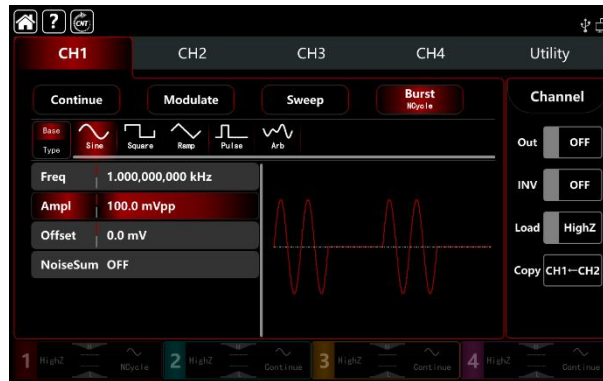




## 1) Select waveform

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

After select waveform, tap **Base** to present the carrier waveform on the right side (sine wave as default.)



## 2) Set waveform frequency

In N cycle and gating modes, waveform frequency defines the signal frequency during period of pulse train. In N cycle mode, output the pulse train at a specified cycle times and waveform frequency. In gating mode, use waveform frequency to output the pulse string when the trigger source is high level.

Note: Waveform frequency is different from pulse string period. Pulse string is used to specify the interval between pulse strings (only in N cycle mode). The default frequency is 1kHz, refer to [The carrier wave frequency settings](#) of AM modulation.

Rotate multifunction knob, push direction key or tap **Freq** tab to pop-out visual numeric keyboard to enter values and select unit.

### 3.3.2 Burst Type

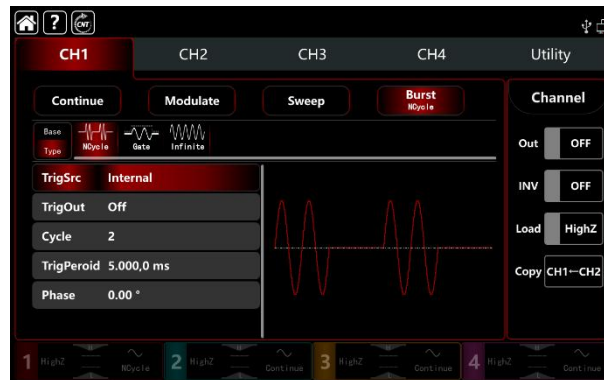
UTG9000T can output three types of pulse train, N cycle, gating and infinite. The default type is N cycle.

## 1) N cycle mode

Tap **NCycle** to turn on N cycle mode, the waveform generator will output a waveform with designated cycle number (pulse string). After output a designated number cycle number, the waveform generator will stop and wait for the next trigger. The trigger source of pulse string can be internal, external or manual in this mode. Rotate multifunction knob or tap **TrigSrc** tab to step through Internal, ExtREdge, ExtFEde and Manul.

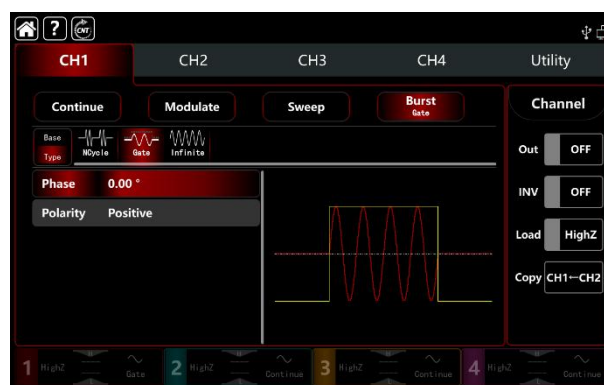
Note: When trigger source is ExtREde, ExtFEde, trigger out option will be hidden in

parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.



## 2) Gating mode

Tap **Gate** to turn on gating mode, trigger source, trigger output, trigger period and cycle number will be hidden in parameter list. It can only use the external trigger source, the waveform generator triggered by the external digital modulation terminal (FSK Trig connector) on the back panel. The waveform generator output succession waveform when trigger the input signal is positive polarity with high level; when trigger the input signal at low level, complete the current waveform period first, and then stop the output, keep the selected waveform start phase at the corresponding level. For noise waveform, if the gated signal is fake, the output will stop immediately. Rotate multifunction, push direction key or tap **Polarity** to step through Positive and Negative.

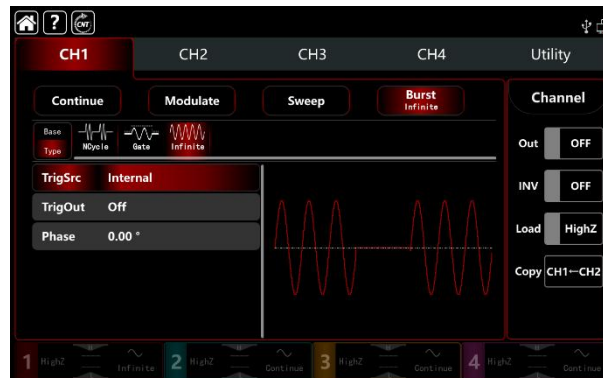


## 3) Infinite mode

Tap **Infinite** to turn on infinite mode, trigger period and cycle number will be hidden in parameter list. In infinite mode, cycle number is infinite. The waveform generator output succession waveform when receiving trigger signal. The trigger source of pulse string can be internal, external or manual in this mode. Rotate multifunction knob or tap **TrigSrc** tab to step through Internal, ExtREdge, ExtFEde and Manul.

Note: When trigger source is external, trigger out option will be hidden in parameter list.

Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.

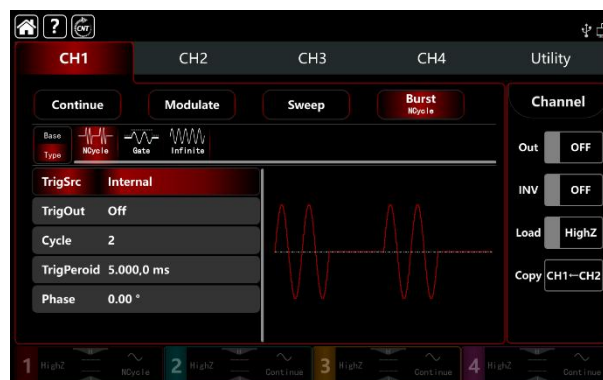


### 3.3.3 Initial Phase of Burst

Start phase of burst can be set to  $0^\circ \sim +360^\circ$ , the default start phase is  $0^\circ$ . Rotate multifunction knob or tap **Phase** tab to pop-out visual numeric keyboard to enter values and select unit.

- For sine, square, ramp and pulse wave,  $0^\circ$  is the point at which the waveform passes 0V (or DC offset value) in forward direction.
- For arbitrary waveform,  $0^\circ$  is the first waveform point which downloaded to the storage.
- Initial phase has no effect on the noise wave.

### 3.3.4 Burst Period



Burst period (period of pulse string) is only for N cycle mode, which means the time from one pulse string to the next pulse string. When trigger source is external or manual, trigger period will be hidden in parameter list. The range of burst period (period of pulse string) can be set to  $1\mu\text{s} \sim 500\text{s}$ ; the default range is 5.000ms. Rotate multifunction knob or tap **TrigPeriod** tab to pop-out visual numeric keyboard to enter values and select unit.

- Burst period (period of pulse string)  $\geq$  waveform period  $\times$  cycle number (number of pulse string)  
At here, waveform period is the reciprocal of the waveform frequency which is mentioned in the

Select Burst.

- If burst period (period of pulse string) is too short, the waveform generator will increase the designated period to output a designated number of cycles.

### 3.3.5 Counting of Burst

In N cycle mode, pulse string counting is used to specify the number of waveform period. It is in the range of 1~50000 periods and 2 by default. In N cycle mode, rotate multifunction knob, push direction key or tap **Cycle** tab to pop-out visual numeric keyboard to enter values and select unit.

- $\text{Cycle number} < \text{Trigger period} \times \text{Waveform frequency}$
- If cycle number exceeds the above limit, the waveform generator increase the pulse string period to adapt the designated pulse string count automatically ( the waveform frequency won't change)

### 3.3.6 Select Trigger Source

The waveform generator will output a frequency sweep when receive a trigger signal and wait next trigger source. The trigger source of frequency sweep can be internal, external and manual. Rotate multifunction knob or tap **TrigSrc** to select the trigger source.

- 1) The waveform generator will continue output the designated frequency when in internal trigger source. The output pulse string frequency controlled by pulse string period. The waveform can output the pulse string of N cycle and infinite type.
- 2) The waveform generator will trigger by the external digital modulation terminal (FSK Trig connector) on the back panel when in external source. The waveform generator output pulse string upon receiving a TTL pulse with designated polarity.

Note: In external trigger source, trigger output will be hidden in parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.

- 3) Manual trigger source present in the current channel setting interface on the right side of the screen. Tap **Manual** to output a pulse string of N cycle or Infinite mode.

### 3.3.7 Trigger Output

When trigger source is internal or manual, the trigger signal (square wave) can be output through external digital modulation terminal (FSK Trig connector) , compatible with TTL level. The default trigger output is OFF. Rotate multifunction knob or tap TrigOut to step through Close, REdge and DEdge.

- Internal trigger source, the waveform generator outputs a square wave with duty ratio of 50%

from external digital modulation terminal (FSK Trig connector) when burst mode starts. The waveform frequency is equal to pulse string period.

- Manual trigger source, the waveform generator outputs a pulse wide than  $1\mu\text{s}$  from external digital modulation terminal (FSK Trig connector) when burst mode starts.
- External trigger source, trigger output will be hidden in parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.

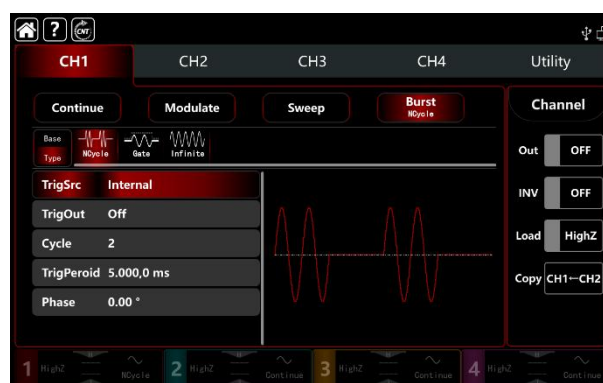
### 3.3.8 Trigger Edge

The external digital modulation terminal (FSK Trig connector) can be designated edge as input or output. When the terminal used as input (ExtREdge/ ExtFEde external trigger source), ExtREde means that rising edge of external signal triggers output a pulse string; ExtFEde means that falling edge of external signal triggers output a pulse string. In gating mode, when polarity is positive, the external signal with high level, it will output a pulse string; when polarity is negative, the external signal with low level, it will output a pulse string. When the terminal used as output (internal trigger or manual trigger source), rising edge represents the rising edge output trigger signal; falling edge represents the falling edge output trigger signal, and the default is rising edge.

### 3.3.9 Comprehensive example

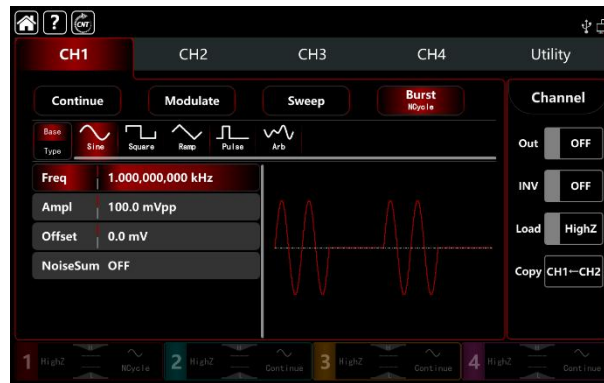
In burst mode, set a sine wave with period 5ms, amplitude 500mVpp as pulse string wave, burst mode set to N cycle, pulse string period 15ms, cycle number 2, the settings steps as following,

- 1) Turn on burst mode: tap **CH1**→**Burst**→**NCycle** accordingly.

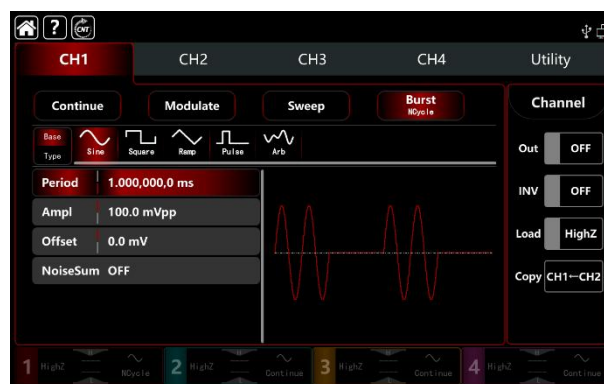


- 2) Select burst waveform

Tap **Base** to select sine wave as the carrier waveform (the default option is sine), so this step has no change.

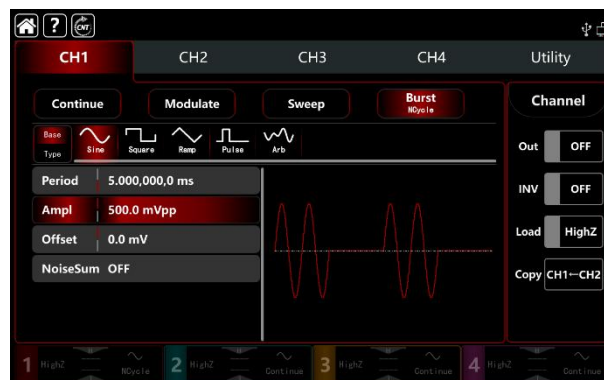


Note: If the setting interface display **Freq**, this means it can only change the frequency parameter, it can't switch to period. 2ms period is corresponding to 500Hz and their reciprocal relationship is  $T=1/f$ . Tap **Freq** to step through frequency and period.



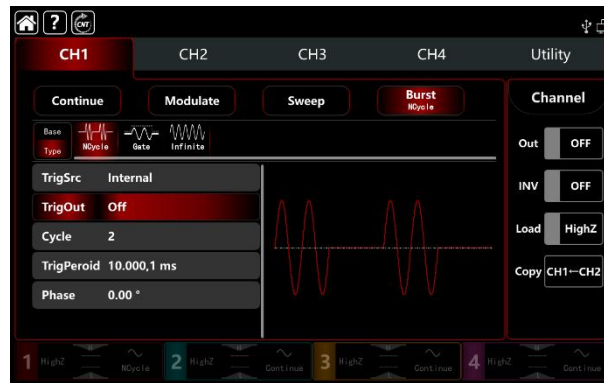
Tap **Period** to pop-out visual numeric keyboard to enter 5ms.

Tap **Ampl** to pop-out visual numeric keyboard to enter 500mVpp.

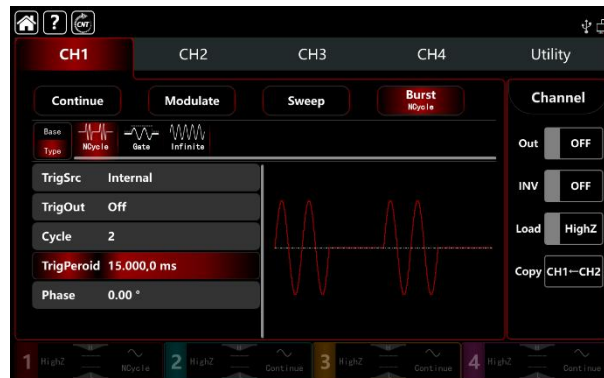


### 3) Set burst period and cycle

After select burst waveform, tap **Type** to turn back to burst interface.

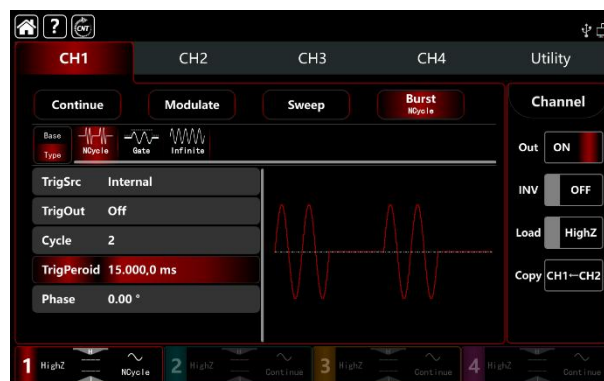


Tap parameter bar to enter value and select unit.



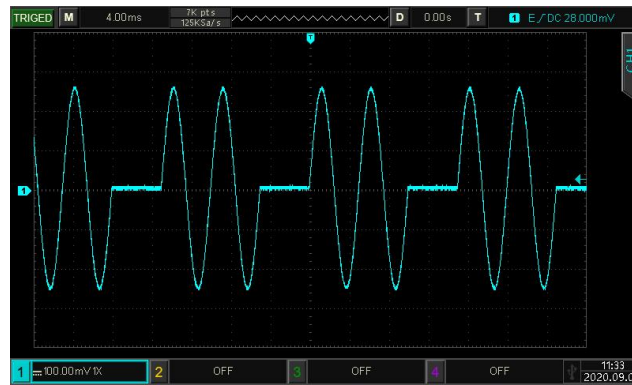
#### 4) Turn on the output channel

Tap channel **Out** button to ON or push **CH1** key on the front panel to quick set the output channel, and it can also turn on at the Utility interface, tap **Utility**→**Channel**→**Output** or double-click the channel tab bar at the bottom of the screen to step through ON/OFF. **CH1** key and **CH1** tab bar backlight light on indicating that the channel 1 output is turned on.



The shape of the burst waveform viewed through an oscilloscope is shown in the figure below,



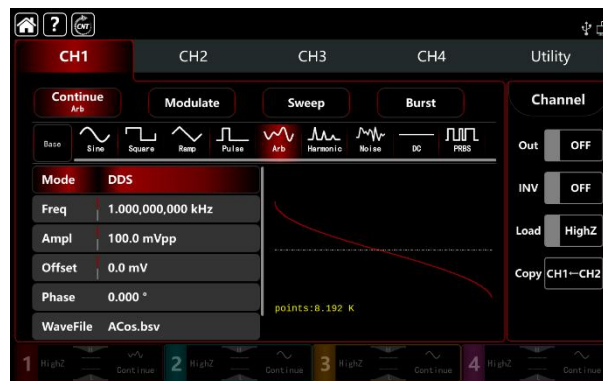


## 3.4 Output Arbitrary Waveform

UTG9000T has store more than 200 standard waveform types in non-volatile memory. See Table 4-4 (Built-in Arbitrary Waveform). The instrument can create and edit arbitrary waveform by USB interface to read arbitrary data file on the front panel.

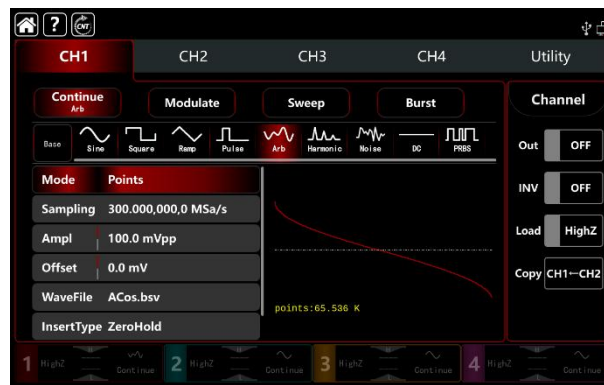
### 3.4.1 Turn on arbitrary waveform mode

Turn on Burst mode: tap **CH1** → **Arbitrary** accordingly, the instrument output the modulated arbitrary waveform according to the current setting.



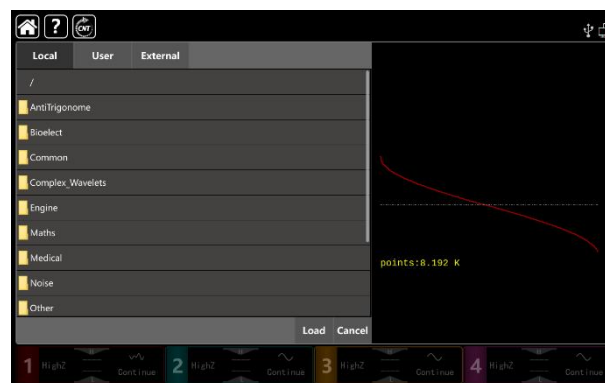
### 3.4.2 Point by point output/ DDS mode

UTG9000T supports point by point and DDS mode. In point by point mode, the waveform generator automatically calculates 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 default mode, the waveform generator output arbitrary waveform by automatic interpolation or select point as fixed length (8.192 points) and the frequency of parameter list. Rotate multifunction knob or tap Mode tab to step through DDS and Points. Point by point interface figure as below.



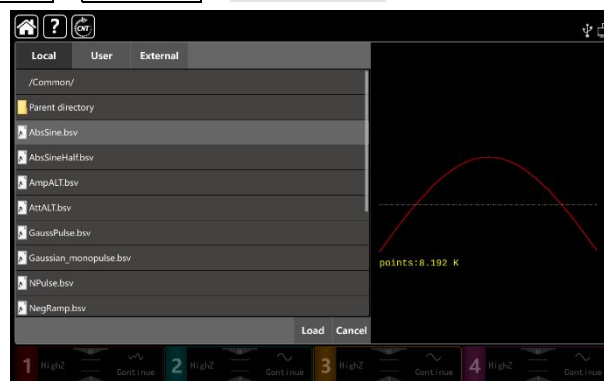
### 3.4.3 Select Arbitrary Waveform

UTG9000T can select arbitrary waveform from internal or external memory storage. Rotate multifunction knob, push direction key or tap **WaveFile** to enter select it. See the figure as below,

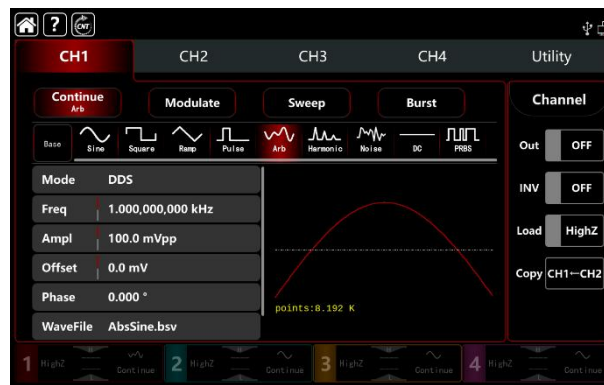


Select the types of arbitrary waveform,

and then tap **WaveFile** → **Local** → **Common** → **AbsSine.bsv**,



Tap **Load** to turn off window automatically, arbitrary waveform selection is finished.



Note: UTG9000T supports the length less than 64M points with file format \*.bsv or \*.csv .

Table 4-4 Built-in Arbitrary Waveform

| Type                          | Waveform           | Description                                   |
|-------------------------------|--------------------|---|
| Common Function<br>(15 types) | AbsSine            | Absolute sine waveform                        |
|                               | AbsSineHalf        | Absolute half-sine waveform                   |
|                               | AmpALT             | Amplify sine waveform                         |
|                               | AttALT             | Attenuated sine waveform                      |
|                               | Gaussian_monopulse | Gaussian monopulse                            |
|                               | 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 waveforms                   |
|                               | StairDn            | Stair-down waveform                           |
|                               | StairUp            | Stair-up waveform                             |
|                               | Trapezia           | Trapezia waveform                             |
| Engine (25 types)             | BandLimited        | Band-limited signal                           |
|                               | BlaseiWave         | Time-velocity curve of explosive vibration    |
|                               | Butterworth        | Butterworth filter                            |
|                               | Chebyshev1         | Chebyshev 1 filter                            |
|                               | Chebyshev2         | Chebyshev 2 filter                            |
|                               | Combin             | Combination function                          |
|                               | CPulse             | C-Pulse signal                                |
|                               | CWPulse            | CW pulse signal                               |
|                               | DampedOsc          | Time-displacement curve of damped oscillation |
|                               | DualTone           | Dual-tone signal                              |
|                               | Gamma              | Gamma signal                                  |

|                  |           |   |
|------------------|-----------|---|
|                  | GateVibr  | Gate self-oscillation signal                    |
|                  | LFMPulse  | Linear frequency modulation pulse               |
|                  | MCNoise   | Mechanical construction noise                   |
|                  | Discharge | Discharge curve of Ni-MH battery                |
|                  | Pahcur    | Current waveform of DC brushless motor          |
|                  | Quake     | Quake waveform                                  |
|                  | Radar     | Radar signal                                    |
|                  | Ripple    | Power ripple                                    |
|                  | RoundHalf | Round half waveform                             |
|                  | RoundsPM  | Rounds phase modulation waveform                |
|                  | StepResp  | Step-response signal                            |
|                  | SwingOsc  | Kinetic energy- time curve of swing oscillation |
|                  | TV        | TV signal                                       |
|                  | Voice     | Voice signal                                    |
| Maths (27 types) | ARB_X2    | Square function                                 |
|                  | Airy      | Airy function                                   |
|                  | Besselj   | Bessel I function                               |
|                  | Besselk   | Modified Bessel function of the second kind     |
|                  | Bessely   | Bessel II function                              |
|                  | Cauchy    | Cauchy distribution function                    |
|                  | Cubic     | Cubic function                                  |
|                  | Dirichlet | Dirichlet function                              |
|                  | Erf       | Error function                                  |
|                  | Erfc      | Complementary error function                    |
|                  | ErfcInv   | Inverted complementary error function           |
|                  | ErfInv    | Inverted error function                         |
|                  | ExpFall   | Exponential fall function                       |
|                  | ExpRise   | Exponential rise function                       |
|                  | Gammaln   | Natural logarithm of gamma function             |
|                  | Gauss     | Gauss distribution (Normal distribution)        |
|                  | HaverSine | HaverSine function                              |
|                  | Laguerre  | 4th-degree Laguerre Polymomial                  |
|                  | Laplace   | Laplace distribution                            |
|                  | Legend    | 5th-degree Legendre Polymomial                  |
|                  | Log       | Logarithmic function with the base of 10        |
|                  | LogNormal | Logarithmic normal distribution                 |
|                  | Lorentz   | Lorentz function                                |
|                  | Maxwell   | Maxwell distribution                            |
|                  | Rayleigh  | Rayleigh distribution                           |

|                       |                      |  |
|-----------------------|----------------------|--|
|                       | Versiera             | Versiera   |
|                       | Weibull              | Weibull distribution                               |
| SectMod (5 types)     | AM                   | Sectioned sine amplitude modulation signal         |
|                       | FM                   | Sectioned sine frequency modulation signal         |
|                       | PFM                  | Sectioned pulse frequency modulation signal        |
|                       | PM                   | Sectioned sine phase modulation signal             |
|                       | PWM                  | Sectioned pulse width frequency modulation signal  |
| Bioelect (6 types)    | Cardiac              | Cardiac signal                                     |
|                       | EOG                  | Electro-Oculogram                                  |
|                       | EEG                  | Electroencephalogram                               |
|                       | EMG                  | Electromyogram                                     |
|                       | Pulsilogram          | Normal pulse waveform                              |
|                       | ResSpeed             | Speed curve of the respiration                     |
| Medical (4 types)     | LFPulse              | Waveform of the low frequency pulse electrotherapy |
|                       | Tens1                | Waveform 1 of the nerve stimulation electrotherapy |
|                       | Tens2                | Waveform 2 of the nerve stimulation electrotherapy |
|                       | Tens3                | Waveform 3 of the nerve stimulation electrotherapy |
| Automotive (17 types) | Ignition             | Ignition waveform of the automotive motor          |
|                       | ISO16750-2 SP        | Automotive starting profile with ringing           |
|                       | ISO16750-2 Starting1 | Automobile voltage waveform 1 due to starting      |
|                       | ISO16750-2 Starting2 | Automobile voltage waveform 2 due to starting      |
|                       | ISO16750-2 Starting3 | Automobile voltage waveform 3 due to starting      |
|                       | ISO16750-2 Starting4 | Automobile voltage waveform 4 due to starting      |
|                       | ISO16750-2 VR        | Automotive supply voltage profile for resetting    |
|                       | ISO7637-2 TP1        | Automotive transients due to disconnects           |
|                       | ISO7637-2 TP2A       | Automotive transients due to inductance in wiring  |
|                       | ISO7637-2 TP2B       | Automotive transients due ignition switching off   |
|                       | ISO7637-2 TP3A       | Automotive transients due to switching             |
|                       | ISO7637-2 TP3B       | Automotive transients due to switching             |
|                       | ISO7637-2 TP4        | Automotive supply profile during starting          |

|                                       |                |   |
|---------------------------------------|----------------|---|
|                                       | ISO7637-2 TP5A | Automotive transients due to battery disconnect |
|                                       | ISO7637-2 TP5B | Automotive transients due to battery disconnect |
|                                       | SCR            | SCR sintering temperature distribution          |
|                                       | Surge          | Surge signal                                    |
| Trigonome<br>Function (21 types)      | CosH           | Hyperbolic cosine                               |
|                                       | CosInt         | Integral cosine                                 |
|                                       | Cot            | Cotangent function                              |
|                                       | CotHCon        | Concave hyperbolic cotangent                    |
|                                       | CotHPro        | Protuberant hyperbolic cotangent                |
|                                       | CscCon         | Concave cosecant                                |
|                                       | CscPro         | Protuberant cosecant                            |
|                                       | CotH           | Hyperbolic cotangent                            |
|                                       | CscHCon        | Concave hyperbolic cosecant                     |
|                                       | CscHPro        | Protuberant hyperbolic cosecant                 |
|                                       | RecipCon       | Concave reciprocal                              |
|                                       | RecipPro       | Protuberant reciprocal                          |
|                                       | SecCon         | Concave secant                                  |
|                                       | SecPro         | Protuberant secant                              |
|                                       | SecH           | Hyperbolic secant                               |
|                                       | Sinc           | Sinc function                                   |
|                                       | SinH           | Hyperbolic sine                                 |
|                                       | SinInt         | Integral sine                                   |
|                                       | Sqrt           | Square root                                     |
|                                       | Tan            | Tangent   |
|                                       | TanH           | Hyperbolic tangent                              |
| Anti-Trigonome<br>Function (17 types) | ACos           | Arc cosine                                      |
|                                       | ACosH          | Arc hyperbolic cosine                           |
|                                       | ACotCon        | Concave arc cotangent                           |
|                                       | ACotPro        | Protuberant arc cotangent                       |
|                                       | ACotHCon       | Concave arc hyperbolic cotangent                |
|                                       | ACotHPro       | Protuberant arc hyperbolic cotangent            |
|                                       | ACscCon        | Concave arc cosecant                            |
|                                       | ACscPro        | Protuberant arc cosecant                        |
|                                       | ACscHCon       | Concave arc hyperbolic cosecant                 |
|                                       | ACscHPro       | Protuberant arc hyperbolic cosecant             |
|                                       | ASecCon        | Concave arc secant                              |
|                                       | ASecPro        | Protuberant arc secant                          |
|                                       | ASecH          | Arc hyperbolic secant                           |
|                                       | ASin           | Arc Sine  |

|                               |                            |   |
|-------------------------------|----------------------------|---|
|                               | ASinH                      | Arc hyperbolic sine                                   |
|                               | ATan                       | Arc tangent   |
|                               | ATanH                      | Arc hyperbolic tangent                                |
| Noise (6 types)               | NoiseBlue                  | Blue noise  |
|                               | NoiseBrown                 | Brown noise (Red noise)                               |
|                               | NoiseGray                  | Gray noise  |
|                               | NoisePink                  | Pink noise  |
|                               | NoisePurple                | Purple noise  |
|                               | NoiseWhite                 | White noise   |
| Window Function<br>(17 types) | Bartlett                   | Bartlett window                                       |
|                               | BarthannWin                | Modified Bartlett-Hann window                         |
|                               | Blackman                   | Blackman window                                       |
|                               | BlackmanH                  | BlackmanH window                                      |
|                               | BohmanWin                  | Bohman window   |
|                               | Boxcar                     | Rectangle window                                      |
|                               | ChebWin                    | Chebyshev window                                      |
|                               | GaussWin                   | Gaussian window                                       |
|                               | FlatTopWin                 | Flat Top weighted window                              |
|                               | Hamming                    | Hamming window  |
|                               | Hanning                    | Hanning window  |
|                               | Kaiser                     | Kaiser window   |
|                               | NuttallWin                 | Nuttall-defined minimum 4-term Blackman-Harris window |
|                               | ParzenWin                  | Parzen window   |
|                               | TaylorWin                  | Taylor window   |
|                               | Triang                     | Triangle window (Fejer window)                        |
|                               | TukeyWin                   | Tukey (tapered cosine) window                         |
| Complex Wavelets<br>(7 types) | 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  |
| Others (38 types)             | ABA_1_1                    |   |
|                               | ABA_1_2                    |   |
|                               | ALT_03                     |   |
|                               | ALT_04                     |   |



|             |                     |
|-------------|---------------------|
| ALT_05      |                     |
| AUDIO       |                     |
| circle      | Circle modulation   |
| COIL_2_1    |                     |
| COIL_2_2    |                     |
| DC_04       |                     |
| diamond     | Rhombus modulation  |
| ECT_1_2     |                     |
| EGR_2       |                     |
| EGR_3_2     |                     |
| EST_03_2    |                     |
| Heart       | Heart modulation    |
| 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     |                     |
| UNIT        | Voice clips         |

### 3.4.4 Create and edit arbitrary waveform

The powerful upper computer software can be used to create and edit complex arbitrary waveform (arbitrary amplitude and shape). For specific operations, please refer to UTG9000T Arbitrary

Waveform Programming Guide. The created arbitrary waveform can import to the function/arbitrary waveform generator.

## 3.5 Output Digital Protocol

The waveform generator can output three types of protocol coding: IIC, SPI and UART. (TTL) The corresponding protocol parameters can be set in different protocol modes. Turn on output terminal on the front panel to export the corresponding signal.

### 3.5.1 SPI Protocol

The waveform generator can create configurable SPI protocol signal parameters in SPI protocol mode.

#### Select SPI mode

Tap **Utility** → **Digital** → **SPI** accordingly, turn on SPI mode to output the current SPI protocol signal.



#### Clock setting

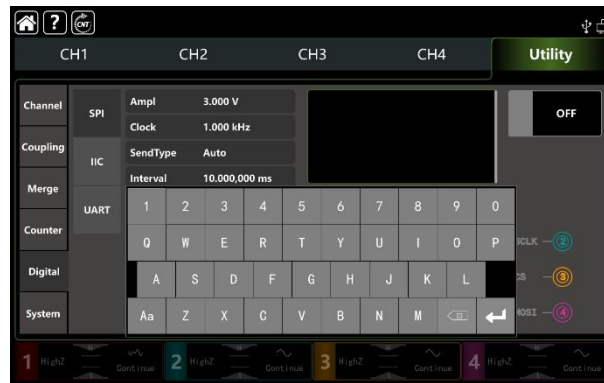
The sending clock of SPI can set by user's need. In SPI mode, tap **Clock** to pop-out visual numeric keyboard to enter values and select unit. The clock range can set to 1Hz~50MHz.

#### Data format setting

The data format of SPI can set by user's need. It have two format types: hexadecimal and character. In SPI mode, tap **Format** to step through HEX and Char.

#### Set data

Tap blank input box on the right side to pop-out visual numeric keyboard to enter bits and tap return key to complete an entry.



## Set send type

It have tow send types: Auto and Manual, In auto mode, the instrument sends the set protocol coding at a time limited length in certain time; in manual mode, push send key to send the set protocol coding.

### 1) Auto send mode

Tap **SendType** to select Auto mode (the default), turn on output function, the protocol signal automatically and continuously outputs the waveform from the channel interface.

### 2) Manual send mode

Tap **SendType** to select Manual mode (the default is Auto), tap **Send** on the right side to send the set waveform.

## Set interval time

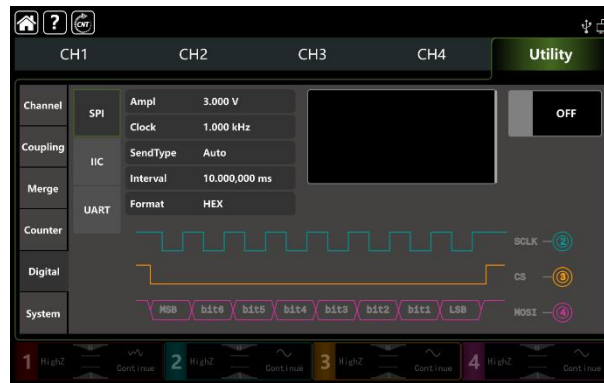
If the send mode is auto, set the interval time of data send according to the actual condition. Tap Interval to pop-out visual numeric keyboard to enter values and select unit. The interval time range can set to 20ns~1000s.

## Comprehensive example

In SPI mode, set hexadecimal 13, 21,34,55,89 as the data format, clock 15kHz, interval time 5ms, the setting steps as following,

### 1) Turn on SPI mode

Tap **Utility** → **Digital** → **SPI** accordingly.

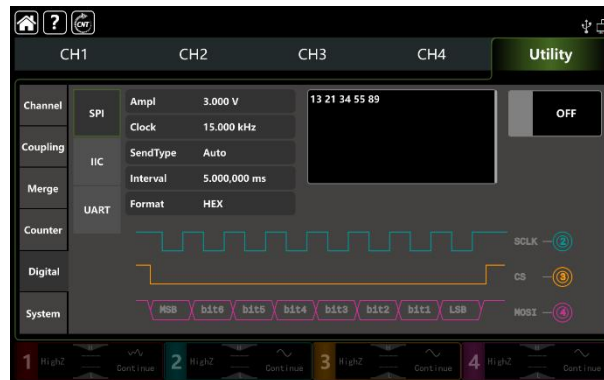


## 2) Set data parameter

Tap **Clock** to pop-out visual numeric keyboard to enter 15kHz.

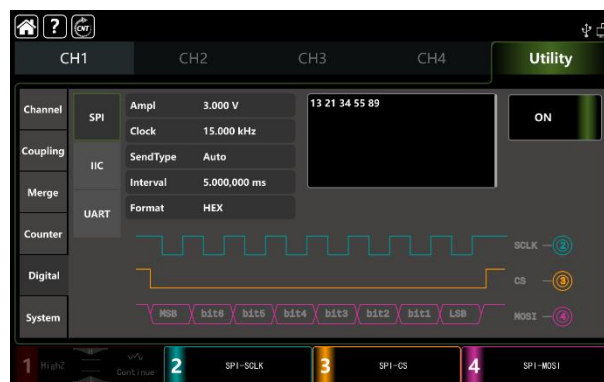
Tap **Interval** to pop-out visual numeric keyboard to enter 5ms.

Tap blank input box to enter 13, 21, 34, 55, 89.



## 3) Turn on output function

Tap **OFF** to turn on the output function, CH2 is SPI-SCLK, CH3 is SPI-CS, CH4 is SPI-MOSI. See the figure as below.

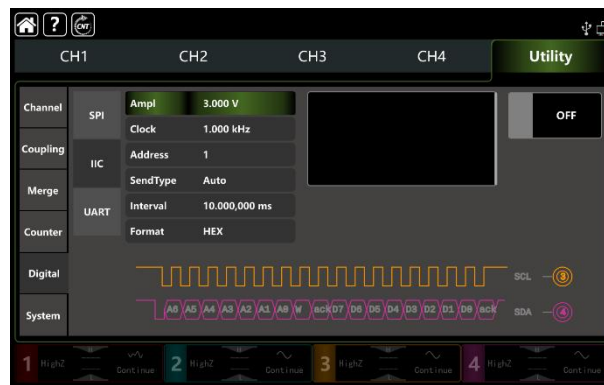


## 3.5.2 IIC Protocol

The waveform generator can create configurable protocol signal parameters in IIC protocol mode.

### Select IIC mode

Tap **Utility** → **Digital** → **IIC** accordingly, turn on IIC mode to output the current IIC protocol signal.



## Clock setting

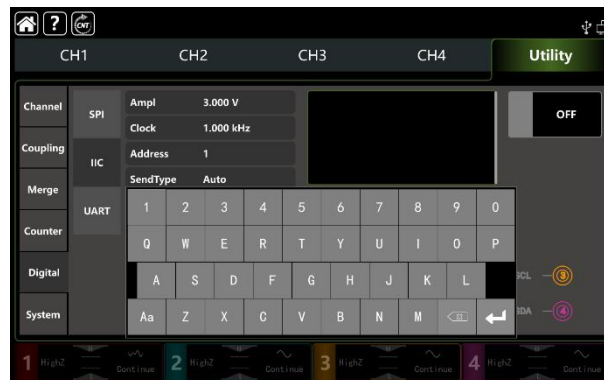
The sending clock of SPI can set by user's need. In IIC mode, tap **Clock** to pop-out visual numeric keyboard to enter values and select unit. The clock range can set to 1Hz~50MHz.

## Data format setting

The data format of IIC can set by user's need. It have two format types: hexadecimal and character. In IIC mode, tap **Format** to step through HEX and Char.

## Set data

Tap blank input box on the right side to pop-out visual numeric keyboard to enter bits and tap return key to complete an entry.



## Set send type

Please refer to section 3.5.1 [Set send type](#)

## Set interval time

If the send mode is auto, set the interval time of data send according to the actual condition. Tap Interval to pop-out visual numeric keyboard to enter values and select unit. The interval time range can set to 20ns~1000s.

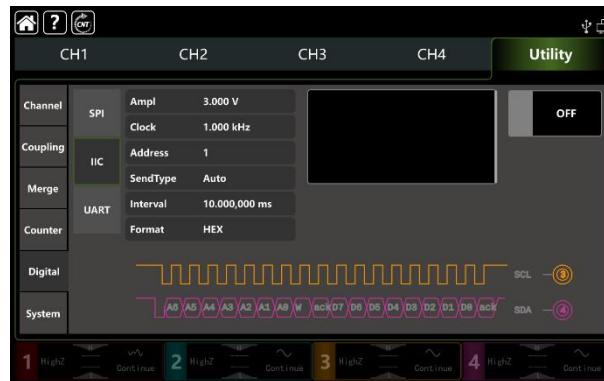
## Comprehensive example

In IIC mode, set the output address to 10 bit, values is 65, clock 500kHz, select decimalist 17, 19, 29,

29, 31 as the data format, interval time 5ms, the setting steps as following,

1) Turn on IIC mode

Tap **Utility** → **Digital** → **IIC** accordingly.



2) Set data parameter

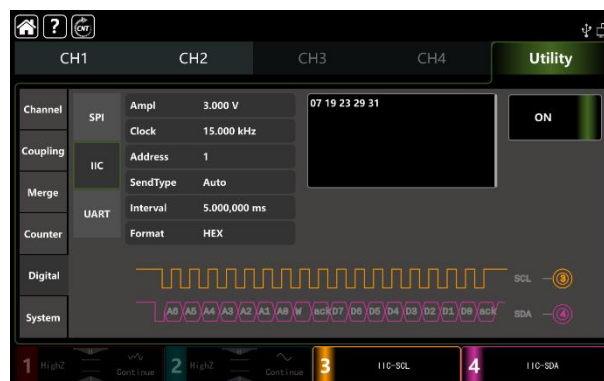
Tap **Clock** to pop-out visual numeric keyboard to enter 15kHz.

Tap **Interval** to pop-out visual numeric keyboard to enter 5ms.

Tap blank input box to enter 17, 19, 29, 29, 31.

3) Turn on output function

Tap **OFF** to turn on the output function, CH3 is IIC-SCL, CH4 is IIC-SDA. See the figure as below.



### 3.5.3 UART Protocol

The waveform generator can create configurable serial protocol signal parameters in UART protocol mode.

#### Select UART mode

Tap **Utility** → **Digital** → **UART** accordingly, turn on UART mode to output the current UART protocol signal.

#### Set baud rate

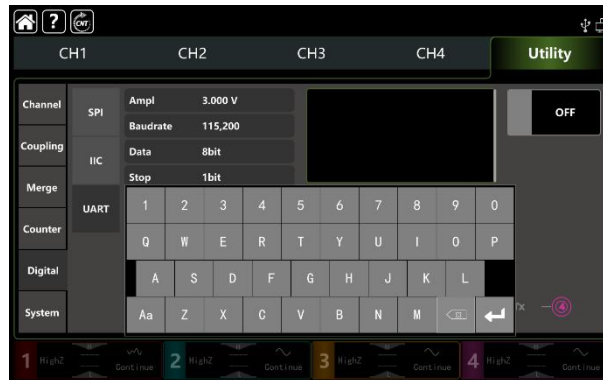
Baud rate can set by user's need. In UART mode, tap **Baudrate** to pop-out visual numeric keyboard to enter values and select unit. The baud rate range can set to 1-1000000.

## Data format setting

The data format of UART can set by user's need. It have two format types: hexadecimal and character. In UART mode, tap **Format** to step through HEX and Char.

## Set data

Tap blank input box on the right side to pop-out visual numeric keyboard to enter bits and tap return key to complete an entry.



## Set send type

Please refer to section 3.5.1 [Set send type](#)

## Select baud rate

The default baud rate is 115200. Tap **Baudrate** to pop-out visual numeric keyboard to enter values.

## Set bit

It can set different bit in UART mode, data have 4, 5, 6, 7, 8 bits. The default bit is 8. Tap **Baudrate** to pop-out visual numeric keyboard to enter values.

## Set stop bit

It can set different stop bit in UART mode. Tap **Stop** to step through 1bit and 2bit. The default is 1bit.

## Set verify mode

Tap **Verify** to step through None, Even, Odd.

## Comprehensive example

In UART mode, set the output baud rate to 4800, data bit to 8bit, set hexadecimal 5, 20, 13, 14 as the data format, select odd verify mode, stop bit as 1bit, interval time 2ms, the settings step as following,

- 1) Turn on IIC mode

Tap **Utility** → **Digital** → **UART** accordingly.



## 2) Set data parameter

Tap **Baudrate** to pop-out visual numeric keyboard to enter 4800.

Tap **Data** to pop-out visual numeric keyboard to select 8bit.

Tap input box to pop-out visual numeric keyboard to enter 2ms.

Data format and stop bit use the default option.



## 3) Turn on output function

Tap **OFF** to turn on the output function, CH4 is UART-TX. See the figure as below.





## Chapter 4 Troubleshooting

Possible faults in use of UTG9000T and troubleshooting methods are listed below. Please handle fault as the corresponding steps. If it can not be handled, contact with the dealer or local office and provide the model information (tap Utility → System ).

### 4.1 No Display on Screen (Blank Screen)

If the waveform generator still does not display after push the power switch on the front panel.

- 1) Inspect whether power source is connected well.
- 2) Inspect whether power switch on the back panel is connected well and on "I" position.
- 3) Inspect whether power button is connected well.
- 4) Restart the instrument,
- 5) If the instrument still can't work, please contact with the dealer or local office for product maintenance service.

### 4.2 No Waveform Output

In correct setting but the instrument has no waveform output display.

- 1) Inspect whether BNC cable and the output terminal is connected well.
- 2) Inspect button whether CH1, CH2, CH3 or CH4 is turned on.
- 3) Keep the current settings into USB, and then push Factory Setting to restart the instrument.
- 4) If the instrument still can't work, please contact with the dealer or local office for product maintenance service.

### 4.3 Fail to Recognize USB

- 1) Inspect whether USB works normally.
- 2) Make sure that USB is Flash type, the instrument does not apply to hard USB.
- 3) Restart the instrument and insert USB again to see if it can work normally.
- 4) If USB still fail to recognize, please contact with the dealer or local office for product maintenance service.

## Chapter 5 Service and Support

### 5.1 Upgrade Product Program

User can get the program update pack from UNI-T marketing department or official website. The waveform generator upgrade by built-in program upgrade system, to make sure that the current function/arbitrary waveform generator program is the latest release version.

1. Have a UTG9000T function /arbitrary waveform generator of UNI-T. Tap **Utility** → **System** to get the information of model, hardware and software version.
2. Upgrade the instrument according to steps of the update file.

### 5.2 Contact US

You can directly contact with Uni-Trend Technology (China) Limited (UNI-T, Inc.) in mainland China if you have any inconvenience in use of the product:

Beijing time 8:00 -17:30, Monday-Friday or e-mail us.

Our e-mail address: **infosh@uni-trend.com.cn**

Please contact with local dealer or sales center of UNI-T for products outside the mainland China. Service support, many products of UNI-T are equipped with plans for extending warranty period and calibration period. Please contact with local dealer or sales center of UNI-T.

Please visit our website to get list of addresses of service centers in various regions.

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

## Appendix A: Factory Setting

| Parameter                       | Factory Default Setting |
|---------------------------------|-------------------------|
| Channel Parameter               |                         |
| Current carrier wave            | Sine wave               |
| Output load                     | High resistance         |
| Channel merge                   | Off                     |
| Channel coupling                | Off                     |
| Sync output                     | Off                     |
| Channel output                  | Off                     |
| Channel output inverse          | Off                     |
| Amplitude limit                 | Off                     |
| Upper amplitude limit           | +1V                     |
| Lower amplitude limit           | -1V                     |
| Fundamental Wave                |                         |
| Frequency                       | 1kHz                    |
| Amplitude                       | 100mVpp                 |
| DC offset                       | 0mV                     |
| Initial phase                   | 0°                      |
| Duty ratio of square wave       | 50%                     |
| Degree of symmetry of ramp wave | 50%                     |
| Duty ratio of pulse wave        | 50%                     |
| Rising edge of pulse wave       | 1ns                     |
| Falling edge of pulse wave      | 1ns                     |
| Arbitrary Wave                  |                         |
| Built-in arbitrary wave         | ACos                    |
| Play mode                       | DDS                     |
| AM Modulation                   |                         |
| Modulation source               | Internal                |
| Modulation wave                 | Sine wave               |
| Modulation frequency            | 100Hz                   |
| Modulation depth                | 100%                    |

|                      |            |
|----------------------|------------|
|                      |            |
| FM Modulation        |            |
| Modulation source    | Internal   |
| Modulation wave      | Sine wave  |
| Modulation frequency | 100Hz      |
| Frequency deviation  | 1kHz       |
|                      |            |
| PM Modulation        |            |
| Modulation source    | Internal   |
| Modulation wave      | Sine wave  |
| Modulation frequency | 100Hz      |
| Phase deviation      | 180°       |
|                      |            |
| PWM Modulation       |            |
| Modulation source    | Internal   |
| Modulation wave      | Sine wave  |
| Modulation frequency | 100Hz      |
| Duty ratio deviation | 49.999825% |
|                      |            |
| ASK Modulation       |            |
| Modulation source    | Internal   |
| ASK rate             | 100Hz      |
|                      |            |
| FSK Modulation       |            |
| Modulation source    | Internal   |
| FSK rate             | 100Hz      |
| Hopping frequency    | 100kHz     |
|                      |            |
| PSK Modulation       |            |
| Modulation source    | Internal   |
| PSK rate             | 100Hz      |
| PSK phase            | 0°         |
|                      |            |
| BPSK Modulation      |            |
| Carrier wave         | Sine wave  |

|                      |           |
|----------------------|-----------|
| Modulation source    | PN3       |
| Phase                | 0°        |
| Phase 1              | 90°       |
| Bitrate              | 100bps    |
|                      |           |
| QPSK Modulation      |           |
| Carrier wave         | Sine wave |
| PN Code              | PN3       |
| Bitrate              | 100bps    |
| Phase 1              | 0°        |
| Phase 2              | 90°       |
| Phase 3              | 180°      |
| Phase 4              | 270°      |
|                      |           |
| OSK Modulation       |           |
| Modulation source    | Internal  |
| Oscillation time     | 2ms       |
| OSK rate             | 100Hz     |
|                      |           |
| DSB-AM Modulation    |           |
| Modulation source    | Internal  |
| Modulation wave      | Sine wave |
| Modulation frequency | 100Hz     |
| Modulation depth     | 100%      |
|                      |           |
| QAM Modulation       |           |
| Constellation        | QAM4      |
| Coding code          | PN3       |
| QAM rate             | 100bps    |
|                      |           |
| SUM Modulation       |           |
| Modulation source    | Internal  |
| Modulation wave      | Sine wave |
| Modulation frequency | 100Hz     |
| Modulation depth     | 100%      |

|                                       |                           |
|---------------------------------------|---------------------------|
| Frequency Sweep                       |                           |
| Type of frequency sweep               | Linear                    |
| Initial frequency                     | 1kHz                      |
| Stop frequency                        | 1MHz                      |
| Frequency Sweep time                  | 10ms                      |
| Trigger source                        | Internal                  |
| Trigger output                        | OFF                       |
| Pulse string                          |                           |
| Mode of pulse string                  | N cycle                   |
| Initial phase                         | 0°                        |
| Burst period (period of pulse string) | 5ms                       |
| Cycle number                          | 2                         |
| Gated polarity                        | Positive                  |
| Trigger source                        | Internal                  |
| Trigger output                        | OFF                       |
| System Parameter                      |                           |
| IP type                               | DHCP                      |
| Clock source                          | Internal                  |
| Clock output                          | OFF                       |
| Sound of buzzer                       | ON                        |
| Separator of numbers                  | ,                         |
| Backlight                             | 100%                      |
| Language*                             | Depend on factory setting |

## Appendix B: Maintenance and Cleaning

### General maintenance

- Please don't store or place the instrument where LCD is exposed to direct sunlight for a long time.
- To avoid damage to the instrument or connecting line, please don't place it in mist, liquid or solvent.

### Cleaning

- Clean the instrument frequently as use condition.
- Cut off the power, and then clean with soft cloth that is wet but not dripping (wipe floating dust off the exterior of instrument with mild detergent or clear water, don't use chemical medicine or detergent containing benzene, methylbenzene, dimethylbenzene, acetone and other potent substances).
- Be careful scratch LCD protection screen when cleaning the instrument.
- Protect the instrument away from any corrosive liquid.

**WARNING:** please confirm that the instrument is completely dry before reconnecting power, to avoid electrical short circuit or even personal injury due to moisture.

This user manual may be revised without prior notice

## Limited Warranty and Liability

UNI-T guarantees that the Instrument product is free from any defect in material and workmanship within three years from the purchase date. This warranty does not apply to damages caused by accident, negligence, misuse, modification, contamination, or improper handling. If you need a warranty service within the warranty period, please contact your seller directly. UNI-T will not be responsible for any special, indirect, incidental, or subsequent damage or loss caused by using this device. For the probes and accessories, the warranty period is one year. Visit [instrument.uni-trend.com](http://instrument.uni-trend.com) for full warranty information.



Learn more at: [www.uni-trend.com](http://www.uni-trend.com)



Register your product to confirm your ownership. You will also get product notifications, update alerts, exclusive offers and all the latest information you need to know.

**UNI-T** is the licensed trademark of UNI-TREND TECHNOLOGY (CHINA) CO., Ltd.

UNI-T products are protected under patent laws in China and internationally, covering both granted and pending patents. Licensed software products are the properties of UNI-Trend and its subsidiaries or suppliers, all rights reserved. This manual contains information that replaces all earlier published versions. The product information in this document subject to update without notice. For more information on UNI-T Test & Measure Instrument products, applications, or service, please contact UNI-T instrument for support, the support center is available on [www.uni-trend.com](http://www.uni-trend.com) -> [instruments.uni-trend.com](http://instruments.uni-trend.com)

<https://instruments.uni-trend.com/ContactForm/>

### Headquarter

UNI-TREND TECHNOLOGY (CHINA)  
CO., Ltd.  
Address: No.6, Industrial North 1st  
Road, Songshan Lake Park, Dongguan  
City, Guangdong Province, China  
Tel: (86-769) 8572 3888

### Europe

UNI-TREND TECHNOLOGY EU GmbH  
Address: Steinerne Furt 62, 86167  
Augsburg, Germany  
Tel: +49 (0)821 8879980

### North America

UNI-TREND TECHNOLOGY US INC.  
Address: 2692 Gravel Drive,  
Building 5, Fort Worth, Texas 76118  
Tel: +1-888-668-8648