User's Manual

UTG9000T Series

Function/ Arbitrary Waveform Generator

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

If the original purchaser sells or transfers the product to the third party within 3 years after purchase, the warranty period should be 3 years from the original purchaser purchases the product from UNI-T or the authorized distributor. Accessories and fuse, etc. are not protected by this warranty.

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 fraquency synthesis) function, it can present high precision, stable, pure and low distortion signal.Plus, it can also offer wave in high frequeny with quick rising edge and falling edge. It is a high-performance, multifunction four channel arbitrary function generator. Convience 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
- ✧ Adjustable noise bandwidth
- ✧ Sine wave output: 600MHz/400MHz/200MHz, 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 amplititude, independent and adjustable 2~16 hamronic 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（opional）or 20MB arbitrary file（.bsv or.csv）, the instrument status file
- ✧ It can read arbitrary wave file（.bsv or.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

- ✧ Double channel can be internal/external modulating, internal/external/trigger respectivelyor 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 configration interface: USB Host,USB Device, LAN, independent input and output 10MHz colock source
- ✧ Easy-to-use multi-purpose knob and numeric keyboard
- ✧ Offer NeptuneLab system management software

Table of Contents

Chapter 1 Safety Information

1.1 Terms and symbols

Terms in the manual

The following terms may used in the manual

WARNING: Warning statement, identifing conditions and and procedures that are dangerous to the user.

CAUTION: Cautionary statement, identifing conditions and procedures that may cause damage to the product and other properties.

Terms on the product

The following terms may used on the product:

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

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

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

Symbols on the product

The following symbols may used on the product

 AC

 Measuring ground terminal

 Frame ground terminal

 ON/OFF

 Danger！High voltage

 Caution, consult the user's manual

 Protective ground terminal

 Conforms to European Union directivies

 Certified by CSA Group to North American safety standards

 N10149 C-tick is registered trademark of Spectrum Management Agency of Australia. It indicates conformity with provisions of Australian EMC Framework formulated according to terms of *Wireless Communication Act* in 1992.

Containing at least one of six harmful substances that exceed maximum concentration value (MCV) and environment-friendly use period (EPUP) of 40 years.

ICES/NMB-001 This manual indicates that the product conform to standard ICES-001 of Canada.

1.2 General Safety Overview

This instrument is designed and produced in strict accordance with GB4793 Safety Requirements for Electronic Measuring Apparatus and IEC61010-1 safety standard, up to Pollution Degree II and overvoltage standard CAT Ⅱ 1000V.

Please read the followinh preventive safety measures:

- In order to prevent electric shock or fire, please use power line and adapter dedicated to this product and approved by the local country.
- This product is grounded through protective ground lead in the power line. In order to prevent electric shock, please inspect whether the power socket to be used for the product is grounded. Make sure that the protective ground terminal connect to the power line is reliable before connectes any other input and output terminal.
- To avoid personal injury and prevent damage to the product or any product connected to this product. In order to avoid possible danger, the product can only be used in the specified scope. Only personnel that have received professional training can execute maintenance procedures.
- In order to prevent fire or electric shock, please pay attention to all rated values and signs of the product. Befor using the product, please read user's manual for further information about the rated value.
- Do not use input voltage above rated value of the instrument.
- Inspect the whether accessories suffer from mechanical damage before use. If so, please replace them.
- Only use the accessories provided of the prouduct. Don't use that if damaged.
- Don't insert metal objects into input and output terminal of the product.
- If the instrument is suspicious of damage, let maintenance personnel to inspect it.
- Don't operate the inustrument when crate is opened.
- Don't operate in humid environment.
- Please don't operate in inflammable and explosive environment.
- Keep the surface of product clean and dry

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Chapter 2 Qick 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 relvenant 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 damged.It can not operate properly or performance test fauilre. 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 sample, visual and easy to use. See Figure 2-1

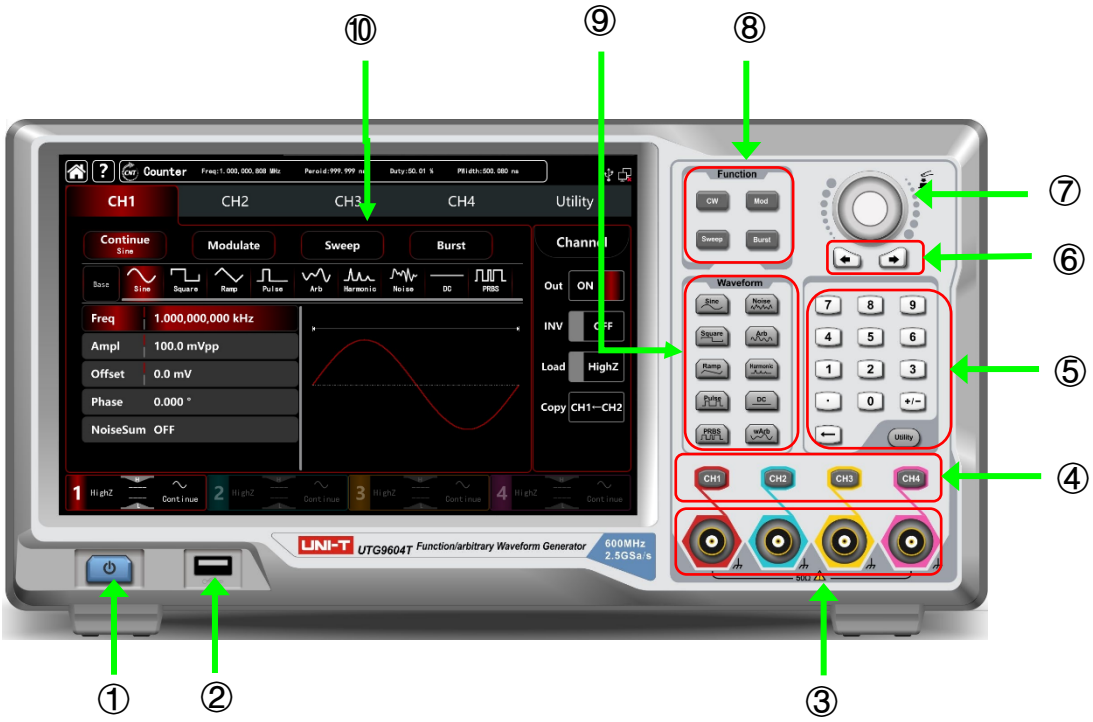


Figure 2-1 Front Panel Structure

①. ON/OFF

Supply voltage of power source is AC 100V~240V. Frequency is 45Hz~440Hz.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).Aferwards, the screen enters function interdace 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 stauts file. USB interface can also used to upgraded the system program, to ensure that the current program of function/abitraty 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 measns 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. Seclect 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 stauts 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

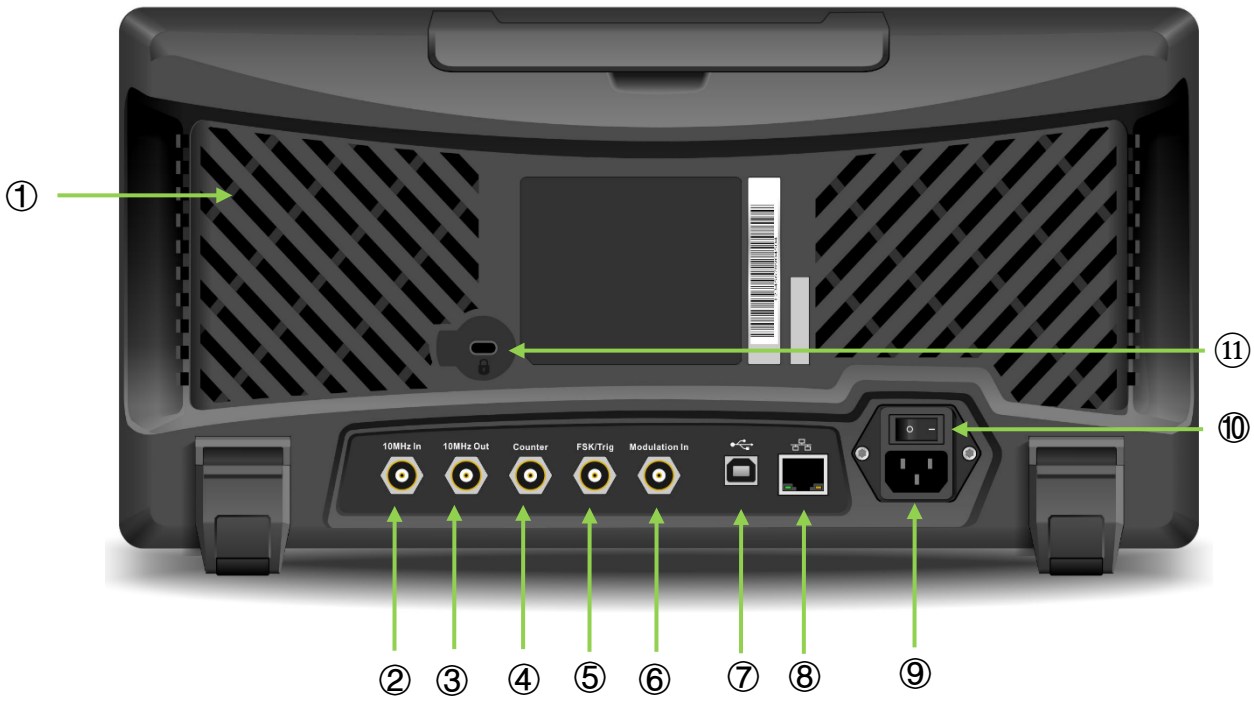


Figure 2-2 Back Front Structure

①. Heat Emission Hole

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

②. 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.

③. External 10MHz intput 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.

④. Frequency Counter Interface

Input signal throught the interdace when using frequency counter.

⑤. External Digital Moudlation 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 through external analog modulation. The corresponding modulation of depth, frequency deviation, phase deviation or duty ratio deviation is controlled by ±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 contr 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

AC power :100~240V，45~440Hz, power fuse: 250V，T2A.

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

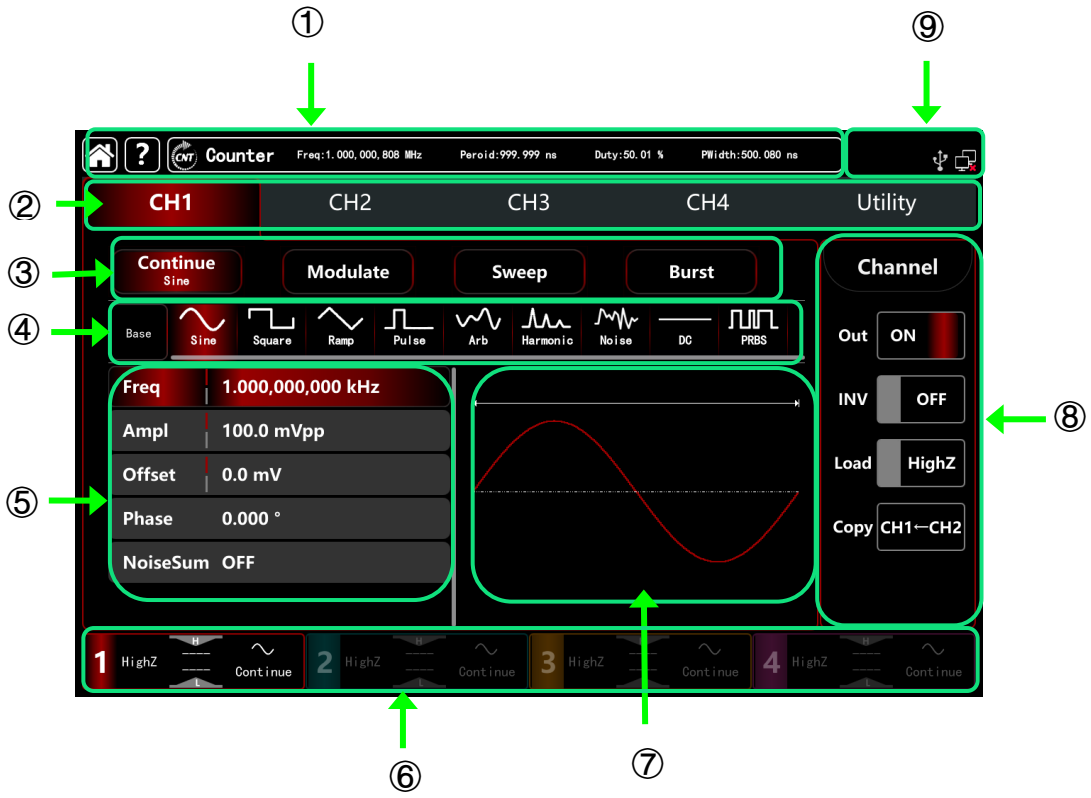


Figure 2-3 Touch Screen Display Interface

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, Frequenct counter: this area does not change with other interface jum

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

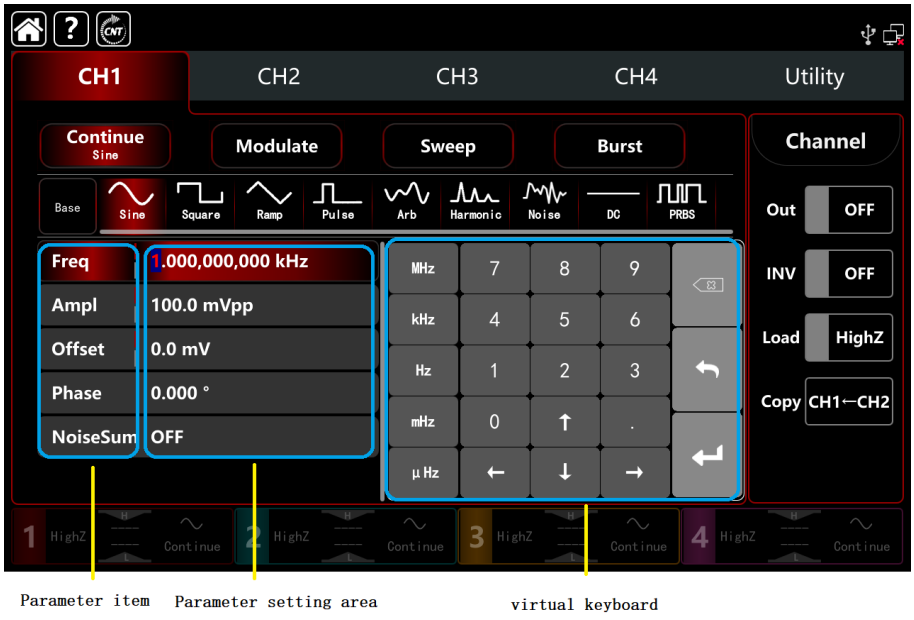


Figure 2-4 Parameter Editing

⑥.CH tab: the current channel which choosed will be highlight.

1) “HighZ”presents load with high resistance,it can set to be 50Ω.

2)  pesents the output wave is sine wave.

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 output 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 lisrt 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.

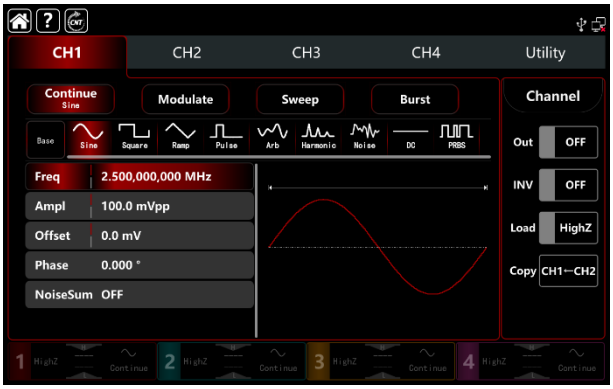


Figure 2-4 Frequency Settings

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

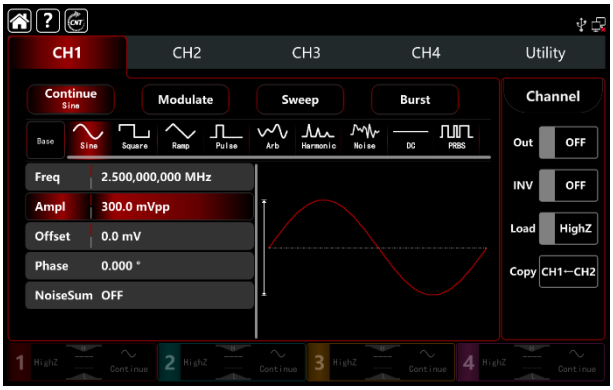


Figure 2-5 Amplitude Settings

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

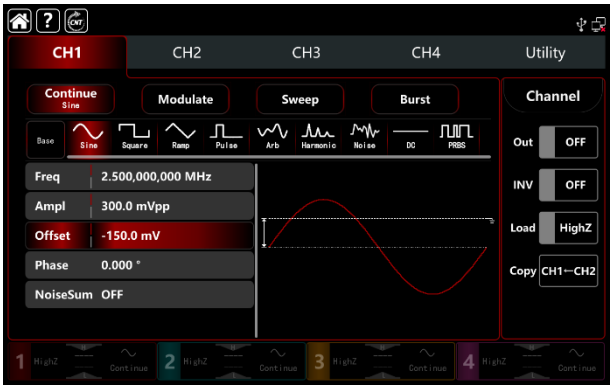


Figure 2-6 DC Offset Voltage Settings

2.3.4 Squre Wave Settings

The duty ratio of square wave presents the time quantum of the square wave at a high leve 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.

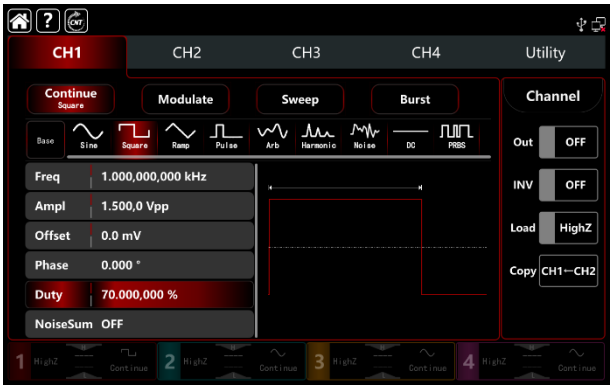


Figure 2-7 Square Settings

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 numerice 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 FEdge.

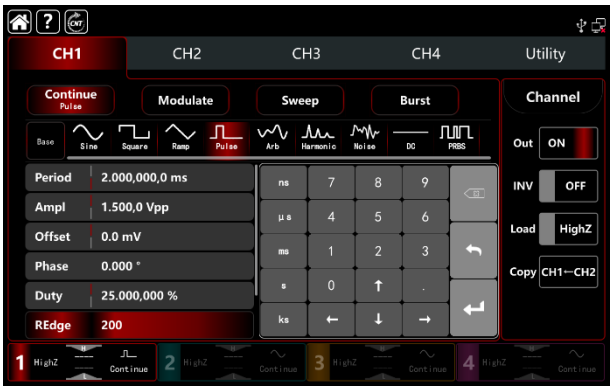


Figure 2-8 Pulse Wave Settings

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.

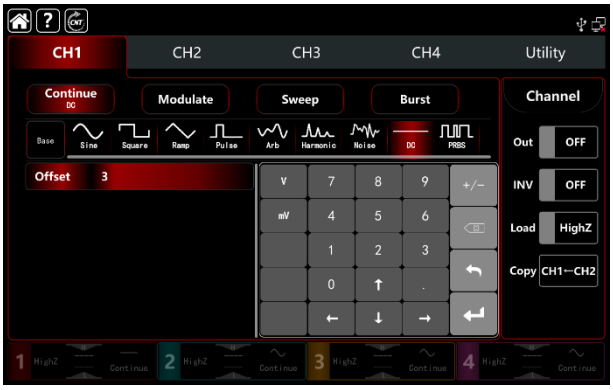


Figure 2-9 DC Settings

2.3.7 Ramp Wave Settings

The symmetry presents the ramp slope is the positive of time quatunm 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 Ampiltude tab, pop-out the virtual numeric keyboard to enter 2Vpp.

3） Tap Symmetry tab, pop-ou numeic keyboard to enter 60%.

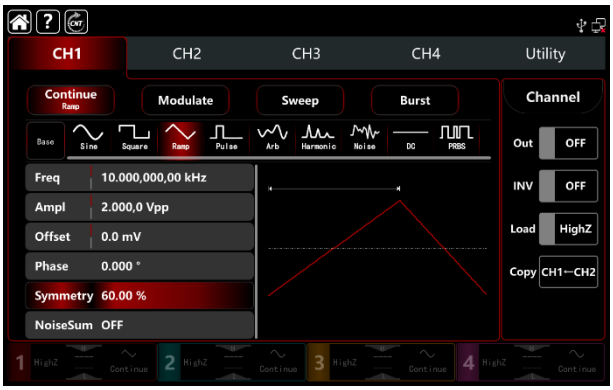


Figure 2-10 Ramp Wave Settings

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.

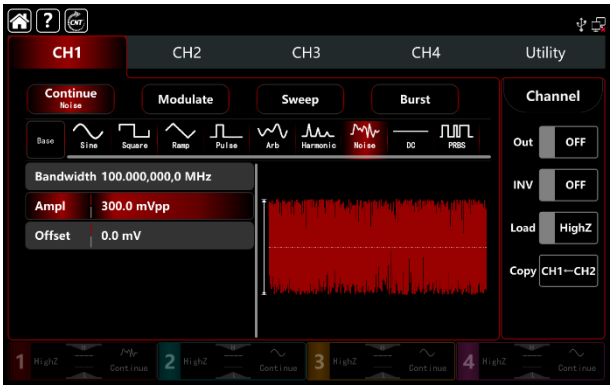


Figure 2-11 Noise Wave Settings

2.3.9 Hamonic Wave Settings

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

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

Usually, the component with frequency f1 is called the carrier wave, f1 serve as the carrier frequency, A1 serve as the carrier wave amplitude, φ1 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 typs 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 numbe tab, pop-out the virtual numeric keyboard to enter 2.
5) Tap Type tab to select All.
6) Tap Amplitue of harmonic wave tab, pop-out the virtual numeric keyboard to enter 4Vpp.

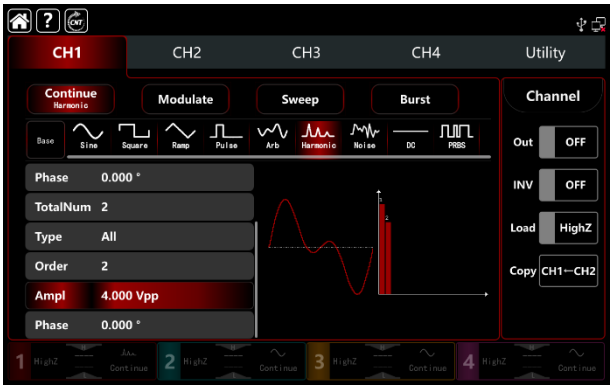


Figure 2-12 Ramp Wave Settings

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.

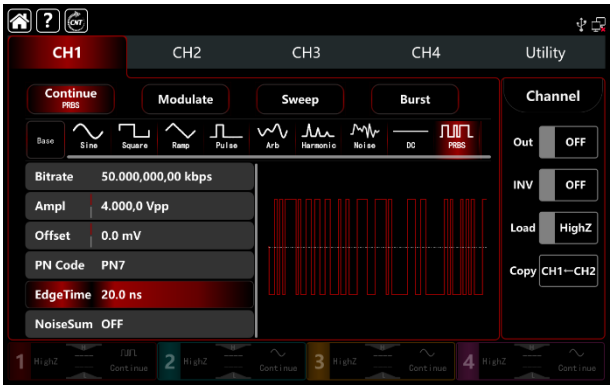


Figure 2-13 PRBS Wave Settings

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

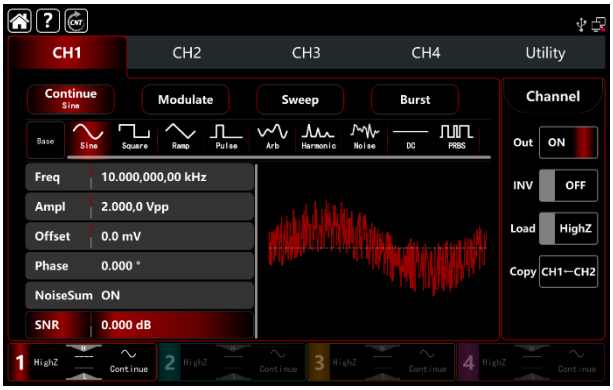


Figure 2-14 Noise Superposition Settings

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 resistence	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 chanel 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 CH3 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

Meue	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

Meue	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: The coupling setting of CH3 to CH4 is the same as CH1 coupling to CH2.

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.

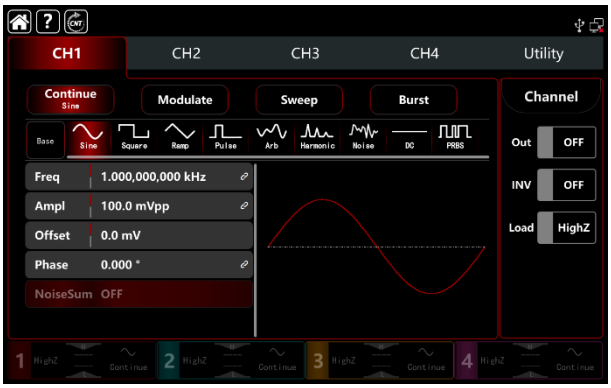


Figure 2-15 Channel Coupling

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.

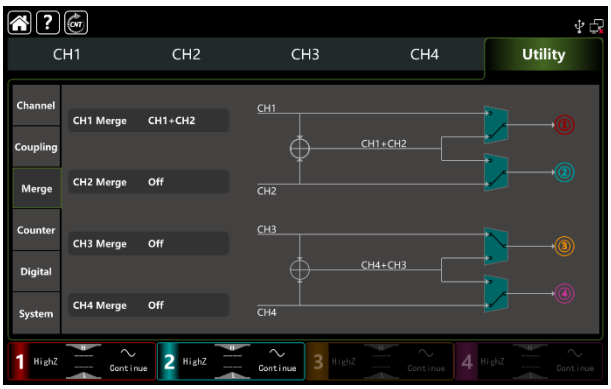


Figure 2-16 Channel Merging

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

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 conculateing the measuring 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 TrigLeve, 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 Internet Settings

Table 2-7 Internet Settings

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

Tap Utility→System to enter the Internet 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 apllied 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 apllied 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 apllied 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.

2.4.6 System

Table 2-8 System Settings

Menu	Sub-menu	Setting	Description
System	Language	Chiese, 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, Set5	Save as a default staute
	Phase	Sync, Independent	Restore to factory settings or save the settings
	Manual		
	Save		Save the preview settings
	Default		
	About		Model name,version information and company address

Tap Utility→System to make the relevant settings

1. Language

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

1. Separator

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

2. Beep

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

3. Backlight

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

4. 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.

5. 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  .

6. 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 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.

7. Phase

Tap Phase step through Sync/Independent.

Sync: The start phase of four channels are associated.

Independent: The start phase of channel is independent.

8. Power On

Tap Powe On to step through Default, Last, Set1, Se2, Set3, Set4, and Set5.

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

9. 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.

10. 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.

11. About

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

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, squarem 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.

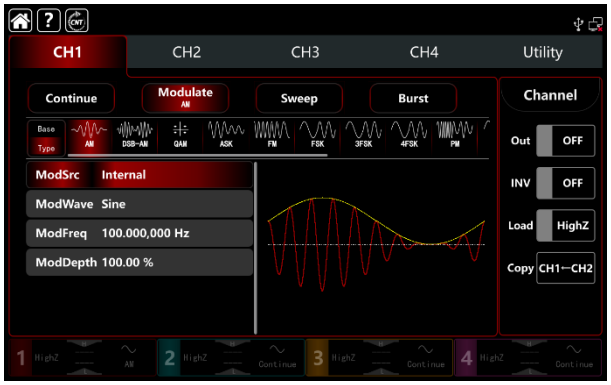
3.1.1 AM (Amplitude Modualtion)

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.

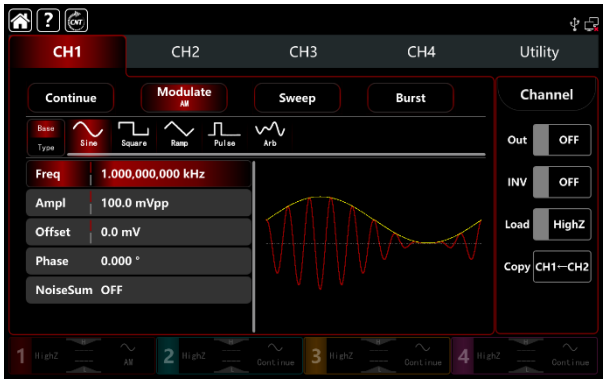
Select AM Modulation

Tap CH1→Modulate→AM to turn on the AM modualtion, the instrument output the moduluated 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		UTG9404T		UTG9204T	
	MIN	MAX	MIN	MAX	MIN	MAX
Sine wave	1uHz	600MHz	1uHz	400MHz	1uHz	200MHz

Square wave	1uHz	200MHz	1uHz	30MHz	1uHz	30MHz
Ramp wave	1uHz	30MHz	1uHz	20MHz	1uHz	10MHz
Pulse wave	1uHz	200MHz	1uHz	160MHz	1uHz	120MHz
Arbitrary wave	1uHz	100MHz	1uHz	80MHz	1uHz	60MHz

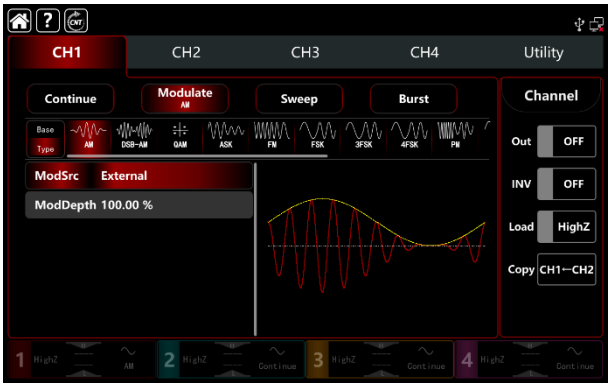
Table 4-2 The carrier wave frequency of CH3 and CH4

Carrier waveform	Frequency					
	UTG9604T		UTG9404T		UTG9204T	
	MIN	MAX	MIN	MAX	MIN	MAX
Sine wave	1uHz	200MHz	1uHz	160MHz	1uHz	120MHz
Square wave	1uHz	60MHz	1uHz	50MHz	1uHz	40MHz
Ramp wave	1uHz	10MHz	1uHz	8MHz	1uHz	3MHz
Pulse wave	1uHz	60MHz	1uHz	50MHz	1uHz	40MHz
Arbitrary wave	1uHz	60MHz	1uHz	50MHz	1uHz	40MHz

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

1) External source

When the modulation source is external, the modulation wave and frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The AM modulation depth is controlled by the ±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 1uHz~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 frequence will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

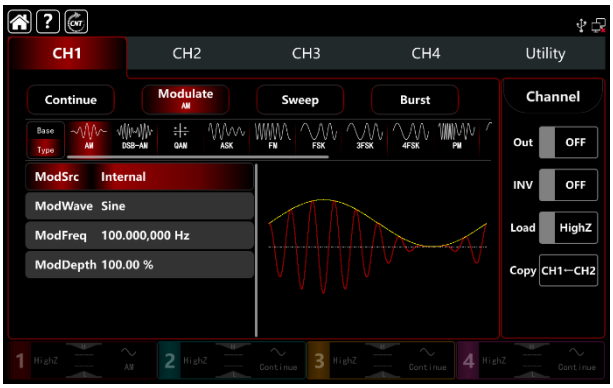
Modulation depth settings

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 ±5V peak-to- peak voltage (connect with the terminal of 50Ω.)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 ±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

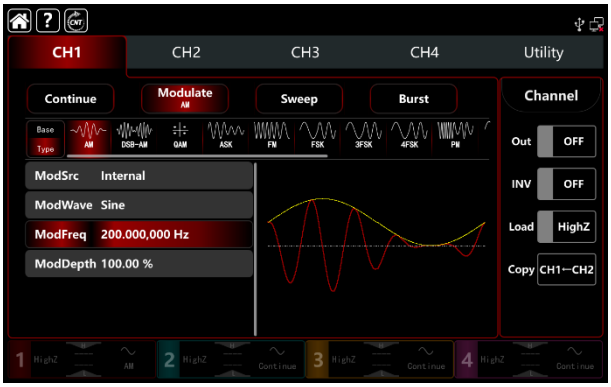
In AM modulation mode, set an internal 200Hz sine wave as a modulating signal, another carrier wave signal with freqeuency 10kHz, amplitude 200mVpp, duty ratio 45%, and set the modulation depth to 80%, the settings steps as following,

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

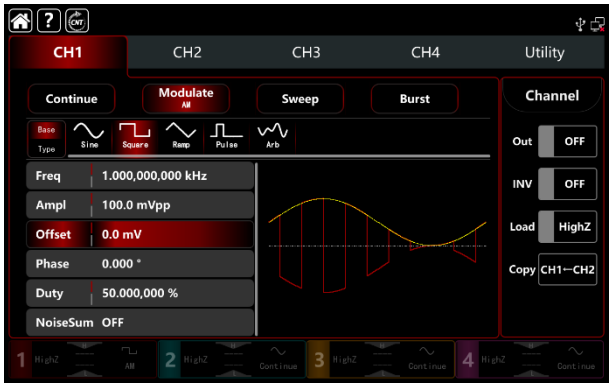
Tap Base to select Square as the carrier waveform (the default option is sine wave).

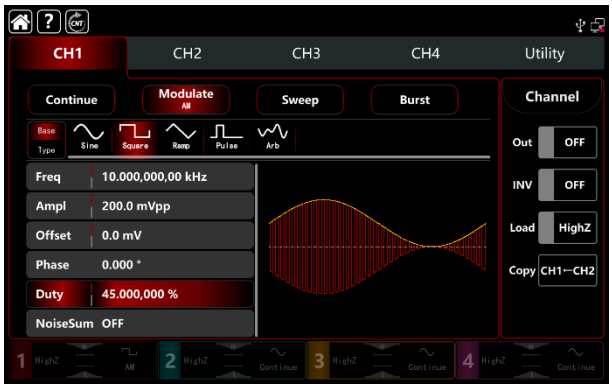
Tap Freq tab to pop-out visual numeric keyboard to enter 10kHz.

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

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

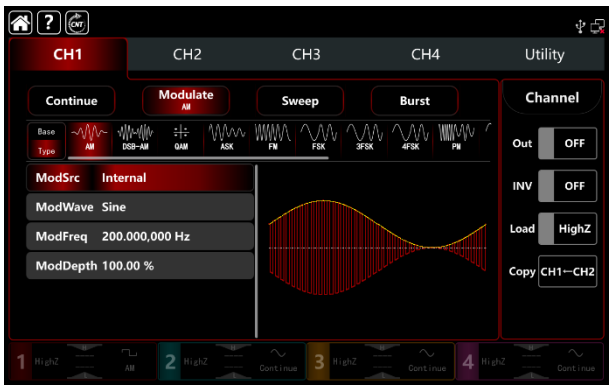
See the Figure as following,



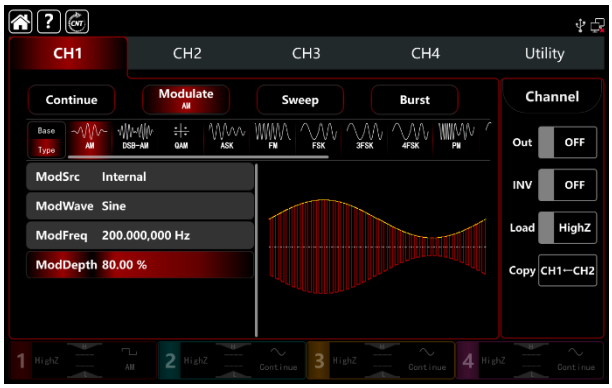


4）Set the modulation depth

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

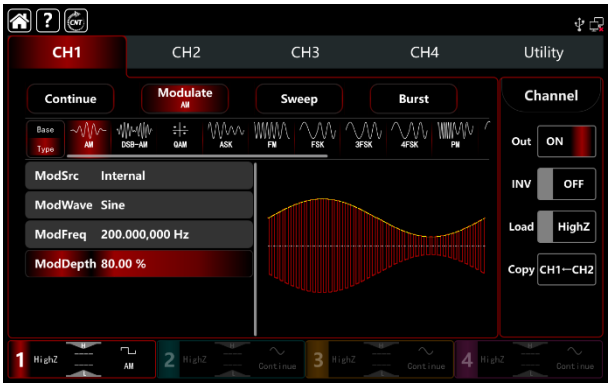


Tap ModDepth tab to pop-out visual numeric keyboard to enter 80%.

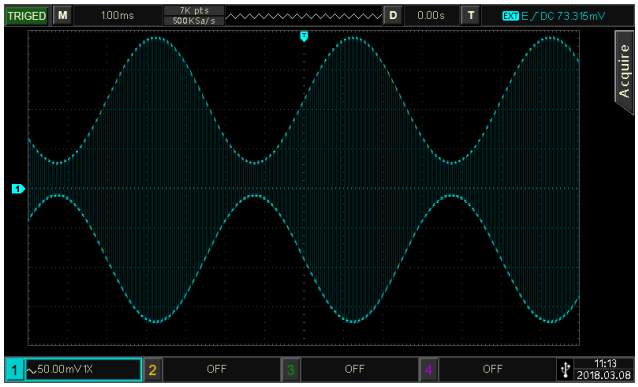


5）Turn on the output channel

Tap channel Out to ON or push CH1 on the front panel to quick set the output channel,and it can aslo 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,

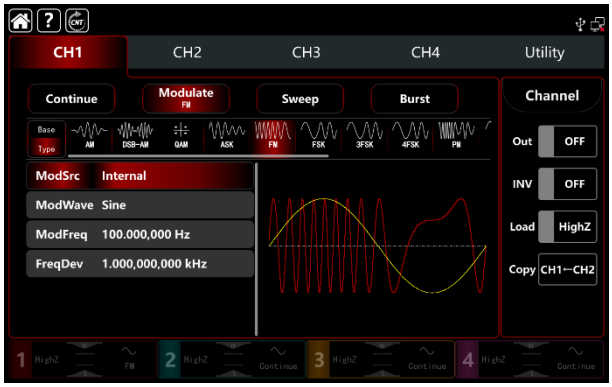


3.1.2 FM (Frequency Modulation)

In frequence modulation mode, the modulated waveform is consist of the carrier wave and the modulation wave. The carrier wave frequency 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.

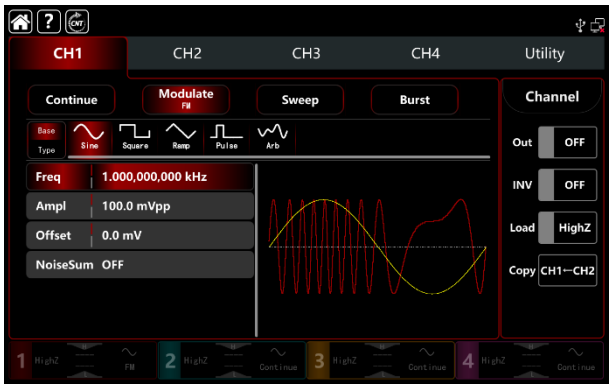
Select FM modulation

Tap CH1→Modulate→FM to turn on FM modulation, the instrument output the moduluated 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.

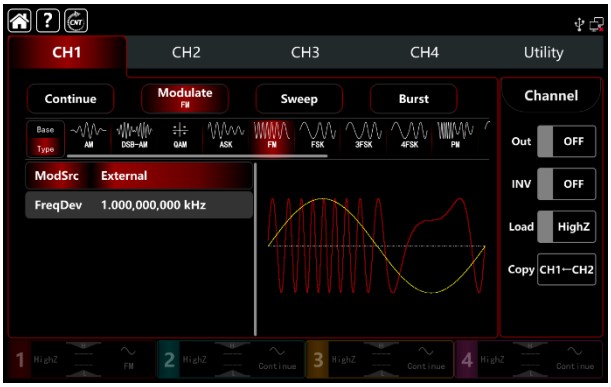


Carrier wave frequency settings

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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The FM offset is controlled by the ±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 1uHz~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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

Modulated frequency deviation settings

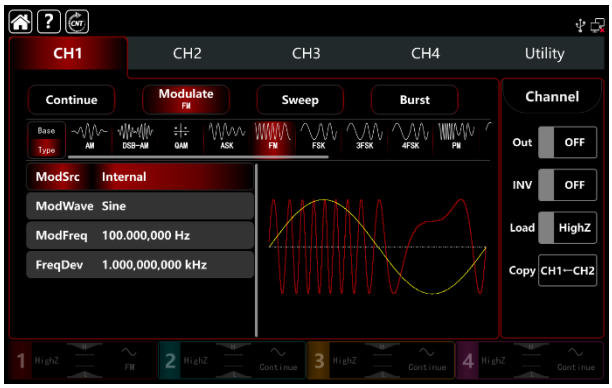
Frequency deviation indicates the frequency deviation changes between in the FM-modulated wave frequency and the carrier wave frequency. FM deviation range can set from 0uHz to half of the maximum current carrier wave frequency. The default range is 1kHz. Rotate multifunction knob, push direction key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

- The frequency deviation must ≤ 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 ≤ 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

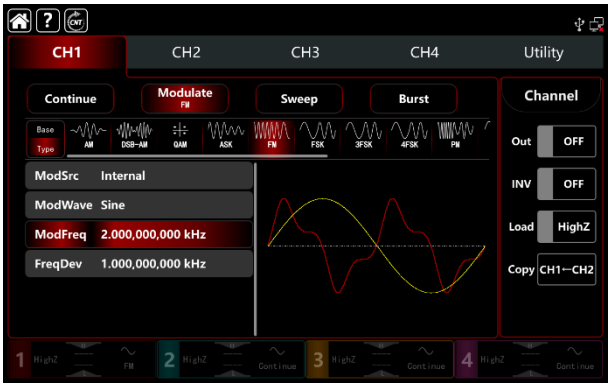
In FM modulation mode, set an internal 2kHz square wave as a modulating signal, another sine wave with freqeuency 10kHz, amplitude 100mVpp as a carrier wave signal , and set the frequency deviation to 5kHz, the settings steps as following,

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



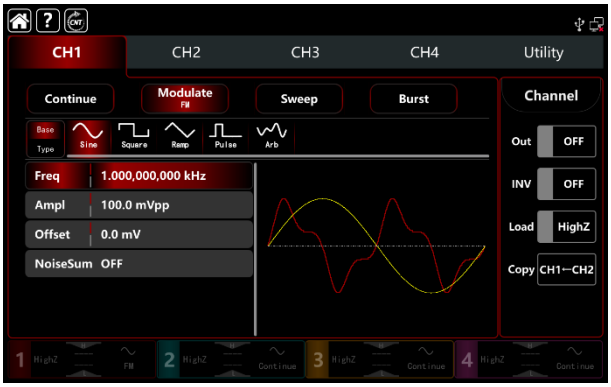
2）Set the parameter of modulating signal

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

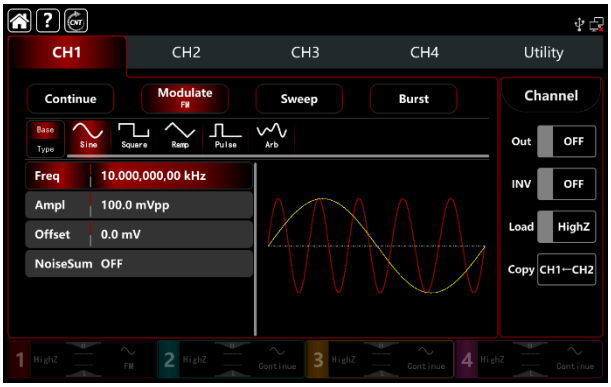


3）Set the parameter of the carrier wave signal

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

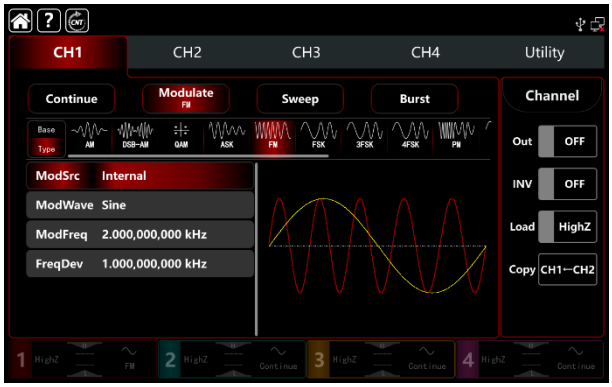


Tap Freq to pop-out visual keyboard to enter 10kHz.

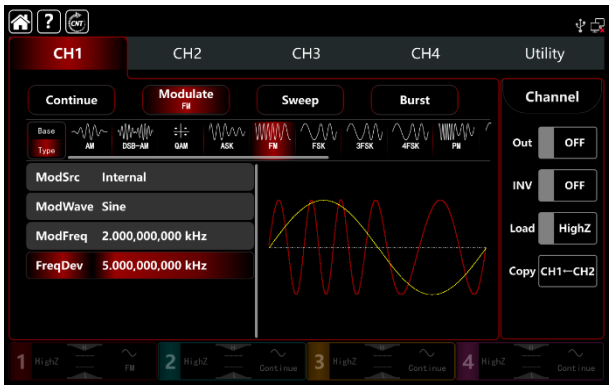


4）Set the frequency deviation

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

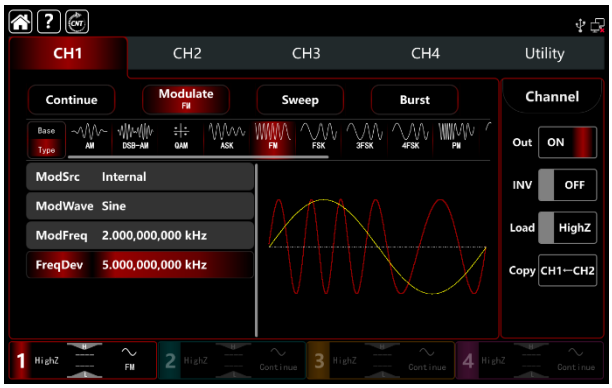


Tap FreqDev tab to pop-out visual numeric keyboard to enter 5kHz.

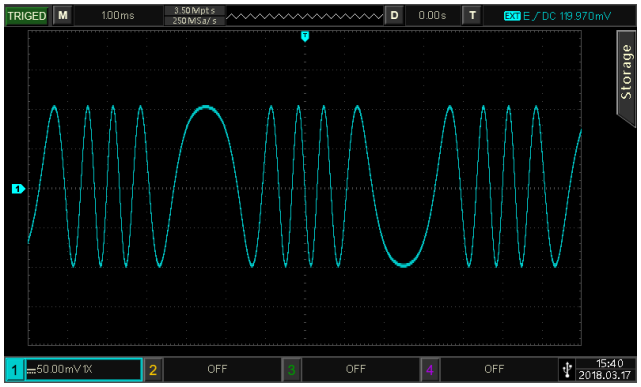


5）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

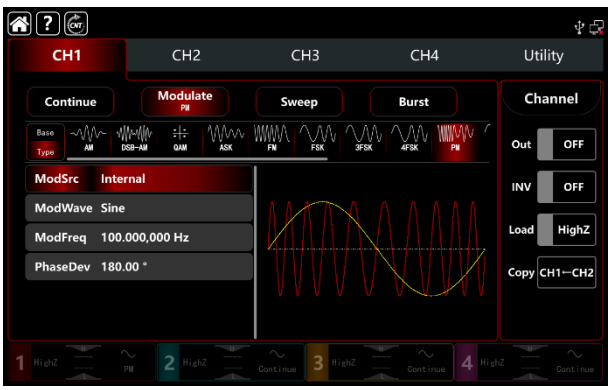


3.1.3 PM (Phase Modualtion)

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.

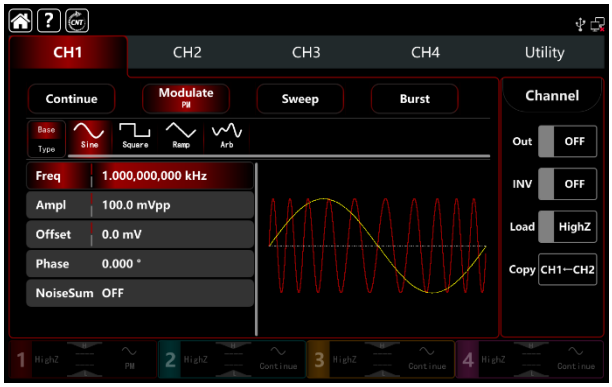
Select PM modulation

Tap CH1→Modulate→PM to turn on the AM modualtion, the instrument output the moduluated 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.

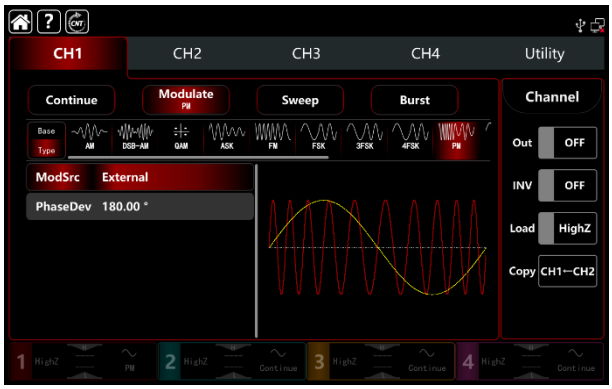


Carrier wave frequency settings

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. Whturn 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 frequence will be hidden in parameter list. The PM offset is controlled by the ±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° , 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 1uHz~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 PM modulation setting interface. When the modulation source is external, the modulation wave and frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

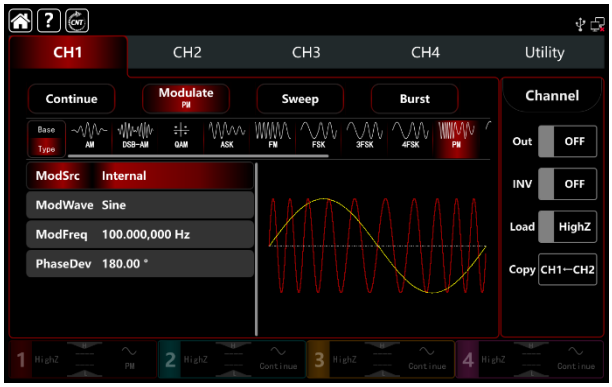
Modulated phase deviation settings

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°~360°, the default range is 180°. 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

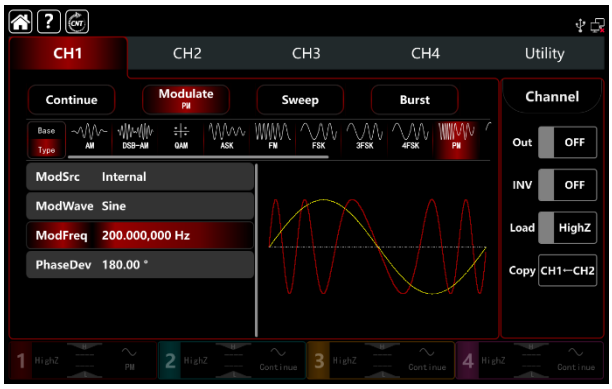
In PM modulation mode, set an internal 200Hz sine wave as the modulating signal, another sine wave with frequency 900Hz, amplitude100mVpp as the carrier wave signal, and set the phase deviation to 200°, the settings steps as following,

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



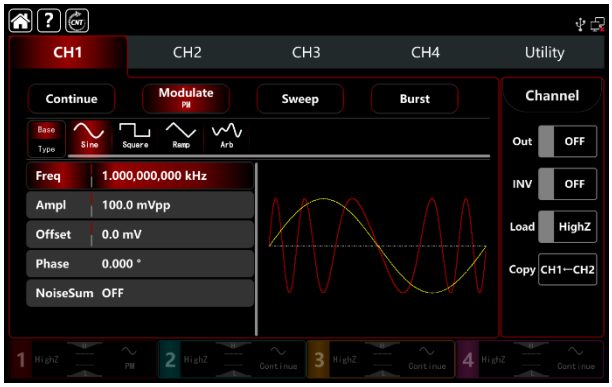
2）Set the parameter of modulating signal

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

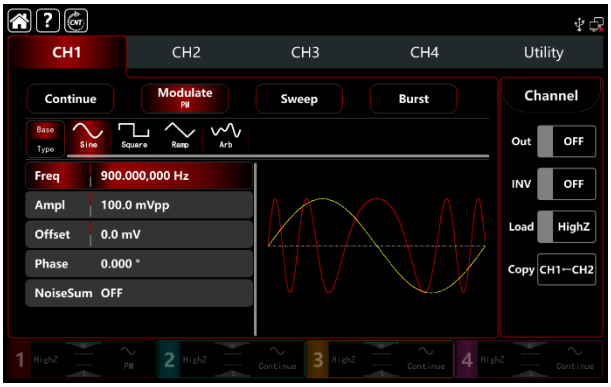


3）Set the parameter of the carrier wave signal

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

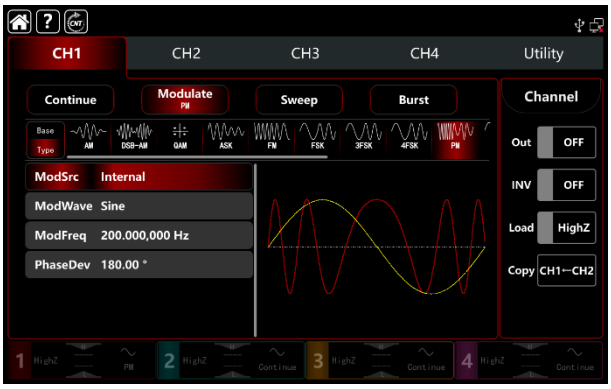


Tap Freq to pop-out visual keyboard to enter 900Hz.

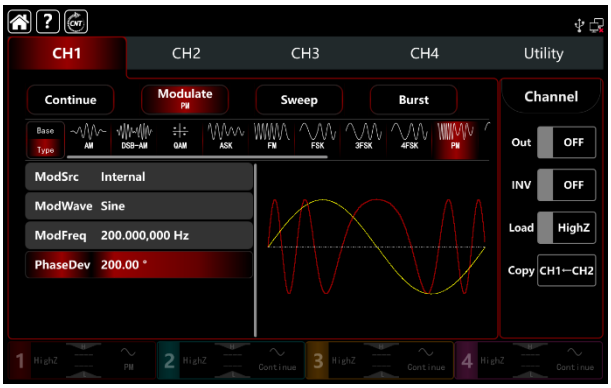


4）Set the phase deviation

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

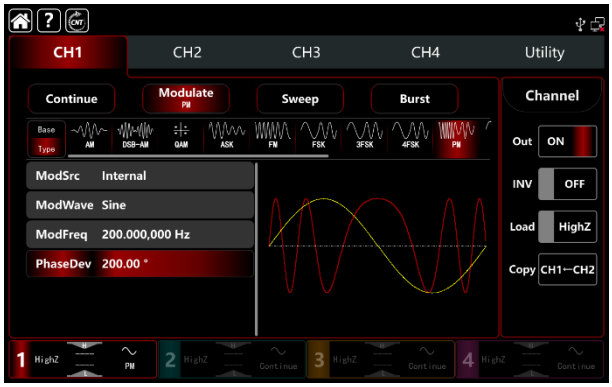


Tap PhaseDev tab to pop-out visual numeric keyboard to enter 200°.

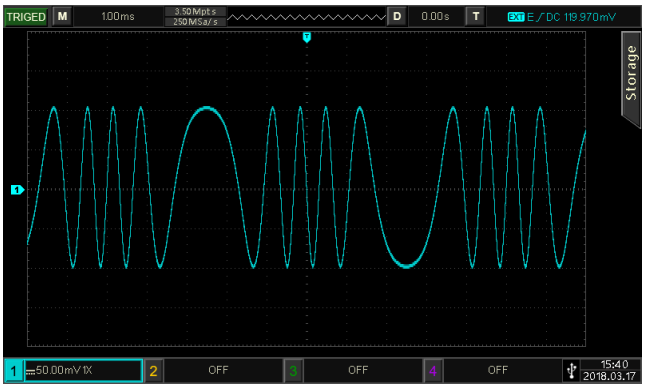


5）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

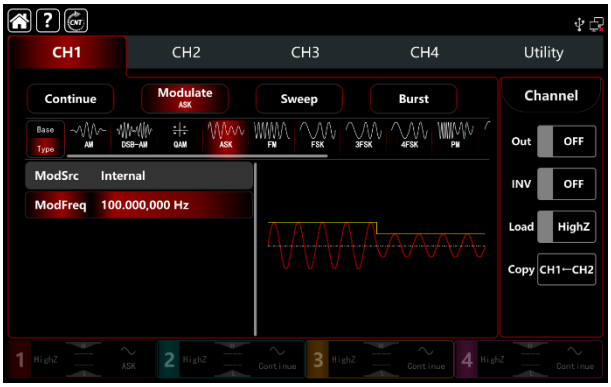


3.1.4 ASK (Amplitude Shift Keying)

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.

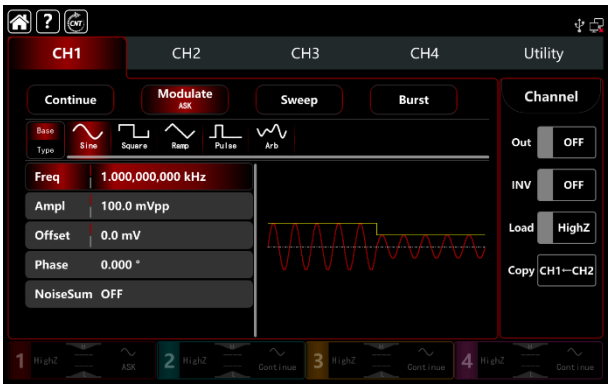
Select ASK modulation

Tap CH1→Modulate→ASK to turn on ASK modulation, the instrument output the moduluated 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.

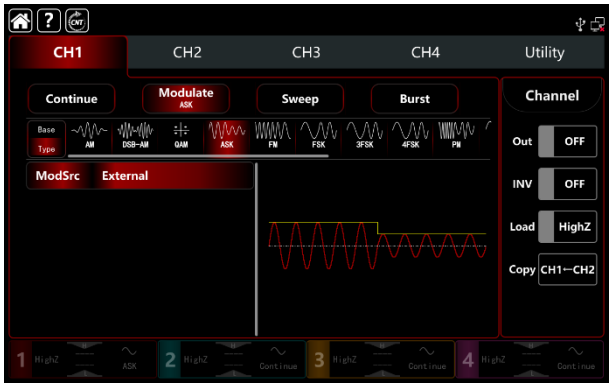


Carrier wave frequency settings

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% (buit-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 paramteter 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

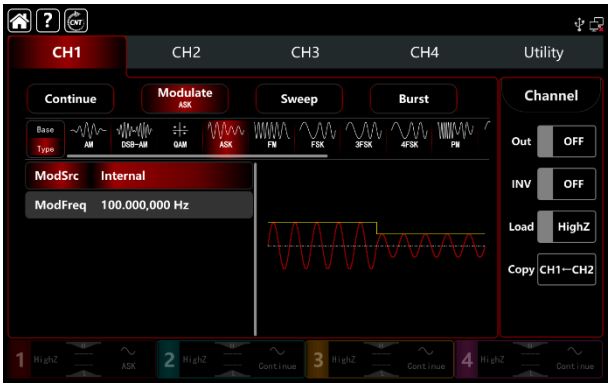
When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1uHz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out visual numeric keyboard to enter values and select unit in ASK modulation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

Comprehensive example

In ASK modulation mode, set an internal logical signal 300Hz as the modulating signal, another sine wave with frequency 15kHz, amplitude2Vpp as the carrier signal, the settings steps as following,

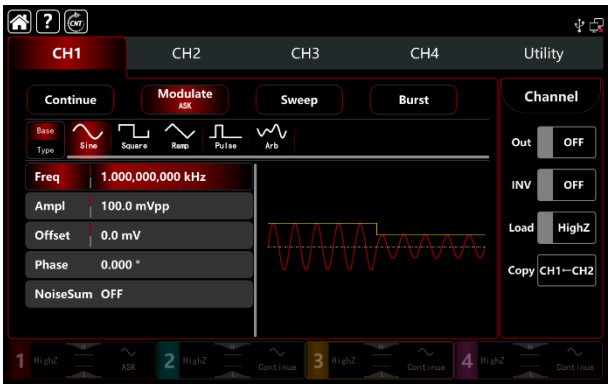
Note: It can only set the frequency of this signal, the frequency is the ASK rate. Logic signal is self-configurable by the instrument.

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



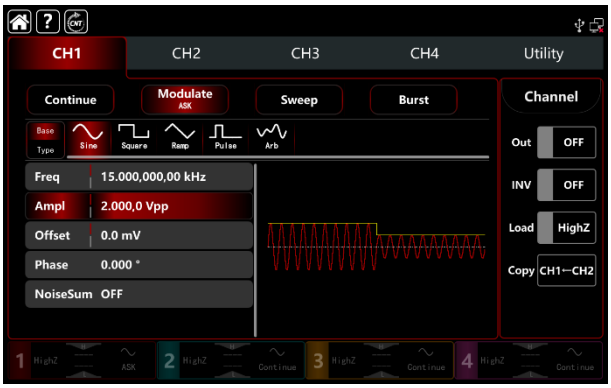
2）Set the parameter of the carrier wave signal

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



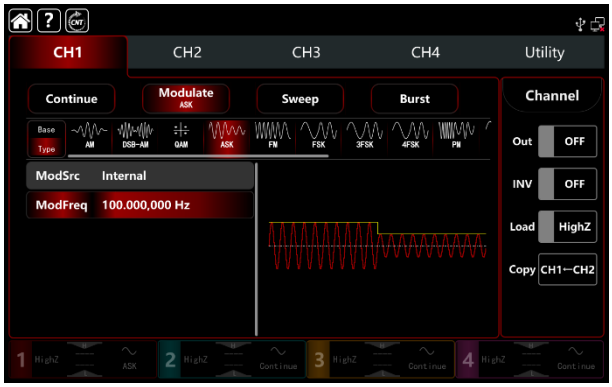
Tap Freq to pop-out visual keyboard to enter 15kHz.

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

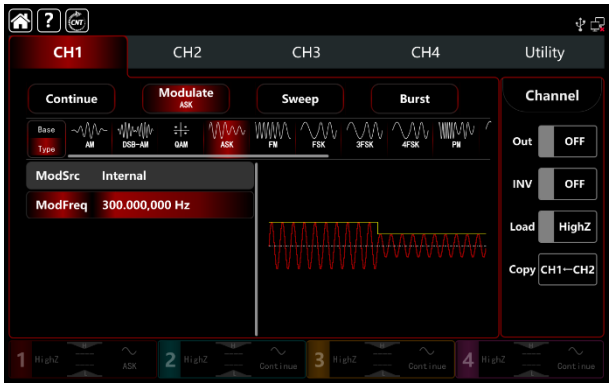


3）Set the parameter of the modulating signal

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

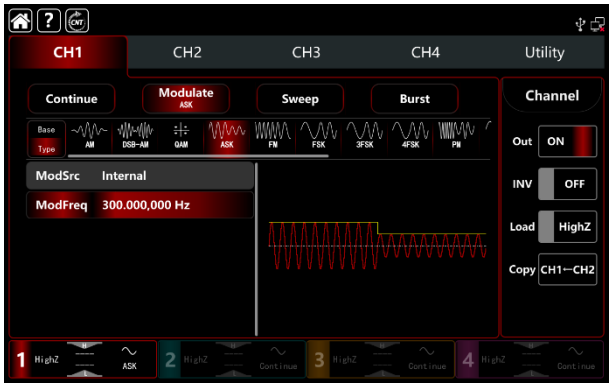


Tap ModSrc tab to pop-out visual numeric keyboard to enter 300Hz.

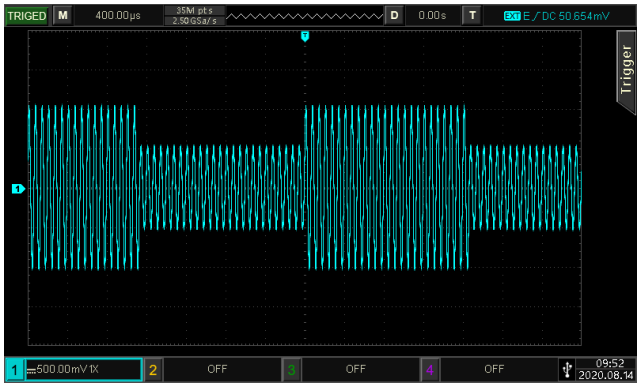


4）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

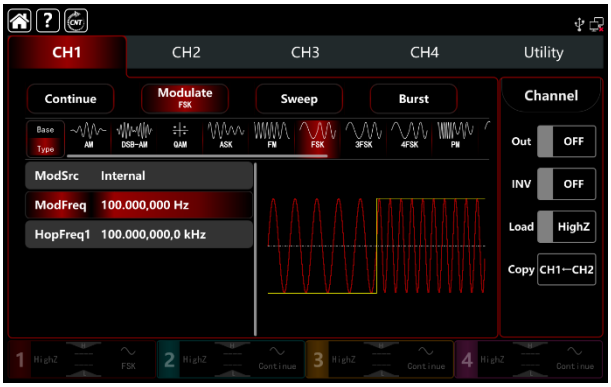


3.1.5 FSK (Frequency Shift Keying)

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.

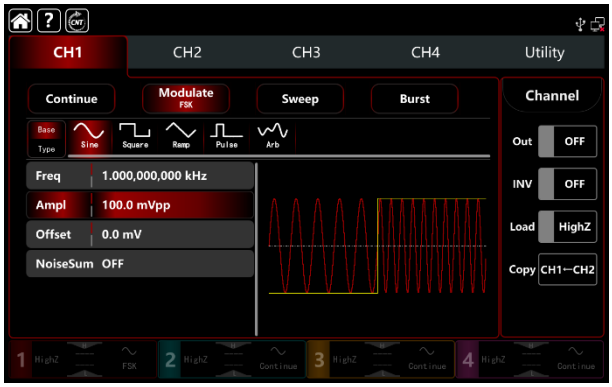
Select FSK modulation

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



Select the carrier waveform

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

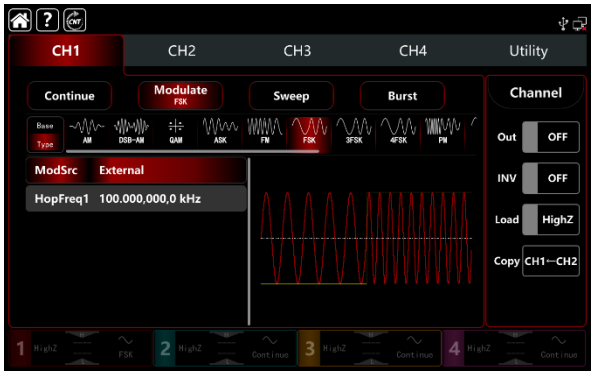


Carrier wave frequency settings

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% (buit-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 paramteter 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 Tabe 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 1uHz~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.

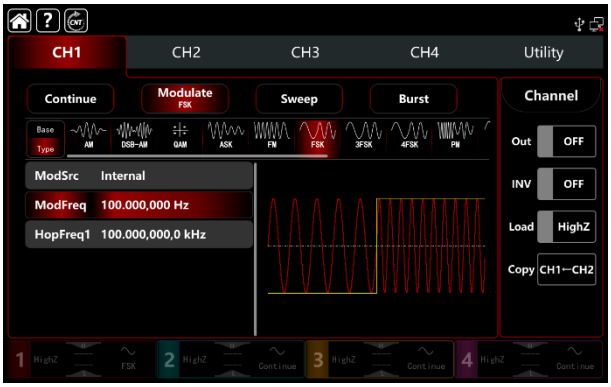
Comperhensive example

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 frequence shift between within 200Hz frequency. The settings steps as following,

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

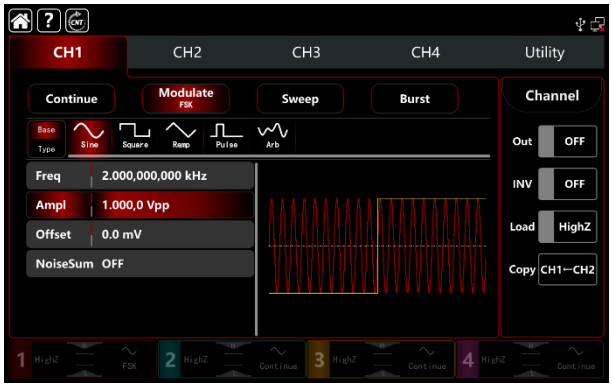
2) Set the parameter of the carrier wave signal

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



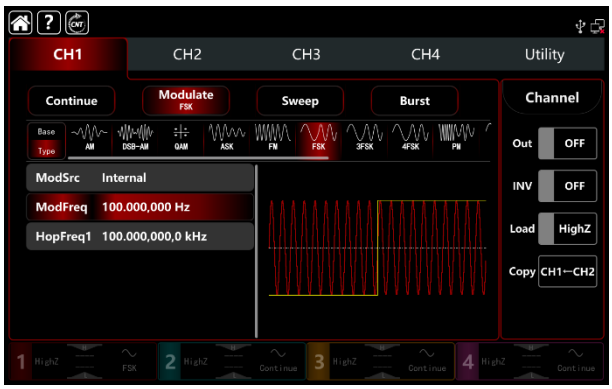
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



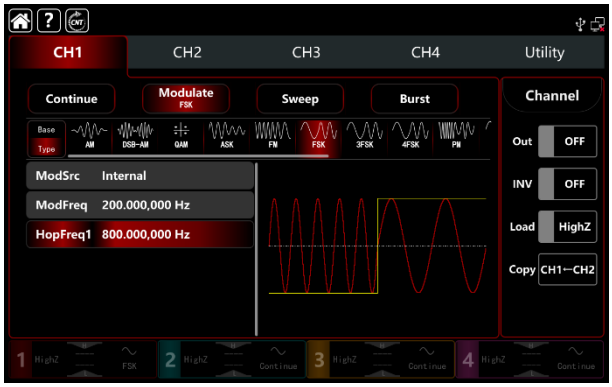
3) Set the hopping frequency and the modulating frequency

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



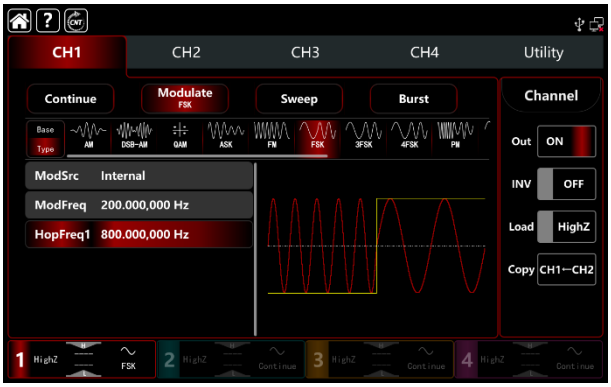
Tap ModFreq to pop-out visual keyboard to enter 200Hz.

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

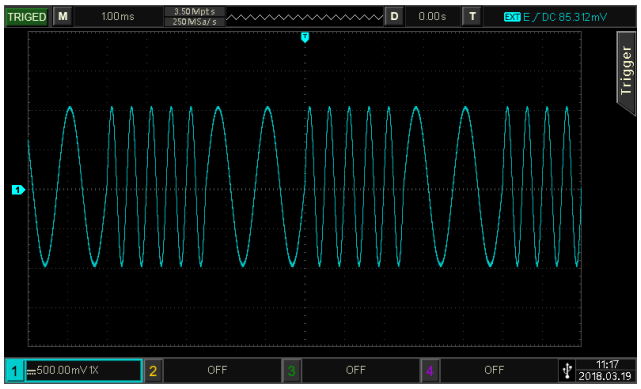


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

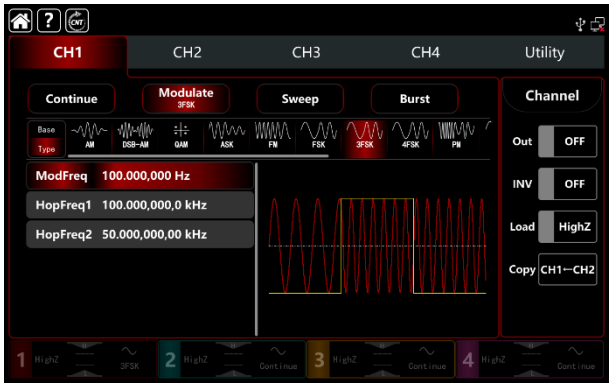


3.1.6 3FSK Modulation (Three Frequency Shift Keying)

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.

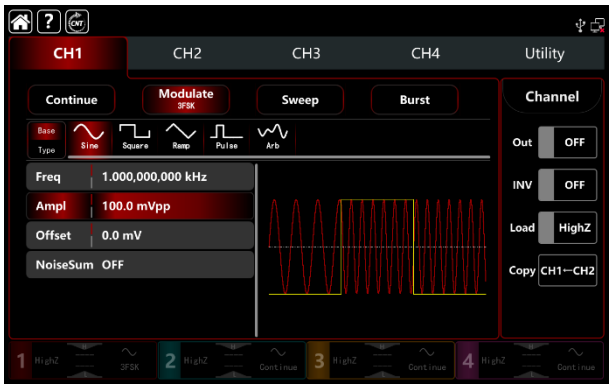
Select 3FSK modulation

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



Select the carrier waveform

The carrier wave of 3FSK: sine, square, ramp, pulse and arbitrarty 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 Tabe 4-1/4-2 of AM modulation.

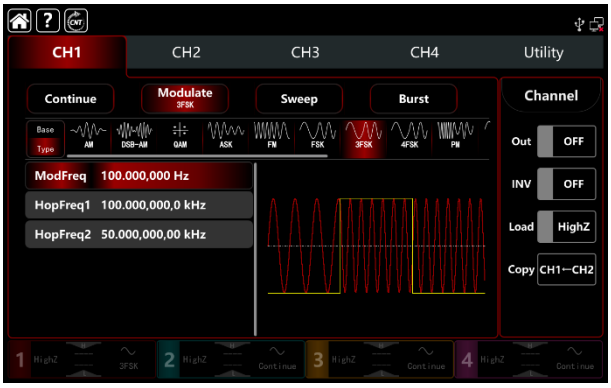
Modulation waveform frequency settings

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 1uHz~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.

Comperhensive example

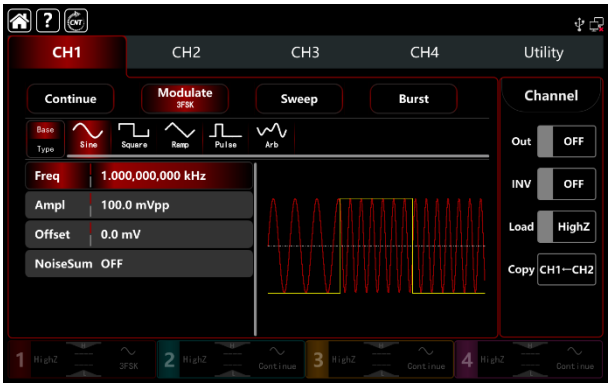
In FSK modulation mode, set an internal 2kHz,1Vpp sine wave as a carrier wave, set HopFreq1 to 1kHz, set HopFreq2 to 5kHz, make the carrier wave and hopping frequence shift between within 100Hz frequency. The settings steps as following,

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



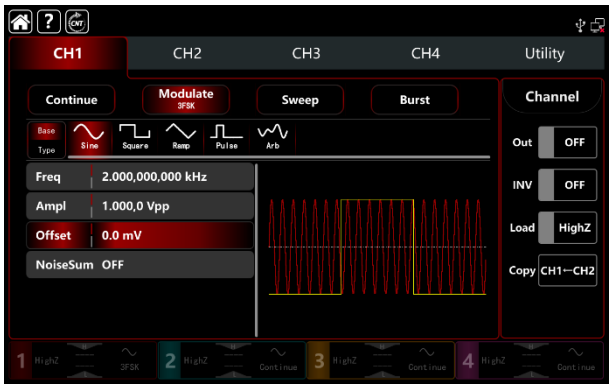
2) Set the parameter of the carrier wave signal

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



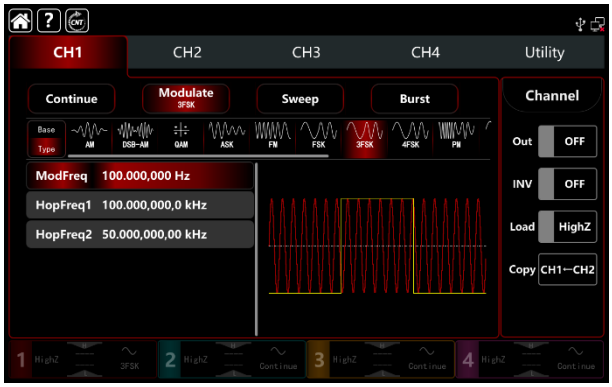
Tap Freq to pop-out visual keyboard to enter 2kHz.

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

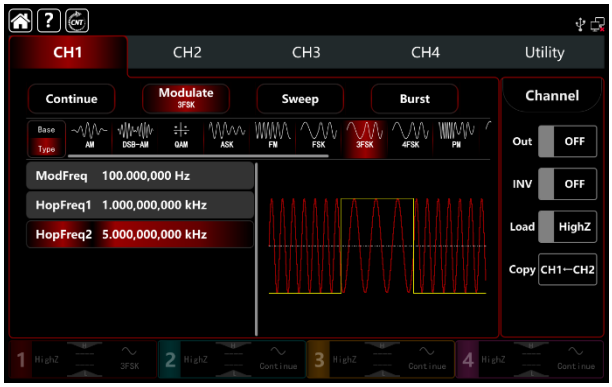


3) Set the hopping frequency and the modulating frequency

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

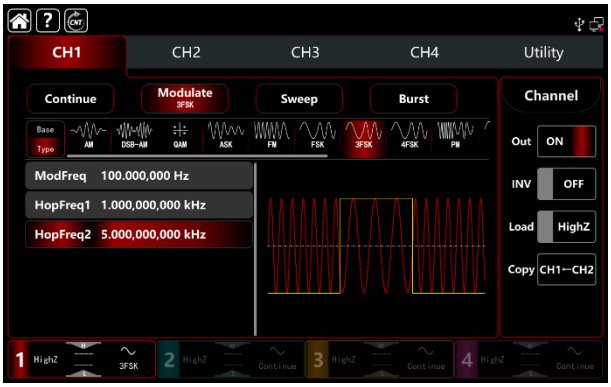


Tap HopFreq1 to pop-out visual keyboard to enter 1kHz.
Tap HopFreq2 to pop-out visual keyboard to enter 5kHz.

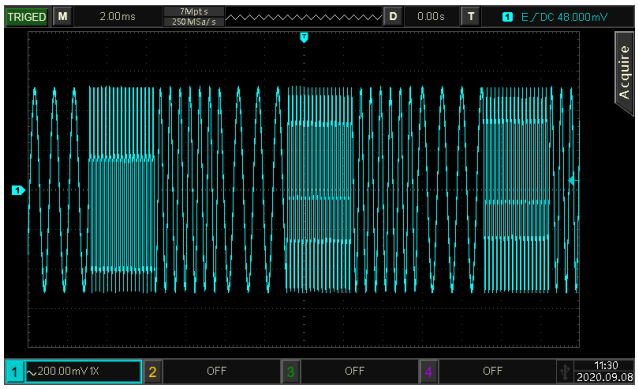


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

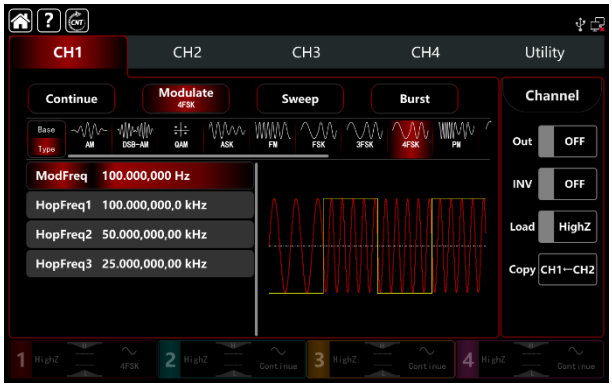


3.1.7 4FSK Modulation (Four Frequency Shift Keying)

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.

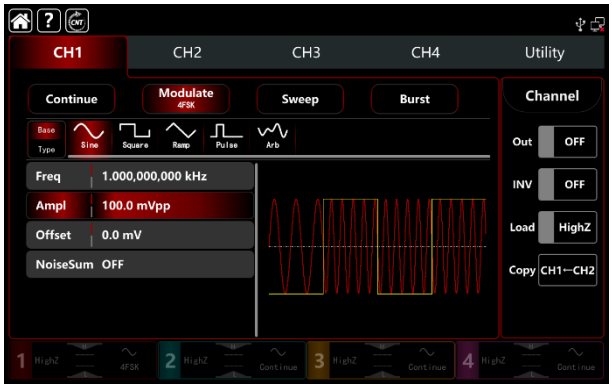
Select 4FSK modulation

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



Select the carrier waveform

The carrier wave of 4FSK: sine, square, ramp, pulse and arbitrarty 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 HopFreq3tab 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 Tabe 4-1/4-2 of AM modulation.

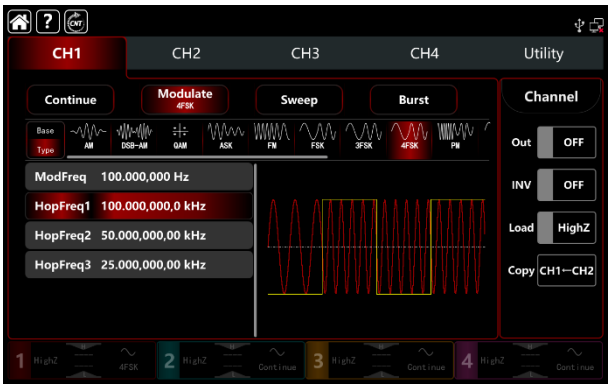
Modulation waveform frequency settings

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 1uHz~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.

Comperhensive example

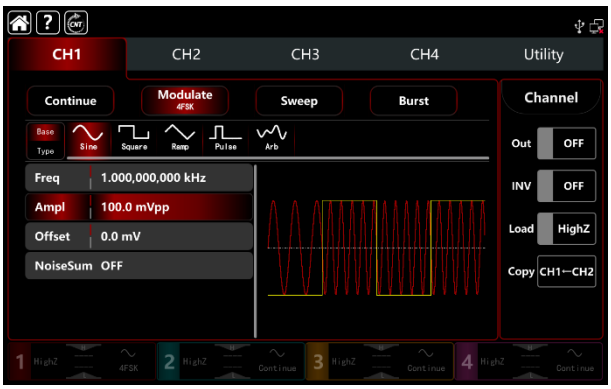
In 4FSK modulation mode, set an internal 500Hz,1Vpp sine wave as a carrier wave, set HopFreq1 to 2kHz, set HopFreq2 to 5kHz, set HopFreq2 to 10kHz, make the carrier wave and hopping frequence shift between within 100Hz frequency. The settings steps as following,

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



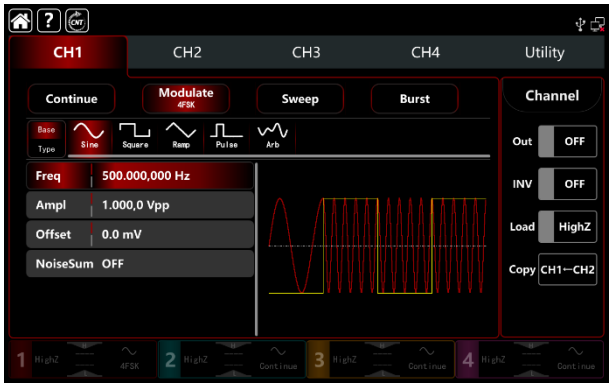
2) Set the parameter of the carrier wave signal

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



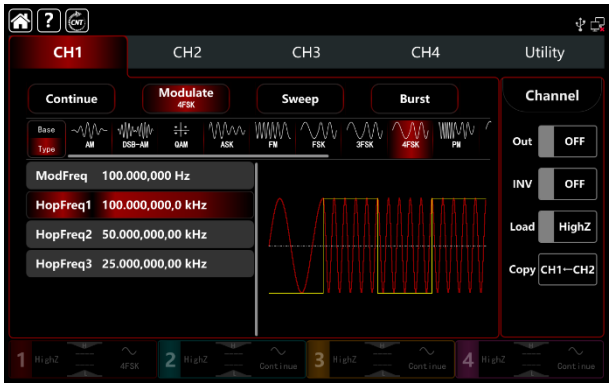
Tap Freq to pop-out visual keyboard to enter 500Hz.

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



3) Set the hopping frequency and the modulating frequency

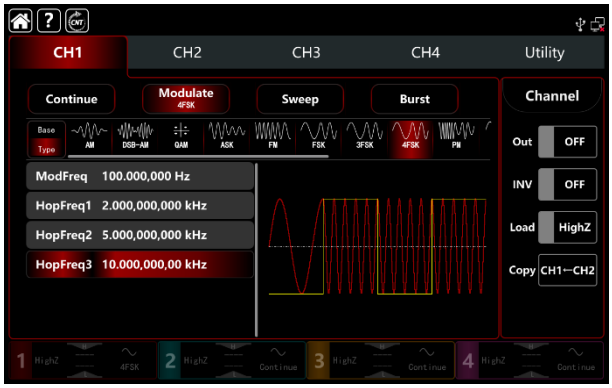
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the modulating frequency.



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

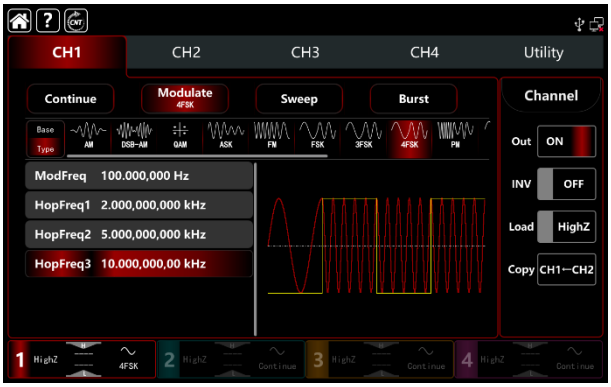
Tap HopFreq2 to pop-out visual keyboard to enter 5kHz.

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

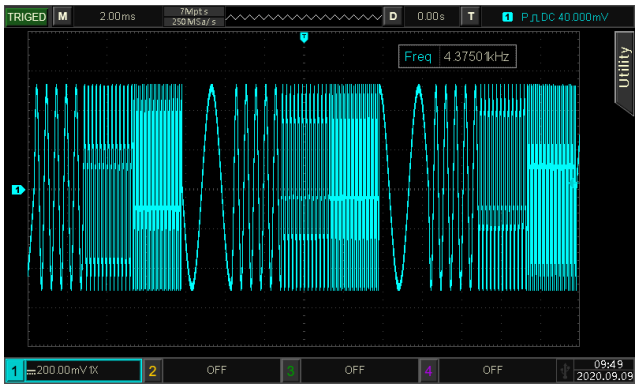


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

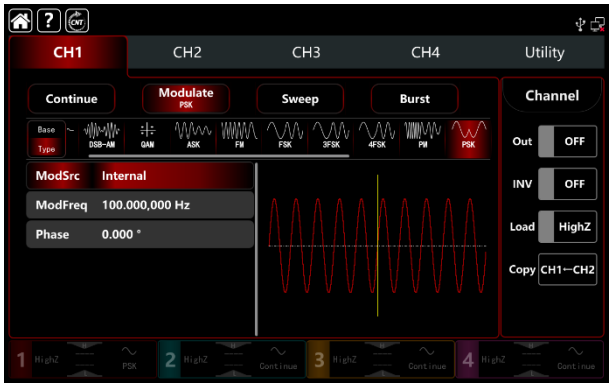


3.1.8 PSK (Phase Shift Keying)

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.

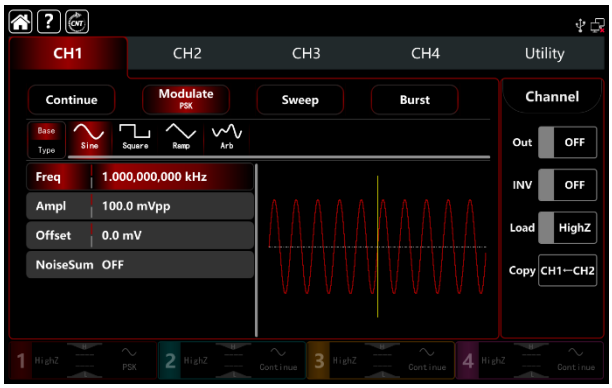
Select PSK modulation

Tap CH1→Modulate→PSK to turn on PSK modulation, the instrument output the moduluated 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 arbitrarty wave (except DC), the default option is sine wave. After select PSK modulation, tap Base to present the carrier waveform on the right side.

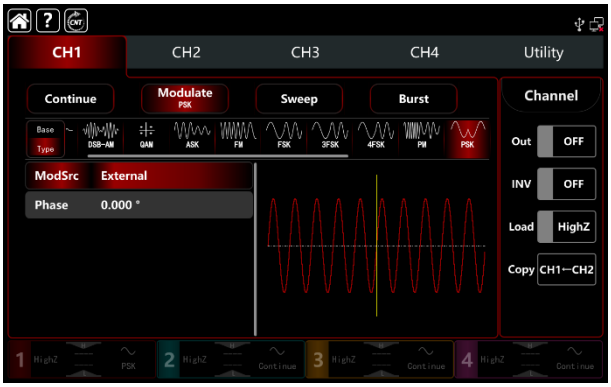


Carrier wave frequency settings

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% (buit-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 paramteter 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 1uHz~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

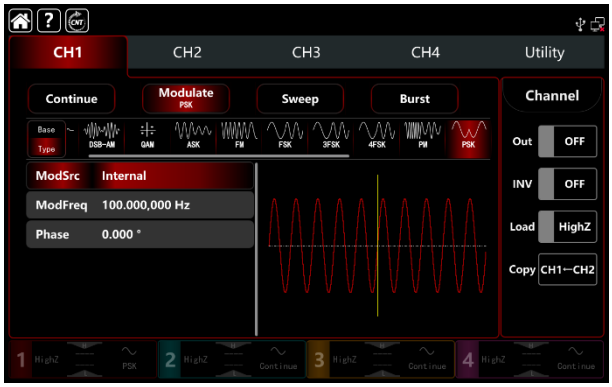
PSK modulation mode presents the changes between the modulated wave phase and the carrier wave phase. The phase range can set to 0º~360º, the default phase is 180º. Rotate multifunction knob, push direction key or tap Phasetab to pop-out visual numeric keyboard to enter values and select unit in PSK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

Comperhensive 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

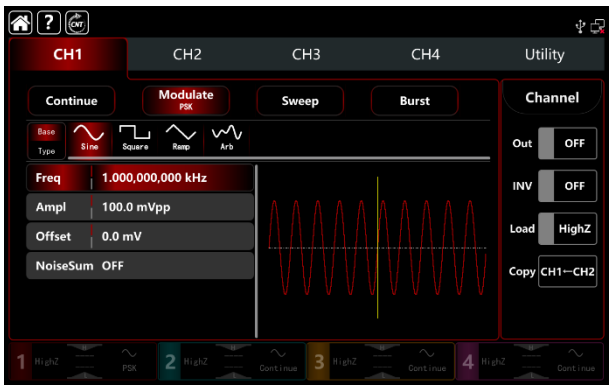
steps as following,

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



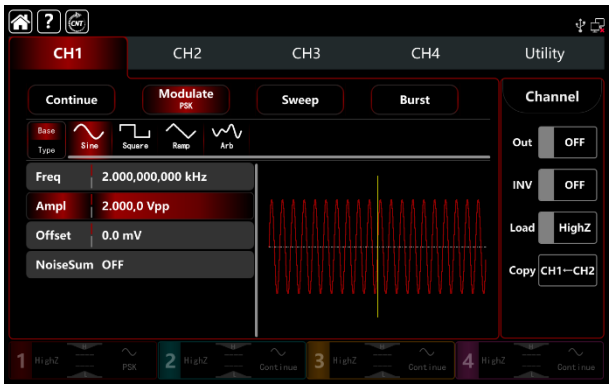
2) Set the parameter of the carrier wave signal

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



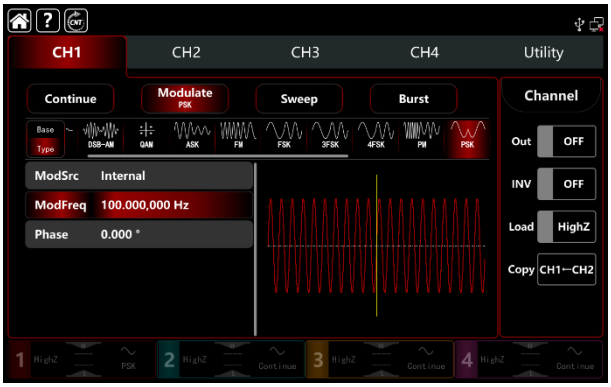
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



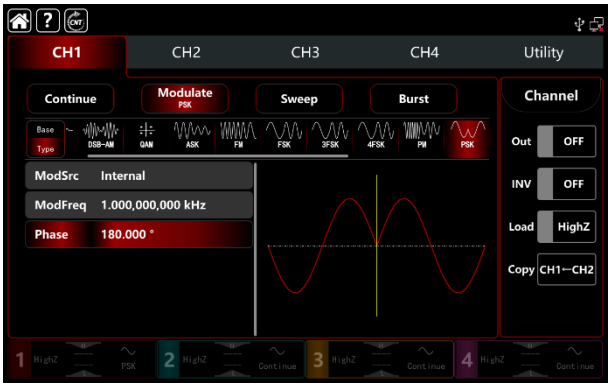
3) Set the modulating frequency and phase

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



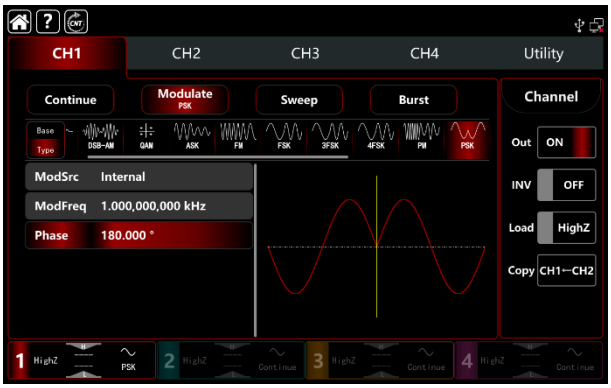
Tap ModFreq to pop-out visual keyboard to enter 1kHz.

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

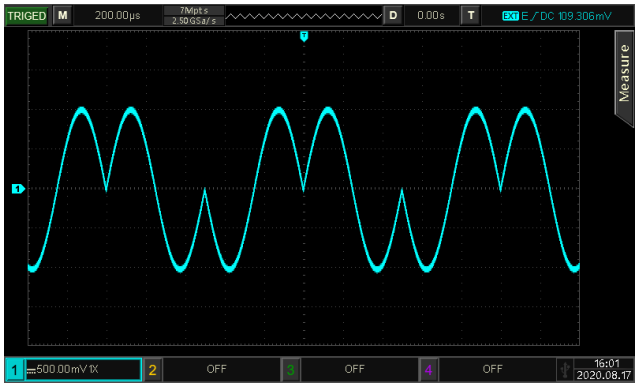


4） Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

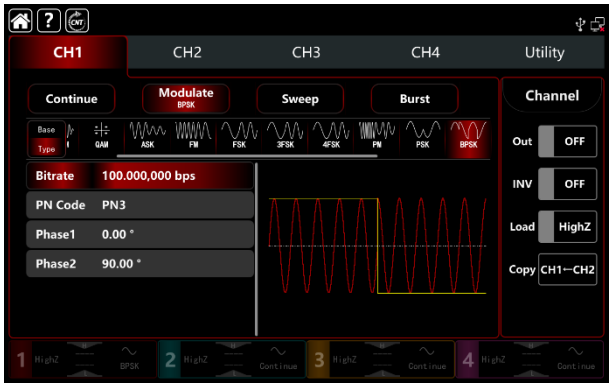


3.1.9 BPSK (Double Phase Shift Keying)

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.

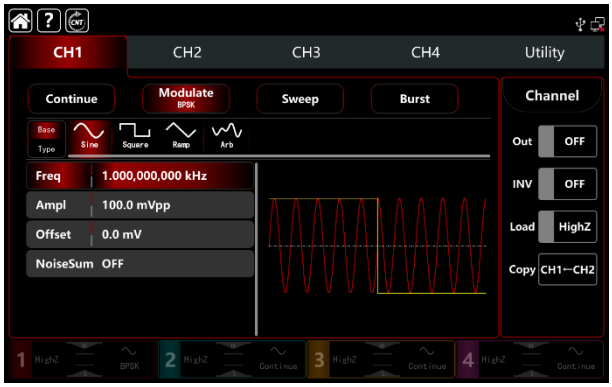
Select BPSK modulation

Tap CH1→Modulate→BPSK to turn on BPSK modulation, the instrument output the moduluated 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 arbitrarty wave (except DC), the default option is sine wave. After select BPSK modulation, tap Base to present the carrier waveform on the right side.

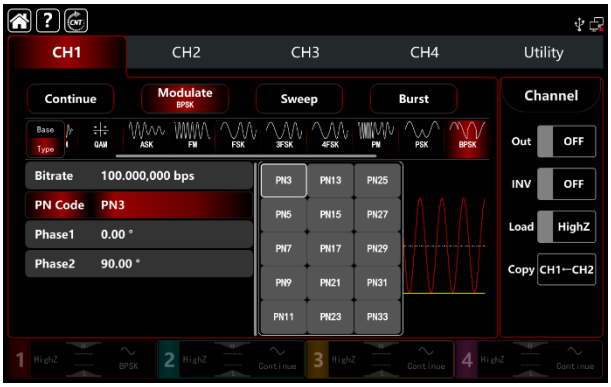


Carrier wave frequency settings

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 cam 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

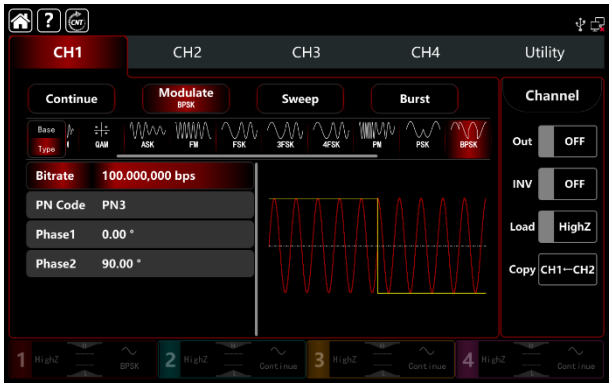
1) Phase1 is the carrier wave phase, the default value is 0°. Rotate multifunction knob, push direction key or tap Phase1 tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

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 0º~360º, the settings steps is the same as Phase1.

Comperhensive example

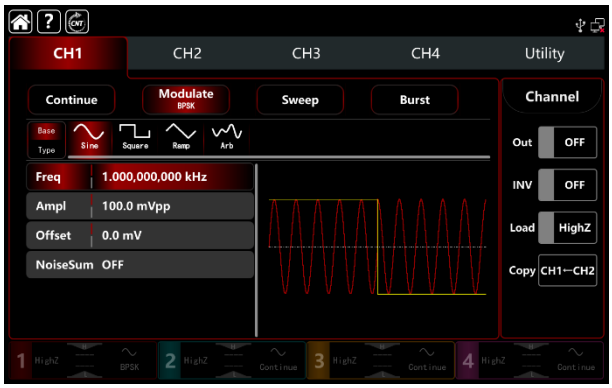
In BPSK modulation mode, set an internal 2kHz,2Vpp sine wave as a carrier wave, set the initial phase to 90°, 1kbps shift frequence between in the carrier wave phase and the modulating wave phase, set PN Code to PN15. The settings steps as following,

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



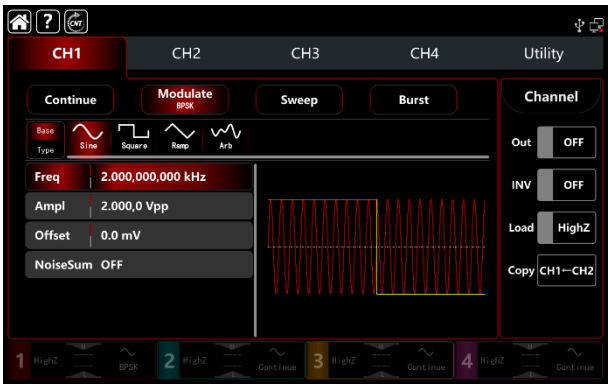
2) Set the parameter of the carrier wave signal

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



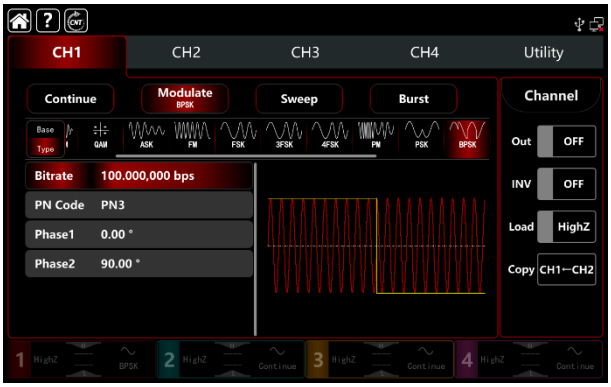
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3) Set the BPSK bitrate and phase

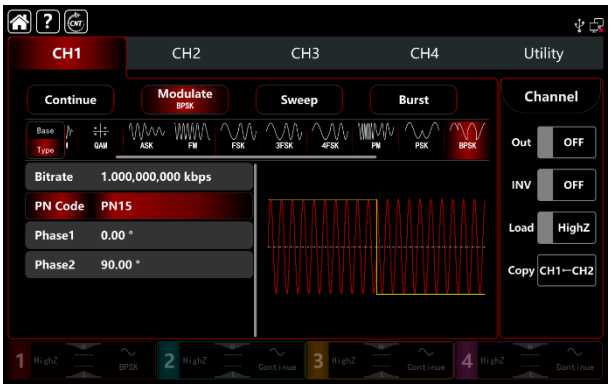
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the BPSK rate and phase.



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

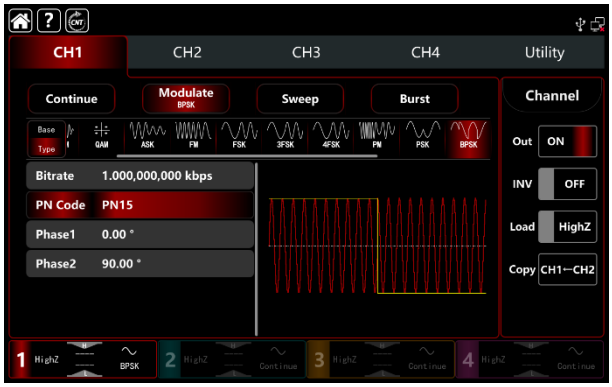
Phase use the default value,phase1: 0°,phase2 ： 90°.

Tape PN Code PN3 to select PN15.

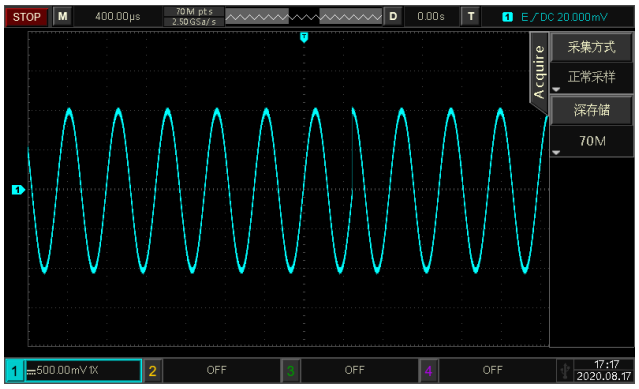


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

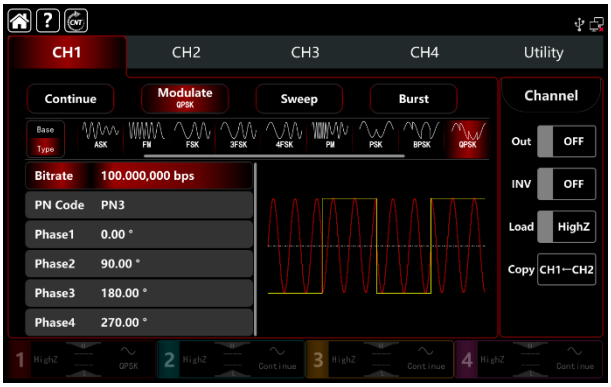


3.1.10 QPSK (Quad-Phase Shift Keying)

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.

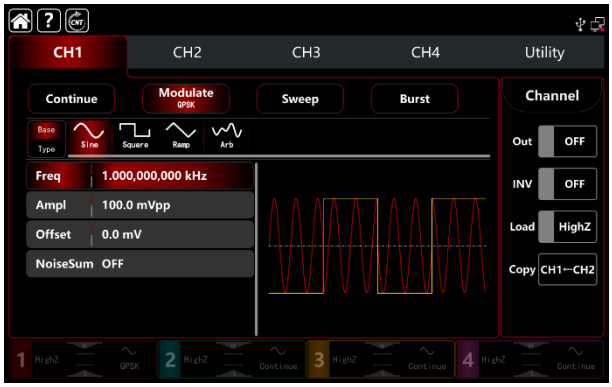
Select QPSK modulation

Tap CH1→Modulate→QPSK to turn on FSK modulation, the instrument output the moduluated 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 arbitrarty wave (except DC), the default option is sine wave. After select QPSK modulation, tap Base to present the carrier waveform on the right side.

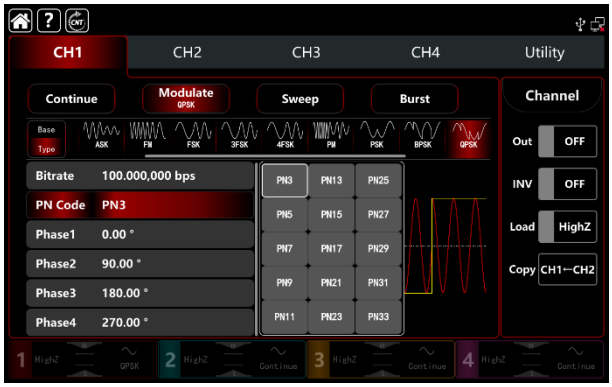


Carrier wave frequency settings

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 cam 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

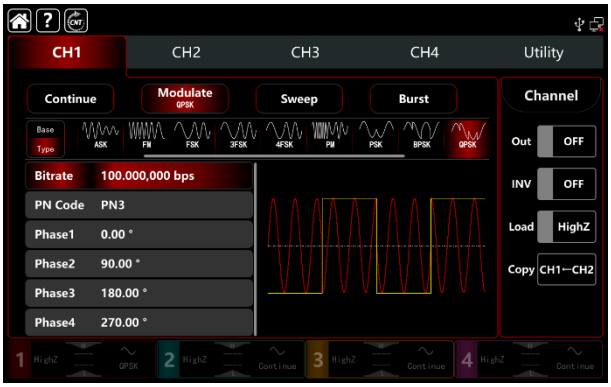
1) Phase1 is the carrier wave phase, the default value is 0°.

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 0º~360º. 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.

Comperhensive example

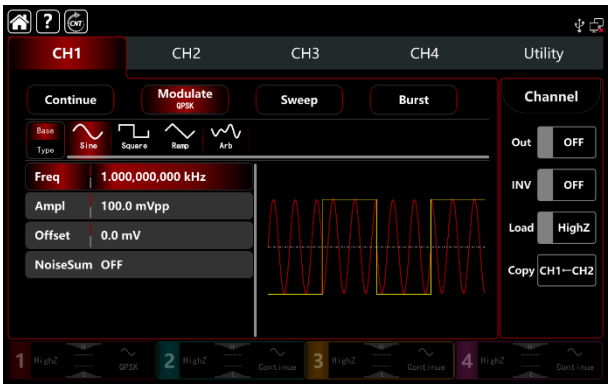
In QPSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the phase of the three fundamental waves and the initial modulation phases be 90 °, 180 ° and 270 ° respectively, hopping frequency 1kbps among the phases, select PN code as PN 15, the setting steps as following,

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



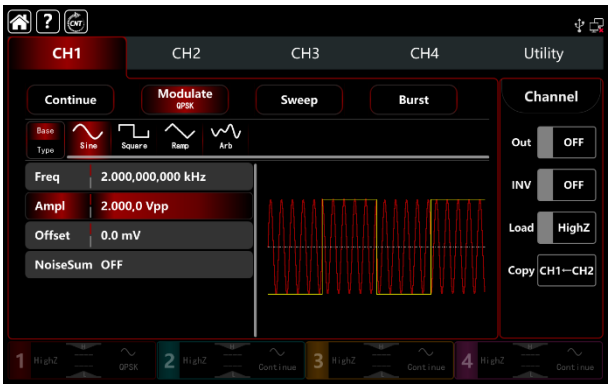
2) Set the parameter of the carrier wave signal

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



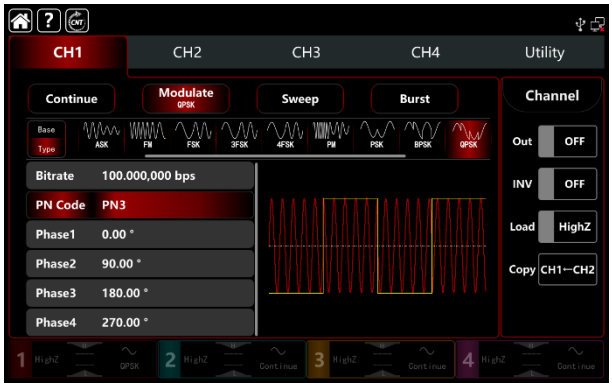
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3）Set QPSK bitrate and the modulating phase

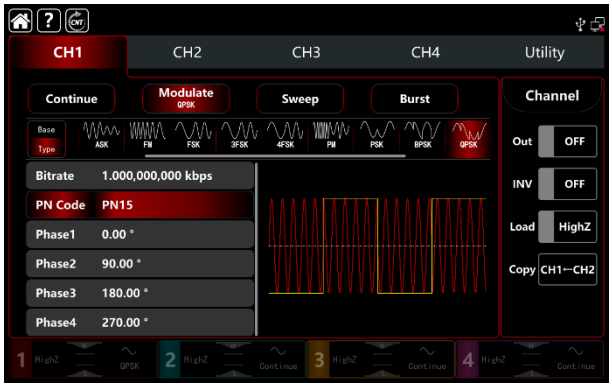
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the QPSK bitrate and phase.



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

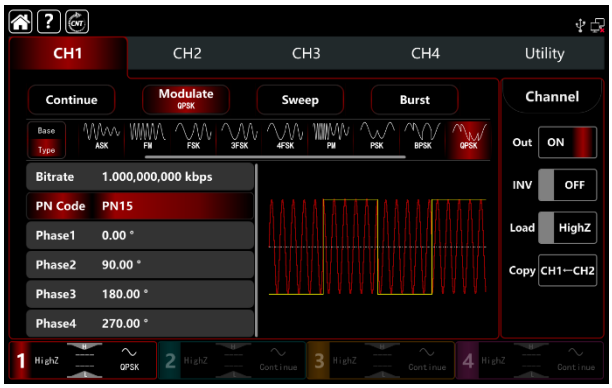
Phase use the default value, phase1: 0°, phase2 ： 90°, phase3:180°, phase4:270°.

Tap PN Code PN3 to select PN15.

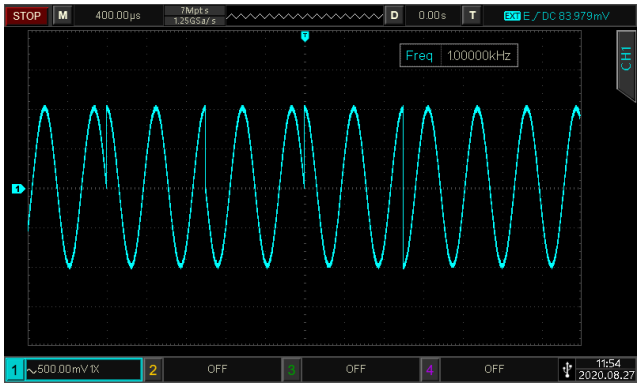


4）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

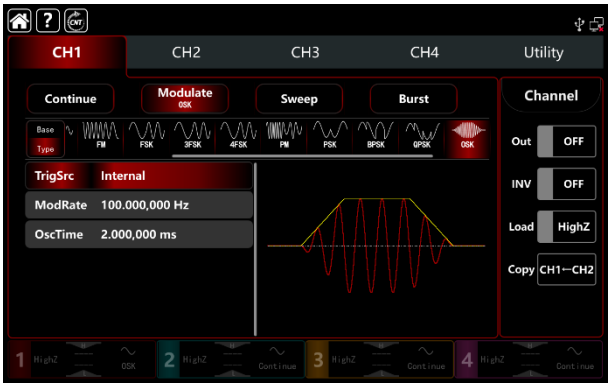


3.1.11 OSK (Oscillation Keying)

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.

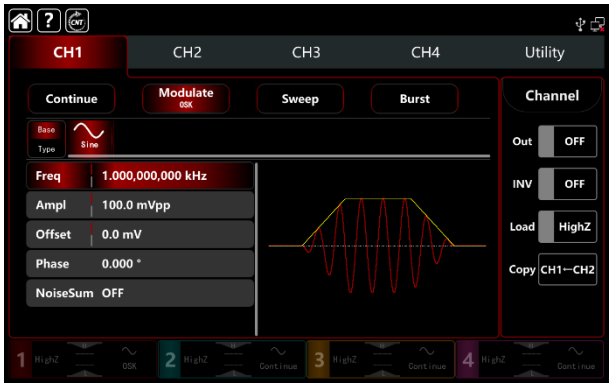
Select OSK modulation

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



Select the carrier waveform

OSK carrier waveform is sine wave.

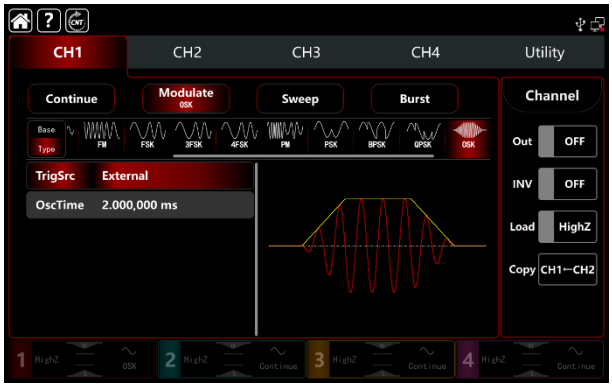


Carrier wave frequency settings

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 paramteter 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 1uHz~2MHz, default 2ms.

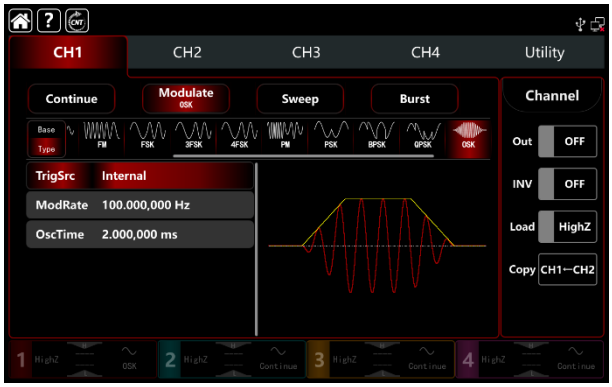
OSK rate settings

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 1uHz~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.

Comperhensive Example

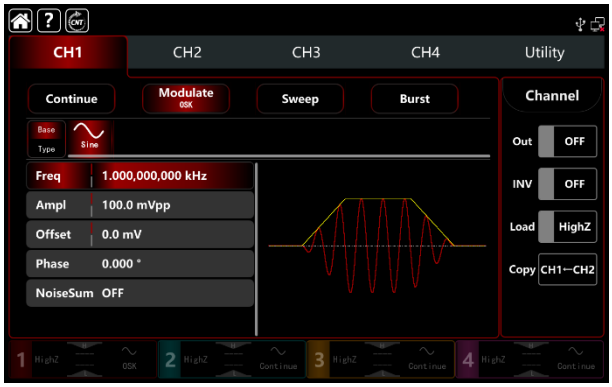
In OSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the frequency 100Hz, oscillation period 1μs, the settings steps as following,

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



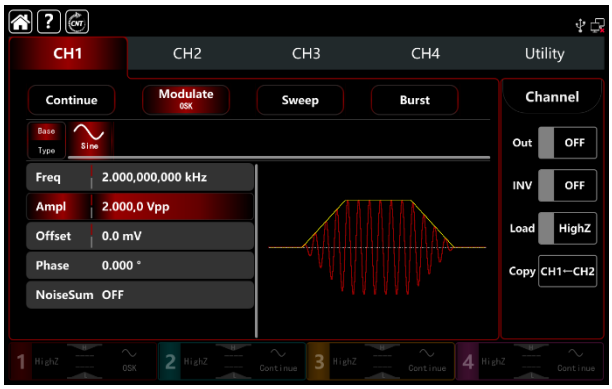
2）Set the parameter of the carrier wave signal

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



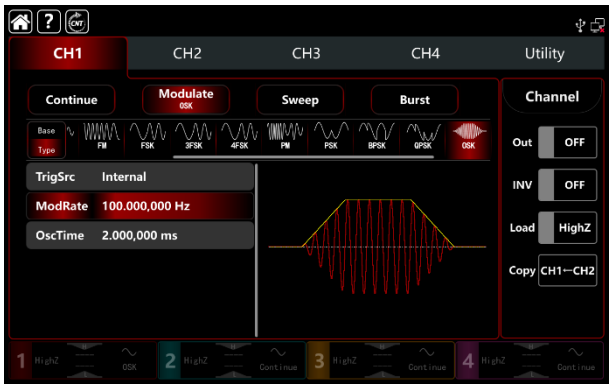
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



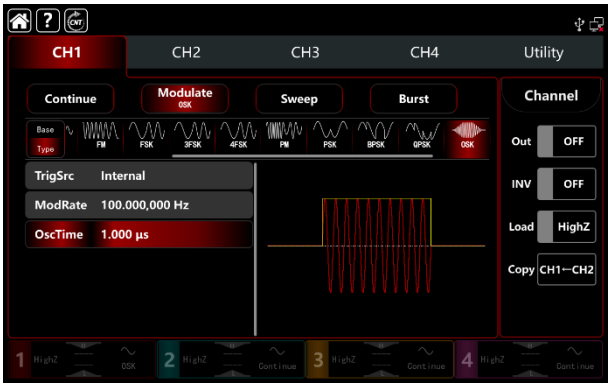
3) Set the modulating rate

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



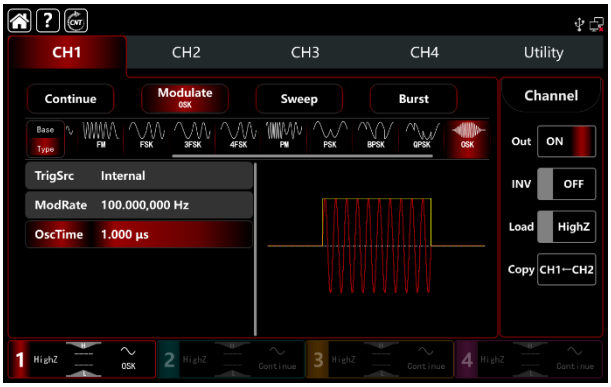
Tap ModRate to pop-out visual keyboard to enter 100Hz (the default 100Hz).

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

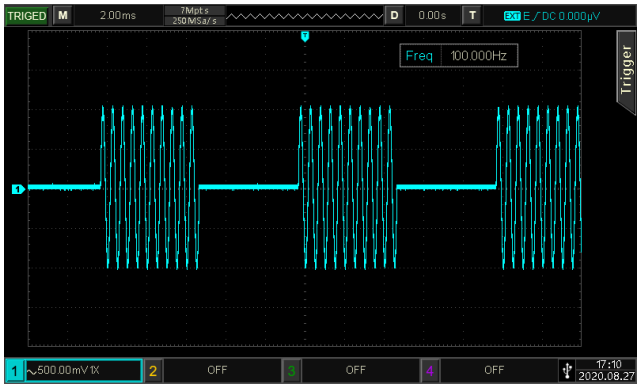


4）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,



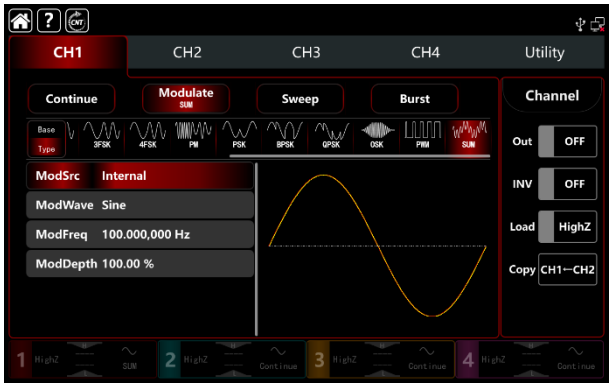
3.1.12 SUM (Sum Modulation)

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.

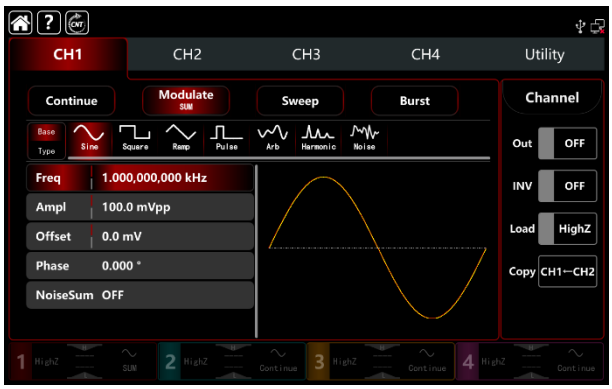
Select SUM modulation

Tap CH1→Modulate→SUM to turn on the AM modualtion, the instrument output the moduluated 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.

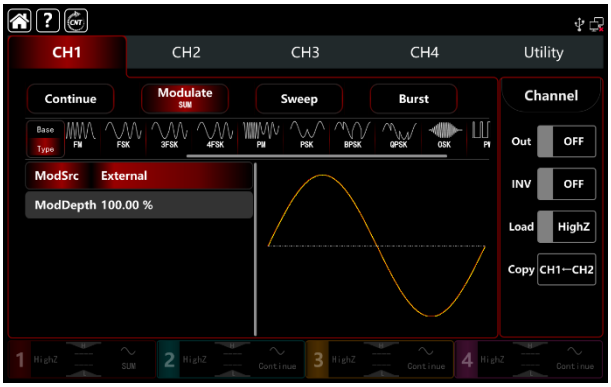


Carrier wave frequency settings

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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The SUM modulation depth is controlled by the ±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 1uHz~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 frequence will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

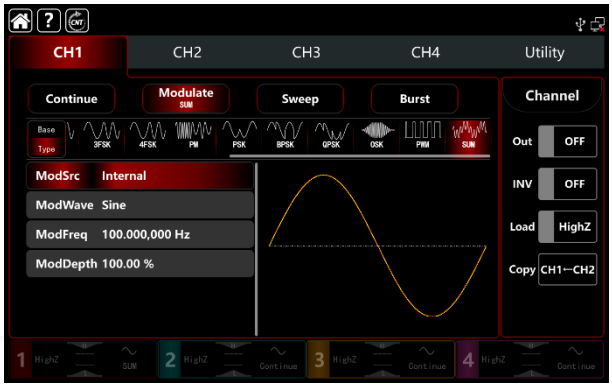
Modulation depth settings

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 ±5V signal level on the external analog modulation input terminal (Modulation In connector) on the back panel.

Comprehensive example

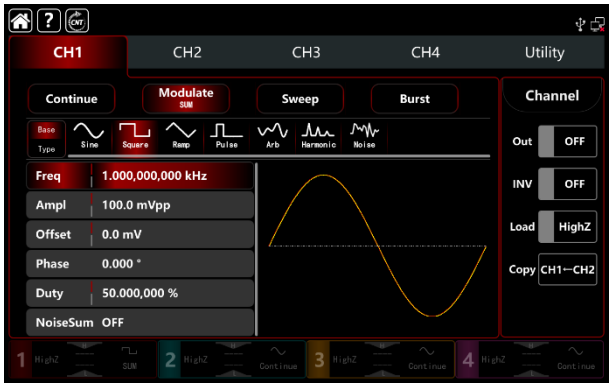
In SUM modulation mode, set an internal 1kHz sine wave as the modulating signal, another square sine with frequency 2kHz, amplitude200mVpp, duty ratio 45% as the carrier wave signal, and set the modulation depth to 80%, the settings steps as following,

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



2）Set the parameter of the carrier wave signal

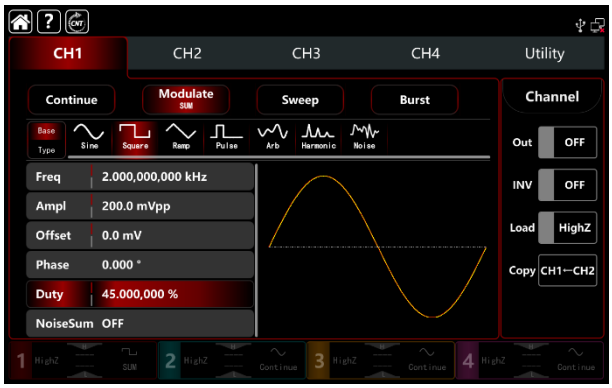
Tap Base to select Square as the carrier waveform (the default option is sine wave).



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

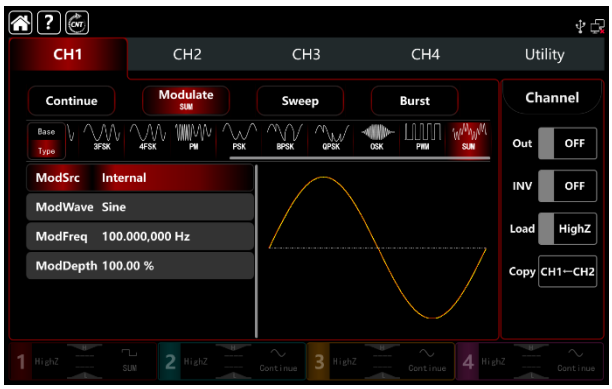
Tap Ampl tab to pop-out visual numeric keyboard to enter 200mVpp.

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



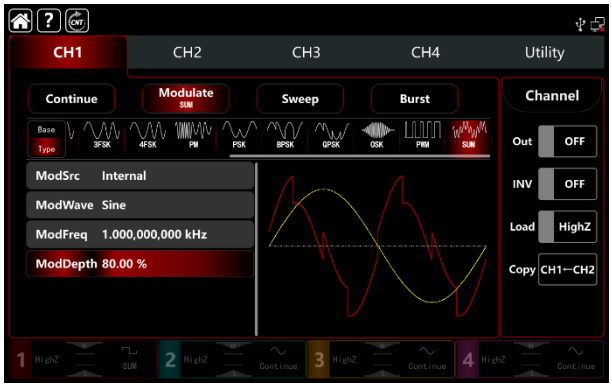
3） Set the modulation frequency and depth

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



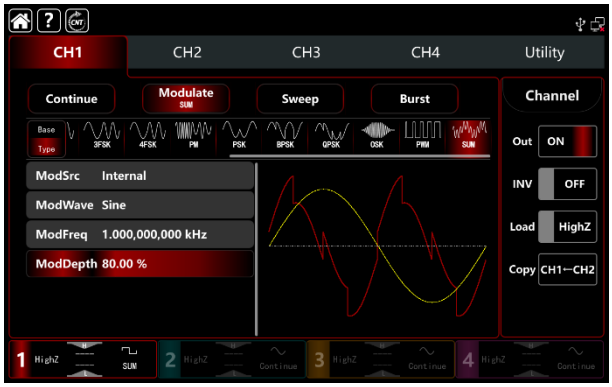
Tap ModFreq tab to pop-out visual numeric keyboard to enter 1kHz.

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

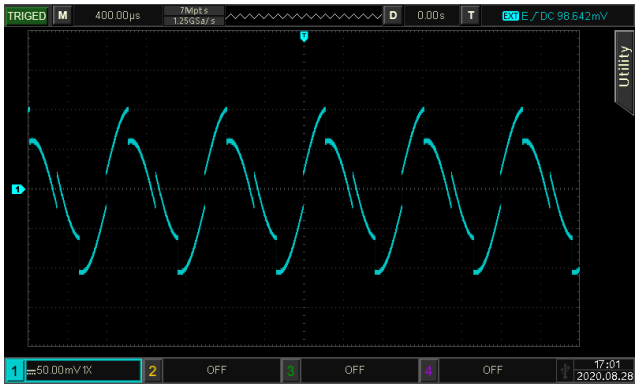


4) Turn on the output channel

Tap channel Out to ON or push CH1 on the front panel to quick set the output channel,and it can aslo 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.



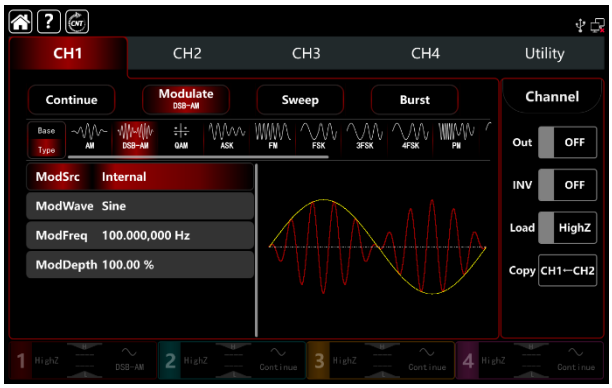
The shape of the AM modulation waveform viewed through an oscilloscope is shown in the figure below,



3.1.13 DSB-AM (Double Side Band Amplitude Modulation)

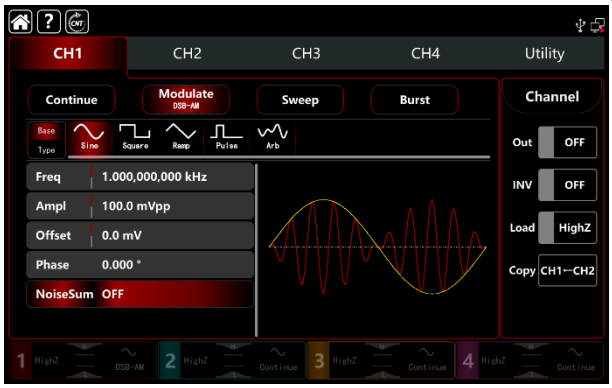
Select FM modulation

Tap CH1→Modulate→DSB-AM to turn on DSB-AM modulation, the instrument output the moduluated 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.



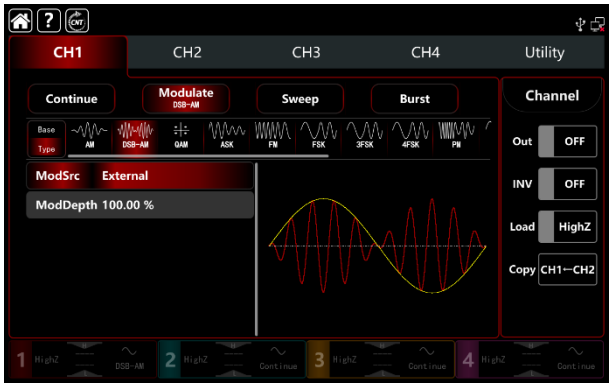
Carrier wave frequency settings

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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The DSB-AM depth is controlled by the ±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

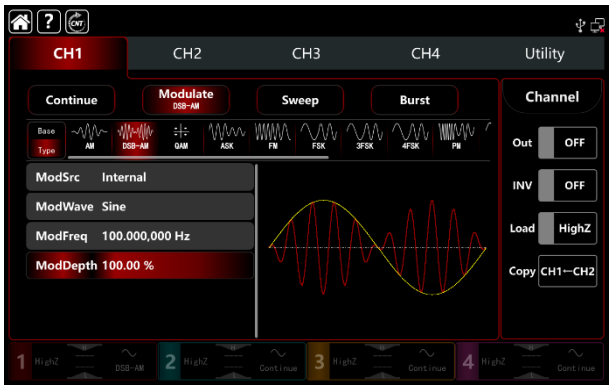
When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1uHz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out visual numeric keyboard to enter values and select unit in modulation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

modulation wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

Comprehensive example

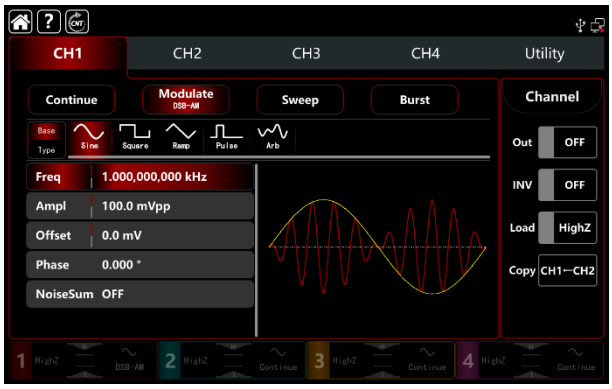
In DSB-AM modulation mode, set an internal 1kHz sqaure wave as a modulating signal, another sine wave signal with frequency 2kHz, amplitude2Vpp as the carrier wave signal, the settings steps as following,

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



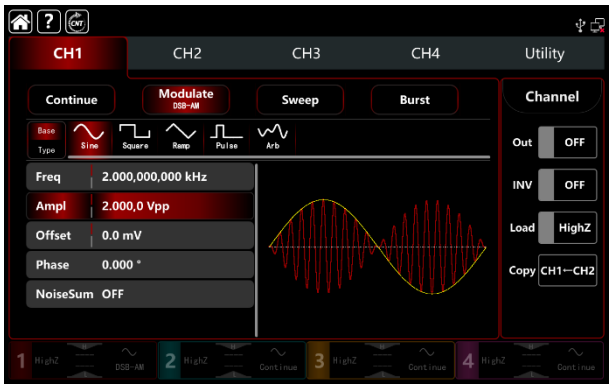
1) Set the parameter of the carrier wave signal

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



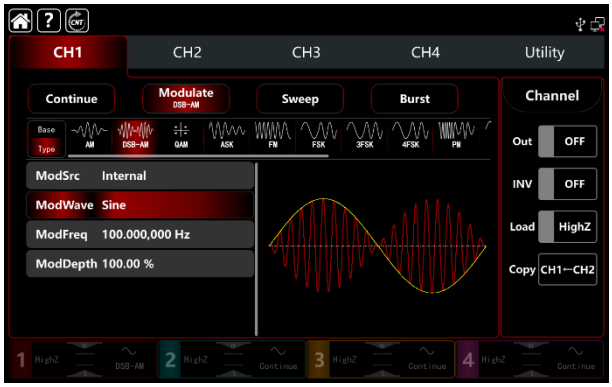
Tap Freq tab to pop-out visual numeric keyboard to enter 2kHz.

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



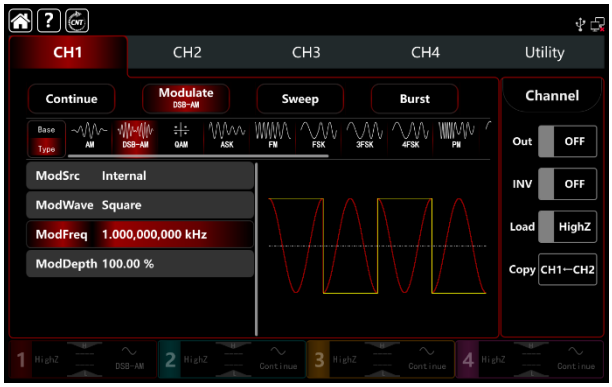
3）Set the modulation wave and frequency

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



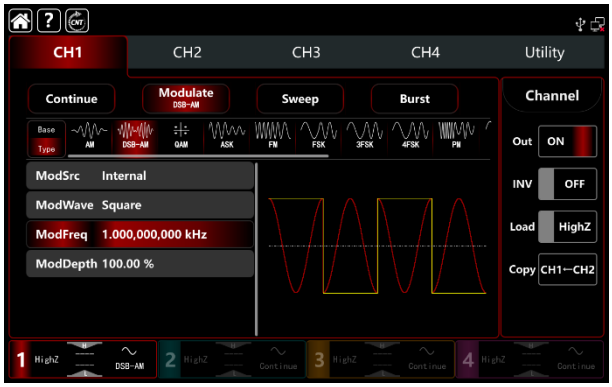
Tap ModWave tab to pop-out visual numeric keyboard to select square wave.

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

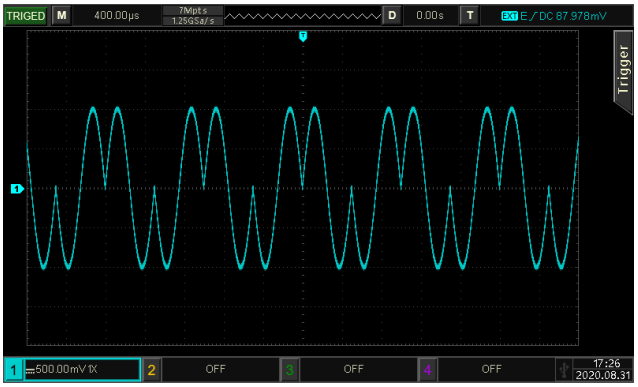


4）Turn on the output channel

Tap channel Out to ON or push CH1 on the front panel to quick set the output channel,and it can aslo 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,



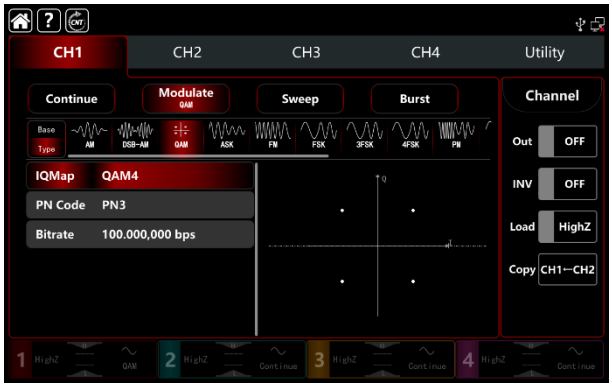
3.1.14 QAM (Quadrature Amplitude Modulation)

In quadrature amplitude modulation mode, set two signals of the same frequency but with phase difference 90°(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 recommened 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.

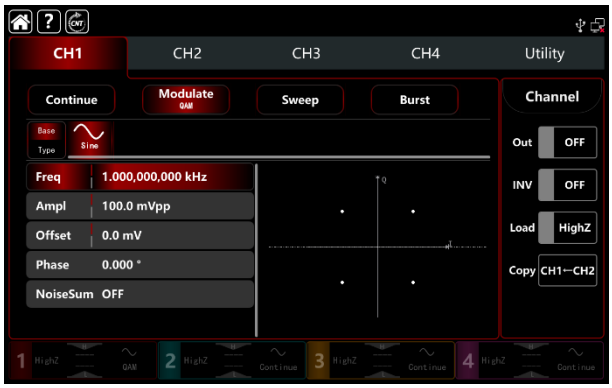
Select QAM modulation

Tap CH1→Modulate→QAM to turn on QAM modulation, the instrument output the moduluated 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.

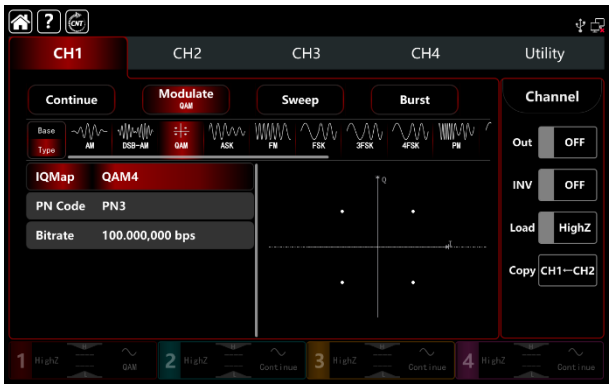
QAM rate settings

In QAM modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The QAM rate range cam 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.

Comperhensive example

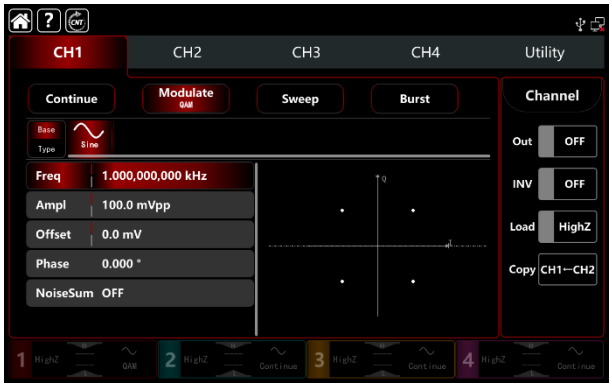
In QAM modulation mode, set an internal 2kHz,2Vpp sine wave as a carrier wave, set the rate to 100bps, modulation type QAM64, PN code PN7, The settings steps as following,

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



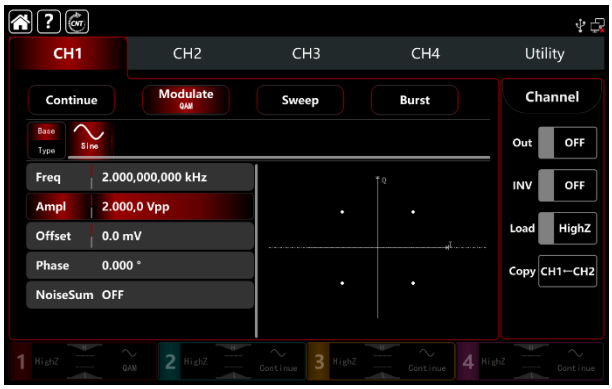
2) Set the parameter of the carrier wave signal

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



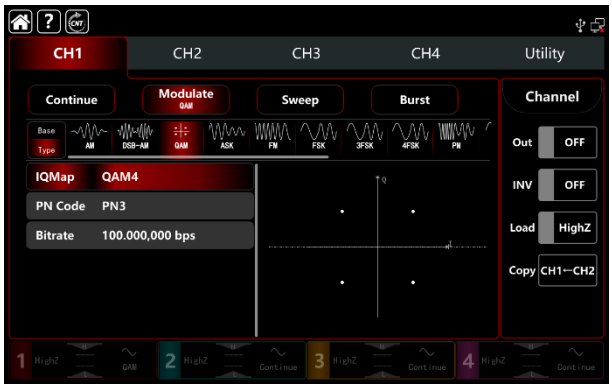
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3) Set the modulation parameter

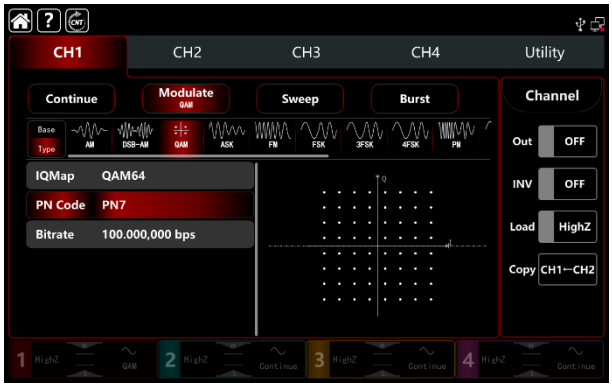
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set parameter.



Tape IQMap→QAM4 to select QAM64.

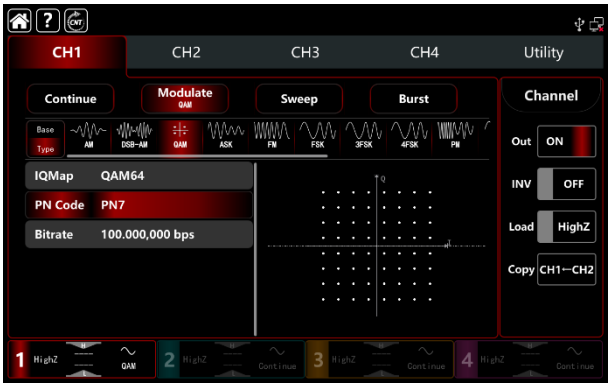
Tape PN Code→PN3 to select PN7.

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

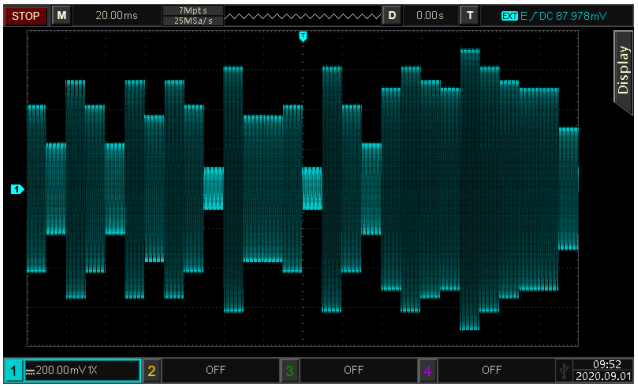


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,



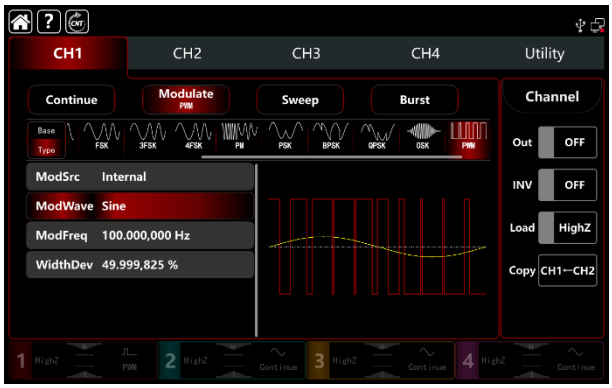
3.1.15 PWM (Pulse Width Modulation)

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.

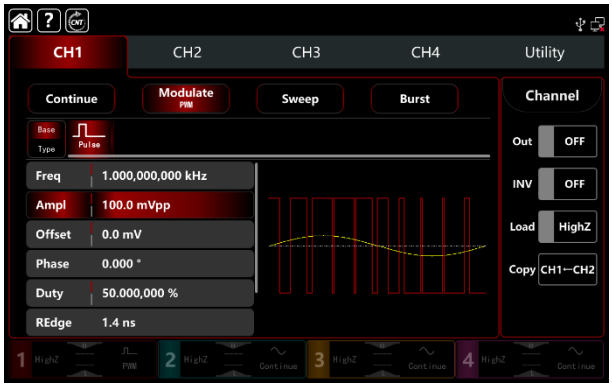
Select PWM modulation

Tap CH1→Modulate→PWM to turn on PWM modulation, the instrument output the moduluated 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.

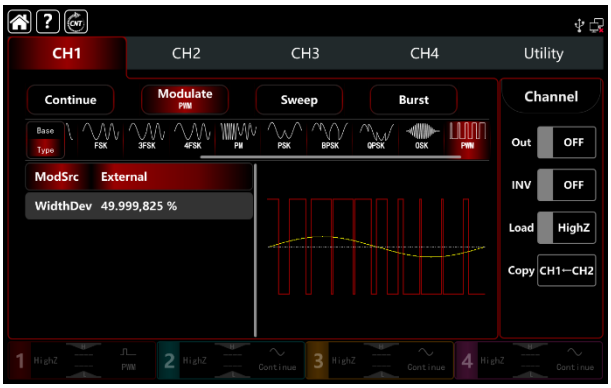


Carrier wave frequency settings

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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The PWM duty ratio offset is controlled by the ±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 1uHz~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 frequence will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The intput external modulating signal frequency range is between 0Hz~50kHz.

Duty ratio deviation settings

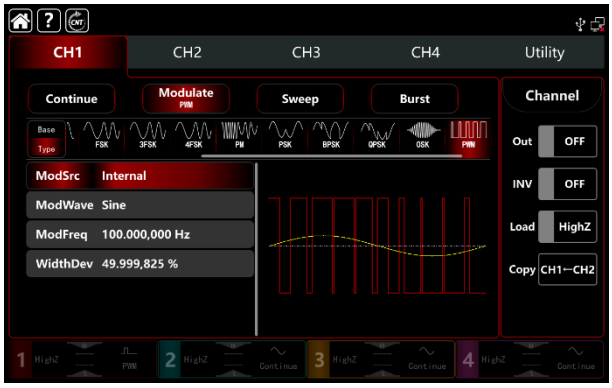
Duty ratio deviation is deviation of modulated waveform from the current carrier duty ratio. The range of PWM can set to 0%~49.999825%, the default is 49.999825%. Rotate multifunction knob, push direction key or tap DutyDev tab to pop-out visual numeric keyboard to enter values and select unit in FM 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 ≤99.99%
- The minimum duty ratio of pulse wave and the currenr edge time will effect the duty ratio settings.

Comperhensive example

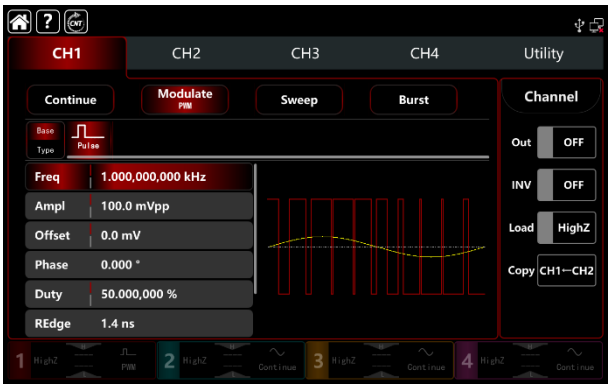
In PWM modulation mode, set an internal 1kHz sine wave as a modulating signal, another pulse wave with freqeuency 10kHz, amplitude 2Vpp， duty ratio 50%, rising/falling edge time 100ns as a carrier wave signal , and set the frequencyduty ratio deviation to 40%, the settings steps as following,

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.

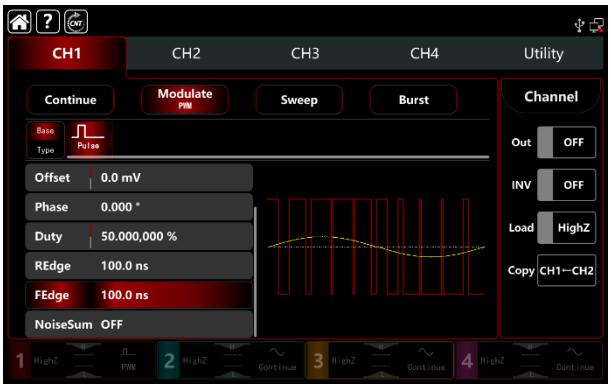


Tap Freq to pop-out visual numeric keyboard to enter 10kHz.

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

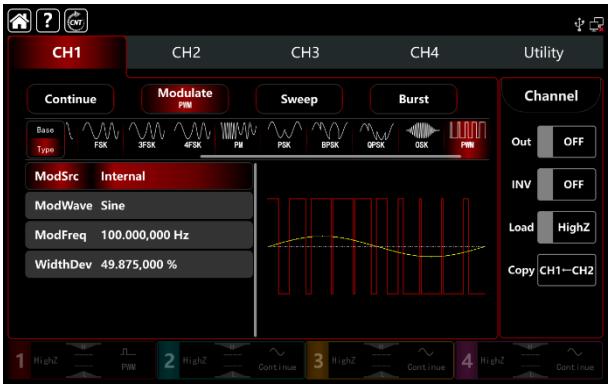
Tap REdge to pop-out visual numeric keyboard to enter 100ns.

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



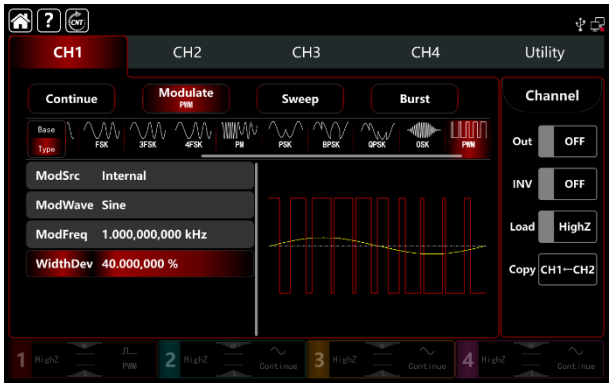
3）Set the modulating parameter

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



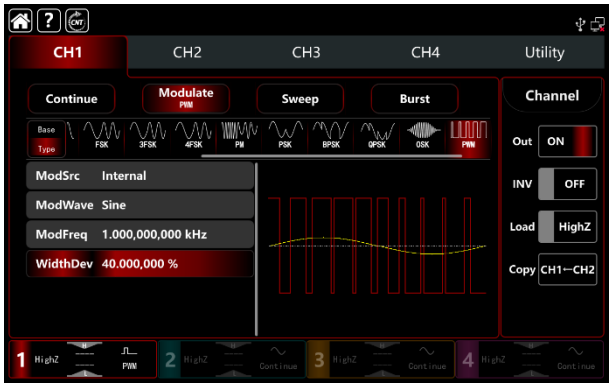
Tap ModFreq to pop-out visual numeric keyboard to enter 1kHz.

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

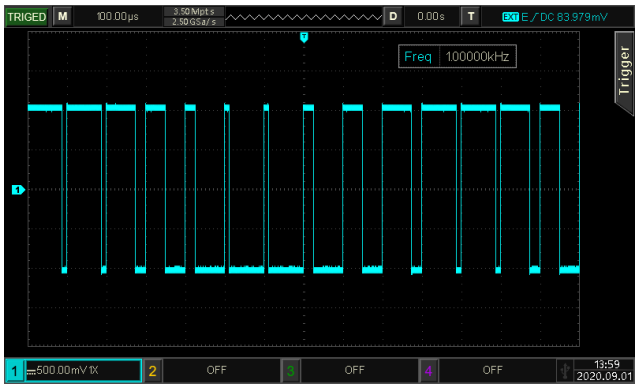


4）Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

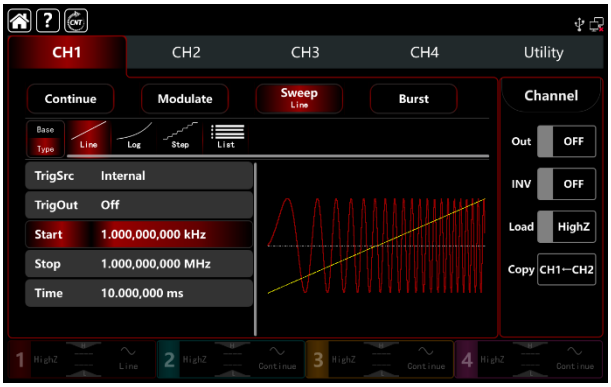


3.2 Output Frequency Sweep Waveform

In frequency sweep mode, the funcyion/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.

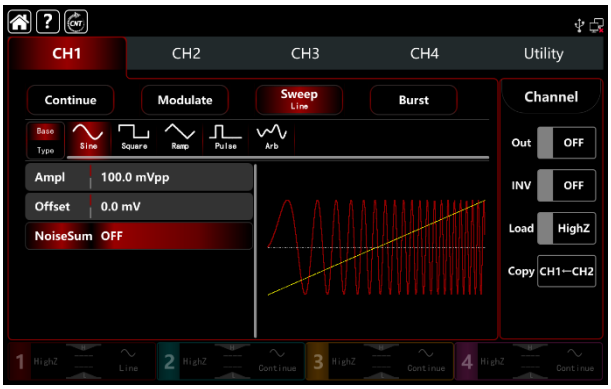
3.2.1 Select Frequency Sweep

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



2) Select the frequency sweep waveform

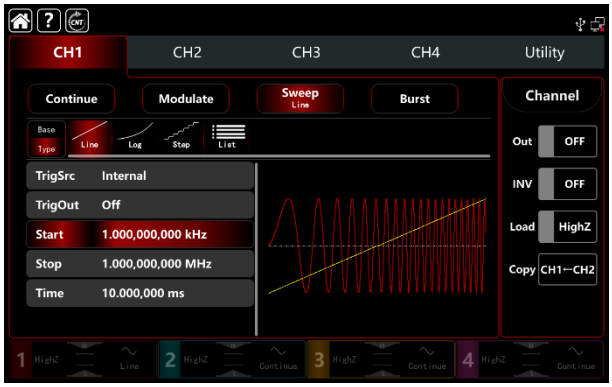
Tape Base tap Base to present the carrier waveform on the right side. See the interface figure as below,



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

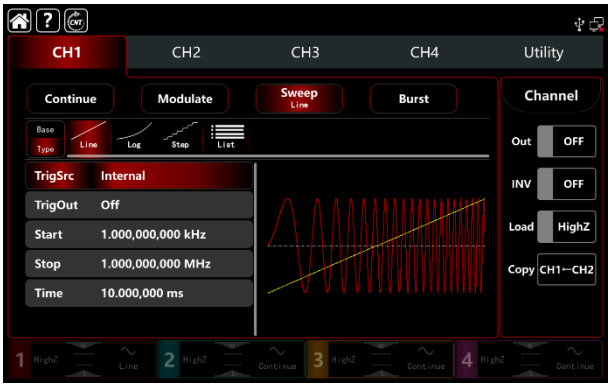
Linear frequency sweep: output frequency in a linear way

Logarithm frequency sweep: output frequency in a logarithm way

Stepping frequency sweep: output frequency in a stepping way

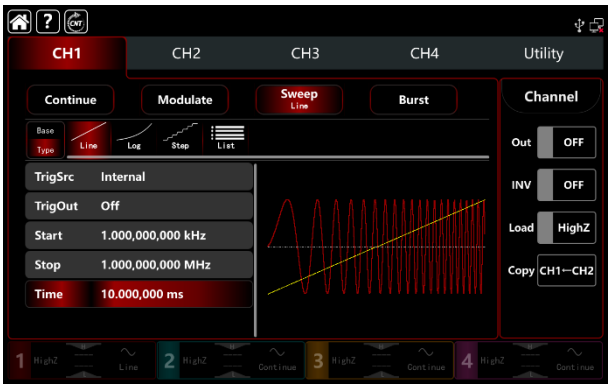
List frequency sweep: output frequency in a list way

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, tapType→Time tab to pop-out visual numeric keyboard to enter values and select unit.



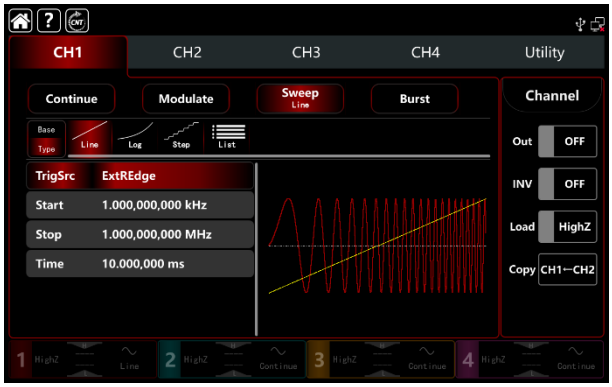
3.2.5 Select trigger source

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 Maunal.

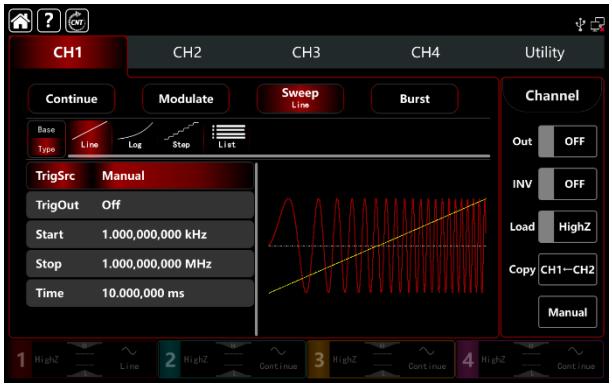
1) The waveform generator will output a succession frequency sweep when in internal trigger source. The rate controlled by frequency sweep time.
2) The waveform generator will trigger by the external digital modulation terminal (FSK Trig connector) on the back panel when in external source. The waveform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

   Note: In external triggrt 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 tigger 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 1μs 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.

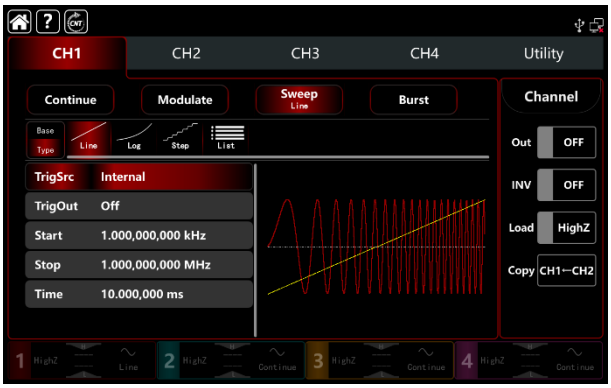
3.2.7 Trigger Edge

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 singal, and the default is rising edge.

3.2.8 Comperhensive example

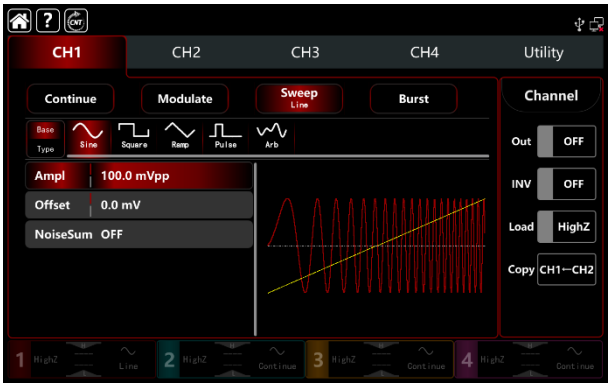
In frequency sweep mode, set a square wave with amplitude 1Vpp, duty ratio 50% as frequency sweep, the frequency sweep type is linear, set the starting frequency to 1kHz, stop frequency 50kHz and frequency sweep time to 2ms, use the internal rising edge trigger source to output frequency sweep. The settings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

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

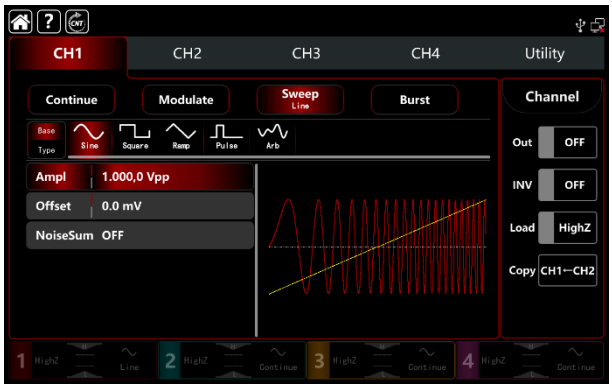


1) Set the parameter of the carrier wave signal

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

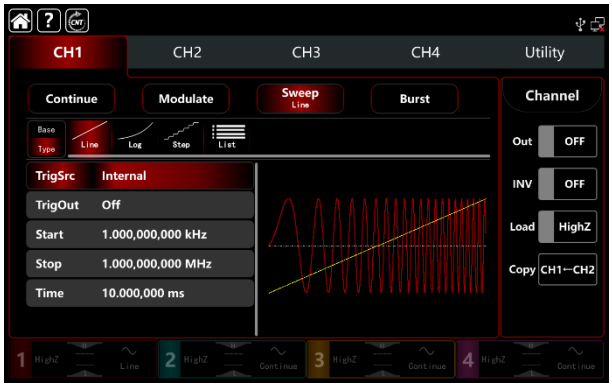


Tap Ampl tab to pop-out visual numeric keyboard to enter 1Vpp.



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.

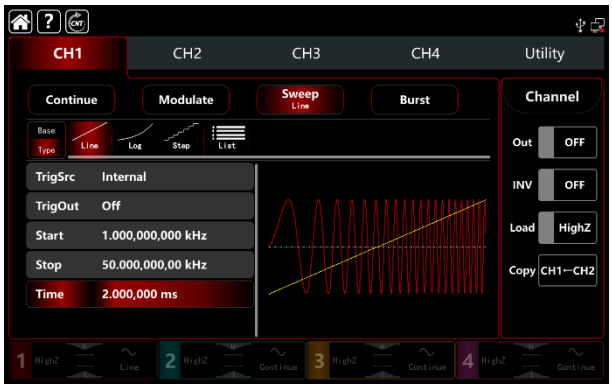


Select Linear as the way of frequency sweep (default).

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

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

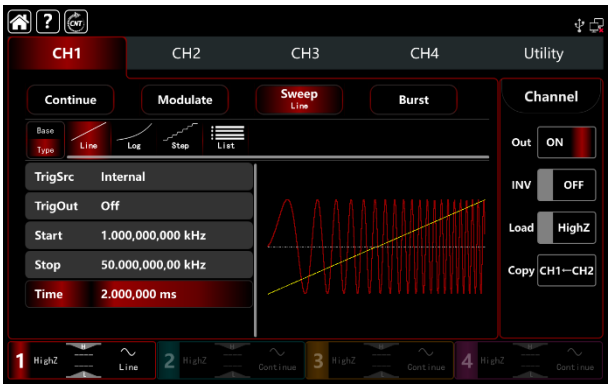
Tap DwellTime tab to pop-out visual numeric keyboard to enter 2ms.



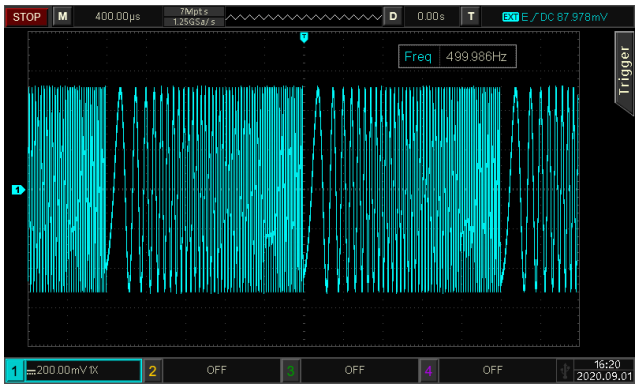
3) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

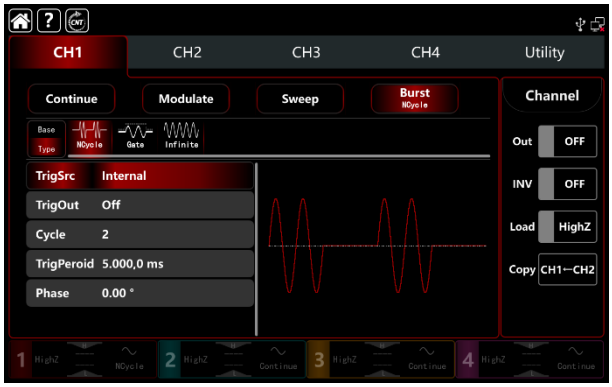


3.3 Output Burst Waveform

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

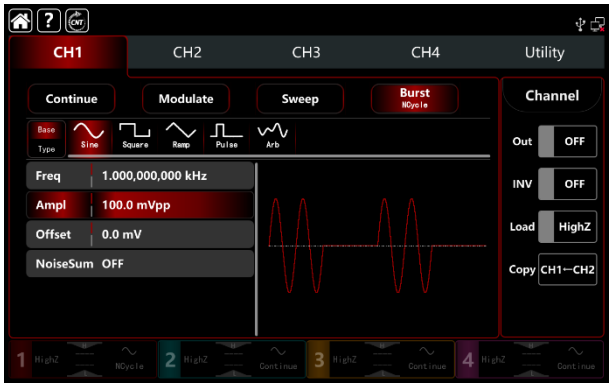
Turn on Burst mode: tap CH1→Burst accordingly, the instrument output the moduluated pulse string waveform according to the current setting.



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.

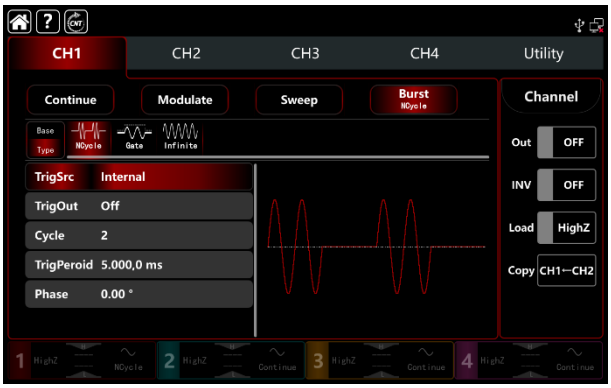
3.3.2 Burst Type

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

1) N cycle mode

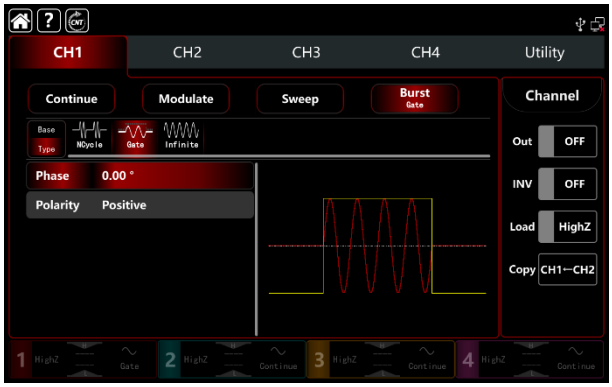
Tap NCycle to turn on N cycle mode, the waveform generator will output a waveform with designated cycle number (pulse string). After output a designated number cycle number, the waveform generator will stop and wait for the next trigger. The trigger source of pulse string can be internal, external or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

Note: When trigger source is ExtREdge, ExtFEdge, 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

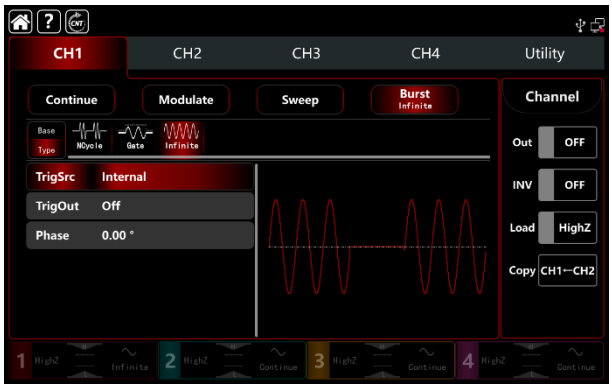
Tap Gate to turn on gating mode, trigger source, trigger output, trigger period and cycle number will be hidden in parameter list. It can only use the external trigger source, the waveform generator trigged by the external digital modulation terminal (FSK Trig connector) on the back panel. The waveform 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, ExtFEdge 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.

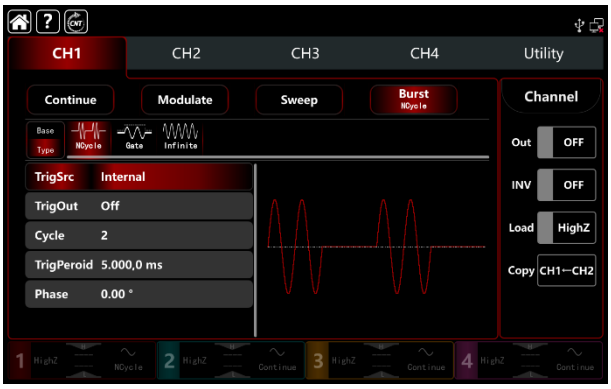


3.3.3 Initial Phase of Burst

Start phase of burst cab set to 0°~ +360°, the default start phase is 0° . 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°is the point at which the waveform passes 0V (or DC offset value) in forward direction.
- For arbitrary waveform, 0° 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 is mean the time from one pulse string to the next pulse string. When trigger source is external or manul, trigger period will be hidden in parameter list. The range of burst period (period of pulse string) can set to 1μs~500s; the default range is 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)≥waveform period×cycle number（number of pulse string）At here, waveform period is the reciprocal of the waveform frequency which 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.

- Cycle number< Trigger period × 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 triggrt 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 tigger 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 Inifinite 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 1μs 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

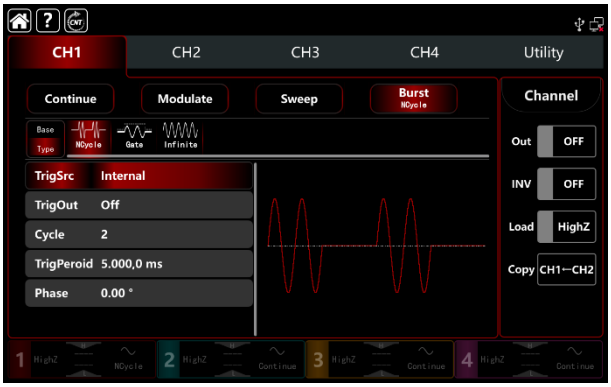
The external digital modulation terminal (FSK Trig connector) can be designated edge as input or output. When the terminal used as input (ExtREdge/ ExtFEdge external trigger source), ExtREdge means that rising edge of external signal triggers output a pulse string; ExtFEdge means that falling edge of 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 singal, and the default is rising edge.

3.3.9 Comprehensive example

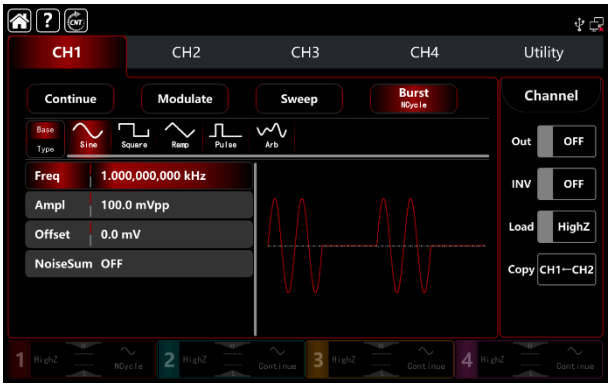
In burst mode, set a sine wave with period 5ms, amplitude 500mVpp as pulse string wave, burst mode set to N cycle, pulse string period 15ms, cycle number 2, the settings steps as following,

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

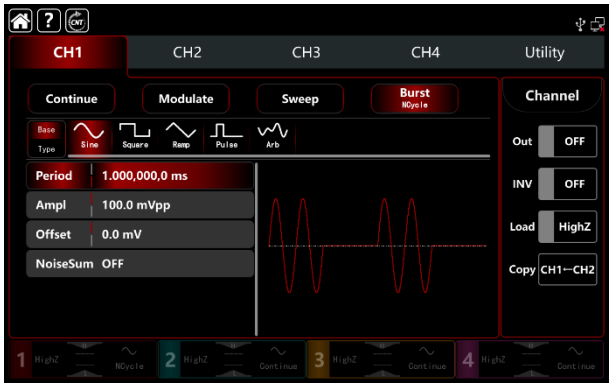


2) Select burst waveform

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

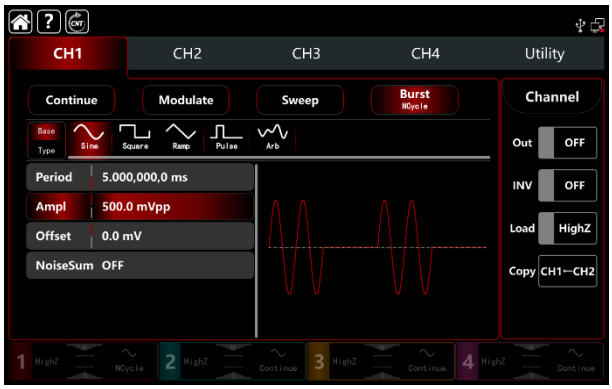


Note: If the setting interface display Freq, this means it can only change the frequency parameter, it can't switch to period. 2ms period is corresponding to 500Hz and their recripocal relationship is T=1/f. Tap Freq to step through frequency and period.



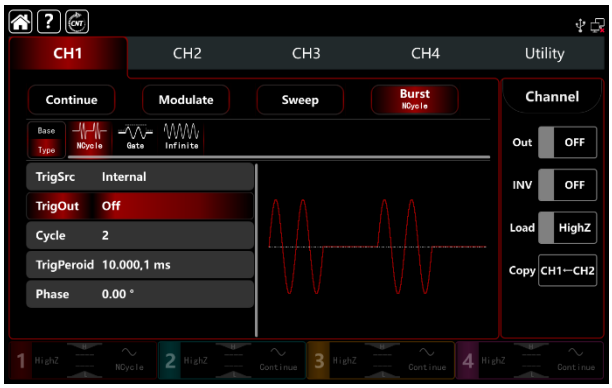
Tap Period to pop-out visual numeric keyboard to enter 5ms.

Tap Ampl to pop-out visual numeric keyboard to enter500mVpp.

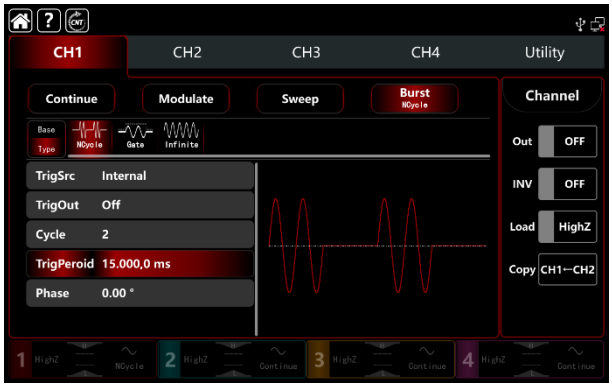


3) Set burst period and cycle

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

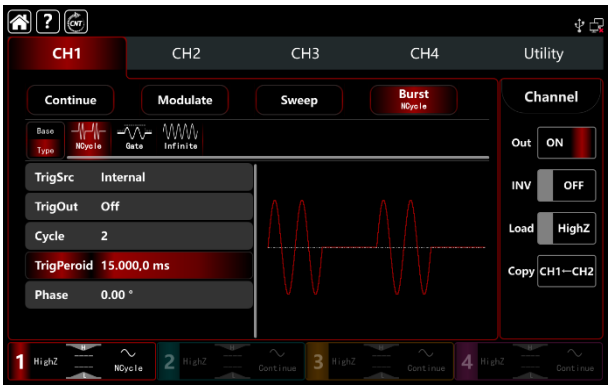


Tap parameter bar to enter value and select unit.

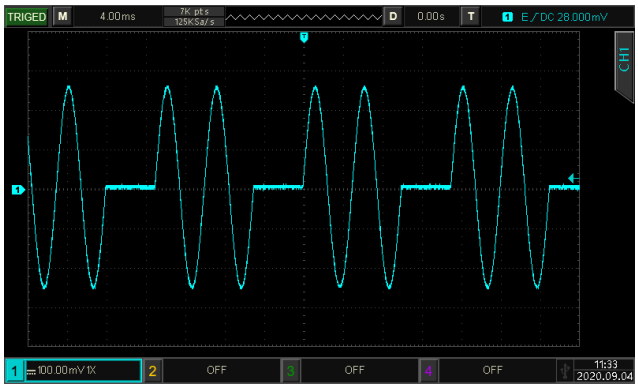


4) Turn on the output channel

Tap channel Out botton to ON or push CH1 key on the front panel to quick set the output channel,and it can aslo 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,

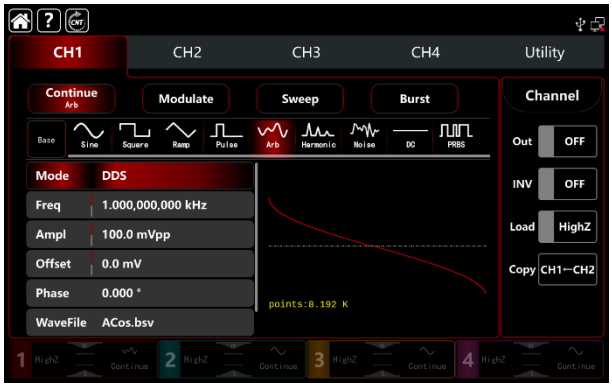


3.4 Output Abitrary Waveform

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

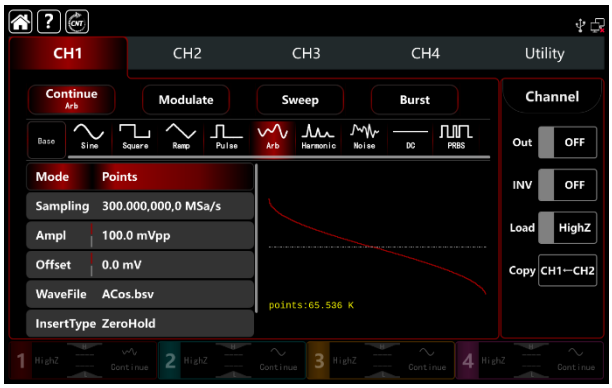
3.4.1 Turn on arbitrary waveform mode

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



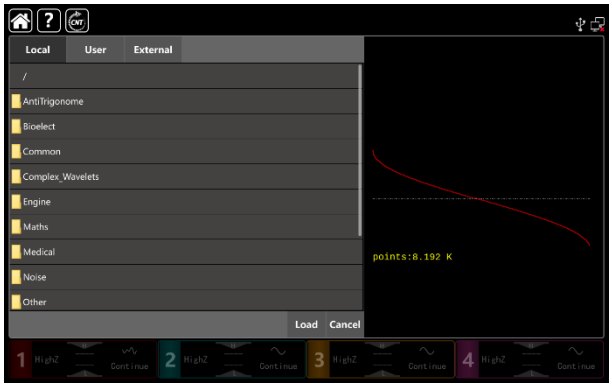
3.4.2 Point by point output/ DDS mode

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.



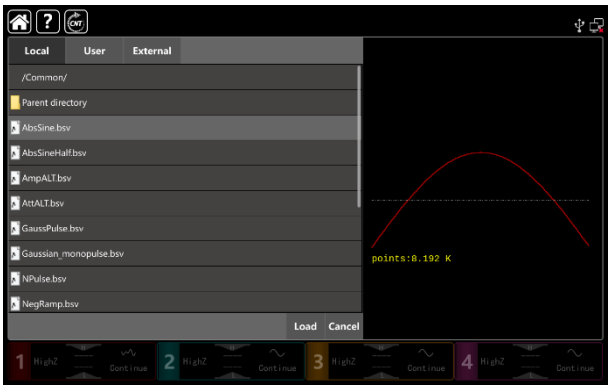
3.4.3 Select Abitrary Waveform

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,

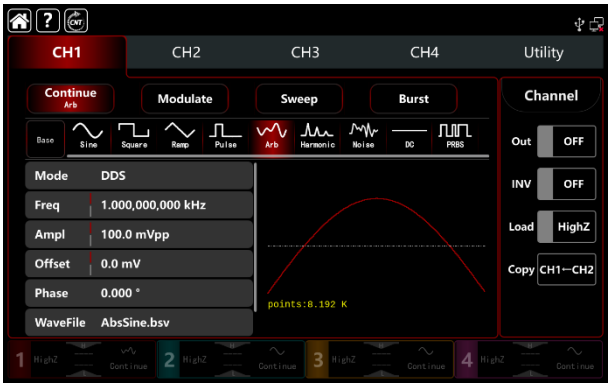


Select the types of arbitrary waveform,

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 64 points with file format *.csv or *.bsv.

Table 4-4 Buit-in Arbitrary Waveform

Type	Name	Description
Common （15 types）	Sin	Sine function
	Square	Sqaure waveform
	Ramp	Sawtooth waveform

	NegRamp	Negative sawtooth waveform
	PPulse	Positive pulse
	NPulse	Negative pulse
	Noise	Noise waveform
	Sinc	Sincfunction
	Cardiac	Electrocardiograph
	EEG	Electroencephalogram
	DualTone	Dual tone multi-frequency
	AbsSine	Sine absolute value
	StairDn	Stair down
	StairUp	Stair up
	Trapezia	Trapezoid
Engine (25 types)	BandLimited	Band-limited signal
	BlaseiWave	Vibration of blasting “Time-vibration velocity”curve
	Butterworth	Butterworth filter
	Chebyshev1	Type I Chebyshev filter
	Chebyshev2	Type II Chebyshev filter
	Combin	Compound function
	CPulse	C-Pulse signal
	CWPulse	CW pulse signal
	DampedOsc	Damped vibrarion “Time-displacement”curve
	DualTone	Dual tone signal
	Gamma	Gamma signal
	GateVibar	Gate self-excited osclliation signal
	LFMPulse	Linear frequency modulation pulse signal
	MCNoise	Construction machinery noise
	Discharge	Discharge curve of Ni-MH battery
	Pahcur	Current waveform of brushless DC motor
	Quake	Earthquake waveform
	Radar	Radar signal
	Ripple	Power ripple
	RoundHalf	Hemispheric waveform

	RoundsPM	RoundsPM waveform
	StepResp	Step response signal
	SwingOsc	Swing osclliation function-time curve
	TV	Television signal
	Voice	Voice signal
Maths （27 types）	Airy	Airy function
	Besselj	Class-I Bessel function
	Besselk	Besselk function
	Bessely	Class-II Bessel function
	Cauchy	Cauchy distribution
	Cubic	Cubics function
	Dirichlet	Dirichlet function
	Erf	Error function
	Erfc	Complementary error function
	ErfcInv	Inverse complementary error function
	ErfInv	Inverse error function
	ExpFall	Exponential falling function
	ExpRise	Exponential rising function
	Gammaln	Natural logarithm of Gamma function
	Gauss	Gaussian distribution (Normal distribution)
	HaverSine	Haversed sine
	Laguerre	Quartic Laguerre polynomial
	Laplace	The Laplace distribution
	Legend	Quintic Legendre Polynomials
	Log	Denary logarithm function
	LogNormal	Logarithmic normal distribution
	Lorentz	Lorentzian function
	Maxwell	Maxwell's distribution
	Rayleigh	Rayleigh distribution
	Versiera	Versiera
	Weibull	Weibull distribution
	ARB_X2	Square function
SectMod （5 types）	AM	Sine wave amplitude modulation
	FM	Sine wave frequency modulation
	PFM	Pulse frequency modulation

	PM	Sine wave phase modualtion
	PWM	Pulse width modualtion
Bioelect（6 types）	Cardiac	Electrocardio signal
	EOG	Electro-oculogram
	EEG	Electroencephalogram
	EMG	Electromyography
	Pulseilogram	Sphygmograph of common people
	ResSpeed	Expiration speed curve of common people
Medical（4 types）	LFPulse	Low frequency pulse electrotherapy waveform
	Tens1	Transcutaneous electric nerve stimulation waveform 1
	Tens2	Transcutaneous electric nerve stimulation waveform 2
	Tens3	Transcutaneous electric nerve stimulation waveform 3
Standard (17 types)	Ignition	Ignition waveform of automobile internal-combustion engine
	ISO16750-2 SP	Profile map of automobile starting oscillation
	ISO16750-2 Starting1	Automobile starting voltage waveform 1
	ISO16750-2 Starting2	Automobile starting voltage waveform 2
	ISO16750-2 Starting3	Automobile starting voltage waveform 3
	ISO16750-2 Starting4	Automobile starting voltage waveform 4
	ISO16750-2 VR	Profile map of the reset working voltage
	ISO7637-2 TP1	Transient phenomena of automobile caused by power cut
	ISO7637-2 TP2A	Transient phenomena of automobile caused by inducatance in wiring
	ISO7637-2 TP2B	Transient phenomena of automobile caused by

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

(17 types)	ACosH	Arc- hyperbolic cosine function
	ACotCon	Arc- hyperbolic cosine function
	ACotPro	Convex arc cotangent function
	ACotHCon	Concave arc- hyperbolic cosine function
	ACotHPro	Convex arc- hyperbolic cosine function
	ACscCon	Concave arc cosecant function
	ACscPro	Convex arc cosecant function
	ACscHCon	Concave arc hyperbolic cosecant function
	ACscHPro	Convex arc hyperbolic cosecant function
	ASecCon	Concave arc secant function
	ASecPro	Convex arc secant function
	ASecH	Arc hyperbolic secant function
	ASin	Arcsin function
	ASinH	Arc hyperbolic sine function
	ATan	Arctan function
	ATanH	Arc hyperbolic tangent function
Noise（6 types）	NoiseBlue	Blue noise
	NoiseBrown	Brown noise(red noise)
	NoiseGray	Gray noise
	NoisePink	Pink noise
	NoisePurple	Purple noise
	Noisewhite	White noise
Window （17 types）	Bartlett	Bartlett window
	BarthannWin	Amended Bartlett window
	Blackman	Blackman window
	BlackmanH	BlackmanH window
	BohmanWin	Bohman window
	Boxcar	Rectangle window
	ChebWin	Chebyshev window
	GaussWin	Gaussian window
	FlattopWin	Flat-top window
	Hamming	Hamming window
	Hanning	Hanning window

	Kaiser	Kaiser window
	NuttallWin	The minimum of four Blackman Harris window
	ParzenWin	Parzen window
	TaylorWin	Taylaor window
	Triang	Quarter window(Fejer window)
	TukeyWin	Tukey window
Complex Wavelets （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
Other （3 types）	ABA_1_1	
	ABA_1_2	
	ALT_03	
	ALT_04	
	ALT_05	
	AUDIO	
	circle	Circle modulaion
	COIL_2_1	
	COIL_2_2	
	DC_04	
	diamond	Diamond modulaion
	ECT_1_2	
	EGR_2	
	EGR_3_2	
	EST_03_2	
	Heart	Heart modulaion
	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 cpmplex arbitrary waveform (arbitrary amplitude and shape). For specific operations, please refer to UTG9000T Abritrary Waveform Programming Guide. The created arbitrary waveform can import to the function/arbitrary waveform generator.

3.5 Output Digital Protocol

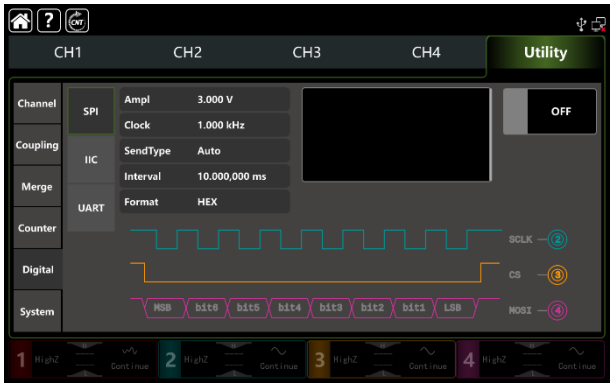
The waveform generator can output three types of protocol conding: IIC, SPI and UART. (TTL) The corresponding protocol parameters can be set in different protocol modes. Turn on output terminal on the front panel to export the corresponding signal.

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

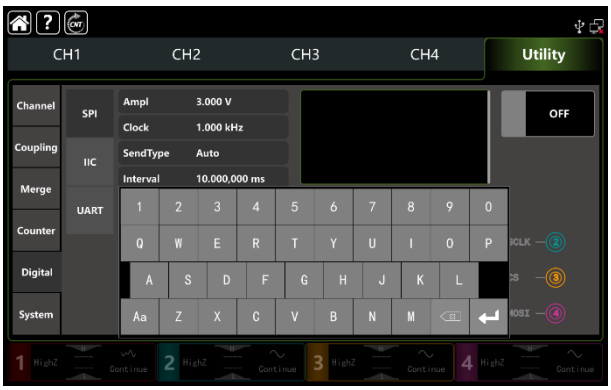
The sending clock of SPI can set by user's need. In SPI mode, tap Clock to pop-out visual numeric keyboard to enter values and select unit. The clock range can set to 1Hz~50MHz.

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 lengthin certain time; in manual mode,push send key to sen 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) Maunal 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

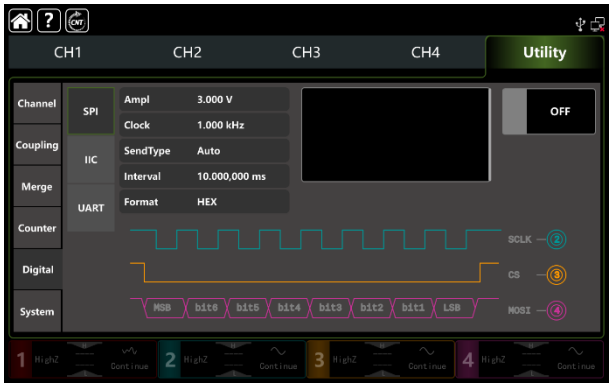
If the send mode is auto, set the interval time of data send according to the actual condition. Tap Interval to pop-out visual numeric keyboard to enter values and select unit. The interval time range can set to 20ns~1000s.

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.

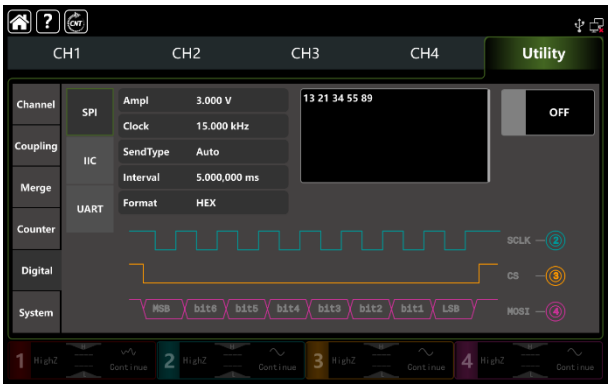


2) Set data parameter

   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 enter13, 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

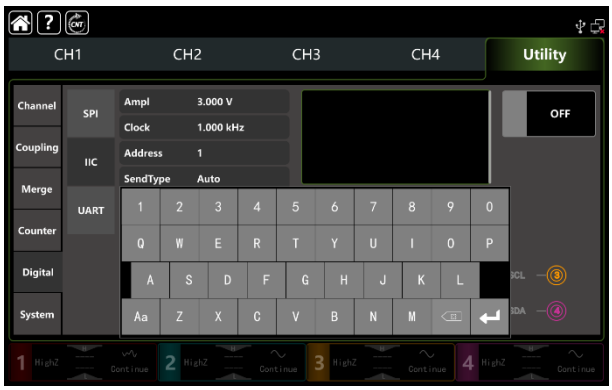
The sending clock of SPI can set by user's need. In IIC mode, tap Clock to pop-out visual numeric keyboard to enter values and select unit. The clock range can set to 1Hz~50MHz.

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

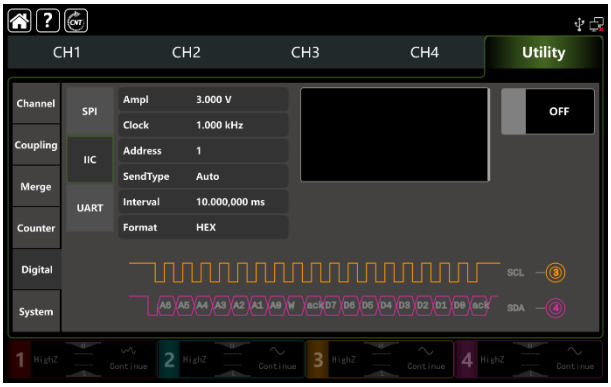
If the send mode is auto, set the interval time of data send according to the actual condition. Tap Interval to pop-out visual numeric keyboard to enter values and select unit. The interval time range can set to 20ns~1000s.

Comprehensive example

In IIC mode, set the output address to 10 bit, values is 65, clock 500kHz, select decimalism 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.

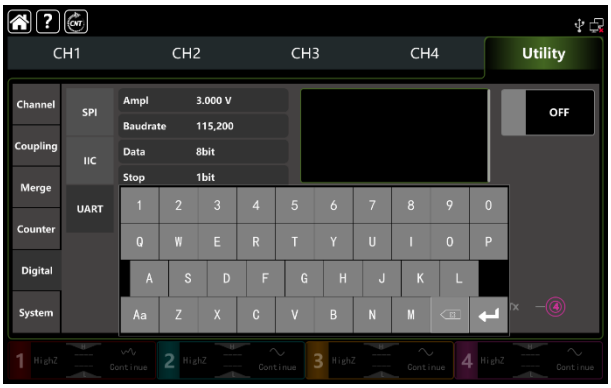
Data format setting

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.


CH1
CH2
CH3
CH4
Utility
Channel
Coupling
Merge
Counter
Digital
System
SPI
IIC
UART
Ampl 3.000 V
Baudrate 480,0
Data 8bit
Stop 1bit
Verify Odd
SendType Auto
Interval 2.000,000 ms
Format HEX
05 20 13 14
ON
D0 D1 D2 D3 D4 D5 D6 D7 Verify Tx
1 HighZ Continue
2 HighZ Continue
3 HighZ Continue
4 UART-TX

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) Restaet 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、CH3orCH4is 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.
5) 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 Warranty

UNI-T (Uni-Trend Technology (China) Limited) guarantees that the products it produces and sells are free from any defects of material and process within 3 years from authorizing the dealer to deliver them. If the product is proven to be defective during warranty period, UNI-T will repair and replace according to provisions of warranty.

To arrange repair or ask for the whole warranty, please contact with the nearest sales or maintenance department of UNI-T.

Except warranties provided in the outline or other applicable warranties, UNI-T does not provide any other express or implied warranties, including but not limited to any implied warranties about tradability and applicability to special purpose of the product. In any case, UNI-T assumes no responsibility for indirect, special or consequent loss.

5.3 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	100%
Duty ratio of pulse wave	50%
Rising edge of pulse wave	1.4ns
Falling edge of pulse wave	1.4ns
Arbitrary Wave	
Built-in arbitrary wave	ACos
Play mode	DDS
AM Modualtion	
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	180°
BPSK rate	100Hz
QPSK Modulation	
Carrier wave	Sine wave
Modulation source	PN3
QPSK rate	100Hz
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
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
Trigger edge	Rising edge
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
Trigger edge	Rising edge
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: Performance Index

Unless otherwise stated, all of the performance index are guaranteed within the following two conditions.

1. The waveform generator has been calibrated and in the calibration period.

2. The waveform generator shall operate continuously for more than 30 minutes at the specified operating temperature (18℃~28℃)

All specifications are guaranteed except those marked “Typical value”.

Model	UTG9604T		UTG9404T		UTG9204T	
Channel	CH1/CH2	CH3/CH4	CH1/CH2	CH3/CH4	CH1/CH2	CH3/CH4
Maximum frequency	600MHz	200MHz	400MHz	160MHz	200MHz	120MHz
Sampling rate	2.5GSa/s（CH1 and CH2） 625MSa/s （CH3 and CH4）					
Waveform	Sine, Square, Ramp, Pulse, Harmonic, Noise, PRBS, DC, Arbitrary wave					
Mode	Continue, Modulate, Sweep, Burst, Frequency counter, Protocol					
Modulation type	AM、FM、PM、DSBAM、QAM、ASK、FSK、3FSK、4FSK、PSK、BPSK、QPSK、OSK、PWM、SUM					
Waveform Characteristic						
Sine Wave						
Frequency range	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
Resolution	1uHz					
Accuracy	±50ppm within 90 days，±100ppm within one year （18°C 至 28°C）					
Harmonic distortion (Typical value) CH1/CH2	Test term：output power 0dBm					
	DC～10MHz	-65dBc				
	10MHz～60MHz	-60dBc				
	60MHz～150MHz	-50dBc				
	150MHz～200MHz	-40dBc				
	200MHz～600MHz	-28dBc				
Harmonic distortion (Typical value) CH3/CH3	Test term：output power 0dBm					
	DC～10MHz	-65dBc				
	10MHz～60MHz	-60dBc				
	60MHz～100MHz	-55dBc				
	100MHz～200MHz	-40dBc				

Total harmonic distortion （Typical value）	0.075%（0 dBm, 10Hz～20kHz）					
Spurious signal (nonharmonics，typical value）	Test term：output power 0dBm					
	DC～10MHz，＜-70dBc					
	＞ 10MHz <-70dBc+6dB/octave					
Phase noise (typical value)	10 MHz： ≤-125 dBc/Hz（typical value，0dBm，10kHz deviation）					
Square Wave						
Frequency range	1μHz～200MHz	1μHz～60MHz	1uHz～160MHz	1μHz～50MHz	1uHz～120MHz	1μHz～40MHz
Resolution	1uHz					
Rising/falling time	＜1.5ns	＜2ns	＜3ns	＜5ns	＜6ns	＜7ns
Overshoot （typical value）	＜2%（1MHz, 1 Vpp, 50Ω load）					
Duty ratio	0.000001%-99.999999%					
Symmetry （duty ratio of 50%）	1% of period +4ns					
Shake （typical value）	100 ps（1Vpp, 50Ω load）					
Ramp Wave						
Frequency range	1μHz～30MHz	1μHz～10MHz	1uHz～20MHz	1μHz～8MHz	1uHz～10MHz	1μHz～3MHz
Resolution	1uHz					
Non-linearity	< 1% of peak output （typical value，1kHz，1Vpp ，symmetry 100%）					
Symmetry	0.0%~100.0%					
Pulse Wave						
Frequency range	1μHz～200MHz	1μHz～60MHz	1uHz～160MHz	1μHz～50MHz	1uHz～120MHz	1μHz～40MHz
Resolution	1uHz					
Pulse width	2.4ns（CH1 and CH2） 8ns（CH3 and CH4）					
Variable edge	1.0ns-10ks	2.0ns-10ks	3.0ns-10ks	5ns-2ks	6ns-2ks	7ns-2ks
Overshoot （typical value）	＜2% ，（1MHz, edge≥2ns ， 1 Vpp, 50Ω load）					

Shake	100ps （1Vpp, 50Ω load）						
Gussian Noise							
Bandwidth	1mHz-600MHz	1mHz-400MHz	1mHz-200MHz	1mHz-200MHz	1mHz-160MHz	1mHz-120MHz	
DC Offset							
Range (Peak value AC+DC）	±5V（50Ω）						
	±10V （high resistance）						
Accuracy of deviation	±1% of deviation value ±0.5%±2mV of amplitude value						
Arbitrary Wave							
Sampling rate	DDS	2.5GSa/s（CH1 and CH2） 625MSa/s （CH3 and CH4）					
	Point by point	1μSa/s-600MSa/s	- -	1μSa/s-400MSa/s	- -	1μSa/s-200MSa/s	- -
Resolution	1uHz						
Waveform length	8pts～64Mpts（CH1 and CH2） 8kpts （CH3 and CH4）						
Vertical resolution	16bits（including symbol）						
Shake	150ps						
Nonvolatile storage	more than 200 waveform						
PRBS Wave							
Bitrate	1μbps-120Mbps	1μbps-60Mbps	1μbps-80Mbps	1μbps-40Mbps	1μbps-40Mbps	1μbps-20Mbps	
Edge time	2.6ns-1000s（CH1 and CH2） 4.2ns-1000s （CH3 and CH4）						
PN code	PN3、PN5、PN7、PN9、PN11、PN13、PN15、PN17、PN21、PN23、PN25、PN27、PN29、PN31、PN33						
Overlay amplitude of noise	noise voltage ≤1Vrms						
Harmonic Wave							
Frequency range	1μHz-300MHz	1μHz-100MHz	1μHz-200MHz	1μHz-80MHz	1μHz-120MHz	1μHz-60MHz	
Harmonic time	16						
Harmonic type	even harmonic, odd harmonic, all harmonics, customize						
Harmonic amplitude	1mV-10Vpp(50Ω load) set the amplitude according to the selected harmonic serial number						
Harmonic phase	0.00°-360.00°						

	set the phase according to the selected harmonic serial number					
Overlay amplitude of noise	noise voltage ≤1Vrms					
Output Characteristics						
Amplitude range Load：HighZ (50Ω load is the half of HighZ)	≤40MHz:2mVpp～20Vpp					
	≤120MHz:2mVpp～10Vpp					
	≤160MHz: 2mVpp～5Vpp					
	≤300MHz: 2mVpp～4Vpp					
	≤400MHz: 2mVpp～2.5Vpp					
	≤500MHz: 2mVpp～1.5Vpp					
	≤600MHz: 2mVpp～1Vpp					
Accuracy（1kHz Sine wave）	(1kHz sine wave，0V deviation, >10mVpp) ±（amplitude value 1%+1mVpp）					
Amplitude flatness （versus to 1kHz sine wave，1Vpp/50Ω）	≤10MHz，0.1dB					
	≤160MHz，0.2dB					
	≤350MHz，0.4dB					
	≤500MHz，0.8dB					
	≤600MHz，0.8dB					
Output Waveform						
Impedance	50Ω typical vaule					
Protection	Channel protection					
Modualtion Type						
AM Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	Sine, square, rising ramp, falling ramp, noise, arbitrary wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Modulation depth	0%～120%					
FM Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	Sine, square, rising ramp, falling ramp, noise, arbitrary wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Frequency deviation	DC-300MHz	DC-100MHz	DC-200MHz	DC-80MHz	DC-100MHz	DC-60MHz

PM Modualtion						
Carrier wave	Sine, square, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	Sine, square, rising ramp, falling ramp, noise, arbitrary wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Phase deviation	0°～360°					
ASK Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	50% duty ratio of square wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
FSK Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	50% duty ratio of square wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Hopping frequency 1	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
3FSK Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	50% duty ratio of square wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Hopping frequency 1	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
Hopping frequency 2	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
4FSK Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	50% duty ratio of square wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Hopping frequency 1	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
Hopping frequency 2	1μHz～	1μHz～	1uHz～	1μHz～	1uHz～	1μHz～

	600MHz	200MHz	400MHz	160MHz	200MHz	120MHz
Hopping frequency 3	1μHz～600MHz	1μHz～200MHz	1uHz～400MHz	1μHz～160MHz	1uHz～200MHz	1μHz～120MHz
PSK Modualtion						
Carrier wave	Sine, square, ramp, arbitrary wave					
Source	Internal/external					
Modulation wave	50% duty ratio of square wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			
Hopping phase	0.00°- 360.00°					
BPSK Modualtion						
Carrier wave	Sine, square, ramp, arbitrary wave					
PN code	PN3、PN5、PN7、PN9、PN11、PN13、PN15、PN17、PN21、PN23、PN25、PN27、PN29、PN31、PN33					
Modulation wave	50% duty ratio of square wave					
Bitrate	1μbps-2Mbps		1μbps-1Mbps			
Hopping phase	0.00°- 360.00°					
QPSK Modualtion						
Carrier wave	Sine, square, ramp, arbitrary wave					
PN code	PN3、PN5、PN7、PN9、PN11、PN13、PN15、PN17、PN21、PN23、PN25、PN27、PN29、PN31、PN33					
Modulation wave	50% duty ratio of square wave					
Bitrate	1μbps-2Mbps		1μbps-1Mbps			
Hopping phase 1	0.00°- 360.00°					
Hopping phase 2	0.00°- 360.00°					
Hopping phase 3	0.00°- 360.00°					
OSK Modualtion						
Carrier wave	Sine wave					
Trigger source	Internal/external					
Oscillation time	1ns～1000s					
Oscillation frequency	1μHz～2MHz		1μHz～1MHz			
SUM Modualtion						
Carrier wave	Sine, square, pulse, ramp, arbitrary, harmonic, noise wave					
Source	Internal/external					
Modulation wave	Sine, square, rising ramp, falling ramp, noise, arbitrary wave					
Modulation frequency	1μHz～2MHz		1μHz～1MHz			

Modulation depth	0.00%-100.00%	
QAM Modualtion		
IQ map	QAM4，QAM8，QAM16，QAM32，QAM64，QAM128，QAM256	
Modulation source	PN3、PN5、PN7、PN9、PN11、PN13、PN15、PN17、PN21、PN23、PN25、PN27、PN29、PN31、PN33	
Modulation rate	1μbps-2Mbps	1μbps-1Mbps
PWM Modualtion		
Carrier wave	Pulse wave	
Source	Internal/external	
Modulation wave	Sine, square, rising ramp, falling ramp, noise, arbitrary wave	
Modulation frequency	1μHz～2MHz	1μHz～1MHz
Width deviation	0%～49.99% of pulse width	
Frequency Sweep		
Carrier wave	Sine, square, ramp, pulse, arbitrary wave	
Type	Linear, logarithm, stepping, list sweep	
Frequency sweep time	1ms～500s	
Trigger source	Internal, external rising edge, external falling edge, manual	
Trigger output	Close, rising edge, falling edge	
Step	2 -2048 steps	
Listfile	Maximum 2048 frequency points for a single file Frequency range is accordance with fundamental wave range	
Burst		
Carrier wave	Sine, square, ramp, pulse, arbitrary wave	
Type	N cycle, infinite, gated	
Initial phase	0～ +360°	
Period	1us～500s	
Cycle number	1-50000	
Gated source	External trigger	
Trigger source	Internal, external rising ede, external falling edge, manual	
Digital Protocol		
SPI		
Interface	CH2 - SCLK、CH3 - nCS、CH4 - MOSI	
Amplitude	1mV-10V	
Clock frequency	1Hz～50MHz	

Send way	Auto, manual					
Interval time	20ns-1000s in auto mode of send way					
Data format	Hexadecimal, character					
Data length	Maximum 2048 bytes					
IIC						
Interface	CH3 - SCL、CH4 - SDA					
Amplitude	1mV-10V					
Clock frequency	1Hz-50MHz					
Address	7bit、10bit					
Send way	Auto, manual					
Interval time	20ns-1000s in auto mode of send way					
Data format	Hexadecimal, character					
Data length	Maximum 2048 bytes					
UART						
Interface	CH4 - TX					
Amplitude	1mV-10V					
Baud rate	1-1000000（customized）					
Data bit	4、5、6、7、8					
Stop bit	1bit、2bit					
Verify bit	None,even, odd					
Send way	Auto, manual					
Interval time	20ns-1000s in auto mode of send way					
Data format	Hexadecimal, character					
Data length	Maximum 2048 bytes					
Channel Coupling&Merge						
Frequency coupling	Ratio	0.00001-10000					
	deviation	-600MHz ~600MHz	-200MHz ~200MHz	-400MHz ~400MHz	-160MH~ 160MHz	-200MHz~ 200MHz	-120MHz ~120MHz
Phase coupling	Ratio	0.00001-10000					
	deviation	-720°- 720°					
Amplitude coupling	Ratio	0.00001-10000					
	deviation	-9.999Vpp-9.999Vpp（50Ω）					
Channel Merge		CH1 merge with CH2, CH3 merge with CH4					
Sync Signal						

Frequency range	≤60MHz（CH3 is synchronized with CH1，CH4 is synchronized with CH2，CH3 can't synchronize with CH4）		
Level	Compatible with TTL		
Output impedance	50Ω，typical value		
Coupling way	DC		
External Modulation Input			
Input frequency	＜50kHz		
Modulation depth	± 5Vpk = 100%		
Input impedance	5kΩ（typical value）		
External Reference Input			
Input frequency	10MHz±50Hz（clock frequency adjustable）		
Level range	Compatible with TTL		
Input impedance	10kΩ (typical value, DC coupling)		
Lock time	＜1s		
Internal Reference Input			
Input frequency	10MHz±50Hz		
Level range	Compatible with TTL		
Level range	50Ω(typical value, DC coupling)		
Trigger input			
Input level	Compatible with TTL		
Slop	Rising or falling, optional		
Pulse width	＞100ns		
Input impedance	＞10kΩ，DC coupling		
Response time	＜1μs，typical value		
Trigger output			
Level	Compatible with TTL		
Pulse width	＞400ns，typical value		
Output impedance	50Ω，typical value		
Maximum frequency	1MHz		
Frequency Counter			
Measurement parameter	Frequency, period, duty ratio, positive pulse width, negative pulse width		
Frequency range	100mHz～800MHz	100mHz-60MHz	≥100mVrms
		60MHz-300MHz	≥200mVrms

		300MHz-500MHz	≥500mVrms
		500MHz-800MHz	≥1Vrms
Coupling mode	AC, DC, HF reject		
Trigger level	-2.5V～2.5V		
Frequency resolution	8bit		
Accuracy	±51ppm		
Sensitivity	0%-100%		
General Technical Specification			
Display mode	10.1 寸 TFT capacitive touch，1280*800 resolution		
Communication interface	USB Host, USB Device, LAN、		
Supply voltage	100～240 VAC，45～440Hz,CAT II		
Power dissipation	Less than 50W		
Fuse wire	2A，T-class，250V		
Environment			
Temperature range	operating：10℃～+40℃		
	Non-operating：-20℃～+60℃		
Cooling method	Forced cooling by fan		
Humidity range	+35℃以下：≤90% relative humidity		
	+35℃～+40℃：≤60% relative humidity		
Altitude	Operating: below 2000 meter		
	Non-operating：below 15000 meter		
Machinery Specification			
Size（reference）	370mm×115mm×185mm		
Net weight	4.04kg		
Gross weight	6.06kg		

Appendix C: Accessories List

Model	UTG9000T
Standard	A power line up to local standard
	A USB data line
	Four BNC cables（1meter）
Optional	

Appendix D: 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

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