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UTG9000T Series Function/ Arbitrary Waveform Generator

User's Manual

2025.7

UNI-T Technologies, Inc.

Perface

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

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

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UTG9000T Series Function/Arbitrary Waveform Generator

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

Features

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

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

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Chapter 1 User's Guide

This manual includes safety requirements, installment and the operation of UTG100X series function/arbitrary generator.

1.1 Inspecting Packaging and List

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

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

1.2 Safety Requirements

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

Safety Precautions

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

Safety Statements

Warning	"Warning" indicates the presence of a hazard. It reminds users to pay attention to a certain operation process, operation method or similar. Personal injury or death may occur if the rules in the "Warning" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions

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

Safety Sign

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

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

Safety Requirements

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

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

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

1.3 Environmental Requirements

This instrument is suitable for the following environment:

- Indoor use
- Pollution degree 2
- In operating: altitude lower than 2000 meters; in non-operating: altitude lower than 15000 meters;
- Unless otherwise specified, operating temperature is 10 to 40°C; storage temperature is -20 to

60°C

- In operating, humidity temperature below to +35°C, ≤90% relative humidity;
  In non-operating, humidity temperature +35°C to +40°C, ≤60% relative humidity

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

1.4 Connecting Power Supply

The specification of input AC power.

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

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

Connecting to service cable

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

Please install AC power cable as follow,

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

1.5 Electrostatic Protection

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

The following measure can reduce the damage of electrostatic discharge.

- Testing in anti-static area as far as possible
- Before connecting the power cable to the instrument, inner and outer conductors of the

instrument should be briefly grounded to discharge static electricity;

- Ensure all the instruments are properly grounded to prevent the accumulation of static.

1.6 Preparation Work

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

1.7 Remote Control

UTG9000T series function/arbitrary waveform generator supports communication with the computer via USB interface. User can use SCPI via USB interface and combined with programming language or NI-VISA to remote control the instrument and operating other programmable instrument which is also supports SCPI.

The detailed information about the installation, remote control mode and the programming, please refer to UTG9000T Series Programming Manual at the official website http:// www.uni-trend.com

1.8 Help Information

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

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

Chapter 2 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 revenant transportation department and the distributor, they will replace or maintain the product.

2.1.2 Inspect the Accessories

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

2.1.3 Inspect the Instrument

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

2.2 Introduction of Panels and Keys

2.2.1 Front Panel

UTG9000T series function/arbitrary waveform generator front panel is 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 100-240VAC (fluctuant ±10%), 50/60Hz; 100-120VAC (fluctuant ±10%). Connect the instrument to the power source with power line in accessories or other lines up to standard. Toggle on the power switch on the back panel to operate the instrument. Turn ON/OFF: backlight is on (red) when power supply in normal. Press the key, the backlight is on (green). Afterwards, the screen enters function interface after displaying start-up interface. In order to prevent accidentally touching ON/OFF to turn off the instrument, this switch key needs to press about 1s to turn off the instrument. The backlight of the key and screen are simultaneously off after turning off the instrument.

② USB Interface

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

③ Channel Output Terminal Output the signal of the wave.

④ Channel Control Terminal

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

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

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

⑤ Numeric Key and Utility

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

⑥ Direction Key

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

⑦ Multifunction Knob/Key

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

⑧ Select Output Mode

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

⑨ Quick Select Wave Types

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

⑩ Display Screen

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

⑪ Over-voltage Protection

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

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

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

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

2.2.2 Back Panel

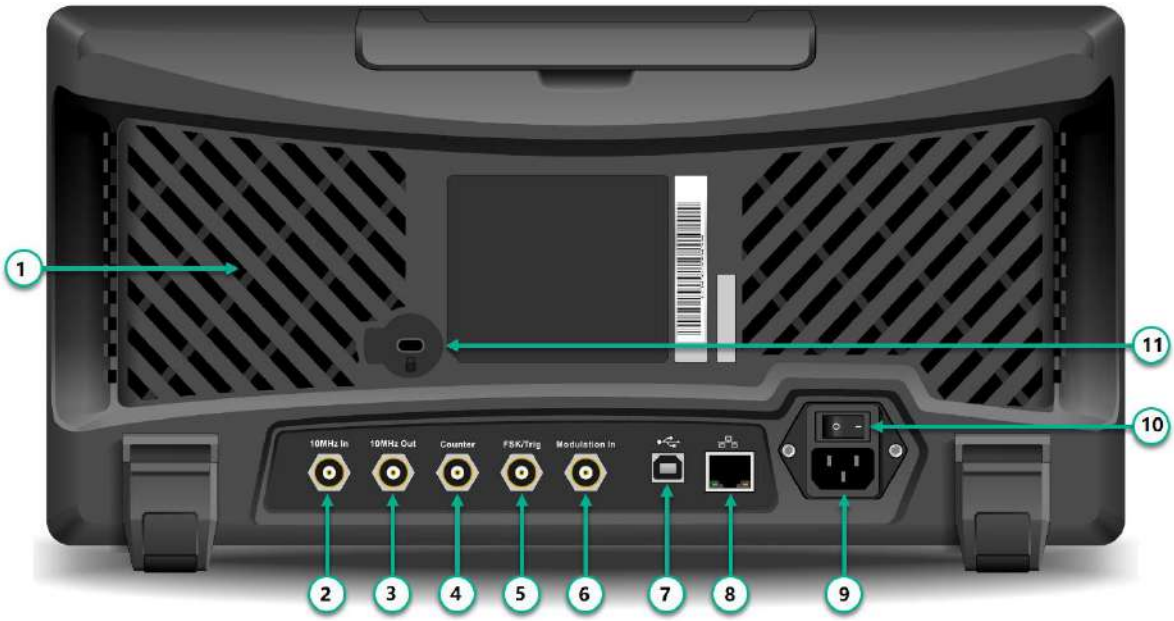


Figure 2-2 Back Front Structure

① Heat Emission Hole

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

② External 10MHz input terminal

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

③ Internal 10MHz output terminal

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

④ Frequency Counter Interface

Input signal through the interface when using frequency counter.

⑤ External Digital Modulation Interface

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

⑥ External Analog Modulation Output Terminal

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

⑦ USB Interface

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

⑧ LAN Port

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

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

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

⑪ Case Locker

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

2.2.3 Touch Screen Display Interface

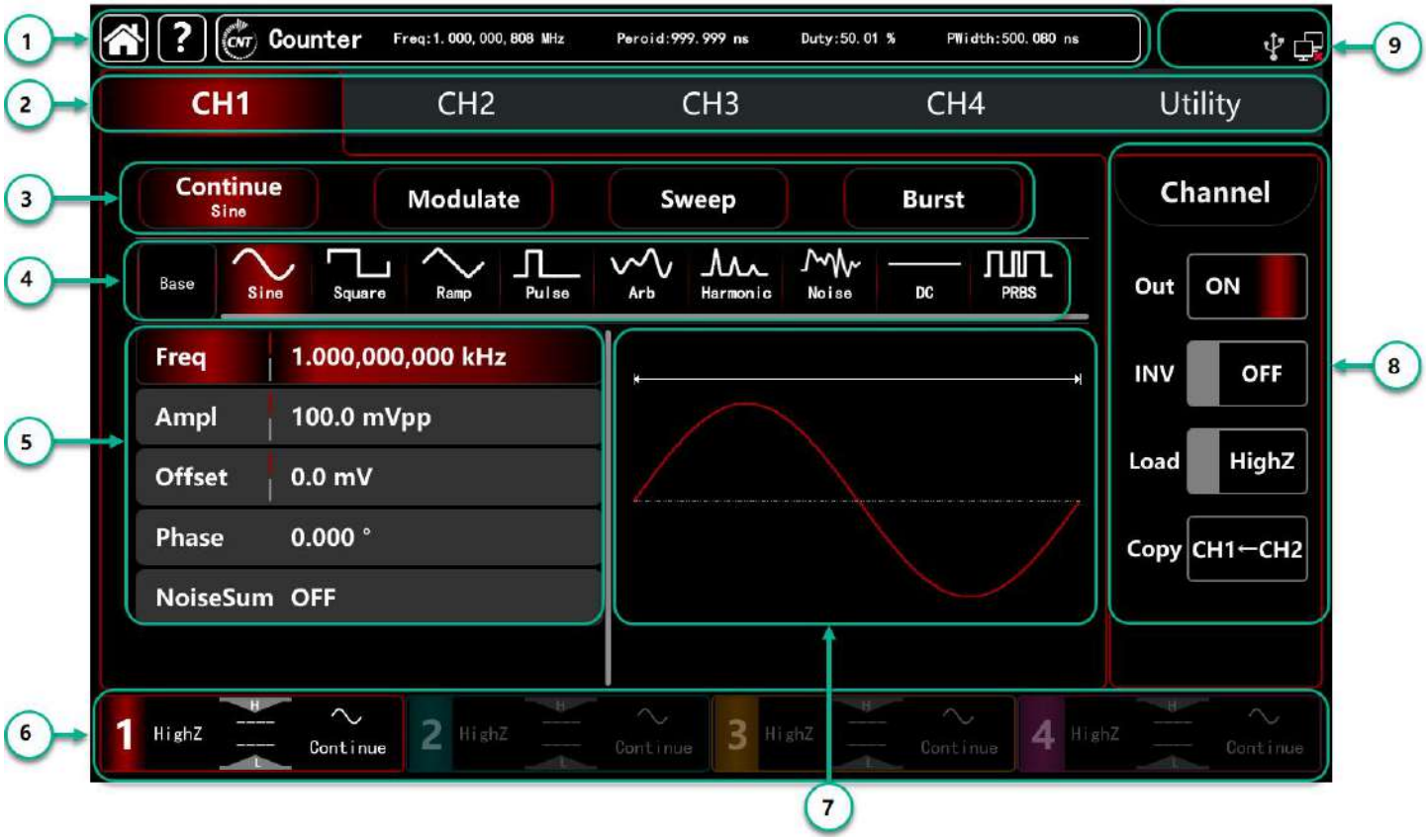


Figure 2-3 Touch Screen Display Interface

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

Description:

① Home key, Help key, Frequency counter: this area does not change with other interface jumps.

1) : Home symbol, tap this symbol to return to the home page in any other interface.

2) : Help symbol, tap this symbol to open the help menu.

3) : Frequency symbol, tap this symbol to open frequency counter, it presents the test result .

② Menu tab: tap CH1, CH2, CH3, CH4 and Utility to make parameter and secondary function settings.

Highlight display: Select tab will be highlight with CH color or cyan of the secondary function, words with white color.

③ Output Mode: continue, modulate, sweep, burst

④ Carrier wave Settings: Nine carrier wave - sine wave, square wave, ramp wave, pulse wave, harmonic wave, noise, PRBS (pseudo random binary sequence), DC, arbitrary wave.

⑤ Parameter List: Display the parameter of the current wave in list format, tap parameter list area to enable editing, virtual numeric keyboard pop-out ,see Figure 2-4

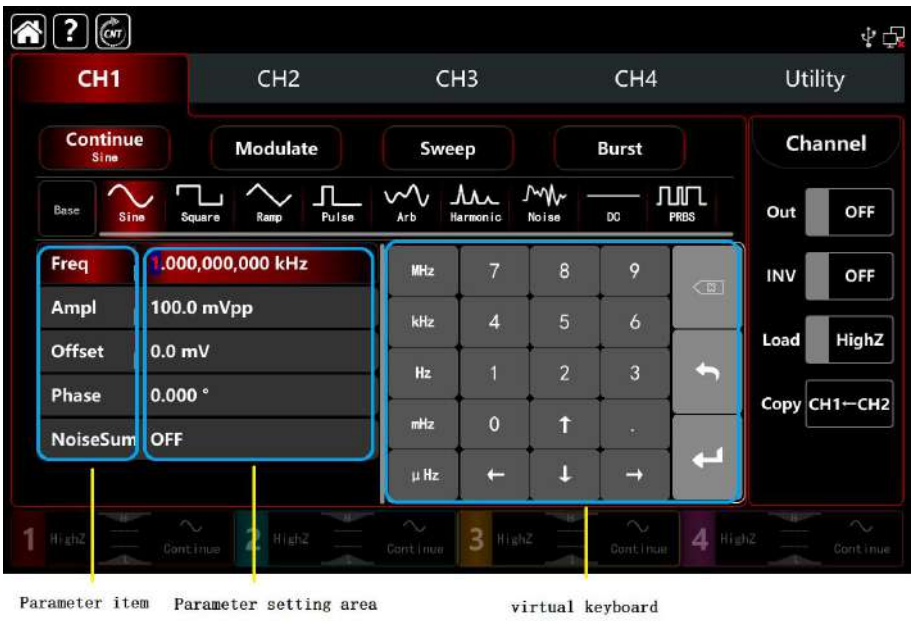


Figure 2-4 Parameter Editing

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

1) "High Z" presents load with high resistance, it can set to be 50Ω.

2) ∿ presents the output wave is sine wave.

3) 3 "Continue" presents the output wave is continue wave, which is output carrier wave only.(Other different mode may presents "carrier wave", "AM", "linear" or "N period")

⑦ Wave Display Area: display the current waveform (it can distinguish by color or highlight of the CH tab, parameter list display the current waveform parameters on the left side.)

Note: There is no waveform display area in Utility page.

⑧ CH Status Settings: quick switch the general settings of the current channel. Tap channel tab to switch output on/off to enable the channel output; inverse on/off to enable 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 list area of Frequency tab, pop-out the virtual numeric keyboard to enter 2.5MHz (or rotate the knob and direction key to make the settings.)
2) Tap word Frequency to step through Frequency/Period

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

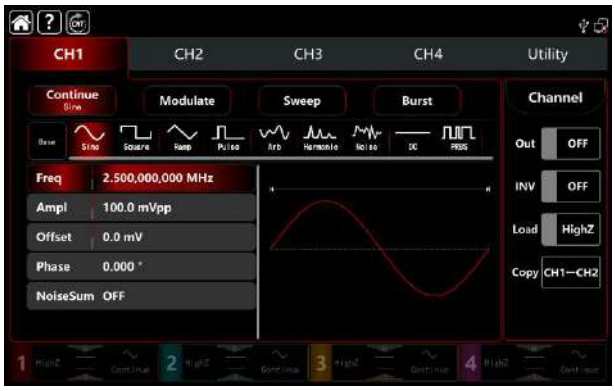


Figure 2-4 Frequency Settings

2.3.2 Output Amplitude Settings

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

The step to set the amplitude to 300mVpp:

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

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

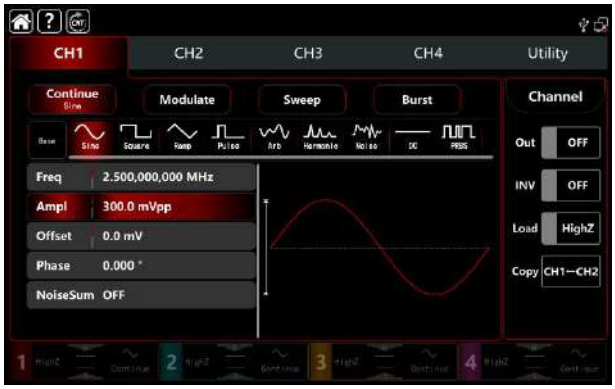


Figure 2-5 Amplitude Settings

2.3.3 DC Offset Voltage Settings

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

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

1) Tap Continue tab to select Sine
2) Tap Offset tab, pop-out the virtual numeric keyboard to enter -150mV
3) Tap word Offset, Amplitude and Offset tab becomes High (maximum)/Low (minimum) level. This method is convenient to set the signal limits of digital applications

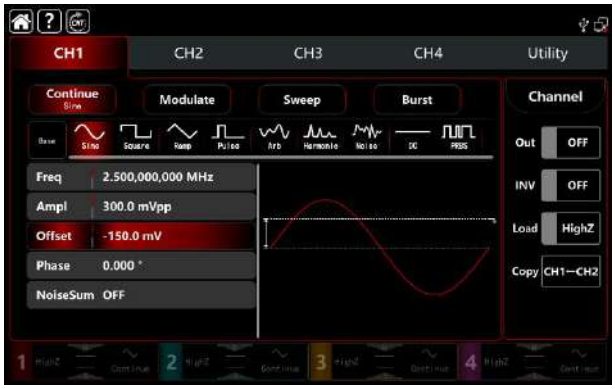


Figure 2-6 DC Offset Voltage Settings

2.3.4 Square Wave Settings

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

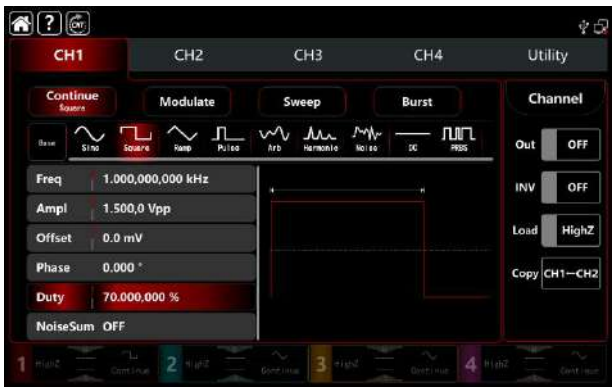


Figure 2-7 Square Settings

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 numeric keyboard to enter 1.5Vpp.
2) Tap Duty tab, pop-out the virtual numeric keyboard to enter 25%.
3) Tap REdge tab, pop-out the virtual numeric keyboard to enter 200us, the same way to set the FEdge.

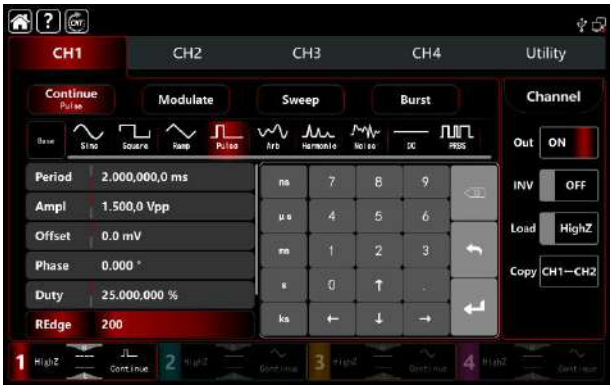


Figure 2-8 Pulse Wave Settings

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.

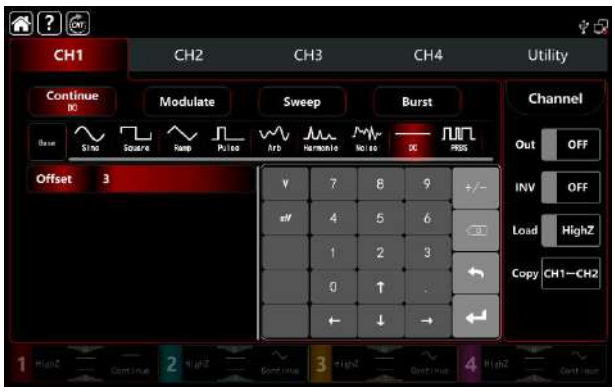


Figure 2-9 DC Settings

2.3.7 Ramp Wave Settings

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

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

1) Tap Continue tab to select Ramp, pop-out the virtual numeric keyboard to enter 10kHz.

2) Tap Amplitude tab, pop-out the virtual numeric keyboard to enter 2Vpp.

3) Tap Symmetry tab, pop-out numeric keyboard to enter 60%.

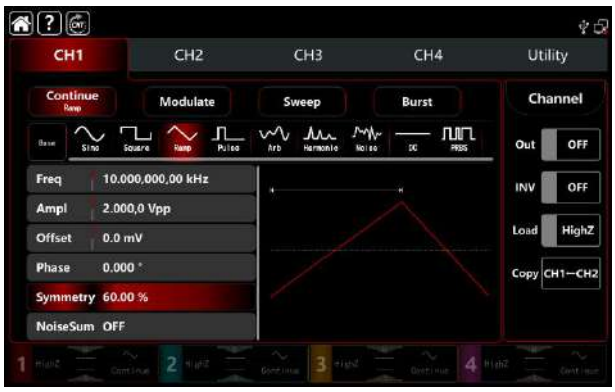


Figure 2-10 Ramp Wave Settings

2.3.8 Noise Wave Settings

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

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

1) Tap Continue tab to select Noise wave mode.

2) Tap Frequency tab, pop-out the virtual numeric keyboard to enter 100MHz.

3) Tap Amplitude tab, pop-out the virtual numeric keyboard to enter 300mVpp.

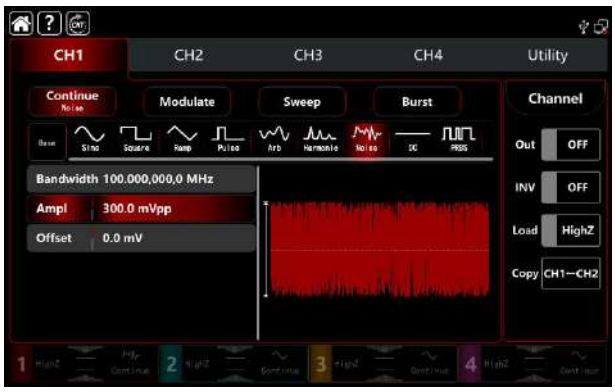


Figure 2-11 Noise Wave Settings

2.3.9 Harmonic Wave Settings

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

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

Usually, the component with frequency f_1 is called the carrier wave, f_1 serve as the carrier frequency, A_1 serve as the carrier wave amplitude, φ_1 serve as the carrier wave phase. And beyond that, the frequency of other component are integer multiples of the carrier frequency are called harmonic wave. Harmonic whose rated frequency is an odd multiple of the carrier wave frequency is called odd harmonic; harmonic whose rated frequency is an even multiple of the carrier frequency are called even harmonic.

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

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

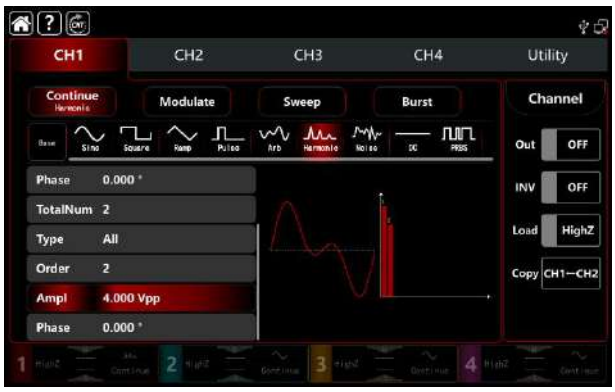


Figure 2-12 Ramp Wave Settings

2.3.10 PRBS Wave Settings

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

1) Tap Continue tab to select PRBS.

2) Tap Bitrate tab, pop-out the virtual numeric keyboard to enter 50kbps.

3) Tap Amplitude tab, pop-out the virtual numeric keyboard to enter 4Vpp.

4) Tap PN code tab, pop-out the virtual numeric keyboard to enter PN7.

The default edge time is 20ns.

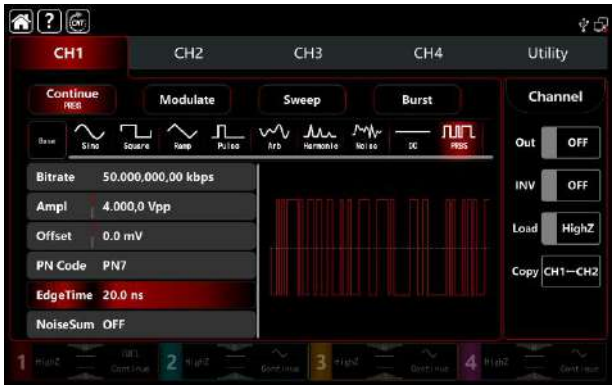


Figure 2-13 PRBS Wave Settings

2.3.11 Noise Superposition Settings

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

1) Tap Continue tab to select Sine.

2) Tap Frequency tab, pop-out the virtual numeric keyboard to enter 10kHz.

3) Tap Amplitude tab, pop-out the virtual numeric keyboard to enter 2Vpp.

4) Tap Noise to turn on.

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

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

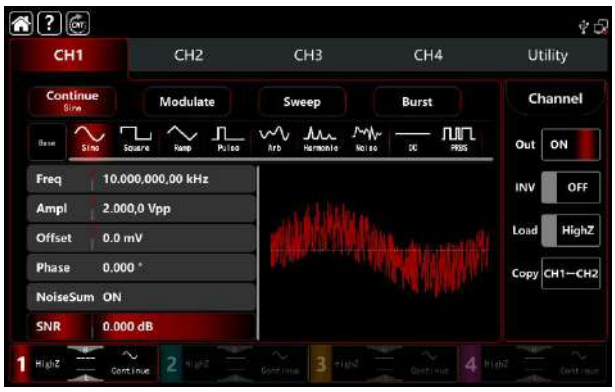


Figure 2-14 Noise Superposition Settings

2.4 Secondary Function Settings

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

2.4.1 Channel Settings

Table 2-1 CH1/2

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

Table 2-2 CH3/4

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

Tap Utility→Channel to make the relevant settings:

1. Output

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

2. Inverse

   Tap INV to step through ON/OFF.

3. Load

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

4. Amplitude Limit

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

5. High

   Tap High to enter the high limit of amplitude.

6. Low

   Tap Low to enter the high limit of amplitude.

7. Sync Output

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

8. Sync Inverse

   Tap Sync-INV to step through ON/OFF.

2.4.2 Channel Coupling

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

Table 2-3 Frequency Coupling

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

Table 2-4 Amplitude Coupling

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

Table 2-5 Phase Coupling

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

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

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

Tap Utility→Coupling to make the relevant settings:

1. Frequency Coupling

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

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

   Tap Freq to step through OFF/ON.

   Tap Type to step through Ratio/Deviation.

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

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

2. Amplitude Coupling

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

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

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

Tap Ampl to step through OFF/ON.

Tap Type to step through Ratio/Deviation.

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

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

3. Phase Coupling

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

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

Tap Phase to step through OFF/ON.

Tap Type to step through Ratio/Deviation.

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

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

4. Display Icon

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

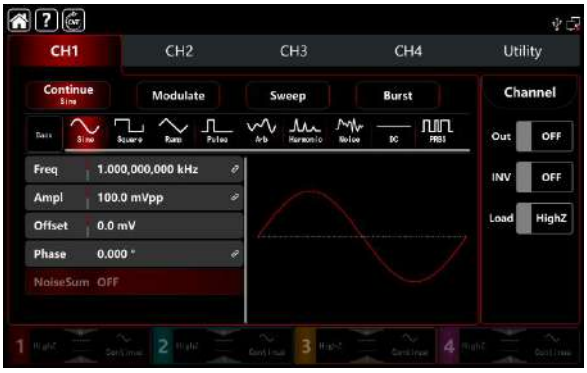


Figure 2-15 Channel Coupling

2.4.3 Channel Merging

Tap Utility→Coupling to make the relevant settings:

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

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

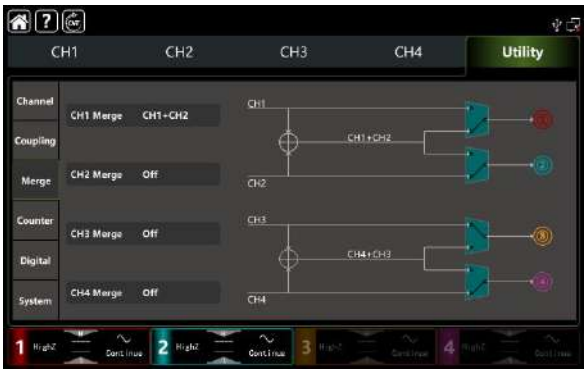


Figure 2-16 Channel Merging

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

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

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

2.4.4 Frequency Counter

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

Table 2-6 Frequency Counter Settings

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

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

Figure 2-17 Frequency Counter

1) Switch

   Tap Switch to step through OFF/ON.

2) Coupling

   Tap Coupling to step through AC/DC. The default option is AC.

3) Trigger Level

   Tap TrigLevel, pop-out the virtual numeric keyboard to enter numbers and tap return key.The default value is 0V.

4) Sensitivity

   Tap sensitivity, pop-out the virtual numeric keyboard to enter numbers and tap return key.The default value is 100%.

5) High Frequency Reject

   Tap HFReject to step through OFF/ON. The default option is OFF

6) Clear

   Tap Clear to delete all the measured result and restart to calculate.

2.4.5 System

System

Table 2-7 System Settings

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

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

Tap Utility→System to make the relevant settings

1. Language

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

2. Separator

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

3. Beep

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

4. Backlight

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

5. Screen Saver

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

6. Clock Source

   Tap Clock Source key to step through Internal/External.

   Internal: supported clock source of 10MHz.

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

7. Clock Output

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

The synchronization approach between the instruments:

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

8. Phase

   Tap Phase step through Sync/Independent.

   Sync: The start phase of four channels are associated.

   Independent: The start phase of channel is independent.

9. Power On

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

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

10. Manual

    Tap Manual to step through SingleChannel/ AllChannel.

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

11. Switch Mode

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

12. Save

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

    Default

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

13. About

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

LAN

Table 2-8 LAN Settings

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

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

1. DHCP

   Tap DHCP to step through OFF/ON.

2. IP Address

   IP address format: nnn.nnn.nnn.nnn, the first of nnn range can set to 1~233, the second 0~255. It is suggest that you inquiry the internet administrator to get an available IP address. Tap IP or push the numeric keyboard to enter numbers. This settings will be stored in non-volatile memory, and the instrument will automatically applied on next boot.

3. Mask

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

4. Gateway

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

5. MAC

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

6. Web access and control devices

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

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

(1) Access Local Area Network

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

Example

Computer IP: 192.168.20.3

Function/Arbitrary Waveform Generator IP: 192.168.20.210

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

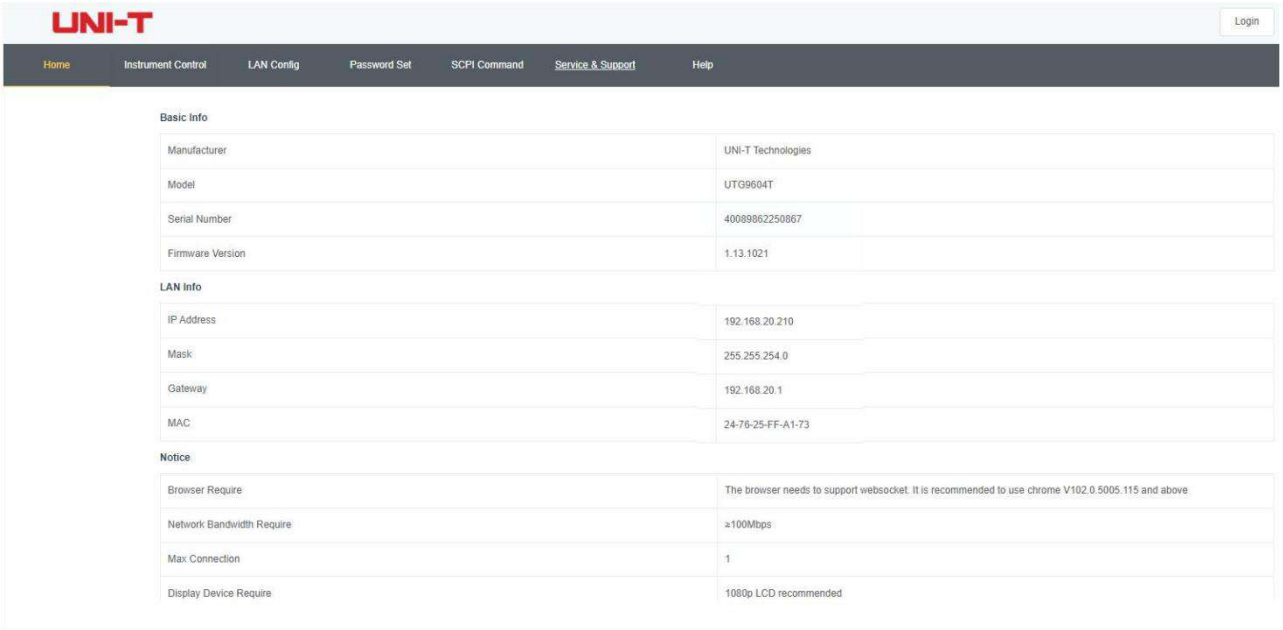


Figure 2-18 Web Basic Information

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

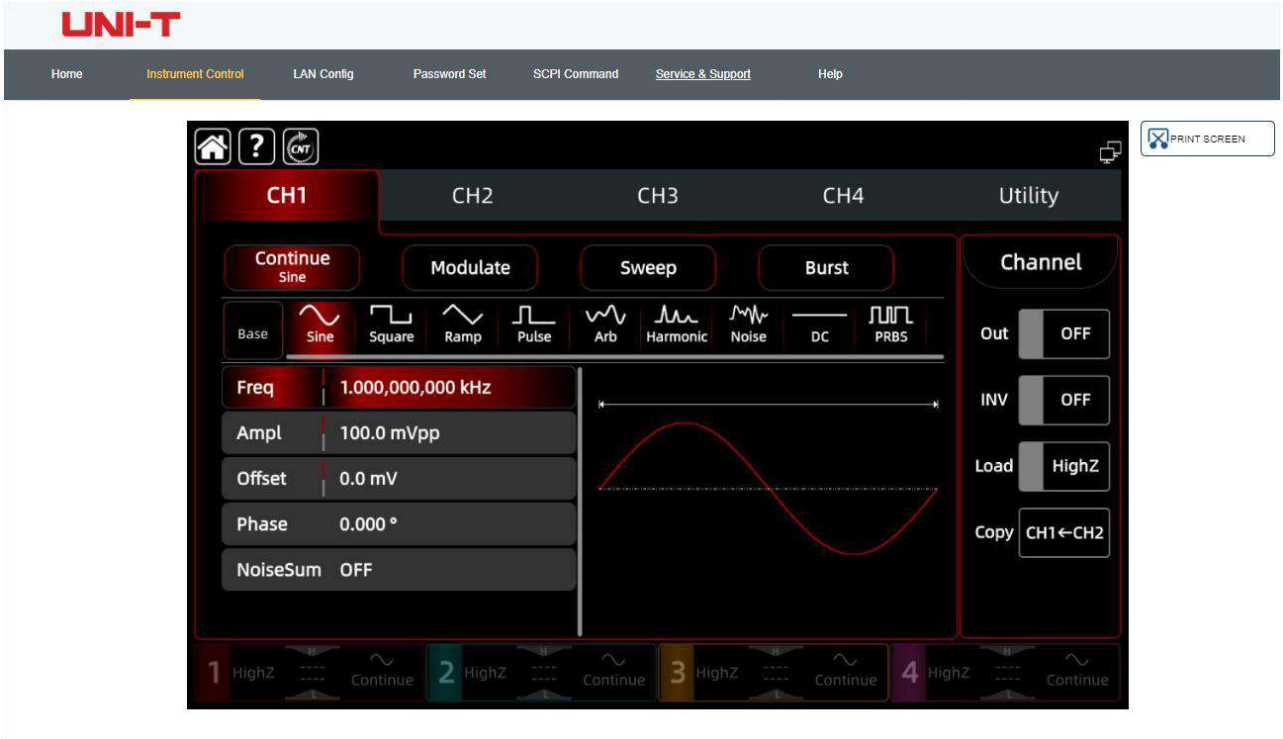


Figure 2-19 Web Control

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

(2) Access Outer Network

a. plug the network cable into Function/Arbitrary Waveform Generatorand the network can be access internet

b. open the frp proxy service on the server

c. configure the frp proxy IP and port of Function/Arbitrary Waveform Generator

d. the browser can access http://IP:web_port, and the access interface is consistent with the above.

Note

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

(3) Network Setting

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

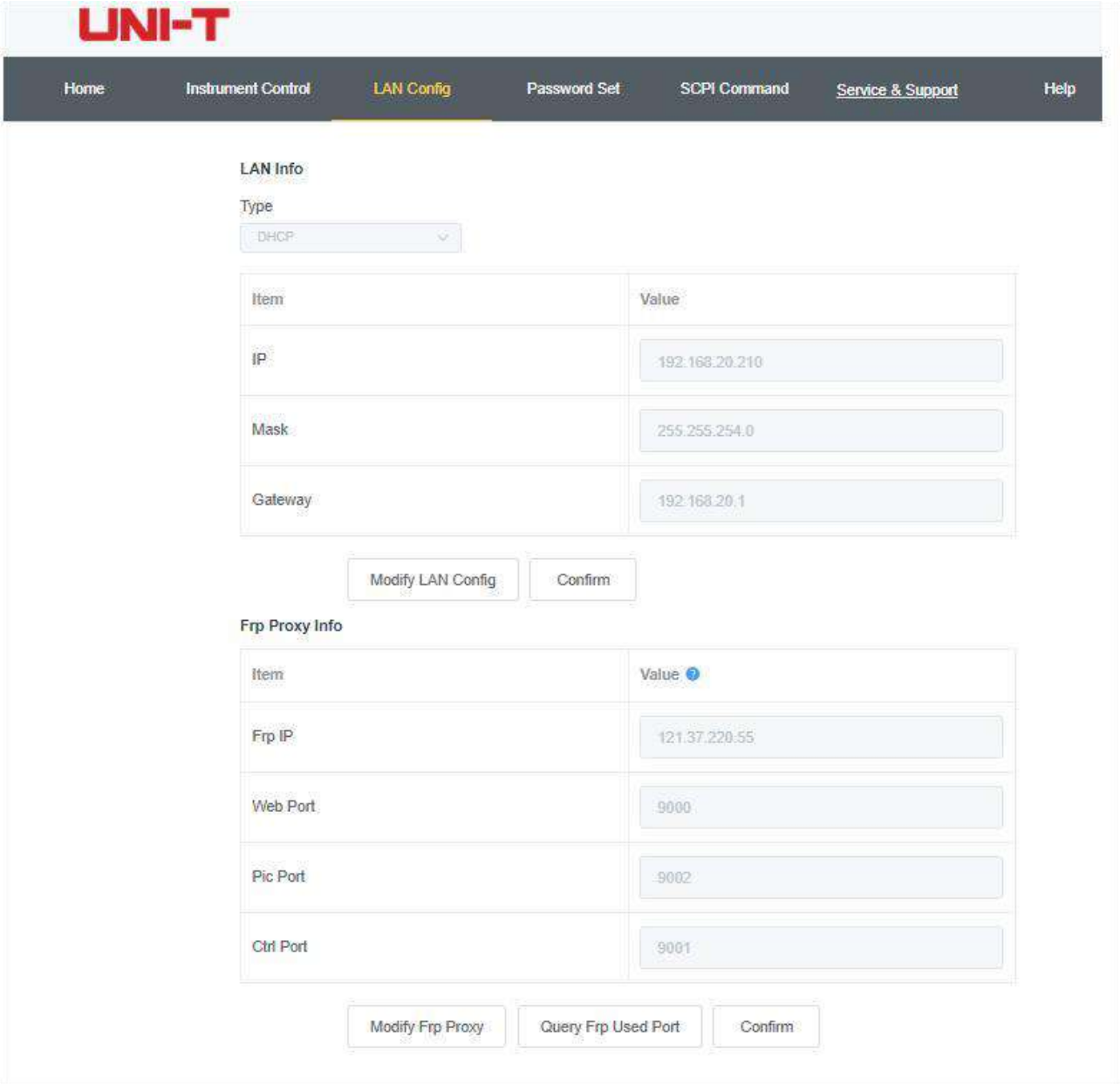


Figure 2-20 Web Network Setting

(4) Password Setting

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

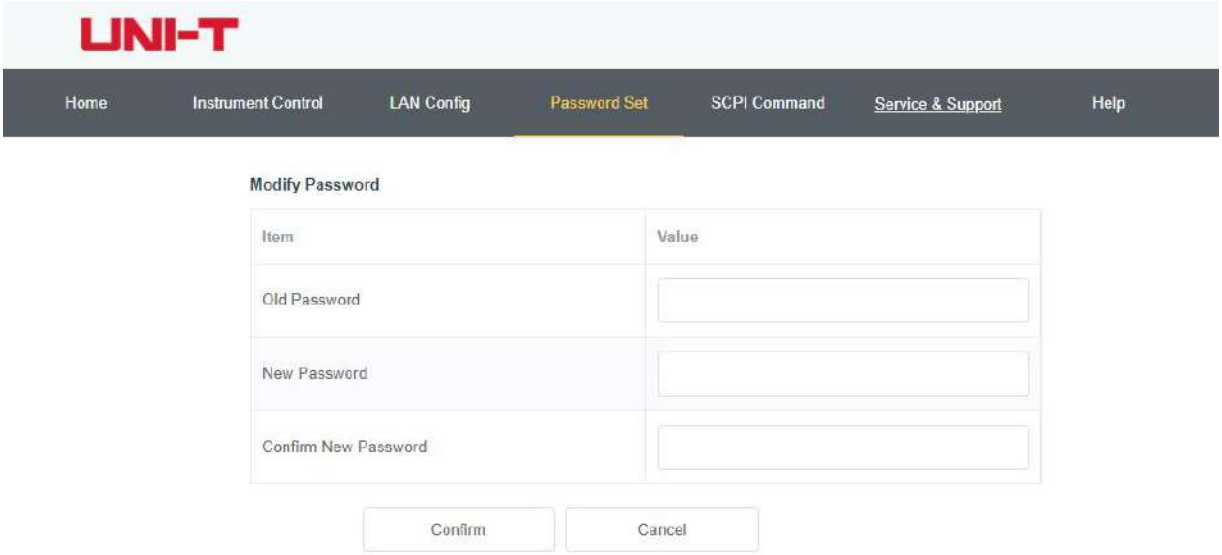


Figure 2-21 Web Password Setting

(5) SCPI

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

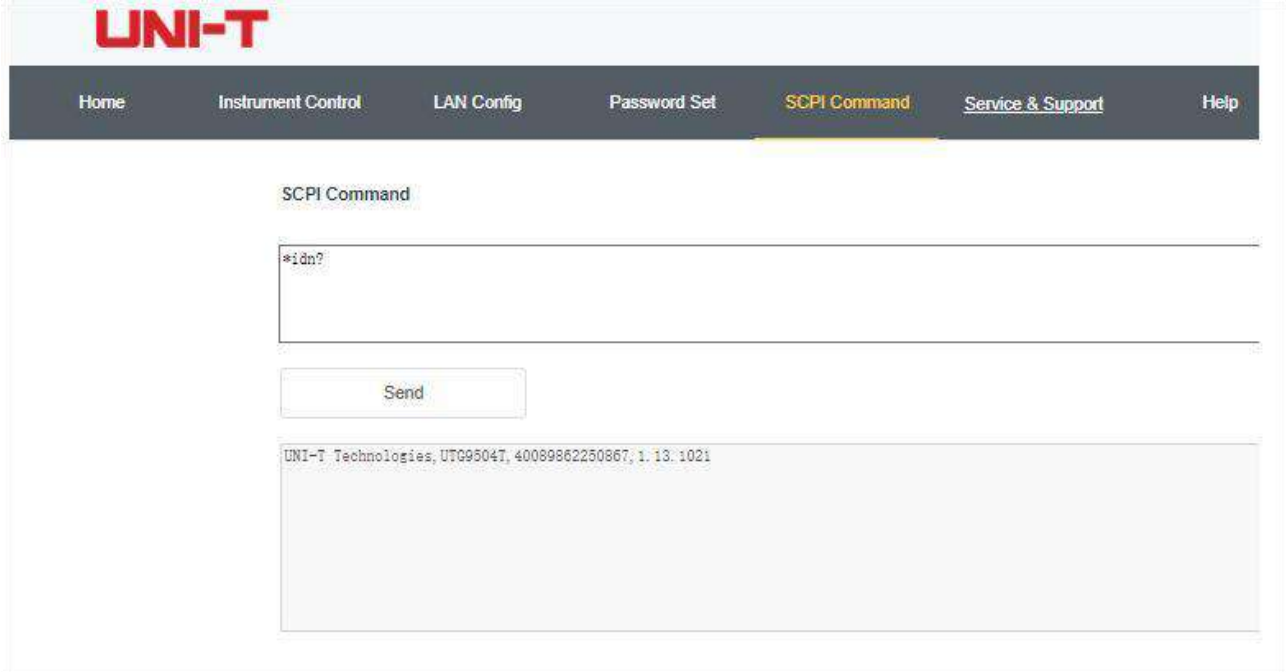


Figure 2-22 SCPI Contro

Chapter 3 Advanced Applications

3.1 Output Modulation Waveform

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

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

The contents of this section as following:

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

Take CH1 as example to introduce these functions.

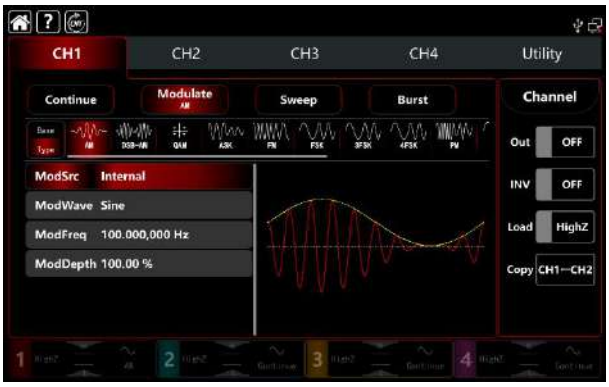
3.1.1 AM (Amplitude Modulation)

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

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

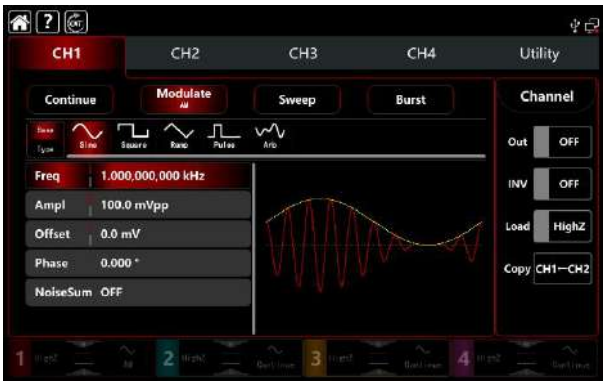
Select AM Modulation

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



Select the carrier waveform

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



Carrier frequency settings

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

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

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

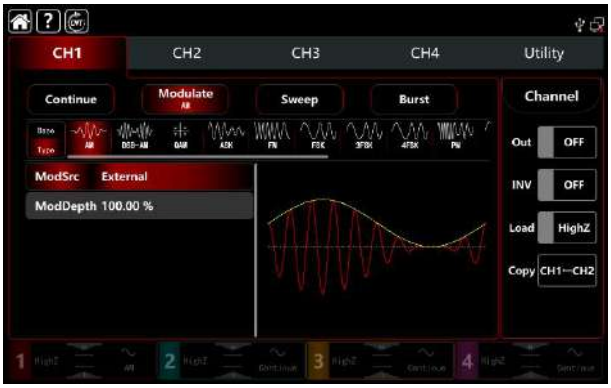
Table 4-2 The carrier wave frequency of CH3 and CH4

Carrier waveform	Frequency					
	UTG9604T		UTG9504T		UTG9354T	
	MIN	MAX	MIN	MAX	MIN	MAX
Sine wave	1μHz	200MHz	1μHz	200MHz	1μHz	160MHz
Square wave	1μHz	60MHz	1μHz	60MHz	1μHz	50MHz
Ramp wave	1μHz	10MHz	1μHz	10MHz	1μHz	8MHz
Pulse wave	1μHz	60MHz	1μHz	60MHz	1μHz	50MHz
Arbitrary wave	1μHz	60MHz	1μHz	60MHz	1μHz	50MHz

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

Select the source of modulation

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



1) Internal source

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

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

- Noise wave: white gaussian noise

2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The AM modulation depth is controlled by the ±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 1μHz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The input external modulating signal frequency range is between 0Hz~50kHz.

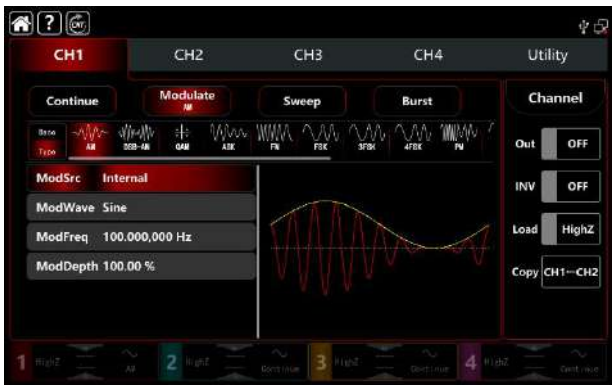
Modulation depth settings

Modulation depth indicates the change of the extent of amplitude, use percentage to express. AM modulation depth range can set between 0%~120%, the default range is 100%.If the modulation depth is 0%, then output a constant amplitude (the half of the carrier wave amplitude); if the modulation depth is 100%, the output amplitude will change by the modulation waveform. When the modulation depth is greater than 100%, the instrument will not output greater than ±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

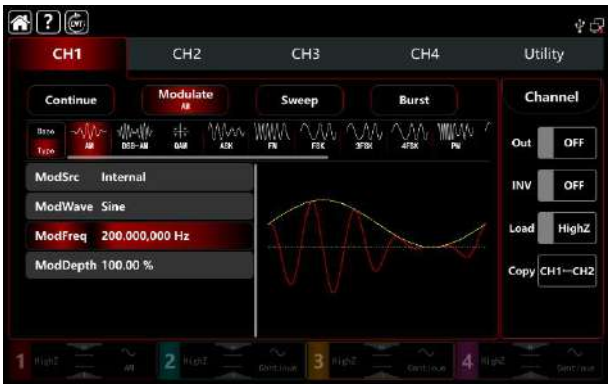
In AM modulation mode, set an internal 200Hz sine wave as a modulating signal, another carrier wave signal with frequency 10kHz, amplitude 200mVpp, duty ratio 45%, and set the modulation depth to 80%, the settings steps as following,

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



2) Set the parameter of modulating signal

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



3) Set the parameter of the carrier wave signal

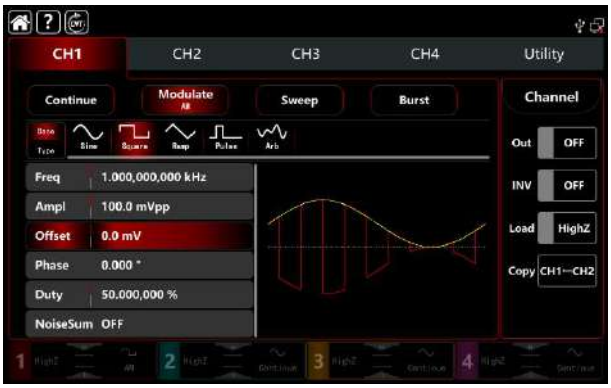
Tap Base to select Square as the carrier waveform (the default option is sine wave).

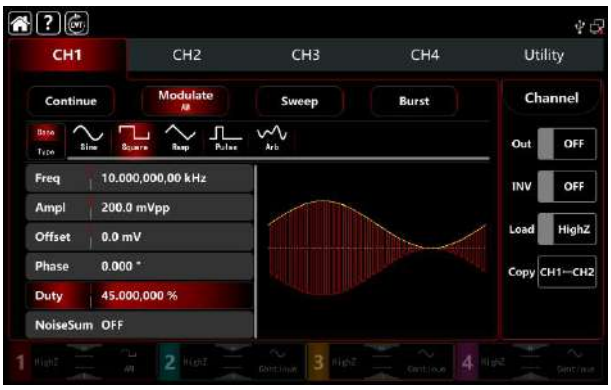
Tap Freq tab to pop-out visual numeric keyboard to enter 10kHz.

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

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

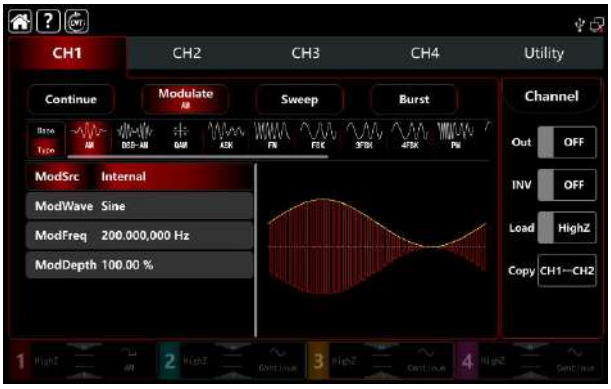
See the Figure as following,



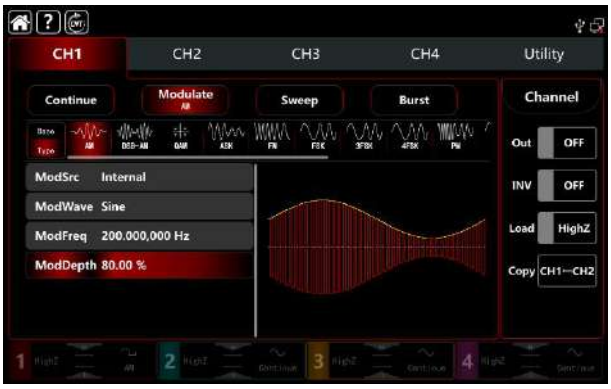


4) Set the modulation depth

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

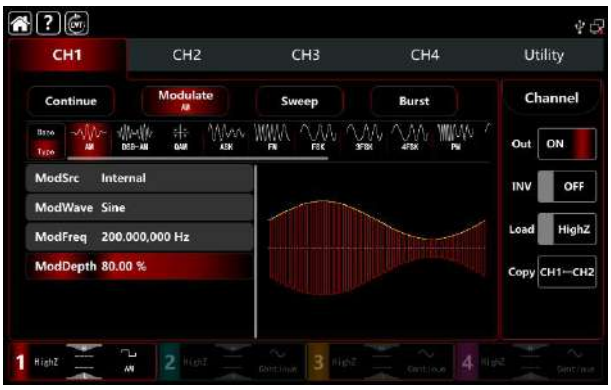


Tap ModDepth tab to pop-out visual numeric keyboard to enter 80%.

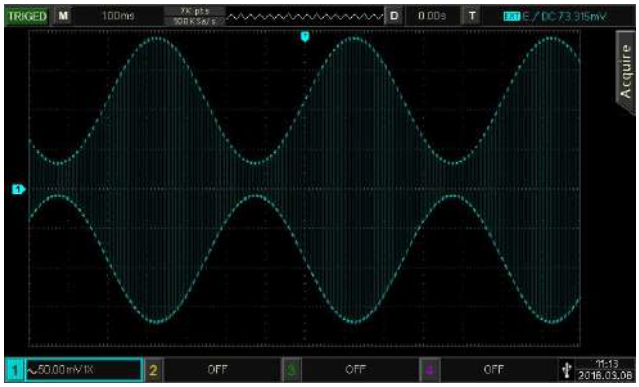


5) Turn on the output channel

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



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

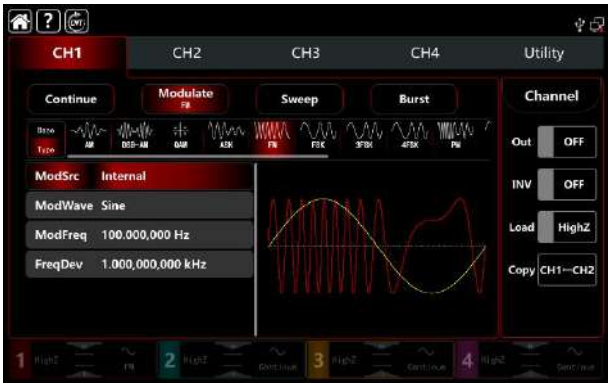


3.1.2 FM (Frequency Modulation)

In frequency modulation mode, the modulated waveform 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

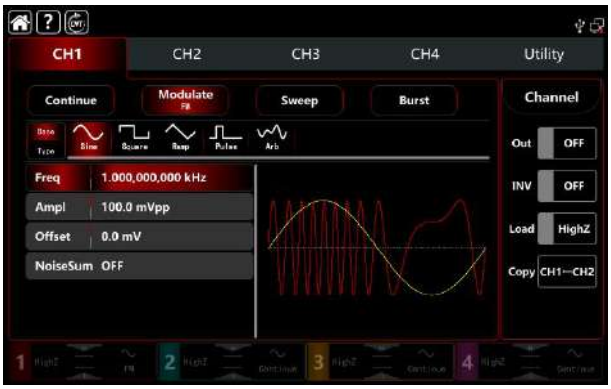
Tap CH1→Modulate→FM to turn on FM modulation, the instrument output the modulated waveform according to the current setting of the modulation wave and the carrier wave.



Select the carrier waveform

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

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

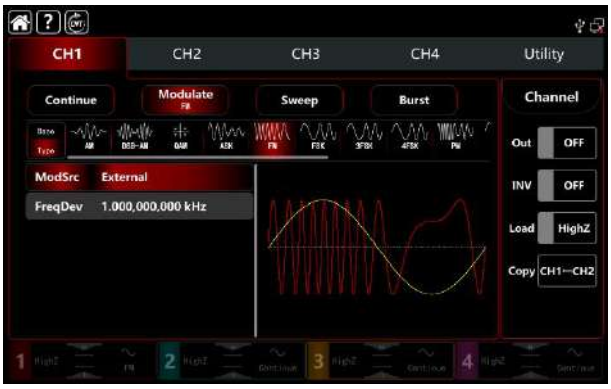


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

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

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

2) External source

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

Modulated frequency deviation settings

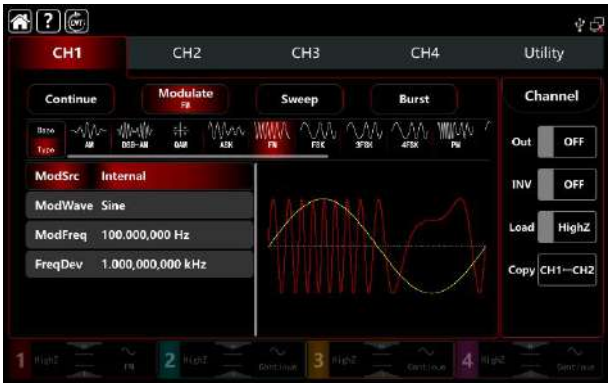
Frequency deviation indicates the frequency deviation changes between in the FM-modulated wave frequency and the carrier wave frequency. FM deviation range can set from 0μHz to half of the maximum current carrier wave frequency. The default range is 1kHz. Rotate multifunction knob, push direction key 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

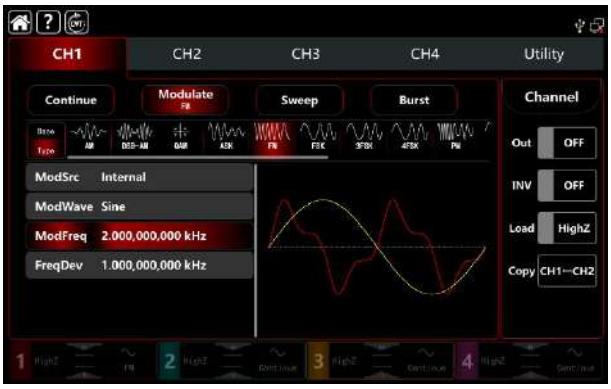
In FM modulation mode, set an internal 2kHz square wave as a modulating signal, another sine wave with frequency 10kHz, amplitude 100mVpp as a carrier wave signal , and set the frequency deviation to 5kHz, the settings steps as following,

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



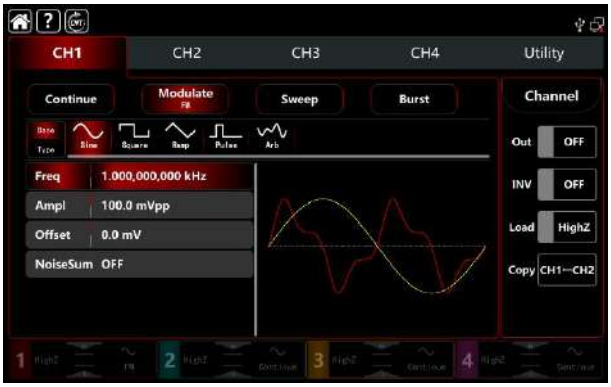
2) Set the parameter of modulating signal

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

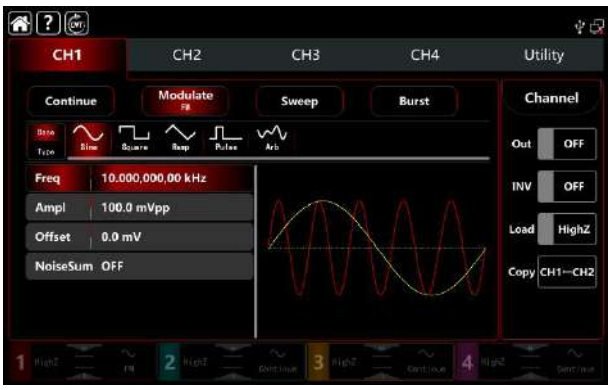


3) Set the parameter of the carrier wave signal

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

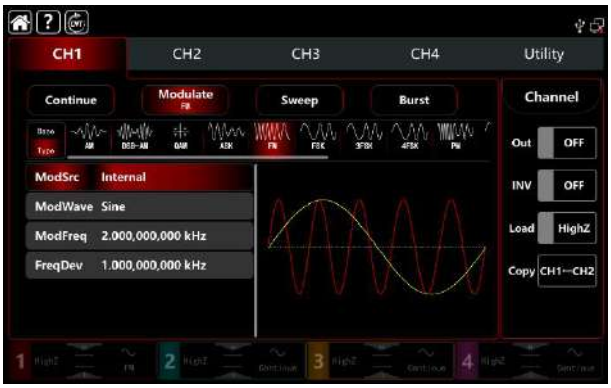


Tap Freq to pop-out visual keyboard to enter 10kHz.

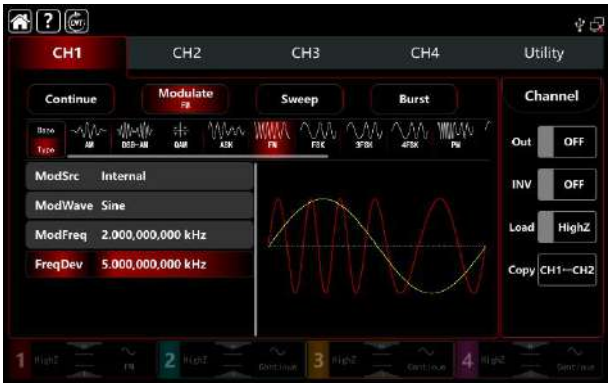


4) Set the frequency deviation

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

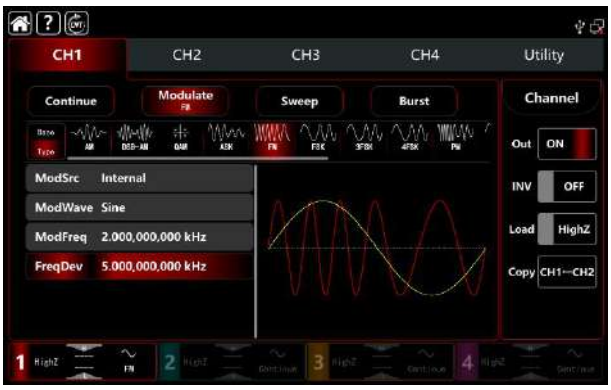


Tap FreqDev tab to pop-out visual numeric keyboard to enter 5kHz.

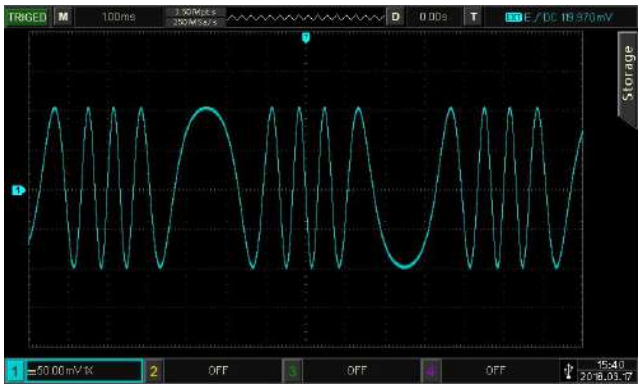


5) Turn on the output channel

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



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

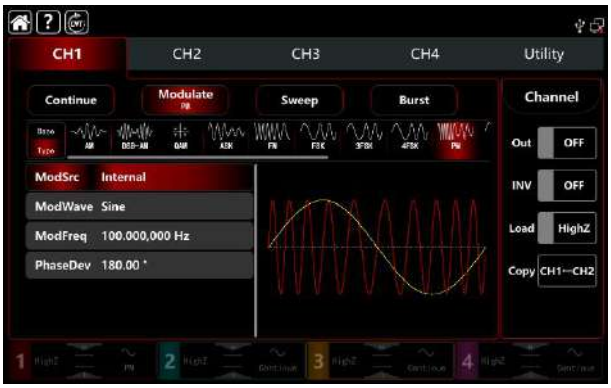


3.1.3 PM (Phase Modulation)

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

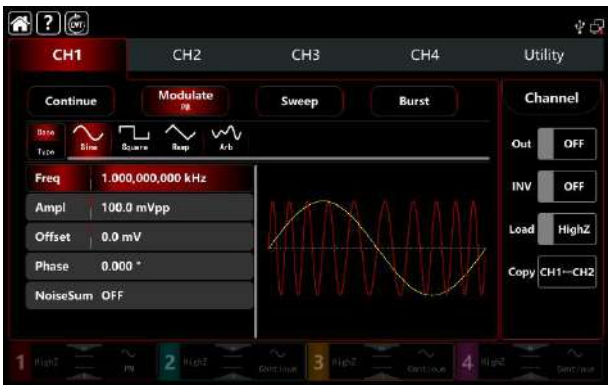
Select PM modulation

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



Select the carrier waveform

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

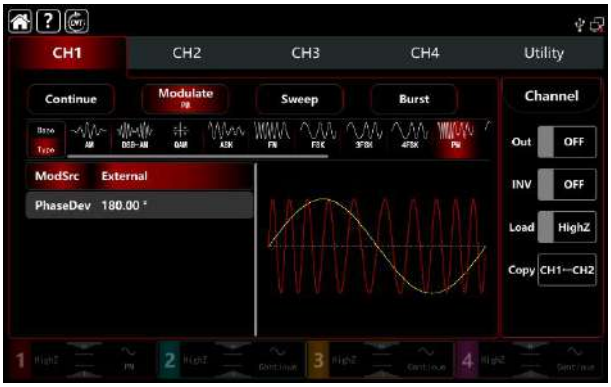


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

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

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

2) External source

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

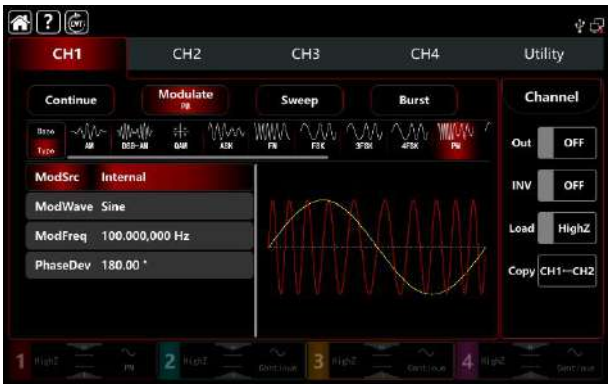
Modulated phase deviation settings

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

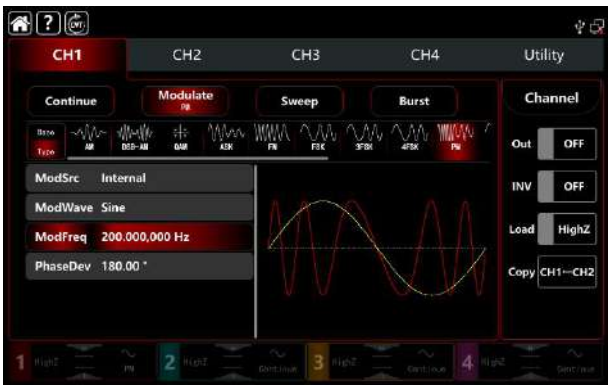
In PM modulation mode, set an internal 200Hz sine wave as the modulating signal, another sine wave with frequency 900Hz, amplitude100mVpp as the carrier wave signal, and set the phase deviation to 200°, the settings steps as following,

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



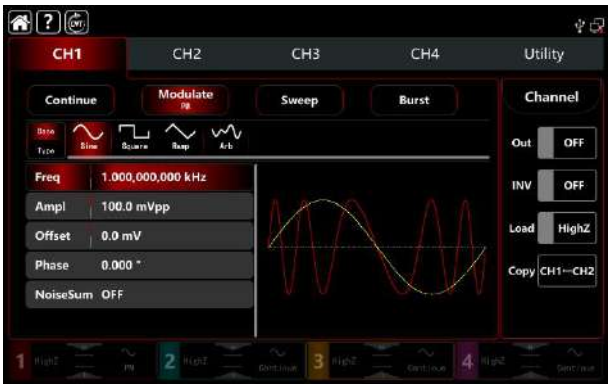
2) Set the parameter of modulating signal

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

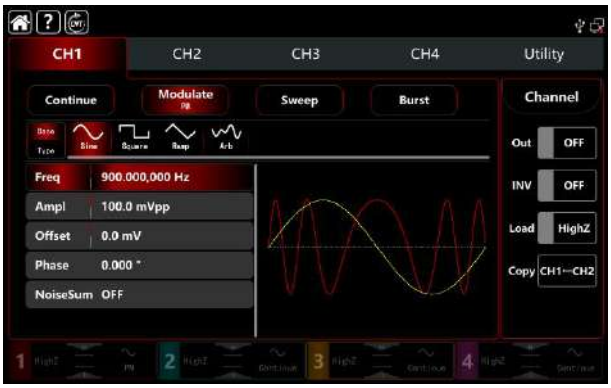


3) Set the parameter of the carrier wave signal

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

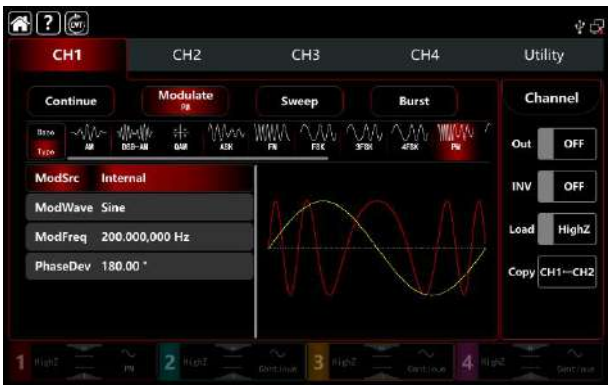


Tap Freq to pop-out visual keyboard to enter 900Hz.

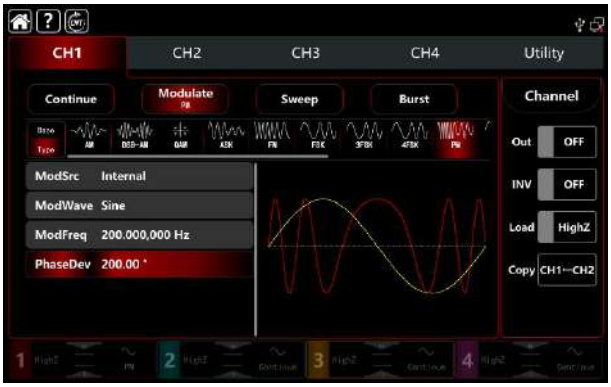


4) Set the phase deviation

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

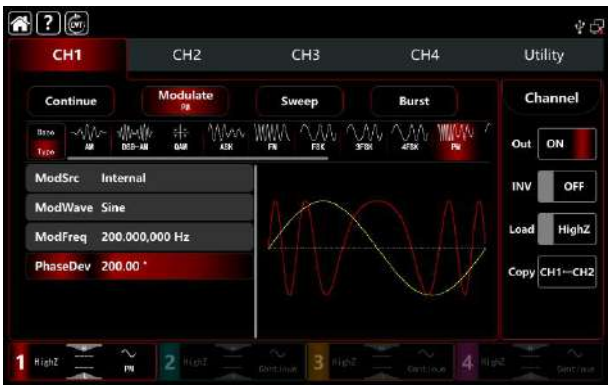


Tap PhaseDev tab to pop-out visual numeric keyboard to enter 200°.

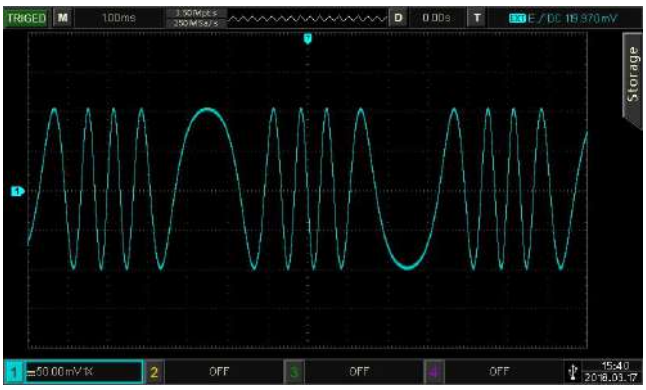


5) Turn on the output channel

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



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

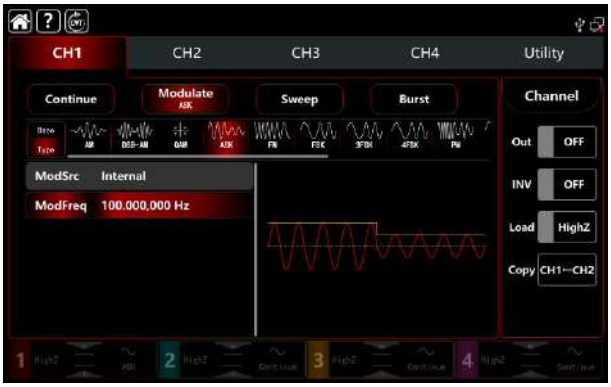


3.1.4 ASK (Amplitude Shift Keying)

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

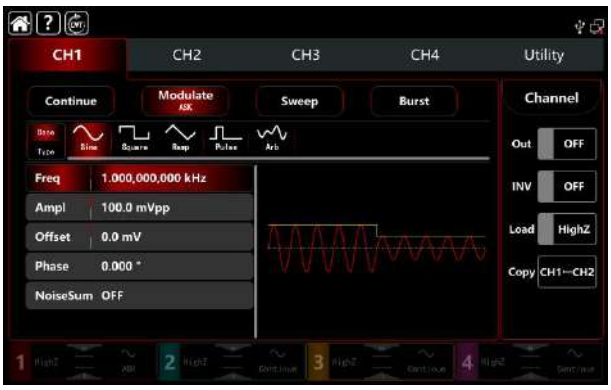
Select ASK modulation

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



Select the carrier waveform

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

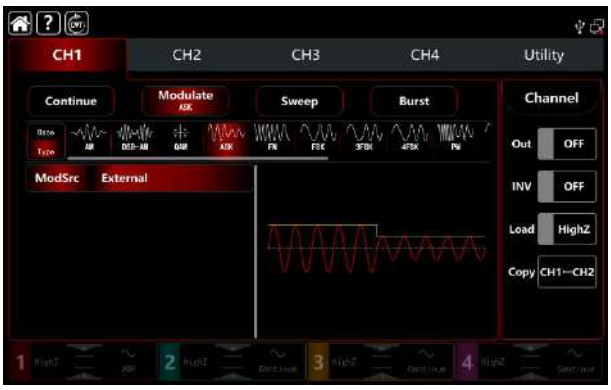


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

   When the modulation source is internal, the modulation wave is a square sine with duty ratio 50% (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 parameter list. Use the external waveform to modulating the carrier wave. The ASK amplitude output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel.- For example, output the current carrier amplitude when the external input is low; output amplitude is less than the current carrier amplitude when the external input is high.

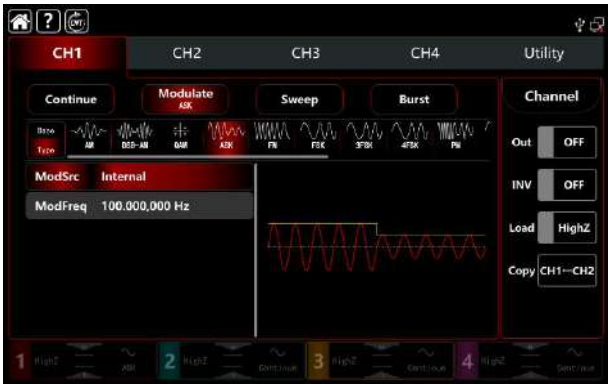
Modulation waveform frequency settings

When the modulation source is internal, it can set the modulation waveform frequency, and the frequency range is between 1μHz~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

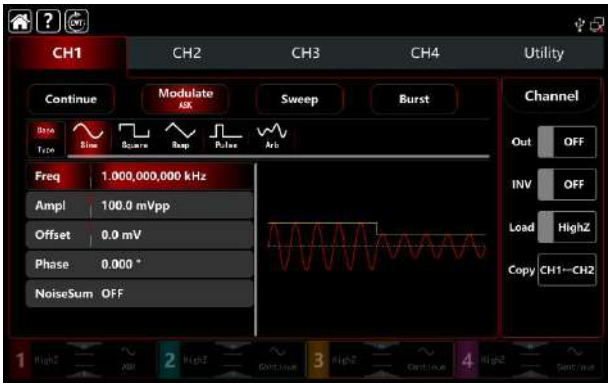
In ASK modulation mode, set an internal logical signal 300Hz as the modulating signal, another sine wave with frequency 15kHz, amplitude2Vpp as the carrier signal, the settings steps as following, Note: It can only set the frequency of this signal, the frequency is the ASK rate. Logic signal is self-configurable by the instrument.

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



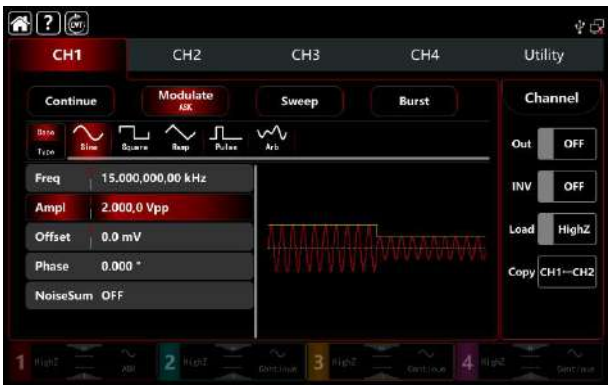
2) Set the parameter of the carrier wave signal

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



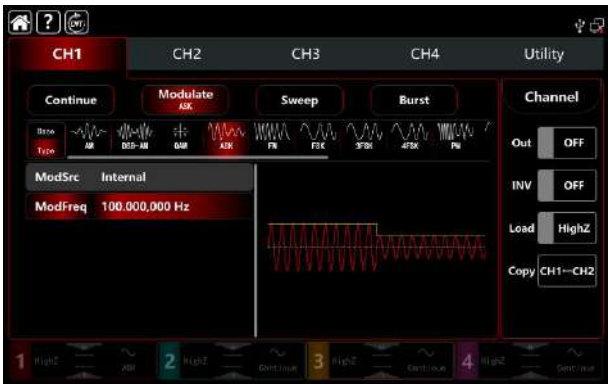
Tap Freq to pop-out visual keyboard to enter 15kHz.

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

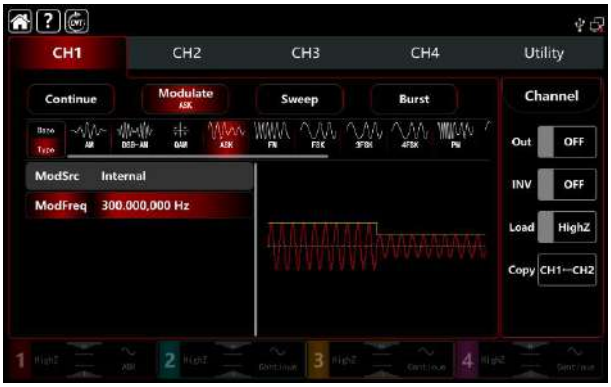


3) Set the parameter of the modulating signal

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

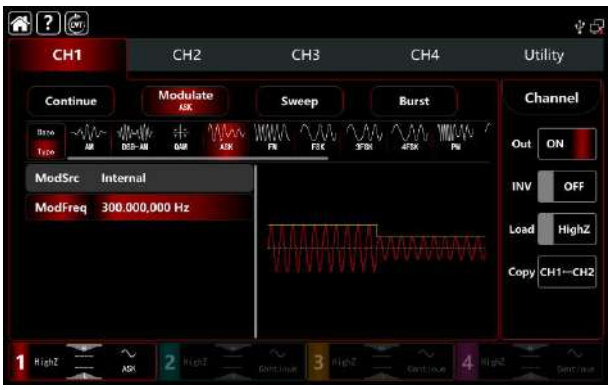


Tap ModSrc tab to pop-out visual numeric keyboard to enter 300Hz.



4) Turn on the output channel

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



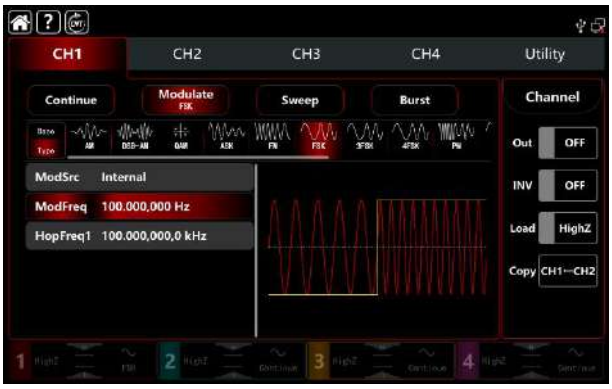
The shape of the ASK modulation waveform viewed through an oscilloscope is shown in the figure below,

3.1.5 FSK (Frequency Shift Keying)

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

Select FSK modulation

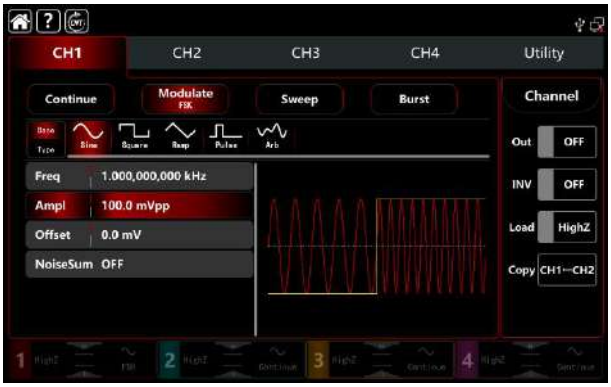
Tap CH1→Modulate→FSK to turn on FSK modulation, the instrument output the modulation waveform according to the current setting.



Select the carrier waveform

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

side.

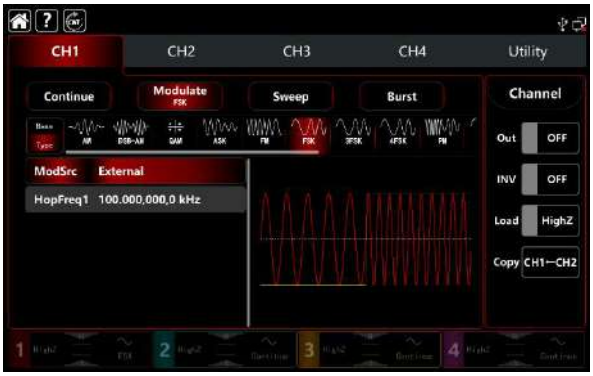


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

   When the modulation source is internal, the modulation wave is a square sine with duty ratio 50% (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 parameter list. Use the external waveform to modulating the carrier wave. The FSK frequency output is controlled by logical level on the external digital modulation terminal (FSK Trig connector) on the back panel. For example, output the current carrier frequency when the external input is low; output hopping frequency when the external input is high.

Hopping frequency settings

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

Modulation waveform frequency settings

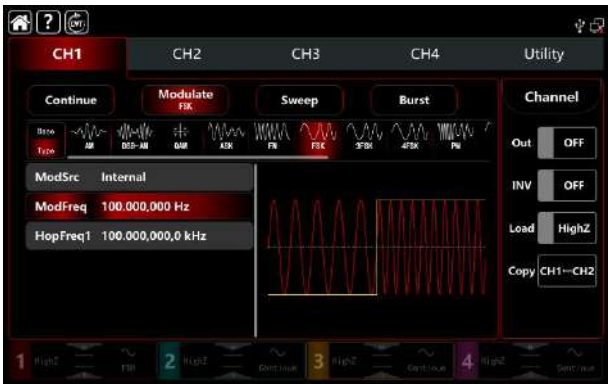
When the modulation source is internal, it can select shift frequency between the carrier wave frequency and hopping frequency. Turn on FSK modulation mode to set the frequency, the range is between 1μHz~2MHz, default 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out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

Comprehensive example

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

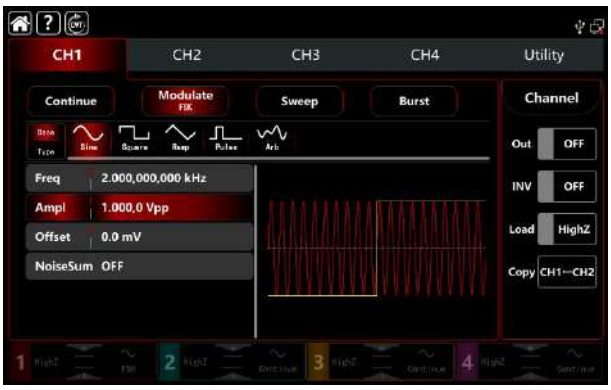
1) Turn on FSK modulation mode: tap CH1→Modulate→FSK accordingly.
2) Set the parameter of the carrier wave signal

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



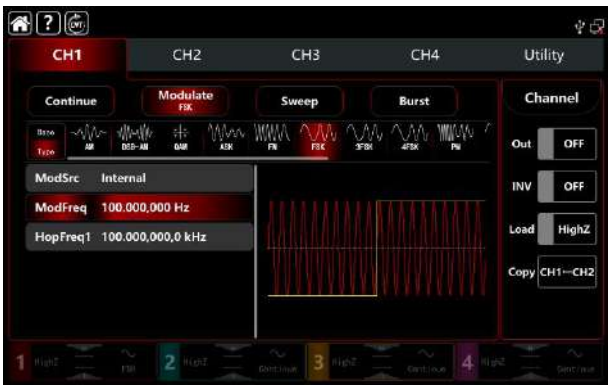
   Tap Freq to pop-out visual keyboard to enter 2kHz.

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



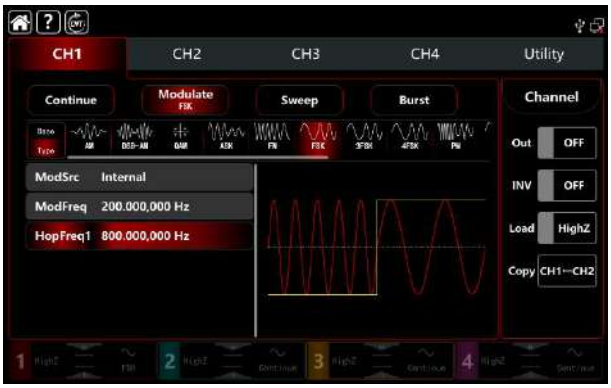
3) Set the hopping frequency and the modulating frequency

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



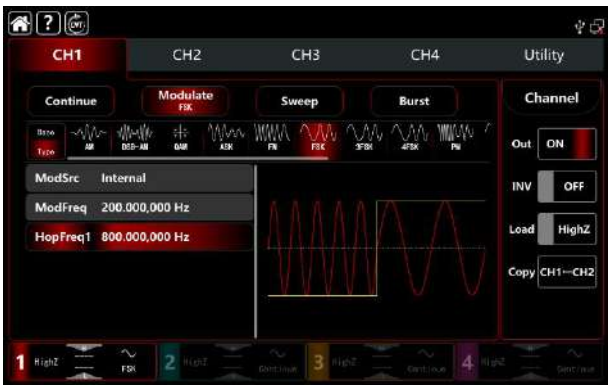
Tap ModFreq to pop-out visual keyboard to enter 200Hz.

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

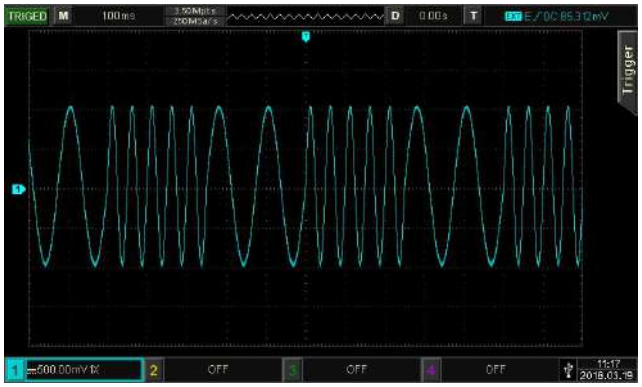


4) Turn on the output channel

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



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

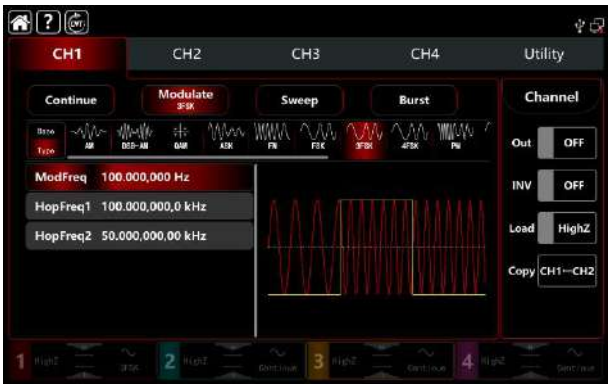


3.1.6 3FSK Modulation (Three Frequency Shift Keying)

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

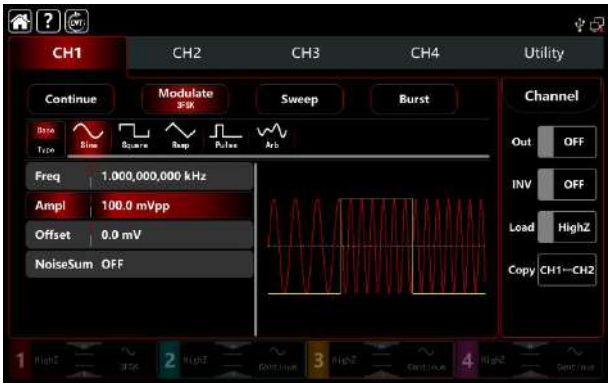
Select 3FSK modulation

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



Select the carrier waveform

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



Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Hopping frequency settings

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

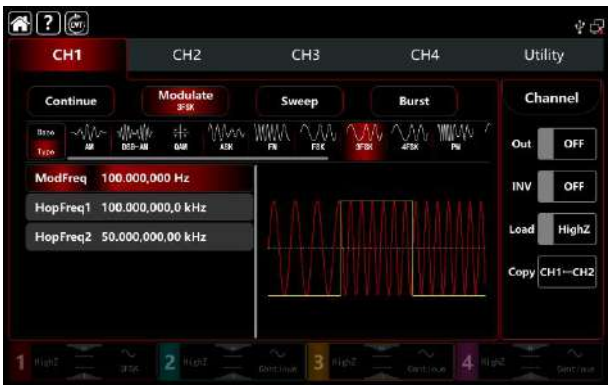
Modulation waveform frequency settings

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

Comprehensive example

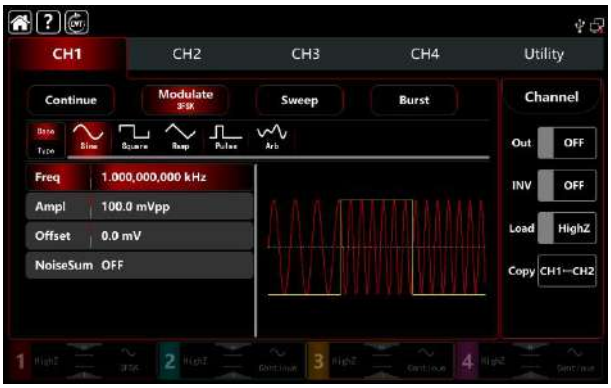
In FSK modulation mode, set an internal 2kHz,1Vpp sine wave as a carrier wave, set HopFreq1 to 1kHz, set HopFreq2 to 5kHz, make the carrier wave and hopping frequency shift between within 100Hz frequency. The settings steps as following,

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



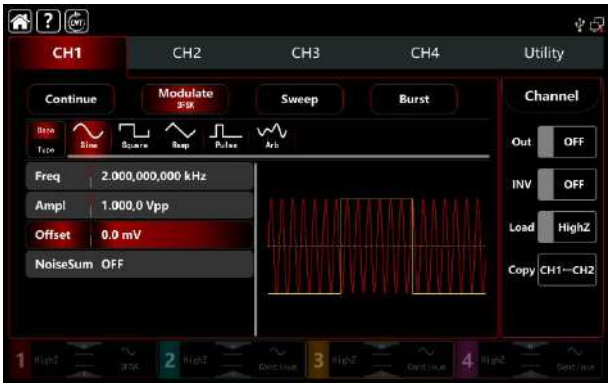
2) Set the parameter of the carrier wave signal

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



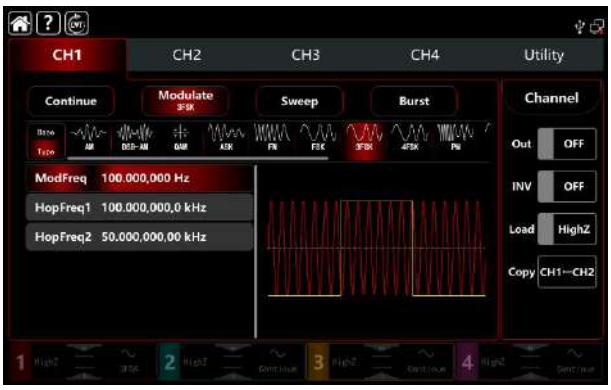
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



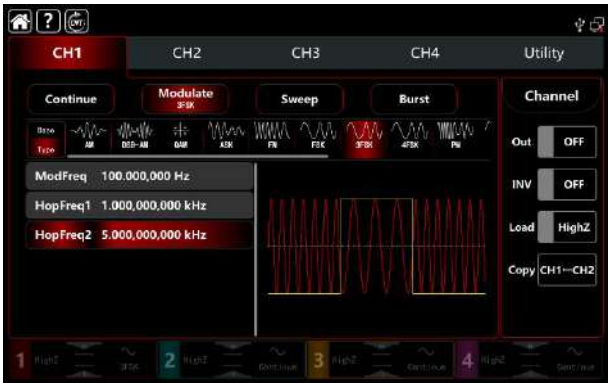
3) Set the hopping frequency and the modulating frequency

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



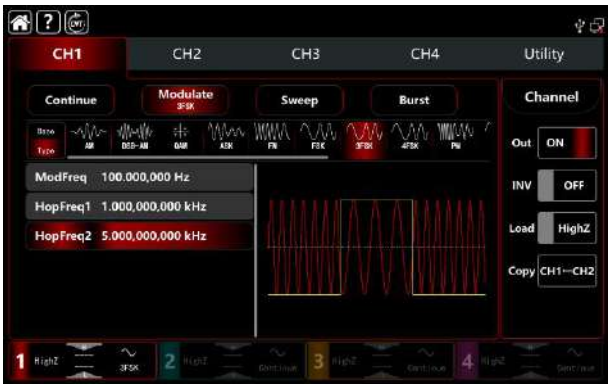
Tap HopFreq1 to pop-out visual keyboard to enter 1kHz.

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

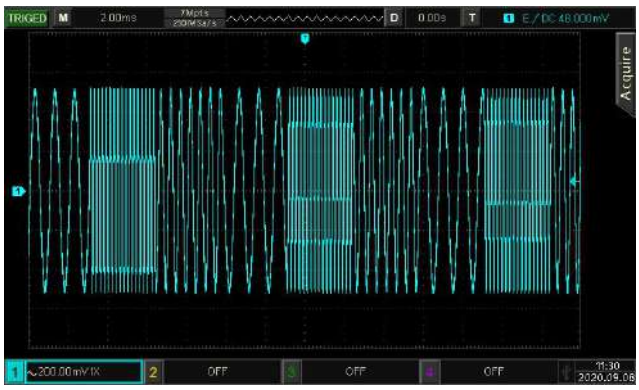


4) Turn on the output channel

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



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

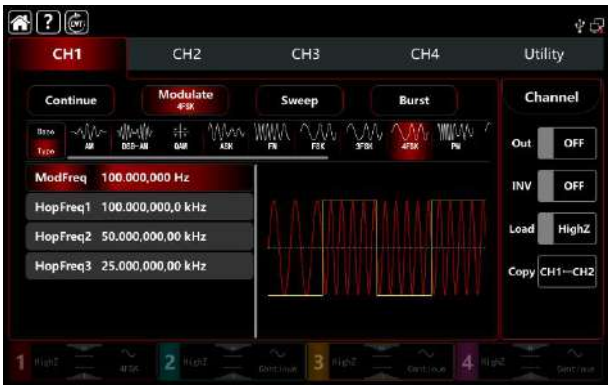


3.1.7 4FSK Modulation (Four Frequency Shift Keying)

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

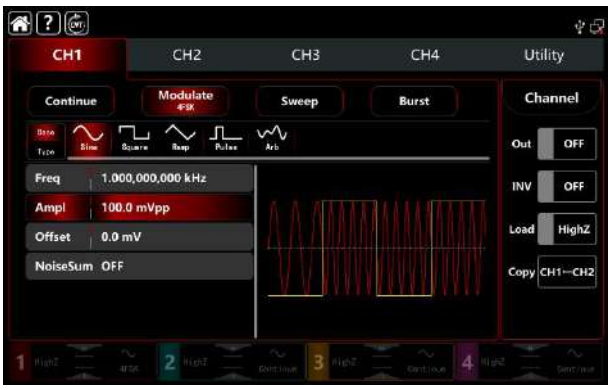
Select 4FSK modulation

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



Select the carrier waveform

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



Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Hopping frequency settings

Rotate multifunction knob, push direction key or tap HopFreq1, HopFreq2 and 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 table 4-1/4-2 of AM modulation.

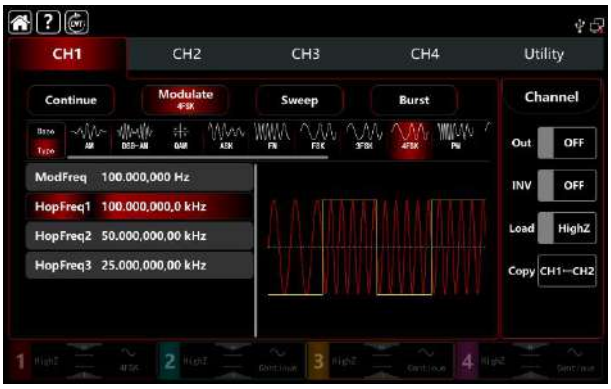
Modulation waveform frequency settings

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

Comprehensive example

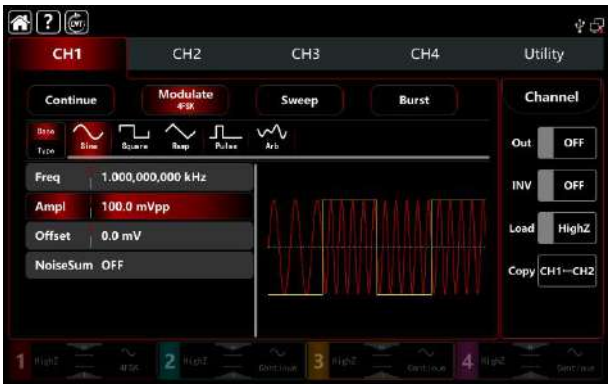
In 4FSK modulation mode, set an internal 500Hz,1Vpp sine wave as a carrier wave, set HopFreq1 to 2kHz, set HopFreq2 to 5kHz, set HopFreq2 to 10kHz, make the carrier wave and hopping frequency shift between within 100Hz frequency. The settings steps as following,

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



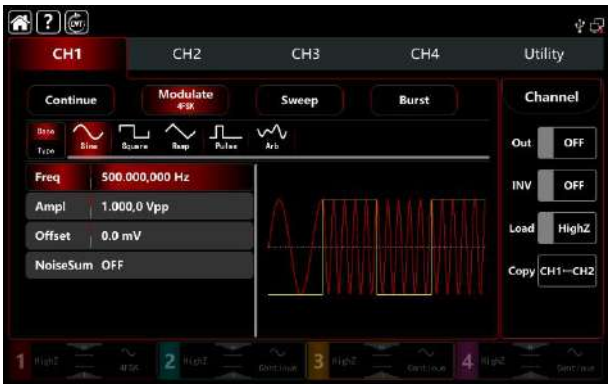
2) Set the parameter of the carrier wave signal

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



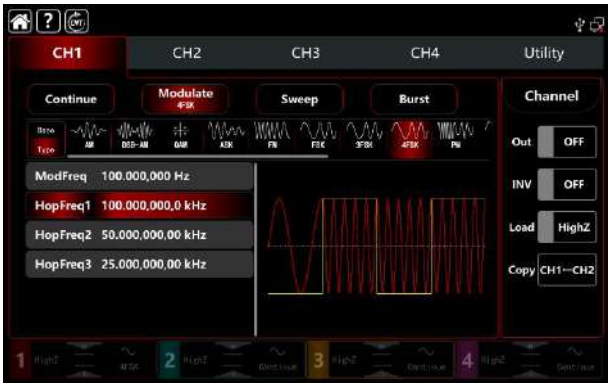
Tap Freq to pop-out visual keyboard to enter 500Hz.

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



3) Set the hopping frequency and the modulating frequency

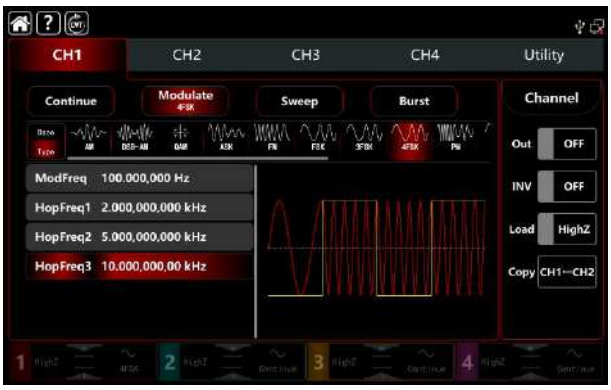
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the modulating frequency.



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

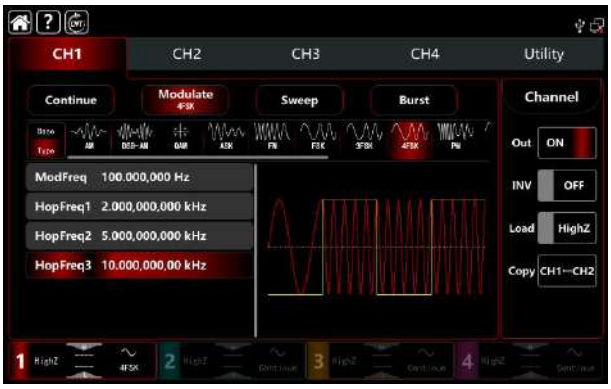
Tap HopFreq2 to pop-out visual keyboard to enter 5kHz.

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

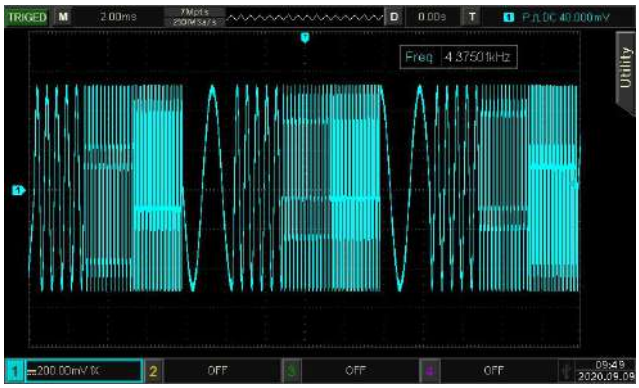


4) Turn on the output channel

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



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

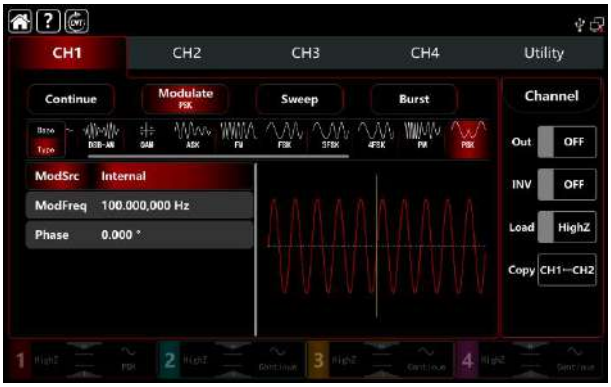


3.1.8 PSK (Phase Shift Keying)

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

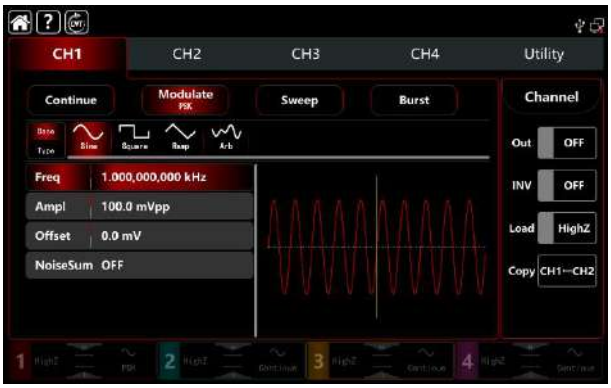
Select PSK modulation

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



Select the carrier waveform

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

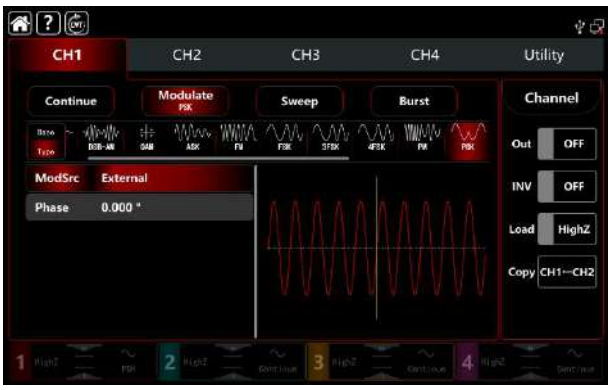


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

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

2) External source

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

Modulation waveform frequency settings

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

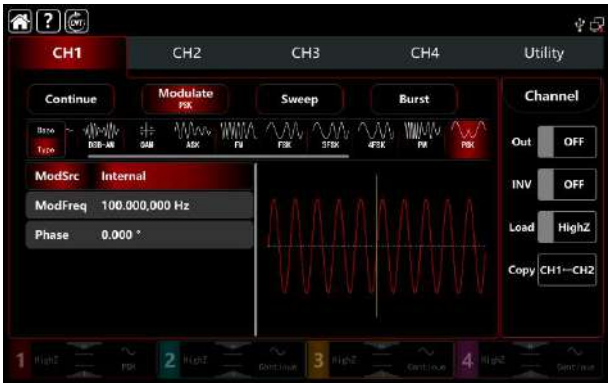
Modulating phase settings

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

Comprehensive example

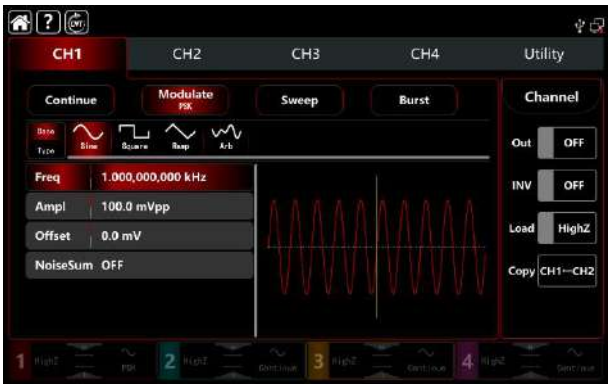
In PSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the frequency 1kHz to shift between the modulating phase 180°and the carrier wave, the settings steps as following,

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



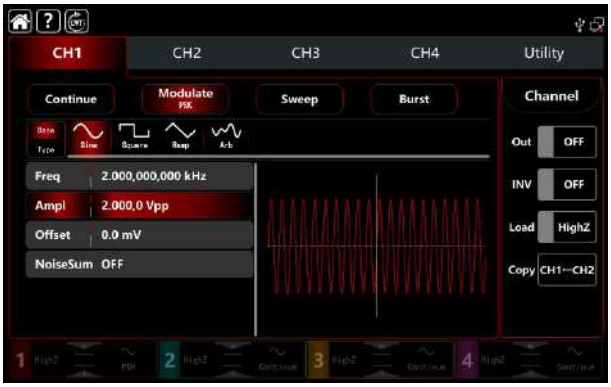
2) Set the parameter of the carrier wave signal

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



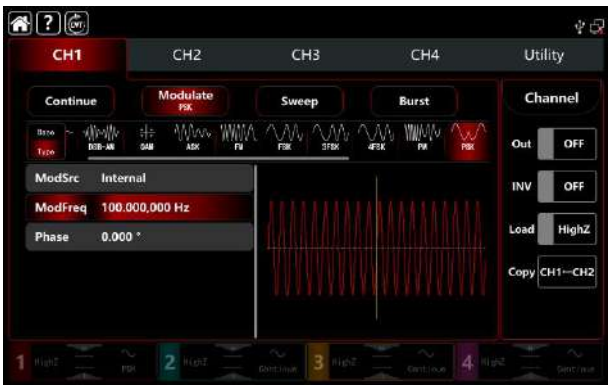
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



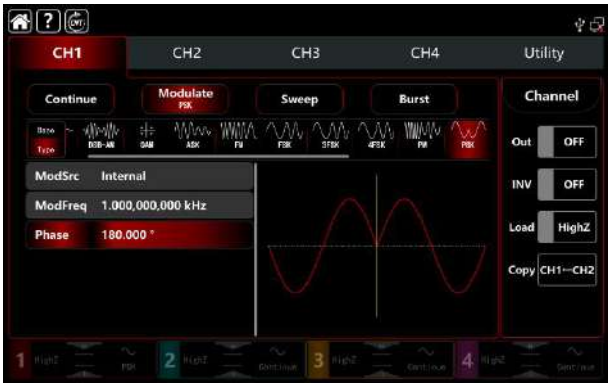
3) Set the modulating frequency and phase

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



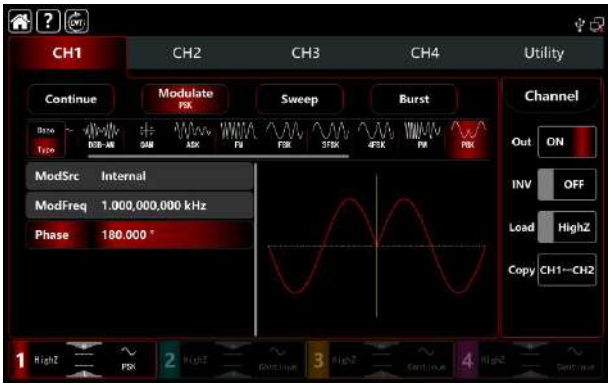
Tap ModFreq to pop-out visual keyboard to enter 1kHz.

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

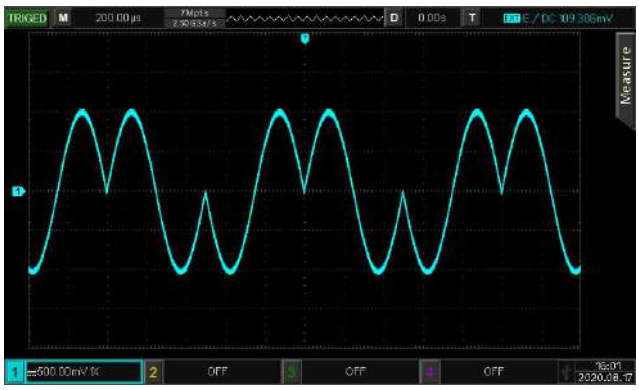


4) Turn on the output channel

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



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

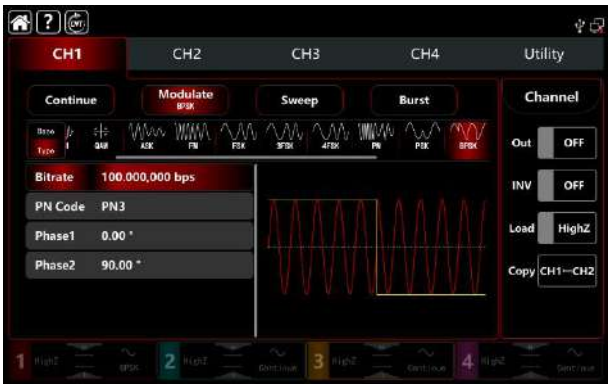


3.1.9 BPSK (Double Phase Shift Keying)

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

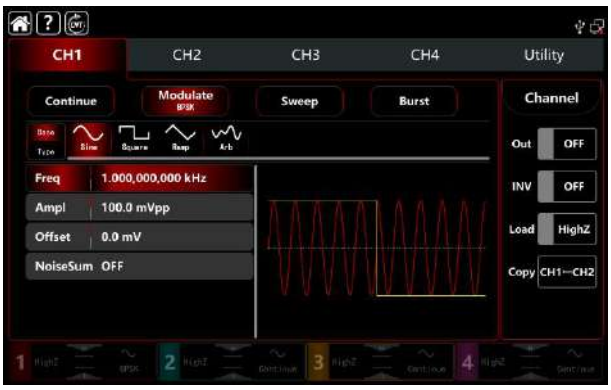
Select BPSK modulation

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



Select the carrier waveform

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

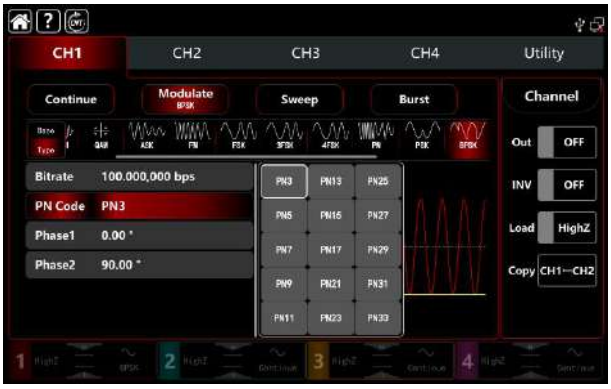


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

The PN code settings

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



BPSK rate settings

In BPSK modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The BPSK bitrate range 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.

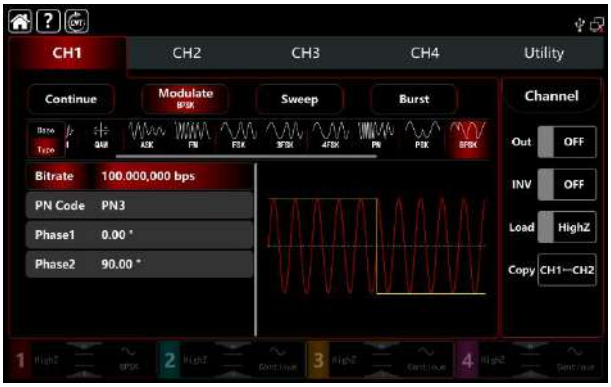
Phase settings

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

Comprehensive example

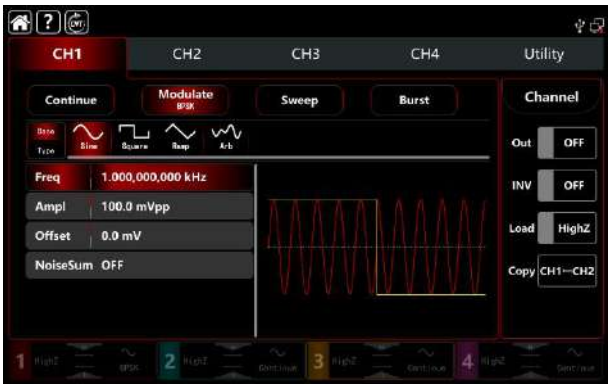
In BPSK modulation mode, set an internal 2kHz,2Vpp sine wave as a carrier wave, set the initial phase to 90°, 1kbps shift frequency between in the carrier wave phase and the modulating wave phase, set PN Code to PN15. The settings steps as following,

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



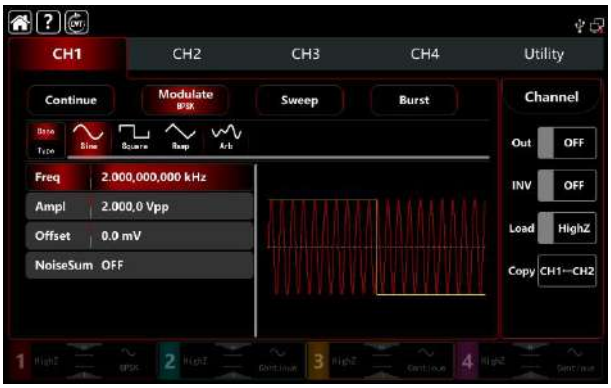
2) Set the parameter of the carrier wave signal

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



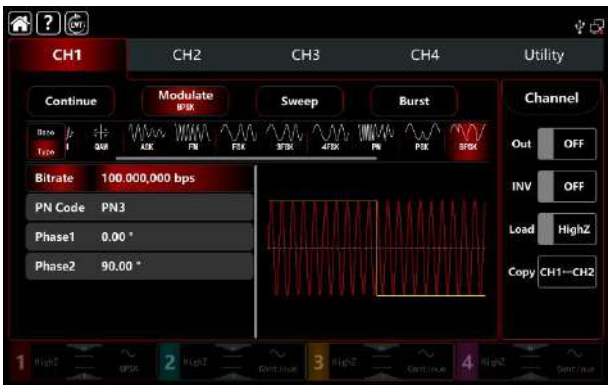
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3) Set the BPSK bitrate and phase

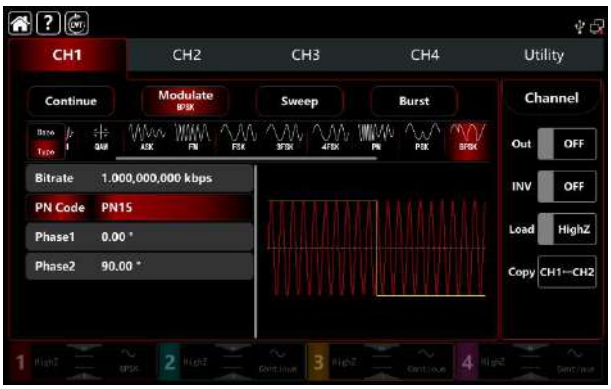
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the BPSK rate and phase.



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

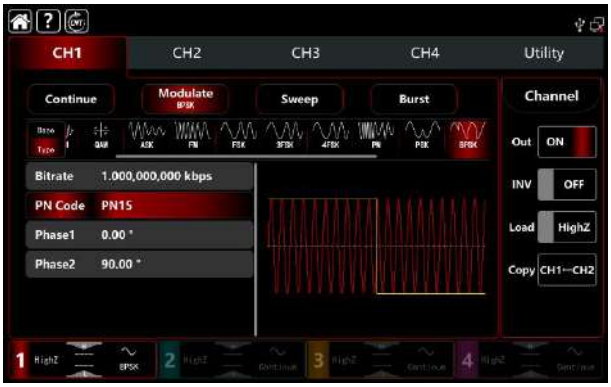
Phase use the default value,phase1: 0°,phase2 ： 90°.

Tape PN Code PN3 to select PN15.



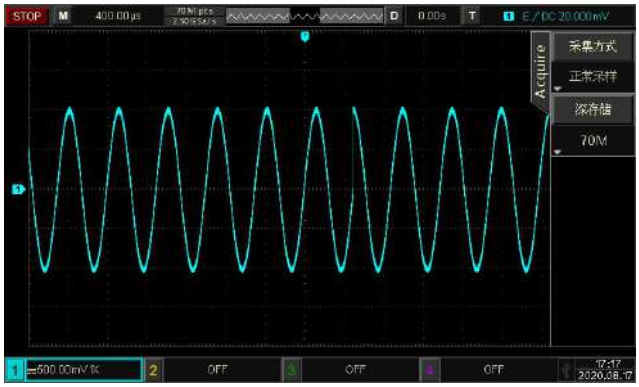
4) Turn on the output channel

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



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

figure below,

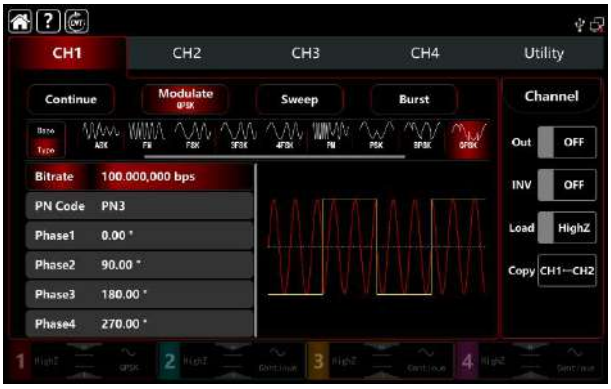


3.1.10 QPSK (Quad-Phase Shift Keying)

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

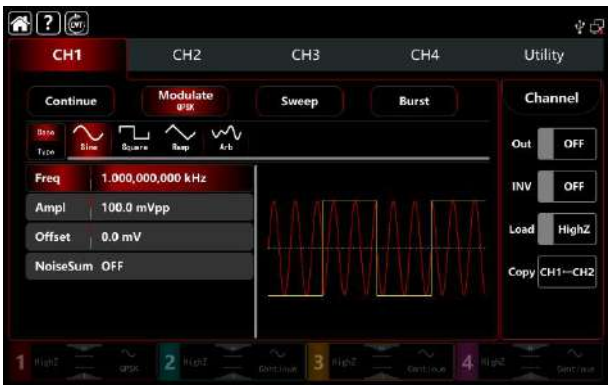
Select QPSK modulation

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



Select the carrier waveform

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

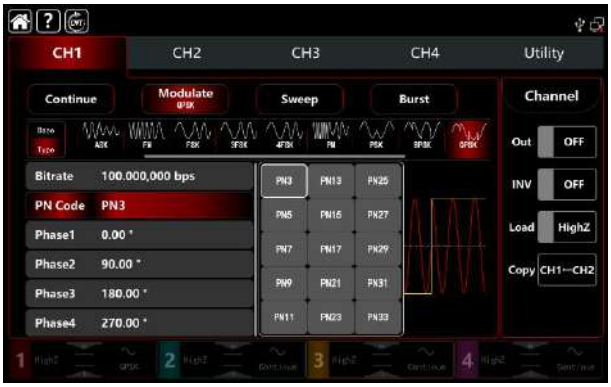


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

The PN code settings

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



QPSK bitrate settings

In QPSK modulation mode, it can set the shift frequency between in the carrier phase and the modulating phase. The QPSK bitrate range 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

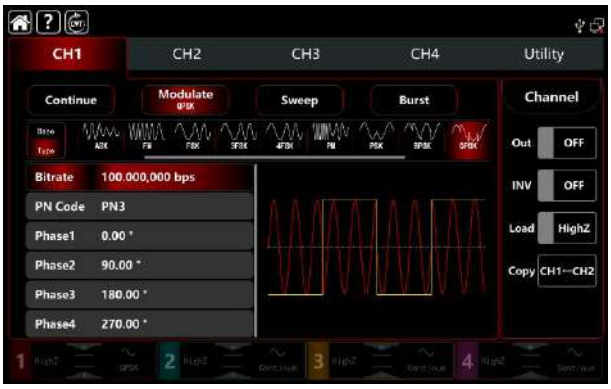
1) Phase1 is the carrier wave phase, the default value is 0°.

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 0°~360°. Rotate multifunction knob, push direction key or tap Phase1 , Phase2 ,Phase3 tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface.

Comprehensive example

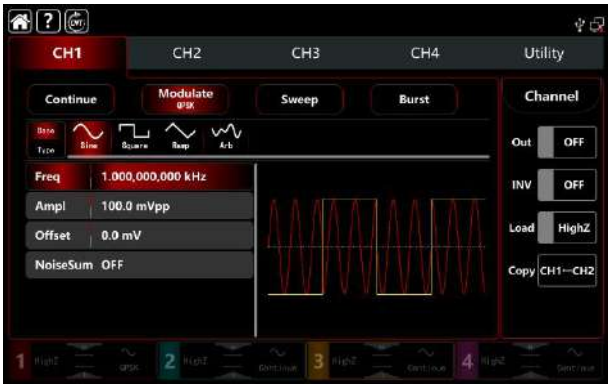
In QPSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the phase of the three fundamental waves and the initial modulation phases be 90 °, 180 ° and 270 ° respectively, hopping frequency 1kbps among the phases, select PN code as PN 15, the setting steps as following,

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



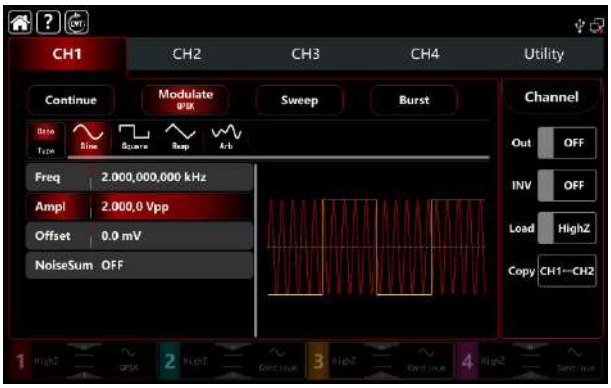
2) Set the parameter of the carrier wave signal

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



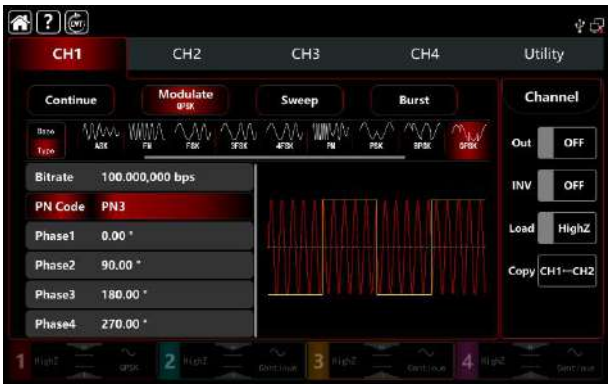
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3) Set QPSK bitrate and the modulating phase

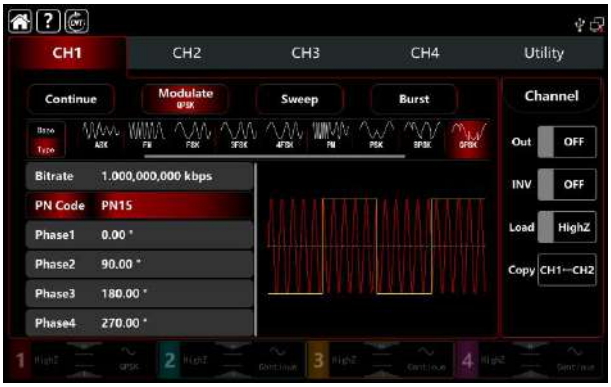
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set the QPSK bitrate and phase.



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

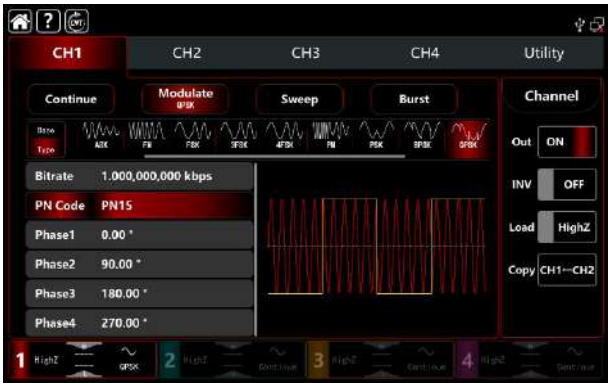
Phase use the default value, phase1: 0°, phase2 ： 90°, phase3:180°, phase4:270°.

Tap PN Code PN3 to select PN15.

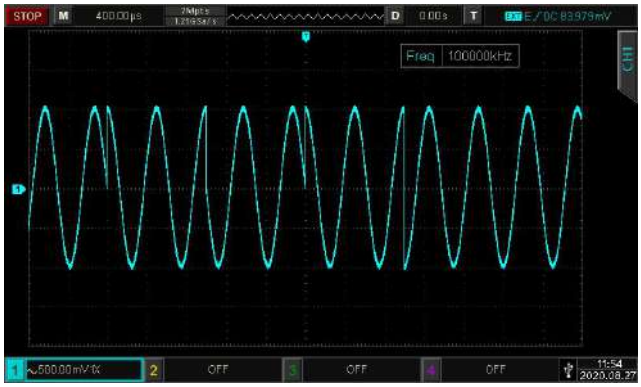


4) Turn on the output channel

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



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

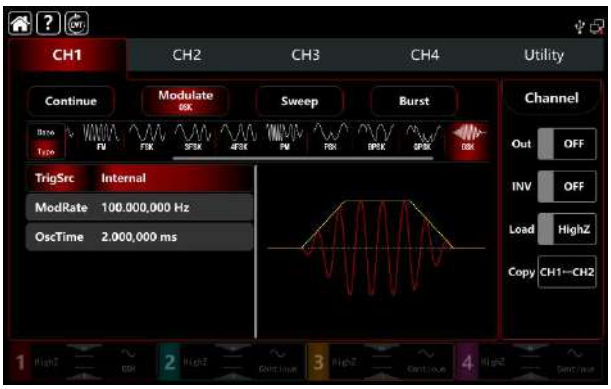


3.1.11 OSK (Oscillation Keying)

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

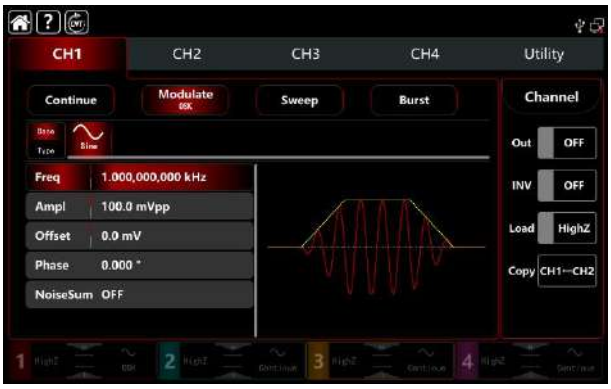
Select OSK modulation

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



Select the carrier waveform

OSK carrier waveform is sine wave.

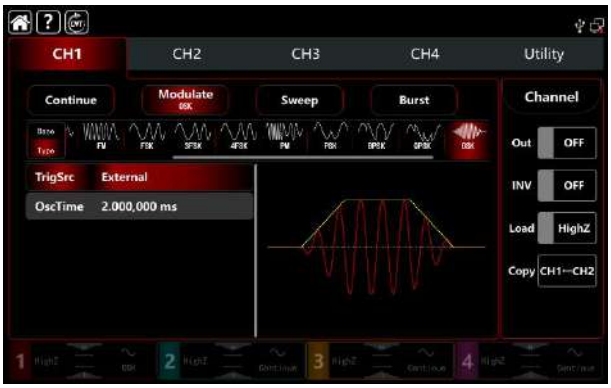


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the trigger source of modulation

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



1) Internal trigger source

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

2) External trigger source

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

Oscillation period settings

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

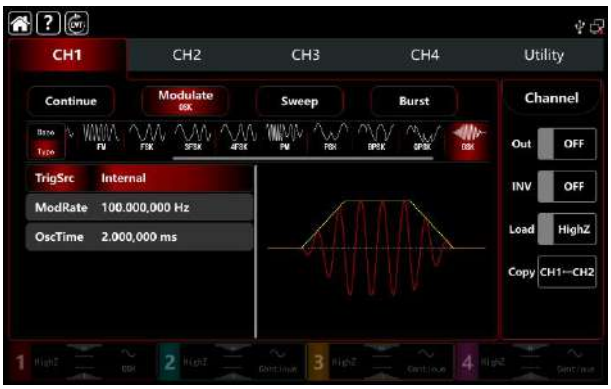
OSK rate settings

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

Comprehensive Example

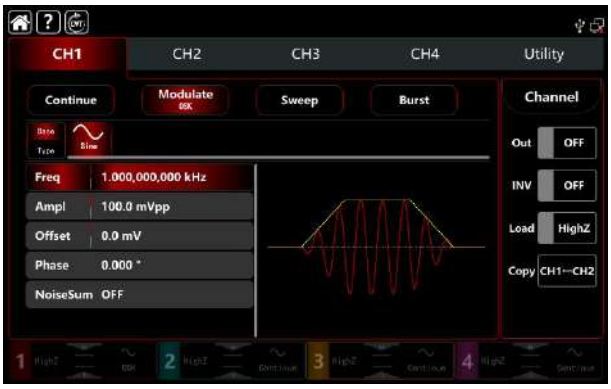
In OSK modulation mode, set an internal 2kHz, 2Vpp sine wave as a carrier wave, set the frequency 100Hz, oscillation period 1μs, the settings steps as following,

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



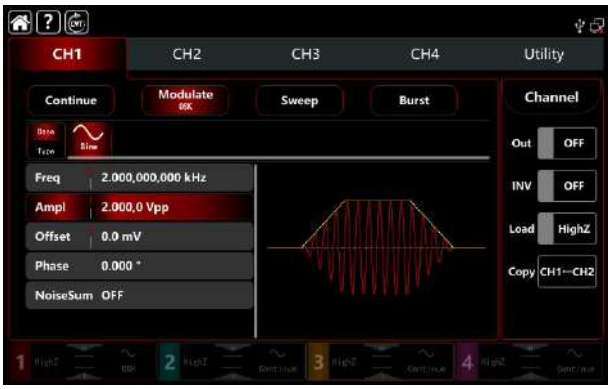
2) Set the parameter of the carrier wave signal

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



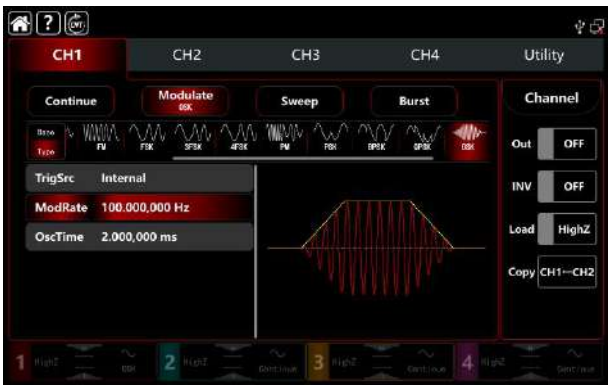
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



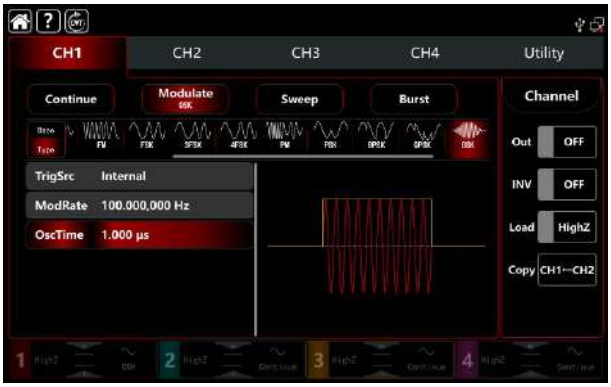
3) Set the modulating rate

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



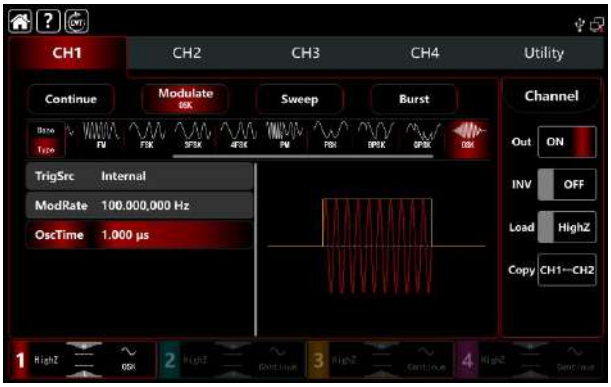
Tap ModRate to pop-out visual keyboard to enter 100Hz (the default 100Hz).

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

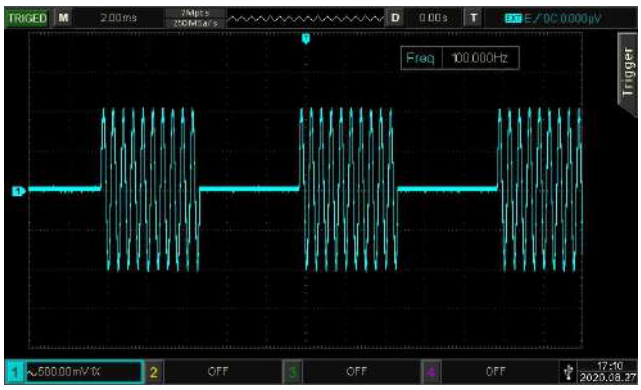


4) Turn on the output channel

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



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

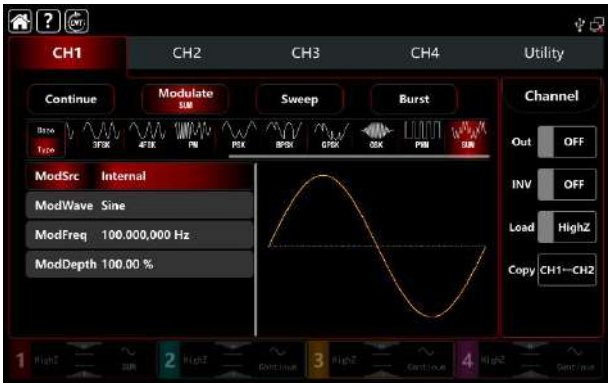


3.1.12 SUM (Sum Modulation)

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

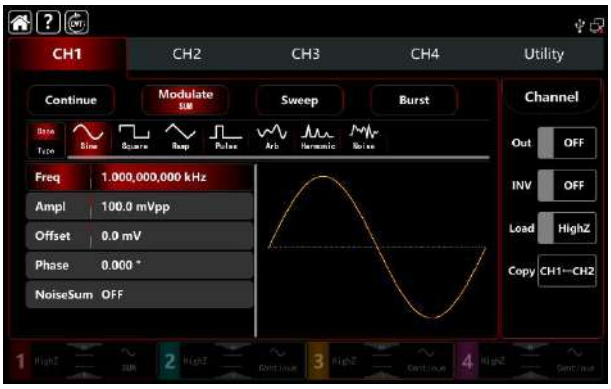
Select SUM modulation

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



Select the carrier waveform

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

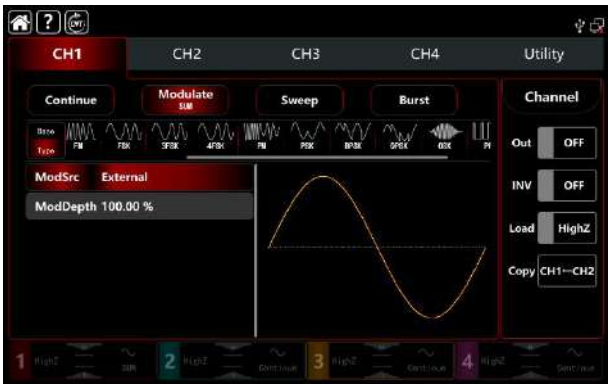


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



Select the source of modulation

1) Internal source

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

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

2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The SUM modulation depth is controlled by the ±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 1μHz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out visual numeric keyboard to enter values and select unit in modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the modulation wave. The input external modulating signal frequency range is between 0Hz~50kHz.

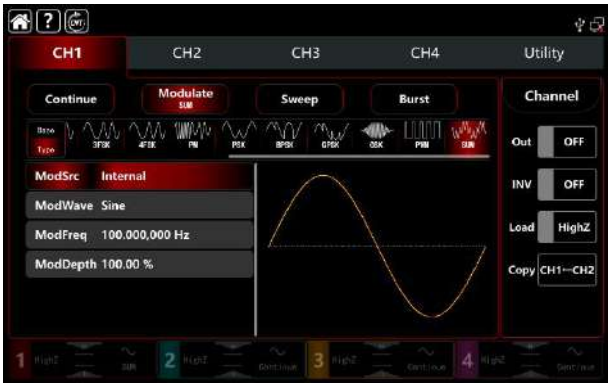
Modulation depth settings

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

Comprehensive example

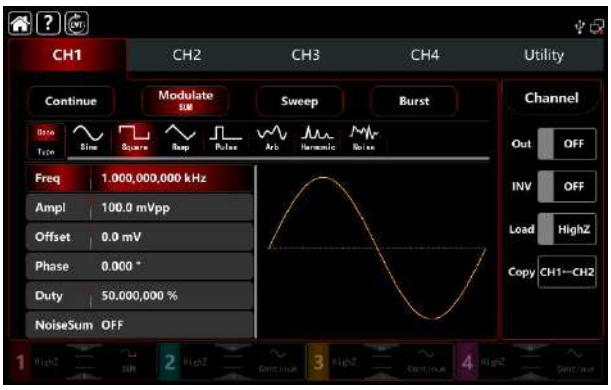
In SUM modulation mode, set an internal 1kHz sine wave as the modulating signal, another square sine with frequency 2kHz, amplitude200mVpp, duty ratio 45% as the carrier wave signal, and set the modulation depth to 80%, the settings steps as following,

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



2) Set the parameter of the carrier wave signal

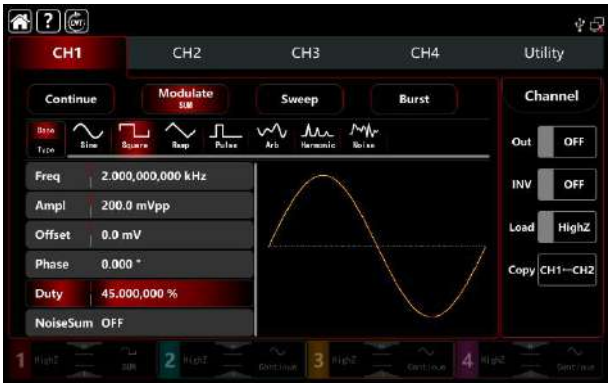
Tap Base to select Square as the carrier waveform (the default option is sine wave).



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

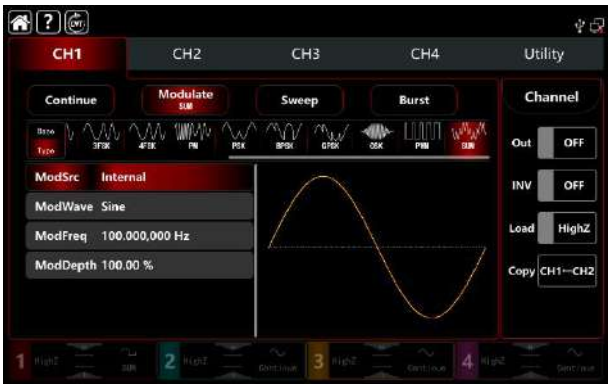
Tap Ampl tab to pop-out visual numeric keyboard to enter 200mVpp.

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



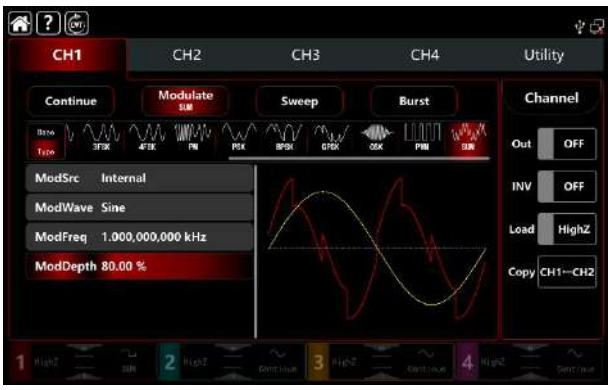
3) Set the modulation frequency and depth

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



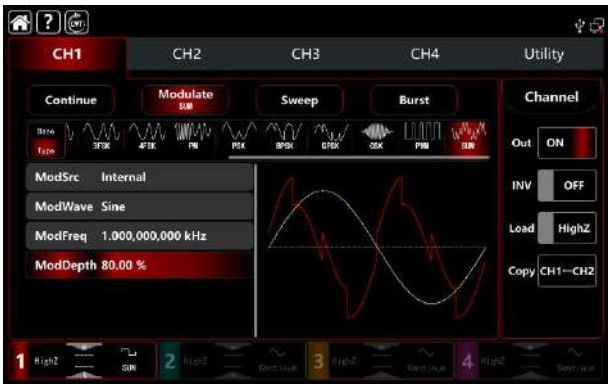
Tap ModFreq tab to pop-out visual numeric keyboard to enter 1kHz.

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

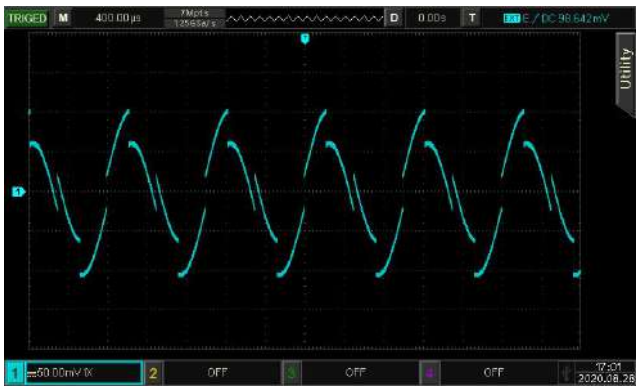


4) Turn on the output channel

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.



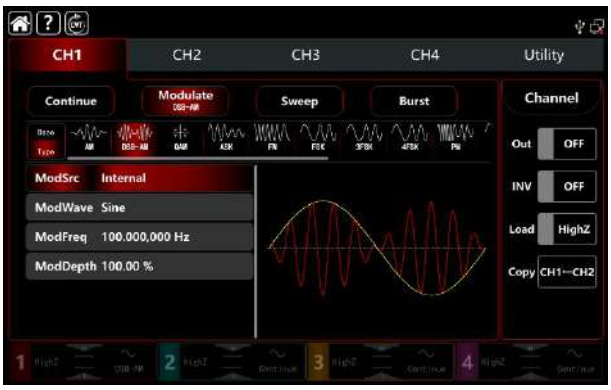
The shape of the AM modulation waveform viewed through an oscilloscope is shown in the figure below,



3.1.13 DSB-AM (Double Side Band Amplitude Modulation)

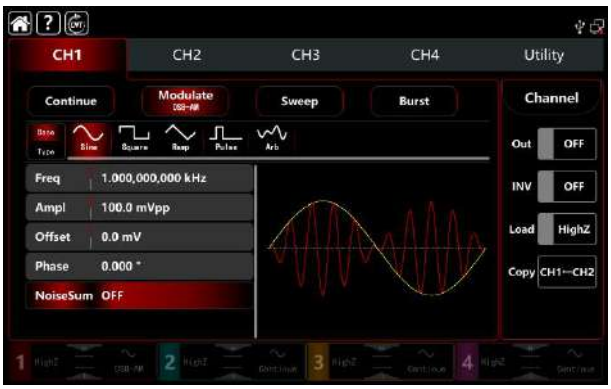
Select FM modulation

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



Select the carrier waveform

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

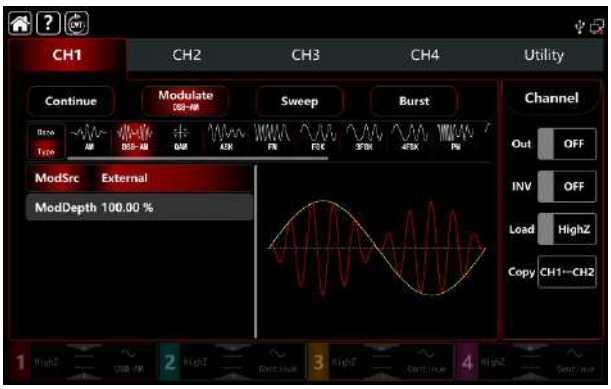


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

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

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

2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The DSB-AM depth is controlled by the ±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.

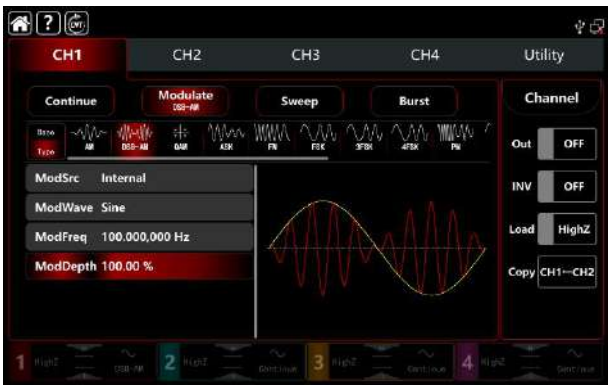
Modulation waveform frequency settings

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

Comprehensive example

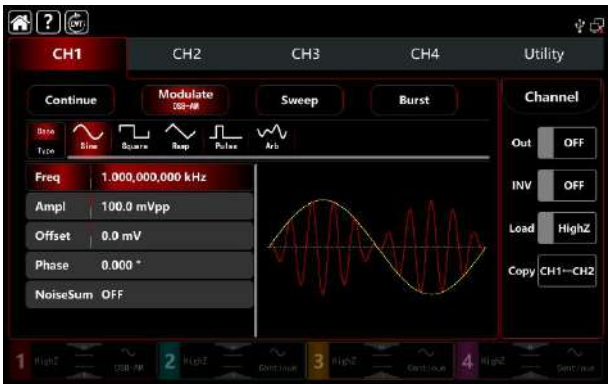
In DSB-AM modulation mode, set an internal 1kHz square wave as a modulating signal, another sine wave signal with frequency 2kHz, amplitude2Vpp as the carrier wave signal, the settings steps as following,

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



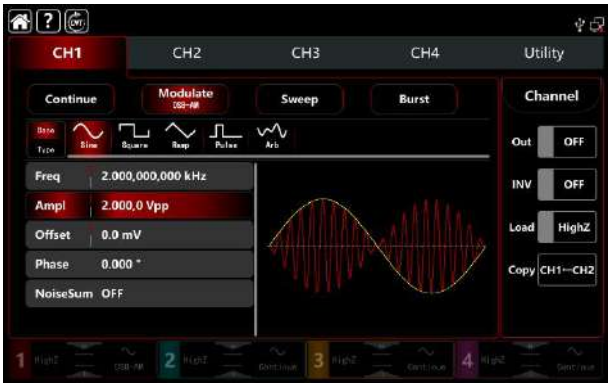
2) Set the parameter of the carrier wave signal

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



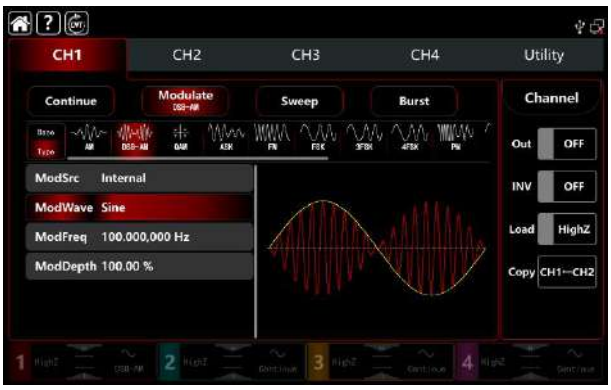
Tap Freq tab to pop-out visual numeric keyboard to enter 2kHz.

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



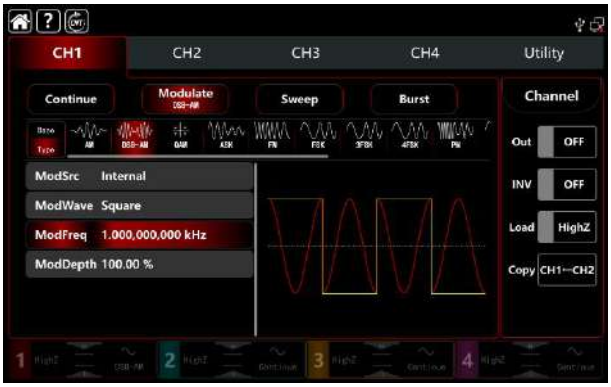
3) Set the modulation wave and frequency

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



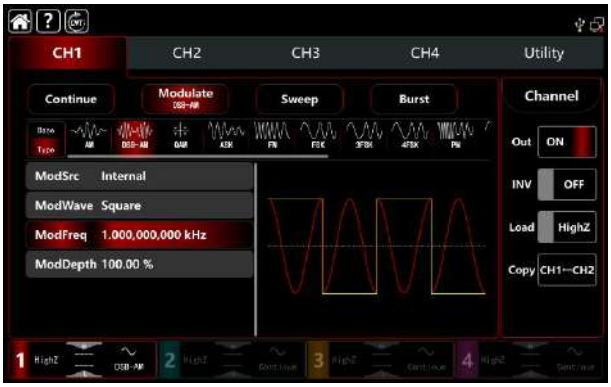
Tap ModWave tab to pop-out visual numeric keyboard to select square wave.

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

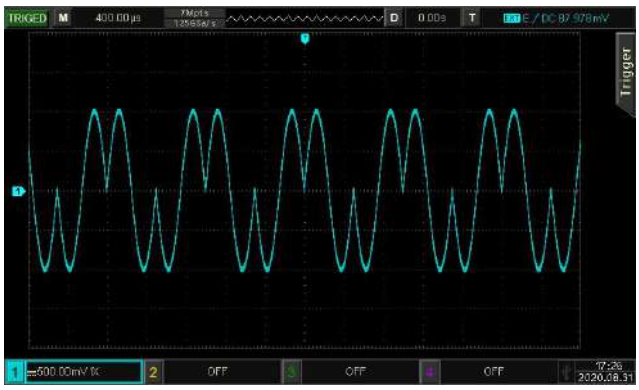


4) Turn on the output channel

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



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



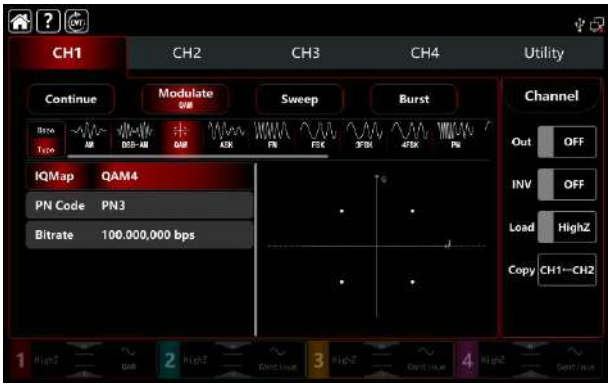
3.1.14 QAM (Quadrature Amplitude Modulation)

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

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

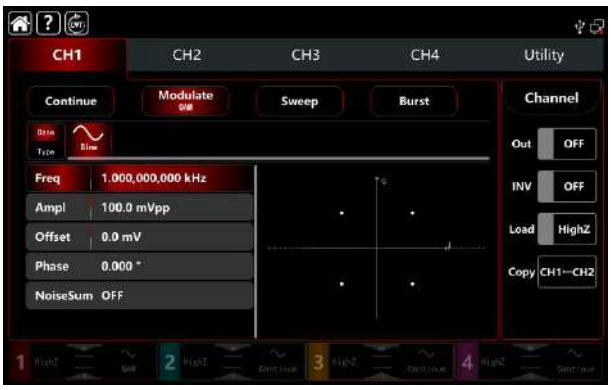
Select QAM modulation

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



Select the carrier waveform

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



Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Modulation type

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

Select PN code

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

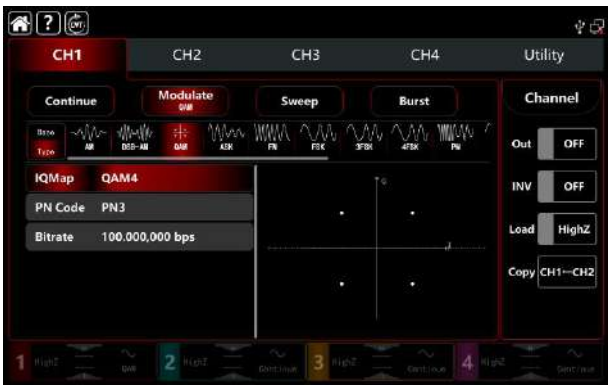
QAM rate settings

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

Comprehensive example

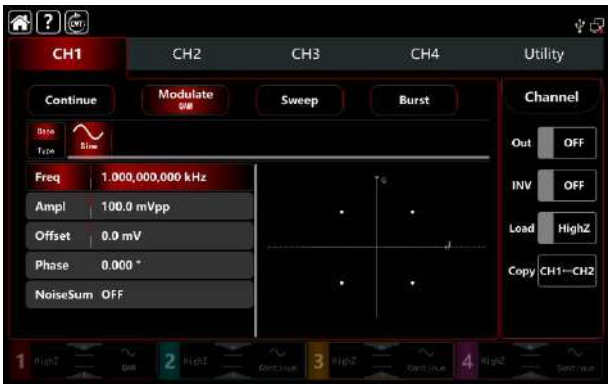
In QAM modulation mode, set an internal 2kHz,2Vpp sine wave as a carrier wave, set the rate to 100bps, modulation type QAM64, PN code PN7, The settings steps as following,

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



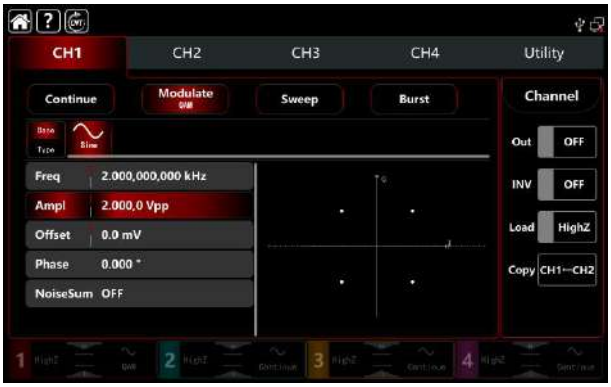
2) Set the parameter of the carrier wave signal

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



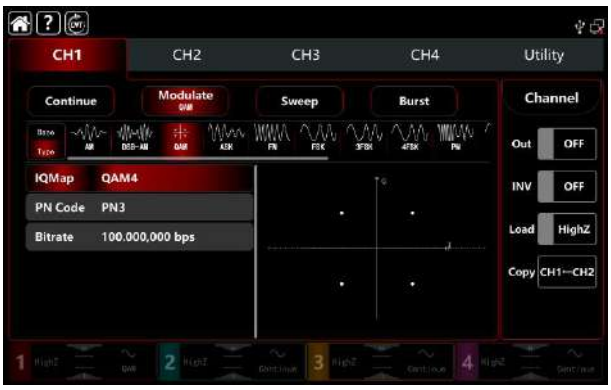
Tap Freq to pop-out visual keyboard to enter 2kHz.

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



3) Set the modulation parameter

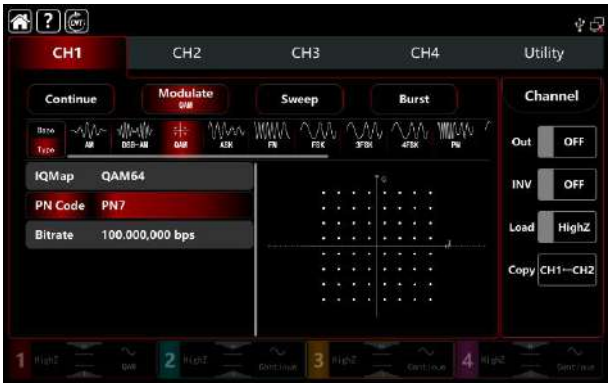
After the parameter setting of the carrier wave, tap Type to return to modulation interface to set parameter.



Tape IQMap→QAM4 to select QAM64.

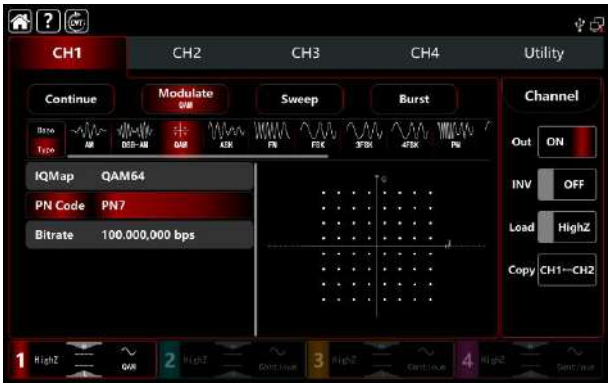
Tape PN Code→PN3 to select PN7.

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

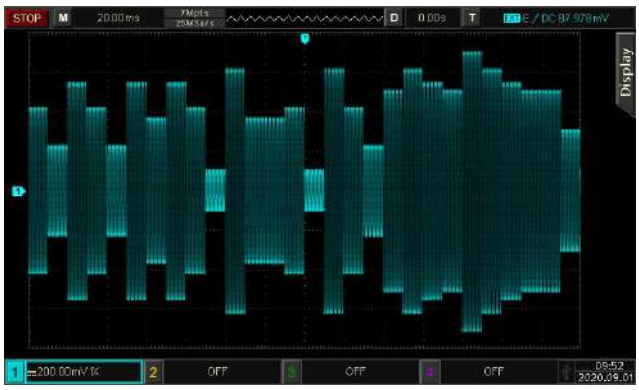


4) Turn on the output channel

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



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

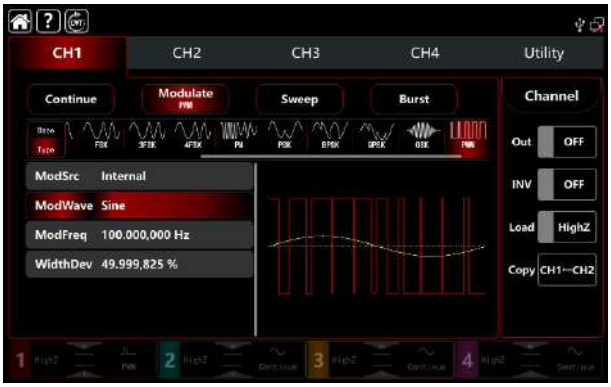


3.1.15 PWM (Pulse Width Modulation)

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

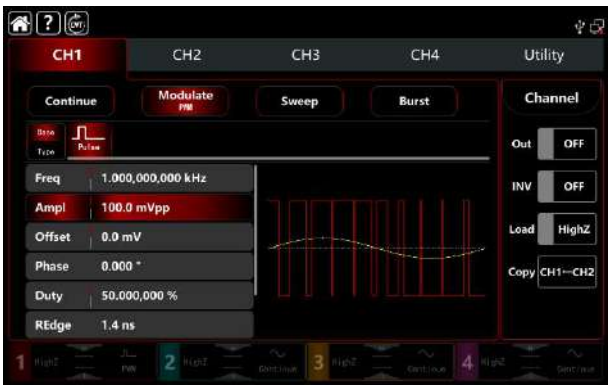
Select PWM modulation

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



Select the carrier waveform

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

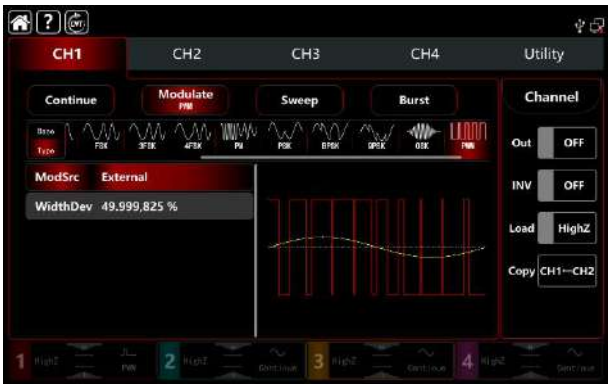


Carrier wave frequency settings

Refer to The carrier wave frequency settings of AM modulation.

Select the source of modulation

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



1) Internal source

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

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

2) External source

When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The PWM duty ratio offset is controlled by the ±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 1μHz~2MHz, the default range is 100Hz. Rotate multifunction knob, push direction key or tap ModFreq tab to pop-out visual numeric keyboard to enter values and select unit in FM modulation setting interface. When the modulation source is external, the modulation wave and frequency will be hidden in parameter list. Use the external waveform to modulating the carrier wave. The input external modulating signal frequency range is between 0Hz~50kHz.

Duty ratio deviation settings

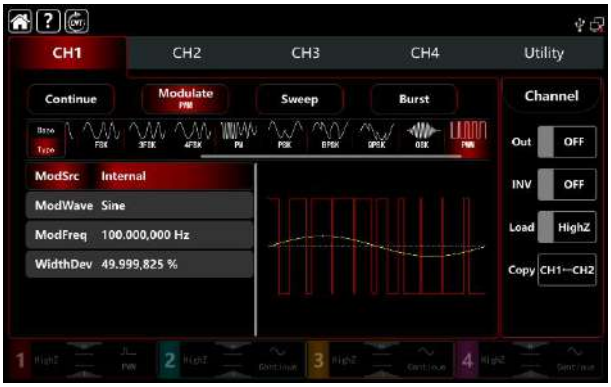
Duty ratio deviation is deviation of modulated waveform from the current carrier duty ratio. The range of PWM can set to 0%~49.999825%, the default is 49.999825%. Rotate multifunction knob, push direction key or tap DutyDev tab to pop-out visual numeric keyboard to enter values and select unit in FM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

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

Comprehensive example

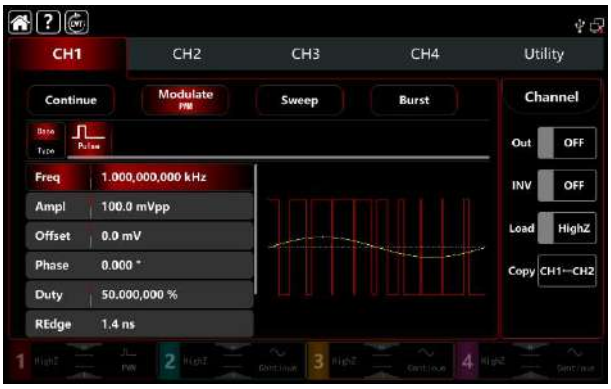
In PWM modulation mode, set an internal 1kHz sine wave as a modulating signal, another pulse wave with frequency 10kHz, amplitude 2Vpp, duty ratio 50%, rising/falling edge time 100ns as a carrier wave signal , and set the frequency duty ratio deviation to 40%, the settings steps as following,

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



2) Set the parameter of the carrier wave signal

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

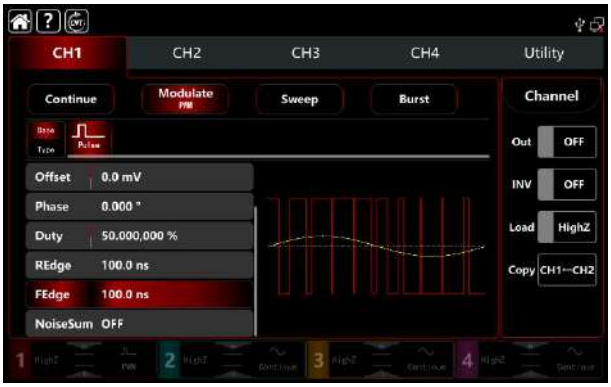


Tap Freq to pop-out visual numeric keyboard to enter 10kHz.

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

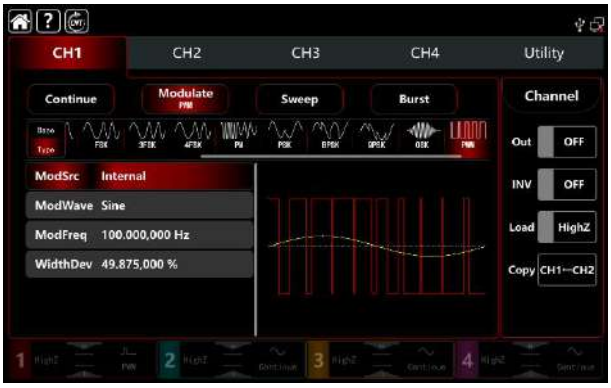
Tap REdge to pop-out visual numeric keyboard to enter 100ns.

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



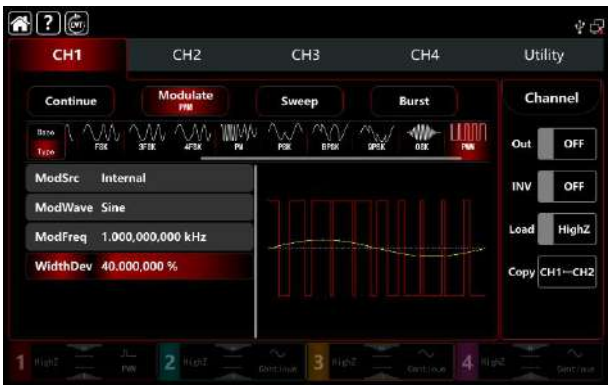
3) Set the modulating parameter

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



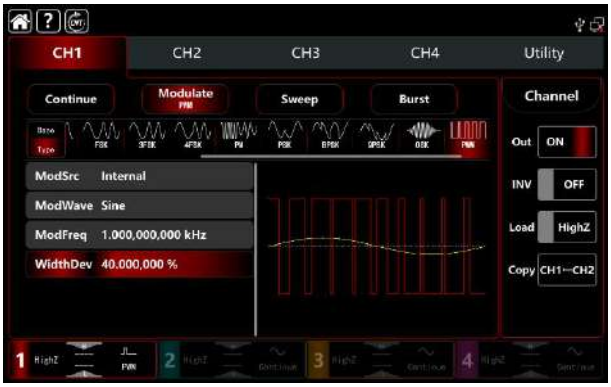
Tap ModFreq to pop-out visual numeric keyboard to enter 1kHz.

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



4) Turn on the output channel

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



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

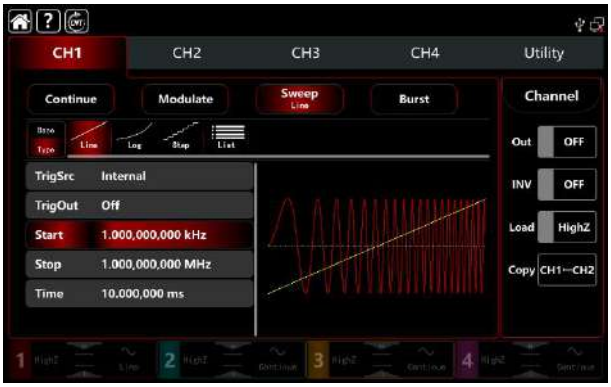
3.2 Output Frequency Sweep Waveform

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

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

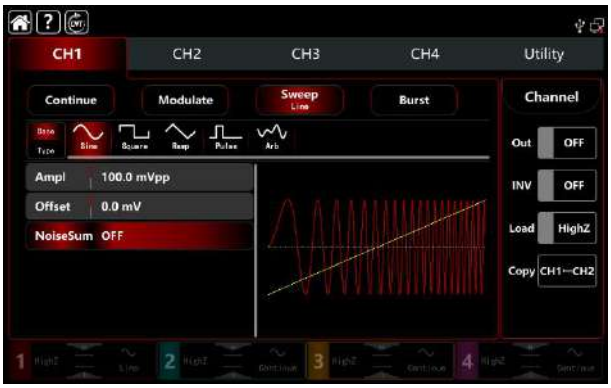
3.2.1 Select Frequency Sweep

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



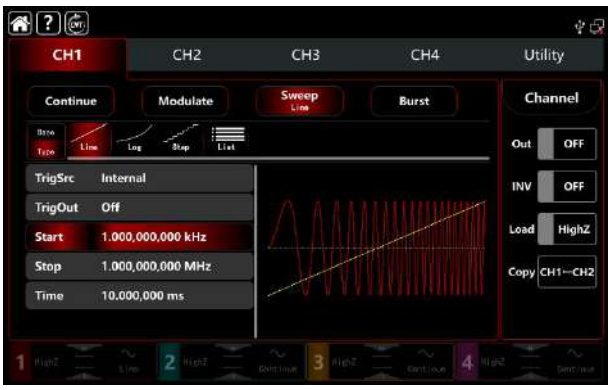
2) Select the frequency sweep waveform

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

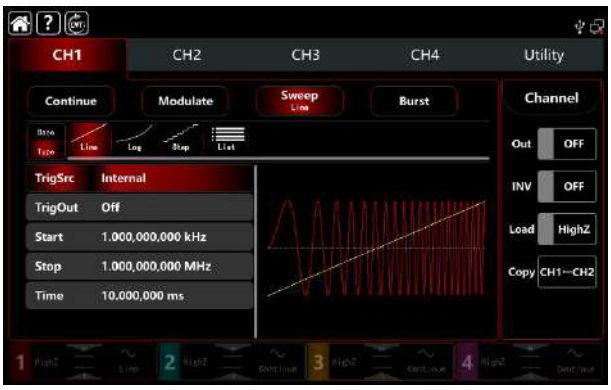
Linear frequency sweep: output frequency in a linear way

Logarithm frequency sweep: output frequency in a logarithm way

Stepping frequency sweep: output frequency in a stepping way

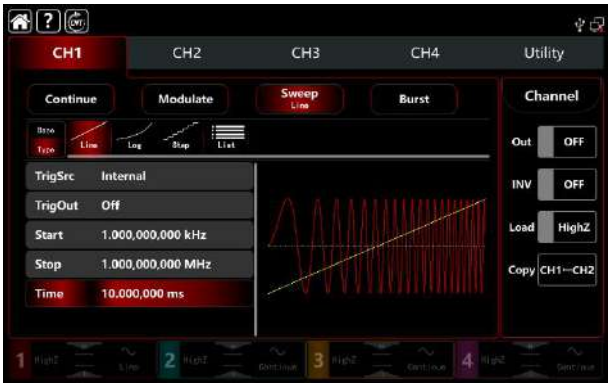
List frequency sweep: output frequency in a list way

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

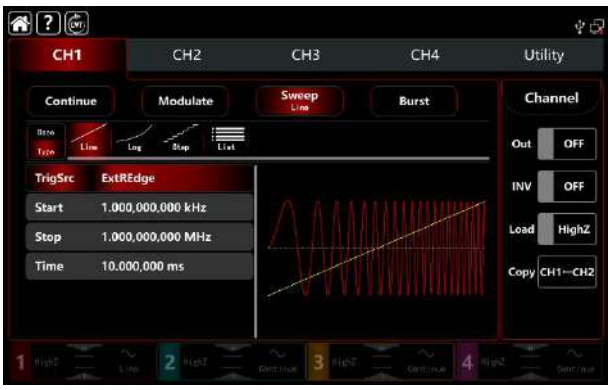


3.2.5 Select trigger source

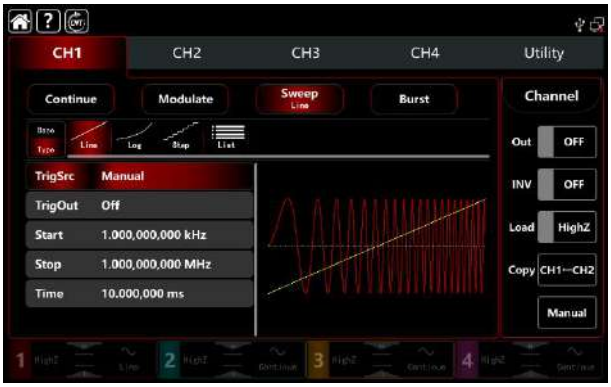
The waveform generator will output a frequency sweep when receive a trigger signal and wait next trigger source. The trigger source of frequency sweep can be internal, external (external rising/falling edge) or manual. Rotate multifunction knob or tap ModSrc to step through Internal, External, ExREdge,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

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

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



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



3.2.6 Trigger Output

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

- Internal trigger source, the waveform generator outputs a square wave with duty ratio of 50% from external digital modulation terminal (FSK Trig connector) when frequency sweep starts. Trigger period depends on designated frequency sweep time.
- Manual trigger source, the waveform generator outputs a pulse wide than 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

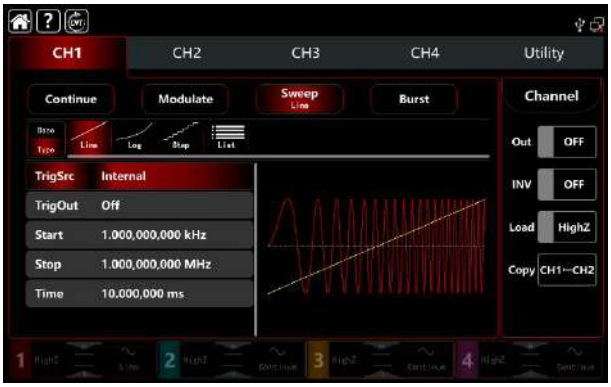
The external digital modulation terminal (FSK Trig connector) can be designated edge as input or output. When the terminal used as input (external trigger source), rising edge means that rising edge of external signal triggers output a frequency sweep; falling edge means that falling edge of

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 Comprehensive example

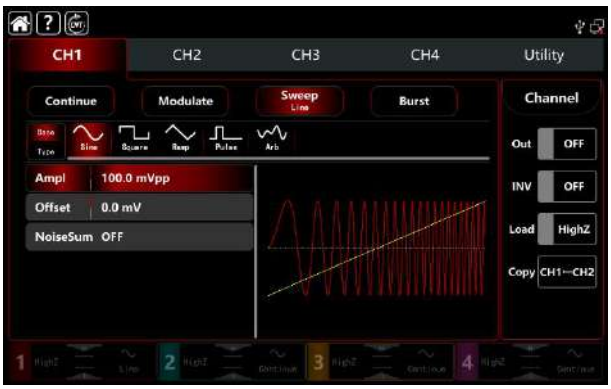
In frequency sweep mode, set a square wave with amplitude 1Vpp, duty ratio 50% as frequency sweep, the frequency sweep type is linear, set the starting frequency to 1kHz, stop frequency 50kHz and frequency sweep time to 2ms, use the internal rising edge trigger source to output frequency sweep. The settings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

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

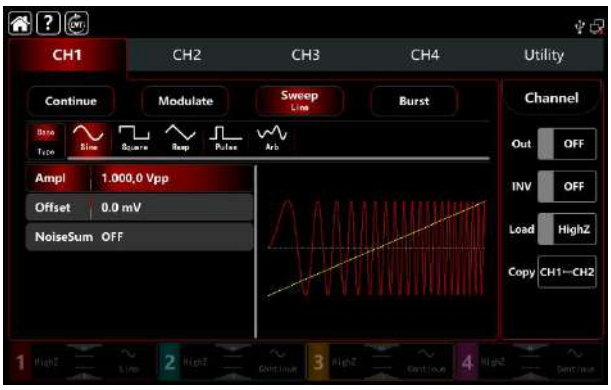


1) Set the parameter of the carrier wave signal

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

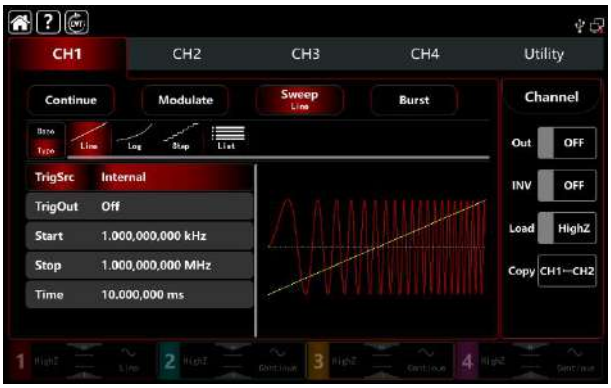


   Tap Ampl tab to pop-out visual numeric keyboard to enter 1Vpp.



2) Set the starting/stop frequency, frequency sweep time, trigger source and edge

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

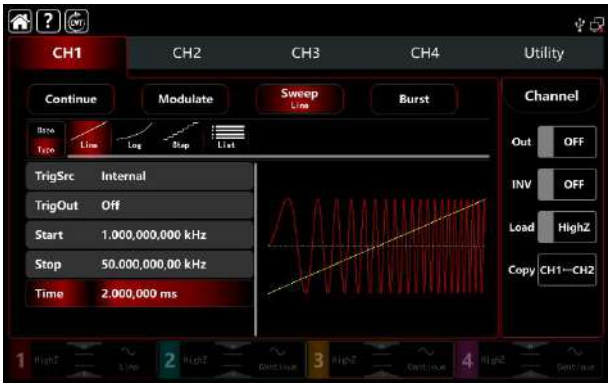


Select Linear as the way of frequency sweep (default).

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

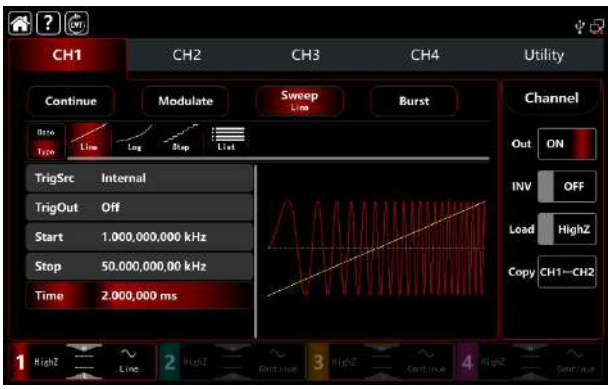
Tap Stop tab to pop-out visual numeric keyboard to enter 50kHz.

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

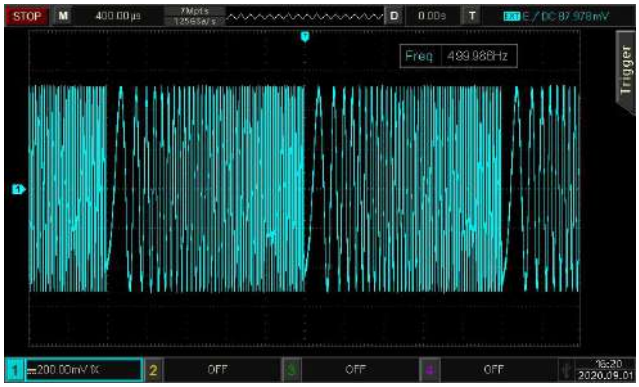


3) Turn on the output channel

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



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

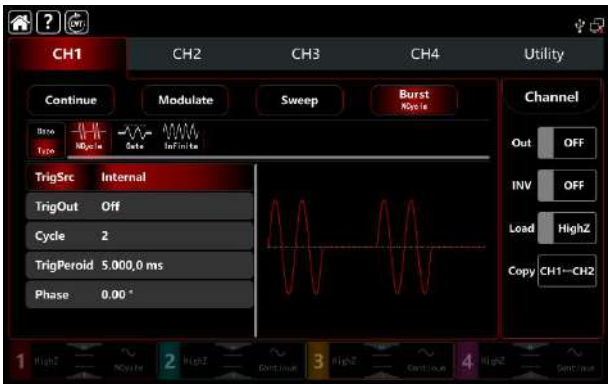


3.3 Output Burst Waveform

The waveform generator can output a designated cycle period wave (pulse string).It has three trigger output mode: internal, external and manual. And offer N cycle, gating and infinite pulse string. It can generate pulse train for sine wave, square wave, ramp wave, pulse wave, arbitrary wave (except DC) and noise (only applicable to gating pulse train). The modulation modes for each channel are independent, it can set the same or different modulation modes to each channel.

3.3.1 Select Burst

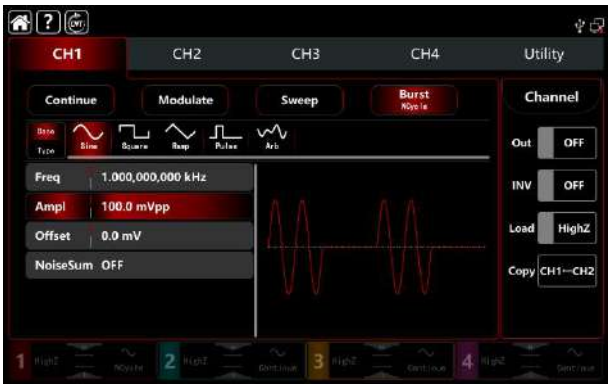
Turn on Burst mode: tap CH1→Burst accordingly, the instrument output the modulated pulse string waveform according to the current setting.



1) Select waveform

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

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



2) Set waveform frequency

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

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

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

3.3.2 Burst Type

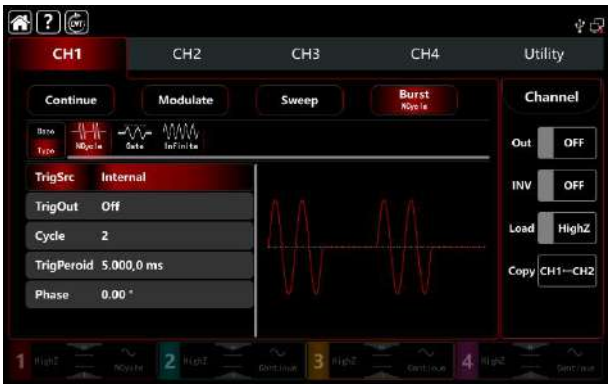
UTG9000T can output three types of pulse train, N cycle, gating and infinite. The default type is N cycle.

1) N cycle mode

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

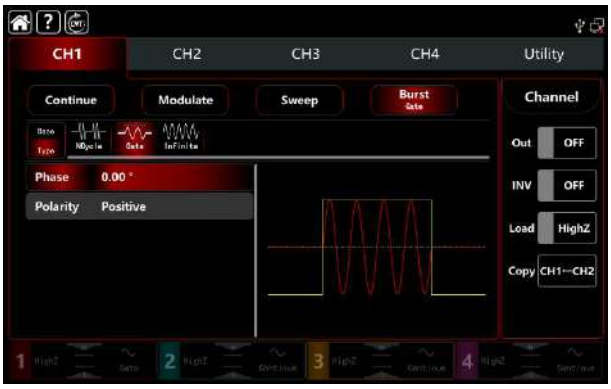
Note: When trigger source is ExtREdge, ExtFEdge, trigger out option will be hidden in

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

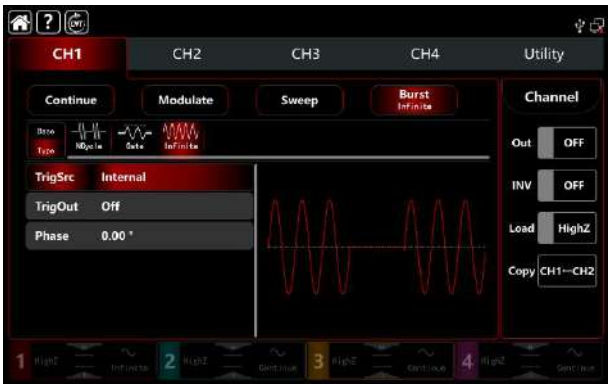
Tap Gate to turn on gating mode, trigger source, trigger output, trigger period and cycle number will be hidden in parameter list. It can only use the external trigger source, the waveform generator trigged by the external digital modulation terminal (FSK Trig connector) on the back panel. The waveform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

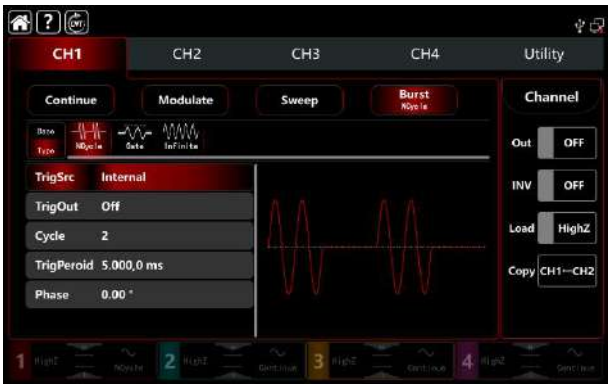


3.3.3 Initial Phase of Burst

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 manual, 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 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 trigger source, trigger output will be hidden in parameter list. Because the trigger output is also output by the external digital modulation terminal (FSK Trig connector). This terminal can not be the external trigger input and internal trigger output at the same time.
3) Manual trigger source present in the current channel setting interface on the right side of the screen. Tap Manual to output a pulse string of N cycle or Infinite mode.

3.3.7 Trigger Output

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

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

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

- Manual trigger source, the waveform generator outputs a pulse wide than 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.

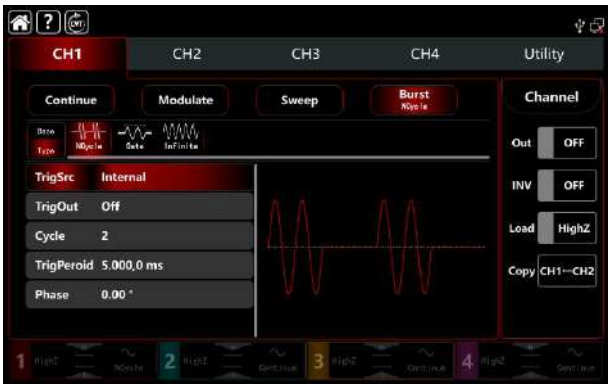
3.3.8 Trigger Edge

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 signal, and the default is rising edge.

3.3.9 Comprehensive example

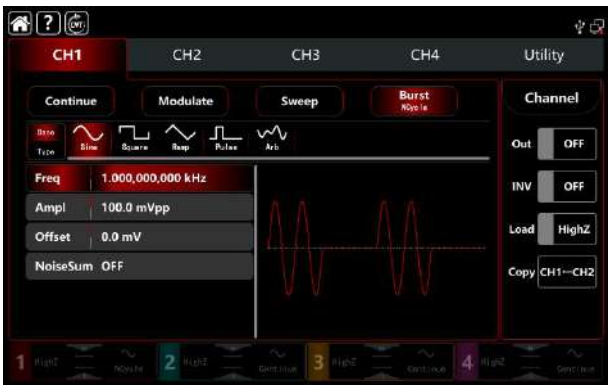
In burst mode, set a sine wave with period 5ms, amplitude 500mVpp as pulse string wave, burst mode set to N cycle, pulse string period 15ms, cycle number 2, the settings steps as following,

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

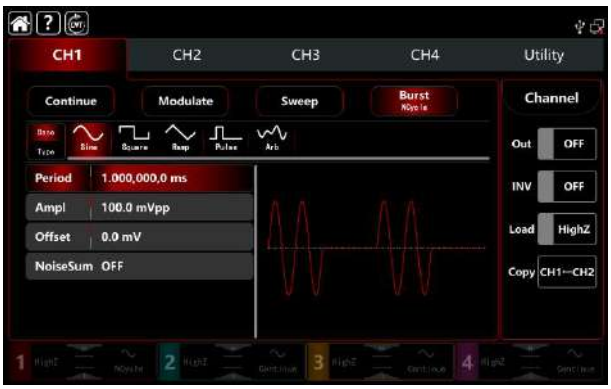


2) Select burst waveform

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

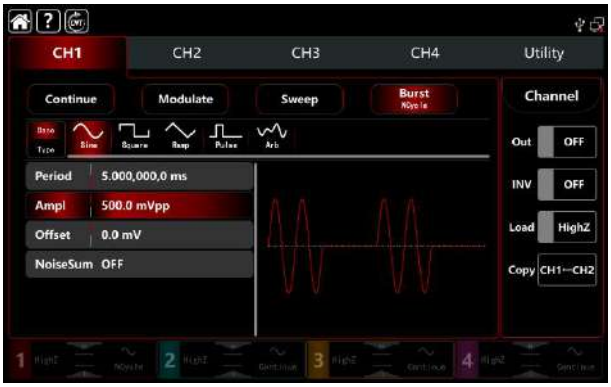


Note: If the setting interface display Freq, this means it can only change the frequency parameter, it can't switch to period. 2ms period is corresponding to 500Hz and their reciprocal relationship is T=1/f. Tap Freq to step through frequency and period.



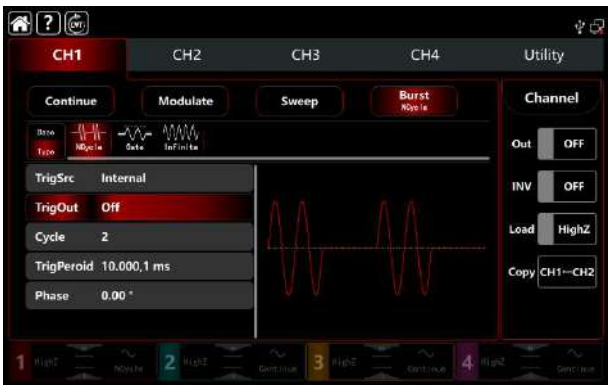
Tap Period to pop-out visual numeric keyboard to enter 5ms.

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

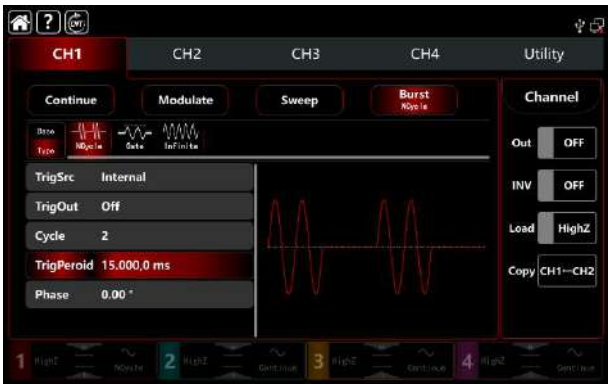


3) Set burst period and cycle

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

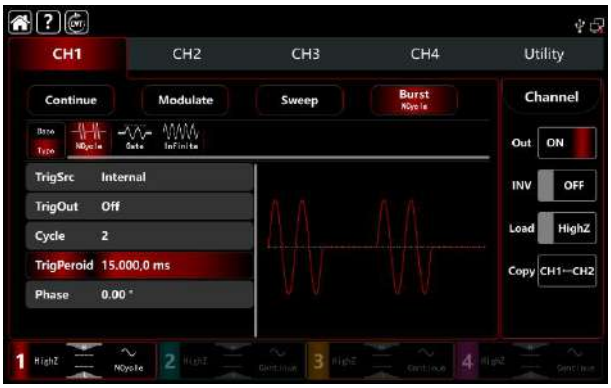


Tap parameter bar to enter value and select unit.

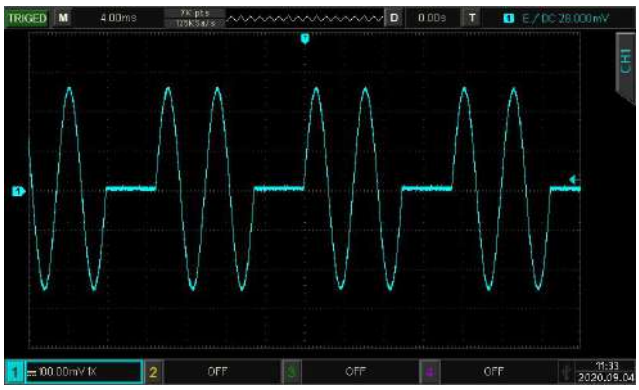


4) Turn on the output channel

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



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

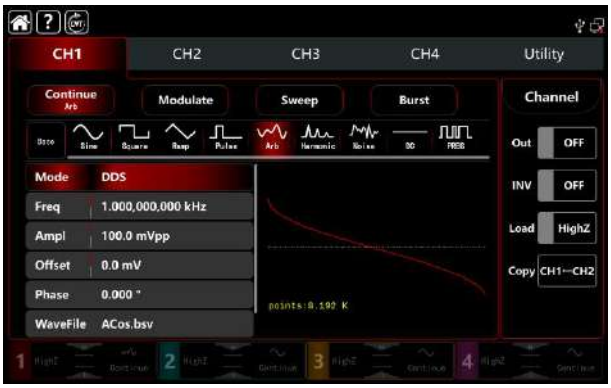


3.4 Output Arbitrary Waveform

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

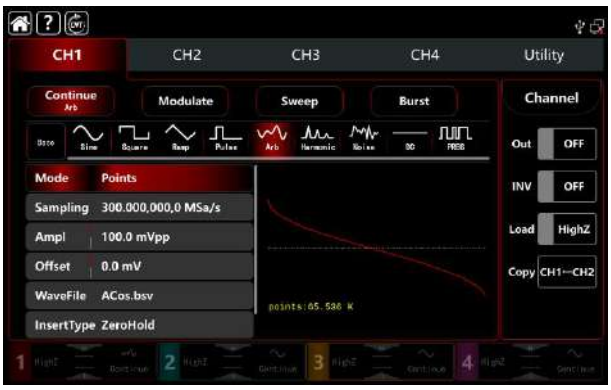
3.4.1 Turn on arbitrary waveform mode

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



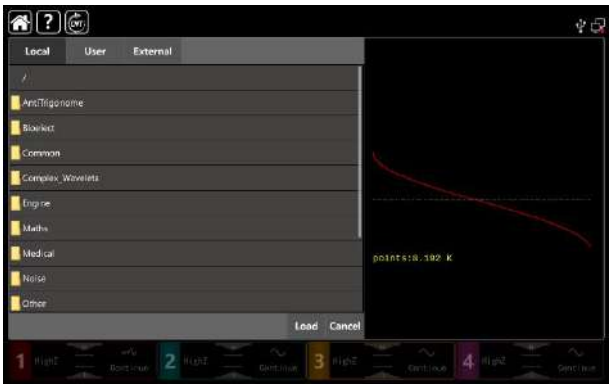
3.4.2 Point by point output/ DDS mode

UTG9000T supports point by point and DDS mode. In point by point mode, the waveform generator automatically calculates frequency of output signal（4577.64Hz）according to waveform length (e.g. 65.536k points) and sampling rate. The waveform generator outputs waveform points one by one with this frequency. It can prevent loss of important waveform point. In DDS default mode, the waveform generator output arbitrary waveform by automatic interpolation or select point as fixed length (8.192 points) and the frequency of parameter list. Rotate multifunction knob or tap Mode tab to step through DDS and Points. Point by point interface figure as below.



3.4.3 Select Arbitrary Waveform

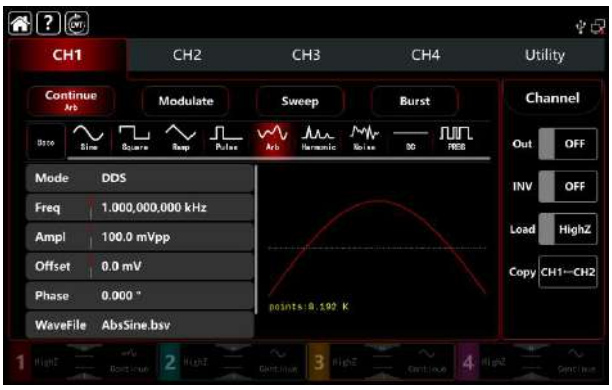
UTG9000T can select arbitrary waveform from internal or external memory storage. Rotate multifunction knob, push direction key or tap WaveFile to enter select it. See the figure as below,



Select the types of arbitrary waveform,

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

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



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

Table 4-4 Built-in Arbitrary Waveform

Type	Waveform	Description
Common Function (15 types)	AbsSine	Absolute sine waveform
	AbsSineHalf	Absolute half-sine waveform
	AmpALT	Amplify sine waveform
	AttALT	Attenuated sine waveform
	Gaussian_monopulse	Gaussian monopulse
	GaussPulse	Gaussian pulse
	NegRamp	Falling ramp
	NPulse	N-Pulse signal
	PPulse	P-Pulse signal
	SineTra	TraSine wave signal
	SineVer	VerSine wave signal
	StairUD	Stair up and down waveforms
	StairDn	Stair-down waveform
	StairUp	Stair-up waveform
	Trapezia	Trapezia waveform
Engine (25 types)	BandLimited	Band-limited signal
	BlaseiWave	Time-velocity curve of explosive vibration
	Butterworth	Butterworth filter
	Chebyshev1	Chebyshev 1 filter
	Chebyshev2	Chebyshev 2 filter
	Combin	Combination function
	CPulse	C-Pulse signal
	CWPulse	CW pulse signal
	DampedOsc	Time-displacement curve of damped oscillation
	DualTone	Dual-tone signal
	Gamma	Gamma signal

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

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

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

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

	ALT_05	
	AUDIO	
	circle	Circle modulation
	COIL_2_1	
	COIL_2_2	
	DC_04	
	diamond	Rhombus modulation
	ECT_1_2	
	EGR_2	
	EGR_3_2	
	EST_03_2	
	Heart	Heart modulation
	IAC_1_1	
	INJ_1_1	
	INJ_2	
	INJ_3	
	INJ_4	
	INJ_5_6	
	INJ_7	
	KS_1_1	
	MAF_1_1	
	MAF_1_2	
	MAF_5_3	
	MAP_1_1	
	MAP_1_2	
	MC_3	
	Mexican hat	Mexican Hat wavelet
	O2PROPA1	
	O2PROPA2	
	O2SNAP	
	STAR02_1	
	TPS_1_1	
	TPS_1_2	
	UNIT	Voice clips

3.4.4 Create and edit arbitrary waveform

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

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

3.5 Output Digital Protocol

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

3.5.1 SPI Protocol

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

Select SPI mode

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

Clock setting

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

Data format setting

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

Set data

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

Set send type

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

1) Auto send mode

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

2) Manual send mode

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

Set interval time

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

Comprehensive example

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

1) Turn on SPI mode

   Tap Utility → Digital → SPI accordingly.

2) Set data parameter

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

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

Tap blank input box to 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 decimalist 17, 19, 29,

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

1) Turn on IIC mode

   Tap Utility → Digital → IIC accordingly.

2) Set data parameter

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

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

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

3) Turn on output function

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

3.5.3 UART Protocol

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

Select UART mode

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

Set baud rate

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

Data format setting

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

Set data

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

Set send type

Please refer to section 3.5.1 Set send type

Select baud rate

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

Set bit

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

Set stop bit

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

Set verify mode

Tap Verify to step through None, Even, Odd.

Comprehensive example

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

1) Turn on IIC mode

   Tap Utility → Digital → UART accordingly.

2) Set data parameter

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

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

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

Data format and stop bit use the default option.

3) Turn on output function

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

Chapter 4 Troubleshooting

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

4.1 No Display on Screen（Blank Screen)

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

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

4.2 No Waveform Output

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

1) Inspect whether BNC cable and the output terminal is connected well.
2) Inspect button whether CH1、CH2、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.
4) If USB still fail to recognize, please contact with the dealer or local office for product maintenance service.

Chapter 5 Service and Support

5.1 Upgrade Product Program

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

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

5.2 Contact US

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

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

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

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

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

Website: http://www.uni-trend.com

Appendix A: Factory Setting

Parameter	Factory Default Setting
Channel Parameter	
Current carrier wave	Sine wave
Output load	High resistance
Channel merge	Off
Channel coupling	Off
Sync output	Off
Channel output	Off
Channel output inverse	Off
Amplitude limit	Off
Upper amplitude limit	+1V
Lower amplitude limit	-1V
Fundamental Wave	
Frequency	1kHz
Amplitude	100mVpp
DC offset	0mV
Initial phase	0°
Duty ratio of square wave	50%
Degree of symmetry of ramp wave	50%
Duty ratio of pulse wave	50%
Rising edge of pulse wave	1ns
Falling edge of pulse wave	1ns
Arbitrary Wave	
Built-in arbitrary wave	ACos
Play mode	DDS
AM 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	90°
Bitrate	100bps
QPSK Modulation	
Carrier wave	Sine wave
PN Code	PN3
Bitrate	100bps
Phase 1	0°
Phase 2	90°
Phase 3	180°
Phase 4	270°
OSK Modulation	
Modulation source	Internal
Oscillation time	2ms
OSK rate	100Hz
DSB-AM Modulation	
Modulation source	Internal
Modulation wave	Sine wave
Modulation frequency	100Hz
Modulation depth	100%
QAM Modulation	
Constellation	QAM4
Coding code	PN3
QAM rate	100bps
SUM Modulation	
Modulation source	Internal
Modulation wave	Sine wave
Modulation frequency	100Hz
Modulation depth	100%

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

Appendix B: Maintenance and Cleaning

General maintenance

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

Cleaning

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

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

This user manual may be revised without prior notice

Limited Warranty and Liability

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

Learn more at: www.uni-trend.com

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

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

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