



User's Manual

UTG1000X Series Function/Arbitrary Waveform Generator

Foreword

Dear Users,

Hello! Thank you for choosing this brand new UNI-T instrument. In order to use this instrument safely and correctly, please read this manual thoroughly, especially the Safety Requirements part.

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

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

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

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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.
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Caution	<i>"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.</i>
Note	<i>"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.</i>

Safety Sign

	Danger	<i>It indicates possible danger of electric shock, which may cause personal injury or death.</i>
	Warning	<i>It indicates that you should be careful to avoid personal injury or product damage.</i>
	Caution	<i>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.</i>
	Note	<i>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.</i>
	AC	<i>Alternating current of device. Please check the region's voltage range.</i>
	DC	<i>Direct current device. Please check the region's voltage range.</i>
	Grounding	<i>Frame and chassis grounding terminal.</i>
	Grounding	<i>Protective grounding terminal.</i>
	Grounding	<i>Measurement grounding terminal.</i>
	OFF	<i>Main power off.</i>
	ON	<i>Main power on.</i>
	Power Supply	<i>Standby power supply: when the power switch is turned off, this device is not completely disconnected from the AC power supply.</i>
CAT I	<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.</i>	
CAT II	<i>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</i>	

		10 meters away from CAT III circuit or sockets more than 20 meters away from CAT IV circuit.
CAT III		Primary circuit of large equipment directly connected to the distribution board and circuit between the distribution board and the socket (three-phase distributor circuit includes a single commercial lighting circuit). Fixed equipment, such as multi-phase motor and multi-phase fuse box; lighting equipment and lines inside large buildings; machine tools and power distribution boards at industrial sites (workshops).
CAT IV		Three-phase public power unit and outdoor power supply line equipment. Equipment designed to "initial connection", such as power distribution system of power station, power instrument, front-end overload protection, and any outdoor transmission line.
	Certification	CE indicates a registered trademark of EU.
	Certification	UKCA indicates a registered trademark of UK.
	Certification	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	This product complies with the marking requirements of WEEE Directive (2002/96/EC). This additional label indicates that this electrical / electronic product must not be discarded in household waste.
	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	<i>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.</i>
Instrument Grounding	<i>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.</i>
AC power supply	<i>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.</i>
Electrostatic prevention	<i>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.</i>
Measurement accessories	<i>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.</i>
Use the input / output port of this device properly	<i>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.</i>
Power fuse	<i>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.</i>
Disassembly and cleaning	<i>There are no components available to operators inside. Do not remove the protective cover. Maintenance must be carried out by qualified personnel.</i>
Service environment	<i>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.</i>
Do not operate in humid environment	<i>Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.</i>
Do not operate in flammable and explosive environment	<i>Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.</i>

Caution	
Abnormality	<i>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.</i>
Cooling	<i>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.</i>
Safe transportation	<i>Please transport this device safely to prevent it from sliding, which may damage the buttons, knobs or interfaces on the instrument panel.</i>
Proper ventilation	<i>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.</i>
Keep clean and dry	<i>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.</i>
Note	
Calibration	<i>The recommended calibration period is one year. Calibration should only be carried out by qualified personnel.</i>

1.4 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.

1.5 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 spectrum analyzer is equipped with a three-prong power cable that meets international safety standards. It provides good case grounding performance for the specification of your country or region.

Please install AC power cable as follow,

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

1.6 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.*

1.7 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. *Press the software switch  on the front panel, the instrument is boot-up.*

1.8 Remote Control

UTG1000X 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 UTG1000X Series Programming Manual at the official website [http:// www.uni-trend.com](http://www.uni-trend.com)

1.9 Help Information

UTG1000X series function/arbitrary waveform generator has built-in help system for each function key and menu control key. Long press any soft key or button to check help information.

Chapter 2 Introduction of UTG1000X Series

This product has DDS(direct digital frequency synthesis) function, it can generate high precision and stable waveform output with a resolution as low as 1 μ Hz. It is an economical, high performance, multifunction function/arbitrary waveform generator. It can generate high precision, stable, pure and low distortion signal. UTG1000X series has convenient operation, superior technical indicators and humanized graphics display. A multi-purpose equipment for the needs of learning, testing and improving work efficiency.

2.1 Main Features

- ▶ Frequency output of 40MHz/20MHz, 1 μ Hz resolution of full frequency band
- ▶ DDS function, it has 200MSa/s sampling rate and 16-bit vertical resolution
- ▶ Square wave with the maximum frequency 20MHz, low jitter
- ▶ Multiple analog and digital modulation function: AM, FM, PM, ASK, FSK, PSK and PWM
- ▶ Supporting sweep frequency and pulse string output
- ▶ Arbitrary wave can generate by the upper software computer
- ▶ Built-in power pre-amplifier, the maximum power output 4W (only for-PA model)
- ▶ 7 bit hard frequency meter
- ▶ Built-in 200 arbitrary waves
- ▶ Standard USB Host and USB Device
- ▶ 4.3 inch high resolution TFT LCD

2.2 Output Features

Channel	CH1,CH2
Amplitude Range	1mVpp~10Vpp (50 Ω)
Waveform	Sine wave, square wave, pulse wave, ramp wave, arbitrary wave, noise, DC
Modulation	AM, FM, PM, ASK, FSK, PSK, PWM
Sweep Frequency	Log, Line

2.3 Panel and Key

2.3.1 Front Panel

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



1. Display Screen

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

2. Function Key

Using Mode, Wave, Utility key to set the modulation, fundamental wave selection and auxiliary function.

3. Numerical Keyboard

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

4. Multifunction Knob / Arrow Key

Multifunction knob is used for changing number (rotate clockwise to increase number) or as the arrow key, press the knob to select the function or to confirm the setup parameter.

When using multifunction knob and arrow key to set the parameter, it is used to switch the digital bits or clear the previous bit or move (to left or right) cursor position.

5. CH1/CH2 Output Control Key

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

output signal of the output port. When **CH1** key or **CH2** key is disabled, the indicator light will be extinguished, the info bar will display "OFF" and turn off the output port.

6. Channel 2

Output interface of CH2.

7. Channel 1

Output interface of CH1.

8. External Digital Modulation or Frequency Meter Interface or Sync Input Interface

In ASK, FSK and PSK signal modulation, when the modulation source is selected externally, the modulation signal is input through the external digital modulation interface, and the corresponding output amplitude, frequency and phase are determined by the signal level of the external digital modulation interface. When the trigger source of the pulse string is selected to be external, a TTL pulse with specified polarity is received through the external digital modulation interface, which can start scanning or output the pulse string with specified number of cycles. When the pulse string mode is gated, the gating signal is input through the external digital modulation interface. When using the frequency meter function, the signal (compatible with TTL level) is input through this interface.

9. Menu Operating Soft Key

Select or view the contents of the labels (located at the bottom of the function screen) corresponding to the soft key labels, and set the parameters with the numeric keypad or multifunction knobs or arrow keys.

10. Power Supply Switch

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

11. USB Interface

This instrument supports FAT32 format USB with the maximum capacity of 32G. It can be used to read or import arbitrary waveform data files stored in USB through USB interface. Through this USB port, the system program can be upgraded to ensure that the function/arbitrary waveform generator is the latest released program version of the company.

Notes

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

The amplitude of the instrument is larger than 250 mVpp, input voltage is larger than $\pm 12.5V$, frequency is less than 10 kHz.

The amplitude of the instrument is less than 250 mVpp, input voltage is larger than $\pm 2.5V$, frequency is less than 10 kHz.

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

2.3.2 Rear Panel

As shown in the following figure,



1. Power Output (- PA models only)

Output interface of power.

2. USB Interface

The USB interface is used to connect to the host computer software to control the instrument (e.g., upgrade the system program to ensure that the current function/arbitrary waveform generator program is the latest version released by the company).

3. Safety Lock

Safety lock (sold separately) can be used for the instrument stay at fixed position.

4. AC Power Input Interface

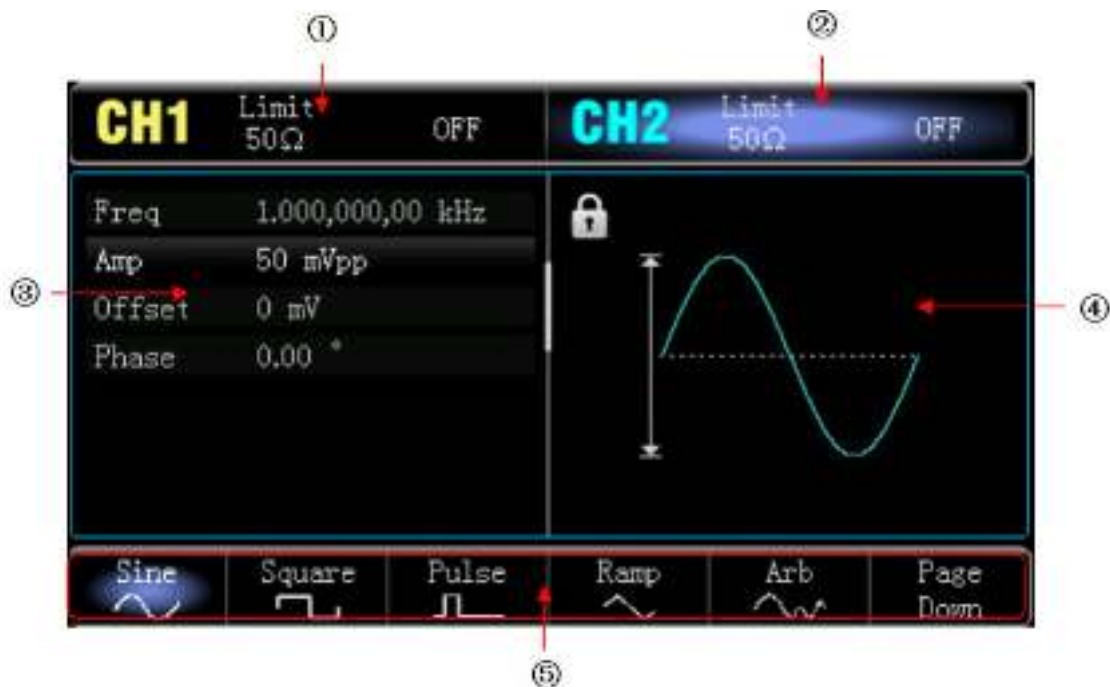
AC power specification of UTG1000X function/arbitrary waveform generator is 100-240VAC (fluctuant $\pm 10\%$), 50/60Hz; 100-120VAC (fluctuant $\pm 10\%$), 400Hz; Power fuse: 250V, T2A. If the waveform generators needs to output high SNR signal, it is recommended use the official standard power adaptor.

5. Grounding Connector

It provides an electrical ground connection point for attaching an antistatic wrist strap to reduce electrostatic damage (ESD) while you are handling or connecting the DUT

2.3.3 Function Interface

As shown in the following figure,



1. CH1 info, the currently selected channel will be highlighted.

"50Ω" indicates the impedance 50Ω to be matched at the output port (1Ω to 999Ω can be adjustable, or high impedance, the factory default is Highz.)

"" indicates the current mode is sine wave. (In different working modes, it may be "fundamental wave", "modulation", "linear", "logarithmic" or "OFF".)

2. CH2 info is the same as CH1.
3. Wave parameter list: Display the parameter of the current wave in a list format. If an item indicates pure white in the list, then it can be set by the menu soft key, numerical keyboard, arrow keys and multifunction knob. If the bottom color of the current character is the color of the current channel (it is white when the system is in setting), it means that this character enters the editing state and the parameters can be set with the arrow keys or numeric keyboard or multifunction knob.
4. Wave Display Area: Display the current wave of the channel (it can distinguish the current belongs to which channel by the color or CH1/CH2 info bar, the wave parameter will display in the list at the left side.)

Notes: There is no wave display area when the system is set up. This area is expanded into a list of parameters.

5. Soft Key Label: To identify the function menu soft key and the menu operation soft key.

Highlight: It indicates that the right center of the label displays the color of the current channel or the gray when

the system is in setting, and the font is pure white.

Chapter 2 Quick Start

3.1 Output Fundamental Wave

3.1.1 Output Frequency

The default waveform is a sine wave with frequency 1 kHz, amplitude 100 mV peak-to-peak (connect with 50Ω port).

The specific steps to change the frequency to 2.5 MHz,

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

3.1.2 Output Amplitude

The default waveform is a sine wave with amplitude 100 mV peak-to-peak (connect with 50Ω port).

The specific steps to change the amplitude to 300mVpp,

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

3.1.3 DC Offset Voltage

DC offset voltage of the waveform is 0V sine wave in default (connect with 50Ω port).

The specific steps to change DC offset voltage to -150mV,

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

Notes: Multifunction and arrow key can also be used to set the parameter.

3.1.4 Phase

The phase of the waveform is 0° in default.

The specific steps to set the phase to 90°,

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

3.1.5 Duty Cycle of Pulse wave

The default frequency of pulse wave is 1 kHz, duty cycle 50%.

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

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

3.1.6 Symmetry of Ramp Wave

The default frequency of ramp wave is 1 kHz, take triangular wave with the symmetry 75% as an example,

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

3.1.7 DC

The default DC is 0 V.

The specific steps to change DC to 3 V,

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

3.1.8 Noise Wave

The default amplitude is 100mVpp, DC offset is 0 V quasi Gaussian noise.

Take the setting of quasi Gaussian noise with amplitude 300mVpp, DC offset 1 V as an example,

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

3.1.9 Power Output

The full bandwidth of built-in power pre-amplifier can reach to 100 kHz, the maximum output power 4W, output slew rate is greater than 18V/μs.

press **CH2** → **PA Output** → **On**. Power output is enabled which means the power pre-amplifier output is activated, output interface is on the rear panel, BNC port.

3.2 Auxiliary Function

Utility can set the frequency meter, system, power for CH1 and CH2. The specific function as shown in the following table.

3.2.1 Channel Setting

Function Menu	Function Sub-menu	Setting	Description
CH1, CH2 setting	Channel output	OFF, ON	
	Channel reverse	OFF, ON	
	Sync output	CH1, CH2, OFF	
	On-load	50Ω, high impedance	1Ω to 999Ω
	Amplitude limit	OFF, ON	
	Upper limit of amplitude		To set the upper limit for amplitude output of the channel
	Lower limit of amplitude		To set the lower limit for

			amplitude output of the channel
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Select **Utility** → **CH1 Setting** (or CH2 Setting) to set the channel.

1. Channel Output

Select **Channel Output**, it can select "OFF" or "ON".

Notes: Press **CH1**, **CH2** key on the front panel to quick enable the channel output.

2. Channel Reverse

Select **Channel Reverse**, it can select "OFF" or "ON".

3. Sync Output

Select **Sync Output**, it can select "CH1", "CH2" or "OFF".

4. On-load

Select **Load**, input range is 1Ω to 999Ω, or it can select 50Ω, high impedance.

5. Amplitude Limit

It supports amplitude limit output to protect on-load. Select **Amp Limit**, it can select "OFF" or "ON".

6. Upper limit of Amplitude

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

7. Lower limit of Amplitude

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

3.2.2 Frequency Meter

This function/arbitrary waveform generator can measure the frequency and duty cycle of compatible TTL level signals. The range of measurement frequency is 100mHz ~ 200MHz. When use the frequency meter, the compatible TTL level signal is input via external digital modulation or frequency meter port (FSK /CNT/Sync connector).

Select **Utility** → **Frequency Meter** to read "frequency", "period" and "duty cycle" value of the signal in the parameter list. If there is no signal input, the parameter list of the frequency meter is always display the last measured value. The frequency meter will only refresh the display if a TTL level compatible signal is input via an external digital modulation or frequency meter port (FSK/CNT connector).

3.2.3 Arbitrary wave manager

Delete, export, and import arbitrary wave from the built-in and external storage devices.

Local arbitrary wave, View

Select the **Utility** → **Tool** → **ArbMnd** → **Local** → **OK** → **Other** → **OK**. All arbitrary waves in the Other list can be

browsed.

User's arbitrary wave, Delete

Select the **Utility** → **Tool** → **ArbMng** → **User** → **OK**, Other List to select arbitrary wave to delete, for example "ABA_1_2.bsv", Select **Delete**, the arbitrary wave is deleted.

User's arbitrary wave, Delete current page

Select the **Utility** → **Tool** → **ArbMng** → **User** → **OK**, Select **Delete Page**, the arbitrary wave of the current page is deleted.

User's arbitrary wave, Delete all

Select the **Utility** → **Tool** → **ArbMng** → **User** → **OK**, Select **Delete All**, the arbitrary wave in the current folder is deleted.

User's arbitrary wave, Export

Select the **Utility** → **Tool** → **ArbMng** → **User** → **OK**, Select the arbitrary waveform that needs to be exported in the "Other" list, such as "ALT_03.bsv", Select **Export**, the arbitrary wave is exported to an external storage device.

User's arbitrary wave, Export All

Select the **Utility** → **Tool** → **ArbMng** → **Internal** → **OK**, Select **Export ALL**, the arbitrary wave in the current folder is exported to the external storage device.

External arbitrary wave, Import

Select the **Utility** → **Tool** → **ArbMng** → **External** → **OK**, select an arbitrary wave directory, press rotary knob, open the arbitrary wave list, List to select arbitrary wave to import, for example "ABA_1_2.bsv", Select **Import**, the arbitrary wave is imported into this arbitrary wave manager in the user directory.

External arbitrary wave, Import current page

Select the **Utility** → **Tool** → **ArbMng** → **External** → **OK**, select an arbitrary wave directory, press rotary knob, open the arbitrary wave list, Select **Import Page**, the arbitrary wave of the current page is imported into this arbitrary wave manager in the user directory.

External arbitrary wave, Import All

Select the **Utility** → **Tool** → **ArbMng** → **External** → **OK**, select an arbitrary wave directory, press rotary knob, open the arbitrary wave list, Select **Import All**, the all arbitrary wave in the current folder is imported into this arbitrary wave manager in the user directory.

3.2.4 System

Function Menu	Function Sub-menu	Setting	Description
	Start Phase	Sync, Independent	
	Language	English, Chinese simplified, Deutsch	
	Beep	OFF/ON	
	Digital Separator	Comma, Space, none	
	Backlight	10%, 30%, 50%, 70%, 90%, 100%	
	Screen Saver	OFF, 1 minute, 5 minutes, 15 minutes, 30 minutes, 1 hour	
	Default Setting		Restore to the factory setting
	Help		Help description
	About		The information of model's name, version and company's website
	Upgrade		Connecting to the upper computer to upgrade.

Select **Utility** → **System** key to enter System setting.

Remarks: Due to the system selection menu **System**, there are two pages, you need to press **Next** key to turn page.

1. Start Phase

Select **PhaseSync** to "Independent" or "Sync".

Independent: The output phase of CH1 and CH2 output phase is not associated;

Sync: The output start phase of CH1 and CH2 is synchronized.

2. Language

Press **Language** to set the system language.

3. Beep

Set whether has beeper alarm when press the key, press **Beep** to select ON or OFF.

4. Digital Separator

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

5. Backlight

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

6. Screen Saver

Press **ScrnSvr** to select OFF, 1 minute, 5 minutes, 15 minutes, 30 minutes or 1 hour. When there is no arbitrary

operation, the instrument enters the screen saver state as the setting time. When **Mode** turns blinking, press arbitrary key to recover.

7. Default Setting

Restore to the factory setting.

8. Help

Built-in help system is provides help text for key or menu on the front menu. Help topic can also provide help text.

Long press any one of soft key or button to check help information, such as press **Wave** key to check. Press arbitrary key or rotary knob to exit the help.

9. About

Press **About** to check model's name, version info and company's website.

10. Upgrade

The instrument is supports connect to the computer to upgrade, the specific steps as follows,

- a. Connecting to the computer via USB;
- b. Press and hold **Utility** knob to turn on the power supply of signal source and then release the button;
- c. Use write tool to write the firmware to the signal source and then restart the instrument.

Chapter 4 Advanced Applications

This chapter is to introduce modulation of AM, PM, FM, ASK, FSK, PSK and PWM. Press **Mode** key to enter modulation mode and press it again to exit.

4.1 Modulation Wave Output

4.1.1 Amplitude Modulation (AM)

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

Select AM Modulation

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



Select Carrier Wave

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



Set Frequency for Carrier Wave

The frequency range of the carrier wave can be set differently. The default frequency of the carrier wave is 1 kHz. The frequency of each carrier wave can refer to the table as follows.

Carrier Wave	Frequency			
	UTG1042X		UTG1022X/-PA	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
Sine Wave	1 μ Hz	40 MHz	1 μ Hz	20 MHz
Square Wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Ramp Wave	1 μ Hz	1 MHz	1 μ Hz	400 kHz
Pulse wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Arbitrary Wave	1 μ Hz	10 MHz	1 μ Hz	5 MHz

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

Select Modulation Wave

The modulation source of this instrument comes from internal, it is sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When AM mode is enabled, the default modulation wave is sine wave. It can be change by multifunction rotary knob or press **ModWave** in AM mode.

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



Set Modulation Frequency

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

Set Modulation Depth

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

- ▶ If the modulation depth is 0%, it outputs a constant amplitude (a half of the carrier wave amplitude).
- ▶ If the modulation depth is 100%, the output amplitude will change with the modulation waveform.

- ▶ When the modulation depth is greater than 100%, the output amplitude of the instrument will not greater than 10 Vpp(on-load is 50 Ω .)
- ▶ It can be change by multifunction rotary knob or press soft key **ModDepth**, and then use numerical keyboard to input number and select unit soft key to complete the setting in AM mode.

Comprehensive Example

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

1) Enabling AM Mode

Press **Mode**→**Shape**→**AM** to turn on AM mode.



2) Set Parameter for Modulation Signal

Base on the step 1, press **ModFreq** soft key and use numerical keyboard to input 200 and then select the unit of parameter to **Hz**.



3) Set Wave and Parameter for Carrier Wave Signal

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



Press **Freq** key to set the frequency, use numerical keyboard to input 1 and then select the unit of parameter to **kHz**;

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

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

As shown in the following figure.



4) Set Modulation Depth

After the parameter setting of the carrier wave is completed, press **Mode** → **Shape** → **AM** to enter AM mode setting,

Press **ModDepth** soft key and use numerical keyboard to input 80 and then select the unit of parameter to **%**.

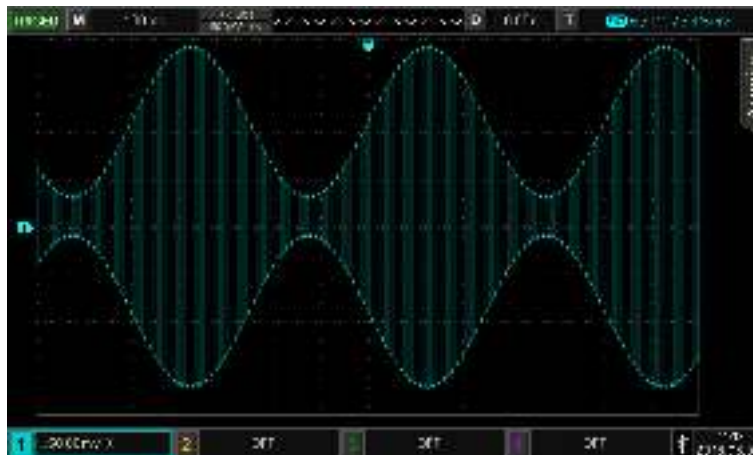


5) Enabling Channel Output

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



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



4.1.2 Frequency Modulation (FM)

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

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



Select Carrier Wave

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



Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Select Modulation Wave

The modulation source of this instrument comes from internal, it is sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When FM mode is enabled, the default modulation wave is sine wave. It can be change by multifunction rotary knob or press **ModWave** in AM mode.

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



Set Modulation Frequency

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

Set Frequency Deviation

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

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

Comprehensive Example

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

1) Enabling FM Mode

Press **Mode** $\rightarrow$ **Shape** $\rightarrow$ **FM** to turn on FM mode.



2) Set Parameter and Wave for Modulation Signal

Base on the step 1, press **ModWave** soft key to select square wave to be the modulation wave, press **ModFreq** soft key and use numerical keyboard to input 2 and then select the unit of parameter to **kHz**.



3) Set Wave and Parameter for Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select sine wave to be the carrier wave (the default is sine wave).



Press **Freq** soft key to set the frequency, use numerical keyboard to input 10 and then select the unit of

parameter to **kHz**;

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



4) Set Frequency Deviation

After the parameter setting of the carrier wave is completed, press **Mode** → **Shape** → **FM** to enter FM mode setting,

Press **FreqDev** soft key and use numerical keyboard to input 5 and then select the unit of parameter to **kHz**.

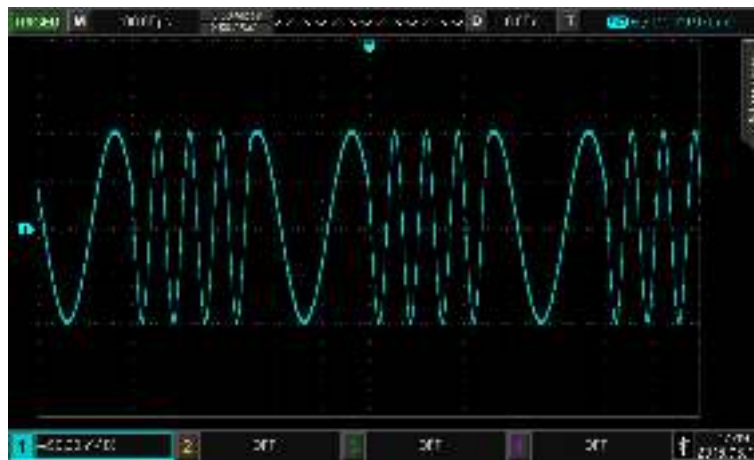


5) Enabling Channel Output

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



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



4.1.3 Phase Modulation (PM)

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

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



Select Carrier Wave

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



Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Select Modulation Wave

The modulation source of this instrument comes from internal, it is sine wave, square wave, rising ramp wave, falling ramp wave, arbitrary wave and noise wave. The default is sine wave. When PM mode is enabled, the default modulation wave is sine wave. It can be change by multifunction rotary knob or press **ModWave** in AM mode.

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



Set Modulation Frequency

The frequency range is 2 mHz~1 MHz(the default is 100 Hz). When PM mode is enabled, the default frequency of

the modulation wave is 100 Hz. It can be change by multifunction rotary knob or press soft key **ModFreq**, and then use numerical keyboard to input number and select unit soft key to complete the setting in PM mode.

Set Phase Deviation

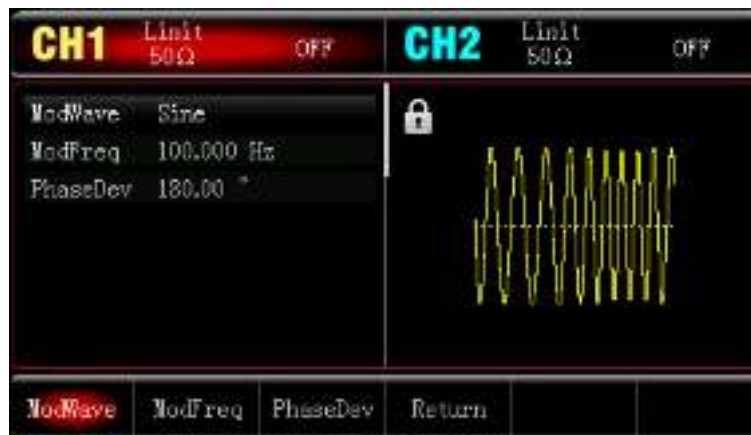
Phase deviation indicates the phase deviation of the wave that has been phase modulated which relative to the phase of carrier wave. PM deviation range can be set to 0° - 360° . The default phase deviation is 180° . It can be change by **PhaseDev** soft key and arrow keys in PM mode.

Comprehensive Example

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

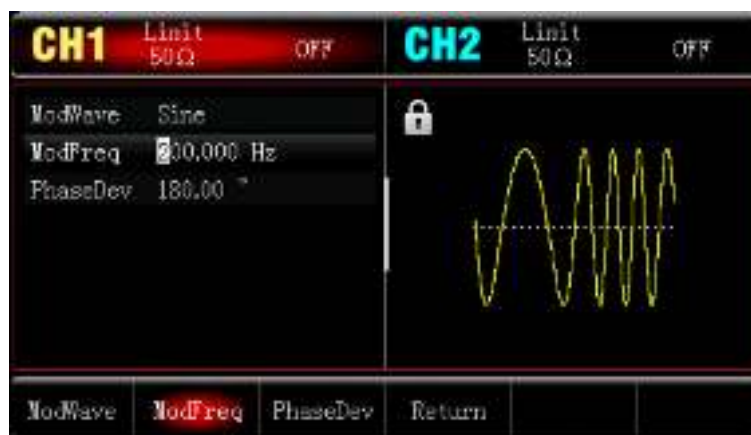
1) Enabling PM Mode

Press **Mode** → **Shape** → **PM** to turn on PM mode.



2) Set Parameter for Modulation Signal

Base on the step 1, press **ModWave** soft key and use numerical keyboard to input 200 and then select the unit of parameter to **Hz**.



3) Set Wave and Parameter for Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select sine wave to be the carrier wave (the default is

sine wave).



Press **Freq** soft key to set the frequency, use numerical keyboard to input 900 and then select the unit of parameter to **Hz**;

Press **Amp** soft key to set the amplitude, use numerical keyboard to input 100 and then select the unit of parameter to **mVpp**. As shown in the following figure.



4) Set Phase Deviation

After the parameter setting of the carrier wave is completed, press **Mode** → **Shape** → **PM** to enter PM mode setting,

Press **PhaseDev** soft key and use numerical keyboard to input 200 and then select the unit of parameter to **°**.

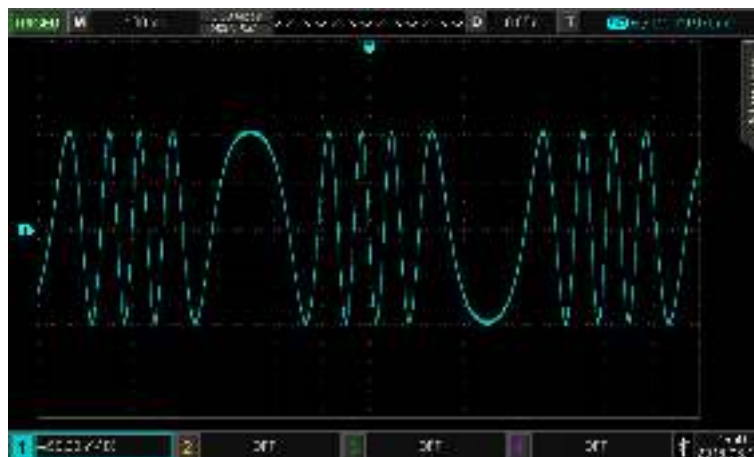


5) Enabling Channel Output

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



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



4.1.4 Amplitude Shift Keying (ASK)

ASK is a digital amplitude modulation, it expresses digital signals "0" and "1" by changing the amplitude of carrier signal. It according to the logical of modulation signal to output the carrier signals with different amplitude. The modulation mode of the two channels are independent. user can set the same or different modulation mode

for the two channels.

Select ASK

Press **Mode** → **Shape** → **ASK** to turn on ASK mode, the waveform generator will output the modulated waveform according to the currently ASK rate and the carrier wave.



Select Carrier Wave

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



Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Set Modulation Source

The modulation source of this instrument can be select internal or external. When ASK mode is enabled, the default modulation source is internal; It can be change by multifunction rotary knob or press **ModSrc** → **External** soft key.



1) Internal Source

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

2) External Source

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

Set ASK Rate

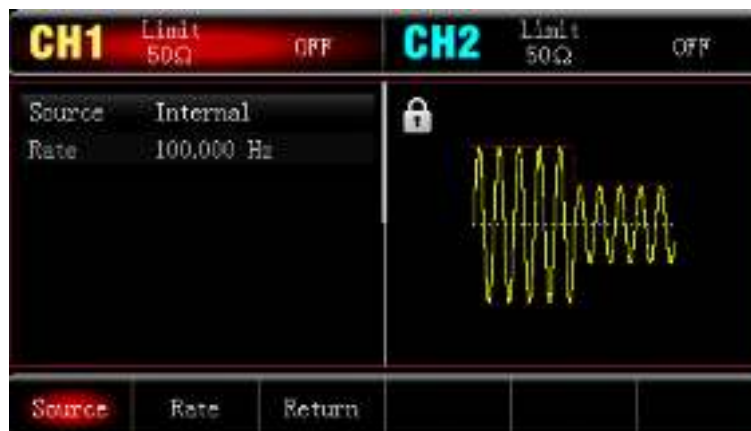
When ASK mode is enabled, it can set ASK rate (the range is 2 mHz~100 kHz). The default is 100 Hz. It can be change by multifunction rotary knob and arrow keys or press soft key **Rate**, and then use numerical keyboard to input number and select unit soft key to complete the setting.

Comprehensive Example

In ASK mode, set an internal 2 kHz, 1 Vpp sine wave as a carrier wave signal, make the frequency and amplitude of the carrier wave to switch at a frequency of 200Hz, the setting steps as follows.

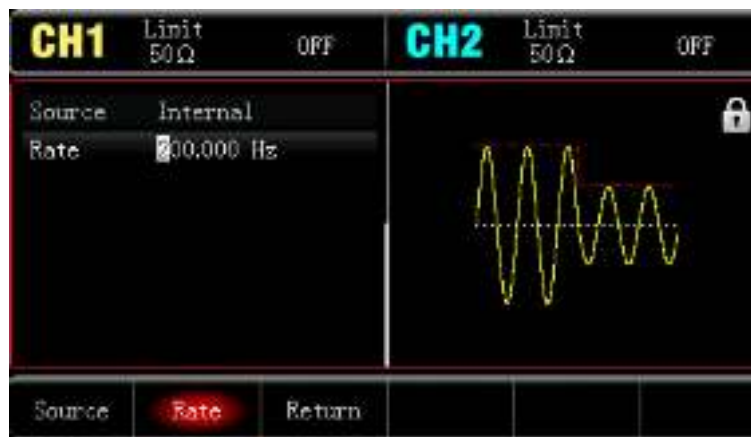
1) Enabling ASK mode

Press **Mode** → **Shape** → **ASK** to turn on ASK mode.



2) Set Modulation Rate

Press soft key **Rate** and use numerical keyboard to input 200 and then select the unit of the parameter to **Hz**.



3) Set Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select sine wave to be the carrier wave (the default is sine wave).



Press **Freq** soft key to set the frequency, use numerical keyboard to input 2 and then select the unit of parameter to **kHz**:

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



4) Enabling Channel Output

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



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

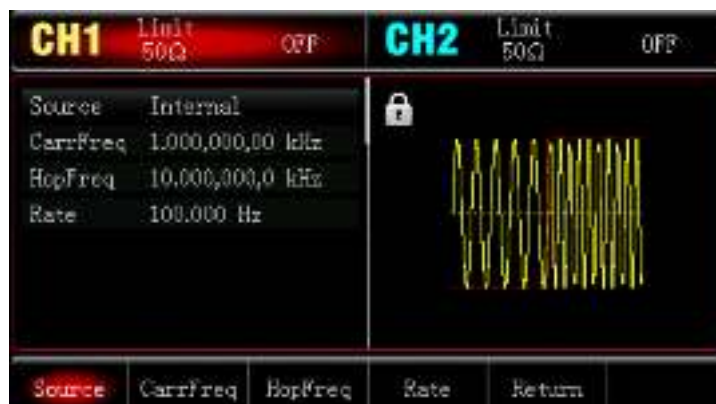


4.1.5 Frequency Shift Keying (FSK)

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

Select FSK

Press **Mode** → **Shape** → **FSK** to turn on FSK mode, the instrument will output the modulated waveform according to the currently setting.



Select Carrier Wave

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

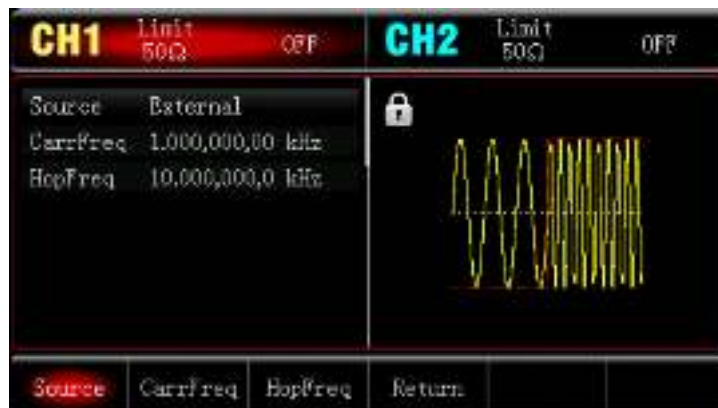


Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Set Modulation Source

The modulation source of this instrument can be select internal or external. When FSK mode is enabled, the default modulation source is internal; it can be change by multifunction rotary knob or press **ModSrc** → **External** soft key.



1) Internal Source

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

2) External Source

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

Set Hopping Frequency

When FSK mode is enabled, the default hopping frequency is 10 kHz. It can be change by multifunction rotary knob and arrow keys or press soft key **HopFreq**, and then use numerical keyboard to input number and select unit soft key to complete the setting. Hopping frequency range is depends on the carrier wave, the frequency setting of the carrier wave can refer to [Set Frequency for Carrier Wave](#) in AM mode.

Set FSK Rate

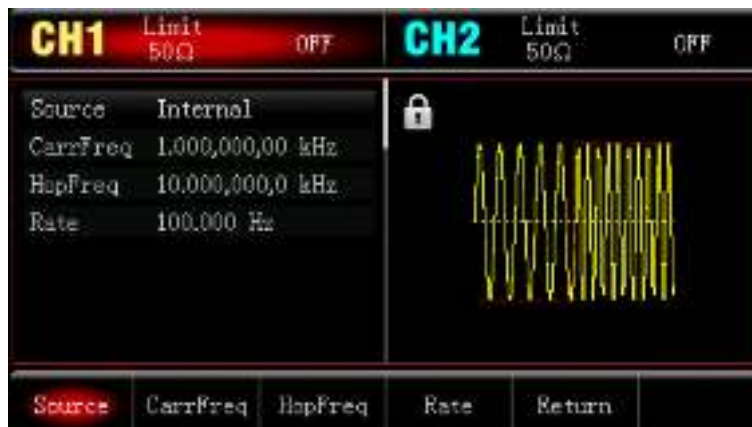
When the modulation source is internal, it can set the frequency of movement between the frequency of carrier wave and hopping frequency. When FSK mode is enabled, it can set FSK rate (the range is 2 mHz~100 kHz). The default is 100 Hz. It can be change by multifunction rotary knob and arrow keys or press soft key **Rate**, and then use numerical keyboard to input number and select unit soft key to complete the setting.

Comprehensive Example

In FSK mode, set an internal 2 kHz, 1Vpp sine wave as a carrier wave signal, set hopping frequency to 800 Hz and make the frequency of the carrier wave and hopping frequency to switch at a frequency of 200Hz, the setting steps as follows.

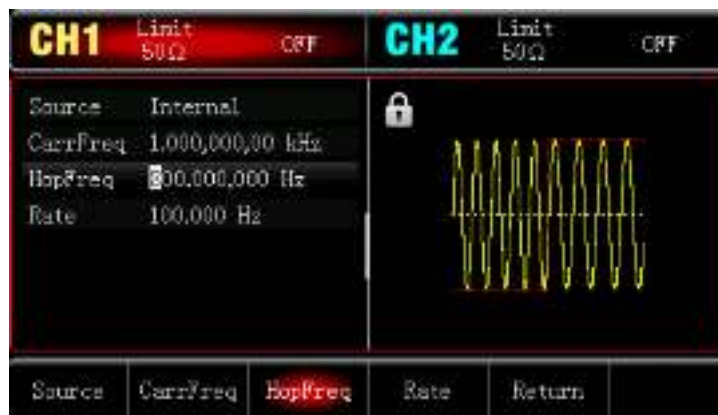
1) Enabling FSK mode

Press **Mode** → **Shape** → **FSK** to turn on FSK mode.



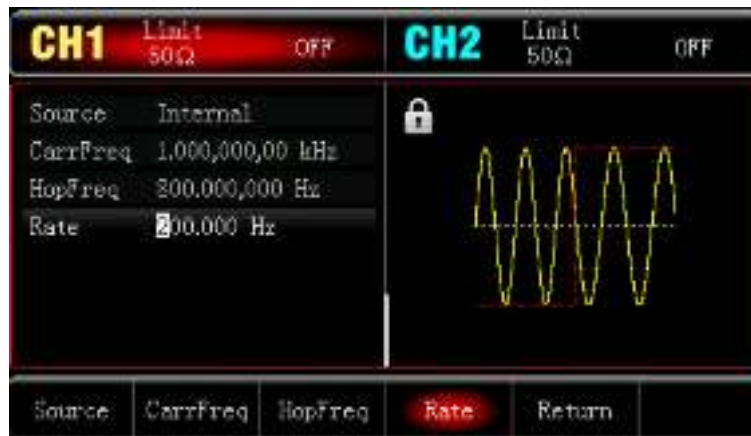
2) Set Hopping Frequency and Modulation Rate

Base on the Step 1, press **HopFreq** soft key and use numerical keyboard to input 800 and then select the unit of the parameter to **Hz**.



3) Set Modulation Rate

Press **Rate** soft key and use numerical keyboard to input 200 and then select the unit of the parameter to **Hz**.



4) Set Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select sine wave to be the carrier wave (the default is sine wave).



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

Press **Amp** soft key to set the amplitude, use numerical keyboard to input 1 and then select the unit of parameter

to V_{pp} .



5) Enabling Channel Output

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



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



4.1.6 Phase Shift Keying (PSK)

In PSK mode, it can make the function/arbitrary waveform generator move between in two preset phases (the phase of the carrier wave and modulation phase). According to the logical level of the modulation signal to output the carrier frequency or modulation phase. The modulation mode of the two channels are independent, user can

set the same or different modulation mode for the two channels.

Select PSK

Press **Mode** → **Shape** → **PSK** to turn on PSK mode, the instrument will output the modulated waveform according to the currently setting.



Select Carrier Wave

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



Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Set Modulation Source

The modulation source of this instrument can be select internal or external. When PSK mode is enabled, the default modulation source is internal; it can be change by multifunction rotary knob or press **ModSrc** → **External** soft key.



1) Internal Source

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

2) External Source

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

Set PSK Rate

When the modulation source is internal, it can set the frequency of movement between the phase of carrier wave and modulation phase. When PSK mode is enabled, it can set PSK rate (the range is 2 mHz~100 kHz). The default is 100 Hz. It can be changed by multifunction rotary knob and arrow keys or press soft key **Rate**, and then use numerical keyboard to input number and select unit soft key to complete the setting.

Set Modulation Phase

Modulation phase indicates the phase of the wave that has been PSK modulated which relative to the phase of carrier wave. PSK range can be set to 0° - 360°. The default is 180°. It can be changed by multifunction rotary knob and arrow keys or press **PhaseDev** soft key.

Comprehensive Example

In PSK mode, set an internal 2 kHz, 2 Vpp sine wave as a modulating signal, set the phase of the carrier wave and modulation phase moves at frequency of 1 kHz at last, the setting steps as follows.

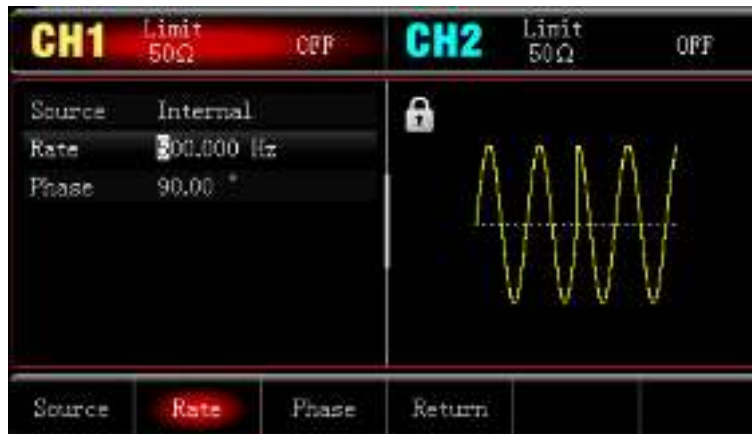
1) Enabling PSK Mode

Press **Mode** → **Shape** → **PSK** to turn on PSK mode.



2) Set Modulation Rate

Press soft key **Rate** and use numerical keyboard to input 500 and then select the unit of the parameter to **Hz**.



3) Set Phase

Press soft key **Phase** and use numerical keyboard to input 180 and then select the unit of the parameter to **°**.



4) Set Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select sine wave to be the carrier wave (the default is sine wave).



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

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

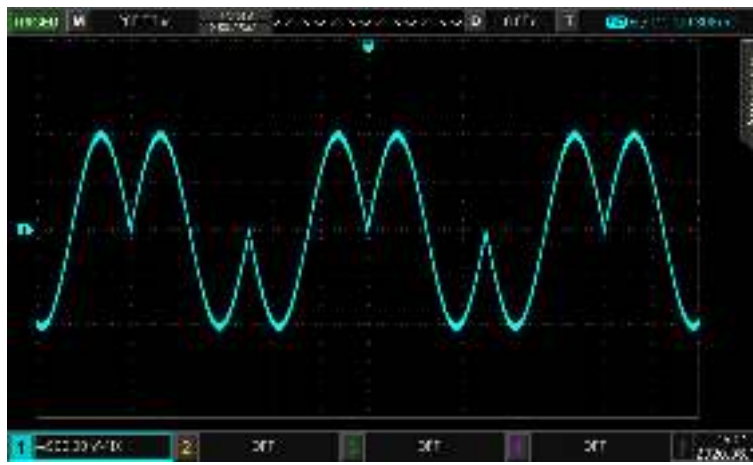


5) Enabling Channel Output

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



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



4.1.7 Pulse Width Modulation (PWM)

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

Select PWM

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



Select Carrier Wave

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



Set Frequency for Carrier Wave

Refer to [Set Frequency for Carrier Wave](#) in AM mode.

Set PWM Rate

When PWM mode is enabled, the frequency of modulation wave will show (the range is 2 mHz~1 mHz). The default is 100 Hz. It can be change by multifunction rotary knob and arrow keys or press soft key **Rate**, and then use numerical keyboard to input number and select unit soft key to complete the setting.

Set Duty Cycle

Duty cycle deviation indicates the deviation of the modulated wave from the currently duty cycle of the carrier wave. PWM duty cycle range can be set to 0% - 49.99%, the default is 20%. It can be change by multifunction rotary knob and arrow keys or press **DutyCycle** key.

Notes

- Duty cycle deviation indicates the change in duty cycle of the modulated wave relative to the original pulse waveform (expressed in %).
- Duty cycle deviation cannot great than the duty cycle of the currently pulse wave.
- The sum of duty cycle deviation and the duty cycle of the currently pulse wave must $\leq 99.99\%$.
- Duty cycle deviation is limited by the minimum duty cycle of pulse wave and the currently edge time.

Comprehensive Example

In PWM mode, set an internal 2 kHz, 1 Vpp pulse wave as a carrier wave signal, set the phase of the carrier wave and modulation phase to switch at a frequency of 1 kHz, the setting steps as follows.

1) Enabling PWM mode

Press **Mode** → **Shape** → **PWM** to turn on PWM mode.



2) Set Modulation Rate

Press **Rate** soft key and use numerical keyboard to input 200 and then select the unit of the parameter to **Hz**.



3) Set Duty Cycle

Press **DutyCycle** soft key and use numerical keyboard to input 50 and then select the unit of the parameter to **%**.



4) Set Carrier Wave Signal

Press **Wave** key to enter the carrier wave interface and select pulse wave to be the carrier wave (the default is

pulse wave).



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

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

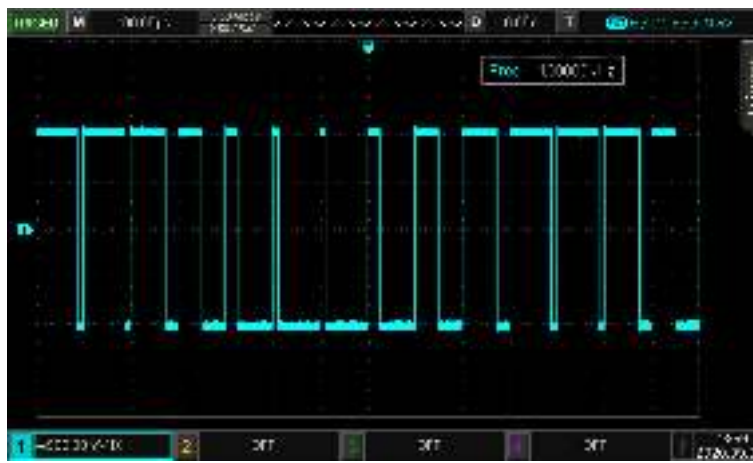


5) Enabling Channel Output

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



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



4.2 Output Frequency Sweep Wave

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

4.2.1 Select Frequency Sweep

1) Enabling Frequency Sweep Mode

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



2) Select Frequency Sweep Wave

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



4.2.2 Set Start and Stop Frequency

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

Press **Mode** **Sweep** **Linear** to enter sweep setting interface, use multifunction rotary knob and arrow key or press soft key **Start** or **Stop** and then use numerical keyboard to input number and select unit soft key to complete the setting.

Notes

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

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

Carrier Wave	Frequency			
	UTG1042X		UTG1022X/-PA	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
Sine Wave	1 μ Hz	40 MHz	1 μ Hz	20 MHz
Square Wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Ramp Wave	1 μ Hz	1 MHz	1 μ Hz	400 kHz
Pulse wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Arbitrary Wave	1 μ Hz	10 MHz	1 μ Hz	5 MHz

4.2.3 Frequency Sweep Mode

Press **Sweep** key to select linear or logarithmic;

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

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

4.2.4 Frequency Sweep Time

In frequency sweep mode, the frequency sweep time (the range is 1ms- 500s), the default is 1s. It can be change by press soft key **Time** and use numerical keyboard to input number and select unit soft key to complete the setting.

4.2.5 Comprehensive Example

In frequency sweep mode, set an internal square wave with amplitude 1Vpp, duty cycle 50% as the frequency sweep wave. Frequency sweep mode is set to linear, set the start frequency to 1kHz, stop frequency to 50 kHz, sweep time to 2ms, use internal source trigger to output the frequency sweep wave.

The setting steps as follows.

1) Enabling Linear Sweep Mode

Press **Mode** → **Sweep** → **Linear** to turn on linear sweep mode.



2) Select Frequency Sweep Wave

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



Press **Amp** soft key to set the amplitude, use numerical keyboard to input 1 and then select the unit of

parameter to **Vpp**;

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



3) Set Start/Stop Frequency, Sweep Time

Press **Mode** **Sweep** **Linear** to enter linear sweep.



Press **Start** or **Stop** soft key, use numerical keyboard to input 1 and then select the unit of parameter to **kHz**.

The default start frequency is 1 kHz.

Press **Stop** soft key, use numerical keyboard to input 50 and then select the unit of parameter to **kHz**.

Press **Time** soft key, use numerical keyboard to input 2 and then select the unit of parameter to **ms**.

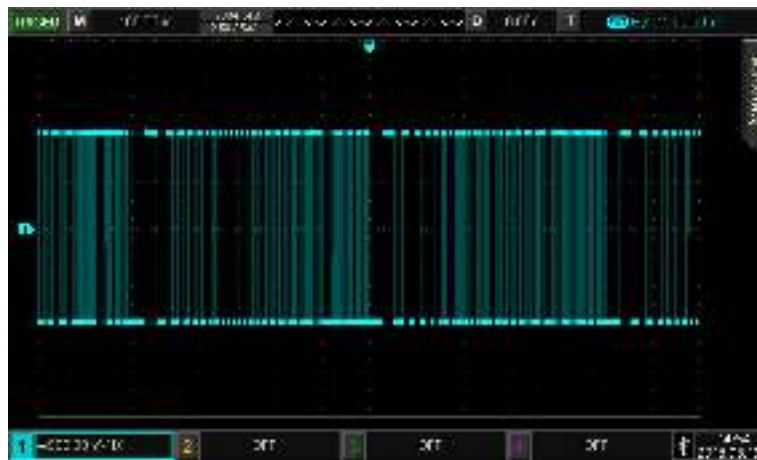


4) Enabling Channel Output

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



To view the shape of the linear sweep wave through an oscilloscope as shown in the following figure.



4.3 Output Pulse String

The waveform generator can create wave with specified cycle number (which is pulse string). UTG1000X supports internal and external trigger to control output the pulse string. Pulse string has three types N cycle, gating and infinite. Sine wave, square wave, ramp wave, pulse wave, arbitrary wave (except DC) or noise (only for gating pulse string) can all generate pulse string. The modulation mode of the two channels are independent, user can set the same or different modulation mode for the two channels.

4.3.1 Select Pulse String

1) Enabling Linear Sweep Mode

Press **Mode** **Burst** to turn on pulse string mode. After the pulse string mode is enabled, waveform generator will output the pulse string according to the currently setting.



2) Select Wave

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

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



3) Set Wave Frequency

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

Notes

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

Table 4-3

Carrier Wave	Frequency			
	UTG1042X		UTG1022X/-PA	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
Sine Wave	1 μ Hz	40 MHz	1 μ Hz	20 MHz
Square Wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Ramp Wave	1 μ Hz	1 MHz	1 μ Hz	400 kHz
Pulse wave	1 μ Hz	20 MHz	1 μ Hz	10 MHz
Arbitrary Wave	1 μ Hz	10 MHz	1 μ Hz	5 MHz

If the frequency of the wave need to be set, please select the wave at first, and then use multifunction rotary knob or press soft key **Freq** to set the frequency, use numerical keyboard to input number and select unit soft key to complete the setting.

4.3.2 Pulse String Type

UTG1000X can output three types of pulse train, N cycle, gating and infinite. The default type is N cycle.

1) N Cycle Mode

Press **NCycle** to enter 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 or external in this mode. It can be change by multifunction rotary knob and arrow keys or press soft key **TrigSrc** to complete the setting (as shown in the following figure).



2) Gating Mode

Press **Gate** to enter gating mode, the trigger source, trigger edge, burst and cycle number options in the parameter list will be automatically hidden. So it can only use the external trigger source, the waveform generator will be triggered by the external digital modulation terminal (FSK/CNT connector) on the back panel.

If the polarity is positive and trigger input signal is high level, the waveform generator will output a continuous

wave; if the trigger input signal is low, it need to complete the currently wave period at first and then stop it, while start phase of the selected wave should keep at the corresponding level. For noise wave, if gating signal turns to fake, the output will be stop immediately. The polarity can be select by multifunction rotary knob and arrow keys or press soft key **Polarity** to complete the setting (as shown in the following figure).



3) Infinite Mode

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



4.3.3 Start Phase of Pulse String

Pulse string phase is phase of the start point for pulse string, it can be set to $0^\circ \sim +360^\circ$. The default start phase is 0° . It can be change by multifunction rotary knob and arrow keys or press soft key **StartPhase** to complete the setting.

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

- Start phase has no effect on the noise wave.

4.3.4 Period of Pulse String



Burst (period of pulse string) is only for N cycle mode, which means the time from one pulse string to the next pulse string. When trigger source is external, burst (period of pulse string) option in parameter list will be hidden. The range of burst (period of pulse string) can be set to $1\mu\text{s}$ ~500s; the default range is 1.001ms. After the type is select N cycle, it can be change by multifunction rotary knob and arrow keys or press soft key **Burst** to complete the setting.

Notes

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

4.3.5 Cycle number of Pulse String

In N cycle mode, pulse string counting is used to specify the number of waveform cycle. The range can be set to 1~50000. The default is 1. After the type is select N cycle, it can be change by multifunction rotary knob and arrow keys or press soft key **Cycle** to complete the setting.

Notes

- Cycle number $<$ Trigger period $\times$ Wave frequency
- If cycle number exceeds the above limits, the waveform generator increase the pulse string period to adapt the designated pulse string count automatically (but the wave frequency won't be change).

4.3.6 Trigger Source

The waveform generator will generate a pulse string output when receive a trigger signal and wait next trigger source. The trigger source of pulse string can be internal and external. It can be change by multifunction rotary

knob and arrow keys or press soft key **TrigSrc** to complete the setting in pulse string type interface.

- 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/CNT connector) on the back panel when in external source. The waveform generator can output pulse string upon receiving a TTL pulse with designated polarity. The waveform can output the pulse string of N cycle and infinite type.

4.3.7 Trigger Edge

The external digital modulation terminal (FSK/CNT connector) can be designated edge as input or output. The rising edge and falling edge can be set, "rising edge" means that rising edge of external signal triggers output a pulse string; "falling edge" means that falling edge of external signal triggers output a pulse string.

In gating mode, when polarity is positive in parameter list, 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. The default is rising edge. It can be change by multifunction rotary knob and arrow keys or press soft key **TrigEdg** → **TailEdge** (press soft key **Polarity** → **Negative** in gating mode) to complete the setting in pulse string type interface.

4.3.8 Comprehensive Example

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

1) Enabling Burst Mode

Press **Mode** → **Burst** → **NCycle** to set burst mode to "N cycle" mode.



2) Select Pulse String Wave

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



The amplitude setting can be set by multifunction rotary knob and arrow keys. (Remarks: If the setting interface displays **Freq**, this means it can only change the frequency parameter, it can't convert to period. If it displays **Period**, then 2ms period is corresponding to 500 Hz and their reciprocal relationship is $T=1/f$). Press **Freq** → **Freq** (the second time press **Freq** soft key is used to the conversion of frequency and period in parameter list), the interface as shown in the following figure.



Press the corresponding soft key to set a parameter, to input numerical value and then select the unit.



3) Set Period and Wave Cycle of Pulse String

After pulse string wave and the relevant parameter is selected, press **Mode** → **Burst** → **NCycle** to return to the interface as follows,



Press the corresponding soft key to set a parameter, to input numerical value and then select the unit.



4) Enabling Channel Output

Press **[CH1]** key on the front panel to quickly turn on CH1 output, or press **[Utility]** key to pop out the label and then press soft key **[CH1]** to turn on channel output. When channel output is enabled, **[CH1]** key is illuminated and the gray OFF character turns to yellow "N Cycle" in **[CH1]** label backlight that means the CH1 output is turned on.



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



4.4 Output Arbitrary Wave

The instrument has 200 kinds of arbitrary waves, wave name refer to built-in arbitrary wave list.

4.4.1 Arbitrary Wave

Press **Mode** → **Arbitrary** to turn on arbitrary wave function, the instrument will output the arbitrary waveform according to the current setting.



4.4.2 Select Arbitrary Wave

User can select the built-in arbitrary wave. When the arbitrary wave function is enabled, use multifunction rotary knob and arrow keys or press soft key **WaveFile** to select the arbitrary wave.

Built-in Arbitrary Wave List: [See Appendix B](#)

Chapter 5 Troubleshooting

Possible faults in use of UT1000X and troubleshooting methods are listed below. Please handle fault as the corresponding steps. If it cannot be handled, please contact with the distributor or local office and provide the model information (press **Utility** → **System** → **About** to check).

5.1 No Display on Screen(Blank Screen)

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

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

5.2 No Waveform Output

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 whether **CH1**, **CH2** button is turned on.
- 3) If the instrument still can't work, please contact with the distributor or local office for product maintenance service.

Chapter 6 Service and support

6.1 Maintenance and Cleaning

(1) General Maintenance

Keep the instrument away from the direct sunlight.

Caution

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

(2) Cleaning

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

- a. Please use a soft cloth to wipe the dust outside the instrument.
- b. When cleaning the LCD screen, please pay attention and protect the transparent LCD screen.

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

Warning

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

6.2 Warranty

UNI-T (UNI-TREND TECHNOLOGY (CHINA) CO., LTD.) ensures the production and sale of products, from authorized dealer's delivery date of one year, without any defects in materials and workmanship. If the product is proven to be defective within this period, UNI-T will repair or replace the product in accordance with the detailed provisions of the warranty.

To arrange for repair or acquire warranty form, please contact the nearest UNI-T sales and repair department.

In addition to permit provided by this summary or other applicable insurance guarantee, UNI-T does not provide any other explicit or implied guarantee, including but not limited to the product trading and special purpose for any implied warranties.

In any case, UNI-T does not bear any responsibility for indirect, special, or consequential loss.

6.3 Contact Us

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

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

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

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

To obtain the address list of our service centers, please visit our website at URL: <http://www.uni-trend.com>

Appendix A Factory Setting

Parameter	Factory Default Setting
Channel Parameter	
Current Carrier Wave	Sine wave
Output On-load	High
Sync Output	OFF
Channel Output	OFF
Channel Output Reverse	OFF
Amplitude Limit	OFF
Upper Limit of Amplitude	+10 V
Lower Limit of Amplitude	-10 V
Fundamental Wave	
Frequency	1 kHz
Amplitude	100 mVpp
DC Deviation	0 mV
Start Phase	0°
Duty Cycle of Square Wave	50%
Symmetry of Ramp Wave	50%
Duty Cycle of Pulse wave	50%
Rising edge of Pulse wave	15ns
Falling edge of Pulse wave	15ns
Arbitrary Wave	
Built-in Arbitrary Wave	AbsSine
AM	
Modulation Wave	Sine wave
Modulation Frequency	100 Hz
Modulation Depth	100%
FM	
Modulation Wave	Sine wave
Modulation Frequency	100 Hz

Frequency Deviation	1 kHz
PM	
Modulation Wave	Sine wave
Modulation Frequency	100 Hz
Phase Deviation	180°
ASK	
ASK Rate	100 Hz
FSK	
Modulation Source	Internal
FSK Rate	100 Hz
Hopping Frequency	10 kHz
PSK	
Modulation Source	Internal
PSK Rate	100 Hz
Phase	180°
PWM	
Modulation Wave	Sine wave
PWM Rate	100 Hz
Duty Cycle	20%
Frequency Sweep	
Frequency Sweep Type	Linear
Start Frequency	1 kHz
Stop Frequency	20 kHz
Sweep Time	100 ms
Pulse String	
Trigger Source	Internal
Start Phase	0°
Polarity	Positive

Burst	1.0001ms
Cycle Number	1
System Parameter	
Beep	ON
Digital Separator	,
Backlight	90%
Language	It depends on the factory setting.

Appendix B Built-in arbitrary wave list

Type	Name	Description
Common (15 types)	AbsSine	Sine absolute value
	AbsSineHalf	Absolute value of half sine
	AmpALT	Amplify sine
	AttALT	Attenuated sine
	Gaussian_monopulse	Gaussian monopulse
	GaussPulse	Gaussian pulse
	NegRamp	Descent slope
	NPulse	N-Pulse signal
	PPulse	P-Pulse signal
	SineTra	Tra sine signa
	SineVer	Ver sine signal
	StairUD	Ladder ladder
	StairDn	Stair down
	StairUp	Stair up
	Trapezia	Trapezoid
Engine (25 types)	BandLimited	Band-limited signal
	BlaseiWave	Vibration of blasting "Time-vibration velocity" curve
	Butterworth	Butterworth filter
	Chebyshev1	Type I Chebyshev filter
	Chebyshev2	Type II Chebyshev filter
	Combin	Compound function
	CPulse	C-Pulse signal
	CWPulse	CW pulse signal
	DampedOsc	Damped vibrarion "Time-displacement" curve

	DualTone	Dual tone signal
	Gamma	Gamma signal
	GateVibar	Gate self-excited oscillation signal
	LFMPulse	Linear frequency modulation pulse signal
	MCNoise	Construction machinery noise
	Discharge	Discharge curve of Ni-MH battery
	Pahcur	Current waveform of brushless DC motor
	Quake	Earthquake waveform
	Radar	Radar signal
	Ripple	Power ripple
	RoundHalf	Hemispheric waveform
	RoundsPM	RoundsPM waveform
	StepResp	Step response signal
	SwingOsc	Swing oscillation function-time curve
	TV	Television signal
	Voice	Voice signal
Maths (27 types)	Airy	Airy function
	Besselj	Class-I Bessel function
	Besselk	Besselk function
	Bessely	Class-II Bessel function
	Cauchy	Cauchy distribution
	Cubic	Cubics function
	Dirichlet	Dirichlet function
	Erf	Error function
	Erfc	Complementary error function
	ErfcInv	Inverse complementary error function
	ErfInv	Inverse error function
	ExpFall	Exponential falling function
	ExpRise	Exponential rising function
	GammaIn	Natural logarithm of Gamma function
	Gauss	Gaussian distribution (Normal distribution)
	HaverSine	Haversed sine
	Laguerre	Quartic Laguerre polynomial
	Laplace	The Laplace distribution
	Legend	Quintic Legendre Polynomials
	Log	Denary logarithm function
	LogNormal	Logarithmic normal distribution
	Lorentz	Lorentzian function
	Maxwell	Maxwell's distribution
	Rayleigh	Rayleigh distribution
	Versiera	Versiera
	Weibull	Weibull distribution
	ARB_X2	Square function
SectMod	AM	Sine wave amplitude modulation
	FM	Sine wave frequency modulation

(5 types)	PFM	Pulse frequency modulation
	PM	Sine wave phase modulation
	PWM	Pulse width modulation
Bioelect (6 types)	Cardiac	Electrocardio signal
	EOG	Electro-oculogram
	EEG	Electroencephalogram
	EMG	Electromyography
	Pulseilogram	Sphygmograph of common people
	ResSpeed	Expiration speed curve of common people
Medical (4 types)	LFPulse	Low frequency pulse electrotherapy waveform
	Tens1	Transcutaneous electric nerve stimulation waveform 1
	Tens2	Transcutaneous electric nerve stimulation waveform 2
	Tens3	Transcutaneous electric nerve stimulation waveform 3
Standard (17 types)	Ignition	Ignition waveform of automobile internal-combustion engine
	ISO16750-2 SP	Profile map of automobile starting oscillation
	ISO16750-2 Starting1	Automobile starting voltage waveform 1
	ISO16750-2 Starting2	Automobile starting voltage waveform 2
	ISO16750-2 Starting3	Automobile starting voltage waveform 3
	ISO16750-2 Starting4	Automobile starting voltage waveform 4
	ISO16750-2 VR	Profile map of the reset working voltage
	ISO7637-2 TP1	Transient phenomena of automobile caused by power cut
	ISO7637-2 TP2A	Transient phenomena of automobile caused by inductance in wiring
	ISO7637-2 TP2B	Transient phenomena of automobile caused by turning off start-up changer
	ISO7637-2 TP3A	Transient phenomena of automobile caused by conversion
	ISO7637-2 TP3B	Transient phenomena of automobile caused by conversion
	ISO7637-2 TP4	Working profile map of automobile in start-up
	ISO7637-2 TP5A	Transient phenomena of automobile caused by power cut of battery
	ISO7637-2 TP5B	Transient phenomena of automobile caused by power cut of battery
	SCR	SCR sintering temperature distribution
	Surge	Surge signal
	CosH	Hyperbolic cosine

Trigonome (21 types)	CosInt	Cosine integral
	Cot	Cotangent function
	CotHCon	Concave hyperbolic cotangent
	CotHPro	Convex hyperbolic cotangent
	CscCon	Concave cosine
	CscPro	Convex cosine
	CotH	Hyperbolic cotangent
	CscHCon	Concave hyperbolic cosecant
	CscHPro	Convex hyperbolic cosecant
	RecipCon	Reciprocal of the depression
	RecipPro	Reciprocal of the projection
	SecCon	The secant of the depression
	SecPro	The secant of the projection
	SecH	Hyperbolic secant
	Sinc	Sinc function
	SinH	Hyperbolic sine
	SinInt	Sine integral
	Sqrt	Square root function
	Tan	Tangent function
	TanH	Hyperbolic tangent
AntiTrigonome (16 types)	ACosH	Arc- hyperbolic cosine function
	ACotCon	Arc- hyperbolic cosine function
	ACotPro	Convex arc cotangent function
	ACotHCon	Concave arc- hyperbolic cosine function
	ACotHPro	Convex arc- hyperbolic cosine function
	ACscCon	Concave arc cosecant function
	ACscPro	Convex arc cosecant function
	ACscHCon	Concave arc hyperbolic cosecant function
	ACscHPro	Convex arc hyperbolic cosecant function
	ASecCon	Concave arc secant function
	ASecPro	Convex arc secant function
	ASecH	Arc hyperbolic secant function
	ASin	Arcsin function
	ASinH	Arc hyperbolic sine function
	ATan	Arctan function
	ATanH	Arc hyperbolic tangent function
Noise (6 types)	NoiseBlue	Blue noise
	NoiseBrown	Brown noise(red noise)
	NoiseGray	Gray noise
	NoisePink	Pink noise
	NoisePurple	Purple noise
	Noisewhite	White noise
Window (17 types)	Bartlett	Bartlett window
	BarthannWin	Amended Bartlett window
	Blackman	Blackman window

	<i>BlackmanH</i>	<i>BlackmanH window</i>
	<i>BohmanWin</i>	<i>Bohman window</i>
	<i>Boxcar</i>	<i>Rectangle window</i>
	<i>ChebWin</i>	<i>Chebyshev window</i>
	<i>GaussWin</i>	<i>Gaussian window</i>
	<i>FlatTopWin</i>	<i>Flat-top window</i>
	<i>Hamming</i>	<i>Hamming window</i>
	<i>Hanning</i>	<i>Hanning window</i>
	<i>Kaiser</i>	<i>Kaiser window</i>
	<i>NuttallWin</i>	<i>The minimum of four Blackman Harris window</i>
	<i>ParzenWin</i>	<i>Parzen window</i>
	<i>TaylorWin</i>	<i>Taylor window</i>
	<i>Triang</i>	<i>Quarter window(Fejer window)</i>
	<i>TukeyWin</i>	<i>Tukey window</i>
<i>Complex Wavelets (7 types)</i>	<i>Complex Frequency B-spline</i>	<i>Complex Frequency B-spline function</i>
	<i>Complex Gaussian</i>	<i>Complex Gaussian function</i>
	<i>Complex Morlet</i>	<i>Complex Morlet wavelet</i>
	<i>Complex Shannon</i>	<i>Complex Shannon function</i>
	<i>Mexican hat</i>	<i>Mexican hat wavelet</i>
	<i>Meyer</i>	<i>Meyer wavelet</i>
	<i>Morlet</i>	<i>Morlet wavelet</i>
<i>Other (34 types)</i>	<i>ABA_1_1</i>	
	<i>ABA_1_2</i>	
	<i>ALT_03</i>	
	<i>ALT_04</i>	
	<i>ALT_05</i>	
	<i>AUDIO</i>	
	<i>COIL_2_1</i>	
	<i>COIL_2_2</i>	
	<i>DC_04</i>	
	<i>ECT_1_2</i>	
	<i>EGR_2</i>	
	<i>EGR_3_2</i>	
	<i>EST_03_2</i>	
	<i>IAC_1_1</i>	
	<i>INJ_1_1</i>	
	<i>INJ_2</i>	
	<i>INJ_3</i>	
	<i>INJ_4</i>	
	<i>INJ_5_6</i>	
	<i>INJ_7</i>	
	<i>KS_1_1</i>	
	<i>MAF_1_1</i>	
	<i>MAF_1_2</i>	

	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	