USER'S MANUAL

Arbitrary Waveform Generator

HDG 2000

V1.0.1

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General Safety Summary

Read the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To evade potential hazards, use this product only as specified.

Only qualified personnel should perform maintenance.

Avoid fire or personal injury.

Use suitable power cord. Use only the power cord specified for this product and certified for the country of use.

Ground the product. This product is provided with protective earth terminals. To minimize shock hazard, the instrument must be connected to the AC power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Check all terminal ratings. To avoid fire or shock hazard, check all ratings and markings on the product. Refer to the product manual for detailed information about ratings before making connections to the product.

Do not operate without covers. Do not operate this product with covers or panels removed.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Assure good ventilation.

Do not operate in wet/damp environments.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Chapter 1 Quick Start

◆Introduction to Instrument

◆Front-Panel Introduction

◆Rear-Panel Introduction

◆Prepare Instrument for Use

1.1 Introduction to Instrument

The Hantek HDG2000 Series is a series of synthesized waveform generators with built-in arbitrary waveform and pulse capabilities.

Features:

- 16 bits resolution, 250MSa/s Sample rate
- 64 Mpts Max. arbitrary waveform Memory Depth
- 2 Channels output
- 100 MHz, 80 MHz, 70 MHz, 60 MHz, 50MHz, 30 MHz, 20MHz, 10MHz or 5MHz maximum sine output frequency
- 7 inch, 16K true color TFT display, WVGA(800X480)
- 16 channels digital output(HDG2000B), together with the analog channel can rebuild the more mixed signals in daily practice
- TCXO timebase standard, OCXO optional for ultra-high stability
- Plenty of interfaces: USB Host, USB Device. LAN optional
- Support AM, FM, PM, ASK, FSK, PSK, BPSK and PWM modulations
- LXI Class C Compliant
- SCPI (Standard Commands for Programmable Instruments) compatibility
- Online Help
- SD card

Models

This section describes the models about the HDG2000 Series of instruments.

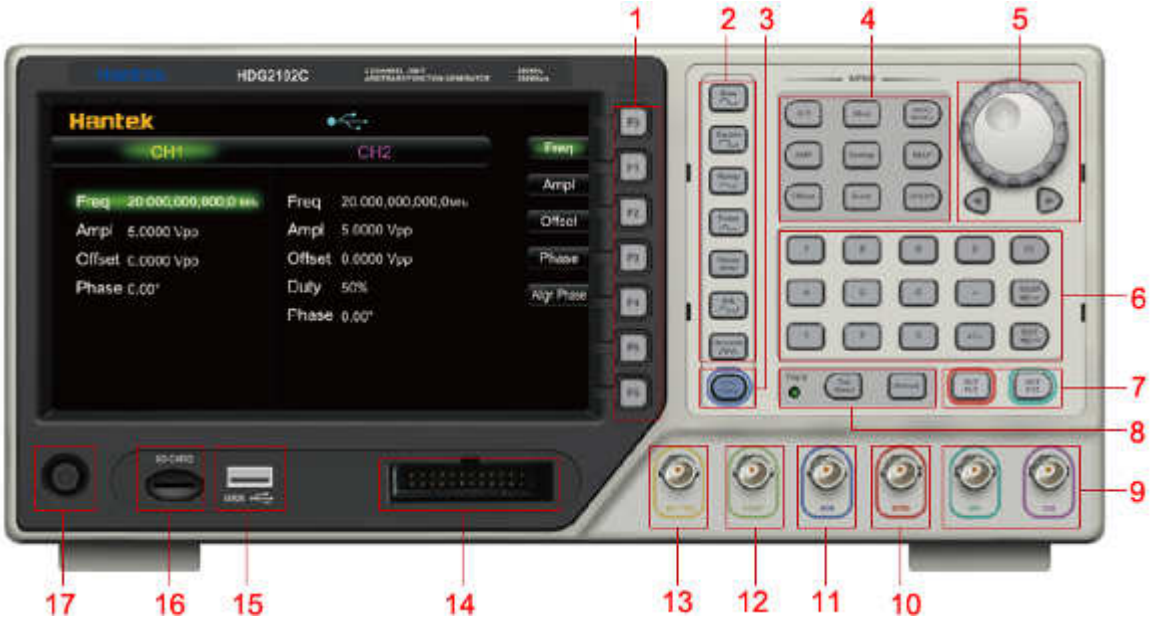
Instrument Models

Model	Description
HDG2002B	5MHz 16bits resolution Arbitrary waveforms 64M Memory Depth
HDG2012B	10MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth
HDG2022B	20MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth
HDG2032B	30MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth
HDG2062B	60MHz 16 bits resolution Arbitrary waveforms

	64M Memory Depth
HDG2082B	80MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth
HDG2102B	100MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth
HDG2032C	30MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth 2GB SD card
HDG2052C	50MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth 2GB SD card
HDG2072C	70MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth 2GB SD card
HDG2102C	100MHz 16 bits resolution Arbitrary waveforms 64M Memory Depth 2GB SD card

1.2 Front Panel

Front Panel can be divided into "F0 to F6 softkeys menu area", "digital keypad area", "Function keypad area", "Hot keypad area", "Mode keypad area", "Trigger keypad area", "Waveform Output area", "knob and cursor arrows keypad area", and “interface of the signal and peripheral devices area”. You can press keys and buttons on the front panel to input or output signals.



1. Menu softkeys F0-F6
2. Function waveform button
3. Channel 1 and Channel 2 Switch Button
4. Function menu
5. Knob and cursor arrows
6. Numeric Keypad
7. Channel 1 and Channel 2 output buttons
8. Trigger button
9. Channel 1 and Channel 2 output Connector
10. Sync Connector
11. Modulation signal Input Connector
12. High frequency Connector(HDG2000C: 24MHz to 2.7GHz)
13. Low frequency (24MHz or lower)/External trigger Connector
14. Digital channel(HDG2000B)
15. USB port
16. SD card port
17. On/Off Switch

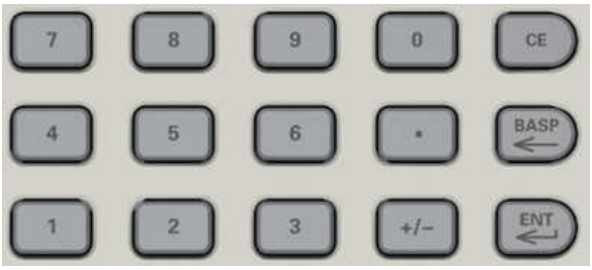
Note: Press and hold any front-panel key or softkey to get context-sensitive help.

Front-Panel Number Entry

◆ You can enter numbers from the front panel in two ways:

Use the knob and cursor keys to modify the number. Rotate the knob to change a digit (clockwise increases). The arrows below the knob move the cursor.

◆ Use the keypad to enter numbers and the softkeys to select units. The **+/-** key changes the number's sign.



CE: Delete Key

BASP: Backspace, backspace and remove the last digit

ENT: Enter Key

Warning: For protection from electrical shock, the power cord ground must not be defeated. If only a two-contact electrical outlet is available, connect the instrument's chassis ground screw to a good earth ground.

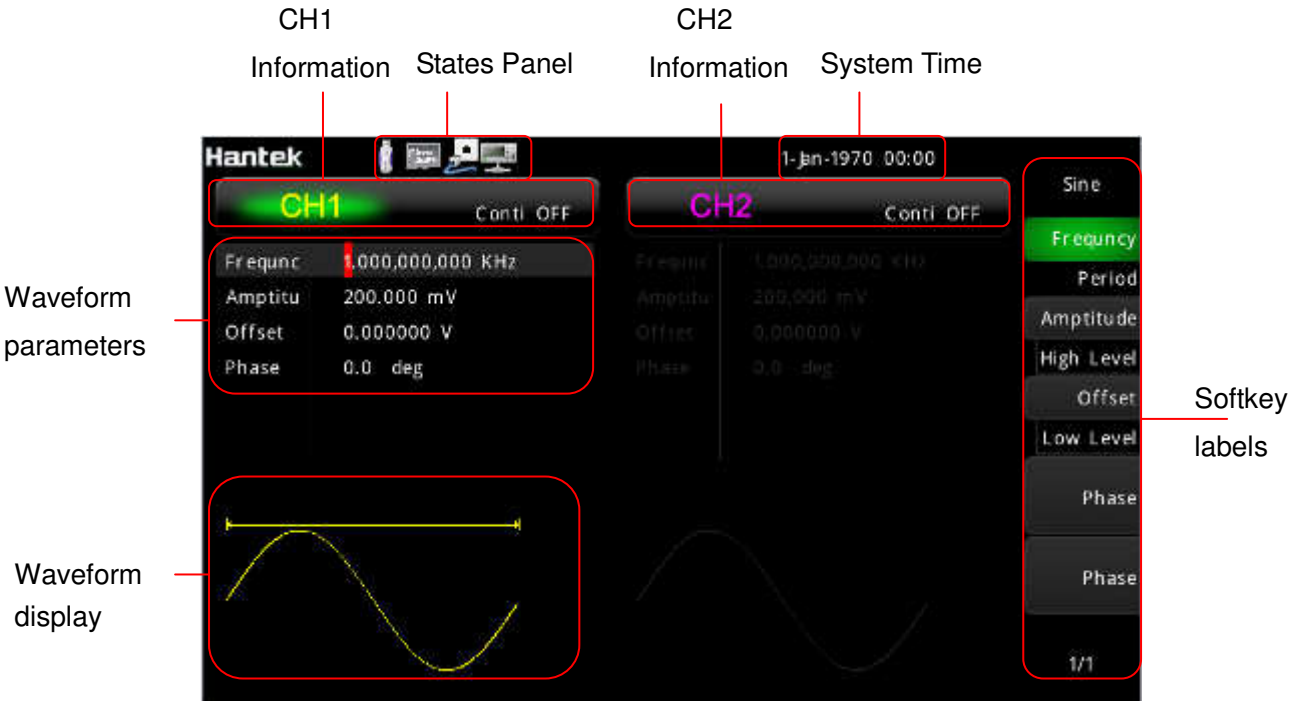
Online Help

Signal generator online help provides two kinds of view. one is content view and the other is index view.

1. The index view is the subject of the online help content according to the ascending order of the view. Choose index by knob, enter to go into the subject.
2. Content view shows a view of specific topic content.go into the content linked by the "link words".
3. Press F5 to exit.

Screen Area

The signal generator can be divided into three regions: the status panel at the top of the screen, the menu panel at the right of the screen, the window area at he left corner of the screen.



Status panel indicates whether external usb device is connected with this device, whether usb device in the rear panel is connected with PC, whether the Internet is connected and the current time.

The menu panel and window area are corresponding. The content of the window area can be modified by controlling the menu panel. There are three main ways of style menu panel item.

One way is operation directly. As is shown, press it, then the operation will be modified, or enter submenu to select, or page to next page to select.

One way is for choosing. It provides a topic and some params. Topic is showed at the top of the menu item and params showed below. Press the Softkeys F0~F6 corresponded to the item to choose different params.

The other way is altering. It appears like choosing. But it don't have topic item, current params is showed on the front of the menu item and the optional item is at below.

Use F6 button to page down or page up. Press F0 to return the parent menu.

1.3 Rear Panel

1. External 10 MHz Reference Input
2. Internal 10 MHz Reference Output
3. USB Interface Connector

1.4 Prepare Instrument for Use

This section describes basic procedures to help you get started quickly with the instrument.

Prepare Instrument for Use

Connect the power cord as desired. Turn the instrument on by pressing the power switch in the lower left corner of front panel.

The instrument's default function is a 1 kHz, 200 mVpp sine wave. At power-on, the channel output connectors are disabled. To enable output on a channel connector, press the key above the channel connector and then press the **Output** button.

If the instrument does not turn on, verify that the power cord is firmly connected (power-line voltage is automatically sensed at power-on). Also make sure that the instrument is connected to an energized power source.

Power Switch:

To turn off the instrument, please press power switch.

Chapter 2 Basic Operation

◆Front-Panel Menu Reference

◆Utility Function

◆Save and Recall

◆Remote Control

2.1 Front-Panel Menu Reference

Overview of the front-panel menus. The remainder of this chapter contains examples of using the front-panel menus.

◆Sine

◆Square

◆Ramp

◆Pulse

◆Noise

◆Arb

◆Harmonic

◆CH1and CH2 switch button

◆Frequency/Time hot key

◆Amplitude hot key

◆Offset hot key

Configures waveform-specific parameters

- ◆ Period/Frequency
- ◆ Amplitude or High and Low Voltage
- ◆ Offset
- ◆ Phase
- ◆ Duty Cycle
- ◆ Symmetry
- ◆ Pulse Width
- ◆ Edge Time
- ◆ Arbitrary Waveform
- ◆ Bandwidth

Specifies unit and parameter preferences

◆Frequency or Period

◆Voltage as Amplitude/Offset or High/Low

◆Voltage units

◆Pulse Width or Duty Cycle

◆Frequency sweep as Center/Span or Start/Stop

Mode：

Configures modulation parameters

- ◆ Modulation on or off
- ◆ Modulation type: AM, FM, PM, 2ASK, 2FSK, 2PSK, BPSK and PWM
- ◆ Modulation source
- ◆ Modulation parameters

Sweep：

Configures frequency sweep parameters

- ◆ Sweep on or off
- ◆ Linear
- ◆ Sweep time
- ◆ Start/stop frequencies or center/span frequencies
- ◆ Hold and return times

Burst：

Configures burst parameters

- ◆ Burst on or off
- ◆ Burst mode: triggered or externally-gated
- ◆ Cycles per burst
- ◆ Burst period

Save/Recall：

Stores and recalls instrument states

Help：

Shows list of Help topics

- Display help topic list
- Display help index list
- Get help on any key

Utility：

1. System setting

Configures system-related parameters

- Language setting: Select local language for front-panel messages and help text
- Security setting: Set password
- Display setting: Enable or disable screen saver; Adjust display brightness
- Sound setting: Enable or disable beeper
- Network setting: Set network
- Time and date setting: Set date and time
- Clock source setting: Select clock source internal or external.

2. System Information

- Device Information
- Hardware information
- Software information
- Law information

3. SysStatus

- Check system status
- Save and recall system status

4. Update

- Update firmware

5. Counter

- Turn on/off counter or frequency meter

6. Self Test

- Perform self test

7. Calibration

◆ Perform calibration

Trigger：

Configures trigger settings

◆ Perform a manual trigger, when illuminated.
◆ Specify the trigger source for sweep, burst or arbitrary waveform advance.
◆ Specify the trigger count and delay.
◆ Specify the slope (rising or falling edge) for an external trigger source.
◆ Specify the slope (rising or falling edge) of the trigger output signal.
◆ Enable / disable the signal output from the "Sync" connector.

Default setting：

Default Settings

Press the Default button in the front panel, and the factory status will be recalled.

2.2 Utility

There are some features to be selected in Utility menu, such as: <System Settings>, <System Information>, <System State >, <Counter>, <Self Test>, <Calibration>.

To choose these features, use the knob and left/right direct button, then push ENT button to confirm.Also you can push F1 and F2 button to choose function, then press ENT button or F4 button to confirm. Press F5 button to exit.

2.2.1 System Settings

The followings are settings:

Language Settings

Security Settings

Display Settings

Sound Settings

Network Settings

Time Settings

Reference Source Settings

Please follow the steps below to enter each settings:

1. Press <Utility> button, select “System Setting”, then press ENT button to do System Settings;
2. In the main menu of System Settings, push F1 to F5 button to go into desired settings
3. Also, user can choose these settings by the konb key.

◆Language Settings

English and Chinese Language are supported; Please follow the steps below to change current language:

1. Press<Utility> button, select “System Setting”, then press ENT button to go into System Settings;
2. Choose “Language Settings”, press ENT button to open Language Settings interface;
3. Push F1 button to choose different language;
4. Push F2 button to exit.

◆Security Settings

To use some functions of the signal generator, it need administrator’s authorization and input password, such as <Upgrade> and <Calibration> function. In the security Settings, the administrator can maintain security keys;

1. Press<Utility> button, and press ENT button to go into System Settings, then choose Security Settings;
2. Press F1 button, the window of inputting password appear; Then input the right password, press F1 key again to set new password using the digital keypad in the front panel.
4. Press F2 button to input the password again.
5. Press F3 to confirm, if the twice password are same, the system will automatically return to <System Settings> window. If not, the password will be empty and wait for next input;
6. Press F4 to exit.

Note: The default password of the system is 88888888. Max number of the password is eight, including digit and ".".

◆Display Settings

Adjust display brightness.

1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Display Settings”;
2. To adjust brightness, please press F1 button, then the menu is highlighted, then rotate the knob on front panel to adjust the parameter values.

Disable or enable saver:

1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Display Settings”;

3. Push F2 button to enable or disable the saver;
4. When the saver is enable, push F3 button to determine after what time ,the saver will be started;
5. push F4 button to exit;

◆Sound Settings

If turn on keypad tone, we can hear sound when press a button.
Please follow the steps below to enable or disable sound:
1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Sound Settings”;
2. Push F1 to enable or disable beep.
3. Press F2 to exit.

◆Network Settings

The system can communicate with PC by Ethernet interface.
1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Network Settings”, press ENT button to open “Network Settings” interface;
2. Press F1 to change IP address, input right format IP values by using digital keypad in the front panel.
4. Press F2 to change subnet mask, input right format subnet mask values by using digital keypad in the front panel.
5. Press F3 to change gateway, enter right format gateway values by using digital keypad in the front panel.
6. Press F4 to change MAC, enter right format MAC values using digital keypad in the front panel.
7. Press F5 to exit.

Note: Not all mode of the machine has Ethernet interface.

◆Time Date Setting

Please follow the steps to change time and date:
1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Time and date Settings”, press ENT button to open “Time and date Settings” interface;
3. Press F1 to change year.
4. Press F2 to change month.
5. Press F3 to change day.
6. Press F4 to change hour.
7. Press F5 to change minute.
8. Press F6 to enter page 2 of main menu, and press F1 to change second value.

9. Press F6 to enter page 2 of main menu, and press F2 to exit.

◆ **Reference Source Settings**

The default is10M internal source. For the synchronization among different devices, please choose external 10M crystals as clock source.

Please follow the steps to change reference clock source:

1. Press<Utility> button, and press ENT button to go into System Settings, then choose “Clock Source”, press ENT button to open “Clock Source” interface.
2. Press F1 to select internal source.
3. Press F1 twice to select external source.
4. Press F2 to exit.

2.2.2 System Infomation

It contains information about the device, hardware, software and law information.

2.2.3 System State

Please follow the steps to view the system's main state:

1. Press<Utility> button, and press F2-> F2->ENT button to go into Systatus interface.
2. Press F5 to exit.

Please follow the steps bellow to save the system state file:

1. Press<Utility> button, and press F2-> F2->ENT button to go into Systatus interface.
2. Press F1 to go into <File Brower>, then select dir(File Win or Disk Win) of the file to be saved.
3. Press F3 in the <File Brower>main menu, and then name the file.
4. Press F3 again to actually save the file.
5 .Then it returns to the system state window.
6. Press F5 to exit.

Please follow the steps bellow to recall the system state file:

1. Press<Utility> button, and press F2-> F2->ENT button to go into Systatus interface.
2. Press F1 to go into <File Brower>, then select dir of the saved file.
3. Press F4 to recall the file selected to recall the state.
4 .Then it returns to the system state window.
5. Press F5 to exit.

2.2.4 Update

It needs to input administrator password to upgrade system. Please follow the steps to update the system:

1. Insert the USB or SD storage device including the latest firmware.
2. Press<Utility> button, and press F2-> F2-> F2->ENT button to go into Update interface.
3. Press F1 button, then input the password in <Password Check> window.
4. Press F1 again, then select the firmware from <File Browser> window.
5. Then it returns to the Upgrade window, press F2 to start the operation.
6. When finish it, please restart press the power on/off button in the front panel.

2.2.5 Counter

Counter function and frequency meter are also built-in the series waveform generator, including low frequency counter, high frequency counter, low frequency meter, high frequency meter.
To measure the frequency low than 100KHz, please select low freq counter and low freq meter.
To measure frequency higher than 10MHz, please select high freq counter and high freq meter.

Please follow these steps to count low frequency signal:

1. Connect the signal to the COUNT connector in the front panel.
2. Press<Utility> button, and press F2-> F2-> F2-> F2->ENT button to go into count interface.
3. Choose low freq counter type.
4. Press F3 to start counter
5. Press F3 again to stop counter

Please follow these steps to measure the frequency of low frequency signal:

1. Connect the signal to the COUNT connector in the front panel.
2. Press<Utility> button, and press F2-> F2-> F2-> F2->ENT button to go into count interface.
3. Choose low freq meter type.
4. Press F3 to start
5. Press F3 again to stop
6. The default gate time is 1s. Please press F4 button and use knob button and digital keypad to modify the value.

Please follow these steps to count high frequency signal:

1. Connect the signal to the COUNT connector in the front panel.
2. Press<Utility> button, and press F2-> F2-> F2-> F2->ENT button to go into count interface.
3. Choose high freq conter type.
4. Press F3 to start counter.
5. Press F3 again to stop counter.

Please follow these steps to measure the frequency of high freqency:
1. Connect the signal to the COUNT connector in the front panel.
2. Press<Utility> button, and press F2-> F2-> F2-> F2->ENT button to go into count interface.
3. Choose high freq meter type.
4. Press F3 to start
5. Press F3 again to stop
6. The default gate time is 1s. Please press F4 button and use knob button and digital keypad to modify the value.

2.2.6 Self Test

To make sure the device can be used normally, please do self test procedure.
During the operation, real-time clock, ADC model, FPGA and the front analog circuit will be tested.

Please follow these steps to start the operation:
1. Press<Utility> button, and press F2-> F2-> F2-> F2-> F2->ENT button to go into self test interface.
2. Press F1 to start.
3. The result of self test will displayed on the screen.
All the whole self test will cost 15 second.

2.2.7 Calibration

Under the premise of well self test, user can do calibration manually. But it needs to administrator privilege.
Calibration will calculate correction factor and try to correct error of the related parameters. During this operation, frequency, ADC offset and DC offset will be calibrated.

Please follow these steps to do calibration:
1. Press<Utility> button, and press F2-> F2-> F2-> F2-> F2-> F2->ENT button to go into calibration interface.
2. Press F1 button and input the password.
3. Press F1 again to start. During the operation, input specific values.
4. Input a value with digital keypad.
5. Press F3 button to save result.
6. Press F4 to exit.

Virtual Keyboard

Virtual keyboard mainly used to input the characters.

Virtual Keyboard's Features:

1. Provide two language: English and Chinese
2. Choose different characters by using knobs, then press enter button to confirm.
3. Modify characters

Please follow these steps to use Virtual Keyboard:

1. Select input method English or Chinese
2. Input character
3. Modify character
4. Confirm to return

Select input method

Firstly, Press F1 to select input method English or Chinese.

input characters

1. If input method is English, shift knob to choose a character, press enter button to input it, then the character appears in the text edit box in the window.
2. If input method is Chinese, rotate knob to choose Chinese pinyin, then the pinyin characters show in the text edit box in the window. At the same time candidate of Chinese characters are showed. Press digital num 1 to 9 to choose or to see next or previous group of candidates by using knob.

Modify characters

1. Press F3 to select the focus widget as Text Edit box.
2. Using left/right direction button and backspace or CE button to modify operation.
3. If continue to input character, press F3 again to select soft keyboard as the focus widget.

Confirm and return

Press F4 to exit.

Password authentication

There are some functions need to input administrator’s password, such as <Security Settings>, <Calibration> and <Upgrade>

The default password is 88888888.

Please follow these steps o check the password:

1. Input the password by the digital keypad;
2. Press F1 button to confirm. If the password is right, function interface will be visited. If not, the

content will be empty and wait for inputting again.
3. Press F3 to exit.

USB Storage Device

The series generator can connect with USB storage device with fat32 format. Most identifiable USB equipment memory is 32G. Wave File generated by <Wave Editor> or State file generated by<System State> can be stored or recalled from the USB Storage Device.

SD Card

The series generator can connect with SD card with Fat32 format. Most identifiable equipment memory is 32G. Wave File generated by <Wave Editor> or status file generated by<System State> can be stored or recalled from the SD card.

2.3 Save and Recall

File Brower

File Brower is a storage device to browse files and save configuration information, consist of internal flash, external USB device and SD card.
Features:
1. Browse files and dirs
2. Create or delete files and dirs
3. Create a new dirs folder
4. Open files identified by the device

Brower files and dirs:
1. Choose a storage media. Press F1 to choose media area in the window as focus area, rotate the knob button and press enter button to change the current media.
2. Choose the file. press F1 to choose file area in the window as focus area, change the current file by rotating the knob button
Delete files:
1. Choose the file. Then press F5 button to delete it.
2. After delete all files in a dir, choose the dir and press F5 to delete it.

Create dirs floder:
Press F4 to create a new dir under parent dir.

Open files:
1. Choose the file.

2. Press Enter button to recall the file, if the file can be recognized, it will be opened automatically. Otherwise, nothing happens.

2.4 Remote Control

The device can communicate with PC by USB port.
The software on the PC can create more waves data and carry out the operation for waveform signal at the same time.

Chapter 3 Features and Function

This section contains details on instrument features, including front panel and remote interface operation. You may want to read Front-Panel Menu Reference first. See SCPI Programming Reference for details on SCPI commands and queries. This section covers:

◆Output Configuration

◆Pulse Waveforms

◆Amplitude Modulation (AM) and Frequency Modulation (FM)

◆Phase Modulation (PM)

◆Frequency-Shift Keying (FSK) Modulation

◆Pulse Width Modulation (PWM)

◆Frequency Sweep

◆Burst Mode

◆Triggering

3.1 Output Configuration

This section describes output channel configuration. Many commands associated with output configuration start with SOURce1: or SOURce2: to indicate a certain channel. User can't omit.

Output Function

The instrument includes six standard waveforms: sine, square, ramp, pulse, noise and Harmonic. There are also nine built-in arbitrary waveforms, and you can create custom waveforms with the embedded waveform editor.

The table below shows which functions are allowed (•) with modulation, sweep, and burst. Selecting a function that is not allowed with a modulation or mode disables the modulation or mode.

Carrier	AM	FM	PM	ASK	FSK	PSK	BPSK	PWM	Burst	Sweep
Sine	·	·	·	·	·	·	·		·	·
Square	·	·	·	·	·	·	·	·	·	·
Ramp	·	·	·	·	·	·	·	·	·	·
Pulse	·	·	·	·	·	·	·		·	·
Gaussian Noise	·								·a	
Arbitrary Waveform	·	·							·	·

(a) Gated burst only

◆Frequency Limitations: Changing functions may change the frequency to meet the new function's frequency limits.

◆Amplitude and offset cannot combine to exceed the instrument's capability. The one you set last may be changed to stay within limits.

◆You may protect a device under test (DUT) by specifying upper and lower output voltage limits.

◆**Front Panel**

◆ **SCPI:**

SOURce<n>: FUNCtion <SINusoid|SQUare|RAMP|PULSe|NOISe|DC|SINC|EXPFall| HAVErsine|LOREntz| DUALtone|GAUSe|ECG| USER| HARMonic| >

Output Frequency

The output frequency range depends on the function (default frequency 1 kHz for all functions). Please refer to Appendix B.

◆Frequency Limitations: Changing functions may change the frequency to meet the new function's frequency limits.

◆Burst Limitation: For internally-triggered bursts, the minimum frequency is 1 Hz.

◆Duty Cycle Limitations: For Square and Pulse, Duty Cycle is limited by the 16ns minimum pulse width specification. For example, at 1 kHz, Duty Cycle may be set as low as 0.01%, because that would result in a pulse width of 100 ns. At 1 MHz, the minimum Duty Cycle is 1.6%, and at 10 MHz it is 16%. Changing to a frequency that cannotproduce the current duty cycle will adjust the duty cycle to meet the minimum pulse width specification.

◆**SCPI:**

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak <voltage>|MINimum|MAXimum

Output Amplitude

The default amplitude is 200mVpp for all functions.

◆Offset Voltage Limitations: The relationship between amplitude and offset is shown below.

Vpp < 2(Vmax – |Voffset|)

◆Setting the high and low levels also sets the waveform amplitude and offset. For example, if you set the high level to +2 V and the low level to -1 V, the resulting amplitude is 3 Vpp, with a -500 mV offset.

◆A DC signal's output level is controlled by the offset voltage (DC Offset Voltage). The DC level may be between ±10 V.

◆**SCPI:**

SOURce<n>:VOLTage <amplitude>|MINimum|MAXimum

DC Offset Voltage

The default offset is 0 V for all functions.

◆Limits Due to Amplitude: The relationship between offset voltage and output amplitude is shown below. The peak output voltage (DC plus AC) cannot exceed the instrument output rating.

◆Setting the high and low levels also sets the waveform amplitude and offset. For example, if you set the high level to +2 V and the low level to -3 V, the resulting amplitude is 5 Vpp, with a -500 mV offset.

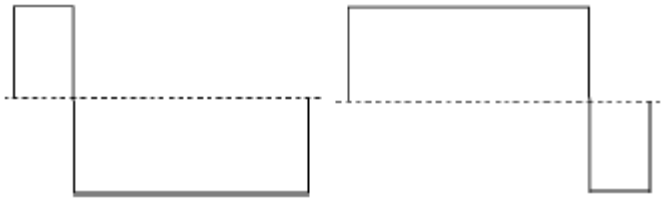
◆**SCPI:**

SOURce<n>:VOLTage:OFFSet <offset>|MINimum|MAXimum

SOURce<n>:VOLTage:OFFSet? [MINimum|MAXimum]

Duty Cycle (Square Waves)

A square wave’s duty cycle is the fraction of time per cycle that the waveform is at a high level. (See Pulse Waveforms for pulse duty cycle details.)



20% Duty Cycle **80% Duty Cycle**

◆Duty Cycle: 0.001% to 99.996% at low frequencies; range reduced at higher frequency. Stored in volatile memory; default 50%.

◆**Front Panel:**

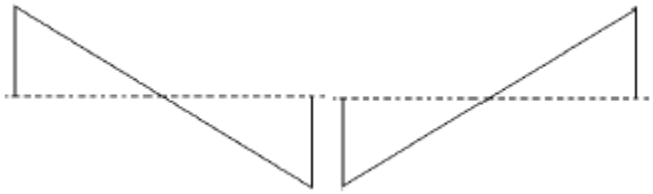
If you use the keypad, press **ENT button** to finish:

◆**SCPI:**

SOURce<n>:FUNCtion:SQUare:DCYCle <percent>|MINimum|MAXimum

Symmetry (Ramp Waves)

Applies to ramp waves only. Symmetry represents the fraction of each cycle that the ramp wave is rising.



0% Symmetry **100% Symmetry**

◆The symmetry (default 50%) is stored in volatile memory; and is remembered when you change to and from other waveforms.

◆When ramp is the modulating waveform for AM, FM, PM, or PWM, the symmetry setting does not apply.

◆**Front Panel:**

◆**SCPI:**

SOURce<n>:FUNCtion:RAMP:SYMMetry <symmetry>|MINimum|MAXimum

SOURce<n>：FUNCtion:RAMP:SYMMetry? [MINimum|MAXimum]

Voltage Autoranging

Autoranging is enabled by default and the instrument selects optimal attenuator settings.

Output Control

By default, channel output is disabled at power on to protect other equipment. To enable a channel's output, see below. When channel output is enabled, the corresponding channel button is lit.

◆Front Panel:

◆**SCPI:**

OUTPut<n> ON|OFF，

OUTPut<n>?

Sync Output Signal

A sync output is provided on the front-panel **Sync** connector. All of the standard output functions (except DC and noise) have an associated **Sync** signal. For applications where you may not want to output the **Sync** signal, you can disable the **Sync** connector(Trig Menu->Syns->OFF). The **Sync** signal may be derived from either output channel in the instrument.

General Behavior

◆By default, the **Sync** signal is derived from channel 1 and is routed to the **Sync** connector (enabled).

◆When the **Sync** signal is disabled, the output level on the **Sync** connector is at a logic "low."

◆For sine, pulse, ramp, square, and triangle waves, the **Sync** signal is a square wave that is "high" in the first half of the cycle and "low" in the last half.

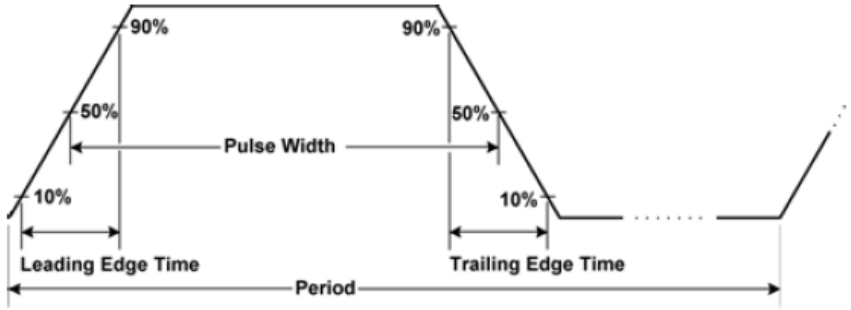
◆**Front Panel:**

◆**SCPI:**

OUTPut:SYNC:SOURce CH1|CH2

3.2 Pulse Waveforms

As shown below, a pulse or square wave consists of a period, a pulse width, a rising edge, and a falling edge.



1. Frequency

Frequency is the number of occurrences of a repeating event per unit time. It is also referred to as temporal frequency, which emphasizes the contrast to spatial frequency and angular frequency. The period is the duration of one cycle in a repeating event, so the period is the reciprocal of the frequency.Units areUhz, mHz, Hz, KHz, MHz.

◆ **Front Panel:**

Select Pulse waveform:

Select frequency instead of period:

◆ **SCPI:**

SOURce<n>:FUNCtion PULSe

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

2. Pulse Width

Pulse width is the time from the 50% threshold of a pulse's rising edge to the 50% threshold of the next falling edge.

◆Pulse width: 16 ns to 1,000,000 s. The default pulse width is 500 µs.

◆Pulse width is limited by "minimum pulse width (16 ns)" and "pulse cycle".

Pulse width ≥ minimum pulse width

Pulse width ≤ pulse cycle-2 x minimum pulse width

◆The instrument will adjust the pulse width to accommodate the specified period.

◆**Front Panel:**

◆**SCPI:**

SOURce<n>:FUNCtion:PULSe:WIDTh <seconds>|MINimum|MAXimum

SOURce<n>:FUNCtion:PULSe:WIDTh? [MINimum|MAXimum]

For example, set pulse width of the channel 1 to 5ms:

SOURce1:FUNCtion:PULSe:WIDTh 0.005

3. Pulse Duty Cycle

The pulse duty cycle is defined as follows:

Duty Cycle = 100x (Pulse Width)/Period

Pulse width is the time from the 50% threshold of a pulse's rising edge to the 50% threshold of the next falling edge.

◆Pulse duty cycle: 0.01% to 99.99% (see restrictions below). The default is 50%.

◆The pulse duty cycle must conform to the following restrictions determined by the minimum pulse width (Wmin). The instrument will adjust the pulse duty cycle to accommodate the specified period. Duty is associated with pulse width, if modify it, then pulse width will be modified automatically. Pulse duty is limited by "minimum pulse width (16 ns)" and "pulse cycle".

Pulse duty≥100 x minimum pulse width/pulse cycle

Pulse duty≤100 x (1 - 2 x minimum pulse width/pulse cycle)

◆**Front Panel:**

Select pulse function:

Toggle to Duty:

◆**SCPI:**

SOURce<n>:PULSe:DCYCle <percent>|MINimum|MAXimum

For example, Set duty of the channel 1 to 30%:

SOURce1: FUNCtion: PULSe: DCYCle 30

4. Edge Times

The edge times set the transition times for the leading and trailing edges of the pulse, either independently or together. The edge time represents the time between the 10% and 90% thresholds.

◆Edge time: default 1μs.

◆The specified edge time must fit within the specified pulse width as shown above. The instrument will adjust the edge time to accommodate the specified pulse width.

◆**Front Panel:**

◆**SCPI:**

SOURce<n>:FUNCtion:PULSe:TRANsition:LEADing<seconds>|MINimum|MAXimum

SOURce<n>:FUNCtion:PULSe:TRANsition:TRAiling <seconds>|MINimum|MAXimum

For example:

a) Set leading time of the channel 1 to 10ns,
   SOURce1:FUNCtion:PULSe:TRANsition:LEADing 0.00000001

b) Set trailing time of the channel 1 to 10ns SOURce1:FUNCtion:PULSe:TRANsition:TRAiling 0.00000001

3.3 Amplitude Modulation (AM) and Frequency Modulation (FM)

A modulated waveform consists of a carrier waveform and a modulating waveform. In AM, the carrier amplitude is varied by the voltage level of the modulating waveform. In FM, the carrier frequency is varied by the voltage level of the modulating waveform. The instrument accepts an internal or external modulation source. One channel can modulate the other.

Select AM or FM before setting up any other modulation parameter.

To Select AM or FM

The instrument allows only one modulation mode to be enabled on a channel. When you enable AM or FM, all other modulations are off. The two channels' modulations are independent from one another, and the instrument can add modulated waveforms from two channels.

◆ The instrument will not allow AM or FM to be enabled with sweep or burst. Enabling AM or FM, turns off sweep and burst.

◆ To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

◆ **Front Panel:**

◆**SCPI:**

SOURce<n>:MOD ON|OFF

SOURce<n>:MOD:TYPe AM|FM

Carrier Waveform Shape

◆AM or FM carrier shape: Sine (default), Square, Ramp, Pulse, Ramp, Noise or Arbitrary waveform. You cannot use DC as the carrier waveform.

◆For FM, the carrier frequency must always be greater than or equal to the frequency deviation. Attempting to set a deviation greater than the carrier frequency will cause the instrument to set the deviation equal to the carrier frequency.

◆The carrier frequency plus the deviation cannot exceed the selected function's maximum frequency plus 100 kHz.

Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 kHz for all functions. 1μHz ~ the highest frequency, please refer to Output Configuration and Appendix B.

◆SCPI:

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

Modulating Waveform Shape

The instrument accepts an internal or external AM or FM modulation source.

You cannot modulate noise with noise or an arbitrary waveform with an arbitrary waveform.

◆The modulating waveform shape (internal source) may be:

- ◆Sine wave
- ◆Square with 50% duty cycle
- ◆UpRamp with 100% symmetry
- ◆Triangle with 50% symmetry
- ◆DnRamp with 0% symmetry
- ◆Noise - white gaussian noise
- ◆Arb - Arbitrary waveform

◆SCPI:

SOURce<n>:MOD:AM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:FM:INTernal:FUNCtion SINusoid|SQUare|RAMP

Modulating Waveform Frequency

The instrument accepts an internal or external modulation source.

◆Modulating frequency (internal source): varies by signal type

◆Modulating frequency (external source): 0 to 100 kHz.

◆SCPI:

SOURce<n>:MOD:AM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FM:INTernal:FREQuency <frequency>|MINimum|MAXimum

Modulation Depth (AM)

The modulation depth is a percentage that represents the amplitude variation. At 0% depth, the amplitude is one-half of the carrier's amplitude setting. At 100% depth, the amplitude varies according to the modulating waveform, from 0% to 100% of the carrier's amplitude.

◆Modulation depth: 0% to 120%. The default is 50%.

◆Front Panel:

◆SCPI:

SOURce<n>:MOD:AM:DEPTh <depth>|MINimum|MAXimum

Frequency Deviation (FM)

The frequency deviation setting represents the peak variation in frequency of the modulated waveform from the carrier frequency.

◆Frequency deviation: 1 μHz to (carrier frequency)/2, default 100 Hz.

◆For FM, the carrier frequency must always be greater than or equal to the frequency deviation. Attempting to set a deviation greater than the carrier frequency will cause the instrument to set the deviation equal to the carrier frequency.

Frequency deviation + Carrier Frequency ≤ the carrier upper frequency limit + 1 kHz

◆Front-Panel

◆SCPI:

SOURce<n>:MOD:FM:DEViation <deviation>|MINimum|MAXimum

Modulating Source

The instrument accepts an internal or external modulation source.

◆Modulating source: Internal (default), Other Channel, or External. The External modulation source may be up to 100 kHz.

◆With the External source, an external waveform modulates the carrier waveform. The modulation depth (AM) or frequency deviation (FM) is controlled by the ±5 V signal level on the front-panel **MOD** connector.

◆**Front-Panel**

After enabling AM or FM, select the modulating source as shown:

◆**SCPI：**

SOURce<n>:MOD:AM:SOURce INTernal|EXTernal

SOURce<n>:MOD:FM:SOURce INTernal|EXTernal

3.4 Phase Modulation (PM)

A modulated waveform consists of a carrier waveform and a modulating waveform. PM is very similar to FM, but in PM the phase of the modulated waveform is varied by the instantaneous voltage of the modulating waveform.

To Select Phase Modulation

◆Only one modulation mode may be enabled at a time. Enabling PM disables the previous modulation mode.

◆Enabling PM turns off sweep and burst.

◆**Front Panel:**

The waveform is output using the present carrier and modulating waveform settings.

◆To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

◆**SCPI:**

SOURce<n>:MOD ON|OFF

SOURce<n>:MOD:TYPe AM|FM|PM|ASK|FSK|PSK|PWM|BPSK

Carrier Waveform Shape

PM carrier shape: Sine (default), Square, Ramp, Pulse or Arbitrary. You cannot use Noise or DC as the carrier waveform.

Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 kHz for all functions. Carrier frequency must be greater than 20 times the peak modulation frequency.

Modulating Waveform Shape

The instrument accepts an internal or external modulation source.

The modulating waveform shape (internal source) may be:

- ◆Sine wave
- ◆Square with 50% duty cycle
- ◆UpRamp with 100% symmetry
- ◆Triangle with 50% symmetry
- ◆DnRamp with 0% symmetry
- ◆Noise - white gaussian noise
- ◆Arb - Arbitrary waveform

◆SCPI:

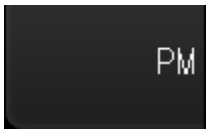
SOURce<n>:MOD:PM:INTernal:FUNCtion SINusoid|SQUare|RAMP

Modulating Waveform Frequency

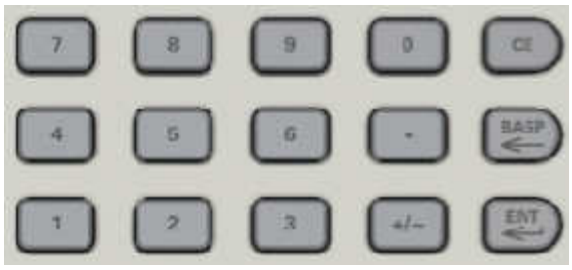
The instrument accepts an internal or external modulation source.

◆Modulating frequency (internal source): from 2 mHz to 500 kHz, default 100 Hz.

◆**Front Panel:**



Then enter the AM or FM frequency with the knob and keypad:



◆**SCPI:**

SOURce<n>:MOD:PM:INTernal:FREQuency <frequency>|MINimum|MAXimum

Phase Deviation

The phase deviation setting represents the peak variation in phase of the modulated waveform from the carrier waveform. The phase deviation can be set from 0 to 360 degrees (default 180).

◆**Front Panel:**

Then set the phase deviation:

◆SCPI:

SOURce<n>:MOD:PM:DEViation <deviation>|MINimum|MAXimum

Modulating Source

The instrument accepts an internal or external modulation source.

◆Modulating source: Internal (default), Other Channel, or External. The External modulation source may be up to 100 kHz.

◆With the External source, the carrier waveform is modulated with an external waveform. The ±5 V signal level present on the front-panel **Mod** connector controls the phase deviation.

◆**Front Panel:**

◆SCPI:

SOURce<n>:MOD:PM:SOURce INTernal|EXTernal

3.5 Frequency-Shift Keying (FSK) Modulation

You can configure the instrument to "shift" its output frequency between two preset values using FSK modulation. Therate at which the output shifts between the two frequencies (called the "carrier frequency" and the "hop frequency") isdetermined by the internal rate generator or the signal level on thefront-panel **TRIG** connector.

To Select FSK Modulation

SOURce<n>:MOD ON|OFF

SOURce<n>:MOD:TYPe AM|FM|PM|ASK|FSK|PSK|PWM|BPSK

- Only one modulation mode may be enabled at a time. Enabling FSK turns off the previous modulation mode.
- You cannot enable FSK when sweep or burst is enabled. Enabling FSK turns off sweep and burst.
- To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

FSK Carrier Frequency

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

Please refer to Output Configuration

- When the External source is selected, the output frequency is determined by the signal level on the front-panel **TRIG** connector. When a logic low is present, the carrier frequency is output. With a logic high, the hop frequency is output.

FSK "Hop" Frequency

SOURce<n>:MOD:FSKey:FREQuency <frequency>|MINimum|MAXimum

The maximum alternate ("hop") frequency depends on the function. The default is 100 Hz for all functions. The internalmodulating waveform is a 50% duty cycle square wave.

Sine: 1 μHz to the highest frequency

Square: 1 μHz to the highest frequency

Ramp: 1 μHz to the highest frequency

Arb: 1 μHz to the highest frequency (except DC)

FSK Rate

SOURce<n>:MOD:FSKey:INTernal:RATE <frequency>|MINimum|MAXimum

The FSK rate is the rate at which the output frequency "shifts" between the carrier frequency and the hop frequency using the internal FSK source.

- FSK rate (internal source): 2mHz to 1 MHz, default 100 Hz.
- The FSK rate is ignored when the external FSK source is selected.

FSK Source

SOURce<n>:MOD:FSKey:SOURce INTernal|EXTernal

May be Internal (default) or External.

- When the Internal source is selected, the rate at which the output frequency "shifts" between the carrier frequency and hop frequency is determined by the FSK rate.
- When the External source is selected, the output frequency is determined by the signal level on the front-panel **TRIG** connector. When a logic low is present, the carrier frequency is output.

With a logic high, the hop frequency is output.

3.6 Pulse Width Modulation (PWM)

This section discusses PWM, which stands for pulse-width modulation. PWM is only available for the Pulse waveform, and the pulse width varies according to the modulating signal. The amount by which the pulse width varies is called the width deviation, and it can be specified as a percentage of the waveform period (that is, duty cycle) or in units of time.

For example, if you specify a pulse with 20% duty cycle and then enable PWM with a 5% deviation, the duty cycle varies from 15% to 25% under control of the modulating signal.

The instrument accepts an internal or external modulation source.

To Select PWM

- You cannot enable PWM when sweep or burst is enabled.
- To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.
- **SCPI:**

  SOURce<n>:MOD ON|OFF

  SOURce<n>:MOD:TYPe PWM

Modulating Waveform Shape

The instrument accepts an internal or external modulation source.

- The modulating waveform shape (internal source) may be:
  - Sine wave
  - Square with 50% duty cycle
  - UpRamp with 100% symmetry
  - Triangle with 50% symmetry
  - DnRamp with 0% symmetry
  - Noise - white gaussian noise
  - Arbitrary waveform
- You can use noise as the modulating waveshape, but you cannot use noise, arbitrary waveforms, or DC as the carrier.
- **Front-Panel:**

- **SCPI:**

SOURce<n>:MOD:PWM:INTernal:FUNCtion SINusoid|SQUare|RAMP

Modulating Waveform Frequency

The instrument accepts an internal or external modulation source.

◆Modulating frequency (internal source): 2mHz to 500KHz. The default is 100 Hz.

◆ **Front Panel:**

◆ **SCPI:**

SOURce<n>:MOD:PWM:INTernal:FREQuency <frequency>|MINimum|MAXimum

PWM Deviation

The PWM deviation setting is the peak variation in width of the modulated pulse waveform.

◆**SCPI：**

SOURce<n>:MOD:PWM:DEViation <deviation>|MINimum|MAXimum

Modulating Source

The instrument accepts an internal or external modulation source.

◆ Modulating source: Internal (default) or External. The External modulation source may be up to 100 kHz.

◆ If you select the *External* modulating source, the deviation is controlled by the ±5 V signal level on the front-panel **MOD** connector. For example, if you have set the deviation to 1 µs, then a +5 V signal corresponds to a 1 µs increase in width. Lower signal levels produce less deviation.

◆ **Front Panel:**

◆ **SCPI：**

SOURce<n>:MOD:PWM:SOURce INTernal|EXTernal

3.7 Frequency Sweep

In frequency sweep mode, the instrument moves from the start frequency to the stop frequency at a specified sweep rate. You can sweep up or down in frequency, with either linea. You can also configure the instrument to output one sweep from start frequency to stop frequency by applying an external or manual trigger. The instrument can sweep sine, square, pulse, ramp, triangle, or arbitrary waveforms (noise and DC are not allowed).

You can specify a hold time, during which the sweep remains at the stop frequency, and a return time, during which the frequency changes linearly from the stop frequency to the start frequency.

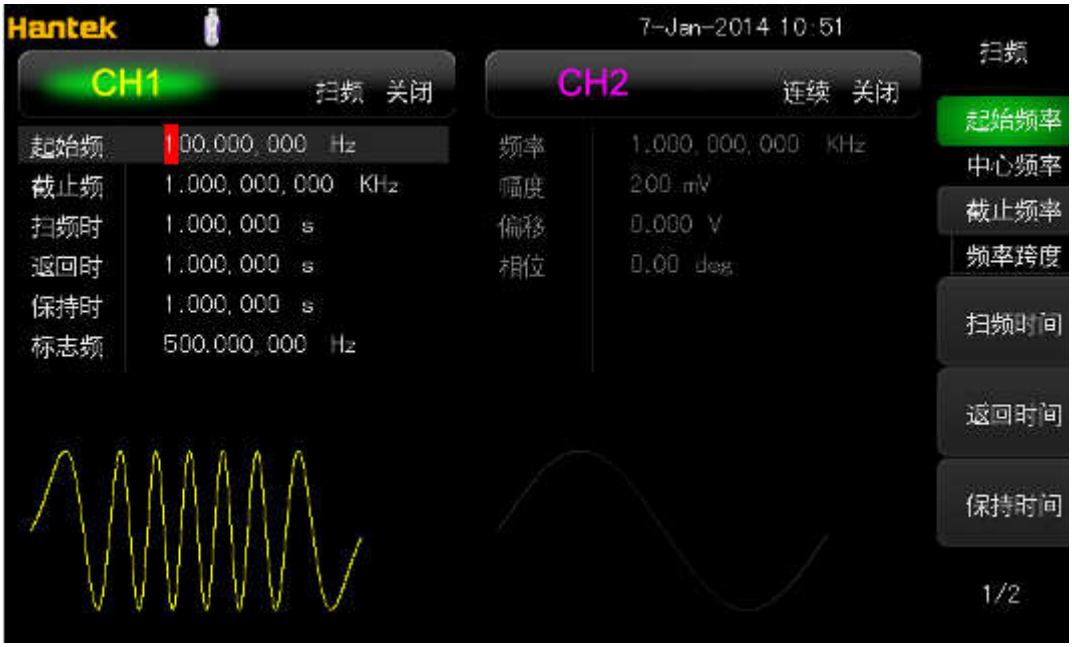
To Select Sweep

The instrument will not allow sweep mode to be enabled at the same time that burst or any modulation mode is enabled. When you enable sweep, the burst or modulation mode is turned off.

◆To avoid multiple waveform changes, enable the sweep mode after configuring the other parameters.

◆**Front Panel:**

Output a sweep using the present amplitude, offset, and frequency:



Press “Sweep” button to close sweep mode.

◆ **SCPI:**

SOURce<n>:SWEep ON|OFF

Start Frequency and Stop Frequency

The start frequency and stop frequency set the sweep’s upper and lower frequency bounds. The sweep begins at the start frequency, sweeps to the stop frequency, and then resets back to the start frequency.

◆ Start and Stop frequencies: 1 μHz to the highest frequency. The sweep is phase continuous over the full frequency range. The default start frequency is 100 Hz. The default stop frequency is 1 kHz.

◆To sweep up in frequency, set the start frequency less than the stop frequency. To sweep down in frequency, set the opposite relationship.

◆ Each channel outputs frequency sweep or pulse sequence from corresponding BNCterminal.

◆ 前面板：

Center Frequency and Frequency Span

You can also set the sweep frequency boundaries of the sweep using a center frequency and frequency span.

- Center frequency: 1 μHz to 30 MHz (limited to 200 kHz for Ramps). The default is 550 Hz.
- Frequency span: -30 μHz to 30 MHz (limited to 200 kHz for Ramps). The default is 900 Hz.
- To sweep up in frequency, set a positive frequency span; to sweep down, set a negative frequency span.
- For sweeps with Marker Off, the **Sync** signal is a square waveform with a 50% duty cycle. (missing or bad snippet) The frequency of the **Sync** waveform is equal to the specified sweep time. The signal is output from the front-panel **Sync** connector.
- For frequency sweeps with Marker On, the **Sync** signal is a TTL "high" at the beginning of the sweep and a "low" atthe marker frequency.

Sweep Time

Sweep time specifies the number of seconds required to sweep from the start frequency to the stop frequency. The instrument calculates the number of points in the sweep based on the sweep time.

- Sweep time: 1 ms to300 seconds, default 1 s.
- **Front-Panel:**

- **SCPI:**

SOURce<n>:SWEep:TIME <seconds>|MINimum|MAXimum

Hold Time and Return Time

Hold time specifies time (in seconds) to remain at the stop frequency, and return time specifies the number of seconds to return from the stop frequency to the start frequency.

- Hold time and return time: 1ms to 300 seconds (default 1s).
- Front Panel:

◆ **SCPI:**

SOURce<n>:SWEep:HTIMe <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:RTIMe <seconds>|MINimum|MAXimum

Marker Frequency

If desired, you can set the frequency at which the signal on the front-panel **Sync** connector goes to a logic low during the sweep. The **Sync** signal always goes from low to high at the beginning of the sweep.

◆ Marker frequency: between the specified start frequency and stop frequency. The default is 550 Hz.

◆ When the sweep mode is enabled, the marker frequency must be between the specified start frequency and stop frequency.

◆ **SCPI:**

SOURce<n>:MARKer ON|OFF

SOURce<n>:MARKer:FREQuency <frequency>|MINimum|MAXimum

Sweep Trigger Source

In sweep mode, the instrument outputs a single sweep when a trigger signal is received. After one sweep from the start frequency to the stop frequency, the instrument waits for the next trigger while outputting the start frequency.

◆ Sweep trigger source: Internal (default), External or Manual.

◆ With the Internal (immediate) source, the instrument outputs a continuous sweep at a rate determined by the total of the hold time, sweep time and return time.

◆ With the External source, the instrument accepts a hardware trigger on the rear-panel Ext Trig connector and initiates one sweep each time Ext Trig receives a TTL pulse with the specified polarity.

◆ The trigger period must be greater than or equal to the specified sweep time.

◆ With the Manual source, the instrument outputs one sweep each time the front-panel **[Trigger]** key is pressed.

◆ **SCPI：**

SOURce<n>:SWEep:TRIGger:SOURce INTernal|EXTernal

SOURce<n>:SWEep:TRIGger:SLOPe POSitive|NEGative

3.8 Burst Mode

The instrument can output a waveform for a specified number of cycles, called a burst. Burst is allowed with sine, square, triangle, ramp, pulse or arbitrary waveforms (noise allowed only in gated burst mode; DC is not allowed).

To Select Burst

Burst cannot be enabled when sweep or modulation is enabled. Enabling burst turns off sweep and modulation.

- To avoid multiple waveform changes, enable burst mode after configuring other parameters.
- **Front-Panel:**

- **SCPI:** SOURce<n>:BURSt ON|OFF

Burst Mode

Burst has two modes, described below. Selected mode controls allowable trigger source, and which other burst parameters apply.

- **Triggered Burst Mode (N Cycle,** INFinity Cycle**):** The instrument outputs a waveform for specified number of cycles (burst count) each time trigger is received. After outputting specified number of cycles, instrument stops and waits for next trigger. The instrument can use an internal trigger to initiate burst, or you can provide external trigger by pressing the front-panel **[Trig Menu]** key, applying trigger signal to front-panel **TRIG** connector, or sending software trigger command from remote interface. INFinity Cycle: The instrument outputs a waveform each time trigger is received. After outputting infinity cycle, instrument stops and waits for next trigger.
- **External Gated Burst Mode:** Output waveform is on or off, based on level of external signal applied to front-panel **TRIG** connector. When the gate signal is true, the instrument outputs a continuous waveform. When the gate signal goes false, the current waveform cycle is completed and the instrument stops while remaining at the voltage level corresponding to the starting burst phase of the selected waveform. The noise waveform output stops immediately when the gate signal goes false.

Parameter	**BURS:MODE (BURS:MODE)**	**Burst Count (BURS:NCYC)**	**Burst Period (BURS:NCYC)**	**Burst Phase (BURS:PHAS)**	**Trigger Source (TRIG:SOUR)**
Triggered Burst Mode: Internal Trigger	TRIGgered	Available	Available	Available	IMMediate
Triggered Burst Mode:	TRIGgered	Available	Not Used	Available	EXTernal

External Trigger					
Gated Burst Mode: External Trigger	GATed	Not Used	Not Used	Available	Not Used

◆ In gated mode, burst count, burst period, and trigger source are ignored.

◆ In gated mode, you can specify polarity of signal on front-panel **TRIG** connector (SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative). Default is Positive.

◆ **SCPI**:

SOURce<n>:BURSt:MODE TRIGgered|GATed|INFinity

Burst Count

Number of cycles (1 to 100,000) to be output per burst, used in the triggered burst mode only (internal or external source).

Number of cycles (1 to 500,000) to be output per burst. The command is valid under N Cycle.

◆ With Internal trigger source, specified number of cycles are output continuously at a rate determined by burst period. The burst period is the time between the starts of consecutive bursts.

◆ In gated burst mode, burst count is ignored.

◆ SCPI:

SOURce<n>:BURSt:NCYCles <cycles>|MINimum|MAXimum

Burst Period

Burst period is the time from the start of one burst to the start of next burst (default 10 ms). Used in internal triggered burst mode only. Burst period differs from "waveform frequency," which specifies the frequency of the bursted signal.

◆ Burst period is used only when Immediate triggering（Internal Trigger） is enabled. The burst period is ignored when manual or external triggering is enabled (or when the gated burst mode is selected).

◆ You cannot specify a burst period that is too short for the instrument to output with the specified burst count and frequency. If the burst period is too short, the instrument will increase it as needed to continuously re-trigger the burst.

Start Phase

Start phase of the burst, from 0 to +360 degrees (default 0).

Burst Trigger Source

In triggered burst mode:

◆ The instrument outputs a waveform of the specified number of cycles (burst count) when a trigger received. After the specified number of cycles have been output, the instrument stops and waits for next trigger.

◆ **Internal:** the instrument outputs continuously when burst mode is enabled.

◆ **EXTernal:** the instrument accepts a hardware trigger at the front-panel **TRIG** connector. The instrument outputs one burst of the specified number of cycles each time **TRIG** receives a TTL pulse with the proper polarity (SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative). External trigger signals during a burst are ignored.

◆ **EXTernal or BUS:** burst count and burst phase remain in effect, but burst period is ignored.

◆ **SCPI：**

SOURce<n>:BURSt:TRIGger:SOURce INTernal|EXTernal

Gate Polarity

Select the gate as high level or low level on the front panel EXT BNC connector to output burst sequence.

◆SCPI：

SOURce<n>:BURSt:GATE:POLarity NORMal|INVerted

SOURce<n>:BURSt:GATE:POLarity?

Set gate polarity to inverted on CH1: SOURce1:BURSt:GATE:POLarity INVerted

3.9 Trigger System

This section describes the instrument's triggering system.

Trigger Overview

This triggering information applies to sweep and burst only. You can issue triggers for sweeps or bursts using internal triggering, external triggering, timer triggering, or manual triggering.

◆Internal (default): instrument outputs continuously when sweep or burst mode is selected.

◆External: uses front-panel **TRIG** connector to control sweep or burst. The instrument initiates one sweep or outputs one burst each time **TRIG** receives a TTL pulse. You can select whether instrument triggers on rising or falling edge.

◆Manual: triggering initiates one sweep or outputs one burst each time you press **[Trig Menu]** on the front panel.

Trigger Sources

This triggering information applies to sweep and burst only. You must specify the source from which the instrument accepts a trigger.

◆Sweep and Burst trigger source: Immediate (default), External, Manual.

◆The instrument will accept a manual trigger, a hardware trigger from the front-panel **TRIG** connector, or continuously output sweeps or bursts using an internal trigger.

◆Trigger source setting is volatile;

◆**SCPI：**

SOURce<n>:SWEep:TRIGger:SOURce INTernal|EXTernal
SOURce<n>:BURSt:TRIGger:SOURce INTernal|EXTernal

Immediate Triggering

Internal trigger mode (default): instrument continuously outputs sweep or burst (as specified by sweep time or burst period).

◆**SCPI:**

SOURce<n>:BURSt:TRIGger

SOURce<n>:SWEep:TRIGger

Manual Triggering

Manual trigger mode: you manually trigger the instrument by pressing **[Trig Menu]** key. The instrument initiates one sweep or burst for each time you press **[Trig Menu]**. The led of button is lit when you are in the trigger menu and the instrument is waiting for a manual trigger. The led of this button blinks when the instrument is waiting for a manual trigger, but you are not in the trigger menu.

External Triggering

In external trigger mode, the instrument accepts a hardware trigger at the front-panel **TRIG** connector. The instrument initiates one sweep or burst each time Ext Trig receives a TTL pulse with the specified edge. The external trigger mode is like the manual trigger mode except that you apply the trigger to the **TRIG** connector.

◆**SCPI**:

SOURce<n>:SWEep:TRIGger:SOURce EXTernal
SOURce<n>:SWEep:TRIGger:SLOPe POSitive|NEGative
SOURce<n>:BURSt:TRIGger:SOURce EXTernal
SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative

Chapter4 Waveform Generation Tutorial

◆Generation of A Sine Wave Function

◆Generation of A Square Wave Function

◆Generation of A Ramp Wave Function

◆Generation of A Pulse Wave Function

◆Generation of A Noise Wave Function

◆Generation of An Arb. Wave Function

◆Generation of A Harmonic Wave Function

◆Method of input params

◆Mode Waveform

The series signal generator can output kinds of standard Functions. For example: Sine wave, square wave, ramp wave, pulse, noise wave, DC signal, sinc, exp fall, lorentz, gause, haver sine, Dual Tone, ECG.

Frequncy

Frequency is the number of occurrences of a repeating event per unit time. It is also referred to as temporal frequency, which emphasizes the contrast to spatial frequency and angular frequency. The period is the duration of one cycle in a repeating event, so the period is the reciprocal of the frequency. Units are μHz, mHz, Hz, KHz, MHz.

Period

Frequency is the number of occurrences of a repeating event per unit time. It is also referred to as temporal frequency, which emphasizes the contrast to spatial frequency and angular frequency. The period is the duration of one cycle in a repeating event, so the period is the reciprocal of the frequency. Units are s, ms, μs, ns.

Amplitude

The amplitude of a periodic variable is a measure of its change over a single period. Units are Vpp, mVpp, μVpp.

DC Offset

When describe a periodic function in the frequency domain, DC offset is the mean value of the waveform.

High Level/ Low Level

The signal level value of the maximum value is signals of high level. The minimum value is low level, units are V, mV, μV etc.

Phase

Unit is degree. The starting phase range can be set from 0 ° to 360 °. The default phase value of 0 °.

Duty

Duty is the pulse duration and pulse ratio of total cycle. Unit is %, the default value is 50%.

Symmetry

Symmetry is defined as an percentage of triangular wave rise time and period.
Symmetry range can be set from 0% to 100%. The default value is 50%.

Pulse Width

Pulse Width is the time interval between the %50 threshold of the pulse rising amplitude and the 50% threshold of the pulse falling amplitude. Pulse duty ratio is defined as the percentage of the pulse width of pulse cycle. Symmetry range can be set from 0% to 100%. The default value is 50%.

Leading Time

It is defined as the response curves from the steady state value of 10% to 90% steady state value.

Trialing Time

It is defined as the response curves from the steady state value of 90% to 10% steady state value

4.1 Generation of A Sine Wave Function

Sine wave is a wave with single frequency. It is named as Sine according to the sine graph. Any complex signal can be seen as a signal combined by different sine wave with different frequency, amplitude.

Please follow these steps to output sine wave:

1. Press Sine button in the front panel, if the waveform is setting as <modulation mode>, <sweep mode> or <burst mode>, please turn off the mode;
2. Press channel output button in the front panel to open channel waveform output switch, then the button is lighting;
3. Oscilloscope shows sine wave.
4. Modify the waveform <Frequency>. One way is to press frequency/cycle shortcut key F/T button in the front panel. Another way is to press F1 button when it displays the main menu of the sine wave. Then the selected parameter is highlighted.
5. Modify the waveform <Amplitude>. One way is to press AMP shortcut key in the front panel. Another way is to press F2 button when it display main menu of the sine wave. Then the selected parameter is highlighted.
6. Modify the waveform <DC OFFSET>. One way is to press Offset shortcut key in the front panel. Another way is to press F3 button when it displays main menu of the sine wave. Then the selected parameter is highlighted.
7. Modify the waveform <Phase>, the way is to press F4 button when it displays main menu of the sine wave. Then the selected parameter is highlighted.
8. To set the same phase between channel 1 and channel 2, please press F5 button when it displays main menu of the sine wave.
9. To change the parameters after being highlighted, user can use the front panel knobs and

digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.

4.2 Generation of A Square Wave Function

Square wave is a non-sinusoidal waveform. There are only "high" and "low" the two values for an ideal square wave.

Please follow these steps to output square wave:

1. Press Square wave button in the front panel, and if the waveform is setting as <modulation mode>, <sweep mode> or <burst mode>, please turn off the mode;
2. Press channel output button in the front panel to open channel waveform output switch, then the button is lighting;
3. Oscilloscope shows Square wave.
4. Modify the waveform <Duty>, the way is to press F5 button when it displays main menu of the square wave. Then the selected parameter is highlighted.
5. Modify other parameters, please refer to <Generation Of A Sine Wave Function>
6. To change the parameters after being highlighted, user can use the front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.
7. To set the same phase between channel 1 and channel 2, please press F5 button when it displays main menu of the square wave.

4.3 Generation of A Ramp Wave Function

Ramp wave is non-sinusoidal waveforms.

Please follow these steps to output ramp wave:

1. Press Ramp wave button in the front panel, and the waveform is setting as <modulation mode>, <sweep mode> or <burst mode>, please turn the mode off;
2. Press channel output button in the front panel to open channel waveform output switch, then the button is lighting;
3. Oscilloscope shows ramp wave.
4. To modify the waveform <Symmetry>, the way is to press F5 button when it displays main menu of the square wave. Then the selected parameter is highlighted.
5. To modify other parameters, please refer to <Generation Of A Sine Wave Function>.
6. To change the parameters after being highlighted, use can use front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.
7. To set the same phase between channel 1 and channel 2, please press F5 button when it displays main menu of the ramp wave.

4.4 Generation of A Pulse Wave Function

Please follow these steps to output Pulse wave.

1. Press Pulse wave button in the front panel, and if the waveform is setting as <modulation mode>, <sweep mode> or <burst mode> ,please turn the mode off;
2. Press channel output button in the front panel open channel waveform output switch, then the button is lighting;
3. Oscilloscope shows pulse wave.
4. To modify the waveform <Leading Time>, the way is press F6 button to enter page 2 of main menu, then press F2 button. Then the selected parameter is highlighted.
5. To modify the waveform <Tailing Time>, the way is press F6 button to enter page 2 of main menu, then press F2 button twice when at the main menu of the square wave, then the selected parameter is highlighted.
6. To modify the waveform <Pulse Width>, the way is press F6 button to enter page 2 of main menu, then press F1 button when at the main menu of the square wave. Then the selected parameter is highlighted.
7. To modify the waveform <Duty>, the way is Press F6 button to enter page 2 of main menu, then press F1 button twice when at the main menu of the square wave. Then the selected parameter is highlighted.
8. To change the parameters after being highlighted, user can use the front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.
9. To make the channel with another channel phase alignment, press F5 button when it displays the main menu of the pulse wave.
10. To modify other parameters, please refer to <Generation Of A Sine Wave Function>

4.5 Generation of A Noise Wave Function

Noise can only in a continuous mode;

Please follow these steps to output a noise wave.

1. Press Noise wave button in the front panel;
2. Press channel output button in the front panel open channel waveform output switch, then the button is lighting;
3. Oscilloscope shows noise wave.
4. To change the parameters after being highlighted, user can use the front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.
5. To modify other parameters, please refer to <Generation Of A Sine Wave Function>

Note: Not do modulation and frequency sweep for noise wave.

4.6 Generation of An Arb. Wave Function

Please follow these steps to output arb wave:
1. Press Arb wave button in the front panel, and if the waveform is setting as <modulation mode>, <sweep mode> or <burst mode>, please turn the mode off;
2. The default waveform for Arbitrary wave is DC wave, To modify the current type of arbitrary wave,when in the main menu of the arbitrary wave, press F6 to enter page 2 of the menu, press the F2 key to enter wave type submenu, then use F1 to F6 function keys to select the waveform and press the F0 key to return to the main menu;
3. Press channel output button in the front panel to open channel waveform output switch, then the button is lighting;
4. Oscilloscope shows arb wave.
5. To modify other parameters, please refer to <Generation Of A Sine Wave Function>
6. To change the parameters after being highlighted, user can use the front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.
7. If <User-Defined Waveforms> is choosed, browse the machine internal dev (FLASH device) or an external storage device (<Usb Storage Device> or<SD card>), choose the waveform file suffix for hwf.
8. If <User-Defined Waveforms> is choosed, the <Sampling Frequency of Arbitrary Wave> and <Magnification Of Arbitrary Wave> params can be modified.
Note: user-defined waveform file can be generated by itself or using other tools.

4.7 Generation of A Harmonic Wave Function

Please follow these steps to output harmonic wave.
1. Press Harmonic wave button in the front panel, and if the waveform is setting as <modulation mode>, <sweep mode> or <burst mode>, please turn the mode off;
2. Press channel output button in the front panel open channel waveform output switch, then the button is lighting;
3. To modify the order of the <Harmonic Wave>, press F4 button when in the harmonic wave menu, then the button is lighting. Use the knob and digital keyboard to modify parameter values;
4. Specify the index of the Harmonic Wave order, press the F1 button when in the harmonic wave menu, then the button is lighting. Use the knob and digital keyboard to modify parameter values;
5. To modify the amplitude of specific harmonic wave, press F2 button when it displays harmonic wave menu, resulting of lighting on the buttons;

6. To modify the phase of specific harmonic wave, press f3 button when in the harmonic wave menu, then the button is lighting;
7. To modify the effective harmonic wave, press F5 button to select desired type in the harmonic wave menu.
8. Oscilloscope shows harmonic wave.
9. To change the parameters after being highlighted, user can use the front panel knobs and digital keyboard to input parameter values. Please refer to the <Method of inputting parameters>.

4.8 Method of input params

There are two methods
1. input by digital keypad in the front panel. Input the params to the dialog showed and choose units to confim or choose cancel to cancel.
2. input by knob button and direction buttons. Select bit in the params by direction buttons and increase or deincrease the value of the bit using konb button.

4.9 Mode Waveform

AM

Amplitude Modulation. AM make the high frequency carrier signal amplitude changes over modulation signal's instantaneous value.

FM

Frequency Modulation. Frequency modulation represent information to the change of instantaneous frequency of the carrier wave.

PM

Phase Modulation. PM is a form of modulation that represents information as variations in the instantaneous phase of a carrier wave

ASK

Amplitude Shift Keying. ASK is a form of amplitude modulation that represents digital data as variations in the amplitude of a carrier wave.
ASK uses a finite number of amplitudes, each assigned a unique pattern of binary digits. Usually, each amplitude encodes an equal number of bits.

FSK

Frequency-shift keying.is a frequency modulation scheme in which digital information is transmitted through discrete frequency
changes of a carrier wave.[1] The simplest FSK is binary FSK (BFSK).
BFSK uses a pair of discrete frequencies to transmit binary (0s and 1s) information.
[2] With this scheme, the "1" is called the mark frequency and the "0" is called the space frequency

PSK

PSK phase shift keying.is a digital modulation scheme that conveys data by changing, or modulating, the phase of a reference signal (the carrier wave).
Any digital modulation scheme uses a finite number of distinct signals to represent digital data.
PSK uses a finite number of phases, each assigned a unique pattern of binary digits.

BPSK

Binary Phase Shift Keying.BPSK (also sometimes called PRK, phase reversal keying, or 2PSK) is the simplest form of phase shift keying (PSK).
It uses two phases which are separated by 180°.

Signal Wave

In <modulation mode>, the signal wave is used to modulate the carrier signal waveform. It's source can ether be internal or be external.
The Shape of the Signal Wave should be choosed, when the source is inernal. Except Noise and Dc, Other wave can be Signal Wave.

Carrier

it is a waveform (usually sinusoidal) or sine wave that is modulated (modified) with an input signal for the purpose of conveying information.[1] This carrier wave is usually a much higher frequency than the input signal

Modulation Depth

it indicates how much the modulation varies around its "original" level. It's range is from 0% to 120%.

Frequency Deviation

it is used in FM radio to describe the maximum instantaneous difference between an FM modulated frequency and the nominal carrier frequency.
it must be less equal he nominal carrier frequency and the sum of the Frequency Deviation and carrier frequency must be less equal the sum
of the max of the type carrier and 10Khz.

Phase Deviation

It indicates by how much the modulated variable varies around its unmodulated level.

Duty Deviation

Duty Deviation and pulse width Deviation is modulated resulting in the variation of the average value of the waveform.

it's range is from 0 to 500ks. it must be less than the Pusle width and be limited with min pusle width and leading or trialing time.

PWM

Pulse Width Modulation. PWM is a modulation technique that conforms the width of the pulse, formally the pulse duration, based on modulator signal information.

Shift Keying Rate

Shift Keying Rate is the rate of the shift.

Hopping Frequncy

It is used in FSK as a rate of carrier frequncy changes.

Chapter5 SCPI Programming Reference

◆Introduction to the SCPI Language

◆Alphabetical List of SCPI Commands and Queries

◆Programming Examples

5.1 Introduction to the SCPI Language

The following four symbols are not the content of SCPI commands and will not be sent with the commands, but are usually used to describe the parameters in the commands.

Braces { }

The parameters enclosed in braces are optional and can be ignored.

Vertical Bar |

The vertical bar is used to separate multiple parameters and one of the parameters must be selected when sending the command.

Triangle Brackets < >

The parameter enclosed in the triangle brackets must be replaced by an effective value.

Square Brackets [ ]

The content (parameter or keyword) enclosed in the square brackets can be omitted. When the parameter is omitted, the instrument will set the parameter to its default.

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based instrument command language designed for test and measurement instruments. SCPI commands are based on a hierarchical structure, also known as a *tree system*. In this system, associated commands are grouped together under a common node or root, thus forming *subsystems*. A portion of the OUTPut subsystem is shown below to illustrate the tree system.

Syntax Conventions

The format used to show commands is illustrated below:

SOURce<n>:VOLTage <amplitude>|MINimum|MAXimum

SOURce<n>:FREQuency:CENTer {<frequency>|MINimum|MAXimum}

The command syntax shows most commands (and some parameters) as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. For shorter program lines, you can send the abbreviated form. For better program readability, you can send the long form.

For example, in the above syntax statement, VOLT and VOLTAGE are both acceptable forms. You can use upper- or lower-case letters. Therefore, VOLTAGE, volt, and Volt are all acceptable. Other forms, such as VOL and VOLTAG, are not valid and will generate an error.

◆Braces (**{ }**) enclose the parameter choices for a given command string. The braces are not sent with the command string.

◆A vertical bar (|) separates multiple parameter choices for a given command string. The bar is not sent with the command string.

◆Triangle brackets in the second example (**< >**) indicate that you must specify a value for the enclosed parameter. For example, the above syntax statement shows the <*frequency*> parameter enclosed in triangle brackets. The brackets are not sent with the command string. You must specify a value for the parameter (for example "FREQ:CENT 1000") unless you select another option shown in the syntax (for example "FREQ:CENT MIN").

◆Some syntax elements (for example nodes and parameters) are enclosed in square brackets

(**[ ]**). This indicates that the element is optional and can be omitted. The brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument chooses a default value.

Command Separators

A colon (**:**) is used to separate a command keyword from a lower-level keyword. You must insert a blank space to separate a parameter from a command keyword.

Using the MIN andMAX Parameters

For many commands, you can substitute "MIN" or "MAX" in place of a parameter. For example, consider the following command:

SOURce<n>:VOLTage:OFFSet <offset>|MINimum|MAXimum

Instead of selecting a specific value for the <*offset*> parameter, you can substitute MIN to set the offset to its minimum value, MAX to set the offset to its maximum value.

SCPI Command Terminators

A command string sent to the instrument must terminate with a <new line> (<NL>) character. The IEEE-488 EOI(End-Or-Identify) message is interpreted as a <NL> character and can be used to terminate a command string in place of a <NL> character. A <carriage return> followed by a <NL> is also accepted. Command string termination will always reset the current SCPI command path to the root level.

IEEE-488.2 Common Commands

The IEEE-488.2 standard defines a set of common commands that perform functions such as reset, self-test, and status operations. Common commands always begin with an asterisk (*****), are three characters in length, and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (**;**) to separate multiple commands as shown below:

*RST**;** *CLS**;** *ESE 32**;** *OPC?

SCPI Parameter Types

The SCPI language defines several data formats to be used in program messages and response messages.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. Special values for numeric parameters such as MIN and MAX are also accepted. You can also send engineering unit suffixes with numeric parameters (e.g., M, k, m, or u). If a command accepts only certain specific values, the instrument will automatically round the input numeric parameters to the accepted values. The following command requires a numeric parameter for the frequency

value:

SOURce<n>:FREQuency:CENTer <frequency>|MINimum|MAXimum

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (like IMMediate, EXTernal). They may have a short form and a long form just like command keywords. You can mix upper- and lower-case letters.

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrumentwill accept "OFF". For a true condition, the instrument will accept "ON".

ASCII String Parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote. You can include the quote delimiter as part of the string by typing it twice without any characters in between.

5.2 Alphabetical List of SCPI Commands and Queries

AM Subsystem
ASK Subsystem
BPSK Subsystem
BURSt Subsystem
CALibration Subsystem
DATA Subsystem
DISPlay Subsystem
FM Subsystem
FREQuency Subsystem
FSKey Subsystem
FUNCtion Subsystem
HARMonic Subsystem
IEEE-488.2 Common Commands
MARKer Subsystem
MEMory Subsystem
MMEMory Subsystem
OUTPut Subsystem
PHASe Subsystem
PM Subsystem
PSK Subsystem
PWM Subsystem
SOURce Subsystem
SWEep Subsystem
SYSTem Subsystem
VOLTage Subsystem

5.2.1 AM Subsystem

The AM subsystem allows you to add amplitude modulation (AM) to a carrier waveform.

SOURce<n>:MOD:AM:DEPTh <depth>|MINimum|MAXimum

SOURce<n>:MOD:AM:DEPTh? [MINimum|MAXimum]

Parameter	Typical Return
0% to 120%, default 50%	+5.000000000000000E+01
Set the modulation of CH1 to 50%: SOURce1:MOD:AM:DEPTh 50	

- To achieve modulation depth greater than 100%, output carrier amplitude may be reduced.
- With AM:SOURce EXTernal, carrier waveform is modulated with an external waveform.

SOURce<n>:MOD:AM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:AM:INTernal:FREQuency? [MINimum|MAXimum]

Set frequency of modulating waveform. The waveform chosen as modulating source will operate at that frequency, within waveform frequency limits.

Parameter	Typical Return
2 mHz to 500 kHz	+1.000000000000000E+02
Set the modulation frequency of CH1 100Hz：SOURce1:MOD:AM:INTernal:FREQuency 100	

- When you select an arbitrary waveform as the modulating source, the frequency changes to the frequency of the arbitrary waveform, which is based on the sample rate and the number of points in the arbitrary waveform.
- This command should be used only with the internal modulation source (AM:SOURce INTernal).

SOURce<n>:MOD:AM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:AM:INTernal:FUNCtion?

Selects shape of modulating waveform.

Parameter	Typical Return
SINusoid|SQUare|RAMP, default SINusoid	SINusoid, SQUare, or RAMP
Select a square wave as the modulating waveform of CH1: SOURce1:MOD:AM:INTernal:FUNCtion SQUare	

- This command should be used only with the internal modulation source (AM:SOURce INTernal).
- Pulse and DC cannot be carrier waveform for AM.

SOURce<n>:MOD:AM:SOURce INTernal|EXTernal

SOURce<n>:MOD:AM:SOURce?

SOURce<n>:MOD:FM:SOURce INTernal|EXTernal

SOURce<n>:MOD:FM:SOURce?

SOURce<n>:MOD:PM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PM:SOURce?

SOURce<n>:MOD:ASKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:ASKey:SOURce?

SOURce<n>:MOD:FSKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:FSKey:SOURce?

SOURce<n>:MOD:PSKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:PSKey:SOURce?

SOURce<n>:MOD:BPSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PWM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PWM:SOURce?

Select the source of the modulating signal.

Parameter	**Typical Return**
INTernal|EXTernal, default INTernal	INTernal, or EXTernal
Select external modulation source of CH1: SOURce1:MOD:AM:SOURce EXTernal (could also substituteASK, FM, BPSK, FSK, PM, PSAK or PWM for AM)	

SOURce<n>:MOD ON|OFF

SOURce<n>:MOD?

Enables or disables modulation.

Parameter	**Typical Return**
ON|OFF, default OFF	ON, or OFF
Enable modulation: SOURce1:MOD ON	

SOURce<n>:MOD:TYPe AM|FM|PM|ASK|FSK|PSK|PWM|BPSK

SOURce<n>:MOD:TYPe?

Select modulation type.

Parameter	**Typical Return**
TYPe AM|FM|PM|ASK|FSK|PSK|PWM|BPSK, default AM	AM, FM, PM, ASK, FSK, PSK, PWM or BPSK
Set FM modulation: SOURce<n>:MOD:TYPe FM	

◆To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

◆Only one modulation mode may be enabled at a time.

◆The instrument will not enable modulation with sweep or burst enabled. When you enable modulation, the sweep or burst mode is turned off.

◆PWM is allowed only when pulse is the selected function.

5.2.2 ASK Subsystem

ASK(Amplitude Shift Keying) is a form of amplitude modulation that represents digital data as variations in the amplitude of a carrier wave.

SOURce<n>:MOD:ASKey:AMPLitude <amplitude>|MINimum|MAXimum

SOURce<n>:MOD:ASKey:AMPLitude? [MINimum|MAXimum]

Sets amplitude of the modulating waveform

Parameter	**Typical Return**
0 Vpp to20 Vpp, default 2Vpp	+1.000000000000000E+00
Set the modulating amplitude to 1Vp-p for CH1:SOURce1:MOD:ASKey:AMPLitude 1	

SOURce<n>:MOD:ASKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:ASKey:INTernal:RATE? [MINimum|MAXimum]

Set the output frequency between carrier frequency and frequency hopping rate of "mobile".

Parameter	**Typical Return**
2 mHz to 1 MHz, default 100Hz	+2.000000000000000E+02
Set the modulating rate to 200Hz on CH1: SOURce1:MOD:ASKey:INTernal:RATE 200	

SOURce<n>:MOD:ASKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:ASKey:SOURce?

Select the source of the modulating signal (INTernal or EXTernal).

Parameter	**Typical Return**
INTernal|EXTernal, default INTernal	INTernal, or EXTernal
Select external modulation source on CH1: SOURce<n>:MOD:ASKey:SOURce EXTernal	

SOURce<n>:MOD:ASKey:POLarity POSitive|NEGative

SOURce<n>:MOD:ASKey:POLarity?

Select **POSitive or NEGative** of the modulating signal to control waveform output.

Parameter	**Typical Return**
POSitive|NEGative, default POSitive	POSitive, or NEGative
Select NEGative of the modulating signal to control waveform output: SOURce1:MOD:ASKey:POLarity NEGative	

5.2.3 BPSK Subsystem

The BPSK subsystem allows you to modulate a wave form with Binary Phase Shift Keying (BPSK), a digital modulation format. In BPSK, the carrier waveform is phase shifted between two phase settings using an on/off keying. The source may be internal, using a square wave at a specified frequency, or external, using the external trigger input.

SOURce<n>:MOD:BPSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:BPSKey:INTernal:RATE? [MINimum|MAXimum]

Sets the rate at which the output phase "shifts" between the carrier and offset phase.

Parameter	Typical Return
2 mHz to 1 MHz, default 100Hz	+2.000000000000000E+02
Set BPSK rate to 200Hz: SOURce1:MOD:BPSKey:INTernal:RATE 200	

◆The BPSK rate is used *only* when the *INTernal* source is selected (BPSK:SOURce INTernal) and is ignored when the EXTernal source is selected (BPSK:SOURce EXTernal).

◆The internal modulating waveform is a square wave with a 50% duty cycle.

SOURce<n>:MOD:BPSKey:PHASe <phase>|MINimum|MAXimum

SOURce<n>:MOD:BPSKey:PHASe ? [MINimum|MAXimum]

Sets the Binary Phase Shift Keying phase shift in degrees.

Parameter	Typical Return
0to 360 degrees, default 180 degrees	+0.000000000000000E-00
Set phase shift to 90 degrees: SOURce1:MOD:BPSKey:PHASe 90	

5.2.4 BURSt Subsystem

This section describes the BURSt subsystem.

Burst Modes

There are two burst modes, described below. The instrument enables one burst mode at a time.

◆**Triggered Burst Mode (default):** The instrument outputs a waveform for a number of cycles (burst count) each time a trigger is received. After outputting the specified number of cycles, the instrument stops and waits for the next trigger. You can configure the instrument to use an internal trigger to initiate the burst or you can provide an external trigger by pressing the front-panel **[Trig Menu]** key, by applying a trigger signal to the front-panel **TRIG** connector, or by sending a software trigger command from the remote interface.

◆**External Gated Burst Mode:** The instrument output is either "on" or "off" based on the level of the external signal applied to the front-panel **TRIG** connector. When this signal is true, the instrument outputs a continuous waveform. When this signal goes false, the current waveform cycle is completed and then the instrument stops while remaining at the voltage corresponding

to the starting burst phase of the waveform.

The following table shows which modes are associated with which burst features.

SOURce<n>:BURSt:GATE:POLarity NORMal|INVerted

SOURce<n>:BURSt:GATE:POLarity?

Selects NORMal or INVerted logic levels on the front-panel **TRIG** connector for an externally gated burst.

Parameter	**Typical Return**
NORMal|INVerted, default NORMal	NORMal, or INVerted
Select INVerted for an externally gated burst: SOURce1:BURSt:GATE:POLarity INVerted	

SOURce<n>:BURSt:MODE TRIGgered|GATed|INFinity

SOURce<n>:BURSt:MODE?

Selects the burst mode.

Parameter	**Typical Return**
TRIGgered|GATed|INFinity, default TRIGgered	TRIGgered, GATed, or INFinity
Set gated burst mode: SOURce<n>:BURSt:MODE GATed	

◆TRIGgered: the instrument outputs a waveform for a number of cycles (burst count) each time a trigger is received from the trigger source (SOURce<n>:BURSt:TRIGger:SOURce).

◆In GATed burst mode, the output waveform is on or off, based on the signal at the rear-panel **TRIG** connector. Select this signal's polarity using SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative. When the gate signal is true, the instrument outputs a continuous waveform.

◆GATed: burst count, burst period, and trigger source are ignored (these are used for the triggered burst mode only). I

SOURce<n>:BURSt:NCYCles <cycles>|MINimum|MAXimum

SOURce<n>:BURSt:NCYCles? [MINimum|MAXimum]

Sets the number of cycles to be output per burst (triggered burst mode only).

Parameter	**Typical Return**
1 to 1 000 000(External or manual trigger); 1 to 500 000(Internal), only for N cycle; Default 1	+5.000000000000000E+00
Return number of cycles per burst: SOURce1:BURSt:NCYCles 5	

SOURce<n>:BURSt ON|OFF

SOURce<n>:BURSt?

Enables or disables burst mode.

Parameter	Typical Return
ON|OFF, default OFF	ON or OFF
Enable burst mode: SOURce1:BURSt ON	

◆Output phase is set to 0 when burst is enabled.

◆To avoid multiple waveform changes, enable the burst mode after configuring the other burst parameters.

◆The instrument will not allow the burst mode to be enabled at the same time that sweep or any modulation mode is enabled. When you enable burst, the sweep or modulation mode is turned off.

SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative

SOURce<n>:BURSt:TRIGger:SLOPe?

Select **POSitive or NEGative** of the external trigger signal to start sweep output.

Parameter	Typical Return
POSitive|NEGative, default POSitive	POSitive or NEGative
Select NEGative of the external trigger signal to start sweep output: SOURce<n>:BURSt:TRIGger:SLOPe NEGative	

5.2.5 CALibration Subsystem

The CALibration subsystem is used to calibrate the instrument.

CALibration:SETup <step>

CALibration?

CALibration:VALue <value>

CALibration:STORe

CALibration?

Performs a calibration using the calibration value (CALibration:VALue).

Parameter	Typical Return
none	0(pass) or +1(fail)
Calibrate using the current value: CALibration?	

◆CALibration:SETup should always precede the CALibration? query.

◆Modifies the volatile version of the calibration constants. Use CALibration:STORe to save these constants in nonvolatile memory at end of calibration.

CALibration:SETup <step>

Configures the calibration step to be performed.

Parameter	Typical Return
Whole number, 1 to 8	none
Prepare for calibration step 5: CALibration:SETup 5	

◆This setting is non-volatile; it will not be changed by power cycling or *RST.

CALibration:STORe

Takes calibration constants in volatile memory (CALibration?), and places them in nonvolatile memory, where they will not be changed by power cycle.

Parameter	Typical Return
none	无
Store calibration constants into non-volatile memory: CAL:STOR	

CALibration:VALue <value>

Specifies the value of the known calibration signal.

Parameter	Typical Return
Numeric, default 0	none
-	

◆This setting is non-volatile; it will not be changed by power cycling or *RST.

5.2.6 COUNter Subsystem

COUNter ON|OFF

COUNter:MEASure?

COUNter:GATEtime

COUNter:GATEtime?

COUNter:TYPE

COUNter ON|OFF

Enable or disable frequency meter.

Parameter	Typical Return
ON|OFF, default OFF	ON , or OFF
COUNter ON	

COUNter:MEASure?

Get current counter measurement value.

Parameter	Typical Return
	Current frequency or counter

COUNter:GATEtime AUTO|USER1|USER2|USER3|USER4|USER5|USER6

COUNter:GATEtime?

Set **GATEtime**

Parameter	Typical Return
AUTO AUTO	AUTO, USER1, USER2, USER3, USER4, USER5,

USER1 1 ms USER2 10 ms USER3 100 ms USER4 1 s USER5 10 s USER6 >10 s	or USER6

COUNter:TYPE LFCOUNTER|LFFREQ|HFCOUNTER|HFFREQ

Set counter type.

Parameter	Typical Return
LF_COUNTER|LF_FREQ|HF_COUNTER |HF_FREQ, default LF_COUNTER	LF_COUNTER, LF_FREQ|HF_COUNTER, or HF_FREQ

5.2.7 DATA Subsystem

The DATA subsystem manages user-defined arbitrary waveforms.

SOURce<n>:DATA:DAC16 <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

Download data (.dac format) to ddr2

SOURce<n>:DATA: <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

Download data (float format) to ddr2

SOURce<n>:DATA:OUTPut <start_addr>,<end_addr>

Output data in specified address.

SOURce<n>:DATA:DAC16 <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

Parameter	Typical Return
<addr> Hexadecimal number, from 0x00to 64M, 4Byte	none
<dots_num> Decimal number	
<binary_block> Binary number, dots_num*2 byte, starting as “#”	
<value> Integer, from -32767 to +32767	

SOURce<n>:DATA: <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

Parameter	Typical Return
<addr> Hexadecimal number, from 0x00to 64M, 4Byte	无
<dots_num> Decimal number	
<binary_block> Binary number, dots_num*4 byte, starting as “#”	
<value> Integer, from -1 to +1	

SOURce<n>:DATA:OUTPut <start_addr>,<end_addr>

Parameter	Typical Return
<start_addr> Hexadecimal number, from 0x00to 64M, 4Byte	
<end_addr> Hexadecimal number, from 0x00to 64M, 4Byte	

5.2.8 DISPlay Subsystem

The DISPlay subsystem controls the instrument's display.

DISPlay:BRIGhtness <brightness>|MINimum|MAXimum

DISPlay:BRIGhtness? [MINimum|MAXimum]

Set the display bringhtness.

Parameter	Typical Return
1% to 100%, default 50%	80%
DISPlay:BRIGhtness 80	

DISPlay:SAVer ON|OFF

DISPlay:SAVer ?

Enable or disable display saver.

Parameter	Typical Return
ON|OFF, default ON	ON, or OFF
Enable display saver: DISPlay:SAVer:STATe ON	

5.2.9 FM Subsystem

SOURce<n>:MOD:FM:DEViation <deviation>|MINimum|MAXimum

SOURce<n>:MOD:FM:DEViation? [MINimum|MAXimum]

Sets the peak frequency deviation in Hz.

Parameter	Typical Return
Default 500Hz	+1.000000000000000E+03
Set peak frequency deviation to 1 kHz: SOURce1:MOD:FM:DEViation 1000	

◆The deviation cannot exceed the carrier frequency. If you attempt to set a deviation that exceeds the carrier frequency (with FM enabled), the instrument will adjust the deviation to the maximum value allowed for that carrier frequency.

◆The carrier frequency plus the deviation cannot exceed the selected function's maximum frequency plus 100 kHz. If you attempt to set the deviation to an invalid value, the instrument adjusts it to the maximum value allowed with the present carrier frequency.

◆If the deviation causes the carrier waveform to exceed a frequency boundary for the current duty

cycle (square waveform only), the instrument will adjust the duty cycle to the maximum value allowed with the present carrier frequency.

◆If you select the *External* modulating source, the deviation is controlled by the ±5 V signal level on the rear-panel **Modulation In** connector.For example, if the frequency deviation is 100 kHz, then a +5 V signal level corresponds to a 100 kHz increase in frequency.Lower external signal levels produce less deviation and negative signal levels reduce the frequency below the carrier frequency.

Deviation is valid under these conditions:

deviation≤carrier frequency

deviation + carrier frequency≤ carrier upper frequency limit + 1 kHz

SOURce<n>:MOD:FM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FM:INTernal:FREQuency? [MINimum|MAXimum]

Sets the frequency of the modulating waveform. The modulating source waveform operates at that frequency, within the frequency limits of that waveform.

Parameter	**Typical Return**
2 mHz to 500 kHz, default 100Hz	+5.000000000000000E+02
Set the modulating frequency to 500Hz: SOURce1:MOD:FM:INTernal:FREQuency 500	

◆When you select an arbitrary waveform as the modulating source, the frequency changes to the frequency of thearbitrary waveform, which is based on the sample rate and the number of points in the arbitrary waveform.

◆This command should be used only with the internal modulation source (FM:SOURce INTernal).

SOURce<n>:MOD:FM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:FM:INTernal:FUNCtion?

This command selects the shape of the modulating waveform.

Parameter	**Typical Return**
SINusoid|SQUare|RAMP, default SINusoid	SINusoid, SQUare, or RAMP
Select a squarewave as the modulating waveform: SOURce1:MOD:FM:INTernal:FUNCtion SQUare	

◆This command should be used only with the internal modulation source (FM:SOURce INTernal).

5.2.10 FREQuency Subsystem

The FREQuency subsystem sets the instrument's output frequency.

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

SOURce<n>:FREQuency? [MINimum|MAXimum]

Sets the output frequency.

Parameter	Typical Return
Different waveform has diffenent frequency range, please refer to Output Configuration and Appendix B	+1.000000000000000E+03
Set output frequency to 100 Hz: SOURce1:FREQuency 100	

SOURce<n>:FREQuency:CENTer <frequency>|MINimum|MAXimum

SOURce<n>:FREQuency:CENTer? [MINimum|MAXimum]

Sets the center frequency. Used with frequency span for a frequency sweep.

Parameter	Typical Return
Different waveform has diffenent frequency range, please refer to Output Configuration and Appendix B Default 550Hz	+1.000000000000000E+03
Set sweep center frequency to 1 kHz: SOURce1:FREQuency:CENTer 1000	

◆The following equation shows how span relates to start and stop frequencies.

Frequency Span = Stop Frequency + Start Frequency

◆The following equation shows how center frequency relates to start and stop frequencies.

Center Frequency = (|Stop Frequency + Start Frequency|)/2

5.2.11 FSKey Subsystem

FSKey subsystem sets Frequency-shift keying (FSK) waveform.

SOURce<n>:MOD:FSKey:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FSKey:FREQuency? [MINimum|MAXimum]

Sets the FSK hopping frequency.

Parameter	Typical Return
please refer to Output Configuration and Appendix B Default 100Hz	+2.000000000000000E+02
Sets hopping frequency of FSK modulating signal to 200Hz on CH1: SOURce1:MOD:FSKey:FREQuency 200	

SOURce<n>:MOD:FSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FSKey:INTernal:RATE? [MINimum|MAXimum]

Set rate of the output frequency between carrier frequency and hopping frequency.

Parameter	Typical Return

2 mHz to 1 MHz, default 100Hz	+2.000000000000000E+02
Sets rate of FSK modulating signal to 200Hz on CH1: SOURce1:MOD:FSKey:INTernal:RATE 200	

◆The FSK rate is used with the internal source(FSK:SOURce INTernal).

5.2.12 FUNCtion Subsystem

The FUNCtion subsystem configures the instrument's output function:

SOURce<n>:FUNCtion <wave>

output waveform

SOURce<n>:FUNCtion:ARBitrary <filename>

Output arbitrary waveform file

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak

peak-to-peak voltage for an arbitrary waveform

SOURce<1|2>:FUNCtion:ARBitrary:SRATe

sample rate for arbitrary waveform

SOURce<n>:FUNCtion:SQUare:DCYCle

pulse duty cycle for pulse

SOURce<n>:FUNCtion:RAMP:SYMMetry

symmetry percentage for ramp

SOURce<n>:FUNCtion:PULSe:DCYCle

pulse duty cycle for pulse

SOURce<n>:FUNCtion:PULSe:WIDTh

pulse width

SOURce<n>:FUNCtion:PULSe:TRANsition:LEADing

Leading edge time for pulse

SOURce<n>:FUNCtion:PULSe:TRANsition:TRAiling

Trailing edge time for pulse

SOURce<n>:FUNCtion <wave>

SOURce<n>:FUNCtion?

Selects output function.

Parameter	Typical Return
SINusoid|SQUare|RAMP| PULSe|NOISe|DC|SINC|EXPFall|HAVErsine |LOREntz| DUALtone|GAUSe| ECG| USER| HARMonic|, default SINusoid	SINusoid, SQUare, RAMP, PULSe, NOISe, DC, SINC, EXPFall、HAVErsine, LOREntz, DUALtone, GAUSe, ECG, USER, or HARMonic|
Set output on channel 1 to sine: SOURce1:FUNCtion SINusoid	

◆NOISe generates white gaussian noise

◆ARB generates the arbitrary waveform currently selected by FUNCtion:ARBitrary.

SOURce<n>:FUNCtion:ARBitrary <filename>, SOURce<n>:FUNCtion:ARBitrary?

Parameter	Typical Return
Effective filename: including user-defined file and built-in waveform file; Common use: ”INT:/Builtin/SINC.hwf”,"INT:/Mywave.hwf"," SD:/mywave.hwf","USB:/mywave.hwf"	File name
Set arbitrary filename output: INT:/Builtin/SINC.hwf SOURce1:FUNCtion:ARBitrary "INT:/Builtin/SINC.hwf", return Int:/Builtin/SINC.hwf	

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak <voltage>|MINimum|MAXimum,

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak?{MINimum|MAXimum}

Sets peak to peak voltage.

Parameter	Typical Return
Discrete values 1,4,5,20, default 1V	+4.000000000000000E+00
Set peak to peak voltage to 4 V: SOURce1:FUNCtion:ARBitrary:PTPeak 4	

SOURce<1|2>:FUNCtion:ARBitrary:SRATe {<sample_rate>|MINimum|MAXimum},

SOURce<1|2>:FUNCtion:ARBitrary:SRATe? {MINimum|MAXimum}

Sets the sample rate for the arbitrary waveform.

Parameter	Typical Return
From 1 to 255, default 1	+2.500000000000000E+07
Set sample rate on CH1 to25MSa/s: SOURce1:FUNCtion:ARBitrary:SRATe 10	

sample rate = 250M/(4*n)

n: the setting value by user

When n is 0, the sample rate is 250M.

SOURce<n>:FUNCtion:SQUare:DCYCle <percent>|MINimum|MAXimum，

SOURce<n>:FUNCtion:SQUare:DCYCle? [MINimum|MAXimum]

Sets pulse duty cycle.

Parameter	Typical Return
0.001% to 99.996%，limited as described below, default 50%	+3.000000000000000E+01
Set duty cycle to 30%: SOURce1:FUNCtion:SQUare:DCYCle 30	

SOURce<n>:FUNCtion:RAMP:SYMMetry <symmetry>|MINimum|MAXimum，

SOURce<n>：FUNCtion:RAMP:SYMMetry? [MINimum|MAXimum]

Sets the symmetry percentage for ramp waves.

Parameter	Typical Return
0% to 100%, default 50%	+3.000000000000000E+01
Set symmetry on CH1 to 30%: SOURce1:FUNCtion:RAMP:SYMMetry 30	

SOURce<n>:FUNCtion:PULSe:DCYCle <percent>|MINimum|MAXimum

SOURce<n>:PULSe:DCYCle? [MINimum|MAXimum]

Sets pulse duty cycle.

Parameter	Typical Return
0 % to 100%, default 50%	+3.000000000000000E+01
Set duty cycle on CH1 to 30%: SOURce1:FUNCtion:PULSe:DCYCle 30	

◆The FUNCtion:PULSe:DCYCle and FUNCtion:PULSe:WIDTh commands affect the same parameter.

◆The pulse duty cycle is defined as:

Duty Cycle = 100 x Pulse Width ÷ Period

Pulse width is the time from the 50% threshold of a pulse's rising edge to the 50% threshold of the next falling edge.

◆The pulse duty cycle range is 0 percent to 100 percent. However, the pulse duty cycle is limited by *minimum pulse width* and *edge time* restrictions, which prevent you from setting exactly 0 percent or 100 percent. For example, for a 1 kHz pulse waveform, you are typically restricted to pulse duty cycles in the range 0.002 percent to 99.998 percent, limited by the minimum pulse width of 16 ns.

◆*Restrictions Based on Pulse Width:* The specified pulse duty cycle must conform to the following restrictions determined by the *minimum pulse width* (Wmin).

Duty Cycle ≥ (Wmin / Period) X 100

Duty Cycle ≤ (1 – Wmin / Period) X 100

SOURce<n>:FUNCtion:PULSe:WIDTh <seconds>|MINimum|MAXimum

SOURce<n>:FUNCtion:PULSe:WIDTh? [MINimum|MAXimum]

Sets pulse width.

Parameter	Typical Return
16ns to 1000μs, default 500μs	+5.000000000000000E-03
Set pulse width on CH1 to 5 ms: SOURce1:FUNCtion:PULSe:WIDTh 0.005	

◆The FUNCtion:PULSe:DCYCle and FUNCtion:PULSe:WIDTh commands affect the same parameter.

◆Pulse width is the time from the 50% threshold of a pulse's rising edge to the 50% threshold of the next falling edge.

◆ Pulse Width ≥ Wmin

Pulse Width ≤ Period - 2 x Wmin

SOURce<n>:FUNCtion:PULSe:TRANsition:LEADing<seconds>|MINimum|MAXimum
SOURce<n>:PULSe:TRANsition:LEADing? [MINimum|MAXimum]

SOURce<n>:FUNCtion:PULSe:TRANsition:TRAiling <seconds>|MINimum|MAXimum
SOURce<n>:PULSe:TRANsition:TRAiling? [MINimum|MAXimum]

Sets the pulse edge time on the leading, trailing, or both edges of a pulse.

Parameter	**Typical Return**
Default 1μs	+1.000000000000000E-08
Set leading edge time on CH1 to 10 ns: SOURce1:FUNCtion:PULSe:TRANsition:LEADing 0.00000001 Set trailing edge time on CH1 to 10 ns: SOURce1:FUNCtion:PULSe:TRANsition:TRAiling 0.00000001	

◆The leading edge time applies to rising edge, and represents the time from the 10% threshold to the 90% threshold of the edge; the trailing edge represents the time from the 90% threshold to the 10% threshold.

◆The specified edge time must fit within the specified pulse width and period. The instrument will limit the edge time to accommodate the specified pulse width or duty cycle.

5.2.13 HARMonicSubsystem

SOURce<n>:HARMonic:AMPL –Harmonic amplitude
SOURce<n>:HARMonic:PHASe –Harmonic phase
SOURce<n>:HARMonic:ORDEr –Harmonic order
SOURce<n>:HARMonic:TYPe –Harmonic type

SOURce<n>:HARMonic:AMPL <sn>,<value>|MINimum|MAXimum
SOURce<n>:HARMonic:AMPL?

Set Harmonic amplitude

Parameter	**Typical Return**
<sn> integer, 2 to 16, default 2; <value>Continuous real Numbers	none
Set second harmonic amplitude to 1 VPPon CH1: SOURce1:HARMonic:AMPL 2,1	

SOURce<n>:HARMonic:PHASe <sn>,<value>|MINimum|MAXimum
SOURce<n>:HARMonic:PHASe? <sn>[,MINimum|MAXimum]

Set Harmonic phase.

Parameter	**Typical Return**

<sn> integer, 2 to 16, default 2; <value>Continuous real Numbers, 0 to 360degrees, default 0	以科学计数形式返回指定次谐波的相位值
Set two Harmonic phase on CH1 to 90 degrees: SOURce1:HARMonic:PHASe 2,90	

SOURce<n>:HARMonic:ORDEr <value>|MINimum|MAXimum

SOURce<n>:HARMonic:ORDEr? [MINimum|MAXimum]

Set Harmonic order.

Parameter	Typical Return
2 to the highest frequency ÷fundamental frequency, integer, Max 16, default 2	+8.000000000000000E+00
Set Harmonic order on CH1 to 8: SOURce1:HARMonic:ORDEr 8	

SOURce<n>:HARMonic:TYPe EVEN|ODD|ALL|USER

SOURce<n>:HARMonic:TYPe?

Select Harmonic type even, odd or all.

Parameter	Typical Return
EVEN|ODD|ALL, default ALL	EVEN, ODD, or ALL
Set harmonic type on CH1 to odd: SOURce1:HARMonic:HARMonic:TYPe ODD	

5.2.14 IEEE-488 Common Commands

*IDN? - Instrument identification

*RCL/*SAV - Recall/save instrument state

*RST - Reset instrument to factory defaults

*TRG - Trigger command, command is valid under sweep mode and burst mode

*TST? - Self-test

***IDN?**

Identification Query. Returns instrument's identification string.

Parameter	Typical Return
none	Return factory, model, series number andvesion
Return the instrument's identification string: *IDN?	

***RST**

Resets instrument to factory default state.

Parameter	Typical Return
none	none
Reset the instrument: *RST	

◆ Does not affect stored instrument states, stored arbitrary waveforms, or I/O settings; these are stored in non-volatile memory.

5.2.15 MARKer Subsytem

SOURce<n>:MARKer –Enable or disable sweep marker function

SOURce<n>:MARKer:FREQuency -Sets the marker frequency

SOURce<n>:MARKer ON|OFF

SOURce<n>:MARKer?

Enable or disable sweep marker function.

Parameter	**Typical Return**
ON|OFF, default OFF	ON, or OFF
Enable sweep marker on CH1: SOURce1:MARKer ON	

SOURce<n>:MARKer:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MARKer:FREQuency? [MINimum|MAXimum]

Sets the marker frequency.

Parameter	**Typical Return**
Any frequency between start and stop frequency, default 550 Hz	+1.000000000000000E+03
Set marker frequency to 1000Hz：SOURce2:MARKer:FREQuency 1000	

5.2.16 MEMory Subsystem

MEMory:STATe:DELete USER1|USER2|USER3|USER4|USER5

Deletes a state storage location.

Parameter	**Typical Return**
USER1|USER2|USER3|USER4|USER5	none
Delete the contents of storage location 1: MEM:STAT:DEL USER1?	

5.2.17 MMEMory Subsystem

The MMEMory subsystem manages the file system in the instrument or on an external USB file system. The file system can store and load several file formats.

Commands and Queries

The MMEMory subsystem includes the following commands and queries.

MMEMory:CATalog? - lists available and used space and files on Mass Memory device

MMEMory:CDIRectory - changes to a directory

MMEMory:COPY -copies a file on Mass Memory device

MMEMory:DELete -removes files from Mass Memory device

MMEMory:LOAD:STATe-loads saved instrument state from file

MMEMory:MDIRectory -makes a new directory (folder)

MMEMory:RDIRectory -removes a directory

MMEMory:STORe:STATe -stores instrument state to file

MMEMory:CATalog?

Returns a list of all files in the current mass storage directory, including internal storage and the USB drive.

MMEMory:CDIRectory <folder>

MMEMory:CDIRectory?

Amend the current path to < directory_name > specified path

ASCII type, String with a string of double quotes, limited to 256 characters

Parameter	**Typical Return**
String with a string of double quotes, limited to 256 characters.	(none)
MMEMory:CDIRectory "SD:/tmp	

MMEMory:COPY <folder>,<file_name>

Copies a file from < folder > to < file_name >(not current path).

<folder> ASCII type, String with a string of double quotes, limited to 256 characters.

<file_name> String with double quotation (including suffix), limited to 40 characters.

Parameter	**Typical Return**
Both files can be any valid file name	(none)
MMEMory:COPY "SD:/tmp","tmp1.hsf"	

MMEMory:DELete <file_name>

Deletes a file. To delete a folder, use MMEMory:RDIRectory.

Parameter	**Typical Return**
Any valid file name, including file extension.	(none)
Delete the indicated file from the root directory of the internal flash file system: MMEMory:DELete "Int:/tmp.hsf"	

MMEMory:LOAD:STATe <file_name>

MMEMory:STORe:STATe <file_name>

Loads or saves a complete instrument setup, using a named file on the mass storage.

Parameter	Typical Return
Any valid file name on current mass storage directory, including file extension.	no
Load a complete instrument setup from the file in internal mass memory: MMEMory:LOAD:STATe "Int:/tmp.hsf" Store instrument setup to the root directory of the internal flash file system: MMEMory:STORe:STATe "Int:/tmp.hsf"	

MMEMory:RDIRectory <folder>

MMEMory:MDIRectory <folder>

MMEMory:MDIRectory makes a new directory (folder) on the mass storage medium.

MMEMory:RDIRectory removes a directory (folder) on the mass storage medium.

Parameter	Typical Return
Any directory name, including the mass storage unit specifier, default INT:\ String with a string of double quotes, limited to 256 characters.	"INT:\"
MMEMory:RDIRectory MMEMory:MDIRectory "test"	

5.2.18 OUTPut Subsystem

The OUTPut subsystem controls the front-panel channel output and **Sync** connectors:

OUTPut<n> - front-panel channel output connector state

OUTPut:SYNC - front-panel **Sync** connector state

OUTPut<n> ON|OFF，

OUTPut<n>?

Enables or disables the front-panel output connector.

Parameter	Typical Return
ON|OFF, default OFF	ON, or OFF
Enable output connector for channel 1: OUTPut1 ON	

◆When output is enabled, the front-panel channel output key is illuminated.

◆OUTPut changes the state of the channel output connector by switching the output relay, without zeroing output voltage.

OUTPut:SYNC:SOURce CH1|CH2

Disables or enables the front-panel **Sync** connector.

Parameter	Typical Return

CH1|CH2, default CH1	ON or OFF
Disable front panel **Sync** connector for CH1: OUTPut:SYNC:SOURce CH1	

5.2.19 PHASeSubsystem

The PHASe subsystem allows you to adjust the waveform phase; this is useful in channel-to-channel and channel-to- ync applications. This subsystem also allows you to use the **10 MHz Out** and **10 MHz In** rear-panel connectors to synchronize multiple instruments.

SOURce<n>:PHASe -sets phase offset of output waveform (not available for arbitrary waveforms or noise)
SOURce<n>:PHASe:SYNChronize -synchronizes phase of both internal channels on a two-channel instrument.

SOURce<n>:PHASe <phase>|MINimum|MAXimum
SOURce<n>:PHASe? [MINimum|MAXimum]
Sets waveform's phase offset angle.

Parameter	**Typical Return**
0 to 360degrees, default 0	+9.0000000000000E+01
Set channel 1 phase offset to 90 degrees: SOURce1:PHASe 90	

◆Use PHASe:SYNChronize to synchronize the phases of the two internal channels.

SOURce<n>:PHASe:SYNChronize
Simultaneously resets all phase generators in the instrument to establish a common, internal phase zero reference point.

Parameter	**Typical Return**
none	none
Reset all phase generators: PHAS:SYNC	

◆SOURce1 and SOURce2 mean nothing for this command.
◆The setting is invalid when any channel is in a modulation mode in two channels.

5.2.20 PM Subsystem

The PM subsystem allows you to phase modulate a waveform.

SOURce<n>:MOD:PM:DEViation <deviation>|MINimum|MAXimum
SOURce<n>:MOD:PM:DEViation? [MINimum|MAXimum]
Sets the phase deviation in degrees. This value represents the peak variation in phase of the

modulated waveform from the carrier waveform.

Parameter	Typical Return
0 to 360degrees, default 180degrees	+9.000000000000000E+01
Set phase deviation to 90 degrees: SOURce1:MOD:PM:DEViation 90	

With the External modulating source, deviation is controlled by the ±5 V signal level on the front-panel **MOD** connector. For example, if you have set the frequency deviation to 180 degrees, then a +5 V signal level corresponds to a +180 degree phase deviation. Lower external signal levels produce less deviation, and negative signal levels produce negative deviation.

SOURce<n>:MOD:PM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PM:INTernal:FREQuency? [MINimum|MAXimum]

Sets the frequency of the modulating waveform. The waveform chosen as the modulating source will operate at that frequency, within the frequency limits of that waveform.

Parameter	Typical Return
2 mHz to 500 kHz, default 100Hz	+1.000000000000000E+04
Set modulating frequency to 10 kHz: SOURce1:MOD:PM:INTernal:FREQuency 10000	

◆This command should be used only with the internal modulation source (PM:SOURce INTernal).

SOURce<n>:MOD:PM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:PM:INTernal:FUNCtion?

Selects shape of modulating waveform.

Parameter	Typical Return
SINusoid|SQUare|RAMP, default SINusoid	SINusoid, SQUare, or RAMP
Select a square wave as the modulating waveform: SOURce1:MOD:PM:INTernal:FUNCtion SQUare	

◆This command should be used only with the internal modulation source (PM:SOURce INTernal).

SOURce<n>:MOD:PM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PM:SOURce?

Select the source(INTrnal or EXTenal) of the modulating signal.

Parameter	Typical Return
INTernal|EXTernal, default INTernal	INTernal, or EXTernal
Select external modulation source for CH1: SOURce1:MOD:FM:SOURce EXTernal	

5.2.21 PSK Subsystem

PSK phase shift keying.is a digital modulation scheme that conveys data by changing, or

modulating, the phase of a reference signal (the carrier wave).

Any digital modulation scheme uses a finite number of distinct signals to represent digital data.

PSK uses a finite number of phases, each assigned a unique pattern of binary digits.

SOURce<n>:MOD:PSKey:PHASe <phase>|MINimum|MAXimum

SOURce<n>:MOD:PSKey:PHASe ? [MINimum|MAXimum]

Sets the phase in degrees.

Parameter	Typical Return
0 to 360 degrees, default 180 degree	+9.000000000000000E+01
Sets the phaseon CH1 to 90degrees: SOURce1:MOD:PSKey:PHASe 90	

SOURce<n>:MOD:PSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PSKey:INTernal:RATE? [MINimum|MAXimum]

Set the “mobile” rate of output frequency between carrier frequency and hopping frequency.

Parameter	Typical Return
2 mHz to 1 MHz, default 100Hz	+2.000000000000000E+02
Set PSK rate on CH1 to 200Hz: SOURce1:MOD:PSKey:INTernal:RATE 200	

SOURce<n>:MOD:PSKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:PSKey:SOURce?

Select the source(INTrnal or EXTenal) of the modulating signal.

Parameter	Typical Return
INTernal|EXTernal, default INTernal	INTernal, or EXTernal,
Select external modulation source for CH1: SOURce<n>:MOD:FSKey:SOURce EXTernal	

SOURce<n>:MOD:PSKey:POLarity POSitive|NEGative

SOURce<n>:MOD:PSKey:POLarity?

Select **POSitive or NEGative** of the modulating signal to control waveform output.

Parameter	Typical Return
POSitive|NEGative, default POSitive	POSitive, or NEGative
Set NEGative of ASK modulating signal on CH1: 将通道 1ASK 调制时的调制极性设置为负极性：SOURce1:MOD:PSKey:POLarity NEGative	

5.2.22 PWM Subsystem

The PWM subsystem allows you to perform pulse width modulation (PWM) on a pulse waveform.

SOURce<n>:MOD:PWM:DEViation <deviation>|MINimum|MAXimum

SOURce<n>:MOD:PWM:DEViation? [MINimum|MAXimum]

Sets pulse width deviation; the ± variation in width (in seconds) from the pulse width of the carrier pulse waveform.

Parameter	Typical Return

0 ns to 500 ks, default 200μs	+1.000000000000000E+00
Set pulse width deviation to1s: SOURce1:MOD:PWM:DEViation 1	

◆The pulse width deviation cannot exceed the current pulse width

◆The pulse width deviation is limited by the current edge time setting.

SOURce<n>:MOD:PWM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PWM:INTernal:FREQuency? [MINimum|MAXimum]

Selects frequency at which output pulse width shifts through its pulse width deviation. The waveform used as the modulating source will operate at that frequency, within frequency limits of that waveform.

Parameter	Typical Return
2 mHz to 500 kHz, default 100Hz	+1.000000000000000E+02
Set internal PWM frequency to 100Hz: SOURce1:MOD:PM:INTernal:FREQuency 100	

◆When you select an arbitrary waveform as the modulating source, the frequency changes to the frequency of the arbitrary waveform, which is based on the sample rate and the number of points in the arbitrary waveform.

◆This command should be used only with the internal modulation source (PWM:SOURce INTernal).

SOURce<n>:MOD:PWM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:PWM:INTernal:FUNCtion?

Selects shape of the internal modulating waveform.

Parameter	Typical Return
SINusoid|SQUare|RAMP, default SINusoid	SINusoid, SQUare, or RAMP
Select a square wave as the modulating waveform shape: SOURce1:MOD:PM:INTernal:FUNCtion SQUare	

◆This command should be used only with the internal modulation source (PWM:SOURce INTernal).

SOURce<n>:MOD:PWM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PWM:SOURce?

Select the source of the modulating signal.

Parameter	Typical Return
INTernal|EXTernal, default INTernal	INTernal, default EXTernal
Select external modulation source:: SOURce1:MOD:FM:SOURce EXTernal	

5.2.23 ROSCillatorSubsystem

The ROSCillator subsystem controls use of the 10 MHz reference oscillator and external reference oscillator input. The reference oscillator is the primary clock for all waveform synthesis. All waveforms are phase-locked to the reference oscillator, which therefore controls output signal frequency and phase.

ROSCillator:SOURce - selects internal or external reference oscillator source

SYSTem:ROSCillator:SOURce INTernal|EXTernal

SYSTem:ROSCillator:SOURce?

Parameter	**Typical Return**
INTernal|EXTernal, default INTernal	INTernal, or EXTernal
Use the external reference oscillator source: SYSTem:ROSCillator:SOURce EXTernal	

◆**EXTernal:**instrument uses signal on the rear-panel **10 MHz In** connector as reference, and generates an error if this signal is absent or the instrument cannot lock to it. In such error cases, instrument output continues, but the frequency will be unstable.

◆**INTernal:** instrument uses the internal reference oscillator and ignores the signal at the **10 MHz In** connector.

5.2.24 SOURce Subsystem

Subsystems Using the Optional SOURce Keyword

Because SOURce subsystem commands are often used without the SOURce keyword, these commands are listed by their individual subsystems, below:

AM
ASK
BPSK
BURSt
DATA
FM
FREQuency
FSKey
FUNCtion
MARKer
PHASe
PM
ROSCillator
SWEep
VOLTage

5.2.25 SWEepSubsystem

SOURce<n>:SWEep:HTIMe <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:HTIMe? [MINimum|MAXimum]

Sets number of seconds the sweep holds (pauses) at the stop frequency before returning to the start frequency.

Parameter	Typical Return
1 ms to 300 s, default 1s	+5.000000000000000E+00
Set sweep hold time to 5 seconds: SOURce1:SWEep:HTIMe 5	

SOURce<n>:SWEep:RTIMe <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:RTIMe ? [MINimum|MAXimum]

Sets number of seconds the sweep takes to return from stop frequency to start frequency.

Parameter	Typical Return
1 ms to 300 s, default 1s	+5.000000000000000E+00
Set sweep return time to 5s: SOURce1:SWEep:RTIMe 5	

SOURce<n>:SWEep ON|OFF

SOURce<n>:SWEep?

Enables or disables the sweep.

Parameter	Typical Return
ON|OFF, default OFF	ON or OFF
Enable sweep: SOURce1:SWEep ON	

SOURce<n>:SWEep:TIME <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:TIME? [MINimum|MAXimum]

Sets time (seconds) to sweep from start frequency to stop frequency.

Parameter	Typical Return
1 ms to 300 s, default 1s	+5.000000000000000E+00
Set sweep time to 5s: SOURce1:SWEep:TIME 5	

5.2.26 SYSTem Subsystem

The SYSTem subsystem manages instrument state storage, power-down recall, error conditions, self test, front-panel display control and remote interface configuration.

SYSTem:BEEPer -issues a single beep

SYSTem:BEEPer:STATe -disables or enables beeper

SYSTem:COMMunicate:LAN:GATEway - Set gateway

SYSTem:COMMunicate:LAN:IPADdress - Set IP address

SYSTem:COMMunicate:LAN:MAC - Find MAC address

SYSTem:COMMunicate:LAN:SMASk - Set smask

SYSTem:ERRor? - reads and clears one error from error queue

SYSTem:LANGuage - Select language

SYSTem:KLOCk - Remote keyboard Lock or unlock keyboard of the front panel

SYSTem:VERSion? -returns version of SCPI used by instrument

SYSTem:BEEPer

Issues a single beep.

Parameter	Typical Return
none	none
SYSTem:BEEPer	

◆This command overrides the current beeper state (the SYSTem:BEEPer:STATe). This means that you can issue asingle beep even if the beeper is turned off.

SYSTem:BEEPer:STATe ON|OFF

Disables or enables the beeper.

Parameter	Typical Return
ON|OFF, on ON	ON, or OFF
Enable beeper: SYSTem:BEEPer:STATe ON	

◆Turning off the beeper does not disable the front-panel key click.

◆A beep is always emitted (even with beep state OFF) when SYSTem:BEEPer is sent.

◆This setting is non-volatile; it will not be changed by power cycling or *RST.

SYSTem:COMMunicate:LAN:GATEway <address>

SYSTem:COMMunicate:LAN:GATEway?

Set gateway.

Parameter	Typical Return
0.0.0.0 to 223.255.255.255(127.x.x.x is not included)	nnn.nnn.nnn.nnn
Set gateway to 192.168.1.1: SYSTem:COMMunicate:LAN:GATEway 192.168.1.1	

SYSTem:COMMunicate:LAN:IPADdress <ip_addr>

SYSTem:COMMunicate:LAN:IPADdress?

Set IPaddress

Parameter	Typical Return
0.0.0.0 to 223.255.255.255(127.x.x.x is not included)	IP: nnn.nnn.nnn.nn
Set IP to 192.168.1.118: SYSTem:COMMunicate:LAN:IPADdres 192.168.1.118	

SYSTem:COMMunicate:LAN:MAC?

Find MAC address

SYSTem:COMMunicate:LAN:SMASk <mask>

SYSTem:COMMunicate:LAN:SMASk?

Set smask

Parameter	**Typical Return**
0.0.0.0 to 255.255.255.255	Smask: nnn.nnn.nnn.nn
Set smask to 192.168.1.118: SYSTem:COMMunicate:LAN:IPADdres 192.168.1.118	

SYSTem:ERRor?

Reads and clears one error from error queue.

Parameter	**Typical Return**
none	-113, "Undefined header; keyword cannot be found"; No error: 0, "No Error"。
Read and clear first error in error queue: SYST:ERR?	

SYSTem:LANGuage ENGLish|SCHinese，SYSTem:LANGuage?

Set language to English or SCHinese.

Parameter	**Typical Return**
ENGLish|SCHinese, default ENGLish	ENGLish, or SCHinese
Set language to SChinese: SYSTem:LANGuage SCHinese	

SYSTem:KLOCk ON|OFF

SYSTem:KLOCk?

Remotely enable or disable front-panel keyboard.

Parameter	**Typical Return**
ON|OFF, default OFF	ON, or OFF
Disable front-panel keyboard: SYSTem:KLOCk ON	

SYSTem:VERSion?

Find and return SCP version information

Parameter	**Typical Return**
none	Return SCPI information
Find and return SCP version information: SYSTem:VERSion?	

5.2.27 VOLTage Subsystem

The VOLTage subsystem sets parameters related to output voltage.

SOURce<n>:VOLTage <amplitude>|MINimum|MAXimum

SOURce<n>:VOLTage? [{MINimum|MAXimum}]

Sets output amplitude.

Parameter	Typical Return
2 mVpp to 20 Vpp, default 200mVpp	+10.0000000000000E+00
Set output amplitude on CH1 to 10Vpp: SOURce1:VOLTage 10	

SOURce<n>:VOLTage:OFFSet <offset>|MINimum|MAXimum

SOURce<n>:VOLTage:OFFSet? [MINimum|MAXimum]

Sets DC offset voltage.

Parameter	Typical Return
-10 to +10V, default 0V	+1.0000000000000E-01
Set offset voltage to on CH1 100 mV: SOURce1:VOLTage:OFFSet 0.1	

◆The relationship between offset voltage and output amplitude is shown below.

|Voffset| < Vmax - Vpp/2

◆Setting the high and low levels also sets the waveform amplitude and offset. For example, if you set the high level to +2 V and the low level to -3 V, the resulting amplitude is 5 Vpp, with a -500 mV offset.

5.3 Programming Examples

These programming examples help you get started with common tasks.

Configure a Sine Wave

Configure a Square Wave

Configure a Ramp Wave

Configure a Pulse Wave

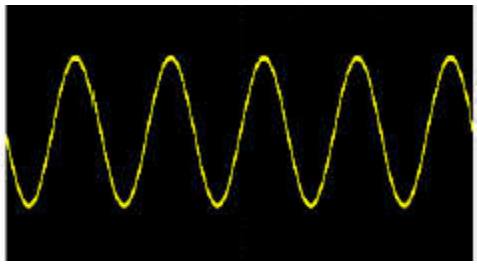
5.3.1 Configure a Sine Wave

This section describes the configuration of a sine wave function.

Description

A sine wave has amplitude, offset, and phase relative to sync pulse.

The following commands produce the sine wave shown above.



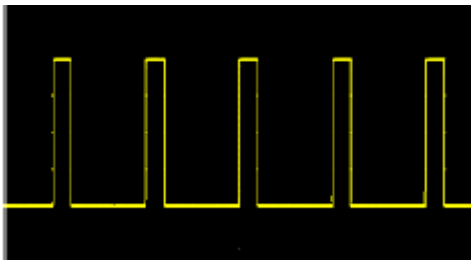
SOURce1:FUNCtion SINusoid
SOURce1:FREQuency 100000
SOURce1:VOLTage 2
OUTPut1 ON
SOURce1:PHASe 90

5.3.2 Configure a Square Wave

Description

A square wave has amplitude, offset, and phase relative to sync pulse. It also has duty cycle and period. Its amplitude and offset can also be set using high and low voltage values.

The following commands produce the square wave shown above.



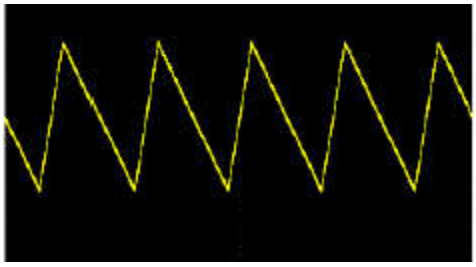
SOURce1:FUNCtion SQUare
SOURce1:FUNCtion:SQUare:DCYCle 20
SOURce1:FREQuency 100000
SOURce1:VOLTage 4
OUTPut1 ON

5.3.3 Configure a Ramp Wave

Description

A ramp wave has amplitude, offset, and phase relative to sync pulse. It also has symmetry for creating triangular and other similar waveforms.

The following commands produce the ramp wave shown above.



SOURce1:FUNCtion RAMP
SOURce1:FUNCtion:RAMP:SYMMetry 25
SOURce1:FREQuency 1000
SOURce1:VOLTage 2
SOURce1:VOLTage:OFFSet 1.0
OUTPut1 ON

5.3.4 Configure a Pulse Wave

Description

A pulse wave has amplitude, offset, and phase relative to sync pulse. It also adds edge slope, period, and duty cycle (orpulse width). Its amplitude and offset can also be set using high and low voltage values.

The following commands produce the pulse wave shown above.

SOURce1:FUNCtion PULS
SOURce1:FUNCtion:PULSe:TRANsition:LEADing 0.00000004
SOURce1:FUNCtion:PULSe:TRANsition:TRAiling 0.000001
SOURce1:FUNCtion:PULSe:WIDTh 0.000003
SOURce1:FREQuency 200000
SOURce1:VOLTage 3
OUTPut1 ON

Appendix A

HDG2000 Series Command Quick Reference

DATA Commands

SOURce<n>:DATA:DAC16 <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

SOURce<n>:DATA: <addr>,<dots_num>,<binary_block>| <value>,<value>, . . .

Output Configuration Commands

SOURce<n>:FUNCtion <wave>，

SOURce<n>:FUNCtion?

FREQUENCY CONTROL

SOURce<n>:FREQuency<frequency>|MINimum|MAXimum

SOURce<n>:FREQuency? [MINimum|MAXimum]

SOURce<n>:FREQuency:STARt<frequency>|MINimum|MAXimum

SOURce<n>:FREQuency:STARt? [MINimum|MAXimum]

SOURce<n>:FREQuency:STOP <frequency>|MINimum|MAXimum

SOURce<n>:FREQuency:STOP? [MINimum|MAXimum]

SOURce<n>:FREQuency:CENTer <frequency>|MINimum|MAXimum

SOURce<n>:FREQuency:CENTer? [MINimum|MAXimum]

SOURce<n>:FREQuency:SPAN <frequency>|MINimum|MAXimum

SOURce<n>:FREQuency:SPAN? [MINimum|MAXimum]

VOLTAGE

SOURce<n>:VOLTage <amplitude>|MINimum|MAXimum

SOURce<n>:VOLTage? [{MINimum|MAXimum}]

SOURce<n>:VOLTage:OFFSet <offset>|MINimum|MAXimum

SOURce<n>:VOLTage:OFFSet? [MINimum|MAXimum]

SQUARE WAVE

SOURce<n>:FUNCtion:SQUare:DCYCle <percent>|MINimum|MAXimum，

SOURce<n>:FUNCtion:SQUare:DCYCle? [MINimum|MAXimum]

RAMP

SOURce<n>:FUNCtion:RAMP:SYMMetry <symmetry>|MINimum|MAXimum，

SOURce<n>：FUNCtion:RAMP:SYMMetry? [MINimum|MAXimum]

PLUSE

SOURce<n>:FUNCtion:PULSe:DCYCle <percent>|MINimum|MAXimum

SOURce<n>:PULSe:DCYCle? [MINimum|MAXimum]

SOURce<n>:FUNCtion:PULSe:WIDTh <seconds>|MINimum|MAXimum

SOURce<n>:FUNCtion:PULSe:WIDTh? [MINimum|MAXimum]

SOURce<n>:FUNCtion:PULSe:TRANsition:LEADing<seconds>|MINimum|MAXimum

SOURce<n>:PULSe:TRANsition:LEADing? [MINimum|MAXimum]

SOURce<n>:FUNCtion:PULSe:TRANsition:TRAiling <seconds>|MINimum|MAXimum

SOURce<n>:PULSe:TRANsition:TRAiling? [MINimum|MAXimum]

ARBITRARY WAVEFORM

SOURce<n>:FUNCtion:ARBitrary <filename>, SOURce<n>:FUNCtion:ARBitrary?

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak <voltage>|MINimum|MAXimum,

SOURce<1|2>:FUNCtion:ARBitrary:PTPeak?{MINimum|MAXimum}

SOURce<1|2>:FUNCtion:ARBitrary:SRATe {<sample_rate>|MINimum|MAXimum}，

SOURce<1|2>:FUNCtion:ARBitrary:SRATe? {MINimum|MAXimum}

OUTPUT

OUTPut<n> ON|OFF，

OUTPut<n>?

OUTPut:SYNC:SOURce CH1|CH2

Modulation Commands

SOURce<n>:MOD ON|OFF

SOURce<n>:MOD?

SOURce<n>:MOD:TYPe AM|FM|PM|ASK|FSK|PSK|PWM|BPSK

SOURce<n>:MOD:TYPe?

AM

SOURce<n>:MOD:AM:DEPTh <depth>|MINimum|MAXimum

SOURce<n>:MOD:AM:DEPTh? [MINimum|MAXimum]

SOURce<n>:MOD:AM:SOURce INTernal|EXTernal

SOURce<n>:MOD:AM:SOURce?

SOURce<n>:MOD:AM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:AM:INTernal:FREQuency? [MINimum|MAXimum]

SOURce<n>:MOD:AM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:AM:INTernal:FUNCtion?

FM

SOURce<n>:MOD:FM:DEViation <deviation>|MINimum|MAXimum

SOURce<n>:MOD:FM:DEViation? [MINimum|MAXimum]

SOURce<n>:MOD:FM:SOURce INTernal|EXTernal

SOURce<n>:MOD:FM:SOURce?

SOURce<n>:MOD:FM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FM:INTernal:FREQuency? [MINimum|MAXimum]

SOURce<n>:MOD:FM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:FM:INTernal:FUNCtion?

PM

SOURce<n>:MOD:PM:DEViation <deviation>|MINimum|MAXimum

SOURce<n>:MOD:PM:DEViation? [MINimum|MAXimum]

SOURce<n>:MOD:PM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PM:SOURce?

SOURce<n>:MOD:PM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PM:INTernal:FREQuency? [MINimum|MAXimum]

SOURce<n>:MOD:PM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:PM:INTernal:FUNCtion?

ASK

SOURce<n>:MOD:ASKey:AMPLitude <amplitude>|MINimum|MAXimum

SOURce<n>:MOD:ASKey:AMPLitude? [MINimum|MAXimum]

SOURce<n>:MOD:ASKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:ASKey:INTernal:RATE? [MINimum|MAXimum]

SOURce<n>:MOD:ASKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:ASKey:SOURce?

SOURce<n>:MOD:ASKey:POLarity POSitive|NEGative

SOURce<n>:MOD:ASKey:POLarity?

FSK

SOURce<n>:MOD:FSKey:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FSKey:FREQuency? [MINimum|MAXimum]

SOURce<n>:MOD:FSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:FSKey:INTernal:RATE? [MINimum|MAXimum]

SOURce<n>:MOD:FSKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:FSKey:SOURce?

SOURce<n>:MOD:FSKey:POLarity POSitive|NEGative

SOURce<n>:MOD:FSKey:POLarity?

PSK

SOURce<n>:MOD:PSKey:PHASe <phase>|MINimum|MAXimum

SOURce<n>:MOD:PSKey:PHASe ? [MINimum|MAXimum]

SOURce<n>:MOD:PSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PSKey:INTernal:RATE? [MINimum|MAXimum]

SOURce<n>:MOD:PSKey:SOURce INTernal|EXTernal

SOURce<n>:MOD:PSKey:SOURce?

SOURce<n>:MOD:PSKey:POLarity POSitive|NEGative

SOURce<n>:MOD:PSKey:POLarity?

BPSK

SOURce<n>:MOD:BPSKey:PHASe <phase>|MINimum|MAXimum

SOURce<n>:MOD:BPSKey:PHASe ? [MINimum|MAXimum]

SOURce<n>:MOD:BPSKey:INTernal:RATE <frequency>|MINimum|MAXimum

SOURce<n>:MOD:BPSKey:INTernal:RATE? [MINimum|MAXimum]

PWM

SOURce<n>:MOD:PWM:DEViation <deviation>|MINimum|MAXimum

SOURce<n>:MOD:PWM:DEViation? [MINimum|MAXimum]

SOURce<n>:MOD:PWM:SOURce INTernal|EXTernal

SOURce<n>:MOD:PWM:SOURce?

SOURce<n>:MOD:PWM:INTernal:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MOD:PWM:INTernal:FREQuency? [MINimum|MAXimum]

SOURce<n>:MOD:PWM:INTernal:FUNCtion SINusoid|SQUare|RAMP

SOURce<n>:MOD:PWM:INTernal:FUNCtion?

Frequency Sweep

SOURce<n>:SWEep ON|OFF

SOURce<n>:SWEep?

SOURce<n>:SWEep:TIME <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:TIME? [MINimum|MAXimum]

SOURce<n>:SWEep:HTIMe <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:HTIMe? [MINimum|MAXimum]

SOURce<n>:SWEep:RTIMe <seconds>|MINimum|MAXimum

SOURce<n>:SWEep:RTIMe ? [MINimum|MAXimum]

SOURce<n>:SWEep:TRIGger:SOURce INTernal|EXTernal

SOURce<n>:SWEep:TRIGger:SOURce?

SOURce<n>:SWEep:TRIGger:SLOPe POSitive|NEGative

SOURce<n>:SWEep:TRIGger:SLOPe?

SOURce<n>:SWEep:TRIGger

Burst Mode

SOURce<n>:BURSt ON|OFF
SOURce<n>:BURSt?
SOURce<n>:BURSt:MODE TRIGgered|GATed|INFinity
SOURce<n>:BURSt:MODE?
SOURce<n>:BURSt:NCYCles <cycles>|MINimum|MAXimum
SOURce<n>:BURSt:NCYCles? [MINimum|MAXimum]
SOURce<n>:BURSt:GATE:POLarity NORMal|INVerted
SOURce<n>:BURSt:GATE:POLarity?
SOURce<n>:BURSt:TRIGger:SOURce INTernal|EXTernal
SOURce<n>:BURSt:TRIGger:SOURce?
SOURce<n>:BURSt:TRIGger:SLOPe POSitive|NEGative
SOURce<n>:BURSt:TRIGger:SLOPe?
SOURce<n>:BURSt:TRIGger

State Storage

MEMory:STATe:VALid? USER1|USER2|USER3|USER4|USER5
MEMory:STATe:DELete USER1|USER2|USER3|USER4|USER5

Mass Memory

MMEMory:CATalog?
MMEMory:CDIRectory <folder>
MMEMory:CDIRectory?
MMEMory:COPY <folder>,<file_name>
MMEMory:DELete <file_name>
MMEMory:RDIRectory <folder>
MMEMory:MDIRectory <folder>
MMEMory:LOAD:STATe <file_name>
MMEMory:STORe:STATe <file_name>

System

DISPlay:BRIGhtness <brightness>|MINimum|MAXimum
DISPlay:BRIGhtness? [MINimum|MAXimum]
DISPlay:SAVer ON|OFF
DISPlay:SAVer ?

Remote Interface Configuration

SYSTem:BEEPer:STATe ON|OFF

SYSTem:BEEPer

SYSTem:LANGuage ENGLish|SCHinese，SYSTem:LANGuage?

SYSTem:KLOCk ON|OFF

SYSTem:KLOCk?

SYSTem:COMMunicate:LAN:GATEway <address>

SYSTem:COMMunicate:LAN:GATEway?

SYSTem:COMMunicate:LAN:IPADdress <ip_addr>

SYSTem:COMMunicate:LAN:IPADdress?

SYSTem:COMMunicate:LAN:SMASk <mask>

SYSTem:COMMunicate:LAN:SMASk?

SYSTem:COMMunicate:LAN:MAC?

SYSTem:ERRor?

SYSTem:ROSCillator:SOURce INTernal|EXTernal

SYSTem:ROSCillator:SOURce?

SYSTem:VERSion?

DISPlay:BRIGhtness <brightness>|MINimum|MAXimum

DISPlay:BRIGhtness? [MINimum|MAXimum]

DISPlay:SAVer ON|OFF

DISPlay:SAVer ?

Phase-Lock

SOURce<n>:PHASe <phase>|MINimum|MAXimum

SOURce<n>:PHASe? [MINimum|MAXimum]

SOURce<n>:PHASe:SYNChronize

Counter

COUNter ON|OFF

COUNter:MEASure?

COUNter:GATEtime UTO|USER1|USER2|USER3|USER4|USER5|USER6

:COUNter:GATEtime?

COUNter:TYPE LFCOUNTER|LFFREQ|HFCOUNTER|HFFREQ

Calibration

CALibration:SETup <step>

CALibration?

CALibration:VALue <value>

CALibration:STORe

IEEE-488

*IDN?

*RCL

*SAV

*RST

*TRG

*TST?

Others

SOURce<n>:MARKer ON|OFF

SOURce<n>:MARKer?

SOURce<n>:MARKer:FREQuency <frequency>|MINimum|MAXimum

SOURce<n>:MARKer:FREQuency? [MINimum|MAXimum]

Appendix B

HDG200B

Model	HDG 2102B	HDG 2082B	HDG 2062B	HDG 2032B	HDG 2022B	HDG 2012B	HDG 2002B
Main Features							
Channel	2						
Memory Depth	64M						
Frenquency	100MHz	80MHz	60MHz	30MHz	20MHz	10MHz	5MHz
Sample Rate	250MSa/s						
Voltage Resolution	16Bit						
Digital Output	16 Channels output						
Frenquency Characteristic							
Standard Waveforms	Sine, Square, Ramp, Pulse, Noise, Sinc, Exponential Rise, Exponential Fall, ECG, Gauss, Haver Sine, Lorentz, Dual-Tone, DC						
Sine	1uHz~Max.						
Square	1uHz~5MHz						
Pluse	1uHz~5MHz						
Ramp/Triangle	1uHz~4MHz						
White Noise	100MHz	80MHz	60MHz	30MHz	20MHz	10MHz	5MHz
Arb.	1uHz~ 30MHz	1uHz~ 25MHz	1uHz~ 25MHz	1uHz~ 20MHz	1uHz~ 20MHz	1uHz~ 10MHz	1uHz~ 5MHz
Resolution	1uHz						
Accuracy	±2ppm, 18~28□						
Sine Wave Spectrum Purity							
Harmonic Distortion	Typical(0dBm) DC-1MHz: <-60dBc; 1MHz-10MHz: <-55dBc; 10MHz-100MHz: <-50dBc						
Total Harmonic Distortion	<0.1% (10Hz-20kHz, 0dBm)						
Spurious signal (non-hormonic)	Typical(0dBm): ≤10MHz: <-65dBc; >10MHz <-65dBc+6dB/spectrum phase						
Phase Noise	Typical(0dBm,10kHz offset,) 10MHz: ≤-115dBc/Hz						
Square							
Rise/Down time	<10ns	<11ns	<12ns	<14ns	<16ns	<18ns	<18ns
Overshoot	<3%(100KHz, 1Vpp)						
Duty Cycle	≤10MHz: 20.0%~80.0%; 10MHz~40MHz: 40.0%~60.0%; >40MHz: 50.0%			8.0%~92.0%			

Non-symmetry	1% of period+5ns						
Jitter(rms)	Typical(1MHz,1Vpp, 50Ω)≤5MHz: 2ppm+500ps; > 5MHz: 500ps						
Ramp							
Linearity	≤1%(1KHz, 1Vpp)						
Symmetry	0%~100%						
Pluse							
Period	33.33ns~ 1Ms	40ns~ 1Ms	40ns~ 1Ms	50ns~ 1Ms	50ns~ 1Ms	100ns~ 1Ms	200ns~ 1Ms
Pulse	≥12ns	≥14ns	≥14ns	≥16ns	≥16ns	≥18ns	≥18ns
Leading Edge Time	≥8ns	≥9ns	≥10ns	≥10ns	≥11ns	≥11ns	≥12ns
Overshoot	<3%(1VPP)						
Jitter(rms)	Typical(1MHz, 1Vpp, 50Ω) ≤5MHz 2ppm+500ps > 5MHz 500ps						
Arb. Wavefrom Generator							
Waveform Length	64M Point						
Vertical Resolution	16 Bit						
Sample Rate	250MSa/s						
Rise/Fall time	Typical(1Vpp):<6ns						
Jitter	Typical(1MHz, 1Vpp, 50Ω) ≤5MHz 2ppm+500ps; > 5MHz 500ps						
Amplitude characteristic							
Amplitude Range	≤20MHz:1mVpp - 20Vpp; ≤60MHz:1mVpp -15Vpp; ≤80MHz:1mVpp -10Vpp; ≤90MHz:1mVpp - 5Vpp; ≤100MHz:1mVpp - 2Vpp						
Accuracy	Typical(1kHz Sine, 0V deviation, >10mVpp, Auto); ±1% of setting ±2mVpp						
Amplitude Flatness	≤10MHz:±0.1dB; ≤60MHz:±0.2dB; ≤100MHz:±0.4dB						
Resolution	1mv or 4 digits						
Impedance	50Ω						
Offset Characteristic							
Range	|Voffset| < Vmax – Vpp/2						
Accuracy	±(1% of setting + 5mV + 0.5% of amplitude)						
Modulation Characteristic							
Modulation Type	AM, FM,PM,2ASK,2FSK,2PSK,PWM						
AM							
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)						

Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Frequency	1Hz~500KHz
Depth	0%~120%
FM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Frequency	1Hz~500KHz
Frequency Deviation	0~360
PM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Frequency	1Hz~500KHz
Frequency Deviation	0%~120%
2ASK	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Square of 50% duty cycle
Code Rate	1Hz~500KHz
2FSK	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Square of 50% duty cycle
Code Rate	1Hz~500KHz
2PSK	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Square of 50% duty cycle
Code Rate	1Hz~500KHz
PWM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)

Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb.
Code Rate	1Hz~500KHz
Width Deviation	0% to 100% of Pulse Width
Burst Characteristic	
Burst Count	1~2000000000
Gated Source	External trigger
Trigger Source	Internal, External or Manual
Sweep Characteristics	
Type	linear
TypeDirection	Up
Sweep time	280 000s
Hold/Return time	280 000s
Trigger Source	Internal, External, Manual
Mark	Falling Edge of Sync signal(programmable)
General Specifications	
Interface	USB host, USB Device, LAN optional
Display	7'' 64K Color TFT Display, 800*480
Power Voltage	100-120VACRMS(±10%), 45Hz to 440Hz, CAT□; 120-240VACRMS(±10%), 45Hz to 66Hz, CAT□
Power Consumption	<60W
Weight	3KG

HDG2000C

Model	HDG2102C	HDG2072C	HDG2052C	HDG2032C
Main Features				
Waveform Length	64M			
Bandwidth	100MHz	70MHz	50MHz	30MHz
Frequency	1uHz– 100MHz	1uHz – 70MHz	1uHz – 50MHz	1uHz – 30MHz
Sample Rate	250MSa/s			
Voltage resolution	16Bit			
SD Card	2GB			
Isolation	Between the Channel and GND			
Frequency Characteristics				
Waveform	Sine, Square, Ramp, Pulse, Noise, Sinc, Exponential Fall, ECG, Gauss, Haver Sine, Lorentz, Dual-Tone, DC			
Sine	1uHz– 100MHz	1uHz – 70MHz	1uHz – 50MHz	1uHz – 30MHz

Square	1uHz – 40MHz	1uHz – 35MHz	1uHz – 30MHz	1uHz – 25MHz
Pluse	1uHz – 30MHz	1uHz – 25MHz	1uHz – 20MHz	1uHz – 15MHz
Ramp	1uHz – 4MHz	1uHz – 3MHz	1uHz – 2MHz	1uHz – 1MHz
White Noise	80MHz	60MHz	60MHz	60MHz
Harmonic	1uHz – 30MHz	1uHz –25MHz	1uHz – 20MHz	1uHz – 15MHz
Arb. Waveform	1uHz – 30MHz	1uHz – 25MHz	1uHz – 20MHz	1uHz – 15MHz
Resolutin	1uHz			
Accuracy	±2ppm， 18℃~28℃			
Sine Wave Spectrum Purity				
Harmonic Distortion	Typical(0dBm) DC-1MHz: <-60dBc; 1MHz-10MHz: <-55dBc; 10MHz-100MHz: <-50dBc			
Total Harmonic Distortion	<0.1% (10Hz-20kHz, 0dBm)			
Spurious signal(non-hormonic)	Typical(0dBm): ≤10MHz: <-65dBc; >10MHz <-65dBc+6dB/spectrum phase			
Phase Noise	Typical(0dBm,10kHz offset,) 10MHz: ≤-115dBc/Hz			
Square				
Rise /Fall time	<10ns	<12ns	<12ns	<14ns
Overshoot	Typical Value(100KHz, 1Vpp) <3%			
Duty Cycle	≤10MHz: 20.0%~80.0%; 10MHz-40MHz: 40.0%~60.0% ; >40MHz: 50.0%(fixed)			
Non-symmetry	1% of period+5ns			
Jitter(rms)	Typical(1MHz,1Vpp, 50Ω), ≤5MHz 2ppm+500ps; > 5MHz 500ps			
Ramp				
Linearity	≤1%(Typical, 1kHz, 1VPP, Symmetry 100%)			
Symmetry	0% - 100%			
Pulse				
Period	40ns – 1000000s	50ns – 1000000s	60ns – 1000000s	70ns – 1000000s
Pulse	≥12ns	≥14ns	≥16ns	≥18ns
Leading/Trailing Edge Time	≥8ns	≥9ns	≥10ns	≥11ns
Overshoot	Typical (1Vpp）<3%			
Jitter(rms)	Typical(1MHz, 1Vpp, 50Ω), ≤5MHz 2ppm+500ps; > 5MHz 500ps			
Arb. Waveform				
Waveform Length	64M Point			
Vertical Resolution	16Bit			
Sample Rate	250MSa/s			

Rise/Fall time	Typical(1Vpp):<6ns
Jitter	Typical(1MHz, 1Vpp, 50Ω), ≤5MHz 2ppm+500ps; > 5MHz 500ps
Amplitude characteristic	
Amplitude Range	≤20MHz:1mVpp—20Vpp; ≤60MHz:1mVpp—15Vpp; ≤80MHz:1mVpp—10Vpp; ≤90MHz:1mVpp—5Vpp; ≤100MHz:1mVpp—2Vpp
Accuracy	Typical(1kHz Sine, 0V deviation, >10mVpp, Auto); ±1% of setting ±2mVpp
Amplitude Flatness(relative to 100kHz, 1Vpp Sine wave)	≤10MHz:±0.1dB ≤60MHz:±0.2dB ≤100MHz:±0.4dB
Units	Vpp
Resolution	1mv or 4 digits
Isolation	<-80dB
Impedance	50Ω(Typical)
Offset Characteristic	
Range	|Voffset| < Vmax – Vpp/2
Accuracy	±(1% of setting + 5mV + 0.5% of amplitude)
Modulation Characteristic	
Modulation Type	AM FM PM 2ASK 2FSK 2PSK PWM
AM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Frequency	1Hz—500KHz
Depth	0% -- 120%
FM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Frequency	1Hz—500KHz
Frequency Deviation	0—360
PM	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
PM Source	Internal/External
PM Modulating Waveforms	Sine, Square, Ramp, Noise, Arb

PM Frequency	1Hz—500KHz
PM Phase Deviation	0°~360°
2ASK	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Square of 50% duty cycle
2ASK Code Rate	1Hz—500KHz
2FSK	
Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
Source	Internal/External
Modulating Waveforms	Square of 50% duty cycle
Code Rate	1Hz—500KHz
2PSK	
2PSK Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
2PSK Source	Internal/External
2PSK Modulating Waveforms	Square of 50% duty cycle
2PSK Code Rate	1Hz—500KHz
PWM	
PWM Carrier Waveforms	Sine, Square, Ramp, Arb. (except DC)
PWM Source	Internal/External
PWM Modulating Waveforms	Sine, Square, Ramp, Noise, Arb.
PWM Frequency	1Hz—500KHz
PWM Width Deviation	0% to 100% of Pulse Width
Burst Characteristic	
Burst Count	2000000000
Gated Source	External trigger
Trigger Source	Internal, External or Manual
Sweep Characteristics	
Direction	Up
Type	linear
Sweep time	280000s

Hold/Return time	280000s
Trigger Source	Internal, External, Manual
Mark	Falling Edge of Sync signal(programmable)
General Specifications	
Interface	USB host, USB Device, SD Card
Display	7’’ 64K Color TFT Display, 800*480 resolution.
Power Voltage	100-120VACRMS(±10%), 45Hz to 440Hz, CAT□; 120-240VACRMS(±10%), 45Hz to 66Hz, CAT□
Power Consumption	<60W
Weight	3Kg