HDG6000B(C) series
Functions and Arbitrary Waveform Generator

User manual

(V1.2)

Content
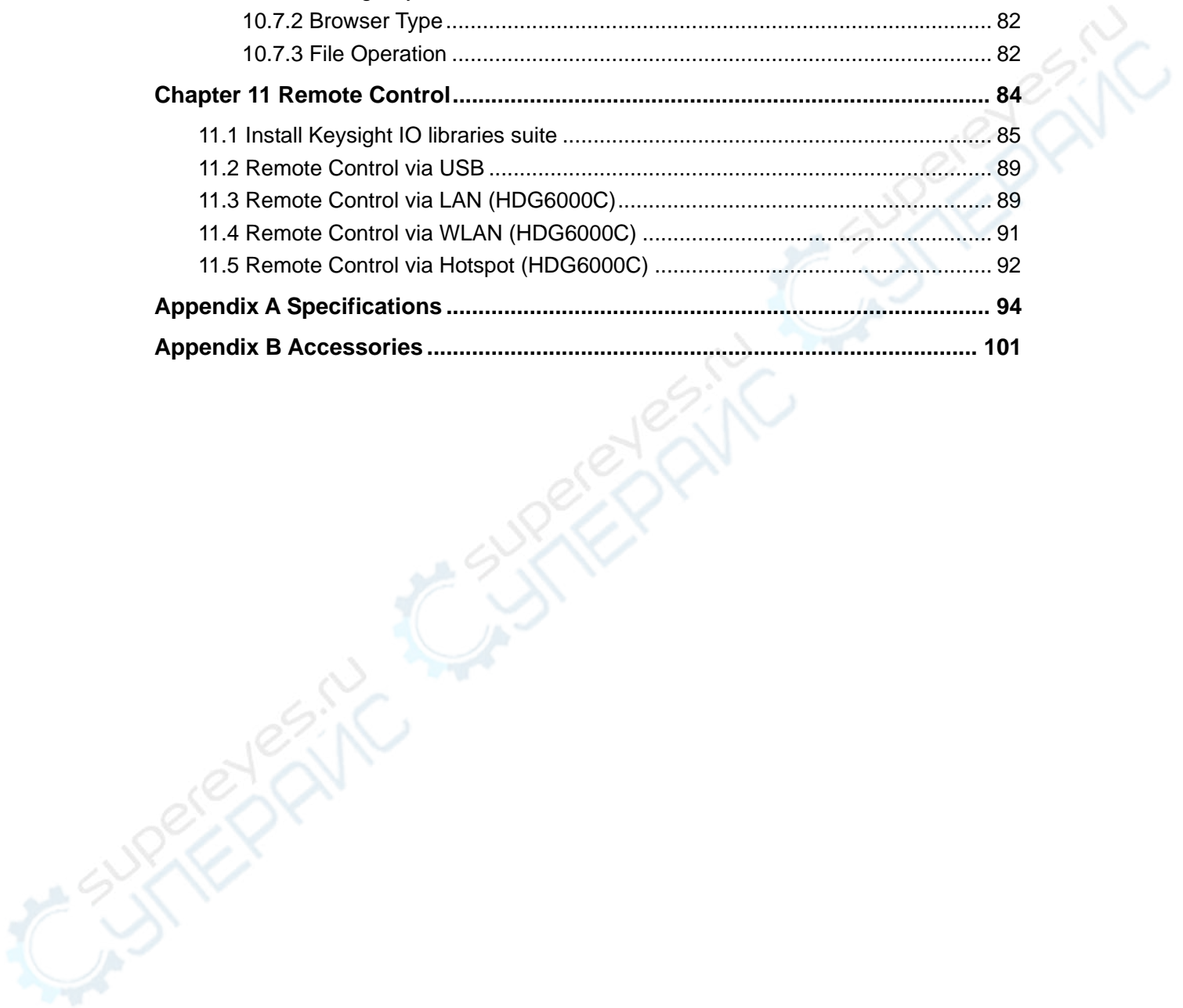
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Safety Requirements

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.

Connect and disconnect properly. Connect a probe with the oscilloscope before it is connected to measured circuits; disconnect the probe from the oscilloscope after it is disconnected from measured circuits.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Connect the probe in a right way. The probe ground lead is at ground potential. Do not connect the ground lead to an elevated voltage.

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.

Safety Terms and Symbols

Terms on the product. The following terms may appear on the product:

Danger	It represents that harms may be caused to you at once if you perform the operation.
Warning	It represents that latent harms may be caused to you if you perform the operation.
Notice	It represents the damage possibly caused to the product or other properties if you perform the operation.

Characters on the product. The following characters may appear on the product:

Notice Please read the manual	Protective ground terminal	Measuring ground terminal	Chassis ground terminal
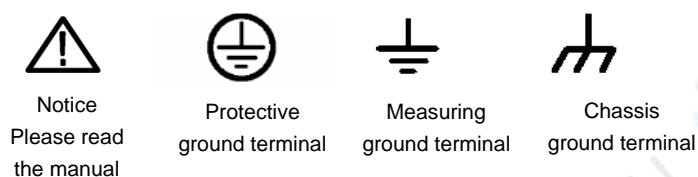
Product Scrapping

Device Recycling

We need extract and utilize natural resources to produce this device. If you do not reclaim the device in a proper way, some substances it contains may become harmful or poisonous to environments or human bodies. To avoid them being released outside and to minimize the waste of natural resources, we suggest you reasonably call back this device to ensure proper recovery and recycling of most materials within it.

Brief Introduction

HDG6000B(C) Series is a series of synthesized waveform generators with built-in arbitrary waveform and pulse capabilities.

Features:

◆ 7 inch, 16K true color TFT display, WVGA(800X480)

◆ 200 MHz, 160 MHz, 110 MHz, and 80 MHz maximum sine output frequency

◆ 16 bits resolution, 1.25GSa/s Sample rate

◆ 64 Mpts Max. arbitrary waveform Memory Depth

◆ 16 channels digital output

◆ Precisely adjust the phases of the two channels

◆ 160 waveforms or functions: Sine, Square, Ramp, Pulse, Noise, Exponential Rise, Exponential Fall, ECG, Gauss, Haversine, Lorentz, Dual Tones, Harmonics, Video Signal, Radar Signal, DC etc.

◆ Rise Time and Fall Time of the Pulse could be adjusted separately

◆ Enable to output harmonic with specified order and amplitude, enable to output up to 16th order of harmonic

◆ Various modulation types: AM, DSB-AM, FM, PM, 2ASK, 2FSK, 2PSK, BPSK, QPSK, 3FSK, 4FSK, OSK and PWM modulations

◆ Support frequency sweep and Burst output

◆ Dual channels can perform internal /external /another channel modulation and internal/external/manual trigger separately or at the same time.

◆ Dual channels can output sync signal separately or at the same time

◆ Provide 7digits/s, 200MHz counter; enable to measure various parameters of external signal such as frequency, period, duty cycle, positive pulse width and negative pulse width

◆ Support waveform copy and state copy between channels

◆ Enable to store and recall arbitrary waveform data files and instrument state files;

◆ Standard interfaces: USB Host and USB Device

◆ Abundant I/O: waveform output, sync signal output, modulation input, 10MHz clock input/output and trigger input/output

◆ Support FAT32 formated USB storage device (flash type) storage

◆ Support 10/100M Ethernet web; users can control the instrument remotely via web.

◆ LXI Class C Compliant

◆ Provide Chinese and English help information, prompt messages and interface display

◆ Provide powerful waveform editing PC software

◆ SCPI (Standard Commands for Programmable Instruments) compatibility

Models

Model	Channels	Bandwidth	Sample Rate	LAN	WIFI	Touch screen	RS232
HDG6082B	2	80MHz	1.25GS/s	-	-	-	-
HDG6112B	2	110MHz	1.25GS/s	-	-	-	-
HDG6162B	2	160MHz	1.25GS/s	-	-	-	-
HDG6202B	2	200MHz	1.25GS/s	-	-	-	-
HDG6082C	2	80MHz	1.25GS/s	Yes	Yes	Yes	Optional
HDG6112C	2	110MHz	1.25GS/s	Yes	Yes	Yes	Optional
HDG6162C	2	160MHz	1.25GS/s	Yes	Yes	Yes	Optional
HDG6202C	2	200MHz	1.25GS/s	Yes	Yes	Yes	Optional

Chapter 1   Quick Start

This chapter introduces the front panel, rear panel, user interface and parameter setting method as well as precautions when using the instrument for the first time.

◆   **General Inspection**

◆   **Front Panel**

◆   **Rear Panel**

◆   **Prepare Instrument for Use**

◆   **The user interface**

◆   **Parameter Setting Method**

◆   **Help**

1.1 General Inspection

Please check the instrument as following steps after receiving an oscilloscope:

Check the shipping container for damage:

Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

Check the accessories:

Accessories supplied with the instrument are listed in "Accessories" in this manual. If the contents are incomplete or damaged, please notify the franchiser.

Check the instrument:

In case there is any mechanical damage or defect, or the instrument does not operate properly or fails performance tests, please notify the franchiser.

1.2 Front Panel

The content below simply describes and introduces the front panel of HDG6000B(C) so that you can get familiar with it well within the shortest time.
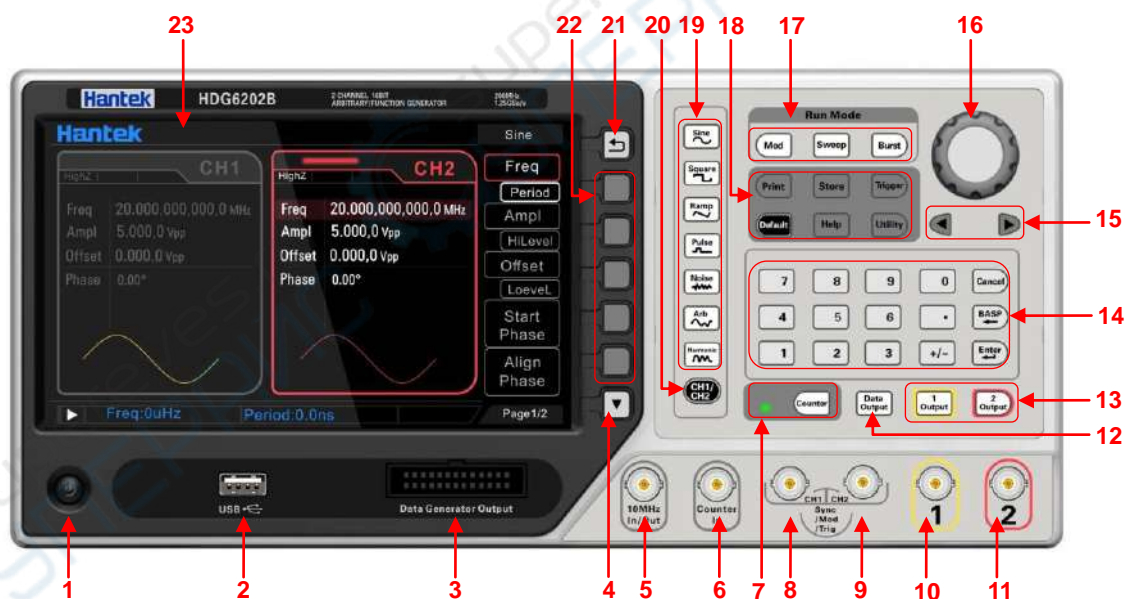
1. **On/Off Switch**
2. **USB device port**
3. **Digital channel**
4. **Page Up/Down.** Open the previous or next page of the current function menu.
5. **10 MHz Reference In/ Out**

    BNC connector with 50Ω nominal output impedance and 5KΩ nominal input impedance. The function of this connector is determined by the type of clock used by the generator.

HDG6000B(C) can use internal or external clock (refer to the introduction in "**Clock Source**").

- ➢ When internal clock source is used, the connector (used as 10MHz Out) can output 10MHz clock signal generated by the internal crystal oscillator of the generator.
- ➢ When external clock source is used, the connector (used as 10MHz In) accepts a 10MHz external clock signal.
- ➢ This connector is usually used to synchronize multiple instruments (refer to the introduction in "**Clock Source**").

6. **Counter In**

   BNC connector with 500Ω nominal input impedance. It is used to accept an external signal to be measured by the counter.

7. **Counter button**

   Press **Counter** to turn the counter on or off. When the counter is turned on, the backlight of the key is illuminated and the left indicator flickers. If the counter interface is currently displayed, press this key again to disable counter function; if the screen currently displays interfaces other than the counter interface, press this key again to switch to counter interface (refer to the introductions in **Counter**).

8. **CH1: Sync/Mod/Trig Output**

   BNC connector with 50Ω nominal output impedance and 1KΩ nominal input impedance. Its function is determined by the current working mode of CH1.

   - ➢ **Mod:**
     If modulation mode is enabled for CH1, and external modulation source is used, this connector accepts an external modulation signal.

   - ➢ **Trig:**
     If CH1 is in sweep or burst mode and external trigger source is used, this connector accepts an external trigger signal (users can set the polarity of the signal).

   - ➢ **Sync:**
     When the sync output of CH1 is enabled, this connector outputs the sync signal corresponding to the current settings of CH1 (refer to the introduction in **Sync**).

9. **CH2: Mod/ Trig/ Sync Output**

   The same as CH1: Mod/ Trig/ Sync Output.

10. **CH1 Output**

    BNC connector with 50Ω nominal output impedance.
    When **1Output** is enabled (the backlight turns on), this connector output waveform according to the current configuration of CH1.

11. **CH2 Output**

    BNC connector with 50Ω nominal output impedance.
    When **2Output** is enabled (the backlight turns on), this connector output waveform according to the current configuration of CH2.

12. **Data Output**: Enable or disable the output of word generator.

13. **Channel ON/OFF**: Enable or disable the output of CH1 or CH2.

14. **Numeric Keyboard**

    It is used to input parameters and consists of numbers (0 to 9), decimal point (.), operators (+/-) and buttons ("Enter", "Cancel" and "BASP"). Note that if a negative is required, please input

an operator "-" before the numbers. (For the use method of the numeric keyboard, refer to the introduction in "**Parameter Setting Method**").

15. **Direction Keys**

    When using the knob and direction keys to set parameters, the direction keys are used to switch the digits of the parameter.

    During file name input, they are used to move the cursor.

16. **Knob**

    During parameter setting, it is used to increase (clockwise) or decrease (counterclockwise) the current highlighted number. It is used to select file storage location or select the file to be recalled when storing or recalling file. It is used to switch the character in the soft keyboard when entering filename.

17. **Run Mode**

    ➢ **Mod:** Generate the modulated waveforms. Provide various analog modulation and digital modulation modes and can generate AM, DSB-AM, FM, PM, 2ASK, 2FSK, 2PSK, BPSK, QPSK, 3FSK, 4FSK, OSK or PWM modulated signal.

    ➢ **Sweep:** Generate the frequency sweeping signal of Sine, Square, Ramp, Pluse, Harmonic and Arbitrary Waveforms (except DC).

    ➢ **Burst:** Generate burst waveforms of Sine, Square, Ramp, Pulse, Harmonic and Arbitrary waveform (except DC).

18. **Operation key**

    Print: It is used to execute the print function to save the content displayed on the screen as image in USB storage device.

    Store: Users can store or recall the instrument state. Provide a built-in non-volatile memory (Home Disk) and can connect an external USB storage device (USB Disk).

    Trigger: In sweep or burst mode, it is used to trigger CH1 or CH2 to generate a sweep or burst output manually (only when **1Output or 2Output** is enabled).

    Default: Restore the default values. It is used to restore the instrument state to the factory default values.

    Help: To get the context help information about any front-panel key or menu softkey, press this key and then press the desired key.

    Utility: Utility Functions and System Settings. It is used to set the utility function parameters and the system parameters.

19. **Waveform Selection**

    There are seven waveform types, include sine, square, Ramp, Pulse, Noise, Arb, and Harmonic. When the function is selected, the backlight of the corresponding key turns on.

20. **Channel 1 and Channel 2 Switch Button**

    Press this button to switch channel Menu.

    When CH1 is selected, users can set the waveform and parameters of CH1.

    When CH2 is selected, users can set the waveform and parameters of CH2.

21. **Return button**

    This key is used to return to the previous menu.

22. Menu softkey

Correspond to the left menus respectively. Press any softkey to activate the corresponding menu.

23. LCD

800 × 480 TFT color LCD is used to display the current function menu and parameters setting, system state as well as prompt messages.

1.3 Rear Panel

1. **AC Power Input**
2. **USB Device**
3. **LAN connector (HDG6000C)**

1.4 Prepare Instrument for Use

Adjust the Supporting Legs

Adjust the supporting legs properly to use them as stands to tilt the oscilloscope upwards for stable placement of the oscilloscope as well as better operation and observation.

Connect the Power Cord

Connect the power cord as desired.

This oscilloscope can accept 100-240 V, 45-440 Hz AC power supply. Please use the power cord supplied with the accessories to connect the oscilloscope to the power source as shown in the figure below.

Turn the instrument on by pressing the power switch in the lower left corner of front panel. If the instrument does not turn on, verify that the power cord is firmly connected. Also make sure that the instrument is connected to an energized power source.

Power Switch:

To turn off the instrument, please press power switch.

1.5 The user interface

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 the left of the screen.
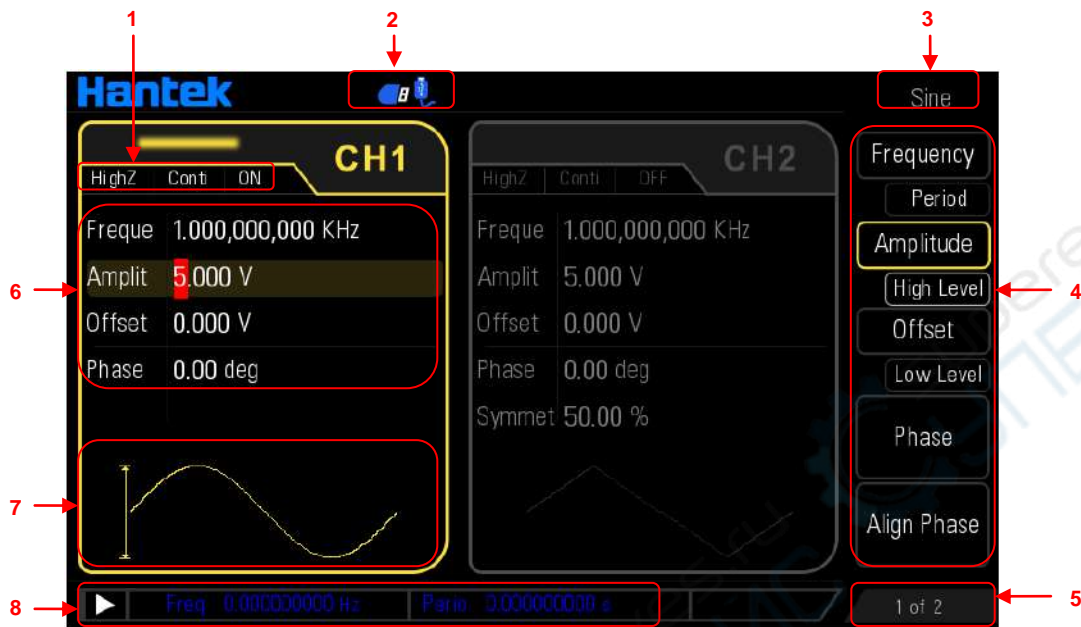
1. **Channel Configurations**

   Display the current output configuration in each channel, including output resistance, mode and type of modulating source or trigger source.

   Output Resistance:

   High Impedance: display "HighZ"

   50Ω: Impedance is 50Ω.

   Mode:

   Modulation: display "Mod"

   Sweep: display "Sweep"

   Burst: display "Burst"

   Continuous output：display "Conti"

   ON/OFF state:

   Channel output ON or OFF

2. **Status Bar**

   The following indicators would be displayed according to the current configuration

   When the generator detects a USB storage device, this indicator will light.

   When the generator works in USB remote mode, this indicator will light.

   When the generator is correctly connected to the LAN, this indicator will light.

   When the generator is connected to the LAN through WiFi, this indicator will light.

 When the hot spot of the generator is opened, this indicator will light. 1 indicates that there is one device connected to this hot spot.

3. **Current Function**

Display the name of the function currently selected. For example, "Sine" indicates that "Sine" waveform function is currently selected and "Arb" indicates that "Arbitrary Waveform" function is currently selected.

4. **Menu**

Display the operation menu corresponding to the function currently selected. For example, the "Sine" function menu is displayed in the above figure.

5. **Menu Page Number**

Display the total number of pages and the current page number of the menu, such as "1 of 1" or "1 of 2".

6. **Channel parameter**

Display the current waveform parameter in each channel.

Press the corresponding softkey and use the numeric keyboard or direction keys and knob to modify this parameter. The parameter that can be modified currently will be highlighted and the red background of the number indicates current cursor location.

7. **Waveform**

Display the currently selected waveform shape in each channel.

8. **Counter**

The brief information of the counter will only be displayed when the frequency counter function is turned on and the interface currently displayed is not the frequency counter interface.

1.6 Parameter Setting Method

Users can use the numeric keyboard or knob and direction keys to set parameters.

1.6.1 Numeric Keyboard

The numeric keyboard consists of:

Number Keys

The 0 to 9 number keys are used to directly input the desired parameter value.

Decimal Point

Press this key to insert a decimal point "." at the current position of the cursor.

Operator Key

The operator key "+/-" is used to modify the operator of the parameter. Press this key to set the parameter operator to "-".

Enter Key

Press this key to finish parameter input and add the default unit for the parameter.

Cancel Key

During parameter input, press this key to clear the input in the active function area and exit parameter input.

BASP Key

(1) During parameter input, press this key to delete the character at the left of the cursor.

(2) During filename edit, press this key to delete the character at the left of the cursor.

1.6.2 Direction keys and Knob

Functions of the direction keys:

◆ During parameter input, use the direction keys to move the cursor to select the digit to be edited.

◆ During filename edit, use the direction keys to move the cursor.

Functions of the knob:

◆ When the parameter is in editable state, turn the knob to increase (clockwise) or reduce (counterclockwise) the parameter with specified step.

◆ During filename edit, use the knob to select the characters in the soft keyboard.

◆ In **Arb** -> **Type -> User**, use the knob to select arbitrary waveform.

◆ In store and recall, use the knob to select the storage location of the file or to select the file to be recalled.

1.7 Help

To get context help information about any front-panel key or menu softkey, press **Help** key to open

the help function and then press the desired key to get corresponding help.

If there is an index of other topics in the content view, users can rotate the knob to choose different indexes, press the **Enter** key or knob to enter the corresponding topic content.

Press **Help** key again to exit.

Chapter 2 Basic Waveform Output

HDG6000B(C) can output basic waveforms (including Sine, Square, Ramp, Pulse and Noise) from one of the channels separately or from the two channels at the same time. At start-up, the channel is configured as a sine waveform with 1KHz frequency and 200mVpp amplitude by default. This chapter introduces how to configure the instrument to output various basic waveforms.

◆ **Select the channel**

◆ **Select the Basic Waveform**

◆ **Basic Waveform Output Example**

2.1 Select the channel

Users can configure HDG6000B(C) to output basic waveform from a single channel or from dual channels at the same time. Please select the desired channel before configuring waveform parameters. At start-up, CH1 is selected by default. Press **CH1/CH2** button at the front panel and the corresponding area in the user interface is illuminated. At this point, users can configure the waveform and parameters of the channel selected.

Note: CH1 and CH2 cannot be selected at the same time. Users can first select CH1 and then select CH2 after configuring the waveform and parameters of CH1.

2.2 Setting the parameter

2.2.1 Select the Basic Waveform

HDG6000B(C) can output 5 kinds of basic waveforms including Sine, Square, Ramp, Pulse and Noise. At start-up, Sine is selected by default.

Press the corresponding button for each waveform at the front panel, and the backlight of the button turns on. The waveform type and the parameter setting menu are displayed on the right of the user interface.

2.2.2 Set the Frequency

Press **Frequency/Period** softkey to highlight "Frequency". At this point, use the numeric keyboard to input the frequency value and select the desired unit from the pop-up unit menu or use the direction keys and knob to modify the current value.

1. For the input method of frequency value, refer to the introduction in "**Parameter Setting Method**".
2. The frequency units available are MHz, KHz, Hz and mHz.
3. Press this softkey again to switch to period setting. At this point, "Period" is highlighted.
4. The period units available are sec, msec, μsec and nsec.

For different instrument models and different waveforms, the setting ranges of frequency are different. For detailed information, please refer to "Frequency Characteristics" in "**Specifications**". The default frequency is 1 KHz.

The frequency displayed on the screen is the default value or the frequency previously set. When the instrument function is changed, if this frequency is valid under the new function, the

instrument will still use this frequency; otherwise, the instrument would display prompt message and set the frequency to the frequency upper limit of the new function automatically.

2.2.3 Set the Amplitude

Press **Amplitude/High Level** softkey to highlight "Amplitude". At this point, use the numeric keyboard to input the amplitude value and select the desired unit from the pop-up unit menu or use the direction keys and knob to modify the current value.
1. For the input method of amplitude value, refer to the introduction in "**Parameter Setting Method**".
2. The amplitude units available are Vpp, mVpp, and Vrms, dBm（50Ω impedance）.
3. Press this softkey again to switch to high level setting. At this point, "High Level" is highlighted.
4. The high level units available are V and mV.

The amplitude range is limited by "Freq/Period" settings. Please refer to "Output Characteristics" in "**Specifications**". The default value is 200mVpp.

Tips:
Switch between Vpp and Vrms
Vpp is the unit for the signal peak-peak value and Vrms is the unit for the signal effective value. The default unit of the instrument is Vpp. Users can quickly switch the current amplitude unit from the front panel.
For different waveforms, the relations between Vpp and Vrms are different. Take sine waveform as an example; the relation of the two units is as shown in the figure below.
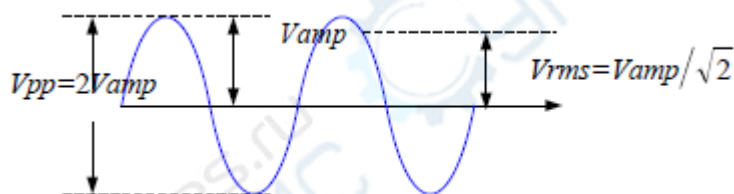
According to the figure above, the conversion relation between Vpp and Vrms fulfills the following equation.

$$Vpp = 2\sqrt{2}Vrms$$

For example, convert 2Vpp to the corresponding value in Vrms.
For sine waveform, press in the numeric keyboard to enter 0.707 and select the Vrms menu.

2.2.4 Set the DC Offset Voltage

Press **Offset/Low Level** softkey to highlight "Offset". At this point, use the numeric keyboard to input the offset value and select the desired unit from the pop-up unit menu or use the direction keys and knob to modify the current value.
1. For the input method of offset value, refer to the introduction in "**Parameter Setting Method**".

2. The DC offset voltage units available are V and mV.

3. Press this softkey again to switch to low level setting. At this point, "Low Level" is highlighted.

4. The low level units available are V and mV.

The settable range of the DC offset voltage is limited by the "Amplitude/High Level" settings. Please refer to the "Output Characteristics" in "**Specifications**". The default value is 0VDC.

2.2.5 Set the Start Phase

Press **Phase** softkey to highlight the softkey. At this point, use the numeric keyboard to input the start phase value and select the unit "Degree" from the pop-up unit menu or use the direction keys and knob to modify the current value. For the input method of phase value, refer to the introduction in "**Parameter Setting Method**".

2.2.6 Align Phase

Press **Align Phase** and the instrument will re-configure the two channels to make them output with the specified frequency and phase.

For two signals whose frequencies are the same or in multiple, this operation will align their phases. For example, assume a sine waveform (1KHz, 8Vpp, 0 °) is output from CH1, while another (1KHz, 8Vpp, 180°) from CH2. Use an oscilloscope to sample and display the waveforms of the two channels. You will see that the phase deviation of the two waveforms displayed on the oscilloscope is not 180°. At this point, press **Align Phase** on the generator and the waveforms shown on the oscilloscope will have a phase deviation of 180° without any adjustment of the start phase of the generator.

Before aligning phase:
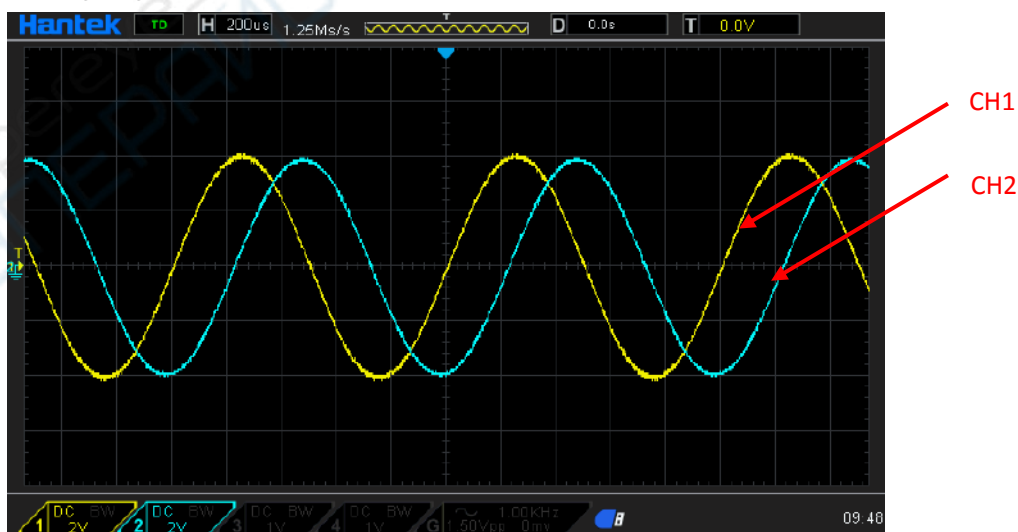
After aligning phase:

CH1

CH2
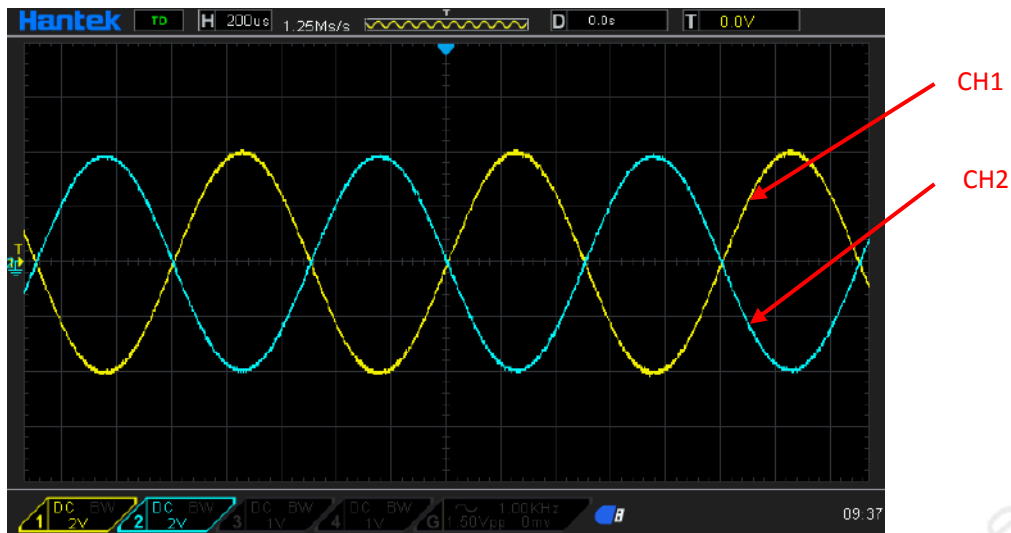
2.2.7 Set the Duty Cycle

Duty Cycle is defined as the percentage that the high level takes up in the whole period as shown in the figure below.
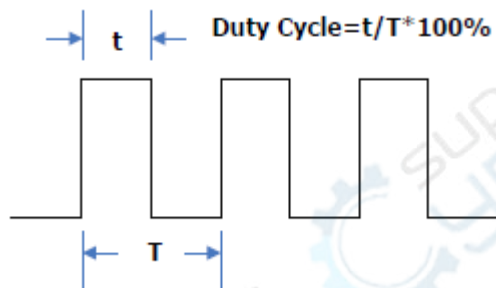
Press **Duty** softkey to highlight. At this point, use the numeric keyboard to input the duty cycle value and select the unit "%" from the pop-up unit menu or use the direction keys and knob to modify the current value. For the input method of duty cycle value, refer to the introduction in "**Parameter Setting Method**".

The duty cycle range is limited by the "**Frequency/Period**" setting. Please refer to "Signal Characteristics" in "**Specifications**". The default value is 50%.

2.2.8 Set the Symmetry

Symmetry is defined as the percentage that the rising period takes up in the whole period as shown in the figure below. This parameter is only available when ramp is selected.
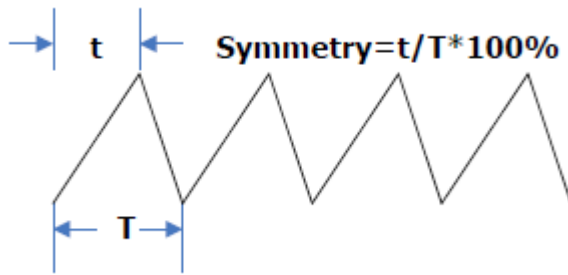
Press **Symmetry** softkey to highlight. At this point, use the numeric keyboard to input the symmetry value and select the unit "%" from the pop-up unit menu or use the direction keys and knob to modify the current value. For the input method of symmetry value, refer to the introduction in "**Parameter Setting Method**".

The setting range of symmetry is from 0% to 100% and the default is 50%.

2.2.9 Set the Pulse Parameters

To output a pulse, users need to set the "Width/Duty", "Leading" and "Trailing", in addition to the basic parameters (such as the frequency, amplitude, DC offset voltage, high level, low level and align phase) introduced above.
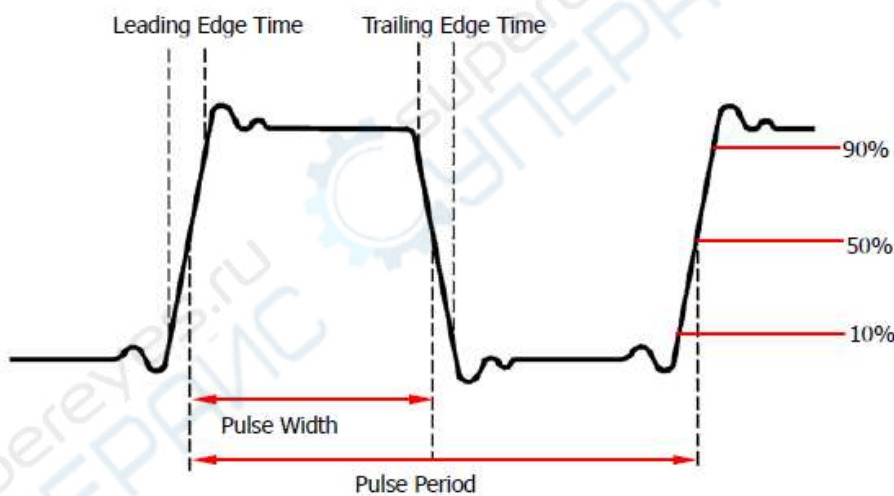
Pulse Width/Duty Cycle
Pulse width is defined as the time from the 50% threshold of a rising edge amplitude to the 50% threshold of the next falling edge amplitude as shown in the figure above.
The settable range of the pulse width is limited by the "Minimum Pulse Width" and the "Pulse Period" (for the ranges of the "Minimum Pulse Width" and "Pulse Period", please refer to "Signal Characteristics" in "**Specifications**"). The default value is 100µs.
1. Pulse Width ≥ Minimum Pulse Width
2. Pulse Width ≤ Pulse Period - Minimum Pulse Width × 2

Pulse duty cycle is defined as the percentage that the pulse width takes up in the whole pulse

period.

The pulse width and pulse duty cycle are correlative. Once a parameter is changed, the other will be automatically changed. The pulse duty cycle is limited by the "Minimum Pulse Width" and "Pulse Period".

1. Pulse Duty Cycle ≥ Minimum Pulse Width ÷ Pulse Period × 100%
2. Pulse Duty Cycle ≤ (1 - 2 × Minimum Pulse Width ÷ Pulse Period) × 100%

Press **Width/Duty** to highlight "Width". At this point, use the numeric keyboard to input the desired value and select the desired unit from the pop-up unit menu or use the direction keys and knob to modify the current value.

1. For the input method of the value, refer to the introduction in "**Parameter Setting Method**".
2. Selectable Pulse Width units: sec, msec, μsec, nsec.
3. Press this softkey again to switch to the duty setting.

Leading/Trailing Edge Time

The leading (rising) edge time is defined as the time required for the pulse amplitude to rise from 10% threshold to 90% threshold; while the trailing (falling) edge time is defined as the time required for the pulse amplitude to fall from 90% threshold to 10% threshold as shown in the figure above.

The range of the leading/trailing edge time is limited by the pulse width currently specified as shown in the formula below. The edge time will be automatically adjusted to match the specified pulse width if the value currently set exceeds the limit value.

Leading/Trailing Edge Time ≤ 0.625 × Pulse Width

Press **Leading/Trailing** softkey to highlight.

Use the numeric keyboard to input the desired value and select the desired unit from the pop-up unit menu or use the direction keys and knob to modify the current value.

1. For the input method of the value, refer to the introduction in "**Parameter Setting Method**".
2. Selectable leading/trailing edge time units: sec, msec, μsec and nsec.
3. The leading edge time and trailing edge time are independent from each other and users can set them separately.

2.2.10 Enable the Channel Output

After configuring the parameters of the waveform selected, waveform output could be enabled.

Press **1Output** or/and **2Output** at the front panel and the backlight of the button turns on. The instrument outputs the configured waveform from the **[1]** or/and **[2]** connector at the front panel.

2.3 Basic Waveform Output Example

Configure the generator to output a pulse waveform with 1.5MHz frequency, 500mVpp amplitude,

5mV$_{DC}$ DC offset, 200ns pulse width, 75ns leading (rising) edge time and 100ns trailing (falling) edge time.

1. Press **CH1/CH2** at the front panel and select CH1. The corresponding area of CH1 in the user interface is illuminated.
2. Press **Pulse** at the front panel and the backlight turns on, indicating that Pulse waveform is selected.
3. Press **Frequency/Period** to highlight "Frequency". Use the numeric keyboard to input the frequency value "1.5" and select the unit "MHz" from the pop-up menu.
4. Press **Amplitude/HiLevel** to highlight "Amplitude". Use the numeric keyboard to input the amplitude value "500" and select the unit "mV" from the pop-up menu.
5. Press **Offset/LoLevel** to highlight "Offset". Use the numeric keyboard to input the offset value "5" and select the unit "mV" from the pop-up menu.
6. Press **Width/Duty** to highlight "Width". Use the numeric keyboard to input "200" and select the unit "ns" from the pop-up menu. At this point, the pulse duty cycle changes accordingly.
7. Press **Leading/Trailing** to highlight "Leading". Use the numeric keyboard to input "75" and select the unit "ns" from the pop-up menu.
8. Press **Leading/Trailing** to highlight "Trailing". Use the numeric keyboard to input "100" and select the unit "ns" from the pop-up menu.
9. Press **1Output** at the front panel to turn the CH1 output on. At this point, the instrument outputs the specified waveform from CH1 according to the current configuration. Connect the output terminal of CH1 to the oscilloscope and the waveform is as shown in the figure below.
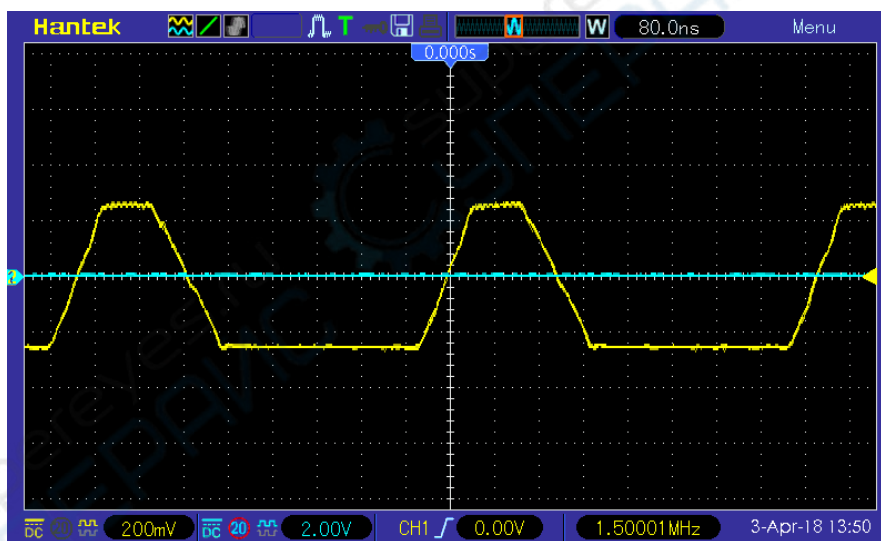
Chapter 3 Arbitrary Waveform Output

HDG6000B(C) can output the built-in waveforms and user-defined arbitrary waveforms from a single channel or from two channels at the same time. The 160 kinds of built-in waveforms are stored in the internal non-volatile memory. The user-defined arbitrary waveforms can contain 64 to 64M data points. Users can edit the arbitrary waveforms via the PC software and then download them to the instrument.

This chapter introduces how to configure the generator to output arbitrary waveforms.

◆ **Enable Arbitrary Waveform**

◆ **Select Arbitrary Waveform**

3.1 Enable Arbitrary Waveform

Press **Arb** to enable arbitrary waveform function and open the operation menu of arbitrary waveform.

Frequency/Period: set the "Frequency/Period" of the arbitrary waveform.

Amplitude/HighLevel: set the "Amplitude/HighLevel" of the arbitrary waveform.

Offset/LowLevel: set the output "Offset/LowLevel" of the arbitrary waveform.

Phase: set the "Start Phase" of the arbitrary waveform.

Align Phase: refer to "**Align Phase**".

Type: select the built-in waveforms or user-defined arbitrary waveforms stored in external memory of the instrument.

3.2 Select Arbitrary Waveform

HDG6000B(C) allows the user to select any of the internal or external memory of the device for waveform output.

Press "Arb" softkey, then press "type" softkey to select the instrument built-in waveform output.

Select more than 160 kinds of arbitrary waveform built in HDG6000B(C), as shown in the following table. Press "type", select a type ("Math", "Project", "Distribution function" and "Trigonometric function", "Window function" and "biology"), and press the corresponding softkey type to select the desired waveform. Press **Return** key to return to main menu.

Name	Description
Common	
DC	DC signal
AbsSine	Absolute value of a Sine
AbsSineHalf	Absolute value of half a Sine
AmpALT	Gain oscillation curve
AttALT	Attenuation oscillation curve
GaussPulse	Gauss pulse
NegRamp	Negative ramp
NPulse	Negative pulse
PPulse	Positive pulse
SineTra	Sine-Tra waveform
SineVer	Sine-Ver waveform
StairDn	Stair-down waveform
StairUD	Stair-up and stair-down waveform
StairUp	Stair-up waveform
Trapezia	Trapezoid waveform
Project	
BandLimited	Bandwidth-limited signal
BlaseiWave	Time-velocity curve of explosive vibration

Butterworth	Butterworth filter
Chebyshev1	Chebyshev1 filter
Chebyshev2	Chebyshev2 filter
Combin	Combination function
CPulse	C pulse
CWPulse	CW pulse
DampedOsc	Time-displacement curve of damped oscillation
DualTone	Dual-tone signal
Gamma	Gamma signal
GateVibar	Gate self-oscillation signal
LFMPulse	Linear FM pulse
MCNoise	Mechanical construction noise
Discharge	Discharge curve of Ni-MH battery
Pahcur	Current waveform of DC brushless motor
Quake	Analog quake waveform
Radar	Analog radar waveform
Ripple	Ripple wave of battery
RoundHalf	RoundHalf wave
RoundsPM	RoundsPM waveform
StepResp	Step-response signal
SwingOsc	Kinetic energy- time curve of swing oscillation
TV	TV signal
Voice	Voice signal
Sec-Mod	
AM	Sectioned sine AM signal
FM	Sectioned sine FM signal
PFM	Sectioned pulse FM signal
PM	Sectioned sine PM signal
PWM	Sectioned PWM signal
Bioelect	
Cardiac	Cardiac signal
EOG	Electro-Oculogram
EEG	Electroencephalogram
EMG	Electromyogram
Pulseilogram	Pulsilogram
ResSpeed	Speed curve of the respiration
Medical	
LFPulse	Waveform of the low frequency pulse electrotherapy
Tens1	Waveform 1 of the nerve stimulation electrotherapy
Tens2	Waveform 2 of the nerve stimulation electrotherapy
Tens3	Waveform 3 of the nerve stimulation electrotherapy
Standard	
Ignition	Ignition waveform of the automotive motor
ISO16750-2 SP	Automotive starting profile with ringing

ISO16750-2 VR	Automotive supply voltage profile for resetting
ISO7637-2 TP1	Automotive transients due to disconnects
ISO7637-2 TP2A	Automotive transients due to inductance in wiring
ISO7637-2 TP2B	Automotive transients due ignition switching off
ISO7637-2 TP3A	Automotive transients due to switching
ISO7637-2 TP3B	Automotive transients due to switching
ISO7637-2 TP4	Automotive supply profile during starting
ISO7637-2 TP5A	Automotive transients due to battery disconnect
ISO7637-2 TP5B	Automotive transients due to battery disconnect
SCR	SCR firing profile
Surge	Surge signal
Math	
Airy	Airy function
Besselj	BesselI function
Bessely	BesselII function
Cauchy	Cauchy distribution function
Cubic	Cubic function
Dirichlet	Dirichlet function
Erf	Error function
Erfc	Complementary error function
ErfcInv	Inverted complementary error function
ErfInv	Inverted error function
ExpFall	Exponential fall function
ExpRise	Exponential rise function
Gauss	Gauss distribution
HaverSine	HaverSine function
Laguerre	4-times Laguerre polynomial
Laplace	Laplace distribution
Legend	5-times Legend polynomial
Log	Logarithm function with the base 10
LogNormal	Logarithmic Gaussian distribution
Lorentz	Lorentz function
Maxwell	Maxwell distribution
Rayleigh	Rayleigh distribution
Versiera	Versiera
Weibull	Weibull distribution
ARB_X2	Square function
Trigonome	
CosH	Hyperbolic cosine
CosInt	Integral cosine
Cot	Cotangent
CotHCon	Concave hyperbolic cotangent
CotHPro	Protuberant hyperbolic cotangent
CscCon	Concave cosecant

CscPro	Protuberant cosecant
CscHCon	Concave hyperbolic cosecant
CscHPro	Protuberant hyperbolic cosecant
RecipCon	Concave reciprocal
RecipPro	Protuberant reciprocal
SecCon	Concave secant
SecPro	Protuberant secant
SecH	Hyperbolic secant
Sinc	Sinc function
SinH	Hyperbolic sine
SinInt	Integral sine
Sqrt	Square root
Tan	Tangent
TanH	Hyperbolic tangent
Anti Trigonome	
ACos	Arc cosine
ACosH	Arc hyperbolic cosine
ACotCon	Concave arc cotangent
ACotPro	Protuberant arc cotangen
ACotHCon	Concave arc hyperbolic cotangent
ACotHPro	Protuberant arc hyperbolic cotangent
ACscCon	Concave arc cosecant
ACscPro	Protuberant arc cosecant
ACscHCon	Concave arc hyperbolic cosecant
ACscHPro	Protuberant arc hyperbolic cosecant
ASecCon	Concave arc secant
ASecPro	Protuberant arc secant
ASecH	Arc hyperbolic secant
ASin	Arc Sinc
ASinH	Arc hyperbolic sine
ATan	Arc tangent
ATanH	Arc hyperbolic tangent
Window	
Bartlett	Bartlett window
BarthannWin	Modified Bartlett-Hann window
Blackman	Blackman window
BlackmanH	BlackmanH window
BohmanWin	Bohman window
Boxcar	Rectangle window
ChebWin	Chebyshev window
FlattopWin	Flat Top weighted window
Hamming	Hamming window
Hanning	Hanning window
Kaiser	Kaiser window

NuttallWin	Nuttall-defined minimum 4-term Blackman-Harris window
ParzenWin	Parzen window
TaylorWin	Taylor window
Triang	Triangle window (Fejer window)
TukeyWin	Tukey (tapered cosine) window

Stored Waveform

Select the user-defined arbitrary waveforms stored in external memory (U Disk). Press **Store** softkey to enter the Store/Recall Interface. Please select and read the desired arbitrary waveform file. For more details, please refer to "**Store and Recall**". To return to arbitrary waveform setting interface, press **Arb**.

Load the arbitrary waveform

Edit the arb waveform by PC software, and export the waveform data to external storage devices. Press **Arb** softkey to enter arb menu, press **Type** -> **User** to choose the waveform data to load.

Chapter 4 Harmonic Output

HDG6000B(C) can be used as a harmonic generator to output harmonic with specified order, amplitude and phase. It is usually used in the test of harmonic detector device or harmonic filter device.

This chapter introduces how to configure the generator to output harmonics. Subjects in this chapter:

◆ **Overview**

◆ **Set the Fundamental Waveform Parameters**

◆ **Set the Harmonic Order**

◆ **Select the Harmonic Type**

◆ **Set the Harmonic Amplitude**

◆ **Set the Harmonic Phase**

4.1 Overview

According to Fourier transform, time domain waveform is the superposition of a series of sine waveforms as shown in the equation below:

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

Generally, component with f_1 frequency is called fundamental waveform, f_1 is fundamental waveform frequency, A_1 is fundamental waveform amplitude and φ_1 is fundamental waveform phase. The frequencies of other components (called harmonics) are all integral multiples of the fundamental waveform frequency. Components whose frequencies are odd multiples of the fundamental waveform frequency are odd harmonics and components whose frequencies are even multiples of the fundamental waveform frequency are even harmonics.

HDG6000B(C) can output up to 16th order of harmonic. After selecting CH1 or CH2, press **Harmonic** at the front panel to enter the harmonic setting menu. Users can set the parameters of fundamental waveform, set the type of harmonic, specify the highest order of harmonic and set the amplitude and phase of each order of harmonic.

After finishing harmonic parameter setting, press **Output1** or/and **Output2** and the backlight of the button turns on, the instrument outputs the specified harmonic from the corresponding output terminal.

4.2 Set the Fundamental Waveform Parameters

Users can set various fundamental waveform parameters such as frequency, period, amplitude, DC offset voltage, high level, low level and start phase. It also supports align phase operation. Please refer to introductions in "**Basic Waveform Output**" to set fundamental waveform parameters.

4.3 Set the Harmonic Order

The highest order of harmonic output cannot be greater than this setting value.

Press **Harmonic** at the front panel to select the waveform and the backlight of the button turns on. Press **Order** softkey (at this point, "Order" on the screen is highlighted) and use the numeric keyboard or the direction keys and knob to input the harmonic order.
The range is limited by the maximum output frequency of the instrument as well as the fundamental waveform frequency.

◆ Order Range: integers within 2 to **maximum output frequency of the instrument ÷ fundamental waveform frequency**.

◆ The maximum is 16.

4.4 Select the Harmonic Type

HDG6000B(C) can output even harmonic, odd harmonic, all orders of harmonic or user-defined orders of harmonic. After entering the harmonic setting menu, press **Type** to select the desired harmonic type.

1. Even

Press this key and the instrument would output fundamental waveform and even harmonics.

2. Odd

Press this key and the instrument would output fundamental waveform and odd harmonics.

3. All

Press this key and the instrument would output fundamental waveform and all the harmonics in order.

Note: The harmonics actually output are determined by the "Order" currently specified.

4.5 Set the Harmonic Amplitude

After entering the harmonic setting menu, press **Amplitude** to set the amplitude of each order of harmonic.

1. Index: press this softkey to select the sequence number of the harmonic to be set.

2. Amplitude: press this softkey to set the amplitude of the harmonic selected. Use the numeric keyboard to input the amplitude value and then select the desired unit from the pop-up menu or use the direction keys and knob to modify the current value.

◆ For the input method of amplitude value, refer to the introduction in "**Parameter Setting Method**".

◆ The amplitude units available are Vpp and mVpp.

4.6 Set the Harmonic Phase

After entering the harmonic setting menu, press **Phase** to set the phase of each order of harmonic.

1. Index: press this softkey to select the sequence number of the harmonic to be set.

2. Phase: press this softkey to set the phase of the harmonic selected. Use the numeric keyboard to input the phase value and then select the unit "°" from the pop-up menu or use the direction keys and knob to modify the current value. For the input method of phase value, refer to the introduction in "**Parameter Setting Method**".

Chapter 5 Modulated Waveform

HDG6000B(C) supports AM, DSB-AM, FM, PM, 2ASK, 2FSK, 2PSK, BPSK, QPSK, 3FSK, 4FSK, OSK and PWM modulations. It can output modulated waveform from a single channel or from two channels at the same time. The modulated waveform consists of carrier waveform and modulating waveform. The carrier waveform can be Sine, Square, Ramp, Pulse, Arbitrary waveform (except DC) or Harmonic. The modulating waveform can be from internal (default), other channel, or external modulation source.

◆ **AM Modulation**

◆ **DSB-AM Modulation**

◆ **FM Modulation**

◆ **PM Modulation**

◆ **2ASK Modulation**

◆ **2FSK Modulation**

◆ **2PSK Modulation**

◆ **BPSK Modulation**

◆ **QPSK Modulation**

◆ **3FSK Modulation**

◆ **4FSK Modulation**

◆ **OSK Modulation**

◆ **PWM Modulation**

5.1 AM Modulation

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.

5.1.1 Select AM Modulation

Press **Mod->Type->AM** to enable AM function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.

◆After AM is enabled, the instrument will generate AM waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.1.2 Carrier Waveform Shape

AM carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.

◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.

◆Noise and DC could not be used as carrier waveform.

5.1.3 Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 KHz for all functions.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 60MHz
Ramp	1µHz to 5MHz
Pulse	1µHz to 50MHz
Arbitrary Waveform	1µHz to 50MHz

After the carrier waveform is selected, you can press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.1.4 Modulating Waveform Source

HDG6000B(C) can receive modulating waveform from Internal (default), External, or Other Channel. Press **Mod** -> **Source** to select the modulation source.

Internal Source

When internal modulation source is selected, press **Shape** to select Sine, Square, Ramp, Noise or Arb as modulating waveform. The default is Sine.

◆ Sine waveform
◆ Square: 50% duty cycle
◆ Ramp: 50% symmetry.

Note: Noise can be used as modulating waveform but cannot be used as carrier waveform.

External Source

With the External source, an external waveform modulates the carrier waveform. The modulation amplitude (AM) is controlled by the ±2.5V signal level on the front-panel **[Sync/Mod/Trig]** connector.

Sync/Mod/Trig

Other Channel

Other channel: CH1 and CH2 can be used as modulation sources reciprocally. When CH1 is used as the modulated wave, CH2 can be used as the modulation source. And vice versa.

5.1.5 Modulating Waveform Frequency

When internal modulation source is selected, press **Frequency** to set the modulating waveform frequency.

◆ Input the desired frequency value using the numeric keyboard or direction keys and knob.
◆ The modulating waveform frequency ranges from 2mHz to 50kHz, and the default value is 100Hz.

Note: This menu will be grayed out and disabled when other modulation sources except the internal modulation source are selected.

5.1.6 Modulation Depth

The modulation depth is a percentage that represents the amplitude variation.

◆ Press **Depth** to set AM modulation depth.
◆ Modulation depth: 0% to 120%. The default is 100%.
◆ At 0% depth, the amplitude is one-half of the carrier's amplitude setting.
◆ At 100% depth, the output amplitude is equal to the specified value.
◆ In >100% modulation, the output amplitude of the instrument would not exceed 10Vpp (50Ω load).

When "Ext" modulation source is selected, the output amplitude of the instrument is also controlled by the ±2.5V signal level at the **[Sync/Mod/Trig]** connector at the front panel. For example, set the modulation depth to 100%, the output amplitude is the maximum when the modulating signal is +2.5V and the minimum when the modulating signal is -2.5V.

5.2 DSB-AM Modulation

In the Double-sideband AM signal, there are only two side frequencies, and there is no carrier component. Its frequency bandwidth is still twice the frequency of the modulated signal.

5.2.1 Select DSB-AM Modulation

Press **Mod->Type->DSB-AM** to enable DSB-AM function.
◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆After DSB-AM is enabled, the instrument will generate DSB-AM waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.2.2 Carrier Waveform Shape

DSB-AM carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
◆Noise and DC could not be used as carrier waveform.

5.2.3 Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 KHz for all functions.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 60MHz
Ramp	1µHz to 5MHz

Pulse	1μHz to 50MHz
Arbitrary Waveform	1μHz to 50MHz

After the carrier waveform is selected, you can press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.2.4 Modulating Waveform Source

HDG6000B(C) can receive modulating waveform from Internal (default), External, or Other Channel. Press **Mod** -> **Source** to select the modulation source.
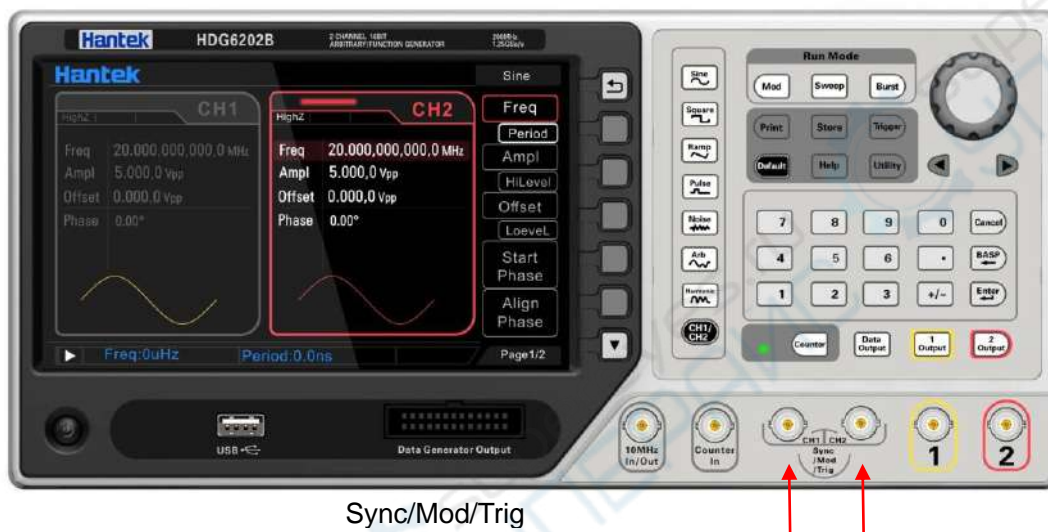
Internal Source
When internal modulation source is selected, press **Shape** to select Sine, Square, Ramp, Noise or Arb as modulating waveform. The default is Sine.
◆ Sine waveform
◆ Square: 50% duty cycle
◆ Ramp: 50% symmetry.
Note: Noise can be used as modulating waveform but cannot be used as carrier waveform.

External Source
With the External source, an external waveform modulates the carrier waveform. The modulation amplitude (DSB-AM) is controlled by the ±2.5V signal level on the front-panel **[Sync/Mod/Trig]** connector.
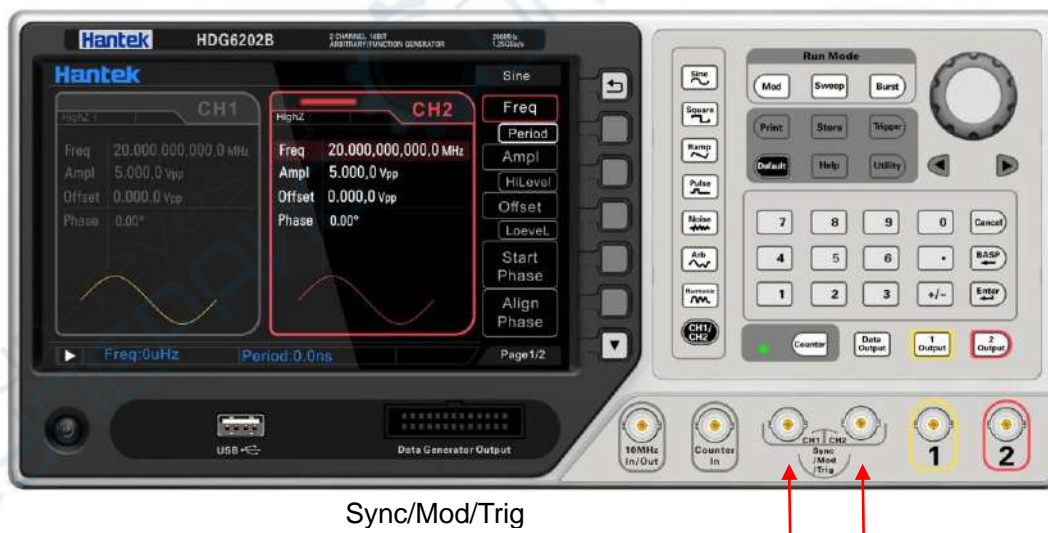
Sync/Mod/Trig

Other Channel
Other channel: CH1 and CH2 can be used as modulation sources reciprocally. When CH1 is used as the modulated wave, CH2 can be used as the modulation source. And vice versa.

5.2.5 Modulating Waveform Frequency

When internal modulation source is selected, press **Frequency** to set the modulating waveform frequency.

◆ Input the desired frequency value using the numeric keyboard or direction keys and knob.
◆ The modulating waveform frequency ranges from 2mHz to 50kHz, and the default value is 100Hz.

Note: This menu will be grayed out and disabled when other modulation sources except the internal modulation source are selected.

5.2.6 Modulation Depth

The modulation depth is a percentage that represents the amplitude variation.
◆ Press **Depth** to set DSB-AM modulation depth.
◆ Modulation depth: 0% to 120%. The default is 100%.
◆ At 0% depth, the amplitude is one-half of the carrier's amplitude setting.
◆ At 100% depth, the output amplitude is equal to the specified value.
◆ In >100% modulation, the output amplitude of the instrument would not exceed 10Vpp (50Ω load).

When "Ext" modulation source is selected, the output amplitude of the instrument is also controlled by the ±2.5V signal level at the **[Sync/Mod/Trig]** connector at the front panel. For example, set the modulation depth to 100%, the output amplitude is the maximum when the modulating signal is +2.5V and the minimum when the modulating signal is -2.5V.

5.3 FM Modulation

A modulated waveform consists of a carrier waveform and a modulating waveform. In FM, the carrier frequency is varied by the voltage level of the modulating waveform.

5.3.1 Select FM Modulation

Press **Mod->Type->FM** to enable FM function.

◆ When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆ After FM is enabled, the instrument will generate FM waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.3.2 Carrier Waveform Shape

FM carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.

Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.

Noise and DC could not be used as carrier waveform.

5.3.3 Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 kHz for all functions.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 60MHz
Ramp	1µHz to 5MHz
Pulse	1µHz to 50MHz
Arbitrary Waveform	1µHz to 50MHz

After the carrier waveform is selected, you can press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.3.4 Modulating Waveform Source

HDG6000B(C) can receive modulating waveform from Internal (default), External, or Other Channel. Press **Mod** -> **Source** to select the modulation source.

Internal Source

When internal modulation source is selected, press **Shape** to select Sine, Square, Ramp, Noise or Arb as modulating waveform. The default is Sine.

◆ Sine waveform
◆ Square: 50% duty cycle.
◆ Ramp: 50% symmetry.

Note: Noise can be used as modulating waveform but cannot be used as carrier waveform.

External Source

With the External source, an external waveform modulates the carrier waveform. The frequency deviation is controlled by the ±2.5 V signal level on the front-panel **[Sync/Mod/Trig]** connector.

Sync/Mod/Trig

Other Channel

Other channel: CH1 and CH2 can be used as modulation sources reciprocally. When CH1 is used as the modulated wave, CH2 can be used as the modulation source. And vice versa.

5.3.5 Modulating Waveform Frequency

When internal modulation source is selected, press **Frequency** to set the modulating waveform frequency.

◆ Input the desired frequency value using the numeric keyboard or direction keys and knob.
◆ The modulating waveform frequency ranges from 2mHz to 50kHz, and the default value is 100Hz.

Note: This menu will be grayed out and disabled when other modulation sources except the internal modulation source are selected.

5.3.6 Frequency Deviation

Frequency deviation is the deviation of the modulating waveform frequency relative to the carrier frequency. Press **Deviation** to set the FM frequency deviation.

◆ Frequency deviation must be lower than or equal to the carrier frequency.
◆ Attempting to set a deviation greater than the carrier frequency will cause the instrument to set the deviation equal to the carrier frequency.
◆ The sum of frequency deviation and carrier frequency must be lower than or equal to the sum of the current carrier frequency upper limit and 1kHz.

When "Ext" modulation source is selected, frequency deviation is controlled by the ±2.5V signal level at the **[Sync/Mod/Trig]** connector at the pront panel. Positive signal level corresponds to frequency increase and negative signal level corresponds to frequency decrease. The lower the

level, the less offset is generated. For example, if the frequency deviation is set to 1KHz, +2.5V signal level corresponds to a 1kHz increase of frequency and -2.5V signal level corresponds to a 1kHz decrease of frequency.

5.4 PM Modulation

A modulated waveform consists of a carrier waveform and a modulating waveform. In PM, the carrier phase is varied by the voltage level of the modulating waveform.

5.4.1 Select Phase Modulation

Press **Mod->Type->PM** to enable PM function.
◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆After PM is enabled, the instrument will generate PM waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.4.2 Carrier Waveform Shape

PM carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
◆Noise and DC could not be used as carrier waveform.

5.4.3 Carrier Frequency

The maximum carrier frequency varies by function, as shown below. The default is 1 kHz for all functions.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 60MHz
Ramp	1µHz to 5MHz
Pulse	1µHz to 50MHz
Arbitrary Waveform	1µHz to 50MHz

After the carrier waveform is selected, you can press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.4.4 Modulating Waveform Source

HDG6000B(C) can receive modulating waveform from Internal (default), External, or Other Channel. Press **Mod** -> **Source** to select the modulation source.
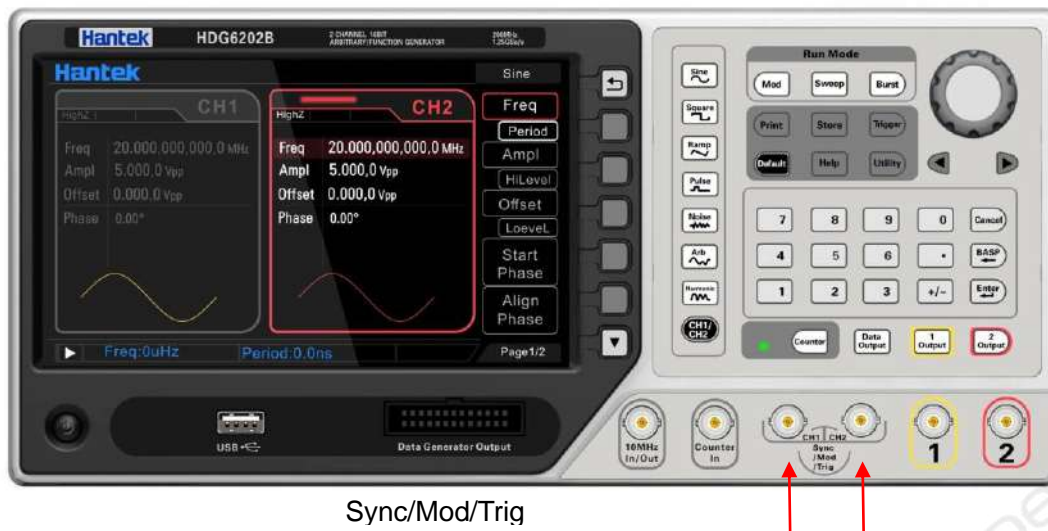
Internal Source
When internal modulation source is selected, press **Shape** to select Sine, Square, Ramp, Noise or Arb as modulating waveform. The default is Sine.
◆ Sine waveform
◆ Square: 50% duty cycle.
◆ Ramp: 50% symmetry.
Note: Noise can be used as modulating waveform but cannot be used as carrier waveform.

External Source
With the External source, an external waveform modulates the carrier waveform. The Phase Deviation is controlled by the ±2.5 V signal level on the front-panel **[Sync/Mod/Trig]** connector.

Sync/Mod/Trig

Other Channel
Other channel: CH1 and CH2 can be used as modulation sources reciprocally. When CH1 is used as the modulated wave, CH2 can be used as the modulation source. And vice versa.

5.4.5 Modulating Waveform Frequency

When internal modulation source is selected, press **Frequency** to set the modulating waveform frequency.
◆ Input the desired frequency value using the numeric keyboard or direction keys and knob.
◆ The modulating waveform frequency ranges from 2mHz to 50kHz, and the default value is 100Hz.
Note: This menu will be grayed out and disabled when other modulation sources except the internal modulation source are selected.

5.4.6 Phase Deviation

Phase deviation is the deviation of the modulating waveform phase relative to the carrier waveform phase. Press **Deviation** to set the PM phase deviation.

◆ Use the numeric keyboard or direction keys and knob to input the desired phase value.
◆ The range of phase deviation is from 0º to 360º.

When "Ext" modulation source is selected, the phase deviation is controlled by the ±2.5V signal level at the **[Sync/Mod/Trig]** connector at the pront panel. For example, if the phase deviation is set to 180º, +2.5V signal level corresponds to a 180º phase variation. The lower the external signal level, the less deviation would be generated.

5.5 2ASK

You can configure the instrument to "shift" its output amplitude between two preset values using 2ASK modulation. The rate at which the output shifts between the two amplitudes (called the "carrier amplitude" and the "modulation amplitude") is determined by the internal signal level of the instrument or the signal level on the front-panel **[Sync/Mod/Trig]** connector.

5.5.1 Select 2ASK Modulation

Press **Mod->Type->2ASK** to enable this function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆After 2ASK is enabled, the instrument will generate 2ASK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.5.2 Carrier Waveform Shape

2ASK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
◆Noise and DC could not be used as carrier waveform.

5.5.3 Carrier Amplitude

Choose carrier waveform shape, press **Amplitude/HighLevel** to highlight "Amplitude", and then use the numeric keyboard or direction keys and knob to input the desired amplitude. The available amplitude range is limited by **Frequency/Period**. Please refer to the "Output Characteristics"

described in "**Specifications**".

5.5.4 Modulating Waveform Source

Press **Mod** -> **Source** to select Internal (default) or External as the modulation source.

Internal Source
When internal modulation source is selected, the modulating waveform is set as a Square with 50% duty cycle, and the rate at which the output amplitude "shifts" between "carrier amplitude" and "modulating amplitude" is determined by "2ASK Rate".

External Source
With the External source, the generator receives the external modulating signal from the **[Sync/Mod/Trig]** connector at the pront panel.
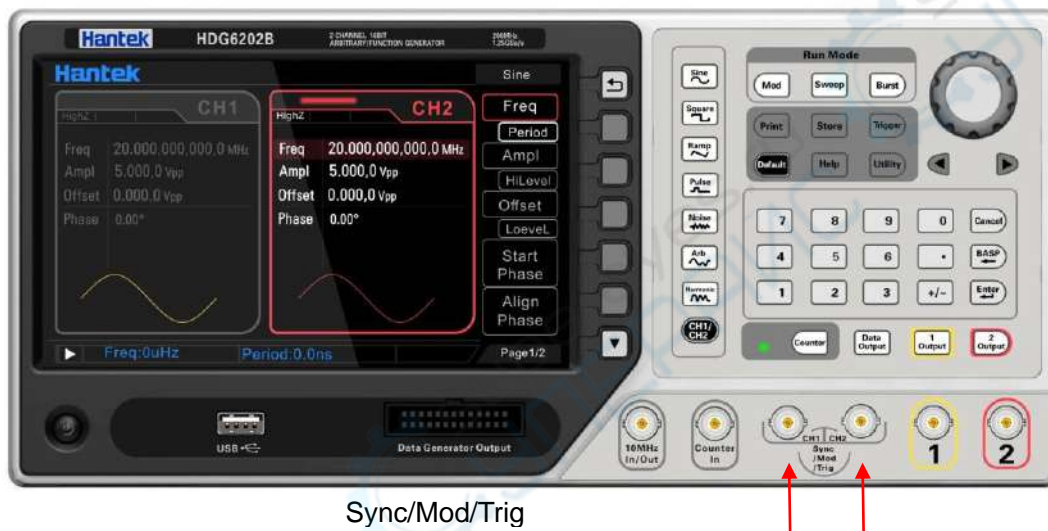
Sync/Mod/Trig

Note: The **[Sync/Mod/Trig]** connector is different when controlling 2ASK and AM/FM/PM modulations externally. In 2ASK modulation, the **[Sync/Mod/Trig]** connector has adjustable edge polarity.

5.5.5 2ASK Rate

When internal modulation source is selected, the 2ASK Rate is the rate at which the output amplitude shifts between "carrier amplitude" and "modulating amplitude". Press **Rate** to set.
◆   Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆   The frequency range is from 2mHz to 1MHz and the default is 100Hz.

Note: This menu will be grayed out and disabled when the external modulation source are selected.

5.5.6 Modulating Amplitude

Press **Amplitude** to set the modulating amplitude.

◆ Use the numeric keyboard or direction keys and knob to input the desired amplitude value.

◆ The range of amplitude (HighZ) is from 1mV to 20V and the default is 100mV.

5.6 2FSK

You can configure the instrument to "shift" its output frequency between two preset values using 2FSK modulation. The rate at which the output shifts between the two frequencies (called the "carrier frequency" and the "hop frequency") is determined by the internal signal level of the instrument or the signal level on the front-panel **[Sync/Mod/Trig]** connector.

5.6.1 Select 2FSK Modulation

Press **Mod->Type->2FSK** to enable this function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.

◆After 2FSK is enabled, the instrument will generate 2FSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.6.2 Carrier Waveform Shape

2FSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.

◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.

◆Noise and DC could not be used as carrier waveform.

5.6.3 Carrier Frequency

Choose carrier waveform shape, press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency.

Different carrier waveforms have different frequency ranges as shown in the table below. For all the carrier waveforms, the default value is 1KHz.

| Carrier Waveform	Frequency Range
Sine	1μHz to 200MHz
Square	1μHz to 50MHz
Ramp	1μHz to 5MHz
Pulse	1μHz to 50MHz
Arbitrary Waveform	1μHz to 50MHz

5.6.4 Modulating Waveform Source

Press **Mod** -> **Source** to select Internal (default) or External as the modulation source.

Internal Source
When internal modulation source is selected, the modulating waveform is set as a Square with 50% duty cycle, and the rate at which the output frequency "shifts" between "carrier frequency" and "modulating frequency" is determined by "2FSK Rate".

External Source
With the External source, the generator receives the external modulating signal from the **[Sync/Mod/Trig]** connector at the pront panel.
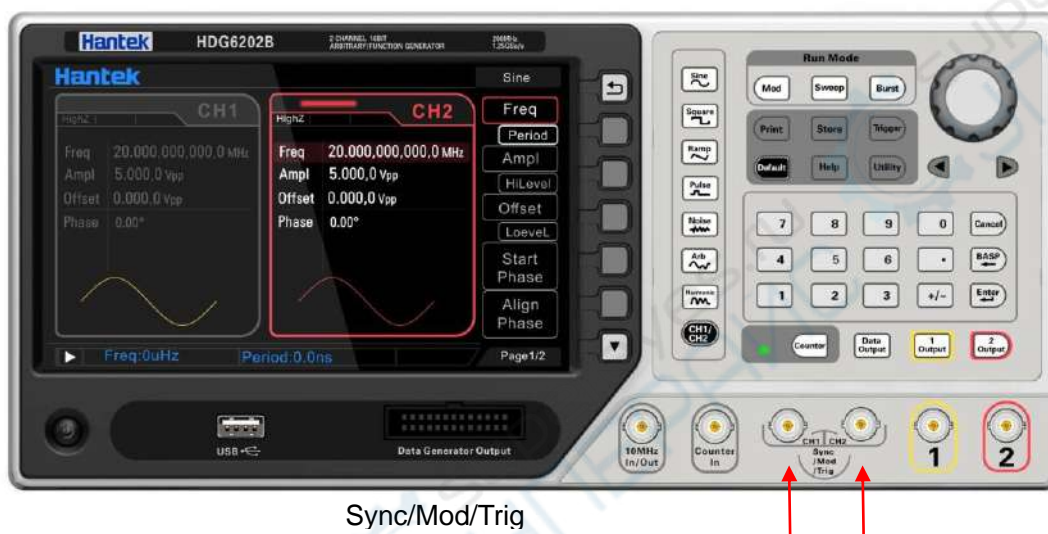
Sync/Mod/Trig

Note: The **[Sync/Mod/Trig]** connector is different when controlling 2FSK and AM/FM/PM modulations externally. In 2FSK modulation, the **[Sync/Mod/Trig]** connector has adjustable edge polarity.

5.6.5 2FSK Rate

When internal modulation source is selected, the 2FSK Rate is the rate at which the output frequency shifts between "carrier frequency" and "modulating frequency". Press **Rate** to set.
◆   Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆   The frequency range is from 2mHz to 1MHz and the default is 100Hz.

Note: This menu will be grayed out and disabled when the external modulation source are selected.

5.6.6 Hopping Frequency

Alternating frequency (hopping frequency) is the modulating frequency. The range of hop frequency depends on the carrier waveform currently selected.

Sine: 1µHz to 200MHz

Square: 1µHz to 50MHz

Ramp: 1µHz to 5MHz

Arb: 1µHz to 50MHz

Press **Hopping** to set the parameter. Use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.7 2PSK

You can configure the instrument to "shift" its output phase between two preset values using 2PSK modulation. The rate at which the output shifts between the two phases (called the "carrier phase" and the "modulation phase") is determined by the internal signal level of the instrument or the signal level on the front-panel **[Sync/Mod/Trig]** connector.

5.7.1 Select 2PSK Modulation

Press **Mod->Type->2PSK** to enable this function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.

◆After 2PSK is enabled, the instrument will generate 2PSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.7.2 Carrier Waveform Shape

2PSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.

◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.

◆Noise and DC could not be used as carrier waveform.

5.7.3 Carrier Phase

Choose carrier waveform shape, press **Phase** to highlight "Phase", and then use the numeric keyboard or direction keys and knob to input the desired phase. The available phase ranges from 0º to 360º and the default value is 0º.

## 5.7.4 Modulating Waveform Source

Press **Mod** -> **Source** to select Internal (default) or External as the modulation source.

Internal Source

When internal modulation source is selected, the modulating waveform is set as a Square with 50% duty cycle, and the rate at which the output phase "shifts" between "carrier phase" and "modulating phase" is determined by "2PSK Rate".

External Source

With the External source, the generator receives the external modulating signal from the **[Sync/Mod/Trig]** connector at the front panel.
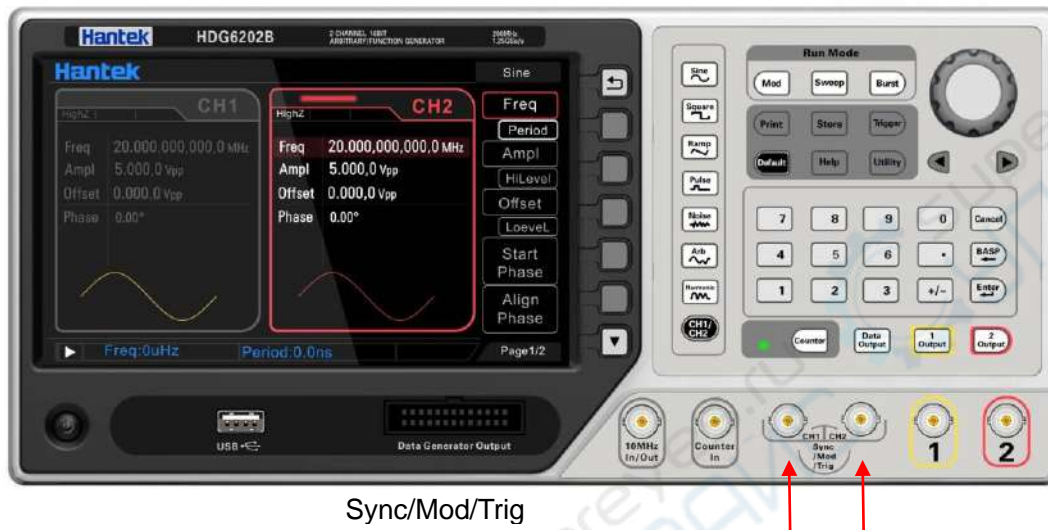
Sync/Mod/Trig

Note: The **[Sync/Mod/Trig]** connector is different when controlling 2PSK and AM/FM/PM modulations externally. In 2PSK modulation, the **[Sync/Mod/Trig]** connector has adjustable edge polarity.

5.7.5 2PSK Rate

When internal modulation source is selected, the 2PSK Rate is the rate at which the output phase shifts between "carrier phase" and "modulating phase". Press **Rate** to set.
◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.

Note: This menu will be grayed out and disabled when the external modulation source are selected.

5.7.6 Modulating Phase

Press **Phase** on modulation menu to set the parameter.
◆ Use the numeric keyboard or direction keys and knob to input the desired amplitude value.
◆ The phase range is from 0º to 360º and the default is 180º.

5.8 BPSK

You can configure the instrument to "shift" its output phase between two preset values using BPSK modulation. The rate at which the output shifts between the two phases (called the "carrier phase" and the "modulation phase") is determined by the internal signal level of the instrument.

5.8.1 Select BPSK Modulation

Press **Mod->Type->BPSK** to enable this function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆After BPSK is enabled, the instrument will generate BPSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.8.2 Carrier Waveform Shape

BPSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
◆Noise and DC could not be used as carrier waveform.

5.8.3 Carrier Phase

Choose carrier waveform shape, press **Phase** to highlight "Phase", and then use the numeric keyboard or direction keys and knob to input the desired phase. The available phase ranges from 0º to 360º and the default value is 0º.

5.8.4 Modulating Waveform Source

BPSK uses internal modulation source. Press **Data Source** softkey, and select 01 code, 10 code, PN15 code or PN21 code as the modulation source. The default data source is 01 code.

5.8.5 BPSK Rate

BPSK uses internal modulation source. Press **Rate** to set the frequency at which the output phase shifts between "carrier phase" and "modulating phase".
◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.

5.8.6 Modulating Phase

Press **Phase** to set the parameter.
- ◆ Use the numeric keyboard or direction keys and knob to input the desired amplitude value.
- ◆ The phase range is from 0º to 360º and the default is 180º.

5.9 QPSK Modulation

You can configure the instrument to "shift" its output phase between four preset values using QPSK modulation. The rate at which the output shifts between the four phases (called the "carrier phase" and three "modulation phases") is determined by the internal signal level of the instrument.

5.9.1 Select QPSK Modulation

Press **Mod->Type->QPSK** to enable this function.

- ◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
- ◆After QPSK is enabled, the instrument will generate QPSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.9.2 Carrier Waveform Shape

QPSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
- ◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
- ◆Noise and DC could not be used as carrier waveform.

5.9.3 Carrier Phase

Choose carrier waveform shape, press **Phase** to highlight "Phase", and then use the numeric keyboard or direction keys and knob to input the desired phase. The available phase ranges from 0º to 360º and the default value is 0º.

5.9.4 Modulating Waveform Source

QPSK uses internal modulation source. Press **Data Source** softkey, and select PN15 and PN21 codes as the modulation source. The default data source is PN15 code.

5.9.5 QPSK Rate

QPSK uses internal modulation source. Press **Rate** to set the frequency at which the output phase shifts between "carrier phase" and "modulating phase".

◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.

◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.

5.9.6 Modulating Phase

Press **Phase1** or **Phase2/Phase3** to set the parameter.

◆ Use the numeric keyboard or direction keys and knob to input the desired amplitude value.

◆ The phase range is from 0º to 360º and the default is 180º.

5.10 3FSK Modulation

You can configure the instrument to "shift" its output frequency between three preset values using 3FSK modulation. The rate at which the output shifts between the three frequencies (called the "carrier frequency" and two "hop frequencies") is determined by the internal signal level of the instrument or the signal level on the front-panel **[Sync/Mod/Trig]** connector.

5.10.1 Select 3FSK Modulation

Press **Mod->Type->3FSK** to enable this function.

◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.

◆After 3FSK is enabled, the instrument will generate 3FSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.10.2 Carrier Waveform Shape

3FSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.

◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.

◆Noise and DC could not be used as carrier waveform.

5.10.3 Carrier Frequency

Choose carrier waveform shape, press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency.

Different carrier waveforms have different frequency ranges as shown in the table below. For all the carrier waveforms, the default value is 1KHz.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 50MHz
Ramp	1µHz to 5MHz
Pulse	1µHz to 50MHz
Arbitrary Waveform	1µHz to 50MHz

5.10.4 Modulating Waveform Source

3FSK uses internal modulation source. The modulation waveform is square.

5.10.5 3FSK Rate

3FSK uses internal modulation source. The 3FSK Rate is the rate at which the output frequency shifts between "carrier frequency" and two "modulating frequencies". Press **Rate** to set.
◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.

5.10.6 Hopping Frequency

Alternating frequency (hopping frequency) is the modulating frequency. The range of hop frequency depends on the carrier waveform currently selected.

Sine: 1µHz to 200MHz
Square: 1µHz to 50MHz
Ramp: 1µHz to 5MHz
Arb: 1µHz to 50MHz

Press **HopFreq1/HopFreq2** to set the parameter. Use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.11 4FSK Modulation

You can configure the instrument to "shift" its output frequency between four preset values using 4FSK modulation. The rate at which the output shifts between the four frequencies (called the "carrier frequency" and three "hop frequencies") is determined by the internal signal level of the instrument or the signal level on the front-panel **[Sync/Mod/Trig]** connector.

5.11.1 Select 4FSK Modulation

Press **Mod->Type->4FSK** to enable this function.
◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.

◆After 4FSK is enabled, the instrument will generate 4FSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.11.2 Carrier Waveform Shape

4FSK carrier shape: Sine (default), Square, Ramp, Pulse, Arbitrary (except DC) or Harmonic waveform.
◆Press the front panel key **Sine**, **Square**, **Ramp**, **Pulse**, **Arb -> Type** or **Harmonic** to select a desired carrier waveform shape.
◆Noise and DC could not be used as carrier waveform.

5.11.3 Carrier Frequency

Choose carrier waveform shape, press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency.

Different carrier waveforms have different frequency ranges as shown in the table below. For all the carrier waveforms, the default value is 1KHz.

Carrier Waveform	Frequency Range
Sine	1µHz to 200MHz
Square	1µHz to 50MHz
Ramp	1µHz to 5MHz
Pulse	1µHz to 50MHz
Arbitrary Waveform	1µHz to 50MHz

5.11.4 Modulating Waveform Source

4FSK uses internal modulation source. The modulation waveform is square.

5.11.5 4FSK Rate

4FSK uses internal modulation source.The 4FSK Rate is the rate at which the output frequency shifts between "carrier frequency" and three "modulating frequencies". Press **Rate** to set.
◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.

5.11.6 Hopping Frequency

Alternating frequency (hopping frequency) is the modulating frequency. The range of hop frequency depends on the carrier waveform currently selected.
    Sine: 1µHz to 200MHz

Square: 1μHz to 50MHz
Ramp: 1μHz to 5MHz
Arb: 1μHz to 50MHz

Press **HopFreq1/HopFreq2/HopFreq3** to set the parameter. Use the numeric keyboard or direction keys and knob to input the desired frequency value.

5.12 OSK Modulation

When OSK (Oscillation Shift Keying) modulation is selected, users can configure the generator to output a sine signal with intermittent oscillation as shown in the figure below (the carrier waveform is 100Hz and the OSK rate is 10kHz). The start-oscillation and stop-oscillation of the internal crystal oscillator are controlled by the internal signal level or signal level at the **[Mod/FSK/Trig]** connector at the frount panel. When the internal crystal oscillator starts to oscillate, the instrument starts to output the carrier waveform and when the internal crystal stops oscillating, the output stops.
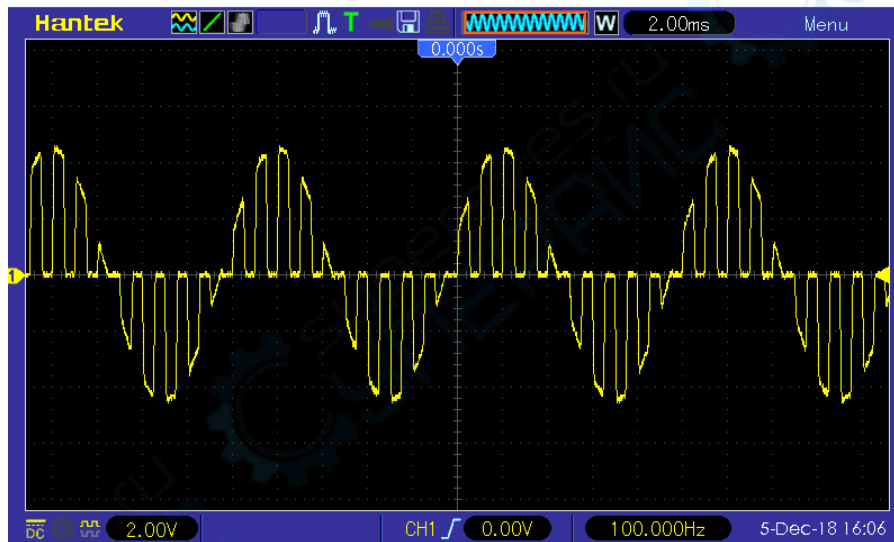
5.12.1 Select OSK Modulation

Press **Mod->Type->OSK** to enable this function.
◆When **Mod** is enabled, **Sweep** or **Burst** will be disabled automatically.
◆After OSK is enabled, the instrument will generate OSK waveform with the currently specified carrier and modulating waveforms. To avoid multiple waveform changes, enable modulation after configuring the other modulation parameters.

5.12.2 Carrier Waveform Shape

OSK carrier waveform can only be sine waveform. Press **Sine** at the front panel.

5.12.3 Carrier Frequency

Choose carrier waveform shape, press **Frequency/Period** to highlight "Frequency", and then use the numeric keyboard or direction keys and knob to input the desired frequency.
The range is from 1μHz to 200MHz. The default frequency is 1KHz.

5.12.4 Modulating Waveform Source

Press **Mod** -> **Source** to select Internal (default) or External as the modulation source.

Internal Source
When internal modulation source is selected, the modulating waveform is set as a Square with 50% duty cycle, and the intermittence time and oscillate time of the output signal is determined by the OSK "Rate".

External Source
With the External source, the generator receives the external modulating signal from the **[Sync/Mod/Trig]** connector at the front panel.

Sync/Mod/Trig
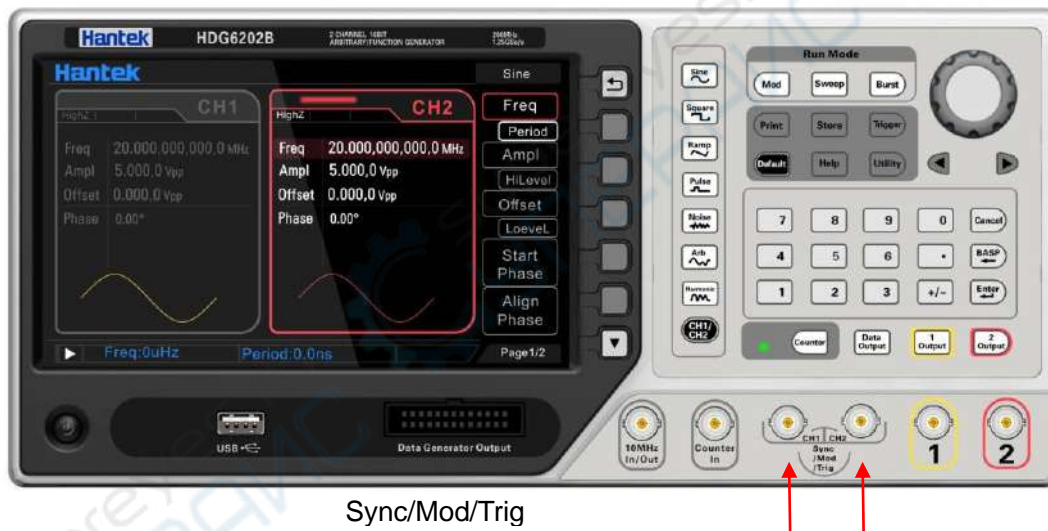
5.12.5 OSK Rate

When internal modulation source is selected, press **Rate** softkey to set the OSK frequency.
◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.
◆ The frequency range is from 2mHz to 1MHz and the default is 100Hz.
Note: This menu will be grayed out and disabled when the external modulation source are selected.

5.12.6 Oscillate Period

Oscillate period is the oscillation period of internal crystal oscillator. The settable range of the

oscillate period is related to the OSK rate currently selected. Press **OscTime** to highlight it and use the numeric keyboard or direction keys and knob to input the desired period. The default range is from 8ns to 4.99975ms.

5.13 PWM

A modulated waveform consists of a carrier waveform and a modulating waveform. In PWM, The pulse width of the carrier waveform varies with the voltage level of the modulating waveform.

5.13.1 Select PWM Modulation

PWM is only available for the Square waveform.
Press **Square** at the front panel first and then press **Mod** to enable PWM function.

◆ If the **Square** function key has not been selected, PWM in **Type** menu is unavailable.
◆ When **Mod** is enabled, **Sweep** or **Burst** will be automatically disabled (if enabled currently).
◆ After PWM is enabled, the instrument will generate PWM waveform with the currently specified carrier and modulating waveforms.

5.13.2 Carrier Waveform Shape

PWM is only available for the Square waveform.
Press **Square** at the front panel to select Square waveform.

5.13.3 Duty Cycle

After the carrier waveform shape is selected, press **Duty** on Square menu to highlight "Duty" and input the desired value using the numeric keyboard or direction keys and knob.

5.13.4 Modulating Waveform Source

Press **Mod** -> **Source** to select "Int" or "Ext" modulating waveform source
HDG6000B(C) can receive modulating waveform from Internal (default), External, or Other Channel. Press **Mod** -> **Source** to select the modulation source.
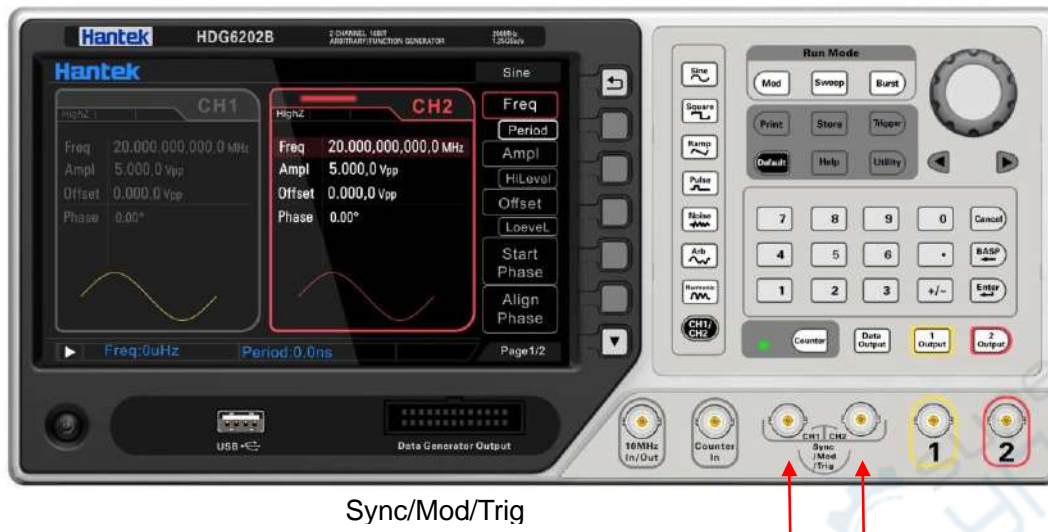
Internal Source
When internal modulation source is selected, press **Shape** to select Sine, Square, Ramp, Noise or Arb as modulating waveform. The default is Sine.
◆ Sine waveform
◆ Square: 50% duty cycle.
◆ Ramp: 50% symmetry.
Note: Noise can be used as modulating waveform but cannot be used as carrier waveform.

External Source

With the External source, an external waveform modulates the carrier waveform. The Phase Deviation is controlled by the ±2.5 V signal level on the front-panel **[Sync/Mod/Trig]** connector.

Sync/Mod/Trig

Other Channel

Other channel: CH1 and CH2 can be used as modulation sources reciprocally. When CH1 is used as the modulated wave, CH2 can be used as the modulation source. And vice versa.

5.13.5 Modulating Waveform Frequency

When internal modulation source is selected, press **Frequency** to set the frequency of the modulating waveform.

◆ Use the numeric keyboard or direction keys and knob to input the desired frequency value.

◆ The frequency range is from 2mHz to 50KHz and the default is 100Hz.

Note: This menu will be grayed out and disabled when other modulation sources except the internal modulation source are selected.

5.13.6 PWM Deviation

Press **Deviation** softkey and input the desired value using the numeric keyboard or direction keys and knob.

Duty cycle deviation represents the variation (in %) of the modulated waveform duty cycle relative to the original pulse duty cycle.
Duty cycle deviation range: 0% to 50%。The duty cycle deviation cannot exceed the current pulse duty cycle. The duty cycle is limited by the minimum duty cycle and current edge time setting.

When "Ext" modulation source is selected, duty deviation is controlled by the ±2.5V signal level at the **[Sync/Mod/Trig]** connector at the front panel.

Chapter 6 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 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, Harmonic or arbitrary waveforms (DC are not allowed).

◆ **Select Frequency Sweep**

◆ **Start Frequency and Stop Frequency**

◆ **Center Frequency and Frequency Span**

◆ **Linear sweep**

◆ **Sweep Time**

◆ **Return Time**

◆ **Hold Time**

◆ **Mark Frequency**

◆ **Sweep Trigger Source**

◆ **Trigger Output Edge**

6.1 Select Frequency Sweep

Press **Sweep** at the front panel to enable the sweep function (the backlight of the key goes on), and **Mod** or **Burst** function will be automatically disabled (if currently enabled).
To avoid multiple waveform changes, enable the sweep mode after configuring the other parameters (as waveforms and amplitudes of fundamental waves).
Press **Sweep** button again to close sweep mode.

6.2 Start Frequency and Stop Frequency

Start frequency and stop frequency are the upper and lower limits of the frequency for frequency sweep. The generator sweeps from the start frequency to the stop frequency and then returns back to the start frequency.

◆ Start Frequency < Stop Frequency: the generator sweeps from low frequency to high frequency.

◆ Start Frequency > Stop Frequency: the generator sweeps from high frequency to low frequency.

◆ Start Frequency = Stop Frequency: the generator outputs with a fixed frequency.

When frequency sweep is enabled, press **Start/Center** to highlight "**Start**". Use the numeric keyboard or direction keys and knob to input the desired frequencies. By default, the start frequency is 100Hz and the stop frequency is 1KHz. Different sweep waveform corresponds to different start frequency and stop frequency range.

Sine: 1μHz to 160MHz
Square: 1μHz to 60MHz
Ramp: 1μHz to 5MHz
Pluse: 1μHz to 50MHz
Arb: 1μHz to 50MHz

6.3 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 = (|Start Frequency + Stop Frequency|) / 2
◆ Frequency Span = Stop Frequency – Start Frequency

When frequency sweep is enabled, press **Start/Center** to highlight "**Center**". Use the numeric keyboard or direction keys and knob to enter the desired frequency values. By default, the center frequency is 550Hz and the frequency span is 900Hz.

Different sweep waveform corresponds to different center frequency and frequency span range and center frequency and frequency span are inter-related. Define the minimum frequency of the waveform currently selected as *F*min, the maximum frequency as *F*max and *F*m = (*F*min+*F*max)/2.

The range of center frequency is from *F*min to *F*max and the parameters for different waveforms are as follows:

Sine: 1μHz to 160MHz
Square: 1μHz to 60MHz
Ramp: 1μHz to 5MHz
Pluse: 1μHz to 50MHz
Arb: 1μHz to 50MHz

The range of the frequency span is influenced by the center frequency:
Center frequency <*F*m: frequency span range is ±2 × (center frequency - *F*min);
Center frequency ≥*F*m: frequency span range is ±2 × (*F*max- center frequency).
Take sine as an example. *F*min is 1μHz, *F*max is 160MHz and *F*m is about 80MHz.

If the center frequency is 550Hz, the range of the frequency span is:
$$±2 × (550Hz – 1μHz) = ±1.099999998kHz;$$
if the center frequency is 155MHz, the range of the frequency span range is:
$$±2 × (160MHz – 155MHz) = ±10MHz.$$

The generator will renewedly sweep from the specified "Start Frequency" after "Center Frequency" or "Frequency Span" is changed.

Note: In large-scale sweep, the amplitude characteristic of the output signal might change.

6.4 Linear sweep

HDG6000B(C) provides Linear sweep type.

The output frequency of the instrument varies linearly in the way of "several Hertz per second". The variation is controlled by "Start Frequency", "End Frequency" and "Sweep Time".

6.5 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.

When **Sweep** is enabled, press **Sweep Time** and use the numeric keyboard or knob to change

the sweep time.
The default value is 1s and the settable range is from 1ms to 50Ks.

6.6 Return Time

Return time specifies the number of seconds to return from the stop frequency to the start
frequency.）
When **Sweep** is enabled, press **Return Time** and use the numeric keyboard or the direction keys
and knob to change the return time.
The default value is 1s and the settable range is from 0s to 50Ks.

6.7 Hold Time

Hold time specifies time (in seconds) to remain at the stop frequency.
When **Sweep** is enabled, press **Return Time** and use the numeric keyboard or the direction keys
and knob to change the return time.
The default value is 1s and the settable range is from 0s to 50Ks.

6.8 Mark Frequency

The sync signal on the **[Sync]** connector at the front panel changes from low-level to high-level at
the specified mark frequency point or greater than the mark frequency. It will output low-level
when the frequency is less than the mark frequency.
When **Sweep** is enabled, press **Tag Freq**, use the numeric keyboard or the direction keys and
knob to modify the mark frequency. The default value is 500Hz and the settable range is limited by
the "Start" frequency and "Stop" frequency.

6.9 Sweep Trigger Source

The sweep trigger source could be internal, external or manual. The generator will generate a
sweep output when a trigger signal is received and then wait for the next trigger signal.

When **Sweep** is enabled, press **Source** in the **2 of 2** menu page to select **Internal**, **External** or
Manual. The default is **Internal**.
◆ **Internal Trigger:** The generator outputs continuous sweep waveform at a rate determined by
the total of the specified sweep time, return time and hold time.
◆ **External Trigger:** The generator receives the trigger signal input from the **[Sync/Mod/Trig]**
connector at the front panel. A sweep will be generated once the connector gets a TTL pulse
with specified polarity. To set the TTL pulse polarity, press **Polarity** to select "Positive" or

"Negative". The default is "Positive".

Sync/Mod/Trig
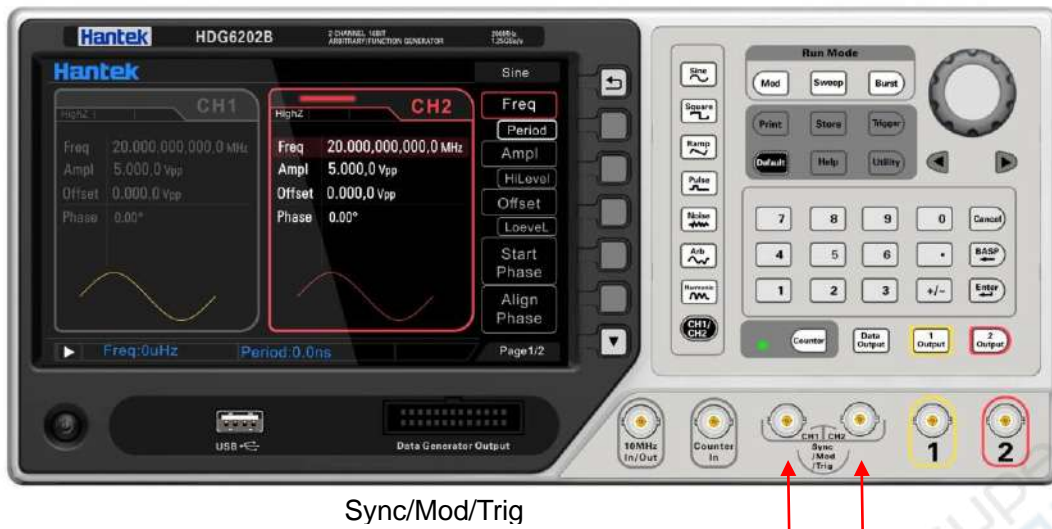
◆ **Manual Trigger:** A sweep will be generated from the corresponding channel once you press **Trigger** at the front panel.

6.10 Trigger Output Edge

In sweep mode, when "Internal" or "Manual" trigger source is selected, the generator will output a TTL compatible signal with specified edge from the **[Sync/Mod/Trig]** connector at the front panel.

Internal and Manual Trigger: The generator outputs a Pulse waveform from the **[Sync/Mod/Trig]** connector at the beginning of the Sweep. The trigger period depends on the specified sweep time, return time and hold time. The pulse waveform changes from high-level to low-level at the specified mark frequency point or greater than the mark frequency.
External Trigger: The **[Sync/Mod/Trig]** connector is used as the input terminal of external trigger signal and has no trigger output.

Chapter 7 Burst

HDG6000B(C) can output a waveform for a specified number of cycles, called a burst. It supports control of burst output by internal, external or manual trigger source; supports three kinds of burst types including N cycle, Infinite cycle and Gated. Burst is allowed with sine, square, ramp, pulse, Harmonic, noise (allowed only in gated burst mode) or arbitrary waveforms (DC is not allowed).

◆ **Select Burst Mode**

◆ **Burst Type**

◆ **Burst Period**

◆ **Burst Phase**

◆ **Burst Trigger Source**

◆ **Gate Polarity**

◆ **Trigger Output Edge**

7.1 Select Burst Mode

Press **Burst** at the front panel to enable Burst function (the backlight of the key goes on), and **Mod** or **Sweep** function will be automatically disabled (if currently enabled).
To avoid multiple waveform changes, enable burst mode after configuring other parameters.

7.2 Burst Type

This instrument could output three types of bursts, including **N Cycle**, **Infinite Cycle** and **Gate**. The default is **N Cycle**.
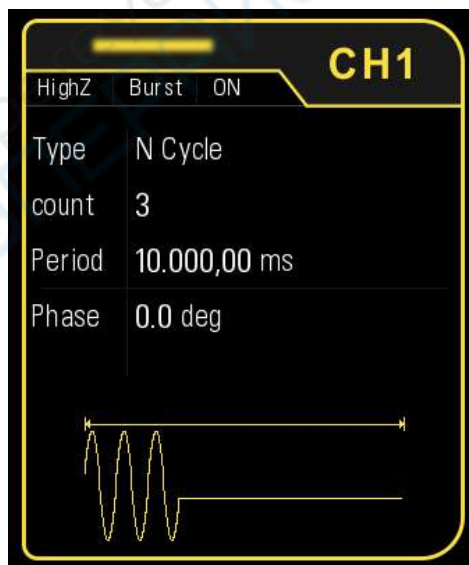
Burst Type	Trigger Source	Carrier Waveform
N Cycle	Int/Ext/Manual	Sine/Square/Ramp/Pulse/Harmonic/Arbitrary waveform (except DC)
Infinite	Int/Ext/Manual	Sine/Square/Ramp/Pulse/Harmonic/Arbitrary waveform (except DC)
Gated	Ext	Sine/Square/Ramp/Pulse/Noise/Harmonic/Arbitrary waveform (except DC)

N Cycle Burst

In N Cycle mode, the generator will output waveform with specified number of cycles after receiving trigger signal. The carrier waveform includes Sine, Square, Ramp, Pulse, Harmonic and arbitrary waveform (except DC).

The trigger source includes "Internal", "External" or "Manual". Besides, users can set the "Phase", "Burst Period" (internal trigger), "Trigger Slope" (external trigger), "Trigger Polarity" (Gamed Burst) and "TrigOut" (manual trigger).

When **Burst** is enabled, press **Type** to select "**N Cycle**". The parameter "Count" on the screen is highlighted and could be edited. At this point, use the numeric keyboard or the direction keys and knob to change the count of cycles; the default is 1 and the settable range is from 1 to 2000 000 000.


Infinite Cycle Burst

In Infinite Cycle mode, the cycle number of the waveform is set as an infinite value. The generator outputs a continuous waveform after receiving trigger signal. The carrier waveform includes Sine, Square, Ramp, Pulse, Harmonic and arbitrary waveform (except DC).

The trigger source includes "Internal", "External" or "Manual". Besides, users can set the "Start Phase" and "Trigger Slope" (external trigger) and "TrigOut" (manual trigger).

When **Burst** is enabled, press **Type** to select "**Inf Cycle**". A schematic diagram of infinite cycle pulse will be displayed on the screen.
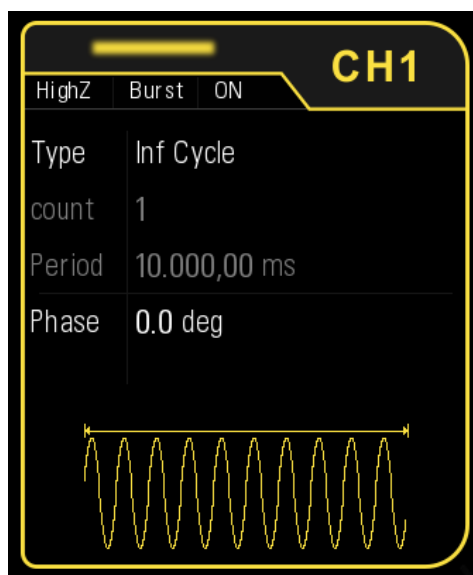
Gated Burst

In Gated Mode, the generator controls the waveform output according to the external signal level from the **[Sync/Mod/Trig]** connector at the front panel. The carrier waveform includes Sine, Square, Ramp, Pulse, Noise, Harmonic and arbitrary waveforms (except DC).

When the gated signal is "True", the generator outputs a continuous waveform; when the gated signal is "False", the generator completes the current period, and then stops and holds on the voltage level corresponding to the initial burst phase of the selected waveform. For Noise waveform, the output will stop immediately once the gated signal becomes "False".

Gated Burst could only be triggered by "Ext" trigger source. Users can also set the "Start Phase".

When **Burst** is enabled, press **Type** to select "Gated" and then press **Polarity** to set the gated polarity as "Positive" (or "Negative"). The generator outputs burst waveform only when the gated signal is "Positive" (or "Negative").
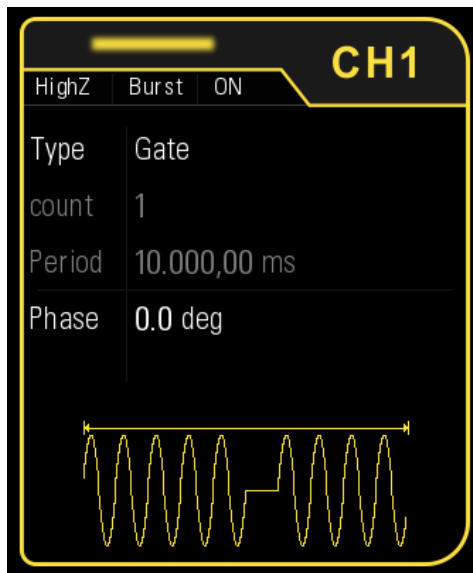
7.3 Burst Period

Burst period is the time from the start of one burst to the start of next burst (default 10 ms). It is only available for N Cycle burst in internal trigger. Burst period differs from "waveform frequency," which specifies the frequency of the bursted signal.

◆ Burst period ≥ 1μs + waveform period × number of bursts. Here, waveform period is the period of burst function (such as Sine and Square).

When **Burst** is enabled, press **Type** (to "N Cycle") **-> Source** (to "Internal"), press **Burst Period** and use the numeric keyboard or the direction keys and knob to input the desired period value. The default is 10ms and the settable range is from 2μs to 500s.

7.4 Burst Phase

Burst phase is defined as the phase of the start point of the burst.
When **Burst** is enabled, press **Phase** and then use the numeric keyboard or knob to input the desired phase. The default value is 0° and the settable range is from 0° to 360°.

◆ For Sine, Square, Ramp and Pulse, 0° is the point where the waveform passes through 0V (or DC offset value) positively.
◆ For arbitrary waveform, 0° is the first point of the waveform.
◆ For Noise, **Start Phase** is unavailable.

7.5 Burst Trigger Source

Burst trigger source could be internal, external or manual. The generator will generate a burst output when a trigger signal is received and then wait for the next trigger

When **Burst** is enabled, press **Source** to select "Internal", "External" or "Manual". The default setting is "Internal".

Internal Trigger
When internal trigger is selected, the generator can only output N cycle burst and the burst frequency is determined by the "Burst Period".

External Trigger
When external trigger is selected, the generator can output N cycle, infinite or gated burst. The generator receives the trigger signal from the **[Sync/Mod/Trig]** connector at the front panel. A burst will be generated once the connector receives a TTL pulse with specified polarity.
To set the TTL pulse polarity, press **Slope** to select "Positive" or "Negative" and the default setting is "Positive".

Sync/Mod/Trig
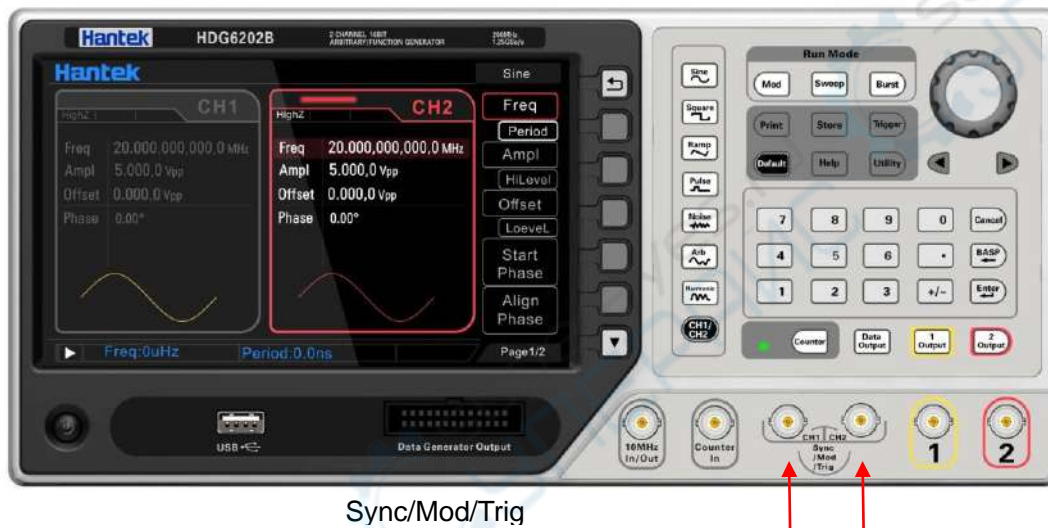
Manual Trigger
When manual trigger is selected, the generator can output N cycle or infinite burst. A burst will be generated from the corresponding channel (if currently turned on) once you press **Trigger** at the front panel. If the corresponding channel is not turned on, the trigger will be ignored.

7.6 Gate Polarity

Gate polarity is only available in gated burst mode. The generator will output burst when the gated signal at the **[Sync/Mod/Trig]** connector at the front panel is "High Level" or "Low Level".

When **Burst** is enabled, press **Type** (to "Gate") -> **Polarity (**to "Positive" or "Negative"). The default is "Positive".

7.7 Trigger Output Edge

In burst mode, when the trigger source is "Internal" or "Manual", the generator would output a TTL-compatible signal with specified edge from the **[Sync/Mod/Trig]** connector at the front panel.

◆ **Internal trigger**: The generator outputs a square waveform with variable duty cycle (related to the carrier period and number of cycles) from the **[Sync/Mod/Trig]** connector at the start of burst. The trigger period is the same with the specified burst period.
◆ **Manual trigger**: The generator outputs a pulse from the **[Sync/Mod/Trig]** connector at the start of burst.
◆ **External trigger**: The **[Sync/Mod/Trig]** connector is used as the input terminal of external trigger signal and has no trigger output.

Chapter 8 Counter

The instrument provides a counter which can measure various parameters (such as frequency, period, duty cycle, positive pulse width and negative pulse width) of external input signal.

◆ **Enable the Counter**

◆ **Set the Counter**

8.1 Enable the Counter

Press **Counter** at the front panel (the backlight of the key turns on) to enable counter function. Input the singal to **[Counter In]** connector to measure.

If the counter is currently turned on and the screen displays the counter interface, pressing **Counter** will disable the counter function.

If the counter is currently turned on and the screen displays the counter interface, pressing other keyboards except Counter will minimize the counter interface.

If the counter is currently turned on and the screen displays interfaces other than the counter interface, pressing **Counter** will switch to the counter interface.

The CH1 sync output will be disabled when the counter is enabled.

8.2 Set the Counter

Gate time
Set the gate time of the measurement system.
Press **Gate time**, and use the direction keys and knob to modify the current value.
The default value is 1s and the settable range is from 10ms to 16s.

Sensitivity
Set the trigger sensitivity of the counter.
Press **Sensitivity**. Use the direction keys and knob to modify the current value.
The default is 50% and the range available is from 0% to 100%.

Trig Level
Set the trigger level of the counter. The system triggers and gets the measurement readings when the input signal reaches the specified trigger level.
Press **TrigLevel**. Use the direction keys and knob to modify the current value.
The default is 0V and the range available is from -2.5V to 2.5V.
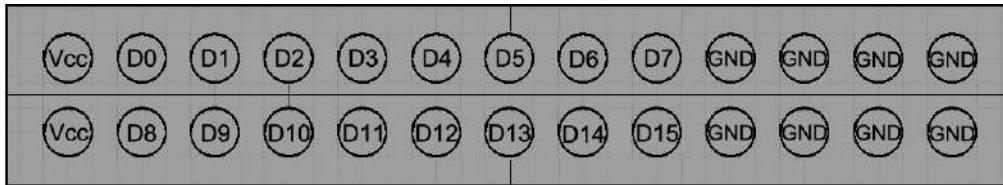
Chapter 9 Digital Generator

The instrument provides a digital generator which can output the digital signal by sync or programmable. The dual channels can still output normally when the digital generator is enabled.

◆ **Terminal Description**

◆ **Function Introduction**

9.1 Terminal Description

Vcc: 3.3V

9.2 Function Introduction

Press **Data Output** key to enable digital generator function (the backlight of the key goes on). The interface is opened and output the signal at the same time.

Press **Function** softkey to set the function.
- ◆ Sync Signal: Output Synchronized signal of CH1 or CH2.
- ◆ Programmable Signal: Users can edit digital signal.
- ◆ OFF: Turn off

Sync Signal Output
1. Select function to sync.
2. Select the sync signal source to CH1 (or CH2).
3. Open CH1 waveform output, Select the Signal Type to "Sine ", frequency to "1KHz", Amplitude to 1V, Y Offset to 0V.
4. Connect Digital Generator Terminals to LOGIC Analyzer Terminals to measure. The output signal of D0-D15 terminals is a square waveform (3.3V, peak- to- peak).

Programmable Signal
Select function to Prog, use the direction keys and knob to modify the value for D0~D15 to 0 or 1. The corresponding terminals will output high level or low level. When the data is set to 0, the corresponding output voltage is 0V. When the data is set to 1, the corresponding output voltage is 3.3V.
Such as, D0~D7: 10101010, D8~D15: 01010101, in the figure below.
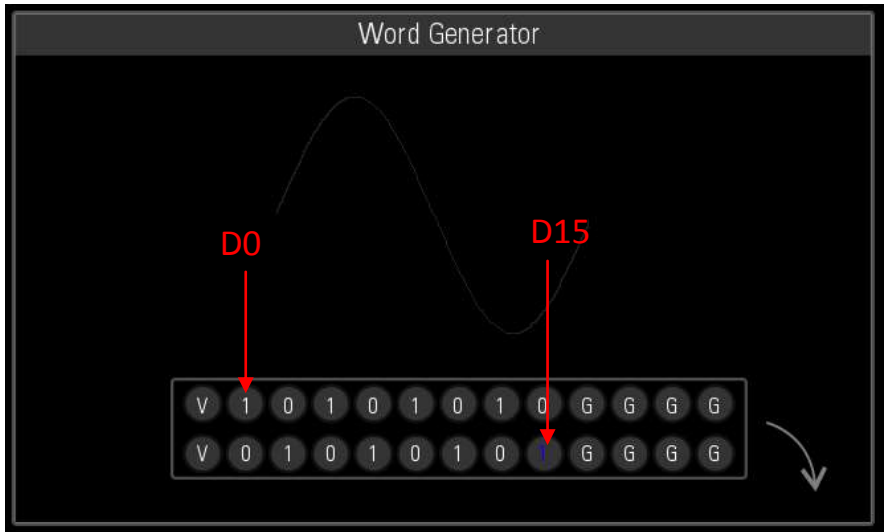
Chapter 10 Utility

The instrumemt allows users to configure the parameters of dual channels, configure remote interfaces and set system parameters.

◆ **Sync**

◆ **Impedance**

◆ **Network for HDG6000C**

◆ **System Setting**

◆ **Print**

◆ **Update**

◆ **Store and Recall**

10.1 Sync

The sync signal is output from the **[Sync]** connector at the front panel. The instrument could output the sync signals of basic waveforms (except Noise), arbitrary waveforms (except DC), Harmonics, Sweep signal, Burst signal and modulated signal from a single channel or two channels at the same time.

◆ The **Sync** signal is a square wave that is "high" in the first half of the cycle and "low" in the second half. When sync signal is disabled, the output level at the **[Sync]** connector is logic low.

◆ The amplitude of Sync signal is not adjustable and fixed at TTL level.

Sync Signals of Various Waveforms

◆ For Sine, Square, Ramp and Pulse, the sync signal is a Square with 50% duty cycle. It is TTL high level relative to 0V (or DC offset) when the output is positive and TTL low level relative to 0V (or DC offset) when the output is negative.

◆ For arbitrary waveform, the sync signal is a square with variable duty cycle. The sync signal is TTL high level when the amplitude of the output waveform reaches certain value.

◆ For harmonics, sync signal is a square with variable duty cycle and takes the harmonic order as reference.

◆ For AM, DSB-AM, FM, PM and PWM, in internal modulation mode, the sync signal is a Square with 50% duty cycle and takes modulating frequency as reference. It is TTL high level in the first half period of the modulation waveform. In external modulation mode, there is no sync signal output.

◆ For 2ASK, 2FSK, 2PSK, BPSK, QPSK, 3FSK, 4FSK and OSK, in internal modulation mode, the sync signal takes their Rate as reference and is a Square with 50% duty cycle. For 2ASK, 2FSK, 2PSK and OSK, in external modulation mode, there is no sync signal output.

◆ For Sweep, the sync signal changes from low-level to high-level at the specified mark frequency point or greater than the mark frequency.

◆ For a N cycle burst, in internal and manual trigger mode, the sync signal is TTL high level when burst starts and transforms to TTL low level while the specified number of cycles end (if the waveform has a relative start phase, the crossing point may not be zero). For an infinite burst, in manual trigger mode, its sync signal is the same as the sync signal of a continuous waveform. For all burst type, in external trigger mode, there is no sync signal output.

10.2 Impedance

The impedance setting is applicable to output amplitude and DC offset voltage. HDG6000B(C) has a 50Ω fixed serial output impedance for the **[1]** connector at the front panel. If the actual load does not match the specified value, the voltage level displayed would not match the voltage level of the component under test. To ensure correct voltage level, the load impedance setting must match the actual load.

Press **Utility** -> **CH1Set** -> **Imped** to select "HighZ" or "50Ω". The default is "HighZ". The impedance setting will be displayed on the screen. As shown in the figure below, the impedance of CH1 is set to a specified value "50 Ω" and the impedance of CH2 is set to "HighZ".

Impedance Setting

The generator will adjust the output amplitude and offset voltage automatically once the impedance setting is changed. For example, the current amplitude is 5Vpp. At this point, change the output impedance from 50Ω to HighZ and the amplitude displayed on the screen will double to 10Vpp. If the output impedance is changed from HighZ to 50Ω, the amplitude will reduce to half of the previous value (2.5Vpp).

Note: Only the displayed values change with the parameter and the real output from the generator does not change.

10.3 Network for HDG6000C

HDG6000C is configured with LAN, WLAN and Hotspot interfaces and supports users to configure the interface parameters for remote communication.

Press **Utility** -> **System** -> **Network** to enter network configuration interface and set the LAN, WLAN and Hotspot interface parameters.

10.3.1 LAN Setting

Press **Utility** -> **System** -> **Network**, and set the **Network** to **eth0**, to enter the LAN parameters configuration interface as shown in the following figure. Users can examine network status and configure network parameters.
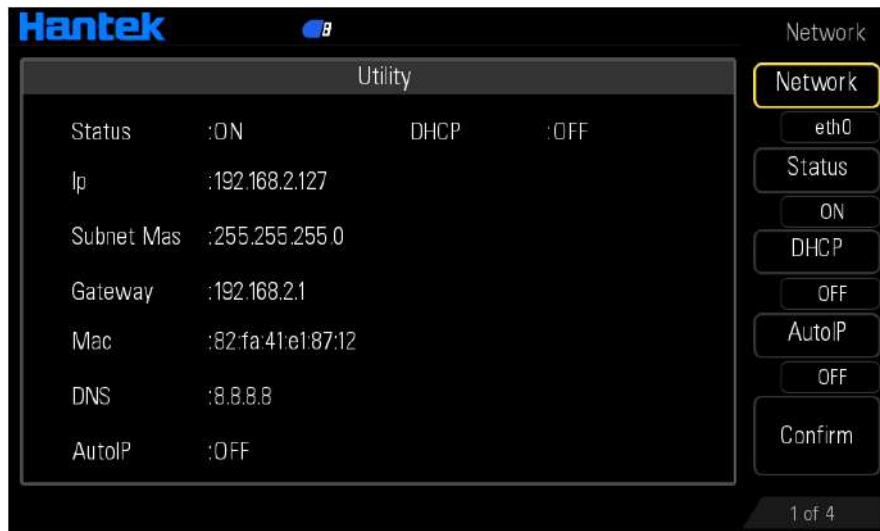
Network Status: ON or OFF

MAC Address

MAC (Media Access Control) address, also called hardware address, is used for defining the position of the network device. For a generator, the MAC address is always unique. It is always used to identify the instrument while assigning IP address for instrument. MAC address (48 bits, namely 6 bytes) is usually expressed in hexadecimal format, such as 00-04-5B-46-A2-C2.

IP Configure Mode

IP configure mode could be DHCP, Auto IP or Manual. In different IP configuration modes, the configuration modes of network parameters (such as IP address) are different.

1. DHCP

In DHCP mode, DHCP server in the current network assigns LAN parameters, e.g. IP address, for the generator.

Press **DHCP** to select "ON" or "OFF" to turn DHCP mode on or off.

2. AutoIP

In AutoIP mode, the generator acquires IP address within 169.254.0.1 and 169.254.255.254 and subnet mask 255.255.0.0 automatically according to the current network configuration.

Press **Auto IP** to select "ON" or "OFF" to turn Auto IP mode on or off. When the DHCP mode and Auto IP mode are turned on at the same time, the instrument will use the DHCP mode; therefore, to enable this mode, set **DHCP** to "OFF".

3. Manual

When users set **DHCP** and **AutoIP** to "OFF", the IP configure mode is Manual mode, the LAN parameters of the generator, e.g. IP address, are defined by users.

The IP address format is nnn.nnn.nnn.nnn. The nnn range is from 0 to 255. It is recommended that users acquire an available IP from their network administrator.

Press **Ip** on the second page of the menu and use the numeric keyboard or direction keys and knob to enter your desired IP.

Set the Subnet Mask

In Manual mode, the subnet mask could be set manually.

The format of subnet mask is nnn.nnn.nnn.nnn, where the nnn ranges from 0 to 255. It is recommended that users acquire an available subnet mask from their network administrator.

Press **Subnet Mask** softkey and use the numeric keyboard or direction keys and knob to enter your desired subnet mask.

Set the Gateway

In Manual mode, the default gateway could be manually set.

The format of default gateway is nnn.nnn.nnn.nnn, where the nnn ranges from 0 to 255. It is recommended that users acquire an available default gateway from their network administrator.

Press **Gateway** softkey and use the numeric keyboard or direction keys and knob to enter your desired gateway address.

Set the Domain Name Server (DNS)

In ManualIP mode, the DNS could be manually set.

The DNS format is nnn.nnn.nnn.nnn, where the nnn ranges from 0 to 255. It is recommended that users acquire an available DNS address from their network administrator.

Press **DNS** softkey and use the numeric keyboard or direction keys and knob to enter your desired DNS address.

Note:

When any parameter is changed, the new parameter will take effect after press the confirm softkey.

10.3.2 WLAN Setting

Press **Utility** -> **System** -> **Network**, and set the **Network** to **wlan0**, to enter the WLAN parameters configuration interface as shown in the following figure.

Wlan Status: ON or OFF

SSID: Service Set Identifier

SSID is the name of a local area network.

Press **Scan Result** softkey to search the Wi-Fi device, use the knob to specify the network and press the knob to confirm. Also, users can use virtual keyboard to enter the desired SSID. Press **SSID** softkey and use the knob to enter.

PSK: Pre Shared Key

PSK is the Pre Shared Key of a local area network. After set the SSID, press **PSK** softkey and use virtual keyboard to enter the correct key.

Note:

1. If you want to connect to the WLAN, you need to turn off the hotspot function first. Press **Hotspot** on the third page of network manu to enter, and set the status to OFF to close the hotspot.

2. When any parameter is changed, the new parameter will take effect or WLAN connection will be executedafter press the confirm softkey.

3. When a "Connect" word appears on the lower part of the WLAN device, the connection is successful.

10.3.3 Hotspot

Press **Utility** -> **System** -> **Network**, and set the **Network** to **wlan0**, press **Hotspot** on the third page of network manu to enter the hotspot parameters configuration interface as shown in the following figure.

Hotspot Status: ON or OFF

SSID: The name of the HDG6000C hotspot. Press **SSID** softkey, use virtual keyboard to change the SSID.

PSK: The Pre Shared Key of the HDG6000C hotspot. Press **PSK** softkey, use virtual keyboard to change the PSK.

Frequency: The working frequency band of the HDG6000C hotspot. It is 2.4GHz.

Channel: The channel number of the hotspot, up to 13.

Users: The number of users that can be connected, up to 8.

IP Start: The start IP address of the HDG6000C hotspot.
IP End: The end IP address of the HDG6000C hotspot.
Subnet Mask: The subnet mask of the HDG6000C hotspot.
The format of IP Start, IP End and subnet mask is nnn.nnn.nnn.nnn. The nnn range is from 0 to 255.

Note: When any parameter is changed, the new parameter will take effect after press the confirm softkey.

10.4 System Setting

10.4.1 Set the System Language

HDG6000B(C) supports menus in Chinese and English as well as provides corresponding help information, prompt messages and interface display.

Press **Utility** -> **System** -> **Language** to select the desired language. When "中文" or "English" is selected, the menus, help information, prompt messages and interfaces are displayed in Chinese or English.
When you press "Default" to recall the default settings, the language will not be affected.

10.4.2 Power On Setting

Set the configuration to be used when the instrument is powered on the next time to "Default" or "Last". The default setting is "Default".
◆ Last: include all the system parameters and output configuration, except clock source.
◆ Default: denote the factory default except some parameters (such as: Language).

Press **Utility** -> **System** -> **Startup** to select the desired configuration type.

When you press "Default" to recall the default settings, this setting will not be affected.

10.4.3 Sound

When the beeper in HDG6000B(C) is turned, the beeper sounds when users operate the front panel.
Press **Utility** -> **System** -> **Sound** to select "On" or "Off" and the default is "Off".

10.4.4 Intensity

Press **Utility** -> **System** -> **Intensity** and use the knob to set the intensity of the screen.
The range is from 1% to 100%.

10.4.5 System Information

Press **Utility** -> **System** -> **System Info** and you can view the information (such as the model, serial number and version number) of the instrument in the system information interface.

10.4.6 Clock Source

HDG6000B(C) provides an internal 10MHz clock source and can receive the external clock source from the **[10MHz In/Out]** connector at the front panel. It can also output the internal clock source from the **[10MHz In/Out]** connector for other devices.

Press **Utility** -> **Clock Source** to select "Internal" or "External". The default is "Internal". If "External" is selected, the instrument will detect whether a valid external clock signal is input from the **[10MHz In/Out]** connector at the front panel. If no valid clock source is detected, the prompt message "No valid 10MHz External Clock is detected" would be displayed and the clock source would be switched to "Internal".

Users can also synchronize two or more instruments by setting the clock source. When two instruments are synchronized, the "Align Phase" function cannot be used. The "Align phase" function can only be used to adjust the phase relation between two output channels of the same instrument and cannot be used to change the phase relation between the output channels of two instruments. Users can change the phase relation between two instruments by change the "Start Phase" of each channel.

Sync methods for two or more instruments:
◆ Synchronization between two instruments:
Connect the **[10MHz In/Out]** connector of Generator A (set the clock source to "Internal") to the **[10MHz In/Out]** connector of Generator B (set the clock source to "External") and set the output frequencies of the two instruments as a same value to realize the synchronization between the two instruments.

◆ Synchronization among multi-instruments:
Divide the 10MHz clock source of a generator (set the clock source to "Internal") into multiple paths; then, connect them to the **[10MHz In/Out]** connectors of the other generators (set the clock source to "External) respectively. Finally, set the output frequencies of all the generators as a same value to realize the synchronization among multi-instruments.

10.5 Print

Users could store the contents displayed on the screen into external USB storage device in "Bmp" format.
Please connect a USB storage device first. When the connection succeeds, an icon will be displayed in the status bar on the screen and the corresponding prompt message will be displayed. And press **Print** button on the front panel to print or store the screenshot.

10.6 Update

Users could update the firmware.
Press **Utility** -> **Update** to enter file browser, and use the knob to select the disk and the firmware.

10.7 Store and Recall

HDG6000B(C) allows users to store the current instrument state in the internal or external memory and recall them when needed.

10.7.1 Storage System Overview

HDG6000B(C) provides an internal memory (home Disk) and an external memory (USB Disk).

Home Disk: Users can store the instrument states to the home disk in .pho format.
USB Disk: available when a USB storage device is detected at the USB Host interface at the front panel. Users can store the state files to the USB disk in .pho format, and recall the state files and the arbitrary waveform files from the USB disk.

State storage includes the waveform, frequency, amplitude, DC offset, duty cycle, symmetry and phase as well as the modulation, sweep and burst parameters of the two channels and the counter parameters.

Press **Store** at the front panel to enable the Store/Recall function and open the Store/Recall interface as shown in the figure below.
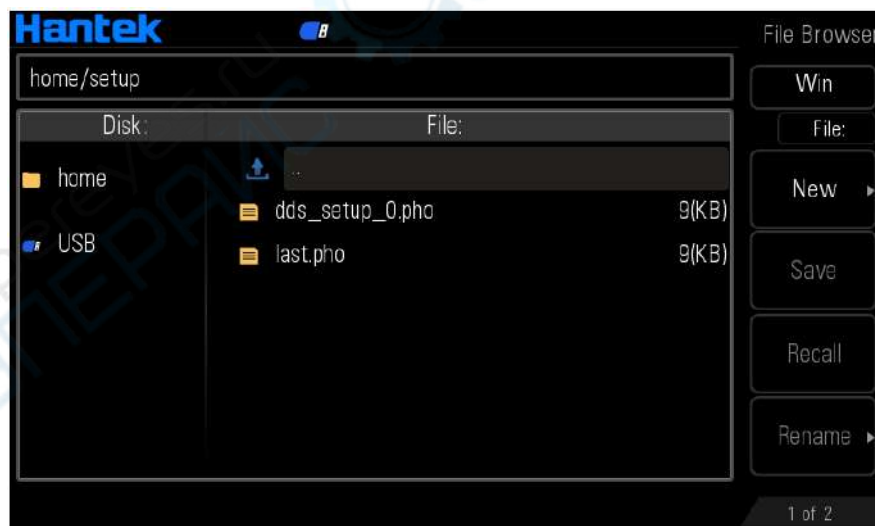
Note: The instrument can only identify filenames consist of English letters, number and underscore. If other characters are used to name the file or folder, the name might be displayed in the store and recall interface abnormally.

10.7.2 Browser Type

Press **Store** -> **Win** to switch between "Disk" and "File". Use the knob to select the desired directory or file.

◆ Disk: when this type is selected, use the knob to switch between Home Disk and USB Disk (when USB storage device is inserted).

◆ File: when this type is selected, use the knob to switch files or folders under the current directory.

Note: when the disk is selected, press the knob to enter the file browser of current disk.

10.7.3 File Operation

When "File" is select as the browser type, users can perform a series of operations on files including Save, Recall, Delete, Rename, Refresh and New Directory or file.

New File

In Store interface, set the **Win** as "File" and then press "New" to enter the filename editing interface as shown in the figure below.

Filename Input Area   Virtual Soft Keyboard
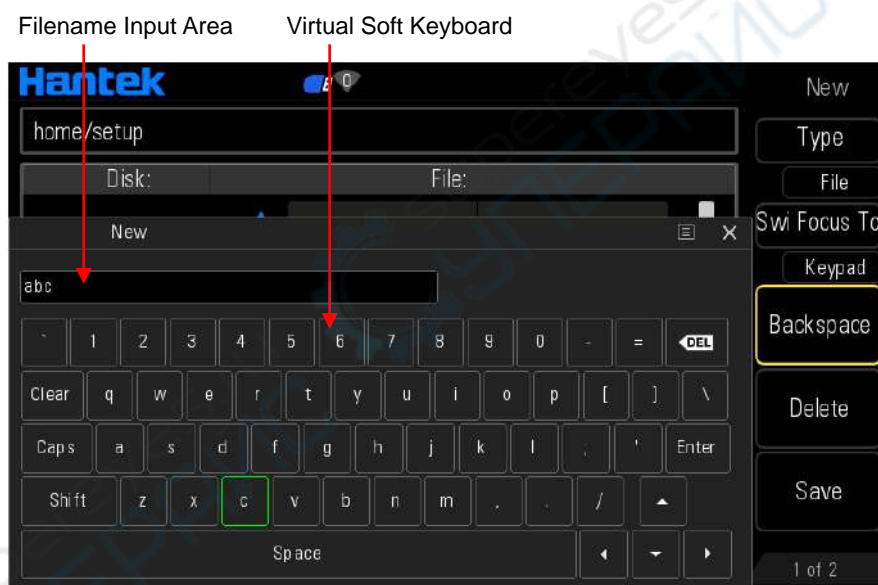
1. Press **Type** softkey to select **File**.
   File: will create a new state file.
   Directory: will create a new folder.
2. Press **Swi Focus To** softkey to select **Name** and **Keyboard.**
   Name: Put the cursor in the Filename Input Area. Use direction keys to move the cursor position and specify the location of the modified character.
   Keyboard: Put the cursor in the Virtual Soft Keyboard. Rotate the knob to move the cursor position and press down the knob to input the character. Select **Caps** in the Virtual Soft Keyboard to switch between uppercase and lowercase.
3. Press **Backspace** softkey to remove the characters in front of the cursor one by one.
4. Press **Delete** softkey to delete all the characters in the Filename Input Area.
5. Press **Save** softkey to save this file.

6. Press **Return** softkey to exit.

Save

Only state files can be stored via the instrument.
Press **Save** softkey to automatically create a new state file and save.

Recall

Press **Recall** softkey to recall the state file or arbitrary waveform file.

Rename

Use the knob to select the specified file or directory and press **Rename** softkey to rename. Refer to the operation method of creating a new file. After the completion of the denominate, press **Confirm** softkey to confirm.

Delete

Use the knob to select the specified file or directory and press **Delete** softkey to delete the selected file or directory.

Refresh

Press **Refrash** softkey to refresh the file list.

New directory

Please make sure that a USB storage device is inserted and identified by the instrument.

Folder name Input Area   Virtual Soft Keyboard
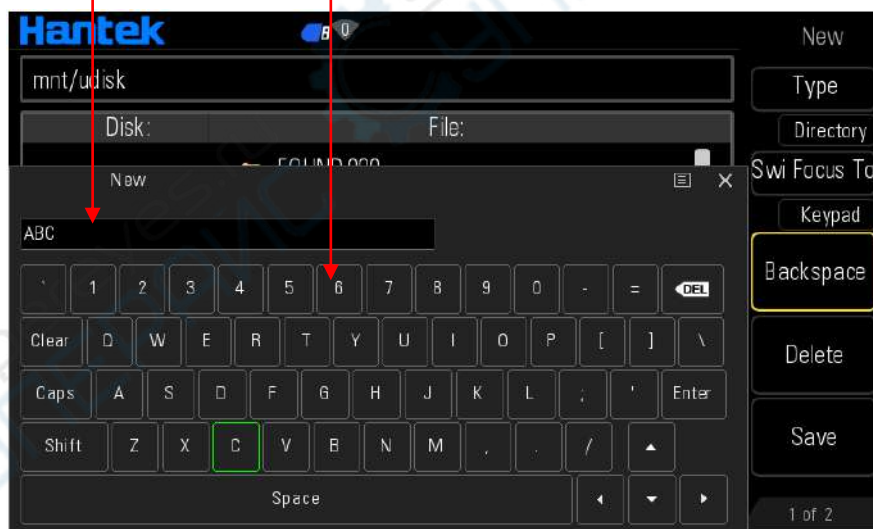
1. In Store interface, press **Win** softkey to select "Disk" and use the knob to select the USB disk. Press the knob to enter USB disk directory.
2. Press **New** softkey to enter the folder name input interface as shown in the figure above.
3. Press **Type** softkey to select Directory.
4. Operate the new folder following the introduction in "**New File**".

Chapter 11 Remote Control

HDG6000B(C) can be controlled remotely through the following two methods.

User-defined programming
Users can program and control the instrument by using the SCPI (Standard Commands for Programmable Instruments) commands. For more information about the commands and programming, refer to the SCPI protocol manual.

Use PC software
Users can use the PC software to send commands to remotely control the instrument. You can download the software from our official website.

HDG6000B only can communicate with PC through USB. HDG6000C can communicate with PC through USB, LAN, WLAN or Hotspot. This chapter will give a detailed introduction of how to use software to control HDG6000B(C) remotely through various interfaces.

Subjects in this chapter:
◆ Install Keysight IO libraries suite
◆ Remote Control via USB
◆ Remote Control via LAN
◆ Remote Control via WLAN
◆ Remote Control via Hotspot

11.1 Install Keysight IO libraries suite

Copy the **Keysight IO libraries suite** from CD disk or open the following websit to download latest one：

http://www.keysight.com/main/software.jspx?ckey=2175637&id=2175637&nid=-11143.0.00&lc=eng&cc=GB

Double click the icon to start installing.

IOLibSuite_17_2_20818_0
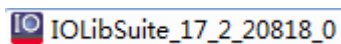
Click 'Next' to continue.

Read License Agreement and accept. Click 'Next' to continue.

Select a Typical and click 'Next' to continue.

Or select a Custom and click 'Next' to continue.

Select "Install Keysight VISA as primary VISA" and click 'Next' to continue.

Click 'Install' to start copying files.

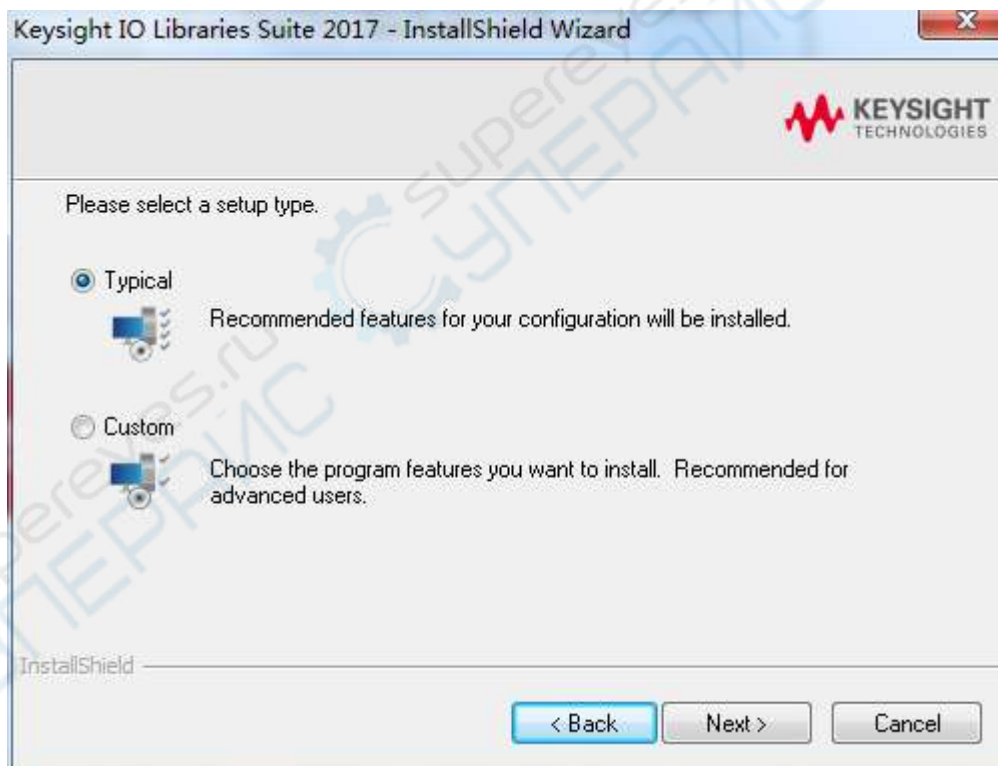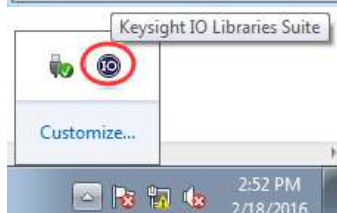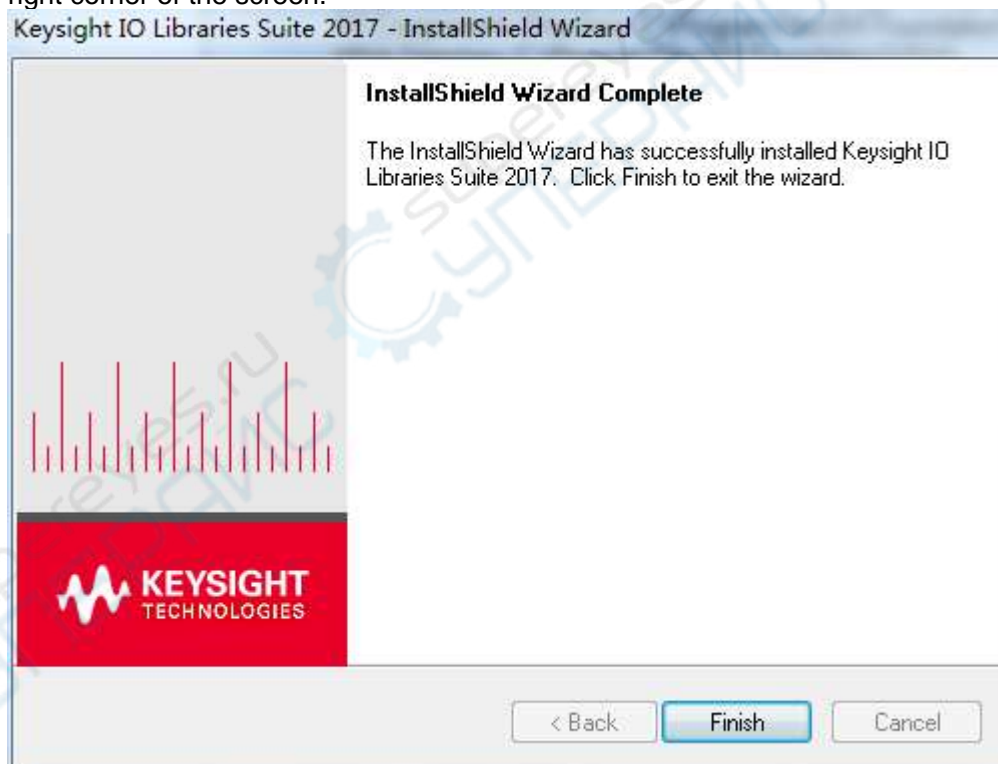The installation is completed automatically. You will see the running IO program in the lower right corner of the screen.

11.2 Remote Control via USB

1. **Connect the device**
   Connect the instrument with your PC using a USB cable.
2. **Search for device resource**
   Start up Keysight IO and the software will automatically search for the instrument resource currently connected to the PC. You can also click **Rescan** to search for the resources.
3. **View the device resource**
   The resource found will appear under the directory, and the model number and USB interface information of the instrument will also be displayed.
   For example, HDG6202C(USB0::0x049F::0x505B::CN1826003000125::0::INSTR)
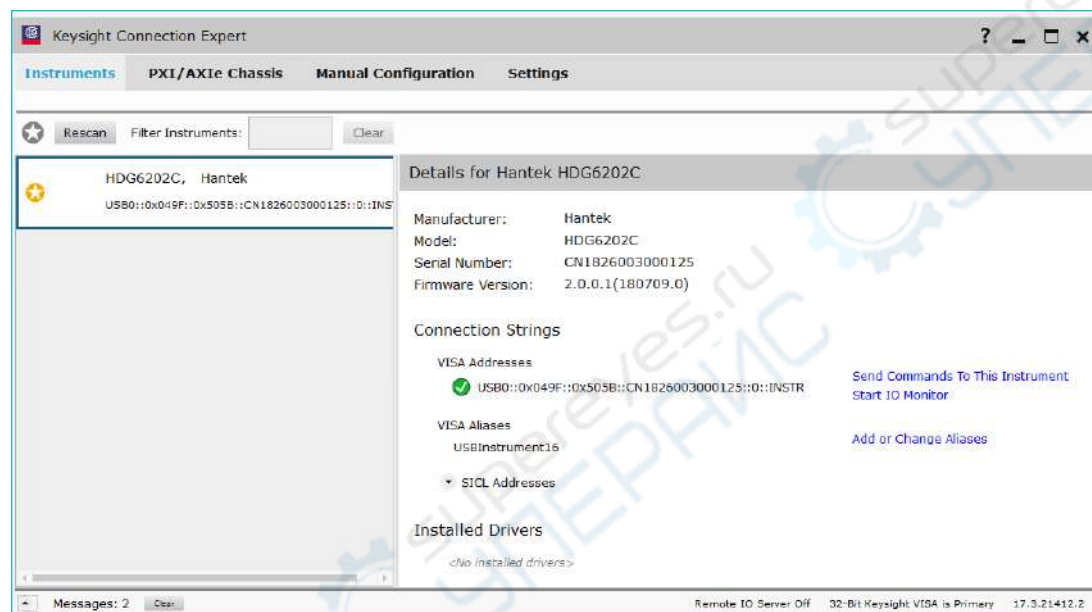
4. **Control the instrument remotely**
   Click "Send Commands To This Instrument" to open Keysight interactive IO interface. You can send commands and read data.

11.3 Remote Control via LAN (HDG6000C)

1. **Connect the device**
   Connect the HDG6000C and the computer to the same router with network line.
   Or connect the HDG6000C to the computer directly with network line. Set the DHCP to "OFF", and the Gateway to be set is the same as the Gateway of the computer.
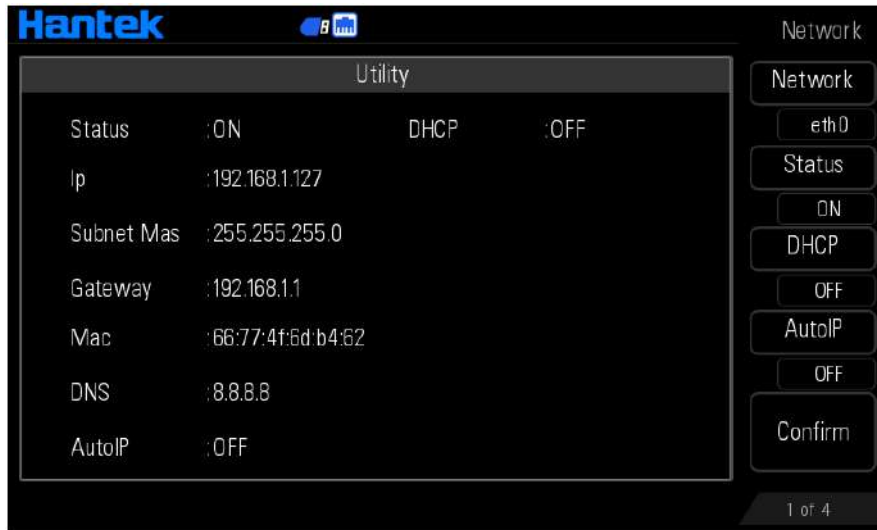
2. Search for device resource

Start up Keysight IO and click "**Connection Expert->Manual Configuration->LAN instrument**". Refer to the following picture to fill in the IP address (such as 192.168.1.127) of the HDG6000C and set the protocol to Socket/5025. And then click "Accept" to add the device. The software will automatically search for the instrument resource currently connected to the PC. You can also click Rescan to search for the resources.
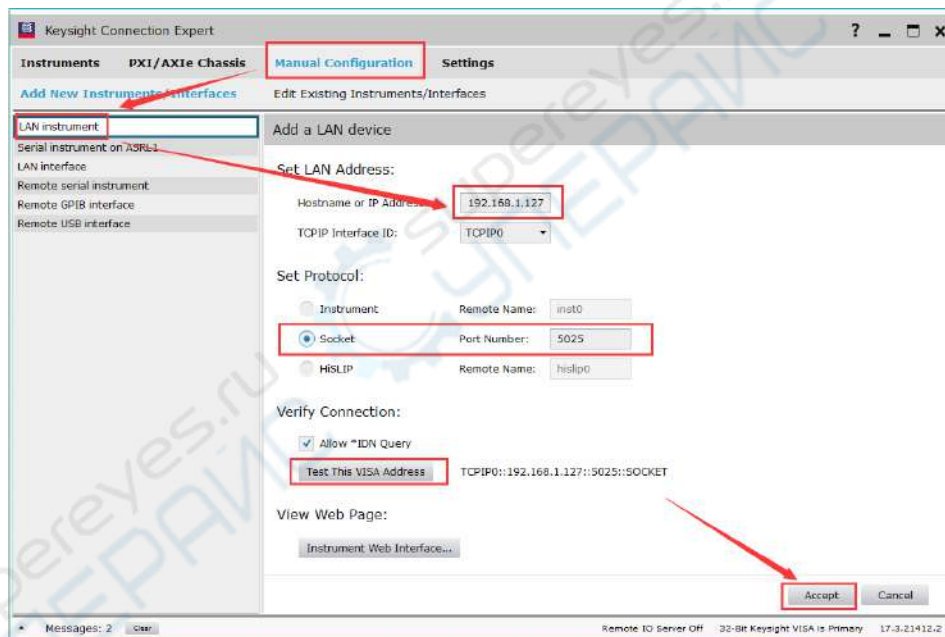
3. View the device resource

The resource found will appear under the directory, and the model number and IP address information of the instrument will also be displayed.

For example, HDG6202C (TCPIP0::192.168.1.127::5025::SOCKET)

## 4. Control the instrument remotely

Click "Send Commands To This Instrument" to open Keysight interactive IO interface. You can send commands and read data.

11.4 Remote Control via WLAN (HDG6000C)

1. **Connect the device**

   First, connect the HDG6000C to the router with Wi-Fi.
   1) Press **"Utility->System->Network->Hotspot"** to close Hotspot.
   2) Set the **DHCP** to ON.
   3) Press **Scan Result** to assign the knob cursor to the device list. Rotate the knob to specify equipment and press knob to comfirm.

   Now connect the computer to the same router with Wi-Fi.
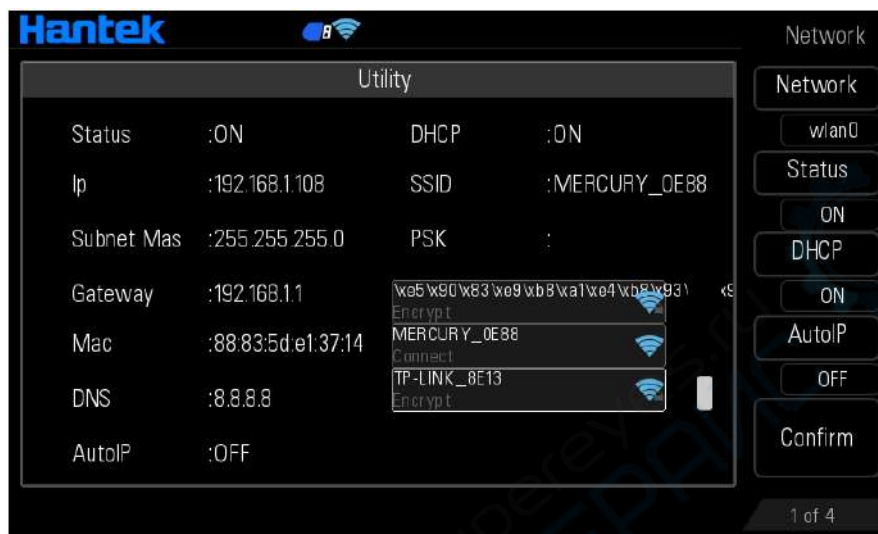
2. **Search for device resource**

   Start up Keysight IO and click "**Connection Expert->Manual Configuration->LAN instrument**". Refer to the following picture to fill in the IP address (such as 192.168.1.108) of the HDG6000C and set the protocol to Socket/5025. And then click "Accept" to add the device. The software will automatically search for the instrument resource currently connected to the PC. You can also click Rescan to search for the resources.
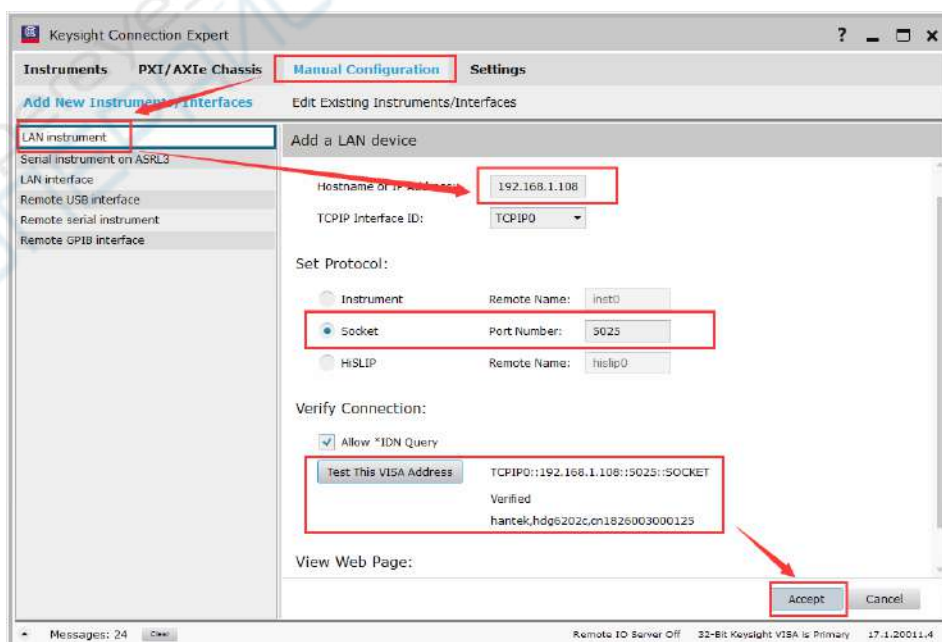
3. View the device resource

The resource found will appear under the directory, and the model number and IP address information of the instrument will also be displayed.

For example, HDG6202C (TCPIP0::192.168.1.108::5025::SOCKET)

4. Control the instrument remotely

Click "Send Commands To This Instrument" to open Keysight interactive IO interface. You can send commands and read data.

11.5 Remote Control via Hotspot (HDG6000C)

1. Connect the device

Open the Hotspot, and use your computer to search the hotspot as "HDG6020C_CN……, default password: 88888888, IP Start: 10.0.0.200, IP End: 10.0.0.250", now connect the hotspot.


2. Search for device resource

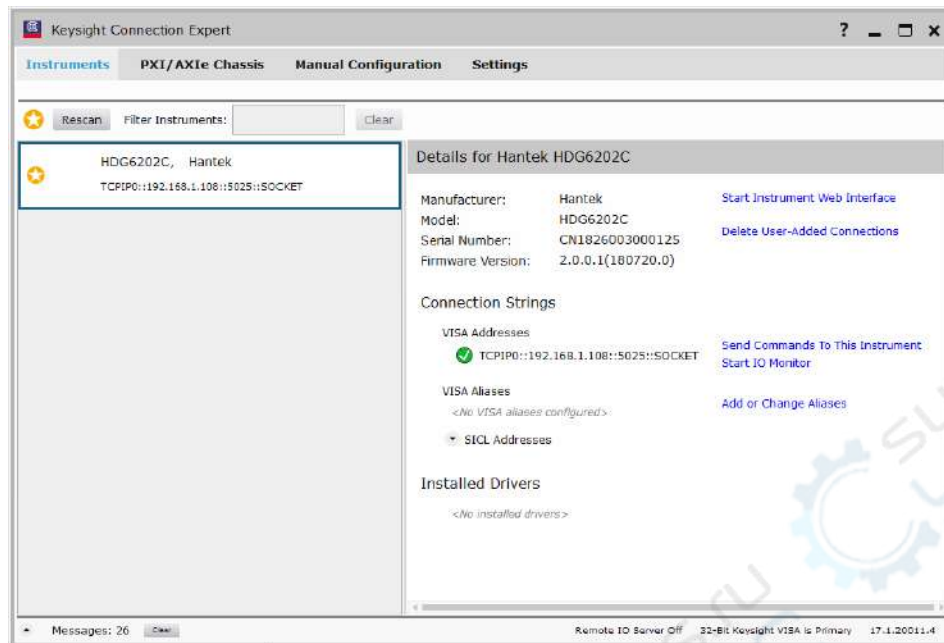Start up Keysight IO and click "**Connection Expert->Manual Configuration->LAN instrument**". Refer to the following picture to fill in the IP address (such as 10.0.0.1) of the HDG6000C and set the protocol to Socket/5025. And then click "Accept" to add the device. The software will automatically search for the instrument resource currently connected to the PC. You can also click Rescan to search for the resources.
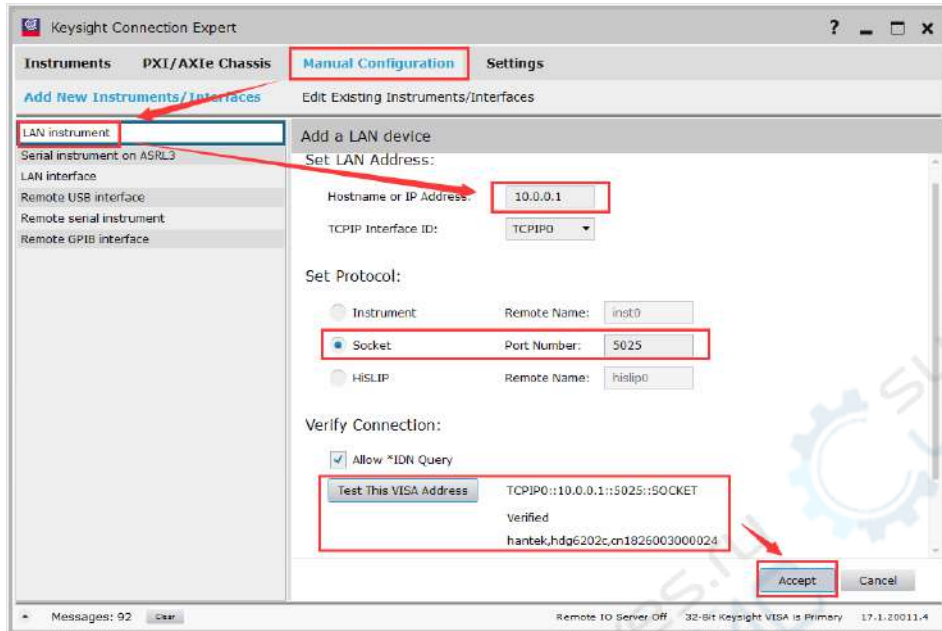
3. **View the device resource**
   The resource found will appear under the directory, and the model number and USB interface information of the instrument will also be displayed.
   For example, HDG6202C (TCPIP0::10.0.0.1::5025::SOCKET)
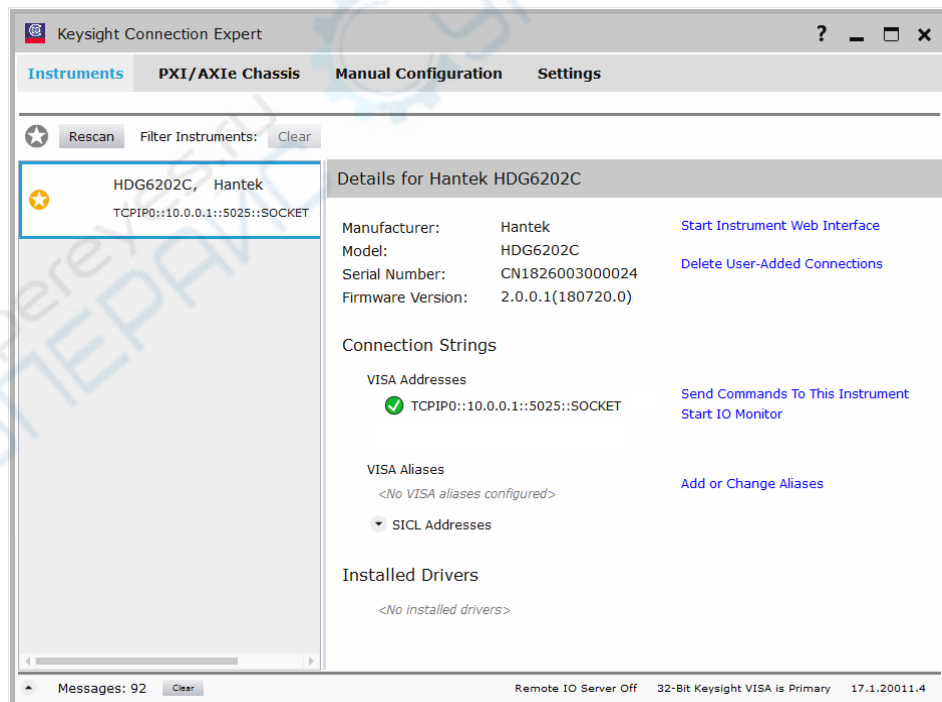
4. **Control the instrument remotely**
   Click "Send Commands To This Instrument" to open Keysight interactive IO interface. You can send commands and read data.

Appendix A Specifications

All technical specifications are applicable to HDG6000B(C) series signal generator. Unless otherwise specified, all technical specifications are guaranteed when the following two conditions are established.

◆ The signal generator is in the calibration period.

◆ The signal generator runs continuously for more than 30 minutes at the specified operating temperature (18 ~28 C).

The specifications used are guaranteed except those marked "typical".

Model	HDG6202B(C)	HDG6162B(C)	HDG6112B(C)	HDG6082B(C)
Channel	2	2	2	2
Memory Depth	64M	64M	64M	64M
Maximum Frequency	200MHz	160MHz	110MHz	80MHz
Sample Rate	1.25GSa/s			
Voltage Resolution	16Bit			
Digital Output	16 Channels output			
Waveforms				
Standard Waveforms	Sine, Square, Ramp, Pulse, Noise, Harmonics			
Arbitrary Waveforms	More than 160 kinds, including Sinc, Exponential Rise, Exponential Fall, ECG, Gauss, Haver Sine, Lorentz, Dual-Tone, DC, etc.			
Frequency Characteristics				
Sine	1uHz~200MHz	1uHz~160MHz	1uHz~110MHz	1uHz~80MHz
Square	1uHz~60MHz	1uHz~50MHz	1uHz~40MHz	1uHz~35MHz
Pulse	1uHz~50MHz	1uHz~40MHz	1uHz~25MHz	1uHz~20MHz
Ramp	1uHz~5MHz	1uHz~4MHz	1uHz~3MHz	1uHz~2MHz
Noise	120MHz	120MHz	110MHz	80MHz
Harmonics	1uHz~100MHz	1uHz~80MHz	1uHz~55MHz	1uHz~40MHz
Arb.	1uHz~50MHz	1uHz~40MHz	1uHz~25MHz	1uHz~15MHz
Resolution	1uHz			
Accuracy	±2ppm, 18~28℃			
Sine Wave Spectrum Purity				
Harmonic Distortion	Typical（0dBm） DC-1MHz: <-60dBc; 1MHz-10MHz: <-55dBc; 10MHz-100MHz: <-50dBc； 100MHz-200MHz: <-40dBc			
Total Harmonic	<0.1% (10Hz-20kHz, 0dBm)			

Distortion			
Spurious signal (non-hormonic)	Typical(0dBm) ≤10MHz：<-65dBc; >10MHz：<-65dBc+6dB/octave		
Phase Noise	Typical(0dBm,10KHz offset) 10MHz:≤-115dBc/Hz		

Square

Rise/Down time	Typical (1Vpp) <8ns	Typical (1Vpp) <10ns	Typical (1Vpp) <12ns
Overshoot	Typical (100KHz, 1Vpp) <3%		
Duty Cycle	≤10MHz: 10.0%~90.0%; 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% of peak output (1KHz, 1Vpp)
Symmetry	0%~100%

Pluse

Period	20ns~1Ms	25ns~1Ms	40ns~1Ms	50ns~1Ms
Pulse	≥10ns	≥10ns	≥12ns	≥18ns
Leading Edge Time	≥5ns	≥5ns	≥7ns	≥11ns
Overshoot	<3%(1Vpp)			
Jitter(rms)	Typical (1Vpp) ≤5MHz 2ppm+500ps > 5MHz 500ps			

Arb. Wavefrom Generator

Waveform Length	64M
Vertical Resolution	16 Bit
Sample Rate	1.25GSa/s
Rise/Fall time	Typical(1Vpp):<6ns
Jitter	Typical (1Vpp) ≤5MHz 2ppm+500ps; > 5MHz 500ps

Harmonic

Harmonic Order	≤16
Harmonic Type	Even, Odd, All
Harmonic Amplitude	can be set for all harmonics
Harmonic Phase	can be set for all harmonics

Amplitude characteristic (50Ω)

Amplitude Range	≤20MHz: 1mVpp ~ 10Vpp; ≤80MHz: 1mVpp ~ 5Vpp; ≤110MHz:1mVpp ~ 2.5Vpp; ≤160MHz:1mVpp ~ 1Vpp; ≤200MHz:1mVpp ~ 0.5Vpp;			
Accuracy	Typical (1kHz Sine, 0V Offset, >10mVpp, Auto) ± 1% of setting ± 2mVpp			
Flatness (relative to 1kHz Sine wave, 500mVpp, 50Ω)	≤1MHz: ±0.1dB; ≤60MHz: ±0.2dB; ≤100MHz: ±0.4dB ≤160MHz: ±0.8dB ≤200MHz: ±1.2dB	≤1MHz: ±0.1dB; ≤60MHz: ±0.2dB; ≤100MHz: ±0.4dB ≤160MHz: ±0.8dB	≤1MHz: ±0.1dB; ≤60MHz: ±0.2dB; ≤100MHz: ±0.4dB	≤1MHz: ±0.1dB; ≤60MHz: ±0.2dB
Units	Vpp, mVpp, Vrms			
Resolution	1mV			
Impedance	50Ω			

Offset Characteristic (50Ω)

Range	|Voltset| < Vmax – Vpp/2
Accuracy	±(1% of setting + 5mV + 0.5% of amplitude）

Modulation Characteristic

Modulation Type	AM, DSB-AM, FM, PM, 2ASK, 2FSK, 2PSK, BPSK, QPSK, 3FSK, 4FSK, OSK, PWM

AM

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External, another channel
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Rate	2mHz~50KHz
Depth	0%~120%

DSB-AM

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External, another channel
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb

Rate	2mHz~50KHz
Depth	0%~120%

FM

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External, another channel
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Rate	2mHz~50KHz

PM

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External, another channel
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Rate	2mHz~50KHz
Phase Deviation	0° to 360°

2ASK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External
Modulating Waveforms	Square with 50% duty cycle
Rate	2mHz~1MHz

2FSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External
Modulating Waveforms	Square with 50% duty cycle
Rate	2mHz~1MHz

2PSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal, External
Modulating Waveforms	Square with 50% duty cycle
Rate	2mHz~1MHz

BPSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)

Source	Internal
Data Source	PN15 code, PN21 code, 01 code, 10 code
Rate	2mHz~1MHz

QPSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal
Data Source	PN15 code, PN21 code
Rate	2mHz~1MHz

3FSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal
Modulating Waveforms	Square
Rate	2mHz~1MHz

4FSK

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Source	Internal
Modulating Waveforms	Square
Rate	2mHz~1MHz

OSK

Carrier Waveforms	Sine
Source	Internal, External
OscTime	8ns~4.99975ms
Rate	2mHz~1MHz

PWM

Carrier Waveforms	Square
Source	Internal, External, another channel
Modulating Waveforms	Sine, Square, Ramp, Noise, Arb
Rate	2mHz~50KHz
Width Deviation	0% to 50%

[Sync/Mod/Trig] Input

Maximum Input Range	75mVRMS to ±2.5Vac+dc

Input Bandwidth	10MHz
Input Impedance	1KΩ

Sweep Characteristics

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)
Type	linear
TypeDirection	Up
Sweep time	1ms to 50Ks
Hold/Return time	1ms to 50Ks
Trigger Source	Internal, External, Manual
Mark	Falling Edge of Sync signal(programmable)

Burst Characteristic

Carrier Waveforms	Sine, Square, Ramp, Pluse, Harmonics, Arb. (except DC)		
Carrier Frequency	2mHz to 100MHz	2mHz to 100MHz	2mHz to 80MHz
Burst Count	1 to 2000 000 000		
Start/Stop Phase	0° to 360°		
Internal Period	2µs to 500s		
Gated Source	External trigger		
Trigger Source	Internal, External or Manual		

Counter

Function	Frequency, Period, Positive/Negative Pulse Width, Duty Cycle	
Frequency Resolution	7 digits/second (Gate Time =1s)	
Frequency	1uHz~200MHz	
Gate time	10ms~16s	
Voltage Range and Sensitivity		
DC Coupling	DC Offset Range	±1.5VDC
	1µHz to 100MHz	50mVRMS to ±2.5Vac+dc
	100MHz to 200MHz	100mVRMS to ±2.5Vac+dc
Pulse Width and Duty Cycle Measurement		
Frequency/Amplitude Range	1µHz to 25MHz	50mVRMS to ±2.5Vac+dc

Pulse Width	Resolution	8ns	
Duty Cycle	Range (Display)	0% to 100%	
Input Characteristics			
Input Range	Breakdown Voltage	±5Vac+dc	Impedance=500Ω
Input Trigger	Trigger Level Range	-2.5V to +2.5V	
	Trigger Sensitivity Range	0% (140mV hysteresis voltage) to 100% (2mV hysteresis voltage)	

Trigger Characteristics

Trigger Input	
Level	TTL-compatible
Slope	Rising or falling (selectable)
Pulse Width	>50ns

Clock Reference

External Reference Input	
Lock Range	10MHz±50Hz
Level	2.5Vpp to 5Vpp
Lock Time	<2s
Impedance (Typical)	5kΩ, AC coupling
Internal Reference Output	
Frequency	10MHz ± 50Hz
Level	3.3Vpp
Impedance (Typical)	50Ω, AC coupling

Sync Output

Level	TTL-compatible
Impedance	50 Ω, nominal value

General Specifications

Interface	HDG6000B: USB Host, USB Device HDG6000C: USB Host, USB Device, LAN, Wi-Fi, Optional RS232
Display	7'' 64K Color TFT Display, 800*480
Power Voltage	100-240V, 45Hz - 440Hz
Power Consumption	<50W
Fuse	T, 3.15A, 250V, 5x20mm

Environment	
Temperature Range	Operating: 10℃ to 40℃ Non-Operating: -20℃ to 60℃
Cooling Method	Convection
Humidity Range	≤+104℉(≤+40°C): ≤90% relative humidity 106℉~122℉ (+41°C ~50°C): ≤60% relative humidity
Altitude	Operating: 3,000 meters No-operating: 15000 meters

Mechanical	
Dimension	318 x 110 x 150mm(L x W x H)
Weight	3KG

Appendix B Accessories

All the following accessories are available by contacting your local HANTEK distributor.

Standard Accessories

- Two BNC to BNC
- A Power line
- A USB Line
- A PC software CD of the oscilloscope
- Warranty Card
- Manufacturer Certificate
- Certificate Of Calibration