AG4151 Arbitrary Waveform Generator

User Manual

General Warranty

Lilliput warrants that the product will be free from defects in materials and workmanship for a period of 3 years (1 year for accessories) from the date of purchase of the product by the original purchaser from the Lilliput Company. This warranty only applies to the original purchaser and is not transferable to the third party. If the product proves defective during the warranty period, Lilliput either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Lilliput for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Lilliput.

In order to obtain service under this warranty, Customer must notify Lilliput of the defect before the expiration of the warranty period. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Lilliput, and with a copy of customer proof of purchase.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Lilliput shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Lilliput representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Lilliput supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

Please contact the nearest Lilliput's Sales and Service Offices for services or a complete copy of the warranty statement.

Excepting the after-sales services provided in this summary or the applicable warranty statements, Lilliput will not offer any guarantee for maintenance definitely declared or hinted, including but not limited to the implied guarantee for marketability and special-purpose acceptability. Lilliput should not take any responsibilities for any indirect, special or consequent damages.

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1. General Safety Requirements

Before any operations, please read the following safety precautions to avoid any possible bodily injury and prevent this product or any other products connected from damage. In order to avoid any contingent danger, this product is only used within the range specified.

Only the qualified technicians can implement the maintenance.

To avoid Fire or Personal Injury:

- **Use Proper Power Cord.** Use only the power cord supplied with the product and certified to use in your country.

- **Product Grounded.** This instrument is grounded through the power cord grounding conductor. To avoid electric shock, the grounding conductor must be grounded. The product must be grounded properly before any connection with its input or output terminal.

- **Check all Terminal Ratings.** To avoid fire or shock hazard, check all ratings and markers of this product. Refer to the user's manual for more information about ratings before connecting to the instrument.

- **Do not operate without covers**. Do not operate the instrument with covers or panels removed.

- **Use Proper Fuse.** Use only the specified type and rating fuse for this instrument.

- **Avoid exposed circuit**. Do not touch exposed junctions and components when the instrument is powered.

- **Do not operate if in any doubt.** If you suspect damage occurs to the instrument, have it inspected by qualified service personnel before further operations.

- **Use your instrument in a well-ventilated area.** Make sure the instrument installed with proper ventilation, refer to the user manual for more details.

- **Do not operate in wet conditions.**

- **Do not operate in an explosive atmosphere.**

- **Keep product surfaces clean and dry.**

2. Safety Terms and Symbols

Safety Terms

Terms in this Manual. The following terms may appear in this manual:

⚠ **Warning:** Warning indicates the conditions or practices that could result in injury or loss of life.

⚠ **Caution:** Caution indicates the conditions or practices that could result in damage to this product or other property.

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

Danger: It indicates an injury or hazard may immediately happen.

Warning: It indicates an injury or hazard may be accessible potentially.

Caution: It indicates a potential damage to the instrument or other property might occur.

Safety Symbols

Symbols on the Product. The following symbol may appear on the product:

⚡ Hazardous Voltage   ⚠ Refer to Manual

⏚ Protective Earth Terminal   ⏛ Chassis Ground

⏚ Test Ground

3. General Characteristics

AG4151 product is multi-function generator which combines Arbitrary Waveform Generation and Function Generation. The product introduces Direct Digital Synthesizer (DDS) technology to provide stable, precise, pure and low distortion signal. The user-friendly interface design and panel layout bring exceptional user experience. Embedded USB Device, USB Host, LAN, support USB storage device. provide more alternative solutions for users.

Features and benefits:

◆ 3.9 inch high resolution (480×320 pixels) TFT LCD display;

◆ Advanced DDS technology, Max.150MHz frequency output;

◆ Max. Sample rate: 400MSa/s, Frequency resolution: 32 bits;

◆ Vertical resolution: 14 bits, up to 1M waveform record length;

◆ Abundant waveform output: Sine, Square, Ramp, Pulse, White Noise, Exponential rise, Exponential fall, Sin(x)/x, DC, 32 channels digital waveform and user defined arbitrary waveform;

◆ Abundant modulation functions: AM, FM, PM, FSK, PWM along with output liner/logarithm sweep and pulse string waveform;

◆ Standard interface: USB Device, USB Host, LAN, COM etc.

4. Quick Start

This chapter will deal with the following topics mainly:

- **Front/Rear Panel Overview**
- **User Interface Overview**
- **How to Implement General Inspection**
- **How to Adjust the Foot Stools**
- **How to Implement Power-On Check**

Front/Rear Panel and User Interface

Front Panel
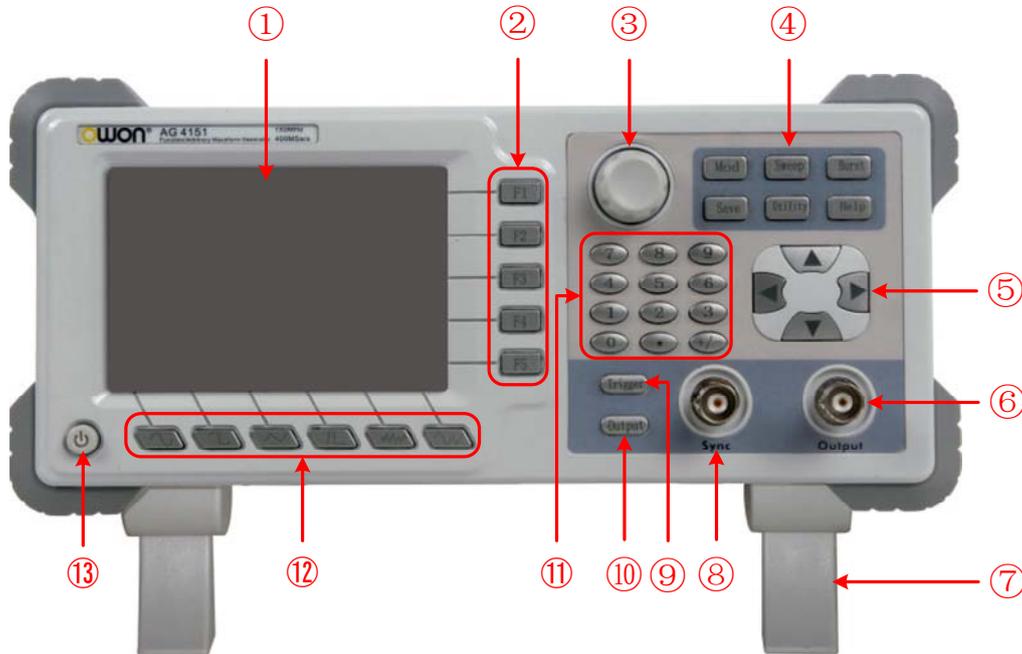
Figure 4-1 Front panel overview

①	**LCD**	Display the user interface
②	**Menu selection buttons**	Include 5 buttons: F1～F5
③	**Knob**	Change the parameter
④	**Function key area**	Include 6 function keys: Mod : Generate the Modulated waveforms Sweep : Sweep Sine, Square or Ramp waveform Burst : Generate burst for Sine, Square, Ramp, Pulse and Arbitrary waveform Save : Store/recall waveform data and configure information Utility : Set the auxiliary system function Help : Read the build-in help information
⑤	**Direction key**	Select menu or move the cursor of the focused parameter
⑥	**Main output terminal**	Output main signal
⑦	**Foot stool**	Make the instrument to be tilted for ease of operation
⑧	**Sync output terminal**	Output sync signal (see P32, "*To Set the Sync Output*")

⑨	**Trigger key**	In Sweep and N-Cycle Burst, if you choose Source as "Manual", every time you press this key, the generator will be triggered once.
⑩	**Output key**	Activate or deactivate the output signal
⑪	**Number keys**	Input parameters, include: number, point and plus/minus sign
⑫	**Waveform selection buttons**	Include: Sine, Square, Ramp, Pulse, Noise and Arbitrary waveform
⑬	**Power button**	Turn on/off the instrument

Rear Panel
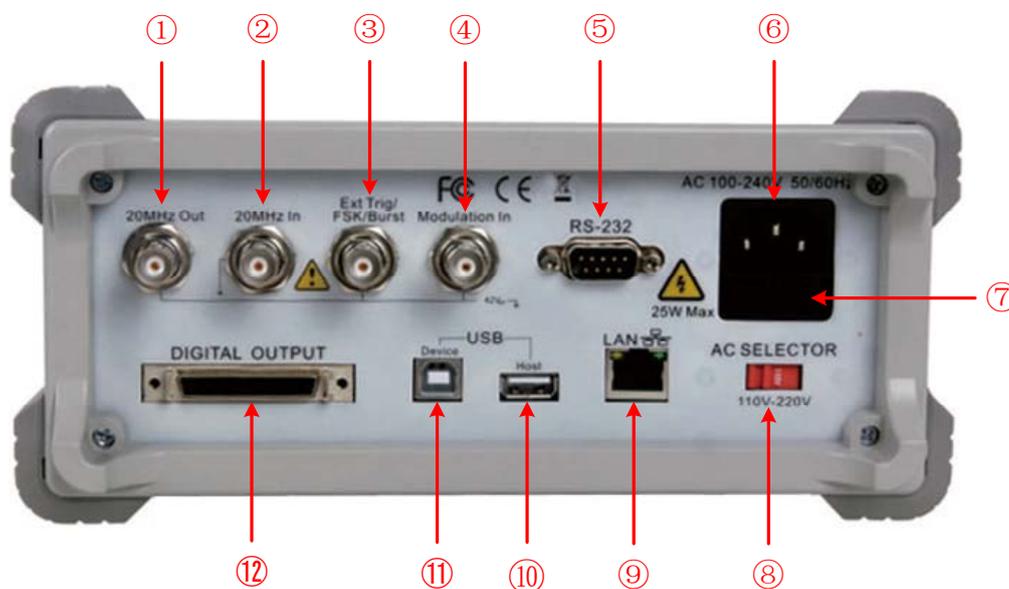
Figure 4-2 Rear panel overview

①	**20MHz reference output**	These two connectors are used to synchronize generators. The connector [20MHz In] accepts an external 20 MHz clock signal, and the connector [20MHz Out] can output a 20 MHz clock signal generated by the crystal inside the generator. (See P35, "*To Set the Clock Source*")
②	**20MHz reference input**	
③	**External Trigger /FSK/Burst**	This signal can be used as external signal source in Sweep, FSK and Burst mode.
④	**Modulation In**	Modulation waveform input, use it as external signal source
⑤	**RS232 port**	Through this interface, the generator can be connected to a PC and controlled via PC software.
⑥	**Power socket**	AC input connector
⑦	**Fuse**	Use the specified fuse according to the voltage scale.
⑧	**Power switch**	Switch between 110V and 220V.

⑨	**LAN port**	Through this interface, the generator can be connected to your local network and controlled via PC software.
⑩	**USB Host port**	Connect as a "host device" with an external USB device, such as connect a USB disk to the instrument.
⑪	**USB Device port**	Connect as a "slave device" with an external device, such as connected to a PC and controlled via PC software.
⑫	**Digital output**	Connect the generator with the logic signal output module (optional). Then, configure specific sequence digital signal in the generator and output the signal through the digital module.

User Interface
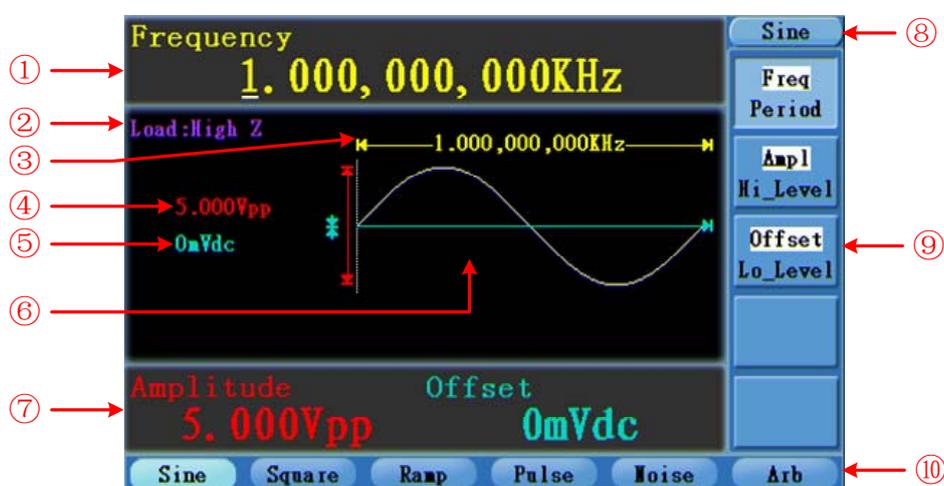
Figure 4-3 User interface (take Sine for instance)

①	Parameter bar 1, display parameters and edit the focused parameter
②	Load, High Z represents high resistance
③	Frequency/period, depends on the highlighted menu item on the right
④	Amplitude/high level, depends on the highlighted menu item on the right
⑤	Offset/low level, depends on the highlighted menu item on the right
⑥	Display current waveform
⑦	Parameter bar 2, display parameters and edit the focused parameter
⑧	Current signal type or mode
⑨	The setting menu of current signal or mode
⑩	Signal type

General Inspection

After you get a new AG4151 Waveform Generator, it is recommended that you should

make a check on the instrument according to the following steps:

1. **Check whether there is any damage caused by transportation.**

   If it is found that the packaging carton or the foamed plastic protection cushion has suffered serious damage, do not throw it away first till the complete device and its accessories succeed in the electrical and mechanical property tests.

2. **Check the Accessories**

   The supplied accessories have been already described in the **Appendix B** "Accessories" of this Manual. You can check whether there is any loss of accessories with reference to this description. If it is found that there is any accessory lost or damaged, please get in touch with the distributor of Lilliput responsible for this service or the Lilliput's local offices.

3. **Check the Complete Instrument**

   If it is found that there is damage to the appearance of the instrument, or the instrument can not work normally, or fails in the performance test, please get in touch with the Lilliput's distributor responsible for this business or the Lilliput's local offices. If there is damage to the instrument caused by the transportation, please keep the package. With the transportation department or the Lilliput's distributor responsible for this business informed about it, a repairing or replacement of the instrument will be arranged by the Lilliput.

Foot Stool Adjustment

Unfold the foot stools on the bottom of the generator, as ⑦ in *Figure 4-1*.

Power-On Check

AC Power Input Setting

AG4151 adopt 110V/220V AC power source. Users should regulate the voltage scale of the **Power Switch** according to the standards in their own country (see *Figure 4-2*) at the rear panel and use an appropriate fuse.

Voltage	Fuse
110V	125 V, F4AL
220V	250 V, F2AL

To change the voltage scale of the instrument, do the following steps:
(1) Turn off the power button at the front panel and remove the power cord.
(2) Check if the fuse installed before leaving factory (250 V, F2AL) can match with the selected voltage scale; if not, pry the cover open using a straight screwdriver (see ⑦ in *Figure 4-2*), change the fuse.

(3) Regulate the **Power Switch** to the desired voltage scale.

Power On

(1) Connect the instrument to the AC supply using the supplied power cord.

> ⚠ **Warning:**
> To avoid electric shock, the instrument must be grounded properly.

(2) Press down the **power button** at the front panel, the screen shows the boot screen.

5. Front Panel Operation

This chapter will deal with the following topics mainly:

- **How to Output Sine Signals**
- **How to Output Square Signals**
- **How to Output Ramp Signals**
- **How to Output Pulse Signals**
- **How to Output Noise Signals**
- **How to Output Arbitrary Signals**
- **How to Generate the Modulated Waveform**
- **How to Generate Sweep**
- **How to Generate Burst**
- **How to Save and Recall**
- **How to Set the Utility Function**
- **How to Use Built-in Help**

To set signals

The following describes how to set and output Sine, Square, Ramp, Pulse, Noise and Arbitrary signals.

To Output Sine Signals

Press ⏦ button to call the user interface of Sine signal, the Sine waveform parameters can be set by operating the Sine setting menu on the right.

The parameters of Sine waveform are: Frequency/Period, Amplitude/High Level, Offset/Low Level. You can operate the menu by using the menu selection buttons on the right.
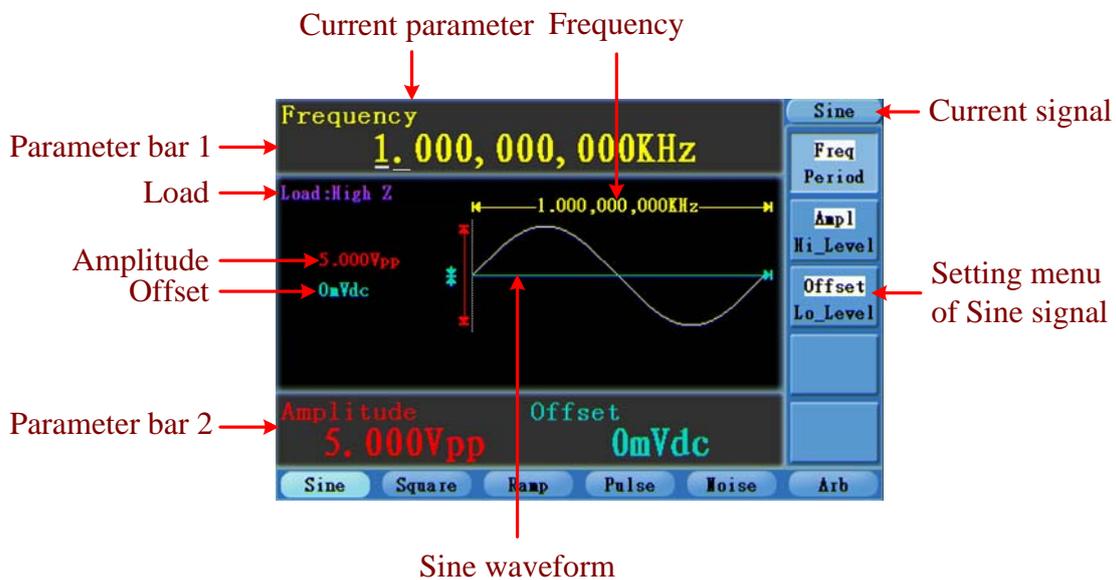
Figure 5-1: The User Interface of Sine Signal

To Set the Frequency/Period

Press **F1** button, the chosen menu item is highlighted, the focused parameter is displayed in Parameter bar 1. Press **F1** button to switch between Frequency/Period.

Two methods to change the chosen parameter:

● Turn the **knob** to change the value of cursor position in the Parameter bar. Press the ◀ / ▶ direction key to move the cursor.

● Press a number key in the front panel, an input box will pop up; keep going to input the value. Press the ◀ direction key to delete the last number. Press **F1** ∼ **F3** to choose the unit, or press **F4** to go to next page and choose other units. Press **F5** to cancel the input.

The frequency range is 1μHz∼150MHz; the period range is 6.7ns∼1Ms.
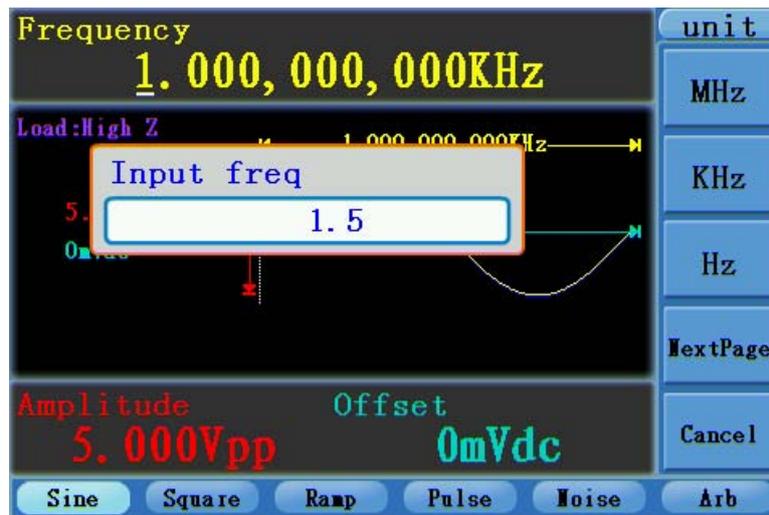
Figure 5-2: Set the frequency using number keys

To Set the Amplitude

Press **F2** , confirm whether the "**Ampl**" menu item is highlighted; if not, press **F2** to switch into "**Ampl**". In the Parameter bar 2, a cursor appears under the value of amplitude. Use the **knob** or the number keys to set the desired value.

To Set the Offset

Press **F3** , confirm whether the "**Offset**" menu item is highlighted; if not, press **F3** to switch into "**Offset**". In the Parameter bar 2, a cursor appears under the value of offset. Use the **knob** or the number keys to set the desired value.

To Set the High Level

Press **F2** , confirm whether the "**Hi_Level**" menu item is highlighted; if not, press **F2** to switch into "**Hi_Level**". In the Parameter bar 2, a cursor appears under the value of amplitude. Use the **knob** or the number keys to set the desired value.

To Set the Low Level

Press **F3** , confirm whether the "**Lo_Level**" menu item is highlighted; if not, press **F3** to switch into "**Lo_Level**". In the Parameter bar 2, a cursor appears under the value of offset. Use the **knob** or the number keys to set the desired value.

To Output Square Signals

Press ⎍ button to call the user interface of Square signal, the Square waveform parameters can be set by operating the Square setting menu on the right.

The parameters of Square waveform are: Frequency/Period, Amplitude/High Level, Offset/Low Level, Duty. You can operate the menu by using the menu selection buttons on the right.

To set the Frequency/Period, Amplitude/High Level, Offset/Low Level, please refer to "*To Output Sine Signals*" on P11.

The frequency range is 1μHz～50MHz; the period range is 20ns～1Ms.

Current parameter   Frequency

Parameter bar 1 →

Load →

Amplitude →

Offset →

Parameter bar 2 →

Current signal

Setting menu of
Square signal

Duty cycle

Figure 5-3: The User Interface of Square Signal

Term Explanation

Duty Cycle:
The percentage that the High Level takes up the whole Period.

To Set the Duty Cycle

(1) Press ⟮**F4**⟯ button, the "**Duty**" menu item is highlighted, the current value of the Duty cycle is displayed in Parameter bar 1.

(2) Turn the **knob** to change the value directly;
or press the number keys to input the desired value, press ⟮**F4**⟯ to choose "%".

For a frequency ≤25MHz, the Duty cycle range is 20%～80%. For a frequency greater than 25MHz, the Duty cycle is 50%.

Current parameter   Duty cycle

Parameter bar 1 →

Input box →
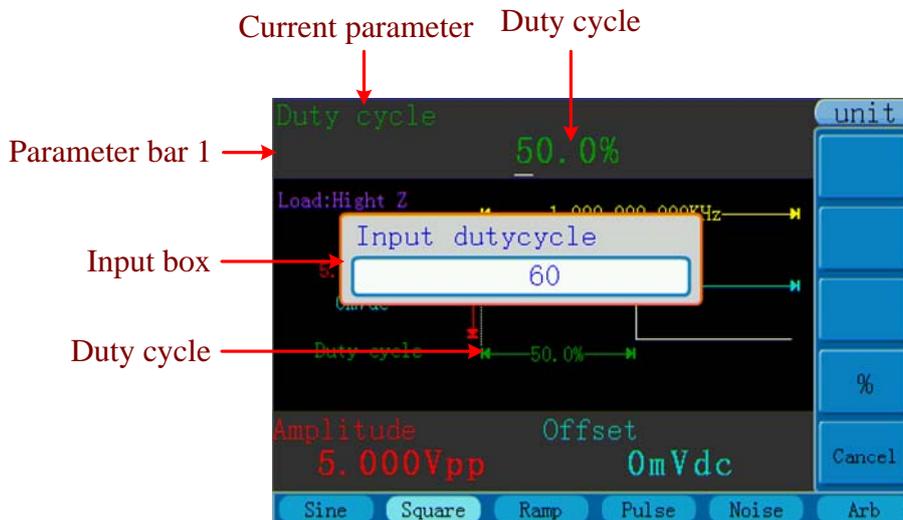
Duty cycle →

Figure 5-4: Set the Duty cycle of Square signal

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To Output Ramp Signals

Press ⟨⟩ button to call the user interface of Ramp signal, the Ramp waveform parameters can be set by operating the Ramp setting menu on the right.

The parameters of Ramp waveform are: Frequency/Period, Amplitude/High Level, Offset/Low Level, Symmetry. You can operate the menu by using the menu selection buttons on the right.

To set the Frequency/Period, Amplitude/High Level, Offset/Low Level, please refer to "*To Output Sine Signals*" on P11.

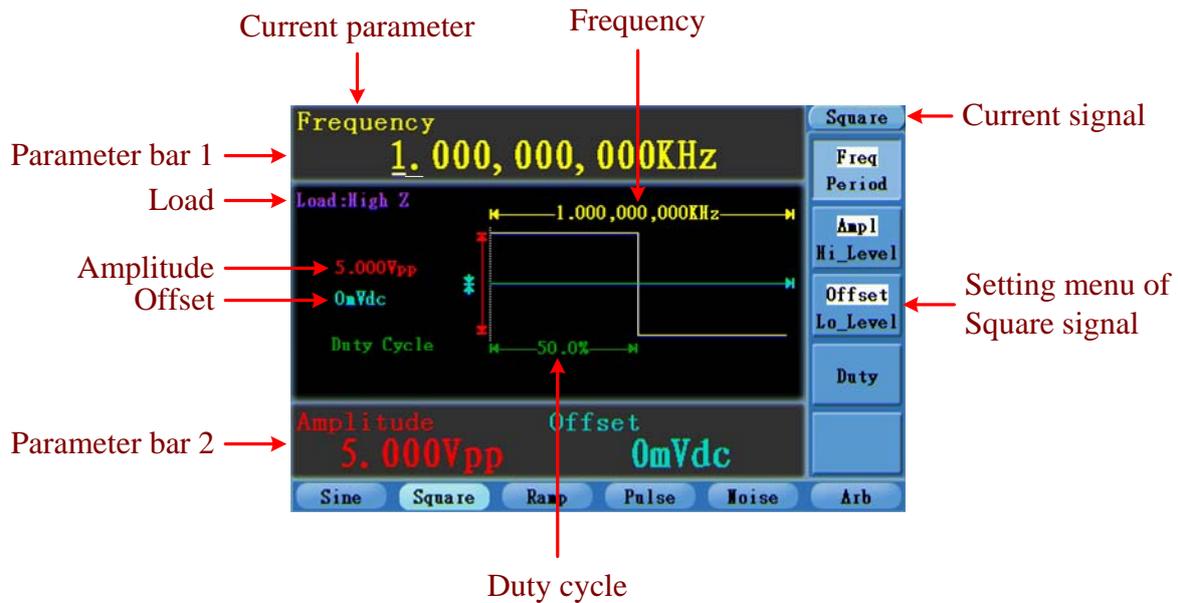The frequency range is 1μHz～1MHz; the period range is 1us～1Ms.
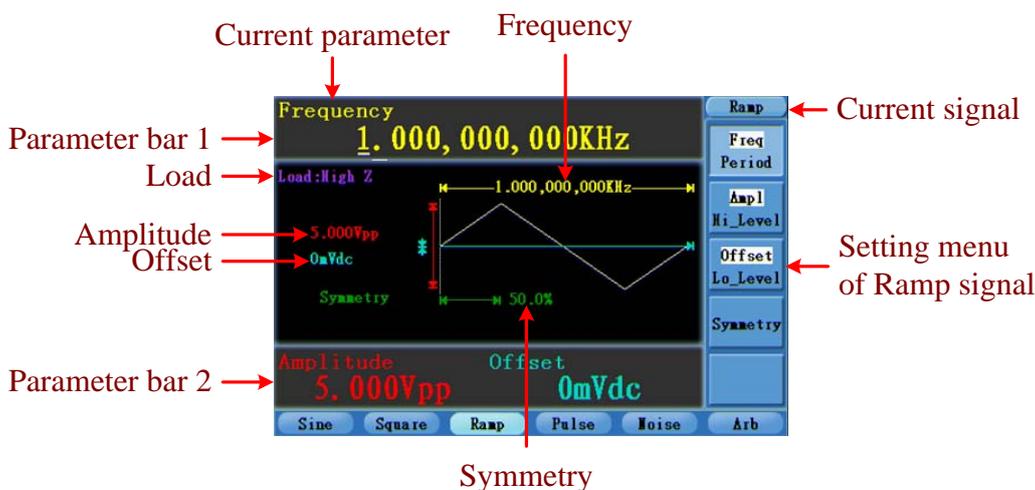
Figure 5-5: The User Interface of Ramp Signal

Term Explanation

Symmetry:
The percentage that the Rising Period takes up the whole Period.

To Set the Symmetry

(1) Press **F4** button, the "**Symmetry**" menu item is highlighted, the current value of the symmetry is displayed in Parameter bar 1.

(2) Turn the **knob** to change the value directly;
or press the number keys to input the desired value, press **F4** to choose "%".

The symmetry range is 0%～100%.

Current parameter Symmetry

Parameter bar 1 →

Input box →
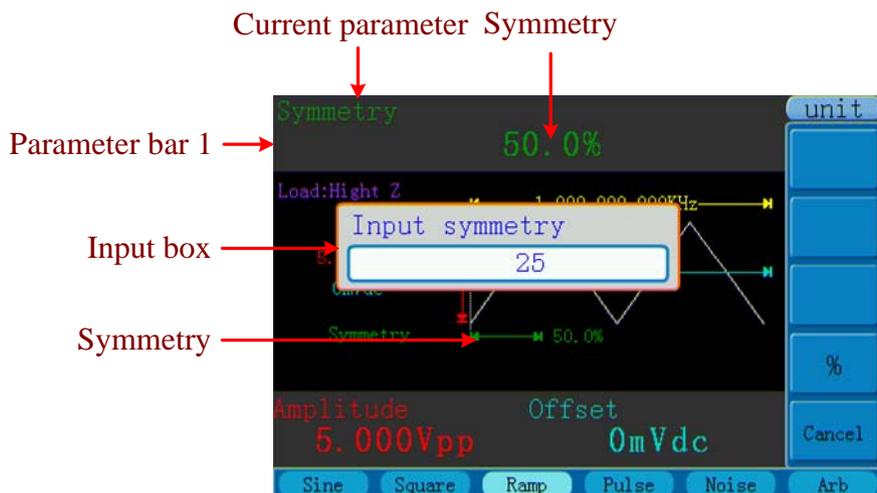
Symmetry →

Figure 5-6: Set the symmetry of Ramp signal

To Output Pulse Signals

Press ⏄ button to call the user interface of Pulse signal, the Pulse waveform parameters can be set by operating the Pulse setting menu on the right.

The parameters of Pulse waveform are: Frequency/Period, Amplitude/High Level, Offset/Low Level, Pulse Width/Duty, Edge Time. You can operate the menu by using the menu selection buttons on the right.

To set the Frequency/Period, Amplitude/High Level, Offset/Low Level, please refer to "*To Output Sine Signals*" on P11.

The frequency range is 1μHz～25MHz; the period range is 40ns～1Ms.

Current parameter   Frequency

Parameter bar 1 →
Load →
Amplitude →
Offset →
Pulse width →

Parameter bar 2 →

← Current signal

Setting menu of Pulse signal

Edge time

Figure 5-7: The User Interface of Pulse Signal

> **Term Explanation**
>
> **Pulse Width:**
> There are two kinds of Pulse Width—positive and negative.
> Positive Pulse Width is the time span between thresholds of 50% of the rising edge amplitude to the next 50% of the falling edge amplitude.
> Negative Pulse Width is the time span between thresholds of 50% of the falling edge amplitude to the next 50% of the rising edge amplitude.
> Pulse Width is determined by Period and Duty Cycle;
> the formula is: Pulse Width = Period * Duty Cycle.
>
> **Edge Time:**
> The time span between the thresholds of the 10% to 90% of the rising edge amplitude is called Rising Time.
> The time span between the thresholds of the 90% to 10% of the falling edge amplitude is called Falling Time.
> The Rising Time and the Falling Time together are called Edge Time.

To Set the Pulse Width / Duty Cycle

(1) Press ☐ **F4** ☐ button, the chosen menu item is highlighted, the focused parameter is displayed in Parameter bar 1. Press ☐ **F4** ☐ to switch between Frequency/Period.

(2) Turn the **knob** to change the value directly;
or press the number keys to input the desired value and choose the unit.

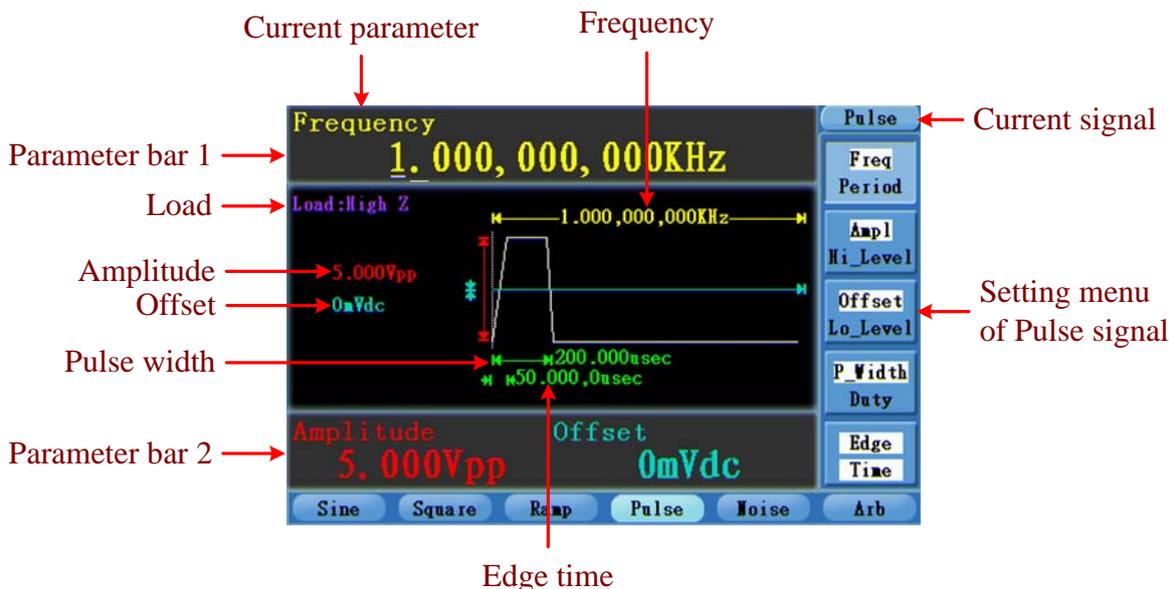The Pulse Width is limited by Period. The min value of the Pulse Width is 20ns. The Duty Cycle range is 0～100%. When the setting of Duty Cycle makes the Pulse Width less than 20ns, the system will automatically adjust the Pulse Width to 20ns.
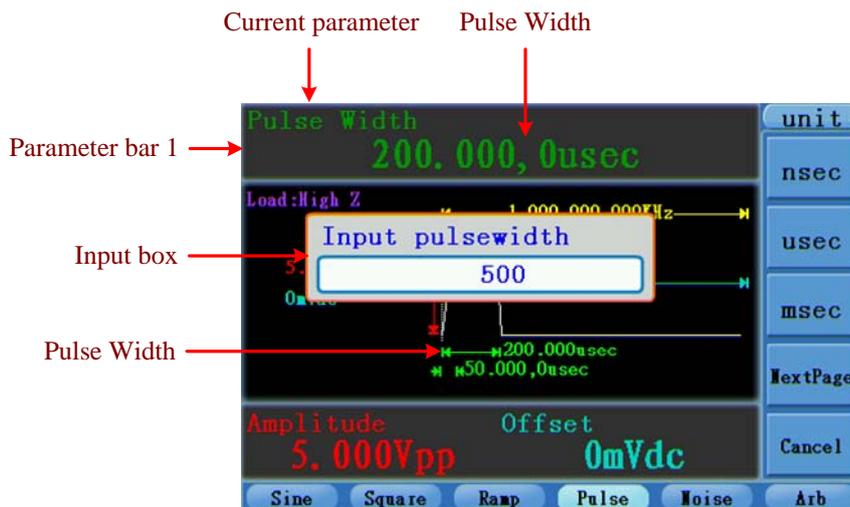
Figure 5-8: Set the Pulse Width of Pulse signal

To Set the Edge Time

(1) Press ☐ **F5** ☐ button, the "**Edge Time**" menu item is highlighted, the current value of the edge time is displayed in Parameter bar 1.

(2) Turn the **knob** to change the value directly;
or press the number keys to input the desired value and choose the unit.

The Edge Time range is 8ns～1ms, and cannot exceed 40% of the Pulse Width.
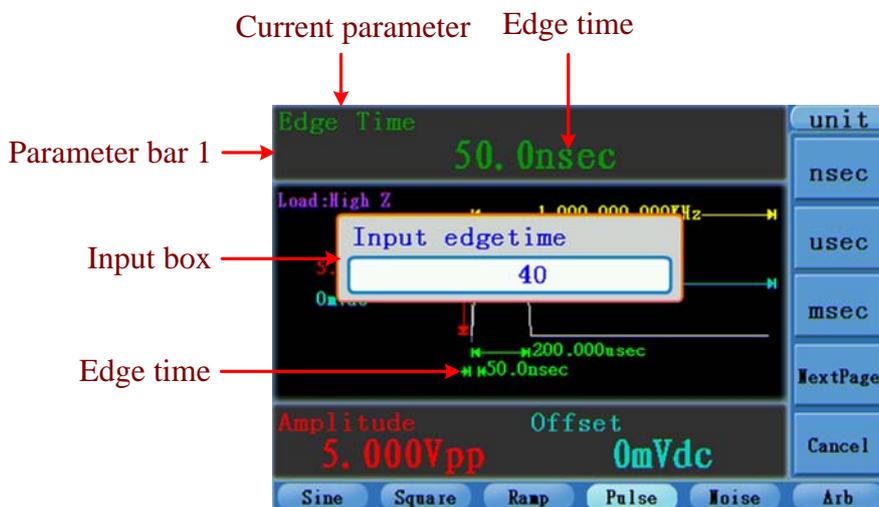
Figure 5-9: Set the Edge Time of Pulse signal

Note:
The rising time and falling time of Pulse signal should have the same value by default.

To Output Noise Signals

The noise signal which the generator output is white noise. Press ⌇ button to call the user interface of Noise signal, the Noise waveform parameters can be set by operating the Noise setting menu on the right.

The parameters of Noise waveform are: Amplitude/High Level, Offset/Low Level. You can operate the menu by using the menu selection buttons on the right.

To set the Amplitude/High Level, Offset/Low Level, please refer to "*To Output Sine Signals*" on P11.

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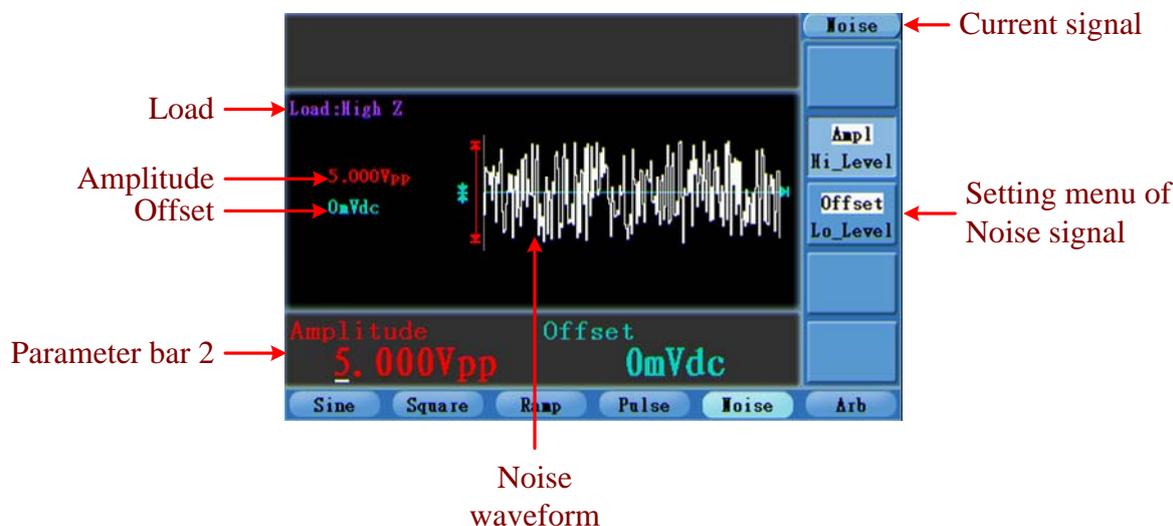
Figure 5-10: The User Interface of Noise Signal

To Output Arbitrary Signals

Press ⌒∿ button to call the user interface of Arbitrary signal, the Arbitrary waveform parameters can be set by operating the Arbitrary setting menu on the right.

The parameters of Arbitrary waveform are: Frequency/Period, Amplitude/High Level, Offset/Low Level, Built-in Waveform. You can operate the menu by using the menu selection buttons on the right.

To set the Frequency/Period, Amplitude/High Level, Offset/Low Level, please refer to "*To Output Sine Signals*" on P11.

The frequency range is 1μHz～10MHz; the period range is 100ns～1Ms.

The Arbitrary signal consists of two types: the system built-in waveform and the user-definable waveform.
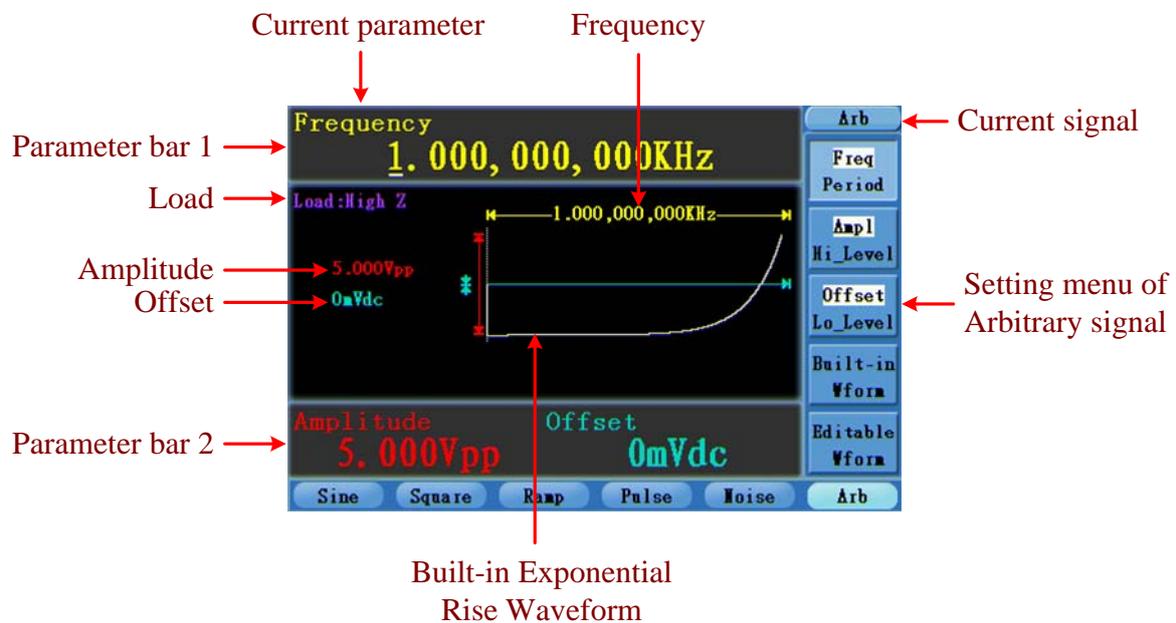
Figure 5-11: The User Interface of Arbitrary Signal

To Select the Built-in Waveform

Press ⌒∿ button, then press **F4** to enter the **Built-in Wform** menu.

There are three built-in Arbitrary waveforms: Exponential Rise, Exponential Fall, sin(x)/x.

The Exponential Rise waveform is shown in the figure above (*Figure 5-11*). The Exponential Fall and sin(x)/x waveform are shown in the figure below.
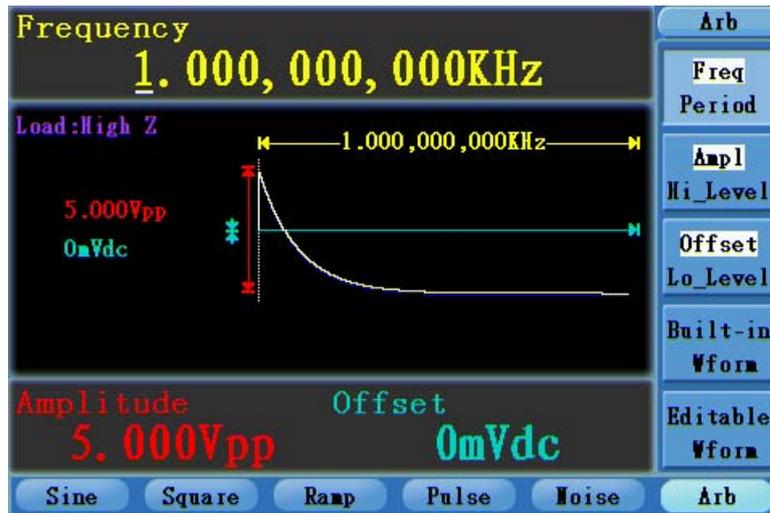
Figure 5-12: The Exponential Fall Waveform
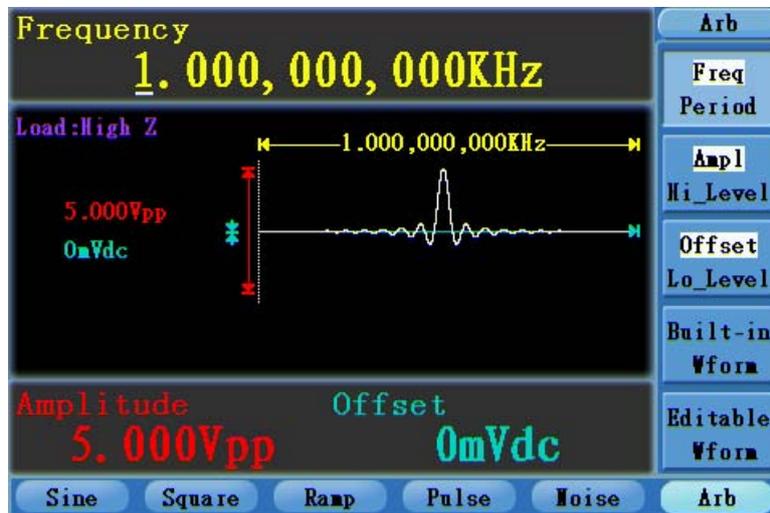
Figure 5-13: The Sin(x)/x Waveform

The User-Definable Waveform

Press ⟨∿⟩ button and press **F5** to select "Editable Wform".

Menu item	Instruction
Create Wform	Create a new waveform.
Select Wform	Select the waveform stored in Flash memory.
Edit Wform	Edit the stored waveform.

How to Create a New Waveform

(1) **Enter the operation menu:** Press ⟨∿⟩ →Editable Wform →Create Wform.

(2) **Set the number of waveform points:** Press **F1** to select "Wform Points", turn the **knob** or press the number keys to input the desired value and choose the unit. X1, XK, XM respectively represent 1, 1000, 1000,000. The waveform points range is 2～ 1000000.

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(3) **Set the interpolation:** Press ⬚F2⬚ to switch between On/Off. If you choose On, the points will be connected with beelines; otherwise, the voltages between two consecutive points will not change, and the waveform looks like a step-up one.

(4) **Edit the waveform points**: Press ⬚F3⬚ to enter the operation menu.
  - Press ⬚F1⬚ to choose "Points", input the number of the point to be edited.
  - Press ⬚F2⬚ to choose "Voltage", input the voltage for the current point.
  - Repeat the step above, set all the points to your needs.
  - Press ⬚F4⬚ to choose "Store", enter the file system. If a U disk is connected, press the ◄ / ► direction key to select the storage. "USBDEVICE" is the U Disk storage, "FLASH" is the internal storage. Choose Next level, enter the desired storage path, choose Save, an input keyboard pops up, input the file name, and then choose DONE.

How to Select a Stored Waveform

(1) **Enter the operation menu:** Press ⟨Λν⟩ →Editable Wform →Select Wform.

(2) Enter the storage path of the desired waveform file. Press the ▲ / ▼ / ◄ / ► direction key to select the desired waveform file.

(3) Choose Recall output.

How to Edit a Stored Waveform

(1) **Enter the operation menu:** Press ⟨Λν⟩ →Editable Wform →Edit Wform.

(2) Enter the storage path of the desired waveform file. Press the ▲ / ▼ / ◄ / ► direction key to select the desired waveform file.

(3) Choose Recall suppress.

How to Delete a Stored Waveform

(1) **Enter the operation menu:** Press ⟨Λν⟩ →Editable Wform →Edit Wform.

(2) Enter the storage path of the desired waveform file. Press the ▲ / ▼ / ◄ / ► direction key to select the desired waveform file.

(3) Choose OK, and then choose Delete.

To Generate the Modulated Waveform

Use the **Mod** button to generate modulated waveform. AG4151 can modulate waveform using AM, FM, PM, FSK and PWM.

AM (Amplitude Modulation)

The modulated waveform consists of two parts: the Carrier Waveform and the Modulating Waveform. The Carrier Waveform can only be Sine. In AM, the amplitude of the Carrier

Waveform varies with the instantaneous voltage of the modulating waveform. The user interface of the AM is shown as below.

Figure 5-14: The User Interface of AM

How to set the parameters of AM

(1) Press **Mod** function button to enter the Modulation mode.

(2) Press **F1** to switch Mod Type to AM. If the Carrier Waveform is not Sine, the system will switch it to Sine automatically.

(3) Press ⎍ button to display the waveform and parameters of the Carrier Waveform. You can change the parameters, please refer to "*To Output Sine Signals*" on P11. Press ⎍ button again to return to the Modulation mode interface.

(4) Press **F5** to select the source. If the source is External, use the **Modulation In** connector in the rear panel to input the external signal, the setting of AM is finished. If you choose Internal, continue to the steps below.

(5) Press **F2** to choose Mod Shape, you can choose Sine, Square or Ramp.

(6) Press **F3** to set AM Frequency. The range is 1μHz～20KHz (Internal source only).

(7) Press **F4** to set Mod Depth. The range is 0%～100%.

Term Explanation

AM Frequency:
The frequency of modulating waveform.

Mod Depth:
The Amplitude Range of modulating waveform. In the 0% Modulation, the output amplitude is the half of the set one. In the 100％ Modulation, the output amplitude is the same with the set one. For an external source, the depth of AM is controlled by the voltage level of the signal connected to the **Modulation In** connector in the rear panel. +5V corresponds to the currently set depth 100%.

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FM (Frequency Modulation)

The modulated waveform consists of two parts: the Carrier Waveform and the Modulating Waveform. The Carrier Waveform can only be Sine. In FM, the frequency of the Carrier Waveform varies with the instantaneous voltage of the modulating waveform. The user interface of the FM is shown as below.
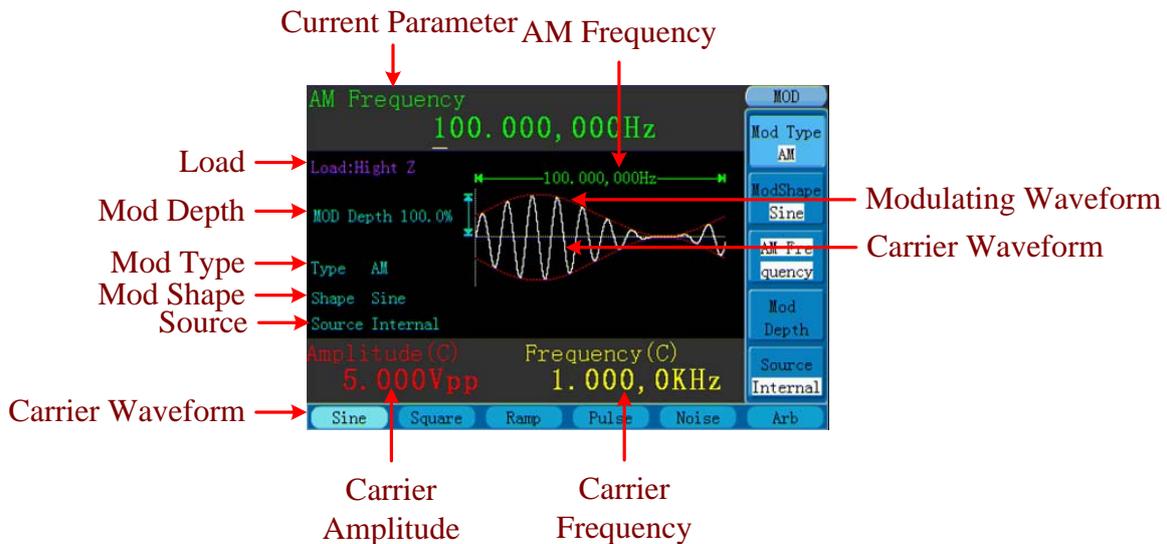

Figure 5-15: The User Interface of FM

How to set the parameters of FM

(1) Press **Mod** function button to enter the Modulation mode.

(2) Press **F1** to switch Mod Type to FM. If the Carrier Waveform is not Sine, the system will switch it to Sine automatically.

(3) Press ⌒ button to display the waveform and parameters of the Carrier Waveform. You can change the parameters, please refer to "*To Output Sine Signals*" on P11. Press ⌒ button again to return to the Modulation mode interface.

(4) Press **F5** to select the source. If the source is External, use the **Modulation In** connector in the rear panel to input the external signal, then skip ahead to step (6). If you choose Internal, continue to the steps below.

(5) Press **F2** to choose Mod Shape, you can choose Sine, Square or Ramp.

(6) Press **F3** to set Mod Frequency. The range is 1μHz～20KHz (Internal source only).

(7) Press **F4** to set FM Deviation. The Deviation should be less than the Carrier Waveform Frequency.

Note:

The Sum of the Deviation and the Carrier Frequency should be equal to or less than maximum frequency of the selected function plus 1kHz.

For an External Source, the Deviation is controlled by the voltage Level of the signal connected to the **Modulation In** connector in the rear panel. +5V corresponds to the selected Deviation and -5V to the negative selected Deviation.

PM (Phase Modulation)

The modulated waveform consists of two parts: the Carrier Waveform and the Modulating Waveform. The Carrier Waveform can only be Sine. In PM, the phase of the Carrier Waveform varies with the instantaneous voltage level of the modulating waveform. The user interface of the PM is shown as below.
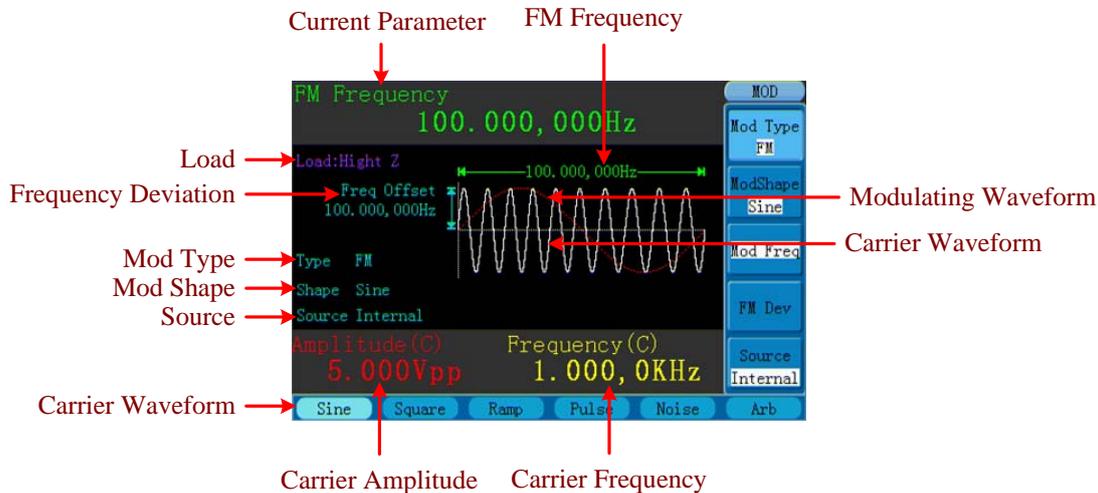

Figure 5-16: The User Interface of PM

How to set the parameters of PM

(1) Press **Mod** function button to enter the Modulation mode.

(2) Press **F1** to switch Mod Type to PM. If the Carrier Waveform is not Sine, the system will switch it to Sine automatically.

(3) Press ⌒ button to display the waveform and parameters of the Carrier Waveform. You can change the parameters, please refer to "*To Output Sine Signals*" on P11. Press ⌒ button again to return to the Modulation mode interface.

(4) Press **F5** to select the source. If the source is External, use the **Modulation In** connector in the rear panel to input the external signal, then skip ahead to step (6). If you choose Internal, continue to the steps below.

(5) Press **F2** to choose Mod Shape, you can choose Sine, Square or Ramp.

(6) Press **F3** to set PM Frequency. The range is 1μHz～20KHz (Internal source only).

(7) Press **F4** to set Phase Deviation. The Phase Deviation between the Modulating

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Waveform and the Carrier Waveform ranging from 0° to 180°.

FSK (Frequency Shift Keying)

The FSK Modulation is a modulation method, the output frequency of which switches between two the pre-set frequencies (Carrier Waveform Frequency and the Hop Frequency). The Frequency of the Output Frequency switch between the carrier waveform frequency and the Hop frequency is called the **FSK rate**. The frequency by which the output frequency switch from each other is determined by the Internal Frequency generator or the Signal Voltage Level offered by the **Ext Trig/FSK/Burst** connector in the rear panel. The Carrier Waveform can only be Sine. The user interface of the FSK is shown as below.
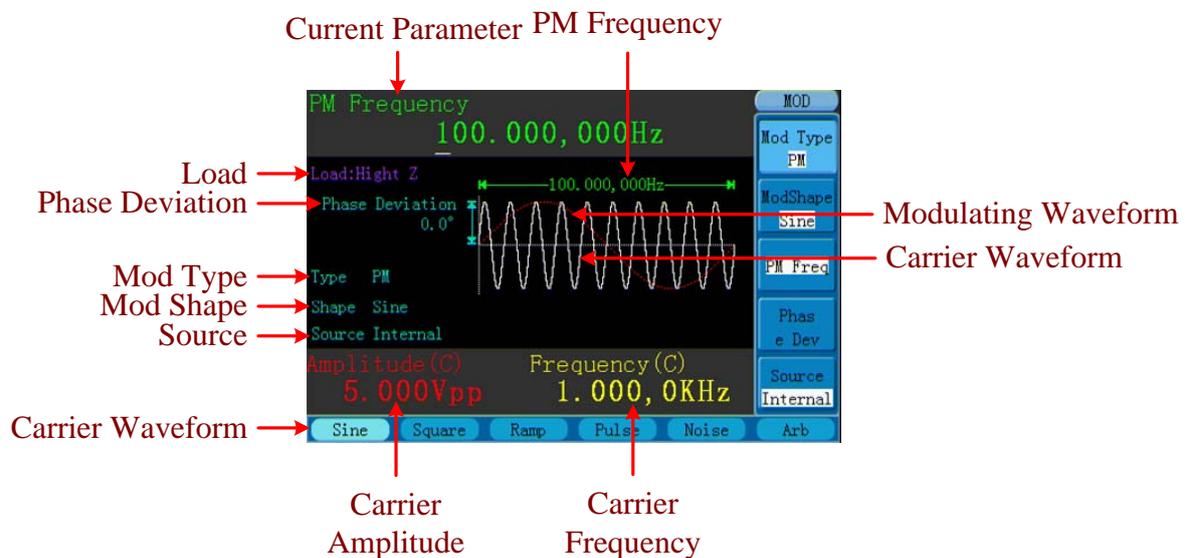

Figure 5-17: The User Interface of FSK

How to set the parameters of FSK

(1) Press **Mod** function button to enter the Modulation mode.

(2) Press **F1** to switch Mod Type to FSK. If the Carrier Waveform is not Sine, the system will switch it to Sine automatically.

(3) Press ⌒ button to display the waveform and parameters of the Carrier Waveform. You can change the parameters, please refer to "*To Output Sine Signals*" on P11. Press ⌒ button again to return to the Modulation mode interface.

(4) Press **F5** to select the source. If the source is External, use the **Ext Trig/FSK/Burst** connector in the rear panel to input the external signal, then skip ahead to step (5). If you choose Internal, continue to the steps below.

(5) Press **F3** to set FSK Rate. The range is 1μHz～100KHz (Internal source only).

(6) Press **F4** to set Hop Frequency. The range is 1μHz～25KHz.

Term Explanation

FSK Rate:
The frequency at which the output frequency shifts between the carrier frequency and the Hop frequency (Internal Modulation only).

PWM (Pulse Width Modulation)

The modulated waveform consists of two parts: the Carrier Waveform and the Modulating Waveform. PWM can only be used for pulse modulation, so the Carrier Waveform must be Pulse. In PWM, the width of the Carrier Waveform (Pulse) varies with the instantaneous voltage of the modulating waveform. The user interface of the PWM is shown as below.
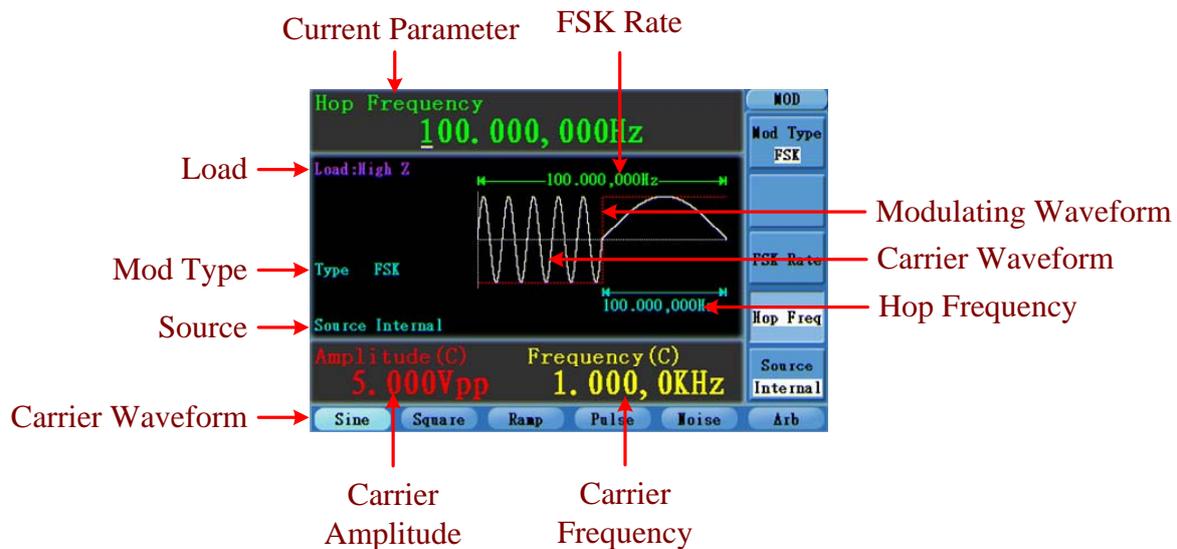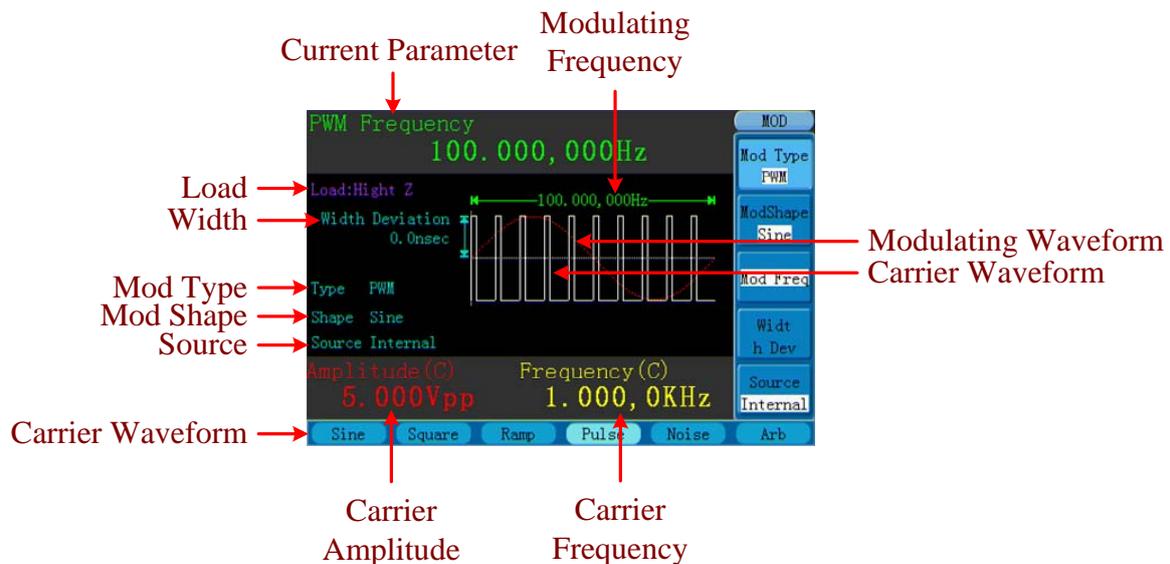

Figure 5-18: The User Interface of PWM

How to set the parameters of PWM

(1) Press **Mod** function button to enter the Modulation mode.

(2) Press **F1** to switch Mod Type to PWM. If the Carrier Waveform is not Pulse, the system will switch it to Pulse automatically.

(3) Press ⎍ button to display the waveform and parameters of the Carrier Waveform. You can change the parameters, please refer to "*To Output Pulse Signals*" on P15. Press ⎍ button again to return to the Modulation mode interface.

(4) Press **F5** to select the source. If the source is External, use the **Modulation In** connector in the rear panel to input the external signal, then skip ahead to step (6). If you choose Internal, continue to the steps below.

(5) Press **F2** to choose Mod Shape, you can choose Sine, Square or Ramp.

(6) Press **F3** to set Mod Frequency. The range is 1μHz～20KHz (Internal source only).

(7) Press **F4** to set Width Deviation/Duty Deviation (depends on the P_Width/Duty

menu item of the Pulse setting menu when you exit the Modulation mode). The maximum range of the Duty Deviation is the smaller one in [Pulse Duty, 1-Pulse Duty]. The maximum range of the Width Deviation is Pulse Width.

To Generate Sweep

In the frequency sweep mode, the generator "steps" from the start frequency to the stop frequency at the sweep rate you specify. Sweep can be generated by Sine, Square or Ramp Waveforms.
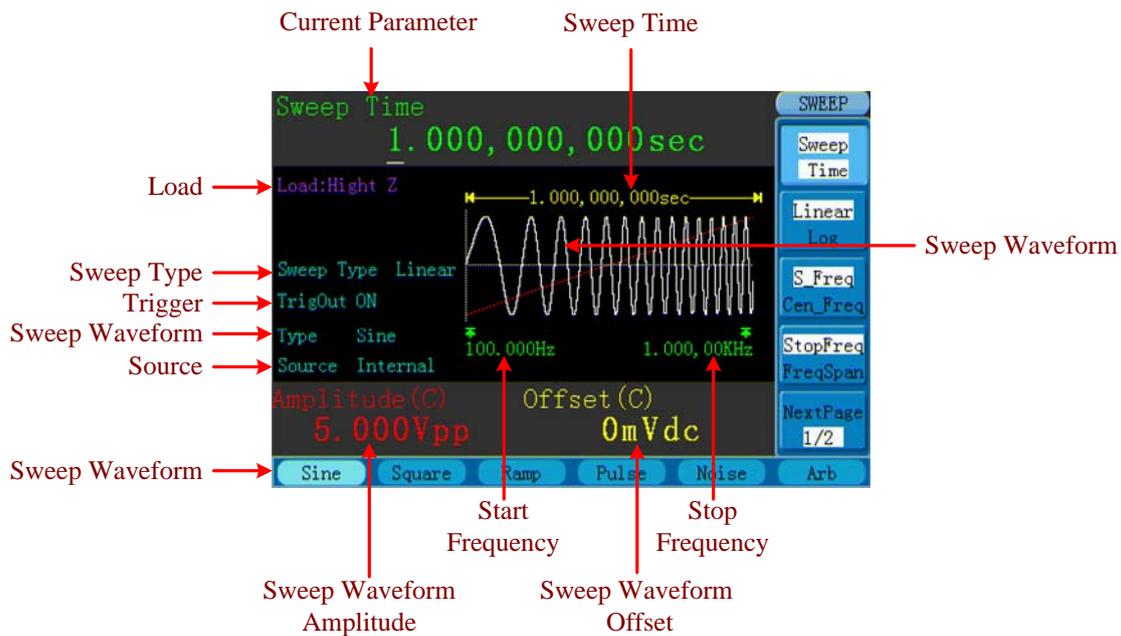
Figure 5-19: The User Interface of Sweep Mode

How to set the parameters of Sweep

(1) When the output signal is Sine, Square or Ramp waveform, press Sweep function button to enter the Sweep mode.

(2) Press ∿ , ⊓ or ∿ button to choose the waveforms. Take Sine for instance, press ∿ to display the waveform and parameters. You can change the parameters, please refer to "*To set signals*" on P11. Press ∿ button again to return to the Sweep mode interface.

(3) Press F1 to set Sweep Time, the Time Span of the Sweep for which the Frequency changes from the Start Frequency to Stop Frequency.

(4) Press F2 to select the Sweep Type. Linear means setting the Sweep with linear spacing; Log means setting the Sweep with logarithmic spacing.

(5) Use Start Freq and Stop Freq or Center Freq and Freq Span to set the range of the frequency. Press F3 to select Sta_Freq or Cen_Freq, and set the desired value.

(6) Press $\boxed{\textbf{F4}}$ to select StopFreq or FreqSpan, and set the desired value.

(7) Press $\boxed{\textbf{F5}}$ to select NextPage, press it again to enter the next page.

(8) Press $\boxed{\textbf{F1}}$ to select the source. Internal means using the internal source. External means using the **Ext Trig/FSK/Burst** connector in the rear panel to input the external signal. Manual means using the external source, set the start and stop time by hand.

To Generate Burst

Using Burst function button can generate versatile waveforms in burst. Burst can last for certain times of waveform cycle (N-Cycle Burst), or to be controlled by external gated signals (Gated Burst). Bust can apply to Sine, Square, Ramp, Pulse and Arbitrary waveforms (Noise can not be used).

Note:
For a burst, the maximum frequency of the used waveform is 25MHz. After pressing the Burst function button, if the frequency is greater than 25MHz, the generator will adjust it to 25MHz automatically.

Term Explanation

Burst:
Output Waveforms with set cycle times. Generally it is called BURST function within every Signal Generator.

N-Cycle Burst:
N-Cycle has specific number of waveform cycles, and every burst is activated by a trigger event.

Gated Burst:
Gated burst use external source to control burst as when to be activated.

Set the N-Cycle Burst

Figure 5-20: The User Interface of N-Cycle Burst

(1) When the output signal is Sine, Square, Ramp, Pulse or Arbitrary waveform, press **Burst** function button to enter the Burst mode.

(2) Press ⟨∿⟩, ⟨⊓⟩, ⟨∧⟩, ⟨⎍⟩ or ⟨∿⟩ button to choose the waveform. Take Sine for instance, press ⟨∿⟩ to display the waveform and parameters. You can change the parameters, please refer to "*To set signals*" on P11. Press ⟨∿⟩ button again to return to the Burst mode interface.

(3) Press **F4** to switch to N Cycle.

(4) Press **F1** to select Burst Period, set it to the desired value.

(5) Press **F3** to select Start Phase, define the Start and the Stop Point in a waveform. The phase varies from -360° to +360°. For an Arbitrary Waveform, 0° is the first waveform point.

(6) Press **F2** to select Delay, set the Time Delay between the Trigger Input and the Start of the N-Cycle Burst. The minimum delay is a function of the specific burst period, and should always be greater than 0s.

(7) Press **F5** to select NextPage, press it again to enter the next page.

(8) Press **F1** to select Cycles or Infinite. Set the number of Waveform Cycle in an N-Cycle (from 1 to 50000). If you choose Infinite, then a continuous waveform will be generated which will not stop until a trigger event happens (**Trigger** button is pressed).

Note:
● If needed, Burst Period will increase to cater to the specific number of cycles.
● For an infinite-cycle Burst, External or Manual Trigger is needed to activate burst.

(9) Press **F2** to select the source. Internal means using the internal source. External means using the **Ext Trig/FSK/Burst** connector in the rear panel to input the external signal. Manual means using the external source, set the start and stop time by hand.

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Set the Gated Burst

Current Parameter

Load

Start Phase

Gated

Waveform

Source

Positive
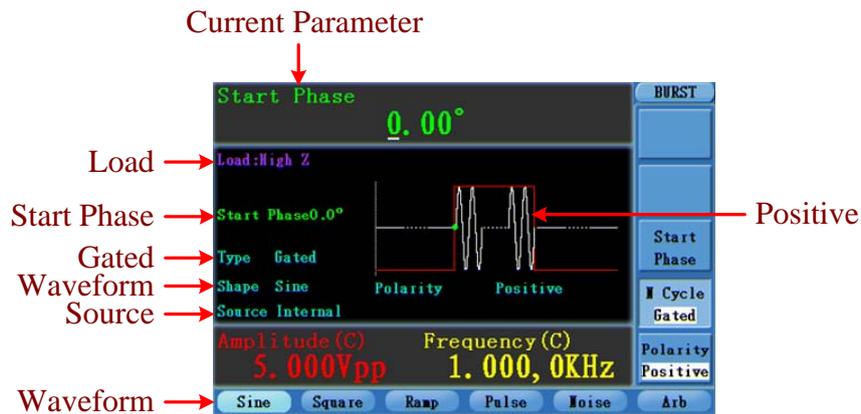
Waveform
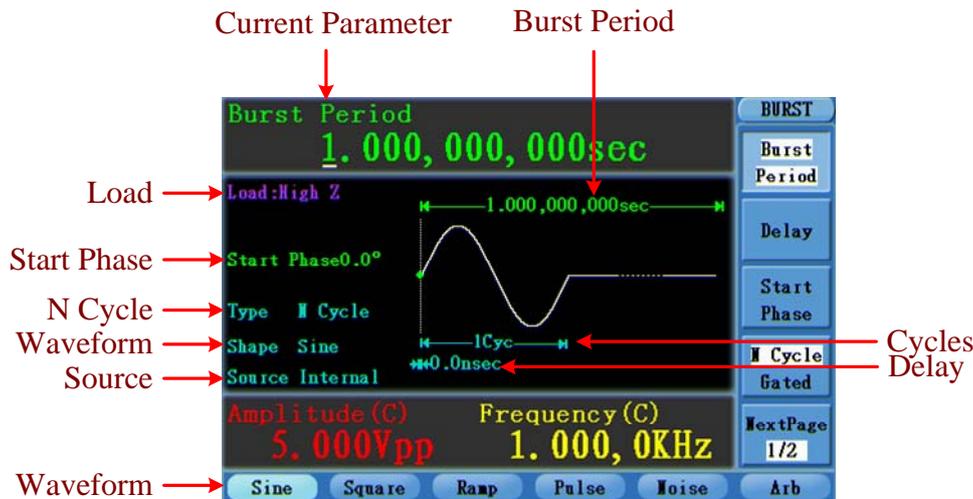
Figure 5-21: The User Interface of Gated Burst

(1) When the output signal is Sine, Square, Ramp, Pulse or Arbitrary waveform, press **Burst** function button to enter the Burst mode.

(2) Press ⏦, ⎍, ⫪, ⊔ or ⩘ button to choose the waveforms. Take Sine for instance, press ⏦ to display the waveform and parameters. You can change the parameters, please refer to "*To set signals*" on P11. Press ⏦ button again to return to the Burst mode interface.

(3) Press **F4** to switch to Gated.

(4) Press **F3** to select Start Phase, define the Start and the Stop Point in a waveform. The phase varies from -360° to +360°. For an Arbitrary Waveform, 0° is the first waveform point.

(5) Press **F5** to switch between Positive/Negative. Set the Polarity for the Gated Signal.

To Save and Recall

Press **Save** function button to enter the file system.

To Use USB Storage

The storage location is divided into the internal storage (FLASH) and the U disk storage (USBDEVICE). When a U disk is connected, the storage menu will show "USBDEVICE" and "FLASH". Otherwise, the storage menu will show "FLASH" only.

(1) **Install the U disk**: insert a USB disk into the "⑩**USB Host port**" on the rear panel in *Figure 4-2*, and the screen will show "Detect USB device". Press **Save** function button to enter the file system, the storage menu will show "USBDEVICE" and "FLASH".

(2) **Enter the storage**: Press the ◀ / ▶ direction key to choose the desired storage. Press **F1** to enter the chosen storage.

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(3) **Remove the U disk**: Remove the U disk from the **USB Host port** on the rear panel. The system will inform you "The USB device is removed", and the "USBDEVICE" in the storage menu will disappear.

To Edit the File Name

In file system, the user can edit the name of a file or a folder. When the system needs the user to input a name, an input keyboard will appear.

Figure 5-22: Edit the File Name

(1) Turn the knob or press the ◄ / ► direction key to move the cursor left and right in the keyboard; press the ▲ / ▼ direction key to move the cursor up and down. Press **F3** to switch between capital and small of the characters.

(2) Press **F1** to enter the current character. Press **F2** to delete the last character .

(3) Press **F4** to finish editing and save the file. Press **F5** to cancel the save operation.

Note: The length of file name is up to 15 characters.

To Set the Utility Function

Press **Utility** function key to enter the Utility Menu. You can set the parameters of the Generator such as: Display Parameter, Output Parameter, Interface Parameter and System Setting. Press **Utility** again to exit the Utility Menu.
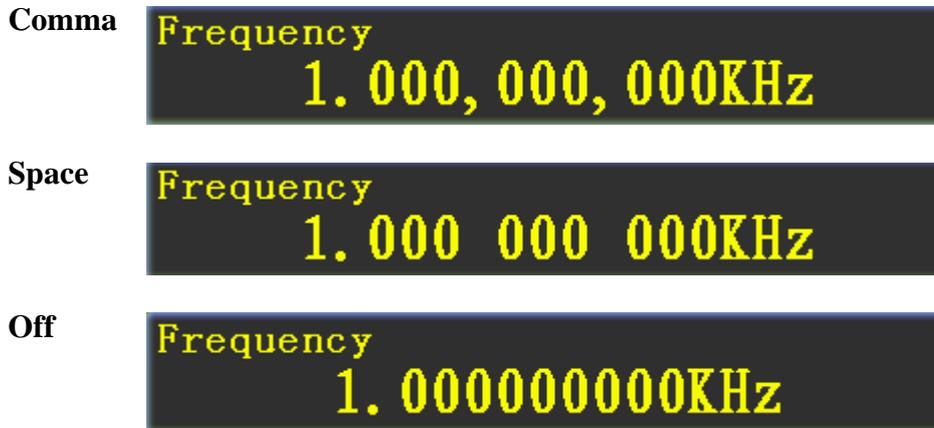
To Set Display Parameter

To Set the Bright

(1) Press **Utility** and choose **Disp Setup**, press **F1** to select Bright.

(2) Turn the **knob** to change the value; or press the number keys to input the desired value in percent, press **F4** to select the unit. The bright range is 0%～100%.

To Set the Separator

The user can set the separator of the displayed parameter.

(1) Press **Utility** and choose **Disp Setup**, press **F2** to select Sep.

(2) Press **F2** to switch between Comma, Space, Off.

Take the Frequency parameter for instance:

Comma

```
Frequency
        1.000,000,000KHz
```

Space

```
Frequency
        1.000 000 000KHz
```

Off

```
Frequency
        1.000000000KHz
```

To Set the Screen Saver

The screen saver will run automatically if no operation is taken for any key within the set time. Press any button to resume.

(1) Press **Utility** and choose **Disp Setup**, press **F3** to select Scrn Svr.

(2) Press **F3** to switch between On/Off.

(3) If On is selected, you can set the screen saver time. Turn the **knob** to change the value; or press the number keys to input the desired time in minutes, press **F4** to select the unit. The screen saver time range is 1～999 minutes.

To Set Output Parameter

To Set the Output Load

For the **Main output terminal** on the Front panel, the Generator has a built-in 50Ωseries impendence. If the actual load does not match the set one, the displayed amplitude and offset are incorrect. This function is used to match the displayed voltage with the expected one.

Steps for setting the Load:

(1) Press **Utility** and choose **Output Setup**, press **F1** to select HighZ or *Ω ("*" represents a value).

(2) To change the load value, after selecting *Ω, turn the **knob** to change it directly; or press the number keys to input the desired value. Press **F3** or **F4** to select the unit. The load range is 1Ω～10KΩ.

Note:

AG4151 has a fixed 50Ω Series Impendence. No matter what Value the set parameter is, if the real load is different from the set one, the displayed voltage will not equal the real voltage.

To Set the Sync Output

The Generator provides Sync output through the **Sync output terminal** on the Front Panel. All standard output functions (except DC and Noise) have a corresponding Sync Signal. For some Sync applications, they can be disabled if users do not want to use them.

Steps for setting the Sync Output:

(1) Press **Utility** and choose **Output Setup**, press ⬚ F2 ⬚ to select Sync.

(2) Press ⬚ F2 ⬚ to switch between On/Off. On is to activate the Sync Signal on the **Sync output terminal** on the front panel. Off is to deactivate it, the output Voltage of the **Sync output terminal** is Level Low.

Note:

When the amplitude is relatively low, disabling Sync Signal can reduce the distortion in output.

The Instructions of the Sync Signal in certain situations:

● In the Inverse Mode, the Waveform that corresponds to the Sync Signal does not Inverse.

● For Sine, Square, Ramp and Pulse Signal, the Sync Signal is a Square Signal with 50% Duty Cycle. When the output is positive, The Sync Signal is TTL Level High compared to 0 V Voltage or DC Offset; when the output is negative, The Sync Signal is TTL Level Low compared to 0 V Voltage or DC Offset.

● For Arbitrary Waveform, the Sync Signal is a Square Waveform with 50% Duty Cycle. At the time when the first output waveform point is generated, the Sync Signal Voltage is TTL Level High.

● For Internal Modulating AM, FM, PM and PWM, the Sync Signal reference is the Modulated Signal (not the Carrier Signal). The Sync Signal is a Square Waveform with 50% Duty Cycle. In the first half modulation period, the Sync Signal is TTL Level High. For External Modulation, the Sync Signal reference is the Carrier Signal (not the Modulated Signal). The Sync Signal is also a Square Waveform with 50% Duty Cycle.

● For FSK, the Sync Signal Reference is the Hop Frequency, and the Sync Signal is a Square Waveform with 50% Duty Cycle. For the Hop Frequency, at the hopping point, the Sync Signal is TTL Level High.

● For a Sweep which disables the Mark function, the Sync Signal is a Square Waveform with 50% Duty Cycle. When the Sweep starts, the Sync Signal is TTL Level High and turns Low at the Center of the Sweep. The Sync Frequency equals the specific Sweep time. For a Sweep that enables the Mark Function, the Sync Signal is TTL Level High at the beginning of the Sweep and turns Low at the Mark Frequency.

● For the Burst, when the burst starts, the Sync Signal is Level High. At the specific point when the Cycle Number ends, the Sync Signal turns Level Low (If the Waveform has a relative starting phase, it may be not zero intersections). For an infinite burst, the Sync Signal is the same with the Sync Signal of the continuous Signal.

● For the External Gated Burst, the Sync Signal follows the External Gated Signal. But, please note that this signal will not turn Level Low until the end of the last period (If the Waveform has a relative starting phase, it may be not zero intersections).

To Set the DC Output

(1) Press **Utility** and choose **Output Setup**, press F3 to select DC.
(2) Press F3 to switch between On/Off.
(3) If On is selected, you can set the DC voltage. Turn the **knob** to change the value; or press the number keys to input the desired value, press F1 or F2 to select the unit.
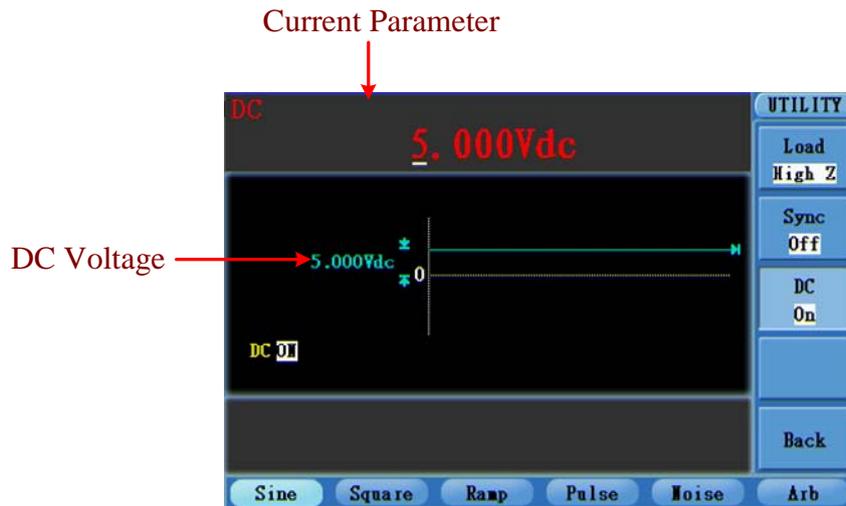
Figure 5-23: The DC Setting Interface

To Set the I/O

To Set the Baud Rate

Press **Utility** and choose **I/O Setup**, press F1 to choose BaudRate, press F1 to switch the RS232 baud rate.

Make sure that the Baud Rate matches that of the computer. The optional rates are: 115.2K, 56K, 38.4K, 9.6K and 4.8K. The default setting is 115.2K.

To Set the LAN

Press **Utility** and choose **I/O Setup**, press F2 to choose LAN, enter the submenu.
Press F1 to set IP Addr, the range of each byte is 1～255.
Press F2 to set Port, the range is 1～4000.
Press F3 to set GateWay, the range of each byte is 1～255.
Setting method: Turn the **knob** to change the value of cursor position in the Parameter bar. Press the ◄ / ► direction key to move the cursor.
After setting, wait a few seconds (saving the parameters requires some time), and restart the waveform generator so that the new setting can be applied.
About the application of this setting, please refer to "*Using LAN Port*" on P37.

To Set the System

Language Setting

Press **Utility** and choose **System**, press **F1** to switch between English/Chinese.

Power On Setting

(1) Press **Utility** and choose **System**, press **F2** to select Power On.
(2) Press **F2** to switch between Default/Last. Default means that all the settings return to default when powered. Last means that all the settings return to the last one when powered.

To Return to Default Setting

Press **Utility** and choose **System**, press **F3** to select Set to Default. All the settings will be set to default. The default settings of the system are as follows:

Output	Default
Function	Sine Wave
Frequency	1kHz
Amplitude/Offset	1 Vpp / 0 Vdc
Terminals	High Z

Modulation	Default
Carrier	1kHz　Sine Wave
Modulating	100Hz Sine Wave
AM Depth	100％
FM Deviation	100Hz
PM Phase Deviation	0°
FSK Hop Frequency	100Hz
FSK Frequency	100Hz
PWM Width Deviation / Duty Deviation	0ns/0%
Source	Internal

Sweep	Default
Start/Stop Frequency	100Hz/1kHz
Time	1 sec
Mode	Linear

Burst	Default
Frequency	1kHz
Count	1 Cycle
Period	1 sec
Phase	0°
延迟	0ns

I/O Configuration	Default
I/O	GPIB（IEEE－488）
Baud Rate	115200 bps
Parity	No (8 bits)
IP Address	192.168.1.99
Port	3000
Gate Way	192.168.1.1

Others	Default
Source	Internal
Signal Output Switch	Off
Sync Signal Output	Off
DC Voltage	0V

To Set the Beep

(1) Press **Utility** and choose **System**, press **F4** to enter the second page of the menu.

(2) Press **F1** to select Beep.

(3) Press **F1** to switch between On/Off. On is to activate the sound when the system informs you. Off is to deactivate it.

View System Information

(1) Press **Utility** and choose **System**, press **F4** to enter the second page of the menu.

(2) Press **F2** to select Sys info. You can view the Version and Serial Number.

To Set the Clock Source

AG4151 provides a 20 MHz internal clock source and also accepts external clock source input from the [20MHz In] connector at the rear panel. It can also output a 20 MHz clock source from the [20MHz Out] connector for other device to use.

Note:
The amplitude of the [20MHz In] input signal must be over 1V.

(1) Press **Utility** and choose **System**, press $\boxed{\textbf{F4}}$ to enter the second page of the menu.

(2) Press $\boxed{\textbf{F3}}$ to select Clock.

(3) Press $\boxed{\textbf{F3}}$ to switch between Internal/External.

To Use Built-in Help

(1) Press **Help** function button, the catalog will display in the screen.

(2) Press $\boxed{\textbf{F1}}$ or $\boxed{\textbf{F2}}$ to choose help topic, or just turn the **knob** to choose.

(3) Press $\boxed{\textbf{F3}}$ to view the details about the topic; press $\boxed{\textbf{F5}}$ to go back to the catalog.

(4) Press **Help** again to exit the help, or just do other operations.

6. Communication with PC

AG4151 Waveform Generator supports communications with a PC through USB, LAN or COM port. You can use the ultrawave communication software to set the parameters, control the output of the Waveform Generator, and synchronously display the screen of the Waveform Generator.

Here is how to connect with PC. First, install the ultrawave communication software on the supplied CD. Then there are several ways of connection to choose from.

Using USB Port

(1) **Connection:** Use a USB data cable to connect the **USB Device port** in the rear panel of the Waveform Generator to the USB port of a PC.
(2) **Install the driver:** When the Waveform Generator is turned on, a dialog will appear on the PC screen and guide you to install the USB driver. The driver is in the "USBDRV" folder under the directory where the ultrawave communication software is installed, such as "C:\Program Files\OWON\ultrawave\USBDRV".
(3) **Port setting of the software:** Run the ultrawave software; click the "MENU" button in the top right corner. Choose "Ports-Settings", in the setting dialog, choose "Connect using" as "USB". After connect successfully, the connection information in the bottom right corner of the software will turn green.

Figure 6-1: Connect with PC through USB port

Using LAN Port

How to connect with a computer directly:

(1) **Connection**. Plug in the LAN cable to the LAN port in the rear panel of the Waveform Generator; plug the other end into the interface of the computer.
(2) **Set the network parameters of the computer**. Since the Waveform Generator can

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not support obtaining an IP address automatically, you should assign a static IP address. Here we set the IP address to 192.168.1.71.

Figure 6-2: Set the network parameters of the computer

(3) **Set the network parameters of the ultrawave software.** Run the software on the computer, choose the "Ports-settings" of the "MENU". Set "Connect using" to LAN. About the IP, the first three bytes is same as the IP in the step (2), the last byte should be different. Here, we set it to 192.168.1.99. The range of the port value is 0～4000, but the port which under 2000 is always be used, so it is suggested to set it to the value above 2000. Here, we set it to 3000.

Figure 6-3: Set the network parameters of the ultrawave software

(4) **Set the network parameters of the Waveform Generator**. In the Waveform Generator, press **Utility** and choose **I/O Setup**, press **F2** to choose LAN, enter the submenu. Set the **IP Addr** and the **Port** to the same value as the "Ports-settings" in the software in step (3). About the setting method, please refer to "*To Set the LAN*" on P33. After restarting the Waveform Generator, if you can get data normally in the

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ultrawave software, the connection is successful.

How to connect with the computer through a router:

(1) **Connection**. Use a LAN cable to connect the Waveform Generator with a router, the LAN port of the Waveform Generator is in the rear panel; the computer should be connected to the router too.

(2) **Set the network parameters of the computer**. Since the Waveform Generator can not support obtaining an IP address automatically, you should assign a static IP address. The Default gateway and Subnet mask should be set according to the router. Here we set the IP address to 192.168.1.71, Subnet mask is 255.255.255.0, Default gateway is 192.168.1.1.
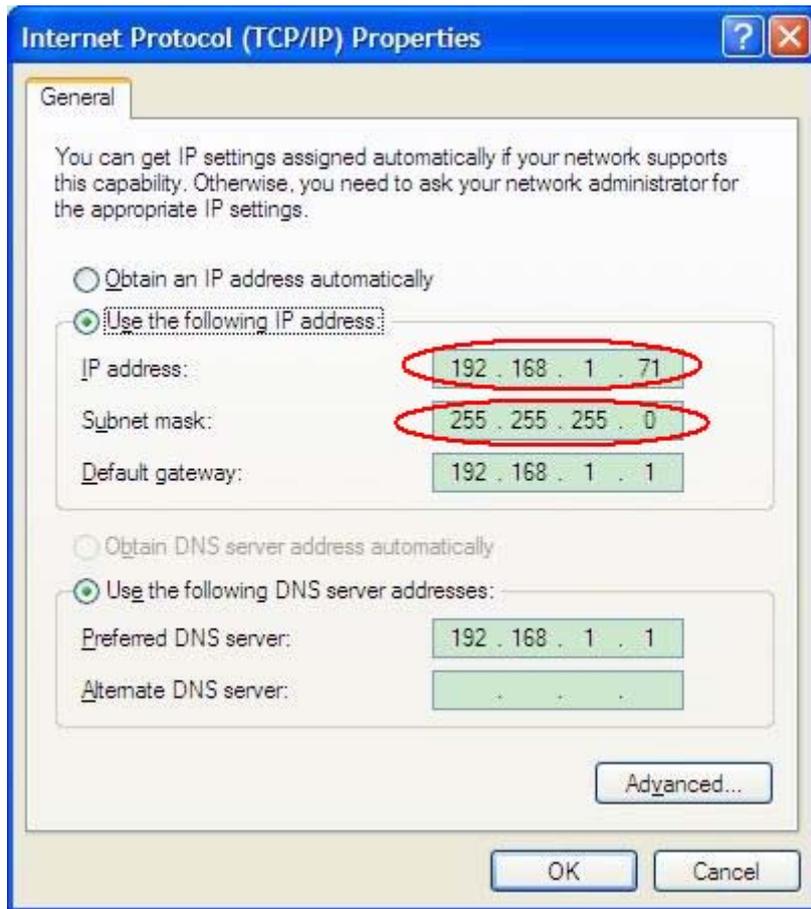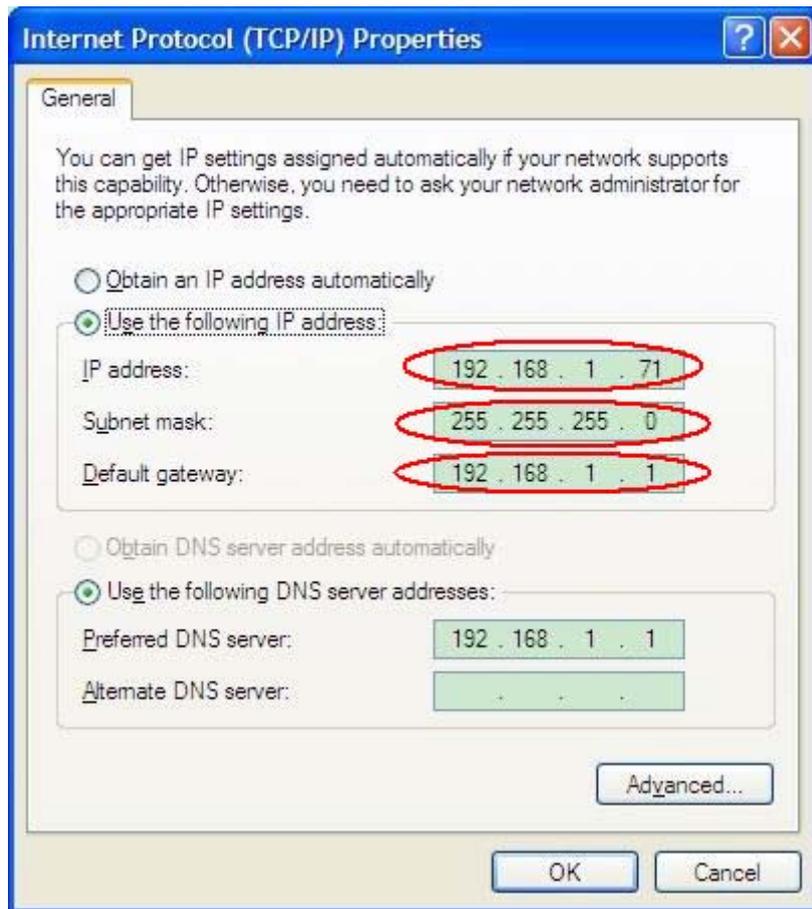

Figure 6-4: Set the network parameters of the computer

(3) **Set the network parameters of the ultrawave software.** Run the software on the computer; choose the "Ports-settings" of the "MENU". Set "Connect using" to LAN. About the IP, the first three bytes is same as the IP in the step (2), the last byte should be different. Here, we set it to 192.168.1.99. The range of the port value is 0～4000, but the port which under 2000 is always be used, so it is suggested to set it to the value above 2000. Here, we set it to 3000.
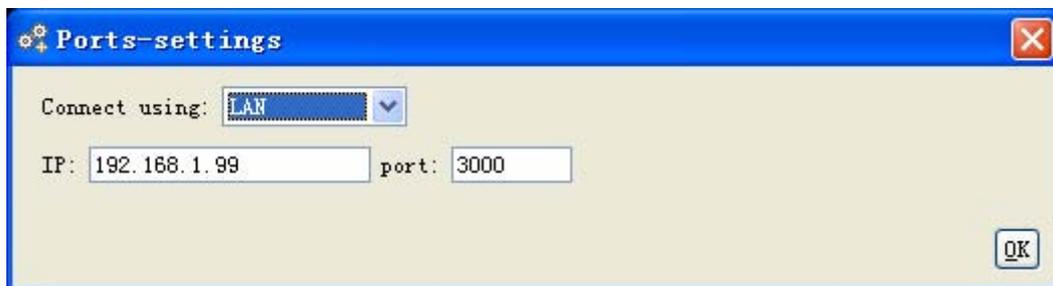
Figure 6-5: Set the network parameters of the ultrawave software

(4) **Set the network parameters of the Waveform Generator**. In the Waveform Generator, press **Utility** and choose **I/O Setup**, press **F2** to choose LAN, enter the submenu. Set the **IP Addr** and the **Port** to the same value as the "Ports-settings" in the software in step (3). The GateWay should be set according to the router. About the setting method, please refer to "*To Set the LAN*" on P33. After restarting the Waveform Generator, if you can get data normally in the ultrawave software, the connection is successful.

Using COM Port

(1) **Connection**. Use a data cable to connect the **COM port** in the rear panel of the Waveform Generator, to the COM port of a PC.
(2) **Port setting of the software:** Run the ultrawave software; click the "MENU" button in the top right corner. Choose "Ports-Settings", in the setting dialog, choose "Connect using" as COM.

To learn about how to operate the software, you can choose "MENU → Help" in the software to open the help file.

7. Troubleshooting

1. **The instrument is powered on but no Display.**

   - Check if the power is connected properly.
   - Check if the Power Switch is in the proper voltage scale.
   - Check if the fuse which is below the AC Power socket is used appropriately and in good condition (the cover can be pried open with a straight screwdriver).
   - Restart the instrument after the steps above.
   - If the problem still exists, please contact **Lilliput** for our service.

2. **The measured value of output signal amplitude disaccords to the displayed value:**

   Check if the actual load matches the set one. Please refer to "*To Set the Output Load*" on P31.

3. **The Sync output terminal does not output Sync Signal:**

   Check if the Sync Output switch is activated, and check if the current output signal has a corresponding Sync Signal. Please refer to "*To Set the Sync Output*" on P32 for more details.

If you encounter other problems, try to reset the settings (refer to "*To Return to Default Setting*" on P34) or restart the instrument. If it still can not work properly, please contact **Lilliput** for our service.

8. Technical Specifications

All these specifications apply to the AG4151 Waveform Generator unless otherwise explanation. To reach these specifications, the instrument must have been operating continuously for more than 30 minutes within the specified operating temperature.

All the specifications are guaranteed unless those marked with "typical".

Waveforms	
Standard Waveforms	Sine, Square, Ramp, Pulse, White Noise
Arbitrary Waveforms	Exponential Rise, Exponential Fall, Sin(x)/x, DC, 32 channels digital waveform, User-Definable Waveform

Frequency Characteristic (Max sampling rate 400MSa/s, frequency resolution 32bits)	
Sine	1 μHz—150MHz
Square	1 μHz—50MHz
Ramp	1 μHz—1MHz
Pulse	1 μHz—25MHz
White Noise	50MHz
Arbitrary	1 μHz—10MHz

Amplitude Characteristic	
Output Amplitude	10mVPP-10VPP (50Ω) 20mVPP-20VPP (High Z)
Amplitude Accuracy	1mVPP or 14 bits
DC Offset Range (AC+DC)	±5V (50Ω) ±10V (High Z)
DC Offset Accuracy	1mV
Output Impedance	50Ω (typical)

Waveform Characteristic	
Sine	
Flatness (when the Amplitude is 1.0 Vp-p (+4 dBm), relative to 100 kHz)	<5 MHz: ±0.15 dB 5 MHz to 25 MHz：±0.3 dB 25 MHz to 100 MHz：±0.5 dB 100MHz to 150 MHz：±1 dB
Harmonic Distortion (when the Amplitude is 1.0 Vp-p)	10 Hz to 1 MHz：<-60 dBc 1 MHz to 5 MHz：<-50 dBc 5 MHz to 25 MHz：<-37 dBc 25 MHz to 150 MHz：<-30 dBc
Total Harmonic Distortion (when the Amplitude is 1 Vp-p)	10 Hz to 20 kHz： <0.2 %

Phase Noise (when the Amplitude is 1 Vp-p)	20 MHz：<10 kHz offset -110 dBc/Hz (typical)
Residue Clock Noise	-57 dBm (typical)
Square	
Rise/Fall Time	<10ns (10%～90%) (typical, 1kHz, 1Vpp)
Jitter (rms)	300ps + 100ppm of period (typical)
Non-symmetry (below 50% Duty Cycle)	1% of period+ 5ns
Overshoot	< 2%
Duty Cycle	20% ~ 80% (to 25 MHz) 50% (> 25 MHz)
Pulse	
Pulse Width	8 ns to 2000 s
Accuracy	1ns
Rising/Falling Edge Time	9ns to 1ms
Overshoot	< 2%
Jitter	300ps + 100ppm of the period
Ramp	
Linearity	< 0.1% of peak output (typical, 1kHz, 1Vpp, Symmetry 100%)
Symmetry	0% to 100%
Arbitrary	
Waveform Length	2 ~ 1M points
Sample Rate	200MSa/s
Amplitude Accuracy	14 bits
Minimum Rise/Fall Time	35ns (typical)
Jitter (RMS)	6 ns + 30ppm

Modulated Waveform	
AM	
Carrier Waveforms	Sine
Source	Internal/ External
Internal Modulating Waveforms	Sine, Square, Ramp, White Noise, Arbitrary
Internal Modulating Frequency	2 mHz ~ 20.00 kHz
Depth	0.0% ~ 100.0%
FM	
Carrier Waveforms	Sine
Source	Internal/ External
Internal Modulating Waveforms	Sine, Square, Ramp, White Noise, Arbitrary
Internal Modulating Frequency	2 mHz to 20.00 kHz
Frequency Deviation	DC to 50 MHz
PM	
Carrier Waveforms	Sine
Source	Internal/ External

Internal Modulating Waveforms	Sine, Square, Ramp, White Noise, Arbitrary
Internal Modulating Frequency	2 mHz to 20.00 kHz
Phase Deviation	0°～180°
FSK	
Carrier Waveforms	Sine
Source	Internal/ External
Internal Modulating Waveforms	50% duty cycle square
Internal Modulating Frequency	2 mHz to 1.000 MHz
PWM	
Carrier Waveforms	Pulse
Source	Internal/ External
Internal Modulating Waveforms	Sine, Square, Ramp, White Noise, Arbitrary
Internal Modulating Frequency	2 mHz to 20.00 kHz
Width Deviation	Pulse width 0% to 100%
Sweep	
Type	Linear, Logarithmic
Carrier Waveforms	Sine, Square, Ramp
Direction	Up / Down
Sweep Time	1 ms to 500 s ± 0.1%
Source	Source, External or Manual
Burst	
Waveforms	Sine, Square, Ramp, Pulse, Arbitrary
Types	Count (1 to 1,000,000 periods), infinite, gated
Start Phase	-360°～ +360°
Internal Period	1 μs – 300 s ± 1%
Gated Source	External Trigger
Trigger Sources	Source, External or Manual

Input/Output	
Rear Panel	
External Modulation Input	
Input Frequency Range	DC-20KHz
Input Voltage Range	± 5 Vpk
Input Impedance	10kΩ (typical)
External Trigger Input	
Level	TTL-compatible
Slope	Rising or falling (selectable)
Pulse Width	>100ns
Trigger Delay	0.0ns-60s
External Reference Clock Input	
Impedance	1 kΩ, AC coupled
Requested Input voltage swing	100 mVp-p to 5 Vp-p
locking range	20 MHz ± 35 kHz

External Reference Clock Output	
Impedance	50 kΩ, AC coupled
Amplitude	5 Vp-p, access 50Ω
Trigger Output	
Level	TTL-compatible
Output Impedance	50Ω (typical)
Pulse Width	>400ns (typical)

Display

Display Type	3.9 inch colored LCD (Liquid Crystal Display)
Display Resolution	480 (Horizontal) × 320 (Vertical) Pixels
Display Colors	65536 colors, 8 bits, TFT screen

Power

Supply	100-240 VACRMS, 50/60Hz, CATⅡ	
Consumption	Less than 50W	
Fuse	110V	125 V, F4AL
	220V	250 V, F2AL

Environment

Temperature	Working temperature: 0 ℃～40 ℃ Storage temperature: －20 ℃～60 ℃
Relative Humidity	≤ 90%
Height	Operating: 3,000 m Non-operating: 15,000 m
Cooling Method	Fan cooling

Mechanical Specifications

Dimension	235mm×110mm×295mm (W*H*D)
Weight	3 kg

Interval Period of Adjustment:

One year is recommended for the calibration interval period.

9. Appendix

Appendix A: Enclosure

Standard Accessories:

- A power cord that fits the standard of the destination country

- A USB cable

- A CD (PC link application software)

- A User Manual

- A BNC/Q9 cable

Appendix B: General Care and Cleaning

General Care

Do not store or leave the instrument where the liquid crystal display will be exposed to direct sunlight for long periods of time.

Caution: To avoid any damage to the instrument, do not exposed it to any sprays, liquids, or solvents.

Cleaning

Inspect the instrument as often as operating conditions require.
To clean the instrument exterior, perform the following steps:

1. Wipe the dust from the instrument surface with a soft cloth. Do not make any scuffing on the transparent LCD protection screen when clean the LCD screen.

2. Disconnect power before cleaning your instrument. Clean the instrument with a wet soft cloth not dripping water. It is recommended to scrub with soft detergent or fresh water. To avoid damage to the instrument, do not use any corrosive chemical cleaning agent.

⚠️ **Warning:** Before power on again for operation, it is required to confirm that the instrument has already been dried completely, avoiding any electrical short circuit or bodily injury resulting form the moisture.