User's Guide

DSO-5200A USB

PC Based Digital Oscilloscope

Operation Manual

Precautions for Safety

The following instructions are provided for safe and correct use of the product and to prevent a potentially dangerous situation or damage in advance. Be sure to read through them before you use the product.

Recommended Usage Environment

- The ambient temperature and relative humidity should be 0-40℃ and 10-80% respective for the normal operation of the product.

Power Source

- The USB terminal and DSO-5200A USB are connected via a USB cable for DC +5V power from the PC. The product does not require an outside power source.

Warning: Be careful not to input excessive power voltage

- The product's input power capacity is fixed as shown below to prevent electric shock and/or fire. Please DO NOT use voltage higher than that prescribed below.

  (Warning) Be sure to check the probe attenuation before measuring the voltage. The voltage that is higher than the maximum input voltage can cause damage to the device and you. In particular, there is the risk of an electric shock when measuring high voltage. So you need to pay extra attention not to have your hand touch the terminal.
- Please eliminate all unused probes or tester leads so that they do not come in contact with surrounding high voltage parts.
- Make sure that the PC's power source is grounded.

Handing Precautions

- The probe ground lead is at ground potential. Do not connect the ground lead to an elevated voltage. Connect the ground lead of the probe to earth ground only.
  If measuring the floating potential, we will recommend the measurement by the differential motion method using CH1 and CH2.
- Do not connect or disconnect the product with the probe or test lead which is connected to a voltage source.
- Do not attempt to operate the product at the situation that a risk of dysfunction or shock expected to happen.
- Stop using the product immediately when you notice something unusual about the smell, smoke or sound.
  And then remove the USB connection form your computer.
- Do not use the product with your hands wet. It can cause an electric shock.
- Do not try the product for the purposes other than those stated.

Usage Location

- If the products crevice is exposed to electric conductors (solids or liquids), the product will short circuit and possibly create dangers of electric shock or fire. Please keep this product away form humidity, water, or dust.
- DO NOT use this product near gas as well as other flammable and/or explosive materials.
- Store the product where direct sunlight can't reach.
- DO NOT use the product where it's dirty, other machines are operated, or there is a high level of electromagnetic waves.
- DO NOT place the product on an unstable cart, stand, or tripod. Such usage creates the dangers of accident and/or damage to product.

Hardware Specification

Input	
Max. sample rate	Real-time sampling: 250MS/s using one channel, 125MS/s Using two channels Equivalent sampling:50GS/s
Channels	2 Channels
Bandwidth	200MHz analog bandwidth
Vertical resolution	9 bits/channel
Gain range	10mV ~ 10V/div @ x1 probe(10mV, 20mV, 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V,10V/div1,2,5 sequence) 100mV ~ 100V/div @ x10 probe 1V ~ 1KV/div @ x100 probe 10V ~ 10KV/div @ x1000 probe
Range	8 divisions
Offset level	+/-4 divisions
Coupling	AC, DC ,GND
Offset increments	0.02 div
Impedance	1M ohm
DC accuracy	+/-3%
Input protection	35Vpk (DC + peak AC < 10 kHz, without external attenuation)
Display Mode	Y-T, X-Y
Timebase	
Timebase range	2ns/div ~ 1h/div(2ns,4ns, 10ns, 20ns, 40ns, 100ns, 200ns, 400ns, 1us, 2us, 4us, 10us, 20us, 40us, 100us, 200us, 400us, 1ms, 2ms, 4ms, 10ms, 20ms, 40ms, 100ms, 200ms, 400ms, 1s,2s, 4s,

	10s,20s,40s,10m,20m,40m,1h /div 1-2-4 sequence)
Acquisition mode	Equivalent sampling:2ns/div ~ 4us/div Real-time sampling: 10us /div ~ 400ms/div Roll mode: 1s/div ~ 1h/div
Range	10 divisions
Buffer size	10K ~1M samples
Trigger	
Mode	Auto, Normal and Single
Type	Edge trigger: Rising edge, falling edge.
Autoset	Yes
Range	10 divisions
Trigger level	+/-4 divisions
Settabillity	0.02 div increments
Math	
Measurements	Vp-p, Vmax, Vmin, Vmean, Vrms, Vamp, Vhigh, Vlow, positive overshoot, negative overshoot, cycle mean, cycle rms, period, frequency, positive pulse width, negative pulse width, rise time (10%~90%), fall time (10%~90%), positive duty cycle, negative duty cycle
Cursor	Time/frequency difference, voltage difference Frequency
Math	Addition, Subtraction, Multiplication, Division
FFT	Rectangular, Hanning, Hamming, Blackman Window
Physical	
Interface	USB2.0
Power	No external power source required. Bus-powered from USB
Dimensions	187 x100 x 33(mm)

Introduction

DSO-5200A USB developed by our company. is a portable PC-based Digital Oscilloscope.

High performance

DSO-5200A USB has the following features: 200MHz analog bandwidth, 250MHz real-time sampling.

USB connected

DSO-5200A USB uses USB that supports plug and play, with 12Mbp communication speed.

No external power required

DSO-5200A USB does not need an external power source, because it is bus-powered from USB

Easy to use

DSO-5200A USB is easy to use. It is intuitive and easy to understand.

Big screen

You can change DSO-5200A USB screen size as you need.

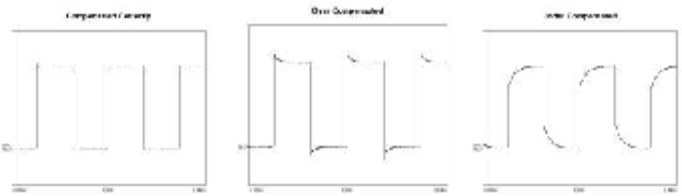
Probe Calibration

DSO-5200A USB Calibration

1. When manufactured, DSO-5200A USB is calibrated manually to obtain maximum performance.
2. You may calibrate DSO-5200A USB 5 or 6 months after purchase.

Probe Compensation

1. You must use a probe with more than 200MHz bandwidth to get undistorted signal.
2. Probe should be compensated whenever it is connected for the first time.
3. Connect calibration signal to channel 1 and push AUTOSET.
4. Check the shape of the displayed waveform.
5. Adjust the probe until the displayed waveform is compensated.



RIGOL

User's Guide

DG1022 Dual-Channel Arbitrary/Waveform Generator

Sept. 2011

RIGOL Technologies, Inc.

The Front/Rear Panel

When you get a new DG1022 Dual-Channel Function/Arbitrary Waveform Generator, first you need to know how to operate the front/ Rear panel correctly. This chapter will make a brief introduction and description for the operation and functions of the Front/ Rear Panel.

Front Panel at a Glance

DG1022 Generator has clear and simple front panel. The Front Panel has a knob, functional keys and menu buttons. The 6 grey buttons below the screen are menu buttons, by using which you can choose different options on the current menu. The rests are the functional keys, with which you can enter different function menus or obtain specific functional applications directly.

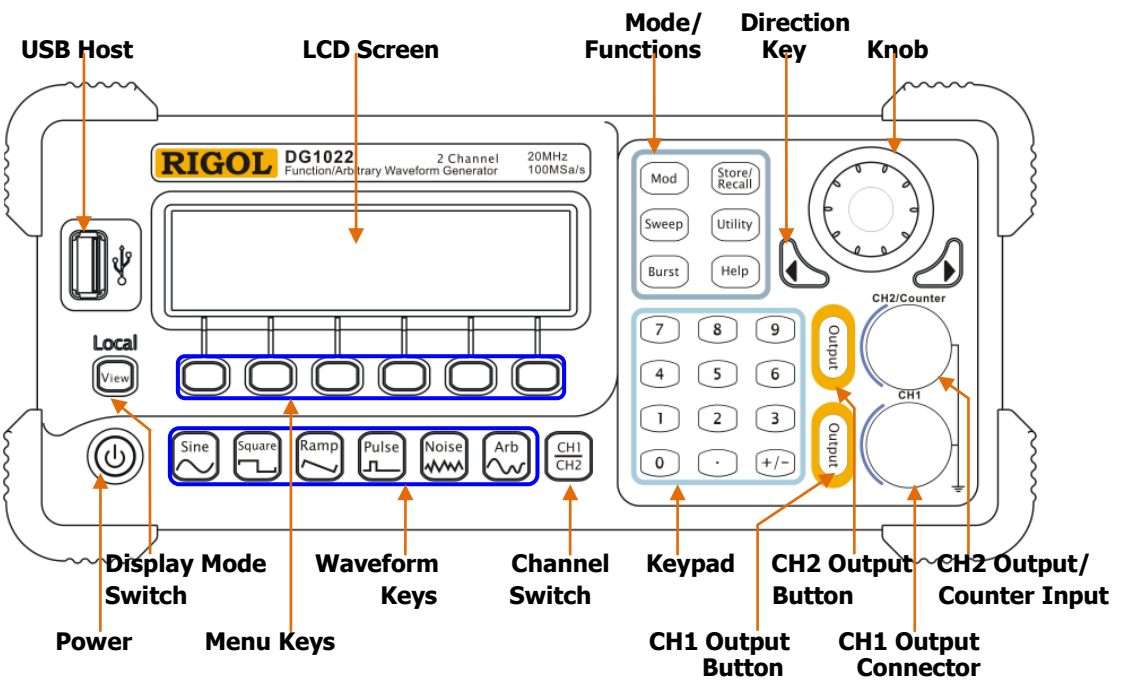


Figure 1-3
Front Panel for DG1022

Rear Panel at a Glance

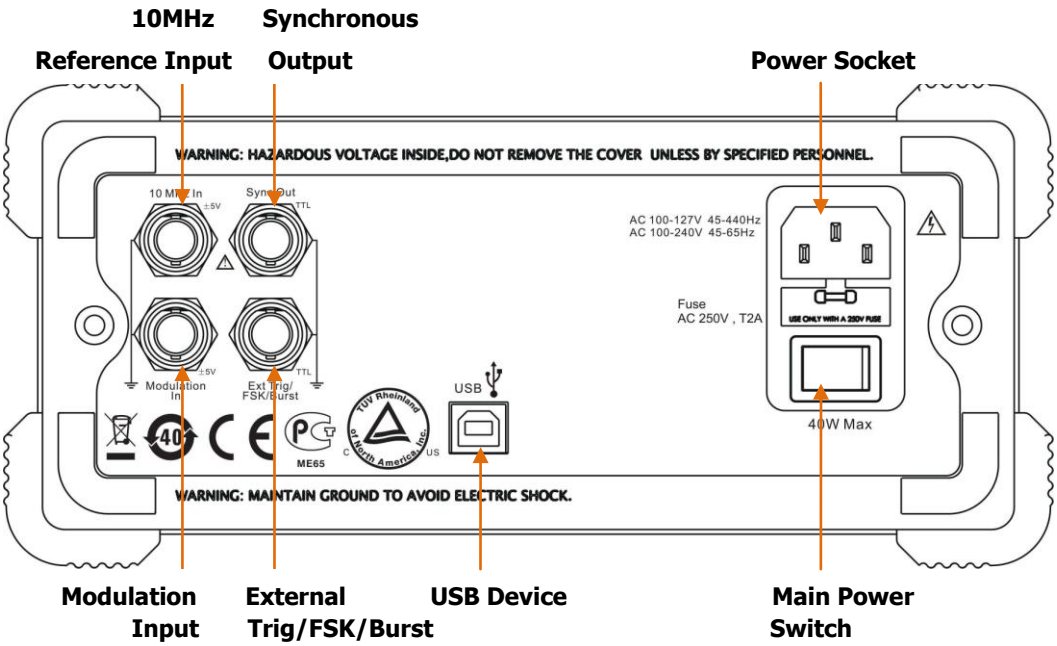


Figure 1-4
Rear Panel for DG1022

User Interface

The Generator provides three display modes: Menu Mode (Single or Double Channel) and Graph Mode (Single Channel). To switch the display mode, press the View button.

To select Channels, press the CH1 / CH2 button.

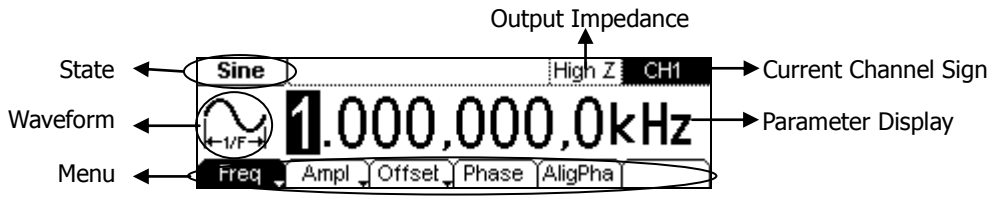


Figure 1-5
User Interface in Menu Mode (Single Channel)

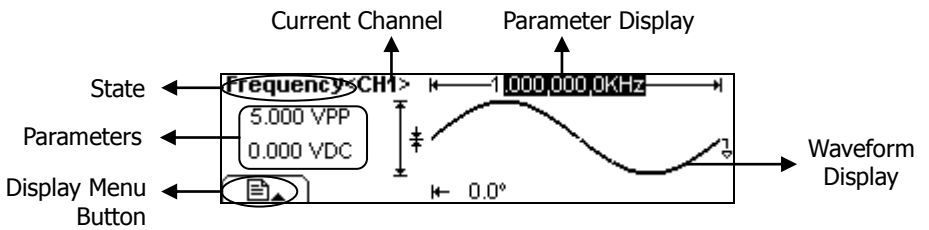


Figure 1-6
User Interface in Graph Mode (Single Channel)

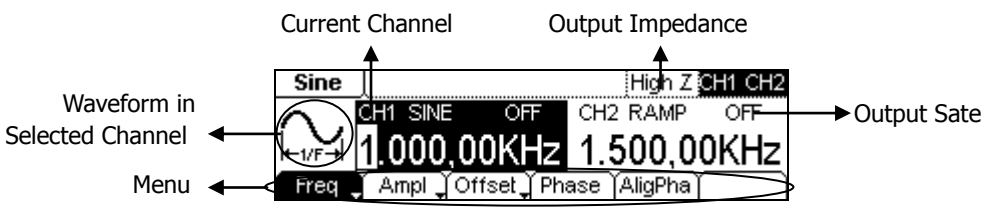


Figure 1-7
User Interface in Menu Mode (Double Channel)

NOTE:

The buttons on the front panel of the instrument are represented by words in a pane, such as Sine which represents the functional key with "Sine" on it on the front panel, while the menu buttons are represented by shadow words such as Freq, which means the "Frequency" option in the Sine menu.

To Set a Waveform

At the left of the operation panel, there are several buttons with waveform icon and two buttons which are used commonly. The following exercises will help you to be familiar with the waveform selection settings. The instructions of the waveform settings are all carried out in the Menu Display Mode.

Waveform Selection

Channel Switch Display Mode Switch

Figure 1-8 Function Buttons Selection

1. Press the Sine button, a "Sine" typeface will display in the state area. The instrument can generate Sine signal with frequency from 1μHz to 20MHz. By setting *Frequency/Period*, *Amplitude/High Level, Offset/Low level and Phase,* Sine signal with different parameters can be generated.

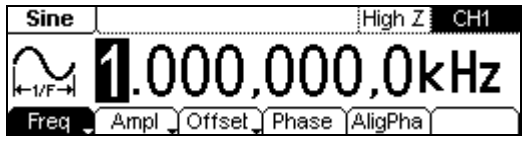


Figure 1-9
Sine Signal in the Menu Display Mode

As shown in Figure 1-9, the default signal parameters are: 1kHz Frequency, 5.0V_{PP} Amplitude, 0 V_{DC} Offset and 0° initial phase.

2. Press the Square button, a "Square" typeface will display in the state area. The instrument can generate Square signal with frequency from 1μHz to 5MHz and variable duty cycle. By setting *Frequency/Period, Amplitude/ High Level, Offset/ Low level, Duty Cycle and Phase*, Square signal with different parameters can be generated.

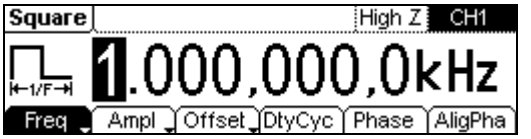


Figure 1-10
Square Signal in the Menu Display Mode

As shown in Figure 1-10, the default signal parameters are: 1kHz Frequency, 5.0V_{PP} Amplitude, 0 V_{DC} Offset, 50% Duty Cycle and 0° initial phase.

3. Press the Ramp button, a "Ramp" typeface will display in the state area. The instrument can generate Ramp signal with frequency from 1μHz to 150 kHz and variable Symmetry. By setting *Frequency/Period, Amplitude/ High Level, Offset/ Low level, Symmetry and Phase*, Ramp signal with different parameters can be generated.

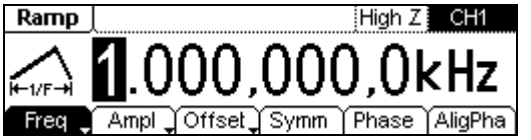


Figure 1-11
Ramp Signal in the Menu Display Mode

As shown in Figure 1-11, the default signal parameters are: 1kHz Frequency, 5.0 V_{PP} Amplitude, 0 V_{DC} Offset, 50% Symmetry and 0° initial phase.

4. Press the Pulse button, a "Pulse" typeface will display in the state area. The instrument can generate Pulse signal with frequency from 500μHz to 3MHz and variable Pulse Width. By setting *Frequency/Period, Amplitude/ High Level, Offset/ Low level, Pulse Width/Duty Cycle and Delay*, Pulse signal with different parameters can be generated.

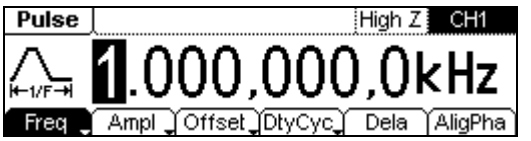


Figure 1-12
Pulse Signal in the Menu Display Mode

To Set Basic Waveforms

To Set Sine Waveform

In the Menu Mode, press the Sine button to call the Sine operation. The top left corner of the screen will show the name of the current waveform. The output Sine waveform parameters are set using the Sine operation menu.

The parameters for Sine waveforms are: *Frequency/ Period, Amplitude/ High Level, Offset/ Low Level and Phase*. Different Sine Signals are generated by using these parameters. As shown in Figure 2-1, select Freq in the operation menu and the frequency parameter will be shown in the parameter area. Users then can change the frequency by using the direction keys and the knob or the keypad.

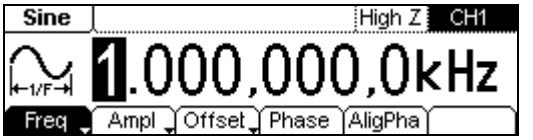


Figure 2-1
Sine Signal Parameter Setting Interface

Table 2-1 Operation Menu for Sine Signal

Menu	Settings	Explanation
Frequency/ Period		Setting the signal's frequency or period; the current parameter will switch at a second press.
Amplitude/ High Level		Setting the signal's Amplitude or High Level; the current parameter will switch at a second press.
Offset/ Low Level		Setting the signal's Offset or Low Level; the current parameter will switch at a second press
Phase		Setting the initial phase of the signal

NOTE:
Waveforms in single channel needn't to set the Aligpha parameter. It is always used to align the phases of the two channels' output signals.

To Set the Output Frequency/Period

1. Press Sine → Freq/Period → Freq, to set the frequency parameter.

   The frequency shown on the screen is the default value when the instrument is powered or the set value beforehand. When setting the function, if the current value is valid for the new waveform, it will be used sequentially. If you want to set the period for the waveform, press Freq/Period button again, switch to the Period parameter (The current operation is displayed in inverse color).

2. Input the desired frequency.

   Use the keypad to input the parameter value directly, and press the corresponding button to select the parameter unit. Or you can use the direction keys to select the digit you want to edit, and then use the knob to change its value.

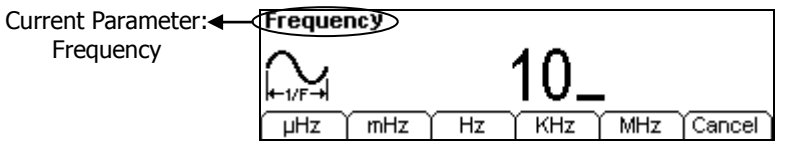


Figure 2-2
Setting the Frequency

Instructions

When using the keypad to enter the digit, you can use the Left direction keys to move the cursor backward and delete or change the value of the previous digit.

- When using the knob to input, use the direction keys to select the digit you want to edit and rotate the knob to change its value.

To Set the Output Amplitude

1. Press Sine → Ampl/HiLev → Ampl, to set the amplitude.

   The amplitude shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially. If you want to set the waveform by high Level or Low Level, press Ampl/HiLev or Offset/Lolev again, switch to HiLev or LoLev parameter (The current operation is displayed in inverse color).

2. Input the desired Amplitude.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button.

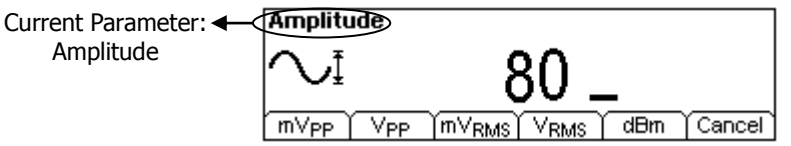


Figure 2-3
Setting the Amplitude

NOTE:
The "dBm" option will appear only when the output impedance is not "High Z".

To Set the Offset

1. Press Sine → Offset/LoLev → Offset, to set the offset.

   The offset shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Offset.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button.

Figure 2-4
Setting the Offset

NOTE: The setting of any waveform for *Frequency*, *Amplitude*, *Offset* and *Phase* are the same as sine wave, so we will not cover this topic again.

To Set the Initial Phase

1. Press Sine → Phase, to set the initial phase.

   The phase shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Phase.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button.

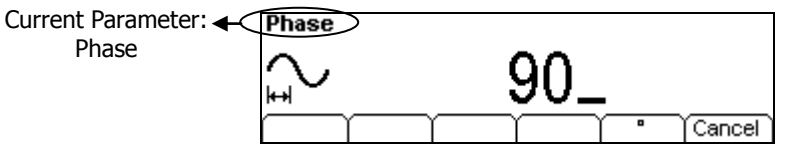


Figure 2-5
Setting the initial phase

After finishing the above operations, press View, in the Graph Mode, the waveform is shown in the following figure.

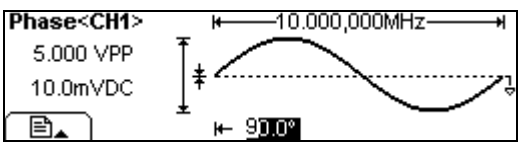


Figure 2-6
Waveform Parameter in the Graph Mode

To Set Square Waveform

Press the Square button, in the Normal Mode, the operation menu will appear at the bottom of the screen. Set the Square parameters by using the operation menu.

The parameters for Square waveforms are: *Frequency/ Period, Amplitude/ High Level, Offset/ Low Level, Duty Cycle and Phase*. See Figure 2-7. In the operation menu, select DtyCyc, and the corresponding parameter will be displayed in inverse color for which users can make a change.

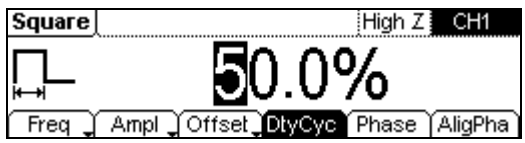


Figure 2-7
Square Signal Parameter Setting Interface

Table 2-2 Square Signal Operation Menu

Menu	Settings	Explanation
Frequency/ Period		Setting the signal's frequency or period; the current parameter will switch at a second press.
Amplitude/ High Level		Setting the signal's Amplitude or High Level; the current parameter will switch at a second press.
Offset/Low Level		Setting the signal's Offset or Low Level; the current parameter will switch at a second press
Duty Cycle		Setting the Duty Cycle for Square Waveform
Phase		Setting the initial phase of the signal

Term Explanation:

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

Please Note : for the Frequency	Duty Cycle Value
Below 3MHz(included):	20% to 80%
From 3MHz to 4MHz (included):	40% to 60%
From 4MHz to 5MHz (included):	50%

To Set the Duty Cycle

1. Press Square → DtyCyc, to set the Duty Cycle.

   The Duty Cycle shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Duty Cycle.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The Generator will change the waveform immediately.

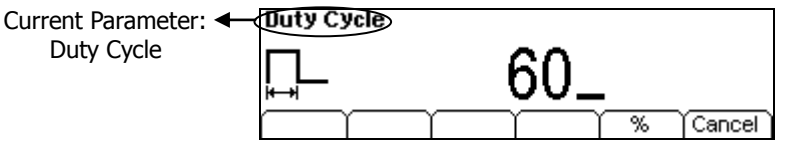


Figure 2-8
Setting the Duty Cycle

Press View, in the Graph Mode, the waveform is shown in the following figure.

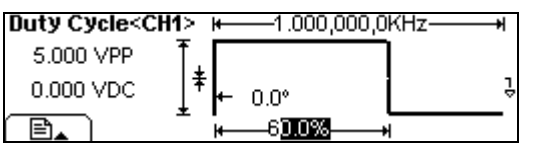


Figure 2-9
Waveform Parameters in the Graph Mode

To Set Ramp Waveform

Press the Ramp button, in the Normal Mode, the operation menu will appear at the bottom of the screen. Set the Ramp parameters by using the operation menu.

The parameters for Ramp waveforms are: *Frequency/ Period, Amplitude/ High Level, Offset/ Low Level, Symmetry and Phase*. See Figure 2-10. In the operation menu, select Symm, and the corresponding parameter will be displayed in inverse color for which users can make a change.

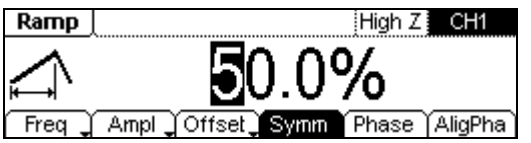


Figure 2-10
Ramp Signal Parameter Setting Interface

Table 2-3 Ramp Signal Operation Menu

Menu	Settings	Explanation
Frequency/ Period		Setting the signal's frequency or period; the current parameter will switch at a second press.
Amplitude/ High Level		Setting the signal's Amplitude or High Level; the current parameter will switch at a second press.
Offset/Low Level		Setting the signal's Offset or Low Level; the current parameter will switch at a second press
Symmetry		Setting the Symmetry for Ramp Waveform
Phase		Setting the initial phase of the signal

Term Explanation:

Symmetry: The percentage that the Rising Period takes up in the whole Period. Input Range: 0~100%

To Set the Symmetry

1. Press Ramp → Symm, to set the Symmetry.
   The Symmetry shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Symmetry.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The Generator will change the waveform immediately.

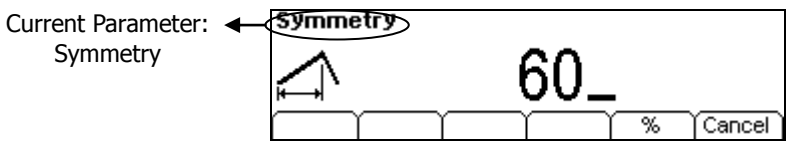


Figure 2-11
Setting the Symmetry

Press View, in the Graph Mode, the waveform is shown in the following figure.

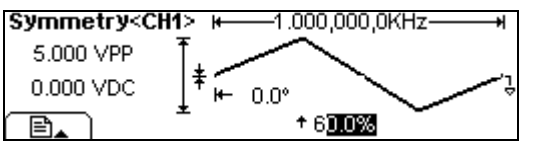


Figure 2-12
Waveform Parameter in the Graph Mode

To Set Pulse Waveform

Press the Pulse button, in the Normal Mode, the operation menu will appear at the bottom of the screen. Set the Pulse parameters by using the operation menu.

The parameters for Pulse waveforms are: *Frequency/ Period, Amplitude/ High Level, Offset/ Low Level, Pulse Width/ Duty Cycle and Delay*. See Figure 2-13, in the operation menu, select Width, and the corresponding parameter will be displayed in inverse color for which users can make a change.

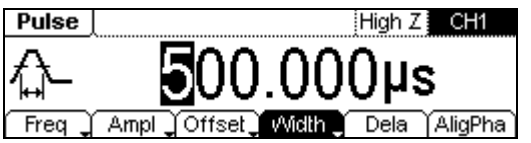


Figure 2-13
Pulse Signal Parameter Setting Interface

Table 2-4 Pulse Signal Operation Menu

Menu	Settings	Explanation
Frequency/ Period		Setting the Frequency or Period of the signal.
Amplitude/ High Level		Setting the Amplitude or High Level of the signal.
Offset/Low Level		Setting the Offset or Low Level of the signal.
Width/ DtyCyc		Setting the Pulse Width or Duty Cycle of the Pulse Waveform.
Delay		Setting the Delay time.

Term Explanation:

Pulse Width: The time span between thresholds of 50% of the rising edge amplitude to the next 50% of the falling edge amplitude.

To Set the Pulse Width

1. Press Pulse → Width, to set the Pulse Width.
   The Pulse Width shown on the screen is the default value when the instrument is powered or the set value beforehand. When changing the function, if the current value is valid for the new waveform, it will be used sequentially.

2. Input the desired Pulse Width.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The Generator will change the waveform immediately.

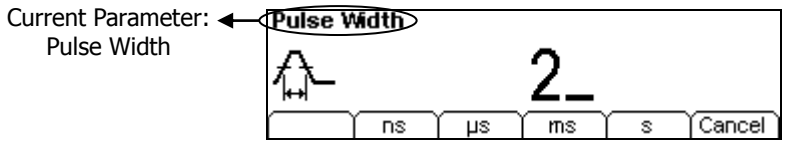


Figure 2-14
Setting the Pulse Width

Key Points:

- **Pulse width is limited by the minimum pulse width and the Pulse period.**
  Minimum Pulse width= 20ns
  Pulse width ≥ Minimum Pulse width
  Pulse width ≤ Pulse period－Minimum Pulse width

- **Pulse duty cycle is limited by the minimum pulse width and the Pulse period.**
  Pulse duty cycle ≥ 100 × Minimum Pulse width ÷ Pulse period
  Pulse duty cycle ≤ 100 × (1－Minimum Pulse width ÷ Pulse period)

- **Settings of "Pulse Width" and "Duty Cycle" are equivalent.**
  Once a parameter is changed, the other one will change accordingly. For instance, the current period is 1ms, the pulse width is 500µs and the duty cycle is 50%, when setting the pulse width to be 200µs, the duty cycle will become 20%.

To Set the Pulse Delay

1. Press Pulse → Dela, to set the Pulse Delay time.
   The Delay time shown on the screen is the default value when the instrument is powered or the set value beforehand.

2. Input the desired Delay time.

   Use the keypad or the knob to input the desired value, choose the unit, and press the corresponding button. The Generator will change the waveform immediately.

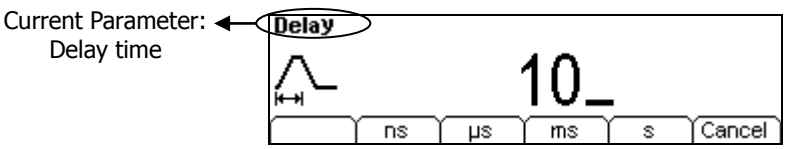


Figure 2-15
Setting the Delay time

Press View, in the Graph Mode, the waveform is shown as in the following figure.

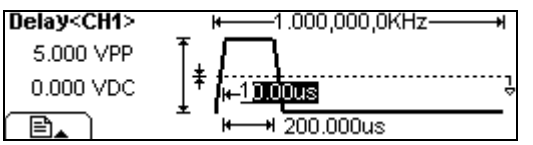


Figure 2-16
Waveform parameters in the Graph mode

To Set the Output

As shown in Figure 1-15, there are two Output buttons on the right side of the front panel, which are used to set the Output Control. The instruction below will help you to be familiar with these functions.

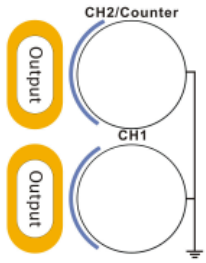


Figure 1-15 Channel Output/Counter Input

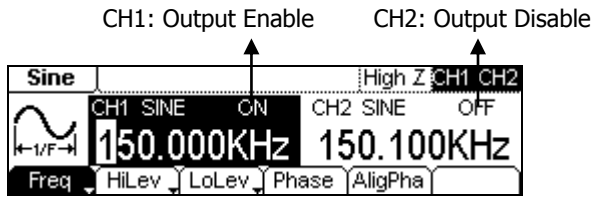


Figure 1-16 Channel Output Control

1. **Channel Output Control**
   Press the Output button to enable/disable the signal output of CH1 or CH2.

2. **Counter Input**
   In the Counter mode, the output connector of CH2 is used as the signal input terminal. At the same time, the output of CH2 will be disabled automatically.

Output from Single Channel

Example 1: Output a Sine Waveform

How to generate a Sine Waveform with 20 kHz frequency, 2.5 V_{PP} Amplitude, 0 V_{DC} Offset and 45° phase.

The operation steps:

1. Set the Frequency.

(1) Press Sine → Freq/Period → Freq which will display in reverse color.

(2) Enter "20" from the keypad and choose the unit "kHz". The Frequency is set to be 20 kHz.

2. Set the Amplitude.

(1) Press Ampl/HiLev → Ampl which will display in reverse color.

(2) Enter "2.5" from the keypad and choose the unit "V_{PP}". The Amplitude is set to be 2.5V_{PP}.

3. Set the Offset.

(1) Press Offset/LoLev → Offset which will display in reverse color.

(2) Enter "0" from the keypad and choose the unit "V_{DC}", The Offset is set to be 0 V_{DC}.

4. Set the Initial Phase.

(1) Press Phase which will display in reverse color.

(2) Enter "45" from the keypad and choose the unit "°". The phase is set to be 45°.

After finishing the above settings, press View, the output of the Generator is shown as in the following figure.

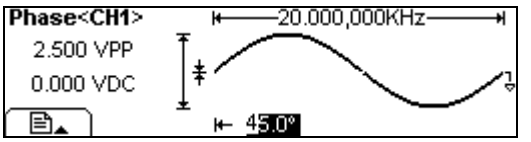


Figure 3-1
Sine Waveform Output

Example 2: Output a Square Waveform

How to generate a Square waveform with 1MHz Frequency, 2 V_{RMS} Amplitude, 10m V_{DC} Offset, 30% Duty Cycle and 30° phase.

The operation steps:

1. Set the Frequency.

(1) Press Square → Freq/Period → Freq which will display in reverse color.

(2) Enter "1" from the keypad and choose the unit "MHz" to set the Frequency as 1MHz.

2. Set the Amplitude.

(1) Press Ampl/HiLev → Ampl which will display in reverse color.

(2) Enter "2" from the keypad and choose the unit "V_{RMS}" to set the Amplitude as 2 V_{RMS}.

3. Set the Offset.

(1) Press Offset/LoLev → Offset which will display in reverse color.

(2) Enter "10" from the keypad and choose the unit "mV_{DC}" to set the Offset as 10m V_{DC}.

4. Set the Duty Cycle.

(1) Press DtyCyc which will display in reverse color.

(2) Enter "30" from the keypad and choose the unit "%" to set the Duty Cycle as 30%.

5. Set the Initial Phase.

(1) Press Phase which will display in reverse color.

(2) Enter "30" from the keypad and choose the unit "°" to set the Phase as 30°.

After finishing the above settings, press View, the generated waveform is shown in Figure 3-2.

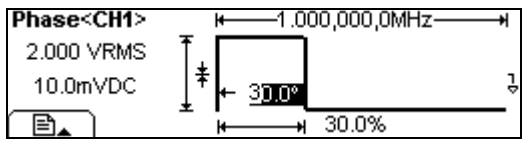


Figure 3-2
Square Waveform Output

Example 3: Output a Ramp Waveform

How to generate a Ramp waveform with 10ms Period, 100mV$_{PP}$ Amplitude, 20mV$_{DC}$ Offset, 80% Symmetry and 60° Phase.

The operation steps:

1. Set the Period.

(1) Press Ramp → Freq/Period → Period which will display in reverse color.

(2) Input "10" from the keypad and choose the unit "ms" to set the Period as 10ms.

2. Set the Amplitude.

(1) Press Ampl/ HiLev → Ampl which will display in reverse color.

(2) Enter "100" from the keypad and choose the unit "mV$_{PP}$" to set the Amplitude as 100mV$_{PP}$.

3. Set the Offset.

(1) Press Offset /LoLev → Offset which will display in reverse color.

(2) Enter "20" from the keypad and choose the unit "mV$_{DC}$" to set the Offset as 20mV$_{DC}$.

4. Set the Symmetry.

(1) Press Symm which will display in reverse color.

(2) Enter "80" from the keypad and choose the unit "%" to set the Symmetry as 80%.

5. Set the Phase.

(1) Press Phase which will display in reverse color.

(2) Enter "60" from the keypad and choose the unit "°" to set the Phase as 60°.

After finishing the above settings, press View, the generated waveform is shown in Figure 3-3.

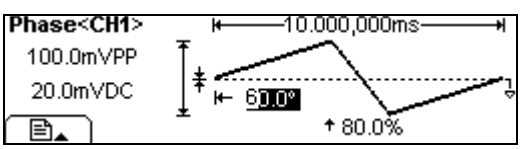


Figure 3-3
Ramp Waveform Output

Example 4: Output a Pulse Waveform

How to generate a Pulse waveform with 5kHz Frequency, 50mVPP Amplitude, 5mVDC Offset, 20μs Pulse Width (Duty Cycle is 10%) and 200μs Delay.

The operation steps:

1. Set the Frequency.

(1) Press Pulse → Freq/Period → Freq which will display in reverse color.

(2) Input "5" from the keypad and choose "kHz" to set the Frequency as 5 kHz.

2. Set the Amplitude.

(1) Press Ampl/ HiLev → Ampl which will display in reverse color.

(2) Enter "50" from the keypad and choose the unit "mVPP" to set the Amplitude as 50mVPP.

3. Set the Offset.

(1) Press Offset /LoLev → Offset which will display in reverse color.

(2) Enter "5" from the keypad and choose the unit "mV DC" to set the Offset as 5mVDC.

4. Set the Pulse Width.

(1) Press DtyCyc/Width → Width which will display in reverse color.

(2) Enter "20" from the keypad and choose the unit "μs" to set the Pulse Width as 20μs.

5. Set the Delay.

(1) Press Dela which will display in reverse color.

(2) Enter "200" from the keypad and choose the unit "μs" to set the Delay as 200μs.

After finishing the above settings, press View, the generated waveform is shown in Figure 3-4.

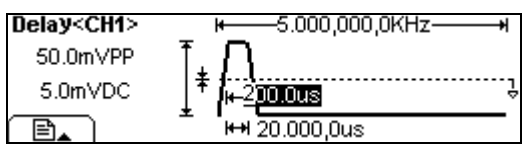


Figure 3-4
Pulse Waveform Output