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Chapter 1 Getting Started Guide

This chapter introduces the precautions for using the oscilloscope for the first time, the front and rear panels, the user interface, as well as the built-in help system.

1.1 General Inspection

It is recommended to follow the steps below before using the Protek 8050 series for the first time.

(1) Check for Damages Caused By Transport

If the packaging carton or the foam plastic cushions are severely damaged, please contact the distributor of this product immediately.

(2) Check Attachment

Please check Appendix A for the list of accessories. If any of the accessories are missing or damaged, please contact Protek distributor or local office of this product.

(3) Machine Inspection

If the instrument appears to be damaged, not working properly, or has failed the functionality test, please contac t protek distributor or local office of this product.

If the equipment is damaged due to shipping, please keep the packaging and notify both the protek transportation department and the Protek distributor protek will arrange maintenance or replacement.

1.2 Before Use

To perform a quick verification of the instrument's normal operations, please follow the steps below:

(1) Connect to the Power Supply

The power supply voltage range is from 100 VAC to 240 VAC, the frequency range is 45Hz to 440Hz. Connect the oscilloscope to the power supply cord that came with the oscilloscope or any power supply cord that meets the host country standards. Turn the power button on the back of the oscilloscope to ON. Now the soft power button  in the front of the oscilloscope should be lit green.

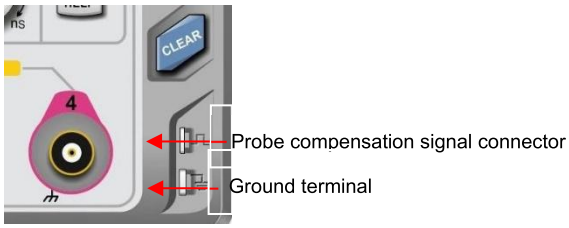
(2) Boot Check

Press the soft power button  and the light should change to red. The oscilloscope then will show a boot animation, and it will enter the normal interface afterwards.

(3) Connect Probe

Take the probe in the attachment and connect its BNC terminal to the BNC of channel 1 of the oscilloscope. Connect the probe to the "probe compensation signal connector" and connect the probe's ground alligator clip to the "ground terminal" shown below. The output of the probe compensation signal

connector should be a 3Vpp square wave, with a 1kHz frequency.



Picture 1-1 Probe compensation signal connector and ground terminal

(4) Function Check

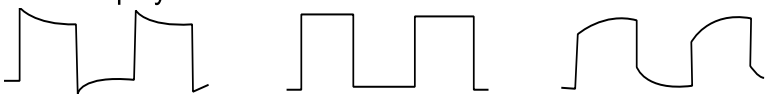
Press the AUTO key, a 3Vpp 1 kHz square wave should appear. Repeat step 3 for all channels. If the output is not a square wave with the above descriptions, please perform the probe compensation step in the next section.

(5) Probe Compensation

When the probe is connected to any input channel for the first time, this step might be required in order to match the probe and the input channel. An uncompensated probe may cause a measurement error. To adjust the probe compensation, please follow the following steps:

① Set the probe menu attenuation coefficient to 10×, and set the switch on the probe to 10x then connect the probe to CH1. Make sure the probe's hooks is properly connected with the oscilloscope. Connect the probe to the "probe compensation signal connector" and connect the probe's ground alligator clip to the "ground terminal". Turn on CH1 and press the AUTO key.

② Observe the waveform displayed.



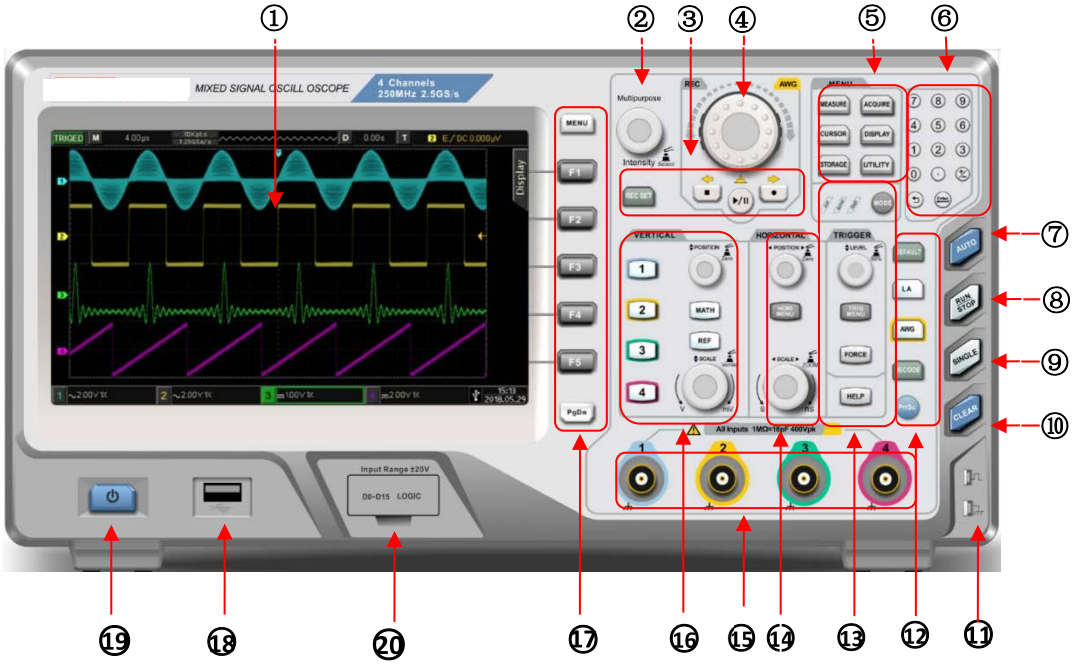
Excessive compensation Correct compensation Insufficient compensation

Picture 1-2 Probe compensation calibration

③ If the displayed waveform does not look like the above "correct compensation" waveform, use a non-metallic screwdriver to adjust the probe's variable capacitance until the display matches the "correct compensation" waveform.

Warning: To avoid electric shock when measuring high voltage using the probe, please ensure that the probe insulation is in good condition and avoid physical contact with any metallic part of the probe.

1.3 Front Panel

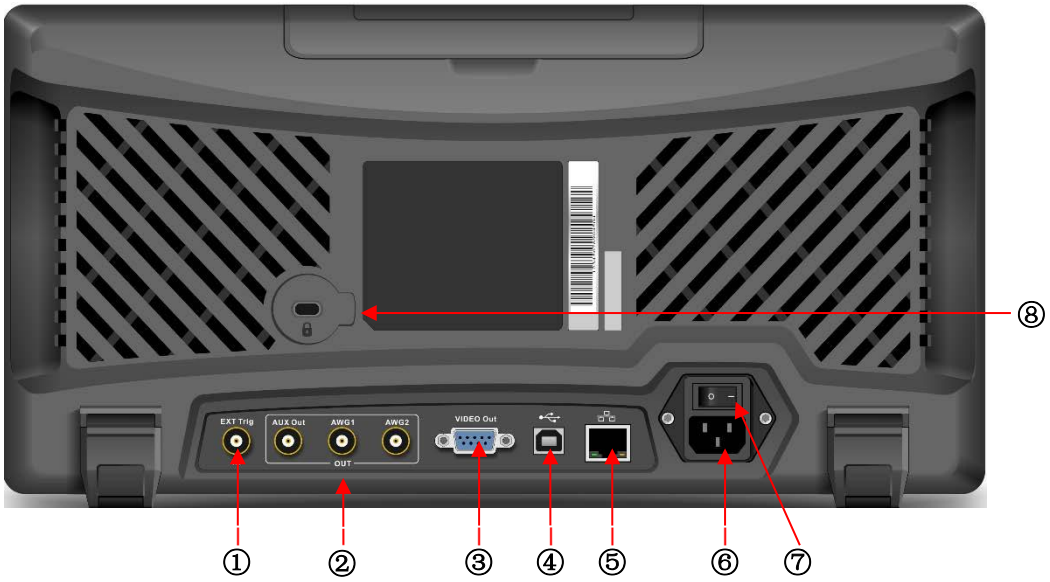


Picture 1-3 Oscilloscope Front Panel

①. Screen display area
②. Multipurpose knob
③. Waveform recording setting
④. Shuttle knob
⑤. Function menu
⑥. Numeric keyboard
⑦. Automatic setting
⑧. Run/stop
⑨. Single trigger
⑩. Clear all
⑪. Probe compensation signal connector and ground terminal
⑫. Factory setting, LA(16 digital channels), AWG (arbitrary waveform generator), protocol decoding, print screen
⑬. Trigger control area (TRIGGER)
⑭. Horizontal control area (HORIZONTAL)
⑮. Analog channel input
⑯. Vertical control area (VERTICAL)
⑰. Menu control
⑱. USB HOST interface
⑲. Power on/off

⑳. Digital channel input interface

1.4 Rear Panel



Picture 1-4 Oscilloscope Rear Panel

①. EXT Trig: External trigger or external trigger/ 5 input

②. Output: output port, supports AUX Out output simultaneously, AWG1 and AWG2 are arbitrary waveform generator output.

③. VIDEO Out: VGA video signal output

④. USB device: USB device interface, the oscilloscope can communicate with the PC through this interface.

⑤. LAN: The oscilloscope can be connected to the local area network for remote control.

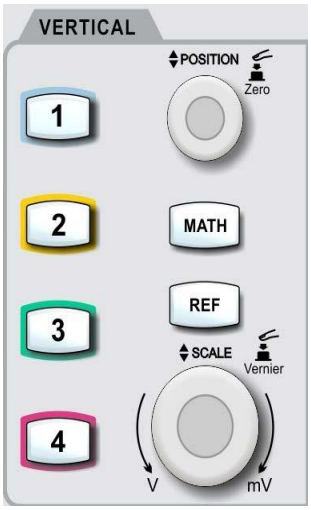
⑥. AC power input socket: AC power input. Use the power cord provided in the accessories to connect the oscilloscope to the AC power supply (100 ~ 240V, 45 ~ 440Hz).

⑦. Power switch: When the AC socket is properly connect to the power supply, turn on this power switch, then press the power on/off on the front panel to turn on the oscilloscope.

⑧. Safety lock: You can use the safety lock (sold separately) to lock the oscilloscope in a fixed position.

1.5 Operation Panel

(1) Vertical Control



① 1, 2, 3, 4: Analog channel setting keys indicate CH1, CH2, CH3, and CH4. The four channel labels are identified by different colors also corresponding to the colors of the waveforms on the screen and the channel input connectors. Press any key to open the related channel menu (or activate and close the channel).

② MATH: Press this key to open the mathematical operation menu for add, subtract, multiply, divide, FFT, logic, and advanced operations.

③ REF: Loads the previously stored reference waveform in the oscilloscope or the USB disk, you can compare the currently measured waveform with the reference waveform.

④ Vertical POSITION: Adjust the vertical position of the current channel waveform, and display the vertical offset value 240.00mV at the baseline cursor. Press this knob to return the channel display position back to the vertical midpoint.

⑤ Vertical SCALE: Adjust the vertical scale of the current channel. Turn clockwise to reduce in scale and turn counterclockwise to increase in scale. The waveform display amplitude will increase or decrease during the adjustment, and the scale information 1 100V 1X at the bottom of the screen will change in real time. The vertical scale has 1, 2, and 5 steps. Press the knob allows the vertical scale adjustment to switch between coarse and fine tuning.

(2) Horizontal control

① HORI MENU: Horizontal menu, displays extended window, independent time base and trigger hold-off.

② Horizontal POSITION: When adjusting the knob, the trigger point moves left and right relative to the center of the screen, and the waveforms of all channels also move left and right. The horizontal displacement value D 0.00s at the top of the screen will change in real time. Press this knob to return the channel display position back to the horizontal midpoint.。

③ Horizontal SCALE: Adjust the time scale of all channels. You can see the waveform is compressed or expanded in the horizontal direction on the screen M 1.00μs rocess, and the time base scale in the lower part of the screen changes in real time. The time base step is 1-2-4. Press the knob to quickly switch between the main window and the extended window.

(3) Trigger Control

① MODE: Press this key to switch the trigger mode to Auto, Normal or Single, and the corresponding backlight of the current trigger mode will turn on.

② LEVEL: Turn clockwise to increase the level, turn counterclockwise to decrease the level. During the adjustment process, the trigger level value T 1 E/DC 0.000μV at the top right of screen will change in real time. Press the knob to quickly return the trigger level to 50% of the trigger signal.

③ TRIG MENU: Displays the contents of the trigger menu. For details, see "Trigger setting system".

④ FORCE: Force trigger key, press this key to force a trigger.

⑤ HELP: Displays the built-in help system contents.

(4) Auto Setting

When this key is pressed, the oscilloscope will automatically adjust the vertical scale factor, sweep time base, and trigger mode according to the input signals.

Note: When using the auto setting function, if the measured signal is a sine wave, the frequency is required to be not less than 20Hz and the amplitude should be in the range of 20mVpp ~ 120Vpp. If this parameter condition is not met, the auto setting function may not be valid.

Run/Stop

Press this key to set the oscilloscope's operating state to "run" or "stop".
RUN state is indicated by green light.
STOP state is indicated by red light.

(6) Single Trigger

Press this key to set the trigger mode to "Single" and the orange backlight will be on.

(7) Clear All

Clears all waveforms on the screen. If the oscilloscope is in the "RUN" state, it will continue to display new waveforms.

(8) Print Screen

Press this key to quickly copy the screen waveforms to a USB storage device in BMP bitmap format.

Multipurpose Knob

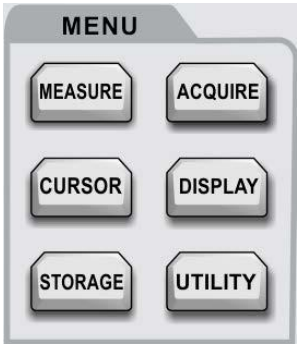
Intensity: In non-menu operation, turn this knob to adjust the brightness of the waveform display. The brightness adjusting range is 0% ~ 100%. You can also press the DISPLAY → WaveBright to adjust it.

Multipurpose: Turn the knob to select the sub-menu, then press the knob to confirm selection.

(10) Shuttle Knob

For certain numeric parameters that can be set in a large range, this knob provides a quick-adjust function. Rotate clockwise (counterclockwise) to increase (decrease) the value. The inner knob can be fine-tuned, and the outer knob can be coarse tuned. For example: When playing back the waveform, use the knob to quickly locate the waveform frames that need to be replayed. Similar parameters also include: trigger hold-off time, pulse width setting, slope time, and so on.

(11) Function Keys



MEASURE: Measure setting menu: you can set the measure source, all parameters, user-defined, perform measurement statistics, select measurement indicators, etc. The user-defined includes a total of 34 kinds of parameter measurements, which can be quickly selected through the Multipurpose knob, and the measurement result will appear at the bottom of the screen.

ACQUIRE: Sampling setting menu for setting the acquisition mode and deep storage.

CURSOR: Cursor measurement menu, you can measure the time or voltage of the waveform manually with cursor.

DISPLAY: Select display settings, such as display type, format, grid brightness, waveform brightness, duration, color temperature, inverse color temperature.

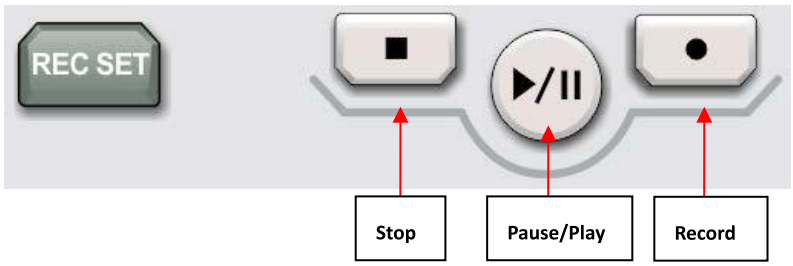
STORAGE: Press this key to enter the storage interface. The types that can be stored include: settings, waveforms. You can store either in the oscilloscope internal or the external USB storage device.

UTILITY: The utility menu can perform the settings such as self-calibration, system information, language, menu display time, waveform recording, pass/fail, square wave output, cymometer, output selection, backlight brightness, clear data, IP, RTC set, etc.

(12) Numeric Keyboard

For some numerical parameters that can be set to a large range, you can directly enter the number plus the time unit, then press the Enter key to confirm if it is without a unit.

(13) Waveform Recording



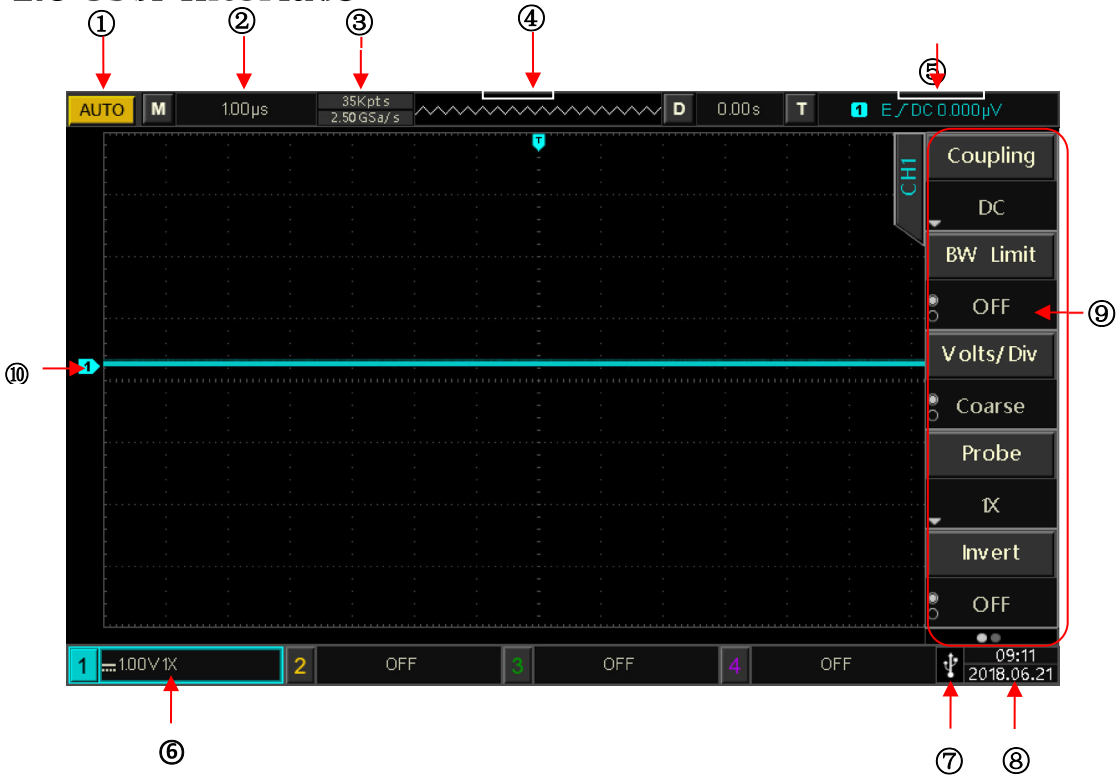
REC SET: Waveform recording setup menu for setting and operation. The setting items can set or display the recording interval, end frame, play delay, and maximum frame.

Stop: Press this key to stop the waveform being recorded or replayed. This key can be used to delete in AWG.

Play/Pause: In the stop or pause state, press this key to playback the waveform, press again to pause playback. This key can be used to select in AWG.

Record: Press this key to start the waveform recording. This key can be right shifter in AWG.

1.6 User Interface



Picture 1-5 Oscilloscope display interface

①. Trigger Status Identification: Includes TRIGED (has been triggered), AUTO, READY, STOP, and ROLL (rolling).

②. Time Base Scale: Indicates the amount of time represented by one grid on the horizontal axis, which can be adjusted by the horizontal SCALE knob.

③. Sampling Rate/ Memory Depth: Indicates the current sampling rate and storage depth.

④. Horizontal Displacement: Shows the horizontal displacement value of the waveform, which can be adjusted by turning the horizontal POSITION knob. Press the knob to return the displacement value back to 0.

⑤. Trigger Status: Displays trigger source, type, slope, coupling, level, etc.

a. Trigger source: There are seven states: CH1 ~ CH4, AC Line, EXT, EXT/5 and D0-D15.

CH1~CH4 will each be of a different trigger color, for example, 1 is CH1.

b. Trigger type: The types are edge, pulse width, video, slope and advanced trigger. For example, E means edge trigger.

c. Trigger edge: The types are rising, falling, and any kinds. For example, ⎍ indicates trigger at the rising edge.

d. Trigger coupling: The types are DC, AC, high frequency suppression, low frequency suppression, and noise suppression. For example, DC indicates DC coupling.

e. Trigger level: Indicates the current trigger level value, corresponding to the  on the right side of the screen. Adjust the LEVEL knob in the trigger control area to change this parameter.

⑥. CH1 Vertical Status: Displays CH1 activation state, channel coupling, bandwidth limitation, vertical scale, and probe attenuation coefficient.

Channel activation state:  When the background includes the channel color, the channel is activated. Press the key [1], [2], [3], [4] to activate or open/close the corresponding channel.

Channel coupling: Includes DC, AC, and grounding. For example,  means CH1 is DC coupling.

Bandwidth limitation: Enable it and there will be a  icon shown on CH1 vertical status bar.

Vertical scale: When CH1 is activated, the vertical scale parameter can be adjusted by the SCALE knob in the vertical control area.

Probe attenuation coefficient: Displays CH1 probe attenuation coefficient: 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, 1000X.

⑦. USB DEVICE Indicator: Displays the indicator when the USB device interface is connected to a USB storage device such as a USB flash disk.

⑧. Current date and time.

⑨. Operation Menu: Displays the current operation menu. Press [F1] ~ [F5] can change the corresponding submenu content.

⑩. Analog Channels and Waveforms: Displays CH1 ~ CH4 channels and waveforms, the color of the channel indicator is consistent with the waveform.

1.7 Special Symbols Introduction

Take the left menu as an example:

: Indicates there is a next level menu.

: Indicates there is a drop-down menu.

: Indicates that the menu has two options.

: Indicates that user can adjust by the Multipurpose knob.

: The number of circles indicates the total pages of the menu. There is no small circle for one single page. For two pages or more, small circles will be shown. Press the PgDn key to turn the pages.

Chapter 2 Vertical Channel Settings

8050 Series provides 4 or 2 analog input channels. The 4 analog channels are CH1~CH4, and the 2 analog channels are CH1 and CH2. The vertical system setting method for all channels are exactly the same.

Take [1] (Channel 1) as an example for the vertical channel settings.

2.1 Open/ Activate/ Close Analog Channel

CH1 ~ CH4 contains 3 states: open, close, and activated.

Open: When the channel is close, press any of [1], [2], [3], [4] to open the corresponding channel.

Close: No waveform displays on the corresponding channel. For any open and activated channel, pressing its channel key can close that channel.

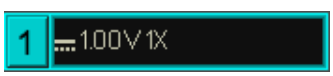
Activated: When multiple channels are opened at the same time, only one channel is activated (Only open state can be activated). Adjusting the POSITION knob and the SCALE knob in the vertical control area can change the settings of the activated channel. Any channel that has been opened but not yet activated could be activated by pressing its corresponding channel key, and the screen will show its corresponding channel menu.

Activated state

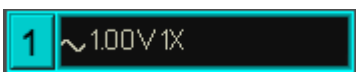
Open but not activated

2.2 Channel Coupling

Press [1]→Coupling to select DC, AC or GND (grounding) mode.



DC



AC

GND

2.3 Bandwidth limitation

Press [1] →BW Limit to turn on the bandwidth limitation (The B icon will appear on the

vertical status bar). The bandwidth of the oscilloscope is limited to about 20MHz, and attenuates any signal above 20MHz. It is commonly used to reduce the high frequency noise within the signal.

B icon appears when the bandwidth limitation is on

2.4 VOLTS/DIV

Press 1 →Volts/Div →Coarse/Fine. Or press the SCALE knob to quickly switch between coarse tuning/fine tuning.

In Coarse tuning, the VOLTS/DIV range is 1mV/div ~ 20V/div by 1-2-5 step.

For example: 10mV—>20mV—>50mV—>100mV

In Fine tuning, it adjusts in 1% of the current vertical scale.

For example: 10.00mV—>10.10mV—>10.20mV—>10.30mV

Note: Div indicates the grids of the display area, /div represents one grid.

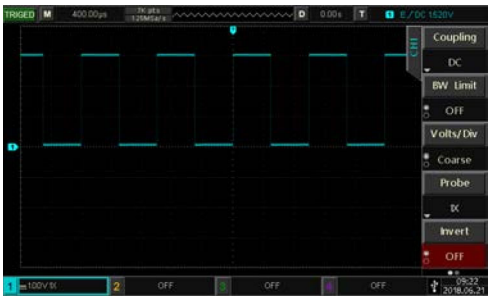
2.5 Probe

In order to match the attenuation coefficient setting of the probe, it is necessary to set the corresponding coefficient in the channel operation menu. If the probe attenuation coefficient is 10:1, the probe coefficient in the channel menu should also be set to 10X to ensure correct voltage reading.

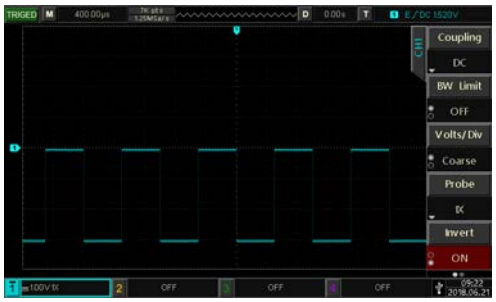
Press 1 →Probe to select 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, 1000X.

2.6 Invert

Press 1 →Invert to turn on the reverse phase. The waveform voltage value will be inverted, and the inverted flag  will appear in the vertical status bar.



Picture 2-1 Invert off

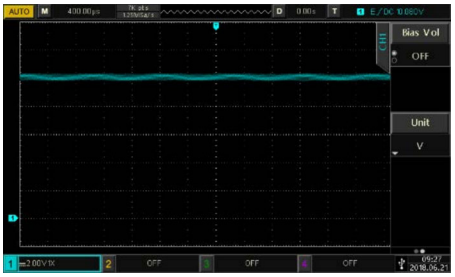


Picture 2-2 Invert on

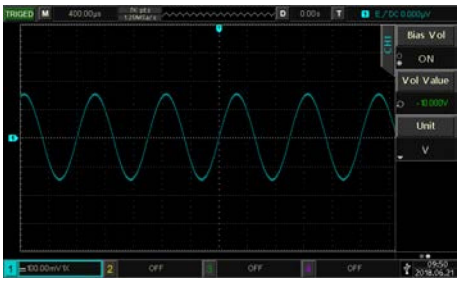
2.7 Bias

When the amplitude of the DC component in the signal is relatively large, waveform observation could be very inconvenient. As shown in picture 2-3, it is really hard to identify the waveform. Using the bias function and the superposition of a -10V bias voltage can eliminate the DC component of the waveform so the AC signal can be clearly observed, and at the same time user can know the DC component volume. As shown in

picture 2-4, press 1 →PgDn →Bias Vol to turn on the bias and rotate the Multipurpose knob counterclockwise to adjust the value to -10V.



Picture 2-3 Bias off



Picture 2-4 -10V Bias on

Note: Press the Multipurpose knob to return the bias to zero.

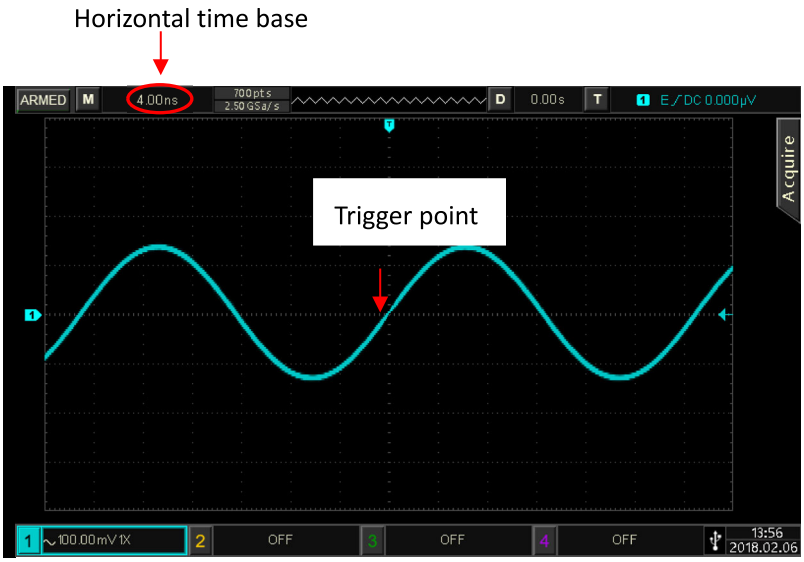
2.8 Unit

Select the amplitude unit for the current channel. Press 1 →PgDn →Unit and adjust the Multipurpose knob to select the unit of V, A, W or U, the default unit is V. User can also switch the channel unit by consecutively pressing the Unit key, then press the Multipurpose knob to confirm, the corresponding unit will appear on the channel status bar.

Chapter 3 Horizontal System Settings

3.1 Horizontal Scale

Horizontal scale, also called the horizontal time base, is the time value represented by each scale in the horizontal direction, which is usually expressed as s/div. With the SCALE knob in the horizontal control area, user can adjust the horizontal scale in 1-2-4 steps, i.e. 2ns/div, 4ns/div, 10ns/div, 20ns/div……40s/div. Turn clockwise to decrease the scale and turn counterclockwise to increase the scale, the scale information (as shown below) on the upper left corner of the screen changes in real time.

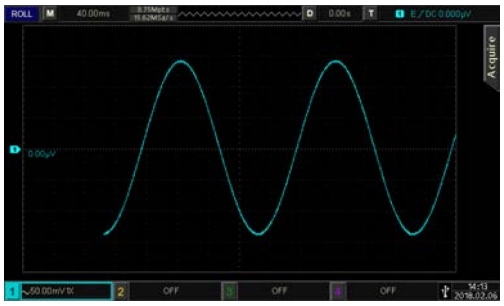


When changing the horizontal time base, the waveform will expand or compress according to the position of the trigger point.

Note: There is no 100ns/div in the horizontal time base, it is changed to 80ns/div.

3.2 ROLL Mode

When the trigger mode is auto, adjust the SCALE knob in the horizontal control area to change the horizontal scale to be slower than 40ms/div, the oscilloscope will be in ROLL mode and will continuously plot the voltage-time trend chart of the waveform on the screen. The earliest waveform first appears on the right end of the screen, then gradually moves to the left, as shown below:



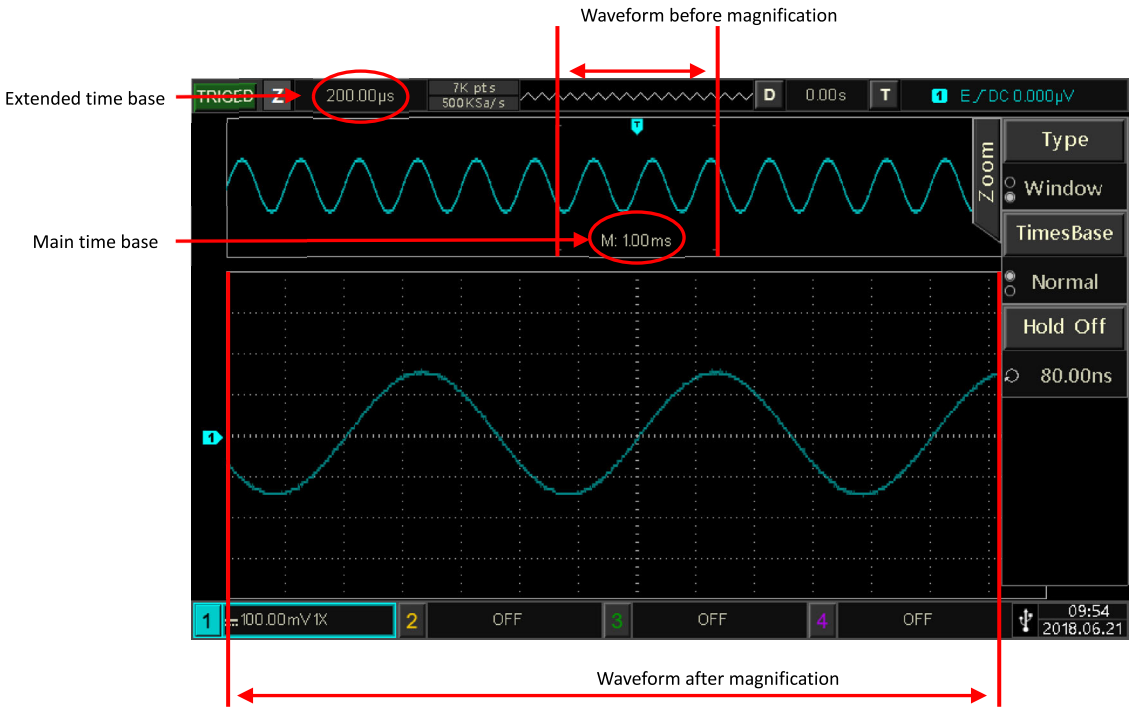
Use the slow sweep mode to observe the low frequency signal, it is recommended to set the Coupling mode to DC.

Note: “Horizontal displacement”, “extended window”, “protocol decoding”, “pass/fail”, “parameter measurement”, “waveform recording’, “waveform brightness”, and “independent time base” are not available in ROLL mode.

3.3 Extended Window

The extended window can be used to magnify a waveform horizontally to view the waveform details.

Press the HORI MENU key on the horizontal control area, then press the Type key to turn on the extended window. Or simply press the SCALE knob on the horizontal control area to directly enter the extended window, the screen will be divided into two display areas, as shown below:



Waveform before Magnification:

The upper part of the screen displays the original waveform, which can be moved left and right through rotating the horizontal POSITION knob, or zoom in and out the selected

area by rotating the horizontal SCALE knob.

Waveform after Magnification:

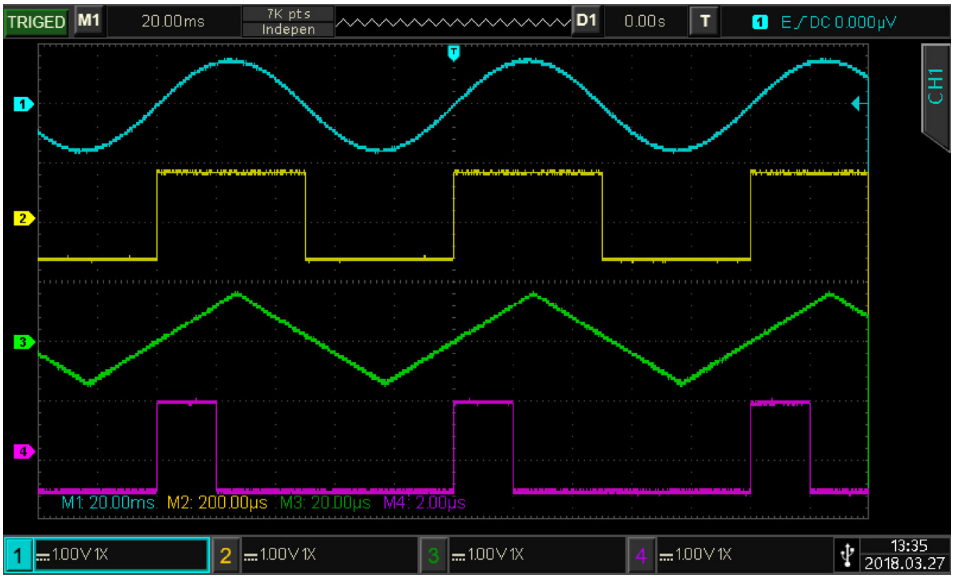
The lower part of the screen displays the horizontally extended waveform, the extended window enhances the resolution relative to the main time base.

Note: The extended window function is only available when the horizontal time base is in the range of 20ms/div ~ 40 ns/div.

3.4 Independent Time Base

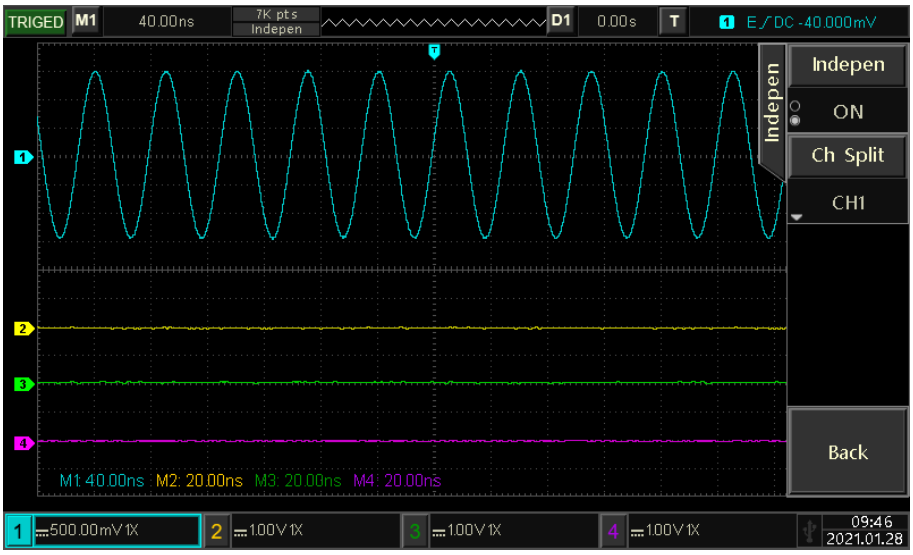
In independent time base, CH1~CH4 can be set to different time base so that user can observe different frequency signals in multiple channels at the same time. Press the HORI MENU → Indepen to enter the independent time base.

As shown below, CH1 is a 10Hz sine wave, CH2 is a 1kHz square wave, CH3 is a 10kHz triangular wave, CH4 is a 100kHz pulse wave. By using the independent time base, signals with different time base can be observed clearly at the same time. Press the CH1 key to enable CH1, then by adjusting the horizontal SCALE knob, user can change the CH1 time base scale, adjustment method for other channels are similar to this.



Split Screen:

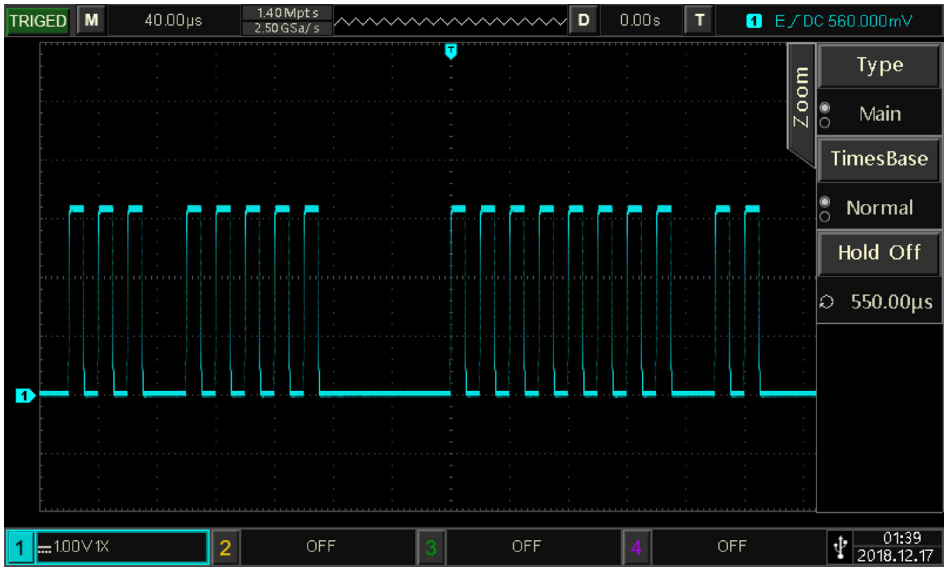
The instrument can split the screen of current channel for easier waveform observation.



3.5 Trigger Hold-off

Trigger hold-off can observe the complex waveforms (such as pulse train). Hold-off time is the amount of time the oscilloscope waits before re-enabling the trigger circuit. During the hold-off period, the oscilloscope will not trigger until the hold-off time is over. For example, a set of pulse train, which is required to trigger on the first pulse, the hold-off time can be set to the pulse train width.

Press the HORI MENU on the horizontal control area and then adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the trigger hold-off time. Input a combined waveform to CH1, and adjust the trigger hold-off time until the waveform can be triggered steadily, as shown below:



Chapter 4 Sampling System Settings

Sampling is taking the analog input signal and converts it into discrete points by using the analog to digital converter (ADC).

Press the ACQUIRE key to enter the sample menu.

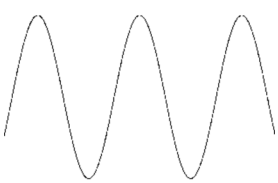
Sample Menu

Functions	Options	Descriptions
Acquisition Mode	Normal sampling	Sampling in the normal way
	Peak sampling	Sampling in peak detection mode
	High resolution	Sampling in high-resolution mode
	Envelope	Sampling in envelope mode
	Average	Sampling in an average way
Average	2 ~ 8192	In the average acquisition mode, you can adjust the Multipurpose knob to set the average number of times. The average number of times can be set to 2^n, and n is an integer from 1 to 13.
Memory Depth	Auto	Set the memory depth to automatic, which is the normal memory depth
	7k	Set the memory depth to 7kpts
	70k	Set the memory depth to 70kpts
	700k	Set the memory depth to 700kpts
	7M	Set the memory depth to 7Mpts
	35M	Set the memory depth to 35Mpts
	70M	Set the memory depth to 70Mpts

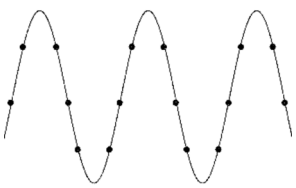
4.1 Sampling Rate

(1) Sampling and Sampling Rate

Sampling means that the oscilloscope samples the input analog signal, converts the sample to digital data, and then collects the digital data into waveform records. Finally, the waveform record is stored in the acquisition memory.



Analog input signal



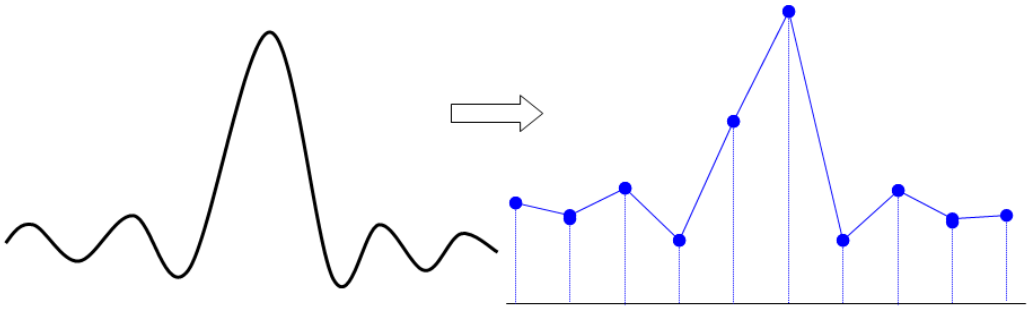
Sampling points

Sampling rate refers to the time interval between two sampling points. The maximum sampling rate of the S series is 2.5 GS/s.

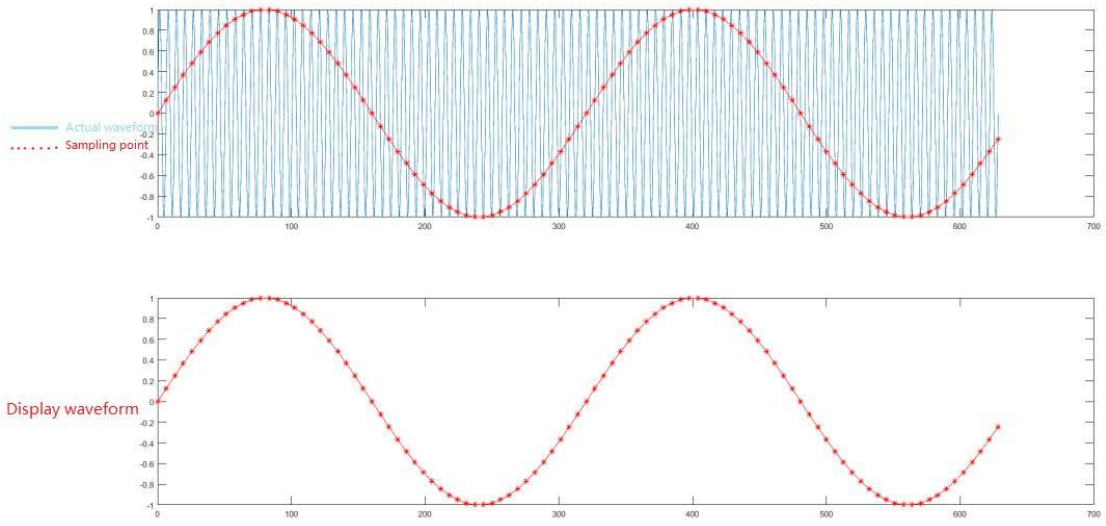
The sampling rate will be affected by the time base scale and the memory depth. MSO3000E oscilloscope displays the sampling rate in real time at the top status bar, user can change the horizontal time base by adjusting the horizontal SCALE knob or change the memory depth to change the sampling rate.

(2) Low Sampling Rate Effect

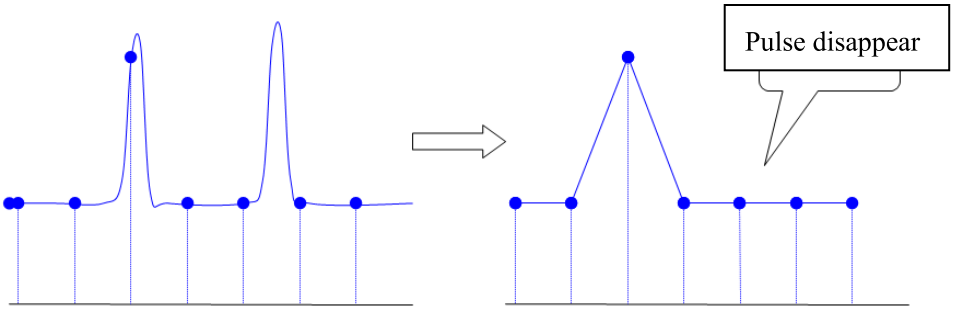
1. Waveform distortion: Due to low sampling rate, the details of the waveform might be missing, the sampling waveform might be much different from the actual signal.



2. Waveform aliasing: Since the sampling rate is less than 2 times of the actual signal frequency (Nyquist Frequency), the frequency of the reconstructed signal will be less than the actual signal frequency.



3. Waveform leakage: Due to low sampling rate, the reconstructed waveform might not reflect the entire actual signal.



4.2 Acquisition Mode

To obtain a waveform from sampling points, press ACQUIRE → Mode to switch the acquisition mode.

(1) Sample (Normal Sampling)

In this acquisition mode, the oscilloscope samples the signal at equal intervals and reconstruct the waveform. For most waveforms, the use of this mode can produce the best display.

(2) Peak (Peak Sampling)

In this acquisition mode, the maximum and minimum values of the input signal are found at each sampling interval, and the waveform is displayed using these values. This way, the oscilloscope can acquire and display a narrow pulse, otherwise the narrow pulse might be missed in the normal sampling mode. Noise might be enlarged in this mode.

(3) High Res (High Resolution)

In this acquisition mode, the oscilloscope averages the neighboring points of the sampled waveform, which can reduce the random noise on the input signal and produce a smoother waveform on the screen.

(4) Envelope

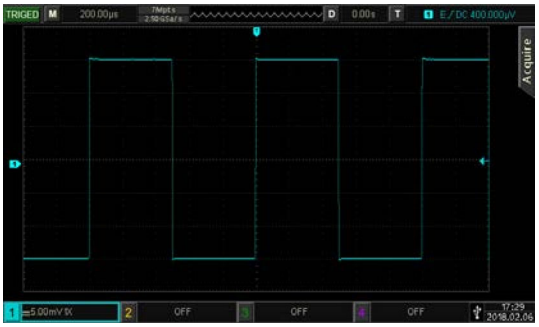
Acquires multiple waveforms, and calculates and displays the maximum and minimum values for all sampling points that are at the same time relative to the trigger points. The general envelope mode uses the peak detection mode for each individual acquisition.

(5) Average

In this acquisition mode, the oscilloscope acquires several waveforms and finds the

average, and displays the final waveform. This method can reduce the random noise. Observe the waveform changes by changing the acquisition mode settings. If the signal contains a large noise, the sample waveforms without average or with 32 times average are displayed below for comparison.

Waveform without average



Waveform with 32 times average

Note: Average and high resolution use different average methods. The former is average of multiple sampling, the latter is average of single sampling.

4.3 Memory Depth

The memory depth refers to the number of waveform points that the oscilloscope can store in one trigger acquisition. It reflects the storage capacity of the acquisition.

Memory depth, sampling rate and wavelength should meet the following formula:

Memory depth = Sampling rate × Horizontal time base × Horizontal grids

8050 Series comes with 70Mpts memory depth (per channel). Press ACQUIRE →Mem Depth to set the memory depth to Auto, 7k, 70k, 700k, 7M, 35M or 70M. The default is automatic.

Chapter 5 Trigger System Settings

Trigger determines when the oscilloscope starts to collect data and display waveform. Once the trigger is correctly set, it can convert unstable signals into meaningful waveforms. In the beginning of data acquisition, it first collects enough data to plot a waveform on the left of the trigger point, and continuously collects data while waiting for the trigger. When a trigger is detected, the device continuously acquires enough data for plotting a waveform to the right of the trigger point.

In this chapter, the 4-channel 8050 Series **will be used as an example.**

5.1 Trigger System Interpretation

(1) Trigger Source

A signal for generating a trigger. Triggers can be obtained from a variety of sources such as input channels (CH1, CH2, CH3, CH4), external trigger (EXT, EXT/5), AC Line, etc.

■ Input Channel: Select any one of the analog signal input terminal CH1 ~ CH4 on the front panel of the oscilloscope as a trigger signal.

■ External Trigger: Select the EXT Trig (EXT or EXT/5 input terminal) input signal from the back of the oscilloscope as a trigger signal. For example, the external clock input can be used on the EXT Trig terminal as a trigger source, including EXT and EXT/5. EXT trigger level ranges from -1.8V ~ +1.8V can be set. EXT/5 trigger level range is increased to -9V ~ +9V.

■ AC Line: Power supply. It can be used to observe signals related to mains, such as relationship between lighting equipment and power supply equipment, so as to achieve stable synchronization.

(2) Trigger Mode

Trigger mode determines the behavior of the oscilloscope during a trigger event. This oscilloscope provides three kinds of trigger modes: Auto, Normal, and Single trigger. Press the MODE on the trigger control area to switch the trigger modes.

■ Auto trigger: When there is no trigger signal, the system automatically runs and displays data. When the trigger signal is generated, it automatically switches to trigger scanning to synchronize with the signal.

Note: This mode allows 40ms/div or slower time scale without triggering in ROLL mode.

■ Normal Trigger: The oscilloscope only collects data when the trigger condition is satisfied. When it is not triggered, the oscilloscope will stop data acquisition and wait for the trigger signal.

■ Single Trigger: Press once the SINGLE key and the oscilloscope will wait for the

trigger. When the instrument detects a trigger, the waveform is sampled and displayed, and enters the STOP state. Press the SINGLE key on the front panel of the oscilloscope to quickly enter the single trigger mode.

(3) Trigger Coupling

Trigger coupling determines which component of the signal will be transmitted to the trigger circuit. The coupling type includes DC, AC, HF Rej (high frequency rejection), LF Rej (low frequency rejection) and Noise Rej (noise rejection).

■ DC: Let all the signal components pass.

■ AC: Blocks DC components and attenuates signals below 10Hz.

■ High frequency rejection: Attenuates high frequency components above 80kHz.

■ Low frequency rejection: Blocks DC components and attenuates low frequency components below 8kHz.

■ Noise rejection: Suppresses high frequency noise in the signal and reduces the probability of the oscilloscope being falsely triggered.

(4) Trigger Sensitivity

The minimum signal required to generate a correct trigger. For example, normally the trigger sensitivity of the input channel (CH1 ~ CH4) is 1div, which means the source signal should be at least 1 div.

(5) Pre-trigger/ Delayed Trigger

Data collected before/after the trigger event.

Trigger position is usually set at the level of the screen, and you can observe 7 grids of pre-trigger and delayed trigger information. The horizontal displacement of the wave can be adjusted by the horizontal displacement POSITION knob in order to observe more pre-trigger information. By observing the pre-trigger data, you can observe the waveform situation before the trigger. For example, capturing the burr generated at the start of the circuit, by observing and analyzing the pre-trigger data, it can help to find out the cause of the burr.

(6) Forced Trigger

Press the FORCE key to generate a forced trigger signal.

If the waveform is not displayed in normal or single trigger mode, press the FORCE key to collect the signal baseline to check whether the acquisition is normal.

5.2 Edge Trigger

Edge trigger uses the rising or falling edge of the trigger signal to generate a trigger.

Press TRIG MENU → Type, and select Edge by the Multipurpose knob, the default trigger type is edge trigger. The trigger type can also be switched by consecutively pressing the Type key, and press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is edge trigger, trigger source is CH1, and it is the rising edge trigger with trigger level of 0.00V.

Edge Trigger Menu

Source:

Press the Source key to select the trigger source of CH1, CH2, CH3, CH4, AC Line, EXT, EXT/5 and D0-D15. The selected source will be displayed on the upper right corner of the screen.

Note: Only selecting the channel with connected signals as the trigger source can obtain a stable trigger.

Edge Type:

Press the Slope key to select which edge the input signal will trigger on, user can select between Rise, Fall and Rise&Fall. The current edge type will be displayed on the upper right corner of the screen.

(1) Rising edge: Triggers at the rising edge of the signal.

(2) Falling edge: Triggers at the falling edge of the signal.

(3) Rise & fall edge: Triggers at the rising edge and the falling edge of the signal.

Trigger Setting:

Press the CommSet key to enter the trigger setting menu.

Trigger Mode:

Press the Mode key to select Auto, Normal, or Single, the corresponding status light will be on. Please refer to the section of Trigger Mode for more details.

Trigger Coupling:

Press the Coupling key to select between DC, AC, HF Rej (high frequency rejection), LF Rej (low frequency rejection) and Noise Rej (noise rejection). For more details, please refer to the section of Trigger Coupling.

5.3 Pulse Width Trigger

The pulse width trigger determines the trigger time according to the pulse width, you can capture the pulse by setting the pulse width condition.

Press TRIG MENU → Type, select Pulse by the Multipurpose knob. You can also switch

the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, which means the trigger type is pulse width, the trigger source is CH1, and the trigger level is 0.00V.

Pulse Width Trigger Menu

Source:

Press Source to select the trigger source, you can select between CH1, CH2, CH3, CH4, AC Line, EXT, EXT/5 and D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Condition:

Press the When key to select from >, < and =.

(1) >: Triggers when the pulse width of the trigger signal is greater than the pulse width setting time.

(2) <: Triggers when the pulse width of the trigger signal is less than the pulse width setting time.

(3) =: Triggers when the pulse width of the trigger signal is equal to the pulse width setting time.

Pulse Width Setting:

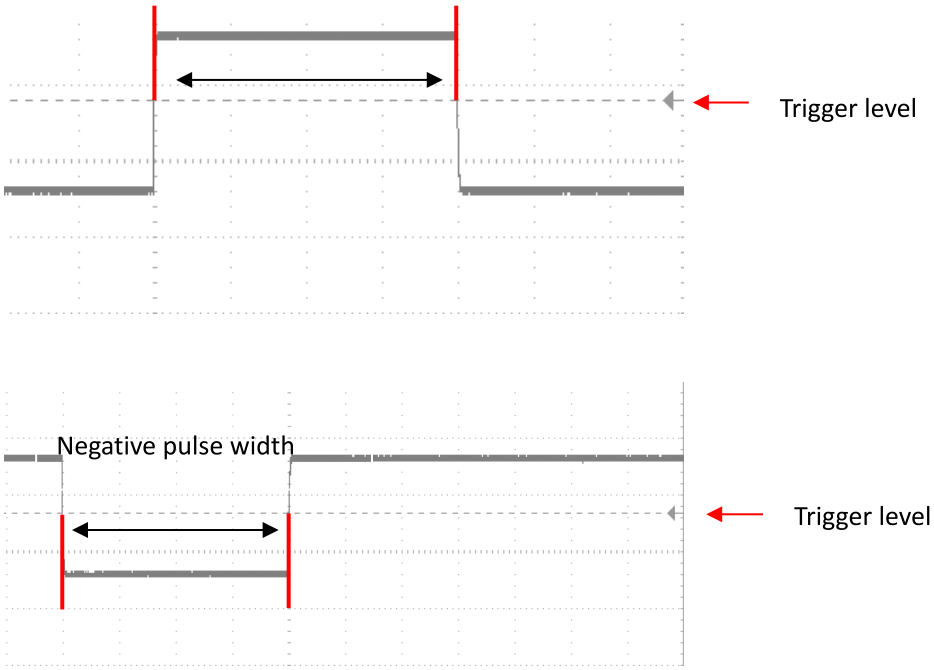
Adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the pulse width time.

Pulse Width Polarity:

Press the Polarity key to select the positive and negative pulse width.

In the oscilloscope, the time difference between the two points where the trigger level intersects with the positive pulse is defined as the positive pulse width; the time difference between the two points where the trigger level intersects with the negative pulse is defined as the negative pulse width, as shown in the figure below.

Positive pulse width



Trigger Setting:

Please refer to the "Trigger Setting" in the edge trigger section.

5.4 Video Trigger

The video signal may contain the image information and the time sequence information, and it has a variety of standards and formats. The MSO3000E can be triggered on the field or line of the NTSC (National Television Standards Committee), PAL (Phase Alternating Line), SECAM (Sequential Couleur A Memoire) standard video signals.

Press TRIGMENU → Type, and select Video by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, which means the trigger type is video, and the trigger source is CH1.

Video Trigger Menu

Source:

Press the Source key to select the trigger source between CH1, CH2, CH3, CH4, EXT and EXT/5. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Video Format:

Press the Standard key to select between PAL, NTSC, and SECAM.

(1) PAL: The frame frequency is 25 frames per second, the TV scan line is 625 lines, the odd field is in the front and the even field is in the rear.

(2) NTSC: The field frequency is 60 fields per second, the frame frequency is 30 frames per second. The TV scan line is 525 lines. The even field is in the front and the odd field is in the rear.

(3) SECAM: The frame frequency is 25 frames per second, the TV scan line is 625 lines, interlaced scanning.

Video Synchronization:

Press the Sync key to select the Even Field, Odd Field, All Line and Line Num (specified lines).

(1) Even Field: Set to trigger and synchronize on the even field of the video signal.

(2) Odd Field: Set to trigger and synchronize on the odd field of the video signal.

(3) All Line: Set to trigger and synchronize on the line signal of the video signal.

(4) Line Num (Specified lines): Set to trigger and synchronize on the specified video lines. You can use the Multipurpose knob to specify the line number, and its setting range is from 1 to 625 (PAL/SECAM), or from 1 to 525 (NTSC).

Tip: In order to observe the waveform details more clearly in the video signal, you can set the memory depth a little bigger. The Protek 8050 Series utilize the Protek original digital three-dimensional technology, it uses a multi-level grayscale display function so that different brightness can reflect the frequency of different parts of the signal. Experienced users can quickly judge the signal quality during the debugging process and find the unusual conditions.

5.5 Slope Trigger

When slope trigger is selected, trigger occurs when the rise or fall slope value matches the value in settings.

Press TRIG MENU → Type, and select Slope by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, which means the trigger type is slope, the trigger source is CH1, and the threshold high level or low level is 0.00V.

Slope Trigger Menu

Source:

Press the Source key to select the trigger source from CH1, CH2, CH3, and CH4. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

Slope Setting:

Press the SlopeSet key to enter the slope setting menu.

Slope:

Press the Slope key to select the slope trigger edge: Rise (rising edge) and Fall (falling edge).

(1) Rising edge: Performs slope trigger by using the rising edge of the trigger signal.

(2) Falling edge: Performs slope trigger by using the falling edge of the trigger signal.

Condition:

Press the When key to select the trigger condition: >, < and =.

(1) >: Triggers when the slew rate of the trigger signal is greater than the set slew rate.

(2) <: Triggers when the slew rate of the trigger signal is less than the set slew rate.

(3) =: Triggers when the slew rate of the trigger signal is basically the same as the set slew rate.

Time Setting:

Adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the time.

Threshold Value:

Press the Threshold key to select the threshold value: Low level, High level, Low&High level. You can also directly press the LEVEL knob in the trigger control area to quickly switch between selections.

(1) Low level: The low level threshold can be adjusted by the LEVEL knob.

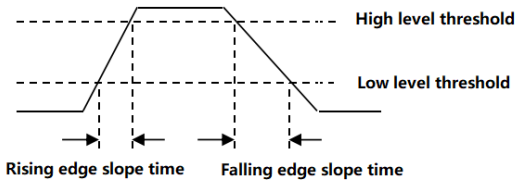
(2) High level: The high level threshold can be adjusted by the LEVEL knob.

(3) High and low level: The high and low level thresholds can be simultaneously adjusted by the LEVEL knob.

Note: The formula for calculating the slew rate is

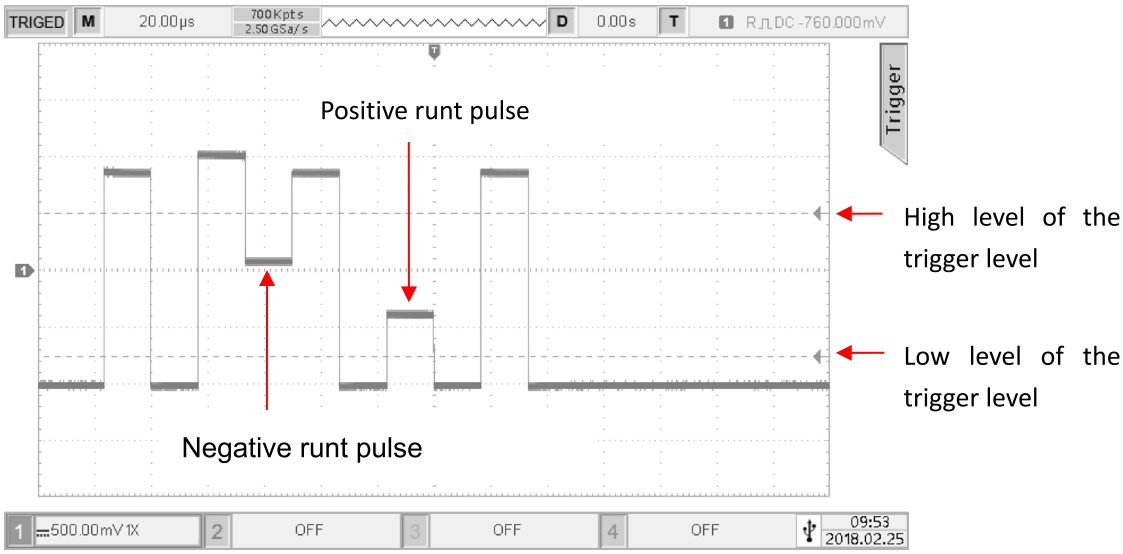
(High level threshold - Low level threshold) ÷ Time

For the set slew rate, the time here is the time setting value. For the slew rate of the trigger signal, the time here refers to the time value between two intersection points where the high level, low level intersect with the trigger signal.



5.6 Runt Trigger

The runt trigger is used to trigger a pulse that has crossed one trigger level but not the other. In this oscilloscope, the positive runt pulse is the pulse that crosses the lower limit of the trigger level but does not cross the upper limit of the trigger level; the negative runt pulse is the pulse that crosses the upper limit of the trigger level but does not cross the lower limit of the trigger level, as shown in the following figure.



Press TRIG MENU → Type, and select Runt by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is runt, the trigger source is CH1, and the low level of the trigger level is -760mV.

Runt Trigger Menu

Source:

Press the Source key to select the trigger source from CH1, CH2, CH3, and CH4. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Polarity:

Press the Polarity key to select the trigger polarity: Positive and Negative.

(1) Positive: Set to trigger on the positive runt pulse.

(2) Negative: Set to trigger on the negative runt pulse.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

Condition:

Press the When key to select the condition: None, >, <, =.

(1) None: Does not set the runt pulse trigger condition.

(2) >: Triggers when the runt pulse width is greater than the set pulse width.

(3) <: Triggers when the runt pulse width is less than the set pulse width.

(4) =: Triggers when the runt pulse width is equal to the set pulse width.

Setting:

Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the time.

Trigger Level:

Press PgDn →TrigLevel to select Low level or High level. You can also directly press the LEVEL knob in the trigger control area to quickly switch between selections.

(1) Low level: The low level of the runt trigger can be adjusted by the LEVEL knob.

(2) High level: The high level of the runt trigger can be adjusted by the LEVEL knob.

5.7 Window Trigger

Select the window trigger, its trigger level has a high level and a low level. The oscilloscope triggers when the rising edge of the input signal crosses the high level or the falling edge crosses the low level.

Press TRIG MENU → Type, and select Window by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is window, the trigger source is CH1, and the low level of the trigger level is 124mV.

Window Trigger Menu

Source:

Press the Source key to select the source from CH1, CH2, CH3, and CH4. The currently

selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Slope:

Press the Slope key to select which slope the input signal will trigger on, you can select from the Rise, Fall and Any edge. The currently slope type is displayed at the upper right corner of the screen.

(1) Rising edge: Triggers on the rising edge of the input signal and when the voltage level is higher than the set high level.

(2) Falling edge: Triggers on the falling edge of the input signal and when the voltage level is lower than the set low level.

(3) Any edge: Triggers on any edge of the input signal and when the voltage level meets the set level.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

Position:

Press the Position key to select the trigger position of Enter, Exit and Time to further determine the trigger time.

(1) Enter: Triggers when the input signals enter into the specified trigger level range.

(2) Exit: Triggers when the input signals exit out of the specified trigger level range.

(3) Time: Triggers when the accumulated hold time after the window enter is greater than or equal to the set window time.

Trigger Level:

Press PgDn → TrigLevel to select Low level or High level. You can also directly press the LEVEL knob in the trigger control area to quickly switch between selections.

(1) Low level: The low level of the window trigger can be adjusted by the LEVEL knob.

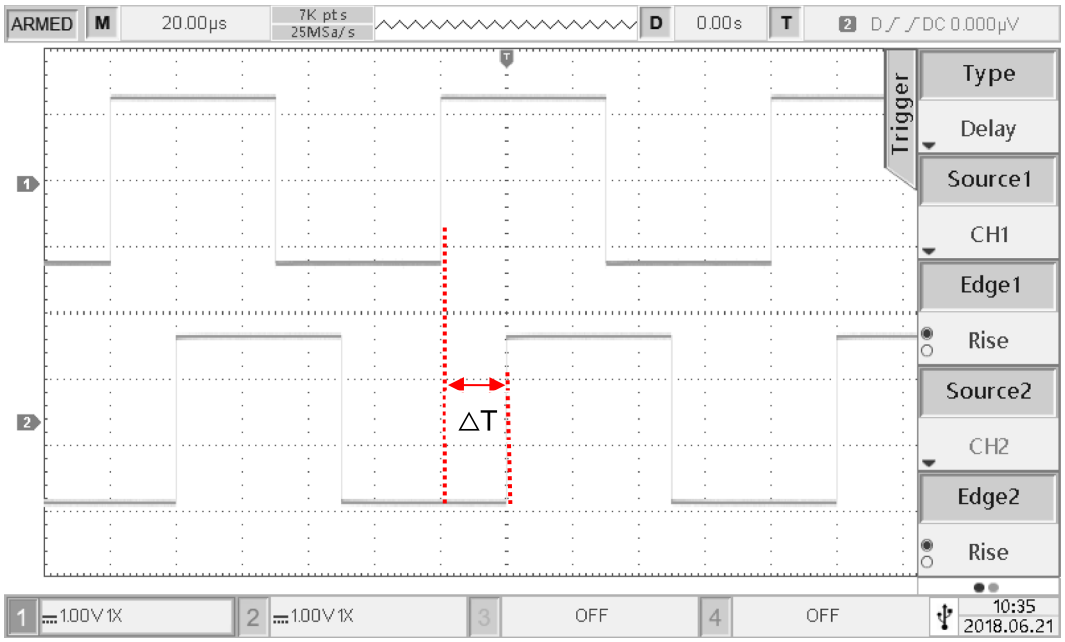
(2) High level: The high level of the window trigger can be adjusted by the LEVEL knob.

Setting:

Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set.

5.8 Delay Trigger

Delay trigger needs to set the trigger source 1 and source 2. The oscilloscope triggers when the time difference (△T) between the edge 1 set by source 1 and the edge 2 set by source 2 meets the preset time limit. As shown in the following figure.



Set edge 1 and edge 2 as the rising edge, △T is the range marked in red in the above figure.

Note: Edge 1 and edge 2 must be the adjacent edges.

Press TRIG MENU → Type, select Delay by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is delay, the trigger source is CH2, and the low level of the trigger level is 0.00V.

Delay Trigger Menu

Source 1:

Press the Source1 key to select the trigger source from CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Edge 1:

Press the Edge1 key to select the trigger edge from Rise and Fall.

(1) Rising edge: Set to trigger at the rising edge of source 1.

(2) Falling edge: Set to trigger at the falling edge of source 1.

Source 2:

Press the Source2 key to select the trigger source from CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Edge 2:

Press the Edge2 key to select the trigger edge from Rise and Fall.

(1) Rising edge: Set to trigger at the rising edge of source 2.

(2) Falling edge: Set to trigger at the falling edge of source 2.

Condition:

Press PgDn → When to select: >, <, < > and > <.

(1) >: Triggers when the time difference (△T) between the edge set by source 1 and the edge set by source 2 is greater than the set time limit.

(2) <: Triggers when the time difference (△T) between the edge set by source 1 and the edge set by source 2 is less than the set time limit.

(3) < >: Triggers when the time difference (△T) between the edge set by source 1 and the edge set by source 2 is greater than the set lower time limit and less than the set upper time limit.

(4) > <: Triggers when the time difference (△T) between the edge set by source 1 and the edge set by source 2 is less than the set lower time limit and greater than the set upper time limit.

Time:

Press PgDn → TimeSel to choose from Normal, Upp limit and Low limit.

(1) Normal: When the trigger condition is > or <, this key can only be normal.

(2) Upper time limit: User can select this option when the trigger condition is < > or > <.

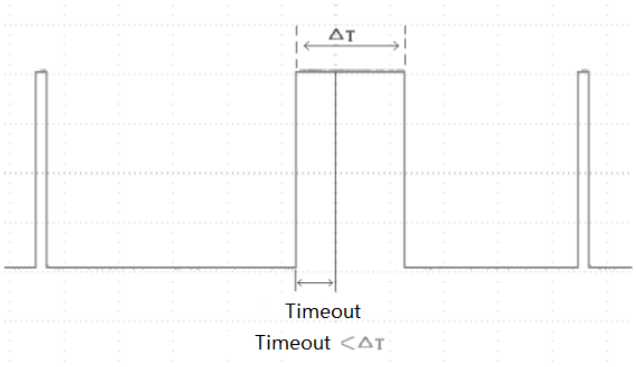
(3) Lower time limit: User can select this option when the trigger condition is < > or > <.

Setting:

Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set.

5.9 Timeout Trigger

Select the timeout trigger to trigger the signal that the time interval (△T) from the rising edge (or falling edge) of the input signal crosses the trigger level to the adjacent falling edge (rising edge) crosses the trigger level is greater than the set timeout time. As shown in the following figure.



Press TRIG MENU → Type, and select TimeOut by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information  is displayed at the upper right corner of the screen, the trigger type is timeout, the trigger source is CH1 and it is triggered at the rising edge, the trigger level is 0.00V.

Timeout Trigger Menu

Source:

Press the Source key to select the trigger source from CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Slope:

Press the Slope key to select which edge the input signal will trigger on, you can select the Rise, Fall and Any edge. The currently edge type is displayed at the upper right corner of the screen.

(1) Rising edge: Set to start timing when the rising edge of the input signal passes the trigger level.

(2) Falling edge: Set to start timing when the falling edge of the input signal passes the trigger level.

(3) Any edge: Set to start timing when any edges of the input signal pass the trigger level.

Timeout Time:

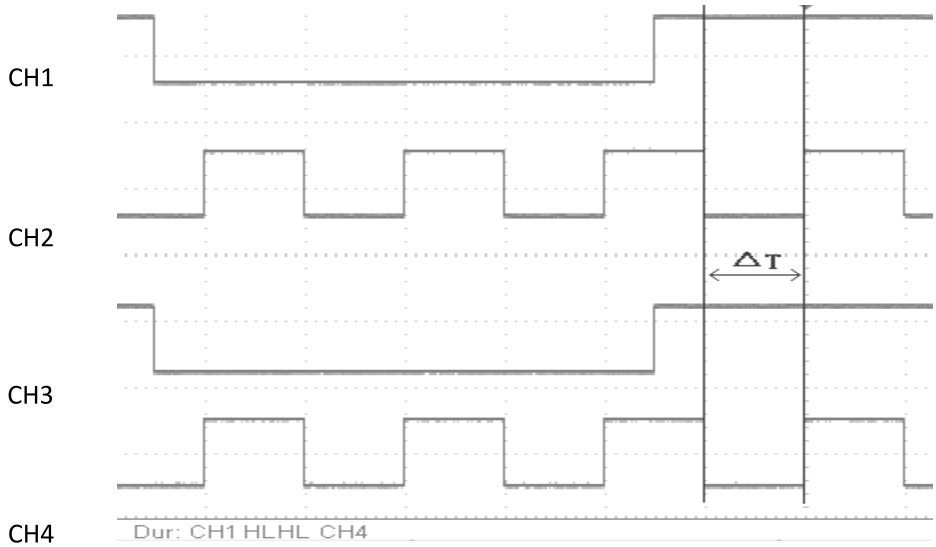
Adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the timeout time.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

5.10 Duration Trigger

With duration trigger selected, the oscilloscope identifies the trigger condition by looking for the duration of the specified codes. The codes are the combination of channel logic "AND", and the value of each channel can be H (high), L (low), or X (ignored). When the duration (△T) of the code meets a preset time, trigger occurs. As shown below.



Picture 5-7 Duration trigger

Press TRIG MENU → Type, select Duration by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is duration, the trigger source is CH1 and it is triggered at the rising edge, the trigger level is 0.00V.

Duration Trigger Menu

Source:

Press the Source key to select the trigger source from CH1, CH2, CH3, CH4 and D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Code:

Press the Code key to select H, L, or X. The code setting of each channel is displayed at the bottom of the screen, as shown in the figure: Dur: CH1 HLXH CH4.

(1) H: Set the code value of the selected channel to high, that is, the voltage level is higher than the trigger level of the channel.

(2) L: Set the code value of the selected channel to low, that is, the voltage level is lower

than the trigger level of the channel.

(3) X: Set the code value of the selected channel to ignored, that is, the channel is not part of the codes. The oscilloscope will not trigger if all channels in the codes are set to X.

Condition:

Press the When key to select: >, < and < >.

(1) >: Triggers when the code duration is greater than the set time.

(2) <: Triggers when the code duration is less than the set time.

(3) < >: Triggers when the code duration is less than the set upper time limit and greater than the set lower time limit.

Time Setting:

Press the TimeSet key to choose from Normal, Upp limit and Low limit.

(1) Normal: When the trigger condition is > or <, this key can only be normal.

(2) Upper time limit: User can select this option when the trigger condition is < >.

(3) Lower time limit: User can select this option when the trigger condition is < >.

Setting:

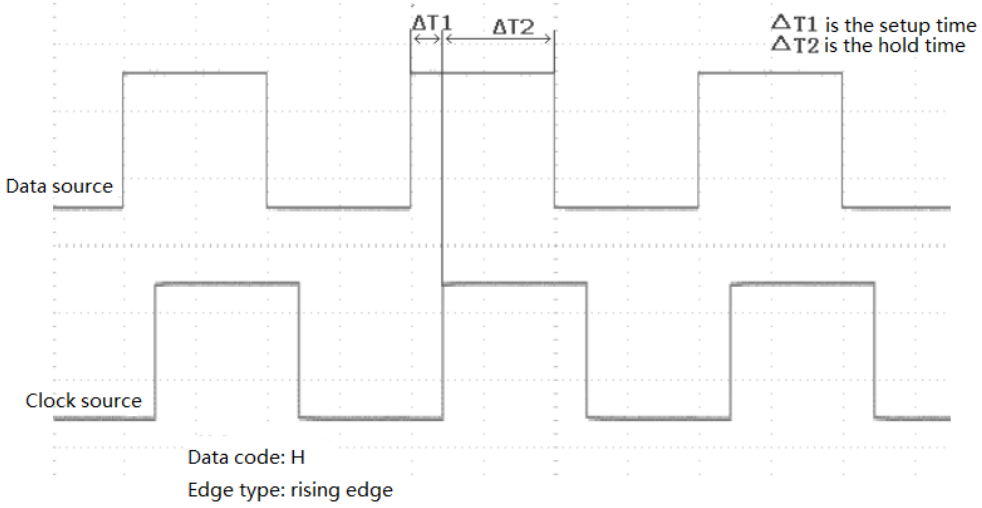
Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

5.11 Setup/Hold Trigger

In setup/hold trigger, you need to set up the data signal line and clock signal line. The setup time begins when the data signal crosses the trigger level and ends when the specified clock edge arrives. The hold time begins when the specified clock edge arrives and ends when the data signal crosses the trigger level again (as shown below). The oscilloscope will trigger when the setup time or the hold time is less than the preset time.



Press TRIG MENU → Type, and select SetupHold by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information  is displayed at the upper right corner of the screen, the trigger type is setup/hold, the trigger source is CH1, and the trigger level is 0.00V.

Setup/Hold Trigger Menu

Data Source:

Press the DataSour key to select CH1, CH2, CH3, CH4 or D0-D15.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Code:

Press the Code key to select H or L.

(1) H: Set the valid code of the data signal to high level.

(2) L: Set the valid code of the data signal to low level.

Clock Source:

Press the ClkSour key to select CH1, CH2, CH3, CH4 or D0-D15.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Clock Edge:

Press the Edge key to select the clock edge type: Rise or Fall.

(1) Rising edge: Set the clock edge type to rising edge.

(2) Falling edge: Set the clock edge type to falling edge.

Setup/Hold:

Press PgDn →Setup/Hold to select from Setup, Hold, S & H.

(1) Setup: Triggers when the setup time is less than the set value.

(2) Hold: Triggers when the hold time is less than the set value.

(3) Setup & Hold: Triggers when the setup time and the hold time are less than the set value.

Time:

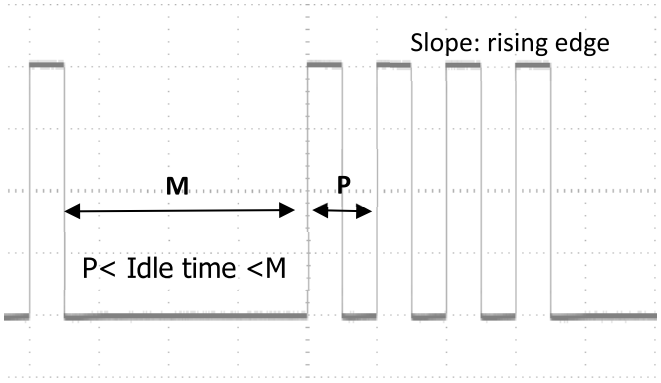
Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the time.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

5.12 Nth Edge Trigger

The Nth edge trigger is triggered on the Nth edge after the specified idle time. For example, in the following waveform, it is set to trigger on the 2nd rising edge after the specified idle time (the time between two adjacent rising edge), then set the idle time as P< idle time <M, M is the time between the 1st rising edge and the next rising edge, P is the maximum time between the counting rising edge.



Press TRIG MENU → Type, and select Nth Edge by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information  is displayed at the upper right corner of the screen, the trigger type is Nth edge, the trigger source is CH1, it is triggered at the rising edge and the trigger level is 0.00V.

Nth Edge Trigger Menu

Source:

Press the Source key to select the trigger source, you can select CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Slope:

Press the Slope key to select which edge the input signal will trigger on, you can select the edge of Rise or Fall. The current edge type is displayed at the upper right corner of the screen.

(1) Rise: Set to trigger on the rising edge of the signal.

(2) Fall: Set to trigger on the falling edge of the signal.

Idle Time:

Adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the idle time.

Trigger Setting:

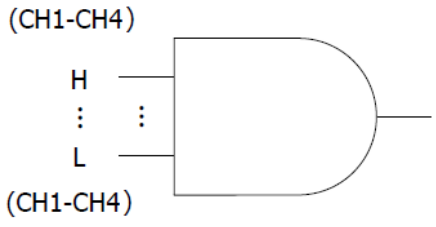
Please refer to the Trigger Setting in the Edge Trigger section for more details.

Edge Value:

Press the PgDn key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the number of edges.

5.13 Code Pattern Trigger

The code pattern trigger identifies the trigger condition by looking for the specified code patterns. The code type is the combination of the channel logic AND, each channel can be set to H (high), L (low), X (ignored). You can also specify a path in the code type as a rising edge or falling edge (only one edge can be specified). If the code pattern of the other channels are "true" (i.e., the actual code is consistent with the default code type), the oscilloscope will trigger on the specified edge. If the edge is not specified, the oscilloscope will trigger at the last edge of the code type "true". If the code pattern of all channels are set to "ignore", the oscilloscope will not trigger.



Press TRIG MENU → Type, and select Pattern by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the type key, then press the Multipurpose knob to confirm.

At this time, the trigger setting information 

is displayed at the upper right corner of the screen, the trigger type is code pattern, the trigger source is CH1, and the trigger level is 0.00V.

Pattern Trigger Menu

Source:

Press the Source key to select the trigger source, you can select CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger.

Code Pattern:

Press the Code key to select H, L, X, Rise or Fall. The code pattern setting of each channel is displayed at the bottom of the screen, as shown: Par: CH1 HHHH CH4。

(1) H: Set the code pattern value of the selected channel to “High”, that is, the voltage level is higher than the trigger level of the channel.

(2) L: Set the code pattern value of the selected channel to “Low”, that is, the voltage level is lower than the trigger level of the channel.

(3) X: Set the code pattern value of the selected channel to “Ignored”, that is, the channel is not part of the code pattern. The oscilloscope will not trigger if all channels in the code pattern are set to “ignored”.

(4) Rise: Set the code pattern to the rising edge of the selected channel.

(5) Fall: Set the code pattern to the falling edge of the selected channel.

Trigger Setting:

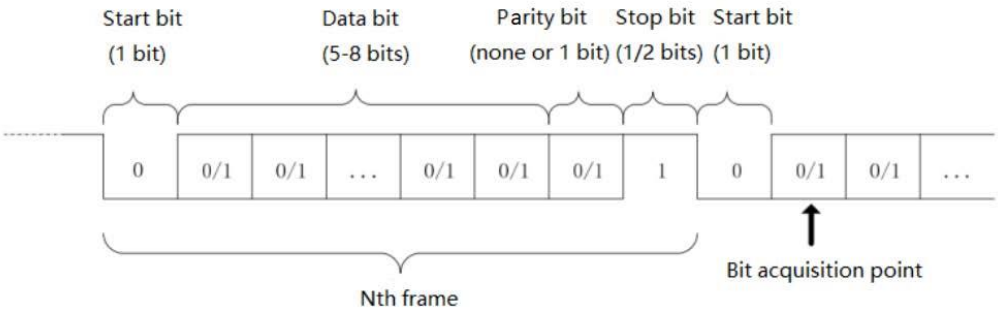
Please refer to the Trigger Setting in the Edge Trigger section for more details.

Chapter 6 Protocol Decoding

8050 Series decodes the input signals of the analog channels using common protocols, including parallel, RS232, I2C, SPI, USB and CAN. Users can easily find errors, debug hardware, and speed up development progress by protocol decoding, which provides guarantees for completing projects with high speed and high quality.

6.1 RS232 Decoding

RS232 interface is the standard asynchronous transmission interface established by Electronic Industries Association. Normally, there are two application types: DB-9 and DB-25, it is suitable for data transmission rate between 0 to 20000b/s, which are widely used in PC communication interface. According to the protocol, the data will be combined to form a group of specific serial bits, and sent out using asynchronous serial method. The data sent each time is composed according to the following rules: a start bit is sent first, followed by 5~8 data bits, then an optional parity bit, and finally 1 or 2 stop bits. The data bits size should be decided by the two communication parties, which can be chosen between 5 to 8 data bits; there may be no parity bits, or the odd parity or even parity can be selected; and the stop bit can be 1 bit or 2 bits. In the following instruction, a data string transmission is called one frame, shown in the figure below:



RS232 Selection:

Press DECODE → Type, and select RS232 by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

Source:

Press the Source key to select the trigger source, you can select CH1, CH2, CH3, CH4 or D0-D15. The currently selected source is displayed at the upper right corner of the screen.

Note: Only selecting the channel with connected signals as a trigger source can obtain a steady trigger and correct decoding.

Polarity:

Press the Polarity key to choose the trigger polarity: Positive or Negative.

(1) Negative: Opposite logic level polarity, i.e. high level is 0, low level is 1.

(2) Positive: Normal logic level polarity, i.e. high level is 1, low level is 0.

Baud Rate:

RS232 communication is an asynchronous transmission communication without clock signals during the data transmission process. In order to solve the data bit problems, the protocol specifies that both communication parties need to agree on the baud rate. Normally, the baud rate is defined as bits transmitted within 1 second. For example, 9600bps means that 9600 bits can be transmitted within 1 second. Note that the start bit, data bit, parity bit and stop bit are all regarded as bits. Therefore, baud rate is not directly equal to valid data transmission rate. The oscilloscope will sample the Bit value according to the set baud rate.

Press the Polarity key to select 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, or Custom (user-defined). When user selects the Custom option, adjust the baud rate by the Multipurpose knob or the shuttle knob.

It is recommended to make reasonable settings based on your RS232 communication hardware and software. Limited by the basic model of the transmission protocol, the RS232 protocol is usually used in short distance (below 20m) and low speed (1Mbps) transmission occasions. Communication beyond these ranges can be disturbed easily or become unreliable.

Bit Width:

Specifies the data bit width of the RS232 protocol signal that needs to be decoded.

Press PgDn →Datawide to select 5bits, 6bits, 7bits, or 8bits.

Bit Sequence:

Specify the data bits of the RS232 protocol signal that needs to be decoded are high bytes in front (MSB) or low bytes in front (LSB).

Press PgDn →BitSeq to select MSB or LSB.

(1) MSB: The high byte of the data transmits first.

(2) LSB: The low byte of the data transmits first.

Stop Bit:

Press PgDn →StopBit to set the stop bit for each frame of data, you can set it to 1 bit or 2 bits.

Parity:

Press PgDn →Parity to set the parity mode for data transmission from None, Even or Odd.

Trigger Condition:

Press PgDn →When to select Start (start of frame), FrameErr (error frame), CheckErr (check error), and Data.

(1) Start of Frame: The waveform trigger is at the start bit of the RS232 protocol (refer to figure). Stable waveforms can be observed by choosing the start of frame trigger when single string signals or multiple same string signals are sent. If the data being sent is changing, the waveform will also change correspondingly.

(2) Error Frame: 0 occurs in the stop state or a data error occurs in the middle of the data bits during the receiving process.

(3) Check Error: Set the RS232 parity bit to 0 or 1 according to the parity principles, the principles are as follows:

- ✧ Odd Parity: If the total number of 1 in the data bits and parity bits is odd, the transmission is correct.
- ✧ Even Parity: If the total number of 1 in the data bits and parity bits is even, the transmission is correct.

With this option, you can quickly find the parity errors during the RS232 communication process, which is convenient for fault analysis and positioning.

(4) Data: Triggers when the data acquired by the oscilloscope is equal to the 2 hexadecimal values set by the user. With this option, you can quickly find the transmission signal with specific data that you are interested in.

Data:

Valid when the trigger condition is data, it can be 00~FF (hexadecimal number).

Set the data using the Multipurpose knob.

Decode Bus:

Press PgDn →DecodeBus to enter the decode bus menu.

(1) BusState: Set the decode bus to Close or Open.

(2) DisType: Set the display format of decode bus, you can set Hex (hexadecimal), Dec (decimal), Bin (binary) or ASCII.

(3) EventTable: Displays the decoded data, corresponding line number, time and error information of the data line in a tabular form for easily observe the longer decoded data.

(4) PseWave (Pseudo Square Wave): Select Open and the bus shows a square wave with logic 1 for high level and logic 0 for low level.

(5) VertPos (Vertical Position): Adjust the Multipurpose knob to change the bus display position.

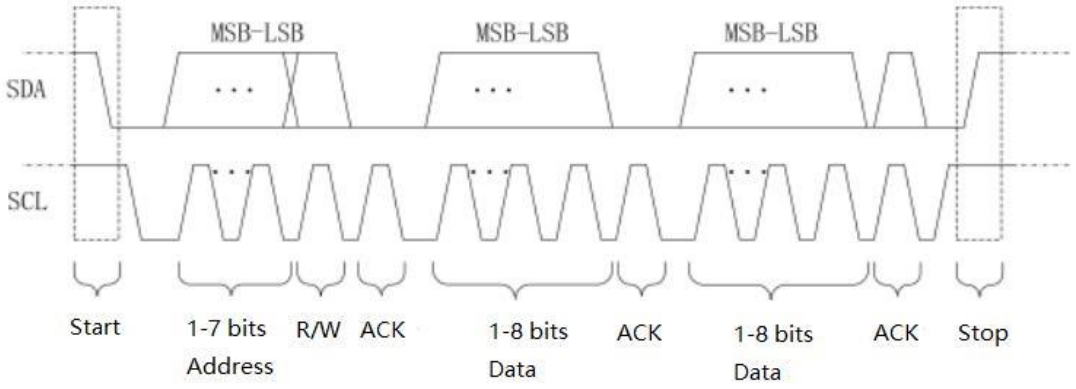
(6) Data Packet: After the device is paused, user can view the decoded data packets.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

6.2 I2C Decode

I2C protocol is usually used to connect a microcontroller and its peripheral equipment, and it is widely used in the field of microelectronics communication control. The bus protocol uses two lines to transmit. One is serial data line SDA, the other is serial clock line. The HOS-SLAVE mechanism is adopted, which is a 2-way communication between host and slave. The bus is multi-host which prevents data destruction through collision detection and arbitration mechanism. It's remarkable that I2C bus has two kinds of address width: 7 bits and 10 bits. The two are compatible and can be combined. Both SCL and SDA are connected to power through pull-up resistors. When the bus is vacant, the two lines are at high level. When any component of bus outputs low level, the bus signals will become low. That is to say, the signals of multi-components are wired AND logic. The special logic relationship is the key point to realize bus arbitration. The protocol requires that data SDA should keep stable when clock line SCL is high. Normally, the data is transmitted by MSB format, as shown below:



I2C Selection:

Press DECODE → Type, and select I2C by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

SCL Source:

Press the SCL key to select the SCL source, you can set any of CH1~CH4 or D0-D15 as the clock input of I2C.

SDA source:

Press the SDA key to select the SDA source, you can set any of CH1~CH4 or D0-D15 as the data input of I2C.

Address Mode:

Press the AddrMode key to select the address mode and set the address bit width of I2C signal that needs to be triggered, you can select 7bits or 10bits.

Operation Direction:

Press PgDn →Direction to select Write or Read.

(1) Write: Triggers when the read/write bit of the I2C protocol is write.

(2) Read: Triggers when the read/write bit of the I2C protocol is read.

Trigger Condition:

Press PgDn →When to set the I2C trigger condition: Start, Restart, Stop, Loss, Addr, Data, A & D.

(1) Start: Triggers at the start time, that is, while the SCL is in high level, the SDA signal has a falling edge.

(2) Restart: Triggers at the restarting moment, that is, after a start signal, and before it stops, the start signal appears again.

(3) Stop: Triggers when the stop bit occurs, that is, while the SCL is in high level, the SDA signal jumps from low to high.

(4) Loss: In I2C protocol, every time after 8 bits of information are transmitted, the data receiver needs to send an acknowledgement signal, which is the ACK bit in the above figure when the SCL is in high level, the SDA signal is low. The loss trigger will occur while the SCL and SDA signal at the ACK bit are both high.

(5) Addr (Address): Triggers when the communication address is the same with the user setting address. It can help to quickly locate the address transmission.

(6) Data: Triggers when the detected data is equal to/ greater than/ less than/ not equal to the set Value. This feature is convenient for the data analysis and can capture the abnormal data.

(7) A & D (Address & Data): Triggers when the addresses are the same and the data relationship meets the set conditions during the transmission process. This trigger condition makes it easy to implement the I2C's specified address and data trigger, and help to analyze the transmission.

Data Setting:

Press PgDn →DataSet to enter the data setting menu.

(1) Condition: Used to determine the data, you can select >, <, =.

>: Valid when the trigger condition is data or address/data, triggers when the actual I2C protocol data is greater than the set data.

<: Valid when the trigger condition is data or address/data, triggers when the actual I2C protocol data is less than the set data.

=: Valid when the trigger condition is data or address/data, triggers when the actual I2C

protocol data is equal to the set data.

(2) Bytes: Valid when the trigger condition is data or address/data, set the data byte size of the specified data from 1~5.

(3) Data(hex): Valid when the trigger condition is data or address/data, each byte length can be set from 00~FF (hexadecimal number). You can set the data by the Multipurpose knob, and press the back key to return to the previous setup menu.

Decode Bus:

Please refer to the RS232 Decode Bus.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

6.3 USB Decode

USB (Universal Serial Bus) is a serial bus standard for connecting computer systems to their peripheral devices, and it is also a technical specification for input and output interfaces. USB uses differential pairs to transmit signals, different protocol versions define different transmission rates such as low speed (1.5Mbps), full speed (12Mbps), high speed (480Mbps), and over speed (5Gbps). The MSO3000E provides both low speed and full speed rates.

USB Selection:

Press DECODE → Type, and select USB by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

D+ Source:

Press the D+ key to set any of CH1~CH4 or D0-D15 as the USB D+ input source.

D- Source:

Press the D- key to set any of CH1~CH4 or D0-D15 as the USB D- input source.

Speed:

Press the Speed key to set Low speed (1.5Mbps) or Full speed (12Mbps).

Trigger Condition:

Press the When key to set the USB trigger condition. MSO3000E provides Sync, Reset, Pause, Resume, End, Token, Data, HandShake and Error.

When the trigger condition is Token packet, set the following:

(1) Token Type: Includes 5 types: Any, OUT, IN, SOF, SETUP.

(2) Endpoint: Adjust the Multipurpose knob to set the endpoint position.
(3) TrigWhen: Includes 8 types: =, !=, <, >, >=, <=, <> and ><.
(4) AddrSet: Adjust the Multipurpose knob to set the address value.

When the trigger condition is HandShake packet, set the following:
Type: Select ANY, ACK, NAK or STALL.

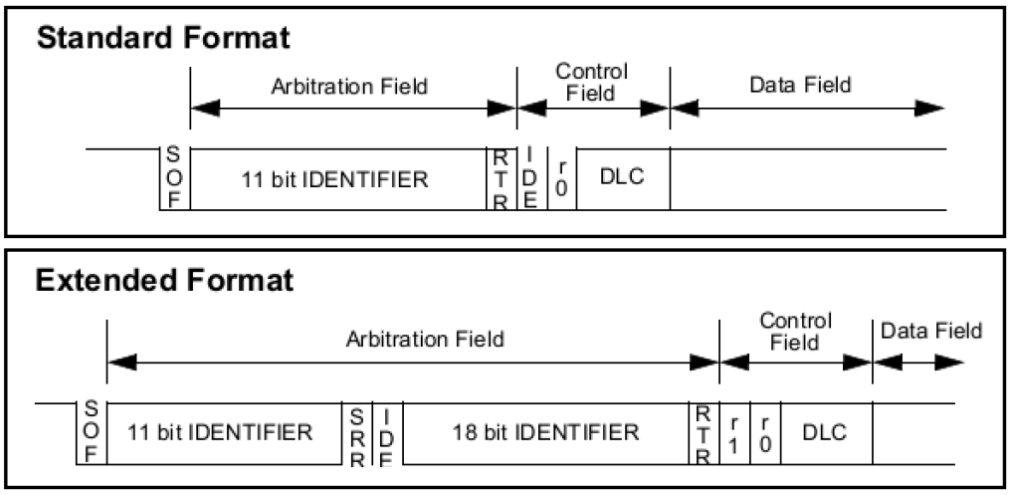
When the trigger condition is data packet, set the following:
(1) Data Type: 3 types of ANY, DATA0, DATA1.
(2) BytesNum: Adjust the Multipurpose knob to set the number of bytes.
(3) Data Offset: Adjust the Multipurpose knob to set the offset value.
(4) Trig When: Includes 8 types: =, !=, <, >, >=, <=, <> and ><.
(5) DataSet: Adjust the Multipurpose knob to set the data value.

Decode Bus:
Please refer to the RS232 Decode Bus.

Trigger Setting:
Please refer to the Trigger Setting in the Edge Trigger section for more details.

6.4 CAN Decode

CAN (Controller Area Network) is a kind of serial communication protocol, which allows devices on the network to communicate with each other directly, and there is no need for the host to control the communication on the network. It adopts the differential signal transmission and uses the bit stuffing method for signal encoding. It will insert a complement bit after every 5 identical bits, and the high bytes data will be sent first. The CAN protocol signal format is shown in the figure below:



CAN Selection:

Press DECODE → Type, and select CAN by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

Signal Type:

Press the SignalType key to set the CAN signal type: CAN_L, CAN_H, RX TX and Diff.

Input +:

Press the Input+ key to set any of CH1~CH4 or D0-D15 as a signal of CAN decoding or differential bus.

Sample %：

Adjust the Multipurpose knob or shuttle knob to set the Input+ sampling point ratio (1%~99%).

Trigger Condition:

Press PgDn →Trig When to set CAN trigger condition: Start, Type, ID, Data, LossAck, BitFill, ID&data and End.

Start: Triggers at the start of the CAN protocol data frame.

Type: Triggers on the specified frame type, including Data, Remote, Error, and Overload.

ID: Set the ID for the specified frame type, and triggers on the specified ID.

Data: A 2-digit hexadecimal number of 1~8 bytes can be set. When the actual CAN protocol signal and the set data meet the data qualification conditions, a trigger occurs. The data qualification includes <, >, ≤, ≥, =, !=.

LossACK: Triggers when the ACK Field of the data frame is lost.

BitFill: Since the CAN signal encoding uses bit stuffing, a complement bit is inserted after every 5 identical bits, and it triggers when the complement bit is filled incorrectly.

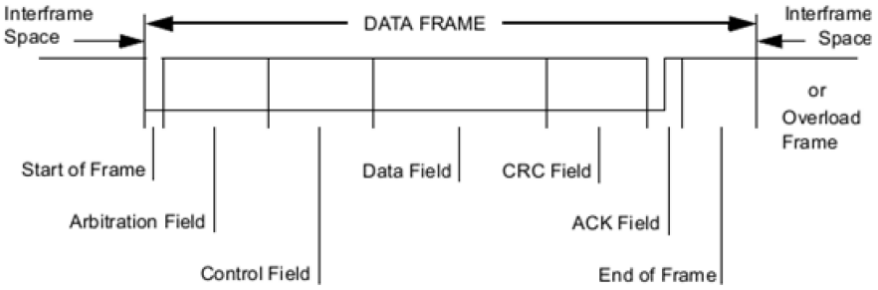
ID&Data: Triggers when it meets the ID and data conditions at the same time.

End: Triggers at the end of the data frame.

Frame Type:

When the trigger condition is Type, the frame type can be set between Data, Remote, Error, and Overload.

(1) Data: Triggers on the data frame of the CAN protocol signal. The data frame format is as follows:



(2) Remote: Triggers on the remote frame of the CAN protocol signal. Remote frames are the same as data frames except that there is no data field. Remote frames and data frames are differentiated by the arbitration field RTR bit.

(3) Error: Triggers on the error frame of the CAN protocol signal. The error frame is represented by a 6-bit continuous level that breaks the bit stuffing rule followed by a recessive value (logic 1) of a minimum of 8 bits as the error delimiter. Error frames are divided into active error frames and passive error frames. Active error frames use 6-bit dominant values (logic 0), and passive frames use recessive values.

(4) Overload: Triggers on the overload frame of the CAN protocol signal. The overload frame format is the same as the active error frame.

Press the Type key and you can set the frame type.

ID Setting:

When the trigger condition is ID or ID&Data, ID setting is required.

Press PgDn → IDSet to enter the ID setting menu:

Format: Set the frame format as Standard or Extended.

StandardID: Standard ID can be 000 ~ FFF.

ExtendedID: Extended ID can be 00000 ~ FFFFF.

Direction: Set the ID direction to Read or Write.

After setting the ID, press the Return key to return to the previous setting menu.

Data Setting:

When the trigger condition is Data or ID&Data, data setting is required.

Press PgDn →DataSet to enter the data setting menu:

TrigWhen: Includes 6 types: =, !=, <, >, <=, >=.

ByteNum: 1 ~ 8 bytes can be set.

Data(hex): Adjust the Multipurpose knob to set the data, press the knob to jump to the next digit to adjust.

After setting the data, press the Return key to return to the previous setting menu.

Baud Rate:

Press PgDn →Rate to set the rate of the CAN protocol signal that needs to be decoded, you can select 10kb/s, 20kb/s, 33.3kb/s, 50kb/s, 62.5kb/s, 83.3kb/s, 100kb/s, 125kb/s,

1Mb/s or Custom (user-defined).

If Custom is selected, users can customize the baud rate by adjusting the Multipurpose knob or shuttle knob.

Decode Bus:

Please refer to the RS232 Decode Bus.

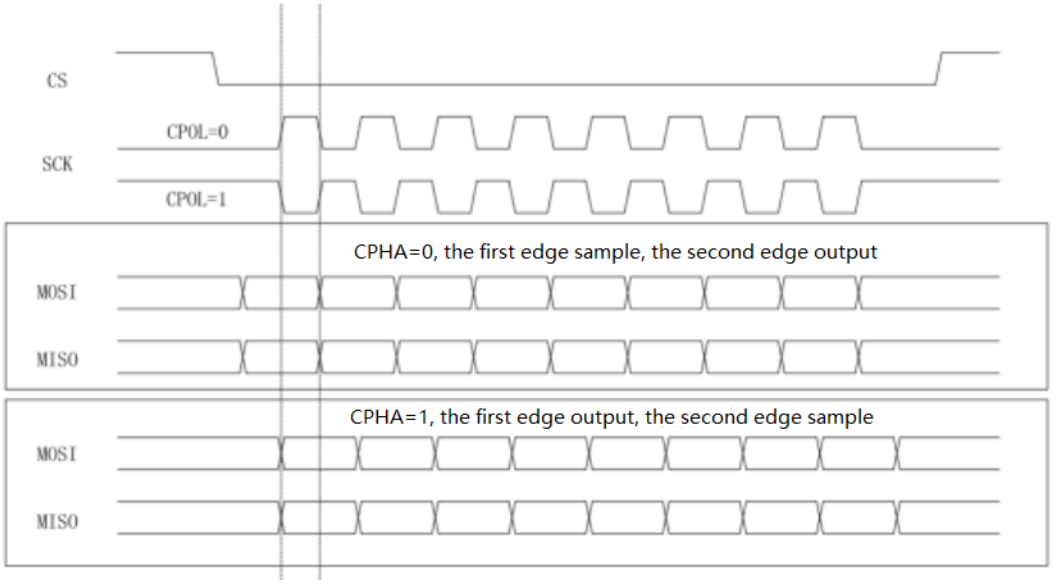
Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

6.5 SPI Decode

SPI interface is a kind of synchronous serial peripheral interface, which can make the host and all kinds of peripheral equipment undertake communication through the serial methods. It is a kind of synchronous communication bus of full duplex. It usually uses four signal lines: MOSI: the host data output, the slave data input; MISO: the host data input, the slave data output; SCLK: clock signal generated by the host; CS: the slave chip selection enable signal.

SPI interface is mainly used for synchronous serial data transmission between the host and low speed peripheral devices. Under the offset pulse of the host, the data is transmitted in bits, that is to say, higher bit first and then lower bit. Since the SPI interface does not need to look for the slave address and is full duplex communication, the protocol itself is relatively simple and therefore is widely used. SPI protocol transmission is shown in the following picture:



Note: At least 3 output channels are required. Therefore, this function is only available on the 4-channel product of series oscilloscopes.

SPI Selection:

Press DECODE → Type, and select SPI by the Multipurpose knob. You can also switch the trigger type by consecutively pressing the Type key, then press the Multipurpose knob to confirm.

CS Source:

Press the CS Source key to set any of CH1~CH4 or D0-D15 as the chip select input of the SPI decoded signal.

SCLK Source:

Press the SCLK Source key to set any of CH1~CH4 or D0-D15 as the clock input of the SPI decoded signal.

MOSI Source:

Press the MOSI Source key to set any of CH1~CH4 or D0-D15 as the data MOSI input of the SPI decoded signal.

MISO Source:

Press the MISO Source key to set any of CH1~CH4 or D0-D15 as the data MISO input of the SPI decoded signal.

CS Polarity:

Press PgDn → CS Polarity, to set the polarity of the chip select signal: Positive or Negative.

Positive: Valid when the chip select signal is positive.

Negative: Valid when the chip select signal is negative.

SCLK Edge:

Press PgDn → SCLK Edge to set the clock signal edge: Rise or Fall.

Rise: Triggers at the rising edge of the clock signal.

Fall: triggers at the falling edge of the clock signal.

MOSI Polarity:

Press PgDn → MOSI Polarity to set the MOSI polarity of the data signal: Positive or Negative.

MISO Polarity:

Press PgDn →MISO Polarity to set the MISO polarity of the data signal: Positive or Negative.

Bit Sequence:

Press PgDn →BitSeq to set the data bits of the SPI protocol signal are high bytes in front (MSB) or low bytes in front (LSB).

Bit Width:

Press PgDn →BitWide to set the bid width of each frame of the SPI protocol signal, it can be 4 ~ 16.

Trigger Condition:

Press PgDn →When to set the SPI trigger condition: Enable chip select or idle time.

Enable chip select includes CS, CS&MOSI, CS&MISO, CS&Any. It triggers on the edge where the chip select level jumps from invalid to valid.

Idle time includes Idle, Idle&MISO, Idle&MOSO, Idle&Any. The idle trigger is triggered at the beginning of a new segment of data after a certain idle time.

Idle Time:

Press PgDn →IdleTime and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set the idle time, the idle time counter counts when the SCK is unchanged, and judges whether the count value exceeds the preset value at the SCK valid edge, if exceeds, the oscilloscope will trigger at the valid edge and clear the counter.

Frame Length:

Press PgDn→FrameLen and adjust the Multipurpose knob to set the length of the data frame.

Data:

Press PgDn→Data and adjust the Multipurpose knob to set the data, press the knob to jump to the next digit to adjust.

Decode Bus:

Please refer to the RS232 Decode Bus.

Trigger Setting:

Please refer to the Trigger Setting in the Edge Trigger section for more details.

Chapter 7 Mathematical Operation

8050 series mixed signal oscilloscope carries a variety of mathematical operations:

- Math: Source 1+source 2, source 1-source 2, source 1*source 2, source 1/source 2
- FFT: Fast Fourier Transform
- Logic operation: AND, OR, NOT, XOR
- Digital filter
- Advanced operation

Press the MATH key on the vertical control area to enter the mathematical operation menu. The POSITION and the SCALE knobs can be used to change the vertical position and the vertical scales of the waveforms. The horizontal time base scale cannot be adjusted independently for the math operation waveforms, it will change automatically according to the horizontal time base scale of the analog input channel.

Math operation cursor  marks the result of a mathematical operation.

7.1 Mathematical Function

Press MATH → Type, and select Math to enter the math menu.

Source 1:

Press the Source1 key to select any of CH1, CH2, CH3 or CH4 as source 1 of mathematical operations.

Operator:

Press the Operator key to select +, -, *, /.

(1) +: The waveforms of source 1 and source 2 are added point by point.

(2) -: The waveforms of source 1 and source 2 are subtracted point by point.

(3) *: The waveforms of source 1 and source 2 are multiplied point by point.

(4) /: The waveforms of source 1 and source 2 are divided point by point.

Source 2:

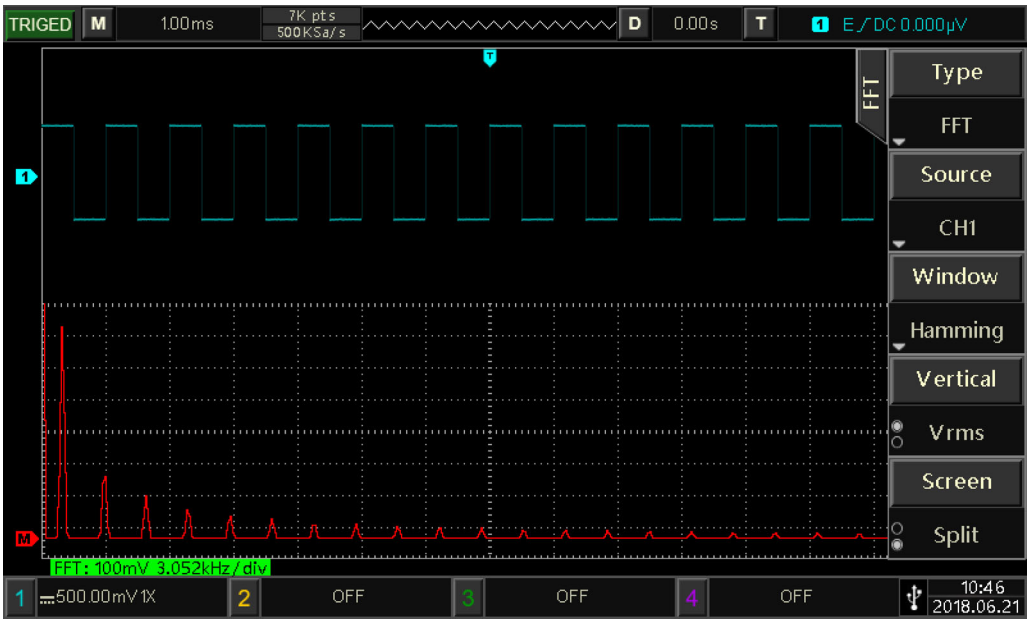
Press the Source2 key to select any of CH1, CH2, CH3 or CH4 as source 2 of mathematical operations.

7.2 FFT

Using FFT (Fast Fourier Transform) mathematical operations, the time domain signal (YT) can be converted into frequency domain signal. The following types of signals can be easily observed using FFT:

- Harmonic content and distortion in measurement system

- Performance of noise in DC power supply
- Vibration Analysis



Picture 7-1 FFT frequency spectrum

Press MATH → Type and select FFT to enter the FFT menu.

Source:

Press the Source key to select any of CH1, CH2, CH3 or CH4 as the source of FFT operations.

Window:

Window function, press the Window key to select Hamming, Blackman, Rectangle, or Hanning.

(1) Rectangle: It has the best frequency resolution and the worst amplitude resolution, which is similar to the one with no window. It is suitable for measuring the following waveforms:

Transient or short pulse, the signal level is almost equal before and after this.

Equal amplitude sine wave with very similar frequency.

Wide-band random noise in a slowly changing spectrum.

(2) Hanning: Compared with the rectangle window, it has better frequency resolution, but poorer amplitude resolution. It is suitable for measuring sine, periodic and narrow-band random noise waveforms.

(3) Hamming: The frequency resolution is slightly better than that of Hanning window, and it is suitable for measuring transient or short pulse, and the waveform with great difference before and after the signal level.

(4) Blackman: It has the best amplitude resolution, and the worst frequency resolution. It is suitable for measuring the single frequency signals or seeking higher harmonics.

Vertical Unit:

The unit of the FFT operation result. Press Vertical to select Vrms or dBVrms. Vrms and dBVrms displays the vertical amplitude in a logarithmic way and a linear way. If you need to display the FFT spectrum in a large dynamic range, dBVrms is recommended.

Screen Setting:

Press the Screen key to select Full or Split screen.

(1) Split screen: Displays the source waveform and the waveform of FFT operation result separately.

(2) Full screen: Displays the source waveform and the FFT operation results on the same window that you can observe the spectrum more clearly and make more accurate measurements.

FFT Operation Tips

Signals with DC components or deviations can cause errors or deviations in the FFT waveform components. To reduce the DC component, the channel can be set to AC coupling.

To reduce the random noise and aliasing frequency components of the repetitive or single pulse, you can set the oscilloscope acquisition mode to Average acquisition.

7.3 Logic Operation

Press MATH → Type and select Logic to enter its menu.

Expression:

Press the Expression key to select AND, OR, NOT, XOR.

(1) AND: Performs “AND” logic operation for every point of source 1 and source 2.

(2) OR: Performs “OR” logic operation for every point of source 1 and source 2.

(3) NOT: Performs “NOT” logic operation for every point of source 1, source 2 will not be displayed at this moment.

(4) XOR: Performs “XOR” logic operation for every point of source 1 and source 2.

Performs logic operations for all points of the source waveform voltage and displays the results. During operation, when the source channel voltage value is greater than the threshold value, it is determined as logic “1”, otherwise it is logic “0”. Converting waveforms to binary for logical operations is shown below:

Source 1	Source 2	AND	OR	XOR		Source1	NOT
0	0	0	0	0		0	1
0	1	0	1	1		1	0
1	0	0	1	1			

1	1	1	1	0			

Source 1:

Press the Source1 key to select any of CH1, CH2, CH3 and CH4 as source 1 of logic operations.

Source 2:

Press the Source2 key to select any of CH1, CH2, CH3 and CH4 as source 2 of logic operations.

Invert:

Press the Invert key to select ON or OFF. Select on to invert the waveform of the logic operation.

Threshold 1:

Press the PgDn key, and adjust the Multipurpose knob to change the value of Threshold 1. When the voltage value of the source channel is greater than the value of Threshold 1, it is identified as logic “1”, otherwise it is logic “0”.

Threshold 2:

Press the PgDn key, and adjust the Multipurpose knob to change the value of Threshold 2. When the voltage value of the source channel is greater than the value of Threshold 2, it is identified as logic “1”, otherwise it is logic “0”.

7.4 Digital Filter

Press MATH → Type, select Filter to enter its menu.

Source:

Press the Source key to select any of CH1, CH2, CH3 and CH4 as the source of digital filter.

Filter Type:

Press the FilterType key to select Low Pass, High Pass, Band Pass or Band Stop.

(1) Low pass: Only signals with the source frequency lower than the current frequency upper limit are allowed to pass.

(2) High pass: Only signals with the frequency higher than the current frequency lower limit are allowed to pass.

(3) Band pass: Only signals with the frequency that are higher than the current frequency lower limit and lower than the current frequency upper limit are allowed to pass.

(4) Band stop: Only signals with the frequency that are lower than the current frequency lower limit or higher than the current frequency upper limit are allowed to pass.

Frequency Lower Limit:

Adjust the Multipurpose knob to change the value of the frequency lower limit. When in low pass, the frequency lower limit is invalid and the menu is hidden.

Frequency Upper Limit:

Adjust the Multipurpose knob to change the value of the frequency upper limit. When in high pass, the frequency upper limit is invalid and the menu is hidden.

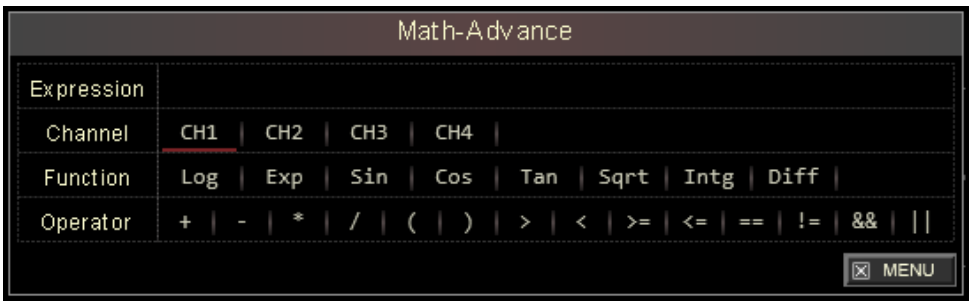
Note: The setting range of the frequency upper and lower limit is related to the current horizontal time base.

7.5 Advanced Operation

Press MATH → Type, select Advanced to enter its menu.

Expression:

Press the Expression key to select ON or OFF. If you select on, it will pop up a Math-Advance dialog box, as shown below:



Adjust the Multipurpose knob to select Channel, Function or Operator, then press the knob to display the options in the list after Expression.

When editing the expression, you can press the Delete key to delete the characters in the list after expression, press the Clear key to clear all the characters in the list after expression.

After the expression is edited, press the Apply key and the oscilloscope will perform calculations based on the set expression and display the result. Press the Expression key and select close to observe the result of the expression operation.

Math-Advance Description

(1) Expression: Here refers to the formula consisting of channels, functions, variables, and operators. The length of the expression must not exceed 36 characters.

(2) Channel: You can select CH1, CH2, CH3, or CH4.

(3) Function: Function options are as follows:

Functions	Descriptions
Log	Calculates the logarithm of the selected source.
Exp	Calculates the index of the selected source.
Sin	Calculates the sine value of the selected source.
Cos	Calculates the cosine value of the selected source.
Tan	Calculates the tangent value of the selected source.
Sqrt	Calculates the square root of the selected source.
Intg	Calculates the integral of the selected source.
Diff	Calculates the discrete-time differential of the selected source.

Note: The device automatically adds “(” after a function is entered, it will be more convenient for your use.

(4) Operator: The description of each operator is as follows:

Functions	Descriptions
+, -, *, /	Arithmetic operators: add, subtract, multiply, divide.
( )	Parenthesis, it is used to increase the operation priority within parenthesis.
<, >, <=, >=, ==, !=	Relational operators: less than, greater than, less than or equal to, greater than or equal to, equal, not equal to.
||, &&	Logical operators: or, and.

Chapter 8 Display System Settings

8.1 Waveform Display Setting

You can set the waveform display type, display format, duration, grid brightness, waveform brightness, and color temperature.

Display Type:

Press DISPLAY → Type to select display mode as Vector or Dots.

(1) Vector: This mode provides the most realistic waveforms in most cases, allowing users to easily view the steep edges of the waveforms (such as square waves).

(2) Dots: Displays the sampling dots directly.

Display Format:

Press DISPLAY → Format to select YT, XY 1&2, XY 3&4.

(1) YT: Displays voltage value on time scale (horizontal scale).

(2) XY 1&2: Displays the Lissajous figure of CH1~CH2 waveforms, you can easily measure the phase difference between the two signals of the same frequency.

(3) XY 3&4: Displays the Lissajous figure of CH3~CH4 waveforms, you can easily measure the phase difference between the two signals of the same frequency. (Only for 4-channel models).

Grid Brightness:

Press DISPLAY →Grid Bright, and adjust the Multipurpose knob or shuttle knob to set the grid brightness.

Waveform Brightness:

Press DISPLAY →WaveBright, and adjust the Multipurpose knob or shuttle knob to set the waveform brightness.

Persist:

Press DISPLAY →Persist to select Min, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s or Infinite.

Color Temperature:

Press DISPLAY →PgDn →Color, select ON and it will directly reflect the probability of waveform signal occurrence. A waveform with a high frequency of occurrence is displayed in warm colors, and a waveform with a low frequency of occurrence is displayed in cool color.

Inverse Color Temperature:

Press DISPLAY →PgDn → ColorInvert and select ON, this function is opposite to the color temperature function.

Note: The inverse color temperature is available only when the color temperature is set to ON.

8.2 XY Mode

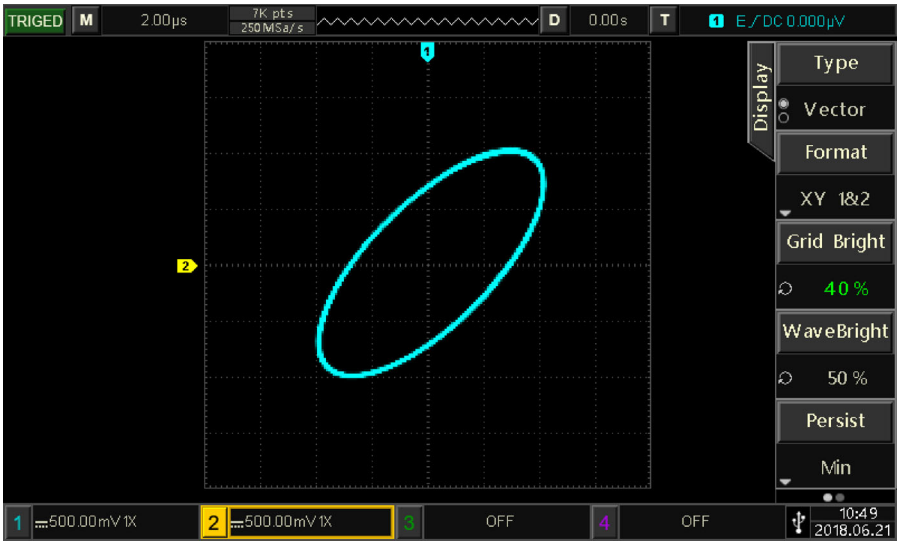
The waveform displayed in XY mode is also called the Lissajous figure.

When XY 1&2 are selected, the CH1 signal is input on the horizontal axis (X axis), and the CH2 signal is input on the vertical axis (Y axis).

When XY 3&4 are selected, the CH3 signal is input on the horizontal axis (X axis), and the CH4 signal is input on the vertical axis (Y axis). Only 4-channel models have this function.

In X-Y mode, when CH1 or CH3 is activated, use the horizontal POSITION knob to move the XY figure in the horizontal direction. When CH2 or CH4 is activated, use the vertical POSITION knob to move the XY figure in the vertical direction.

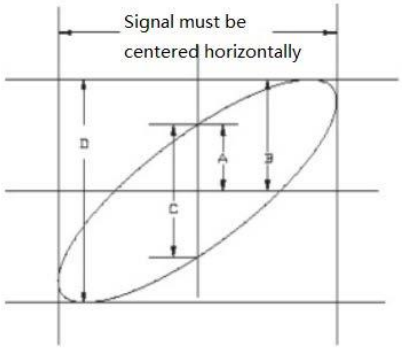
Adjust the vertical SCALE knob to change the amplitude of each channel, and adjust the horizontal SCALE knob to change the time base to get a better display effect of the Lissajous figures. The waveform in XY mode is shown in the following figure:



Picture 8-1 Waveform display in XY mode

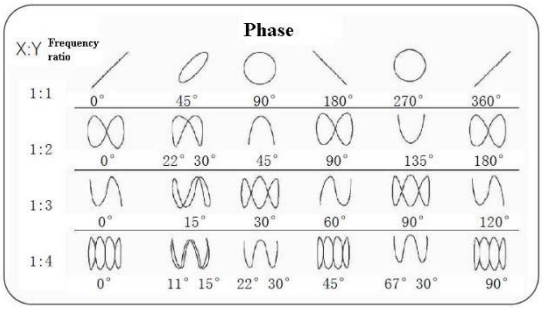
8.3 Application of XY Mode

The Lissajous method makes it easy to observe the phase difference between two signals of the same frequency. The following figure shows the observation of phase difference.



According to sinθ = A/B or C/D, θ is the phase difference angle between channels, and the definition of A, B and C, D are shown above, it can be calculated that the phase difference angle θ = ± arcsin (A/B) or θ = ± arcsin (C/D). If the main axis of the ellipse is in the quadrants I, III, then the calculated phase difference angle should be in the quadrants I, IV, i.e. within (0~π/2) or (3π/2~2π); If the main axis of the ellipse is in the quadrants II, IV, then the calculated phase difference angle should be within (π/2~π) or (π~3π/2).

In addition, if the frequency or phase difference of the two detected signals is an integer, the frequency and the phase relationship between the two signals can be calculated according to the pattern in the following chart:

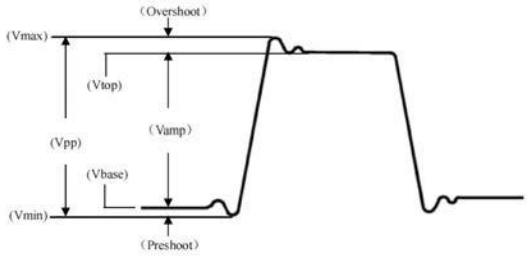


Chapter 9 Automatic Measurement

9.1 Parameter Measurement

8050 series mixed signal oscilloscope can automatically measure 34 kinds of parameters.

Voltage:



Vmax: Voltage value from the highest point to GND.

Vmin: Voltage value from the lowest point to GND.

Vtop: Voltage value from the flat top to GND.

Vbase: Voltage value from the bottom to GND.

Middle: (Vtop + Vbase) / 2

Vpp: Vmax – Vmin

Vamp: Vtop – Vbase

Mean: Average amplitude of the waveform on screen

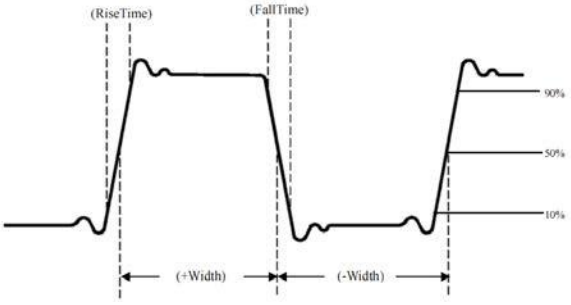
CycMean: Average amplitude of the waveform in one period

RMS: The effective value. According to the energy produced by the AC signal in the conversion, the equivalent energy that the DC voltage corresponds to.

CycRMS: The RMS of one period.

.

Time:



Period: Time between two consecutive, same-polarity edges of a repetitive waveform.

Frequency: The reciprocal of the period

Rise time: Time needed for waveform amplitude rising from 10% to 90%.

Fall time: Time needed for waveform amplitude falling from 90% to 10%.
+Width: The width of a positive pulse at 50% amplitude
-Width: The width of a negative pulse at 50% amplitude

FRFR: Time between the first rising edge of source 1 to the first rising edge of source 2
FRFF: Time between the first rising edge of source 1 to the first falling edge of source 2
FFFR: Time between the first falling edge of source 1 to the first rising edge of source 2
FFFF: Time between the first falling edge of source 1 to the first falling edge of source 2
FLRF: Time between the first rising edge of source 1 to the last falling edge of source 2
FRLR: Time between the first rising edge of source 1 to the last rising edge of source 2
FFLR: Time between the first falling edge of source 1 to the last rising edge of source 2
FFLF: Time between the first falling edge of source 1 to the last falling edge of source 2

Others:
+Duty (Positive duty cycle): Ratio of positive pulse width to period.
-Duty (Negative duty cycle): Ratio of negative pulse width to period.
OverSht (Overshoot): (Vmax - Vtop) / Vamp
PreSht (Preshoot): (Vmin - Vbase) / Vamp
Area: Algebraic sum of the voltage and time product of all points on the screen.
CycArea (Cycle area): The area of one period.
Phase: The phase difference between the master source and the slave source.

9.2 Automatic Measurement Menu

Press the MEASURE key on the front panel to enter the automatic measurement menu.
Automatic Measurement Menu (page 1)

Functions	Options	Descriptions
MasterSrc	CH1, CH2, CH3, CH4, MATH, D0-D15	Select any of CH1, CH2, CH3, CH4, MATH and D0-D15 as signal source for automatic parameter measurement
All Para	OFF	Close all parameters
	ON	Pops up a dialog box of all parameters on the waveform display area
User Defined		A user-defined parameter selection interface pops up on the waveform display area, adjust the Multipurpose knob to select and press the knob to confirm to show the parameter on the screen. Press the User Def key again to close the user-defined

		parameters dialog box.
Statistic	OFF	Close the statistical analysis function.
	Peak	Automatic calculates and displays the current User Def parameters of the average, maximum, and minimum. Only applicable when parameters in User Def are present.
	Difference	Automatic calculates and displays the current User Def parameters of the average, standard deviation, and measurement times. Only applicable when User Def parameters are present.
SlaveSrc	CH1, CH2, CH3, CH4, MATH, D0-D15	Select the slave source that requires two channels for measurement.

Automatic Measurement Menu (page 2)

Functions	Options	Descriptions
IndicatorSel		Adjust the Multipurpose knob to select the parameter indicated by the indicator among the 34 parameters of automatic measurement.
Indicator	OFF	Close indicator.
	ON	Open parameter indicator.
Clear		Clear all User Def parameters.

9.3 All Parameters Measurement

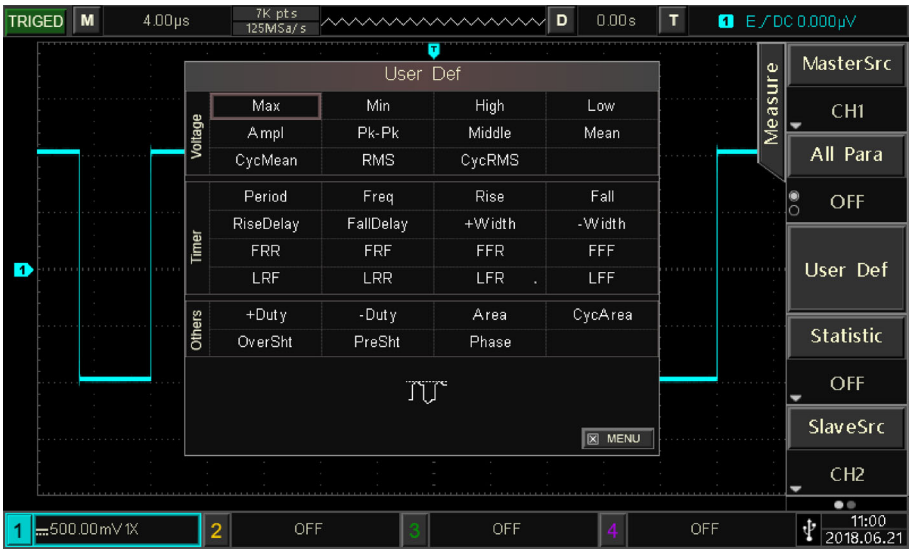
Press MEASURE →All para, select on to measure 34 parameters at one time, as shown below:

Measured parameters color are consistent with the current channel (source).

When "----" is shown, it indicates that the current source has no signal input, or the measurement result is not valid (too large or too small).

9.4 User Defined Parameters

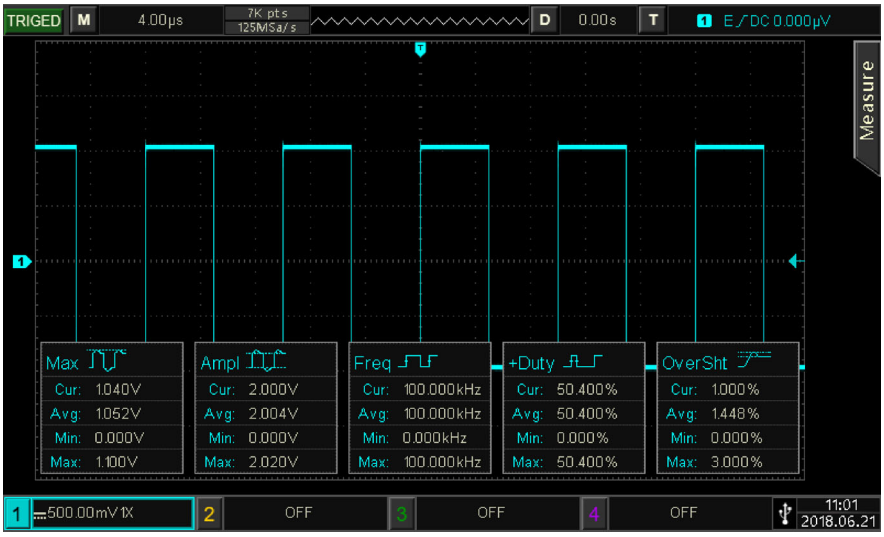
Press MEASURE → User Def, the user-defined parameter selection interface is displayed. As shown below:



Select the parameters by adjusting the Multipurpose knob, and press the knob to confirm. For every selected parameter, a * symbol will appear in front of the parameter.

Press the User Def (F3) key to close the user defined parameter selection menu and the parameters will be displayed at the bottom of the screen. For convenience and immediate view of the automatic measurement results of these parameters, up to 5 parameters can be defined at the same time.

Users can also choose to open the measurement statistical function with the Statistic (F4) key, as shown below:

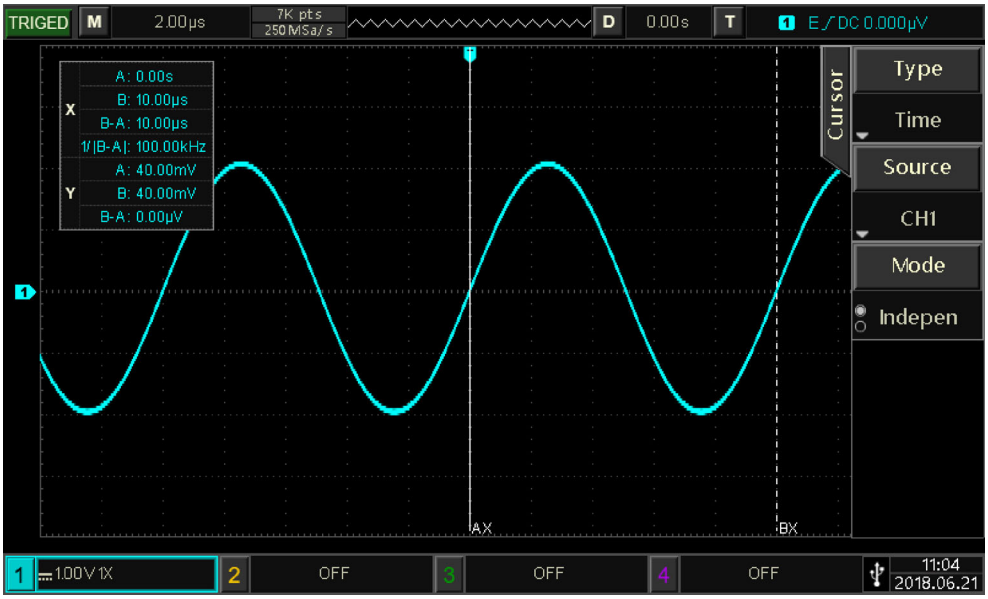

TRIGED
M
4.00μs
7K pts
125MSa/s
D
0.00s
T
1 E⎍DC 0.000μV
Measure
Max
Cur: 1.040V
Avg: 1.052V
Min: 0.000V
Max: 1.100V
Ampl
Cur: 2.000V
Avg: 2.004V
Min: 0.000V
Max: 2.020V
Freq
Cur: 100.000kHz
Avg: 100.000kHz
Min: 0.000kHz
Max: 100.000kHz
+Duty
Cur: 50.400%
Avg: 50.400%
Min: 0.000%
Max: 50.400%
OverSht
Cur: 1.000%
Avg: 1.448%
Min: 0.000%
Max: 3.000%
1 500.00mV 1X
2 OFF
3 OFF
4 OFF
11:01
2018.06.21

Chapter 10 Cursor Measurement

The cursor can be used to measure the X axis value (time) and the Y axis value (voltage) of the selected waveform. Press the CURSOR key to enter the cursor measurement menu.

10.1 Time Measurement

Press the CURSOR key to enter the cursor measurement menu, then press Type to select Time; press Source to select the channel to be measured; press Mode to select Indepen (default). As shown in the figure below:



The upper left corner of the display area shows the cursor measurement information: "X" indicates the time measurement, "Y" indicates the voltage measurement.

Time:

The Multipurpose knob can adjust the vertical cursor AX, press the Multipurpose knob to switch to cursor BX, the adjustment method of cursor BX is the same as AX.

BX-AX: The time measurement.

1/|BX-AX|: The reciprocal of time, or frequency.

For a periodic signal, if the AX and BX are set at the same position on the rising edge of two adjacent cycles, then BX-AX is the period of the signal, and 1/|BX-AX| is the frequency of the signal.

Voltage:

Indicates the waveform voltage value of the current cursor position, that is, AY, BY, and BY-AY.

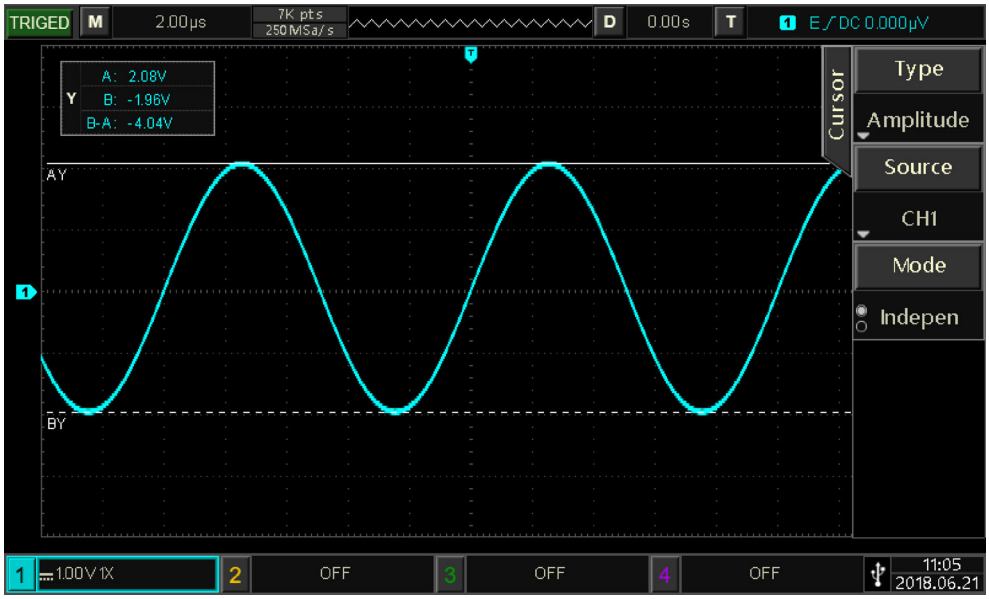
Press Mode to select tracking, adjust the Multipurpose knob and the cursor AX and BX will

move simultaneously.

10.2 Voltage Measurement

The method for voltage measurement is similar to the method for time measurement, only that the vertical cursor becomes the horizontal cursor.

Press the CURSOR key to enter the cursor measurement menu, then press Type to select Amplitude; press Source to select the channel to be measured; press Mode to select Indepen (default). As shown in the figure below:



The Multipurpose knob can be used to adjust the horizontal cursor AY on the screen, press the Multipurpose knob to switch to cursor BY, the adjustment method of cursor BY is the same as AY.

Press Mode to select tracking, adjust the Multipurpose knob and the cursor AY and BY will move simultaneously.

The upper left corner of the display area shows the cursor measurement information:
AY, BY: Voltage values represented by the current positions of cursor AY and BY.
BY - AY: Voltage difference between two cursors.

Chapter 11 Storage and Load

With the storage function, you can save the oscilloscope's settings, waveforms, and screen images to the oscilloscope or external USB storage devices, and load the saved settings or waveforms anytime. Press the STORAGE key to enter the storage function setting interface.

Note: For the external USB storage device, only supports FAT format, the NTFS format is not compatible.

11.1 Setting Storage and Load

Press STORAGE →Type, select Set to enter the setting storage menu.

Setting Storage Menu

Functions	Options	Descriptions
Type	Set	
Disk	DSO	Press Save to save the settings to the oscilloscope.
	USB	Press Save to save the settings to an external USB storage device.
Input Name		Press Input Name to display the virtual keyboard, then letters and numbers can be chosen by the Multipurpose knob.
Save		Saves settings to a specified storage location.
Load		Loads the previously saved settings in the specified memory location to return the oscilloscope to the previously saved setting state.

11.2 Waveform Storage and Load

Press STORAGE →Type, select Wave to enter the waveform storage menu.

Waveform Storage Menu

Functions	Options	Descriptions
Type	Wave	
Source	CH1, CH2, CH3, CH4	Set which channel waveform to be saved.
Disk	DSO	Press Save to save the waveforms to the oscilloscope.
	USB	Press Save to save the waveforms to an external USB storage device.
	USB CSV	When Save is pressed, the waveform will be saved to an external USB storage device in .csv format. This format can be opened on the PC directly through software such as Excel.

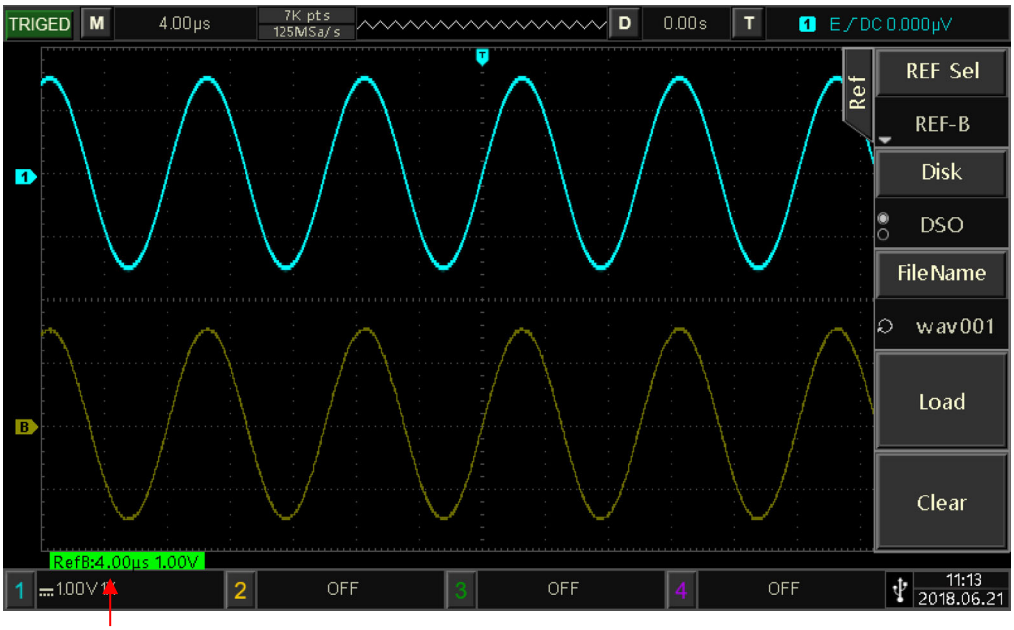
Input Name		Press Input Name to display the virtual keyboard, then letters and numbers can be chosen by the Multipurpose knob.
Save		Saves waveforms to a specified storage location.

After the waveform is saved, you can select the REF key on the vertical control area to enter the REF waveform load menu.

REF Waveform Load Menu

Functions	Options	Descriptions
REF Sel	Ref-A, Ref-B, Ref-C, Ref-D.	Select any of the four references to load waveforms.
Disk	DSO	Press Load to recall the waveform from the oscilloscope.
	USB	Press Load to recall the waveform from the external USB storage device
--		
Load		Loads the previously saved waveform and displays it on screen
Clear		Close current REF waveform

The loaded REF waveform is shown below:



Ref waveform status display

After loading, the Ref waveform status will be displayed in the lower left corner, including time base scale and amplitude scale. At this point you can use the vertical and horizontal

control knob to adjust the Ref waveform's position on the screen, the time base scale, and the amplitude scale.

Remark:

- Only when the oscilloscope is connected to an external USB storage device such as a USB flash drive can you select the disk as USB, and then save the settings to the USB storage device. When the USB storage device is not connected, it will prompt "USB device is not inserted".
- When loading, the disk and file name must be set to match the one previously saved, if the settings have not been saved to the selected location before, it will prompt "Load Failed".

11.3 Print Screen

The PrtSc key can be used to store the current screen in BMP format to an external USB storage device. The bitmap can be opened directly on the PC. This function can only be used when external USB storage device is connected.

11.4 Arbitrary Wave Storage and Loading

Press the STORAGE →Type, select Arb to enter the arbitrary wave storage menu.

Arbitrary Wave Storage Menu

Functions	Options	Descriptions
Type	Arb	
Source	CH1, CH2, CH3, CH4	Set which channel waveform to be saved.
Disk	DSO	Press Save to save the waveforms to the oscilloscope.
	USB	Press Save to save the waveforms to an external USB storage device.
Input Name		Press Input Name to display the virtual keyboard, then letters and numbers can be chosen by the Multipurpose knob.
Save		Saves waveforms to a specified storage location.

Saved arbitrary wave can be loaded by AWG function. Please refer to the **Select Arbitrary Wave** in the AWG section for more details.

Chapter 12 Auxiliary Function Settings

Press the UTILITY key to enter the auxiliary function settings menu.

12.1 System Function Settings

Self-calibration:

Self-calibration allows the oscilloscope to work optimally to obtain the most accurate measurements. You can perform this function at any time, especially when the ambient temperature range reaches or exceeds 5°C. Before performing the self-calibration operation, make sure that the oscilloscope is operating for more than 20 minutes.

Press UTILITY → Self Cal and a warning dialog box pops up: “Please ensure that no signal is connected to any input channel”. After confirming, press Sure to start self-calibration, it takes about 5mins.

System Information:

Press UTILITY → Version to view the oscilloscope’s model number, software and hardware version number.

Language：

Press UTILITY → Language to select simplified Chinese or English.

Menu Display:

The time of the menu display. You can press 

to show or hide the menu.
Press UTILITY → Menu Time, you can select menu displaying time of 1s, 2s, 5s, 10s, 20s, or Manual by adjusting the Multipurpose knob.

Square Wave Output:

Press UTILITY → PgDn → Square to set the square wave output frequency: 10Hz, 100Hz, 1kHz and 10kHz.

Frequency meter:

Press UTILITY → PgDn → Cymometer, select on and 

will be displayed at the top of the screen.

The frequency meter is the counter of trigger event frequency in the trigger channel, it is valid when the trigger type is Edge or Pulse.

AUX Output Selection:

Press UTILITY → PgDn → OutputSel to select Trigger or PassFail.

When Trigger is selected, AUX output terminal outputs the trigger synchronization signal.
When Pass/Fail is selected, AUX outputs the pass/fail signal.

Backlight Brightness:

Press UTILITY → PgDn → BackLight, and adjust the brightness of the screen by the Multipurpose knob.

Clear Data:

Press UTILITY → PgDn → Clear Data →Sure (F1) to clear the data stored in the device.

Network Settings:

Connect the device with a valid network cable, then press UTILITY → PgDn → IP Config to enter the IP setting interface.

IP Type:

Press the IP Type key to switch the IP access mode: Manual or Automatic.

IP Address:

The format of the IP address is nnn.nnn.nnn.nnn, the range of the first nnn is from 1 to 223, the range of the other three nnn is from 0 to 255. It is recommended that you consult your network administrator for an available IP address.

Press IP Addr to enter the IP address setting menu. When the access mode is manual, set the IP address by adjusting the Multipurpose knob. When the access mode is automatic, you can only view the IP address.

Subnet Mask:

The format of the subnet mask is nnn.nnn.nnn.nnn, the nnn range is from 0 to 255. It is recommended that you consult your network administrator for an available subnet mask.

Press Sub Mask to enter the subnet mask setting menu. When the access mode is manual, set the subnet mask by adjusting the Multipurpose knob. When the access mode is automatic, user can only view the subnet mask.

RTC Setting:

Press UTILITY →PgDn→ RTC Set to enter the date and time setting menu. Adjust the digits by Multipurpose knob, after the first digit is adjusted, press the Multipurpose knob and the cursor will jump to the second digit, the adjustment method is similar to the first digit, the latter digit and so on. After all adjustments, press Sure to save the settings.

12.2 Waveform Recording

Press UTILITY → Record to enter waveform recording menu.

Setting:

Press Operation, select setting to make parameter settings for waveform recording. You can also press REC SET to quickly enter the recording setting interface.

Recording Interval:

Set the interval between each frame of the waveform recording.

Press the Interval key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set.

End Frame:

Press the End Frame key and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set that the waveform recording will automatically stop recording when it reaches this frame.

Playback Delay:

Set the interval time between each frame during the waveform playback.

Press Play Delay, and adjust the Multipurpose knob (shuttle knob or numeric keyboard) to set.

Max Frame Size:

Displays the maximum number of frames that can be recorded in the current situation (The maximum number of frames varies based on the current memory depth).

Operate:

Press Rec Op, select Operation to enter the operation interface.

Record:

Press Rec to start recording. You can also press  directly to start recording.

Stop:

Press Stop to stop the waveform recording. You can also press  to stop recording.

Play:

Press Play and the waveform starts playing back, you can also press  directly to start playback, press this key again to pause. Adjust the Multipurpose knob (shuttle knob or numeric keyboard) to jump to the specified number of frames.

12.3 Pass/Fail

The Pass/Fail uses a template to detect whether the input signal satisfies the template requirements. If the input signal exceeds the limited range of the template, it is judged as failed.

(1) Function Introduction

Press UTILITY →PgDn→ PassFail to enter its menu.

Enable:

Press Enable, select ON to make the relevant settings for the Pass/Fail.

Output:

Press Output to select Fail or Pass.

(1) Fail: Set the AUX interface on the back panel of the oscilloscope to output pulses when “fail” and produce beeps.

(2) Pass: Set the AUX interface on the back panel of the oscilloscope to output pulses when “pass” and produce beeps.

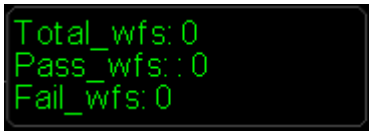
Note: AUX output selection needs to be switched to Pass/Fail.

Source:

Press Source, select CH1, CH2, CH3, or CH4 to set the test source of Pass/Fail.

Message:

Press Message, select ON and the test result statistics will be displayed at the upper left corner of the screen, as shown below:



Total_wfs means the total number of frames tested; Pass_wfs means the number of frames passed; Fail_wfs means the number of frames failed.

Stop Setting:

Press PgDn→ StopSetup to enter its menu as follows:

Functions	Options	Descriptions
Stop Type	PassTimes	Set the Pass/Fail function to stop the test automatically after it reaches the specified threshold value of pass
	FailTimes	Set the Pass/Fail function to stop the test automatically after it reaches the specified threshold value of failure

When	>=, <=	Set the stop condition
Threshold		Use the Multipurpose knob to set the stop condition threshold
Back		Returns to previous menu, the Pass/Fail menu

Template Setting:

Press PgDn → MaskSetup to enter its menu. As shown below:

Functions	Options	Descriptions
Ref Wave	CH1, CH2, CH3, CH4	Select a channel waveform in CH1~CH4 and plus the horizontal and vertical tolerance as the conditions for creating a template
X Mask	1 ~ 255	Use the Multipurpose knob to select the horizontal tolerance
Y Mask	1 ~ 255	Use the Multipurpose knob to select the vertical tolerance
Create		Creates a template with above conditions
Back		Returns to previous menu, the Pass/Fail menu

Operation:

After the above settings are completed, press the Operate key and select ON, the device will start recording the waveforms.

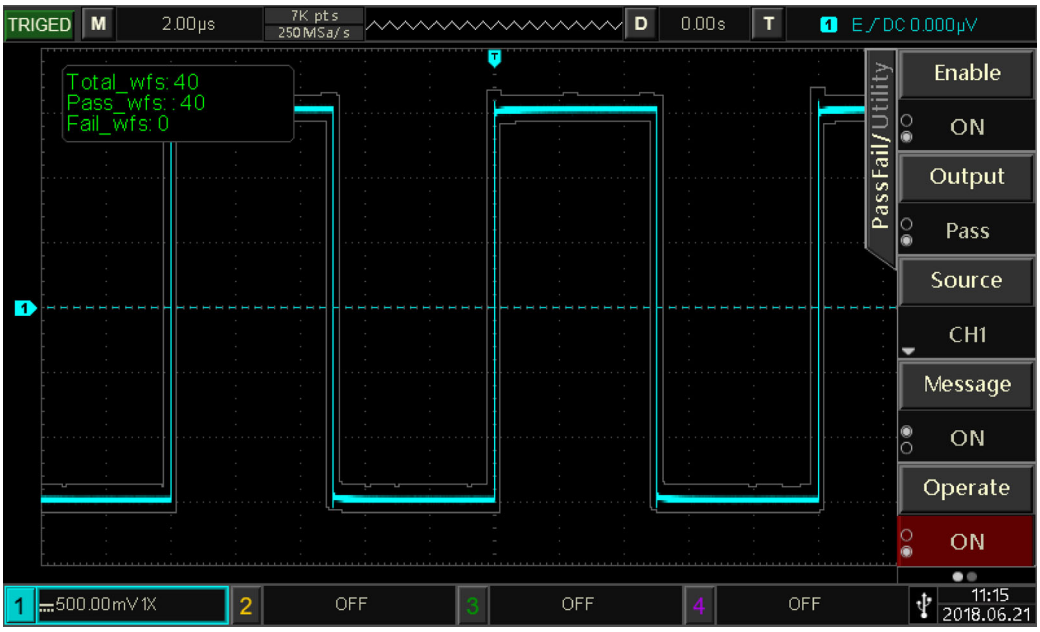
Note: After selecting the Enable in Pass/Fail menu as ON, you need to set the stop settings and template settings before you can perform the Pass/Fail function. Otherwise it will prompt "Function is Disabled".

(2) Example

Input the 1kHz, 3V square wave to CH1, and observe the results under the specified Pass/Fail conditions.

① Enter Pass/Fail menu: Press UTILITY →PgDn→ Pass/Fail.
② Set Enable: Press the Enable key and select ON.
③ Set output condition: Press the Output key and select Fail.
④ Set source: Press the Source key and set the source to CH1.
⑤ Open message: Press the Message key and select ON.
Stop setting: Press the StopSetup key to enter the stop setting menu; set the Stop Type to FailTimes and adjust the Multipurpose knob to set the threshold to 10; then press F5 to return to the Pass/Fail menu.
⑥ Template setting: Press the Masksetup key to enter the menu; press Ref wave and select CH1; press the X Mask key and adjust the Multipurpose knob to set the horizontal tolerance to 10 and the vertical tolerance to 5; then press the Create key. Press the Back key to return to the Pass/Fail menu.

⑦ Start test: Press PgDn→ Operate and select ON to start the test. See figure below:



The Pass/Fail function will run continuously, and stop once 10 fail tests have been reached, or the user manually suspends the test (when Operate is set to OFF).

12.4 System Upgrade

This series oscilloscope can use U disk to upgrade the software to give users a more convenient and flexible experience. To use this feature, please follow the following steps:

① Press UTILITY to enter the auxiliary function menu, then press Version to view the machine's model number, software and hardware version information.

② Download the upgrade file from the UNI-T website or get it from the UNI-T distributor. The upgrade file is consistent with the model and hardware version of the device, and the software version is higher than the original version. Please save the upgrade file in the root directory of the U disk.

③ When the device is in the off state, insert the U disk and turn it on, after entering the upgrade interface, press F1 to confirm the upgrade.

④ The upgrade process takes about 5mins. After the upgrade, shut down the device and unplug the USB flash disk.

⑤ Turn on the device to check whether the system information is the same as the provided version information, the same indicates that the upgrade was successful.

Note: please make sure that the power supply is on throughout the upgrade process in order to avoid the incomplete upgrade. If the system is not completely upgraded, it might not be able to restart.

Chapter 13 Digital Channel

series mixed signal digital oscilloscope are equipped with 2 analog channels and 16 digital channels. For digital channels, the oscilloscope compares the voltage from each sampling to preset logical threshold. If the voltage at the sample point is greater than the threshold, it will be stored as logic 1, otherwise it will be stored as logic 0. Logic 1 and logic 0 will be intuitively displayed by graph for easily error detection and analysis in circuit design (hardware/software design).

Before using the digital channel, please use the UT-M15 logic probe provided as its manual to connect the oscilloscope to the measured device.

13.1 Digital Channel Opening

Press LA → ON/OFF key to enter the channel setting menu.

1) Press the SelectCH key to open the D0~D15 selecting list, press F1 or adjust the Multipurpose knob to select any channel, press the knob to open (D0) or close (D5) the channel.
2) Press D7-D0/D15-D8 key to simultaneously open or close channel D7-D0 or D15-D8.

Note: At the same time, channels of D7~D0 or D15~D8 are also able to be controlled individually by the SelectCH key.

3) Press the Group key to enter the list of groups, press F4 or adjust the Multipurpose knob to select any group, and press the knob to open (Group 1) or close (Group 2) the group.

Notice: Only digital channels after group setting are available for customized grouping. Please refer to **13.3 Group Setting** about how to customize the groups.

13.2 Digital Channel Selection

Press LA → Current key, press F1 or adjust the Multipurpose knob to select any channel and press the knob to confirm.

13.3 Group Setting

Press LA → GroupSet key to enter group setting menu which can grouping or cancel grouping 16 digital channels as needed.

1) Grouping

The customized grouping of Group1~4 are the same, take Group 1 as an example:

Press Group1 key to open channel selecting list with status icon, adjust the Multipurpose knob to select the channels that adding to Group 1, press F1 key or the Multipurpose knob to add the channel to Group 1 and marked it as D0, the other channels will be marked as D5.

In a similar way, users can grouping other channels. A channel can only be grouped to one group, and the channels already in other groups are not optional and turn grey 

.

13.4 Waveform Size

Press LA → Wavesize key to select display mode as needed: S, M (default) and L.
Note: size L will only be available when less than 8 channels are opened currently.

13.5 Ordering

Press LA → ReOrder key to select the sort order (from top to bottom) of current opened channels on screen to be D0~D15 (default) or D15~D0.

13.6 Threshold Setting

Press LA → Threshold key to enter threshold setting menu. Threshold level independent adjustment can set threshold individually for 2 groups of channels: Type L and Type H. If the input signal voltage exceeds the current threshold, will be defined as Logic 1, otherwise it will be Logic 0.

Press Type(L) or Type(H) key to open type selecting list, which you can select preset value or customize value.

1) The preset value includes TTL, 5.0V CMOS, 3.3V CMOS, 2.5V CMOS, 1.8V CMOS, ECL, PECL, LVDS and 0V. Press the Multipurpose knob after selecting, to apply the threshold level to Type L or Type H.
2) Select User, adjust Multipurpose knob to set user-defined threshold in the range of -20.0V ~ +20.0V as needed.

13.7 Digital BUS Setting

Users can set D0~D7, D8~D15, D0~D15 or 3 groups of customized channels to be digital bus. Every digital bus value will be displayed on the bottom of screen by data or graph. 2 digital buses are allowed to be created by users.

Press LA → Digital BUS key to enter digital bus setting menu.

1) Press BUS group key to select BUS1 or BUS2.
2) Press BUS status key to turn on or off the digital bus.
3) Press Sel CH key to select the according channel for BUS1 and BUS2 between D0-D7, D8-D15 or customized value.
4) Press Endian key to set the endian of digital bus to be normal (D0 low phase, default) or reverse (D0 high phase).
5) Press Format key to select the digital bus display format between hexadecimal base,

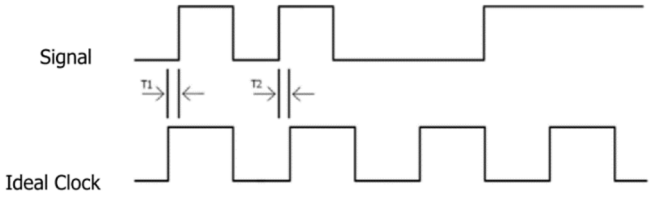
decimal base, binary base or ASCII.

6) Press RefClock key to select any channel between D0-D15, select NULL, the reference clock will not be set.
7) Press Edge type key to set the sampling edge type of reference clock to be rising edge or falling edge.
8) Press Jitterctrl key to turn on/off the jitter control function.

Jitter refers to the signal short-term deviation from ideal time position at a particular time. See T1 and T2 in the figure below, when the bus does not select a reference clock, the hopping state of each channel will cause changes of bus data, then unwanted data appears due to jitter. When jitter control is turned on, the bus will not display the changes in bus data caused by a jitter time, but still remain the valid data.

9) Press JitterTime key, adjust the outer shuttle knob to adjust the jitter time by rough tuning, and adjust the Multipurpose knob or the inner shuttle knob to operate fine tuning. The range can be set from 1ns to 1ms.

   Note: jitter control and jitter time can be set only if the digital bus have not set a reference clock.



10) Press Show Type key to set the display type of digital bus: data or graph. Press display type key to set the display type of digital bus: data or graph. The data of digital bus will be displayed directly in data mode; In graph mode,

13.8 Label Setting

Press LA → Label key to enter label setting menu, which can set customized label for specific digital channels. Press Label Sel key to select the channel (D0~D15) that needs to be set.

1) Preset label

Press Preset key, press F1 or adjust Multipurpose knob to select required label, press the knob to confirm. The optional preset labels are ACK, AD0, ADDR, BIT, CAS, CLK, DATA, HALT, INT, UB, LOAD, NMI, OUT, PIN, RAS, RDY and RST.

2) Input label

Press Input key to input label manually. The labels will be named after the according channel by default, such as 

. Users can set a customized labels for each channel.

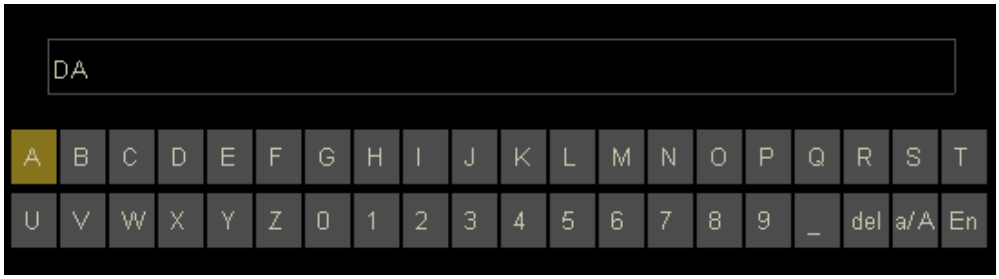
The customized labels includes capital letter A~Z, lowercases a~z, numbers 0~9, underline and space, the length should not be over 4 characters.

For example: change 

to 

, press input key to enter the input interface, adjust

and press the Multipurpose knob to select any character. Adjust the knob to a/A and press to switch capital letter or lowercases. Press Sure key to confirm input and the label of channel will be changed to D0 A D0.



13.9 Delay Calibration

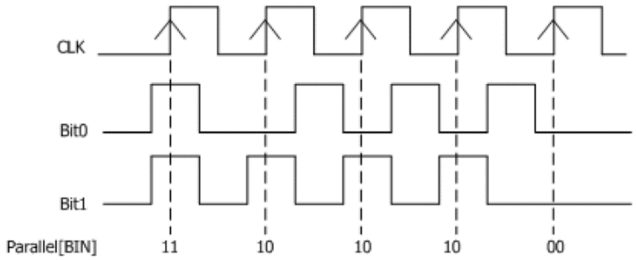
In the actual measurement of oscilloscope, error (zero offset) maybe caused by probe cable transmission delay. Zero offset is the offset between the intersection of the waveform and the trigger level line relative to the trigger position.

Press LA → Delay-Cal key, adjust the Multipurpose knob to set the required delay time in the range of -100 ns to 100 ns. Press the Multipurpose knob to restore the delay time to 0.00 s.

Note: this parameter is related to the model and the current setting of the horizontal time base. The larger the horizontal time base is, the larger step is set.

13.10 Parallel Decoding

Parallel bus is composed of clock line and data line. As shown in figure, CLK is the clock line, the Bit0 and Bit1 are the 0^{th} digit and the 1^{st} digit of data line. The oscilloscope will sample the data of channel at the rising edge, falling edge or both of them in clock. Every data point will be defined as logic 1 or logic 0 according to the threshold level.



Press LA → Parallel Dec key to enter the parallel decoding menu.

1) Data line setting

Press Bus bit key to set the data width of parallel bus, which means the bits number of data per frame

Press Cur bit key to select bit that needs to be set, the default selecting bit is 0.

Then press channel key to select a channel as source between CH1, CH2 and D0-D15.

2) Clock line setting

Press RefClock key to select any channel between CH1, CH2 and D0-D15 as clock channel, select NULL, the reference clock will not be set.

Press Edge type key to select sampling on rising edge or falling edge of clock. If there is no clock channel is selected, it will sample when the channel data hopping in decoding.

3) Display setting

Press Format key to select the display format of bus between hexadecimal base, decimal base, binary base or ASCII.

Press BUS status key to turn on or off the display of digital bus.

4) Event table setting

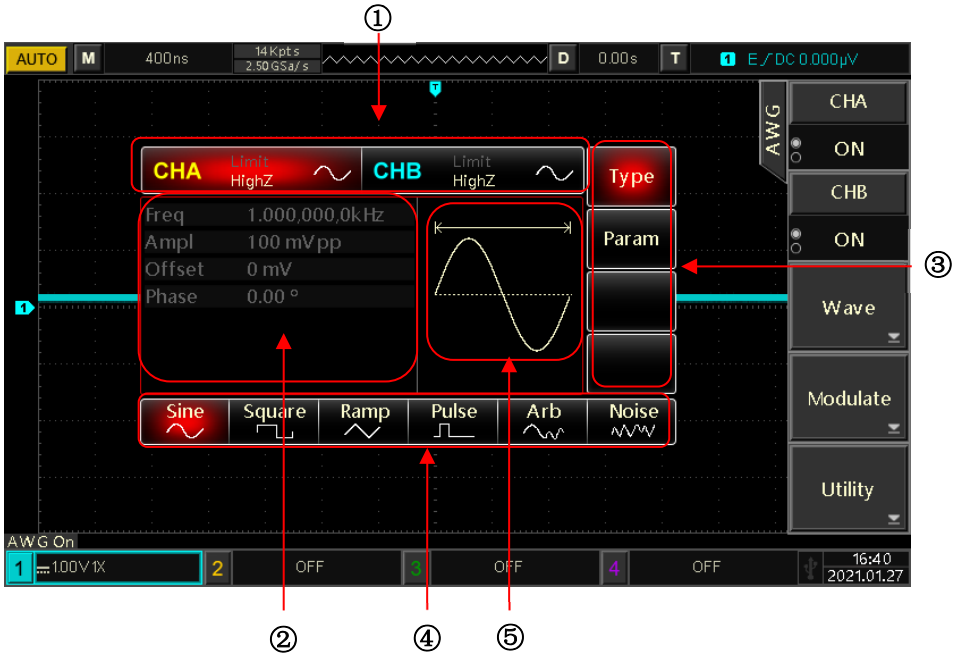
The event table will be displayed the decoded data, its corresponding number and time by form, which makes easier observation for longer decoded data. Press EventTable key and select ON. This operation is only available when the status of BUS is enabled.

Chapter 14 Arbitrary Waveform Generator AWG

8050 Series uses built-in arbitrary waveform generator and direct digital synthesis technology to produce accurate and stable waveform output. It is an economic, multi-functional arbitrary waveform generator with 1μHz resolution.

14.1 Open Arbitrary Waveform Generator

Press AWG key to enter the interface of arbitrary waveform generator as shown in figure.



✧ ①: CH1/CH2: the chosen channel will be highlighted.

1) **Limit** is the limit of output range, white means valid and grey means invalid.
2) **Highz** means the output terminal matched impedance is high (**Highz** or **50Ω** are selectable, **Highz** is set by default).
3)  means sine wave (fundamental waveform, modulation or OFF may be displayed in different work modes).

✧ ②: Waveform parameters list, shows settable items in white color, users can set the parameters by menu operating keys, numeric keys, direction keys and multifunction knob. The character is editable by numeric keyboard, direction keys and multifunction knob if it shows in current channel's color (white in system setting).

✧ ③and④: Key labels display current functions of keys. The selected items of ③will

be highlighted, and the indicating content is shown in ④.

✧ ⑤: Waveform display area, displays the waveform currently of the channel (the current waveform of which channel can be distinguished by the color or the highlight of the CH1/CH2 bar, and the parameter list is on the left).

14.2 Basic Waveform Output

By a single channel or dual channels simultaneously, AWG can output basic waveform, which includes sine wave, square wave, ramp wave, pulse wave and noise wave. Press AWG key, the instrument will output a sine wave with frequency of 1kHz and amplitude of 100mVpp by default. This part introduces the instrument configuration of various basic waveforms output, take CHA as an example:

1. Set the output frequency

After pressing AWG, to modify the frequency (default setting: 1kHz) to 2.5MHz, press MENU →Wave → Param, input 2.5 by numeric keyboard and select the unit MHz.

2. Set the output amplitude

To modify the amplitude (default setting: 100mVpp) to 300mVpp, press MENU →Wave → Param, and adjust Multipurpose knob to Ampl, input 300 and select the unit mVpp.

3. Set the DC offset voltage

The waveform is sine wave with DC offset voltage of 0V by default.

To modify it to -150mV, press MENU →Wave → Param, and adjust Multipurpose knob to Offset, input -150 and select the unit mV.

4. Set the phase

The phase is 0° by default. To set the phase to be 90°, press MENU →Wave→ Param, and adjust Multipurpose knob to Phase, input 90 and select the unit ° .

5. Set the duty cycle of pulse wave

The default duty cycle of pulse wave is 50%, to modify it to 25% (limited by minimum pulse width 80ns), press MENU →Wave, adjust Multipurpose knob to Pulse and press the knob, adjust the knob to Duty, input 25 and select the unit %.

6. Set the symmetry of ramp wave

The default symmetry of ramp wave is 50%. Take the ramp wave with symmetry of 75% as example, press MENU →Wave, adjust Multipurpose knob to Ramp and press the knob, adjust Multipurpose knob to Symmetry, input 75 and select the unit %.

7. Set the DC voltage

To modify the default DC voltage 0V to 3V, press MENU →Wave, adjust Multipurpose knob to DC, input 3 and select the unit V.

8. Set noise wave

The quasi-gaussian noise with amplitude of 100mVpp and the DC offset of 0V is set by default. Take the quasi-gaussian noise with amplitude of 300mVpp and the DC offset of 1V as example, press MENU →Wave, and adjust Multipurpose knob to Noise and press the knob, adjust Multipurpose knob to Ampl, input 300, and select the unit mVpp. Then adjust Multipurpose knob to Offset, input 1 and select the unit V.

14.3 Advanced Applications

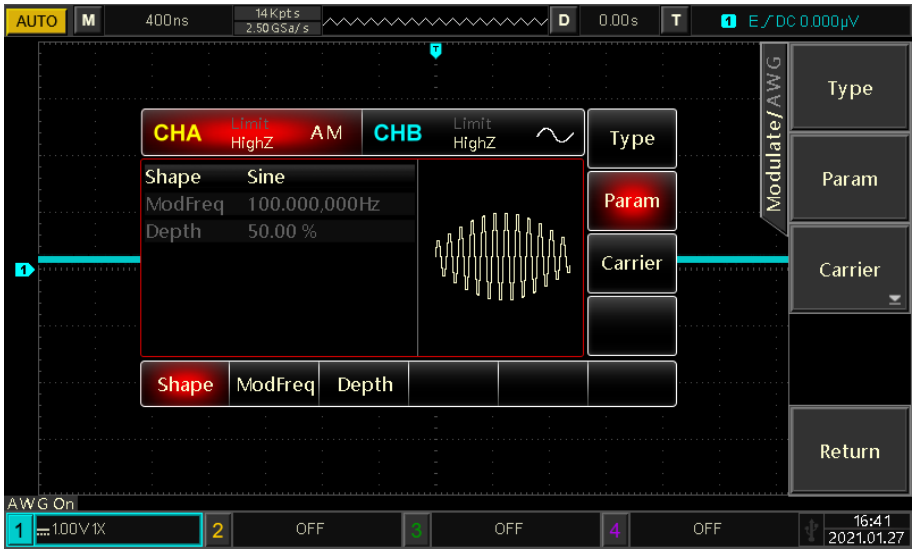
AM and PM can be output by AWG. Press AWG key to enter the interface of arbitrary waveform generator. Take CHA as an example:

(1)Amplitude Modulation (AM)

In amplitude modulation, the modulated waveform is composed of carrier wave and modulation wave, the amplitude of carrier wave varies with the amplitude of modulation wave.

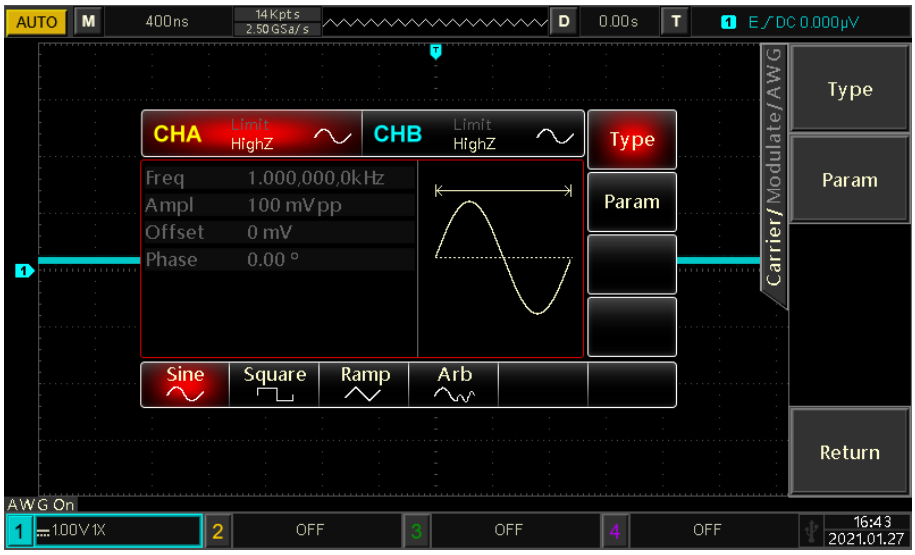
AM Selection

Press MENU →Modulate, adjust Multipurpose knob to AM(default) and press the knob.



Carrier Waveform Selection

The AM carrier waveform includes Sine (default), Square, Ramp and Arb (except for DC). To select carrier waveform, after selecting AM, press Carrier and the Multipurpose knob to select required carrier wave.



Carrier Frequency Setting

Settable ranges of carrier wave varies with different carrier waveform, frequency of 1kHz is set for all the carrier wave by default, please see the frequency ranges below:

Carrier Waveform	Frequency	
	Minimum	Maximum
Sine wave	1μHz	50MHz
Square wave	1μHz	15MHz
Ramp wave	1μHz	400kHz
Pulse wave	1μHz	15MHz
Arbitrary wave	1μHz	5MHz

To set the frequency of carrier wave, after selecting carrier waveform, please adjust the Multipurpose knob to Freq, input required value and unit.

Modulation Wave Setting

The modulation wave can be set as Sine (default), Square, UpRamp, DnRamp, Arb or Noise. To modify the modulation wave in AM function, adjust the Multipurpose knob to Shape and press the knob, then users can select modulation wave by the knob.

- Square wave: the duty cycle is 50%
- UpRamp wave: the symmetry is 100%
- DnRamp wave: the symmetry is 0%
- Arbitrary wave: if arbitrary wave is selected as modulation wave, function/Arbitrary waveform generator will limit the length of arbitrary wave in 4kpts by auto snapshot.
- Noise: white Gaussian noise

Modulation Frequency Setting

Modulation wave frequency can be set in the range of 2mHz~50kHz (default: 100Hz). To modify it, users should enable AM function at first, adjust the Multipurpose knob to ModFreq, input the required value and unit.

Modulation Depth Setting

Modulation depth is the degree of amplitude variation by percentage. AM modulation depth can be set to 0%~120% (default: 50%).

When the modulation depth is set as 0%, a constant amplitude is output (half of the set carrier amplitude).

When the modulation depth is set as 100%, the output amplitude varies with the modulation waveform.

When the modulation depth is set over 100%, the output amplitude will not exceed 10Vpp (load: 50Ω). To modify the modulation depth, adjust Multipurpose knob to Depth in the interface of AM function, then input value and unit of %.

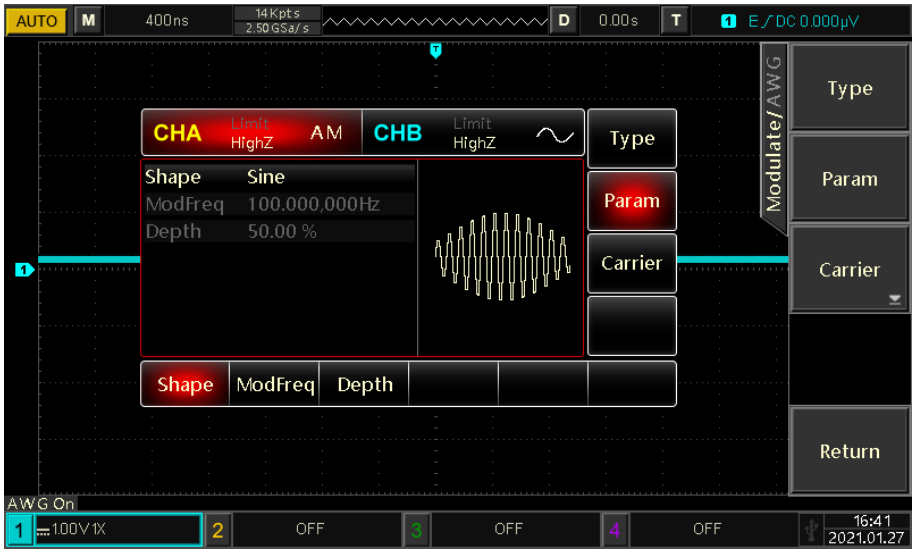
Example:

At first, enable the AM mode, then set the 200Hz sine wave inside as the modulation signal and set a square wave with frequency of 10kHz, amplitude of 200mVpp and duty cycle of 45% as the carrier signal. Finally, set the modulation depth as 80%.

The specific steps are as follows:

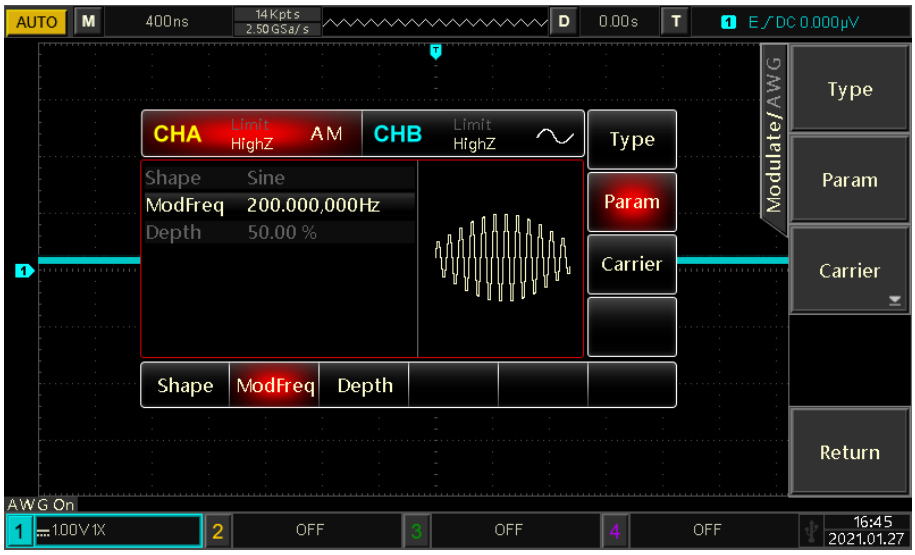
1) Enable AM function

Press MENU →Modulate, adjust Multipurpose knob to AM (default) and press the knob.



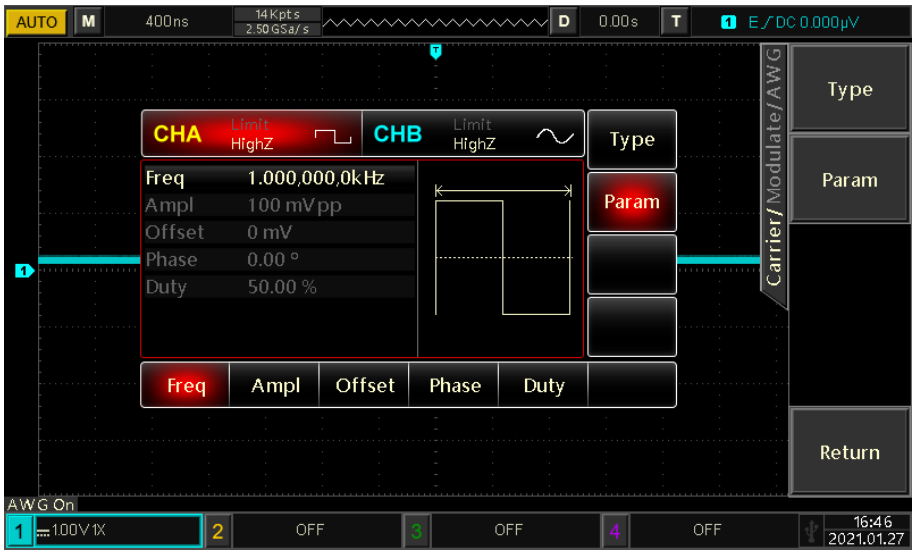
2) Modulation Signal Parameters Setting

Following the step 1), adjust Multipurpose knob to ModFreq, input 200 and select the unit Hz.



3) Carrier Waveform and Parameters Setting

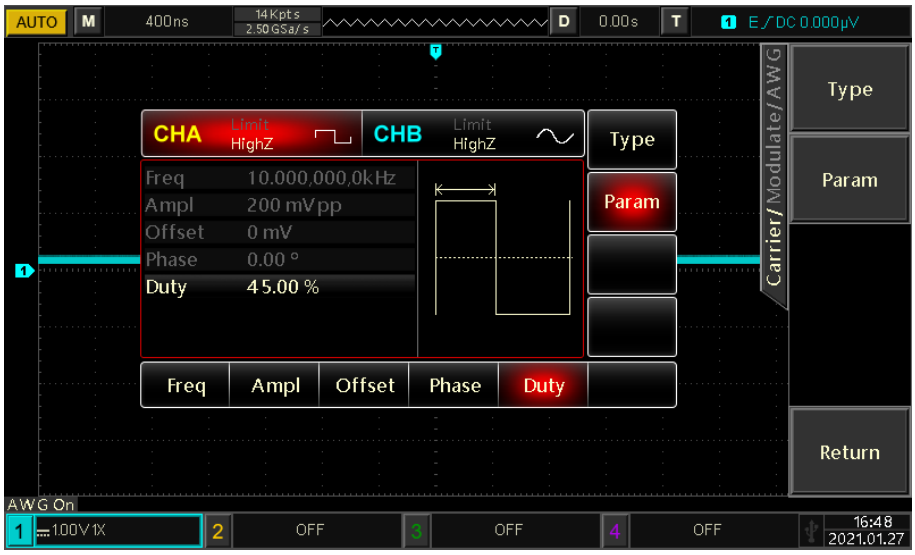
Press the Carrier key to enter carrier waveform selecting interface, adjust Multipurpose knob to Square and press the knob to select square wave as carrier wave.



Adjust Multipurpose knob to Freq, input 10 and select the unit kHz.

Adjust Multipurpose knob to Ampl, input 200 and select the unit mVpp.

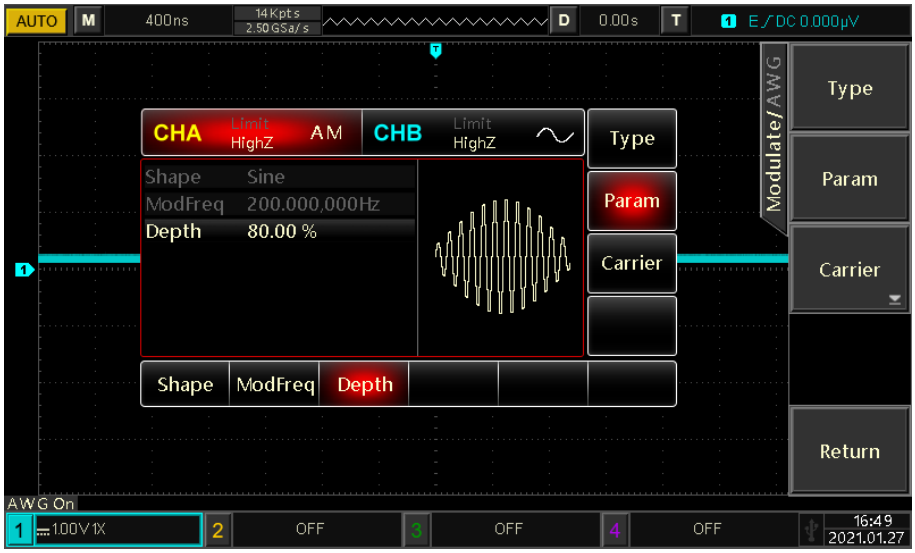
Adjust Multipurpose knob to Duty, input 45 and select the unit %.



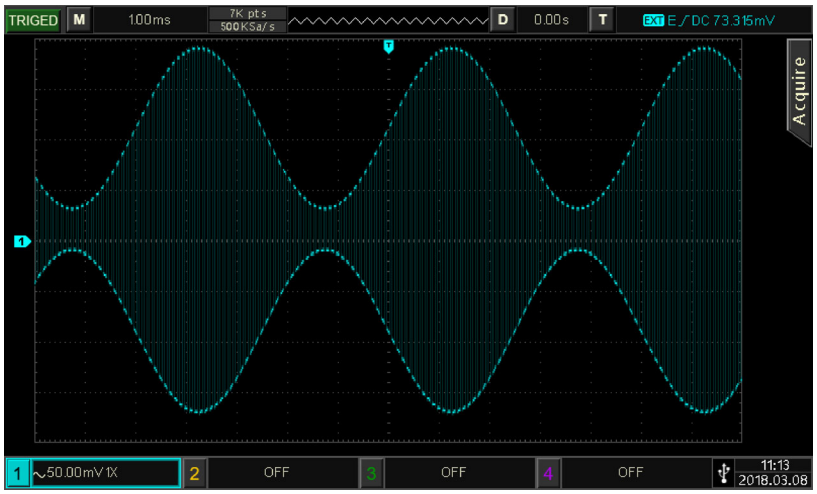
4) Modulation Depth Settings

After carrier wave setting, press Return key to enter AM setting.

Adjust Multipurpose knob to Depth, input 80 and select the unit %.



5) Output waveform and check the AM waveform by oscilloscope as figure shown.

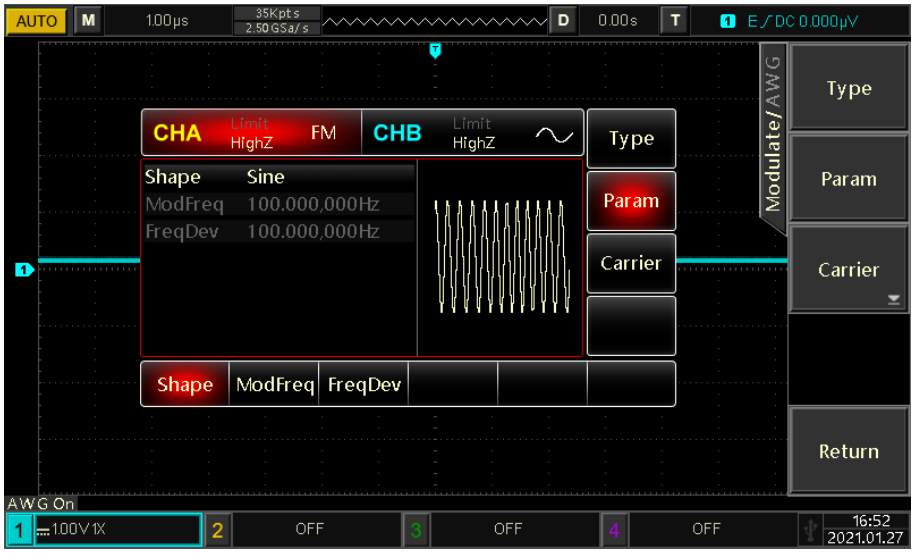


(2)Frequency Modulation (FM)

In frequency modulation, the modulated waveform is composed of carrier wave and modulation wave. The frequency of carrier wave varies with its amplitude.

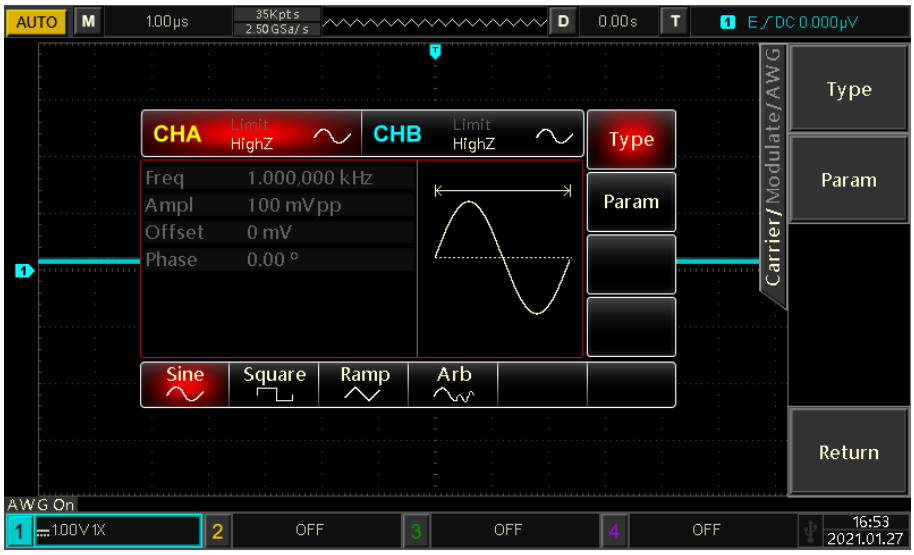
FM Selection

Press MENU →Modulate, adjust Multipurpose knob to FM (default: AM) and press the knob.



Carrier Waveform Selection

The FM carrier waveform includes Sine (default), Square, Ramp and Arb (except for DC). To select carrier waveform, select FM, press the Carrier key and Multipurpose knob to select required carrier wave.



Carrier Frequency Setting

Please refer to **Carrier Frequency Setting** in AM function.

Modulation Wave Setting

The modulation wave can be set as Sine (default), Square, UpRamp, DnRamp, Arb or Noise. After enabling the FM function, to modify the modulation wave, adjust the Multipurpose knob to Shape and press the knob, then users can select required modulation wave by the knob.

- Square wave: the duty cycle is 50%
- UpRamp wave: the symmetry is 100%
- DnRamp wave: the symmetry is 0%
- Arbitrary wave: if arbitrary wave is selected as modulation wave, function/Arbitrary waveform generator will limit the length of arbitrary wave in 4kpts by auto snapshot.
- Noise: white Gaussian noise

Modulation Frequency Setting

Modulation wave frequency can be set in the range of 2mHz~50kHz (default: 100Hz). To modify it, users should enable FM function at first, adjust the Multipurpose knob to ModFreq in the interface, input the value and select unit.

Frequency Deviation Setting

Frequency deviation is the deviation of the frequency of the FM modulated waveform with respect to the carrier wave frequency. The range of FM modulation frequency deviation is minimum DC to maximum half of current carrier bandwidth, and the default value is 100Hz. To modify the frequency deviation, adjust Multipurpose knob to FreqDev of FM function, then input value and unit.

- If frequency deviation is less than or equal to the carrier wave frequency, the frequency deviation will be auto limited to the maximum allowed for the current

carrier wave frequency.

- If the sum of frequency deviation and the carrier wave frequency is less than or equal to the maximum allowed frequency of current carrier wave, and the frequency deviation is set as an invalid value, it will be auto limited to the maximum allowed for the current carrier wave frequency.

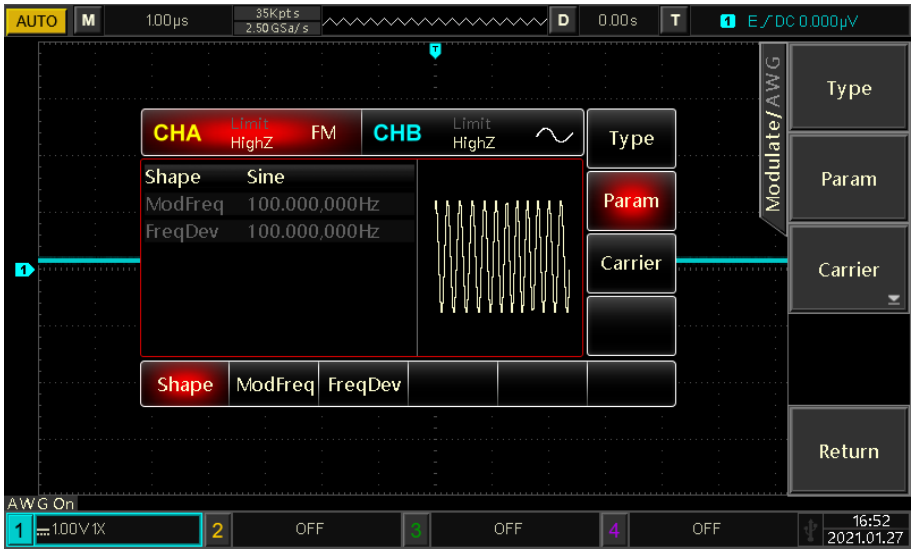
Example:

At first, enable the FM mode, then set the 2kHz square wave inside as the modulation signal and set a sine wave with frequency of 10kHz and amplitude of 100mVpp as the carrier signal. Finally, set the frequency deviation as 5kHz.

The specific steps are as follows:

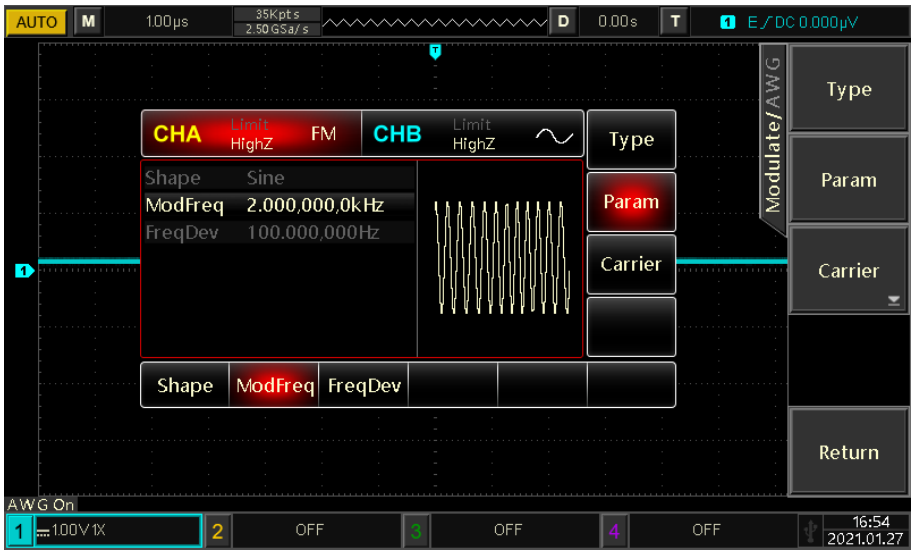
1) Enable FM function

Press MENU →Modulate, adjust Multipurpose knob to FM (default: AM) and press the knob.



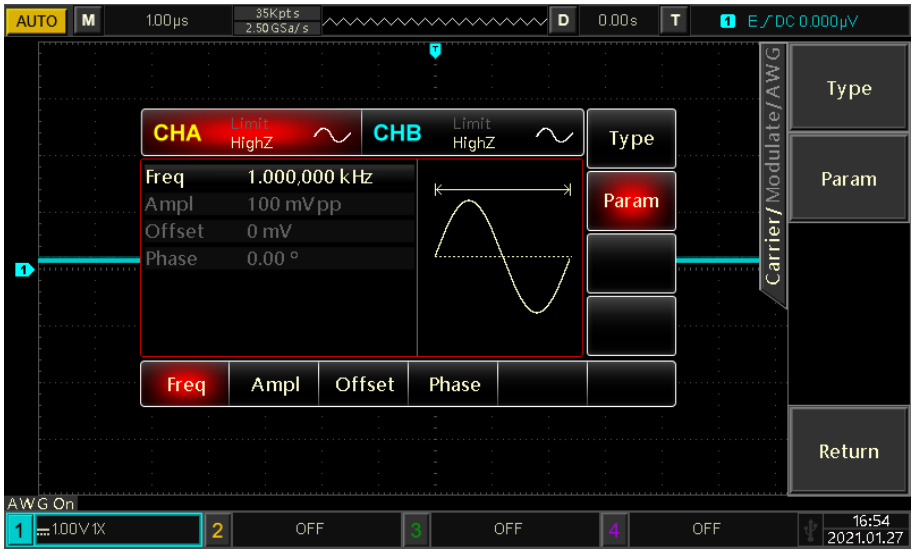
2) Modulation Signal Parameters and Waveform Setting

Following the step 1), adjust Multipurpose knob to Shape, select Square as modulation waveform. Adjust Multipurpose knob to ModFreq, input 2 and select the unit of kHz.



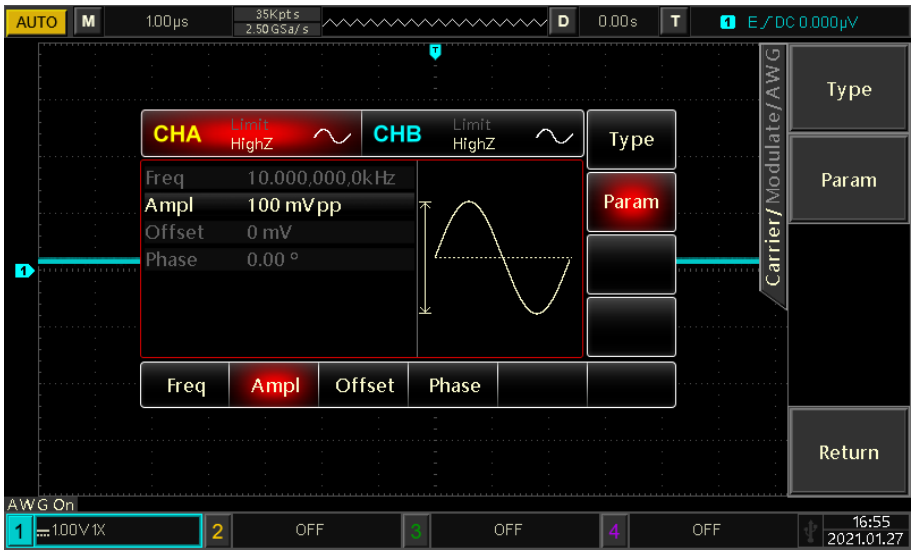
3) Carrier Waveform and Parameters Setting

Press the Carrier key to enter carrier waveform selecting interface, adjust Multipurpose knob to Square and press the knob to select square wave as carrier wave.



Adjust Multipurpose knob to Freq, input 10 and select the unit kHz.

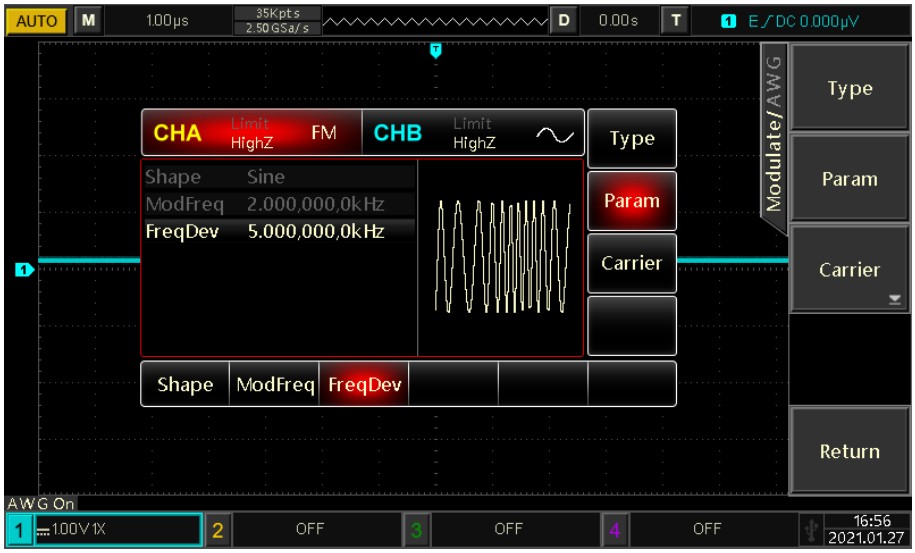
Adjust Multipurpose knob to Ampl, input 100 and select the unit mV.



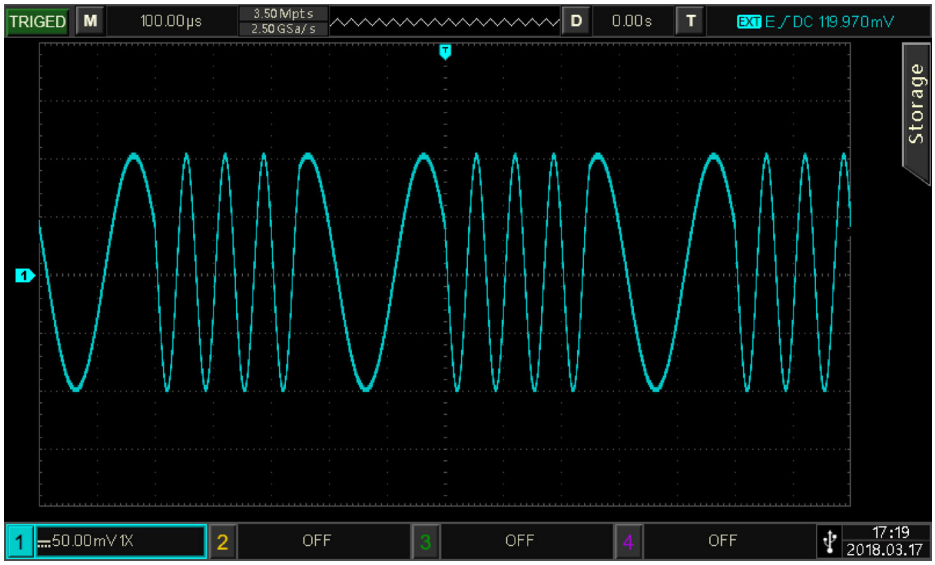
4) Frequency deviation Setting

After setting the carrier wave, press the Return key to enter FM settings:

Adjust Multipurpose knob to FreqDev, input 5 and select the unit of kHz.



5) Output waveform and check the FM waveform by oscilloscope as figure shown.

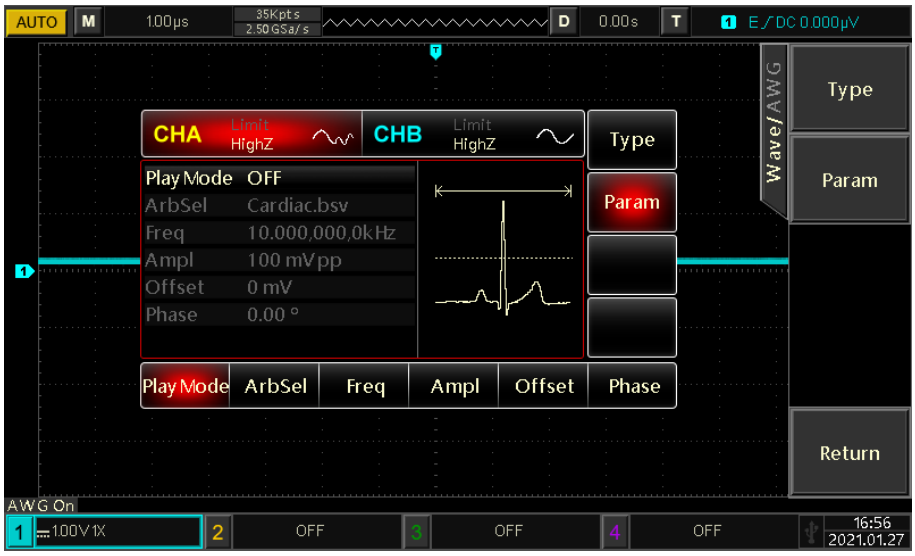


1. Output Arbitrary Waveform

10 kinds of arbitrary waveforms are saved in the product, please see the list of arbitrary wave inside for their names.

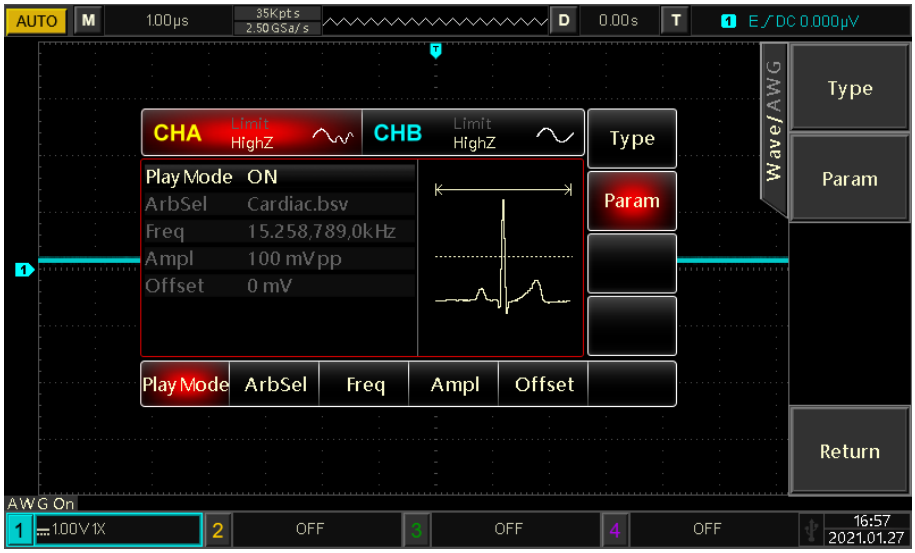
Enabling the Arbitrary Wave Function

Press MENU →Wave, adjust Multipurpose knob to AW and press the knob to enable the arbitrary wave function.



Point-by-point Output/Play Mode

AWG function supports point-by-point output of the arbitrary waveforms. In point-by-point output mode, the signal generator will calculate the output signal frequency according to the waveform length and sampling rate, then output the waveform point-by-point by this frequency, which prevents important waveform points from being lost and the mode is set as OFF by default. In this case, the waveform outputs at a fixed length and frequency by software automatic interpolation or snapshot. To modify it, adjust the Multipurpose knob to Play Mode, press the knob to switch it to ON.



Select Arbitrary Wave

Local arbitrary waveforms can be selected by users. After enabling the arbitrary wave function, adjust the Multipurpose knob to ArbSel and press the knob, select Local and select required arbitrary wave by the Multipurpose knob.

Local Arbitrary Wave List

Types	Name	Description
10 types of Common Functions	Cardiac	Cardiac cycle
	Hamming	Hamming window
	ExpFall	Exponential falling function
	Sinc	Sinc function
	Gauss	Gaussian distribution/Normal distribution
	Blackman	Blackman window
	Laplace	Laplace distribution
	HaverSine	Haversine function
	Lorentz	Lorentz function
	ExpRise	Exponential rising function

14.4 Utility Settings

Utility Menu	Utility Sub-menu	Settings	Description
CHA Set, CHB Set	Output	ON/OFF	
	Reverse	ON/OFF	
	OutLoad	50Ω, High Z	

	Limit	ON/OFF	
	LimitHigh		Set the high limit of amplitude
	LimitLow		Set the low limit of amplitude.

Channel setting, take CHA as an example:

1. Output Setting

Press MENU →Utility →CHA Set →Output, the output can be set as ON (default) or OFF.

2. OutLoad Setting

Press MENU →Utility →CHA Set →OutLoad, the out load can be set as HighZ (default) or 50Ω.

3. Amplitude Limit Setting

Press MENU →Utility →CHA Set →Limit, the output can be set as ON or OFF (default).

4. High limit of Level Setting

Press MENU →Utility →CHA Set →LimitHigh, input value by numeric keyboard to set the high limit of amplitude.

5. Low limit of Level Setting

Press MENU →Utility →CHA Set →LimitLow, input value by numeric keyboard to set the low limit of amplitude.

Chapter 15 Additional Function Keys

15.1 Auto Setting

Automatic settings will according to the input signal, choose appropriate time base scales, amplitude scales, and triggering parameters so that the waveform automatically properly displays on the screen. Press the AUTO key to enable automatic settings.

Automatic setting applies only to the following conditions:

① Automatic setting is suitable for setting up simple single frequency signals, and not for complex combination waves.

② The measured signal frequency is not less than 10Hz, the amplitude is not less than 20mVpp, and the square wave duty cycle is more than 5%.

③ The automatic setting is only for the open channels and not for the closed channels.

15.2 Run / Stop

Use the RUN/STOP key on the front panel for control. When the key is pressed and the green light is on, it indicates the RUN state, and if the red light is on after the key press, it is the STOP state. In the running state, the oscilloscope is continuously acquiring waveforms and the upper part of the screen shows “AUTO”; in the stop state, the oscilloscope stops the acquisition and the upper part of the screen shows “STOP”. Press the RUN/STOP key to switch the waveform sampling between the run and stop states.

15.3 Clear

Press the CLEAR key on the front panel of the oscilloscope to clear the loaded REF waveform on the screen.

15.4 Factory Setting

By pressing the DEFAULT key, you can quickly restore to factory settings. MSO3000E series mixed signal oscilloscope factory settings are as below:

System	Function	Factory Setting
Vertical System	CH1	1V/DIV
	Vertical Displacement	0 (Vertical midpoint)
	Coupling	DC
	Bandwidth Limitation	Off
	VOLTS/DIV	Coarse tuning
	Probe	1×

	Invert	Off
	Bias Voltage	Off
	CH2, CH3, CH4	Off
	MATH, REF	Off
Horizontal System	Extended Window	Off
	Horizontal Time Base	1μs/div
	Horizontal Displacement	0 (Horizontal midpoint)
Trigger System	Hold-off Time	100.00ns
	Trigger Type	Edge
	Source	CH1
	Slope Type	Rising
	Coupling Mode	DC
	Trigger Mode	Automatic
Display	Type	Vector
	Format	YT
	Duration	50ms
	Grid Brightness	40%
	Waveform Brightness	40%
Other System	Storage Type	Waveform
	Frequency Meter	Off
	Measurement	Off, clear all measurements
	Cursor	Off
	Language	Keep the settings that saved at shutdown
	Square Wave Output	1kHz
	Menu Display	Manual
	Backlight Brightness	30%
	Output Selection	Keep the settings that saved at shutdown

Chapter 16 System Prompts and Troubleshooting

16.1 System Prompt Information Description

Operation at limit: In the current state, adjustment has reached the limit and cannot continue. When the vertical scale knob, time base knob, level offset, vertical offset or trigger level, etc. reaches the adjustment limit, the prompt will show up.

USB device is not inserted: When the USB storage device is not connected, this prompt appears if you select a storage disk as USB.

Load Failed: When loading a saved setting or waveform, this prompt appears if there is no stored setting or waveform in the memory location.

16.2 Trouble Shooting

(1) When the power button is pressed and the oscilloscope shows black screen:

①Check whether the power supply connection and the power supply are normal or not.

②Make sure the power switch at the back of the oscilloscope is opened, press the front panel power button and confirm green light is present.

③If there is a relay sound, it indicates that the oscilloscope starts normally. Try the following operations: press the DEFAULT key, then press F1, if device returns to normal, it means backlight brightness is too low.

④After completing the above steps, restart the oscilloscope.

⑤If you still cannot use this product normally, please contact UNI-T and let us serve you.

(2)After signal acquisition, waveform does not appear on display:

①Check if the probe is connected to the signal test point.

②Check if the signal line is connected to the analog channel input.

③Check the analog channel of the input signal and that channel is open.

④Connect the probe to the probe compensation signal connector on oscilloscope's front panel and check whether the probe is normal.

⑤Check to see if there is a signal to be detected (solve the problem by comparing the channel with signal generated and the one with problem).

⑥Press AUTO key for signal re-acquisition.

(3) The measured voltage amplitude value is 10 times larger or smaller than the actual value:

Make sure the probe attenuation coefficient in the channel matches the attenuation of the probe used.

(4) There is a waveform but not stable:

① Check the Source in the trigger menu and confirm that it matches the input channel of the actual signal.

② Check the trigger type: normal signals should use Edge trigger mode. Stable waveform will be displayed only by setting to the correct trigger mode.

③ Try changing the Coupling to HF Rej or LF Rej in order to filter out the high or low frequency noise which might interfere the trigger.

(5) Pressing the RUN/STOP key and no waveform is displayed:

① Check whether the Mode is Normal or Single, and whether the trigger level has exceeded the waveform range. If so, center the trigger level or set the trigger mode to auto with the AUTO key.

② Press the AUTO key to complete the above settings automatically.

(6) Waveform refresh rate is too slow:

① Check whether the acquisition mode is Average in the ACQUIRE menu, and the Averages is large.

② You can speed up the refresh rate by reducing the number in Averages or select other acquisition mode such as Sample (normal sampling).

Chapter 17 Technical Index

Aside from specification labeled “typical”, all specifications are guaranteed.

Unless otherwise stated, all technical specifications are applicable to probes with attenuation 10X and 8050 series mixed signal oscilloscope. Oscilloscope must first meet the following two conditions in order to achieve these standards:

■ The instrument must be operated at the specified operating temperature for more than thirty minutes.

■ If the operating temperature range reaches or exceeds 5 degree Celsius, user must turn on the system function menu to perform self-calibration.

Input	
Input Coupling	DC, AC, GND
Input Impedance	Analog channels: 1MΩ ± 2% // 18pF ± 3pF
Probe Attenuation Coefficient	Digital channels: 0.001×, 0.01×, 0.1×, 1×, 10×, 100×, 1000×
Maximum Input Voltage	Analog channel: CATI 300 Vrms, CATII 100 Vrms, Transient Overvoltage 1000 Vpk
	Digital channel: CAT I 40 Vrms

Vertical				
Model	Protek 8152	Protek 8252	Protek 8154	Protek 8254
Analog Bandwidth	150MHz	250MHz	150 MHz	250MHz
Rise Time (Typical)	≤ 2.4ns	≤ 1.4ns	≤ 2.4ns	≤ 1.4ns
Analog Channels	2		4	
Digital Channels	2+16			
Vertical Resolution	8bit			
Vertical Scale	1mV/div ~ 20 V/div (1-2-5 base)			
Vertical Displacement Range	1mV/div ~ 50 mV/div: ± 2V 100 mV/div ~ 1 V/div: ± 40V 2V/div ~ 20 V/div: ± 400V			
Bandwidth Limit (Typical)	20MHz			

Low Frequency Response (AC coupling, -3dB)	≤ 5 Hz (on BNC)
DC Gain Accuracy	≤ ±3% (Sampling or average sampling method)
DC Offset Accuracy	≤ ±3% (Sampling or average sampling method)
Channel Isolation	DC to maximum bandwidth: >40 dB

Digital Vertical Channels	
Threshold	Adjustable threshold for one set of 8 channels
Threshold Selection	TTL (1.4V) 5.0V CMOS (+2.5V), 3.3 V CMOS (+1.65V) 2.5V CMOS (+1.25V), 1.8 V CMOS (+0.9V) ECL (-1.3V) PECL (+3.7V) LVDS (+1.2V) 0V User-defined
Threshold Range	±20.0V, 10mV stepping
Threshold Accuracy	±(100mV + 3% threshold setting)
Dynamic Range	±10V + threshold
Minimum Voltage Swing	500mVpp
Vertical Resolution	1 bit

Horizontal	
Timing Scale	2ns/div ~ 40s/div (1-2-4 base)
Timing Accuracy	≤ ± (50+ 2×Service Life)ppm
Delay Range	Pre-trigger (negative delay) : ≥1 screen width Post-trigger (positive delay) : 1s ~ 50s
Time Base Mode	YT, XY, ROLL

Waveform Capture Rate	200,000 wfms/s

Sampling	
Sampling Mode	Real-time sampling
Real-time Sampling Rate	2.5GS/s (single channel), 1.25GS/s (dual channel), 1.25GS/s (quad channel), 1.25GS/s (digital channel)
Acquisition Mode	Sampling, peak detection, high resolution, envelope, and average
Average Value	After all channels have reached N samples at the same time, the number of N can be selected between 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 and 8192.
Waveform Interpolation	sin(x)/x
Memory Depth	Auto, 7kpts, 70kpts, 700kpts, 7Mpts,35Mpts,70Mpts optional

Trigger	
Trigger Level Range	Internal: Center of the screen ± 8 grids EXT: ± 1.8V EXT/5: ± 9V
Trigger Mode	Automatic, normal, single
Trigger Hold-off Range	80ns~10s
High Frequency Suppression	80kHz
Low Frequency Suppression	8kHz
Noise Suppression	Reduces waveform noise (10 mV/div ~ 20 V/div, the sensitivity of DC coupling trigger is reduced 2 times)
Trigger Sensitivity	≤ 1div
Edge Trigger	
Edge Type	Rising, falling, any
Pulse Width Trigger	
Pulse Width Condition	>, <, =
Polarity	Positive, negative pulse width

Pulse Width Range	3.2ns ~ 10s
Runt Trigger	
Pulse Width Condition	>, <, =
Polarity	Positive, negative
Pulse Width Range	6.4ns ~ 10s
Window Trigger	
Window Type	Rising edge, falling edge, any edge
Trigger Position	Window enter, exit, time
Window time	6.4ns ~ 10s s
N-Edge Trigger	
Edge Type	Rising edge, falling edge
Idle Time	6.4ns ~ 10s
Number of Edges	1 ~ 65535
Delay Trigger	
Edge Type	Rising edge, falling edge
Delay Type	Greater than, less than, within range, out of range
Delay time	Normal: 6.4ns ~ 10s Lower time limit: 6.4ns ~ 10s Upper time limit: 28.8ns ~ 10s
Timeout Trigger	
Edge Type	Rising edge, falling edge, any edge
Timeout	6.4ns ~ 10s
Duration Trigger	
Code	H, L, X
Trigger Condition	Greater than, less than, within range
Duration Time	Normal: 6.4ns ~ 10s Lower time limit: 6.4ns ~ 10s Upper time limit: 28.8ns ~ 10s
Setup/Hold Trigger	
Edge Type	Rising edge, falling edge
Data Type	H, L
Setup Time	6.4ns ~ 10s
Hold Time	6.4ns ~ 10s
Slope Trigger	

Slope Condition	Positive slope (greater than, less than, specified range) Negative slope (greater than, less than, specified range)
Time Setting	6.4ns ~ 10s
Video Trigger	
Signal System Horizontal Scanning Frequency Range	Supports standard NTSC, PAL and SECAM broadcast system with line numbers ranging from 1 ~ 525 (NTSC) and 1 ~ 625 (PAL/SECAM).
Code Trigger	
Code Setting	H, L, X, rising edge, falling edge
RS232 Decode	
Trigger Condition	Start of frame, error frame, parity error, data
Baud Rate	2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, user-defined
Data Bit Width	5 bits, 6 bits, 7 bits, 8 bits
I2C Decode	
Trigger Condition	Start, restart, stop, lost acknowledgment , address, data, address/data
Address Bit Width	7 bits, 10 bits
Address Range	0 to 119, 0 to 1023
Byte Size	1bit to 5bits
Data Qualifier	Equal to, greater than, less than
SPI Decode	
Trigger Condition	Chip select, timeout
Idle Time	80 ns ~ 1s
Data Bits	4 bits to 32 bits
Data Setting	H, L, X
Clock Edge	Rising edge, falling edge
USB Decode	
Signal Speed	Low speed, full speed
Trigger Condition	Synchronization, reset, pause, restore, packet tail, token packet, data packet, handshake packet, SOF, error.
CAN Decode	
Signal Type	Rx/Tx, CAN_H, CAN_L, Difference
Trigger Condition	Frame start, frame type, ID, data, ACK missing, bit stuffing error, ID and data, frame end
Signal Rate	10kbps, 20kbps, 33.3kbps, 50kbps, 62.5kbps, 83.3kbps, 100kbps, 125kbps, 1Mbps, user-defined

Sampling Point	1% to 99%	
Frame Type	Data frame, remote frame, error frame and overload frame	
Measure		
Cursor	Manual	Voltage difference between cursors (△V) Time difference between cursors (△T) The reciprocal of △T (Hz) (1/△T)
	Tracking Mode	Voltage and time at waveform point
	Indicator	Allows cursor display during automatic measurement
Automatic Measurement	Maximum, minimum, peak-to-peak, median, top, bottom, amplitude, period average, average, periodic RMS, RMS, overshoot, preshoot, frequency, period, rise time, fall time, positive pulse width, negative pulse width, rise delay, fall delay, FRFR、FRFF、FFFR、FFFF、FRLF、FRLR、FFLR、FFLF, positive duty ratio, negative duty ratio, phase, area, cycle area.	
Number of Measurement	Displays 5 measurements at the same time	
Measurement Range	Screen or cursor	
Measurement Statistics	Average, maximum, minimum, standard deviation and the number of measurements	
Frequency Meter	6-bit hardware frequency meter	

Arbitrary Waveform Generator AWG	
Channel	Dual channel
Maximum Frequency	50MHz
Sampling Rate	250MSa/s
Waveforms	Sine wave, square wave, ramp wave, pulse wave, noise, DC, arbitrary wave
Operating Modes	Output channel selection, duration, modulation
Modulation Types	AM, FM
Characteristics of Waveforms	
Sine Wave	
Frequency Range	1μHz~50MHz

Resolution	1μHz
Accuracy	±50ppm in 90 days, ±100ppm in a year (18°C~28°C)
Harmonic Distortion (typical)	Test condition: output power 0dBm, -40dBc
Total Harmonic Distortion (typical)	< 1% (DC~20kHz, 1Vpp)
Square Wave	
Frequency Range	1μHz~15MHz
Resolution	1μHz
Rising/falling Time	< 13ns (typical value, 1kHz, 1Vpp)
Overshoot (typical value)	< 2%
Duty Cycle	1%~99% (limited by current frequency setting)
Jitter (typical value)	2ns
Ramp Wave	
Frequency Range	1μHz~400kHz
Resolution	1μHz
Nonlinearity	1% (typical value, 1kHz, 1Vpp, symmetry 50%)
Symmetry	0.1%~99.9%
Pulse Wave	
Frequency Range	1μHz~15MHz
Resolution	1μHz
Pulse Width	≥20ns
Adjustable Edge	12ns~8s
Overshoot (typical value)	< 2% (typical value, 1Vpp, 1kHz, 1Vpp)
Jitter	2ns
Gaussian Noise	
Bandwidth	50MHz bandwidth (-3dB) (typical value)

DC Offset	
Range (peak value AC+DC)	±1.5V（50Ω）
	±3V (high resistance)
Offset Accuracy	Offset setting ±2%
Characteristics of Arbitrary Wave	
Frequency Range	1μHz~5MHz
Resolution	1μHz
Waveform Length	8~512k dots (Play Mode)
Vertical Resolution	16bits (includes icons)
Sampling Rate	250MSa/s
Nonvolatile Storage	Sinc, Exponential rising, Exponential falling, Cardiac, Gaussian, Lorentz, Haversine
Characteristics of Output	
Amplitude Range	10mVpp~3Vpp; (50Ω）
	20mVpp~6Vpp; (high resistance)
Accuracy (1kHz sine wave)	±5%
Amplitude Flatness (compare with 1Vpp/50Ω)	Test condition: typical value (sine wave, 2.0Vpp)
	±0.5dB
Waveform Output	
Impedance	50Ω typical value
Protection	Channel protection
Modulation Type	
Amplitude Modulation AM	
Carrier Wave	Sine wave, square wave, ramp wave, arbitrary wave
Modulated Wave	Sine wave, square wave, ramp wave, noise, arbitrary wave
Modulation Frequency	2mHz~50kHz
Modulation	0%~120%

Depth	
Frequency Modulation FM	
Carrier Wave	Sine wave, square wave, ramp wave, arbitrary wave
Modulated Wave	Sine wave, square wave, ramp wave, noise, arbitrary wave
Modulation Frequency	2mHz ~50kHz
Frequency Deviation	DC ~25MHz

Mathematical Operations	
Waveform Calculation	A+B, A-B, A×B, A/B, FFT, logic operation, digital filtering, advanced operation
FFT Window Type	Rectangle, Hanning, Blackman, Hamming
FFT Display	Split screen; time base can be adjusted independently
FFT Vertical Scale	Vrms, dBVrms
Digital Filter	Low-pass, high-pass, band-pass and band-stop
Logic Operation	AND, OR, NOT, XOR
Advanced Operation	Log, Exp, Sin, Cos, Tan, Sqrt, Inth, Diff

Storage	
Setting	Internal (256 sets), external USB storage device
Waveform	Internal (256 sets), external USB storage device
Bitmap	External USB storage device, it can also store the relevant parameter information.

Display	
Display Type	8-inch TFT LCD
Display Resolution	800 horizontal×RGB×480 vertical pixels
Display Color	24bit true-color
Duration	Minimum, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s and infinite.
Menu Duration	1s, 2s, 5s, 10s, 20s, manual
Display Type	Dots, vector

Interface	
Standard/Opti	Standard: USB-Host, USB-Device, LAN, VGA, EXT Trig, AUX Out, LA,

onal Interface	Signal source output interface (WaveGen) Optional: multimeter module (UT-M12)

General Technical Specifications	
Probe Compensation Signal Output	
Output Voltage	About 3Vp-p
Frequency	10Hz, 100Hz, 1kHz (default), 10kHz
Power Supply	
Power Supply Voltage	100V ~ 240VACrms
Frequency	45Hz ~ 440Hz
Fuse	2.5A, T, 250V
Environment	
Temperature Range	Operational: 0°C ~ +40°C
	Non-Operational: -20°C ~ +60°C
Cooling Method	Fan forced cooling
Humidity Range	Operational: below +35°C ≤ 90% relative humidity Non-Operational: +35°C ~ +40°C ≤ 60% relative humidity
Altitude	Operational: below 3000m Non-Operational: below 15,000m
Mechanical Specifications	
Size	370mm(W)×195mm(H)×125mm(D)
Weight	4.2kg
Calibration Interval	
Recommend to perform calibration once a year	

Chapter 18 Accessories

Appendix A Accessories and Options

Model Number	Protek 8152 / Protek 8252
	Protek 8154 / Protek 8254
Standard Accessories	Power cord that complies with the country's standard
	USB data cable (UT-D14)
	1/2 passive probes (200MHz / 300MHz)
	A set of logical analysis probe UT-M15
	Multimeter module (UT-M12)

All accessories (standard accessories and optional items), please order from the local Protek dealers.

Appendix B Maintenance and Cleaning

(1) General Maintenance

Do not store or place the instrument in places where the LCD monitor will be exposed to direct sunlight for a long time. Caution: Do not allow sprays, liquids and solvents to be stained on the instrument or probe to prevent damage.

(2) Clean

Refer to the operating conditions of the instrument and probe and perform frequent checks. Clean the outer surface of the instrument according to the following steps:

● Please use a soft cloth to wipe the dust off the instrument and the probes. When cleaning the LCD screen, please pay attention and protect the transparent LCD screen.

● Please disconnect the power supply, then with a damp but not dripping soft cloth, wipe the instrument. Do not use any abrasive chemical cleaning agent on the instrument or probes.

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

Appendix C Warranty Overview

Protek Insturment Co.,Ltd. (Call us "Protek") ensures the production and sale of products, from authorized dealer's delivery date of one years, without any defects in materials and workmanship.