multicomp PRO



Digital Ultra Phosphor Oscilloscope

Model No. MP720112, MP720113, MP720114 and MP720115

When using electrical appliances, basic safety precautions should always be followed to reduce the risk of fire, electric shock and injury to persons or property.

Read all instructions before using the appliance and retain for future reference.

- This meter is designed to meet IEC61010-1, 61010-2-032, and 61010-2-033 in Pollution Degree 2, Measurement Category (CAT II 150V when switched to 1X and 300V CAT II when switched to 10X) and double Insulation.
- Check that the voltage indicated on the rating plate corresponds with that of the local network before connecting the product to the mains power supply.
- Do not operate this product with a damaged plug or cord, after a malfunction or after being dropped or damaged in any way.
- Check the product before use for any damage. Should you notice any damage on the cable or casing, do not use.
- This product contains no user-serviceable parts. All repairs should only be carried out by a qualified engineer. Improper repairs may place the user at risk of harm.
- Take caution when voltages are above 60V DC and 30V ACrms.
- The earth probe must only be used to connect to ground, never connect to a voltage source.
- This product must be earthed using the mains power cord ground connection.
- Do not disconnect from the mains supply and it's ground connection when any item is connected to this product for measurement.
- Children should be supervised to ensure that they do not play with the product.
- Always disconnect from the mains when the product is not in use or before cleaning.
- Do not use the product for any purpose other than that for which it is designed.
- Do not operate or store in an environment of high humidity or where moisture may enter the product as this can reduce insulation and lead to electric shock.

PRODUCT OVERVIEW

Main Features

- Two and four channels with HD colour 8" LCD display
- Real-time continuous hardware waveform recording and waveform analysis
- Multi waveform mathematical operation function
- Automatic measurement of 34 waveform parameters
- Edge, video, pulse width and advanced trigger functions
- Waveform capture rate of up to 80,000wfms/s
- Supports plug and play USB storage devices and communication with PC
- Unique waveform recording and replay function

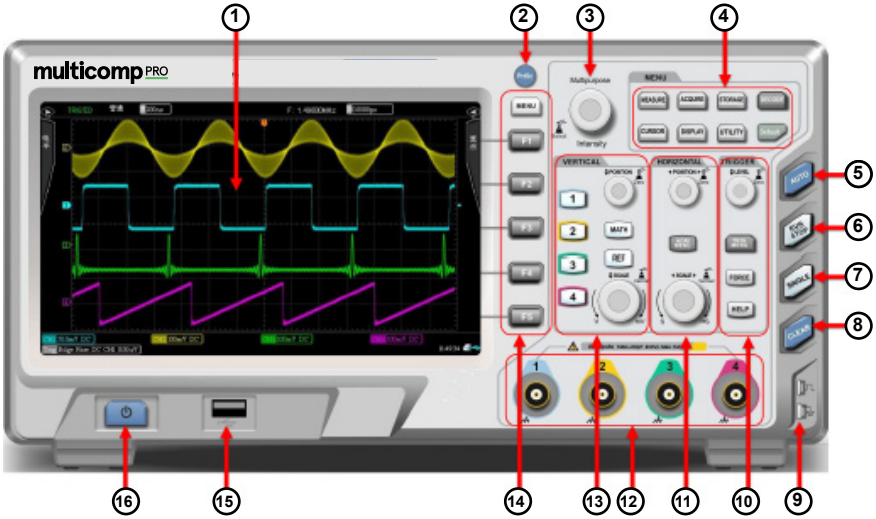
WHAT'S INCLUDED

- Digital Oscilloscope Unit
- Mains power lead
- User Manual
- Communications software CD
- USB lead
- Selectable 1:1/10:1 passive probes

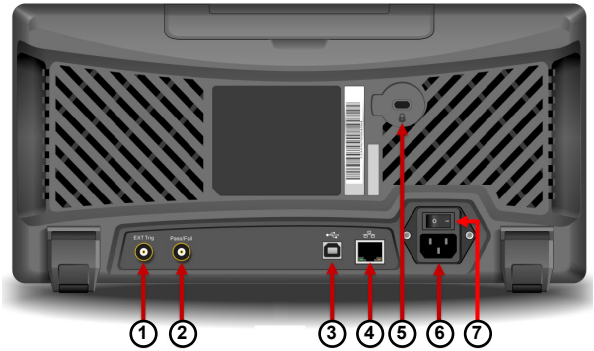
OPERATING PARAMETERS

- The oscilloscope also has high performance index and powerful functions required for faster measurements.
- Faster signals can be observed with the oscilloscope via 1GS/s real-time sampling.
- Powerful trigger and analysis ability make it easier to capture and analyse waveforms.
- Clear LCD and mathematical operating functions make it easy to use to observe and analyse signal problems in a faster and clearer way.

CONTROLS AND CONNECTIONS



1. Screen display area
2. Copy/print screen
3. Multi-functional control
4. Function menu
5. Automatic setting
6. Run/stop
7. Single trigger control
8. All clear
9. Calibration and ground terminal
10. Trigger control area
11. Horizontal control area
12. Analogue channel inputs
13. Vertical control area
14. Control menu
15. USB HOST Interface
16. Power on/off

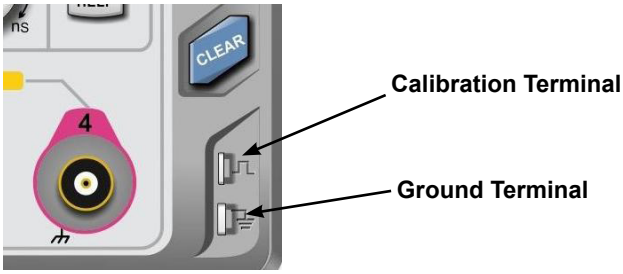


REAR PANEL

1. External trigger input
2. Pass/Fail output
3. USB Socket
4. LAN network
5. Safety Lock
6. AC Power Socket
7. Main power switch

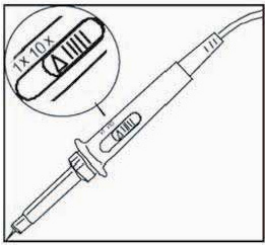
OPERATION

- **Boot check**
- Power on the unit at the rear followed by the soft power button on the front panel.
- The oscilloscope then run through a set on self test functions followed by the display screen showing.
- Take the probe and connect its BNC header to the BNC terminal of the oscilloscope. Connect the probe's main alligator clip to the "Calibration terminal" and the ground clip also connected to the "Ground terminal".



Probe compensation

- Perform this adjustment when connecting the probes to any input channel for the first time or errors in the measurement may result.
- Set the attenuation coefficient in the probe menu and the switch on the probe to 10x
- Enable CH1 and press AUTO.
- Observe the shape of the displayed waveform.





Over Compensation **Correct Compensation** **Under Compensation**

- Adjust the variable capacitor on the probe with an insulated screwdriver until a correct waveform is achieved.

AUTO SET WAVEFORM DISPLAY

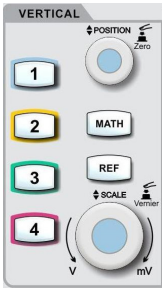
- The oscilloscope features an AUTO SET function which automatically adjusts the vertical deflection factor, scanning time base and trigger mode based on the input signal until the most appropriate waveform is displayed.

Using the AUTO SET function

- Connect the signal to be measured to the signal input channel.
- Press AUTO and the oscilloscope will adjust the vertical scale factor, timebase, and trigger mode according to the input signals.

DISPLAY SETTING CONTROLS

Vertical control panel



- 1 2 3 4: open or close the four channels display. Model dependent.
- MATH: Open the mathematical operations menu for add, subtract, multiply, divide, FFT, filtering, logic, and advanced operations.
- REF: Recall previously stored reference waveforms, can compare currently measured waveform with reference waveforms.
- VERTICAL POSITION CONTROL: Used to adjust the vertical position of the current channel waveform. Press this control to return the channel display back to the midpoint position.
- VERTICAL SCALE CONTROL: Used to adjust the vertical scale of the current waveform. The vertical scale has 1, 2, and 5 steps.
- Pressing the button allows the vertical adjustment to switch between coarse and fine adjustment mode.

Level (horizontal) control panel



- Displays window extension, independent timing, and holdoff time.
- HORIZONTAL POSITION CONTROL: Adjusts the horizontal position of the current channel waveform. Press this control to return the channel display back to the midpoint position.
- HORIZONTAL SCALE CONTROL: Used to adjust the vertical scale of the current waveform. The vertical scale has 1, 2, and 5 steps.
- Pressing the SCALE button allows the vertical adjustment to switch between main and extensible window mode.

Trigger system



- TRIGGER LEVEL CONTROL: Adjusts the currently selected trigger level. Press the control to return the trigger level back to the midpoint position.
- TRIG MENU: Press to display the trigger menu.
- FORCE: Press to generate a trigger event once.
- HELP: Displays built-in help system.

Auto Setting



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

Run/Stop



- Press the key to “run” or “stop” sampling. RUN state is indicated by green light. STOP state is indicated by red light.

Single



- Set to single trigger mode. After the trigger point the oscilloscope will stop sampling.

Clear



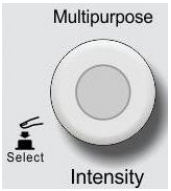
- Clear all waveforms. If the oscilloscope is in the “RUN” state, it will continue to display new waveforms. The screen will momentarily clear if in “stop” state when “run” is pressed and sampling re-starts.

Screen Copy



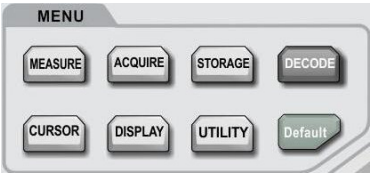
- Copy the screen to a BMP format image and store it to USB device.

Multi-function Control



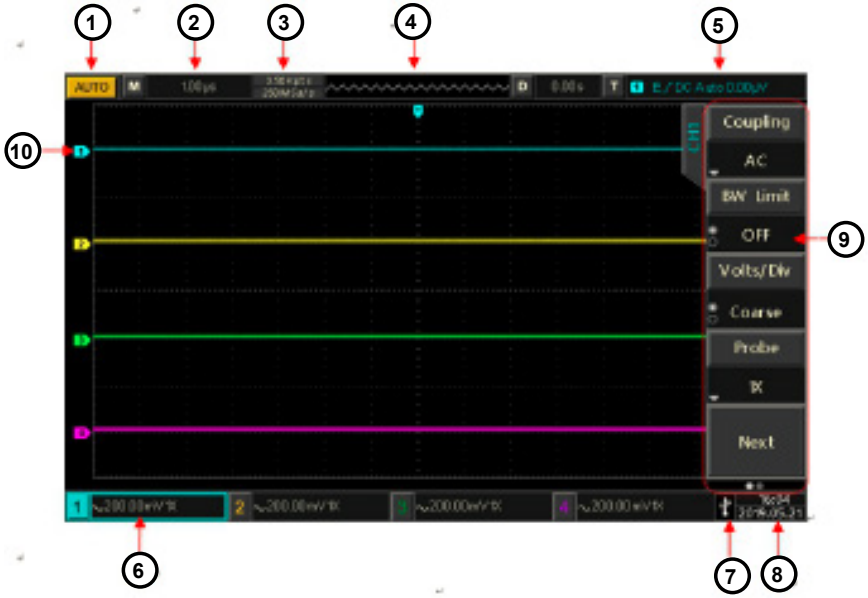
- Press the DISPLAY button and press F3 or F4 to select the brightness options, then use the control to adjust the brightness.
- Press the control to confirm the setting.
- During menu operations the control can be used to select various sub menu options, then press it again to confirm selection.

Function Keys



- MEASURE: Measure setting menu: can set measure source to all parameters, custom parameters, perform measurement statistics, select measurement indicators, etc.
- ACQUIRE: Sampling setting menu to set up acquisition mode and storage.
- STORAGE: Storage interface can select different types of storage and waveform settings, which can be stored internally or through USB device.
- CURSOR: Cursor measurement menu can measure waveform's time and voltage manually with cursor. Press F1 to turn on or off.
- DISPLAY: Select display settings, such as display type, format, duration, grid brightness, and waveform brightness.
- UTILITY: The utility menu can choose between some less commonly used settings such as self-calibration, system information, language, menu display, waveform recording, pass test, square wave output, frequency meter, system upgrades, back-light brightness, output, etc. using relevant function button.
- DEFAULT: Restore to factory default settings.

USER INTERFACE



1. **Trigger Status Identification:** Include TRIGED (has been triggered), AUTO, READY, STOP, and ROLL (rolling)
2. **Timing Scale:** Indicates the amount of time represented by one square, which can be adjusted by the horizontal scale control.
3. **Sampling Rate/Acquisition Mode:** Indicates the current sampling rate and storage depth.
4. **Horizontal Displacement:** Shows the horizontal displacement, which can be adjusted by turning the horizontal position control. Pressing the control returns the displacement back to 0.
5. **Trigger Status:** Displays trigger source, type, slope, coupling, level, etc.

- TRIGGER SOURCE: There are seven states: CH1~CH4, AC Line, EXT, and EXT/5.

Note: CH1~CH4 will each be displayed a different trigger colour.

- TRIGGER TYPE: The types are edge, pulse width, video, slope, and advanced trigger.
- TRIGGER SLOPE: The types are rising, falling, and rising/falling.
- TRIGGER COUPLING: The types are DC, AC, high frequency, low frequency and noise.
- TRIGGER LEVEL: Indicates the current trigger level value, can be adjusted with the trigger level control.

6. **CH1 Vertical Identification:** Displays CH1 activation state, channel coupling, bandwidth limit, vertical profile, and probe attenuation coefficient.

- CHANNEL ACTIVATION STATE: When the background colour is consistent with the channel colour, the channel is activated. Press CH1~CH4 to open/close the corresponding channel.
- CHANNEL COUPLING: Includes DC, AC, and grounding.
- BANDWIDTH LIMITATION: When the bandwidth limit function is turned on, a BW icon will appear in the display.
- VERTICAL PROFILE POSITION: When CH1 is activated, the vertical profile can be adjusted with the vertical scale control.
- PROBE ATTENUATION FACTOR: Displays CH1 probe attenuation coefficient: 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, and 1000X

7. **USB Device Identification:** This icon will be displayed when an USB storage device is connected.
8. **Current date and time.**
9. **Operation Menu:** Displays the current operation menu. Use F1 ~ F5 to navigate through menu contents
10. **Analogue Channels:** Displays CH1~CH4 waveforms with matching tag and waveform colour.

USER INTERFACE SYMBOLS


Indicates there is a next level menu.


Indicates there is a drop-down menu.


Indicates the menu has two options.


Indicates the user can adjust by the Multi-function control.


The number of circles indicates the total pages of the menu.

INSTRUMENT SETUP

Vertical system setup

- The 2 analogue channels are CH1 and CH2, and for 4 channel models the channels are CH1 to CH4. Each channel should be set up individually.
- Press CH1 to CH4 and the system will display the operation menu for that channel.
- CH1~CH4 contains 3 states: open, activate, and shut down.
- Open: Allows the corresponding channel waveform to display on the screen.
- ACTIVATION: Only opened state can be activated. In the active state, the vertical menu and the vertical control controls (POSITION, SCALE) are for changing activated channel setting. Any of the channels that have been opened but not activated could be activated by the corresponding channel keys
- OFF: No waveform appears on the display.

Functions Menu	Setup	Notes
Coupling	AC	Intercepts the DC quantities of the input signal.
	DC	Pass AC and DC quantities of input signal
	GROUND	Disconnect input signal
Bandwidth Limit	On	Limit bandwidth to 20MHz to reduce noise display.
	Off	Full bandwidth
Vertical Sensitivity	Coarse tune	Coarse tune in steps of 1-2-5 to set up the deflection factor of the vertical system.
	Fine tune	Fine tune is further tuning within the coarse tune set up to improve the vertical resolution.
Probe	1X, 10X, 100X and 1000X	Select either value based on the probe attenuation factor to keep the vertical deflection factor reading correct.
Next Page		Go to the second page of the channel menu
Invert	On	Waveform invert function on.
	Off	Normal waveform display.
Bias	On	Turns on bias function
	Off	Turns off the bias function
Bias Voltage		Adjust with the multi purpose control, the bias voltage is used to offset the DC voltage the signal
Return to Zero		Returns the bias voltage back to 0V
Return		Return to the first page of the channel menu

Channel coupling setup

- If for example a signal is applied to CH1 which has a sine signal that contains DC quantities.
- Press F1 to select AC and set up as AC coupling. Any DC quantities in the signal are now intercepted.
  Press F1 to select DC.
- Both AC and DC quantities of the signal being measured can now pass through.
- The waveform displays both AC and DC quantities of the signal.

- Press F1 to select GROUND.
  Both AC and DC quantities of the signal being measured are now intercepted.
- The waveform is not displayed in this mode but the signal remains connected to the channel circuit.

Channel bandwidth setup

- If for example a signal is applied to CH1 which is a pulse signal that contains high frequency oscillation.
- Press CH1 to select Channel1.
- Press F2 to set the BANDWIDTH LIMIT OFF so it is set up as full bandwidth.
- The signal being measured can now pass through even if it contains high frequency quantities.
- Press F2 to set BANDWIDTH LIMIT ON so that frequency quantities higher than 20MHz in the signal being measured will be limited.

Vertical Volts/Div adjustment setup

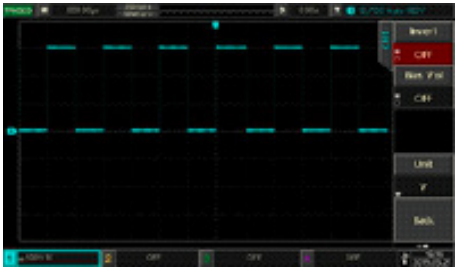
- The VOLTS/DIV range of the vertical deflection factor can be adjusted either in coarse or fine tune mode.
- In COARSE TUNE the VOLTS/DIV range is 1mV/div~2V/div. Tuning is in steps of 1-2-5. For example: 10mV - >20mV - >50mV - >100mV.
- In FINE TUNE mode it adjusts in 1% of the current amplitude value steps.
  For example: 10.00mV—>10.10mV—>10.20mV—>10.30mV.

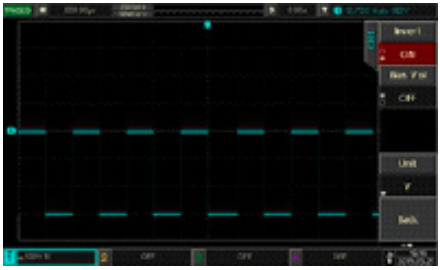
Probe rate setup

- To match the probe attenuation factor setup, it is necessary to set up the probe attenuation factor in the channel operation menu accordingly.
- For example when the probe attenuation factor is 10:1, set the probe attenuation factor at 10X in the menu. This principle applies to other values to ensure the voltage reading is correct.
- The coefficients can be set to 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, and 1000X.

Waveform inversion (Reverse Phase)

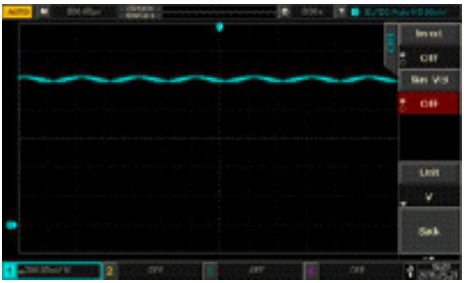
- The displayed signal is inverted 180 degrees with respect to the ground level.
- The vertical identification will display a reverse phase logo ↓.

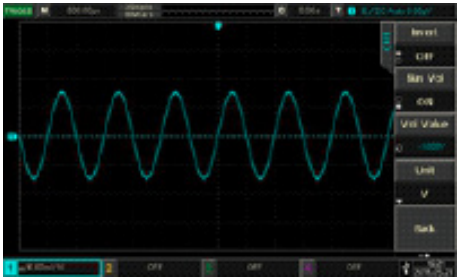




Bias

- When the amplitude of the DC component in the signal is relatively large, waveform observation could be very inconvenient.
- Using the bias function and the superposition of a -1V bias voltage can eliminate the DC component of the waveform so the AC signal can be clearly observed.
- Press 1 → PgDn → Bias to turn on bias and rotate the multi-function control counter clockwise to adjust the value to -10V. Press multi-function again to return bias to zero.



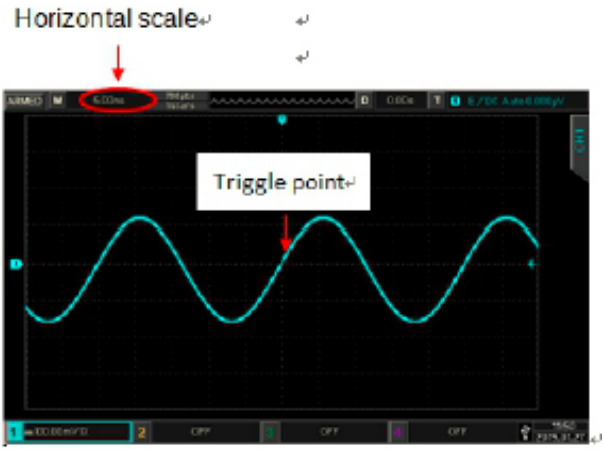


Unit

- Select the amplitude unit for the current channel. Press 1 → PgDn → UNIT and adjust the multi-function control to select the unit of “V”, “A”,”W” or “U”.
- The default unit is V.
- It’s also possible to switch the channel units by consecutively pressing the unit key, then press the Multi-function control to confirm, the corresponding unit will appear on the channel status bar.

Horizontal Scale

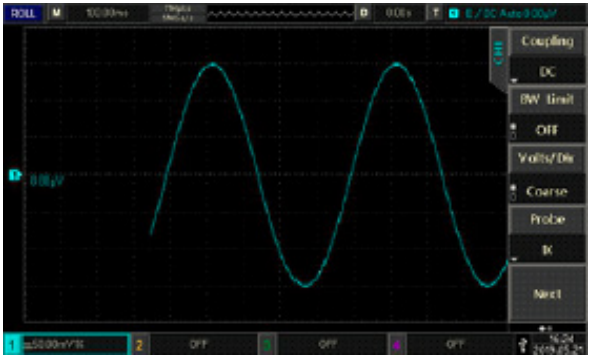
- Horizontal scale, also the horizontal time base, is the time value represented by each scale in the horizontal direction, which is usually expressed as s/div. With the SCALE control in the horizontal control area, user can adjust the horizontal scale in 1 – 2 – 5 steps, i.e. 5ns/div, 10ns/div, 20ns/div, 50ns/div to 50s/div.
- Turn clockwise to decrease the scale and turn counter clockwise to increase and the scale information 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 trigger point position.

ROLL mode

- When the trigger mode is auto, adjust the SCALE control in the horizontal control area to change the horizontal scale to be slower than 50ms/div, and the oscilloscope will be in ROLL mode and will continuously plot the waveform voltage-time trend chart on the screen.
- The earliest waveform first appears on the right end of the screen, and then gradually moves to the left.

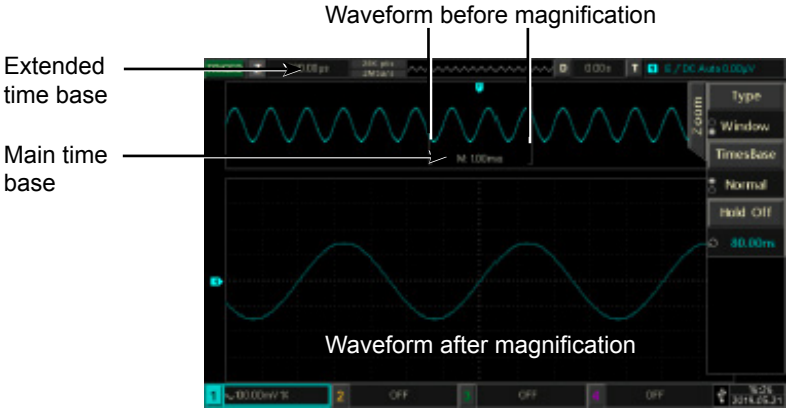


- Use the slow sweep mode to observe low frequency signal, and setting “channel coupling” method to “DC” is recommended.

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

Extended Window

- Used to enlarge waveform, the extended waveform setting cannot be slower than main waveform setting.
- Press the HORI MENU button in the control panel then press the type key can turn on the extended window or simply press the SCALE control to directly enter the extended window, the screen will be divided into two display areas.

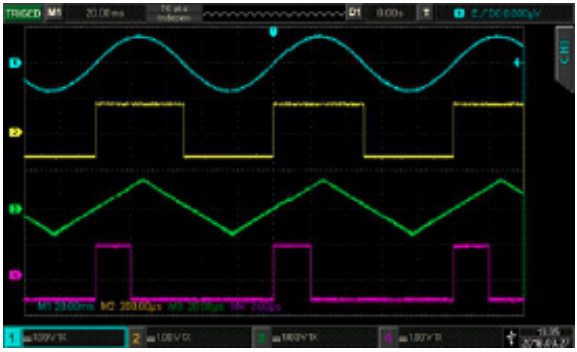


- Under the window scale mode the screen is divided into two display areas as the above picture shows. The upper part displays the original waveforms, which can move left and right through rotating the horizontal POSITIONAL control or can enlarge and reduce the selected areas by rotating the control horizontal SCALE.
- The lower part displays the horizontal scale waveform.

Note: The extended window function is only available when the horizontal time base is between 20ms/div~5us/div.

Independent Time Base

- In independent time base, CH1~CH4 can be arranged in timing, so that the channel can observe signals of different frequencies.
- Press HORI MENU →Time base setting to enter the independent time base.
- As shown below, CH1 is a 100kHz sine wave, CH2 is a 10 Hz square wave, CH3 10kHz triangular wave, CH4 1kHz pulse wave. By using the independent time base, frequency signals with large variation can be observed.



Trigger Hold-off

- Trigger hold-off can observe complex waveforms (such as pulse series).
- Hold-off time is the time for the oscilloscope to re-enable the trigger. In the period of release and suppression, the oscilloscope will not be triggered. For example, a set of pulse series, which is required to trigger on the first pulse, can set the release time to the pulse width.
- Press the HORI MENU button to enter the level control menu. Use the multi-function control to select trigger release.
- Input a combined waveform to CH1, and adjust the trigger hold-off time until the waveform can be triggered steadily.



Set Sampling System

- Sampling is taking analogue input and converts into a discrete points using an analogue to digital converter (ADC).
- Press ACQUIRE key to enter the sample menu.

Functions	Options	Description
Sampling mode	Normal Peak High Res Envelope Average	
Average	2~8192	In average sampling mode, use multi-function control to set average time, number can be in the range of 2^n, where n is 1~13
Storage depth	Auto 28k 280k 2.8M 28M 56M	Automatic storage depth Set storage depth to 28kpts Set storage depth to 280kpts Set storage depth to 2.8Mpts Set storage depth to 28Mpts Set storage depth to 56Mpts

Sampling and Sampling Rate

- When the analogue signal is sampled, the sample is then converted into digital data. The digital data is collected as the waveform is being recorded, and the recorded data is then stored in the memory.



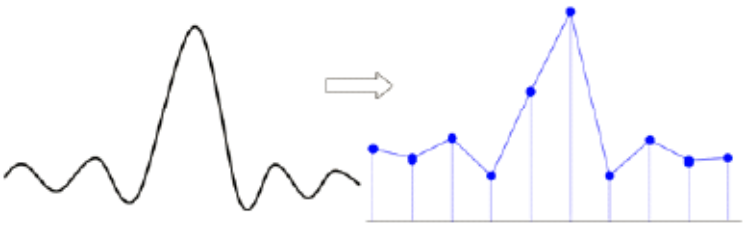
Analogue Signal



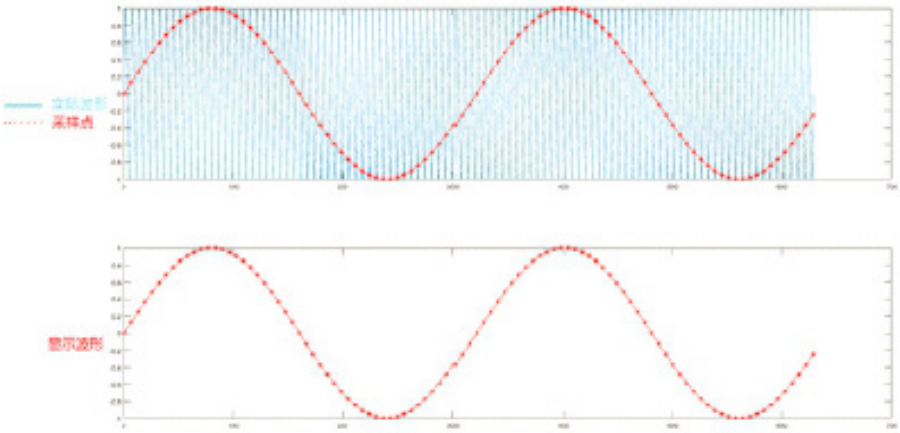
Sampling Points

Low Sampling Rate Effect

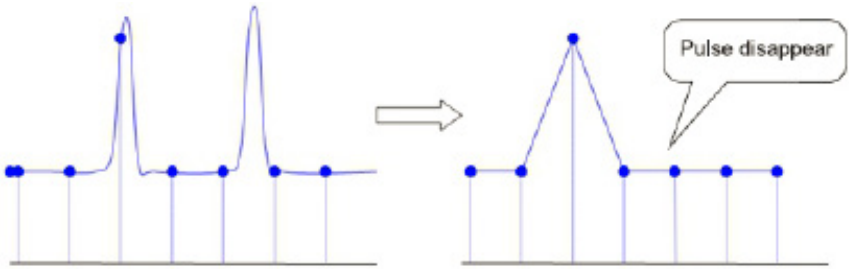
- WAVEFORM DISTORTION: Due to low sampling rate, the details of the waveform might be missing, the sampling waveform might be different than the actual signal.



- WAVE MIXING: When the sampling rate is 2 times lower than the actual signal frequency (Nyquist frequency), the frequency of the reconstructed signal will be less than the actual signal frequency.



- WAVEFORM LEAKAGE: Due to low sampling rate, the reconstructed waveform might not reflect the actual signal.



Acquisition Mode

- To obtain a waveform from sampling points, press the ACQUIRE key then F1 to switch between acquisition methods.

Normal Sampling

- In this acquisition mode, the signal is sampled and reconstructed with equal time intervals. For most waveforms, the use of this mode can produce the best effect.

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 mode. Noise might be enlarged in this mode.

High Resolution

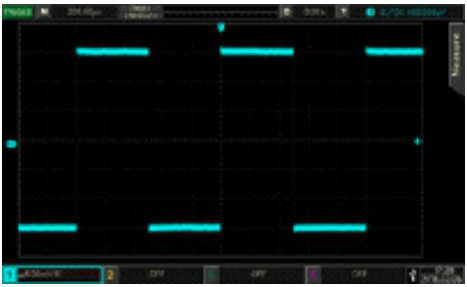
- In this acquisition mode, the oscilloscope can reduce random noise from the input signal and generate smoother waveforms.

Envelope

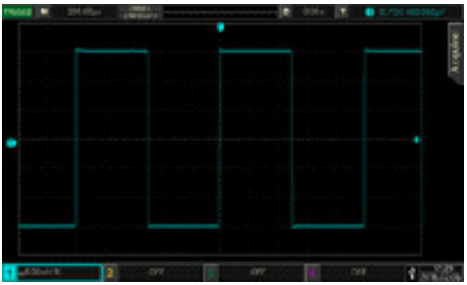
- The sampling points gathered at same time are calculated and the maximum and minimum values are displayed. Peak detection mode is used for individual acquisitions using general envelope mode.

Average

- In this acquisition mode, the oscilloscope obtains several waveforms and finds the average, and displays the final waveform. This method can reduce random noise.
- By changing the acquisition mode settings, the resulting waveform display changes.
- The un-averaged and the 32 times averaged waveform are displayed below for comparison.



Waveform without average



Waveform with 32 times average

NOTE: Average and high resolution uses different average methods. The former is multiple sampling average, the latter is single sampling average.

Storage Depth

- The storage depth is the number of waveforms that can be stored in the oscilloscope during a trigger acquisition. It reflects the memory 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 Default is 56Mpts memory depth (per channel).
- Press ACQUIRE → Memory depth to set the memory depth to automatic, 28k, 280k, 2.8M, 28M or 56M. The default is automatic.

TRIGGER MODE SETUP

Setting up the Trigger system

- Triggering decides when the oscilloscope collects data and displays waveforms. Once the trigger is correctly set up, it can convert unstable display into significant waveforms.
- When beginning to collect data the oscilloscope first collects sufficient data to draw a waveform on the left of the triggering point.
- While waiting for the triggering condition to occur it will continuously collect data. When sufficient data is acquired to draw a waveform on the right of the triggering point.

Trigger Source - Trigger can be obtained from various sources: Input channel (CH1, CH2, CH3 or CH4), external trigger (EXT, EXT/5) or Line A/C etc.

1. **Input channel** - the most common trigger source is input channel. The selected trigger source can operate normally whether the input is displayed or not. Select any one of the analogue signal input terminal CH1~CH4 on the front panel of the oscilloscope as a trigger signal.
2. **External trigger** - Select the input Trig EXT from the back of the oscilloscope. For example, the external clock input can be used on the Trig EXT terminal as a trigger source. EXT signal trigger level ranges from -0.9V~ +0.9V can be set. The EXT/5 trigger signal divides the actual signal by 5, so the trigger level can be increased to -4.5V ~ +4.5V.
3. **AC Line** - Power supply signal, used to observe the relationship between power signals such as lighting equipment and power supply equipment, to obtain stability in synchronization.

Trigger Mode - determines the action of the oscilloscope when there is no trigger. There are three trigger modes - auto, normal and single.

1. **Auto Trigger** - samples the waveform data when there is no trigger signal input. The scan base is shown on the display. When the trigger signal is generated it automatically turns to trigger scan for signal synchronisation.

Note: when the time base of the scan waveform is set to 50ms/div or slower, the auto mode allows no trigger signal.

2. **Normal Trigger** - In this mode waveforms are only sampled when triggering conditions are met. The system stops acquiring data and waits when there is no trigger signal. When a trigger is generated, trigger scan occurs.
3. **Single Trigger** - In this mode press RUN button once and the oscilloscope will wait for trigger. When one trigger is detected, it will sample and display the acquired waveform, then stop.

Trigger coupling - determines which quantities of the signal are transmitted to the trigger circuit. Coupling modes are DC, AC, low frequency reject and high frequency reject.

1. **DC** - allowing all quantities to pass.
2. **AC** - intercepting DC quantities and attenuating signals under 10Hz.
3. **High frequency suppression:** Attenuates high frequency components over 80kHz.
4. **Low frequency suppression:** Blocks the DC component and attenuates low frequency components below 8kHz.
5. **Noise suppression:** Suppress high frequency noise in the signal, and reduces probability of error.

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

Pre-Trigger/Delayed Trigger - data sampled before/after triggering. The trigger position is typically set at the horizontal centre of the screen. You are able to view five divisions of pre-trigger and delayed trigger information. Use the horizontal position control to adjust the horizontal shift of the waveform to see more pre-trigger information.

Forced Trigger
Press the FORCE key to generate a forced trigger signal.
If the waveform is not displayed in normal or single shot mode, press the FORCE button to collect the signal baseline to ensure acquisition is normal.

Edge Trigger:
- When selecting edge trigger, you are triggering at the rising and falling edges of the input signal.
- Press the TRIG MENU → type to select edge with the multi-function control, and the defaulted trigger type is edge. User can also switch the trigger type by consecutively pressing the type button, and then press the and use the multi purpose control to confirm.

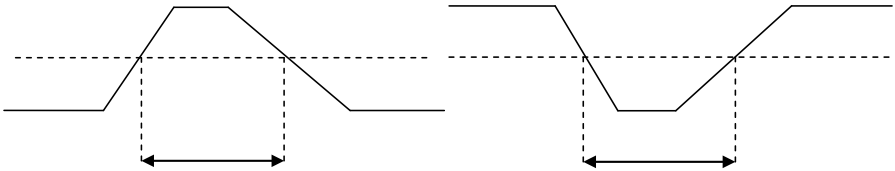
Functions Menu	Setup	Notes
Type	Edge	
Signal source selection	CH1 to CH4 EXT, EXT/5 AC Line	Set Ch1 to CH4 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal Set AC line as trigger
	Grid Alternate	Set up as grid trigger Ch1, CH2 trigger their own signals alternatively
Inclination	Rising Falling	Set to trigger on the signals rising edge Set to trigger on the signals falling edge
Trigger Mode	Auto Normal Single	Set to sample waveform only if no trigger condition is detected Set to sample waveform only if trigger condition is satisfied Set to sample waveform once when detecting one trigger and then stop
Trigger coupling	DC AC H/F reject L/F reject Noise Suppression	Intercept DC quantities of the input signal Allow AC and DC quantities of the input signal to pass Reject high frequency quantities above 50kHz of the signal Reject low frequency quantities below 5kHz of the signal Suppress the noise of the trigger signal, trigger sensitivity is halved.

Pulse Trigger

- Pulse trigger means determining the triggering time based on the pulse width. You can acquire abnormal pulse by setting the pulse width condition.
- Press the TRIG MENU button then press F1 to select trigger type and then set the pulse width using the multi-function control.

Functions Menu	Setup	Notes
Type	Pulse	
Trigger source	CH1 to CH4 EXT, EXT/5 AC Line	Set Ch1 to CH4 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal Set AC line as trigger
Pulse width condition	Larger Smaller Equal	Trigger when pulse width is larger than default value Trigger when pulse width is smaller than default value Trigger when pulse width equals to default value
Pulse width setting	4.0ns~10.0s	The pulse width time can be set from 4.0ns~10.0s using the multi-function control
Trigger polarity	Pos pulse width Neg pulse width	Set positive pulse as the trigger signal Set negative pulse width as the trigger signal
Trigger mode	Auto Normal Single	The system automatically samples waveform data when there is no trigger signal input. The scan baseline is shown on the display. When the trigger signal is generates it automatically turns to trigger scan. The system stops acquiring data when there is no trigger signal. When the trigger signal is generated trigger scan occurs. One trigger will occur when there is an input trigger signal. Then trigger will stop.

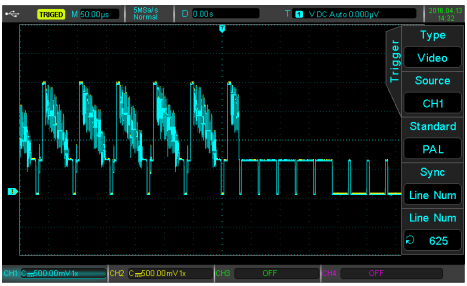
- PULSE WIDTH: The time difference between the trigger level and the positive pulse is defined as the positive pulse width, and the time difference between the trigger level and the negative pulse is defined as the negative pulse width, shown in the following diagram.



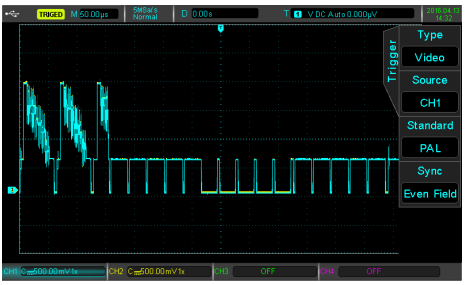
Video Trigger

- The waveform of the video signal includes the image signal and the time sequence signal, and each kind of signal uses different standards and formats.
- Basic measurement functions, which can be triggered in NTSC, SECAM, PAL, and other standard video formats.
- Press the TRIG MENU, Press F1 to select the trigger type, then set to video trigger using the multi-function control.

Functions Menu	Setup	Notes
Type	Video	
Trigger source	CH1 to CH4 EXT, EXT/5 AC Line	Set Ch1 to CH4 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal Set AC line as trigger
Standard	PAL NTSC SECAM	Uses PAL format video signals Uses NTSC format video signals Uses SECAM format video signals
Synchronisation	All lines Specified lines Odd field Even field	Set the TV line to synchronise with trigger Set synchronised trigger on the specified line and adjust by turning the multi-function control on the front panel Set video odd field to synchronised trigger Set video even field to synchronised trigger



Video Line Sync



Video Field Sync

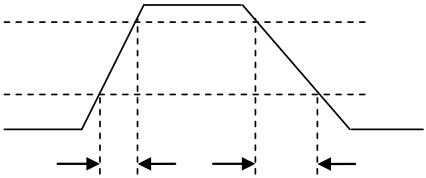
Slope Trigger

- When slope trigger is selected, trigger occurs when the rise or fall slope value matches the value in settings.
- Press the TRIG MENU, Press F1 to select the trigger type, then set to slope trigger using the multi-function control.

Functions Menu	Setup	Notes
Type	Slope	
Trigger source	CH1 to CH4	Set Ch1 to CH4 as the signal source trigger signal
Trigger Setting		Enters trigger setting menu
Slope Setting		Enters slope setting menu
Slope	Falling Rising	Triggers with falling slope Triggers with rising slope
Condition	< > =	When slew rate setting is smaller than signal slew rate, trigger occurs When slew rate setting is greater than signal slew rate, trigger occurs When slew rate setting is equal to signal slew rate, trigger occurs
Time Setting		Use the multi-function control to set time, the slew rate shown on bottom of the screen also changes

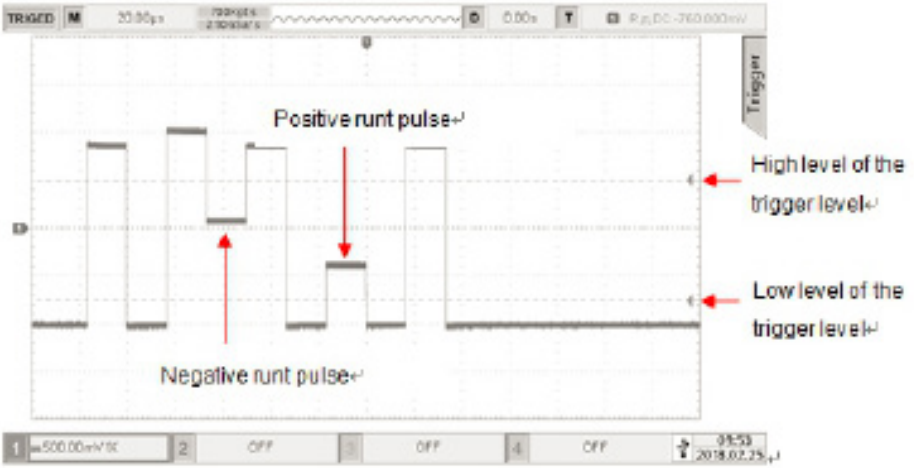
Threshold	Low	The slope of the low threshold level can be adjusted with the LEVEL control
	High	The slope of the high threshold level can be adjusted with the LEVEL control
	High and Low	The slope of the high and low threshold level can be adjusted with the LEVEL control

Slew Rate = (High threshold level – Low threshold level) / Time



Runt Trigger Menu

- 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.



- Press TRIG MENU → TYPE and select runt by the multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control 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 button to select any of 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 stable trigger.

Polarity:

- Press the polarity button to select the trigger polarity of 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 condition button 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 multi-function control to set the time.

Trigger Level

- Press PgDn → TRIGGER LEVEL to select low/high level as trigger level or press the LEVEL control to quickly switch between selections.

1. Low level: The low level of the runt trigger can be adjusted by the LEVEL control.
2. High level: The high level of the runt trigger can be adjusted by the LEVEL control.

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 multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control to confirm.

Source:

- Press the source button to select 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 stable trigger.

Slope:

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 PgDn → 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 the PgDn → trigger level key to select low level or high level. You can also directly press the LEVEL control in the trigger control area to quickly switch between selections.

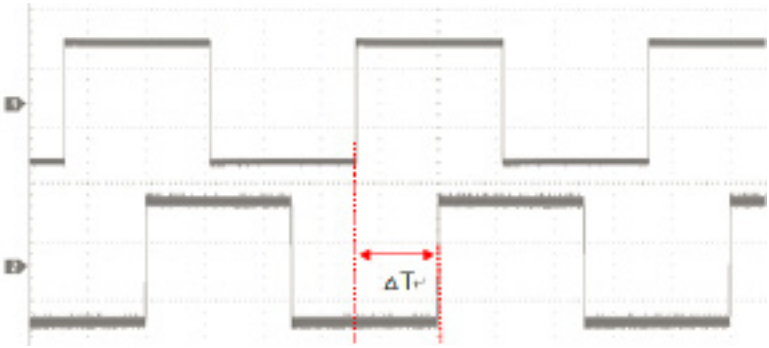
1. Low level: The low level of the window trigger can be adjusted by the LEVEL control.
2. High level: The high level of the window trigger can be adjusted by the LEVEL control**.**

Setting

- Press the PgDn key and adjust the multi-function control to set the time.

Delayed 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.



- Press TRIG MENU → TYPE and select delay by the multi-function control. You can also switch trigger type by consecutively pressing the type key, then press the multi-function control to confirm.

Source 1:

- Press the source button to select 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 stable trigger.

Edge 1

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 source button to select 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 stable trigger.

Edge 2

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.

Condition

- Press the PgDn → CONDITION to select: “>”, “<”, “< >”, :> <”.

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 the PgDn → TIME key to choose: normal, upper time limit, and lower time limit.

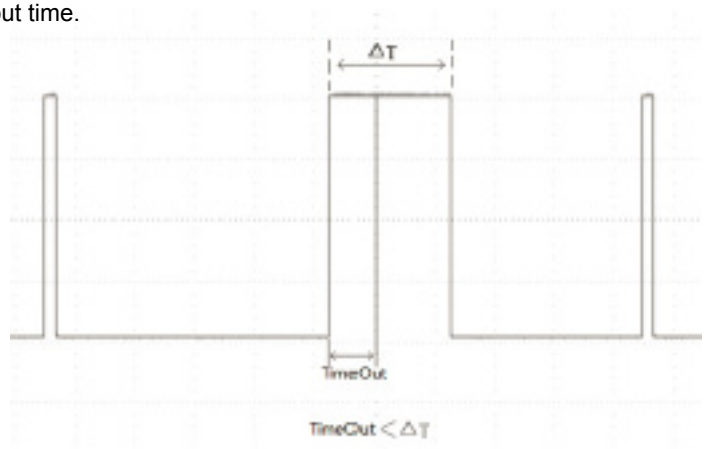
1. Normal: When the trigger condition is “>” or “<”, this key can only be normal.
2. Upper time limit: select this option when the trigger condition is “< >” or “> <”.
3. Lower time limit: select this option when the trigger condition is “< >” or “> <”.

Setting:

- Press the PgDn key and adjust the multi-function control to set the time.

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.



- Press TRIG MENU → TYPE and select timeout by the multi-function control. You can also switch trigger type by consecutively pressing the type key, then press the multi-function control to confirm.

Source

- Press the source button to select CH1, CH2, CH3, and CH4. The currently selected source is displayed at the upper right corner of the screen.

Slope

- Press the SLOPE key to select which edge the input signal will trigger on, you can select the rising edge, falling edge, 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:

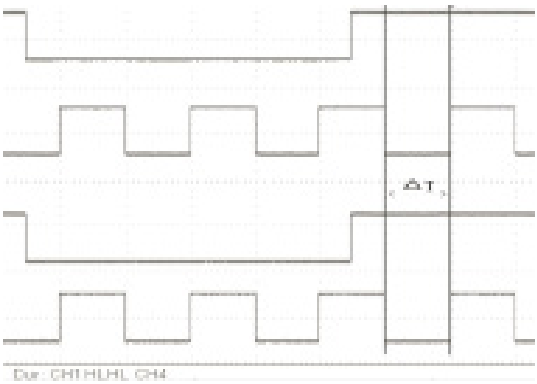
- Adjust the multi-function control to set the timeout time.

Trigger Setting:

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

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.



- Press TRIG MENU → TYPE select duration by the multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control 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.

Source

- Press the source button to select 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 stable 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.

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 “ignored”.

Condition:

- Press the condition key to select: “>”, “<”, “< >”.

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 PgDn → time setting to choose: normal, upper time limit, and lower time 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:

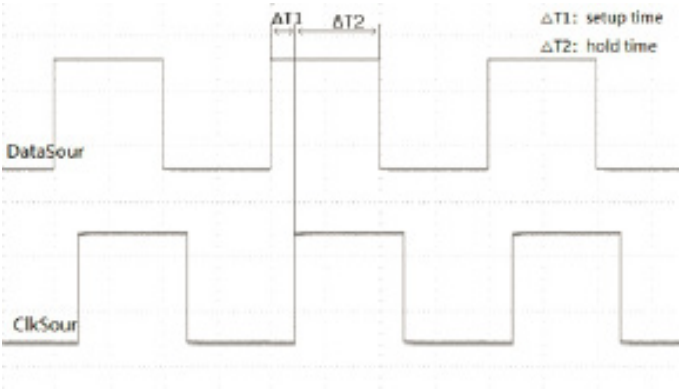
- Press the PgDn key and adjust the multi-function control to set the time.

Trigger Setting:

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

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 setup/hold by the multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control to confirm
- 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.

Data Source:

- Press the data source button to select CH1, CH2, CH3, or CH4.

Note: Only selecting the channel with connected signals as a trigger source can obtain a stable 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 clock source button to select CH1, CH2, CH3, or CH4.

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

Clock Edge:

- Press the clock edge key to select the clock edge type: rising edge, or falling edge.

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 setup, hold, setup & hold.

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:

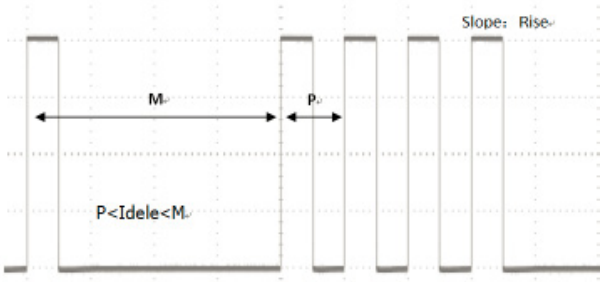
- Press the PgDn key and adjust the multi-function control to set the time.

Trigger Setting:

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

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 multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control to confirm
- 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, and the trigger level is 0.00V.

Source:

- Press the source button to select CH1, CH2, CH3, or CH4.

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

Slope

- Press the SLOPE key to select which edge the input signal will trigger on, you can select the rising edge, falling edge, 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.

Idle Time:

- Adjust the multi-function control to set the idle time.

Trigger Setting:

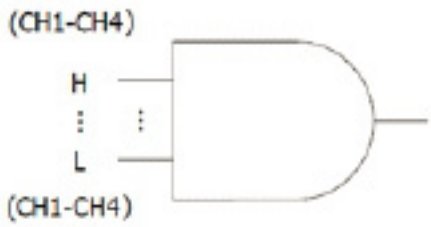
- Please refer to the Trigger Setting in the Edge Trigger section for more details.

Edge Value:

- Press the PgDn key and adjust the multi-function control to set the number of edges.

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 patterns 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 patterns of all channels are set to “ignore”, the oscilloscope will not trigger.



- Press TRIG MENU → TYPE and select code pattern by the multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control to confirm
- 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.

Source

- Press the source button to select CH1, CH2, CH3, or CH4.

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

Code pattern

- Press the code key to select H, L, X, rising edge, or falling edge. The code pattern setting of each channel is displayed at the bottom of the screen.

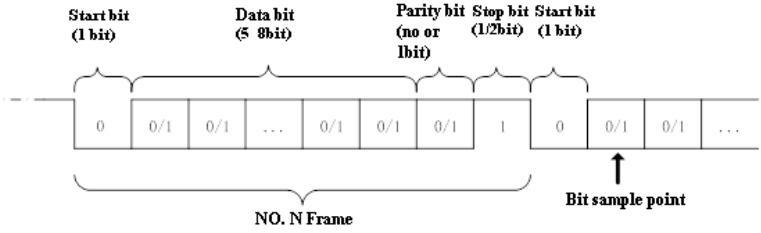
1. H: Set the code pattern value of the selected channel to “High”, that is, the voltage level is higher than the trigger level of the channel.
2. L: Set the code pattern value of the selected channel to “Low”, that is, the voltage level is lower than the trigger level of the channel.
3. X: Set the code 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. Rising edge: Set the code pattern to the rising edge of the selected channel.
5. Falling edge: 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.

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



RS232 Selection

- Press the DECODE button, → TYPE.
- Rotate the multi-function control to select to RS232 protocol mode, and press the control to open the RS232 protocol mode.
- You can also switch the RS232 mode by consecutively pressing the type key then press multi-function control to confirm.

Source

- Press the source button to select any of CH1, CH2, CH3, or 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 stable trigger and correct decoding.

Polarity

- Press the polarity button to choose the trigger polarity: positive polarity or negative polarity.

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

Bit Width

- Specifies the data bit width of the RS232 protocol signal that needs to be decoded.
- Press bit width to select 5bits, 6bits, 7bits, or 8bits.

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 button to select 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, or user-defined, which users adjust the baud rate by the Multipurpose control
- 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 Sequence

- Specify high bytes in front (MSB) or low bytes in front (LSB) to be the data bits of the RS232 protocol signal that needs to be decoded.
- Press PgDn → BIT sequence 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 → STOP BIT 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, you can choose none, even parity or odd parity.

Trigger Condition

- Press PgDn → TRIGGER CONDITION to select start of frame, error frame, parity 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. Parity 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 multi-function control.

Decode Bus

- Press PgDn → DECODE BUS to enter the decode bus menu.

1. Bus Status: Set the decode bus to on or off.
2. Display Format: Set the display format of decode bus, you can set hexadecimal, decimal, binary or ASCII.
3. Event List: 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. Pseudo Square Wave: Select on and the bus shows a square wave with logic 1 for high level and logic 0 for low level.
5. Vertical Position: Adjust the Multipurpose control to change the bus display position.
6. Data Packet: After the device is paused, user can view the decoded data packets.

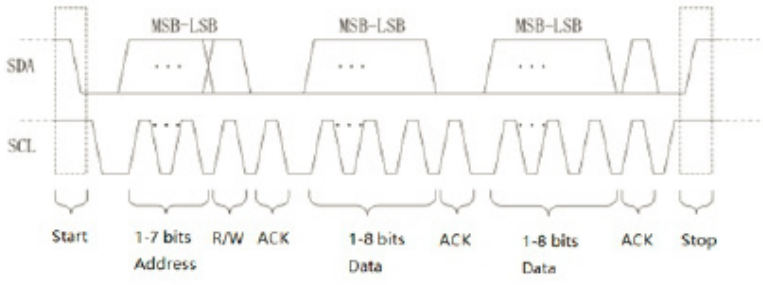
Trigger Setting

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

I2C Decode

- I2C protocol is usually used to connect a micro controller 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 host-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. The 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



IC2 Selection

- Press DECODE → TYPE , and select I2C by the multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the multi-function control to confirm.

CL Source

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

SDA source

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

Address Mode

- Press the address 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 Pg Dn → OPERATION DIRECTION , and 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 Pg Dn → TRIGGER CONDITION and set the data address by Multi-function control. The ranges are 0~0x7F, 0~0xFF and 0~0x3FF depending on different settings in address mode.

Data Setting

- Press Pg Dn → DATA SETTING to enter the data setting mode.

1. Comparison 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: 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 Multi-function control, and press the back key to return to the previous setting menu.

Decode Bus

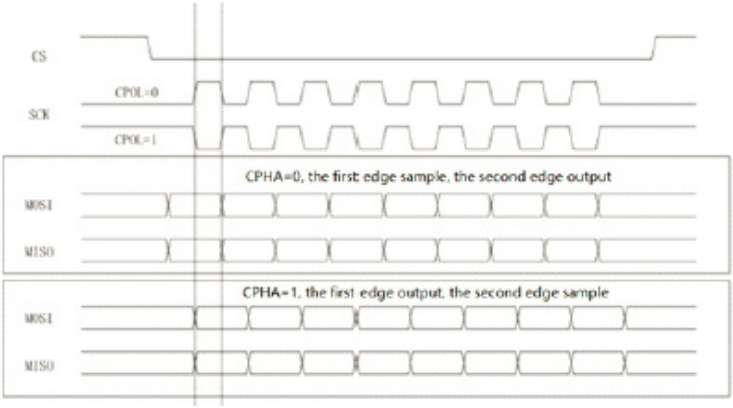
- Please refer to the RS232 Decode Bus.

Trigger Setting

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

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 shift 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.



Note: At least 3 output channels are required. Therefore, this function is only available on the 4-channel product of MP720114 & MP720115 series oscilloscopes.

SPI Selection

- Press DECODE → TYPE and select SPI by the Multi-function control. You can also switch the trigger type by consecutively pressing the type key, then press the Multipurpose control to confirm.
- CS Source:
  Press the CS source button to set any of CH1~CH4 as the chip select input of the SPI decoded signal.

SCLK Source

- Press the SCLK source button to set any of CH1~CH4 as the clock input of the SPI decoded signal.

MOSI Source

- Press the MOSI source button to set any of CH1~CH4 as the data MOSI input of the SPI decoded signal.

MISO Source

- Press the MISO source button to set any of CH1~CH4 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 polarity or negative polarity.

1. Positive polarity: Valid when the chip select signal is positive.
2. Negative polarity: Valid when the chip select signal is negative.

SCLK Edge

- Press PgDn → SCLK EDGE to set the clock signal edge: rising edge or falling edge.

1. Rising edge: Triggers at the rising edge of the clock signal.
2. Falling edge: 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 polarity or negative polarity.

MISO Polarity

- Press PgDn → MISO POLARITY to set the MISO polarity of the data signal: positive polarity or negative polarity.

Bit Sequence

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

Bit Width

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

Trigger Condition

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

1. 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.
2. Idle time includes Idle, Idle & MISO, Idle & MOSO, and 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 → IDLE TIME and adjust the multi-function control (shuttle control or numeric keypad) 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 → FRAME LENGTH and adjust the multi-function control to set the length of the data frame.

Data

- Press PgDn → DATA and adjust the multi-function control to set the data, press the control 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.

OPERATION

Mathematical Operations

- Math: Source 1 + source 2, source 1 - source 2, source 1 * source 2, source 1 / source 2
- FFT: Fast Fourier Transform
- Logical: AND, OR, NOT, and XOR
- Digital Filter
- Advanced operation
- Press MATH button to enter the mathematical operation menu is. The POSITION and the SCALE controls can be used to change the vertical position and the vertical profile of the mathematical operations. Under maths operation the horizontal position cannot be independently adjusted, it will change automatically according to the analogue input channel signals.

Mathematical Function

- Press MATH → TYPE and select math to enter the math menu..

Functions Menu	Options	Description
Source 1	CH1 to CH4	Set any one of the CH1~CH4 as Math Source 1
Operator	+ - * /	Source 1 + Source 2 Source 1 - Source 2 Source 1 * Source 2 Source 1 / Source 2
Source 2	CH1 to CH4	Set any one of the CH1~CH4 as Math Source 2

FFT spectrum analysis

- Using FFT (Fast Fourier Transform) algorithm you can convert the domain signals (YT) into frequency domain signals.
- With FFT you can observe the following types of signals:
  1. Measure the harmonic wave composition and distortion of the system.
  2. Demonstrate the noise characteristics of the DC power.
  3. Analyse oscillation.
- Signals with DC quantities or DC offset will cause error or offset FFT waveform quantities. To reduce DC quantities select AC coupling.
- To reduce random noise and frequency aliasing as a result of repeated or single pulse event, set the acquired mode of the oscilloscope to average acquisition.



- Press MATH → TYPE and select FFT to enter the FFT menu.

Functions Menu	Setup	Notes
Type	FFT	To carry out FFT algorithm functions
Signal source	CH1 to CH4	Set CH1 to CH4 as FFT source
Window	Hanning Hamming Blackman Rectangle	Set Hanning window function Set Hamming window function Set Blackman window function Set Rectangle window function
Vertical Unit	Vrms, dBVrms	Set vertical unit as linear or dB (log)

Window function

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.

- **Screen Setting**

Press the screen setting key to set full screen 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.

Logic Operation

- Press MATH → TYPE and select logic operation 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 source 1 key to select any of CH1, CH2, CH3 or CH4 as source 1 of logic operations.

Source 2

- Press the source 2 key to select any of CH1, CH2, CH3 or 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 PgDn key, and adjust the multi-function control 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 PgDn key, and adjust the multi-function control 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”.

Digital Filter

- Press MATH → TYPE and select digital filter to enter its menu.

Source

- Press the source button to select any of CH1, CH2, CH3 or CH4 as the source of digital filter.

Filter Type

- Press the filter type 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 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 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 control 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 control to change the value of the frequency upper limit. When in high pass, the frequency upper limit is invalid and the menu is hidden.

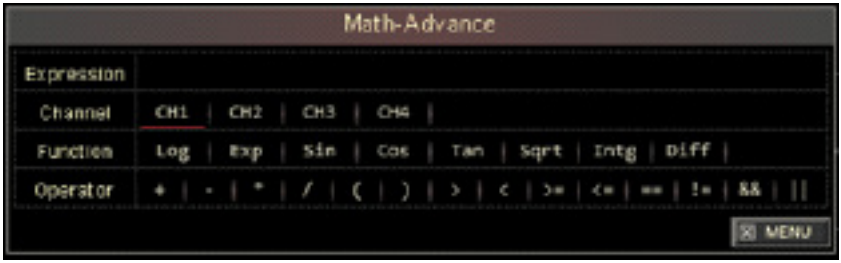
Note: The setting range of the frequency upper and lower limit is related to the current horizontal time base.

Advanced Operation

- Press MATH → TYPE and select advanced operation 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.



- Adjust the multi-function control to select “Channel”, ”Function”, or ”Operator”, then press the control 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 to close in order 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	Description
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.

Operator Description

Functions	Description
+, -, *, /	Arithmetic operators: add, subtract, multiply, divide.
( )	Calculates the 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.

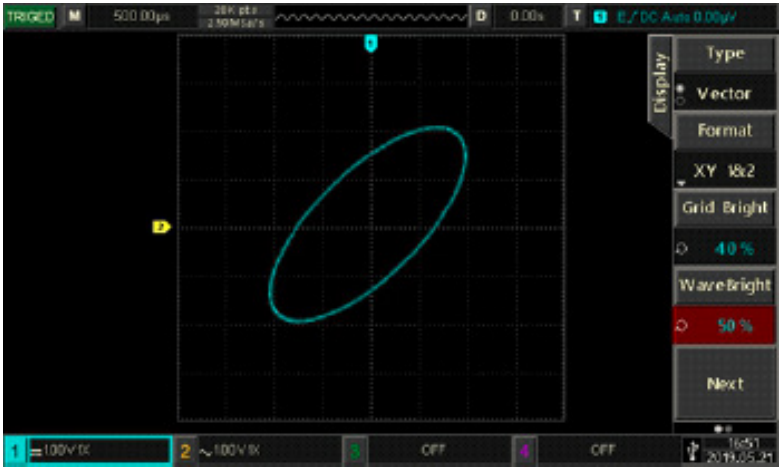
Set Display System

- You can set the waveform display type, display format, duration, grid brightness, waveform brightness, and colour temperature.
- Press DISPLAY → TYPE to select vector or point display.

Functions	Options	Description
Type	Vector Point	Using lines to display between samples Displays points directly
Format	YT XY 1&2 XY 3&4	Displays voltage value on time scale (horizontal scale) Display Lissajous graph of CH1~CH2 waveforms Display Lissajous graph of CH3~CH4 waveforms (MP720114 &115 only)
Persist	Close	Displayed waveform refreshes at normal rate
	50ms,100ms, 200ms,500ms, 1s,5s,10s, 20s	Displayed waveform refreshes after specified time
	Continuous	Waveform refreshes at a continuous rate
Grid Brightness	1%~100%	Set the grid brightness, Use multi-function control to adjust settings
Waveform Brightness	1%~100%	Set the waveform brightness, Use multi-function control to adjust settings
Inverse Colour Temp	Normal Inverse	Reverses colour mode (only when colour temp function is active)

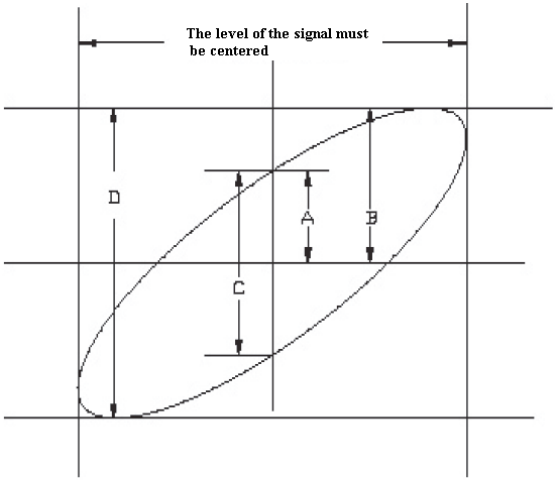
XY Mode

- 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 control to move the XY figure in the horizontal direction. When CH2 or CH4 is activated, use the vertical POSITION control to move the XY figure in the vertical direction.
- Adjust the vertical SCALE control to change the amplitude of each channel, and adjust the horizontal SCALE control to change the time base to get a better display effect of the Lissajous figures.

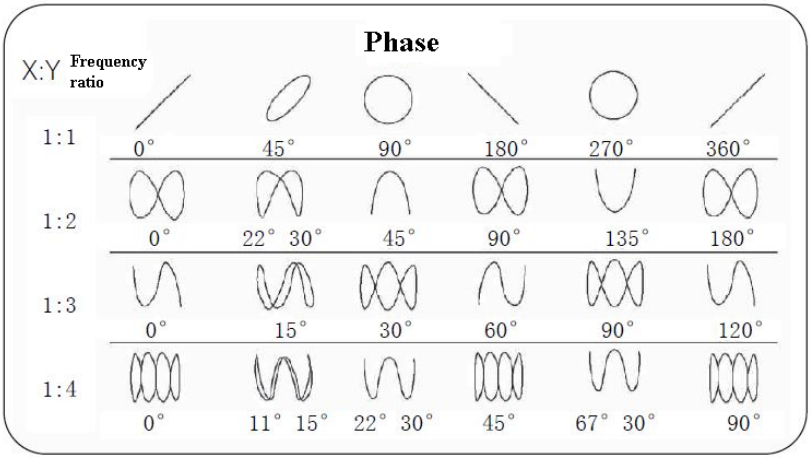


Application of XY Mode

- The phase difference between the two signals of the same frequency can be easily observed by Lissajous method. The following chart gives the observation of phase difference.



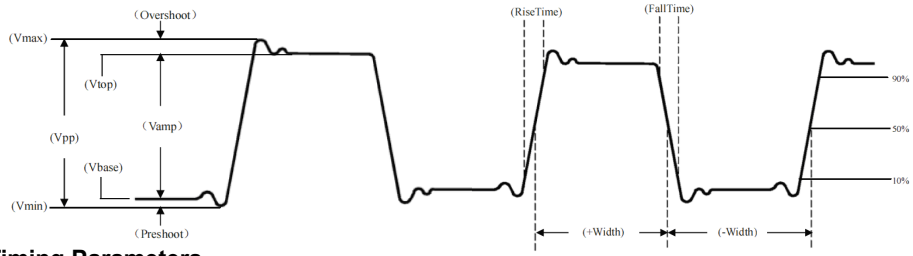
- Since sinθ = A/B or C/D, theta (θ) is the angle between the two signals, the definition of A, B and C, D is shown above. We can draw a difference angle θ = ± arcsin(A/B) or θ = ± arcsin(C/D). If the principal axis of an ellipse is in quadrants I and III, then the phase angle should be in I, IV quadrant, in 0 to (π / 2) or (3 π / 2) to 2 π. If the principal axis of an ellipse in II, IV quadrant, then the phase angle should be (π /2) to π or π to (3 π/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:



AUTOMATIC MEASUREMENT

Voltage Parameters

- The following parameters can be measured automatically:
  1. Vmax: Voltage at the highest point with respect to GND
  2. Vmin: Voltage at the lowest point with respect to GND
  3. Vtop: Highest stable voltage
  4. Vbase: Lowest stable voltage
  5. Middle: Midpoint between highest and lowest stable voltage
  6. Vpp: Vmax – Vmin
  7. Vamp: Vtop – Vbase
  8. Mean: Average amplitude of the waveform on screen
  9. CycMean: Average amplitude of a waveform in one period
  10. 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
  11. CycRMS: The RMS of one period
  12. Overshoot: The ratio of the difference between Vmax and Vtop
  13. Preshoot: The ratio of the difference between Vmin and Vbase
  14. Area: The product of time and voltage for all points on the screen
  15. CycArea: The product of time and voltage for all points in one period



Timing Parameters

- The following parameters can be measured automatically:
  1. Period: The duration of one cycle of a repetitive waveform
  2. Frequency: The reciprocal of the period
  3. Rise time: The time it takes the waveform amplitude to increase from 10% to 90%
  4. Fall time: The time it takes the waveform amplitude to decrease from 90% to 10%
  5. +Width: The width of a positive pulse at 50% amplitude
  6. -Width: The width of a negative pulse at 50% amplitude
  7. +Duty: The ratio of positive pulse width to period
  8. -Duty: The ratio of negative pulse width to period

Delay Parameters

- The following parameters can be measured automatically:
  1. FRR: Time between the first rising edge of source 1 to the first rising edge of source 2
  2. FRF: Time between the first rising edge of source 1 to the first falling edge of source 2
  3. FFR: Time between the first falling edge of source 1 to the first rising edge of source 2
  4. FFF: Time between the first falling edge of source 1 to the first falling edge of source 2
  5. LRF: Time between the last rising edge of source 1 to the last falling edge of source 2
  6. LFR: Time between the last falling edge of source 1 to the last rising edge of source 2
  7. LFF: Time between the last falling edge of source 1 to the last falling edge of source 2
  8. LRR: Time between the last rising edge of source 1 to the last rising edge of source 2

- Press the MEASURE button to enter the automatic measurement menu.

Functions	Options	Description
Signal source	CH1 to CH4	Select the data source from any one of the channels
All parameters	ON OFF	Close all Parameters Pop-up window with all parameters is displayed
User defined	ON/OFF	Open/Close menu for user defined parameters. When it is on, define all parameters required with the Multi-function control. It can customize and display up to 5 parameters at the same time.
Measurement Statistical Analysis	OFF Peak Difference	Turn OFF feature Automatic calculation of user defined parameters of average, max, and min. Only applicable when user defined parameters are present. Automatic calculation of user defined parameters of average, difference, and number of measurements. Only applicable when user defined parameters are present.
Next page		Go onto the next page
Signal source	CH1 to CH4	Select the data source from any one of the channels
Indicator selection		Using the Multi-function control, up to 34 parameters can be selected.
Indicator	ON OFF	Open parameter indicator Close parameter indicator
Clear		Clears all parameters
Return		Return to automatic measure main menu

All Parameters Measurement

- Press MEASURE → ALL PARAMETERS to enter automatic measurement menu used to select all 34 parameters.



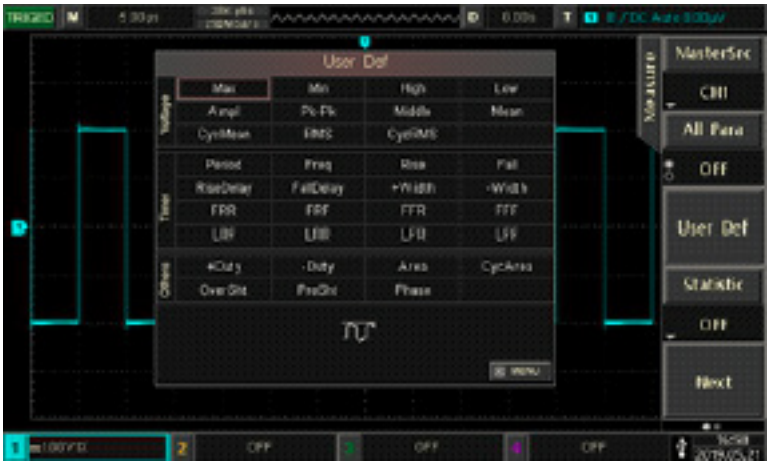
- Measured parameters colour are consistent with the current channel.
  When "----" is shown, it indicates that the current source has no signal input, or the measurement result is not valid (too big or too small).

User Defined Parameters

- Press the MEASURE → USER DEFINED to enter the user defined measurement interface.



- Adjust the parameters with the multi-function control, press the multi-function control to confirm selection. For every selected parameter, a * symbol will appear in front of the parameter.
- F3 can be pressed to turn off user defined parameter selection menu and the parameters will be display at the bottom of the screen.
- For convenience and immediate view of these parameters, up to 5 parameters can be defined at the same time.
- To open the measurement statistical function press the F4 key.

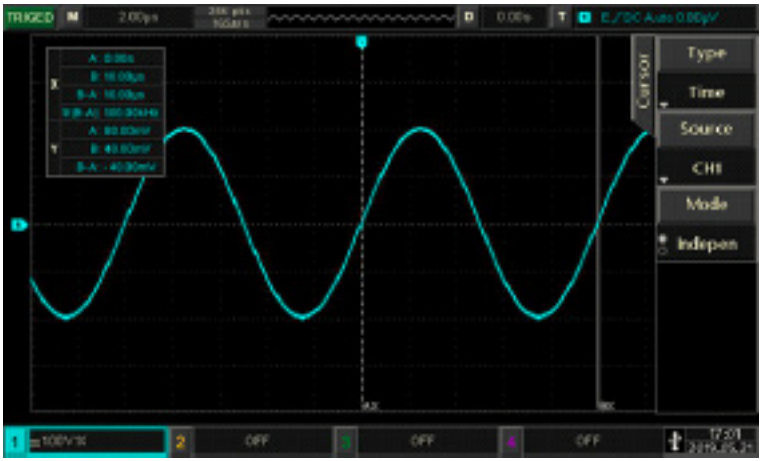


CURSOR MEASUREMENT

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

Time Measurement

- Press the CURSOR button to enter the cursor measurement menu. Then press the TYPE key to select the type to measure.
- Press SOURCE to select the source of the time measurement channel and set the pattern to independent.
- The multi-function control can adjust the vertical cursor AX, press it to switch to cursor BX.

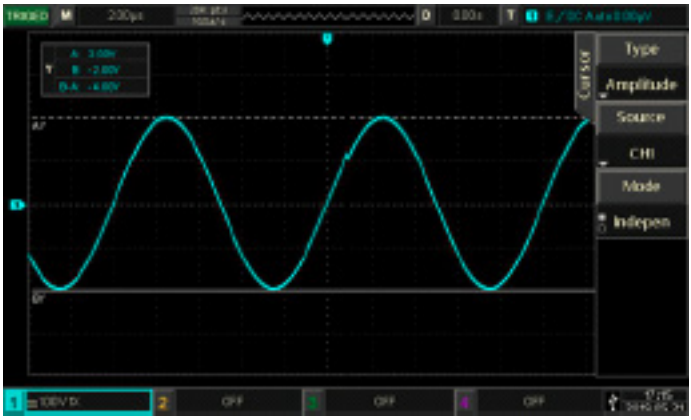


- The measured values are shown in the upper left corner of the waveform display area. The value of BX-AX is the time measurement, and 1/|BX-AX| is the reciprocal of time, or frequency.
- For a periodic signal, if AX and BX are set at the rising edge of adjacent cycles, then BX-AX is the signal's period, and 1/|BX-AX| is the frequency.
- Parameters can also display the voltage value at cursor's current position. That is AY, BY, and BY-AY.

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 t select the channel to be measured; press mode to select independent (default).
- The multi-function control can be used to adjust the horizontal cursor AY on the screen, press the multi-function control to switch to cursor BY. The value of BY-AY is the voltage measurement (V).

- When the setting is set to trace mode with the F3 key, the multi-function control can adjust both AY and BY at the same time.



- On the upper left corner of the display area, BY and AY are represented by the current position of the cursor BY and AY respectively. BY-AY indicates the voltage difference between the two cursors.

STORAGE AND RECALL

- With the storage function, you can save the oscilloscope's settings, waveforms, and screen images to the oscilloscope's internal or external USB storage devices, and recall the saved settings or waveforms anytime.
- Press the STORAGE key to enter the storage function setting interface.
- Only FAT format USB storage devices are supported. It is also not compatible with NTFS format.
- 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. When the USB storage device is not connected, it will prompt "USB device is not inserted".

Storage Setting and Recall

- Press the STORAGE → TYPE to enter the storage setting menu.

Functions	Options	Description
Type	Storage Settings	
Disk	DSO USB	Data saved on the oscilloscope Data saved on USB drive
File name		File name can be chosen using the multi-function control. Names can be chosen from set001 to set225
Save		Saves the setting to the selected destination
Callback		Recalls the saved settings and returns the oscilloscope to the previously saved state

- You can only select a USB device when external storage devices are plugged in.
- Callback only works when previously saved files on the drive have the correct file names.

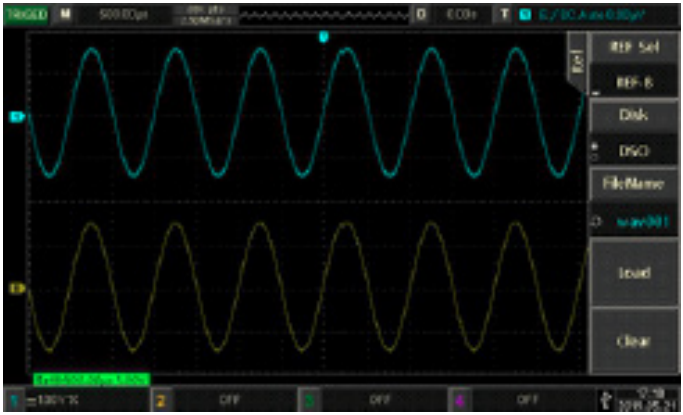
Waveform Storage and Recall

- Press the STORAGE → TYPE button to enter the waveform storage setting menu.

Functions	Options	Description
Type	Waveform Storage	
Source	CH1 to CH4	Select waveform storage source from any one of CH1~CH4
Disk	DS0	When Save is pressed, the waveform will be saved to the oscilloscope
	USB	When Save is pressed, the waveform will be saved to a connected external USB device
	USB CSV	When Save is pressed, waveform will be saved to an external USB device in CSV format
File name		File name can be chosen using the multi-function control. Names can be chosen from wav001 to wav255
Save		Saves the waveform to the chosen destination

- Press the REF button to enter the callback setting menu. Then press the REF key again to enter waveform callback menu.

Functions	Options	Description
Reference	REF-A to REF-D	Select from any of the four references to callback waveform
Disk	DS0	When REF is pressed, the waveform will be recalled from the oscilloscope memory
	USB	When REF is pressed, the waveform will be recalled from the connected external USB device
	USB CSV	When Save is pressed, waveform will be saved to an external USB device in CSV format
File name		File name can be chosen using the multi-function control. Names can be chosen from set001 to set225
Callback		Recalls previously saved waveform and displays it on screen
Clear		Close current REF waveform



- After callback, the Ref waveform will be displayed in the lower left corner, including timing scale and amplitude shift. At this point you can use the vertical and horizontal control control to adjust the ref waveform's position, time base, and amplitude shift.

Screen Copy

- 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 devices are connected.

AUXILIARY FUNCTION SETTING

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

Functions	Options	Descriptions
Self-correcting		Start self-correcting function
System Info		Displays oscilloscope model number, software version, firmware version, etc
Language		Displays menu language of oscilloscope
Menu Display	1s, 2s, 5s, 10s, 20s Manual	Set the menu to auto hide after a specified time, or manually using MENU key Press MENU key to recall hidden menu
1/3		Enters Auxiliary function setting menu (2)

- Auxiliary function settings menu 2.

Functions	Options	Descriptions
Waveform recording		Enters Waveform Recording Menu
Pass test		Enters Pass Test Menu
Square wave output	10Hz, 100Hz, 1kHz, 10kHz	Set the probe compensation signal output frequency, the default is 1kHz (range = 3V, cannot be changed)
Frequency meter	OFF ON	Turn off frequency meter function Turn on frequency meter function
2/3		Enters Auxiliary function setting menu (3)

Note: The frequency meter is a counter for trigger events. The frequency meter is valid for edge or pulse width, but not for trigger source.

- Auxiliary function settings menu 3.

Functions	Options	Descriptions
System upgrade		Enters oscilloscope software update
Back-light brightness	10%~100%	Use the multi-function control to select back-light brightness, from 10%~100%
Output selection	Trigger Pass Test	Set the PASS/FAIL output terminal behind the oscilloscope to trigger Set the PASS/FAIL output terminal behind the oscilloscope to pass test
3/3		Enters Auxiliary function setting main menu

Waveform Recording

- Press UTILITY → WAVEFORM RECORDING to enter the waveform recording menu.

Functions	Options	Description
Record	Close Settings Operation	Close the recording function Enter the record settings menu Enter the record operation menu

- Recording settings menu.

Functions	Options	Description
Record	Settings	Set recording parameters
Record length	100ns~10s	Set waveform record interval between each frame
End frame	1~65000	Set the frame where recording automatically ends
Playback delay	10ms~1s	Set the delay between each frame set when playing
Largest frame	65000	Shows the maximum number of frames which can be recorded (will change according to current storage depth)

- After setting up all the recording parameters, press OPERATE to enter the record operation menu

Functions	Options	Description
Record	Operation	Carry out record, playback, and stop operation.
Playback		Playback the recorded waveform
Stop		Stop recording or playback waveform
Record		Start recording waveform

PASS TEST

- The pass (fail) test is by using a template to detect whether the input signal satisfies the template requirements.

Function Introduction

- Press UTILITY → PgDn → PASS/FAIL to enter the test menu.

Functions	Options	Description
Enable test	Close Open	Close Pass Test Open Pass Test
Output	Fail Pass	Set the Pass/Fail interface on the rear panel to a “failure” pulse and sound a buzzer Set the Pass/Fail interface on the rear panel to a “pass” pulse and sound a buzzer
Source	CH1 to CH4	Set the source channel for the Pass Test
Message	Close Open	Turn off the display information Turn on the display information
1/2		Enter Pass Test menu (2)

Functions	Options	Description
Operation	Close Open	Disable Pass Test Enable Pass Test
Stop setting		Enters Stop Settings Menu
Template setting	CH1 to CH4	Enters Template Settings Menu
2/2		Enter Pass Test menu

- After opening the pass test, you are required to set the stop settings and template settings before you can perform the test function. Otherwise you'll be prompted "Function is Disabled".
- Stop settings menu.

Functions	Options	Description
Stop type	Pass count	The test function stops after it reaches a specified pass count number
	Fail count	The test function stops after it reaches a specified fail count number
Condition	>=,<=	Stop condition setting
Threshold		Use the multi-function control to select the stop condition threshold
Return		Return to previous menu

- Template settings menu.

Functions	Options	Description
Reference waveform	CH1 to CH4	Select a channel CH1~CH4 with horizontal and vertical tolerance as template
Horizontal tolerance	1~255	Use the multi-function control to select the horizontal tolerance
Vertical tolerance	1~255	Use the multi-function control to select the vertical tolerance
Create template		Create template with above conditions
Return		Return to previous menu

SYSTEM UPGRADE

- Press UTILITY to enter the auxiliary function menu, then SYSTEM INFORMATION to view system information, access the machine's model number, software, and hardware version information.
- Having downloaded the latest version consistent with the oscilloscope model, place the file on the root directory of a USB drive inserted into the oscilloscope USB port.
- Power the device on with the USB inserted and press UTILITY to enter the auxiliary function menu.
- Press F1 to confirm the upgrade.
- The upgrade process takes a few seconds then the oscilloscope will power off and restart automatically to complete the process.
- Do not disconnect the power supply during this process or interrupt it otherwise damage may occur to the oscilloscope.

OTHER FUNCTION KEYS

Automatic Setting

- Automatic settings will according to the input signal, choose appropriate time base files, range profile, 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 signal frequency is not less than 20Hz, the amplitude is not less than 20mVpp, and the square wave duty cycle is more than 5%.
  3. Only opened channel can be used for automatic setting.

Run/Stop

- When the RUN/STOP key is pressed, a green light will be on, indicating the RUN status.
- When the key is pressed again and a red light appears, it indicates the STOP status.
- The RUN state enables the oscilloscope to be in continuous acquisition, the upper screen will display AUTO.
- During the STOP state, the oscilloscope stops collecting data, and the upper screen displays STOP.

Clear

- By pressing the DEFAULT button to clear the loaded REF waveform on the screen.

Factory Settings

- By pressing the DEFAULT button the factory default settings are restored as below:

System	Function	Factory Setting
Vertical System	CH1	1V/DIV
	Vertical displacement	0 (vertical midpoint)
	Coupling	DC
	Bandwidth limit	Off
	Lattice	Coarse tuning
	Probe	1×
	Invert	Off
	Bias voltage	Off
	CH2, CH3, CH4	Off
	Math, Ref	Off
Horiontal System	Extended Window	Off
	Horizontal Time Base	1μs/div
	Horizontal Displacement	0 (Horizontal midpoint)
Trigger System	Hold Time	80.00ns
	Trigger Type	Edge
	Source	CH1

System	Function	Factory Setting
Trigger System	Slope Type	Rising
	Coupling Mode	DC
	Trigger Mode	Auto
Display	Type	Vector
	Format	YT
	Duration Time	50ms
	Grid Brightness	40%
	Waveform Brightness	40%
Other Systems	Storage Type	Waveform
	Frequency Meter	Off
	Measurements	Off, Clears all measurements
	Cursor	Off
	Language	Keep current
	Menu Display	Manual
	Square wave output	1kHz
	Back-light brightness	30%
	Output selection	Keep current

TROUBLESHOOTING

System Information Description

- OPERATION AT LIMIT: In the current state, adjustment has reached the limit and cannot continue. When the vertical scale control, timing control, level shift, vertical shift or trigger reaches adjustment limit.
- USB DEVICE IS NOT INSERTED: When the USB storage device is not connected to the oscilloscope.
- LOAD FAILED: When the location did not store the setting or waveform needed.

When the power button is pressed and the oscilloscope is black screen:

- Check the power supply connection
- Make sure the power switch at the back of the oscilloscope is open, press the front panel power key and confirm green light is present
- If there is a sound, it indicates that the oscilloscope is activated. Try the following operation:
- Press DEFAULT key then F1 and if the device returns to normal the back-light brightness is set too low. Restart the oscilloscope.

After signal acquisition, waveform does not appear on display:

- Check if the probe is connected to the signal test point.
- Check if the signal line is connected to the analogue channel input.
- Check the input signal of the analogue channel and that channel is open.
- Make sure the probe is connected to the compensation piece and check whether the probe is normal.
- Check to see if there is a signal to be detected.
- Press AUTO button for signal re-acquisition.

There is a waveform but not stable:

- Check the trigger source in the trigger menu and confirm that the signal and channel are consistent.
- Check the trigger type, normal signals should use edge trigger mode. Stable waveform will be displayed only by setting to the correct trigger mode.
- Try changing the trigger coupling to high frequency or low frequency in order to suppress or remove noise caused by interference.

The measured amplitude value is 10 times larger or smaller than the actual value:

- Make sure the probe attenuation coefficient matches the attenuation of the probe used.

Pressing RUN/STOP key and no waveform is displayed:

- Check whether the trigger menu's trigger method is set to normal, and whether the trigger level has exceeded the waveform range. If it exceeded, centre the trigger level or set the trigger mode to auto with the AUTO key.
- Press AUTO button to complete the above setting.

Waveform refresh rate is too slow:

- Check whether the acquisition is set average, and the number of times it averages.
- You can speed up by display by reducing the average times or select other methods such as normal sampling.

SPECIFICATION

Input	
Input coupling	DC, AC, GND
Input impedance	1MΩ ± 2% // 20pF ± 3pF
Probe attenuation	0.001× 0.01× 0.1× 1× 10× 100× 1000×
Maximum input voltage	CATI 300 Vrms, CATII 100 Vrms Transient Overvoltage 1000 Vpk

Vertical				
Model	MP720115	MP720114	MP720113	MP720112
Bandwidth	100MHz	70MHz	100MHz	70MHz
Rise Time (Typical)	≤3.5ns	≤5ns	≤3.5ns	≤5ns
Channels	4		2	
Vertical resolution	8 bit			
Vertical Scale	1mV/div~20 V/div(1-2-5 base)			
Vertical Displacement Range	1mV/div ~ 200 mV/div: ± 2V 500 mV/div ~ 2 V/div: ± 40V 5V/div ~ 20 V/div: ± 400V			
Bandwidth Limit (typical)	20MHz			
Low Frequency Response (AC coupling, -3dB)	≤5Hz (on BNC)			

DC Gain Accuracy	≤±3% (Sampling or average sampling method)
DC Offset accuracy	≤±3% (Sampling or average sampling method)
Channel Separation	DC to maximum bandwidth: >40 dB

Horizontal	
Timing Scale	5ns/div ~ 50s/div (1-2-5 base)
Timing Accuracy	≤±(50+ 2×Service Life)ppm
Delay	Pre-trigger (Negative Delay): ≥1 Screen Width Post-trigger (Positive Delay): 1 s~50 s
Timebase	YT, XY, ROLL
Waveform Capture Rate	80,000 wfms/s (single channel, horizontal time base 50ns/div, point display, auto memory depth)

Sampling	
Sampling Mode	Real-time sampling
Real-time sampling rate	1GS/s(Single Channel), 500MS/s(Dual Channel), 250MS/s(Quad Channel)
Acquisition Mode	Sampling, peak detection, high resolution, envelope, and average
Average Value	After all channels reach N times sampling, N times in 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, and 8192
Waveform Interpolation	sin(x)/x
Storage Depth	Auto, 28kpts, 280kpts, 2.8Mpts, 28Mpts, 56Mpts

Trigger	
Trigger level range	Internal: Center of the screen ± 8 grids External: ± 0.9V External/5: ±4.5V
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 Condition	>, <, =
Polarity	Positive, negative pulse width
Pulse width range	4ns ~ 10s
Runt Trigger	
Pulse Width Condition	, <, =
Polarity	Positive, negative
Pulse Width Range	8ns ~ 10s
Window Trigger	
Window Type	Rising edge, falling edge, any edge
Trigger Position	Window enter, exit, time
Window time	8ns ~ 10s
N-Edge Trigger	
Edge Type	Rising edge, falling edge
Idle time	8ns ~ 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: 8ns ~ 10s Lower time limit: 8ns ~ 10s Upper time limit: 32ns ~ 10s
Duration Trigger	
Code	H, L, X
Trigger condition	Greater than, less than, within range
Duration time	Normal: 8ns ~ 10s Lower time limit: 8ns ~ 10s Upper time limit: 32ns ~ 10s
Setup/Hold Trigger	
Edge Type	Rising edge, falling edge
Data Type	H, L
Setup Time	8ns ~ 10s
Hold Time	8ns ~ 10s

Slope Trigger	
Slope Condition	Positive slope (greater than, less than, specified range) Negative slope (greater than, less than, specified range)
Time Setting	8ns ~ 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	Rising edge, falling edge
Code Setting	H, L, X
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

Measure		
Cursor	Manual	Voltage between cursors (▲V) Time between cursors (▲T) Frequency (Hz) (1/▲T)
	Trace Mode	Voltage and time at waveform point
	Indicator	Allows auto display of cursor
Auto 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, FRR, FRF, FFR, FFF, LRF, LRR, LFR, LFF, positive duty ratio, negative duty ratio, phase, area, cycle area.	

Measurement number	Displays 5 at the same time
Measurement range	Screen or cursor
Measurement statistics	Average value, maximum value, minimum value, standard deviation and the number of measurements
Frequency meter	6-bit

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 files can be adjusted independently
FFT Vertical Scale	Vrms, dBVrms
Digital Filter	Low-pass, high-pass, band-pass and band-stop
Logical operation	AND, OR, NOT, XOR
Advanced Operation	Log, Exp, Sin, Cos, Tan, Sqrt, Inth, Diff

Storage	
Setting	Internal (256), External USB
Waveform	Internal (256), External USB
Bitmap	External USB storage device, it can also store the relevant parameter information.

Display	
Display	8 inch TFT LCD
Resolution	800 horizontal x 480 vertical RGB
Colour	24bits true colour
Duration	Minimum, 50ms, 100ms, 200ms, 500ms, 1s, 5s, 10s, 20s and infinite.
Menu Duration	1s, 2s, 5s, 10s, 20s, manual
Display Type	Point, vector

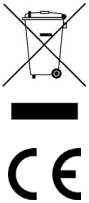
Interface	
Standard	Standard: USB-Host, USB-Device, LAN, EXT Trig, AUX Out

General Technical Specifications	
Probe compensated signal output	3Vp-p 10Hz, 100Hz, 1kHz (default), 10kHz
Power supply	100V-240V~45Hz-440Hz
Fuse	2.5A, T, 250V
Humidity/ temperature range	Operational: below +35°C <90% relative humidity Storage: +35°C - +40°C <60% relative humidity
Altitude	Operational: Below 3000m Storage: Below 15,000m
Size	336mm(W)×164mm(H)×108(D)mm
Weight	3.5kg
Maintenance	Recommend calibration check annually

MAINTENANCE

Cleaning

- Periodically wipe the case with damp cloth and mild detergent. Do not use abrasives or solvents for cleaning. Disconnect from the mains first.
- Clean the measurement probe tips occasionally, as dirt on the probes can affect reading accuracy.
- Take care to avoid scratching the glass display when cleaning the LCD.
- Do not leave the oscilloscope where the LCD screen will be exposed to strong direct sunlight for long periods.



INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT.

When this product has reached the end of its life it must be treated as Waste Electrical & Electronic Equipment (WEEE). Any WEEE marked products must not be mixed with general household waste, but kept separate for the treatment, recovery and recycling of the materials used. Contact your local authority for details of recycling schemes in your area.

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