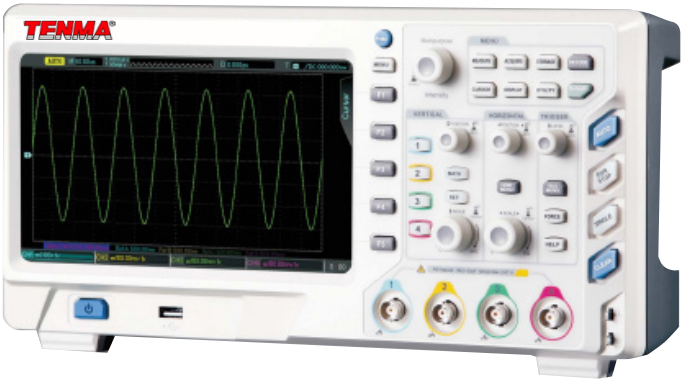
TENMA®



Digital Phosphor Storage Oscilloscope

Model No. 72-14520, 72-14525, 72-14530 & 72-14535

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 50,000wfms/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

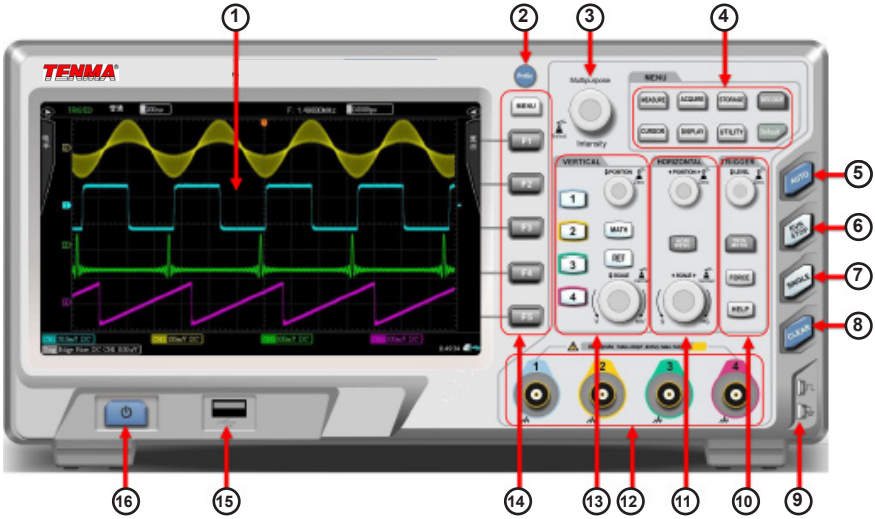
Optional accessories

- LAN port module

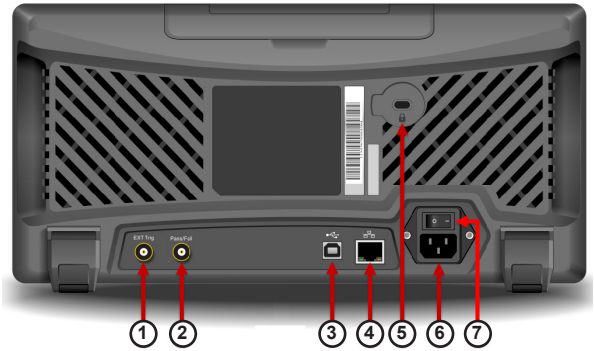
OPERATING PARAMETERS

- 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. Multifunctional 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

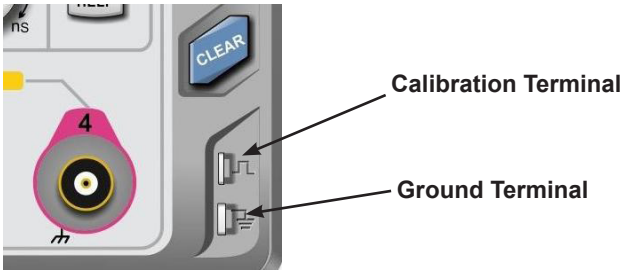


REAR PANEL

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

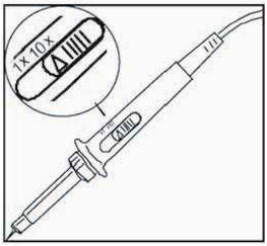
OPERATION

- **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

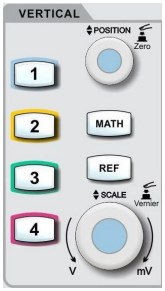
- The oscilloscope features an AUTO SET function which automatically adjusts the vertical deflection factor, scanning time base and trigger mode based on the input signal until the most appropriate waveform is displayed.

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 knob 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.

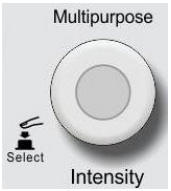
Clear

- 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

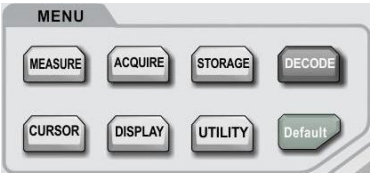
- Copy the screen to a BMP format image and store it to USB device.

Multi-purpose Control



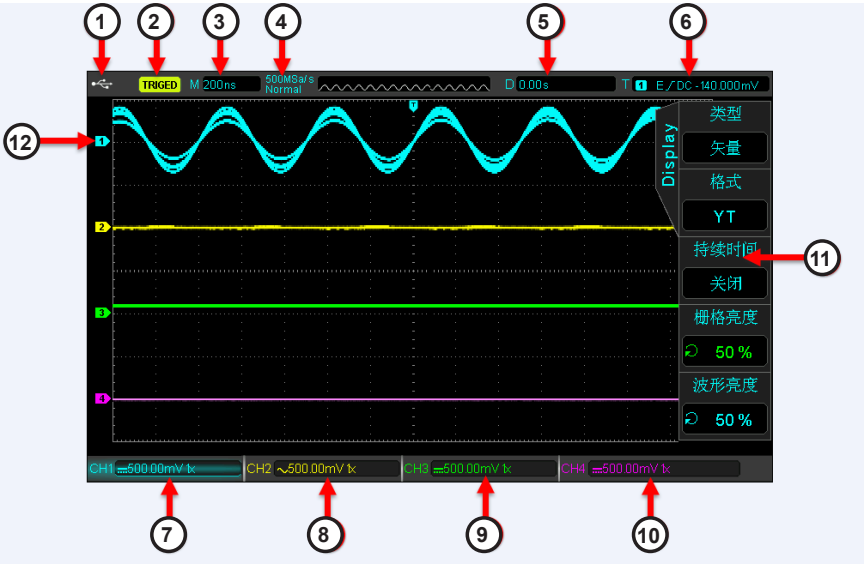
- Press the DISPLAY button and press F3 or F4 to select the brightness options, then use the control to adjust the brightness.
- Press the control to confirm the setting.
- During menu operations the control can be used to select various sub menu options, then press it again to confirm selection.

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. **USB Device Identification:** This icon will be displayed when an USB storage device is connected.
2. **Trigger Status Identification:** Include TRIGED (has been triggered), AUTO, READY, STOP, and ROLL (rolling)
3. **Timing Scale:** Indicates the amount of time represented by one square, which can be adjusted by the horizontal scale control.
4. **Sampling Rate/Acquisition Mode:** Indicates the current sampling rate and storage depth.
5. **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.
6. **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.

7. **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

8. **CH2 Vertical Identification:** Same as 7 but for CH2
9. **CH3 Vertical Identification:** Same as 7 but for CH3
10. **CH4 Vertical Identification:** Same as 7 but for CH4
11. **Operation Menu:** Displays the current operation menu. Use F1 ~ F5 to navigate through menu contents
12. **Analogue Channels:** Displays CH1~CH4 waveforms with matching tag and waveform colour.

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 knobs (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

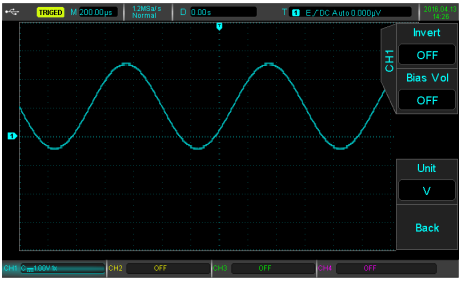
- The VOLTS/DIV range of the vertical deflection factor can be adjusted either in coarse or fine tune mode.
- In COARSE TUNE the VOLTS/DIV range is 1mV/div~2V/div. Tuning is in steps of 1-2-5. For example: 10mV - >20mV - >50mV - >100mV.
- In FINE TUNE mode it adjusts in 1% of the current amplitude value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

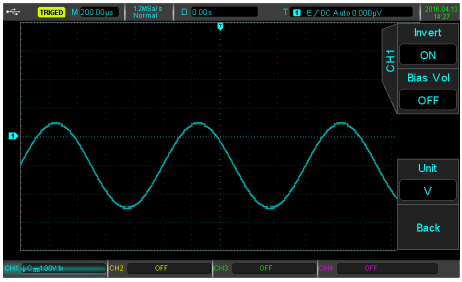
Probe rate setup

- 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)

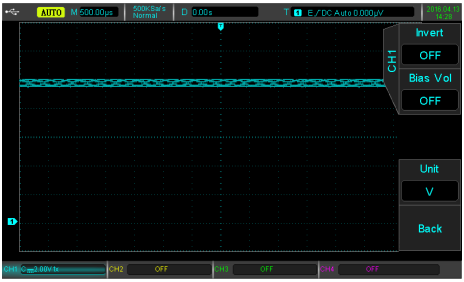
- The displayed signal is inverted 180 degrees with respect to the ground level.
- The vertical identification will display a reverse phase logo ↓.

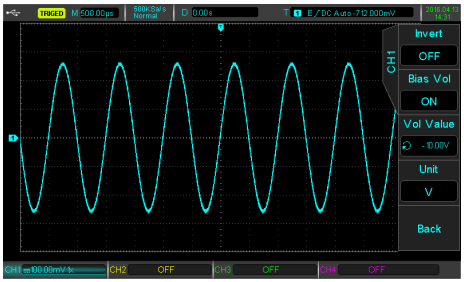




Bias

- 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 -10V bias voltage can eliminate the DC component of the waveform so the AC signal can be clearly observed.





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 -1.8V~ +1.8V can be set. The EXT/5 trigger signal divides the actual signal by 5, so the trigger level can be increased to -9V ~ +9V.
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. **Low Frequency Reject** - Intercepting DC quantities and attenuating low frequency quantities under 80kHz.
4. **High Frequency Reject** - Attenuating high frequency quantities over 50kHz.

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 TRIG MENU and press F1 to select the trigger type and use the multifunction control to confirm.

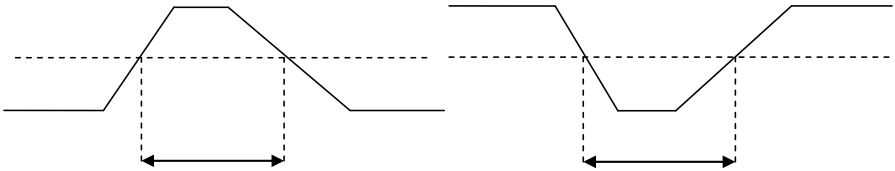
Functions Menu	Setup	Notes
Type	Edge	
Signal source selection	CH1 to CH4 EXT, EXT/5 AC Line	Set Ch1 to CH4 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal Set AC line as trigger
	Grid Alternate	Set up as grid trigger Ch1, CH2 trigger their 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-purpose 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-purpose 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.

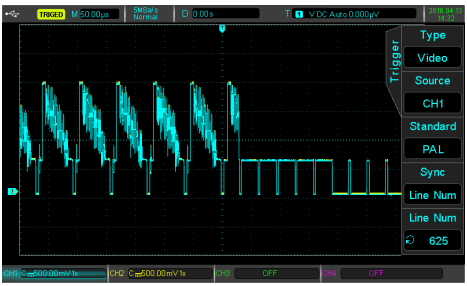
- PULSE WIDTH: The time difference between the trigger level and the positive pulse is defined as the positive pulse width, and the time difference between the trigger level and the negative pulse is defined as the negative pulse width, shown in the following diagram.



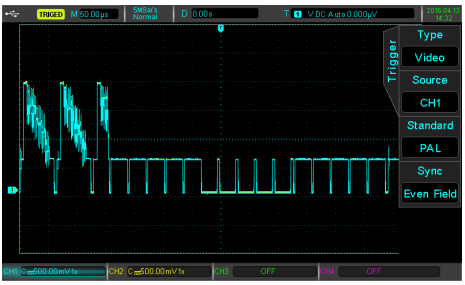
Video Trigger

- 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-purpose 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 multifunction 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

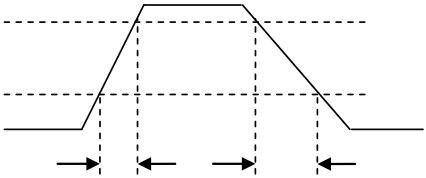
Slope Trigger

- 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-purpose 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-purpose control to set time, the slew rate shown on bottom of the screen also changes

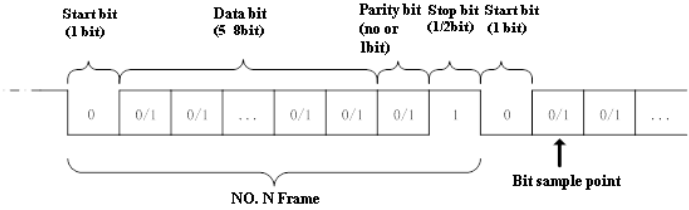
Threshold	Low	The slope of the low threshold level can be adjusted with the LEVEL control
	High	The slope of the high threshold level can be adjusted with the LEVEL control
	High and Low	The slope of the high and low threshold level can be adjusted with the LEVEL control

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



RS232 Trigger and Decode (Optional)

- Press the DECODE button at the right corner, choose the TYPE option to open the protocol type list. Rotate the multi-purpose control to select to RS232 protocol mode, and press the control to open the RS232 protocol mode.



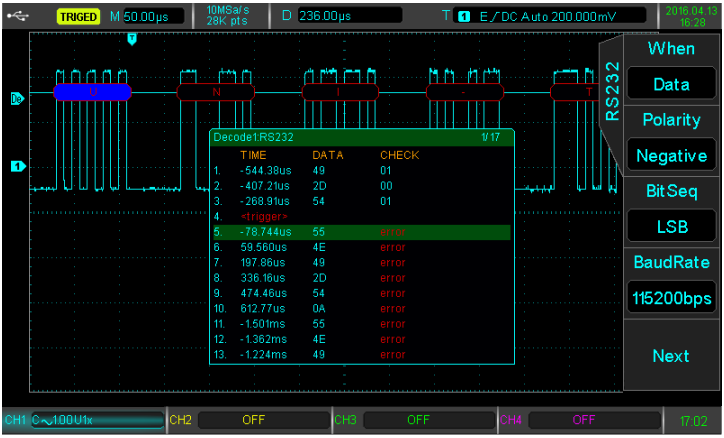
- TRIGGER SOURCE: Select the Source Channel
- Select this option and the source font will become green. Press any signal source button to switch between CH1-CH4 as the source. The appropriate logic level can be adjusted when the corresponding signal source is selected. The way to adjust the signal level is the same with adjusting the trigger level.
- To avoid the effect of noise, it is suggested to set the level compare at the waveform centre area to obtain accurate results.
- TRIGGER SETTING: Set the Trigger Selection
- Select this option to enter the trigger setting menu. The Trigger Mode can be set to Auto or Normal. The Trigger Coupling can be set to DC, AC, low frequency, high frequency suppression, or noise suppression. Select RETURN to return to the previous menu.
- BIT SETTING: Set the Data Bit
- Select this option to enter the bit setting interface.
- DATA BIT WIDTH SETTING: Select DATA BIT WIDTH SETTING, and the data bit width selection list will pop up.
- Press the DATA BIT WIDTH SETTING selection key again to switch between 5/6/7/8 bits. The data bit width can also be selected using the multifunction control.
- Press the control to confirm the selected data bit width.

- DATA SETTING: Rotate the knob under the bit setting interface to set the data. The upper and lower bounds of the data
  are directly related to the data bit width.
  - 5-bit corresponds to 0——31
  - 6-bit corresponds to 0——63
  - 7-bit corresponds to 0——127
  - 8-bit corresponds to 0——255
- STOP BITS SETTING: Select the STOP BITS option to open the stop bits selection list.
- Press the STOP BITS option key again to switch between 1 or 2 bits.
- The Multi-purpose control can also be used for this function.
- PARITY BIT SETTING: Select the PARITY BITS option under the bit setting interface, and the parity selection list will pop up.
- Press the PARITY BIT option key again to switch between zero, odd, and even. Zero means no parity. Even and odd mean even parity and odd parity respectively.
- The Multi-purpose control can also set the parity bit.
- Press the RETURN option button key to return to the previous menu.
- Press NEXT PAGE key to enter the following settings:
- CONDITION: Trigger Condition Settings
- There are four kinds of trigger methods: Start of frame, error frame, parity error, and data.
- Press the CONDITION option button and the trigger condition list will pop up.
- Press the CONDITION button again to switch between the four modes.
- The Multi-purpose control can also set the trigger condition.
- START OF FRAME: The waveform trigger is at the start bit of the RS232 protocol (referred to the drawing). Stable waveforms can be observed by choosing the start of frame when single string signals or multiple same string signals are sent. If the data being sent is changing, the waveform will also change correspondingly.
- 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 1st bit is odd for data bit and parity bit, the transmission will be correct.
- EVEN PARITY: If the 1st bit is even for data bit and parity bit, the transmission will be correct.
  This function can quickly check the transmission process with parity error during RS232 communication, for ease of analysing and locating faults.
- ERROR FRAME: The error frame can be classified to two kinds. One is parity error (odd or even error), the other is transmission error. The transmission error conditions are as follows:
  1. The signal is not set to 1 where there should be stop bits, then the frame data is wrong.
  2. When signals suddenly change and become unstable, this function can quickly test for transmission errors.
- DATA: The waveform triggers when the data of BIT SETTING menu is equal to the data the oscilloscope is collecting. Note that the data setting range is related to the data bit width. This function can quickly find the transmitting signals of particular data set.

- POLARITY: Set the signal polarity.
- Normally, the positive polarity is used in RS232 protocol. The high level and low level stands for logic 1 and 0 respectively. Some users might use negative polarity, which is that the high level and low level stands for 0 and 1 respectively. Therefore, the design is optimized to meet demands from different users.
  Choose the POLARITY option key, and the polarity selection list will pop up. Press the POLARITY option key again to switch between positive polarity and negative polarity. The Multi-purpose can also be used.
- BIT SEQUENCE: Set the data bit sequence
- Normally, the lower bit is transmitted first in RS 232 communication. For example: if bit [7:0] is transmitted, the bit [0] will be transmitted firstly, and bit [7] transmitted last. Considering that users probably use MSB, that is, bit [7] is firstly. The transmitting methods can be set by users.
  Select the Bit Sequence option key, and the bit sequence selection list will pop up. Press the bit sequence again to switch between LSB and MSB. The Multi-purpose knob can also be used.
- BAUD RATE: Set the transmitting baud rate.
- There are no clock signals for asynchronous serial communication. In order to analyse the data, the two communication parties need to agree on the baud rate.
- Press the BAUD RATE option key, and the baud rate selection list pops up. Press the BAUD RATE key again to switch between different baud rates. The available baud rates are: 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, and customized. The customized baud rate can be set from 1 to 5000000 (5 million).
- After selecting the customized baud rate, the customized value can be adjusted using the Multi-purpose control. Press the corresponding baud rate display button to increase the baud rate digit being controlled in order to quickly set to the desired baud rate.
- It is recommended that the interface length should be less than 20m and with speed below 1Mbps. Outside of these ranges and the communication can be unreliable.
- If a more detailed communication analysis is needed, the protocol decoding function can be used. Oscilloscopes will capture the continuous communication data for you when using this function. The communication contents can be shown on screen or in the event list.
- BUS SETTING: Press the PRESS SETTING option key to enter the decoding bus setting.
- BUS STATUS: Press the BUS STATUS option key, and the bus control selection list pops up. The decoding function can be open or closed. The Multi-purpose knob can also be used.
- DISPLAY FORMAT: Press the DISPLAY FORMAT option key, and four kinds of display methods can be used: hexadecimal, decimal, and binary, and ASCII. The Multi-purpose control can also be used.
- EVENT LIST: Press the EVENT LIST option key, and the decoding events can be open or closed. The Multi-purpose control can also be used.
- PSEUDO SQUARE WAVE: Press the PSEUDO SQUARE WAVE option key, and the pseudo square wave function can be opened and closed. The Multi-purpose control can also be used. The pseudo square wave displays 0/1 collected by the oscilloscope. The function can display logic 0 and 1 on the screen under the condition that the input waveform is severely distorted.

- Press the NEXT PAGE option key to enter the following settings:
- VERTICAL POSITION: Press the VERTICAL POSITION option key and rotate the Multi-purpose control to adjust the position of decoding data on the screen.
- EVENT LIST CHECK: When the Oscilloscope is in the state of decoding, the RUN/STOP button is green. At this moment, press the RUN/STOP and the Oscilloscope will stop refreshing waveform and the button will turn red. The collected data will be stored in the Oscilloscope. The menu will display decoding data selection list, the button can display the captured times of transmission signals and the number the selected data.
- The selected decoding data will be highlighted green. The Multi-purpose control can select any collected data.

Input signals are shown in figure below: data width is 8 bits, data bit is 0*55, and stop bit is 1 bit, even parity. The trigger condition is: data, negative polarity, the bit sequence is LSB, the baud rate is 115200bps.
The bus settings are: Bus is open, the display format is ASCII, event list open.



I2C Protocol Trigger and Decode (Optional)

- I2C protocol is usually used to connect micro-controller and its peripheral equipment, a widely used protocol in the field of microelectronics communication control. The bus protocol uses two wires to transmit.
- One is serial data cable SDA, the other is serial clock cable.

I2C Start Trigger

- Press the DECODE button. Then press the TYPE option key to open protocol type list. Rotate Multi-purpose control to select the SPI protocol mode. Press Multi-purpose control to start the SPI protocol mode.
- SCL: Select clock source
  Press this option key and the present clock source font becomes green. Press the SCL button again to switch any channel among CH1-CH4 as clock source. The corresponding logic level can be adjusted when the corresponding signal source is selected. The way of adjusting is the same with that of trigger level. To avoid the effect of signal noise, it is suggested that the comparative level should be set in the waveform centre area to obtain accurate results.

- Press the SCLK EDGE button to set the clock source as rising edge or falling edge.
- SDA: Select data source
  Press this option key and the present clock source font becomes green. Press the SDA button again to switch any channel among CH1-CH4 as clock source. The logic level can be adjusted when the corresponding signal source is selected. The way of adjusting is the same with that of trigger level. To avoid the effect of signal noise, it is suggested that the comparative level should be set in the waveform centre area to obtain the accurate captured result.
- CONDITION: Trigger Condition Selection
- Press this option button and the trigger timing selection will display. The following are the trigger timing conditions:

1. START: Trigger at the starting moment. Namely, SDA occurs at falling edge when SCL is at logic high. Note that the restarting state is stored in I2C, the starting signal can occur again (restart) before first signal's stop signal. Both the start and the restart can produce a trigger signal.
2. RESTART: Triggers at the restarting moment. When a start signal occurs before the previous signal ends, this situation is defined as restart signal.
3. STOP: Triggers when the stop bit occurs. Namely, SDA goes from low to high when SCL is high.
4. LOSS: It is the loss confirmation trigger. Every time after 8 bits are transmitted in I2C protocol, the data receiver transmits the receiving signal, which is the answering bit in figure above. The SDA signal is low and SCL high. The loss confirmation trigger occurs on the receiving bit, when SCL and SDA and both high.
5. ADDR: It is address trigger. The address trigger will occur if the communication address is the same with the user setting address. It can help to quickly locate using address.
6. DATA: It is data trigger. The data trigger can occur with the following conditions: equal/greater/less/unequal. It is convenient to analyse data and capture abnormal data.
7. ADDR DATA: It is address data trigger. The trigger occurs when the addresses are the same during transmitting and the data satisfies the setting condition. It is convenient to realize the I2C specified address trigger and data trigger, and help analyse the transmission.

- Press the NEXT PAGE function key to enter additional I2C trigger settings:

Address Setting

- Press the ADDR button to set the related address information.
- WIDTH: It is the address width selection. Press this option button and the address width selection list pops up. Press the WIDTH function button again to select 7 or 10 bits width. Rotating the multi-purpose control can also select the width. Press the multi-purpose control to confirm selection.
- ADDRESS: Within this interface, directly rotate the multi-purpose control to set the address value. Note that the set value is related to the present bit width. The seven bit address can be set from 0x0 to 0x7F and the ten bit address can be set from 0x0 to 0x3FF.
- DIRECTION: Set the read-write direction. Select this option and the read/write selection list will pop up. Press the read/write option key to switch between each other. After the selection list pops up, the multi-purpose control can also be used. Press the multi-purpose control to confirm selection.

Data Setting

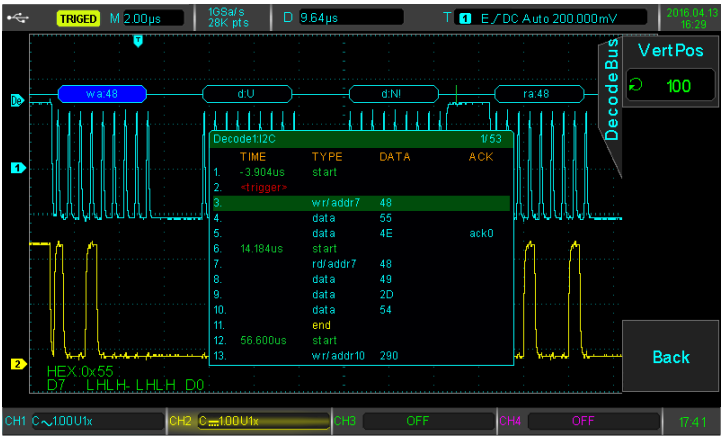
- Select this option to set the related data information.
- BYTE: Set the data byte. Select this option and the data byte selection list pops up. Press the button again to switch between 1, 2, 3, 4, and 5 bytes. The multi-purpose control can also be used.
- BIT: Select the bit. Directly rotate the multi-purpose control to select the bit under the data set interface. The selected bit will be highlighted red at the bottom left corner

Note: the selected bits are directly related to the set bytes. For example, the bit of 0 to 7 can be selected if 1 byte is set.

- DATA BIT: Set every bit of data. The present data bit can be set to H/L as required. The bottom left corner will display the present data setting condition, and the value can be set with hexadecimal and MSB method.
- All Bits: Set the entire bit to the same value. It is helpful to quickly set the value and reset. Press the NEXT PAGE option key to enter additional I2C trigger settings.
- DATA CONDITION: Use this option to set the relation between the captured and set data when data is triggering. The captured data can be set to equal, greater, or less than the set data.
- TRIGGER SETTING: Set the trigger selection.
  Use this option to enter the trigger setting menu. The trigger mode can be set to auto or normal. The trigger coupling can be set to: DC, AC, low frequency, high frequency suppression, and noise suppression. Press the RETURN to return to the previous menu.
- If a more detailed communication analysis is needed, the native protocol decoding function can be used. The oscilloscope will capture the continuous communication data which can be displayed directly by the screen or in the event list to make communication analysis quicker, more accurate, and more convenient.
- BUS SETTING: Use this option to enter decode bus settings:
- BUS STATUS: Use this function to enable bus control selection list, to open or close the decoding function. You can also operate using the multi-purpose control after the selection list pops up.
- DISPLAY FORMAT: Use this feature and the display format can be switched between hexadecimal, decimal, and binary. The multi-purpose control can also be used after the selection list pops up.
- EVENT LIST: The event list can be open or closed using this feature. We can also operate through the multi-purpose control. The event list contains the decoded data for continuous collection which can be directly displayed on the screen, which contains data capture time, data content, and parity status
- PSEUDO SQUARE WAVE: The pseudo wave function can be open or closed using this feature. The multi-purpose control can also be used after opening the function list. The waveform is displayed using the 0/1 collected by the oscilloscope. This feature is useful when the input wave is severely distorted.
- VERTICAL POSITION: Use this feature and rotate the multi-purpose control to adjust the position of decoded data on the screen.
- Event List Check: When the oscilloscope is in the state of decoding, RUN/STOP is green. At the moment when pressing RUN/STOP, RUN/STOP is red. The oscilloscope will stop refreshing waveform and the collected data will be stored in the oscilloscope. The menu will display decoded data selection.
  The button displays the times of captured transmission signal and the

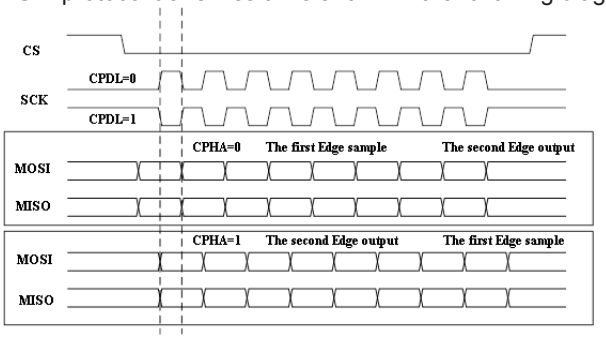
corresponding number of the present selected data. The selected decoding data will be highlighted green. The multi-purpose control can select any collected data. This function can find the content of captured multiple transmission communication and help to debug the system conveniently.

- Input the signal as shown the figure below. The oscilloscope is set up as follows. SCL selection is CH1. SDA selection is CH2. The condition is Addr. The set address is 7bits, 0x48 and the direction is writing. The data do not need to be set because data trigger is used.
- The bus status is open during setting the bus. The displayed format is ASCII. Open the event selection and the display is as follows:



SPI Protocol Trigger and Decode (Optional)

- SPI interface is a kind of synchronized 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 output; SCLK: time signal the host transmits; CS: the slave chip selection enable signal.
- SPI interface is mainly used to transmit the serial data between the host and low speed peripheral devices. The data are transmitted according to the bit, that is to say, higher bit first and then lower bit. SPI interface do not need look for the slave address. The communication is of full duplex and the protocol itself is easier. So it is widely used. SPI protocol transmission is shown in the following diagram:



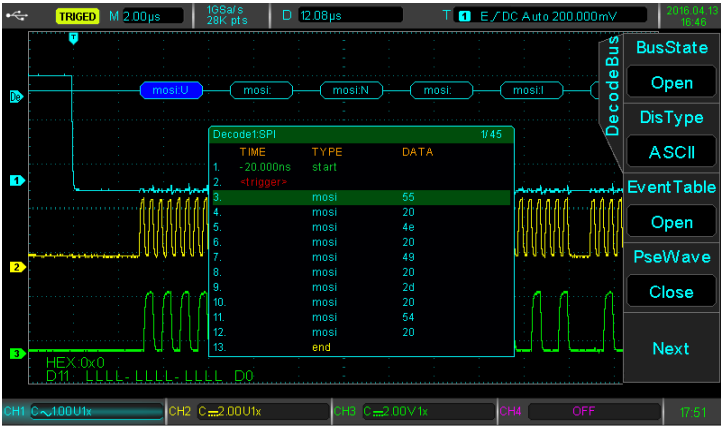
Start SPI Trigger

- Press the DECODE button then press the TYPE option key to open protocol type list. Rotate Multi-purpose control to select the SPI mode. Press to confirm selection.
- CS SETTING: Set Chip Selection Enable Signal
  Use this feature to enter the enable signal setting up interface. Press the CS SOURCE option button to switch any channel among CH1-CH4 as chip selection signal. The corresponding logic level can be adjusted when the corresponding signal source is selected. The way of adjusting is the same with that of trigger level. To avoid the effect of signal noise, it is suggested that the comparative level should be set in the waveform centre area to obtain the accurate captured result. Press the CS POLARITY option button to set the positive or negative polarity of the chip selection signal. The normal SPI communication uses the transmission signal with negative polarity.
- SCLK SETTING: Set the Clock Signal
  Use this function to enter the clock signal setting interface. Press the SCLK button to switch any channel among H1-CH4 as clock source. The corresponding logic level can be adjusted when the corresponding signal source is selected. The way of adjusting is the same with that of trigger level. To avoid the effect of signal noise, it is suggested that the comparative level should be set in the waveform centre area to obtain the accurate captured result. Press the SCLK EDGE button to set the clock source as rising edge or falling edge.
- MOSI SETTING: Set Master Output Slave Input Signal
  Use this function and enter the MOSI signal setting interface. Press the MOSI Source button to switch any channel among CH1-CH4 as data source. If MOSI is off, there will be no corresponding data in decoded display. The corresponding logic level can be adjusted when the corresponding signal source is selected. To avoid the effect of signal noise, it is suggested that the comparative level should be set in the waveform centre area to obtain accurate captured result. Press the MOSI POLARITY button to set the positive or negative polarity of the chip selection signal. The normal SPI communication uses the transmission signal with negative polarity.
- CONDITION: Select the Trigger Condition
  Use this function to switch the trigger condition between CS, Idle, CS&Data, and Idle&Data. CS will trigger when chip selection enable is effective. Idle is idle trigger. CS&Data will trigger when enable is effective and the data is correct. Idle&Data will trigger when it is idle and the data is correct.

Condition Setting

- BIT ORDER: Set the bit order to MSB/LSB
- DATA SETTING: Set the comparative values
- BIT WIDTH: Set the data bit width need to be compared. The range is 4-32 bits
- BIT: Select the bit. The Multi-purpose control can select bit under the data setting interface when a certain bit is needed to be set. The present selected bit will be highlighted red at the left corner. Note that the bit you can select is directly related to the byte you set. For example, if 1 byte is selected, the bit you can select is 0-7.
- DATA BIT: Set every data. The present bit can be set to H/L as required. The present data setting status will be displayed at the left corner of the screen. The set value display by the method of hexadecimal and MSB.
- ALL BITS SET: the all bits to the same value, which is helpful for you to set and reset quickly.

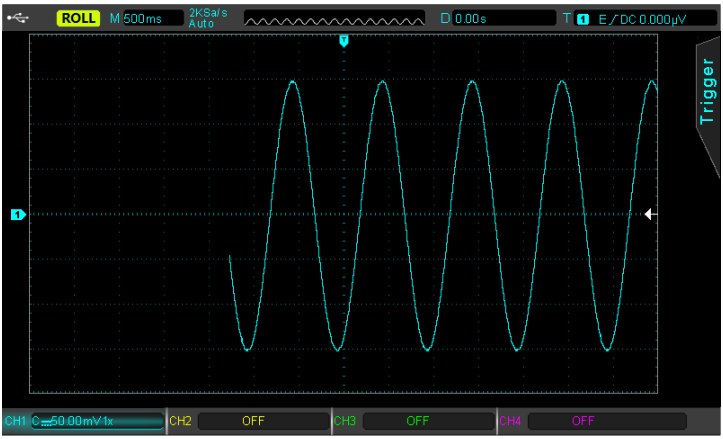
- TRIGGER CHANNEL: Press the button to select comparative data channel and switch between MOSI and MISO.
- FRAME LENGTH: The bit width of SPI communication is usually different due to the different situation. Now the Multi-purpose control can select the data bit of the decoding data switch either 4, 8, and 16.
- Press the RETURN to return to the first level menu.
- IDLE TIME: Set the idle time value. The Multi-purpose control can set the different overtime value.
- TRIGGER SETTING: Set the trigger selection
  Press the button TRIGGER SETTING to enter the trigger setting menu. The Trigger Mode can be set to Auto or Normal.
- The Trigger Coupling can be set: DC, AC, low frequency, high frequency suppression, and noise suppression.
- Press the RETURN to return to first level menu.
- If you need more detailed communication analysis, you can use native protocol decoding function. The oscilloscope will capture the continuous communication data. The communication content can be displayed by the screen or the event list.
- BUS SETTING: Press SETTING to enter the decoding bus setting.
- BUS STATUS: Press the button BUS STATUS, and the bus control selection list pops up. The decoding function can be open or closed. The multi-purpose control can also be used.
- DISPLAY FORMAT: Press the button DISPLAY FORMAT, and then there are four kinds of display options: hexadecimal, decimal, and binary and ASCII. The multi-purpose control can also set it after the list displays.
- EVENT LIST: Press the button EVENT LIST, and the decoding events can be open or closed. The multi-purpose control can also set it after the list displays.
- PSEUDO SQUARE WAVE: Select this option and the pseudo square wave function can be open and closed. The multi-purpose control can also be used.
- The pseudo square wave displays 0/1 collected by oscilloscope. The function can display logic 0 and logic 1 on the screen under the condition that the input waveform is severely distorted.
- Press the NEXT PAGE to enter the following settings.
- VERTICAL POSITION: Press the button and rotate the multi-purpose control, which can adjust the position of decoding data on the screen. It is convenient for you to observe the waveform and decoding data.
- EVENT LIST CHECK: When the oscilloscope is in the state of decoding, RUN/STOP is green. At the moment when pressing RUN/STOP, RUN/STOP is red. The oscilloscope will stop refreshing waveform and the collected data will be stored in the oscilloscope. The menu will display decoding data selection.
- The button displays the times of captured transmission signal and the corresponding number of the present selected data. The selected decoding data will be highlighted in green. The multi-purpose control can select any collected data. This function can find the content of captured multiple transmission communication and help to conveniently debug the system.



OPERATION

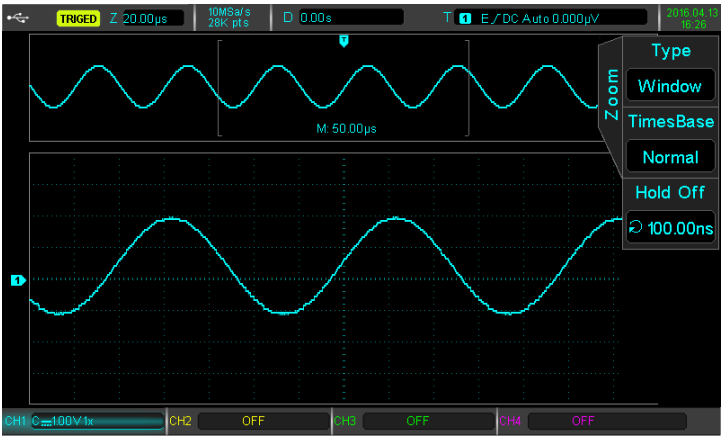
Set Level System

- ROLL mode
- When the trigger is in automatic mode and using the SCALE knob to adjust the horizontal level to slower than 50ms/div, and the oscilloscope will be in ROLL mode. At this point, the trigger system will not work, the oscilloscope will be continuous on the screen to draw the waveform of the voltage - time chart.



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. Press F1 to select the window scale.



- 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 through rotating the knob horizontal SCALE.
- The lower part displays the horizontal scale waveform.

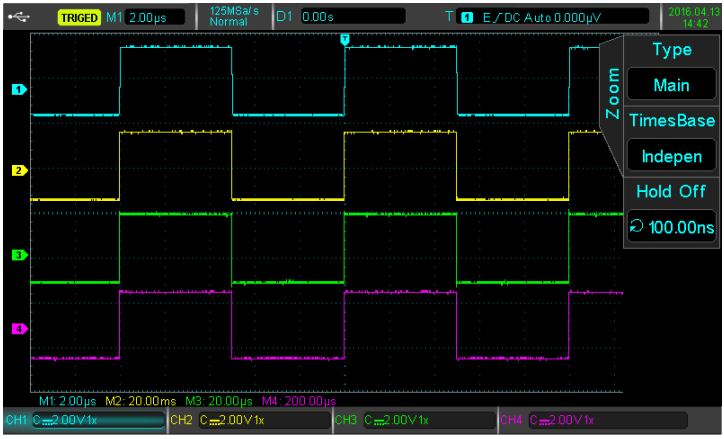
Note: that scale time base improves definition compare with the main time base (as the above picture shows).

- Because the waveforms displayed by the whole lower part are corresponding to the areas selected by upper half part, rotating the horizontal SCALE control to reduce the selected areas can improve the scale time base, namely, can improve the waveforms horizontal SCALE multiple.

Note: The max scale time base is 200ns/div.

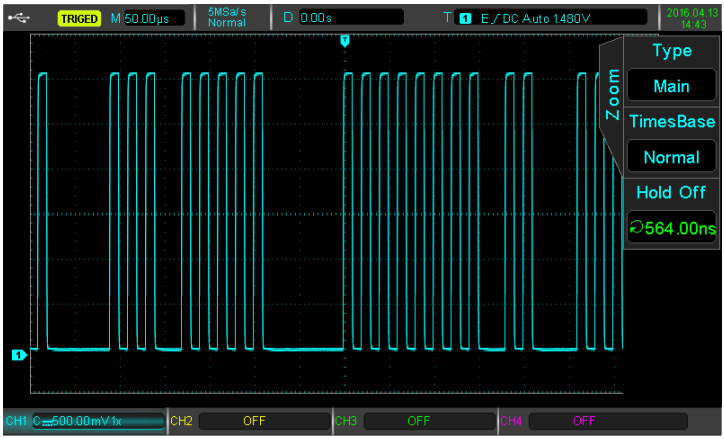
Independent Time Base

- In independent time base, CH1~CH4 can be arranged in timing, so that the channel can observe signals of different frequencies.
- 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 Release

- Trigger release can observe complex waveforms (such as pulse series).
- Release 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-purpose control to select trigger release.



Mathematical Operations

- Math: +, -, *, and /
- FFT: Fast Fourier Transform
- Logical: AND, OR, NOT, and XOR
- Custom Advanced Operations
- Digital Filter
- 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.

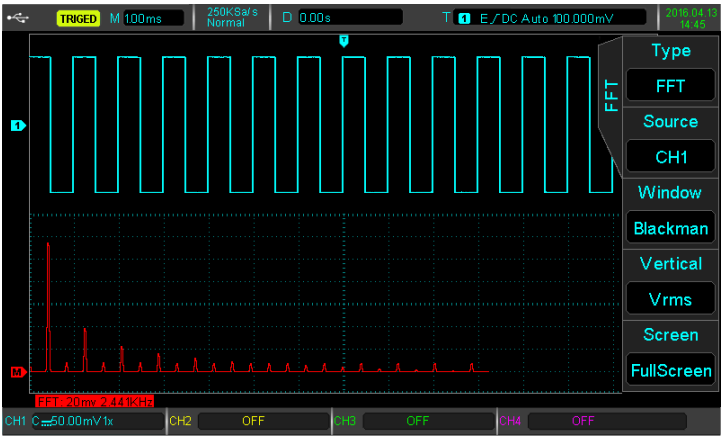
Mathematical Function

- Press MATH button then F1 to choose the type math.

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 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 button then F1 to select FFT and 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)

Select the FFT window

- Assuming the YT waveform is constantly repeating itself, the oscilloscope will carry out FFT conversion of time record of a limited length. When this cycle is a whole number, the YT waveform will have the same amplitude at the start and finish. There is no waveform interruption.
- If the YT waveform cycle is not a whole number there will be different amplitudes at the start and finish, resulting in transient interruption of high frequency at the connection point. In frequency domain this is known as leakage.
- To avoid leakage multiply the original waveform by one window function to set the value at 0 for start and finish compulsively. See the following table:

FFT Window	Feature	Most suitable measurement item
Rectangle	The best frequency resolution, the worst amplitude resolution. Basically similar to a status without adding window.	Temporary or fast pulse. Signal level is generally the same before and after. Equal sine wave of very similar frequency. There is broad-band random noise with slow moving wave spectrum.
Hanning	Frequency resolution is better than the rectangle window but amplitude resolution is poorer.	Sine, cyclical and narrow-band random noise.
Hamming	Frequency resolution is marginally better than Hanning window.	Temporary or fast pulse. Signal level varies greatly before and after.
Blackman	The best amplitude resolution and the poorest frequency resolution.	Mainly for single frequency signals to search for higher-order harmonic wave.

Set Vertical Unit

- Vertical units can be Vrms or dBVrms.
- Press F4 to select the desired unit. Vrms and dBVrms show the vertical amplitude by means of logarithmic and linear.
- To display the FFT spectrum in a larger dynamic range, dBVrms can be used.

Functions Menu	Setup	Notes
Type	Logic	To carry out +, -, x, ÷ functions
Operator	AND OR NOT XOR	Signal source 1AND Signal source 2 Signal source 1 OR Signal source 2 Signal source 1NOT Signal source 1 Signal source 1XOR Signal source 2
Signal source 1	CH1 to CH4	Set any one of the CH1~CH4 for logic as source 1
Signal source 2	CH1 to CH4	Set any one of the CH1~CH4 for logic as source 2
Reverse	Open, Close	Reverse logic waveform

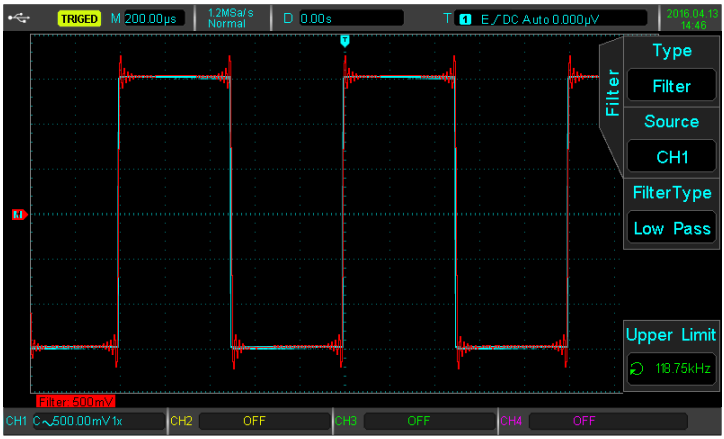
- During operation, when the source channel voltage value is greater than the corresponding channel trigger value, the logic decision will be 1, otherwise it is 0. Waveform transform will be in binary operation. Four logical operations examples are shown in the table below.

S1	S2	AND	OR	XOR	S1	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		

Digital Filter

- Press MATH button then F1 to enter the digital filter menu.

Functions Menu	Setup	Notes
Type	Digital Filter	
Source	CH1 to CH4	Set CH1 to CH4 for digital filter source
Filter type	Low pass High pass Band pass	Set filter to low pass Set filter to high pass Set filter to band pass
Frequency lower limit		Only valid in high pass or band pass. Use multi-purpose control to modify lower limit value
Frequency upper limit		Only valid in low pass or band pass. Use multi-purpose control to modify upper limit value



Digital Filter

Set Sampling System

- Sampling is taking analogue input and converts into a discrete points using an analogue to digital converter (ADC).

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

- Sampling rate refers to the time interval between two sampling points. The maximum sampling rate of the UPO2000CS series is 1 GS/s.
- The sampling rate will be affected by the timing scale and the change of storage depth. UPO2000CS oscilloscopes sampling rate is displayed in real-time at the top of the screen in the status bar.
- The horizontal SCALE control can adjust the horizontal timebase or modify the memory depth.
- Press ACQUIRE key to enter the sampling menu.

Functions	Options	Description
Sampling mode	Normal Peak High Res Envelope Average	
Average	2~8192	In average sampling mode, use multi-purpose 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	Automatic storage depth Set storage depth to 28kpts Set storage depth to 280kpts Set storage depth to 2.8Mpts Set storage depth to 28Mpts

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

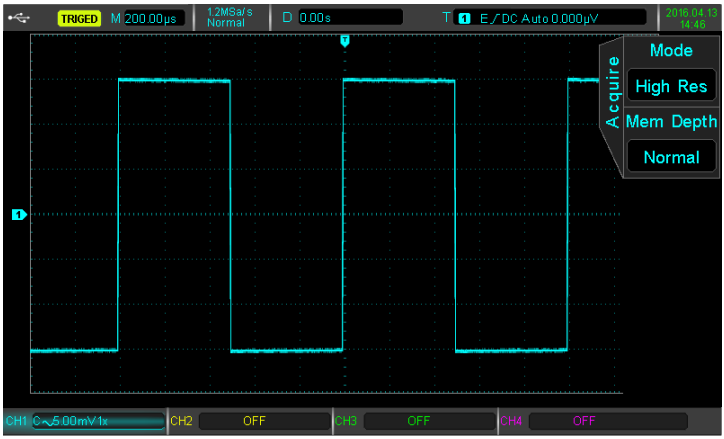
- In this acquisition mode, the signal is sampled and reconstructed with equal time intervals. For most waveforms, the use of this mode can produce the best effect.

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

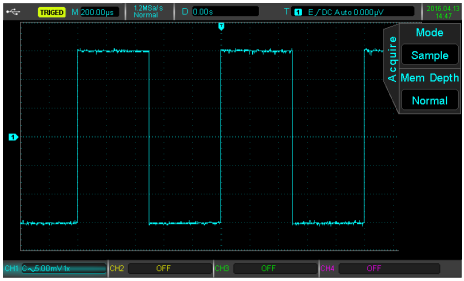
- In this acquisition mode, the oscilloscope can reduce random noise from the input signal and generate smoother waveforms.



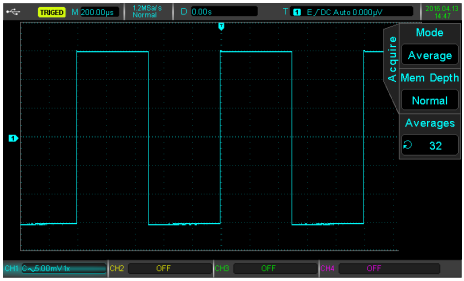
High Resolution mode to minimize noise from small signal

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.



Un-averaged



32x Averaged

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

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.

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.
- Default is 28Mpts storage depth (per channel). Users can set up their own storage depth as automatic, 28K, 280K, 2.8M, and 28M.

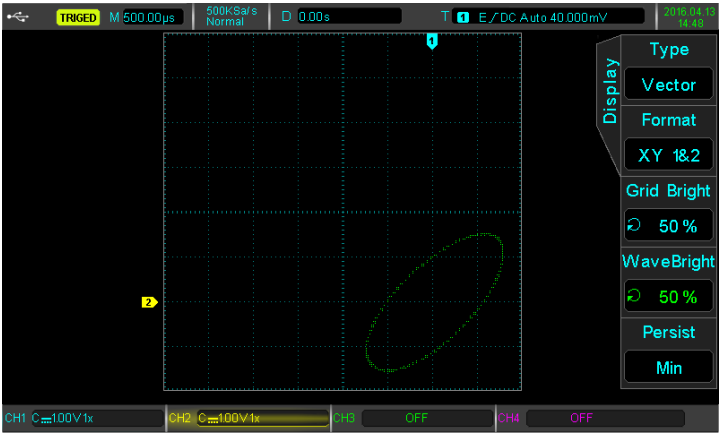
Set Display System

- You can set the display type of the waveform, display format, duration, grid brightness, and waveform brightness.
- Press the DISPLAY key to enter the display menu.

Functions	Options	Description
Type	Vector Point	Using lines to display between samples Displays points directly
Format	YT XY 1&2 XY 3&4	Display level on time scale Display Lissajous graph of CH1~CH2 waveforms Display Lissajous graph of CH3~CH4 waveforms (UPO2XX4CS only)
Duration time	Close	Displayed waveform refreshes at normal rate
	100ms / 200ms 500ms / 1s / 2s /5s / 10s	Displayed waveform refreshes after specified time
	Continuous	Waveform refreshes at a continuous rate
Grid Brightness	1%~100%	Set the grid brightness, Use multi-purpose control to adjust settings
Waveform Brightness	1%~100%	Set the waveform brightness, Use multi-purpose control to adjust settings

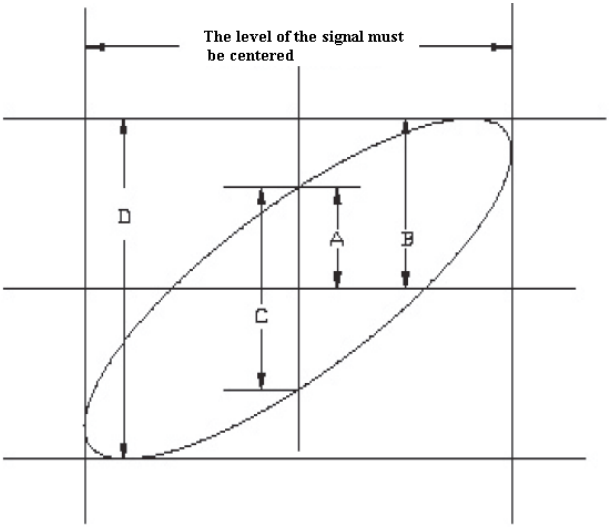
XY Pattern

- The XY mode display is also called Lissajous graph.
- When XY 1&2 are selected, the CH1 signal will be entered on the horizontal axis (X), and the CH2 on the vertical axis (Y).
- When XY 3&4 are selected, the CH3 signal will be entered on the horizontal axis (X), and the CH4 on the vertical axis (Y). UPO2XX4CS only.
- In X-Y mode, when CH1 or CH3 are activated, use the horizontal POSITION control to adjust the graph horizontally.
- When CH2 or CH4 are activated, use the horizontal POSITION control to adjust the graph vertically.
- The vertical SCALE control to be used to adjust each channel's amplitude level.
- The horizontal SCALE control can be used to adjust the time position in order to obtain a well displayed Lissajous graph.

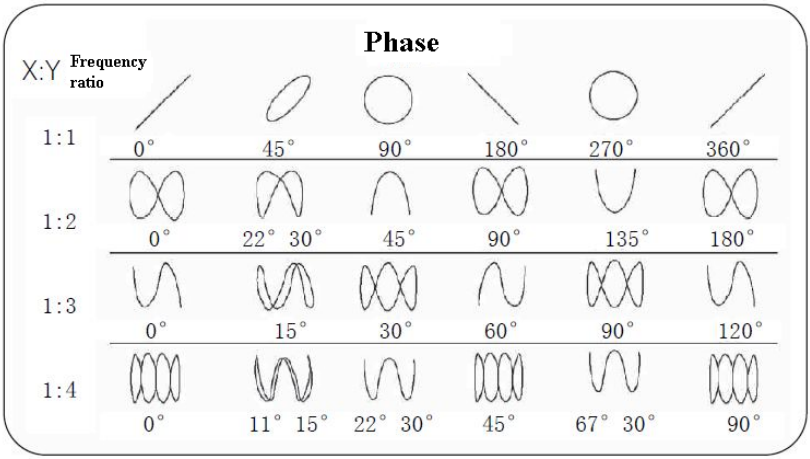


Application of XY Mode

- 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:



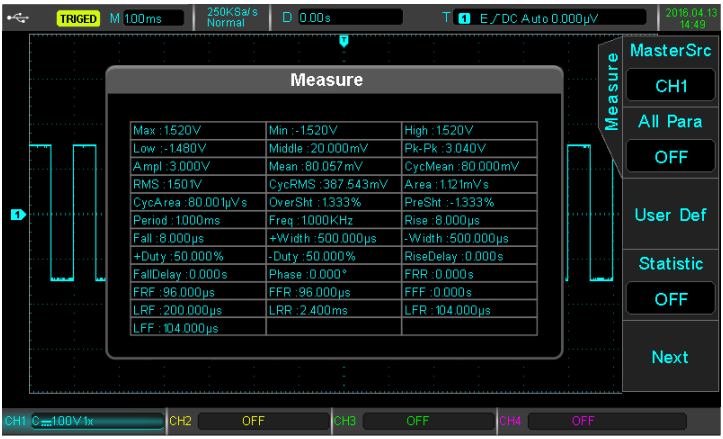
AUTOMATIC MEASUREMENT

- 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-purpose 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-purpose 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

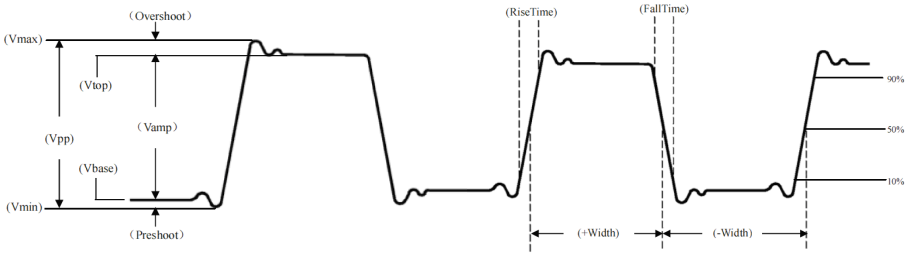
- Press MEASURE key to enter automatic measurement menu then F1 to select the source. F2 can be used to select all 34 parameters.



- 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).

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

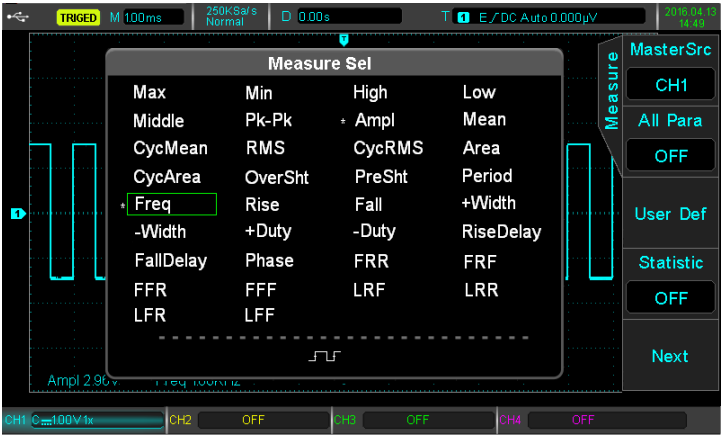
- The following parameters can be measured automatically:
  1. Period: The duration of one cycle of a repetitive waveform
  2. Frequency: The reciprocal of the period
  3. Rise time: The time it takes the waveform amplitude to increase from 10% to 90%
  4. Fall time: The time it takes the waveform amplitude 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

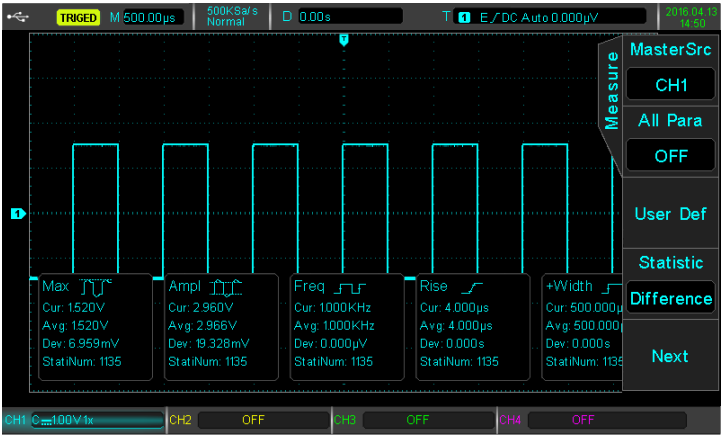
User Defined Parameters

- Press the MEASURE button to enter the automatic measurement menu. Then press the F1 key to select the source of the measurement.
- The user defined parameter interface is accessed by pressing F4.



User Defined Parameter Selection

- Adjust the parameters with the multi-purpose control, press the multi-purpose 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.



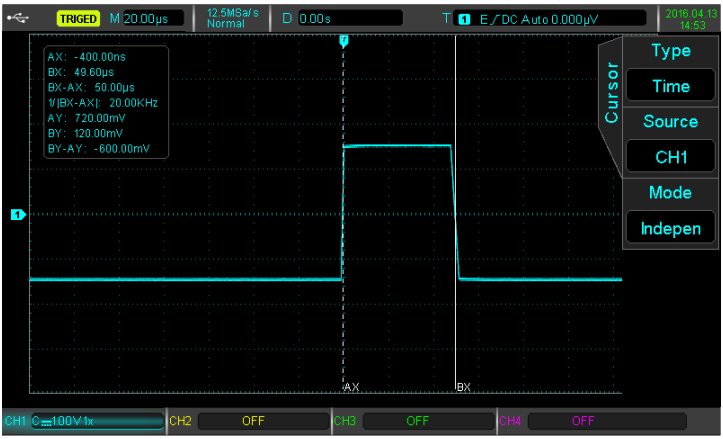
User Defined Parameter Statistics

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 F1 key to select the type to measure.
- Press F2 to select the source of the time measurement channel and set the pattern to independent.
- The multi-purpose control can adjust the vertical cursor AX, press it to switch to cursor BX.

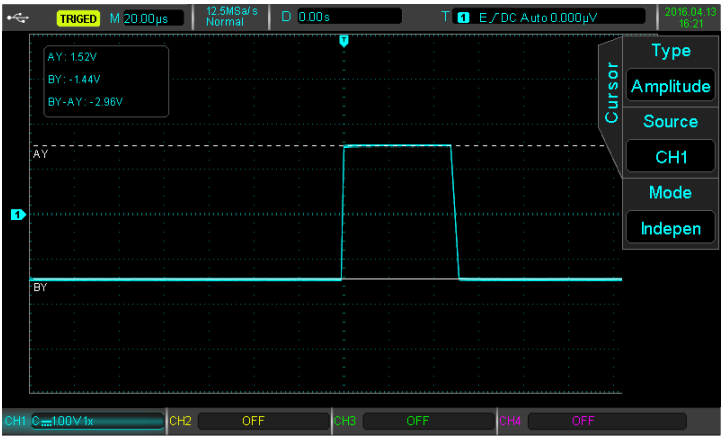


- The measured values are shown in the upper left corner of the waveform display area. The value of BX-AX is the time measurement, and 1/|BX-AX| is the reciprocal of time, or frequency.
- For a periodic signal, if AX and BX are set at the rising edge of adjacent cycles, then BX-AX is the signal's period, 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.
- The multi-purpose control can be used to adjust the BX and AX positions when setting is set to trace using the F3 key.

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 button to enter the cursor measurement menu. Then press the F1 key to select the type to voltage.
- Press F2 to select the source of the voltage measurement channel and set the pattern to independent.
- The multi-purpose control can be used to adjust the horizontal cursor AY on the screen, press the multi-purpose 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-purpose 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.

Storage Setting and Recall

- Press the STORAGE button to enter the storage setting menu. Then press the F1 key and select the type as settings.

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-purpose 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.

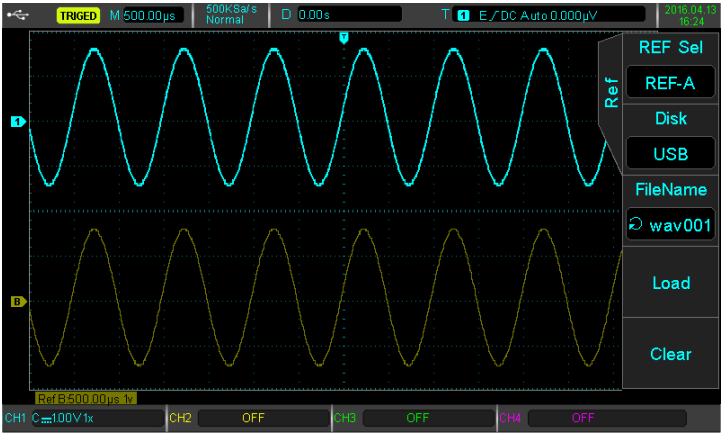
Waveform Storage and Recall

- Press the STORAGE button to enter the storage setting menu. Then press the F1 key and select the type as waveform.

Functions	Options	Description
Type	Waveform Storage	
Source	CH0 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
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-purpose 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 knob 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-purpose 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 button then F5 to enter the auxiliary function setting menu then press F1 to enter the wave 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 F1 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 button then F5 to enter the secondary menu then press F2 to enter the test menu.

Functions	Options	Description
Allow 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
Display info	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-purpose 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-purpose control to select the horizontal tolerance
Vertical tolerance	1~255	Use the multi-purpose 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, press F1 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.
- Press UTILITY to enter the auxiliary function menu then press F5 twice to enter page 3 menu then press F1 to select system upgrade.
- Press F1 again to confirm.
- 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 50Hz, the amplitude is not less than 30mVpp, 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.

Factory Settings

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

System	Function	Factory Setting
Vertical System	CH1	Return to the parameter measurement display menu
	Vertical displacement	0
	Coupling	DC
	Bandwidth limit	Off
	Lattice	Coarse
	Probe	1×
	Reverse	Off
	Bias voltage	Off
	CH2, CH3, CH4	Off
	Math, Ref	Off
Trigger System	Hold Time	100.00ns
	Trigger Type	Edge
	Source	CH1
	Slope Type	Rising
	Coupling Mode	DC
	Trigger Mode	Auto

System	Function	Factory Setting
Display	Type	Vector
	Format	YT
	Duration Time	100ms
	Grid Brightness	50%
	Waveform Brightness	60%
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	100%
	Output selection	Trigger

TROUBLESHOOTING

System Information Description

- OPERATION AT LIMIT: In the current state, adjustment has reached the limit and cannot continue. When the vertical scale knob, 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
Time delay between channels (typical)	150ps

Vertical				
Model	72-14535	72-14530	72-14525	72-14520
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	mV/div~50 mV/div: ±2V 100 mV/div~1 V/div: ±40V 2V/div~20 V/div: ±400V			
Bandwidth Limit (typical)	20MHz			
Low Frequency Response (AC coupling, -3dB)	≤5Hz (on BNC)			

DC Gain Accuracy	≤±4% (Sampling or average sampling method)
DC Offset accuracy	≤±4% (Sampling or average sampling method)
Channel Separation	DC to maximum bandwidth: >40 dB

Horizontal	
Timing Scale	5ns/div ~ 50s/div (1-2-5 base) 2ns/div ~ 50s/div (1-2-5 base) (UPO2202CS)
Timing Accuracy	1mV/div~20 V/div (1-2-5 base)
Delay	Pre-trigger (Negative Delay): ≥1 Screen Width Post-trigger (Positive Delay): 1 s~50 s
Timebase	YT, XY, ROLL
Waveform Capture Rate	50,000 wfms/s

Sampling	
Sampling Mode	5ns/div ~ 50s/div (1-2-5 base) 2ns/div ~ 50s/div (1-2-5 base) (UPO2202CS)
Real-time sampling rate	GS/s(Single Channel), 500MS/s(Dual Channel), 250MS/s(Quad Channel) 1GS/s(Single Channel), 500MS/s(Dual Channel) (UPO2202CS)
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

Trigger	
Trigger level range	Internal: Centre of the screen ± 8 grids External: ± 0.8V
Trigger mode	Automatic, normal, single
Trigger hold off range	100ns~10s
High frequency suppression	50kHz
Low frequency suppression	5kHz
Noise suppression	Reduce Noise Waveform (10mV/div~20 V/div, DC coupling trigger sensitivity reduced by 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

Slope Trigger	
Slope Condition	Positive slope (greater than, less than, specified range) Negative slope (greater than, less than, specified range)
Time Setup	8ns~10s

Video Trigger	
Signal System Frequency Range	Supports NTSC, PAL and SECAM systems, rows range is 1~525 (NTSC) and 1~625 (PAL/SECAM)

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	Max, Min, Peak-Peak, Top, Bottom, Amplitude, Mean, Middle, Period Mean, RMS, Period RMS, Area, Period Area, Overshoot, Preshoot, Frequency, Period, Rise Time, Fall Time, Positive Pulse, Negative Pulse, Positive Duty Ratio, Negative Duty Ratio, Delay A->B, Delay A->B, Delay B->A, Delay B->A.	
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	

Storage	
Setting	Internal (256), External USB
Waveform	Internal (256), External USB
Bitmap	External USB

Mathematical Operations	
Waveform calculation	A+B, A-B, A×B, A/B, FFT, Logic 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
Logical operation	AND, OR, NOT, XOR

Display	
Display	8 inch TFT LCD
Resolution	800 horizontal x 480 vertical RGB
Colour	160,000,000
Duration	Min, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, unlimited
Menu Duration	1s, 2s, 5s, 10s, 20s, manual
Display Type	Point, vector

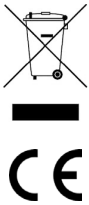
Interface	
Standard	USB-Host, USB-Device, LAN, EXT Trig, AUX Out

General Technical Specifications	
Probe compensated signal output	3Vp-p 10Hz, 100Hz, 1kHz (default), 10kHz
Power supply	100V-240V~45Hz-440Hz
Fuse	3A, T level, 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.

Made in China. PR2 9PP

Man Rev 1.0