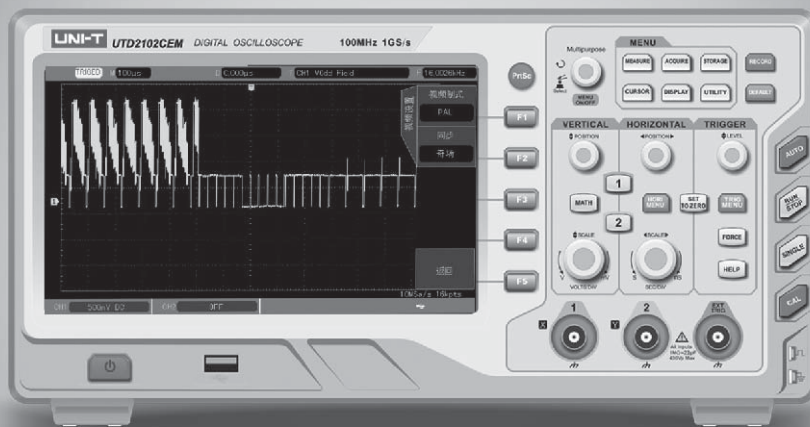


UNI-T®



UTD2000CEM Series Digital oscilloscope User Manual

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PREFACE

Dear Users:

Hello! Thank you for choosing this brand new UNI-T device. In order to safely and correctly use this instrument, please read this manual thoroughly, especially the Safety Notes part. After reading this manual, it is recommended to keep the manual at an easily accessible place, preferably close to the device, for future reference.

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● Trademark Information

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● Document Version

UTD2000CEM-20170422-V2.00

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- UNI-T products are protected by patent rights in China and foreign countries, including issued and pending patents.
- UNI-T reserves the rights to any product specification and pricing changes.
- UNI-T reserves all rights. Licensed software products are properties of Uni-Trend and its subsidiaries or suppliers, which are protected by national copyright laws and international treaty provisions.
- Information in this manual supercedes all previously published versions.

Warranty

UNI-T will guarantee that the product will be free from defects for a three-year period. If the product is re-sold, the warranty period will be from the date of the original purchase from an authorized UNI-T distributor. Probes, other accessories, and fuses are not included in this warranty. If the product is proved defective within the warranty period, UNI-T reserves the rights to either repair the defective product without charging of parts and labor, or exchange the defected product to a working equivalent product. Replacement parts and products may be brand new, or perform at the same specifications as brand new products. All replacement parts, modules, and products become the property of UNI-T.

The "customer" refers to the individual or entity that is declared in the guarantee. In order to obtain the warranty service, "customer" must inform the defects within the applicable warranty period to UNI-T, and to perform appropriate arrangements for the warranty service. The customer shall be responsible for packing and shipping the defective products to the designated maintenance center of UNI-T, pay the shipping cost, and provide a copy of the purchase receipt of the original purchaser. If the product is shipped domestically to the location of the UNI-T service center, UNI-T shall pay the return shipping fee. If the product is sent to any other location, the customer shall be responsible for all shipping, duties, taxes, and any other expenses.

This warranty shall not apply to any defects or damages caused by accidental, machine parts' wear and tear, improper use, and improper or lack of maintenance. UNI-T under the provisions of this warranty has no obligation to provide the following services:

- a) Any repair damage caused by the installation, repair, or maintenance of the product by non UNI-T service representatives.
- b) Any repair damage caused by improper use or connection to an incompatible device.
- c) Any damage or malfunction caused by the use of a power source that does not conform to the requirements of this manual.
- d) Any maintenance on altered or integrated products (if such alteration or integration leads to an increase in time or difficulty of product maintenance).

This warranty written by UNI-T for this product, and it is used to substitute any other express or implied warranties. UNI-T and its distributors do not offer any implied warranties for merchantability or applicability purposes.

For violation of this guarantee, UNI-T is responsible for the repair or replacement of defective products is the only remedy available to customers. Regardless of whether UNI-T and its distributors are informed that any indirect, special, incidental, or consequential damage may occur, UNI-T and its distributors shall not be responsible for any of the damages.

General Safety Overview

This instrument strictly complies with the safety requirements for electronic measuring instrument GB4793 and IEC 61010-1 safety standard during design and manufacturing. Please understand the following safety preventative measures, to avoid personal injury, and to prevent damage to the product or any connected products. To avoid possible dangers, be sure to use this product in accordance with the regulations.

- Only trained personnel can perform the maintenance program.
- Use the correct power line: Only use the dedicated UNI-T power supply appointed to the local region or country for this product.
- Correct Plug: Don't plug when the probe or test wire is connected to the voltage source.
- Ground the product: This product is grounded through the power supply ground wire. To avoid electric shock, grounding conductors must be connected to the ground. Please be sure that the product is properly grounded before connecting to the input or output of the product.
- Correct connection of oscilloscope probe: Ensure that the probe ground and ground potential are correctly connected. Do not connect ground wire to high voltage.
- Check all terminal ratings: To avoid fire and the large current charge, please check all the ratings and the marks on the product. Please also refer to the product manual for details on the ratings before connecting to the product.
- Do not open the case cover or front panel during operation.
- Only use fuses with ratings listed in the technical index
- Avoid circuit exposure: Do not touch exposed connectors and components after power is connected.
- Do not operate the product if you suspect it is faulty, and please contact UNI-T authorized service personnel for inspection. Any maintenance, adjustment, or replacement of parts must be performed by UNI-T authorized maintenance personnel.
- Maintain proper ventilation
- Please do not operate the product in humid conditions
- Please do not operate in inflammable and explosive environment
- Please keep the product surface clean and dr

Safety Terms and Symbols

- The following terms may appear in this manual:
Warning: The conditions and behaviors may endanger life.
Note: The conditions and behaviors may cause damage to the product and other properties.
- The following terms may appear on the product:
Danger: Performing this operation may cause immediate damage to the operator.
Warning: This operation may cause potential damage to the operator.
Note: This operation may cause damage to the product and devices connected to the product.
- The following symbols may appear on the product:



High Voltage



Caution!
Refer to Manual



Protective
Ground Terminal



Ground Terminal
for Chassis



Ground Terminal
for Testing

Perface

This manual describes the operation of the UTD2000CEM series digital oscilloscope . The manual includes the following sections:

- Chapter 1 Introduction Guide
- Chapter 2 Vertical channel setting
- Chapter 3 Trigger system setting
- Chapter 4 Horizontal system setting
- Chapter 5 Mathematical operation
- Chapter 6 Sampling system setting
- Chapter 7 Display system setting
- Chapter 8 Automatic measurement
- Chapter 9 Cursor measurement
- Chapter 10 Storage and callback
- Chapter 11 Auxiliary function setting
- Chapter 12 Other function keys
- Chapter 13 System prompt and troubleshooting
- Chapter 14 Technical specification
- Chapter 15 Appendix

Brief introduction of UTD2000CEM series digital phosphor oscilloscope

1) UTD2000CEM series digital oscilloscope contains the following 2 models

Model	Analog channel number	Analog bandwidth
UTD2102CEM	2	100MHz
UTD2072CEM	2	70MHz

2) UTD2000CEM series digital oscilloscope is based on UNI-T's unique Ultra Phosphor technology. A multi-functional, high performance oscilloscope that is easy to use, with excellent technical specifications, a perfect combination of many functionalities that can help users to quickly conduct testing. UTD2000CEM series is aimed at satisfying the most extensive oscilloscope markets, including communications, semiconductors, computers, aerospace defense, instrumentation, industrial electronics, consumer electronics, automotive electronics, field maintenance, R&D, education, etc.

3) Main features of UTD2000CEM series digital oscilloscope:

- Configure 100MHz/70MHz two levels bandwidth, providing two channels for each model
- The highest real-time sampling rate: 1GS/s, can capture the faster signal
- Standard storage depth of 32Mpts.
- Waveform capture rate of up to 30,000wfms/s
- Waveform uninterrupted recording supports up to 8000 waveforms
- 8 inches WVGA (800 * 480) TFT LCD, ultra wide screen, vivid color, clear display
- Abundant trigger features, including a variety of advanced trigger
- Standard configuration interface: USB-OTG, Pass/Fail (pass / fail)
- Automatic measurement of 34 waveform parameters
- Support USB disk storage and software upgrades via USB disk, one key copy screen capture function
- Support Plug and Play USB devices, and can use USB interface to communicate with the computer

Chapter 1 – Introduction Guide

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

1.1 General Inspection

It is recommended to follow the steps below before using the UTD2000CEM series for the first time.

1.1.1 Check for Damages caused by Transport

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

1.1.2 Check attachments

Please check Appendix A for the list of accessories. If any of the accessories are missing or damaged, please contact UNI-T or local distributors of this product.


1.1.3 Machine Inspection

If the instrument appears to be damaged, not working properly, or has failed the functionality test, please contact UNI-T or local distributors of this product. If the equipment is damaged due to shipping, please keep the packaging and notify both the transportation department and UNI-T distributors, UNI-T will arrange maintenance or replacement.


1.2 Before Use

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




1.2.1 Connect to the Power Supply

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

1.2.2 Boot Check


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

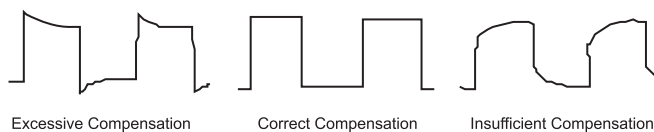
1.2.3 Basic Function Check

After the oscilloscope enters the normal interface, find the  button at the bottom right of the operation panel. Long press  button to hear the voice of the relay switch, and then press the  button, the screen will automatically complete the signal condition, 1kHz, 3Vpp square wave signal appears on the screen. Press the key again, then the internal reference input is disconnected, the channel can be in a normal external input state.

1.2.4 Probe Compensation

When the probe is connected to any input channel for the first time, this step might be required in order to match the probe and the input channel. Please follow the following steps:

- ① Set the attenuation coefficient in the probe menu and the switch on the probe to 10x, and connect the probe to CH1. Make sure the probe's connector is properly connected with the oscilloscope. Connect the probe's main clip and ground clip to the oscilloscope's calibration and ground terminal respectively. Open CH1 and press the  button.
- ② Observed waveforms



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



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

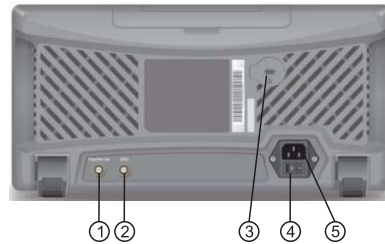
1.3 Front panel introduction



Front panel

- ①. Screen display area
- ②. Multifunction knob
- ③. Function menu key
- ④. Control menu softkey.
- ⑤. Probe compensation signal connecting piece and grounding
- ⑥. Trigger control area.
- ⑦. Horizontal control area.
- ⑧. Vertical control area.
- ⑨. Analog channel input.
- ⑩. Power soft key

1.4 Back panel introduction



Back panel

- ①. Pass/Fail : Pass/fail test output, also supports Trig_out output
- ②. AWG : This model does not support
- ③. Security lock: you can use the security lock (sold separately) Oscilloscope can be locked in a fixed position through the key hole .
- ④. Power Switch: after the AC socket is connected to the power supply, turn on the Power Switch. Press the ⏻ button on the front panel to Power On.
- ⑤. AC power input socket : AC power input port . Use the power cord supplied within the accessory package to connect the oscilloscope to the AC power supply (the power supply for the oscilloscope to require is 100 to 240 V, 50Hz/60Hz).

1.5 Operation Panels

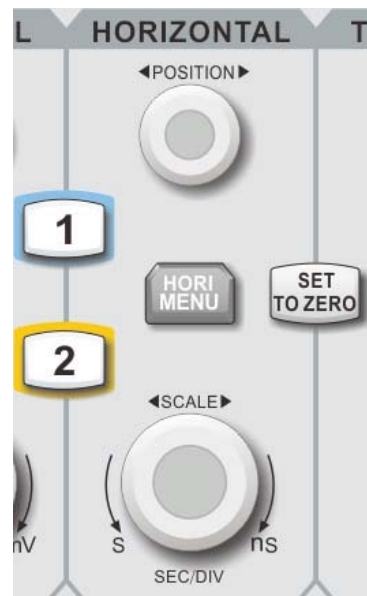
This section describes the front panel operations to help users to quickly familiarize with the UTD2000CEM series.

(1) Vertical Control



- ①. Press button to open or close the two channels display.
- ②. Press button to open the mathematical operations menu for add, subtract, multiply, divide, FFT, filtering, logic, and advanced operations.
- ③. Vertical Position Knob: Used to adjust the vertical position of the current channel waveform.
- ④. Vertical Scale Knob: Used to adjust the vertical scale of the current waveform. The vertical scale has 1, 2, and 5 steps.

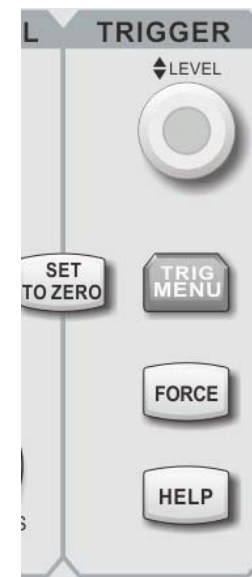
(2) Level Control



- ①. Press button to display window extension and holdoff time.
- ②. Horizontal Position Knob : used to adjust the horizontal position of the current channel waveform.
- ③. Horizontal Scale Knob : used to adjust the vertical scale of the current waveform. The vertical scale has 1, 2, and 5 steps.

7

(3) Trigger Control




- ① Trigger Level Knob : used to adjust the currently selected trigger level.
- ② Press to pop-up the trigger menu.
- ③ Press to force generate a single trigger event .
- ④ Press to display the built-in help information .
- ⑤ Press to center the trigger level, trigger position, and channel position simultaneously.


(4) 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.


(5).Run/Stop

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


(6).Single trigger

 Press this key to set up single trigger mode.

(7).Correction signal switching

 Long press the key to drive the correction signal to enter or leave the channel

(8).Screen copy

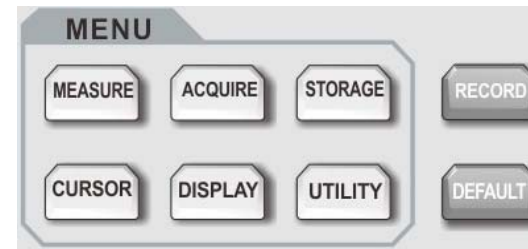
 Press this key to quickly copy the screen waveform to the USB storage device in BMP bitmap format









(9).Multipurpose Knob



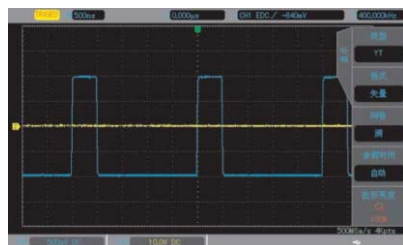
Multipurpose: During menu operations , turn the knob to select submenu, then press the knob to confirm the options .

(10).Function Keys



- ①  Measure setting key: can set measure source to all parameters, custom parameters and perform measurement statistics, select measurement indicators, etc.
- ②  Sampling setting key: set up acquisition mode and the storage depth .
- ③  Storage interface key: can select different types for storage and waveform, which can be stored internally or through USB device.
- ④  Cursor measurement key : can measure waveform's time and voltage manually with cursor.
- ⑤  Display setting key : used for the display settings such as display type, format, duration, grid brightness, and waveform brightness.
- ⑥  The utility key : can be used to choose 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, backlight brightness, output, etc.
- ⑦  Press this key to restore to factory default settings.
- ⑧  Press this key to open the waveform recording menu.

1.6 User interface



Display interface

- ①. Trigger status identification: include TRIGED , AUTO, READY, STOP, and ROLL
- ②. Indicates the amount of time represented by one square, which can be adjusted by the horizontal scale knob.
- ③. Shows the horizontal displacement, which can be adjusted by turning the horizontal position knob.
- ④. Displays trigger source, type, slope, coupling, level, etc.
 - a. Trigger Source: they are CH1, CH2, AC Line, EXT, etc.
 - b. Trigger types : edge, pulse width, video, slope, etc.
 - c. Trigger slope: rising, falling, and rising/falling. For example, is rising.
 - d. Trigger coupling: DC, AC, high frequency, low frequency and noise. For example, is DC coupling.
- ⑤. Hardware frequency meter: display the frequency information of current channel.
- ⑥. USB device Identification : This icon will be displayed when an USB storage device is connected.
- ⑦. Channel vertical status Identification: Displays channel activation state, channel coupling, bandwidth limit, vertical profile, and probe attenuation coefficient.
- ⑧. Sampling Rate/Acquisition Mode: Indicates the current sampling rate and storage depth.

Chapter 2 -Vertical Channel Setting

2.1 Open / activate / close analog channel

CH1~CH2 contains 3 states: open, activate, and shut down.

Open: Allows the corresponding channel waveform to be displayed on the screen.

Activate: Only opened state can be activated. In the active state, the vertical menu and the vertical control knobs (POSITION, SCALE) are available for changing activated channel setting. Any of the channels that has been opened but not been activated could be activated by pressing the corresponding channel keys

Shut down : No waveform appears on the display.

The table below describes the channel menu:

Functions	Options	Description
Coupling	DC	Pass AC and DC components of the input signal
	AC	Pass AC part of input signal only
	Ground	Displays ground signal
Bandwidth Limitation	Full bandwidth	Turns off bandwidth limit function
	20M	Limits bandwidth to 20MHz to reduce the noise.
Vertical Sensitivity	Coarse Adjustment	The vertical sensitivity of the current channel can be set to 1, 2, and 5 order.
	Fine Adjustment	Set Fine Adjustment to be within the coarse range. Set the channel's vertical sensitivity with 1% of the current amplitude value.
Probe		A value is automatically selected according to the probe's attenuation coefficient, to ensure consistency between the vertical profile readout and the displayed waveform.
Reverse Phase	Off	Normal waveform display
	On	Reverse waveform

2.2 Channel Coupling

Using CH1 as an example, when a signal is connected to CH1 and activated, press F1 and select channel coupling via the multipurpose knob. You can also switch to channel coupling by continuously pressing the F1 key. Press the multipurpose knob to confirm selection.

2.3 Bandwidth Limitation

When bandwidth limitation is open, the bandwidth of the oscilloscope is limited to about 20MHz, and attenuates any signal above 20MHz. It is commonly used to reduce the high frequency noise. When the bandwidth limit function is on, the BW logo will appear in the vertical state identification

2.4 Vertical Sensitivity

The vertical sensitivity is divided into coarse and fine adjustments.

In coarse adjustment, the sensitivity range is from 1mV/div ~ 20V/div, with 1 – 2 – 5 order.

For example: 10mV - >20mV - >50mV - >100mV

In fine adjustment, it is adjusted with 1% of the current amplitude value .

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

Note: div means square of the display area , one div(square) stands for one grid

2.5 Probe

In order to set the attenuation coefficient of the probe, the coefficient needs to be set up in the channel operation menu. If the probe attenuation coefficient is 10:1, the probe coefficient should then be set to 10X to ensure correct voltage reading.

The coefficients can be set to 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, and 1000X with 1 – 2 – 5 order.

2.6 Reverse Phase

When reverse phase is turned on, the waveform flips 180 degrees. A reverse phase logo will appear in the vertical state identification

Chapter 3 - Trigger System Setting

Trigger determines when the oscilloscope starts to collect data and displays waveform. Once the trigger is correctly set, it can convert unstable signals into meaningful waveforms. In the beginning of data acquisition, it collects enough data to compose the waveform starting at the left of the trigger point, and continues until the trigger condition is met.

3.1 Trigger System Interpretation

(1) Trigger Source

Trigger Source : a signal to be used to generate a trigger.

Triggers can be obtained from a variety of sources such as input channels (CH1, CH2), external trigger (EXT), Line AC, alternate trigger, etc.

- Input channel: Select any one of the analog signal input terminal (CH1,CH2) on the front panel of the oscilloscope as a trigger signal.
- 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 -3V~ +3V which can be set.
- AC Line : Power supply signal, used to observe the relationship between power signals such as lighting equipment and power supply equipment, to obtain stable synchronization.
- Alternate trigger: automatically turn on the independent time base after being selected .

(2) Trigger Mode

This oscilloscope provides three kinds of trigger modes: Auto trigger, Normal trigger, and Single trigger

- Auto trigger: When there is no trigger signal, the system automatically runs and displays data. When the trigger signal is generated, it automatically switch to trigger scanning and signal synchronization.

Note: This mode allows 50ms/div or slower time shift without triggering in ROLL mode.

- Normal trigger: The oscilloscope can only collect data when the trigger condition is satisfied. When it is not triggered, the oscilloscope will wait for the triggered signal.
- Single trigger : When the user presses the "run" button, the oscilloscope will wait for the trigger. When the instrument detects a trigger, the waveform is sampled and displayed, and enters the STOP state. Press the SINGLE button on the front panel of the oscilloscope to quickly enter the single trigger mode.

(3) Trigger Coupling

Trigger coupling determines which part of the signal will be transmitted to the trigger circuit. The coupled type includes DC, AC, low frequency, high frequency suppression, and noise suppression.

- DC : Pass all components of the signal
- AC: Blocks the DC component and attenuates any signal components below 10Hz.
- High frequency suppression: Attenuates high frequency components over 1MHz.
- Low frequency suppression: Blocks the DC component and attenuates low frequency components below 680 kHz.
- Noise suppression: Suppress high frequency noise in the signal, and reduces probability of error.

(4) Trigger Sensitivity

The minimum signal required to generate a correct trigger. For example, normally the input channel (CH1~CH2) trigger sensitivity is 1div, which means the signal should be at least 1 div.

(5) Pre-Trigger / Delayed Trigger

Data collected before / after the Trigger event.

Trigger position is usually set at the level center of the screen, and you can observe 7 grids of pre-trigger and delay trigger information. The horizontal displacement of the wave can be adjusted by the horizontal displacement position knob in order to observe more pre-trigger information.

(6) Forced Trigger

Press the FORCE key to generate a forced trigger signal.

If the waveform is not displayed in normal mode or single shot mode, press the FORCE button to collect signal baseline to ensure the acquisition is normal.

3.2 Edge Trigger

The signal can be triggered by the rising or falling edge.

Press the TRIG MENU to enter the trigger menu. Press F1 to select the trigger type, and select the edge trigger mode with the multipurpose knob.

The edge trigger menu descriptions :

Functions	Options	Descriptions
Type	Edge	
Sources	CH1, CH2	Set any one of the CH1,CH2 as a trigger signal
	EXT	Set external trigger as the source
	AC Line	Set AC line as trigger
	Alternate trigger	Set CH1, CH2 as alternate trigger source
	fall	Set the falling edge as the trigger signal
	Rise/fall	Set the rising and falling edge as the trigger signal
	DC	Pass all components of the signal
AC	Blocks the DC components of the signal	

Trigger Coupling	High frequency suppression	Suppression of signal frequency above 1.23MHz
	Low frequency suppression	Suppression of signal frequency below 680kHz
	Noise suppression	Suppress the noise of the trigger signal, trigger sensitivity is halved.
Trigger Mode	Auto	When the signal input is not triggered, the system automatically collects the waveform data and displays the scan baseline on the screen. When a trigger signal is generated, it automatically turns to the trigger scan.
	Normal	The data acquisition stops when the signal is not triggered.
	Single	Generates a trigger , and then stops
Slope	Rise	Set the rising edge of the signal as trigger
	Fall	Set the falling edge of the signal as trigger
	Rise/fall	Set the rising and falling edge of the signa as trigger

3.3 Pulse Width Trigger

Pulse width trigger can set the capture condition through the pulse width. Press the TRIG MENU button to enter the trigger menu. Press F1 to select trigger type, and select the Pulse Width Trigger mode with using the Multipurpose knob.

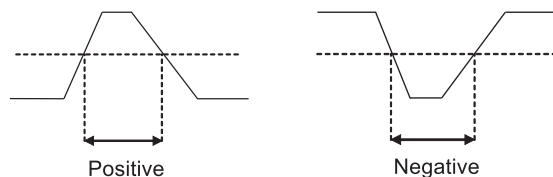
The pulse width trigger setting menu (1) :

Functions	Options	Descriptions
Type	Pulse Width	
Sources	CH1, CH2	Set any one of the CH1,CH2 as the trigger source
	EXT	Set external trigger as the trigger source
	AC Line	Set AC line as the trigger source
Trigger Coupling	DC	Pass all components of the signal
	AC	Blocks the DC components of the signal
	High frequency suppression	Suppression of signal frequency above 1.23MHz
	Low frequency suppression	Suppression of signal frequency below 680kHz
	Noise suppression	Suppress the noise of the trigger signal, trigger sensitivity is halved.
Trigger Mode	Auto	When the signal input is not triggered, the system automatically collects the waveform data and displays the scan baseline on the screen. When a trigger signal is generated, it automatically turns to the trigger scan.
	Normal	The data acquisition stops when the signal is not triggered.
	Single	Generates a trigger , and then stops
Pulse Width Setting		Enter settings page
Next Page		Enter Trigger Setting Menu (2)

The pulse width trigger setting menu (2) :

Functions	Options	Descriptions
Type	Pulse Width	
Pulse Width Polarity	Positive	Set positive pulse as trigger signal
	Negative	Set negative pulse as trigger signal
Pulse Width Condition	>	Triggered when the pulse width is greater than the setting time
	<	Triggered when the pulse width is smaller than the setting time
	=	Triggered when the pulse width is equal to the setting time
Pulse Width Setting	20.0ns~10.0s	The pulse width time can be set from 20.0ns~10.0s by using the Multipurpose knob

Pulse Width: The time difference between the trigger level of the positive pulse is defined as the positive pulse width, and the time difference between the trigger level of the negative pulse is defined as the negative pulse width, as shown in the following diagram.



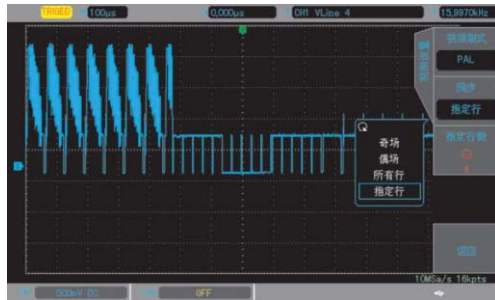
3.4 Video Trigger

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. UPO2000CEM provides the basic measurement functions, which can be triggered in NTSC, PAL, and other standard video formats.

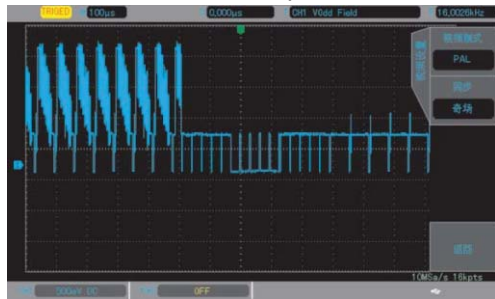
Press the TRIG MENU, Press F1 to select the trigger type, set to video trigger mode with using the Multipurpose knob.

The video trigger menu descriptions :

Functions	Options	Descriptions
Type	Video	
Source	CH1, CH2	Set any one of the CH1,CH2 as trigger source
rmat	PAL	Uses PAL format video signals
	NTSC	Uses NTSC format video signals
Video Sync	Even field	Set the video to sync and trigger on even field
	Odd field	Set the video to sync and trigger on odd field
	All lines	Set the video to sync and trigger on all lines
	Specific lines	Set the video to sync and trigger on specific lines
Specific Lines		When video sync is set at specific lines, using the multipurpose knob can adjust the number of lines: For PAL/SECAM: 1~625 lines. For NTSC: 1~525 lines



Video Line Sync



Video Field Sync

3.5 Slope Trigger

When slope trigger is selected, trigger occurs when the rising or falling slope value matches the value in settings.

Press the TRIG MENU, press F1 to select the trigger type, select slope trigger mode with using the Multipurpose knob.

Slope Trigger Menu

Functions	Options	Descriptions
Type	Slope	
Sources	CH1, CH2	Set any one of the Ch1, CH2 as trigger source
Trigger Coupling	DC	Pass all components of the signal
	AC	Blocks the DC components of the signal
	High frequency suppression	Suppression of signal frequency above 1.23MHz
	Low frequency suppression	Suppression of signal frequency below 680kHz
Trigger Mode	Noise suppression	Suppress the noise of the trigger signal, trigger sensitivity is halved.
	Auto	When the signal input is not triggered, the system automatically collects the waveform data and displays the scan baseline on the screen. When a trigger signal is generated, it automatically turns to the trigger scan.
	Normal	The data acquisition stops when the signal is not triggered.
	Single	Generates a trigger, and then stops
Slope Setting		Enters slope setting menu

Slope Setting Menu

Functions	Options	Descriptions
Slope	Falling	Triggers with falling slope
	Rising	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	20.0ns ~10.0s	Pulse width can be set in 20.0ns~10.0s range, Use the multipurpose knob to set time,
Threshold	Low	The slope of the low threshold level can be adjusted with the LEVEL knob
	High	The slope of the high threshold level can be adjusted with the LEVEL knob
	High and Low	The slope of the high and low threshold level can be adjusted with the LEVEL knob

3.6 Under-range Trigger Trigger

The Under-range Trigger occurs when a pulse crosses over one trigger level but not over the other one. Press the TRIG MENU button to enter the trigger menu. Press F1 to select trigger type and use the Multipurpose knob to select Under-range Trigger mode.

Under-range Trigger Menu (1):

Functions	Options	Descriptions
Type	Under-range	
Sources	CH1, CH2	Set any one of the Ch1, CH2as a trigger signal
Trigger Coupling	DC	Pass all components of the signal
	AC	Blocks the DC components of the signal
	High frequency suppression	Suppression of signal frequency above 1.23MHz
	Low frequency suppression	Suppression of signal frequency below 680kHz
Trigger Mode	Noise suppression	Suppress the noise of the trigger signal, trigger sensitivity is halved.
	Auto	When the signal input is not triggered, the system automatically collects the waveform data and displays the scan baseline on the screen. When a trigger signal is generated, it automatically turns to the trigger scan.
	Normal	The data acquisition stops when the signal is not triggered.
	Single	Generates a trigger, and then stops
Under-range Setting		Enters Under-range Trigger Menu (2)

Under-range Trigger Menu (2)

Functions	Options	Descriptions
Polarity	Positive Polarity	
	Negative Polarity	
	Irrelevant	
Condition	<	Triggers when set pulse width is less than under-range width
	>	Triggers when set pulse width is greater than under-range pulse width
	=	Triggers when set pulse width is equal to under-range pulse width
Time Setting	20.0ns~10ns	Use the multipurpose knob to set the pulse width time in 20.0ns~10.0s range
Threshold	Low	The slope of the low threshold level can be adjusted with the LEVEL knob
	High	The slope of the high threshold level can be adjusted with the LEVEL knob
	High and Low	The slope of the high and low threshold level can be adjusted with the LEVEL knob

3.7 Beyond-range Trigger

When beyond-range trigger is selected, a high and a low trigger levels are chosen. The trigger event occurs when the input signal is higher than the high trigger level, or lower than the low trigger level. Press the TRIG MENU button to enter the trigger menu. Press F1 to select trigger type, use the Multipurpose knob to select to beyond-range mode.

Beyond-range Trigger Menu (1):

Functions	Options	Descriptions
Type	Beyond-range	
Sources	CH1, CH2	Set any one of the Ch1, CH2as a trigger signal
Trigger Coupling	DC	Pass all components of the signal
	AC	Blocks the DC components of the signal
	High frequency suppression	Suppression of signal frequency above 1.23MHz
	Low frequency suppression	Suppression of signal frequency below 680kHz
	Noise suppression	Suppress the noise of the trigger signal, trigger sensitivity is halved.
Trigger Mode	Auto	When the signal input is not triggered, the system automatically collects the waveform data and displays the scan baseline on the screen. When a trigger signal is generated, it automatically turns to the trigger scan.
	Normal	The data acquisition stops when the signal is not triggered.
	Single	Generates a trigger , and then stops
Beyond-range Setting		Enters Beyond-range Setting Trigger Menu (2)

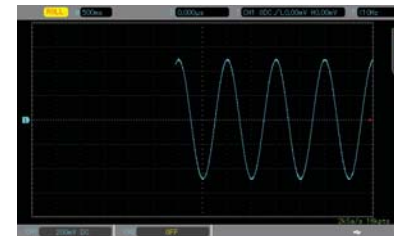
Beyond-range Setting Trigger Menu (2)

Functions	Options	Descriptions
Slope type	Rise	
	Fall	
	Rise /Fall	
Condition	Enter	Triggers when input signal enters trigger level range
	Return	Triggers when input signal leaves trigger level range
	Time	Triggers when time in trigger level mode matches the set time
Time setting	20.0ns~10.0s	Using the multipurpose knob to set the pulse width time in 20.0ns~10.0s range
Trigger Level	Low	The slope of the low threshold level can be adjusted with the LEVEL knob
	High	The slope of the high threshold level can be adjusted with the LEVEL knob
	High and Low	The slope of the high and low threshold level can be adjusted with the LEVEL knob

Chapter 4 - Horizontal System setting

4.1 ROLL mode

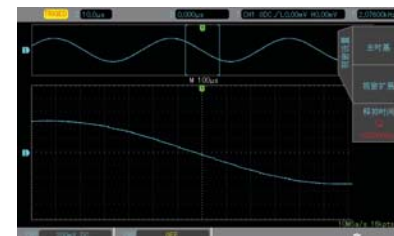
When the trigger is in automatic mode and using the SCALE knob to adjust the horizontal level to slower than 50ms/div, and the oscilloscope will be in ROLL mode. At this point, the trigger system will not work, the oscilloscope will be continuous on the screen to draw the waveform of the voltage - time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



ROLL Mode Waveform

4.2 Extended Window

Used to enlarge waveform, the extended waveform setting cannot be slower than main waveform setting.



Extended Window display

Press the button HORI MENU in the control panel. Press F1 to select the Extended Window . Under the Extended Window 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 knob horizontal POSITIONAL 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 knob horizontal SCALE 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.

4.3 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 Multipurpose knob to select trigger release.

Chapter 5 - Mathematical Operation

UTD2000CEM series oscilloscope carries a variety of mathematical operations:

- Math: Source 1+ source 2, source 1- source2, source 1* source 2, source 1/ source2
- FFT : Fast Fourier Transform
- Digital Filter

Press the MATH button to enter the mathematical operation menu. The POSITION and the SCALE knobs can be used to change the vertical position and the vertical profile of the mathematical operations. Under mathematical operations, the horizontal position cannot be independently adjusted, it will change automatically according to the analog input channel signals.

5.1 Mathematical Function

Press MATH button, then press F1 to choose the type (math)

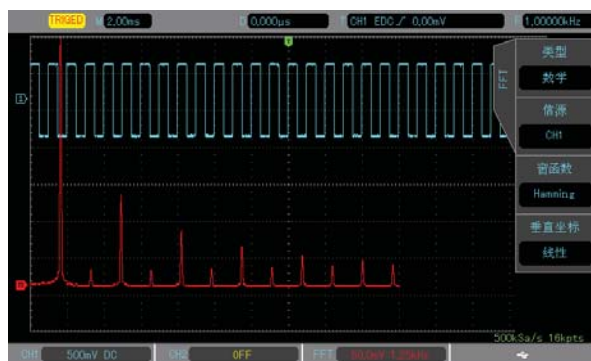
Math Menu

Functions	Options	Descriptions
Type	Math	
Source 1	CH1, CH2,	Set any one of the Ch1, CH2 as Math Source 1
Operator	+	Source 1 + Source 2
	-	Source 1 - Source 2
	*	Source 1 * Source 2
	/	Source 1 / Source 2
Source 2	Ch1,CH2	Set any one of the CH1, CH 2 as Math Source 2

5.2 FFT

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

- Harmonic content and distortion in measurement system
- Performance of noise in DC power supply
- Vibration Analysis



FFT frequency spectrum

Press MATH button, then press F1 to select FFT to enter the FFT menu. FFT menu

Functions	Options	Descriptions
Type	FFT	
Source	CH1, CH2	Set any one of the CH1,CH2 for FFT source
Window	Hamming	Use Hamming Window Function
	Blackman	Use Blackman Window Function
	Rectangle	Use Rectangle Window Function
	Hanning	Use Hanning Window Function
Vertical Unit	Vrms, dBVrms	Set vertical unit as linear or dB (log)

FFT Tips

Signals with DC components might cause mistakes or inaccuracies in FFT calculation. In order to reduce error, it is advised to set the channel to AC. In order to reduce interference or noise from isolated events, the capture mode can be set to average.

(1) Select Window Function

UTD2000CEM series provides 4 kinds of common window functions:

- Rectangle : The best frequency resolution and the worst amplitude resolution are similar to the condition of no window , suitable for measuring the following waveform:
 - a. Transient or short pulse, the signal level is approximately equal to the before and after
 - b. Constant amplitude sine wave with similar frequency
 - c. random noise with slow broadband spectrum
- Hanning : Compared with the rectangular window, it has better frequency resolution, but less range. It is suitable for measuring sine, periodic and narrow-band random noise.
- Hamming : Slightly better in the frequency resolution than the Hanning window, suitable for measuring transient or short pulse, large variance of before and after signals.
- Blackman : The best range resolution, the worst frequency resolution, it can be used to measure the single frequency signal, to find higher harmonics.

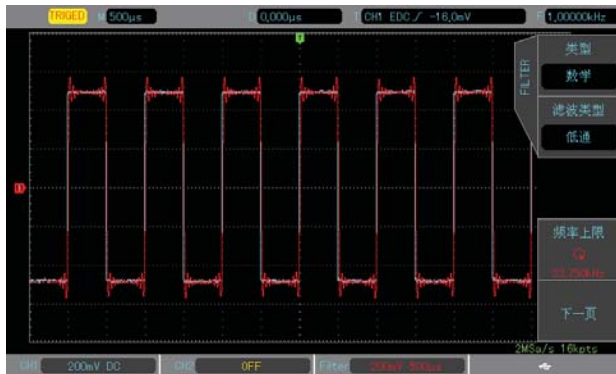
(2) Set Vertical Unit

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.

5.3 Digital Filter

Press MATH button, then press F1 to select digital filter to enter the menu. Digital Filter Menu

Functions	Options	Descriptions
Type	Digital Filter	
Filter Type	Low Pass	Set filter to low pass
	High Pass	Set filter to high pass
	Band Pass	Set filter to band pass
Frequency Lower Limit		Only valid in high pass or band pass; Use Multipurpose knob to modify lower limit value
Frequency Upper Limit		Only valid in low pass or band pass; Use Multipurpose knob to modify upper limit value
Source	CH1, Ch2	Set any one of the Ch1, CH2 for digital filter source
vertical displacement		Independently adjust the position of the filtered waveform
Horizontal displacement		Independently adjust the position of the filtered waveform



Digital Filter

Chapter 6 - Sampling System Setting

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

Sampling menu

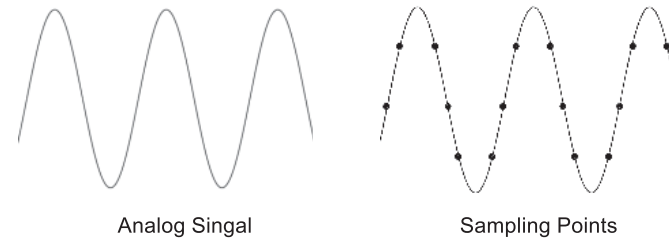
Functions	Options	Descriptions
Sampling Mode	Normal	Sampling in a normal manner
	Peak	Sampling with peak detection
	High Resolution	Sampling with a high resolution
	Average	Sampling in an average manner

Average	2~512	In average sampling mode, use Multipurpose knob to set average time, number can be in the range of 2n, where n is 1~13 integer
Storage Depth	Auto	Automatic storage depth
	32k	Set storage depth to 32kpts
	320k	Set storage depth to 320kpts
	3.2M	Set storage depth to 3.2Mpts
Fast sampling	OFF	
	ON	

6.1 Sampling Rate

(1) Sampling and Sampling Rate

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



Sampling rate refers to the time interval between two sampling points. The maximum sampling rate is 1 GS/s.

The sampling rate will be affected by the timing scale and the change of storage depth. UTD2000CEM oscilloscopes sampling rate is displayed in real-time at the top of the screen in the status bar. The horizontal SCALE knob can be used to adjust the horizontal timebase or modify the memory depth.

(2) Low Sampling Rate Effect

1. **Waveform Distortion:** Due to low sampling rate, the details of the waveform might be missing, the sampling waveform might be different than the actual signal
2. **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.
3. **Waveform Leakage:** Due to low sampling rate, the reconstructed waveform might not reflect the actual signal

6.2 Acquisition Mode

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

(1) Normal Sampling

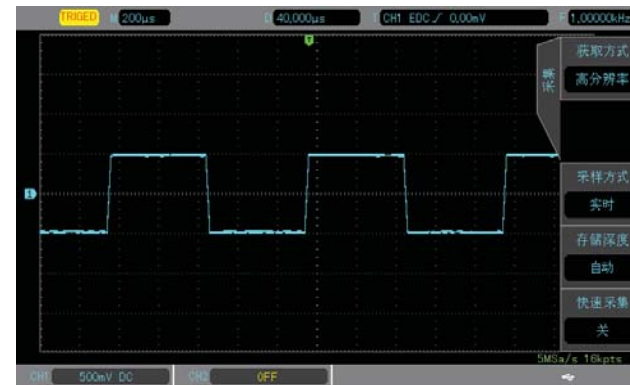
In this acquisition mode, the signal is sampled and reconstructed with equal time intervals. For most waveforms, the use of this mode can produce the best effect.

(2) 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 by 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.

(3) High Resolution

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

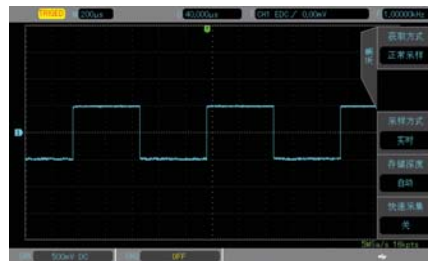


High Resolution mode to minimize noise from small signal

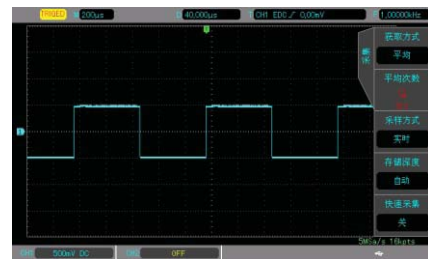
(4) Average

In this acquisition mode, the oscilloscope obtains several waveforms and finds the average, and displays the final waveform. This method can reduce random noise.

Via changing the acquisition mode settings, the resulting waveform display will be changed. The unaveraged and the 32 times averaged waveform are displayed below for comparison.



Unaveraged



32X Averaged

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

6.3 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. UTD2000CEM series' standard is 32 Mpts storage depth (per channel). Users can set up their own storage depth as automatic, 32k, 320k, 3.2M, and 32M.

Chapter 7 - Display System Setting

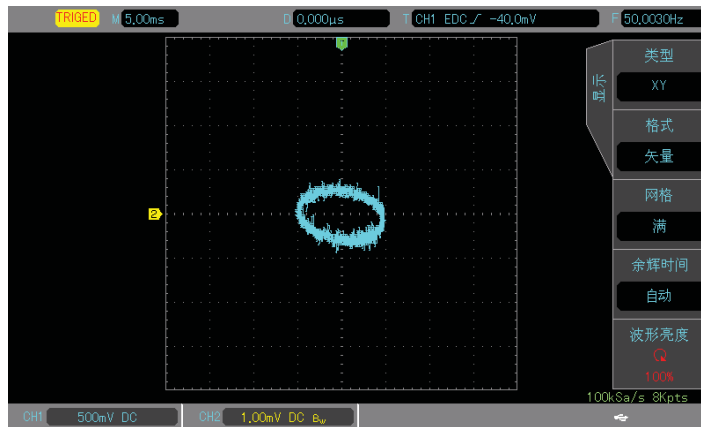
You can set the display type of the waveform, display format, duration, grid brightness, and waveform brightness. Press the DISPLAY key to enter the display menu.

Display menu

Functions	Options	Descriptions
Type	YT	Display level on time scale
	XY	Display Lissajous graph of CH1~CH2 waveforms
Format	Vector	Using lines to display between samples
	Point	Displays points directly
grid	Full	
	Grid	
	Crosshair	
	Frame	
Afterglow time	Automatic	waveform on screen refreshes with normal refresh rate
	Short afterglow Long afterglow	The waveform data on the screen refreshes after specified time
	Infinite persistence	The waveform data on the screen is maintained until the function is off
Waveform Brightness	1%~100%	Set the waveform brightness, Use Multipurpose knob to adjust settings

7.1 XY Mode

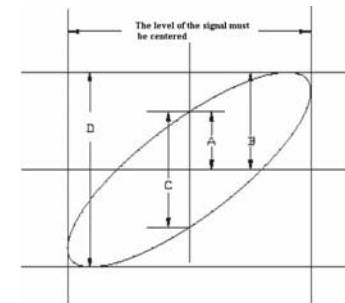
The XY mode display is also called Lissajous graph. When XY 1&2 are selected, the CH1 signal will be entered on the horizontal axis (X), and the CH2 on the vertical axis (Y). In X-Y mode, when CH1 is activated, use the horizontal POSITION knob to adjust the graph horizontally. When CH2 is activated,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



XY Display Mode

7.2 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 $\sin\theta = A/B$ 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 $\theta = \pm \arcsin(A/B)$ or $\theta = \pm \arcsin(C/D)$. 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 $(\pi / 2)$ or $(3 \pi / 2)$ to 2π . If the principal axis of an ellipse in II, IV quadrant, then the phase angle should be $(\pi / 2)$ to π or π to $(3 \pi / 2)$. 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 .

Chapter 8 - Automatic Measurement

UTD2000CEM series digital fluorescence oscilloscope can automatically measure up to 34 parameters. Press the MEASURE button to enter the automatic measurement menu.

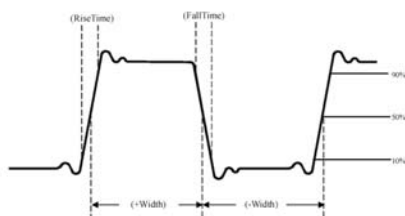
Automatic Measurement menu

Functions	Options	Descriptions
All Parameters	Off	Close all Parameters
	On	Pop-up a frame with all parameters presenting
User Defined	On/Off	Open/Close menu for user defined parameters. When it is on, define all required parameters with using the Multipurpose knob.
Indicator	Off	Real-time dynamically indicates measurement parameters
	Parameter 1~5	
Advanced measurement		Enter advanced measurement menu
Measurement statistics	Off	Turn off the feature
	On	Automatic calculation of user defined parameters of average, max, and min. Only applicable when user defined parameters are present.
Reset statistics		Restart statistics
Clear		Clear all measurement

Advanced measurement menu

Functions	Options	Descriptions
Measurement parameters	Delay	Delay measurement
	Phase	Phase measurement
Source	CH1-CH1 CH1-CH2	
	CH2-CH1 CH2-CH2	
edge		FRR : time between the first rising edge of source 1 and the first rising edge of source 2 FRF : time between the first rising edge of source 1 and the first falling edge of source 2 FFR : time between the first falling edge of source 1 and the first rising edge of source 2 FFF : time between the first falling edge of source 1 and the first falling edge of source 2 LRF : time between the last rising edge of source 1 and the last edge of source 2 LRR : time between the last rising edge of source 1 and the last rising edge of source 2 LFR : time between the last falling edge of source 1 and the last rising edge of source 2 LFF : time between the last falling edge of source 1 and the last falling edge of source 2

8.3 Timing parameters



Timing Parameter

- Period: The duration of one cycle of a repetitive waveform
- Frequency: The reciprocal of the period
- Rise time: The time it takes the waveform amplitude to increase from 10% to 90%
- Fall time: The time it takes the waveform amplitude to decrease from 90% to 10%
- +Width: The width of a positive pulse at 50% amplitude
- -Width: The width of a negative pulse at 50% amplitude
- +Duty: The ratio of positive pulse width to period
- -Duty: The ratio of negative pulse width to period

8.4 Delay parameters

- FRR: Time between the first rising edge of source 1 to the first rising edge of source 2
- FRF: Time between the first rising edge of source 1 to the first falling edge of source 2
- FFR: Time between the first falling edge of source 1 to the first rising edge of source 2
- FFF: Time between the first falling edge of source 1 to the first falling edge of source 2

- LRF: Time between the last rising edge of source 1 to the last falling edge of source 2
- LRR: Time between the last rising edge of source 1 to the last rising edge of source 2
- LFR: Time between the last falling edge of source 1 to the last rising edge of source 2
- LFF: Time between the last falling edge of source 1 to the last falling edge of source 2

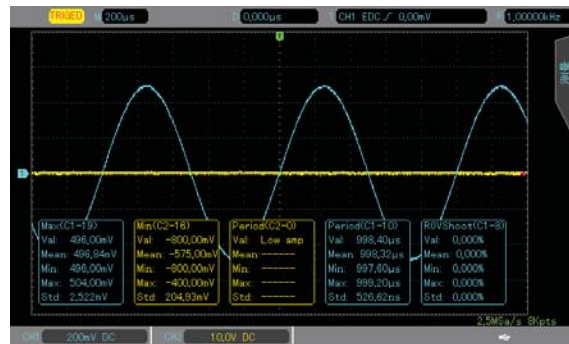
8.5 User defined parameters

Press the MEASURE button to enter the automatic measurement menu. Takes the current activation channel as the source of measurement. The user defined parameter selection interface can be chosen by F2.



User Defined Parameter Selection

Adjust the parameters with the multipurpose knob, press the Multipurpose knob button to confirm selection. For every selected parameter, a * symbol will appear in front of the parameter. Press F2 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.



Open the D-value measurement statistics after defining parameter

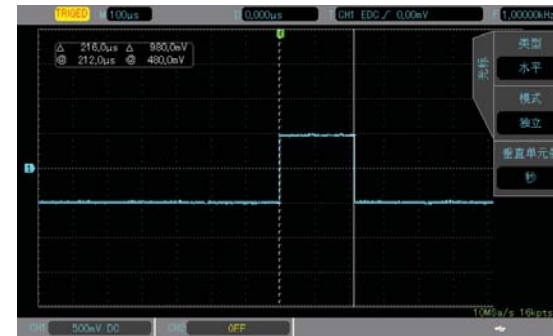
Chapter 9 - Cursor Measurement

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.

9.1 Time Measurement

Press the CURSOR key to enter the cursor measurement menu, then press F1 to select the type to time.

- Press F2 to set the pattern to independent.
- The Multipurpose knob can adjust the vertical cursor AX, press the multipurpose knob to switch to cursor BX.



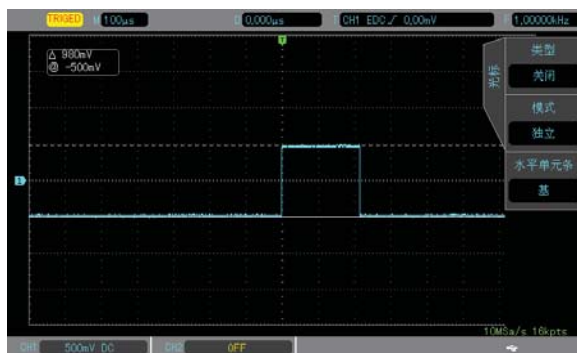
The measured values are shown in the upper left corner of the waveform display area. The value of BX-AX is the time measurement, and $1/|BX-AX|$ is the reciprocal of time.

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. The voltage value can also be displayed at cursor's current position. That is AY, BY, and BY-AY. The Multipurpose knob can be used to adjust the BX and AX positions when setting is set to trace mode with using the F2 key.

9.2 Voltage Measurement

- The method for voltage measurement is similar to the method for time measurement, only that the vertical cursor becomes the horizontal cursor.
- Press the CURSOR key to enter the cursor measurement menu, then press F1 to select the type as voltage.
- Press F2 to set the pattern to independent

The Multipurpose knob can be used to adjust the horizontal cursor AY on the screen, press the Multipurpose knob to switch to cursor BY. The value of BY-AY is the voltage measurement (V). When the setting is set to trace mode with using the F2 key, the Multipurpose knob 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.

Chapter 10 - Storage and Callback

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. UTD2000CEM series oscilloscope supports FAT format USB storage devices. It is not compatible with NTFS format.

10.1 Storage Setting and Callback

Press STORAGE button, then press F1 to select the type of settings, then to enter the storage menu
Settings for the storage menu.

Functions	Options	Descriptions
Type	Storage Setting	
Source	CH1,CH2	
Disk	DSO	Data will be saved on the oscilloscope
	USB	Data will be saved on USB drive
Save		Saves settings to selected disk
Callback		Call back previously saved settings, returns the oscilloscope to the previously saved setting state

Remarks

- Oscilloscope can only select USB device when U disk or other external storage devices are plugged in.
- Callback only works when previously saved disk and the file name are consistent, or else it will fail to load.

10.2 Waveform Storage and Callback

Press the STORAGE button, then press F1 to set the type of waveform , then to enter waveform storage menu.
Waveform storage menu.

Functions	Options	Descriptions
Type	Waveform Storage	
Source	CH1, CH2	Select waveform storage source from any one of CH1,CH2
Disk	DSO	When Save is pressed, waveform will be saved to the oscilloscope
	USB	When Save is pressed, waveform will be saved to external USB device
Save		Saves the waveform to selected disk
Callback		Enter the REF menu for the details

After the waveform is saved, you can use the REF key for callback. Press the REF key to enter the waveform callback menu.

Waveform Callback Menu

Functions	Options	Descriptions
Type	RefA、RefB	
Disk	DSO	When Save key is pressed, waveform will be saved to the oscilloscope
	USB	When Save key is pressed, waveform will be saved to external USB device
Callback		Callback previously saved waveform and display 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.

10.3 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.

Chapter 11- Auxiliary Function Setting

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

Auxiliary function setting menu (1)

Functions	Options	Descriptions
System configuration		Enter system configuration page
Interface configuration		Enter interface configuration page
Pass test		Enter pass test page
Wave record		Enter wave record page
1/3		Enters Auxiliary function setting menu (2)

Auxiliary function settings menu (2)

Functions	Options	Descriptions
Measurement unit	V/A	
AUTO strategy		Enter AUTO strategy page
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 is not valid for the other trigger type .

Auxiliary function settings menu (3)

Functions	Options	Descriptions
Recorder		Enter recorder page
waveform generator		Enter waveform generator page
Square wave output	1Hz/10Hz/100Hz/ 1kHz/10kHz/100kHz	Set up frequency of reference waveform
System Upgrade		Enter oscilloscope software update page

11.1 System configuration

System configuration menu (1)

Functions	Options	Descriptions
Self calibration		press the Select key to start the self calibration
System information		prompting the system name and version
Clean information		press the Select key to clean up
Time setup		Enter time setup page
Next page		Enter next page

System configuration menu (2)

Functions	Options	Descriptions
Factory settings		pop-up default dialog box, press the select key to start
Contrast ratio		Use Multipurpose to adjust the screen contrast ratio, Max 100
Screen protection	Close 1 minute 5 minutes 10 minutes 30 Minutes	Select whether to open the screen saver, if opened, the screen will be closed when the set - time arrives, Press any key to restore.
Return		Return UTILITY root directory

Time menu setting

Functions	Options	Descriptions
Time display	On/Off	Control display
Minute &hour		Selected via the F2 button, use Multipurpose key to adjust
Date&month		Selected via the F3 button, use Multipurpose key to adjust
Year		Selected via the F4 button, use Multipurpose key to adjust
Confirm		Make the modification to be valid

11.2 interface configuration

Functions	Options	Descriptions
Language	Simplified Chinese English Traditional Chinese	
Menu display	Manual 2s, 5s, 10s, 20s	Control the display /hide time of the side bar menu
Grid brightness		Use Multipurpose key to modify the display brightness of the grid, the highest 32
Return		

11.3 Pass Test

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

(1) Function Introduction

Press UTILITY, then press F5 to enter the secondary menu, then press F2 to enter the test menu.

Pass Test Menu (1)

Functions	Options	Descriptions
Allow Test	Close	Close Pass Test
	Open	Open Pass Test
Output	Fail	Set the Pass/Fail interface on the rear panel : output pulse signal and produce buzzing when "failure"
	Pass	Set the Pass/Fail interface on the rear panel : output pulse signal and produce buzzing when "pass"
Source	CH1、CH2	Set the source of the pass test
Display Info	Close	Turn off display information
	Open	Turn on display information
1/2		Enter Pass Test Menu (2)

Pass Test Menu (2)

Functions	Options	Descriptions
Operation	Close	Disable Pass Test
	Open	Enable Pass Test
Stop Setting		Enters Stop Settings Menu
Template Setting		Enters Template Settings Menu
2/2		Return to Pass Test Menu (1)

After opening the pass test, you need to set the stop settings and template settings before you can perform the test function. Otherwise you'll be prompted "Function is Disabled". The stop setting and template settings menus are shown as below.

Stop settings menu

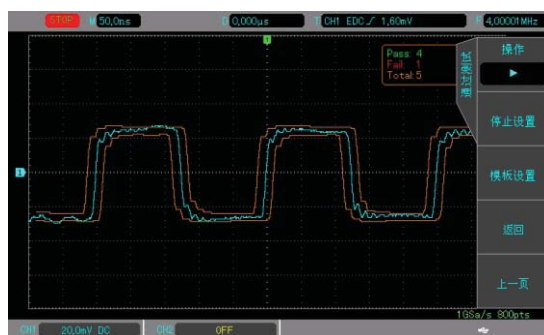
Functions	Options	Descriptions
Stop Type	Pass Count	The test function stops after it reaches a specified pass count number
	Fail Count	The test function stops after it reaches a specified fail count number
Condition	>=、<=	Stop condition setting
Threshold		Use the multipurpose knob to select stop condition threshold
Return		Return to previous menu

Template settings menu

Functions	Options	Descriptions
Reference Waveform	CH1,CH2	Select a channel CH1,CH2 with horizontal and vertical tolerance as a template
Horizontal Tolerance	1~255	Use the multipurpose knob to select the horizontal tolerance
Vertical Tolerance	1~255	Use the multipurpose knob to select the vertical tolerance
Create Template		Create template with above conditions
Return		Return to previous menu

(2) Application Example

Input 1kHz, 3V square wave from CH1, observe the result of the pass test:



Pass Test

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

- ① To enter the test menu: Press UTILITY, then press F5 to enter auxiliary menu second page, then press F2 to enter the test menu.
- ② Set the test: press F1 to enable the test set
- ③ Set the source: press F3 to set the source to CH1
- ④ Template settings: press F5 to enter the next page, then press F3 to enter the template settings menu. Press F1 to select the reference waveform to CH1; press F2 and F3, set the level threshold with the multipurpose knob to 10, set the vertical threshold to 5, then press F4 to create a template, press F5 to return to the test menu
- ⑤ Stop setting: press F2 to enter stop setting menu, set the stop type to pass count, and set the threshold to 10 with multipurpose knob, press F5 to return to the test menu
- ⑥ Set the output conditions: press F5 to return to the first page of the test menu, set the output condition to 'fail' using the F2 key
- ⑦ Open display information: press F4 to set display information to open
- ⑧ Start test: press F5 to enter the second page of the test menu, then press F1 to open the operation to start the test. See figure below:

11.4 waveform record

Press UTILITY, then press F5 to enter the secondary menu, then press F1 to enter the waveform record menu .

Waveform record menu

Functions	Options	Descriptions
Waveform record operation	Close	Close waveform record function
	Setup	Enter waveform record menu
	Operation	Enter waveform record operation

Press F1 to select the waveform record operation and set waveform record parameters

Waveform record menu

Functions	Options	Descriptions
Record operation	Setup	Set up the record parameters
Resource	CH1,CH2,CH1&CH2	Select the record channel
Length of record	Normal	Record the actual acquisition depth waveform
	Screen	Recording screen waveform
Interval of record	10ms~1000s	Set the delay between each frame while playing
End frame	4000/8000	Show maximum number of frames that can be recorded (maximum number of frames will change according to the current storage depth)

After setting up the record parameter , Press F1 to select the waveform record operation and perform the waveform record .

Waveform record operation menu :

Functions	Options	Descriptions
Record operation	Operate	Recording, playback, stop, etc..
Playback		Playback of recorded waveform
Stop		Stop recording or playing back waveform
Record		Perform recording waveform
Quick record		Quickly perform recording waveform (unable to view the current record waveform)

11.5 AUTO strategy

Auto strategy opration menu :

Functions	Options	Descriptions
Channel setting	Lock / open	allow if automatically modifying channel settings
Sample setting	Lock / open	allow if automatically modifying sample settings
Trigger setting	Lock / open	allow if automatically modifying trigger settings
Signal recognition	Lock / open	allow if automatically identifying the closed channels

11.6 Recorder

Recorder operation menu

Functions	Options	Descriptions
Run		Pay back the record datas
Stop		Stop recording
Record		Start to record
Setup		Enter record setting menu

Recorder setting menu

Functions	Options	Descriptions
Coarse / fine adjustment		When Playback, Use Multipurpose key to control step size
Interval		Use Multipurpose key to adjust the time , Max up to 1000s
Playback mode	Point by point frame by frame	the playback mode Piont or Frame
Cycle playback	On /Off	

11.7 Waveform generator

Waveform generator menu (1)

Functions	Options	Descriptions
Output	On/Off	Turn on /off AWG output
waveform	sine wave square wave Sawtooth wave Triangular wave Pulse wave	To select the base waveform
Setup		Enter the parameter menu setting

Waveform generator menu (2)

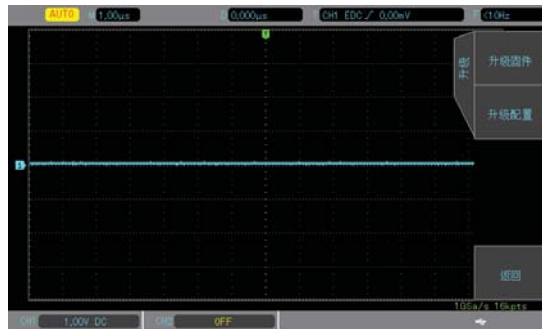
Functions	Options	Descriptions
frequency		Use Multipurpose key to adjust signal frequency
amplitude		Use Multipurpose key to adjust signal amplitude
Shifting		Use Multipurpose key to adjust signal Shifting
Pulse width /duty cycle/ symmetry		Modify Pulse width for pulse signal, Modify duty cycle for square wave signal, Modify symmetry for sawtooth wave

11.8 System Upgrade

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

- ① Press UTILITY to enter the auxiliary function menu, press F1 to view system information, access the machine's model number, software, and hardware version information.

- ② Software upgrade file can be found on UNI-T website or UNI-T distributors. Software file is consistent with the machine model and hardware version. Software version higher than the current version is stored in the root directory of U disk.
- ③ Insert USB disk, press UTILITY to enter the auxiliary function menu, press F1 to select system to be upgraded. Press SELECT to confirm



- ④ Upgrade process takes different time based on different contents to be upgraded. After the upgrade, system will automatically restart in order to complete the upgrade.
Note: please make sure that the power supply is on throughout the upgrade process in order to avoid the incomplete upgrade. If the system is not completely upgraded, it might not be able to restart.

Chapter 12- Other Function Keys

12.1 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.

- 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

12.2 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, indicating 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. Press RUN/STOP key to switch run/stop state.

12.3 Factory Setting

By pressing the DEFAULT button, you can quickly restore to factory settings. UTD2000CEM series oscilloscope factory settings are as below:

System	Function	Factory Setting
Vertical System	CH1	1V/DIV
	Vertical Displacement	0
	Coupling	DC
	Bandwidth Limit	Off
	Lattice	Coarse
	Probe	1×
	Reverse	Off
	Bias Voltage	Off
	CH2	Off
	MATH、REF	Off
Horizontal System	Extended Window	Off
	Horizontal Timebase	1μs/div
	Horizontal Displacement	0
Trigger System	Hold Time	100.00ns
	Trigger Type	Edge
	Source	CH1
	Slope Type	Rising
	Coupling Mode	DC
	Trigger Mode	Auto

	Type	Vector
Display	Format	YT
	Duration Time	100ms
	Grid Brightness	50%
	Waveform Brightness	60%
Other System	Storage Type	Waveform
	Frequency Meter	Off
	Measurements	Off, Clears all measurements
	Cursor	Off
	Language	Keep current
	Menu Display	Manual
	Square wave output	1kHz
	Backlight brightness	100%
	Output selection	Trigger

Chapter 13- System prompt and Troubleshooting

13.1 System Information Description

Operation at limit : In the current state, adjustment has reached the limit and cannot continue. When the vertical scale knob, timing knob, level shift, vertical shift or trigger reaches adjustment limit, the display will show up.

USB device is not inserted: When the USB storage device is not connected to thoscilloscope.

Load Failed : When the location did not store the setting or waveform needed.

13.2 Trouble shooting

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

- ① Check the power supply connection
- ② 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
- ③ If there is a sound, it indicates that the oscilloscope is activated. Try the following operation: press DEFAULT key, then press F1 key, if device return to normal, it means backlight brightness is too low
- ④ After completing the above steps, restart the oscilloscope.
- ⑤ If you still cannot solve this problem, please contact UNI-T and let us serve you.

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

- ① Check if the probe is connected to the signal test point
- ② Check if the signal line is connected to the analog channel input
- ④ Check the input signal of the analog channel and that channel is open
- ⑤ Make sure that the probe is connected to the compensation piece and check whether the probe is normal
- ⑤ Check to see if there is a signal to be detected
- ⑥ Press AUTO button for signal re-acquisition

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

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

(4) There is a waveform but not stable:

- ① Check the trigger source in the trigger menu and confirm that the signal and channel are consistent

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

③ Try changing the trigger coupling to high frequency or low frequency in order to suppress or remove noise caused by interference

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

① 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, center the trigger level or set the trigger mode to auto with the AUTO key

② Press the AUTO button to complete the above settings

(6) Waveform refresh rate is too slow:

① Check whether the acquisition mode is set to average, and the number of average is too big

② You can speed up the refresh rate by reducing the average times or select other methods such as normal sampling

Chapter 14- Technical specification

Aside from specification labeled "typical", all specifications are guaranteed. Unless otherwise stated, all technical specifications are applicable to probe attenuation 10X and with UTD2000CEM series oscilloscope.

Oscilloscope must first meet the following two conditions in order to achieve these standards:

- The instrument must be operated at the specified operating temperature for more than thirty minutes.
- If the operating temperature exceeds 5 degrees Celsius from normal operating temperature, self calibration needs to be performed.

Input		
Input Coupling	DC, AC, GND	
Input Impedance	1MΩ ± 1% // 20pF ± 3pF	
Probe Attenuation Coefficient	1m×, 2m×, 5m×, 10m×, 20m×, 50m×, 100m×, 200m×, 500m×, 1×, 2×, 5×, 10×, 20×, 50×, 100×, 200×, 500×, 1000×	
Maximum Input Voltage	CAT I 300 Vrms, CAT II 100 Vrms, Transient Overvoltage 1000 Vpk	
Horizontal		
Timing Scale	5ns/div ~ 50s/div (1-2-5 base)	
Timing Accuracy	≤ ±(50+ 2×Service Life)ppm	
Delay	Pre-trigger (Negative Delay): ≥1 Screen Width Post-trigger (Positive Delay): 1 s~50 s	
Timebase	YT,XY,ROLL	
Vertical		
Model	UTD2102CEM	UTD2072CEM
Bandwidth	100MHz	70MHz
Rise Time (Typical)	≤3.5ns	≤5ns
Channels	2	2

Vertical Resolution	8bit
Vertical Scale	1mV/div~20 V/div(1-2-5 base)
Vertical Displacement Range	±8div
Bandwidth Limit (typical)	20MHz
Low Frequency Response (AC coupling, -3dB)	≤5 Hz (on BNC)
DC Gain Accuracy	Sampling or average sampling method) <5 mV: ±4% ≥5 mV: ±3%
DC Offset accuracy	≤ ±4% (Sampling or average sampling method)
Channel Separation	DC to maximum bandwidth : >40 dB
Sampling	
Sampling	Teal-time Sampling , Equivalent sampling
Real-time Sampling Rate	1GS/s(Single Channel), 500MS/s(Dual Channel),
Acquisition Mode	Sampling, peak detection, high resolution, envelope, and average
Average Value	After all channels reach N times sampling, N times in 2,4,8,16,32,64,128,256,512
Waveform Interpolation	sin(x)/x
Storage Depth	Auto, 28kpts, 280kpts, 2.8Mpts, 28Mpts

Trigger	
Trigger Level Range	Internal: Center of the screen ± 15 grids External: ± 6V
Trigger Mode	Automatic, normal, single
Trigger Holdoff Range	100ns~10s
High Frequency Suppression	1.23MHz
Low Frequency Suppression	680kHz
Noise Suppression	Reduce Noise Waveform (10 mV/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	20ns ~ 10s
Under-range Pulse Trigger	
Pulse Condition	>, <, >>
Polarity	Positive, negative
Pulse Width Range	20ns~10s

Beyond-range Pulse Trigger		
Beyond-range type	Rising, falling, any	
Trigger Position	Entering, exiting, time	
Beyond-range time	20ns~10s	
Slope Trigger		
Slope Condition	Positive slope (greater than, less than, specified range)	
	Negative slope (greater than, less than, specified range)	
Time Setup	20ns~10s	
Video Trigger		
Signal System Frequency Range	Supports NTSC, PAL, rows range is 1~525 (NTSC) and 1~625 (PAL/SECAM)	
Measure		
Cursor	Manual	Voltage between cursors (ΔV) Time between cursors (ΔT) Frequency (Hz) ($1/\Delta T$)
	Trace Mode	Voltage and time at waveform point
	Indicator	Allows auto display of cursor

Auto Measurement	The maximum value, minimum value, peak value, top value, amplitude, period average value, average value, cycle RMS, RMS, area, period area, overshoot, preshoot, rising, falling, frequency, period, rise time, fall time, pulse width, positive pulse width, negative pulse width, burst pulse width, positive duty cycle, negative duty cycle, phase, FRR, FRF, FFR, FFF, LRR, LRF, LFR, LFF, etc. total quantity of 34 measurement parameters
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	Hardware 6 bit frequency meter
Mathematical Operations	
Waveform Calculation	A+B, A-B, A×B, A/B, FFT
FFT Window Type	Rectangle, Hanning, Blackman, Hamming
FFT Display	Split screen; time base can be adjusted independently
FFT Vertical Scale	Vrms, dBVrms
Digital Filter	Low pass, High pass, Band pass
Storage	
Setting	Internal (20), External USB
Waveform	Internal (20), External USB

Bitmap	External USB
Display	
Display type	8-inch TFT LCD
Display Resolution	800 horizontal ×480 vertical (RGB)
Display Color	160,000,000
Duration	Auto / Short afterglow / Long afterglow / Infinity
Menu Duration	1s, 2s, 5s, 10s, 20s, manual
Display Type	Point, Vector
Interface	
Standard/ Optional	Standard : USB-OTG, Pass/Fail interface Optional : USB-LA Logic analyzer (UT-M09) Waveform Generator (UT-M11) DMMs

General Technical Specifications

Probe compensated signal output	
Output Voltage	3Vp-p
Frequency	10Hz, 100Hz, 1kHz(default), 10kHz, 100kHz

Power Supply	
Power Supply Voltage	100V~240VACrms
Frequency	50Hz~60Hz
Fuse	3A, T level, 250V
Environment	
Temperature Range	Operational : 0°C~+40°C
	Non-Operational : -20°C~+70°C
Cooling	Forced cooling fan
Humidity range	Operational : below +35°C ≤90%Relative humidity
	Non-operational : +35°C~+40°C ≤60%Relative humidity
Altitude	Operational : Below 3000m ;
	Non-operational : Below 15,000m
Mechanical Specifications	
Size	336mm(W)×164mm(H)×108(D)mm
Weight	3.5kg
Maintenance Period	
Recommend to perform calibration once a year	

Chapter 15 - Appendix

Appendix A – Accessories and Options

MODE	UTD2072CEM
	UTD2102CEM
Standard accessories	Power line meets local country standard
	USB data cable
	2 sets of passive probes (100MHz)
	Quick guide
	CD (Includes manual and application software)

For all accessories (standard and optional), please order at UNI-T local dealers

Appendix B – Maintenance and Cleaning

(1) General Maintenance

Do not store or place the instrument and liquid crystal display in direct sunlight. Caution: do not spray liquid or solvent on the instrument or probe.

(2) Clean

Refer to the operating conditions of the instrument and probe and perform frequent checks. Clean the outer surface of the instrument according to the following steps:

Please use a soft cloth to wipe the dust off probes and the instrument.

When cleaning the LCD screen, please pay attention and protect the LCD screen.

Please disconnect the power supply, then with a damp but not dripping soft cloth, wipe the instrument.

Do not use any chemical abrasive cleaning agent on the instrument or probes.

Warning: Please confirm that the instrument is completely dry before use, to avoid damage caused by electrical short circuit caused by moisture.

Appendix C Warranty Overview

UNI-T (Uni-Trend Technology (China) Ltd.) ensures the production and sale of products, from authorized dealer's delivery date of three years, without any defects in materials and workmanship. If the product is proven to be defective within this period, UNI-T will repair or replace the product in accordance with the detailed provisions of the warranty.

To arrange for repair or acquire warranty form, please contact the nearest UNI-T sales and repair department.

In addition to permit provided by this summary or other applicable insurance guarantee, Uni-T does not provide any other explicit or implied guarantee, including but not limited to the product trading and special purpose for any implied warranties. In any case, UNI-T for indirect, special, or consequential loss does not bear any responsibility.

Appendix D Contact Us

If the use of this product has caused any inconvenience, you can contact Uni-Trend Technology (China) Limited directly in mainland China:

Between 8:30am to 5:30pm Beijing time, Friday to Monday

Products from regions outside of China, please contact your local UNI-T dealer or sales center.

Many of the products that support UNI-T have an extended the warranty period plan and a calibration period, please contact your local UNI-T dealer or sales center.

To obtain the address list of our service centers, please visit our website at URL: <http://www.uni-trend.com>

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