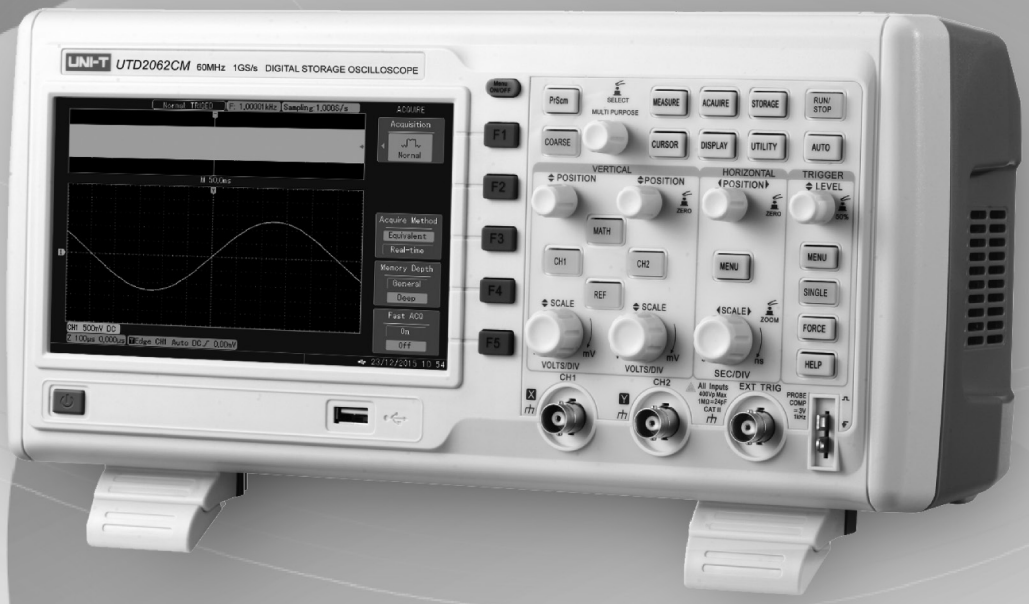
UNI-T®

UTD2000M

Operating Manual



Digital Storage Oscilloscope

Preface

Dear Users,

Thank you for purchasing UNI-T product. To operate this instrument correctly, please read this Manual, especially its “Safety Information” carefully before use.

In case you have read it, it is recommended that you keep this manual properly along with the instrument or place it in another accessible location for possible future use.

If the original purchaser resells or transfers this product to any third party within 3 years since the date of purchase, then the warranty period shall be 3 years starting from the date such product is purchased from UNI-T or its authorized distributor. Probe, fuse and other accessories are not subject to this warranty.

If the product is proved to be defective during the applicable warranty period, UNI-T may, at its discretion, determine either to repair it without charging the cost for parts and labor or replace it with an equivalent product (at our discretion). The parts, modules or replacements that are used for warranty purpose can be brand new ones or repaired but functionally equivalent to new products. All replaced parts, modules or products are properties of UNI-T.

The users hereinafter referred to in this Manual are individuals or entities having rights expressively stipulated in this warranty. In order to have the promised service under this warranty, users must report defect to UNI-T within the applicable warranty period, including making proper arrangement for the performance of such service. The users shall be responsible in packaging the defective product and delivers it to a maintenance center assigned by UNI-T with freight prepaid and provision of the duplicate of the original Certificate of Purchase owned by the original purchaser. If the product is to be delivered to a place within the boundary of the country, where our maintenance center is located, UNI-T shall pay the cost incurred in returning the product to the users. However, if such product has to be returned to any other place, the users shall pay all the freight, tariff, tax or any other expense.

This warranty is not applicable to any defect, failure or damage caused by accident, normal wear of parts, use of product in such applications which are beyond the scope of use for such product, improper use or improper or insufficient maintenance or service. According to this warranty, UNI-T is not obliged to provide any of the following services:

a) Repair any damage caused by installation, repairing or maintenance unless it is conducted by an authorized service representative;

b) Repair any damage caused by improper use or connection with any incompatible equipment;

c) Repair any damage or failure caused by the use of a power which is not provided by UNI-T.

d) Repair modified or product that has been integrated into other product (if such modification or integration may increase the time spent to repair or make it difficult to repair).

This warranty is drafted by UNI-T for the use of the product only and is buyer's sole and exclusive remedy which is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. UNI-T or its authorized distributor shall not be liable for any special, indirect, incidental or consequential damages or losses, regardless of whether or not they have been notified of such possibilities.

General Safety Precautions

The Generator is strictly designed and manufactured as per GB4793 Safety Requirements for Electronic Measuring Instruments and Safety Standard Coded IEC61010-1. It is a product in compliance with Insulation Over-voltage Standard coded CAT I 600V and Pollution Degree II. To avoid personal damages, the damage of this product or any other connecting product or possible hazard, the following safety precautions should be read and understood.

Only those who have received professional training are allowed to repair it.

Avoid fire hazard and personal damage:

Use correct power cable: Only those special power cables approved by the home country are allowed to use with this product.

Correct pulling & plugging: Please do not pull or plug the plug when the probe or test leads are connected to a power source.

Reliable grounding: This product connects to the ground through grounding wire of the power. To avoid electrical shock, the grounding wire must actually connect to the ground. Ensure the unit is correctly grounded before connecting the input or output of this unit.

Correct connection of the probes of the unit: the ground wire of the probe has the same earth potential as that of earth wire, so please do not connect it to high voltage.

Check the ratings of all terminals: To avoid fire hazard or the shock of extremely large current, before connecting this unit to power, please check all ratings and marks shown on the unit, and read this Manual to know detailed information about every rating.

Do not operate with covers open: This unit shall not be turned on while its cover or panel is open.

Use ONLY appropriate fuse: Only use a fuse whose model and ratings specific to the unit.

Avoid exposure to energized parts: Please do not contact any exposed connectors or components once the unit is connected to power.

Stop operation in case of a suspected fault: In case you suspect this unit is faulty, please have it checked by qualified maintenance personnel.

Maintain appropriate ventilation

Do not operate in damp environment.

Please do not operate in flammable or explosive environment.

Keep unit surface clean and dry

Safety Terms and Symbols

Terms in the manual

Following terms may appear in this Manual:

Warning: "Warning" specifies conditions and actions that may pose life-threatening hazards to the user.

Caution: "Caution" identifies conditions and actions that may cause damage to the product or other properties.

Terms on the product: Following terms may show on the product:

DANGER indicates you are exposed to a potential hazard that may bring immediate damage to you as you read the marking.

WARNING indicates you are exposed to a potential hazard that may not bring immediate damage to you as you read the marking.

CAUTION indicates any damage that may happen to the product or other properties

Symbols on the product: Following symbols may show on the product:

High voltage

Be sure to refer to the manual

Protective ground terminal

Frame ground terminal

Measuring ground terminal

Foreword

This Manual has introduced information relating to the operation of this UTD2000CM Series Digital Storage Oscilloscope. Following chapters are included into this Manual:

Chapter 1 User Guide: Brief introduction of its functions and provide installation guide.

Chapter 2 Settings: Introduce the operation of this unit.

Chapter 3 Application examples: Provide examples on how to meet various measuring needs.

Chapter 4 System Message and Troubleshooting

Chapter 5 Service & Support

Chapter 6 Appendix

Appendix A: Technical Indexes

Appendix B: Accessories

Appendix C: Servicing & Maintenance

Appendix D: Words on Keypads (Shown in Comparison Table)

Appendix E: Factory Settings

Introduction to UTD2000CM Series Digital Storage Oscilloscope

UTD2000CM Series Digital Storage Oscilloscope is a perfect combination of user-friendliness, excellent technical indexes and multiple functional features. A unit that can help users to complete their measurement work faster.

This Manual contains information for the following 8 models of this series of digital storage oscilloscope

Model	Bandwidth	Real-time sampling rate	Maximum memory depth
UTD2042HM	40MHz	1GS/s	16Mpts
UTD2042CM	40MHz	1GS/s	32Mpts
UTD2062HM	60MHz	1GS/s	16Mpts
UTD2062CM	60MHz	1GS/s	32Mpts
UTD2102HM	100MHz	1GS/s	16Mpts
UTD2102CM	100MHz	1GS/s	32Mpts
UTD2202HM	200MHz	1GS/s	8Mpts
UTD2202CM	200MHz	1GS/s	16Mpts

UTD 2000CM Series Digital Storage Oscilloscopes provide users with simple and functionally clear front panel for them to perform all basic operations. There are scale and position knob for all channels, which provides intuitive operation that conforms to the usage habits of conventional instrument users. Users can operate proficiently without the need to spend much time to learn and get familiar with its operation. To speed up the adjustment for the ease of measurement, the instrument will display suitable waveform and range once the users press AUTO key directly.

Aside from easy to use, UTD 2000CM Series Digital Storage Oscilloscopes has the high performance indexes and strong functions that are needed to complete measuring task faster. By offering real-time sampling and equivalent sampling at the rate of 1GSa/s and 50GSa/s respectively, faster signals can be observed on the instrument. The strong triggering and analytical ability has made it easier to capture and analyze waveform. The clear LCD and mathematical function enable users to observe and to analyze signal issues clearer and faster.

Following features may help you understand how this unit can meet your measurement demand.

- Double analog channel;
- High definition color LCD, Resolution 800×480;
- Waveform capture rate up to 150,000 wfms/s, which equals to 75 times of that of the competing products;
- Memory depth up to 32 Mpts, making it possible for the instrument to maintain the highest sampling rate

at a wider time base scope, while taking into account the integrity and detail of a waveform;

- Fine window expansion function for precise analysis of the detail and general look of waveform;
- Sufficient triggering function, including edge, video, pulse width, slope ,alternative and Less Amplitude Pulse triggering;
- Auto measuring 34 waveform parameters plus 2 advance parameters;
- Unique waveform recording and playback function;
- Support U disk storage, software updating via U disk, one-key print screen, etc.;
- Support plug and play USB device, PC communication via USB;
- Waveform, settings, bitmap storage and reproduction of waveform and settings;
- Built-in 6-digit hardware frequency meter;
- Embedded FFT and digital filtering;
- Mathematical function for multiple waveforms (including: plus, minus, times and divide);
- Unique Auto settings which can be used in accordance with your needs;
- Unique keypad lock allows you to disable the function of certain keys or knobs;
- OSD in multiple languages;
- Independent time base function allows simultaneous and independent time base setup for dual channel;

Accessories:

- Two 1.2 meters long probes, 1:1/10:1 and in conformity to EN61010-031:2008. For details, refer to “appendix on accessories” shown in the Manual;
- A power cable that conforms to the standard of the home country;
- A User Manual
- A Warranty Card
- USB Cable: UT-D06
- Communication control software for UTD2000CM series oscilloscopes

Table of Contents

Chapter 1 User Guide

UTD2000CM Series Digital Storage Oscilloscopes are small sized and portable benchtop digital storage oscilloscopes that offer convenient and user-friendly front panel for basic measurement.

This chapter will illustrate how to conduct the followings operations:

△General check

△Functional check

△Probe compensation

△Auto setup for waveform display

△Preliminary understanding of vertical system

△Preliminary understanding of horizontal system

△Preliminary understanding of trigger system

1.1 Preliminary Understanding of the Unit's Front Panel

Once you have the Unit in hand, first, you need to understand its front panel. This chapter provides brief description and introduction of the operation and functions of the front panel of UTD2000CM series instruments, so that you may get familiar with the operation of UTD2000CM Series Digital Storage Oscilloscope.

UTD2000CM offers simple and functionally clear front panel to users for their basic operations. Knobs with similar functions like they have on other digital storage oscilloscope, as well as function keys are located on the panel. The five keys located at the right side of the display are menu operation keys (From top to bottom are F1 to F5.) Through them, you can do menu setup accordingly. Other keys are function keys, through which you can enter into different function menu or access a specific function directly.

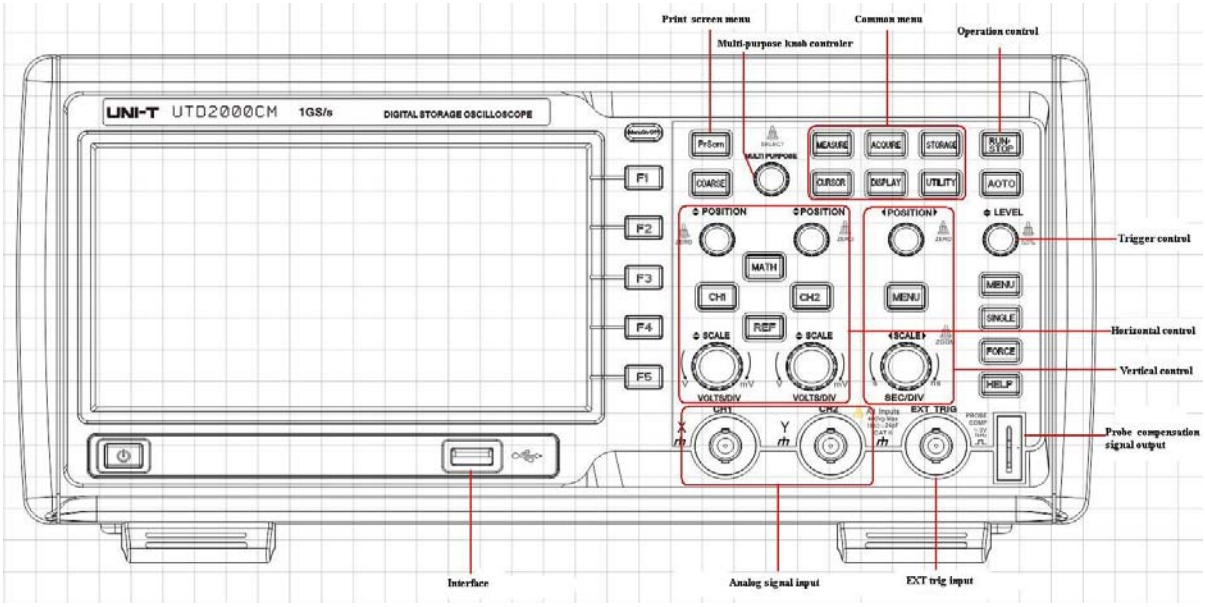


Fig 1-1 Front Panel - UTD 2000CM

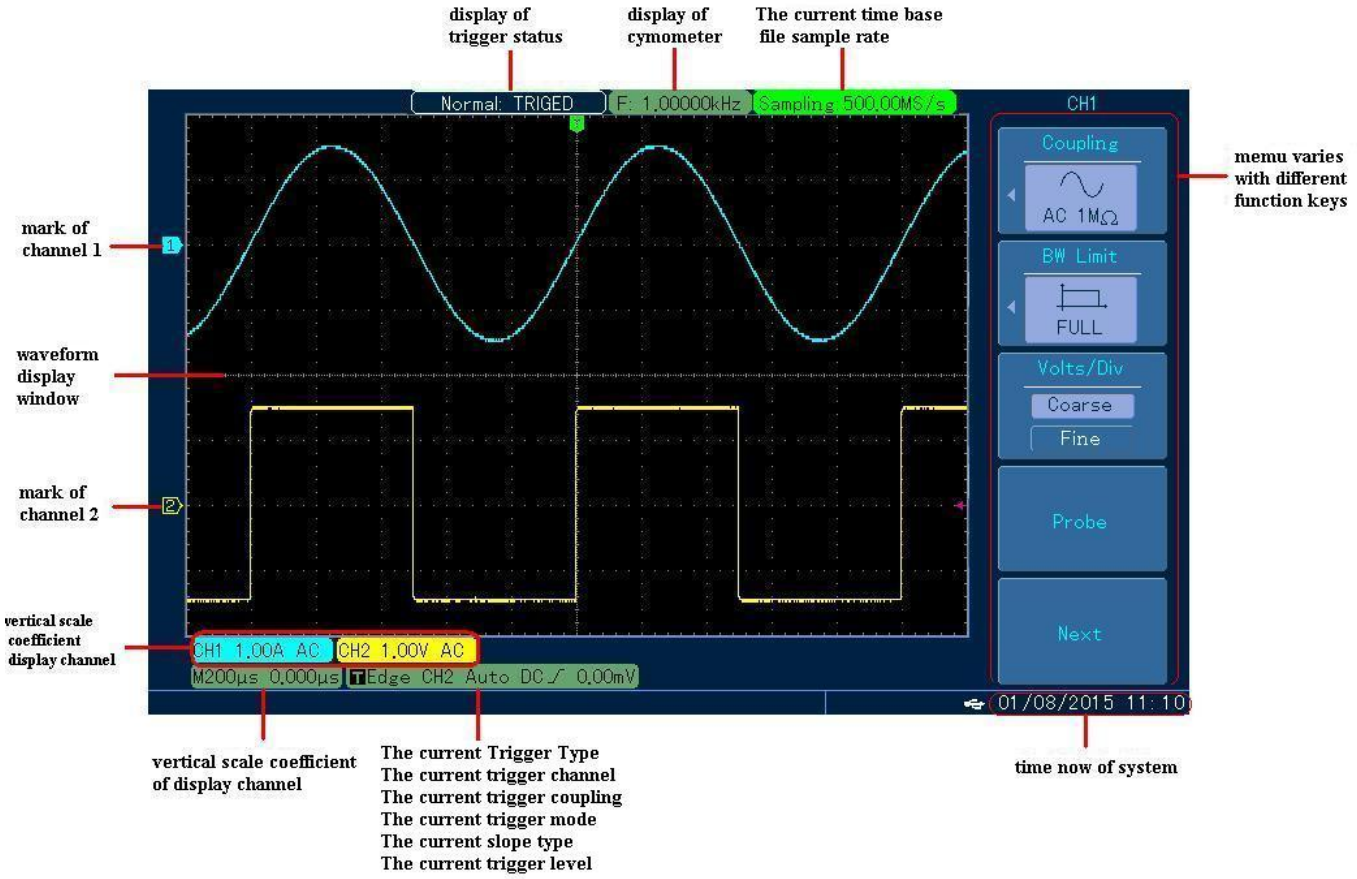


Figure 1-2 Screen Display – UTD2000CM

Notes: Real-time sampling rate at current time base are not available for UTD2202HM&CM.

To use the menu system, please follow the following steps:

1. Press a menu key to display the menu to be used.

2. Press F1 to F5 located to the right of the screen to select a menu item. If the menu item contains multiple submenus, then again press F1 to F5 to make a selection.

3. Some menu items require numeric entry or making multiple choices to complete the setting, in this case, a

multi-functional knob may be turned to do setup and to make the choice.
MEASURE: For auto waveform measurement;
ACQUIRE: Set sampling mode;
STORAGE: Save a waveform to or load a waveform from memory or U Disk;
CURSOR: Activate the cursor for manual cursor measurement;
DISPLAY: Set wave format and type;
UTILITY: Activate system tools, i.e. system configuration;
HORIZONTAL MENU: Set window expansion and trigger hold off;
TRIGGER MENU: Adjust the parameter for triggering part;
MULTI PURPOSE: move cursor; set the numeric values for some menu items or multiple choice menus; press the knob for confirmation;
VERTICAL POSITION: Move the vertical position of a waveform selected. The displayed position of the channel returns to the vertical median of the screen once this knob is pressed;
HORIZONTAL POSITION: Move the horizontal displayed position of a trigger point. The pre-trigger point returns to the horizontal median of the screen once this knob is pressed;
TRIGGER LEVEL: Adjust the trigger point of a waveform. Press this knob to set trigger level as 50% or vertical reference zero level;
RUN/STOP: Start or stop data acquisition for a waveform;

1.2 Initial Settings

The following procedures explain how to verify the normal operation of this unit rapidly, how to compensate the passive probe using built-in compensating signal, how to run the compensation program for signal path (self-correcting) so as to obtain maximized signal accuracy, and how to set time and date.

- All initial setup procedures should be performed when this unit is used for the first time;
- Probe compensating adjustment should be done when the probe is connected to any input channel for the first time;
- Self-correcting program should be run when the change in ambient temperature reaches 5℃ or more.

1.3 General Check

Before using a new UTD2000CM Series Digital Storage Oscilloscope, you are recommended to check it according to the steps listed below.

Check if there is any damage caused by transportation:

In case you find the packaging carton or polyfoam cushion has any serious damage, please contact the UNI-T distributor who sells it immediately.

Check accessories:

We have made detailed description of the accessories that come with this instrument in “Accessories of UTD2000CM Digital Storage Oscilloscope”, as stated earlier in this Manual. You can refer to this to check whether there is any missing accessory. In case you find any missing or damaged accessory, please contact the UNI-T distributor who sells it or local representative office of UNI-T.

Check the whole instrument:

In case the instrument is found having damaged housing, working improperly or to have failed the

performance test, please contact the UNI-T distributor who sells it or local representative office of UNI-T.

When the product is damaged due to the transit, keep the package and inform the shipping agency and UNI-T distributor and the UNI-T distributor will arrange the maintenance or replacement for you.

Functional check

Do a fast functional check to know if the instrument can work properly.

Please follow the following steps:

1. Power supply: 100V ~ 240V, 45Hz~440Hz. Turn on the power switch after the unit is connected to power. Press the soft start key located on the front panel and wait for the unit to start normally.

> Warning: To avoid electrical shock when probes are used in measuring high voltage, please ensure that their insulated wire is in good condition and do not touch any metal part of them when they are connected to high voltage source.

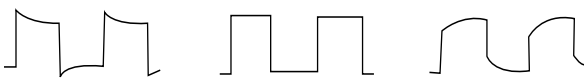
2. Connect the output terminal of the probes to Channel 1, while connect their input terminal to signal connect piece for PROBE COMP.
3. Press AUTO key, then a square wave should be shown on the displayer (approximately 3 Vpp, 1 KHz)
4. Press CH1 key for once to shut channel 1 off, and press CH2 for once to turn channel 2 on.
5. Press UTILITY key first, then press F5 and F2 one after another to enter into Auto strategy. Turn on all setups and repeat step 2 and 3.

1.4 Probe Compensation

Following adjustment must be conducted when the probes are connected to any input channel for the first time, so that they can be matched with the input channel. Probes that have not undergone such compensating correction may result in measurement error or wrong measurement. In case you need to adjust the probe compensation, please follow the following steps:

1. Set the attenuation coefficient in probe menu to 10×and turn the switch on the probe to 10×, and then connect the probes to channel 1. In case hook heads are used on the probes, they should be ensured to have reliable contact with the probes. Connect the tip of the probe to signal output connector of the probe compensator, the earth clamp to ground wire end of the probe compensation connect piece, after that, turn on channel 1 and then press AUTO key.

2. Observe the waveform being displayed.



overcompensation correct compensation insufficient compensation

Fig. 1-3 Compensation for Probe Correction

3. If the waveform being displayed is the one shown above indicating overcompensation or insufficient compensation, you can use an adjusting pen with non-metal handle to adjust the variable capacitance installed on the probe till a waveform as the one indicating correct compensation is shown on the displayer.

Warning:

To avoid electrical shock when probes are used in measuring high voltage, please ensure that their insulated wire is in good condition and do not touch any metal part of them when they are connected to high voltage source.

Remark: When the "attenuation" switch of the probe is turned to 1×, the bandwidth of this instrument will be limited by the probe to 6MHz. In order to use its full bandwidth, please ensure that the switch has been turned to 10×.

1.5 Run Auto Calibration Program

Running auto calibration program can realize the best accuracy of instrument. You can run this operation at any time. But it is a must whenever the changes in ambient temperature reaches 5℃ or more.

To run auto calibration program, please follow the following steps.

1. Disconnect all probes or power cables from the channel's input connector;
2. Press UTILITY key;
3. Press F1 key to select "system configuration" displayed at the right of the displayer;
4. Press F1 key to select "auto calibration program";
5. Press multi-function knob to confirm the execution of auto calibration program, and it may take several minutes to complete this process.

1.6 Auto Setup for Waveform Display

This instrument has auto setup function that can auto adjust the vertical scale coefficient, time base and trigger mode in accordance with the input signal until the most appropriate waveform has been displayed. It requires the frequency of the signal under test to be no less than 40Hz and the duty ratio to be more than 1%.

Auto setup steps:

1. Connect the signal under test to signal input channel;
2. Press AUTO key so that it will auto adjust the vertical scale coefficient, time base and trigger mode. In case you need to have clearer observation, when auto setup completes, please perform manual adjustment until you get the best waveform displaying effect that you want.

1.7 Set Time and Date

To set time and date, please follow the following steps:

1. Press UTILITY key;
2. Press F1 to enter into "System Configuration".
3. While in "System Configuration", press F4 to select "time setup". Then use menu keys located to the right ride of the displayer and multi-function knob to set time and date.
4. Press "Confirmation" to save the set time and date when setup completes.

1.8 Preliminary Understanding of Vertical System

As shown below, there are a number of keys and knobs located within the vertical control area. The following

exercise will help you get familiar with vertical setups.

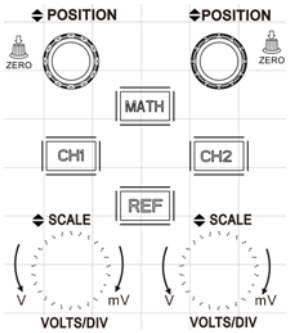


Fig. 1-4 Vertical Control Area Shown on the Front Panel

Turn the "VERTICAL POSITION" knob to move waveform in vertical direction and channel displaying position returns to median once this knob is pressed down.

CH1, CH2, REF, MATH keys are for the display of operational menus for vertical channel, opening or closing a waveform being displayed through the channel.

"SCALE" is used to set vertical scale coefficient

1. Press "POSITION" knob (for vertical shift) to make the waveform display signal at the central position of the window. Turn the "POSITION" knob (for vertical shift) to control the vertical displaying position of the signal. The reference marker of the ground level of the channel moves up and down with the waveform.

2. Change the setup of vertical system and observe the change of status information. You can know the vertical range change from the information shown in the status bar located at the lower part of the waveform window. Turn the vertical "SCALE" knob to change the coefficient of vertical scale - "VOLTS/DIV" and you may notice from the status bar the corresponding change of vertical scale coefficient shown for each channel. If press CH1, CH2, REF, MATH key one after another, the screen will display the operational menus, logos, waveforms and range status information for the corresponding channel.

Measurement Skills:

If channel coupling method is DC, you can measure the signal's DC component swiftly by observing the distance between waveform and electrical level of the signal earth.

If the coupling method is AC, DC component contained in the signal will then be filtered, which make it easier for you to display the AC component using higher sensitivity.

1.9 Preliminary Understanding of Horizontal System

As shown below, there are two keys and two knobs located within the horizontal control area. The following exercise will help you get familiar with horizontal time base setups.

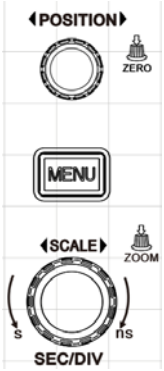


Fig. 1-5 Horizontal Control Area Shown on the Front Panel

Turn the "POSITION" knob (for movement) to move the horizontal position for all channels and of REF waveforms, which will return to median swiftly once this knob is pressed down.

MENU for horizontal menu, display window and hold off

"SCALE" is used to set the scale coefficient for horizontal time base - "SEC/DIV". Press this shortcut for quick access into window expansion screen. When "window expansion" is enabled, this can also be used to adjust windows scale and amplification factor.

1. Use horizontal "SCALE" knob to change the setup of horizontal time base range and observe the change of status information. Turn horizontal "SCALE" knob to change time base range – "SEC/DIV", and you may notice from the status bar the corresponding change of the display of corresponding time base range, in detail, the horizontal scan rate has been changed from 2ns/div～50s/div, stepping in the form of "1-2-5".
2. Use horizontal "POSITION" knob to adjust horizontal position of the signal in waveform window. While the horizontal "POSITION" knob is being turned, waveform can be observed moving in horizontal direction. Press down the horizontal "POSITION" knob to return the trigger point to horizontal median.
3. Press MENU key to display "Zoom" menu. Under this menu, press F3 to open "expanded window", then press F1 to shut off the "expanded window" and return to main window. Under this menu, "MULTI PURPOSE" knob can also be turned to set "trigger hold off"

Definitions

Trigger point: it refers to the position of actual trigger point relative to midpoint of the memory. Turn the horizontal "POSITION" knob to move the trigger point in horizontal direction.

Trigger hold off: It refers to the interval between the generation of a trigger and the restart of trigger circuit next time. Trigger hold off can be adjusted by turning "MULTIPURPOSE" knob, which is intended for observing composite or complicated signal.

1.10 Preliminary Understanding of Trigger System

As shown in Fig 1-6, there are three keys and one knob located within the trigger menu control area. The following exercise will help you get familiar with horizontal time base setups.

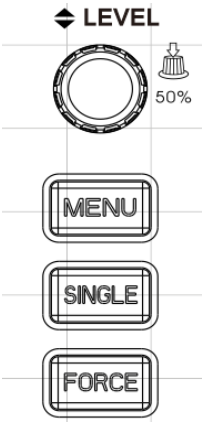


Fig. 1-6 Trigger System Shown on the Front Panel

"LEVEL" knob for triggering level: when the edge, pulse width or slope triggering mode is used, we can turn "LEVEL"

knob to set the trigger condition for trigger signal to generate a trigger. The trigger level can be set as the vertical median (50%) of the trigger signal swiftly by pressing the "LEVEL" knob down, and will be set as "zero" if pressed again.

MENU: Display the content of trigger menu.

1. Use "LEVEL" knob to change trigger level. We can see "trigger logo" on the screen indicating trigger level line, which moves up and down with the turning of the knob. While moving the trigger level, corresponding change in the value of trigger level can be observed from the bottom of the screen.
2. Use "TRIGGER MENU" to change trigger settings.

Press F2 key to select "signal source" as CH1 (select with the use of "MULTIPURPOSE" knob and press "MULTIPURPOSE" knob down to confirm the selection or select directly via touch control)

Press F3 key and then press F1 key to set "trigger coupling" as "DC" .

Press F4 key and then press F1 key to set "trigger mode" as "AUTO"

Press F5 key and then press F2 key to set "slope type" as "ascend"

3. Press SINGLE to generate trigger only for once.
4. Press FORCE key: Force to generate a trigger signal, which is mainly applied in Normal and Single trigger modes.

注：Notes:

Mark the auxiliary function of "shift knob", press down to return to median swiftly.

Mark the auxiliary function of "trigger level knob", press down to return to vertical earth level swiftly, which is the zero trigger level.

Mark the auxiliary function of "MULTIPURPOSE knob", press down to confirm the selection.

Mark the shortcut for accessing "window expansion", press down to enter into window display mode.

Chapter 2 Instrument Settings

So far, you've got preliminary understanding of the operation of "vertical control area", "horizontal control area" and "trigger system menu". Through the introduction we've made in Chapter 1, users should be familiar with how to do settings via menu operation, if not, please reread Chapter 1.

This chapter mainly covers the following topics:

■Waveform Brightness Settings

■Vertical System Settings (CH1, CH2, MATH, POSITION, VOLTS/DIV)

■Horizontal System Settings (HORI MENU, POSITION, SEC/DIV)

■Trigger System Settings (TRIGGER MENU, FORCE, SINGLE, LEVEL)

■Sampling Mode Settings (ACQUIRE)

■Displaying Mode Settings (DISPLAY)

■Storage and Load (STORAGE)

■System Settings (UTILITY)

■Auto Measurement (MEASURE)

■Cursor Measurement (CURSOR)

■Select & Start Key (AUTO, RUN/STOP)

■Multi-purpose Key (MULTIPURPOSE)

You are suggested to read this chapter carefully so as to understand the multiple measurement function and system operation of UTD2000CM series instruments.

2.1 Waveform Brightness Settings

You can adjust the waveform brightness by using “MULTIPURPOSE” knob after opening CH1 or CH2.
Press DISPLAY to open DISPLAY menu. Press F5 to select “waveform brightness setting menu”, then change waveform brightness using “MULTIPURPOSE” knob.

Figure 2-1 Waveform Brightness Settings

In comparison to an ordinary digital oscilloscope, UTD2000CM series digital storage oscilloscopes allow us to do waveform brightness setting. When the instrument is in its maximum brightness, all waveforms are shown in maximum brightness. A change in brightness can be seen in a waveform being displayed when level of brightness is being reduced gradually.

2.2 Vertical System Settings

CH1 & CH2 Channels and Their Settings

Each channel has an independent “vertical menu”, containing items specific to that channel. Press CH1 or CH2 key to display operation menu for CH1 or CH2 respectively. See below Table 2-1 for details.

menu	settings	Description	Menu	Settings	Description
Coupling	AC DC EARTH	Block the DC component in an input signal Allow the passage of both AC and DC components in an input signal 。 Disconnect input signal	Probe	Current Voltage 1× 10× 100× 1000× User-defined	Probe Type Settings Based on the attenuation coefficient of the probe to select a value in order to maintain accurate reading for vertical deflection factor. Totally, there are five options to choose from, which are 1×、10×、100×、1000× and user-defined.
Bandwidth Limitation	Open Close	Limit bandwidth to 20MHz, so as to reduce the displayed noise Full bandwidth	Phase Reversed	On Off	Turn on the reversed waveform function; Normal display of waveforms
Volts/Grids	Rough Fine	Follow 1-2-5 stepping to set vertical deflection factor during rough tuning Further division within the scope of rough tuning can be done in fine tuning so as to improve vertical resolution.			

2.2.1 Channel Coupling Settings

Take the application of signal in CH1 as an example, for which the signal under test is a sinusoidal signal containing DC component. Press F1 and then use “MULTIPURPOSE” knob to select AC 1MΩ, whose channel coupling is set as AC coupling mode. Thus the DC component contained in the signal under test is blocked. Waveform display is shown as below.

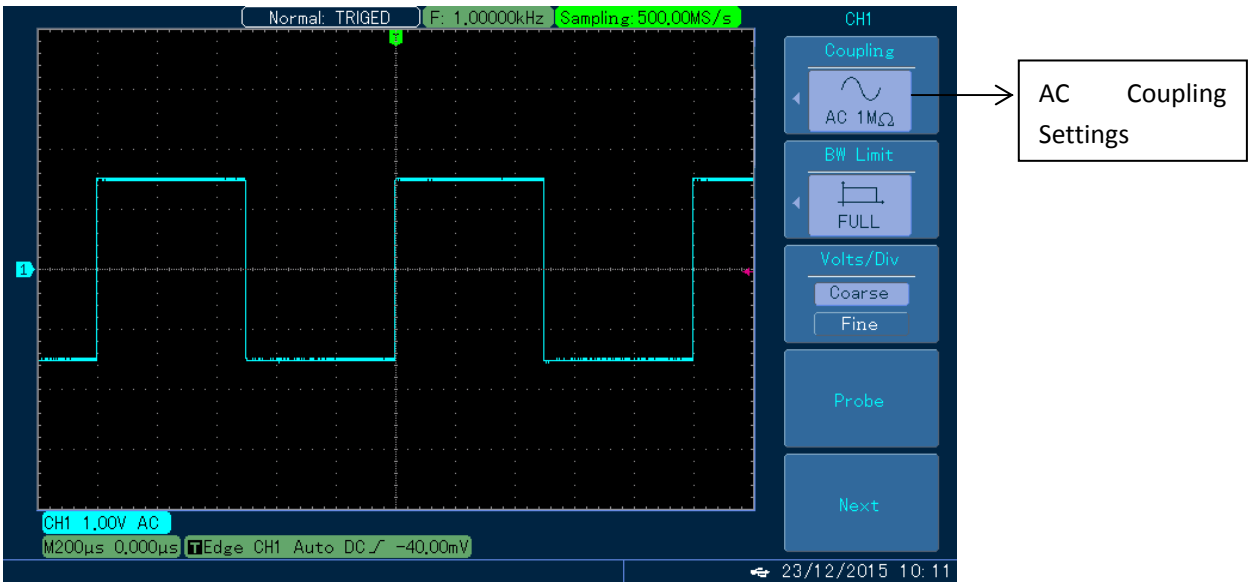


Fig. 2-2 DC Component in a Signal has been Blocked

Press F1 and then press F1 to select DC 1MΩ, whose channel coupling is set as DC coupling mode. Thus it allows the passage of both AC and DC components contained in the signal under test, which is input to CH1. Waveform display is shown as below.

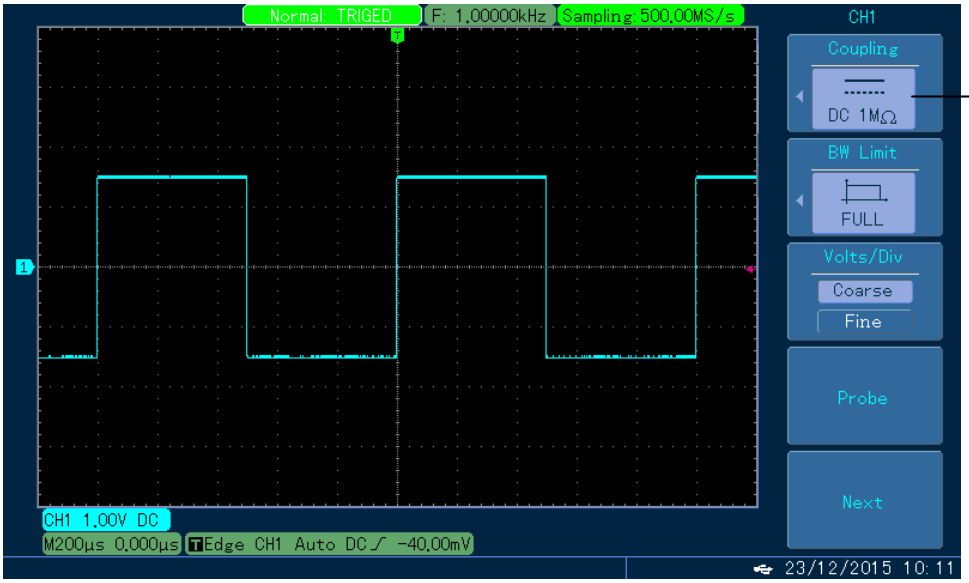


Fig. 2-3 Both the AC and DC Components in a Signal have been Displayed Simultaneously

Press F1 and then press F3 to select grounding as the channel coupling mode. Thus both AC and DC components contained in the signal under test are blocked. Waveform display is shown as below. Under this mode, though no waveform is being displayed on the screen, the input signal still maintains connection with the channel circuit.

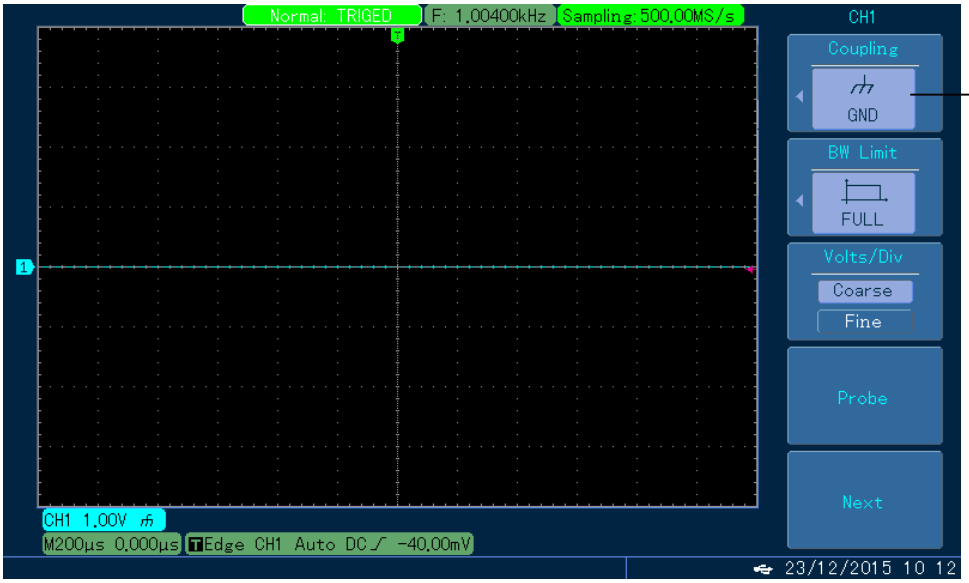


Fig. 2-4 Both the AC and DC Components in a Signal have been blocked Simultaneously

2.2.2 Channel's Bandwidth Limit Setting

Take the input of a sinusoidal signal in approximately 25MHz in CH1 as an example: Press CH1 to open CH1, then press F2, set bandwidth limit as full bandwidth, meaning no restriction on channel's bandwidth and all high-frequency component contained in signal under test can be passed. Waveform being displayed is shown below.

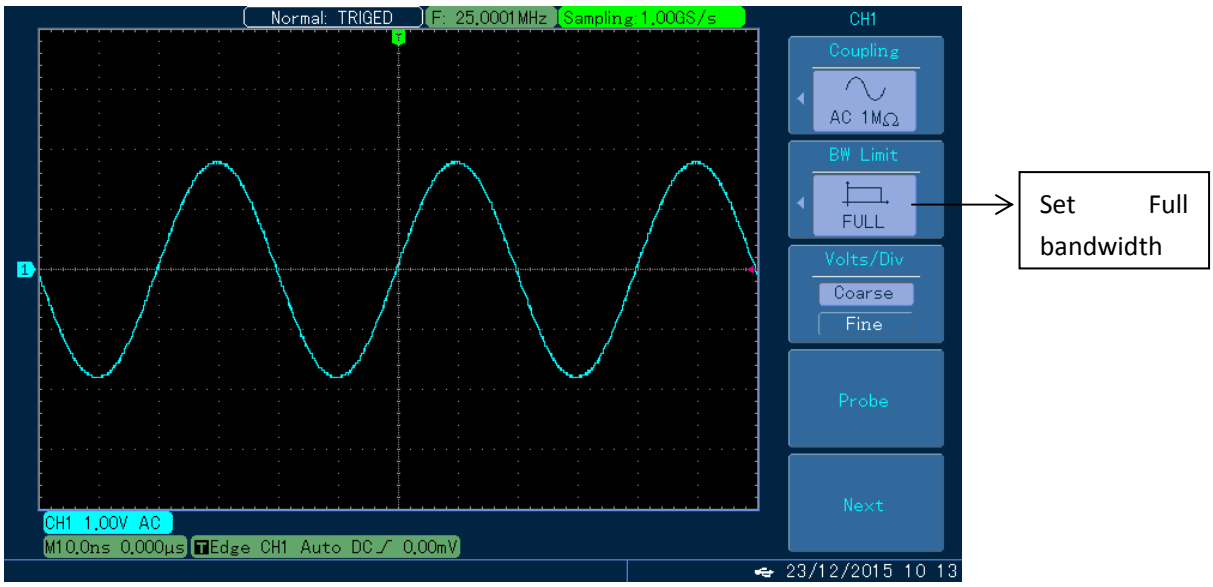


Fig. 2-5 Waveform Displayed at Full Bandwidth

Press F2 and then set the current bandwidth as 20MHz by turning the "MULTIPURPOSE" knob, then the noise and high-frequency component that are higher than 20MHz will be restricted. Waveform being displayed is shown below.

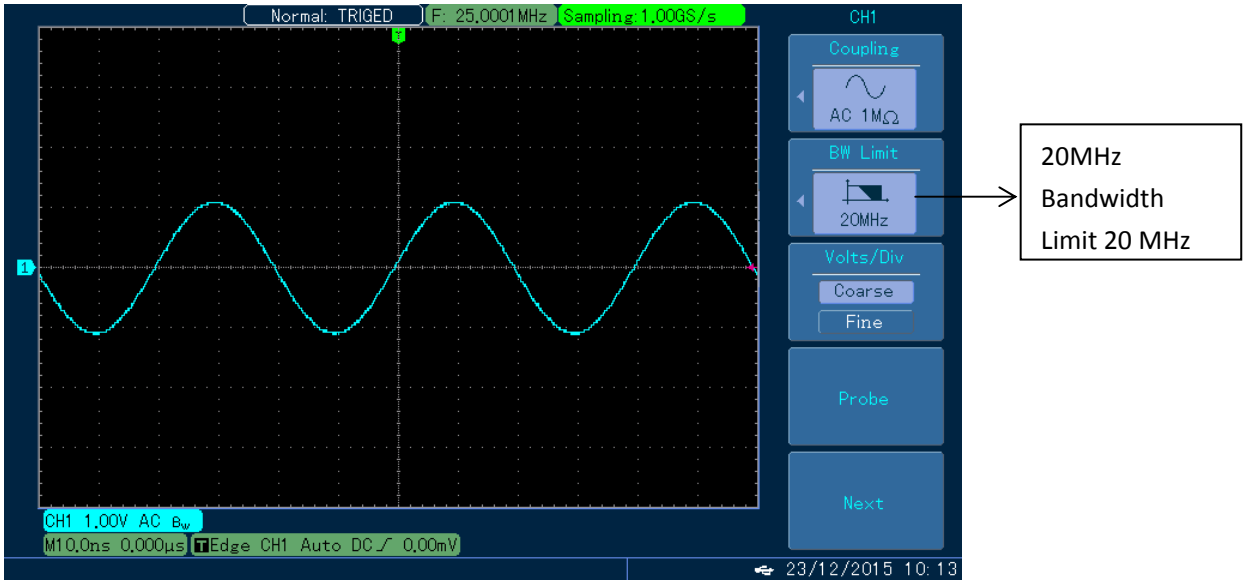


Fig. 2-6 Waveform Displayed at a Limited Bandwidth

2.2.3 Probe Amplification Factor Setting

This setting should be set in accordance with probe's attenuation coefficient. In detail, probe attenuation

coefficient should be set in operation menu of the channel, i.e. in order to ensure correct voltage readings, if the probe attenuation coefficient is 10:1, then the probe coefficient in channel menu should be set as 10× accordingly, and the rest can be inferred like this.

Below is an example showing the setting and vertical range for probe with an attenuation coefficient of 10:1.

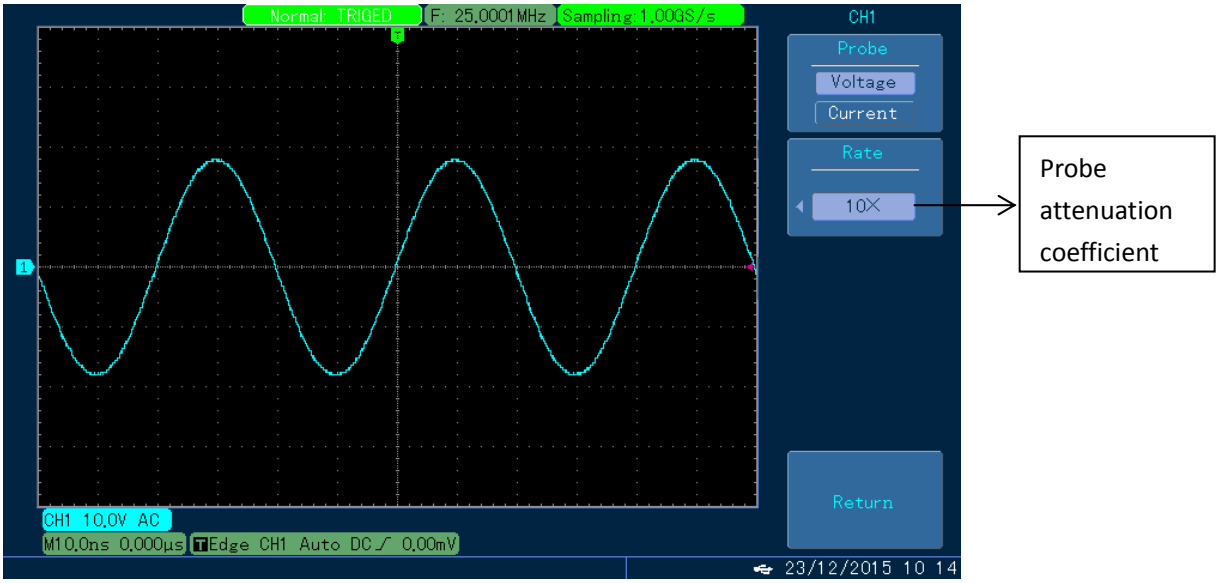


Fig. 2-7 Probe Coefficient Setting in Channel Menu

Apart from setting a predefined amplification factor of 1×, 10×, 100× and 1000×, it also allows users to set desired coefficients that suit to specific applications. Normally, the probes of oscilloscope are voltage probes. However, this instrument also allows us to set probes as current ones in order to meet different measurement needs. Detailed settings are shown below.

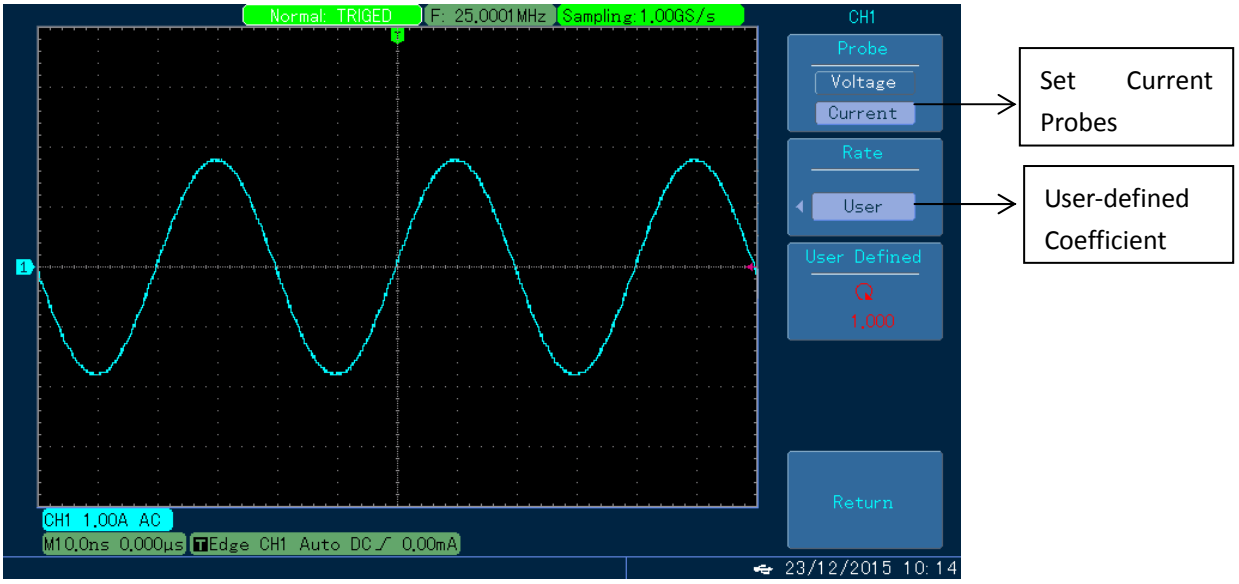


Fig. 2-8 User-defined Probe Settings, Including Current Probes

Notes: There are no current probes and user-defined coefficient settings for UTD2202HM&CM.

2.2.4 Vertical Scale Coefficient (Volts/Grids) Settings

Two modes, rough and fine tunings may be used in adjusting the vertical scale coefficient (volts/grids). During rough tuning, the volts/grids scope is 2mV/div～10V/div, stepping in 1-2-5 format.

During fine tuning, the vertical scale coefficient within current vertical range is being changed under an even smaller stepping, hence to realize the uninterrupted and constant adjusting of vertical scale coefficient within the scope of 2mV/div～10V/div.

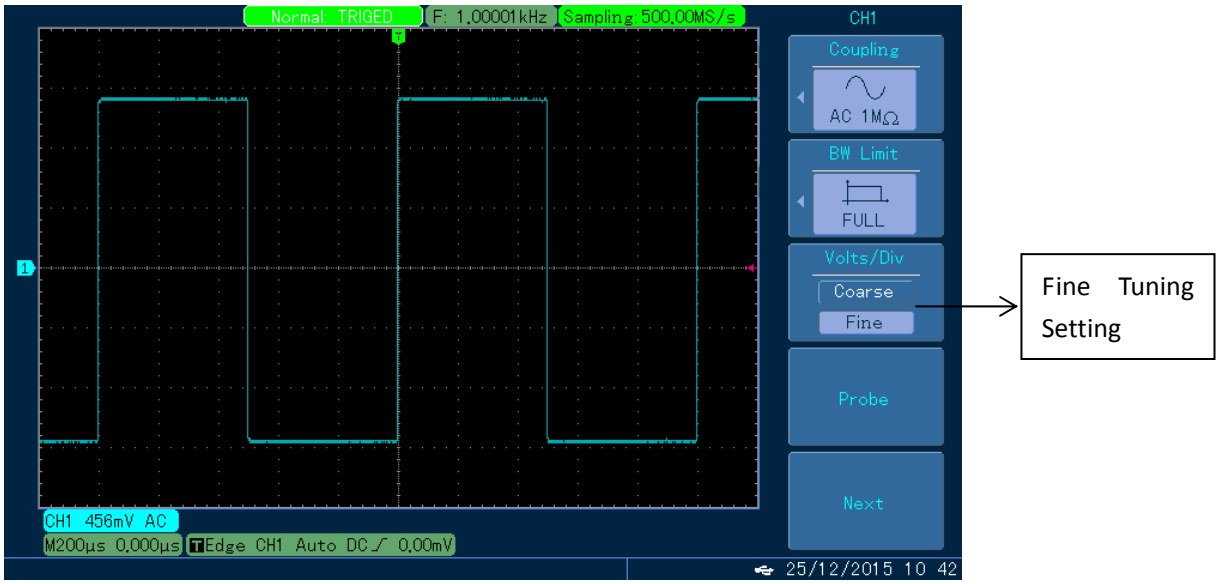


Fig. 2-9 Rough and Fine Tunings of Vertical Deflection Factor

2.2.5 Phase Reversed Waveform Setting

Reversed waveform: signal displaying phase turns 180° . Refer to Fig. 2-10 for a waveform that has not been reversed and refer to Fig. 2-11 for a reversed one.

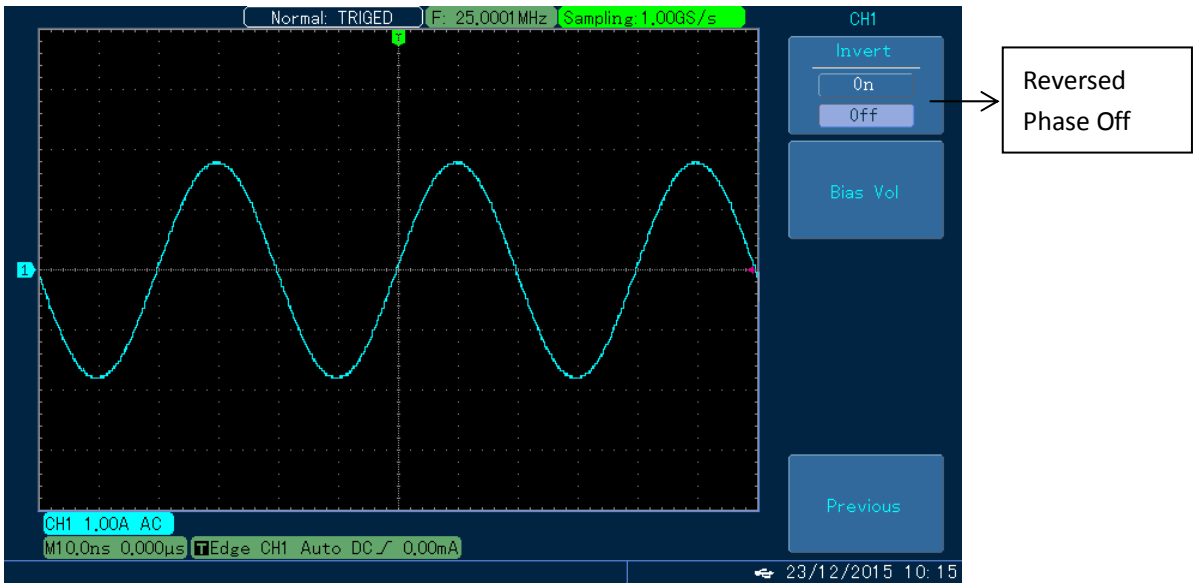


Fig. 2-10 Waveform having no Reversed Phase

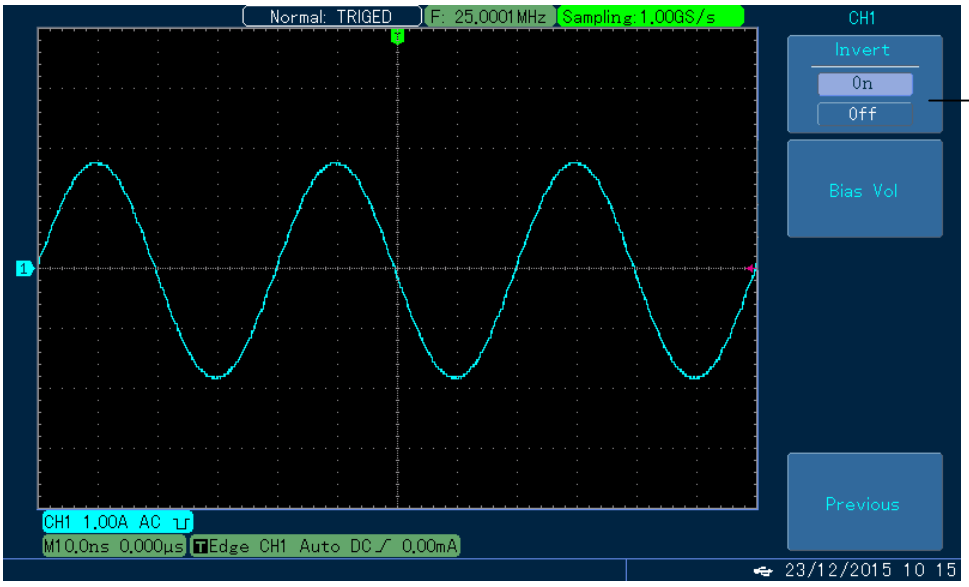


Fig. 2-11 A Phase Reversed Waveform

2.2.6 Bias Voltage Setting

It becomes inconvenient to observe waveform when the amplitude of DC component in a signal under test is very large relative to the amplitude of AC component in that signal, as shown in Fig. 2012.

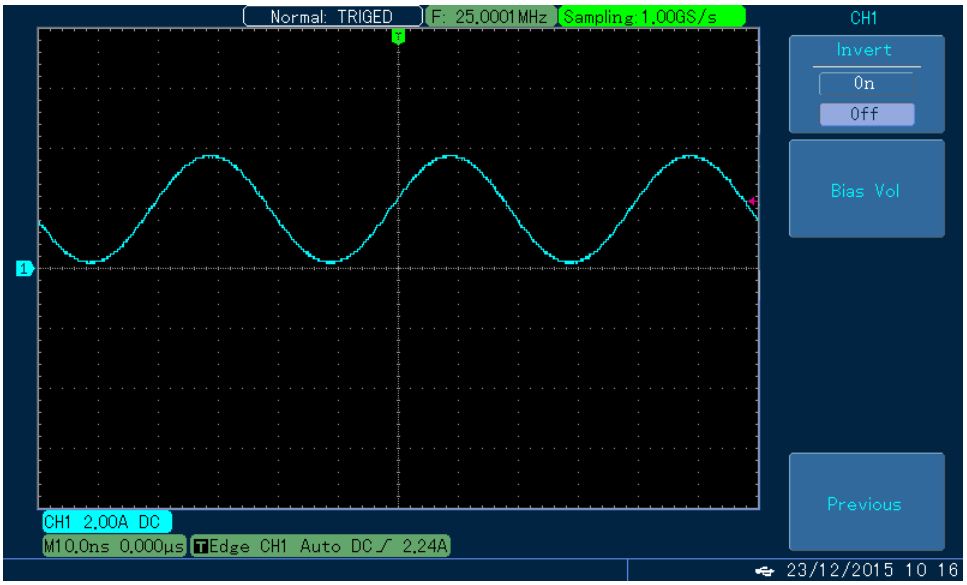


Fig. 2-12 Signal Containing DC Component

Then we can use bias voltage function to offset the DC component in a signal, so that the signal can be displayed better on the screen. Once we enter into the functional menu of bias voltage, we can set bias voltage by turning MULTIPURPOSE knob. As shown in Fig. 2-13, we can calculate the DC component of a signal with the use of bias voltage.

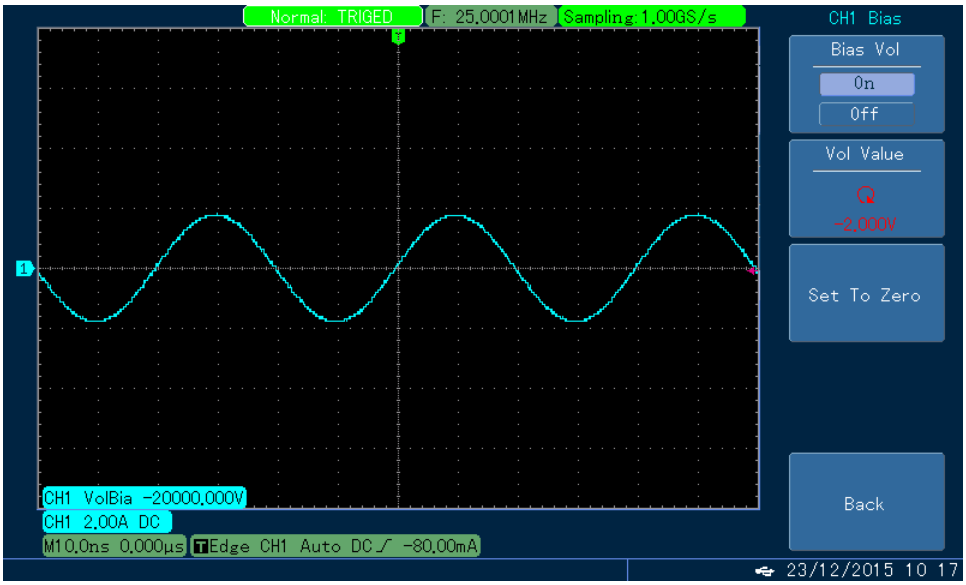


Fig. 2-13 Waveform under Bias Voltage

2.2.7 Realization of Mathematical Function

Mathematical function refers to the display of calculation results for adding, deducting, multiplying or dividing between waveforms of CH1 and CH2, as well as displaying the waveform after using FFT or digital filtering. The menus are shown below.

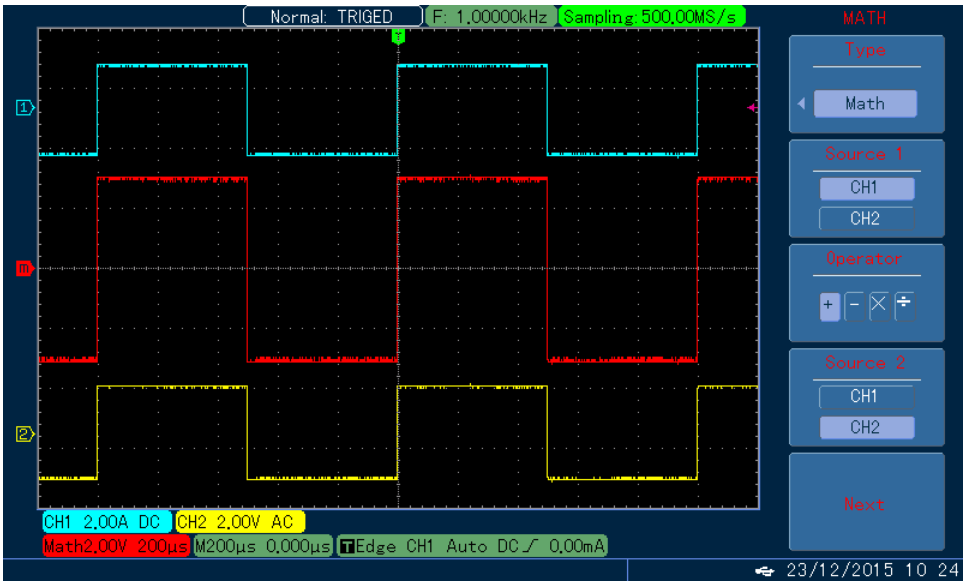


Fig. 2-14 Mathematical Calculations

Table 2-2: Explanation on Mathematical Calculation Menu

Menu	Setting	Description
Type	Math	For adding, deducting, multiplying or dividing
Operand 1	CH1 CH2	Set operand 1 as the waveform in CH1 Set operand 1 as the waveform in CH2
Operator	+ – ×	Operator 1+Operator 2 Operator 1-Operator 2 Operator 1×Operator 2

	÷	Operator 1÷Operator 2
Operand 2	CH1 CH2	Set operand 2 as the waveform in CH1 Set operand 2 as the waveform in CH2
Scale	1/1 1/10 1/100 1/1000	Scaling the waveform as per a scale, totally, there are four scales: 1/1, 1/10, 1/100, 1/1000

FFT Spectrum Analysis

Using FFT, we can change time domain signal (YT) to frequency domain signal. It allows us to observe the following types of signal conveniently with the use of FFT.

- Harmonic content and distortion in measuring system
- Express noise characteristic in DC power
- Analyzing vibration

Fundamental component 1kHz

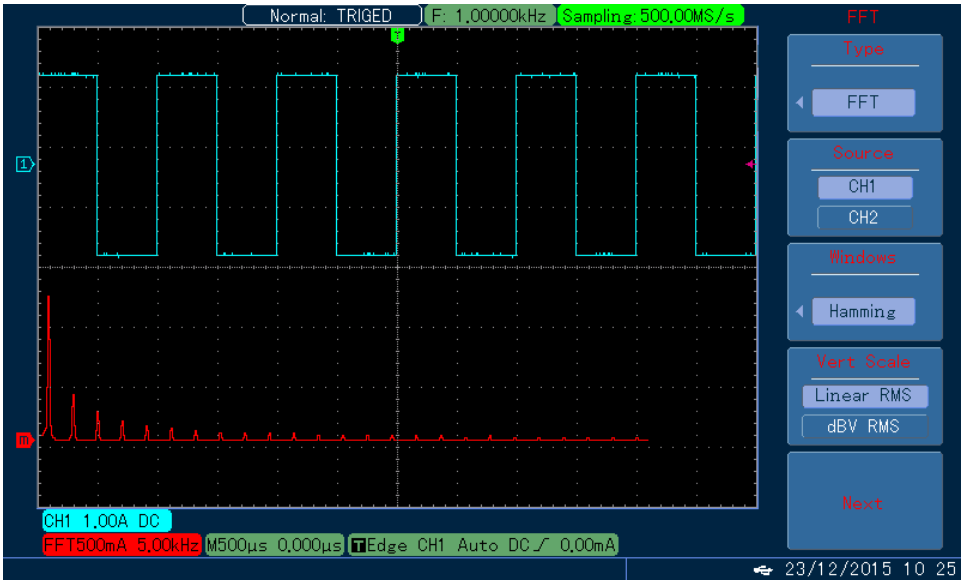


Fig. 2-15 FFT Spectrums

Table 2-3: FFT Menu

Menu	**Setting**	**Description**
Type	FFT	FFT mathematical calculation
Signal Source	CH1 CH2	Set CH1 as the computing waveform Set CH2 as the computing waveform
Window Function	Hamming Blackman Rectangle Hanning	Set Hamming window function Set Blackman window function Set Rectangle window function Set Hanning window function

Vertical Coordinate	Linear/dBv	Set the unit of vertical coordinate to be linear or dBv

FFT Operation Skills .

A signal with DC component or bias may result in wrong or biased waveform component analysis using FFT. To reduce DC component, AC coupling mode may be selected. Also to reduce random noise caused by repeat or single pulse incident and aliasing frequency component, the signal acquiring mode of digital storage oscilloscope can then be set as “averaged acquiring”.

Select FFT Window

Based on the assumption that YT waveform is being repeated constantly, the oscilloscope will conduct FFT transformation over the limited time record. When the cycle is an integer, the amplitudes for YT waveform at the beginning and in the end are identical, so the waveform will not be interrupted. However, if the cycle of YT waveform is a non-integer, it will result in different amplitudes for waveform at the beginning and in the end, thus to cause high frequency transient interruption at the joint. In frequency domain, this effect is called a leakage. Therefore, in order to prevent leakage from happening, we multiply the original waveform by a window function so as to force the value at the beginning and in the end to be zero. Refer to the following table for the application of window function.

Table 2-4: FFT Window Selection

FFT Window	Feature	Most Suitable Measuring Content
Rectangle	Best frequency resolution and worst amplitude resolution. Basically similar to the condition without window.	Transient state or short pulse and the signal level remains more or less the same before and after this. Constant amplitude sinusoid with extremely close frequency has wide bandwidth random noise that has relatively slow-changing spectrum.
Hanning Hamming	In comparison to rectangle window, it has relatively good frequency resolution and relatively bad amplitude resolution. Hamming Hanning The frequency resolution of Hamming window is a bit better than that of Hanning window.	Sine, cycle and narrow band random noise Transient state or short pulse with signal level varies widely before and after this.
Blackman	Best amplitude resolution and worst frequency resolution.	Mainly used for single frequency signal and for searching higher sub-harmonic

Definition

FFT Resolution: it is defined as the quotient of a division between sampling rate and operating points. In case of a fixed operating points, the lower the sampling rate, the better the FFT resolution.

Nyquist frequency: For a waveform with the maximum frequency of f, the original waveform can only be built with the use of a sampling rate that is at least 2f. This is also referred to as Nyquist Code. The “f” here is Nyquist frequency, while the “2f” is Nyquist sampling rate.

Digital Filtering Function

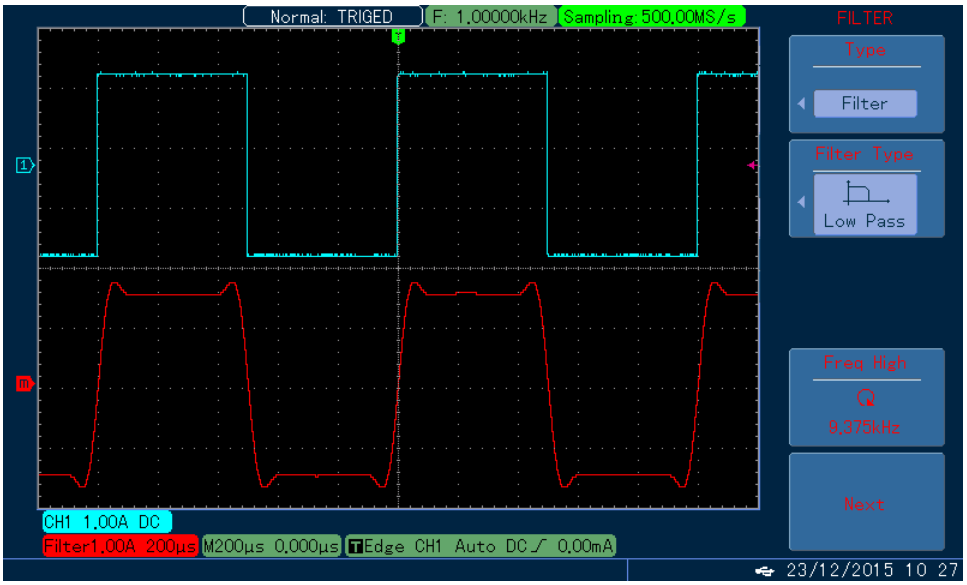


Fig. 2-16 Digital Filtering

Table 2-5: Digital Filtering Menu

Menu	Setting	Description
Type	Digital Filtering	Digital Filtering
信源 Signal Source	CH1 CH2	Set CH1 as the object of filtering Set CH2 as the object of filtering
Filter Type	Low-pass High-pass band-pass	Set the filter to be low-pass filtering Set the filter to be high-pass filtering Set the filter to be band-pass filtering
Frequency - Lower limit	———	Only effective during high-pass filtering or band-pass filtering; use “MULTIPURPOSE” knob to set lower limit of frequency
Frequency –upper limit	———	Only effective during low-pass filtering or band-pass filtering; use “MULTIPURPOSE” knob to set lower limit of frequency

2.2.8 Reference Waveform

REF menu can load or close reference waveform. The reference waveform is stored either in the nonvolatile memory of the instrument or in an extended U disk and bears the following names: REF A, REF B. When the reference waveform needs to be displayed (load) or hidden (close), please follow the following steps:

Press REF key.

1. Press F2 to load and select the location of signal source using "MULTIPURPOSE" knob. There are totally 10 places to choose from. When you've chosen one place to save waveform, i.e. "1", press "MULTIPURPOSE" to confirm the selection, then you can load the waveform that is originally saved at this place. Regarding storage and reload reference waveform stored in a U disk, please refer to "Storage and Reload".
2. Press F1 key to select "REF B", and then select the second signal source that involves in computing process, which is the same as what's in step 2.
3. To close the reference waveform, please close REF menu.

In actual application, when we use oscilloscope to test and observe relevant waveforms, we can make comparison between current waveform and the reference waveform, thus to analyze. Press REF key to display reference waveform menu. See Table 2-6 for explanations on settings.

Remark: By the time the reference waveform has been reloaded or imported, press auto key again, this waveform still exists.

Table 2-6 REF Menu

Menu	Setting	Description
Reference Waveform	REF A REF B	Set the reference waveform as REF A Set the reference waveform as REF B
load		Load 10 storage positions from the unit, and use "MULTIPURPOSE" knob to select one stored waveform from those 10 positions and press "MULTIPURPOSE" knob to confirm.
import	When U Disk has been inserted No insertion of U Disk	Press F5 key to pop out a file selection dialog box, listing waveform files saved in the root directory of current U disk. Use "MULTIPURPOSE" knob to select one stored waveform and press "MULTIPURPOSE" knob to confirm. Press F5 key, prompting "function is not available, please insert U disk"

Remark 1: We can choose from 1 to 10 if we want to choose an internal storage position; A U disk should be inserted if we want to choose an external storage. Then we will receive a prompt message, showing USB device has been installed successfully. Then Press F5 to "import" menu, and enter into file option dialog box (USB).

Remark 2: In the file option dialog box (USB), all waveform files saved in the U disk will be shown. Use "MULTIPURPOSE" knob to select one stored waveform and press "MULTIPURPOSE" knob to confirm.

2.3 Horizontal System Settings

Horizontal Control Knob

We can use horizontal control knob to change horizontal scale (time base) and to trigger horizontal position in the memory (trigger position). The vertical midpoint across the horizontal direction of the screen is the time reference point of a waveform. The change of horizontal scale may result in an expansion or contraction of

waveform relative to center of the screen. The change of horizontal position equals to the change of position relative to trigger point of a waveform.

Horizontal Position: Adjust the horizontal position of a waveform in channel (including mathematical calculations). The resolution of this control key changes with the time base.

Horizontal Scale: Adjust the horizontal position of a waveform in channel (including mathematical calculations). The resolution of this control key changes with the time base.

Horizontal Scale: Adjust the main timebase, which is “SEC/DIV”. When the “extended time base” is opened, the window width can be changed by turning horizontal scale knob to change delayed scan time base.

Two horizontal control knobs: “SCALE” knob for changing horizontal time base scale; “POSITION” knob (Horizontal shift) for changing the relative position of trigger point on screen.

Horizontal Control Key MENU: To display “horizontal” menu (See Table below)

Table 2-7 Horizontal Menu Description

Menu	Setting	Description
Main Window	——	Press F1 key to return to “main window”
Window Expansion	——	Press F3 key to enter into “expanded window”
Hold off	96.0000ns～1.5000s	Use “MULTIPURPOSE” knob to adjust “hold off”

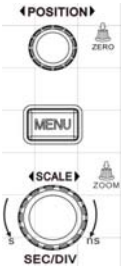


Fig. 2-17 Horizontal System Controls

Window Expansion

Window expansion is used to zoom in a section of waveform in order to image details. The setting of window expansion must not slower than the setting of main time base.

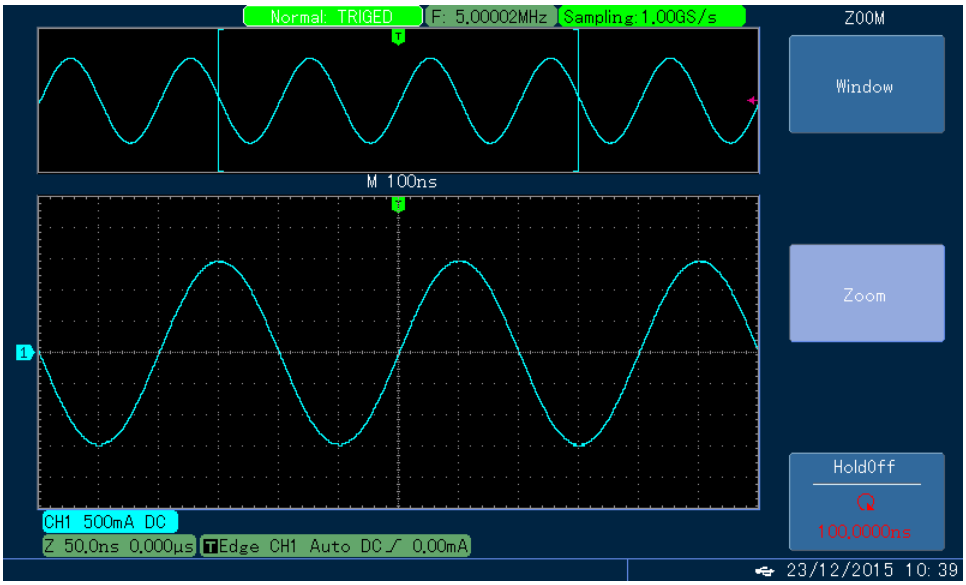


Fig. 2-18 Screen Display for Expanded Window

Under window expansion mode, the screen is separated into two displaying area, which is shown above. Original waveform is being displayed in the upper part which allows horizontal shifting by turning “POSITION” knob or by turning horizontal “SEC/DIV” knob to enlarge or reduce the selected area. The lower part shows horizontal expanded waveform. What is worth noting is that expanded time base has improved the resolution if compared with main time base (as shown above). Since the waveform being displayed in the lower part corresponds to the selected area shown in upper part, turning horizontal “SEC/DIV” knob to reduce selected area can help improve expanded time base, as it improves the horizontal amplification factor for such waveform.

Notes: Maximum expanded time base is 50ns/div.

2.4 Trigger System Settings

The triggering act determines when the digital storage oscilloscope begins to collect data and displays waveform. Once the trigger has been set correctly, it can transform unstable display into meaningful waveforms. When the digital storage oscilloscope begins to collect data, it first collects enough data to draw a waveform at the left side of the trigger point. While the instrument is waiting for the occurrence of a triggering condition, it is also collecting data consecutively. When a trigger condition is detected, the instrument will collect sufficient data consecutively so as to draw a waveform at the right side of the trigger point. The trigger control area shown on operation panel of UTD2000CM-EDU series oscilloscope includes “LEVEL” knob (for trigger level), MENU key, FORCE key (for force trigger) and SINGLE key (for single trigger).

“LEVEL” Knob (For Trigger Level)

Use “LEVEL” control in “Trigger Section” to adjust trigger level. When trigger level is being adjusted, there will be a horizontal line appearing on the screen temporarily to indicate electrical level. When this line disappears, trigger level will be marked as a small arrow.

Press “LEVEL” knob to set trigger level as equal to 50% of the amplitude of original waveform triggered.

Force Trigger FORCE

Press FORCE key (for force trigger) to force trigger an immediate trigger event. This function can be used in following aspects:

When using “Normal” trigger mode, if no waveform is shown on the screen, press FORCE (force trigger) key

to acquire signal baseline so as to confirm whether the acquisition is normal;

After pressing SINGLE key to set single trigger, FORCE (force trigger) key can be pressed to execute experimental acquisition so as to check the control settings.

Trigger Control MENU

Trigger Type: Edge, Pulse width, video, slope, less amplitude pulse, alternative

Edge Triggering: Trigger occurs when the edge of a triggering signal reaches a given level.

Pulse Width Triggering: Trigger occurs when the pulse width of a triggering signal reaches a preset triggering condition.

Video Triggering: Perform field triggering or row triggering to standard video signal.

Slope Triggering: Trigger occurs when the slope of triggering signal meets the condition.

Less Amplitude Pulse Triggering: Trigger the pulse signal that has passed one trigger level but has failed to pass another one.

Alternative Triggering: Trigger signals that has no frequency connections.

2.4.1 Edge Triggering

Edge triggering refers to a trigger that occurs at the edge of an input signal, namely the trigger threshold value. When “edge triggering” is selected, it means the trigger occurs at the rising edge and falling edge of an input signal.

Table 2-8 Edge Triggering

Menu	Setting	Description
Type	Edge	
Signal Source	CH1、CH2 EXT、EXT/5 AC LINE Alter	Set CH1 or CH2 as the source of trigging signal Set external triggering or the quotient of dividing external triggering signal by 5 as the signal source Set mains supply as the source of trigger Alternatively use CH1 or CH2 as the source of trigger
Trigger Coupling	DC AC Low Frequency Reject High Frequency Reject	Pass both the AC and DC component in an input signal; Block the DC component in an input signal; Reject the low frequency component (less than 80KHz) contained in a signal; Reject the high frequency component (higher than 80KHz) contained in a signal;
Triggering Mode	Auto Normal	When there is no input of trigger signal, the system will automatically acquire waveform data and display scanning baseline on the screen; when there is a trigger signal, it will then automatically switch into trigger scanning.

	Single	Stop data acquisition when there is no trigger signal and when there is a trigger signal, it will conduct trigger scanning. The unit occurs a trigger and then stops whenever there is any input of trigger signal.
Edge Type	Rising Falling Rising and falling	Set to trigger at the rising edge of a signal Set to trigger at the falling edge of a signal Set to trigger once respectively at the rising edge and the falling edge of a signal.

2.4.2 Pulse Width Triggering

Since pulse width triggering determines the triggering time based on the width of the pulse, you can capture abnormal pulse by setting pulse width condition.

Table 2-9

Menu	**Setting**	**Description**
Type	Pulse Width	
Signal Source	CH1、CH2 EXT、EXT/5 AC LINE Alter	Set CH1 or CH2 as the source of trigging signal Set external triggering or the quotient of dividing external triggering signal by 5 as the signal source Set mains supply as the source of trigger Alternatively use CH1 or CH2 as the source of trigger
Trigger Coupling	DC AC Low Frequency Reject High Frequency Reject	Pass both the AC and DC component in an input signal; Block the DC component in an input signal; Reject the low frequency component (less than 80KHz) contained in a signal; Reject the high frequency component (higher than 80KHz) contained in a signal;
Triggering Mode	Auto Normal Single	When there is no input of trigger signal, the system will automatically acquire waveform data and display scanning baseline on the screen; when there is a trigger signal, it will then automatically switch into trigger scanning. Stop data acquisition when there is no trigger signal and when there is a trigger signal, it will conduct trigger scanning. The unit occurs a trigger and then stops whenever there is any input of trigger signal.
Pulse Width Setting	See Table 2-10	Conduct pulse width setting

Pulse Width Setting

Menu	Setting	Description
Pulse Width Polarity	Positive Pulse Width Negative Pulse Width	Set positive pulse width as the trigger signal Set negative pulse width as the trigger signal
Pulse Width Condition	<	Trigger occurs when the pulse width of an input signal is less than the preset pulse width time;

	> =	Trigger occurs when the pulse width of an input signal is larger than the preset pulse width time; Trigger occurs when the pulse width of an input signal equals the preset pulse width time;
Pulse Width Time	20.0ns～10.0s	20.0ns～10.0s; Trigger pulse width is set between 20.0ns～10.0s using “MULTIPURPOSE” knob
Return	——	Return to “pulse width triggering” menu

2.4.3 Video Triggering

Once video triggering is selected, it allows triggering occurs at the field or row of a standard video signal in NTSC or PAL format. Trigger coupling is preset to be DC. See below table for menu introduction.

Table 2-11 Video Triggering

Menu	**Setting**	**Description**
Type	Video	
Signal Source	CH1、CH2 EXT、EXT/5	Set CH1 or CH2 as the source of trigging signal. Set external triggering or the quotient of dividing external triggering signal by 5 as the signal source
Video Setting	See Table 2-12	Enter into video setting

Table 2-12 Video Setting

Menu	**Setting**	**Description**
Video Format	NTSC PAL	NTSC format video signal PAL format video signal
Synchronization	Odd Field Even Field All Rows Specific Row	Set to trigger at the odd field; Set to trigger at the even field; Set to trigger synchronization on row signal; Set to trigger synchronization on a specific row signal; Use “MULTIPURPOSE” to adjust; PAL format, 625 rows, NTSC format: 525 rows

When video format is chosen to be PAL and in row synchronization, the screen display is shown in Fig. 2-19

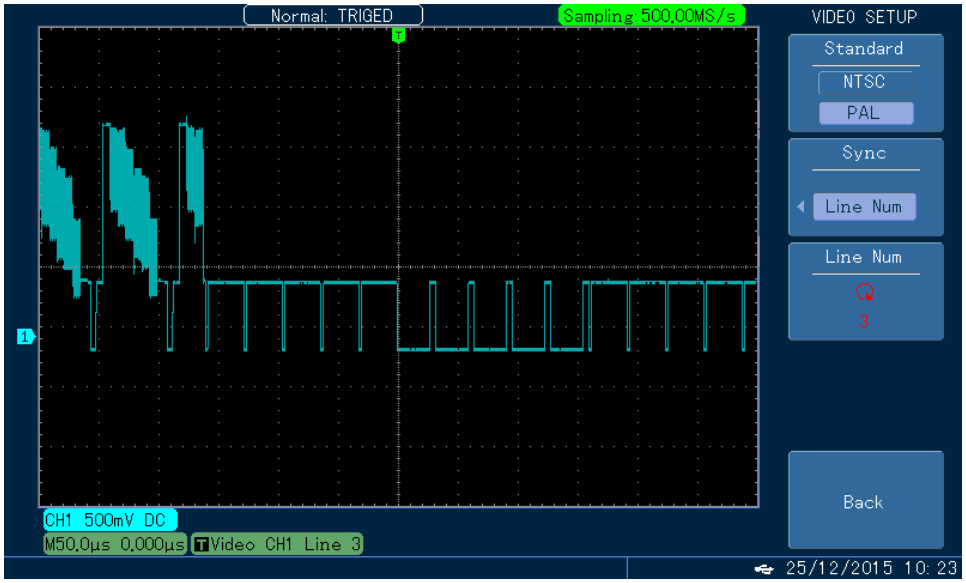


Fig. 2-19 Video Triggering: Row Synchronization

If in field synchronization, the screen display is shown in Fig. 2-20.

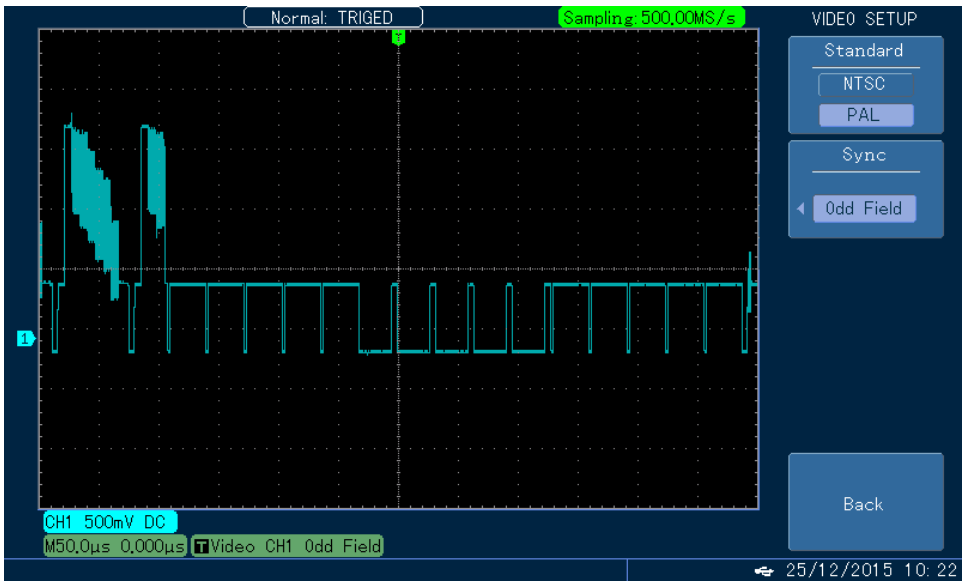


Fig. 2-20 Video Triggering: Field Synchronization

2.4.4 Slope Triggering

Slope triggering refers to a trigger that occurs on positive or negative slope for a given time, thus it is suitable for observing sawtooth wave or triangular wave. See below Table 2-13 for detailed settings.

Table 2-13 Slope Triggering

Menu	Setting	Description
Slope Type	Falling Rising	Set to trigger at the edge of trigger signal when slope is falling; Set to trigger at the edge of trigger signal when slope is rising;
Slope Condition	> <	Set to trigger when slope at edge is larger than a preset value;

	=	Set to trigger when slope at edge is smaller than a preset value; Set to trigger when slope at edge equals a preset value;
Time Setup	20ns～10s	Set slew rate time
Threshold value	Low Level High Level High and Low level	Set a threshold level for low level, a signal with low level must be smaller than the preset value; Set a threshold level for high level, a signal with high level must be higher than the preset value; Also set threshold level for high and low level;
Return	----	Return to “slope triggering” menu

Notes: Only by selecting those channels that has signal input as the source for triggering, can we get reliable triggered waveform.

Slope Condition

Oscilloscope defines the positive slope time as the time differences between two cross points that are formed when rising slope intersects with both up levels and low level. Likewise, negative slope time is defined as the time differences between two cross points that are formed when falling slope intersects with both up levels and low level.

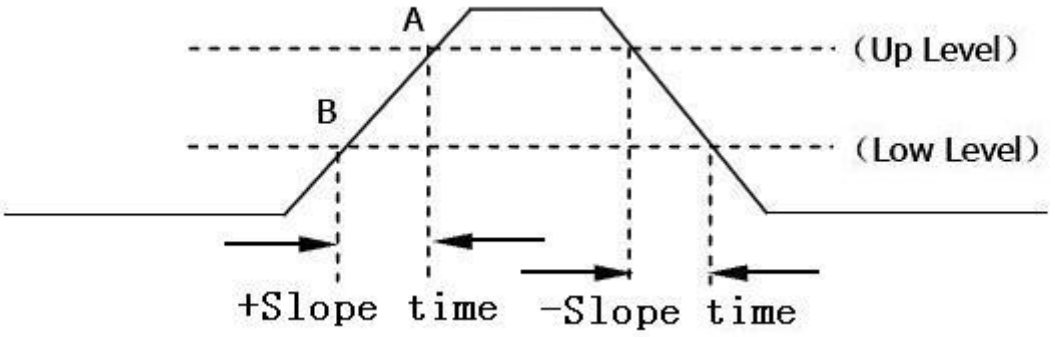


Fig. 2-21 Positive Slope Time/Negative Slope Time

2.4.5 Less Amplitude Pulse Triggering

Trigger the pulse signal that has passed one trigger level but has failed to pass another one, as shown below.

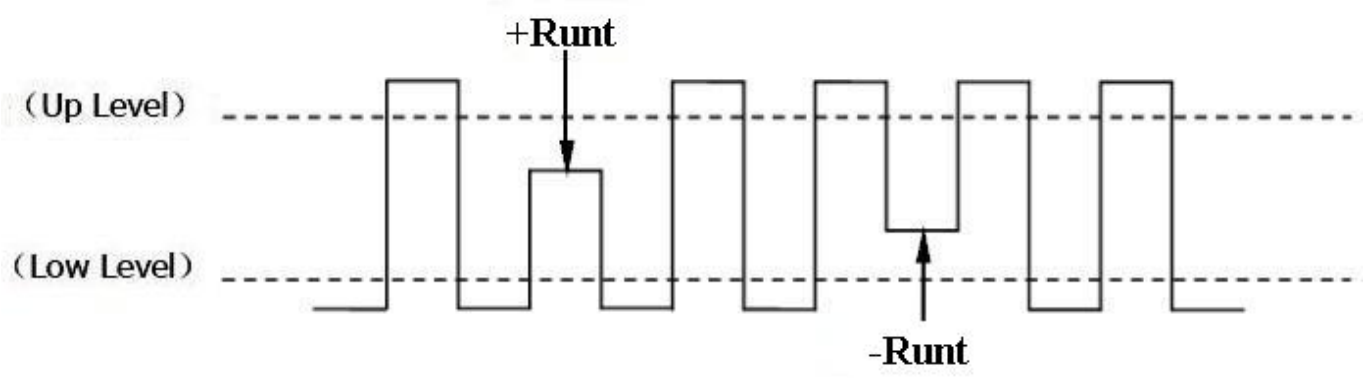


Fig. 2-22 Schematic Diagram for Less Amplitude Pulse Triggering

Trigger Type

Press TRIGGER MENU key, then press F1, after that, turn "MULTIPURPOSE" knob to select trigger type. Press "MULTIPURPOSE" knob down to select less amplitude pulse triggering.

Signal Source

Press F2 to switch among trigger source where you can choose one from CH1, CH2, EXT, EXT/5, AC LINE and ALTER. Once complete the setting, current signal source will be displayed at a lower position of the screen.

Notes: Only by selecting those channels that has signal input as the source for triggering, can we get reliable triggered waveform.

Pulse Polarity

Press F1 to select the pulse polarity that can arouse less amplitude pulse triggering.

Negative polarity: trigger on negative less amplitude pulse.

Positive polarity: trigger on positive less amplitude pulse.

Triggering Condition

Press F2 to set triggering condition for less amplitude pulse triggering.

Irrelevant: do not set triggering condition for less amplitude pulse triggering.

>: Trigger when the less amplitude pulse width is larger than the preset lower limit of pulse width.

<: Trigger when the less amplitude pulse width is smaller than the preset upper limit of pulse width.

=: Trigger when the less amplitude pulse width equals the preset pulse width.

Notes: UTD2202HM&CM does not have less amplitude pulse triggering.

2.4.6 Trigger Hold Off Settings

The function of trigger hold off is to observe complicated waveform (i.e. pulse string). Hold off time refers to the waiting time before oscilloscope restarts its trigger circuit. During such time, the oscilloscope won't be triggered until such time ends. For example, see Fig. 2-23, which is a pulse string. If we demand trigger to occur at the first pulse of this pulse string, then we can set hold off time to be the width of this pulse string.

Table 2-14 Trigger Hold off Menu

Menu	Setting	Description
Window	——	Press F1 key to enter into "main window"
Window Expansion	——	Enter into window expansion menu, see Table 2-8
Hold off	96.0000ns～1.50000s	Use "MULTIPURPOSE" to adjust hold off time

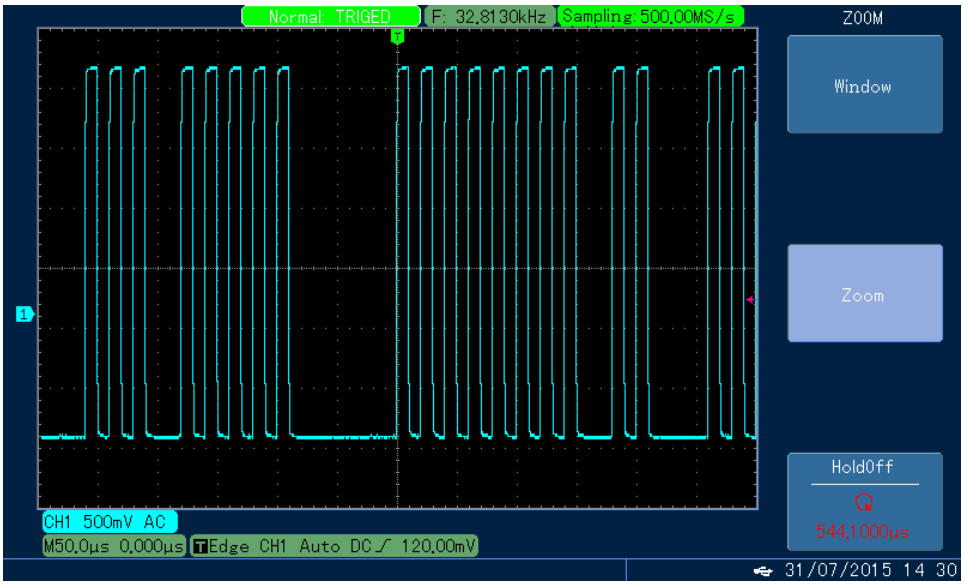


Fig. 2-23 Trigger Hold off for Synchronization of Complicated Waveforms

Operational Instructions

1. Firstly, we use the method for the synchronization of normal signal, which is to select “edge” and “trigger source” from “trigger menu”, and adjust trigger level, thus trying the best to stabilize the waveform display.
2. Press horizontal MENU key to display horizontal menu.
3. Change the hold off time by turning “MULTIPURPOSE” knob located on the upper part of the unit panel till the waveform display has been stabilized.

Operation Skills: Normally, the hold off time is slightly less than the time of “major cycle”, i.e. when observing the waveform for RS232 communication signal, if the hold off time is set to be slightly more than the edge starting time of each frame of data, it will be easier to observe.

Definitions

1. Trigger Source: it is used to generate trigger signal. A variety of signal source can be used as trigger source: CH1, CH2, EXT, EXT/5, AC LINE, etc.

■ Input channel: The most commonly used trigger source is either CH1 or CH2. When a channel is selected as the trigger source channel, we ignore whether or not its input waveform has been displayed.

■External trigger: trigger signal can be input directly through input end of external trigger, i.e. we can use an external clock or signal from circuit under test as the trigger source. EXT trigger receives external trigger signal via input end of “EXT TRIG”, which is settable for signal with trigger level between -0.8V and +0.8V. When the source is “EXT/5”, EXT trigger signal has been divided by 5 to expand the scope of trigger level to “-4V~+4V”, thus to enable the input of relatively larger signal during external triggering.

■AC LINE: mains supply, such trigger mode can be used to observe signal related to mains supply, i.e. the relation between lighting equipment and power provision equipment, hence to acquire stable synchronization.

2. Trigger mode: it determines the act of an oscilloscope when a trigger occurs. This oscilloscope provides three kinds of trigger modes: auto, normal and single.

■ Auto trigger: When there is no input of trigger signal, the system runs and collects data automatically while displaying them; when there is any trigger signal, it automatically switches into trigger scanning, thus to

synchronize with the signal.

Notes: Under this mode, it allows the occurrence of a rolling waveform that has no trigger signal at 50ms/div or even slower time base.

■ Normal Trigger: Under such mode, oscilloscope captures a waveform only when the trigger condition is satisfied. The unit will stop collecting data and waiting to be triggered when there is no trigger signal. Once there is a trigger signal, it starts trigger scanning.

■ Single Trigger: When the unit is in this mode, it starts to wait the trigger once the "Run" key is pressed by a user. When the unit detects a trigger, it takes samples and displays the waveform it has taken and then stops.

3. Trigger Coupling: it determines what components of a signal are being transmitted to trigger circuit. Couplings include DC, AC, low frequency reject and high frequency reject.

■ "DC" allows all components of a signal to pass.

■ "AC" blocks "DC" component and attenuates signal of less than 10Hz.

■ "Low frequency reject" blocks DC component and attenuates any low frequency component that is less than 80 KHz.

■ "High frequency reject" attenuates any high frequency component that is higher than 80 KHz.

4. Pre-trigger/Delayed Trigger: It refers to the data collected before/after a trigger event. Normally, trigger position is set at the horizontal center of a screen where you can observe pre-trigger and delayed trigger information up to 6 div. There you can adjust the horizontal displacement by turning "POSITION" knob (for horizontal displacement), thereby to check more pre-trigger information. By observing pre-trigger data, users can observe the waveform condition before trigger, i.e. to capture the burrs produced at the startup of a circuit, by observing and analyzing pre-trigger data, it helps us to find out the cause of burrs.

2.5 Sampling System Settings

As shown below, ACQUIRE key located in the control area is the menu key for sampling system.

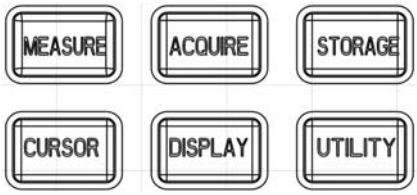


Fig. 2-24 Function Keys for Sampling System

Once ACQUIRE key is pressed, it pops out the sampling setting menu, which can be used to set the sampling mode.

Table 2-14 Sampling Menu

Menu	Setting	Description		
Acquiring Mode	Normal Sampling Peak Detection Average High Resolution	Normal sampling mode Peak detection mode, which is used to detect burrs and to reduce the possibility of having false waveform; Set average sampling mode and display average times; Set high resolution display;		
Sampling Mode	Equivalent Real time	It requires multiple times of repeated sampling before acquiring the sampling data needed to form a waveform; Acquiring all data needed to form a waveform during a single triggering.		
Memory Depth	Normal	Normal memory depth: 6kpts		
	Deep Memory	Memory Depth	Bandwidth≤100MHz	16Mpts or 32Mpts
			Bandwidth>100MHz	8Mpts or 16Mpts
快速采集 Fast Sampling	On Off	Fast sampling is enabled if it is on. By fast sampling, it only takes samples with minimal memory depth, which are needed for displaying, as a result, it realizes continuous and super high waveform capture rate.		
Average Times (when using average sampling)	2～512	Set average times, which steps from the multiple of 2, i.e. 2, 4, 8, 16, 32, 64, 128, 256 and 512. Use “MULTIPURPOSE” knob to change average times.		

2.5.1 Acquiring Mode

Change the acquiring mode settings and observe the consequent change in waveform display.

Normal Sampling:

Under this mode, oscilloscope takes signal samples at an equal time interval so as to rebuild a waveform. For most waveforms, it ensures best displaying effect with the use of mode.

Peak Detection

Under this mode, oscilloscope takes both the maximum and minimal signal values within the sampling interval so as to acquire signal envelopes or narrow pulses that might be lost. Though the use of this mode can avoid signal aliasing, the noise displayed is relatively large.

Under this mode, oscilloscope can display all pulses with pulse width at least equals to sampling period.

The use of peak detection mode can effectively reduce the appearance of false waveform.

Average

Under this mode, oscilloscope will average the waveform samples taken repeatedly to reduce the random

noise in input signal and to improve vertical resolution. The more the times of averaging, the smaller volume the noise and the higher the vertical resolution, but the waveform being displayed also responses slower to the change of waveform.

Once “average mode” is selected, turn “MULTIPURPOSE” knob to set the times of averaging needed, which is available in 2, 4, 8, 16, 32, 64, 128, 256, 512 and 1024 with default setting, 2.

In case a large amount of noise is contained in the signal, if it takes no average mode or takes 32nd power of 2 times of averaging, then respectively, waveforms sampled are shown in below Fig. 2-25 and Fig. 2-26.

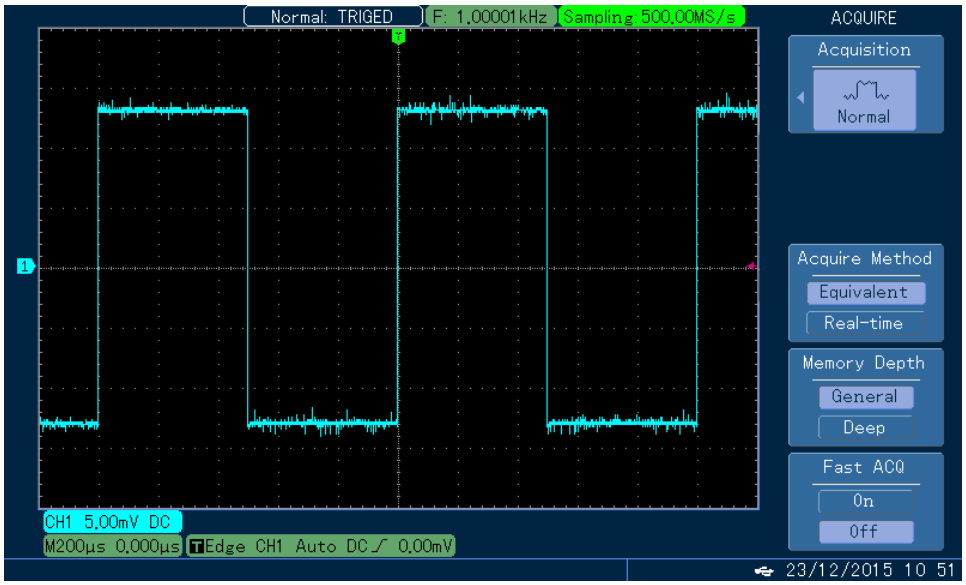


Fig. 2-25 Waveform Sampled without the Use of Averaging

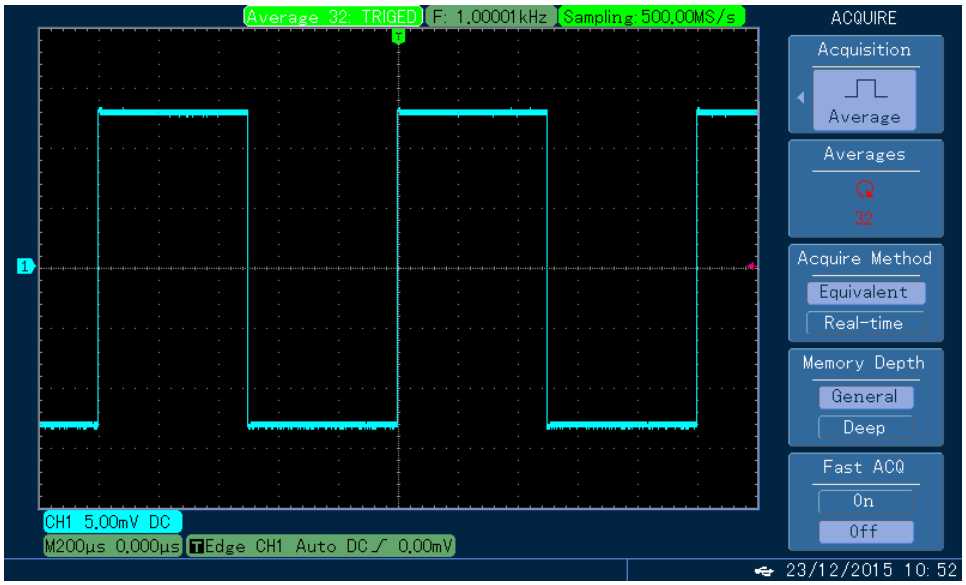


Fig. 2-26 Waveform Sampled Taking 32nd Power of 2 Times of Averaging

High Resolution

This mode adopts super sampling technology that averages the proximal points of waveform being sampled. In this way, it reduces the random noise in the input signal and displays an even more smooth waveform on the screen. It is commonly applied in such circumstance where the sampling rate of digital converter is higher than the saving rate of sampling memory.

Notes: The average methods used by “average” and “high resolution” modes are different as the former is an average of repeat sampling, while the latter is an average of single sampling.

Notes: UTD2202HM&CM has no “high resolution” setting in terms of acquiring mode.

2.5.2 Sampling Mode

If the time base falls in between 20ns/div and 2ns/div, the data being displayed then has exceeded the sampling rate of 1GS/S, so equivalent sampling mode should be adopted to perform repeat sampling in order to acquire the sample data required for the display of a waveform.

2.5.3 Memory Depth

If users intend to observe more details of a waveform, they are suggested to use “deep memory”, which provides them with details of waveforms under expanded window, and will not cause failure to see details of a waveform due to the larger frequency it has. Under deep memory mode, the window can be expanded to 10000 times, whereas in normal mode, this figure is only 10. See blow Fig. 2-21 and Fig. 2-22.

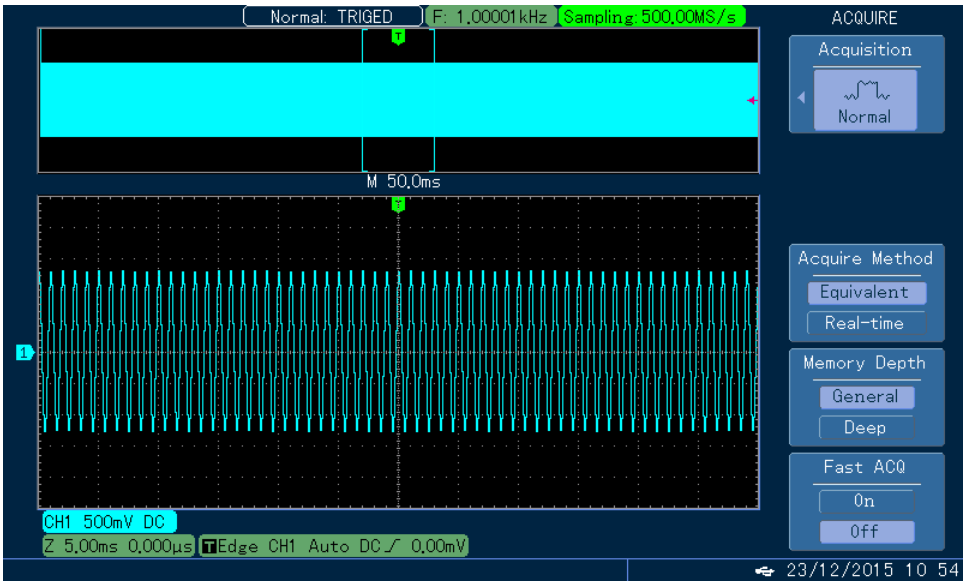


Fig. 2-27 Waveform Expanded under Normal Mode

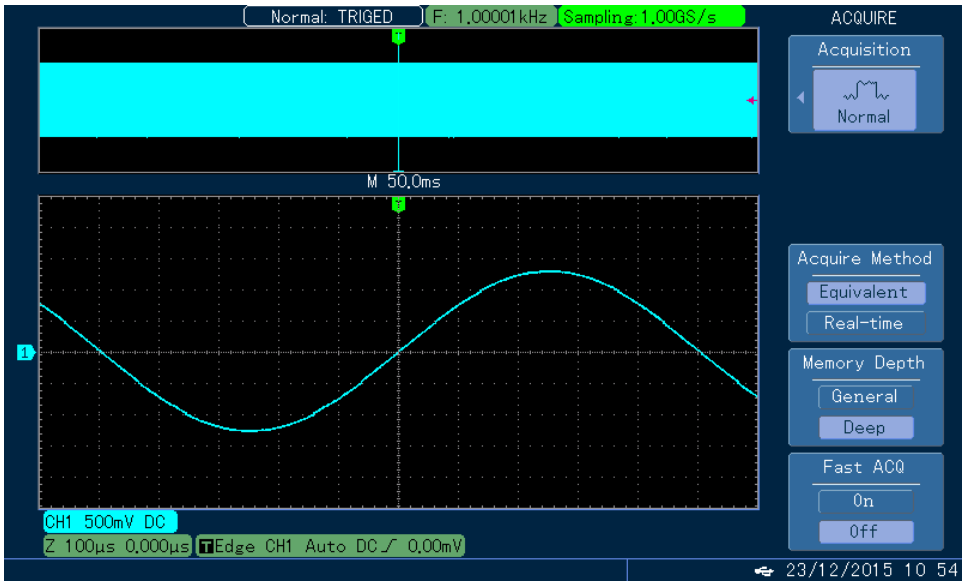


Fig. 2-28 Waveform Expanded Under Deep Memory

Notes:

If intend to observe signal envelopes and avoid signal aliasing, please use peak detection mode.

If time base is slower than 100ms/div, and hence need to adopt deep memory, the trigger mode has to be set to normal or single.

Deep memory and fast sampling can not be opened at the same time.

2.5.4 Fast Sampling

Fast sampling allows users to capture waveform rapidly. With this function, the unit can capture 150,000 waveforms per second (150,000 wfms/s), making it possible for users to see burrs and other accidental transient signal within a few seconds. Refer to Fig. 2-29 and Fig. 2-24 respectively for unit with fast sampling off and on.

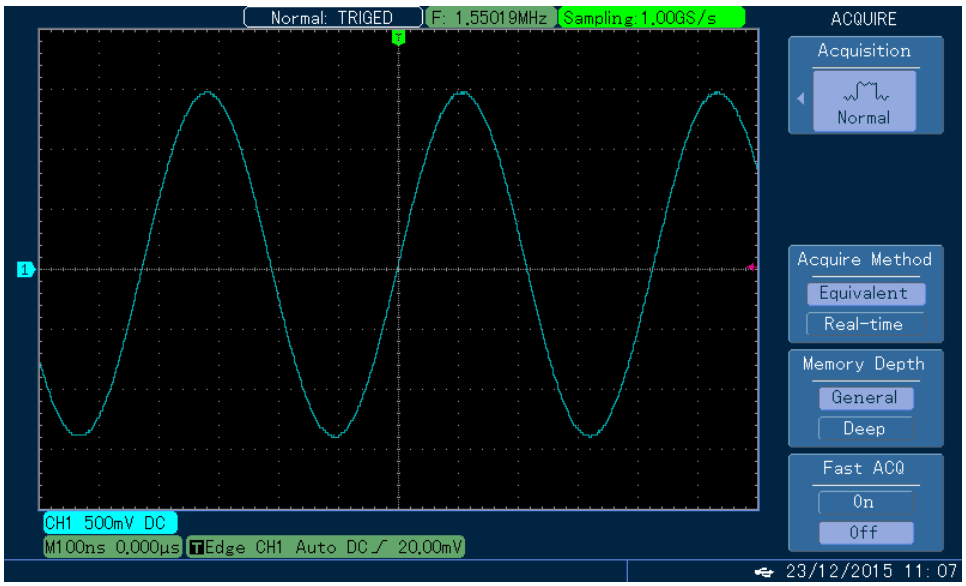


Fig. 2-29 Waveform with Fast Sampling off

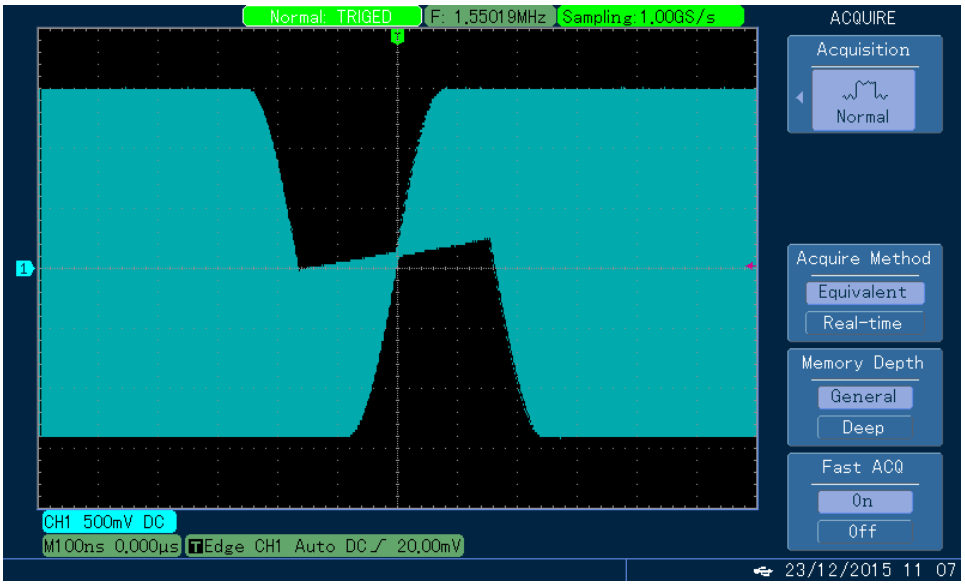


Fig. 2-30 Waveform with Fast Sampling on

Notes:

To see more details of a waveform, please use “deep memory”.

To capture some abnormal signal, please use “fast sampling mode”.

For single channel, fast sampling is effective only for a sampling rate between 1ms/div and 100ns/div, while for dual channel, fast sampling is effective only for a sampling rate between 1ms/div and 200ns/div.

Definitions

Real-time Sampling: one time sampling of all data needed. The highest real time sampling rate of unit is 1GS/s.
Normal Mode: “Normal Sampling Mode” can be used in any time base for fastest sampling. Normal Mode is the default model.
Peak Detection Mode: Under this acquiring mode, oscilloscope picks up both the maximum and minimal values within each sampling interval of an input signal and then use these values for waveform displaying. In this way, it allows an oscilloscope to acquire and display narrow pulse. Otherwise, these narrow pulses would have been omitted if it is under normal mode, but the noise also appears to be larger while under such mode.
Average Mode: Under this mode, oscilloscope will acquire a few waveforms and calculates their average value before displaying final waveform. For periodic signal, we can use this method to reduce random noise.
High Resolution: Process the acquired waveform with software (average a series of data taken from the waveform into a point for displaying) and then display the final waveform. Resolution can be improved with the use of this mode so as to help read from the screen.
Equivalent Sampling: All data needed which are acquired through repeat sampling using low sampling clock equals to data acquired using high sampling clock.
Memory Depth: Generally, it refers to the maximum data length among a screen of data acquired.
Fast Sampling: it only takes samples with minimal memory depth, which are needed for displaying, as a result, it shortens the stop time during waveform sampling, realizes continuous and super high waveform capture rate and improves the probability of finding rare problematic incidents.

2.6 Display System Settings

As shown below, DISPLAY key located in the control area is the function menu for display system.

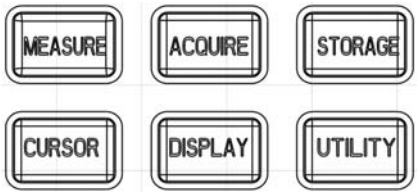


Fig. 2-31 Display System Menu Key

Press DISPLAY key to pop out the setting menu shown in below table and adjust the display mode through this menu.

Table 2-15 Display Menu

Menu	Setting	Description
Type	YT XY	Display voltage value relative to time (Horizontal Scale) X-Y Display Mode
Format	Vector Point	Sampling points are shown by their connecting lines. Direct display of sampling points
Grid	Full, Grid, Cross-hair, Frame	Set the grid displaying mode for waveform displaying area to be full, grid, cross-hair or frame.
Continue	Auto Short persistence Long persistence Infinite	Waveform being displayed updates by normal refresh rate; Waveform data being displayed holds for a short period of time before updates; Waveform data being displayed holds for a long period of time before updates; Original waveform data being displayed remains so and displays along with any new data included till this function is shut off.

X-Y Mode

Under this mode, horizontal axis (x-axis) displays the voltage of CH1, while the vertical axis (Y-axis) displays the voltage of CH2.

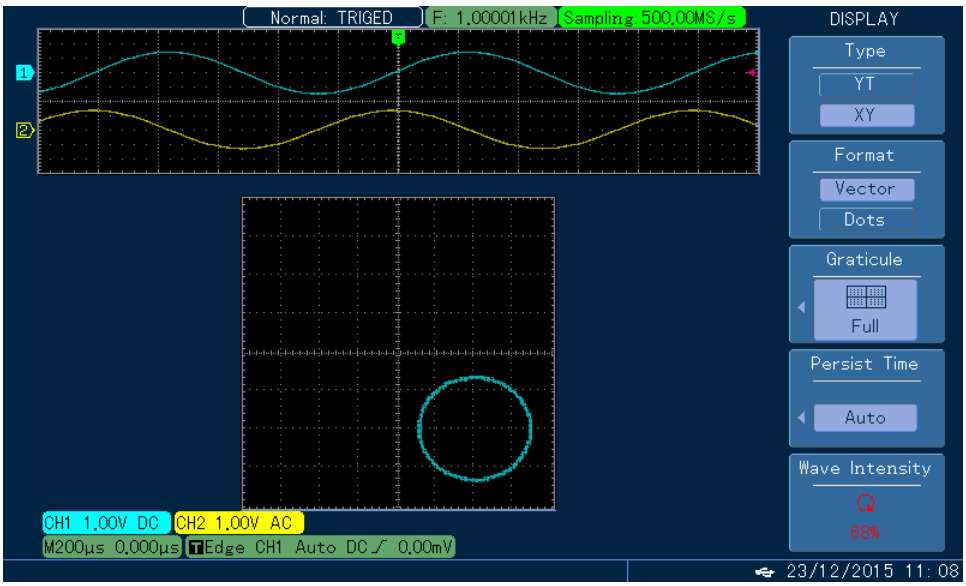


Fig. 2-32 Waveform Display under X-Y Model

Notes:

Under X-Y mode, we use “POSITION” knob (for displacement in channel 1) to move XY graphic in horizontal direction and use “POSITION” knob (for displacement in channel 2) to move XY graphic in vertical direction. The

size and shape of XY graphic can be adjusted via “SCALE” knob for both channels. Changing time base can acquire a Lissajous pattern with good displaying effect.

With its unique X-Y display mode, it can display waveform in a channel and X-Y Lissajous pattern simultaneously. In addition, this series of units also have following functions, for example,

- Auto Measuring Function
- Cursor Measuring Function
- Reference or Mathematical Function

Following Functions are not Effective under X-Y Mode

- Window Expansion Function
- Horizontal “POSITION” knob

Key Points

Display Format: “Vector Display” will fill in the blank area between proximal sampling points, while “Point Display” only displays sampling points.

Waveform Capture Rate: waveform capture rate refers to the waveform refreshing times per second and it impacts the unit’s capability to display the dynamic change of signal rapidly.

2.7 Storage System Settings

As shown below, STORAGE key located in the control area is the function menu for storage system.

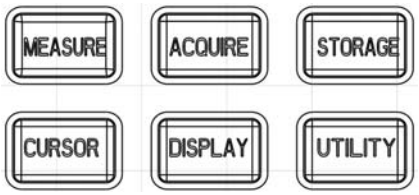


Fig. 2-33 Storage System Menu Key

Press STORAGE key to display storage system settings where it allows you to save a waveform shown on the oscilloscope or the unit’s settings into the internal storage or U-disk, and reload the saved waveform from “REF A” or “REF B” submenu or reload the saved settings from certain submenu. After U Disk is inserted, waveform displaying area can then be saved into the U-disk in the format of bitmap.

Operation Steps:

Press STORAGE key to enter into “submenu”, including reference waveform, settings and bitmap.

1、 Select “Reference Waveform” submenu to enter into “Reference Waveform Storage Menu” shown below, See Table 2-16; After the reference waveform is saved, reload the same using “REF” key (reference waveform, page XX). See REF-operation steps for details.

Table 2-16 Reference Waveform Storage Menu

Menu	Setting	Description
Type	Reference waveform	Select the waveform being displayed for signal source
Signal Source	CH1 CH2	Set that the waveform is from CH1 Set that the waveform is from CH2
Save	1～10	Save the reference waveform into internal storage of the unit. Select storage location using “MULTIPURPOSE” knob

		and press down the same to confirm.
Export	See Table 2-17	Enter into USB Menu

Table 2-17 Exportation of Reference Waveform – USB Menu

Menu	Setting	Description
File Name	——	Use both "MULTIPURPOSE" knob and "F1" key to set the name of the reference waveform file, which is to be exported into U-disk.
File Format	CSV, Internal	See "Remark"
Confirmation	——	Once confirmed, return to the "Reference Waveform Storage Menu". If there is a connected U-disk, export the same to U-disk, otherwise, a prompt message, "function is not available, please insert U-disk" will appear at the lower left corner of the screen.

Remark:

On "internal" and "CSV" format: When the "reference waveform is to be exported to U-disk, users can choose between "internal" and "CSV" format. A file in "internal" format can be imported into an oscilloscope to display from "REF" menu, but can not be displayed on any other medium, while a file in "CSV" format can be opened by a computer in the format of EXCEL, which is a group of two dimensional data on relation between voltage and time.

2、Select "Settings" to enter into "Settings Storage Menu", See Table 2-18.

Table 2-18 Settings Storage Menu

Menu	Setting	Description
Type	Settings	Save current panel settings
Save	1～10	Save settings into internal storage. Select storage location using "MULTIPURPOSE" knob and press down the same to confirm.
Load	1～10	Load 10 storage positions from the instrument. Use "MULTIPURPOSE" knob to choose one from them and press down the same to confirm.
Import	——	List of Setting Files pops up once U-disk is connected
Export	See Table 2-19	Enter into USB menu

Remark:

After U-disk is connected to the oscilloscope, choose "import". If there are corresponding saved setting files in the root directory of U-disk, the oscilloscope will pop up relevant dialog box, listing all saved setting files in the root directory of U-disk. Use "MULTIPURPOSE" knob to choose one saved settings and press down the same to confirm. In case no U-disk has been inserted, it will prompt "no valid data".

Table 2-19 Settings Exportation – USB Menu

Menu	Setting	Description
File Name	——	Use both "MULTIPURPOSE" knob and "F1" key to set the name of the "setting file", which is to be exported into U-disk.
Confirmation	——	Once confirmed, return to the "Settings Storage Menu". If there is a connected U-disk, export the same to U-disk, otherwise, a prompt message, "function is not available, please insert U-disk" will appear.

3、 Select “Bitmap” to enter into “Bitmap Exportation Menu”, see Table 2-20

Remark: Bitmap format file can only be exported into a U-disk.

Table 2-20 Bitmap Exportation Menu

Menu	Setting	Description
Bitmap	——	Export the waveform being display into U-disk in the format of bitmap.
Export	See Table 2-21	Enter into USB menu

Table 2-21 USB Menu

Menu	Setting	Description
File Name	——	Use both “MULTIPURPOSE” knob and “F1” key to set the name of the file, which is to be imported from U-disk.
Confirmation	——	Once confirmed, return to the “Settings Storage Menu”. If there is a connected U-disk, export the same from U-disk, otherwise, a prompt message, “function is not available, please insert U-disk” will appear.

4、**One key Print Screen**

Insert a U-disk into the Oscilloscope and then press PrScrn key. The screen image will be saved into U-disk readily under a default file name of DSO***.BMP.

2.8 Auto Measuring

As shown below, MEASURE key is for auto measuring function. The following introduction will help you get familiar with the powerful auto measuring function provided by this UTD2000CM series digital storage oscilloscope.

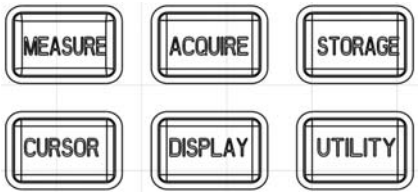


Fig. 2-34 Measuring Function Menu

Operational Instructions:

Operational instructions: First to press MEASURE key, the screen will display four functional options, as shown in Table 2-22:

Table 2-22 Measuring Menu (1)

Menu	Setting	Description
All Parameters	——	Display all measuring parameters; Pressing F5 key will auto shut off all measuring parameters.
Customized	——	Press F2 key, use “MULTIPURPOSE” knob to select all the required

Parameters		parameter and press down to confirm; allow 4 parameters to be displayed simultaneously, which, from left to right, are parameter 1 to parameter 4.
Indicator	——	It uses a “line” to show the physical significance of the measuring parameters intuitively; turn on the indicator and choose the parameter to be indicated from parameter 1 to parameter 4.
Clear	——	Clear all customized parameters
Next Page		Enter into next page

Table 2-23 Measuring Menu (2)

Menu	**Setting**	**Description**
Advanced Parameter	Delay Phase	Time interval between rising and falling edges of a waveform in any channel, see Table 2-24 and 2-25.
Previous Page		Return to previous page

Table 2-24 Delay Menu

Menu	**Setting**	**Description**
From	CH1、CH2	Select a channel’s waveform as the reference waveform for a “delay”;
From waveform edge	Rising and falling	Select the midpoint between 10% and 90% of the rising or falling edge of a waveform;
To	CH1、CH2	Select a channel’s waveform as the waveform for “delay” measurement;
To waveform edge	Rising and falling	Select the midpoint between 10% and 90% of the rising or falling edge of a waveform;
Confirmation	——	Complete the selection of measuring points for the measurement of a delayed waveform and return to measuring menu.

Table 2-25 Phase Menu

Menu	**Setting**	**Description**
From	CH1、CH2	Select a waveform in a channel as the reference waveform for a phase.
To	CH1、CH2	Select a waveform in a channel as the waveform for phase measurement.
Confirmation	——	Complete the selection of measuring points for the measurement of a phase differentiated waveform and return to measuring menu.

Customized parameters are for quick parameter measurement. This instrument has 2 additional advanced measurements in addition to 24 general measurement parameters it has. General users may not need to measure all the parameters, but just a few of them. Therefore, users can set those required as customized parameters, which will be shown on the screen.

Refer to steps listed below for selecting and clearing of customized parameter.

1. Press MEASURE key to display auto measuring menu, and then select customized parameter submenu from it,

then the screen will pop up a dialog box for customized parameter selection.

2. Make the selection by turning “MULTIPURPOSE” knob and then confirm the selection by pressing it down. Once you complete the selection of customized parameter, press F5 key to close the dialog box for customized parameter selection.

3. In case a certain measurement choice has to be cleared, i.e. “frequency”, follow the step 1 and select “frequency” from the popped up dialog box for customized parameter selection. Then the “frequency” listed to the bottom of the screen will be cleared.

4. Customized parameters allow the measurement of different channels at the same time. The method is that if CH1 is to be measured, press CH1 for once, then the color of measurement shown in the measurement dialog box turns to blue and all the measurement parameters selected are in blue fonts, see Fig. 2-35. Likewise, press CH2 if the customized parameters are intended for the measurement of CH2, See Fig. 2-36.

Remarks:

When conducting advanced parameter measurement, the advanced parameter selected can not be cleared separately, instead, they must be cleared from the screen with the use of “clear function menu”.

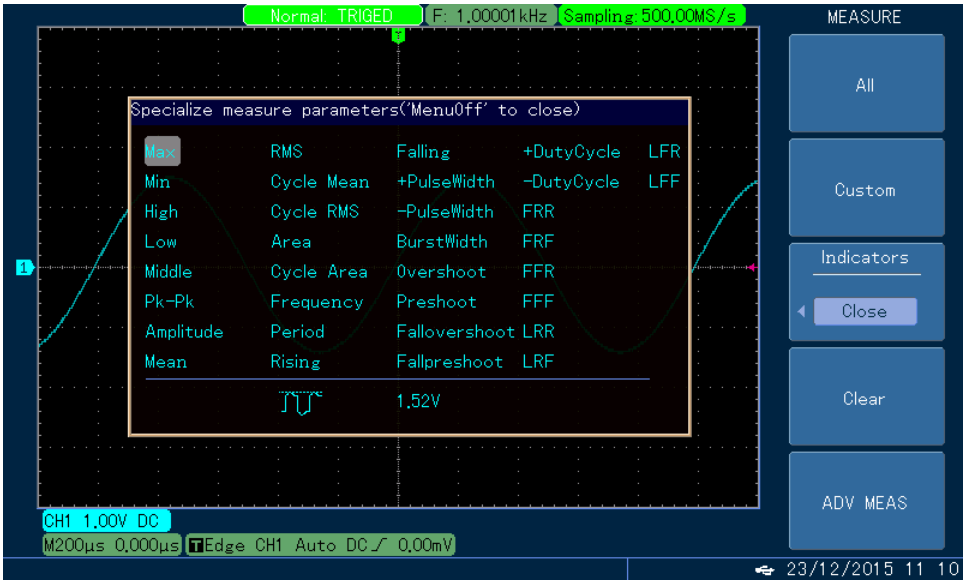


Fig. 2-35 Measuring CH1 Using Customized Parameter

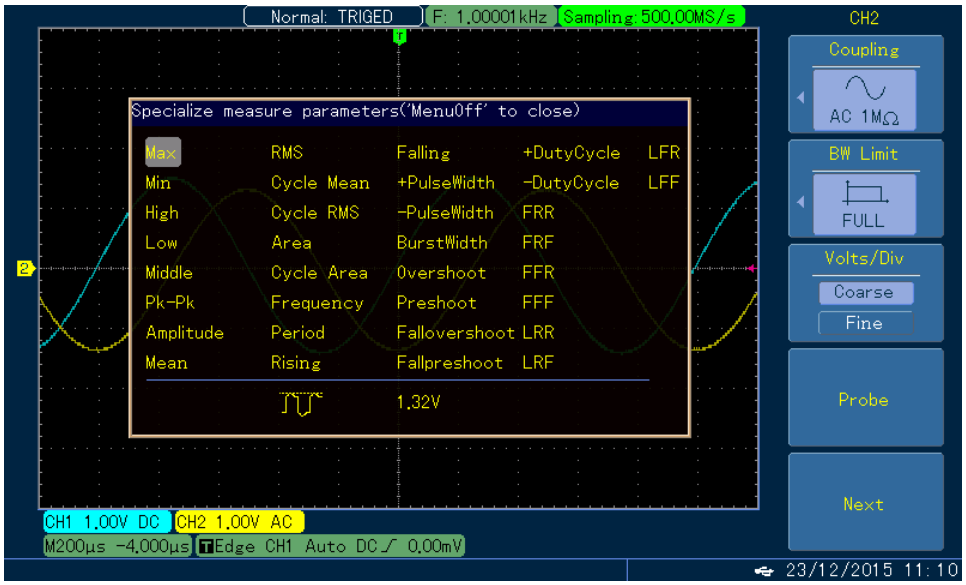


Fig. 2-36 Measuring CH2 Using Customized Parameter

Auto Measuring of Voltage Parameters:

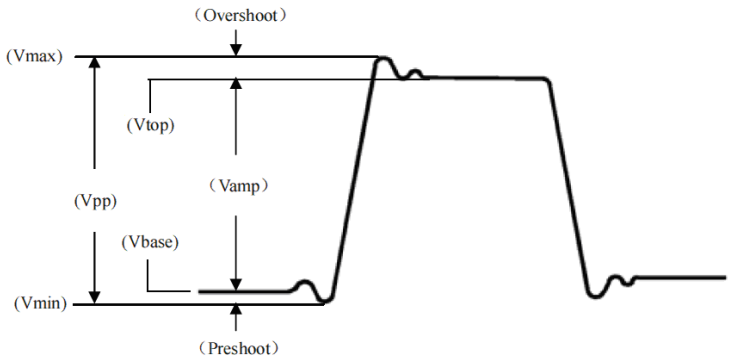


Fig. 2-37 Schematic Diagram for Voltage Parameters

1. Oscilloscopes with bandwidth less than 100MHz can auto measure the following voltage parameters:

Max: The voltage value between the highest point of a waveform and GND.

Min: The voltage value between the lowest point of a waveform and GND.

High: The voltage value between the top of a waveform and GND.

Low: The voltage value between the bottom of a waveform and GND.

Middle: Half of the summed voltage value for “High” and “Low”.

Pk-Pk: The voltage value between the highest and the lowest points of a waveform.

Ampl: The voltage value between the top and the bottom of a waveform.

Mean: Mean amplitude of the waveform being displayed by the screen.

CycMean: Mean amplitude for signal within a cycle.

RMS: RMS of the waveform being displayed.

CycRMS: Namely the RMS, in another word, it is the DC voltage value that may generate an amount of

energy equals to the converted energy which is generated by AC signal within a cycle.

Area: The product of voltage and time for a waveform being displayed by the screen.

CycArea: the product of voltage and time for a waveform being displayed by the screen during a cycle.

Oversht: Ratio between the difference between “Max” and “High” and the amplitude.

PreSht: Ratio between the difference between “Min” and “Low” and the amplitude.

2. Oscilloscopes with bandwidth more than 100MHz can auto measure the following voltage parameters:

Vpp: the voltage value between the highest and the lowest points of a waveform.

Vmax: The voltage value between the highest point of a waveform and GND.

Vmin: The voltage value between the lowest point of a waveform and GND.

Vamp: The voltage value between the top and the bottom of a waveform.

Vmid: Half of the summed voltage value for “High” and “Low”.

Vtop: The voltage value between the top of a waveform and GND.

Vbase: The voltage value between the bottom of a waveform and GND.

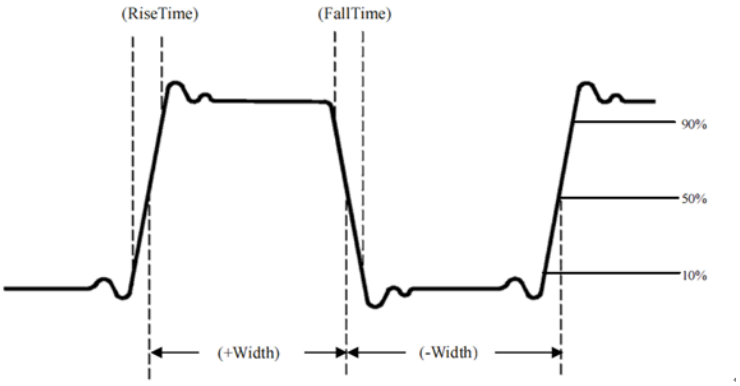
Overshoot: Ratio between the difference between “Max” and “High” and the amplitude.

Preshoot: Ratio between the difference between “Min” and “Low” and the amplitude.

Average: Mean amplitude for signal within a cycle.

Vrms: Namely the RMS, in another word, it is the DC voltage value that may generate an amount of energy equals to the converted energy which is generated by AC signal within a cycle.

Auto Measuring of Time Parameters



UTD2000CM series Oscilloscopes can automatically measure a number of time parameters, including the frequency, cycle, rise time, fall time, positive pulse width, negative pulse width, delay, positive duty ratio and negative duty ratio.

1. Oscilloscopes with bandwidth less than 100MHz can auto measure the following time parameters, followed by their respective definitions:

Rise: Time taken for the amplitude of a waveform to rise from 10% to 90%.

Fall: Time taken for the amplitude of a waveform to fall from 90% to 10%.

Positive pulse width: Pulse width for positive pulse at 50% of amplitude.

Negative pulse width: Pulse width for negative pulse at 50% of amplitude.

Positive duty ratio: Ratio between positive pulse width and cycle.

Negative duty ratio: Ratio between negative pulse width and cycle.

-Overshoot: Ratio between the difference between "Min" and "Low" and the amplitude after waveform falls.

-Preshoot: Ratio between the difference between "Max" and "High" and the amplitude before waveform falls.

BurstWidth: The duration of burst pulse, measure the whole waveform.

FRR: Time between first rising edges of CH1 and CH2.

FRF: Time between the first rising edge of CH1 and the first falling edge of CH2.

FFR: Time between the first falling edge of CH1 and the first rising edge of CH2.

FFF: Time between the first falling edges of CH1 and CH2.

LRR: Time between the first rising edge of CH1 and the last rising edge of CH2.

LRF: Time between the first rising edge of CH1 and the last falling edge of CH2.

LFR: Time between the first falling edge of CH1 and the last rising edge of CH2.

LFF: Time between the first falling edge of CH1 and the last falling edge of CH2.

2. Oscilloscopes with bandwidth more than 100MHz can auto measure the following time parameters, followed by their respective definitions:

RiseTime: Time taken for the amplitude of a waveform to rise from 10% to 90%.

FallTime: Time taken for the amplitude of a waveform to fall from 90% to 10%.

Positive pulse width: Pulse width for positive pulse at 50% of amplitude.

Negative pulse width: Pulse width for negative pulse at 50% of amplitude.

Delay (rising or falling edge): Time delayed between "from waveform" to "to wave" (during advanced measurement)

Positive duty ratio: Ratio between positive pulse width and cycle.

Negative duty ratio: Ratio between negative pulse width and cycle.

2.9 Cursor Measurement

Press CURSOR key to display measurement cursor and cursor menu, and then use "MULTIPURPOSE" knob to change cursor position.

Under CURSOR mode, the cursor can be moved for measurement. There are two modes available, which are the voltage and the time. When measuring voltage, the cursor type has first to be set as voltage, then the positions of the two cursors should be adjusted respectively by pressing "SELECT" key and by turning "MULTIPURPOSE" knob prior to the measurement of ΔV. Likewise, if cursor type has been set as time, we can use them to measure Δt. Cursor also has another two modes, which are independent and tracking. Under independent mode, we can

adjust the positions of those two cursors separately, while under tracking mode, we can realize the simultaneous movement of the two cursors by pressing "SELECT" key.

Table 2-26 Time - Cursor Measurement Menu

Menu	Setting	Description
Type	Time	Cursors are used to measure time
Mode	Independent Tracking	Either cursor can be moved separately; Two cursors can be moved simultaneously, while maintaining Δt unchanged;
Vertical Unit	Second Hz % phase	Measurement parameter is time measurement parameter is frequency measurement parameter is percentage measurement parameter is phase

Table 2-27 Voltage – Cursor Measurement Menu

Menu	Setting	Description
Type	Voltage	Cursors are used to measure voltage
Mode	Independent Tracking	Either cursor can be moved separately; Two cursors can be moved simultaneously, while maintaining ΔV unchanged;
Horizontal Unit	Base %	Measurement parameter is voltage measurement parameter is percentage

Remarks

1. While the unit is in independent or tracking mode, use "MULTIPURPOSE" knob to select one cursor. The selected cursor is in full line and turn "MULTIPURPOSE" knob to move cursor position.

2. Percentage has two optional settings. The reason current position is set to be 100% is because Δ value between two cursors is set to be 100%, which is one be 0%, while the other one be 100%. The reason 6-grid position is set to be 100% is because the area within ±3div of the screen is set to be 100%.

3. When cursor function is opened, measurement value will be displayed on the upper left corner of the screen. @ is the selected cursor value.

2.10 Auxiliary Function Settings

2.10.1 Use of "UTILITY" Key

Utility Key located in function menu area is the key for auxiliary functions.

Press "UTILITY" key to pop up auxiliary function setting menu.

Table 2-28 Auxiliary Function Menu (1)

Menu	Setting	Description

System Configuration	Auto Calibration System Information Clear Information Time Settings Factory Settings Contrast Ratio	Run auto calibration; Display unit mode, version, serial number, etc.; Delete reference waveform and settings saved; Enter into time and date settings, see Table 2-28 Restore to factory settings, See Appendix E; Adjust contrast ratio of the screen;
Screen Configuration	Language Screen Style Menu Display Grid Brightness Return	Use “MULTIPURPOSE” knob to select the language needed and press the same knob to confirm; Classic, tradition and modern; Set the waiting time before a menu is closed automatically. Optional choices are 5s, 10s, 20s and manual. If manual is selected, the unit will not close automatically. It needs to press MENU ON/OFF to close or open it; Use “MULTIPURPOSE” knob to adjust the grid brightness of the displaying area; Return to “auxiliary function menu”;
Pass Detection	Open, close	Detect if the input signal is within the preset scope;
Waveform Recording	See Table 2-27	Setup the waveform recording;
Next Page		Enter into Next Page;

Table 2-28 Auxiliary Function Menu (2)

Menu	**Setting**	**Description**
Frequency Meter	Open & Close	It will be displayed on the top right corner of the screen, see remarks;
AUTO Strategy	See Table 2-36	Conditional settings on the use of “Auto”;
Close Menu	--	Close the menu display shown at the right side of the screen (it can be done by pressing “menu off/on” key.)
Previous Page	--	Return to previous page

Remarks:

Frequency meter is the counter of the frequencies of trigger events that are occurred in the trigger channel. Frequency meter is only valid for edge or pulse width triggering, but can not be used in an alternative mode of trigger source. In addition, the trigger related frequency meter is invalid for video triggering.

Table 2-29 Pass Detection (1)

Menu	**Setting**	**Description**
Allow Detection	Close Open	Open “Pass/Fail” Detection.
Output	Pass Fail	Confirm the buzzer and the output condition of “Pass/Fail” interface located behind the oscilloscope.
Signal Source	CH1 CH2	Choose the signal source under test.
Display Information	Open Close	Choose whether or not to display statistical information on the screen
Next Page	——	Enter into next page

Table 2-30 Pass Detection (2)

Menu	**Setting**	**Description**
Operation	Stop	Stop “Pass/Fail” detection.

	Run	Restart “Pass/Fail” detection and count.
Stop Condition	See Table 2-31	Set a threshold value for time of pass or fail and use it as a condition, when such condition is reached, count and “Pass/Fail” detection will be stopped automatically.
Template Condition	See Table 2-32	Create a template condition for “Pass/Fail” detection.
Return	--	Return to function menu
Previous Page	——	Return to previous page

Table 2-31 Pass Detection (Stop Condition Menu)

Menu	**Setting**	**Description**
Stop Type	Pass Count Fail Count	Set the “stop type” to be “Pass” or “Fail” count
Stop Condition	>= <=	Set “Stop Condition”
Threshold Value	1～10000	Use “MULTIPURPOSE” knob to set the threshold value for “Stop Condition”
Return	--	Return to function menu

Table 2-32 Pass Detection (Template Condition Menu)

Menu	**Setting**	**Description**
Reference Waveform	CH1 CH2 REFA	Take waveform in CH1 or CH2 or REF A as the reference waveform;
Horizontal Tolerance	1～100	Use “MULTIPURPOSE” knob to set;
Vertical Tolerance	1～100	Use “MULTIPURPOSE” knob to set;
Create a Template	--	Create and save a template and return to previous page

Table 2-33 Waveform Recording Menu

Menu	**Setting**	**Description**
▶ (F1)		Playback Key 1、 Once this key is pressed, the unit starts playing back and displays on the screen the number of screens to be played back. Playing back can be terminated by turning “MULTIPURPOSE” knob in the process. Then waveform in screen with any number can be selected and displayed further by using “MULTIPURPOSE” knob. 2 、To continue playback of the whole, press F1 first to stop and then press F2.
■（F2）	——	Stop Recording
●（F3）	——	Recording key. Press this key and then press MENU ON/OFF key based on the displayed information to start the recording. Meanwhile, the number of the screen (maximum number is 100 screens) to be recorded will be displayed on the screen. The

		recorded data will be lost when the unit is turned off. This function is disabled while the unit is in “SCAN” or “AVERAGE” state.

Time 2-34 Time Settings

Menu	Setting	Description
Time Display	Close, Open	Open the time display, which may fail to display if the frequency meter is opened.
Minute & Hour	——	Press F2 to choose to set minute or hour, and then use “MULTIPURPOSE” knob to adjust;
Day & Month	——	Press F3 to choose to set day or month, and then use “MULTIPURPOSE” knob to adjust;
Year	——	Press F4 to select, and then use “MULTIPURPOSE” knob to adjust;
Confirmation	——	Confirm the setting and return to auxiliary menus.

2.10.2 The Use of key lock

In some circumstance, a careless misoperation may well cause the whole measurement to start all over again. UTD2000CM series instruments can help you prevent the occurrence of such accidents by locking some keys or knobs that may not be used conveniently, which is extremely important for beginners.

Detailed Operation Steps:

1、 Press “SELECT” key for two consecutive times, and press HELP key immediately to enter into key lock log in screen;

2、 Once the log in screen appears, enter password in the “password entry field” (the F1-F5 keys shown to the right corresponds to “1-5”) and then select the “log-in button” by turning “MULTIPURPOSE” knob, finally, press “SELECT” key to confirm the log-in. The preset password can be changed to a new one by selecting “change password button”.

Remark:

The initial password of this unit is “12345”;

The universal password of this unit is “35142”

3、 Once log in the key lock, turn “MULTIPURPOSE” knob to select the keys that need to be disabled. Press “SELECT” key to disable or enable those selected keys.

4、 Press MemuOn/Off to return.

Notes: key lock function is not available for UTD2202HM&CM.

2.11 Auto Settings

2.11.1 Auto Settings

Auto settings can be used to simply operation. By pressing AUTO key, this instrument can adjust vertical scale coefficient and horizontal time base based on the amplitude and frequency of a waveform, and display that waveform steadily on the screen. When performing auto settings, the system will perform auto adjustment in accordance with the settings of AUTO strategy. The system is set as followings when AUTO strategy is opened.

Table 2-35 Auto Settings

Function	Open	Lock
Bandwidth Limit	Full bandwidth	Full bandwidth or maintain current settings of 20MHz.
Vertical Scale Coefficient	Adjust in accordance with signal amplitude	Adjust in accordance with signal amplitude
Volts/Grid	Rough tuning	Rough tuning
Phase Reversed	Close	Open, close or maintain current settings
Horizontal Position	Auto Adjustment	Auto Adjustment
Second/Grid	Adjust in accordance with signal frequency	Adjust in accordance with signal frequency
Acquiring Mode	Normal sampling	Maintain one current setting while the unit is in normal sampling, peak value or average state;
Sampling Mode	Equivalent or maintain current settings real-timely	Equivalent or maintain current settings real-timely
Fast Sampling	Close	Close
Trigger Type	Edge	Maintain current setting while the unit is in edge, pulse width, video or slope triggering mode.
Trigger Signal Source	According to signal of CH1 or CH2, see remarks	Maintain current setting while the unit is in CH1, CH2, EXT, EXT/5 or AC Line mode.
Trigger Coupling	Maintain current setting while the unit is in DC, AC, Low frequency reject or high frequency reject mode;	Maintain current setting while the unit is in DC, AC, Low frequency reject or high frequency reject mode;
Trigger Mode	Auto	Auto
Hold Off	Minimum Value	Maintain current setting
Trigger Level	Set to be 50%	Set to be 50%
Slope Type	Rising	Maintain current setting
Signal Identification	Automatically adjust the channel	Currently opened channel

Remarks:

The adjustment of trigger signal source while the Unit is in “AUTO” is based on the following points:

1. If only one channel has input signal, then set the signal input channel as the trigger source.
2. When more than one channel are used, the auto setting function sets the vertical control of each channel and uses the active channel with minimal number to set horizontal and trigger control.
3. If no signal has been found in all channels, then use CH1 channel as the trigger source.

2.11.2 Auto (Auto Settings) Strategy

In actual use, many times, we hope the unit is able to auto set itself the way we want it be. In this sense, auto (auto

settings) strategy seems to be quite important.

Open: Relevant settings restore to default when the unit is switched to AUTO state, and then perform auto settings.

Lock: Relevant default modes will be locked when the unit is switched to AUTO state, and then perform auto settings.

The items that need to be set when enable “auto settings” in “Auto Strategy Menu”, see following table for details:

Table 2-36 Items to be Set for “Auto Settings” (1)

Function	Setting	Description
Channel Settings	Lock Open	Selected channel settings will not be changed when auto setting is enabled; Refer to default settings to do channel settings when auto setting is enabled (See Table 2-35);
Sampling Settings	Lock Open	Selected sampling settings will not be changed when auto setting is enabled; Refer to default settings to do sampling settings when auto setting is enabled (See Table 2-35);
Trigger Settings	Lock Open	Selected trigger settings will not be changed when auto setting is enabled; Refer to default settings to do trigger settings when auto setting is enabled (See Table 2-35);
Signal Identification	Lock Open	Lock: maintain the open or closed state of the channel; Open: Open or close the channel based on whether or not there is any signal input;
Cycle displayed	Single Cycle Multi-cycle	It will display single cycle for any input signal when auto setting is enabled; It will display multi-cycle for any input signal when auto setting is enabled;

Table 2-37 Items to be Set for “Auto Settings” (2)

Function	Setting	Description
Sampling Mode	Normal Sampling	Maintain current setting while the unit is in sampling, peak value or average mode;
Channel Settings	Bandwidth limit: full bandwidth Phase reversed: off	Bandwidth limit: Maintain current setting - full bandwidth or 20MHz. Maintain current setting - reversed phase open or closed.
Trigger Settings	Trigger: Edge Trigger source: automatically searching Trigger mode: auto Trigger edge: rising	Trigger: Maintain current setting while the unit is in edge, pulse width, video or slope triggering mode. Trigger source: maintain selected trigger source unchanged Trigger mode: Auto Maintain trigger setting unchanged
Signal Identification	Automatically searching signal	Do not search signal when the channel is closed
Cycle displayed	Multi-cycle	Waveform will be displayed in multi-cycle when auto setting is enabled.

2.12 The Use of “RUN/STOP” and “MENU ON/OFF” Keys

RUN/STOP Key

On the upper right corner of the unit’s operation panel, there is a key, RUN/STOP, which, once pressed with green light on, shall indicate operation state, otherwise, if red light on, shall indicate stoppage. When in operation state, it indicates that the digital storage oscilloscope is acquiring waveform continuously, with an “AUTO” sign appearing on top of the screen. When in stoppage, the sign, “STOP” appears on top of the screen. This key switches waveform sampling between operation and stoppage.

Menu ON/OFF Key

Display or hide current menu

This oscilloscope can display or hide menu through the use of “**Menu ON/OFF”** key. However, this key is invalid for “help information box”, which can be closed by repressing “HELP” key.

Chapter 3 Application Examples

3.1 Measure simple signals

Observe unknown signal of a circuit and measure and display the frequency and amplitude of that signal rapidly.

1. To display the signal rapidly, please follow the following steps:

①、Set the probe attenuation coefficient to be 10×, and set the switch on the probe to be 10×.

②、Connect probe of CH1 to the measuring point of the circuit.

③、Press AUTO key.

The oscilloscope will run auto setup to achieve best effect of waveform displaying. On this basis, users can further adjust the vertical and horizontal scale till the display of a waveform satisfies your requirements.

2. Voltage and time parameters for auto measuring of signals

Oscilloscopes can measure most of the displaying signals automatically. To measure peak-peak value and frequency of a signal, please follow the following steps:

①、Press MEASURE key so as to display auto measuring menu;

②、Press F2 key to select measuring menu;

③、Use "MULTIPURPOSE" knob to select peak-peak value, press the same to confirm and then choose frequency;

④、Press F5 key to exit select box.

Right now, measurement result of peak-peak value and frequency are displayed at the lower part of the screen respectively, as shown below.

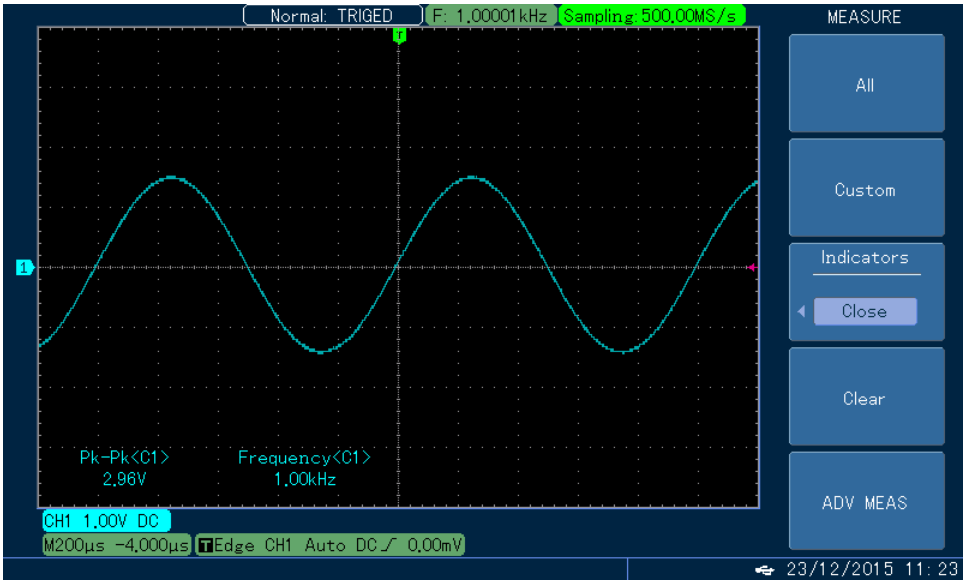


Fig. 3-1 Auto Measuring

3.2 Capture a Single Time Signal

The advantages and features of digital oscilloscope lie in that it can capture non-cycle signal conveniently, including pulse and burr. To capture a single time signal, first of all, users must have certain prior knowledge on that kind of signal so that they can set the trigger level and trigger edge accordingly. For example, if the pulse in question is a logic signal of TTL level, then the trigger level should be set to 2 volts approximately and the trigger edge should be set to rising edge trigger. If users are uncertain about the condition of the signal, they are suggested to observe the signal first through auto or common trigger method so as to confirm the trigger level and trigger edge.

Operational Steps are the followings;

1. Set the probe and the attenuation coefficient of CH1 channel the same way as in the former case.
2. Set trigger settings.

①.Press MENU key located in the trigger control area to display trigger setting menu.

②. While under this menu, use menu operation key, “F1 to F5”, respectively to set the trigger type as edge, signal source as CH1, trigger coupling as DC, trigger mode as single time and slope type as rising.

③. Adjust horizontal time base and vertical scale to a proper scope.

④. Turn “LEVEL” knob to adjust an appropriate trigger level.

⑤. Press RUN/STOP key to start the oscilloscope and let it wait the appearance of a signal that satisfies the trigger condition, in case there is a signal that satisfies the set trigger level, the unit shall take a sample for once and have it displayed on the screen. With this function, occasional events can be easily captured, i.e. sudden burr with relatively large amplitude: the trigger level is set to be a bit higher than normal signal level. Press RUN/STOP key to standby and when the burr appears, the unit will trigger automatically and record waveform for a period before and after the trigger. In order to observe the waveform before the occurrence of burrs easily, negative delayed trigger in different length can be obtained by changing the horizontal position of the trigger position through turning the horizontal “POSITION” knob located on the horizontal control area of the panel.

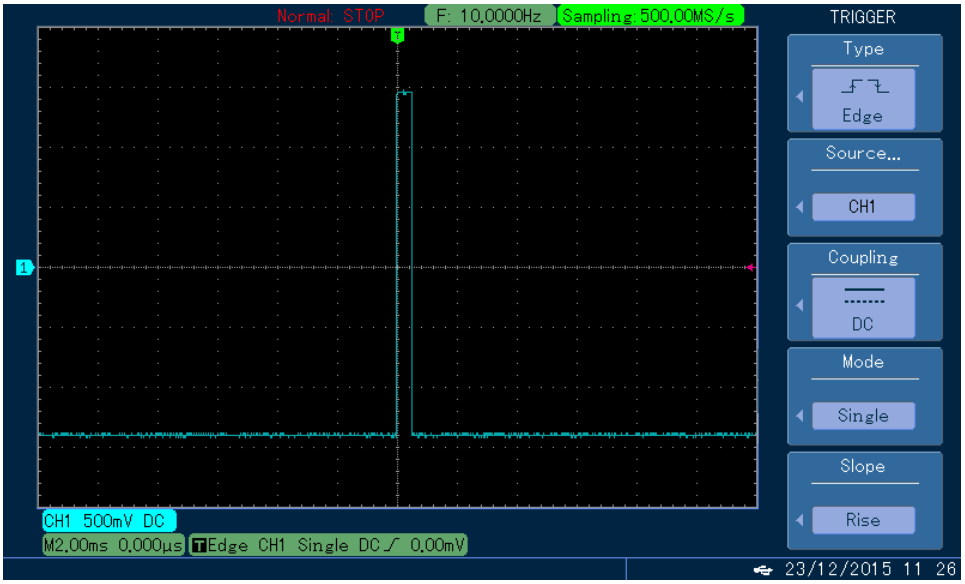


Fig. 3-2 Capture a Single Time Signal

3.3 Reduce Random Noise in a Signal

If the signal under test contains random noise, users can filter or reduce the noise by adjusting the settings of this oscilloscope in order to avoid its interference on subject signal during the measurement (waveform is shown in below picture).

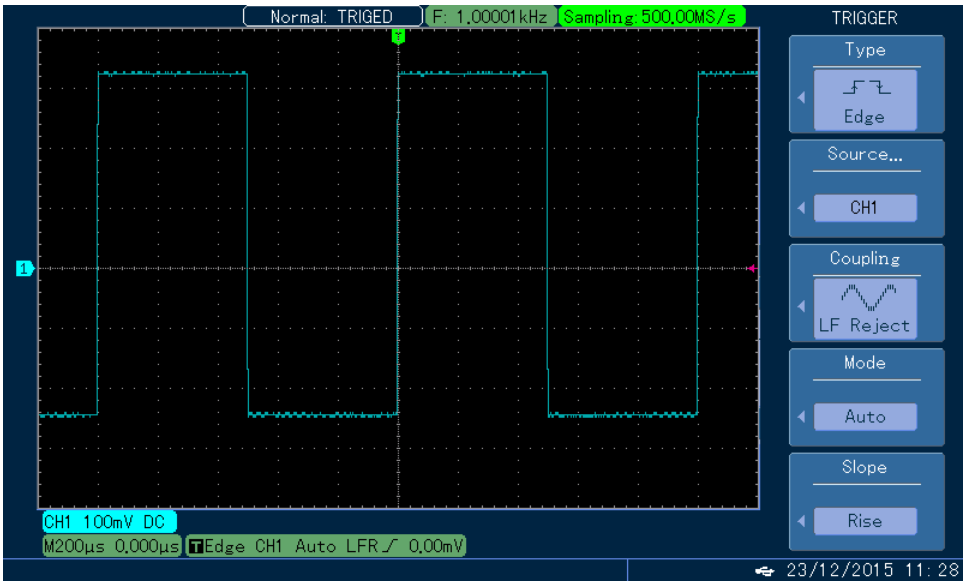


Fig. 3-3 Reduce Random Noise in a Signal

Operation Steps are the followings:

1. Set the probe and the attenuation coefficient of CH1 channel the same way as in the former case.
2. Connect to the signal and make the waveform display steadily on the screen of the Oscilloscope.

Refer to former case for detailed operation. See corresponding descriptions in the foregoing chapters for the adjustment of time base and vertical scale.

3. Improve trigger by setting trigger coupling.

(1). Press MENU key located in the trigger area to display trigger setup menu;

(2). Set trigger coupling in low frequency or high frequency reject. Low frequency reject is about setting up a high-pass filter to filter low frequency signal component that is below 80 Hz and allow high frequency signal component to pass, whereas high frequency reject is about setting up a low-pass filter to filter high frequency signal component that is above 80 Hz and allow low frequency signal component to pass. By setting up the low or high frequency rejects respectively, low or high frequency noise can be rejected, thus to acquire stable trigger;

1. Reduce displayed noise by setting sampling mode

If random noise is contained in the signal under test, it will result in a waveform that is too coarse. Therefore, average sampling method or high resolution should be applied in this case so as to eliminate the display of random noise and make the waveform slimmer for the ease of observation and measurement.

Reduce random noise using average mode

Random noise has been reduced and it is easier to observe details of a signal once average value is taken, detailed operation are:

Press ACQUIRE key located on menu area of the panel to display sampling setting menu. Press F1 and then press “MULTIPURPOSE” knob to set sampling mode to “average” state and press “SELECT” to confirm. Next, adjust the average times by turning “MULTIPURPOSE” knob, which steps forward from 2 to 512, in power of 2 times, till the display of waveform meets the observation and measurement demand (See below picture).

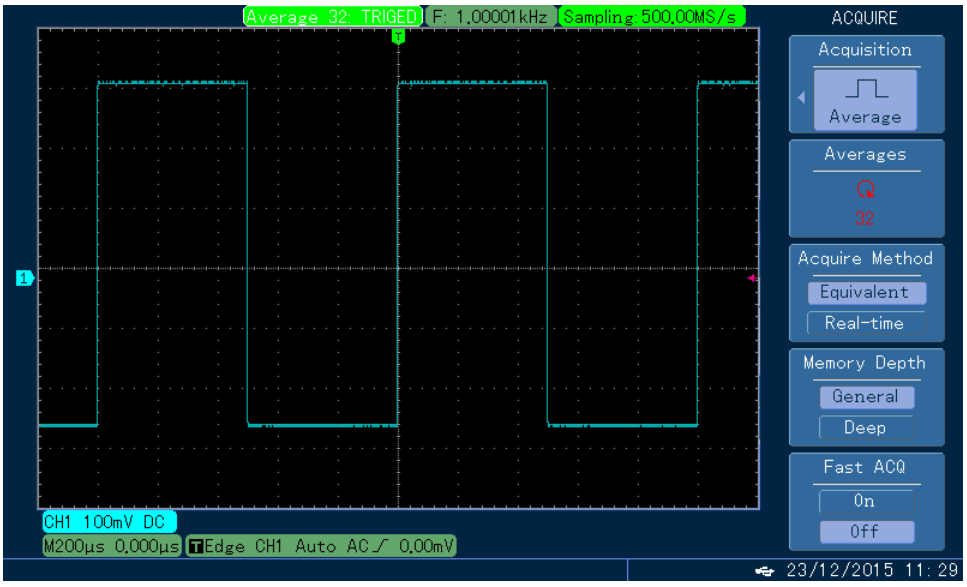


Fig. 3-4 Signal Noise has been Rejected

Notes: The use of average sampling makes waveform display and update slower, as well as having no persistence effect, which is a normal phenomenon.

High Resolution Reduces Random Noise

Average mode has certain defects: the use of average sampling makes waveform display and update slower, as well as having no persistence effect, which is inconvenient for operation under certain circumstance. However, high resolution well overcomes this issue. Average modes used by “average” and “high resolution” modes are not the same, with former being the “average based on multiple samplings” and the latter being the “average based on a single sampling”. Specific operations are:

Press ACQUIRE key located on the menu area of the panel to display sampling setting menu. Press F1 key and then press “MULTIPURPOSE” knob to set sampling mode as “high resolution” and then “SELECT” to confirm. Below is a picture showing random noise has been reduced.

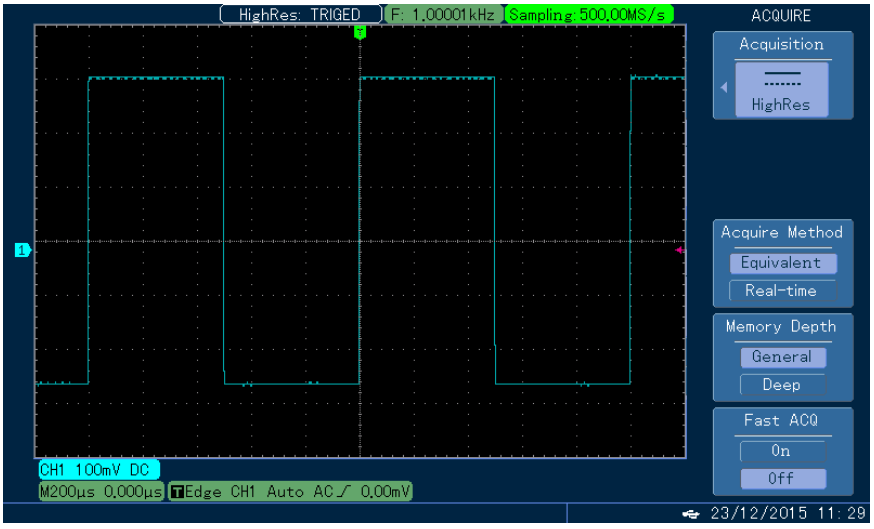


Fig. 3-5 High Resolution Rejects Signal Noise

3.4 The Application of Cursor Measurement

This oscilloscope can automatically measure parameters for 34 kinds of waveforms. All auto measurement parameter can be measured using cursors. Time and voltage parameters of a waveform can be measured rapidly with the use of cursors.

1. Measure a peak frequency of a sine signal

To measure a peak frequency of a sine signal, please follow the following steps:

1）. Press CURSOR key to display “cursor measurement menu”;

2）. Press F1 key to open cursor measurement function;

3）. Press F1 key again to set cursor type to be “time”;

4）. Press F3 key to set the vertical unit as “Hz”;

5）. Use “MULTIPURPOSE” knob to move cursor 1 to the first peak value of the sine signal;

6）. Press “SELECT” to select cursor 2 and then turn “MULTIPURPOSE” knob to move cursor 2 to the second peak value of the sine signal;

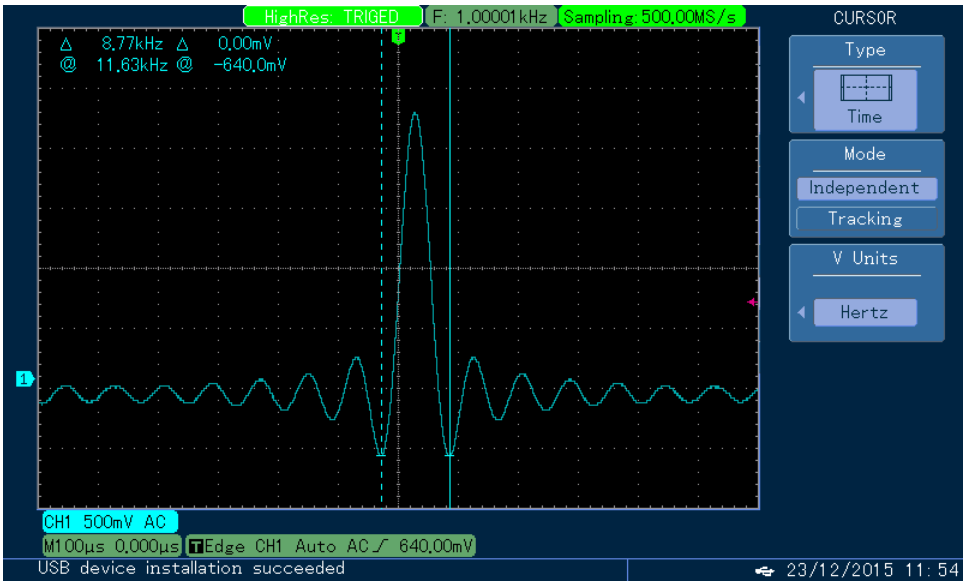


Fig. 3-6 Use Cursors to Measure Signal Frequency

2. Measure Negative Duty Ratio of Pulse Signal

1. Press “CURSOR” key to display “cursor measurement menu”;

2. Press F1 key to open cursor measurement function;

3. Press F1 key again to set cursor type to be “time”;

4. Press F3 key to set the vertical unit as “ratio”;

5. Use “MULTIPURPOSE” knob to move cursor 1 to the first rising edge of the pulse;

6. Press “MULTIPURPOSE” knob down to select cursor 2, and then turn “MUTIPURPOSE” to move cursor 2 to the second rising edge of the pulse;

7. Press F4 and it displays “current position - 100%”, meaning to set△value between current cursor 1 and cursor 2 to 100%;

8. Use “MULTIPURPOSE” knob to move cursor 1 to the first falling edge of the pulse, then the△ value is the negative duty ratio.

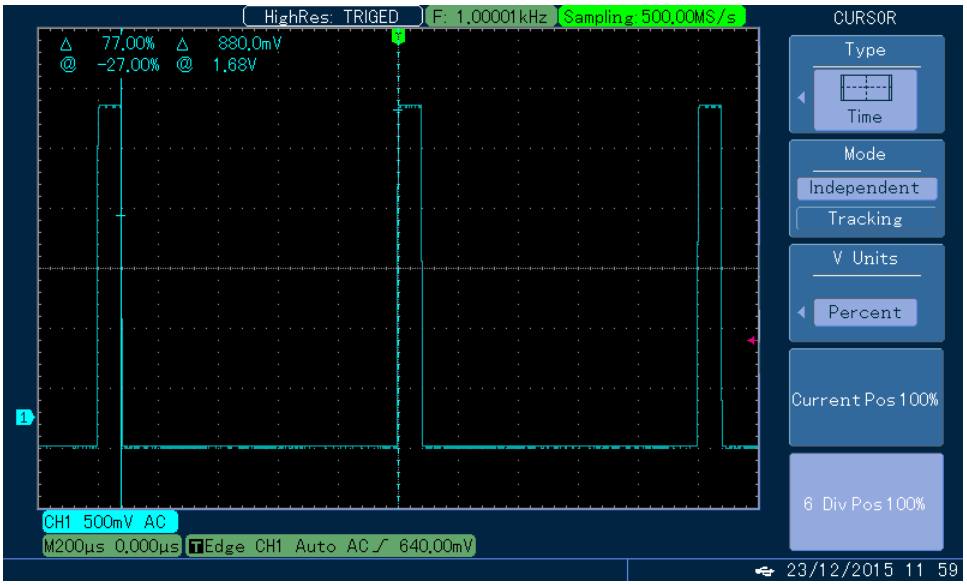


Fig. 3-7 Use Cursors to Measure Negative Duty Ratio of Pulse

3. Measure phase difference of two signals

Measure phase difference caused when a sine signal passes a circuit. In details, CH1 connects to the input signal of the circuit while CH2 connects to the output signal of the circuit. For the ease of measurement, displacements of CH1 and CH2 are set to the midpoints, as shown in Fig. 3-8, and then following below steps to measure:

1. Press “CURSOR” key to display “cursor measurement menu”;
2. Press F1 key to open cursor measurement function;
3. Press F1 key again to set cursor type to be “time”;
4. Press F3 key to set the vertical unit as “phase”;
5. Use “MULTIPURPOSE” knob to move cursor 1 to the midpoint of the first rising edge of the pulse (the cross point with GND of the channel);
6. Press “SELECT” to select cursor 2, and then turn “MUTIPURPOSE” to move cursor 2 to the midpoint of the second rising edge of the pulse;
7. Press F4 and it displays “current position – 360° ”, meaning to set△value between current cursor 1 and cursor 2 to 360° ;
8. Press CH2 and then press CURSOR to set cursor measuring to be targetted at the signal of CH2. Maintain the position of cursor 1 unchanged, but change the position of cursor 2.
9. Use “MULTIPURPOSE” knob to move cursor 2 to the midpoint of the first rising edge of CH2, then the△value is the phase difference between the two signals.

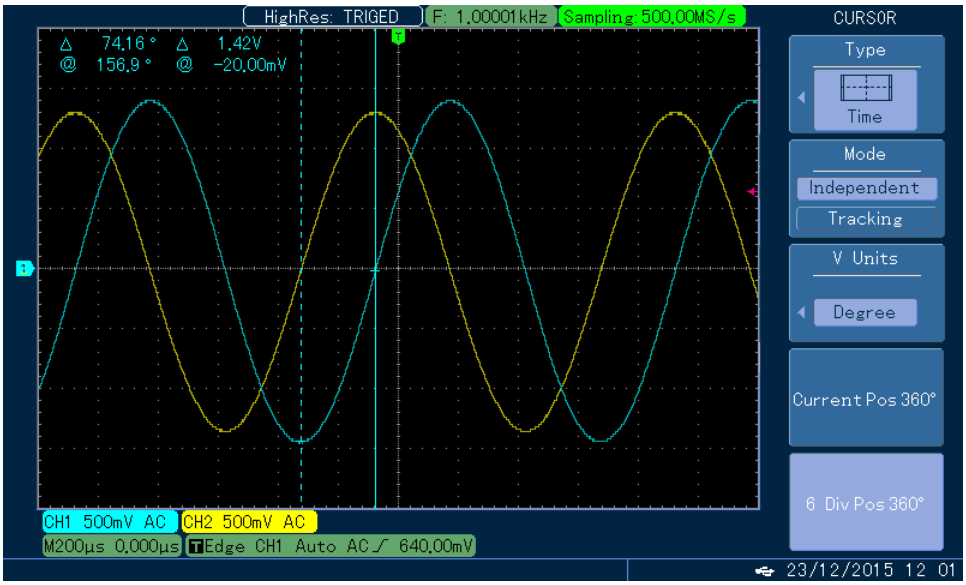


Fig. 3-8 Use Cursors to Measure Phase Difference between two Signals

3.5 The Application of X-Y Function

Check the phase difference between signals of the two channels

Example: Measure phase difference caused when a signal passes a circuit. In details, connect the oscilloscope to the circuit and monitor the input and output signals of the circuit. In case we want to check the input and output of the circuit on X – Y coordinate graphs. Please follow the following steps to operate:

1. Set the probe attenuation coefficient to be 10×, and set the switch on the probe to be 10×;
2. Connect the probe of CH1 to the input of the network, and then connect the probe of CH2 to the output of the network;
3. If channels have not been displayed, then press down CH1 and CH2 menu keys to open the two channels;
4. Press AUTO key;
5. Adjust the “vertical scale knob” to make the amplitudes of the two signals appear approximately equal;
6. Press DISPLAY menu key to load the display of control menu;
7. Press F1 to select X-Y. The oscilloscope will display the input and output characteristics of this circuit in Lissajous pattern;
8. Adjust vertical unit and vertical position knobs to achieve best waveform displaying effect;
9. Observe and calculate the phase difference using ellipse oscilloscopic graphic method.

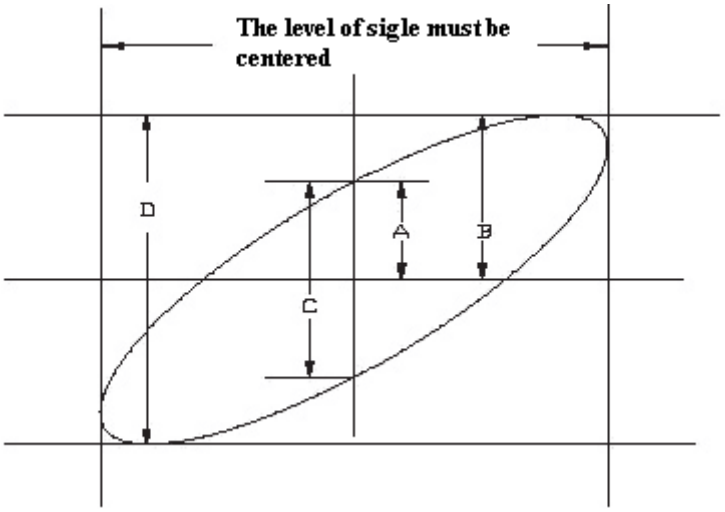


Fig. 3-9 X-Y Schematic Diagram

Based on sin θ =A/B or C/D, among which, θ is the angle of phase difference between channels. See above graphic for the definition of A, B, C and D. Hence we can conclude that the angle of phase difference, θ =±arcsin（A/B） or θ =±arcsin（C/D）. If the principal axis of the ellipse is within quadrant I or III, then the angle of phase difference obtained should be within quadrant I or IV, that is within 0~π/2 or 3π/2~2π. If the principal axis of the ellipse is within quadrant II or IV, then the angle of phase difference obtained should be within quadrant II or III, that is within π/2~π or π~3π/2. In addition, if either the frequency or phase difference of the two signals under test is in integral multiple, the frequency and phase relation of the two signals can then be calculated based on the graphic.

X-Y Phase Difference Table

Signal-Frequency Ratio	Phase Difference					
	0°	45°	90°	180°	270°	360°
1：1						

3.6 Example of Video Triggering

Observe a video circuit and apply video triggering to acquire stable display of video output signal.

Video Field Trigger

To do video field trigger, please follow the following steps to operate:

1. Press MENU key located in the trigger control area to display trigger menu;
2. Press F1 key and then use “MULTIPURPOSE” knob to set trigger type as “Video”;
3. Press F2 key and then use “MULTIPURPOSE” knob to set trigger source as “CH1”;
4. Press F5 to enter into Video Setting. Press F1 to set video format to PAL;
5. Press F2 to synchronize to odd or even field.

Time base knob located in the horizontal control area should be used to adjust horizontal time base so as to get a clear waveform display.

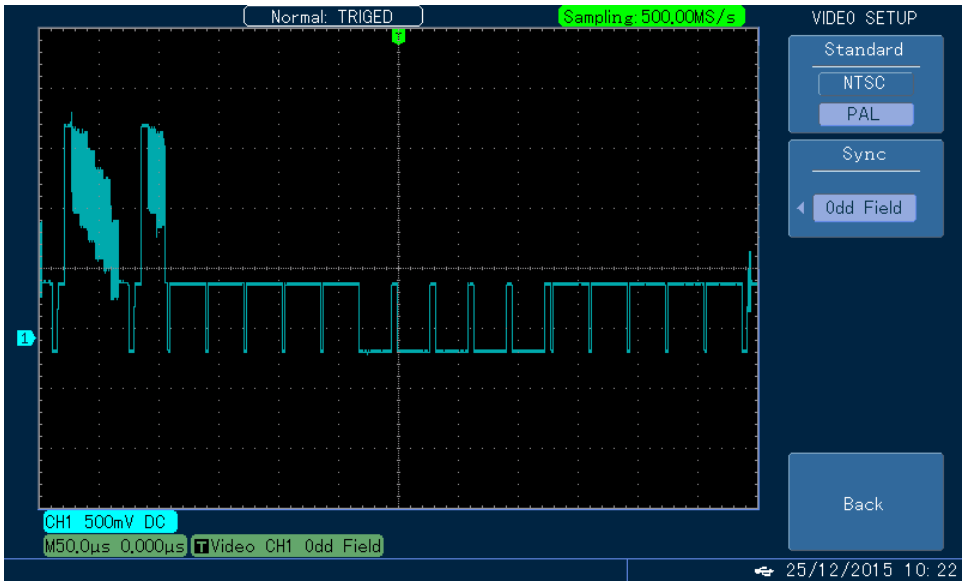


Fig. 3-10 Video Field Trigger

Video Row Trigger

To do video row trigger, please follow the following steps to operate:

1. Press MENU key located in the trigger control area to display trigger menu;
2. Press F1 key and then use “MULTIPURPOSE” knob to set trigger type as “Video”;
3. Press F2 key and then use “MULTIPURPOSE” knob to set trigger source as “CH1”;
4. Press F5 to enter into Video Setting. Press F1 to set video format to PAL;
5. Press F2 and then use “MULTIPURPOSE” knob to select row synchronization;
6. Use “MULTIPURPOSE” knob to set the “row” to be any row;
7. Time base knob located in the horizontal control area should be used to adjust horizontal time base so as to get a clear waveform display.

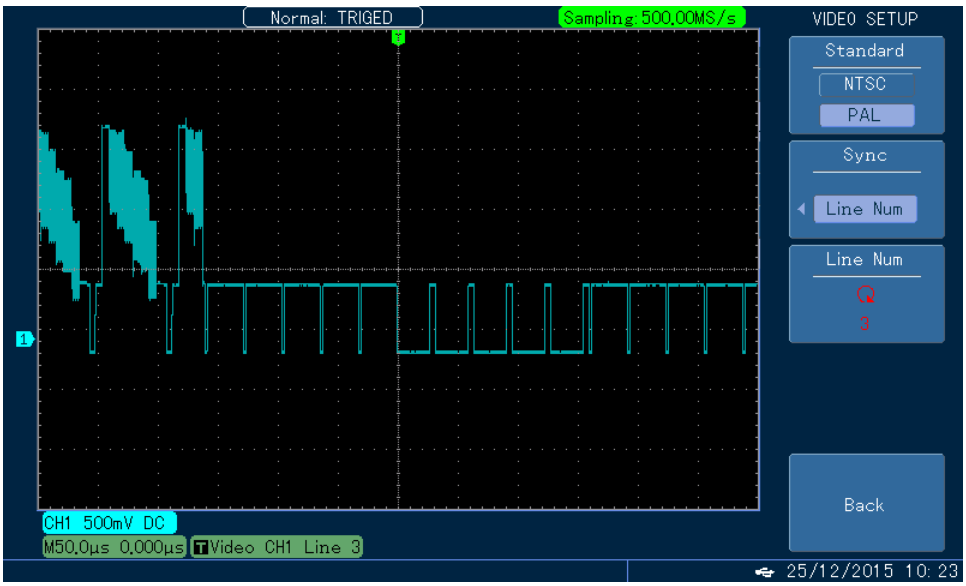


Fig. 3-11 Video Row Trigger

3.7 Example of Less Amplitude Pulse Trigger

Less amplitude pulse in digital signal normally represents metastable condition and may put the digital system into an unknown state. To capture the waveform of such unknown state, we can choose less amplitude pulse trigger.

Less amplitude trigger can be used to trigger the pulse signal that has passed one trigger level but has failed to pass another one.

Less amplitude triggering can only accept those triggers aroused by pulses within two prescribed amplitudes for both entry and exit.

Following is the operation steps explained by taking a specific case as an example:

1、 Press MENU key located in the trigger control area to enter into trigger type menu;

2、 Then press F1 and use "MULTIPURPOSE" knob to select less amplitude pulse in the ejected menu, then press "SELECT" to confirm the selection;

3、 Press F2 to set signal source as CH1;

Now the waveform we see can not be triggered stably;

4、 Press F3 to select high and low level respectively, and use trigger level knob to adjust the corresponding high and low level separately;

5、 Press F5 to enter into less amplitude pulse settings;

Less amplitude pulse settings:

1、 Press F1 to select positive or negative polarity;

2、 Press F2 to select specific trigger condition (select "＞" as for this case), and then use "MULTIPURPOSE" knob to set a specific trigger time.

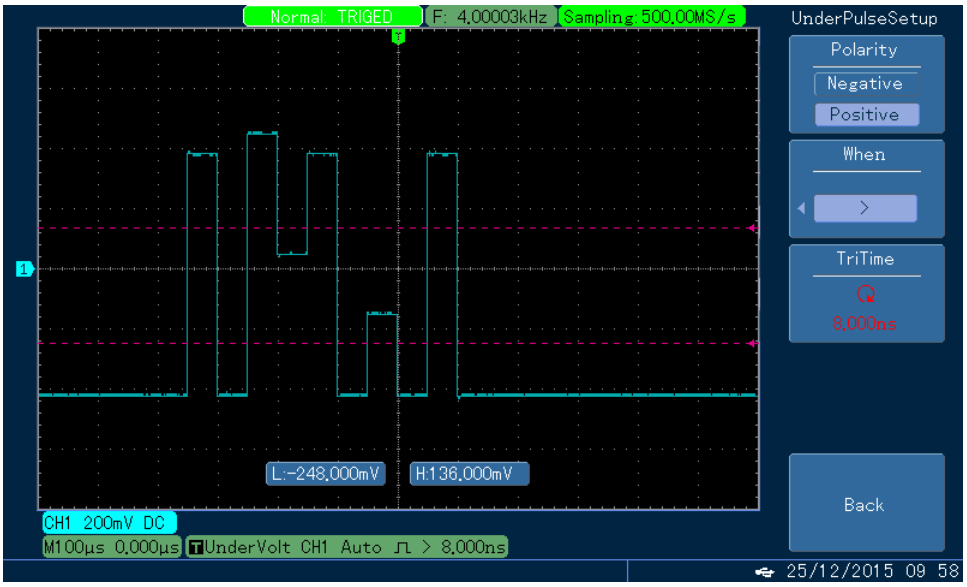


Fig 3-12 Less Amplitude Pulse Trigger (Positive Polarity)

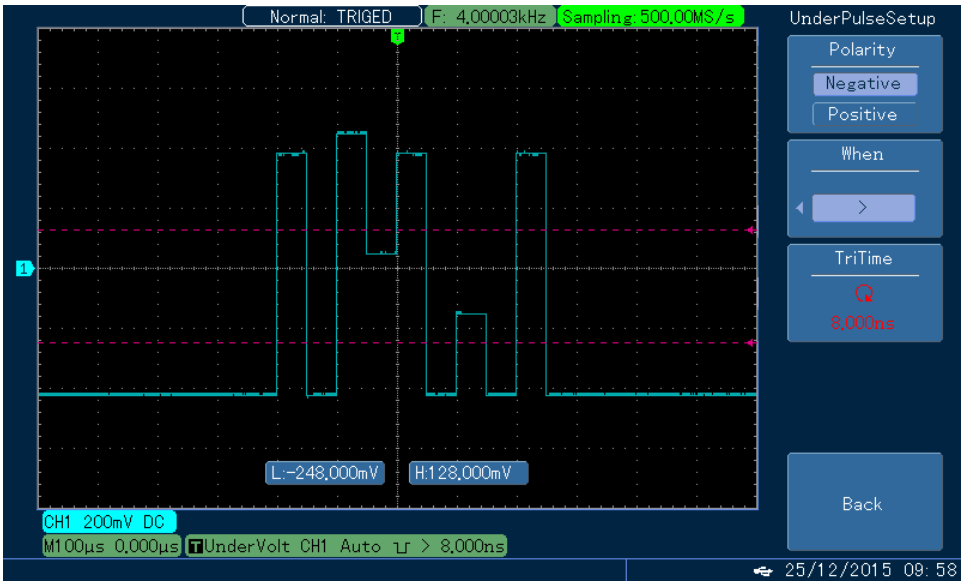


Fig. 3-13 Less Amplitude Pulse Trigger (Negative Polarity)

Notes: Refer to “trigger condition” in the chapter of less amplitude triggering for details on it.

3.8 Use of Storage Function

In case we need to use oscilloscope for waveform observation at a remote site and intend to bring the waveform information back to office for the preparation of a report or for any other analysis. Then, we can save the data into a USB-disk.

Save Bitmap

To save the images shown on the screen of an oscilloscope to a U-disk, there are two methods to follow:

1、For a quick save of image into a U-disk, please follow the following steps:

A. Insert U-disk into the USB-HOST port located on the front panel of the oscilloscope;

B. After press the PrScrn key located above the screen, a saving progress bar appears below the waveform displaying area. Once this bar runs to the end, the screen image will be saved to the root directory of the U-disk successfully under the name of DSO***.BMP.

2、For easier identification of the saved image, we can set a descriptive name for each image, please refer to the following steps to operate:

A. Insert U-disk into the USB-HOST port located on the front panel of the oscilloscope;

B. Press STORAGE key and then press F1. Thereafter, use “MULTIPURPOSE” knob to select bitmap;

C. While in bitmap storage menu, press F3 to enter into USB menu;

D. By pressing F1 key and using “MULTIPURPOSE” knob to set the name of the file to be saved. After press F5 key for confirmation, the screen image will be saved to the root directory of the U-disk successfully under the designated name.

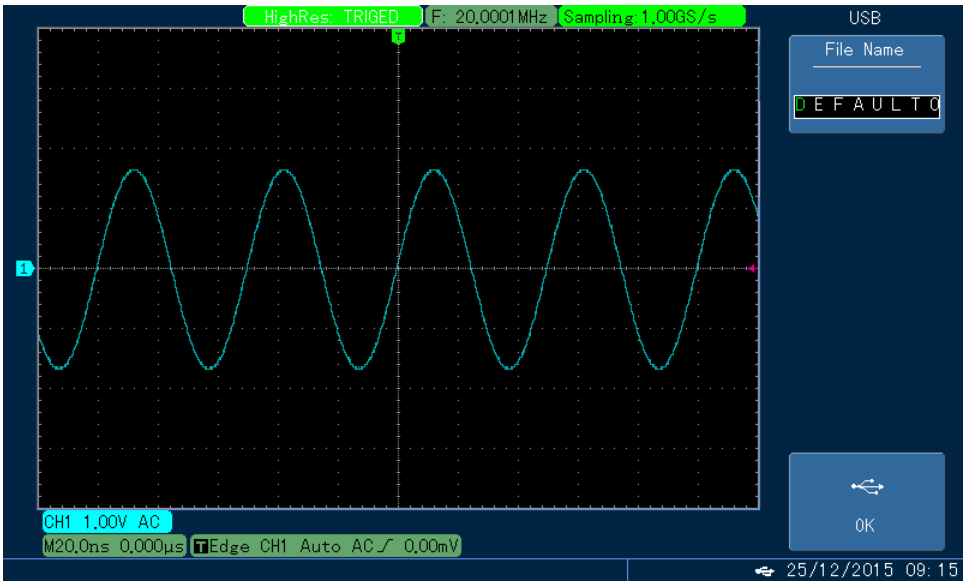


Fig. 3-14 Save Bitmap into a U-Disk

Save the Settings of this Instrument

To save the measured waveform data into a U-disk, following steps can be followed:

1、Insert U-disk into the USB-HOST port located on the front panel of the oscilloscope;

2、Press STORAGE key and then press F1. Thereafter, use "MULTIPURPOSE" knob to select "Settings";

3、While in waveform storage menu, press F5 to enter into USB menu;

4、Press F1 key and change the file name by turning "MULTIPURPOSE" knob. After press F5 for confirmation, the screen image will be saved to the root directory of the U-disk successfully under the designated name.

Save Waveform Data

UTD2000CM series instruments also provide waveform storage function, which can be used to export data in CSV format for analysis. Please follow the following steps to operate:

1、Insert U-disk into the USB-HOST port located on the front panel of the oscilloscope;

2、Press STORAGE key and then press F1. Thereafter, use "MULTIPURPOSE" knob to select "Settings";

3、Press F2 key to select signal source- CH1 or CH2;

4、While in waveform storage menu, press F5 to enter into USB menu;

5、Press F1 key and change the file name by turning "MULTIPURPOSE" knob.

6、Press F2 to export data in CSV format to U-disk or save in the flash memory of this unit;

7、After press F5 for confirmation, the waveform data will be saved to the root directory of the U-disk successfully under the designated name.

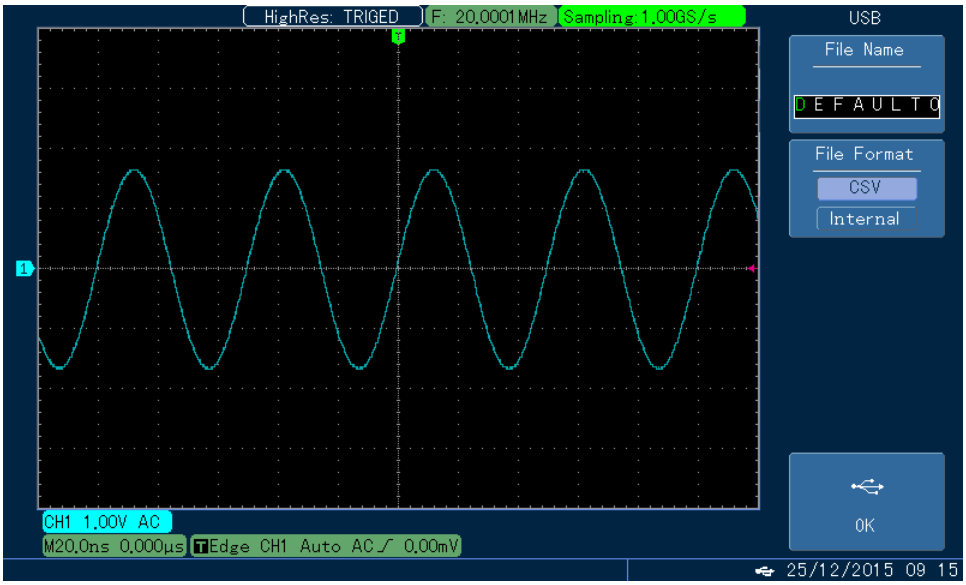


Fig. 3-15 Save the waveform into U-disk

Notes: CSV format files can be opened by EXCEL in scatter diagram form or by MATLAB software for further analysis.

3.9 Pass/Fail Detection

Detect whether or not the input signal is within the preset scope, it fails if not, otherwise it passes. In addition, we can use the "Pass/Fail" output terminal, located behind the oscilloscope, to export "Pass/Fail" signal.

1. Press UTILITY key and then press F3 to enter into "pass detection menu";
2. Set signal source: enter into P/F TEST (Pass Detection) menu and press F3 to set signal source.
3. Template Setting: Press F5 to enter into next page and then press F3 to enter into template setting menu. Press F1, and then select reference waveform using "MULTIPURPOSE" knob. Press F3 and F4, and then set horizontal and vertical tolerance by using "MULTIPURPOSE" knob (Horizontal: 1-100 Pixel; Vertical: 1-100 Pixel). After that, press F5, set and save the template, and return to Pass/Fail menu.
4. Set output condition: Press F5 to return to the first page of "Pass/Fail" menu. Press F2 to set the "Pass/Fail" port (located behind the oscilloscope) and the judgment condition for output of buzzer. While in "Pass/Fail" menu, press F1 to open the "Detection" State, as shown in Fig. 3-13.
5. Press F4 key to set whether the judgment result will be shown;
6. Press F5 key to enter into the second page of "Pass/Fail menu". Press F2 to enter into stoppage setting menu: Press F1, F2 key to set stoppage type and stoppage condition. Then set the threshold value using "MULTIPURPOSE" knob. Once complete the setting. Press F5 to return to the "Pass/Fail" menu, as shown in Fig. 3-14.
7. Press F1 to start the detection. Once the instrument is in operation, press F1 again to stop it manually. Notes: After it is stopped each time, the count of "Pass/Fail" times will be started all over again, as shown in Fig. 3-15.

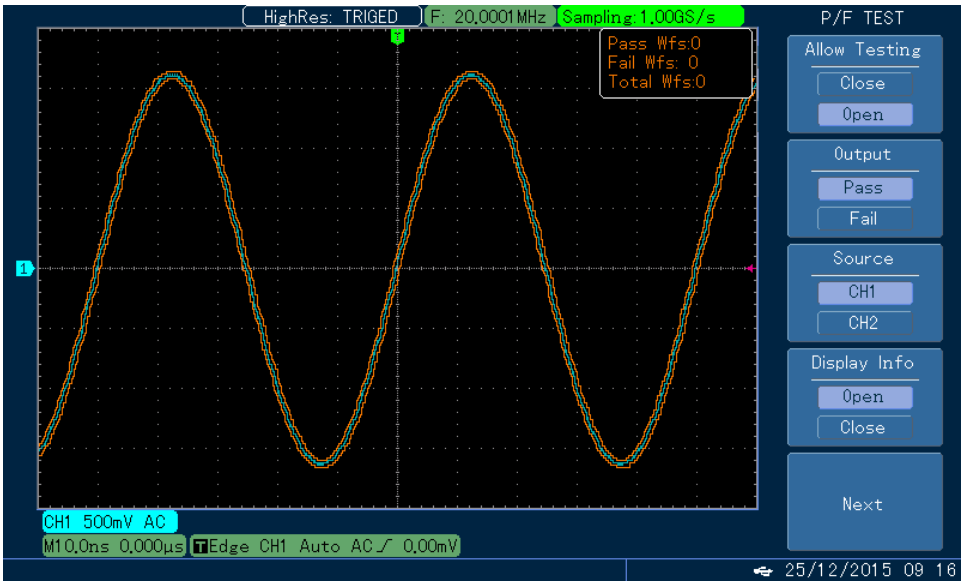


Fig. 3-16 “Pass/Fail” Detection Setting (1)

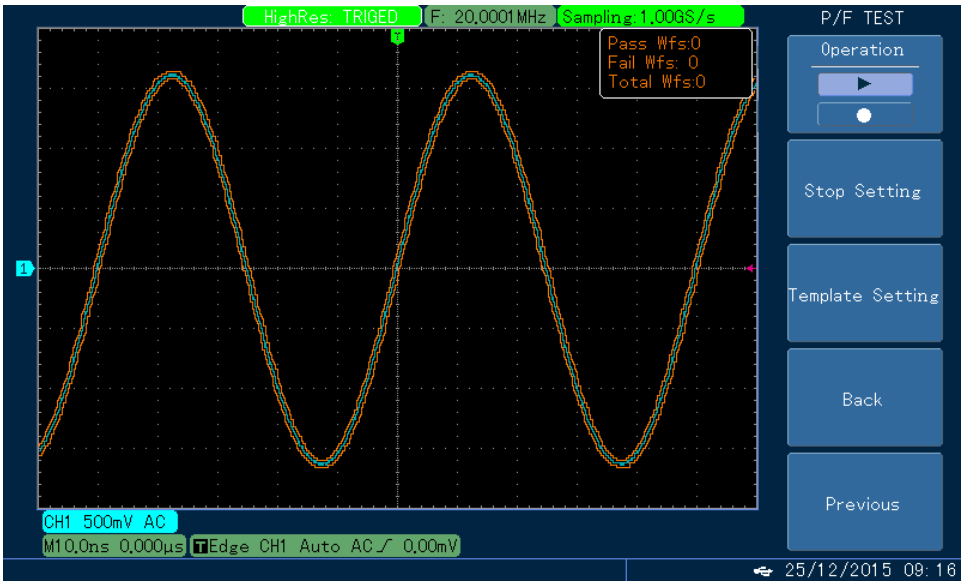


Fig. 3-17 “Pass/Fail” Detection Setting (2)

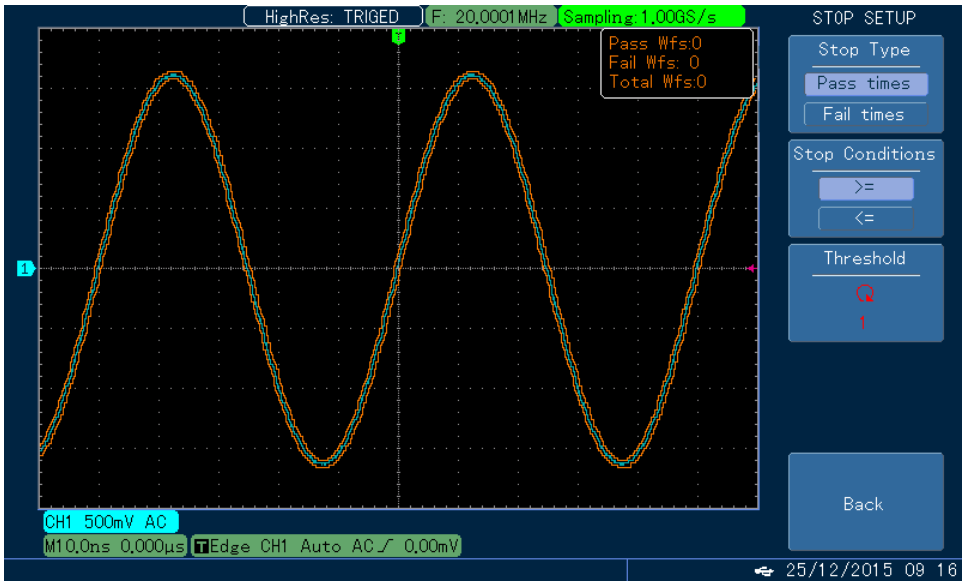


Fig. 3-18 “Pass/Fail” Detection Setting (3)

3.10 Use Updating Software Contained In a U-disk

It is more convenient and user-friendly for us to use updating software contained in a U-disk for unit updating. Please follow the following steps in order to use this function:

1.Please download the updating software from internet and save it into a U-disk (Users are suggested to use the type of U-disk that we recommend);

2.Turn off the oscilloscope and insert U-disk, then turn it on;

3.If only one program file is contained in the U-disk, the unit will show the confirmation screen. Press F5 to proceed updating and press F1 to exit updating program.

If there are two or more program files saved in the U-disk, the instrument will show file selection screen, which allows users to select program files through “multipurpose” knob, and then Press F5 to confirm (Press F1 to exit updating program). Now the unit will show the updating confirmation screen. Press F5 to proceed updating

4.Wait till the updating process completes with a prompt message showing updating has been completed successfully. Now, turn off the oscilloscope, and restart it gain.

Chapter 4 System Message & Troubleshooting

4.1 Explanation on System Messages

Adjusting Limit Reached: It prompts that under current state, the adjustment gained through the use of the "MULTIPURPOSE" knob has reached its limit and that we should stop further adjusting. Such message appears when vertical scale coefficient knob, time base knob, horizontal and vertical displacement knobs and trigger level reach their adjustment limit.

USB Device Installed Successfully: When a U-disk is inserted into an oscilloscope, if successfully connected, this message appears on the screen.

USB Device Removed: This message appears on the screen, when a U-disk is removed from an oscilloscope.

I/O Operation Failure: In case the communication with U-disk is not successful or no document in the U-disk is found to be in conformity with the requirements.

Saving: This message appears on the screen with progress bar showing to its right when saving a waveform.

4.2 Troubleshooting

1．In case the oscilloscope still shows black screen (displaying nothing) when both the power and soft start switch are turned on, please follow the following steps to deal with it accordingly.

①、Check if power plugs are connected properly and whether the mains supply is normal.

②、Check if the power switch is indeed turned on, when it is turned on, the soft start switch on the front panel should have red light on. Once the soft start switch is pressed down, if the unit does start, we should hear the noise of relay.

③、If there is the noise of relay, it indicates the oscilloscope has been started normally. Then we can try the following operations: press UTILITY key, then press F1 and F5 one after another, finally, turn "MULTIPURPOSE" knob to right. If it becomes normal, it indicates that the unit's contrast ratio had been set too low.

④、Once above steps are completed, please restart the oscilloscope.

⑤、If still the unit can not work properly, please contact us and let us help you.

2. If the screen shows no waveform after the signal has been sampled, please follow the following steps to deal with it accordingly:

①、Check if the probes have been correctly connected to the signal wires.

②、Check if signal wires have been correctly connected to BNC (channel connector).

③、Check if the probes have been correctly connected to subject under test.

④、Check if the subject under test has generated any signal (it is suggested to connect channel that has signal to channel that may have problem in order to find the problem)

⑤、Resample the signal again.

3．Amplitude of the voltage to be measure is 10 times larger or smaller than actual value: Check if the attenuation coefficient of the channel is consistent with the attenuation coefficient of the probes used.

4、Though waveform can be displayed, it can not be displayed stably:

①、Check the trigger source setting in trigger menu to see if it is in conformity with the channel that has actual signal input.

②、Check trigger type: it should set to be edge triggering for common signals. Waveform can only be

displayed stably after trigger type is set correctly.

③、Try to change coupling as “high frequency reject” or “low frequency reject” display so as to filter those high or low frequency noises that may interfere the trigger.

3. No reaction after pressing RUN/STOP key:

①、Check if the “trigger mode” in trigger menu has been set to “normal” or “single time” and trigger level has exceeded the waveform scope. If so, center the trigger level or set trigger mode to “AUTO”;

②、按Press AUTO key to complete above settings automatically;

4. If the displaying speed gets slower once the average sampling mode is selected:

①、If averaging times is above 32 times, usually the displaying speed will get slower, which is a normal phenomenon.

②、Averaging times can be reduced.

5. The display of waveform appears in stair-step shape:

①、This phenomenon is normal, which is possibly due to over low horizontal time base. This can be improved by enlarging horizontal time base to improve horizontal resolution.

②、It is possible because that the display mode has been set to vector. The connecting line between sample points may cause it. It can be solved by setting display mode to point display.

Chapter 5 Service & Support

5.1 Program Updating

Contact marketing Department of UNI-T or log into our website to obtain the latest program package, unzip the package and apply embedded program updating system to update the current program of your oscilloscope, making sure your unit enjoys the latest version of program released by UNI-T.

Preparations Before Updating

1、Find your oscilloscope and then acquire and record its model, hardware version and software version from the system information submenu of UTILITY menu.

2、Contact marketing Department of UNI-T or log into our website to obtain the latest program package that is for oscilloscopes with identical model and hardware version.

3、Prepare a U-disk (disk format is FAT or FAT32). After the obtained updating program package is unzipped, place the same to root directory of the U-disk. The suffix of updating program is “uts”.

Conditions Required for Program Updating

1、Applicable product mode of the updating program package must be consistent with the mode of the oscilloscope to be updated;

2、Applicable hardware version of the updating program package must be consistent with the hardware version of the oscilloscope to be updated;

3、he software version of the updating program package must higher or at least equal to current software version of the oscilloscope to be updated;

4、Applicable FLASH type of the updating program package must be consistent with the FLASH type of the oscilloscope to be updated.

Program Updating

1、Turn the oscilloscope off and insert the U-disk that contains the copy of the program updating file to USB HOST port of the unit.

2、Connect the unit to power and start the unit. The oscilloscope will automatically enter into the welcome screen of the program update system, as shown in Fig. 5-1.

Fig. 5-1 Screen of the program update system

3、Users can follow the prompt message shown on the updating screen to update the program.

4、 “Congratulation, Updata process Success!
Please pull out U-disk and reboot.”。

When the program updating progress runs to 100%, it will display ok to indicate that current program updating has been completed successfully. As it is shown in Fig. 5-2, it prompts that

“Congratulation, Update process Success!
Please pull out U-disk and reboot”.

Notes:

1、Please do not cut off the power in the process of updating, otherwise, it may have unknown mistakes.

2、Once the program updating completes, please restart the oscilloscope. The oscilloscope will be initialized and it may take 30 seconds to 1 minute before entering into the operation screen.

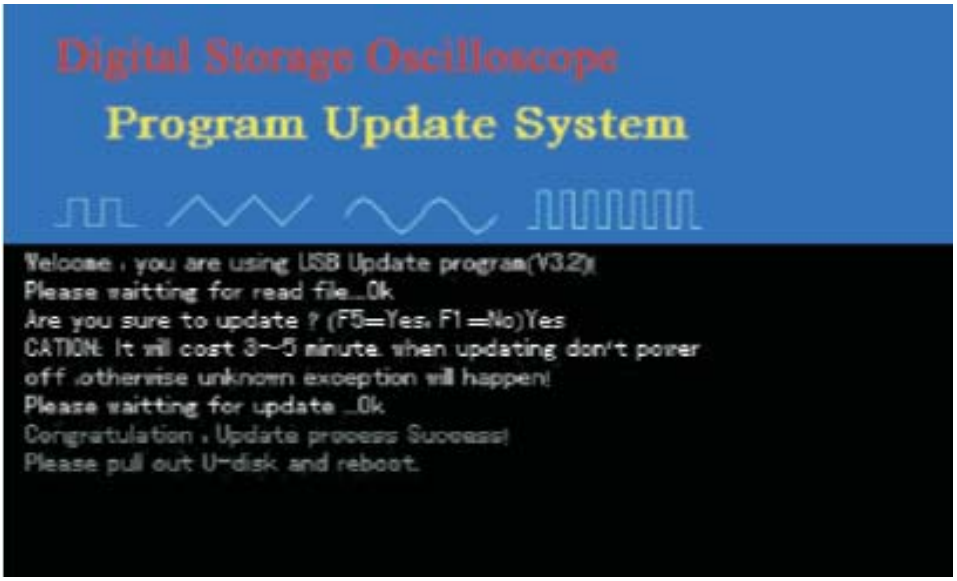


Fig. 5-2 Completion of U-disk Updating

5.2 Warranty Summary

Each product produced and sold by UNI-T is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is three years and begins on the date of shipment made by our authorized distributors. In case our product is proved to be defective within the warranty period, UNI-T shall repair or replace it in accordance with detailed provisions set forth in the warranty.

If you need our repair service or request the full content of this warranty, please contact the nearest UNI-T sales or service center.

This warranty is drafted by UNI-T for the use of the product only and is buyer's sole and exclusive remedy which is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. UNI-T or its authorized distributor shall not be liable for any special, indirect, incidental or consequential damages or losses, regardless of whether or not they have been notified of such possibilities.

5.3 How to Contact Us

In case this product has brought you any inconvenience during your use of it, you may directly contact Uni-Trend Technology (China) Limited if you are in mainland China.

Contact Time: AM 8:00 to PM 5:30 (Beijing Time), from Monday to Friday or use Email to contact us.

Our Email address is infosh@uni-trend.com.cn

For product support outside mainland China, please contact your local UNI-T distributors or sales center.

Extended warranty or calibration period are available to many of our products, for details, please contact your local UNI-T distributors or sales center.

To obtain the list of addresses for our service centers around the world, please visit our website: http://www.uni-trend.com

Chapter 6 Appendix

Appendix A: Technical Indexes

Unless otherwise stated, all technical indexes are applicable to probes with attenuation switch set to be 10× and UTD2102CM series digital storage oscilloscopes. Those digital storage oscilloscopes must first comply with the following two conditions in order to meet those specification standards.

■The unit must be running under a specific operating temperature for more than 30 minutes.

■If the change in operating temperature reaches or exceeds 5℃, system function menu has to be opened to execute “auto calibration” program. Other than those marked with the word “typical”, the effectiveness of all specifications are guaranteed.

Technical Indexes

Sampling Mode		
Sampling Mode	Real-time Sampling	Equivalent Sampling
Sampling Rate	Single Channel: 1GS/s; Dual Channel (both) : 500MS/s	50GS/S
Average Value	When all channels reach N times of sampling simultaneously, wherein “N” can be any number among 2, 4, 8, 16, 32, 64, 128, 256 and 512.	

Input				
Input Coupling			DC, AC, GND	
Input Impedance			Bandwidth≤100MHz	1±2%MΩ，Parallel connection with 24±3pF
			Bandwidth＞100MHz	1±2%MΩ，Parallel connection with 18±3pF
Probe	Probe Type		Voltage, Current (Bandwidth ≤100MHz)	
			Voltage (Bandwidth＞100MHz)	
	Probe Attenuation Coefficient Setting	Bandwidth ≤ 100MHz	1×, 10×, 100×, 1000× or user-defined	
		Bandwidth ＞ 100MHz	1×、10×、100×、1000×	
Maximum Input Voltage			400V（DC＋AC Peak Value, Input Impedance 1MΩ）	
Time Delay Between Channels (Typical)			50ps	

Horizontal		
Waveform interpolation	sin(x)/x	
Memory Depth	UTD2000CM	Bandwidth≤100MHz: Single Channel: Normal-6kpts; Deep -32Mpts Dual channel:Normal-6kpts, Deep -16Mpts Bandwidth＞100MHz: Single Channel: Normal-6kpts; Deep -16Mpts Dual channel:Normal-6kpts, Deep - 8Mpts
	UTD2000HM	Bandwidth≤100MHz: Single Channel: Normal-6kpts; Deep -16Mpts Dual channel:Normal-6kpts, Deep -8Mpts Bandwidth＞100MHz: Single Channel: Normal-6kpts; Deep -8Mpts Dual channel:Normal-6kpts, Deep -4Mpts
Waveform Capture Rate	≥150000wfms/s	
Horizontal Scale (s/div)	2ns/div～50s/div, stepping in 1-2-5 format	
Sampling Rate & Delay Time Accuracy	±50ppm(any time interval≥1ms) ±50ppm(any time interval≥1ms)	
Time Interval (△T) Measurement Accuracy (Full Bandwidth)	Single:±(1 sampling time interval +50ppm×readings +0.6ns) ＞16 average values:±(1 sampling time interval +100ppm×readings +0.4ns）	

Bandwidth				
Product Series	Model	Analog Bandwidth	Single Bandwidth	Rising Time
UTD2000CM	UTD2042CM UTD2042HM	40MHz	60MHz	≤8.7ns
	UTD2062CM UTD2062HM	60MHz	100MHz	≤5.8ns
	UTD2102CM UTD2102HM	100MHz	100MHz	≤3.5ns
	UTD2202CM UTD2202HM	200MHz	100MHz	≤1.8ns

Vertical		
A/D Converter	8 bit resolution	
Deviation Scale Coefficient (Volts/Grid) Scope (v/div)	Bandwidth≤100MHz	2mV/div～10V/div (At Input BNC)
	Bandwidth＞100MHz	2mV/div～5V/div（At Input BNC）
Displacement Scope	±8div	
Selectable Analog Bandwidth Limit (Typical)	20MHz	
DC Gain Accuracy	Vertical Sensitivity: 2mV/div±4% (sampling or average sampling); Vertical Sensitivity: 5mV/div ～ 10V/div ± 3% (sampling or average sampling);	
Low Frequency Response (AC Coupling, -3dB)	≤10Hz (On BNC)	
DC Measurement Accuracy (Average Sampling)	When vertical displacement is zero and N≥16: ±(5%×readings +0.1 grid + 1mV) and select 2mV/div; ±(3%×readings +0.1 grid+1mV) and select 5mV/div～5V/div. When vertical displacement is not zero and N≥16: ±[3%×(readings + vertical displacement readings)+(1%×vertical displacement readings)]+0.2div) 5mV/div～200mV/div + 2mV; 200mV/div~5V/div + 50mV	
Measurement Accuracy for Voltage Difference (△V)	Under the same settings and environment condition, voltage difference between any two arbitrary points located on the waveform formed after taking average value for at least 16 waveforms captured (ΔV): ±(3%×readings +0.05 div)	

Trigger Sensitivity		
Trigger Sensitivity	Internal Trigger	≤1div
	EXT	≤60mV
	EXT/5	≤300mV
Trigger Level Scope	Internal	Distance from screen center ±8div
	EXT	±800mV
	EXT/5	±4.0V
Trigger Level Accuracy (Typical): time used for rising and falling Signal ≥ 20ns	Internal	±(0.3div×V/div)(distance from screen center±4div)
	EXT	±(6% set value＋40mV)
	EXT/5	±(6% set value＋200mV)
Pre-trigger Capacity	Normal mode/scanning mode, pre-trigger/delay trigger, pre-trigger depth is adjustable	
Hold Off Scope	100ns～1.5s	
Set level to 50% (Typical)	Execute when input signal frequency≥50Hz	
Edge Trigger		
Edge Type	Rising edge, falling edge, rising & falling	

Pulse Width Trigger		
Trigger Mode	＞, ＜, ＝ positive pulse width; ＞, ＜, ＝ negative pulse width	
Pulse Width Scope	20ns～10s	
Video Trigger		
Trigger Sensitivity (Video Trigger, Typical)	Internal	2div
	EXT	400mV
	EXT/5	2.0v
Signal format & Row/Field Frequency (Video Trigger Type)	Support standard NTSC & PAL; Row number scope is 1-525 (NTSC) and 1-625 (PAL)	
Slope Trigger		
Trigger Mode	＞, ＜, ＝ positive slope; ＞, ＜, ＝ negative slope	
Time Settings	20ns-10s	

Less Amplitude Pulse Trigger	
Trigger Mode	＞, ＜, ＝ positive polarity; ＞, ＜, ＝ negative polarity
Time Settings	4ns-10s
Alternative Trigger	
CH1 Trigger	Edge, pulse width, video
CH2 Trigger	Edge, pulse width, video

Measurement		
Cursor	Manual Mode	Voltage difference between cursors (ΔV); time difference between cursors (ΔT); inverse of ΔT (Hz) (1/ΔT);
	Tracking Mode	Voltage value and time value for a point on waveform;
	Auto measuring Mode	Allow cursor to be displayed during auto measuring;
Auto Measuring	34 kinds of measurement, including maximum value, minimum value, top value, bottom value, median value, Peak to peak value, amplitude value, average value, root-mean-square, cycle average value, cycle RMS, area, cycle area, frequency, cycle, rising edge, falling edge, positive pulse width, negative pulse width, burst pulse width, overshoot, pre-shoot, positive duty ratio, and negative duty ratio.	
Mathematical Operation	plus, minus, times, divide, phase reverse	
Waveform Storage	10 groups of waveforms, 10 kinds of settings	
FFT	Window	Hanning,Hamming,Biackman-Harris,Rectangular
	Sampling	1024 points

	points	
Lissajous Pattern	Phase difference	±3degrees
Trigger Frequency Meter		
Readings Resolution	6-digit	
Accuracy	±51ppm	
Frequency Scope	For AC coupling, from 10Hz to full bandwidth	
Trigger Type	Pulse width or edge	

General Technical Specifications

Display	
Display Type	Diagonal length: 178 mm (7 inches), TFT LCD
Display Resolution (Display)	800 Horizontal Pixel×RGB×480 Vertical Pixels
Display Color	64K colors
Waveform Display Area	12 grids, each grid has 50 points; vertical: 8 grids, each grid has 50 points

Output of Probe Compensator	
Output Voltage (Typical)	Approximately 3Vp-p, load≥1MΩ
Frequency	100Hz、1kHz、10kHz

Ports	
Standard Configuration	1 USB (D), 1 USB (H), Pass/Fail
Optional Accessories	LAN、GPIB、RS232

Power	
Mains Voltage	100～240VACrms，45～440Hz
Power Consumption	No more than 40VA
Fuse	F1.6AL 250V。Installed on the power strip inside the unit.

Ambient Environment	
Temperature	Operation: 0℃～+40℃
	Non-operation: -20℃～+60℃
Cooling Method	Forced Cooling Provided by Fan
Humidity	〈35℃:≤90%RH ,＋35℃～＋40℃:≤60%RH
Height	Operation: below 3,000 meters
	Non-operation: below 15,000

Machinery Specification		
Dimension	Width	330mm
	Height	155mm
	Depth	130mm
G.W (N.W)	Package excluded	2.9kg
	Package included	5.0kg

IP Protection
IP2X

Calibration Frequency
It is suggested to be calibrated every 1 year.

Appendix B: Accessories

Standard Accessories:

- Two 1.2 meters long passive probes, 1:1/10:1 and in conformity to EN61010-031:2008. For details, refer to “appendix on accessories” shown in the Manual;
  When switch is in “1×” position, probes should comply with 150V CAT II;
  When switch is in “10×” position, probes should comply with 300V CAT II;
- A power cable that conforms to the standard of the home country;
- A User Manual;
- A Warranty Card;
- Communication control software for UTD2000CM series oscilloscopes (USB-DEVICE);
- USB Cable: UT-D06

Optional Accessories

- UTD2000CM LAN Module：UT-M01

- UTD2000CM LA Module: UT-M09

For all accessories (including standard and optional ones), please order them from local UNI-T distributors.

Appendix C: Maintenance & Cleaning

General Maintenance

Do not store or place the instrument in places where its LCD may expose to direct sunshine for a long time.

Caution: To avoid any damage to the instrument or its probes, please do not let them have any contact with spray, liquid or solvent.

Cleaning

Please check the instrument and its probes regularly based on its working conditions. Refer to following steps to clean its exterior surface.

1. Please use a soft cloth to wipe off the dust on the instrument or its probes. Be careful not to scratch the transparent LCD protective layer when cleaning the LCD of the instrument.
2. Disconnect the power before cleaning, and then clean it with damped cloth without dropping water. Mild detergent or water can be used to clean dust on the instrument, but do not apply any abrasive chemical detergent so as to avoid damage to the instrument or its probes.

Warning: To avoid any short circuit or even personal injury arisen from residual water, please make sure the instrument is totally dried before powering it on.

Appendix D: Words on Keypads (Shown in Comparison Table)

MEASURE	MENU
ACQUIRE	HELP
STORAGE	HORIZONTAL
RUN/STOP	TRIGGER
VERTICAL	POSITION
CURSOR	LEVEL
DISPLAY	VOLTS/DIV
UTILITY	SEC/DIV
AUTO	EXT
CH1	MATH
CH2	REF
COARSE	Menu ON/OFF
FORCE	ZERO
50%	Z00M
SELECT	MULTI PURPOSE

Appendix E: Factory Settings

This appendix will introduce the change of relevant settings when UTILITY key – Factory Settings is selected. Please refer to below table for details.

System	Function	Factory Settings
Vertical System	CH1	5V/DIV
	CH2	5V/DIV
	Coupling Mode	AC 1MΩ
	Bandwidth Limit	Full Bandwidth
	Volts/Grid	Rough Tuning
	Probe	1×
	Phase Reversed	Closed
	Bias Voltage	Closed
	MATH、REF	Closed
Horizontal System	Expanded Window	Closed
	Horizontal Time Base	500s/div
	Horizontal Displacement	Horizontal Midpoint
Trigger System	Hold Off Time	Minimal Value: 100.0000ns
	Trigger Type	Edge
	Signal Source	CH1
	Coupling Mode	DC
	Trigger Mode	Auto
	Slope Type	Rising
Display	Display Type	
	Format	Vector
	Persistence	Short Persistence
	Waveform Brightness	88%
Other System	Save Type	Setup
	Frequency Meter	Open
	Measurement	Closed, clear all measurement
	Cursor	Closed
	Contrast Ratio	50/100
	Language	Maintain
	Screen Style	Classic
	Menu Display	Manual
	Grid Brightness	32/32

This user manual may be revised without prior notice

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