DSO1000E/F Series
Digital Storage Oscilloscope
User Manual

（Version 1.5）

Copyright Declaration

General Safety Summary

Read the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To evade potential hazards, use this product only as specified.

Only qualified personnel should perform maintenance.

Avoid fire or personal injury.

Use suitable power cord. Use only the power cord specified for this product and certified for the country of use.

Connect and disconnect properly. Connect a probe with the oscilloscope before it is connected to measured circuits; disconnect the probe from the oscilloscope after it is disconnected from measured circuits.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Connect the probe in a right way. The probe ground lead is at ground potential. Do not connect the ground lead to an elevated voltage.

Check all terminal ratings. To avoid fire or shock hazard, check all ratings and markings on the product. Refer to the product manual for detailed information about ratings before making connections to the product.

Do not operate without covers. Do not operate this product with covers or panels removed.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Assure good ventilation.

Do not operate in wet/damp environments.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Safety Terms and Symbols

Terms on the product. The following terms may appear on the product:

Danger	It represents that harms may be caused to you at once if you perform the operation.
Warning	It represents that latent harms may be caused to you if you perform the operation.
Notice	It represents the damage possibly caused to the product or other properties if you perform the operation.

Characters on the product. The following characters may appear on the product:

Notice Please read the manual	Protective ground terminal	Measuring ground terminal	Chassis ground terminal

Product Scrapping

Device Recycling

We need extract and utilize natural resources to produce this device. If you do not reclaim the device in a proper way, some substances it contains may become harmful or poisonous to environments or human bodies. To avoid them being released outside and to minimize the waste of natural resources, we suggest you reasonably call back this device to ensure proper recovery and recycling of most materials within it.

Brief Introduction to the Series of digital storage oscilloscope

DSO1000E/F Series oscilloscopes cover the bandwidths from 80MHz to 250MHz, and provide the real-time up to 1GSa/s. In addition, they have 7 inch color TFT LCD as well as WINDOWS-style interfaces and menus for easy operation.

What's more, the plenty menu information and the easy-to-operate buttons allow you to gain information as much as possible in measurement; the multifunctional knobs and the powerful shortcut keys help you save a lot of time in operation; the Auto Scale function lets you detect sine and square waves automatically; By using the three methods the oscilloscope provides (context-sensitive, hyperlinks, and an index), you may master all operations on the device in quite a short time so as to greatly improve your efficiency in production and development.

Model	Channels	Bandwidth	Sample Rate	AFG
DSO-1084E	4	80MHz	1GS/s	-
DSO-1104E	4	100MHz	1GS/s	-
DSO-1204E	4	200MHz	1GS/s	-
DSO-1254E	4	250MHz	1GS/s	-
DSO-1084F	4	80MHz	1GS/s	Yes
DSO-1104F	4	100MHz	1GS/s	Yes
DSO-1204F	4	200MHz	1GS/s	Yes
DSO-1254F	4	250MHz	1GS/s	Yes

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1.1 General Inspection

Please check the instrument as following steps after receiving an oscilloscope:

Check the shipping container for damage:

Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

Check the accessories:

Accessories supplied with the instrument are listed in "Accessories" in this manual. If the contents are incomplete or damaged, please notify the franchiser.

Check the instrument:

In case there is any mechanical damage or defect, or the instrument does not operate properly or fails performance tests, please notify the franchiser.

1.2 Prepare Instrument for Use

Adjust the Supporting Legs

Adjust the supporting legs properly to use them as stands to tilt the oscilloscope upwards for stable placement of the oscilloscope as well as better operation and observation.

Connect the Power Cord

Connect the power cord as desired.

This oscilloscope can accept 100-240 V, 45-440 Hz AC power supply. Please use the power cord supplied with the accessories to connect the oscilloscope to the power source as shown in the figure below.

Turn the instrument on by pressing the power switch in the lower left corner of front panel. If the instrument does not turn on, verify that the power cord is firmly connected. Also make sure that the instrument is connected to an energized power source.

Power Switch:

To turn off the instrument, please press power switch.

1.3 Brief Introduction of Front Panel

The content below simply describes and introduces the front panel and the back part of this series of digital oscilloscope so that you can get familiar with this series of digital oscilloscope well within the shortest time.
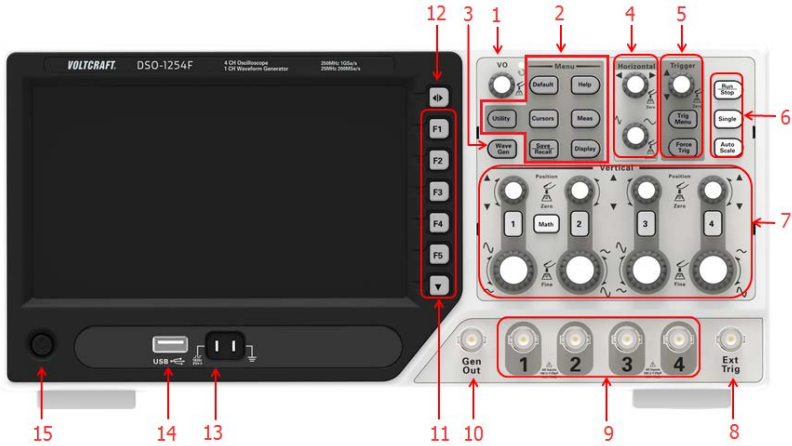
1.   Universal Knob
2.   Function Button
3.   Waveform Generator
4.   Horizontal System
5.   Trigger System
6.   Fast Action Button(Run/Stop, Single, Auto Scale)
7.   Vertical System
8.   External Trigger Input Channel
9.   CH1~CH4 Input Channel for signal
10. Waveform Generator Output
11. Function Softkeys
12. Menu Button
13. Probe Compensation terminal
14. USB Port
15. Power Button

1.4 Accidence of the user interface

This section will make you understand the front operation panel of this series of digital oscilloscope at first before use.
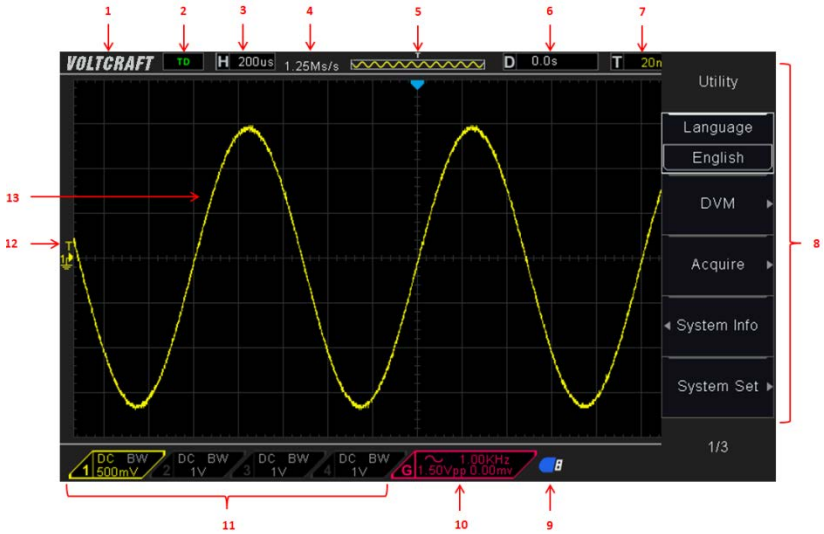
Figure 1-2 Interface display

1. Voltcraft logo
2. Trigger Status

   Auto: The oscilloscope works in auto mode and is acquiring waveforms in the absence of triggers.

   Ready: All pre-triggered data have been acquired and the oscilloscope is ready to accept a trigger.

   Roll: The oscilloscope is acquiring and displaying waveform data continuously in roll mode.

   Stop: The oscilloscope has stopped acquiring waveform data.
3. Readout shows main time base setting.
4. Sample rate.
5. Main Time Base Window

6.   Tigger time

7.   Trigger level, Readout tells trigger level.

8.   Operating Menu shows different information for respective function keys.

9.   If this icon lights up/active, it means the USB disk has been connected.

10. If this icon lights up/active, it means the wave generator works

11. The information of coupling, Bandwidth and volt/div of CH1~CH4.

12. Channel Marker

13. Window displays waveform.

1.5 Functional Check

Follow the steps below to perform a quick functional check to your oscilloscope.

1.5.1   Connect the oscilloscope

Set the switch on the probe to 10X and connect the probe to Channel 1 on the oscilloscope. First, align the slot in the probe connector with the protuberance on the CH1 BNC and push to connect; then, turn to right to lock the probe in place; after that, connect the probe tip and reference lead to the PROBE COMP connectors. There is a mark on the panel: Probe COMP ~2V@1KHz.

CH1: to connect with the probe

PROBE COMP

1.5.2   Observe the waveform

Press the **[Auto Scale]** button and you should see within a few seconds a square wave of about 2V peak-to-peak at 1KHz in the display. Press the **[CH1]** MENU button twice to remove Channel 1. Push the **[CH2]** MENU button and repeat the steps to observe CH2, CH3 and CH4.
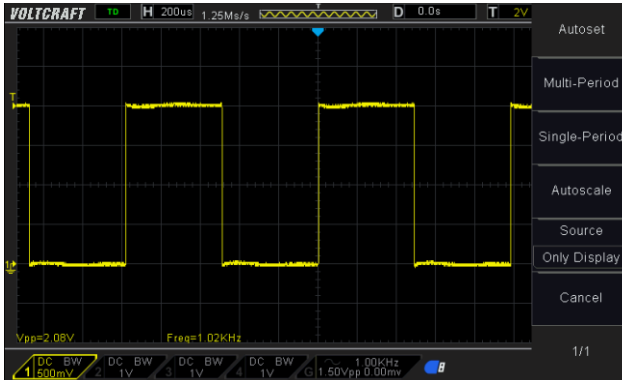
1.6 Probe Introduction

1.6.1   Safety

When using the probe, keep your fingers behind the guard on the probe body to avoid electric shock. Do not touch metallic portions of the probe head while it is connected to a voltage source. Connect the probe to the oscilloscope and connect the ground terminal to ground before you start any measurements.
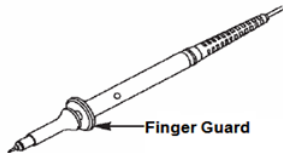
1.6.2   Probe Check Wizard

Every time you connect a probe to an input channel, you should use the probe check wizard to verify that this probe is operating correctly.

Use the vertical menu (for example, push the **[CH1]** MENU button) to set the Probe attenuation factor.

1.6.3   Manual Probe Compensation

Upon the first connection of a probe and an input channel, you should manually perform this adjustment to match the probe to the input channel. Uncompensated or

miscompensated probes may lead to errors or faults in measurement. To adjust the probe compensation, follow the steps below.

1. Set the Probe option attenuation in the channel menu to 10X. Set the switch on the probe to 10X and connect the probe to Channel 1 on the oscilloscope. If you use the probe hook-tip, ensure it is firmly inserted onto the probe. Attach the probe tip to the PROBE COMP ~2V@1KHz connector and the reference lead to the PROBE COMP Ground connector. Display the channel and then press the Auto Scale button.

2. Check the shape of the displayed waveform.

Compensated correctly

Overcompensated

Undercompensated
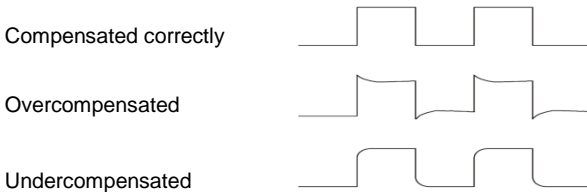
3. If necessary, use a nonmetallic screwdriver to adjust the variable capacity of your probe until the shape of the waveform turns to be the same as the above figure. Repeat this step as necessary. See the figure below for the way of adjustment.
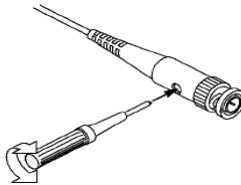
1.6.4 Probe Attenuation Setting

Probes are of various attenuation factors which affect the vertical scale of the signal. The Probe Check function is used to verify if the Probe attenuation option matches the attenuation of the probe.

You can push a vertical menu button (such as the **CH1** MENU button) and select the Probe option that matches the attenuation factor of your probe.

Make sure that the Attenuation switch on the probe matches the Probe option in the oscilloscope. Switch settings are 1X and 10X.

When the Attenuation switch is set to 1X, the probe limits the bandwidth of the oscilloscope to 6MHz. To use the full bandwidth of the oscilloscope, be sure to set the

switch to 10X.
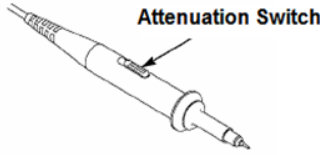
1.7 Remote Control via USB

1.7.1 Install Software

Caution: You must install the software before using the oscilloscope on PC.

1. While in Windows, insert the installation CD into the CD-ROM drive.

2. The installation should start up automatically. Otherwise in Windows Explorer, switch
   to the CD-ROM drive and run *Setup.exe*. According to the installation information,
   please install it step by step.

Download and install IO libraries suite.

Please download latest IO Libraries Suite from the website:

http://www.keysight.com/main/software.jspx?ckey=2175637&lc=chi&cc=CN&nid=-11143.0.00&id=2175637

Also you can install the software named IOLibSuite in the CD.

Double click IO Libraries Suite program and install it. According to the installation
information, please install it step by step. The installation maybe takes several minutes.
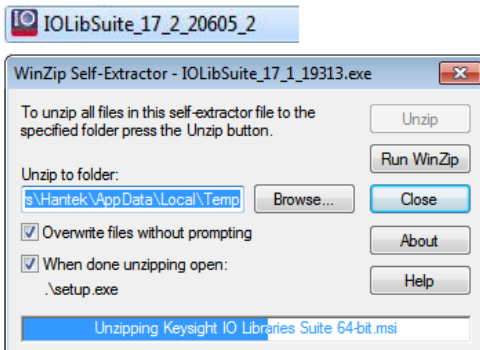
After installation, you can see it in bottom right corner.
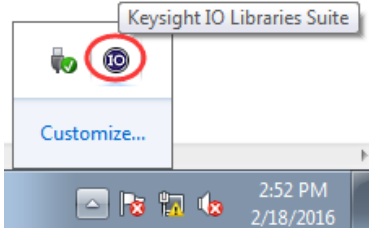
1.7.2   Connect DSO scope to PC

1. Power on. Connect DSO scope to PC via USB cable. The driver will install by itself.

When the driver is installed successfully, there will have a prompt as follows:
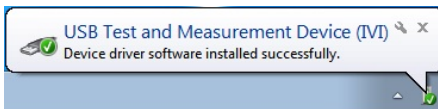
2. After installing successfully, users can see driver information in device manager.
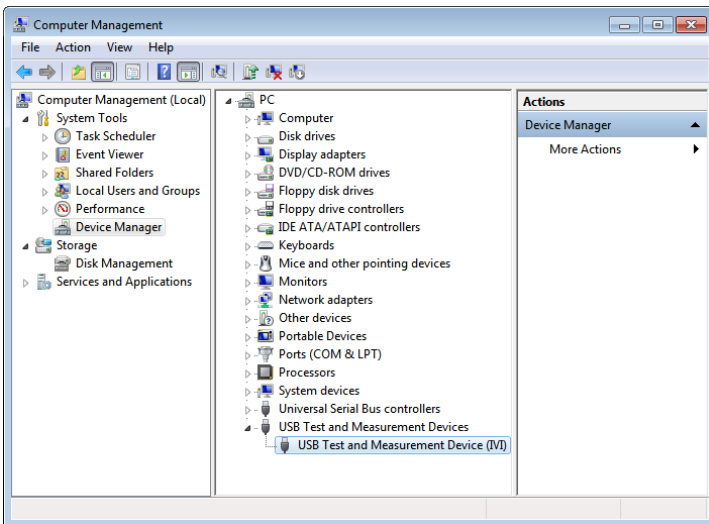
3. Click Keysight IO libraries suite icon in bottom right corner, and choice "Connection Expert". Now users can see the device information.
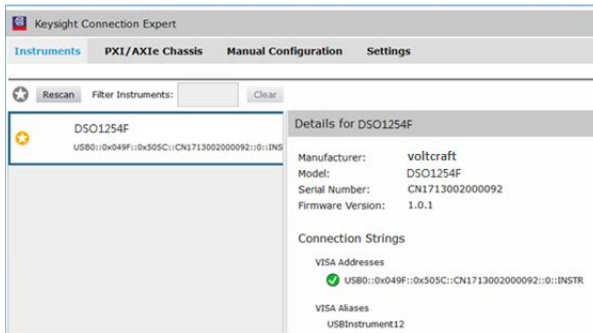
4. If installing unsuccessfully, right click to update the driver manually, and choice the correct route: C:\Program Files\IVI Foundation\VISA\IVI USB Staging\b841aa80\Windows

5. Double click "DSO-xxxx" shortcut on desktop to open the software of DSO device. The device is connected with PC successfully. You can see "Connected" tip in status column.

1.7.3   User's Interface of PC

Click the DSO software icon on the desk after you finished the software setting and equipment connecting. Then a user interface will be showed as follows:
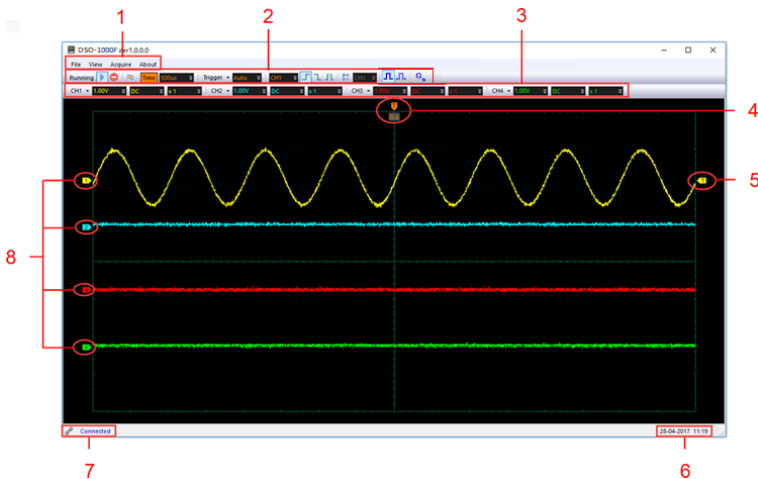
In addition to displaying waveforms, the display area is filled with many details about

the waveform and the oscilloscope control settings.

1. The Main Menu

2. The Toolbar

3. Control Panel

4. The Horizontal Trigger Position

   Drag Horizontal Position icon on screen to adjust the trigger position against screen.
Double click the icon to reset the trigger point back to the screen center.

5. The Trigger Level

   Drag the trigger level icon on screen to adjust the trigger level position against
screen.

6. It shows the system time.

7. Connect Status

8. The markers show the CH1/CH2/CH3/CH4 reference points of the displayed
waveforms. If there is no marker, the channel is not displayed.

Chapter 2 Function Introduction

This chapter provides some general information that you need to learn before using an oscilloscope. It contains:

◆ **Menu and Control Keys**

◆ **Connector**

◆ **Universal Knobs and Softkeys**

◆ **Oscilloscope Setup**

◆ **Horizontal Controls**

◆ **Vertical System**

◆ **Trigger System**

◆ **Save/Recall**

◆ **Measure System**

◆ **Acquire**

◆ **Display**

◆ **Utility System**

◆ **Fast Action Buttons**

2.1 Menu and Control Keys

As shown in the figure below:

Figure 2-1 Control keys

All the keys are described as follows:

- **[CH1], [CH2], [CH3], [CH4]:** display setup menus of channel 1 and channel 2.
- **[Math]:** display "Arithmetical operation" waveform menu.
- **[Horizontal]:** Set Horizontal system.
- **[Trig Menu]:** display Trigger control menu.
- **[Force Trig]:** It is used for finishing acquisition of the current waveform no matter whether the oscilloscope detects trigger, and it is mainly applied to "Normal" and "Single" in the trigger mode.

- **[Default]:** recall the default factory setup.
- **[Help]:** enter the on-line help system.
- **[Utility]:** display "UTILITY FUNCTION" menu.
- **[Cursors]:** display the "CURSOR" menu. The [V0] knob can be used for regulating the position of the cursor when the "CURSOR" menu is displayed and the cursor is triggered.
- **[Meas]:** show the "Measure" menu.
- **[Wave Gen]:** show the waveform generator menu.
- **[Save Recall]:** show the "Save/Recall" menu of setups and waveform.
- **[Display]:** show the "Display" menu.
- **[Auto Scale]:** automatically set the control state of the oscilloscope so as to display suitable waveform.

- ■ **[Run/Stop]:** continuously acquire waveform or stop acquisition
- ■ **[Single]:** Acquire a single trigger, finish acquisition and then stop.

2.2 Connector

Figure 2-2 Connector

- ■ **CH1, CH2, CH3, CH4:** for an input connector of a measured signal.
- ■ **EXT TRIG:** be used as an input connector of an external trigger source. Use **[Trig Menu]** button to select "External" trigger source (only for Edge trigger), and the trigger signal source can be used for triggering in the third channel while acquiring data.

- ■ **Gen Out:** Waveform signal output.

- ■ **Probe compensation:** The probe compensation signal is output and grounded so that the probe is matched with the channels of the oscilloscope.

2.3 Universal Knobs and Softkeys

V0: **Universal** Knob. Under different menu options, it supports selecting menu options (MEASURE), moving cursors and levels (Slope Trigger). Press this knob to reset data (trigger holdoff, overtime of the overtime trigger and slope trigger), select menu options and so on. Easy to operate.

Press the **Wave Gen** button on the front panel to open the arbitrary waveform generator function.

Hide/Show softkey. Push it to hide the menu options on the right side of the screen and give a full screen display of waveforms. Push it again to show the menu options.

F1-F5: These five softkeys are all multi-functional. They are in charge of selecting corresponding menu options on the screen in different menu modes.

▼ This functional softkey is mainly used to turn pages and confirm a selection, such as 'next page', 'previous page'.

2.4 Oscilloscope Setup

While operating the oscilloscope, you may often use four features: Auto Scale, saving a setup, recalling a setup and default setup. Hereinafter they are introduced one by one.

Auto Scale: This function can be used to adjust the horizontal and vertical scales of the oscilloscope automatically and set the trigger coupling, type, position, slope, level and mode, etc., to acquire a stable waveform display.

Saving a Setup: By default, the oscilloscope will save the setup each time before being closed, and automatically recall the setup once being turned on. (Note: If you modify the setup, please wait for more than 10 seconds before turning off the oscilloscope to ensure the proper storage of new settings.) You can save 10 settings permanently in the oscilloscope and reset them as necessary.

Recalli a Setup: The oscilloscope can recall any of your saved setups or the default factory setup.

Default Setup: The oscilloscope is preset for normal operations when it is shipped from the factory. This is the default setup. You may recall this setup at any time for your requirements.

2.5 Horizontal Controls

Use the horizontal controls to change the horizontal scale and position of waveforms. The horizontal position readout shows the time represented by the center of the screen, using the trigger time as zero. When you change the horizontal scale, the waveform will expand or contract to the screen center. The readout near the upper right of the screen shows the current horizontal position in second. The oscilloscope also has an arrow icon at the top of the graticule to indicate the horizontal position.

1. Horizontal Position Knob: Used to control the trigger position against the screen center. Push this button to reset the trigger point back to the screen center.

AN: Used to set the horizontal position as zero.

Universal Knob
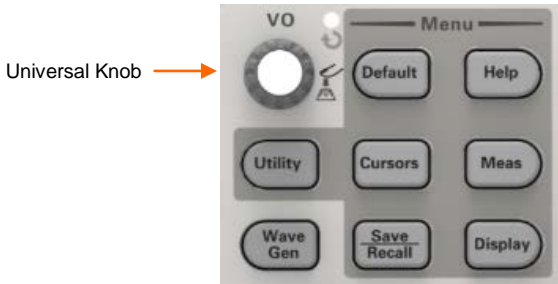
2.SEC/DIV Knob: Used to change the horizontal time scale so as to magnify or compress the waveform horizontally. If the waveform acquisition is stopped (by using the **[Run/Stop]** or **[Single]** button), the SEC/DIV control will expand or compress the waveform.

Note: Press **SEC/DIV** Knob to enter Dual-window Mode.

Single-window Mode
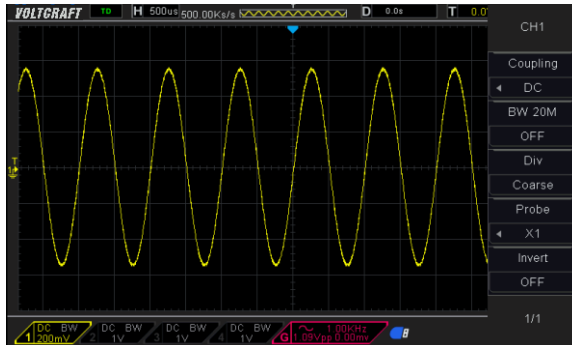
Dual-window Mode (Full Screen)

Location of expanded window data in memory

Major Window

Minor Window
(Expanded Window)
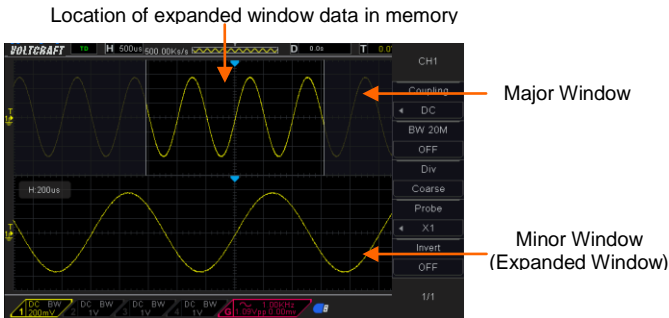
Press **SEC/DIV** Knob again to exit Dual-window Mode.

2.6 Vertical System

2.6.1 Vertical Controls

Vertical controls can be used to display and remove waveforms, adjust vertical scale and position, set input parameters and perform math calculations. Each channel has a separate vertical menu to set. See below for menu description.

Vertical Position

Volts/div
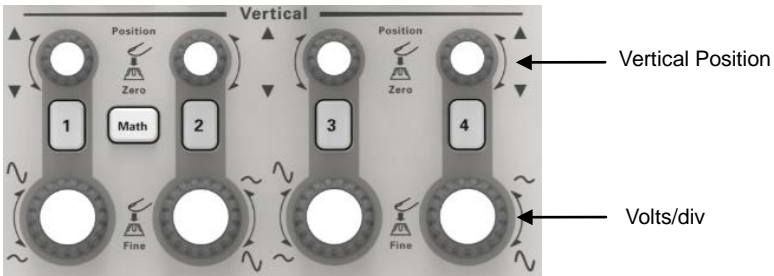
1. **Vertical Position Knob:** Move the channel waveform up and down on the screen. In dual-window mode, move the waveforms in both windows at the same time in a same direction. Push this knob to return waveforms to the vertical center position on the screen. Two channels correspond to two knobs. Also you can press this knob to switch between coarse and fine.

2. **VOLTS/DIV Knob**

Control the oscilloscope to magnify or attenuate the source signal of the channel waveform. The vertical size of the display on the screen will change (increase or decrease) to the ground level.

3. **Menu (CH1, CH2, CH3, CH4):** Display vertical menu options; turn on or off the display of channel waveforms.

Options	Settings	Comments
Coupling	DC AC GND	DC passes both DC and AC components of the input signal. AC blocks the DC component of the input signal and attenuates signals below 10Hz. Ground disconnects the input signal.
BW 20MHz	OFF ON	Limits the bandwidth to reduce display noise; filters the signal to eliminate noise and other unnecessary HF components.
Div	Coarse Fine	Selects the resolution of the VOLTS/DIV knob. Coarse defines a 1-2-5 sequence. Fine changes the resolution to small steps between the Coarse settings.
Probe	1X 10X 100X 1000X	Selects a value according to the probe attenuation factor so as to ensure correct vertical readouts. Reduce bandwidth to 6MHz when using a 1X probe.

Invert	OFF ON	The invert function turns the displayed waveform 180 degrees, with respect to the ground level. When the oscilloscope is triggered on the inverted signal, the trigger is also inverted.

Coupling

- If the channel adopts a DC coupling mode, you can quickly measure the DC component of the signal by observing the difference between the waveform and the signal ground.
- If the channel adopts an AC coupling mode, the DC component in the signal is filtered. By this mode, the AC component of the signal is displayed at a higher sensitivity.
- If the channel adopts a GND coupling mode, cut off the input signal. Inside the channel, the channel input is connected with a zero volt reference electric level.

Fine Resolution

In the fine resolution setting, the vertical scale readout displays the actual VOLTS/DIV setting. The vertical scale changes only after you adjust the VOLTS/DIV control and set to coarse.

Remove Waveform Display

To remove a waveform from the screen, first push the menu button to display the vertical menu, then push again to remove the waveform. A channel waveform which is unnecessary to be displayed can be used as a trigger source or for math operations.

2.6.2   Math Operation

The series of scope supports many math operations between analog channels waveforms, including addition (+), subtraction (-), multiplication (*), division (/) and FFT. You can use cursors to measure it. The contents of this chapter:

- Units for Math Waveforms
- Math Operators
- To Adjust the Math Waveform Scale and Offset

Note: If the analog channel or the math function display is truncated (waveforms do not display on the screen completely), the resulting math will also be truncated.

Operation	Unit
Addition (+)or subtraction (-)	V
multiplication (*)	V∧2
division (/)	None
FFT	dB, Vrms,

Addition or Subtraction

Math operators perform arithmetic operations - add or subtract operation - on any two analog input channels. When you select addition or subtraction, the Source A and Source B values are added or subtracted point by point, and the result is displayed.

1. Press the **[Math]** button on the front panel to enter the MATH function menu.

2. Press the **Source 1** and **Source 2** softkey respectively, and then turn the Universal Knob to select the source to do math operation. Analog channels (CH1~CH4) can be used as Source 1 or source 2.

3. Press the **Operation** softkey and then turn the universal to select + or -to make addition or subtraction operation. The resulting math waveform is displayed on the screen and labeled with "M".

Scale: Press the **Scale** softkey, and then turn the Universal Knob to select the vertical scale.

Multiplication and Division

Math operators perform arithmetic operations multiplication or division operation on any two analog input channels. When you select multiplication or division, the **Source 1** and **Source 2** values are multiplied or divided point by point and the result is displayed.

1. Press the **[Math]** button on the front panel to enter the MATH function menu.

2. Press the **Source 1**and **Source 2** softkey respectively, and then turn the **Universal Knob** to select the source to do math operation. Analog channels (CH1 ~CH4) can be used as Source 1 or source 2.

3. Press the **Operation** softkey and then turn the universal to select ***** or **/** to make multiplication or division operation. The resulting math waveform is displayed on the screen and labeled with "M".

Scale: Press the **Scale** softkey, and then turn the Universal Knob to select the vertical scale.

FFT Operation

FFT is used to compute the fast Fourier transform using analog input channels or reference waveforms. FFT takes the digitized time record of the specified source and transforms it to the frequency domain. When the FFT function is selected, the FFT spectrum is plotted on the oscilloscope display as magnitude in dBV versus frequency. The readout for the horizontal axis changes from time to frequency (Hertz) and the vertical readout changes from volts to dB. FFT operation can facilitate the following works:

◆ Measure harmonic components and distortion in the system

◆ Measure the characteristics of the noise in DC power

◆ Analyze vibration

To display a FFT waveform:

1. Press the **[Math]** button on the front panel to open the MATH function menu.

2. Press the **Operation** softkey and then turn the **Universal Knob** to select **FFT**. The resulting math waveform is displayed on the screen and labeled with "M".

3. Press the **Source** softkey, and then turn the **Universal Knob** to select the source to do FFT operation. Analog channels (CH1~CH4) can be used as the source.

4. Press **Center** softkey and then turn the **Universal Knob** to adjust the frequency of the frequency domain waveform corresponding to the horizontal center of the screen.

5. Press **Span** softkey and then turn the **Universal Knob** to adjust the the horizontal scale of the frequency domain waveform.

6. Press the **Vertical Units** softkey to select the unit of vertical axis. The units of the vertical axis can be dB or Vrms which use a logarithmic scale or a linear scale to display vertical amplitude respectively. If you need to display the FFT frequency spectrum in a relatively larger dynamic range, dBVrms is recommended.

7. Press the **Scale** softkey to select the vertical scale.

8. Press the **Window** softkey, and then turn the **Universal Knob** to select an appropriate window.

Spectral leakage can be considerably decreased when a window function is used. The series of scope provides six kinds of FFT window functions which have different characteristics and are applicable to measure different waveforms. You need to select the window function according to different waveforms and their characteristics. Please read the table below carefully to make an appropriate option according to the input signal.

Window	Measurement	Characteristics
Rectangular	Pulse or Transient Waveform	Special-purpose window applicable to discontinuous waveforms. This is actually the same as no windows.
Hanning	Periodic Waveform	Better frequency, poorer amplitude accuracy than Flattop
Hamming	Transient or short pulse	A litter bit better frequency resolution than Hanning.
Blackman	Single frequency signal, search for higher order harmonics.	The best amplitude resolution; the poorest frequency resolution
Bartlett (Triangle)	Narrow band signal with stronger	Better frequency resolution.
Flattop	Periodic Waveform	Better amplitude, poorer frequency accuracy than Hanning

9. Press the **Show-Only** softkey to select **to display** FFT operation results only and not display the source channel.

Note:

● Signals with DC components or deviation would cause an error or deviation of the FFT waveform components. To reduce the DC components, set the Channel **Coupling** to **AC.**

● To reduce the random noise and aliasing frequency components of repetitive or single pulse, set the **Acquisition** of the oscilloscope to **Average**.

Using Cursors to measure FFT waveform

To make cursor measurements, press the **Cursors** button to turn the cursors, and then press the **Mode** softkey to select **Manual or Track**, Use the AX and BX cursors to measure frequency values and the difference between two frequency values (BX-AX). Use the AY and BY cursors to measure amplitude in dB and difference in amplitude (BY-AY).

2.7 Trigger System

The trigger determines when the oscilloscope begins to acquire data and display a waveform. Once a trigger is properly set up, the oscilloscope can convert unstable displays or blank screens to meaningful waveforms. Here introduce some basic concepts about trigger.

Trigger Source: The trigger can be generated with multiple sources. The most common one is the input channel (CH1~CH4). Whether the input signal is displayed or not, it can trigger normal operations. Also the trigger source can be any signal connected to an external trigger channel (only for Edge trigger).

Trigger Mode: You can select the Auto or Normal mode to define how the oscilloscope acquires data when it does not detect a trigger condition. Auto Mode performs the acquisition freely in absence of valid trigger. It allows the generation of untriggered waveforms with the time base set to 100ms/div or slower. Normal Mode updates the displayed waveforms only when the oscilloscope detects a valid trigger condition.

Before this update, the oscilloscope still displays the old waveforms. This mode shall be used when you want to only view the effectively triggered wveforms. In this mode, the oscilloscope displays waveforms only after the first trigger. To perform a single sequence acquisition, push the **[Single]** button.

Trigger Position: The horizontal position control establishes the time between the trigger position and the screen center.

Trigger Level: It sets the amplitude level the signal must cross to cause an acquisition when using the Edge or Pulse Width trigger.

Force Trigger: Used to complete an acquisition regardless of an adequate trigger signal. This button becomes useless if the acquisition is already stopped.

Trigger Level
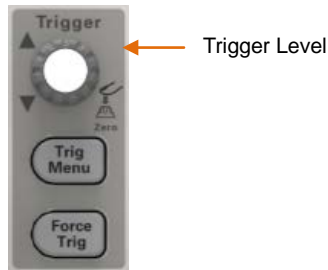
Holdoff: To use Trigger Holdoff, push the **Trig Menu** button and press **Holdoff** softkey. The Trigger Holdoff function can be used to generate a stable display of complex waveforms (such as pulse trains). Holdoff is the time between when the oscilloscope detects one trigger and when it is ready to detect another. During the holdoff time, the oscilloscope will not trigger. For a pulse train, the holdoff time can be adjusted to let the oscilloscope trigger only on the first pulse in the train.
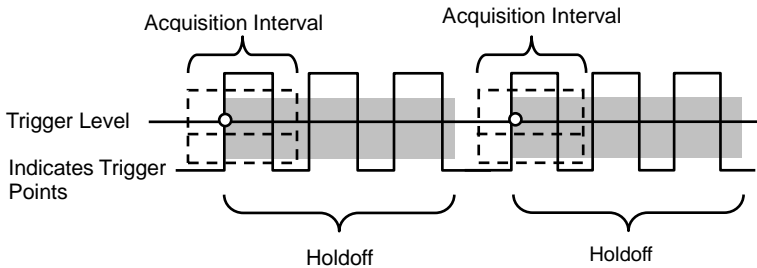
2.7.1   Edge Trigger

Edge trigger distinguishes the trigger points by seeking the specified edge (rising, falling, rising & falling) and trigger level.
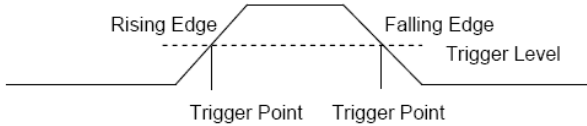
1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, turn the Universal Knob to set select "Edge" and then push the knob to confirm.

3. Press the **Source** softkey, turn the Universal Knob to select CH1~CH4 or EXT as the trigger source.

4. Press the **Slope** softkey, turn the Universal Knob to select the desired trigger edge (rising, falling or rising & falling), and then press down the knob to confirm.

5. Turn the Trigger Level Knob to adjust the trigger level to obtain stable trigger.

6. Press of **50%** softkey to set the trigger level to the vertical midpoint between the peaks of the trigger signal.

The trigger level values are displayed at the upper right corner of the screen.

*Note: Press the **[Auto Scale]** button will set the trigger type to Edge and slope to rising.*

2.7.2   Pulse Trigger

Trigger on the positive or negative pulse with a specified width.

1. Press the **[Trig Menu]** button on the front panel to enter the TRIGGER function

menu.

2. Press the **Type** softkey, turn the **Universal Knob** to select Pulse and then push the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4 as the trigger source.

4. Turn the **Trigger Level** Knob to adjust the trigger level to the desired place.

5. Press the **Polarity** softkey to select Positive or Negative pulse that to trigger on.

6. Press the **When** softkey, turn the **Universal Knob** to select the desired condition, and push down the knob to confirm.

- ● < (less than a time value): trigger when the positive or negative slope time of the input signal is lower than the specified time value.

  For example, for a positive pulse, if you set t (pulse real width) < 100ns, the waveform will trigger.

- ● > (greater than a time value): trigger when the positive or negative slope time of the input signal is greater than the specified time value.

  For example, for a positive pulse, if you set t (pulse real width) >100ns, the waveform will trigger.

- ● != (not equal to time value): trigger when the positive or negative slope time of the input signal is not equal to the specified time value.

- ● = (equal to time value): trigger when the positive or negative slope time of the input signal is equal to the specified time value.

  For example, for a positive pulse, if you set t (pulse real width) = 200ns, the waveform will trigger.
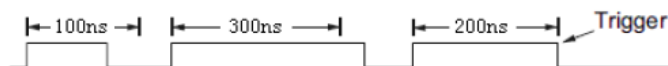
7. Press the Next Page softkey and press of **50%** softkey to set the trigger level to the vertical midpoint between the peaks of the trigger signal.

The trigger level values are displayed at the upper right corner of the screen.

Trigger When: The pulse width of the source must be ≥5ns so that the oscilloscope can detect the pulse.

Triggers when pulse is less than width setting

Triggers when pulse is greater than width setting

Threshold level

Triggers when pulse is not equal to width setting ±5%

Triggers when pulse is equal to width setting ±5%

Threshold level

Tolerance

Tolerance

● = Trigger Point

=, ≠: Within a ±5% tolerance, triggers the oscilloscope when the signal pulse width is equal to or not equal to the specified pulse width.

<, >: Triggers the oscilloscope when the source signal pulse width is less than or greater than the specified pulse width.

2.7.3   Video Trigger

Video triggering can be used to capture the complicated waveforms of most standard analog video signals. The trigger circuitry detects the vertical and horizontal interval of the waveform and produces triggers based on the video trigger settings you have

selected. The series of scope support standard video signal field or line of NTSC (National Television Standards Committee), PAL (Phase Alternating Line).
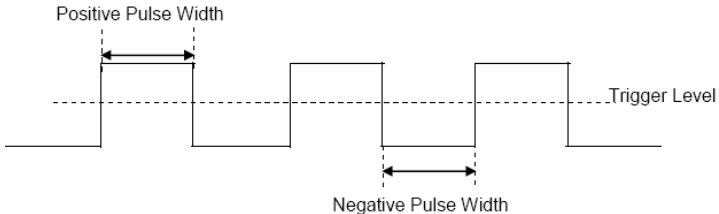
1. Press the **[Trig Menu]** button on the front panel to enter the Trigger function menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select Video and push down the knob to confirm.

3. Press the **Source** softkey turn the Universal Knob to select CH1~CH4 as the trigger source.

4. Press the **Standard** softkey to select the desired video standard. The series of scope support the following video standards: PAL and NTSC.

5. Press the **Sync** softkey, then turn the Universal Knob to select field or line.

2.7.4   Slope Trigger

The slope trigger looks for a rising or falling transition from one level to another level in the specified time range. In the series of scope, positive slope time is defined as the time difference between the two crossing points of trigger level line A and B with the positive edge as shown in the figure below.
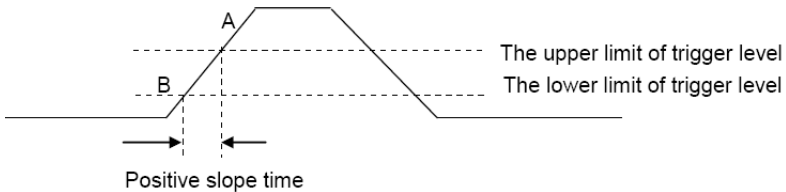
1. Press the **[Trig Menu]** button on the front panel to enter the Trigger function menu.

2. Press the **Type** softkey, turn the **Universal Knob** to set select Slop and then push the knob to confirm.

3. Press the **Source** softkey, turn the Universal Knob to select CH1~CH4 as the trigger source.

4. Press the **Slop** softkey, turn the **Universal Knob** to set select the desired trigger edge (rising or falling), and then push down the knob to confirm.

5. Press the **Level** softkey and press of Lower Upper softkey to select Lower(V2) or Upper(V1) the trigger level; then turn the **Trigger Level** Knob to adjust the position. The trigger different level value between Upper and Lower is displayed at the upper

right corner of the screen.

The Lower trigger level cannot be upper than the upper trigger level. V1 means the upper trigger level while V2 means the lower trigger level.

6. Press the **When** softkey, then turn the **Universal Knob** to select the desired slope condition, and push down the knob to confirm.
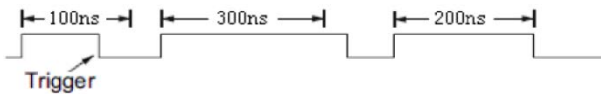
- < (less than a time value): trigger when the positive or negative slope time of the input signal is lower than the specified time value.
- > (greater than a time value): trigger when the positive or negative slope time of the input signal is greater than the specified time value.
- !=(not equal to a time value): trigger when the positive or negative slope time of the input signal is not equal to the specified time value..
- =(equal to a time value): trigger when the positive or negative slope time of the input signal is equal to the specified time value.
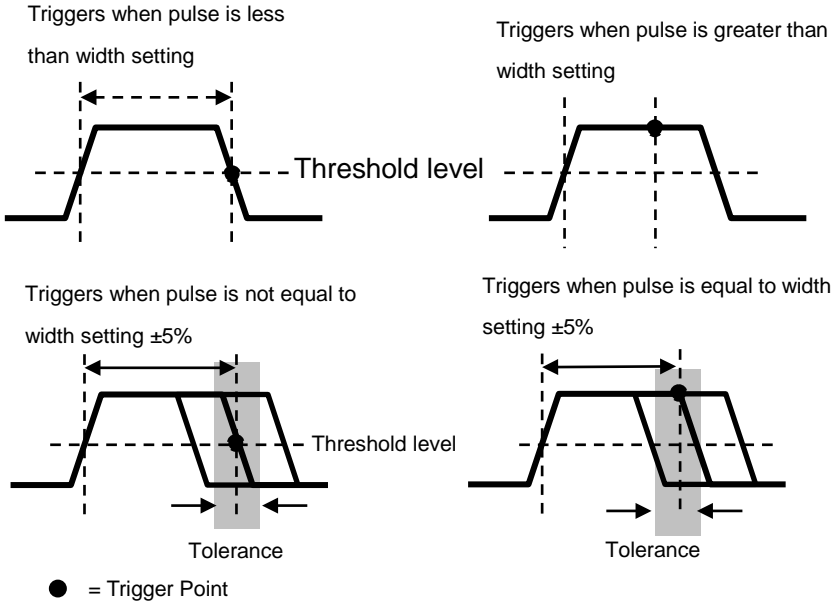
2.7.5   Overtime Trigger

Trigger when the time interval ($\triangle$T) from when the rising edge (or falling edge) of the input signal passes through the trigger level to when the neighboring falling edge (or rising edge) passes through the trigger level is greater than the timeout time set, as shown in the figure below.
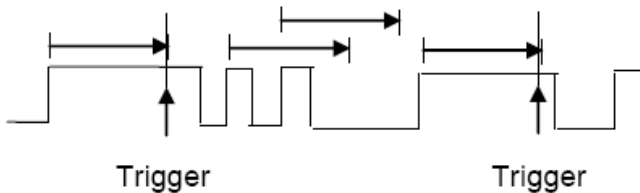
1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then use the **Universal Knob** to select Overtime and push down the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4 as the trigger source. Select channel with signal input as trigger source to obtain stable trigger.

4. Press the **Polarity** softkey to select Positive or Negative edge.

5. Press the **Time** softkey, turn the **Universal Knob** to select the desired value.

6. Press of **50%** softkey to set the trigger level to the vertical midpoint between the peaks of the trigger signal.

2.7.6   Window Trigger

Windows trigger provides a high trigger level and a low trigger level. The instrument triggers when the input signal passes through the high trigger level or the low trigger level.

Horizontal Trigger Position

High Level

Low Level

- If the lower and the upper trigger levels are both within the waveform amplitude range, the oscilloscope will trigger on both rising and falling edge.
- If the upper trigger level is within the waveform amplitude range while the lower trigger level is out of the waveform amplitude range, the oscilloscope will trigger on rising edge only.
- If the lower trigger level is within the waveform amplitude range while the upper trigger level is out of the waveform amplitude range, the oscilloscope will trigger on falling edge only.

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger function menu.

2. Press the **Type** softkey, then use the **Universal Knob** to select Window and push down the knob to confirm.

3. Press the **Source** softkey, turn the Universal Knob to select CH1~CH4 as the trigger source.

4. Press **Level** softkey to select Lower or Upper trigger level or both level, then turn the **Trigger Level** Knob to adjust the position. The trigger level values are displayed at the upper right corner of the screen. The trigger different level value between Upper and

Lower is displayed at the upper right corner of the screen.

The Lower trigger level cannot be upper than the upper trigger level. V1 means the upper trigger level while V2 means the lower trigger level.

2.7.7   Pattern Trigger

Identify a trigger condition by looking for a specified pattern. This pattern is a logical "AND" or "Or" combination of channels. Each channel can have a value of high (1), low (0) or don't care (X). A rising, falling edge, rising or falling can be specified for one channel included in the pattern. When an edge is specified, the oscilloscope will trigger at the edge specified if the pattern set for the other channels are true (namely the actual pattern of the channel is the same with the preset pattern). If no edge is specified, the oscilloscope will trigger on the last edge that makes the pattern true. If all the channels in the pattern are set to "Don't Care", the oscilloscope will not trigger.
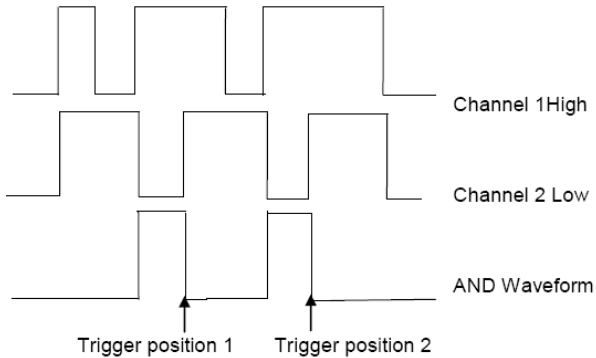
Trigger position 1   Trigger position 2
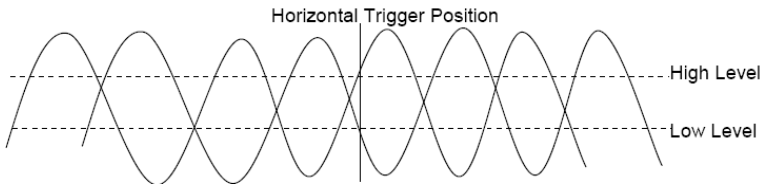
To set interval trigger:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then use the **Universal Knob** to select Pattern and push down the knob to confirm.

3. Press the **Logic** softkey, turn the **Universal Knob** to select a logical "AND" or "Or" combination of channels and push down the knob to confirm.

4. Press **Pattern** to set the pattern of the current signal source, turn the **Universal Knob** to select a pattern. At this point, the corresponding pattern is displayed on the

menu. The patterns of channels CH1-CH4 are presented from left to right. You can set the pattern of a signal source when the souce is open. Press **Pattern** softkey to set pattern for other source.

  1: Set the pattern of the channel selected to "H", namely the voltage level is higher than the trigger level of the channel.

  0: Set the pattern of the channel selected to "L", namely the voltage level is lower than the trigger level of the channel.

  X: Set the pattern of the channel selected to "Don't Care", namely this channel is not used as a part of the pattern. When all channels in the pattern are set to "Don't Care", the oscilloscope will not trigger.

  ▯: Set the pattern to the rising edge of the channel selected.

  ▮: Set the pattern to the falling edge of the channel selected.

  ▮: Set the pattern to the rising or falling edge of the channel selected.

5. Press the **Level** softkey to set the trigger level. For the analog channels, the trigger level of each channel needs to be set independently. For example, set the trigger level of CH1. Press **Level** softkey to select CH1, and then use **Trigger level** knob to modify the level. Press **Pattern** softkey to set the trigger level for other source.

2.7.8   Interval Trigger

Trigger when the time difference between the neighboring rising or falling edges meets the time limit condition (<, >, !=, =).
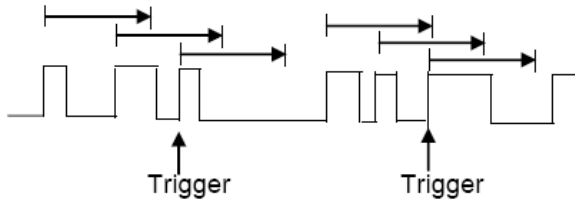
To set interval trigger:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function

menu.

2. Press the **Type** softkey, then use the Universal Knob to select Interval and push down the knob to confirm.

3. Press the **Source** softkey, turn the Universal Knob to select CH1~CH4 as the trigger source.

4. Press the **Slope** softkey to select rising or falling edge.

5. Press the **When** softkey, turn the Universal Knob to select desired condition.

- < (less than a time value): trigger when the positive or negative pulse time of the input signal is less than the specified time value.

- > (greater than a time value): trigger when the positive or negative pulse time of the input signal is greater than the specified time value.

- != (not equal to a time value): trigger when the positive or negative pulse time of the input signal is not equal to the specified limit of time.

- = (equal to a time value): trigger when the positive or negative pulse time of the input signal is equal to the specified limit of time.

6. Press the **When** softkey (<, >, !=, =), turn the **Universal Knob** to select the desired condition.

2.7.9 Under Amp Trigger

The Runt trigger looks for pulses that cross one threshold but not another as shown in the picture below.
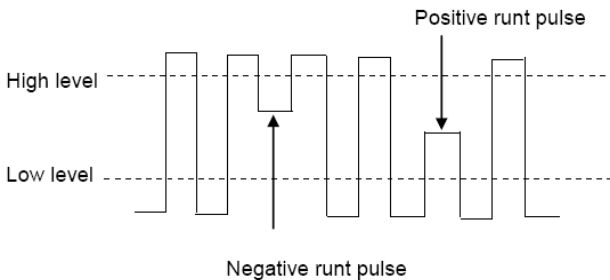
- A positive runt pulse across through a lower threshold but not an upper threshold.
- A negative runt pulse across through an upper threshold but not a lower threshold.

To trigger on runt pulse:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select Under Amp and push down the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4as the trigger source.

4. Press the **Polarity** softkey to select Positive or Negative pulse to trigger.

5. Press the When softkey, turn the **Universal Knob** to select the desired condition (<, >, != or =).

6. Press the **Width** softkey, and then turn the **Universal Knob** to select the desired value.

7. Press the Next Page softkey to enter the second page of the TRIGGER system function menu. Press the **Level** softkey to select Lower or Upper trigger level, and the turn the **Universal Knob** to set the position.

2.7.10 UART Trigger

To trigger on UART trigger:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select UART and push down the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4 as the trigger source.

4. Set the following parameters.

   Idle Level - Set the idle level High or Low to match your device under test.

   Baud - Press the **Baud Rate** softkey, then press the **Universal Knob** and select a baud rate to match the signal in your device under test. If the desired baud rate is not listed, select Custom on the Baud softkey, and then press the Custom softkey and turn the Universal Knob to set the desired baud rate.

   ☐ Parity - Parity Check. Choose odd, even, or none, based on your device under test.

▢ Data Bits - Data Length, Set the number of bits in the UART2 words to match your device under test (selectable from 5-8 bits).

5. Press the **When** softkey and set up the desired trigger condition:

▢ Start - The oscilloscope triggers when a start bit occurs.

▢ Stop - Triggers when a stop bit occurs on measured signal. The trigger occurs on the first stop bit regardless of using 1, 1.5 or 2 stop bit.

▢ Spec Data - Triggers on a data byte that you specify. For use when the device under test data words are from 5 to 8 bits in length

    a. Press the **When** softkey, and choose an equality qualifier. You can choose equal to(=), not equal to(!=), less than(<), or greater than(>) a specific data value.

    b. Press the **Data** softkey, and turn V0 to set the data value for your trigger comparison. The range of the data value is 0x00 to 0xff.

    This works in conjunction with the **When** softkey.

  Parity error: The oscilloscope triggers when the parity check is error when there is parity check.

  Com error: The oscilloscope triggers when the received data is error.

Note: *Use V0 to set the data. When the arrow shows vertical on the top left of Data menu, turn V0 to set the value of the current data bit; then press V0, the arrow shows horizontal, and turn V0 to select the data bits that you want to set.*

*: Horizontal arrow, turn the **Universal Knob** to select a digit.*

*: arrow, turn the **Universal Knob** to set the value of the selected digit.*

For example1, source: CH1; baud: 19200; Idle: High; Parity: No; Data Bit: 8; when: "Start". The trigger result is shown below:
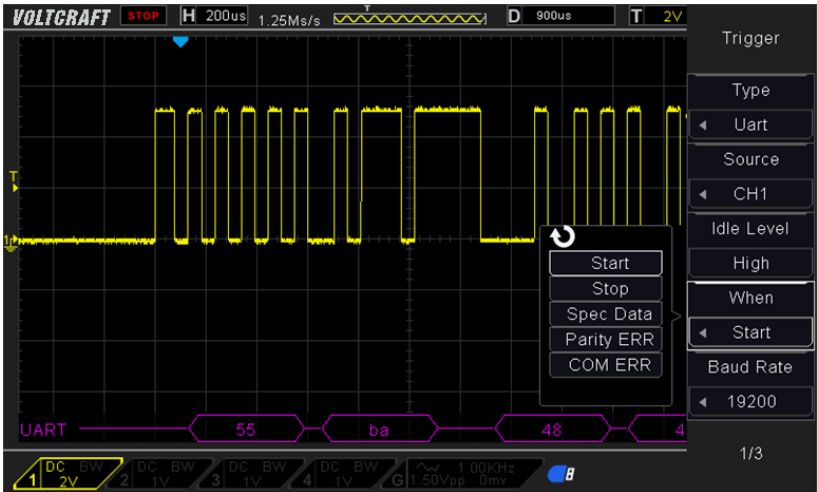
For example2, source: CH1; baud: 19200; Idle: High; Parity: No; Data Bit: 8; when: "Stop". The trigger result is shown below:
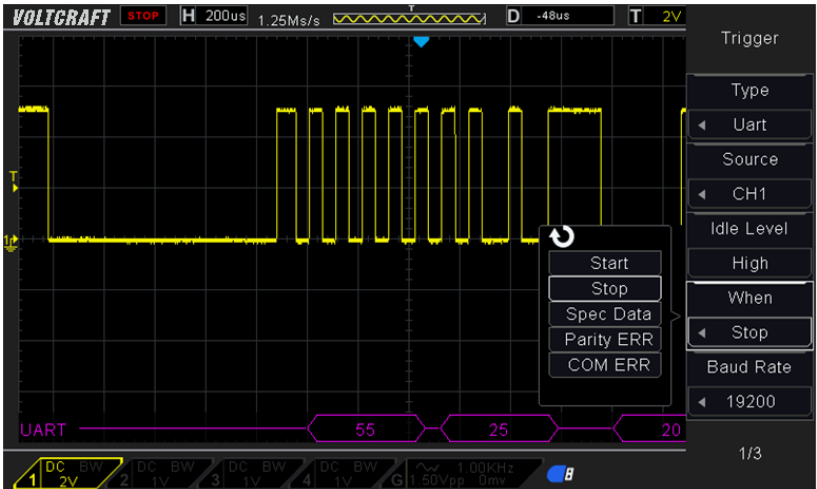
For example3, source: CH1; baud: 19200; Idle: High; Parity: No; Data Bit: 8; Data: 0x55; When: Spec Data; When: equal (=).The trigger result is shown below:
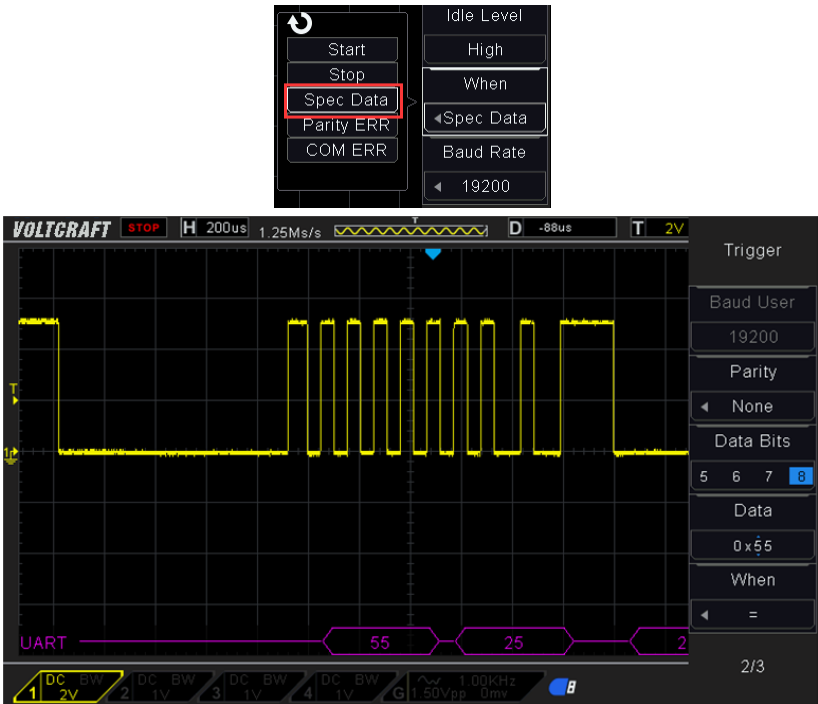
Uart Decode interpretation:

    1. The decode data is displayed in hexadecimal;

    2. The decoded data is at the bottom of the waveform interface. The color of decode data is displayed purple;

    3. When there are "?" or "adjust the time base", you need to adjust the time base to see the decoding results.

UART text interface is shown as below:
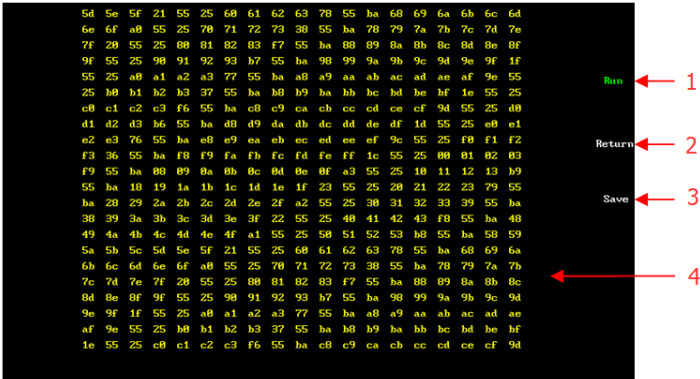
1. Run/Stop decode;
2. Return to the previous interface;
3. Save data. Available when the USB memory device is inserted.
4. Decoded data area.

2.7.11 LIN Trigger

LIN triggering can trigger on the rising edge at the Sync Break exit of the LIN
single-wire bus signal (that marks the beginning of the message frame), the Frame ID,
or the Frame ID and Data. A LIN signal message frame is shown below:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function
menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select LIN and push down
the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4 as the
trigger source.

4. Press the **Buad Tate** softkey, and turn the **Universal Knob** to set the Baud Rate.

5. Press the **Idle Level** softkey, and turn the **Universal Knob** to set the Idle Level.

6. Press the **Identifier** softkey, and turn the **Universal Knob** to set the Identifier. The
range is from 0x00 to 0x3f.

7. Press **When** softkey to set trigger condition.

   • Interval Field - The oscilloscope triggers when the interval field end.

- Sync Field –The oscilloscope triggers when the synchronous field end.
- Id Field –The oscilloscope triggers when the Id field end.
- Sync Id Error - The oscilloscope triggers when the Synchronization ID ERROR end.
- Identifier (Frame ID) - The oscilloscope triggers when a frame with an ID equal to the selected value is detected. Use the Universal Knob to select the value for the Frame ID.
- ID and Data (Frame ID and Data) - The oscilloscope triggers when a frame with an ID and data equal to the selected values is detected. Use the Universal Knob to select the value for the ID and Data.

--Press **Data** software, use V0 to set the data, refer to 2.7.10;

--**Data Mask:** When set to "ON", the data is ignored when it is triggered; the setting is "OFF", and the data on the data line must be consistent with the data of the index so that it can trigger;

--**Data Index**: The range is 0 to 3. It can set four hexadecimal data.

For example, source: CH1; baud: 19200; Idle: High; When: ID and Data; ID: 0x25; Data: 00 01 02 03. And set the trigger level. The trigger result is shown below:
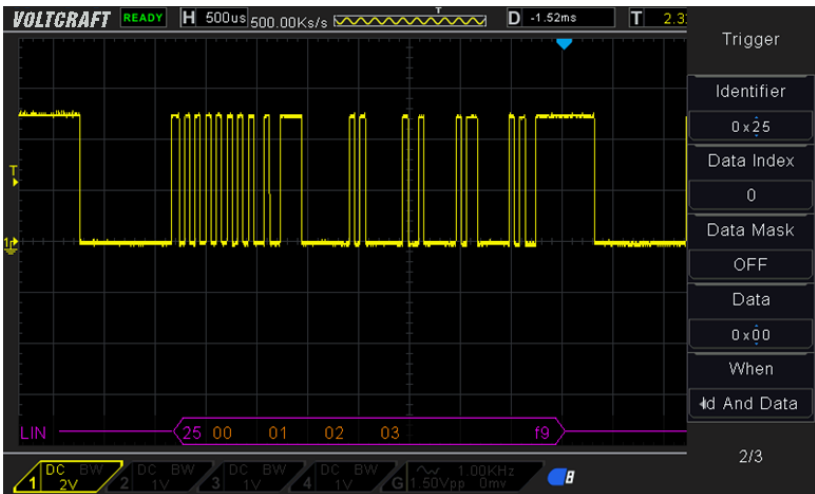
LIN Decode interpretation:

　　1. The decode data is displayed in hexadecimal;

　　2. The decoded data is at the bottom of the waveform interface. The color of "frame ID" and "checksum"decode data is displayed purple;

　　3. When there are "?" or "adjust the time base", you need to adjust the time base to see the decoding results.

　　4. In the Lin decode result, the synchronous field "55" is not decoded and displayed.

LIN text interface is shown as below:
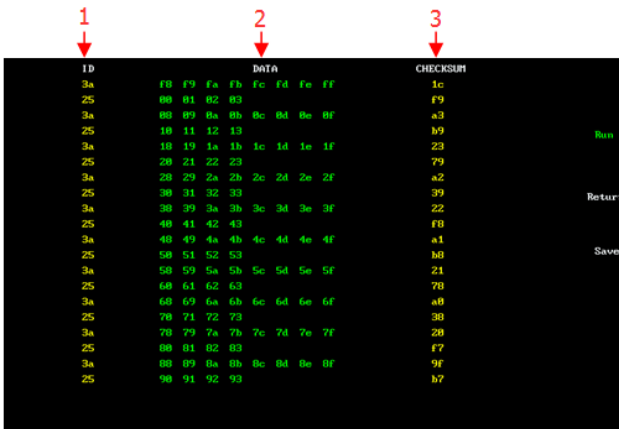
1.　　ID: The ID value of the current frame;

2.　　Data: The data of the current frame;

3.　　Checksum.

2.7.12 CAN Trigger

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select CAN and push down the knob to confirm.

3. Press the **Source** softkey, turn the **Universal Knob** to select CH1~CH4 as the trigger source.

4. Press the **Buad Tate** softkey, and turn the **Universal Knob** to set the Baud Rate.

5. Press the **Idle Level** softkey, and turn the **Universal Knob** to set the Idle Level.

6. Press the **Identifier** softkey, and turn the **Universal Knob** to set the Identifier.

Note: The Identifier means Remote ID and Data ID.

7. Press **When** softkey to set trigger condition.

- Start - The oscilloscope triggers at the start of a frame.
- Remote ID- The oscilloscope triggers on remote frames with the specified ID.
- Data ID - The oscilloscope will trigger on data frames matching the specified ID
- Frame ID - The oscilloscope will trigger on data frames od remote frames matching the specified frame data.
- Data Frame and data –The oscilloscope will trigger on data frames matching the specified data frame ID and data.

  a. Press the **Data** softkey to select the ID number.

  b. Press the **Data** softkey to move the current bit, and turn the universal to select the byte to be set.

    --Press **Data** software, use V0 to set the data, refer to 2.7.10;

    --**Data Mask:** When set to "ON", the data is ignored when it is triggered; the setting is "OFF", and the data on the data line must be consistent with the data of the index so that it can trigger;

    --**Data Index**: The range is 0 to 3. It can set four hexadecimal data.

- Error –The oscilloscope will trigger on error frames matching the specified data.
- All Error - The oscilloscope will trigger when any form error or active error is encountered. Not include judgment of CRC errors.
- Ack Error –The oscilloscope will trigger when the comfirm is high.
- Overload Frame - The oscilloscope will trigger on overload frames.

For example1, Source: CH1; Baund Rate: 1000000; Idle Level: Low; When: Start Bit. The trigger result is shown below:
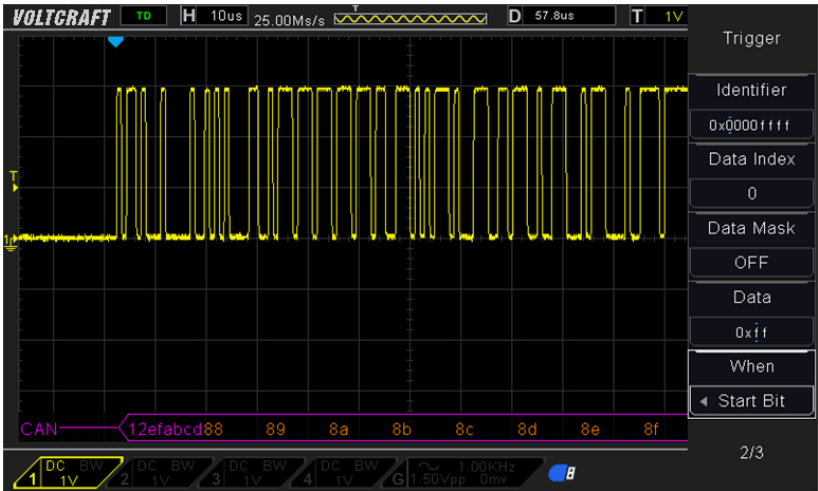
For example2, Source: CH1; Baund Rate: 1000000; Idle Level: Low; When: Data ID; **Identifier: 0x12efabcd.** The trigger result is shown below:
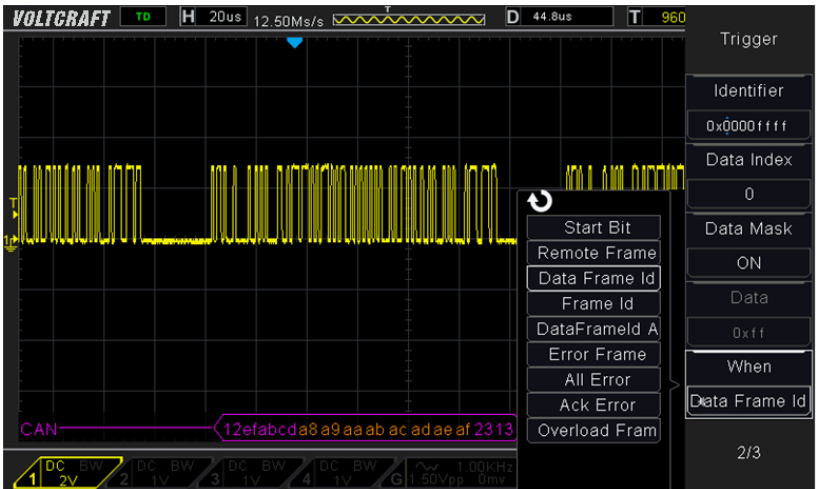
CAN Decode interpretation:

   1. The decode data is displayed in hexadecimal;

   2. The decoded data is at the bottom of the waveform interface. The color of "frame ID" is displayed purple, the "Data" is orange, the "CRC" is purple;

   3. When there are "?" or "adjust the time base", you need to adjust the time base to see the decoding results.

CAN text interface is shown as below:

1. ID: The ID value of the current frame, displayed as hexadecimal;
2. Frame type: "SFF"- Standard data frame, "SRF"- Standard remote frame, "EFF"-
   Extended data frame, "ERF"- Extended remote frame;
3. DLE: Data bytes of current frame;
4. Data: The data of current frame;
5. CRC：The CRC check code of current frame.

2.7.13 SPI Trigger

In SPI trigger, when timeout condition is satisfied, the oscilloscope triggers when the
specified data is found. When using SPI trigger, you need to specify the SCL clock
sources and SDA data sources. Below is the sequential chart of SPI bus.
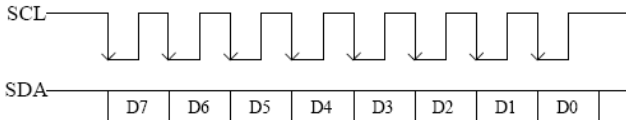
1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function
menu.
2. Press the **Type** softkey, then turn the **Universal Knob** to select SPI and push down
the knob to confirm.

3. Source Selection: Press **SCL** and **SDA** softkey to specify the data sources of SCL and SDA respectively. They can be set to CH1-CH4.

Note: Select channel with signal input as trigger source to obtain stable trigger.

4. Data Line Setting:

□ Press Data Width to set the number of bits of the serial data character string. The serial data string can be specified to be from 4, 8, 16, 24, 32 bits long.

   Press Data softkey, use V0 to set the data, refer to 2.7.10.

   Data Mask: it is hexadecimal, 0-Mask, f-No Mask, 1~e mask some data.

5. Trigger Condition: Press **Overtime** softkey to set the timeout, the range is from 8 ns to 10 s.

Timeout: the clock (SCL) signal need to maintain a certain idle time before the oscilloscope searches for a trigger. The oscilloscope will trigger on when the data (SDA) satisfying the trigger conditions is found.

6. Slope: Clock Edge: Press **Slope** softkey to select the desired clock edge.

   Rising: sample the SDA data on the rising edge of the clock.

   Falling: sample the SDA data on the falling edge of the clock.

7. When select SCL channel, press SCL and use **Trigger Level** knob to modify the trigger level of the SCL channel. When select SDA channel, use **Trigger Level** knob to modify the trigger level of the SDA channel.

For example： SCL: CH1; SDA: CH2; Slope: Rising; Data Width: 8; Data Mask: 0x000000ff; Data: 0x000000f5; Overtime: 190ns. The trigger result is shown below:
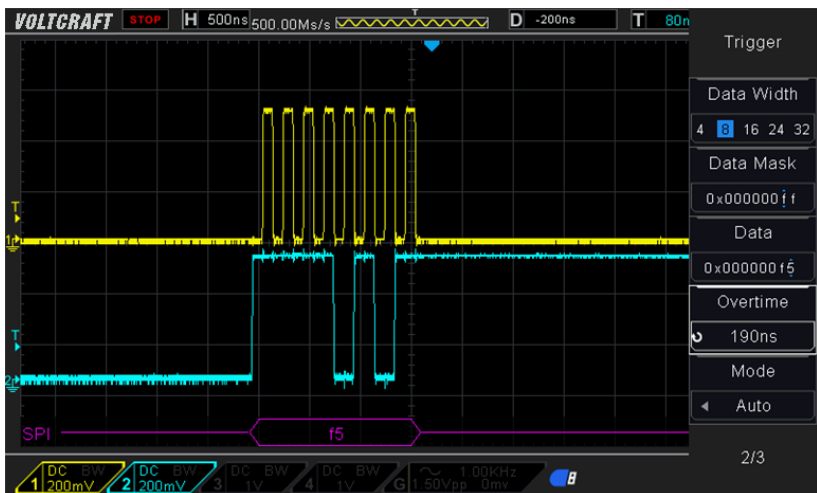
SPI Decode interpretation:

　1. The decode data is displayed in hexadecimal;

　2. The decoded data is at the bottom of the waveform interface. The color of "Data" is displayed purple;

　3. When there are "?" or "adjust the time base", you need to adjust the time base to see the decoding results.

SPI text interface is shown as below:
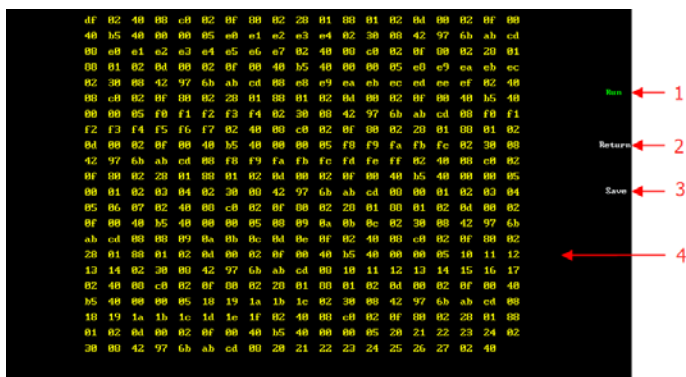
1.　Run/Stop decode;

2. Return to the previous interface;

3. Save data. Available when the USB memory device is inserted.

4. Decoded data area.

2.7.14 IIC Trigger

IIC (Inter-IC bus) signals setup consists of connecting the oscilloscope to the serial data (SDA) line and the serial clock (SCL) line and then specifying the input signal threshold voltage levels.

To set up the oscilloscope to capture IIC signals, please refer to the following:

1. Press the **[Trig Menu]** button on the front panel to enter the Trigger system function menu.

2. Press the **Type** softkey, then turn the **Universal Knob** to select **IIC** and push down the knob to confirm.

3. Source Selection: Press **SCL** and **SDA** softkey, turn the Universal Knob to to specify the data sources of SCL and SDA respectively. They can be set to CH1-CH4.

4. Press **When** softkey to set trigger condition. Select trigger condition "Start Bit", connect the SCL signal to CH1 and connect the SDA signal to CH2.

   Press the corresponding **Level** softkey; then, turn the **Trigger Level** knob to set the signal threshold voltage level.

• Data must be stable during the entire high clock cycle or it will be interpreted as a start or stop condition (data transitioning while the clock is high).
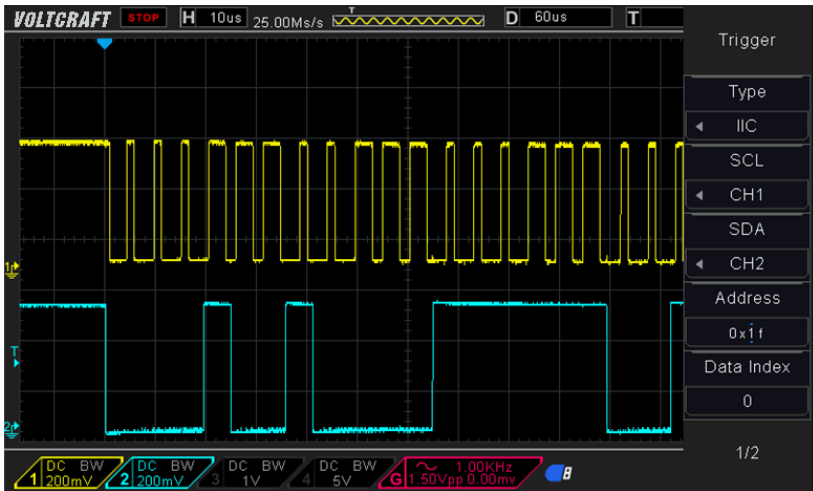
Trigger condition:

Trigger Condition: Press **When** softkey to select the desired trigger condition.
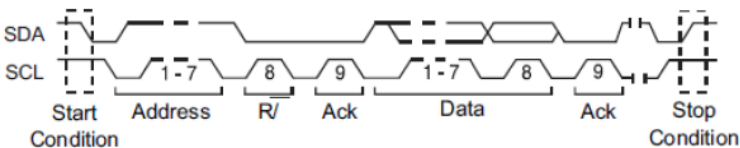
• Start: trigger when SDA data transitions from high level to low level while SCL is high level.

• Stop: trigger when SDA data transitions from low level to high level while SCL is high level.

• MissedACK: trigger when the SDA data is high level during any acknowledgement of SCL clock position.

• Address: the trigger searches for the specified address value. When this event occurs, the oscilloscope will trigger on the read/write bit.

   The AddrBits is "7 bits"; --so the range can be from 0 to 0x7F.

• Restart: trigger when another start condition occurs before a stop condition.

• Address and Data: the trigger searches for the specified address and data value on the data line (SDA). When this event occurs, the oscilloscope will trigger on the clock line (SCL) transition edge of the last bit of data. After this trigger condition is selected:

--Press **Data** software, use V0 to set the data, refer to 2.7.10;

--**Data Mask:** When set to "ON", the data is ignored when it is triggered; the setting is "OFF", and the data on the data line must be consistent with the data of the index so that it can trigger;

--**Data Index**: The range is 0 to 3. It can set four hexadecimal data.

Trigger Level:

5. When select SCL channel, press SCL and use **Trigger Level** knob to modify the trigger level of the SCL channel. When select SDA channel, use **Trigger Level** knob to modify the trigger level of the SDA channel.

For example1: SCL: CH1; SDA: CH2; When: Start Bit. The trigger result is shown below:
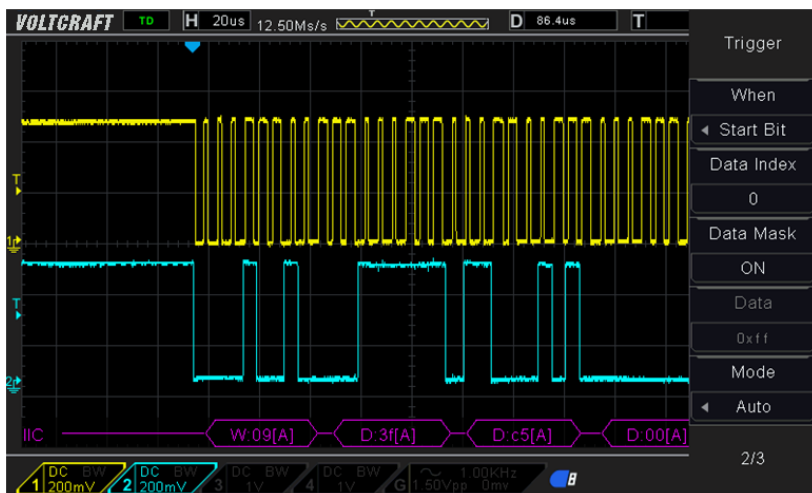
For example2: SCL: CH1; SDA: CH2; When: Address and Data; Address: 09; Data: 3f xx xx xx (The data mask of index 0 is "OFF", the data mask of others are "ON"). The trigger result is shown below:
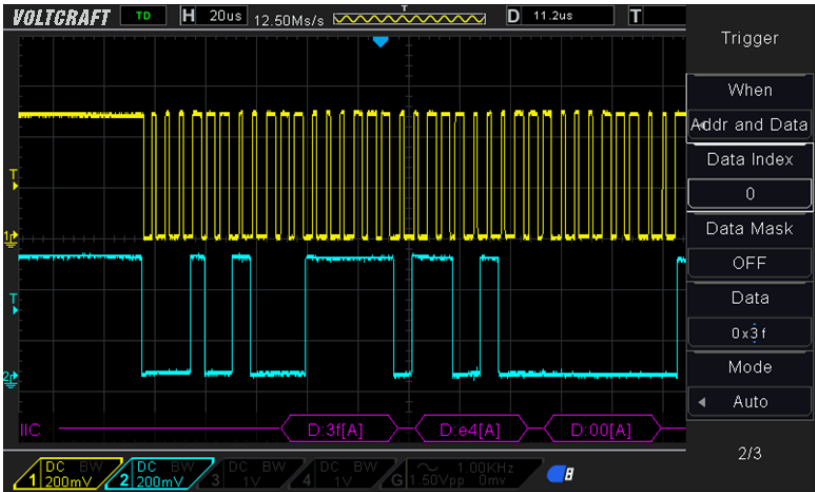
IIC Decode interpretation:

1. The decode data is displayed in hexadecimal;

2. The decoded data is at the bottom of the waveform interface. The color of "Address" and "Data" are displayed purple; "W" indicates the write operation, "R" indicates the read operation, "D" indicates the decoded data, "~A" indicates the unacknowledged bit;

3. When there are "?" or "adjust the time base", you need to adjust the time base to see the decoding results.

IIC text interface is shown as below:

1. Address: In the address bar, "R" represents the read operation, and "W" represents the write operation;
2. Data: It is the data sent by a read or write operation;
3. ADDR ACK: "Y" means response, and "N" means no response.

2.8 Save/Recall

Oscilloscope setups, waveforms, Ref, and CSV files can be saved to internal oscilloscope memory or to a USB storage device. The saved setups, waveforms and Ref can be recalled from an USB Host interface on the front panel to connect an USB device for external storage.

The scope supports setups, waveforms, Ref and CSV files storage. The default save type is setups.

1. Setups

It's the default storage type of the scope. It saves the settings of the oscilloscope in internal or external memory in ".SET" format. At most 9 setting files (from No.1~No.9) can be stored in internal memory. The stored settings can be recalled.

2. Wave(Binary)

The scope saves the waveform data in memory in ".lwf format.

3. Reference

The scope saves the waveform data in memory in ".REF" format. At recall, the reference waveform will be displayed on the screen directly.

4. CSV

It saves the waveform data in external memory in ".CSV" format. The stored files contain the waveform data of the displayed analog channels and the main setting information of the oscilloscope. The recall of CSV file is not supported.

2.8.1 Internal Save and Recall

Internal save and recall support Setups in Save/Recall. In the following part, the save and recall method and procedures are introduced.

Save the specified oscilloscope setting in internal memory.

1. Connect the signal to the oscilloscope and obtain stable display.

2. Press **[Save/Recall]** button on the front panel to enter the SAVE/RECALL function menu.

3. Press the **Save** softkey and then turn the **Universal Knob** to select Setup and then press the knob to confirm.

4. Press the **Save To** softkey to select Internal to save the current setup of the oscilloscope to the internal memory.

5. Press the **SetUp** softkey button, then turn the **Universal Knob** to select the location to save. The internal memory can save as many as 9 setup files, from No.1～No.9.

6. Press the **Save** softkey to save the current setup to the appointed location. After a few seconds, it will pop-out the message "Save successfully".

Load the specified type of file in internal memory.

If want to recall the setup after having finished the steps above, please do the following steps: Press the **Recall** softkey, and then turn the **Universal Knob** to select the location that you want to recall, press the **Recall** softkey to recall the setup, and it will pop-out the message "Recall Successfully".

Note: if need to delete a setup file in the memory, please save a new setup to the same location to overwrite it.

2.8.2   External save and recall

Before using external storage and recall, make sure that the USB flash device is connected correctly. External storage supports all the types of files in save, but in recall, CSV are not supported.

Save the specified type of file in the external USB flash device.

1. Press the **[Save/Recall]** button on the front panel to enter the SAVE/RECALL function menu.

2. Insert the USB storage device into the front panel USB Host interface, if thedevice is

recognized successful, the pop-uptip "Storage device is connected".

3. Press the **Save** softkey to select Save Type.

4. Use the **SaveTo** softkey to external location. Press Save softkey and into USB storage interface. File can be stored under the root directory or in a certain folder under the root directory of the USB storage device.

5. Press the **Save** softkey to save the current waveform to the external USB storage device,

Load the specified type of file in the external USB storage device.

1. Insert the USB storage device into the front panel USB Host interface, if thedevice is recognized successful, the pop-uptip "Storage device is connected".

2. Press the **[Save/Recall]** button on the front panel to enter the SAVE/RECALL function menu.

3. Press the **Type** softkey to select Wave or Setup

4. Press the **Recall** softkey to enter the SAVE/RECALL file system.

5. Turn the Universal Knob to select the file to be recalled, press the **Recall** softkey to recall the waveform or setup.

2.9 Measure System

The oscilloscope displays graphs of voltage versus time and can help to measure the displayed waveform. There are several ways to take measurements, using the graticule, the cursors or performing an automatic measurement.

2.9.1   Scale measurement

Graticule: This method allows you to make a quick, visual estimate and take a simple measurement through the graticule divisions and the scale factor.

For example, you can take simple measurements by counting the major and minor graticule divisions involved and multiplying by the scale factor. If you counted 6 major vertical graticule divisions between the minimum and maximum values of a waveform and knew you had a scale factor of 50mV/division, you could easily calculate your peak-to-peak voltage as follows:

<div align="center">6 divisions x 50mV/division = 300mV.</div>

2.9.2 Cursor measurement

Cursor: This method allows you to take measurements by moving the cursors. Cursors always appear in pairs and the displayed readouts are just their measured values. There are two kinds of cursors: Amplitude Cursor and Time Cursor. The amplitude cursor appears as a horizontal broken line, measuring the vertical parameters. The time cursor appears as a vertical broken line, measuring the horizontal parameters.

The cursor measurement includes two modes: Manual mode and Tracking mode.

1. Manual mode:

Horizontal cursors or vertical cursors appear in pair to measure time or voltage, and the distance between the cursors can be manually regulated. The signal source should be set as a waveform to be measured before the cursors are used.

2. Tracking mode:

A horizontal cursor is intersected with a vertical cursor to form a cross cursor. The cross cursor is automatically located on the waveform, and the horizontal position of the cross cursor on the waveform is regulated by selecting "Cur A" or "Cur B" and rotating the [UNIVERSAL] knob. The coordinates of the cursor point will be displayed on the screen of the oscilloscope.

Push the **CURSOR** button to display the Cursor Menu.

Options	Settings	Comments
Mode	Manual Track	Select a measurement cursor and display it.
Source	CH1~CH4 MATH	Select a waveform to take the cursor measurement. Use the readouts to show the measurement.
Select Cursor	AX(BX) AXBX AY(BY) AYBY	A selected cursor is highlighted, which can be moved freely. Both cursors can be selected and moved at the same time. The box behind the cursor displays the location of the cursor.

Moving Cursors: Press the key near Select Cursor to select a cursor and turn **Universal Knob** to move it. Cursors can be moved only when the Cursor Menu is displayed.
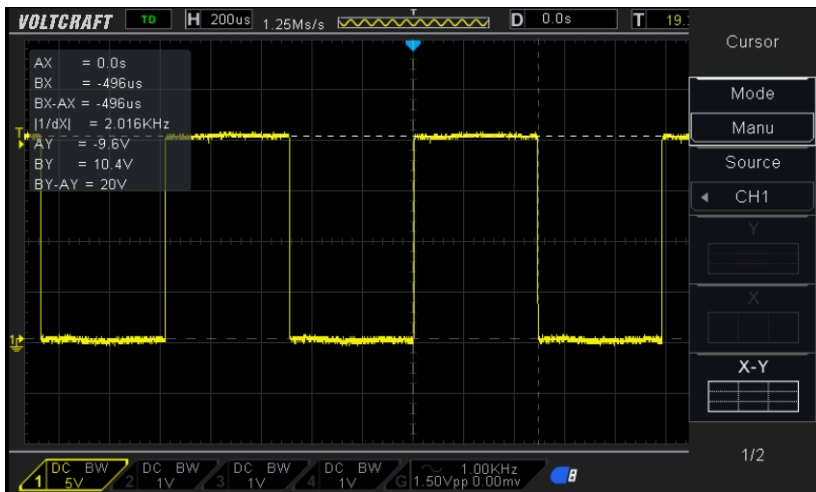
2.9.3 Automatic Measurement

Automatic Measurement: The oscilloscope performs all the calculations automatically in this mode. As this measurement uses the waveform record points, it is more precise than the graticule and cursor measurements. Automatic measurements show the measurement results by readouts which are periodically updated with the new data acquired by the oscilloscope.

Push the **Meas** button to perform auto measurements. There are 32 types of measurements and up to 4 can be displayed at a time.

Perform the steps below and select voltage or time parameters to make automatic measurements.

1. Press the **[Meas]** button on the front panel to enter the Measure function menu.

2. Press the **Source** softkey, and then use the **Universal Knob** to select the desired channel.

3. Press the **Type** softkey, and then turn the **Universal Knob** to select the desired measurement parameter.

4. Press the **Universal Knob** to add the measurement parameter, the parameters and value will be shown above the menu, and the statistics status will update.

5. To turn off the statistic function, press the **Statistics** softkey to select OFF.

The measurement display area can display 4 measurement parameters at most, and the measurements will arrange according to the selecting order. If add a sixth measurement parameter, it will delete the first measurement.

Note: If the parameter does not match the measured condition, it will display as "*****".

To Clear Measurement Parameters

Press the **Clear All** softkey to clear all the measurement parameters that are displaying on the screen.

Statistic Function

Make statistic and display the current, average, minimum, maximum, root mean square error and count values of at most 4 measurement items that are turned on last.

1. Press the **[Meas]** button on the front panel to enter the Measure function menu.

2. Press the **Statistics** softkey to select ON.

	cur	avg	max	min	rmse	count
PkPk	2.32V	7.05V	2.01KV	-980mV	97.56V	8363
Freq	2KHz	1.96KHz	2.02KHz	-980mHz	290.11Hz	8363
VMean	199.96mV	8.19V	2.01KV	-980mV	126.06V	7735
VMax	1.36V	1.33V	1.38V	0.0V	27.86mV	7467

To Make All Measurement

All measurement could measure all parameters of the current measurement source and display the results on the screen.

Do the following steps to make all parameters measurement.

1. Press the **[Meas]** button on the front panel to enter the MEASURE function menu.

2. Press the **All Measure** softkey to select ON.

3. Press the **Source** softkey to select the measure source (CH1~CH4).
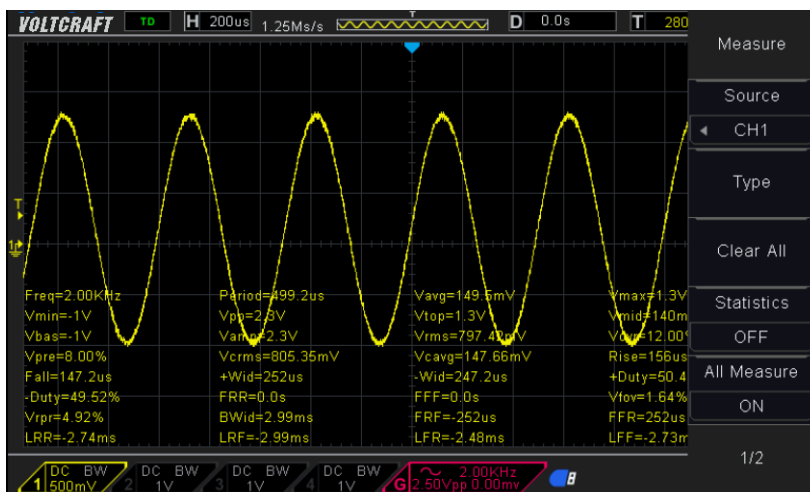
Options	Settings	Comments
Source	CH1~CH4	Select the measure source.
Measurement Type		
1	Frequency	Calculate the waveform frequency by measuring the first cycle.
2	Period	Calculate the time of the first cycle.
3	Average	Calculate the arithmetic mean voltage over the entire waveform.
4	Pk-Pk	Calculate the absolute difference between the greatest and the smallest peaks of the entire waveform.
5	RMS	Calculate the Root Mean Square voltage over the entire waveform.
6	PeriodRms	Calculate the actual RMS measurement of the first complete cycle in the waveform.
7	Min	The most negative peak voltage measured over the entire waveform.
8	Max	The most positive peak voltage measured over the entire waveform.
9	RiseTime	Measure the time between 10% and 90% of the first rising edge of the waveform.
10	FallTime	Measure the time between 90% and 10% of the first falling edge of the waveform.

11	+ Width	Measure the time between the first rising edge and the next falling edge at the waveform 50% level.
12	- Width	Measure the time between the first falling edge and the next rising edge at the waveform 50% level.
13	+ Duty	Measure the first cycle waveform. Positive Duty Cycle is the ratio between positive pulse width and period.
14	- Duty	Measure the first cycle waveform. Negative Duty Cycle is the ratio between positive pulse width and period.
15	Vbase	Measure the highest voltage over the entire waveform.
16	Vtop	Measure the lowest voltage over the entire waveform.
17	Vmid	Measure the voltage of the 50% level from base to top.
18	Vamp	Voltage between Vtop and Vbase of a waveform.
19	Overshoot	Defined as (Base - Min)/Amp x 100 %, Measured over the entire waveform.
20	Preshoot	Defined as (Max - Top)/Amp x 100 %, Measured over the entire waveform.
21	PeriodAvg	Calculate the arithmetic mean voltage over the first cycle in the waveform.
22	FOVShoot	Defined as (Vmin-Vlow)/Vamp after the waveform falling.
23	RPREShoot	Defined as (Vmin-Vlow)/Vamp before the waveform falling.
24	BWidth	The duration of a burst measured over the entire waveform.
25	FRR	The time between the first rising edge of source 1 and the first rising edge of source 2 of 50 voltage level.
26	FFF	The time between the first falling edge of source 1 and the first falling edge of source 2 of 50 voltage level.
27	FRF	The time between the first rising edge of source 1 and the first falling edge of source 2.

28	FFR	The time between the first falling edge of source 1 and the first rising edge of source 2.
29	LRR	The time between the first rising edge of source 1 and the last rising edge of source 2.
30	LRF	The time between the first rising edge of source 1 and the last falling edge of source 2.
31	LFR	The time between the first falling edge of source 1 and the last rising edge of source 2.
32	LFF	The time between the first falling edge of source 1 and the last falling edge of source 2.
	Off	Do not take any measurement.

2.10 Acquire

Run Control

Press the **[Run/Stop]** or **[Single]** button on the front panel to run or stop the sampling system of the scope.

When the **[Run/Stop]** is green, the oscilloscope is running, that is, acquiring data when trigger conditions are met. To stop acquiring data, press the **[Run/Stop]** button. When stopped, the last acquired waveform is displayed.

When the **[Run/Stop]** button is red, data acquisition is stopped. Red "Stop" is displayed next to the trademark logo in the status line at the top of the display. To start acquiring data, press **[Run/Stop]**.

To capture and display a single acquisition (whether the oscilloscope is running or stopped), press **[Single]** button. The Single run control lets you view single-shot events without subsequent waveform data overwriting the display.

When **[Single]** is pressed the display is cleared, the trigger mode is temporarily set to Normal (to keep the oscilloscope from auto-triggering immediately), the trigger circuitry is armed, the Single key is illuminated, and the oscilloscope waits until a user defined trigger condition occurs before it displays a waveform.

When the oscilloscope triggers, the single acquisition is displayed and the oscilloscope is stopped (the **[Run/Stop]** button is illuminated in red). Press **[Single]** button again to acquire another waveform.

When you acquire an analog signal, the oscilloscope will convert it into a digital one.

The real-time acquisition has four modes: Normal, Peak Detect, Average and High Resolution. The acquisition rate is affected by the setting of time base.

Normal: In this acquisition mode, the oscilloscope samples the signal in evenly spaced intervals to establish the waveform. This mode accurately represents signals in most time. However, it does not acquire rapid variations in the analog signal that may occur between two samples, which can result in aliasing and may cause narrow pulses to be missed. In such cases, you should use the Peak Detect mode to acquire data.

Peak Detect: In this acquisition mode, the oscilloscope gets the maximum and minimum values of the input signal over each sample interval and uses these values to display the waveform. In this way, the oscilloscope can acquire and display those narrow pulses that may have otherwise been missed in Normal mode. However, noise will appear to be higher in this mode.

Average: In this acquisition mode, the oscilloscope acquires several waveforms, averages them, and displays the resulting waveform. You can use this mode to reduce random noise.

High Resolution(HR): This mode uses a kind of ultra-sample technique to average the neighboring points of the sample waveform to reduce the random noise on the input signal and generate much smoother waveforms on the screen. This is generally used when the sample rate of the digital converter is higher than the storage rate of the acquisition memory.

Note: "Average" and "HR" modes use different averaging methods. The former uses "Multi-sample Average" and the latter uses "Single Sample Average".

Time Base: The oscilloscope digitizes waveforms by acquiring the value of an input signal at discrete points. The time base helps to control how often the values are digitized. Use the SEC/DIV knob to adjust the time base to a horizontal scale that suits your purpose.

Push the **UTILITY** button and press **Acquire** softkey to set the acquisition parameter.

Options	Settings	Comments
Mode (Real Time)	Normal	Acquire and accurately display most waveforms.
	Peak Detect	Detect glitches and eliminate the possibility of
	Average	aliasing.

	HR	Reduce random or uncorrelated noise in signal display. The number of averages is selectable.
Disp Mode	YT XY Roll	YT format shows the vertical voltage in relation to time (horizontal scale); XY format displays a dot between CH1 and CH2 each time when a sample is acquired, where the voltage or current of CH1 determines the X coordinate of the dot (horizontal) and the voltage or current of CH2 determines the Y coordinate (vertical). For detailed information, refer to descriptions on XY format in the following text.
Averages	4, 8, 16, 32, 64, 128	Select the number of averages by pressing F3 or F4.
Memory Depth		Select the memory depth for different board models.

Normal: For the oscilloscope model with the bandwidth of 100MHz, the maximum sample rate is 1GS/s. For time base with insufficient sample rate, you may use the Sine Interpolation Algorithm to interpolate points between sampled points to produce a complete waveform record (4K by default).

Normal Acquisition Intervals
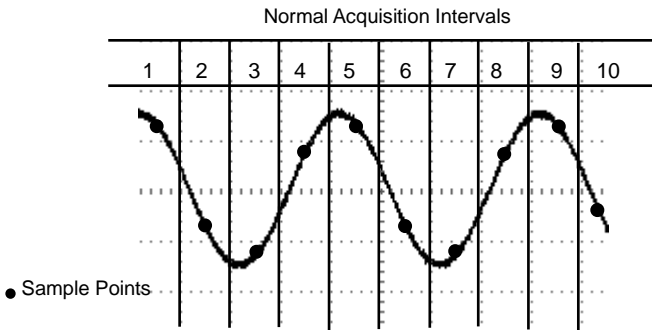
Normal Mode Acquires a Single Sample Point in Each Interval

Peak Detect: Use this mode to detect glitches within 10ns and to limit the possibility of aliasing. This mode is valid at the SEC/DIV setting of 4µs/div or slower. Once you set the SEC/DIV setting to 4µs/div or faster, the acquisition mode will change to Normal because the sample rate is fast enough that Peak Detect is unnecessary. The

oscilloscope does not display a message to tell you that the mode has been changed to Normal.

Average: Use this mode to reduce random or uncorrelated noise in the signal to be displayed. Acquire data in Normal mode and then average a great number of waveforms. Choose the number of acquisitions (4, 8, 16, 32, 64 or 128) to average for the waveform.

Stopping the Acquisition: When you are running the acquisition, the waveform display is live. Stop the acquisition (press the **[Run/Stop]** button) to freeze the display. In either mode, the waveform display can be scaled or positioned by vertical and horizontal controls.

2.10.1 XY Mode

The XY mode is used to analyze phase differences, such as those represented by Lissajous patterns. The format plots the voltage on CH1 against the voltage on CH2, where CH1 is the horizontal axis and CH2 is the vertical axis. The oscilloscope uses the untriggered Normal acquisition mode and displays data as dots.

The oscilloscope can acquire waveforms in YT mode at any sampling rate. You may view the same waveform in XY mode. To perform this operation, stop the acquisition and change the display mode to XY.

2.10.2 Roll Mode

In Roll mode, the waveform display rolls from right to left. No trigger or horizontal offset control of waveforms is available during Roll Mode, and it's only available when set to 100ms/div or slower.

2.11 Display

The waveform display is affected by settings of the oscilloscope. A waveform can be measured once it is captured. The different styles to display a waveform on the screen give significant information about it.

Push the **[Display]** button and the following menu appears.

Options	Settings	Comments
Type	Vectors Dots	Vectors fill up the space between adjacent sample points in the display; Dots only displays the sample points.
Source Intensity		Adjustable, Turn the multi-functional knob to adjust.
Grid	Dotted line Real line OFF	Off only displays the horizontal and vertical coordinates at the center graticule on the screen.
Grid Intensity		Adjustable, Turn the multi-functional knob to adjust.
Key Reuse		Set the function of **[Force Trig]** button, Force trigger or save picture to USB.
Screen Brightness		Adjustable, Turn the multi-functional knob to adjust.
Persist	OFF Infinite 1s, 5s, 10s,30s	Sets the time length to display each displayed sample point.

2.12 Utility System

Push the **UTILITY** button to display the Utility Menu as follows.

Options	Comments
Language	Set the language
DVM	Enable the DVM measure function.
Acquire	Enter acquire function.
System Info	Display the software and hardware versions, serial number and some other information about the oscilloscope.
System Set	Set the sound, Network, time and date.
Update	Insert a USB disk with upgrade program. Press the Update Program button and the Software Upgrade dialog pops up. Refer to tips to upgrade or cancel.
Calibrate	Press this option and the Self Calibration dialog pops up. Refer to tips to perform the self calibration or cancel.

Self Test	Self test function.
Pass/Fail	Pass/Fail function
Front Panel Self Test	Test the function of all keys and knobs on the front panel.

Self Calibration: The self calibration routine can optimize the precision of the oscilloscope to fit the ambient temperature. To maximize the precision, you should perform the self calibration once the ambient temperature changes by 5℃ or more. Follow the instructions on the screen.

Tip: Press any menu button on the front panel to remove the status display and enter a corresponding menu.

2.12.1   Update Firmware

This series of oscilloscope can upgrade the software by the USB flash disc, which needs about 5 minutes.

The firmware is upgraded by the following steps:

1. Plug the USB flash disc in which a firmware program is saved in USB Host interface on the front panel of the oscilloscope.
2. Press **[Utility]** button to skip to the Utility menu.
3. Press **Update->Update Firmware** softkey.
4. Select the file and press **Universal Knob** to confirm. Then press **Start updating** softkey to update the firmware.

Reboot the machine after finishing upgrading, and the software version is upgraded. The oscilloscope should be self-corrected once after upgrading.

2.12.2   Self Calibration

The self calibration routine helps optimize the oscilloscope signal path for maximum measurement accuracy. You can run the routine at any time but should always run it if the ambient temperature changes by 5℃ or more. For a more accurate calibration, please power on the oscilloscope and wait for 20 minutes until it has adequately warmed up.

To compensate the signal path, disconnect any probes or cables from the front-panel input connectors. Then, push the **[Utility]** button, select Calibrate option and follow the

directions on the screen.

2.12.3　Pass/Fail

"Pass/Fail" is used for judging whether the input signal is in a built rule range and outputting the past or failed waveform so as to detect the change condition of the signal.

Page 1 of the pass/fail function menu:

Option	Setup	Description
Pass/Fail	ON	Run the pass/fail function.
	OFF	Stop the pass/fail function.
Source	CH1~CH4	Select the signal input channel.
Regular		Skip to a rule setup menu.
Message	OFF	Close waveform pass/fail time display information.
	ON	Open waveform pass/fail time display information.
Stop	On	Enter STOP state if output exist.
	Off	Continue to run if output exists.
Page 1/2		Skip to page 2 to the pass/fail menu.

Page 2 of the pass/fail function menu:

Option	Setup	Description
Output	ON	
	OFF	
Mode	Pass	Output a negative pulse train when the test is passed.
	Fail	
	Pass Ring	Output a negative pulse train when the test is failed. .
	Fail Ring	
Return		Skip to Utility menu

Regule setup menu:

Option	Setup	Description
Vertical		Use the **Universal knob** to set a horizontal tolerance range: 0.020div-4.00div。
Horizontal		Use the **Universal knob** to set a vertical

	tolerance range: 0.025div-8.00div。
Create	Create a rule template according to the two setups above.
Save	Select a save position for the rule.

Regule save menu:

Option	Setup	Description
SavaTo	Local Memory	1-10
Save		Save the rule setups.
Recall		Recall the waved rule setups.

2.13 Fast Action Buttons
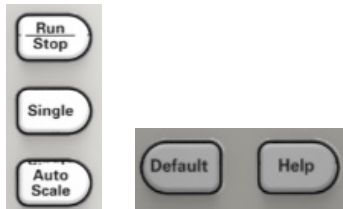
Auto Scale: Automatically set the oscilloscope controls to generate a usable display of the input signals. Refer to the following table for relative content.

Single: Acquire a single waveform and then stop the acquisition.

Run/Stop: Continuously acquire waveforms or stop the acquisition.

Help: Display the Help menu.

Default: Recall the factory setup. Refer to the following table for relative content.

2.13.1 AUTO SCALE

Auto Scale is one of the advantages digital oscilloscopes have. When you push the Auto Scale button, the oscilloscope will identify the type of waveform (sine or square wave) and adjust controls according to input signals so that it can accurately display the waveform of the input signal.

Functions	Settings
Acquire Mode	Adjusted to Normal or Peak Detect
Cursor	Off
Display Format	Set to YT
Display Type	Set to Vectors for an FFT spectrum; otherwise, unchanged
Horizontal Position	Adjusted
SEC/DIV	Adjusted
Trigger Coupling	Adjusted to DC, Noise Reject or HF Reject
Trigger Holdoff	Minimum
Trigger Level	Set to 50%
Trigger Mode	Auto
Trigger Source	Adjusted; Auto Scale can not be used for the EXT TRIG signal
Trigger Slope	Adjusted
Trigger Type	Edge
Trigger Video Sync	Adjusted
Trigger Video Standard	Adjusted
Vertical Bandwidth	Full
Vertical Coupling	DC (if GND was chosen before); AC for the video signal; otherwise, unchanged
VOLTS/DIV	Adjusted

The Auto Scale function examines all channels for signals and displays corresponding waveforms. Auto Scale determines the trigger source according to the following conditions.

> ➢ If multiply channels get signals, the oscilloscope will use the channel with the lowest frequency signal as the trigger source.

> ➢ If no signals are found, the oscilloscope will use the lowest-numbered channel displayed in Auto Scale as the trigger source.

> ➢ If no signals are found and no channels are displayed, the oscilloscope will display and use Channel 1 as the trigger source.

When you use the Auto Scale function and the oscilloscope determines that the signal is similar to a sine wave, the oscilloscope displays the following options.

Wave Options	Details
Multi-Period	Display multiple periods that have appropriate vertical and horizontal scales.

Single-Period	Set the horizontal scale to display about one period of the waveform.	
Autoscale	Autoscale setting.	
Source	Select the source: only display the current source or all sources.	
Cancel	Let the oscilloscope recall the previous setup.	

2.13.2 Default Setup

When you push the DEFAULT SETUP button, the oscilloscope will display the CH1 waveform and remove all the others. When you are at the default setup, press F1 to **Undo Preset**. Then the oscilloscope returns to the status before default setup. The table below gives the options, buttons and controls that change settings at default setup.

Menu or System	Option, Button or Knob	Default Setting
Acquire	(Three mode options)	Normal
	Averages	16
	Run/Stop	Run
Cursor	Type	Off
	Source	CH1
	Horizontal (amplitude)	±3.2div
	Vertical (time)	±4div
Display	Type	Vectors
	Persist	Off
	Format	YT
Horizontal	Window Mode	Single-window
	Trigger Knob	Level
	Position	0.00s
	SEC/DIV	200µs
Math	Operation	—
	Source	CH1-CH2
	Position	0div
FFT	Vertical Scale	20dB
	FFT Operation	

	Source	CH1
	Window	Hanning
	FFT Zoom	X1
Measure	Source	CH1
	Type	None
Trigger (Edge)	Type	Edge
	Source	CH1
	Slope	Rising
	Mode	Auto
	Level	0.00v
Trigger (Pulse)	When	>
	Pulse Width	200ns
	Polarity	Positive
	Mode	Auto
Trigger (Video)	Polarity	Positive
	Sync	ScanLine
	Standard	NTSC
Trigger (Slope)	Slope	Rising
	Mode	Auto
	When	>
Trigger (Overtime)	Source	CH1
	Polarity	Positive
	Mode	Auto
	Time	20ns
Vertical System, All Channels	Bandwidth Limit	Unlimited
	VOLTS/DIV	Coarse
	Probe Attenuation	1X
	Invert	Off
	Position	0.00div (0.00V)
	VOLTS/DIV	1V

The following settings do not change when you push the **[Default]** button.

- ➢   Language Option
- ➢   Saved Settings
- ➢   Saved Reference Waveforms
- ➢   Display Contrast
- ➢   Calibration Data

Chapter 3 Waveform Generator

The series oscilloscope is equipped with waveform generator function, with one channel of arbitrary waveform output. User can edit the arbitrary waveform or choose the regular waveforms such as Sine, Ramp, Square, Exponent, Noise, DC and AM/FM.

◆　　**Set Wave Type and Parameters**

◆　　**Edit Arbitrary Waveform**

◆　　**Output Arbitrary Waveform**

3.1 Set Wave Type and Parameters

1. Press the **[Wave Gen]** button on the front panel to open the arbitrary waveform generator function.

2. Press the **Wave** softkey; then turn the **Universal Knob** to select the desired waveform and push down the knob to confirm. Press the Wave Type softkey continually can also select the waveform type.

3. Press the **Frequency** softkey to set frequency.

4. Press the **Amplitude** softkey to set amplitude.

5. Press the **Offset** softkey to set offset.

6. Press the **Duty** softkey in the second page to set the duty of Square and Ramp waveform.

Set the value of frequency, Amplitude or Offset:

: Horizontal arrow, turn the **Universal Knob** to select a digit.

: Vertical arrow, turn the **Universal Knob** to set the value of the selected digit.

The waveform will output from GEN OUT BNC port.

7. Press the **modulation** softkey to enter modulation menu.

   The modulation types are AM and FM.

8. Press the **Burst** softkey to enter burst menu.

   The burst types are N cycle and Gate.

3.2 Edit Arbitrary Waveform

User can't edit arbitrary waveform directly under **Wave Gen** interface for the device. Firstly, please double click "WaveEditorSetup.exe" in WaveEditor folder in CD disk and install Arbitrary Waveform Editor software according to installation wizard. After the software installed successfully, you can see **WaveEditor** icon on desktop. Double-click the icon to enter arbitrary waveform generator window.
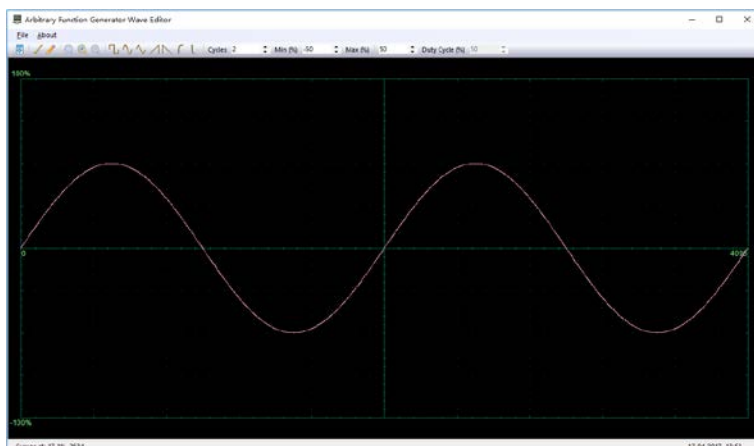
Menu:

Import from CSV: Import the CSV format file to the arbitrary waveform generator window.

Export as CSV: Save as CSV format file.

Import from ARB: Import the ARB format file to the arbitrary waveform generator window.

Export as ARB: Save as ARB format file.

Note: The device can recall ARB format file in USB disk, but CSV format file can't be recalled by the device.

Toolbar buttons

 : **Download waveform data to the device.**

 : **Smooth Drawing Mode.** You can draw any waveform shape using the left-mouse.

 : Line Drawing Mode. You can click on the waveform to draw a straight line from the previous point.

 : **Zoom tools.** To zoom the time axis in or out, click the **+** or **-** zoom button and then click on the waveform area. Click the **100%** button to restore the time axis to its original scale.

 : **Standard waveform shapes.** Draw a standard waveform with the settings specified in the numerical controls below the toolbar. The current waveform will be erased.
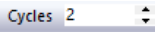
 : **Cycles.** The number of cycles to draw. This control is used in conjunction with the **Standard waveform shapes buttons**. Select one of the standard waveform shapes and then enter the number of cycles, and it will draw the requested number of cycles of the waveform.
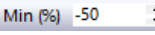
 : **Minimum.** When one of the **Standard waveform shapes buttons** is pressed, this control sets the minimum signal level.
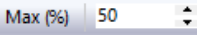
 : **Maximum.** When one of the **Standard waveform shapes buttons** is pressed, this control sets the maximum signal level.
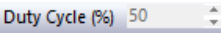
 : **Duty cycle.** When a square, triangular or ramp waveform is selected using one of the **Standard waveform shapes buttons**, this control sets the duty cycle of the signal. Duty cycle is defined as the time that the signal spends above zero volts divided by the total cycle time. Thus, a symmetrical square or triangular wave has a duty cycle of 50%. Reducing the duty cycle shortens the positive part of the cycle and lengthens the negative part, and increasing the duty cycle does the opposite.

Note:

The F**requency, Amplitude, Offset** parameter of the ARB waveform can not be regulated in this WaveEditor software, but it can be done by tuning on the device directly (refer to above Chapter 3.1) after the waveform data is downloaded to device (refer to below Chapter 3.3).

Do not use the WaveEditor and the DSO software at the same time, it will cause errors.

3.3 Output Arbitrary Waveform

1. Press the **Wave Gen** button on the front panel to enable the AWG function and enter the Wave Gen function menu.

2. Connect the device with PC which has installed the WaveEditor software using a USB cable.

3. Double click the WaveEditor icon to open the program.

4. Select a waveform file or draw an arbitrary waveform; then click the in toolbar and select waveform data download position to download waveform data to the device.
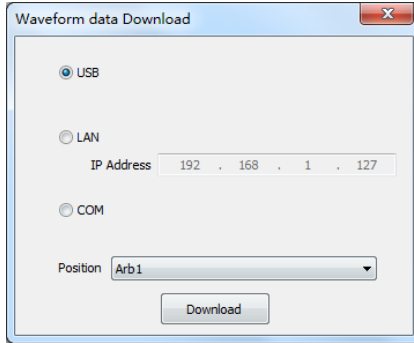
5. The waveform will output from GEN OUT BNC port.

Also, you can recall ARB format file in USB disk to output a waveform.

1. Press the **Wave Gen** button on the front panel to enter Wave Gen function menu.

2. Press the **Wave** softkey, turn the **Universal Knob** to select Arb1~Arb4 and then push the knob to confirm.

3. Press **Recall** softkey and select desired recalled ARB format file in USB disk.

4. The waveform will output from GEN OUT BNC port.

Chapter 4 Troubleshooting

4.1 Problem Settlement

1. If the oscilloscope does not start up at power on, follow these steps:

1） Check the power cord to verify it has been connected properly;

2） Check the power on/off button to ensure it has been pushed;

3） Then restart the oscilloscope.

Contact your local VOLTCRAFT distributor or directly keep touch with VOLTCRAFT
Technical Support department if the oscilloscope still can not be turned on normally.

**2. If there is no display of waveforms on the screen when the oscilloscope is
turned on, follow these steps:**

1） Check the probe to assure its proper connection to the input BNC;

2） Check the channel switch (CH1~CH4 menu buttons) to make sure it has been
turned on;

3） Check the input signal to verify it has been connected to the probe correctly;

4） Affirm that all measured circuits have signals to output;

5） Turn up the magnitude for DC signals with large magnitude;

6） In addition, you may press the Auto Measure button to perform an automatic
detection of signals at first.

Contact VOLTCRAFT Technical Support department in time if there is still no display of
waveforms.

3. If the waveform of the input signal is distorted seriously, follow these steps:

1） Check the probe to assure its proper connection to the channel BNC;

2） Check the probe to assure its good connection to the measured object;

3） Check the probe to verify it has been well calibrated. Otherwise, refer to the
content about calibration described in this manual.

4. If the waveform is rolling continuously on the screen but can not be triggered, follow these steps:

1) Check the trigger source to make sure it consistent with the input channel;

2) Check the trigger level to assure its correct adjustment. You may push the TRIGGER LEVEL knob to reset the trigger level back to the center of the signal;

3) Check the trigger mode to confirm it is a right choice for the input signal. The default trigger mode is edge trigger. However, it is not suitable for all kinds of input signals.

Chapter 5 General Care and Cleaning

5.1 General Care

Do not put or leave the device in a place where the LCD display will be exposed to direct sunlight for long periods of time.

Note: To avoid damage to the oscilloscope or probes, do not expose them to sprays, liquids, or solvents.

5.2 Cleaning

Examine the oscilloscope and probes as often as operating conditions require. To clean the exterior surface, perform the following steps:

1） Use a lint-free cloth to remove floating dust on the outside of the oscilloscope and probes. Take care to avoid scratching the glabrous display filter.

2） Use a soft cloth dampened with water to clean the oscilloscope. For more efficient cleaning, you may use an aqueous solution of 75% isopropyl alcohol.

Note: To avoid damage to the surface of the oscilloscope or probes, do not use any corrosive or chemical cleaning agents.

Appendix A: Technical Specifications

All specifications herein mentioned apply to the series oscilloscopes. Before checking an oscilloscope from VOLTCRAFT to see if it complies with these specifications, make sure it meets the following conditions:

➢ The oscilloscope must have been operating continuously for twenty minutes under the specified operating temperature.

➢ The Do Self Cal operation must be performed through the Utility menu if the operating temperature changes by more than 5℃.

➢ The oscilloscope must be within the factory calibration interval.

All specifications are guaranteed unless noted 'typical'.

Oscilloscope Specifications

Horizontal

Sample Rate Range	1GS/s(Single-channel); 500MSa/s(Dual-channel); 250MSa/s(Three/Fourchannel)
Waveform Interpolation	(sin x)/x
Record Length	Maximum 64K samples per single-channel; maximum 32K samples per dual-channel (4K, 32K optional)
SEC/DIV Range	2ns/div to 100s/div, in a 1, 2, 5 sequence
Sample Rate and Delay Time Accuracy	±50ppm
Delta Time Measurement Accuracy (Full Bandwidth)	Single-shot, Normal mode
	± (1 sample interval +100ppm × reading + 0.6ns)
	>16 averages
	± (1 sample interval + 100ppm × reading + 0.4ns)
	Sample interval = s/div ÷ 200

Vertical

A/D Converter	8-bit resolution, each channel sampled simultaneously			
VOLTS/DIV Range	500μV/div to 10V/div at input BNC			
Position Range	500μV/div to 20mV/div, ±200mV 50mV/div to 200mV/div, ±1V 500mV/div to 2V/div, ±20V 5V/div to 10V/div, ±30V			
Selectable Analog Bandwidth Limit, typical	20MHz			
Low Frequency Response (-3db)	≤10Hz at BNC			
Rise Time at BNC, typical	DSO1084	DSO1104	DSO1204	DSO1254
	≤4.4ns	＜3.5ns	≤1.8ns	<1.4ns
DC Gain Accuracy	±3% for Normal or Average acquisition mode, 10V/div to 10mV/div ±4% for Normal or Average acquisition mode, 5mV/div to 500μV/div			

Note: Bandwidth reduced to 6MHz when using a 1X probe.

Acquisition

Acquisition Modes	Normal, Peak Detect, Average and HR	
Acquisition Rate, typical	Up to 2000 waveforms per second per channel (Normal acquisition mode, no measurement)	
Single Sequence	Acquisition Mode	Acquisition Stop Time
	Normal, Peak Detect	Upon single acquisition on all channels simultaneously
	Average	After N acquisitions on all channels simultaneously, N can be set to 4, 8, 16, 32, 64 or 128

Trigger

Mode	Auto, Normal	
Level	CH1~CH4	±4 divisions from center of screen
	EXT	0~3.3V
Holdoff Range	20ns ~ 10s	
Trigger Level Accuracy	CH1~CH4	0.2div × volts/div within ±4 divisions from center of screen
	EXT	± (6% of setting + 40mV)
Edge Trigger		
Slope	Rising, Falling, Rising&Falling	
Source	CH1~CH4/EXT	
Pulse Width		
Polarity	Positive, Negative	
Condition(When)	<, >, !=, =	
Source	CH1~CH4	
Width Range	8ns ~ 10s	
Resolution	8ns	
Video Trigger		
Signal Standard	NTSC, PAL	
Source	CH1~CH4	
Sync	ScanLine, LinrNum, OddField, EvenField and AllField	
Slope Trigger		
Slope	Rising, Falling	
Condition(When)	<, >, !=, =	
Source	CH1 ~ CH4	
Time Range	8ns ~ 10s	
Resolution	8ns	
Overtime Trigger		
Source	CH1~CH4	
Polarity	Positive, Negative	
Time Range	8ns ~ 10s	

Resolution	8ns
Window Trigger	
Source	CH1~CH4
Pattern Trigger	
Pattern	0: Lower level; 1: High level;
Level	CH1~CH4
Interval Trigger	
Slope	Rising, Falling
Condition(When)	<, >, !=, =
Source	CH1~CH4
Time Range	8ns ~ 10s
Resolution	8ns
Under Amp	
Polarity	Positive, Negative
Condition(When)	<, >, !=, =
Source	CH1~CH4
Time Range	8ns ~ 10s
Resolution	8ns
UART Trigger	
Condition(When)	Start, Stop, Data, Parity Error, COM Error
Source (RX/TX)	CH1~CH4
Data format	Hex
Condition(When)	<, >, !=, =
Data Length	1 byte
Data Bits Width	5 bit, 6 bit, 7 bit, 8 bit
Parity Check	None, Odd, Even
Idle Level	High, Low
Baud Rate(Selectable)	110/300/600/1200/2400/4800/9600/14400/19200/38400/57600/115200/230400/380400/460400 bit/s
Baud Rate (Custom)	300bit/s~334000bit/s
LIN Trigger	

Condition(When)	Interval Field, Sync Field, Id field, Sync Id Error, Identifier, Id and Data
Source	CH1~CH4
Data format	Hex
Baud Rate (Selectable)	110/300/600/1200/2400/4800/9600/14400/19200/38400/57600/115200/230400/380400/460400 bit/s
Baud Rate (Custom)	300bit/s~334000bit/s
CAN Trigger	
Condition(When)	Start Bit, Remote Frame, Data Frame Id, Frame Id, DataFrame Id A, Error Frame, All Error, Ack Error, Overload Fram
Source	CH1~CH4
Data format	Hex
Baud Rate (Selectable)	10000, 20000, 33300, 500000, 62500, 83300, 100000, 125000, 250000, 500000, 800000, 1000000
Baud Rate (Custom)	5kbit/s~1Mbit/s
SPI Trigger	
Condition	Data
Source (CS/CLK/Data)	CH1~CH4
Data format	Hex
Data Length	4, 8, 16, 24, 32
IIC Trigger	
Source (SDA/SCL)	CH1~CH4
Data format	Hex
Data Index	0~7
When(Condition)	Start, Stop, No Ack, Address, Data, Restart

Inputs

Inputs	
Input Coupling	DC, AC or GND

Input Impedance, DC coupled	1MΩ±2% in parallel with 20pF±3pF
Probe Attenuation	1X, 10X
Supported Probe Attenuation Factors	1X, 10X, 100X, 1000X
Overvoltage Category	300V CAT II
Maximum Input Voltage	300V$_{RMS}$ (10X)

Measurements

Cursors	Voltage difference between cursors: △V Time difference between cursors: △T Reciprocal of △T in Hertz (1/ΔT)
Automatic Measurements	Frequency, Period, Average, Pk-Pk, RMS, PeriodRms, Min, Max, RiseTime, FallTime, + Width, - Width, + Duty, - Duty, Vbase, Vtop, Vmid, Vamp, Overshoot, Preshoot, PeriodAvg, FOVShoot, RPREShoot, BWidth, FRR, FFF, FRF, FFR, LRR, LRF, LFR and LFF

General Specifications

Display	
Display Type	7 inch 64K color TFT (diagonal liquid crystal)
Display Resolution	800 horizontal by 480 vertical pixels
Display Contrast	Adjustable
Probe Compensator Output	
Output Voltage, typical	About 2Vpp into ≥1MΩ load
Frequency,	1kHz

typical		
Power Supply		
Supply Voltage	100-120VAC$_{RMS}$(±10%), 45Hz to 440Hz, CAT Ⅱ 120-240VAC$_{RMS}$(±10%), 45Hz to 66Hz, CAT Ⅱ	
Power Consumption	<30W	
Fuse	T, 3.15A, 250V, 5x20mm	
Environmental		
Operating Temperature	0 to 50 °C (32 to 122 °F)	
Operation Humidity	≤90% relative humidity	
Storage Temperature	-40 to +71 °C (-40 to 159.8 °F)	
Storage Humidity	≤60% relative humidity	
Cooling Method	by Fan	
Altitude	Operating and Nonoperating	3,000m (10,000 feet)
	Random Vibration	0.31g$_{RMS}$ from 50Hz to 500Hz, 10 minutes on each axis
	Nonoperating	2.46g$_{RMS}$ from 5Hz to 500Hz, 10 minutes on each axis
Mechanical Shock	Operating	50g, 11ms, half sine

Mechanical	
Dimension	318 x 110 x 150mm(L x W x H)
Weight	2900g

Arbitrary Waveform Generator Mode

(DSO1084F,DSO1104F,DSO1204F,DSO1254F)

Waveform Frequency	Sine: 0.1Hz~25MHz
	Square: 0.1Hz~10MHz
	Ramp: 0.1Hz~1MHz
	EXP: 0.1Hz~5MHz
Amplitude	5mV~3.5Vp-p(50Ω)
	10mV~7Vp-p(High impedance)
DAC	2K~200MHz adjustable
Frequency Resolution	0.10%
Channel	1CH waveform output
Waveform Depth	4KSa
Vertical Resolution	12 bit
Frequency Stability	<30ppm
Output Impedance	50 Ω

Appendix B: Accessories

All the following accessories are available by contacting your local VOLTCRAFT distributor.

Standard Accessories

- Probe×4 (1.5m), 1:1, (10:1) Passive Probes

- A Power line

- A USB Line

- A BNC to BNC(Only for the scopes with waveform generator function)

- A PC software CD of the oscilloscope

-

Appendix C Harmful and Poisonous Substances or Elements

Component[2]	Harmful and poisonous substances or elements [1]					
	Pb	Hg	Cd	Cr(Vi)	PBB	PBDE
Shell and Chassis	X	0	0	X	0	0
Display Module	X	X	0	0	0	0
Circuit Board	X	0	0	X	0	0
Power Supply	X	0	0	X	0	0
Electric Wire and Cable Assembly	X	0	0	0	0	0
Connector	X	0	0	X	0	0
Fastener and Installed Hardware	X	0	X	X	0	0
Other Accessories (including probes)	X	0	0	X	0	0
Others	0	0	0	0	0	0

'X' means that at least the content of this poisonous and harmful substance in a homogeneous material of this component exceeds the limit specified in the SJ/T 11363-2006 standard.

'0' indicates that the content of this poisonous and harmful substance in all homogeneous materials of this component is refrained under the limit stated in the SJ/T 11363-2006 standard.

This component list contains components approved in the file *'Management Measures'*.

Appendix D To replace the fuse

The fuse of the series of scope is replaceable.

Fuse Rating: T, 3.15A, 250V, 5x20mm

Please refer to the following to replace it.

Warning: Remove power cord & all test probe before open the housing and replace the fuse.
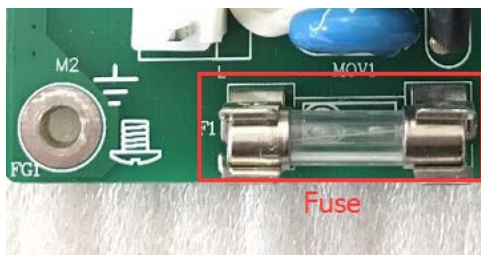
1.   Remove all the screws on the shell, and separate the rear shell from other part.

2. Remove all the screws on the metal cover, separate metal cover from other part.
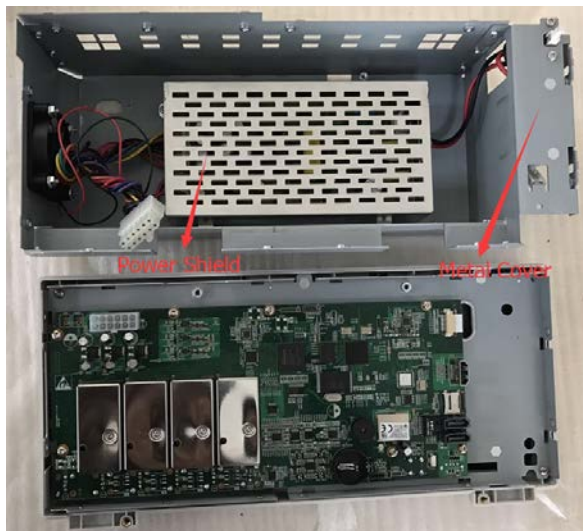
3. Remove all the screws on the power shield, then remove it. You can see the fuse on the power board. And replace a new fuse with the same specification.

Appendix E   Open Source Information

General Information:

Kernel Version	Linux3.2.35
Supported File system	ubi, Fat32
Drivers	Buzzer Driver, DMA Driver, FPGA Driver, I2C Driver,SPI Driver, IO-bank Driver, USB Host Driver, LCD Driver, USB massstorage、gadget Driver
Linux Applications	Busybox1.18.4 ,gnupg1.4.11
U_boot Version	Vivi_3.2.35
Sourcecode download website	http://www.produktinfo.conrad.com

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