

# **DSO4000B(C) Series**

## **Digital Storage Oscilloscope**

### **User Manual**

(Version 1.0)

# Copyright Declaration

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# 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

DSO4000B(C) Series oscilloscopes cover the bandwidths from 80MHz to 200MHz, 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 Autoset function lets you detect sine and square waves automatically; the Probe Check Wizard guides you to adjust the probe compensation and set the Probe option attenuation factor. 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 |
|----------|----------|-----------|-------------|-----|
| DSO4084B | 4        | 80MHz     | 1GS/s       | -   |
| DSO4104B | 4        | 100MHz    | 1GS/s       | -   |
| DSO4204B | 4        | 200MHz    | 1GS/s       | -   |
| DSO4254B | 4        | 250MHz    | 1GS/s       | -   |
| DSO4084C | 4        | 80MHz     | 1GS/s       | Yes |
| DSO4104C | 4        | 100MHz    | 1GS/s       | Yes |
| DSO4204C | 4        | 200MHz    | 1GS/s       | Yes |
| DSO4254C | 4        | 250MHz    | 1GS/s       | Yes |

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# Chapter 1 Introduction

- ◆ General Inspection
- ◆ Prepare Instrument for Use
- ◆ Accidence of front panel and the user interface
- ◆ Functional Check
- ◆ Probe Introduction

## 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 guide. 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. 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 (power-line voltage is automatically sensed at power-on). 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 Accidence of front panel and the user interface

This section will make you understand the front operation panel of this series of digital oscilloscope at first before use.

### 1.3.1 User Interface

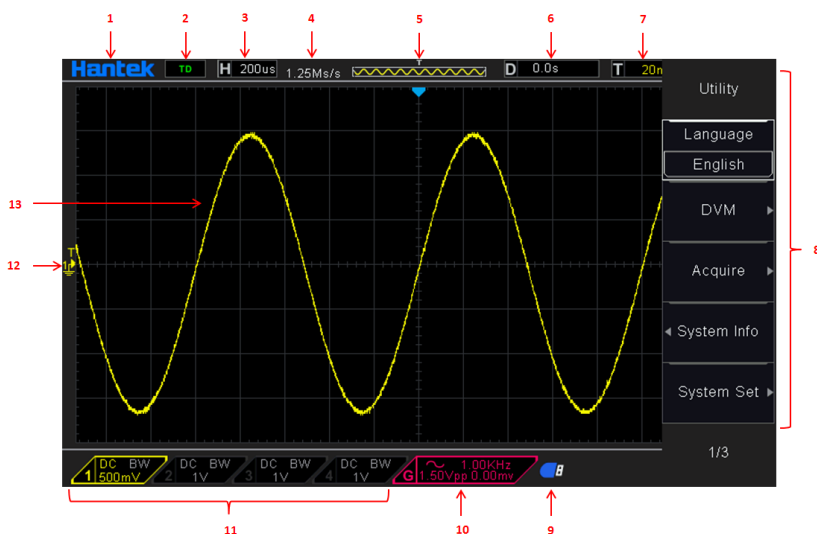


Figure 1-2 Interface display

1. Hantek 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.

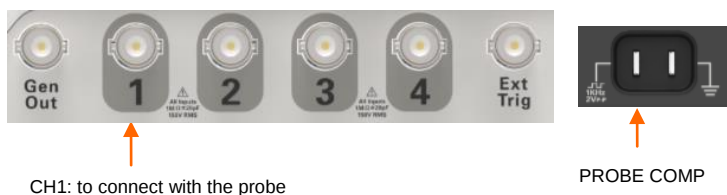
3. Readout shows main time base setting.
4. Sample rate.
5. Main Time Base Window
6. Tigger time
7. Trigger level, Readout tells trigger level
8. Operating Menu shows different information for respective function keys.
9. If this icon lights up/active, it means the USB disk has been connected.
10. If 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.

## 1.4 Functional Check

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

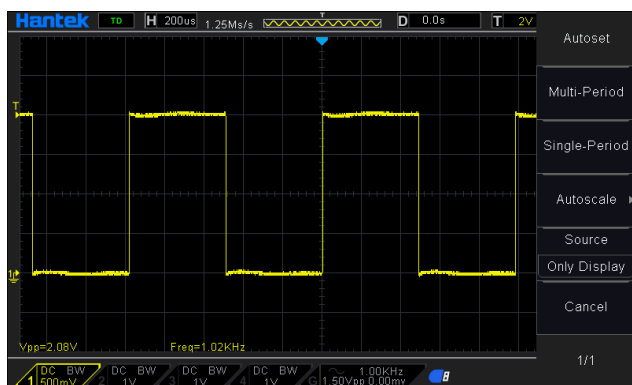
### 1.4.1 Connect the oscilloscope

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.



### 1.4.2 Observe the waveform

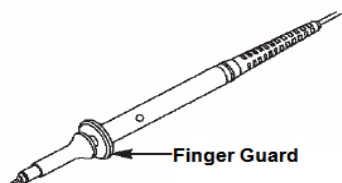
Press the AUTOSET button and you should see within a few seconds a square wave of about 2V peak-to-peak at 1KHz in the display. Press the CH1 MENU button twice to remove Channel 1. Push the CH2 MENU button and repeat Step 2 and Step 3 to observe CH2, CH3 and CH4.



## 1.5 Probe Introduction

### 1.5.1 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.



### 1.5.2 Use of 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. There are two ways to do this:

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

Press the PROBE CHECK button to use the Probe Check Wizard and configure the probe option attenuation factor properly following menu prompts.

### 1.5.3 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 AUTOSET button.

2. Check the shape of the displayed waveform.

Compensated correctly



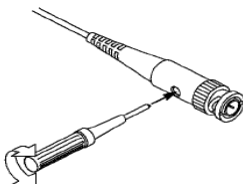
Overcompensated



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.



## 1.5.4 Probe Attenuation Setting

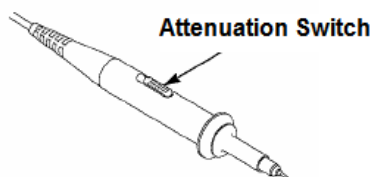
Probes are of various attenuation factors which affect the vertical scale of the signal. The Probe Check function is used to verify if the Probe attenuation option matches the attenuation of the probe.

As an alternative method to Probe Check, you can push a vertical menu button (such as the CH 1 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.



# 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**
- ◆ **Default setups**
- ◆ **Multi-functional Knobs and Buttons**
- ◆ **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]:** display “HORIZONTAL” menu.
- **[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

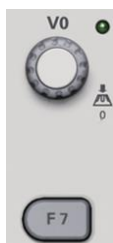
- **CH1, CH2, CH3, CH4:** for an input connector of a measured signal.
- **EXT TRIG:** be used as an input connector of an external trigger source. Use [TRIG MENU] to select “EXT” trigger source, and the trigger signal source can be used for triggering in the third channel while acquiring data in two channels.
- **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 Default setups

The **[DEFAULT]** key represents the default setup function, most of the options and control setups of the factory are recalled by pressing them, some setups are not changed, and the following setups are not reset:

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

## 2.4 Multi-functional Knobs and Buttons



V0: Multi-functional 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.

F7: Push this button in single-window mode to switch between dotted line



F0: **Hide/Show** button. 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 buttons are all multi-functional. They are in charge of selecting corresponding menu options on the screen in different menu modes. For example, in the UTILITY menu, F1-F5 respectively correspond to 'System Info' – 'Advance'.

F6: This functional button is mainly used to turn pages and confirm a selection, such as 'next page', 'previous page', and 'press F6 to confirm' appearing when you push Self Calibration option.

## 2.5 Oscilloscope Setup

While operating the oscilloscope, you may often use three features: Autoset, saving a setup and recalling a setup. Hereinafter they are introduced one by one.

**Autoset:** 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 5 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.

**Recalling 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.

## 2.6 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. M represents 'Main Time Base', and W indicates 'Window Time Base'. 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.

Multi-functional  
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 SEQ button), the SEC/DIV control will expand or compress the waveform. In dual-window mode, push this knob to select major or minor window. When the major window is selected, this knob provides the same functions as it provides in single-mode window. When the minor window is selected, turn this knob to scale the waveform whose magnification is up to 1000.

Notes:

1. For more information of the trigger holdoff, see [Section Trigger Controls](#).

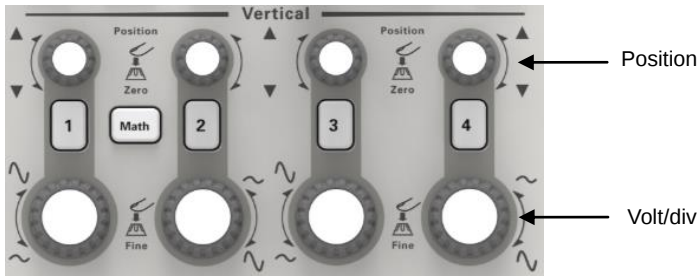
### 2.6.1 Scan Mode Display (Roll Mode)

With the SEC/DIV control set to 80ms/div or slower and the trigger mode set to Auto, the oscilloscope works in the scan acquisition mode. In this mode, the waveform display is updated from left to right without any trigger or horizontal position control.

## 2.7 Vertical System

### 2.7.1 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.



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.

## 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. Also you may use this knob to switch between coarse and fine.

3. **Menu (CH1, CH2, Ch3, CH4):** Display vertical menu options; turn on or off the display of channel waveforms.

| Options               | Settings              | Comments                                                                                                                                               |
|-----------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coupling              | DC                    | DC passes both DC and AC components of the input signal.                                                                                               |
|                       | AC                    | AC blocks the DC component of the input signal and attenuates signals below 10Hz.                                                                      |
|                       | GND                   | Ground disconnects the input signal.                                                                                                                   |
| 20MHz Bandwidth Limit | Limit Off<br>Limit On | Limits the bandwidth to reduce display noise; filters the signal to eliminate noise and other unnecessary HF components.                               |
| DIV                   | Coarse<br>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 Attenuation | 1X    | 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. |
|                   | 10X   |                                                                                                                                                      |
|                   | 100X  |                                                                                                                                                      |
|                   | 1000X |                                                                                                                                                      |
| Invert            | Off   | Inverts the waveform relative to the reference level.                                                                                                |
|                   | On    |                                                                                                                                                      |

## 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.

4. **MATH MENU:** Display the waveform math operations. See the table below for details.

The MATH menu contains source options for all math operations.

| Operations | Source Options       | Comments                                                                                            |
|------------|----------------------|-----------------------------------------------------------------------------------------------------|
| Operator   | +, -, *, / , FFT     |                                                                                                     |
| FFT        | CH1, CH2<br>CH3, CH4 | Five types of window available for selection: Hanning, Flattop, Rectangular, Bartletta and Blackman |

---

Zoom: Use the FFT Zoom button to adjust the window size.

Scale: x1, x2, x5, x10.

---

*Note: All selected menus are highlighted in orange.*

## 2.7.2 Math FFT

This chapter elaborates how to use the Math FFT (Fast Fourier Transform). You can use the Math FFT mode to convert a time-domain (YT) signal into its frequency components (spectrum), and to observe the following types of signals:

- Analyze harmonics in power cords;
- Measure harmonic content and distortion in systems;
- Characterize noise in DC power supplies;
- Test impulse response of filters and systems;
- Analyze vibration.

To use the Math FFT mode, perform the following tasks:

- Set the source (time-domain) waveform;
- Display the FFT spectrum;
- Choose a type of FFT window;
- Adjust the sample rate to display the fundamental frequency and harmonics without aliasing;
- Use zoom controls to magnify the spectrum;
- Use cursors to measure the spectrum.

### 2.7.2.1 Setting Time-domain Waveform

It is necessary to set the time-domain (YT) waveform before using the FFT mode. Follow the steps below.

1. Push the AUTOSSET button to display a YT waveform.
2. Turn the VERTICAL POSITION knob to vertically move the YT waveform to the center (zero division) so as to ensure the FFT will display a true DC value.
3. Turn the HORIZONTAL POSITION knob to position the part of the YT waveform to be analyzed in the center eight divisions of the screen. The oscilloscope uses the 2048 center points of the time-domain waveform to calculate the FFT spectrum.

4. Turn the VOLTS/DIV knob to ensure the entire waveform remains on the screen. If the entire waveform is invisible, the oscilloscope may display wrong FFT results by adding high-frequency components.
5. Turn the SEC/DIV knob to provide the resolution you need in the FFT spectrum.
6. If possible, set the oscilloscope to display multiple signal cycles.

If you turn the SEC/DIV knob to select a faster setting (fewer cycles), the FFT spectrum will display a larger frequency range and reduce the possibility of FFT aliasing.

To set the FFT display, follow the steps below.

1. Push the MATH MENU button;
2. Set the Operation option to FFT;
3. Select the Math FFT Source channel.

In many situations, the oscilloscope can also generate a useful FFT spectrum despite the YT waveform not being triggered. This is especially true if the signal is periodic or random (such as noise).

*Note: You should trigger and position transient or burst waveforms as close as possible to the screen center.*

### **Nyquist Frequency**

The highest frequency that any real-time digital oscilloscope can measure without errors is half of the sample rate, which is called the Nyquist frequency. Frequency information beyond the Nyquist frequency is undersampled which brings about the FFT aliasing. The math function can convert the center 2048 points of the time-domain waveform to an FFT spectrum. The resulting FFT spectrum contains 1024 points from DC (0Hz) to the Nyquist frequency. Usually, the screen compresses the FFT spectrum horizontally to 250 points, but you can use the FFT Zoom function to expand the FFT spectrum so that you can clearly view the frequency components at each of the 1024 data points in the FFT spectrum.

*Note: The oscilloscope's vertical response is a little bit larger than its bandwidth (60MHz, 70MHz, 100MHz or 200MHz, depending on the model; or 20MHz when the Bandwidth Limit option is set to Limited). Therefore, the FFT spectrum can display valid frequency information above the oscilloscope bandwidth. However, the amplitude information near or above the bandwidth will not be accurate.*

2.7.2.2 Displaying FFT Spectrum

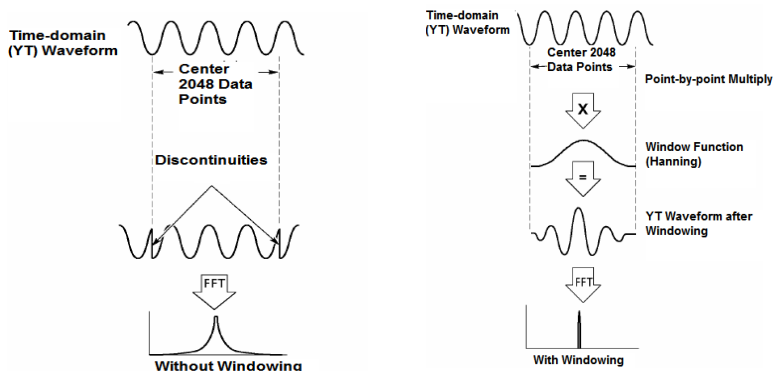
Push the MATH MENU button to display the Math menu. Use the options to select the Source channel, the Window algorithm and the FFT Zoom factor. Only one FFT spectrum can be displayed at a time.

| Math FFT Options | Settings                                               | Comments                                                                         |
|------------------|--------------------------------------------------------|----------------------------------------------------------------------------------|
| Source           | CH1, CH2                                               | Choose a channel to be the FFT source.                                           |
| Window           | Hanning, Flattop, Rectangular, Bartle tta and Blackman | Select a type of the FFT window. For more information                            |
| FFT Zoom         | X1, X2, X5, X10                                        | Change the horizontal magnification of the FFT display. For detailed information |
| Vertical Base    | Vrms dBrms                                             | Set the Vertical Base in a mode.                                                 |

2.7.2.3 Selecting FFT Window

Using windows can eliminate the spectral leakage in the FFT spectrum. The FFT algorithm assumes that the YT waveform repeats all the time. When the number of cycles is integral (1, 2, 3 ...), the YT waveform starts and ends at the same amplitude and there are no discontinuities in the signal shape.

If the number of cycles is nonintegral, the YT waveform starts and ends at different amplitudes and transitions between the start and end points will cause discontinuities in the signal that introduces high-frequency transients.



Applying a window to the YT waveform changes the waveform so that the start and stop values are close to each other, which reduces the discontinuities.

The Math FFT function has three FFT Window options. There is a trade-off between frequency resolution and amplitude accuracy for each type of window. You shall determine which one to choose according to the object you want to measure and the source signal characteristics.

| Window      | Measurement                                | Characteristics                                                                                        |
|-------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Hanning     | Periodic Waveform                          | Better frequency, poorer amplitude accuracy than Flattop                                               |
| Flattop     | Periodic Waveform                          | Better amplitude, poorer frequency accuracy than Hanning                                               |
| Rectangular | Pulse or Transient Waveform                | Special-purpose window applicable to discontinuous waveforms. This is actually the same as no windows. |
| Blackman    | Best magnitude, worst frequency resolution | Single frequency waveforms, to Find higher order harmonics.                                            |

#### 2.7.2.4 FFT Aliasing

Problems occur when the time-domain waveform acquired by the oscilloscope contains frequency components higher than the Nyquist frequency. The frequency components above the Nyquist frequency will be undersampled and displayed as lower frequency components that 'fold back' from the Nyquist frequency. These erroneous components are called aliases.

## 2.7.2.5 Eliminating Aliases

To eliminate aliases, use the following methods.

- Turn the SEC/DIV knob to set a faster sample rate. Because the Nyquist frequency increases as you increase the sample rate, the aliased frequency components will be displayed correct. If too many frequency components appear on the screen, you may use the FFT Zoom option to magnify the FFT spectrum.
- If there is no need to observe the frequency components above 20MHz, set the Bandwidth Limit option to Limited.
- Filter the signal input from outside and limit the bandwidth of the source waveform to lower than the Nyquist frequency.
- Identify and ignore the aliased frequencies.
- Use zoom controls and cursors to magnify and measure the FFT spectrum.

## 2.7.2.6 Magnifying and Positioning FFT Spectrum

You may scale the FFT spectrum and use cursors to measure it through the FFT Zoom option which enables the horizontal magnification. To vertically magnify the spectrum, use the vertical controls.

### Horizontal Zoom and Position

You can use the FFT Zoom option to magnify the FFT spectrum horizontally without changing the sample rate. The available zoom factors are X1(default), X2, X5 and X10. When the zoom factor is set to X1 and the waveform is located at the center graticule, the left graticule line is at 0Hz and the right is at the Nyquist frequency.

You magnifies the FFT spectrum to the center graticule line when you change the zoom factor. That is, the axis for horizontal magnification is the center graticule line. Turn the Horizontal Position knob clockwise to move the FFT spectrum to the right. Push the SET TO ZERO button to position the center spectrum at the center of the graticule.

### Vertical Zoom and Position

When the FFT spectrum is being displayed, the channel vertical knobs become the zoom and position controls corresponding to their respective channels. The VOLTS/DIV knob provides the following zoom factors: X1(default), X2, X5 and X10. The FFT spectrum is magnified vertically to the marker M (math waveform reference

point on the left edge of the screen). Turn the VERTICAL POSITION knob clockwise to move up the spectrum.

### 2.7.2.7 Using Cursors to Measure FFT Spectrum

You may use cursors to take two measurements on the FFT spectrum: amplitude (in dB) and frequency (in Hz). Amplitude is referenced to 0db that equals 1VRMS here. You may use cursors to measure at any zoom factor.

Push the CURSOR button, choose the Source option and then select Math. Press the Type option button to select between Amplitude and Frequency. Click the SELECT CURSOR option to choose a cursor. Then use the V0 knobs to move Cursor S and Cursor E. Use the horizontal cursor to measure the amplitude and the vertical cursor to measure the frequency. Now the display at the DELTA menu is just the measured value, and the values at Cursor S and Cursor E.

Delta is the absolute value of Cursor S minus Cursor E.

## 2.8 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.

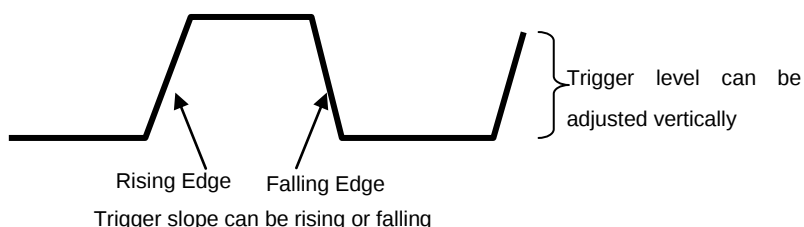
**Trigger Source:** The trigger can be generated with multiple sources. The most common one is the input channel (alternative between CH1–CH4). Whether the input signal is displayed or not, it can trigger normal operations. Also the trigger source can be any signal connected to an external trigger channel or the AC power line (only for Edge triggers). The source with the AC power line shows the frequency relationship between the signal and the AC commercial power.

**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 80ms/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 waveforms. In this mode, the oscilloscope displays waveforms only after the first trigger. To perform a single sequence acquisition, push the SINGLE SEQ button.

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

**Slope and Level:** The Slope and Level controls help to define the trigger. The Slope option determines whether the trigger point is on the rising or falling edge of a signal. To perform the trigger slope control, press the TRIG MENU button, select an Edge trigger, and use the Slope button to select rising or falling. The TRIGGER LEVEL knob controls the trigger point is on which position of the edge.



## 2.8.1 Trigger Controls

The trigger can be defined through the Trigger Menu and front-panel controls. There are six types of trigger: Edge, Video, Pulse Width, Alter, Slope and Overtime. Refer to the following tables to find a different set of options for each type of trigger.



### 1. Level

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

## 2. Force Trigger

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

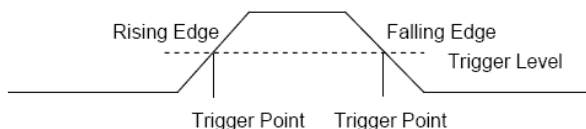
## 3. TRIG Type

DSO4000B(C) provides multiple advanced trigger functions, including various serial bus triggers.

- ◆ Edge trigger
- ◆ Pulse trigger
- ◆ Video trigger
- ◆ Slope trigger
- ◆ DropOut trigger
- ◆ Window trigger
- ◆ Pattern trigger
- ◆ Interval trigger
- ◆ Runt trigger
- ◆ UART trigger
- ◆ LIN trigger
- ◆ CAN trigger
- ◆ SPI trigger
- ◆ IIC trigger

### 2.8.1.1 Edge Trigger

Edge trigger distinguishes the trigger points by seeking the specified edge (rising, falling, rising & falling) and trigger level.

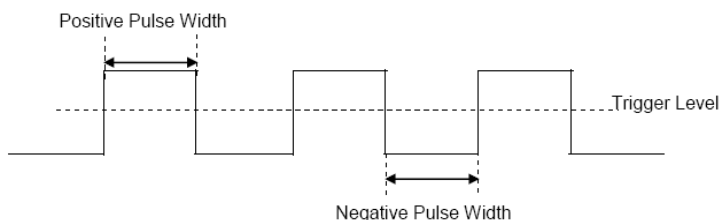


1. Press the **[TRIG MENU]** button on the front panel to enter the Trigger system function menu.

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, CH2, CH3, CH4, 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.
- Note: Press the **AUTO SET** button will set the trigger type to Edge and slope to rising.

### 2.8.1.2 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. The current trigger polarity is displayed at the upper right corner of the screen.
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)  $> 100\text{ns}$ , the waveform will trigger.

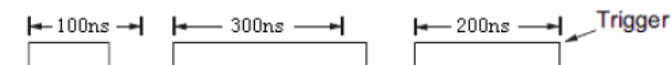


- $\neq$  (not equal to time value): trigger when the positive or negative slope time of the input signal is not equal to the specified time value.



- $=$  (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)  $= 200\text{ns}$ , the waveform will trigger.

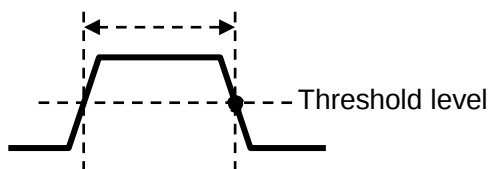


6. Press the Next Page softkey and press of Lower Upper softkey to select Lower or Upper the trigger level; then turn the Trigger Level Knob to adjust the position.

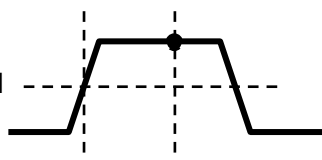
The trigger level values are displayed at the upper right corner of the screen.

**Trigger When:** The pulse width of the source must be  $\geq 5\text{ns}$  so that the oscilloscope can detect the pulse.

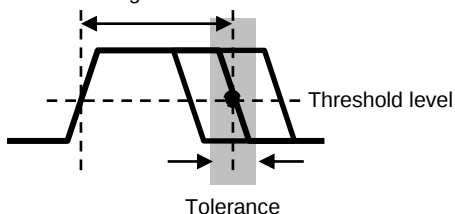
Triggers when pulse is less than width setting



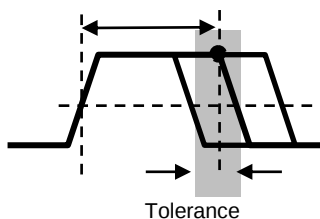
Triggers when pulse is greater than width setting



Triggers when pulse is not equal to width setting  $\pm 5\%$



Triggers when pulse is equal to width setting  $\pm 5\%$



● = Trigger Point

=,  $\neq$ : Within a  $\pm 5\%$  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.

### 2.8.1.3 Video Trigger

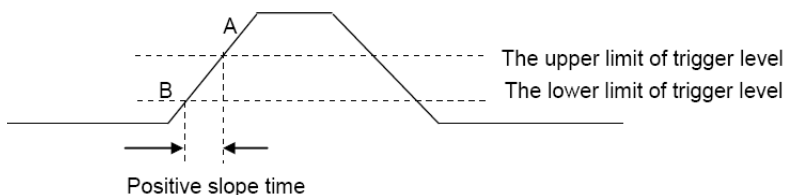
Video triggering can be used to capture the complicated waveforms of most standard analog video signals. The trigger circuitry detects the vertical and horizontal interval of the waveform and produces triggers based on the video trigger settings you have selected. DSO4000 supports standard video signal field or line of NTSC (National Television Standards Committee), PAL (Phase Alternating Line) and custom video signal trigger.

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. DSO4000 supports the following video standards:

#### 2.8.1.4 Slope Trigger

The slope trigger looks for a rising or falling transition from one level to another level in the specified time range. In DSO4000, 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 or Upper the trigger 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.
6. Press the **When** softkey, then turn the **Universal Knob** to select the desired slope condition, and push down the knob to confirm.

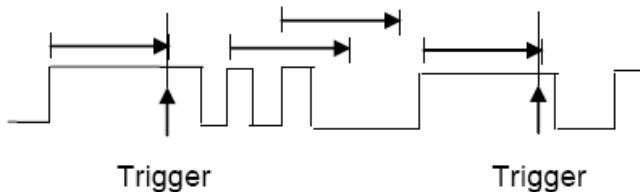
- < (less than a time value): trigger when the positive or negative slope time of

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 upper limit of time and lower than the specified lower limit of time value..
- =(equal to a time value): trigger when the positive or negative slope time of the input signal is equal to the specified upper limit of time and lower than the specified lower limit of time value.

### 2.8.1.5 Overtime Trigger

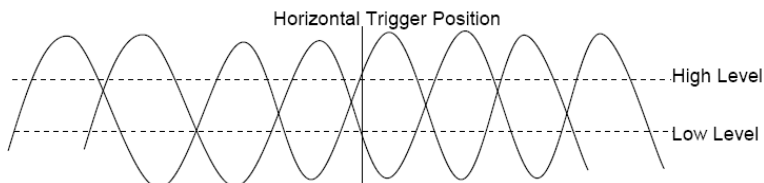
Trigger when the time interval ( $\Delta T$ ) from when the rising edge (or falling edge) of the input signal passes through the trigger level to when the neighboring falling edge (or rising edge) passes through the trigger level is greater than the timeout time set, as shown in the figure below.



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.

### 2.8.1.6 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.



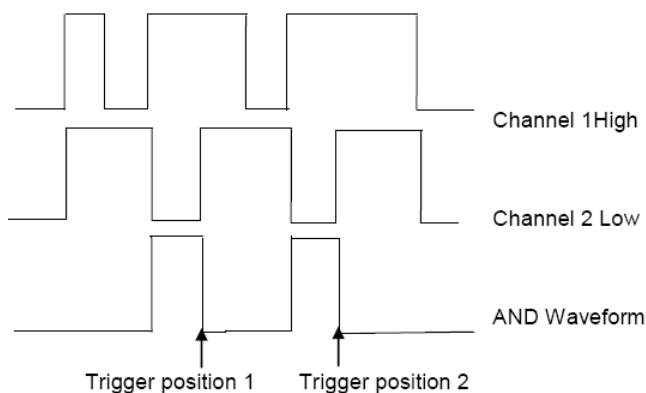
- If the lower and the upper trigger levels are both within the waveform amplitude range, the oscilloscope will trigger on both rising and falling edge.
- If the upper trigger level is within the waveform amplitude range while the lower trigger level is out of the waveform amplitude range, the oscilloscope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

### 2.8.1.7 Pattern Trigger

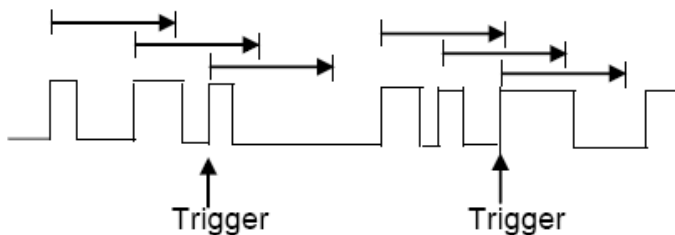
The Pattern trigger identifies a trigger condition by looking for a specified pattern. The

pattern trigger can be expanded to incorporate delays similar to other triggers. Pattern durations are evaluated using a timer. The timer starts on the last edge that makes the pattern —true—. Potential triggers occur on the first edge that makes the pattern false, provided that the time qualifier criterion has been met. SDS2000X provides 4 patterns: logical AND, OR, NAND and NOR combination of the channels. Each channel can set to low, high or invalid.



## Interval Trigger

Trigger when the time difference between the neighboring rising or falling edges meets the time limit condition ( $<$ ,  $>$ ,  $!=$ ,  $=$ ).



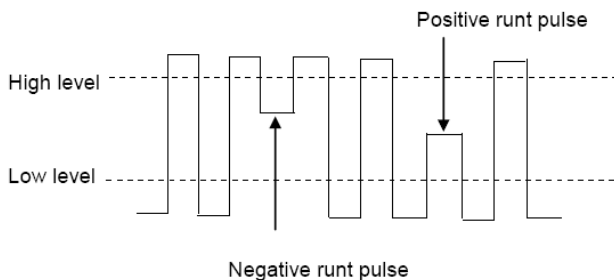
To set interval trigger:

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 value.

### 2.8.1.8 Runt 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~CH4 as 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.

### 2.8.1.9 UART Triggering

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).

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.

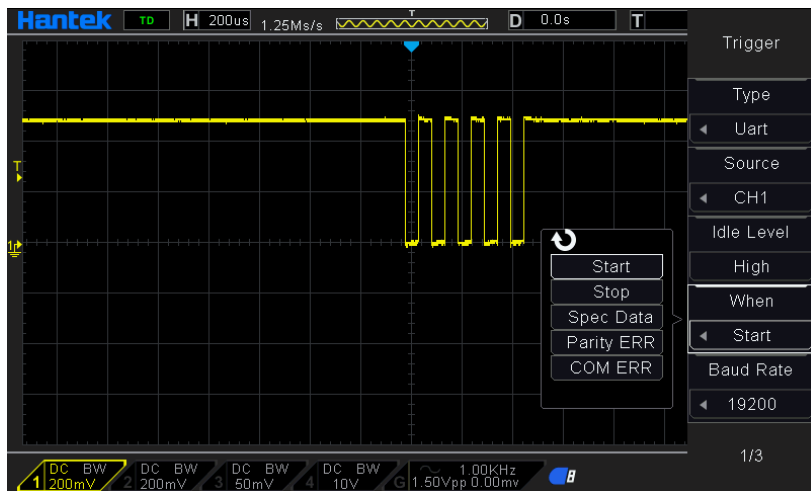
b. Use the **Data** softkey to choose the data value for your trigger comparison. This works in conjunction with the **When** softkey. The range of the data value is 0x00 to 0xff.

**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.

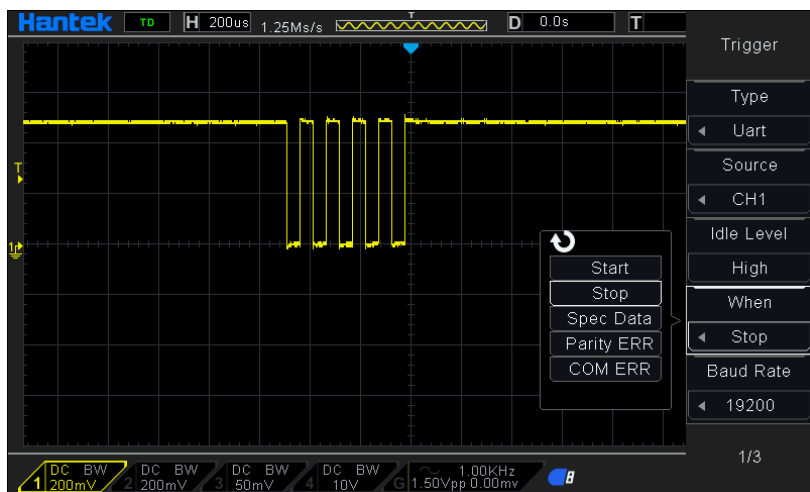
For example1, baud: 19200; Parity: No; Data Bit: 8;

We set: **Idle: High; baud: 19200; when: "Start"**



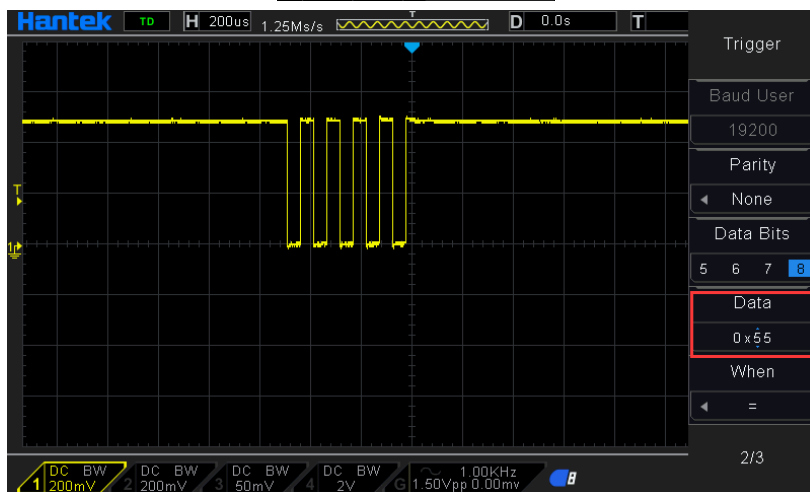
For example2, baud: 19200; Parity: No; Data Bit: 8;

We set: **Idle: High; baud: 19200; when: "Stop"**



For example3, baud: 19200; Parity: No; Data Bit: 8; Data: 0x55

We set: Idle: High; baud: 19200; Data: 0x55; When: Spec Data; When: equal(=)



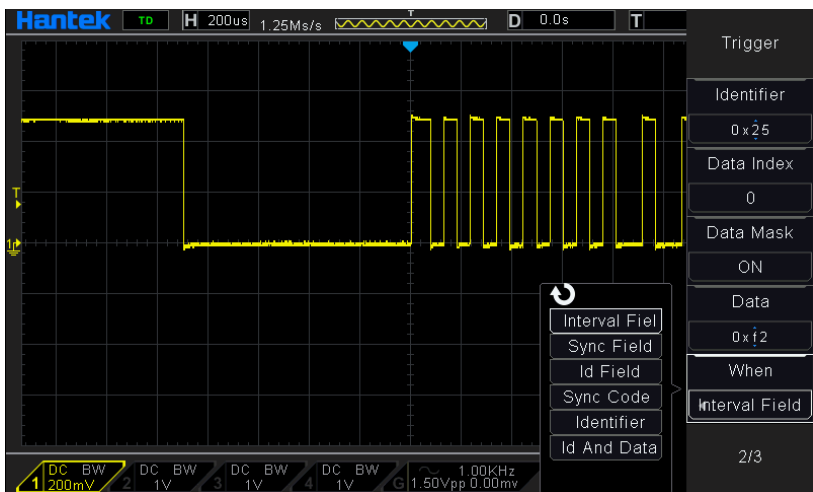
### 2.8.1.10 LIN Triggering

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. Set the Baud Rate.
5. Set the Idle Level.
6. Set the Identifier. The range is from 0 to 0x3f.
7. Press **When** softkey to set trigger condition.
  - Internal Field — The oscilloscope triggers when a start bit occurs
  - 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.

Data Index: Set the data index, the range is from 0 to 3.

**Note:** When DataMask is ON, the setting data is invalid.



### 2.8.1.11 CAN Triggering

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. Set the Baud Rate.
5. Set the Idle Level.
6. Set the Identifier.
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.
    - a. Press the **Identifier** softkey to select the ID number.
    - b. Press the **Identifier** softkey to move the current bit, and turn the universal to select the byte to be set.
  - Data ID - The oscilloscope will trigger on data frames matching the specified ID

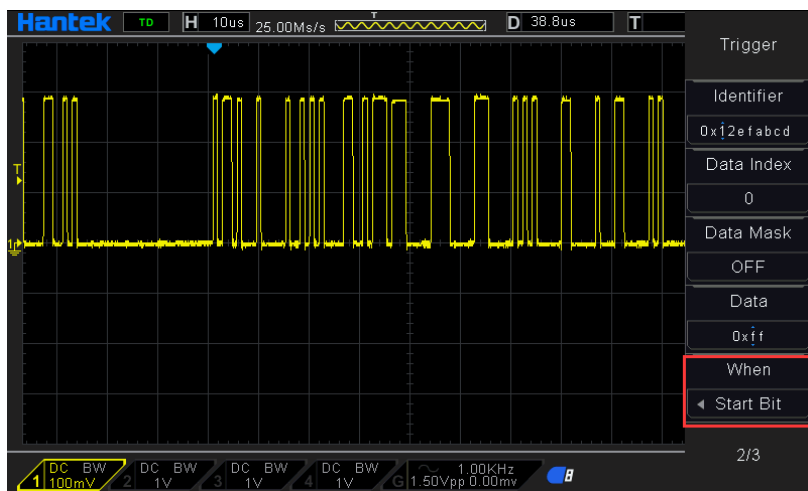
**Note: The Identifier means Remote Id and Data ID.**

- Remote Data - The oscilloscope will trigger on data frames matching the specified remote 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.
- Data Frame data –The oscilloscope will trigger on data frames matching the specified data frame 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.
- Ack Error –The oscilloscope will trigger when the confirm is high.
- Overload Frame - The oscilloscope will trigger on overload frames.

Data Index: Set the data index, the range is from 0 to 3.

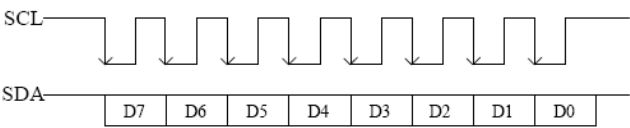
Note: When DataMask is ON, the setting data is invalid.

**Source: CH1; Baund Rate: 1000000; Idle Level: Low; Identifier:0x12efabcd;**



2.8.1.12 SPI Triggering

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** to set the value of the current bit from 0 to f.

**Data Mask:** 0-Mask, f-No Mask, 1~e mask some data.

- 5. Trigger Condition: Press **Timeout** 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.

### 2.8.1.13 IIC Trigger

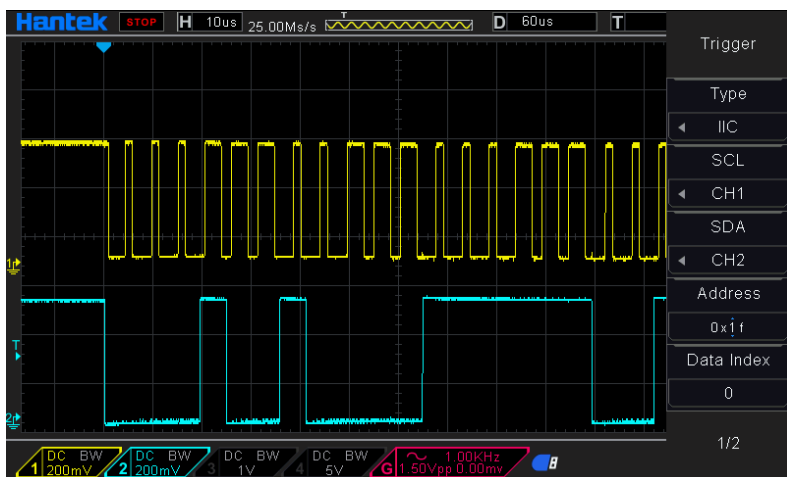
IIC (Inter-IC bus) signals setup consists of connecting the oscilloscope to the serial data (SDA) line and the serial clock (SCL) line and then specifying the input signal threshold voltage levels.

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 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.

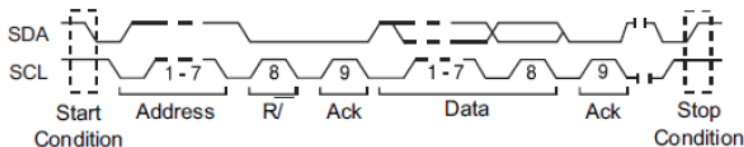
Press the corresponding **Level** softkey; then, turn the **Trigger Level** knob to set the signal threshold voltage level.

- 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. After this trigger condition is selected:
  - --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.
- Data: the trigger searches for the specified 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** softkey to select the desired data bit;

Data Index: Set the data index, the range is from 0 to 3.

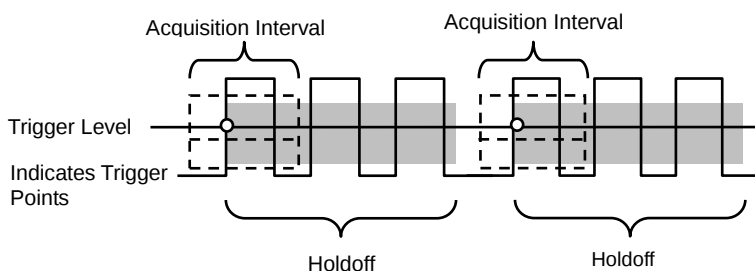
Note: When DataMask is ON, the setting data is invalid.

## 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.

## 2.8.2 Holdoff

**Holdoff:** To use Trigger Holdoff, push the HORIZONTAL Menu button and set the Holdoff Time option by pressing F4. 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.



## 2.9 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. Set the save type to CSV, and set the Para Save option to On or Off to turn on or of the parameters storage function.

## 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”.

## 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. Press the **Save** softkey to select Wave or Setup
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. Press the [**Save/Recall**] button on the front panel to enter the SAVE/RECALL function menu.
2. Press the **Type** softkey to select Wave or Setup
3. Press the **Recall** softkey to enter the SAVE/RECALL file system.
4. Turn the Universal Knob to select the file to be recalled, press the **Recall** softkey to recall the waveform or setup.

## 2.10 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.

### 2.10.1 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:

$$6 \text{ divisions} \times 50\text{mV/division} = 300\text{mV}.$$

### 2.10.2 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<br>Track                  | Select a measurement cursor and display it.                                                                                                                                          |
| Source           | CH1~CH4<br>MATH                  | Select a waveform to take the cursor measurement.<br>Use the readouts to show the measurement.                                                                                       |
| Select<br>Cursor | AX(BX)<br>AXBX<br>AY(BY)<br>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.

### 2.10.3 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 **MEASURE** 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 **[MEASURE]** 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. To select and display measurement parameters. 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.

## 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 **[MEASURE]** 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, MATH, REFA, REFB, REFC, REFD).

| Options                 | Settings  | Comments                                                                                              |
|-------------------------|-----------|-------------------------------------------------------------------------------------------------------|
| <b>Source</b>           | CH1~CH4   | Select the measure source.                                                                            |
| <b>Measurement Type</b> |           |                                                                                                       |
| 1                       | Frequency | Calculate the waveform frequency by measuring the first cycle.                                        |
| 2                       | Period    | Calculate the time of the first cycle.                                                                |
| 3                       | Mean      | 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                       | CRMS      | Calculate the Root Mean Square voltage over the entire waveform.                                      |
| 6                       | PRMS      | 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                       | Rising    | Measure the time between 10% and 90% of the first rising edge of the waveform.                        |
| 10                      | Falling   | 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 | Base        | Measure the highest voltage over the entire waveform.                                                       |
| 16 | Top         | Measure the lowest voltage over the entire waveform.                                                        |
| 17 | Middle      | Measure the voltage of the 50% level from base to top.                                                      |
| 18 | Amplitude   | Voltage between Vtop and Vbase of a waveform.                                                               |
| 19 | Overshoot   | Defined as $(\text{Base} - \text{Min})/\text{Amp} \times 100 \%$ , Measured over the entire waveform.       |
| 20 | Preshoot    | Defined as $(\text{Max} - \text{Top})/\text{Amp} \times 100 \%$ , Measured over the entire waveform.        |
| 21 | PMean       | Calculate the arithmetic mean voltage over the first cycle in the waveform.                                 |
| 22 | FOVShoot    | Defined as $(\text{Vmin} - \text{Vlow})/\text{Vamp}$ after the waveform falling.                            |
| 23 | RPREShoot   | Defined as $(\text{Vmin} - \text{Vlow})/\text{Vamp}$ before the waveform falling.                           |
| 24 | BWidth      | The duration of a burst measured over the entire waveform.                                                  |
| 25 | Delay 1-2 ↑ | The time between the first rising edge of source 1 and the first rising edge of source 2.                   |
| 26 | Delay 1-2 ↓ | The time between the first falling edge of source 1 and the first falling edge of source 2.                 |
| 27 | LFF         | The time between the first falling edge of source 1 and the last falling edge of source 2.                  |
| 28 | LFR         | The time between the first falling edge of source 1 and the last rising edge of source 2.                   |
| 29 | LRF         | The time between the first rising edge of source 1 and the last falling edge of source 2.                   |
| 30 | LRR         | The time between the first rising edge of source 1 and the last rising edge of source 2.                    |

|    |     |                                                                                            |
|----|-----|--------------------------------------------------------------------------------------------|
| 31 | FFR | The time between the first falling edge of source 1 and the first rising edge of source 2. |
| 32 | FRF | The time between the first rising edge of source 1 and the first falling edge of source 2. |
|    | Off | Do not take any measurement.                                                               |

**Taking Measurements:** For a single waveform (or a waveform divided among multiple waveforms), up to 8 automatic measurements can be displayed at a time. The waveform channel must stay in an 'ON' (displayed) state to facilitate the measurement. The automatic measurement can not be performed on reference or math waveforms, or in XY or Scan mode.

## 2.11 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. The Single run control lets you view single-shot events without subsequent waveform data overwriting the display. Use Single when you want maximum memory depth for pan and zoom.

When **[SINGLE SEQ]** 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 SEQ]** button

again to acquire another waveform.

When you acquire an analog signal, the oscilloscope will convert it into a digital one. There are two kinds of acquisition: Real-time acquisition and Equivalent acquisition. The real-time acquisition has three modes: Normal, Peak Detect, and Average. 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.

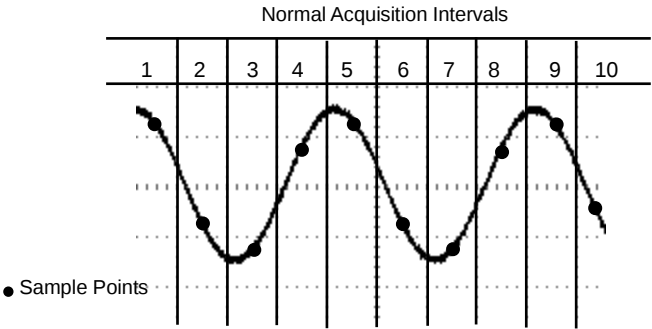
**Equivalent Acquisition:** This kind of acquisition can be utilized for periodic signals. In case the acquisition rate is too low when using the real-time acquisition, the oscilloscope will use a fixed rate to acquire data with a stationary tiny delay after each acquisition of a frame of data. After repeating this acquisition for N times, the oscilloscope will arrange the acquired N frames of data by time to make up a new frame of data. Then the waveform can be recovered. The number of times N is related to the equivalent acquisition rate.

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

| Options             | Settings      | Comments                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>(Real Time) | Normal        | Acquire and accurately display most waveforms.                                                                                                                                                                                                                                                                                                                                                                       |
|                     | Peak Detect   | Detect glitches and eliminate the possibility of aliasing.                                                                                                                                                                                                                                                                                                                                                           |
|                     | Average       | Reduce random or uncorrelated noise in signal display. The number of averages is selectable.                                                                                                                                                                                                                                                                                                                         |
|                     | HR            |                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Disp Mode           | YT            | 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. |
|                     | XY            |                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Averages            | 4, 8, 16, 32, | Select the number of averages by pressing F3 or F4.                                                                                                                                                                                                                                                                                                                                                                  |
|                     | 64, 128       |                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Memory<br>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 Mode Acquires a Single Sample Point in Each Interval

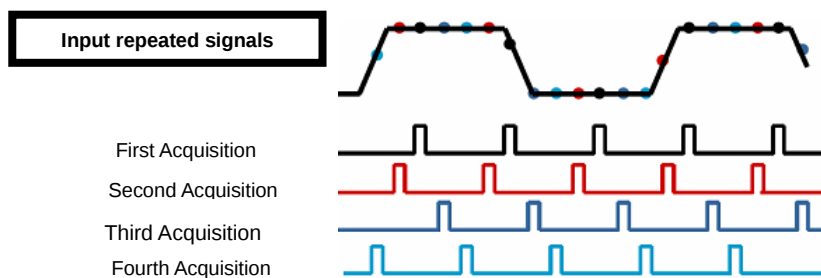
**Peak Detect:** Use this mode to detect glitches within 10ns and to limit the possibility of aliasing. This mode is valid at the SEC/DIV setting of 4 $\mu$ s/div or slower. Once you set the SEC/DIV setting to 4 $\mu$ s/div or faster, the acquisition mode will change to Normal because the sample rate 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, 16, 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.

**Equivalent Acquisition:** Just repeat the Normal acquisition. Use this mode to take a specific observation on repeatedly displayed periodic signals. You can get a resolution of 40ps, i.e. 25GSa/s sample rate, which is much higher than that obtained in real-time acquisition.

The acquisition principle is as follows.



As shown above, acquire input signals (cycle repeatable) for more than once at a slow sample rate, arrange the sample points by the time they appear, then recover waveforms.

## 2.12 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.

There are two modes to display waveforms Single-window and Dual-window. Refer to [Horizontal Controls](#) for more information.

Push the DISPLAY button and the following menu appears.

| Options        | Settings                             | Comments                                                                                                       |
|----------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Type           | Vectors<br>Dots                      | Vectors fill up the space between adjacent sample points in the display; Dots only displays the sample points. |
| Persistency    | OFF<br>1S-30S selectable<br>Infinite | Sets the time length to display each displayed sample point.                                                   |
| Contrast       |                                      | Adjustable, Turn the multi-functional knob to adjust.                                                          |
| Grid           | Dotted line<br>Real line<br>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.                                                          |
| Wave Intensity |                                      | Adjustable, Turn the multi-functional knob to adjust.                                                          |

### 2.12.1 XY Format

The XY format 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 sampling rate is fixed at 1 MS/s.

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

## 2.13 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   |                                                                                                                                                      |
| Pass/Fail   | Pass/Fail function                                                                                                                                   |
| Key Record  |                                                                                                                                                      |
| Front Panel |                                                                                                                                                      |
| Self Test   |                                                                                                                                                      |

**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°C 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.

### 2.13.1 Firmware Update

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] to skip to the “UTILITY” menu.
3. Press “Update Firmware”.
4. Select the file and refer to Upgrade dialog to upgrade.

Reboot the machine after finishing upgrading, and the software version is upgraded.

The oscilloscope should be self-corrected once after upgrading.

**2.13.2 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 the Do Self Cal option and follow the directions on the screen.

**2.13.3 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                                        |
|---------------------|---------|----------------------------------------------------|
| Enable Test         | ON      | Run the pass/fail function.                        |
|                     | OFF     | Stop the pass/fail function.                       |
| Source              | CH1~CH4 | Select the signal input channel.                   |
| Operation           | Run     | Run pass/fail                                      |
|                     | Stop    | Stop pass/fail                                     |
| Display information | OFF     | Close waveform pass/fail time display information. |
|                     | ON      | Open waveform pass/fail time display information.  |

Page 2 of the pass/fail function menu:

| Option     | Setup     | Description                                              |
|------------|-----------|----------------------------------------------------------|
| Output     | 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 |                                                          |
| Stop on    | On        | Enter STOP state if output exist.                        |
| Output     | Off       | Continue to run if output exists.                        |
| Rule setup |           | Skip to a rule setup menu.                               |
| Page 2/2   |           | Back to t page 1 to the pass/fail menu                   |

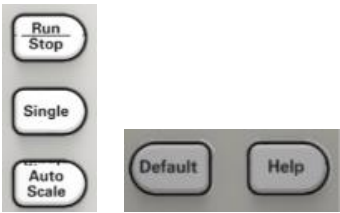
Rule setup menu:

| 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.   |
| Operation  | Create | Create a rule template according to the two setups above.                       |
|            | Save   | Select a save position for the rule.                                            |
| Back       |        | Back to page 2 of the pass/fail menu.                                           |

Rule save menu:

| Option    | Setup        | Description                          |
|-----------|--------------|--------------------------------------|
| Storage   | Local Memory | Select location of saved rule        |
|           | USB Flash    |                                      |
| Location  | 0-9          |                                      |
| Operation | Save         | Save the rule setups.                |
|           | Recall       | Recall the waved rule setups.        |
| Back      |              | Back to page of the rule setup menu. |

# 2.14Fast Action Buttons



**AUTOSET:** Automatically set the oscilloscope controls to generate a usable display of the input signals. Refer to the following table for relative content.

**SINGLE SEQ:** Acquire a single waveform and then stop the acquisition.

**RUN/STOP:** Continuously acquire waveforms or stop the acquisition.

**HELP:** Display the Help menu.

**DEFAULT SETUP:** Recall the factory setup. Refer to the following table for relative content.

## 2.14.1 AUTOSET

Autoset is one of the advantages digital oscilloscopes have. When you push the AUTOSET 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; Autoset 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 Autoset function examines all channels for signals and displays corresponding waveforms. Autoset 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 Autoset 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.

### Sine Wave:

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

| Sine Wave Options | Details                                                                                                                                                                                                                                       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Multi-cycle Sine  | Display multiple cycles that have appropriate vertical and horizontal scales.                                                                                                                                                                 |
| Single-cycle Sine | Set the horizontal scale to display about one cycle of the waveform.                                                                                                                                                                          |
| FFT               | Convert the input time-domain signal to its frequency components and display the result as a graph of frequency versus amplitude (spectrum). Since it is a math calculation, see <a href="#">Section 5.3.1 Math FFT</a> for more information. |
| Undo Setup        | Let the oscilloscope recall the previous setup.                                                                                                                                                                                               |

### Square Wave or Pulse:

When you use the Autoset function and the oscilloscope determines that the signal is similar to a square wave or pulse, the oscilloscope displays the following options.

| Square Wave Options | Details                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Multi-cycle Square  | Display multiple cycles that have appropriate vertical and horizontal scales.                                                                       |
| Single-cycle Square | Set the horizontal scale to display about one cycle of the waveform. The oscilloscope displays Min, Mean and Positive Width automatic measurements. |
| Rising Edge         | Display the rising edge.                                                                                                                            |
| Falling Edge        | Display the falling edge.                                                                                                                           |
| Undo Setup          | Let the oscilloscope recall the previous setup.                                                                                                     |

### 2.14.2 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) | $\pm 3.2\text{div}$ |
|                | Vertical (time)        | $\pm 4\text{div}$   |
| Display        | Type                   | Vectors             |
|                | Persist                | Off                 |
|                | Format                 | YT                  |
| Horizontal     | Window Mode            | Single-window       |
|                | Trigger Knob           | Level               |
|                | Position               | 0.00s               |

|                 |                 |             |
|-----------------|-----------------|-------------|
|                 | SEC/DIV         | 200 $\mu$ s |
| 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        |
|                 | Coupling        | DC          |
|                 | Level           | 0.00v       |
| Trigger (Video) | Polarity        | Normal      |
|                 | Sync            | All lines   |
|                 | Standard        | NTSC        |
| Trigger (Pulse) | When            | =           |
|                 | Set Pulse Width | 1.00ms      |
|                 | Polarity        | Positive    |
|                 | Mode            | Auto        |
|                 | Coupling        | DC          |
| Trigger (Slope) | Slope           | Rising      |
|                 | Mode            | Auto        |
|                 | Coupling        | DC          |
|                 | When            | =           |
| Trigger (Alter) | CH1             |             |
|                 | Type            | Edge        |
|                 | Slope           | Rising      |

|                                  |                           |                 |
|----------------------------------|---------------------------|-----------------|
|                                  | Mode                      | Auto            |
|                                  | Coupling                  | DC              |
|                                  | Level                     | 0.00v           |
|                                  | CH2                       |                 |
|                                  | Type                      | Edge            |
|                                  | Slope                     | Rising          |
|                                  | Mode                      | Auto            |
|                                  | Coupling                  | DC              |
|                                  | Level                     | 0.00v           |
| Trigger (OT)                     | Source                    | CH1             |
|                                  | Polarity                  | Positive        |
|                                  | Mode                      | Auto            |
|                                  | Time                      | 20ns            |
| Vertical System,<br>All Channels | Coupling                  | DC              |
|                                  | Bandwidth Limit           | Unlimited       |
|                                  | VOLTS/DIV                 | Coarse          |
|                                  | Probe                     | Voltage         |
|                                  | Voltage Probe Attenuation | 10X             |
|                                  | Invert                    | Off             |
|                                  | Position                  | 0.00div (0.00V) |
|                                  | VOLTS/DIV                 | 1.00V           |

The following settings do not change when you push the DEFAULT SETUP 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, Trapezia, DC, Exponent, AM/FM.

Push the **Wave Gen** button to display the DDS Menu.

Generate the Sine waveform

To output a Sine Wave, please do the following steps:

1. Press F1 button to select "Sine".
2. Set the Wave Parameter:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Offset: Set the output wave vertical level offset.

Generate the Ramp waveform

To output a Ramp Wave, please do the following steps:

1. Press F1 button, then turn the **Universal Knob** to select "Ramp".
2. Set the Wave Parameter:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.
  - Offset: Set the output wave vertical level offset.

Generate the Square waveform

To output a Square Wave, please do the following Step:

1. Press F1 button, then turn the **Universal Knob** to select "Square".
2. Set the Wave Parameter:
  - Frequency: Set the output wave frequency.
  - Amplitude: Set the output wave amplitude.

Offset: Set the output wave vertical level offset.

Duty: The duty of the output wave.

Generate the Exponent waveform

To output an Exponent Waveform, please do the following steps:

1. Press F1 button, then turn the **Universal Knob** to select "Exp".
2. Set the Wave Parameters:

Frequency: Set the output wave frequency.

Amplitude: Set the output wave amplitude.

Offset: Set the output wave vertical level offset.

# 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 HANTEK distributor or directly keep touch with HANTEK 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 (such as CH1, CH2 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 HANTEK 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 or press the SET TO 50% button 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 Services and Support

Thank you for choosing HANTEK. Please contact us through the following ways should you have any inquiry regarding our products. We shall do our best to help you.

1. Contact your local HANTEK distributor;
2. Contact your local HANTEK field office;
3. Contact HANTEK headquarters in China.

## **Headquarters**

Qingdao Hantek Electronic Co., Ltd

<http://www.hantek.com>

Address: 5/F, No.177 Zhuzhou Road (Huite Industry City), Qingdao, China  
266101

Tel: +86-532-88703687 / 88703697

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Email: [service@hantek.com](mailto:service@hantek.com)

## **Technical Support**

Tel: +86-532-88703687

Email: [support@hantek.com](mailto:support@hantek.com)

# Chapter 6    General Care and Cleaning

## 6.1 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.

## 6.2 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 DSO5000 series oscilloscopes. Before checking an oscilloscope from HANTEK 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°C.
- The oscilloscope must be within the factory calibration interval.

All specifications are guaranteed unless noted 'typical'.

## Oscilloscope Specifications

### Horizontal

|                                                  |                                                                                                 |                                            |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------|
| Sample Rate Range                                | 1GS/s                                                                                           |                                            |
| 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                                    | DSO4084 DSO4104                                                                                 | DSO4204 DSO4254                            |
|                                                  | 2ns/div to 100s/div, in a 1, 2, 5 sequence                                                      | 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,<br>each channel sampled simultaneously                                                                                              |            |               |            |
| VOLTS/DIV Range                            | 500 $\mu$ V/div to 10V/div at input BNC                                                                                                               |            |               |            |
| Position Range                             | 500 $\mu$ V/div to 20mV/div, $\pm 400$ mV<br>50mV/div to 200mV/div, $\pm 2$ V<br>500mV/div to 2V/div, $\pm 40$ V<br>5V/div to 10V/div, $\pm 50$ V     |            |               |            |
| Selectable Analog Bandwidth Limit, typical | 20MHz                                                                                                                                                 |            |               |            |
| Low Frequency Response (-3db)              | $\leq 10$ Hz at BNC                                                                                                                                   |            |               |            |
| Rise Time at BNC, typical                  | DSO4084                                                                                                                                               | DSO4104    | DSO4204       | DSO4254    |
|                                            | $\leq 4.4$ ns                                                                                                                                         | $< 3.5$ ns | $\leq 1.8$ ns | $< 1.4$ ns |
| DC Gain Accuracy                           | $\pm 3\%$ for Normal or Average acquisition mode, 10V/div to 10mV/div<br>$\pm 4\%$ for Normal or Average acquisition mode, 5mV/div to 500 $\mu$ V/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 |

**TTrigger**

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

|                         |                                                                                           |
|-------------------------|-------------------------------------------------------------------------------------------|
| Resolution              | 8ns                                                                                       |
| <b>Window Trigger</b>   |                                                                                           |
| Source                  | CH1~CH4                                                                                   |
| <b>Pattern Trigger</b>  |                                                                                           |
| Pattern                 | 0: Lower level; 1: High level;                                                            |
| Level                   | CH1~CH4                                                                                   |
| <b>Interval Trigger</b> |                                                                                           |
| Slope                   | Rising, Falling                                                                           |
| Condition(When)         | <, >, !=, =                                                                               |
| Source                  | CH1~CH4                                                                                   |
| Time Range              | 8ns ~ 10s                                                                                 |
| Resolution              | 8ns                                                                                       |
| <b>Under Amp</b>        |                                                                                           |
| Polarity                | Positive, Negative                                                                        |
| Condition(When)         | <, >, !=, =                                                                               |
| Source                  | CH1~CH4                                                                                   |
| Time Range              | 8ns ~ 10s                                                                                 |
| Resolution              | 8ns                                                                                       |
| <b>UART Trigger</b>     |                                                                                           |
| 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                                                                      |
| <b>LIN Trigger</b>      |                                                                                           |

|                           |                                                                                                                    |
|---------------------------|--------------------------------------------------------------------------------------------------------------------|
| Condition(When)           | Interval Field, Sync Field, Id field, Sync Id Error, Identifier, Id and Data                                       |
| Source                    | CH1~CH4                                                                                                            |
| Data format               | Hex                                                                                                                |
| Baud Rate<br>(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                                                                                               |
| <b>CAN Trigger</b>        |                                                                                                                    |
| 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<br>(Selectable) | 10000, 20000, 33300, 500000, 62500, 83300, 100000, 125000, 250000, 500000, 800000, 1000000                         |
| Baud Rate (Custom)        | 5kbit/s~1Mbit/s                                                                                                    |
| <b>SPI Trigger</b>        |                                                                                                                    |
| Condition                 | Data                                                                                                               |
| Source<br>(CS/CLK/Data)   | CH1~CH4                                                                                                            |
| Data format               | Hex                                                                                                                |
| Data Length               | 4, 8, 16, 24, 32                                                                                                   |
| <b>IIC Trigger</b>        |                                                                                                                    |
| 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,<br>DC coupled            | 1M $\Omega$ $\pm$ 2% in parallel with 20pF $\pm$ 3pF                                                                                                                                                                                                                                                                                                                                               |                                                              |
| Probe<br>Attenuation                      | 1X, 10X                                                                                                                                                                                                                                                                                                                                                                                            |                                                              |
| Supported Probe<br>Attenuation<br>Factors | 1X, 10X, 100X, 1000X                                                                                                                                                                                                                                                                                                                                                                               |                                                              |
| Maximum Input<br>Voltage                  | Overvoltage Category                                                                                                                                                                                                                                                                                                                                                                               | Maximum Voltage                                              |
|                                           | CAT I and CAT II                                                                                                                                                                                                                                                                                                                                                                                   | 300V <sub>RMS</sub> (10 $\times$ ), Installation<br>Category |
|                                           | CAT III                                                                                                                                                                                                                                                                                                                                                                                            | 150V <sub>RMS</sub> (1 $\times$ )                            |
|                                           | Installation Category II: derate at 20dB/decade above 100kHz to 13V peak AC at 3MHz* and above. For non-sinusoidal waveforms, peak value must be less than 450V. Excursion above 300V should be of less than 100ms duration. RMS signal level including all DC components removed through AC coupling must be limited to 300V. If these values are exceeded, damage to the oscilloscope may occur. |                                                              |

## Measurements

|                           |                                                                                                                                                                                                                                                                                                         |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors                   | Voltage difference between cursors: $\Delta V$<br>Time difference between cursors: $\Delta T$<br>Reciprocal of $\Delta T$ in Hertz (1/ $\Delta T$ )                                                                                                                                                     |
| Automatic<br>Measurements | Frequency, Period, Mean, Peak-to-peak, Cycle RMS, PRMS, Minimum, Maximum, Rise Time, Fall Time, + Width, - Width, + Duty, - Duty, Base, Top, Middle, Amplitude, Overshoot, Preshoot, Pmean, FOVShoot, RPRESshoot, BWidth, Delay 1-2 $\uparrow$ , Delay 1-2 $\downarrow$ , LFF, LFR, LRF, LRR, FFR, EFRF |

## General Specifications

|              |                                                |
|--------------|------------------------------------------------|
| Display      |                                                |
| Display Type | 7 inch 64K color TFT (diagonal liquid crystal) |

|                          |                                                                                                                                   |                                                                  |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Display Resolution       | 800 horizontal by 480 vertical pixels                                                                                             |                                                                  |
| Display Contrast         | Adjustable (16 gears) with the progress bar                                                                                       |                                                                  |
| Probe Compensator Output |                                                                                                                                   |                                                                  |
| Output Voltage, typical  | About 5Vpp into $\geq 1\text{M}\Omega$ load                                                                                       |                                                                  |
| Frequency, typical       | 1kHz                                                                                                                              |                                                                  |
| Power Supply             |                                                                                                                                   |                                                                  |
| Supply Voltage           | 100-120VAC <sub>RMS</sub> ( $\pm 10\%$ ), 45Hz to 440Hz, CAT II<br>120-240VAC <sub>RMS</sub> ( $\pm 10\%$ ), 45Hz to 66Hz, CAT II |                                                                  |
| Power Consumption        | <30W                                                                                                                              |                                                                  |
| Fuse                     | 2A, T rating, 250V                                                                                                                |                                                                  |
| Environmental            |                                                                                                                                   |                                                                  |
| Temperature              | Operating: 32°F to 122°F (0°C to 50°C)                                                                                            |                                                                  |
|                          | Nonoperating: -40°F to 159.8°F (-40°C to +71°C)                                                                                   |                                                                  |
| Cooling Method           | Convection                                                                                                                        |                                                                  |
| Humidity                 | +104°F or below (+40°C or below): $\leq 90\%$ relative humidity                                                                   |                                                                  |
|                          | 106°F to 122°F (+41°C to 50°C): $\leq 60\%$ relative humidity                                                                     |                                                                  |
| Altitude                 | Operating and Nonoperating                                                                                                        | 3,000m (10,000 feet)                                             |
|                          | Random Vibration                                                                                                                  | 0.31g <sub>RMS</sub> from 50Hz to 500Hz, 10 minutes on each axis |
|                          | Nonoperating                                                                                                                      | 2.46g <sub>RMS</sub> from 5Hz to 500Hz, 10 minutes on each axis  |
| Mechanical Shock         | Operating                                                                                                                         | 50g, 11ms, half sine                                             |

### Arbitrary Waveform Generator Mode

|                    |         |             |
|--------------------|---------|-------------|
| Waveform Frequency | Sine:   | 0.1Hz~25MHz |
|                    | Square: | 0.1Hz~10MHz |

|                      |                                                |
|----------------------|------------------------------------------------|
|                      | Ramp: 0.1Hz~100KHz<br>EXP: 0.1Hz~5MHz          |
| Amplitude            | 5mV~3.5Vp-p(50Ω)<br>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 HANTEK distributor.

### Standard Accessories

- Probe×4 (1.5m), 1:1, (10:1) Passive Probes
- A Power line
- A USB Line
- A PC software CD of the oscilloscope
- Warranty Card
- Manufacturer Certificate
- Certificate Of Calibration

# Appendix C Harmful and Poisonous Substances or Elements

| Component <sup>2</sup>               | Harmful and poisonous substances or elements <sup>1</sup> |    |    |        |     |      |
|--------------------------------------|-----------------------------------------------------------|----|----|--------|-----|------|
|                                      | 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*'.