Chapter 1 User's Guide

LW 2000L series is a kind of desktop digital storage oscilloscope (D.S.O) with small and lightweight features. It provides customers with convenient and easy operating front panel to carry on the basic operation. The Panel includes knob and function keys. The function of knob is similar with that of other oscilloscopes. Column on the right side of the screen is the screen copy key (PrtSc; can be used to keep the current operation interface to an external USB storage devices in image format) and five menu operation keys (top to down defined for F1 key to F5 key). Through them, you can set current menu for different options. Others are function keys, through them you can enter different functional menu or get specific functions directly.
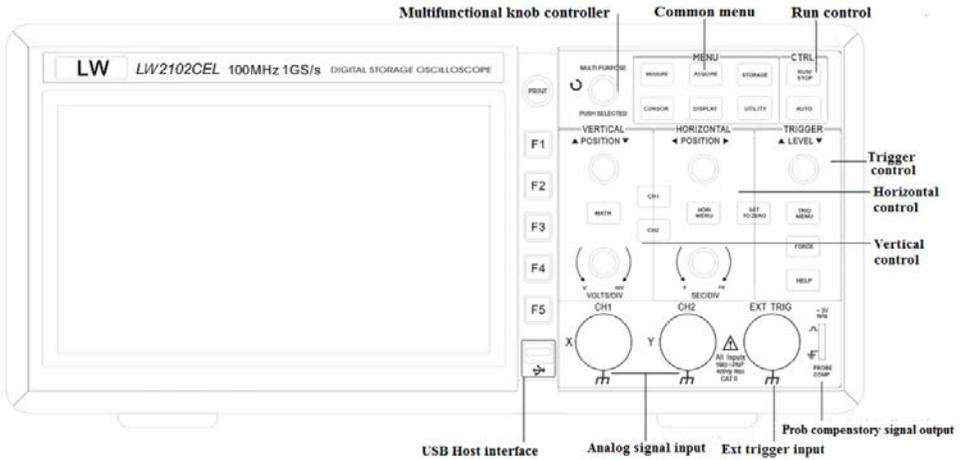
Figure 1-1   LW2000L panel operating figure

Show horizontal trigger position
Trigger state display
Show time of center tick
CH1 sign
CH2 sign
The menu display have differences for different functional keys
Waveform display window
Display channel vertical tick coefficient   Display the main time base setting
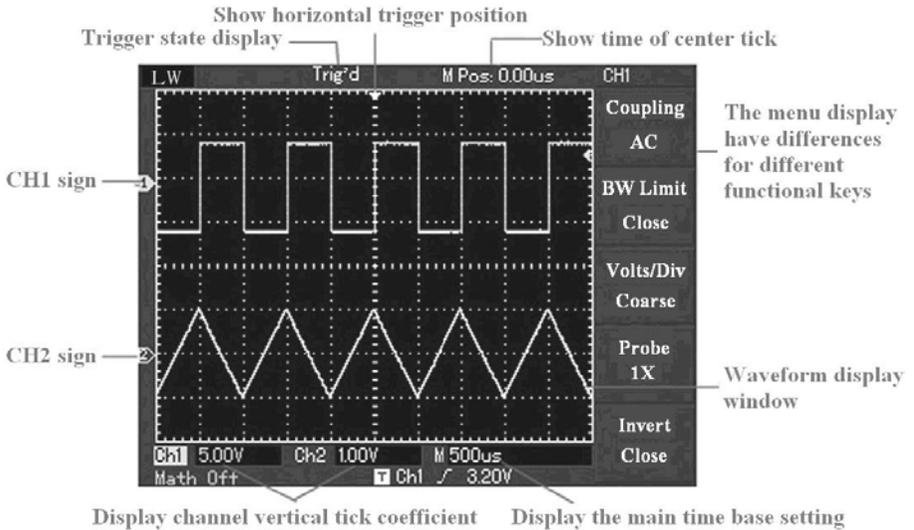
Figure 1-2 display interface figure

1.1: General inspection

When you get a new LW2000L oscilloscope, it should be inspected according to the following steps.

1.1.1 Check the damage coursed by transportation

If you found the packing box or foam plastic protection mat have serious damage, please reserve it at first until the machine and accessories through the electrical and mechanical properties test.

1.1.2:Check attachment

About accessory details, in appendix B of this manual has been described You can check whether there are lack of accessories refer to the manual.If attachment is found missing or damaged,please contact with the local dealers or office.

1.1.3: Check the whole machine

If you found instrument's appearance damaged, work abnormal or fails to pass performance test, please contact with the LW local dealer or office which are responsible for the business. If you find the instrument is broken or work abnormal or fail to performance test, please contact with the LW local dealer or office which

are responsible for the business. If the instrument's damage is caused by the transport, please pay attention to keep packing, notify the transportation department and the distribution of the product of LW dealer, LW will arrange repair or replacement.

1.2:Function test

Once you carry out the machine, please do a quick function test to verify whether this instrument operates normally or not. Please test it accord to the follow steps:

1.2.1:connect power supply

Plug the instrument to AC power. Input voltage for this oscilloscopes is AC 100 volts to AV 240 volts, frequency is 45Hz to 440Hz. After that, press "UTILITY" menu firstly, choose F1 to execute. Then it will enter to the next page. press F1 again, callout the "factory setting". Press "CH1"button to enter CH1 menu.

1.2.2:Oscilloscope access signal

LW2000L series are dual channel input oscilloscopes with another external trigger input channel. Please access signal accord to the following steps:

①Connect oscilloscope probe to CH1 input terminal, and set the attenuation rate switch at 10 x (FIG. 1-3).
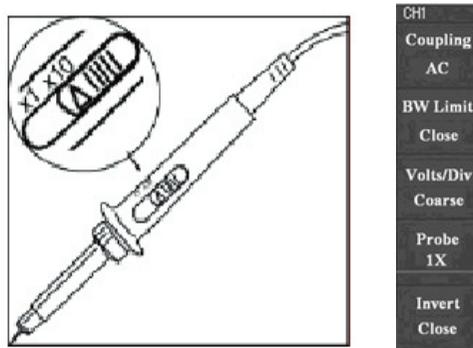
Figure 1-3 probe attenuation rate switch setting

②In digital storage oscilloscope to set the probe attenuation factor.The attenuation coefficient change instrument's vertical magnification, which makes results correctly reflect the measured signal amplitude. To set the probe attenuation coefficient , Please press F4 key for menu display of 10× make menu display as 10×.

③.Connect probe and grounding clip to corresponding connection ends of probe compensating signal. then press "AUTO"button. Within several seconds, square wave is displayed(1kHz, square, Vpp 3V) . Check CH2 in the same way and press OFF function button to close the CH1,press CH2 function button to open the CH2, Repeat steps 2 and 3 steps.

1.3: Probe compensating

when connecting probe with any input channel at the first time, it need to do the adjustment to make probe match with the input channel. Without compensation it will lead to the measurement error or mistake. please according to the following steps to adjust probe compensating.

1.3.1: Set the probe attenuation menu coefficient as 10 x, the switch on the probe at 10 x, and connect probe with CH1. If want to use the probe head hook, should ensure reliable contact with the probe. It has to connect probe end to signal output connector of probe compensator then connect grounding clip to earth wire connector of probe compensator. It also has to power on CH1 and press [AUTO].

1.3.2: Observe the waveform display.

Compensation　　　　　　　Proper compensation　　　　　Inadequate compensation
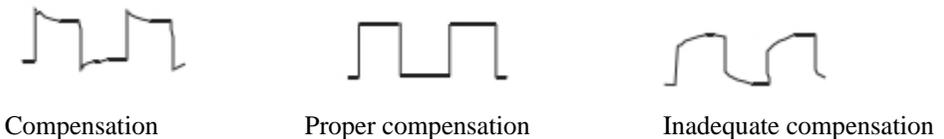
Figure 1-4 Probe compensating correction

1.3.3: If the displayed waveform as the above figures "compensation insufficient" or "compensation over". With a screwdriver to adjust variable capacity of nonmetal handles on the probe until the screen's waveform is as the above figure "compensation correct".

Caution: To avoid being electric shock while using the probe in measuring high voltage, please ensure that the probe's insulation wire is good, and please don't touch metal parts while connect with high voltage.

LW

1.4:Automatic settings of waveform display

LW2000L series digital storage oscilloscope has automatically setting functions. According to the input signals, it can automatically adjusted the vertical deflection factor, scanning time base and trigger mode until   the most appropriate waveform display. Automatic set required signal's frequency is equal or more than 20Hz, duty greater than 1%.

1.5Using automatic settings:

①Connect measured signal with the input signal channel.

②Press "AUTO" button. Oscilloscope will automatically set Vertical deflection, scan coefficient, and trigger mode. If need to further observe carefully, can should carry on the manual adjustment after automatic settings until the needed waveform to the best effect.

1.6:Preliminary understanding vertical system

As the chart shows, there are a series of buttons and knobs in the vertical control. The exercises below gradually lead you to be familiar with using of vertical Settings.
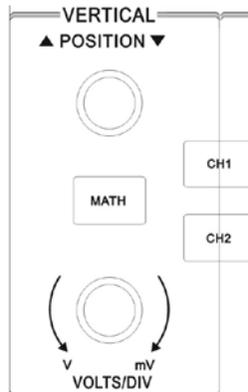
Figure 1-5 vertical control area in the panel

Use the vertical position knob to make the waveform signals display in the window. Vertical display position of signal can be controlled by vertical position knob.When turning around the vertical position,   "GROUND" identification will move up and down as followed waveform.

Measurement techniques:

If channel coupled way is DC, you can observe the gap between the measured signals and the GROUND signal to measure signal's DC component. If the coupled way is AC, signal's dc component was filtered. With this way you use higher sensitivity to show ac component of signal.

Vertical position of dual analog channels to recover zero shortcuts key（SET TO ZERO）:

The key is used to adjust the vertical, horizontal displacement and trigger delay to zero (center point).

②Change the vertical setting and observe state information's changes. You can use information which displayed under the state window to make sure if there are any vertical gear changes. Turn the vertical scaling knob change "v /grid" vertical gear, it can be found that the display of status bar corresponding channel gear's has a corresponding change. Press CH1, MATH, the REF, CH2 screen display the corresponding channel's operation menu marks, waveform and gear status information. Press OFF buttons to close the current selection channel.

1.6 Preliminary understanding horizontal system

As the chart shows, there are a series of buttons and knobs in the level control. The exercises below gradually lead you to be familiar with using of level Settings.
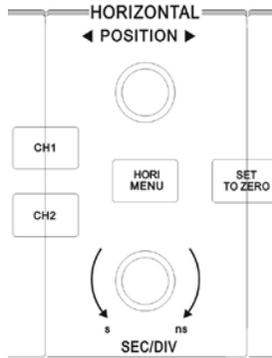
Figure 1-6 horizontal control area in the panel

1.Use horizontal SCALE knob to alter horizontal time base gear then observe alternation of status information. To rotate horizontal SCALE knob to alter "s/div" time base gear so as to show corresponding variation of time base gear display for corresponding channels of status bar. Horizontal scanning speed steps from 2ns/div~50s/div by way of 1-2-5mode.

Note: LW2000L series oscilloscope, because of its different models, there are also some differences for the horizontal time gear.

2. Use horizontal POSITION knob to adjust signal's horizontal position at waveform window, horizontal POSITION knob control signal's trigger shift. When applied in the trigger shift, turning level POSITION knob ,can observe the waveform will move level shift as followed the knob.

3. Press the MENU button, show Zoom MENU. In this menu, press F3 can open "**windows spread**" and press F1 to close windows and return to the main time gear. In this menu, can also set "**trigger release**" time.

Triggers point back to horizontal zero shortcuts key: Through the shortcut key "SET TO ZERO" to make the trigger point recovery to the vertical center rapidly, and also can rotate POSITION knob to adjust horizontal position of signal on waveform.

Nouns explanation

Trigger point: It refers to position of actual trigger point by comparing with

middle point of storage instrument. Users can move trigger horizontally by rotating horizontal POSITION knob.

Trigger hold off: It refers to interval to start up trigger circuit again. Hold off time can be set by rotating multi-purpose knob controller.

1.7 Preliminary understanding trigger system

As shown in figure 1-7 in a triggering menu control site, there are a knob and three buttons. The exercises below will gradually lead you to be familiar with trigger system's settings.
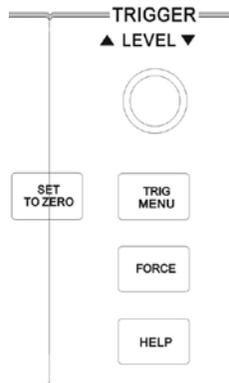
Figure 1-7 trigger menu on the panel

1.Use trigger level knob to change trigger level, it can be see the trigger symbol to indicate the trigger level line. With the level of rotation knob up and down .In a mobile trigger level, can observe the numerical corresponding change of trigger level at the bottom of the screen.

2.Used TRIGGER MENU with F1-F5 key to change triggers Settings.

3.Press the button of "**SET TO ZERO**"to set trigger level at vertical center point of trigger signal amplitude

4.Press FORCE button: force to generate a triggered signal which is mainly applied for normal and single trigger mode.

Chapter 2: Instrument Setup

■Set vertical system （CH1,CH2,MATH,VERTICAL POSITION,VERTICAL

SCALE）

■Set horizontal system （HORI MENU,HORIZONTAL POSITION,HORIZONTAL

SCALE）

■Set trigger system（**TRIGGER LEVEL,TRIG MENU,FORCE**）

■Set Sampling way （ACQUIRE）

■Set display way （DISPLAY）

■STORAGE and export （STORAGE）

■aid system set （UTILITY）

■automatic measurement （MEASURE）

■cursor measurement （CURSOR）

■use implementation button （AUTO:RUN/STOP）

2.1:Set vertical system

CH1 and CH2 channels and setup:Every channel has its own vertical menu.
item can be set individually according to different channels. Press CH1 function or
CH2 function keys, system shows CH1 or CH2 operation menu, see table 2-1:

Table2-1：Channel menu explanation

Function menu	Setup	Description

Coupling	AC DC GND	Stop DC part of input signal Pass DC and AC part of input signal cut off input signal
Bandwidth limit	Open closed	To limit band width to 20MHzso as to reduce display noise. Full bandwidth。
V/GRID	Coarse tuning Fine tuning	To set vertical deflection coefficient for coarse tuning by 1-2-5 system. To refine within setup scope of coarse tuning for fine tuning so as to improve vertical resolution.
probe	1× 10×	To select one value according to probe attenuation coefficient to keep correct vertical deflection coefficient. There are totally 4 kinds, namely, 1×, 10×
reversed	Open closed	Open waveform reversed function。 Waveform display normal。

2.1.1:Mathematical functions

Mathematical functions are to show CH1, CH2 waveform's results of addition,

subtraction, multiplication, divide and FFT operation。

table 2-2： Mathematical operation menu explanation

Functional menu	Setup	Description
Type	Math	Do +：−：×：÷ operation
Source 1	CH1 CH2	Set source 1 as CH1channel wave Set source 1 as CH2channel wave
	+	Source 1+ Source 2

operation	–	Source 1–Source 2
	×	Source 1×Source 2
	÷	Source 1÷Source 2
Source 2	CH1	Set source 2 as CH1channel wave
	CH2	Set source 2 as CH2channel wave

FFT spectrum analysis

Use fast Fourier transform (FFT) mathematical, but you can convert (YT) time signal into frequency domain signals. USES FFT can easily observe the following **types of signal:**

●measuring system harmonic content and distortion

●Express noise characteristics of dc power supply

●Analysis vibration amplitude of mathematics

2-3：FFT menu explanation

Functional menu	Setup	Description
type	FFT	FFT Mathematical operation
source	CH1 CH2	Set source 1as operation wave Set source 2as operation wave
window	Hanning Hamming Blackman Rectangle	Set Hanning window function Set Hamming window function Set Blaclman window function Set Rectangle window function

Choose FFT window

Hypothesis YT waveform is in repeated conditions, oscilloscope do the FFT transformation to the limited length records of time. So when the cycle is integers, YT waveform amplitude is the same at the beginning and the end, and the waveform won't produce interrupt. However, if the period for the YT waveform is not integers, which will lead waveform amplitude different at the beginning and the end so as to generate high-frequency transient interrupt. In frequency domain, the effect is called leakage. So to avoid leakage, multiply a window function with the original waveform,

force the value of the beginning and end is 0. See table bellowed application window function:

Table 2-4：

FFTwindow	feature	The most appropriate measurement content
Rectangle	The best frequency resolution, the weakest margin resolution is the same as no window state	temporary state or short pulse, Sine wave of Signal level is equal .frequency is near and also have slow ,wave spectrum of pulse random noise
Hanning	Compared with Rectangle, it has better frequency resolution, weaker aptitude resolution.	Sine, cycle and narrow pulse random noise temporary state or short pulse, signal level have big difference
Hamming	Hamming resolution, is a bit better than Hanning	
Blackman	The weakest frequency resolution, the best margin resolution	Main used for single signal and search higher harmonious wave

Nouns explanation:

FFT Resolution: defined sampling and operation point's contractor. When the computing point is fixed, the lower sampling rate the better FFT resolution.

Nyquist frequency: the highest frequency f's waveform must use the 2f sampling rate to rebuild original waveform. It is also called the Nyquist theorem, here is the f is Nyquist frequency and 2f is Nyquist sampling rate.

2.1.2:reference waveform

REF menu can open or closed waveform that from reference memory waveform. Waveform is stored in oscilloscope nonvolatile memory, and has the following names: RefA, RefB. To display (v) or hidden reference waveform, please execute the following steps:

(1): Press the REF. menu button of front panel

(2):Press RefA (RefA reference) and select source, through rotating the multifunction button of the front panel, to choose, the position of the source position were 1-10. When choosing a digital waveform, such as "1" and press callback to call out original positional waveform.

If the waveform is in U disk storage, you can insert U disk, then press F2, there are two options: disk DSO/USB, can choose USB. from U disk call out the deposited waveform, the screen will displays the waveform.

After the completion of the callback, press cancel button (F5) to returns superior menu.

(3):Press RefB (RefA reference option), choose the second source of the operation, methods is the same as steps 2. In practical applications, with LW2000/3000 oscilloscope measure and observe related waveform. You can observe the waveform and compare the current and reference waveform. And do the analysis presses the REF buttons to show that reference waveform menu, setting see table below:

2.2 Setup of horizontal system
2.21 Horizontal shift knob

With horizontal shift knob could lead to a wave moving on the screen, when clockwise the knob, waveform moves to the left, will see more signal   before the trigger points at this time, on the other hand, can see more signal after the trigger point.

Level scale: adjust the time base,say the s/div. When extended time base is opened, window width will be changed by changing the horizontal scale knob delayed scan time base. Details please see extended time base is introduced.

Table 2-5Level control buttons menu:

Functional menu	Description	setting
Main time base	——	1:open Main time base； 2:if press main time base then close video extended window after open video extended window.
＿＿		
video extended	——	Open video extended。

——		
Trigger delay		Adjust delay time。
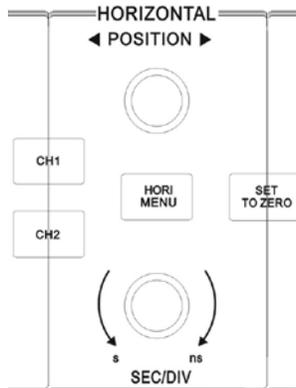
Figure 2-1 horizontal system interface

Nouns Explanation

Y-T mode: Y axle refers to voltage and X axle refers to time quantum under this mode.

X-Y mode: X axle refers to CH1 voltage and Y axle refers to CH2 voltage under this mode.

Slow scanning mode: Instrument will enter into slow scanning sampling mode when setting horizontal time base control to 100ms/div or less. It is suggested to set channel coupling to DC when observing low-frequency signal by applying for slow **scanning mode. s-div:** Time base control can expand or compress waveform for horizontal scale (or time base) unit if stopping waveform sampling (by using RUN/STOP key).

2.2.3:Windows expand

Windows expand to enlarge a wave, in order to check image detail. Windows extended's setting should not be slower than the setting of main time base.

When the expanded time base, distribute and display for two areas. the above part is wave, you moves it through level position knob waveform, or turn SCALE knob

level expanding and minimize the area.

The down part of the original waveform area is level extended waveform. Notable is, when the yankees, when compared to raise the resolution (pictured above). Because of the down part of the wave is corresponded with the selected up half part, thus turn SCALE level knob to reduce chosen regional can improve the expansion time base, which increased the waveform's extending multiples.

X-Y way

This method only applies in CH1 and CH2. Choose x-y display mode, the horizontal axis display CH1voltage, the vertical axis shows CH2 voltage.

Waveform level extended part's main time base delay sweep time base's wave level extends part.

Note: oscilloscope in normal x-y mode can capture waveform in any sampling rate. In x-y way, you also can adjust the sampling rate and vertical gear of channel. X-y way's default sampling rate is 100MS/s. normally, reduced sampling rate, you can get the good LiShayuk result. The following functions in the x-y display way don't have effect.

■ automatic test mode

■ cursor measurement model

■ reference or mathematical operation waveform

■ vector display type

■ level MENU button

■ trigger control

2.3:Sets trigger system

Trigger can determine data acquisition time and waveform display for digital storage oscillograph. It can convert instable display to meaningful waveform once correct setup. Digital storage oscillograph will collect sufficient data to map

waveform in the left side of trigger point firstly. It will acquire data continuously and synchronously when waiting for trigger conditions. It also will acquire sufficient data continuously to map waveform in the right side of trigger point. Trigger control area of operation panel of digital storage oscillograph includes trigger level

adjustment knob and trigger menu key of [TRIG MENU];

SET the trigger level during a signal's vertical midpoint "SET TO ZERO; Mandatory trigger buttons "FORCE".

Trigger level: Trigger level will set signal voltage which corresponds to trigger point.

"SET TO ZERO":SET the trigger level trigger signal amplitude of the vertical midpoint.

"FORCE" : forced to generate a trigger signal, mainly applied to the trigger mode and "normal" and "single" mode.

"TRIG MENU" : trigger Settings MENU.

2.3.1:Trigger control

Trigger mode: edge, pulse width and alternate trigger.

Edge trigger: Trigger when edge of trigger signal reaches a certain given level.

Pulse width trigger: Trigger when pulse width of trigger signal reaches certain set trigger conditions

Alternate trigger: applicable to trigger the signal without associated frequency.

Now we do the explanation for the following trigger menu.

2.3.1.1:Edge trigger:

Edge in the input signal's triggered edge threshold. In selecting "edge", namely in triggering the input signal on the rising and falling edge trigger.

Table 2-7

Functional menu	setup	Description
type	edge	

Source select	CH1	Set CH1 as signal trigger signal
	CH2	Set CH2 as signal trigger signal
	EXT	Set the external trigger input channel as source triggered signals
	Mains supply Alternation	Set mains supply trigger CH1and CH2 alternate to trigger their signal respectively
slope factor	Rising Declining	Set trigger of up edge of signal Set trigger of down edge of signal
Trigger mode	automatic normal Einmal	Setting you can also collect waveform In no triggered condition. Setting you can collect waveform within triggered condition. Setting you can collect waveform with detecting one triggered waveform and stop.
Trigger coupling	DC AC HF restrain LF restrain	Stop the DC component of the input signal Get through the AC and DC component of the input signal Restrain high frequency component of above 80MHz in signal Restrain low frequency component of below 80MHz in signal

2.3.1.2:Pulse width trigger

Pulse width trigger

Pulse width trigger according to the width of pulse to determine the trigger time. You can set pulse-width's conditions to capture abnormal pulse.

Table 2-8

Functional	setup	Description

menu		
type	Pulse width	
Trigger source	CH1 CH2 EXT Commercial power Alternate	Set CH1 as source trigger signal Set CH2 as source trigger signal Set ext trigger input channel as source trigger signal Set Commercial power as source trigger signal CH1 and CH2's signal trigger alternately
Pulse condition	Bigger Smaller equal	trigger when the pulse's width is bigger than settled value trigger when the pulse's width is smaller than settled value trigger when the pulse's width is equal with settled value
Puse width setup	20ns~10s	To set pulse width of 20ns to 10s then regulate by multi-purpose knob in upper part of front panel.
Next page1/2		Enter into next page.

Table 2-9

Functional menu	setup	Description
type	Pulse width	
Trigger polar	Positive pulse negative pulse	Set Positive pulse as source trigger signal Set negative pulse as source trigger signal

Trigger way	Auto	System collects waveform data automatic when there is no trigger signal. In the screen display the scanning time line; it will convert into trigger scanning while there is trigger signal.
	normal	
	single	Instrument will stop collecting data when there is no trigger signal , It will generate trigger scanning while there is trigger signal. Once there is trigger signal ,generate a trigger and stop
Trigger coupling	DC AC High-frequency inhibition	High-frequency inhibitionTo pass through AC & DC components of trigger signal. To obstruct DC components of trigger signal. To obstruct pass through of high-frequency components of signal and only low-frequency components can pass through.
Previous page 2/2	────	Return to previous page.

2.3.1.3:Alternate trigger

Alternate triggered signals are from two vertical channels, this way can be used to observe and triggered the two different signals which there are not any related with two. Trigger alternating menu list 2-11:

Table 2-10 Alternate trigger way setting

Functional menu	Setup	Description
Type	Edge	Set trigger way as Edge trigger

Trigger source	alternate	CH1 and CH2 trigger alternately
Slope	Up	Set trigger slope as up edge
Trigger way	Auto	Set trigger way as auto
Trigger coupling	Ac	Set trigger coupling way as AC

2.3.2:Trigger coupling Settings

After enter the trigger setting menu, you can set menu to trigger the coupling way to obtain the most stable, the synchronization. Trigger coupling menu.

Functional menu	Setting	Explanation
Type	Edge	
Trigger source	alternate	CH1 and CH2 trigger alternately
Slope	Up	Set trigger slope as up edge
Trigger way	Auto	Set trigger way as auto
coupling	DC AC High frequency suppression low frequency suppression	Set stop DC pass Set allow all the current pass Stop the high frequency of signal pass, only allow low frequency pass Stop the low frequency of signal pass, only allow high frequency pass

2.3.3:trigger release time adjustment

Use trigger release time to adjust, we can observe complex waveform (such as pulse waveform series). Release time means oscilloscope restart use trigger circuit's waiting time. In the delay time, oscilloscope will not trigger until the end of release time. For example, a group of pulse series, you need to trigger at the first pulse then you can set release time for pulse width. As shown in figure 2-18. Trigger release table as followed menu see:

Table 2-12

Functional menu	Setting	Explanation
Main time base	——	1:open the Main time base 2:If after open the video extended window ,press main

		time base to close video extended window
——		
video extended	——	open extend time base
——		
Trigger hold off		To adjust inhibition time.

2.3.4:Operating instructions

1. First of all, according to normal signal synchronous way, select the trigger edge of "TRIG MENU", trigger source, the slope of edge, and adjust the trigger level, make waveform stable display.

2. Press the "**HORI MENU**" button to display horizontal menus.

3. Adjust the multi-purpose knob of upper panel,then the trigger release time will change until the waveform display stability.

2.3.5:Nouns explanation

1. Trigger source: To gain trigger from many kinds of information sources, namely, input channel (CH1 & CH2), external trigger (EXT) and municipal power.

■ **input channel:** The most commonly used input source is the trigger input (choose one). Selected as a trigger source channel, regardless of whether the input is shown it can work normally.

■**external trigger:** the trigger source can be used to collect data on the two channels and trigger   on a third channel at the same time. For example, can use external clock or signals from the circuit under test as a trigger source. EXT trigger source is used to connect to external trigger signal of EXT TRIG joint . EXT can use signals directly, you can use EXT in the signal trigger level range is -3 v to + 3 v.

■**Municipal power:** Such trigger mode can be used to observe signal with regard to municipal power. For instance, it can provide relationship between lighting equipment and power supply equipment so as to gain stable synchronization.

■**Trigger mode:** It is to determine behavior mode of digital storage oscillograph without trigger event.This digital storage oscillograph can also provide 3 triggers : namely, automatic, normal and single trigger modes.

■**Automatic trigger:** The system will acquire waveform data automatically so as to display scanning base line on the screen without trigger signal input. It will convert to trigger scanning automatically for signal synchronization when producing trigger signal.

Note: Without trigger signal is allowed under "automatic" mode when setting scanning waveform to 5-ms/div or less time base.

■Normal trigger: Digital storage oscillograph can not acquire waveform until meeting trigger conditions under ordinary trigger mode. Trigger scanning can be produced when producing trigger signal.

■Single trigger: User can press "operation" button once under single trigger mode for entry and trigger waiting for digital storage oscillograph. It will sample and display all acquired waveform then stop after digital storage oscillograph detects once trigger.

3.Trigger coupling: Trigger coupling can determine category of signal component conveyed to trigger circuit. Coupling types include DC, AC, low-frequency inhibition and high-frequency inhibition.

■Pass through all components of signals under DC mode.

■Obstruct DC components with signal attenuation to be less than 400Hz under AC mode.

■Obstruct DC components with attenuation of low-frequency component of less than 80kHz under "low-frequency inhibition" mode.

■Attenuate high-frequency components of more than 80kHz under "high-frequency inhibition" mode.

4. Pre-trigger/delay trigger: To trigger data acquired in ahead/after event. Trigger position is often set in the horizontal center on the screen. You can observe pre-trigger and delay information of 5div . You can also rotate horizontal position to regulate horizontal displacement of waveform and review more pre-trigger details. You can observe waveform in ahead of trigger by observing pre-trigger data. For instance, burring reason can be shown by

observation and analysis on pre-trigger data after capturing burring during circuit startup.

2.4. Setup of sampling system

As the chart shows, the ACQUIRE in the control area are system function keys for sampling system.
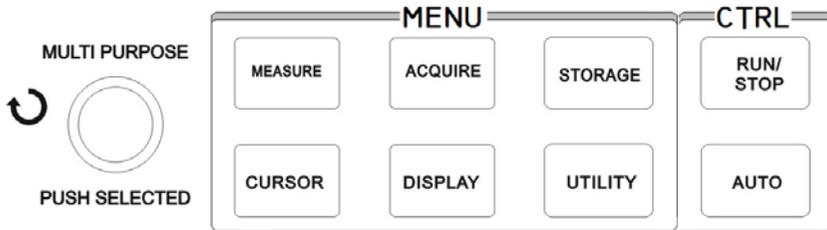
Figure 2-2function keys for sampling system.

Use ACQUIRE button, popping sampling settled menu through the menu button to adjust sampling control.

Form 2-13Sampling menu

Functional menu	Setup	Description
Obtainment mode	Sampling Peak-value detection Average	Activate ordinary sampling mode. Activate peak-value detection mode. Set average sampling mode and display average times.
Average times	2~256	Set average times for step by multiples of 2, namely, 2, 4, 8, 16, 32, 64, 128 and 256. As shown in Figure 2-18, average times can alter by pressing left multi-purpose knob.
Sampling mode	Real-time Equivalent	Set sampling mode to real-time sampling mode. Set sampling mode to equivalent sampling mode.

Fast acquisition	ON	Acquire by higher screen refreshing rate to reflect dynamic effect of waveform excellently. Close fast acquisition.

Note:

Please choose to observe a single signal in real-time sampling way.

Please choose to observe high-frequency cycle in sampling periodic signals.

To observe signal's envelope, please choose to peak detection.

Expect that reduce the random noise of signal, please choose average sampling, and the average number can multiple 2 as step, from 2 to 256 sets average number.

Noun explanation

Real-time sampling: real-time sampling is a way which collects full memory space in every sample. Real-time sampling's highest rate is 1GS/s. In 50ns or faster Settings, oscilloscope automatic put the interpolation algorithm between sampling points.

Equivalent sampling: It refers to repeated sampling mode. It can facilitate careful observation of repeated periodic signals. It can be adopted to gain horizontal resolution which is higher than real-time sampling resolution greatly.

The equivalent sampling: namely repeated sampling way. The equivalent sampling way is a good way to observe periodic signals carefully; use equivalent sampling methods can get much higher horizontal resolution than the real-time sampled which is 40ps resolution, namely the equivalent 50GS/s.

Sampling way: According to equal time intervals do the sampling to make oscilloscope rebuild waveform.

Peak detection ：In this way，oscilloscope found maximum and minimum in each

input signal sampling interval and use these values shows waveform. So, oscilloscope can display narrow pulses, otherwise the narrow pulses in the "sampling" mode might have been overlooked. In this way, the noise seems much more.

Average way: In this way, oscilloscope gets several waveforms and gets the average value, and then finally displays waveform. You can use this way to reduce random noise.

2.5:Set the display system

As the chart shows, the DISPLAY in the control system is for the function keys.
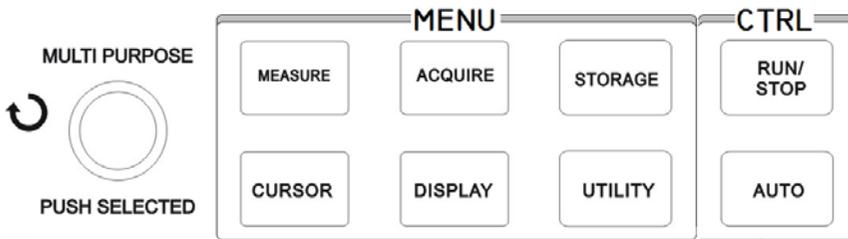
Figure 2-3functional keys in the sampling system（display）

Use DISPLAY button popup menu shown as below. Use the menu button to adjust the display way.

Table 2-14 display menu

Functional	setup	Description

menu		
Display type	Vector point	display sampling points by wire
		Directly display sampling points
format	YT	Oscilloscope work mode
	XY	X-Y display mode，CH1 is X input，CH2 is Y input。
continuous	closed	Real-time updating of screen waveform
	1s	To update after keeping waveform data shown in the
	2s	screen for 1s;
	5s	To update after keeping waveform data shown in the
	Infinite	screen for 2s;
		To update after keeping waveform data shown in the
		screen for 5s;
		To always keep display of original waveform data
		shown in the screen
		until this function is inactivated if new data is added
		into display continuously;
Waveform brightness	1% - 100%	To set waveform brightness

Key points:

Display type: To fill in blank between adjacent sampling points during vector display.
Only sampling points will be displayed for point display.

Storage and callout

As shown in following figure, STORAGE in MENU control area is function key of
storage system.
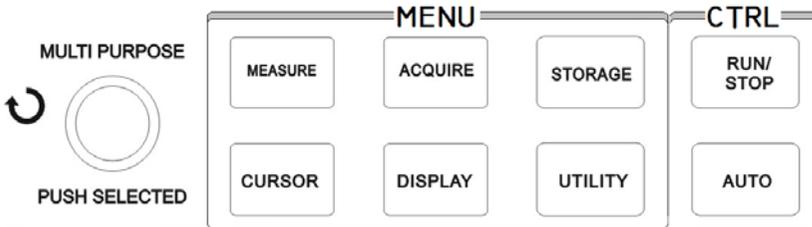
Figure 2-4 functional keys in the sampling system （storage）

STORAGE key can be used to display storage setup menu. You can save

oscillograph waveform or setup status to internal storage area or U disk to call out saved waveform by RefA (or RefB) or call out setup status by STORAGE key. Waveform display area of oscillograph can be saved to DSO contents in U disk in a form of bitmap. Saved bitmap can be read by PC computer.

Operation steps

Please press STORAGE Enter into type menus. There are 3 types, namely, waveform, setup and bitmap.

1.Select menu Settings enter into waveform storage, see table 2-16.

2.Select Settings enter into the store menu, shown in table 2- 18.

3.Select   bitmap enter into a bitmap stored menu, shown in table 2-19.

Form 2-16

Functional menu	Setup	Description
Type	Waveform	Choose waveform storage and call out menu
Source	CH1 CH2	Choose waveform from CH1 channel Choose waveform from CH2 channel
Storage position	1 ∼ 20	1 20 refer to positions to store 20 groups of waveform. There are 200 groups of waveform positions for storage to USB. (Storage position and quantity vary with machine model.)
Save	——	Storage waveform
Next page 1/2	——	Enter into Next page

Form 2-17 Storage menu (the second page)

Functional menu	Setup	Description
Disk	DSO USB	Choose oscilloscope internal memory device Choose external U disk(This function can not be used until plugging in U disk.)
Storage depth	normal long storage	Set storage depth as normal To set storage depth to long storage. (Note: This function can not be activated until plugging in

		U disk. Callout can not be done until using loading function of computer communication software or waveform analysis load when saving data to U disk.)
Previous page 2/2	——	Return to previous page.

Form 2-18 Setup of storage menu

Functional menu	Setup	Description
Setting		Choose panel setting menu
Setting/storage menu	1 ~ 20	Operation setup to save 20 groups of panels: To select by multi-purpose knob in upper part of front panel. (This function can not be used until plugging in U disk)
Storage		Storage setting
Call back		Call back setting
——		

Form 2-19 Bitmap storage menu

Functional menu	Setup	Description
Bitmap		Select bitmap menu
——		
Storage position	1~200	2 0 0bitmap data can be saved by selecting multi-purpose knob in upper part of front panel. (only can be saved in USB disk)
Save		Save bitmap data
——		

2.6:auxiliary functional setting

As the chart shows, the UTILITY in the MENU is auxiliary function.
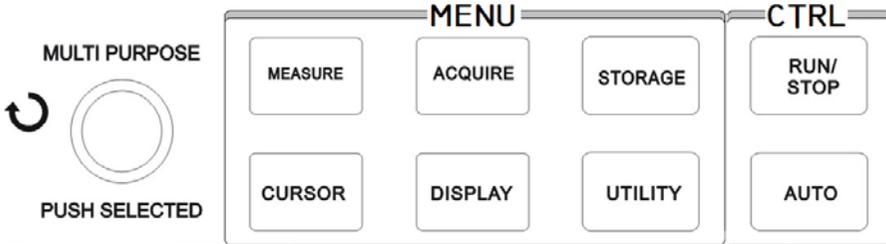
Figure 2-5 functional keys in the sampling system（function）

Use UTILITY key to pop auxiliary system functional setting menu

Table 2-20（page 1）

Function menu	Setup	Description
Self-correction	execution cancel	To carry out self-correction. To cancel self-correction and return to previous page.
――		
Waveform recording	Show in table 2-23	Set waveform recording operation
language		choose interface language
Nextpage1/3		Enter into next page

Tabel 2-21（page 2）

Function menu	Setup	Description
Factory Settings		Set factory Settings
――		
Interface style	style1 style2 style3 style4	Set 4 interface styles for digital storage oscillograph.
――		
Next page2/3	――	Enter into next page

Auxiliary function menu（page 3）

Function menu	Setup	Description
System information	——	Display information of current oscilloscope system.
——	——	
——	——	
Frequency meter	Open close	Open trigger frequency meter Close trigger frequency meter
previous page3/3	——	Return to the first page.

Table 2－22Waveform recording menu（1）

Function menu	Setup	Description
Information source	CH1 CH2 CH1+ CH2	Select CH1 as recording signal source. Select CH2 as recording signal source. Select ct CH1+CH2 as recording signal source.
Operation		Enter into next page: record operation menu (As shown in the table below)
save	1~30	Save newly recorded waveform for U disk plug-in. Storage position can be selected by multi-purpose knob.
Recall	1~30	Call out recorded waveform from U disk then select recording position by multi-purpose knob.
Return	——	Return to previous level of menu.

Table 2－22Waveform recording menu（2）

Function menu	Setup	**Description**
●（F1）	——	Record by pressing recording key for synchronous display of recorded quantity in lower part of the screen.
▶（F2）	——	Enter into next page: record operation menu
■（F3）	——	1.Playback key. 2. Press the key for playback and display of current

		playback screen No. in lower right corner of screen. Playback can be stopped by rotating multi-purpose knob controller in upper part of panel. However, waveform of a certain screen can be selected for repeated playback by continuing to rotate it. 3. If need to continue full playback, press F3 to stop first then press F2 4 max record data: 1000 screen
(F4)		Return to previous level of menu.
	——	

Points:

Self calibration: Self-correction: Self-correction procedure is to correct measurement error caused by digital storage oscillograph due to ambient variation. For more accurate calibration, please open power, then wait for instrument oscilloscope preheated for 20 minutes, then press UTILITY (auxiliary function keys), and follow the tip of screen operation.

Language option: LW2000L series oscilloscope has multiple languages.

Wanted to choose to display languages, please press the menu button and choose proper language.

2.7:Automatic measurement

As the chart shows, MEASURE is automatic measurement function keys. The following description will make you became familiar with great powerful automatic measurement function of LW2000L digital oscilloscope.
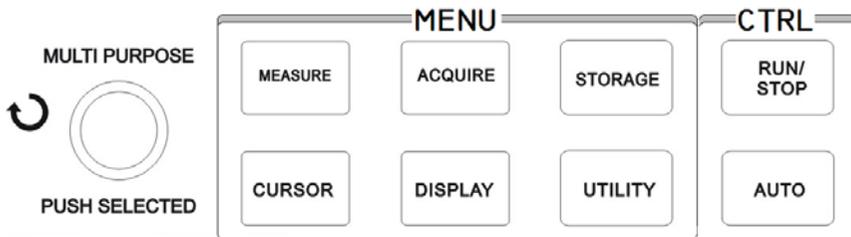
Figure 2-6functional keys in the sampling system（auto measure）

2.7.1Automatic measurement of voltage parameters

Voltage parameters which can be measured by LW2000Lseries oscillograph automatically are as follows:

Peak value (Vpp): voltage value from high to low of waveform.

The maximum value (Vmax): Voltage from the highest waveform point to GND (ground);

The minimum (Vmin): the voltage of waveform's lowest point to the GND

Amplitude (Vamp): waveform voltage value from top to bottom

Vtop value (Vtop): the voltage of waveform flat-roofed to GND

Bottom value (Vbase): the voltage of waveform pan to GND

Overshoot (Overshoot): the ratio of between amplitude and waveform's difference of Vmax and Vtop

Punching (Preshoot): the ratio of between amplitude and waveform's difference of Vmin and Vbase

r.m.s values (Vrms): Namely RMS. According to the energy of ac signal generated in 1 cycle, which corresponds to produce equivalent energy, namely r.m.s values

2.7.2:The automatic measuring of time parameters

LW2000L can automatically measure   signal parameters is as following：

Rise time: the time of wave amplitude from 10% rising to 90%

Down time: the time of wave amplitude from 90% rising to 10%

Positive pulse Width (+ Width): Positive pulse in 50% amplitude of the pulse Width.

Negative pulse Width (-Width), negative pulse in 50% amplitude of the pulse Width.

Delay 1-2 (rise CH1, 2): the rise edge of the time delay.

Delay 1-2 (drop CH1, 2): the falling edge of the time delay.

+duty: the ratio between Positive pulse width and the cycle.

-duty: the ratio between negative pulse width and the cycle.

2.7.3:Measuring menu

Instructions: firstly, press the MEASURE keys to show the display area of 5 measurements value, user can press the F1 ~ F5 keys and screen enter measurement selected menu shown in table 2-23:

Table 2-23

Function	setup	Description

LW

menu		
Return		Return to parameter measurement display menu.
Informat ion source	CH1 CH2	Select channel of measurement parameters. Select channel of measurement parameters.
Voltage kind		Enter into voltage parameter menu.
Time kind		Enter into time parameter menu.
All paramete rs		Display/close all measurement parameters.

Of which: Menu included by "voltage kind" is shown in Form 2-24 to 2-27

Function/m easurement item	Description
Return	Return to menu shown in Form 2-23.
Preshoot	Return to parameter measurement display menu and substitute original position parameter after selection.
Amplitude	the same as above
Overshoot	the same as above
Next page (1/4)	Page turning

Table 2－25

Function/meas urement item	Description
Previous page	Return to previous page.
Average value	Return to parameter measurement display menu and substitute original position parameter after selection.
Peak value	the same as above
Root-mean-squ are	the same as above
Next page(2/4)	Page turning

Table 2-26

Function/measurement item	Description
Previous page	Return to previous page.
Top value	Return to parameter measurement display menu and substitute original position parameter after selection.
Bottom value	the same as above
Middle value	the same as above
Next page3/4)	Page turning

Table 2-27

Function/measurement item	Description
Previous page	Return to previous page.
The maximum value	Return to parameter measurement display menu and substitute original position parameter after selection.
The minimum value	the same as above
——	
First page(4/4)	Return to first page(as shown as table 2-23)

Menu included by "time category" is shown in Form 2-28 to Form 2-30.

Table 2-28

Function/measurement item	Description
Return	Return to menu shown in Form 2-23.
Frequency	Return to parameter measurement display menu and substitute original position parameter after selection.
Cycle	the same as above
Rise Time	the same as above
Next page (1/3)	Page turning

Table 2-29

Function/measurement item	Description
Previous page	Return to previous page.
fall time	Return to parameter measurement display menu and substitute original position parameter after selection.
+width	the same as above
-width	the same as above
Next page(2/3)	Page turning

Table 2-30

Function/measurement item	Description
Previous page	Return to previous page.
Delay	Enter into delay option menu (shown in Form 2-31) after selection.
+duty	Return to parameter measurement display menu and substitute original position parameter after selection.
-duty	the same as above
First page(3/3)	Return to the first page (as shown as table 2-28)

Table 2-31

Function/measurement item	Description	
Channel	CH1/CH2/MATH	Select measured channel.
Channel	CH1/CH2/MATH	Select the reference channel
Enter		Return to parameter measurement display menu and substitute original position parameter after selection.

2.7.4. Cursor measurement

press CURSOR button to display measurement cursor and cursor menu then use multi-purpose knob controller to alter cursor position. As shown in following figure, CURSOR in MENU
control area is cursor measurement function key.
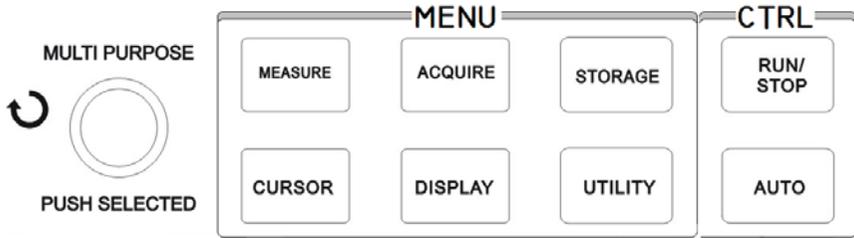
Figure 2-7functional keys in the sampling system（cursor）

move cursor for measurement under **CURSOR** mode. There are 3 modes, namely, voltage, time and tracing. △V can be measured by pressing **PUSH SELECT** and **F2** keys on the panel and multi-purpose knob controller to adjust positions of 2cursors respectively during voltage measurement.Similarly, it can be measured if selecting time. Cursor of digital storage oscillograph can also trace signal variation automatically under tracing mode with waveform display.

Remark：
1. Function of **" PUSH SELECT"**: select   two cursors on screen.
Function of coarse and fine tuning: Adjust the speed of moving the cursor
1. Voltage/time measurement mode: The first or second cursor will appear at the same time. Cursor
position on the screen can be adjusted by multi-purpose knob controller. User can press **PUSH SELECT** key
(or multi-function knob key) to select cursor to adjust.Displayed reading is also time or voltage between 2
cursors.
2. Tracing mode: Horizontal and vertical cursors can intersect to become a crossing cursor. Crossing cursor
can position on the waveform automatically to adjust horizontal position of crossing cursor on the
waveform by rotating multi-purpose knob controller. Digital storage oscillograph can also display
coordinate of cursor point at the same time.
3. Measurement value will be displayed in upper right corner of the screen automatically when
opening cursor function.

2.7.5 Use run button

RUN/STOP key is in upper right corner of front panel of digital storage oscilloscope. Press the key so that green lamp is on to show operation status. Red lamp can be on after pressing the key to show stop status.
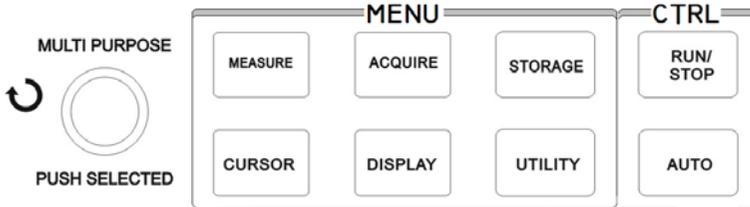
Figure 2-8run/stop key

2.7.6Automatic setup

As shown in above figure, automatic setup is to simplify operation. Digital storage oscillograph can adjust vertical deflection coefficient and horizontal time base gear automatically for stable waveform display on the screen according to waveform amplitude and frequency when user presses AUTO key. System setup is shown in following form during automatic setup:

Table 2-32

Function/measurement item	Description
Obtainment mode	Sampling
Display format	Set to YT
Horizontal position	Automatic adjustment
Second/grid	Adjustment according to signal frequency
Trigger coupling	AC
Trigger hold off	The minimum value
Trigger level	Set to 50%
Trigger mode	Automatic
Trigger	Set to CH1; Set to CH2 when exerting on signal for it if there

source	is no signal for CH1;
Trigger gradient	rise
Trigger type	Edge
Vertical band width	all
Volt/grid	Adjustment according to signal amplitude

RUN/STOP: To acquire waveform or stop acquisition continuously.

The key can be pressed for switchover of waveform sampling between operation and stop. User can press the key under operation status so that green lamp is on. "Auto" can be displayed in upper part of the screen. Old digital storage oscilloscope can acquire waveform continuously while red lamp is on by pressing the key under stop status. Digital storage oscilloscope can stop acquisition when displaying "Stop" in upper part of the screen.

Chapter 3: Appendix
Appendix A: Technical Indicators
Unless there are other explanations, all the technical specifications are applicable for 10X attenuation switch settled of detector and LW2000L series digital oscilloscope. At first Oscilloscope must meet the following two conditions then it can achieve these specifications

■Instruments must be running under the operating temperatures for over 30 minutes continuously.

■If operating temperature's variation ranges achieve or exceed 5 degrees Celsius, you must open the system function menu and execute "correction" program. Unless marked "typical" specifications, all the specifications are guaranteed

Specifications

LW

Sampling		
Sampling type	Real time sampling	equivalent sampling
Sampling rate	1GS/s	50GS/s
TEST METHOD：	Real-time	Equivalent
AVERAGE VALUE	after all the channels have carry out N times sampling，the number can be selected between 2:4:8:16:32:64:128 and 256.	

input	
Input coupling	（DC:AC:GND）
Input impedance	1±2％MΩ 24±3pF in parallel
Probe attenuation ratio setting	1×，10×，100×，1000×
Maximum input voltage	400V（DC+AC Vpp:1MΩ Input impedance）
Time delay between channels（typical）	150ps

level	
Waveform interpolation	Sin(x)/x
Record length	2×600k sampling point
Storage depth	Signal channel is 25k, dual channel is 12.5K
Scanning range（s/div）	2ns/div-50s/div Follow 1-2-5 step
Sample rate and delay time precision	±50ppm（any ≥1ms 的 Time interval）
Time interval (△T)measure precision (full bandwidth)	sole：±（1 sampling interval time +100ppm×reading+0.6ns） ＞16 average value：±（1 sampling interval time +100ppm×reading+0.4ns）

Vertical

LW

LW2000L user manual

Analog digital converter (A/D)	8-bit resolution with synchronous sampling for 2 channels
Scope of deflection coefficient (V/div)	1mV/div ~20V/div（in input BNC)
Displacement range	≥±10 div
More meaning	100 MHz,80MHz,60 MHz,40 MHz
A single bandwidth	100 MHz,80MHz,60 MHz,40 MHz
(Typical) optional band width limitation	20 MHz
Low-frequency response (AC coupling, -3dB)	≤10Hz(in BNC)
Rise time （typical in BNC）	3.5 ns respectively in bandwidth or less (100 MHz, 80 MHz, 60 MHz, 40 MHz)
DC gain precision (by adopting sampling or sampling mode of average value)	±5% if the vertical sensitivity is 1mV/div or 2mV/div; ±4% if the vertical sensitivity is 5mV/div; ±3% if the vertical sensitivity is 10mV/div to 20V/div;
DC measurement precision (by adopting average sampling mode)	If vertical displacement is 0 and N≥16: ±(5%×reading+0.1 grid+1mV) by selecting 1mV/div or 2mV/div; ±(4%×reading+0.1 grid+1mV) by selecting 5mV/div; ±(3%×reading+0.1 grid+1mV) by selecting 10mV/div to 20V/div; If vertical displacement is not 0 and N≥16: ±\u12304X(3%×(reading+vertical displacement reading)+(1%×vertical displacement reading)】+0.2div; To add 2mV when setting from 5mV/div to 200mV/div: To add set value by 50mV when setting from 200mV/div to 20V/div;
Measurement precision of voltage difference (△V) (by adopting sampling mode of average value	Voltage difference between any 2 points on the waveform after calculating average value for at least 16 captured waveform under the same setup and environment conditions: ±(3%×reading+0.05div

Trigger	
Trigger sensitivity	Internal Trigger：≤1div EXT trigger：≤0.2V
Trigger level scope	Away screen center±8div
(Typical) precsion of trigger level for signal of which RiseTime or DescendTime is not less than 20ns	±（0.3div×V/div）(within scope of ±4div from screen center)
Pre-trigger ability	Normal mode/scanning mode, pre-trigger/delay trigger with adjustable pre-trigger depth
Inhibition scope	100ns – 1.5s
(Typical) level set to 50%	Operation if frequency of input signal is not less than 50Hz
Edge trigger	
Edge type	Ascend, descend, ascend & descend
Pulse width trigger	
Trigger mode	To be more than, less than or equivalent to positive/negative pulse width;
Pulse width scope	20ns-10s
Alternate trigger	
CH1 trigger	Edge, pulse width
CH2trigger	Edge, pulse width

Measurement		
Cursor	Manual mode	Voltage difference (△V) between

		cursors; Time difference (△T) between cursors; Reciprocal of △T (1/△T)
	Tracing mode	Voltage and time of waveform point
	Automatic measurement mode	It is allowed to display cursor during automatic measurement.
Automatic measurement	Peak value, amplitude, the maximum value, the minimum value, top value, bottom value,middle value, average value, root-mean-square, overshoot, preshoot, frequency, cycle,Rise Time, Descend Time, positive pulse width, negative pulse width, positive duty cycle, negative duty cycle and delay	
Specify parameter measurement	Three kinds	
Mathematical operation	+, -,×, ÷	
Stored waveform	Internal:20 groups of waveform and 20 kinds of setup USB：200 pairs of waveform storage storage, 200 groups of interface	
FFT	Window	Hanning,Hamming,Blackman-Harris,Rectangle
	Sampling point	1024 points
Lissajous's figure	phase difference	±3degrees

Trigger frequency meter	
Reading resolution	6 位
Trigger sensitivity	≤30Vrms
(Typical) precision	±51ppm (+1 word)

Display

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LW

Display type	Diagonal with diagonal of 178mm (7 inches)
Display resolution	800 (horizontal) ×RGB×480 (vertical pixels)
Display color	color
Waveform display area	Level 12, 25 dot/div; 8 vertical, 25 dot/div
Contrast (typical)	adjustment
(Typical) backlight strength	300nit
Category of display language	Simplified Chinese, traditional Chinese, English, Spanish, Portuguese, French

Interface functions	
Standard configuration	1USB OTG

Power	
Power voltage	100-240VACRMS，45-440Hz，CAT II
Power consumption	To be less than 30VA
Fuse	F1.6AL 250V on power board in the machine.

environment	
Temperature range	operation：0°C～+40°C Non-operation：-20°C～+60°C
Cooling method	Fan force to cool
Humidity range	<+35°C：≤90%RH +35°C～+40°C：≤60%RH)
altitude	Operation: less than 3,000m Non-operation: less than15,000

Mechanical specifications			
Dimension	Width	320mm	

	Height	150mm	
	Depth	130mm	
weight	Not include package	About 2.5kg	
	Include package	About4.0 Kg	

IP protection	ip2 X

Adjustment interval	Suggested calibration period is 1 year.

Appendix B: attachment of LW2000L oscilloscope

Standard fittings:

● two 1.2 meters, 1:1（10:1）passive probe.
    When the switch in 1 x, it means 150V CAT grade.
    When the switch in 10 xs, it means 300V CAT grade

● a power line

● a "use manual.

The contents of this manual are subject to change without prior notice