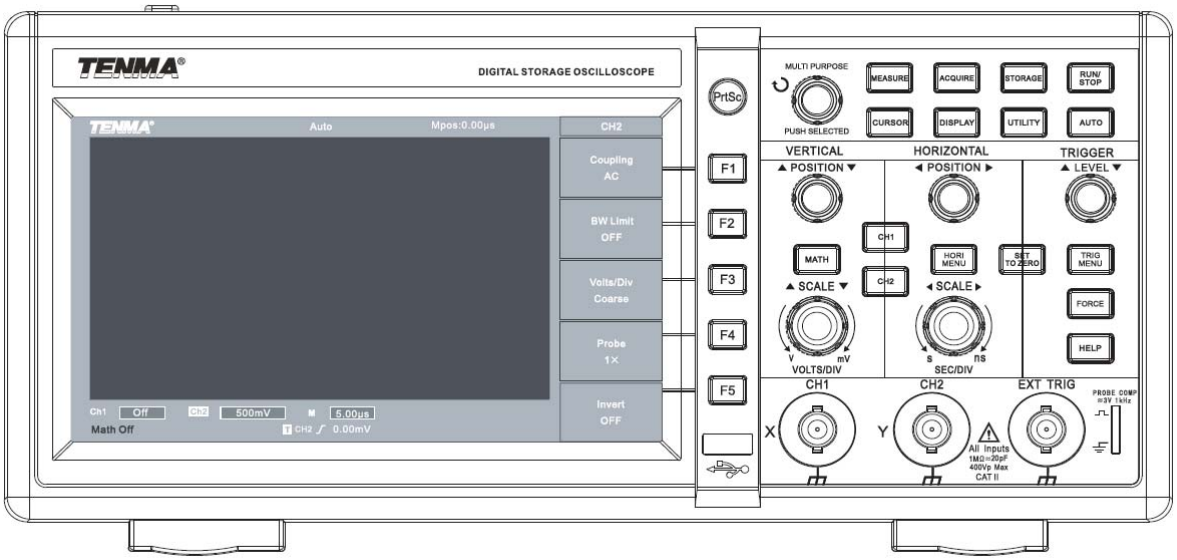
TENMA®



Digital Storage Oscilloscope

Model: 72-7610/72-10510

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Ⅰ. Safety Information

72-7610/72-10510 oscilloscopes are designed and manufactured under the safety requirements of IEC61010-1 safety standards, and conforms to insulation and overvoltage standards, CATII (150V or 300V depending on probe setting) and pollution degree II safety standards. Please follow precautions below in order to avoid personal injuries, product damages, or damages to any products connected with the instrument.

To avoid possible danger, please operate according to directions below.

- Only professionals can execute the maintenance procedure.
- Prevent fire and personal injuries.
- Use the dedicated power lines recognized by your country.
- Do not plug or unplug when the probe or test lead has been connected to voltage source.
- Ground product reliably to avoid electrical shock. The products are grounded via power earth cord. Prior to connecting the input or output terminals of the products, make sure the products are grounded correctly.
- Correctly connect the oscilloscope probes. The probe earth cord and the ground are of the same potential. Please do not connect the cord with high voltage source.
- Check the rated values of all terminals. To avoid fire and electrical shock, please check all rated values and remarks on products; before connecting the products, check rated values in the manual.
- Do not open the front panel or back case during operation.
- Use proper fuses. Only use the specified fuses of the same specifications.
- Avoid circuit exposure. Please do not contact with exposed plugs or elements after powering on.
- Stop operating when any product is suspected to be out of order and can ask the qualified technician to inspect.
- Keep proper ventilation.
- Please do not operate in the humid environment.
- Please do not operate in inflammable and explosive environments.
- Please keep product surface clean and dry.

Symbols on products: such symbols may appear on products.

	High voltage
	Please check the manual
	Protective ground terminal

	Case ground terminal
	Measuring ground terminal

Safety terms and symbols

The terms below may be in the manual,

Warning: warning statements refer to conditions and actions that may endanger life.

Attention: attention statements refer to conditions and actions that may cause damages to the product or other properties.

The terms below may appear on products,

Danger: indicating there is direct danger close to the marking.

Warning: indicating there is potential danger close to the marking.

Attention: indicating there is potential damage to the product and other properties.

Ⅱ. Accessories

Standard accessories:

- Two probes (selectable for 1:1 and 10:1). They conform to EN61010-031 standards.
  - When the switch is in 1× position, it belongs to 150V CAT II.
  - When the switch is in 10× position, it belongs to 300V CAT II.
- One power cord
- One user manual
- One oscilloscope communication control software CD
- One USB Cable

Optional accessories:

LAN port module

Please order all the accessories (standard and optional accessories) from the local distributors.

Ⅲ. Product Overview

These digital storage oscilloscope provides the users with simple front panel to operate various functions. Scale and position knobs of each channel provide visual operations that are in line with users' habits. Users may be able to master it without spending plenty of time

learning and understanding. In order to accelerate adjustment and facilitate measurement, users can directly press AUTO key and the oscilloscope will then display applicable waveform and range settings.

Apart from the easy operation, the oscilloscope also has high performance index and powerful functions required for faster measurements. Faster signals can be observed with the oscilloscope via 500MS/s (or 1GS/s) real-time sampling and 25GS/s (or 50GS/s) equivalent sampling. Powerful trigger and analysis ability make it easier to capture and analyze waveforms. Clear LCD and mathematical operating functions make it easier for users to observe and analyze signal problems in a faster and clearer way.

From the following parameter features, you can understand how the oscilloscope can satisfy your measurement requirements.

- Two analog channels
- High resolution LCD display, 320×240 (or 400×240) resolution
- Supports plug-and-play USB storage equipment for computer communication
- Automatic waveform and state settings
- Waveform saving and replay feature
- Delicate window extension function and precise analysis on waveform details and overview
- Automatic measurement of 28 waveform parameters
- Automatic cursor tracking measurement function
- Unique functions of waveform recording and play-back
- Built-in FFT software function
- Multi-waveform mathematical operation function (including: addition, subtraction, multiplication and division)
- Edge, video, pulse width, alternating trigger and other functions
- Multi-language menu selection
- Simplified Chinese and English help information display

IV. Functions

The oscilloscope is disk type. It is designed with the conventional user interface for any basic digital storage oscilloscope in the test and measurement industry.

This section will cover the following as the beginning guide of the oscilloscope:

1. Get to Know the User Interface
2. General Inspections
3. Functional Inspections
4. Probe Compensation
5. Automatic Settings of Waveform Display

6. Introduction to the Vertical System
7. Introduction to the Horizontal System
8. Introduction to the Trigger System

1. Get to Know the User Interface

Getting to understand different parts of the user interface is one of the most important tasks to know the operations. The oscilloscope user interface consists of:

- Vertical control
- Horizontal control
- Trigger control
- LCD display area
- Function buttons (F1, F2, F3, F4, F5)
- User menu area
- Input terminal (CH1, CH2, EXT TRIG)
- Multi-purpose knob
- USB interface

Please get familiar with the user interfaces shown in Figure 1-1 and Figure 1-2.

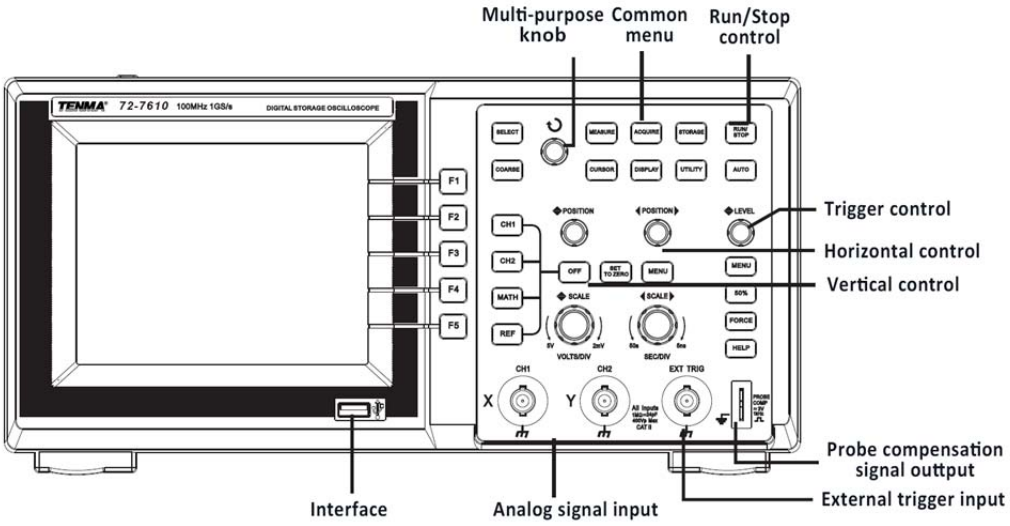


Figure 1-1: 72-7610 Panel Diagram - 5.7-inch TFT color LCD display

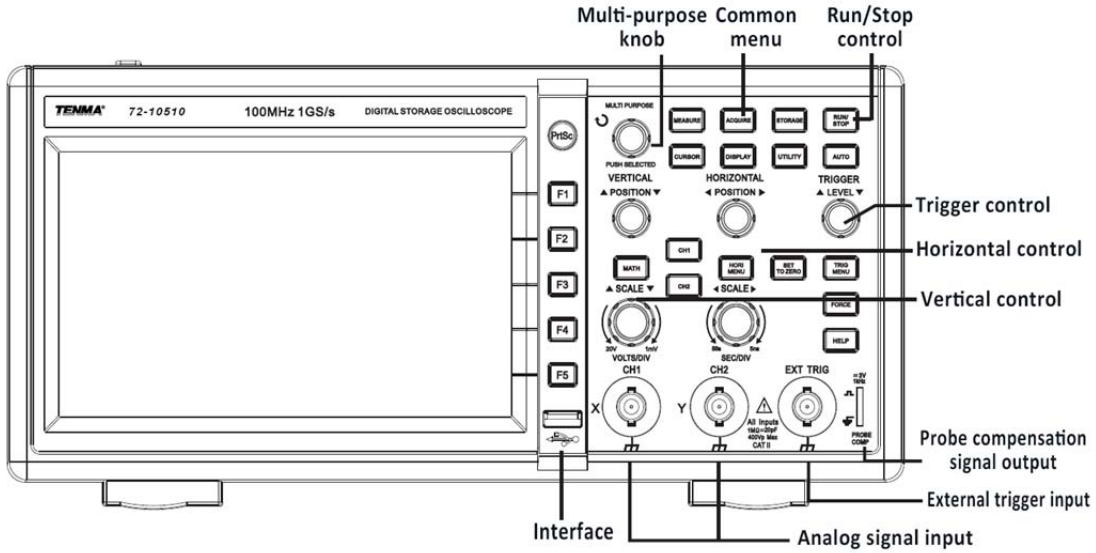


Figure 1-2: 72-10510 Panel Diagram -7-inch TFT color LCD display

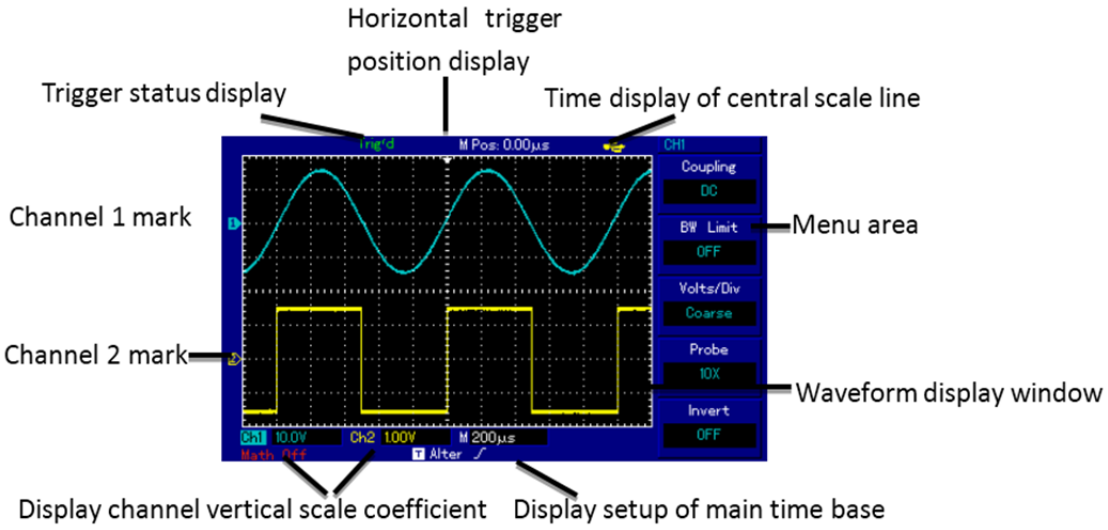


Figure 1-3: User Interface Menu Display (taking 72-10510 as an example)

2. General Inspections

It is recommended to inspect the oscilloscope according to the following steps.

1. Inspect whether there are damages caused by transportation

In case of badly damages to packing box or foamed plastic mat, you should replace immediately.

2. Accessories inspection

For provided accessories details, description has been made in “Accessories” section of this user manual. If you find any accessory is missing or damaged, please contact Tenma distributors or the local offices.

3. Check the main instrument

In case of damages to the appearance of instrument, abnormal operation or failure to pass the performance tests, please contact Tenma distributors or the local offices.

If the instrument is damaged due to transportation, please pay attention to keeping the package, notify the transportation department and Tenma. They will make arrangement for repair or replacement.

3. Function Inspections

Conduct a fast functional inspection to verify whether the oscilloscope runs normally. Please take the following steps:

Power on the oscilloscope

Users can power on the oscilloscope with voltage supply of AC 100V – AC 240V and frequency of 45Hz – 440Hz. After powering on, in order to activate the best working status, press UTILITY menu after waiting 30 minutes, then press F1 for self-calibration. On the next menu interface, press F1 button again for “factory settings” as shown in Figure 1-4.

Figure 1-4

Warning: please confirm that the oscilloscope has been safely grounded to avoid hazard.

Oscilloscope accessing to signal

1) The oscilloscope has two input channels with an additional external trigger input channel. Please check the signal according to the following steps. Connect a probe to CH1 input terminal and set the attenuation rate switch on the probe as 10× (Figure 1-5)

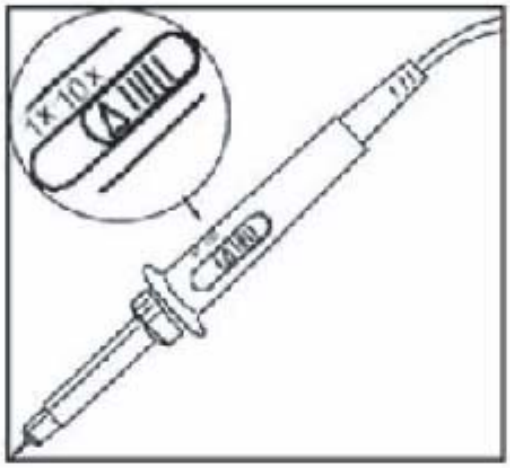


Figure 1-5 Setting of Probe Attenuation Rate Switch

2) It is required to set probe attenuation coefficient on the oscilloscope.
Attenuation coefficient changes the vertical range rate of instrument, thus making the measurement result correctly reflect the amplitude of measured signals. Probe attenuation coefficients are set in the following ways: press F4 to make the menu display 10×.

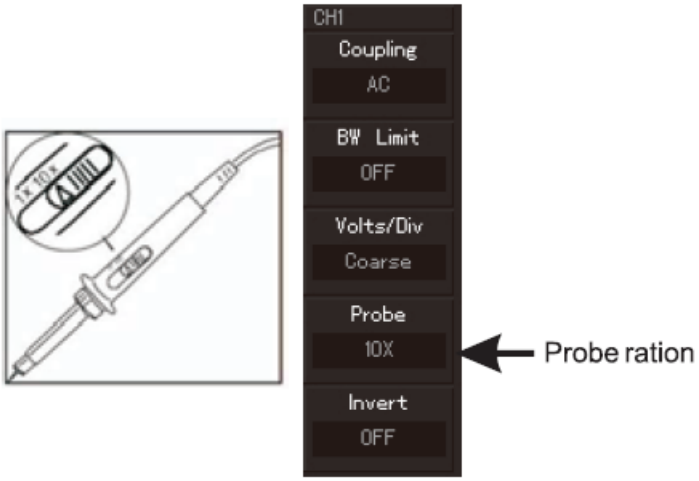


Figure 1-6 Setting of Attenuation Coefficient on the oscilloscope

3) Connect the probe pin and ground clamp to the corresponding terminal of the probe compensation signal. Press AUTO key. Within several seconds, square wave display (1kHz, about 3V, peak-to-peak value) is as shown in Figure 1-7. Check CH2 in the same way; press OFF function key to close CH1; press CH2 function key to turn on CH2; repeat step 2 and 3.

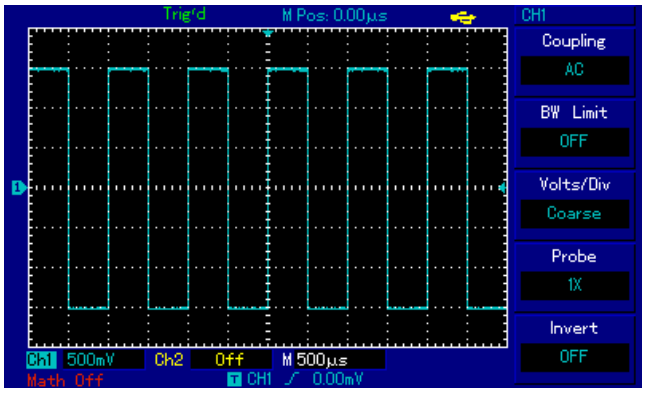


Figure 1-7 Probe Compensation Signal

4. Probe Compensation

When connecting the probe with any input channel for the first time, it is required to make the adjustment, matching the probe with the input channel. Probe without being compensated and calibrated will cause measurement error or mistake. To adjust probe compensation, follow the steps below:

1. Set the probe menu attenuation coefficient as 10×, place the switch on the probe at 10× and connect the oscilloscope probe with CH1. Connect the probe end to the signal output connector of the probe compensator, and connect the ground clamp to the ground lead connector of probe compensator. Turn on CH1 and press AUTO.

2. Observe displayed waveform

Over-compensation Correct compensation Under-compensation

Figure 1-8a Probe Compensation and Correction

If the screen displays “under-compensation” or “over-compensation” for waveform as shown in above figures, use screwdriver with nonmetal handle to adjust the variable capacitance on the probe until screen displays “correct compensation” for waveform as shown in the below figure.

Figure 1-8b: Correct compensation

Warning: To avoid electrical shock when measuring high voltage with probe, please ensure that the insulation lead of the probe is in good condition and do not contact the metal part of the probe when connecting to power supply.

5. Automatic Setting of Waveform Display

The oscilloscope has automatic setting function. According to input signals, automatically adjust the vertical deflection factor, scanning time base and trigger mode until the most appropriate waveform is displayed. In automatic setting, the frequency of the measured signal is required to be ≥ 50Hz and the duty ratio is > 1%.

Apply automatic setting

1. Connect measured signal to signal input channel.
2. Press AUTO key. The oscilloscope will automatically set its vertical deflection factor, scanning time base and trigger mode. If further careful observation is required, adjustment can be conducted again after automatic setting until the waveform display reaches required optimum effect.

6. Introduction to the Vertical System

As shown in the figure on next page, there are a series of keys and knobs in the vertical control area. Practices below will gradually guide you to get familiar with the controlling of the vertical system.

Figure 1-9 Vertical Control Area on the Panel
Model 72-7610 (Left) Model 72-10510 (Right)

1. Use the vertical position knob to move the vertical position of the waveform display on the LCD screen. By default, waveforms should be displayed at the center of the screen.

2. Users should see the waveform will move vertically upward and downward when the knob is rotated.

3. Users can also change the waveform scale by rotating the scale knob on the vertical system. Please notice that the “V/div” will be changed to indicate the corresponding vertical scale level.

4. Users can enable/disable the input channel by pressing the [CH1] and [CH2] button on the vertical system. (For 72-10510)

Attention:
To disable the input channel for 72-7610, please press [OFF] button on the vertical system.

More vertical system setting will be explained in “Operations” section of this user manual.

7. Introduction to the Horizontal System

As shown in the figure on next page, there is one key and two knobs within the horizontal control area. Practices below will gradually guide you to get familiar with the horizontal time base setting.

Figure 1-10 Horizontal Control Area on the Panel
72-7610 (Left) 72-10510 (Right)

1. Use horizontal SCALE knob to change horizontal time base scale settings and observe the state information changes. Turn horizontal SCALE knob to change “s/div” time base scale, and you can find corresponding changes in the time base scale display of corresponding channel in the status bar.
Horizontal scanning rate steps up in the multiples of 1, 2 and 5
e.g. 1 ms /div->2 ms/div->5 ms/div->10ms /div…. etc.

Note: the horizontal time base range of 72-7610/72-10510 varies between 2ns/div and 50s/div. Details are listed in technical specifications.

2. Use horizontal POSITION knob to adjust the signal horizontal position in the waveform window. Horizontal POSITION knob controls the signal trigger shift. When applied to trigger shift, the waveform horizontal movement can be observed along with POSITION knob turning.

More horizontal system setting will be explained in “Operations” section of this user manual.

8. Introduction to the Trigger System

As shown in Figure 1-11, one knob and three (or two) keys are in the trigger menu control area. Practices below will gradually guide you to be familiar with the trigger system setting.

Figure 1-11 Trigger Menu on the Panel

72-7610 (Left) 72-10510 (Middle) Trigger Menu Display (Right)

More trigger system settings will be explained in “Operations” section of this user manual.

Ⅴ. Specifications

Unless otherwise specified, all technical specifications are applicable to the probes with attenuation switch set as 10× and to the oscilloscope. The oscilloscope must first meet the following two conditions to satisfy those specification standards:

The oscilloscope must continuously run for over half an hour in the operating temperature environment.

A. Technical Specifications

Sampling System Specifications			
Sampling rate		Real-time	Equivalent
Sampling rate	72-7610	1GS/s	50GS/s
	72-10510	25MS/s	_____
Average	N can be chosen among 2, 4, 8, 16, 32, 64, 128 and 256; N is the number of average samples.		

Note: The real time sampling rate of 72-7610 is 250MS/s, without equivalent sampling.

Input Channel Specifications		
Input coupling	DC, AC and GND	
Input impedance	72-7610	1±2%MΩ with 21±3pF
	72-10510	1±2%MΩ with 24±3pF
Probe attenuation coefficient	1×, 10×, 100×, 1000×	

Maximum input voltage	400V (DC+AC peak value, 1MΩ input impedance)	
Time delay between Channels (Typical)	150ps	
Horizontal System Specifications		
Waveform interpolation	Sin (x) /x	
Horizontal resolution	25pixels/div	
Record length	2×512k sampling point	
Storage depth	25k	
Scanning scope	72-7610	2ns/div-50s/div
	72-10510	2ns/div-50s/div
Sampling rate and delay time accuracy	±50ppm (any interval≥1m)	
Measurement accuracy of time interval (△T) (full bandwidth)	Single time: ± (1 sampling interval+50ppm×reading+0.6ns)	
	>16 average values: ± (sampling interval+50ppm×reading+0.4ns)	

Vertical System Specifications		
Analog-to-digital converter (A/D)	8-bit resolution, sampling at two channels at the same time	
Deflection coefficient (V/div) range (at input BNC)	72-7610	2mV/div-5V/div
	72-10510	1mV/div-20V/div
Vertical range	±10div (72-7610 is ±5div)	
Selectable bandwidth limitation (Typical)	20MHz	
Low frequency response (AC coupling, -3dB)	≤10Hz (at BNC)	
DC gain accuracy (sampling or average sampling mode)	**72-7610：** ±4% (When vertical sensitivity is 2mV/div or 5mV/div) ±3% (When vertical sensitivity is 10mV/div- 5V/div)	

	72-10510： ±5% (When vertical sensitivity is 1mV/div or 2mV/div) ±4% (When vertical sensitivity is 5mV/div) ±3% (When vertical sensitivity is 10mV/div -20mV/div)
DC measurement accuracy (average sampling mode)	**72-7610：** When vertical position is 0 and N≥16: ± (4%×reading + 0.1div + 1mV) at 2mV/div and 5mV/div; ± (3%×reading + 0.1div + 1mV) from 10mV/div to 5V/div; When vertical position is not at 0 and N≥16: ±[3%×(reading + vertical position reading) + (1%×vertical position reading)]+0.2div) from 2mV/div to 200mV/div + 2mV The setting value from 200mV/div to 5V/div plus 50mV
	72-10510： When vertical position is 0 and N≥16: ± (5%×reading+0.1div+1mV) and selects 1mV/div or 2mV/div; ± (4%×reading+0.1div+1mV) and selects 5mV/div; ± (3%×reading+0.1div+1mV) and selects 10mV/div or 20mV/div; When vertical position is 0 and N≥16: ±(3%×(reading + vertical position reading) + (1%×vertical position reading)]+0.2div) The setting from 5mV/div to 200mV/div plus 2mV; the setting value from 200mV/div to 20V/div plus 50mV
Measurement accuracy of voltage difference (△V) (average sampling mode)	Under the same setting and environment conditions and after averaging the captured waveforms with a quantity of ≥16, the voltage difference (ΔV) between any two points on the waveform: ± (3%×reading+0.05div)

Note: The range of deflection factor for 72-10510 is 2mV/div-10V/div (in the place of input BNC).

Bandwidth for Each Model			
Model	**Analog Bandwidth**	**Real-Time Bandwidth**	**Rise Time**
72-7610	150MHz	100MHz	2.3ns
72-10510	25MHz	25MHz	14ns

Trigger System Specifications		
Trigger sensitivity	≤1div	
Range of trigger level	Interior	From the screen center ±5div
	EXT	±3V
	EXT/5*	±15V
Trigger level accuracy (Typical) applicable for the signal with rising and falling time ≥20ns	Interior	±(0.3div×V/div) (within±4div from the screen center)
	EXT)	±(6% setting value+40mV)
	EXT/5*	±(6% setting value +200mV)
Pre-trigger capacity	Normal mode/scan mode, pre-trigger/delay trigger, the pre-trigger depth adjustable	
Hold-off range	72-7610	100ns - 1.5s
	72-10510	80ns - 1.5s
Set the level to 50% (Typical).	Operate under the condition of input signal frequency of ≥50Hz	
Edge Trigger		
Edge type	Rise, fall, rise and fall	
Pulse Width Trigger		
Trigger mode	(>, <, and =) positive pulse width and (>, <, and =) negative pulse width range	
Pulse width range	20ns - 10s	
Video Trigger*		
Trigger sensitivity (video trigger, Typical)	Interior	2div Vpp
	EXT)	400mV
	EXT/5*	2V
Signal model and line/field frequency (video trigger type)	Support standard NTSC and PAL, and the line ranges are respectively 1-525 (NTSC) and 1-625 (PAL).	

Alternating Trigger	
CH1 trigger	Edge, pulse width, and video
CH2 trigger	Edge, pulse width, and video

Note: No EXT/5 function for 72-10510.

Measurements		
Cursor	Cursor Parameters	Voltage difference between cursors (△V), Time difference between cursors (△T), Reciprocal of △T (Hz) (1/△T)
	Track	Voltage value and time value of point of waveform
Automatic measurement	Vpp, Vamp, Vmax, Vmin, Vtop, Vbase, Vmid, Average, Vrms, Overshoot, Preshoot, Frequency, Period, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Delay	
Math operation	+, -, ×, ÷	
Store (waveform and setting)	20 groups of waveforms, and 20 kinds of settings	
FFT	Window	Hanning, Hamming, Blackman, Rectangle
	Sampling size	1024 points
Lissajous figure	Phase difference	±3 degrees
Trigger frequency meter	(72-10510 only)	
Reading resolution	6 bits	
Trigger sensitivity	≤30Vrms	
Accuracy (typical)	±51ppm (+1 character)	

B. General Technical Specifications

Display		
	72-7610	72-10510
Display types	5.7-inch LCD	7-inch LCD
Display resolution	320 horizontal×240 vertical pixels (RGB)	400 horizontaB×240 vertical pixels (RGB)
Display color	Color	
Waveform luminance	Adjustable (color) (72-10510 only)	
Backlight intensity (typical)	300nit	

Probe Compensator Output	
Output voltage (Typical)	About 3Vpp, when the load≥1MΩ
Frequency (Typical)	1kHz

Interface Function		
Standard configuration	72-7610	1 USB device; 1 USB Host
	72-10510	1 USB OTG
Optional component	LAN communication port for 72-7610	

Power Source	
Power voltage	100-240VAC RMS, 45-440Hz CAT II
Power consumption	Less than 30 VA
Fuse	F1.6AL 250V (Fuse is inside the instrument housing)

Environment Specifications	
Temperature Range	Operating Temperature Range: 0℃～+40℃
	Storage Temperature Range: -20℃-+60□
Cooling	Build-in cooling fan
Operating Humidity Range	<35℃: ≤90%RH 35℃-40℃: ≤60%RH
Operating Altitude	Below 3,000m

Mechanical Specifications			
		72-7610	72-10510
Size	W	320mm	306mm
	H	150mm	147mm
	D	130mm	122mm
Weight	Excluding package	2.5kg	2.2kg
	Including package	4.0kg	3.3kg

IP Protection
IP 2x

Calibration Interval
The recommended calibration interval is one year.

Ⅵ. Operations

Until now, you have had basic understanding about the vertical, horizontal, and trigger system controls of the oscilloscope. We recommend you to re-read the “Functions” section if you are still not familiar with the basic operation controls.

In this section, you will learn different settings related to the oscilloscope:

1. Set the Vertical System
   (CH1, CH2, MATH, REF, OFF)

2. Set the Horizontal System
   (MENU or HORI MENU)

3. Set the Trigger System
   (MENU, TRIG MENU, 50% and FORCE)

4. Set the Acquire System (ACQUIRE)

5. Set the Display System (DISPLAY)

6. Set the Storage and Load System (STORAGE)

7. Set the Utility System (UTILITY)

8. Set the Measurement Parameters (MEASURE)

9. Set the Cursor Measurement (CURSOR)

10. System Message Examples and Troubleshooting

It is suggested to read this section carefully to understand multiple measuring functions and system operation methods of the oscilloscope.

1. Set the Vertical System

Each channel for the oscilloscope can be set independently on the vertical system menu. After pressing CH1 or CH2 function key, the system shall display function menu of CH1 or CH2 channel. See Table 2-1 below for description.

Table 2-1

Function Menu	Setting	Description
Coupling	AC	Block the DC component of input signal.
	DC	Pass through DC and AC components of input signal
	Grounding	Disconnect input signal.
Bandwidth Limit	On	Limit bandwidth to 20MHz to reduce display noise.
	Off	Full bandwidth
V/div	Rough adjustment	Set vertical deflection factor by coarse adjustment based on 1-2-5 scale. Rough adjustment setting range is further subdivided for fine adjustments to improve vertical resolution.
	Fine adjustment	
Probe	1× 10× 100× 1000×	Please set the probe compensation system ratio to match the attenuation coefficient of the probe to be used.
Invert	On	Activate waveform invert function. A waveform will be displayed reversely.
	Off	A waveform is displayed normally.

Setting coupling channel

You will learn from the below example to change input channel coupling.

Suppose the signal being measured in CH1 is a sinusoidal signal containing DC component. Press F1 to select AC coupling. Then the DC component is blocked and the waveform display is shown in the figure below.

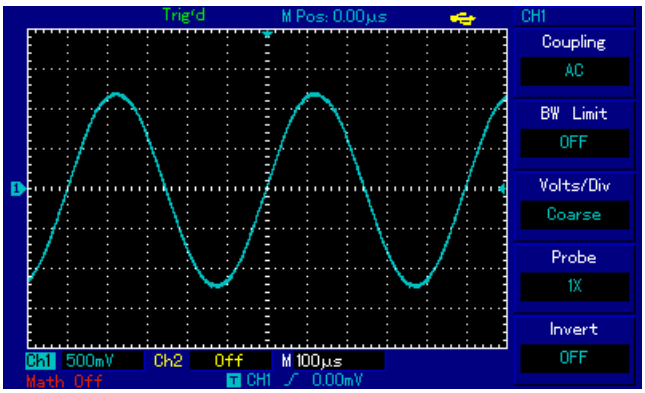


Figure 2-1 Blocked Signal DC Component

If you press F1 to select DC coupling, both the DC and AC components of the signal being measured in CH1 can pass. The waveform display is shown in the figure below.

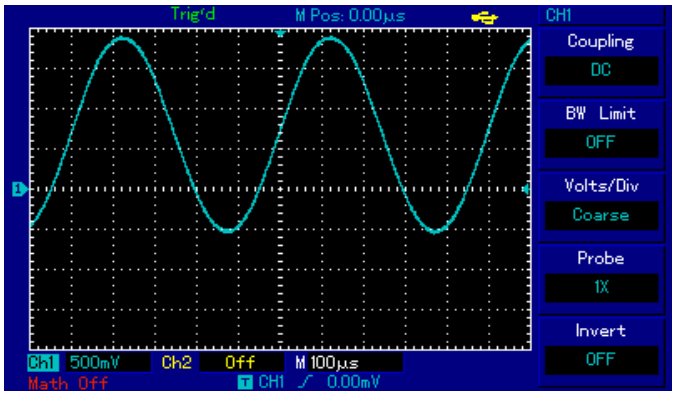


Figure 2-2 Simultaneous Display of Signal DC and AC Components

If you Press F1 to select grounding, to set CH1 to connect to the internal ground of the instrument, both DC and AC components of the input signal are blocked. The waveform display is shown in the figure below.

Note: although no waveform is displayed on the screen in this mode, input signal is still connected with channel circuit.

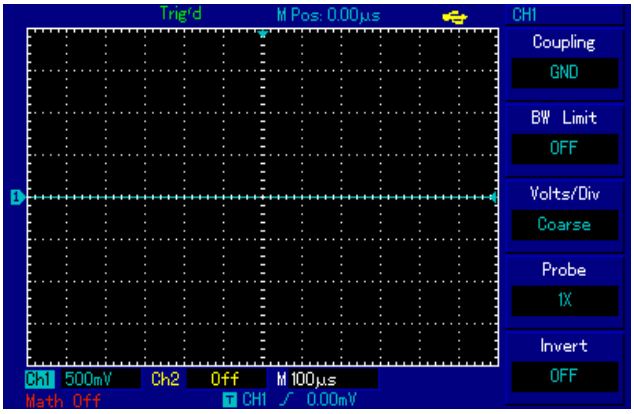


Figure 2-3 Simultaneous Blocking of Signal DC and AC Components

Setting channel bandwidth Limit

You will learn through the following example to change the bandwidth limit of the input channel. Assuming that the input signal to CH1 is a 40MHz sinusoidal signal. If you press F2

to set bandwidth limit as OFF, CH1 is with full bandwidth. All AC and DC high-frequency components in the measured signal can pass through. The waveform is displayed as below.

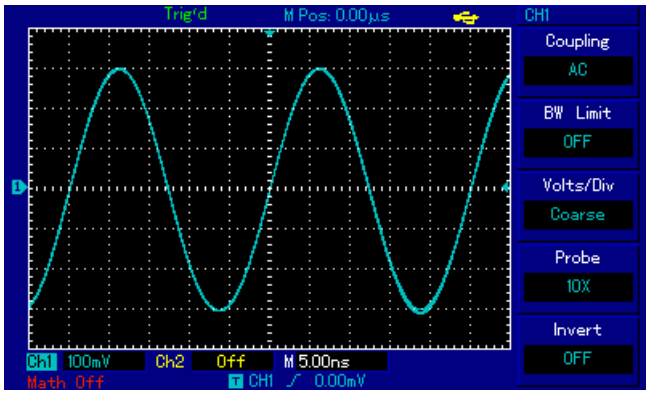


Figure 2-4 Waveform Display When Bandwidth Limit is OFF

If you press F2 again to set the bandwidth limit as ON, the noises or high-frequency component over 20MHz in measured signal shall be attenuated. The waveform is displayed as below.

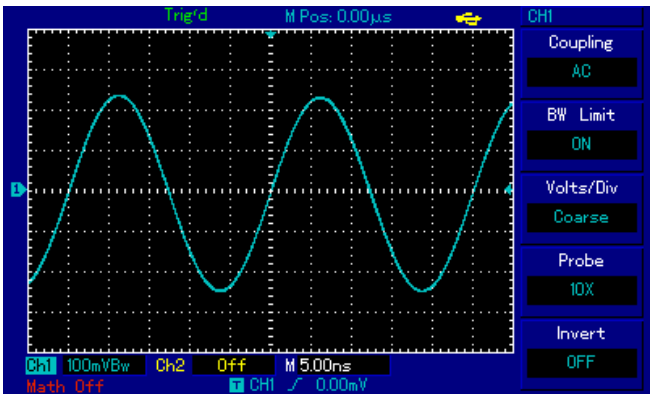


Figure 2-5 Waveform Display When Bandwidth Limit is ON

Setting probe rate

In order to cooperate with probe attenuation coefficient setting, it is required to set the probe attenuation coefficient on channel function menu. If the probe attenuation coefficient is 10:1, the probe coefficient on channel function menu shall be set as 10× and vice-versa.

You can press F4 function key to select different probe coefficients for the input channel as showed in the figure below.

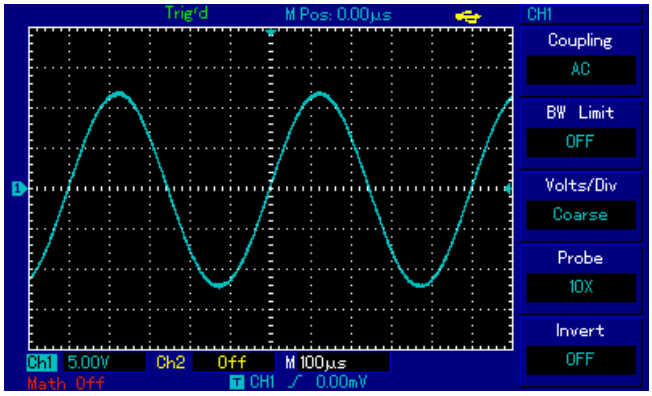


Figure 2-6 Probe Attenuation Coefficient Setting in Channel Menu

Vertical V/div adjustment setting

Vertical deflection factor V/div scale adjustments consist of coarse adjustment and fine adjustment by pressing F3 function key.

Coarse adjustment, V/div can be adjusted by multiplying 1, 2 and 5,

e. g. 10mV/div->20mV/div ->50mV/div…. etc.

Fine adjustments refer to changing deflection factor with smaller stepping within the current vertical scale.

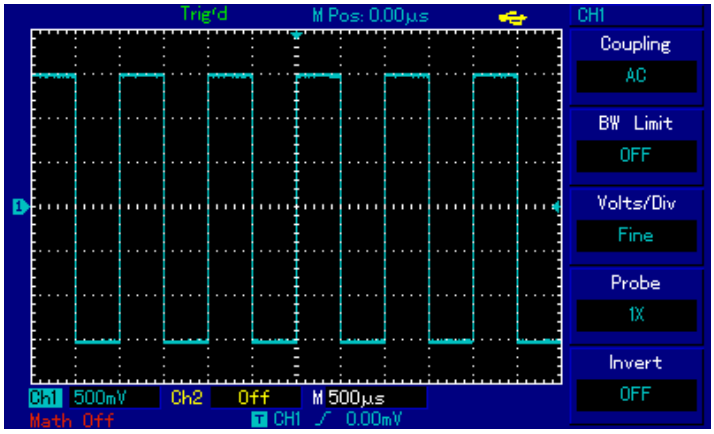


Figure 2-7 Coarse and Fine Adjustments of Vertical Deflection Factors

Settings of waveform inverting

Waveform inverting can be set by pressing F5 function button. The measured input signal will be displayed with 180-degree difference (Vertically invert) if the waveform inverting is ON. Please see Figure 2-8 for a non-inverted waveform and Figure 2-9 for an inverted waveform.

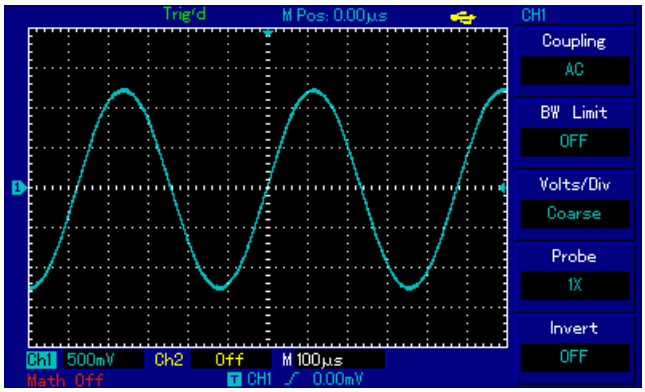


Figure 2-8 Vertical Channel Inverted Setting (Invert: OFF)

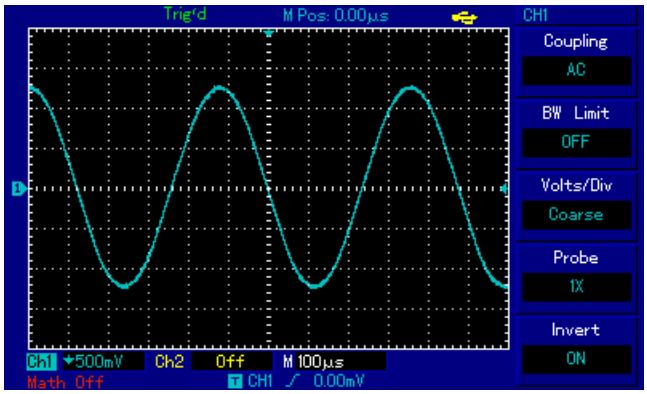


Figure 2-9 Vertical Channel Inverted Setting (Invert: ON)

Mathematical operation function

The oscilloscope supports mathematical operation function for the input signals.

The figure below shows the match result for CH1 + CH2 as an example.

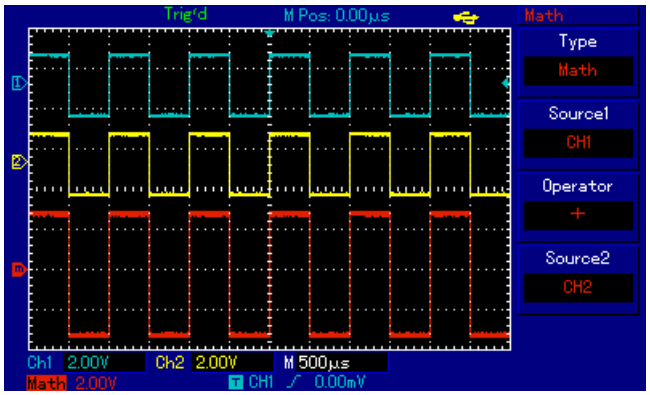


Figure 2-10 Mathematical Operations

After pressing the MATH button at the menu area to active mathematic operations.

By pressing F1 at math menu, you can select mathematic operations or FFT operations.

Table 2-2: Math Menu

Function Menu	Settings	Description
Type	Math	Mathematic operations
Signal source 1(F2)	CH 1 CH 2	You can select signal source 1 as CH 1 or CH2
Operator (F3)	+ – × ÷	Signal source 1 + signal source 2 Signal source 1 - signal source 2 Signal source 1 × signal source 2 Signal source 1 ÷ signal source 2
Signal source 2 (F4)	CH1 CH2	You can select signal source 2 as CH1 or CH2

FFT spectral analysis

By pressing F1 button again in mathematical operation mode to enter FFT (Fast Flourier transform) operations, the time domain (YT) signal can be converted into frequency domain signal.

It is convenient to observe the following signals by FFT operations:

- Harmonic content and distortion in measurement system
- Noise characteristics in DC power supply display
- Vibration analysis

Table 2-3: FFT Menu Description

Function Menu	Settings	Description
Type	FFT	FFT mathematical operations
Signal source (F2)	CH1 CH2	Set to select CH1 or CH2 as waveform to be transform
Window (F3)	Hanning Hamming Blackman Rectangle	Set to select Hanning, Hamming, Blackman, or Rectangle window function
Vertical unit (F4)	Vrms dBVrms	Set vertical units as Vrms or dBVrms

FFT operation skills

Signal with DC component or deflection will lead to error or deviation of FFT waveform component. AC coupling mode can be selected to reduce DC component. In order to reduce random noise of repeated or single pulse event and aliasing frequency components, the average acquiring mode is set.

Select FFT window

Assuming that YT waveform is continuously repeated, the oscilloscope shall conduct FFT conversion for time record with finite length. In this case, when the cycle is an integer, YT waveforms are of the same amplitude at starting and ending positions, without interrupting. However, if the YT waveform cycle is not an integer, the waveform amplitudes shall be different at starting and ending positions, and high-frequency transient interruption shall occur at the joints. In frequency domain, this effect is called leakage. Therefore, in order to avoid the generation of leakage, by multiplying original waveform by a window function, the value at forced starting and ending positions is 0. See the table below for window function application:

Table 2-4 FFT Window Function

FFT Window	Features	The most suitable measurement content
Rectangle	The best frequency resolution and the worst amplitude resolution. It is basically similar to the condition without window.	Signal levels, before and after transient state and short pulse are basically equal. Constant amplitude sinusoid with very similar frequency possesses bandwidth random noise with slow spectrum change.
Hanning	Compared with rectangular window, it has better frequency resolution and worse amplitude resolution.	Random noise of sine, cycle and narrow-band.
Hamming	The frequency resolution of Hamming window is slightly superior to Hanning window’ s.	Signal levels, before and after transient state or short pulse, are of large difference.

Blackman	The best amplitude resolution and the worst frequency resolution.	Mainly used for single frequency signal seeking for higher sub harmonic.

Load a reference waveform

Any of the pre-saved waveform can be loaded by pressing the REF button on 72-7610. For 72-10510, pressing the STORAGE button starting load the pre-saved waveform. Please see the item, "Set the Storage and Load system" for how to save a waveform.

Explanation of nouns

FFT resolution: defined as the quotient of sampling and operation point. When the number of operation point is fixed, the lower the sampling rate is, the better the FFT resolution will be.

Nyquist frequency: for waveform with f maximum frequency, at least 2f sampling rate is required to reconstruct original waveform. It is also called Nyquist rule, where f refers to Nyquist frequency, while 2f refers to Nyquist sampling rate.

After pressing the REF button, users should be able to select two of the Ref A F1 and Ref B F2 on the function menu to load the pre-saved waveform.

Assume that you select Ref A, you will be able to see the load function menu as below.

Table 2-5 Load Function Menu

Function Menu	Settings	Description
Source (@)	1～20	Destination (Position of the internal memory) where the waveform will be loaded There are 20 sets of internal memory available to storage waveform navigated by the multipurpose knob.
Disk (F2)	DSO	Select to load a pre-saved waveform from the internal memory of the oscilloscope
	USB	Select to load a pre-saved waveform from the external USB device (selection can only be available after inserting USB)
OFF (F3)	——	Turn off reference waveform
Load (F4)	——	Press to load a pre-saved waveform

Assuming that users have already stored a waveform into the internal memory location 3. To load this waveform back to Ref A, users should do the following on the Load function menu.
Select the memory location 3 by using multi-purpose knob
Select DSO on the Disk selection
Press F4, a loading progress bar will be shown on the screen.
If loading is done, a white waveform should be displayed on the screen labelled Ref A.
If no waveform is stored at the selected memory location, you will see a system message show “no data in the position”

Users can turn off the Ref A reference waveform by pressing OFF F3 button on the load function menu.

Attention:
Loading the pre-saved waveform into Ref B follows the same procedure as above.

If waveform is stored to the USB device, 200 available memory locations can be selected. Please see “Set the Storage and Load System” for how to save a waveform to USB device.

2. Set the Horizontal System

The horizontal control knob can be used to change the horizontal scale (time base) and trigger horizontal position (trigger position) in internal storage. The vertical midpoint in screen horizontal direction is the time reference point of waveform. Changing of horizontal scale can lead to expansion or shrink of waveforms relative to screen center. When the horizontal position changes, the position relative to waveform trigger point will be changed.
The horizontal system can be controlled by the following panel buttons/knobs.

Figure 2-11 Horizontal System Interface
72-7610 (Left) 72-10510 (Right)

The horizontal position control knob is used to adjust the horizontal position of channel waveform (including mathematical operations). The resolution of the horizontal position control knob varies at different time bases.

The horizontal scale control knob is used to change the time base shown as s/div of channel waveform. If the extension time base is turned on, the window width will be changed by adjusting the delay scanning time base after turning the horizontal scale knob.

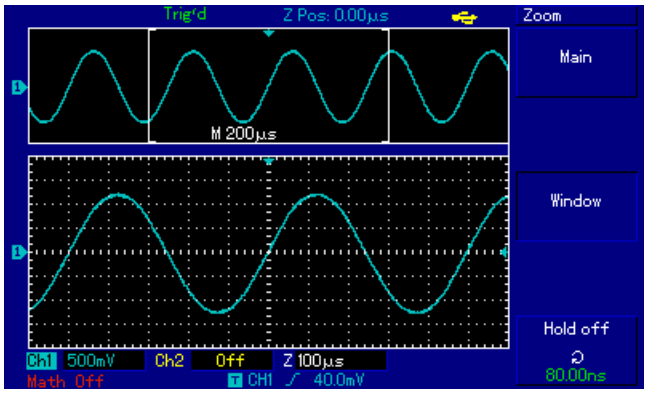
Horizontal menu button: users can press to enter the horizontal menu function. (See table below)

Table 2-6 HORI MENU / MENU

Function Menu	Settings	Description
Main time base (F1)	——	Press to turn on the main time base
——		
Window extension (F3)	——	Press to turn on the extension time base
——		
Trigger hold-off (@)	——	To adjust the trigger hold-off time by multi-purpose knob

Window extension time base function is used to observe the waveform detail for a given window of the waveform. Users can active this function by pressing F3 button at the horizontal function menu.

Waveform horizontal extension



Extension time base

Horizontally extended part of waveform

Figure 2-12 Screen Display under Window Extension

Under window extension time base, there are two display areas, as shown in the figure above. The original waveform is displayed in the upper part; this area can be moved left and right by turning the POSITION knob or can be zoomed and shrunk by turning the SCALE knob.

The waveform generated through horizontal extension time base of the selected original waveform area shall be displayed in the lower part. As the waveform displayed in the whole lower part corresponds to the selected area in the upper part, the extension time base can be enhanced by turning the SCALE knob to reduce the selected area of the waveform.

Trigger hold-off time adjustment

Trigger hold-off time is the interval between two trigger events (100ns by default);
Trigger hold-off time can be adjusted by using the multi-purpose knob at the horizontal function menu.

During trigger hold-off, the oscilloscope will not be triggered for any new event until the hold-off time is over. For example, if a train of pulse shall be triggered from the first pulse upon request, then the hold-off time can be set as the pulse train width. As shown in Figure 2-13.

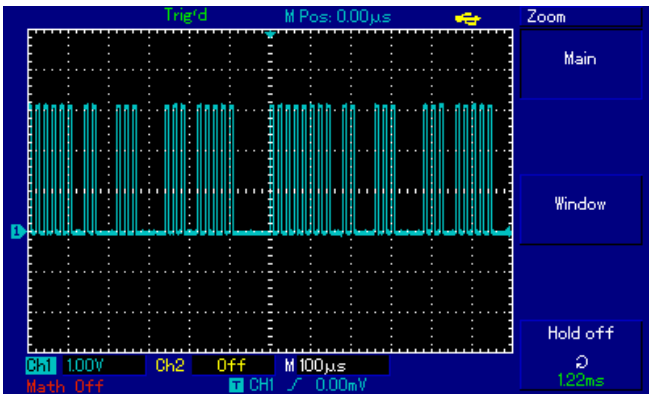


Figure 2-13 Trigger Hold-off for Synchronization of Complex Waveform

The trigger setting decides when the waveform data will start to be collected and display on the screen. Once trigger is correctly set, it can convert unstable display into meaningful waveform display. The starting trigger conditions of data acquisition are satisfied. After a signal trigger is detected, the oscilloscope will continuously collect data and display waveform on the right of the trigger point.

Trigger control area of the operation panel includes: trigger level adjustment knob; trigger menu key: TRIG MENU for 72-10510 and [MENU] for 72-7610.

For 72-7610, the trigger level can be set as 50% of signal vertical midpoint by the 50% button. For 72-10510, it is achieved by pressing SET TO ZERO key.

Forcing trigger shall be achieved by pressing FORCE button. FORCE trigger is: a trigger signal generated by force is mainly applied in trigger mode and “normal” and “single” mode.

3. Set the Trigger System

Trigger level knob: trigger knob is used to adjust the trigger level (To set the voltage level corresponding to trigger point).

Trigger level knob: trigger knob is used to adjust the trigger level (To set the voltage level corresponding to trigger point).

Trigger Type

The oscilloscope supports: edge, pulse width, video trigger and alternating trigger;

Edge Trigger: Edge trigger mode refers to triggering of trigger threshold on the input signal edge.

Pulse Width Trigger: trigger produces when the pulse width of the trigger signal satisfies some set trigger >, < or = condition.

Video Trigger: conduct field or line trigger for standard video signal. Users can activate the video trigger by pressing [F1] button at [TRIG MENU] for 72-10510, by pressing [F1] button at [MENU] for 72-7610;

Alternating Trigger: applicable to trigger signals without frequency correlation.
All kinds of trigger menus shall be respectively described as follows.
Users can activate the alternative trigger by pressing [F2] button at [TRIG MENU] for 72-10510, by pressing [F2] button at [MENU] for 72-7610;

Edge Trigger

Edge trigger mode refers to the triggering of the threshold on the input signal edge. When selecting “edge trigger”, trigger on the rise edge or fall edge of input signal shall be completed.

Table 2-7 (Page 1)

Function Menu	Settings	Description
Type	Edge	
Source (F2)	CH1	Set CH1 as the triggering signal source
	CH2	Set CH2 as the triggering signal source
	EXT	Set external trigger input channel as the triggering signal source
	EXT/5	Set external trigger source (divided by 5) as trigger level range (Only for 72-7610)
	AC Line	Set AC power line as trigger source
	Alter	Set to alternative trigger between CH1 and CH2 as signal source

Table 2-7 (Page 2)

Slope (F3)	Rising	Set trigger on the signal rising edge
	Falling	Set trigger on the signal falling edge
	Rise/fall	Set trigger on the signal both rising and falling edge
Mode (F4)	Automation	Set to automatic trigger. The oscilloscope will continuously perform data acquisition without triggering signal.
	Normal	Set to normal trigger. The oscilloscope will only perform data acquisition when there is triggering signal.
	Single	Set to single trigger. The oscilloscope will only perform 1 cycle of the data acquisition when there is triggering signal.
Trigger coupling (F5)	AC	Block the DC component of triggering signal
	DC	Pass through DC and AC components of triggering signal
	High-frequency rejection	Reject high-frequency component of the triggering signal (over 80kHz signals)

	Low-frequency rejection	Reject low-frequency component of the triggering signal (below 80kHz signals)

Pulse Width Trigger

For pulse width trigger, the trigger time shall be subject to pulse width of the triggering signal. You can capture abnormal pulse by setting pulse width conditions.

Table 2-8 (Page 1)

Function Menu	Settings	Description
Type	Pulse width	
Source (F2)	CH1	Set CH1 as triggering signal source
	CH2	Set CH2 as triggering signal source
	EXT	Set external trigger input channel as triggering signal source
	EXT/5	Set external trigger source (divided by 5) as trigger level range (Only for 72-7610)
	AC Line	Set AC power line as trigger source
	Alter	Set to alternating trigger between CH1 and CH2 as signal source
Pulse width conditions (F3)	>	Trigger when pulse width is greater than the setting values;
	<	Trigger when pulse width is less than the setting values;
	=	Trigger when pulse width is equal to the setting values;
Pulse width setting (@)		Set the pulse width to 20ns~10s by using the multi-purpose knob on the front panel
Next page 1/2	——	Go to next page

Table 2-8 (Page 2)

Function Menu	Settings	Description
Type	Pulse width	Set the positive pulse width as trigger signal; Set the negative pulse width as

		trigger signal.
Trigger polarity (F2)	Positive	Set the positive pulse width as trigger signal
	Negative	Set the negative pulse width as trigger signal
Mode (F3)	Automation	Set to automatic trigger. The oscilloscope will continuously perform data acquisition without triggering signal.
	Normal	Set to normal trigger. The oscilloscope will only perform data acquisition when there is triggering signal.
	Single	Set to single trigger. The oscilloscope will only perform a cycle of data acquisition when there is triggering signal.
Trigger coupling (F4)	AC	Block the DC component of triggering signal
	DC	Pass through DC and AC components of triggering signal
	High-frequency rejection	Reject high-frequency component of the triggering signal (over 80kHz signals)
	Low-frequency rejection	Reject low-frequency component of the triggering signal (below 80kHz signals)
Previous page 2/2	——	Go to previous page

Video Trigger

The oscilloscope supports video trigger compactable to NTSC or PAL standard video signals. Trigger coupling will automatic preset to DC coupling if the video trigger is active. Video trigger menus are shown in the table below:

Table 2-9 Video Trigger Setting

Function Menu	Settings	Description
Type	Video	
Source (F2)	CH1	Set CH1 as triggering signal source

	CH2	Set CH2 as triggering signal source
	EXT	Set external trigger input channel as triggering signal source
	EXT/5	Set external trigger source (divided by 5) as trigger level range (Only for 72-7610)
	AC Line	Set AC power line as trigger source
Standards (F3)	PAL	Select to PAL video standard
	NTSC	Select to NTSC video standard
Synchronization (F4)	All lines	Set trigger synchronization to video line
	Designated line	Set trigger to synchronize in designated video line number. Adjust video line number by using the multipurpose knob in the upper part of front panel.

Figure 2-14 is an example for the display when PAL video trigger model is selected as standard and synchronization mode is all line synchronization.

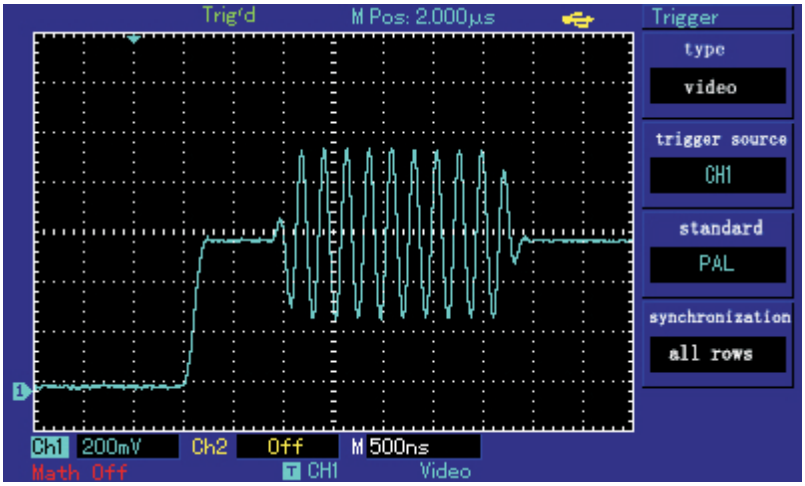


Figure 2-14 Video Trigger: Line Synchronization

Figure 2-15 is an example for the display when PAL video trigger model is selected as standard and synchronization mode is set to field synchronization.

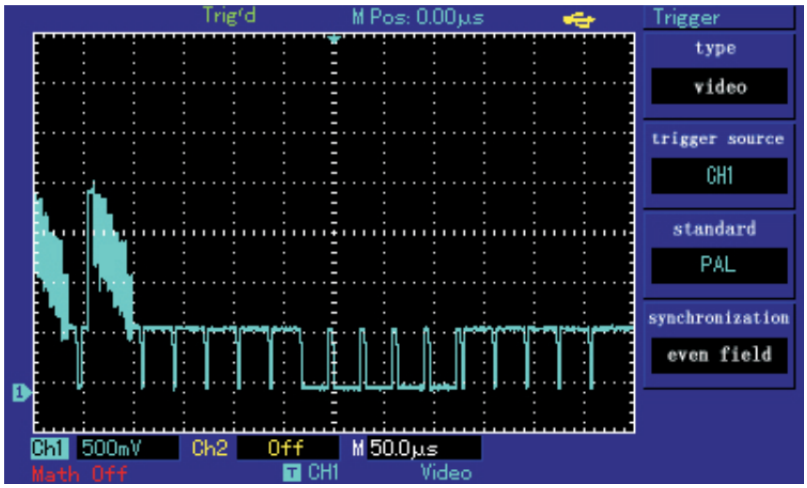


Figure 2-15 Video Trigger: Field Synchronization

Alternating Trigger

During alternating trigger, the trigger signal comes from two input channels, CH1 and CH2 alternately. Alternating trigger is useful for observing two signals with different frequencies.

See the figure below for the display of triggered alternating waveform and Table 2-11 for triggered alternating menu setting:

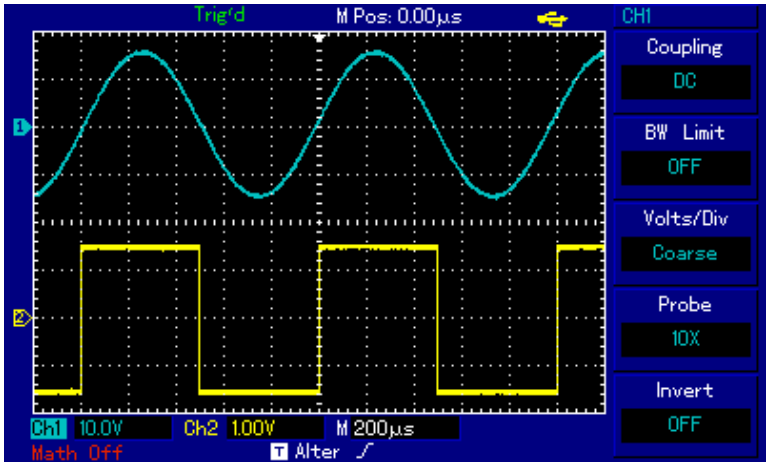


Figure 2-16 Observing Signals with Two Different Frequencies by Alternating Trigger Mode

Table 2-10 Alternating Trigger Mode Setting

Functional menu	Settings	Description
Type	Edge	Edge trigger mode is set.
Trigger source	Alternating	CH1 and CH2 alternating trigger
Slope	Ascending	Rise edge is set for slope trigger.

Trigger mode	Automation	Auto trigger mode is set.
Trigger coupling	AC	AC trigger coupling mode is set.

Force Trigger

Force trigger can be understood as forcing the oscilloscope to refresh the data acquisition process, so users can observe waveform capturing. To enable force trigger, please press FORCE button.

One of the very useful applications for force trigger is in the “normal” and “single” triggering mode. When the triggering signal does not present, the oscilloscope will stop data acquisition. You can press the force trigger to re-enable the data acquisition of the oscilloscope to see the current input signal.

Explanation of nouns

1. Trigger source: Trigger can be achieved from several signal sources: input channels (CH1 and CH2), external triggers (EXT and EXT/5) and AC line.

■ **External trigger (EXT TRIG):** Meaning to set the triggering source according to the given external connection to the “EXT TRIG” input channel. This can be a significant application for the oscilloscope to perform data acquisition using CH1 and CH2 based on an external clock signal connects to the “EXT TRIG” input channel. External trigger signal connects to “EXT TRIG” input terminal is used for EXT and EXT/5 trigger source selection. When selecting EXT as trigger source, external trigger levels voltage range limited to -3V and +3V. Whereas, if EXT/5 is selected as trigger source, external trigger level voltage range can be expanded to -15V-+15V. (EXT/5 is only available for 72-7610.)

■ **AC line trigger:** Use AC line power as trigger source. This can be significant to observe the signals correlated to AC line power for applications in lighting equipment and power supply equipment research and development.

2. Trigger mode: Deciding the oscilloscope behavioral pattern under no trigger event condition. Three trigger modes are available: auto, normal and single.

■ **Auto trigger:** Set to automatic trigger mode. The oscilloscope will continuously perform data acquisition without triggering signal. When there is trigger signal, the oscilloscope will automatically synchronize with the trigger signal.

Attention: when scanning waveform is set on 50ms/div or slower time base, no trigger signal is needed under “auto trigger” mode.

■ **Normal trigger:** Set to normal trigger mode. The oscilloscope will perform data acquisition only when trigger conditions are satisfied.

■ **Single trigger:** Set to single trigger mode. The oscilloscope will perform one-cycle data

acquisition only when trigger conditions are satisfied.

4. Set the Acquire System

Users can change the data acquisition mode by pressing ACQUIRE button as shown in the figure below.

Model 72-7610

Model 72-10510

Figure 2-17 Function Key of Sampling System

While ACQUIRE button is pressed, the data acquisition setting menu for the oscilloscope will display.

Table 2-11 Acquire Menu

Function Menu	Settings	Description
Acquisition Mode (F1)	Sampling	Set to sampling acquisition mode
	Peak value	Set to peak value acquisition mode
	Average	Set to average acquisition mode
Averages (@)	2~256	In average sampling mode, set average number by using the multipurpose knob (Averages can be set as 2, 4, 8, 16, 32, 64, 128, 256)
Sampling (F3)	Real-time	Set to Real-time sampling
	Equivalence	Set to Equivalent sampling
Fast Acq (F4)	ON	Turn on fast acquiring. Waveform capturing rage up to 2k waveform/second.
	OFF	Turn off fast acquiring

By changing the acquisition setting, users can observe the input signal in different ways. The example below is a noise waveform acquired by different acquisition settings of the oscilloscope.

Figure 2-18 shows the original signal in sampling mode, users can see that the waveform displayed includes relative large noise.

Figure 2-19 shows the same signal with in average mode with 64 averages, please observe that the waveform display is becoming much smoother.

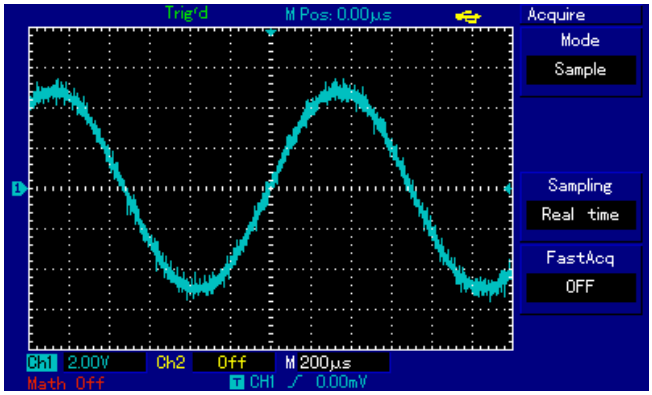


Figure 2-18 Waveform display in sampling mode

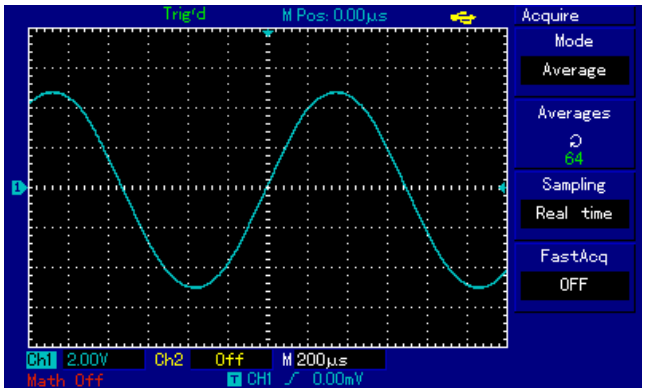


Figure 2-19 Waveform display in average mode with 64 averages

Notes:

1. Please select real-time sampling mode when observing single signal.
2. Please select equivalent sampling mode when observing high frequency periodic signal.
3. Please select peak detection mode when hoping to observe the signal envelope for

modulation signal.

4. Please select average sampling mode when hoping to reduce the random noise in displayed signals.

Explanation of nouns

Real-time sampling mode:

Data sampling with the system real-time rate is used to observe the waveform within the rate.

Equivalent sampling mode:

Data sampling with the rate higher than the maximum. This is used to observe the periodical waveform at beyond the maximum sampling rate.

5. Set the Display System

Users can change the display setting of the oscilloscope by pressing the DISPLAY button. Please refer to the figure below.

Model 72-7610

Model 72-10510

Figure 2-20 Function Keys of Display System

After pressing DISPLAY button, the function menu will change to the display setting for the oscilloscope.

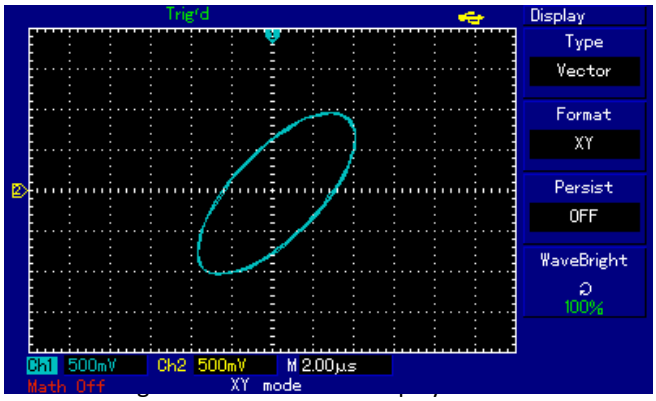
Table 2-12 Display Menus

Function Menu	Settings	Description

Types (F1)	Vector	Display as vector of sampling points
	Dots	Display any of the sampling points
Format (F2)	YT	Display Y-axis as voltage level of input signal and X-axis as time
	X Y	Display Y-axis as CH2 voltage level of input signal and X-axis as CH1 voltage level of input signal
Persist (F3)	Off	Real-time updating (Display) of the acquired signal.
	1s	Display the acquired signal every 1s
	2s	Display the acquired signal every 2s
	5s	Display the acquired signal every 5s
	Infinite	Accumulate to display all the acquired
Waveform Brightness (@)	1 % - 100%	Set waveform brightness by multi-purpose knob from 1% to 100%.

X Y Mode

Users can enter the X-Y mode by pressing Display button and select F2. In this mode, CH1 and CH2 are required to be applied simultaneously. The figure below shows an example for the X-Y mode display.



Attention:

The following functions will be disabled at X Y display mode.

Automatic measurement

Cursor measurement

6. Set the Storage and Load System

Users can enter the storage and load menu by pressing the STORAGE button.

Model 72-7610

Model 72-10510

Function Key of Sampling System (STORAGE)

Below steps will guide you to store a waveform into the internal memory of the oscilloscope:

Press the Storage button and you will see the following menu.

Table 2-13 Waveform Storage Menu

Function Menu	Settings	Description
Type (F1)	Waveform	Select to store an acquired waveform
Source (F 2)	CH 1	Select waveforms from CH1 channel to be saved
	CH 2	Select waveforms from CH2 channel to be saved
Dest (@)	1～20	Destination (Position of the internal memory) where the waveform will be saved. There are 20 sets of internal memory available to store waveform navigated by the multipurpose knob.
Save	——	Store waveform
Next page	——	Get to the next page

1/2		

Press F2 to select the waveform source to be saved.
Use the multi-purpose knob to select the storage memory destination.
Press F4 to store the waveform
Attention:
Any waveform storage will overwrite previous memory space at the same memory location.
To load a waveform from the internal memory, please refer to the item, “Load a Reference Waveform” in this section.

Below steps will guide you to store a waveform to USB device:
Insert a USB disk into the “USB Host” interface. If the USB is connected successfully, you should see the system message “USB device install successfully” shown on the screen.
Press the Storage button and you will see the following menu.

Table 2-14 Waveform Storage Menu (Page 1)

Function Menu	Settings	Description
Type (F1)	Waveform	Select to store an acquired waveform
Source(F2)	CH1	Select waveforms from CH1 channel to be saved
	CH2	Select waveforms from CH2 channel to be saved
Dest (@)	1～20	Destination (Position of the internal memory) where the waveform will be saved. There are 20 sets of internal memory available to store waveform navigated by the multipurpose knob.
Save	——	Store waveform
Next 1/2 [F5]	——	Get to the next page

Press F5 to go to next function menu

Users should see below function menu.

Table 2-14 Waveform Storage Menus (Page 2)

Function	Settings	Description

Menu		
Disk (F1)	DSO	Select to store an acquired waveform into the internal memory of the oscilloscope
	USB	Select to store an acquired waveform into the USB device
Length (F2)	Normal	Select normal data length (Same data number as displayed)
	Long	Select long data length (Same as data number as data buffered in the DSO FIFO)
——	——	——
——	——	——
Previous 2/2 [F5]	——	Go to the previous page

Press F1 to select USB as storage destination.
Press F2 to select Normal storage.
Press F5 to go to the first page of the function menu.
Use the multi-purpose knob to select the storage memory destination (please notice that there will be 200).
Press F4 to store the waveform.
Remove the USB disk.

Attention:
Any waveform storage will overwrite previous memory space in the same memory location.
If "Long" length data is selected, the data cannot be re-loaded back to display and can only be re-load through software application.
To load a waveform from the USB disk, please refer to "Load a Reference Waveform" in this section.

Below steps will guide to store a setting to the internal memory of the oscilloscope:
Press the Storage button and you will see the following menu.

Table 2-15 Waveform Storage Menu (Page 1)

Function Menu	Settings	Description
Type (F1)	Waveform	Select to store an acquired waveform
	Setup	Select to store a setting
Source (F2)	CH1	Select waveforms from CH1 channel to be saved

	CH2	Select waveforms from CH2 channel to be saved
Dest (@)	1～20	Destination (Position of the internal memory) where the waveform will be saved. There are 20 sets of internal memory available to storage waveform navigated by the multipurpose knob.
Save [F4]	——	Store waveform
Next page 1/2	——	Get to the next page

Press F1 to select Setup.
Use the multi-purpose knob to select the storage memory location.
Press F4 to store the setting

Attention:
Any storage of the setting will over-write previous memory space in the same memory location.

Table 2-15 Setting Storage Menu (Page 2)

Function Menu	Settings	Description
Type (F1)	Setup	Select to store a setting
Setup (@)	1～20	Destination (Position of the internal memory) where the Setup will be saved. There are 20 sets of internal memory available to store Setup navigated by the multipurpose knob.
Save [F3]		Press to store setup into selected storage memory destination
Load [F4]		Press to load a Setup from the selected storage memory destination

Below steps will guide you to load a setting from the internal memory of the oscilloscope:
From the setting storage menu (Page 1)
Use the multi-purpose knob to select the storage memory location.
Press F4 to load the pre-stored setting.

If no pre-stored setting is in the memory location, a warning, “no data in the position” will appear.

Below steps will guide you to store a bitmap to USB device:

Insert a USB disk into the “USB Host” interface. If the USB is connected successfully, you should see the “USB device install successfully” notification on the screen.

Press Storage button and you will see the following menu.

Table 2-16 Bit Map File Storage Menu (Page 1)

Function Menu	Settings	Description
Type (F1)	Wave	Select to store an acquired waveform
	Setup	Select to store a setting
	Bit Map	Select to store a bitmap file into the USB disk only
Source (F2)	CH1	Select waveforms from CH1 channel to be saved
	CH2	Select waveforms from CH2 channel to be saved
Dest (@)	1～20	Destination (Position of the internal memory) where the waveform will be saved. There are 20 sets of internal memory available to storage waveform navigated by the multipurpose knob.
Save	——	Store waveform
Next 1/2 [F5]	——	Get to the next page

Press F1 to go to bitmap selection.

Users should see below function menu.

Table 2-16 Bit Map File Storage Menu (Page 2)

Function Menu	Settings	Description
Type (F1)	Bit Map	Select to store a bitmap file into the USB disk only
——	——	——
Dest (@)	1～200	Destination (Position of the USB disk memory) where the bitmap files will be saved. There are 200 sets of USB disk

		memory available to store bitmap file navigated by the multipurpose knob.
Save [F4]	——	Press to store a bitmap file
	——	

Use the multi-purpose knob to select the storage memory destination (please notice that 200-group data storage is available).
Press F4 to store a bitmap file into a USB disk;
Remove the USB disk.

7. Set the Utility System

By pressing the UTILITY function button in the menu area, users can do different utility settings, where the button location is shown in the figure below.

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Figure 2-23 Function Key of Sampling System (Function)

There are three function menu pages for the utility system setting shown in Table 2-17, 18, 19 below.

Table 2-17 Utility Menu Page 1

Function Menu	Settings	Description
Self-Adj (F1)	Execute	Press to execute self-calibration function
	Close	Leave self-calibration
Pass/Fail (F2)	See Table 2-22	Set waveform Pass/Fail operation

Recorder (F3)	See Table 2-20	Set waveform recording operation
Language (F4)	Language	Press to change to different system language
Next(1/3) (F5)		Press to next Utility Function Menu page

Table 2-18 Utility Menu Page 2

Function Menu	Settings	Description
Reset (F1)		Reset to factory default settings
Quick Correction (F2)	On	To turn on the channel fast correction function
	OFF	To turn off the channel fast correction function
Skin (F3)		Change the skin for the function menu
Grid Bright (@)	1%-100%	Adjust the grid brightness by using the multi-purpose knob
Next 2/3	——	Get to the next page

Table 2-19 Utility Menu Page 3

Function Menu	Settings	Description
Version (F1)		Press to view the system version
LAN (F2)		Press to enter the LAN address setting Notice that LAN is an option for 72-7610
——	——	——
Frequency Counter * (F4)	ON	To turn ON frequency counter
	OFF	To turn OFF frequency counter
First 3/3 (F5)	——	Back to page 1

The oscilloscope waveform recorder function is generally easy to operate.
Users should set up Source and Operation according to the below table.

Table 2-20 Waveform Recorder Menu

Function Menu	Settings	Description

Source (F1)	CH1	Select CH1 as recording signal source
	CH2	Select CH2 as recording signal source
	CH1+ CH2	Select CH1 and CH2 as recording signal sources
Operation (F2)	See Table 2-21 for detail	Sub-menu for operations
Save (@) (F3)		Save waveform recording into USB memory; Select from 1-200 memory locations; Press F3 to save.
Load (@) (F4)		Load the waveform recording into USB memory; Select from 1-200 memory locations; Press F3 to load.
Return (F5)		Press to return to Utility function menu

After pressing the F2 button on the waveform recorder menu, you should see the waveform recorder operation menu below.

Table 2-21 Waveform Recorder Operation Menu

Function Menu	Setting	Description
Record (F1)		Press to start waveform recording; The number of waveform being recorded is shown on the screen.
Replay (F2)		Press to start waveform replay
Stop (F3)		Press to stop waveform recording
Return (F4)	——	Go back to previous menu

One of the very useful functions for the oscilloscope is the pass/fail detection.
You can create a template of pixels area to compare with the input signal. Users can also

select the output condition for the logical result between the templates of area and the input source.

You can enable PASS/FAIL function by pressing F1 on PASS/FAIL function menu. After turning on this function, you can see the total number of waveform being processed, the number of waveform passed and the number of waveform failed on the LCD screen.

Table 2-22 Pass/Fail Function Menu

Function Menu	Settings	Description
Status (F1)	ON	Press to turn on PASS/FAIL function
	OFF	Press to turn off PASS/FAIL function
Source (F2)	CH1	Select CH1 as the detection signal source
	CH2	Select CH2 as the detection signal source
	MATH	Select MATH result as the detection signal source
	Ref A	Select Ref A as the detection signal source
	Ref B	Select Ref B as the detection signal source
Output (F3)	Pass	Select the logical result as input signal within the template of pixels area
	Fail	Select the logical result as input signal outside of the template of pixels area
	Pass/Halt	Same as Pass output condition; Stop once detected.
	Fail/Halt	Same as Fail output condition; Stop once detected.
Template (F4)	See Table 2-23	Press to create template of pixels area
Back (F5)	/	Return to Utility Function Menu

After pressing the F4 on the Pass/Fail function menu, you can create a template of pixels to be compared.

Table 2-23 Template Setting

Function Menu	Settings	Description

Create (F1)	/	According to adjustment, build horizontal and vertical Pass/Fail tolerance range
Horizontal (F2 and @)	1-200 Pixel	Press [F2] to select horizontal length and use the multi-purpose knob to set the pixel length for the horizontal length
Vertical (F3 and @)	1-100 Pixel	Press [F3] to select vertical length and use the multi-purpose knob to set the pixel length for the vertical length
Return (F4)	/	Return to pass detection menu

You will need to press F1 to confirm creating the pixel template after setting the horizontal and vertical length of the pixels.

8. Set the Measurement Parameters

The oscilloscope supports up to 28 automatic waveform measurement parameters. You can view 5 measurement parameters at the same time the most on F1-F5 function menu. To view measurement parameters, please press MEASURE on the control panel.

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Figure 2-24 Function Key of Auto Measurement Parameters

For each measurement parameter located at F1-F5 on the function measurement, you can press F1-F5 for the settings (Measurement Sub Menu)

Table 2-24 Measurement Sub Menu

Function Menu	Settings	Description
Back (F1)		Return to measurement parameter

		function menu
Source (F2)	CH1	Select CH1 as source
	CH2	Select CH2 as source
Volt (F3)		Select different voltage parameters
Time (F4)		Select different time parameters
Parameters (F5)		Press to display all the measurement parameters of the input source. Or, press to turn off parameter display.

Voltage Parameters

Below are the automatically measured voltage parameters for the oscilloscope and their definitions:

Vpp:Peak-to-peak voltage.

Vmax: Maximum voltage.

Vmin: Minimum voltage.

Vmid: Medium voltage.

Vamp: The voltage amplitude from waveform top to bottom.

Vtop: The voltage value from waveform top to GND (Ground).

Vbase: The voltage value from waveform base to GND (Ground).

Over-shoot: The ratio of (Vmax – Vtop) to voltage amplitude (Vamp).

Pre-shoot: The ratio of (Vmin – Vbase) to voltage amplitude (Vamp).

Average: The average signal amplitude within 1 cycle.

Vrms: Root-mean-square value (effective value).

Time Parameters

Rise Time: The time of waveform amplitude rising from 10% to 90%.

Fall Time: The time of waveform amplitude falling from 90% to 10%.

+Width: The width of positive pulse at 50% amplitude.

-Width: The width of negative pulse at 50% amplitude.

Delay (rising edge): The delay time between rising edges. Delay (falling edge): the delay time between falling edges.

+Duty: The ratio of positive pulse width to cycle.

-Duty: The ratio of negative pulse width to cycle.

9. Set the Cursor Measurement

Users can press the CURSOR button to enable the cursor measurement function of the oscilloscope, where the location of the CURSOR button can be found in the figure below.

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Figure 2-25 Function Key of Sampling System (CURSOR)

The oscilloscope supports 3 different types of cursor measurements.
Volt: Voltage (Vertical System)
Time: Time (Horizontal System)
Track: Volt and Time working at the same time.
At the **Volt** cursor measurement, users should be able to see **ΔV**, **Va**, and **Vb** parameters on the display screen, where **ΔV is the difference between Va and Vb;**
Users can move Va courser by rotating the multi-purpose knob. Once the location of Va courser is an ideal one, users can press the multi-purpose knob (the SELECT button on 72-7610) to switch to Vb; Users can move Vb cursor by rotating the multi-purpose knob in the same way as moving the Va cursor.

At the **Time** cursor measurement, users can perform referring to Volt cursor measurement by using the multi-purpose knob and SELECT button on 72-7610.

The **Track** cursor measurement is similar to the time cursor measurement except it will automatically track voltage level where the time cursor is pointing at the screen. (Not for 72-10510).

After activating the COARSE button, there will be quicker response for the cursor movement.

10. System Message Examples and Troubleshooting

System Message Examples

- "Operation at limit":

System will show "Operation at limit" when users try to operate beyond the system limit; For example, setting the horizontal scale to more than 50.00s.

- "Saving" Progress Bar

When users are saving a bitmap file or a waveform and setup file, system will show the

“Saving” progress bar. Please wait until the whole saving progress completes.

- “Loading” Progress Bar

When users are loading waveform and setup files, system will show the “Load” progress bar. Please wait until the whole loading progress completes.

Troubleshooting:

- After pressing the power button, the screen is dark and has no display:

① Check if the power connector is properly connected to the power socket
② Check if the power button is pressed to the ON position
③ Restart the instrument after completing the above checking
④ If the oscilloscope still does not work normally, please contact with Tenma

- Cannot acquire signal waveform

① Check if the probe BNC connector is properly connected to the oscilloscope
② Check if the probe is working properly by connecting the probe to “Probe compensation signal output”
③ Check if the probe is properly connected to the device under test
④ Try to acquire signal again

- The voltage amplitude measured is 10 times higher or lower than the actual value:

- Check if the attenuation coefficient of the channel matches with the attenuation rate of the probe used.

- The signal waveform is not stable:

① Check if the trigger source setting in the trigger menu matches with the actual channel input of the signal
② Check the trigger mode. Most of the signals can be triggered in edge trigger mode, while video signals can be triggered in video trigger mode. Only in correct trigger mode the waveform can be stably displayed.
③ Change the coupling to “high frequency rejection” or “low frequency rejection” display to filter out the high frequency or low frequency noise that disturbs the trigger

- No waveform display after pressing RUN/STOP key

① Check if the trigger level exceeds the waveform range and the trigger mode is “Normal” or “Single”, if yes, manually set the trigger level to the center or change the trigger mode to AUTO.
② Or press AUTO button next to the RUN/STOP button, the above settings will be completed automatically.

- The waveform refreshing is slow:

① Check if the Acquire mode is “Average” mode

② In “Average” mode, waveform refreshing is slow because it displays the average value of the waveform to reduce the random noise in displayed signal.

③ Change to “Sample” mode or “Peak” mode for the desired display.

- The waveform display do not smooth

① The horizontal time base division value may be too small, increase the horizontal time base division to improve the waveform smoothness;

② If the display type is “Vector”, the signal waveform may not be smooth between dots. This can be improved by setting the display type to “Dot”.

Ⅶ. Maintenance & Cleaning

A. General Maintenance

Please do not store or place the instrument at any places where the LCD of the instrument is exposed to sunlight directly.

Warning: Please do not stain the oscilloscope or probe with spray, liquid or solvent to avoid instrument or probe damage.

B. Cleaning

Check the instrument and probe frequently. Clean the surface of the instrument according to the following steps:

1. Please wipe the instrument and probe surface with soft cloth. Pay attention not to scratch the LCD screen.
2. Wipe the instrument with wet cloth without dripping after disconnecting the power supply. Use gentle detergent or clear water to clean. Do not use any abrasive chemical agent to avoid instrument or probe damage.

Warning: Please make sure that the oscilloscope is completely dry before powering on again to avoid electrical short circuit or injury.

INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT.

This symbol indicate that separate collection of Waste Electrical and Electronic Equipment (WEEE) or waste batteries is required. Do not dispose of these items with general household waste. Separate for the treatment, recovery and recycling of the materials used. Waste batteries can be returned to any waste battery recycling point which are provided by most battery retailers. Contact your local authority for details of the battery and WEEE recycling schemes available in your area.

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