

# **PC Oscilloscope Spectrum Analyzer Logic Analyzer**

## **DSO-29xxA&B Series**

**User's Manual**

Revision I



CLOCK COMPUTER CORP.

<http://www.clock-link.com.tw>

Associates Contents.....	4
Install Hardware .....	4
Install Software.....	4
Guide to operation.....	4
Main screen.....	6
Menu bar .....	6
Tool bar .....	7
State list.....	7
Timing window.....	8
Introduction .....	9
Ground Point Tick Marks.....	9
Trigger Level Tick Marks .....	9
Logic Analyzer Binary data.....	9
Trigger Cursor .....	10
Horizontal V1Bar and V2Ba .....	10
Vertical Cursor A and Cursor B .....	10
Horizontal Scroll Bar .....	10
Vertical Scroll Bar.....	11
Multi-window.....	12
Channel display.....	15
Channel Dialog Box.....	16
Probe .....	16
Coupling.....	16
Volts/Division.....	17
Offset .....	17
Tool Bar.....	17
Hardware Specifications.....	18
Clock Specifications .....	22
Internal.....	22
External.....	22
Analog to Digital skew.....	22
Display .....	22
Calibrate Probe .....	22
Probe calibration .....	22
Programming Library.....	23
File menu commands .....	23
Load data (File menu).....	25
Transfer data to excel.....	26
Settings File Format .....	26

Data File Format .....	26
File Save (File menu).....	26
Auto save settings command (File menu).....	27
Print Setup command (File menu).....	27
Exit command (File menu) .....	27
View menu commands .....	27
Search by cursor .....	29
Search by group .....	29
Electronic Counter .....	30
Clock Jitter Analyze.....	31
Setting up group .....	33
Setting up the state window .....	34
Capture by software .....	35
Timing menu commands .....	36
Lines .....	37
Dots.....	37
Lines and Dots .....	37
Persistence mode (Timing menu) .....	37
Backup menu commands .....	38
Measurements menu commands (Window menu).....	38
Parameter measurements.....	39
Trigger menu commands .....	40
Trigger levels specifications of DSO-29xxA/B Series.....	40
How to set trigger word .....	42
Trigger position .....	42
Trigger level .....	43
Width bit .....	44
Width bit with timing .....	48
Width bit by rising (falling) clock .....	50
1 Bit data by rising clock (SPI) .....	52
I <sup>2</sup> C .....	54
X-Y Oscilloscope plot screen .....	55
FFT commands (Window menu).....	56
Help menu commands .....	57
USB driver install.....	58
Windows 2000 USB driver install .....	58
Windows XP USB driver install .....	61
Windows Vista USB driver install .....	64
Technical Support .....	67

Software Updates.....	67
APPENDIX .....	68
Fast Fourier Transformations .....	68
Understanding FFT's Application .....	68
Introduction to FFT.....	68
Typical FFT of Applications .....	68
Fundamental principles .....	68
Magnitude.....	69
Decibel (db).....	69
Logarithm .....	69
The Characteristics of Weight Function .....	70
Functionality .....	70
FFT .....	71
BW.sweep.....	71
Source .....	71
Points.....	71
Window .....	71
Gain type.....	71
Certificate for DSO-29xxA/B Series .....	72
Introduction .....	72
Offset and amplify calibration .....	73
Frequency Bandwidth.....	74
Trigger position calibration .....	74
Logic Analyzer trigger test.....	74

## Associates Contents

- 1). The DSO-29xxA Series or DSO-29xxB Aluminum unit.
- 2). Logic Analyzer Pod.
- 3). Two pieces (DSO-2902A Series) or Four pieces (DSO-2904A or B Series) calibrated 300MHz probe with (x1, x10). 10pF input Capacitance.
- 4). Ten piece color wires and easy hook clips.
- 5). USB 2.0 cable.
- 6). Universal Power Supply with DC Adapter  
**5.4V/2.4A** (DSO-2902A Series) or **6.0V/3.0A** (DSO-2904A or B Series).
- 7). DSO-29xxA/B User's Manual.
- 8). Software CD.
- 9). Dynamic Link Library [DLL]:  
It is optional to order. It also include a visual basic demo source code software libraries are available to allow the user to write custom programs to control the instrument.

## Install Hardware

- 1). Turn off the computer and all peripheral connected. Remove the computer power cord from the wall outlet.
- 2). Locate an available USB interface (USB 2.0 or USB 1.1 version).
- 3). Connect the included USB cable to USB interface.
- 4). Plug in power source from **+5.4V / +6.0V** DC Adapter.
- 5). After checking all connections, turn on the computer peripherals.  
You are now ready to install the software.

## Install Software

- 1). Insert the distribution CD into drive E: ("E" is CD driver).
- 2). Select File menu.
- 3). Enter file to run <E:\dso29xxA/B\setup.exe>
- 4). Follow the on screen instructions.

## Guide to operation

When making measurements with the Digital Storage Oscilloscope / Logic Analyzer, meaningful

data can only be captured with some prior knowledge of the characteristics of the circuit under test. Before initiating any capture cycles, the DSO must be configured using the control program. See The software section later in the manual for instructions on these procedures.

To connect the DSO to the test circuit, there are two standard BNC probes, one for each Analog input channel and a series of mini-clips on the Logic Analyzer Pod for the Logic input channels. The scope probes have removable hook clips on their ends and an attached alligator clip for the signal ground connection. The Logic Analyzer Pod has inputs for 8 channels, D0 channel is the external clock input, and 3 ground points.

For synchronous data captures, external clock sources can be connected to the D0 channel. At times, it may also be necessary to connect the test circuit to the computer system itself. This will eliminate more noise in the test application due to ground level differentials. This is especially true when dealing with high speed timing analysis. Use a heavy gauge wire to make a connection between the test circuit ground and the case of the computer. Each Analog channel probe has a calibration adjustment. It is important that this calibration be made at least twice a year. See calibration for more information.

**When connecting the probe to any signal, make sure that the signal voltage is within the limits of the DSO. Check the technical information section for absolute maximum and recommended maximum input voltage for the probes.**

Logic Analyzer Pod Markings:

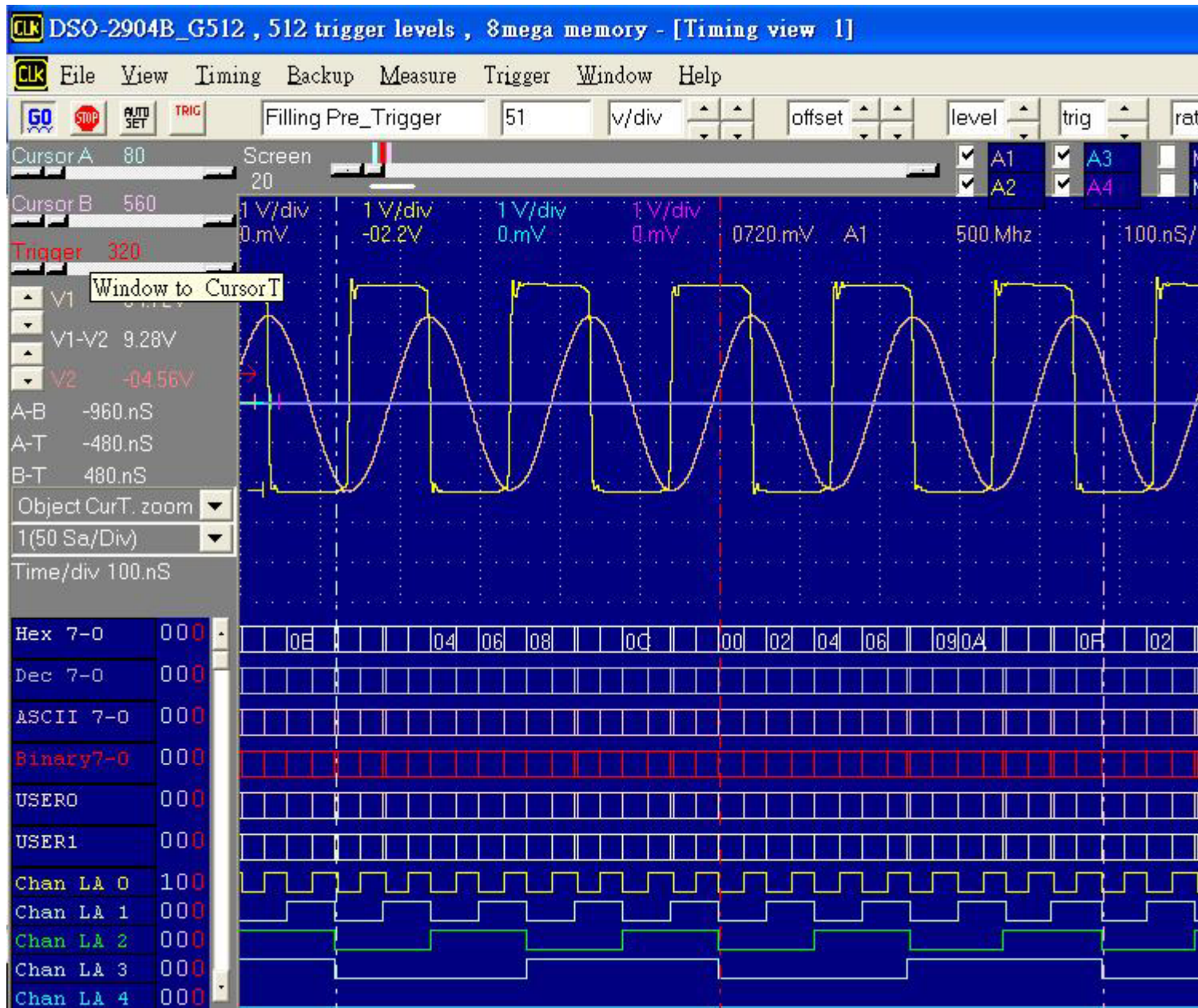
D0 ~ D7     Channel data inputs for DSO-29xxA/B.  
                  (DSO-2902A-M2 & M512 support D0 ~ D3 only).

GND            Signal ground connection.

The wires and the clips that come with the pods are modular. The pods, wires, and clips can all be disconnected from each other by gently pulling them apart. Removing just the clips, but leaving the wires connected to the pods allows connections to be made to wires and posts of the test circuit of up to 0.64 mm (0.025 in).

**Do not insert wires or posts greater than this diameter as that will expand the contacts in the wire beyond the allowed limited, possibly damaging the connector.**

## Main screen

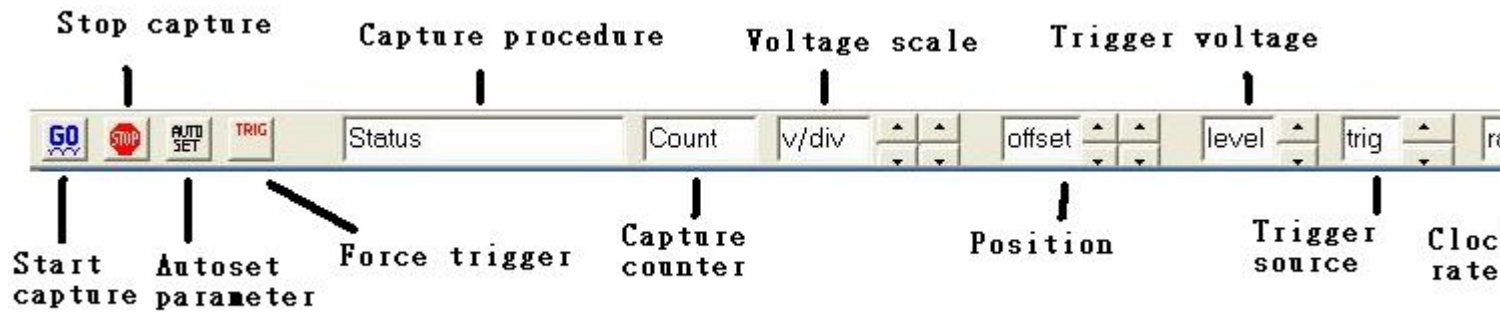


## Menu bar





## Tool bar



## State list

Data is displayed in state list format in this window.

Hex 7-0	000	28	29	2A	2B	2C	2D
Dec 7-0	000	40	41	42	43	44	45
ASCII 7-0	000	(	)	*	+		
Binary7-0	000	00101000	00101001	00101010	00101011	00101100	00101101
USER0	000	/READ	/WRITE	/READ		/READ	
USER1	000						
Chan LA 0	100						
Chan LA 1	001						
Chan LA 2	010						

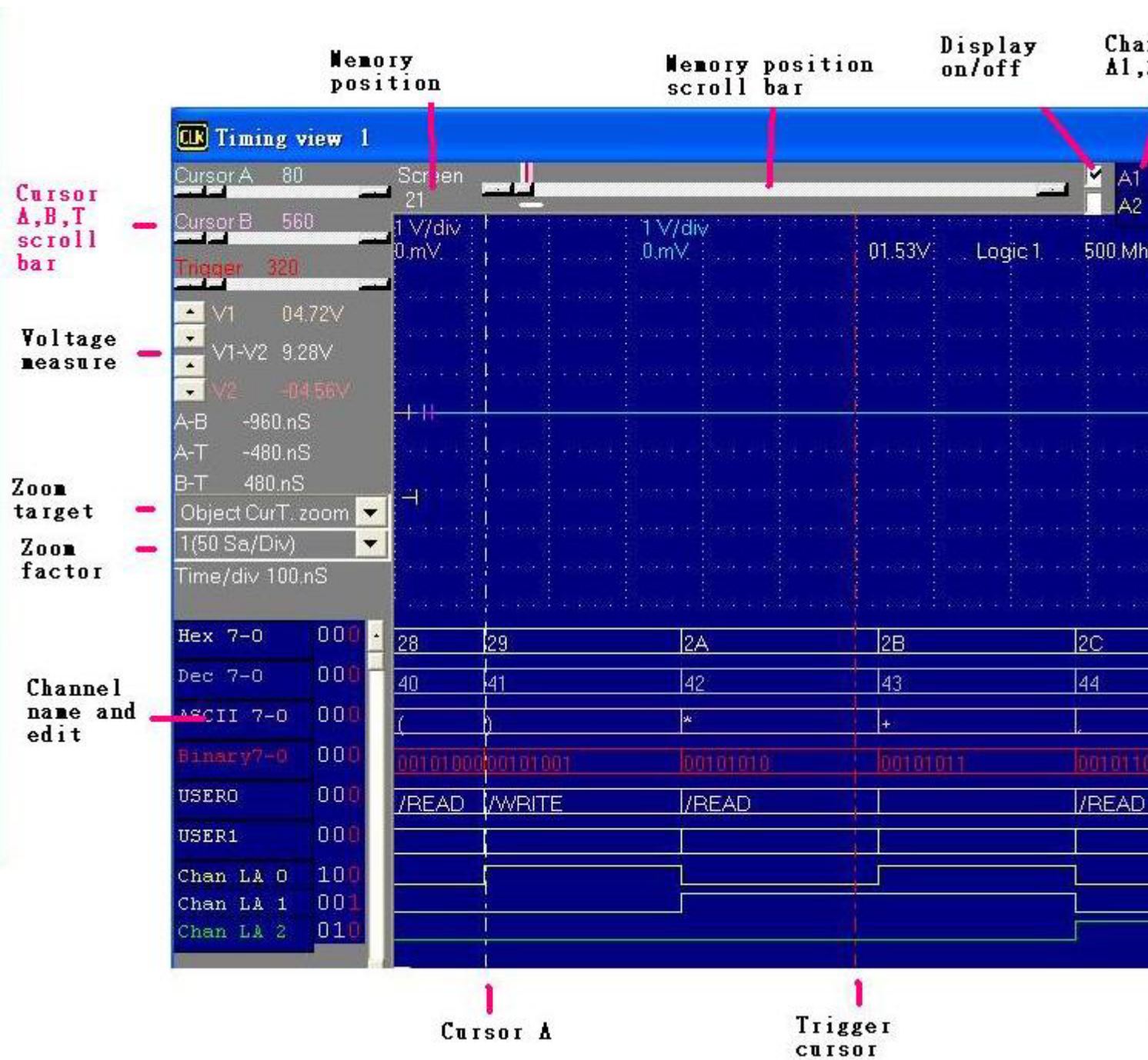
Position	Hex 7-0	Dec 7-0	ASCII 7-0	Binary7-0	USER0	USER1
0	28	40	(	00101000	/read	
1	28	40	(	00101000	/read	
2	28	40	(	00101000	/read	
3	28	40	(	00101000	/read	
4	28	40	(	00101000	/read	
5	28	40	(	00101000	/read	
6	28	40	(	00101000	/read	
7	28	40	(	00101000	/read	
8	28	40	(	00101000	/read	
9	28	40	(	00101000	/read	
10	28	40	(	00101000	/read	
11	28	40	(	00101000	/read	
A	28	40	(	00101000	/read	
B	28	40	(	00101000	/read	
T	28	40	(	00101000	/read	
16	28	40	(	00101000	/read	

Annotations on the left side of the state list table:

- Partition of timing and state:** points to the vertical scroll bar.
- Memory position:** points to the Position column.
- Cursor A,B,T position:** points to the A, B, and T row selection buttons.



# Timing window



## Introduction

The main display is made up of some areas. On the left side of the screen is the settings / parameter display. In the middle are the data displays. The top is the analog waveform

display. The bottom is the logic analysis digital waveform display. Above the analog display is a "Thumbnail" graph representing the data buffer. This also shows the location of the cursors and which part of the buffer is being displayed.

On the upper left edge of the screen is the scroll selector area.

On the right side of the screen you will see the settings for one of the analog channels.

You can select the active channel with the "select" button (next to channel name).

Just to the right of the analog waveform display are markers for the ground points.

Ch.A1 markings are closest to the display, than Ch.A2. These "Tick marks" will be displayed in the same color as the channel.

Just to the left of the analog waveform display are markers for trigger level settings. These "Tick marks" will be displayed in the same color as the trigger cursor.

The lower left section of the screen contains the channel labels for the logic analyzer.

These can be edited on screen by clicking on them or by selected edit channel names from

The Channel / settings menu. The labels can be any alphanumeric string up to fourteen characters long. In the name edit window you can also change the order of the channels.

To select one of the cursors for scrolling click on its selection button or select it from the view menu.

## Ground Point Tick Marks

Located to the right of the Analog Display. The Ground Point Tick Marks are `-' shaped.

These display the ground points of each analog channel. Ground Point Tick Marks associated with Channel A1 are leftmost and Channel A2 through A4 are successively further to the right.

They are color coded the same as the data channels that they refer to. These Tick Marks can be moved by grabbing and dragging with a pointing device, or from the Channel dialog box.

## Trigger Level Tick Marks

Located to the left of the Analog Display. The active Trigger Level (s) are displayed here with

Level 1 displayed to the right of level 2. The Trigger Level Tick Mark is '→' shaped. They display

the trigger levels and are color coded the same as the trigger cursor. These tick marks can be moved by grabbing and dragging with a pointing device, or by the trigger dialog box.

## Logic Analyzer Binary data

To the left of the Logic Display are the binary values of each logic input at the Vertical

Cursor A and Vertical Cursor B positions. To the right of the Logic Display are the binary

values of each logic input at the Trigger Cursor position.

### Trigger Cursor

The Trigger Cursor is a vertical cursor that defines the actual trigger position within the data buffer of the trigger channel. Pre and post trigger information are directly related to the Trigger Cursor position.

The trigger cursor position can be changed by:

- Grabbing and dragging the Trigger Cursor with a pointing device
- Selecting the Trigger cursor by clicking on the Trigger button (in the Selection Buttons) and using the Horizontal Scrollbar.

### Horizontal V1Bar and V2Ba

The Horizontal Cursors provide an easy means of voltage measurements. For a selected channel, the voltage difference between the two cursors is shown in the Parameters Display area.

V1Bar and V2Bar can be moved by:

- Grabbing and dragging the cursors with a pointing device
- Selecting the Cursor by clicking on the V1Bar or V2Bar button and using the Vertical Scrollbar.

### Vertical Cursor A and Cursor B

The Vertical Cursors provide an easy means to make time measurements. For a selected channel, the time difference between the two VBar and the trigger cursor is shown in the Parameters display area.

Cursor A and Cursor B can be moved by:

- Grabbing and dragging the cursor.
- Selecting the Cursor by clicking on the Cursor A or Cursor B button and using the horizontal Scrollbar.
- Selecting the trigger cursor from the view menu.

### Horizontal Scroll Bar

This scroll bar is used in conjunction with a selected waveform or cursor. The Horizontal Scroll Bar will move a selected waveform or cursor left or right in the display area. The Horizontal Scroll Bar works with Display, Analog input channels, Memory, Logic Analyzer channels, Cursor A, Cursor B, and Trigger Cursor.

## Vertical Scroll Bar

This scroll bar is used in conjunction with a selected waveform or cursor. The Vertical Scroll Bar will move a selected waveform or cursor up or down in the display area. The Vertical Scroll Bar works with Display, Analog input channels, Memory, V1Bar, and V2Bar.

[Channel display](#) Select display Channel(A1, 2, 3, 4 and M1, 2, 3, 4).

[Object point](#) Set cursor Bar (V1, V2, Trigger, Screen (left or center) ) for zoom operates reference. Moves one or more cursors to the display area. These commands are also available by clicking on the toolbar.

[Object is cursor A](#) Centers waveform display area around Cursor A.

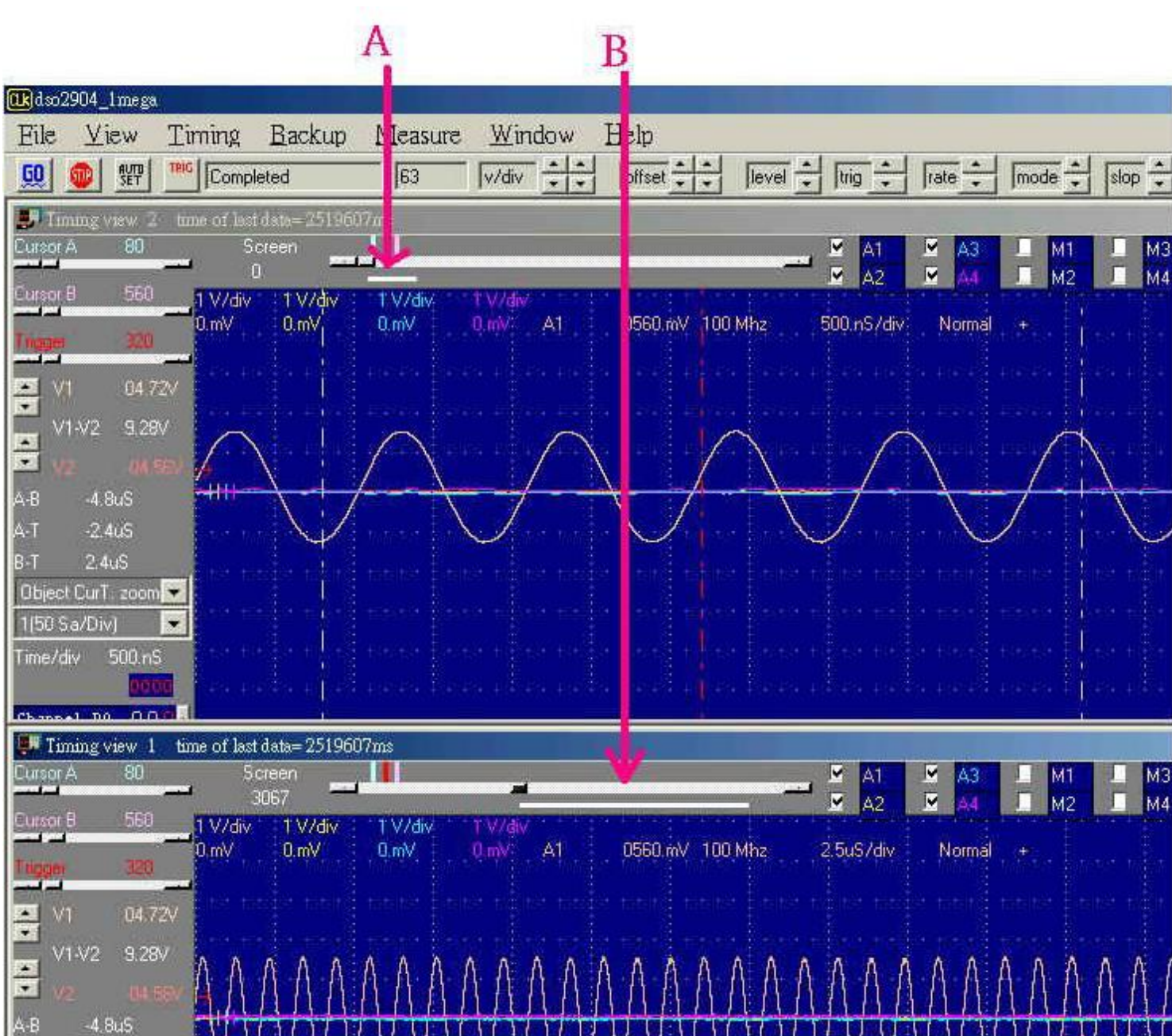
[Object is cursor B](#) Centers waveform display area around Cursor B.

[Object is cursor trigger](#) Centers waveform display area around the Trigger Bar.

[Object is cursor A1-4](#) Let v1 and v2 have reference object.



## Multi-window



This software is a revolution software, it have a lot of new function, even tradition famous Oscilloscope have not these powerful function. This software show a lot of timing, let user easy to compare and analyzer timing, tradition software no matter it is stand alone or computer base oscilloscope only show one timing, these one timing software only analyzer one segment of buffer, unlike this software it can look buffer in beginning and buffer in middle and buffer in end at the same time. the following picture part A show it is locate at beginning and part B at middle of buffer at the same time, every individual timing also support their own cursor, voltage measurement, zoom factor ....etc.

**Data1- 4 to timing by point** User point which timing memory should be placed for captured data, it can let user captured 2 or 4 set different data to buffer and display, the sequence pointed by user, this function let user have 1 Mega\*4 memory size.

**Data1- 4 to timing by auto** The same is true for it, it automatically capture 2 or 4 sets data to buffer, and the sequence is 4,3,2 then 1.

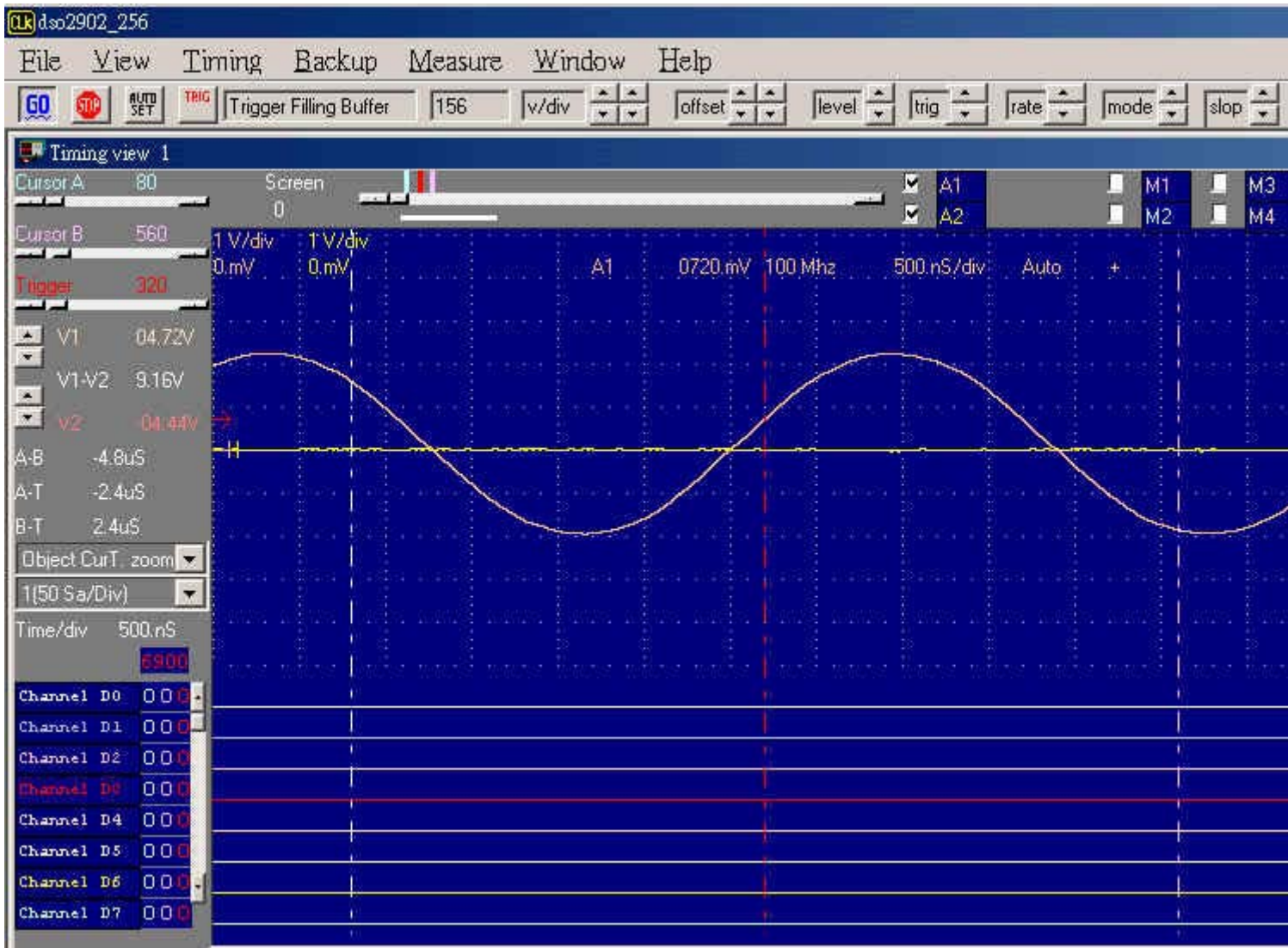
**Timing1- 4<-data** Activate timing display. we suggest user use more than 1 monitor to get better show. Another new function are let memory expand to 10 times by software.

DSO2904A-G512 is 1 Mega memory size for 4 analog channel. This software can let it look have 10 Mega memory size when user open 10 timing and set 10 timing by auto function. (it need 1 Giga system memory or more).

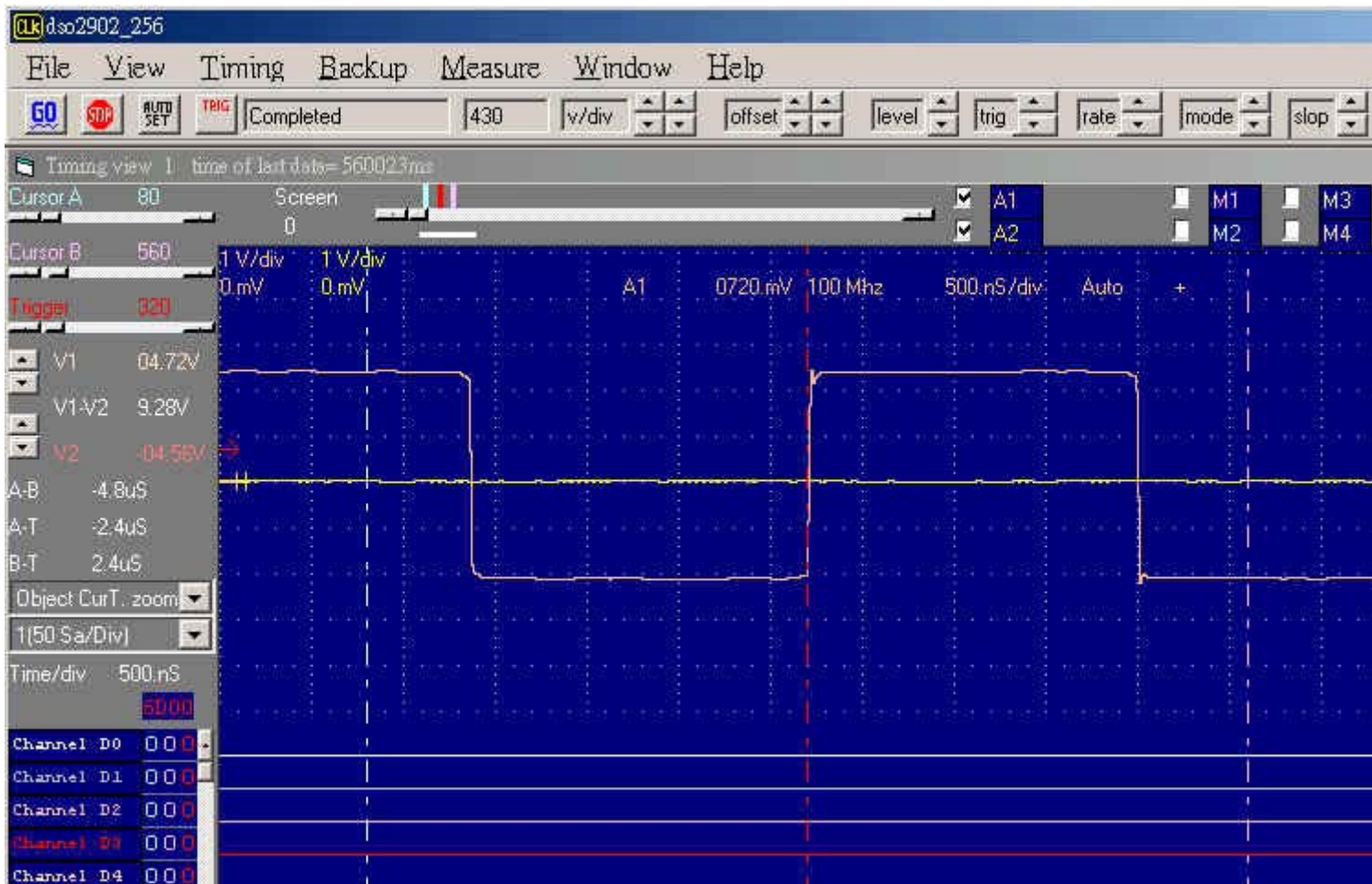
the method is software continue capture data to these 10 timing, every timing have 1 Mega individual buffer, so user can look almost 1 Giga memory. it better than any famous oscilloscope in the world.

the third good function are it can show long timing when you have two monitor, the following show two monitor long timing, it can let user easy analyze timing, so stand alone oscilloscope can not do it, because they only have one monitor.





The fourth function is it can support two different timing at different monitor. the follow picture is left monitor show square waveform and right monitor show another waveform. it easy compare last capture data and current data at different monitor. these functions even famous oscilloscope have not support it.



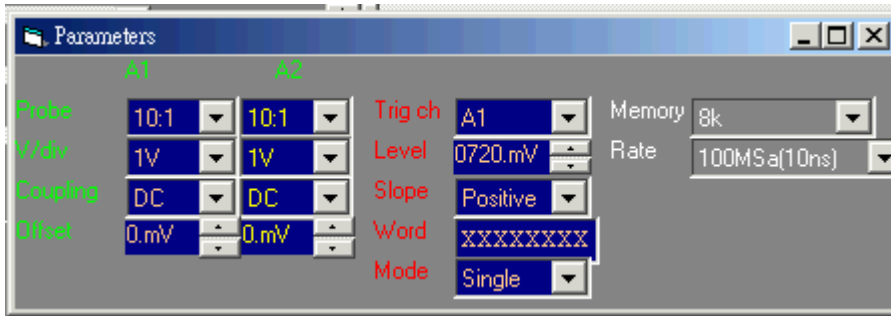
## Channel display

When Display is checked, the channel will be displayed on the screen.

When Display is not checked, the channel will not be displayed on the screen. Turning display off for a channel will both speed up and un-clutter the display. However the data is still acquired from that channel unless transfer is turned off.

## Channel Dialog Box

Show the Channel Dialog Box. All channel parameters are displayed in this box and can be altered in it as well. You can bring up this dialog by clicking on the "view menu", select tall or wide window. A different channel can be selected by hitting the "A1, A2, A3, A4" Ch Select button.



### Probe

This controls the attenuation level for the probe inputs. This should be set to match the probe itself, either 1X, 10X, 100X or 1000X. When working with signal amplitudes within  $\pm 0$  V, either the 1X or the 10X setting can be used. However, if the signal amplitude is outside of  $\pm 0$  V, use the 10X setting. Note that using the 10X setting with both the probe and the scope even for signals within  $\pm 0$  V will provide better frequency response through the system due to smaller voltage swings through to the digitizer.

Voltage range Probe and probe settings:

10mv/div to 2v/div @probe 1:1

100mv/div to 20v/div @probe 10:1

1000mv/div to 200v/div @probe 100:1

10v/div to 2000v/div @probe 1000:1

### Coupling

The three selections available are AC, DC, and GND couple. Coupling can also be changed by Channel dialog box.

In the AC setting, the signal for the selected channel is coupled capacitively, effectively blocking the DC components of the input signal and filtering out frequencies below 10 Hz. The input impedance is  $1\text{M}\Omega \parallel 5\text{pF}$ . In the DC setting, all signal frequency components of the signal for the selected channel, are allowed to pass through. The input impedance is  $1\text{M}\Omega \parallel 5\text{pF}$ . In the GND setting, both the input and the A/D converter are connected to ground. Again, the input Impedance is  $1\text{M}\Omega \parallel 5\text{pF}$ . Use for setting the Ground reference point on the display or if calibrating the DSO board.

## Volts/Division

V/Div controls the vertical sensitivity factor in Volts/Division for the selected analog channel. Each V/Div step follows in a 1-2-5 sequence. To get the best representation of the input signal, Set V/Div such that the maximum amplitude swing is displayed on the screen. This will match the signal amplitude to use most of the digitizer's range, allowing the most bits to be used. Volts / division can be set via the V/div Combo to Settings.

Volts/Division Probe can be set to

10mV, 20mV, 50mV, 100mV, 200mV, 500mV, 1V, 2V (1:1)

100mV, 200mV, 500mV, 1V, 2V, 5V, 10V, 20V (10:1)

1V, 2V, 5V, 10V, 20V, 50V, 100V, 200V (100:1)


10V, 20V, 50V, 100V, 200V, 500V, 1000V, 2000V (1000:1)

## Offset

This parameter offsets the input signal in relation to the digitizer. This changes the usable input voltage range. The input voltage range is the offset +/- 5 divisions. Thus if you moved the offset to 1.00V with 1V /division the usable range would be 5.00V to -5.00V. Data outside the input range is clipped and stored as either the max or min input value. The offset references the 0.00V point (GND) for the input channel.

The ground point is marked on the screen by the Ground Point Tick Marks to the right of the Analog Display. To change the offset in this dialog box, move the elevator button in the scroll bar. The offset can also be changed by grabbing and moving the appropriate Ground Point Tick Mark in the analog display area.


## Tool Bar

 The Go command tells the DSO to start acquiring data when the trigger conditions are satisfied.

Pressed means start capture.

 Pressed means stop capture.

 Automatic setup parameters for capture.

 Force hardware to get capture data even trigger has not happen.

## Hardware Specifications

Model	DSO-2904A-G512 DSO-2904B-G512 [1GHz]	DSO-2904A-G2 [1GHz]	Remark
Sampling Rate	2Ch 2MSa/s to 1GSa/s by 1, 2, 5 sequence 4Ch 1Sa/s to 500MSa/s by 1, 2, 5 sequence		Internal clock
External Clock	0 to 100 MHz for logic analyzer 10 to 100 MHz for analog channel 200Kohm // 4pF, ±50V Max.		From Channel D0
Record Length	2Ch 2K/32K/256K/2Mega for DSO-2904A-G512 4Ch 1K/16K/128K/1Mega for DSO-2904A-G512 2Ch 2K/32K/256K/8Mega for DSO-2904B-G512 4Ch 1K/16K/128K/4Mega for DSO-2904B-G512		Point
Analog Channel	A1, A2, A3, A4		4 Ch
Input Bandwidth	2Ch DC - 170MHz 4Ch DC - 125MHz		@BNC Connect
Input Impedance	1Mohm // 15pF		
Max. Input Voltage	±50v (±100v Transient)		@Probe 1:1
Sensitivity	10mv/div to 4v/div		
Trigger Level (Universal)	512	2	
Repetitive Mode	Up to 20 GHz		
Spectrum FFT	150 MHz (Fast Fourier Transform)		
Electronics Counter	Max. 7 Digits Resolution		
X - Y Plot	Allow to graph one channel to another		
Math.	+,-		
Multi-Window	Yes		
Operate	Mouse		
Digital Channel	D0 – D7 (8ch)		Logic Analyzer Pod
Input Bandwidth	DC - 100MHz		
Sampling Rate	250 MHz		
Record Length	512K for DSO-2904A-G2 512K for DSO-2904A-G512 2 Mega for DSO-2904B-G512		
Input Impedance	200Kohm // 4pF		
Max. Input Voltage	±50v (±100v Transient)		
Threshold Voltage	-1.8v ~ +4.5v		by 36mv step
Trigger Qualify	0,1, X (don't care) settings for all digital channels		
Trigger Level (Universal)	512	2	
Power Supply	DC Adapter 6V/3.0A		
PC Interface	USB 1.1/2.0		
Net Weigh	1.8 KGS		
Size (Dimension)	220mm x 142mm x 40mm		Aluminum Case
Accessories	User's Manual, Calibrated Probe (1:1, 10:1) x 4 pcs. Logic Analyzer Pod, Color wires with clips x 10 pcs. USB 2.0 cable, Software CD, DC Adapter 6V/3.0A.		



Model	DSO-2902A-G512 [1GHz]	DSO-2902A-G2 [1GHz]	Remark
Sampling Rate	1Ch 2MSa/s to 1GSa/s by 1, 2, 5 sequence 2Ch 1Sa/s to 500MSa/s by 1, 2, 5 sequence		Internal clock
External Clock	0 to 100 MHz for logic analyzer 10 to 100 MHz for analog channel 200Kohm // 4pF, ±50V Max.		From Channel D0
Record Length	1Ch 2K/32K/256K/2Mega 2Ch 1K/16K/128K/1Mega		Point
Analog Channel	A1, A2		2 Ch
Input Bandwidth	1Ch DC - 170MHz 2Ch DC - 125MHz		@BNC Connect
Input Impedance	1Mohm // 15pF		
Max. Input Voltage	±50v (±100v Transient)		
Sensitivity	10mv/div to 4v/div		@Probe 1:1
Trigger Level (Universal)	512	2	
Repetitive Mode	Up to 20 GHz		
Spectrum FFT	150 MHz (Fast Fourier Transform)		
Electronics Counter	Max. 7 Digits Resolution		
X - Y Plot	Allow to graph one channel to another		
Math.	+,-		
Multi-Window	Yes		
Operate	Mouse		
Digital Channel	D0 – D7 (8ch)		Logic Analyzer Pod
Input Bandwidth	DC - 100MHz		
Sampling Rate	500MHz		
Record Length	1Mega		
Input Impedance	200Kohm // 4pF		
Max. Input Voltage	±50v (±100v Transient)		
Threshold Voltage	-1.8v ~ +4.5v		by 36mv step
Trigger Qualify	0,1, X (don't care) settings for all digital channels		
Trigger Level (Universal)	512	2	
Power Supply	DC Adapter 5.4V/2.4A		
PC Interface	USB 1.1/2.0		
Net Weigh	1.4 KGS		
Size (Dimension)	220mm x 142mm x 40mm		Aluminum Case
Accessories	Calibrated Probe (1:1, 10:1) x 2 pcs. User's Manual, Color wires with clips x 10 pcs. USB 2.0 cable, Software CD. Logic Analyzer pod, DC Adapter 5.4V/2.4A.		



Model	DSO-2904A-M512 [500 MHz]	DSO-2904A-M2 [500 MHz]	Remark
Sampling Rate	2Ch 50MSa/s to 500MSa/s by 1, 2, 5 sequence 4Ch 1Sa/s to 250MSa/s by 1, 2, 5 sequence		Internal clock
External Clock	0 to 100 MHz for logic analyzer 10 to 100 MHz for analog channel 200Kohm // 4pF, ±50V Max.		From Channel D0
Record Length	2Ch 2K/32K/256K/1Mega 4Ch 1K/16K/128K/512K		Point
Analog Channel	A1, A2, A3, A4		4 Ch
Input Bandwidth	2Ch DC - 125MHz 4Ch DC - 60MHz		@BNC Connect
Input Impedance	1Mohm // 15pF		
Max. Input Voltage	±50v (±100v Transient)		
Sensitivity	10mv/div to 4v/div		@Probe 1:1
Trigger Level (Universal)	51 2	2	
Repetitive Mode	Up to 20 GHz		
Spectrum FFT	110 MHz (Fast Fourier Transform)		
Electronics Counter	Max. 7 Digits Resolution		
X - Y Plot	Allow to graph one channel to another		
Math.	+,-		
Multi-Window	Yes		
Operate	Mouse		
Digital Channel	D0 – D7 (8ch)		Logic Analyzer Pod
Input Bandwidth	DC - 50MHz		
Sampling Rate	125MHZ		
Record Length	256K		
Input Impedance	200Kohm // 4pF		
Max. Input Voltage	±50v (±100v Transient)		
Threshold Voltage	-1.8v ~ +4.5v		by 36mv step
Trigger Qualify	0,1, X (don't care) settings for all digital channels		
Trigger Level (Universal)	512	2	
Power Supply	DC Adapter 6V/3.0A.		
PC Interface	USB 1.1/2.0		
Net Weigh	1.4 KGS		
Size (Dimension)	220mm x 142 mm x40mm		Aluminum Case
Accessories	User's Manual, Calibrated Probe (1:1, 10:1) x 4 pcs. Logic Analyzer Pod, Color wires with clips x 10 pcs. USB 2.0 cable, Software CD, DC Adapter 6V/3.0A.		

Model	DSO-2902A-M512 [500MHz]	DSO-2902A-M2 [500MHz]	Remark
Sampling Rate	1Ch 50MSa/s to 500MSa/s by 1, 2, 5 sequence 2Ch 1Sa/s to 250MSa/s by 1, 2, 5 sequence		Internal clock
External Clock	0 to 100 MHz for logic analyzer 10 to 100 MHz for analog channel 200Kohm // 4pF, ±50V Max.		From Channel D0
Record Length	1Ch 2K/32K/256K/1Mega 2Ch 1K/16K/128K/512K		Point
Analog Channel	A1, A2		2 Ch
Input Bandwidth	2Ch DC - 125MHz 4Ch DC - 60MHz		@BNC Connect
Input Impedance	1Mohm // 15pF		
Max. Input Voltage	±50v (±100v Transient)		
Sensitivity	10mv/div to 4v/div		@Probe 1:1
Trigger Level (Universal)	512	2	
Repetitive Mode	Up to 20 GHz		
Spectrum FFT	110 MHz (Fast Fourier Transform)		
Electronics Counter	Max. 7 Digits Resolution		
X - Y Plot	Allow to graph one channel to another		
Math.	+,-		
Multi-Window	Yes		
Operate	Mouse		
Digital Channel	D0 – D3 (4ch) [ 8Ch Trigger]		Logic Analyzer Pod
Input Bandwidth	DC - 50MHz		
Sampling Rate	125MHZ		
Record Length	256K		
Input Impedance	200Kohm // 4pF		
Max. Input Voltage	±50v (±100v Transient)		
Threshold Voltage	-1.8v ~ +4.5v		by 36mv step
Trigger Qualify	0,1, X (don't care) settings for all digital channels		
Trigger Level (Universal )	512	2	
Power Supply	DC Adapter 5.4V/2.4A		
PC Interface	USB 1.1/2.0		
Net Weigh	1.4 KGS		
Size (Dimension)	220mm x 142mm x 40mm		Aluminum Case
Accessories	Calibrated Probe (1:1, 10:1) x 2 pcs. User's Manual, Color wires with clips x 10 pcs. USB 2.0 cable, Software CD. Logic Analyzer pod, DC Adapter 5.4V/2.4A.		

## Clock Specifications

### Internal

Sampling Rate: 1 Sa/s to 500 MSa/s for DSO-2902A-G2, DSO-2902A-G512, DSO-2904A-G2, DSO-2904A-G512, DSO-2904B-G512.

1 Sa/s to 1 GSa/s for reducing channel mode.

1 Sa/s to 250 MSa/s for DSO-2902A-M2, DSO-2902A-M512, DSO-2904A-M2, DSO-2904A-M512.

1 Sa/s to 500 MSa/s for reducing channel mode.

Time base: 50ps / Division to 10000s / Division displayable.

### External

Frequency: 0 to 100 MHz for Logic Analyzer.

10 to 100 MHz for Analog channel.

External Clock Delay: ~10ns

### Analog to Digital skew

Analog channels to channels skew are 1ns.

Analog channels are 5ns tolerance compare to Logic channels.

External Clock: 2/0 ns relative to clock edge.

Minimum required: a minimum of 256 Mbytes RAM is necessary to use the DSO control program. 1 Giga Bytes system RAM will be better.

### Display

Magnification: from 1/1000X to 50X

Cursors: There are two cursors. Cursor-A Cursor-B, V1 and V2 they are time and voltage cursor.

They can be moved using the horizontal and vertical scroll bars or by grabbing and dragging them. Differences are automatically calculated and displayed on the screen.

## Calibrate Probe

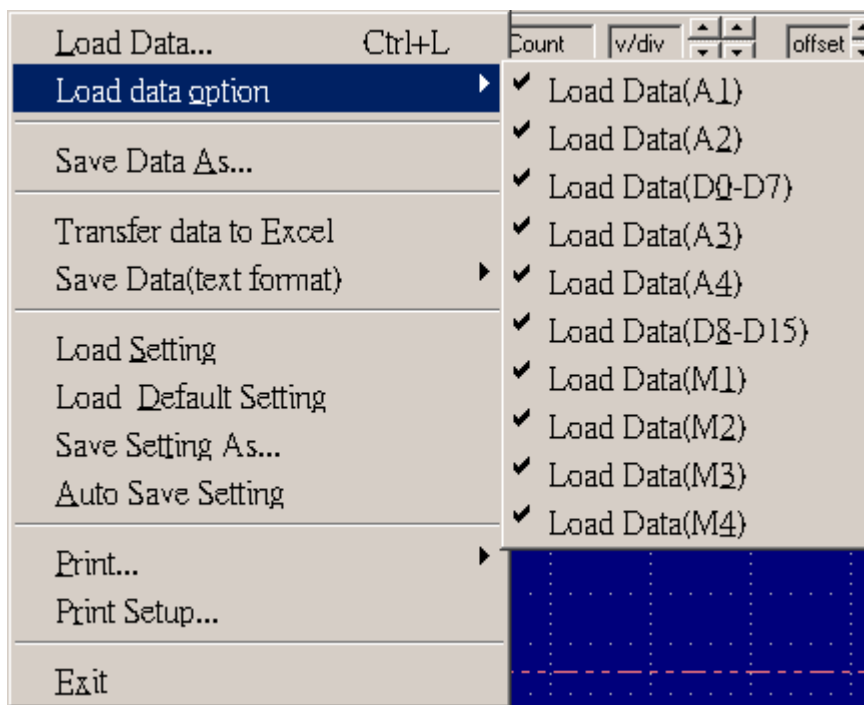
### Probe calibration

- 1) Connect the scope probe Ground Connection to the BNC GND.
- 2) Hold the probe's tip against the calibration point on the BNC center Hole.
- 3) A Square wave signal should appear on the screen.
- 4) Adjust the probe calibration until a true square wave is shown on the screen, noting the Corners of the waveform which should be sharp and square, not rounded over or peaky.

## Programming Library

The VISUAL BASIC programming library is a source code level set of procedures that allow full control of the DSO-29xxA/B from your own programs. This is an optional package. The package includes the source files for the library, example code for using the library. The library consists of subroutines for full control of the DSO-29xxA/B. This includes routines to initialize the board, setup trigger conditions, setup acquisition parameters like sample clock rate and source, choose the gain and coupling settings, transfer data from the board to the PC, and save and load data to files.

## File menu commands



The File menu offers the following:

[Load data](#) This option loads a full data file (.dso), with a setting file (.ini) together.

[Load data option](#) This option loads a data file (.dso), depend on the select of A1, 2, 3, 4 or D0 ~ D7.

[Save Data](#) Saves a file to a specified file name. Saves settings or data files.

[Transfer data to excell](#) Export data to excell programs format.

[Save Data\(text format\)](#) Export data to text format.

[Load setting](#) This option loads a previously 'Save setting' setups.

[Save setting](#) This option saves the current settings to a file.

[Load Default Setting](#) Load default.ini to load parameters to factory defaults.

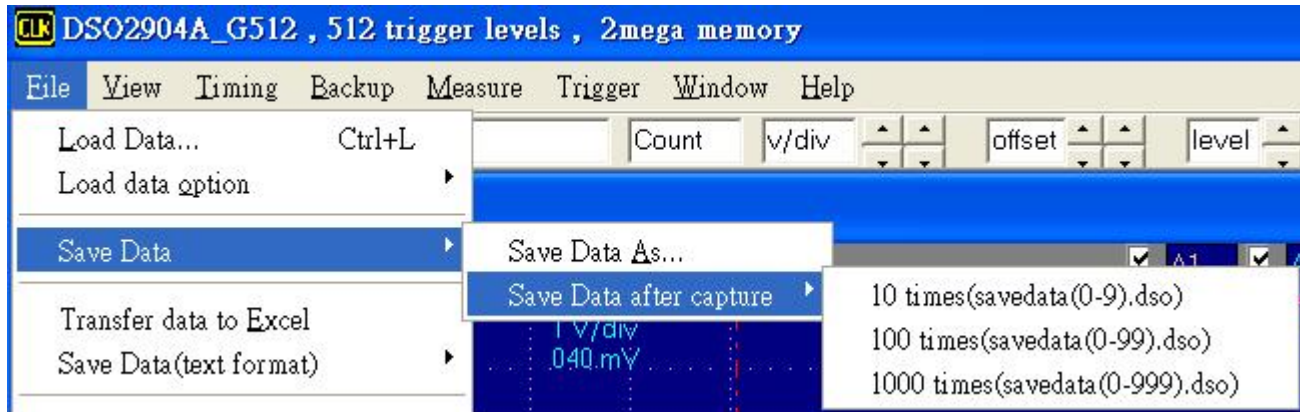
[Auto save settings](#) Auto load Dsoxx.ini setting file on program start run to set all configuration.

[Print](#) This option allows you to print the data.

[Print Setup select](#) output style, printer and printer connection.

[Exit](#) Exit DSO software

Save data after capture: It saves to hard disk from 10 -1000 times. if you need records mass data. but you need check your hard disk free capacity.



The following is source code of DSO-29xxA/B save and load data Visual C program.

Sometime users want to analyze data by themselves. it is useful for user to understand how program write and read data.

Every binary code describes 1 channel. For example 00110001 data mean channel 0 is high, channel 1 is low...etc at first record.

```
_declspec(dllexport)void _stdcall vc_savedata (uchar board_model,uchar *buflogic0, int length ,LPSTR sfile)
```

```
{
int result,ii,jj,kk;
FILE *fp;
fp = fopen( sfile, "w+b" );
if ((board_model == dso2902_64)||board_model == dso2902_128)||board_model == dso2902_256)||
(board_model == dso2904_64)||board_model == dso2904_256){
kk=257;
}
if ((board_model == dso2902_512)||board_model == dso2904_512){
kk=513;
}
if ((board_model == dso2902_1mega)||board_model == dso2904_1mega){
kk=1025;
}
for(ii=0;ii<10;ii++){ result = fwrite( &buflogic0[1024*kk*ii], length, 1, fp ); }
fclose( fp );
```

```

}
_declspec(dllexport)void _stdcall vc_loaddata (uchar *buflogic0, int length ,LPSTR sfile,int position)
{
int result,ii;
FILE *fp;
fp = fopen( sfile, "r+b" );
result =fseek(fp ,length*position,0);
result = fread( &buflogic0[0], length, 1, fp );
fclose( fp );
}

```

### Load data (File menu)

Specify which file to open in the file open dialog box:

File Name:

Type or select the filename you want to open. This box lists files with the extension you select  
In the List Files of Type box. List Files of Type:

Select the type of file you want to open:

INI [Settings File Format](#)

DSO [Data File Format](#)

Drives

Select the drive in which to retrieve the file that you want to open.

Directories

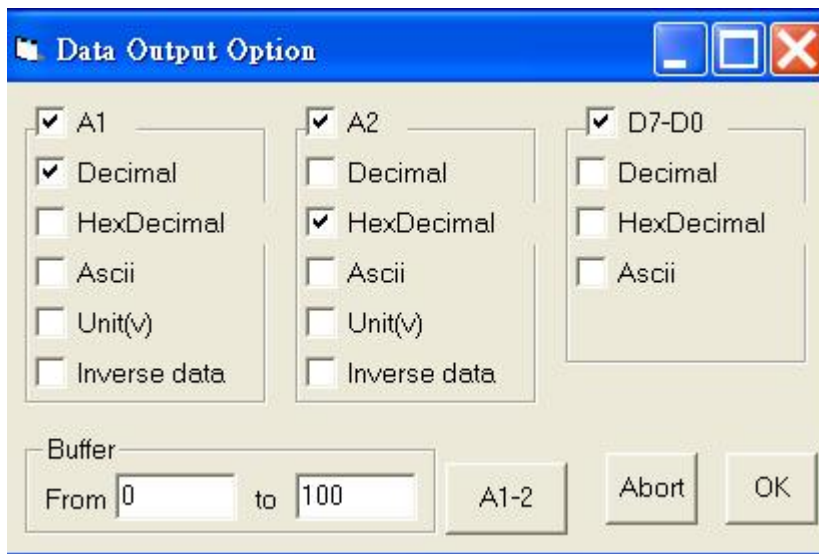
Select the directory in which to retrieve the file that you want to open.

Click on OK when done, or Cancel to abort.



## Transfer data to excel

Use this to output data to other programs.



How to use:

- 1). Data: Select which data to output: Individual [group](#) or all channels  
Select base to output data in.
- 2). Start and End: Select data address range.
- 3). Click OK to save data.

## Settings File Format

The settings are now saved in an .INI file format and should be self explanatory.

## Data File Format

data stored in binary format.

## File Save (File menu)

The following options allow you to specify the name and location of the file you're about to save: Type a new filename to save a document with a different name. A filename can contain up to eight characters and an extension of up to three characters. You must use one of the listed extensions to specify the type of file you wish to save.

Save File as Type

INI [Settings File Format](#)

DSO [Data File Format](#)

Drives

Select the drive in which you want to save the file.

## Directories

Select the directory in which you want to save the file.  
Click on the OK button when done, or Cancel to abort.

## Auto save settings command (File menu)

Turns on or turns off the Auto save option. When this option is on, all settings will be loaded when start the program.

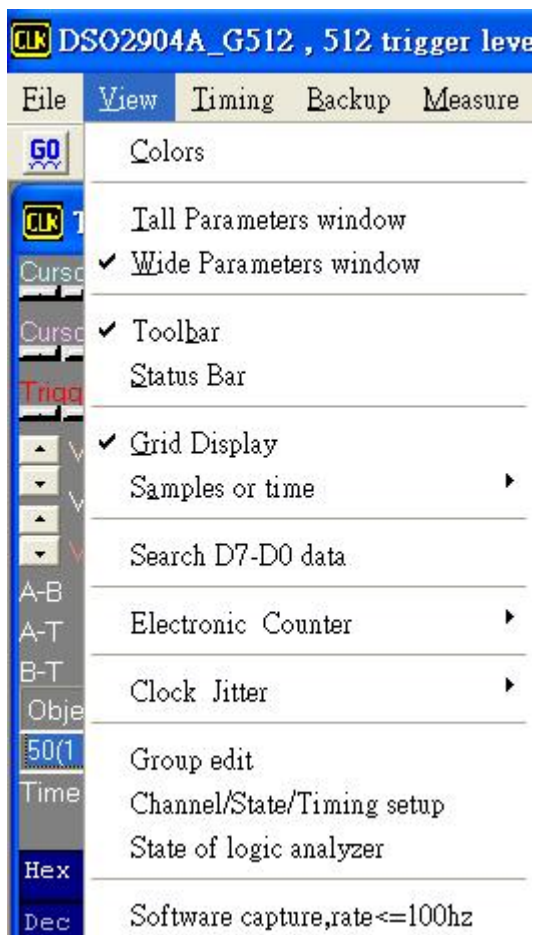
## Print Setup command (File menu)

Print Setup dialog box allows you to configure the printer.

## Exit command (File menu)

Use this command to end your session. You can also use the Close command on the application control menu.

## View menu commands



The View menu offers the following:

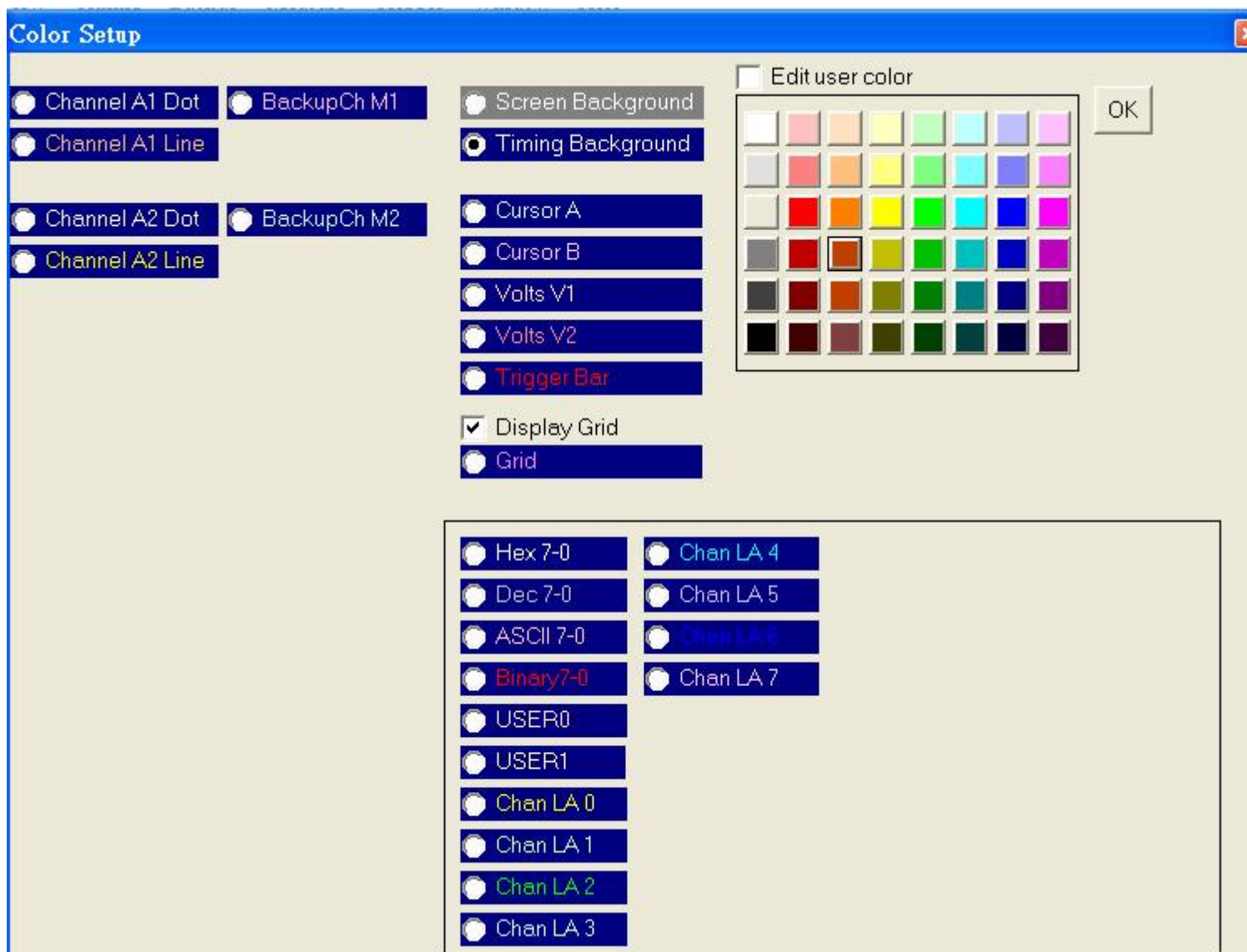
**Color** Change colors of the entire display. The current colors are displayed on screen. To change the color of an item select it from the pick list. Then use the color palate to pick a new color.

**Note: Items that are the same color as the background will not be visible.**

Channel names can edit at timing window directly.

Channel names should be edited at color form.

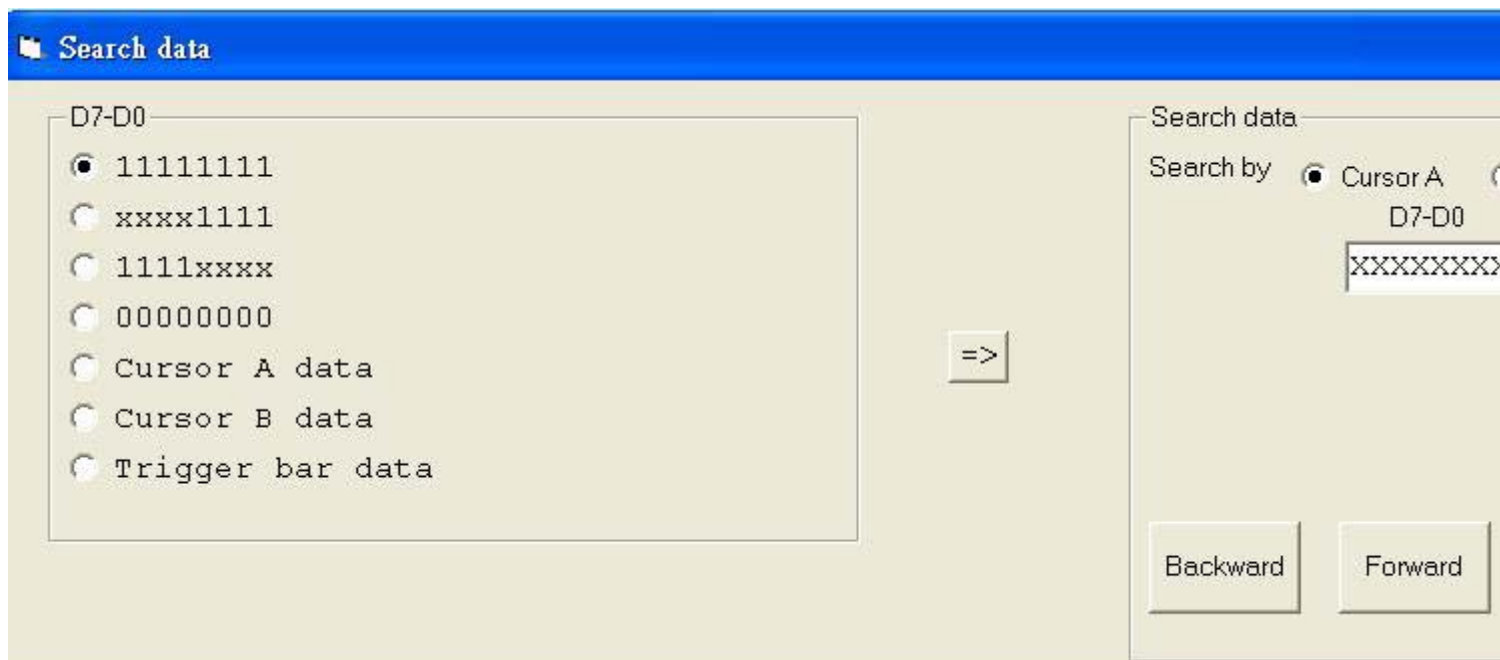
Color form also can set all cursor color.



- Tall parameters window    Show parameter in tall way.
- Tall parameters window    Show parameter in wide way.
- Tool Bar    Show or hide Tool Bar.
- Status Bar    Show or hide Status Bar.
- Grid    Show or hide grid on analog display.
- Time or Samples    For Timing display, display Time like as 12.34ms, or display how many samples.
- Trigger word    Set Trigger word for digital channel D0 ~ D7.

### Search by cursor

Select one of cursor A, B, T and specific word. or edit search word directly.  
 It will search all memory and channel after Push forward or backward.

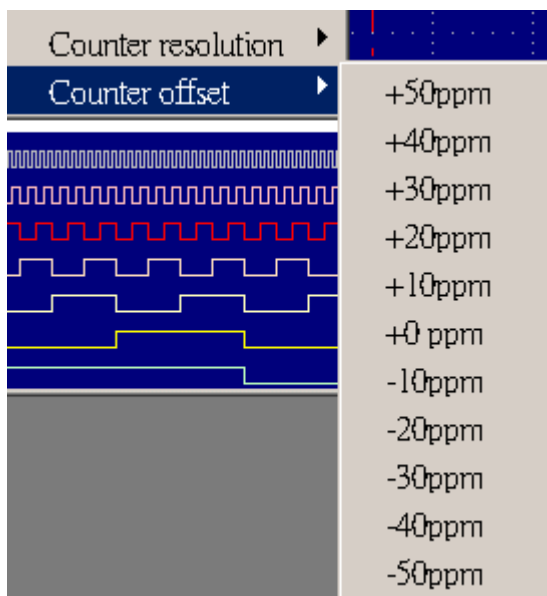
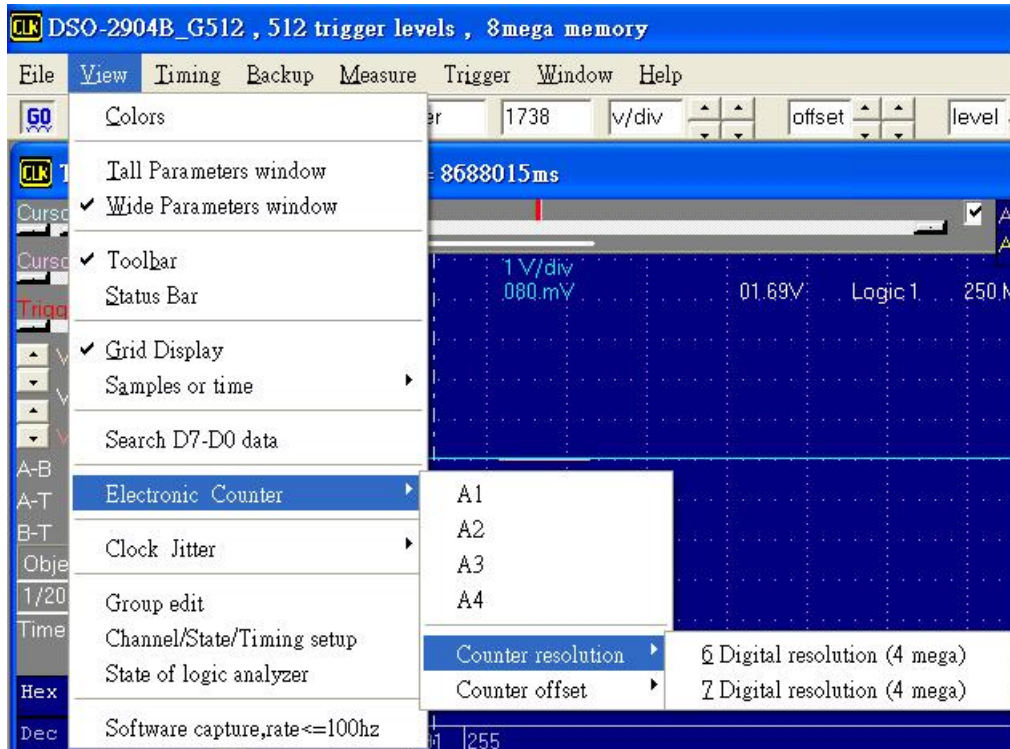


### Search by group

The same is true for search by group after selecting search group check item. It uses group definition to quickly edit search word.

## Electronic Counter

DSO29xxA/B support high accuracy and high resolution electronic counter base on oscillator inside. It can reach 7 digits resolution by selecting large memory one of 512K, 1Mega. It also has frequency calibration offset. user need use atomic clock to make sure you have a extra high accuracy clock to calibrate.



## Clock Jitter Analyze

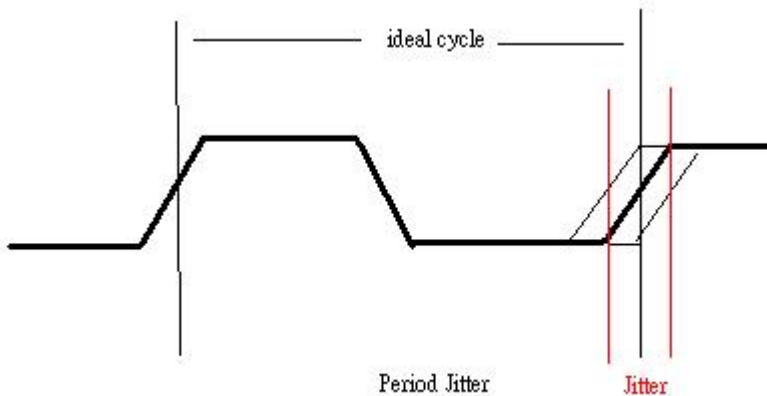
DSO29xxA/B support high accuracy Clock Jitter Analyzer base on oscillator inside. it has following function.

M1 ← A1 Period Jitter, M2 ← A1 Cycle to Cycle Jitter.

M1 ← A2 Period Jitter, M2 ← A2 Cycle to Cycle Jitter.

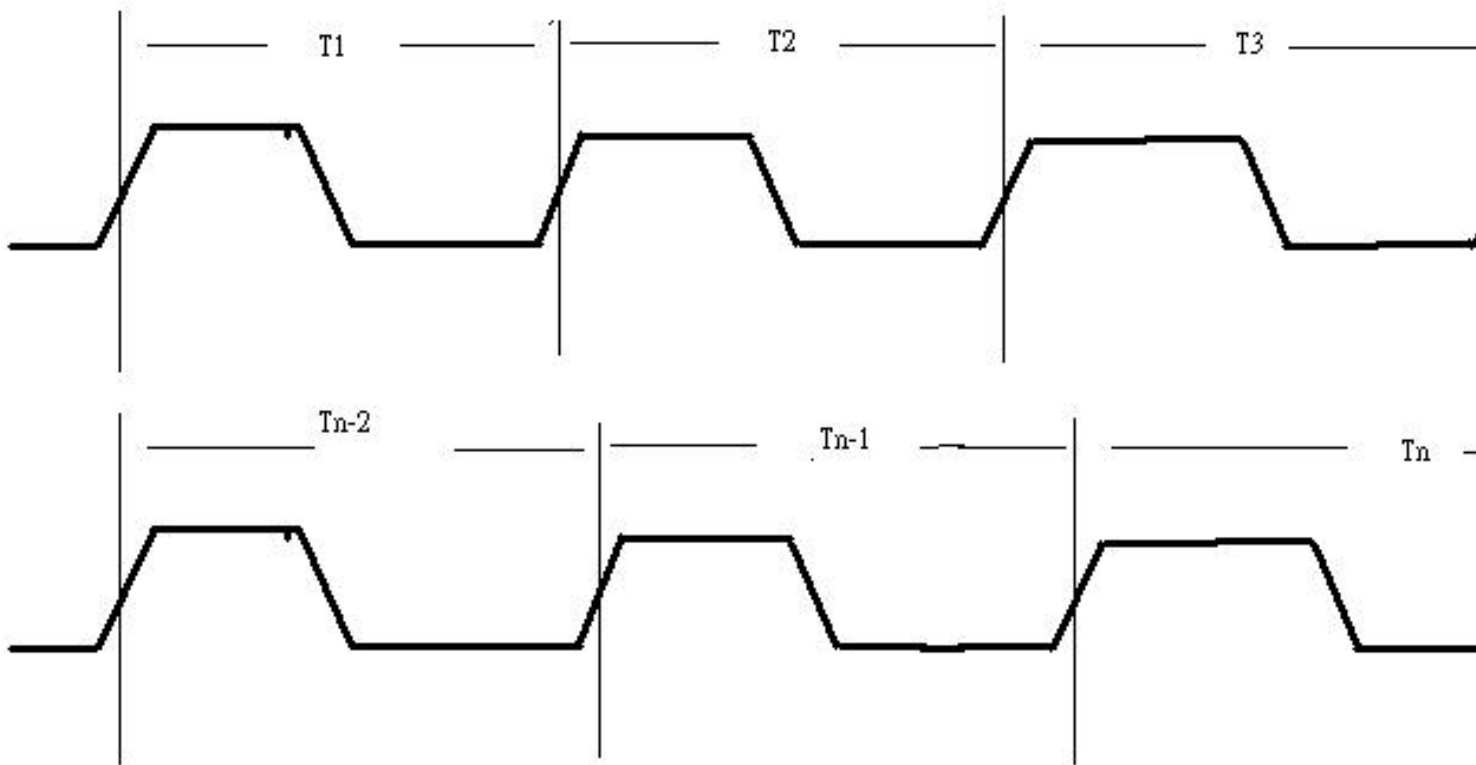
M3 ← A1 Time Interval Period Jitter.

M3 ← A2 Time Interval Period Jitter.



Period jitter is maximum change deviation in a clock transition from a ideal clock. This Software support two reference ideal clock. One is user input interval period value (M3← A1 Time Interval Period Jitter). another is program automatic search all memory to get mean clock period (M1← A1 Period Jitter). then put jitter to every clock cycle in backup memory.





cycle to cycle period jitter is the change in a clock transition from its corresponding position in the previous cycle.

cycle to cycle Jitter  $j1 = t2 - t1$

cycle to cycle Jitter  $j2 = t3 - t2$

Long term period jitter is the change in a clock transition from first clock to end of clock in memory compare to ideal clock.

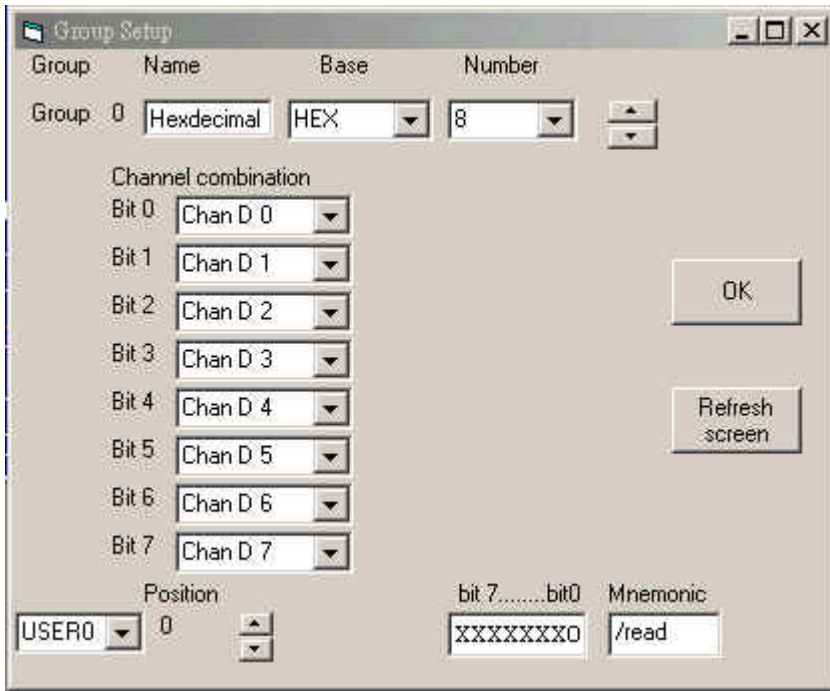
it can get Long term period jitter T1 from diagram after choose M3 ← A1 Time Interval Period Jitter. it also shows the first and ending lock position.

## Setting up group

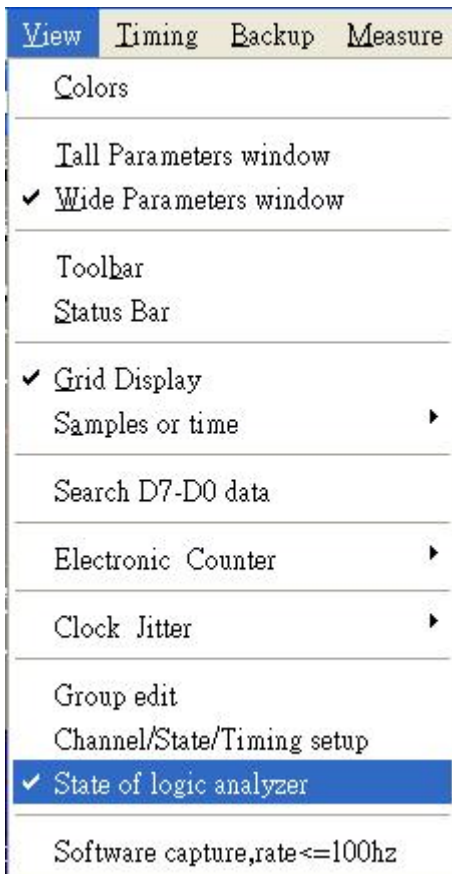
set following after select group edit.

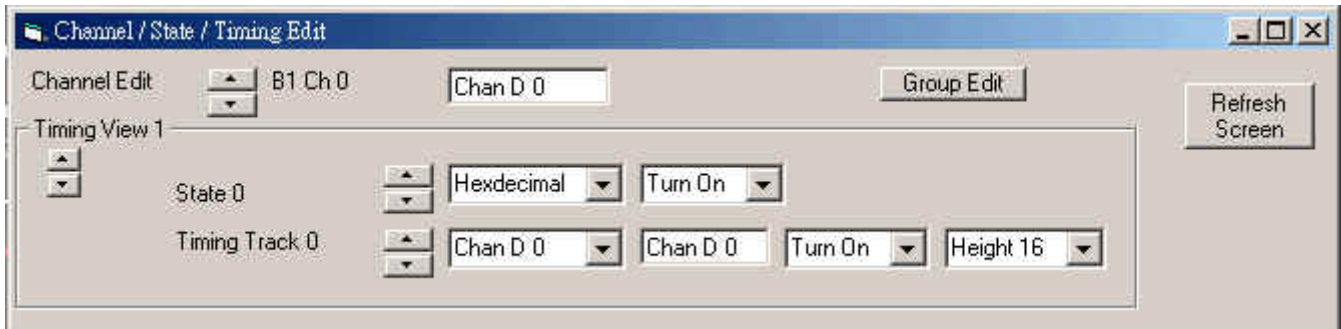


- 1). Select which group to display. Groups can be in different bases.
- 2). Set Base.
- 3). Set channel combination.



## Setting up the state window





Setting up the state / timing display.

- 1). Set group.
- 2). Select which group to display. Groups can be in different bases.
- 3). Select display channel on or off. Timing display also can define timing height.

### Capture by software

DSO use internal clock to capture hardware to buffer. It will wait very long time to filling buffer when selecting low frequency clock rate like 100hz,50hz....1hz.

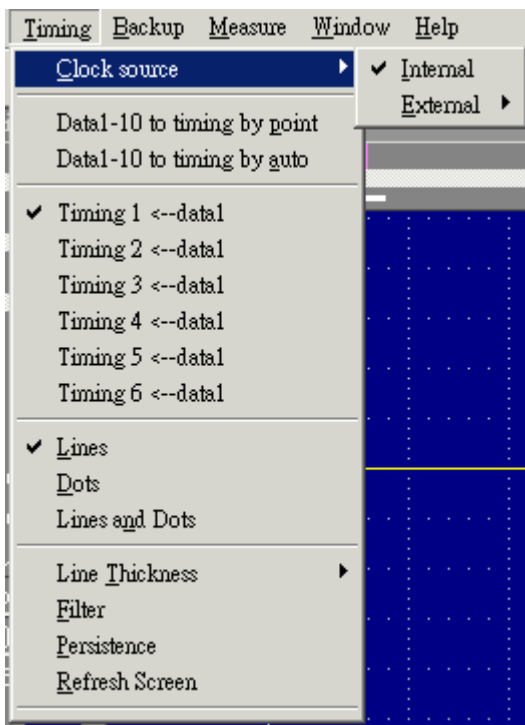
The screen is unchanged during capture data. So some DSO use software capture data, show data immediately after capturing data. but in this situation, it will lost trigger function. So, we still maintain hardware capture by internal clock when using low clock rate.

It support a option, it can turn hardware capture to software capture after selecting software capture in below menu.

**Caution: don't run other program when use this function, and use fast computer to get high accuracy.**



## Timing menu commands



**Clock source** Select internal clock or external clock (D0 channel), set rising or falling edge for set external clock.

**Data1-10 to timing by point** User point which timing memory should be placed for captured data, it can let user captured 2 or 10 set different data to buffer and display, the sequence pointed by user, this function let user have 128k x10 or 256k x10 memory size.

**Data1-10 to timing by auto** The same is true for it, it automatically capture 2 or 10 sets data to buffer, the sequence is 10, 9, 8, 7, 6, 5, 4, 3, 2 then 1.

**Timing1-10<-data** Activate timing display. we suggest user use more than 1 screen to get better show

### Lines

Checking this option will display only the lines connecting the data points of the analog waveform. Logic data is unaffected by this option.

### Dots

Checking this option will display only the data points of the analog waveform. Logic data is unaffected by this option.

### Lines and Dots

Checking this option will display the lines connecting the data points and the data points of the analog waveform. Logic data is unaffected by this option. This is the slowest display option.

**Note: The lines and dots can be set to different colors.**

**Filter** Filter is an averaging function and is defined as:

$$\text{Display Point data1} = (\text{data0} + 2 * \text{data1} + \text{data2}) / 4$$

**Persistence** Data from previous captures remains on screen and is overlaid by new data.

**Refresh screen** Clear/refresh the display (useful in persistence mode).

### Persistence mode (Timing menu)

Turns on or turns off Persistence Mode. In this mode, with each acquisition of data, all Previous waveform data remains on the display area. This mode is useful for finding abnormal waveform those occur infrequently. Persistence Mode is also useful for evaluating signal jitter. Scroll, zoom, change display width, or any update of the screen will erase all of the old data and will initiate a new Persistence Mode capture.

To turn Persistence On, select Persistence from the View Menu. To turn Persistence Off, select Persistence again from the View Menu.

All old data can be cleared, or erased from the display by selecting Refresh screen from the

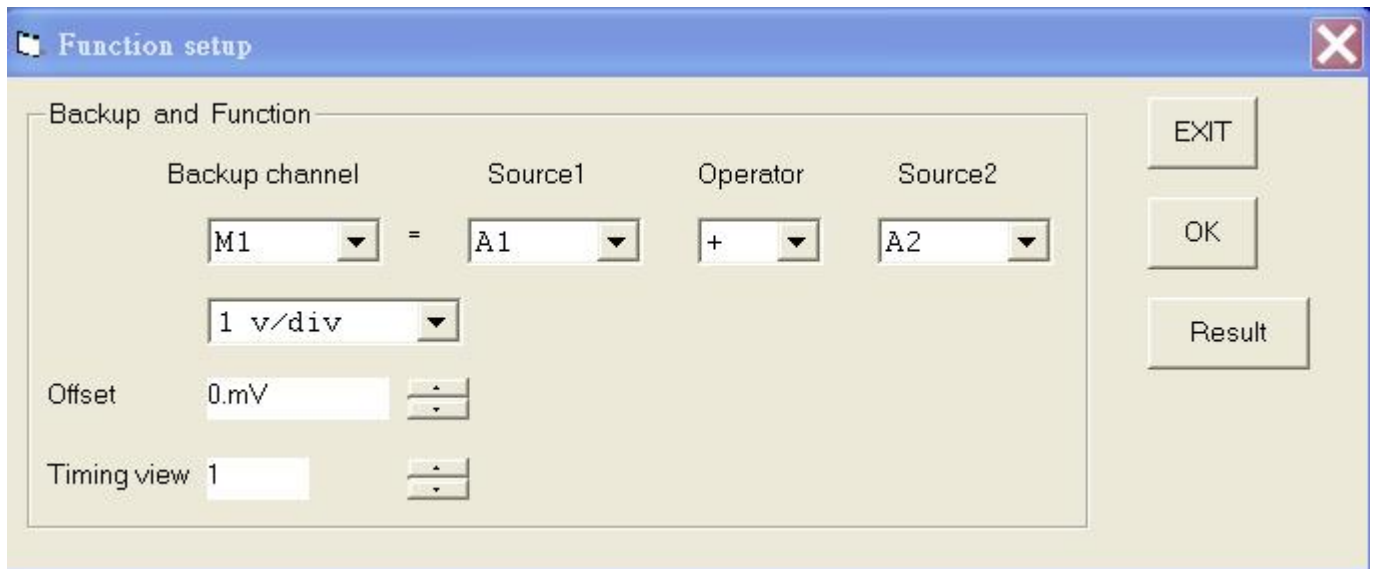


View menu, by clicking on the 'refresh' button from the toolbar.

**Note: scroll, zoom, change display width, or any update of the screen will erase all of the old data.**

See also: View menu, Toolbar, clear button.

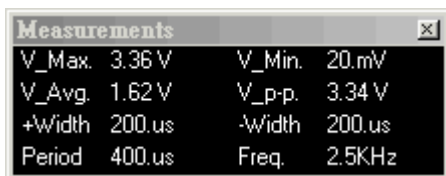
### Backup menu commands



Backup Analog Channel A1, 2, 3, 4 to M1, 2, 3, 4 channel:

M1= A1 + A2 Store channel A1 with v/div plus channel A2 with v/div to M1 (memory 1) for current timing view.

### Measurements menu commands (Window menu)



Automatic measurements on input waveforms can be performed. These include frequency, 7 period, rise time, fall time, min, max, area, ....

Pulse parameter measurements are performed as specified by ANSI / IEEE std 181-1977 IEEE Standard on Pulse Measurement and Analysis by Objective Techniques. Up to 10 signal parameters can be measured, tested, and displayed simultaneously. To setup a measurement, select the **Measurements (Setup menu)** and choose one of the tests to setup (1 to 10)....

## Parameter measurements

**Area** Sum of all voltages \* sample time.

Cursor A (time) Position of Cursor A in time.

Cursor B (time) Position of Cursor B in time.

V1Bar (voltage) Position of V1Bar in voltage.

V2Bar (voltage) Position of V2Bar in voltage.

trigger cursor Position of trigger cursor in time.

A - B (time) Time difference between Cursor A and Cursor B.

V1 - V2 (voltage) Voltage difference between V1Bar and V2Bar.

A - T (time) Time difference between Cursor A and trigger cursor.

B - T (time) Time difference between Cursor B and trigger cursor.

**V\_max.** Maximum voltage.

**V\_min.** Minimum voltage.

**peak to peak** The difference between maximum and minimum voltages.

**Average** Average of minimum and maximum voltages.

**rms SQRT**  $( (1/ \# \text{ samples}) * (\text{sum} ((\text{each voltage}) * (\text{each voltage}))) ) )$

**rms (AC)**  $\text{SQRT}( (1/ \# \text{ samples}) * (\text{sum} ((\text{each voltage} - \text{mean}) * (\text{each voltage} - \text{mean}))) ) )$

**period** Average time for a full cycle for all full cycles in range.

**duty cycle (rising)** A ratio of width (rising) to period. starting with a positive edge using midpoint.

**duty cycle (falling)** A ratio of width (falling) to period. starting with a negative edge using midpoint.

**risetime(10..90)** Average time for a rising transition between the 10% to the 90% points.

**risetime(20..80)** Average time for a rising transition between the 20% to the 80% points.

**falltime(10..90)** Average time for a falling transition between the 10% to the 90% points.

**falltime(20..80)** Average time for a falling transition between the 20% to the 80% points.

**pulse width (positive)** Average width of positive pulses measured at 50% level.

**pulse width (negative)** Average width of negative pulses measured at 50% level.

**frequency** Average frequency of waveform.

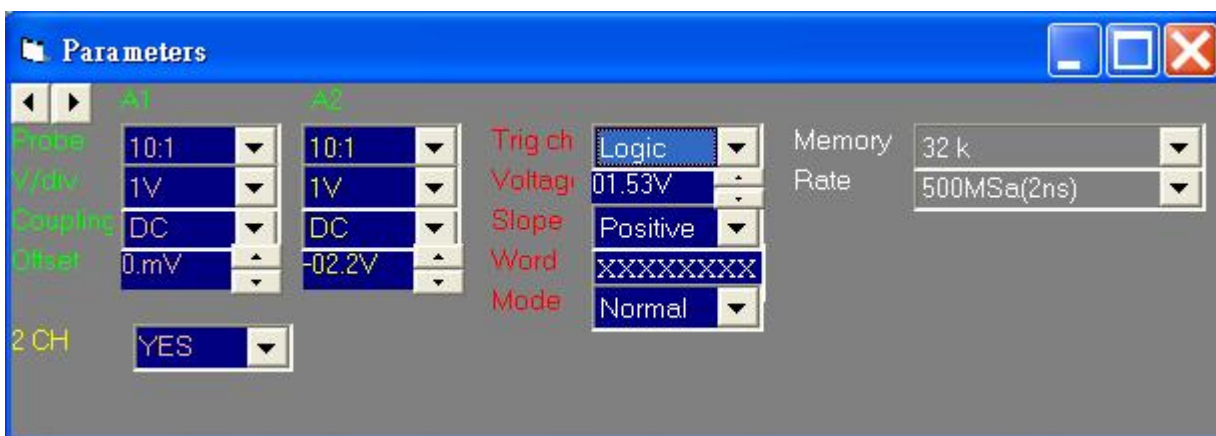
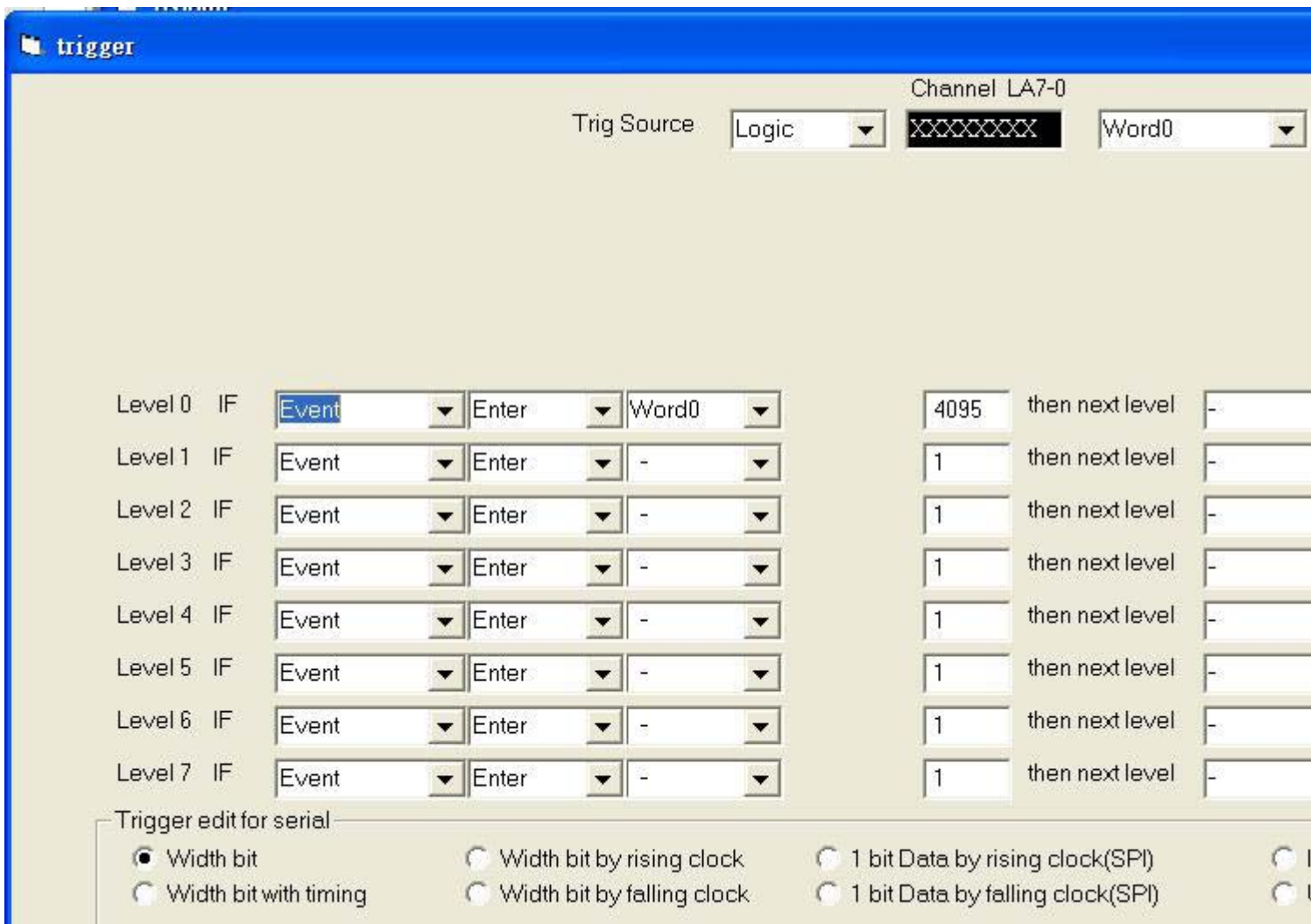
## Trigger menu commands

### Trigger levels specifications of DSO-29xxA/B Series

<p><b>DSO-2904A-G2</b>  <b>DSO-2902A-G2</b>  <b>DSO-2904A-M2</b>  <b>DSO-2902A-M2</b></p> <p>2 Trigger Levels</p>	<p>with IF word xx happen yy times then next level else go to level 0 trigger structure.</p> <p>4095 event counter/every level .</p> <p>1 to 4095* (1 sec to 10nsec) delay time /every levels.</p> <p>-----</p> <p>width pulse detect from &lt;15 nsec to 4095 sec / every levels..</p> <p>trigger before delay (YES)</p> <p>SPI interface (NO)</p> <p>serial trigger (RS232...) (NO)</p> <p>I<sup>2</sup>C serial trigger (NO)</p>
<p><b>DSO-2904B-G512</b>  <b>DSO-2904A-G512</b>  <b>DSO-2902A-G512</b>  <b>DSO-2904A-M512</b>  <b>DSO-2902A-M512</b></p> <p>512 Trigger Levels</p>	<p>with IF word xx happen yy times then next level else go to level 0 trigger structure .</p> <p>4095 event counter/every level .</p> <p>1 to 4095* (1 sec to 10nsec) delay time /every levels.</p> <p>width pulse detect from &lt;15 nsec to 4095 sec /every levels..</p> <p>trigger before delay (YES)</p> <p>SPI interface (YES)</p> <p>serial trigger (RS232...) (YES)</p> <p>I<sup>2</sup>C serial trigger (YES)</p> <p>all kind of trigger (YES)</p> <p>It is universal trigger structure.</p>

A trigger word is the pattern that the Logic Analyzers needs to see before it will start to acquire data. The trigger word is made of a series of "1", "0" and "x" (don't care) bits.

It can set at trigger form or parameters form as following.



Ch7...0

Edit pattern for channels 7 to 0

Logic

Trigger if condition is true or false.

"Enter" logic need trigger condition from false to true.

"Exit" logic need trigger condition from true to false.

### How to set trigger word

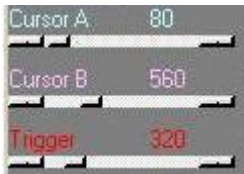
1). You can edit all 8 channels at a time.

Edit the pattern: The LSB is to the right. Each bit can be set to "0", "1" or "x" (don't care, true, false).

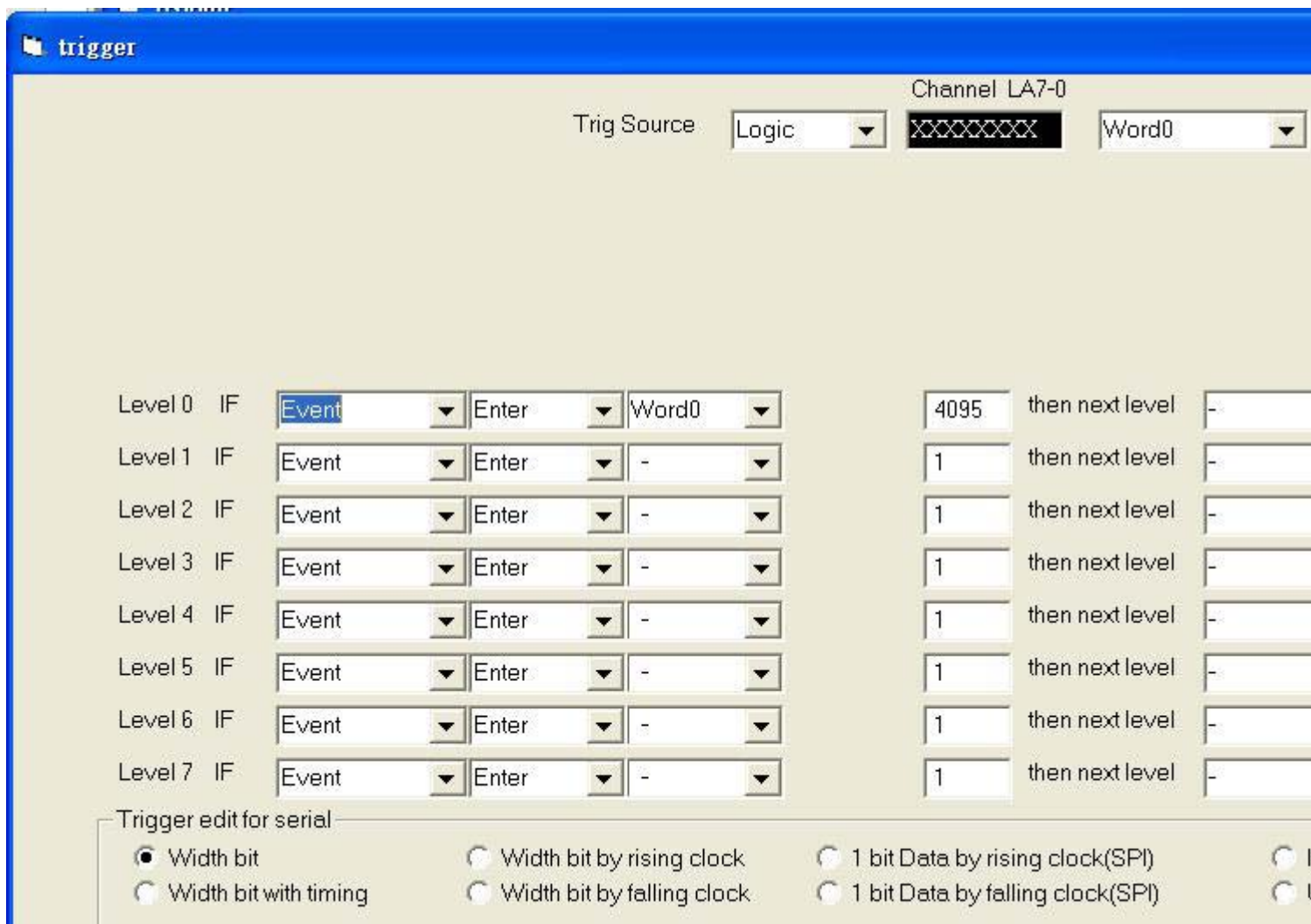
2). You can set the trigger logic to "Enter" (trigger when pattern matches) or "Exit" (trigger when pattern stops matching).

### Trigger position

The trigger position defines how much data is captured prior to the trigger event and how much data stored after it. You set the Trigger position by moving the [trigger cursor](#). This feature allows you to see the data that led up to the trigger as well as what happened after the trigger.



## Trigger level



This DSO29xxA/B support 2, 512 trigger levels. Depend on which model user bought it.

All trigger source can come from analog channel A1~A3 or 8 channel logic analyzer. The following chapter will describe it by logic analyzer channel only.

Because logic world now is very complex, like SPI, RS232, I<sup>2</sup>C.... need a lot of trigger level to complete it. Every trigger level support " if xx happen yy times then next level else go to level 0".

Event: allow trigger happen after match trigger condition max 4095 times delay: wait 1 to 4095\*(1 sec to 10nsec).

<Pulse Width: Detect pulse width small than xx sec.

<Pulse Width: Detect pulse width big than xx sec.

You can set the trigger logic to "Enter" (trigger when pattern matches) or "Exit" (trigger when pattern stops matching).

Two trigger check be selected "trigger group" and serial trigger.

Trigger group check: Select which base you want to edit in.

Serial trigger: 7 kind of serial trigger can be selected as following:



## Width bit

Tradition logic analyzer only supports 1 trigger level. Advance logic analyzer can let this trigger word pass n time.

n =1 to 4095.

In the following example, it will trigger if condition trigger word 55 happen 10 times.

like as 77,44,22,55,66,55,66,55,66,55,66,55,44,55,33,55,22,55,22,55,77,55 ← trigger here

The screenshot shows a software interface for configuring a trigger. At the top, the window title is 'trigger'. On the right, it says 'Channel LA7-0'. Below this, there is a 'Trig Source' dropdown menu set to 'Logic', a text box containing the binary value '01010101', and a 'Word0' dropdown menu.

The main configuration area consists of eight levels (Level 0 IF to Level 7 IF). Each level has three dropdown menus: 'Event', 'Enter', and 'Word0'. To the right of these dropdowns are input fields for a count and a 'then next level' dropdown. For Level 0, the count is '10' and 'then next level' is '-'. For Levels 1 through 7, the count is '1' and 'then next level' is '-'. There are also empty dropdown menus to the right of the 'then next level' dropdowns.

Below the levels is a section titled 'Trigger edit for serial'. It contains several radio button options: 'Width bit' (selected), 'Width bit with timing', 'Width bit by rising clock', 'Width bit by falling clock', '1 bit Data by rising clock(SPI)', '1 bit Data by falling clock(SPI)', and two partially visible options '1 bit Data by rising clock(SPI)' and '1 bit Data by falling clock(SPI)'. There are also two 'Clear trigger' buttons.

At the bottom, there is a list of trigger words. The first word is '0', followed by '55', and then three empty boxes. Each word has a '8 Bit' dropdown menu next to it. To the right of this list are two 'Go to level 0' buttons and a vertical scrollbar.

It also can set delay n time, n =1 to 4095. time delay unit from 10nsec to 1 sec. Some time We call this function as TRIGGER BEFORE DELAY.

It is useful when we need to look data after reset signal a long period. In next diagram. It trigger after 10 times trigger word 55 with 10nsec\*100 time delay like as

77,44,22,55,66,55,66,55,66,55,66,55,44,55,33,55,22,55,22,55,77,55 ----- 1 u sec delay ← trigger here



At this time all DSO29XXA/B model can work well because it only use two trigger levels to complete.

DSO29XXA/B has 2,512 trigger levels model.

It needs more than 2 trigger levels to complete next diagram example.

The following model can work for it. It is 512 trigger levels model.

**DSO-2904A-G512**

**DSO-2904B-G512**

**DSO-2902A-G512**

**DSO-2904A-M512**

**DSO-2902A-M512**

A serial of width bit stream like 33 follow 55 follow 77.

it will not trigger if data stream is 33,66,55,77.

trigger

Channel LA7-0

Trig Source

Level 0 IF	<input type="text" value="Event"/>	<input type="text" value="Exit"/>	<input type="text" value="Word0"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>
Level 1 IF	<input type="text" value="Event"/>	<input type="text" value="Match"/>	<input type="text" value="Word1"/>	<input type="text" value="1"/>	then next level	else go to
Level 2 IF	<input type="text" value="Event"/>	<input type="text" value="Exit"/>	<input type="text" value="Word1"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>
Level 3 IF	<input type="text" value="Event"/>	<input type="text" value="Match"/>	<input type="text" value="Word2"/>	<input type="text" value="1"/>	then next level	else go to
Level 4 IF	<input type="text" value="Event"/>	<input type="text" value="Enter"/>	<input type="text" value="-"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>
Level 5 IF	<input type="text" value="Event"/>	<input type="text" value="Enter"/>	<input type="text" value="-"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>
Level 6 IF	<input type="text" value="Event"/>	<input type="text" value="Enter"/>	<input type="text" value="-"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>
Level 7 IF	<input type="text" value="Event"/>	<input type="text" value="Enter"/>	<input type="text" value="-"/>	<input type="text" value="1"/>	then next level	<input type="text" value="-"/>

Trigger edit for serial

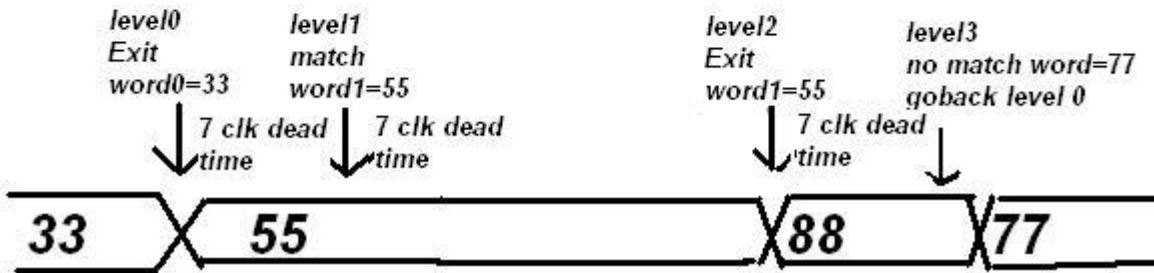
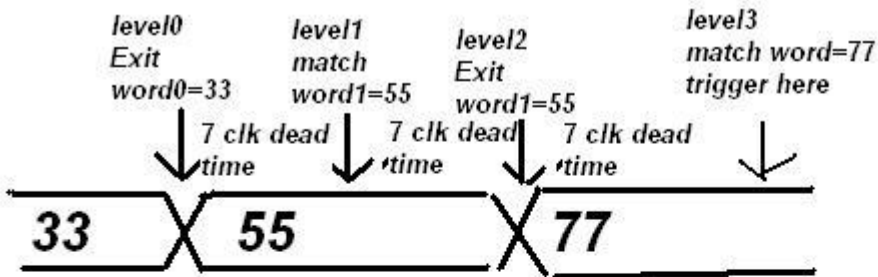
Width bit     
  Width bit by rising clock     
  1 bit Data by rising clock(SPI)     
  1 bit Data by falling clock(SPI)

Width bit with timing     
  Width bit by falling clock

0

Clear trigger

Go to level 0



The dead time of trigger level to next level is 7-10 clocks.

The dead time should be double when it is selected reducing channel mode.

## Width bit with timing

Channel LA7-0

Trig Source Logic 00110011 Word0

Level	IF	Event	Enter	Word	Delay	Count	Action
Level 0	IF	Event	Enter	Word0	1	1	then next level
Level 1	IF	Delay			10ns	24	then next level
Level 2	IF	Event	Match	Word1	1	1	then next level else go to
Level 3	IF	Delay			10ns	14	then next level
Level 4	IF	Event	Match	Word2	1	1	then next level else go to
Level 5	IF	Event	Enter	-	1	1	then next level
Level 6	IF	Event	Enter	-	1	1	then next level
Level 7	IF	Event	Enter	-	1	1	then next level

Trigger edit for serial

Width bit
  Width bit by rising clock
  1 bit Data by rising clock(SPI)
  U

Width bit with timing
  Width bit by falling clock
  1 bit Data by falling clock(SPI)
  U

Period 1ns 200

0

33	8 Bit
55	8 Bit
77	8 Bit
	8 Bit

Clear trigger

Go to level 0

A serial of width bit stream like 33 follow 55 follow 77 by some timing.

It is 200nsec interval in this case.

Trigger commend wait 300nsec after detect trigger word 33 then check it in 200sec every time. 300nsec mean cross trigger word 33 200nsec plus trigger word 55 200nsec /2, equal 300nsec. but system need 7 clock dead time to turn level to level, so it can set 240nsec and 140nsec instead.

The following model can work for it. It is 512 trigger levels model.

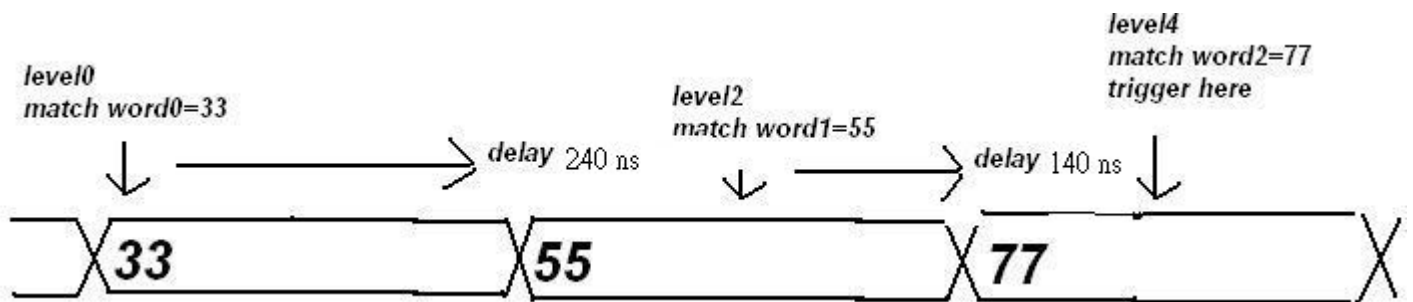
**DSO-2904A-G512**

**DSO-2904B-G512**

**DSO-2902A-G512**

**DSO-2904A-M512**

**DSO-2902A-M512**





## Width bit by rising (falling) clock

A serial of width bit stream synchronous with clock, channel 7 default as clock. channel 0~6 as data. Data flow 77, 00, 55 synchronous with channel 7 clock rising edge as following diagram. Word 3 set to 1xxxxxx

It detects data 77 after ch7 clock rising edge else go to trigger level 0 to judge continuously.

Channel LA7-0

Trig Source Logic X1110111 Word0

Level	IF	Event	Action	Word	1	then next level	
Level 0	IF	Event	Enter	Word3	1	then next level	-
Level 1	IF	Event	Match	Word0	1	then next level	else go to
Level 2	IF	Event	Enter	Word3	1	then next level	-
Level 3	IF	Event	Match	Word1	1	then next level	else go to
Level 4	IF	Event	Enter	Word3	1	then next level	-
Level 5	IF	Event	Match	Word2	1	then next level	else go to
Level 6	IF	Event	Enter	-	1	then next level	-
Level 7	IF	Event	Enter	-	1	then next level	-

Trigger edit for serial

Width bit  Width bit by rising clock  1 bit Data by rising clock(SPI)  1 bit Data by falling clock(SPI)

Width bit with timing  Width bit by falling clock

Chan LA7 As clock

0 77 7 Bit

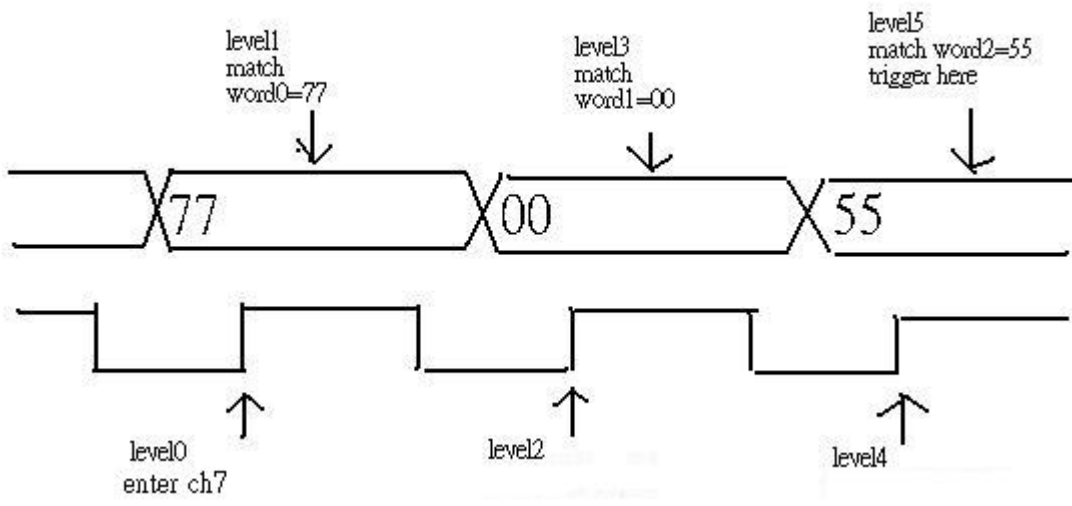
00 7 Bit

55 7 Bit

7 Bit

Clear trigger

Go to level 0



The same is true for falling clock.

The following model can work for it. It is 512 trigger levels model.

[DSO-2904A-G512](#)

[DSO-2904B-G512](#)

[DSO-2902A-G512](#)

[DSO-2904A-M512](#)

[DSO-2902A-M512](#)

## 1 Bit data by rising clock (SPI)

A serial of bit stream synchronous with clock.

LA0 default as data, LA1 default as clock, and LA2 default as chip select.

It is same as "width bit by rising clock".

but it detect one bit only when clock is rising.

trigger

Channel LA7-0

Trig Source Logic XXXXXXXX1 Word0

Level	IF	Event	Exit	Word	Match	Action
Level 0	IF	Event	Exit	Word2	1	then next level
Level 1	IF	Event	Enter	Word1	1	then next level
Level 2	IF	Event	Match	Word0	1	then next level else go to
Level 3	IF	Event	Enter	Word1	1	then next level
Level 4	IF	Event	Match	Word0	1	then next level else go to
Level 5	IF	Event	Enter	Word1	1	then next level
Level 6	IF	Event	No Match	Word0	1	then next level else go to
Level 7	IF	Event	Enter	Word1	1	then next level

Trigger edit for serial

Width bit  Width bit by rising clock  1 bit Data by rising clock(SPI)

Width bit with timing  Width bit by falling clock  1 bit Data by falling clock(SPI)

LA0 As Data, LA1 As Clock, LA2 as CS

0 33 8 Bit 8 Bit 8 Bit 8 Bit

Clear trigger

Go to level 0

it also can select LSB out first or MSB out first

for example a stream 001111, LSB out first mean data flow is 111100.

MSB out first mean data flow is 001111.

The same is true for falling clock.

The following model can work for it. It is 512 trigger levels model.

**DSO-2904A-G512**

**DSO-2904B-G512**

**DSO-2902A-G512**

**DSO-2904A-M512**

**DSO-2902A-M512**

## I<sup>2</sup>C

It is same as "one bit by rising clock".

a serial of bit stream synchronous with clock. LA0 default as data, LA1 default as clock in I<sup>2</sup>C format.

Level 0 ~ 1 is I<sup>2</sup>C start format.

The screenshot shows the 'trigger' software interface for configuring I<sup>2</sup>C levels. The window title is 'trigger'. At the top right, it says 'Channel LA7-0'. Below that, 'Trig Source' is set to 'Logic' and the trigger pattern is 'XXXXXXXX11'. A dropdown menu shows 'Word0'. The main area contains a table of 8 levels (Level 0 IF to Level 7 IF) with various settings for event, match, word, and action. Below the table is a section for 'Trigger edit for serial' with radio buttons for different trigger types. At the bottom, there is a list of levels with their addresses and bit widths, and buttons for 'Clear trigger' and 'Go to level 0'.

Level	IF	Event	Match	Word	Action	Next Level
Level 0	IF	Event	Exit	Word0	1	then next level
Level 1	IF	Event	Match	Word1	1	then next level
Level 2	IF	Event	Enter	Word3	1	then next level
Level 3	IF	Event	Match	Word2	1	then next level
Level 4	IF	Event	Enter	Word3	1	then next level
Level 5	IF	Event	No Match	Word2	1	then next level
Level 6	IF	Event	Enter	Word3	1	then next level
Level 7	IF	Event	Match	Word2	1	then next level

Trigger edit for serial

Width bit       Width bit by rising clock       1 bit Data by rising clock(SPI)       1 bit Data by falling clock(SPI)

Width bit with timing       Width bit by falling clock       1 bit Data by falling clock(SPI)       1 bit Data by rising clock(SPI)

0      LA0 As Data, LA1 As Clock, LA2 as CS

55	7 Bit	7bit Add
0	2 Bit	2 bit r/w+ack
f0	8 Bit	8 bit Command
0	1 Bit	1 bit ack

Clear trigger

Go to level 0

I<sup>2</sup>C need 73 trigger levels to complete trigger.

That is why DSO29XXA/B need design 512 trigger levels.

The following model can work for it. It is 512 trigger levels model.

**DSO-2904A-G512**

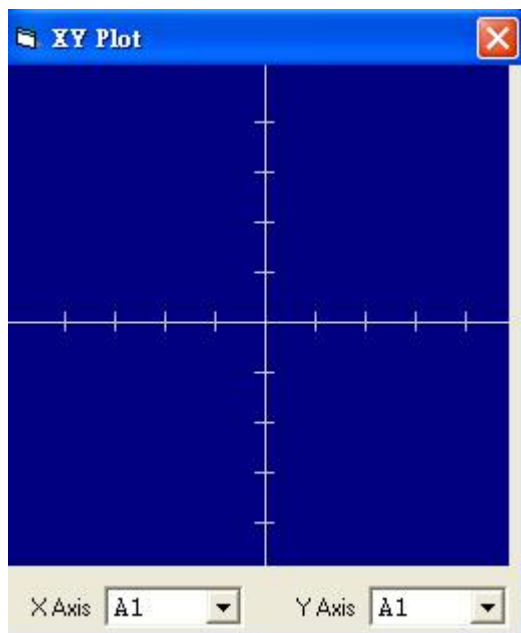
**DSO-2904B-G512**

**DSO-2902A-G512**

**DSO-2904A-M512**

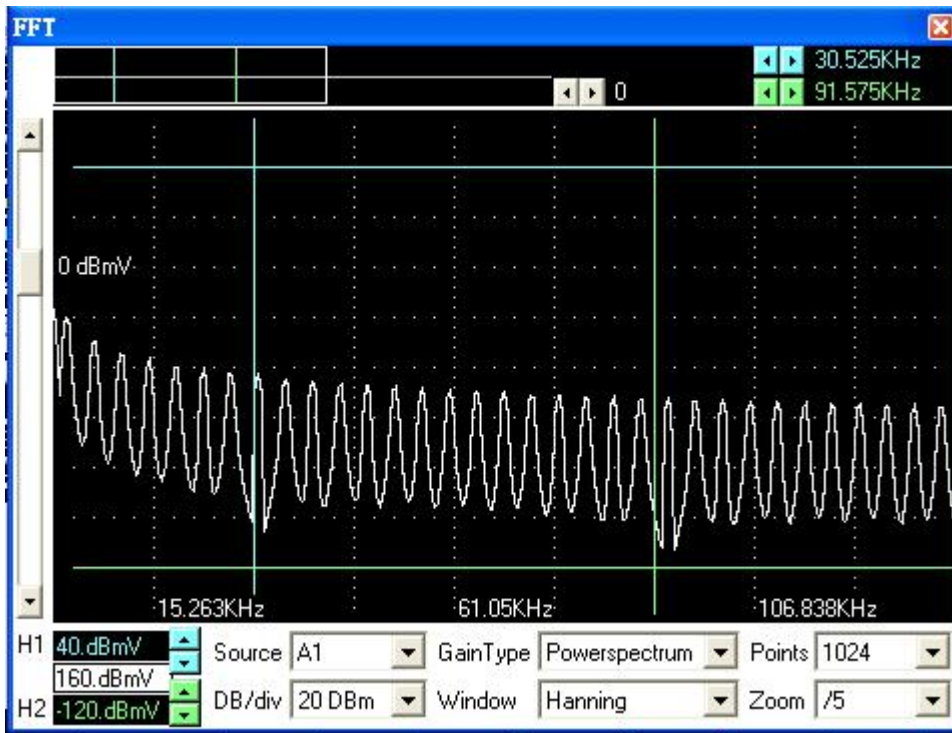
**DSO-2902A-M512**

### X-Y Oscilloscope plot screen



**An X-Y Plot allows you to graph one channel vs. another.**

## FFT commands (Window menu)



The FFT window allows control and display of FFT's.

The following controls are available:

Window Select the FFT window type: (Triangular, Hanning, Hamming, Blackman-Harris, Rectangular, Wetch and Parzen).

Sample points Select how many points the FFT will sample, points can't exceed memory depth.

Horizontal zoom Select horizontal zoom ratio.

The FFT routines will process the selected channel starting at Cursor A and continue until "Sample Points" number of points has been reached. If Cursor A is not within the buffer, start of buffer will be used.

Waterfall display shows successive FFT breakdowns simultaneously on the screen offset from each other. This creates a waveform that shows the frequency behavior overtime. Up to 10 FFT break downs are shown at one time with the oldest furthest back. Typical use include impulse response decay time in audio work.

To save FFT data go to File Save and choose a file type of "FFT".



Further information on FFT's can be found in the following sources:

Embedded Systems Programming magazine Volume 3, Number 5, May 1990  
Embedded Systems Programming magazine Volume 7, Number 9, Sept 1994  
Embedded Systems Programming magazine Volume 7, Number 10, Oct 1994  
Embedded Systems Programming magazine Volume 8, Number 1, Jan 1995  
Embedded Systems Programming magazine Volume 8, Number 2, Feb 1995  
Embedded Systems Programming magazine Volume 8, Number 5, May 1995  
Circuit Cellar Ink, The Computer Applications Journal Issue 52 Nov 1994  
Circuit Cellar Ink, The Computer Applications Journal Issue 61 Aug 1995  
Dr. Dobb's Journal Issue 227 Feb 1995

### Help menu commands

show our web site

<http://www.clock-link.com.tw>

## USB driver install

### Windows 2000 USB driver install

When USB2.0 control interface be connected to computer, screen will display as following:



Click Next to continue



Click Next to continue



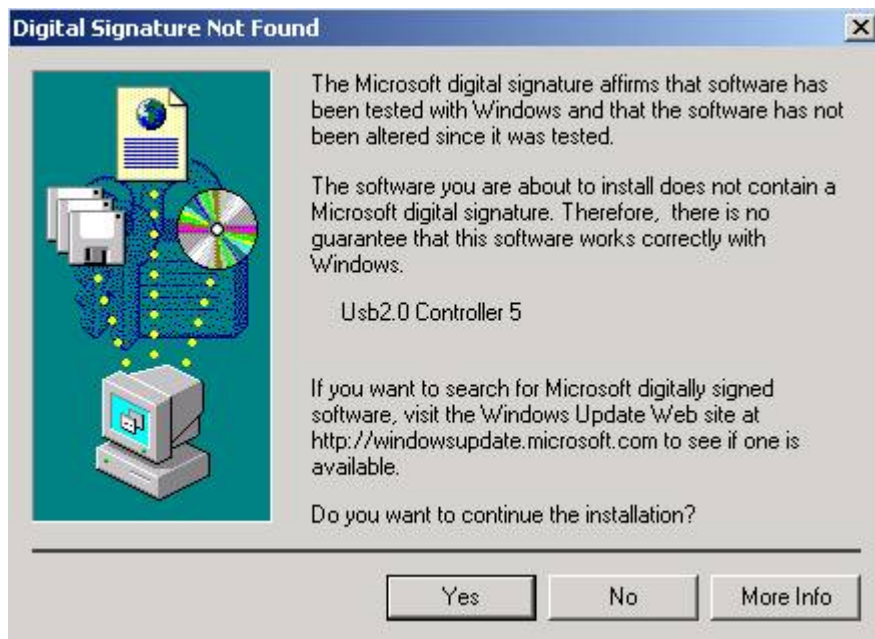
Click Next to continue



Edit or browse path to ...USB20driver\win2000\_XP\gene.inf  
(here F: is CD location, dso25216 may be dso29xxA/B)  
Press OK



Click Next to continue



Click Yes to continue



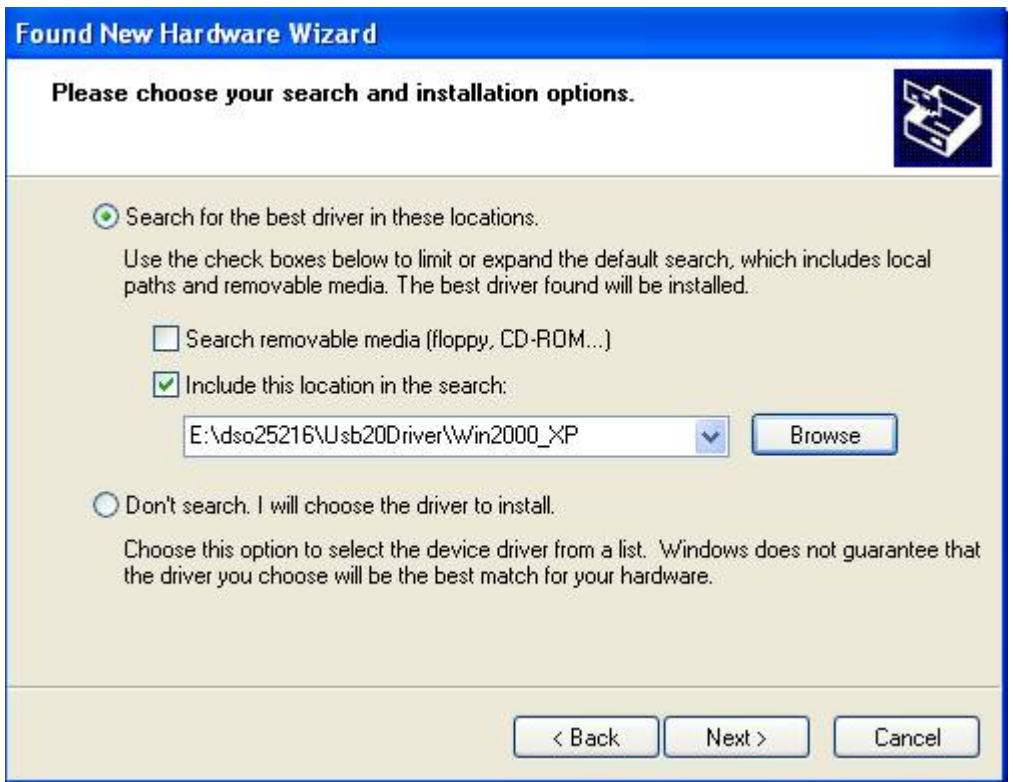
Completing install

Windows XP USB driver install

When USB2.0 control interface be connected to computer, screen will display as following:

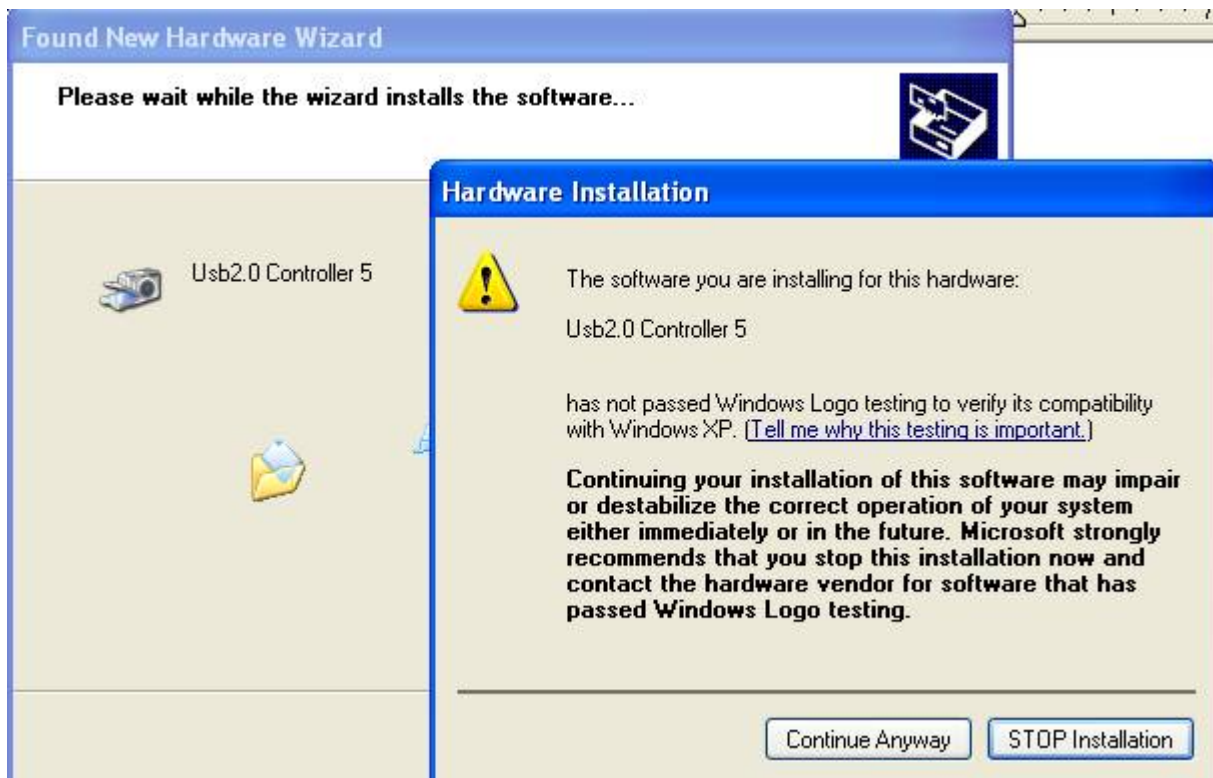


Click Next to continue



Edit or browse path to ...USB20driver\win2000\_XP\gene.inf  
(here E: is CD location, dso25216 may be dso29xxA/B)  
Click Next to continue





Press Continue Anyway

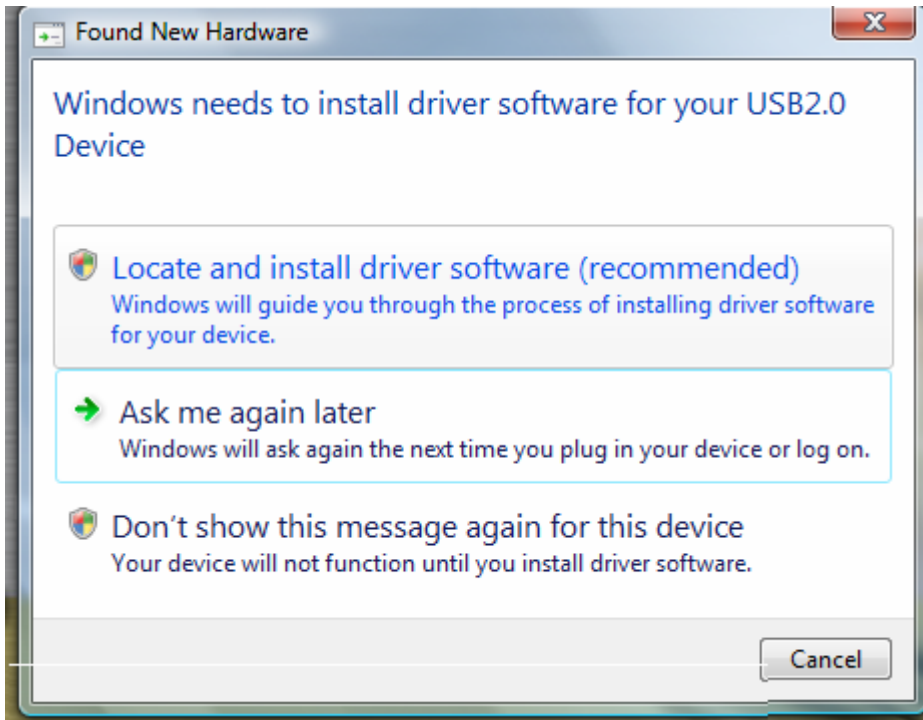


Completing install

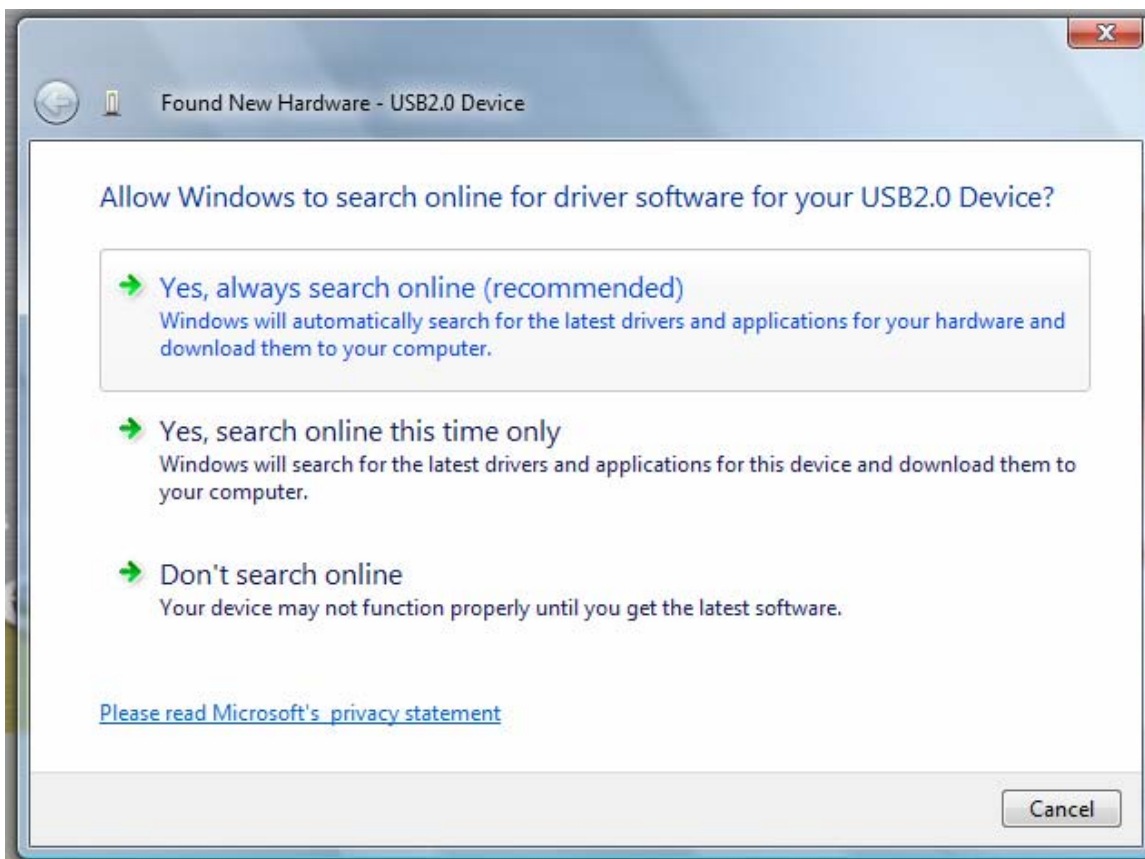


## Windows Vista USB driver install

When USB2.0 control interface be connected to computer, screen will display as following:



Press **Locate and install driver software (recommended)** Continue Anyway

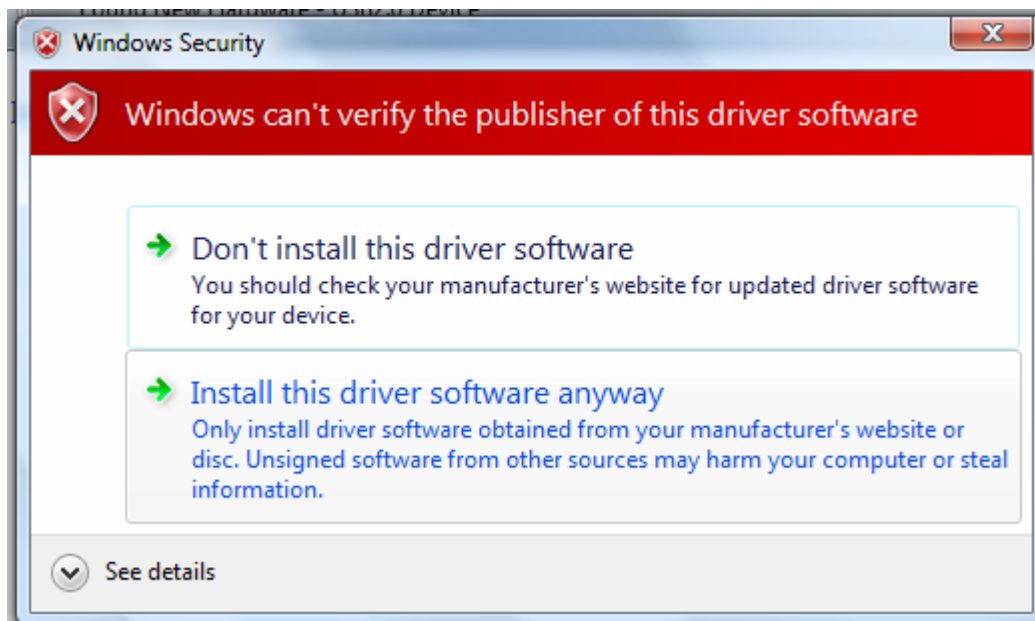


Press Continue Anyway



Press **Insert the disc that came with your USB2.0 Device**

Click Next to continue



Press **Install this driver software anyway** to Continue



Completing install

## Technical Support

Technical Support can be reached at



CLOCK COMPUTER CORP.

克拉克電腦股份有限公司

7F., No: 5. Lane 236, Section 5.

Roosevelt Road. Taipei, 116. Taiwan.

Phone: 886-2-29321685. 29340273. 29335954.

Fax: 886-2-29331687.

Email: [ufclockc@ms9.hinet.net](mailto:ufclockc@ms9.hinet.net)

## Software Updates

Software can be downloaded from our website.

Web: [www.clock-link.com.tw](http://www.clock-link.com.tw)

Software ©copyright

Clock Computer Corp.

7F., No: 5. Lane 236, Section 5.

Roosevelt Road. Taipei, 116. Taiwan.

All Right Reserved

Phone: 886-2-29321685. 29340273. 29335954.

Fax: 886-2-29331687.

Email: [ufclockc@ms9.hinet.net](mailto:ufclockc@ms9.hinet.net)

## APPENDIX

### Fast Fourier Transformations

#### Understanding FFT's Application

##### Introduction to FFT

Detecting and measurement are the basic functions of signal processing. In some application, It is important to analyze the periodic components of sinusoidal signals. FFT can serve as a tool to dismember a signal into its periodic components for analysis purposes.

#### Typical FFT of Applications

- 1). Antenna's directional diagram is a function of Fourier's Transformation of transmitting current.
- 2). On the front and back focus planes of convex lens in an optical system, the amplitude distribution is a Fourier's Transformation.
- 3). In Probability, a power density spectrum is a Fourier's Transformation.
- 4). In Quantum Theory, the Momentum and Location of a particle are connected through Fourier's Transformation.
- 5). In Linear System, Fourier Transformation is the product of System Transmission Function times Input Signal Fourier Transformation.
- 6). The Noise Analysis of signal detecting can be obtained through Fourier Transformation. These are all different applications, but they share the same analytical path which is Fourier Transformation.

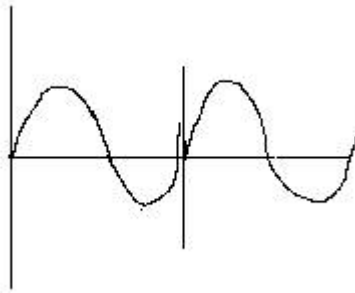
#### Fundamental principles

The Fourier Transformation Formula:

$$F(x) = (1/M) \sum_{K=0}^{2M-1} T_k \{ \cos [2\pi K(x/M)] + i \sin [2\pi K(x/M)] \}$$

- $T_k$  : The mapping data value for the Time Domain  
 $F(x)$  : The mapping data value for the Frequency Domain  
 $M$  : FFT data length  
 $X$  : The mapping data value for the Frequency Domain  
 $i$  : Imaginary number

The result of the formula is a vector of complex number. To show this on the screen, we resent the Frequency as horizontal coordinate, we make the leftmost position representing zero frequency that is the direct current component. Harris had pointed out that due to periodic characteristics of FFT, we could observe the phenomena of discontinuation at the boundaries of a finite length sequence. Therefore when we select randomly a signal sample, we could see points of discontinuation as a result of periodic expansion. This would produce leakage of Frequency Spectrum across the whole frequency band. To suppress the amplitude of sample around the boundaries, we must apply Weight function to it.



discontinuation

The Vertical Axis on the screen is expressed in terms of Magnitude, Decibel (db) and Logarithm.

### Magnitude

$$M_n = \sqrt{R_n^2 + I_n^2}$$

### Decibel (db)

$$\text{dbm Ps} = 10 \log (M_n^2 / M_{\text{ref}}^2) \\ 20 \log (M_n / M_{\text{ref}})$$

Here  $M_{\text{ref}}$  represents the reference value. It is define as 0 dbm or 0.316 V Peak-to-Peak Value or Effective Value 0.244V. It is define as 1.0 mW or it is defined as Resistance Value 50  $\Omega$ .

### Logarithm

In this mode, the display is expressed in decibel and the Measurement is expressed in Magnitude. Generally speaking, the Spectrum Processing System is expressed in the following formula:

$$Y(k) = \sum_{n=0}^{N-1} A(n) * X(k-n)$$

This formula utilizes Weighting function that is also known as Window.

For example, Hanning, Hamming, Blackman, Triangle and Rectangle.

These are further explained as following:

Hanning: It is  $\cos \alpha (\theta)$  type window, expressed mathematically as following:

$$a(n) = 0.5 [ 1 - \cos ( 2 \pi n / N ) ]$$

Hamming: It is similar to Hanning. The only difference is the coefficients for cosine term.

$$a(n) = 0.54 - 0.46 \cos ( 2 \pi n / N ) , n = 0, 1, 2, \dots, N-1$$

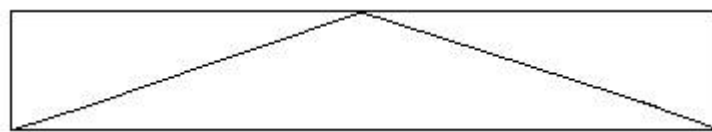
Blackman: It is the sum of a series of cosine terms. It is equal to Weighting function.

$$a(n) = \sum_{m=0}^M (-1)^m \cos \left( 2 \pi n m / N \right), n = 0, 1, 2, \dots, N-1$$

Triangle: Triangle Weighting Function, It is define as following:

$$a(n) = \begin{cases} 2n/N & n=0,1,2,\dots, N/2 \\ a(N-n) & n=(N/2)+1,\dots, N-1 \end{cases}$$

Rectangle: Rectangle Weighting Function



window coefficients



FFT. of window

Triangle Weighting Function

## The Characteristics of Weight Function

Window	Highest Side Lobe	3db Bandwidth (bins)	5db Bandwidth (bins)	Scallop Loss (db)
Hanning	-35	1.54	2.14	1.26
Hamming	-43	1.30	1.81	1.78
Blackman	-61	1.56	2.19	1.27
Triangle	-27	1.28	1.78	1.82
Rectangle	-13	0.89	1.21	3.92

## Functionality

The functionality of FFT can be achieved through the use of Utility. To use the Utility, We must set Channel/Math first, and then turn on FFT or Bw.sweep. We have to Bear that in mind that we could only analyze one channel at a time. After finish all the settings, we could see the screen showing FFT Channel. We describe the differences between FFT and Bw,sweep as follow:



## FFT

If we are using this mode, we are analyzing Channel A1 or Channel A2 in an Real Time Mode. To achieve the state of Synchronized Display. We are measuring time Domain while we are displaying Fourier Frequency Domain. In addition to that, we are able to analyze the stored signal easily. We only need to read the file on A1 Channel or A2 Channel, and then thrown on FFT. Whether we turn on Go or not is the difference in retrieving signals.

## BW.sweep

When turning on this mode, we are analyzing A1 Channel or A2 Channel through the Frequency Sweep Mode to achieve the State of Frequency Output. The user must apply additional frequency to the point of measurement. Also we have to increase the frequency from small to large gradually The finer the increment of frequency, the better the obtained data will be. Attention must be made to clear the Frequency and record Sweep Frequency again every time when we turn on Go to retrieve signal. When a user set the Mode, he can also set the FFT parameters. These are the required settings and they are explained as following:

## Source

From channel A1, A2, M1 or M2.

## Points

The points to be used are 256, 512, 1024, 2048, 4096, 8192, 16384 and 33678.

The user could think of these points as the scope of period. It can be understood that the more points we are taking, the better the results will be except the speed of it would be sacrificed. This is because the more you analyze the more time it takes to get the job done. It is an user's responsibility to make a judgment as to how a compromise should be achieved.

## Window

The window is also known as (Weighting function), it includes Hanning (a fixed value, generally Is peaking), Hamming, Blackman, Triangle and Rectangle. Please refer to the Fundamental Principle of this article. Due to periodic characteristics of FFT, we observe the discontinuation Phenomena around the boundaries of the finite length sequence. We must use Window to suppress the amplitude of the sample around the boundaries.

## Gain type

The Vertical Axis on the screen is expressed in terms of magnitude, Power Spectrum and Logarithm.

- 1. Magnitude:** The magnitude of the Polar Coordinates on the screen.
- 2. Logarithm:** in this mode, it display Power spectrum and the measurement is expressed as Magnitude.
- 3. Power Spectrum:** By formula  $P_s = 20 \log (M_n/M_{ref})$ .  
Here  $M_{ref}$  represents the Reference Value of 0.316V.

It is defined as 0 dbm. 0.316V p-p or 0.244V Effective Value also known as 1.0mW and the Resistance of 50  $\Omega$ .

The Vertical Axis on the screen is expressed in terms of Magnitude, db or Logarithm. These are explained as following:

**DB/div:** It is active only when Gain Type is set to Power spectrum. It is the unit of the Vertical coordinate. It represents DBm. There are four different scales: 5, 10, 20, 50 DBm.

**DB/offset:** It is active only when Gain Type is set to Power spectrum. It can change the position of FFT to make it going up and down.

To obtain the measured data, using Ctrl and Alt keys plus Left or Right key to measure frequency. to measure Magnitude, we can use Ctrl or Alt key plus Up or Down key. after that we can get the data displayed in the rectangle frame of FFTb parameter.

**Notes:** It is highly desirable to confirm the following items before doing analyzing:

- 1). If the measurement is for low frequency, we ought to make sure the frequency of the sample is not too large. Since the larger the frequency of the sample the large the Bandwidth. The sample frequency needs to be as twice as large as the frequency to be measured.
- 2). It is undesirable to use Logic Analyzer and FFT simultaneously.
- 3). It is desirable to have waveform on the Time Domain. The stronger the waveform the better the accuracy of the results.
- 4). To obtain the highest speed on FFT, we could turn all the channels off except for FFT.
- 5). The values of Depth can be 4K, 64K. When using 4K, we are using the real part and Imaginary part of the integer results of the Simulator Output for independent Probability Noise Signal. The MSE calculation results is obtained using 16 bits FFT processor with db less than 75 DB. If using db value greater than 75 DB, we are going to get too great an inaccuracy. When we are using 64K Depth, we are doing floating point calculation therefore the machine we use must have floating point math coprocessor.

## Certificate for DSO-29xxA/B Series

### Introduction

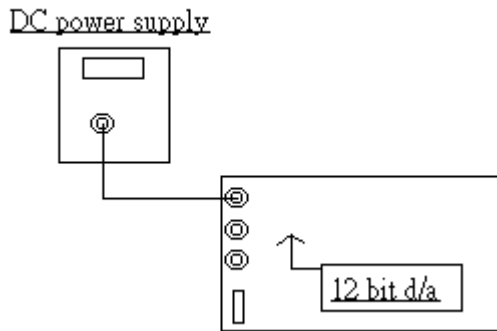
#### Calibration equipment used

HP 33120A Serial No: US36034172

Clock Computer Corp. LA-55160 Pattern Generator

HP 8648A Signal Generator Serial No: 3625U00521

This oscilloscope of DSO-29XXA/B has built in automatic calibration system include Hardware and software. in theory, user don't need use any instrument to adjust and calibration even after long term period using. the following is the compare diagram between traditions calibration and automatically calibration:



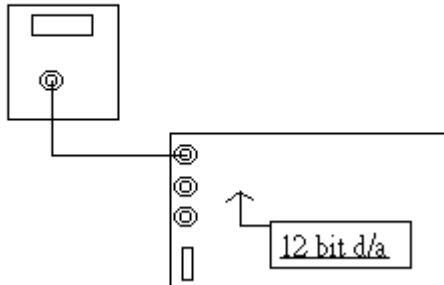
### Offset and amplify calibration

The tradition calibration for vertical offset and amplifier use a vertical source as oscilloscope Input source. DSO-29xxA/B use a high accuracy 12 bit d/a converter to instead it when every time push 'GO' button to capture data in first time and change rate every time. Set dc power supply to ground as oscilloscope input to test vertical offset or we call it vertical position for some other oscilloscope.our DSO-29xxA/B has a relay short to ground then capture data. it will use 12 bit d/a converter to adjust the level until DSO-29xxA/B can capture ground level at proper position. the same is true for amplifier adjust. Hardware and software should work on it to make sure the amplify has enough accuracy. the following is one of test result:

	Scale	Input	Result	Input	Result
Cha1	10 mv/div	-40 mv	-40.4 mv	40 mv	39.2 mv
Cha1	20 mv/div	-80 mv	-80.8 mv	80 mv	78.3 mv
Cha1	50 mv/div	-200 mv	-201 mv	200 mv	202 mv
Cha1	100 mv/div	-500 mv	-400.8 mv	400 mv	400 mv
Cha1	200 mv/div	-800 mv	-802 mv	800 mv	785 mv
Cha1	500 mv/div	-2000 mv	-2017 mv	2000 mv	2004 mv
Cha1	1 v/div	-4 v	-4.05 v	4 v	3.96 v

## Frequency Bandwidth

Sine wave generator



Let sine wave generator output peak to peak 600mv from 1 Hz to 80MHz.

Set DSO-29XXA/B proper sample rate and scale.

The result for DSO-29XXA/B should be in peak to peak 598mv to 602mv.

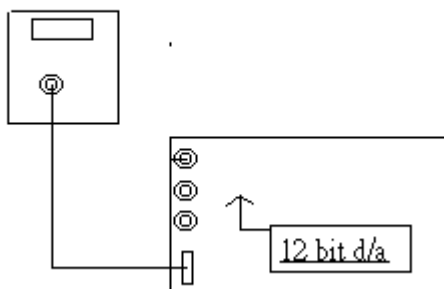
## Trigger position calibration

DSO-29XXA/B use software let trigger position always lock in 100% accuracy position, even

You zoom in the waveform, still lock in 100 % accuracy position.

## Logic Analyzer trigger test

**LA\_55160 pattern generator**



Use LA-55160 arbitrary pattern generator to output some specific word like 01010101 or 00001111 ... etc.

then set trigger word. it should get trigger word at proper position.