MSO3000 Series
Protocol + Logic Analyzer
Manual

MSO1000/2000 Series 3 in 1 Analyzer
(Protocol + Logic + Simple DSO)
Manual

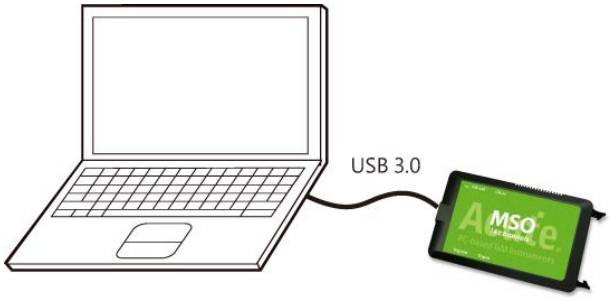
Publish: 2022/12

Table of Contents

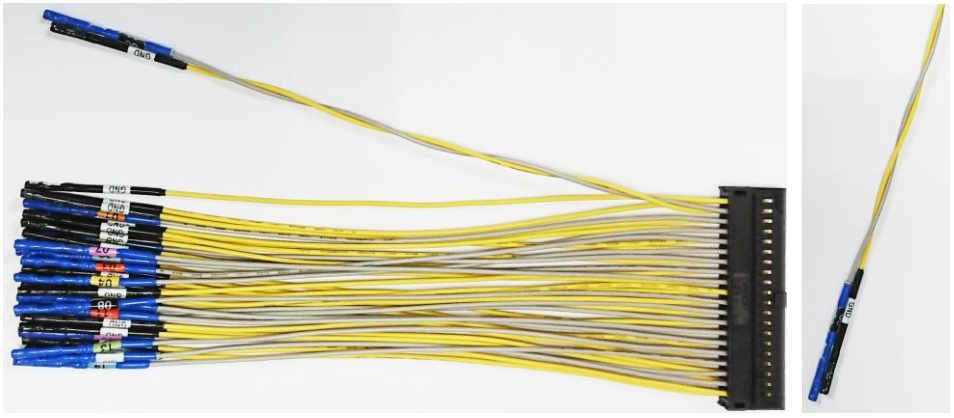
Chapter 1 Installation and Settings

Hardware installation

Connect the device to the computer with USB 3.0 cable (Pic.1). After confirming that the connection is complete, you can turn on the software and connect the signal cable to the object to be tested for observation. Before you start measuring, please make sure the GND is correctly connected. If possible, we suggest twisted pair the Data Pin and GND to improve the signal quality (Pic.2). Also, we recommend using the short cable for measurement when the signal speed is over 150MHz.



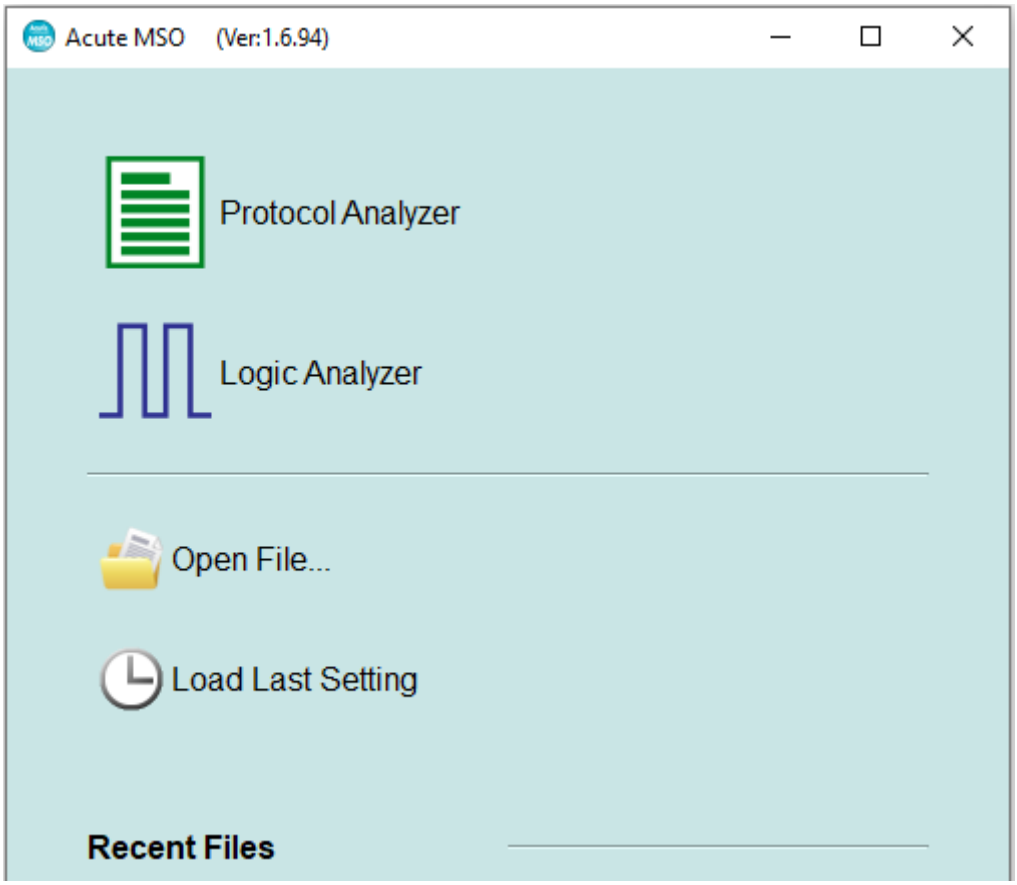
(Pic.1)



(Pic.2)

Software installation

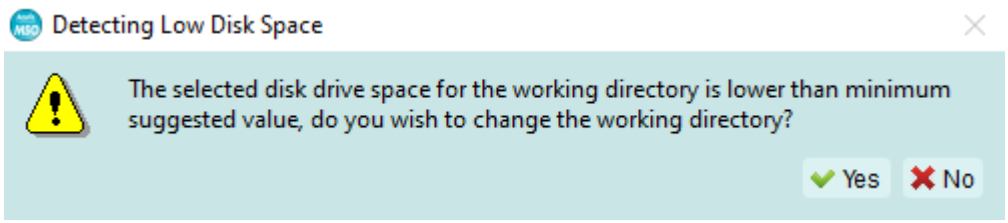
Download and install the software from Acute Technology Inc. website. Click on **Support** > **Download** > **Software**. The “start icon” of MSO series ( ) will appear on both desktop and program set. An intro screen will pop up asking you to choose either Logic Analyzer or Protocol Analyzer mode.



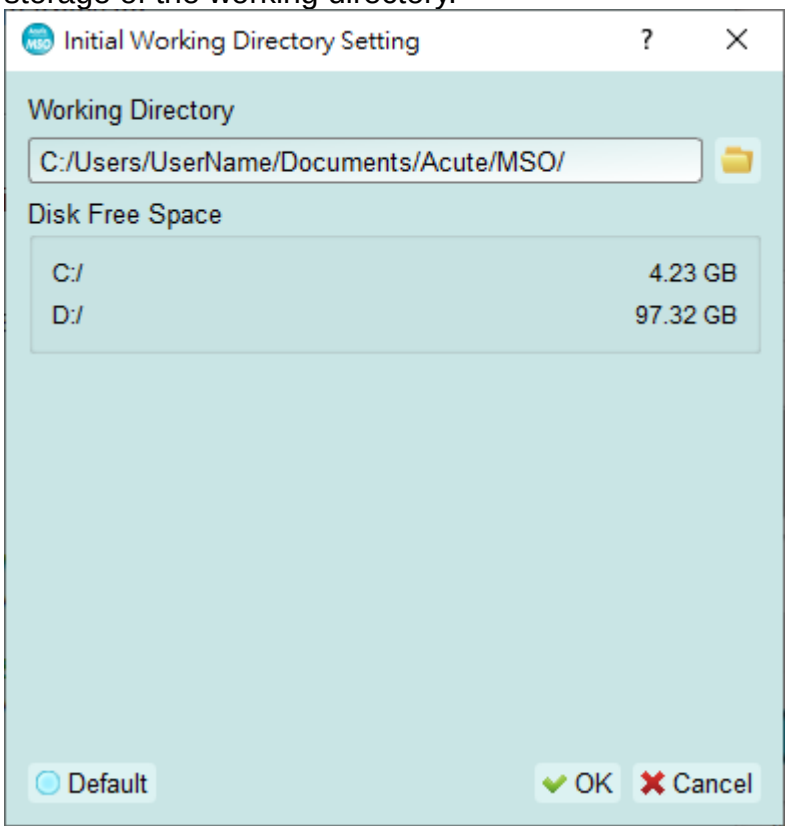
You may add a Logic Analyzer or Protocol Analyzer window later after entering the main window by selecting the icon below,

or click Add Logic Analyzer (LA) or Add Protocol Analyzer (PA) icon within the file menu.

The warning window as shown below will appear before the intro screen if the remaining space of the working directory is too low (< 50G).



It is recommended to choose the hard disk with larger remaining space for the storage of the working directory.



Specification table

Model		MSO1008E	MSO1116E	MSO2116B	MSO2216B	MSO2216B+
Power	Power Source	USB bus-power (+5V)				
	Static Power Consumption	0.9W				
	Max Power Consumption	< 3.9W	< 6W			
Hardware Interface		USB3.0				
Channels (Data / Clock / Ground)		8 / 1 / 23	16 / 1 / 23			
Total Memory		2Gb	4Gb		8Gb	
Analog Input	Channels	Group I (CH0~7)	Group I, II (CH0~7, CH8~15)			
	Sample Rate(Group I or II)	200MHz / 1CH, 100MHz / 2CH, 50MHz/4CH, 25MHz / 8CH				
	Sample Rate(Group I or II)	The minimum value of Group I or II settings				
	Bandwidth	40MHz				
	ADC Bits	12				
Digital Input	Timing Analyzer (Asynchronous)	Available channels (Conventional / Transitional Timing) - Memory per channel				
	2 GHz	(4 / 3)– 512 Mb	(4 / 3)– 1 Gb	(8 / 7)– 512 Mb	(8 / 7)– 1 Gb	
	1 GHz	(8 / 6)– 256 Mb	(8 / 6)– 512 Mb	(16 / 14)– 256 Mb	(16 / 14)– 512 Mb	
	500 MHz	(8 / 6)– 256 Mb	(16 / 12)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 512 Mb	
	250 MHz and lower	(8 / 6)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 512 Mb	
	State Clock Rate (Synchronous, External Clock)	150 MHz		200 MHz		
	Storage	Conventional Timing, Transitional Timing				
Channel to channel skew		< 1ns				
Threshold	Group	1 (CH0~7 & CKI)	2 (CH0~7 & CKI, CH8~15)			
	Range	+20V ~ -20V				
	Resolution	50mV				
	Accuracy	±100mV + 5%*Vth				
Input Voltage	Non-Destructive	Over +/-42V DC & AC				
	Operation (Normal/High Division)	-20V ~ +20V / -10V ~ +10V				
	Sensitivity (0.5/0.75/1 Vpp)	100 MHz / 120 MHz / 150 MHz		180 MHz / 200 MHz / 220 MHz		
	H/W Schmitt (On/Off)	560 mV / 80 mV				
Impedance		1 mΩ / 2 pF				
Temperature	Operating / Storage	5°C~45°C (41°F~113°F) / -10°C~65°C (14°F~149°F)				
I/O port	Trig-In	TTL 3.3V (Rising / Falling)				
	Trigger pulse approval	> 8 ns				
	Trig-Out	TTL 3.3V, Pulse Width				
	Ref. Clock Input	10MHz, Vpp=3.3 to 5V				
	Ref. Clock Output	10MHz, TTL 3.3V				
	Connector type	MCX jack / female				
Trigger	Resolution	500ps				
	Channels	8	16			
	States	16				
	Events	16				
	Pre / Post	Yes				
	Pass Counter	Yes (0~1048575 times)				
	Digital	Channel, Pattern, Single / Multi Level, Width, Time-out, External				
	Analog	Rising / Falling				
	Bus I	I2C, SPI, UART				
	Bus II	---	BiSS-C, CAN2.0B/CAN FD, DP_Aux[1], HID over I2C, I2S, LIN2.2, USB PD 3.0			

	Bus III	---	DALI, I3C, LPC, MDIO, Mini/Micro LED, MIPI RFFE, MIPI SPMI 2, Modbus, PMBus, Profibus, SMBus, SVI2, USB1.1	
	Bus IV	---		eMMC 4.5, eSPI, MII, RGMII, RMII, SVID[3], SD 2.0 (SDIO 2.0), Serial Flash (SPI NAND)
Protocol Analyzer	I	I2C, SPI, UART		
	II	---	BiSS-C, CAN2.0B/CAN FD, DP_Aux[1], HID over I2C, I2S, LIN2.2, USB PD 3.0	
	III	---	DALI, I3C, LPC, MDIO, Mini/Micro LED, MIPI RFFE, MIPI SPMI 2, Modbus, PMBus, Profibus, SMBus, SVI2, USB1.1	
	IV	---		eSPI, MII, RGMII, RMII, SVID[3]
Software Features	Power Sequence	---	Input setup .CSV file for Timing Sequence and H/W Strap check.	
	Measurement	Digital or Analog waveforms		
	Zoom / Report Window	YES		
	Note editor	Edit notes on Waveform Window		
	Quick Bus Decode Setup	YES		
	Trigger / Auxiliary cursors	1/25		
	Data Logger	Saved to Hard Disk Drive		
	Bus Decode	1-Wire, 3-Wire, 7-Segment, A/D Mux Flash, AccMeter, ADC, APML, AVSBus, BiSS-C, BSD, BT1120, CAN 2.0B/FD, Close Caption, CODEC_SSI, DALI, DMX512, DP_Aux[1], EDID, eMMC 5.1/MMC, eSPI, FlexRay, HD Audio, HDLC, HDQ, HID over I²C, I²C, I²C EEPROM, I²S (PCM, TDM), I3C, IrDA, ITU-R BT.656 (CCIR656), JTAG, JVC IR, LCD1602, LED_Ctrl, LIN 2.2, Line Decoding, Line Encoding, Lissajous, LPC, LPT, Math, M-Bus, MDDI, MDIO, MHL CBUS, Microwire, Mini/Micro LED, MIPI CSI LP, MIPI DSI LP, MIPI RFFE, MIPI SPMI 2.0, Modbus, NEC IR, PECI 3.0, PMBus, Profibus, PS/2, PWM, QEI, QI, RC-5, RC-6, S/PDIF, SD 2.0 (SDIO 2.0), Serial Flash, Serial IRQ, SGPIO, Smart Card, SMBus (SBS, SPD), SMI, SoundWire, SPI, SPI-NAND, SSI, ST7669, SVI2, SVID[2], SWD, SWIM, SWP, UART, ULPI, UNI/O, USB 1.1, USB PD 3.0, Wiegand, ...		
	Line Decoding	Biphase Mark, Differential-Manchester, Manchester (Thomas, IEEE802.3), Miller, Modified Miller, NRZI, …		
	Line Encoding	AMI(Standard, B8ZS, HDB3), Biphase Mark, CMI, Differential-Manchester, Manchester (Thomas, IEEE802.4), MLT-3, Miller, Modified Miller, NRZI, Pseudoternary, …		
Dimension	L x W x H (mm^3)	123 x 76 x 21(mm^3)		
Lead Cable	Data / CLK / NC / GND	8 / 1 / 8 / 23	16 / 1 / 0 / 23	
Grippers		10	20	
Stack Cable	MCX to MCX (30cm)	1		2

[1]Optional DP AUX adapter needed.

[2] Upon request ONLY by users who have signed CNDA with Intel, SVID decode supported by all MSO models

[3]Upon request ONLY by users who have signed CNDA with Intel, SVID trigger & PA supported by MSO2216B / B+ ONLY.

Specification table (International & Microchip)

International		MSO2008W	MSO2116W	MSO2116B	MSO2216B	MSO2216B+
Microchip		MSO2008N	MSO2116N	MSO2116M	MSO2216M	MSO2216M+
Power	Power Source	USB bus-power (+5V)				
	Static Power Consumption	0.9W				
	Max Power Consumption	< 3.9W	< 6W			
Interface		USB3.0				
Channel (Data / Clock / Ground)		8 / 1 / 23	16 / 1 / 23			
Total Memory		2Gb	4Gb		8Gb	
Analog Input	Channels	Group I (CH0~7)	Group I, II (CH0~7, CH8~15)			
	Sample Rate (Group I or II)	200MHz / 1CH, 100MHz / 2CH, 50MHz/4CH, 25MHz / 8CH				
	Sample Rate (Group I or II)	The minimum value of Group I or II settings				
	Bandwidth	40MHz				
	ADC Bits	12				
Digital Input	Timing Analysis (Asynchronous)	Available channels (Conventional / Transitional Timing) - Memory per channel				
	2 GHz	(4 / 3)– 512 Mb	(4 / 3)– 1 Gb	(8 / 7)– 512 Mb	(8 / 7)– 1 Gb	
	1 GHz	(8 / 6)– 256 Mb	(8 / 6)– 512 Mb	(16 / 14)– 256 Mb	(16 / 14)– 512 Mb	
	500 MHz	(8 / 6)– 256 Mb	(16 / 12)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 512 Mb	
	250 MHz and lower	(8 / 6)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 256 Mb	(16 / 16)– 512 Mb	
	State Clock Rate (Synchronous, External Clock)	150 MHz		200 MHz		
	Data Storage	Conventional Timing, Transitional Timing				
Channel to channel skew		< 1ns				
Threshold	Group	1 (CH0~7 & CKI)	2 (CH0~7 & CKI, CH8~15)			
	Range	+20V ~ -20V				
	Resolution	50mV				
	Accuracy	±100mV + 5%*Vth				
Input Voltage	Non-Destructive	Over +/-42V DC & AC				
	Operation (Standard / High Resolution)	-20V ~ +20V / -10V ~ +10V				
	Sensitivity (0.5/0.75/1 Vpp)	100 MHz / 120 MHz / 150 MHz		180 MHz / 200 MHz / 220 MHz		
	H/W Schmitt (On/Off)	560 mV / 80 mV				
Impedance		1 MΩ / 2 pF				
Temperature	Operating / Storage	5°C~45°C (41°F~113°F) / -10°C~65°C (14°F~149°F)				
I/O port	Trig-In	TTL 3.3V (Rising / Falling)				
	Trigger pulse approval	> 8 ns				
	Trig-Out	TTL 3.3V, Pulse Width				
	Ref. Clock Input	10MHz, Vpp=3.3 to 5V				
	Ref. Clock Output	10MHz, TTL 3.3V				
	Connector type	MCX jack / female				
Trigger	Resolution	500ps				
	Channels	8	16			
	States	16				
	Events	16				
	Pre / Post	Yes				
	Pass Count	Yes (0~1048575 times)				
	Digital	Channel, Pattern, Single / Multi Level, Width, Time-out, External				

	Analog	Rising / Falling		
	Bus I	I2C		
	Bus II	---	CAN 2.0B/CAN FD, LIN2.2, SPI, UART (RS232)	
	Bus III	---	BiSS-C, DALI, DP_Aux[1], HID over I2C, I2S, I3C, LPC, MDIO, Mini/Micro LED, MIPI RFFE, MIPI SPMI 2, Modbus, PMBus, Profibus, SMBus, SVI2, USB1.1, USB PD 3.0	
	Bus IV	---		eMMC 4.5, eSPI, MII, RGMII, RMII, SVID[3], SD 2.0 (SDIO 2.0), Serial Flash (SPI NAND)
Protocol Analyzer	I	I2C		
	II	---	CAN 2.0B/CAN FD, LIN2.2, SPI, UART (RS232)	
	III	---	BiSS-C, DALI, DP_Aux[1], HID over I2C, I2S, I3C, MDIO, MIPI RFFE, Modbus, PMBus, Profibus, PWM, SMBus, USB1.1, USB PD 3.0	
	IV	---		eSPI, MII, RGMII, RMII, SVID[3]
Software Features	Power Sequence	---	Input setup .CSV file for Timing Sequence and H/W Strap check.	
	Measurement	Digital or Analog waveforms		
	Zoom / Report Window	YES		
	Note editor	Edit notes on Waveform Window		
	Quick Bus Decode Setup	YES		
	Trigger / Auxiliary cursors	1/25		
	Data Logger	Saved to Hard Disk Drive		
	Bus Decode	1-Wire, 3-Wire, 7-Segment, A/D Mux Flash, AccMeter, ADC, APML, AVSBus, BiSS-C, BSD, BT1120, CAN 2.0B/FD, Close Caption, CODEC_SSI, DALI, DMX512, DP_Aux[1], EDID, eMMC 5.1/MMC, eSPI, FlexRay, HD Audio, HDLC, HDQ, HID over I²C, I²C, I²C EEPROM, I²S (PCM, TDM), I3C, IrDA, ITU-R BT.656 (CCIR656), JTAG, JVC IR, LCD1602, LED_Ctrl, LIN 2.2, Line Decoding, Line Encoding, Lissajous, LPC, LPT, Math, M-Bus, MDDI, MDIO, MHL CBUS, Microwire, Mini/Micro LED, MIPI CSI LP, MIPI DSI LP, MIPI RFFE, MIPI SPMI 2.0, Modbus, NEC IR, PECI 3.0, PMBus, Profibus, PS/2, PWM, QEI, QI, RC-5, RC-6, S/PDIF, SD 2.0 (SDIO 2.0), Serial Flash, Serial IRQ, SGPIO, Smart Card, SMBus (SBS, SPD), SMI, SoundWire, SPI, SPI-NAND, SSI, ST7669, SVI2, SVID[2], SWD, SWIM, SWP, UART, ULPI, UNI/O, USB 1.1, USB PD 3.0, Wiegand, ...		
	Line Decoding	Biphase Mark, Differential-Manchester, Manchester (Thomas, IEEE802.3), Miller, Modified Miller, NRZI, …		
	Line Encoding	AMI(Standard, B8ZS, HDB3), Biphase Mark, CMI, Differential-Manchester, Manchester (Thomas, IEEE802.4), MLT-3, Miller, Modified Miller, NRZI, Pseudoternary, …		
Dimension	L x W x H (mm3)	123 x 76 x 21		
Lead Cable	Data / CLK / NC / GND	8 / 1 / 8 / 23	16 / 1 / 0 / 23	
Grippers		10	20	
Stack Cable	MCX to MCX (30cm)	1		2

[1]Optional DP AUX adapter needed.

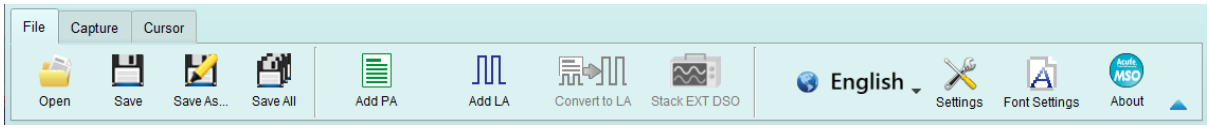
[2] Upon request ONLY by users who have signed CNDA with Intel, SVID decode supported by all MSO models

[3]Upon request ONLY by users who have signed CNDA with Intel, SVID trigger & PA supported by MSO2216B / B+ ONLY.

Chapter 2 Function list and operation

Protocol Analyzer

File



 **Open file:** Load the file.

 **Save file:** Save the current window.

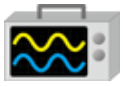
 **Save as:** Save as new file with specified range.

 **Save all:** Save all Protocol Analyzer / Logic Analyzer windows to files.

 **Add Protocol Analyzer:** Add a Protocol Analyzer window.

 **Add Logic Analyzer:** Add a Logic Analyzer window.

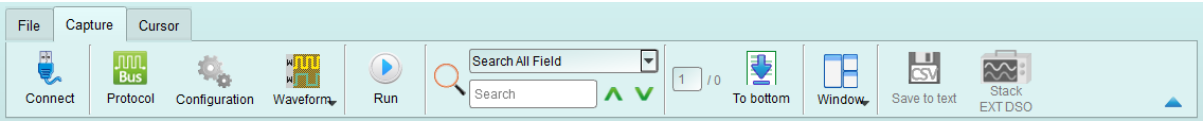
 **Convert to Logic Analyzer:** When the “show waveform” capture mode is enabled; you can click this function to transfer the waveform and setting parameters into the Logic Analyzer window and continue to use the Logic Analyzer window to capture signals.

 **Stack Oscilloscope:** Currently not supported in Protocol Analyzer mode.

 **Language:** Display language. You can select either English, Traditional Chinese, or Simplified Chinese.

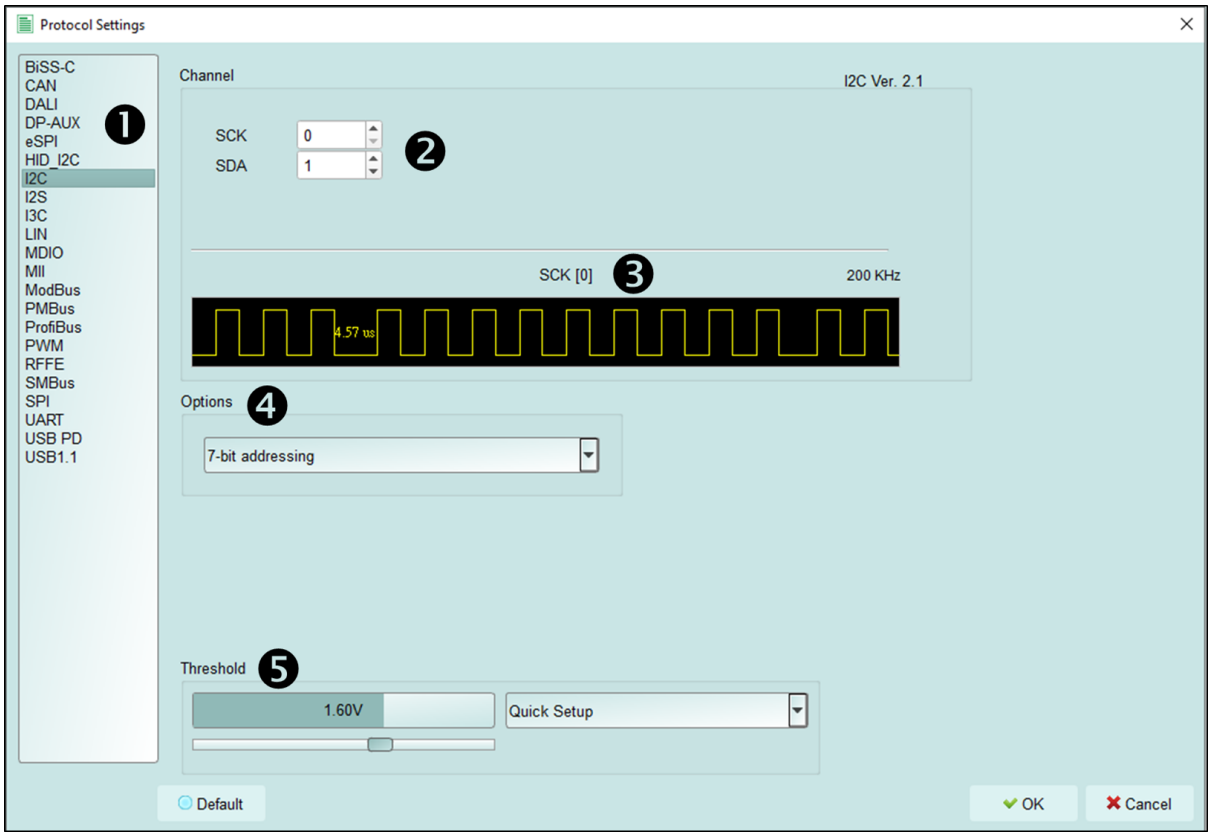
 **Settings:** Here you can set the working directory, the label height, whether to load the last setting, the waveform display mode and its color.

Capture



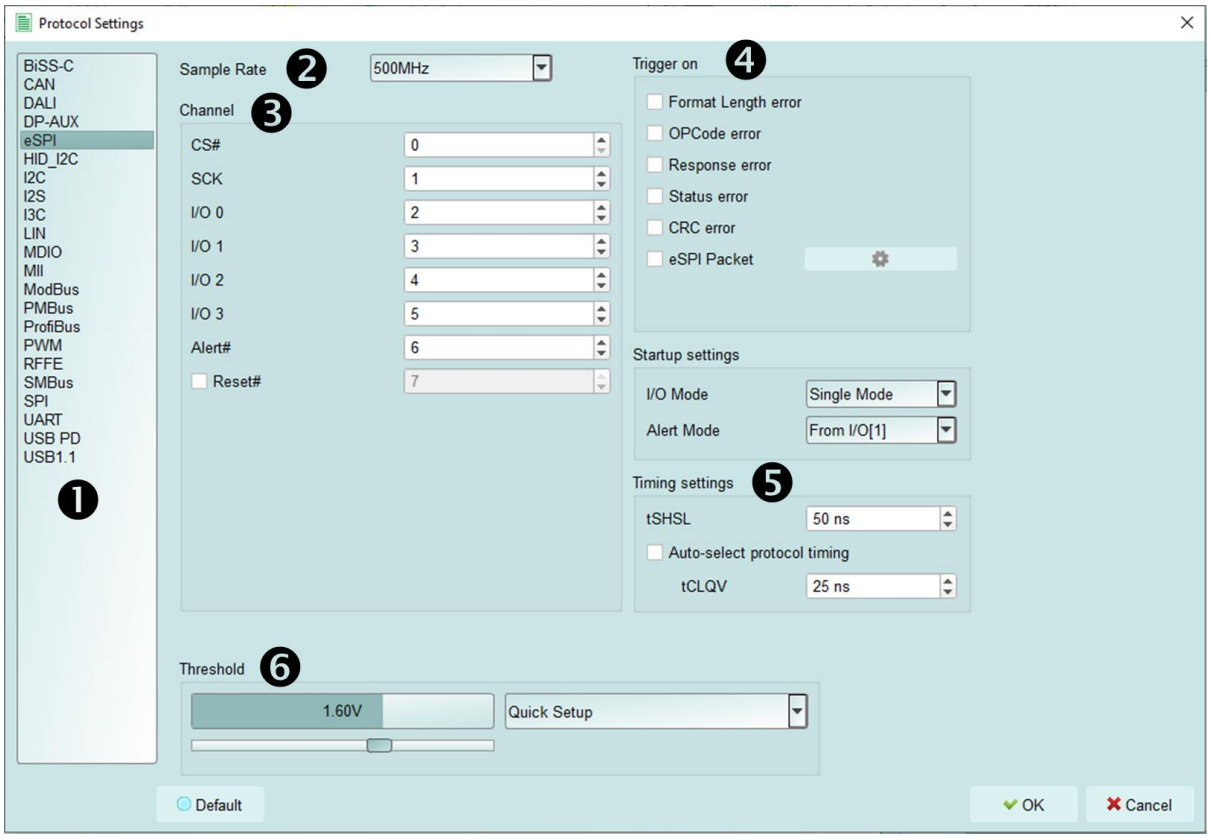
Protocol Settings

Pattern 1



1. **Select the protocol**
2. **Channel settings**
3. **Waveform:** The signal's waveform and frequency are automatically detected.
4. **Options:** Set the capture and decoding parameters for protocol.
5. **Threshold:** It can be set according to the voltage level of the signal.

Pattern 2

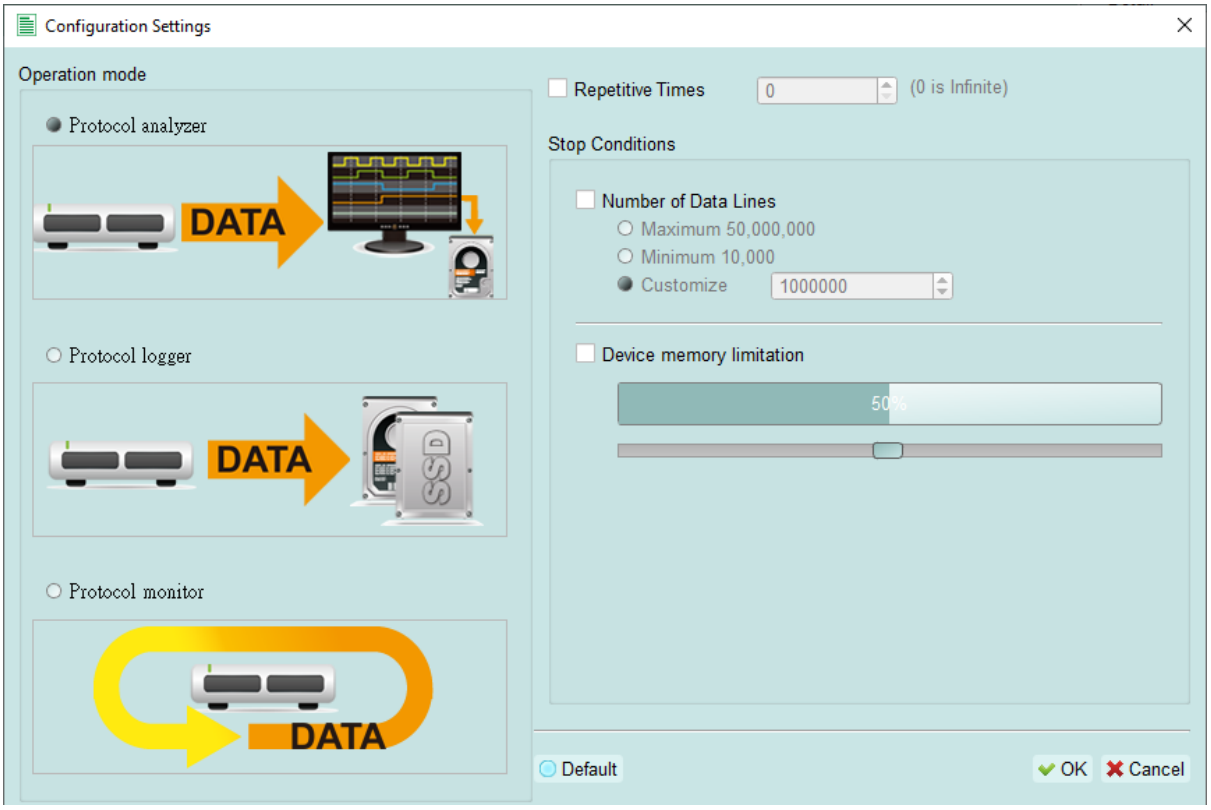


1. **Select the protocol**
2. **Set the sample rate**
3. **Channel settings**
4. **Trigger on**
5. **Options:** You can set the capture and decoding parameters for protocol.
6. **Threshold:** It can be set according to the voltage level of the signal.

Operating mode and memory setting

There are three configurations ( ) for operating mode and memory settings.

Mode 1 Protocol Analyzer



- **Function description**

  1. Send the captured data to the PC and display the analysis results immediately.
  2. If you will not capture large amount of data, you do not need to set the memory limit.
  3. Result from capturing and displaying data at the same time, the requirements for USB transfer rate and computer performance are high. If the software consumes the data slower than the rate the data captured, data may fill the device memory and stop capturing automatically.
  4. If you navigate the software during capture, the computer may respond slower than normal situation.

- **Repetitive Times**

  1. Whenever the stop condition is met, it automatically saves data to the

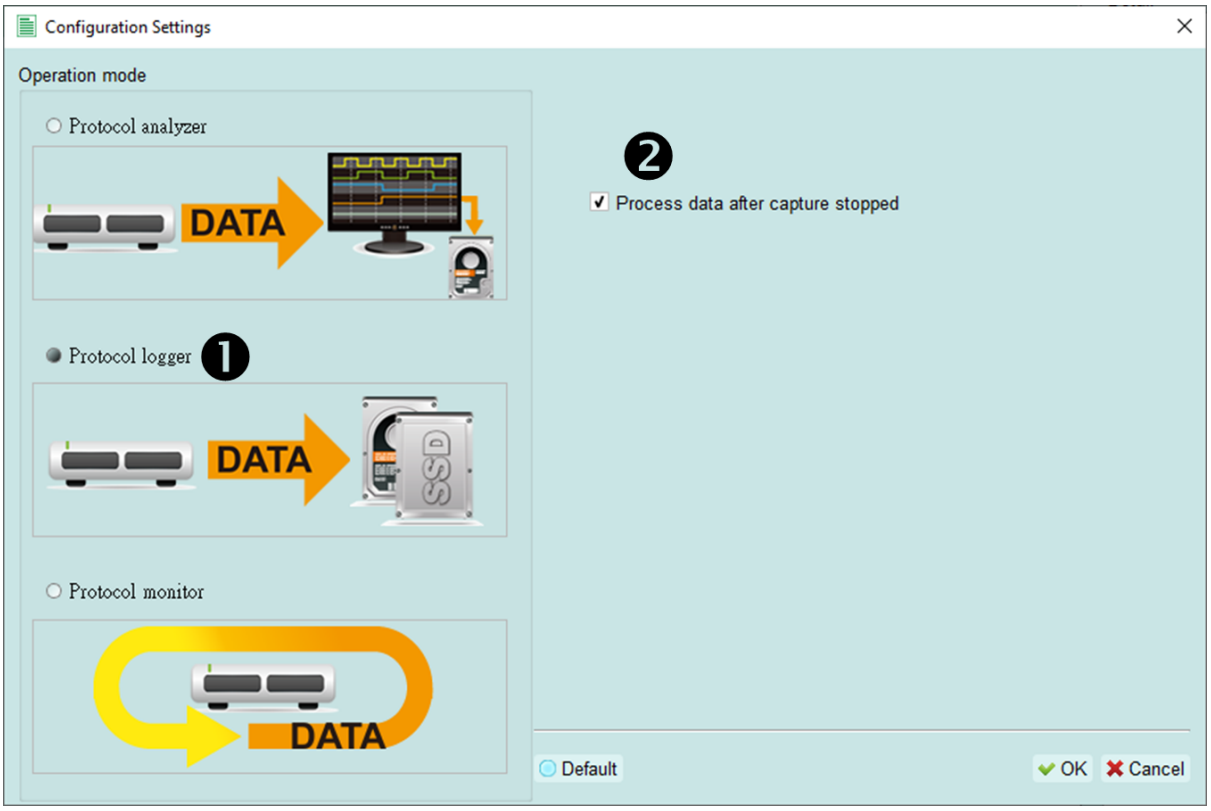
file. It's so called a single capture process.

2. Repeat the capture process according to the set number of times. If the number of times is 0, the capture process will be repeated continuously.

- **Stop Conditions**

1. Number of Data Lines: If enabled, it can automatically stop according to the number of lines. You can enable this function if you do not need to capture for a long period but a fixed amount of data lines instead. This function is default to OFF.
2. Device memory limitation: If enabled, it will stop automatically when the device memory is filled up to the set condition.

Mode 2 Protocol Logger



Function description

1. The data are saved to a logger file (.LOG). They are not further processed and displayed until you stop capturing or reload the logger file.

No matter you choose to process the data right after the capture

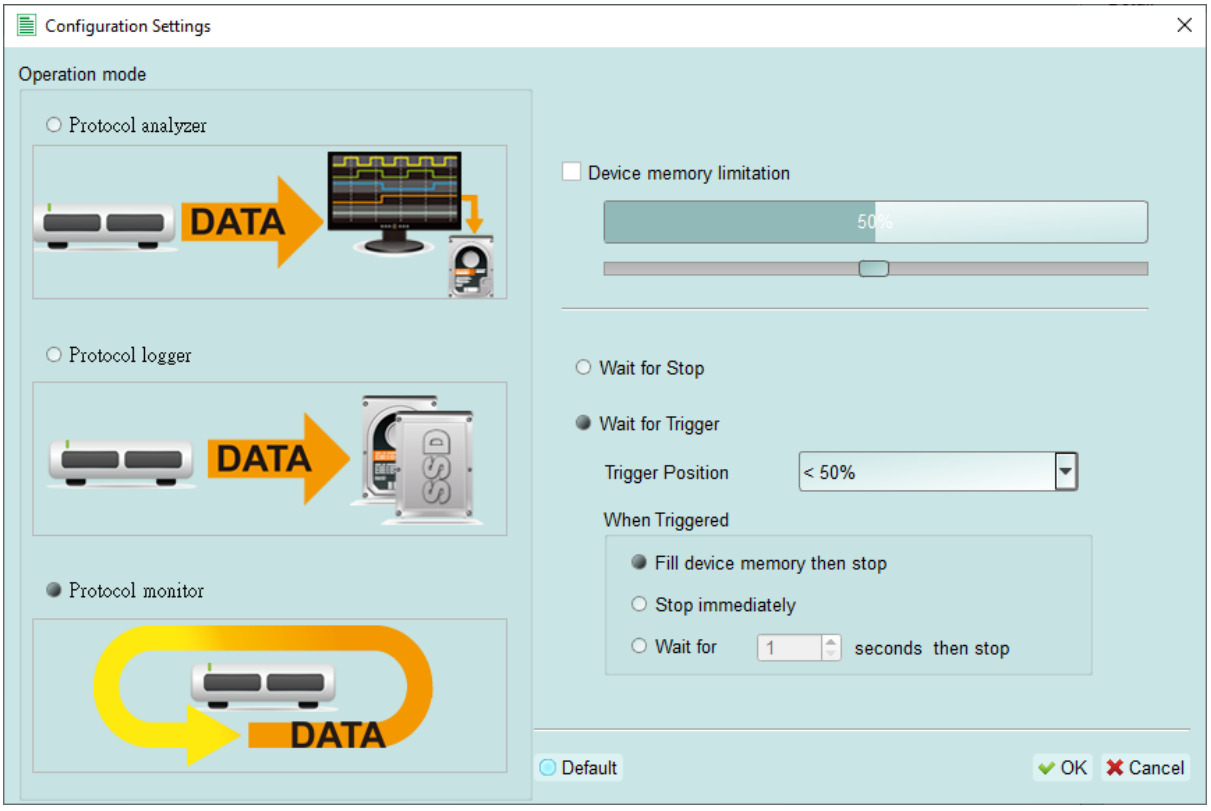
process or reopen the logger file, the file automatically be converted from .LOG to .MSW.

2. As long as the hard disk is large enough and fast enough to respond, a large amount of data can be stored.
3. Due to the large amount of logger data, the follow-up analysis takes a long time, and the requirements for USB transmission rate, computer performance and hard disk space are high.

- **Run data process after capture stopped**

Check this option to process data right after you stop capturing, or the software will only save the logger data file (.LOG) without analyzing.

Mode 3 Protocol Monitor



- **Function description**

1. In this mode, the device keeps the data in its RAM and does not send it back to PC. Newly captured data will continue to overwrite oldest data when the device memory is full. It can be used to monitor incoming data for

a long time, until the user manually stops capturing, or the set trigger condition is met.

2. The total amount of data is less or equal to the total amount of device memory.
3. The requirements for USB transfer rate or computer performance are low.
4. If you did not set a trigger, or you did but wish to retrieve the data before the memory is full, you must manually press the stop button before the data will be sent to the computer.

- **Device memory limitation**

  If unchecked, use the maximum memory of the device.

  If checked, you can adjust the device memory usage. Set up lower memory usage to shorten the processing time.

- **Data capture will continue until pressing “Stop” (Wait for stop)**

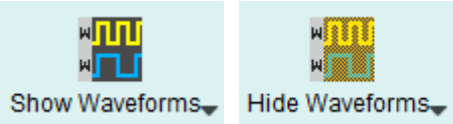
  Even if the device memory is full, it continues capturing new data and replaces the oldest ones. After you press “Stop”, it sends back the newest data stored in the device to the computer.

- **Data capture will continue until the trigger condition is met (Wait for Trigger)**

  If the trigger condition is not set, there will be no Pre/Post Trigger relationship and only the **Capturing** will be shown until the device memory is full. If the trigger condition is set, data will be filled according to the **Trigger Position** settings. Data capture will continue until the trigger condition is met or **Stop** is pressed, then it will stop by one of the three actions:

  - Fill device memory then stop
  - Stop immediately
  - Wait for a few seconds then stop

Show Waveforms / Hide Waveforms



If you select “Show Waveforms”, the device will capture the waveform data. It requires more device memory. Please decide show or hide waveform before capture.

When “Show Waveforms” is enabled, the waveform area will provide the following functions:

1. Bus Decode 

   Press this button to refresh the bus decode.

2. Stop the bus decode 

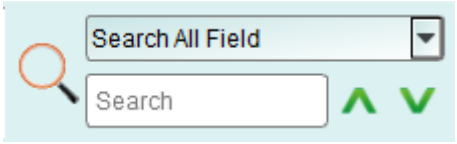
   This button can stop the bus decode right away.

3. Add User Notes 

4. Waveform zoom in/out 

   You can use these buttons or mouse wheel to zoom in or out the waveforms.

Search



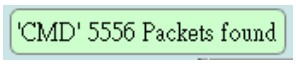
Search function can search data in the report window.

1. Enter search criteria in the text field.

   A  mark will appear in front of each row meeting the search criteria.

2. Search the previous / next piece of data.
3. Specify all fields or target fields to search.

   Specifiy fields to narrow the search range, to search faster.

It will show the total number of packets found with green 

background. If no data is found, it will show an 

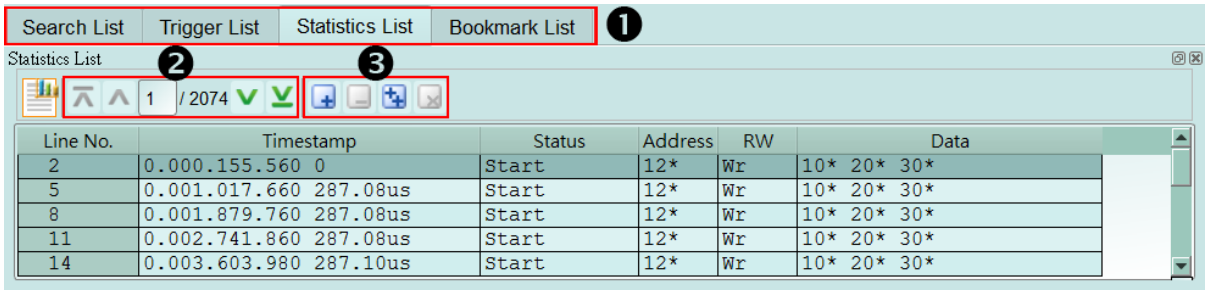
orange background.

To bottom

Press this button to move to the bottom of the window. If you press this button while the device is capturing data, it will continue to show the latest data.

Window

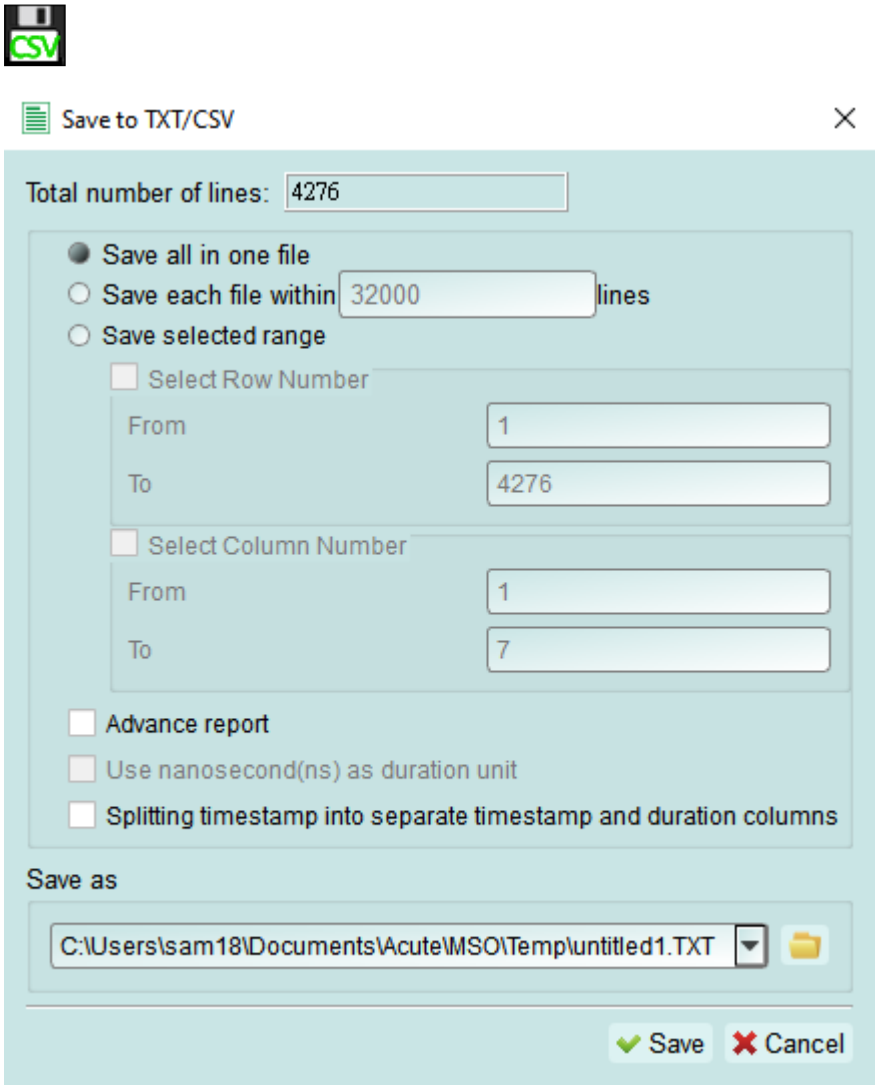
Enable/disable multiple display lists, such as: Trigger List, Statistic List …etc.



Line No.	Timestamp	Status	Address	RW	Data
2	0.000.155.560 0	Start	12*	Wr	10* 20* 30*
5	0.001.017.660 287.08us	Start	12*	Wr	10* 20* 30*
8	0.001.879.760 287.08us	Start	12*	Wr	10* 20* 30*
11	0.002.741.860 287.08us	Start	12*	Wr	10* 20* 30*
14	0.003.603.980 287.10us	Start	12*	Wr	10* 20* 30*

1. Select different display list.
2. Use the control buttons to move the current position, or input row number to jump to specified row.
3. Use the control buttons to add /remove selected row to Bookmark List.

Saved as text file



Contents of the report may be saved as .TXT or .CSV.

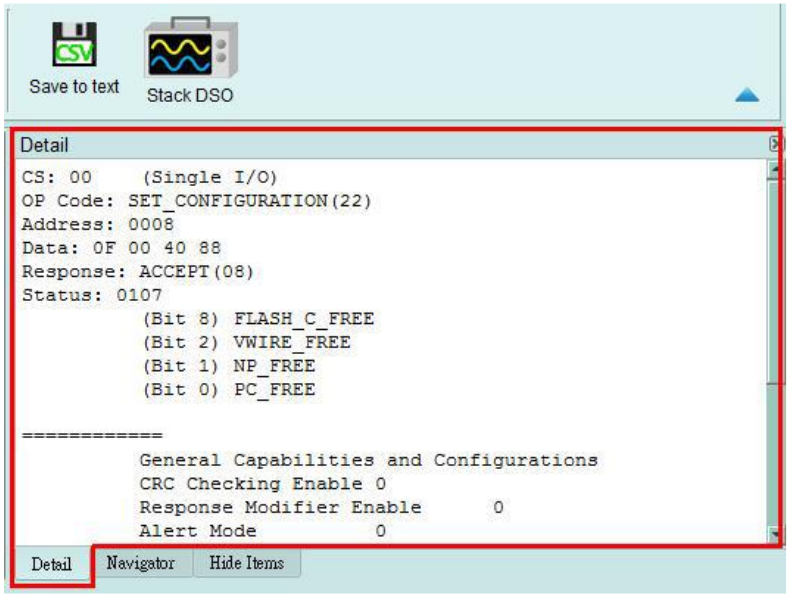
Save options:

1. You can select to save the data as a file or according to the number of rows.
2. Advanced reports

   Check this option to save detailed data in protocol analyzer mode.

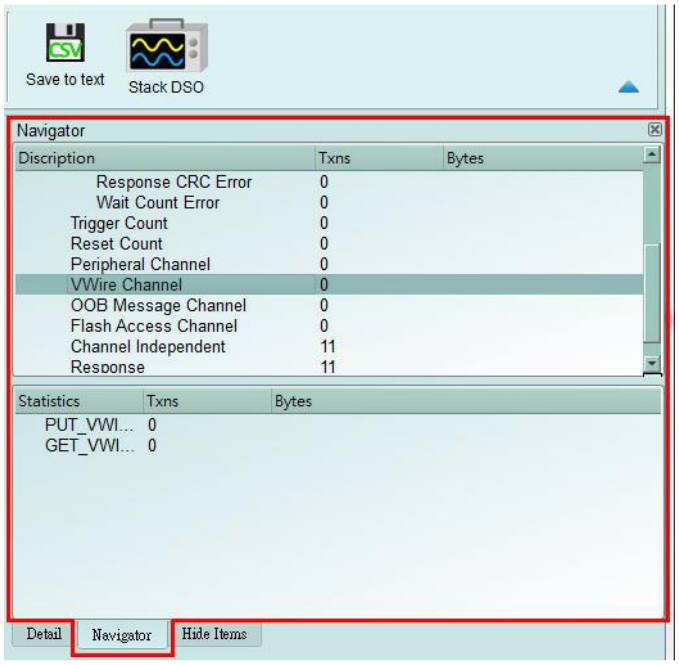
Detail window

Many protocols contain a large number of numerical data, it is not suitable to display in the report window at one time, so you can click the Data column of the report window with the mouse first, and the data will be displayed in the detail window.



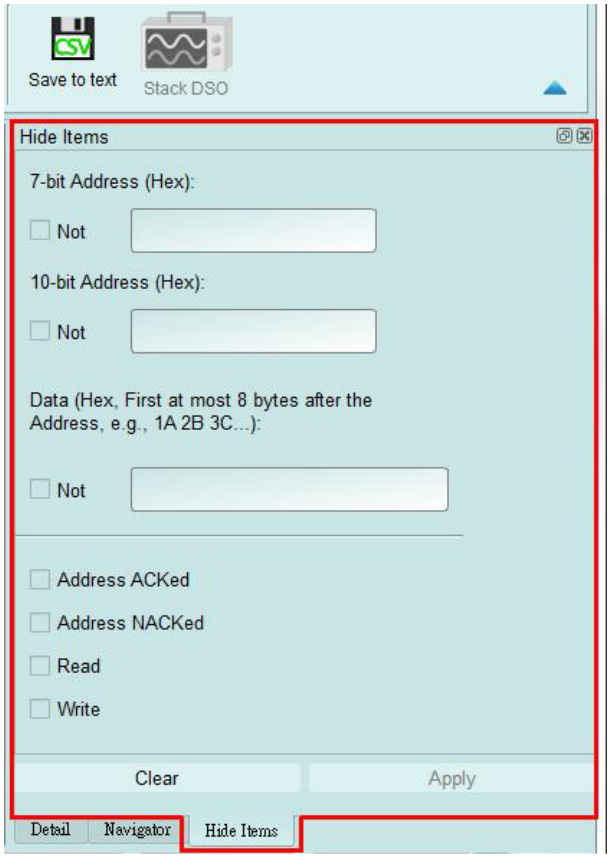
Statistics window

According to protocols' different characteristics, statistics are made to understand the entire transmission situation, you may also click on the statistic trace to summarize all records of the selected trace into the statistic list window.

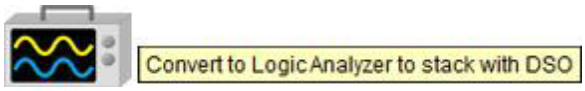


Hide Data window

Select item to hide certain data, click “Clear” to restore.

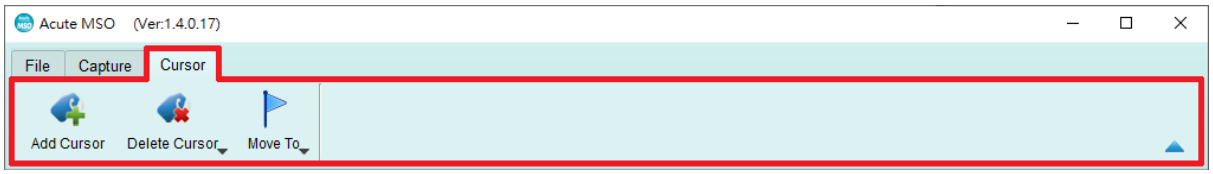


Stack external oscilloscope



The stack oscilloscope can only be enabled in the Logic Analyzer mode. If you want to enable the stack oscilloscope in the protocol Analyzer mode, you must first press the "Convert to Logic Analyzer and Stack Oscilloscope" button to switch to the Logic Analyzer mode to enable this function.

Cursor



This function includes the cursor setting and the waveform search function matching the cursor.

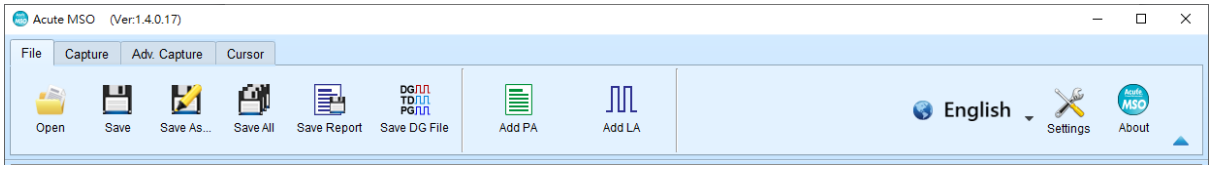
Logic Analyzer

Window

1. **Toolbar:** Including trigger, sampling rate, threshold and other capture parameters.
2. **Channel Label:** You can use the icon () below to add and delete the channel. Press left mouse button on the channel label to change the channel parameter settings; Click the gear button on the upper right corner of the Bus channel to change the advanced parameter settings; Select and drag a channel label to another channel label to combine two or more channel labels.
3. **Report Window Toolbar:** In the report window, you can choose to display the channel data () or decode result (), waveform statistics (), and report the result as .CSV and .TXT output ().
4. **Status Bar:** Show connection status of the device.
5. **Info:** Display channel, value and trigger information, they can be changed in File -> Settings.
6. **Waveform Area:** Use mouse wheel to zoom in/out the waveform; use cursors to see the time interval or frequency. Please refer to the cursor section below for the

cursor usage.

File



 Open file: Load the file.

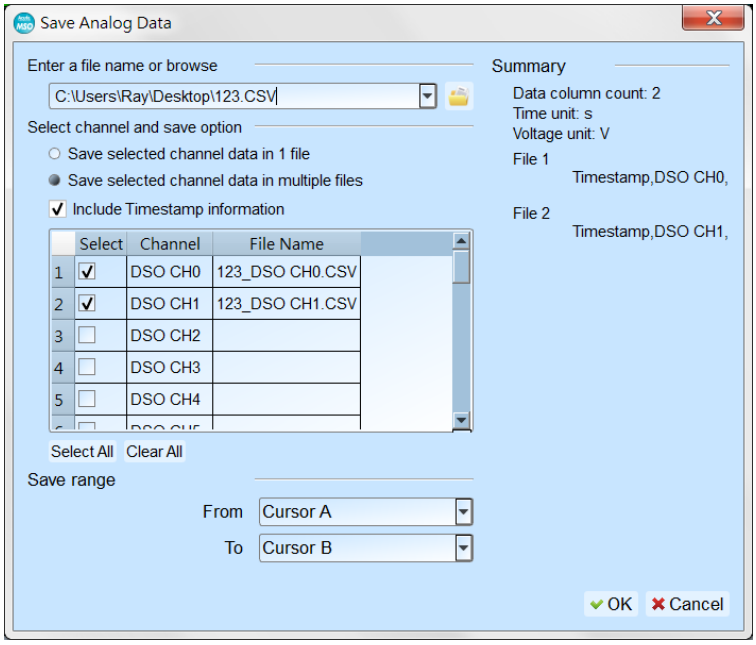
 Save file: Save the current file.

 Save as: Save as new file with specified range.

 Save all: Save all Protocol Analyzer / Logic Analyzer windows to files.

 Save report: Save the bus decode report.

 Save Analog Data: Save MSO captured analog data to .CSV or .TXT file.



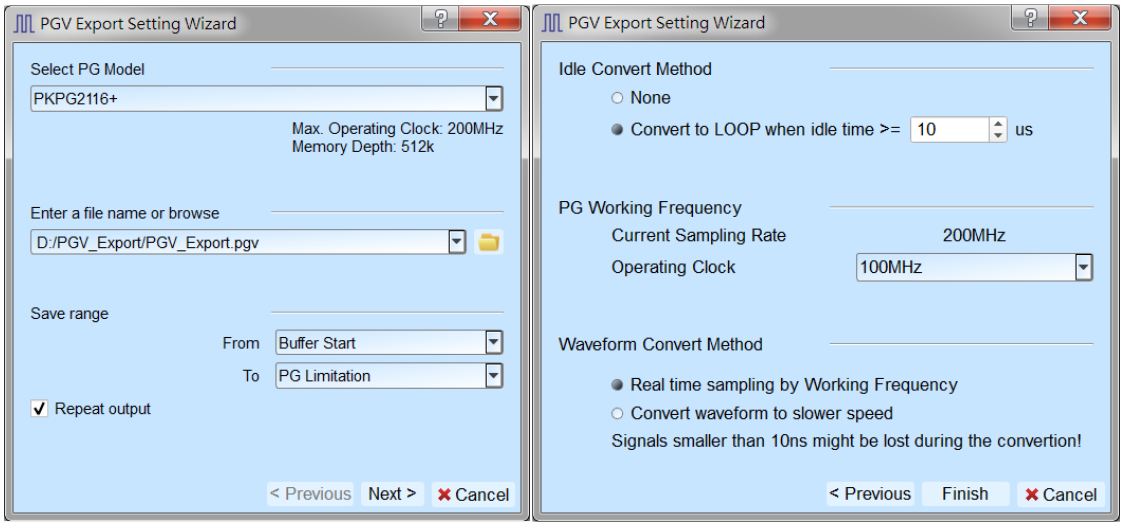
Store the captured analog data into text format file, the available options are:

1. Save selected channel data in 1 file: The analog data will be stored into a single file, data of each channel will be separated by “comma”.
2. Save selected channel data in multiple files: The analog data of each channel will be stored into individual files respectively with user input file name appended with channel name.

3. Include Timestamp information: Choose to store the timestamp information into the first column of each file, the Timestamp information will be stored with time unit of seconds.
4. Data selection list: Select channels need to be stored, the list will also show data store column or file name at the 3rd column of the list if the channel is selected for output.
5. Save Range: Choose to change the data save range.

DG
TD
PG Saved as a DG file:

Convert captured waveform to DGW format for the Acute Digital Pattern Generator(PKPG、PG2000、DG3000、TD3000), which can be used to resend the digital signals.



1. Select DG/PG Model: The software will check the maximum working frequency and memory depth according to the selected DG/PG model.
2. Enter a file name or browse: Enter a file name and directory to save the converted DGW/PGV file.
3. Save range: Select the waveform range to convert to DGW/PGV file, you may select either waveform within cursor range, or select maximum available range according to DG/PG's maximum memory. (Exported file size larger than DG/PG's maximum memory may not be opened by the DG/PG's software.)
4. Repeat output: Check to add "Jump to start" command at the end of DGW/PGV file.

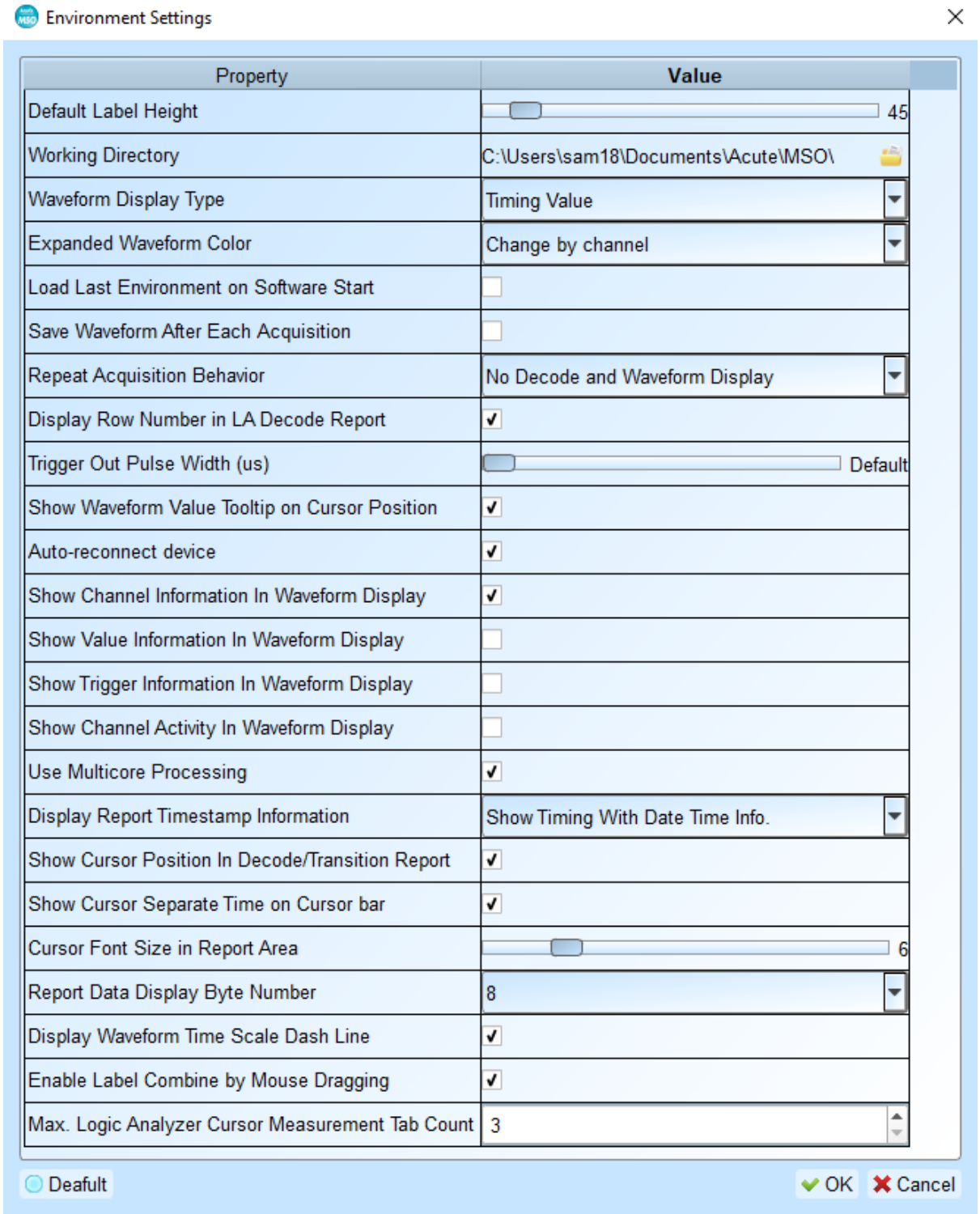
5. Idle Convert Method: Select to replace signal pulse width greater than specified time to a short block of waveform with Loop instructions to save the DG/PG's memory. (The waveform will become more complicated and not easy to read/edit after enable this option)
6. DG/PG Working Frequency: Specify the DG/PG working frequency.
7. Waveform Convert Method: When the LA's sampling frequency is faster than the DG/PG's working frequency, the software provides two different ways to convert the DGW/PGV wave form, one is the real time sampling mode with DG/PG's maximum working frequency (Small signal might be lost during the conversion), the other is convert the original high speed waveform to slower DGW/PGV waveform (Slower signal speed might introduce some signal timing issue since the setup/hold time will also be changed)

 Add Protocol Analyzer: Add a protocol analyzer window.

 Add Logic Analyzer: Add a logic analyzer window.

 Language: Display language. You can select English, Traditional Chinese, or Simplified Chinese

Settings: Here you can set the working directory, the label height, whether to load the last setting, the waveform display mode and its color.



1. Default Label Height: Modify the channel height of the waveform area.
2. Working Directory: The directory where the temporary files and waveforms are stored when the software is in operation.

3. Waveform Display Type: Select which information to display between waveform edges. You can select either **display time value**, **logic value** or **not to display**.
4. Expanded waveform color: You can choose whether the colors are different between channels.
5. Load Last Environment on Software Start: When the software starts, load the settings as the file that was previously closed, waveforms will not be loaded.
6. Save Waveform After Each Acquisition: This file is stored in the working directory.
7. Repeat Acquisition Behavior: Whether to display waveform decoding, to display, choose display time (1/2/5 s).
8. Display row number in LA Decode Report: Show row number on the left to the reporting area.
9. Trigger Out Pulse Width (us): The default length is from trigger point to the end of capture.
10. Show Channel Information in Waveform Display: Show numbers of used channels, show additional names for bus decode.
11. Show Value Information in Waveform Display: Displays the value at the position of the current selected cursor. It shows 0 or 1 on digital channels, voltage value on analog channels, and parallel bus value on bus channels. If it is a protocol channel, it also shows decode information in the same column. Please refer to the cursor section for detailed instruction.
12. Show Trigger Information in Waveform Display: Display trigger setting values.
13. Show Channel Activity In Waveform Display: Sum up the change types of the edge channel of the captured waveform.
14. Use Multicore Processing: Use multi-core to speed up data processing.
15. Display Report Timestamp Information: Display the timestamp column with timing info format / timing info with date time format (trigger point is at 0 s) / sample count format.
16. Show Cursor Position in Decode/Transition Report: Show cursor position in the report area time field.
17. Show Cursor Separate Time on Cursor bar: Add additional time between

cursors on the horizontal timeline of the waveform area.

18. Cursor Font Size in Report Area: Cursor font size for cursor position in decode/transition report (refer to item 16).
19. Report Data Display Byte Number: This is an item set for protocol analyzer mode, and you can modify the report field to show the number of Bytes.
20. Display Waveform Time Scale Dash Line: Add dash lines on the waveform area to correspond time line to report area.
21. Enable Label Combine by Mouse Dragging: Use the left mouse button to drag a channel label onto another channel label to combine channels.
22. Max. Logic Analyzer Cursor Measurement Tab Count: Displays the number of groups of cursor measurement values in the lower right corner. Minimum of 3 groups, maximum of 10 groups.

Keyboard Shortcuts

Function	Key
Move to cursor position	A-Z
Add a cursor to the mouse position	Shift + A-Z
Start capture	Enter
Stop capture	ESC
Search	F3 or Ctrl+F
Zoom In on waveform area	Number Pad +
Zoom Out on waveform area	Number Pad -

Capture

Quick Settings

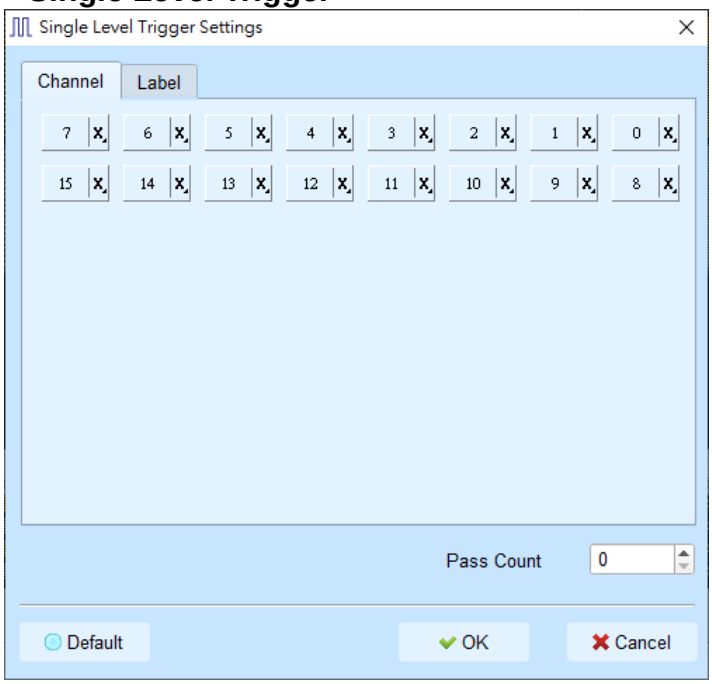
Immediately configure required channels and related settings. When configuring specific bus decode, the sampling rate and threshold will also be set according to the default conditions.

Trigger Parameter Setting

- **Manual Trigger**

After setting up, Click “Stop” button to position trigger point.

- **Single Level Trigger**

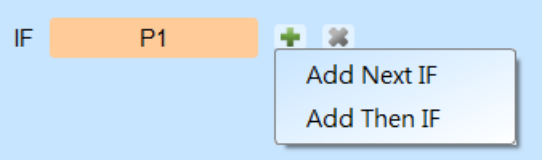


1. **Channel/Label:** You can select Don’t care(X)、Rising Edge(↑)、Falling Edge(↓)、Low(0)、High(1)、Either(↕) or specified value as trigger conditions.

2. **Pass Count:** The number of times to ignore triggering signals that match the trigger parameters. It is set to 0 by default to indicate that it is not ignored.

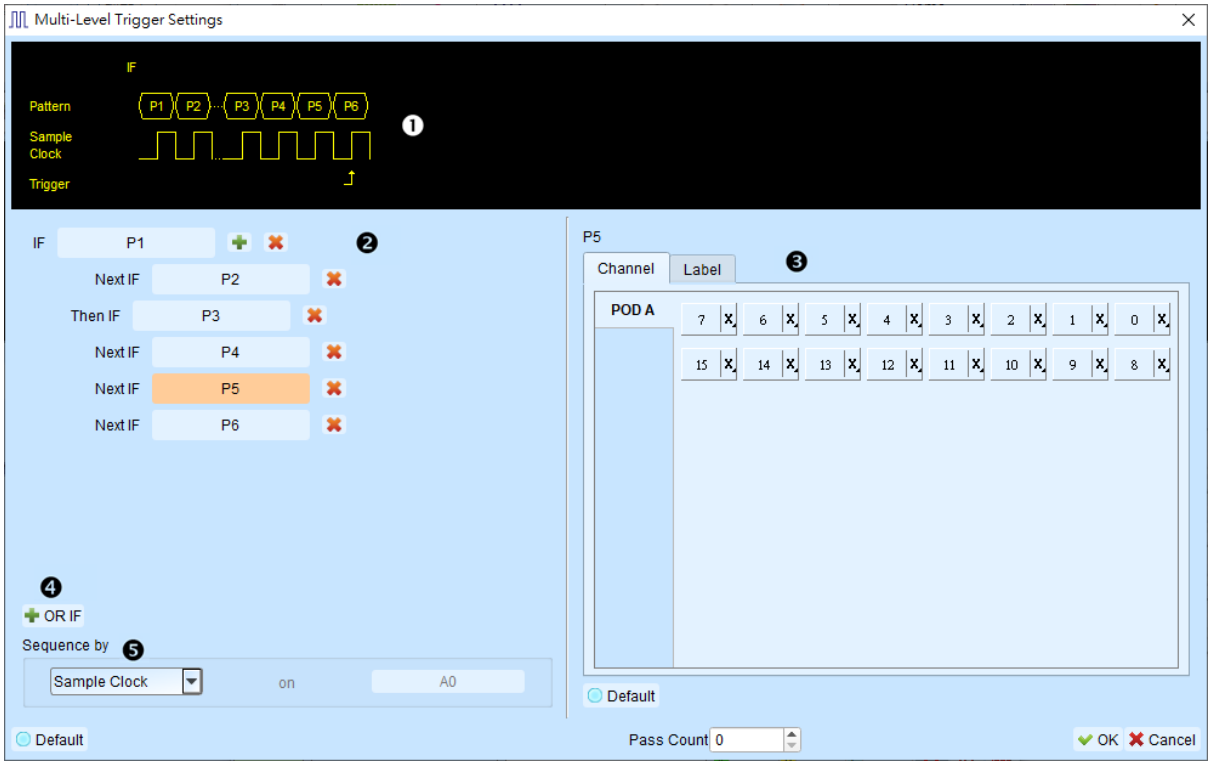
• Multi-Level Trigger

Multi-level trigger is composed of multiple single level trigger. This function has maximum 16 levels, each level must be set separately and set in the same way as the single level trigger. When adding a new level, press the button on the top to select the relationship between each level. The relationship between each state can be a continuous trigger (Next IF) or a non-continuous trigger (Then IF).



1. **Schematic diagram of the current set of trigger conditions**
2. **Trigger conditions setting**

   As shown in the picture below, the first and the second classes are continuous trigger, the relationship between the second and third classes are non-continuous trigger, and the third, fourth, fifth and sixth classes are continuous trigger.



Difference between continuous trigger and non-continuous trigger:

Continuous trigger: The signal captured by two adjacent sample clocks must meet the conditions to trigger.

Non-continuous trigger: It is triggered only when both the first condition and the second condition is met, no matter how many signals appear in between the first condition and the second condition. Therefore, such a trigger condition is not continuous at all.

A continuous trigger mode is usually set when Synchronous or State is used for measurement, because the use of synchronous clock is usually in a measurement state, and the signal is in a continuous state. Under the Asynchronous or Timing situation, the signal usually meet the continuous trigger condition only at edges, while it is difficult for most of the signals to meet the conditions of continuous triggering, it is suitable to set non-continuous trigger as a condition.

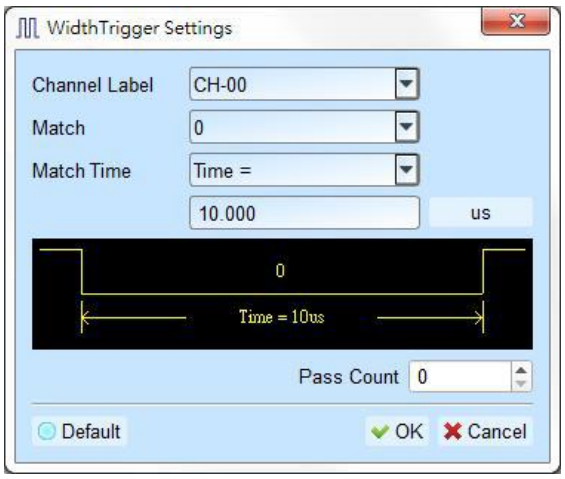
3. **The area to set the trigger condition for each class.**
4. **OR IF** is to establish a parallel trigger condition. It will trigger when either condition is met.
5. **Sequence by**

   The user can also set incidental conditions for triggering. In general, the trigger setting uses the data captured by the sampling point as the condition. If you only want to trigger at the edge of a specific channel, you should use the “Sequence by” setting. With this function, the user does not have to set trigger conditions for each edge, but just focus on the data to be set. For example, the signal data to be measured is valid only when the clock is at the rising edge. There are four data lines. In this case, you can set the Sequence by as Custom Rising, and then select the Clock pin as the valid condition for the data. Then, you can set the conditions for other data lines in accordance with Multi Level triggering conditions.

This function is not supported when the sampling frequency is above 250 MHz.

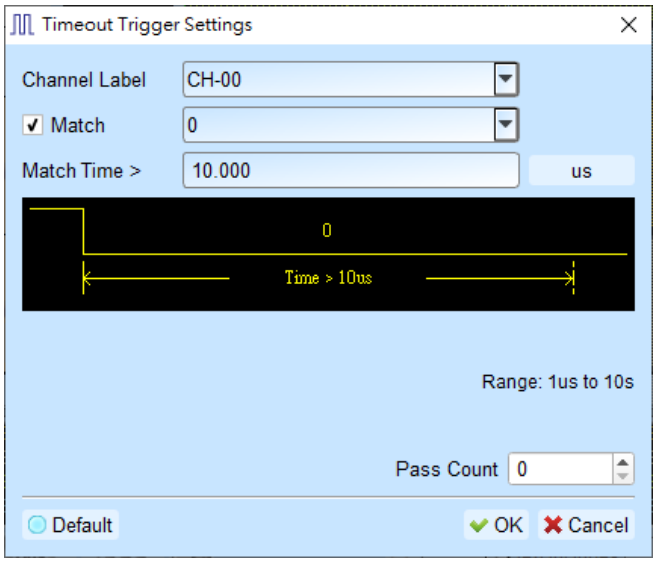
- **Width Trigger**

  The width trigger can set the trigger signal when the channel meets the trigger conditions and the length of the full pulse width.



- **Timeout Trigger**

  Timeout trigger can set the time width as trigger conditions. When the signal duration exceeds the set value, it will produce a trigger signal without waiting until a complete pulse is formed.

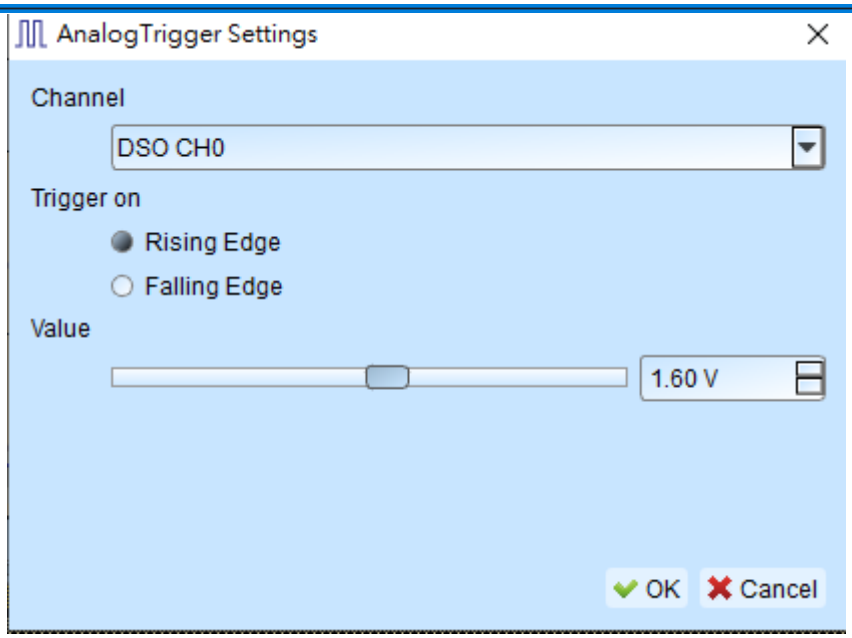


- **External Trigger**

  The Trigger In input pulse signal of the device is taken as the trigger condition.

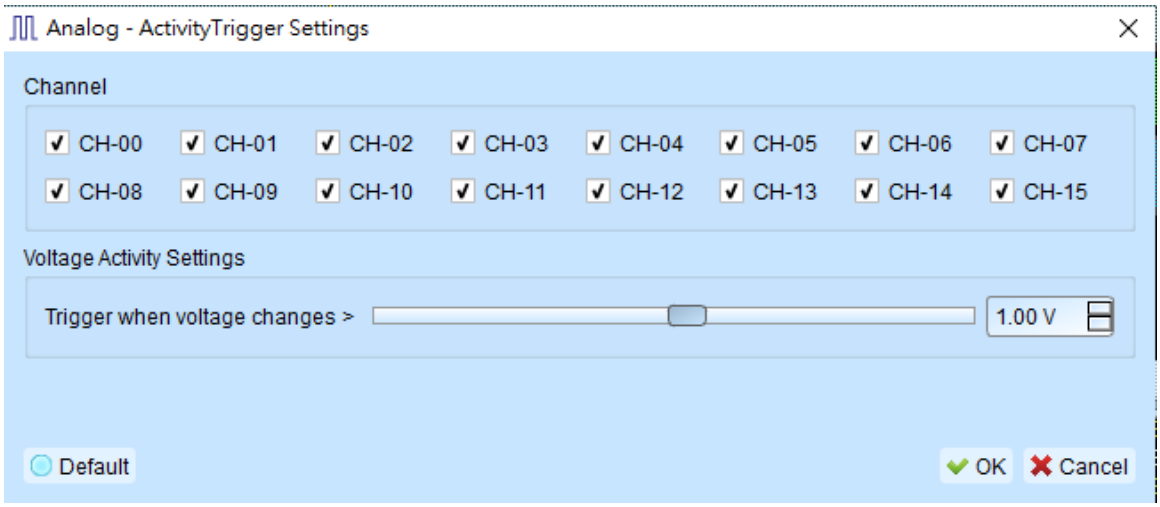
- **Analog Trigger - Edge**

  Use the rising/falling edge of the MSO analog channel as the trigger condition.



Analog Trigger – Activity

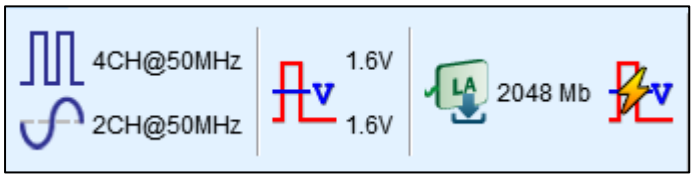
Use the voltage change of the MSO analog channel as the trigger condition.

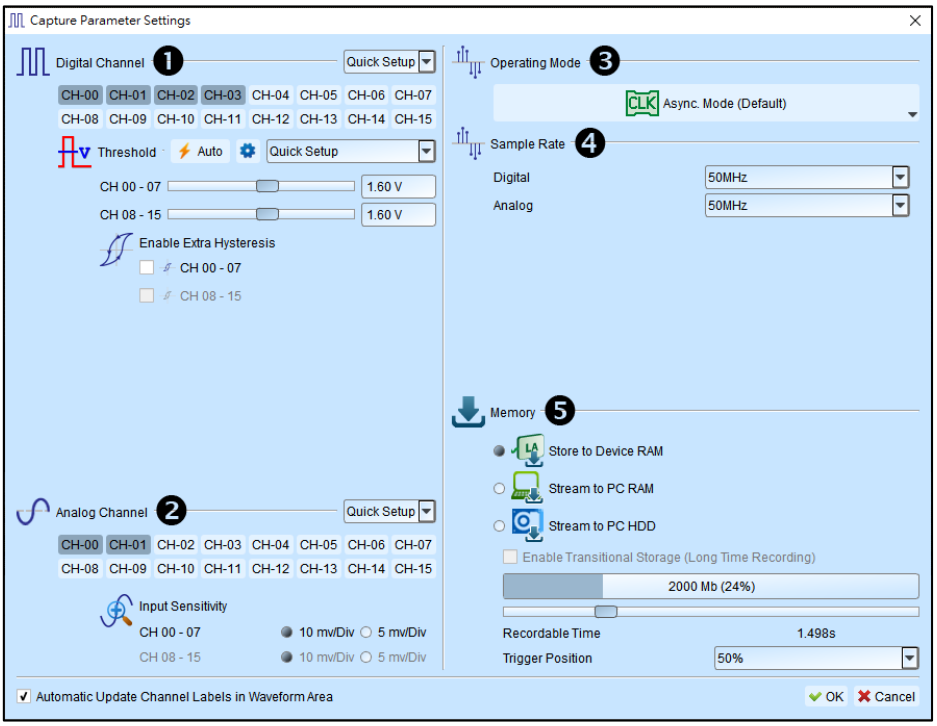


Protocol trigger

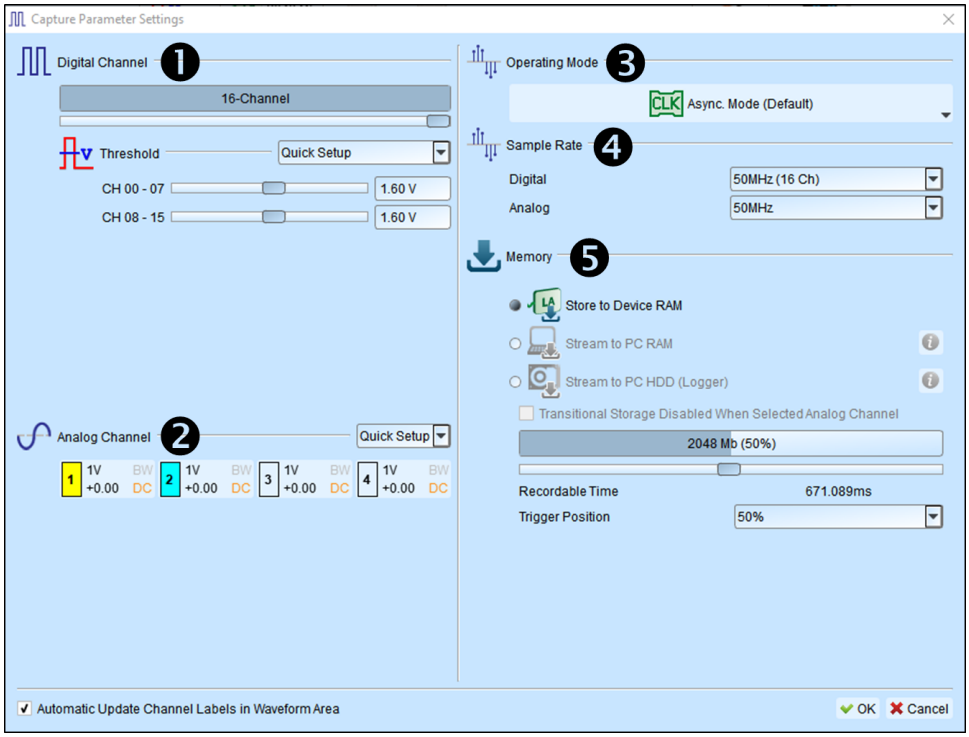
Please refer to LA Decode & Trigger manual.

Channels, Threshold, Sample Rate, Device Memory Usage





MSO1000, MSO2000 series interface



MSO3000 series interface

1. Digital Channel Settings:

   a. Choose the channel you want to measure, it sets threshold automatically, you can adjust manually. 8 channels are a set of adjustable units, there are two sets.

   b. **(MSO1000, MSO2000 series only)** Provide Extra Hysteresis function, turn on to reduce noise, turn off to increase sensitivity, replacing the past Schmitt function.

   c. The number of usable channels will vary depending on the trigger function setting or sampling rate.

2. Analog Channel Settings:

For MSO1000, MSO2000

a. You can choose the channel you want to measure.

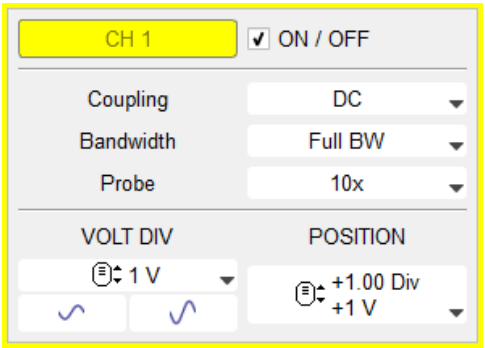
b. Input Sensitivity provides two different revolutions

(1). Voltage Range: +-10V, Minimum Scale: 5mV/Div.

(2). Voltage Range: +-20V, Minimum Scale: 10mV/Div.

For MSO3000

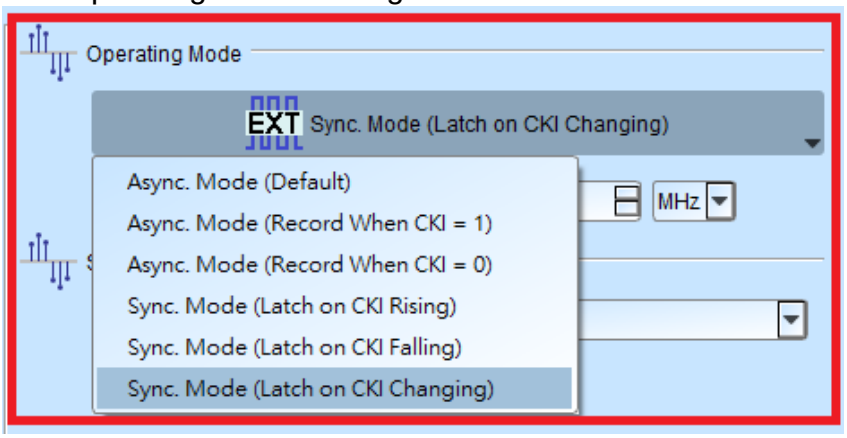
The number of available channels will be displayed in the analog setting column, each channel is set separately.



ON / OFF	Enable/disable the channel.
Coupling	The input signal is DC/AC coupled. DC coupling does not process the signal, while AC coupling removes the DC level from the signal.
Bandwidth	The bandwidth limit can be set to Full bandwidth / 100 MHz / 20 MHz. Full bandwidth means that there is no

	additional bandwidth limit, when the limit is 20 MHz or 100 MHz, it means that the set value will be used as the upper limit of the bandwidth.
Probe	Probe parameter settings. It can be set as a current probe or a voltage attenuation probe. If you use a voltage attenuation probe, please check the attenuation. The voltage value displayed on the screen will be correct only after it is consistent with the software screen setting.
Volt Div	Set the voltage value of each large division in the vertical direction.
Position	Set channel level. You can drag the channel label on the left side of the waveform area to change the level.

3. Operating Mode Settings:



Asynchronous Mode:

Asynchronous mode, also known as timing analysis, is based on the internal clock as a sample rate. It is recommended that the sample rate to be about 10 times the signal to be measured, with the minimum not less than 5 times. Any rates lower than 5 times will cause distortion. Asynchronous sampling will cause sampling error from the actual capture to the signal, with the error time being the reciprocal of the sample rate.

The default mode is to capture the signal at the sampling frequency. If you want to increase the time of signal capture, you can add a qualifier by selecting CKI and setting a channel to be 0 or 1. For example, when Chip Select is 0 to allow to

capture the signal, you can select the asynchronous mode (recorded when CKI = 0) to add the qualifier. After the qualifier condition is selected, the device will automatically turn on the transpose mode to capture the signal.

Synchronous Mode:

Synchronous mode, also known as state analysis, uses the external input clock as the sample rate. The channel marked with CK1 on the signal line is the external clock input channel. When the external clock stops, the signal capture will also stop, forming a synchronous operation between the two.

4. Sample Rate:

MSO 3000 series

Digital Available Channel	
Sample Rate	Conventional/Transitional
2 GS/s (Max)	8 / 7
1 GS/s	16 / 14
500 MS/s	16 / 16
250 MS/s	16 / 16

Analog Available Channel	
Sample Rate	
1 GS/s (Max)	1
500 MS/s	2
250 MS/s	4

MSO 2000 series

Digital Available Channel	
Sample Rate	Conventional/Transitional
2 GHz (Max)	8 / 7
1 GHz	16 / 14
500 MHz	16 / 16
250 MHz	16 / 16
200 MHz below	16 / 16

Analog Available Channel	
Sample Rate	
200 MHz (Max)	2 (Ch0, Ch8)
100 MHz	4 (Ch0-1, Ch8-9)
50 MHz	8 (Ch0-3, Ch8-11)
25 MHz below	16

MSO 1000 series

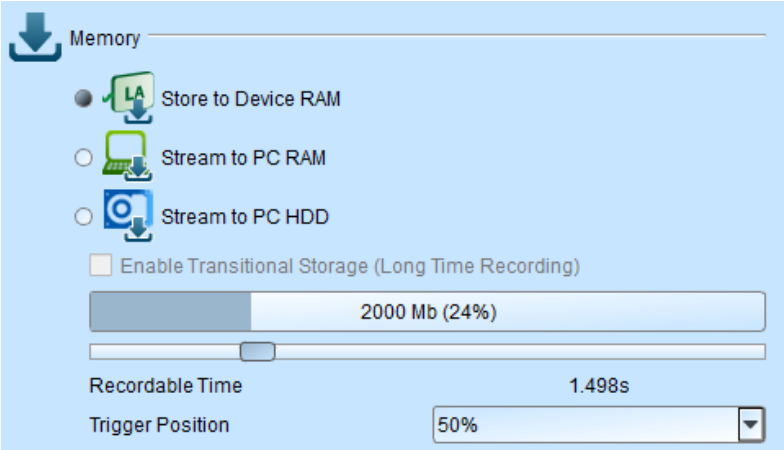
Digital Available Channel		
	Conventional/Transitional	
Sample Rate	1008E	1116E
2 GHz (Max)	4 / 3	4 / 3
1 GHz	8 / 6	8 / 6

Analog Available Channel	
Sample Rate	
200MHz (Max)	2 (Ch0, Ch8)
100 MHz	4 (Ch0-1, Ch8-9)
50 MHz	8 (Ch0-3, Ch8-11)

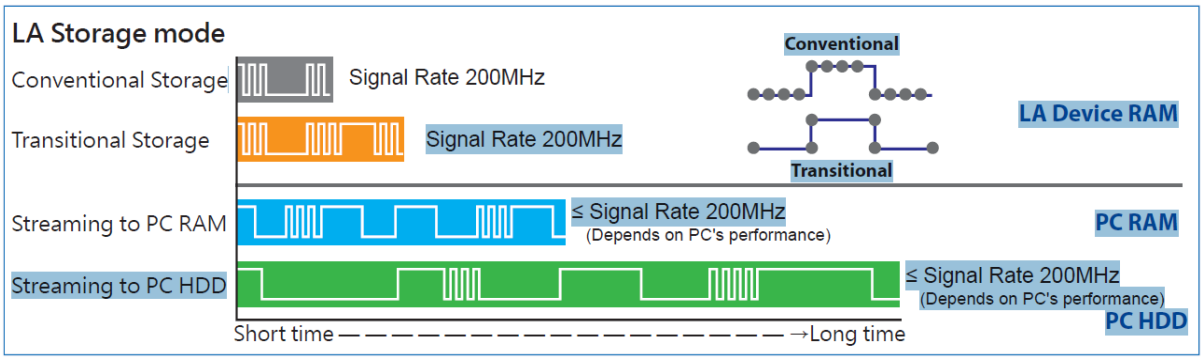
500 MHz	8 / 6	16 / 12
250 MHz	8 / 6	16 / 16
200 MHz below	8 / 6	16 / 16

25 MHz below	16

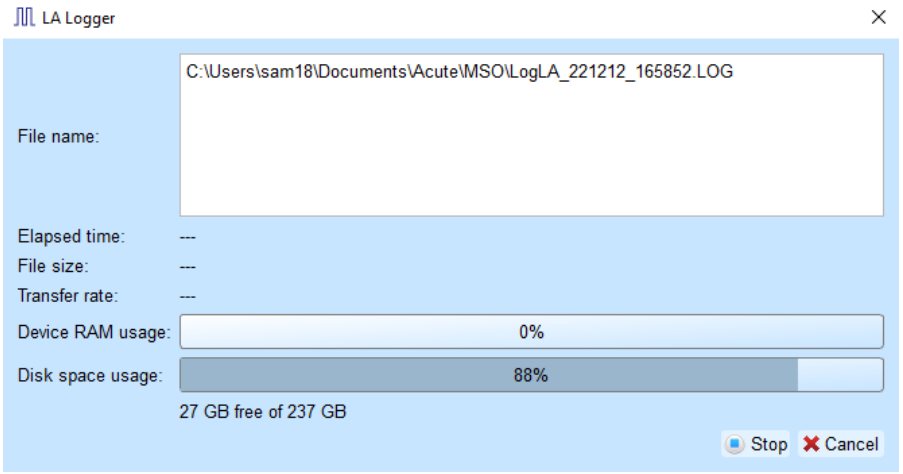
5. Memory Settings:

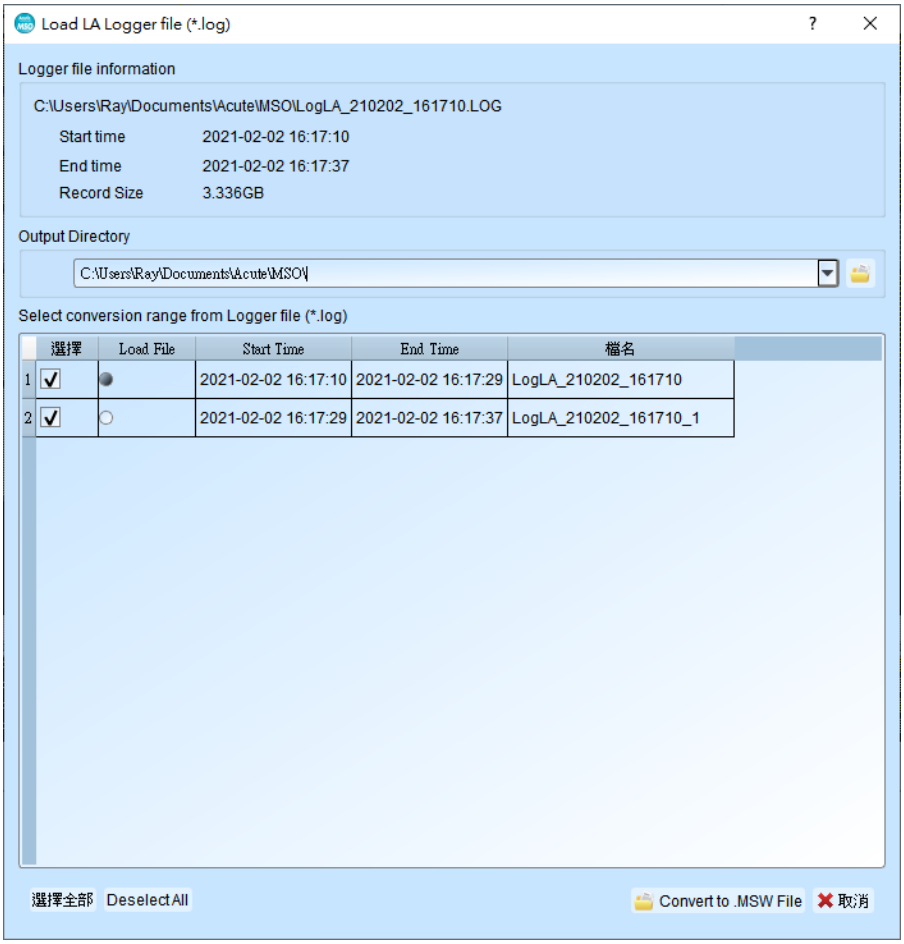


a. Storage Mode: Store to Device RAM, Stream to PC RAM, Stream to PC HDD



- Traditional Storage: Record every sample point.
- Transition Storage: Record the time intervals between edges. If the signal does not change frequently, the recording time can be greatly increased. When MSO analog channels are enabled, it doesn't support transition storage mode.
- Stream to PC RAM: Use transitional storage to stream data to PC RAM. The record length that can be captured depends on the performance of the computer. If the device memory or the PC RAM is insufficient, it will automatically stop.
- Stream to PC HDD: Use transitional storage and use device memory as buffer, then stream the data to PC HDD. The record length that can be captured depends on the performance of the computer. If the device memory or the PC RAM is insufficient, it will automatically stop.



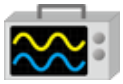


This function will keep saving the original data .log to PC HDD. After the capture stopped, the files will be cut automatically, each file is about 3GB, and you can choose the file to be converted to .msw or the file to be opened. It takes about 9GB of PC RAM to convert the file, please make sure the PC RAM is sufficient.

b. Record time: According to the current settings, we can estimate the time the waveform was captured. If enable transition storage, this function will be disabled.

c. Trigger Position：Set the position of the trigger point in the used memory in percentage. For example, set to 50%. Means that the device memory will retain up to 50% to store pre-trigger data.

Stack DSO (Oscilloscope)



Install the special software provided by each oscilloscope brand to stack MSO and oscilloscope. The software names are shown in the following table:

DSO brand	Software
Acute	Acute DSO software
Tektronix	Please download the **TEKVISA CONNECTIVITY SOFTWARE** from the Tektronix website.
Agilent Keysight	Please download the **KEYSIGHT IO LIBRARIES SUITE** from the Keysight website.
LeCroy	Please download the **NI VISA** and Drivers from the **NI** website.
HAMEG	Please download the **NI VISA** and Drivers from the **NI** website.
Rohde & Schwarz	Please download the **NI VISA** and Drivers from the **NI** website.

Oscilloscope supportive models:

DSO brand	Model	USB	TCP/IP
Acute	DS-1000 TravelScope	V	
Tektronix	TDS1000B/1000C/2000B/3000/3000B/ 3000C/5000B/7000 DPO2000/3000/4000/4000B/5000/7000 7000C/70000/70000B DSA70000/70000B MSO2000/3000/4000/4000B/5000 MDO3000/4000 TPS2000/2000B	V	V
Agilent	DSO1000A/5000A/DSO6000A/6000L 7000A/7000B/9000A MSO6000A/7000A/7000B/9000A DSO-X 4000A /MSO-X 4000A DSO-X 3000A /MSO-X 3000A DSO-X 2000A/MSO-X 2000A	V	V
Keysight	DSO-X 3000T MSO-X 3000T	V	V
LeCroy	WaveRunner / WaveSurfer / HDO4000 / HDO6000 / SDA 8 Zi-A / DDA 8 Zi-A		V
HAMEG	HMO3000/2000/1000	V	V
R & S	RTO1000/RTE1000		V

There are two methods for hardware wiring:

MSO is the Master, while the oscilloscope is the Slave.

Wiring direction is from MSO's Trig-Out the oscilloscope's Trig-In (see Figure 1)

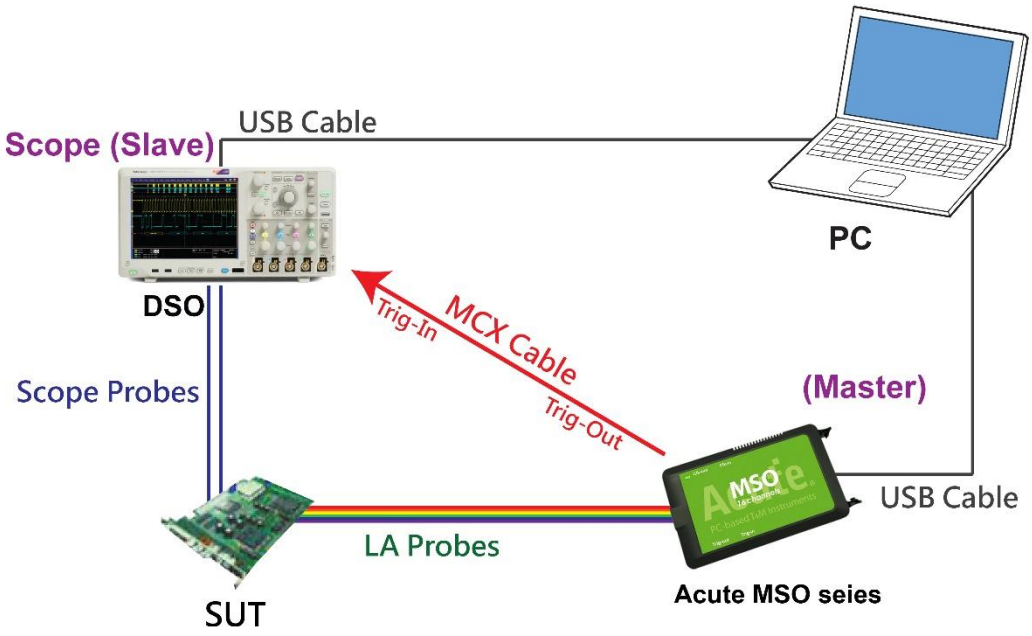


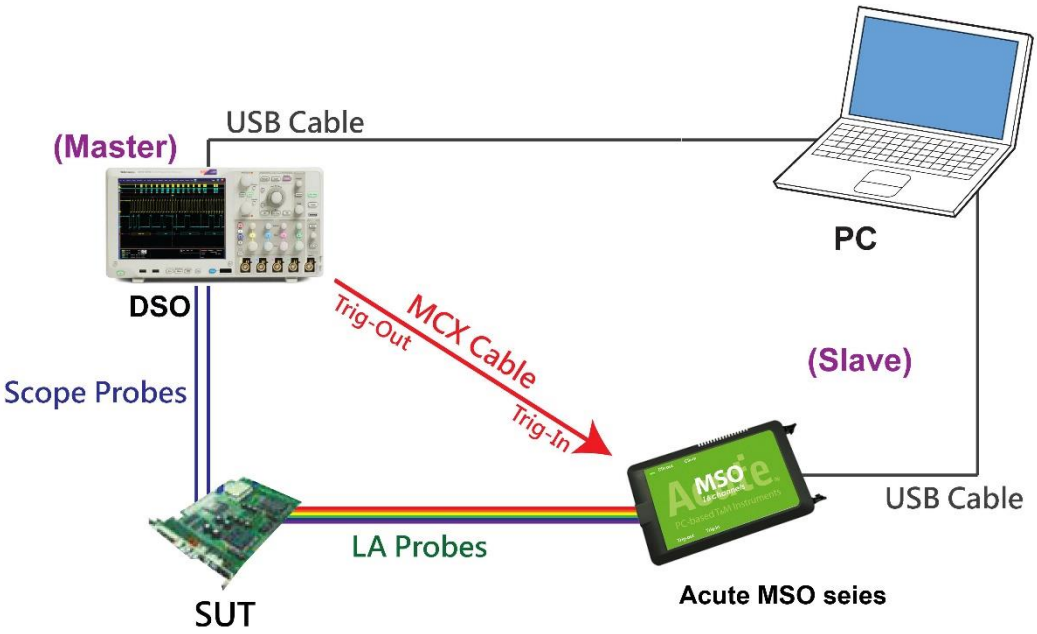
Figure 1

In Figure 1, the USB or Ethernet (TCP / IP) interface is connected to the computer, and then connect the BNC-MCX cable to the MSO Trig-Out and the trigger input interface (Ext-Trig, Aux-In or Trig-In) of the oscilloscope. MDO4000 series is fixed in the analog channel CH4.

The oscilloscope is the Master, while the MSO is the Slave.

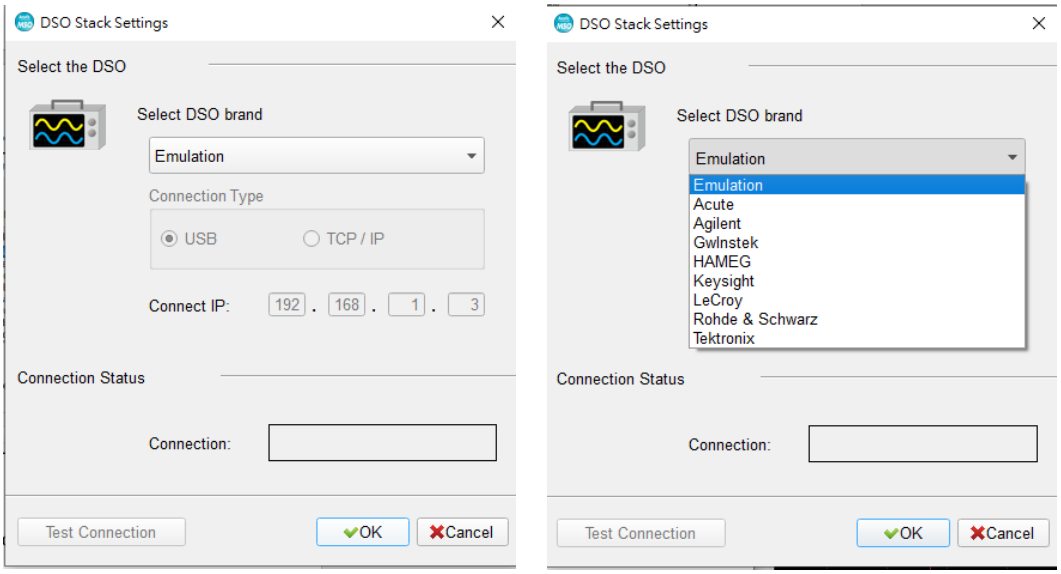
Wiring direction is from the oscilloscope's Trig-Out MSO's Trig-In (see Figure 2).

Figure 2



In Figure 2, the BNC-MCX cable is connected to the MSO Trig-In and the trigger output interface (Trig-Out) of the oscilloscope. After completing the above actions, press the

"Stack Oscilloscope" button, as shown below:



Select the DSO

Select the DSO brand to stack. When there is no DSO to stack, emulation is the mode to read back the storage files of DSO stacked.

Connection Type

It can be used to select USB, TCP / IP, according to the connection interface provided by the DSO brand.

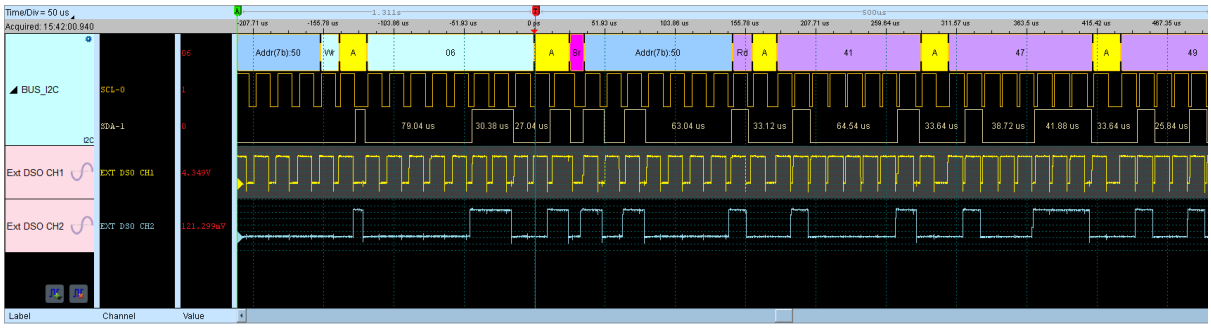
Connect IP

Select TCP / IP for the connection mode and enter IP address. When using the Ethernet crossover cable, it is recommended that the IP settings of the two machines to be 192.168.1.2 and 192.168.1.3 respectively. Gateway is the same, set to 192.168.1.1, and DHCP is set to OFF. If the IP setting does not take effect, please disable and then enable the network, or reboot to make the network settings effective.

Test Connection / Connection Status

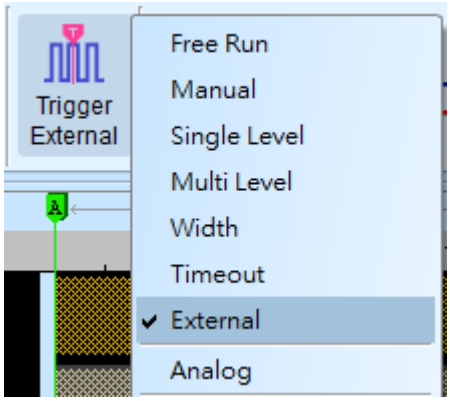
Connect the oscilloscope, it will show the current stacked oscilloscope model and automatically add the oscilloscope channel to the waveform window.

Screen of oscilloscope stack



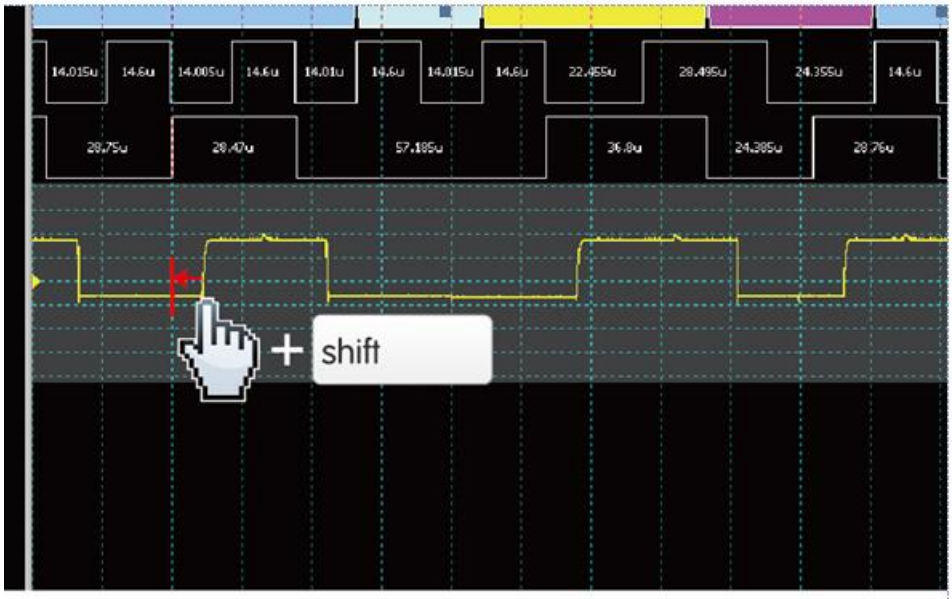
Set oscilloscope as master, MSO as slave

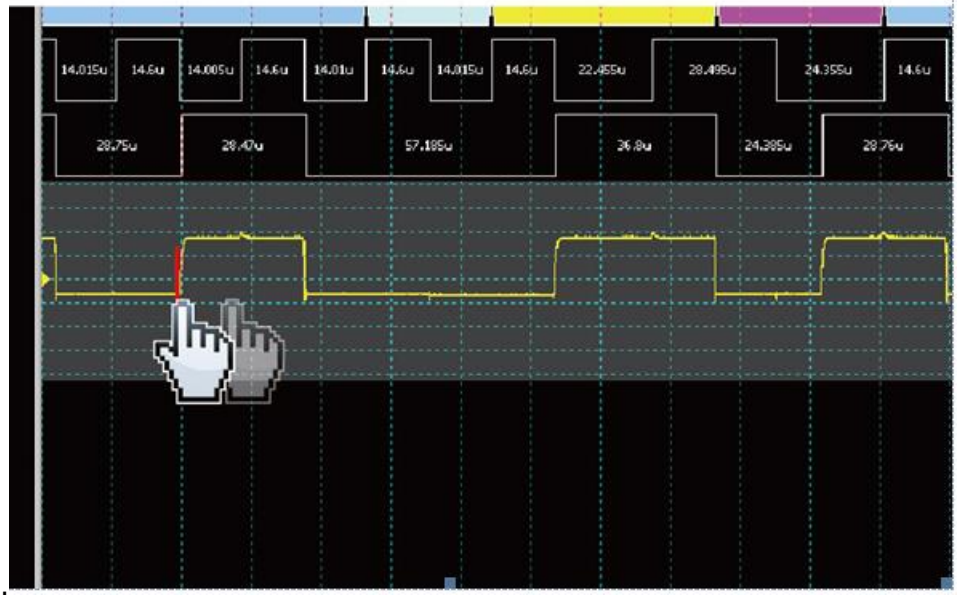
If the stack is composed of the oscilloscope as the master and MSO as the slave, you must not only complete the above-mentioned basic settings but also set the external trigger signal. For the hardware wiring, please refer to Figure 2. Press "Trigger Condition" → "External Trigger", as shown below



Stack Delay

When MSO is triggered successfully, the Trig-Out signal is transmitted through Cable to the DSO with a time delay, resulting in a time phase deviation between the logic and the analog waveforms. Therefore, the stack delay time must be set to compensate the delay. In the waveform display screen, you can put the mouse on the top of the DSO waveforms, hold down the Shift key, and then use the left mouse button to drag the DSO waveforms to the appropriate location to complete the stack delay





correction.

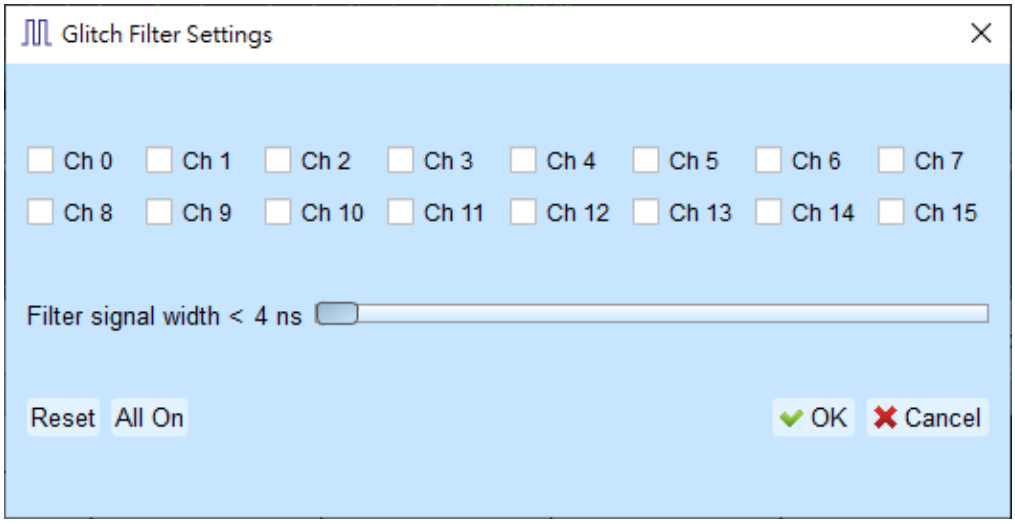
Stack Cable:

BNC-MCX cable

Advanced Capture Settings

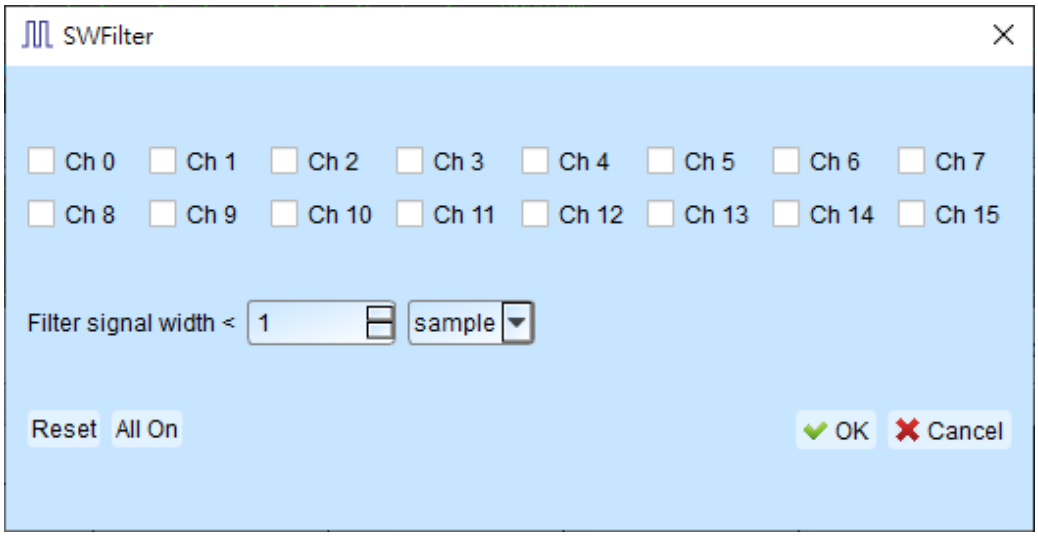
• Glitch filter settings

The hardware glitch filter function is used to filter out unwanted glitches and logical misjudgment caused by slow transitions. It can be regarded as a low pass filter. Notice that the glitches may sometimes lead to poor quality of data transmission. You can stack a logic analyzer and an oscilloscope to check the signal integrity and whether there are unexpected glitches.



This filter can filter the signals of less than 5 ns - 35 ns wide. If this filter function is enabled, it will filter before the hardware is triggered. Channels that use the glitch filter function are marked with a red dot on the channel label for identification.

- **Software Glitch filter settings**

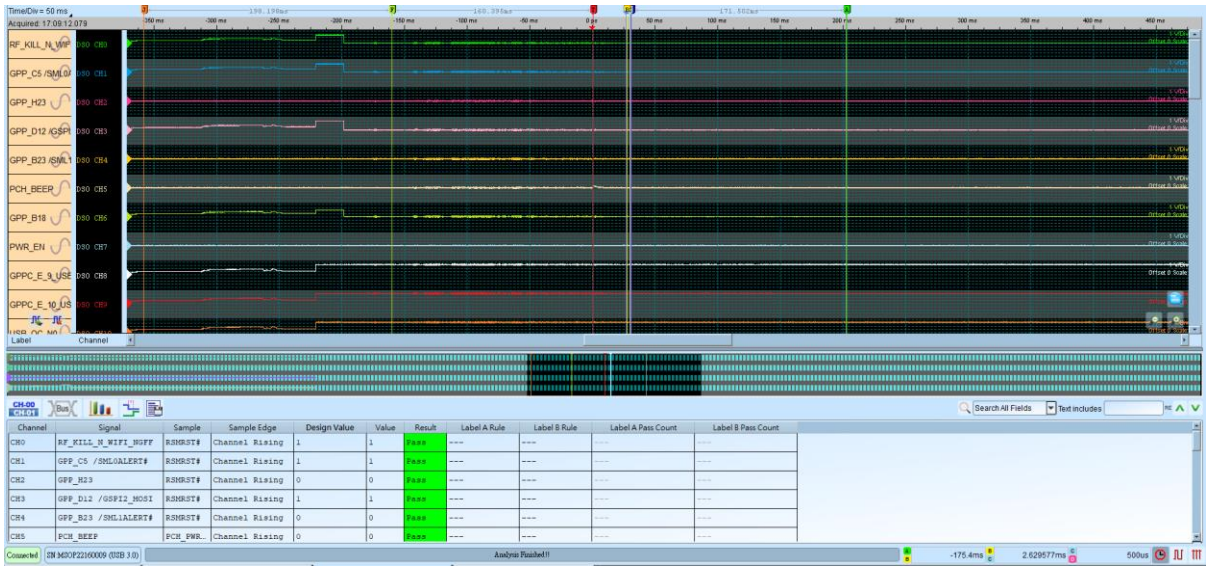


This filter function can be set to filter the signals with pulse width range from 1 ps to 1ms. Enable this filter function will only change the display and decode contents, the trigger and recordable time will remain not effected. Disable this filter function will restore all waveform contents back to the original unfiltered waveform.

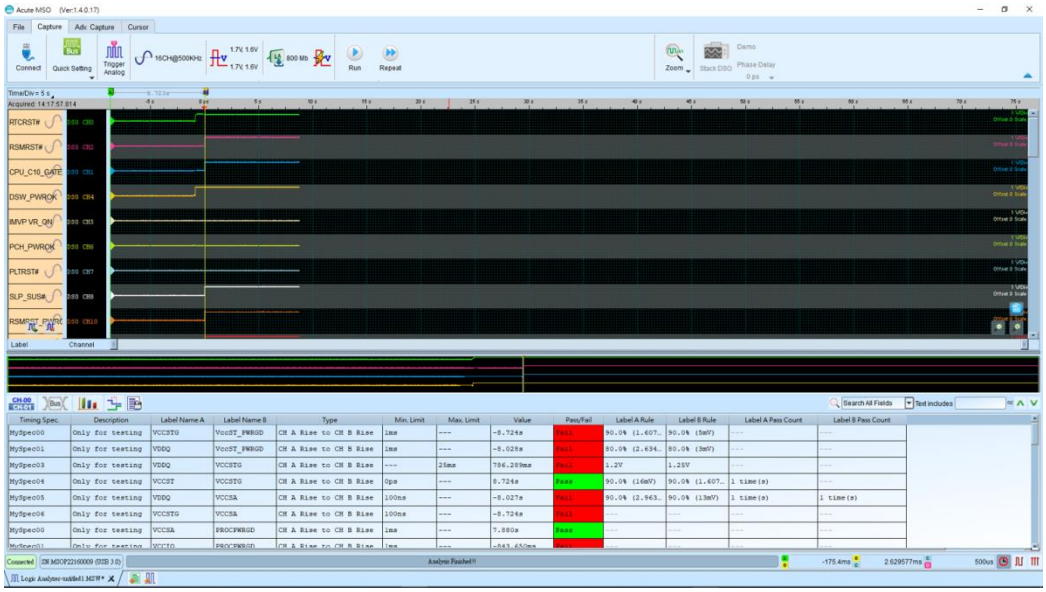
- **Timing check**

  Import the .csv file of the timing check items; the parameters and measurement items must be input to the file beforehand. There are two main measurements, as follow; you can also check whether it meets the design value.

1. HW Strap: Measure the actual voltage at the sample points.

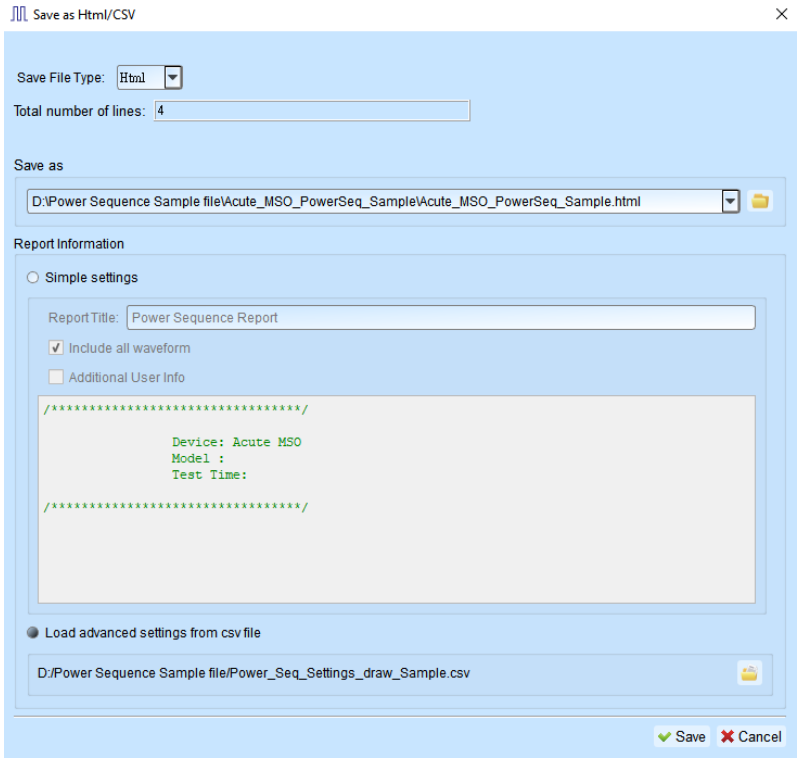


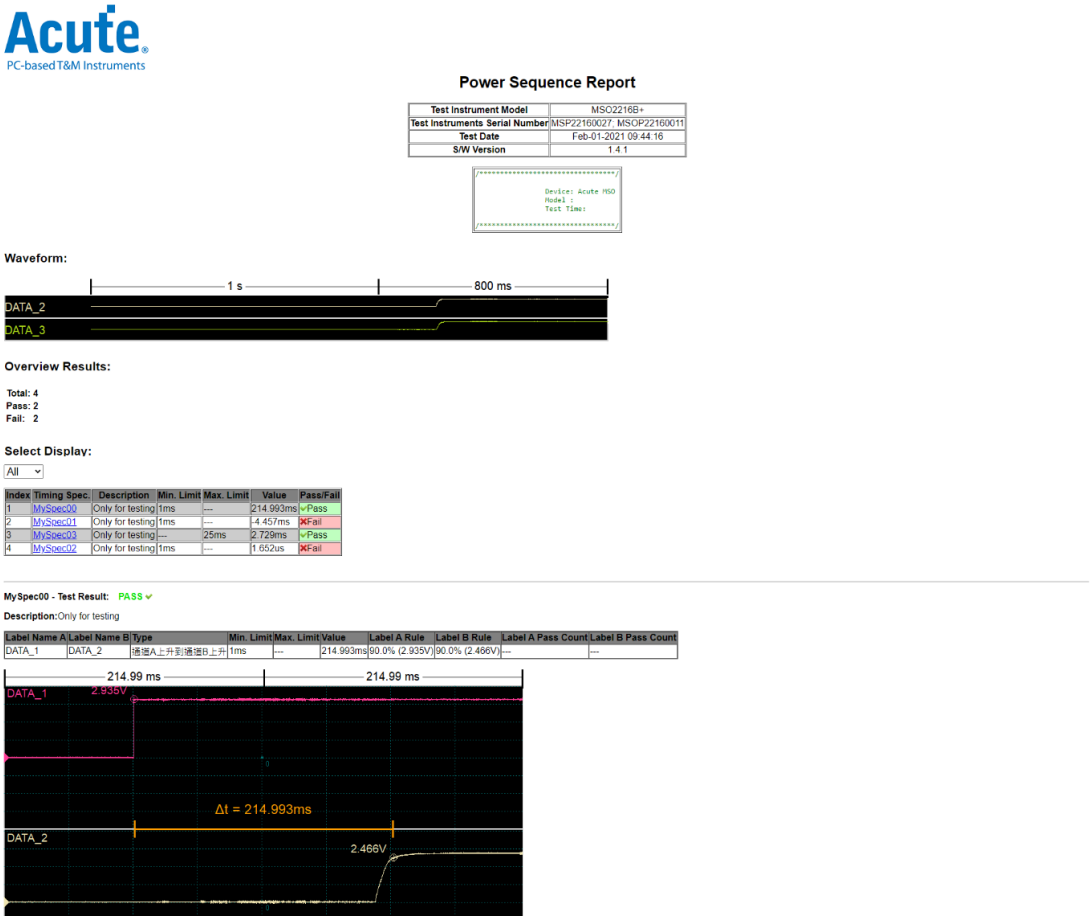
2. Timing sequence: Measure power-on(off) sequence.



1. Generating a power sequence html format report:

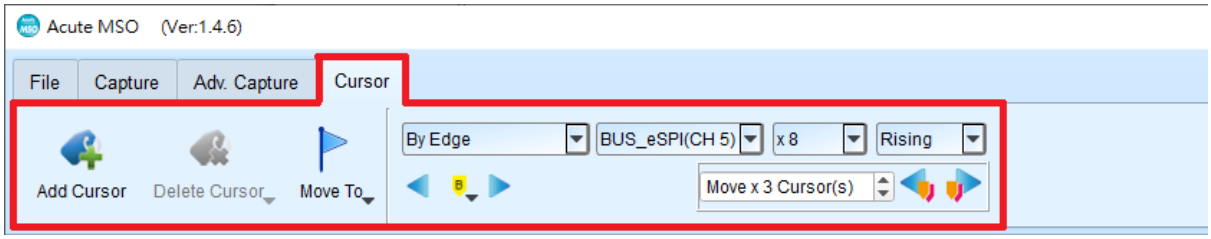
   The power sequence report provides with waveform screenshots and testing results, user can edit the report title and user-defined information.



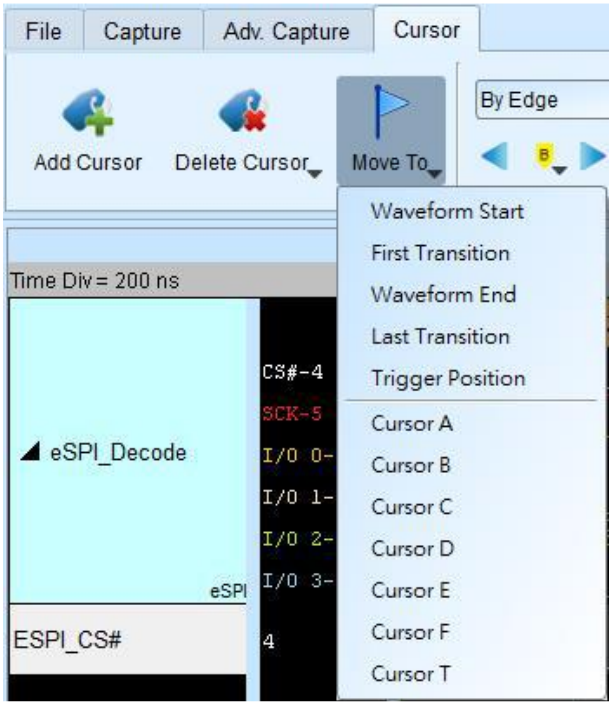


Cursor

This function includes the cursor setting and the waveform search function matching the cursor.



Move To: Move the focused timestamp position in the waveform area according to the selection.



Waveform Start: Move to the beginning of waveform.

First Transition: Move to first waveform transition.

Waveform End: Move to the end of waveform.

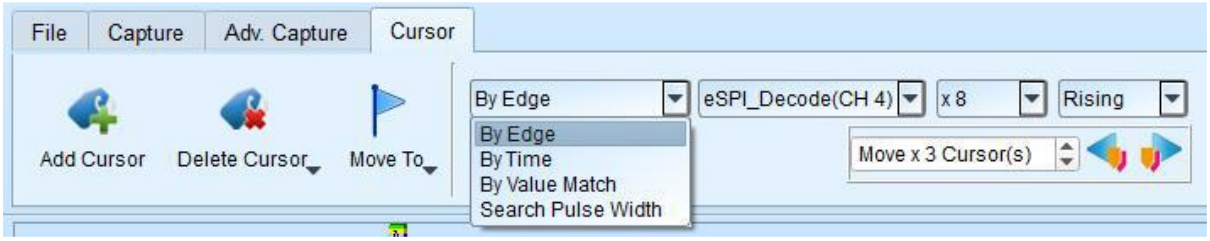
Last Transition: Move to last waveform transition.

Last Transition on selected channel: Move to the last waveform transition of selected label.

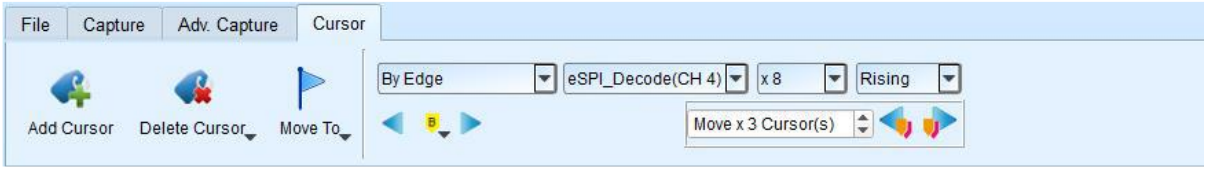
Trigger Position: Move to the trigger position.

Cursor A-Z: Move to the Cursor position.

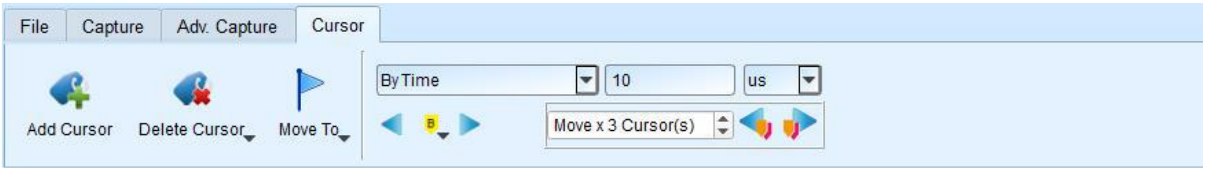
Waveform search is divided into four modes:



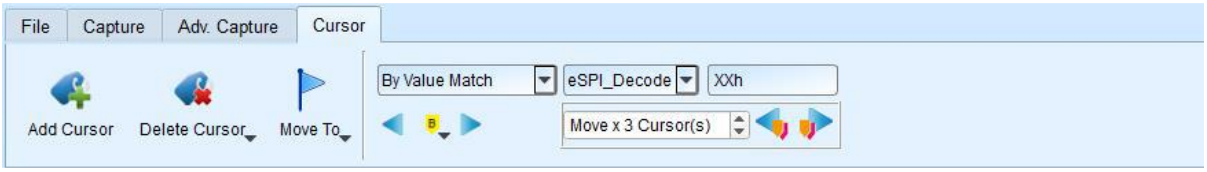
1. By Edge: Move the specified cursor according to the number of Rising/Falling/Either edges (x1 ~ x4096) of the specified channel.



2. By Time: Move the specified cursor forward or backward to a certain amount of time.



3. By Value Match: In search of displayed value content of the specified channel, if the specified channel is a protocol, the text comparison will be used for the search; if the specified channel is the bus or channel, the numerical comparison will be used for the search.



4. Search Pulse Width: The waveform pulse widths meeting the conditions can be searched on the specified channels. The single-cursor movement function on the left side or the multiple-cursor movement function on the right side can be used on any operation meeting or exceeding the conditions.
   All of the above operations can be used to move a single cursor on the left or multiple cursors on the right.

The starting point of the search is set to the current position of the selected cursor.

Cursor usage:

The cursor system has two special purpose cursors: the triggering cursor T and the search specific cursor B, respectively. To add a new cursor, you can click the “Add Cursor Button” () on the top or press the Shift+ letter key. To delete a cursor, you can click the “Delete Cursor Button” () on the top.

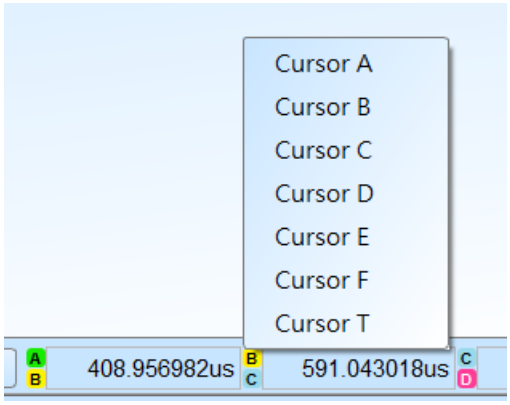
Cursor movement method:

1. Drag the cursor sign or cursor line to move the cursor.
2. Use the keyboard A-Z to quickly navigate to the cursor’s location.
3. Use the keyboard Shift + A-Z to move the cursor to the place where the mouse cursor is. If the cursor does not exist, it will add the cursor to the mouse cursor’s location; this could save you time dragging the cursor.

At the bottom right of the screen shows the frequency / time, the value will change as the cursor moves.

 From left to right are the interval time, frequency calculation, the number of sampling statistics, respectively.

Clicking the cursor name, you can switch the cursor.

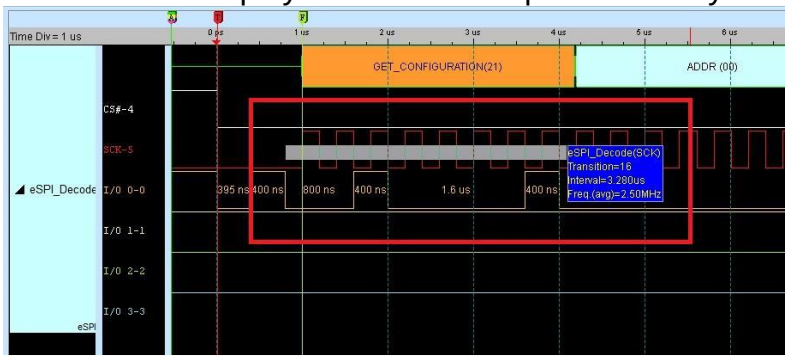


Waveform and Report

Waveform

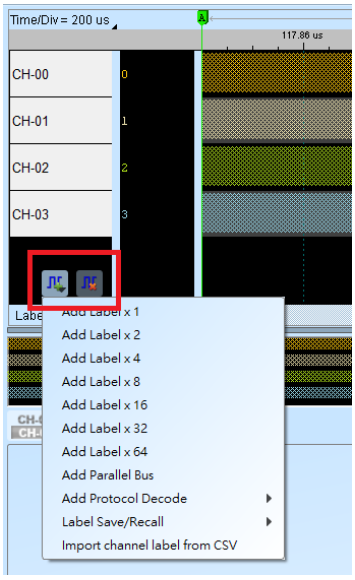
1. Use the left mouse button to drag the waveform in the wave form display area.
2. You can use the mouse wheel or click the zoom in button on the screen  to zoom in/out the waveform.
3. To add text/graphic annotation  , you can add text or graphic annotation data in the waveform area.
4. Quick calculation function

   Use the right mouse button to box out an area in the waveform display area, it will show the number of signal transitions in the observation interval, the length of time and the average frequency information. This function can also be used in the waveform display area under the protocol analyzer mode.

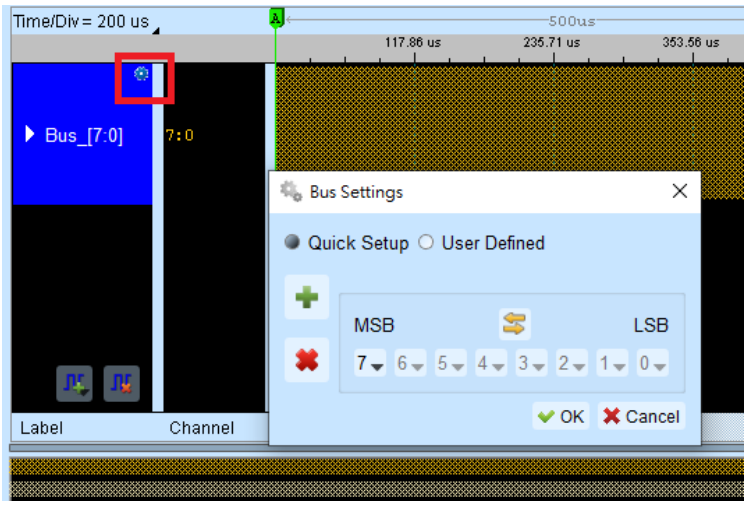


5. Add/Delete the waveform label.

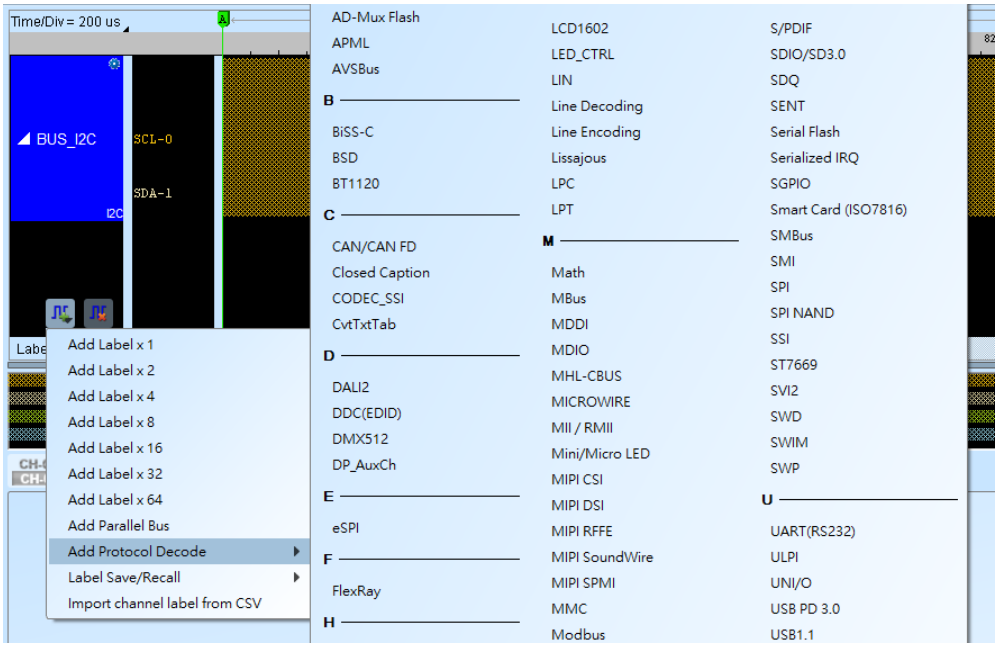
- Add labels



- Add parallel bus



- Add protocol decode

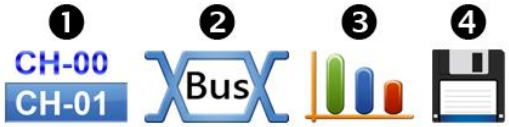


- Label Save/Recall: Save the current channel settings or load the saved channel label.
- Import channel label from CSV file. The file format is as follows,

	A	B
1	name1	1
2	name2	2
3	name3	3
4	name4	4
5		

Notice: The feature can only import channel name and number. It cannot import parallel bus or protocol decode.

Report Area



1. Display the channel status.
2. Display the results of the bus decode, or create customize report from multiple decodes.
3. Waveform data statistics

   Select measurement type and channels. The default measurement range is the entire waveform area, you can specify a certain range between two cursors.

   Digital Measurement:

Type	Channels
Period	1
Frequency	1
Edge Count	1
Cycle Count	1
Positive Cycle Count	1
Negative Cycle Count	1
Positive Pulse count	1
Negative Pulse count	1
Positive Pulse Width	1
Negative Pulse Count	1
Channel-to-Channel Rising Delay	2
Channel-to-Channel Falling Delay	2
Channel Rising to Channel Falling Delay	2
Channel Falling to Channel Rising Delay	2
Phase Delay	2

Analog Measurement:

Type	Channels
Frequency	1
Period	1
V Max.	1
V Min.	1
V High	1
V Low	1
V Peak to Peak	1
V Amplitude	1
V RMS.	1
V Mean	1
V Mid	1
High Duty	1
Low Duty	1
High Period	1
Low Period	1
Rise Time	1
Fall Time	1
V Pos. Overshoot	1
V Neg. Overshoot	1
V Rising Pre-shoot	1
V Falling Pre-shoot	1
Ch to Ch Rising Delay	2
Ch to Ch Falling Delay	2
Ch Rising to Ch Falling Delay	2
Ch Falling to Ch Rising Delay	2
Phase Delay	2
Rising Edge Count	1
Falling Edge Count	1
Edge Count	1

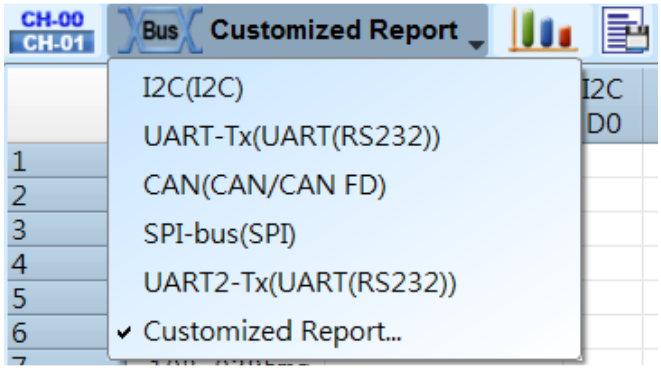
4. Save report area

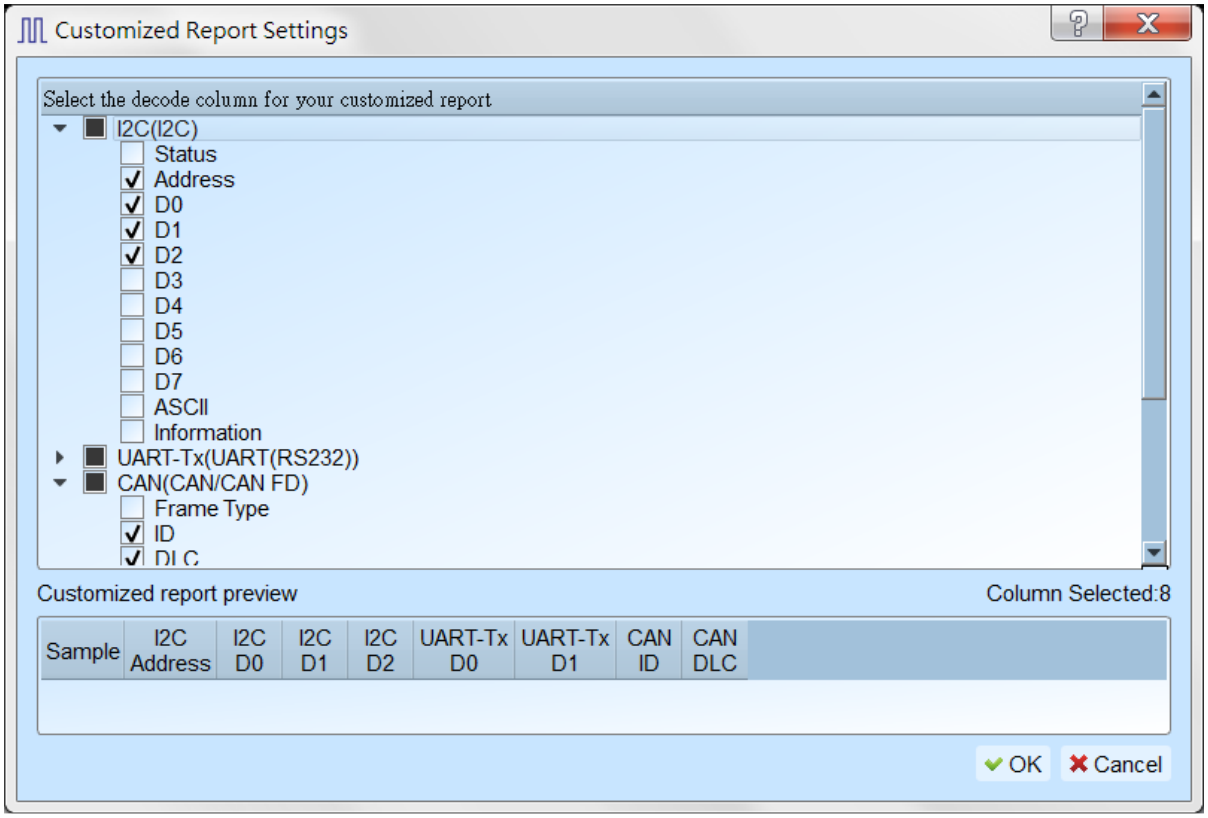
   Save the report area as text files.

Bus Decode Settings

Please refer to the bus trigger and Analyzer manual.

Customized Report Settings





All bus decodes enabled in waveform area will be listed in the settings window, select columns wanted from each reports, the preview window will show selected column and combine them to create your customized report.

Note: The Bus Decoders must be setup correctly in order to fetch the correct column names for the customized report.

Chapter 3 Technical Support

Contact information

Acute website: https://www.acute.com.tw

E-Mail: service@acute.com.tw

Tel: +886-2-29993275

Fax: +886-2-29993276

If 

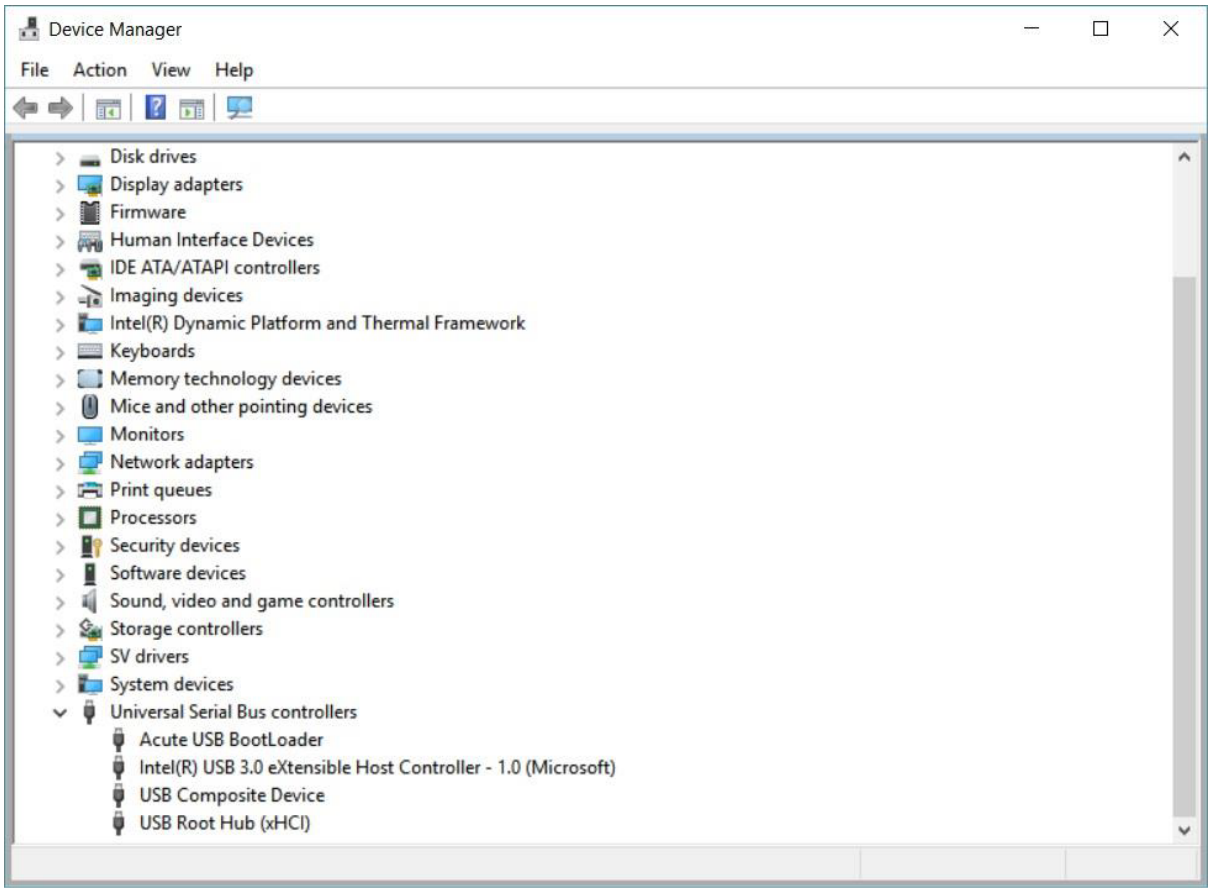
shows up in the Demo mode during the execution of MSO software, please try the following steps to solve the issue:

(1) Install the latest version of the MSO software, please go to the official website of Acute Technology Inc. – Download - Software, and then select the MSO to download and install.

(2) Please use the original USB3.0 Cable in the kit.

(3) Go to the device manager and check the driver status

Please connect the device USB cable to the computer and then go to the system device manager to check whether the Acute USB Bootloader or Acute USB3.0 Product shows up. Please go to the Acute Website-Download -Software, download the USB3.0 driver and follow the troubleshoot manual in the package to reinstall the driver.



(4) Remove all probes and re-plug the USB3.0 Cable or restart the computer to check whether the driver appears.

(5) After you take the above steps but the problem is still unsolved, please contact us.