# User Manual
# TravelBus
# 2-in-1 Analyzer
# (Protocol & Logic)


Publish: 2022/12

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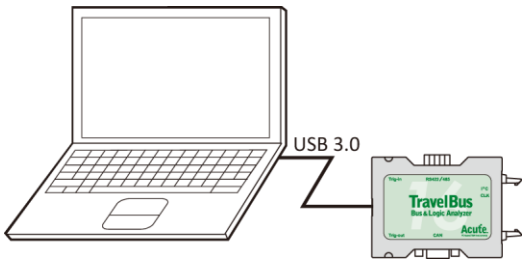
# Chapter 1 Installation

## Hardware

Connect the TravelBus to the PC with the USB 3.0 cable in the TravelBus kit.

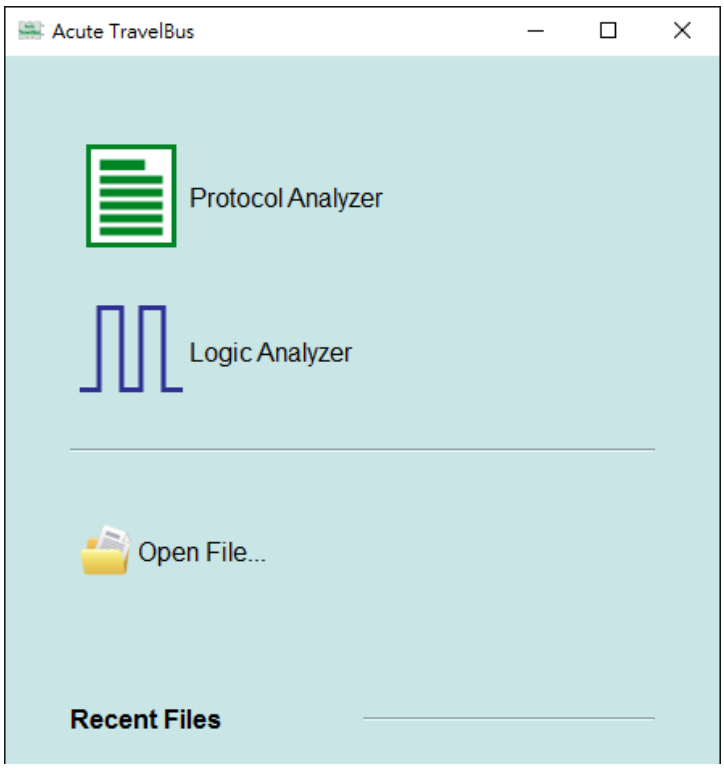



## Software

Install the software from

https://www.acute.com.tw/logic-analyzer-en/support/download/software

Run **TBA.exe** ( ) and choose the Protocol Analyzer or Logic Analyzer in the menu window below.




**Open File…** will open the old file (.TBW).

# Chapter 2 Operations

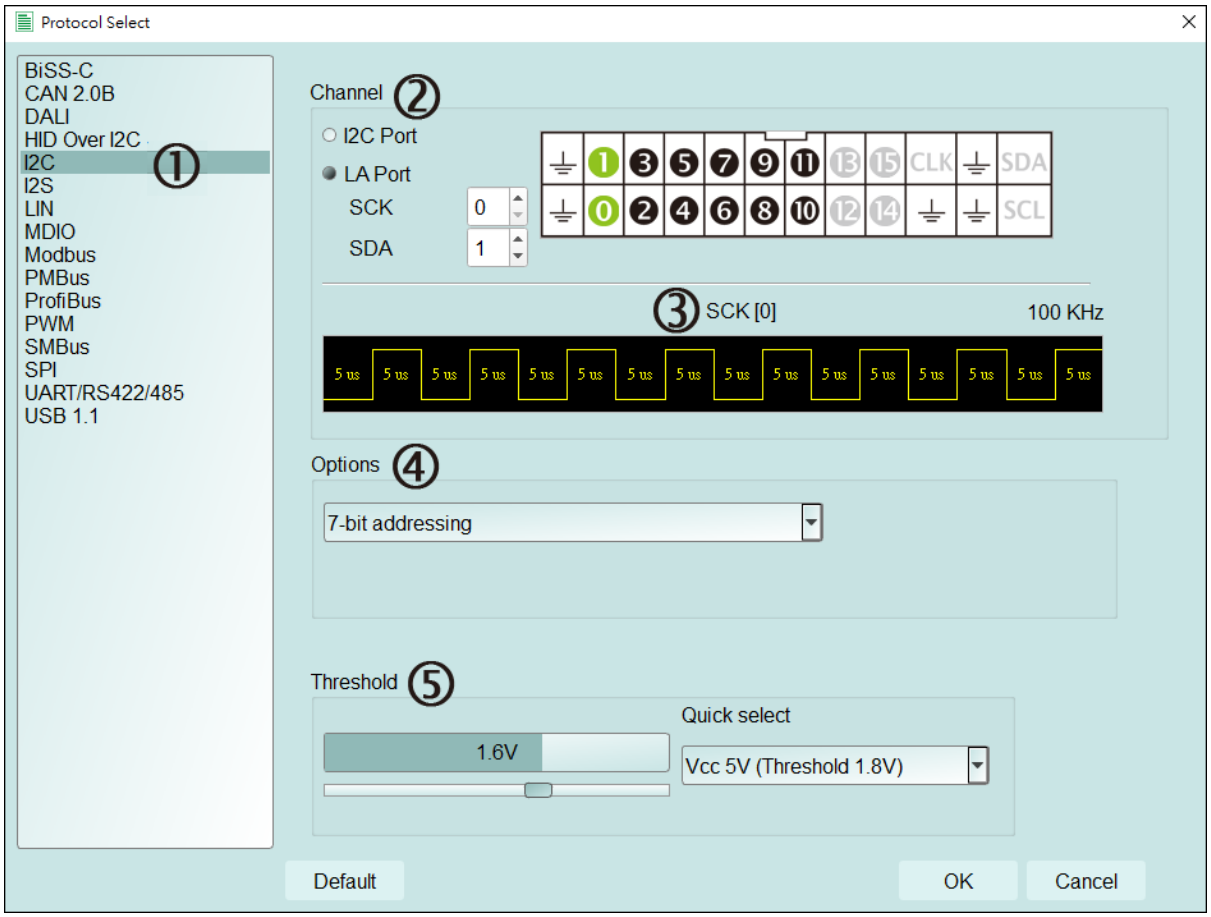
## Protocol Analyzer

### Main Window


1. **Toolbar** includes Protocol, Waveform, Run, Search and Save to text which format is .csv or .txt.
2. **Report Window** displays real-time protocol data.
3. **Waveform** displays the waveforms only when the Waveform option is checked.
4. **Status Bar** shows if the TravelBus is connected to the PC, what protocol, time captured/available time to capture, ….
5. **Detail/Navigator/Filter** shows the protocol data detail and is able to filter those data.
6. **Cursors** display the time/frequency difference between cursors.

Click **Protocol Select** (  ) to open the software window below:

1. Choose I²C.




2. **Channel**：

   Choose either I²C ports or LA ports (channel 0~15) to measure the I²C signal. The I²C ports are only for low speed I²C signal.

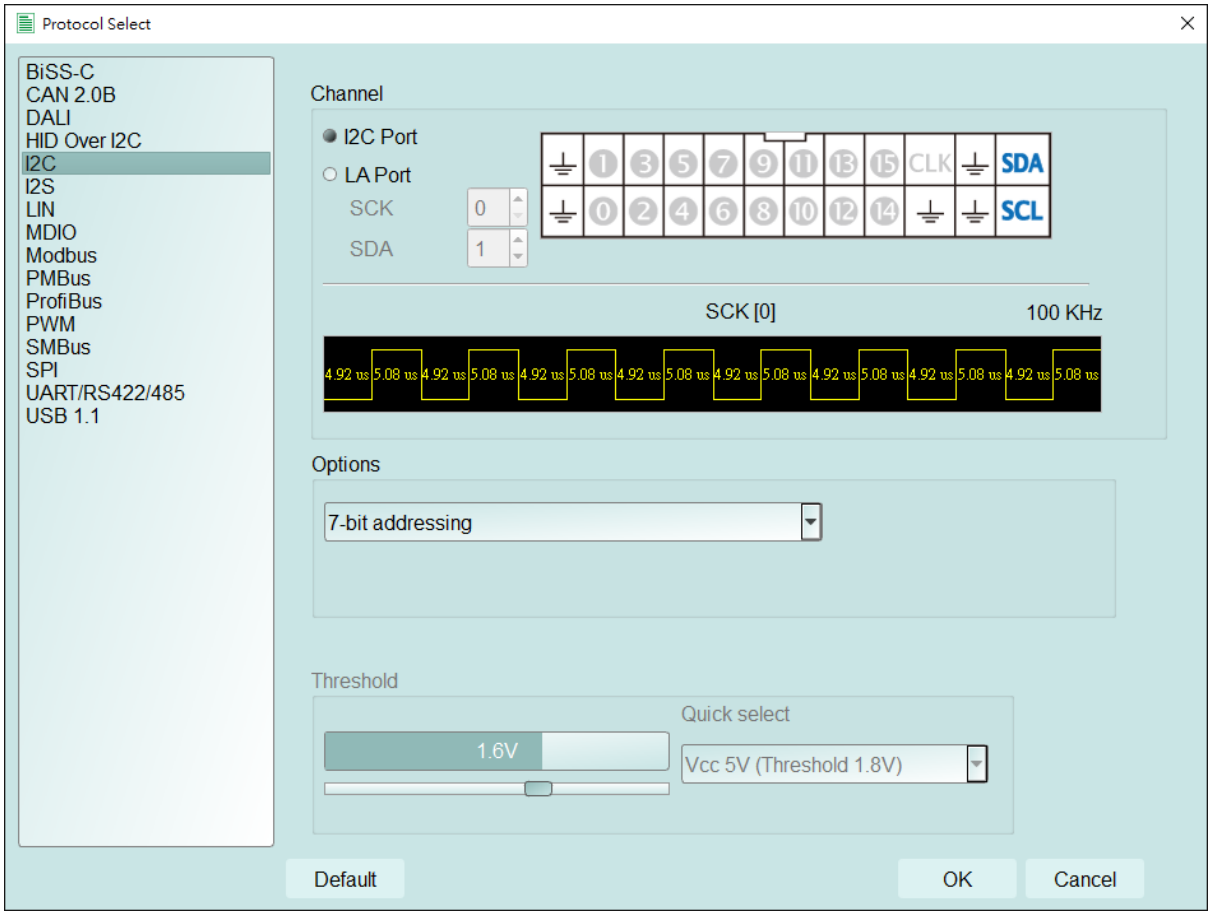
3. **Waveform**：

   The TravelBus auto-detects the signal frequency and displays the real-time waveform.

4. **Options**：Choose the address mode.

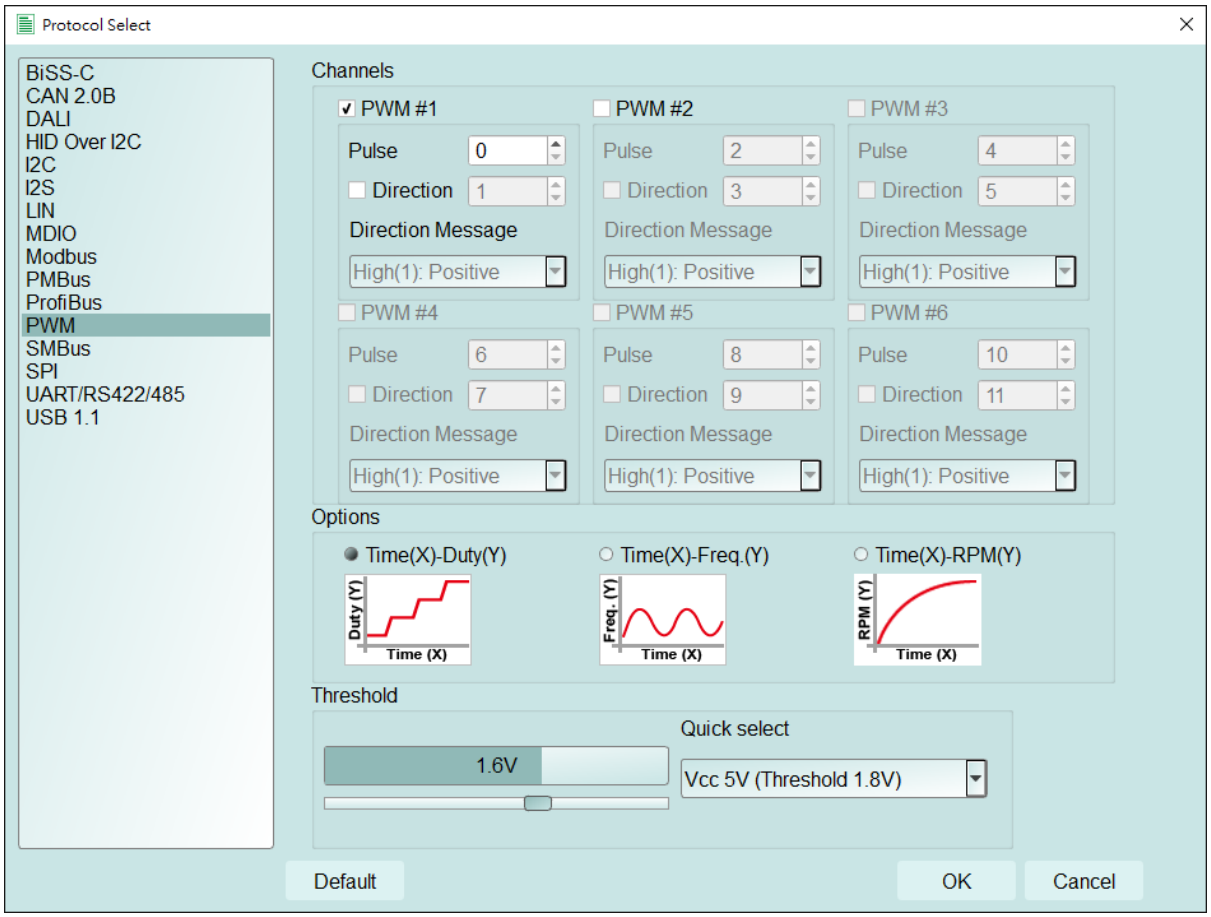
5. **Threshold**：The threshold is provided by default for each protocol or can be set manually.

If the I²C Port is selected, the SDA and SCL channels are I²C ports for slow I²C signal

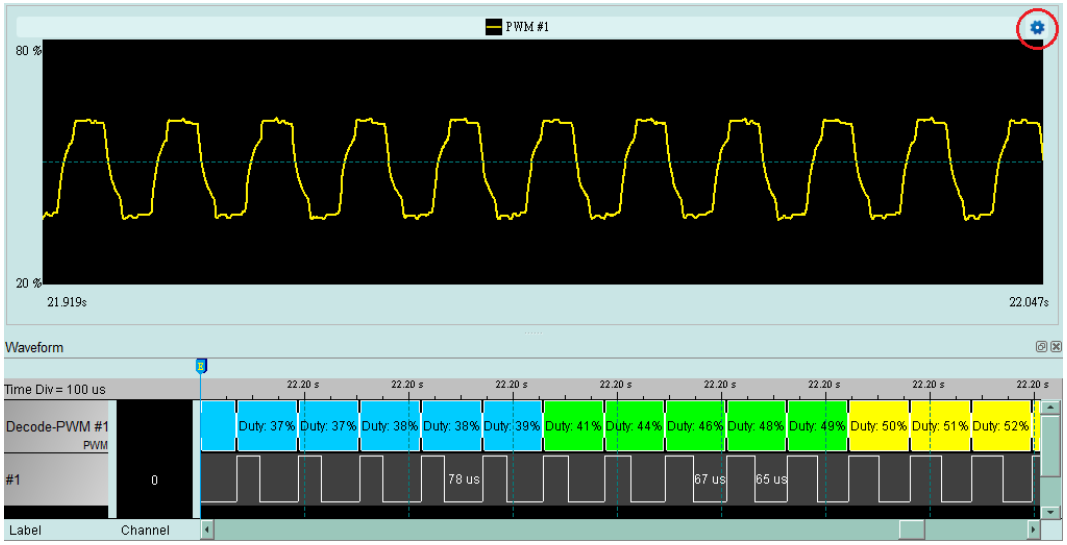


**PWM**

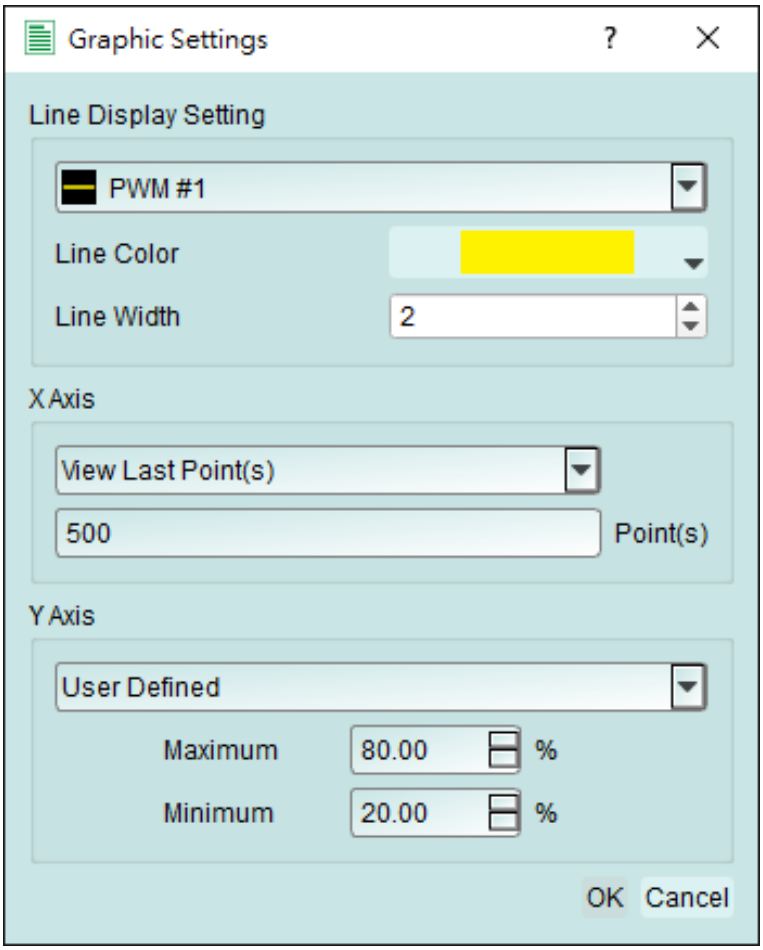
PWM decode can show at most six PWM curves on the screen. The direction can be determined by Direction Message on Direction channel. It can be choose High or Low to represent the positive direction, and the example of practical application is the positive or negative rotation of the motor. You may choose one of the three curves, duty-cycle, frequency and RPM.



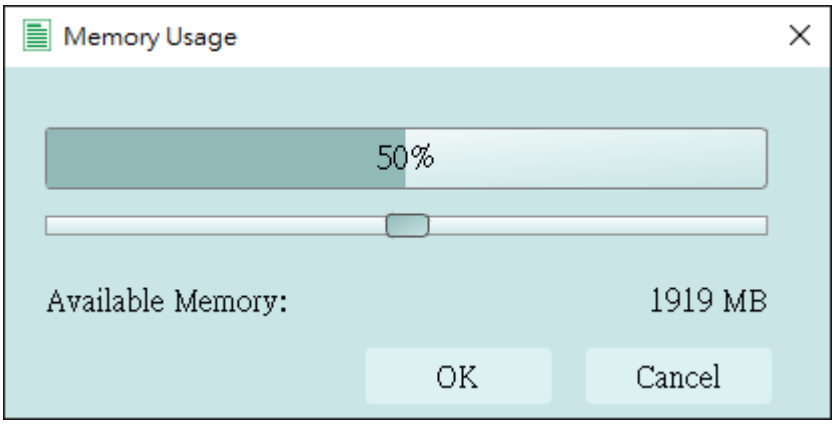

Click on the upper right **Graphic Settings** to change the plot setting.



You may change the line display setting and the range of axes in **Graphic Settings**.




Click **Memory Usage** (  ) on the Main Window to set the percentage of the PC RAM for use.

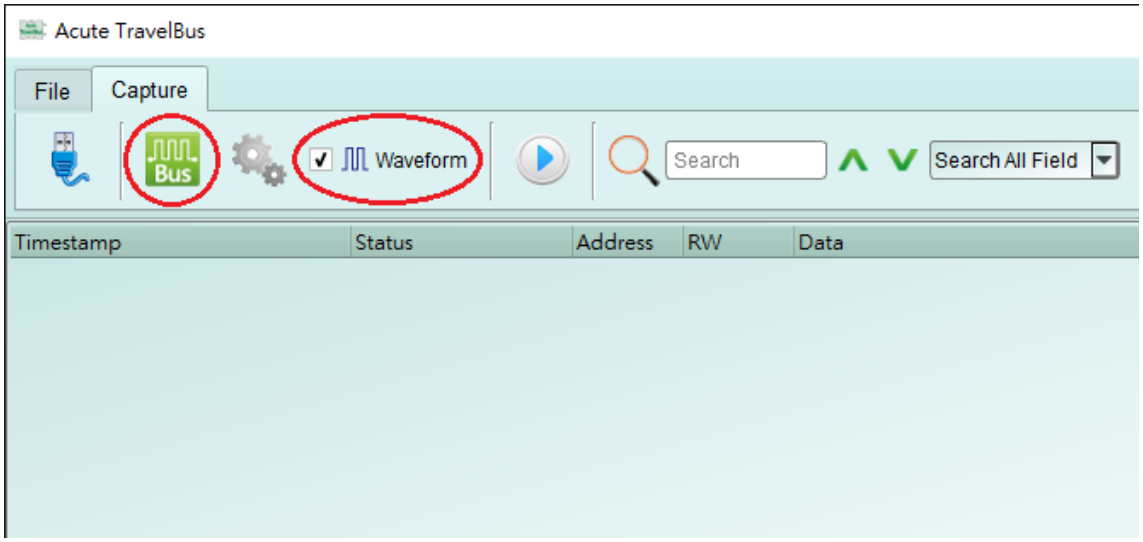



**Stack with the DSO**

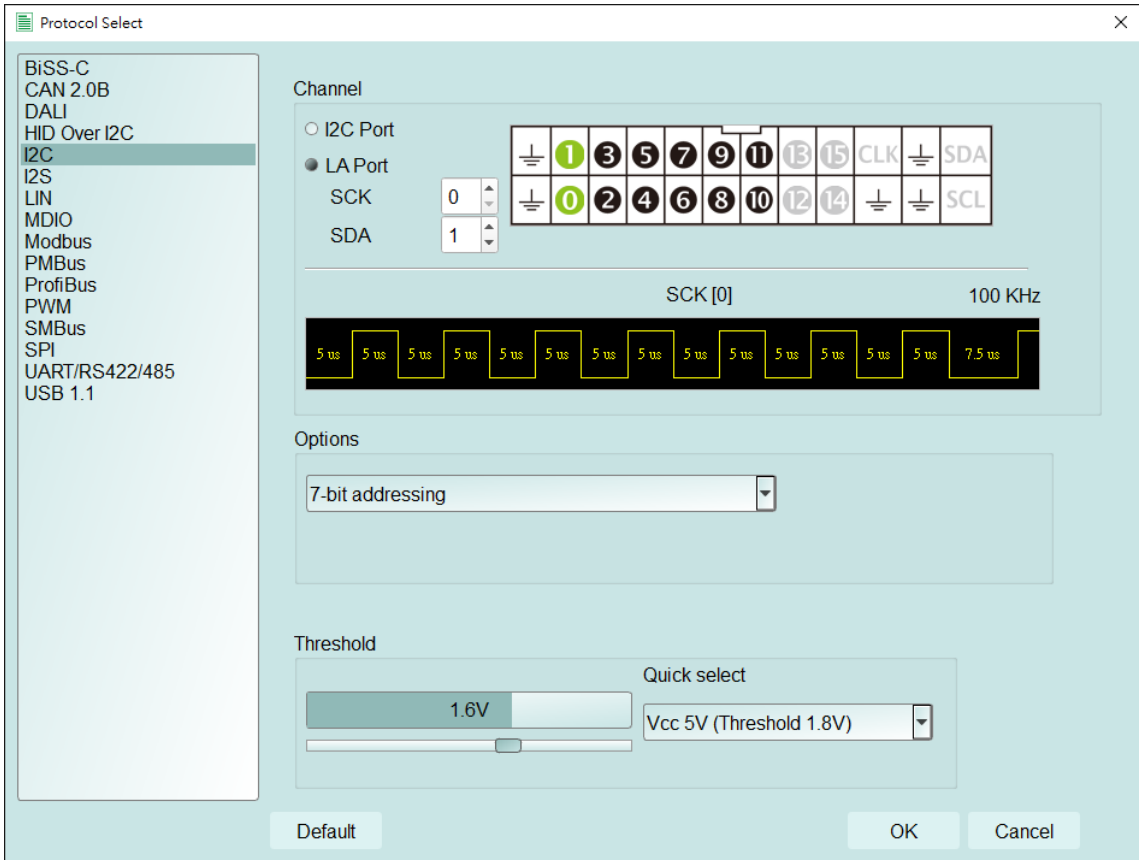
The TravelBus, when used as a logic analyzer, is able to stack with the Acute TravelScope DSO to form an MSO.

**Example**

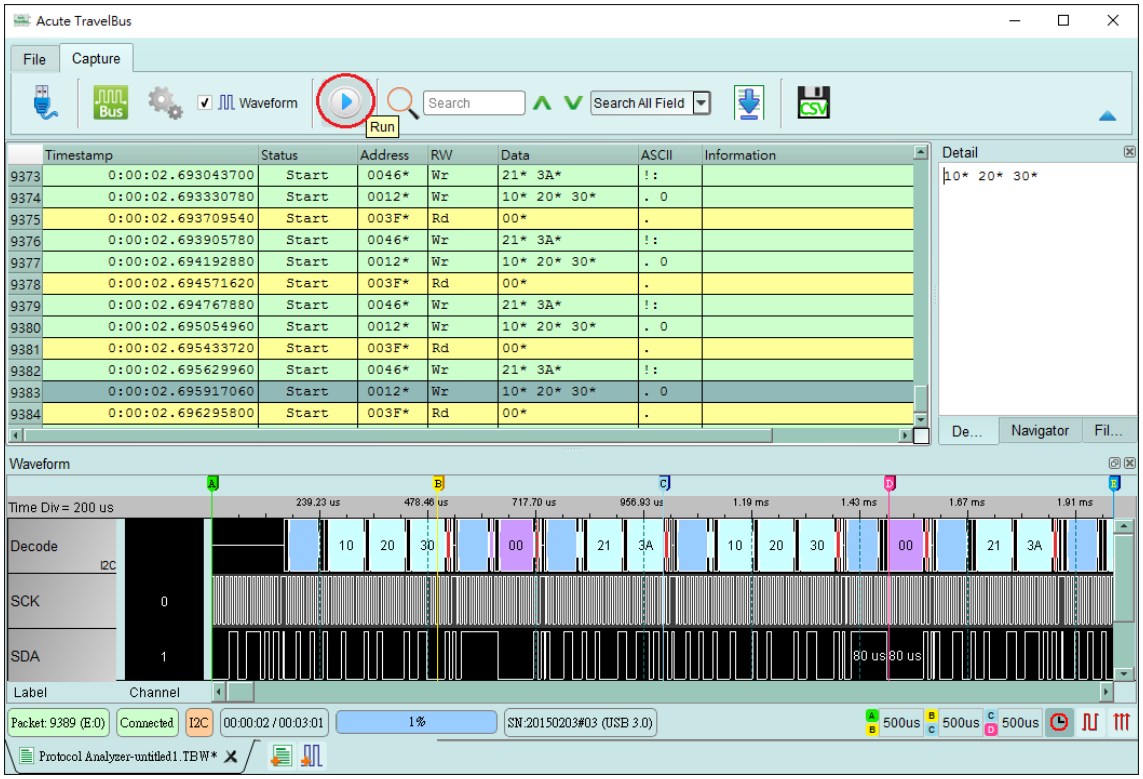
Click **Waveform** to store the protocol data with waveform.



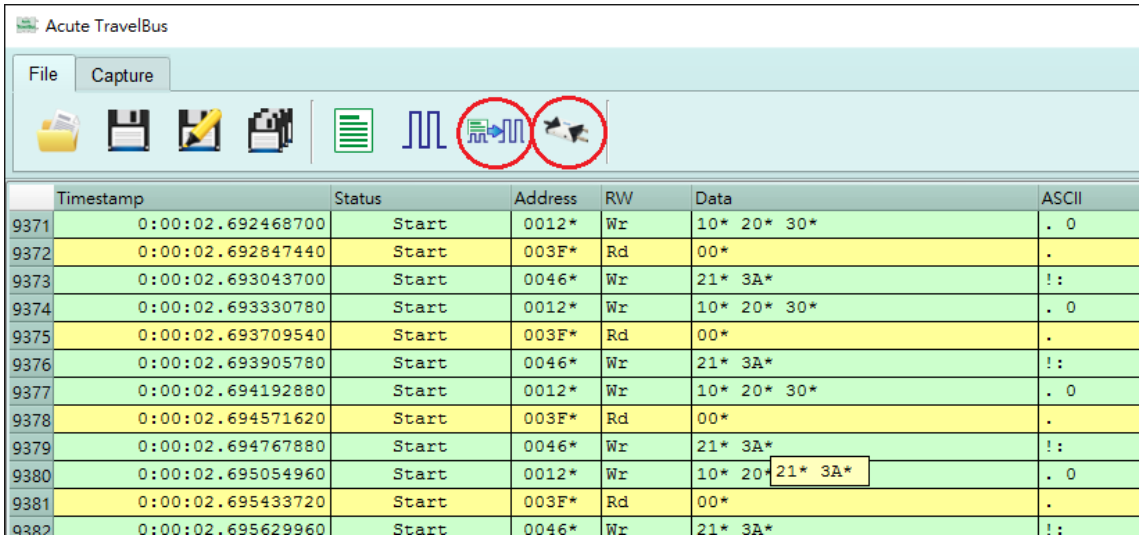

Choose **I²C** for protocol settings, click **OK** by default settings or reset manually.



Click **Run** (  ) to capture the data.

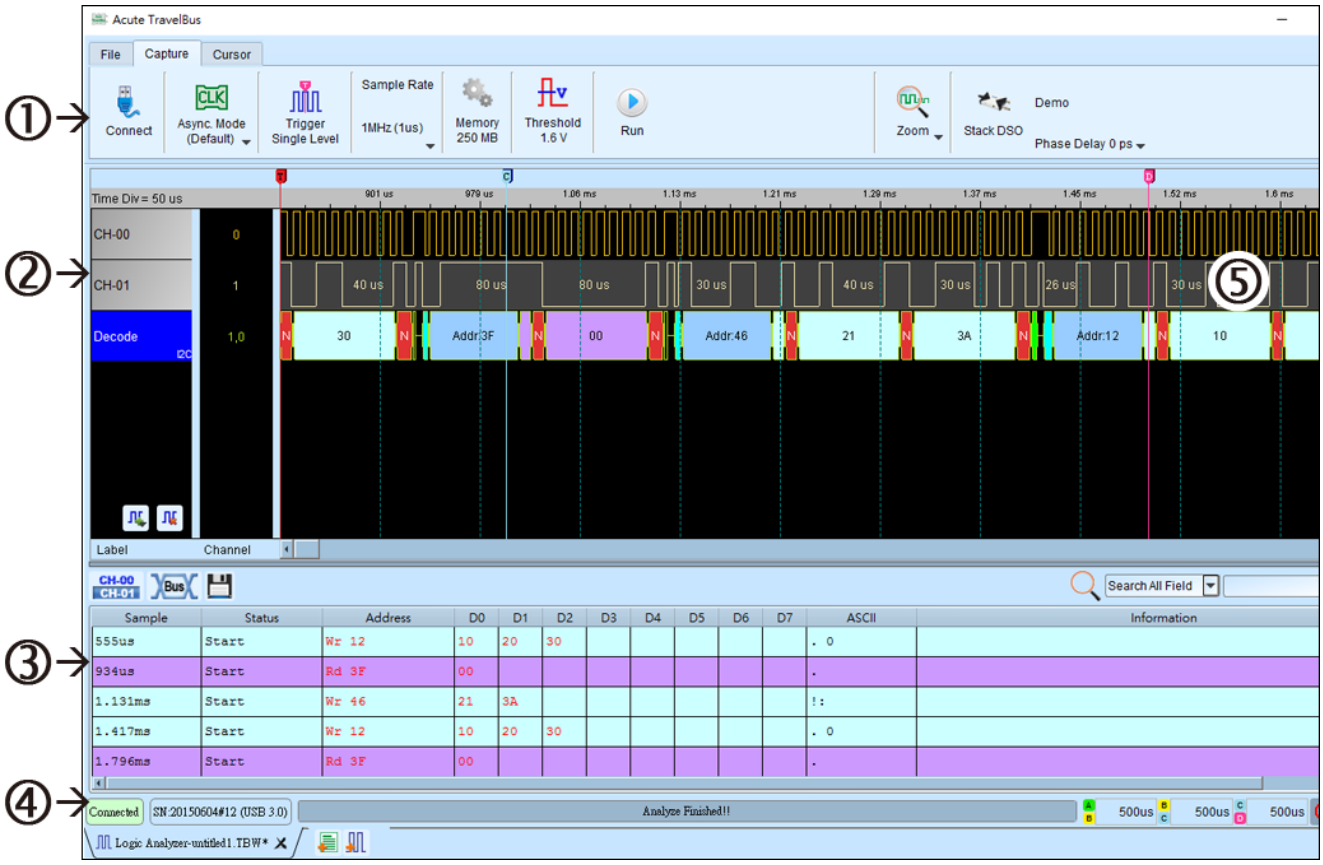



Click **Convert to Logic Analyzer to stack with DSO**  in **File** to stack the Acute TravelScope DSO; all data captured and settings in Protocol Analyzer will be moved to the Logic Analyzer. This operation will be elaborated in Logic Analyzer. You can also simply convert Protocol Analyzer to Logic Analyzer with the data and setting by clicking **Convert to Logic Analyzer**  in **File.**



# Logic Analyzer

## Main Window

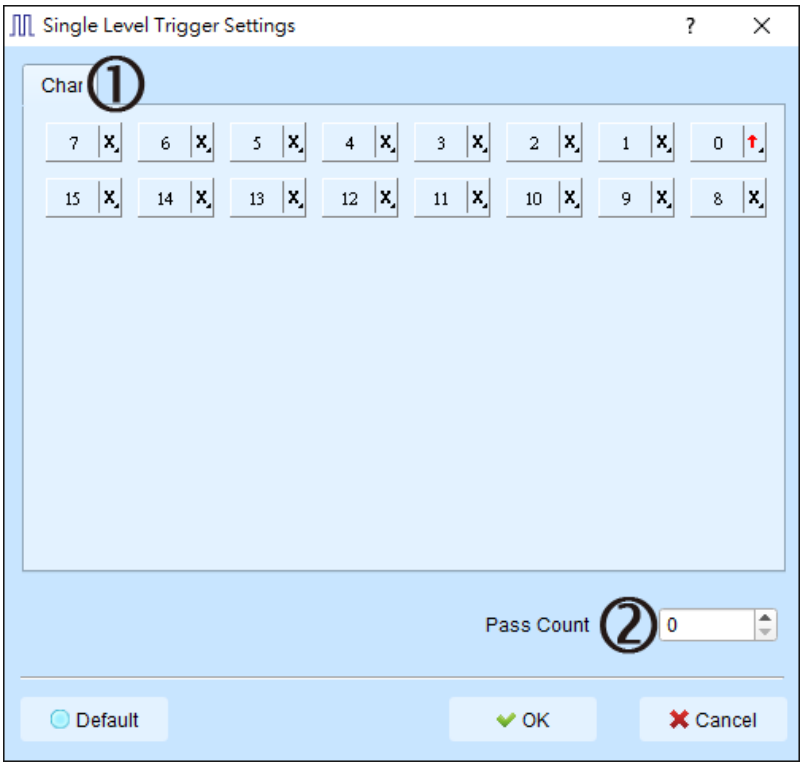



1. **Toolbar** includes Trigger, Sample Rate, Threshold and Run.
2. **Label Field** is to add or to delete the channel(s) by pressing the icons ( , ). You may modify the channel settings by clicking its label.
3. **Report Window** displays either the data ( CH-00 CH-01 ) or decode ( Bus ) which can be exported text file in .csv or .txt ( ).
4. **Status Bar** shows if the TravelBus is connected to the PC.
5. **Waveform Window**：

   You may roll the mouse wheel to zoom in/out the waveforms and see the time difference between cursors.

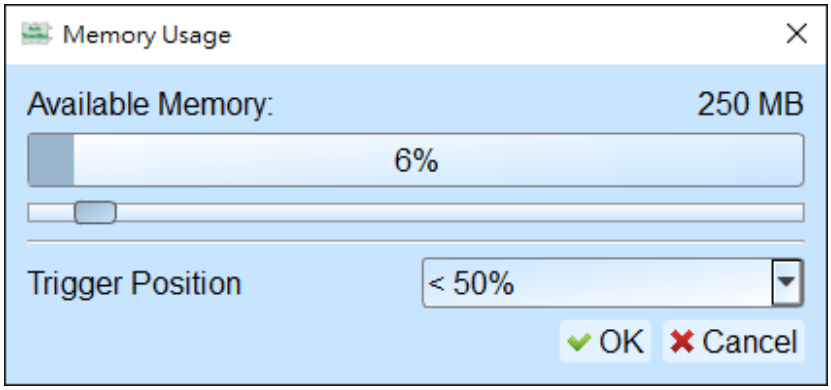
**Trigger** ( )

Single Level Trigger Settings




1. **Channel** is to choose the trigger event as any (x), rising (↑), ….
2. **Pass Count** is to pass the trigger event(s) for the number of times you input.

**Memory Usage (**  **)**

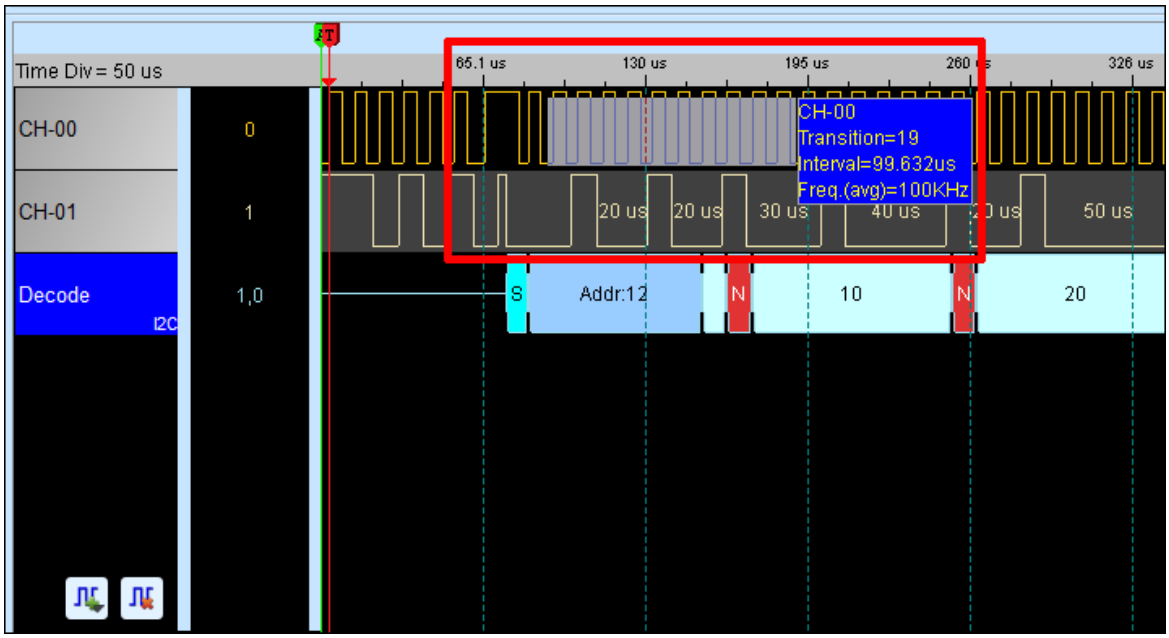



**Available Memory** is to set the percentage of the available PC RAM for use.

**Trigger Position** is to set the trigger position at the percentage of the memory used.

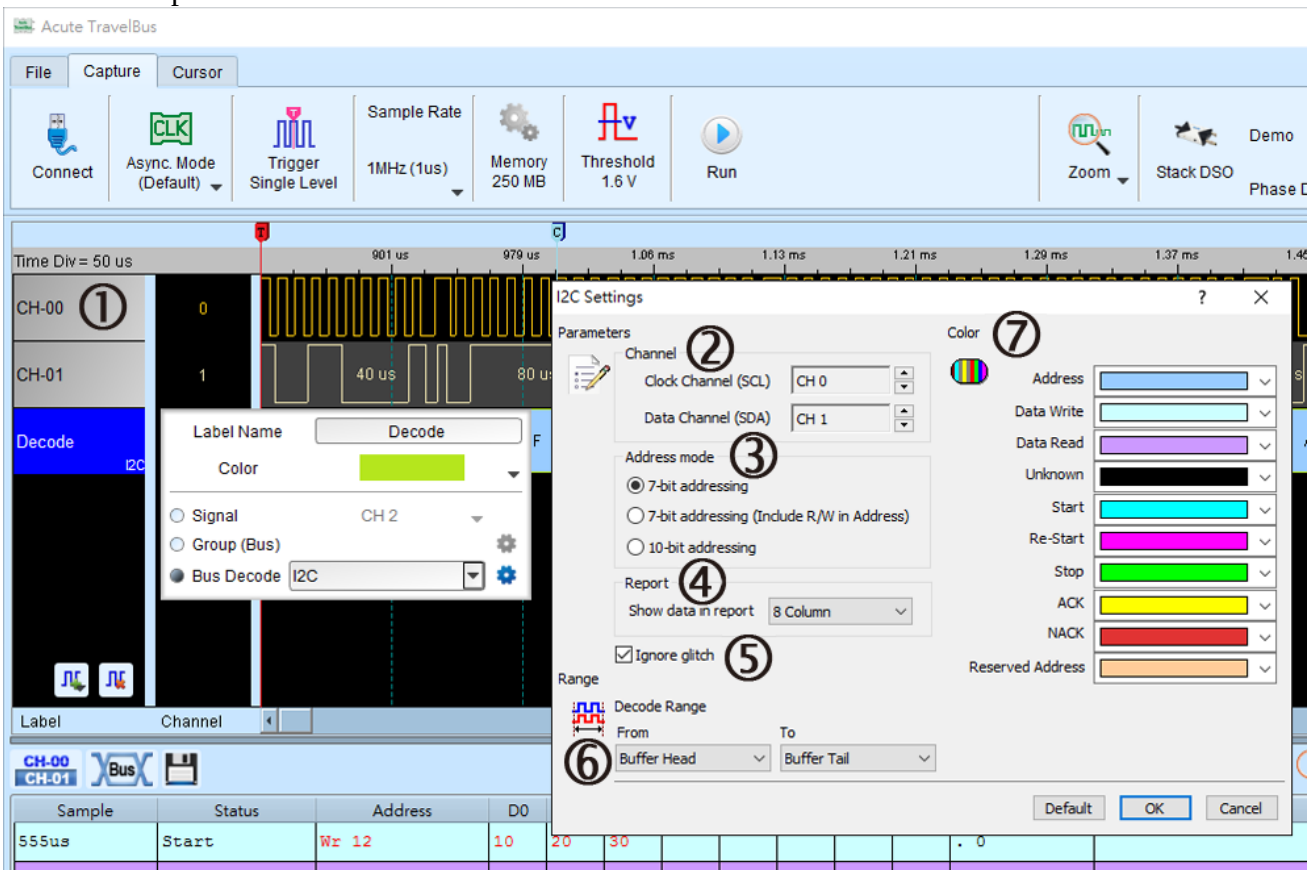
### Waveform Window

In the Waveform Window, right-click and drag the mouse on the waveform to show the number of transitions, the interval and average frequency of the waveform. The Protocol Analyzer supports this function too.



## Bus Decode Setting

I²C example




1. Left-click on any channel and choose Bus Decode.
2. **Channel** is to set the clock and data channels.
3. **Address mode**：

   7-bit addressing.

   7-bit addressing (including R/W in Address) will show 8-bit addressing including 7-bit address and 1-bit Rd/Wr.

   10-bit addressing.
4. **Report** is to show either 8- or 16-columns data in the Report Window.
5. **Ignore glitch** will ignore those glitches occurred when high sample rates on the slow slew-rate transitions.
6. **Range** is to set the start and the end in the memory buffer to decode the bus.
7. **Color**：Set the channel color.

### Stack with DSO

Using TravelBus and the Oscilloscope Stack functions, you need to install the special software provided by each oscilloscope brand. 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**<br>**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 | Models | USB | TCP/IP |
|---|---|---|---|
| **Acute** | DS-1000<br>TravelScope | V | |
| **Tektronix** | TDS1000B/1000C/2000B/3000/3000B/<br>3000C/5000B/7000<br>DPO2000/3000/4000/4000B/5000/7000<br>7000C/70000/70000B<br>DSA70000/70000B<br>MSO2000/3000/4000/4000B/5000<br>MDO3000/4000<br>TPS2000/2000B | V | V |
| **Agilent** | DSO1000A/5000A/DSO6000A/6000L<br>7000A/7000B/9000A<br>MSO6000A/7000A/7000B/9000A<br>DSO-X 4000A /MSO-X 4000A<br>DSO-X 3000A /MSO-X 3000A<br>DSO-X 2000A/MSO-X 2000A | V | V |
| **Keysight** | DSO-X 3000T<br>MSO-X 3000T | V | V |
| **LeCroy** | WaveRunner / WaveSurfer / HDO4000 /<br>HDO6000 / SDA 8 Zi-A / DDA 8 Zi-A | | V |
| **HAMEG** | HMO3000/2000/1000 | V | V |
| **Rohde & Schwarz** | RTO1000/RTE1000 | | V |

There are two methods for hardware wiring:

**TravelBus is the Master, while the oscilloscope is the Slave.**

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

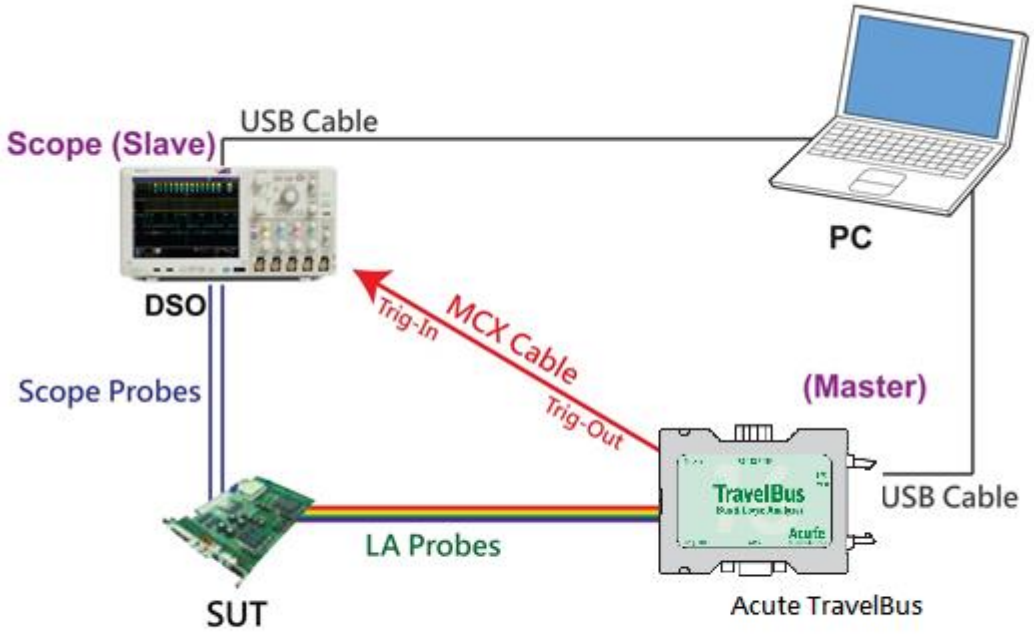



Figure 1

In Figure 1, the USB or Ethernet (TCP / IP) interface is connected to the computer, and then connect the BNC-MCX cable to the TravelBus 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 TravelBus is the Slave.**

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

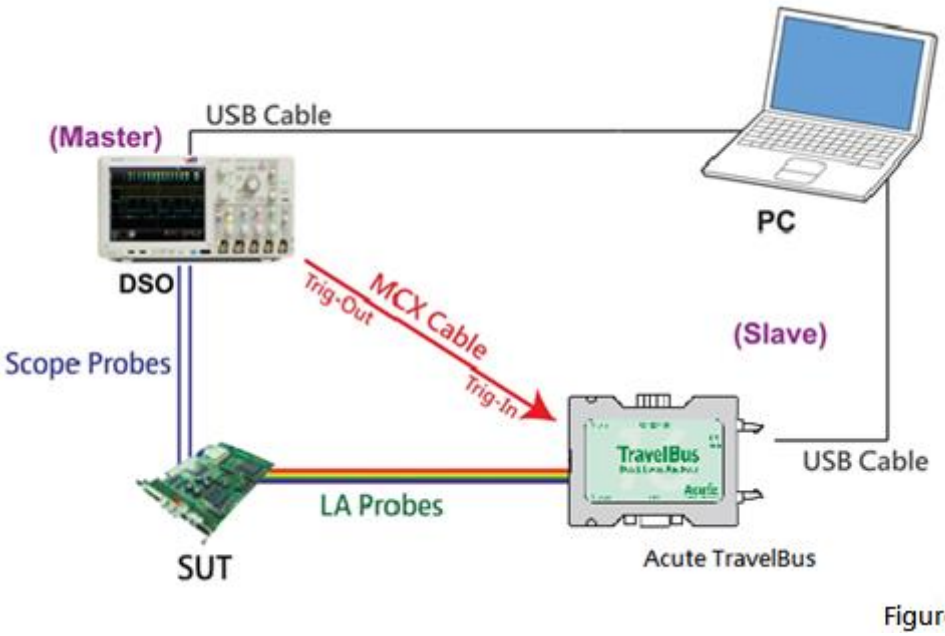
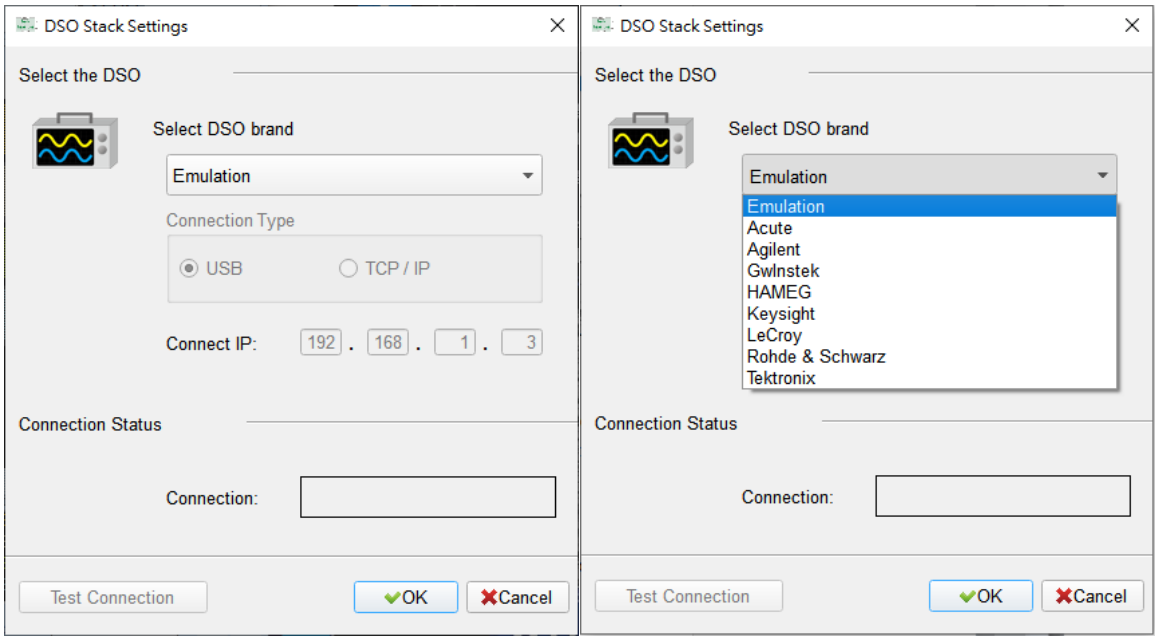



Figure2

In Figure 2, the BNC-MCX cable is connected to the TravelBus 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 brand that needs to be stacked on the oscilloscope. When there is no DSO hardware available for stacking, emulation is the mode used to read back the storage files of DSO stack.

**Connection Type**

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

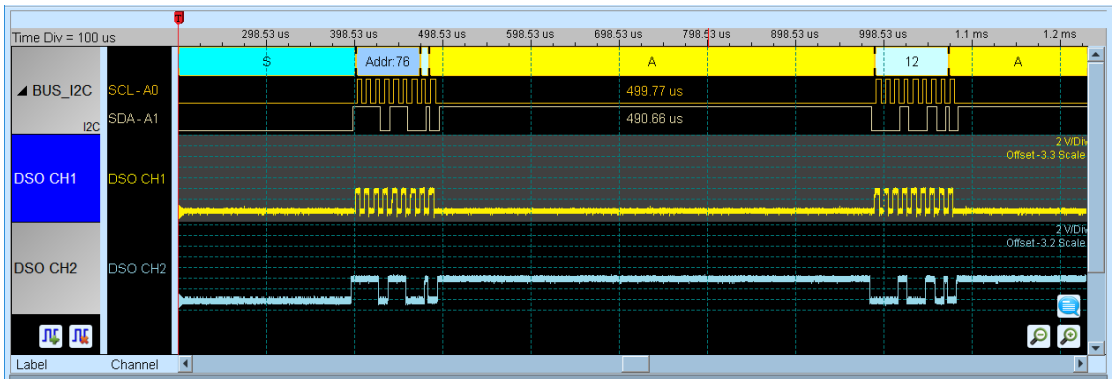
**Connect IP**

It can be used to select TCP / IP for the connection mode and enter IP address. When the Ethernet crossover cable is used, it is recommended that the IP settings of the two machines 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**

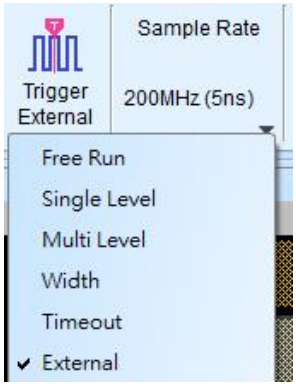
It can be used to connect the oscilloscope / display the current stack oscilloscope model and automatically add the oscilloscope channel to the waveform window.

**Screen of oscilloscope stack**



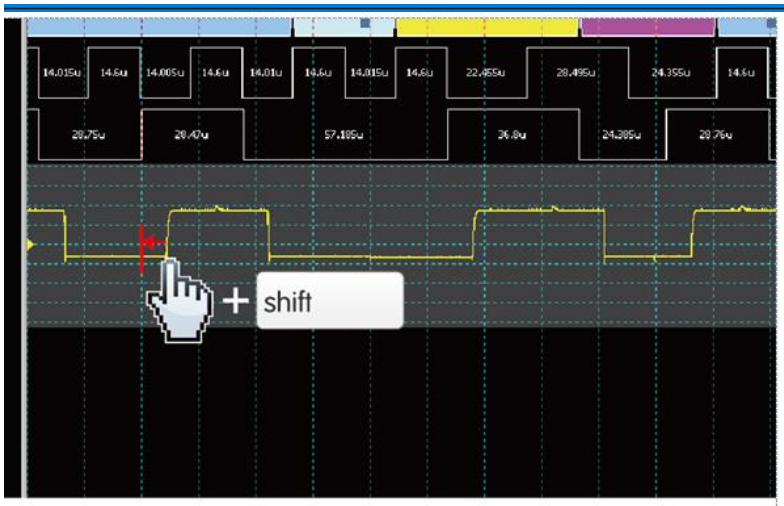

**Oscilloscope is set as the master, while the TravelBus is set as the slave**

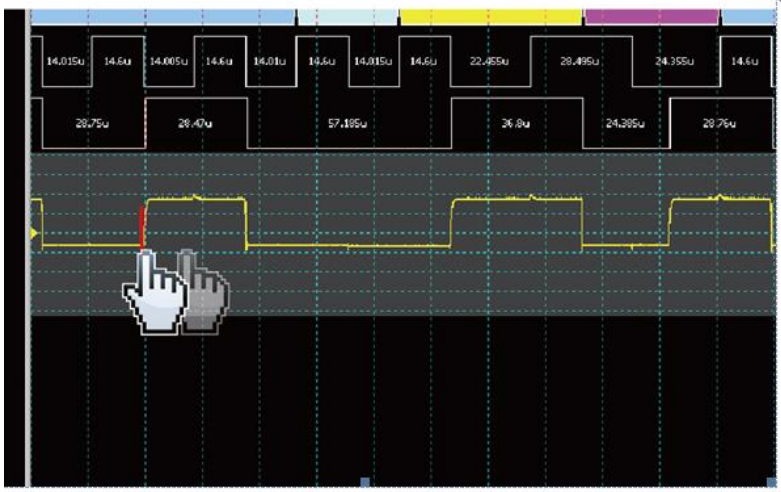
If the stack is composed of the oscilloscope as the master and TravelBus as the slave, you must not only complete the above-mentioned basic settings but also set the external trigger signal. For the hardware wiring, please refer to Figure 2. Press "Trigger Condition" → "External Trigger", as shown below.




**Stack Delay**

When TravelBus is triggered successfully, the Trig-Out signal is transmitted through Cable to the DSO with a time delay, resulting in a deviation between the logic and the analog signal time displayed by the 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 mouse's left button to drag the DSO waveforms to the appropriate location to complete the stack delay correction.

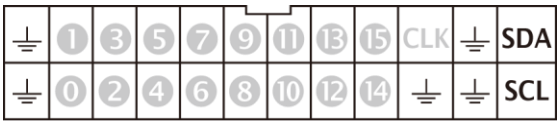


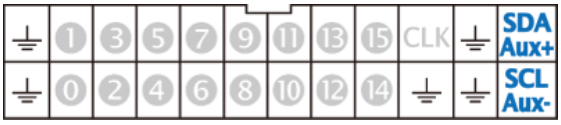
# Chapter 3 Dedicated Channel Description

I2C、DP AUX port are supported on the TB2000/TB3000 series

I2C

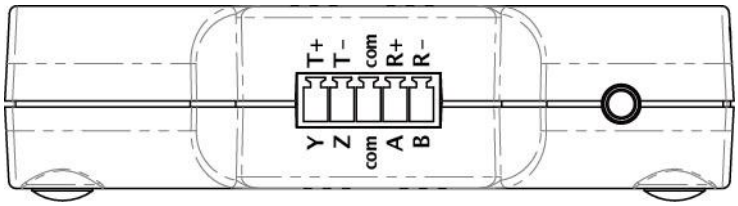



DP AUX

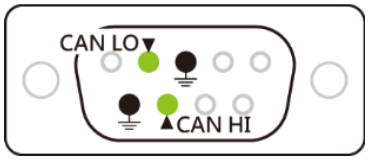



There are additional RS422 / 485、CAN / CAN-FD port supported on the TB2016B/TB3016B,

RS422 / 485



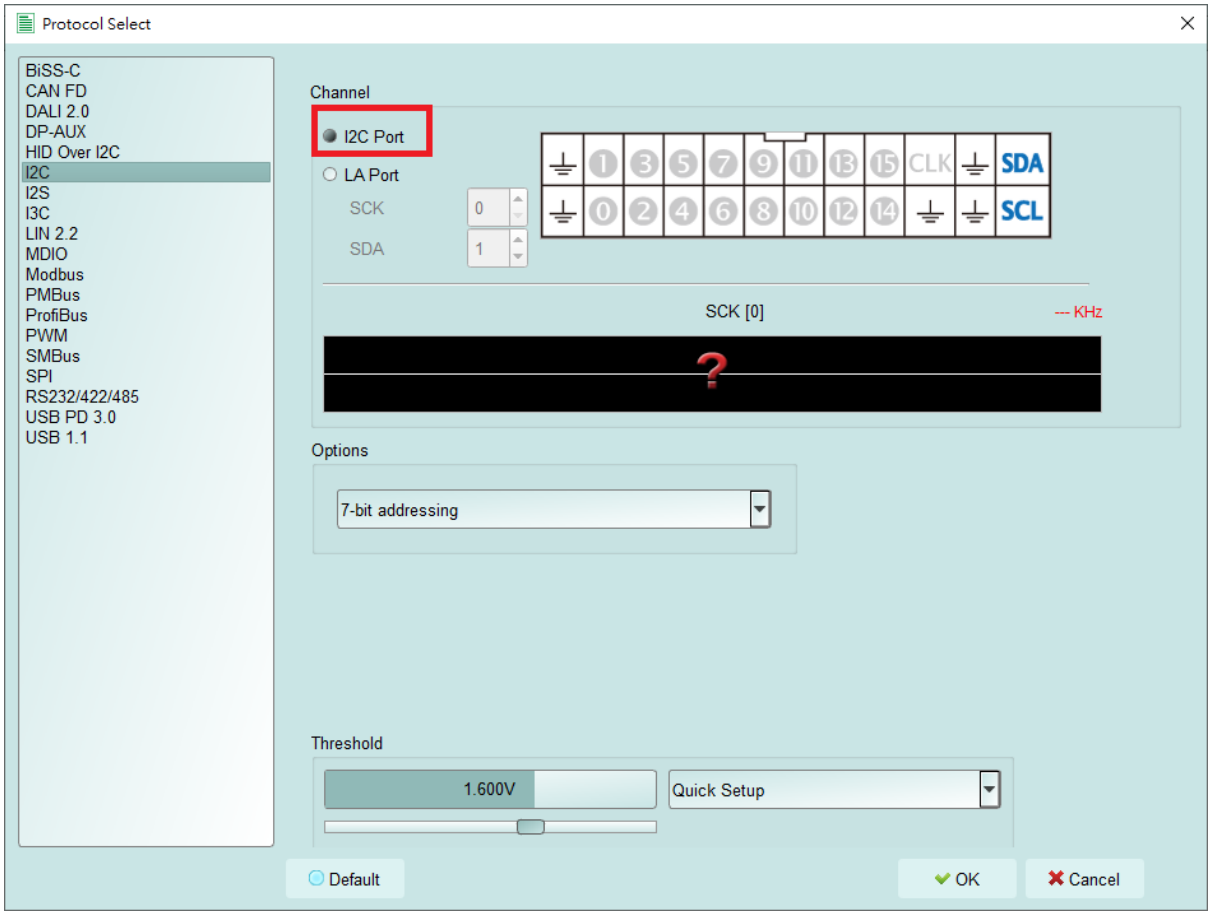

CAN / CAN-FD




(DP AUX, RS485, CAN / CAN-FD are differential signal. Since TB2000/TB3000 series have the converter inside, there is no need to set the threshold before measure)

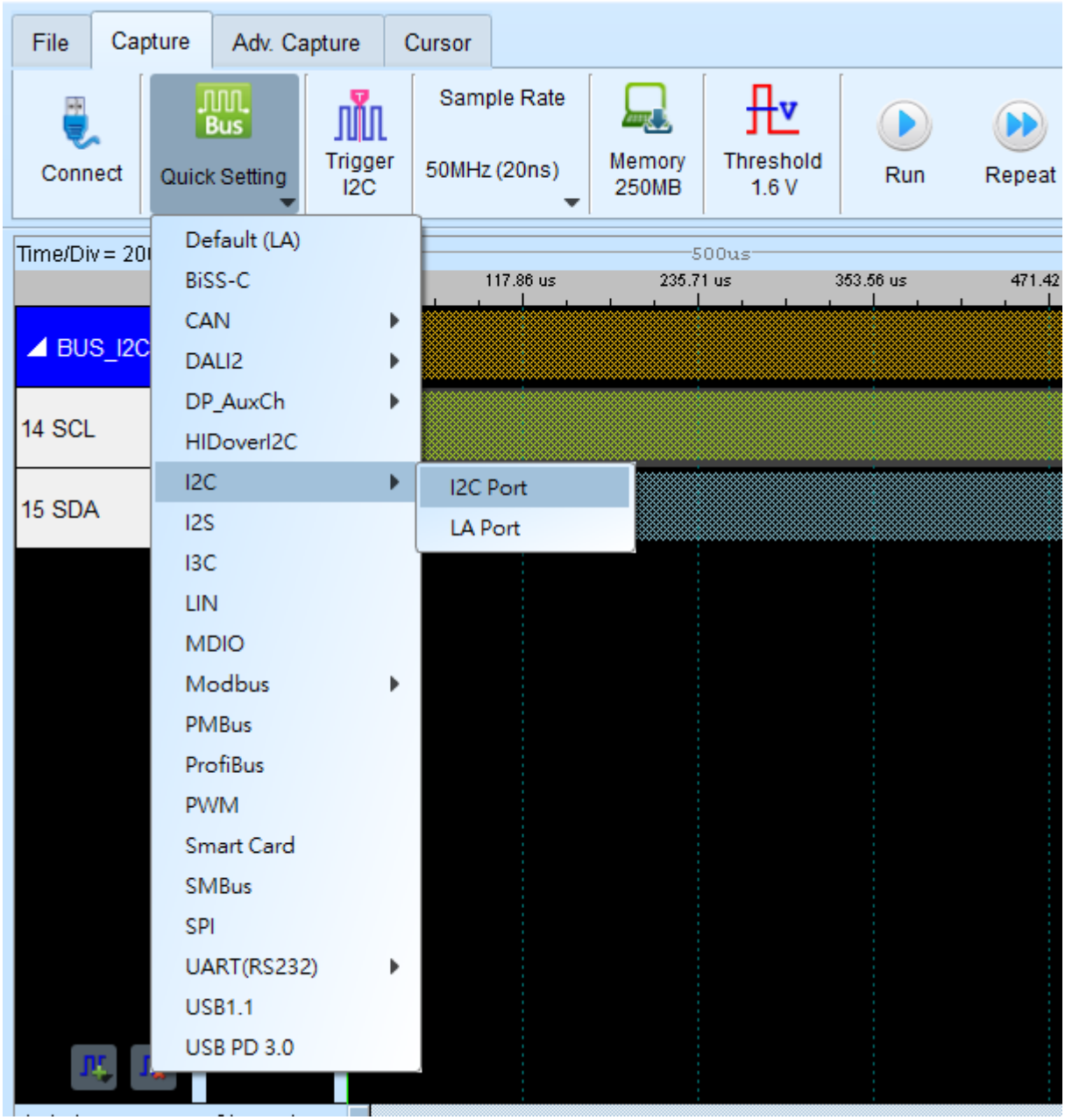
# Protocol Analyzer mode

Please modify the channel settings in the Protocol Setting.



## Logic Analyzer mode

Use Quick Setting to change channel settings. Warning: Don’t change the trigger type after quick setting, or the dedicated channel can’t not use.




(If the I2C port is on, only the I2C Clause Trigger can use. If change to the other trigger mode, the I2C port can’t use. Unless re-Quick Setting.)

# Chapter 4 Specifications

| Model | | TB3016F | TB3016E | TB3016B |
|---|---|---|---|---|
| Power | Power Source | USB bus-power (+5V) | | |
| | Static Power Dissipation | 0.75W | | |
| | Max Power Dissipation | < 2.5W | | |
| Hardware Interface | | USB 3.0 | | |
| Timing Analysis (Asynchronous, Max. Sample Rate) | | 800MHz* | | |
| State Clock Rate (Synchronous, External Clock) | | 200MHz* | | |
| Channels (Data / CLK / $I^2C$ / DP_Aux / CAN / RS485 ) | | 16 / 1 / 2 / - / - | | 16 / 1 / 2 / 2 / 4 |
| Timing Vs Channels | Timing Analysis | Available channels | | |
| | 800 MHz | 8 | | |
| | 400 MHz | 16 | | |
| | 200 MHz | 16 | | |
| Threshold | Group | 2 (ch0~7, ch8~15 & clk0) | | |
| | Range | ±6V | | |
| | Resolution | 50mV | | |
| | Accuracy | ±100mV + 5%*Vth | | |
| Trigger | Time resolution | 5 ns | | |
| | Channels | 16 (Max.) | | |
| | Pre/Post Trigger Setting | Yes | | |
| | Pass Counter | Yes (0~65536 times) | | |
| | Event Types | Channel, Pattern, Single, Width, Time-out, External | | |
| | Module I | $I^2C$, MIPI I3C 1.1, SPI, UART (RS232) | | |
| | Module II | --- | HID over $I^2C$ , $I^2S$ , LIN2.2, MDIO, PMBus, SMBus, USB1.1 | |
| | Module III | --- | | BiSS-C, CAN2.0B, CAN-FD, DALI2.0, DP_AUX, SENT, Modbus, ProfiBus, RS422, RS485, USB PD 3 |
| | Input port (for Stack) | --- | | TTL 3.3V |
| | Output port (for Stack) | --- | | TTL 3.3V |
| Input Voltage | Maximum | ±40V DC, 15Vpp AC | | |

| | | | | |
|---|---|---|---|---|
| | Sensitivity | 0.5Vpp @150MHz | | |
| Impedance | | 200KΩ // < 5pF | | |
| Maximum target signal speed | | Data Port: 14 MHz, CAN Port: 10 Mbps,<br>I²C Port: 400 KHz 3.3V, RS485 Port: Baud rate 20 Mbps | | |
| Temperature | Operating / Storage | 5°C ~ 45°C (41°F ~ 113°F) ) / -10°C ~ 65°C (-14°F ~ 149°F) | | |
| Protocol Analyzer | Module I | I²C, MIPI I3C 1.1, SPI, UART (RS232) | | |
| | Module II | --- | HID over I²C, I²S, LIN2.2, MDIO, PMBus, SMBus, USB1.1 | |
| | Module III | --- | --- | BiSS-C, CAN2.0B, CAN-FD, DALI2.0, DP_Aux, Modbus, Profibus, PWM, RS422, RS485, USB PD 3 |
| Software features | Bus decode | 1-Wire, 3-Wire, 7-Segment, AccMeter, ADC, APML, BiSS-C, BSD, CAN2.0, CAN FD, Close Caption, CODEC_SSI, DALI2.0, Digital LED, DMX512, DP_Aux, EDID, FlexRay, HDLC, HDQ, HID over I²C, I²C, I²C EEPROM, I²S, ITU656, IrDA, JTAG, JVC IR, LCD1602, LIN2.2, Line Decoding, Line Encoding, LPT, M-Bus, Math, MDIO, MHL Cbus, Microwire, Mini/Micro LED, MIPI CSI LP, MIPI DSI LP, MIPI I3C 1.1, MIPI SoundWire, Modbus, NEC IR, PECI, PMBus, Profibus, PS/2, PWM, QEI, QI, RC-5, RC-6, RT_SWI, SDQ, SENT, SGPIO, Smart Card (ISO7816), SMBus, SMI, SPI, SSI, ST7669, SWD, SWIM, SWP, UART, UNI/O, USB1.1, USB PD 3, Wiegand | | |

* Measure signal under 14 MHz ONLY due to data transmission limitation.

| Model | | TB2016F | TB2016E | TB2016B |
|---|---|---|---|---|
| Power | Power Source | USB bus-power (+5V) | | |
| | Static Power Dissipation | 0.75W | | |
| | Max Power Dissipation | < 2.5W | | |
| Hardware Interface | | USB 3.0 | | |
| Timing Analysis (Asynchronous, Max. Sample Rate) | | 200MHz* | | |
| State Clock Rate (Synchronous, External Clock) | | 200MHz* | | |
| Channels (Data / CLK / $I^2C$ / CAN / RS485 ) | | 16 / 1 / 2 / - / - | | 16 / 1 / 2 / 2 / 4 |
| Trigger | Time resolution | 5 ns | | |
| | Channels | 16 (Max.) | | |
| | Conditions | Yes (4) | | |
| | Pre/Post Trigger Setting | Yes | | |
| | Pass Counter | 0~65536 times | | |
| | Event Types | Channel, Pattern, Single, Width, Time-out, External | | |
| | Module I | $I^2C$, RS232, SPI | | |
| | Module II | --- | HID over $I^2C$ , $I^2S$ , LIN2.2, MDIO, PMbus, SMBus, USB1.1 | |
| | Module III | --- | | BiSS-C, CAN2.0B, CAN-FD, DALI2.0, DP_AUX, SENT, Modbus, ProfiBus, RS422, RS485, USB PD3.0 |
| | Input port (for Stack) | --- | | TTL 3.3V |
| | Output port (for Stack) | --- | | TTL 3.3V |
| | Range | -6V ~ +6V | | |
| | Voltage resolution | 50mV | | |
| Threshold | Accuracy | ±100mV + 5%*Vth | | |
| Input Voltage | Maximum | ±40V DC, 15Vpp AC | | |
| | Sensitivity | 0.5Vpp @150MHz | | |
| Impedance | | Impedance | | |
| Temperature | Operating Temperature | 5°C ~ 45°C (41°F ~ 113°F) | | |
| | Storage Temperature | -10°C ~ 65°C (14°F ~ 149°F) | | |
| Bus Decode | Module I | DALI, HID over $I^2C$, $I^2C$, $I^2S$, LIN, MDIO, PMBus, RS232, SMBus, SPI, USB1.1 | | |
| | Module II | --- | CAN, Modbus, ProfiBus, RS422, RS485 | |
| | Module III | --- | --- | BiSS-C, PWM |

*Measure signal under 14MHz ONLY due to data transmission limitation

| Model | | TB1016E | TB1016B | TB1016B+ |
|---|---|---|---|---|
| Power | Power Source | USB bus-power (+5V) | | |
| | Static Power Dissipation | 0.75W | | |
| | Max Power Dissipation | < 2.5W | | |
| Hardware Interface | | USB 3.0 (USB 2.0 Compatible) | | |
| Timing Analysis (Asynchronous, Max. Sample Rate) | | 200MHz* | | |
| State Clock Rate (Synchronous, External Clock) | | 200MHz* | | |
| Channels (Data / CLK / $I^2C$ / CAN / RS485 ) | | 16 / 1 / 2 / - / - | 16 / 1 / 2 / 2 / 4 | |
| Trigger | Time resolution | 5 ns | | |
| | Channels | 16 (Max.) | | |
| | Conditions | Yes (4) | | |
| | Pre/Post Trigger Setting | Yes | | |
| | Pass Counter | 0~65536 times | | |
| | Event Types | Pattern, Channel, Transition, Width | | |
| | Module I | DALI, HID over $I^2C$, $I^2C$, $I^2S$, LIN, MDIO, PMBus, RS232, SMBus, SPI, USB1.1 | | |
| | Module II | --- | CAN, Modbus, ProfiBus, RS422, RS485 | |
| | Module III | --- | --- | BiSS-C |
| | Input port (for Stack) | --- | TTL 3.3V | |
| | Output port (for Stack) | --- | TTL 3.3V | |
| | Range | -6V ~ +6V | | |
| | Voltage resolution | 50mV | | |
| Threshold | Accuracy | ±100mV + 5%*Vth | | |
| Input Voltage | Maximum | ±40V DC, 15Vpp AC | | |
| | Sensitivity | 0.5Vpp @150MHz | | |
| Impedance | | 200KΩ // < 5pF | | |
| Temperature | Operating Temperature | 5°C ~ 45°C (41°F ~ 113°F) | | |
| | Storage Temperature | -10°C ~ 65°C (14°F ~ 149°F) | | |
| Bus Decode | Module I | DALI, HID over $I^2C$, $I^2C$, $I^2S$, LIN, MDIO, PMBus, RS232, SMBus, SPI, USB1.1 | | |
| | Module II | --- | CAN, Modbus, ProfiBus, RS422, RS485 | |
| | Module III | --- | --- | BiSS-C, PWM |

*Measure signal under 14MHz ONLY due to data transmission limitation

# Chapter 5 Service

Contact information:

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Phone: +886-2-2999 3275

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Troubleshooting:

If the TravelBus is in "Demo mode", please follow the steps below:

(1) Use the USB3.0 cable (only) in the product package.

(2) Check if the USB driver is in the Device Manager.

(3) Install the latest version software from

https://www.acute.com.tw/logic-analyzer-en/support/download/software

(4) Re-plug the USB3.0 cable or reboot the OS to check if the USB driver exists.

(5) Contact us for further help if above procedures do not work.