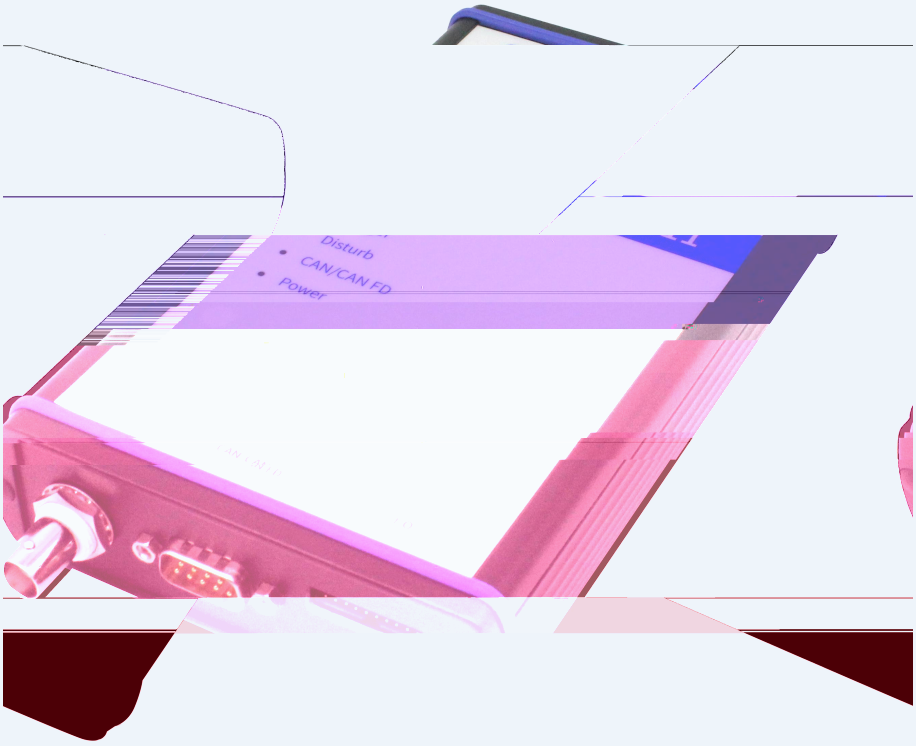
TOSUN



Version: V1.0 | English

Copyright Information

Shanghai TOSUN Technology Ltd

No. 9 Building, 1288 Jiasong North Road, Jiading District, Shanghai (Headquarters)

Buildings 14-17, Lane 4849 Cao’an Highway (Shanghai Research Institute)

In an effort to provide users with the best possible service, Shanghai TOSUN Technology Ltd. (hereinafter referred to as TOSUN Technology) has made every attempt to present accurate and detailed product information as possible in this manual. However, due to the time-sensitive nature of the content, TOSUN Technology cannot guarantee the timeliness and applicability of the information at all times.

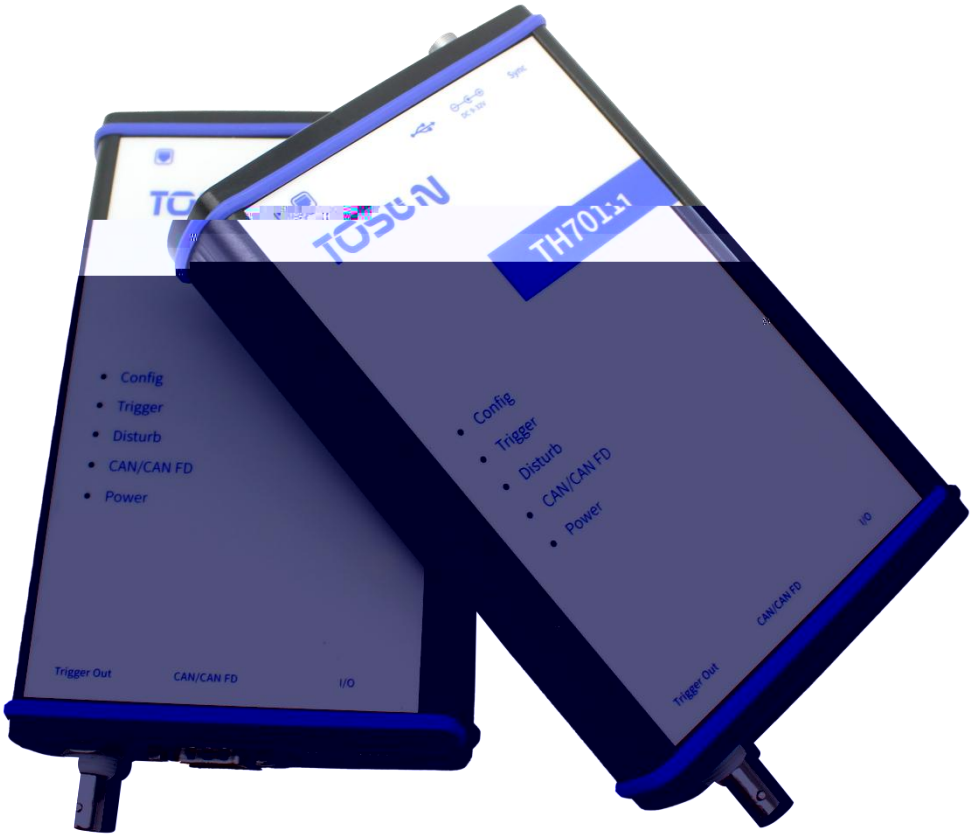
The information and data contained in this manual are subject to change without prior notice. For the latest updates, please visit the official website of TOSUN Technology or contact our support team directly. We appreciate your understanding and continued support!

@ Copyright 2024-2025, Shanghai TOSUN Technology Ltd. All rights reserved.

Conformance testing is a testing process used to verify whether components meet relevant standards, thereby ensuring product quality. CAN/CAN FD conformance testing refers to the process of testing whether CAN/CAN FD nodes comply with the CAN communication protocol specifications. In a CAN/CAN FD network, inconsistencies in the quality of various nodes may lead to network issues or failures. Therefore, to ensure the normal and safe operation of the CAN/CAN FD network, it is essential to perform CAN/CAN FD conformance testing.

The CAN/CAN FD disturbance interface TH7011 launched by TOSUN, is the core product used for CAN/CAN FD bus conformance testing.

- ECU Bus-off behavior test;
- ECU sampling point test;
- Frame disturbance and frame trigger output;
- Bit timing tolerance test;
- ...

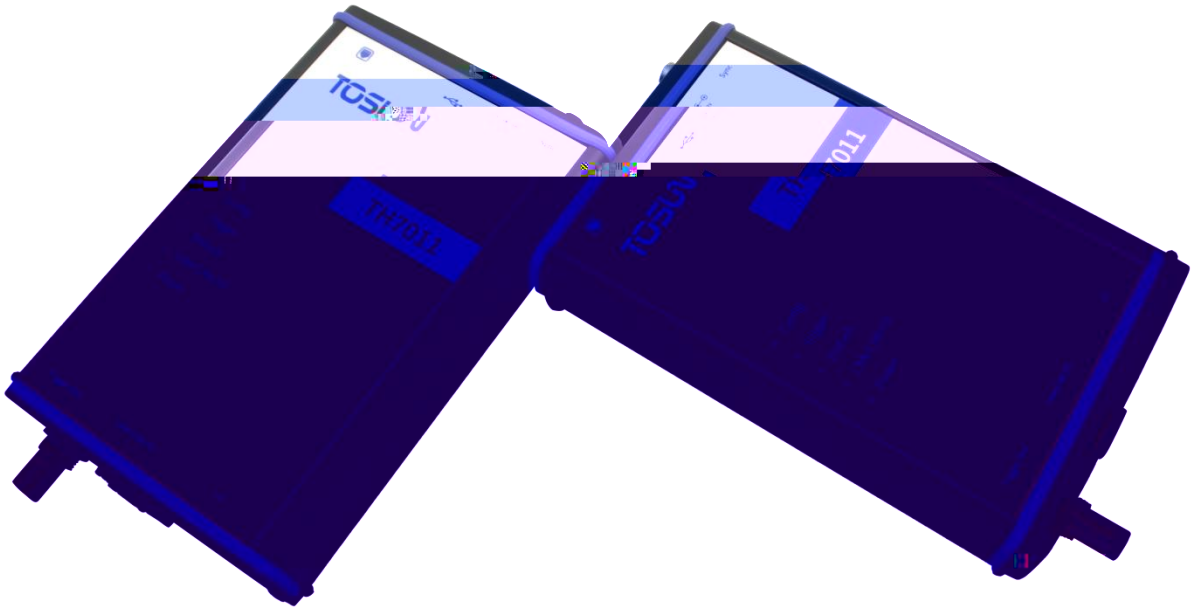


The information pr in this document is for reference only and does not constitute any form of guarantee or by TOSUN. TOSUN Technology reserves the right to modify contents in this document without prior notice. The company assumes no responsibility for the accuracy of the information contained herein or for any damages resulting from the use of this document. We sincerely apo

TH7011 is a CAN/CAN FD bus disturbance device that connects to a PC via an RJ45 Ethernet interface or USB2.0 interface. Its driver-free design for Windows systems ensures broad compatibility and easy integration.

When used in conjunction with the powerful TSMaster software, the TH7011 supports targeted bit-value disturbances on the CAN/CAN FD bus. It also provides multiple trigger modes such as frame trigger, error trigger, and software trigger as well as features like bit-width deviation testing, bus-off behavior testing, and waveform capture and storage.

The TH7011 is ideal for conformance testing to verify whether nodes comply with CAN/CAN FD protocol standards, ensuring safe and stable operation of the CAN/CAN FD network.

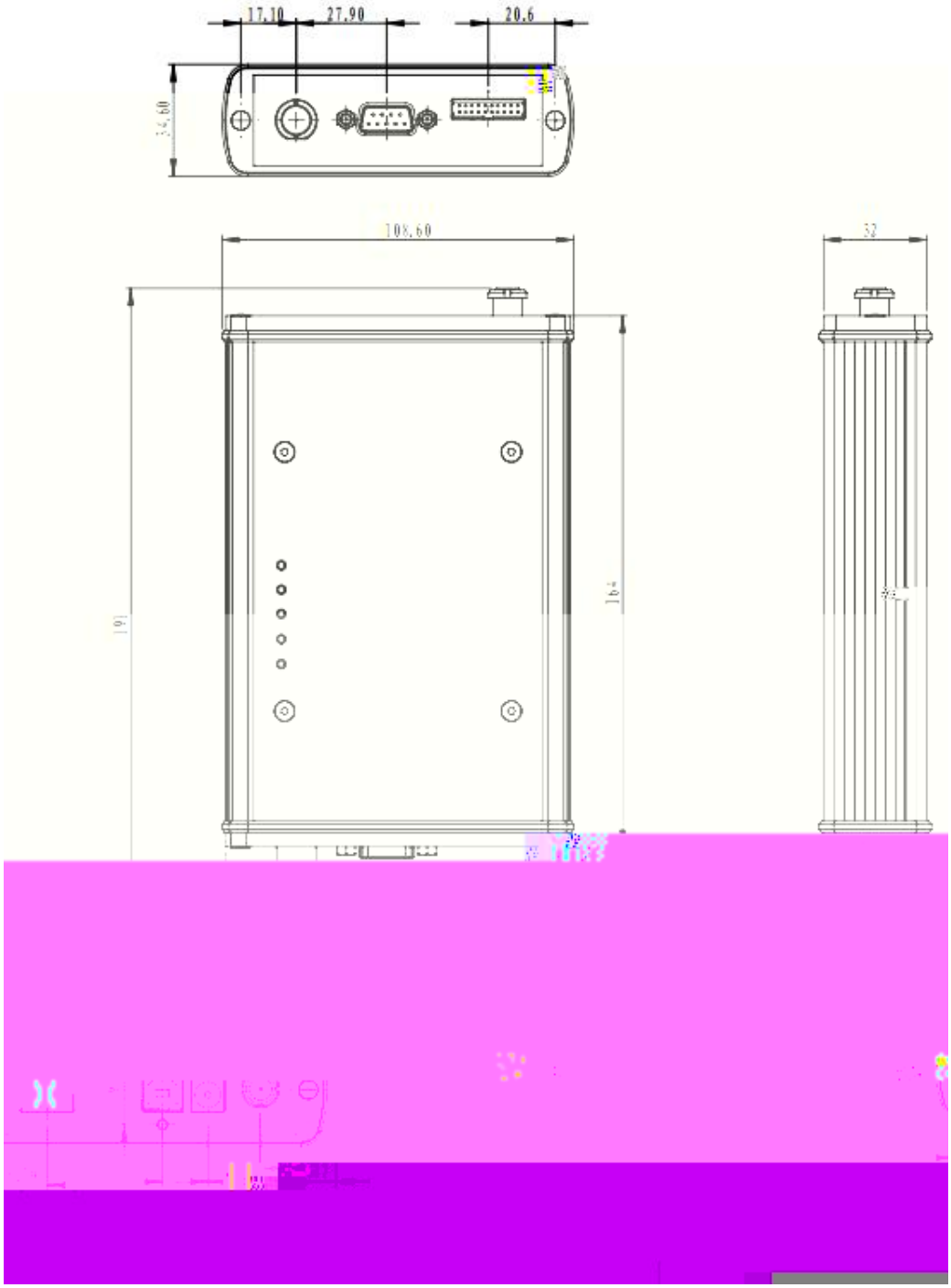


- ✓ Supports disturbance with specific bit values of CAN/CAN FD messages.
- ✓ Supports multiple trigger modes: frame trigger, error frame trigger, software trigger, etc.
- ✓ Customizable disturbance sequence or message sequence, with up to 65536 disturbance points.
- ✓ Supports CAN error frame level detection.
- ✓ Supports CAN disturbance count statistic function.
- ✓ Supports whole-bit dominant disturbance, recessive disturbance, and toggle disturbance for CAN frames.
- ✓ Supports configuration and transmission of CAN disturbance sequences.
- ✓ Supports configuration of CAN frame triggered level length.
- ✓ Supports CAN bus bit time tolerance testing.
- ✓ Supports CAN bus Bus-off behavior testing.
- ✓ Supports sample point testing.

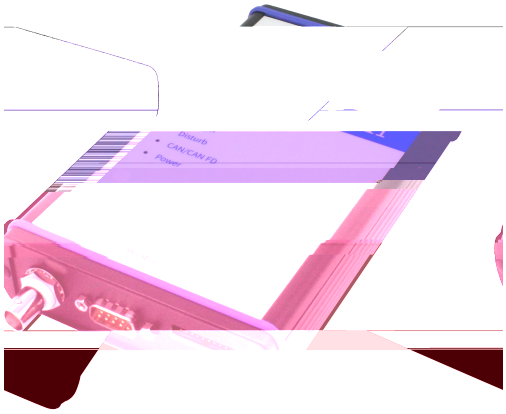
CAN/CAN FD Channel	CAN: 125Kbps-1Mbps CAN FD: max 5Mbps
Digital CAN Disturbances	Min.step size 5ns
I/O Function (Specifically for ISO-16845)	Digital outputs: 2 Digital inputs: 2 Analog outputs/inputs: 6 (configurable)
Interface	1x D-SUB9 (male) for 1 CAN/CAN FD channel 1x Binder for external trigger 1x Binder for time synchronization 1x 2.0mm 20pin header connector for I/O
PC Interface	RJ45 Ethernet, USB2.0
Software	TSMaster
Power Supply	DC Power Supply (9-32V)
Power Consumption	Typical value: 5W
Case Material	Metal
Dimensions	Approx. 164*106*35mm
Weight	Approx. 420g (without packaging)/Approx. 775g (with packaging)
Operating Temperature	-40 80

Operating Humidity	10%　　90% (non-condensing)
Operating Environment	Avoid corrosive gases

Parameter		Test Condition	Minimum Value	Typical Value	Maximum Value	Unit
Operating Voltage	External DC Power Supply	Sampling point test	9	12	32	V
Operating Current	External DC Power Supply	Sampling point test	--	0.42	--	A
Power Consumption	External DC Power Supply	Sampling point test	--	5	--	W
CAN Interface	Bus pin voltage resistance	CANH　CAHL	-58	--	+58	V
	Isolation withstand voltage	Leakage current less than 1mA	2500	--	--	VDC



✓ Main device: TH7011

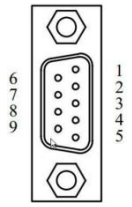


✓ USB cable

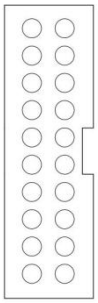
✓ Category 6 Gigabit Ethernet cable

✓ 12v2A power supply

- TimeSync interface
- DC power supply interface
- USB2.0 interface
- RJ45 Ethernet interface
- Trigger Out interface
- DB9 male

	PIN2	CAN FD_Low
	PIN3	CAN FD_GND
	PIN7	CAN FD_High

- 20Pin header connector

	PIN1	TXD	PIN2	AIAO0
	PIN3	RXD	PIN4	AIAO1
	PIN5	GND	PIN6	AIAO2
	PIN7	DI1	PIN8	AIAO3
	PIN9	DI2	PIN10	AIAO4
	PIN11	UART_RX	PIN12	AIAO5
	PIN13	GND	PIN14	GND

	PIN15	DO1	PIN16	GND
	PIN17	DO2	PIN18	VCC_5V
	PIN19	UART_TX	PIN20	VCC_5V

Diagram of LED indicator:

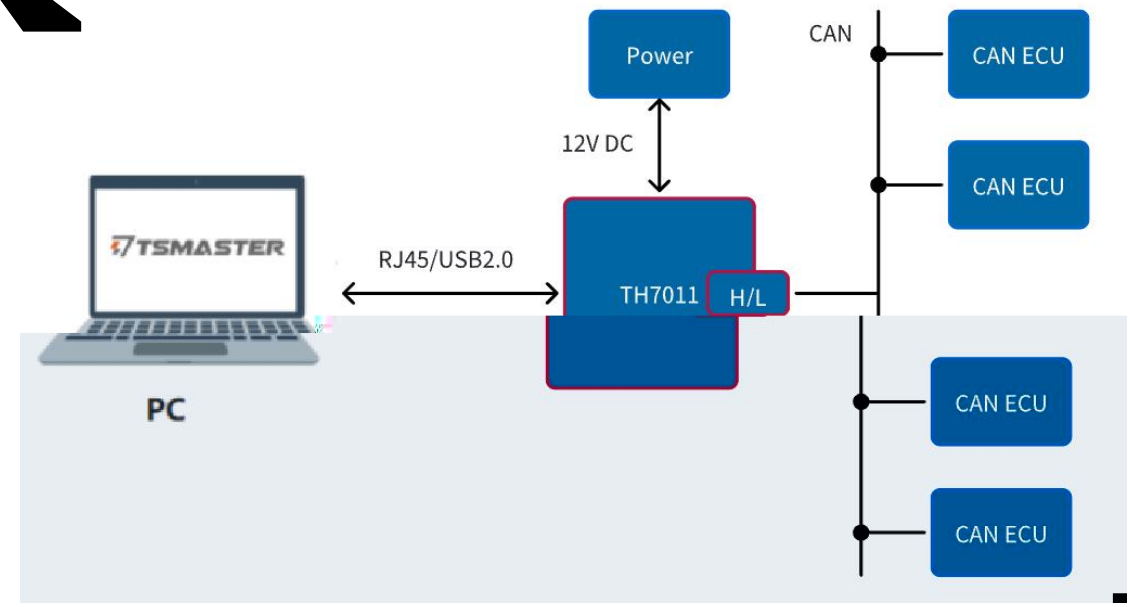
Description of indicator:

Config	Indicator for configuration
Trigger	Indicator for trigger
Disturb	Indicator for disturbance
CAN/CAN FD	Indicator for CAN/CAN FD
Power	Indicator for power supply

Description of LED color:

Config Green	Lights up after approximately 8 seconds after the device powers up. Configuration can only begin after lights up.

Trigger Green	Light up when triggered (not yet available)
Disturb Green	Light up when interfered
CAN/CAN FD Green	Light up when CAN channel is



Connect the TH7011 device to a computer via Ethernet, and connect the CAN ECU device to the TH7011. With the powerful TSMaster software on the PC, you can control the TH7011 disturbance

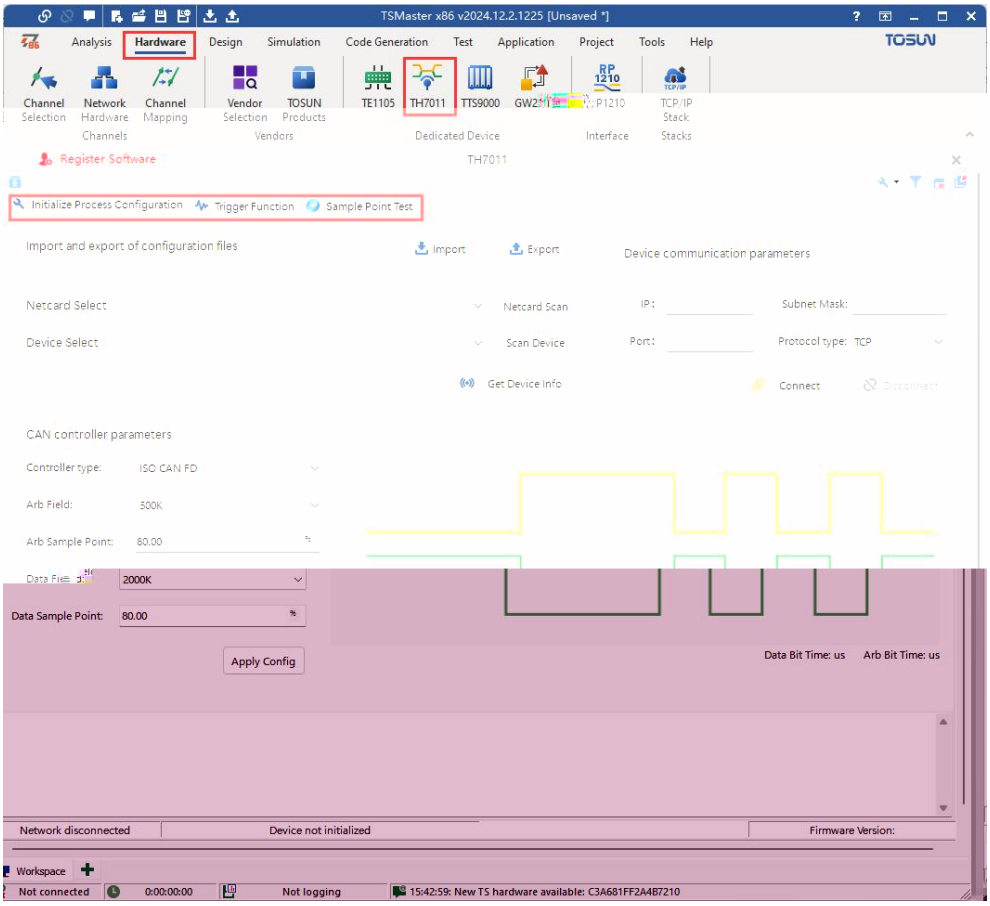
TSMaster software download link:

https://www.tosunai.com/downloads

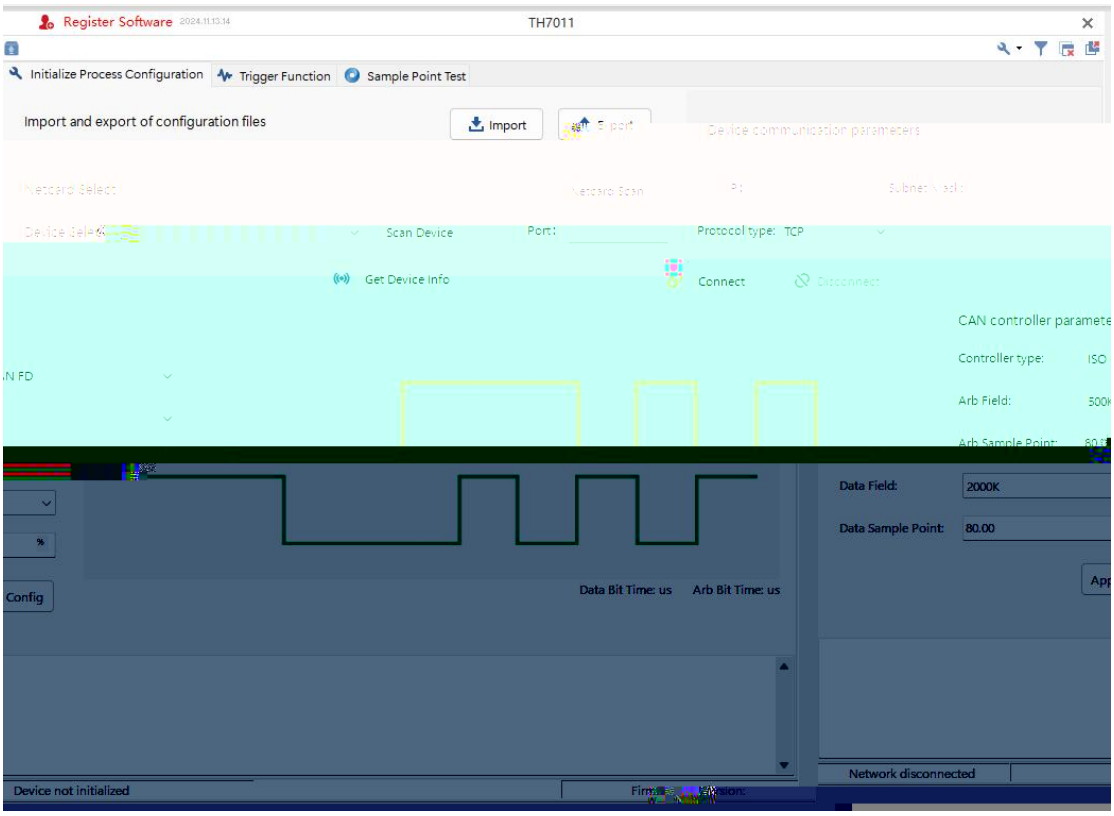
If the link is not accessible, you can contact the corresponding sales personnel or visit the official TOSUN website to obtain the software. Meanwhile, you can scan the QR code to follow the TOSUN official account to get the download link.

After the installation, you can see the following software on the PC.

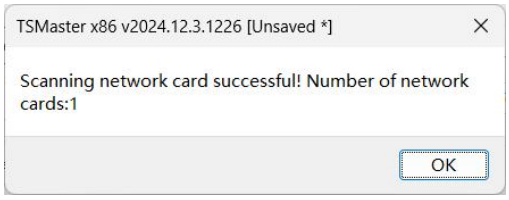
In TSMaster, open the TH7011 configuration window.

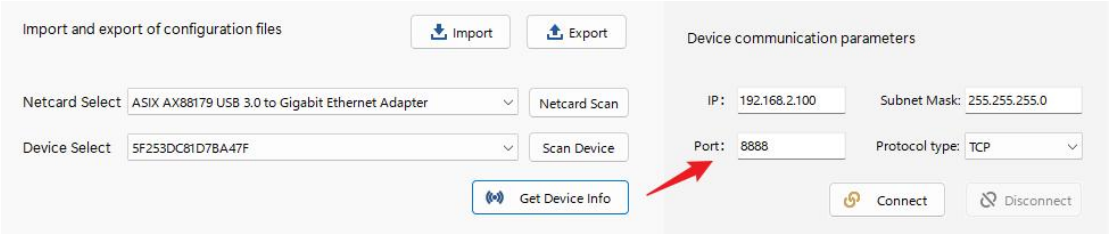


◆ Initialization GUI

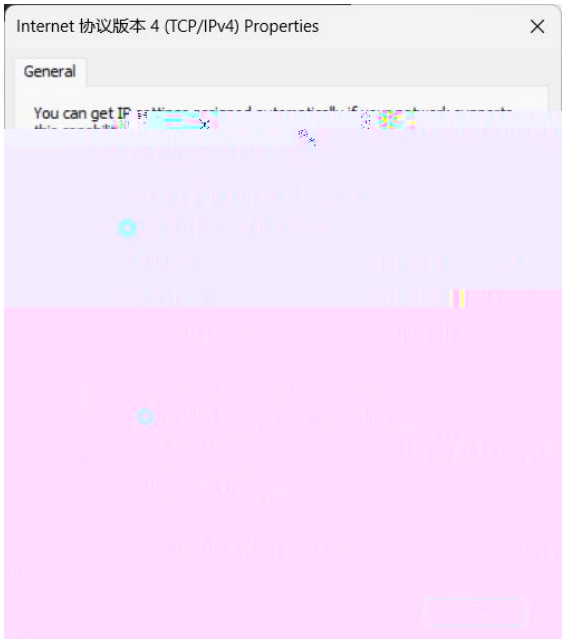


(1) Click “Scan Network Card”, and select the network card from the drop-down box after the scanning is successful. If the computer has multiple network cards, you can choose which one to use.

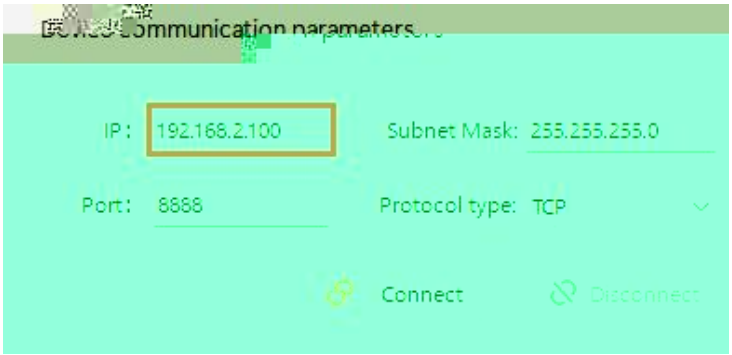




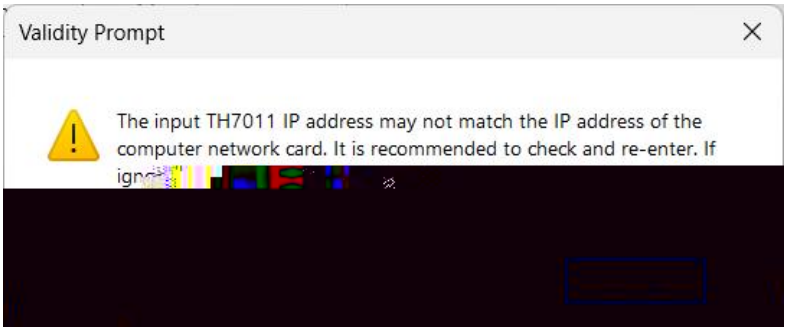
(4) Before connecting to the device, check and ensure that the Ethernet IP address of the PC is in the same network segment as the IP address of the disturbance interface device.

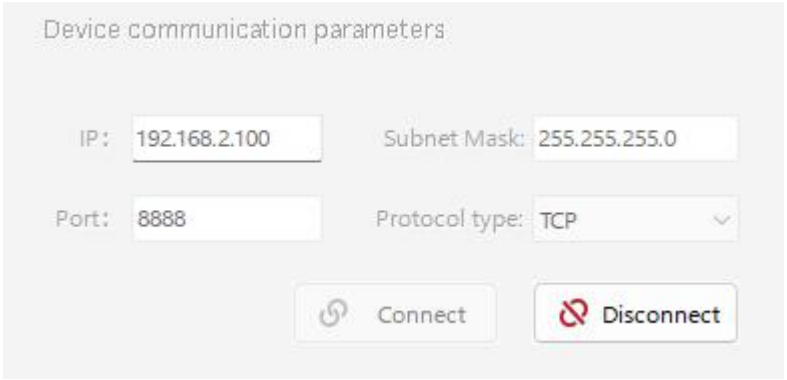


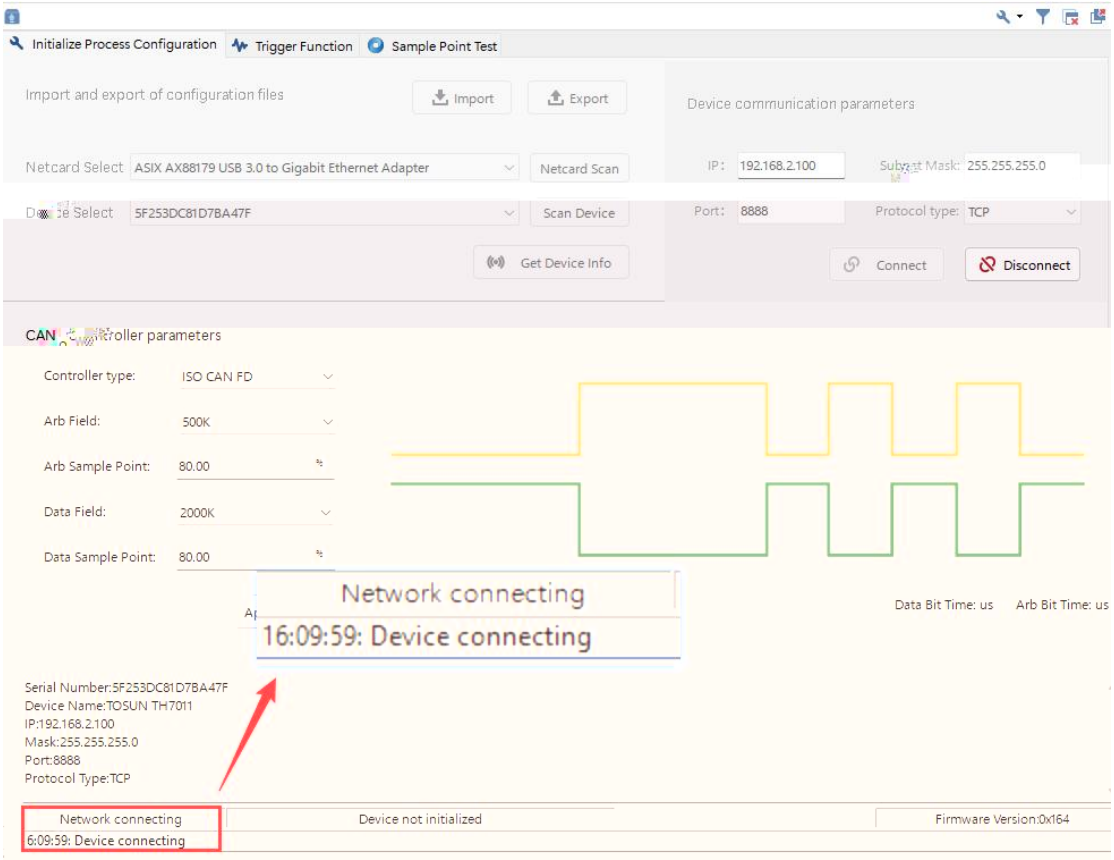
If the computer’s network segment is 192.168.2.xx, you can manually change the IP address of the device's communication parameters to be in the same network segment. If the connection to the device fails, check if this is the cause.



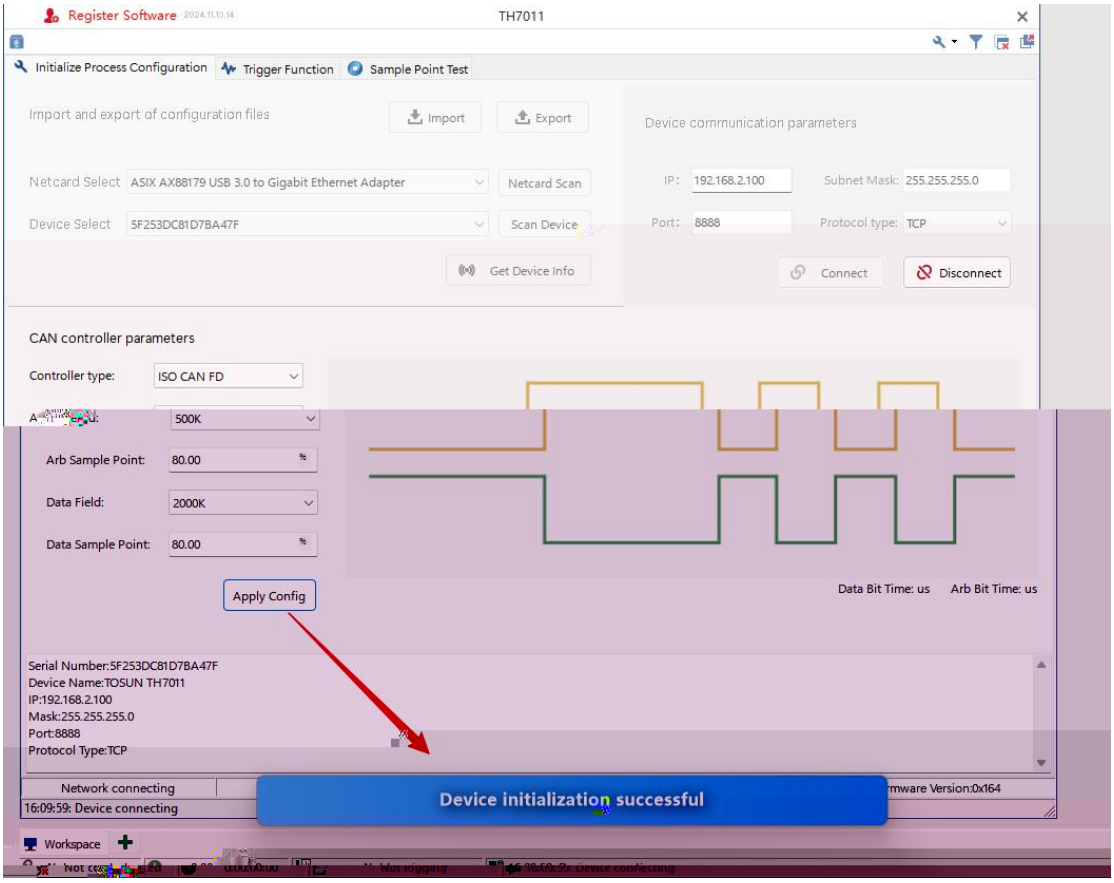
(5) Based on the computer's network segment settings, click “Connect Device”, and click “Yes” in the pop-up window. The button will turn gray, and the status bar below will display “Device connected”.



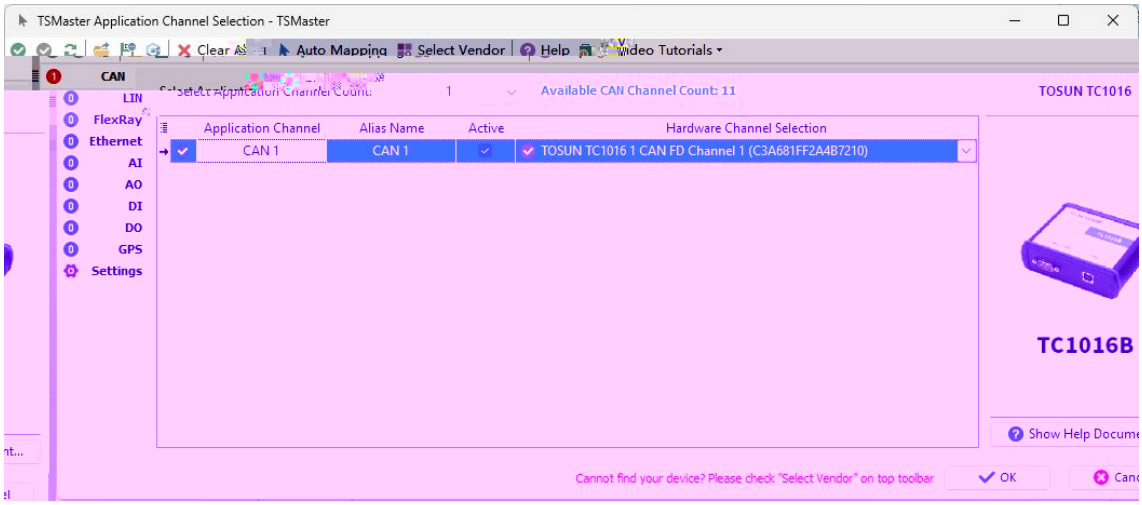




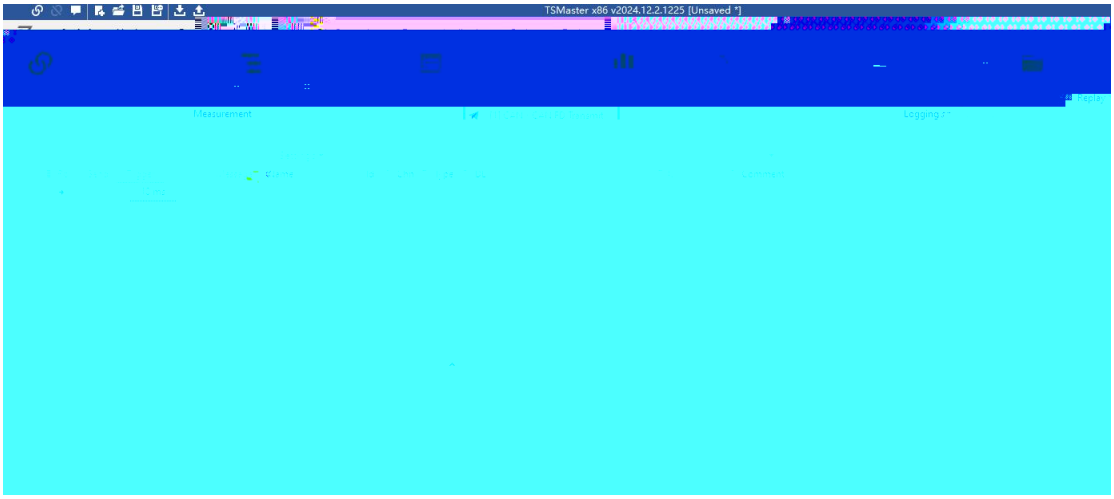
(6) Select the corresponding parameters from “Device CAN Control Parameters”, and click “Initialize Device”, and the log bar below will display “Initialization Successful”.

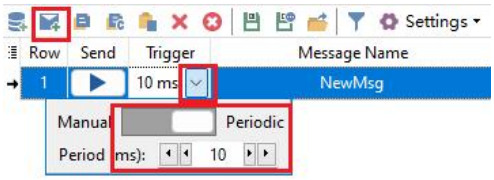


After completing the device initialization, verify whether the disturbance interface is connected to the bus to ensure its normal operation. Taking the TOSUN TC1016 device as an example, connect the CAN1 channel of the TC1016 to the disturbance interface, and in TSMaster Hardware->Channel Selection, select the hardware channel as the CAN1 of the TC1016.



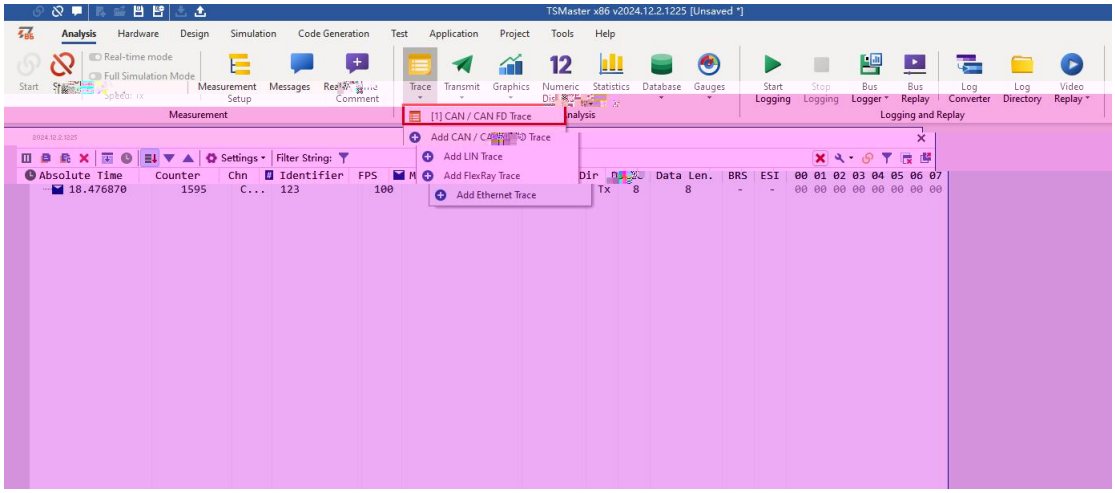
Send any one frame of periodic message in the CAN/CAN FD Transmit window of TSMaster.





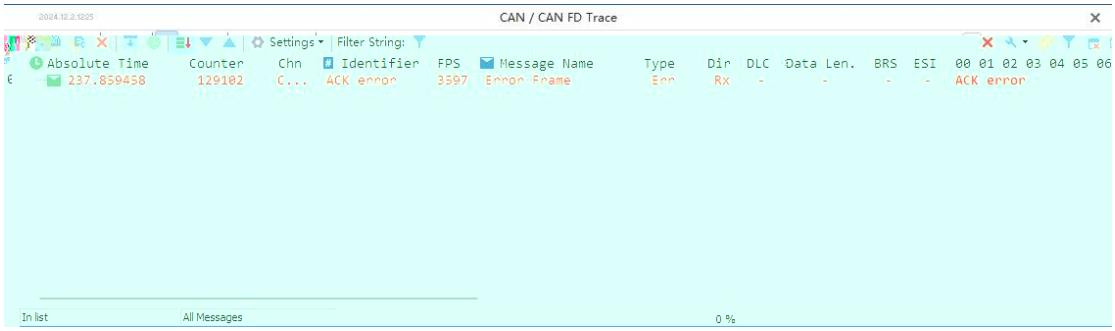
In the CAN/CAN FD Transmit window of TSMaster, check whether the communication is normal.

- Normal Communication

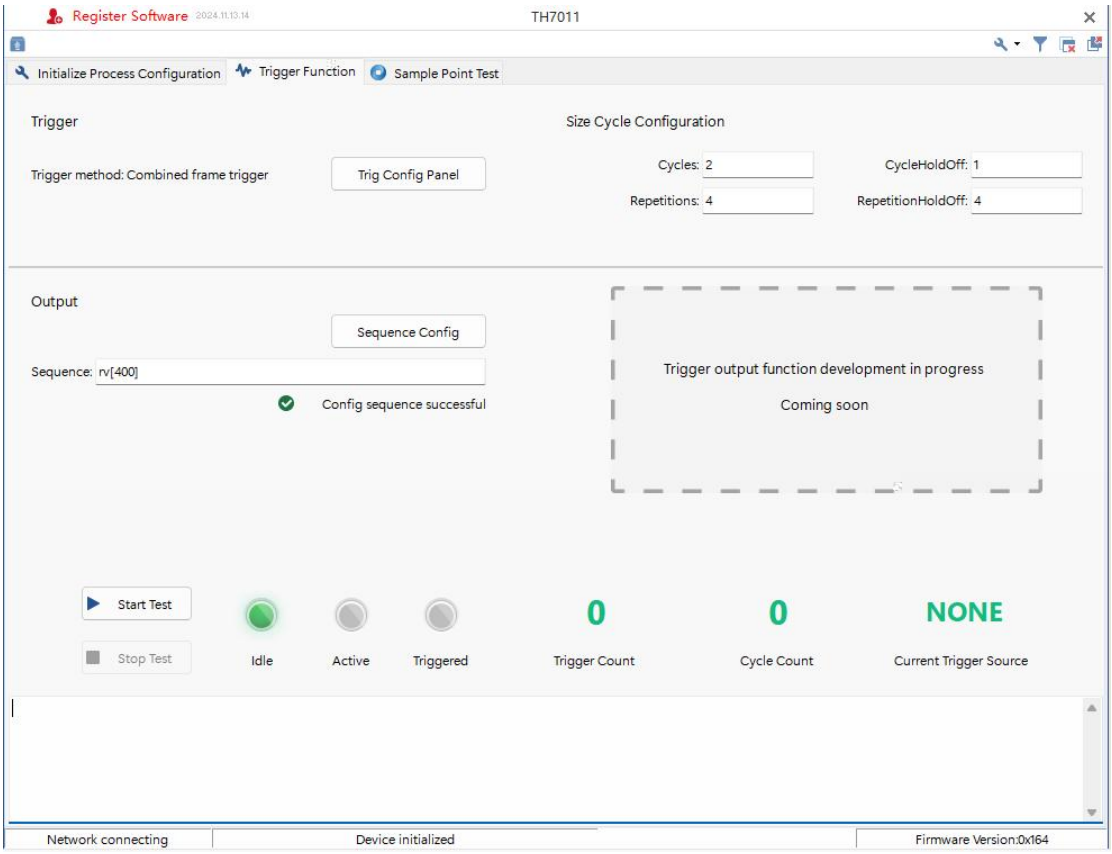


◆ Abnormal Communication

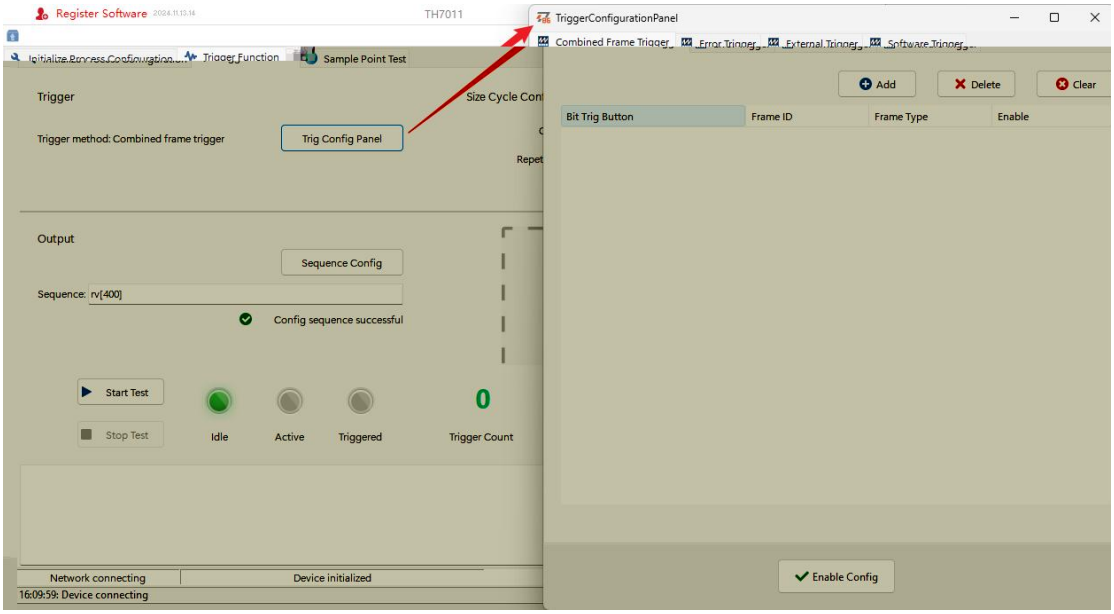
At this point, please check whether the harness connection is correct, see 2.7 Hardware Interface.



Configure parameters such as trigger, cycle, and output on the Trigger Configuration Panel.

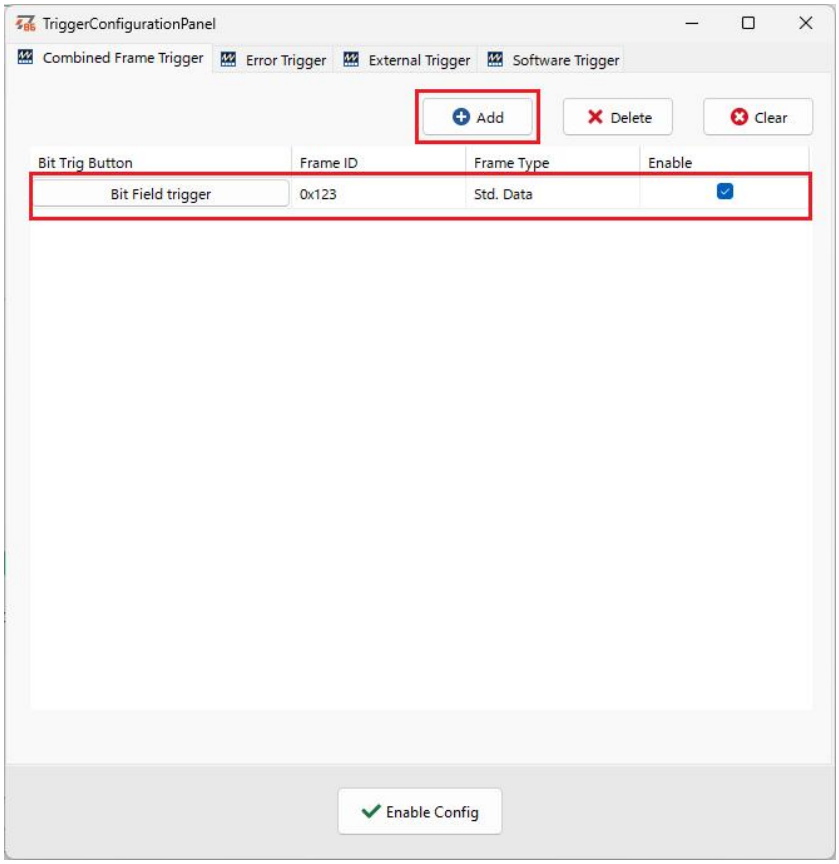


Click “Trigger Configuration Panel” to enter the interference trigger configuration interface.

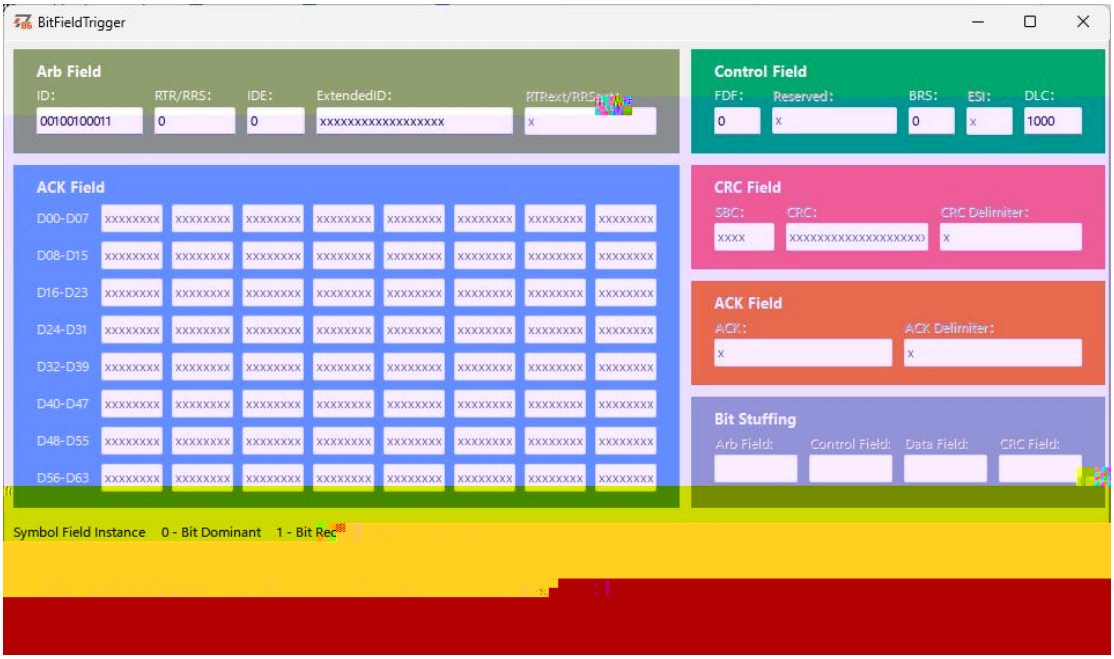


◆ Combined Frame Trigger

(1) Click the “Add” button to add a “Bit Field trigger” function.

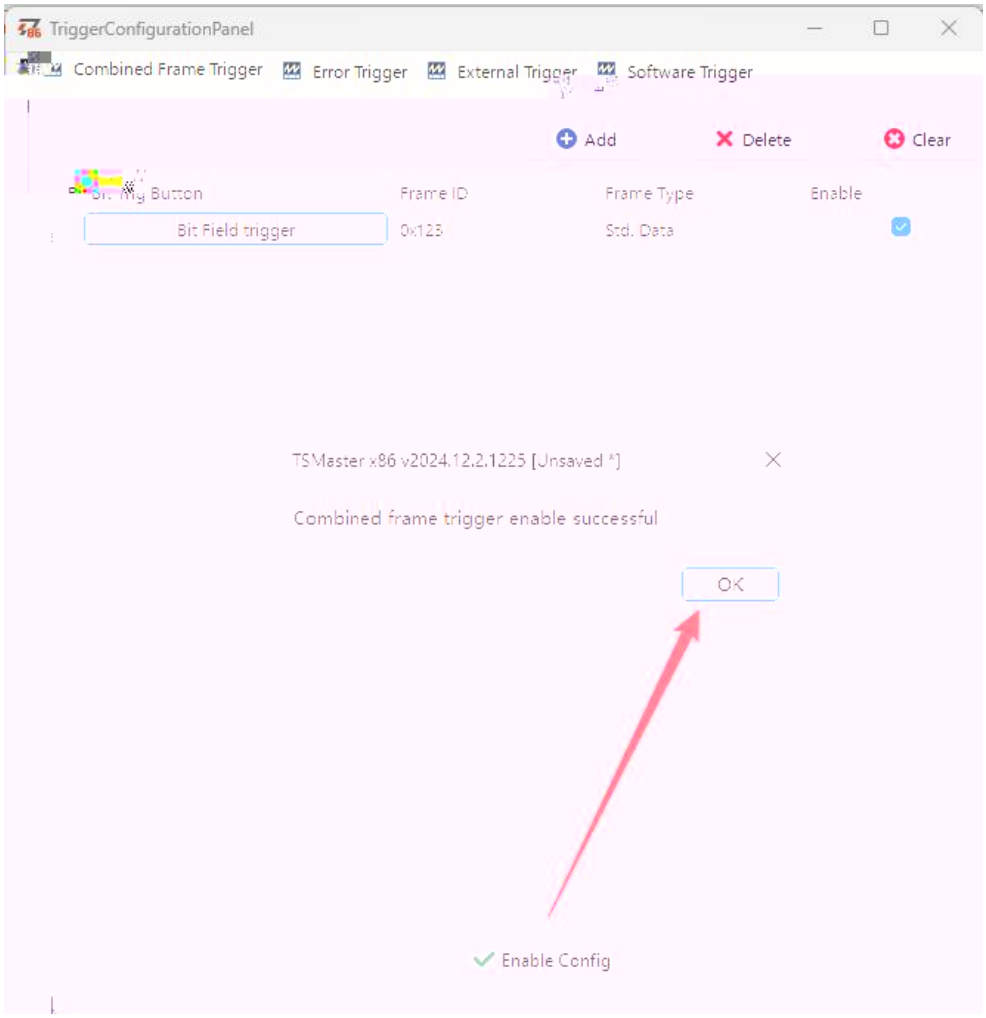


(2) Click the “Bit Field trigger” button to enter the configuration panel, where users can select the bit of Arb field/control field/data field/CRC field for trigger.

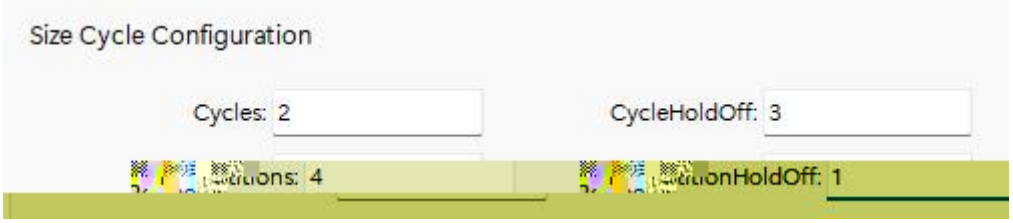


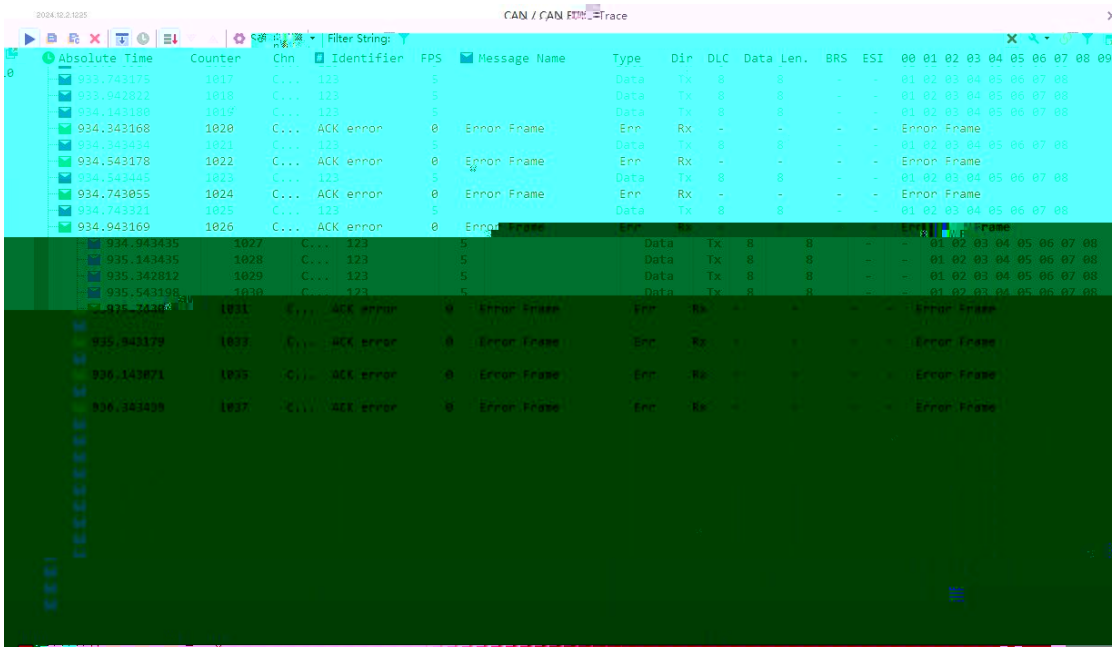
		trigger condition is configured as CRCFIELD, and the trigger offset is set to 16, this indicates the disturbance is targeted at the ACK bit.

(3) After configuring the Bit Field trigger, click “Enable Configuration” to activate it.



(2) Size Cycle Configuration





Take a cycle of 2, a cycle interval of 3, a repetition of 4 times, and a repetition interval of 1 as an example, the above figure shows that a total of 8 error frames are generated (cycle * number of repetitions).

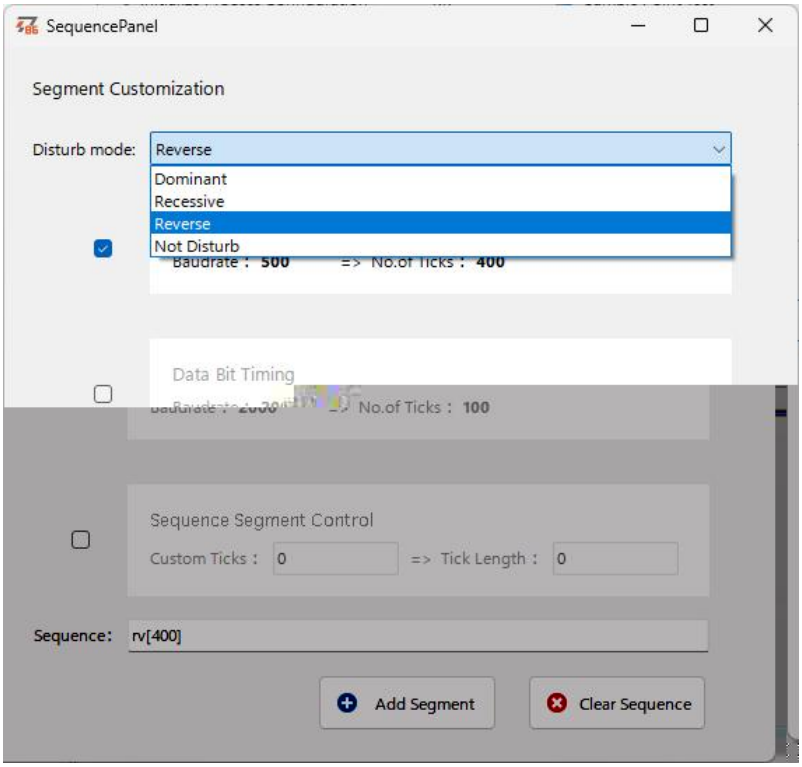
: Counting from 1 to 7 is one cycle, and 12 to 18 is the second cycle.

: It refers to the interval between two cycles. As shown in the above figure, there are 4 normal frames between the first and second cycles. However, the actual cycle interval is 4 due to the existence of the repetition interval.

: As shown, there are 4 error frames within one cycle, which is the meaning of repetitions.

: Within a cycle, such as the cycle counting from 1 to 7, we can see that between each two error frames, there is one normal frame. This is the RepetitionHoldOff.

(3) Output Configuration



There are four disturb mode:

: The state that is forcibly disturbed into a dominant state, i.e., a low-level state.

: The state that is forcibly disturbed into a recessive state, i.e., a high-level state.

: The state where the signal is disturbed from dominant (0) to recessive (1), or from recessive (1) to dominant (0).

: When there are multiple disturbance segments, the first segment can be configured as not disturb.

(During use, first click "Clear Sequence", then click "Add Segment" for the configuration to take effect.)

- Error Trigger
  Temporarily unavailable, will be available in the future.

- External Trigger
  Temporarily unavailable, will be available in the future.

- Software Trigger

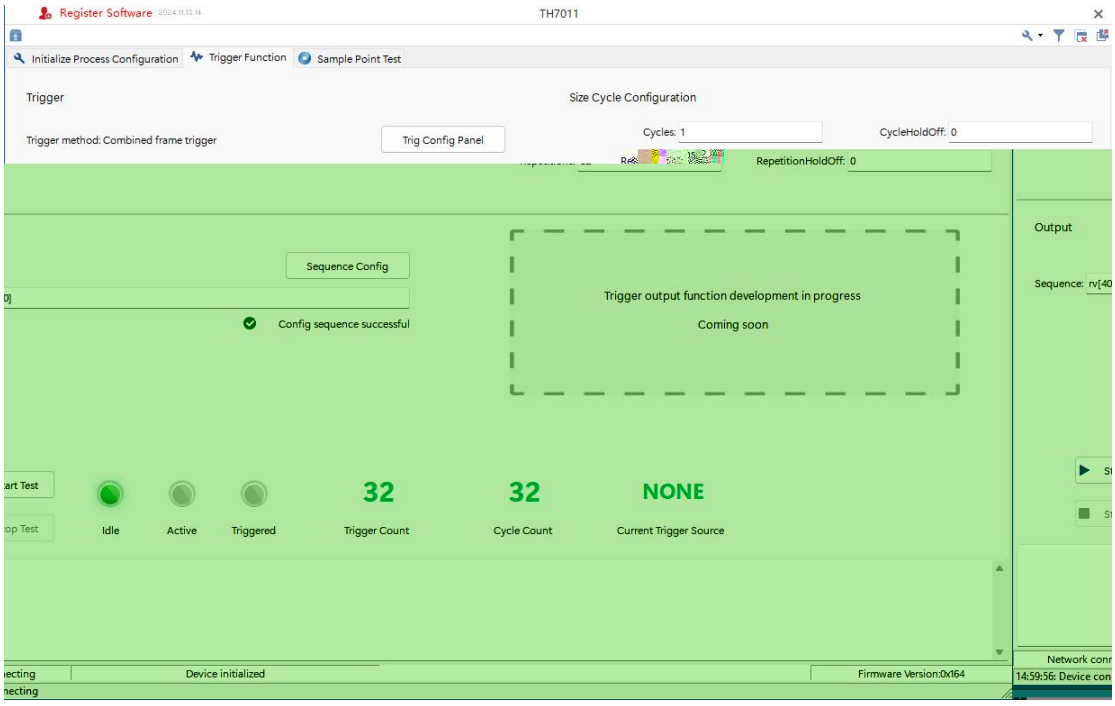
Temporarily unavailable, will be available in the future.

The current node sends error frames to the bus, and the Transmit Error Counter (TEC) starts counting. When the number of interference events, consisting of consecutive identical error frames, reaches a specified value, the device will enter a Bus-Off state. The number of interference events is determined by the cycle multiplied by the repeat count in the cycle configuration settings.

◆ Note

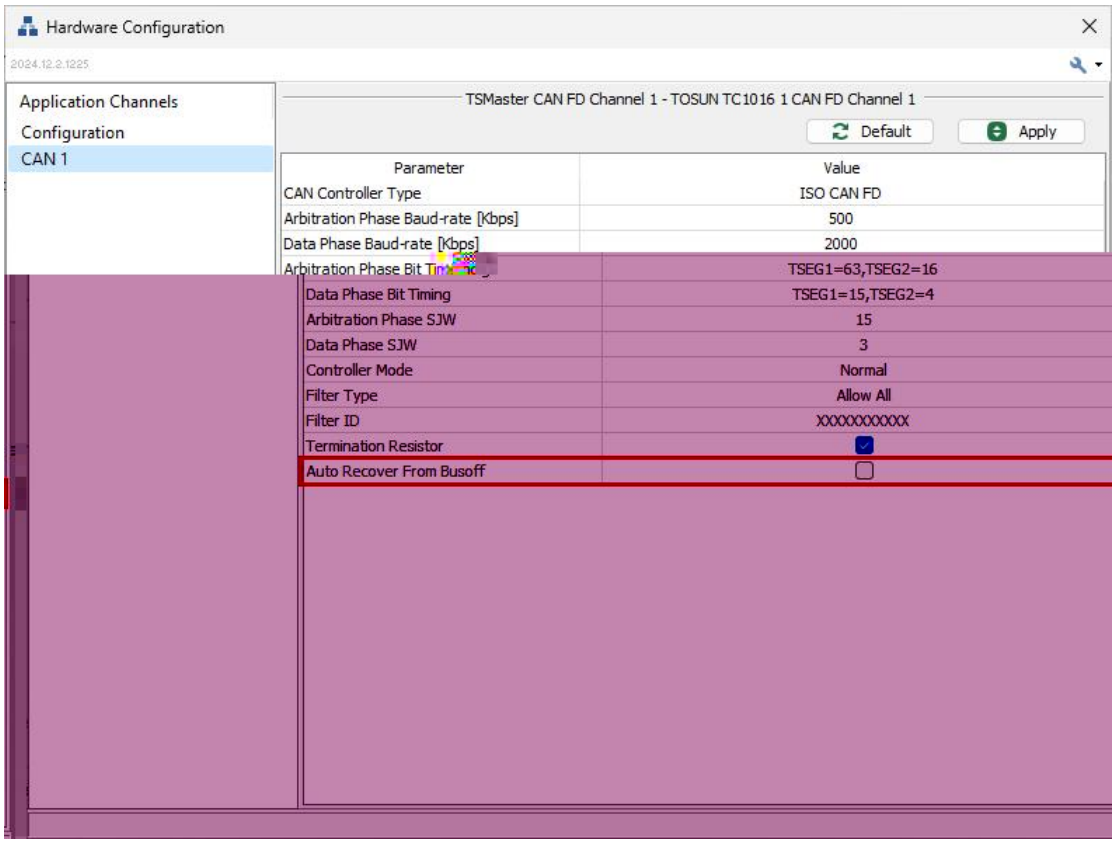
(1) Interference must be continuous, and the repeat interval should be set to 0.

(2) The behavior of the device entering the Bus-Off state is influenced by multiple factors, including the behavior of the error counter, the type of error frames, the intensity and duration of interference, bus load, and hardware and software configurations. Different hardware devices may show different behaviors under different conditions.

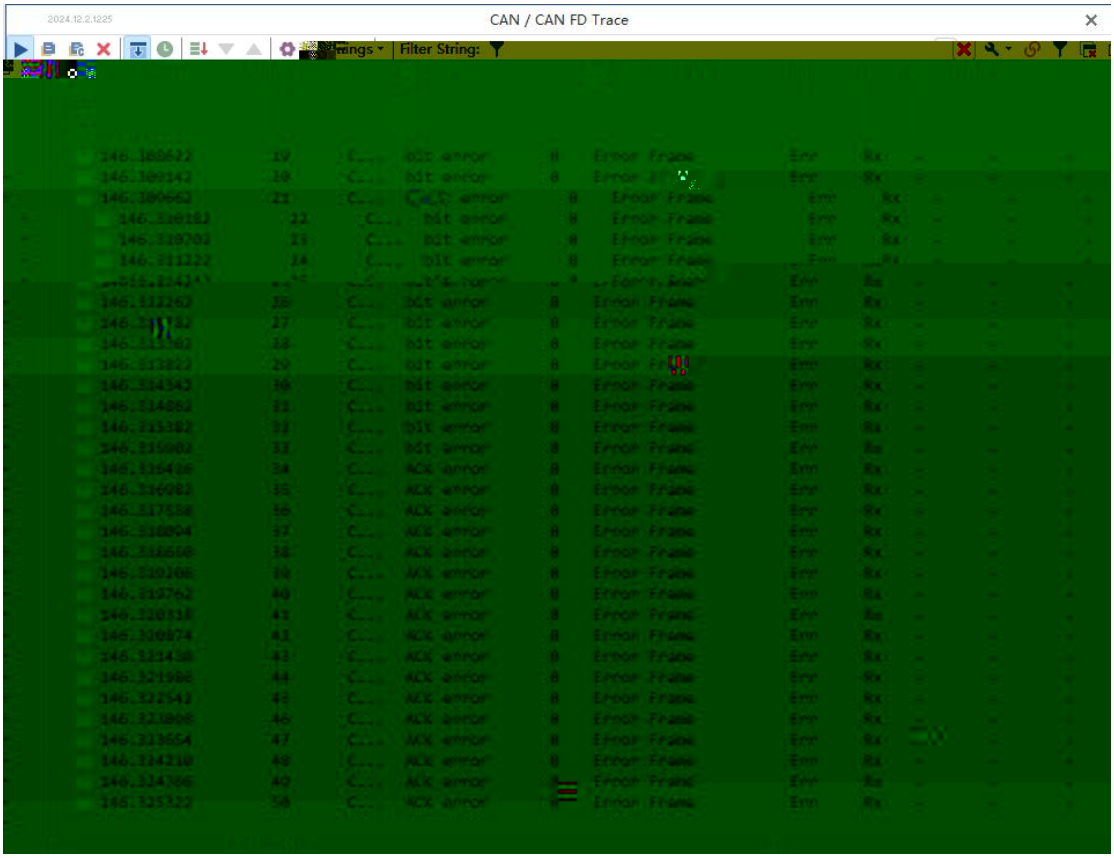


Taking the TC1016 as an example, in the hardware configuration, disable the “Auto Recover

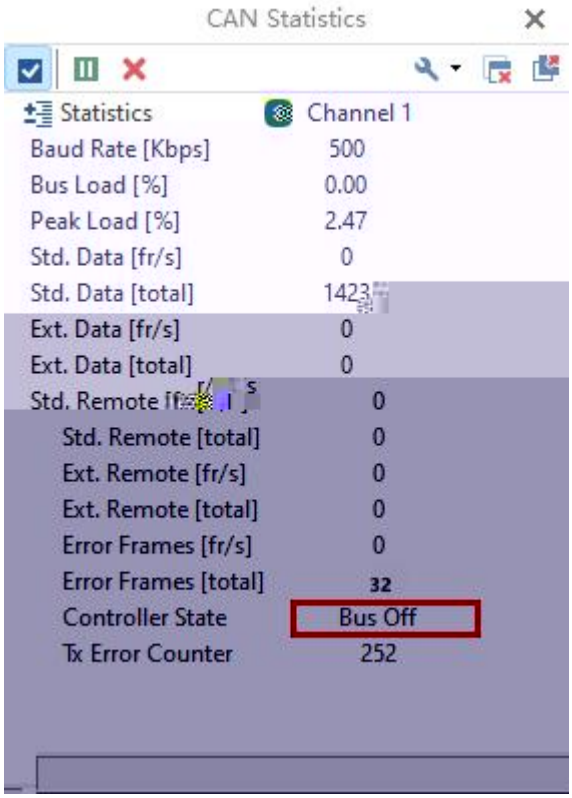
From BusOff” option.



When the TC1016 is set to start message transmission and is subjected to interference using a disturbance interface, it can be observed that after 32 consecutive frames of interference (bit errors), message transmission/reception stops.



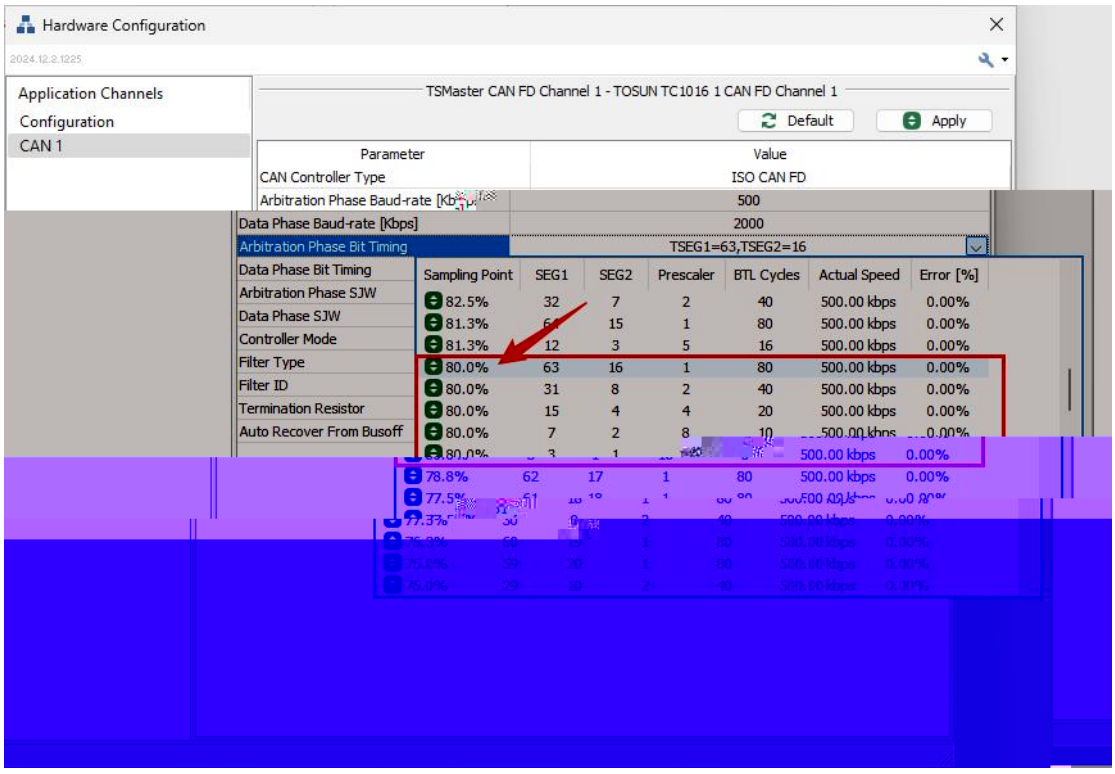
Open the CAN statistics data and it can be observed that the controller status is displayed as "BusOff".



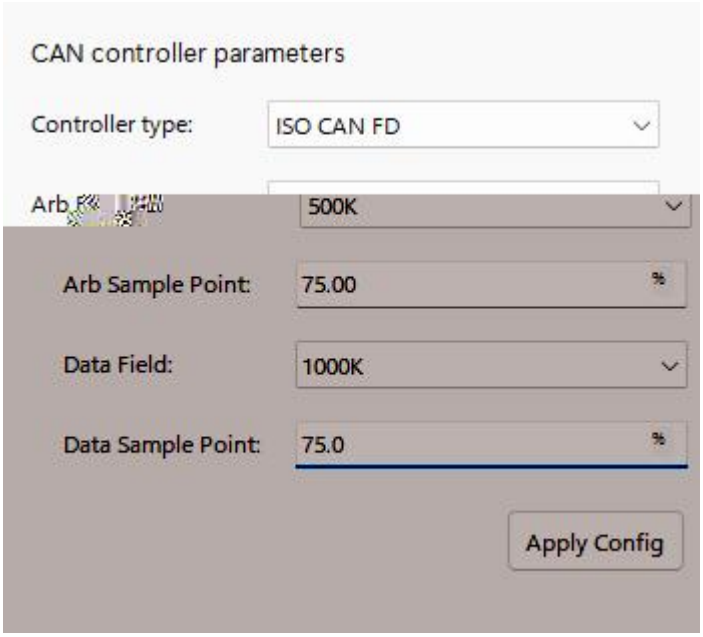
The disturbance interface sends test packets while inverting the bits within the packets to cause the receiving node to report corresponding error frames, allowing for the sampling of the reception points of the node under test.

◆ Note

(1) The higher the TQ value of the device under test, the more accurate the sampling point test results will be. As shown in the figure below, selecting the highest TQ value at 80% provides more accurate results:



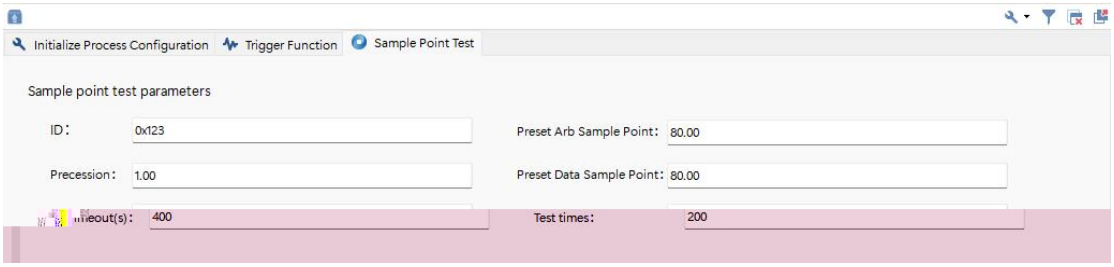
(2) The sampling point of the disturbance interface should be slightly smaller than that of the device under test. For example, if the device under test is set to 80%, the disturbance interface can be set to 75%.

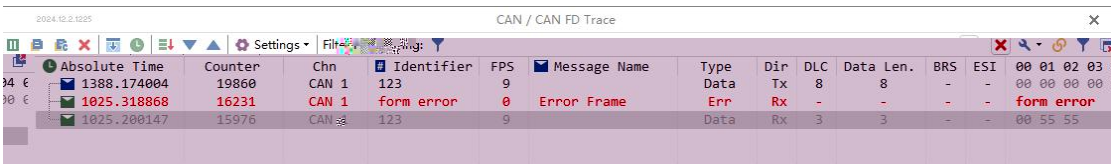


◆ Testing Steps

(1) During testing, connect the device under test to the disturbance interface using a DB9 cable. In TSMaster, click “Start”. The device does not need to perform any operation or send messages, only maintain the connection.

(2) Configure the testing parameters on the disturbance interface, then click “Start Sampling Point Test”. The disturbance interface will send messages to the device under test and perform interference to run the sampling point test.





The sample point test form can specify the CAN or CAN FD frame ID for sending

disturbance that used to test the sampling point location through the ID parameter. Be careful not to duplicate the frame ID sent by other nodes on the bus.

The precision of the sampling point test set by the user.

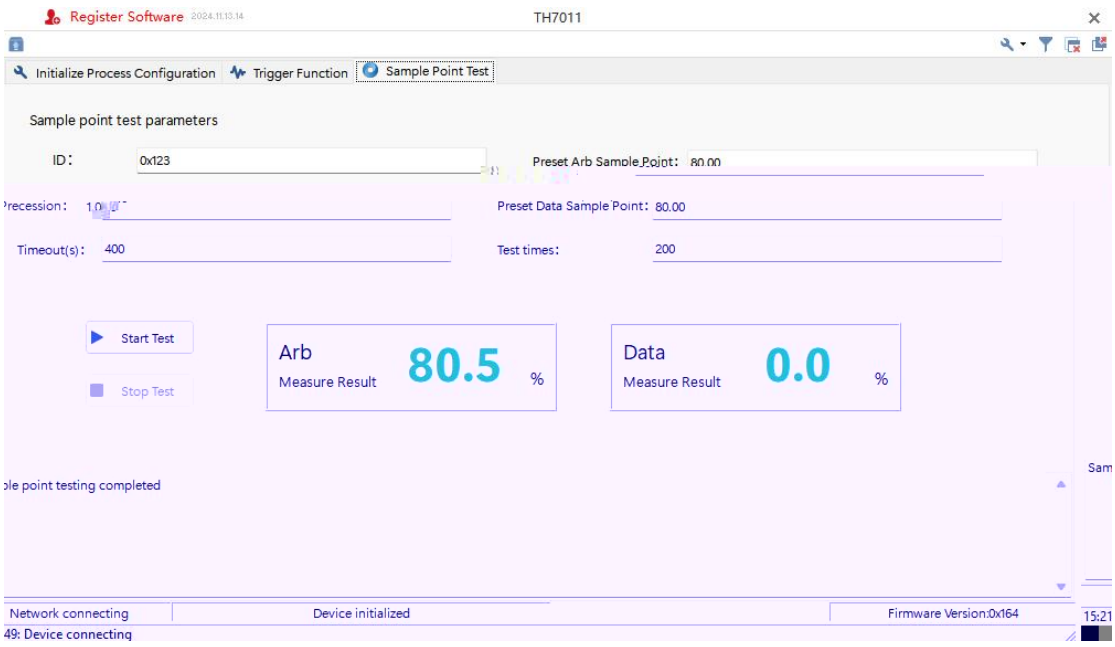
The timeout duration for testing sampling points. If this time is exceeded, the sampling point test will stop.

Allows the user to choose between using Preset Arb Sample/Preset Data Sample, or allowing the system to self-correct to sampling points that enable normal communication for sampling point testing.

This function only works when the self-correct mode is set to preset sampling points. If the user already knows the approximate value of the sampling point of the tested component, they can fill in the Preset Arb Sample/Preset Data Sample here.

Specifies how many times to apply disturbance for each level sequence configuration.

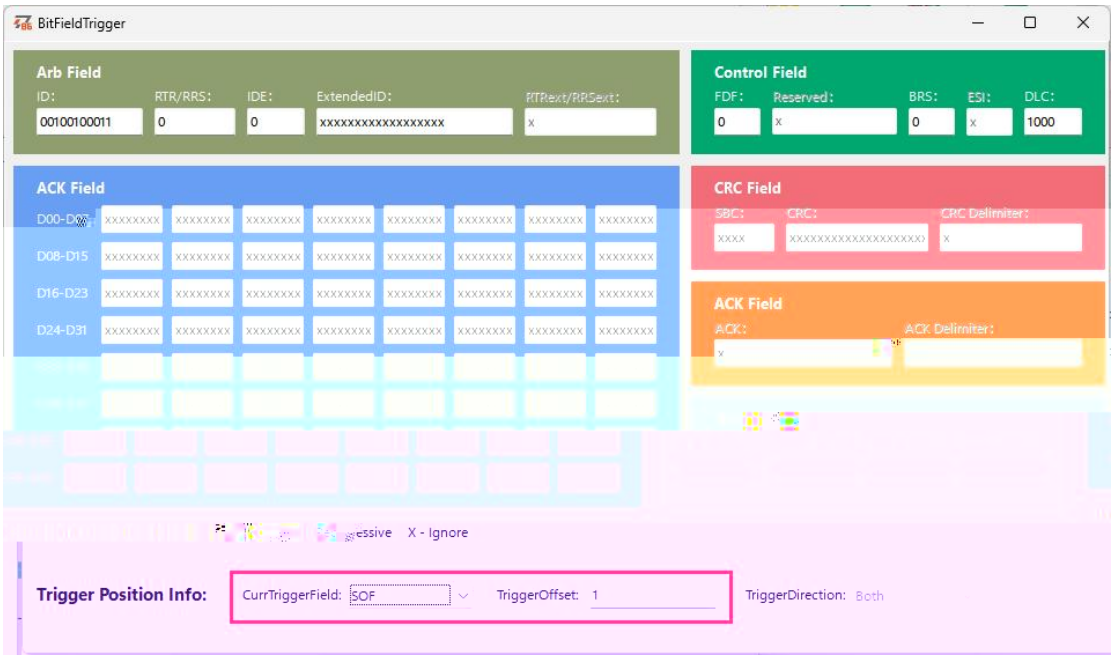
(3) As shown in the figure below, the device under test is configured with the maximum TQ value at an 80% sampling point, and the disturbance interface is set to a 75% sampling point for the test results:



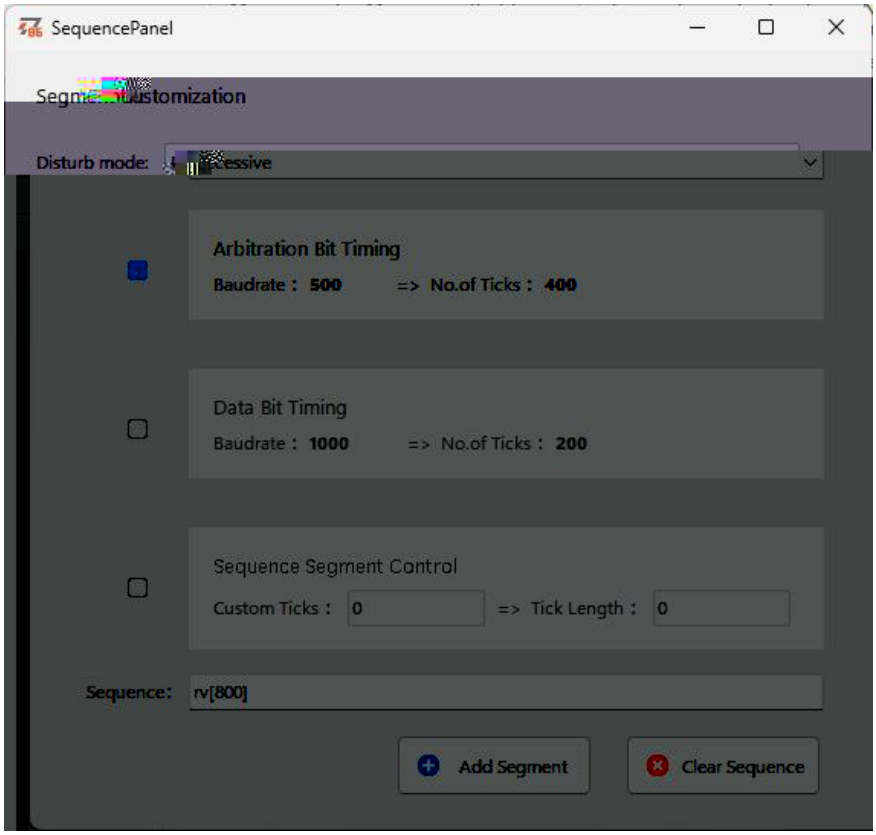
Refer to section 2.7 Hardware Interface. The disturbance interface is equipped with an IO interface, where Pin14 and Pin15 can be used to monitor the interference status. The specific steps are as follows:

(1) Connect the Pin14 and Pin15 pins of the I/O interface to the oscilloscope using wires.

(2) Set the disturbance interface trigger condition to SOF with a trigger offset of 1, targeting the interference on ID bit [28].



(3) The output configuration is as follows:

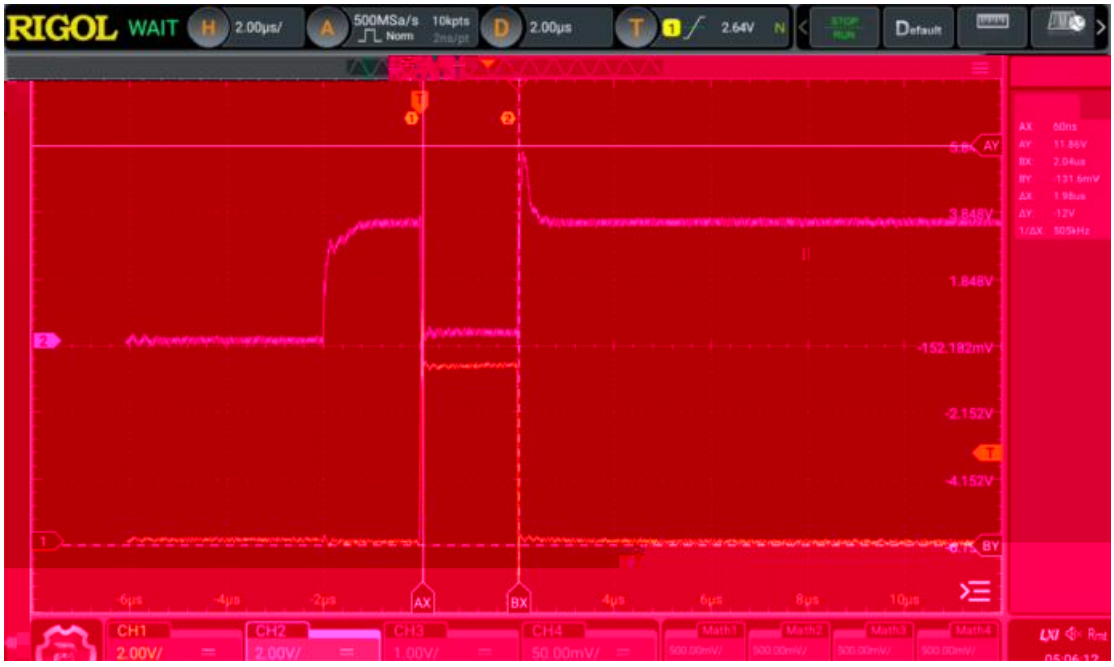


(4) For example, if the data segment baud rate is set to 500 Kbps, and the bit time for the CAN signal is 2 microseconds. Set the oscilloscope's horizontal time base to 2 microseconds, so each column (2 microseconds) on the oscilloscope corresponds to one bit of a CAN frame.

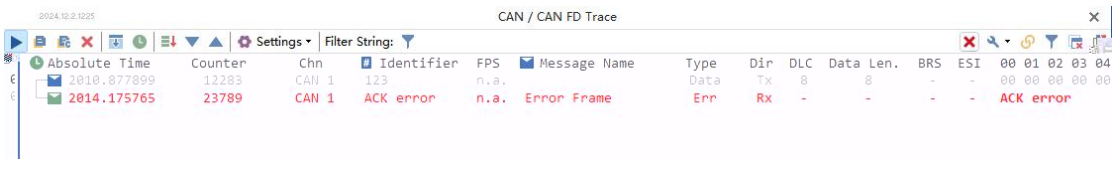
(5) Start the interference and use the oscilloscope to capture the signal. As shown in the figure below, the yellow CH1 waveform represents the output signal from the disturbance interface's I/O interface. The prominent part indicates the interference applied by the disturbance interface. The blue waveform represents the CAN bus signal's CAN_H. Adjust the oscilloscope's horizontal time base to 2 microseconds, and observe that the second bit of the CAN signal, i.e., ID[28], has been interfered with.

The waveform before enabling interference:

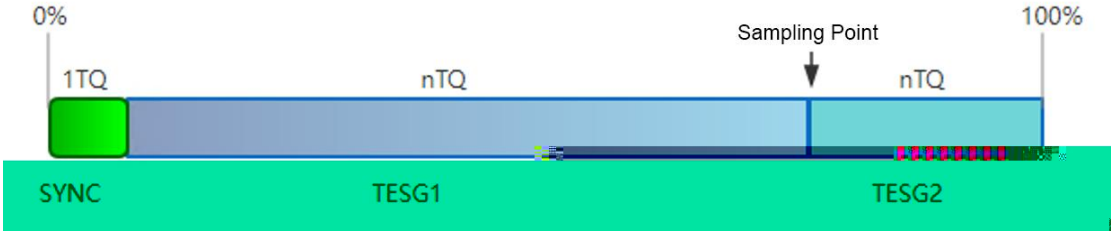
The waveform after enabling interference:



If the interference is successful, error frames will appear in the TSMaster message information window:



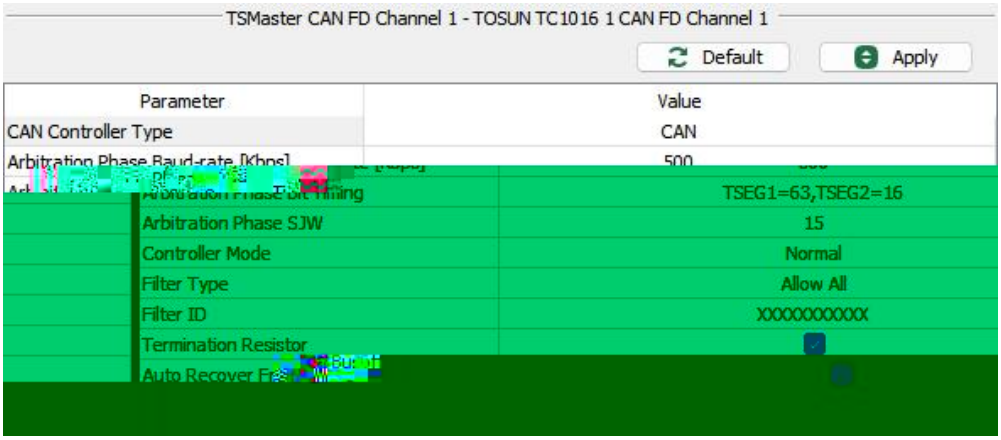
The bit time of CAN is divided into the Sync Segment, Time Segment 1 (TSEG1), and Time Segment 2 (TSEG2). These segments are composed of different numbers of the minimum time unit of the bus level, known as TQ (Time Quantum). The TQ is derived by frequency division of the chip's crystal oscillator period.



The theoretical calculation value of the sampling point is:

$$Sp = \frac{Sync + TSEG1}{Sync + TSEG1 + TSEG2}$$

Take a TOSUN device with a sampling point of 80% at a baud rate of 500K as an example, the frequency division coefficient at this time is 1, TSEG1 is 63, and TSEG2 is 16.



Then the sampling point is: (1+63) / (1+63+16) = 80%

The TH7011 utilizes a clock frequency of 200MHz, resulting in a minimum clock cycle of T0

= 1/200M = 5ns (nanoseconds).

When the baud rate is 500Kbps, T1 = 1/500K = 2000ns (nanoseconds).

Therefore, the time required to disturb with one bit is: T0/T1 = 400 ticks.

Compared to similar products in the market, the TH7011 has a higher clock frequency and smaller step size, which give it the following advantages:

Higher Test Accuracy - Allows for more accurate adjustments to the parameters of the disturbance signal.

Broader Test Range - Theoretically supports up to 65,536 disturbance points.

More Flexible Test Strategies - Enables the formulation of more flexible and diverse testing strategies.

More Reliable Test Results - Helps to reduce uncertainty and errors during the testing process.

Sampling points refer to the specific locations where the receiving nodes determine the logic of a signal (such as 0 or 1). In a CAN bus network, it is crucial for multiple nodes to maintain the same sampling points as much as possible to ensure accurate and synchronized reception and processing of signals under the same sampling frequency. If the sampling points of nodes in the network are inconsistent, it may lead to sampling errors, further triggering malfunctions in the entire network.

Use disturbance to disrupt the logical level at the specified location or nearby, observe whether the CAN message produces an error frame. If an error frame appears, the location of the disturbance is the sampling point position.

a. The rise and fall edge error caused by the disturbance of a bit in VH7011 can be considered negligible.

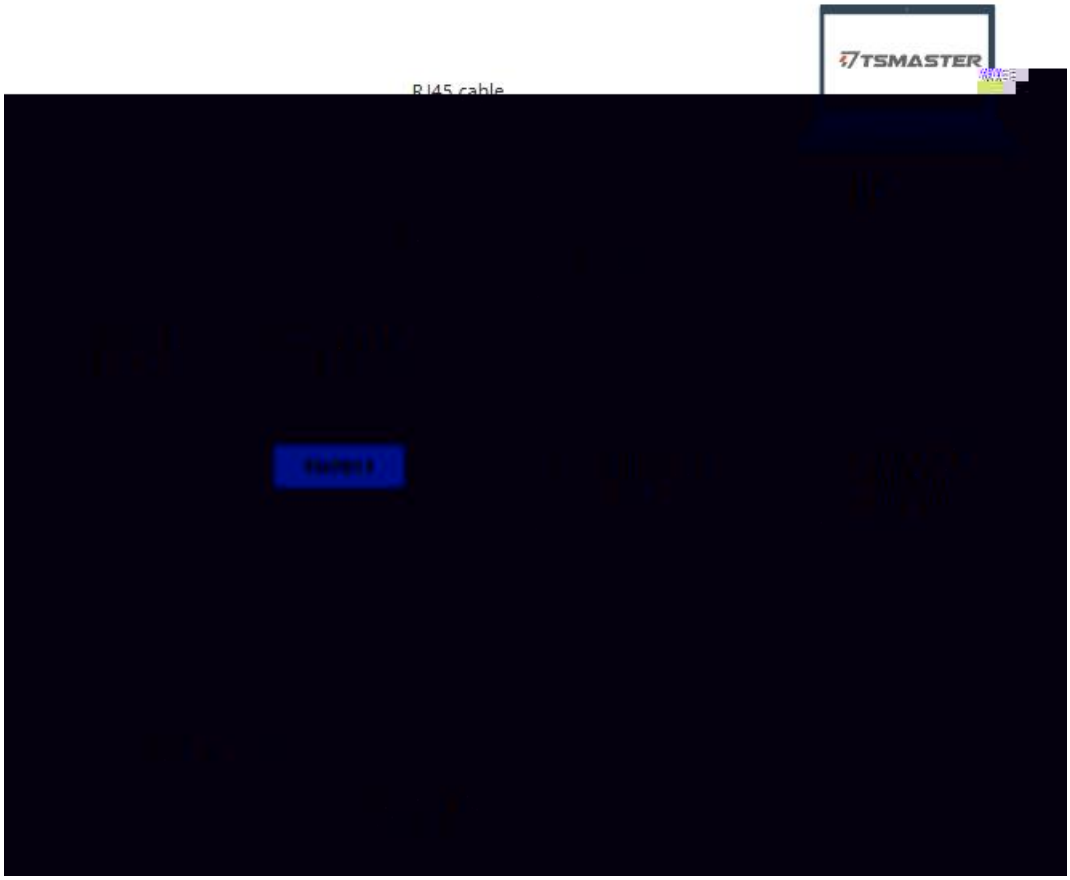
b. The sampling point position of the measured item itself deviates from the expected.

electromagnetic disturbance and power supply noise, leading to noise in the signal, which affects the accurate judgment of the sampling point.

e. Performance differences in CAN transceivers, such as conversion rate, gain, bandwidth, and other parameters, may cause signal deformation or distortion, affecting the determination of the sampling point.

f. The bus load conditions will affect the transmission characteristics and waveform of the signal, thereby affecting the sampling point.

g. Environmental conditions such as temperature and humidity may cause changes in the electrical characteristics of the CAN bus, thereby affecting signal transmission and the accuracy of the sampling point.



(1) Currently, the disturbance interface cannot monitor messages directly. If you want to monitor CAN/CAN FD messages during interference, as shown in the figure above, you need to connect an additional CAN/CAN FD analyzer device (e.g., TOSUN TC1013 or TC1014) to the bus.

(2) During sampling point testing, to avoid interference from the CAN/CAN FD analyzer device on the test results, please do not connect any CAN/CAN FD devices while using the sampling point testing feature.

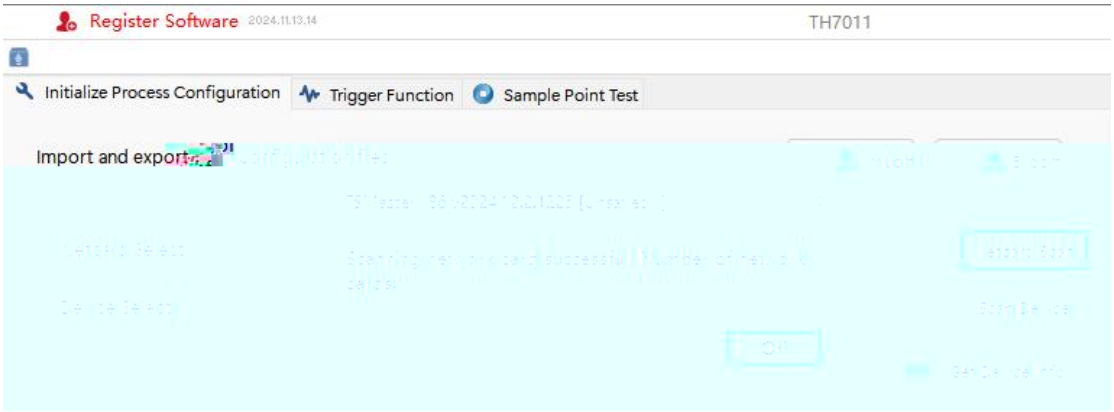
The disturbance interface toolbox is not yet integrated into the TSMaster software. Currently, to use the disturbance interface toolbox, you need to get the plugin from TOSUN's sales or the technical support team and load it.

If you encounter a loading failure as shown in the figure below, please check that your TSMaster version is 2024.2.28 or later (In future updates, once the integration is complete, the disturbance interface toolbox can be accessed directly with a dedicated button in TSMaster. Thank you for your understanding).

If you encounter a disturbance interface failure, such as the error message “Not a valid Win32 application”:

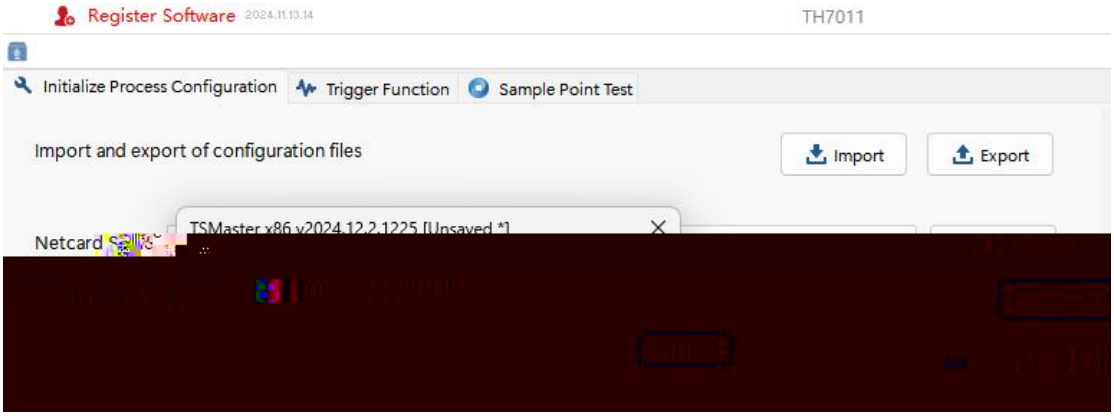
(1) Try running the disturbance interface toolbox using the TSMaster x86 version program.

(2) Ensure that the issue is not caused by encryption systems installed on your computer.



(1) Check if the disturbance interface has started correctly, i.e., whether the Power and Config indicators are lit. If they are not lit, verify the power supply. If they are lit, check if the network cable is properly connected.

(2) Some computers require drivers for the wired network interface card to function. Please ensure that the network card driver on your computer is properly installed.



(1) Please ensure that the disturbance interface toolbox is updated to the latest version.

(2) In some cases, it may be necessary to disable Windows firewall or antivirus software.

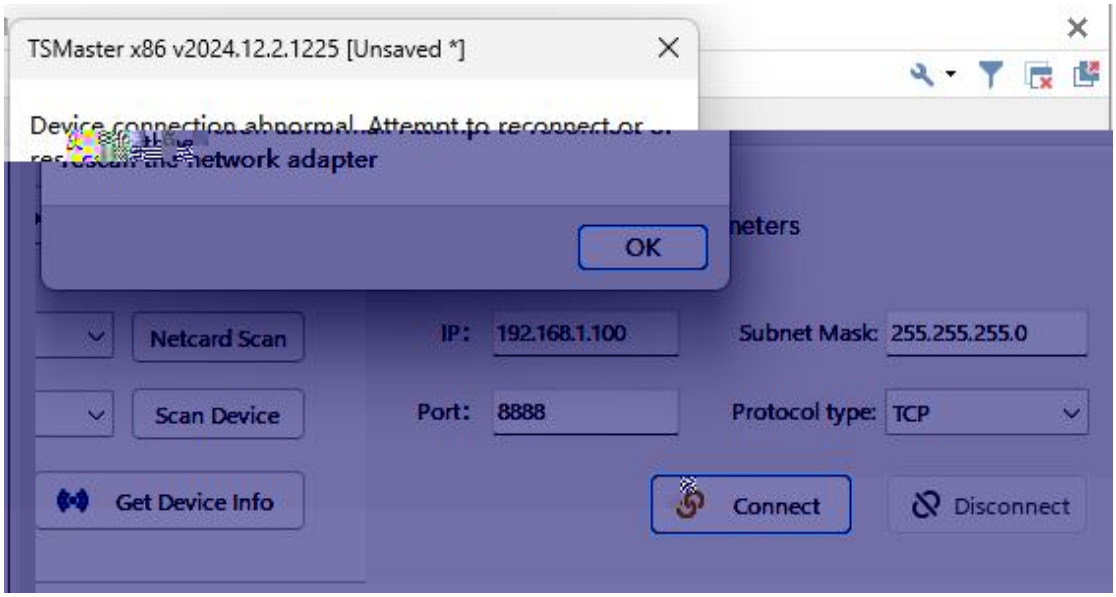
a. Disable the computer's firewall. In some cases, if the firewall cannot be disabled, configure to allow the Windows firewall to accept ICMP type 8 packets by opening cmd as an administrator and running the netsh firewall set icmpsetting 8 command.

b. In some enterprise networks, firewalls may disable the ping function. To use the disturbance interface normally, ensure that the ping function for the gateway is enabled.

(3) If multiple network cards are present on the computer, ensure that the selected network card is the one connected to the disturbance interface.

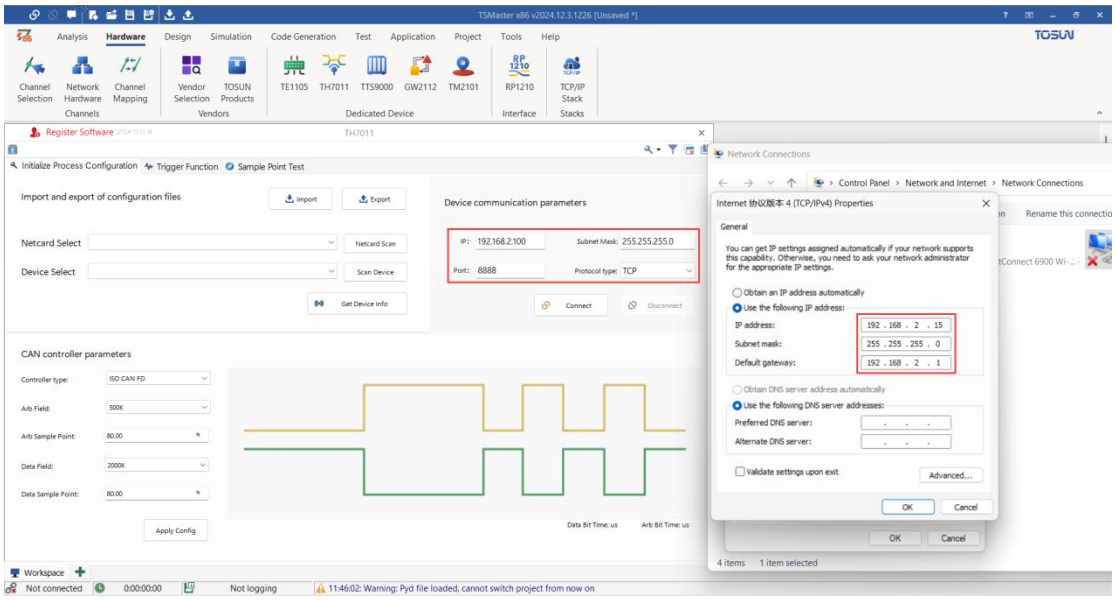
(4) Verify the device wiring by checking whether the Power and Config indicators on the disturbance interface are all lit, and ensure the Ethernet port's indicator light is flashing yellow.

(5) Confirm that the issue is not caused by encryption systems installed on the computer.



(1) Please check if the disturbance interface toolbox is updated to the latest version.

(2) Set the computer to a static IP address and ensure it is in the same subnet as the disturbance interface.



(3) In some cases, you may need to disable the Windows firewall or antivirus software.

(4) Check if the hardware connections are functioning properly.

The main electrical components of TH7011 are semiconductor components. Although the equipment has a long service life, they may also accelerate aging and significantly reduce their service life under an incorrect environment. Therefore, during the use of the equipment, periodic inspection should be carried out to ensure that the use environment maintains the required conditions.

It is recommended to conduct inspections at least once every 6 months to 1 year. Under improper environmental, more frequent inspections should be conducted. As shown in the table below, if you encounter problems during maintenance, please read the following content to find the possible causes of the problem. If the problem still cannot be solved, please contact Shanghai TOSUN Technology Ltd.

Item	Inspection	Standard	Action
Power Supply	Inspect for voltage fluctuations at the power supply end	Power supply port +12V DC	Use a voltage meter to check the power input end. Take necessary actions to keep the voltage fluctuations within

			the acceptable range.
Surrounding Environment	Check the ambient temperature of the surrounding environment. (Including the internal temperature of enclosed environments)	-40 ~+80	Use a thermometer to check the temperature and ensure that the ambient temperature within in the acceptable range.
	Check the ambient humidity. (Including the internal humidity of enclosed environments)	The relative humidity must be within the range of 10% to 90%	Use a hygrometer to check the humidity and ensure that the ambient humidity within the acceptable range.
	Check for the accumulation of dust, powder, salt, and metal shavings	No accumulation	Clean and protect the equipment.
	Check for any contact with water, oil, or chemical sprays on the equipment	No contact	Clean and protect the equipment if necessary.
	Check for the presence of corrosive or flammable gases in the equipment area	No presence	Inspect by the smell, or using a sensor.
	Check for levels of vibration and shock	Vibration and shock are within the acceptable range	Install padding or other shock-absorbing devices if necessary.
	Check for noise sources near the equipment	No significant noise source	Isolate the equipment from noise sources or protect the equipment.
Wiring Installation	Check the crimped connectors in the external wiring	Ensure enough space between the connectors	Visually inspect and adjust if necessary
	Check for damage in the external wiring	No damage	Visually inspect and replace the wiring if necessary.

TOSUN

Engineer Everything !

Software

Support CAN(FD)/LIN/FlexRay/SOME/IP and DoIP

Bus monitoring/Transmiting/Automated testing

TSMASTER

Hardware

1/2/4/8/12-channel CAN FD/CAN to USB/PCIe device

datalogger

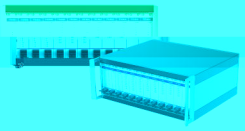
TTS test systems

-CAN FD/CAN

relay and fault injection boards

-Resistors for sensor simulation

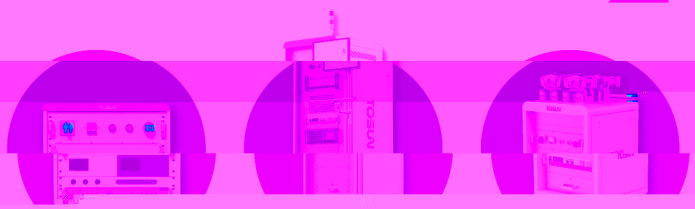
-Digital I/O, Analog I/O boards available



CAN CAN FD

About TOSUN

User-by-Wire Chassis Testing Solutions



International Organization

Quality Assurance

ISO9001:2015

CE Certification

Contact Us :

+86 21-5956 0506

sales@tosunai.com

website :