TOSUN

TH7012 Product Manual

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tosunai.com

Copyright Information

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Why Do We Need Devices with Bus Interference and ISO 16845 Testing Functions?

Conformance testing Conformance testing is a process used to verify whether a component meets relevant standards, ensuring product quality. CAN/LIN conformance testing specifically checks whether a CAN (FD)/LIN node complies with the CAN/LIN communication protocol. In a CAN/LIN network, inconsistent node quality may cause network failures or even complete breakdowns. Therefore, conducting protocol-level testing is essential to ensure the safe and stable operation of the CAN (FD)/LIN network.

The ISO 16845 protocol is a CAN conformance testing standard developed by the International Organization for Standardization (ISO). It is primarily used to verify whether a CAN controller complies with the ISO 11898-1 standard. By defining test cases and parameters, this standard ensures that CAN devices from different manufacturers can interoperate at both the data link and physical layers, and that CAN-related products under development (IUT – Implementation Under Test) meet international standards. This, in turn, enhances overall system performance and reliability.

Our TH7012 CAN (FD)/LIN Bus Interference and ISO 16845 Testing Device is a core product for testing CAN (FD)/LIN bus protocols and verifying whether a CAN IP core in the IUT complies with the ISO 11898-1 standard.

What Can the Devices with Bus Interference and ISO 16845 Testing Functions Do?

- CAN/LIN sampling point testing for the device under test (DUT)
- Sending interference messages on specific bits of the LIN bus
- LIN data frame bit inversion
- Trigger output for LIN frame interference
- Configurable LIN frame length
- Measurement of LIN frame bit timing
- Trigger output for LIN frame interference

- Sending interference messages on specific bits of the CAN (FD) bus
- CAN (FD) data frame bit inversion
- Trigger output for CAN (FD) frame interference
- Testing CAN (FD) Bus-Off behavior
- Testing CAN (FD) bit timing tolerance
- ISO 16845 verification of IUT handling of special identifiers, padding bits, data lengths, and non-symmetric modes
- ISO 16845 verification of IUT handling of bit errors, CRC errors, stuffing errors, and format errors
- ISO 16845 verification of IUT handling of overload frames
- ISO 16845 verification of IUT behavior in passive error states
- ISO 16845 verification of CAN frame bit timing accuracy
- ...

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1. About this User Manual

1.1 Disclaimer

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2.TH7012

2.1 Overview

The TH7012 is a versatile device for CAN (FD) bus interference, LIN bus interference, and ISO 16845 testing. It connects to a PC via an RJ45 Ethernet interface or USB interface, and the driver-free design for Windows ensures broad system compatibility. TH7012 supports three working modes: CAN (FD) interference mode, LIN interference mode, and ISO 16845 testing mode. The following describes each mode in detail.

LIN Interference Mode:

When configured with the PC software in LIN interference mode, TH7012 supports:

- Interfering with specific bits of a LIN frame
- Flipping specific bits of a LIN frame
- Interference count statistics
- Sampling point testing
- Sending incomplete frame headers based on user configuration, where the header can include:
  - Sync break only
  - Sync break + sync field
  - Sync break + sync field + protected ID field
- Configurable data segments and inter-byte intervals in frame responses
- ±14% offset in transmit baud rate
- Bit-time measurement
- Trigger output for LIN frame interference

CAN (FD) Interference Mode:

When configured in CAN (FD) interference mode, TH7012 supports:

- Interfering with specific bits of CAN (FD) frames
- Configurable interference lengths
- Multiple trigger modes, including frame trigger, error trigger, and software trigger
- Bit-timing deviation testing
- Bus-off behavior testing
- Sampling point testing

ISO 16845 Testing Mode:

When configured in ISO 16845 testing mode, TH7012 can verify the IUT's (Implementation Under Test) handling of:

- Standard frames, extended frames, CAN FD frames, and CAN FD extended frames with various identifiers and lengths
- Error handling, including bit errors, CRC errors, stuffing errors, format errors, and overload frames
- Behavior in active and passive error states

TH7012 is designed for CAN (FD)/LIN protocol testing, ensuring that nodes comply with communication protocol specifications and guaranteeing safe and reliable network operation. It can also be used to verify whether the IUT's CAN IP core complies with the ISO-11898-1 CAN communication protocol standard.

2.2 Features

- ✓ Interference of specific bits in LIN frames
- ✓ LIN interference count statistics
- ✓ Full-bit interference, dominant/recessive bit inversion in LIN frames
- ✓ Configurable LIN frame interference pulse width
- ✓ CAN (FD)/LIN sampling point testing
- ✓ Configurable LIN frame headers
- ✓ ±14% LIN transmit baud rate offset
- ✓ Measurement of LIN frame time slots
- ✓ Trigger output for LIN interference
- ✓ Interference of specific bits in CAN (FD) frames
- ✓ Custom CAN (FD) interference sequences or message sequences (up to 65,536 points)
- ✓ CAN (FD) interference count statistics
- ✓ Full-bit interference, dominant/recessive bit inversion in CAN (FD) frames

- ✓ CAN (FD) interference sequence configuration and transmission
- ✓ Configurable CAN (FD) frame interference pulse width
- ✓ CAN (FD) bus bit-timing tolerance testing
- ✓ CAN (FD) bus-off behavior testing
- ✓ ISO 16845 verification of IUT response to special identifiers and frame lengths
- ✓ ISO 16845 verification of IUT handling of CAN standard frames
- ✓ ISO 16845 verification of IUT handling of CAN extended frames
- ✓ ISO 16845 verification of IUT handling of CAN FD frames
- ✓ ISO 16845 verification of IUT handling of CAN FD extended frames
- ✓ ISO 16845 verification of IUT response to bit errors
- ✓ ISO 16845 verification of IUT response to stuffing errors
- ✓ ISO 16845 verification of IUT response to format errors
- ✓ ISO 16845 verification of IUT response to CRC errors
- ✓ ISO 16845 verification of CAN frame bit-timing accuracy
- ✓ ISO 16845 verification of IUT handling of overload frames
- ✓ ISO 16845 verification of IUT response to non-nominal bit rates and error counter detection

2.3 Technical Data

Channel	1* LIN 1* CAN (FD) 1* UART
PC Interface	USB 2.0 RJ45 Ethernet
Driver	Driver-free for Windows
Power Supply	USB-powered or external DC input (9-36V)
Power Consumption	3W

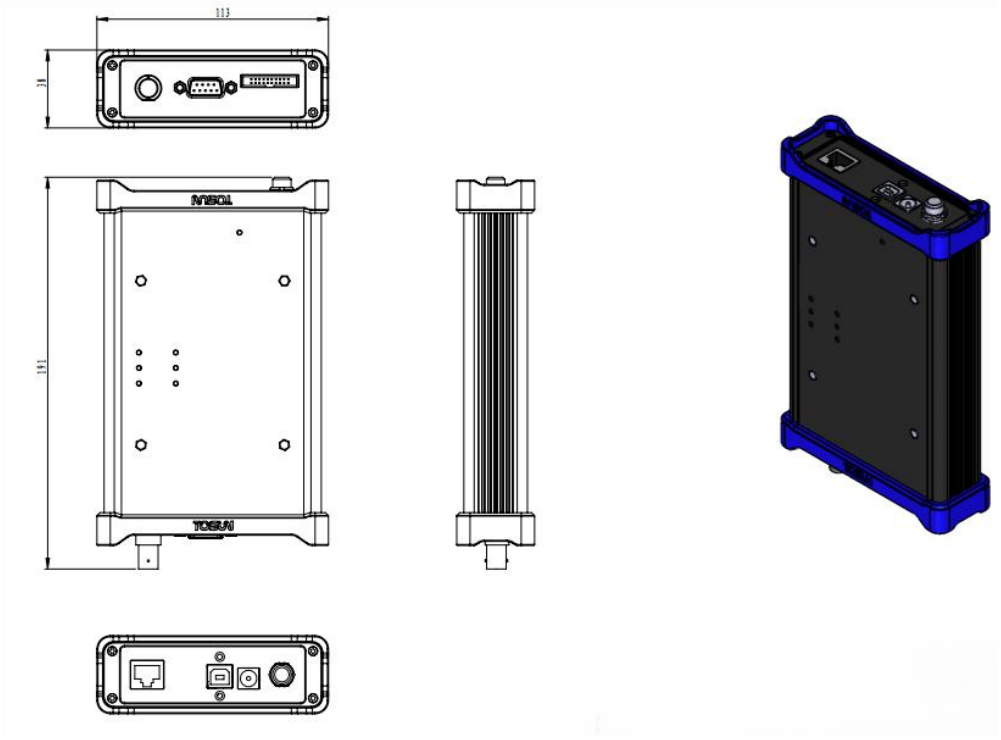
Enclosure Material	Metal enclosures
Dimensions	Approx. 191*118*38mm
Weight	Approx. 420g (without packaging)/775g (with packaging)
Operating Temp.	-40℃~80℃
Operating Humidity	10% ～ 90% RH (non-condensing)
Environment	Avoid corrosive gases

2.4 Electrical Data

Parameter		Test Conditions	Min	Typical	Max	Unit
Operating Voltage	USB power	LIN Tx/Rx	--	5	--	V
	External DC power	LIN Tx/Rx	9	12	36	V
Operating Current	USB power	LIN Tx/Rx	--	0.15	--	A
	External DC power	LIN Tx/Rx	--	0.25	--	A
Power Consumption	External DC power	LIN Tx/Rx	--	3	--	W
LIN Interface	Bus pin voltage tolerance	LIN-to-GND voltage	0	--	40	V
	Isolation voltage	Leakage ＜ 1mA	0	--	2500	VDC
CAN Interface	Bus pin voltage tolerance	CANH, CAHL	-58	--	+58	V
	Isolation voltage	Leakage ＜ 1mA	0	--	2500	VDC

UART Interface	Bus pin voltage tolerance	CANH, CAHL	0	--	5	V
	Isolation voltage	Leakage ＜ 1mA	0	--	2500	VDC

2.5 Mechanical Dimensions



2.6 Packing List

✓ Main device: TH7012

✓ USB cable

✓ Category 6 Gigabit Ethernet cable

✓ 12V 2A power adapter

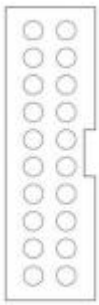
2.7 Hardware Interface

- SYNC Interface
- DC Power Input
- USB 2.0 Port

- RJ45 Ethernet Port
- Trigger Output
- DB9 Connector Pins:

DB9 Pin	PIN Number	Definition
CAN FD/LIN	PIN2	CAN_L
	PIN3	GND
	PIN7	CAN_H
	PIN8	LIN

- 20-Pin I/O interface:

I/O Pin	PIN Number	Definition	PIN Number	Definition
	PIN1	TXD/16845-CAN-TXD	PIN2	AIAO0
	PIN3	RXD/16845-CAN-RXD	PIN4	AIAO1
	PIN5	GND	PIN6	AIAO2
	PIN7	DI1/16845-UART_RX	PIN8	AIAO3
	PIN9	DI2	PIN10	AIAO4
	PIN11	DI3	PIN12	AIAO5
	PIN13	GND	PIN14	GND
	PIN15	DO1/16845-UART_TX	PIN16	GND
	PIN17	DO2	PIN18	VCC_5V
	PIN19	DO3	PIN20	VCC_5V

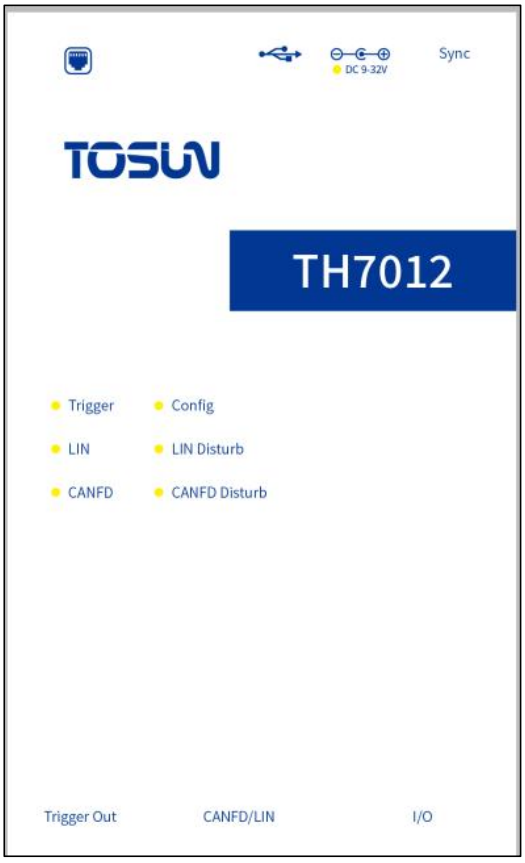
In ISO 16845 testing mode, PIN1 and PIN3 serve as CAN interfaces, while PIN7 and PIN15 serve as UART interfaces. Specifically:

The CAN interface is used for consistency testing.

The UART interface is used for the TH7012 to verify whether the data sent by the IUT is correct and to send configuration information to the IUT.

2.8 LED Indicators

Diagram of LED indicator:



Description of indicator:

Indicator	**Definition**
Trigger	Trigger indicator: lights up when an interference trigger is set and executed
Config	Configuration indicator: lights up after configuration is completed

LIN	LIN indicator: lights up when the device is initialized in LIN mode
CAN FD	CAN (FD) indicator: lights up when the device is initialized in CAN (FD) mode
LIN Disturb	LIN interference indicator: lights up during LIN interference
CAN FD Disturb	CAN (FD) interference indicator: lights up during CAN (FD) interference

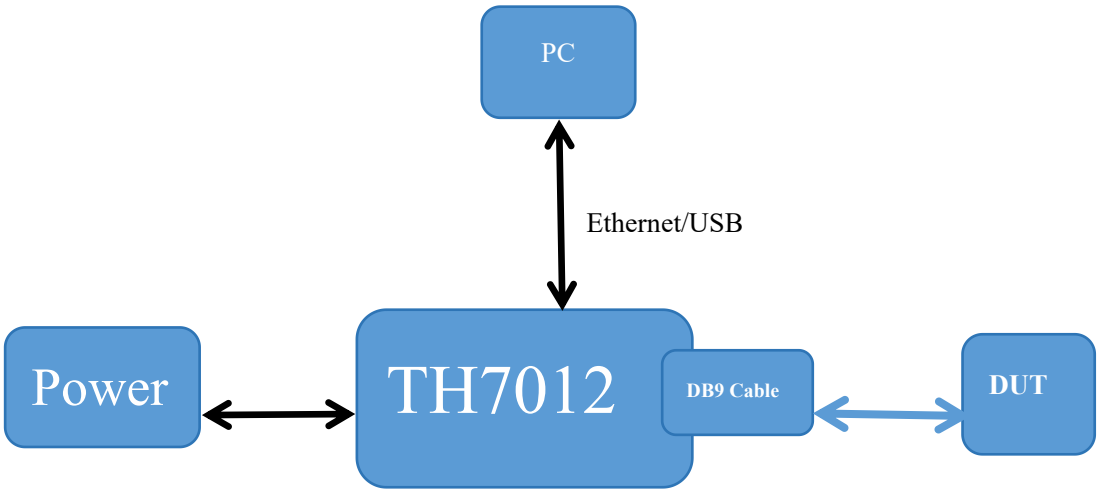
2.9 Optional Accessories

NA

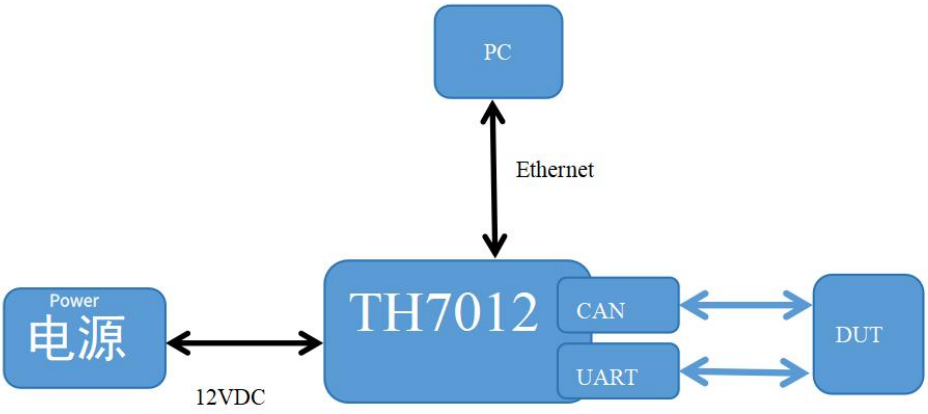
3. Quick Start

3.1 System Connections

In CAN (FD)/LIN functional mode, the TH7012 connects to the PC via Ethernet (RJ45) or USB, while the DUT's CAN (FD)/LIN interface connects to the TH7012 using a DB9 cable. On the PC side, users can operate the TH7012 through the host software to perform sampling point tests, interference, and bit flipping.



In ISO 16845 functional mode, the TH7012 connects to the PC via Ethernet (RJ45). The DUT's UART interface and CAN interface connect to the TH7012 using a 20-pin cable. Similarly, the device is controlled from the PC via the host software to carry out CAN conformance testing.



3.2 Driver Installation

All hardware is designed with a driver-free architecture, ensuring excellent system compatibility. No additional driver installation is required across various operation systems, including Windows7/8/10/11 and Linux.

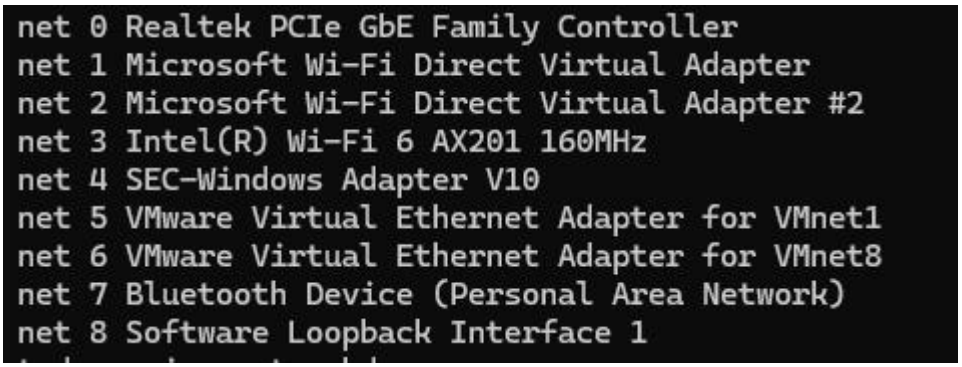
3.3 Function Configuration

In LIN mode, TOSUN provides the DLL (Dynamic Link Library), header files, and the usage guide to control the TH7012 device from the PC, as documented in "TH7012_TSDEV_code_description. pdf". In CAN (FD) mode, the corresponding resources are available in "TH7011_TSDEV_code_description. pdf". In ISO 16845 mode, the corresponding resources is documented in "16845_TSDEV_code_description.pdf".

3.3.1 Device Connection

The following steps describe how to connect to the TH7012 from a PC:

1. Based on the provided DLL and header files, the PC uses the host application to establish an Ethernet connection with the device. Use tsdev_api_get_netif_cnt(&cnt) to obtain the number of network interfaces on the PC. Then, iterate with tsdev_api_get_netif_name(i, &netif_name) to get the name of each network interface and print them out.



As shown in the figure, there are 8 network interfaces. Physically, interface 0 is connected to TH7012, so interface 0 is selected.

2. Ensure that the PC and TH7012 are on the same subnet but not using the same IP address (default IP: 192.168.1.10). Use tsdev_api_get_netif_connect_status(0, &sta) to establish the connection.

3. Create a handle using tsdev_api_create(&ctx, &handle_p, NULL). This handle will be used throughout the testing process. Set ctx.com_par.eth.netif_name to the selected network interface.

4. Call tsdev_api_scan(handle_p, &cnt, 500, 0) to scan for online TOSUN devices. A return value of cnt > 0 indicates that devices are found.

5. Call tsdev_api_get_info(handle_p, 0, &info) to retrieve information on the first detected device.

6. Call tsdev_api_open(handle_p, info.uid, NULL, 10000) to open the connection to the device.

After these steps, the PC is successfully connected to the TH7012.

3.3.2 Mode Selection

Use the tsdev_api_disturb_dev_get_mod function to retrieve the current operating mode, and determine whether a mode change is required.

- 0: CAN (FD) mode
- 1: LIN mode
- 2: ISO 16845 test mode

Use the tsdev_api_disturb_dev_set_mod(handle_p, &dev_mod) function to set the current operating mode.

- dev_mod = 0: CAN (FD) mode
- dev_mod = 1: LIN mode
- dev_mod = 2: ISO 16845 test mode

Note: A power cycle is required for the new mode to take effect.

3.3.3 LIN Interference Mode

3.3.3.1 LIN Interference Function

TH7012 supports the following three LIN interference modes:

1. Forced Dominant - Forces the LIN bus into the dominant (low) state.

2. Forced Recessive - Forces the LIN bus into the recessive (high) state.

3. Bit Inversion - Inverts a bit from dominant to recessive or vice versa. (Note: Bit inversion mode is not supported in receive mode.)

Users can configure which field of the LIN frame to inject interference into (e.g., sync break, sync field, etc.), as well as the target bit, interference length, and repeat count.

Using the provided DLL and header files, interference can be controlled from the PC as follows:

1. Use tsdev_api_th7012_lin_disturb_ctrl(handle_p, 0) to disable interference.
2. Use tsdev_api_th7012_lin_basic_config to configure the baud rate.
3. Use tsdev_api_th7012_lin_mode_config to set the LIN operation mode.
4. Use tsdev_api_th7012_lin_disturb_config to configure: target frame field, bit position, dominant or recessive mode, interference length, number of repetitions
5. Use tsdev_api_th7012_lin_disturb_ctrl(handle_p, 1) to enable interference.

At this point, the configuration of interference function is complete.

Bit Inversion requires a slightly different procedure:

1. Steps 1 - 3 are the same as above.
2. Use tsdev_api_th7012_lin_invert_config to configure the inversion domain and bit location.

To query actual interference execution count, call tsdev_api_th7012_read_word.

3.3.3.2 LIN Sampling Point Measurement

The sampling point test in LIN mode operates as follows:

The TH7012 is configured as master receiver mode, while the DUT (ECU) is set to slave transmitter mode and properly deployed. The TH7012 sends the frame header and receives the normal response frame from the DUT. During the DUT's transmission, the TH7012 introduces disturbances into the response frame until an error occurs on the bus. The bit position at which the error occurs is identified as the DUT's sampling point.

The TH7012 can be controlled through the PC software in combination with the provided DLL and header files, enabling the sampling point test function for the DUT.

Usage procedure (PC software interface):

1. Call tsdev_api_th7012_lin_basic_config to configure the LIN bit rate.
2. Call tsdev_api_th7012_lin_mode_config to configure the LIN frame operating mode.
3. Call tsdev_api_th7012_lin_sample_point_test to obtain the sampling point test results.

Once these steps are completed, the sampling point test configuration is finished.

3.3.4 CAN Interference Mode

3.3.4.1 CAN Interference Function

The CAN interference function provides three modes:

1. Forced Dominant - Forces the CAN bus into the dominant (low) state.

2. Forced Recessive - Forces the CAN bus into the recessive (high) state.

3. Bit Inversion - Inverts a bit from dominant to recessive or vice versa.

Users can configure the disturbed CAN (FD) frame field (e.g., arbitration field, data field, etc.), the target bit, interference length, and repeat count.

Usage procedure (PC software interface):

1. Call tsdev_api_th7011_init to configure the TH7012 bit rate and sampling point.

2. Call tsdev_api_th7011_disturb_config_trans to configure disturbance parameters, including repeat count, target field (arbitration/data, etc.), disturbance position, disturbance polarity, and disturbance sequence length.

3. Call tsdev_api_th7011_stop to terminate the disturbance process.

Optionally, call tsdev_api_th7011_query to check the actual disturbance count against the configured value.

3.3.4.2 CAN Sampling Point Measurement

The sampling point test in CAN (FD) mode is based on the following principle:

By introducing disturbances at or near a specified bit position, the system monitors whether the CAN frame produces an error frame. If an error frame occurs, the disturbed position is identified as the sampling point.

Usage procedure:

1. Call tsdev_api_th7011_init to configure the TH7012 bit rate and sampling point.

2. Call tsdev_api_tsdev_sample_point_test(handle_p, &Sample_Point, &sample_point_result) to obtain the sampling test results. The results include both arbitration field and data field sampling points.

3.3.5 ISO 16845 Test Mode

In ISO 16845 test mode, the TH7012 supports standardized compliance test procedures.

Usage procedure:

1. Configure the frame data and test parameters, including frame type, bit rate, test case ID, and timeout. This is done through the th7011_16845_test_case_frame_data structure.

2. Call tsdev_api_th7011_16845_test_start to send the configuration to the device and start the test.

3. Call tsdev_api_th7011_16845_test_get_result to query the test result.

These three steps form the complete workflow for a single test case. Users can either iterate through all test cases or select specific ones to verify whether the DUT's CAN IP core complies with the standard.

4. Inspection and Maintenance

The TH7012 primarily contains semiconductor components, which typically have a long service life. However, adverse environmental conditions may accelerate aging and degrade performance. To ensure proper operation, regular inspections are recommended to maintain the required environmental conditions.

It is recommended to inspect the device at least once every 6 to 12 months. In harsher environments, inspections should be performed more frequently. Refer to the table below for inspection criteria and recommended actions. If issues persist, please contact Shanghai TOSUN Technology Ltd.

Item	Inspection	Standard	Action
Power Supply	Check voltage fluctuation at power input	+12V DC at power port	Use a voltmeter to verify input voltage. Take corrective actions if out of range.
Ambient Conditions	Check ambient temperature (including internal temperature within enclosures)	-40℃~+80℃	Use a thermometer to ensure temperature is within specified range.
	Check the ambient humidity. (Including internal humidity within enclosures)	10% – 90% RH, non-condensing	Use a hygrometer to ensure humidity is within specified range.
	Check for accumulation of dust, powder, salt, and metal debris	No accumulation	Clean the device and prevent future contamination.
	Check for exposure to water, oil, or chemicals	No exposure	Clean the device and improve environment protection.
	Check for corrosive or	No presence	Use sensors or smell

	flammable gases		detection to verify.
	Check for vibration and mechanical shock	Within allowable limits	Install padding or vibration isolation measures if necessary.
	Check for noise sources near the device	No significant noise sources nearby	Isolate or shield the device from noise sources.
Installation & Wiring	Check crimped connectors in external wiring	Adequate clearance between connectors	Visually inspect and adjust as needed.
	Check for damage to external wiring	No visible damage	Visually inspect and replace damaged cables if necessary.

TOSUN

Engineer Everything !

Software

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

UDS diagnostics/ECU flashing/CCP/XCP calibration

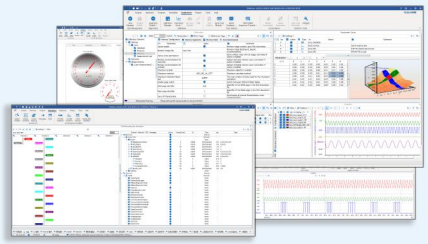
Embedded code generation/Application builder

Encrypted release/Logging and bus replay

Graphical programming/Residual bus simulation

C and Python scripting

Bus monitoring/Transmiting/Automated testing



TSMASTER

Hardware

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

1/2/6-channel LIN to USB/PCIe device

Multi channel FlexRay/CAN FD to USB/PCIe device

Multi channel automotive Ethernet/CAN FD to USB/PCIe device

Automotive Ethernet media conversion device (T1 to Tx)

Multi-channel CAN FD/Ethernet/LIN datalogger

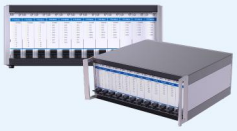
TTS test systems

-CAN FD/CAN/FlexRay/LIN communication boards

-Relay and fault injection boards

-Resistors for sensor simulation

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



CAN CAN FD LIN FlexRay OPEN ALLIANCE

Solutions

- Bus Conformance
- Network Automation Testing System
- Charging Testing System
- EMB Calibration Testing Equipment
- Information Security Solutions
- Steer-by-Wire Chassis Testing Solutions
- EOL Testing Equipment
- Motor Performance
- Durability Testing Solutions
- FCT

About TOSUN

The core product, TSMaster, is a comprehensive tool for automotive R&D, testing, production, and after-sales. It integrates essential functions with hardware support to streamline processes and ensure precision, making it ideal for automotive professionals.

International Organization

ASAM CiA

Quality Assurance

ISO9001:2015

CE Certification

CE

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