TOSUN

TC4016 Product Manual

Version： V1.0 | English

tosunai.com

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.

Why Are SENT and PSI5-Based ECU Simulation Nodes Needed?

As automotive electronic systems continue to evolve rapidly, efficient communication between sensors and ECUs has become critical to ensuring system performance and reliability. SENT (Single Edge Nibble Transmission) and PSI5 (Peripheral Sensor Interface 5), as next-generation sensor interface protocols, are increasingly adopted in the automotive industry due to their high accuracy, fast transmission rates, and strong noise immunity.

However, during R&D and testing phases, how to efficiently validate communication between ECUs and sensors has emerged as a key challenge.

SENT and PSI5-based ECU simulation nodes, such as the TC4016, are designed precisely to address this need. These nodes can simulate real sensor environments, allowing developers to rapidly validate ECU behavior, thereby shortening development cycles and improving product quality.

What Can SENT and PSI5-Based ECU Simulation Devices Do?

- Support for CAN/CAN FD networks at various baud rates
- Support for digital/analog input and output (DIDO, AIAO)
- Compatibility with SENT and PSI5 interfaces, capable of receiving data from various types of SENT and PSI5 sensors
- Support for multi-device hardware time synchronization
- ...

Contents

1. About this User Manual

1.1 Disclaimer

The information provided in this document is for reference only and does not constitute any form of guarantee or commitment by TOSUN. TOSUN Technology reserves the right to modify the contents and data 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 appreciate any error reports or suggestions for improvement, as they help us deliver more efficient products in the future.

1.2 Copyright

All rights to this document and its contents are reserved by TOSUN Technology. No part of this document may be reproduced, distributed, transmitted, disseminated, republished, or otherwise used in any form or by any means without the explicit prior written permission of TOSUN Technology.

3.TC4016

3.1 Overview

The TC4016 is an ECU (Electronic Control Unit) simulation node based on SENT (Single Edge Nibble Transmission) and PSI5 (Peripheral Sensor Interface 5) protocols. It is capable of receiving sensor data from a wide range of devices with SENT and PSI5 interfaces.

The TC4016 integrates 2 channels of CAN/CAN FD, 4 channels of Digital Input/Output (DIDO), and 3 channels of Analog Input/Output (AIAO).

Connected to a PC via Ethernet, the TC4016 enables real-time monitoring, analysis, and simulation of SENT, PSI5, and CAN/CAN FD bus data. It provides a reliable data environment for R&D and testing personnel, significantly accelerating the development cycle.

The TC4016 supports secondary development through APIs available for both Windows and Linux platforms. It is compatible with various development environments such as C++, C#, LabVIEW, and Python, enabling seamless integration into a wide range of test systems with high efficiency and usability.

3.2 Features

- ✓ Hardware-based message timestamping with microsecond-level accuracy, meeting advanced timing requirements
- ✓ Driver-free design for Windows, ensuring excellent compatibility
- ✓ 20 SENT channels, with the first 10 channels supporting SPC mode
- ✓ 16 PSI5 channels
- ✓ 2 CAN/CAN FD channels
- ✓ Supports 4 Digital I/O (DIDO) and 3 Analog I/O (AIAO) channels
- ✓ Configurable CAN bit rate from 125Kbps to 1Mbps; CAN FD supports up to 8Mbps
- ✓ Software-configurable 120Ω termination resistors for CAN channels
- ✓ Self-ACK (Self-Acknowledgment) support for CAN communication
- ✓ Hardware time synchronization across multiple devices
- ✓ Example project and API interfaces provided, simplifying secondary development

3.3 Technical Data

Channel	2* CAN/CAN FD 4* DIDO 3* AIAO 20* SENT (the first 10 channels supporting SPC mode)

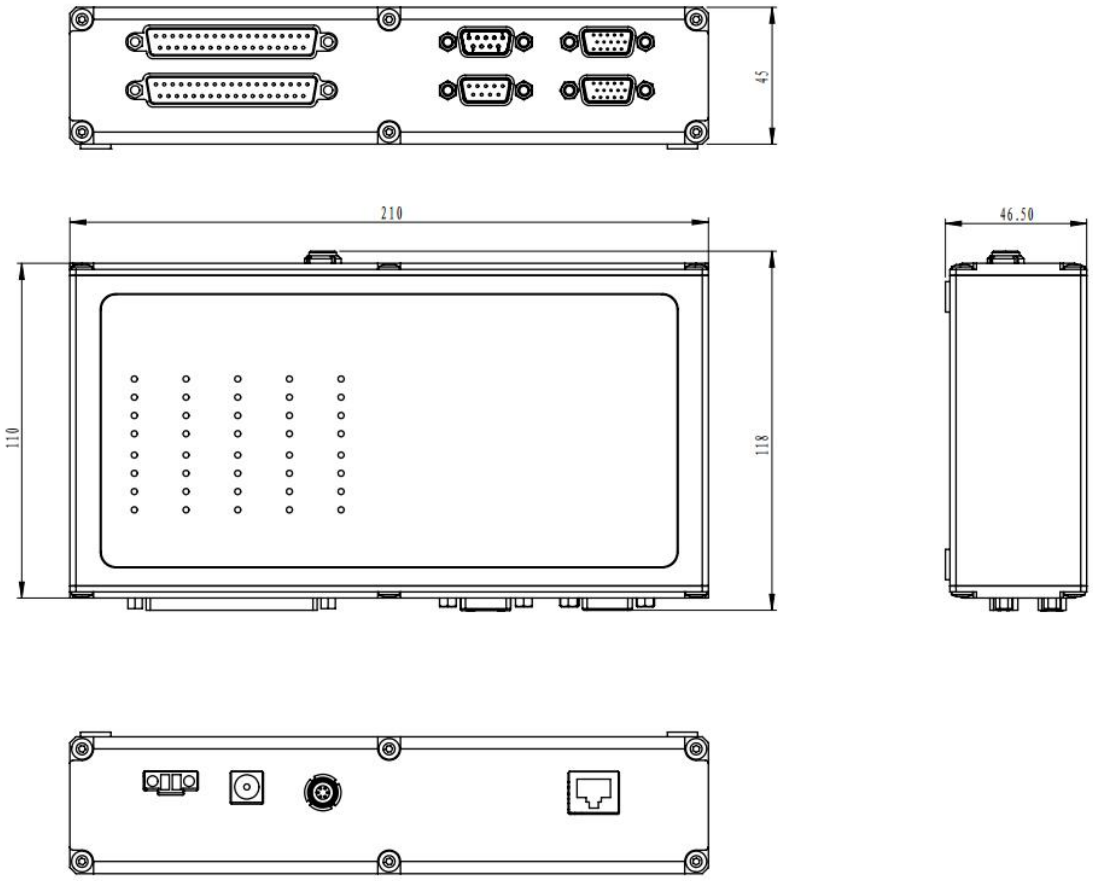
	16* PSI5
PC Interface	Gigabit Ethernet
Driver	Driver-free for Windows
Software	TSMaster
Termination	120Ω software-configurable termination resistors
Timestamp	1μs hardware-level timestamp accuracy
Max. Tx Frame Rate*	Up to 20,000 frames per second
Max. Rx Frame Rate*	Up to 20,000 frames per second
Isolation (CAN)	CAN channels support DC 2500V galvanic isolation; ESD protection compliant with ±8 kV contact discharge, ±15 kV air discharge.
DIDO	Digital Input (DI) voltage range: 0 - 39.5 V DI threshold adjustable via built-in hysteresis comparator and configurable Vref (0 - 3.28 V). DI Threshold Calculations: - High-level threshold (VAH): (330 + 499 × Vref) / 1098 - Low-level threshold (VAL): 0.455 × Vref Digital Output (DO) levels: Low = 0 V, High = 5 V or 12 V (DO does not support direct load driving)
AIAO	Analog Input (AI) voltage range: 0 - 39.5 V Analog Output (AO) voltage range: 0 - 29.5 V (AO does not support direct load driving)
SENT	Idle polarity: High Tick time range: 3 - 50 μs Nibble count: 0 - 8 Data types supported: Fast Channel and Slow Channel
PSI5	Channel modes: Synchronous / Asynchronous Bus sustaining voltage: 5.15 V / 6.65 V / 7.70 V Comparator threshold current: 13 mA / 26 mA Baud rates: 125 kbps / 189 kbps Max. slot length: 33 bits Slot time range: 0 - 480 μs Checksum types: Parity / CRC
Power Supply	DC 9-32V
Power Consumption	5W (without external sensor connection)
Enclosure Material	Aluminum alloy enclosure
Dimensions	Approx. 110*70*36mm
Weight	Approx. 150g (without packaging)/368g (with packaging and accessories)
Operating Temp.	-40°C~80°C
Operating	10% ～ 90% RH (non-condensing)

Humidity	
Environment	Avoid corrosive gases

3.4 Electrical Data

Parameter		Test Conditions	Min	Typical	Max	Unit
Operating Voltage	DC input	All CAN channels transmitting at full load; all SENT & PSI5 channels enabled	9	12	32	V
Operating Current	DC input	All CAN channels transmitting at full load; all SENT & PSI5 channels enabled	--	0.4	--	A
Power Consumption	DC input	All CAN channels transmitting at full load; all SENT & PSI5 channels enabled	--	5	--	W
CAN /CAN FD Interface	Bus pin voltage tolerance	CANH, CAHL	-58	--	+58	V
	Isolation voltage	Leakage ＜ 1mA	2500	--	--	VDC

3.5 Mechanical Dimensions



3.6 Packing List

✓ Main device: TC4016

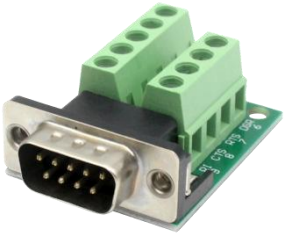
✓ 12V 2A power adapter

✓ Category 6 Gigabit Ethernet cable

✓ Time Sync box harness

✓ DB9 female to dual male signal cable

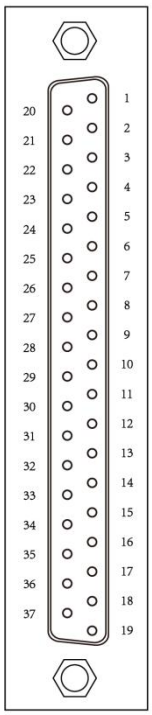
✓ DB9 male connector



✓ Custom harness - SENT/PSI5 (Pending details)

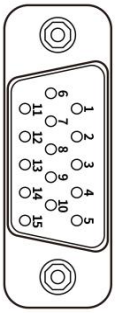
3.7 Hardware Interface

- 1000Base-T Ethernet (RJ45)
- Time synchronization interface
- Power input (circular adapter)
- Power input (phoenix terminal)
- DB37 male * 2 (SENT)

DB37 Pin	Channel	PIN Number	Definition	PIN Number	Definition	PIN Number	Definition
	SENT 1-10	PIN1	SENT1	PIN2	GND	PIN3	VCC_5V
		PIN4	SENT3	PIN5	GND	PIN6	VCC_5V
		PIN7	SENT5	PIN8	GND	PIN9	VCC_5V
		PIN10	SENT7	PIN11	GND	PIN12	VCC_5V
		PIN13	SENT9	PIN14	GND	PIN15	VCC_5V
		PIN16	NULL	PIN17	NULL	PIN18	NULL
		PIN19	NULL	PIN20	VCC_5V	PIN21	SENT2
		PIN22	GND	PIN23	VCC_5V	PIN24	SENT4
		PIN25	GND	PIN26	VCC_5V	PIN27	SENT6
		PIN28	GND	PIN29	VCC_5V	PIN30	SENT8
		PIN31	GND	PIN32	VCC_5	PIN33	SENT10

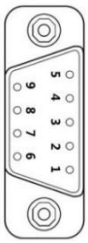
					V		
		PIN34	GND	PIN35	NULL	PIN36	NULL
		PIN37	NULL				
	Channel	**PIN Number**	**Definition**	**PIN Number**	**Definitio n**	**PIN Number**	**Definition**
	SENT 11-20	PIN1	SENT11	PIN2	GND	PIN3	VCC_5V
		PIN4	SENT13	PIN5	GND	PIN6	VCC_5V
		PIN7	SENT15	PIN8	GND	PIN9	VCC_5V
		PIN10	SENT17	PIN11	GND	PIN12	VCC_5V
		PIN13	SENT19	PIN14	GND	PIN15	VCC_5V
		PIN16	NULL	PIN17	NULL	PIN18	NULL
		PIN19	NULL	PIN20	VCC_5 V	PIN21	SENT12
		PIN22	GND	PIN23	VCC_5 V	PIN24	SENT14
		PIN25	GND	PIN26	VCC_5 V	PIN27	SENT16
		PIN28	GND	PIN29	VCC_5 V	PIN30	SENT18
		PIN31	GND	PIN32	VCC_5 V	PIN33	SENT20
		PIN34	GND	PIN35	NULL	PIN36	NULL
		PIN37	NULL				

- DB15 male * 2 (PSI5):

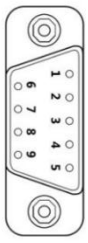
DB15 Pin	**Channel**	**PIN Number**	**Definition**	**PIN Number**	**Definition**	**PIN Number**	**Definition**
	PSI5 1-8	PIN1	PSI5_1	PIN2	DGND	PIN3	DGND
		PIN4	DGND	PIN5	PSI5_5	PIN6	PSI5_2
		PIN7	DGND	PIN8	DGND	PIN9	DGND
		PIN10	PSI5_6	PIN11	PSI5_3	PIN12	PSI5_4
		PIN13	DGND	PIN14	PSI5_8	PIN15	PSI5_7
	Channel	**PIN Number**	**Definition**	**PIN Number**	**Definition**	**PIN Number**	**Definition**
	PSI5	PIN1	PSI5_9	PIN2	DGND	PIN3	DGND

	9-16	PIN4	DGND	PIN5	PSI5_13	PIN6	PSI5_10
		PIN7	DGND	PIN8	DGND	PIN9	DGND
		PIN10	PSI5_14	PIN11	PSI5_11	PIN12	PSI5_12
		PIN13	DGND	PIN14	PSI5_15	PIN15	PSI5_16

- DB9 female interface (I/O):

DB9 Pin	Channel	PIN Number	Definition
	I/O	PIN1	DIDO1
		PIN2	DIDO3
		PIN3	DGND
		PIN4	AIAO1
		PIN5	AIAO3
		PIN6	DIDO2
		PIN7	DIDO4
		PIN8	AGND
		PIN9	AIAO2

- DB9 male interface (CAN/CAN FD)：

DB9 Pin	Channel	PIN Number	Definition
	CANFD 1/2	PIN2	CAN 1_L
		PIN3	DGND
		PIN4	CAN 2_L
		PIN5	Shield
		PIN7	CAN 1_H
		PIN8	CAN 2_H

3.8 LED Indicators

Diagram of LED indicator:

Description of indicator:

Indicator	**Definition**
Power	Indicator for power
Link	Indicator for connection
CANFD 1-2	Indicator for CANFD channels
PSI5 1-16	Indicator for PSI5 channels
SENT 1-20	Indicator for SENT channel

Description of LED color/status:

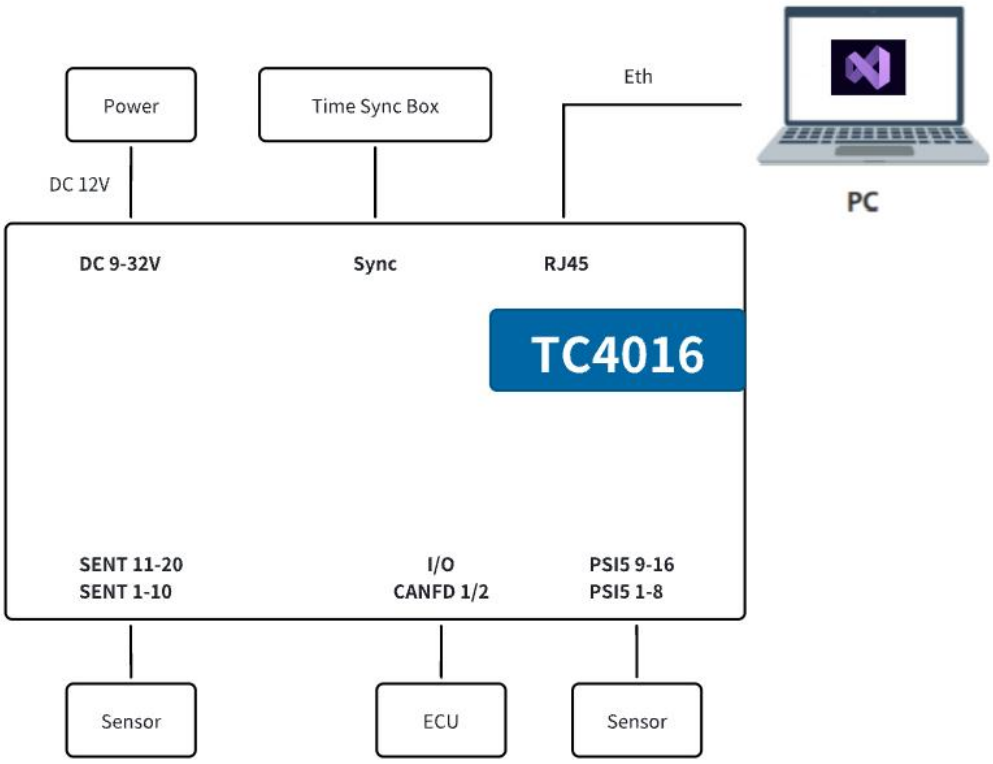
Color	**Description**
Power: Green	Power supply normal
Link: Green	Hardware connection established
CAN FD 1-2: Green/Red	CAN FD channel transmitting or receiving data correctly/CAN FD channel error
PSI5 1-16: Green/Red	PSI5 channel transmitting or receiving data correctly/CAN FD channel error
SENT 1-20: Green/Red	SENT channel transmitting or receiving data correctly/CAN FD channel error

3.9 Optional Accessories

N/A

4. Quick Start

4.1 System Connections



The TC4016 device can be powered via either the DC 12V power adapter interface or the Phoenix terminal block. Connect the RJ45 Ethernet interface of the device to a PC. Depending on application requirements, users can connect corresponding interfaces — SENT, CAN/CAN FD, DIDO, AIAO, and PSI5 — to sensors or ECUs. Once connected, the TC4016 can be controlled directly from the PC.

4.2 Driver Installation

All TOSUN hardware adopts a driver-free design, ensuring excellent system compatibility. No additional driver installation is required—devices can be used directly across various operating

systems including Windows 7/8/10/11 and Linux.

4.3 TC4016 Device Integration with Host Software

Please refer to the TC4016 example projects for detailed integration.

4.3.1 Device Usage Workflow

1. Initialize the device context.
2. Create a library handle.
3. Obtain device information and open the device.
4. Perform device operations:
    (1) IO operations;
    (2) CAN operations;
    (3) SENT operations;
    (4) PSI5 operations;
5. Close the device handle.

4.3.2 IO Operations

1. Register the callback function.
2. Set the field cmd in the tsdev_dev_io_cmd_resp.cmd0_resp0 structure to tsdev_dev_dido_set_glb_par for receiving status reports.
3. Configure structure parameters and send configuration requests.
4. Perform specific operations by sending operational commands, including:
    (1) Setting high level to 12V or 5V;
    (2) Bridging mode: DIDO channels 1 & 2 form one group; channels 3 & 4 form another. In each group, if any one channel outputs high, both channels output high;
    (3) DI acquisition, DIDO output and readback;
    (4) AI acquisition, AIAO output and readback.

4.3.3 CAN Operations

1. Register the callback function.
2. Configure structure parameters such as baud rate, termination resistance, etc., and send the configuration request.
3. Perform actions like transmitting CAN/CAN FD messages by sending operational commands.

4.3.4 SENT Operations

1. Register the callback function.
2. Configure structure parameters and send the configuration request.
3. Monitor SENT data via the callback function.

4.3.5 PSI5 Operations

1. Register the callback function.
2. Configure structure parameters and send the configuration request.
3. Monitor PSI5 data via the callback function.

4.4 Usage Examples

4.4.1 CAN Communication Example

1. After powering on the device, connect the CAN/CAN FD pins of the TC4016 to other CAN/CAN FD devices.

2. Configure the CAN/CAN FD settings. The TC4016 will transmit and receive CAN/CAN FD data and report it to the PC via Ethernet.

3. Configure communication parameters for both ends of the CAN/CAN FD channel, for example:

120 Ω termination resistor: Enabled

Arbitration phase baud rate (Kbps): 500

Data phase baud rate (Kbps): 2000

Controller mode: Normal mode

4. Once configured, all nodes on the CAN bus can communicate with the TC4016.

5. The transmitted and received data can be accessed using the corresponding API, as shown in the figure below:

4.4.2 IO Example

After powering on the device, connect the CAN/CAN FD pins of the TC4016 to other

CAN/CAN FD devices.

Configure the parameters of the IO interface, such as:

DIDO channel mode: Write;

DIDO hysteresis comparator threshold: 200 mV;

DIDO channel acquisition mode: Read

3. Through the DB9 male connector, an external power supply can be connected to the TC4016 IO channels, and the acquisition values can be retrieved, as illustrated:

The decimal data is converted into binary, where a bit value of 1/0 indicates a high/low level detected on the corresponding channel.

4.4.3 SENT Communication Example

1. After powering on the device, connect the SENT sensor to the corresponding pins.

2. Configure the SENT channel. Once data is received from the sensor, TC4016 will report it to the PC via Ethernet.

3. Use the TOOMOSS SENT tool to simulate a sensor and send data to the TC4016.

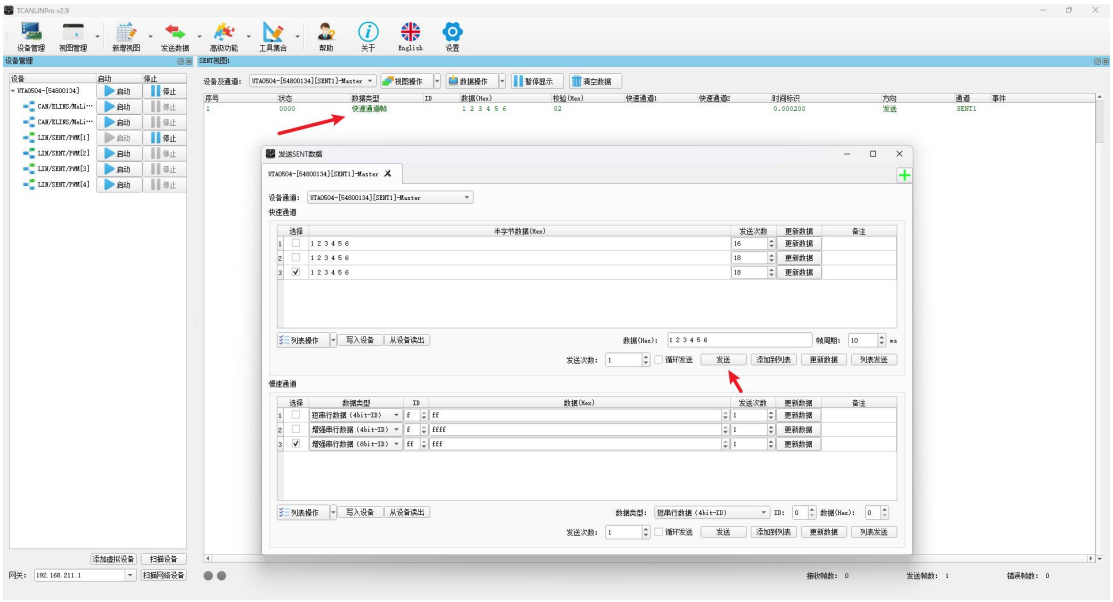
4. Configure the SENT channel parameters of TC4016, for example:

Channel: 0

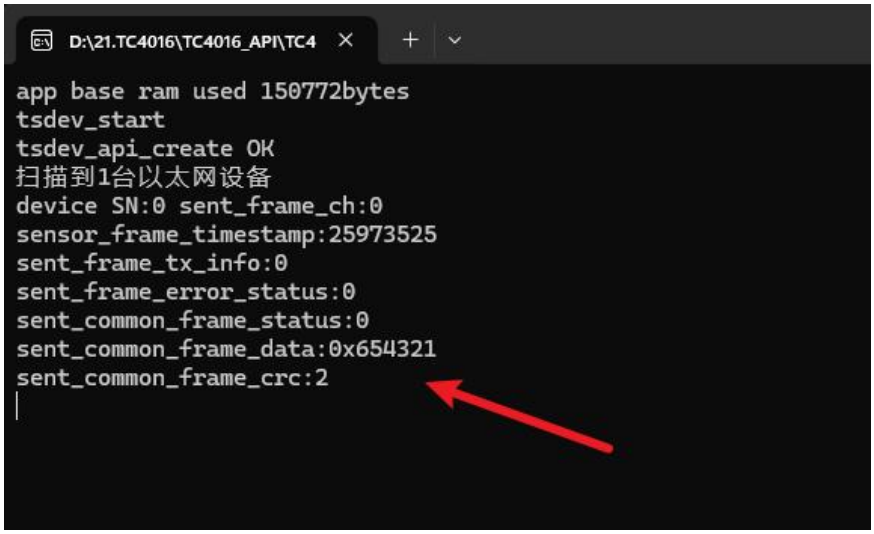
Tick time: 3 µs

Number of nibbles: 6

5. After configuration, use the TOOMOSS SENT tool to transmit data to the TC4016, as shown below:



6. The SENT data reported by TC4016 will be received on the PC, as shown below:



4.4.4 PSI5 Communication Example

1. After powering on the device, connect the PSI5 sensor to the corresponding pins.

2. Configure the PSI5 settings. Data received by the TC4016 will be reported to the PC via Ethernet.

3. Use the Infineon TLE4999I3 linear Hall sensor (PSI5 format: P10P-400/4H) to transmit data to the TC4016.

4. Configure the PSI5 channel parameters of TC4016, for example:

Channel: 0

Channel mode: Synchronous

Baud rate: 189 kbps

Comparator threshold current: 26 mA

Number of slots: 4

Synchronization period: 65535 µs

Synchronization delay: 0 µs

Bus holding voltage: 5.15 V

Bus trigger voltage: 4.8 V

Slot 1:

Check method: None

Slot length: 13 bits

Slot duration: 96 µs

Slot 2:

Check method: None

Slot length: 13 bits

Slot duration: 96 µs

Slot 3:

Check method: None

Slot length: 13 bits

Slot duration: 96 µs

Slot 4:

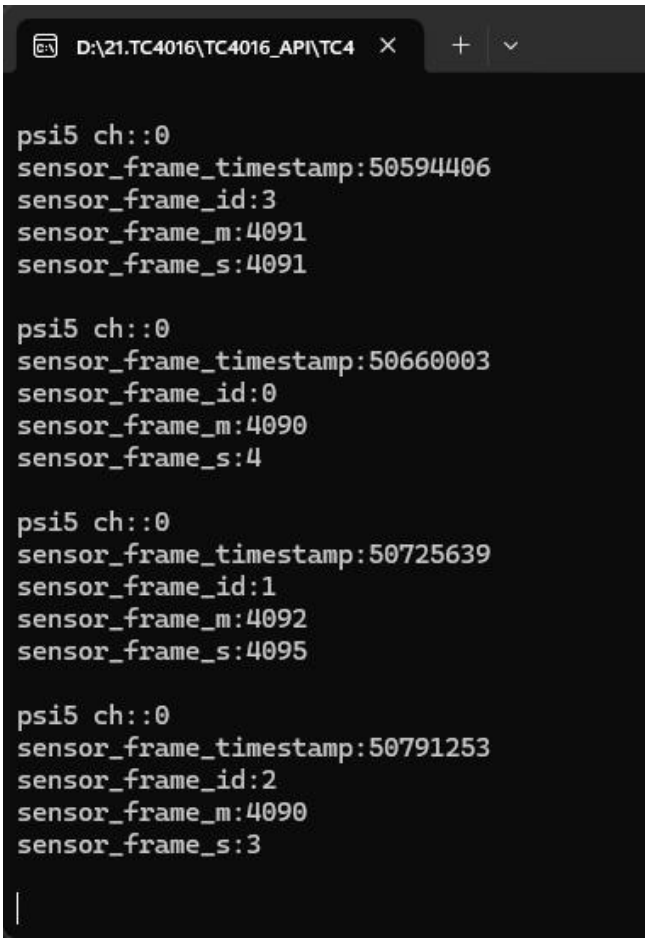
Check method: None

Slot length: 13 bits

Slot duration: 96 µs

5. After configuration, view the sensor data reported by TC4016 to the host software, as

shown below:



5. Inspection and Maintenance

The TC4016 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 flammable gases	No presence	Use sensors or smell 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

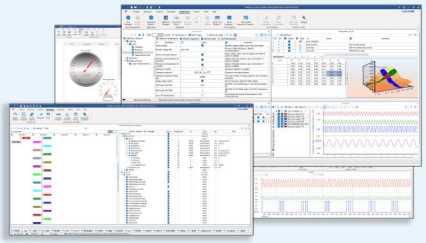
Embedded code generation/Application builder

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

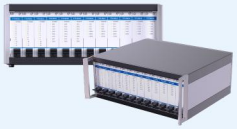
TTS test systems

-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

Contact Us :

+86 21-5956 0506

sales@tosunai.com

website :

www.tosunai.com

Beijing/Shanghai/Guangzhou/Chengdu/Changzhou/Taipei/Stuttgart/Seoul