TOSUN-TS3004
User Manual

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Product Features & Interface Overview

TC-K Channel to CAN FD Interface

Product Name	Channel
TS3004	CAN FD * 1
	TC-K Channel * 8

Copyright Information

Shanghai TOSUN Technology Ltd.

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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!

Contents

1. Introduction

The TS3004 is a high-performance thermocouple temperature acquisition device, featuring an integrated high-precision cold junction compensation circuit. It supports digital acquisition of up to 8 channels of K-type thermocouple signals and directly outputs temperature data in degrees Celsius (℃). The measurement range covers -200℃ to 1370℃, and input terminals can withstand overvoltage transients of up to ±45V.

Key Features:

- High-precision measurement: integrated cold junction compensation enables direct temperature output in degrees Celsius.

- Wide measurement range: supports temperature measurement from -200℃ to 1370℃, with ±45V overvoltage.

- Flexible ordering options: standard version supports K-type thermocouples, J, N, R, S, T, E, B types are available upon customization.

- Noise immunity & diagnostics: supports 50 Hz power-line filtering (60 Hz optional) and provides sensitive thermocouple fault detection.

Operating Modes:

The operating mode is selected via a 4-bit hardware ID DIP switch:

- Default Mode (ID 0~14): Upon power-up, the CAN baud rate is fixed at 1 Mbps. It supports configuration via communication commands; received configuration messages are stored in memory.

- Custom Mode (ID 15): Upon power-up, it automatically loads the most recently stored CAN configuration parameters (e.g., baud rate, filter settings). In this mode, configuration via communication commands is disabled.

Application Ecosystem:

The device uses a standard D-Sub 9-pin connector and can communicate with other CAN-based devices.

When used together with the TSMaster software, the TS3004 supports loading DBC database files, enabling convenient monitoring, analysis, and simulation of CAN bus data.

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> This document covers the operation of the device on Windows.

1.1. Technical Specifications

➢ **Device Specifications**

Parameter	Description
Connector	Standard D-Sub, 9-pin
Power Supply	Phoenix terminal power supply
Power Consumption	1.5 W
ESD Protection	±4 kV contact discharge, ±8 kV air charge
Enclosure Material	Metal
Dimensions	150 * 97.6* 72 mm
Weight	422.6 g
Operating Temperature	TBA
Operating Humidity	10% ~ 90% RH (no condensing)

➢ **CAN Specifications (Default Mode)**

Parameter	Description
Connection Standard	High-speed CAN (ISO 11898-2 compliant)
Supported Protocols	Full support for CAN (ISO 11898-1 compliant)
CAN Baud Rate	Fixed at 1 Mbps
Sample Point	82.5%
CAN Frame Data Length	Up to 8 bytes (extended data frame)
Termination Resistor	Built-in 120Ω, configurable via hardware DIP switch

➢ **CAN Specifications (Custom Mode)**

Parameter	Description
Connection Standard	High-speed CAN (ISO 11898-2 compliant)
Supported Protocols	Full support for CAN and CAN FD (ISO 11898-1 compliant)
CAN Baud Rate	125 kbps ~ 1 Mbps
CAN Frame Data Length	Up to 8 bytes
CAN FD Baud Rate	125 kbps ~ 8 Mbps
CAN FD Frame Data Length	Supports 3-byte and 16-byte frames; BRS supported
Termination Resistor	Built-in 120Ω, configurable via hardware DIP switch
Bus-Off Auto Recovery	Disabled by default; recovery command available in Default Mode

➢ **Functional Specifications**

Parameter	Description
Thermocouple Acquisition	Digitalize K-type thermocouple signals and outputs temperature in ℃
Cold Junction Compensation	Integrated
Operating Mode Selection	Default/Custom via hardware DIP switch
Fault Management	Displays the fault error with the highest priority when multiple faults occur
Overvoltage Protection	±45 V
Noise Immunity	50 Hz (60 Hz optional)
Measurement Range	-200℃~1370℃
Linearity Error	TBA

> The device supports input overvoltage protection of ±45 V.
>
> If interference exceeding ±45 V is present in the operating environment, please contact TOSUN technical support to adjust the protection circuitry in order to enhance overvoltage tolerance.
>
> Note that modifying the protection circuitry will increase input offset voltage and may affect measurement accuracy.

1.2. Electrical Specifications

➢ **Power Characteristics**

Parameter	Condition	Min	Typ.	Max	Unit
Operating Voltage	Phoenix terminal power supply	9	12.0	36	V
Power Consumption	Phoenix terminal power supply	--	1.5	--	W

➢ **CAN Interface Characteristics**

Parameter	Condition	Min	Typ.	Max	Unit
Termination Resistance	Enabled	--	120	--	Ω
	Disabled	--	∞	--	--
Isolation Voltage	Insulation resistance test	2500	--	--	VDC

➢ **EMC Performance**

Test Item	Standard	Condition	Level	Unit
ESD	IEC 61000-4-2	Contact discharge	±4	kV
		Air discharge	±8	kV

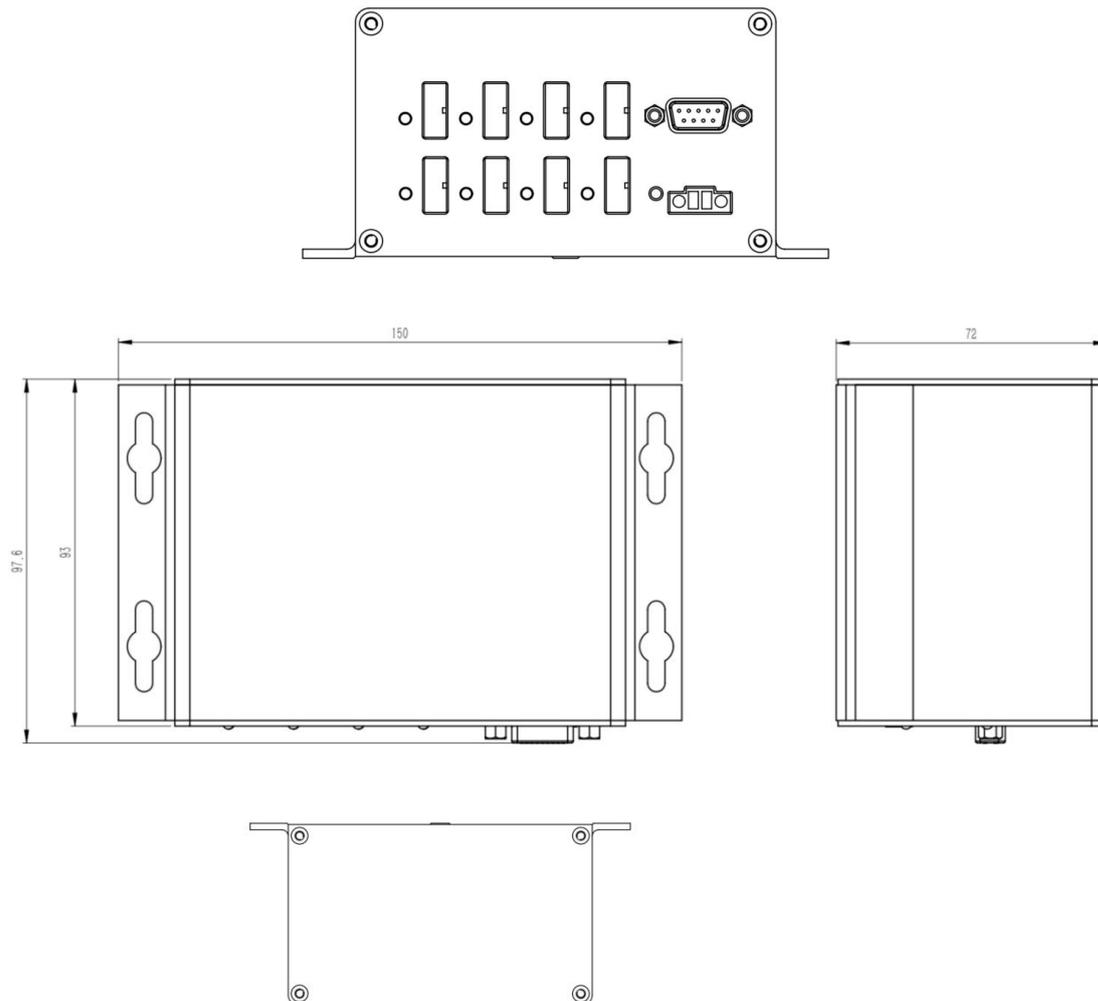| EFT/Burst | IEC 61000-4-4 | Electrical   fast transient | ±2 | kV |

➢ **Mechanical Dimensions**

Unit: mm

Figure 1-1 Mechanical Dimensions
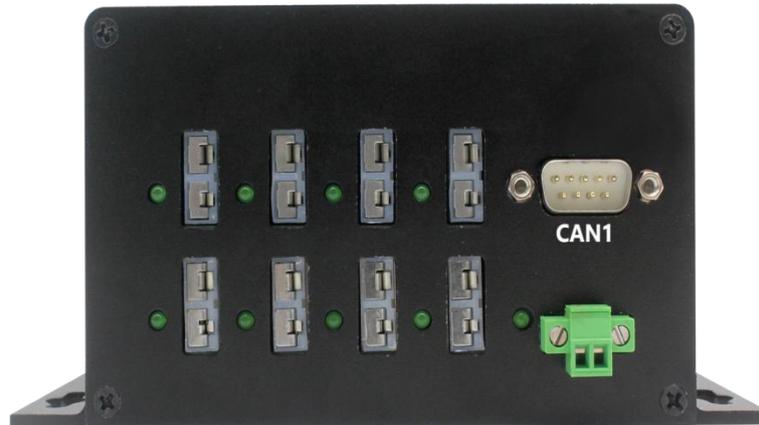
1.3. Pin Definition

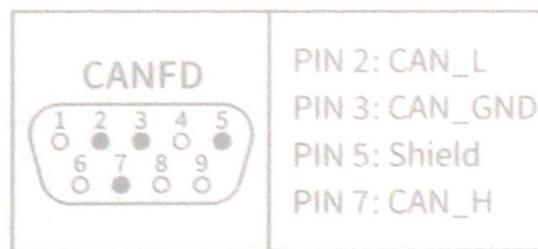➢ **CAN Interface**

Figure 1-2 Hardware Interface (CAN FD)

Figure 1-3 Pin Assignment (CAN FD)

1.4. LED Indicators
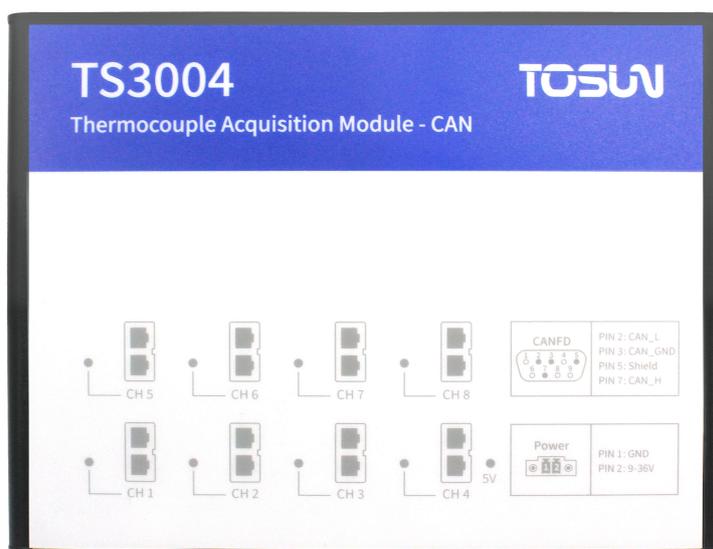
Figure 1-4 Front Panel Layout

➢ **LED Definitions**

Indicator	Description
CH 1 ~ 8	Thermocouple input channel 1 ~ 8
Power	Power indicator

➢ **LED Color Description**

Indicator	Color	Description
CH 1 ~ 8	Green (ON)	Normal thermocouple acquisition
	Green (OFF)	Thermocouple open circuit, over-range, not connected, or device not powered
Power	Green (ON)	Device powered on

1.5. System Requirements

➢ **PC Requirements**

■ Operating System: Windows

➢ **Downloads**

■ PDF user manual

■ TS3004 DBC file

> ℹ The download link is available on the official website of Shanghai TOSUN Technology Ltd.: https://www.tosunai.com/

1.6. Packing List

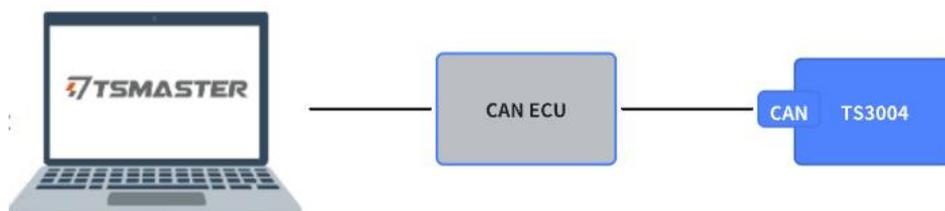| Item	Qty.	Illustration	Standard/Optional
TS3004 Main Device	**1**		**Standard**
2-Pin Flange-locking Connector	**1**		**Standard**

2. Application Example in Windows

Figure 2-1 Example in Windows

> ℹ For TSMaster installation instructions, please refer to the appendix.

2.1. Hardware Connection

2.1.1. CAN

The TS3004 provides one CAN interface for communication with other CAN devices.

A built-in termination resistor is available and can be enabled or disabled using the hardware 120 Ω (red) DIP switch, depending on the actual application scenario.

> ℹ DIP switch configuration:
>
> To configure the termination resistor, remove the enclosure cover and locate the red DIP switch labeled "120R ON" on the board. Use the this switch to enable or disable the termination resistor.

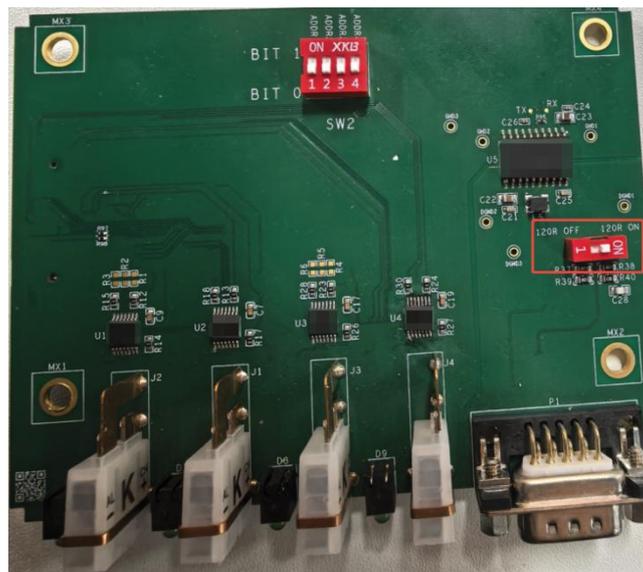Figure 2-2 Hardware DIP Switch

> ℹ Pay attention to the termination-resistor enable settings. The TS3004 comes with built-in termination resistors, which can be enabled or disabled via the hardware DIP switch. The recommended configuration is to enable one 120Ω termination resistor at each end of the CAN bus, ensuring that the total bus resistance stays at 60Ω.
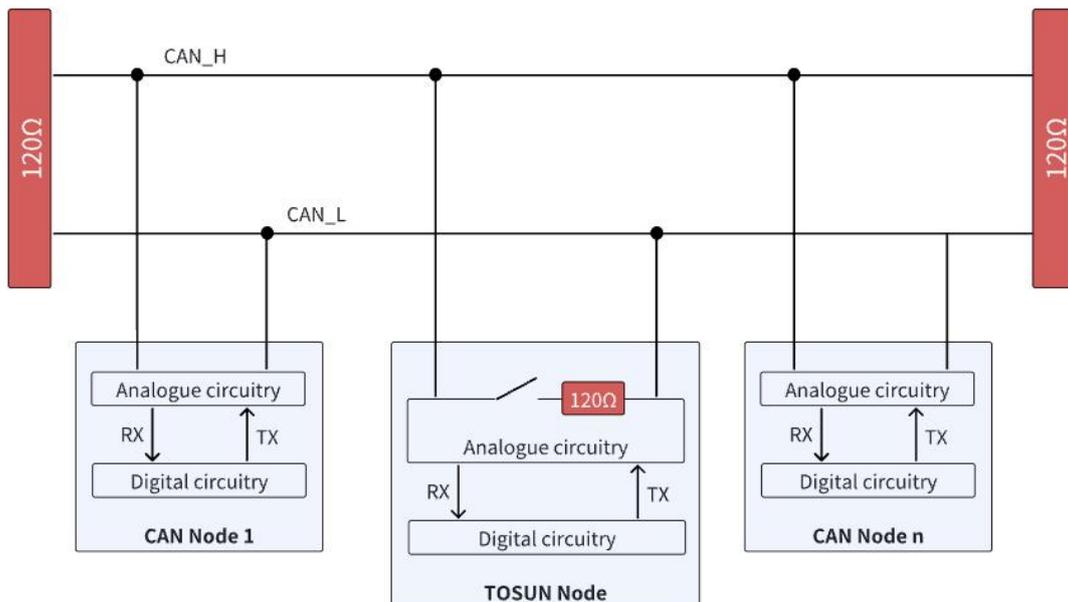

Figure 2-3 Connecting to the CAN Bus

2.2. Usage Example

2.2.1. Interface Communication Modes

The TS3004 communicates via the CAN interface and supports two operating modes:

● Default Mode (ID = 0–14)

● Custom Mode (ID = 15)

The operating mode is selected using the hardware ID DIP switch.

➢ **Default Mode**

In Default Mode, the CAN baud rate is fixed at 1 Mbps (1000 kbps) with a sample point of 82.5%.

This mode supports all communication commands, including but not limited to:

● Configuring periodic message reporting

● Setting the thermocouple type

● Reading the thermocouple type

● Configuring the CAN controller type

● Configuring the CAN message type

All configuration parameters are stored in non-volatile memory after being set.

Except for CAN controller type and CAN message type, which do not take effect in Default Mode and are only applied in Custom Mode, all other configuration commands take effect immediately.

CAN controller and message type configuration includes:

● Selecting CAN or CAN FD communication

● Setting the communication baud rate

● Configuring the data frame type and data length

● Setting the synchronization jump width (SJW)

● Enabling or disabling Bus-Off auto recovery

➢ **Custom Mode**

When the hardware DIP switch is set to ID = 15 and the device is powered on, the TS3004 enters

Custom Mode.

In this mode, the device automatically applies configuration parameters previously stored in non-volatile memory during Default Mode operation, such as message reporting period, thermocouple type, CAN controller type, and CAN message type.

In Custom Mode, communication commands are not supported. Only thermocouple temperature reporting (DAQ messages) is enabled.

> In Custom Mode, thermocouple temperature values are parsed and decoded
>
> only when the CAN message parameters configured in Default Mode are set to
>
> extended frame format, and DLC = 3.
>
> If any other CAN message parameters are configured, the device will still
>
> transmit thermocouple temperature (DAQ) messages, but the temperature data
>
> will not be parsed or decoded.

2.2.2. Multi-Device Communication Configuration in Default Mode

Connect the CAN device to the TS3004 CAN interface.

Configure the CAN device communication parameters as shown in the figure below, with the communication baud rate set to 1000 kbps.
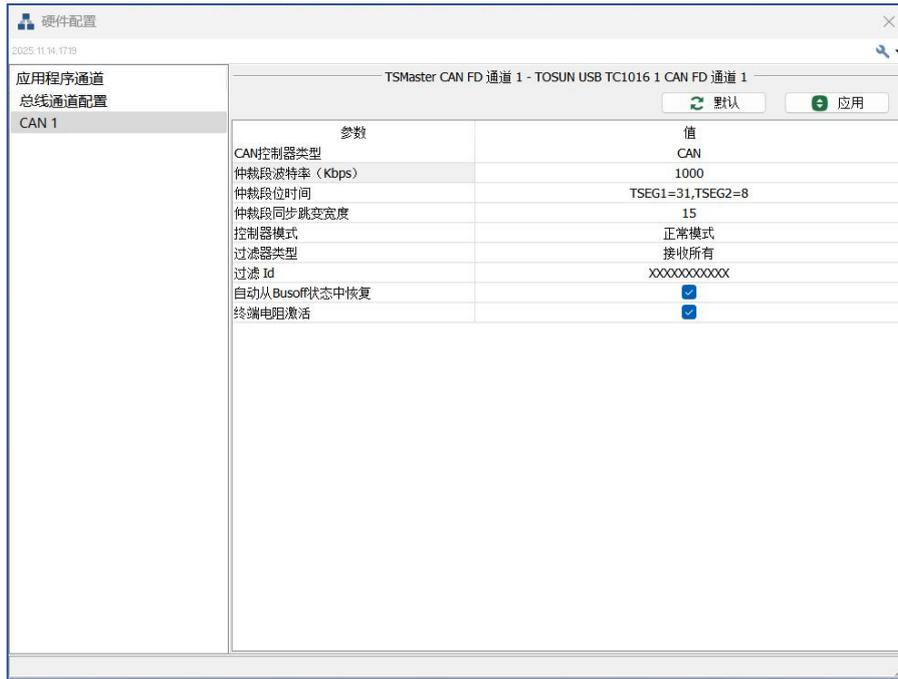
Figure 2-4 CAN Communication Configuration

2.3. Communication Command Description

The communication command message ID format is 0xXX0Y27ZZ, where:

XX indicates the message direction:

- 00 - Module Receive (Request)

- 08 - Module Response (Response)

- 18 - Module Report (Report)

Users should send messages using the 00 (Request) format.

Y represents the device ID field, set by the 4-bit DIP switch, with a configurable range of 0 to15. Each ID corresponds to a dedicated DBC file, supporting 16 DBC files in total: TS3004_N01_r to TS3004_N16_r.

ZZ indicates the command type (CMD).

Communication commands are classified into three categories:

- Request: sent by the user to initiate configuration or query operations.

- Response: returned by the device after processing a Request.

- Report: actively transmitted by the device for periodic or event-driven data reporting.

Some commands use signal multiplexing, meaning that a single message ID may be shared by multiple commands.

> Byte order: all data fields are organized in a little-endian format.

2.3.1. Periodic Report Message Configuration

Purpose	Enable or disable periodic report messages and configure the reporting periods.							
CMD:0x04	B0	B1	B2	B3	B4	B5	B6	B7
Request	TOCMD	Channel	Period_ms				Para1	Para2
Response	Result							
Parameter Description	TOCMD: U8 Command ID corresponding to the DAQ message types. In this command, the value must be 0x2E. Channel: U8 Thermocouple channel number, ranging from 1 to 8. Period_ms:U32/Unit ms Reporting period. A value of 0 disables periodic reporting. The valid range depends on the message type. Default value: 1s. Once configured, the parameter is stored in Flash memory. After power cycling, the device continues operating with the last configured reporting period. Para1&Para2: U8							

	Reserved parameters. Any value from 0x00 to 0xF may be used.

Remarks	Set thermocouple channel 1 to report every 1 ms:
	
	`0x2E 0x00 0x01 0x00 0x00 0x00 0x55 0x55`
	
	(0x55 may be replaced by any value)
	
	Set thermocouple channel 2 to report every 2000 ms:
	
	`0x2E 0x01 0xD0 0x07 0x00 0x00 0x55 0x55`
	
	(0x55 may be replaced by any value)
	
	Disable all active report messages on the device:
	
	`0xFF 0xFF 0x00 0x00 0x00 0x00 0xFF 0xFF`

2.3.2. Set Thermocouple Type

Purpose	Set the thermocouple type for the specified channel.							
CMD:0x61	B0	B1	B2	B3	B4	B5	B6	B7
Request	SubCMD	Channel	Thermo_Type					
Response	Result	SubCMD						

Parameter Description	`SubCMD: U8`
	
	Sub-command for setting the thermocouple type.
	Fixed value: 0x07.
	
	`Channel: U8`
	
	Thermocouple channel number, ranging from 1 to 8.
	
	`Thermo_Type: U8`
	
	Thermocouple type selection:
	
	`0x00 = B Type`							

	`0x01 = E Type`
	
	`0x02 = J Type`
	
	`0x03 = K Type`
	
	`0x04 = N Type`
	
	`0x05 = R Type`
	
	`0x06 = S Type`
	
	`0x07 = T Type`

Remarks	The thermocouple type configuration is non-volatile. Once set, the configuration is stored in Flash and retained after power cycling. Example: Set Channel 1 to Type K: `0x07 0x00 0x03` The configuration is written to Flash with checksum verification. If Flash verification fails, all channels default to Type K.

2.3.3. Read Thermocouple Type

Purpose	Read the configured thermocouple type of the specified channel.							
CMD:0x61	B0	B1	B2	B3	B4	B5	B6	B7
Request	SubCMD	Channel						
Response	Result	SubCMD	Channel	Thermo_Type				

Parameter Description	SubCMD: U8 Sub-command for reading the thermocouple type. Channel: U8 Thermocouple channel number, ranging from 1 to 8. Thermo_Type: U8 Thermocouple type (same encoding as in Set Thermocouple Type). Note: Reading and setting thermocouple types share the same CMD.
Remarks	Read the thermocouple type of Channel 1: 0x08 0x00

2.3.4. Thermocouple Temperature Report (DAQ)

Purpose	Report the current thermocouple temperature.							
CMD:0x2E (Default)	B0	B1	B2	B3	B4	B5	B6	B7
Report	Channel	Temperature						
Parameter Description	Channel: U8 Thermocouple channel number, ranging from 1 to 8. Temperature: U16 Factor = 0.05 Offset = -273.15 Unit ℃ temperature value							
Remarks	By default, one report per channel per second is transmitted.							

2.3.5. Read Thermocouple Temperature

Purpose	Read the current thermocouple temperature.							
CMD:0x2F	B0	B1	B2	B3	B4	B5	B6	B7
Request	Channel							
Response	Result	Channel	Temperature					
Parameter Description	Channel: U8 Thermocouple channel number, ranging from 1 to 8. Temperature: U16 Factor = 0.05 Offset = -273.15 Unit ˚C temperature value							
Remarks	One temperature value is reported for each request.							

2.3.6. Set CAN Mode

Purpose	Command is issued in Default Mode; parameters take effect in Custom Mode.							
CMD:0x62	B0	B1	B2	B3	B4	B5	B6	B7
Request	SubCMD	FDOE / NBRP / NTSEG1 / NTSEG2 / NSJW / DBRP / DTSEG1 / DTSEG2 / DSJW / Reserve/ ABOM						
Response	Result	SubCMD						

Parameter Description	SubCMD: U8 Sub-command for CAN mode configuration. Fixed value: 0x05. FDOE: U1 ● 0: CAN (default); ● 1: CAN FD. NBRP: U5 NTSEG1: U8 NTSEG2: U7 NSJW: U7 Arbitration phase parameters DBRP: U5 DTSEG1: U5 DTSEG2: U4 DSJW: U4 Data phase parameters All timing parameters are expressed as actual physical values minus 1. Example: BRP = 0 ➔ division factor = 1. CAN clock: 40 MHz Baud rate formula: `Baudrate = f_CAN / [ (BRP + 1) × (1 + TSEG1 + TSEG2 +1 +1) ]` Example configurations: Arbitration phase: `BRP=0, TSEG1=30, TSEG2=7` → 1 Mbps Data phase: `BRP=0, TSEG1=2, TSEG2=0` → 8 Mbps For classic CAN, only arbitration phase parameters are required. (Bit rate: 1000 kbps, sample point: 82.5%) Reserve: U1 Reserved. ABOM: U1 Automatic Bus-Off Management ● 0: Disabled (default);

- 1: Enabled.

2.3.7. Set Message Parameters

Purpose	Command is issued in Default Mode; parameters take effect in Custom Mode.							
CMD:0x62	B0	B1	B2	B3	B4	B5	B6	B7
Request	SubCMD	FunID		MsgID				IS_EXT/FDF/BRS/DLC
Response	Result	SubCMD						
Parameter Description	SubCMD: U8 Sub-command for message configuration. Fixed value: 0x06. FunID: U8 Supported value: 0x2E (Thermocouple Temperature Report). MsgID: FunID CAN identifier for the specified FunID. If not configured, the default ID is used. Effective only when ID = 15 (Custom Mode). IS_EXT: U1 ● 0: Standard frame (default); ● 1: Extended frame. FDF: U1 ● 0: Classic CAN (default); ● 1: CAN FD. BRS: U1							

- 0: Disabled (default);

- 1: Enabled.

DLC: U4

Range: 0~15

Supported values:

- 0x03 (3 bytes, default)

- 0x0A (16 bytes)

When DLC = 0x0A, FDF must be set to 1, otherwise the configuration is invalid.

Data Format:

- DLC = 0x03

One channel temperature per frame, reported according to the channel's configured period.

- DLC = 0x0A

One frame reports all channel temperatures:

```
CH1 temperature(2 bytes, little-endian)

CH2 temperature(2 bytes)

CH3 temperature(2 bytes)

CH4 temperature(2 bytes)

CH5 temperature(2 bytes)

CH6 temperature(2 bytes)

CH7 temperature(2 bytes)

CH8 temperature(2 bytes)
```

- Reporting period follows Channel 1's configured period.

Temperature conversion:

Temperature (° C) = RawValue × 0.05 − 290

2.4. Fault Code Description

Absolute zero is −273.15 °C.

Fault codes range from −274 to −282. (If multiple faults occur simultaneously, only the highest fault code is reported.)

Fault Code	Fault Name	Description
-274	NO_THERMOCOUPLE	Thermocouple not connected or poor contact
-275	OPEN_Fault	Thermocouple open-circuit fault
-276	OVUV_Fault	Overvoltage or undervoltage input
-277	TCLOW_Fault	Thermocouple temperature too low
-278	TCHIGH_Fault	Thermocouple temperature too high
-279	CJLOW_Fault	Cold junction temperature too low
-280	CJHIGH_Fault	Cold junction temperature too high
-281	TC_Range_Fault	Thermocouple out of range
-282	CJ_Range_Fault	Cold junction out of range

3. Appendix

3.1. Software Installation

The section describes the steps for installing the TSMaster software on a Windows PC.

➢ **TSMaster Software Download**

https://www.tosunai.com/downloads/

If the site is unavailable, contact your sales representative or visit the TOSUN official website.

You may also scan the QR code below to follow the official WeChat account and obtain download links.

Figure 3-1 TOSUN Official WeChat Account

➢ **Software Installation**

1. Double-click the TSMaster installer and select the installation language.
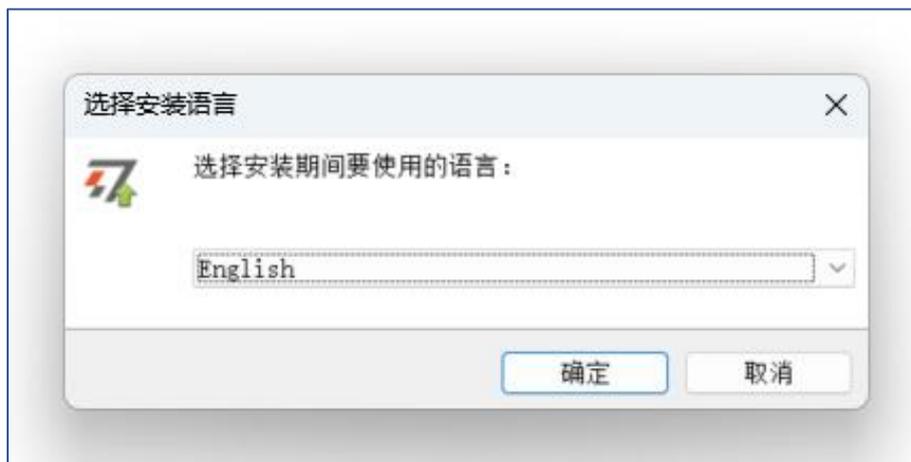
Figure 3-2 TSMaster Installation

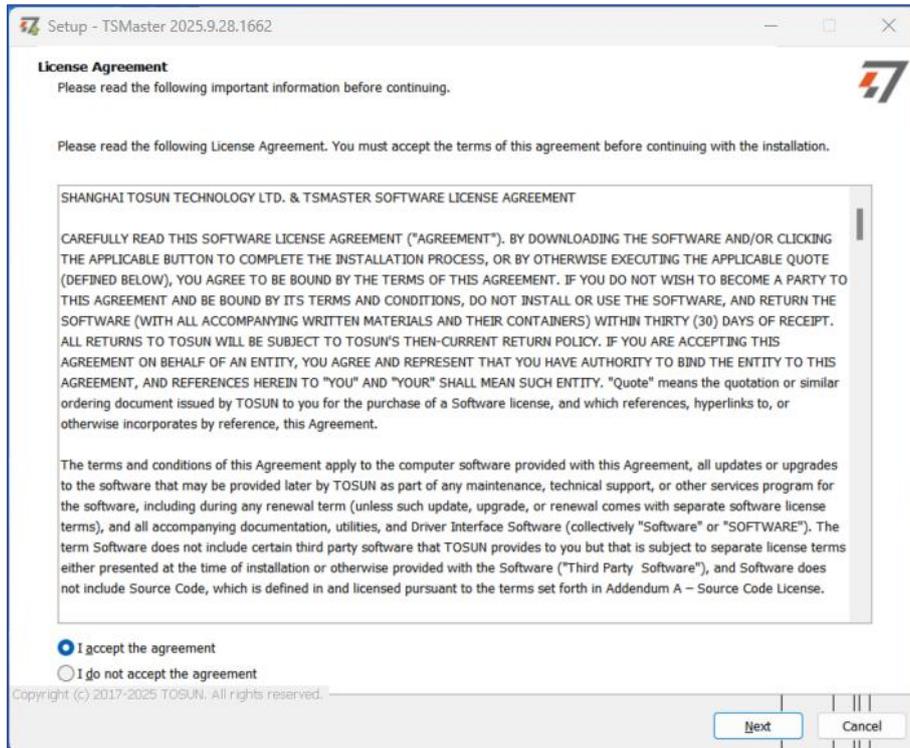2. Accept the license agreement and click "Next".

Figure 3-3 TSMaster Installation

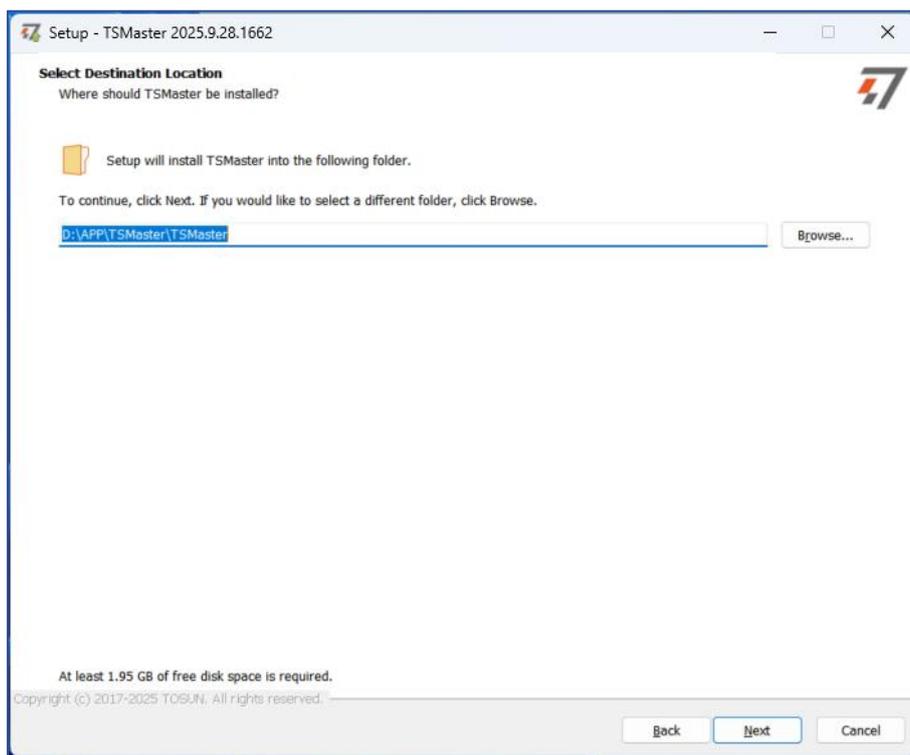3. Choose an installation directory and click "Next ".

Figure 3-4 TSMaster Installation

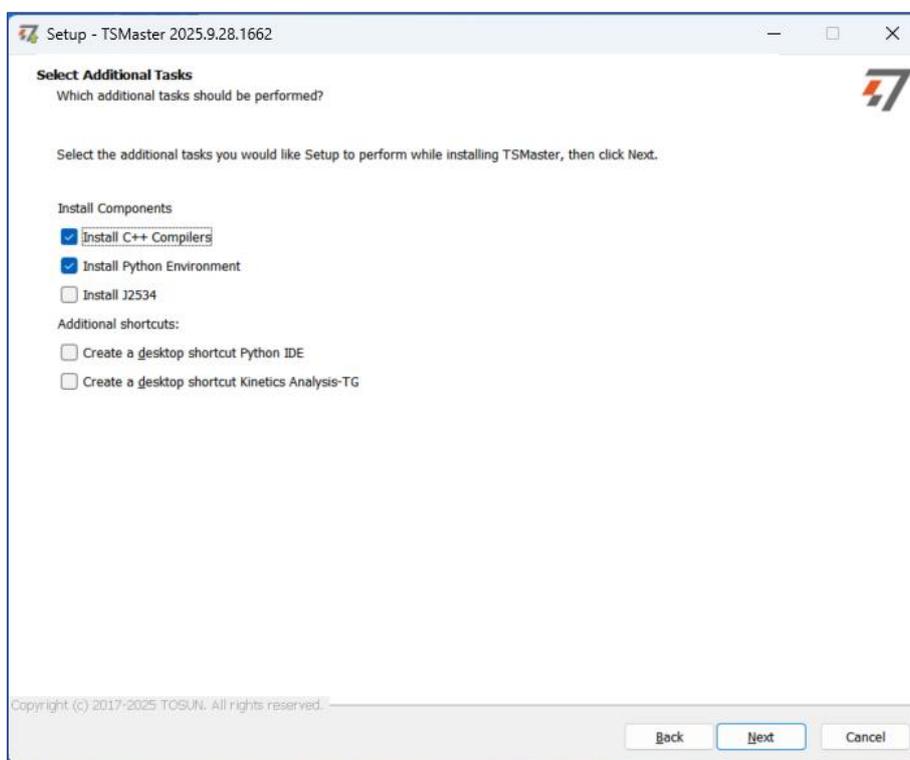4. Select additional tasks as needed and click "Next".

Figure 3-5 TSMaster Installation

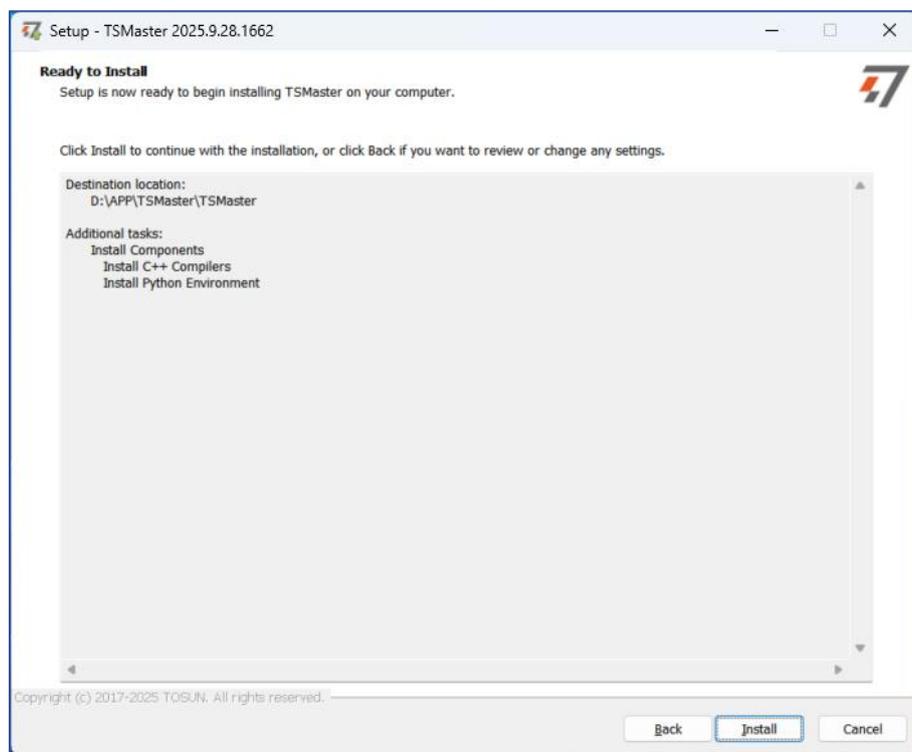5. Click "Install" and wait for completion.
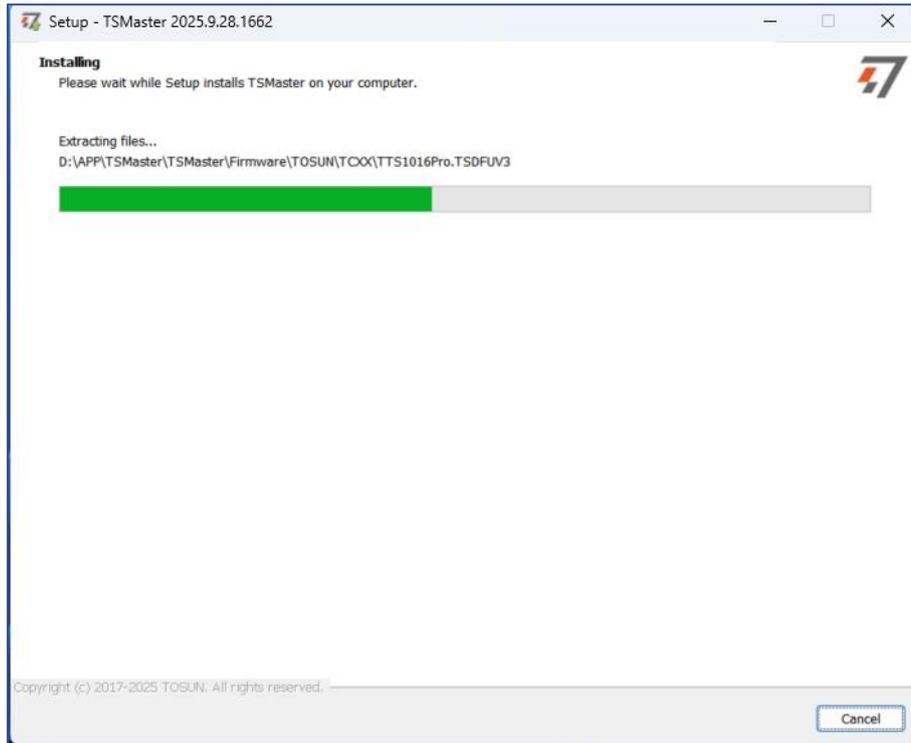

Figure 3-6 TSMaster Installation

Figure 3-7 TSMaster Installation

6. Click "Finish" to complete installation.

Figure 3-8 TSMaster Installation

4. Inspection and Maintenance

The TS3004 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.

➢ **Power Environment Inspection**

Item	Check Content	Standard/ Range	Action/Measure
Power Supply	Check voltage fluctuation at power input	Power port: +12V DC	Use a voltmeter at the input; ensure voltage fluctuation is within range
Ambient Conditions	Check ambient temperature (including internal temperature within enclosures)	-40°C ~ +80°C	Use a thermometer to ensure temperature is within specified range
	Check the ambient humidity (including internal humidity within enclosures)	10% ~ 90% RH	Use a hygrometer to ensure humidity is within specified range

➢ **Contamination & Protection Check**

Item	Check Content	Standard/ Range	Action/Measure

| Contamination	Check for accumulation of dust, powder, salt, and metal debris	None	Clean the device and prevent future contamination
	Check for exposure to water, oil, or chemicals	None	Clean and shield if necessary
Hazardous Gases	Check for corrosive or flammable gases	None	Use sensors or odor detection to verify

➢ **Mechanical Stress & EMI Check**

Item	Check Content	Standard/ Range	Action/Measure
Mechanical Stress	Check vibration and shock levels	Within specified limits	Install padding or vibration isolation measures if necessary
Electromagnetic Environment	Check for noise sources near the device	No significant noise sources	Isolate or shield the device from noise sources

➢ **Installation & Wiring Check**

Item	Check Content	Standard/ Range	Action/Measure
Wiring	Check crimped connectors in external wiring	Adequate clearance between connectors	Visually inspect and adjust as needed
	Check for damage to external wiring	No 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
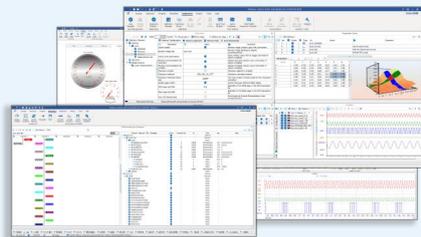
TSMASTER

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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