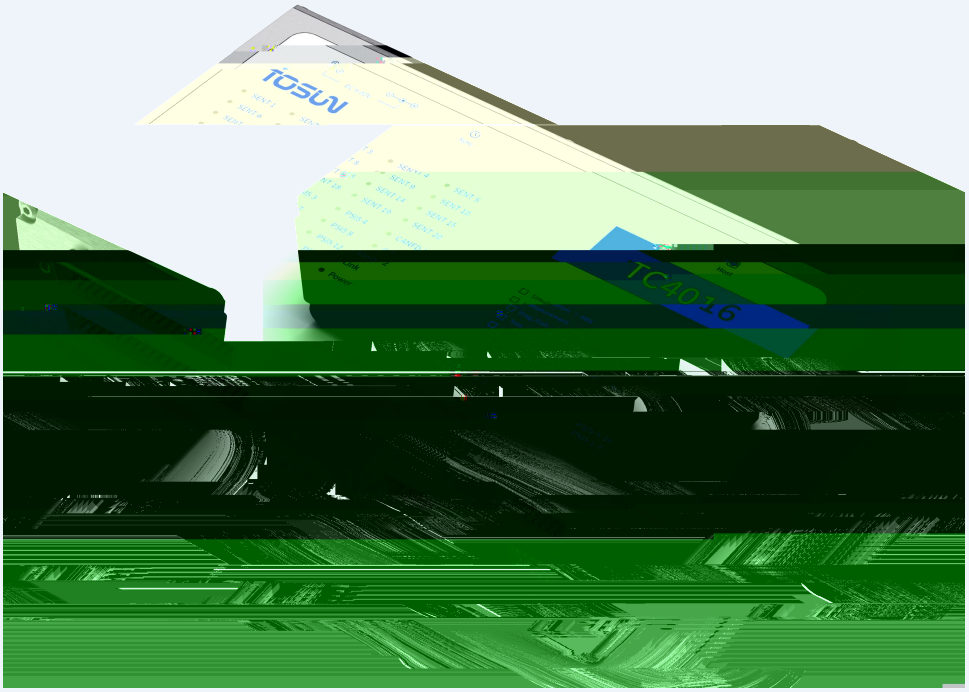
TOSUN




Version V1.0 | English

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.

- 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
- ...

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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.

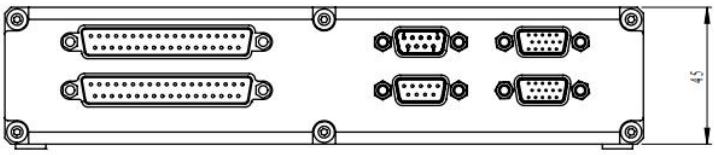

- ✓ Hardware-based message timestamping with microsecond-level accuracy, meeting advanced timing requirements
- ✓ Driver-free design for Windows, ensuring excellent compatibility
- ✓ 20 SENT channels, with the first 10 channels supporting SPC mode
- ✓ 16 PSI5 channels
- ✓ 2 CAN/CAN FD channels
- ✓ Supports 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 120 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

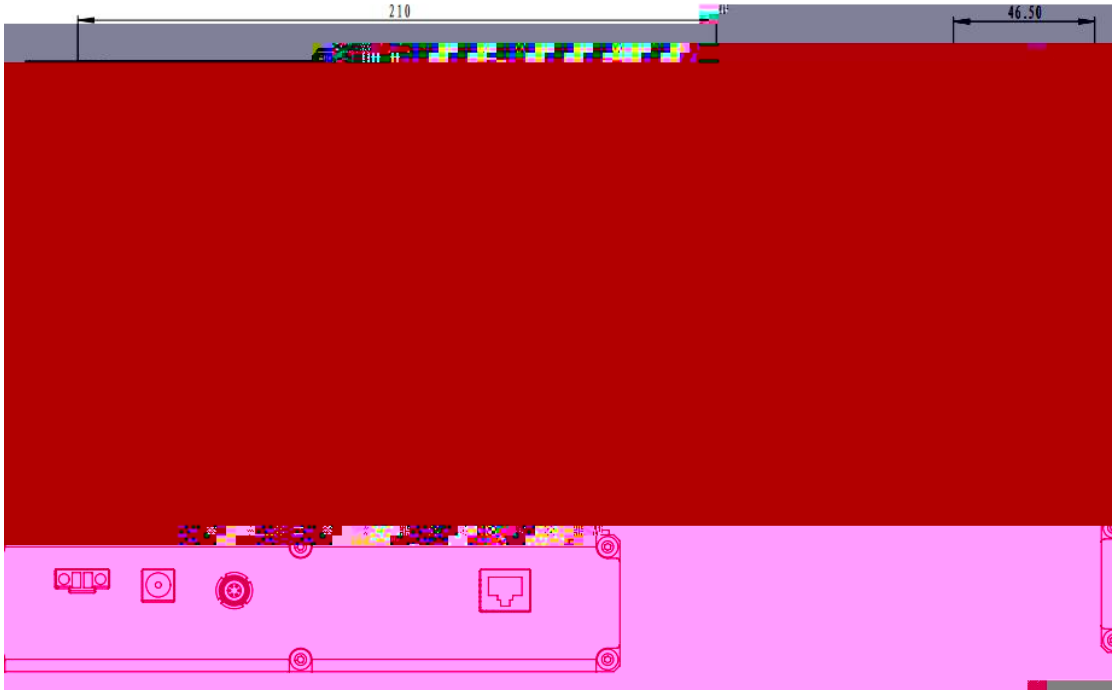
| | |
|---|---|
| Channel | 2* CAN/CAN FD<br>4* DIDO<br>3* AIAO<br>20* SENT (the first 10 channels supporting SPC mode) |

| | |
|---|---|
| | 16* PSI5 |
| PC Interface | Gigabit Ethernet |
| Driver | Driver-free for Windows |
| Software | TSMaster |
| Termination | 120 q software-configurable termination resistors |
| Timestamp | 1 εs 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<br>DI threshold adjustable via built-in hysteresis comparator and configurable Vref (0 3.28 V).<br>DI Threshold Calculations:<br>- High-level threshold (VAH): (330 + 499 Vref) / 1098<br>- Low-level threshold (VAL): 0.455 Vref<br>Digital Output (DO) levels: Low = 0 V, High = 5 V or 12 V<br>(DO does not support direct load driving) |
| AIAO | Analog Input (AI) voltage range: 0<br>Analog Output (AO) voltage range: 0<br>(AO does not support direct load driv |
| SENT | Idle polari<br>Tick time<br>50 Õs<br>Nibble cou<br>ata type port Cha ow Channel<br>annel s: Sy us ous<br>sus voltag ž |
| PSI5 | |

| | |
|---|---|
| Humidity | |
| Environment | Avoid corrosive gases |

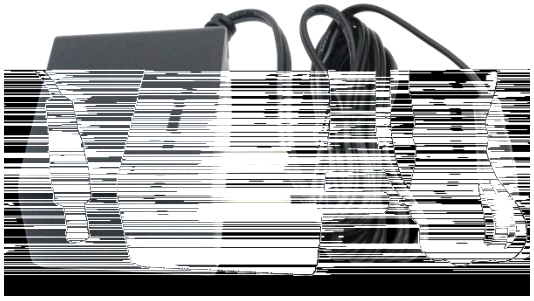
| Parameter | | Test Conditions | Min | Typical | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Voltage | DC input | All CAN channels transmitting at full load; all SENT & PSI5 channels enabled | 9 | 12 | 32 | V |
| Operating Current | DC input | All CAN channels transmitting at full load; all 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 |



✓ Main device: TC4016

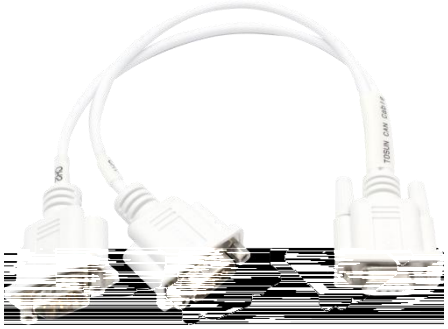

✓ 12V 2A power adapter



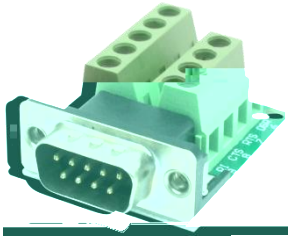
✓ Category 6 Gigabit Ethernet cable

✓ Time Sync box harness

✓ DB9 female to dual male signal cable



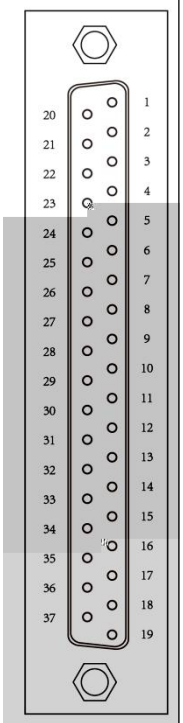
✓ DB9 male connector



✓ Custom harness - SENT/PSI5 (Pending details)

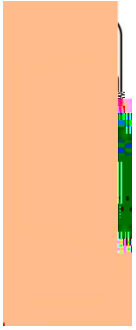


- 1000Base-T Ethernet (RJ45)
- Time synchronization interface
- Power input (circular adapter)
- Power input (phoenix terminal)
- DB37 male * 2 (SENT)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
|  | 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 | | | | |
| | | | | | | | |
| | 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_5V | PIN21 | SENT12 |
| | | PIN22 | GND | PIN23 | VCC_5V | PIN24 | SENT14 |
| | | PIN25 | GND | PIN26 | VCC_5V | PIN27 | SENT16 |
| | | PIN28 | GND | PIN29 | VCC_5V | PIN30 | SENT18 |
| | | PIN31 | GND | PIN32 | VCC_5V | PIN33 | SENT20 |
| | | PIN34 | GND | PIN35 | NULL | PIN36 | NULL |
| | | PIN37 | NULL | | | | |

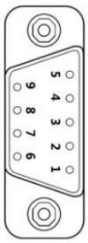
- DB15 male * 2 (PSI5):

| DB15 Pin | | | | | | | |
|---|---|---|---|---|---|---|---|
|  | 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 |
| | | | | | | | |
| | PSI5 | PIN1 | PSI5_9 | PIN2 | DGND | PIN3 | DGND |

D

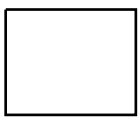
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9-16 | PIN4 | DGND | PIN5 | PSI5_13 | PIN6 | PSI5_10 |
| | | PIN7 | DGND | PIN8 | DGND | PIN9 | DGND |
| | | PIN10 | PSI5_14 | PIN11 | PSI5_11 | PIN12 | PSI5_12 |
| | | PIN13 | DGND | PIN14 | PSI5_15 | PIN15 | PSI5_16 |

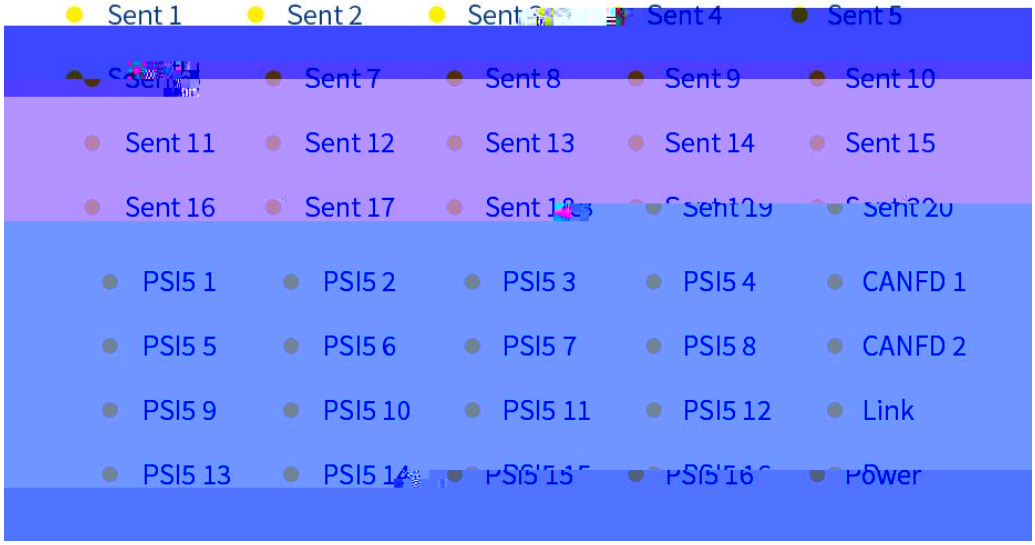
- DB9 female interface (I/O):



PIN1 DIDO1
PIN2 DIDO3
PIN3 I

I/O





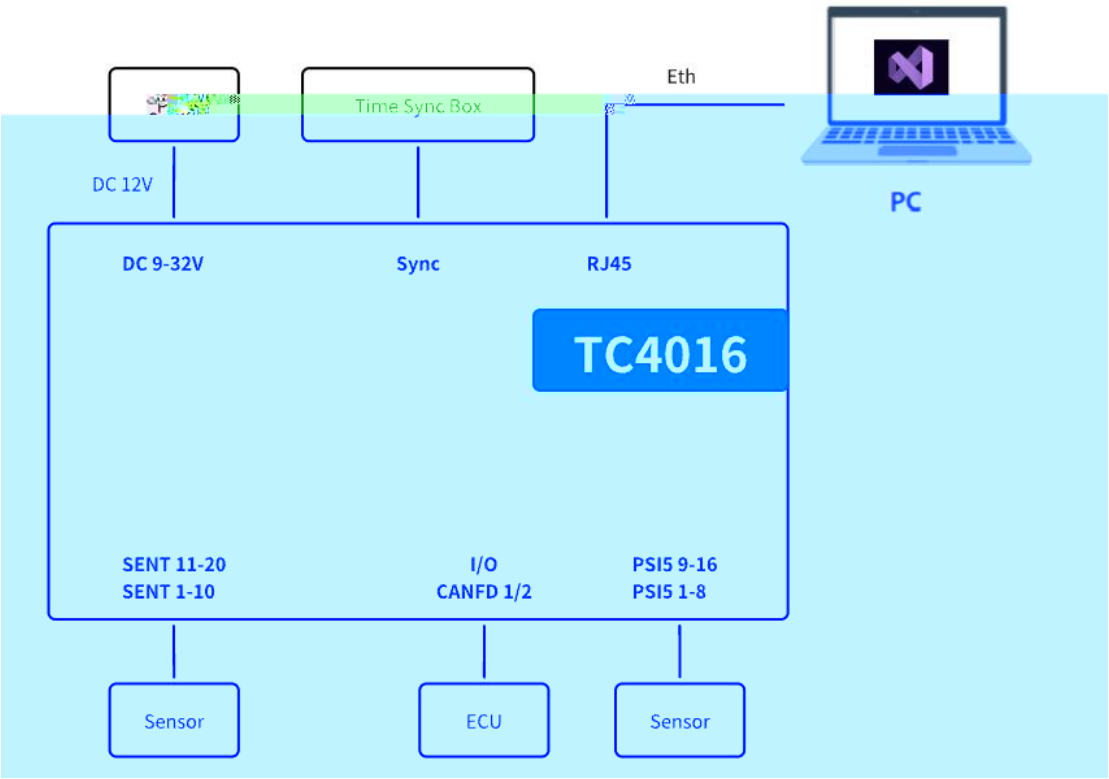

Description of indicator:

| | |
|---|---|
| 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:

| | |
|---|---|
| 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 |

N/A




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.

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.

Please refer to the TC4016 example projects for detailed integration.

1.

1. Register the callback function.

2. Configure structure parameters and send the configuration request.

3. Monitor SENT data via the callback function.

1. Register the callback function.

2. Configure structure parameters and send the configuration request.

3. Monitor PSI5 data via the callback function.

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

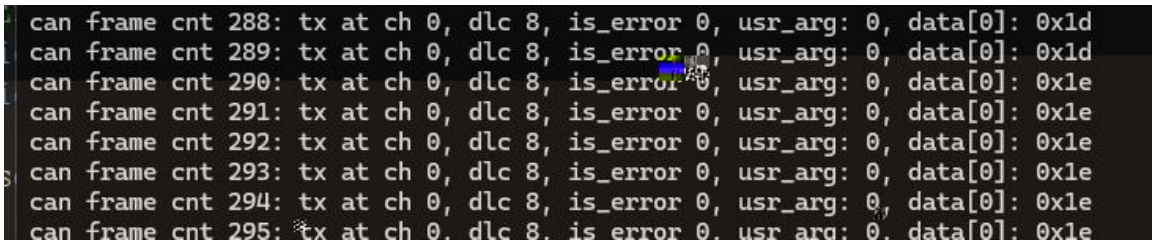
Arbitration phase baud rate (Kbps): 500

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:




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:

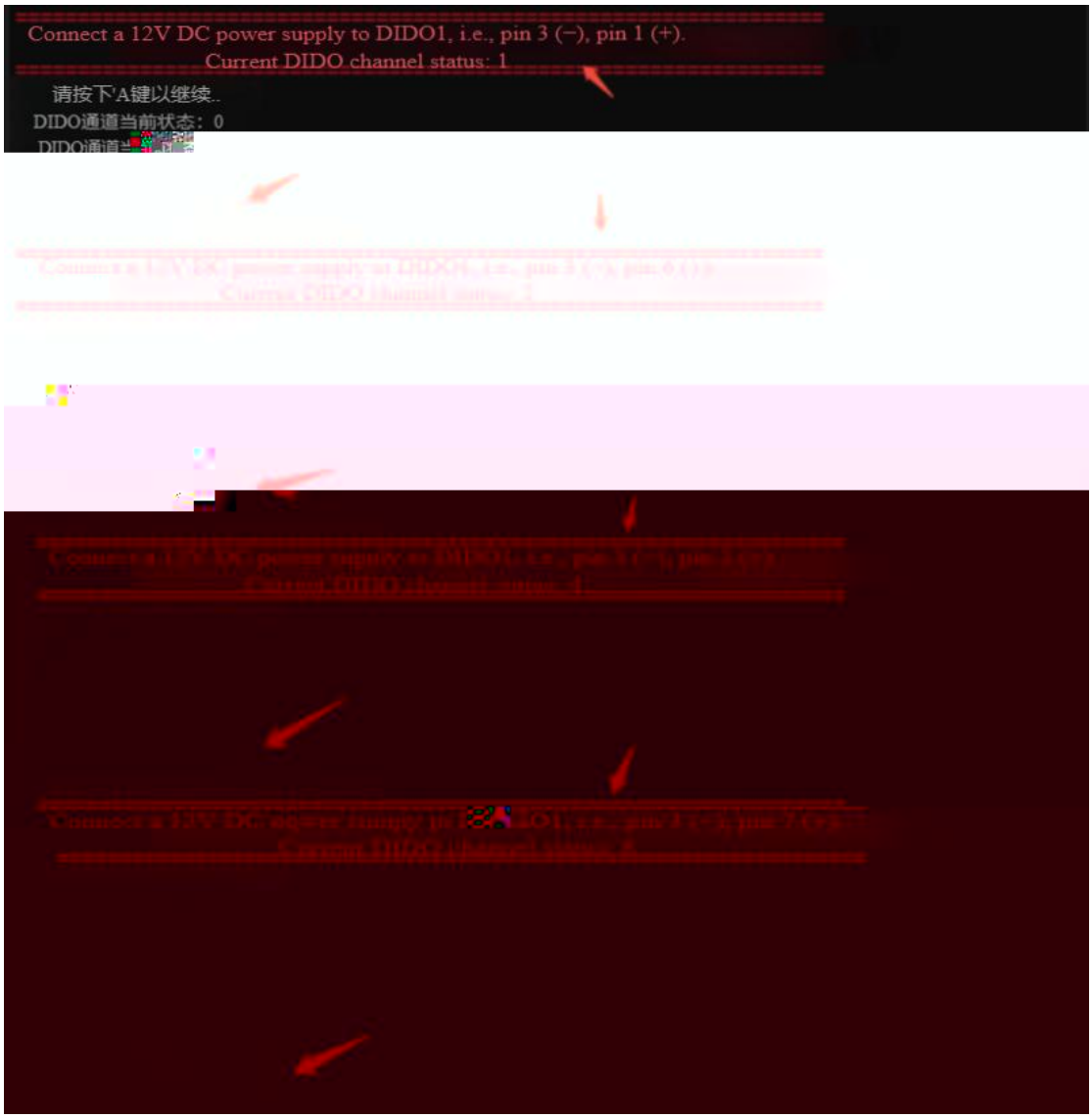
DIDO channel mode: Write;

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.




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.

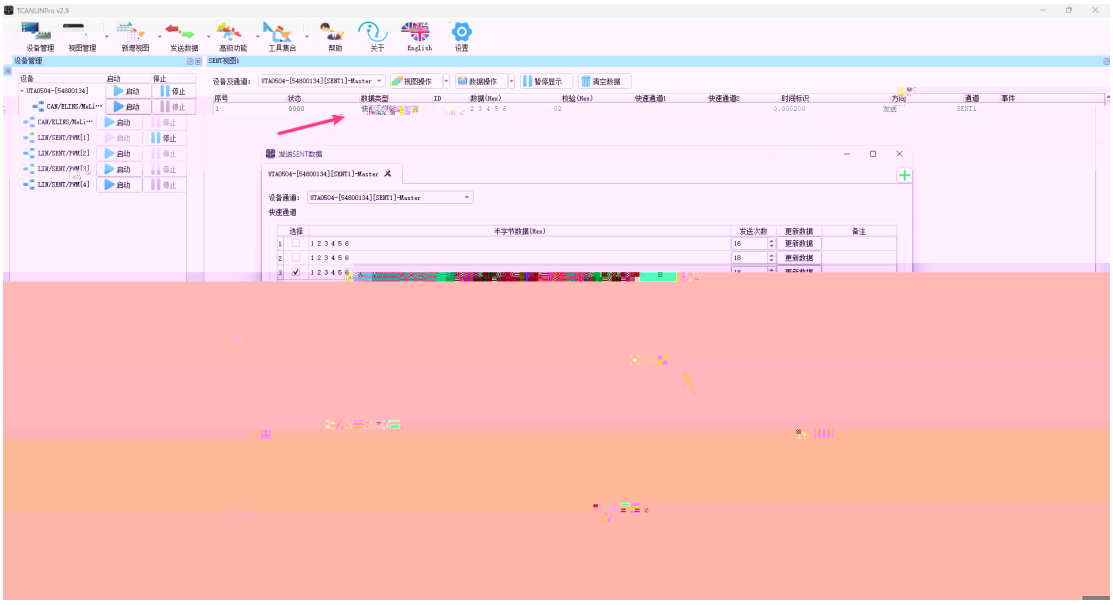
4. Configure the SENT channel parameters of TC4016, for example:

Channel: 0

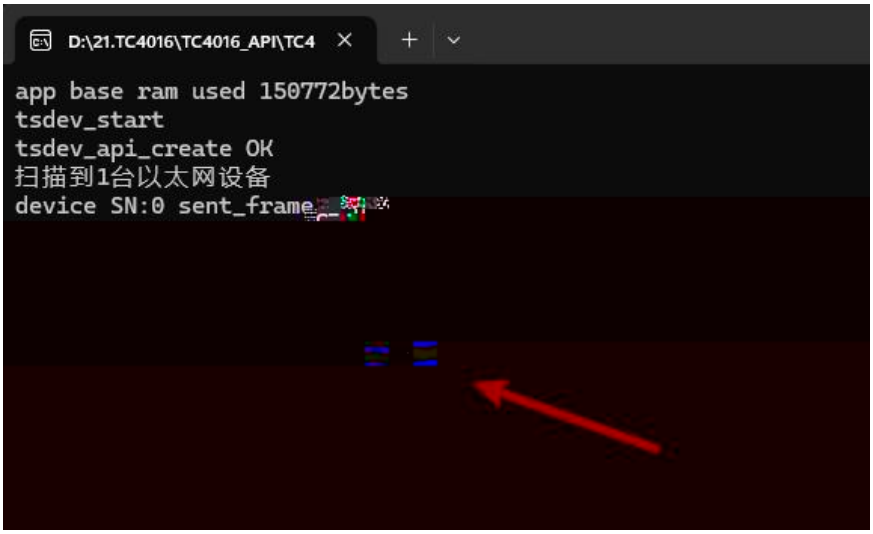
Tick time: 3 Õs

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:




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 Õs

Synchronization delay: 0 Õs

Bus holding voltage: 5.15 V

Bus trigger voltage: 4.8 V

Slot 1:

Check method: None

Slot length: 13 bits

Slot duration: 96 Õs

Slot 2:

Check method: None

Slot length: 13 bits

Slot duration: 96 Õs

Slot 3:

Check method: None

Slot length: 13 bits

Slot duration: 96 Õs

Slot 4:

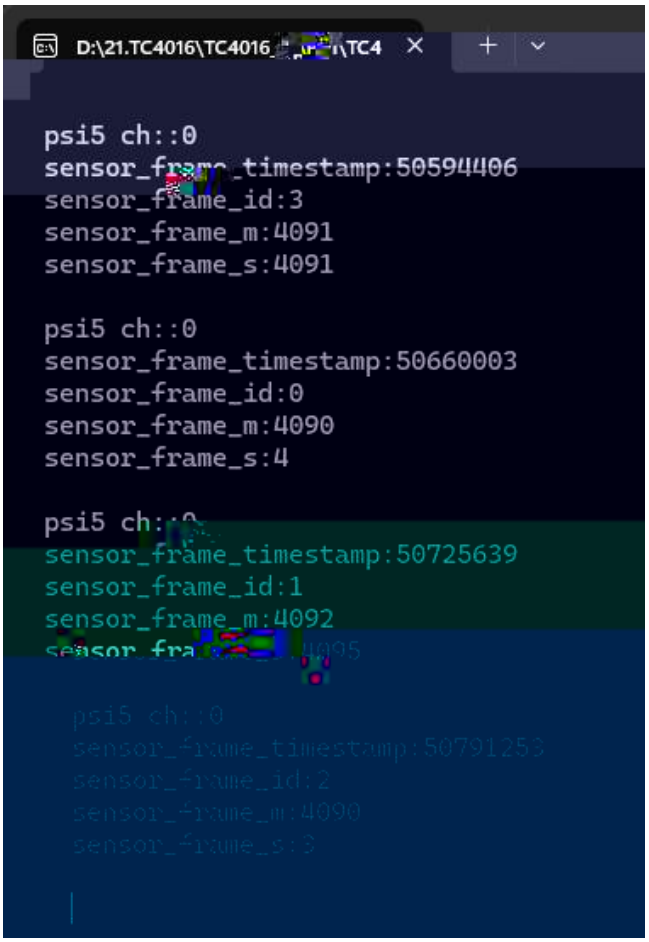
Check method: None

Slot length: 13 bits

Slot duration: 96 Õs

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

shown below:



| | | | |
|---|---|---|---|
| | | | 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

## Hardware

-Resistors for sensor simulation

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

TSMASTER

## Solutions

## About TOSUN

ISO9001:2015

CE Certification

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