NEXILICA

KIR23

Multiple sensing board over CAN bus

Revision: 1.0

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1. Features

- **Integrated type K Thermocouple connector**
- **Digital IR sensor interface**
- **Dual onboard NTC thermistors**
- **Factory-calibrated across full temperature range**
- **CAN 2.0A with CANOpen protocol support**
- **Configurable Node ID via onboard jumpers**
- **Wide operating temperature range: -20°C to +125°C**
- **Wide input voltage range: 9–28 V**
- **Compact dimensions: 50 mm × 40 mm**

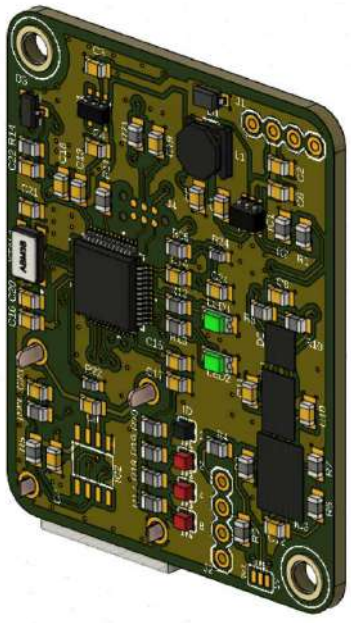

Figure 1: KIR23 1.0

2. Description

The KIR23 is a high-reliability, multi-sensor temperature monitoring PCB developed for precision thermal measurement in embedded and industrial environments. Designed with versatility and integration in mind, the board combines three complementary sensing technologies—NTC thermistors, a digital infrared (IR) sensor, and a Type K thermocouple interface—into a single, compact platform.

This module is ideal for applications requiring both contact and non-contact temperature measurements across a wide range of operating conditions. The onboard IR sensor enables remote surface temperature detection, while the thermocouple and NTC sensors provide accurate contact-based readings, including internal diagnostics and ambient conditions.

The KIR23 is engineered for seamless integration into CAN-based systems. It supports CAN 2.0A communication and is fully compatible with the CANOpen protocol, allowing for real-time data acquisition and networked sensor deployments. The board is preloaded with firmware and features a jumper-based Node ID configuration system, enabling easy deployment in multi-node environments without the need for reprogramming.

Its rugged electrical design supports a wide input voltage range (9–28 V), and the board is factory-calibrated to ensure consistent performance across its full operating temperature range.

3. Electrical Characteristics

PARAMETERS	MIN	TYP	MAX	UNIT
Voltage Supply	9	12	28	V
Supply Current	14	21	32	mA
Operating Temperature	-20	25	125	°C

Table 1: Operating conditions table

Notes: tested in climatic chamber at up to 160°C, for temperatures between 125°C and 160°C the board turns off but after it's cooled down it returns to normal functionality.

4. Board pin-out

4.1. Main connector

The board comes with four pre-soldered wires. The table below shows the corresponding pin-out based on the color of the cable.

CABLE COLOR	SIGNAL
Red	VCC (Power)
Black	GND (Ground)
White	CAN-H
Blue	CAN-L

Table 2: Cable color to signal mapping

4.2. IR sensor pinout

Switchcraft Dura-Twist Threaded Locking Connector.

Board side part: TS2P4M20.

IR sensor side part: TS2C4F20C.

Temperature ratings: -40°C to +135°C.

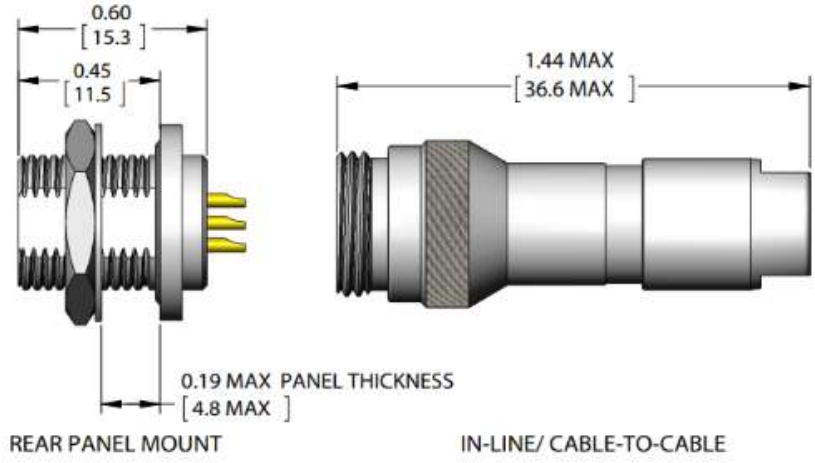

Figure 2: Connector

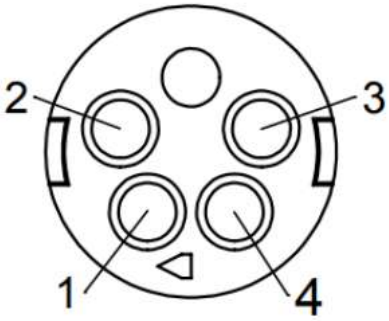

Figure 3: Male pinout

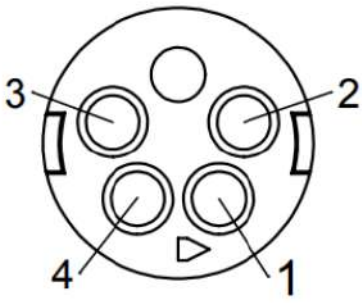

Figure 4: Female pinout

5. CAN communication

KIR23 is equipped with a robust CAN 2.0A interface, enabling reliable and deterministic communication in electrically noisy environments. The board is fully compatible with the CANOpen protocol, a standardized communication profile widely used in industrial automation and embedded systems.

5.1. Protocol specifications

Standard: CAN 2.0A (11-bit identifier)

Baud Rate: 125 kbit/s (default)

Protocol Layer: CANOpen (CiA 301 compliant)

Physical Layer: Differential signaling via CAN H and CAN L

Termination: External 120R termination required at both ends of the CAN bus

5.2. Node ID configuration

KIR23 supports dynamic Node ID assignment using four onboard jumpers (JP1–JP4). Each jumper represents a binary bit, allowing for up to 16 unique Node IDs (0–15) per network segment. The NodeID can be represented as follow:

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uint8_t NodeID = JP1 + (JP2 << 1) + (JP3 << 2) +
     (JP4 << 3);
```

This hardware-based configuration eliminates the need for software reprogramming when deploying multiple boards in a networked system.

5.3. CANOpen integration

KIR23 is fully compatible with the CANOpen protocol, enabling seamless integration into industrial automation systems and embedded networks that rely on standardized communication. CANOpen, defined by the CiA (CAN in Automation) organization, provides a higher-layer protocol for device interoperability, configuration, and real-time data exchange.

5.3.1 CANOpen Profile Support

Protocol Layer: CANOpen (CiA 301)

Device Type: Generic I/O device (custom profile)

Communication Objects:

- TPDO1 (0x180 + NodeID): Board sensor data (NTC, VCC, diagnostics)
- TPDO2 (0x280 + NodeID): IR sensor data (ambient and object temperatures)
- TPDO3 (0x380 + NodeID): Thermocouple data (internal and external temperatures)

PDO Type: Transmit PDOs (TPDOs), 8 bytes each

Transmission Type: Event-driven or synchronous (configurable via Object Dictionary)

5.4. Object dictionary

The KIR23 firmware includes a pre-defined CANOpen Object Dictionary, which maps all sensor data and configuration parameters to standard 16-bit index/subindex pairs. This allows for:

- **PDO Mapping**: Customization of which data is sent in each PDO
- **Device Configuration**: Access to parameters such as sensor calibration, diagnostic thresholds, and transmission intervals
- **Diagnostics and Status**: Monitoring of device health, error codes, and operational state

The CANOpen services supported by KIR23 are:

- **NMT (Network Management)**: Start, stop, reset, and pre-operational states
- **SDO (Service Data Object)**: Read/write access to configuration parameters

- **PDO (Process Data Object)**: Real-time data transmission
- **Heartbeat Protocol**: Node monitoring and failure detection
- **Emergency Messages (EMCY)**: Optional support for fault reporting

5.5. Integration workflow

This integration model allows the KIR23 to function as a plug-and-play sensor node in any CANOpen-compliant system, reducing development time and ensuring interoperability with a wide range of industrial controllers and gateways. This step-by-step guide outlines how to integrate the KIR23 into a CANOpen network, from physical setup to operational data acquisition.

Step 1: Physical Setup

1. Connect Power Supply: Provide a regulated DC voltage between 9 V and 28 V to the VCC and GND wires.
2. Connect to CAN Bus: connect CAN H (white wire) and CAN L (blue wire) to the corresponding lines on the CAN bus and ensure the CAN bus is properly terminated with 120R resistors at both ends.
3. Verify Wiring: Double-check polarity and signal integrity before powering on.

Step 2: Configure Node ID

The KIR23 uses four onboard jumpers (JP1–JP4) to set its Node ID. Each jumper represents a binary bit:

- JP1 = Bit 0 (LSB)
- JP2 = Bit 1
- JP3 = Bit 2
- JP4 = Bit 3 (MSB)

Example: to set Node ID = 5 (binary 0101), close JP1 and JP3.

Tip: Use unique Node IDs for each device on the same CANOpen network to avoid conflicts.

Step 3: Power On and Initialization Upon powering the board, the device enters Pre-Operational Mode and begins transmitting Heartbeat messages to indicate its presence and status. No TPDOs are sent until the device is transitioned to Operational Mode.

Step 4: Network Management (NMT)

Use a CANOpen master or configuration tool (e.g., CANopenNode, PCAN-View, Kvaser CANopen Stack) to send an NMT Start Remote Node command. This transitions the KIR23 to Operational Mode, enabling TPDO transmission.

Step 5: Optional Configuration via SDO

If needed, use Service Data Objects (SDOs) to:

- Remap PDOs (e.g., change which sensor data is sent in which TPDO)
- Adjust transmission types (e.g., synchronous vs. asynchronous)
- Set diagnostic thresholds or sampling intervals

These settings are accessed via the Object Dictionary using standard CANOpen index/subindex addressing.

Note: The default configuration is suitable for most applications and does not require modification.

Step 6: Data Acquisition

Once in Operational Mode, the KIR23 begins transmitting the following TPDOs:

- TPDO1 (0x180 + NodeID): NTC sensors, input voltage, board diagnostics
- TPDO2 (0x280 + NodeID): IR sensor ambient and object temperatures
- TPDO3 (0x380 + NodeID): Thermocouple internal and external temperatures

Each TPDO is 8 bytes and follows a fixed structure

for easy parsing.

Step 7: Monitoring and Diagnostics

Use the CANOpen master to:

- Monitor Heartbeat messages for node health
- Read diagnostic bytes in each TPDO for sensor status
- Handle EMCY (Emergency) messages if enabled in firmware

5.6. Data packets

The device sends all the data read by the sensors in three different packets. The packets are defined as PDOs. Here are reported some basics info. The detailed description can be found in the CANOpen Object Dictionary.

Packet 1 (Board sensors data): TPDO1 - ID 0x180 + NodeID

Data 0: NTC1 MSB

Data 1: NTC1 LSB

Data 2: NTC2 MSB

Data 3: NTC2 LSB

Data 4: Input VCC MSB

Data 5: Input VCC LSB

Data 6: Board Diagnostic MSB

Data 7: Board Diagnostic LSB

Packet 2 (IR sensor data): TPDO2 - ID 0x280 + NodeID

Data 0: IR Sensor Ambient Temperature MSB

Data 1: IR Sensor Ambient Temperature LSB

Data 2: IR Sensor Object Temperature b3

Data 3: IR Sensor Object Temperature b2

Data 4: IR Sensor Object Temperature b1

Data 5: IR Sensor Object Temperature b0

Data 6: IR Data Diag MSB

Data 7: IR Data Diag LSB

Packet 3 (TC sensor data): TPDO3 - ID 0x380 + NodeID

Data 0: Thermocouple Internal Temperature MSB

Data 1: Thermocouple Internal Temperature LSB

Data 2: Thermocouple Temperature b3

Data 3: Thermocouple Temperature b2

Data 4: Thermocouple Temperature b1

Data 5: Thermocouple Temperature b0

Data 6: Thermocouple Diagnostic MSB

Data 7: Thermocouple Diagnostic LSB

6. Mechanical drawings

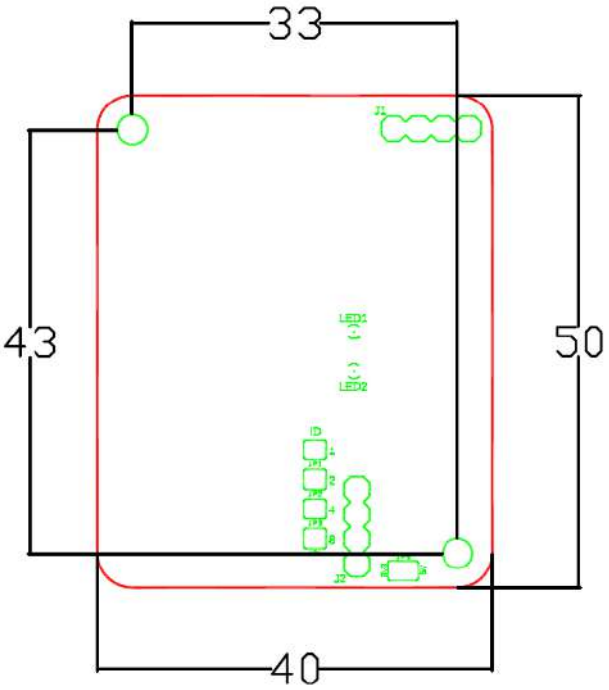

Figure 5: KIR23 v1.0 dimensions