![IXXAT logo]

CANio 250

I/O-to-CAN Gateway

![IXXAT logo]

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Content

1   General information

The CANio 250 is a universal interface for analog and digital signals.

This manual is intended to help you to learn more about the CANio 250. Please read this manual before using the CANio 250 for the first time. Therefore it is restricted to the essential topics. For further details – mainly with respect to the application software – the corresponding manuals are provided online.

1.1   Highlights

- Power supply 6 - 32 V DC
- CAN bus connection according to ISO 11898-2 with galvanic isolation
- Communication as CAN node or CANopen device
- Up to 16 digital inputs (5V CMOS level)
- Up to 16 digital outputs (5V CMOS level, max. 30mA)
- Monitoring of the power supply
- Additional digital input on power supply connector
- 2 LEDs (both two-colored) controllable via software
- 1 LED for the CAN bus status
- 1 LED for the power supply
- Robust aluminum housing
- Temperature range -40 °C to 70 °C

1.2   Designs and device variants

The CANio 250 is available in the following variants:

Order number	Designs and device versions
1.01.0099.00000	CANio 250 Standard
1.01.0099.00001	CANio 250 Plug-In

2   Connector assignments
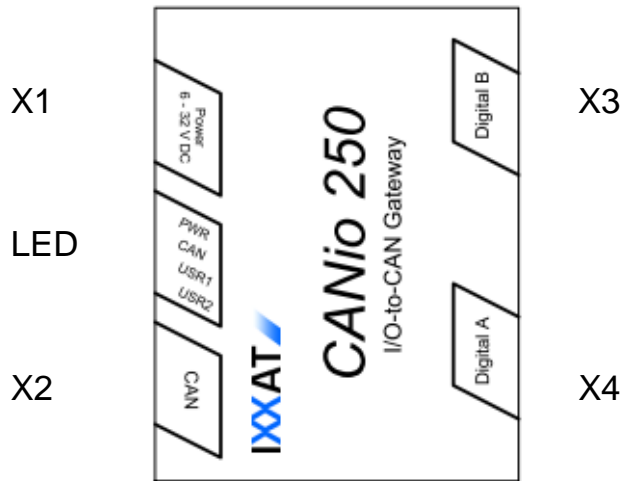
Figure 2-1: Connector assignments

2.1   Connector (X1) power supply 6-32 V DC

The CANio 500 is supplied with DC voltage of 6 V – 32 V The scope of supply includes a made-up cable for power supply. The terminal assignment is given in table 2-1.

The type of connector is: Binder cable socket 99-0976-100-03

The CANio 250 is protected against reverse polarity, undervoltage and over-voltage. It is switched off in the case of reverse polarity or undervoltage. The CANio survives overvoltage up to 60 V and load dump undamaged. In the event of voltages above this, an internal fuse may be tripped. If the internal fuse is tripped, the CANio 250 is no longer operational and must be returned to for repair.

The additional digital input is also connected on this connector.

Pin no. X1	Signal	Wire color
1	PWR (+)	white
2	GND (-)	brown
3	Additional digital input on pow-er supply connector	Shield
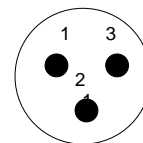
Table 2-1: Pin assignment power supply

2.2   Connector (X2) CAN

CAN is available on connector X2 with a bus connection according to ISO 11898-2. The signals of the bus connection are available on the 9-pin D-Sub connector (pins, male) (see table 2-2).

Pin Nr.	Signal
1	-
2	CAN Low
3	GND_GND
4	-
5	-
6	-
7	CAN High
8	Reserviert
9	-
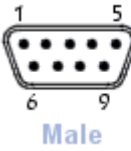
Table 2-2: Pin assignment CAN connector D-Sub 9

2.3   Connector (X3, X4) digital A/B

The digital signals are available on connector X3/4. Connector X3 is designed as a 9-pin D-Sub (socket, female), connector X4 is designed as a 9-pin D-Sub (pins, male) (see table 2-3).

The functions of the digital inputs and outputs are described in chapters 4.3.

Pin Nr.	Signal	Beschreibung
1	DIG_1	Digital In/Out 1
2	DIG_2	Digital In/Out 2
3	DIG_3	Digital In/Out 3
4	DIG_4	Digital In/Out 4
5	DIG_5	Digital In/Out 5
6	DIG_6	Digital In/Out 6
7	DIG_7	Digital In/Out 7
8	DIG_8	Digital In/Out 8
9	GND	Ground

Table 2-3: Pin assignment digital interface connector D-Sub

3 LED displays

The CANio 250 has four two-colored LEDs (see Figure 2-1). The LEDs react as follows according to the operating mode of the CANio 250.

3.1 PWR - LED

The Power-LED (PWR) is lit green when the CANio 250 is connected to the power supply. The Power-LED (PWR) is lit red when the power supply is connected with reverse polarity.

3.2 CAN - LED

The CAN-LED displays the status of the CANopen State Machine (green) and the error status. In the 'CAN BUS OFF' status, no more communication is possible and the CAN - LED is permanently lit red.

3.3 USR 1/2 - LED

The User-LEDs (USR 1/2-LED) which can be freely programmed by the user, can be switched via CAN messages. More information is given in chapters 5.1.3.

4 Description of functions

4.1 Introduction

The CANio 250 allows monitoring or setting of digital signals via a CAN network.

4.2 Galvanic isolation

In the case of galvanic isolation, the ground of CAN (GND_CAN) is isolated from the rest of the circuit.

The ground of the power supply [GND (-)] and of the digital and analog interfaces are connected to each other.

4.3 Digital outputs

In total, the CANio 250 supports up to 16, 5V CMOS compatible, digital in-/outputs. The digital outputs can be switched or monitored with CAN messages. More information is given in chapters 5.1.3.

The in-/output function can be selected in groups of 8. In this way, maximum 16 inputs, 16 outputs or 8 in-/outputs can be supported by the device.

The load at the digital outputs should not exceed 30mA. By a internal series resistor it is secured, that the device will not be damaged in case of a over-load. However, the maximum presentable output voltage is reduced in that case. The in-/outputs are not protected against reverse polarity.

4.4 Additional digital input on connector (X1)

The additional digital input on the power supply connector (X1) has a fixed threshold of approx. 7 V and can be used, for example, in the automotive sector for the monitoring of terminal 15.

4.5 Power supply PWR(+)

The power supply PWR(+) is monitored and measured with an additional analog channel. The input voltage range is between 6 and 32 V.

The voltage on the input can be calculated from the AD value as follows:

U_{IN} = AD value / 4095 * 3.30 * 10 [V]

Simplified:

U_{IN} = AD value * 8.0586 [mV]

5   Software

CANio 250 can be operated as a simple CAN module as well as a CANopen slave.

The CANio 250 is delivered with a standard configuration. The following chapters do refer to this standard configuration. Anyhow it is possible, to configure the device for the personal, specific requirements. Beside others, configurable are:

- Baudrate
- Node number, Message-IDs
- Cycle time of the messages
- Debounce time
- Behavior of the digital inputs (default value, edge triggering)

The configuration possibilities are versatile. Details are described in the CANio 250 manual which can be downloaded from the IXXAT Homepage[1].

Dependent on the use case, the various configuration possibilities can be achieved as described below:

- Via the comfortable CANio 250 configuration tool which can be downloaded from the IXXAT homepage[1].
- In pure CAN networks with the message sequences described in the CANio 250 manual
- In CANopen networks by the corresponding LSS services or objects (see CANio 250 manual)

Should the desired functionality not be reached by the described configuration possibilities, the "Application Development Kit (ADK)[2]" to be purchased at IXXAT can be used to design a specific application which can be executed on the CANio 250.

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[1] http://www.ixxat.com/can_canio250_digital_can_modul_en.html

[2] http://www.ixxat.com/can_canio500_adk_en.html

5.1 CANio 250 as a CAN module

5.1.1 CAN Identifier
The CANio 250 supports CAN identifier with 11 bits.

5.1.2 CAN baudrate
As default, the CANio 250 is delivered with the CAN baudrate 250kBit/s.

5.1.3 Node number
As default, the CANio 250 is delivered with the (CANopen-) node number 10d (0x0A). This information is required to determine the CAN identifiers of its transmit and receive messages respectively.

5.1.4 Digital outputs
The digital outputs of the CANio 250 are controlled with the following CAN message:

CAN identifier	Data field (length = 4)			
	Byte 0	**Byte 1**	**Byte 2**	**Byte 3**
0x200 + node number of the CANio 250 *Saved configuration*: saved identifier	Digital Outputs Group A	Digital Outputs Group A	reserved	digital outputs to control the USR 1/2 LEDs

Assignment of the data field is unvarying, even if the corresponding digital port is not programmed as outputs group.

Assignment of byte 0:

Bit number	Meaning
0	Value of digital output 1
1	Value of digital output 2
2	Value of digital output 3
3	Value of digital output 4
4	Value of digital output 5
5	Value of digital output 6
6	Value of digital output 7
7	Value of digital output 8

Assignment of byte 1:

Bit number	Meaning
0	Value of digital output 9
1	Value of digital output 10
2	Value of digital output 11
3	Value of digital output 12
4	Value of digital output 13
5	Value of digital output 14
6	Value of digital output 15
7	Value of digital output 16

Assignment of byte 3:

Bit number	Meaning	Value	Reaction
1:0	controls USR 1 LED	00	LED is switched off
		01	LED is lit green
		10	LED is lit red
		11	LED is switched off
3:2	controls USR 2 LED	00	LED is switched off
		01	LED is lit green
		10	LED is lit red
		11	LED is switched off
4 - 7	are being ignored		

Factory settings of the digital outputs:
- The digital outputs are initialized with 0.
- USR 1 LED and USR 2 LED are switched off.

5.1.5 Digital inputs

The CANio 250 transmits the values of the digital inputs with the following CAN message:

CAN identifier	Data field (length = 4)			
	Byte 0	**Byte 1**	**Byte 2**	**Byte 3**
0x180 + node number of the CANio 250 *Saved configuration*: saved identifier	Values of the digital inputs Group A	Values of the digital inputs Group A	reserved	Additional digital input and HW info

Assignment of the data field is unvarying, even if the corresponding digital port is not programmed as inputs group.

Assignment of byte 0:

Bit number	Meaning
0	Value of digital input 1
1	Value of digital input 2
2	Value of digital input 3
3	Value of digital input 4
4	Value of digital input 5
5	Value of digital input 6
6	Value of digital input 7
7	Value of digital input 8

Assignment of byte 1:

Bit number	Meaning
0	Value of digital input 9
1	Value of digital input 10
2	Value of digital input 11
3	Value of digital input 12
4	Value of digital input 13
5	Value of digital input 14
6	Value of digital input 15
7	Value of digital input 16

Assignment of byte 3:

Bit number	Value	Meaning
Additional digital input, see chapter 4.4.2		
0	0	no voltage is connected
	1	voltage is connected
HW info – Programming of the Digital Ports A and B		
1	0	Digital A is Inputs
	1	Digital A is Outputs
2	0	Digital B is Inputs
	1	Digital B is Outputs
3	not relevant	
7:4	reserved	Always 0

The values of the digital inputs are transmitted if at least one valid value of a digital input has changed or at the latest after 500 ms ("Msg Cycle Time"). Only valid values are transmitted and not those that were last read.

Factory setting:
- all digital inputs are interrupt triggered but not debounced

5.1.6 Digital inputs: edge events

In addition to the values of the digital inputs CANio 250 transmits the related edge events with the following CAN messages:

CAN identifier	Data field (length = 8)			
	Byte 0	**Byte 1**	**…**	**Byte 7**
0x480 + node number of the CANio 250 *Saved configuration*: saved identifier	edge events of digital input 1	edge events of digital input 2	…	edge events of digital input 8

CAN identifier	Data field (length = 8)			
	Byte 0	**Byte 1**	**…**	**Byte 7**
0x680 + node number of the CANio 250 *Saved configuration*: saved identifier	edge events of digital input 9	Values of the digital inputs Group 10	…	edge events of digital input 16

The single data bytes do inform about the count of detected edge events of a digital input before the final value has been taken.

5.1.7 Value of the power supply PWR(+)

The value of the power supply PWR(+) is transmitted with the following CAN message:

CAN identifier	Data field (length = 2)
	Byte 0/1
0x380 + node number of the CANio 250 *Saved configuration*: saved identifier	Value of the power supply PWR(+): see chapter 4.7 LSB first

Note for „Value of the power supply PWR(+)":
- It is a 16 – bit value
- Only the lower 12 bit are relevant
- The conversion from raw to physical value is described in chapter 4.7

This analog input is polled cyclically. The read value is not analyzed or processed.

The value of the power supply PWR(+) is transmitted if its value has been changed by a configurable delta value or at the latest after 500 ms.

Default configuration:
- Delta value for this input: 50 (0x32)
- The input is read every cycle of the CANio 250

5.1.8 Heartbeat message

With this CAN message, the CANio 250 signals that it is operational. This message is transmitted cyclically.

CAN identifier	Data field (length = 1)	
	Byte 0	
	Value	**Description**
0x700 + node number of the CANio 250	0x00	Bootup – Message: after power-on, the CANio 250 logs on to the CAN bus with this message
	0x05	„operational": the CANio 250 is operational: ▪ Process data can be received and transmitted ▪ It can be configured ▪ Emergency messages are generated: see 5.1.8 ▪ Heartbeat messages are generated ▪ The state machine of the CANio 250 can be controlled by the command message: see 5.1.12
	0x04	„stopped": ▪ Process data is not received nor transmitted ▪ It can't be configured ▪ No emergency messages are generated ▪ Heartbeat messages are generated ▪ The state machine of the CANio 250 can be controlled by the command message.
	0x7F	„preoperational": ▪ Process data is not received nor transmitted ▪ It can be configured ▪ Emergency messages are generated: see 5.1.8 ▪ Heartbeat messages are generated ▪ The state machine of the CANio 250 can be controlled by the command message.

Note:

▪ After Power On or an internal Reset the *Bootup* message is transmitted. The transmission of the Bootup message can't be switched off.

Default configuration:

- The heartbeat message is transmitted every 500 ms.

5.1.9 Emergency messages

The presence or absence of errors is displayed with the following CAN message:

CAN identifier	Data field (length = 8)		
	Bate 0..1	**Byte 2**	**Byte 3..7**
0x80 + node number *Saved configuration*: saved identifier	error code LSB first	general error status	details LSB first

Error code:

Value	Meaning	Error Class
0x0000	A previously detected error no longer exists: the error involved is described in bytes 3-7	
0x8000	„Interrupt Enable" of the digital inputs or „Interrupt Enable" of the analog inputs is not activated. This error code is in fact a warning: The general error state is not changed by this warning	
Communication error with the CAN bus:		
0x8100	Loss of a transmit message: at least one CAN message could not be transmitted: bytes 3-7: not relevant	0x10
0x8110	Loss of a receive message: at least one CAN message could not be received: bytes 3-7: not relevant	0x10
0x8210	The number of received data of a CAN message with which process data were transmitted was too small: bytes 3-7: not relevant	0x10
0x8140	There was previously a bus-off. The CANio 250 communicates again with the CAN-bus: bytes 3-7: not relevant	0x10

General error status:

The general error status displays the status of the error categories. The error categories are bit-encoded: 0 means free of errors, 1 not free of errors The CANio 250 is free of errors if all bits are reset.

Supported error categories:

Bit	Meaning	Comment
0	general error status	this bit is set with every error that is detected
		it is only reset when no more errors are active.
1	Reserved	= 0
2	reserved	= 0
3	Reserved	= 0
4	Communication error with the CAN bus	this error type is only reset by a power-on
5	Reserved	= 0
6 - 7	reserved	= 0

5.1.10 Error management

In the case of a bus-off, the CAN controller is automatically restarted.

5.1.11 Factory settings

The CANio 250 is delivered with the following default configuration:

- Node number: 10 (0x0A)

- CAN Baudrate: 250 kBit/s

- Digital ports:
  - Digital A: Inputs 1..8
  - Digital B: Outputs 9..16

- Digital outputs:
  - CAN Identifier: 0x200 + node number
  - Default value digital outputs: 0
  - Default value User LEDs 1 / 2: off

- Digital inputs:
  - CAN Identifier: 0x180 + node number
  - Event timer: 500 ms
  - Inhibit time: 0ms
  - Interrupt enable: TRUE
  - Edge detection: falling and rising edge
  - Debounce time: 0x0000
  - CAN Identifier edge
    events Digital A: 0x480 + node number
  - CAN Identifier edge
    events Digital B: 0x680 + node number

- Analogue input power supply:
  - CAN Identifier: 0x380 + node number
  - Event timer: 500 ms
  - Inhibit time: 0 ms
  - Delta value: 50

5.1.12 Reserved CAN identifiers

To guarantee a basic communication, the CANio 250 uses specific CAN identifiers. These identifiers can't be changed.

List of the reserved CAN identifiers:

CAN Identifier	Meaning
0x000	Command to steer the state machine of the CANio 250: see 5.1.12
0x600 + node number 0x580 + node number	These identifiers are reserved for configuration messages.
0x700 + node number	This identifier is reserved for the heartbeat message.

	Even in case that the CANio 250 shall not generated heartbeat messages, at the end of it's initialization it will transmit a *Bootup* message. The Bootup message uses this identifier.
0x7E5 0x7E4	These identifiers are reserved for messages to configure the node number and the CAN baudrate.

5.1.13 Steering the state machine of the CANio 250

The internal state machine of the CANio 250 can be steered by a specific command:

CAN identifier	Data field (length = 2)	
	Byte 0	**Byte 1**
0x000	Command	Node number

Description of the node number:

Node number	Consequence
0x00	Every CANio 250 in the network needs to execute this command
0x01 – 0x7F	The specific CANio 250 using the selected node number needs to execute the command. Otherwise the command is ignored.
else	Is ignored

Supported commands:

Command	Meaning	Consequence
0x01	„operational"	The CANio 250 is operational: ▪ Process data is received and transmitted ▪ It can be configured ▪ Emergency messages are generated ▪ Heartbeat messages are generated. Data byte 0 contains 0x05
0x02	„stopped"	The digital outputs are initialized with their factory default values. The CANio 250 is conditionally operational: ▪ Process data is not received nor transmitted ▪ It can't be configured ▪ Emergency messages are not generated

		▪ Heartbeat messages are generated. Data byte 0 contains 0x04.
0x80	„preoperational"	This command has no consequence for the digital outputs.
		The CANio 250 is conditionally operational:
		▪ Process data is not received nor transmitted
		▪ It can't be configured
		▪ Emergency messages are not generated
		▪ Heartbeat messages are generated. Data byte 0 contains 0xff.
0x81	Reset	The CANio 250 needs to be initialized completely. The Reset is described more in detail later in this document.
		The CANio 250 does not communicate with the CAN bus during this initialization.
		After being initialized, it will announce itself with the *Bootup* message at the CAN bus.
		It will be in the state „operational"
0x82	Limited Reset	The CANio 250 shall only initialize these features, with which it will communicate via the CAN bus. This limited Reset is described more in detail later in this document.
		The CANio 250 does not communicate with the CAN bus during this initialization.
		After being initialized, it will announce itself with the *Bootup* message at the CAN bus.
		It will be in the state „operational"
Else	Not defined	Will be ignored

Description of the Reset:

The CANio 250 is being initialized completely. In case that a configuration has been stored, the CANio 250 will be initialized with this configuration. In case that no configuration has been stored, or a stored one has been declared invalid, the CANio 250 will be initialized with the factory default values (see 5.1.10).

The digital outputs will be initialized with their "configured" default values.

Description of the limited Reset:

In case of the limited Reset, the I/O functionality will not be initialized:

- The configuration of the digital inputs and outputs is not changed.
- The digital outputs are not changed.

The parameters of the CAN messages the CANio 250 is using are initialized:

- CAN identifiers
- Event Timer of the CAN messages
- Inhibit Time of the CAN messages

After a configuration has been stored, these objects are initialized with the stored configuration. In case that no configuration has been stored, or a stored one has been declared invalid, the CANio 250 will be initialized with the default values (see 5.1.10).

6   General

6.1   Support

For more information on our products, FAQ lists and installation tips, please refer to the support area on our homepage (http://www.ixxat.de). There you will also find information on current product versions and available updates.

If you have any further questions after studying the information on our homepage and the manuals, please contact our support department. In the support area on our homepage you will find the relevant forms for your support request. In order to facilitate our support work and enable a fast response, please provide precise information on the individual points and describe your question or problem in detail.

If you would prefer to contact our support department by phone, please also send a support request via our homepage first, so that our support department has the relevant information available.

6.2   Returning hardware

If it is necessary to return hardware to us, please download the relevant RMA form from our homepage and follow the instructions on this form. In the case of repairs, please also describe the problem or fault in detail on the RMA form. This will enable us to carry out the repair quickly.

6.3   Note on disposal of used devices

This product is subject to the ElektroG (electrical and electronic equipment act) and is to be disposed of in accordance with this act.   The products of IXXAT that are subject to the ElektroG are devices for exclusive commercial use and are marked with the symbol of the crossed out garbage can.

Based on the B2B regulation, disposal is governed separately in the Terms of Sale of IXXAT in accordance with § 10 para. 2 clause 3 of the Electrical and Electronic Equipment Act (ElektroG) in the version of 16.03.2005.

When products supplied by IXXAT are no longer used, the customer is obliged to dispose these products at his/her own expense. It is to be noted that, unlike privately used devices (B2C), they may not be disposed of at the collection centers of public disposal contractors (e.g. municipal recycling centers). The statutory regulations for disposal are to be complied with.

If products delivered were passed on to third parties, the customer is obliged to take back the delivered products at his/her expense when no longer used and to correctly dispose of them in accordance with the statutory regulations or to impose these obligations on the third parties.

The Terms of Sale and their supplements as well as further information on the disposal of used devices can be downloaded from www.ixxat.de.

6.4   Note on EMC

This product is a class A device. This means that it is designed for industrial use and meets the EMC requirements for industrial devices.

If the product is used in offices or residential areas, it may cause radio interference in extreme cases.

To ensure perfect operation of the device, the following points are to be observed for EMC reasons.

- only use the accessories and cables provided
- all cables must be shielded
- the shield of the interfaces must be connected to the device connectors and the remote station

If problems occur when operating the device despite all the points listed, the distance between possible sources of interference (e.g. motors, frequency converters) or susceptible devices (radio receivers) and the device should be increased.

6.5   FCC Compliance

Declaration of conformity

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation

Class A digital device – instructions

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

6.6 EC DECLARATION OF CONFORMITY

IXXAT Automation declares that the product: CANio 250

with article number(s):   1.01.0099.xxxxx

complies with EC Directive 2004/108/EC.

Applicable harmonized standards   EN 55022:2006 + A1:2007
EN 61000-6-2:2005

01.04.2013, Dipl.-Ing. Christian Schlegel, CEO

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