CAN-CBX-Bridge-FD

CAN Bridge for connecting CAN Classic and CAN FD Networks

Hardware Manual

to Product C.3090.02

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Notes

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This manual contains important information and instructions on safe and efficient handling of the CAN-CBX-Bridge-FD. Carefully read this manual before commencing any work and follow the instructions.
The manual is a product component, please retain it for future use.

The software used in the CAN-CBX-Bridge-FD is subject to the license terms of the respective authors or rights holders. CAN-CBX-Bridge-FD may only be used in accordance with these license terms!

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Document History

The changes in the document listed below affect changes in the hardware as well as changes in the description of the facts, only.

Rev.	Chapter	Changes versus previous version	Date
1.0	all	First English version of CAN-CBX-Bridge-FD manual	2024-10-08
1.1	-	Safety instructions added/revised	2025-09-03
	1.2	Editorial change in figure 2	
	4.2.4	Note on compatibility revised	
	11.4.3	Chapter updated	

Technical details are subject to change without further notice.

Classification of Warning Messages and Safety Instructions

This manual contains noticeable descriptions, warning messages and safety instructions, which you must follow to avoid personal injuries or death and property damage.

This is the safety alert symbol.
It is used to alert you to potential personal injury hazards. Obey all safety messages and instructions that follow this symbol to avoid possible injury or death.

DANGER, WARNING, CAUTION

Depending on the hazard level the signal words DANGER, WARNING or CAUTION are used to highlight safety instructions and warning messages. These messages may also include a warning relating to property damage.

DANGER
Danger statements indicate a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING.
Warning statements indicate a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION
Caution statements indicate a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Notice statements are used to notify people on hazards that could result in things other than personal injury, like property damage.

NOTICE
This NOTICE statement indicates that the device contains components sensitive to electrostatic discharge.

NOTICE
This NOTICE statement contains the general mandatory sign and gives information that must be heeded and complied with for a safe use.

INFORMATION

INFORMATION
Notes to point out something important or useful.

Safety Instructions

- When working with the CAN-CBX-Bridge-FD follow the instructions below and read the manual carefully to protect yourself from injury and the CAN-CBX-Bridge-FD from damage.
- The assembly is classified as open equipment and must therefore be installed in a control cabinet that is designed for the specific environmental conditions. The control cabinet should be made of metal to improve the electromagnetic immunity of the device. It should be equipped with a key locking mechanism to prevent any unauthorized access.
- Do not use damaged or defective cables to connect the CAN-CBX-Bridge-FD and follow the CAN wiring hints in chapter: "Correct Wiring of Galvanically Isolated CAN CC Networks" .
- In case of damages to the device, which might affect safety, appropriate and immediate measures must be taken, that exclude an endangerment of persons and domestic animals and property.
- The galvanic isolation of the CAN-CBX-Bridge-FD has only functional tasks and is not a protection against hazardous electrical voltage.
- The CAN-CBX-Bridge-FD is a device of protection class III according to DIN EN 61140 and may only be operated on supply circuits that offer sufficient protection against dangerous voltages.
- External circuits connected to the interfaces of the CAN-CBX-Bridge-FD must be sufficiently protected against dangerous voltage.
- The user is responsible for compliance with the applicable national safety regulations.
- Do not open the housing of the CAN-CBX-Bridge-FD .
- The CAN-CBX-Bridge-FD must be securely installed before commissioning.
- The permitted operating position is specified as shown (Figure 3). Other operating positions are not allowed.
- Never let liquids get inside CAN-CBX-Bridge-FD. Otherwise, electric shocks or short circuits may result.
- Protect the CAN-CBX-Bridge-FD from dust, moisture, and steam.
- Protect the CAN-CBX-Bridge-FD from shocks and vibrations.
- The CAN-CBX-Bridge-FD may become warm during normal use. Always allow adequate ventilation around the CAN-CBX-Bridge-FD and use care when handling.
- Do not operate the CAN-CBX-Bridge-FD adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.

DANGER

Hazardous Voltage - Risk of electric shock due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the CAN-CBX-Bridge-FD is to be integrated.

→ All current circuits which are connected to the device must be sufficiently protected against hazardous voltage, before you start with the installation.

→ Ensure the absence of voltage before starting any electrical work.

→ Before you switch on the supply voltage, check that all plug connectors are correctly seated.

NOTICE

Electrostatic discharges may cause damage to electronic components.

→ Take the appropriate precautions for handling electrostatic discharge sensitive devices.

Qualified Personnel

This documentation is directed exclusively towards personnel qualified in control and automation engineering. The installation and commissioning of the product may only be carried out by qualified personnel, which is authorized to put devices, systems, and electric circuits into operation according to the applicable national standards of safety engineering.

Conformity

The CAN-CBX-Bridge-FD is an industrial product and meets the demands of the EU regulations and EMC standards printed in the conformity declaration at the end of this manual.

WARNING.
In a residential, commercial, or light industrial environment the CAN-CBX-Bridge-FD may cause radio interferences in which case the user may be required to take adequate measures.

Intended Use

The intended use of the CAN-CBX-Bridge-FD is the operation as CAN Bridge for connecting CAN classic and CAN FD Networks
The guarantee given by esd does not cover damages which result from improper use, usage not in accordance with regulations or disregard of safety instructions and warnings.

- The CAN-CBX-Bridge-FD is a built-in unit for installation in control cabinets, for example. It is intended for indoor use only.
- The operation of the CAN-CBX-Bridge-FD in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the CAN-CBX-Bridge-FD for medical purposes is prohibited.

Service Note

The CAN-CBX-Bridge-FD does not contain any parts that require maintenance by the user. The CAN-CBX-Bridge-FD does not require any manual configuration of the hardware except of the configuration of the configuration switch. Unauthorized intervention in the device voids warranty claims.

Disposal

Products marked with a crossed-out dustbin must not be disposed of with household waste. Devices which have become defective in the long run must be disposed in an appropriate way or must be returned to the manufacturer for proper disposal. Please, contribute to environmental protection.

Typographical Conventions

Throughout this manual the following typographical conventions are used to distinguish technical terms.

Convention	Example
File and path names	**`/dev/null`** or **`<stdio.h>`**
Function names	***open()***
Programming constants	`NULL`
Programming data types	`uint32_t`
Variable names	*Count*

Number Representation

All numbers in this document are base 10 unless designated otherwise. Hexadecimal numbers have a prefix of 0x. For example, 42 is represented as 0x2A in hexadecimal.

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1 Overview

1.1 About this Manual

This hardware manual describes the hardware of the CAN-CBX-Bridge-FD.
In this manual the CAN generations CAN CC (CAN classic) and CAN FD (CAN flexible data rate) are collectively referred to as CAN. Differences of these CAN generations are noted accordingly where relevant.

1.2 Description of CAN-CBX-Bridge-FD

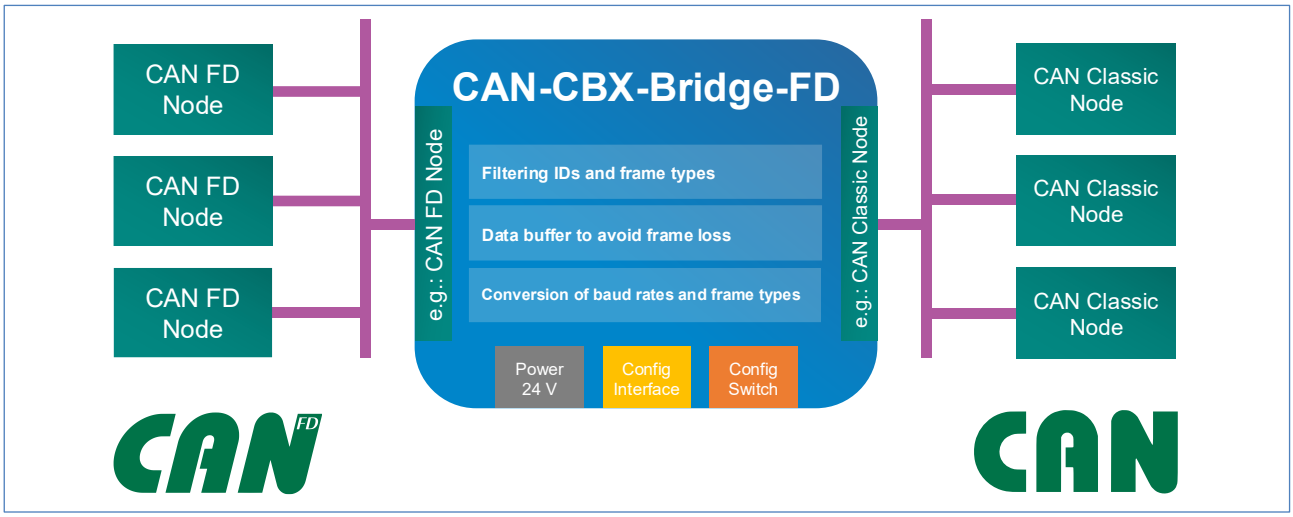


Figure 1: CAN-CBX-Bridge-FD functionality

The CAN-CBX-Bridge-FD module can link two independent CAN FD networks designed according to ISO11898-1. The CAN FD interfaces are of course fully backwards compatible with CAN CC and can also be used in CAN CC applications. Furthermore, the CAN-CBX-Bridge-FD enables the connection of CAN CC and CAN FD networks and converts CAN CC to CAN FD frames for this. The networks can operate with different bit rates.

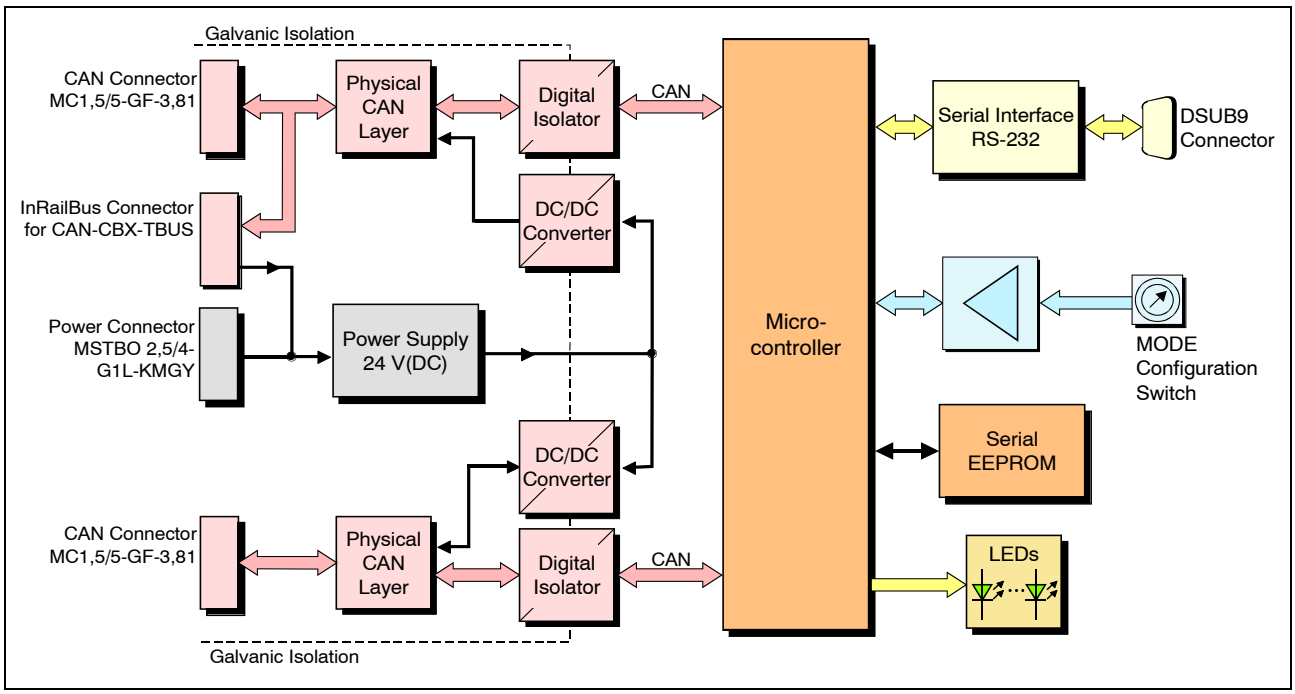


Figure 2: Block circuit diagram

The module works with a microcontroller, which buffers the CAN data in a local SRAM.

The ISO 11898-2-compatible CAN FD interfaces allow each a maximum data transfer rate of 8 Mbit/s, or 1 Mbit/s for CAN CC applications.
The CAN interfaces are galvanically isolated by optocouplers and DC/DC converters.

Using the serial interface, the CAN-CBX-Bridge-FD module can be easily configured and updated via a terminal.

The CAN-CBX-Bridge-FD has been developed as a functionally compatible replacement for the previous CAN-CBM-Bridge/2 (C.2853.02) and replicates all bridge and transfer options of this as identically as possible.

The configuration switch MODE can be used to select permanently programmed configurations. These configurations are selected via configuration switch positions not equal to '0'. They can, for example, contain fixed assignments of CAN identifiers of the two networks.

Customer-specific options for customized series production in reasonable quantities are available on request. For example, it is possible to make customer-specific presetting of bit rates and filter options. Please contact our sales team for detailed information.

1.3 Glossary

Abbreviations

Abbreviation	Term
API	Application Programming Interface
CAN	Controller Area Network In this manual the term CAN only includes CAN CC and CAN FD. CAN XL is not supported
CAN CC	CAN classic
CAN FD	CAN flexible data rate
CPU	Central Processing Unit
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
HW	Hardware
I/O	Input/Output
LSB	Least Significant Bit
MSB	Most Significant Bit
n.a.	not applicable
OS	Operating System
PDO	Process Data Object
SDK	Software Development Kit
SDO	Service Data Object
TDC	Transmitter Delay Compensation

2 Views with Connectors

2.1 Positions of the Connectors and the Coding Switch

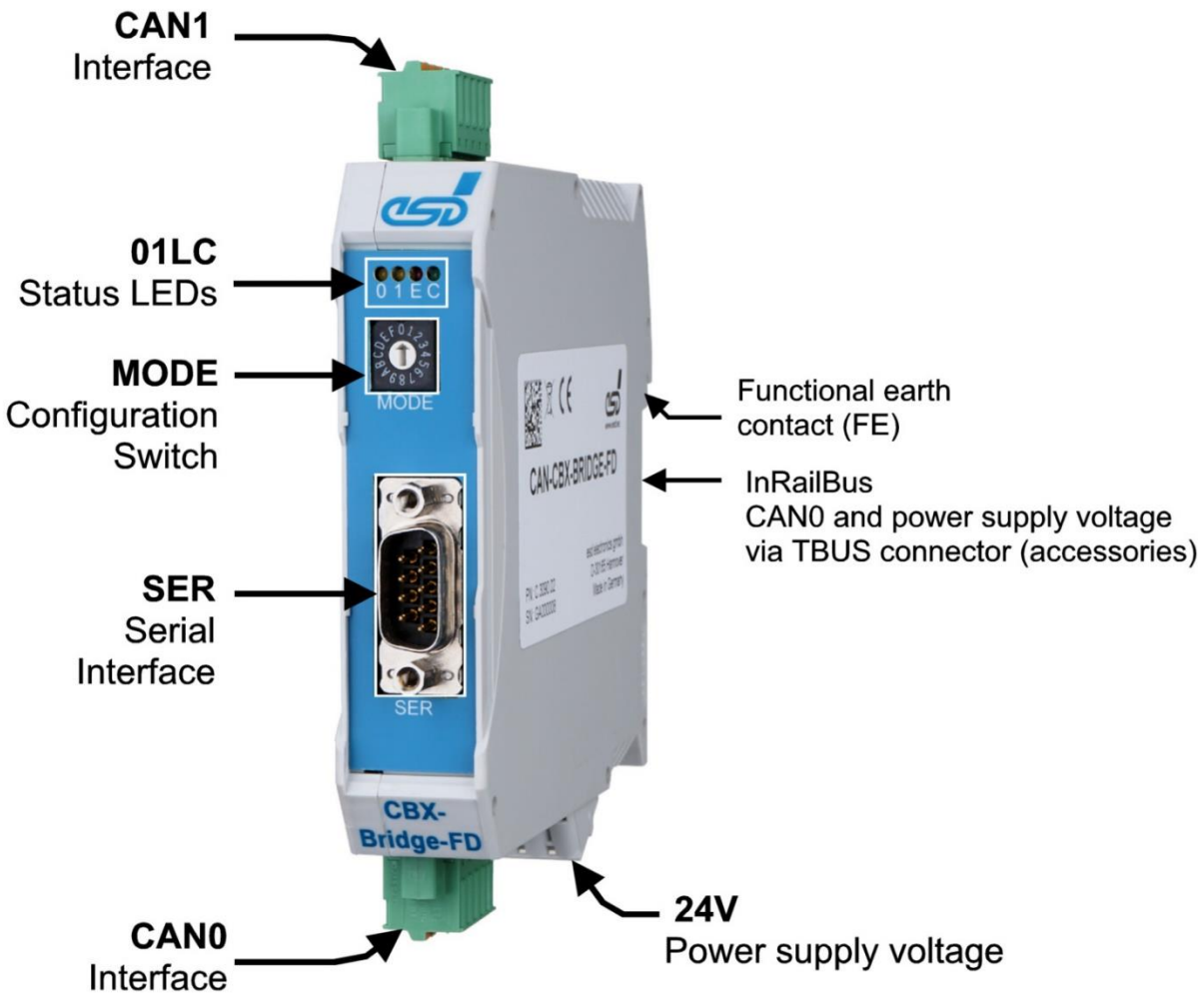


Figure 3: Position of the connectors

See also from page 35 for the signal assignments of the connectors.
For conductor connection and conductor cross section see page 38.

NOTICE
Read chapter “Installing and Uninstalling Hardware” from page 29, before you start with the installation/uninstallation of the hardware!

2.2 CAN Interfaces and 24V Power Supply

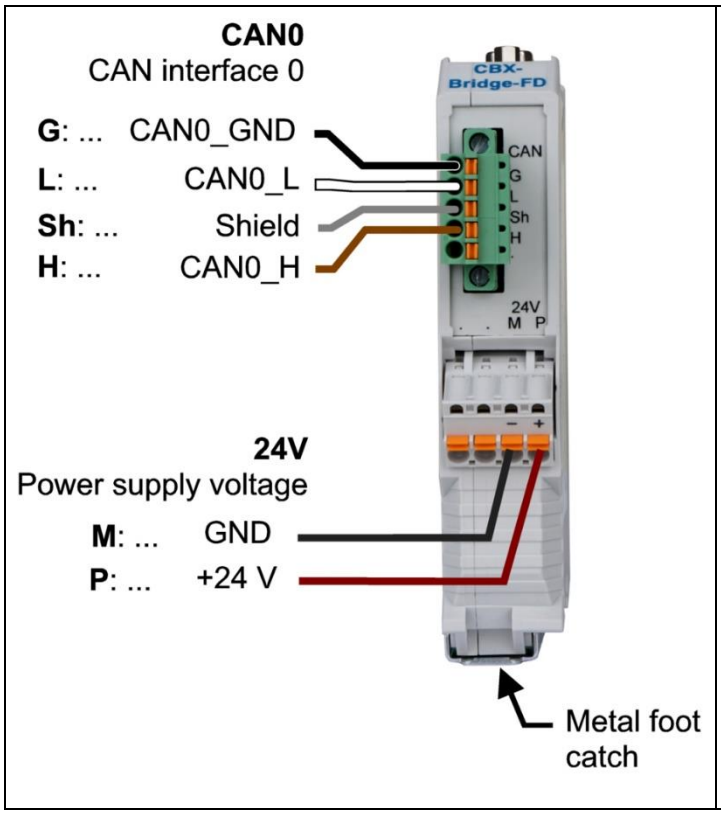


Figure 4: View of the lower side

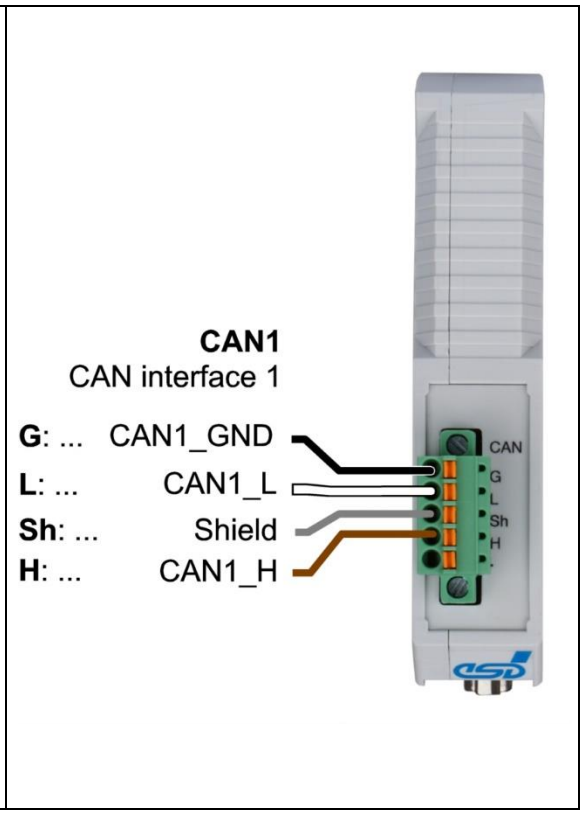


Figure 5: View of the upper side

See also from page 35 for the signal assignments of the connectors.
For conductor connection and conductor cross section see page 38.

NOTICE
Read chapter “Installing and Uninstalling Hardware” from page 29, before you start with the installation/uninstallation of the hardware!

2.3 LED Display

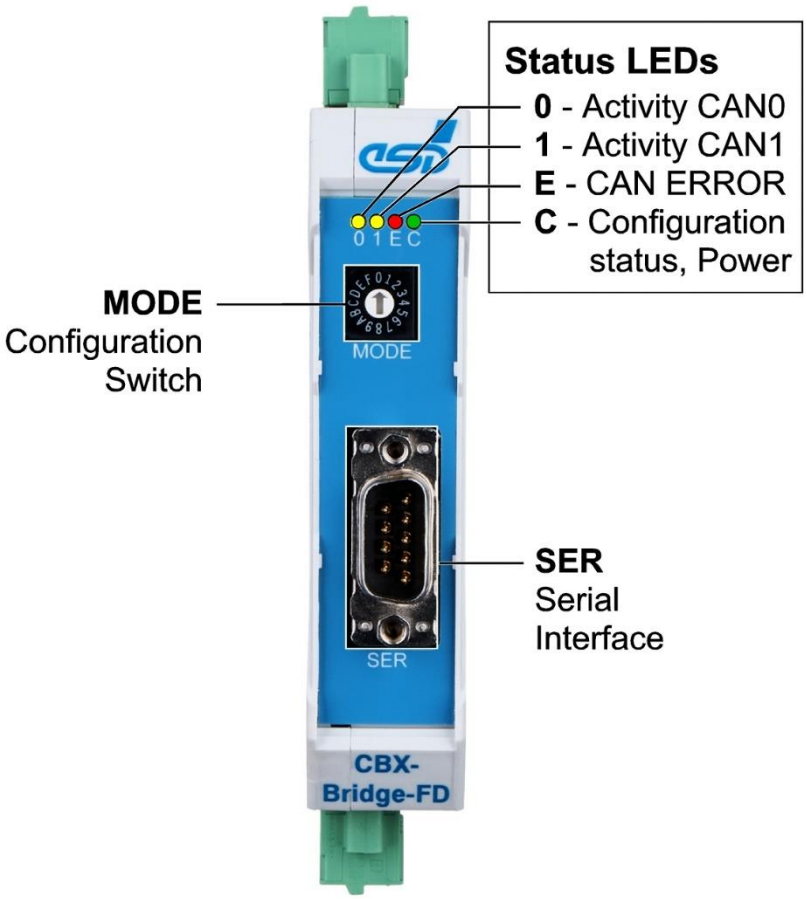


Figure 6: Position of LEDs and configuration switch in the front panel

LED	Colour	Function	Indicator State	Description
0	yellow	Activity CAN0	Off	No activity on CAN0 or CAN Error
			On	CAN0 activity - data transfer on CAN0
1	yellow	Activity CAN1	Off	No activity on CAN1 or CAN Error
			On	CAN1 activity – data transfer on CAN1
E	red	CAN ERROR	Off	CAN interfaces run without error
			On	CAN Error (such as Bus-Warn, Error Passive, Bus-Off) occurred in CAN0 or/and CAN1
C	green	Configuration Status, Power	Off	No power supply
			blinking	CAN-CBX-Bridge-FD is not completely configured (e.g. bit rate not set)
			On	CAN-CBX-Bridge-FD is configured correctly and runs error-free

Table 1: Description of LEDs

2.4 Side View with Label

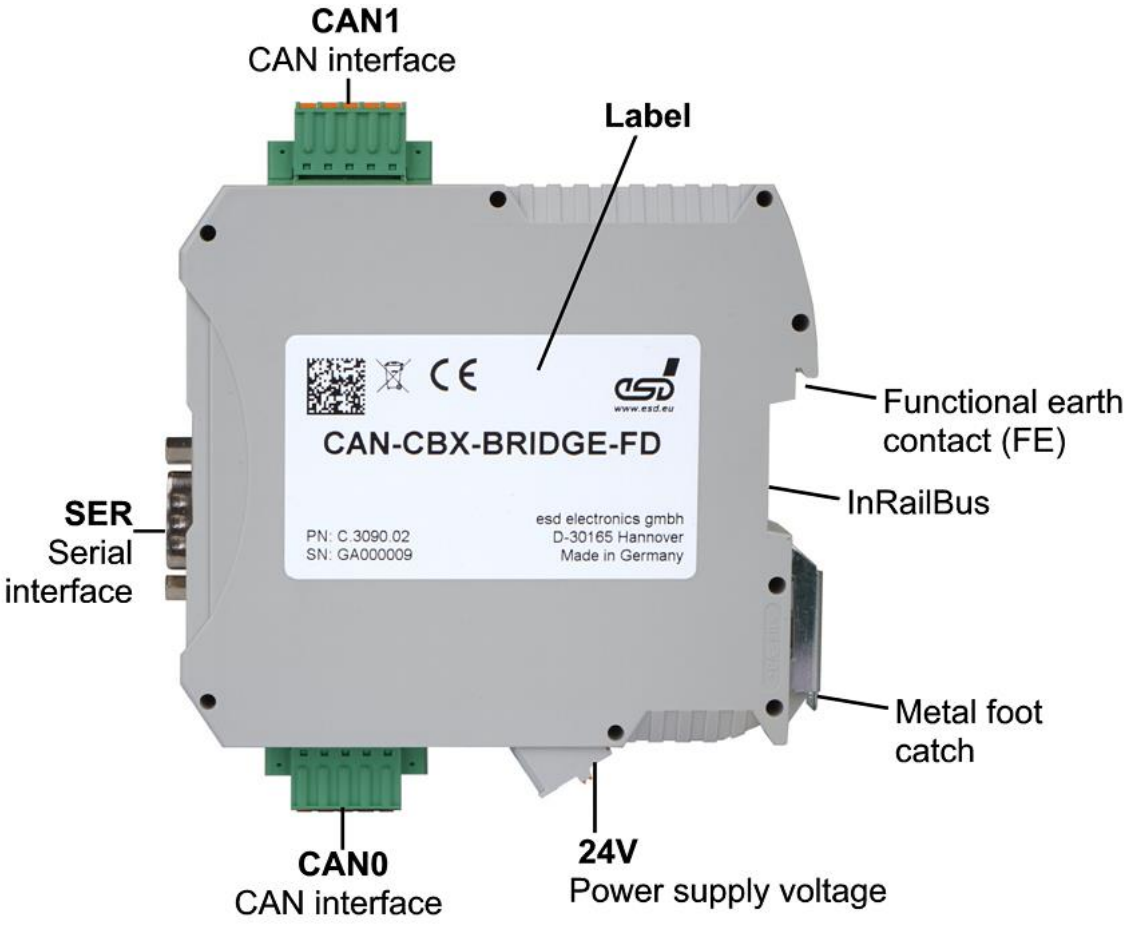


Figure 7: View of the CAN-CBX-Bridge-FD with label (Example)

The label (Figure 7) shows among others the name, esd order No. (PN) and the serial number (SN).

Label	CAN-CBX-Bridge-FD
Name:	CAN-CBX-Bridge-FD
PN (esd order No.):	C.3090.02
SN (Serial number):	Individual number of the module e.g.: GA000009

Table 2: Description of the label

3 Hardware-Configuration

3.1 Serial Interface

3.1.1 Configuration

The following settings are fixed and cannot be changed:
Bit rate: 9600 Baud
Data bits: 8
Parity: no
Stop bit: 1
Handshake: NONE

The serial interface is controlled by the microcontroller.
The bit rate is 9600 Baud. Set the user's terminal / PC to this value.
The bit rate of the serial interface cannot be changed.

3.1.2 Connecting the RS-232 Interface

The pin assignment of the DSUB9 socket is described in chapter 8.3 on page 37.
The signal name is given as an example for the connection of the CAN-CBX-Bridge-FD to a PC.

NOTICE
For the connection of the CAN-CBX-Bridge-FD module to the RS-232 interface of a PC a null modem cable must be used!

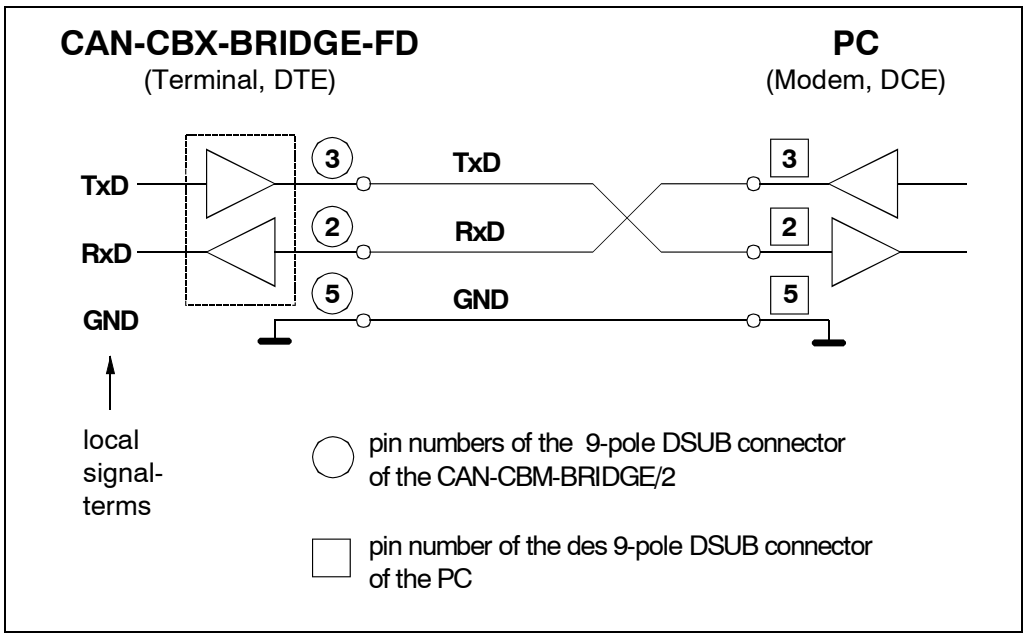


Figure 8: Connection diagram for RS-232 operation

3.2 CAN Interfaces

The CAN bit rates of the two CAN interfaces can be programmed via the serial interface. Programming can be carried out both via indices and via the specification of dedicated bit timing registers of the processor. The indices for CAN classic are described in Table 4, page 20.
Two bit rates must be programmed for CAN FD:
The nominal CAN FD bit rate index (arbitration bit rate), as described in Table 4, page 20, and the CAN FD data bit rate index as described in Table 5, page 20. Optionally the bit timing registers of the processor can be set directly, see chapter 4.2.2.2 on page 21.

3.3 Function of the Configuration Switch - MODE

The CAN-CBX-Bridge-FD can be configured via the serial interface.
Predefined configurations of the bit rate and frame filter settings are easily selectable via the configuration switch MODE, the rotary DIP switch in the front panel of CAN-CBX-Bridge-FD (see Figure 3).
As delivered, preset configurations are provided for switch positions 1 - 3 and D. If the CAN-CBX-Bridge-FD has no valid configuration and the switch is set to '0', it is inactive on CAN.

NOTICE
The configuration switch MODE may only be set when the CAN-CBX-Bridge-FD is switched off.

3.3.1 Parameter of the Switch Positions

Switch position	Bit Rate Index		Masks		Description
	CAN net 0	CAN net 1	M0:1	M1:0	
0	CAN inactive on both nets				
1	0x0	0x0	FD: 0 RTR: x 29-Bit: x Rest: x	FD: 0 RTR: x 29-Bit: x Rest: x	All CAN CC frames are transmitted in all directions. CAN FD frames are destroyed.
2	0x2:0x11	0x2:0x11	FD: x RTR: x 29-Bit: x Rest: x	FD: x RTR: x 29-Bit: x Rest: x	All CAN FD and CAN CC frames are transmitted in all directions, i.e. full transparency
3	0x2:0x11	0x2	FD: x RTR: x 29-Bit: x Rest: x	FD: 0 RTR: x 29-Bit: x Rest: x	All CAN FD frames are transferred from 0 to 1 and reduced to 8 bytes if necessary. On net 1 there is only CAN CC communication, while on net 0 there is mixed communication.
D	0x4	0x4	FD: 0 RTR: x 29-Bit: x ID-Bit_0=0: x ID-Bit_0=1: 0	FD: 0 RTR: x 29-Bit: x ID-Bit_0=0: 0 ID-Bit_0=1: x	CAN FD frames are destroyed, differentiation between even/odd identifiers, see also description of switch position **D**, page 18
4 and higher	CAN on both nets inactive like ‘0’				

Table 3: Parameters of the switch position

Description Bit Rate Index:

0x0	CAN CC bit rate index (see Table 4), page 20
0x2:0x11	CAN FD bit rate indices, 2 indices, separated by colon, Arbitrations bit rate index**:** Data phase bit rate index (see Table 4) (see Table 5) page 20

Description Masks:

0 If the corresponding identifier bit (CAN FD, RTR, 29-Bit, etc.) is set to this value (‘0’), the frame is not transmitted.

x If the corresponding identifier bit (CAN FD, RTR, 29-Bit, etc.) is set to this value (‘x’), all frames are transmitted.

See also chapter 4.2.4 on page 24 for further information about the filter masks.

Special Configuration: Switch position D

- CAN FD frames are destroyed.
- All valid messages received on CAN net 0 with an "even" identifier (ID-Bit_0 = 0) should be sent unchanged on CAN net 1, regardless of all other identifier bits.
- All valid messages received on CAN net 0 with an "odd" identifier (ID-Bit_0 = 1) should be discarded, regardless of all other identifier bits.
- All valid messages received on CAN net 1 with an "even" identifier (ID-Bit_0 = 0) should be discarded, regardless of all other identifier bits.
- All valid messages received on CAN net 1 with an "odd" identifier (ID-0 = 1) should be sent unchanged on CAN net 0, regardless of all other identifier bits.

4 Configuring CAN-CBX-Bridge-FD

This chapter describes the procedure for the configuration of the CAN-CBX-Bridge-FD, which can easily be done for example by means of the free terminal programs 'Tera Term' or 'PuTTY'.

4.1 Serial Interface and Configuration Switch

The serial interface of the PC has to be configured with the values which are described in chapter “Configuration”, (page 16).

4.2 Commands

After switching on the operating voltage, the CAN-CBX-Bridge-FD wakes up with the output of a message in the terminal program.

Example of a message after booting the CAN-CBX-Bridge-FD:

Output:	CAN-CBX-BRIDGE/3 1.5 (C) 2024 esd electronics gmbh, Hannover

In this example the CAN-CBX-Bridge-FD comes with firmware version 1.5.

The commands can be entered via the terminal program and must be completed with Carriage Return (CR, 0x0D) or Line Feed (LF, 0x0A).
When the command is entered, the firmware will send a prompt ‘>’.
All firmware outputs end with CR-LF (0x0D 0x0A), including the echo, regardless of whether you have sent CR or LF, you will receive CR-LF in the echo.

4.2.1 Display Configuration

R Display current configuration (on delivery both CAN networks are configured without bit rate -> switch position 0 (see Table 4 in chapter 0).

Example:

Input:	**R**
Output:	B0 : 0
	B1 : 0

4.2.2 CAN Bit Rate Configuration

4.2.2.1 Bit Rate Index

CAN CC Bit Rate Index / CAN FD Nominal Bit Rate Index
This table shows the bit rate index (**HexIndex**) used for CAN CC.
It is also used for the nominal CAN FD bit rate (Arbitration bit rate) called **HexIndexArbitration**

HexIndex / HexIndexArbitration (Hex)	Bit rate [kbit/s]
0	1000
1	666,6
2	500
3	333,3
4	250
5	166,7
6	125
7	100
8	66,7

HexIndex / HexIndexArbitration (Hex)	Bit rate [kbit/s]
9	50
A	33,3
B	20
C	12,5
D	10
E	800
F	85,106
10	83,33

Table 4: CAN CC and Nominal CAN FD bit rate index (**HexIndex/HexIndexArbitration**)

CAN FD Data Field Bit Rate Index
This table shows the bit rate index (**HexIndexData**) used for the CAN FD data field.

HexIndexData (Hex)	Bit rate [kbit/s]
0	1000
2	500
11	2000 TDC
12	4000 TDC
13	5000 TDC
14	8000 TDC
15	10000 TDC

TDC – Transmitter Delay Compensation switched on.

Table 5: CAN FD data bit rate index (**HexIndexData**)

CAN CC Bit Rate

With the command **B<net>:<HexIndex>** you can configure the bit rate of the non-FD net with net number **net**, (**net** = 0 for CAN0 , **net** = 1 for CAN1)
If values between 0x0 to 0x10 are specified for **HexIndex**, the bit rate is configured according to Table 4 on page 20.

Example:
In this example the bit rate of CAN net 1 (**net** = 1) shall be configured to 250 kbit/s.
From Table 4 you get the **HexIndex** = 0x4. Your input therefore is:

Input: **B1:4**

CAN FD Bit Rate

With command **B<net>:<HexIndexArbitration>:<HexIndexData>** you can configure the nominal and the data bit rates of CAN FD nets with net number **net** (**net** = 0 for CAN0, **net** = 1 for CAN1)
HexIndexArbitration is the hexadecimal Index for the nominal bit rate (arbitration bit rate). For **HexIndexArbitration** the same bit rates as those defined as **HexIndex** for non-FD nets are used. See Table 4.
HexIndexData is the hexadecimal Index of the data bit rate, see Table 5.

Example:
In this example the nominal bit rate of CAN net 1 (**net** = 1) shall be configured to 500 kbit/s and the data bit rate to 2 Mbit/s.
From Table 4 you get the **HexIndexArbitaration** = 0x2 and
from Table 5 you get the **HexIndexData** = 0x11
Your input therefore is:

Input: **B1:2:11**

4.2.2.2 Bit Rate Values

B<net>:<HexValue>
B<net>:<HexValueArbitration>:<HexValueData>

Optionally the bit timing registers of the processor can be set directly.
If the Bit31 (0x80000000) is set, the bit rate is interpreted as RAW-TSEG setting.

CAN CC Bit Rate Value

With the command **B<net>:<HexValue>** you can configure the **HexValue** of the CAN CC net with net number **net**, (**net** = 0 for CAN0 , **net** = 1 for CAN1)

The other bits have the following meaning:

Bit	HexValue/ HexValueArbitration
Bit 0 … Bit 6	TSEG2
Bit 7 … Bit 14	TSEG1
Bit 15... Bit 23	PRESCALER
Bit 24 ... Bit30	SJW

Table 6: **HexValue** (CAN CC) and **HexValueArbitration** (CAN FD)

CAN FD Bit Rate Value

With the command **B<net>:<HexValueArbitration>:<HexValueData>** you can configure the nominal bit rate value (**HexValueArbitration**, Table 6)
and the data bit rate values (**HexValueData**, Table 7) of CAN FD nets with net number **net** (**net** = 0 for CAN0, **net** = 1 for CAN1)

Bit	HexValueData
Bit 0 … Bit 3	SJW
Bit 4 … Bit 7	TSEG2
Bit 8 ... Bit 12	TSEG1
Bit 16 ... Bit 20	PRESCALER
Bit 23	TDC – Enable

Table 7: **HexValueData** (CAN FD only)

The CAN-Core runs with 80 MHz.
The bit rate results from the register settings:

Bit rate = 80000000Hz/((PRESCALER+1)*(TSEG1+TSEG2+3))

Example:
PRESCALER = 0, TSEG1= 62, TSEG2 = 15

Bit rate = 80000000Hz/((0+1)(62+15+3)) = 1.000.000 Hz = 1 Mbit/s

4.2.2.3 Bit Rate as canonical Values

`B<net>:<brp>,<tseg1>,<tseg2>,<sjw>`
`B<net>:<brp>,<tseg1>,<tseg2>,<sjw>:<dbrp>,<dtseg1>,<dtseg2>,<dsjw>,<tdc>`

For convenience, it is also possible to enter the baud rate as canonical values:
CAN CC bit rate: **`B<net>:<brp>,<tseg1>,<tseg2>,<sjw>`**
CAN FD bit rate: **`B<net>:<brp>,<tseg1>,<tseg2>,<sjw>:<dbrp>,<dtseg1>,<dtseg2>,<dsjw>,<tdc>`**.
The individual values are given in decimal (!) format and start at 0. The firmware will shift the values to the correct bit positions and form a (hex) **`B`** command with bit 31 set.
The outcome can be checked via the **`R`** command.
Valid ranges for the values can be deducted from Table 6 and Table 7 see page 21.
Values too big to fit into the bitfield will result in an error message on the console.
The value for **`<tdc>`** can only be 0 (off) or 1 (on).

NOTICE
For reliable FD communication, especially at higher bitrates, it is recommended to set brp=dbrp, in other words the prescalers should be the same.

4.2.3 CAN FD Identifier Bit, RTR-Bit, 29-bit ID select and ID Conversion

`I0:<ID Net 0> I1:<ID Net 1>`

This command assigns an identifier of CAN net **0** to an identifier of CAN net **1**. The identifier **`ID Net 0`**, which is received by CAN net **0** is assigned to identifier **`ID Net 1`** of CAN net **1**.

NOTICE
If you want to configure 29-bit CAN identifier (value range Bit28 ... Bit0), Bit29 has to be configured (0x20000000).

Example:
In this example the 29-bit identifier 0x3456789 of net **0** is mapped to the 11-bit identifier 0x543 of net **1**.

Input: **`I0:23456789 I1:543`**

Example:
In the following example the 11-bit identifier **`ID Net 0`** = 0x200 is mapped to the 11-bit identifier **`ID Net 1`** = 0x300.

Input: **`I0:200 I1:300`**

`I1:<ID Net 1> I0:<ID Net 0>`

This command assigns an identifier of CAN net **1** to an identifier of CAN net **0**.
The identifier **`ID Net 1`**, which was received by CAN net **1** is transmitted to identifier **`ID Net 0`** of CAN net **0**.

Example:
In this example the 29-bit identifier **`ID Net 1`** = 0x4567893 is to be transmitted to the 11-bit identifier **`ID Net 0`** = 0x205.

Input: **`I1:24567893 I0:205`** >Enter<

A total of 32 assignments is possible for both directions.
The bits 31 to 29 of the identifiers are defined as follows:

Bit	Meaning	Bit set to	Description
Bit31	CAN FD select	1	CAN FD frame - The filter ignores normal frames when receiving. If necessary, messages from the other network are converted into CAN-FD frames and sent as such. See also **Special Cases** page 23
		0	Non-FD frame - CAN FD frames are deleted
Bit30	RTR	1	Remote frame (Remote transmission request)
		0	No RTR frame
Bit29	29-bit ID select	1	29-bit identifier
		0	11-bit identifier

Table 8: Identifier bits 31 to 29

NOTICE
Please note that the bits are numbered from right to left (Bit31 … ← … Bit0).
The first bit from the left is therefore Bit31.

Bit31 is the CAN FD Bit. For example:
Identifier **`ID Net 1`** = 0x123 (Bit31 = 0) will respond to non-FD frames, both normal data frames and RTR frames.

Identifier **`ID Net 1`** = 0x80000123 (Bit31 = 1) will respond to CAN FD frames. The filter will ignore normal frames (source ID) or generate CAN FD frames (target ID).

Special Cases - Conversion from CAN CC to CAN FD and vice versa
If the CAN FD bit (Bit 31) is different for *id-from* and *id-to*, the frame is converted (as far as possible). The following special cases are relevant:

From CAN CC to CAN FD:
- If the DLC is greater than ‘8’ (= 9 ... F, with 8 data bytes), it is set to ‘8’ at CAN FD.
- If it is an RTR-frame it is not transmitted.

From CAN FD to CAN CC:
- If the frame is longer than 8 bytes of data, the DLC (8 ... F) is accepted, but the data is cut off after 8 bytes.

4.2.4 Filter Masks

M<net-from>:<net-to>:<mask>

This command defines masks for identifiers.
This means that all identifiers or specific areas of identifiers can be assigned.

Here is: **<net-from>:** 0,1...
<net-to>: 0,1...
<mask>: 0, 1, x... <Bit31 … ← … Bit0>
0: the corresponding bit must be logically 0
1: the corresponding bit must be logically 1
x: the status of the corresponding bit does not matter

NOTICE
Please note that the bits are numbered from right to left (Bit31 … ← … Bit0).
The first bit from the left is therefore Bit31.

The **mask** consists of 32 bits (with characters 0, 1, x).
The bits 31 to 29 are interpreted as follows:

Bit	Meaning
Bit31	CAN FD
Bit30	RTR
Bit29	29-bit ID select

Table 9: Bit31 – Bit29

Compatibility mode (30 bits)
For compatibility with predecessor devices that only supported 30-bit masks, the new device also accepts masks with 30 characters (Bit29 … Bit0).
In this case, Bit30 (RTR) and Bit31 (CAN FD) are automatically interpreted as x (don't care).
This ensures that existing configurations from earlier products continue to work without modification.

If no CAN FD bit rate is set at the destination network, the same applies as described above under "From CAN FD to CAN CC" see page 23.
Bit29 is used to distinguish between 11-bit and 29-bit identifiers.
If you set the 29-bit bit to 1, only 29-bit frames will pass through this filter, but not 11-bit frames.
The Bit29 is the distinction bit, the following bit is the MSB of the CAN identifier, etc.

Bit 29	Meaning
0	11-bit identifier
1	29-bit identifier

Table 10: Meaning Bit29

Examples:
In the following examples only 11-bit or 29-bit identifiers are let through from net 0 to net 1:

Example for 11-bit Identifier

Input: **M0:1:xx0xxxxxxxxxxxxxxxxxxxxxxxxxxx** >Enter<

Example for 29-bit Identifier:

Input:	**M0:1:xx1xxxxxxxxxxxxxxxxxxxxxxxxxxx**	>Enter<

In the following examples only the **odd 11-bit or 29-bit identifiers between 0x0 and 0xFF** are let through from net 0 to net 1:

Example – odd 11-bit Identifier:

Input:	**M0:1:xx00000000000000000000xxxxxxx1**	>Enter<

Example – odd 29-bit Identifier:

Input:	**M0:1:xx10000000000000000000xxxxxxx1**	>Enter<

It is possible to define four 11-bit or 29-bit masks at the same time.

4.2.5 Other Commands

E - Store all settings to EEPROM

After the configuration has been successfully completed, the settings are valid immediately. The configured data can be stored in the configuration memory by means of command **E**. Up to 16 configurations can be stored in the configuration memory (EEPROM). The command **E** saves the configuration selected by the configuration switch (MODE see Figure 3) at power-up, or if 'L' command was used, the last loaded configuration.

Input:	**E**

EP<code> - Store all settings to EEPROM, protected with code (hex, 32bit)

If you save the configuration with **EP<*code*>** instead of **E**, it is saved as "protected". When saving, you specify a 32-bit value (*code*), which is the code that can be used to remove the protection.

Input:	**EP<*code*>**

Example:
Input: **EP1234BEEF**
The configuration is now saved and protected with the *code* = *1234BEEF*
If you load the configuration, you cannot change it unless you remove the protection with the "P" command.

NOTICE
If the code is not known, the protection cannot be removed.
Keep the code in a safe place for further use!

P<*code*> – Unprotect current configuration

To unprotect the configuration if the configuration is protected with EP<*code*> before, use **P<*code*>**.

Input:	**P<*code*>**

Example:
Input: **P1234BEEF**
This removes the protection if the code from the example above (see command **EP**) is

used. If the code is not known, the protection cannot be removed!
On delivery, all 16 configurations are not protected. All configuration slots are freely programmable.

C – Clear all settings (also in EEPROM) and deactivate bridge

You can delete a configuration again by means of the command **C**.
The command deletes **all** identifier assignments and resets the CAN bit rates NONE, no bit rate. The configuration memory is also deleted.
The command **C** clears the configuration selected by the configuration switch MODE at power-up, or if 'L' command was used, the last loaded configuration.

Input: **C**

L<cfg-nr> – Switch to / load config specified by cfg-nr (0 ... F)

L can be used to load and activate the configuration assigned to a specific configuration switch position.

Input: ***L***

Example:
Input: **L5**
Input: L5 would in principle be equivalent to turning the rotary configuration switch to 5 and making a power cycle or reset (**Q** command).

C and **E** commands then affect the configuration for the selected configuration switch position. **E** saves and **C** clears the configuration as usual, but now for the current configuration set or selected with the **L** command.
There are 16 configurations that can be saved in principle.

Q - Reset

The command **Q** triggers a reset of the CAN-CBX-Bridge-FD. This command only restarts the module. The configured settings are not changed.

Input: **Q**

D – Read/Show config solder bridges and rotary switch(es) state

The command **D** shows the setting of the coding switch. S: 0 … F (hexadecimal format).
The answer to the D command looks like this: S:*XXYZ*
XX = solder bridges, *YZ* = configuration switches
The solder bridges and the non-populated configuration switch are for future-use only and currently ignored by the firmware.
As only one configuration switch is equipped, Z is the position of this configuration switch and Y is always 0xF. The solder bridges are not equipped, therefore XX is always 00.
The command is only used for test purposes. The configuration switch is normally only read out at startup (except for this command).
Example:
In the following example the configuration switch is adjusted to 0xA.

Input: **D**
Output: S: *00F*A

U – Firmware update

See chapter 4.2.7 for further information.

V – Print version

The command **V** can be used to display the software and hardware versions.

Example:

Input: **V**

Output:
```
Firmware V1.5 built May 14 2024 16:37:35
GCC 12.3.1 20230626
CMSIS V5.0.3
HAL V1.2.2
FreeRTOS V10.3.1
CPU STM32G4 Category 3 Revision Y
MCAN V3.2.1 2014-12-18
Serialnumber AA000001
```

H or **?** **– Help Text**

With the commands **H** or **?** a help text can be shown, which contains a list of the available commands:

Input: **H**

Output:

C - Clear all settings (also in EEPROM) and deactivate bridge

E - Store all settings to EEPROM

EP<code> - Store all settings to EEPROM, protected with code (hex, 32bit)

R - Read/Show all settings

B<net>:<baud> - Set baud rate

B<net>:<brp>,<tseg1>,<tseg2>,<sjw> - Set baud rate

B<net>:<baud-arb>:<baud-data> - Set FD baud rate

B<net>:<brp>,<tseg1>,<tseg2>,<sjw>:<dbrp>,<dtseg1>,<dtseg2>,<dsjw>,<tdc> - Set CAN FD baud rate

M<net-from>:<net-to>:<mask> - Set mask (max: 4 per net)

I<net-from>:<id-from> I<net-to>:<id-to> - Set single id forwarding (max: 32 per net)

L<cfg-nr> - Switch to / load config specified by cfg-nr (0 ... F)

P<code> - Unprotected current configuration

D - Read/Show config solder bridges and rotary switch(es) state

Q - Reset

U - Firmware update

V - Print version

4.2.6 Modifying Existing Configurations

It is not possible to modify single parameters of an existing configuration except for the baud rates. The entire configuration must be deleted and reprogrammed.
Therefore, you can call the command **C** (see page 26) and clear all parameters. After that you must configure the CAN-CBX-Bridge-FD again with the correct parameters.
Do not forget to call the command **E** to store the configured data to the configuration memory.

4.2.7 Firmware Update

The firmware update is done via the serial interface.

U **Firmware Update**
With the command **U** you can update the firmware of the CAN-CBX-Bridge-FD..

Input: **U**

After the command, the update file must be sent with the terminal program without protocol. During the transmission the update is fail-safe, but not for the subsequent recopying (duration approx. 2-3 seconds).
The firmware update is protected by CRCs and the 2-3 seconds during which the power must not be switched off only begin after a valid firmware has been successfully transferred.

5 Installing and Uninstalling Hardware

To install or uninstall the CAN-CBX-Bridge-FD please follow the installation notes.

Step	Procedure	See Page
	**NOTICE** **Read the safety instructions at the beginning of this document carefully before you start with the hardware installation!**	From 5
	**DANGER** Hazardous Voltage - Risk of electric shock due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the CAN-CBX-Bridge-FD is to be integrated. → The CAN-CBX-Bridge-FD is a device of protection class III according to DIN EN 61140 and may only be operated on supply circuits that offer sufficient protection against dangerous voltages. → External circuits connected to the interfaces of the CAN-CBX-Bridge-FD must be sufficiently protected against dangerous voltages. → Compliance with the applicable national safety regulations is the responsibility of the user. → Ensure the absence of voltage before starting any electrical work.	
To install, continue as described in chapter 5.1‘Installing the Hardware’. To uninstall, continue as described in chapter 5.2 ‘Uninstalling the Hardware’.		

Table 11: Danger warning and instructions

5.1 Installing the Hardware

Step	Procedure	See Page
	Read and follow the safety instructions at the beginning of chapter 5.	
1.	Mount the CAN-CBX-Bridge-FD module and connect the interfaces (power supply voltage, CAN0, CAN1 interface) as described in chapter 2.1 and 2.2.	12, 13
	See also chapter 8 for ‘Connector Assignments’.	35
	**NOTICE** Incorrect wiring of the 24V power supply voltage can cause damage to the module! → Make sure to connect the cables correctly to the 24V line connector! → Only use suitable cables for the line plug → If applicable, observe the instructions for using the InRailBus.	35, 36 from 49
2.	Please note that the CAN bus must be terminated at both ends! esd offers special T-connectors and termination connectors for external termination. Additionally, the CAN_GND signal must be connected to earth at exactly one point in the CAN network. For details, please read chapter ‘Correct Wiring of Galvanically Isolated CAN CC Networks’.	39
3.	Set the configuration switch MODE according to your needs or program the CAN-CBX-Bridge-FD as needed.	17
4.	Before you switch on the supply voltage, check that all plug connectors are correctly seated. Switch on the 24 V-power supply voltage.	
5.	Continue with the installation of the software, as described in chapter 3.	16

Table 12: Hardware installation

5.2 Uninstalling the Hardware

Step	Procedure	See Page
1.	Read and follow the safety instructions at the beginning of chapter 5.	29
2.	Make sure that all connected interfaces and power supply are switched off.	
3.	Disconnect the CAN-CBX-Bridge-FD from the connected interfaces.	12
4.	Use a screwdriver to pull the fastening spring downwards while swivelling the CAN-CBX-Bridge-FD module upwards until it comes loose.	51
5.	Carefully remove the CAN-CBX-Bridge-FD.	

Table 13: Hardware uninstallation

6 Technical Data

6.1 General Technical Data

Power supply voltage	Nominal voltage: 24 V Input voltage range 12 V … 32 V DC Current consumption: $I_{24VTYPICAL}$ = approx. 25 mA, I_{24VMAX} = approx. 35 mA
Protective circuits	Reverse voltage protection Overvoltage protection (triggering voltage = 32 V)
Temperature range	-20 °C ... +70 °C °C ambient temperature
Humidity	Max. 90%, non-condensing
Protection class	IP20
Pollution degree	Maximum permissible according to DIN EN 61131-2: Pollution Degree 2
Housing	Plastic housing for carrier rail mounting NS35/7,5 DIN EN 60715 (ME MAX)
Form factor / Dimensions	Width: 22.5 mm, height: 99 mm, depth: 114.5 mm (without connectors)
Weight	Max. 150g

Table 14: General data of the module

6.2 Connectors

Name	Function, Interfaces	Type	Durability (e.g. grade, contact surface, mating cycles)	Name in schematic diagram
CAN0	CAN Interface	5-pos. Phoenix Contact PCB terminal block MC 1,5/5-GF-3,81 including cable connector FK-MCP 1,5/5-STF-3,81	25 mating cycles	X150
CAN1	CAN Interface	5-pos. Phoenix Contact PCB terminal block MC 1,5/5-GF-3,81 including cable connector FK-MCP 1,5/5-STF-3,81	25 mating cycles	X170
SER	Serial (RS232)	DSUB9, pin contacts	200 mating cycles	X230
24V	24V-power supply	4-pos. Phoenix Contact PCB terminal block MSTBO 2,5/ 4-G1L KMGY including cable connector FKCT 2,5/4-ST KMGY with push-in spring connection	25 mating cycles	X101
InRailBus	CAN0 and 24V power supply via InRailBus	5-pos. TBUS connection, for CAN-CBX-TBUS connector see Order Information InRailBus Accessories, page 49	n.a	X100

Table 15: Connectors

6.3 CAN (FD) Interfaces

Number of CAN interfaces	2 (CAN0, CAN1)
CAN controller	According to ISO 11898-1, contained in CPU
Physical CAN Layer	High-speed CAN interface according to ISO 11898-2, CAN CC bit rate 10 kbit/s up to 1 Mbit/s CAN FD bit rates up to 8 Mbit/s
Galvanic isolation	Separation by means of independent digital isolators and DC/DC-converters for each interface. Voltage over CAN isolation (CAN to housing/EARTH or “PE (mounting rail)”; CAN to Host/System Ground; CAN to CAN): 1kV DC @ 1s (I < 1 mA)
Bus termination	None, Terminating resistor has to be set externally if required
Connector	CAN0, CAN1 (see 6.2) The signals of CAN0 are also connected through to TBUS.

Table 16: Data of the CAN interface

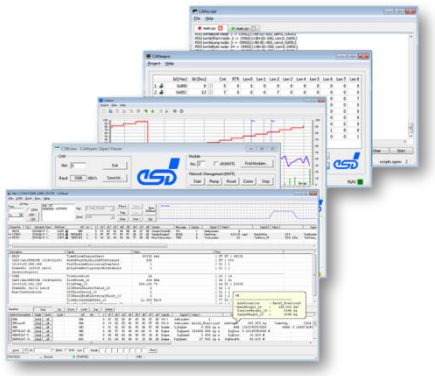
6.4 Serial Interface

Number	1 asynchronous serial interface
Standard	EIA/TIA-232E
Controller	Integrated in CPU
Bit rate	9600 Baud, 8 Bit, No Parity 1 Stop-Bit
Physical Interface	RS232 with RxD, TxD
Galvanic isolation	None
Software	Standard operating system driver
Connector	SER (see 6.2)

Table 17: Data of the serial interface

6.5 Software Support

CAN Tools
esd offers additional free-of-charge tools which support efficient setup and analysis of CAN applications and networks.
The CAN Tools are operational with all esd PC-CAN interfaces (e.g. PCIe, USB, EtherCAN/2 ...)



The following CAN Tools are available:

CANreal	Display and record of CAN message frames
CANplot	Graphical display of CAN data
CANrepro	Replay of pre-recorded CAN messages
CANscript	Python based scripting tool
COBview	Analysis and diagnostics of CANopen® nodes

System Requirements:
- Windows 32-bit or 64-bit system
- esd CAN driver installed

As part of the esd software development kit (CAN SDK) of the NTCAN-API the CAN Tools are included in delivery of the CAN-CD.
The CAN SDK can also be downloaded free-of-charge from the esd website.

7 Software Licenses

NOTICE
The software from esd and from third parties used in the CAN-CBX-Bridge-FD is subject to the license terms of the respective authors or rights holders. CAN-CBX-Bridge-FD may only be used in accordance with these license terms!
By using the CAN-CBX-Bridge-FD you agree to the terms of these software licenses.

You can download the licenses from our website, see the following chapter.

7.1 3rd Party Software License Terms

License Name	Identifier (from SPDX License List)
MIT License	MIT
BSD 3-Clause "New" or "Revised" License	BSD-3-Clause

Table 18: 3rd Party Software License Terms

- The CAN-CBX-Bridge-FD uses the opensource operating system FreeRTOS™.
  For the full license text see FreeRTOS, Amazon.com, Inc., Licence Details:
  https://www.freertos.org/a00114.html#license_comparison

  This also includes the MIT open source license.
  You can also download the text of the MIT License from our homepage, see **Table 18**.

- CMSIS End User License Agreement, For the full text of the End user licence agreement for the cortex microcontroller software interface standard (CMSIS) deliverables see:
  CMSIS_END_USER_LICENCE_AGREEMENT.pdf

- The CAN-CBX-Bridge-FD uses the libraries of ST Microelectronics
  The library of ST is subject to the 3rd Party Software License Terms of BSD-3-Clause, see **Table 18**.

7.2 Open-Source Software Copy

You may obtain a copy of the open-source source code, if and as required under the license by sending a mail to oss-compliance@esd.eu

You may also obtain a copy of the open-source source code, if and as required under the license, by sending a check or money of EUR 25.00 to:
esd electronics gmbh
Vahrenwalder Str. 207
30165 Hannover, Germany

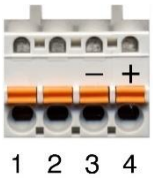
8 Connector Assignments

8.1 24V Power Supply Voltage Plug

DANGER
The CAN-CBX-Bridge-FD is a device of protection class III according to DIN EN 61140 and may only be operated on supply circuits that offer sufficient protection against dangerous voltages.

Device socket: Phoenix Contact PCB header MSTBO 2,5/4-G1L-KMGY
Cable plug: Phoenix Contact cable connector FKCT 2,5/4-ST, 5.0 mm pitch, Push-in spring connection, included in the scope of delivery (Phoenix Contact order No.: 19 21 90 0)
For conductor connection and conductor cross section see page 38.

Pin Position on cable plug:



Pin Assignment:

			24V	
Device housing label	.	.	M	P
Connector label	(none)	(none)	-	+

Pin	1	2	3	4
Signal	P24 (+ 24 V)	M24 (GND)	M24 (GND)	P24 (+ 24 V)

Please refer to the connecting diagram page 13.

INFORMATION
The P24 pins (pin 1, 4) and the M24 pins (pin 2, 3) are connected internally.

NOTICE
There is a connection between the 24V plug and the InRailBus so that the module can be supplied via the InRailBus. Note that this connection is not designed to feed the 24V supply voltage via the plug to the InRailBus.
Feeding through the 24V power supply voltage can cause damage on the module!
Further wiring via the plug is possible. Use pin 1 and 2 as input wiring and pins 3 and 4 as output to the next module for example. Note that the limit values of the plug must not be exceeded and that voltage drops may occur in the plug.

→ Make absolutely sure to connect the cables correctly to the cable plug!
→ Use only suitable cables for the line plug.

Signal Description:
P24... Power supply voltage (Nominal voltage = +24 V)
M24... Reference potential

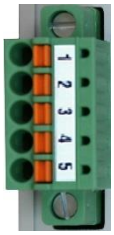
8.2 CAN

CAN0 is connected via the via the CAN connector on the lower side of the module (see Figure 4).
CAN1 is connected via the via the CAN connector on the upper side of the module (see Figure 5).

Device connector: Phoenix Contact PCB header MC 1,5/5-GF-3,81
Cable plug: Phoenix Contact cable connector FK-MCP 1,5/5-STF-3,81,
Push-in spring connection, 3.81 mm pitch
Phoenix Contact Order No.: 1851261 (included in delivery)
For conductor connection and conductor cross section see page 38

Pin Position:

(Cable plug)



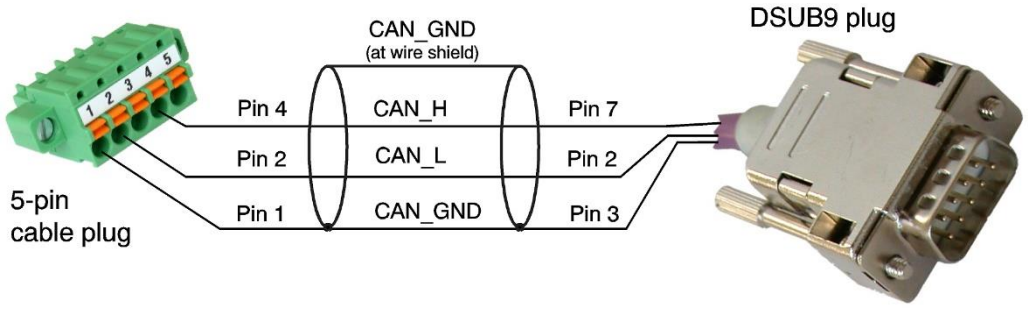
Pin Assignment:

Imprint	Signal	Pin
G	CANx_GND	1
L	CANx_L	2
Sh	Shield	3
H	CANx_H	4
●	-	5

Signal Description:

CANx_L, CANx_H …	CAN signal lines of CAN interface x (x = 0, 1)
CANx_GND …	Reference potential of the local CAN physical layer of CAN x (x = 0, 1) To ensure reliable CAN communication, this pin must always be connected!
Shield …	If a separate cable shield is used: Pin for line shield connection (connected to the potential of the DIN rail)
- …	Reserved, do not connect

Recommendation of an adapter cable from 5-pin cable plug (here Phoenix Contact FK-MCP1,5/5-STF_3,81 with spring-cage-connection) to 9-pin DSUB:



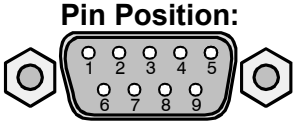
The assignment of the 9-pin DSUB-connector and the cable plug is designed according to CiA 303 part 1.

INFORMATION
esd offers assembled CAN cables according to recommendations of CiA 303 part1 and CiA 106 as accessories, see 13.1, page 57.

8.3 Serial Interface

Device connector: DSUB9 connector, pin contacts

Pin Position:



Pin Assignment:

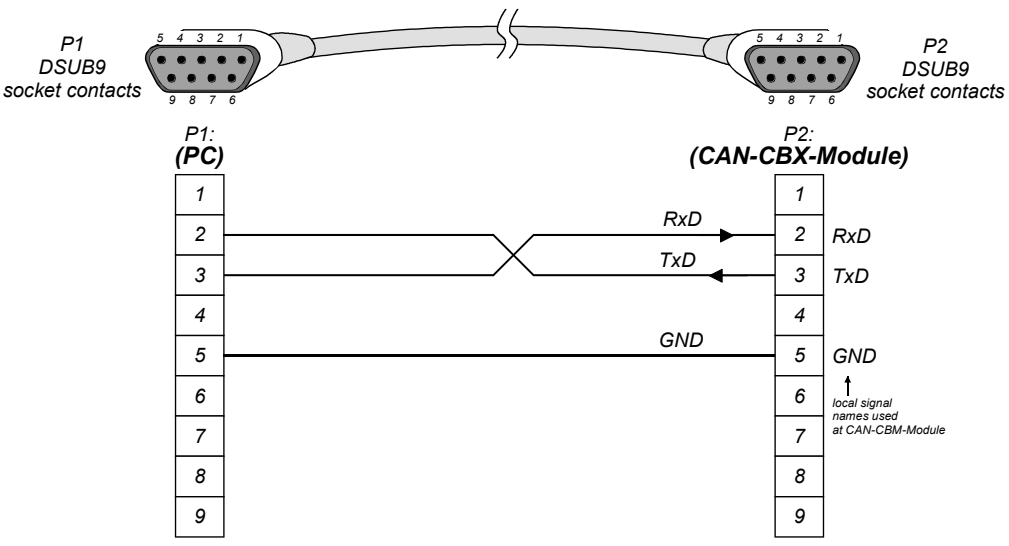
Signal	Pin		Signal
		1	Reserved
Reserved	6	2	Rx (Input)
Reserved	7	3	Tx (Output)
Reserved	8	4	Reserved
Reserved	9	5	GND
Shield			

Signal Description:

Rx, Tx	Signal lines (input, output) of the RS-232 interface
Shield	Shielding (connected with the case of the 9-pin DSUB connector)
GND	Reference potential
Reserved	Reserved for future applications, do not connect!

8.3.1 Terminal Connection

The access line of the serial interface (RS-232) of the CAN-CBX-Bridge-FD to a PC is shown below.



8.4 Conductor Connection/Conductor Cross Section

The following table contains an extract of the technical data of the cable plugs.

Characteristics	*Connector Type*[1]	
	Power Supply Voltage 24 V Cable connector	CAN Cable connector
Connector type plug component	FKCT 2,5/..-ST KMGY	FK-MCP 1,5/5-STF-3,81
Connection method	Push-in spring connection	Push-in spring connection
Stripping length	10 mm	9 mm
Nominal cross section	2.5 mm²	1.5 mm²
Conductor cross section rigid.	0.2 mm² … 2.5 mm²	0.14 mm² … 1.5 mm²
Conductor cross section flexible	0.2 mm² … 2.5 mm²	0.14 mm² … 1.5 mm²
Conductor cross section AWG	24 … 12	26 … 16
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm² … 2.5 mm²	0.25 mm² … 1.5 mm²
Conductor cross section flexible, with ferrule with plastic sleeve	0.25 mm² … 2.5 mm²	0.25 mm² … 0.75 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min./max.	0.5 mm² … 1.5 mm²	not allowed

8.5 24 V and CAN0 via InRailBus

Power supply voltage and CAN0 can optionally be fed via the InRailBus.
Use the mounting-rail bus connector (CAN-CBX-TBus) for the connection via the InRailBus, see Order Information InRailBus Accessories (page 49).
Read and follow the instructions for connecting power supply and CAN0 signals via InRailBus (see from page 50)!

1 Technical Data from Phoenix Contact website, printed circuit board connector, plug component

9 Correct Wiring of Galvanically Isolated CAN CC Networks

NOTICE
This chapter applies to CAN networks with bit rates up to 1 Mbit/s.
If you work with higher bit rates, as for example used for CAN FD, the information given in this chapter must be examined for applicability in each individual case.
For further information refer to the CiA® CAN FD guidelines and recommendations (https://www.can-cia.org/).

For the CAN wiring all applicable rules and regulations (EU, DIN), such as regarding electromagnetic compatibility, security distances, cable cross-section or material, must be obeyed.

9.1 CAN Wiring Standards

The flexibility in CAN network design is a major strength of the various extensions based on the original CAN standard ISO 11898-2, such as CANopen®, ARINC825, DeviceNet® and NMEA2000. However, taking advantage of this flexibility absolutely requires a network design that considers the interactions of all network parameters.

In some cases, the CAN organizations have adapted the scope of CAN in their specifications to enable applications outside the ISO 11898 standard. They have imposed system-level restrictions on data rate, line length and parasitic bus loads.

However, when designing CAN networks, a margin must always be planned for signal losses over the entire system and cabling, parasitic loads, network imbalances, potential differences against earth potential, and signal integrities. **Therefore, the maximum achievable number of nodes, bus lengths and stub lengths may differ from the theoretically possible number!**

esd has limited its recommendations for CAN wiring to the specifications of ISO 11898-2.
A description of the special features of the derived specifications CANopen, ARINC825, DeviceNet, and NMEA2000 is omitted here.

The consistent compliance with the ISO 11898-2 standard offers significant advantages:

- Reliable operation due to proven design specifications
- Minimization of error sources due to sufficient distance to the physical limits.
- Easy maintenance because there are no "special cases" to consider for future network modifications and troubleshooting.

Of course, reliable networks can be designed according to the specifications of CANopen, ARINC825, DeviceNet and NMEA2000, **however it is strictly not recommended to mix the wiring guidelines of the various specifications!**

9.2 Light Industrial Environment (*Single* Twisted Pair Cable)

9.2.1 General Rules

NOTICE
esd grants the EU Conformity of the product if the CAN wiring is carried out with at least single shielded **single** twisted pair cables that match the requirements of ISO 11898-2. Single shielded *double* twisted pair cable wiring as described in chapter 9.3 ensures the EU Conformity as well.

The following **general rules** for CAN wiring with single shielded *single* twisted pair cable should be followed:

1	A suitable cable type with a wave impedance of about 120 Ω ±10% with an adequate conductor cross-section (≥ 0.22 mm²) must be used. The voltage drop over the wire must be considered.
2	For light industrial environment use at least a two-wire CAN cable, the wires of which must be assigned as follows: • Two twisted wires must be assigned to the data signals (CAN_H, CAN_L). • The cable shield must be connected to the reference potential (CAN_GND).
3	The reference potential CAN_GND must be connected to the functional earth (FE) at exactly **one** point.
4	A CAN bus line must not branch (exception: short cable stubs) and must be terminated with the characteristic impedance of the line (generally 120 Ω ±10%) at both ends (between the signals CAN_L and CAN_H and **not** at CAN_GND).
5	Keep cable stubs as short as possible (l < 0.3 m).
6	Select a working combination of bit rate and cable length.
7	Keep away cables from disturbing sources. If this cannot be avoided, double shielded wires are recommended.

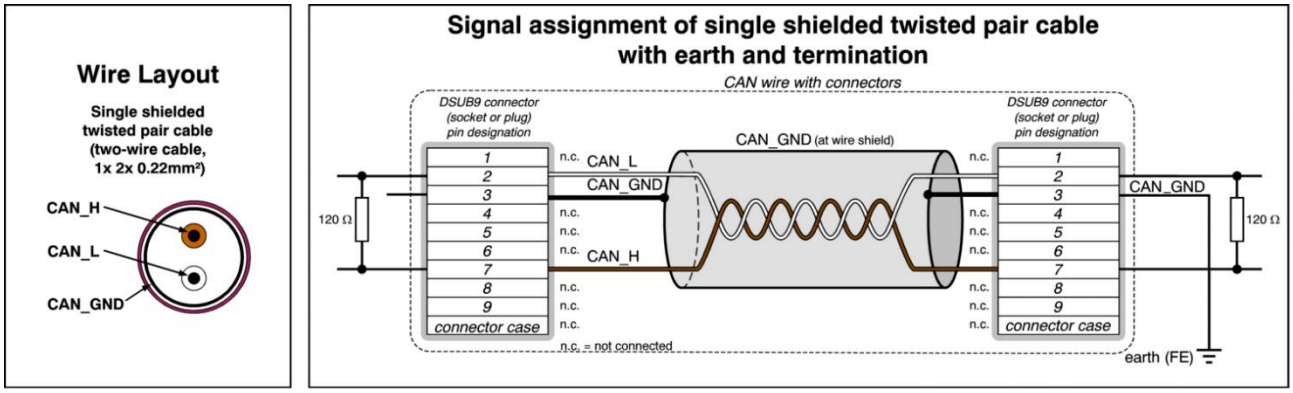


Figure 9: CAN wiring for light industrial environment

9.2.2 Cabling

- To connect CAN devices with just one CAN connector per net use a short stub (< 0.3 m) and a T-connector (available as accessory). If these devices are located at the end of the CAN network, the CAN terminator “CAN-Termination-DSUB9” can be used.

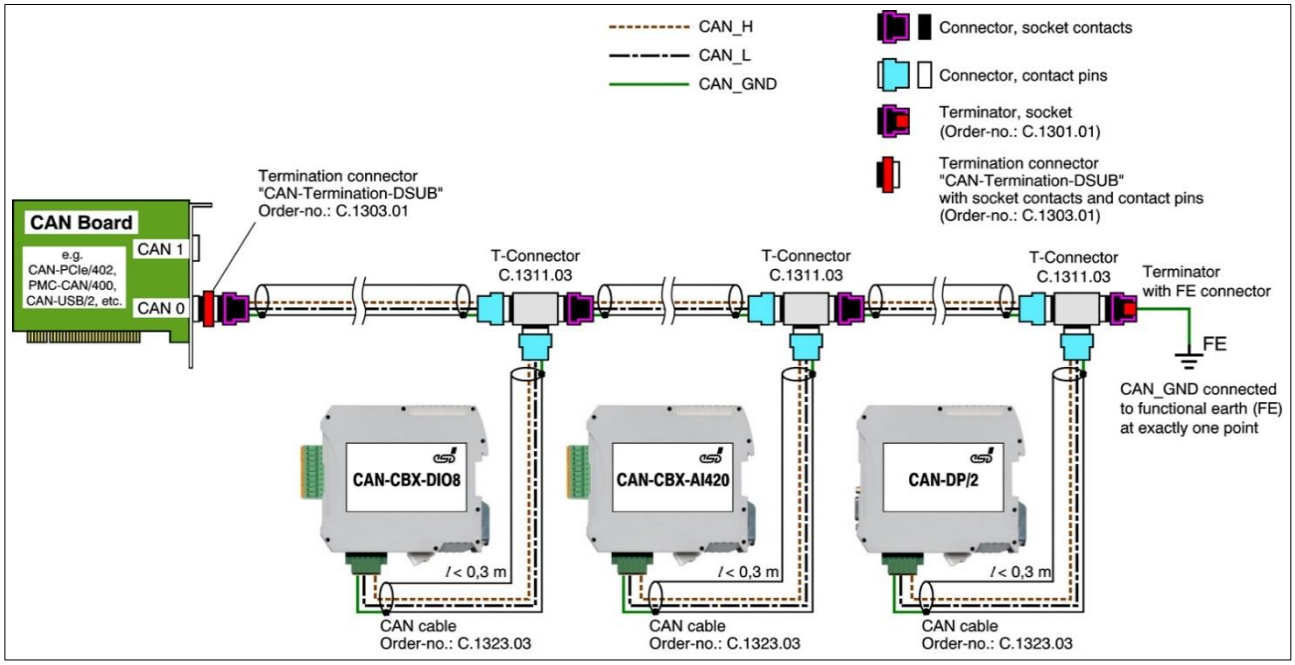


Figure 10: Example for proper wiring with single shielded single twisted pair wires

9.2.3 Branching

- In principle the CAN bus must be realized in a line. The nodes are connected to the main CAN bus line via short cable stubs. This is normally realised by so called T-connectors. esd offers the CAN-T-Connector (Order No.: C.1311.03)
- If a mixed application of single twisted and double twisted cables cannot be avoided, ensure that the CAN_GND line is not interrupted!
- Deviations from the bus structure can be realized by using repeaters.

9.2.4 Termination Resistor

- A termination resistor must be connected at both ends of the CAN bus.
  If an integrated CAN termination resistor is connected to the CAN interface at the end of the CAN bus, this integrated termination must be used instead of an external CAN termination resistor.
- 9-pole DSUB-termination connectors with integrated termination resistor and pin contacts and socket contacts are available from esd (order no. C.1303.01).
- For termination of the CAN bus and grounding of the CAN_GND, DSUB terminators with pin contacts (order no. C.1302.01) or socket contacts (order no. C.1301.01) and with additional functional earth contact are available.

9.3 Heavy Industrial Environment (Double Twisted Pair Cable)

9.3.1 General Rules

The following **general rules** for the CAN wiring with single shielded *double* twisted pair cable should be followed:

1	A suitable cable type with a wave impedance of about 120 Ω ±10% with an adequate conductor cross-section (≥ 0.22 mm²) must be used. The voltage drop over the wire must be considered.
2	For heavy industrial environment use a four-wire CAN cable, the wires of which must be assigned as follows: • Two twisted wires must be assigned to the data signals (CAN_H, CAN_L) and • The other two twisted wires must be assigned to the reference potential (CAN_GND). • The cable shield must be connected to functional earth (FE) at least at one point.
3	The reference potential CAN_GND must be connected to the functional earth (FE) at exactly **one** point.
4	A CAN bus line must not branch (exception: short cable stubs) and must be terminated with the characteristic impedance of the line (generally 120 Ω ±10%) at both ends (between the signals CAN_L and CAN_H and **not** to CAN_GND).
5	Keep cable stubs as short as possible (l < 0.3 m).
6	Select a working combination of bit rate and cable length.
7	Keep away CAN cables from disturbing sources. If this cannot be avoided, double shielded cables are recommended.

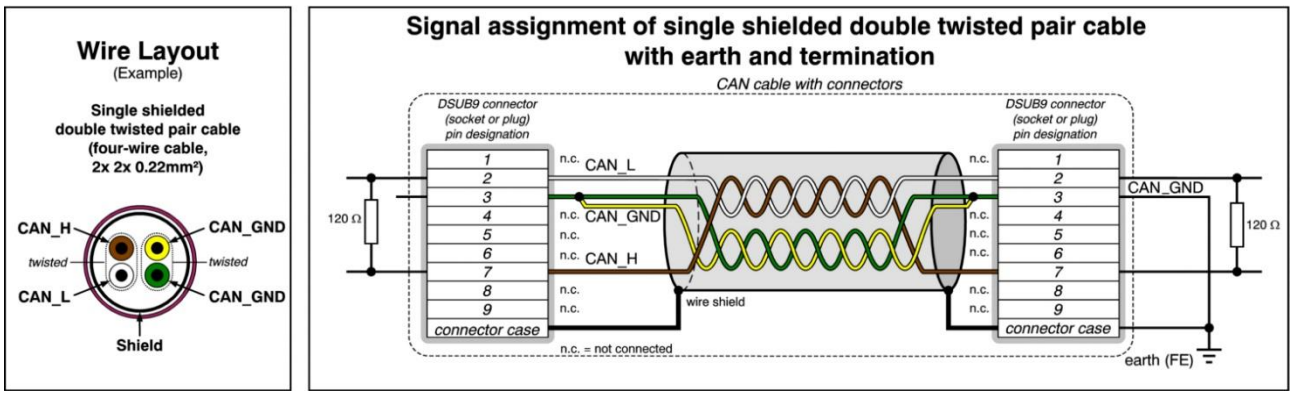


Figure 11: CAN wiring for heavy industrial environment

9.3.2 Device Cabling

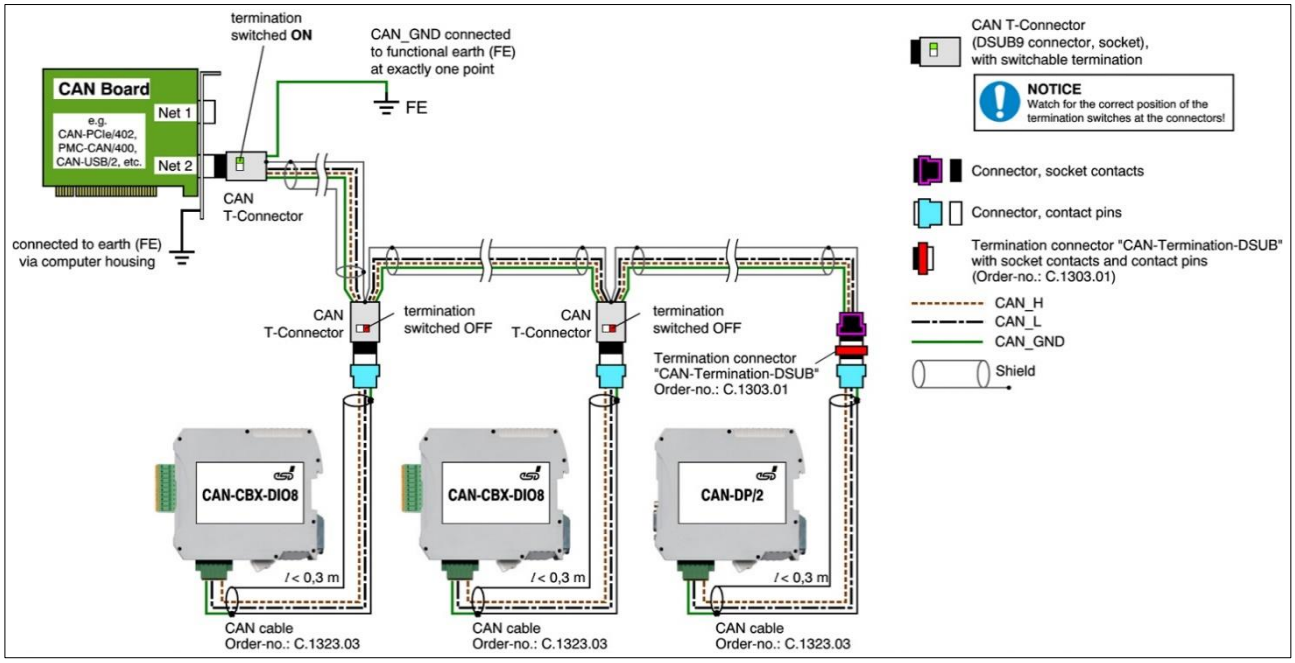


Figure 12: Example of proper wiring with single shielded double twisted pair cables

9.3.3 Branching

- In principle, the CAN bus must be realized in a line. The nodes are connected to the main CAN bus line via short cable stubs. This is usually realised via so called T-connectors. When using esd's CAN-T-Connector (order no.: C.1311.03) in heavy industrial environment and with four-wire twisted cables, it must be noted that the shield potential of the conductive DSUB housing is not looped through this type of T-connector. This interrupts the shielding. Therefore, you must take appropriate measures to connect the shield potentials, as described in the manual of the CAN-T-Connector. For further information on this, please refer to the CAN-T-Connector Manual (order no.: C.1311.21).
  Alternatively, a T-connector can be used, in which the shield potential is looped through, for example the DSUB9 connector from ERNI (ERBIC CAN BUS MAX, order no.:154039).
- If a mixed application of single twisted and double twisted cables cannot be avoided, ensure that the CAN_GND line is not interrupted!
- Deviations from the bus structure can be realized by using repeaters.

9.3.4 Termination Resistor

- A termination resistor must be connected at both ends of the CAN bus.
  If an integrated CAN termination resistor is connected to the CAN interface at the end of the CAN bus, this integrated termination must be used instead of an external CAN termination resistor.
- 9-pole DSUB-termination connectors with integrated termination resistor and pin contacts and socket contacts are available from esd (order no. C.1303.01).
- 9-pole DSUB-connectors with integrated switchable termination resistor can be ordered for example from ERNI (ERBIC CAN BUS MAX, socket contacts, order no.:154039).

9.4 Electrical Grounding

- For CAN devices with galvanic isolation the CAN_GND must be connected between the CAN devices.
- CAN_GND should be connected to the earth potential (FE) at **exactly one** point of the network.
- Each *CAN interface with electrical connection to earth potential* acts as a grounding point. For this reason, it is recommended not to connect more than one *CAN device with electrical connection to earth potential.*
- Grounding can be done for example at a termination connector (e.g. order no. C.1302.01 or C.1301.01).

9.5 Bus Length

The bus length of a CAN network must be adapted to the set bit rate. The maximum values result from the fact that the time required for a bit to be transmitted in the bus system is shorter the higher the transmission rate is. However, as the line length increases, so does the time it takes for a bit to reach the other end of the bus. It should be noted that the signal is not only transmitted, but the receiver must also respond to the transmitter within a certain time. The transmitter, in turn, must detect any change in bus level from the receiver(s). Delay times on the line, the transceiver, the controller, oscillator tolerances and the set sampling time must be considered.
In the following table you will find guide values for the achievable bus lengths at certain bit rates.

Bit Rate [kbit/s]	Theoretical values of reachable wire length **with esd interface** l_{max} [m]	**CiA recommendations** (07/95) for reachable wire lengths l_{min} [m]	Standard values of the cross-section according to CiA 303-1 [mm²]
1000	37	25	0.25 to 0.34
800	59	50	0.34 to 0.6
666.$\overline{6}$	80	-	
500	130	100	
333.$\overline{3}$	180	-	
250	270	250	
166	420	-	0.5 to 0.6
125	570	500	
100	710	650	0.75 to 0.8
83.$\overline{3}$	850	-	
66.$\overline{6}$	1000	-	
50	1400	1000	
33.$\overline{3}$	2000	-	not defined in CiA 303-1
20	3600	2500	
12.5	5400	-	
10	7300	5000	

Table 19: Recommended cable lengths at typical bit rates (with esd-CAN interfaces)

Optical couplers are delaying the CAN signals. esd modules typically achieve a wire length of 37 m at 1 Mbit/s within a proper terminated CAN network without impedance disturbances, such as those caused by cable stubs > 0.3 m.

NOTICE
Please note that the cables, connectors, and termination resistors used in CANopen networks shall meet the requirements defined in ISO 11898-2.
In addition, further recommendations of the CiA, like standard values of the cross section, depending on the cable length, are described in the CiA recommendation CiA 303-1 (see CiA 303 CANopen Recommendation - Part 1: “Cabling and connector pin assignment,” Version 1.9.0, Table 2). Recommendations for pin-assignment of the connectors are described in CiA 106: “Connector pin-assignment recommendations ”.

9.6 Examples for CAN Cables

esd recommends the following two-wire and four-wire cable types for CAN network design. These cable types are used by esd for ready-made CAN cables, too.

9.6.1 Cable for Light Industrial Environment Applications (Two-Wire)

Manufacturer	Cable Type
U.I. LAPP GmbH Schulze-Delitzsch-Straße 25 70565 Stuttgart Germany www.lappkabel.com	e.g. UNITRONIC ®-BUS CAN UL/CSA (1x 2x 0.22) (UL/CSA approved) Part No.: 2170260 UNITRONIC ®-BUS-FD P CAN UL/CSA (1x 2x 0.25) (UL/CSA approved) Part No.: 2170272
ConCab GmbH Äußerer Eichwald 74535 Mainhardt Germany www.concab.de	e. g. BUS-PVC-C (1x 2x 0.22 mm²) Order No.: 93 022 016 (UL appr.) BUS-Schleppflex-PUR-C (1x 2x 0.25 mm²) Order No.: 94 025 016 (UL appr.)

9.6.2 Cable for Heavy Industrial Environment Applications (Four-Wire)

Manufacturer	Cable Type
U.I. LAPP GmbH Schulze-Delitzsch-Straße 25 70565 Stuttgart Germany www.lappkabel.com	e.g. UNITRONIC ®-BUS CAN UL/CSA (2x 2x 0.22) (UL/CSA approved) Part No.: 2170261 UNITRONIC ®-BUS-FD P CAN UL/CSA (2x 2x 0.25) (UL/CSA approved) Part No.: 2170273
ConCab GmbH Äußerer Eichwald 74535 Mainhardt Germany www.concab.de	e. g. BUS-PVC-C (2x 2x 0.22 mm²) Order No.: 93 022 026 (UL appr.) BUS-Schleppflex-PUR-C (2x 2x 0.25 mm²) Order No.: 94 025 026 (UL appr.)

INFORMATION
Ready-made CAN cables with standard or custom length can be ordered from **esd**.

10 CAN Troubleshooting Guide

The CAN Troubleshooting Guide is a guide to finding and eliminating the most common problems and errors when setting up CAN bus networks and CAN-based systems.

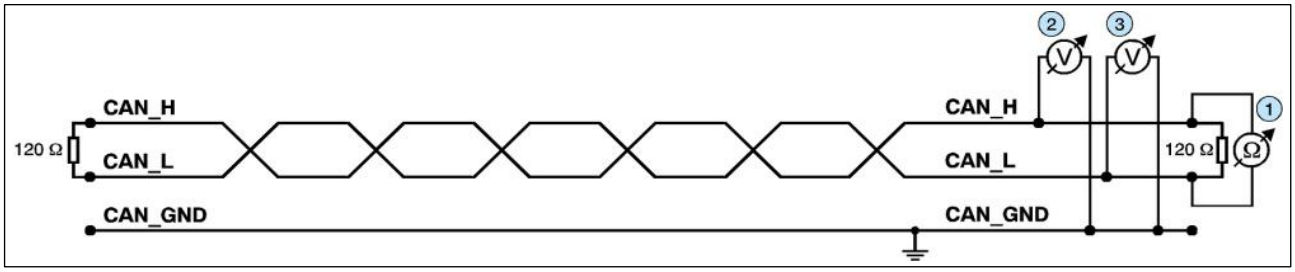


Figure 13: Simplified diagram of a CAN network

Termination
The bus termination is used to match impedance of a node to the impedance of the bus line used. If the impedance is mismatched, the transmitted signal is not completely absorbed by the load and will be partially reflected back into the transmission line.
If the impedances of the sources, transmission lines and loads are equal, the reflections are avoided. This test measures the total resistance of the two CAN data lines and the connected terminating resistors.

To **test this, please proceed as follows:**

1. Switch off the supply voltages of all connected CAN nodes.
2. Measure the DC resistance between CAN_H and CAN_L at one end of the network, measuring point ① (see figure above).

Expected result:
The measured value should be between 50 Ω and 70 Ω.

Possible causes of error:

- If the determined value is below 50 Ω, please make sure that:
  - There is no **short circuit** between CAN_H and CAN_L wiring.
  - **No more than two** terminating resistors are connected.
  - The transceivers of the individual nodes are not defective.

- If the determined value is higher than 70 Ω, please make sure that:
  - All CAN_H and CAN_L lines are correctly connected.
  - Two terminating resistors of 120 Ω each are connected to your CAN network (one at each end).

10.1 Electrical Grounding

The CAN_GND of the CAN network should be connected to the functional earth potential (FE) at only **one** point. This test indicates whether the CAN_GND is grounded at one or more points.

Please note that this test can only be performed with galvanically isolated CAN nodes.

To test this, please proceed as follows:

1. Disconnect the CAN_GND from the earth potential (FE).
2. Measure the DC resistance between CAN_GND and earth potential (see figure on the right).

Do not forget to reconnect CAN_GND to earth potential after the test!

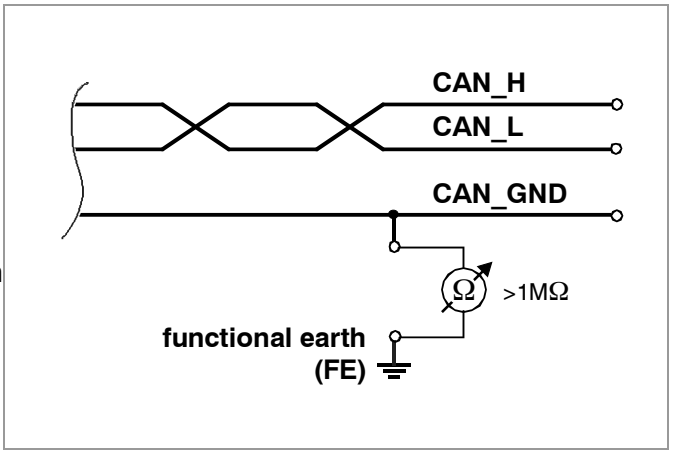


Figure 14: Simplified schematic diagram of ground test measurement

Expected result:
The measured resistance should be greater than 1 MΩ. If it is smaller, please search for additional grounding of the CAN_GND wires.

10.2 Short Circuit in CAN Wiring

A CAN bus might possibly still be able to transmit data even if CAN_GND and CAN_L are short-circuited. However, this will usually cause the error rate to rise sharply.
Ensure that there is no short circuit between CAN_GND and CAN_L!

10.3 Correct Voltage Levels on CAN_H and CAN_L

Each node contains a CAN transceiver that outputs differential signals. When the network communication is idle the CAN_H and CAN_L voltages are approximately 2.5 V measured to CAN_GND. Defective transceivers can cause the idle voltages to vary and disrupt network communication.

To test for defective transceivers, please proceed as follows:

1. Switch on all supply voltages.
2. Terminate all network communication.
3. Measure the DC voltage between CAN_H and CAN_GND, measuring point ②.
   (See “Simplified diagram of a CAN network” on previous page).
4. Measure the DC voltage between CAN_L and CAN_GND, measuring point ③.
   (See “Simplified diagram of a CAN network” on previous page).

Expected result:
The measured voltage should be between 2.0 V and 3.0 V.

Possible causes of error:

- If the voltage is lower than 2.0 V or higher than 3.0 V, it is possible that one or more nodes have defective transceivers.
    - If the voltage is lower than 2.0 V, please check the connections of the CAN_H and CAN_L lines.
- To find a node with a defective transceiver within a network, please check individually the resistances of the CAN transceivers of the nodes (see next section).

10.4 CAN Transceiver Resistance Test

CAN transceivers have circuits that control CAN_H and CAN_L. Experience shows that electrical damage can increase the leakage current in these circuits.

To measure the current leakage through the CAN circuits, please use an ohmmeter and proceed as follows:

1. Switch **off** the node ④ and **disconnect** it from the CAN network.
   (See figure below.)
2. Measure the DC resistance between CAN_H and CAN_GND, measuring point ⑤
   (See figure below.)
3. Measure the DC resistance between CAN_L and CAN_GND, measuring point ⑥
   (See figure below.)

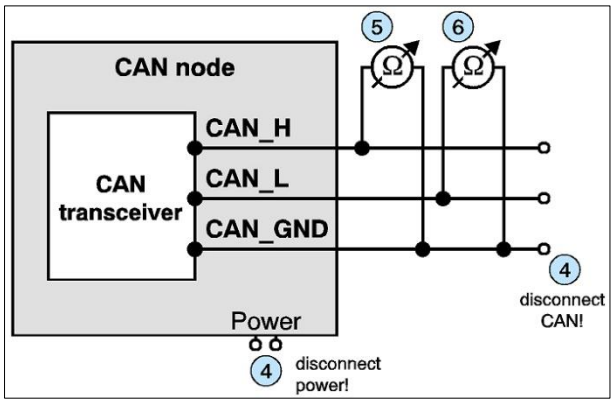


Figure 15: Measuring the internal resistance of CAN transceivers

Expected result:
The measured resistance should be greater than 10 kΩ for each measurement.

Possible causes of error:

- If the resistance is significantly lower, the CAN transceiver may be defective.
- Another indication of a defective CAN transceiver is a very high deviation of the two measured input resistances (>> 200 %).

10.5 Support by esd

If you have followed the troubleshooting steps in this troubleshooting guide and still cannot find a solution to your problem, our support team can help.
Please contact our support by email to support@esd.eu or by phone **+49-511-37298-130.**

11 Optional InRailBus

11.1 Order Information InRailBus Accessories

Type	Properties	Order No.
Accessories		
 **CAN-CBX-TBus**	DIN-rail bus connector of the CBX-InRailBus for CAN-CBX modules (ME 22,5 TBUS 1,5/ 5-ST-3,81 KMGY)	C.3000.01
 **CAN-CBX-TBus-Connector-Socket**	Terminal plug of the CBX-InRailBus for the connection of the +24V power supply voltage and the CAN interface (MCVR 1,5/5-ST-3,81 AU), socket contacts	C.3000.02
 **CAN-CBX-TBus-Connector-Plug**	Terminal plug of the CBX-InRailBus for the connection of the +24V power supply voltage and the CAN-Interface (IMC 1,5/ 5-ST-3,81 AU), pin contacts	C.3000.03

11.2 Conductor Connection/Conductor Cross Section

The following table contains an extract of the technical data of the cable plugs.

Characteristics	*Connector Type*[2]	
	CAN-CBX-TBus-Connector-Socket	CAN-CBX-TBus-Connector-Plug
Connector type plug component	MCVR 1,5/5-ST-3,81 AU	IMC 1,5/ 5-ST-3,81 AU
Connection method	Screw connection with tension sleeve	Screw connection with tension sleeve
Stripping length	7 mm	7 mm
Nominal cross section	1.5 mm²	1.5 mm²
Conductor cross section rigid.	0.14 mm² … 1.5 mm²	0.14 mm² … 1.5 mm²
Conductor cross section flexible	0.14 mm² … 0.5 mm²	0.14 mm² … 1.5 mm²
Conductor cross section AWG	28 … 16	28 … 16
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm² … 1.5 mm²	0.25 mm² … 1.5 mm²
Conductor cross section flexible, with ferrule with plastic sleeve	0.25 mm² … 0.5 mm²	0.25 mm² … 0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min./max.	0.5 mm² ... 0.5 mm²	0.5 mm² ... 0.5 mm²

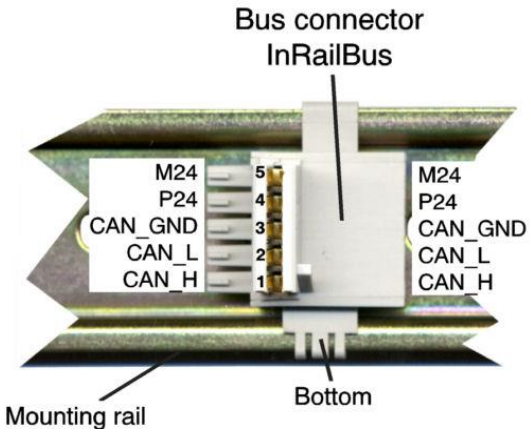
2 Technical Data from Phoenix Contact website, printed circuit board connector, plug component

11.3 Connector Assignment 24V and CAN0 via InRailBus (Option)

DANGER
The CAN-CBX-Bridge-FD is a device of protection class III according to DIN EN 61140 and may only be operated on supply circuits that offer sufficient protection against dangerous voltages.

Connector type: Mounting-rail bus connector of the CBX-InRailBus
Phoenix Contact ME 22,5 TBUS 1,5/5-ST-3,81 KMGY

Connector View:



Pin Assignment:

Pin	Signal
5	M24 (GND)
4	P24 (+24 V)
3	CAN_GND
2	CAN_L
1	CAN_H

S	FE (PE_GND)

Signal Description:

CAN_L, CAN_H ...	CAN signals
CAN_GND ...	reference potential of the local CAN-Physical layers
P24...	power supply voltage +24 V
M24...	reference potential
FE...	functional earth contact (EMC) (connected to mounting rail potential)

11.4 Using InRailBus (Option)

This chapter describes the installation of the module using InRailBus for the connection of CAN0 and 24V as an example for CAN-CBX-modules.

11.4.1 Installation of the Module when using the InRailBus Connector

If the CAN bus signals and the power supply voltage shall be fed via the InRailBus, please proceed as follows:

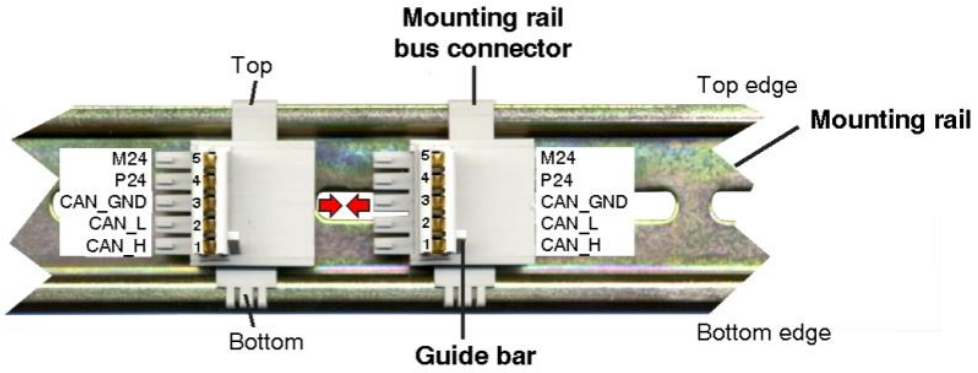


Figure 16: Mounting rail with bus connector

1. Position the InRailBus connector on the mounting rail and snap it onto the mounting rail using slight pressure. Plug the bus connectors together to contact the communication and power signals (in parallel with one). The bus connectors can be plugged together before or after the CAN-CBX module is plugged on.

2. Hold the CAN-CBX module tilted backwards at a slight angle and place it on the bus connector so that the DIN rail guideway is placed on the top edge of the mounting rail.

Figure 17: Mounting CAN-CBX modules

3. Now swivel the CAN-CBX module onto the mounting rail by moving the module downwards according to the direction of the arrow in Figure 17. The housing is mechanically guided by the guide bar of the bus connector.

4. When mounting the CAN-CBX module the moveable snap-on foot snaps onto the bottom edge of the mounting rail.
   The module is now firmly seated on the mounting rail and is connected to the InRailBus via the bus connector. If necessary, connect the bus connectors to each other and connect the +24 V supply voltage and the CAN interface to the InRailBus as described below.

Figure 18: Mounted CAN-CBX module

11.4.2 Connecting via the InRailBus

To connect the power supply and the CAN signals via the InRailBus, a terminal plug is needed. The terminal plug is not included in the scope of delivery and must be ordered separately (order no.: C.3000.02, see order information for InRailBus Accessories).

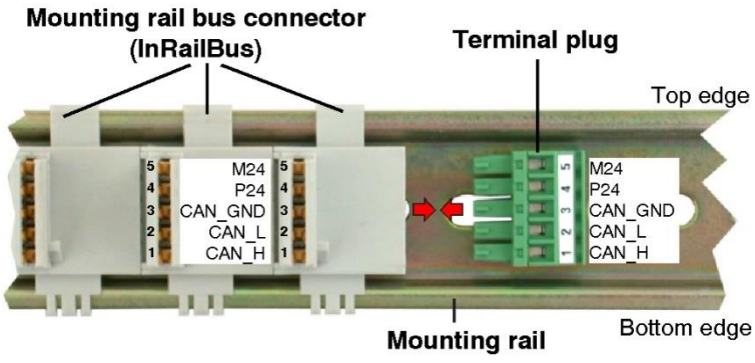


Figure 19: Mounting rail with InRailBus and terminal plug

Insert the terminal plug from the right into the socket side of the outer mounting rail bus connector of the InRailBus, as shown in Figure 19. Then connect the CAN interface and the supply voltage via the terminal plug.

11.4.3 Connection of the Supply Voltage

DANGER
Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the CAN-CBX-module is to be integrated.

→ Read the safety instructions at the beginning of this document (from page 5) carefully before you start with the hardware installation!
→ Ensure the absence of voltage before starting any electrical work.
→ Switch off the power supply, before you connect it to the system.

DANGER
The CAN-CBX-Bridge-FD is a device of protection class III according to DIN EN 61140 and may only be operated on supply circuits that offer sufficient protection against dangerous voltages.

There are two ways to feed the 24 V power supply voltage into the CBX station:

- via the terminal plug of the InRailBus, see 11.4.3.1
- via the 24 V connector of the first module in the CBX station, see 11.4.3.2

NOTICE
The two connections for the 24 V power supply (via InRailBus or 24 V connector) are connected internally and must not be supplied by two independent power sources at the same time!
Connecting 24 V at both connectors will cause damage to the CAN-CBX module.
Also read the chapter on the assignment of the 24 V connector for further information.

11.4.3.1 Connection of the Power Supply Voltage via InRailBus

NOTICE
If you feed the 24V power supply via the terminal plug of the InRailBus (see Figure below), the maximum load current must not exceed $I_{MAX\_LOAD\_InRailBus}$ = 8 A.

Figure 20: Connection via terminal plug

11.4.3.2 Connection of the Power Supply Voltage via 24 V Connector

NOTICE
Note that the connection between the 24V plug and the InRailBus is not designed to feed the 24V supply voltage via the plug to the InRailBus!
If the modules are mounted on the DIN rail without InRailBus connectors, it is allowed to bridge the power supply from one module to another (see Figure below), but the maximum load current must not exceed $I_{MAX\_LOAD\_24V\_plug}$ = 2 A.

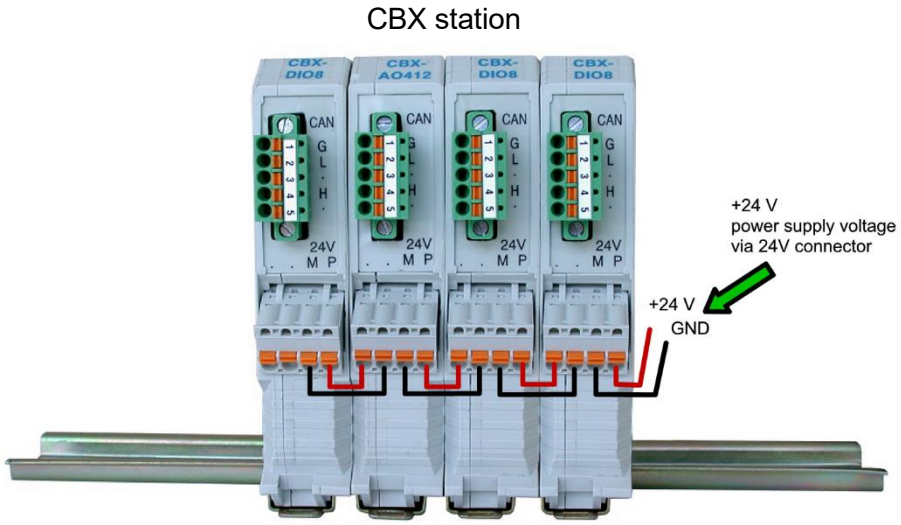


Figure 21: Connection via 24V Connector

11.4.3.3 Earthing of the Mounting Rail

NOTICE
The module is connected to the mounting rail via its functional earth contact. This improves the stability against electromagnetic disturbances. The mounting rail must therefore be connected to a suitable functional earth contact in the environment or in the installation. It must be ensured that the impedance of the connection is kept low.
The functional earth contact of the module does not ensure electrical safety.

11.4.4 Connection of CAN

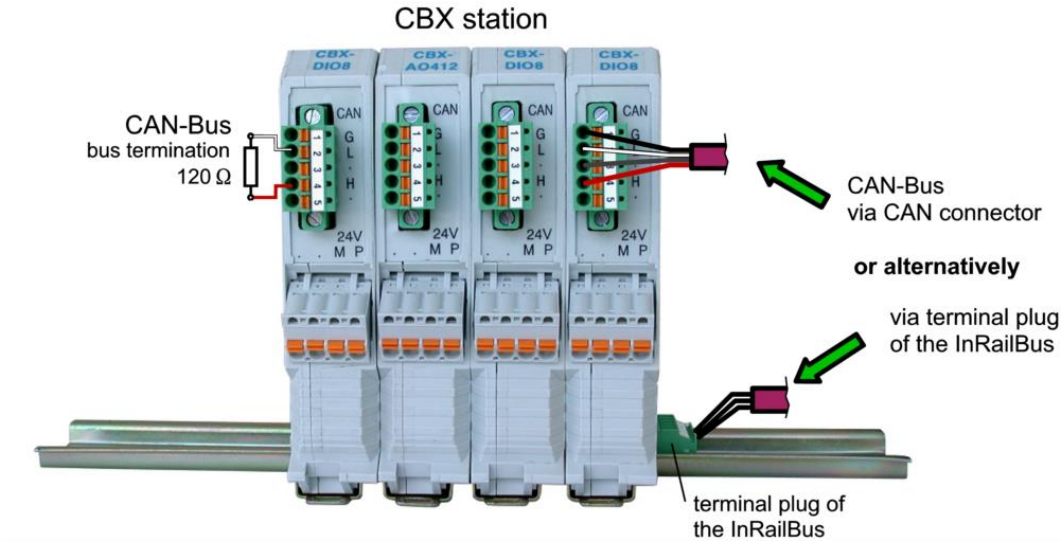


Figure 22: Connecting the CAN signals to the CAN-CBX station

In general, the CAN signals can be fed in via the InRailBus or via the CAN connector of the first CAN-CBX module in the CAN-CBX station. The signals are then connected through the CAN-CBX station via the InRailBus. The CAN signals may be lead through via the CAN connector of the CAN-CBX module mounted at the other end of the CBX station. However, the CAN signals must not be connected via the CAN connectors of the middle CAN-CBX modules of the CBX station, as this would lead to impermissible branching.
Please note that a bus terminating resistor must be connected to the CAN-CBX module located at the end of the InRailBus if the CAN bus ends there (see Figure 22).

11.4.5 Remove the CAN-CBX Module from InRailBus

If the CAN-CBX module is only connected via the InRailBus, proceed as follows when removing it: Release the module from the mounting rail by moving the snap-on foot (see Figure 18) downwards (e.g., with a screwdriver). This releases the module from the bottom edge of the mounting rail, and it can be removed.

INFORMATION
It is possible to remove individual devices from the CBX station without interrupting the InRailBus connection, because the contact chain will not be disrupted.

12 Declaration of Conformity

EU-KONFORMITÄTSERKLÄRUNG
EU DECLARATION OF CONFORMITY

Adresse / *Address*
esd electronics gmbh
Vahrenwalder Str. 207
30165 Hannover
Germany

esd erklärt, dass das Produkt *esd declares, that the product*	Typ, Modell, Artikel-Nr. *Type, Model, Article No.*
CAN-CBX-Bridge-FD	**C.3090.02**
die Anforderungen der Normen *fulfills the requirements of the standards*	**EN 61000-6-2:2005,** **EN 61000-6-3:2007/A1:2011**
gemäß folgendem Prüfbericht erfüllt. *according to test certificate.*	**EMVP No.: 0233-202307**
Das Produkt entspricht damit der EU-Richtlinie „EMV" *Therefore, the product conforms to the EU Directive 'EMC'*	**2014/30/EU**
Das Produkt entspricht den EU-Richtlinien „RoHS" *The product conforms to the EU Directives 'RoHS'*	**2011/65/EU, 2015/863/EU**

Diese Erklärung verliert ihre Gültigkeit, wenn das Produkt nicht den Herstellerunterlagen entsprechend eingesetzt und betrieben wird, oder das Produkt abweichend modifiziert wird.
This declaration loses its validity if the product is not used or run according to the manufacturer's documentation or if non-compliant modifications are made.

Name / *Name*	T. Bielert
Funktion / *Title*	QM-Beauftragter / *QM Representative*
Datum / *Date*	Hannover, 2023-10-24

Rechtsgültige Unterschrift / *authorized signature*

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13 Order Information

13.1 Hardware

Type	Properties	Order No.
CAN-CBX-Bridge-FD	CAN DIN rail module with 2 CAN FD interfaces with up to 8 Mbit/s and physical layer according to ISO-11898 with galvanic isolation on COMBICON connectors. Firmware with bridge function for setting bit rate and filters for each CAN interface via serial RS-232 configuration interface.	C.3090.02
Accessories:		
CAN-Cable-S, 0.3 m (plug)	CAN cable assembly, Metallised plastic housing, 0.3 m length, 1x DSUB9 plug and 3 wire end sleeves,	C.1323.03
CAN-Cable-S, 0.3 m (socket)	CAN cable assembly, Metallised plastic housing, 0.3 m length, 1x DSUB9 socket and 3 wire end sleeves,	C.1323.04

Table 20: Order information hardware

13.2 Manuals

PDF Manuals
For the availability of the manuals see table below.
Please download the manuals as PDF documents from our esd website https://www.esd.eu for free.

Manuals		Order No.
CAN-CBX-Bridge-FD-ME	CAN-CBX-Bridge-FD Manual English	C.3090.21

Table 21: Available manuals

Printed Manuals
If you need a printout of the manual additionally, please contact our sales team (sales@esd.eu) for a quotation. Printed manuals may be ordered for a fee.