CAN/402-Slot2-LIN

2-Channel LIN Adapter for CAN FD Boards of the esd CAN 402-Series

Hardware Manual

For product C.2045.12

Notes

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⚠️	This manual contains important information and instructions on safe and efficient handling of the CAN/402-Slot2-LIN. Carefully read this manual before commencing any work and follow the instructions. The manual is a product component, please retain it for future use.

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CAN/402-Slot2-LIN can be used with:	CAN-PCIe/402-2-FD	(C.2045.64)
	CAN-PCI/402-2-FD	(C.2049.64)

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	-	First English manual of the adapter CAN/402-Slot2-LIN, generated from CAN-PCIe/402-Manual Rev. 1.5	2023-05-23

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/402-Slot2-LIN follow the instructions below and read the manual carefully to protect yourself from injury and the CAN/402-Slot2-LIN from damage.
- The device is a built-in component. It is essential to ensure that the device is mounted in a way that cannot lead to endangering or injury of persons or damage to objects.
- Do not use damaged or defective cables to connect the CAN/402-Slot2-LIN and follow the CAN wiring hints in chapter: "Correct Wiring of Electrically Isolated CAN 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/402-Slot2-LIN has only functional tasks and is not a protection against hazardous electrical voltage.
- The CAN/402-Slot2-LIN may only be operated on supply circuits that provide sufficient protection against dangerous voltages.
- Circuits connected to the interfaces of the CAN/402-Slot2-LIN must be sufficiently protected against dangerous voltage
- The user is responsible for compliance with the applicable national safety regulations.

- The device must be securely installed in the control cabinet before commissioning.
- Protect the CAN/402-Slot2-LIN from dust, moisture, and steam.
- Protect the CAN/402-Slot2-LIN from shocks and vibrations.
- The CAN/402-Slot2-LIN may become warm during normal use. Always allow adequate ventilation around the CAN/402-Slot2-LIN and use care when handling.
- Do not operate the CAN/402-Slot2-LIN 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/402-Slot2-LIN is to be integrated.
→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ Ensure the absence of voltage before starting any electrical work

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NOTICE
Electrostatic discharges may cause damage to electronic components.

→ To avoid this, please discharge the static electricity from your body before you touch the CAN/402-Slot2-LIN.
→ Furthermore, you should prevent your clothes from touching the CAN/402-Slot2-LIN, because your clothes might be electrostatically charged as well.

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/402-Slot2-LIN 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.

Intended Use

The intended use of the CAN/402-Slot2-LIN is the operation as LIN adapter for CAN FD boards of the esd CAN 402 Series.

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.

- As a is a sub-assembly the CAN/402-Slot2-LIN is intended for incorporation in an apparatus.
- The CAN/402-Slot2-LIN is intended for indoor use only.
- The operation of the CAN/402-Slot2-LIN in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the CAN/402-Slot2-LIN for medical purposes is prohibited.

Service Note

The CAN/402-Slot2-LIN does not contain any parts that require maintenance by the user. The CAN/402-Slot2-LIN does not require any manual configuration of the hardware. 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, and binary numbers have a prefix of 0b. For example, 42 is represented as 0x2A in hexadecimal and 0b101010 in binary.

Table of Contents

List of Tables

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1 Overview

1.1 About this Manual

This manual describes the hardware of the adapter CAN/402-Slot2-LIN.
The adapter can be used with the CAN-PCIe/402-2-FD and the CAN-PCI/402-2-FD. In the following text, the two CAN-boards are therefore described together as CAN-PCI(e)/402, unless there are differences between the two boards that are relevant for the description.
For further information about the CAN-PCI(e)/402-boards please refer to the manuals (1), (2).

1.2 Glossary

Abbreviation	Term
API	Application Programming Interface
CAN	Controller Area Network
CiA	CAN in Automation
FD	Flexible Data
I/O	Input/Output
LIN	Local Interconnect Network
n.a.	not applicable
PCI	Peripheral Component Interconnect (Computer Bus)
PCIe	Peripheral Component Interconnect Express (Computer Bus)
SDK	Software Development Kit

1.3 References

(1) esd electronics, CAN-PCIe/402 Manual, Hannover, esd electronics gmbh,
esd order No. C.2045.21
(2) esd electronics, CAN-PCI/402 Manual, Hannover, esd electronics gmbh,
esd order No.: C.2049.21
(3) esd electronics, NTLIN Structure, Function and C/C++API Manual, Hannover, esd
electronics gmbh, 2022-08-09, esd order No.: C.2007.21
(4) esd electronics, NTCAN-API Manual Part 1: Structure, Function and C/C++ API,
Hannover, esd electronics gmbh, 2022-05-30, esd order No.: C.2001.21
(5) esd electronics, NTCAN-API Manual Part 2: Installation, Configuration and Firmware
Update, Hannover, esd electronics gmbh, 2021-10-27, esd order No.: C.2001.21,
(6) esd electronics, CANreal Manual, Hannover, esd electronics gmbh, 2019-08-23
esd order No.: C.1107.21
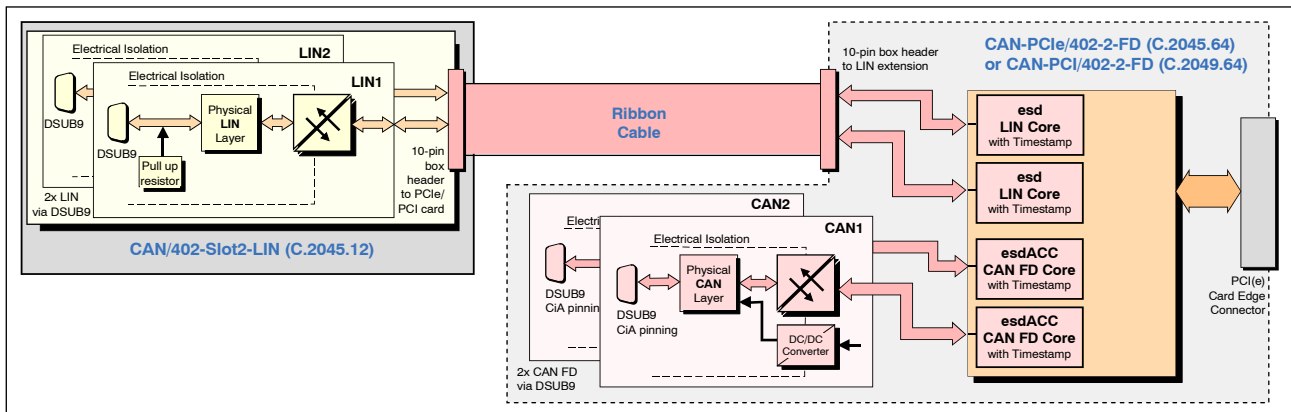
1.4 Description of CAN/402-Slot2-LIN

Figure 1: Block circuit diagram CAN/402-Slot2-LIN with CAN-PCI(e)/402 Board

The LIN adapter CAN/402-Slot2-LIN provides the physical layers of two additional LIN interfaces as extension for 2-channel CAN FD boards of the esd CAN 402 series. It can be used with the CAN-PCIe/402-2-FD in PCI Express® form factor and the CAN-PCI/402-2-FD in PCI form factor.

The LIN interfaces are designed according to ISO 17987-4:2016 and they are accessible via DSUB9 connectors in the slot bracket of the adapter board.
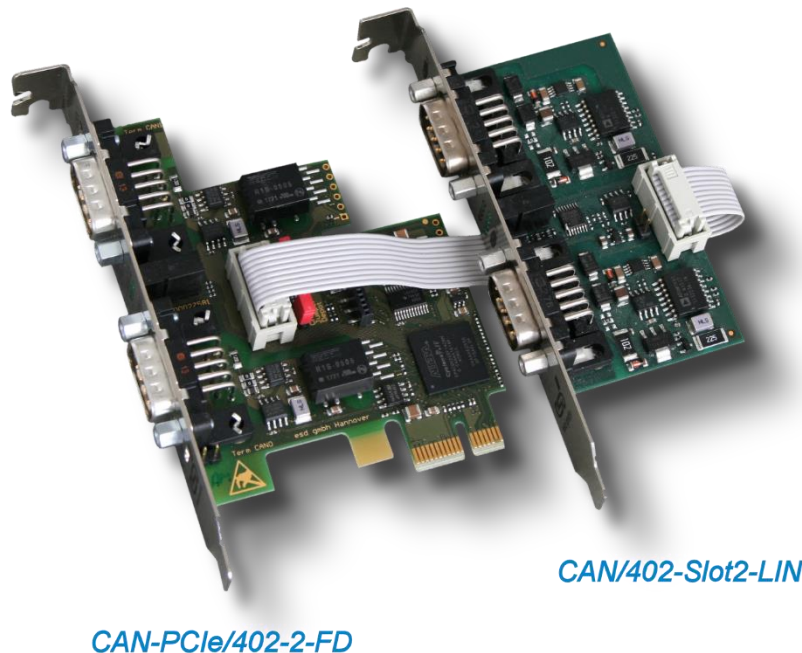

Figure 2: Example: CAN/402-Slot/2-LIN connected to CAN-PCIe/402-2-FD

The CAN/402-Slot2-LIN is automatically detected by the CAN-PCI(e)/402 via I²C bus.
LIN commander and LIN responder interfaces are supported.

1.5 Front Panel with LEDs

Figure 3: CAN402-Slot/2-LIN front panel

1.5.1 LEDs

The CAN/402-Slot2-LIN Adapter is equipped with four green LEDs as described in **Figure 3**.

Label	Name	Indicator State	Description
A	ACT LIN0	off	No LIN bus connection and/or no data transfer on LIN0
		on	Connected to LIN bus 0 and data transfer on LIN0
B	ACT LIN1	off	No LIN bus connection and/or no data transfer on LIN1
		on	Connected to LIN bus 1 and data transfer on LIN1
C	reserved	-	-
D	Power (FPGA OK)	off	Power supply voltage off,
		on	Power supply voltage on,

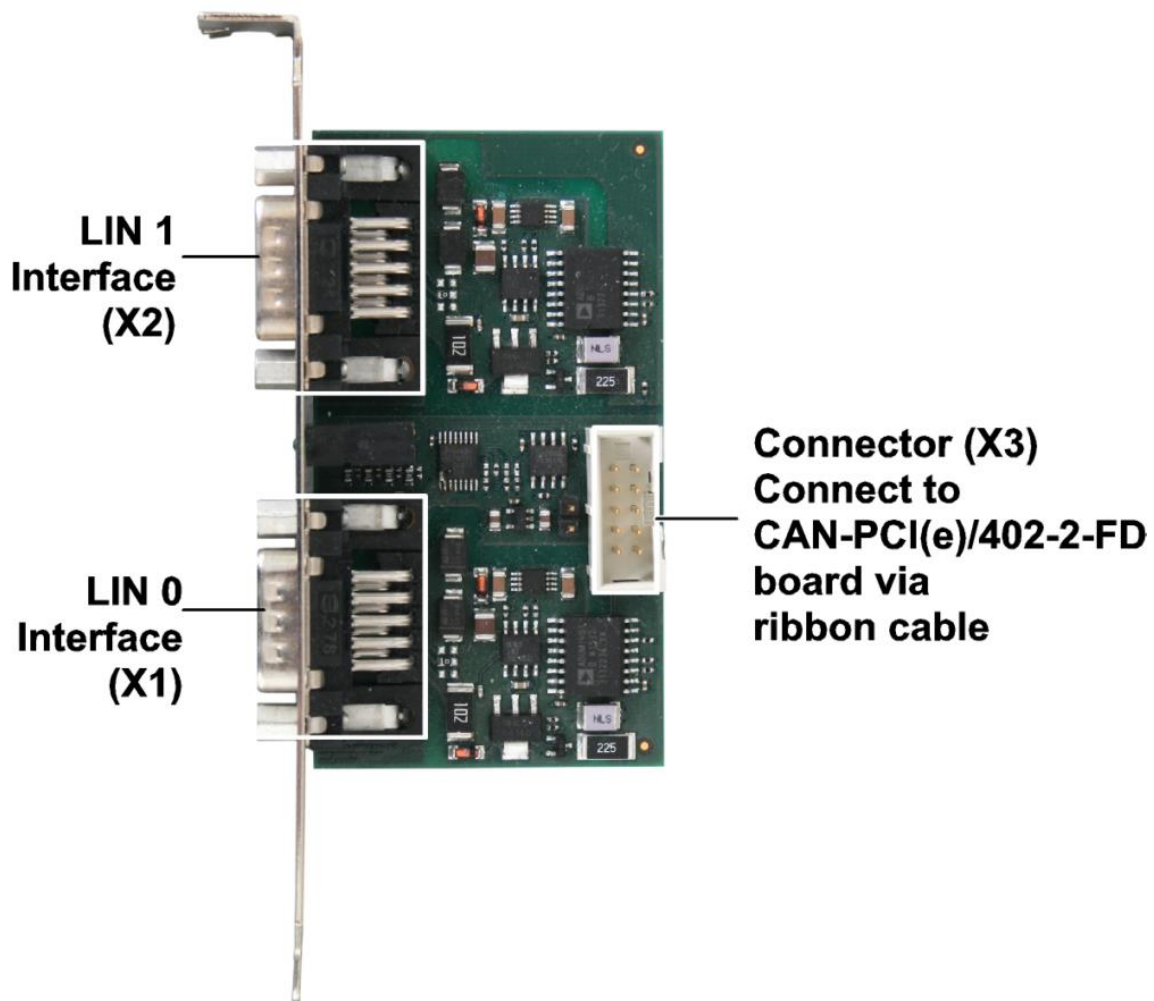**Table 1:** Additional LEDs on LIN-adapter board

1.6 PCB View

Figure 4: PCB view of CAN/402-Slot2-LIN

> **NOTICE**
> Read chapter "Installing and Uninstalling" on page 15, before you start with the installation of the hardware!

2 Technical Data

2.1 General Technical Data

Ambient temperature	0...75°C
Humidity	Maximum 90 %, non-condensing
Power supply	5 V DC ±5%
Power consumption	Maximum 0.5 W
Connectors	LIN One DSUB9 connector per channel, connector with pin contacts Additional connector equipped on the adapter board: X3 connection to CAN/402-Slot2-LIN via ribbon cable (10-pin shrouded box header)
Dimensions	44 mm x 80 mm x 21.6 mm (length x width x height)
Weight	50 g

2.2 LIN Interfaces

|	
Number	2
Requirement	Useable with CAN-PCIe/402-2-FD or CAN-PCI/402-2-FD The firmware version of these CAN FD boards must be at least: 0.0.72 (0x0048), see chapter 4.1.1
Specification	LIN Specification versions 1.3, 2.1 and 2.2A
LIN Controller	IP-Core
LIN Protocol	According to ISO 17987:2016
LIN Transceiver	MCP2003B - variant with Dominate Timeout Feature
Physical LIN Layer	LIN interface according to ISO 17987-4:2016 Bit rates supported from 1000 Bit/s up to 20 kBit/s, Automatic bit rate detection and resynchronisation, The EN Pin can be switched by the FPGA, Switchable commander pull-up resistor
Electrical isolation	Via magnetic coupler **NOTICE** Functional insulation only! Dielectric strength of insulation (LIN to slot bracket/EARTH; LIN to Host/System Ground; LIN to LIN): 1kV DC @ 1s (I < 1 mA)
Bus termination	Commander pull-up resistor (1K) can be enabled via software
Connector	2x DSUB9

3 Connector Pin Assignment

3.1 LIN

The two independent DSUB9 connectors have the same pin assignment. Both interfaces are galvanically isolated.

Device connector: 9-pin DSUB connector with pin contacts.

Pin Position:
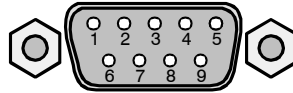
Pin Assignment:

Signal	Pin	Pin	Signal
		1	Reserved
Reserved	6	2	Reserved
Reserved	7	3	GNDx
Reserved	8	4	LINx
V_LINx	9	5	GNDx

Signal Description:

X …	Number of LIN interface.
	x = 0, for the signals of LIN net 0, or
	x = 1, for the signals of LIN net 1.
LINx …	LIN signal line of LIN net x
V_LINx …	Power supply of LIN net x (8 V < V_{BUS} < 32 V)
GNDx …	Reference potential of the local LIN physical layer of LIN net x. Must always be connected!
Reserved …	Reserved for future applications, do not connect!

> **NOTICE**
> esd grants the EU conformity of the product if the wiring is carried out with shielded cables. We recommend using 4-wire cables as specified for CAN networks. See chapter "Cable for heavy industrial Environment Applications (Four-Wire)" in the manual of the CAN-PCI(e/402) (1),(2).
> Assembled cables with standard or customized length can be ordered from esd.

3.2 Connector X3

Connector X3 is used to connect the CAN/402-Slot2-LIN to CAN-PCI(e/402) via the ribbon cable.

Device connector: 10-pin shrouded box header, pin contacts

Signal	Pin		Pin	Signal
GND	10		9	LIN1_EN
LIN1_Rx	8		7	LIN0_EN
LIN1_Tx	6		5	I²C_SDA
LIN0_Rx	4		3	I²C_SCL
LIN0_Tx	2		1	V5P0

NOTICE
esd grants the EC conformity of the CAN/402-Slot2-LIN if the ribbon cable supplied with the product is used to connect it to the CAN-PCI(e)/402 board

4 Installing and Uninstalling

NOTICE
Read the safety instructions at the beginning of this document carefully before you start to install or remove the CAN/402-Slot2-LIN!

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/402-Slot2-LIN is to be integrated.

→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ Never carry out work while power supply voltage is switched on!
→ Ensure the absence of voltage before starting any electrical work.

NOTICE
Electrostatic discharges may cause damage to electronic components.

→ To avoid this, please discharge the static electricity from your body *before* you touch the CAN/402-Slot2-LIN.
→ Furthermore, you should prevent your clothes from touching the CAN/402-Slot2-LIN, because your clothes might be electrostatically charged as well.

Step	Procedure:
1.	Switch off your system and all connected peripheral devices (monitor, printer, etc.).
2.	Take measures against electrostatic discharge.
3.	Disconnect the system from the mains. Make sure that no risk arises from the system into which the CAN/402-Slot2-LIN shall be inserted. Read the manual of the system used and follow the instructions of the system manufacturer.

DANGER
Hazardous Voltage - Risk of electric shock due to unintentional contact with uninsulated live parts with high voltages.

→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ If the system does not have a flexible mains cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (i.e., with caution label).
→ Ensure the absence of voltage before starting any electrical work.
→ Cover or block off adjacent live parts.

4. If necessary, open the case. To do this, follow the instructions of the system manufacturer.

To install the CAN/402-Slot2-LIN in the system continue with step 5 below.
To remove the CAN/402-Slot2-LIN continue with step 14.

5. The CAN/402-Slot2-LIN can only be operated together with the CAN-PCI(e)/402 board (firmware version $\geq$ 0.0.72, see chapter 4.1.1 for further information). The CAN-PCI(e)/402 board must be installed as described in its manual (1), (2).

6. Use the ribbon cable supplied with the CAN/402-Slot2-LIN to connect it to the CAN-PCI(e)/402 board, as described in Figure 5. Connect the ribbon cable to the shrouded box header (X3) on the CAN/402-Slot2-LIN board and to the shrouded box header on your CAN-PCI(e)/402 board.

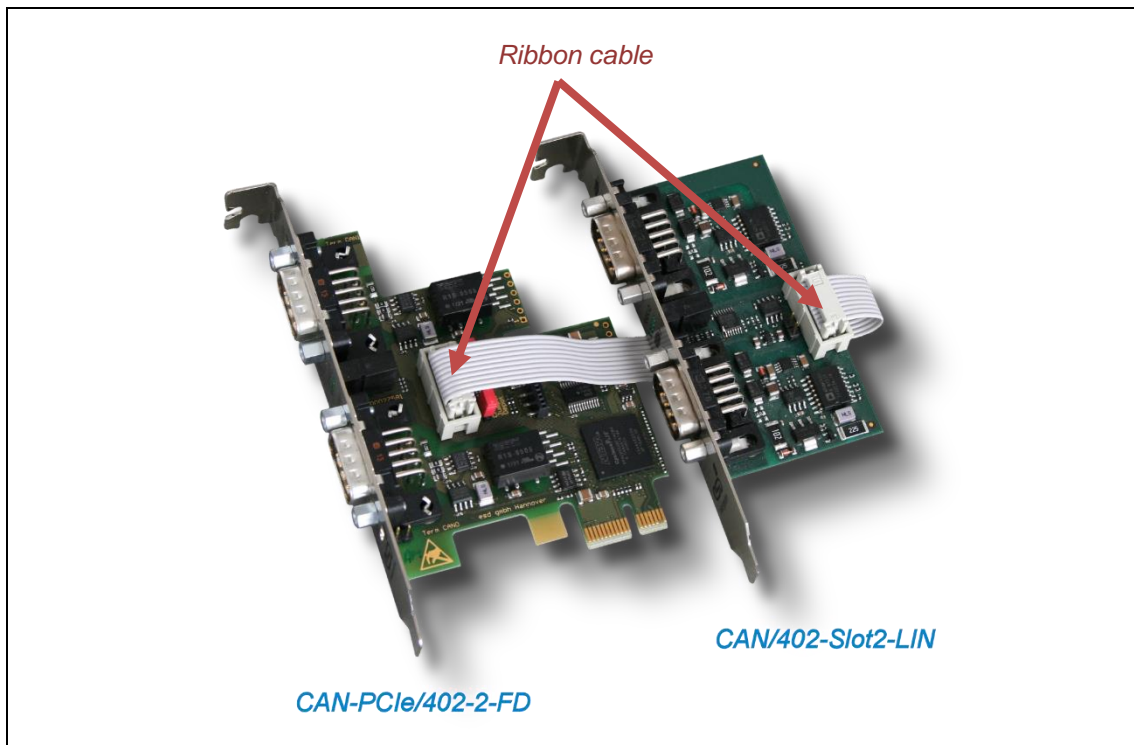(CAN-PCIe/402-2-FD: X300, or CAN-PCI/402-2-FD: X500)

Figure 5: Example: CAN/402-Slot2-LIN connected to CAN-PCIe/402-2-FD

7.   Select two adjacent free slots that are suitable for the PCI or PCIe card used.
        Remove the slot covers in the rear panel of the PC.

8.   Insert the CAN/402-Slot2-LIN to the right of the CAN-PCI(e)/402 into the selected slots.
        Be sure to route the connection cable behind the LIN adapter to the CAN board as shown in
        Figure 5. Carefully push the boards until they snap into place.
        Fasten the front panels with a screw if necessary.

9.   Close the system's case again.

10.   Connect the LIN interfaces via the DSUB9 connectors in the front panel of the CAN/402-Slot2-LIN.

11.   Connect the system to mains again (mains connector or safety fuse).

12.   Switch on the system and the peripheral devices.

13.   End of hardware installation. Continue with the software installation.

To uninstall the CAN/402-Slot2-LIN continue as described below after you have performed the steps 1.-4.:

14.   Disconnect the LIN interfaces from the DSUB9 connectors in the front panel of the CAN/402-Slot2-LIN.
        Disconnect the ribbon cable from the connected CAN-PCI(e)/402 board.
        If necessary, remove the screws on the front panel.
        Pull out the CAN/402-Slot2-LIN carefully.
        If necessary, close the housing cover again.

4.1 Software Support

Device drivers for Windows® and Linux® are included in delivery of the CAN-PCI(e)402-2-FD boards. Drivers for other operating systems, especially real-time operating systems like QNX® are available. Please contact our support team: support@esd.eu for more information or if you want NTLIN support for other operating systems.

Using the LIN Application Programming Interface (NTLIN-API) gives the application developer the possibility to change the esd LIN hardware as well as the operating system without the need to change the LIN I/O related parts of the application.

The NTLIN-API is described in the NTLIN Application Developers Manual (3).
As part of the esd software development kit (CAN SDK), the NTLIN-API is included in delivery of the CAN-CD. The CAN SDK can also be downloaded free-of-charge from our website:
https://esd.eu/en/products/can-sdk

4.1.1 Required FW Revision of the CAN-PCI(e)402-2-FD

To be able to support the CAN/402-Slot2-LIN, the CAN-PCI(e)402-2-FD boards must have at least firmware revision ≥ 0.0.72 (0x0048). If necessary, the local firmware can be updated. For the CAN-PCI(e)/402 there is an update tool which is part of the driver archive, see (5).
Please contact our Technical Support if you need further information on this.
If you don't know the current firmware revision of your CAN-PCI(e)402-2-FD, you can easily find out, for example by using our CAN Tool *CANreal* or the console test application *CANtest.*

4.1.1.1 Get Firmware Revision Number via *CANreal*

Procedure:
- Start the CANreal application on your PC.
- Select the network (*Net*) and the bitrate (*Baud*) of the interface of the CAN-PCI(e)402-2-FD board and click *Start.*
- Click on *Help* in the main menu and then click on *About* in the context menu.
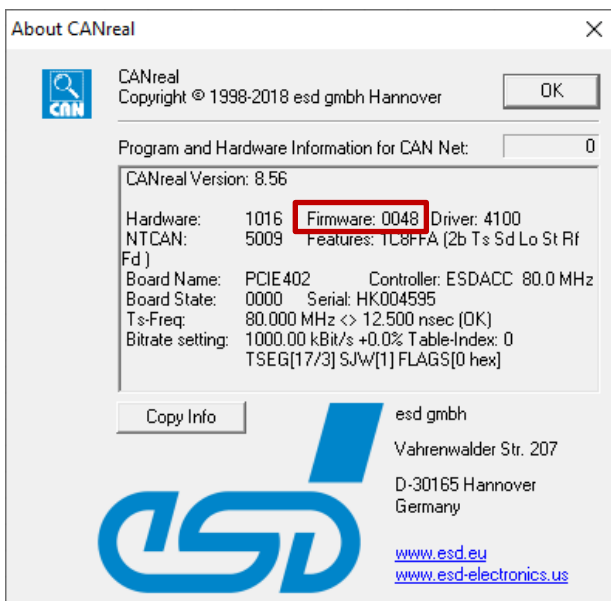
The information window *About CANreal* opens.

The window provides program and hardware information for example about the selected CAN net (net 0 here), the CANreal version and the reversion of the hardware, the firmware, and the driver.
Please note that the firmware version is displayed in hexadecimal format!

The example (Figure 6) on the left shows Firmware: 0048 (0x0048), i.e.: 0.0.72 in decimal format.

Figure 6: Example: *About CANreal*

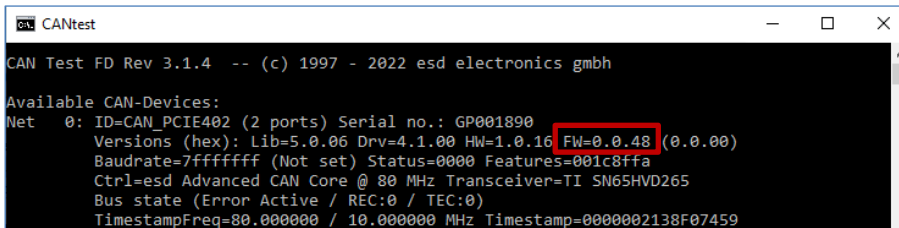For more information on CANreal, see the CANreal manual (6).

4.1.1.2 Get Firmware Revision Number via *CANtest*

Procedure:
- Start the *CANtest* application on your PC.
- Enter the command: `cantest –2`

The data is read out and displayed as shown in the example below.
The window provides program and hardware information for example about the CAN nets (Net 0 here), the serial number and the versions of the library, the driver, the hardware, and the firmware and others. Please note that the firmware versions are displayed in hexadecimal format!

In the example (Figure 7) on the left, the firmware version is FW=0.0.48 (0x0048), i.e.: 0.0.72 in decimal format.

Figure 7: Example: Data of available CAN devices

For more information on *CANtest*, see (4).

5 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* **CAN/402-Slot2-LIN**	Typ, Modell, Artikel-Nr. *Type, Model, Article No.* **C.2045.12**	
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.*	**0218-202212**	
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, 2023-01-03

T. Bih

Rechtsgültige Unterschrift / *authorized signature*

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6 Order Information

6.1 Hardware

Type	Properties	Order No.
CAN/402-Slot2-LIN	Adapter board to extend an esd CAN interface board by two LIN interfaces. Compatible with CAN-PCIe/402-2-FD (C.2045.64) and CAN-PCI/402-2-FD (C.2049.64). The LIN interface is designed and galvanically isolated according to ISO 17987-4:2016. Scope of delivery: LIN adapter board and connection cable.	C.2045.12

Table 2: Order information hardware

6.2 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/402-Slot2-LIN-ME	Hardware manual in English (this manual)	C.2045.23
NTLIN-API-ME	Application Developers Manual	C.2007.21

Table 3: 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.