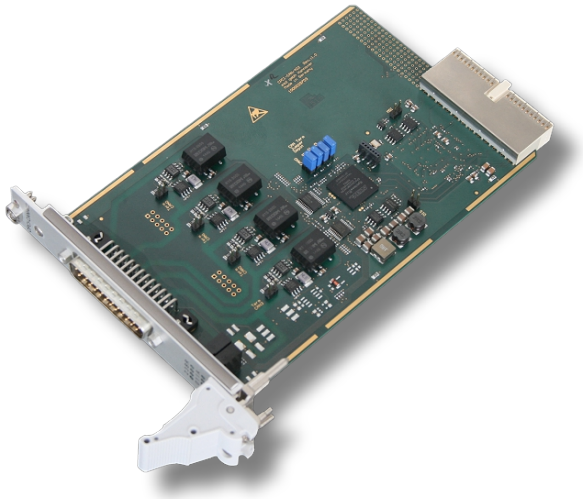
CPCI-CAN/402-4, CPCI-CAN/402-4-FD

CompactPCI® Board with 4x CAN (Layer 2, CANopen®, J1939, ARINC 825) or optional 4x CAN FD



Hardware Manual

to Products I.2332.08,
I.2332.68

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N O T E

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This manual contains important information and instructions on safe and efficient handling of the CPCI-CAN/402-4(-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.

Document file:	I:\Texte\Doku\MANUALS\CPCI\CPCI-CAN402\CPCI-CAN402-4-(FD)_Hardware-Manual_en_12.odt
Date of print:	2019-04-10
Document type number:	DOC0800

Hardware version:	CPCI-CAN/402 Rev. 1.0

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	2016-07-29
1.1		CPCI-CAN/402-4-FD version included in this manual	2018-04-10
	1.	Chapter revised	
	4.	Description of CPCI-CAN/402-4-FD version added	
	5.	Figure corrected	
	6.	Description of CPCI-CAN/402-4-FD version added	
	7.2	Figure inserted	
	10.	Application Note to CAN/402 Boards inserted	
	11.	New Declaration of Conformity	
	12.	Order Information revised	
1.2	1.	Chapter revised, note on CAN FD added. Note on potential interoperability revised	2019-04-10
	6.8	Chapter revised, note on Windows and Linux operating systems added	
	10.	Chapter “Application Note to CAN/402 Boards” revised and subsection for Linux OS added.	
	11.	Declaration of Conformity 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 CPCI-CAN/402-4(-FD) follow the instructions below and read the manual carefully to protect yourself from injury and the CPCI-CAN/402-4(-FD) 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 CPCI-CAN/402-4(-FD) 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.
- Current circuits which are connected to the device have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
- The CPCI-CAN/402-4(-FD) may only be driven by power supply current circuits, that are contact protected.
  A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with this conditions.

- The device has to be securely installed in the control cabinet before commissioning.
- Protect the CPCI-CAN/402-4(-FD) from dust, moisture and steam.
- Protect the CPCI-CAN/402-4(-FD) from shocks and vibrations.
- The CPCI-CAN/402-4(-FD) may become warm during normal use. Always allow adequate ventilation around the CPCI-CAN/402-4(-FD) and use care when handling.
- Do not operate the CPCI-CAN/402-4(-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 CPCI-CAN/402-4(-FD) is to be integrated.

→ Disconnect all hazardous voltages (mains voltage) before opening the system.

→ Ensure the absence of voltage before starting any electrical work

NOTICE

Electrostatic discharges may cause damage to electronic components.

To avoid this, perform the steps described on page 14 *before* you touch the CPCI-CAN/402-4(-FD), in order to discharge the static electricity from your body.

Qualified Personal

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

Conformity

The CPCI-CAN/402-4(-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 CPCI-CAN/402-4(-FD) may cause radio interferences in which case the user may be required to take adequate measures.

The CPCI-CAN/402-4(-FD) is a sub-assembly intended for incorporation into an apparatus by a manufacturer. The manufacturer of the final system must decide, whether additional EMC or EMI protection requirements are necessary.

Intended Use

The intended use of the CPCI-CAN/402-4 is the operation as CompactPCI board with 4 CAN interfaces. The intended use of the CPCI-CAN/402-4-FD is the operation as CompactPCI board with 4 CAN FD interfaces.
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 CPCI-CAN/402-4(-FD) is intended for installation in a CompactPCI system.
- The operation of the CPCI-CAN/402-4(-FD) in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the CPCI-CAN/402-4(-FD) for medical purposes is prohibited.

Service Note

The CPCI-CAN/402-4(-FD) does not contain any parts that require maintenance by the user. The CPCI-CAN/402-4(-FD) does not require any manual configuration of the hardware, except of the configuration of the CAN termination jumpers. Unauthorized intervention in the device voids warranty claims.

Disposal

Devices which have become defective in the long run have to be disposed in an appropriate way or have to be returned to the manufacturer for proper disposal. Please, make a contribution to environmental protection.

Abbreviations

API	Application Programming Interface
CAN	Controller Area Network
CPU	Central Processing Unit
CiA	CAN in Automation
HW	Hardware
I/O	Input/Output
LSB	Least Significant Bit
MSB	Most Significant Bit
n.a.	not applicable
OS	Operating System
SDK	Software Development Kit

Table of contents

1. Overview

1.1 About this manual

This manual describes the hardware of the CPCI-CAN/402. The following versions of the product are described:

- CPCI-CAN/402-4-FD	4 CAN FD interfaces	(backwards compatible with Classical CAN)
- CPCI-CAN/402-4	4 CAN interfaces	(Classical CAN only)

CPCI-CAN/402-4 and the CPCI-CAN/402-4-FD are described together as CPCI-CAN/402-4(-FD). Differences of the board versions are noted where they are described.

1.2 Classical CAN and CAN FD Version

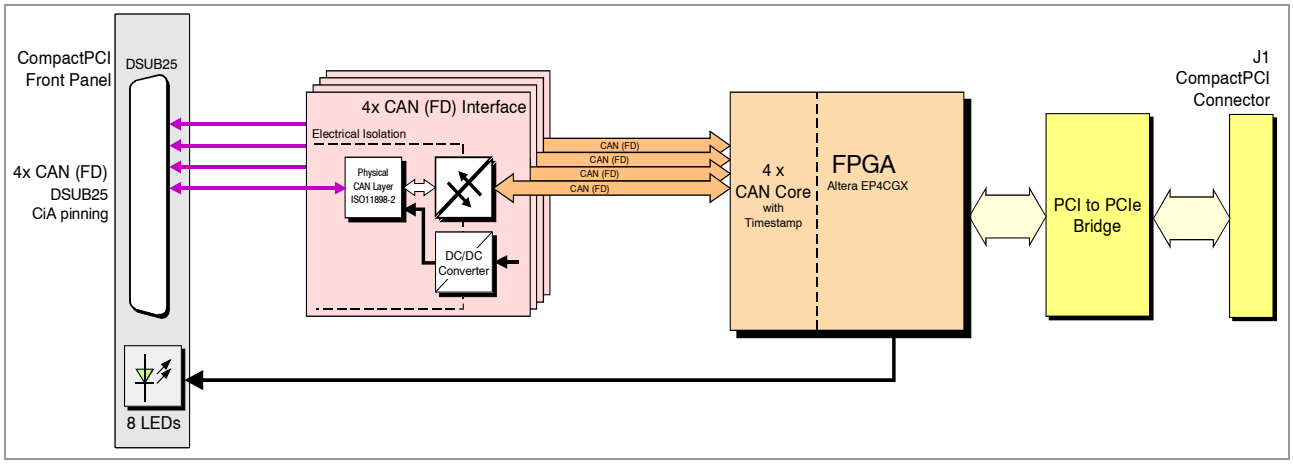


Figure 1: Block circuit diagram

The CPCI-CAN/402-4(-FD) is a CompactPCI board designed for the PCI bus that features four electrically isolated CAN (FD) interfaces according to ISO 11898-2. The interfaces are easily accessible via a DSUB25 connector in the front panel.

CPCI-CAN/402-4-FD
The CPCI-CAN/402-4-FD supports four CAN FD interfaces with bit rates from 10 kbit/s up to 5 Mbit/s. The independent CAN FD nets are designed according to ISO 11898-1:2015.

CPCI-CAN/402-4
The hardware of the Classical CAN version CPCI-CAN/402-4 and the CAN FD version CPCI-CAN/402-4-FD is equal but both versions come with different CAN controllers in the FPGA images. The electrically isolated high-speed CAN interfaces support bit rates up to 1 Mbit/s.

INFORMATION
The CPCI-CAN/402-4 is not recommended for new designs. (It can still be used in existing systems, e.g. if the drivers shall not be reinstalled.)
Please use the successor CPCI-CAN/402-4-FD for new projects. The CAN FD version can also be used for Classical CAN applications!

CAN FD
With a higher bit rate in the data phase in combination with the increase of efficiency by a higher number of user-data bytes, CAN FD offers a higher data throughput while maintaining the benefits of Classical CAN.

The Classical CAN version CPCI-CAN/402-4 can only be used in Classical CAN applications because its controller is not CAN FD capable.

The CAN FD version CPCI-CAN/402-4-FD is fully backwards compatible with CAN and can also be used in Classical CAN applications.

INFORMATION
Every CAN FD controller is backward compatible to the Classical CAN protocol.
Classical CAN nodes and CAN FD nodes can communicate with each other as long as the CAN FD frame format remains unused!

You can insert for example the CAN FD version CPCI-CAN/402-4-FD in your Classical CAN application if you want to replace a Classical CAN component. The CAN FD board automatically communicates like a Classical CAN board (the existing program code can be used unchanged). The CPCI-CAN/402-4-FD has to communicate with the CAN nodes via Classical CAN frames, because Classical CAN controllers do not tolerate CAN FD frames. All controllers have to use the same Classical CAN Bitrate.

INFORMATION
During the initialisation of the CAN controller of the CAN FD boards the application determines via software if the CAN FD boards communicate with Classical CAN or with CAN FD.
See NTCAN-API Manual Part 1: “Application Developers Manual” for further information.

NOTICE
The system integrator has to verify that all CAN nodes on the bus are set to the same bit rate!

If you work with a Classical CAN application and want to migrate to CAN FD in the future, you can replace your Classical CAN nodes one after another until all CAN nodes are replaced by CAN FD nodes.

esdACC
The CAN FD or CAN interfaces are driven by the ISO 16845:2004 certified esdACC (esd advanced CAN Core) implemented in an Intel® (formerly Altera®) FPGA.

CAN Data Management
The FPGA supports bus mastering (first-party DMA) to transfer data to the host memory. This results in a reduction of overall latency on servicing I/O transactions in particular at higher data rates and a reduced host CPU load.
Due to the usage of MSI the CPCI-CAN/402-4(-FD) can be operated for example in Hypervisor environments.
Furthermore the CPCI-CAN/402-4(-FD) provides high resolution 64-bit hardware timestamps for CAN messages with bit time accuracy.

Additional free-of-charge esd CAN tools for Windows® are downloadable from our website. The tools offer efficient setup and analysis of Classical CAN applications and networks.

NOTICE
CPCI-CAN/402-4(-FD) boards which are equipped with the Pericom® PCI-to-PCI bridge PI7C9X111SL might have a potential interoperability problem in Microsoft Windows or in Linux® operating systems. Please read chapter “Application Note to CAN/402 Boards“ on page 37 for information about this.

Customized options are available for customized series production in reasonable quantities. Please contact our sales team for detailed information.

Customized Options are for example:

- Extended temperature range: -40° C … +75° C
- Error simulation support
- IRIG-B interface
  An optional IRIG-B interface offers inputs for analog or RS-422 IRIG-B coded signals. Both are electrically isolated. IRIG-B evaluation is controlled by an 8051 microcontroller, integrated in the FPGA.
- All signals via Rear I/O (P3)
- 2x CAN FD via DSUB9

2. PCB View with Connectors

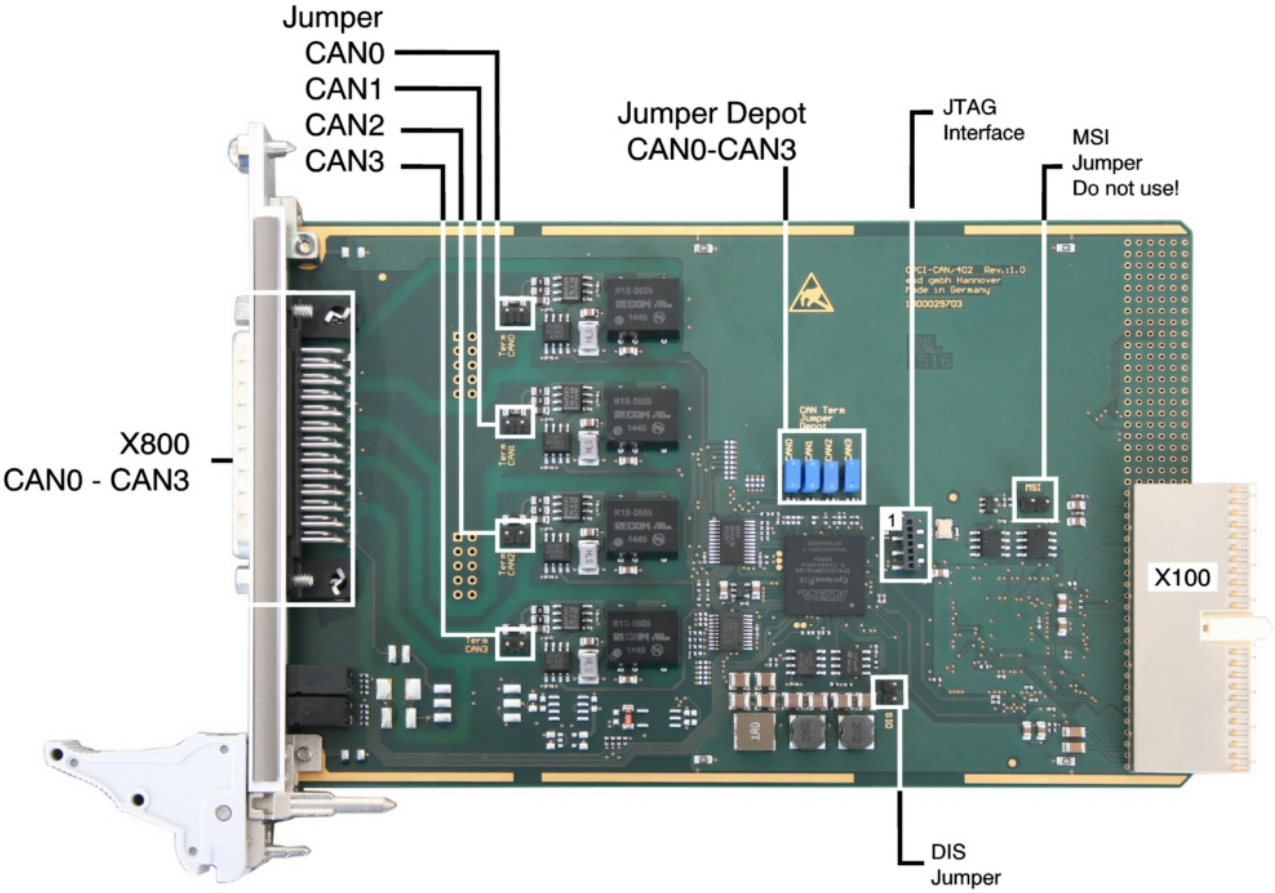


Figure 2: PCB top view

NOTICE
Read chapter “Hardware Installation” on page 14, before you start with the installation of the hardware!

See also page 23 for signal assignment of the connectors.

3. Jumper Configuration

3.1 CAN Termination

An on-board termination resistor of 120Ω can be individually enabled for each CAN or CAN FD channel via jumpers.
For the position of the jumpers and jumper depots on the CPCI-CAN/402-4(-FD) see Figure 2 on page 12.

NOTICE
It is strongly recommended to keep the jumpers which are not needed for CAN termination on the corresponding jumper depots CAN0 - CAN3!
A missing jumper in the depot will be interpreted as an internally terminated CAN interface.

Jumper	Jumper set	Jumper not set	Jumper Depot
JP600	internal termination of CAN0	CAN0 has to be terminated externally	JP530
JP610	internal termination of CAN1	CAN1 has to be terminated externally	JP531
JP700	internal termination of CAN2	CAN2 has to be terminated externally	JP532
JP710	internal termination of CAN3	CAN3 has to be terminated externally	JP533

3.2 MSI

The “MSI Enable” jumper JP300 is reserved. Do not use!
See chapter “Message-Signalled Interrupt Handling” on page 20 for more information about MSI.

For the position of the jumper on the CPCI-CAN/402-4(-FD) see Figure 2 on page 12.

3.3 DIS

Via jumper JP410 the CAN functionality can be disabled.

Jumper	Jumper set	Jumper not set
JP410	Disable CAN functionality	Normal CAN functionality

For the position of the jumper on the CPCI-CAN/402-4(-FD) see Figure 2 on page 12.

4. Hardware Installation

NOTICE
Read the safety instructions at the beginning of this document carefully, before you start with the hardware installation!

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 CPCI-CAN/402-4(-FD) is to be integrated.
→ Disconnect all hazardous voltages (mains voltage) before opening the system.
→ 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 by touching the metal case of the CompactPCI system *before* you touch the CPCI-CAN/402-4(-FD).
→ Furthermore, you should prevent your clothes from touching the CPCI-CAN/402-4(-FD), because your clothes might be electrostatically charged as well.

Procedure:

1. Switch off your system and all connected peripheral devices (monitor, printer, etc.).
2. Discharge your body as described above.
3. Disconnect the system from the mains.

   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. Open the case if necessary.
5. Set the jumpers for the internal termination of the CAN (FD) interfaces according to your needs (see page 13).
6. Insert the CPCI-CAN/402-4(-FD) board into the selected CompactPCI slot. Carefully push the board until it snaps into place.
7. Attach the CPCI-CAN/402-4(-FD) board.
8. Connect the CAN or CAN FD interfaces via the DSUB25 connector in the front panel of the CPCI-CAN/402-4(-FD).
   You can use the cable CAN/400-4-1C4 by esd (see Order Information, page 41) as adapter from the DSUB25 connector to 4 DSUB9 connectors.

NOTICE
To ensure the EC Conformity shielded cables have to be used.
In an adapter cable FE (functional earth) shall be connected to the cable shield.
CPCI-CAN/402-4(-FD): It is recommended to use the cable CAN/400-4-1C4, as described in chapter 'Adapter Cable DSUB25 to DSUB9', page 24.
The conformity is granted when using this cable.

9. Close the system' s case again.

10. **NOTICE**
Please note that the CAN bus has to be terminated at both ends!

If the integrated CAN termination of the CAN (FD) interface is not set via the jumpers, the interface has to be terminated externally, read chapter “Correct Wiring of Electrically Isolated CAN Networks“, from page 26.
For external termination esd offers suitable termination connectors for the CAN bus. Additionally the CAN_GND signal has to be connected to earth at exactly one point.
A CAN participant with electrical connection to earth potential acts as an earth connection.

11. Connect the system to mains again (mains connector or safety fuse).
12. Switch on the system and the peripheral devices.

5. LEDs

5.1 Position of the LEDs

The CPCI-CAN/402-4(-FD) is equipped with eight green LEDs in the front panel.

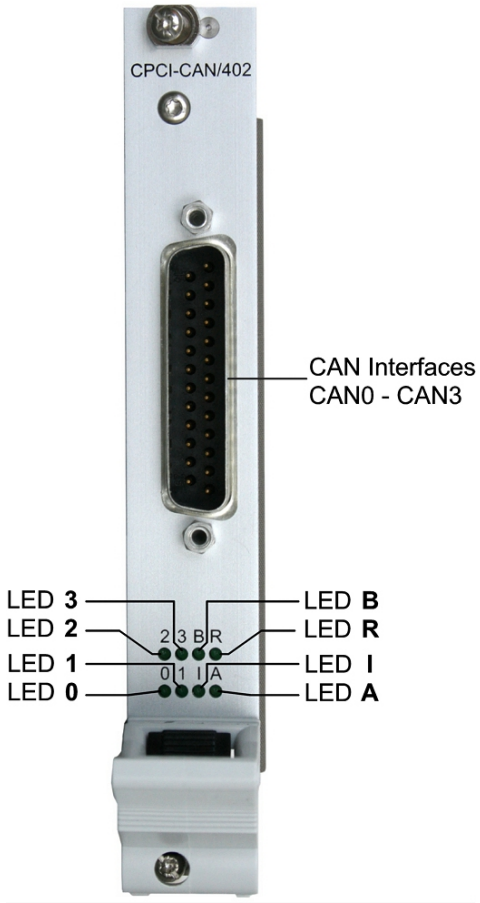


Figure 3: Front panel view of CPCI-CAN/402-4(-FD)

Label	Name	Indicator State	Description
3	CAN3	off	no CAN bus connection and/or no CAN traffic on CAN3
		on	connected to CAN bus 3 and CAN traffic on CAN3
2	CAN2	off	no CAN bus connection and/or no CAN traffic on CAN2
		on	connected to CAN bus 2 and CAN traffic on CAN2
1	CAN1	off	no CAN bus connection and/or no CAN traffic on CAN1
		on	connected to CAN bus 1 and CAN traffic on CAN1
0	CAN0	off	no CAN bus connection and/or no CAN traffic on CAN0
		on	connected to CAN bus 0 and CAN traffic on CAN0

Table 1: Description of CAN LEDs

Label	Name	Indicator State	Description
B	-	off	reserved
R	Power	off	CPCI-CAN/402-4(-FD) not ready, FPGA not loaded
		on	CPCI-CAN/402-4(-FD) is ready for operation, FPGA is loaded
I	-	off	reserved for IRIG-B option
A	-	on	reserved

Table 2: Description of LEDs B, R, I and A

6. Technical Data

6.1 General Technical Data

Power supply voltage	Via CompactPCI bus: nominal voltage: 3.3 V (5V tolerant), typical current consumption (incl. CAN traffic): at 3.3V: $I_{max.3.3V}$ = 1.1A Absolute maximum power at 3.3V ($I_{max.3.3V}$ = 1.1A): $P_{max:3.3}$ = 3.63 W
Connectors	CAN0 ... CAN3 (X800, 25-pin DSUB) - CAN Interfaces CAN0-CAN3, (optional IRIG-B available on request) J1 CompactPCI board connector (X100, 110-pin male connector) Only for test- and programming purposes: X400 (7-pin socket strip) JTAG Interface
Temperature range	Operation : 0 °C ... +75 °C Storage: -40°C ... +85 °C
Humidity	max. 90%, non-condensing
Dimensions	PCB only: 100 mm x 160 mm without front panel Front panel: 3U/4HP
Weight	150 g
Conformity	EN 61000-6-2, EN 61000-6-4, EMC, RoHS, CE

Table 3: General data of the module

6.2 Hardware Components

FPGA	EP4CGX Altera FPGA
PCI to PCIe Bridge	Pericom PI7C9X111SLBFDE

Table 4: Hardware components

6.3 CAN Interface (CPCI-CAN/402-4)

Number of CAN interfaces	4x high-speed CAN interfaces (CAN0 -CAN3)
CAN controller	esdACC in EP4CGX Altera FPGA, according to ISO 11898-1 (CAN 2.0 A/B),
Physical Layer	Physical layer according to ISO 11898-2, bit rate up to 1 Mbit/s
Bus termination	On-board terminating resistors can be individually set between CAN-H and CAN_L via jumpers, resistance: 120 Ω ±5%, 250 mW
Electrical isolation	Electrical isolation via digital isolator and DC/DC-converters is possible: voltage over CAN isolation (CAN to slot bracket/EARTH; CAN to host/system ground; CAN to CAN): 500V DC @ 1s (I < 1 mA)
Connector	1x 25-pin DSUB, male

Table 5: Data of the CAN interface (CPCI-CAN/402-4)

6.4 CAN FD Interface (CPCI-CAN/402-4-FD)

Number of CAN FD interfaces	4x CAN FD interfaces (CAN0 - CAN3)
CAN controller	esdACC in EP4CGX Altera FPGA, according to ISO11898-1:2015
Physical Layer	Physical layer according to ISO 11898-2, CAN bit rates from 10 kbit/s up to 5 Mbit/s with the same CAN transceiver
Bus termination	On-board terminating resistors can be individually set between CAN-H and CAN_L via jumpers, resistance: 120 Ω ±5%, 250 mW
Electrical isolation	Electrical isolation via digital isolator and DC/DC-converters is possible: voltage over CAN isolation (CAN to slot bracket/EARTH; CAN to host/system ground; CAN to CAN): 500V DC @ 1s (I < 1 mA)
Connector	1x 25-pin DSUB, male

Table 6: Data of the CAN FD interface (CPCI-CAN/402-4-FD only)

6.5 CompactPCI Bus

Host bus	PCI-Bus according to PCI Local Bus Specification 3.0
PCI-data/address bus	32 Bit, 33/66 MHz
Microprocessor	optional 32-bit Microcontroller in FPGA (MicroBlaze)
Board dimension	according to CompactPCI-Specification, Rev. 2.2
Connector	
Bus mastering	bus master DMA capability, supported by FPGA
Connector coding	3.3 V (5 V tolerant)

Table 7: Data of the CompactPCI bus

6.6 IRIG-B Interface (Option)

INFORMATION
The IRIG-B option is not equipped on the CPCI-CAN/402-4 or CPCI-CAN/402-4-FD, order No.: I.2332.08 or I.2332.68.
The IRIG-B option is only available in a customized version on request

Number	1x analog and 1x RS-422 compatible (via front panel, both electrically isolated), 1x RS-422 compatible (at J2 only)
Controller	8051 microcontroller
Connector	DSUB25

Table 8: Data of the serial interface

6.7 Message-Signalled Interrupt Handling

The CPCI-CAN/402-4(-FD) supports MSI. The equipped PCI-to-PCIe bridge is able to convert MSI's from the PCIe bus to “Hardware” Interrupt lines or to PCI MSI'.

It depends on the operating system whether MSI or Hardware Interrupts are enabled on the CPCI-CAN/402-4(-FD).

6.8 Software Support

The CAN layer 2 (CAN-API) software installation and the software drivers are described in the manual:
“NTCAN-API Part 1: Structure, Function and C/C++ API” Application Developers Manual and
“NTCAN-API Part 2: Installation, Configuration and Firmware Update” Installation Guide
(esd-order No.: C.2001.21)

NOTICE
CPCI-CAN/402-4(-FD) boards which are equipped with the Pericom® PCI-to-PCI bridge PI7C9X111SL might have a potential interoperability problem in Microsoft Windows or in Linux® operating systems. Please read chapter “Application Note to CAN/402 Boards“ on page 37 for information about this.

6.8.1 CPCI-CAN/402-4-FD

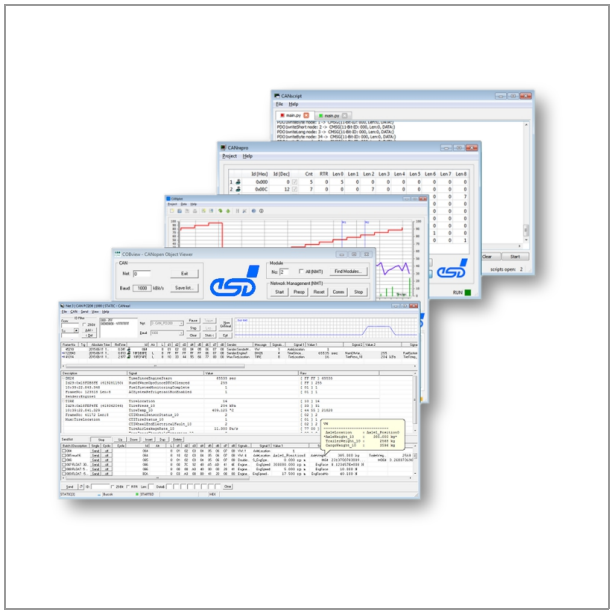
The CAN layer 2 (NTCAN-API) drivers for Windows and Linux are included in the scope of delivery of CPCI-CAN/402-4-FD. Additional CAN layer 2 (NTCAN-API) drivers for Real-time OS can be ordered separately. Higher layer protocols (CANopen, J1939, ARINC825) are supported for Classical CAN applications on CPCI-CAN/402-4-FD only.
See Order Information on page 42 for availability of the drivers. For detailed information about the driver availability for your operating system, please contact our sales team: sales@esd.eu.

6.8.2 CPCI-CAN/402-4

The CAN layer 2 (NTCAN-API) drivers for Windows and Linux are included in the scope of delivery of CPCI-CAN/402-4. Additional CAN layer 2 (NTCAN-API) drivers for Real-time OS can be ordered separately. Higher layer protocols (CANopen, J1939, ARINC825) are supported.
See Order Information on page 41 for availability of the drivers. For detailed information about the driver availability for your operating system, please contact our sales team: sales@esd.eu.

6.8.3 CAN Tools

esd offers additional free-of-charge tools which support efficient setup and analysis of Classical 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
- 30 MB free HD drive space
- esd CAN driver installed

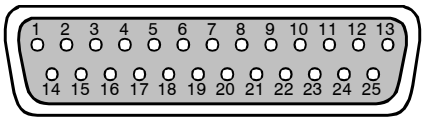
As part of the esd software development kit (CAN SDK) of the NTCAN-API the CAN Tools are included in delivery of the CAN-CD.
The CAN SDK can also be downloaded free-of-charge from the esd website.

7. Connector Assignments

7.1 CAN

Device connector: 25-pin DSUB connector, male

Pin Position:



Pin Assignment:

Signal	Pin		Signal
		1	CAN 0 L
CAN 0 H	14	2	CAN 0 GND
reserved	15	3	reserved
CAN 1 L	16	4	CAN 1 H
CAN 1 GND	17	5	reserved
reserved	18	6	CAN 2 L
CAN 2 H	19	7	CAN 2 GND
reserved	20	8	reserved
CAN 3 L	21	9	CAN 3 H
CAN 3 GND	22	10	reserved
reserved	23	11	reserved
reserved	24	12	reserved
reserved	25	13	reserved

Shield	S

Signal Description:

CAN_Y_L, CAN_Y_H ...	CAN signal lines of CAN interface Y (Y = 0, 1, 2, 3)
CAN_Y_GND ...	reference potential of the local CAN physical layer Y (Y = 0, 1, 2, 3)
Shield ...	shielding (connected with the case of the 25-pin DSUB connector)
reserved ...	reserved for future applications, do not connect!

NOTICE
To ensure the EC Conformity shielded cables have to be used. In the adapter cables FE (functional earth) shall be connected to the cable shield. It is recommended to use the cable CAN/400-4-1C4 (order no. C.2047.19), as described in chapter 'Adapter Cable DSUB25 to DSUB9', from page 24.

7.2 Adapter Cable DSUB25 to DSUB9

esd offers the adapter cable CAN/400-4-1C4 1xDSUB25-to-4xDSUB9 (see Order Information on page 41) as accessory for the CPCI-CAN/402-4(-FD).
This adapter only connects the four CAN (FD) interfaces to the DSUB25 front panel connector. The cable comes with a DSUB25 female socket and four DSUB9 male connectors for the CAN interfaces (CAN0 -CAN3).

NOTICE
To ensure the EC Conformity shielded cables have to be used. In this adapter cables FE (functional earth) is connected to the cable shield.

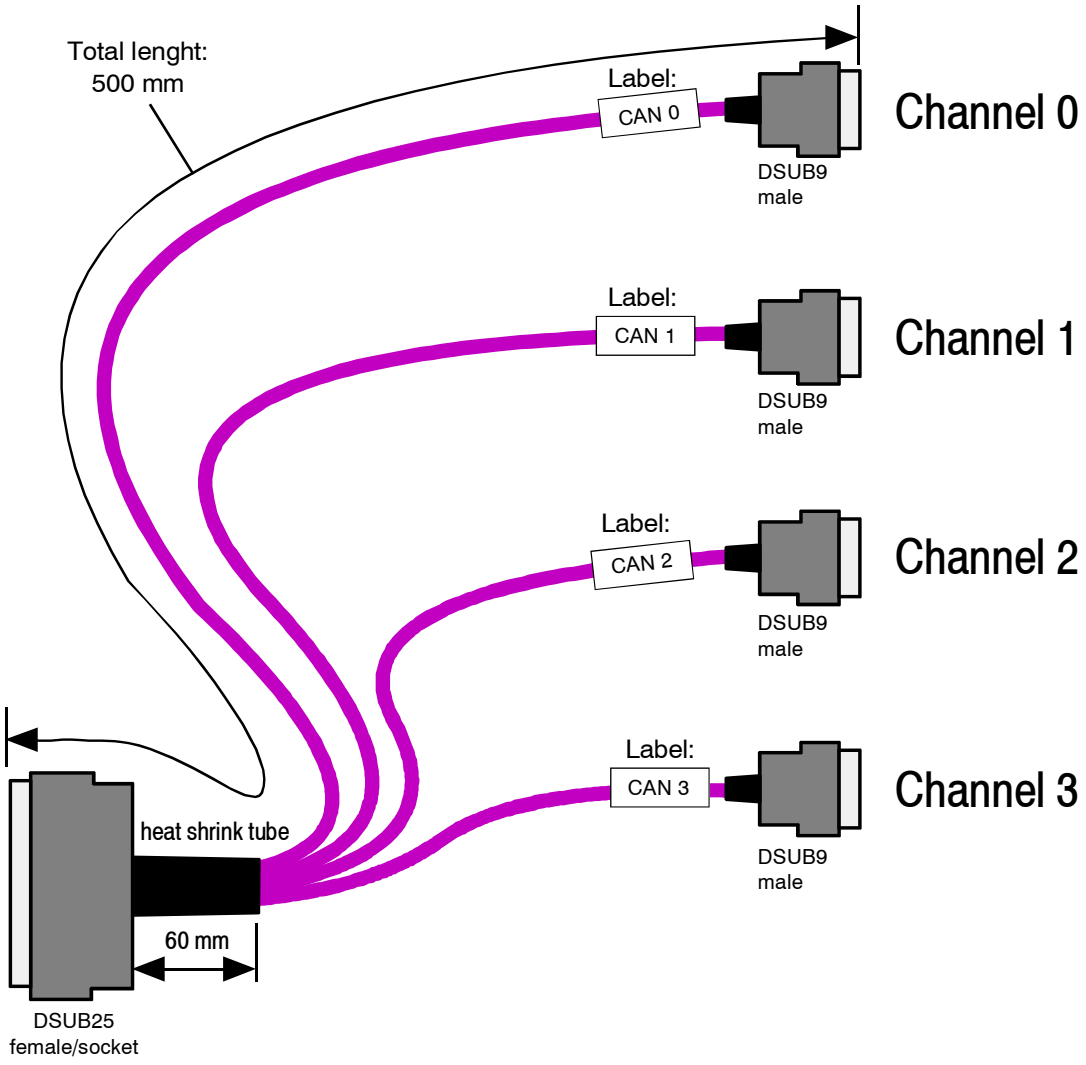


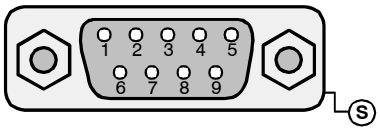
Figure 4: Adapter DSUB25 to 4x DSUB9

DSUB25 Connector		Cable		DSUB9 Connnector		Signal Name
Connector Type	Pin No.	Interface	Wire (internal)	Connector Type	Pin No.	
DSUB25 socket, female						
	1	CAN0	white	DSUB9 plug, male	2	CAN0_L
	14		brown		7	CAN0_H
	2		green		3	CAN0_GND
	Housing		shield		Housing	FE
	16	CAN1	white	DSUB9 plug, male	2	CAN1_L
	4		brown		7	CAN1_H
	17		green		3	CAN1_GND
	Housing		shield		Housing	FE
	6	CAN2	white	DSUB9 plug, male	2	CAN2_L
	19		brown		7	CAN2_H
	7		green		3	CAN2_GND
	Housing		shield		Housing	FE
	21	CAN3	white	DSUB9 plug, male	2	CAN3_L
	9		brown		7	CAN3_H
	22		green		3	CAN3_GND
	Housing		shield		Housing	FE

CANx-GND signals are isolated from each other. They are not tied together by the adapter cable.

7.2.1 CAN Interfaces at DSUB9 Male (4x)

Pin Position:



Pin Assignment:

Signal	Pin		Signal
-	1	6	-
CANx_L	2	7	CANx_H
CANx_GND	3	8	-
-	4	9	-
-	5		

FE	S (Shield)

Signal Description:

Name	Description
-	Reserved - Do not use! This pin is not connected at the module.
CANx_L, CANx_H, CANx_GND	CAN signals of CAN node x (x= 0, 1, 2, 3). Physical layer according to ISO11898-2.
FE	Functional earth (FE) is connected to the housing of the DSUB9 connector and to the shield of the cable

8. Correct Wiring of Electrically Isolated CAN 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), e.g. regarding electromagnetic compatibility, security distances, cable cross-section or material, have to be observed.

8.1 Standards concerning CAN Wiring

The flexibility in CAN network design is one of the key strengths of the various extensions and additional standards like e.g. CANopen, ARINC825, DeviceNet and NMEA2000 that have been built on the original ISO 11898-2 CAN standard. In using this flexibility comes the responsibility of good network design and balancing these tradeoffs.

Many CAN organizations and standards have scaled the use of CAN for applications outside the original ISO 11898. They have made system level tradeoffs for data rate, cable length, and parasitic loading of the bus.

However for CAN network design margin must be given for signal loss across the complete system and cabling, parasitic loadings, network imbalances, ground offsets against earth potential and signal integrity. **Therefore the practical maximum number of nodes, bus length and stub length are typically much lower.**

esd has concentrated her recommendations concerning CAN wiring on the specifications of the ISO 11898-2. Thus this wiring hints forgoes to describe the special features of the derived standards CANopen, ARINC825, DeviceNet and NMEA2000.

The consistent compliance to ISO 11898-2 offers significant advantages:

- Durable operation due to well proven design specifications
- Minimizing potential failures due to sufficient margin to physical limits
- Trouble-free maintenance during future network modifications or during fault diagnostics due to lack of exceptions

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

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

8.2.1 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 8.3. 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 cable type with a wave impedance of about 120 Ω ±10% with an adequate conductor cross-section (≥ 0.22 mm²) has to be used. The voltage drop over the wire has to be considered.
2	For light industrial environment use at least a two-wire CAN cable. Connect • the two twisted wires to the data signals (CAN_H, CAN_L) and • the cable shield to the reference potential (CAN_GND).
3	The reference potential CAN_GND has to be connected to the functional earth (FE) at exactly **one** point.
4	A CAN net must not branch (exception: short cable stubs) and has to 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.

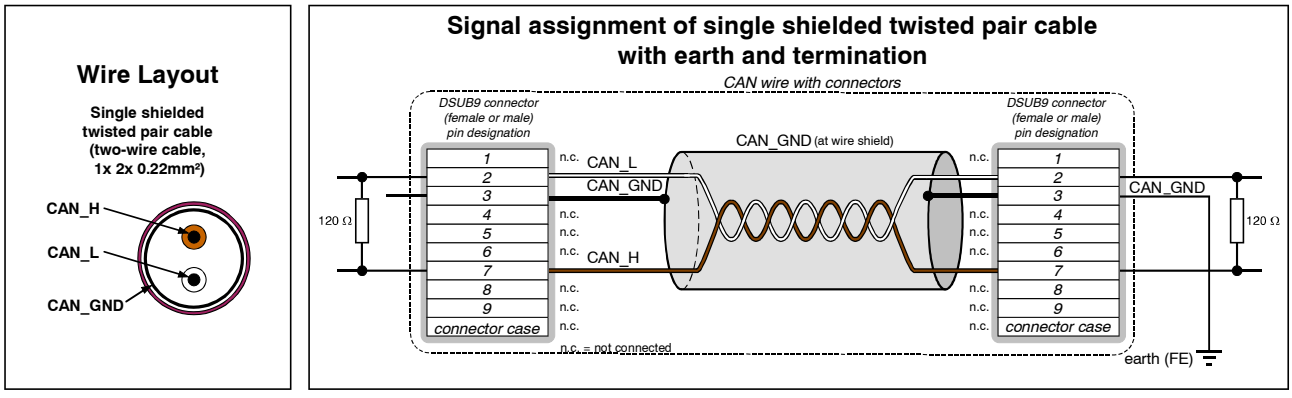


Figure 5: CAN wiring for light industrial environment

8.2.2 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 this devices are located at the end of the CAN network, the CAN terminator “CAN-Termination-DSUB9” can be used.

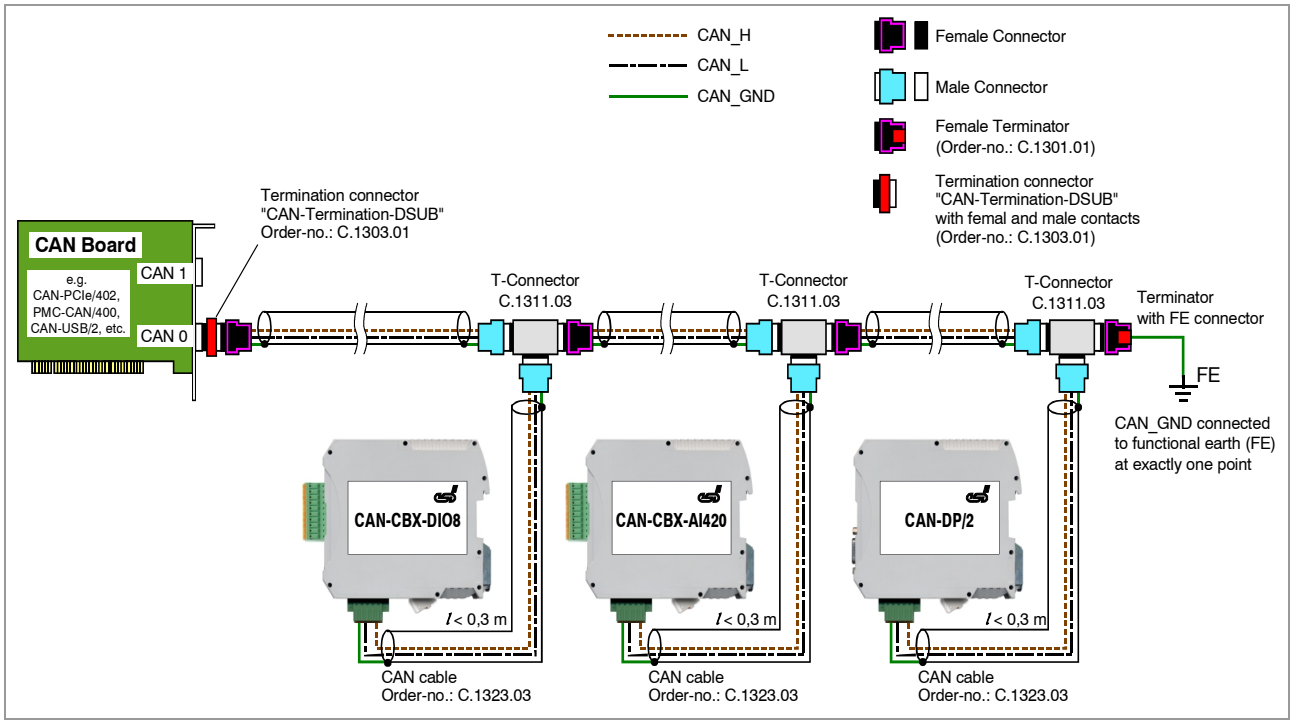


Figure 6: Example for proper wiring with single shielded single twisted pair wires

8.2.3 Branching

- In principle the CAN bus has to be realized in a line. The participants 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 is unavoidable, take care that the CAN_GND line is not interrupted!
- Deviations from the bus structure can be realized by the usage of repeaters.

8.2.4 Termination

- A termination resistor has to be connected at both ends of the CAN bus.
  If an integrated CAN termination resistor which is equipped at the CAN interface at the end of the bus is connected, this one has to be used for termination instead of an external CAN termination plug.
- 9-pin DSUB-termination connectors with integrated termination resistor and male and female contacts are available from esd (order no. C.1303.01).
- DSUB termination connectors with male contacts (order no. C.1302.01) or female contacts (order no. C.1301.01) and additional functional earth contact are available, if CAN termination and grounding of CAN_GND is required.

8.3 Heavy Industrial Environment (*Double* Twisted Pair Cable)

8.3.1 General Rules

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

1	A cable type with a wave impedance of about 120 Ω ±10% with an adequate conductor cross-section (≥ 0.22 mm²) has to be used. The voltage drop over the wire has to be considered.
2	For heavy industrial environment use a four-wire CAN cable. Connect • two twisted wires to the data signals (CAN_H, CAN_L) and • the other two twisted wires to the reference potential (CAN_GND) and • the cable shield to functional earth (FE) at least at one point.
3	The reference potential CAN_GND has to be connected to the functional earth (FE) at exactly **one** point.
4	A CAN bus line must not branch (exception: short cable stubs) and has to 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 can not be avoided, double shielded cables are recommended.

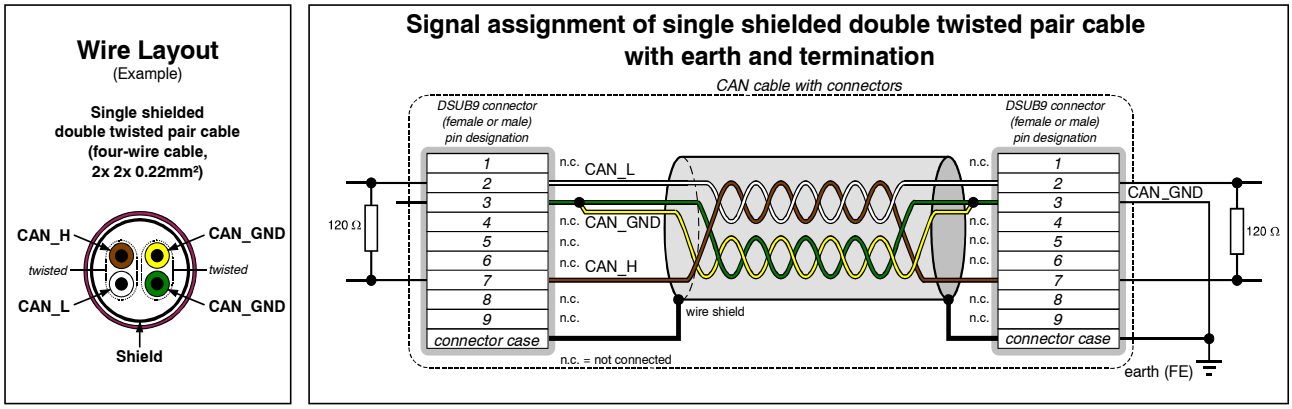


Figure 7: CAN wiring for heavy industrial environment

8.3.2 Device Cabling

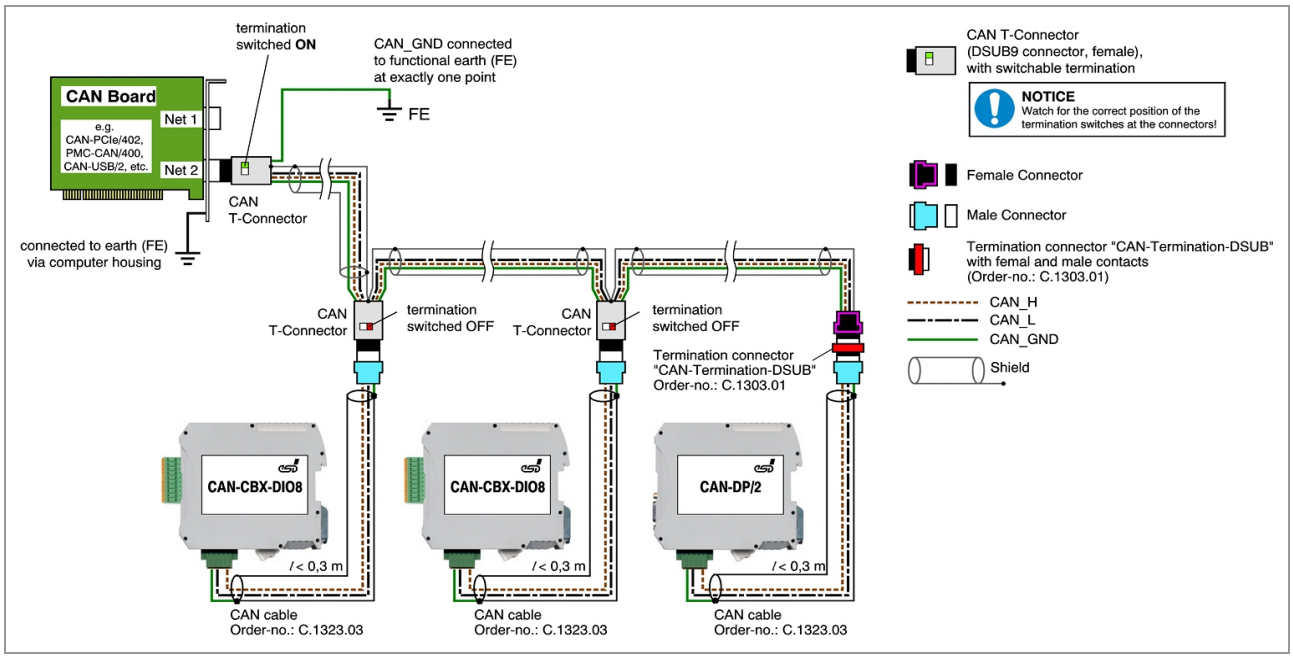


Figure 8: Example of proper wiring with single shielded double twisted pair cables

8.3.3 Branching

- In principle the CAN bus has to be realized in a line. The participants are connected to the main CAN bus line via short cable stubs. This is normally realised by so called T-connectors. When using esd's CAN-T-Connector (order no.: C.1311.03) it should be noted that the shield potential of the conductive DSUB housing is not looped through this T-Connector type. Thus the shielding is interrupted. Therefore you have to take adequate measures to connect the shield potentials, as described in the manual of the CAN-T-Connector. For further information on this read 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, e.g. the DSUB9 connector from ERNI (ERBIC CAN BUS MAX, order no.:154039).
- If a mixed application of single twisted and double twisted cables is unavoidable, take care that the CAN_GND line is not interrupted!
- Deviations from the bus structure can be realized by the usage of repeaters.

8.3.4 Termination

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

8.4 Electrical Grounding

- For CAN devices with electrical 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 made e.g. at a termination connector (e.g. order no. C.1302.01 or C.1301.01).

8.5 Bus Length

NOTICE
Please note that the cables, connectors and termination resistors used in CANopen networks shall meet the requirements defined in ISO11898-2.
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 1.8.0, Table 2).

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
800 666,6̄ 500 333,3̄ 250	59 80 130 180 270	50 - 100 - 250	0,34 to 0,6
166 125	420 570	- 500	0,5 to 0,6
100 83,3̄ 66,6̄ 50	710 850 1000 1400	650 - - 1000	0,75 to 0,8
33,3̄ 20 12,5 10	2000 3600 5400 7300	- 2500 - 5000	not defined in CiA 303-1

Table 9: Recommended cable lengths at typical bit rates (with esd-CAN interfaces)

- Optical couplers are delaying the CAN signals. esd modules typically reach a wire length of 37 m at 1 Mbit/s within a proper terminated CAN network without impedance disturbances like e.g. caused by cable stubs > 0.3 m.

8.6 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.

8.6.1 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.)

8.6.2 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**.

9. CAN Troubleshooting Guide

The CAN Troubleshooting Guide is a guide to find and eliminate the most frequent hardware-error causes in the wiring of CAN networks.

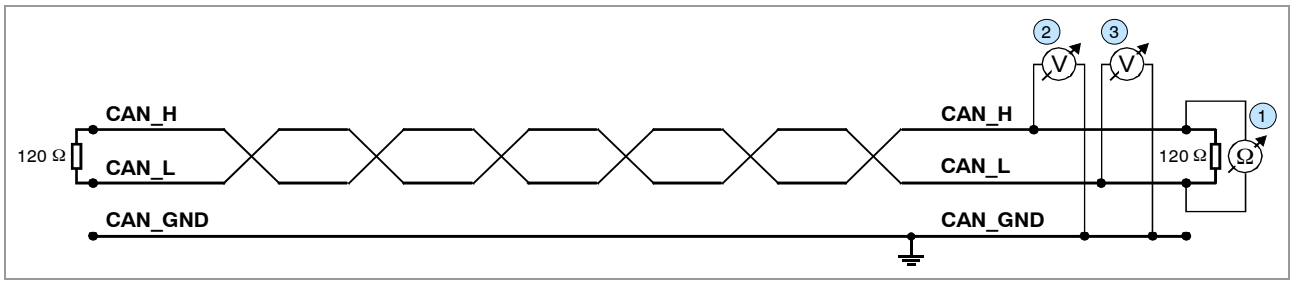


Figure 9: Simplified diagram of a CAN network

9.1 Termination

The termination is used to match impedance of a node to the impedance of the transmission line being used. When impedance is mismatched, the transmitted signal is not completely absorbed by the load and a portion is reflected back into the transmission line. If the source, transmission line and load impedance are equal these reflections are avoided. This test measures the series resistance of the CAN data pair conductors and the attached terminating resistors.

To test it ,please

1. Turn off all power supplies of the attached CAN nodes.
2. Measure the DC resistance between CAN_H and CAN_L at one end of the network ① (see figure above).

The measured value should be between 50 Ω and 70 Ω.

If the value is below 50 Ω, please make sure that:
- there is no **short circuit** between CAN_H and CAN_L wiring
- there are **not more than two** terminating resistors connected
- the nodes do not have faulty transceivers.

If the value is higher than 70 Ω, please make sure that:
- there are no open circuits in CAN_H or CAN_L wiring
- your bus system has two terminating resistors (one at each end) and that they are 120 Ω each.

9.2 Electrical Grounding

The CAN_GND of the CAN network should be connected to the functional earth potential (FE) at only **one** point. This test will check if the CAN_GND is grounded in several places.
To test it, please

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).
3. Reconnect CAN_GND to earth potential.

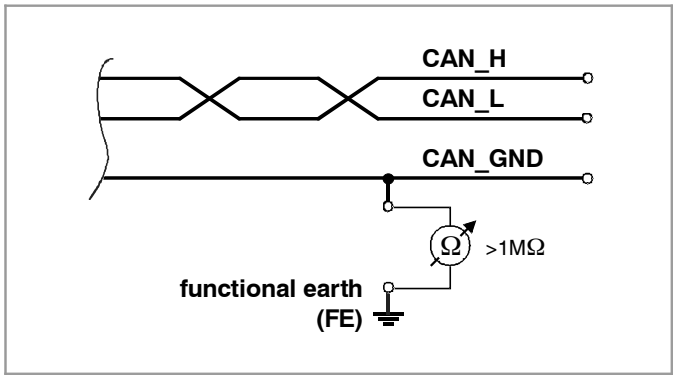


Figure 10: Simplified schematic diagram of ground test measurement

The measured resistance should be higher than 1 MΩ. If it is lower, please search for additional grounding of the CAN_GND wires.

9.3 Short Circuit in CAN Wiring

A CAN bus might possibly still be able to transmit data if there is a short circuit between CAN_GND and CAN_L, but generally the error rate will increase strongly. Make sure that there is no short circuit between CAN_GND and CAN_L!

9.4 CAN_H/CAN_L-Voltage

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. Faulty transceivers can cause the idle voltages to vary and disrupt network communication.

To test for faulty transceivers, please

1. Turn on all supplies.
2. Stop all network communication.
3. Measure the DC voltage between CAN_H and CAN_GND (2) (see figure at previous page).
4. Measure the DC voltage between CAN_L and CAN_GND (3) (see figure at previous page).

Normally the voltage should be between 2.0 V and 3.0 V.

If it is lower than 2.0 V or higher than 3.0 V, it is possible that one or more nodes have faulty transceivers. For a voltage lower than 2.0 V please check CAN_H and CAN_L conductors for continuity.

To find the node with a faulty transceiver within a network please test the CAN transceiver resistance (see below) of the nodes.

9.5 CAN Transceiver Resistance Test

CAN transceivers have circuits that control CAN_H and CAN_L. Experience has shown that electrical damage of the circuits may increase the leakage current in these circuits.

To measure the current leakage through the CAN circuits, please use a resistance measuring device and:

1. Switch **off** the node and **disconnect** it from the network (4)
   (see figure below).

2. Measure the DC resistance between CAN_H and CAN_GND (5)
   (see figure below).

3. Measure the DC resistance between CAN_L and CAN_GND (6)
   (see figure below).

The measured resistance has to be about 500 kΩ for each signal. If it is much lower, the CAN transceiver it is probably faulty.
Another indication for a faulty transceiver is a very high deviation between the two measured input resistances (>> 200 %).

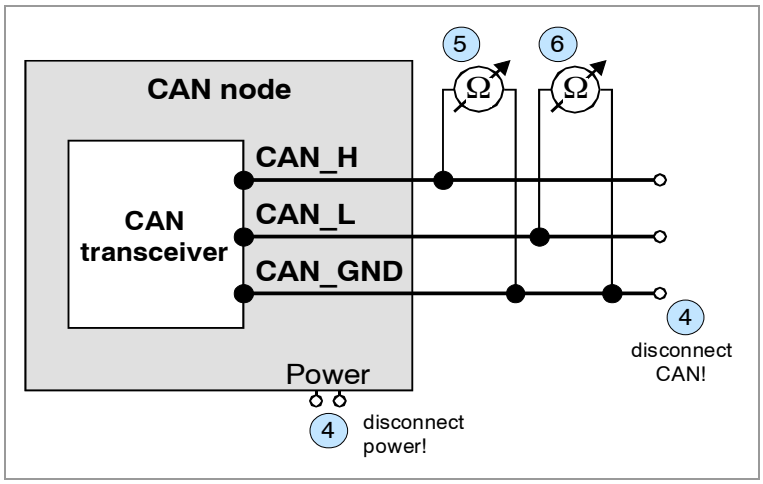


Figure 11: Measuring the internal resistance of CAN transceivers

9.6 Support by esd

If you have executed the fault diagnostic steps of this troubleshooting guide and you even can not find a solution for your problem our support department will be able to assist.
Please contact our support via email at **support@esd.eu** or by phone **+40-511-37298-130**.

10. Application Note to CAN/402 Boards

Potential Interoperability with Windows or Linux OS

NOTICE
This chapter is to alert users to a potential interoperability problem that affects esd CPCI-CAN/402-4(-FD) boards which are equipped with the Pericom® PCI-to-PCI bridge PI7C9X111SL.

Depending on the host computer system the following CPCI-CAN/402-4(-FD) articles may be affected:

Article	Order no.
CPCI-CAN/402-4	I.2332.08
CPCI-CAN/402-4-FD	I.2332.68

10.1 Windows Operating System

Potential Interoperability Problem with enabled PCI Express Native Control Mode

Problem Description
Microsoft Windows operating systems including Windows Vista, Windows Server 2008, and later versions include a feature called “PCI Express Native Control”. Many current motherboards offer support for the PCI Express Native Control feature in their BIOS.

If this feature is enabled by Windows, it enforces additional mandatory features which are not implemented in the bridge of the CPCI-CAN/402-4(-FD) boards. This may prevent the start of the default PCI-to-PCI bridge driver (Code 10). This problem occurs e.g. on most ACER PC Windows systems.

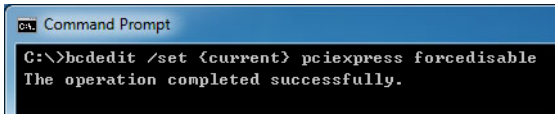
Based on our information Pericom does not plan to revise the silicon of the PCI-to-PCI bridge to be compatible with the Windows supplied bridge driver.

Solution: Disabling PCI Express Native Control Feature in Windows
The PCI Express Native Control can be switched off by commands in the command prompt window with administrator rights.

Use the command `BCDEdit /set`

to set a boot entry option value in the Windows boot configuration data store (BCD):

1. Boot the Windows system.
2. Open the command prompt window with administrator rights (right-click to `C:\Windows\System32\cmd.exe` and select “*Run as Administrator*”).
3. Enter the command: `bcdedit /set {current} pciexpress forcedisable`



4. Restart your computer.

NOTICE
If you disable the PCI Express Native mode this may cause loss of other system features, such as Hot Plug, which requires the PCI Express Native mode (see link to MSDN for more details).

To restore the previous state type the following commands:

```
bcdedit /deletevalue {current} pciexpress
```
or
```
bcdedit /set {current} pciexpress default
```

Links to further Information

- About `BCDEdit /set` command:
  https://msdn.microsoft.com/en-us/library/windows/hardware/ff542202%28v=vs.85%29.aspx?ppud=4
- About PCI Express Native Control:
  https://msdn.microsoft.com/en-us/library/windows/hardware/dn631753%28v=vs.85%29.aspx
- ACPI website:
  http://www.acpi.info
- PCI-SIG website:
  http://pcisig.com

10.2 Linux Operating System

Potential Interoperability Problem caused by Active State Power Management Reconfiguration

Problem Description

Recent Linux kernels try to reconfigure and optimize the Active State Power Management settings of PCI Express links. In the course of the reconfiguration the kernel triggers an erratum of the PCI-to-PCIe reverse bridge PI7C9X111SL that is used on the shown products. Caused by this erratum the PCIe link stays in the link retraining state and is not usable.

This can be diagnosed by looking at the lspci output for the PCIe device behind the Pericom bridge that looks like this in the failure case:

```
root@host# lspci -s 3:0.0 -v -x
03:00.0 CANBUS: ESD Electronic System Design GmbH Device 0402 (rev ff) (prog-if ff)
        !!! Unknown header type 7f
00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
10: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
20: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
30: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```

Solution: Booting the System with the additional Kernel Parameter "pcie_aspm=off"
As a workaround you may boot the system with the additional kernel parameter "pcie_aspm=off" which will disable ASPM reconfiguration for the whole machine.
If you are able to build your Linux kernel yourself you may apply this patch to introduce a workaround for this Pericom reverse bridge.

```
--- drivers/pci/pcie/aspm-orig.c        2018-04-01 23:20:27.000000000 +0200
+++ drivers/pci/pcie/aspm.c     2018-11-07 14:08:58.301927694 +0100
@@ -218,6 +218,7 @@
        child = list_entry(linkbus->devices.next, struct pci_dev, bus_list);
        BUG_ON(!pci_is_pcie(child));

+
        /* Check downstream component if bit Slot Clock Configuration is 1 */
        pcie_capability_read_word(child, PCI_EXP_LNKSTA, &reg16);
        if (!(reg16 & PCI_EXP_LNKSTA_SLC))
@@ -251,6 +252,16 @@
        /* Retrain link */
        reg16 |= PCI_EXP_LNKCTL_RL;
        pcie_capability_write_word(parent, PCI_EXP_LNKCTL, reg16);
+       if (0x12d8 == parent->vendor && 0xe111 == parent->device) {
+            /*
+             * Due to an erratum in the Pericom PI7C9X111SLB bridge in
+             * reverse mode the retrain link bit needs to be cleared
+             * manually to allow the link training to succeed.
+             */
+            pci_info(parent,"PI7C9X111SLB workaround: Clear PCI_EXP_LNKCTL_RL again.\n");
+            reg16 &= ~PCI_EXP_LNKCTL_RL;
+            pcie_capability_write_word(parent, PCI_EXP_LNKCTL, reg16);
+       }

        /* Wait for link training end. Break out after waiting for timeout */
        start_jiffies = jiffies;
```

An equivalent patch was submitted to the linux-pci kernel mailing list (see https://lore.kernel.org/linux-pci/20190406143031.GB200379@google.com/T/) but it will take some time until it will show up in the production kernels of Linux distributions.

11. 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.*
CPCI-CAN/402-4	**I.2332.08**
CPCI-CAN/402-4-FD	**I.2332.68**
CAN/400-4-1C4 1xDSUB25-to-4xDSUB9	**C.2047.19**
die Anforderungen der Normen *fulfills the requirements of the standards*	**EN 61000-6-2:2005,** **EN 61000-6-4:2007/A1:2011**
gemäß folgendem Prüfbericht erfüllt. *according to test certificate.*	**H-K00-0614-16**
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, 2019-04-05

T. Bie

Rechtsgültige Unterschrift / *authorized signature*

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12. Order Information

12.1 Hardware

Type	Properties	Order No.
CPCI-CAN/402-4-FD	3U/4HP CompactPCI classic (CPCI 2.0) Interface card with 4x **CAN FD** at front via 25-pole DSUB and with esd Advanced CAN Core (esdACC), incl. CAN layer 2 software driver for Windows and Linux on CD-ROM	I.2332.68
CPCI-CAN/402-4	3U/4HP CompactPCI classic (CPCI 2.0) Interface card with 4x **CAN** at front via 25-pole DSUB and with esd Advanced CAN Core (esdACC), incl. CAN layer 2 software driver for Windows and Linux on CD-ROM	I.2332.08
Accessories		
CAN-/400-4-1C4 1xDSUB25-to-4xDSUB9	Adapter cable DSUB25 female to 4x DSUB9 male, length: 0.5m	C.2047.19

Table 10: Order information

12.2 Software for CPCI-CAN/402-4

Please note that these drivers are for **Classical CAN operation only!**

Type		Order No.
CAN layer 2 software drivers for Windows and Linux on CD-ROM are included in delivery of CPCI-CAN/402-4 (I.2332.08). Additional CAN layer 2 object licences including CD-ROM:		
CAN-DRV-LCD CDROM+Lizenz QNX	Object Licence and CD-ROM for QNX 4.x and 6.x	C.1101.32
CAN-DRV-LCD CDROM+Lizenz RTX	Object Licence and CD-ROM for RTX(64)	C.1101.35
CAN-DRV-LCD CDROM+Lizenz VxWorks	Object Licence and CD-ROM for VxWorks 5.x and 6.x	C.1101.55
CAN-DRV-LCD On Time RTOS-32	Object Licence and CD-ROM for On Time RTOS-32	C.1101.45
Higher-Layer Protocols including CD-ROM (Classical CAN Applications only):		
CANopen-LCD Windows/Linux	CANopen Object Driver Licence + CD-ROM for Windows / Linux	C.1101.06
CANopen-LCD QNX	CANopen Object Driver Licence + CD-ROM for QNX	C.1101.17
CANopen-LCD RTX	CANopen Object Driver Licence + CD-ROM for RTX	C.1101.16
CANopen-LCD VxWorks	CANopen Object Driver Licence + CD-ROM for VxWorks	C.1101.18
J1939 Stack for Windows (Object)	J1939 Stack for esd CAN Hardware, Windows Object Code, incl. J1939 Simulation Tool	C.1130.10
J1939 Stack for Linux (Object)	J1939 Stack for esd CAN Hardware, Linux Object Code	C.1130.11
J1939 Stack for RTX (Object)	J1939 Stack for esd CAN Hardware, RTX Object Code	C.1130.12
ARINC 825-LCD Windows/Linux/LabVIEW	Licence and CD for esdACC based CAN-Boards for Windows/ Linux/ LabVIEW, incl. Object Driver Licence	C.1140.06
ARINC 825-LCD QNX	Licence and CD for esdACC based CAN-Boards for QNX, incl. Object Driver Licence	C.1140.17
ARINC 825-LCD RTX	Licence and CD for esdACC based CAN-Boards for RTX, incl. Object Driver Licence	C.1140.16
ARINC 825-LCD VxWorks	Licence and CD for esdACC based CAN-Boards for VxWorks, incl. Object Driver Licence	C.1140.18
For detailed information about the driver availability for your special operating system, please contact our sales team.		

Table 11: Order information software for CPCI-CAN/402-4

12.3 Software for CPCI-CAN/402-4-FD

Type		Order No.
CAN layer 2 software drivers for Windows and Linux on CD-ROM are included in delivery of CPCI-CAN/402-4-FD (I.2332.68). Additional CAN layer 2 object licences including CD-ROM:		
CAN-DRV-LCD CDROM+Lizenz QNX	Object Licence and CD-ROM for QNX 4.x and 6.x	C.1101.32
CAN-DRV-LCD CDROM+Lizenz RTX	Object Licence and CD-ROM for RTX64	C.1101.35
The CAN layer 2 software drivers and Higher-Layer Protocols of the CPCI-CAN/402-4 can also be used with the CPCI-CAN/402-4-FD, because CAN FD is fully backwards-compatible with CAN. Please note that these drivers are for **Classical CAN operation only!** Read chapter “Software for CPCI-CAN/402-4”, page 41 for availability of software for Classical CAN Applications.		
For detailed information about the driver availability for your special operating system, please contact our sales team.		

Table 12: Order information software for CPCI-CAN/402-4-FD

12.4 Manuals

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

Manuals		Order No.
CPCI-CAN/402-4(-FD)-ME	Hardware manual in English	I.2332.21
CAN-API-ME	NTCAN-API: Application Developers Manual NTCAN-API: Driver Installation Guide	C.2001.21

Table 13: 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.