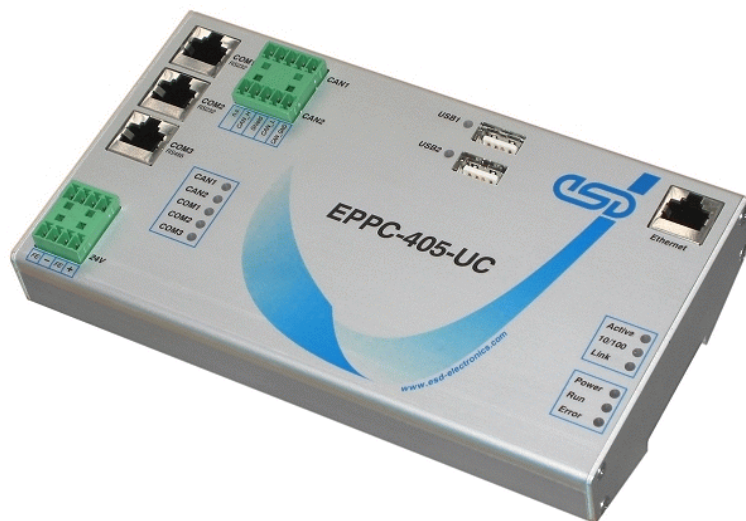


EPPC-405-UC

**Embedded PowerPC
with CAN, USB and ETHERNET**



Hardware Manual

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

Chapter	Changes as compared with previous version
-	First issue
-	-

Technical details are subject to change without further notice.

NOTE

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esd electronic system design gmbh
Vahrenwalder Str. 207
30165 Hannover
Germany

Phone: +49-511-372 98-0
Fax: +49-511-372 98-68
E-mail: info@esd-electronics.com
Internet: www.esd-electronics.com

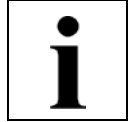
USA / Canada:
esd electronics Inc.
12 Elm Street
Hatfield, MA 01038-0048
USA

Phone: +1-800-732-8006
Fax: +1-800-732-8093
E-mail: us-sales@esd-electronics.com
Internet: www.esd-electronics.us

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1. Overview

1.1 Description of the EPPC-405-UC-Module

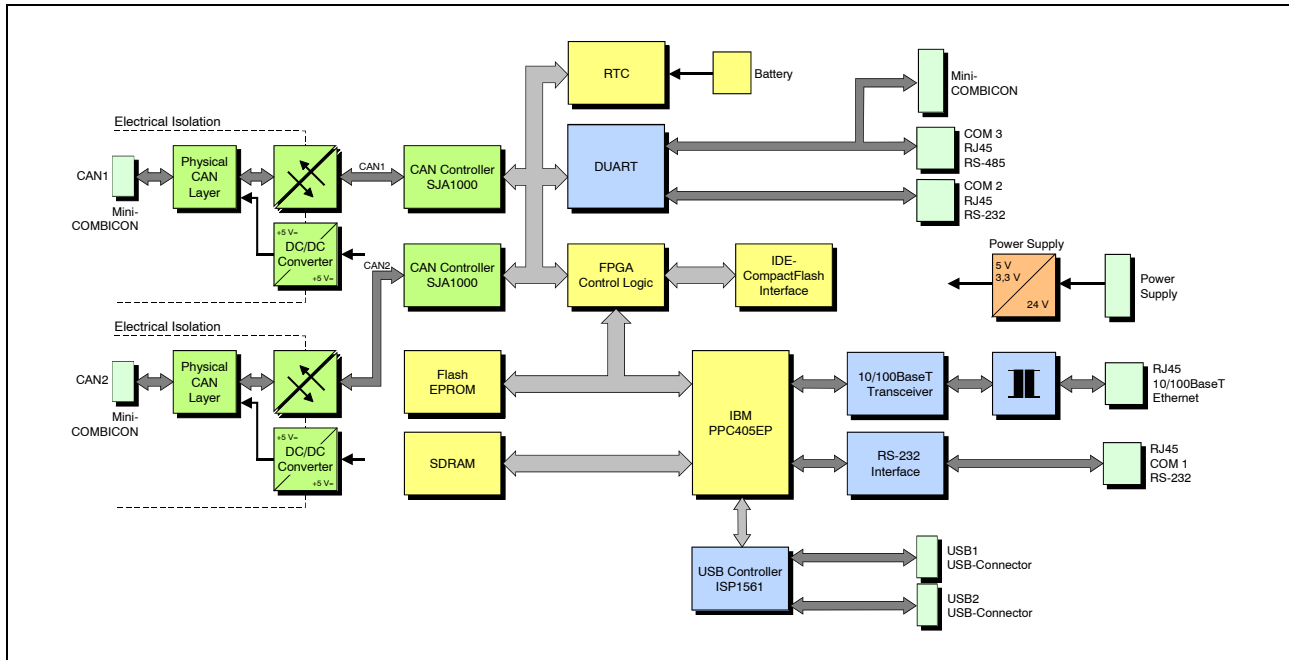


Figure 1.1: Block circuit diagram

The EPPC-405-UC module is a stand-alone PowerPC in a stable, compact aluminium case.

Apart from a powerful CPU the PowerPC 405EP processor has got a SDRAM controller, a PCI-bus interface, a controller for the serial interface and a MII-interface as Ethernet interface.

The memory equipment of the EPPC-405-UC comprises up to 64 Mbyte SDRAM as internal memory, 1 Mbyte NOR-Flash and up to 128 Mbyte NAND-Flash. Furthermore, the board has got a CompactFlash interface. The CompactFlash cards can be accessed like an IDE-drive with standard-system drivers. The CompactFlash slot is inside the module and can not be accessed from outside.

All connectors of the module (except CompactFlash) are easily accessible via the front panel.

The three serial interfaces are equipped with RJ45 sockets.

The serial interfaces COM1 and COM2 are designed as RS-232 interfaces and the interface COM3 as RS-485 interface. The signals of this interface are also accessible via a COMBICON connector.

Both CAN interfaces are controlled by a SJA1000-CAN controller. The interfaces are designed according to ISO11898, they are isolated by magnetic data couplers and can be used for transmission rates of up to 1 Mbit/s.

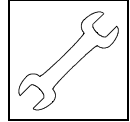


Overview

The Ethernet interface is suitable for 10 Mbit/s and 100 Mbit/s nets. It is connected via an RJ45 socket.

Furthermore, the board is equipped with two USB host interfaces (socket type A).

The LEDs in the front panel show the status of the module.



2. Installation / Maintenance

2.1 Installation Dimensions

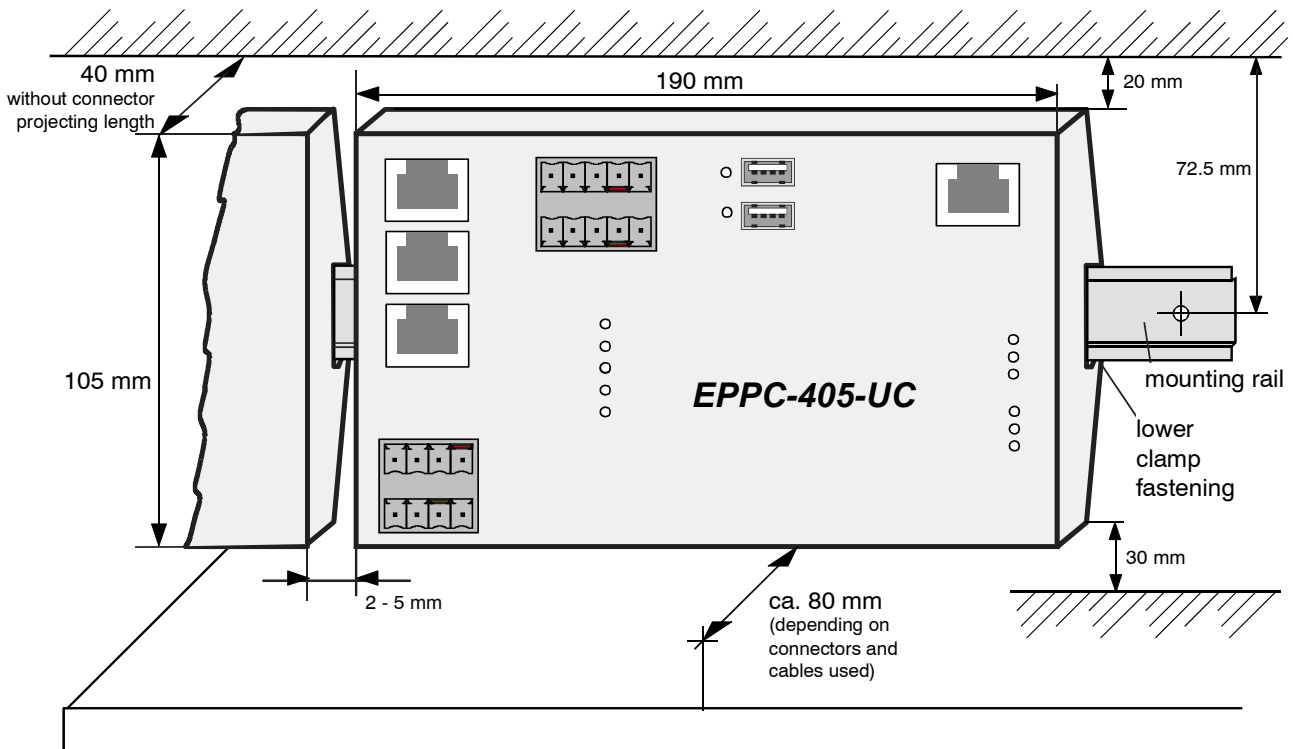


Figure 2.1.1: Dimensions of the EPPC-405-UC module

The space required in front of the front panel depends on the connectors and cables used. The value of 80 mm must be regarded as guide value. See also the figure below.

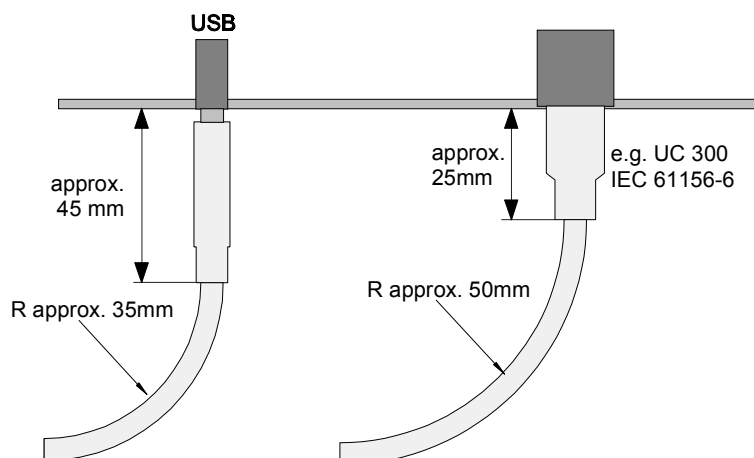
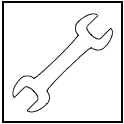


Figure. 2.1.2: Installation dimensions of the cables



Installation

2.2 Mounting / Demounting

Mounting:

- M1. For the mounting in the control enclosure position the lower clamp fastening of the EPPC-405-UC module from below at the mounting rail. By pushing the module up and to behind simultaneously it snaps in.
- M2. Connect the plugs. Switch on the power supply and the participants to whose CAN network or serial interface the EPPC-405-UC module is to be connected.

Demounting:

- D1. Switch off the power supply and the other participants to whose network the EPPC-405-UC module is connected (exception: not necessary for USB). Disconnect all plugs from the EPPC-405-UC module.
- D2. Unfix the module from the mounting rail by pushing the module up and to the front simultaneously.

2.3 EPPC-405-UC PCB View

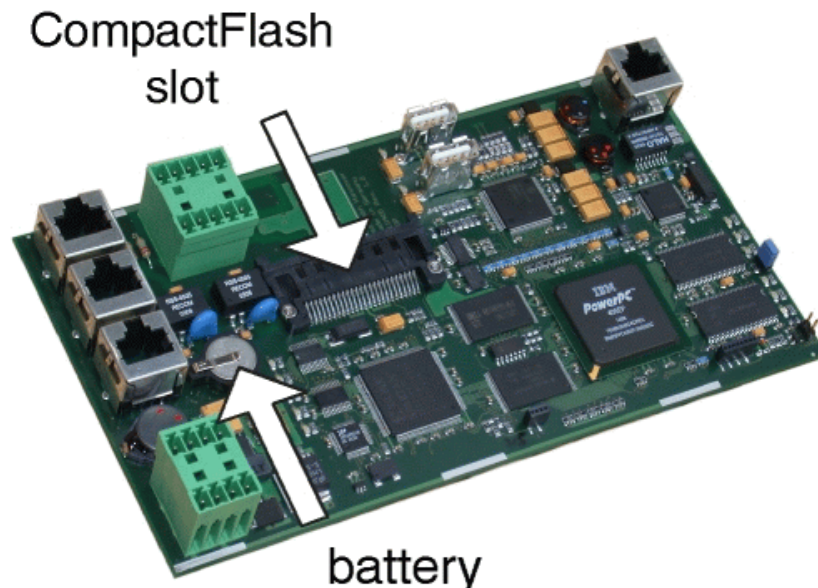
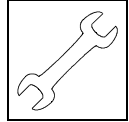


Figure 2.3.1: View of the EPPC-405-UC PCB



2.4 Change of the Battery:

The EPPC-405-UC module has a RTC (Real Time Clock), which is energised by a battery. The battery is fixed in a holder directly on the board.

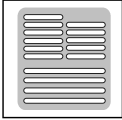
Battery type: coin cell, 3V e.g. Panasonic CR1220 according to IEC 1220. It has an estimated lifetime of approximately 4 years.

1. Remove the module as described under 'Demounting' on page 6.
2. Unfasten the four upper, lateral screws, which fix the front panel. Remove the front panel.
3. Remove the old battery carefully out of the holder (see Figure 2.3.1) and replace it with the new battery.
4. Replace the front panel again and fix it with the lateral screws.
5. Install the module as described under 'Mounting' on page 6.

2.5 Replace the CompactFlash Card

The CompactFlash slot is located directly on the PCB. It is not accessible if the case is closed. The slot fits for card type I.

1. Remove the module as described under 'Demounting' on page 6.
2. Unfasten the four upper, lateral screws, which fix the front panel. Remove the front panel.
3. Unfasten the both lower screws on one side of the module. Remove the side panel.
4. Pull the board carefully to the open side along the track out of the case. Now the CompactFlash-card can be removed (see Figure 2.3.1) and replaced if necessary.
5. Insert the board along the lower guide track in the case.
6. Replace the side panel and fix it with the lower screws on the case.
7. Replace the front panel and fix it with the four lateral screws.
9. Install the module as described under 'Mounting' on page 6.



3. Summary of Technical Data

3.1 General Technical Data

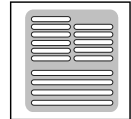
Ambient temperature	0...50°C
Humidity	max. 90 %, non-condensing
Connectors	X700 (8-pole RJ45-socket) - RS-232 interface COM1 X1300 (8-pole RJ45-socket) - RS-232 interface COM2 X1310 (8-pole RJ45-socket) - RS-485 interface COM3 X1700A (4-pole MINI COMBICON, double level header) - the signals of the RS-485 interface COM3 are additionally led to this connector X1700B (4-pole MINI COMBICON, double level header) - Power supply 24 V X1200A (5-pole MINI COMBICON, double level header) - CAN interface CAN 2 (ISO11898) X1200B (5-pole MINI COMBICON, double level header) - CAN interface CAN 1 (ISO11898) X800 (8-pole RJ45 socket) - Ethernet Twisted Pair (IEEE 802.3) X1610 (4-pole USB socket) - USB-Host interface USB2 X1620 (4-pole USB socket) - USB-Host interface USB1 X1400 (50-pole CompactFlash slot) - CompactFlash cards
Dimensions	190 x 105 x 40 mm (incl. projecting length of the connectors and integrated clamp fixing for 35 mm rail mounting)
Weight	580 g

Table 3.1: General technical data

3.2 Power Supply

Input voltage	24 V / DC \pm 10 %
Power consumption	approx. 4 W
Connector	4-pole connector in MINI COMBICON style with double level header

Table 3.2: Power supply



3.3 Microprocessor and Memory

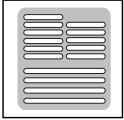
CPU	PowerPC 405EP / 200 MHz / 32 bit optional: 133 MHz / 266 MHz
NOR-Flash	1 Mbyte (boot-loader)
NAND-Flash-EPROM	32 up to 128 Mbyte
SDRAM	standard: 32 Mbyte optional: 64 Mbyte
CompactFlash slot	<ul style="list-style-type: none"> - for CompactFlash memory according to CompactFlash™ - Specification - suitable for card design type I - 3.3 V power supply - drive in 'True IDE' mode

Table 3.3: Microprocessor and memory

3.4 Serial Interfaces

Number	3 serial interfaces: COM1: RS-232 interface COM2: RS-232 interface COM3: RS-485 interface
Controller	COM1: integrated in PowerPC 405EP COM2+3: external Duart
Bit rate	COM1: max. 115.2 Kbit/s COM1: max. 120 Kbit/s COM3: max. 1.5 Mbit/s
Physical interface	COM1: RS-232C COM2: RS-232C COM3: RS-485
Connectors	COM1: 8-pole RJ45 socket COM2: 8-pole RJ45 socket COM3: 8-pole RJ45 socket and 4-pole MINI-COMBICON connector with double level header

Table 3.4: Serial interface



3.5 CAN Interfaces

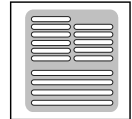
Number	2
CAN controller	SJA1000
CAN protocol	CAN 2.0A/2.0B
Physical interface	connection in accordance with ISO 11898
Transmission rate	10 Kbit/s ... 1 Mbit/s
Electrical isolation	via magnetic data couplers IL712
Bus termination	has to be set externally
Connector	MINI-COMBICON with double level header (2 x 5-pole) (type: MCDV 1,5/5-G1-3,81)

Table 3.5: CAN interfaces

3.6 ETHERNET Interface

Number	1
Bit rate	10 Mbit/s, 100 Mbit/s
Controller	PowerPC 405EP
Physical interface	Twisted Pair (IEEE802.3) 10/100BaseT
Electrical isolation	via transformer
Connector	8-pole RJ45 socket

Table 3.6: Ethernet interface



3.7 USB-Host interface

Number	2 x USB 2.0 Host
Controller	ISP 1561 (OHCI)
Connector	USB1: X1620, 4-pole USB socket type A USB2: X1610, 4-pole USB socket type A

Table 3.7: USB-Host interface

3.8 Clock (RTC)

Function	time and calendar
Battery	coin cell with holder (IEC type 1220)

Table 3.8: RTC

3.9 Software-Support

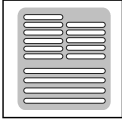
The boot monitor U-Boot* is stored in the NOR-Flash memory. Therefore it is possible for the EPPC-405-UC to boot with various operating systems from the network, the local Flash memory or the CompactFlash memory.

The operating systems Linux and VxWorks are available with corresponding drivers for the local interfaces. Further operating systems are available on request.

Furthermore CAN-transmission protocols like CANopen are available.

The EPPC-405-UC operates as a PLC with the optional IEC61131-3 programming and run-time system CoDeSys.

* <http://sourceforge.net/projects/u-boot/>



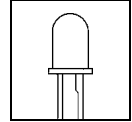
3.10 Order Information

Type	Properties	Order No.
EPPC-405_UC	IBM PPC 405EP, 200 MHz, 32 MB SDRAM, 32 MB NAND-Flash, 2 x RS232, 1 x RS485, 2 x CAN	I.2005.02
EPPC-405-UC-CoDeSys	CoDeSys Programming system	I.2005.33
EPPC-405-UC-Linux	Linux operating system	I.2005.32
EPPC-405-UC-VxW	VxWorks operating system	I.2005.31
EPPC-405-MD	User manual in English ^{*1)}	I.2005.21
EPPC-405-ENG	Engineering manual in English ^{*2)} Content: circuit diagrams, PCB top overlay drawing, data sheets of significant components	I.2005.25

1*) If module and manual are ordered together, the manual is free of charge.

2*) This manual is liable for costs, please contact our support.

Table 3.9: Order information



4. Front Panel View with Connectors and LEDs

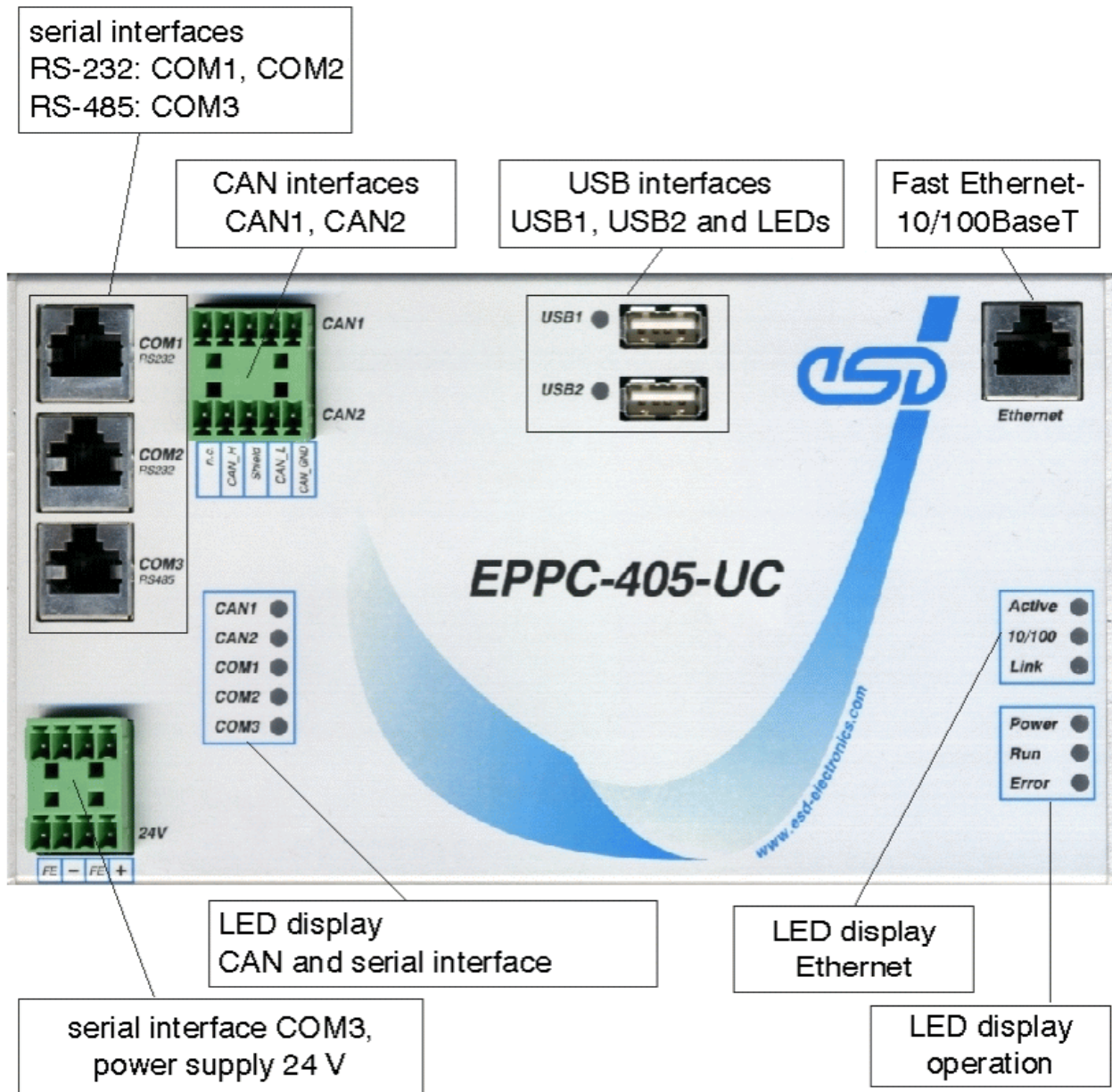
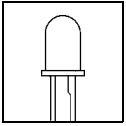


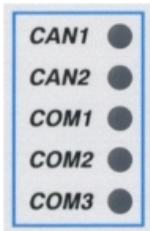
Figure 4.1: Front panel view



LED-Display

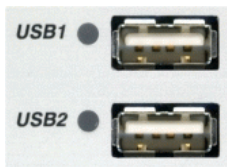
4.1 LED Display

The display function of the LEDs is described in the tables below:



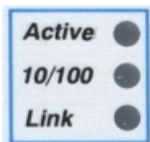
LED	Description	Display function of the LEDs (on)
CAN1	LED902	CAN1 messages are received or transmitted
CAN2	LED903	CAN2 messages are received or transmitted
COM1	LED904	COM1 messages are received or transmitted
COM2	LED905	COM2 messages are received or transmitted
COM3	LED906	COM3 messages are received or transmitted

Table 4.1.1: LED display CAN and serial interface



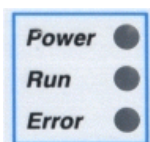
LED	Description	Display function of the LEDs (on)
USB1	LED1627	USB1: Supply voltage (Vcc_USB) for external USB devices
USB2	LED1617	USB2: Supply voltage (Vcc_USB) for external USB devices

Table 4.1.2: LED display USB1 and USB2



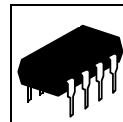
LED	Description	Display function of the LEDs (on)
Active	LED802	Ethernet (reception of Ethernet data packets)
10/100	LED800	Ethernet bit rate: LED on: 100 Mbit/s LED off: 10 Mbit/s
Link	LED801	Link Status Ethernet (connection to switch, hub etc.)

Table 4.1.3: LED display Ethernet



LED	Description	Display function of the LEDs (on)
Power	LED907	Supply voltage (+24 V) on
Run	LED900	Local CPU is in RUN status (LED flashes at access to SDRAM, i.e. the LED can be blinking or flashing permanently in normal operation)
Error	LED901	Control by application

Table 4.1.4: LED display module status



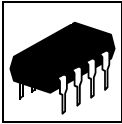
5. Description of the Units

5.1 PowerPC Microcontroller PPC405EP

5.1.1 General

The general functions of the PowerPC 405EP will not be explained in this manual. The manual of the microcontroller can be downloaded from the homepage of the manufacturer IBM, at:

<http://www-3.ibm.com/chips/products/powerpc/processors/>

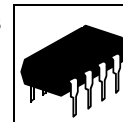


5.1.2 Address Assignment

Start address [HEX]	End address [HEX]	Unit
0x0000_0000	0x03FF_FFFF	SDRAM (max. 64 Mbyte)
0x8000_0000	0xEF5F_FFFF	PCI Core memory
		Internal periphery:
0xEF60_0300	0xEF60_0307	UART0 register (see 405EP manual table 21-2 , S. 21-5) *
0xEF60_0400	0xEF60_0407	UART1 register (see 405EP manual table 21-2 , S. 21-5) *
0xEF60_0500	0xEF60_0510	IIC0 register (see 405EP manual table 22-1 , S. 22-3)
0xEF60_0600	0xEF60_0601	OPB-arbiter register (see 405EP manual table 2-5 , S. 2-11)
0xEF60_0700	0xEF60_077F	GPIO-controller register (see 405EP manual table 23-1 , S. 23-3)
0xEF60_0800	0xEF60_0867	Ethernet register (see 405EP manual chapter 19, S.19-1)
0xF000_0000	0xF000_007F	CAN controller CAN 1
0xF000_0100	0xF000_017F	CAN controller CAN 2
0xF000_0400	0xF000_0407	UART2 register *
0xF000_0408	0xF000_040F	UART3 register *
0xF000_0500	0xF020_05FF	RTC
0xF010_0000	0xF010_000F	IDE/CompactFlash
0xF010_0100	0xF010_010F	FPGA internal registers
0xFFC0_0000	0xFFDF_FFFF	Flash-EPROM Bank 0 (NAND Flash)
0xFFE0_0000	0xFFFF_FFFF	Flash-EPROM Bank 1 (NOR Flash)

* The UARTs are 16550-compatible.

Table 5.1.1: Address ranges

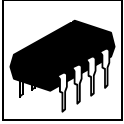


5.1.3 Interrupt Assignment

Interrupt	External IRQ	Assignment	Level Interpretation
IRQ 25	EXT IRQ 0	CAN0	low active, level sensitive
IRQ 26	EXT IRQ 1	CAN1	low active, level sensitive
IRQ 27	EXT IRQ 2	UART2	high active, level sensitive
IRQ 28	EXT IRQ 3	UART3	high active, level sensitive
IRQ 30	EXT IRQ 5	PCI_INT_A /USB	low active, level sensitive
IRQ 31	EXT IRQ 6	CompactFlash	high active, level sensitive

Table 5.1.2: Assignment of the interrupts 25...31

All further interrupt sources are PPC405-internal. They are described in the PPC405 manual.



Description of the Units

5.2 Serial Interface

5.2.1 Default Setting

The default setting for the three serial interfaces is:

Bit rate:	9600 Baud
Data bits:	8
Parity:	none
Stop bits:	1
Handshake:	XON/XOFF

5.2.2 Configuration

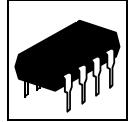
The serial interface COM1 is controlled by the microcontroller PPC405EP. The bit rate of the interfaces can be configured by software. The serial controller integrated in the PowerPC 405EP and the RS-232 driver of the interface COM1 support bit rates of up to 115.2 Kbit/s.

The serial interfaces COM2 and COM3 are controlled by the XR16C2850 controller.

The serial controller XR16C2850 and the RS-232 driver of the interface COM2 support bit rates of up to 120 Kbit/s.

The serial controller XR16C2850 and the RS-485 driver of the interface COM3 support bit rates of up to 1.5 Mbit/s.

The procedure to change the bit rate depends on the operating system. It is therefore advisable to refer to the manual of the operating system.



5.2.3 Connecting the RS-232 Interfaces COM1 and COM2

The diagram is used to explain the short terms for signals as used in the chapter 'Connector Assignments'. The signal terms are exemplary for the connection of the EPPC-405-UC as modem (DCE) via the adapter cable RJ45-DSUB9.

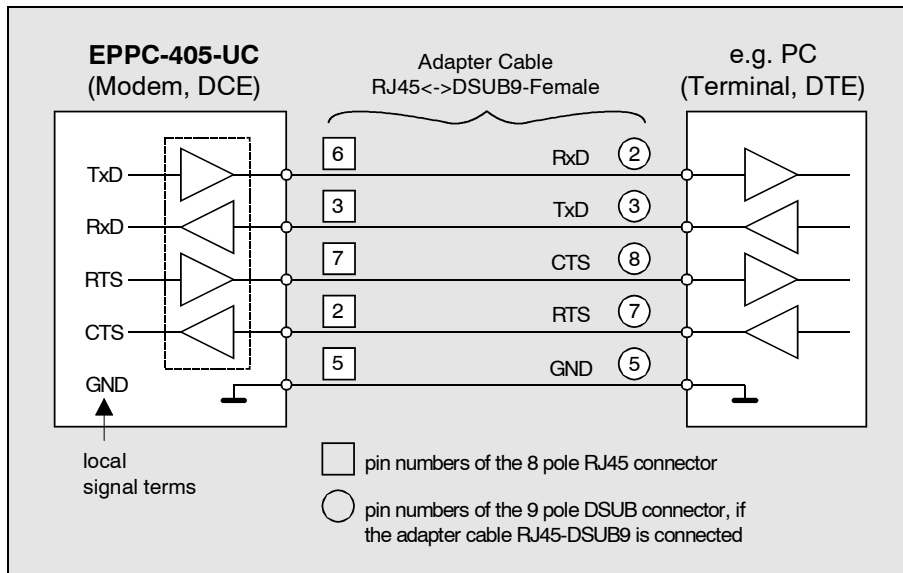
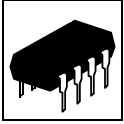


Figure 5.2.1: Connection diagram for RS-232 operation



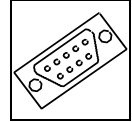
Description of the Units

5.3 CAN Interface

5.3.1 General

The EPPC-405-UC has got two independent CAN interfaces. Each of these CAN interfaces has got its own SJA1000 controller.

The CAN interfaces CAN1 and CAN2 can be accessed via the Mini-COMBICON connector X1200A/B in the front panel. An 82C250/82C251 is used as driver unit. The differential CAN bus signals are electrically isolated from other signals by magnetic data couplers (IL712) and DC/DC-converters.



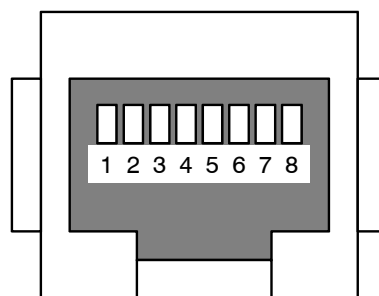
6. Connector Assignment

6.1 Serial Interface

6.1.1 COM1: RS-232 Interface on X700 (RJ45-Socket)

For details on the connection of the serial interfaces please also refer to chapter ‘Serial Interfaces’ on page 18. From the principle circuit diagrams in that chapter you will be able to clearly determine the signal direction (Rx<->Tx).

Pin Position:



Cut-out for
fastening lever

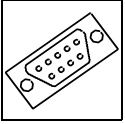
Pin Assignment:

Pin	Local Signal Name
1	n.c.
2	CTS (Input)
3	RxD (Input)
4	n.c.
5	GND
6	TxD (Output)
7	RTS (Output)
8	n.c.

8-pole RJ45-socket

n.c. ... not connected

The data direction of the signal is given as viewed from the EPPC-405-UC module.

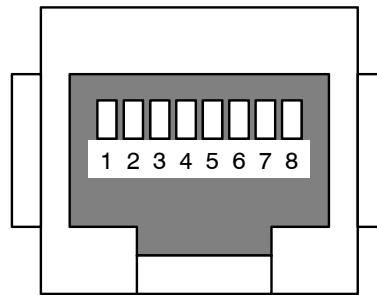


Connector Assignment

6.1.2 COM2: RS-232 Interface on X1300 (RJ45-socket)

For details on the connection of the serial interfaces please also refer to chapter ‘Serial Interfaces’ on page 18. From the principle circuit diagrams in that chapter you will be able to clearly determine the signal direction (Rx<->Tx).

Pin Position:



Cut-out for
fastening lever

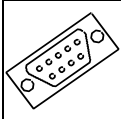
Pin Assignment:

Pin	Local Signal Name
1	n.c.
2	CTS (Input)
3	RxD (Input)
4	n.c.
5	GND
6	TxD (Output)
7	RTS (Output)
8	n.c.

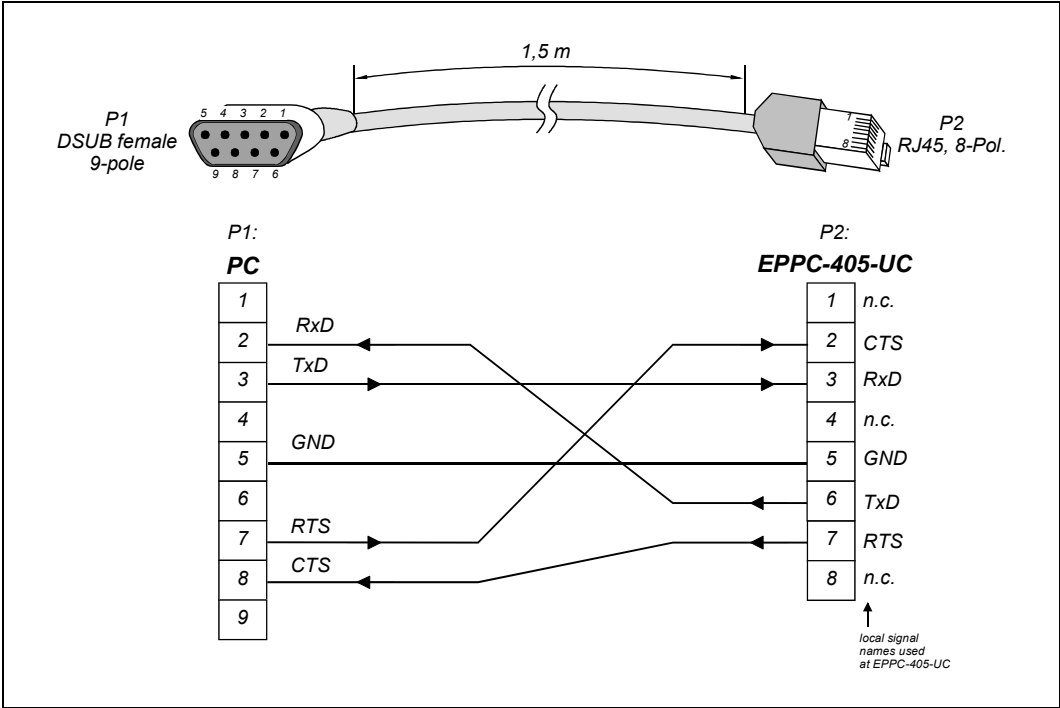
8-pole RJ45-socket

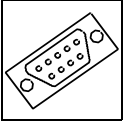
n.c. ... not connected

The data direction is given as viewed from the EPPC-405-UC module .



6.1.3 COM1 and COM2: Connection Cable RJ45-DSUB9

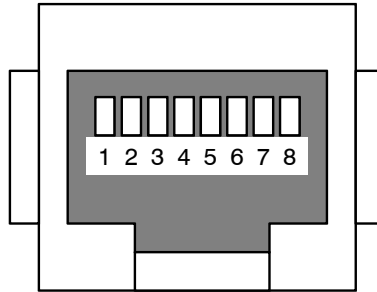




Connector Assignment

6.1.4 COM3: RS-485 Interface on X1310 (RJ45-socket)

Pin Position:



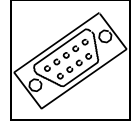
Cut-out for
fastening lever

Pin Assignment:

Pin	Signal
1	RxD/TxD- (Input/Output)
2	GND
3	RxD/TxD+ (Input/Output)
4	n.c.
5	GND
6	n.c.
7	n.c.
8	n.c.

8-pole RJ45-socket

n.c. ... not connected

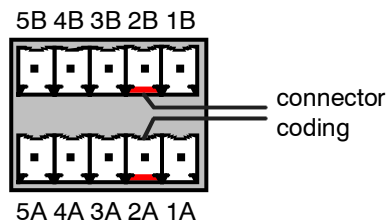


6.2 CAN Bus Interfaces CAN1, CAN2 (X1200A/B)

The signals of the interface CAN1 can be accessed via connector X1200B. The signals of the interface CAN2 can be accessed via connector X1200A.

To avoid to mix-up the connectors with the connectors of the interface COM3 (X1700A) and the 24 V power supply (X1700B) the connectors are coded with coding pins on pin 2A and pin 2B.

Pin Position with Connector Coding:



Pin Position:

X1200B: CAN1

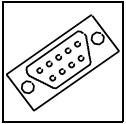
Pin	5B	4B	3B	2B	1B
Signal	n.c.	CAN_H	Shield	CAN_L	CAN_GND

X1200A: CAN2

Pin	5A	4A	3A	2A	1A
Signal	n.c.	CAN_H	Shield	CAN_L	CAN_GND

Signal description:

CAN_L, CAN_H ...	CAN signal lines
CAN_GND ...	reference potential of the local CAN physical layer
Shield ...	shield
reserved ...	reserved for future application

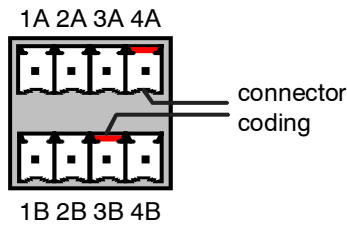


Connector Assignment

6.3 Serial Interface COM3, 24 V Power Supply (X1700A/B)

To avoid to mix-up the connectors of the interface COM3 (X1700A) and the 24 V-power supply (X1700B) the connectors are coded with coding switches at pin 4A and 3B.

Pin Assignment and Connector Coding:



Pin Position:

X1700A: RS-485 interface COM3

Pin	1A	2A	3A	4A
Signal	FE	GND	RxD/TxD- (Input/Output)	RxD/TxD+ (Input/Output)

X1700B: 24 V power supply

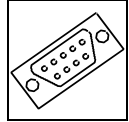
Pin	1B	2B	3B	4B
Signal	FE	M24 (GND)	FE	P24 (+ 24V)

Signal description:

FE... functional earth ground contact (EMC)

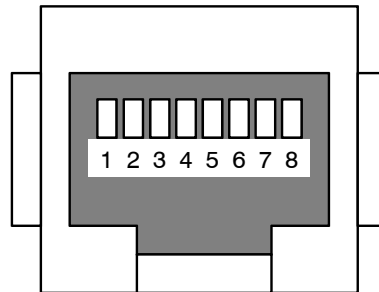
M24... ground for 24 V connection

P24... + 24 V supply voltage



6.4 Ethernet Interface (X300)

Pin Position:

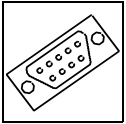


Cut-out for
fastening lever

Pin Assignment:

Pin	Signal
1	TP01 (TxD+)
2	TP02 (TxD-)
3	TP03 (RxD+)
4	TP04
5	TP05
6	TP06 (RxD-)
7	TP07
8	TP08

8-pole RJ45-socket

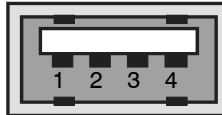


Connector Assignment

6.5 USB Interfaces

The signals of the interface USB1 can be accessed via connector X1620. The signals of the interface USB2 can be accessed via connector X1610. Both interfaces are USB-Host interfaces of type A.

Pin Position:



Pin Assignment:

X1620: USB1

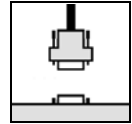
Pin	1	2	3	4	Shell
Signal	Vcc (+ 5V max. 500 mA)	D-	D+	GND	Shield

USB socket (Typ A)

X1610: USB2

Pin	1	2	3	4	Shell
Signal	Vcc (+ 5V max. 500 mA)	D-	D+	GND	Shield

USB socket (Typ A)



7. Correctly Wiring Electrically Isolated CAN Networks

Generally all instructions applying for wiring regarding an electromagnetic compatible installation, wiring, cross sections of wires, material to be used, minimum distances, lightning protection, etc. have to be followed.

The following **general rules** for the CAN wiring must be followed:

1.	A CAN net must not branch (exception: short dead-end feeders) and has to be terminated by the wave impedance of the wire (generally $120 \Omega \pm 10\%$) at both ends (between the signals CAN_L and CAN_H and not at GND)!
2.	A CAN data wire requires two twisted wires and a wire to conduct the reference potential (CAN_GND)! For this the shield of the wire should be used!
3.	The reference potential CAN_GND has to be connected to the earth potential (PE) at one point. Exactly one connection to earth has to be established!
4.	The bit rate has to be adapted to the wire length.
5.	Dead-end feeders have to kept as short as possible ($l < 0.3 \text{ m}$)!
6.	When using double shielded wires the external shield has to be connected to the earth potential (PE) at one point. There must be not more than one connection to earth.
7.	A suitable type of wire (wave impedance ca. $120 \Omega \pm 10\%$) has to be used and the voltage loss in the wire has to be considered!
8.	CAN wires should not be laid directly next to disturbing sources. If this cannot be avoided, double shielded wires are preferable.

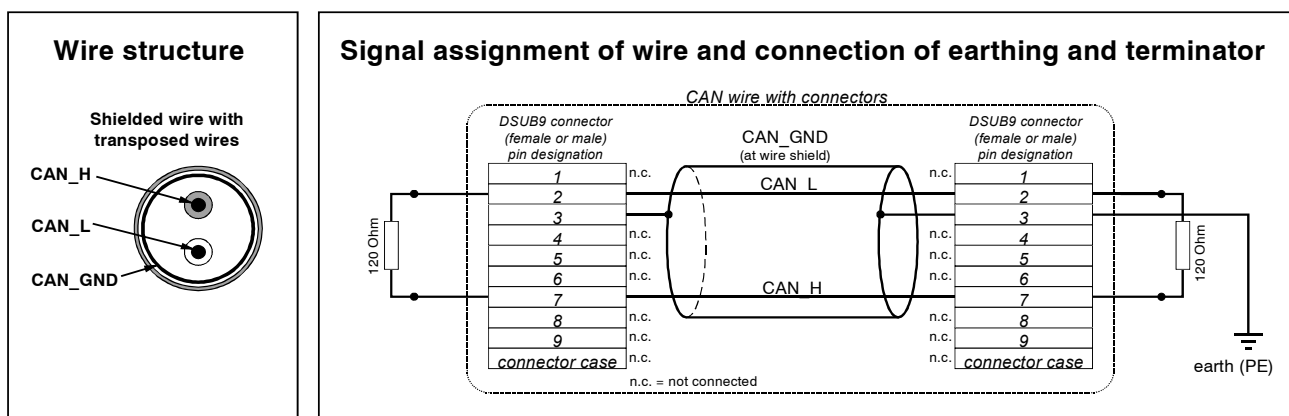
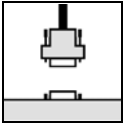


Figure: Structure and connection of wire



Wiring

Cabling

- for devices which have only one CAN connector per net use T-connector and dead-end feeder (shorter than 0.3 m) (available as accessory)

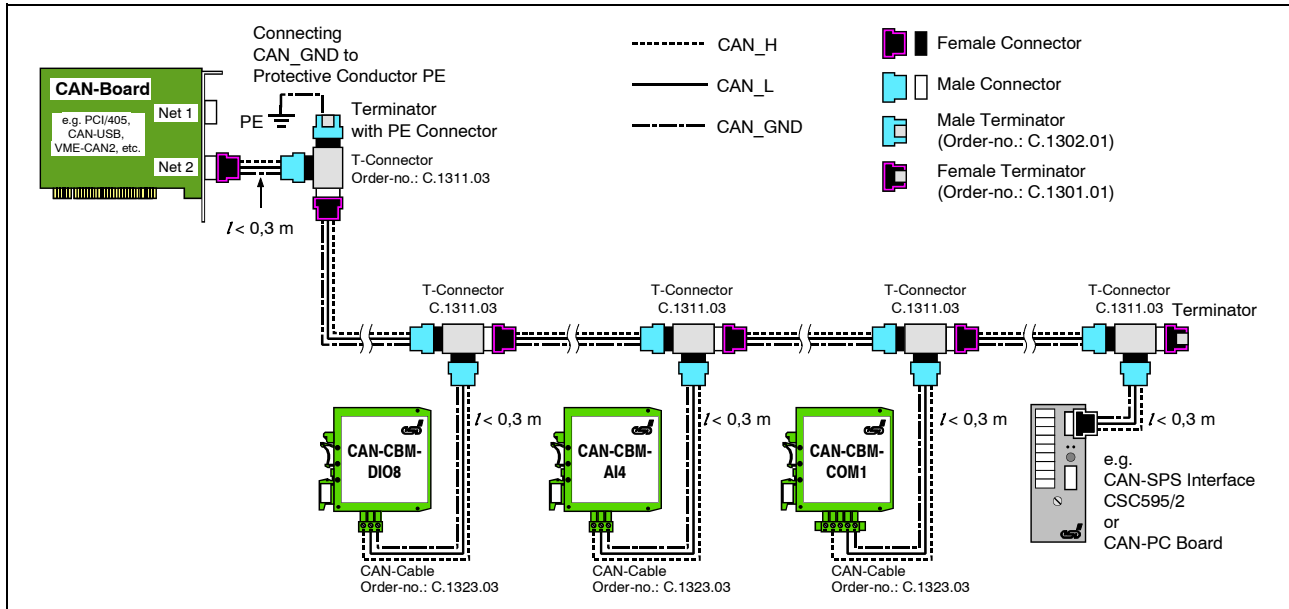


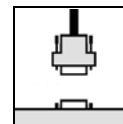
Figure: Example for correct wiring (when using single shielded wires)

Terminal Resistance

- use **external** terminator, because this CAN later be found again more easily!
- 9-pin DSUB-terminator with male and female contacts and earth terminal are available as accessories

Earthing

- CAN_GND has to be conducted in the CAN wire, because the individual esd modules are electrically isolated from each other!
- CAN_GND has to be connected to the earth potential (PE) at **exactly one** point in the net!
- each CAN user without electrically isolated interface works as an earthing, therefore: do not connect more than one user without potential separation!
- Earthing CAN e.g. be made at a connector

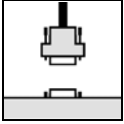


Wire Length

- Optical couplers are delaying the CAN signals. By using fast optical couplers and testing each board at 1 Mbit/s, however, esd CAN guarantee a reachable length of 37 m at 1 Mbit/s for most esd CAN modules within a closed net without impedance disturbances like e.g. longer dead-end feeders. (Exception: CAN-CBM-DIO8, -AI4 and AO4 (these modules work only up to 10 m with 1 Mbit/s))

Bit rate [Kbit/s]	Typical values of reachable wire length with esd interface l_{\max} [m]	CiA recommendations (07/95) for reachable wire lengths l_{\min} [m]
1000	37	25
800	59	50
666.6	80	-
500	130	100
333.3	180	-
250	270	250
166	420	-
125	570	500
100	710	650
66.6	1000	-
50	1400	1000
33.3	2000	-
20	3600	2500
12.5	5400	-
10	7300	5000

Table: Reachable wire lengths depending on the bit rate when using esd-CAN interfaces



Wiring

Examples for CAN Wires

Manufacturer	Type of wire
U.I. LAPP GmbH Schulze-Delitzsch-Straße 25 70565 Stuttgart Germany www.lappkabel.de	e.g. UNITRONIC ®-BUS CAN UL/CSA (UL/CSA approved) UNITRONIC ®-BUS-FD P CAN UL/CSA (UL/CSA approved)
ConCab GmbH Äußerer Eichwald 74535 Mainhardt Germany www.concab.de	e.g. BUS-PVC-C (1 x 2 x 0,22 mm ²) Order No.: 93 022 016 (UL appr.) BUS-Schleppflex-PUR-C (1 x 2 x 0,25 mm ²) Order No.: 94 025 016 (UL appr.)
SAB Bröckskes GmbH&Co. KG Grefrather Straße 204-212b 41749 Viersen Germany www.sab-brockskes.de	e.g. SABIX® CB 620 (1 x 2 x 0,25 mm ²) Order No.: 56202251 CB 627 (1 x 2 x 0,25 mm ²) Order No.: 06272251 (UL appr.)

Note: Completely configured CAN wires can be ordered from **esd**.