CAN-CBM-COM1

CAN - RS-232-,
RS-422-, RS-485-
or TTY-Interface

Hardware - Manual

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Changes in the chapters

The changes in the user's manual listed below affect changes in the *hardware* as well as changes in the *description* of the facts only.

Chapter	Changes versus previous version
-	Manual extended for CAN-CBM-COM1 CANopen-to-Serial for CANopen firmware
-	-

Technical details are subject to change without further notice.

N O T E

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1. Overview

1.1 Description of the Module

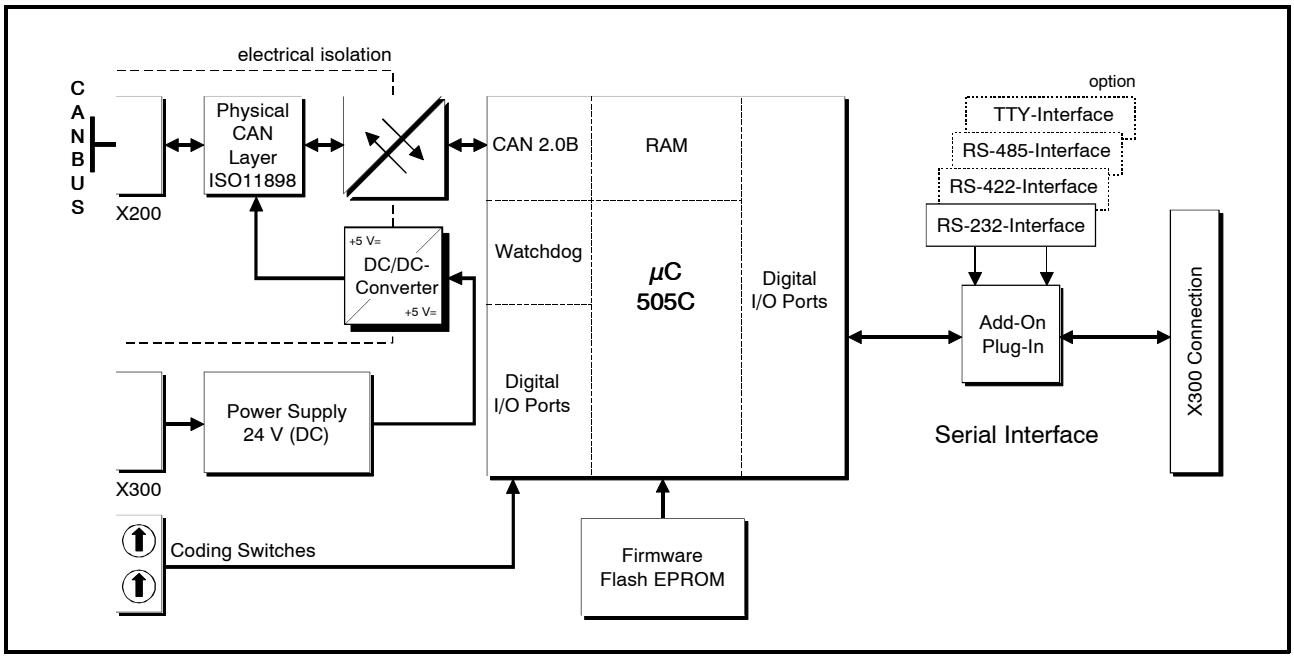


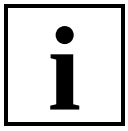
Fig. 1.1.: Block diagram of CAN-CBM-COM1-Module

The module CAN-CBM-COM1 offers the linking of the CAN net to a serial interface. The module can be equipped with the serial interfaces RS-232, RS-422, RS-485 or TTY. In the standard version the plug-in-place is equipped with an RS-232 driver and for the other interfaces with piggybacks.

The CAN-CBM-COM1 module operates with a local microcontroller of C505 type, which has an integrated CAN controller.

The CAN-CBM-COM1 **CAN**-to-Serial module (C.2841.02) works with the **esd** protocol. Beyond this the module is available as CAN-CBM-COM1 **CANopen**-to-Serial module (C.2841.03, C.2841.04) which works with CANopen firmware. Both modules are equipped with the same hardware and are described together in the following. Differences which result from the various software, e.g. the state of the LEDs, are described separately.

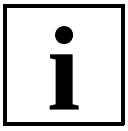
The default bit rate of the CAN bus can be programmed or be changed by jumper clips on the board. The CAN identifier of the CAN-CBM-COM1 CAN-to-Serial module is selectable via two rotary switches, accessible from the outside of the module. In addition, the identifier can be programmed via CAN bus. For the CAN-CBM-COM1 CANopen-to-Serial module the Node-ID is selectable via the two rotary switches.



Overview

The ISO 11898-compatible CAN interface allows a maximum data transmission rate of 1 Mbit/s (max. 35 m cable length).The CAN interface is electrically isolated by means of optocouplers and DC/DC-converters.

An additional supervision function improves the operation safety:
The watchdog timer, integrated into the microcontroller, causes an automatic RESET of the CAN module after the watchdog period has expired.



1.2 Summary of Technical Data

1.2.1 General technical Data

Power supply	permitted voltage range: 10...30 V/DC current consumption (at 20 ˚C): typ. 30 mA (RS-232 operation) typ. 40 mA (RS-485 operation)
Connectors	X300 (Combicon-style 12-pin MSTB 2,5/12-ST-08) - serial interface, power supply X200 (Combicon-style, 5-pin MSTB 2.5/5-5.08) - CAN interface
Temperature range	0...50 ˚C ambient temperature for CAN-CBM-COM1-T: -40 ... + 85 ˚C extended temperature range
Humidity	max. 90%, non-condensing
Dimensions	width: 25 mm height: 88 mm depth: 85 mm (including hat-rail mounting and connector projection Combicon)
Weight	approx. 85 g

Table 1.2.1: General technical data

1.2.2 CAN- and Microcontroller Unit

CAN interface	physical layer according to ISO 11898, electrical isolation by optocouplers and DC/DC converters
Transfer rate	selectable by jumpers or programmable between 10 kbit/s and 1 Mbit/s
CAN identifier (**esd** protocol)	selectable via coding switches and jumpers or programmable, the module requires one Rx identifier and one Tx identifier at operation with default parameters
esd-module no. (**esd** protocol)	selectable via coding switches or programmable
Node-ID (CANopen firmware)	selectable via coding switches
Microcontroller	C505, OTP
EEPROM	I²C-EEPROM for storage of parameters
LED display	four LEDs for status display of the microcontroller

Table 1.2.2: Technical data of CAN- and microcontroller units

1.2.3 Serial Interface

Controller	C505
Buffering of the serial data	256 byte memory in Tx- and 256 byte memory in Rx-direction
Standard interface	RS-232
Possible interface equipment	RS-232 RS-422 RS-485 TTY-passive
Handshake	CTS/RTS and XON/XOFF
Baudrate	RS-232: max. 38,4 kbit/s RS-422: max. 125 kbit/s RS-485: max. 125 kbit/s TTY: typ. 1200 bit/s

Table 1.2.3: Technical data of the serial interface

1.2.4 Software Support

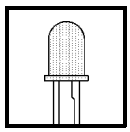
The complete EPROM-resident communication firmware for operating the CAN-CBM-COM1-module is contained in the product package.

1.3 Order Information

Type	Features	Order No.
CAN-CBM-COM1 CAN-to-Serial	Serial Interface RS-232, Power supply 10 VDC...30 VDC with **esd** protocol	C.2841.02
CAN-CBM-COM1 CANopen-to-Serial	Serial Interface RS-232, Power supply 10 VDC...30 VDC CANopen firmware temperature range: 0 ... 50 ˚C	C.2841.03
CAN-CBM-COM1 CANopen-to-Serial	Serial Interface RS-232, Power supply 10 VDC...30 VDC CANopen firmware temperature range: -40 ... 85 ˚C	C.2841.04
Instead of RS-232 with (please state clearly in order):	RS-422 Adapter RS-485 Adapter TTYp-Adapter	X.1930.02 X.1930.04 X.1930.06
CAN-CBM-COM1-ME	English manual for C.2841.02 [1*)]	C.2841.21

[1*)]... If ordered together with the module, the manual is included in the product package.

Table 1.3.1: Order information for module CAN-CBM-COM1



2. Case View and LED Description

2.1 Case

The board is installed in a polyamide case (UEGM–MSTB) by the manufacturer Phoenix Contact.
The front has a 12-pin Combicon connector (MSTBT 2.5/12-ST-5.08) to connect the power supply and the serial interface.
Two yellow, one red and one green LED show the current module status.

The two HEX coding switches for manual configuration are on the upper case side.
The CAN connection, a 5-pin Combicon connector (MSTBT2.5/5-5.08), is at the lower case side.

The case can be locked onto carrier rails according to EN 50 022 (hat- rail) by means of clips at the back of the case.

2.2 Front View with Position of LEDs and Coding Switches

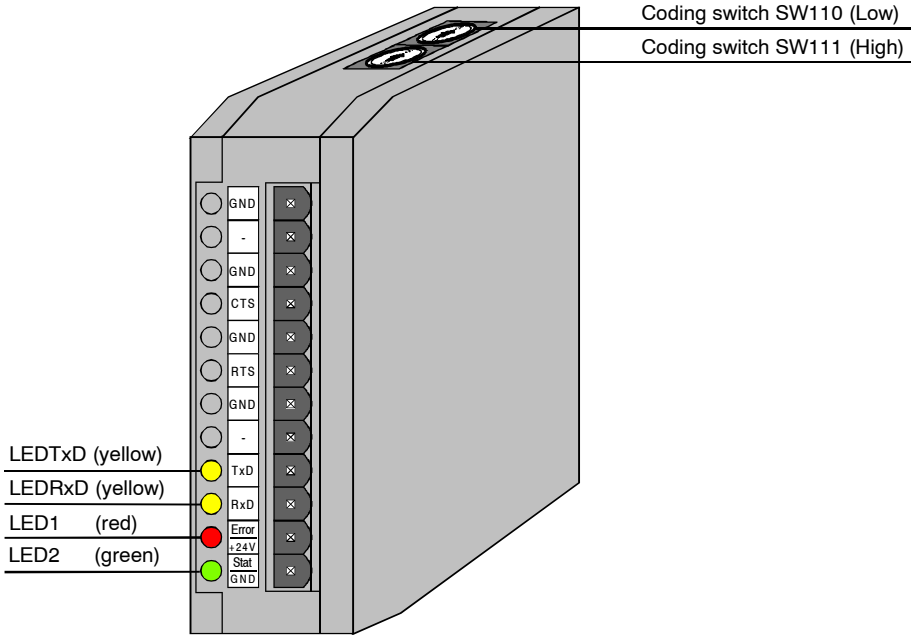


Fig. 2.2.1: Positions of LEDs and coding switches

2.3 LED Display

The module has two yellow, one red and one green LED (see page 9).
The functions of **both yellow LEDs** are described in the following table.

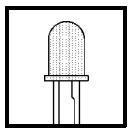
LED	Name	Colour	Status of LED	Status
Tx	LEDTxD	yellow	off	no Tx signals are received
			on	Tx signals are received
RxD	LEDRxD	yellow	off	no RxD signals are received
			on	RxD signals are received

Table 2.3.1: Names and displays of the yellow LEDs

The **red and green status LED** are described in the following table.

LED	Name	Colour
Error	LED1	red
Stat	LED2	green

Table 2.3.2: Names of the red and green LED

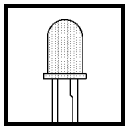


2.3.1 State of Red and Green LED with esd Protocol

The table below describes the states of the green and the red LED for the CAN-CBM-COM1 CAN-to-Serial module (C.2841.02) working with the esd protocol.

State of LEDs	Status of CAN module
green LED (Stat) - constantly on red LED (Error) - off	Condition of module OK, module works with the parameters stored in the EEPROM.
LEDs flash: green LED (Stat) - 250 ms, red LED (Error) - 50 ms	Condition of module OK, module works with the default parameters, because EEPROM data are faulty or deleted.
LEDs flash: green LED (Stat) - 40 ms, red LED (Error) - 40 ms	actual CAN bus error
LEDs flash: green LED (Stat) - 50 ms , red LED (Error) - 250 ms	The module discovered a temporary CAN bus error which is not active anymore.
green LED (Stat) - off red LED (Error) - constantly on	Voltage supply OK, all other functions of the module out of order -> microcontroller C505 does not work or an internal error did occur. Please, contact the service.

Table 2.3.3: Display of the status LEDs with **esd** protocol



LED Display

2.3.2 State of Red and Green LED with CANopen Firmware

The tables below desribe the states of the green and the red LED for the CAN-CBM-COM1 CANopen-to-Serial module (C.2841.03, C.2841.04) working with the CANopen firmware.

CANopen-RUN-LED	State of the CAN module	Description
Single flash	STOPPED	-
Blinking	PRE-OPERATIONAL	-
LED on	OPERATIONAL	-

Table 2.3.4: Display of the green CANopen-Run-LED

CANopen-Error-LED	State of the CANmodule	Description
LED flashes 1x (single flash)	warning limit reached	- at least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
LED flashes 2x (double flash)	Error Control Event	- a ‘Guard Event’ or or a ‘Heartbeat Event’ has occurred
LED on	Bus Off	- the CAN controller is bus off

Table 2.3.5: Display of the red CANopen-Error-LED

3. Hardware Configuration

3.1 PCB View with Position of the Jumpers

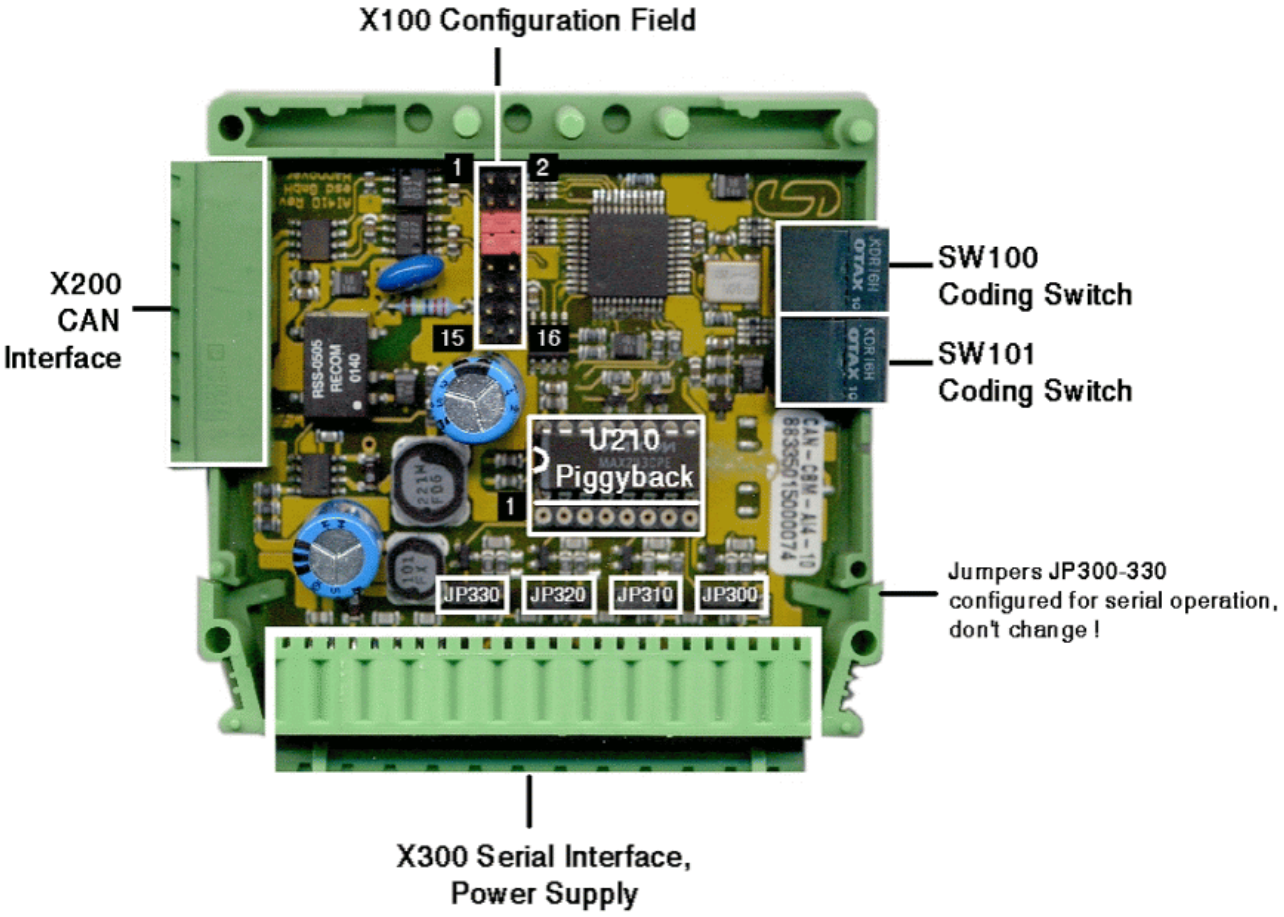


Fig. 3.1.1: Position of jumpers

3.2 Jumpers and Coding Switches

The coding switches for the manual configuration and the setting of the module number are on the upper side of the case (see page 9).

coding switch SW 100 (Low)
coding switch SW 101 (High)

The arrangement of the Jumpers and the coding switches on the component layer can be taken from figure 3.1.1. (page 13).

3.2.1 Default Settings of the Jumpers and the Coding Switches

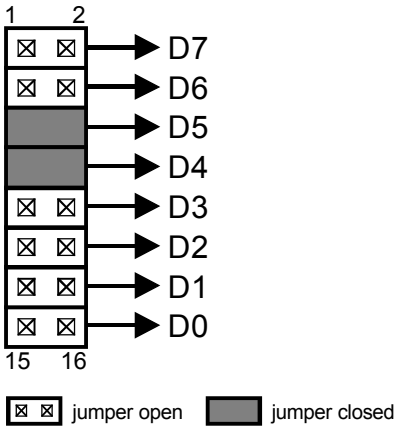
The respective default setting (see table below) at delivery of the board is entered.

Jumper / Coding Switch	Function	Adjustment
Jumper X100	Configuration	bit rate 125 kbit/s
Coding switches SW100 - LOW SW101 - HIGH	for esd protocol (CAN-to-Serial): CAN identifier bits id11-id4 for CANopen firmware (CANopen-to-Serial): Module ID	depending on user
Jumper JP300...JP330	I/O-Port Configuration	serial operation **Don't change these jumpers !**

Table 3.2.1: Default settings of the jumpers and coding switches

3.2.2 Jumpers and Coding Switches of the CAN Assemblies

3.2.2.1 Configuration Field (X100)

Jumper X100	Bit	Function
	D7	Mode 0: CANlink 1: standard
	D6 D5 D4 D3	CAN bit rate Default: 125 kbit/s
	D2 D1	reserved
	D0	for esd protocol: Rx/Tx-Identifier code C0 for CANopen firmware: reserved

Jumper closed --▸ Bit = '1'!

Table 3.2.2: Configuration of the jumper X100

Function of the bits:

Mode (D7): If this jumper is inserted the CAN-CBM-COM1 module is working automatically with the CANlink protocol after a RESET in the default state. Is the jumper not inserted (default setting) the module is not automatically working with the CANlink protocol. It is also possible to activate the CANlink function by the software, if it was not automatically activated by this jumper.

Jumper not inserted ... no CANlink
Jumper inserted ... CANlink

Bit rate (D6-D3): Transfer rate

An inserted jumper sets the corresponding bit to '1', here! In the column 'l_{max}' the maximum possible line length of the CAN is specified.

jumper bits				C505-register		bit rate [kbit/s]	typical values of the attainable line length l_{max} [m]	minimum attainable line length l_{min} [m]
D6	D5	D4	D3	BTR0 [HEX]	BTR1 [HEX]			
0	0	0	0	00	14	1000	37	20
0	0	0	1	00	18	666.6	80	65
0	0	1	0	00	1C	500	130	110
0	0	1	1	01	18	333.3	180	160
0	1	0	0	01	1C	250	270	250
0	1	0	1	02	1C	166	420	400
0	**1**	**1**	**0**	**03**	**1C**	**125**	**570**	**550**
0	1	1	1	04	1C	100	710	700
1	0	0	0	45	2F	66.6	1000	980
1	0	0	1	09	1C	50	1400	1400
1	0	1	0	4B	2F	33.3	2000	2000
1	0	1	1	18	1C	20	3600	3600
1	1	0	0	5F	2F	12.5	5400	5400
1	1	0	1	31	1C	10	7300	7300
1	1	1	0	00	16	800	59	42

The details in the table base on the limit values of the bit timing of the CAN protocol, the run times of the local CAN interface and the run times of the cable. The run time of the cable is presumed with approx. 5.5 ns/m. Further influences, e.g., by the terminal resistances, the specific resistance, the cable geometry or other external disturbance influences with the transfer have not been included!

Table 3.2.3: Setting the transfer rate by X100

Rx/Tx-Identifier-Code C0 (D0) (only for **esd** protocol):

The CAN-CBM-COM1 module (C.2841.02) has got two identifiers in the default state: A Tx identifier and an Rx identifier. The identifier bits id11 to id4 are adjusted by the coding switches 'LOW' (SW100) and 'HIGH' (SW101) (see following chapter 'CAN identifier bits id11...id4').

Is the CANlink protocol activated by jumper J110 or the firmware (see software manual of the module) the module additionally uses the identifier TxId2 and RxId2 for the exchange of protocol data.

The lowest identifier bits distinguish between the Tx and Rx identifiers.

To construct a CAN net in which two CAN-CBM-COM1 modules communicate with each other without a programming of the identifiers, it is possible to select by the jumper clip C0, which module should transmit (TxId) and which should receive on the same identifier (RxId).

An adjusted jumper clip sets C0 to the value '1'.

Identifier bits		Allocation of the CAN Tx and Rx identifiers	
id2	id1	C0 = 0 (Default adjustment)	C0 = 1
0	0	Rx1	Tx1
0	1	Tx1	Rx1
1	0	(Rx2)	(Tx2)
1	1	(Tx2)	(Rx2)

The identifiers TxId2 and RxId2 are only used, if CANlink is activated!

Table 3.2.4: Allocation of the CAN Rx and Tx identifiers by C0

3.2.2.2 CAN Identifier Bits (only for esd protocol)

With the coding switches 'HIGH'(SW101) and 'LOW'(SW100) the identifier bits id4 to id11 of the CAN identifiers of the CAN-CBM-COM1 module (CAN-to-Serial, C.2841.02) are adjusted. These 8 identifier bits are identical for all channels.
The distinction between the channels and the Rx and Tx identifiers occurs by the lowest 2 bits (id1, id2). The allocation to these bits can be selected by the jumper clip X100 (see preceding chapter).
The identifier bit id3 has always be set to '0'.

The composition of the CAN identifiers of the CAN-CBM-COM1 module (CAN-to-Serial) is shown below:

id11	id10	id9	id8	id7	id6	id5	id4	id3	id2	id1
DIP switch 'HIGH' (SW101) $0...$F				DIP switch 'LOW' (SW100) $0...$F				always set to '0'	Rx/Tx and channel selection (see page 17)	

Table 3.2.5: Allocation of the CAN identifier bits id11 to id4 to the coding switches

If the module runs with the default parameters, the value adjusted by the coding switches also corresponds to the **esd** module no. (see software manual of the module).
The local software of the module provides also the possibility to program all 11 bits of the identifiers of the module independently. Further information about this can be taken from the software manual of the module.

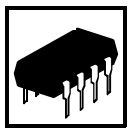
Attention: The user has to secure that the identifiers of following modules are selected with an offset of +$2 (+$4, if CANlink is used), because otherwise intersections of the identifiers would arise!

3.2.2.3 Node-ID (only for CANopen firmware)

With the coding switches 'HIGH'(SW101) and 'LOW'(SW100) the Node-ID of the CAN-CBM-COM1 module (CANopen-to-Serial, C.2841.03, C.2841.04) is set. The value range of the Node-ID is 0 to 127 ($0...7F_h$).

Coding switch HIGH (SW101)	Coding switch LOW (SW100)
$0...$7	$0...$F

Table 3.2.6: Setting of Node-ID



4. Description of the Assemblies

4.1 CAN Interface

4.1.1 Bitrate

The transmission speed can be varied from 10 kbit/s to 1.0 Mbit/s. The selection of the bit rate is made by the configuration field X100.

The local software of the module provides the possibility to reprogram the bit rate. The programmed bit rate replaces the bit rate adjusted by X100. Further information about this can be taken from the software manual of the module.

A detailed overview of the possible bit rates can be taken from the description of jumper clip X100 (see page 16).

1.5.2 Transmit and Receive Circuit of the CAN Interface (Physical Layer)

The physical CAN interface of **esd** complies with the ISO 11898 standard. The connection to the bus occurs by a 5-pin Combicon connector.

The voltage supply of the CAN bus is electrically isolated from the 24 V supply and the microcontroller C505.
The electrical isolation of the signals to the CAN bus is realized by optocouplers.

4.2 Serial Interface X300 (12-pin Combicon, male)

4.2.1 Configuration

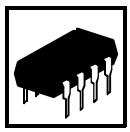
The serial Interface of the CAN-CBM-COM1 can be configured as RS-232, RS-422, RS-485 or TTY interface, depending on the insertion of driver (for RS-232) and piggyback (for RS-422, RS-485 and TTY).

The interface is controlled by the microcontroller component C505. To buffer the serial data 256 bytes memory is supported for both data directions.

The maximum possible bit rate of the serial interfaces is limited by the selected physical layer:

Physical Interface	Bit Rate
RS-232	max. ca. 38,4 kbit/s
RS-422	max. ca. 125 kbit/s
RS-485	max. ca. 125 kbit/s
TTY	typical: 1200 bit/s

Table 4.2.1: Bit rates of the serial interface



4.2.2 Connection of the Serial Interfaces at DSUB9 Connector

Below the wiring of the serial interface in relation to the data direction is shown. The figures should explain the short terms of the signals used in the appendix (connector assignment). Furthermore the circuit layouts of the various available piggybacks can be found in the appendix (circuit diagrams).

4.2.2.1 The RS-232 Interface

The signal description is given exemplary for the connection of the CAN-CBM-COM1 module as a modem (DCE).

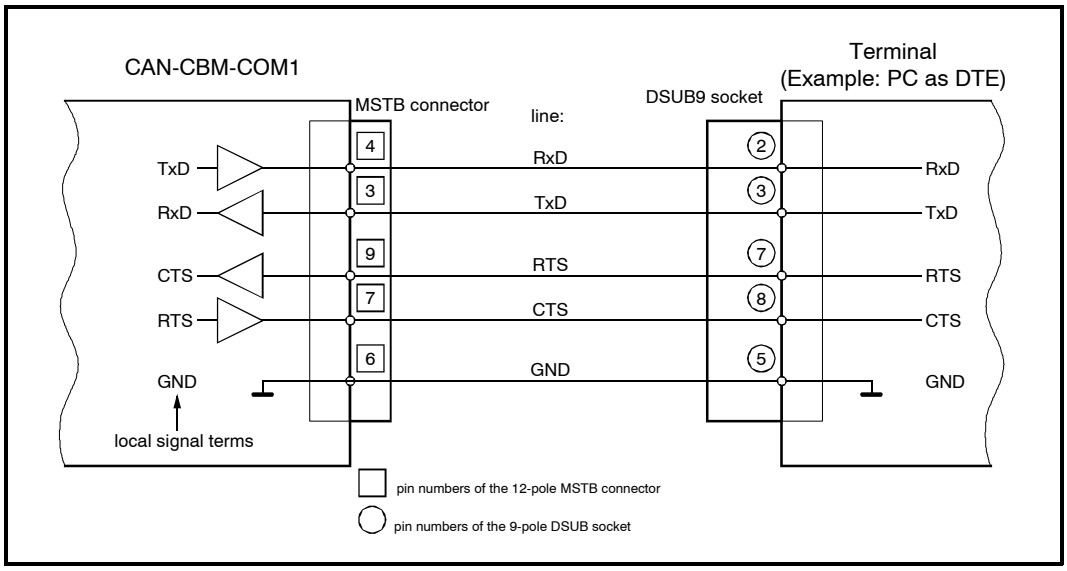


Fig. 4.2.2: Connection scheme for RS-232 operation

4.2.2.2 The RS-422 Interface

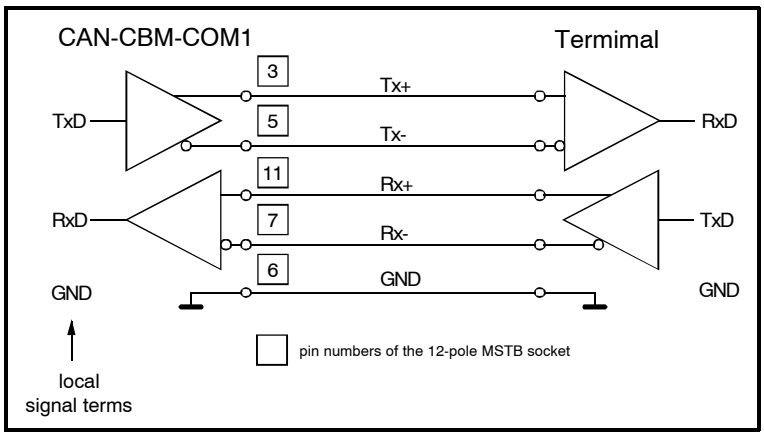


Fig. 4.2.4: Connection scheme for RS-422 operation

4.2.2.3 The RS-485 Interface

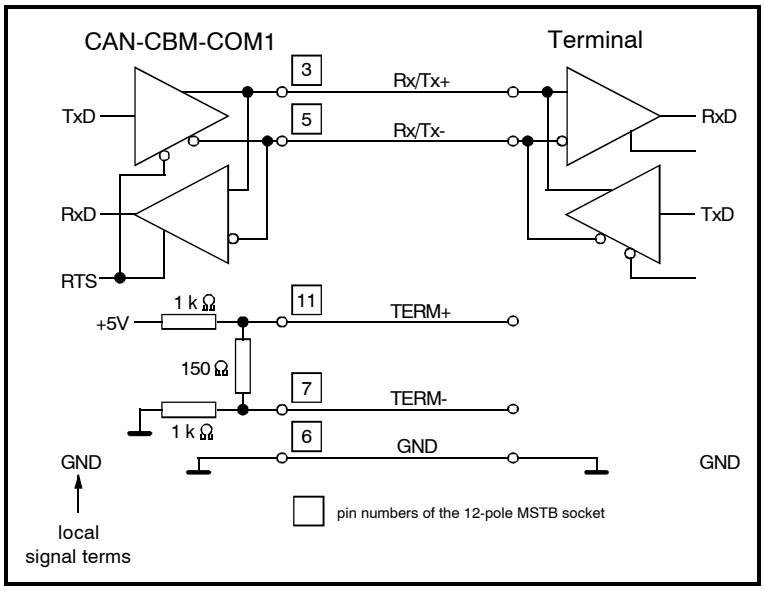
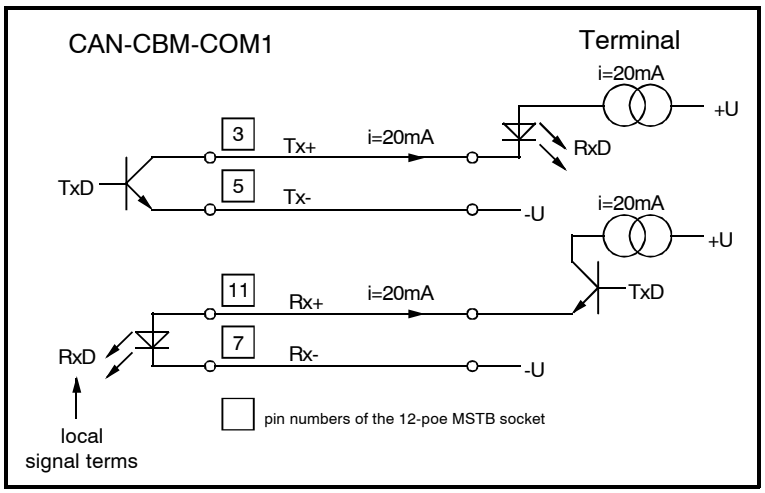


Fig. 4.2.5: Connection scheme for RS-485 operation

To activate the terminal-resistance network which is on the piggyback, e.g. the pin 3 and 11 as well as pin 5 and 7 of the MSTB connector have to be connected.



4.2.2.4 The TTY(20 mA) Interface

Fig. 4.2.6: Connection scheme for TTY operation (passive)

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5. Connector Assignment

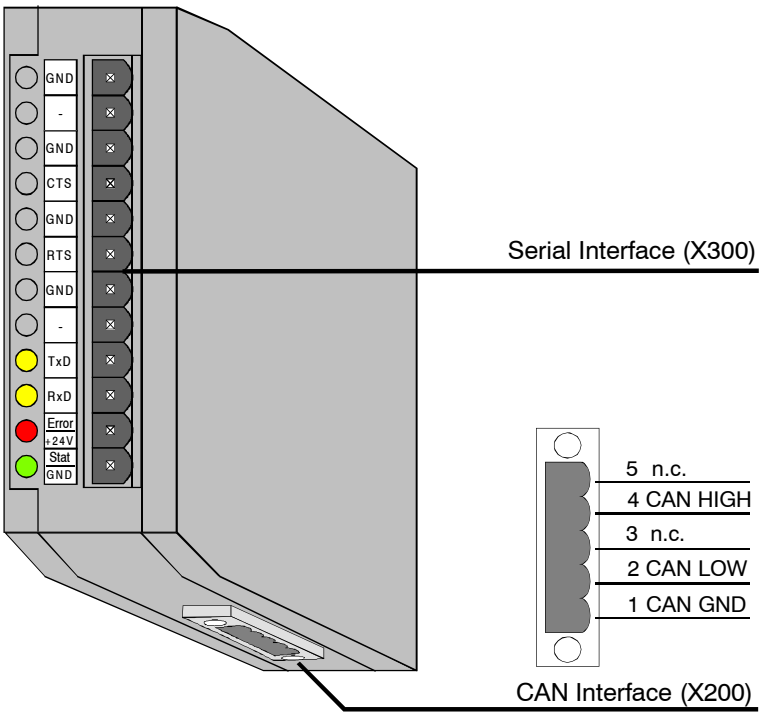
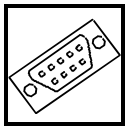


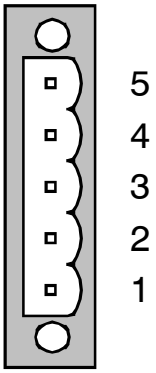
Fig. 5.1.1: Position of connector X200 and X300



Connector Assignment

5.1 CAN-Interface (X200, 5-pol. Combicon-Style)

Pin Position:

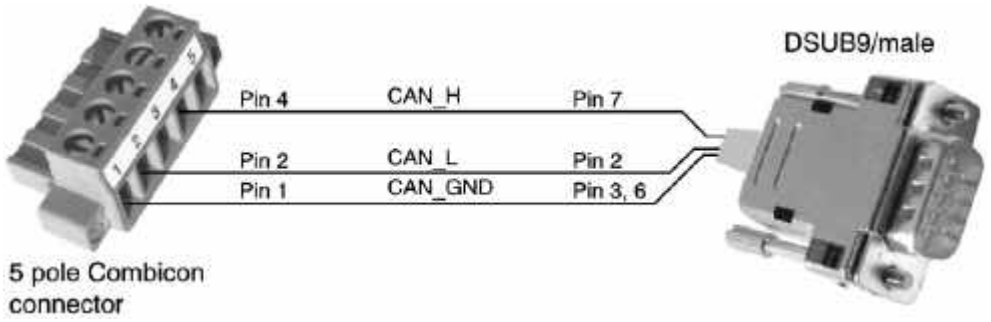


Pin Assignment:

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

Signal Description:

CAN_L,
CAN_H... CAN-signal lines
CAN_GND ... reference potential of CAN-physical layer

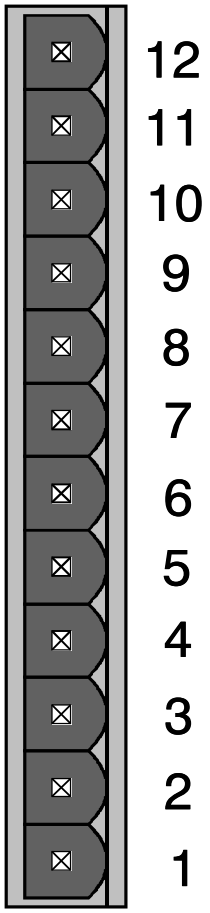


The 9-pin DSUB connector is assigned in accordance with CiA DS 102.

Fig 5.1: Adapter cable 5-pole Combicon to 9-pole DSUB

5.2 Serial Interface (X300, 12-pol. Combicon-Style)

Pin Position:



Pin Assignment:

Pin	Signal RS-232	Signal RS-422	Signal RS-485	Signal TTY
12	GND	GND	GND	GND
11	n.c.	Rx+	Term+	Rx+
10	GND	GND	GND	GND
9	CTS	GND	GND	I2
8	GND	GND	GND	GND
7	RTS	Rx-	Term-	Rx-
6	GND	GND	GND	GND
5	n.c.	Tx-	Tx/Rx-	Tx-
4	Tx	n.c.	n.c.	I1
3	RxD	Tx+	Tx/Rx+	Tx+
2	+24 V	+24 V	+24 V	+24 V
1	GND	GND	GND	GND

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6. 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 Ω ±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 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 Ω ±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.

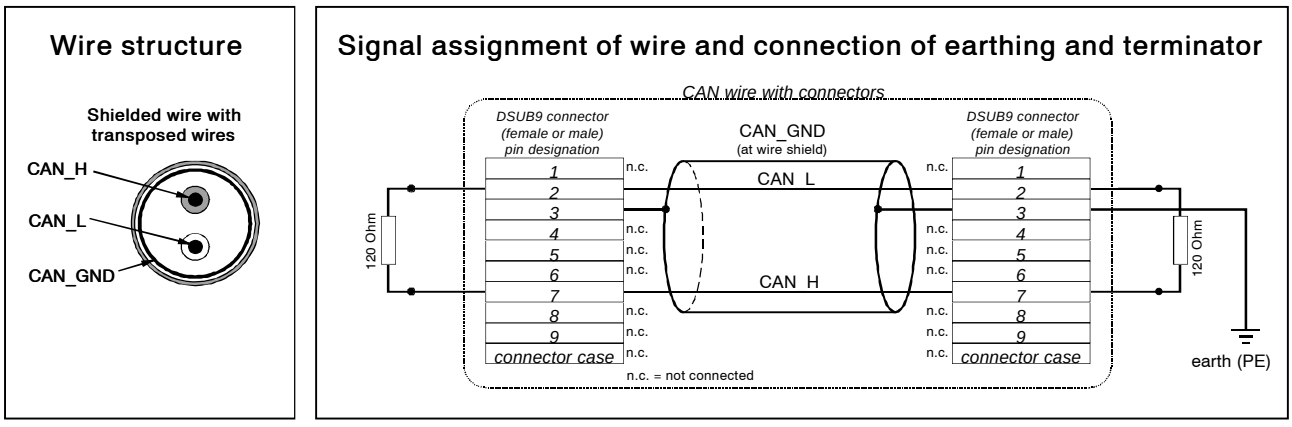


Figure: Structure and connection of wire

Cabling

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

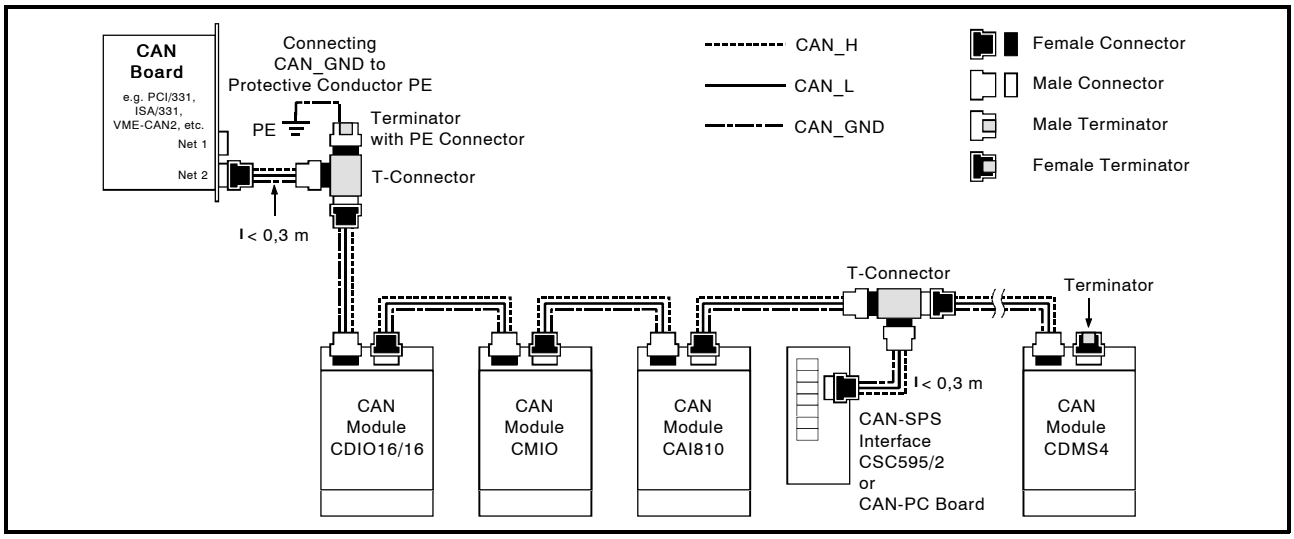


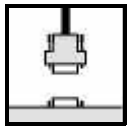
Figure: Example for correct wiring (when using single shielded wires)

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

Examples for Suitable Types of Wire

Manufacturer	Type of wire
U.I. LAPP GmbH & Co. KG Schulze-Delitzsch-Straße 25 70565 Stuttgart	UNITRONIC ®-BUS LD, UNITRONIC ®-BUS FD P LD
metrofunk KABEL-UNION GmbH Postfach 410109 12111 Berlin	LiYCY 2 x 0,38 mm², LiYCY 2 x 0,5 mm², LiYCY 2 x 0,75 mm², LiYCY 2 x 1,0 mm², 1P x AWG 22 C, 1P x AWG 20 C

Manufacturer	Type of wire
Alcatel Kabelmetal Kabelkamp 20 30179 Hannover	DUE 4401, DUE 4001, DUE 4402
ConCab Kabel GmbH Äußerer Eichwald 74535 Mainhardt	1 x 2 x 0,22 mm² Order no.: 93022016 (UL approved)

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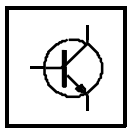

7. Circuit Diagrams

The PDF-file of this document does not contain the circuit diagrams. The circuit diagrams are shipped on request.