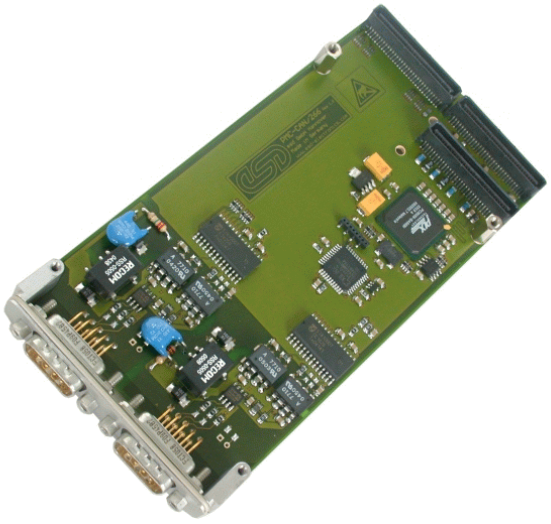
PMC-CAN/266

66 MHz PMC-CAN-Interface



Hardware Manual

to Product C.2040.xx

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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
1.2	New picture of PCB view
3.3	Description of PIM module inserted
3.5	Order information of PMC-CAN/266-RIO added
4.	Chapter 'Configuration Resistors' expanded
5.4	Signal assignment of connector P14 corrected

Further technical changes are subject to change without notice.

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Contents

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1. Overview

1.1 Module Description

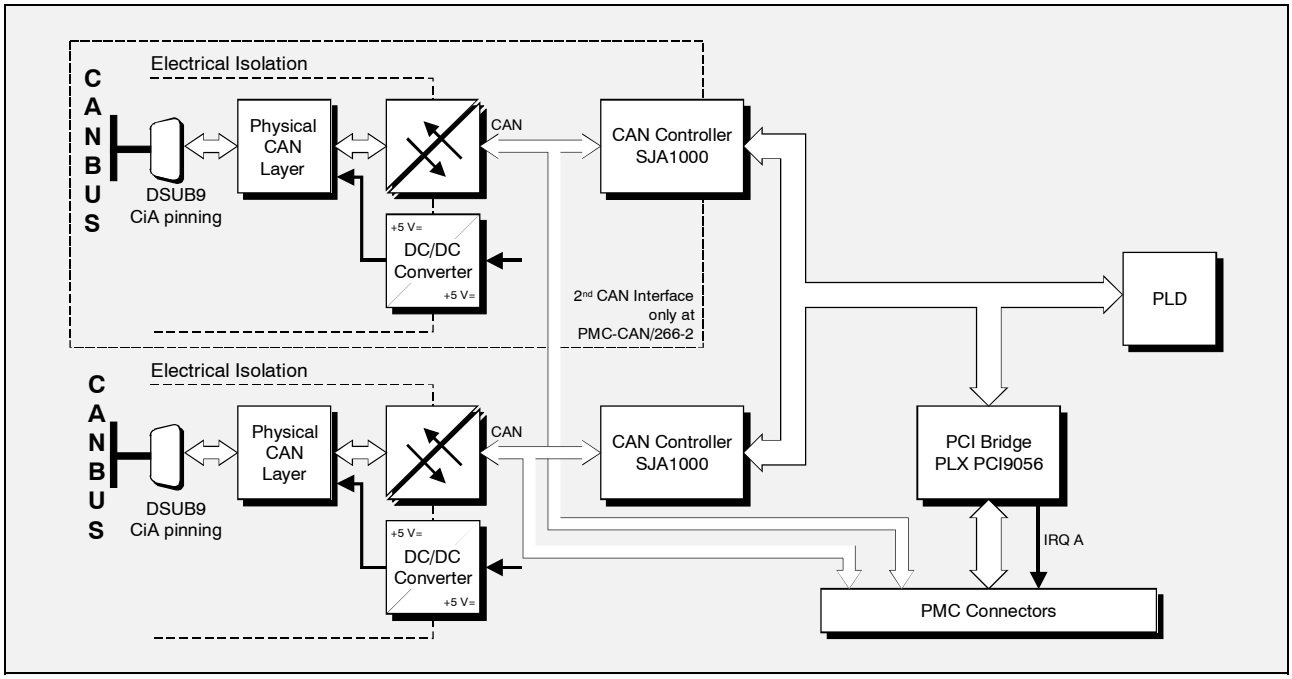


Fig. 1.1.1: Block-circuit diagram of the PMC-CAN/266 module

The PMC-CAN/266 is a PMC module for 66 MHz PCI-bus systems with one or optional two CAN-interfaces. The PMC-CAN/266 works with a bus width of 32 bits. The module can also be used in 66 MHz and 33 MHz bus systems.

The ISO 11898 compliant CAN-interfaces allow a data transfer rate of 1 Mbit/s. Among many other features the bit rate can be configured by software.
The CAN interface is electrically isolated from the other potentials by optocouplers and DC/DC-converters.

1.2 PCB View with Connector Designations

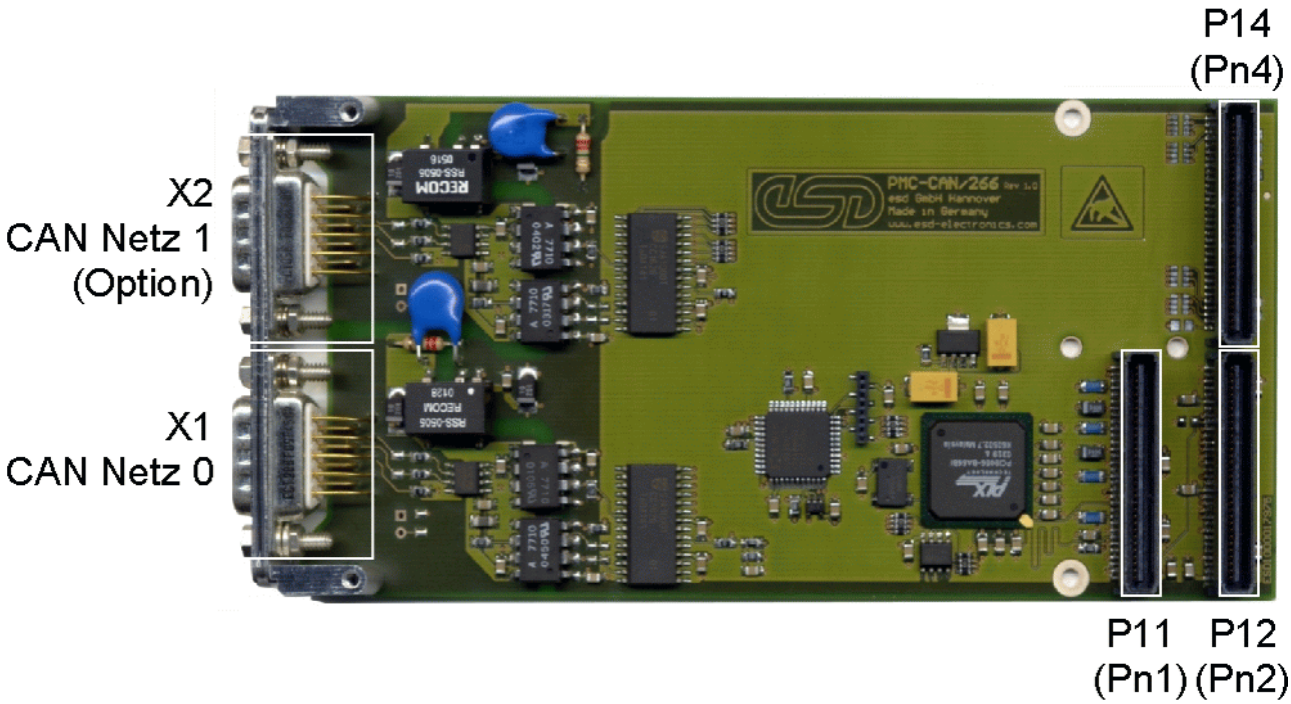
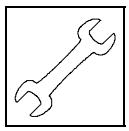


Fig. 1.2.1: View of PCB layer facing the carrier board with connector position



2. Hardware Installation

The PMC-CAN/266 module can be used on various carrier boards, therefore, the carrier system will generally be called ‘computer’, below.

Attention!
Electro static discharge may cause damage to electronic devices. In order to avoid this, please make sure to follow the instructions below *before* touching the CAN-module:

- Switch off the power supply of your computer but leave it connected to mains to make sure that the computer case remains earthed.
- Now touch the metal case of the PC to discharge your static electricity.
- Even your clothes must not touch the CAN-module.

1. Switch off your computer and all connected peripheral devices (monitor, printer, etc.). Switch off the CAN-devices of the network the CAN-module is to be connected to.

2. Discharge yourself as described above.

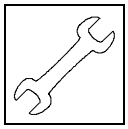
3. Disconnect the computer from mains.
   If the computer does not have a flexible network cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (note).

4. Open the case.

5. Plug the PMC-CAN/266 module onto a suitable carrier board.
   Connect module and carrier board by means of screws. Use the four M2.5 x 6 mm screws which are contained in the product package of the module.

6. Install the carrier board into your system.

7. Close the computer case.



Installation

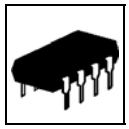
8. Connect the CAN.
   Please note that the CAN-bus must be terminated at both ends. esd offers special T-connectors and terminators for this. Additionally, the CAN-GND must be connected to earth at *exactly one* point in the CAN network. Therefore, the terminator connectors additionally have an earth contact. A CAN-device whose CAN-interface is not electrically insulated acts as an earth connection like the CAN-GND.
   Please pay attention to the notes on a correct wiring of CAN-networks at the end of this manual!

   The first CAN-interface (CAN-network 0) is connected via the DSUB-connector (X1) and the second CAN-interface (CAN-network 1) is connected via the DSUB-connector (X2).

9. Connect the computer to mains again (mains connector or safety fuse).

10. Switch on the computer, the peripheral devices and the other CAN-devices again.

11. End of hardware installation.
    The software installation will be described in the manual “CAN-API, Installation Guide’.



3. Summary of Technical Data

3.1 General Technical Data

Ambient temperature	0...50 ˚C
Humidity	max. 90%, non-condensing
Power supply voltage	via PMC-connector; required supply voltages: 5 V ± 5% **and** 3.3 V ± 5%
Current consumption (typ. at 20 ˚C)	5 V: 0.16 A (2x CAN) 3.3 V: 0.17 A
Connectors	P11 (Pn1)(64-pole PMC-connector) - PCI-signals P12 (Pn2)(64-pole PMC-connector) - PCI-signals P14 (Pn4)(64-pole PMC-connector) - CAN-TTL-signals (optional) X1 (DSUB9/male) - CAN-interface 1 (network 0) X2 (DSUB9/male) - optional CAN-interface 2 (network 1)
Dimensions	148.33 mm x 74.04 mm
Installation	by means of four screws M2.5 x 6 mm and spacing bolts (contained in the product package)
Weight	ca. 100 g
Approvals	according to RoHS directives (Restriction of Hazardous Substances in Electrical and Electronic Equipment, 2002/95/EC)

Table 3.1.1: General data of the module

3.2 PCI Bus

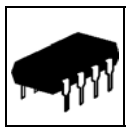
Host bus	PCI-bus in accordance with PCI Local Bus Specification 2.2
PCI-data bus	32 bit
PCI bus clock rate	66 MHz / 3.3 V signalling level or 33 MHz / 3.3 V or 5.0 V signalling level
Controller	PLX PCI9056
Interrupt	interrupt signal A

Table 3.2.1: PCI-bus data

3.3 CAN-Interface

Number	1, optionally 2 CAN-interfaces
CAN-controller	SJA1000
CAN-protocol	Basic-CAN 2.0A/B
Physical interface	physical layer in accordance with ISO 11898, transfer rate programmable from 10 Kbit/s to 1 Mbit/s
Bus termination	has to be set externally
Electrical isolation of the CAN-interface from other units	both possible CAN-interfaces are electrically isolated from each other and from the PCI-bus potentials by means of optocouplers and DC/DC-converters
Option: ISO-11898 Transceiver Modules	external adapter boards with CAN interface, DSUB9 connector, electrical isolation via optocouplers and DC/DC-converter, physical layer according to ISO11898, transmission rate up to 1 Mbit/s. - CAN-ADA-ISO11898 (Order No.: C.2012.26): one CAN interface, signals of the second CAN interface can be connected through, connection of the CAN-TTL-level signals via 10-pole post connector - CAN-PHYSLAY-HSP (Order No.: C.1201.01): one CAN interface, connection of the CAN-TTL-level signals to the adapter board via 8-pole connection strip or via wires directly connected with the board. - PIM-CPU/405 (Order No.: V.2025.02): PIM-interface module, two CAN interfaces

Table 3.3.1: Data of the CAN-interface



3.4 Software Support

Contained in the product package are software examples in source code for DOS and Windows 3.11. Furthermore, software drivers are available for VxWorks, QNX, Windows, Linux and other UNIX operating systems. Support for other operating systems (e.g. LynxOS, RTX) on request.
The firmware can be loaded from the PC into the Flash EPROM.

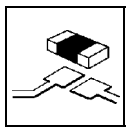
A software package for CANopen is available for VxWorks, QNX, Windows and Linux operating systems.

3.5 Order Information

Type	Description	Order No.
PMC-CAN/266-1	1x CAN 2.0A/B, ISO 11898 (1 CAN-network, SJA1000)	C.2040.02
PMC-CAN/266-2	2x CAN 2.0A/B, ISO 11898 (2 CAN-networks, SJA1000)	C.2040.04
PMC-CAN/266-RIO	2x CAN 2.0A/B, signals with TTL-level via connector P14 (Pn4)	C.2040.08
Optional Rear I/O-Adapters:		
CAN-ADA-ISO11898	CAN adapter, CAN-TTL signals to CAN interface with DSUB9 connector (ISO11898), TTL-signals of the second CAN interface can be connected through	C.2012.26
CAN-PHYSLAY-HSP	CAN-TTL signals to CAN interface with DSUB9 connector (ISO11898)	C.1201.01
PIM-CPU/405	PIM-Interface Module, 2x CAN-TTL signals to CAN interfaces with DSUB9 connector (ISO11898), electrically isolated with high speed opto couplers	V.2025.02
Software:		
CAN-DRV-LCD	Software Object Licence for Windows and Linux, incl. driver on CD	C.1101.02
PMC-CAN/266-Co	CANopen Master/Slave Obj. Licence	C.2040.12
Manuals:		
PMC-CAN/266-ME	English manual for C.2040.02 and C.2040.04 [1*)] (this manual)	C.2040.21
PMC-CAN/266-ENG	Engineering manual in English [2*)] Content: Circuit diagrams, PCB top overlay drawing, data sheets of significant components	C.2040.25
CAN-API-ME	Software manual of the CAN-API in English [1*)]	C.2001.21
CAL/CANopen-ME	CANopen software manual [1*)]	C.2002.21

1*) If ordered together with the product, the manual will be delivered free of charge.
2*) This manual is liable for costs, please contact our support.

Table 3.5.1: Order Information



4. Configuration Resistors

In the basic version of the PMC-CAN/266 for standard operation with up to two ISO11898 CAN interfaces accessible at the front panel no changes in the configuration resistor equipment have to be made.
If the TTL-level CAN-signals shall be routed to the PMC-I/O-connector P14 (Pn4) the configuration resistors have to be installed as described below.

4.1 Comparison of Different Signal Assignments

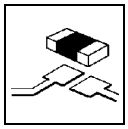
Signal Assignment 1 (Standard):
In the standard equipment of the PMC-CAN/266-1 (1xCAN, order no.: C.2040.02) and the PMC-CAN/266-2 (2x CAN, order no.:C.2040.04) the CAN-signals of the CAN-controller are assigned to the local ISO11898-interface (DSUB9).

Signal Assignment 2:
For the PMC-CAN/266-RIO (order no.: C.2040.08) the unidirectional TTL-level CAN-signals of the controllers can be routed to the connector P14 (Pn4). Assigning the signals to P14 and the DSUB-connectors at the same time is not permissible!

The assignment of the P14 connector can be adapted by the configuration resistor equipment to the carrier board used.

Note: By default the PMC-CAN/266-RIO is equipped with Resistor Option A, so that the TTL-level CAN-signals are routed to pins 1-10!
Please specify on order, if the TTL-level CAN-signals shall be routed to pins 55-64 (as in Resistor Option B).

Resistor Option	Assignment of P14 (Pn4) on PMC-CAN/266-RIO with TTL-Level CAN-Signals	Application (Examples)	
		VMEbus-PMC-Carrier-Board: VME-PMC-CADDY (Order No.: V.1911.01)	PMC Interface Module: PIM-CPU/450 (Order No.: V.2025.02)
A (Default for PMC-CAN/266-RIO)	Pin 1-10	Standard Assignment P2 on VME-PMC-CADDY c1-c5 and a1-a5 (refer to hardware-manual)	TTL-signals CAN0 and CAN1 routed to PIM-module
B (please, specify on order)	Pin 55-64	Standard Assignment P2 on VME-PMC-CADDY c28-c32 and a28 - a32 (refer to hardware-manual)	not permissible



4.2 Changing the Signal Assignments

4.2.1 Resistor Option A

The PMC-CAN/266-RIO is by default equipped with resistor option A.
The TTL-level CAN signals are routed to pins 1-10 of the PMC-connector P14 (Pn4).

The following resistor networks and resitors have to be equipped:

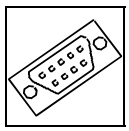
Resistors:	Resistor networks:
RX100 = 0 Ω	RN100 = 0 Ω
RX101 = 0 Ω	RN101 = 0 Ω

4.2.2 Resistor Option B

The resistor option B must be specified on order of the PMC-CAN/266-RIO.
The TTL-level CAN signals are routed to pins 55-64 of the PMC-connector P14 (Pn4).

The following resistor networks and resitors have to be equipped:

Resistors:	Resistor networks:
RX102 = 0 Ω	RN102 = 0 Ω
RX103 = 0 Ω	RN103 = 0 Ω

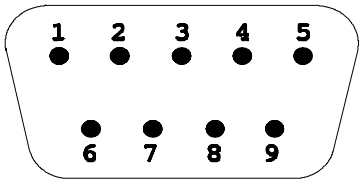


5. Connector Assignment

5.1 CAN-Bus Interfaces (X1, X2)

The signals are identically assigned to the connector of CAN interface 1 (X1) and optional CAN interface 2 (X2). The connectors are male 9-pole DSUB-connectors.

Pin Position:



Pin Assignment:

Signal	Pin		Signal
CAN_GND	6	1	reserved
		2	CAN_L
CAN_H	7	3	CAN_GND
reserved	8	4	reserved
reserved	9	5	shield

9-pole DSUB-connector

Signal Description:

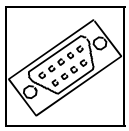
CAN_L, CAN_H...	CAN-signal lines
CAN_GND ...	reference potential of the local CAN-physical layer
Shield ...	potential of the connector case
reserved ...	reserved for future applications

5.2 Assignment of 64-pole PMC-Connector P11 (Pn1)

Pin	Signal name	Signal name	Pin
1	-	-	2
3	GND	INTA*	4
5	-	-	6
7	PMCPRSNT*=GND	+5V	8
9	-	-	10
11	GND	-	12
13	CLK	GND	14
15	GND	-	16
17	-	+5V	18
19	+5V	AD31	20
21	AD28	AD27	22
23	AD25	GND	24
25	GND	C/BE3*	26
27	AD22	AD21	28
29	AD19	+5V	30
31	+5V	AD17	32
33	FRAME*	GND	34
35	GND	IRDY*	36
37	DEVSEL*	+5V	38
39	GND	LOCK*	40
41	-	SBO*	42
43	-	GND	44
45	+5V	AD15	46
47	AD12	AD11	48
49	AD09	+5V	50
51	GND	C/BE0*	52
53	AD06	AD05	54
55	AD04	GND	56
57	+5V	AD01	58
59	AD02	AD01	60
61	AD00	+5V	62
63	GND	-	64

Connector design in accordance with PMC SPECIFICATION IEEE1386.1/Draft 2.0 - 04-APR-1995

- ... This pin is not assigned on the module.



5.3 Assignment of 64-pole PMC-Connector P12 (Pn2)

Pin	Signal name	Signal name	Pin
1	-	-	2
3	-	-	4
5	-	GND	6
7	GND	-	8
9	-	-	10
11	-	3.3V	12
13	RST*	-	14
15	3.3V	-	16
17	-	GND	18
19	AD30	AD29	20
21	GND	AD26	22
23	AD24	3.3V	24
25	IDSEL	AD23	26
27	3.3V	AD20	28
29	AD18	GND	30
31	AD16	C/BE2*	32
33	GND	-	34
35	TRDY*	3.3V	36
37	GND	STOP*	38
39	PERR*	GND	40
41	3.3V	SERR*	42
43	C/BE1*	GND	44
45	AD14	AD13	46
47	GND	AD10	48
49	AD08	3.3V	50
51	AD07	-	52
53	3.3V	-	54
55	-	GND	56
57	-	-	58
59	GND	-	60
61	-	3.3V	62
63	GND	-	64

Connector design in accordance with PMC SPECIFICATION IEEE1386.1/Draft 2.0 - 04-APR-1995

- ... This pin is not assigned on the module.

5.4 Assignment of 64-pole PMC-Connector P14 (Pn4)

The Rx/Tx-signals of the CAN-controllers can be assigned to PMC-connector P14. The signals are only available, if the configuration resistors (see chapter of the same name) are accordingly set.

Attention: The signals are TTL-level and are not electrically isolated from the micro controller units!

P14 (Pn4) Assignment with Configuration Resistor Option A

Signal	Pin		Signal
-	63	64	-
-	61	62	-
-	59	60	-
-	57	58	-
-	55	56	-
-	53	54	-
:	:	:	:
:	:	:	:
-	11	12	-
RX11*	9	10	GND
TX11*	7	8	RX10*
RX01*	5	6	TX10*
TX01*	3	4	RX00*
Vcc	1	2	TX00*

P14 (Pn4) Assignment with Configuration Resistor Option B

Signal	Pin		Signal
RX11*	63	64	GND
TX11*	61	62	RX10*
RX01*	59	60	TX10*
TX01*	57	58	RX00*
Vcc	55	56	TX00*
-	53	54	-
:	:	:	:
:	:	:	:
-	11	12	-
-	9	10	-
-	7	8	-
-	5	6	-
-	3	4	-
-	1	2	-

- ... This pin is not assigned on the module.

5.5 Connection Options: ISO-11898 CAN-Adapter

5.5.1 CAN-ADA-ISO11898 (C.2012.26)

The adapter CAN-ADA-ISO11898 (C.2012.26) can be connected with a ribbon cable to a backplane connector of the board which carries the PMC module. The CAN-TTL signals led through the backplane can then be transferred to a CAN-ISO11898-Interface.

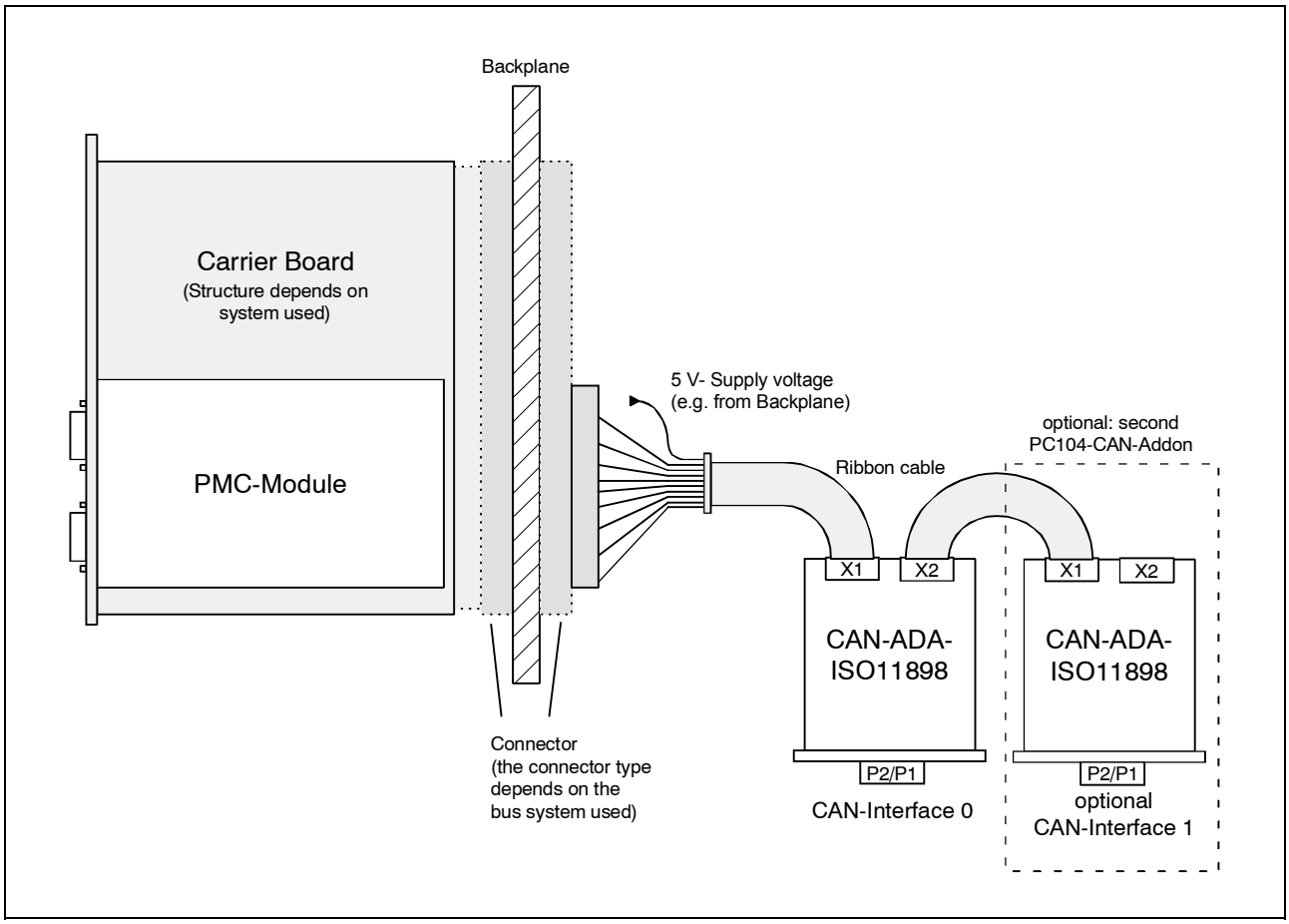


Fig. 5.5.1: Wiring CAN-ADA-ISO11898 adapter

The adapter is equipped with two post connectors (X1, X2). The ribbon cable with the CAN-TTL signals is connected to post connector X1. A second adapter can be connected via post connector X2. The adapter version CAN-ADA-ISO11898 is equipped with a CAN-Interface with DSUB9 connector.

For further information about the adapters please refer to the manual CAN-ADA-ISO11898 / CAN-ADA-DN.

5.5.2 CAN-PHYSLAY-HSP (C.1201.01)

The adapter CAN-PHYSLAY (C.1201.01) can be connected with a ribbon cable to the backplane connector of the board which carries the PMC module. The CAN-TTL signals led through the backplane can then be transferred via a 8-pole strip or via 4 wires directly soldered on the adapter board to a CAN-ISO11898-Interface.

For every CAN channel one CAN-PHYSLAY-HSP adapter is required.

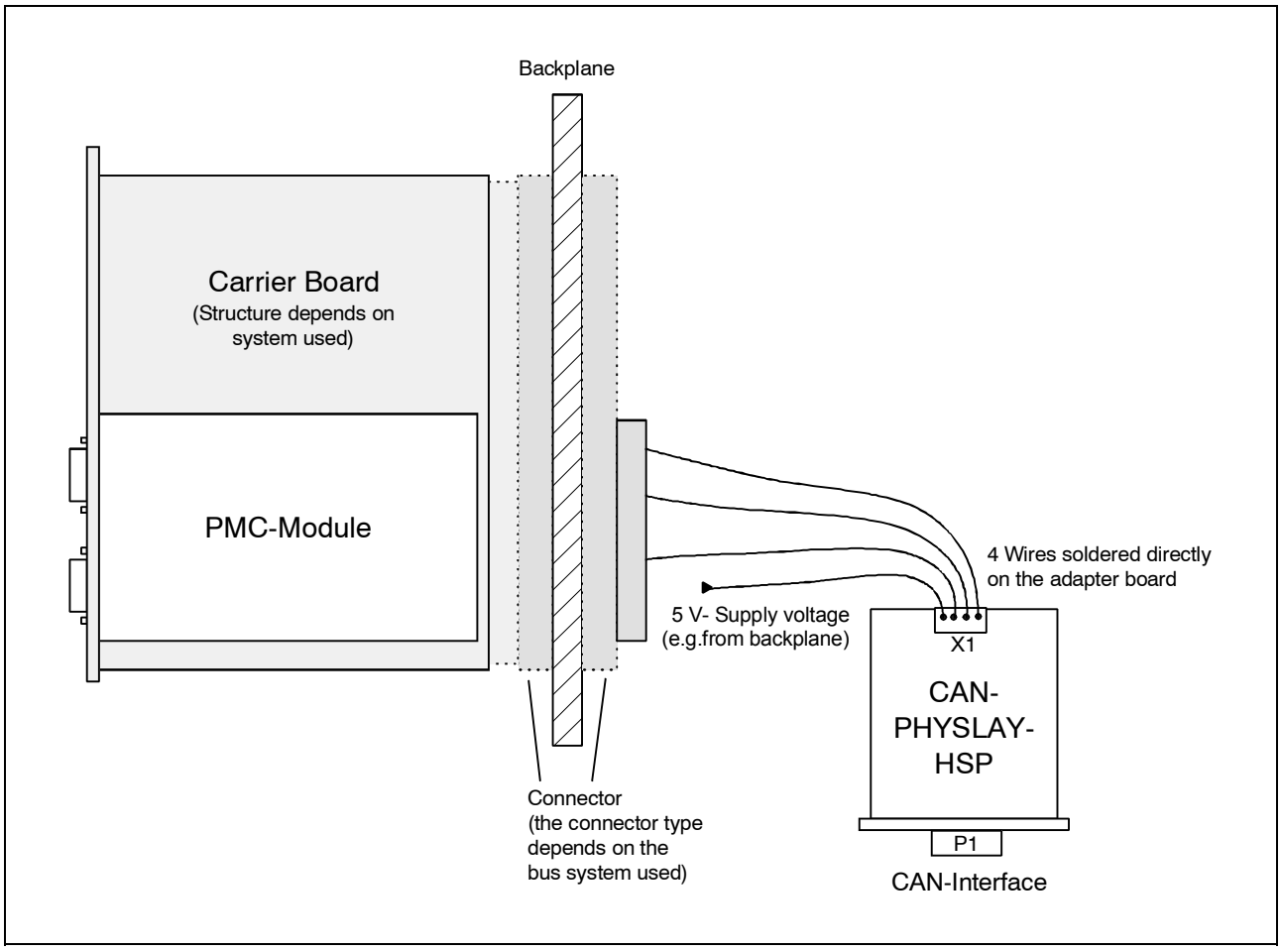


Fig. 5.5.2: Wiring CAN-PHYSLAY-HSP adapter

For further information about the adapter please refer to the manual CAN-PHYSLAY-HSP.

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 W ±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.

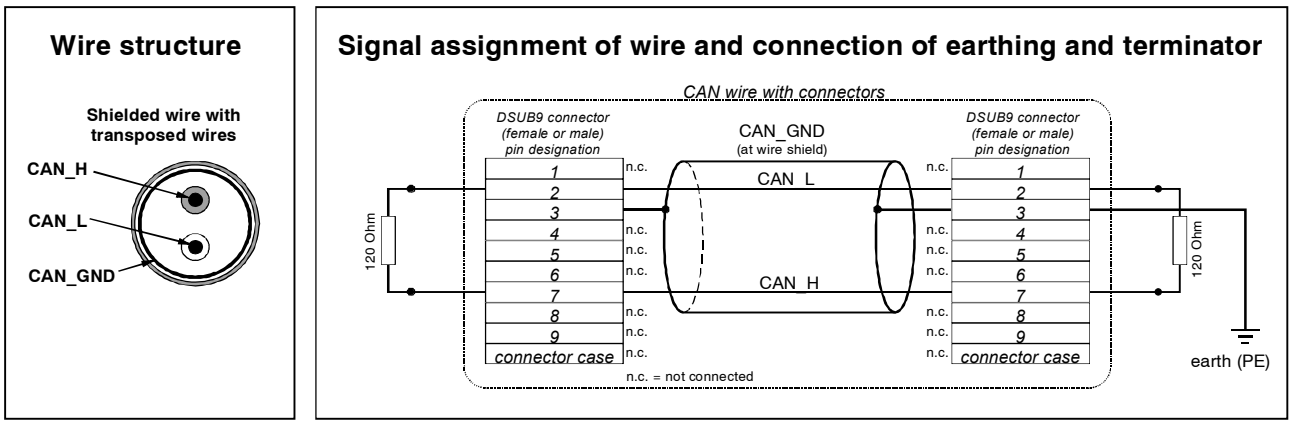


Figure: Structure and connection of wire

Cabling

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

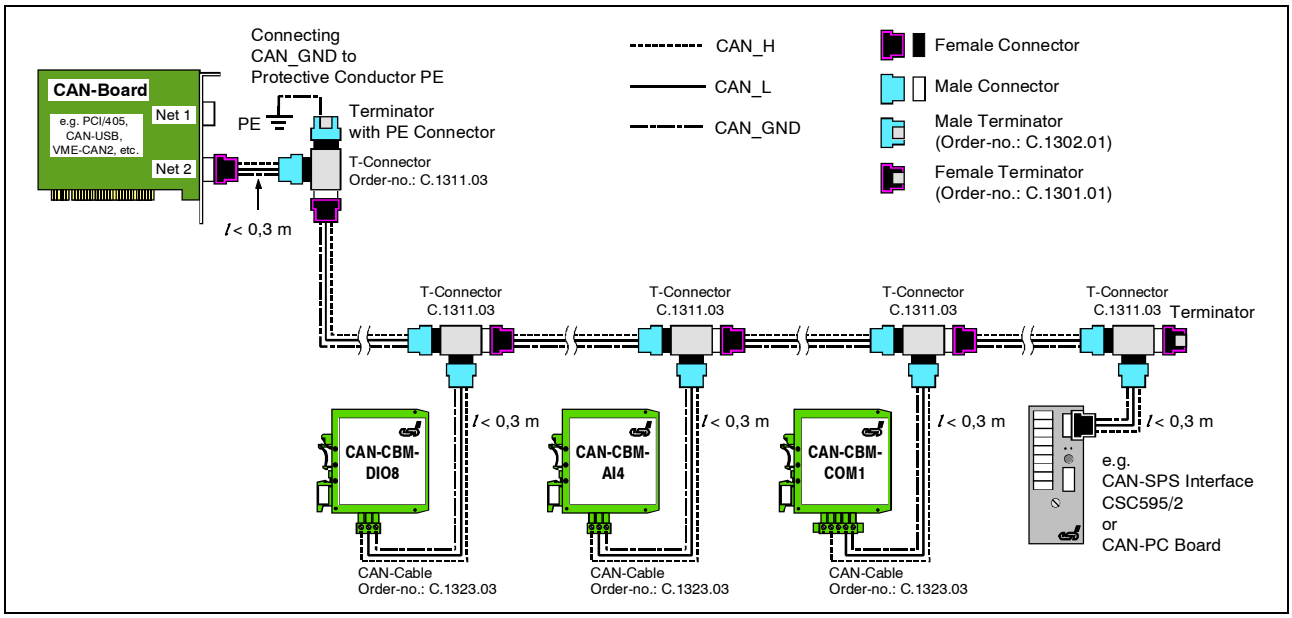


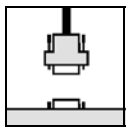
Figure: Example for correct wiring (when using single shielded wires)

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))

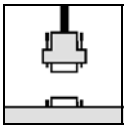
Bit rate [Kbit/s]	Typical values of reachable wire length **with esd interface** l_{max} [m]	**CiA recommendations** (07/95) for reachable wire lengths l_{min} [m]
1000	37	25
800	59	50
666.6	80	-
500	130	100
333.3	180	-
250	270	250
166	420	-
125	570	500
100	710	650
66.6	1000	-
50	1400	1000
33.3	2000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

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

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 mm²) Order No.: 93 022 016 (UL appr.) BUS-Schleppflex-PUR-C (1 x 2 x 0,25 mm²) 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 mm²) Order No.: 56202251 CB 627 (1 x 2 x 0,25 mm²) Order No.: 06272251 (UL appr.)

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



7. CAN-Bus Troubleshooting Guide

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

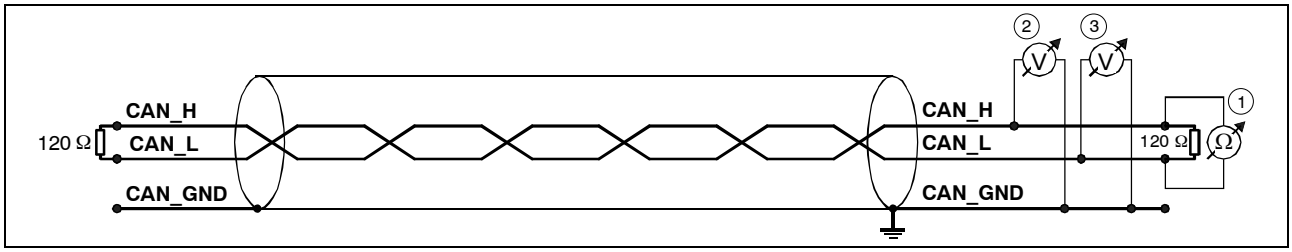


Figure: Simplified diagram of a CAN network

7.1 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 eliminated. 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 the middle and ends of the network (1) (see figure above).

The measured value should be between 50 and 70 Ω. The measured value should be nearly the same at each point of the network.

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
- 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.

7.2 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 volts. 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 GND (2) (see figure above).
4. Measure the DC voltage between CAN_L and GND (3) (see figure above).

   Normally the voltage should be between 2.0 V and 4.0 V.
   If it is lower than 2.0 V or higher than 4.0 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. For a voltage higher than 4.0 V, please check for excessive voltage.

To find the node with a faulty transceiver please test the CAN transceiver resistance (see next page).

7.3 Ground

The shield of the CAN network has to be grounded at only one location. This test will indicate if the shielding is grounded in several places.

To test it, please

1. Disconnect the shield wire from the ground.
2. Measure the DC resistance between Shield and ground.
3. Connect Shield wire to ground.

The resistance should be higher than 1 M Ω. If it is lower, please search for additional grounding of the shield wires.

7.4 CAN Transceiver Resistance Test

CAN transceivers have one circuit that controls CAN_H and another circuit that controls CAN_L. Experience has shown that electrical damage to one or both of the circuits may increase the leakage current in these circuits.

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

1. Disconnect the node from the network. Leave the node unpowered (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).

Normally the resistance should be between 1 M Ω and 4 M Ω or higher. If it is lower than this range, the CAN transceiver is probably faulty.

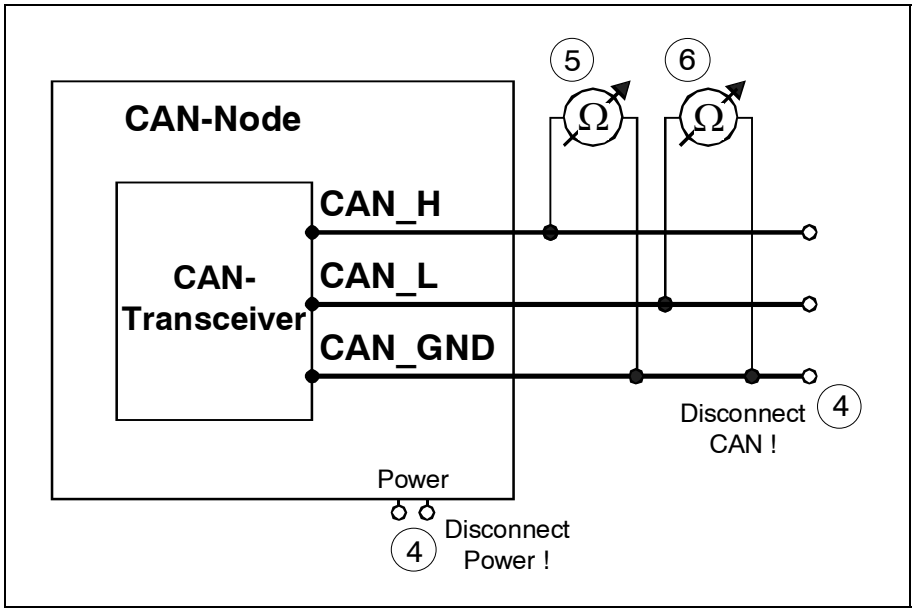


Figure: Simplified diagram of a CAN node