CAN-PCI/360

PCI-CAN-Interface

Hardware Installation
and
Technical Data

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Changes in the chapters

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

Chapter	Changes compared to previous version
-	Editorial revision.
-	-

Technical details are subject to change without further notice.

N O T E

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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
7667 W. Sample Road
Suite 127
Coral Springs, FL 33065
USA

Phone: +1-800-504-9856
Fax: +1-800-288-8235
E-mail: sales@esd-electronics.com

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1. Overview

1.1 Description of the Module

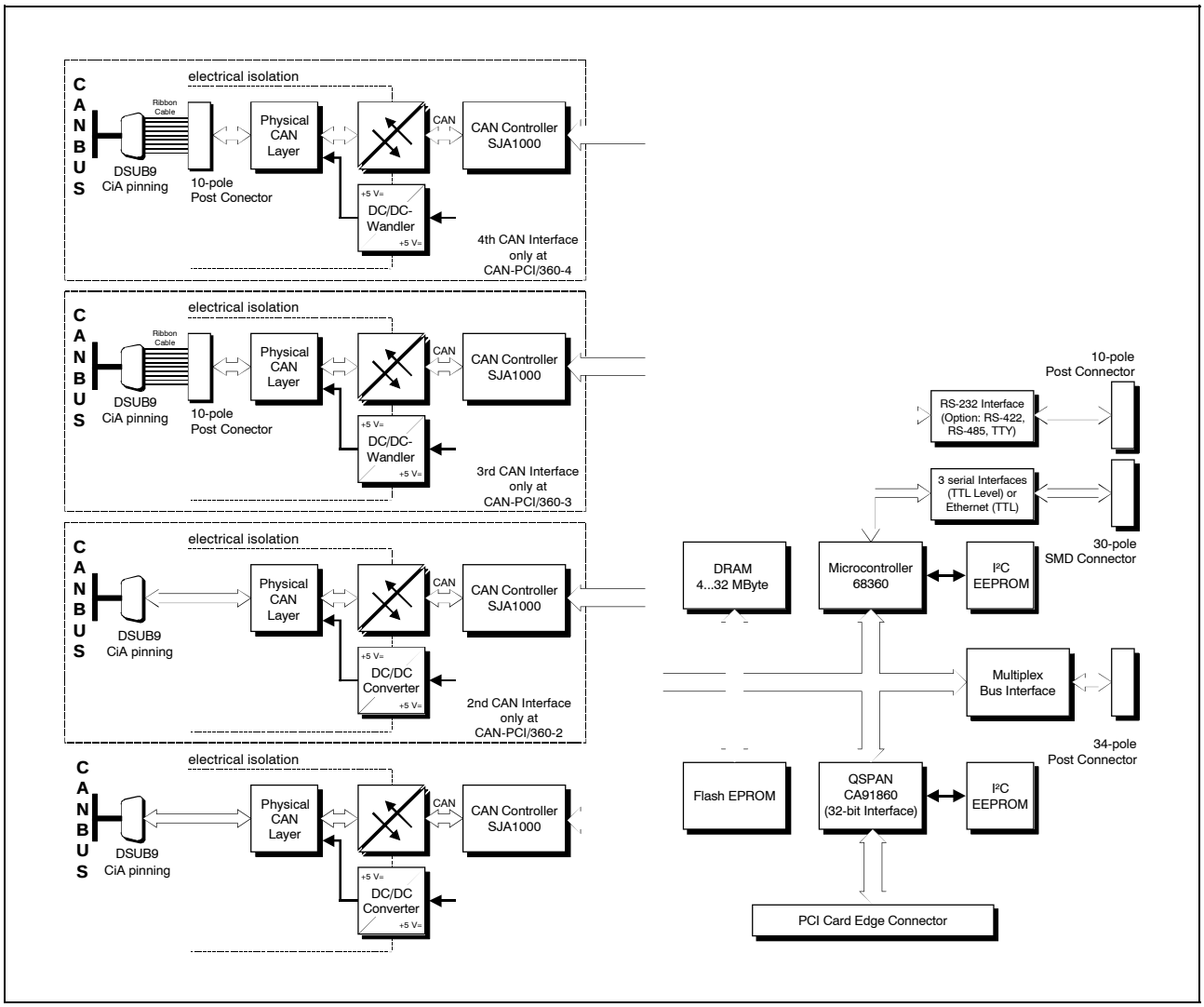


Fig. 1.1.1: Block circuit diagram of the CAN-PCI/360 module

The module CAN-PCI/360 is a PC-plug-in board for the PCI-bus. It operates with a 68360 microcontroller which is responsible for the local management of CAN-data.

The module can be equipped with four equal CAN-interfaces. Two interfaces are connected directly by means of 9-pin DSUB-connectors on board, the other two by means of two further DSUB-connectors which are installed in a separate slot sheet. The CAN-data is buffered in a local DRAM. Data safety and data consistency of up to 1 Mbit/s are guaranteed.

The CAN-interface, compatible to ISO11898, allows a data transfer rate of up to 1 Mbit/s. Like many other properties of the CAN-interfaces, the bit rate can be configured by means of software. The CAN-interface is electrically insulated from other voltage potentials.

In standard option the module has also got an RS-232 interface, an add-on slot by means of which the 68360 controller ports for three further serial interfaces or an Ethernet interface can be connected, as well as a multiplex-bus interface for the option to connect peripheral units in the future.

1.2 PCB View with Connector Assignment

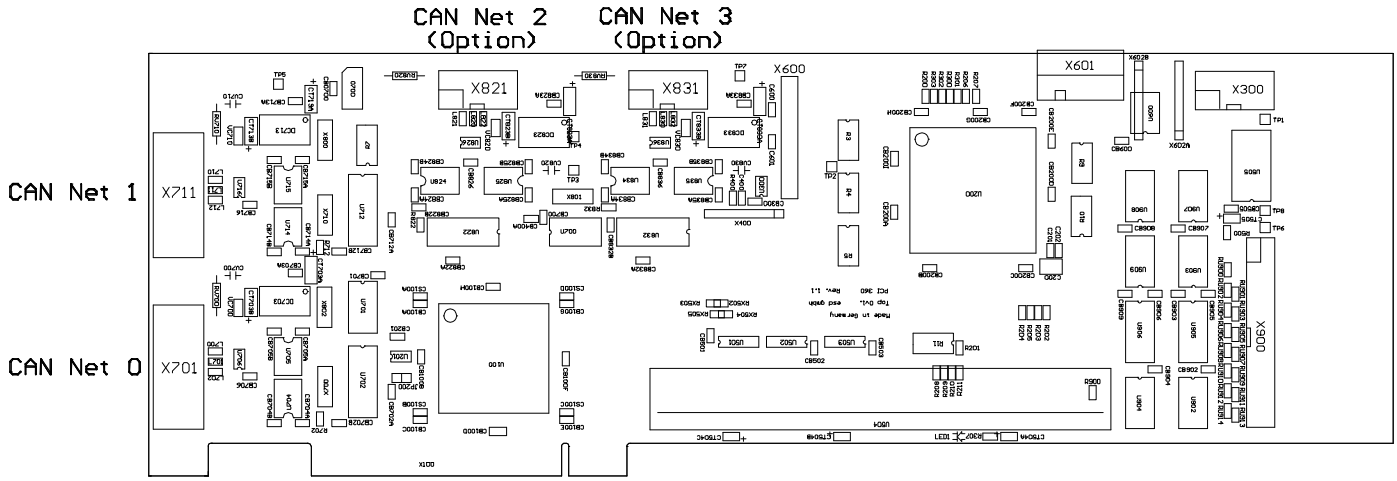
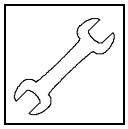


Fig. 1.2.1: Module view (diagram without fastening device and handle)



2. Hardware Installation

Attention!
Electrostatic discharge can damage electronical components. In order to prevent this, please follow the steps below *before* touching the CAN-module to discharge the static electricity of your body:

➽ Switch off the power supply of your PC, but leave it connected to mains.

➽ Please touch the metal case of the PC now to discharge yourself.

➽ Furthermore you should prevent to touch the CAN-module with your clothes, because these can be charged electrostatically as well.

Installation procedure:

1. Switch off the PC and all connected peripheral devices (monitor, printer, etc.). Additionally, switch off all other CAN-devices to whose network the CAN-module is to be connected in this procedure.

2. Discharge the electrostatic electricity of your body as described above.

3. Disconnect the PC from mains.

4. Remove the PC case.
   In order to remove the PC case a few screws have to be removed at the back of the PC in most cases.

5. Select an available PCI-bus plug-in space and remove the plug-in cover at the back of the PC case. The CAN-module can be plugged into any plug-in slot. Please take care not to plug it into an ISA-plug-in slot accidentally, because this can damage both PC and the CAN-module!

   The plug-in cover is secured with a screw. Please keep the screw after you have removed it, because you will need it to secure the module.

5.1 Only for more than two CAN-interfaces:
   If your module has got three or four CAN-interfaces, you have select an available plug-in slot to which the slot sheet for the additional CAN-interfaces is to be installed. Please remove the plug-in cover and keep the screw.

6. Plug the CAN-module into the selected PCI-plug-in slot.
   Please push the module carefully into the slot until it clicks in.

➽➽

7. Secure the module.
   Please use the screw removed from the plug-in cover for this (see step 5).

7.1 Only for more than two CAN-interfaces:
Install the slot sheet with the DSUB-connectors for CAN-interfaces 2 (and 3) and secure it with the screw (see step 5.1). Plug the connectors of the flat ribbon cables into the post connectors on board: The cable of the lower DSUB-connectors into X821, and the cable of the upper DSUB-connector into X831.

> **Attention:** The flat ribbon cables must **not** be plugged into post connectors X300 or X601! Risk of damage!

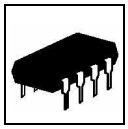
8. Close the PC.
   Secure the case with the according screws at the back.

9. Connect the CAN-bus.
   Please remember that the CAN-bus has to be terminated at both ends. esd offers T-connectors and terminators. Additionally, the CAN-GND-signal has to be grounded at *exactly one* point in the CAN-network. Therefore the CAN-termination connectors have got a grounding contact. A CAN-device whose CAN-interface is not electrically insulated corresponds to the grounding of the CAN-GND.
   The first CAN-interface (CAN-network 0) is connected by means of the lower DSUB-connector (X701), and the second CAN-interface (CAN-network 1) is connected by means of the upper DSUB-connecter (X711).
   If applicable: The third CAN-interface (CAN-network 2) is connected by means of the lower DSUB-connector and the additional slot sheet, and the fourth CAN-interface (CAN-network 3) is connected by means of the upper DSUB-connector.

10. Connect your PC to mains again.

11. Switch on the PC, the peripheral devices and the other CAN-bus devices.

12. End of hardware installation.
    For the software installation an installation program is available which is described in the software manual of the module called ‘CAN-API, Software Tools and Installation Notes’..



3. Description of Units

3.1 Microcontroller 68360

The address position of the local units can be programmed in the microcontroller. The following table represents the wiring of units with the chip-select signals of the controller.

Signal name in circuit diagram	68360-chip-select signal	Unit
CS-F*	CS0*(CSBOOT*)	Flash EPROM
RAS1*	CS1*	DRAM-module
RAS2*	CS2*	
CS-C*	CS3*	CAN-interface (is divided into the lines CS-C0* to CS-C3* by means of the address lines A8 and A9 to select one of the four possible CAN-interfaces)
CS-EXT*	CS4*	extension bus
CS-T*	CS5*	timekeeper
CSREG*	CS6*	register channel of the QSpan
IMSEL	CS7*	image select of he QSPan

Table 3.1.1: Assignment of chip-select lines

The microcontroller also allows other masters, such as the PCI-controller (Qspan), to access the units.

Accesses of the microcontroller 98360 with A32=1 lead to the PCI-bus.

3.2 DRAM-Equipping

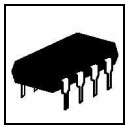
The DRAM-module is controlled by means of the memory controller integrated in the microcontroller 68360. The multiplexing of address lines, however, is the responsibility of its own multiplexers to make the DRAM also accessible for external PCI-bus masters. The composition of address pairs by the multiplexer has been selected in a way that the DRAM-module can also be controlled in page mode. The following table shows the capacities of DRAM-modules which can be used and the formation of address pairs.

Buffer capacity	Address pairs		DRAM address
	row address	column address	
1 Mbyte 2 Mbyte	A11	A2	MA2
	A12	A3	MA3
	A13	A4	MA4
	A14	A5	MA5
	A15	A6	MA6
	A16	A7	MA7
	A17	A8	MA8
	A18	A9	MA9
	A19	A10	MA10
4 Mbyte 8 Mbyte	A20	A21	MA11
16 Mbyte 32 Mbyte	A22	A23	MA12
64 Mbyte 128 Mbyte	A24	A25	MA13

Table 3.5.1: Formation of address pairs

3.3 Timekeeper

The timekeeper offers battery-buffered memory capacity in SRAM-technology. As an additional function it has got an internal counter with a time basis of one second. The quartz required for this has been integrated into the case of the battery which can be plugged on. The counter format corresponds to the date and time coded in BCD format with separate values for year, month, day, weekday, hour, minute and second. These values are read by reading accesses to particular address areas.
The eight data lines of the timekeeper are connected to the local data lines D24...D31 of the microcontroller 68360.



3.4 CAN-Interfaces

In standard option the CAN-PCI/360 is available with four CAN-interfaces in accordance with ISO11898. The interfaces are accessible via DSUB-connectors. Alternatively, CAN-interfaces 0 and 1 are also available as DeviceNet interfaces. Each CAN- or DeviceNet interface is electrically insulated from the other units and has got a separate CAN-controller (SJA1000).

3.5 Serial Interfaces

An RS-232 interface is available for the communication withe the microcontroller 68360 (fourth interface of the 68360). It is connected via a 10-pin post connector.
Optionally the interface is also available with other physical interfaces (RS-422, RS-485 or TTY). This option has to be specified when the CAN-PCI/360 module is ordered, because it cannot be added later.

The microcontroller ports for serial interfaces 1 to 3 are accessible via a 30-pin SMD-socket strip (type: SAMTEC CLT-115-02-F-D-A). The socket strip has been designed for the mounting of an add-on board. Three drilled holes are available to secure such an add-on board.

3.6 The Multiplex Bus

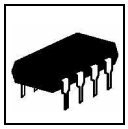
In order to leave the option to access the local bus externally for coming tests or applications, the CAN-PCI/360 module has got a so-called multiplex bus. It offers a 16-bit wide path to the data bus, 24 address lines, 5 interrupt lines and all control lines required to access a bus multiplexed on 34 connector pins (X900).

4. Summary of Technical Data

4.1 General Technical Data

Ambient temperature	0...55 ˚C
Humidity	max. 90%, non-condensing
Power supply	via PCI-bus, nominal voltage: 5 V ±5%, current (typical at 20°C): 570 mA
Connectors	X100 (card edge) - PCI-bus X600 (30-pin SMD-socket strip) - add-on plug-in slot for serial interfaces 1...3 X601 (10-pin post connector) - RS-232-interface (serial interface 4) X602A,X602B (8-pin socket strips) - piggyback plug-in slot as alternative to RS-232 interface X700, X710 (8-pin SMD-socket strips) - plug-in slots for DeviceNet-adapter X701 (DSUB9/male) - CAN-network 1 X711 (DSUB9/male) - CAN-network 0 X800, X801, X802 (8-pin SMD-socket strips) - CAN-controller interface at microcontroller X821 (DSUB9/male) - optional CAN-network 2 X831 (DSUB9/male) - optional CAN-network 3 X900 (34-pin post connector) - multiplex bus The following connectors are only used for programming or testing: X300 (10-pin post connector) - BDM-interface X400 (8-pin contact strip) - ISP-programming
Dimensions	106.68 mm x 312.0 mm (+28 mm handle)
Weight	ca. 250 g

Table 4.1.1: General data of the module



4.2 Microcontroller

Type	68360
Cycle frequency	25 MHz
Data/address bus	32 bit data width, 32 bit address bus
Interrupts	7 IRQ-inputs
Memory management	internal memory controller with DRAM-interface and eight chip select outputs
Serial controller	up to four serial interfaces, optional Ethernet interface
Further features	interface for direct connection of a serial EEPROM, background debug mode

Table 4.2.1: Microcontroller data

4.3 Memory Units

FLASH-EPROM	data bus: memory capacity:	8 bits 1 Mbyte	
DRAM	SIMM-module, flat in socket data bus: memory capacity: access time:	 32 bits standard: max.: 60 ns	 16 Mbyte 128 Mbyte
Serial EEPROMs	EEPROM at microcontroller 68360 memory capacity: EERPOM at PCI-controller memory capacity:	 1 kbyte 256 kbyte	

Table 4.3.1: Technical data of memory units

4.4 Timekeeper

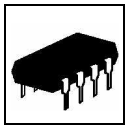
Type	SGS-Thomson M48T58Y
Memory	SRAM 8k x 8 bits
Time basis	1 second
Time format	24 hours BCD-format
Time deviation	±35 ppm (±1.53 minute/month) ±4 ppm (with set calibration bit)
Data consistency	ca. 7 years at 25°C ambient temperature

Table 4.4.1: Data of time keeper

4.5 PCI-Bus

Host bus	PCI-bus in accordance with PCI Local Bus Specification 2.1
PCI-data bus	32 bits
Controller	QSpan CA91C860, external serial EEPROM
Interrupt	interrupt signal A
Plug-in position	no restrictions in plug-in position, PCI-bridges are tolerated
Board dimension	Long Card
Connector	PCI-Card-Edge-Connector

Table 4.5.1: PCI-bus data



4.6 CAN-Interface

Number	1, optionally up to 4 CAN-interfaces
CAN-controller	one SJA1000 for each CAN-network
CAN-protocol	Basic-CAN 2.0A/B
Physical interface	physical layer in accordance with ISO 11898 or DeviceNet, transmission rate can be programmed from 10 kbit/s to 1 Mbit/s
Bus termination	has to be set externally
Wiring	CAN-network 0: DSUB9 (X701) in slot cover of PCB CAN-network 1: DSUB9 (X711) in slot cover of PCB CAN-network 2: DSUB9 (X821) in separate slot cover CAN-network 3: DSUB9 (X831) in separate slot cover
Electrical insulation of CAN-interface from other units	the two possible CAN-interfaces are electrically insulated from the PCI-bus potential by means of optical couplers and DC/DC-converters
DeviceNet option	an adapter board each for CAN-channels 0 and 1 with Phoenix Combicon connectors (or equivalent), optical couplers and CAN-drivers in accordance with DeviceNet specification ‘DeviceNet Communication Model and Protocol, Rel. 2.0’

Table 4.6.1: Data of the CAN-interface

4.7 Software Support

The product package contains software examples for DOS (Library) and Windows 3.11 (DLL). Additionally, software drivers for Windows NT/2000/XP and Windows 9x/ME are available. The Windows-NT driver is in kernel mode and is multiprocessor steady. The Windows-9x/ME driver is realised as VxD. The firmware can be loaded from PC into the Flash-EPROM.

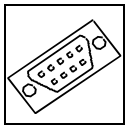
Software packages are available for CANopen and DeviceNet.

4.8 Order Information

Type	Features	Order No.
CAN-PCI/360-2	2x CAN 2.0 A/B, ISO11898, 16 Mbyte DRAM	C.2022.04
CAN-PCI/360-4	4x CAN 2.0 A/B, ISO11898, 16 Mbyte DRAM, incl. additional slot cover with DSUB-connectors and flat-ribbon cables	C.2022.06
DN-PCI/360-2	2x DeviceNet, 16 Mbyte DRAM	C.2022.08
Options:		
CAN-PCI/360-95	Windows 95 VxD driver	C.2022.10
CAN-PCI/360-NT	Windows NT Device driver	C.2022.11
CAN-PCI/360-Co	CANopen Master/Slave-Obj. licence	C.2022.12
CAN-PCI/360-ME *)	English user manual for C.2022.04 ... C.2022.08	C.2022.21
CAN-API-ME *)	English user manual for C.2022.10 and C.2022.11	C.2001.21
CAL/CANopen-ME *)	English user manual for C.2022.12	C.2002.21

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

Table 4.8.1: Order information

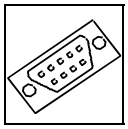


5. Connector Assignment of CAN-Bus Interfaces

5.1 CAN-Interfaces

The CAN-interfaces are divided onto the connectors as follows:

CAN-interface	Connector
CAN-network 0	DSUB9: X701 (lower)
CAN-network 1	DSUB9: X711 (upper)
CAN-network 2	post connector (X821) to DSUB9 in separate slot cover (lower)
CAN-network 3	post connector (X831) to DSUB9 in separate slot cover (upper)

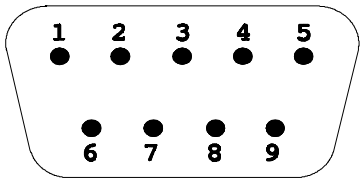


Connector Assignment

5.1.1 CAN-Interfaces at 9-pin DSUB-Connectors (X701, X711)

The position of signals in connectors of the CAN-network is identical. The connectors are 9-pin male DSUB-connectors.

Pin Position:



Pin Assignment:

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

9-pin male DSUB-connector

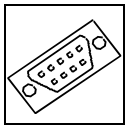
Signal Description:

CAN_L, CAN_H... CAN-signal lines

CAN_GND ... reference potential of the local CAN-physical layer

shield ... potential of the connector case

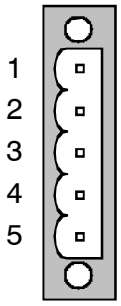
reserved ... reserved for future applications



5.1.2 DeviceNet Option

If a CAN-channel of the module has got a DeviceNet interface, the respective DSUB-connector is not available.
5-pin Phoenix-Combicon connectors MSTB 2.5/-GF-5.08 (or equivalent) are used as DeviceNet connectors.

Pin Position:



Pin Assignment:

Pin	Signal
1	V-
2	CAN-
3	Shield
4	CAN+
5	V+

Signal Description:

V+... power supply for the CAN-interface (U_{VCC} = 24 V ± 4%)

V-... reference potential for V+ and CAN+/CAN-

CAN+, CAN-... CAN-signals

Shield... shield
(connected to ground (front panel) via a high-impedance RC-combination (1MΩ, 10nF/500V))

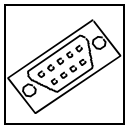
5.1.3 Optional CAN-Interfaces 2 and 3

The optional CAN-interfaces 2 and 3 have got 10-pin post connectors on the CAN-PCI/360. Via those connectors they can be connected to 9-pin DSUB-connectors via flat ribbon cables. The DSUB-connectors are installed into the back cover of the PC by special PC-holding angles.

The following table represents the assignment of the 10-pin post connectors. The assignment which results when the connectors are connected 1 to 1 with the DSUB-connectors, is identical to the assignment of CAN-channels 0 and 1.

Signal name	Pin		Signal name
-	1	2	CAN_GND
CAN_L	3	4	CAN_H
CAN_GND	5	6	-
-	7	8	-
Shield	9	10	-

10-pin post connector



5.2 Serial Interface 4

5.2.1 RS-232-Interface at 10-Pin Post Connector X601

In standard version, when the module leaves manufacturing, serial interface 4 is designed as a RS-232-interface. The signals are directly accessible on the board via a 10-pin post connector.

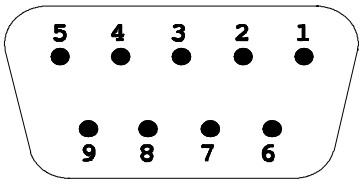
Signal		Pin		Signal	
CD4	(input)	1	2	-	
RxD4	(input)	3	4	RTS4	(output)
TxD4	(output)	5	6	CTS4	(input)
(RTS4)	(output)	7	8	Rx+/-	(input)
GND		9	10	-	

10-pin post connector

5.2.2 RS-232-Interface at 9-pin DSUB-Socket

The signals of serial interface 4 can be connected to a DSUB-socket in a second slot cover by means of a flat ribbon cable, so that the interface can be accessed externally.

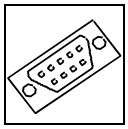
Pin Position:



Pin Assignment:

Signal	Pin		Signal
CD4 (input)	1	6	-
RxD4 (input)	2	7	(RTS4) (output)
TxD4 (output)	3	8	CTS4 (input)
(RTS4) (output)	4	9	Rx+/- (input, only at piggyback socket)
GND	5		

9-pin DSUB-socket



5.2.3 Option: RS-422, RS-485, TTY-Active/Passive

Alternatively to the RS-232-driver two base strips can be equipped optionally. These base strips have been designed for piggybacks, which are available with RS-422-, RS-485-, TTY-passive or TTY-active interfaces.

The assignment of the 10-pin post connector when using piggybacks is represented in the following table. The signal names used in the table correspond to the physical data directions as seen from the CAN-PCI/360, that means that the Tx-signals are represented as data outputs and the Rx-signals are represented as data inputs.

Connector pin		Signal assignment			
10-pin post connector X601	9-pin DSUB-socket in second slot cover	RS-422	RS-485	TTY-passive	TTY-active
1	1	-	-	-	-
2	6	-	-	-	-
3	2	Tx+	Rx/Tx+	Tx+	Tx-
4	7	Tx-	Rx/Tx-	Tx-	(GNDA)
5	3	-	-	(I1+)	Tx+
6	8	GND	GND	(I2+)	Rx+
7	4	Rx-	1*) (for Rx/Tx-)	Rx-	(GNDA)
8	9	Rx+	1*) (for Rx/Tx+)	Rx+	Rx-
9	5	GND	GND	GND	GND
10	-	-	-	-	-

1*) In RS-485 operation these pins are connected to a terminating resistor network which is situated on the piggyback.

( ) The signals given in brackets have been assigned, however, they are not required for operating the interface.

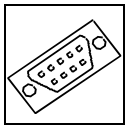
5.3 Serial Interfaces 1...3

The TTL-signals of serial interfaces 1...3 of the microcontroller 68360 are connected to a 30-pin SMD-socket strip (type: SAMTEC CLT-115-02-F-D-A). The socket strip has been designed for the installation of an adapter board or a piggyback. Possible areas for the use of such a piggyback are, for instance, up to three additional serial interfaces or an AUI-adapter.

	Signal	Pin		Signal	68360-port
-	+5V	1	2	+5V	-
-	+5V	3	4	CD3-	PC9
PA4	RXD3	5	6	TXD3	PA5
PC8	CTS3-	7	8	RTS3-	PC2
-	+12V	9	10	+12V	-
-	+12V	11	12	CD2-	PC7
PA3	TXD2	13	14	RXD2	PA2
PC1	RTS2-	15	16	CTS2-	PC6
-	-12V	17	18	-12V	-
-	GND	19	20	GND	-
-	GND	21	22	CD1-	PC5
PA0	RXD1	23	24	TXD1	PA1
PC4	CTS1-	25	26	RTS1-	PC0
PA9	-	27	28	GND	-
-	GND	28	30	RSTMICRO*	-

30-pin socket strip

The adapter board can be installed by means of screws with distance hulls or threaded bolts at three points.



5.4 Multiplex-Interface at X900

Signal	Pin		Signal
GND	1	2	GND
GND	3	4	LTG0
GND	5	6	LTG1
:	7	8	LTG2
:	9	10	LTG3
:	11	12	LTG4
:	13	14	LTG5
:	15	16	LTG6
:	17	18	LTG7
:	19	20	LTG-BERR
:	21	22	LTG-MUX
:	23	24	LTG-IRQ
:	25	26	LTG-A
:	27	28	LTG-B
:	29	30	LTG-DTACK
GND	31	32	LTG-C
GND	33	34	GND

34-pin post connector

6. Correctly Wiring Electrically Insulated 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.

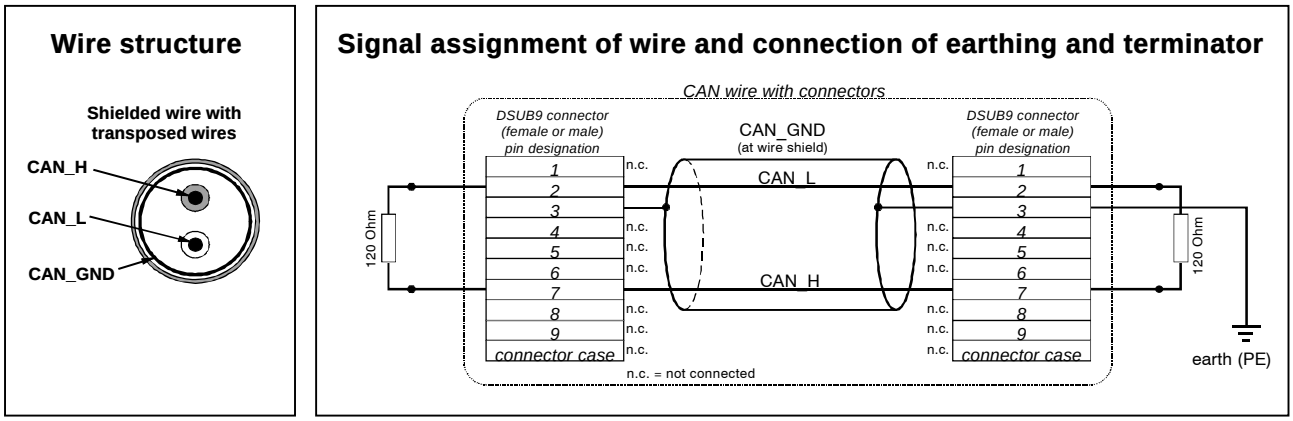


Figure: Structure and connection of wire

Cabling

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

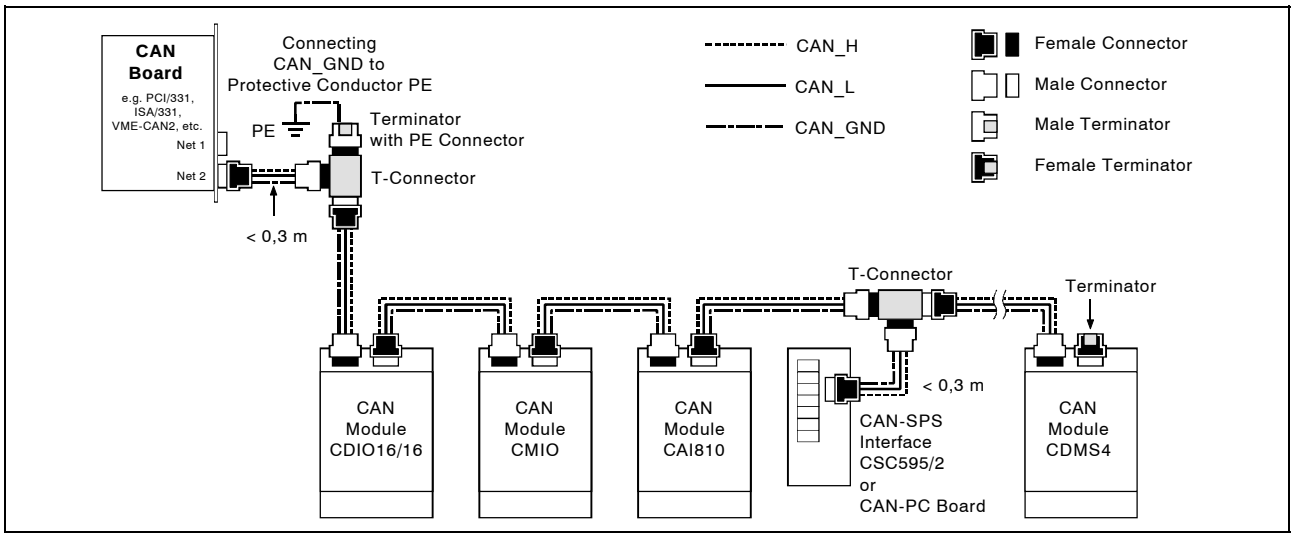


Figure: Example for correct wiring (when using single shielded wires)

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 insulated 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 insulated 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))

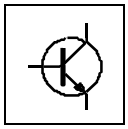
Bit rate [kbit/s]	Typical values of reachable wire length **with esd interface** l_{max} [m]	**CiA recommendations** (07/95) for reachable wire lengths l_{min} [m]
1000	37	25
800	59	50
666.6	80	-
500	130	100
333.3	180	-
250	270	250
166	420	-
125	570	500
100	710	650
66.6	1000	-
50	1400	1000
33.3	2000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



7. Circuit Diagrams

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