



CAN-USB-Mini

USB 1.1-CAN-Interface



Hardware Installation and technical Data

to Product C.2064.xx

Installation and technical Data **CAN-USB-Mini** Rev. 1.1



NOTE

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|---------------------|------------------|
| PCB version: | CAN-USB Rev. 1.2 |
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Changes in 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 versus previous version |
|---------|---|
| 3.1 | Power supply current consumption corrected |
| - | Notes on USB interface compability limitation to USB nets with USB interface version number ≥ 1.1 inserted |

Technical details are subject to change without further notice.

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1. Overview

1.1 Module Description

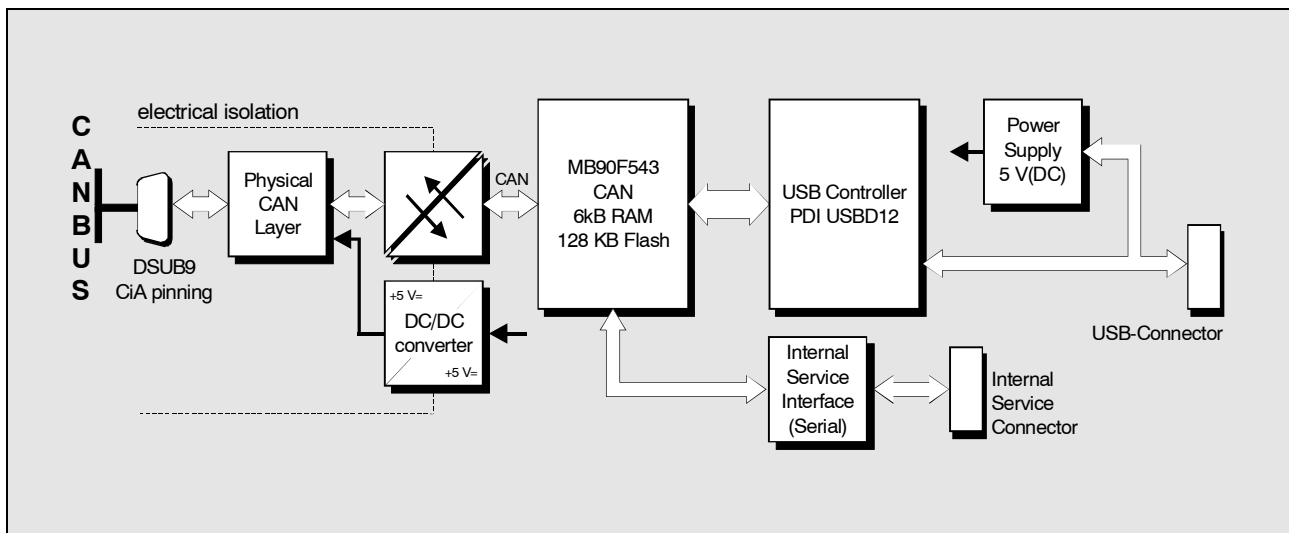


Figure 1.1: Block-circuit diagram of CAN-USB-Mini module

The CAN-USB-Mini module is an intelligent CAN interface with a MB90F543 micro controller for local CAN data management.

The ISO 11898-compliant CAN interface allows a maximum data transfer rate of 1 Mbit/s. Like many other features of CAN interfaces, the bit rate can be set by means of software.

CAN interface and other voltage potentials are electrically isolated by means of optical couplers and DC/DC converters.

The supply voltage is fed via USB bus.

The module is equipped with four green LEDs in the front panel which show the current module status.



1.2 Case View with LED and Connector Description

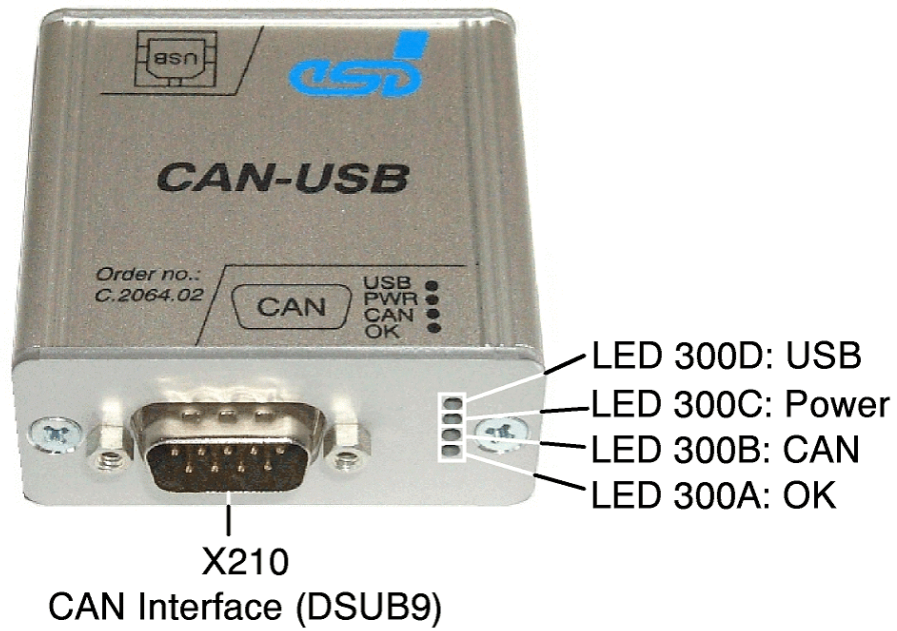


Figure 1.2.1: CAN Interface and LEDs



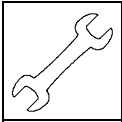
Figure 1.2.2: USB Interface



1.3 LED-Displays

| LED | NAME | Status | Description |
|---------|-------|--------------------------|--|
| LED300D | USB | on | USB module is enumerated (a node-ID is assigned to the USB module) |
| | | short-time switch off | the module receives data from USB bus or sends data on USB bus |
| LED300C | Power | on | module is in operation, the 5 V power supply is applied to the module |
| LED300B | CAN | flashes | data is received or send on the CAN bus |
| LED300A | OK | on | CAN interface is initialized, bit rates are set |
| | | off | CAN Error occurred |

Table 1.3: Description of LED display



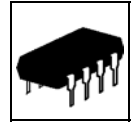
2. Hardware Installation

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. Connect the CAN-USB-Mini-module with the USB bus of the PC.
3. Connect the CAN bus to the 9-pin male DSUB connector.
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 isolated corresponds to the grounding of the CAN-GND.
4. Connect your PC to mains again.
5. Switch on the PC, the peripheral devices and the other CAN bus devices.
6. End of hardware installation.

Note:

The software installation is described in the manual 'CAN-API, Installation Guide'.



3. Summary of technical Data

3.1 General technical Data

| | |
|-------------------|---|
| Temperature range | 0...50 °C ambient temperature |
| Humidity | 90 %, not condensing |
| Power supply | via USB 1.1 bus, nominal voltage: 5 V current consumption: max. 250 mA * |
| Connectors | X210 (DSUB9/male) - CAN bus X300 (USB socket, series B) - USB bus X200 (intern) - Service interface |
| Case dimensions | 55 mm x 55 mm x 25 mm |
| IP-rating | IP 40 |
| Weight | 70 g |

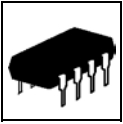
Table 3.1: General Data of CAN-USB-Mini-Module

*** Note:** Please note that the current consumption of the module of 250 mA has to be supplied (high powered bus-powered device).
The maximum current consumption of 250 mA has to be guaranteed also if a hub is used. Therefore it is highly recommended to use a self-powered hub.

3.2 USB-Interface and Microcontroller

| | |
|-----------------|---|
| USB Controller | PDI USBD12 |
| USB-Interface | USB 1.1, bitrate 12 Mbit/s |
| Microcontroller | MB90F543 |
| Memory | 3 k x 16 bit SRAM, 64 k x 16 bit flash EPROM |

Table 3.2: USB interface and microcontroller



3.3 CAN Interface

| | |
|---|---|
| Number of CAN interfaces | 1x CAN |
| CAN controller | MB90F543 |
| CAN protocol | Basic-CAN 2.0A/B |
| Physical Layer | according to ISO 11898, transmission rate programmable from 10 Kbit/s to 1 Mbit/s |
| Bus termination | has to be set externally |
| Electrical isolation of CAN-interfaces from other units | via optical couplers and DC/DC converters |

Table 3.3: Data of CAN interface

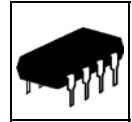
Attention: When CAN-frames are received the simultaneous coincidence of the following conditions may cause data loss:

1. CAN 2.0A frames (CAN 2.0B frames are uncritical)
2. bit rate = 1Mbit/s (lower bit rates are uncritical)
3. A longer period of 100% busload (small bursts are transmitted error-free)
4. CAN frames with data length ≤ 1 byte (no data loss at frames with 2...8 bytes!)

The software indicates this with an error-event (see manual: ‘CAN-API, Function Description’)

3.4 Software Support

For CAN-USB-Mini drivers for Windows and Linux are available.



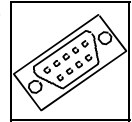
3.5 Order Information

| Type | Features | Order No. |
|------------------|--|-----------|
| CAN-USB-Mini | 1 x CAN 2.0A/B, ISO 11898, USB 1.1 | C.2064.02 |
| CAN-DRV-LCD | Object-Licence for Windows and Linux | C.1101.02 |
| CAN-USB-Mini-ME | User manual in English. 1*) | C.2064.21 |
| CAN-API-ME | CAN-API manual in English to C.1101.02 1*) | C.2001.21 |
| CAN-USB-Mini-ENG | Engineering manual in English 2*) Content: Circuit diagrams, PCB top overlay drawing, data sheets of significant components | C.2064.25 |

1*) If ordered together with the module, the manual is included in the shipment.

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

Table 3.5: Order information

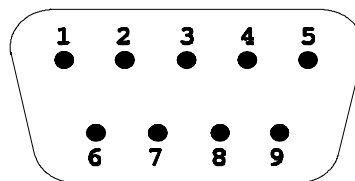


4. Connector Assignment

4.1 CAN Interface at DSUB9 Connector

The connector is a 9-pin male DSUB connector.

Pin Position:



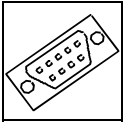
Pin Assignment:

| Signal | Pin | | Signal |
|-----------|-----|---|----------|
| (CAN_GND) | 6 | 1 | reserved |
| CAN_H | | 2 | CAN_L |
| reserved | 7 | 3 | CAN_GND |
| reserved | | 4 | reserved |
| reserved | 8 | 5 | Shield |
| reserved | | 9 | reserved |

9-pin DSUB connector

Signal description:

| | |
|-----------------|--|
| CAN_L, CAN_H... | CAN signal lines |
| CAN_GND ... | reference potential of local CAN physical layer |
| (CAN_GND) ... | optional reference potential of local CAN physical layer |
| Shield... | Shielding (connected with case of 9-pin DSUB connector) |
| reserved ... | reserved for future applications |

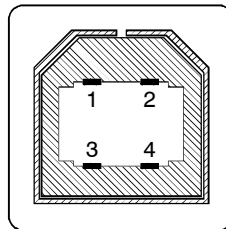


Connector assignment

4.2 USB-Socket

Attention: The module may only be operated at USB nets with USB interface version numbers ≥ 1.1 -interface!

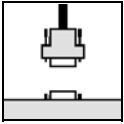
Pin position:



Pin Assignment:

| Pin | Signal |
|-------|-----------|
| 1 | V_{BUS} |
| 2 | D- |
| 3 | D+ |
| 4 | GND |
| Shell | Shield |

USB socket (series B)



Wiring

5. 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. |

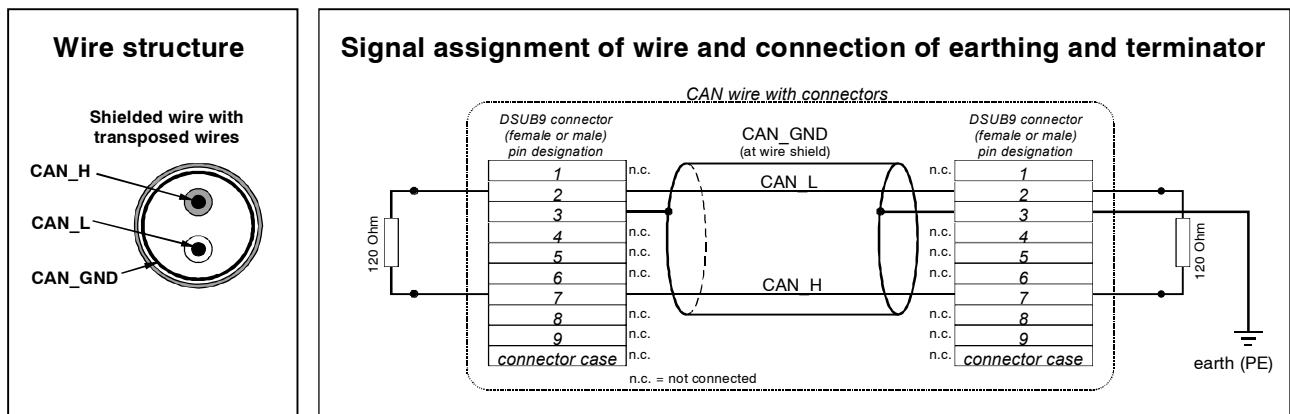
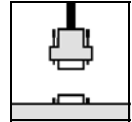


Figure: Structure and connection of wire



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)

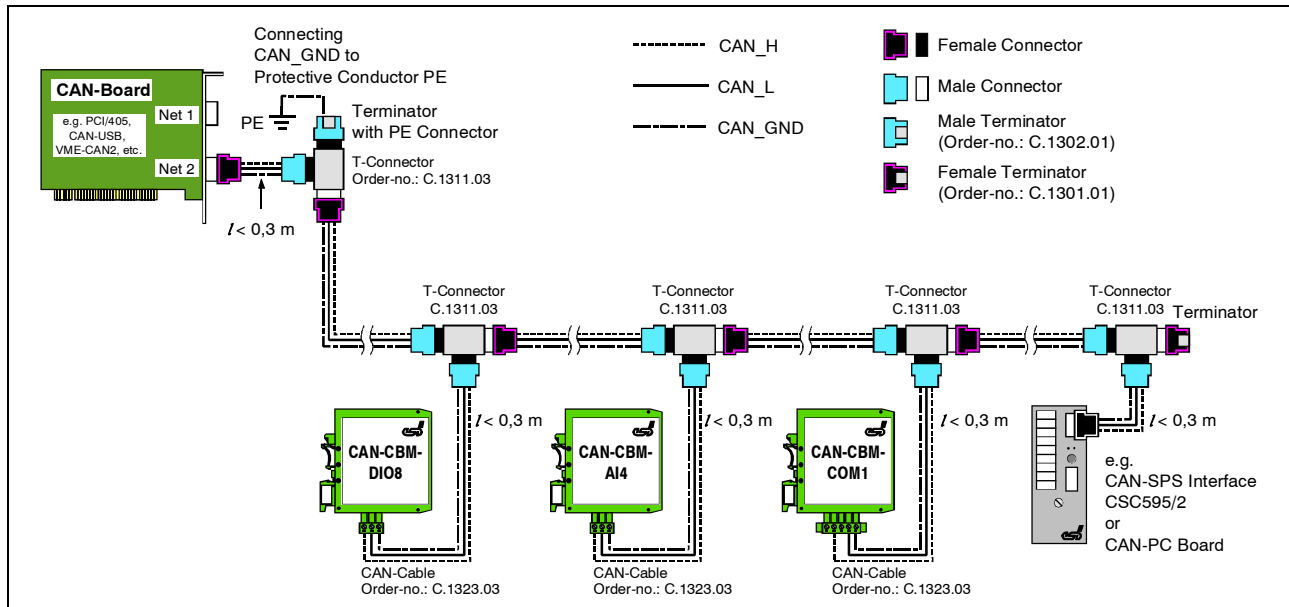


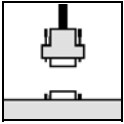
Figure: Example for correct wiring (when using single shielded wires)

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



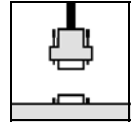
Wiring

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 |

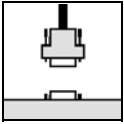
Table: Reachable wire lengths depending on the bit rate when using esd-CAN interfaces



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 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**.



6. 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.

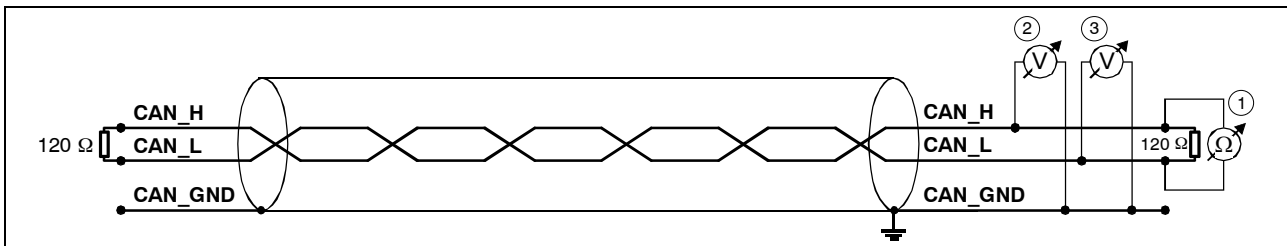


Figure: Simplified diagram of a CAN network

6.1 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).

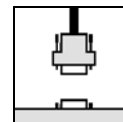
The measured value should be between 50 and 70 Ω. The measured value should be nearly the same at each point of the network.

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.



6.2 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).

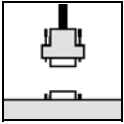
6.3 Ground

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.



6.4 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.

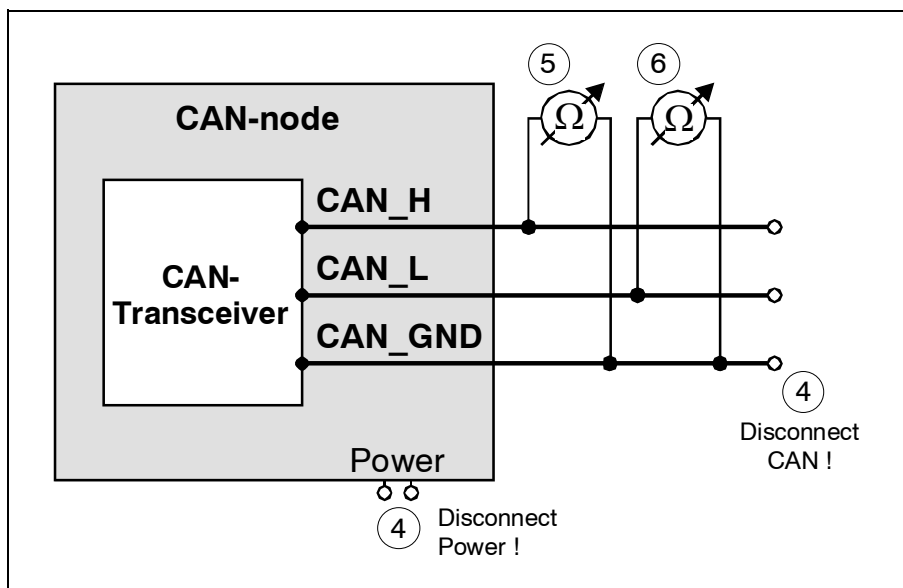


Figure: Simplified diagram of a CAN node

EG-KONFORMITÄTSERKLÄRUNG DECLARATION OF CONFORMITY



Adresse
Address

esd electronic system design gmbh
Vahrenwalder Str. 207
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esd erklärt, daß das Produkt
esd declares, that the product

CAN-USB-Mini

Typ, Modell, Artikel-Nr.
Type, Model, Article No.

C.2064.xx

die Anforderungen der Normen
fulfills the requirements of the standards

EN 61000-6-3 (11/2005)
EN 61000-6-2 (03/2006)

gemäß folgendem Prüfbericht erfüllt.
according to test certificate.

H-K00-0272-06

Das Produkt entspricht damit den EG-Richtlinien
Therefore the product corresponds to the EU-Directives

89/336/EWG geändert durch
(changed by) 91/263/EWG,
92/31/EWG and 93/68/EWG

Diese Erklärung gilt für alle Exemplare, die das CE-Zeichen tragen und verliert ihre Gültigkeit,
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*This declaration is valid for all units with the CE label on it and it lose its validity if a modification
is done on the product.*

Name / *Name*
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Dr. Ing. Werner Schulze
Geschäftsführer / *Managing Director*
Hannover, den 26.04.2006

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