



# CAN-USB-Mini

## USB 1.1-CAN-Interface



## Hardware Installation and technical Data

to Product C.2064.xx



## NOTE

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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
-	New case colour.
3.4, 3.5	Note: 'Linux driver only supported up to kernel version 2.6.4' inserted.
4.2	Picture 'USB pin assignment' corrected.

Technical details are subject to change without further notice.



## Safety Instructions and Conformity

- When working with CAN-USB-Mini follow the instructions below and read the manual carefully to protect yourself and the CAN-USB-Mini from damage.  
esd does not guarantee for damages which result from improper use or disregard of safety instructions and warnings.
- Do not open the housing of the device. It does not contain any serviceable parts and does not require any manual configuration of the hardware.  
Dismantling the housing by personnel which is not authorized by esd causes the loss of all warranty claims.
- In order to prevent over voltage damage due to thunder storm, unplug the device from USB and CAN beforehand.
- Never let liquids get inside the device. Otherwise, electric shocks or short circuits may result.
- Protect the device from dust, moisture and steam. Remove all cables before cleaning. Clean the device with a slightly moist, lint-free cloth. Intensive cleaning agents or solvents are not suitable.
- Protect the device from shocks and vibrations.
- The device may become warm during normal use. Always allow adequate ventilation around the device and use care when handling.
- Do not operate the device adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature of 0°...50 °C.
- Do not use damaged or defective cables to connect the device and follow the CAN wiring hints at the end of the manual.
- The device is intended for indoor use only.
- The operation of the device in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the device for medical purposes is prohibited.
- The device meets the demands of the EU regulations and EMC standards printed in the conformity declaration at the end of this manual.

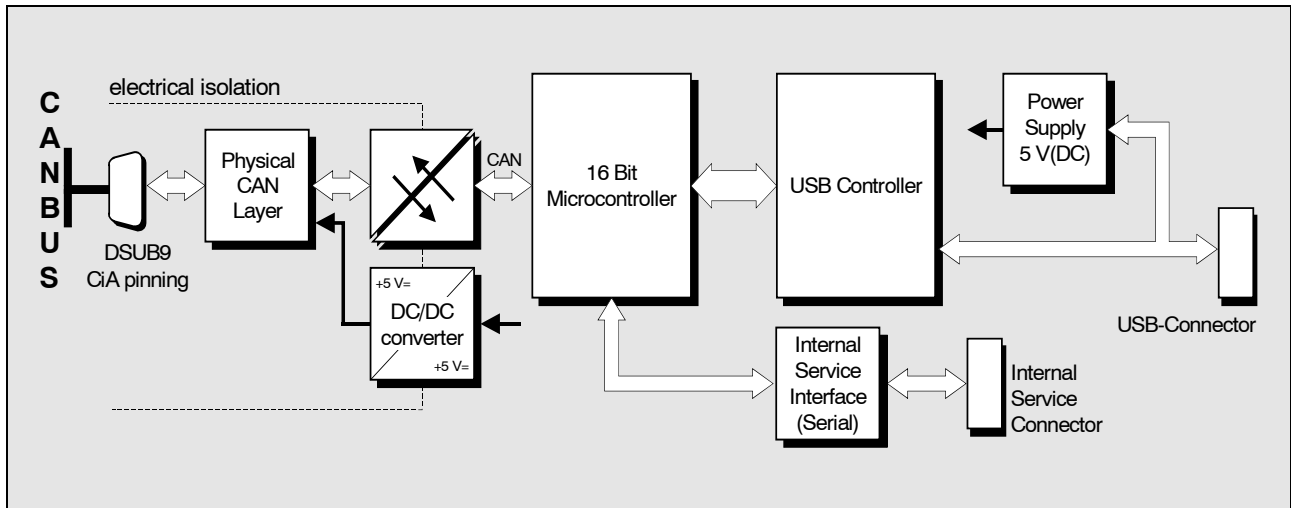
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# 1. Overview

## 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 16 bit microcontroller 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

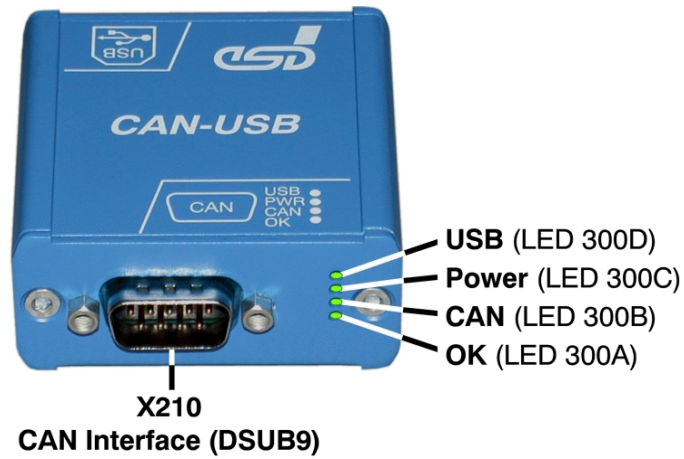


Figure 1.2.1: CAN Interface and LEDs



Figure 1.2.2: USB Interface

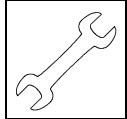


### 1.3 LED-Displays

LED			Description
NAME	Number	Status	
USB	LED300D	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
Power	LED300C	on	module is in operation, the 5 V power supply is applied to the module
CAN	LED300B	flashes	data is received or send on the CAN bus
OK	LED300A	on	CAN interface is initialized, bit rates are set

**Table 1.3:** Description of LED display





## 2. Hardware Installation

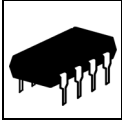


**Please read carefully the safety notes at the beginning of this document!**

### Installation procedure:

1. Switch off the PC (or Notebook) 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. 350 mA *
Connectors	X210 (DSUB9/male) - CAN bus X300 (USB socket, series B) - USB bus
Case dimensions	55 mm x 55 mm x 25 mm
IP-rating	IP 40
Weight	70 g

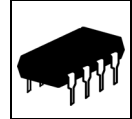
**Table 3.1:** General data of CAN-USB-Mini

\* **Note:** Please note that the current consumption of the module of 350 mA has to be supplied (high powered bus-powered device).  
The maximum current consumption of 350 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-Interface	USB 1.1, bitrate 12 Mbit/s
Microcontroller	16 bit microcontroller

**Table 3.2:** USB interface and microcontroller



### 3.3 CAN Interface

Number of CAN interfaces	1
CAN protocol	ISO 11898-1 (11 and 29 bit CAN identifier are supported)
Physical Layer	CAN High Speed interface according to ISO 11898-2, 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 = 1 Mbit/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  $\leq 1$  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 the CAN-USB-Mini CAN layer 2 drivers (CAN-API) are available for Windows 2K/XP, Windows XP x64 and Windows CE. Linux driver are available up to kernel version 2.6.4.

CANopen support is available for Windows 2K/XP, Windows XP x64 and Linux (up to kernel version 2.6.4).

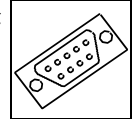


### 3.5 Order Information

Type	Features	Order No.
CAN-USB-Mini	1 x CAN 2.0A/B, ISO 11898, USB 1.1	C.2064.02
CAN-DRV-LCD	CAN-layer 2 (CAN-API) object licence for Windows incl. CD-ROM	C.1101.02
CANopen-LCD	CANopen object licence for Windows incl. CD-ROM	C.1101.06
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

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

**Table 3.5:** Order information

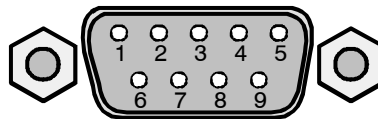


## 4. Connector Assignment

### 4.1 CAN Interface at DSUB9 Connector

The connector is a 9-pin male DSUB connector.

#### Pin Position:



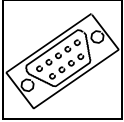
#### Pin Assignment:

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

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

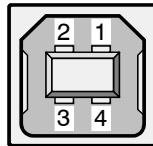


## Connector Assignment

### 4.2 USB-Socket

**Attention:** The module may only be operated at USB nets with USB interface version numbers  $\geq$  1.1-interface!

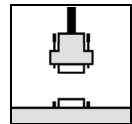
#### Pin Position:



#### Pin Assignment:

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

USB socket (series B)

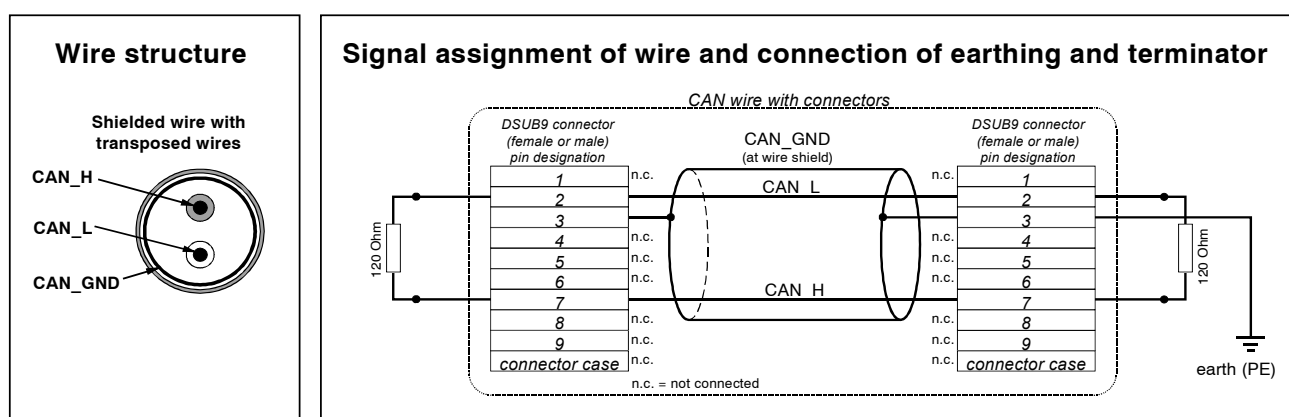


## 5. Correctly Wiring Electrically Isolated CAN Networks

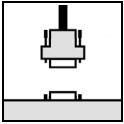
Generally all instructions applying for wiring regarding an electromagnetic compatible installation, wiring, cross sections of wires, material to be used, minimum distances, lightning protection, etc. have to be followed.

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 <b>not</b> at GND)!
2.	A CAN data wire requires <b>two twisted</b> 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 <b>one</b> point. Exactly <b>one</b> 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 <b>one</b> point. There must be not more than <b>one</b> connection to earth.
7.	A suitable type of wire (wave impedance ca. $120 \Omega \pm 10\%$ ) has to be used and the voltage loss in the wire has to be considered!
8.	CAN wires should not be laid directly next to disturbing sources. If this cannot be avoided, double shielded wires are preferable.



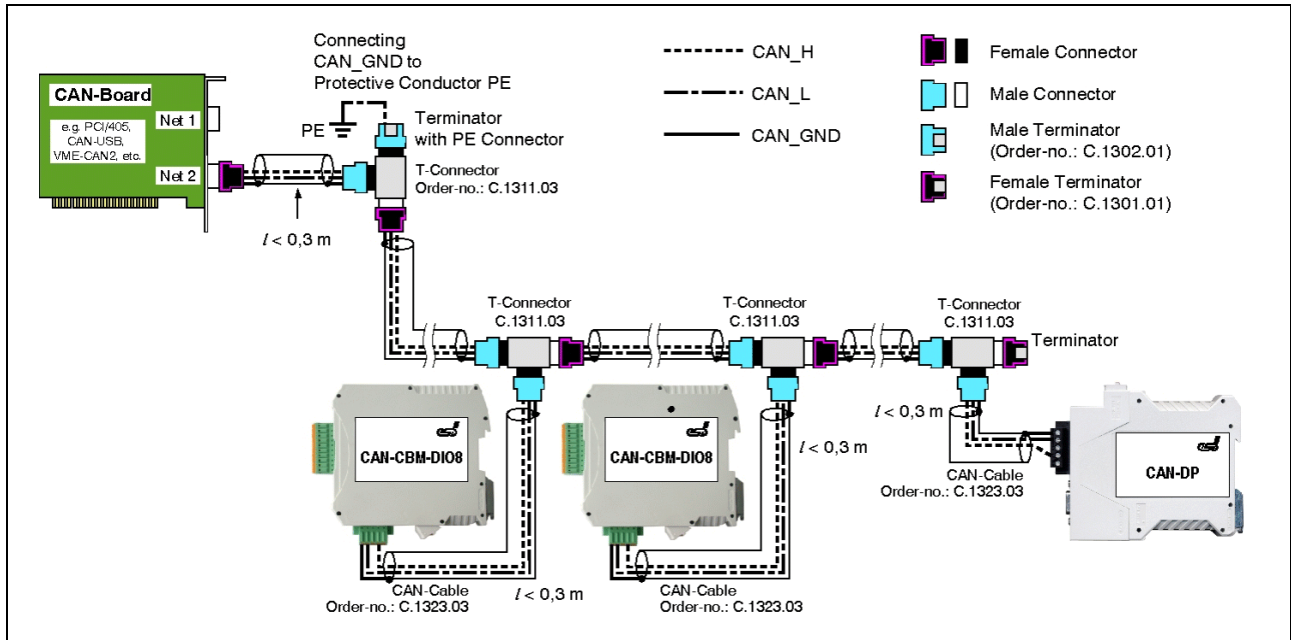
**Figure:** Structure and connection of wire



## Wiring

## Cabling

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



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

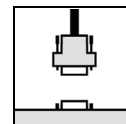
## Terminal Resistance

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

## Earthing

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



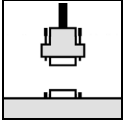


## Wire Length

- Optical couplers are delaying the CAN signals. By using fast optical couplers and testing each board at 1 Mbit/s, esd modules typically reach a wire length of 37 m at 1 Mbit/s within a closed net without impedance disturbances like e.g. longer dead-end feeders.

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

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

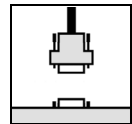


## Wiring

## Examples for CAN Wires

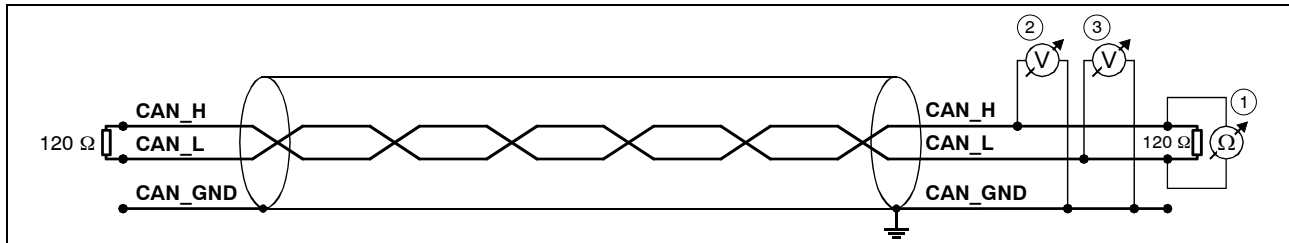
Manufacturer	Type of wire
U.I. LAPP GmbH Schulze-Delitzsch-Straße 25 70565 Stuttgart Germany <a href="http://www.lappkabel.de">www.lappkabel.de</a>	e.g. UNITRONIC ®-BUS CAN UL/CSA (UL/CSA approved) UNITRONIC ®-BUS-FD P CAN UL/CSA (UL/CSA approved)
ConCab GmbH Äußerer Eichwald 74535 Mainhardt Germany <a href="http://www.concab.de">www.concab.de</a>	e.g. BUS-PVC-C (1 x 2 x 0.22 mm <sup>2</sup> ) Order No.: 93 022 016 (UL appr.) BUS-Schleppflex-PUR-C (1 x 2 x 0.25 mm <sup>2</sup> ) Order No.: 94 025 016 (UL appr.)
SAB Bröckskes GmbH&Co. KG Grefrather Straße 204-212b 41749 Viersen Germany <a href="http://www.sab-brockskes.de">www.sab-brockskes.de</a>	e.g. SABIX® CB 620 (1 x 2 x 0.25 mm <sup>2</sup> ) Order No.: 56202251 CB 627 (1 x 2 x 0.25 mm <sup>2</sup> ) 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).

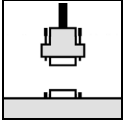
The measured value should be between 50  $\Omega$  and 70  $\Omega$ . The measured value should be nearly the same at each point of the network.

If the value is below 50  $\Omega$ , 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  $\Omega$ , 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  $\Omega$  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.

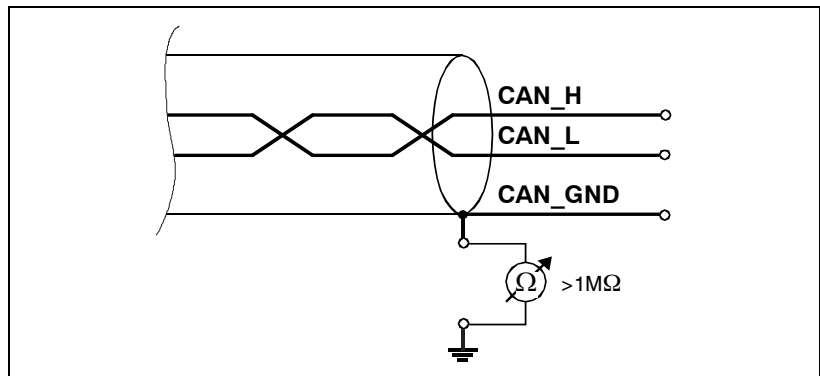
If it is lower than 2.0 V or higher than 4.0 V, it is possible that one or more nodes have faulty transceivers. For a voltage lower than 2.0 V please check CAN\_H and CAN\_L conductors for continuity. For a voltage higher than 4.0 V, please check for excessive voltage.

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 (Shield) from the ground.
2. Measure the DC resistance between Shield and ground (see picture on the right hand).
3. Connect Shield wire to ground.



**Fig.:** Simplified schematic diagram of ground test measurement

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



# EG-KONFORMITÄTSERKLÄRUNG DECLARATION OF CONFORMITY



Adresse  
*Address*

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

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,  
wenn Veränderungen am Produkt vorgenommen werden.

*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*  
Funktion / *Title*  
Datum / *Date*

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

Rechtsgültige Unterschrift / *authorized Signature*