

EMCtools

Microbox 100Base-T1 Automotive Ethernet



EMCtools - lab life made easy

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1. Introduction

100Base-T1 (Automotive Ethernet IEEE 802.3bw) is a fast bus system in vehicles for driver assistance and infotainment systems. The automotive industry has developed the 100BASE-T1 Ethernet interface for this based on BroadR-Reach technology.

It uses a full duplex Ethernet Communication via an unshielded twisted pair (UTP). The 100BASE-T1 signals are PAM-3 modulated with levels of differential signal between -1 V and +1 V.

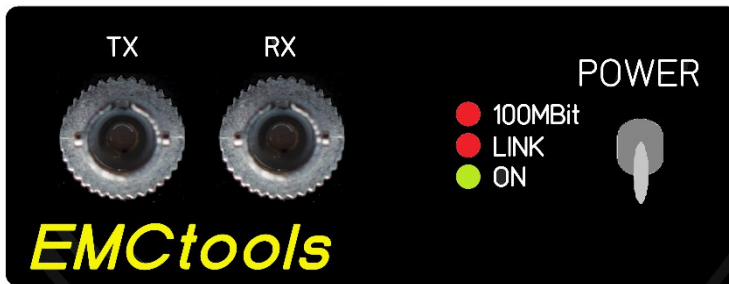
The data rate is 100 Mbit/s and significantly higher compared to traditional bus systems such as the CAN bus.

Our EMCtools Microbox has been designed for emission and susceptibility tests. Using multilayer technology, shielding and sophisticated circuit design full bus compatibility and the ability to perform tests at electromagnetic field levels of 270 V/m and above could be achieved. The handy plastic housing allows tests with limited test space and a minimum of impact on the field.

The EMCtools Microbox uses standard multimode fiber optic cables and allows direct connection to the electric bus via D-SUB connectors.

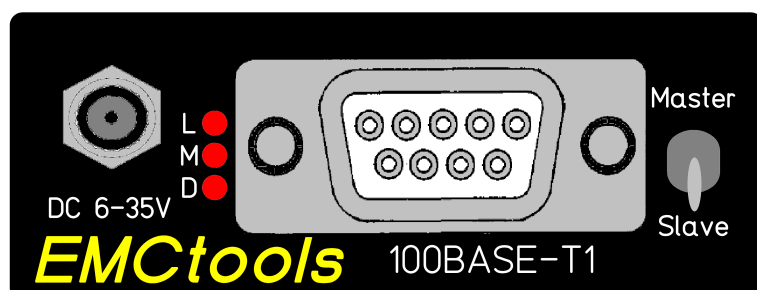
2. Hardware Interfaces of EMCtools Microbox 100BASE-T1

The Microbox is built into a handy, rugged plastic housing (138x66x27mm). Power is supplied externally e.g. by using an external battery or power-supply.



Front Panel Microbox 100BASE-T1

Description	Explanation
TX	Fiber Optic Transmit Port – TX transmitter of the fiber optic data transmission
RX	Fiber Optic Receive Port – RX receiver of the fiber optic data transmission
100MBit	Control LED “100Mbit” On: Speed = 100MBit Off: Speed = 10MBit
LINK	Control LED “LINK” Active Status display of fiber optic link “Blinking” indicates packets going through TX
ON	Control-LED “ON” Power on/off status
POWER	Power Power on/off toggle switch



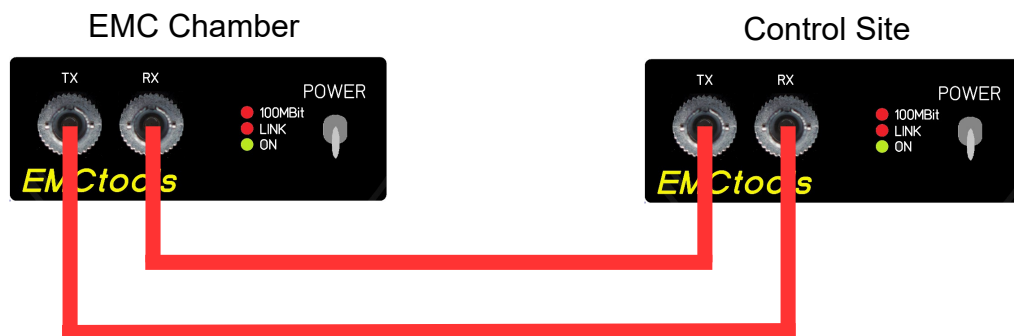
Rear panel Microbox 100Base-T1

Description	Explanation
DC 6-35V	Power supply (DC 6-35V) DC Power Jack 5.5/2.1mm
L	Control LED "L" Active Status display of 100BASE-T1 Link On: Link „OK“ Off: no Link
M	Control LED "M" On: 100Base-T1 Port is set to Master Off: 100Base-T1 Port is set to Slave
D	Control LED "D" "Blinking" indicates packets going through TX
100Base-T1	D-SUB 100BASE-T1 connector (see chapter 6.)
Master Slave	Master/Slave toggle switch

3. Standard Setup of EMCtools Microbox 100BASE-T1

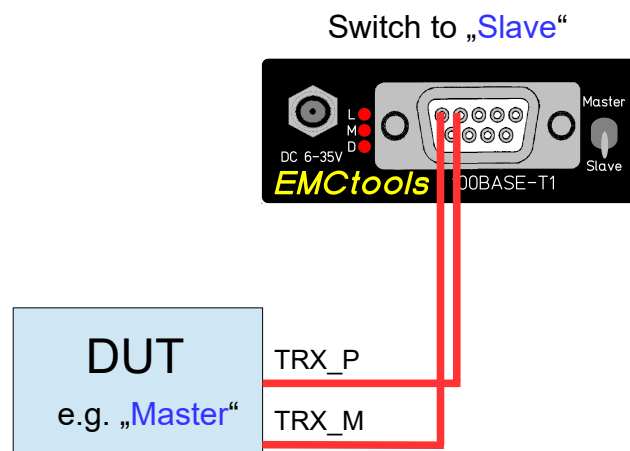
The setup for operating a fiber optic data transmission for automotive Ethernet 100BASE-T1 using the Microbox 100BASE-T1 is easy:

1. Connect two Microboxes with crossed fiber optic cables:

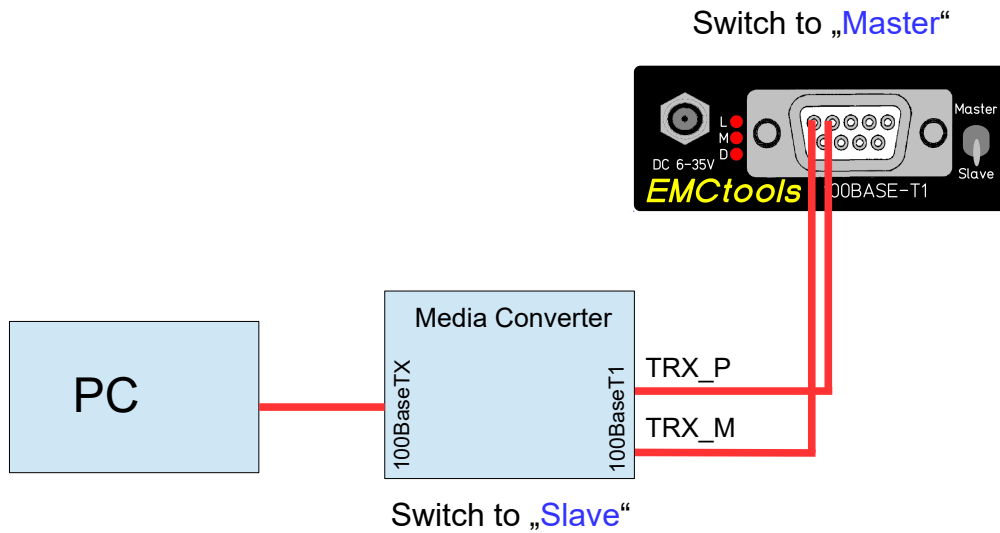


2. Connect the electrical 100BASE-T1 -bus cables inside the EMC Chamber to the Microbox.

- if DUT is set as „Master“ → set the Microbox as „Slave“
- if DUT is set as „Slave“ → set the Microbox as „Master“



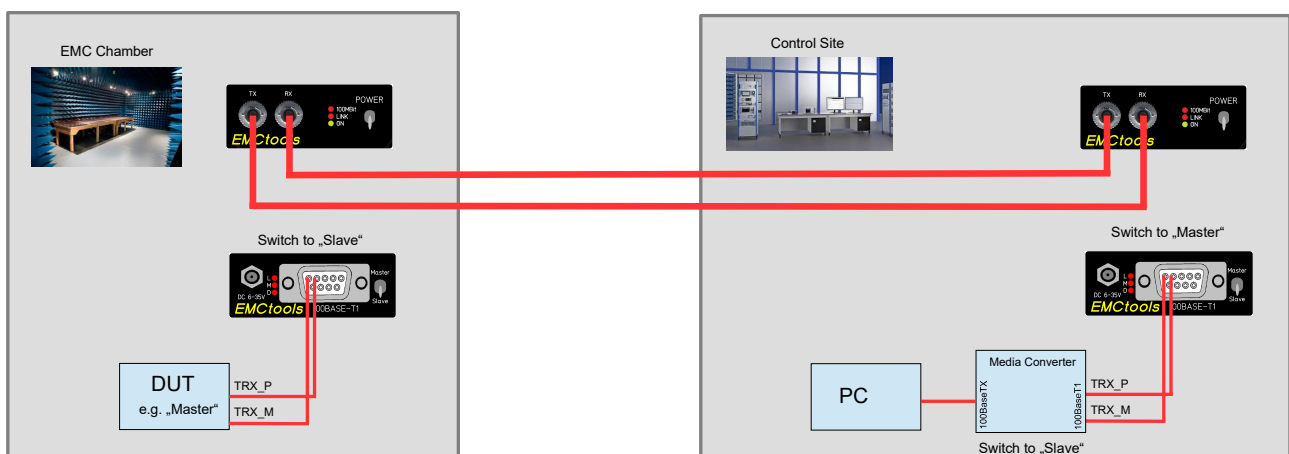
3. Connect the electrical 100BASE-T1 -bus cables at the Control Site to the Microbox.



- Set Microbox to same configuration as the DUT in the EMC Chamber.
e.g. if DUT is set as „Master“ inside the EMC Chamber
→ Set Microbox at Control Site also to „Master“
- The Microbox at the Control Site always represents the DUT inside the EMC Chamber.

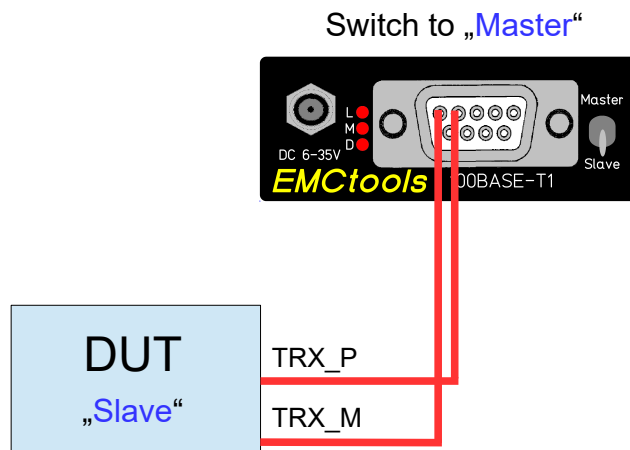
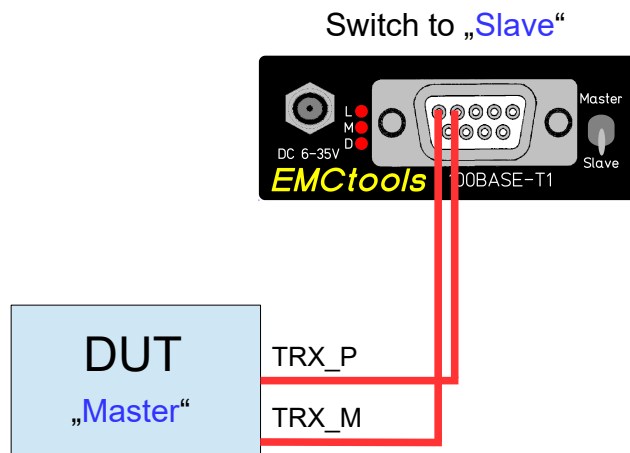
4. Plug in the power cables with attached cable ferrites and connect power

5. Switch on both Microboxes



4. Setting the bus-options of the *EMCtools* Microbox

100BASE-T1 bus is a point-to-point connected bus. This means that there are only 2 electrical bus participants (nodes) connected to the electrical bus cable. One of them must be the bus "Master", the other one must be set to bus "Slave".



5. Microbox “Link Combine” - feature

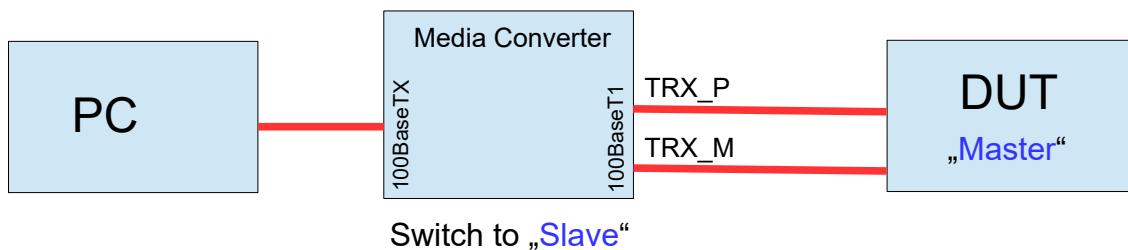
This is a new feature starting with S/N: 500119 and 505048:

As with any bus interface, the most important criterion for EMC Immunity tests with the 100Base-T1 bus is the correct functioning of the data transmission.

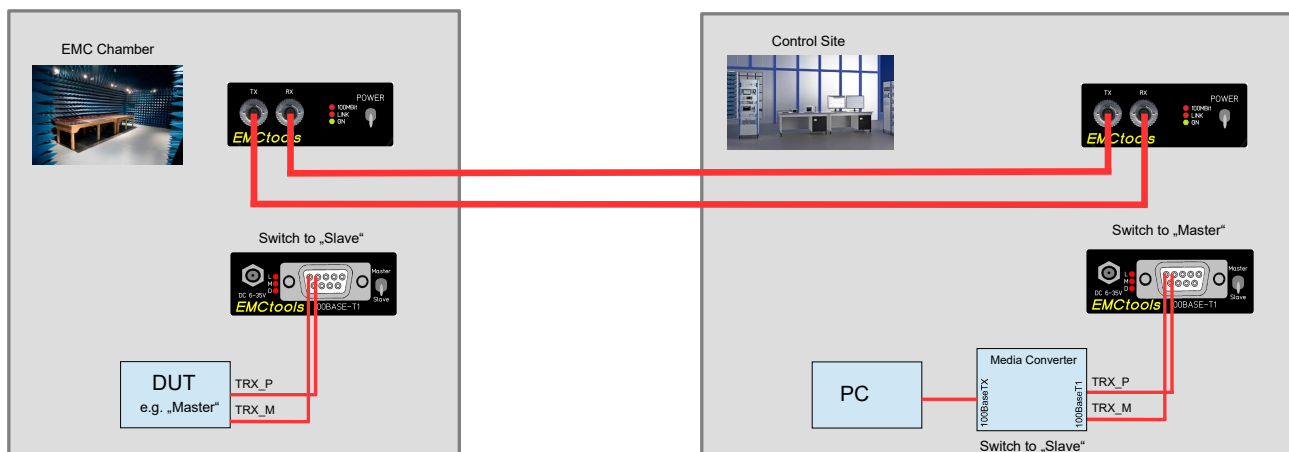
A data transmission in an automobile is considered ok as long as the data in the system is transmitted correctly and in time. It may happen that the bus signal has a very poor Signal to Noise (S/N) ratio, but communication is still functional. In the real car you would not even notice this. The decisive factor here is that the bus LINK between the two partners is still present and functional.

Let us analyse this in detail:

Standard Setup: DUT bus is connected directly to Control PC/Laptop:



EMC test setup: DUT bus is **NOT** connected directly to Control PC/Laptop:



Now we have two separate electrical 100Base-T1 busses:

- Bus 1 connects the DUT to the fiber optic transmitter inside the EMC chamber
- Bus 2 connects the fiber optic transmitter to the Control PC/Laptop outside the

chamber.

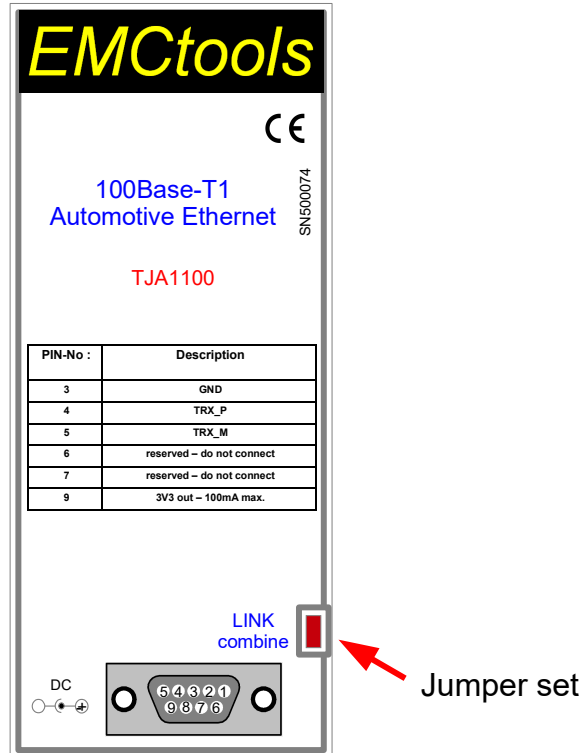
Both busses establish a 100Base-T1 bus link. If the bus link inside the EMC chamber fails due to RF-field or BCI currents the bus link outside the EMC chamber is still ok. A link failure in the EMC chamber (between DUT and fiber optic transmitter) can only be detected outside the chamber by missing data. And this may be very difficult.

With the LINK-combine option of our Microbox 100Base-T1 it is possible to make a „LINK failure“ in the EMC chamber visible outside the EMC chamber. This means that if a „LINK failure“ occurs inside the chamber due to RF radiation, the link is also interrupted simultaneously outside the chamber between fiber optic transmitter and Control PC/Laptop.

Please note:

For correct operation jumpers have to be set on **both sides** of the 100Base-T1 fiber optic connection

The "LINK combine" function is set on both Microboxes. The function is activated by setting the jumpers.



Setting up Link combine :

- First setting up the Microboxes as described in chapter 3
- Check the functionality
- Then **switch off both** Microboxes

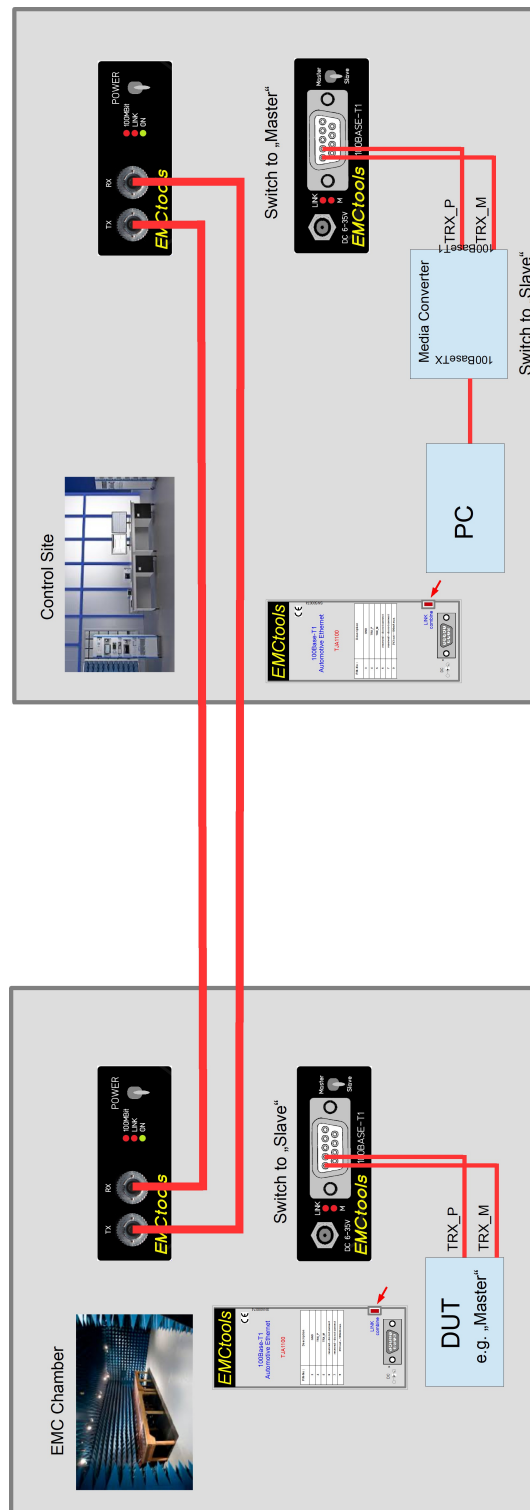
Attention:

The Microbox that is switched on first passes the link status of its 100BASE-T1 connection to the second Microbox.

So if the Microbox that is turned on first has a link failure (between the DUT and the Microbox), it will cause a link failure at the remote Microbox.

- Switch on the Microbox in the **chamber**
(this will be the one that passes the link status)
- Switch on the Microbox at the **control site**

The function “LINK combine” is now activated.



Complete set-up set with „LINK combine“

6. Bus front end circuit of EMCtools Microbox

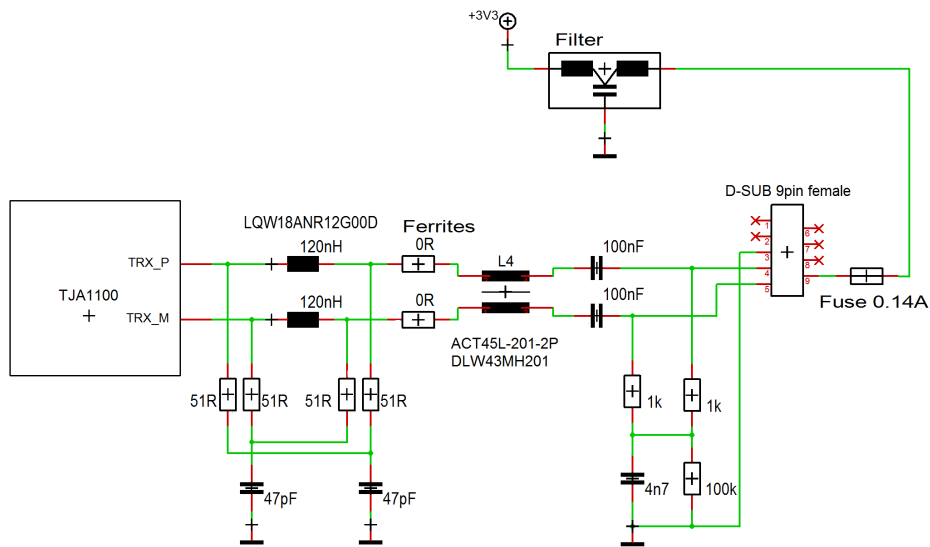


Fig.4: EMCtools Microbox 100BASE-T1 – Ferrites are optional

D-SUB PIN-No :	Description:
1	NC
2	NC
3	GND
4	TRX_P
5	TRX_M
6	reserved – do not connect
7	reserved – do not connect
8	NC
9	3V3 out – 100mA max.

7. ESD Protection:

Microbox 100BASE-T1 is protected against electrostatic discharge in lab use.

Attention :

This built in protection is not sufficient if you intend to perform ESD tests.
Here an additional ESD protection for 100BASE-T1 is needed.

8. Delivered devices of the system and accessories:

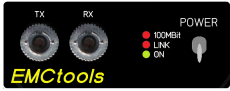
Microbox 100BASE-T1-Set:

- 2 pcs EMCtools Microbox 100BASE-T1
- 1 pcs printed manual
- 2 pcs power supply cable (1m) with cable ferrite (DC-plug: Switchcraft S761K)
- 2 pcs cable ferrite for bus cable (Ferrite: Würth Part-No: 74271142)

9. Available accessories:

- rechargeable Battery Box for EMCtools Microbox (Mod. 350)
 - to be used inside the EMC chamber
- Plug-In wall supply for EMCtools Microbox (Mod. 165 or Mod.167)
 - to be used outside the EMC chamber
- ESD-Protector for 100BASE-T1 (Mod. 510)
- ESD-Protector Tester for 100BASE-T1 (Mod. 515)

10. Troubleshooting

Error	Reason
<p>➤ L - LED („Link LED“) off</p>  <p>➤ and 100MBit / LINK LED's on</p> 	<p>Master / Slave incorrectly set</p>
<p>➤ 100MBit / LINK LED's off on both sides</p> 	<p>LWL connection between the Microboxes swapped</p>
<p>➤ 100MBit / LINK LED's off on just one side of the Microbox Set</p> 	<p>One FO cable defective or dirty</p>

11. Technical data EMCtools Microbox 100BASE-T1 Automotive Ethernet:

Datarate:	100Mbit/s
Power supply:	6 – 35V DC, 400mA / 6V, 200mA / 12 V, 100mA / 24V DC Power Jack 2.1mm, center pin positive Protected against wrong polarity
Fiber optic:	F-ST, duplex 50/125µm or 62.5/125µm F-SMA, duplex 50/125µm or 62.5/125µm (OPTION)
Bus-connector:	9-pin Sub-D
Bus options setting:	Master / Slave
Bus ESD-Protection:	+/- 6kV, IEC 61000-4-2; 150 pF, 330 Ohm
Temperature range:	operating: -20 – 60°C (-4 – 140° F) storage: -40 – 85°C (-40 – 185° F)
Housing Size:	138 x 65 x 27 mm (160 x 65 x 27 mm incl. connector outline)
Weight:	210 g / pcs

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Declaration of Conformity

Hereby we declare, that our product is compliant with the CE directives and standards listed below.

Product: **EMCtools Microbox**

Model: 100BASE-T1

Directives: 2004/108/EG (EMC)

Standards: DIN EN 61326-1 (2006)
DIN EN 61000-4-3 (2008)
DIN EN 61000-4-2 (2009)
DIN EN 55022 (2008)

Tested Setup: Typical setup for fiber optic conversion of bus, locally supplied by battery.

Ostrach, January 15th, 2019

A handwritten signature in black ink, appearing to read 'Armin Lenk', is written over the printed name.

Lenk
Dipl.-Ing. (FH)