

OptoLyzer® MOCCA LAN



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Chapter 1 Preface

1.1 Intended Use

The OptoLyzer MOCCA LAN device is intended to be used for developing, testing, or analyzing CAN[®] or Ethernet (IEEE 802.3) based automotive products and systems by persons with experience in developing automotive devices.

1.2 Scope of Delivery

The delivery covers the following:

- OptoLyzer MOCCA LAN device
- Power cable
- USB cable
- USB stick (license dongle, optional)
- CAN termination resistors (optional)
- SYNC cable V3 (optional)
- CAN breakout cable (optional)

Check your shipment for completeness. If you have any objections, direct them to Sales@K2L.de. Providing the delivery note number eases the handling.

1.3 Overview OptoLyzer MOCCA Family

Table 1.1 shows the feature sets of the OptoLyzer MOCCA family devices. The numbers indicate how many interfaces/channels are available.

Table 1.1 OptoLyzer MOCCA Family

| | OptoLyzer MOCCA | compact 50e | compact 150o | compact 150c | CLF | CL | FD | LAN |
|----------------------|-----------------|-------------|--------------|--------------|-----|----|-----------------|-----------------|
| INTERFACE | | | | | | | | |
| Analog Audio Out | | 1x | 1x | 1x | | | | 1x |
| Analog Line In | | 1x | 1x | 1x | | | | 1x |
| CAN | | 6x | 6x | 6x | 6x | 6x | 4x ^a | 2x |
| CAN FD | | | | | | | 2x ^a | |
| Ethernet | | 1x | 1x | 1x | 1x | | 1x | 4x ^b |
| FlexRay ^c | | 1x | 1x | 1x | 1x | | 1x | |
| LIN | | 6x | 6x | 6x | 6x | 6x | 6x | |
| MOST | | 1x | 1x | 1x | | | | |
| Relay | | 1x | 1x | 1x | 1x | | 1x | |
| S/PDIF | | 1x | 1x | 1x | | | | |
| Trigger/ECL | | 1x | 1x | 1x | 1x | | 1x | |
| USB | | 1x | 1x | 1x | 1x | 1x | 1x | 1x |

- a. The OptoLyzer MOCCA FD supports 6 CAN channels, 2 of them can be used as CAN FD channels.
- b. 2x TX, 2x T1
- c. FlexRay A/B

1.4 Definitions of Terms

For better understanding of the following chapters, this section provides explanation to special terms used in the description of the OptoLyzer MOCCA device user manual.

Table 1.2 Definitions of Terms

| TERM / ABBREVIATION | DESCRIPTION |
|---------------------------|---|
| CAN | Controller Area Network |
| D | Depth |
| DUT | Device Under Test |
| H | Height |
| LAN | Local Area Network |
| LIN | Local Interconnect Network |
| Low speed CAN Transceiver | Fault tolerant CAN Transceiver |
| MDIX | Medium Dependent Interface Crossover |
| OBD | On-Board-Diagnostics is a mechanism that is used in vehicles allowing self-diagnostic and reporting of the diagnostic results. |
| Quiet-Wire® | A 100Base-TX compatible technology from Microchip Technology Inc., offering superior EMC characteristics. |
| RCA | Type of electrical connector used for transmitting audio and video signals (also known as cinch, introduced by Radio Corporation of America). |
| Sync | Synchronization |
| USB | Universal Serial Bus |
| W | Width |

1.5 References

- [1] Electrical Physical Layer Specification Version 2.0
Refer to FlexRay Consortium.
- [2] International Organization for Standardization
<http://www.iso.org>
- [3] Telecommunications Industry Association
<http://www.tiaonline.org>
- [4] International Electrotechnical Commission
<http://www.iec.ch>

Chapter 2 Safety Instructions

2.1 Supply and Synchronization

Complex network architectures can be found very often in an automotive environment. To get a proper impression about the system behavior i.e., to analyze the complete data transfer over all connected automotive bus systems it is required to refer all data relative to a common time base. This can be achieved by connecting different devices of the OptoLyzer MOCCA family over a time synchronization cable (i.e., SYNC cable V3). The synchronization cable is also capable of carrying power. The OptoLyzer MOCCA LAN has to be a timing slave if it is one of the time synchronized devices. The mode (timing slave) can be set e.g., in the OptoLyzer Studio.

When concatenating OptoLyzer MOCCA devices one of the two Sync/Power connectors is intended to be used for the power supply and the other for cascading the OptoLyzer MOCCA device by using the optional SYNC cable V3.

During cascading, caution has to be taken, since the first device in the chain can take the maximum current of 4 A. Do not cascade more than five devices in chain.

For all setups either a fuse of max. 4 A in the supply cable to the first device or the use of the current limitation of the laboratory power supply is mandatory.

2.2 Restrictions in Operation

The OptoLyzer MOCCA device integrates temperature sensitive components. Therefore do not cover the device with any objects. Covering disables the cooling. Make sure to allow enough airflow to the OptoLyzer MOCCA device, when the device is assembled. Do never place the running OptoLyzer MOCCA device in a closed case or box. Do not stack any OptoLyzer MOCCA devices.

Figure 2.1 Device Arrangement



Chapter 3 Definitions Limit Class

3.1 Emission

The OptoLyzer MOCCA device has been qualified against the requirements according to the standard EN 55022:2010, class A.

Warning

The OptoLyzer MOCCA device is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Chapter 4 Introduction

The OptoLyzer MOCCA LAN is a hardware interface supporting Automotive Ethernet development. The device is equipped with two interfaces for each of the following Ethernet physical layers:

- 10Base-T
- 100Base-T1
- 100Base-TX
- Quiet-Wire technology

The OptoLyzer MOCCA LAN is capable of spying on the traffic of an Ethernet point-to-point (PTP) connection but can also be used as a media converter between different Ethernet physical layers (e.g., between 100Base-T1 and 100Base-TX). The collected data can be displayed and analyzed within the OptoLyzer Studio software running on a PC. The connection to the PC is realized via a USB 2.0 interface. When a 100Base-T1 connection is observed, there is one additional 1000Base-T port available, that can be used to connect to a data logger device. Besides supporting Automotive Ethernet the OptoLyzer MOCCA LAN provides two High-Speed CAN interfaces allowing to spy CAN data.

For custom applications, the OptoLyzer MOCCA LAN can also be controlled with the help of K2L.Bus, which is an open .NET API. Various examples describe how the API can be applied (refer to our web site: <http://www.K2L.de>).

Keeping the firmware of the hardware interface up to date can easily be accomplished with the free of charge version of K2L's OptoLyzer Studio.

4.1 Feature Summary

The following list covers the key features of the hardware platform.

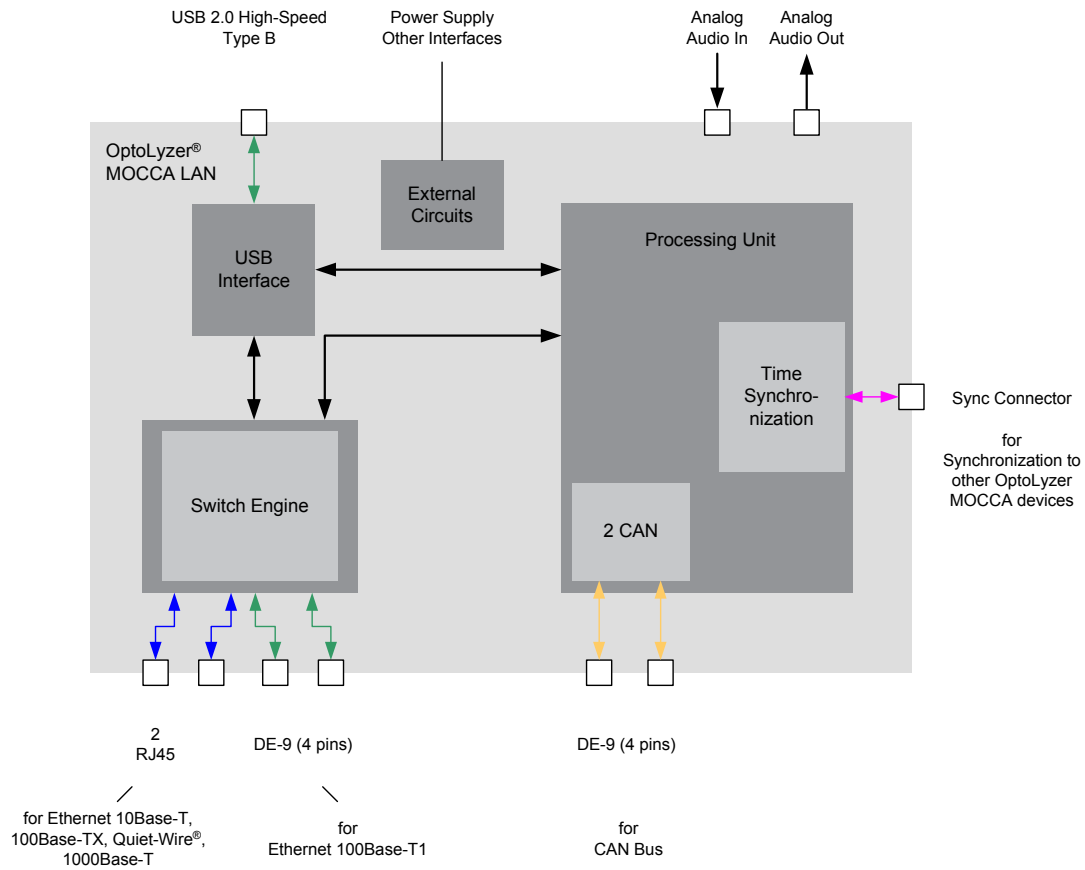
- Compact automotive networking hardware interface
- Supports various Ethernet physical layers:
 - 10Base-T
 - 100Base-T1
 - 100Base-TX
 - Quiet-Wire technology
- 2 High-Speed CAN interfaces
- 1000Base-T interface for connection to external data logger device
- USB 2.0 port supporting Full-Speed with 12 Mbit/s and High-Speed with 480 Mbit/s
- Analog audio input and output for audio streaming
- Device supports the following use cases ([Chapter 9, "Use Cases," on page 23](#)):
 - Spying a point-to-point connection between two 100Base-TX Ethernet devices
 - Spying a point-to-point connection between two 100Base-T1 Ethernet devices
 - Spying a point-to-point connection between a 100Base-TX and a 100Base-T1 Ethernet device (Ethernet media converter)
 - Data Logger use case
 - Ethernet message injection
- Time synchronization with other cascaded devices of the OptoLyzer MOCCA family (over SYNC cable V3)
- 12 V power forwarding via the Sync connector
- Possibility to update devices via OptoLyzer Studio

- K2L.Bus API
 - Easy programmable hardware access
 - Various programming examples

4.2 Block Diagram

The block diagram shows the features available for the OptoLyzer MOCCA LAN device.

Figure 4.1 Block Diagram for OptoLyzer MOCCA LAN Variant



4.3 Properties of Supported Bus Systems

The OptoLyzer MOCCA LAN device is intended to be used as stimulation, test and analysis device for automotive field buses with DUTs connected to them. Therefore the design is constrained to ensure the behavior to be as passive as possible.

4.3.1 CAN

The accuracy of CAN time stamps is 100 μ s (or better, typically 40 μ s).

4.3.1.1 High-Speed Transceiver

High-Speed CAN bus systems according to ISO 11898-2:2015 [2] are terminated with 120 Ω at each end. Therefore the OptoLyzer MOCCA device does not terminate the bus. Transmission speeds are supported up to 1 Mbits/s.

4.3.2 Ethernet

Auto MDIX is supported, therefore the LAN interface can connect via straight and crossed patch cables. The physical layers 10Base-T, 100Base-TX, 100Base-T1 and Quiet-Wire are supported. Messages sent from the embedded Ethernet controller are provided with a unique MAC address. The accuracy of Ethernet time stamps is 100 μ s (or better, typically 40 μ s).

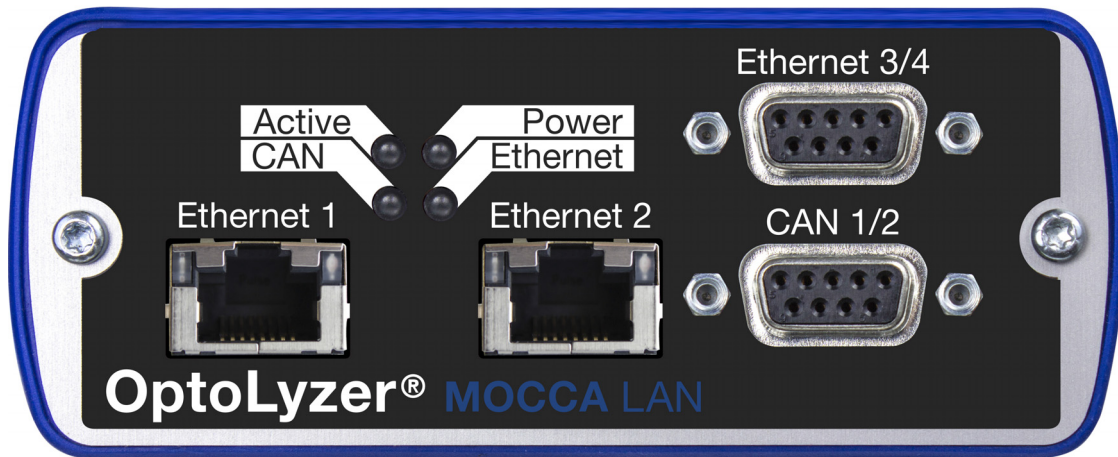
Chapter 5 Hardware Description

The following chapter describes all connectors.

5.1 Front Panel

Figure 5.1 depicts the front panel of the OptoLyzer MOCCA LAN.

Figure 5.1 Front Panel - OptoLyzer MOCCA LAN



All possible components of the front panel are described below:

- Table 5.1 describes the connectors from left to right and top to down.
- Table 5.2 describes the LEDs.

Table 5.1 Connectors on the Front Panel

| INTERFACE | DESCRIPTION |
|--------------|--|
| Ethernet 1 | The Ethernet 1 connector is an RJ45 receptacle according to TIA-568 [3]. It supports transmission of: 10Base-T 100Base-TX, Quiet-Wire 1000Base-T |
| Ethernet 2 | The Ethernet 2 connector is an RJ45 receptacle according to TIA-568 [3]. It supports transmission of: 10Base-T 100Base-TX, Quiet-Wire 1000Base-T |
| Ethernet 3/4 | The Ethernet 3/4 connectors are accessible via pins of a DE-9 connector and can be connected to the wires of a shielded/unshielded twisted pair. They support transmission of: 100Base-T1 For the pin out refer to Section 6.6, "Ethernet 3/4," on page 20 . |
| CAN 1/2 | This connector offers two High-Speed CAN instances with baud rates from 33.333 kbit/s to 1 Mbit/s depending on the cable length. The CAN interfaces can be controlled by a customer application. Details about the CAN bus properties are described in Section 4.3.1, "CAN," on page 13 . For the pin out refer to Section 6.1, "High-Speed CAN," on page 18 . |

The OptoLyzer MOCCA device offers four LEDs. All LEDs except the Power LED are tri-colors.

Table 5.2 LEDs

| INTERFACE | DESCRIPTION | COLOR | DESCRIPTION |
|-----------|--|-------|---|
| Active | This LED indicates any activity. | Red | Reserved |
| | | Green | Reserved |
| | | Blue | <ul style="list-style-type: none"> ■ Slowly blinking: Firmware running (normal operation) ■ Fast blinking: Twinkle function |
| CAN | This LED indicates the bus state of the CAN bus. | Red | - |
| | | Green | - |
| | | White | - |
| Power | This LED indicates a powered device and the device is in flash mode. | Green | <ul style="list-style-type: none"> ■ Powered device ■ Device is in flash mode if Active LED is not slowly blinking additionally after some seconds. |
| Ethernet | This LED indicates the bus state of the Ethernet bus. | Red | Error (as long as error occurs, at least 0.5 s) |
| | | Green | Normal operation |
| | | White | Slowly blinking: Bus activity |

5.2 Rear Panel

Figure 5.2 depicts the rear panel of the OptoLyzer MOCCA LAN.

Figure 5.2 Rear Panel - OptoLyzer MOCCA LAN

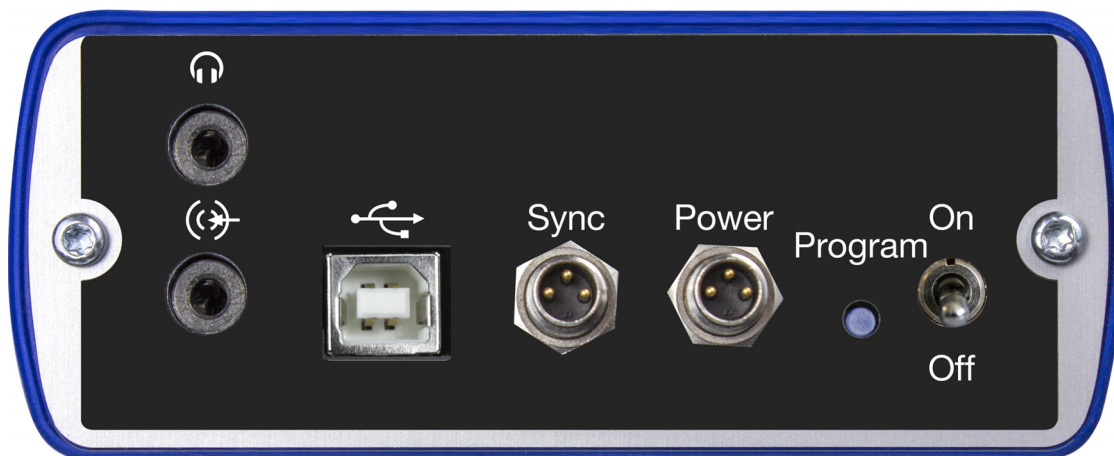


Table 5.3 describes the connectors of the rear panel from top to bottom and left to right.

Table 5.3 Connectors on the Rear Panel




| INTERFACE | SYMBOL | DESCRIPTION |
|------------------|---|--|
| Analog Audio Out |  | The OptoLyzer MOCCA LAN provides an analog audio out interface (a stereo headphone output). It has a 3.5 mm jack plug. Output Power: $P_{o, Max, Rms} = 32 \text{ mW}$ (at $R = 15 \Omega$, $V_{out} = 690 \text{ mV}_{RMS}$) The bandwidth is 24 bit stereo. Rx and Tx transmission must cover the same bit number per channel. |
| Analog Line In |  | The OptoLyzer MOCCA LAN provides an analog Line In. The analog Line In input impedance is 10 k Ω . The analog input is converted into a digital stream with resolutions of 24 bits / channel (stereo). It has a 3.5 mm jack plug. Rx and Tx transmission must cover the same bit number per channel. |
| USB |  | The USB port is a standard USB 2.0 B-type receptacle. |
| Sync / Power | | The Synchronization (Sync) and the Power connector have the identical pin assignment i.e., each socket can be used either for synchronization or power purposes. Restrictions are described in Section Chapter 2, "Safety Instructions," on page 9 . The OptoLyzer MOCCA device is intended to be powered by the wall power supply (optionally available) or by any other power supply which is capable to deliver 12 V and 1 A. If the wall power supply is not used, the included power cable has to be used to connect the 12 V supply to the OptoLyzer MOCCA device. For the pin out refer to Section 6.2, "Synchronization and Power," on page 19 . |
| Program | | The Program button allows to set the OptoLyzer MOCCA LAN into flash mode. For more details refer to Section 8.1, "Prepare OptoLyzer MOCCA LAN for Flashing," on page 22 . |

Table 5.3 Connectors on the Rear Panel

| INTERFACE | SYMBOL | DESCRIPTION |
|--------------|--------|---|
| Power Switch | | On (top position): The device is powered. Off (bottom position): The device is switched off. |

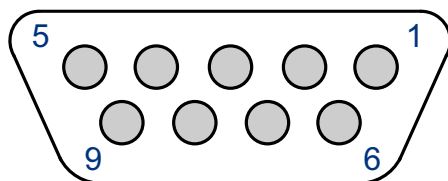
Chapter 6 Pin Assignment of the Connectors

6.1 High-Speed CAN

Connector type for both High-Speed CAN connectors: DE-9

Figure 6.1 shows the connector pin assignment as it is visible on the front panel.

Figure 6.1 DE-9 Connector



The provided GND pins (Table 6.1) must not be used unless there is no other GND connection. These pins must not be used for supply purpose.

Table 6.1 Pin Assignment of Connector High Speed CAN1/2

| PIN NO. | SIGNAL | DESCRIPTION |
|---------|------------|---------------------------|
| 1 | | Not connected |
| 2 | CAN 1-Low | Low-level CAN 1 bus line |
| 3 | GND | Signal ground |
| 4 | CAN 2-Low | Low-level CAN 2 bus line |
| 5 | | Not connected |
| 6 | | Not connected |
| 7 | CAN 1-High | High-level CAN 1 bus line |
| 8 | | Not connected |
| 9 | CAN 2-High | High-level CAN 2 bus line |

6.2 Synchronization and Power

Connector type: Binder sensor connector series 768, 3 pole, ordering number: 09 3419 82 03

Suitable female connector: Binder M8 IP40 series 768, 3 pole, ordering number: 99 3400 100 03

There are two connectors for synchronization and power. [Figure 6.2](#) shows the pins as they are visible on the rear panel for these connectors. For more details about synchronization and power refer to [Section 2.1, "Supply and Synchronization," on page 9](#).

Figure 6.2 Pin Assignment of the Sync and Power Connector

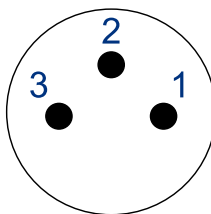


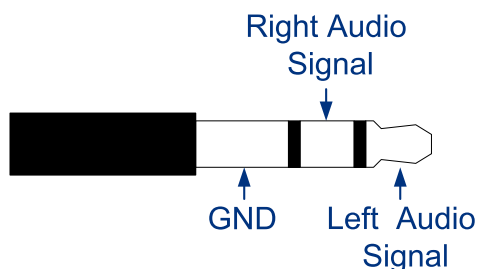
Table 6.2 Pin Assignment of the Sync and Power Connector

| PIN NO. | SIGNAL | DESCRIPTION |
|---------|--------|----------------------|
| 1 | 12 V | Power supply |
| 2 | Sync | Synchronization line |
| 3 | GND | System ground |

6.3 Analog Audio In/Out

Both the stereo line-in and the stereo headphone output are connected to an audio phone connector.

Figure 6.3 Pin Assignment of the Analog Audio In/Out Connector



6.4 USB

The USB port is a standard USB 2.0 B-type receptacle.

6.5 Ethernet 1/2

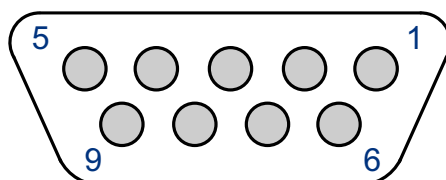
The Ethernet connectors 1 and 2 are implemented as a RJ45 receptacles according to TIA-568 [3].

6.6 Ethernet 3/4

Connector type for the Ethernet 3/4 connector: DE-9

Figure 6.4 shows the connector pin assignment as it is visible on the front panel.

Figure 6.4 DE-9 Connector (Ethernet 3/4)



This connector allows to connect two Automotive Ethernet connections according to standard 100Base-T1. By default, Ethernet 3 is master and Ethernet 4 is slave.

Table 6.3 Pin Assignment of the Ethernet 3/4 Connector

| PIN NO. | SIGNAL | DESCRIPTION |
|---------|--------------|---------------------------------|
| 1 | Ethernet 3 P | Ethernet 3, 100Base-T1 positive |
| 2 | Ethernet 3 N | Ethernet 3, 100Base-T1 negative |
| 3 | GND | Signal ground |
| 4 | Ethernet 4 N | Ethernet 4, 100Base-T1 negative |
| 5 | Ethernet 4 P | Ethernet 4, 100Base-T1 positive |
| 6 | GND | Signal ground |
| 7 | GND | Signal ground |
| 8 | GND | Signal ground |
| 9 | GND | Signal ground |

Chapter 7 Technical Specifications

The table below covers characteristics of the OptoLyzer MOCCA device and its networking interfaces.

Table 7.1 Device and Bus Characteristics

| PARAMETER | | VALUE |
|-------------------------|----------------------------|--------------------------|
| RAM | | DDR2 2Gb |
| NAND Flash | | DDR2 2Gb |
| Controllers | | |
| µProcessor | | Atmel SAMA5D35 @ 536 MHz |
| CAN Transceivers | | |
| | High-Speed CAN Transceiver | Microchip MCP2562 |
| Ethernet Switch | | Microchip KSZ9567 |
| Automotive Ethernet | | NXP TJA1100 |

The table below covers mechanical characteristics of the OptoLyzer MOCCA device.

Table 7.2 Mechanical Characteristics

| PARAMETER | VALUE | UNIT |
|---------------------------|----------------|------|
| Dimensions (H x W x D) | 45 x 112 x 116 | mm |
| Weight | 400 | g |
| Ambient Temperature Range | 0..+60 | °C |

The table below covers electrical characteristics of the OptoLyzer MOCCA device.

Table 7.3 Electrical Characteristics

| PARAMETER | MIN | TYP | MAX | UNIT | COMMENT |
|--|-----|-----|-----|------|---------|
| Operating Voltage Range | 5.5 | 12 | 27 | V | |
| OptoLyzer MOCCA LAN Current Consumption (operation) | | 800 | | mA | |

Chapter 8 Maintenance

8.1 Prepare OptoLyzer MOCCA LAN for Flashing

The OptoLyzer MOCCA LAN can be flashed via the OptoLyzer Studio. Follow these steps to switch to the flash mode:

1. Turn the OptoLyzer MOCCA LAN off.
2. Press the Program button located on the rear panel.
3. Switch the Power button to On while the Program button is pressed.

The OptoLyzer MOCCA LAN is in flash mode afterwards.

Chapter 9 Use Cases

9.1 Spying Ethernet Data

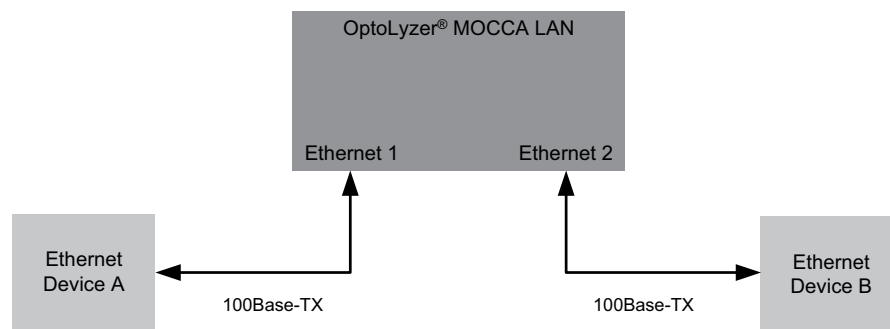
Use Case 1:

The OptoLyzer MOCCA LAN can **spy** either the traffic of

- a 10Base-T Ethernet point-to-point connection (no figure) or of
- a 100Base-TX Ethernet point-to-point connection ([Figure 9.1](#)) or of
- a Quiet-Wire point-to-point connection (no figure).

[Figure 9.1](#) shows an example of a **100Base-TX Ethernet point-to-point connection** (whereby the connection of the Ethernet Device A/B to the Ethernet interface 1/2 is selected arbitrarily).

Figure 9.1 Spying a Connection between two 100Base-TX Ethernet Devices

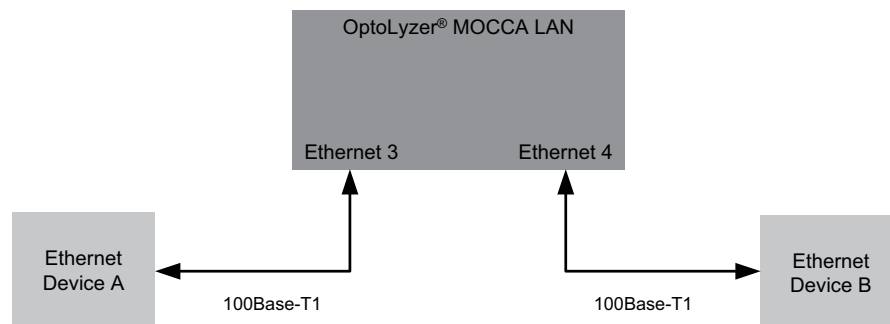


Use Case 2:

The OptoLyzer MOCCA LAN can **spy** the traffic of a 100Base-T1 Ethernet point-to-point connection.

[Figure 9.2](#) shows an example of a **100Base-T1 Ethernet point-to-point connection** (whereby the connection of the Ethernet Device A/B to the Ethernet interface 3/4 is selected arbitrarily).

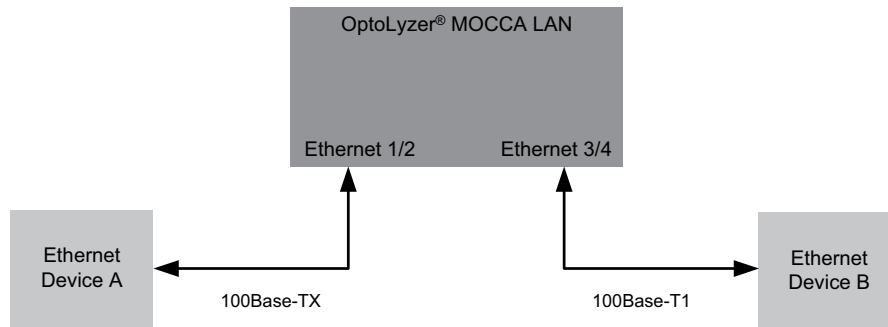
Figure 9.2 Spying a Connection between two 100Base-T1 Ethernet Devices



Use Case 3:

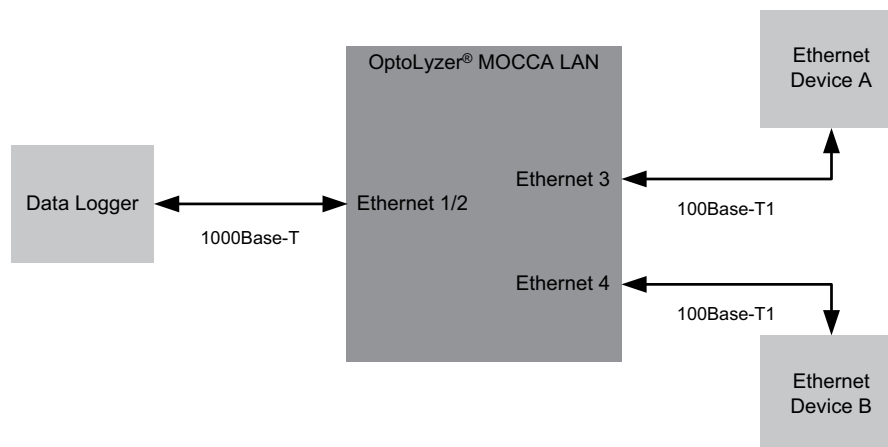
The OptoLyzer MOCCA LAN is able to **spy** the Ethernet traffic of a **point-to-point connection between a 100Base-T1 Ethernet and a 100Base-TX Ethernet device**. In this case it is used as a **media converter** between different Ethernet physical layers. [Figure 9.3](#) shows an example how the media converter can be realized (whereby the Ethernet Device A can be connected either to the Ethernet interface 1 or to the Ethernet interface 2 and the Ethernet Device B either to the Ethernet interface 3 or to the Ethernet interface 4). In addition, it is possible to use the media converter functionality without spying.

Figure 9.3 Spying a Connection between a 100Base-TX and a 100Base-T1 Ethernet Device

**Use Case 4:**

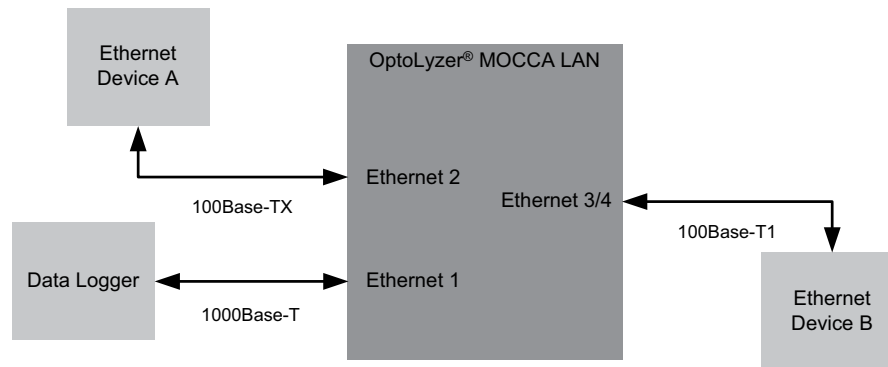
The OptoLyzer MOCCA LAN can act as interface to a **data logger** and transmit all data spied on a 100Base-T1 point-to-point connection to the data logger using a 1000Base-T Ethernet connection. [Figure 9.4](#) shows how this use case can be realized (whereby the data logger can be connected either to Ethernet interface 1 or 2 and the connection of the Ethernet Device A/B to the Ethernet interface 3/4 is selected arbitrarily).

Figure 9.4 Data Logger Use Case - 100Base-T1 to 100Base-T1



It is also possible to combine use case 3 ([Figure 9.3](#)) and use case 4 ([Figure 9.4](#)). This means the OptoLyzer MOCCA LAN is used as a **media converter** between different Ethernet physical layers **and** all data is transmitted to a **data logger**.

Figure 9.5 Data Logger Use Case with Media Converter

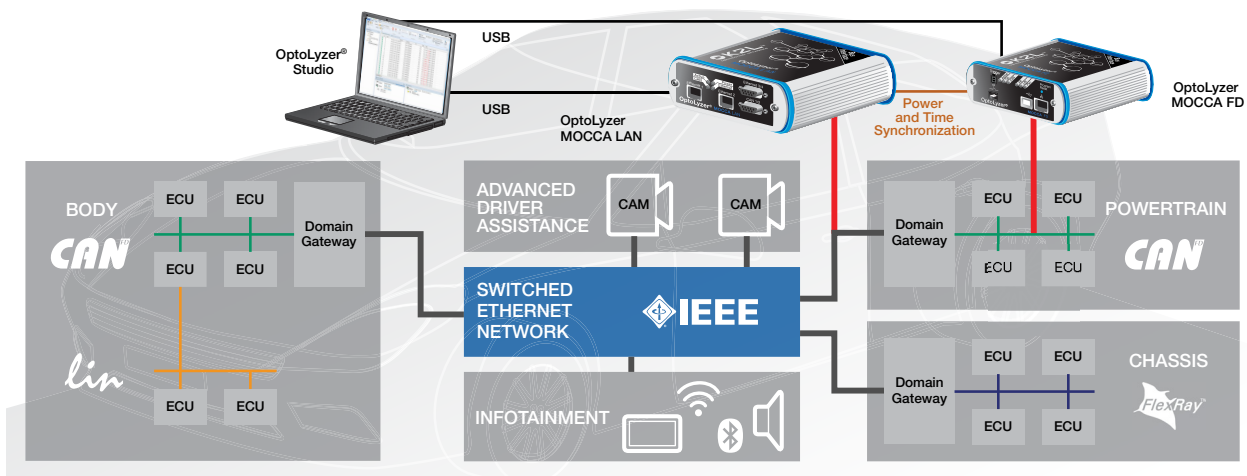


9.2 Time Synchronization

Complex network architectures can be found very often in an automotive environment. To get a proper impression about the system behavior i.e., to analyze the complete data transfer over all connected automotive bus systems it is required to refer all data relative to a common time base. This can be achieved by connecting different devices of the OptoLyzer MOCCA family over a time synchronization cable (i.e., SYNC cable V3). The synchronization cable is also capable of carrying power. The OptoLyzer MOCCA LAN has to be a timing slave if it is one of the time synchronized devices.

Figure 9.6 shows a scenario in which the OptoLyzer MOCCA LAN observes an Ethernet connection between the switch and the powertrain domain gateway. At the same time the OptoLyzer MOCCA FD observes the CAN FD traffic between the Electronic Control Units (ECUs) of the powertrain domain. Time-synchronized data, collected by the OptoLyzer MOCCA devices, is transmitted over USB to the OptoLyzer Studio that is running on a PC.

Figure 9.6 Time Synchronization



Chapter 10 Revision History

Table 10.1 Customer Revision History

| REVISION LEVEL | SECTION/FIGURE/ ENTRY | CORRECTION |
|----------------|---|---|
| DS60001522B | Section 4.3.1, "CAN" | Accuracy of CAN time stamps corrected: 60 μ s -> 100 μ s |
| | Section 4.3.2, "Ethernet" | Accuracy of Ethernet time stamps corrected: 60 μ s -> 100 μ s |
| DS60001522A | Initial Version | |

Further Information

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