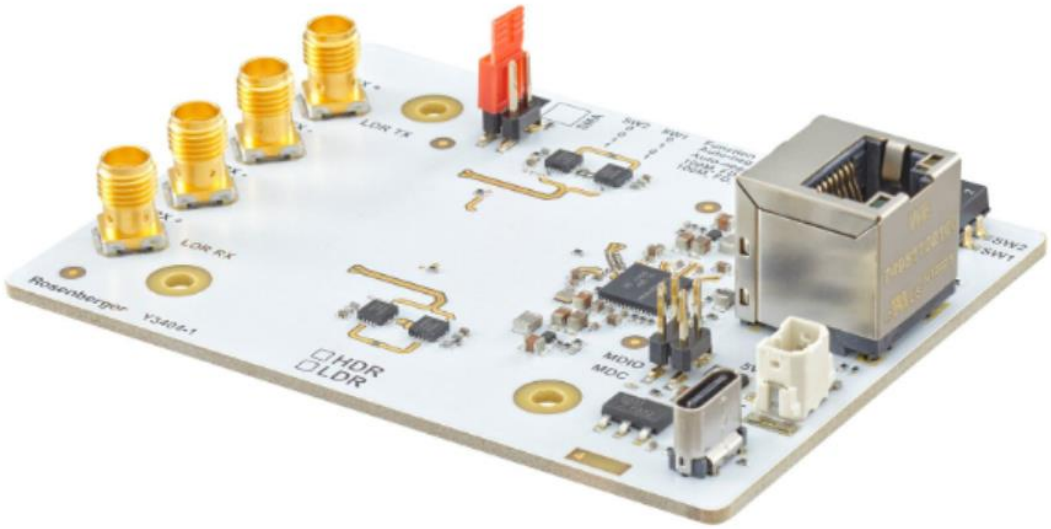
Rosenberger

RoProxCon - SoM
Evaluation Board

Users Guide



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List of Abbreviations

MDI	Media Dependent Interface
PHY	Physical Layer Transceiver
SGMII	Serial Gigabit Media Independent Interface
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

1 Revision History

Date of this revision: 17.02.2025

Revision Number / Date	Author	Approved	Summary of Changes	Changes marked
V1.0 / 17.02.2025	Johannes Winkler	Simon Huber	Initial Draft	N/A

2 Introduction

This user's guide describes how to set up the RoProxCon – SoM Evaluation Board correctly and which transmission tests can be performed.

The RoProxCon – SoM (System on Module) is a radio module for transmitting high-speed data contactless over a short distance in the centimetre range.

It also allows full functionality while one of the transmission partners rotates around the direct axis of view.

Compared to mechanically coupled connectors, the RoProxCon system allows more freedom of movement, for example, regarding axial misalignment and tilt.

With the RoProxCon – SoM Evaluation Board, this mechanical flexibility can also be tested.

3 Content of the evaluation kit

3.1 Electronics

There is one printed circuit boards MI1C813-900 included in the evaluation kit package.

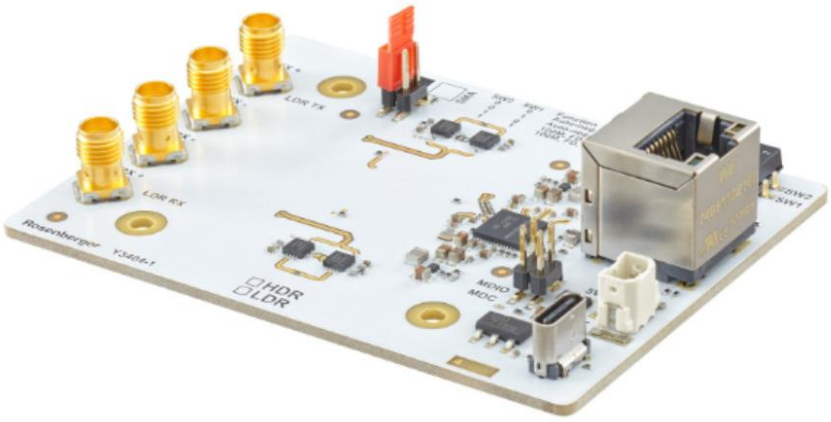

Figure 1: 3D view of MI1C813-900

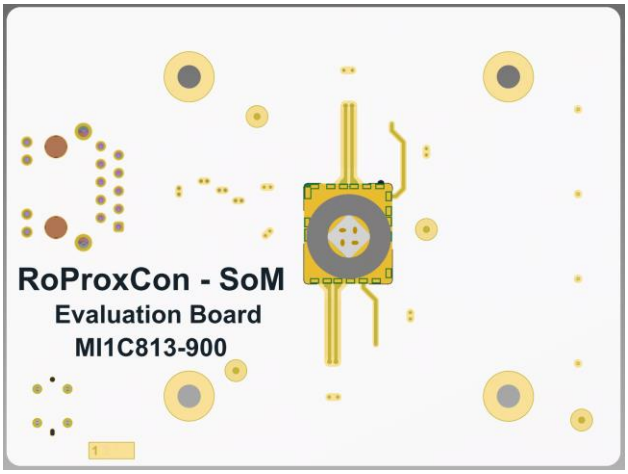

Figure 2: Top View of MI1C813-900

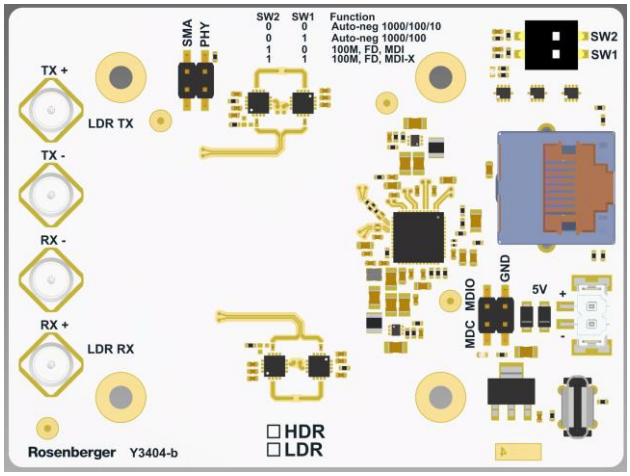

Figure 3: Bottom View of MI1C813-900

On the board, one RoProxCon – SoM is soldered and connected to a gigabit Ethernet PHY + RJ45 connector and directly to SMA connectors. With a jumper, the board can either be configured to use gigabit Ethernet for Ethernet-based applications like 10/100/1000BASE-T, PROFINET, EtherCAT (connect the board via the RJ45) or use other customer-specific protocols (connect the board via SMA connectors). See more details in chapter 5 for Ethernet and chapter 6 for other customer-specific protocols.

Furthermore, for power supply, a USB-C and auxiliary connector is mounted on the bottom side of the PCB.

Please see the Interface description for detailed functions.

3.2 Accessories

One Phoenix terminal block cable connector with the manufacturer number *1704853* is also part of the evaluation kit.

It can be used to supply the evaluation kit over the auxiliary power supply PCB connector.

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Figure 4: Cable connector for auxiliary power

4 Structure of the evaluation kit

4.1 Block diagram

As mentioned before the evaluation kit can be used for ethernet and other customer specific protocols, depending on the configuration.

For ethernet on the board a 10/100/1000BASE-T Ethernet Phy is assembled and for customer specific protocols the RoProxCon – SoM is directly connected to SMA connectors.

To supply the Phy IC and the SoM buck converters are used, which regulate an input voltage of 5 V down to the necessary supply voltage for the SoM (3.3 V) and the Ethernet-Phy (1.1 V / 2.5 V).

As can be seen in Figure 5, the RoProxCon – SoM is connected via the SGMII to the ethernet phy. The SGMII consists of one differential 100 Ω transmit pair and one differential 100 Ω receive pair.

On the other side of the ethernet phy the 10 / 100 / 1000BASE-T MDI is connected.

It is connected via four differential 100 Ω pairs to a RJ45 connector with integrated magnetics.

The connection to the SMA connectors is separated from the ethernet signal path due to a RF switch and connected via one differential 100 Ω transmit pair and one differential 100 Ω receive pair.

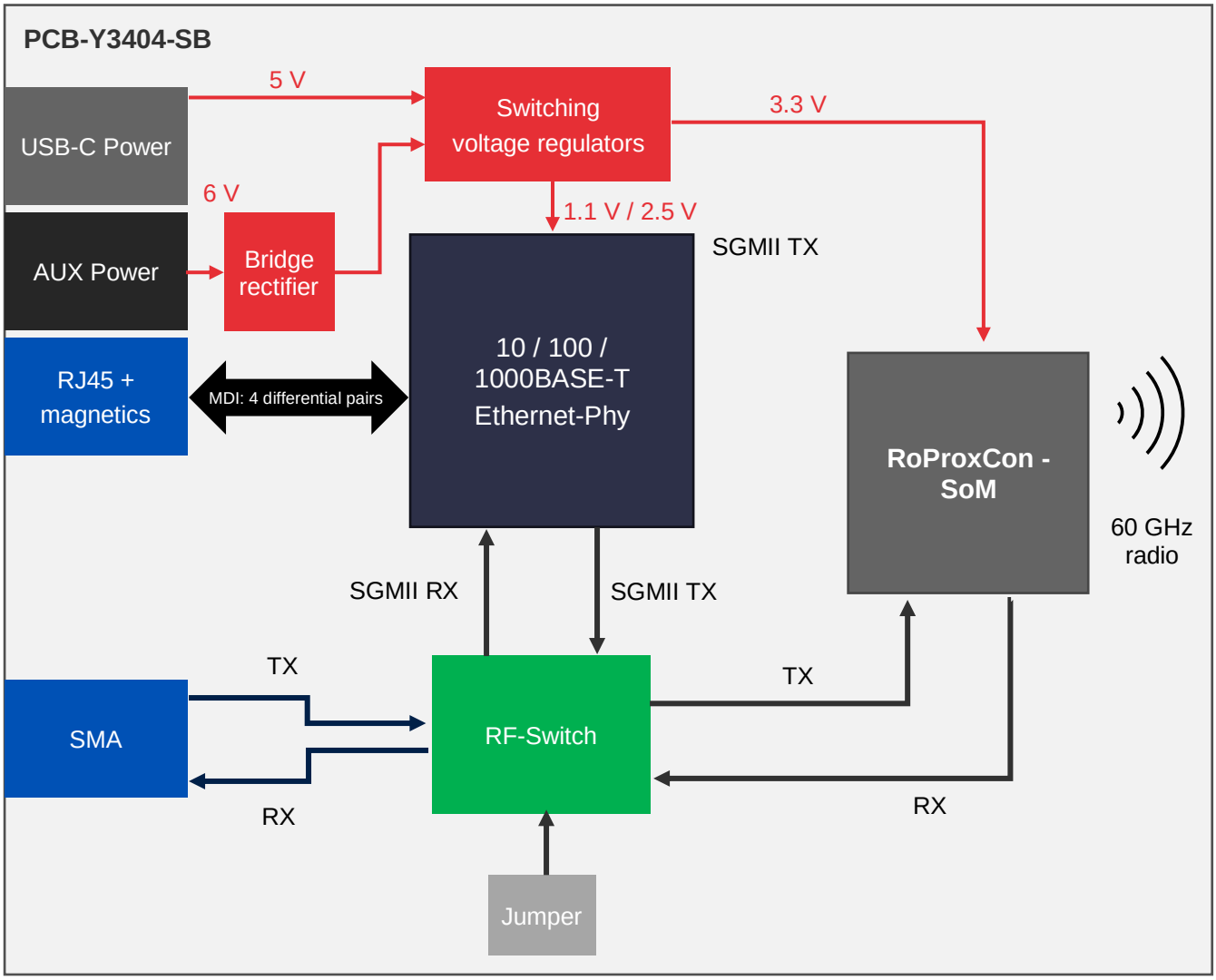
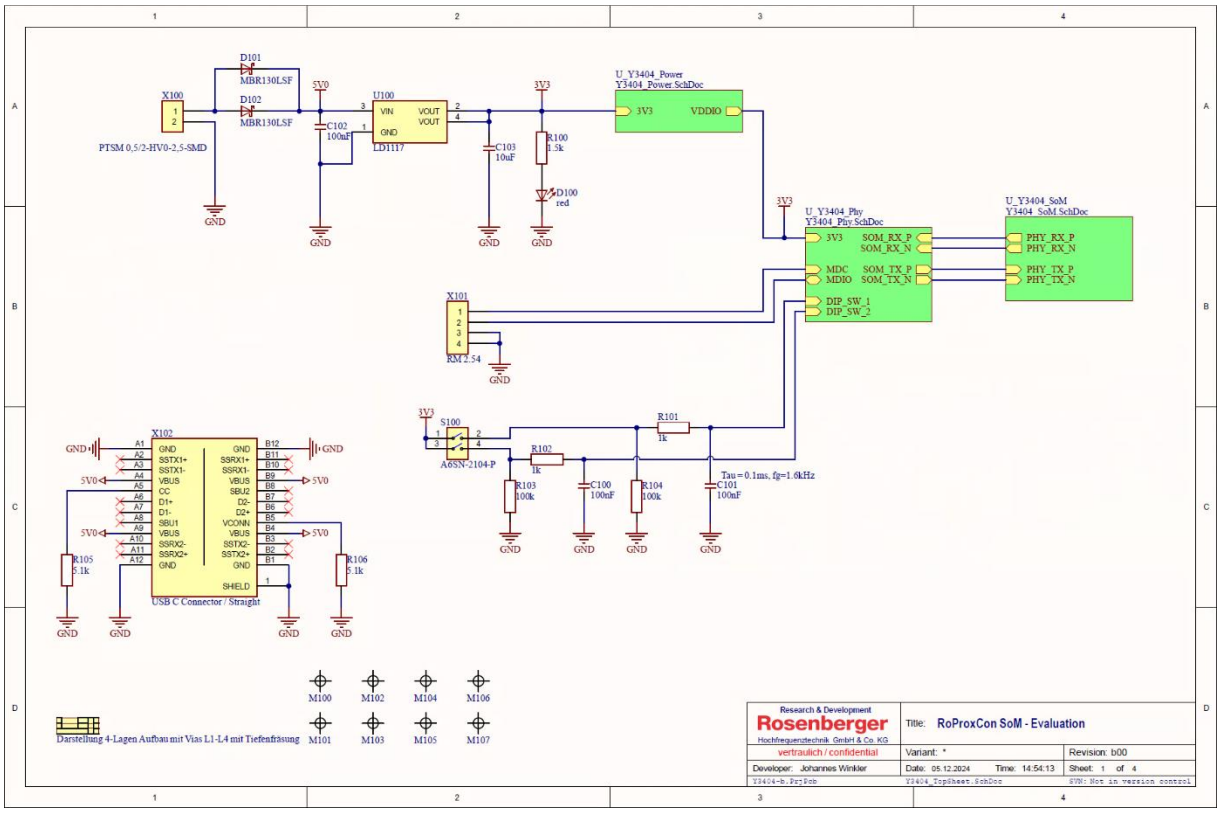
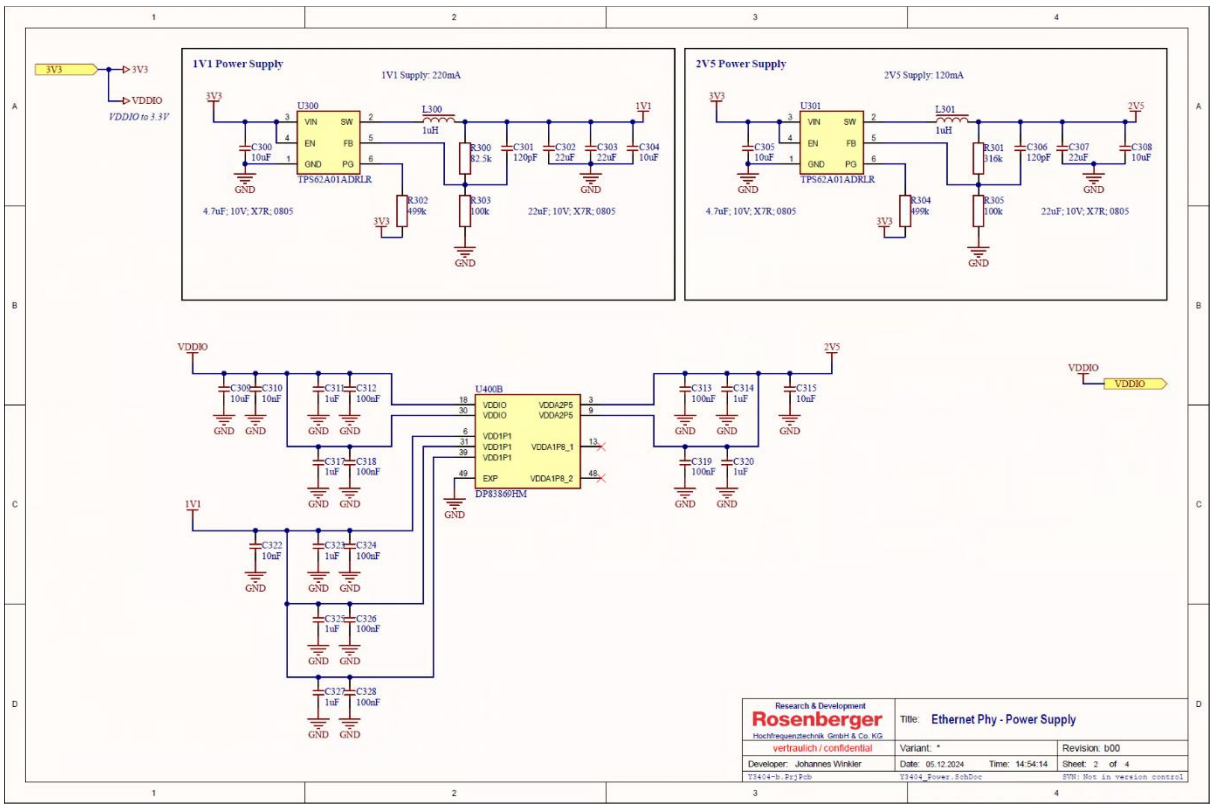
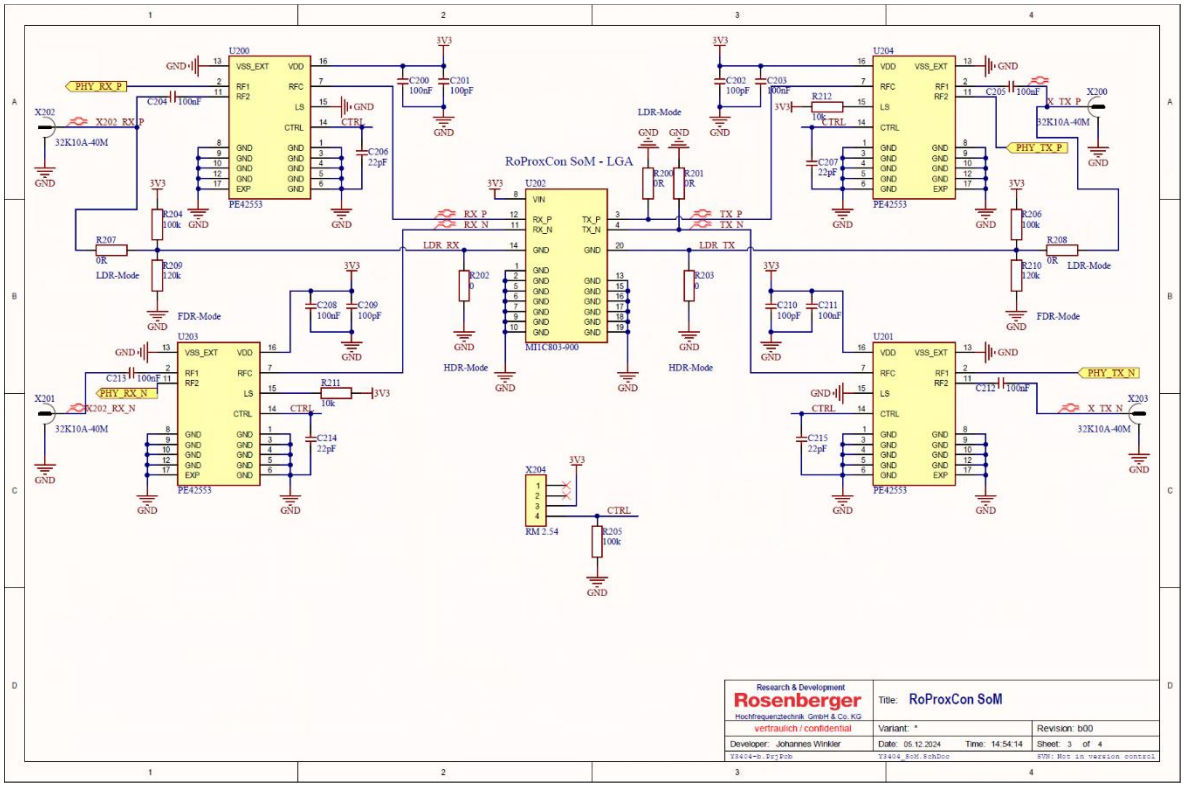


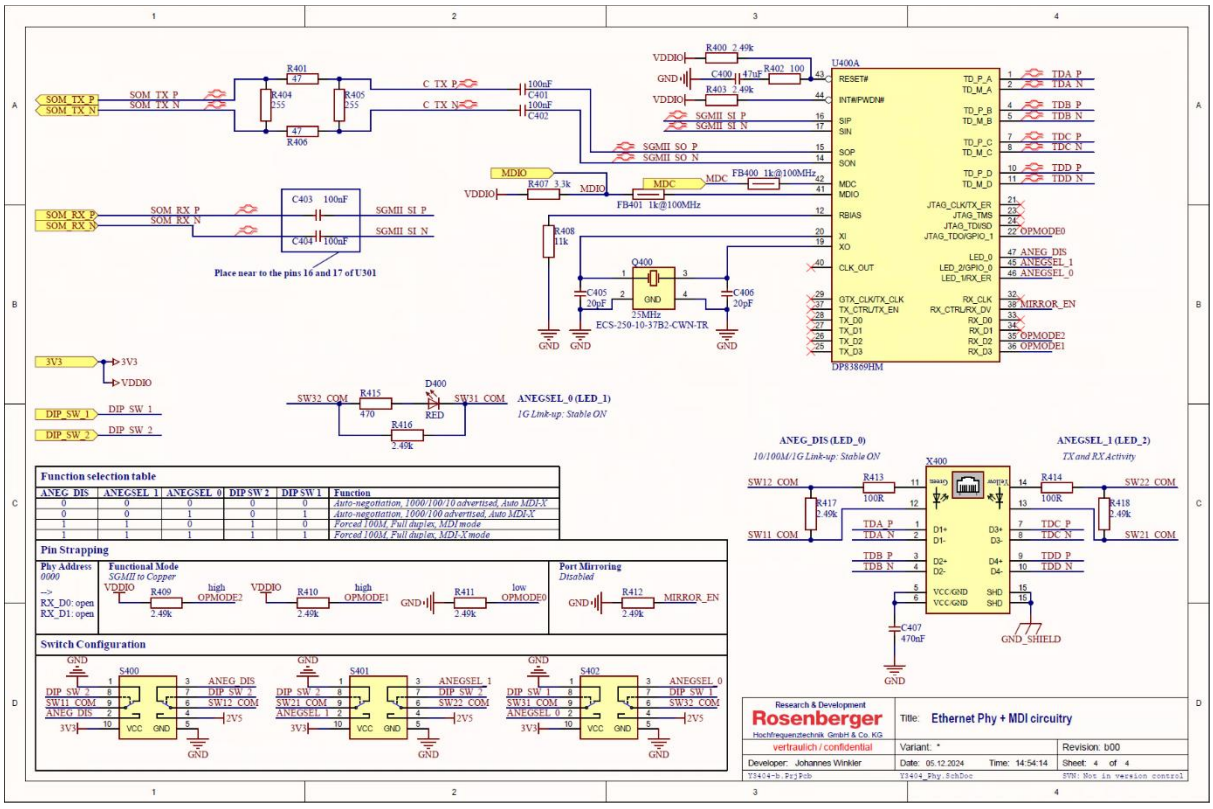
Figure 5: Block diagram of MI1C813-900

4.2 Schematics

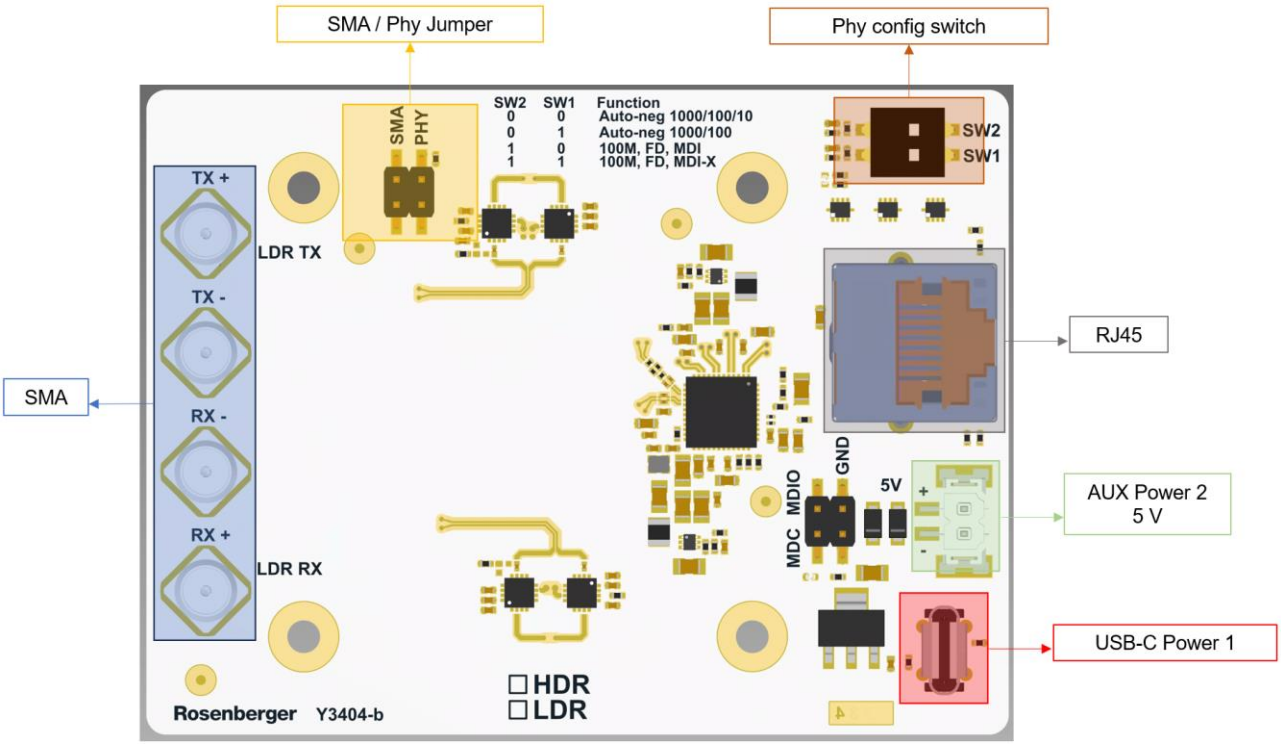





RoProxCon SoM - LGA
Research & Development
Rosenberger
Hochfrequenztechnik GmbH & Co. KG
vertraulich / confidential
Title: RoProxCon SoM
Variant: *
Revision: b00
Developer: Johannes Winkler
Date: 05.12.2024
Time: 14:54:14
Sheet: 3 of 4


Place near to the pins 16 and 17 of U301
Function selection table
Pin Strapping
Switch Configuration
Research & Development
Rosenberger
Hochfrequenztechnik GmbH & Co. KG
vertraulich / confidential
Title: Ethernet Phy + MDI circuitry
Variant: *
Revision: b00
Developer: Johannes Winkler
Date: 05.12.2024
Time: 14:54:14
Sheet: 4 of 4

4.3 Interface description



SMA	SMA connectors for standard SMA cables TX: Connections for a transmitter (e.g. external generator) RX: Connections for a receiver (e.g. oscilloscope)
SMA / Phy Jumper	Jumper to configure mode
Phy config switch	Switch to configure ethernet phy
RJ45	RJ45 PCB connector for Ethernet patch cables – please use CAT 5e or higher
AUX Power 2 / 5V	Power supply connector for auxiliary power
USB-C Power 1	USB-C PCB connectors only for power supply – no USB data transmission

5 Recommended setup Gigabit Ethernet

5.1 Gigabit Ethernet Testing

For ethernet testing the SMA / Phy Jumper must be configured as shown in Figure 6 and two boards must be used parallel to each other and connected like in Figure 7.

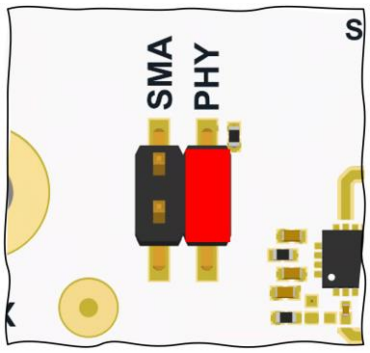


Figure 6: SMA / Phy Jumper Config Ethernet

Caution: Regardless of the Evalboard version, always set the jumper as shown in Figure 6 to enable communication via Ethernet.

In Figure 7, you can see the switches that allow you to set the data transfer rate on the Ethernet PHY.
The below table shows which options are possible and how to set each switch.
By default the board comes with option A pre selected.

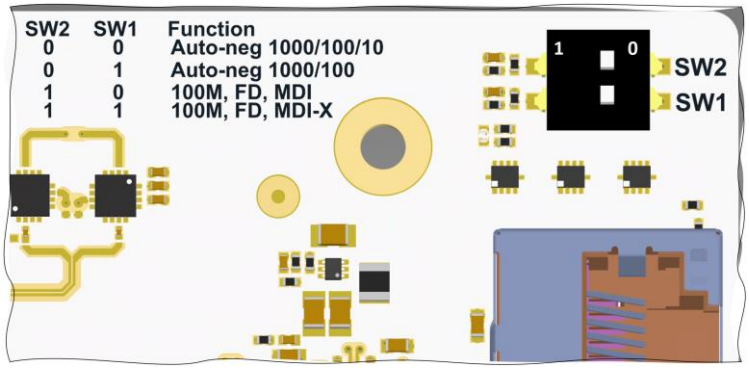


Figure 7: Switches to configure the speed standard at the ethernet phy

Option	SW2	SW1	Function
A	**0**	**0**	*Autonegotiation 1000/100/10BASE-T* Phy selects the speed automatically, depending on the communication partner
B	**0**	**1**	*Autonegotiation 1000/100BASE-T* Phy selects the speed (excluding 10 Mbps) automatically, depending on the communication partner
C	**1**	**0**	100BASE-TX, Full Duplex, MDI Phy will only negotiate 100BASE-TX in MDI mode with communication partner
D	**1**	**1**	100BASE-TX, Full Duplex, MDI-X Phy will only negotiate 100BASE-TX in MDI-X mode with communication partner

Caution: Always ensure the board is powered off before changing any settings.

Figure 8 shows, how the evaluation kit must be connected to the test computers.

To test the gigabit ethernet transmission (1000BASE-T) it is necessary to use at least CAT 5e cables or higher.

To supply the evaluation kit without an additional supply unit, the USB slots of the two notebooks can be used. Just connect them with the USB-C connectors of the evaluation kit.

After this described setup is finished, the ethernet transmission test via the network analysis tool IPerf.

It is free and can be downloaded here: https://iperf.fr/iperf-download.php

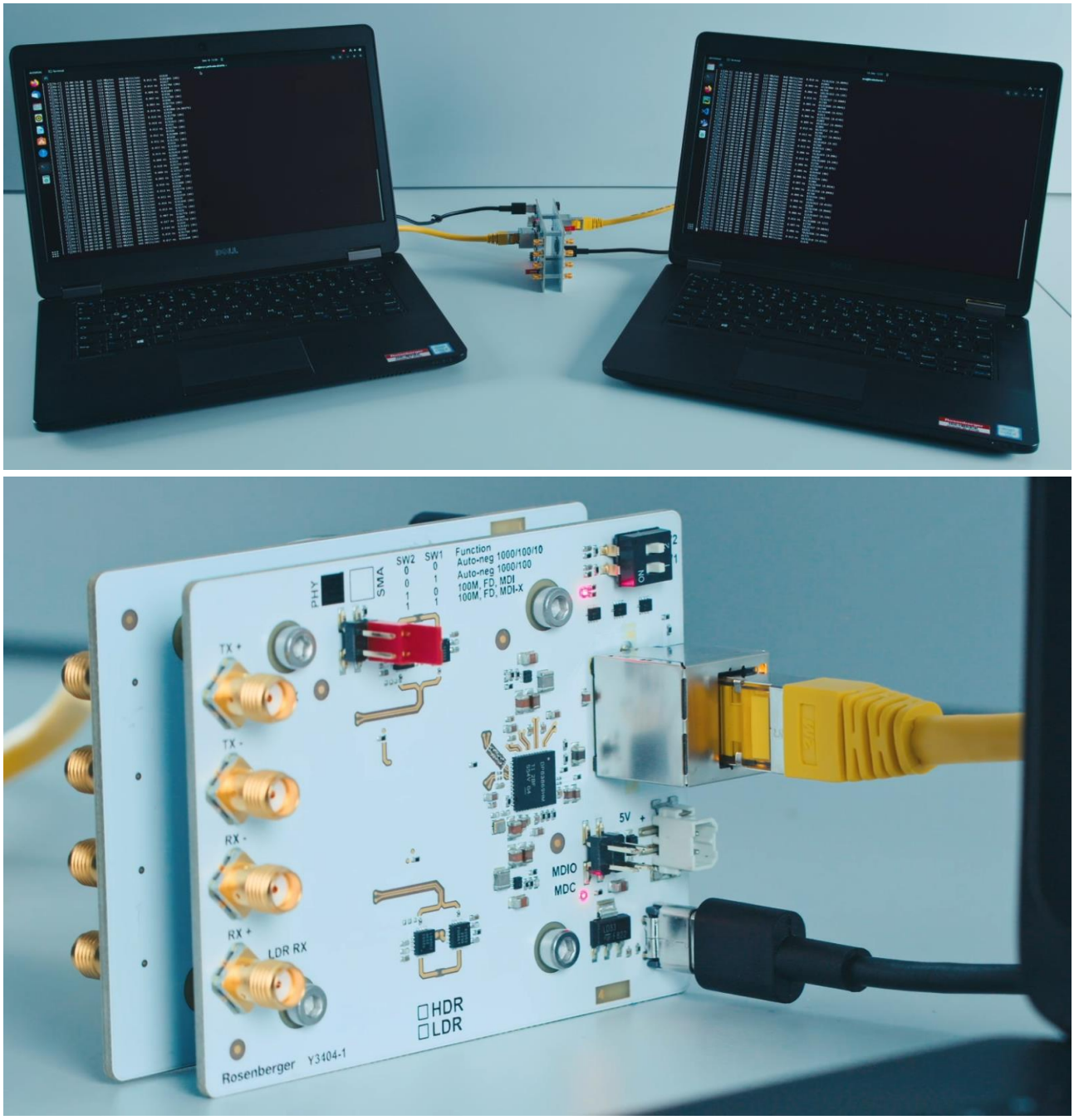


Figure 8: Test setup ethernet testing

In the next chapter the usage of the iPerf analysis tool for a 1000BASE-T transmission test is described.

5.2 Auto negotiation

In some applications the two transmission partners do not support the same ethernet derivate. Or, more precisely, negotiate different Ethernet standards with the RoProxCon Evalkit.

The auto negotiation process, specified in IEEE 802.3 clause 28, is designed to always negotiate the fastest possible transmission speed.

For example, one side can only transmit 100BASE-TX and the other one is able to transmit 1000BASE-T.

Since the Ethernet Phy on the evaluation board is configured for auto negotiation, the first side is negotiated to 100BASE-TX and the other to 1000BASE-T.

In this case, the communication between the two end points will fail. (See Figure 9)

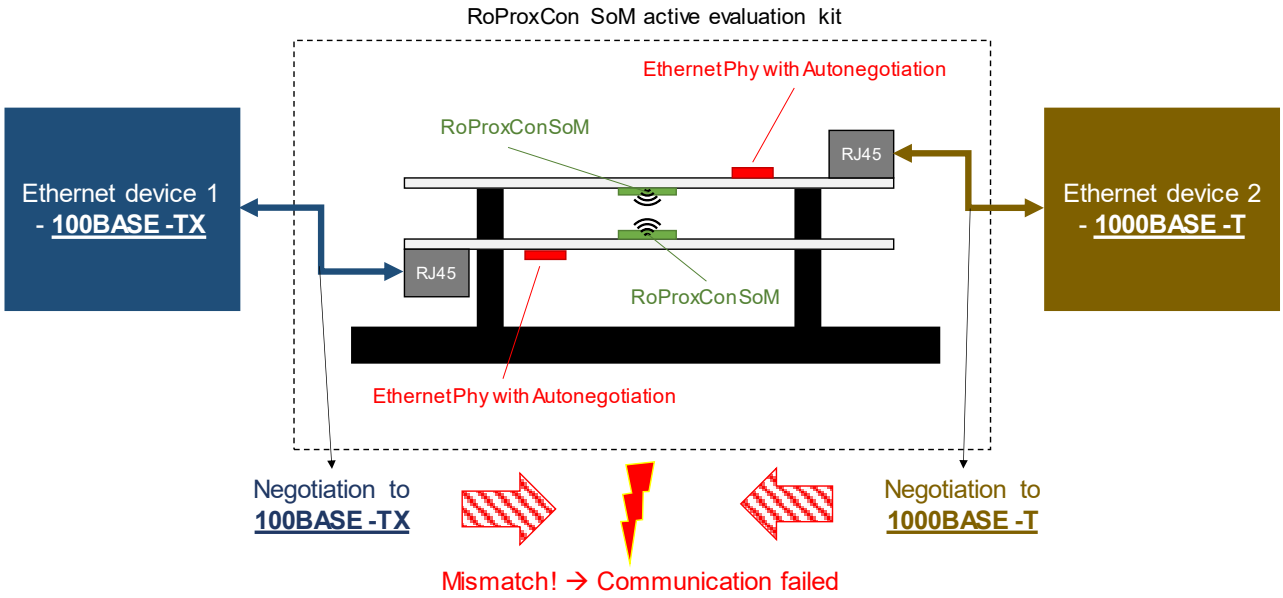


Figure 9: Autonegotiation issue with RoProxCon evaluation kit

To avoid this problem, you should ensure that the communication partners on both sides negotiate the same Ethernet derivative.

The next chapter describes how to do this e.g., with a Windows Ethernet device.

5.3 Presettings in Windows

Before the IPerf tool can be used the following settings and preparations must be done:

1. Identical settings regarding data rate at both communication sides (e.g. Windows PC)
   a. In Windows 10: network settings --> ethernet adaptor settings --> properties

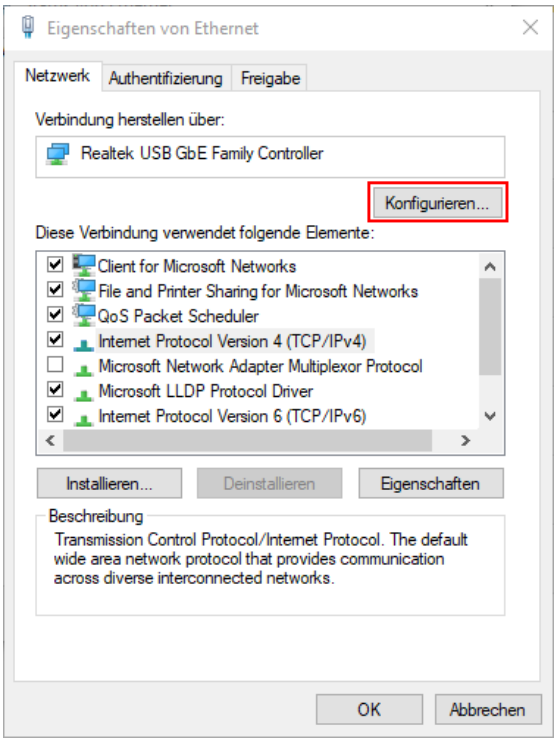


Figure 10: Ethernet adapter settings in Windows 10

   b. --> configure --> advanced --> Speed & Duplex

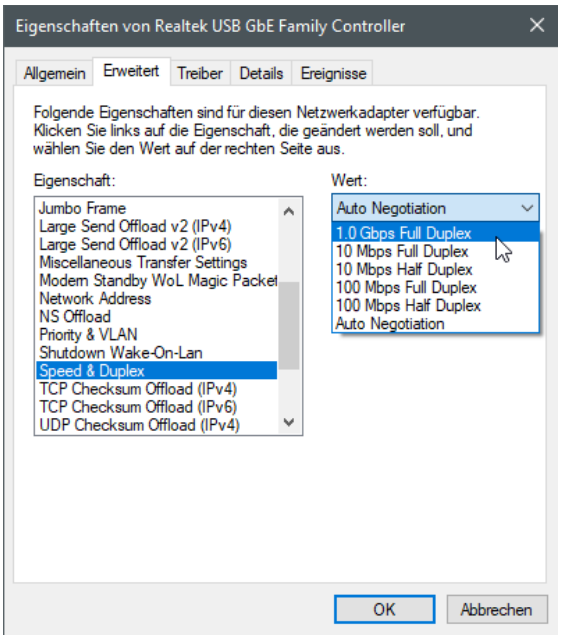


Figure 11: Ethernet adapter speed settings in Windows 10

It is possible to test each available data rate, up to 1 Gbit/s with the evaluation kit. But it must be ensured that the same settings are used on both sides.

2. Static IP addresses at both communication partners
    a. In Windows 10: network settings --> ethernet adaptor settings --> properties (see Figure 10)
    b. --> Internet Protocol Version 4 (TCP/IPv4)

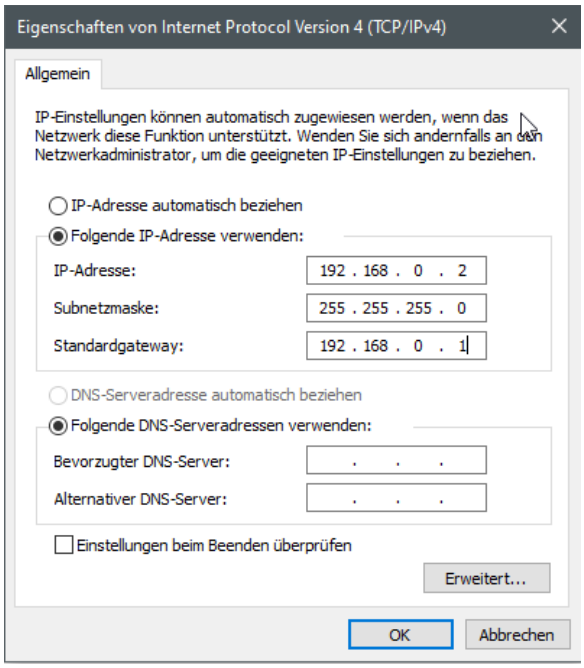


Figure 12: IP address settings in Windows 10

    c. The address of one PC should set to **192.168.0.2** the other can have the address **192.168.0.3** (other address settings also work of course)

5.4 IPerf transmission test

After downloading and installing the Iperf tool on Windows (please follow the instructions on https://iperf.fr), a PowerShell terminal can be opened in the installation folder. (“shift + right click --> open PowerShell window”)

At one PC a IPerf server can be started by

```
.\iperf3.exe -server.
```

If the IPerf server was started on the one PC a client can be started in UDP-mode with the command

```
.\iperf3.exe -udp -bandwidth 1G -client 192.168.0.2 -time 360 -len 63k
```

at the other communication partner.

Following table describes the options used at the above command:

Option	Description
-bandwidth 1G	Use Gigabit-Ethernet transmission speed (1000BASE-T)
-client 192.168.0.2	Start a client for the server with IP-address 192.168.0.2
-time 360	Transmission duration is 360 seconds
-len 63k	Transmission of 63 KB of data

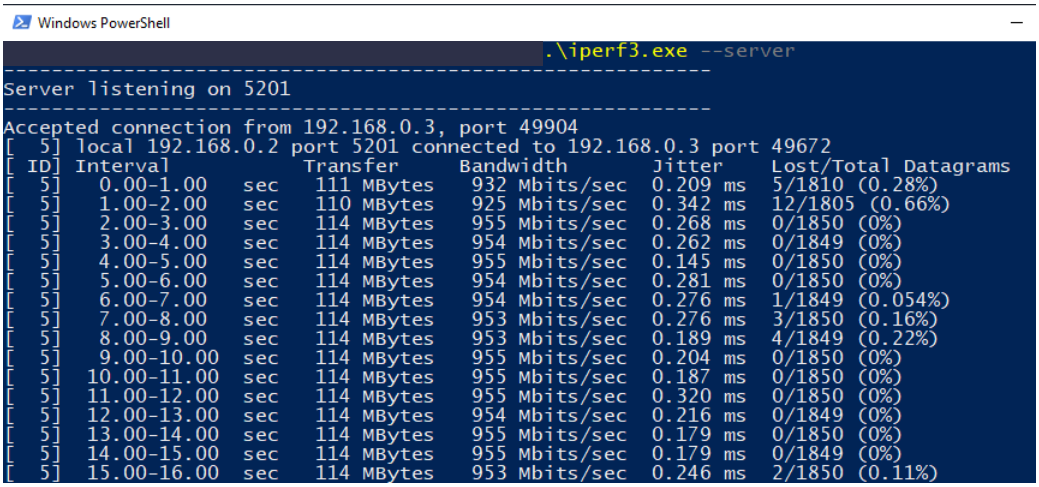


Figure 13: Snippet from the terminal output of IPerf network tool - server side

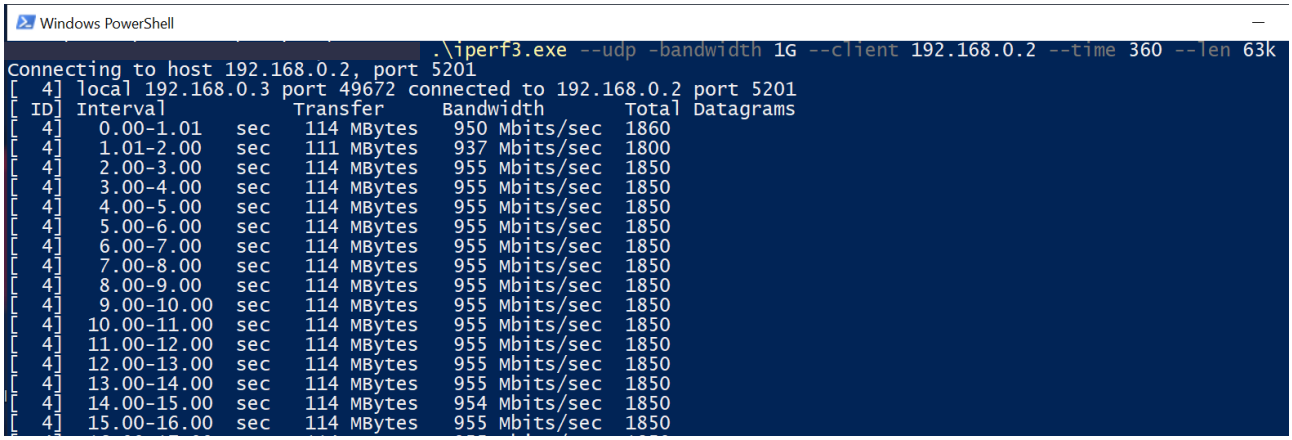


Figure 14: Snippet from the terminal output of IPerf network tool - client side

For more information and documentation regarding the IPerf software tool please visit https://iperf.fr/iperf-doc.php#3doc.

6 Recommended setup customer specific protocol

To test customer specific protocols and connect the RoProxCon SoM directly, the SMA / Phy Jumper must be configured as shown in Figure 15 and two boards must be used parallel to each other.

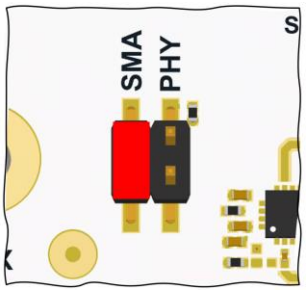


Figure 15: SMA / Phy Jumper Config Customer Specific Protocol

The following figures show an example of how specific protocols can be tested with the RoProxCon Eval-board SoM.

An arbitrary signal generator and a real-time oscilloscope are connected to the SMA connectors on the Eval-board. This allows measurements to be carried out in the time domain, such as determining a bit error rate or jitter behavior.

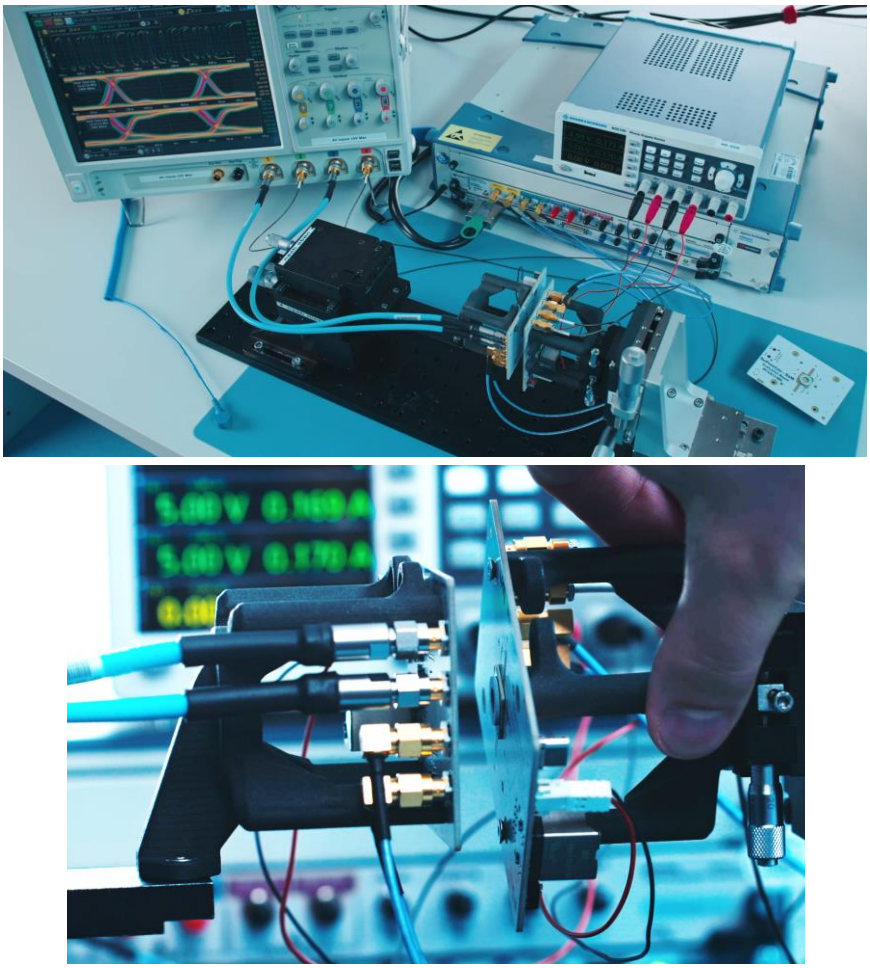


Figure 16: Test setup with signal generator and oscilloscope for specific protocols