# EESX Hardware Integration Guide

## Embedded Ethernet Switch eXtended

## Product Family

## EESX20 and EESX30

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Germany

# Contents

# Safety instructions

This documentation contains instructions which must be observed to ensure your own personal safety and to avoid damage to devices and machinery.

- **Certified usage**

  The device may only be employed for the purposes described in the catalog and technical description, and only in conjunction with external devices and components recommended or approved by the manufacturer. The product can only be operated correctly and safely if it is transported, stored, installed and assembled properly and correctly. Furthermore, it must be operated and serviced carefully.

- **Qualification requirements for personnel**

  Qualified personnel as understood in this manual and the warning signs are persons who are familiar with the setup, assembly, startup, and operation of this product and are appropriately qualified for their job. This includes, for example, those persons who have been:

  - ► trained or directed or authorized to switch on and off, to ground and to label power circuits and devices or systems in accordance with current safety engineering standards;
  - ► trained or directed in the care and use of appropriate safety equipment in accordance with the current standards of safety engineering;
  - ► trained in providing first aid.

- **National and international safety regulations**

  - ☐ Make sure that the electrical installation meets local or nationally applicable safety regulations.

- **CE marking**

  The labeled devices comply with the regulations contained in the following European directive(s):

  - ► **2011/65/EU and 2015/863/EU (RoHS)**
    Directive of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

  - ► **2014/30/EU (EMC)**
    Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.

In accordance with the above-named EU directive(s), the EU conformity declaration will be available to the relevant authorities at the following address:

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Germany

You find the EU conformity declaration as PDF file for downloading on the Internet at: https://www.doc.hirschmann.com/certificates.html

The device can be used in industrial environments.
Interference immunity: EN 61000-6-2

The assembly guidelines provided in these instructions must be strictly adhered to in order to observe the EMC threshold values.

**Warning!** This is a class A device. This device can cause interference in living areas, and in this case the operator may be required to take appropriate measures.

- **UKCA marking**

  - **S.I. 2012 No. 3032**
    Restriction of the Use of Certain Hazardous Substances in Electrical and Electronical Equipment Regulations**.**

  - **S.I. 2016 No. 1091**
    Electromagnetic Compatibility Regulations

The UKCA conformity declaration will be available to the relevant authorities at the following address:

Belden UK Ltd.
1 The Technology Centre, Station Road
Framlingham, IP13 9EZ, United Kingdom

You find the UKCA conformity declaration as PDF file for downloading on the Internet at:
https://www.doc.hirschmann.com/certificates.html

- **Maintenance**

  - ☐ When designing this device, Hirschmann was largely able to forego using wear parts. The parts subject to wear are dimensioned to last longer than the lifetime of the product when it is operated normally.
  - ☐ Relays are subject to natural wear. This wear depends on the frequency of the switching operations. Check the resistance of the closed relay contacts and the switching function periodically according to the frequency of the switching operations.
  - ☐ Hirschmann continually works on improving and developing their software. You should regularly check whether there is a new version of the software that provides you with additional benefits. You will find software information and downloads on the product pages of the Hirschmann website.

- **ESD guidelines**

  The media modules contain components highly sensitive to electrostatic fields. These components can be easily destroyed or have their lives shortened by an electrical field or by a discharge caused by touching the contacts. You can find more information about devices vulnerable to electrostatic fields in IEC/TR 61340-5-2 (2007-08)

- **Recycling note**

  After usage, this product must be disposed of properly as electronic waste, in accordance with the current disposal regulations of your county, state and country.

- **WARNING**

  Parts on EESX20/30 module or EESX-Evaluation-Board should not touched in operation!

  Due to possible hot spots of electronical components – especially the case of integrated circuits.

# About this Guide

This document provides technical specifications for the Embedded Ethernet Switch eXtended (EESX) Evaluation-Board. It also illustrates hardware integration guidelines for a Hirschmann Embedded Ethernet Switch eXtended (EESX) module. It describes the board level interfaces as well as the key operation parameters. Additionally, it provides the necessary information for a developer to validate their application design using the EESX-Evaluation-Board.

The information in this publication merely contain general descriptions or performance factors which, when applied in an actual situation, do not always correspond with the described form and may be amended by way of the further development of products. The desired performance factors shall only be deemed binding if these are expressly agreed on conclusion of the contract. Please note that some characteristics of the recommended accessory parts may differ from the appropriate product. This might limit the possible operating conditions for the entire system.

**Legend**
The symbols used in this manual have the following meanings:

| | |
|---|---|
| ▶ | Listing |
| □ | Work step |
| ■ | Subheading |

## Revision History

| Version | Date | Page | Description |
|---|---|---|---|
| 1.0 | 09/2014 | | Preliminary |
| 1.1 | 02/2015 | | General revised |
| 1.2 | 08/2015 | | Chapter “Recommended magnetics” added |
| 1.3 | 11/2016 | 28 | Schematic of Interface connection (1*9 Transceiver) modified |
| 1.4 | 01/2017 | 26 | Schematic of Interface connection 100Mbps (1*9 Transceiver) modified |
| 1.5 | 04/2020 | 21<br>24,25,26,28<br>31<br>32 | changed UE_Ok to input and updated description for VMag_P12<br>changed “not used” to “do not connect”<br>added comment to Figure 3-8<br>changed R111=4.7K to R111=1K |
| 1.6 | 03/2021 | 8, 14, 21, 33<br>20,23<br><br>1,2<br>44 | UE_ok and accociated push button,<br>do not connect I2C_Clk_x for low level<br>2× graphics for pin assignments of interface connectors CO201 & CO202 added<br>Technical support address and Copyright text changed<br>Chapter “Further support” changed |
| 1.7 | 08/2023 | 34 | Added information: “To help avoid unexpected Ethernet signal behavior, use transformers without common mode chokes” |
| 1.8 | 09/2023 | 5, 6 | CE marking and UKCA marking added |

# 1 EESX-Evaluation-Board Interfaces

## 1.1 Overview

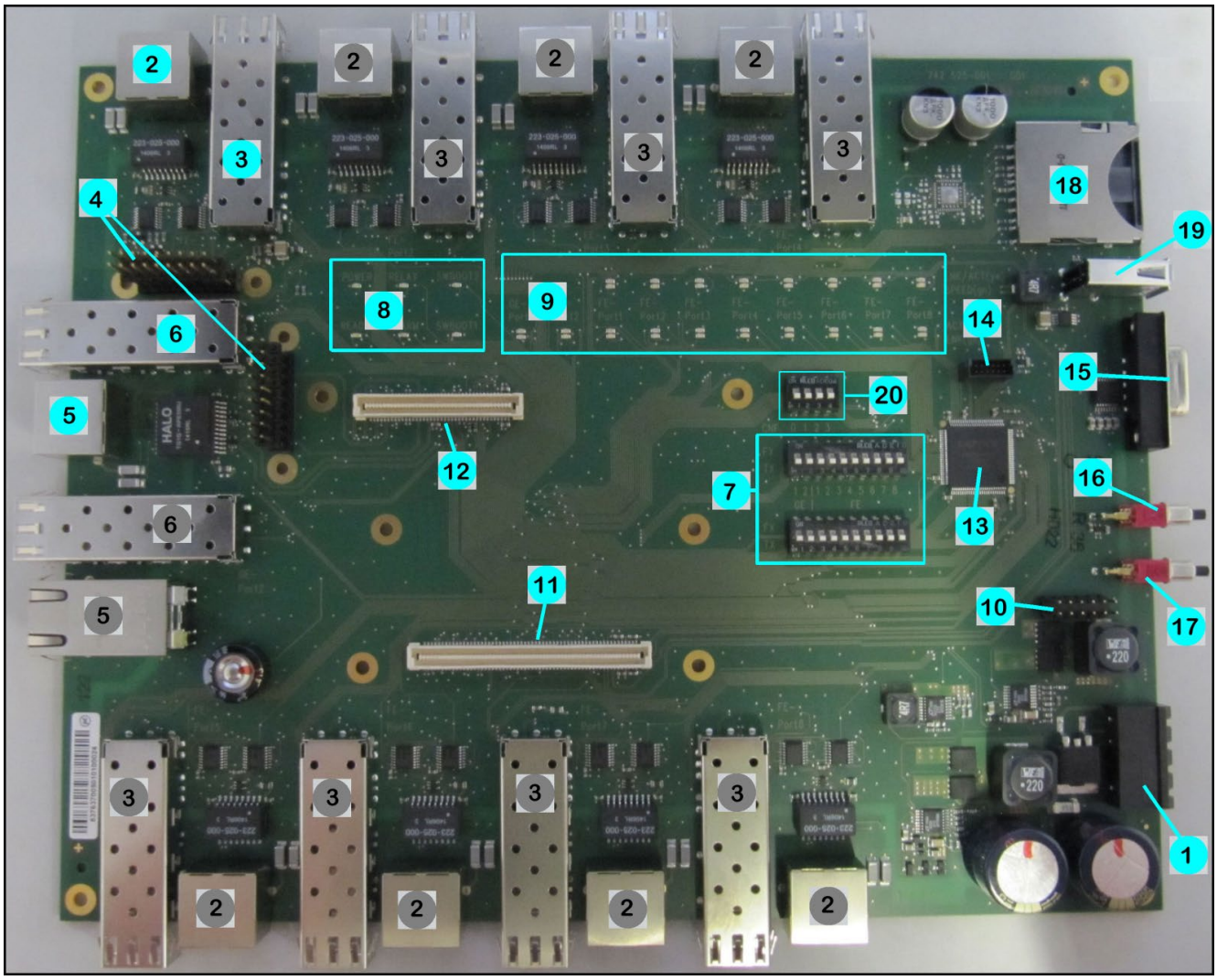



*Figure 1-1: Components of the PCB-assembly*

The hardware EESX-Evaluation-Board offers:

(1) DC Jack for 24 VDC external power supply

(2) 8 x Magnetics + RJ45 connector for 10/100Base-TX.

(3) 8 x SFP cages for 100Base-FX transceivers.

(4) 2 x DSC adapter for 100Base-FX transceivers at FE-Port 1 and GE-Port 1

(5) 2 x Magnetics + RJ45 connector for 10/100/1000Base-TX.

(6) 2 x SFP cages for 1000/100Base-FX transceivers.

(7) Mode-switches to set hardware mode to Base-TX (Copper) or to Base-FX (optical fibre)

(8) LEDs for module status

(9) LEDs for status information of link and data activity per port as well for device status

(10) 12-pin header with signals as measuring points (CO402)

(11) 120-pin, dual-row vertical male EESX connectors (CO201)

(12) 80-pin, dual-row vertical male EESX connectors (CO202)

(13) CPLD for control signals

(14) CPLD JTAG connector (CO401)

(15) RS-232 connector (SubD-9) for serial communication

(16) Push button: “Ue_Ok” (SW401) – Power supply Reset

(17) Push button: “PGOOD_PLD” (SW402)

(18) SD Card slot

(19) USB connector

(20) Configuration switch (currently without function)

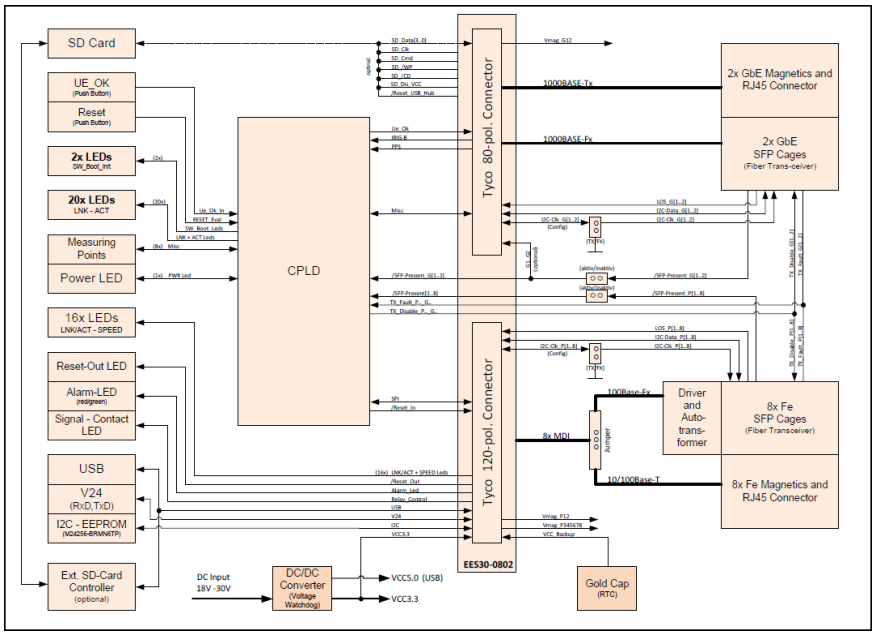



*Figure 1-2: Block diagram EESX-Evaluation-Board*

## 1.2 Power supply

Connect the DC jack on the EESX-Evaluation-Board to a 24 VDC power supply. Connect pins (1, 4) of the jack to +UE and the center pins (2, 3) of the jack to GND.

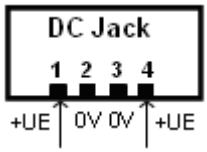



*Figure 1-3: DC jack connection*

The nominal voltage of the EESX-Evaluation-Board is 24V DC but also the EESX-Evaluation-Board can be supplied with +18 V up to +30 V at *UE1* and/ or *UE2*.

Supply the EESX-Evaluation-Board only inside this voltage range!

The Capacitance of C305 and C307 summed in the schematic should be at least 1000 uF at 24V power supply to ensure faultless operation if voltage interruptions of 10 ms occur!

## 1.3 Twisted Pair Ethernet Interface

The 10/100 and 1000 Mbit/s Ethernet ports (IEEE 802.3 10/100 Base-TX) use RJ45 sockets, and support:

- ► Auto negotiation
- ► Auto polarity
- ► Auto crossing (if auto negotiation is activated)
- ► 1000 Mbit/s full-duplex mode, only Ports 1 and 2 of EESX30
- ► 100 Mbit/s half-duplex mode, 100 Mbit/s full-duplex mode
- ► 10 Mbit/s half-duplex mode, 10 Mbit/s full-duplex mode

Default configuration: auto negotiation enabled.

**Note**:

EESX20: Ports 1 to 8 support Fast Ethernet, e.g. 10/100 Base-T (TX) full or half duplex.

EESX30: Ports 1 and 2 support Gigabit Ethernet, e.g. 10/100/1000 Base-T (TX) full or half duplex.

Ports 3 to 10 support Fast Ethernet, e.g. 10/100 Base-T (TX) full or half duplex.

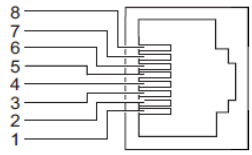
| Figure | Pin | Function | |
|---|---|---|---|
|  | 1 | RD+ | Receive Data + |
| | 2 | RD- | Receive Data - |
| | 3 | TD+ | Transmit Data + |
| | 6 | TD- | Transmit Data - |
| | 4,5,7,8 | Not used | |



*Figure 1-4: RJ45 Ethernet socket (100Mbit/s)*

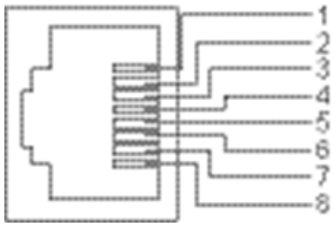
| Figure | Pin | Funktion |
|---|---|---|
|  | 1 | PMDX1+_G |
| | 2 | PMDX1-_G |
| | 3 | PMDX0+_G |
| | 4 | PMDX3+_G |
| | 5 | PMDX3-_G |
| | 6 | PMDX0-_G |
| | 7 | PMDX2+_G |
| | 8 | PMDX2-_G |



*Figure 1-5: RJ45 Ethernet socket (1000 Mbit/s)*

Connect only cable for Ethernet data transfer to these ports!

## 1.4 Fiber optic Ethernet Interface

The EESX-Evaluation-Board provides SFP cages for optical Fast Ethernet (100Base-FX) SFP transceivers for every Ethernet port. Even EESX30 module supports additionally 1000BASE-FX for GE-at Ports # 1 and 2.

An optical DSC (1*9) transceiver is available at FE-Port 1 and can be implemented at costumer's design for each FE-Port. (DSC transceiver at (Gigabit) GE-Ports are currently not supported by the software.)

Please contact the Hirschmann Service to order single DSC transceivers for your development. Find the contact data of the service in the last chapter of this manual.

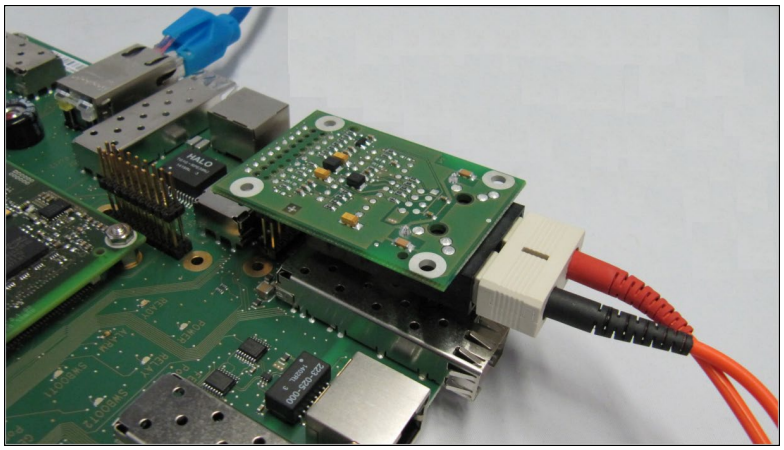


*Figure 1-6: FE-Port 1 with DSC transceiver for* 100Base-FX

## 1.5 Mode-switch Settings for Ethernet Ports

Each Fast Ethernet port (FE) can operate in either 10/100Base-TX (using RJ45 connectors) or 100Base-FX mode (using the SFP port) selected by the two Mode-switches (see Figure 1-7). The Gigabit Ethernet ports (GE) can operate in either 1000Base-TX or 100/1000Base-FX mode.

To change between TX and FX mode both switchover contacts of each port must be put to TX or FX position.

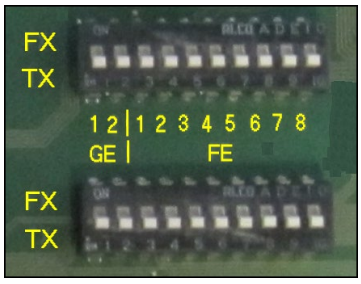



*Figure 1-7: Enable Copper (TX) or optical (FX) communication interface*

**Note**: See chapter 3.4 for more information about setting the ports to TX or FX mode.

**Note**: Port mode changes are activated after resetting the device.

## 1.6 Port count

Depending from the hardware type of EESX module the port count used in the software is different.

Module EESX20 has eight Fast Ethernet ports (FE) and EESX30 has additionally two Gigabit Ethernet ports (GE).

In Table 1-1 means *Physical Port* the port numbering on EESX-Evaluation-Board and *Logical Port* means the numbering by the software.

| **EESX-Evaluation-Board Physical Port** | **EESX20 Module Logical Port** | **EESX30 Module Logical Port** |
|---|---|---|
| GE-Port 1 | Not available | Port 1 |
| GE-Port 2 | Not available | Port 2 |
| FE-Port 1 | Port 1 | Port 3 |
| FE-Port 2 | Port 2 | Port 4 |
| FE-Port 3 | Port 3 | Port 5 |
| FE-Port 4 | Port 4 | Port 6 |
| FE-Port 5 | Port 5 | Port 7 |
| FE-Port 6 | Port 6 | Port 8 |
| FE-Port 7 | Port 7 | Port 9 |
| FE-Port 8 | Port 8 | Port 10 |

*Table 1-1: Port assignment from Evalboard to EESX20/30*

## 1.7 LED Status Indication

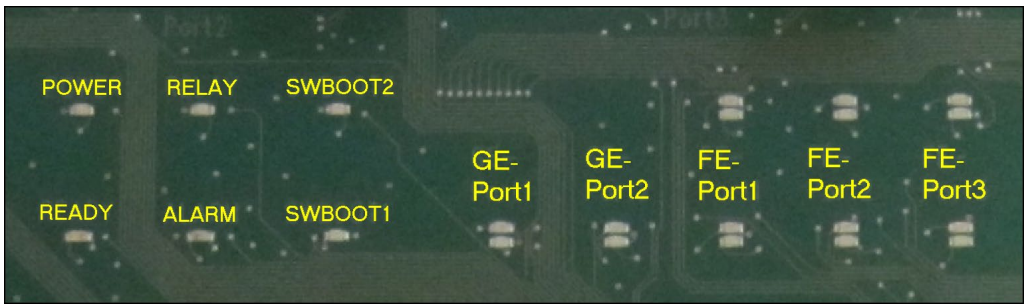



*Figure 1-8: Status LEDs on EESX-Evaluation-Board*

| | Status | Description |
|---|---|---|
| POWER | Off<br>Green | EESX-Evaluation-Board is unpowered.<br>EESX-Evaluation-Board is powered. |
| RELAY | Off<br>Green | Signal “Relay_Control” is low, System is not ready.<br>Signal “Relay_Control” is high, System is ready. |
| SWBOOT2 | Off<br>Green | Software is not loaded.<br>Software is loaded. |
| READY | Off<br>Light green | Software is not loaded, System is not ready.<br>Software is loaded, System is ready. |
| ALARM | Off<br>RED | System (software) is running.<br>System indicates abnormal operation status. |
| SWBOOT1 | Off<br>Green | Software is not loading.<br>Software is loading. |
| | | |
| GE-Port[1..2] | Off<br>Green<br><br>Off<br>Yellow blinking | No link (no physical connection).<br>Link is up (physical connection available).<br><br>No data traffic.<br>Data traffic. |
| FE-Port[1..8] | Off<br>Green<br><br>Off<br>Yellow blinking | No link.<br>Link is up.<br><br>No data traffic.<br>Data traffic. |

*Table 1-2: LED status indication*

## 1.8 Measuring Point Connectors

The 12-pin, dual-row connector on the EESX-Evaluation-Board give access to several EESX spare signals on connector CO402 which are reserved for future use. (See (10) in Figure 1-1.)

The signals are LVTTL level.

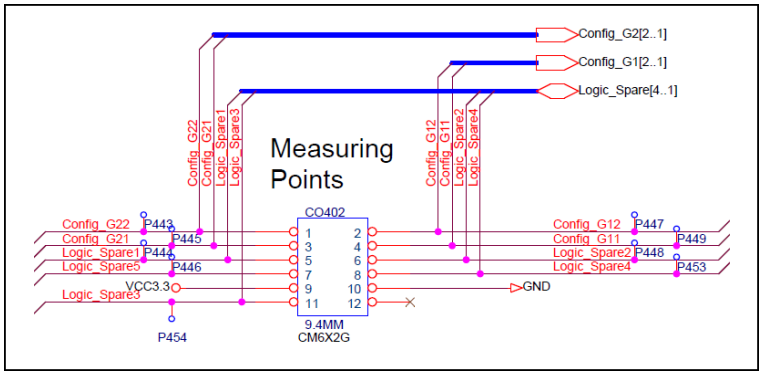



*Figure 1-9: EESX-Evaluation-Board schematic (part Measuring points)*

## 1.9 EESX Socket (CO201 and CO202)

The 120-pin dual-row socket CO201 and 80-pin dual-row socket CO202 on EESX-Evaluation-Board are used to mount the EESX20/30 module. Both sockets are the electrical interface between the EESX module and its Evaluation-Board. The interface connects the power supply, the Ethernet, logical and other signals.

For more details see chapter 2.

## 1.10 JTAG Connection (CPLD)

The CPLD IC401 (Lattice IC LCMXO2-640-4, see (13) in Figure 1-1) on EESX-Evaluation-Board can be programmed via connector CO401.

| Pin # | Signal | Pin # | Signal |
|---|---|---|---|
| 1 | VCC3.3_PLD | 2 | RTCK |
| 3 | TCK | 4 | TMS |
| 5 | n.c. | 6 | TDI |
| 7 | TDO | 8 | GND |
| 9 | n.c. | 10 | n.c. |
| 11 | n.c. | 12 | n.c. |

*Table 1-3: Pin assignment CO401*

## 1.11 Sub D9 Socket RS232

A serial data RS232 (V24_TxD/RxD) connection is available on the EESX-Evaluation-Board to provide access to the EESX module. This enables you to set up a connection to the Command Line Interface (CLI) and system monitor. For more information on the CLI functionality, refer to the Command Line Interface (EES) Reference Manual.

The serial interface uses RS232 (V.24) without hardware handshake. A SubD9 connector is mounted on the EESX-Evaluation-Board for this purpose.

RS232 socket pin description (SubD9 female):

- Pin 2 -> RxD (Data from the EESX-Evaluation-Board to the host)
- Pin 3 -> TxD (Data from host to Evaluation-Board)
- Pin 5 -> GND

Configure your terminal emulator (for example, Hyperterm, TeraTerm, PUTTY) with the following settings to issue CLI commands to the EESX module through the RS232 connection:

| Terminal Settings | |
|---|---|
| Speed | 9600 Baud |
| Data | 8 bit |
| Stop bit | 1 bit |
| Hand shake | off |
| Parity | none |

*Table 1-4: Parameters*

## 1.12 Push Buttons

The following push buttons are available on the EESX-Evaluation-Board:

- Push button SW401 to signal “Ue_Ok”: Resets the EESX module if button pushed. See (16) in Figure 1-1. The Reset is not done as a result of the signal Ue_Ok change. It is due to a power supply reset at the EESX-Evaluation-Board.
- Push button SW402 to signal “PGOOD_PLD“:See (17) in Figure 1-1. Tracks the signal “PGOOD_PLD” to ground (GND) potential if button pushed. This button is for test purposes.

# 2 EESX Module Socket

## 2.1 Mechanics

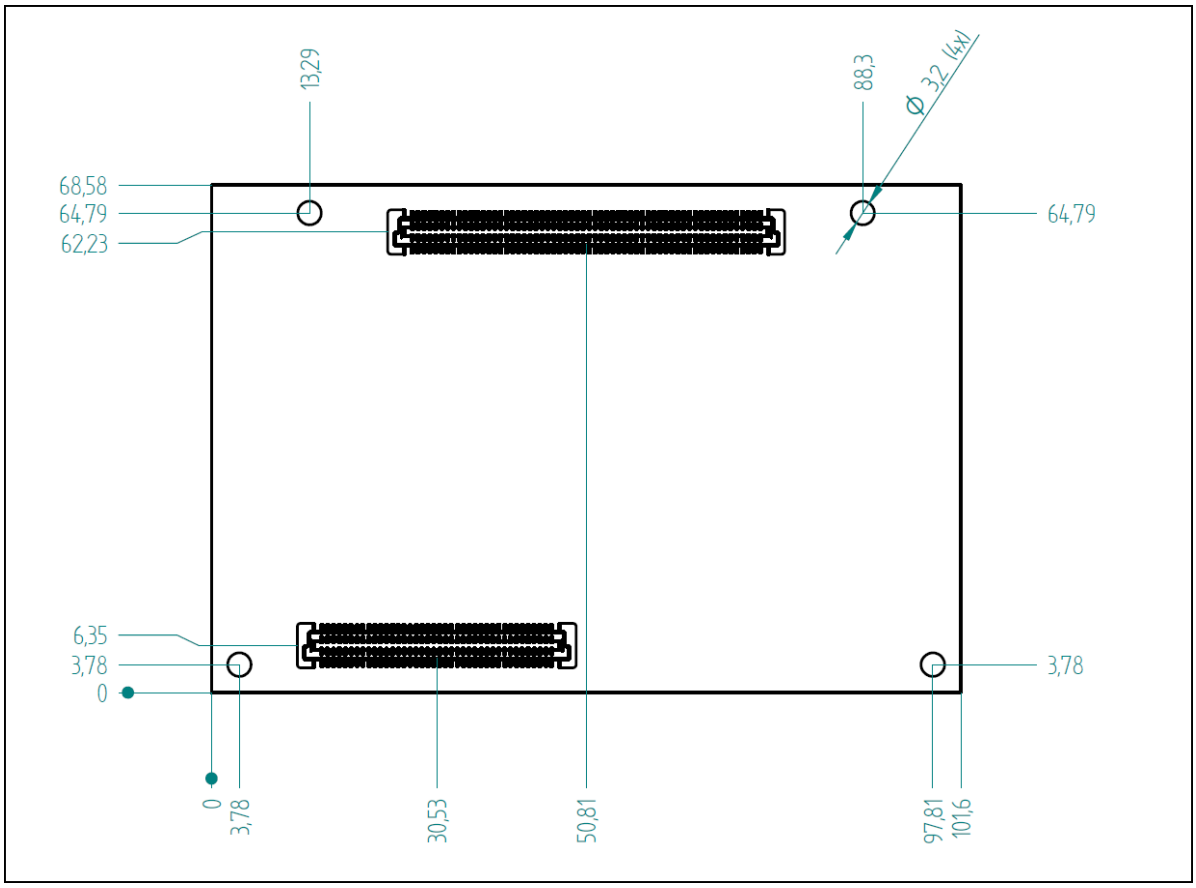



*Figure 2-1: EESX module with interconnectors; Bottom view*

The opposite interconnectors on the EESX-Evaluation-Board are manufactured by TE Connectivity (www.te.com).

Part number:

- Connector male 120 pins: 5084614-5 (Package Tube) or 5-5177986-5 (Package Tape and Reel).
- Connector male 80 pins: 5084614-3 (Package Tube) or 5-5177986-3 (Package Tape and Reel).

A stacking height of 5 mm is obtained as illustrated in Figure 2-2; at some positions less than 3 mm due to high components.

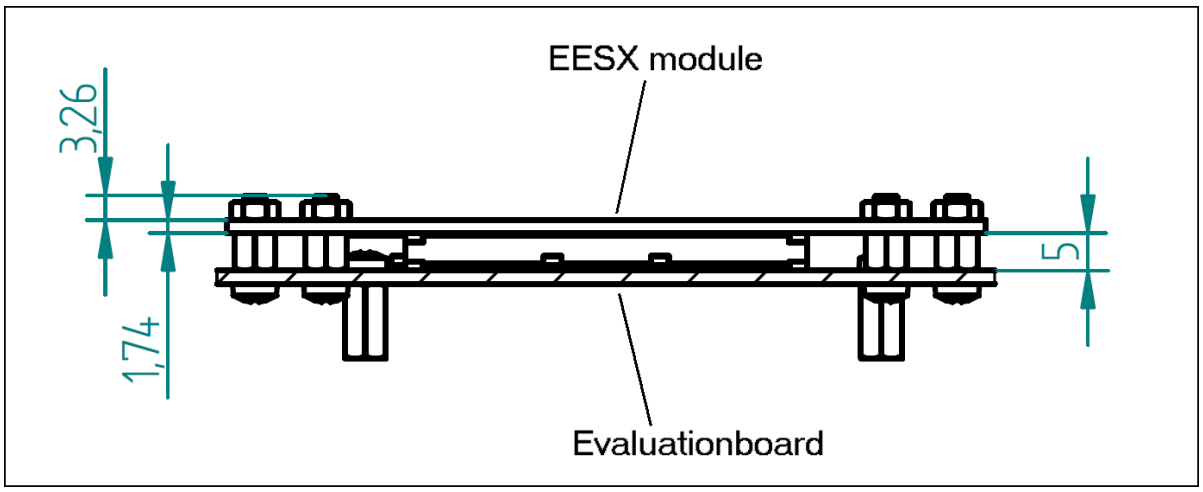



*Figure 2-2: EESX module mounted on EESX-Evaluation-Board with screws and nuts; sectional drawing*

**Note:**

It is recommended for costumer's applications to let the space idle beneath the module board for better heat dissipation of the module.

### 2.1.1 EESX-Module with Heat Spreader

The figure below shows the position of the drill-holes for the screws of the cooling block and the total height of the module. For details about the Heat dissipation parameters see chapter “Heat sink”:

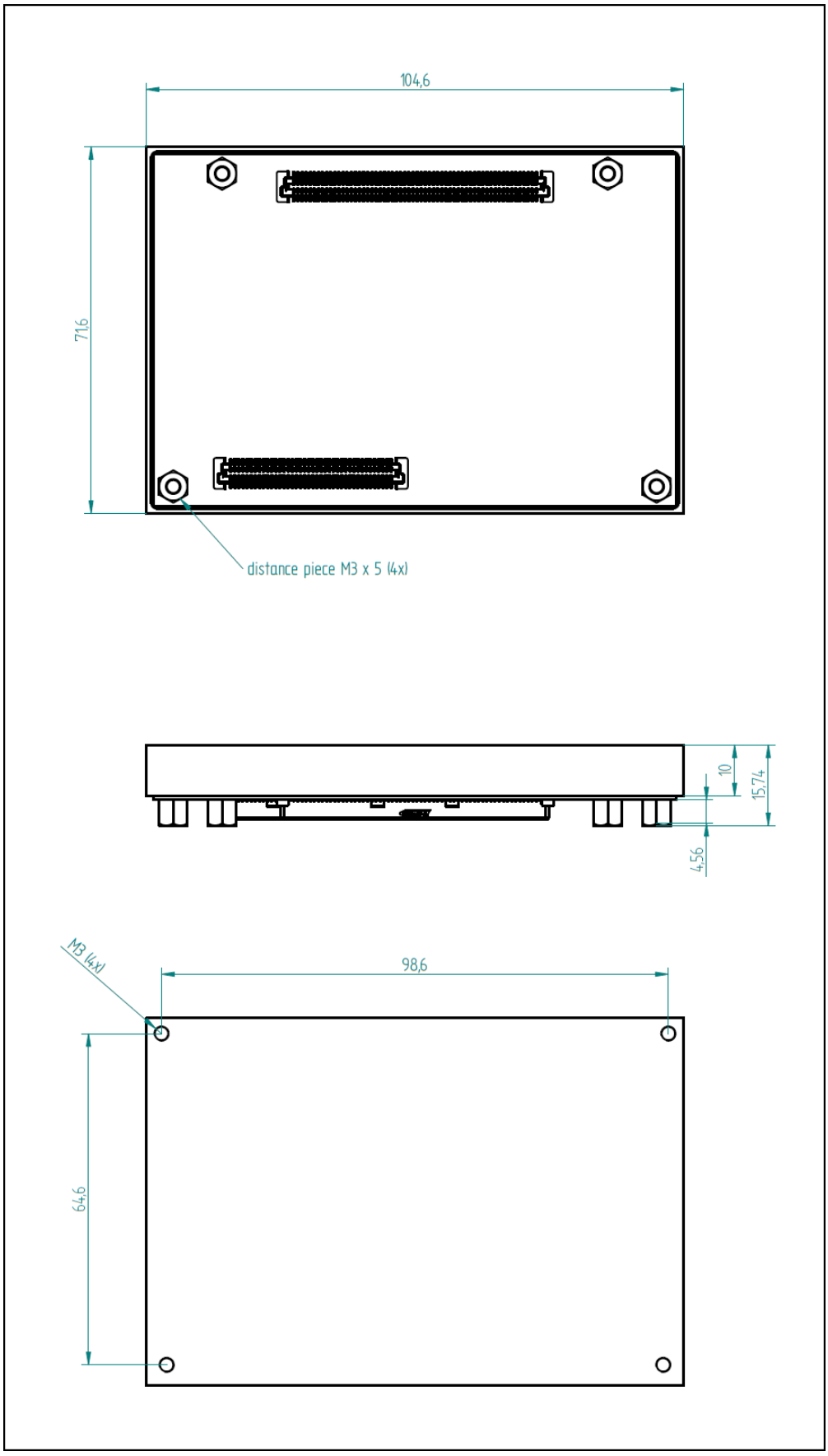



*Figure 2-3: EESX module with mounted cooling plate; Bottom-, side-, and top-view*

### 2.1.2 Components to be cooled on EESX-Module

The following ICs should be cooled if the permissible case temperature will be exceeded.
(See Chapter *Technical Data* for case temperature.)

| Component | x-direction / mm | y-direction / mm |
|---|---|---|
| IC401 | 28 | 28 |
| IC901 | 17,5 | 17,5 |
| IC902 | 14 | 8 |
| IC1002 | 6 | 8 |
| IC602 (EESX30 only) | 12,2 | 12,2 |
| IC202 | 6,82 | 4,5 |
| IC203 | 7 | 4,5 |
| IC205 | 4,5 | 7 |

*Table 2-1: Dimensions of ICs to be cooled on EESX-Module (related to Figure 2-4)*

**Component positions on ESSX board for a heat sink**
In the picture below are the positions of the components on EESX board which should be connected to a heat sink for cooling.

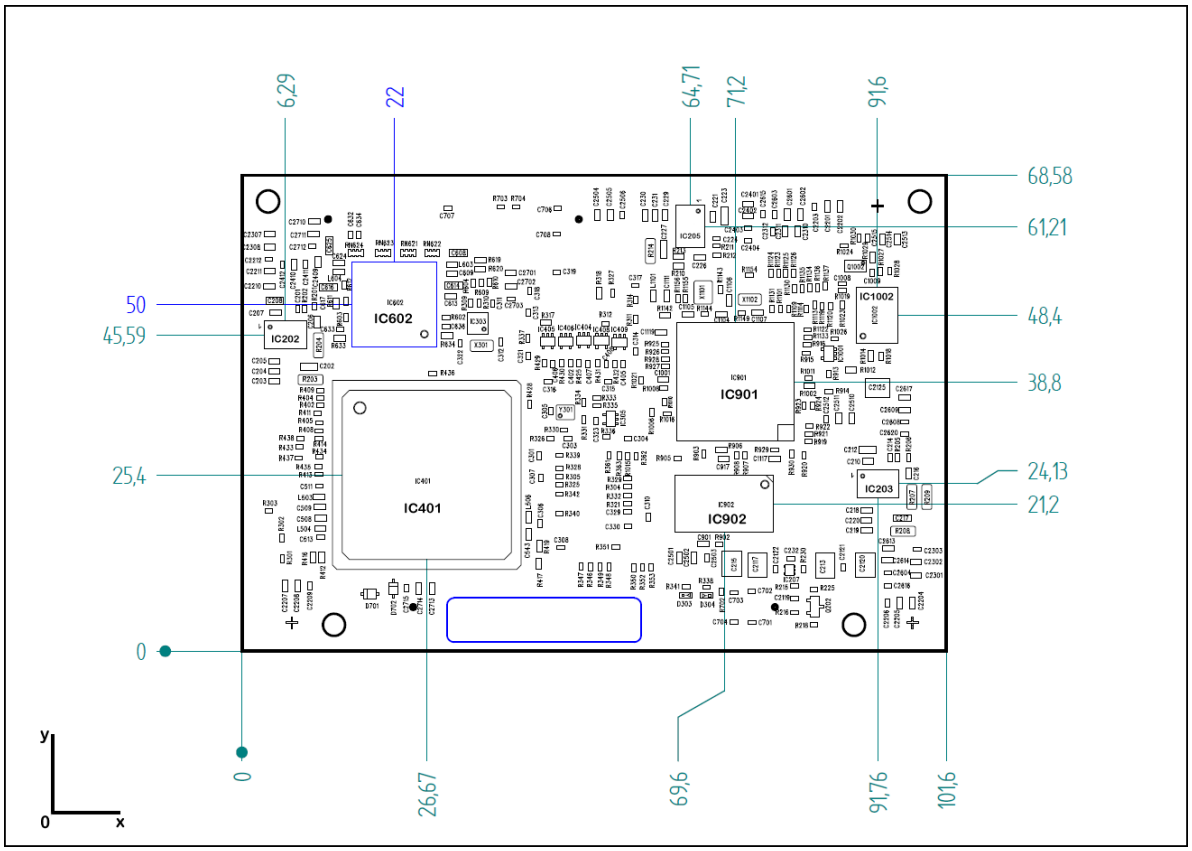



*Figure 2-4: Positions of ICs to be cooled on EESX-Module TOP VIEW*

**Component heights on ESSX board for a heat sink**

| Component | Height (min.) | Height (nominal) | Height (max.) |
|---|---|---|---|
| IC401 | 2.20 mm | 2.33 mm | 2.52 mm |
| IC901 | Not available | Not available | 1.60 mm |
| IC902 | Not available | Not available | 1.20 mm |
| IC1002 | 0.70 mm | 0.75 mm | 0.80 mm |
| IC202, IC203, IC205 | 1.05 mm | 1.1 mm | 1.15 mm |
| IC602 (EESX30 only) | Not available | Not available | 1,78 mm |

*Table 2-1: Component heights of ICs to be cooled on EESX-Module*

According to supplier's data sheets. Recommended additional tolerance: 0.4 mm.

## 2.2 PIN Assignment at connector CO201

Table 2-1 and Table 2-2 describe the pin out and signals names of the interconnectors CO201 mounted on the EESX-Evaluation-Board and its complementary one on the module.

| CO201 | | | |
|---|---|---|---|
| **Pin** | **Name** | **Pin** | **Name** |
| 1 | VCC3.3_EES | 2 | VCC3.3_EES |
| 3 | VCC3.3_EES | 4 | VCC3.3_EES |
| 5 | VCC3.3_EES | 6 | Ue_Ok |
| 7 | GND | 8 | GND |
| 9 | GND | 10 | GND |
| 11 | VMag_P38 | 12 | VMag_P12 |
| 13 | USB_D+ | 14 | USB_/OC |
| 15 | USB_D- | 16 | USB_Pwr_on |
| 17 | V24_TxD | 18 | I2C_Clk_Aux |
| 19 | V24_RxD | 20 | I2C_Da_Aux |
| 21 | /System_ready | 22 | /LED_Alarm |
| 23 | SPI_MISO_Aux | 24 | Relay_Control |
| 25 | SPI_MOSI_Aux | 26 | /Reset_in |
| 27 | LOS_P8 | 28 | LOS_P7 |
| 29 | LOS_P6 | 30 | LOS_P5 |
| 31 | LOS_P4 | 32 | LOS_P3 |
| 33 | LOS_P2 | 34 | LOS_P1 |
| 35 | /LED_Lnk_Act_P8 | 36 | /LED_Lnk_Act_P7 |
| 37 | /LED_Lnk_Act_P6 | 38 | /LED_Lnk_Act_P5 |
| 39 | /LED_Lnk_Act_P4 | 40 | /LED_Lnk_Act_P3 |
| 41 | /LED_Lnk_Act_P2 | 42 | /LED_Lnk_Act_P1 |
| 43 | /LED_Speed_P8 | 44 | /LED_Speed_P7 |
| 45 | /LED_Speed_P6 | 46 | /LED_Speed_P5 |
| 47 | /LED_Speed_P4 | 48 | /LED_Speed_P3 |
| 49 | /LED_Speed_P2 | 50 | /LED_Speed_P1 |
| 51 | I2C_Clk_P8 | 52 | I2C_Clk_P8 |
| 53 | I2C_Clk_P6 | 54 | I2C_Clk_P8 |
| 55 | I2C_Clk_P4 | 56 | I2C_Clk_P8 |
| 57 | I2C_Clk_P2 | 58 | I2C_Clk_P8 |
| 59 | SPI_Clk_Aux | 60 | SPI_/SS_Aux |
| 61 | GND | 62 | GND |
| 63 | I2C_Da_P8 | 64 | I2C_Da_P7 |
| 65 | I2C_Da_P6 | 66 | I2C_Da_P5 |
| 67 | GND | 68 | GND |
| 69 | I2C_Da_P4 | 70 | I2C_Da_P3 |
| 71 | I2C_Da_P2 | 72 | I2C_Da_P1 |
| 73 | GND | 74 | GND |
| 75 | TD+P8 | 76 | RD+P8 |
| 77 | TD-P8 | 78 | RD-P8 |
| 79 | GND | 80 | GND |
| 81 | TD-P7 | 82 | RD-P7 |
| 83 | TD+P7 | 84 | RD+P7 |

| CO201 | | | |
|---|---|---|---|
| **Pin** | **Name** | **Pin** | **Name** |
| 85 | GND | 86 | GND |
| 87 | TD+P6 | 88 | RD+P6 |
| 89 | TD-P6 | 90 | RD-P6 |
| 91 | GND | 92 | GND |
| 93 | TD-P5 | 94 | RD-P5 |
| 95 | TD+P5 | 96 | RD+P5 |
| 97 | GND | 98 | GND |
| 99 | TD+P4 | 100 | RD+P4 |
| 101 | TD-P4 | 102 | RD-P4 |
| 103 | GND | 104 | GND |
| 105 | TD-P3 | 106 | RD-P3 |
| 107 | TD+P3 | 108 | RD+P3 |
| 109 | GND | 110 | GND |
| 111 | TD+P2 | 112 | RD+P2 |
| 113 | TD-P2 | 114 | RD-P2 |
| 115 | GND | 116 | GND |
| 117 | TD-P1 | 118 | RD-P1 |
| 119 | TD+P1 | 120 | RD+P1 |

*Table 2-2: Pin assignment of interface connector CO201*

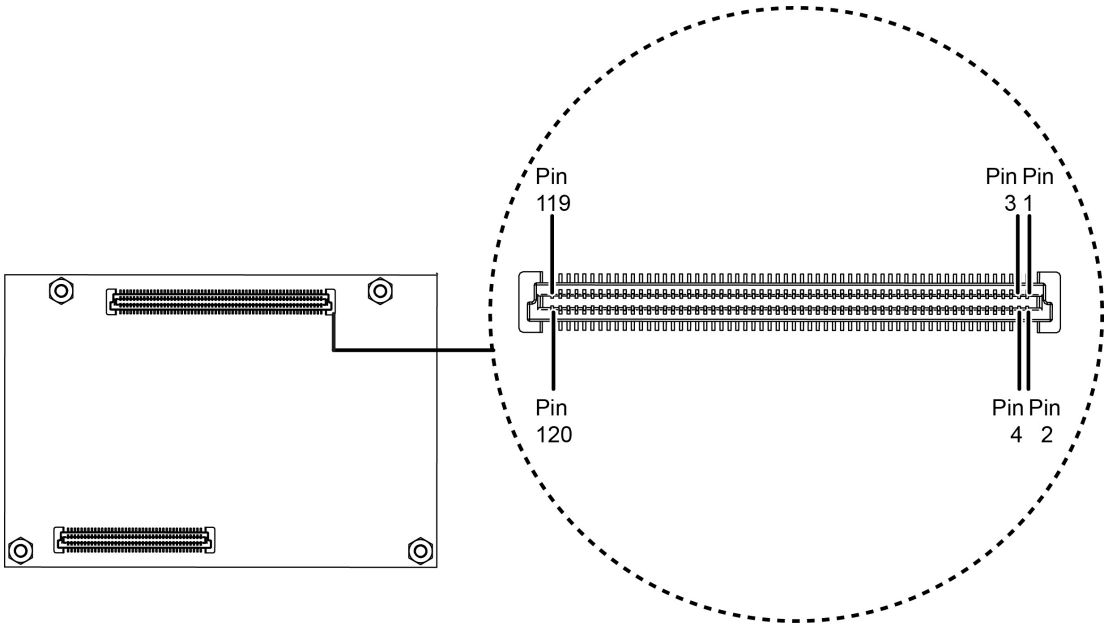



*Figure 1 Pin assignment of interface connector CO201*

## 2.3 PIN Description for connector CO201

| Signal Name | Type I/O (EESX) | Type (EESX) | Description |
|---|---|---|---|
| VCC3.3_EES | Power | 3.3 Volts +-5% | Power supply of the module for 3.3 Volts. |
| Ue_Ok | *Input* | LVTTL | Not used |
| GND | Ground | 0 Volts | Ground potential for signals and power supply. |
| VMag_P38 | Power | 2.5 Volts | Power supply for FE-Ports' magnetics. |
| VMag_P12 | Power | 2.5 Volts | Power supply for FE-Ports' magnetics. |
| USB_D+/- | *Bidirectional* | 5 Volts diff. | Differential USB data line. |
| USB_/OC | *Input* | LVTTL | Indicates overcurrent or thermal shutdown conditions. Active low. |
| USB_Pwr_on | Power | LVTTL | USB Power source output for 5 Volts. Enable = high |
| V24_TxD | *Output* | LVTTL | Transmit line of RS232 interface. |
| V24_RxD | *Input* | LVTTL | Receive line of RS232 interface. |
| I2C_Clk_Aux | *Bidirectional* | LVTTL | Clock line of I2C-Auxiliry-bus. |
| I2C_Da_Aux | *Bidirectional* | LVTTL | Data line of I2C-Auxiliry-bus. |
| /System_ready | *Output* | LVTTL | Control signal of LED "System ready". (low active) |
| /LED_Alarm | *Output* | LVTTL | Control signal of LED "Alarm". (low active) |
| SPI_MISO_Aux | *Input* | LVTTL | MISO line of SPI-bus to the CPLD chip. |
| SPI_MOSI_Aux | *Output* | LVTTL | MOSI line of SPI-bus to the CPLD chip. |
| Relay_Control | *Output* | LVTTL | Signal for Relay control |
| /Reset_in | *Input* | LVTTL | Module reset. (low active) |
| LOS_P[1..8] | *Logical signal* | LVTTL | Loss of signal for port 1 to 8. (for optical transceivers) |
| /LED_Lnk_Act_P[1..8] | *Output* | LVTTL | LED signals port 1 to 8 |
| /LED_Speed_P[1..[8] | *Output* | LVTTL | LED signals port 1 to 8 |
| I2C_Clk_P[1..8] | *Bidirectional* | LVTTL | Clock line of I2C-Port[1..8]-bus. (for optical transceivers) |
| SPI_Clk_Aux | *Output* | LVTTL | Clock line of SPI-bus to the CPLD chip. |
| SPI_/SS_Aux | *Output* | LVTTL | Slave select line of SPI-bus to the CPLD chip. |
| I2C_Da_P[1..8] | *Bidirectional* | LVTTL | Data line of I2C-Port[1..8]-bus. (for optical transceiver) |
| TD+/-P[1..8] | *Output analog* | 100BaseTX: +- 1V diff.<br>10BaseTX: +- 2,5V diff.<br>100BaseFX | Differential transmit lines for FE-Port [1..8] |
| RD+P[1..8] | *Input analog* | 100BaseTX: +- 1V diff.<br>10BaseTX: +- 2,5V diff.<br>100BaseFX | Differential receive lines for FE-Port [1..8] |

*Table 2-3: Pin Descriptions (View from module side for I/O type)*

## 2.4 PIN Assignment at connector CO202

Table 2-1 and Table 2-2 describe the pin out and signal names of the interconnectors CO202 mounted on the EESX-Evaluation-Board and its complementary ones on the module.

| CO202 | | | |
|---|---|---|---|
| **Pin** | **Name** | **Pin** | **Name** |
| 1 | GND | 2 | GND |
| 3 | VMag_G12 | 4 | VMag_G12 |
| 5 | VMag_G12 | 6 | VMag_G12 |
| 7 | I2C_Clk_G2 | 8 | SD_Dat3 |
| 9 | I2C_Clk_G1 | 10 | SD_Clk |
| 11 | GND | 12 | GND |
| 13 | I2C_Da_G2 | 14 | SD_Cmd |
| 15 | I2C_Da_G1 | 16 | SD_Dat1 |
| 17 | Logic_Spare3 | 18 | SD_Dat2 |
| 19 | /SFP_Present_EES_G2 | 20 | SD_Dat0 |
| 21 | /SFP_Present_EES_G1 | 22 | SD_/WP |
| 23 | GND | 24 | GND |
| 25 | LOS_G2 | 26 | SD_/CD |
| 27 | LOS_G1 | 28 | Logic_Spare4 |
| 29 | GND | 30 | GND |
| 31 | Logic_Spare2 | 32 | Logic_Spare1 |
| 33 | Config_G11 | 34 | Config_G21 |
| 35 | Config_G12 | 36 | Config_G22 |
| 37 | GND | 38 | GND |
| 39 | SD_Dis_VCC | 40 | /Reset_USB_Hub |
| 41 | VCC_Backup | 42 | VCC_Backup |
| 43 | GND | 44 | GND |
| 45 | PMDX1+G1 | 46 | PMDX0+G1 |
| 47 | PMDX1-G1 | 48 | PMDX0-G1 |
| 49 | GND | 50 | GND |
| 51 | PMDX3+G1 | 52 | PMDX2+G1 |
| 53 | PMDX3-G1 | 54 | PMDX2-G1 |
| 55 | GND | 56 | GND |
| 57 | PMDX3+G2 | 58 | PMDX2+G2 |
| 59 | PMDX3+G2 | 60 | PMDX2-G2 |
| 61 | GND | 62 | GND |
| 63 | PMDX1+G2 | 64 | PMDX0+G2 |
| 65 | PMDX1-G2 | 66 | PMDX0-G2 |
| 67 | GND | 68 | GND |
| 69 | SGIN-G1 | 70 | SGOUT-G1 |
| 71 | SGIN+G1 | 72 | SGOUT+G1 |
| 73 | GND | 74 | GND |
| 75 | SGIN-G2 | 76 | SGOUT-G2 |
| 77 | SGIN+G2 | 78 | SGOUT+G2 |
| 79 | GND | 80 | GND |

*Table 2-4: Pin assignment of the interface connectors CO202*

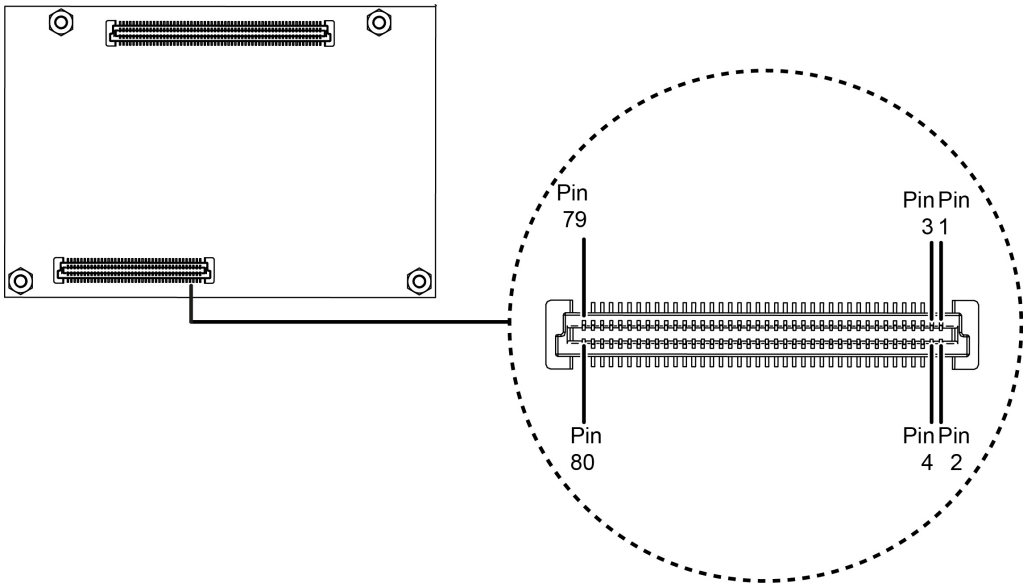



*Figure 2 Pin assignment of the interface connectors CO202*

## 2.5 PIN Description for connector CO202

| Signal Name | Type I/O (EESX) | Type (EESX) | Description |
|---|---|---|---|
| GND | Ground | 0 Volts | Ground potential for signals and power supply. |
| VMag_G12 | Power | 1.8 Volts | Power supply for Gigabit-Ports' magnetics. |
| I2C_Clk_G[1..2] | *Bidirectional* | LVTTL | Clock lines of I2C for Gigabit-Ports 1 and 2. (for SFP-transceiver) |
| I2C_Da_G[1..2] | *Bidirectional* | LVTTL | Data lines of I2C for Gigabit-Ports 1 and 2. (for SFP-transceiver) |
| SD_Dat[0..3] | *Bidirectional* | LVTTL | Data lines 0..3 of the SD Card interface. |
| SD_Clk | *Output* | LVTTL | Clock line of the SD Card interface. |
| SD_Cmd | *Output* | LVTTL | Command line of the SD Card interface. |
| SD_/WP | *Output* | LVTTL | Write protect signal of the SD Card interface. (low active) |
| SD_/CD | *Output* | LVTTL | |
| SD_Dis_VCC | *Output* | LVTTL | Disable of SD-Card power supply on Evalboard.<br>High = disable / Low = enable |
| Logic_Spare[1..4] | *[Bidirectional]* | LVTTL | Spare signals for logic on the Evaluation-Board. |
| /SFP_Present_EES_G[1..2] | *Logical signal* | LVTTL | Signal "SFP present" at Gigabit-Ports 1 and 2. (low active), (for optical transceivers) |
| LOS_G[1..2] | *Logical signal* | LVTTL | Signal "Loss Of Signal" at Gigabit-Ports 1 and 2. (high active), (for optical transceivers) |
| Config_G[11,12,21,22] | *Logical signal* | LVTTL | Selection of a certain System configuration. Currently without function. |
| /Reset_USB_Hub | *Input* | LVTTL | Reset of USB Hub. (low active) |
| VCC_Backup | Power | | Backup of VCC for Real time clock on EESX module, Backup-capacitor on Evaluation-Board. |

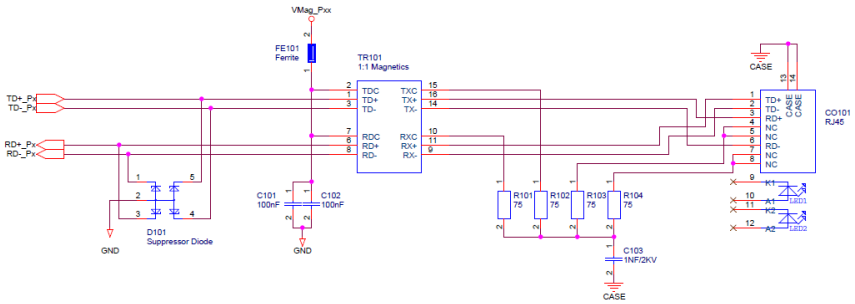
| Signal Name | Type I/O (EESX) | Type (EESX) | Description |
|---|---|---|---|
| PMDX0+/-G[1..2] | *Bidirectional analog* | 100/1000BaseTX: +-1V diff.<br>10BaseTX: +-2,5V diff. | 1st differential line pair for Gigabit-TX-Port [1..2] |
| PMDX1+/-G[1..2] | *Bidirectional analog* | 100/1000BaseTX: +-1V diff.<br>10BaseTX: +-2,5V diff. | 2nd differential line pair for Gigabit-TX-Port [1..2] |
| PMDX2+/-G[1..2] | *Bidirectional analog* | 100/1000BaseTX: +-1V diff.<br>10BaseTX: +-2,5V diff. | 3rd differential line pair for Gigabit-TX-Port [1..2] |
| PMDX3+/-G[1..2] | *Bidirectional analog* | 100/1000BaseTX: +-1V diff.<br>10BaseTX: +-2,5V diff. | 4th differential line pair for Gigabit-TXPort [1..2] |
| SGIN+/-G[1..2] | *Input analog* | 100BaseFX<br>1000BaseFX | Differential line pair for Gigabit-FX-Port [1..2] for data going to the module. |
| SGOUT+/-G[1..2] | *Input analog* | 100BaseFX<br>1000BaseFX | Differential line pair for Gigabit-FX-Port [1..2] for data coming from the module. |

*Table 2-5: Pin Descriptions (View from module side for I/O type)*

# 3 Application Guide Line

This chapter provides recommendations for implementation of the Ethernet and SPI interfaces.

## 3.1 Ethernet interface for 10/100Base-TX connection



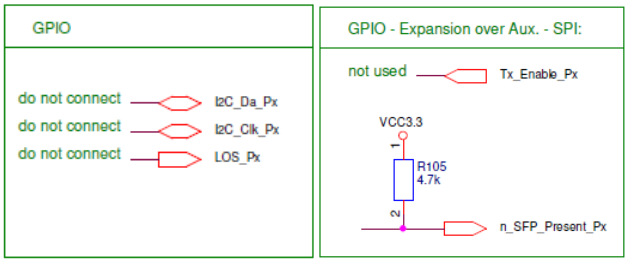




*Figure 3-1: 10/100Base-TX interface recommandation*

| Signal Description: VMag_Pxx | |
|---|---|
| | EESX-0802<br>EESX-0800 |
| Port-1 - Port-2<br>Port-3 - Port-8 | VMag_P12<br>VMag_P38 |

| Signal Description: | |
|---|---|
| GND | Signal - Ground |
| CASE | Chassis - Ground |

*Table 3-1: 10/100Base-TX center tap voltage*

For operational reasons the ports require different supply voltages for the center taps of the magnetic poles. See table 3-1 for details.

## 3.2 Ethernet interface for 1000Base-TX

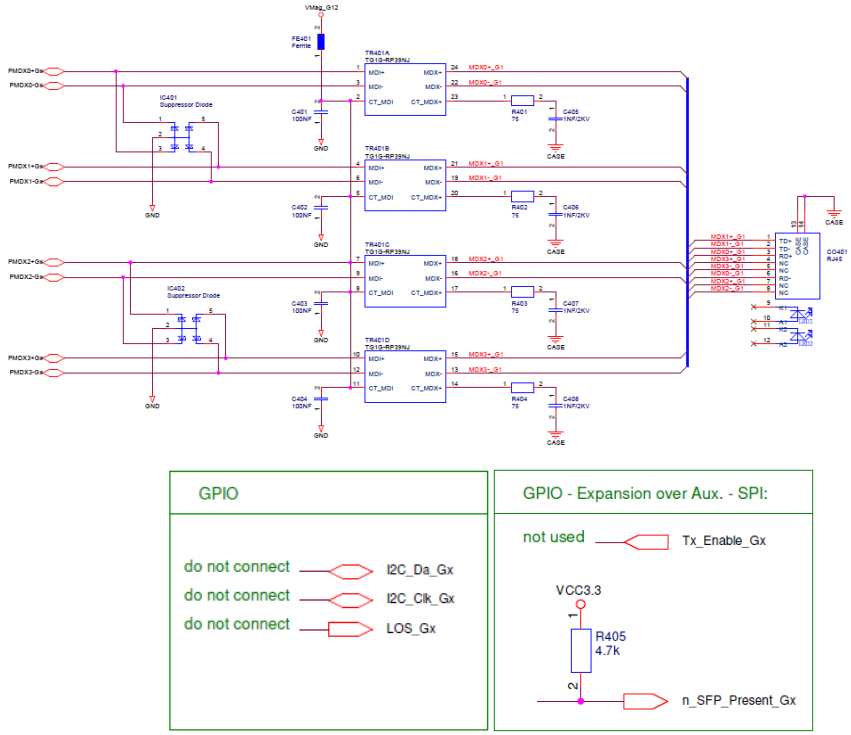



*Figure 3-2: 1000Base-TX interface recommandation*

## 3.3 Ethernet interface for 100Base-FX

### 3.3.1 Interface Connection (SFP Transceiver)

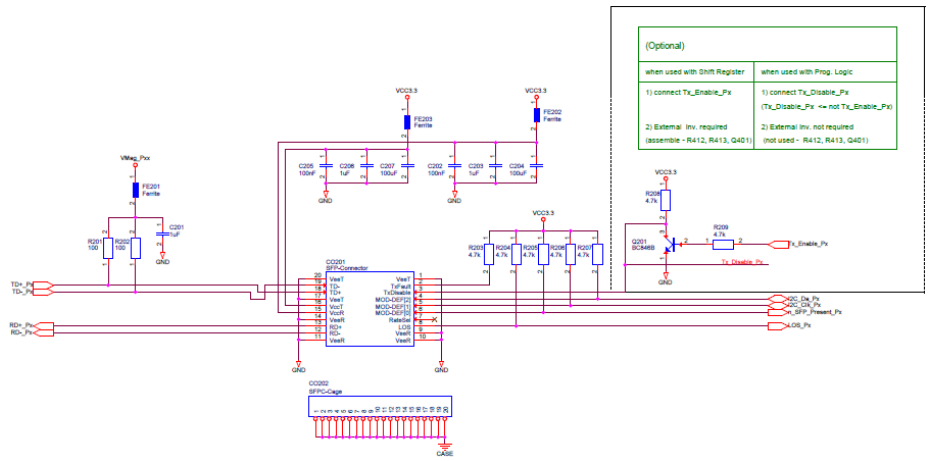



*Figure 3-3: 100Base-FX (SFP) interface recommandation*

| Signal Description: VMag_Pxx | |
|---|---|
| | EESX-0802<br>EESX-0800 |
| Port-1 - Port-2<br>Port-3 - Port-8 | VMag_P12<br>VMag_P38 |

| Signal Description: | |
|---|---|
| GND | Signal - Ground |
| CASE | Chassis - Ground |

*Table 3-2: 100Base-FX (SFP) schematic information*

### 3.3.2 Interface connection (1*9 Transceiver)

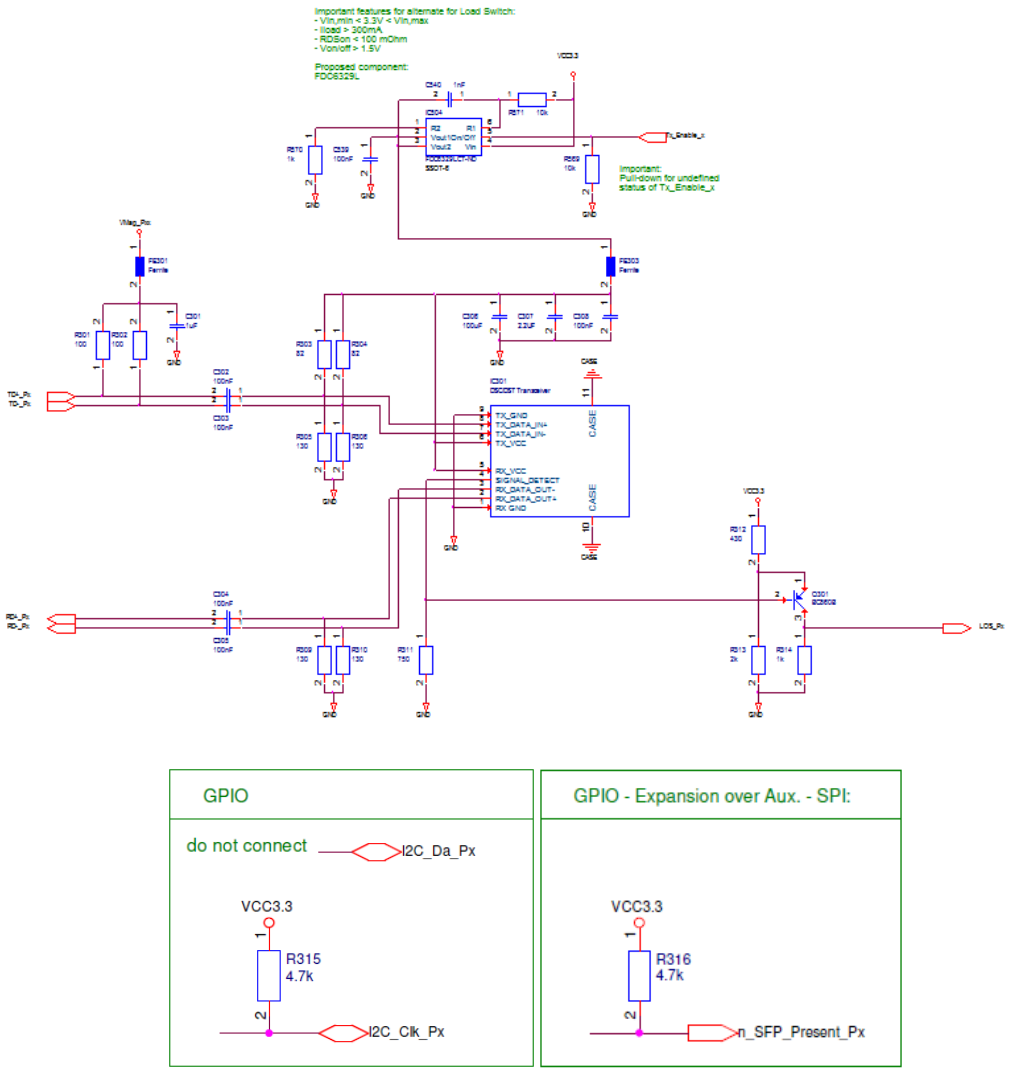



*Figure 3-4: 100Base-FX (1*9 transceiver) interface recommendation*

| Signal Description: VMag_Pxx | |
|---|---|
| | EESX-0802<br>EESX-0800 |
| Port-1 - Port-2<br>Port-3 - Port-8 | VMag_P12<br>VMag_P38 |

| Signal Description: | |
|---|---|
| GND | Signal - Ground |
| CASE | Chassis - Ground |

*Table 3-3: 100Base-FX (1*9 transceiver) schematic information*

## 3.4 Ethernet interface for 1000Base-FX

### 3.4.1 Interface Connection (SFP Transceiver)

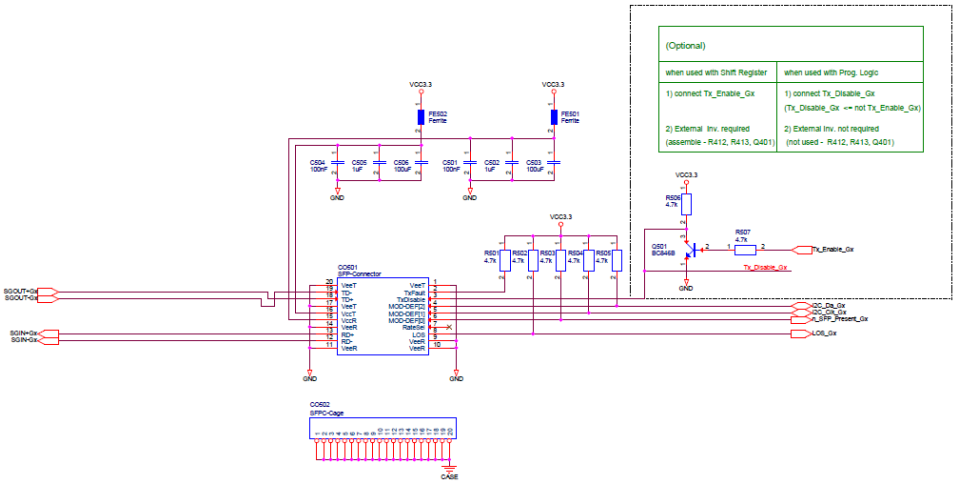



*Figure 3-5: 1000Base-FX (SFP) interface recommandation*

### 3.4.2 Interface connection (1*9 Transceiver)

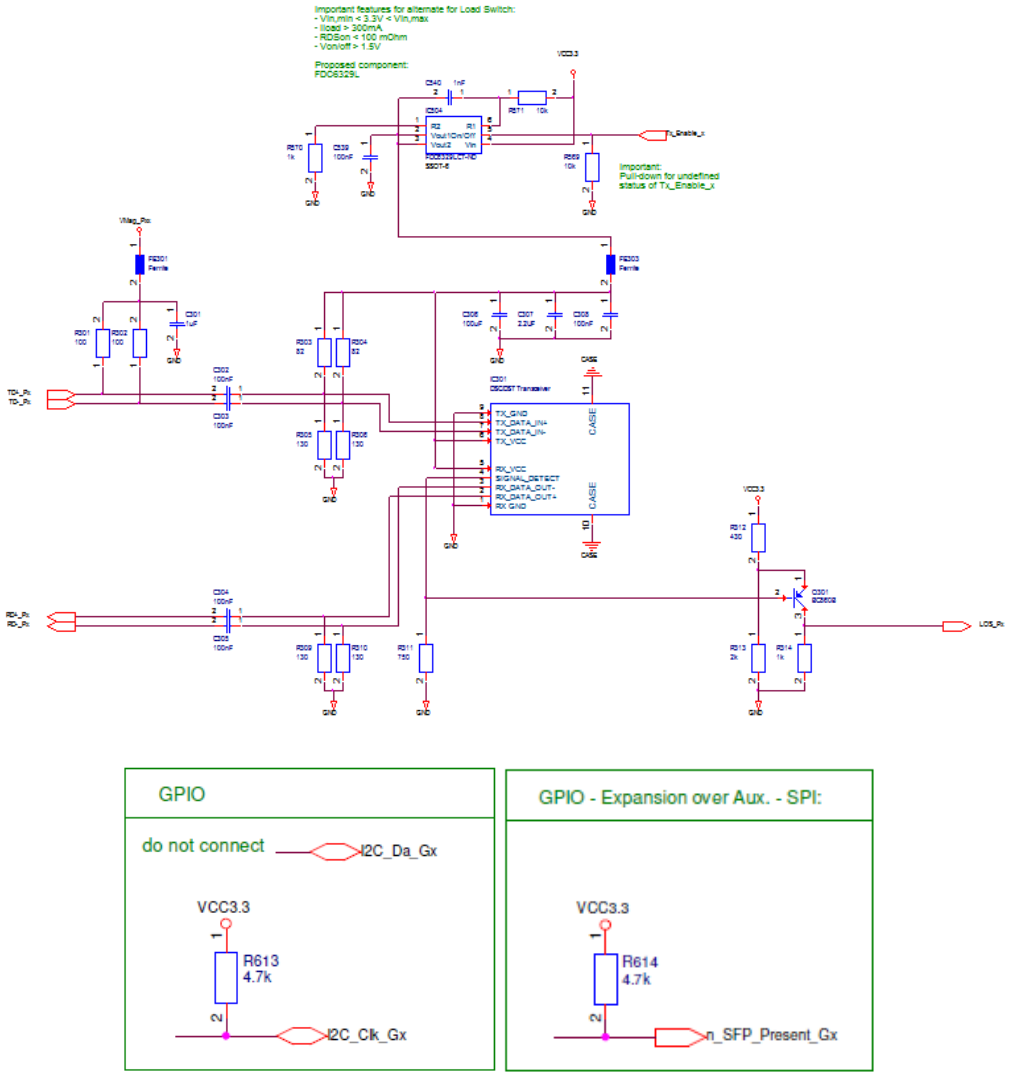



*Figure 3-6: 1000Base-FX (1*9 transceiver) interface recommendation*

The feature 1*9 Transceiver is currently not supported for the Gigabit ports 1 and 2. Use the Fast Ethernet ports instead.

## 3.5 SPI Interface connection

The EESX module provides a SPI interface (acts as SPI master) for status indication.

The EESX-Evaluation-Board communicates with the on-board CPLD via a SPI interface. The CPLD serializes and de-serializes the SPI data stream and provides the signals to I/O pins.

| Pin | Direction * | Description |
|---|---|---|
| SPI_/SS | Serial Control Output | SPI **s**lave **s**elect (also called chip select) control signal, storage Register |
| SPI_Clk | Serial Data clock | The clock signal produced from the master device to synchronize the data transfer. |
| SPI_MOSI | Serial Data Output | SPI data, **m**aster **o**ut /**s**lave **i**n |
| SPI_MISO | Serial Data Input | SPI data, **m**aster **i**n /**s**lave **o**ut |

* With respect to the EESX module.

*Table 3-4: SPI connector pin assignment*

The SPI-pins out definitions are described in Table 3-4. In the target application, the CPLD can be replaced alternatively with standard logic shift registers, for example the ICs 74HC595 or 74HC165 (see figure 3-4) which convert an in-coming 8 bit parallel data stream to an out-going serial data stream.

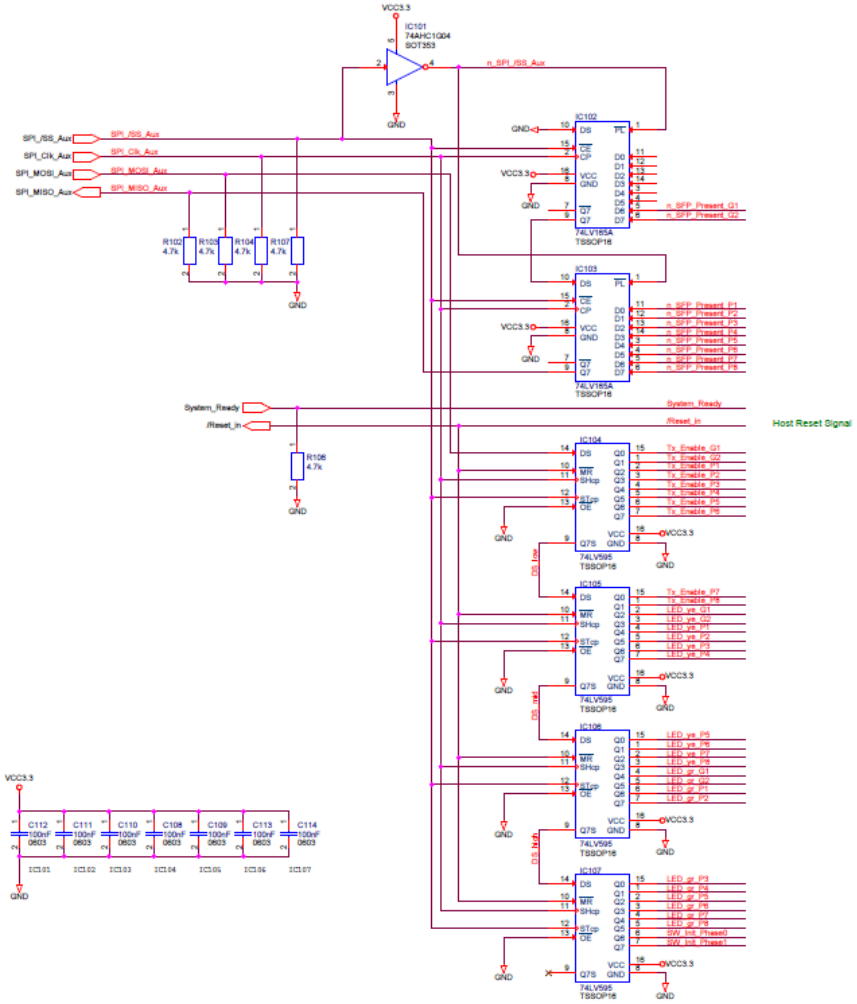



Figure 3-7: SPI implementation example as alternative for the CPLD chip

### 3.5.1 SPI Protocol Timing

Figure 3-5 illustrates every timing parameter in the SPI Protocol. These timing parameters are a result of the EESX internal operation and both constrain host behavior and characterize EESX operation. Note that Figure 3-5 is not drawn to scale, but is instead drawn only to illustrate where the parameters are measured. The EESX is the master and sends data on SPI_MOSI and receives data on SPI_MISO.

Attention: This is just a general drawing. The content of the SPI_MOSI and SPI_MISO bits must be taken from Table 3-6 and 3-7.

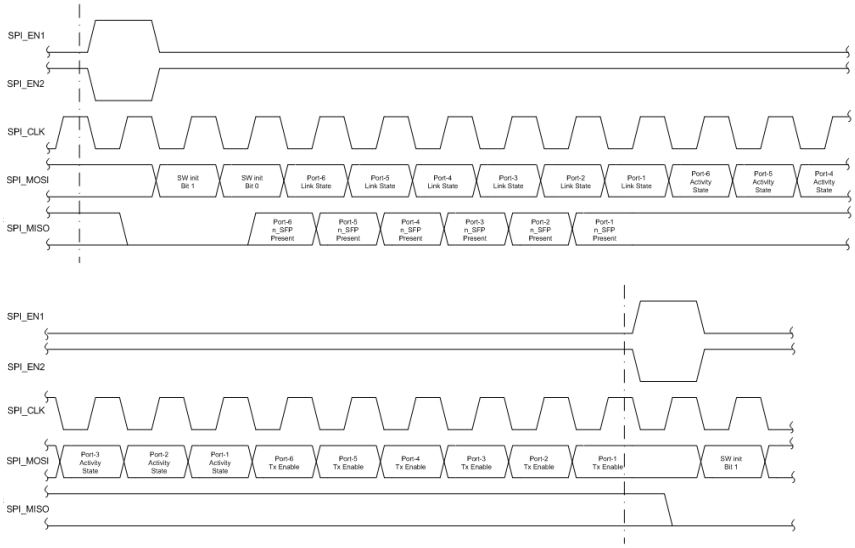



*Figure 3-8: SPI Timing Diagram*

Reading signals from the EESX module is similar to writing to it. The *SPI_/SS_Aux* read/write command is sent first, followed by send and receive information in 32 bit patterns. The EESX module transmits link and data activity status information for every port. It transmits general status information to the host system on *SPI_MOSI_Aux* and also reads status information from the host system on *SPI_MISO_Aux*, providing of SFP transceivers is installed.

| Bit | Signal name | Description |
|---|---|---|
| 31…<br>30 | *SW_Init_Phase[1..0]* | Software initializing during boot phase. |
| 29…<br>22 | *LED_gr_P[8..1]* | Link status for FE-Ports 8..1 on Evaluation-Board; green LEDs / high = link, low = no link |
| 21…<br>20 | *LED_gr_G[2..1]* | Link status for GE-Ports 2..1 on Evaluation-Board; green LEDs / high = link, low = no link |
| 19…<br>12 | *LED_ye_P[8..1]* | Port activity for FE-Ports 8..1 on Evaluation-Board; yellow LEDs / high = link, low = no link |
| 11…<br>10 | *LED_ye_G[2..1]* | Port activity for GE-Ports 2..1 on Evaluation-Board; yellow LEDs / high = link, low = no link |
| 09…<br>02 | *Tx_Enable_P[8..1]* | Enable signals for optical transceivers for FE-Ports 8..1; low=transceiver disabled, high = transceiver enabled |
| 01…<br>00 | *Tx_Enable_G[2..1]* | Enable signals for optical transceivers for GE-Ports 2..1; low=transceiver disabled, high = transceiver enabled |

*Table 3-6: SPI transmitted information (from the EESX module to a host system)*

The transmitted information (like port status for LED indication for example) will be further processed by the host system.

The information in Table 3-7 can be read from the EESX module to support optical transceivers (SFP).

| Bit | Signal name | Description |
|---|---|---|
| 31…<br>24 | *n_SFP_Present_P[8..1]* | Signal “SFP present” for FE-Ports 8..1 on Evaluation-Board;<br>low = SFP module is present / high = SFP module is not present |
| 23…<br>22 | *n_SFP_Present_G[2..1]* | Signal “SFP present” for GE-Ports 2..1 on Evaluation-Board;<br>low = SFP module is present / high = SFP module is not present |
| 21…<br>00 | not used | |

*Table 3-7: SPI received information (from a host system to the EESX module)*

If the target application works without SPI – GPIO expansion then it is necessary to connect the *SPI_MISO_Aux* signal as follows…

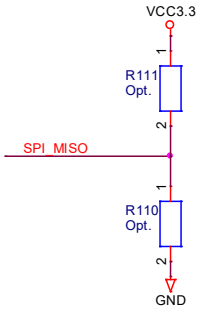



*Figure 3-9: Alternative SPI implementation example*

| Configuration without SPI - GPIO Expansion<br>(This applies to all Ports) | | |
|---|---|---|
| Port 1..6 | Tx - Mode (Copper)<br>Fx - Mode (DSC/DST)<br><br>(without I2C Interface) | Fx - Mode (SFP)<br><br>(with I2C Interface) |
| R111<br>R110 | 1k<br>not used | not used<br>4.7k |

*Table 3-8: Assembly information for alternative example*

## 3.6 I2C Interface connection

For each Ethernet port there is one I2C bus connected to a SFP transceiver. This connection is only required for the 100Base-FX mode in which a SFP transceiver is used. This interface can be used to read transceiver status information, such as transceiver type, temperature, optical receive power and other information provided by the selected SFP transceiver.

In addition, the I2C_Clk_x pins are used to pre-set the port mode during start-up. If a high level is detected on the pin during start-up, the port will be set to fiber mode (100Base-FX), while the detection of a low level will set the port to copper mode (10/100Base-TX). To set the I2C_Clk_x line to a high level, connect a 4.7KOhm pull-up resistor to the VCC3.3 supply. To set the I2C_Clk_x line to a low level, do not connect this pin. There is an internal 47K pulldown resistor.

## 3.7 Host Device connection over an Ethernet Interface

This chapter describes connecting the EESX module to a host device. The application is approved only for port 6.

Devices for a galvanic separation are not present on the EESX module itself. Appropriate isolation can be achieved by using an external 1:1-Ethernet transformer.

If no electrical isolation is required, the module can also be connected directly to another Ethernet PHY device. In this case, capacitive coupling can be applied.

### 3.7.1 Capacitive Coupling – 100Base-FX

The Ethernet signals TD-/+_FX_P* and RD-/+_FX_P* shall be coupled directly with a capacitor (100 nF) for all ports in FX-Mode (see *Figure 3-10*) if the capacitors are not implemented in the used SFP and 1*9 transceivers.

On the host device side, the circuit is dependent of the used PHY component. Please refer to the data sheet of the appropriate PHY vendor.

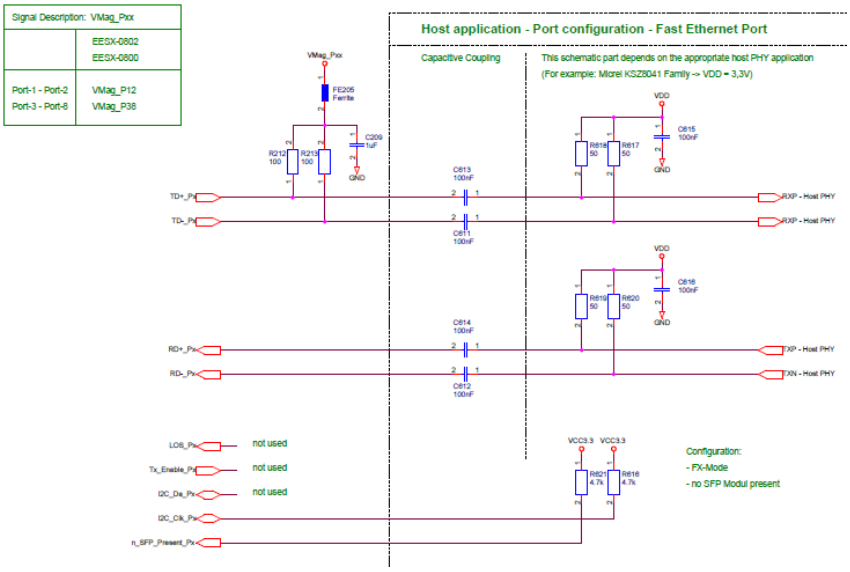



*Figure 3-10: Capacitive Coupling - Circuit Diagram*

### 3.7.2 Magnetics Coupling – 10/100Base-TX

The Ethernet signals TD-/+_/TX_P* and RD-/+_TX_P* shall be coupled with a magnetic transformer for all ports in TX-Mode (see *Figure 3-11*).

To help avoid unexpected Ethernet signal behavior, Hirschmann recommends using transformers without common mode chokes on the EESX chip side.

On the host device side, the circuit is dependent of the used PHY component. Please refer to the data sheet of the appropriate PHY vendor.

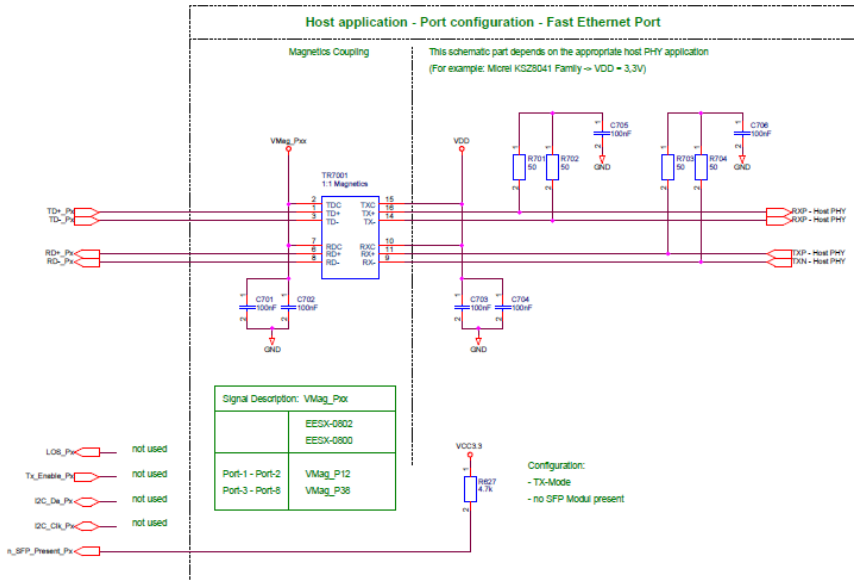



*Figure 3-11: Magnetics Coupling - Circuit Diagram*

### 3.7.3 Capacitive Coupling – 1000Base-FX

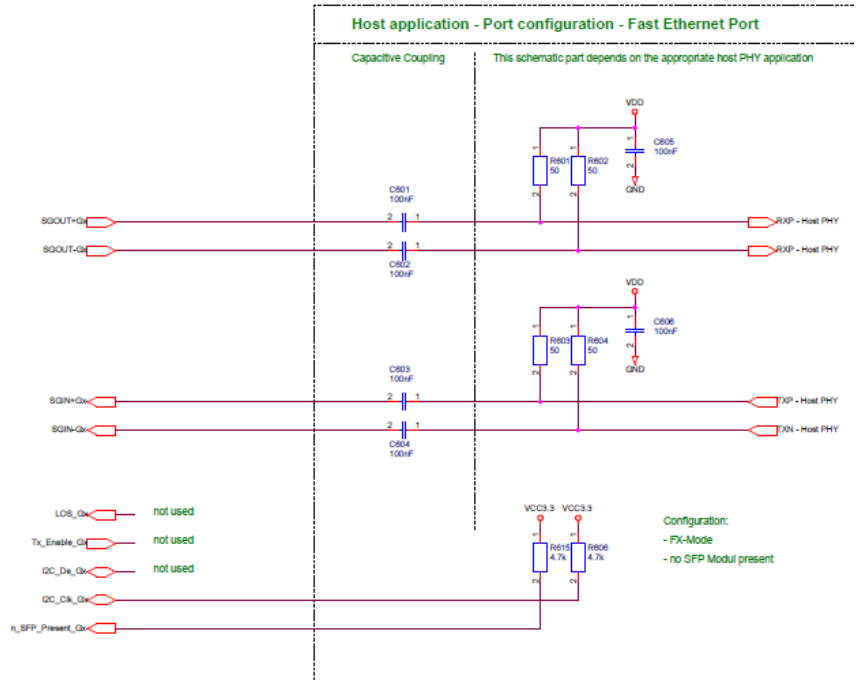



*Figure 3-12: Capacitive Coupling - Circuit Diagram*

### 3.7.4 Magnetics Coupling – 1000Base-TX

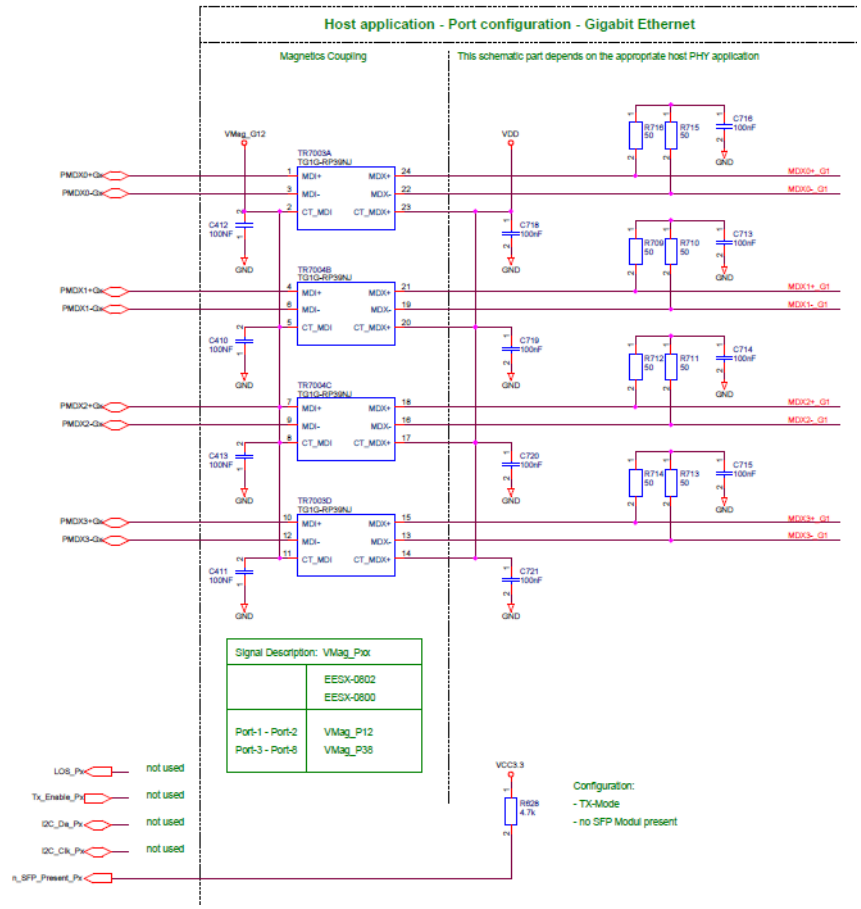



*Figure 3-13: Capacitive Coupling - Circuit Diagram*

## 3.8 Layout recommendations

Some recommendations to adapt the EESX-Evaluation-Board design to your application design.

A) Quick switches

- The mode switches SW403 and SW601 can be removed in customer's application design - if only using TX- *OR* FX- (SFP or DSC) Mode. (Without Mode switches connect the open nets to the correct net or potential).

Just as can be removed the (signal path) Quick switches IC701 up to IC708 for ports 1 to 4 and IC801 up to IC808 for ports 5 to 8. Connect the signal pathes coming from the switching IC directly to the TX or FX port.

B) Ethernet Jack for twisted pair

- Use Ethernet Jacks with spring contacts for twisted pair copper mode to improve galvanic contact to metal housing due to EMC reasons.

C) Ethernet Jack with integrated transformer for twisted pair

- Use RJ45 Ethernet Jacks with integrated transformers to reduce space and to facilitate an easier electrical isolation on the PCB – if isolation of 2250 kV DC between Ethernet port signal contacts and potential of the EESX module (Ground and all other nets) according IEEE standard 802.3 is required.

- For Instance the CO1502 at GE port 2 on EESX-Evaluation-Board has an integrated transformer for Gigabit- and Fast-Ethernet applications.

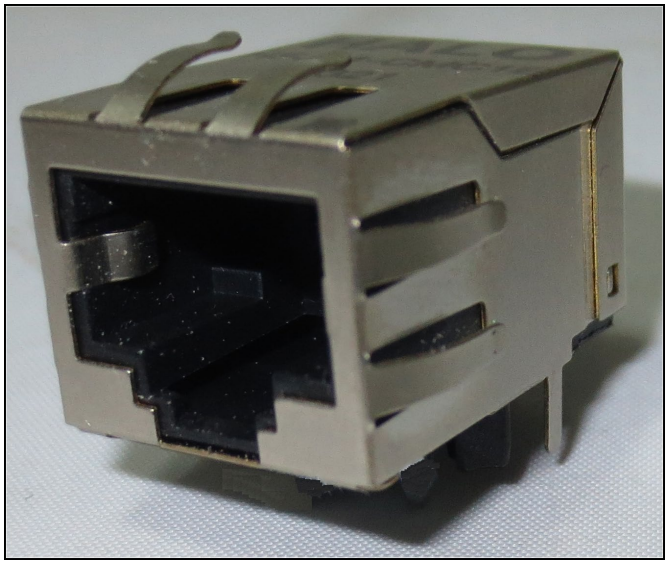


Figure 3-14: Single port RJ45 Ethernet Jack with integrated transformer and spring contacts

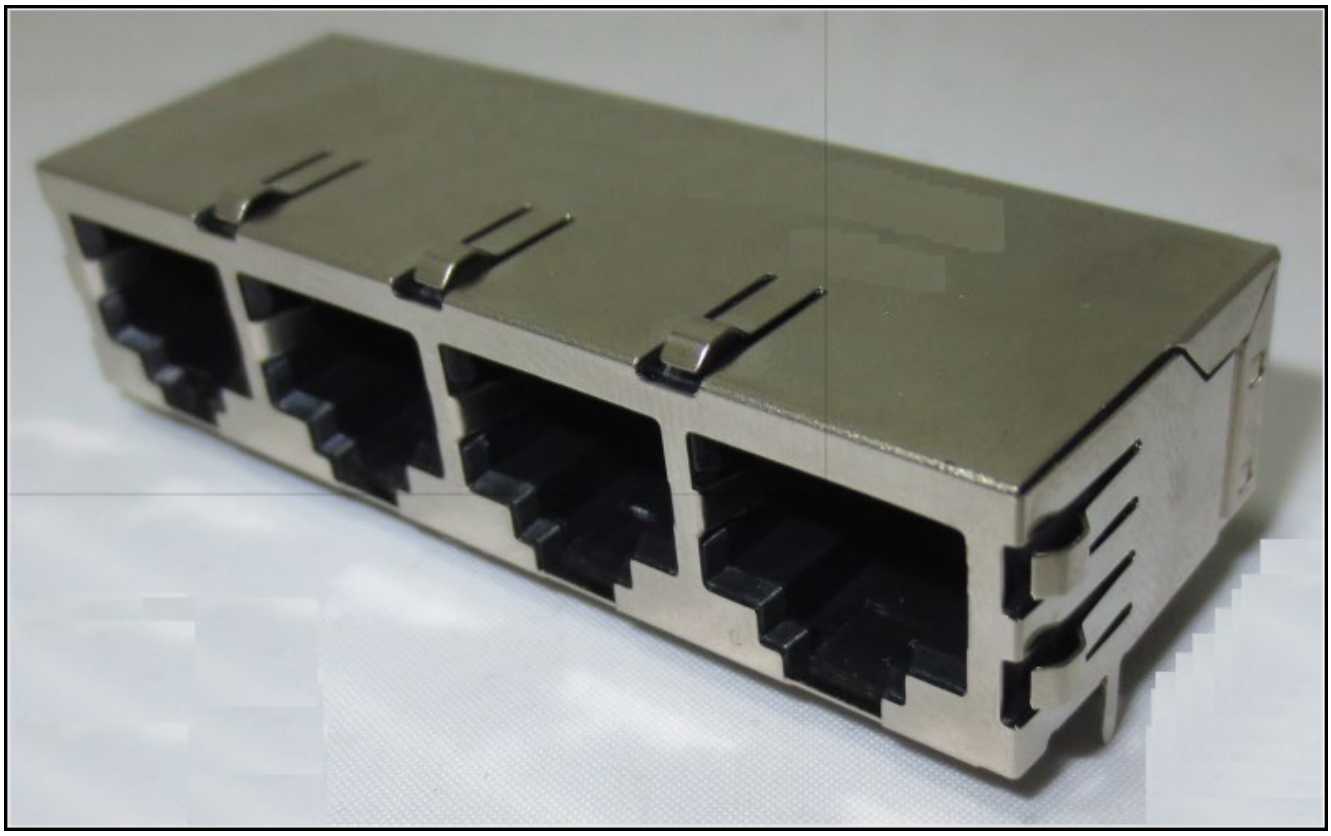


Figure 3-15: 4-port RJ45 Ethernet Jack with integrated transformers and spring contacts

## 3.9 Recommended Magnetic

| Producer | Typ | Datarate | Temp. Range | Misc |
|---|---|---|---|---|
| HALO Electronics, Inc | TG110-HPE7N5LF | 100Mbit/s | -40°C to 85°C | PoE+ |
| | | | | |

# 4 Heat sink

**Case Temperature on the EESX-Board**

**Note:** The Case temperature on the EESX module should not be exceeded!
Case temperature for EESX20: 91°C
Case temperature for EESX30: 85°C

## 4.1 Permissible operating temperature

The maximum permissible operating temperature of the EESX module is +91 °C for EESX20 and +85°C for EESX30 at the measuring point of the Case Temperature. Operate the device only up to this maximum temperature.

The measuring point for the Case temperature of the EESX module is on the bottom side. See the following picture where the Case Temperature has to be measured on ESSX module.

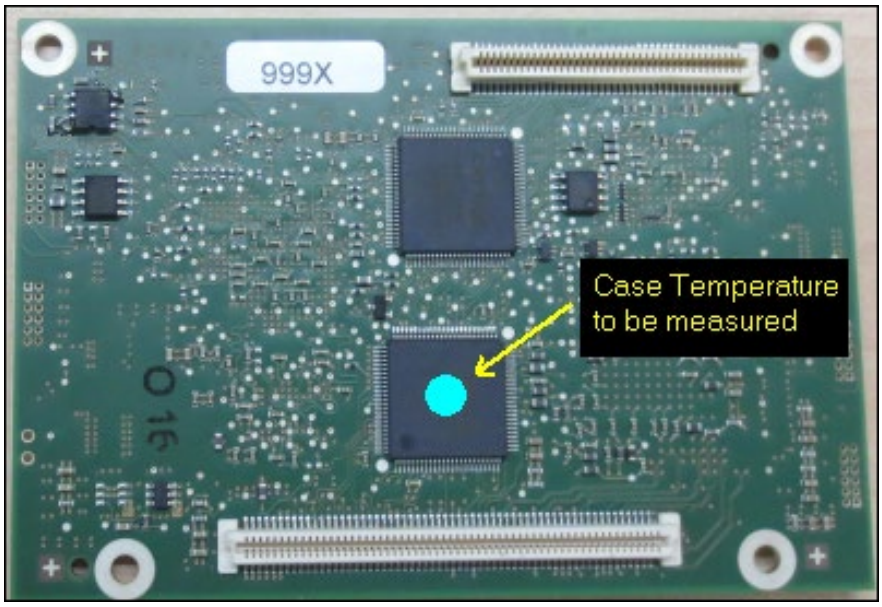



*Figure 4-1: Measure Case temperature on the chip near the long connector*

In case of exceeding the case temperature during operation an additional cooling will be necessary. The module will be offered also with a mounted cooling plate where an additional heat sink can be mounted on the top.
See details in chapter “Mechanics”.

## 4.2 Estimation of heat sink's cooling performance

To determine that the location is suitable for installing the device, perform a reference measurement:
- Install the device in the planned location.
- Switch on the device and wait until it has reached its operating temperature.
- Check whether the operating temperature at the measuring point remains below the maximum permissible value.
- If the operating temperature of the device exceeds the maximum permissible value, switch off the device and change the installation location, or provide additional cooling for the device.

WARNING
**FIRE HAZARD**
Exceeding the maximum permissible operating temperature can cause the device to catch fire.
**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

**Example: Heat dissipation with a cooling element**
The following calculation delivers an estimated expected module temperature based on ambient temperature.

***Formula for estimating the device temperature with a cooling element:***
$R_{th} \times P = {}_{\Delta}T$
${}_{\Delta}T = T_{case} - T_{ambient}$

*Explanation of symbols:*
$R_{th}$ Thermal resistance of the heat sink [*K/W*]
$P$ Thermal Power [*W*]
[*K*] Kelvin
[*W*] Watt
${}_{\Delta}T$ Temperature difference between case and ambient air [*K*]
$T_{case}$ Temperature of printed circuit board (Case Temperature at measuring point) [*K*]
$T_{ambient}$ Temperature of the ambient air [*K*]

# 5 Technical Data

| Parameter | min. | typ. | max. | Unit |
|---|---|---|---|---|
| **Switch type** (Standard Ports) | | Store- and- Forward | | |
| **Latency** (end receive – begin transmit) | | | | |
| 10 Mbit; 64 ... 1518 Byte Paketlänge | 5,0 | 7,8 | 10,0 | µs |
| 100 Mbit; 64 ... 1518 Byte Paketlänge | 6,0 | 8,0 | 11,0 | µs |
| 1000 Mbit; 64 ... 1518 Byte Paketlänge | 6,0 | 8,0 | 11,0 | µs |

*Table 5-1: Switch parameter*

**Electrical Specifications**

| Symbol | Description | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| VCC24 | Supply voltage EESX-Evaluation-Board (DC) | +18 | +24 | +30 | V |
| VCC3.3 | Supply voltage EESX | 3,3 - 5% | +3,3 | +3,3 +5% | V |
| VCC3.3 | Maximum Ripple EESX (AC) | | | +/- 50 | $mV_{pp}$ |
| $P_{IN}$ (VCC3.3) | Power Consumption EESX module only<br>EESX20<br>EESX30 | | | <br>5<br>7 | <br>W<br>W |
| $P_{IN}$ (VCC24) | Power Consumption EESX-Evaluation-Board with EESX30 module<br>Tx mode<br>Fx mode (depends from plugged SFP modules) | | | <br>8,1<br>12,5 | <br>W<br>W |

*Table 5-2: Power supply and power consumption*

Tables 5-3 and 5-4 show port specification – Differential lines according to IEEE 802.3.

| Parameter (Tx-Mode, 10Base-T) | min. | typ. | max. | Unit |
|---|---|---|---|---|
| Output signal by 100 Ω | 2,2 | | 2,8 | V |

| Parameter (Tx-Mode, 100Base-Tx) | min. | typ. | Max. | Units |
|---|---|---|---|---|
| Output signal by 100 Ω | 0,95 | | 1,05 | V |
| Symmetry output signal | 98 | | 102 | % |
| **Parameter (Tx-Mode, 1000Base-Tx)** | **min.** | **typ.** | **Max.** | **Units** |
| Output signal by 100 Ω | 0,95 | | 1,05 | V |
| Symmetry output signal | 98 | | 100 | % |

*Table 5-3: Electrical specification Ethernet Tx lines*

| Parameter (Fx-Mode, 100/1000Base-Fx) | min. | typ. | Max. | Unit |
|---|---|---|---|---|
| Output signal by 100 Ω (Peak to peak) | 0,5 | | 2,4 | $V_{pp}$ |
| Output resistance | | 100 | | Ω |
| Input resistance | | 100 | | Ω |

*Table 5-4: Electrical Specification Ethernet Fx lines*

| Symbol | Description | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| $f_{max\ SPI}$ | Clock Frequency SPI | | 1 | 16 | MHz |
| $t_{su}$ (Setup time) | SPI_MOSI before SPI_Clk ↑ | 40 | | | ns |
| | SPI_Clk ↑ before SPI_En1 ↑ | 40 | | | ns |
| | SPI_En2 before SPI_Clk ↑ | 40 | | | ns |
| | SPI_MISO before SPI_Clk ↓ | 20 | | | ns |
| | Parallel Data Input before SPI_En2 ↑ | 20 | | | ns |
| $t_h$ (Hold time) | SPI_MOSI after SPI_Clk ↑ | 20 | | | ns |
| | SPI_MISO after SPI_Clk ↓ | 20 | | | ns |
| | Parallel Data Input after SPI_En2 ↑ | 20 | | | ns |
| $t_{pd}$ (Output Delay) | SPI_MOSI after SPI_Clk ↑ | | 0,5 x $1/f_{max}$ | | ns |
| | SPI_MISO after SPI_Clk ↑ | 0 | | 20 | ns |

*Table 5-5: Timing Specification SPI*

| Parameter | min. | typ. | max. | Unit |
|---|---|---|---|---|
| Storage temperature | -40 | | +80 | °C |
| Humidity (non-condensing) preliminary | 10 | | 85 | % |
| Air-pressure by operating | 795 (+2000 m a.s.l) | | | hPa |
| Air-pressure by storage preliminary | 620 (+4000 m a.s.l) | | | hPa |

*Table 5-6: Miscellaneous*

**Board Weights**

| Name | Net weight |
|---|---|
| EESX20 | 42 g |
| EESX30 | 42 g |
| EESX-Evaluation-Board | 370 g |

*Table 5-7: Board Weights*

**Ambient Air Temperature**

**EESX20/30 module**

| Product | Comment |
|---|---|
| **Operating Ambient Air Temperature** | |
| EESX20/30 module | - 40°C (16h) [1)]<br>+ 85°C (16h) [1)] |
| **Non Operating Ambient Air Temperature** | |
| EESX20/30 module | - 40°C (16h) [1)]<br>+ 85°C (16h) [1)] |
| **Damp Heat** | |
| EESX20/30 module | + 55 °C/ + 25 °C,<br>12h – 12h, 2 cycles |

*Table 5-8: Ambient temperature conditions (tested on EESX-Evaluation-Board)*

**Note:** The items marked with [1)] means ambient air temperature.

**EESX-Evaluation-Board**

| Product | Comment |
|---|---|
| **Operating Ambient Air Temperature** | |
| EESX-Evaluation-Board | + 5°C [1)]<br>+ 40°C [1)] |
| **Non Operating Ambient Air Temperature** | |
| EESX-Evaluation-Board | - 40°C (16h) [1)]<br>+ 85°C (16h) [1)] |

**Note:** The items marked with [1)] means ambient air temperature.

Parts on EESX20/30 module or EESX-Evaluation-Board should not touched in operation!

Due to possible hot spots of electronical components – especially the case of integrated circuits.

**MTBF**

| Product Standard | Comment |
|---|---|
| **MTBF Value** | |
| EESX20 | 207,4 years Gb 25°C<br>87,2 years Gb 60°C |
| EESX30 | 198,6 years Gb 25°C<br>85,1 years Gb 60°C |

*Table 5-9: MTBF values of the EESX module according Telcordia SR332*

# 6 Further support

## Technical questions

For technical questions, please contact any Hirschmann dealer in your area or Hirschmann directly.

You find the addresses of our partners on the Internet at http://www.hirschmann.com.

A list of local telephone numbers and email addresses for technical support directly from Hirschmann is available at https://hirschmann-support.belden.com.

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