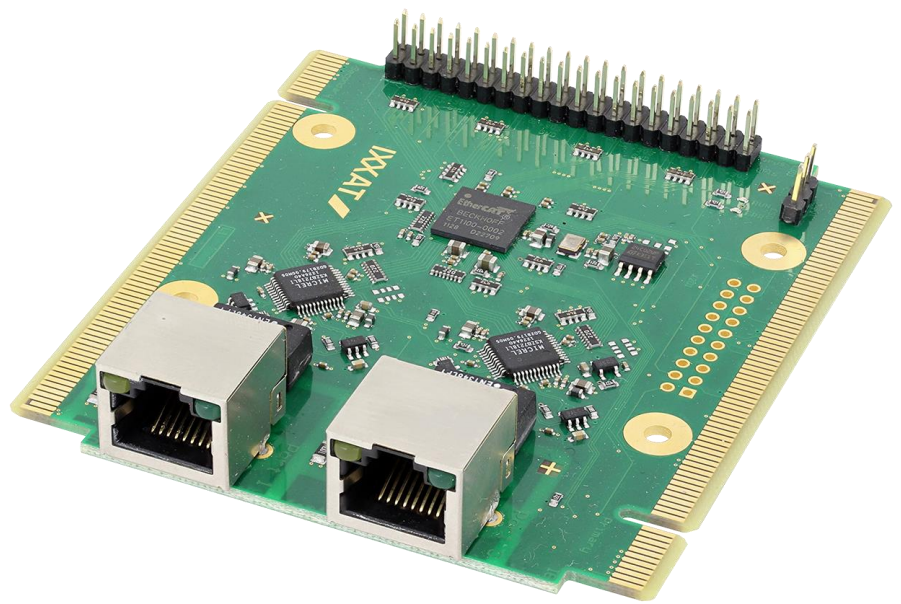


TWR-ETHERCAT-SLV

EtherCAT module for the Freescale Tower System





IXXAT Automation GmbH

Leibnizstr. 15
88250 Weingarten
Germany

Tel.: +49 751 56146-0
Fax: +49 751 56146-29
Internet: www.ixxat.com
E-Mail: info@ixxat.com

Support

In case of unsolvable problems with this product or other IXXAT products please contact IXXAT in written form:

Fax: +49 751 56146-29
E-Mail: support@ixxat.de

Further international support contacts can be found on our webpage
www.ixxat.com

Copyright

Duplication (copying, printing, microfilm or other forms) and the electronic distribution of this document is only allowed with explicit permission of IXXAT Automation GmbH. IXXAT Automation GmbH reserves the right to change technical data without prior announcement. The general business conditions and the regulations of the license agreement do apply. All rights are reserved.

Registered trademarks

All trademarks mentioned in this document and where applicable third party registered are absolutely subject to the conditions of each valid label right and the rights of particular registered proprietor. The absence of identification of a trademark does not automatically mean that it is not protected by trademark law.

1	Introduction	5
	1.1 Features	5
2	References	6
3	Interfaces	7
	3.1 Freescale Tower System Modular Development Platform Connector	7
	3.1.1 Connector X200A (Primary card edge)	9
	3.1.2 Connector X200B (Primary card edge)	10
	3.1.3 Connector X200C (Secondary card edge)	11
	3.1.4 Connector X200D (Secondary card edge)	11
	3.1.5 X301: Chip select for SPI-Connection	12
	3.2 Alternative MCU connection	12
	3.2.1 Connector X201	13
	3.3 LEDs	14
	3.4 GPIO	15
	3.4.1 Connector X300	15
	3.5 EtherCAT interface	16
	3.5.1 Connector X400-1A / X400-2A	17
4	Schematics	18
	4.1 Top Level	18
	4.2 Tower System Connection / Power	19
	4.3 ET1100 / EEPROM	20
	4.4 Ethernet PHY and RJ45	21
5	Bill of materials	22
6	Appendix	24
	6.1 Support	24
	6.2 Returning hardware	24
	6.3 Information on EMC	24

1 Introduction

The TWR-ETHERCAT-SLV EtherCAT module for the Freescale Tower System is an evaluation board for EtherCAT slave development. It is designed to work as a peripheral module for the Freescale Tower System Modular Development Platform with a connection over the Elevator Modules. One of two available Kinetis MCU modules TWR-K60N512 or TWR-K60F120M may be used as main controller board. The TWR-K60F120M is the preferred MCU module for use in an assembled Tower System with the TWR-ETHERCAT-SLV EtherCAT slave module.

The EtherCAT module may alternatively be operated with any other MCU that supports the board's interfaces over a generic pinheader connection.

For EtherCAT slave operation, the ET1100 ASIC from Beckhoff is used.

This document covers all hardware-related topics that are necessary to operate the module.

The software for the Kinetis K60 MCU that supports communication with the ET1100 ASIC (EtherCAT stack software) is provided by rt-labs¹. This software may be downloaded from:

<http://ethercat.rt-labs.com/download>

1.1 Features

- TWR-ETHERCAT-SLV: Freescale Tower System Modular Development Platform peripheral board
- Alternative MCU connection over generic pinheader connector
- EtherCAT Slave with Beckhoff ET1100 ASIC
- 2x RJ45 connector (8P8C)
- Process Data Interface via SPI with Chip Select (CS) selection²
- Device configuration and device description data in 2kBit I²C-EEPROM (accessible from MCU)
- 16 General purpose inputs to the ET1100
- 16 General purpose outputs from the ET1100

¹ rt-labs, Barlastgatan 2, SE-414 63 Göteborg, Sweden, info@rt-labs.com, +46 31 240 250

² CS Selection only available when the TWR-ETHERCAT-SLV board is used as Freescale Tower System Modular Development Platform peripheral board.

2 References

- [1] ET1100 Datasheet V1.8:
http://download.beckhoff.com/download/Document/EtherCAT/Development_products/EtherCAT_ET1100_Datasheet_all_v1i8.pdf
- [2] TWR-K60N512 User's Manual Rev. 1.1
http://cache.freescale.com/files/32bit/doc/ref_manual/TWR-K60N512-UM.pdf
- [2] ST 24C02 I²C EEPROM datasheet Rev. 2
<http://www.st.com/st-web-ui/static/active/en/resource/technical/document/datasheet/DM00071904.pdf>

3 Interfaces

3.1 Freescale Tower System Modular Development Platform Connector

The TWR-ETHERCAT-SLV module is designed to interface with a Kinetis MCU module, the TWR-K60F120M or the TWR-K60N512, over the Elevator module. At least a connection on the primary side (white Elevator) is mandatory.

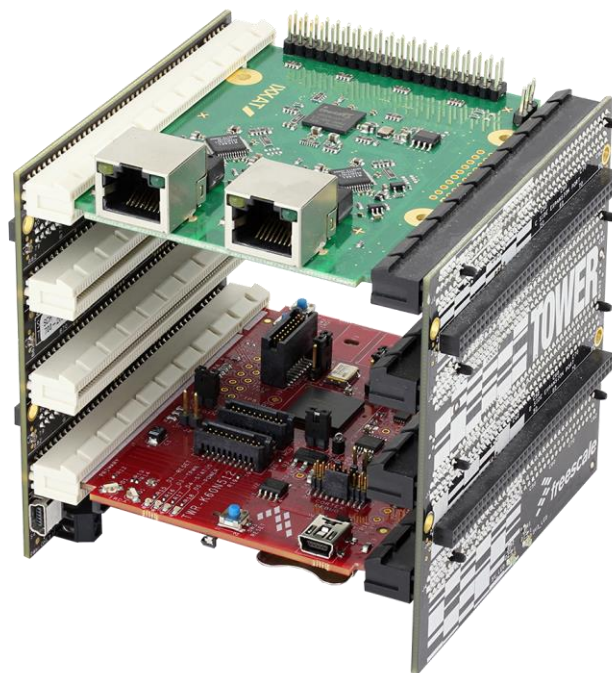


Figure 3-1: Assembled Freescale Tower System modular development platform with TWR-K60N512 MCU module, Elevator modules and the TWR-ETHERCAT-SLV EtherCAT Slave peripheral module

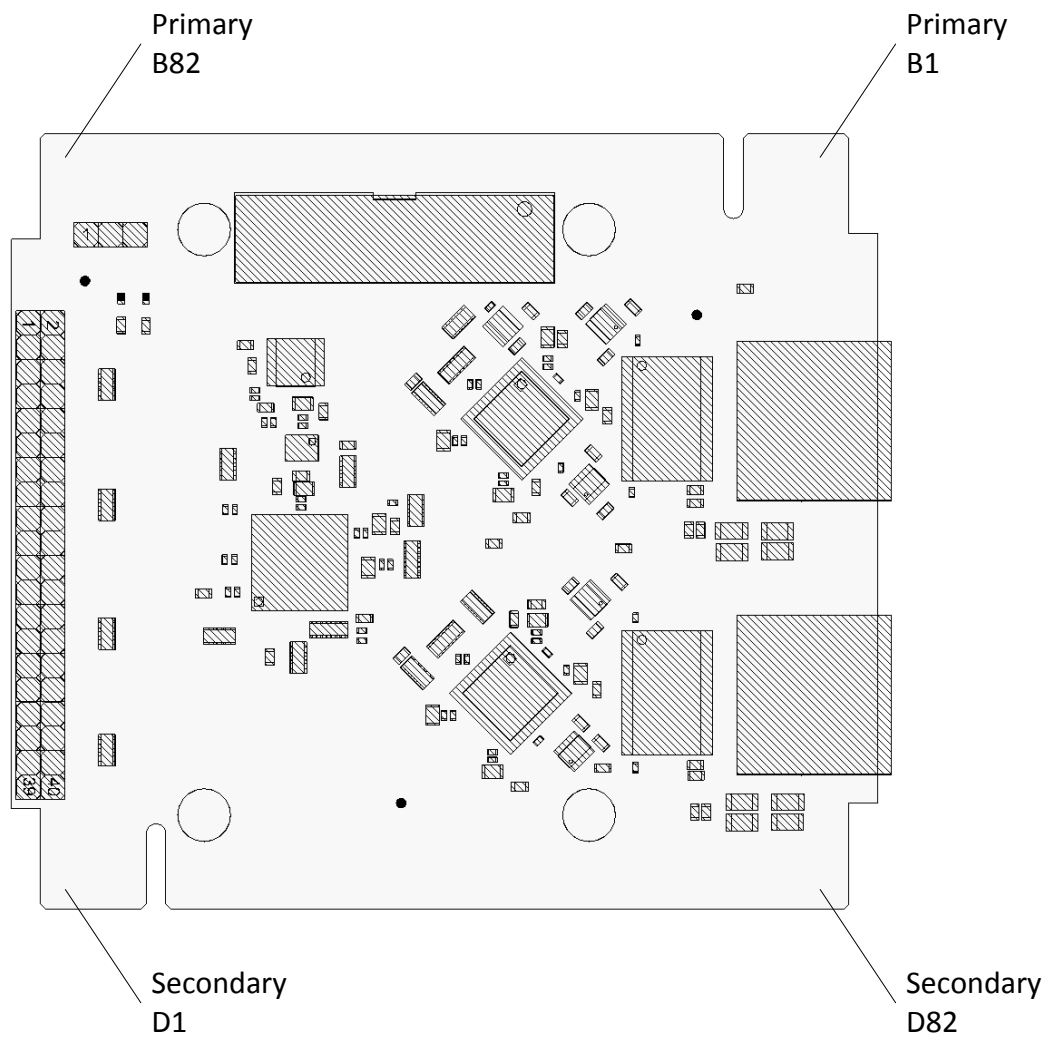


Figure 3-2: Primary and Secondary card edges for connection to the Tower System Elevator modules, top view (component side)

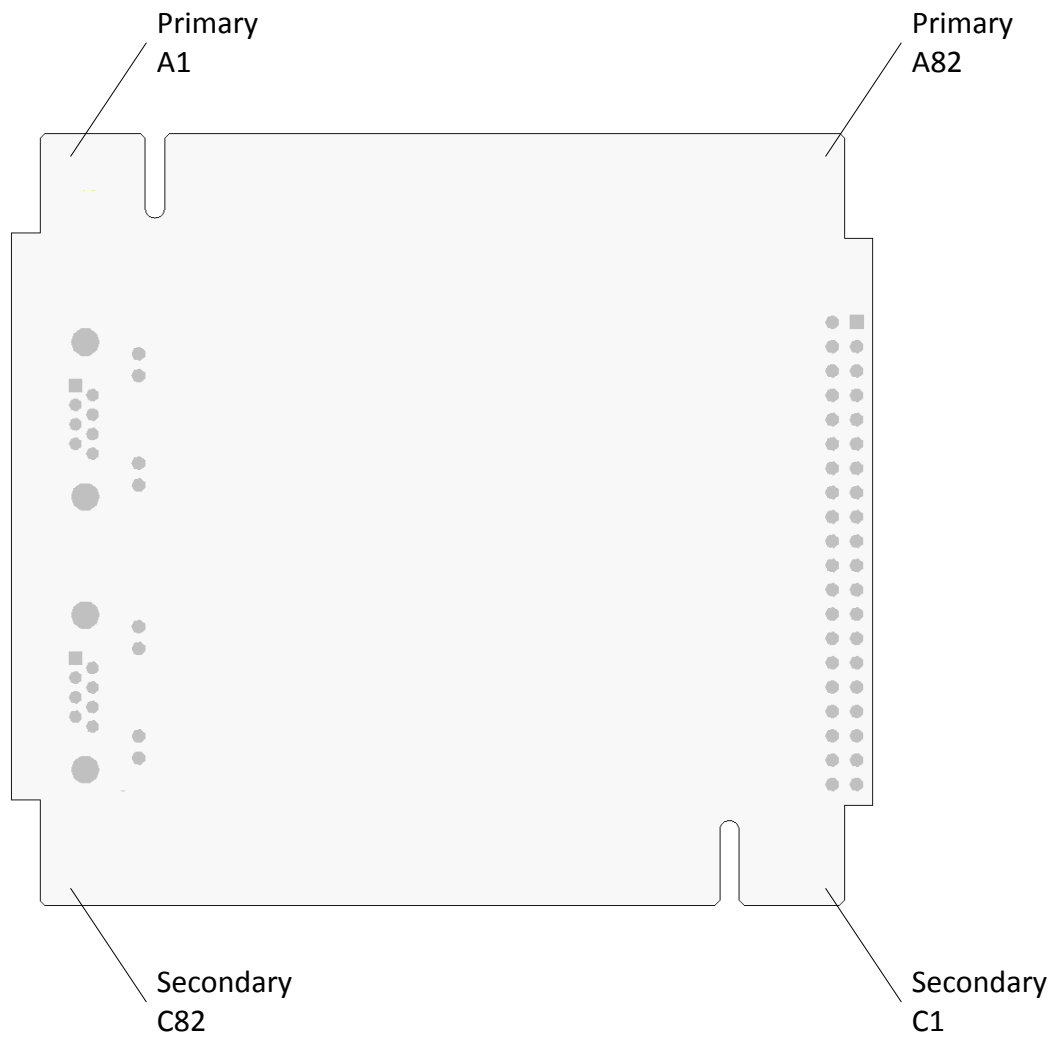


Figure 3-3: Primary and Secondary card edges for connection to the Tower System Elevator modules, bottom view (non-component side)

3.1.1 Connector X200A (Primary card edge)

TWR-ELEV (primary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
A1	+5V	+5V
A2	GND	GND
A3	+3.3V	+3.3V
A4	+3.3V	+3.3V
A5	GND	GND
A6	GND	GND
A7	SCL0	I2C.SCL
A8	SDA0	I2C.SDA

TWR-ELEV (primary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
A9	GPIO9/CTS1	ASIC_CONTROL.LATCH1
A10	GPIO8/ SDHC_D2	GPIO2
A11	GPIO7/ SD_WP_DET	GPIO3
A26	GND	GND
A31	GND	GND
A35	GPIO6	ERR_LED
A36	+3.3V	+3.3V
A49	GND	GND
A65	GND	GND
A81	GND	GND
A82	+3.3V	+3.3V

Pins not stated here are not connected on the TWR-ETHERCAT-SLV module.

3.1.2 Connector X200B (Primary card edge)

TWR-ELEV (primary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
B1	+5V	+5V
B2	GND	GND
B3	+3.3V	+3.3V
B5	GND	GND
B6	GND	GND
B21	GPIO1/RTS1	ASIC_CONTROL.LATCH0
B22	GPIO2 /SDHC_D1	GPIO0
B23	GPIO3	ASIC_CONTROL.RESET
B26	GND	GND
B31	GND	GND
B35	GPIO4	ASIC_CONTROL.EEPROM_LOADED
B36	+3.3V	+3.3V
B44	SPI0_MISO (IO1)	SPI.MISO
B45	SPI0_MOSI (IO0)	SPI.MOSI
B46	SPI_CS0_b	SPI.CS0
B47	SPI_CS1_b	SPI.CS1
B48	SPI_CLK	SPI.CLK
B49	GND	GND
B51	SDA1	GPIO1
B62	IRQ_A	SPI.IRQ

TWR-ELEV (primary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
B65	GND	GND
B81	GND	GND
B82	+3.3V	+3.3V

Pins not listed here are not connected on the TWR-ETHERCAT-SLV module.

3.1.3 Connector X200C (Secondary card edge)

TWR-ELEV (secondary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
C1	+5V	+5V
C2	GND	GND
C3	+3.3V	+3.3V
C4	+3.3V	+3.3V
C5	GND	GND
C6	GND	GND
C26	GND	GND
C31	GND	GND
C36	+3.3V	+3.3V
C49	GND	GND
C65	GND	GND
C81	GND	GND
C82	+3.3V	+3.3V

Pins not listed here are not connected on the TWR-ETHERCAT-SLV module.

3.1.4 Connector X200D (Secondary card edge)

TWR-ELEV (secondary)	TWR-K60N512 / TWR-K60F120M	TWR-ETHERCAT-SLV
D2	GND	GND
D3	+3.3V	+3.3V
D5	GND	GND
D6	GND	GND
D26	GND	GND
D31	GND	GND
D36	+3.3V	+3.3V
D49	GND	GND
D65	GND	GND
D81	GND	GND
D82	+3.3V	+3.3V

Pins not listed here are not connected on the TWR-ETHERCAT-SLV module.

3.1.5 X301: Chip select for SPI-Connection

The TWR-K60F120M and TWR-K60N512 MCU modules support two chip select (CS) lines for SPI0 on the Elevator connection. The user may select by jumper which CS shall be used to control the interface to the ET1100.

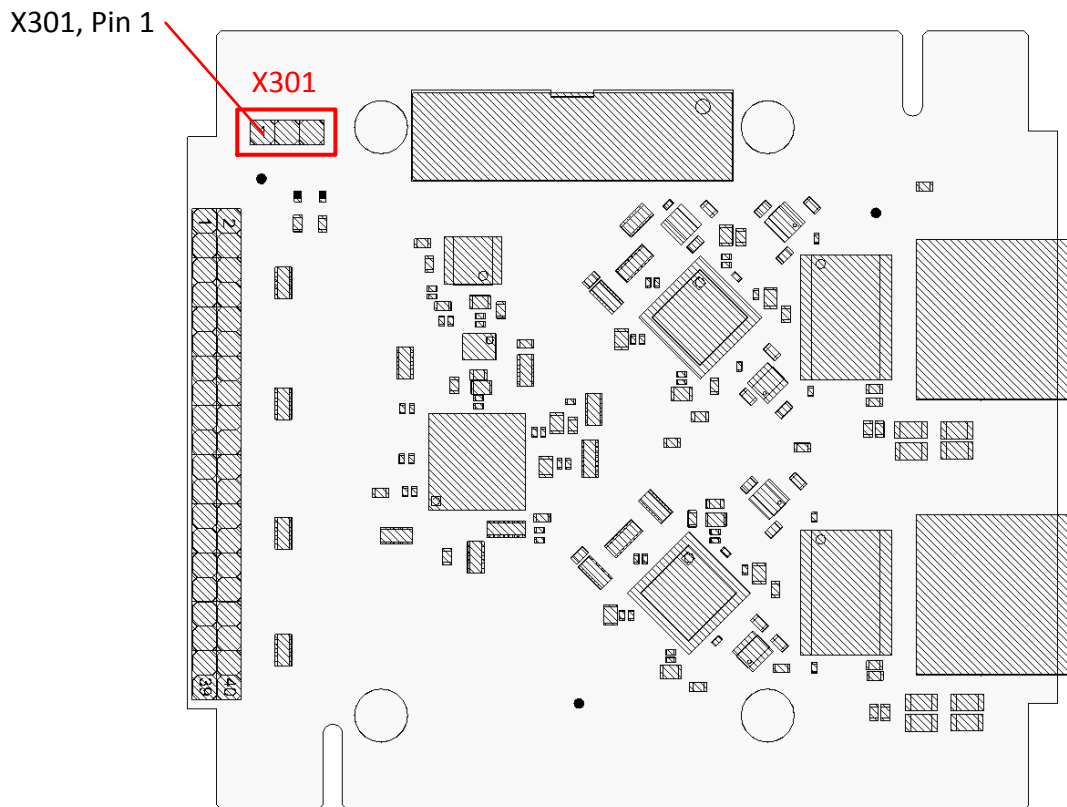


Figure 3-4: Positions and orientation of X301, top view (component side)

The following jumper settings are available:

Jumper on pins	Chip select
1-2	SPI_CS1_b
2-3	SPI_CS0_b

Please note that the CS selection is only available for operation with the Freescale Tower System, not for the alternative MCU connection via X201.

3.2 Alternative MCU connection

If the board is not assembled in a Freescale Tower System using the TWR-ELEV Elevator modules as connectors, the connection to the MCU may be established via the alternate connector X201. Please note that the

connector is not mounted on delivery. The user will have to solder this 2x10 Pin 2,54mm grid pinheader connector.

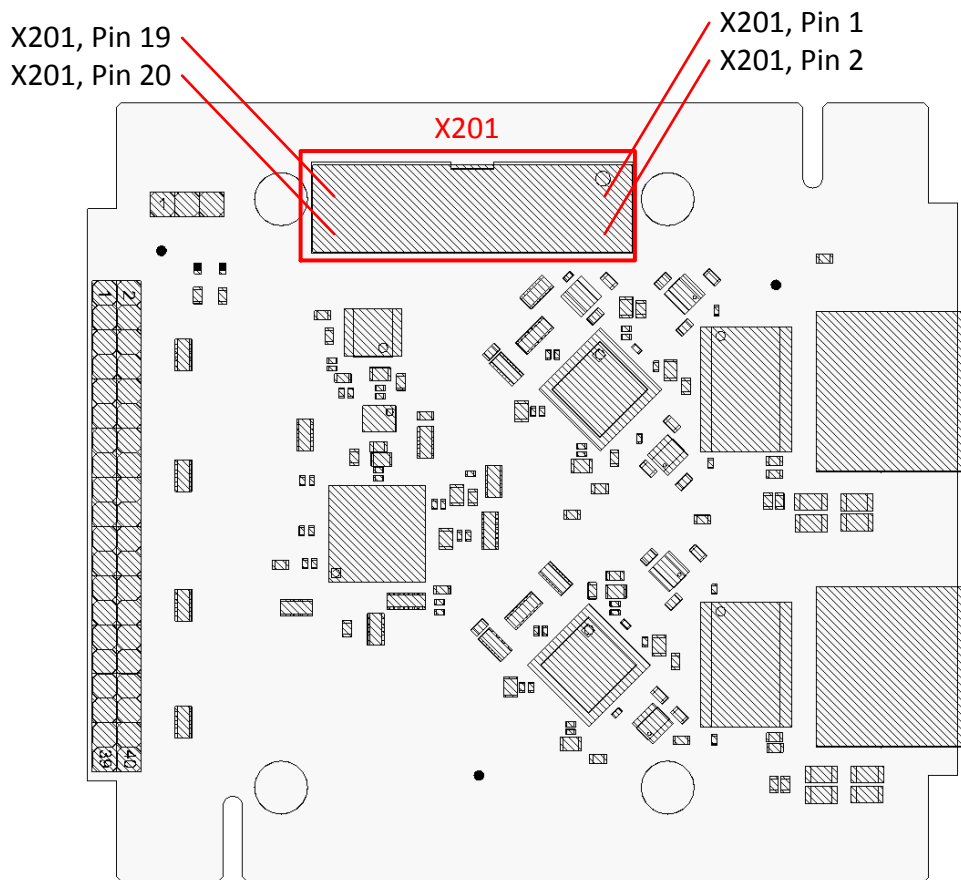


Figure 3-5: Positions and orientation of X201, top view (component side)

3.2.1 Connector X201

PIN	Signal
1	+3.3V
2	ASIC_CONTROL.RESET
3	GND
4	ASIC_CONTROL.EEPROM_LOADED
5	GND
6	ASIC_CONTROL.LATCH0
7	GND
8	ASIC_CONTROL.LATCH1
9	GND
10	I2C.SDA
11	+3.3V
12	I2C.SCL

PIN	Signal
13	GND
14	GND
15	GND
16	SPI.MISO
17	GND
18	SPI.MOSI
19	+3.3V
20	+3V3

3.3 LEDs

The TWR-ETHERCAT-SLV module contains two LEDs: The ERR-LED and the RUN-LED. The ERR-LED is controlled by the Kinetis K60 MCU via GPIO over the TWR-ELEV Elevator connection (see 3.1.1 Connector X200A (Primary card edge)). The RUN-LED is controlled by the ET1100.

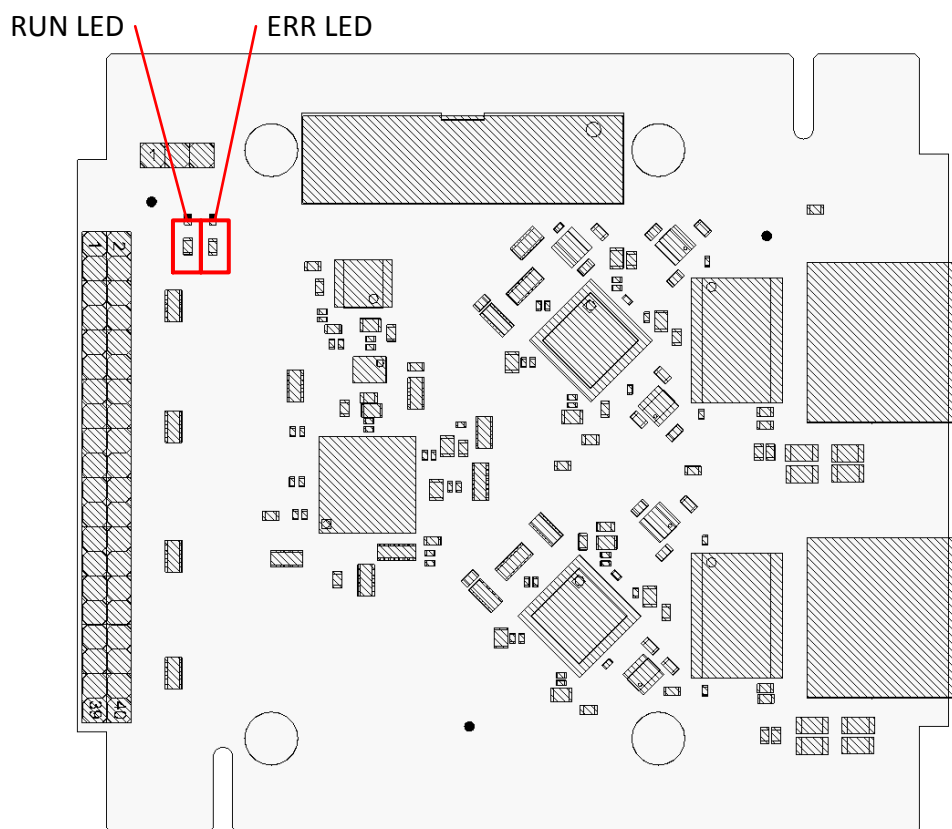


Figure 3-6: Positions of the LEDs, top view (component side)

3.4 GPIO

The GPIOs from the ET1100 are connected to the X300. Please note that the inputs are connected via 4k7 pull-down resistors to GND signal level.

16 Inputs (GPI) and 16 outputs (GPO) are available on X300.

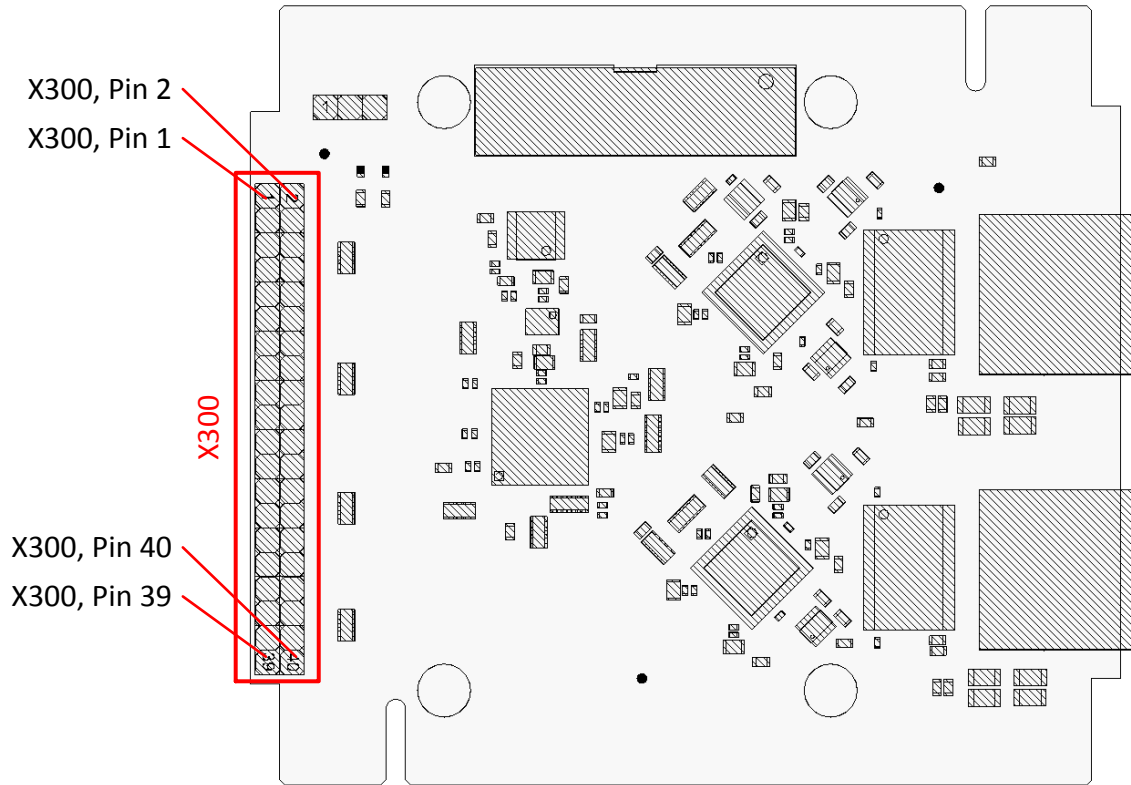


Figure 3-7: Positions and orientation of X300, top view (component side)

3.4.1 Connector X300

Pin	Connection
1	+3.3V
2	GND
3	GPO 0
4	GPI 0
5	GPO 1
6	GPI 1
7	GPO 2
8	GPI 2
9	GPO 3
10	GPOI 3
11	+3.3V
12	GND

Pin	Connection
13	GPO 4
14	GPI 4
15	GPO 5
16	GPI 5
17	GPO 6
18	GPI 6
19	GPO 7
20	GPI 7
21	+3.3V
22	GND
23	GPO 8
24	GPI8
25	GPO 9
26	GPI 9
27	GPO 10
28	GPI 10
29	GPO 11
30	GPI 11
31	+3.3V
32	GND
33	GPO 12
34	GPI 12
35	GPO 13
36	GPI 13
37	GPO 14
38	GPI 14
39	GPO 15
40	GPI 15

3.5 EtherCAT interface

The connection to the EtherCAT network is established via two RJ45-jacks with standard Ethernet pin assignment. The network interfaces are galvanically isolated to each other and the MCU part of the circuit.

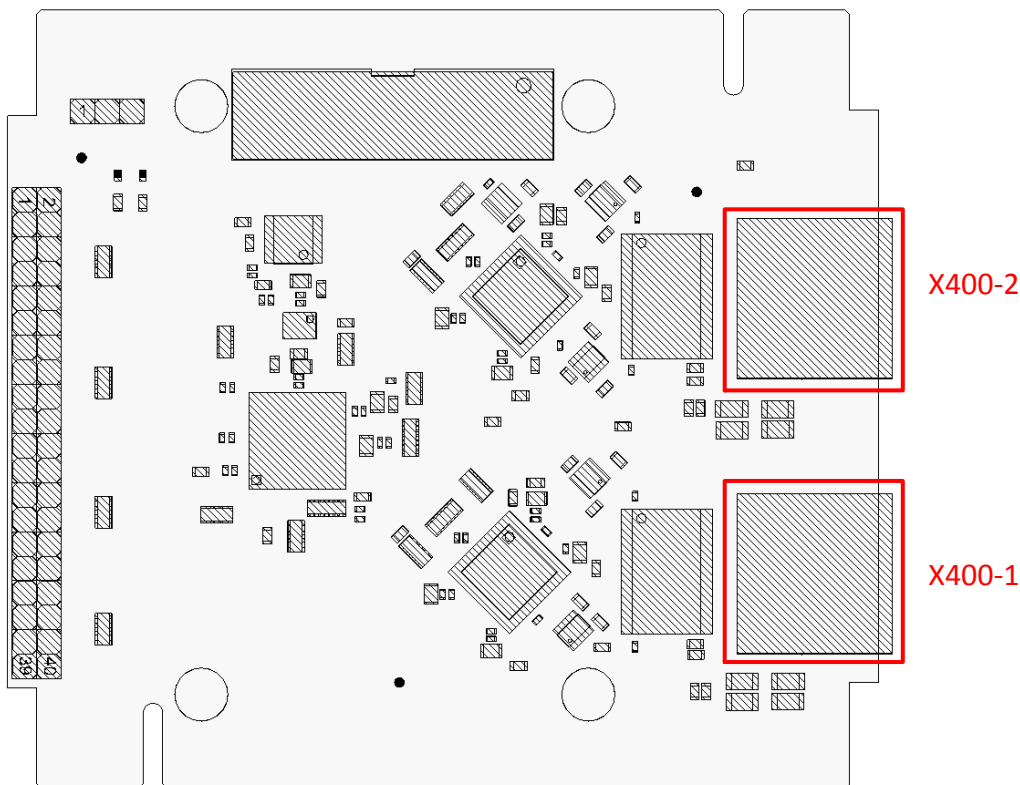


Figure 3-8: Positions of X400-1 and X400-2, top view (component side)

3.5.1 Connector X400-1A / X400-2A

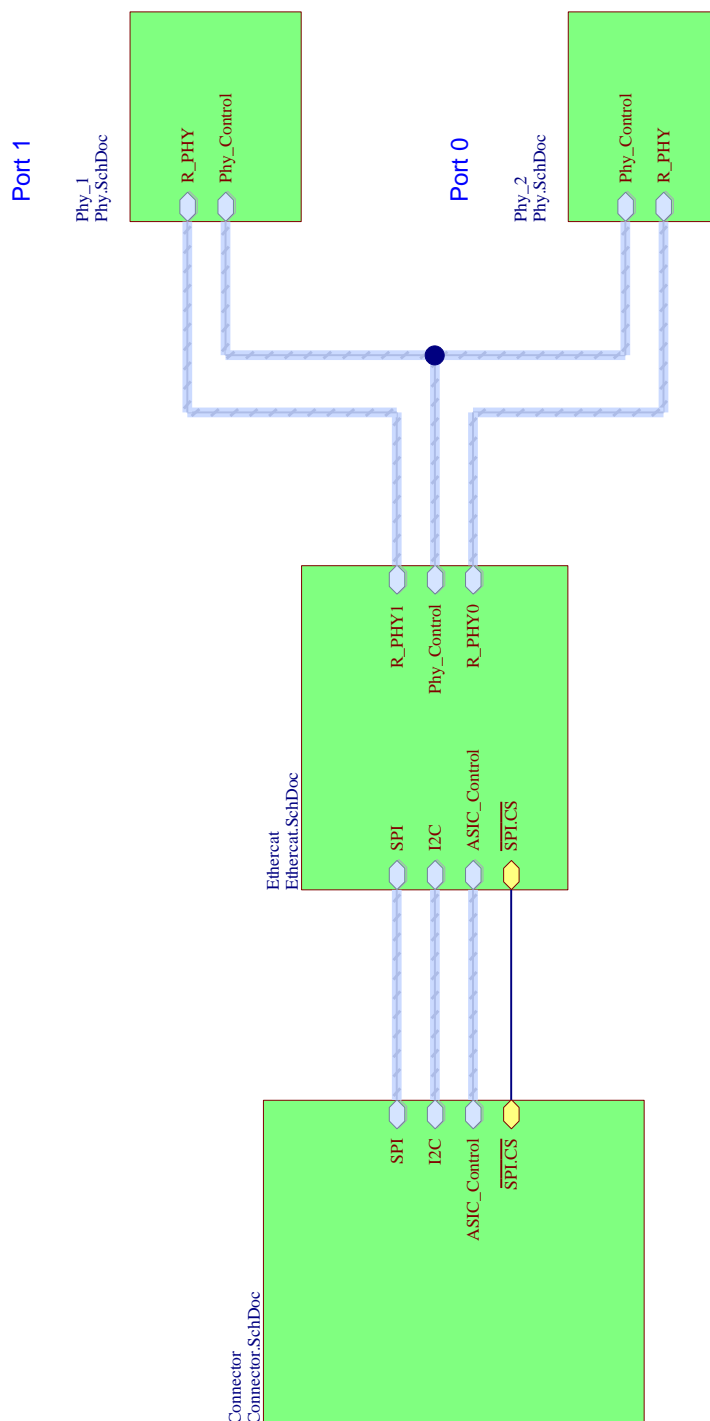
Pin	Connection
1	Transmission Data +
2	Transmission Data -
3	Receiver Data +
4	Coupled to virtual GND
5	Coupled to virtual GND
6	Receiver Data -
7	Coupled to virtual GND
8	Coupled to virtual GND
Shield	Coupled to PE

4 Schematics

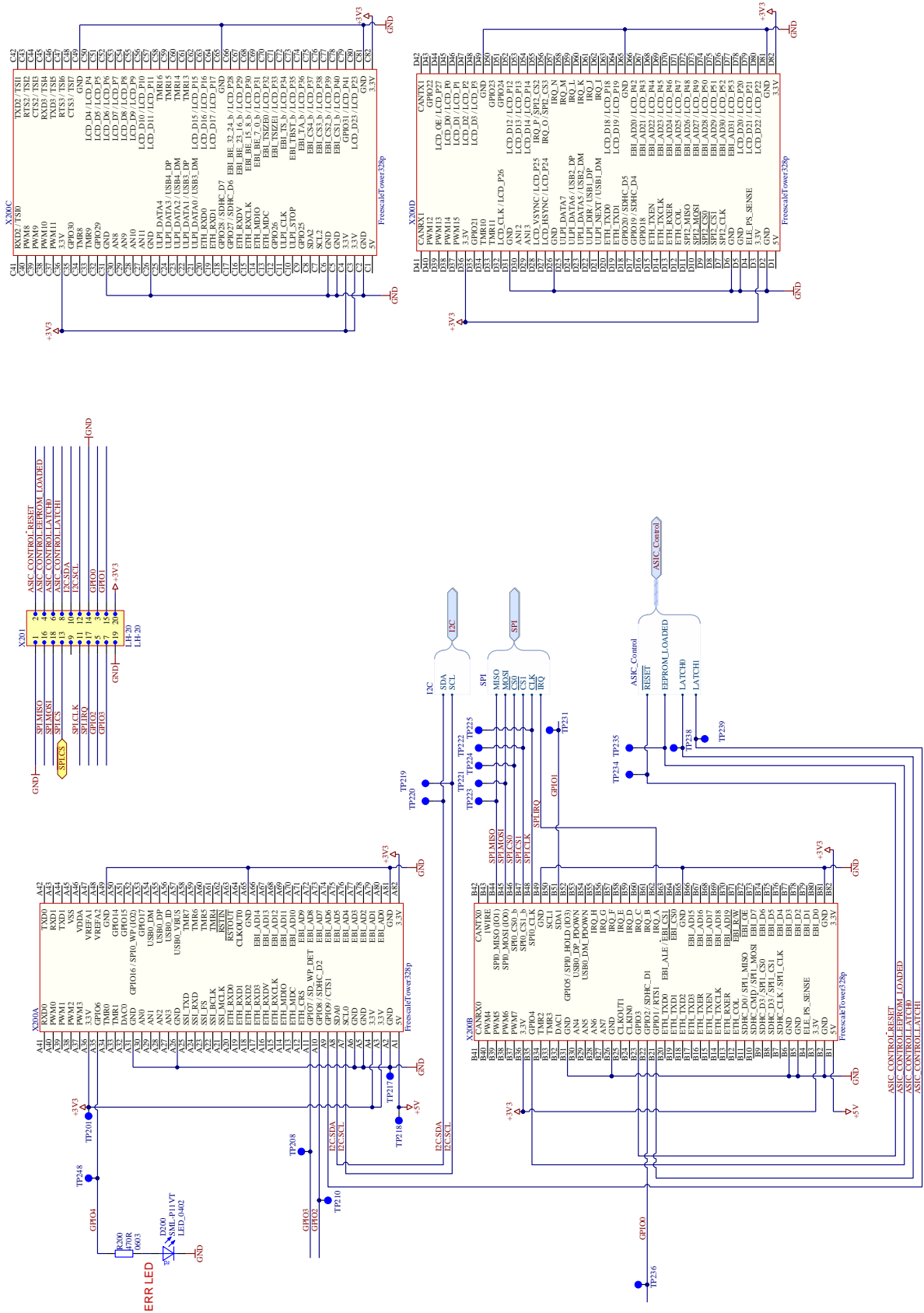
Revision 1.1

4.1 Top Level

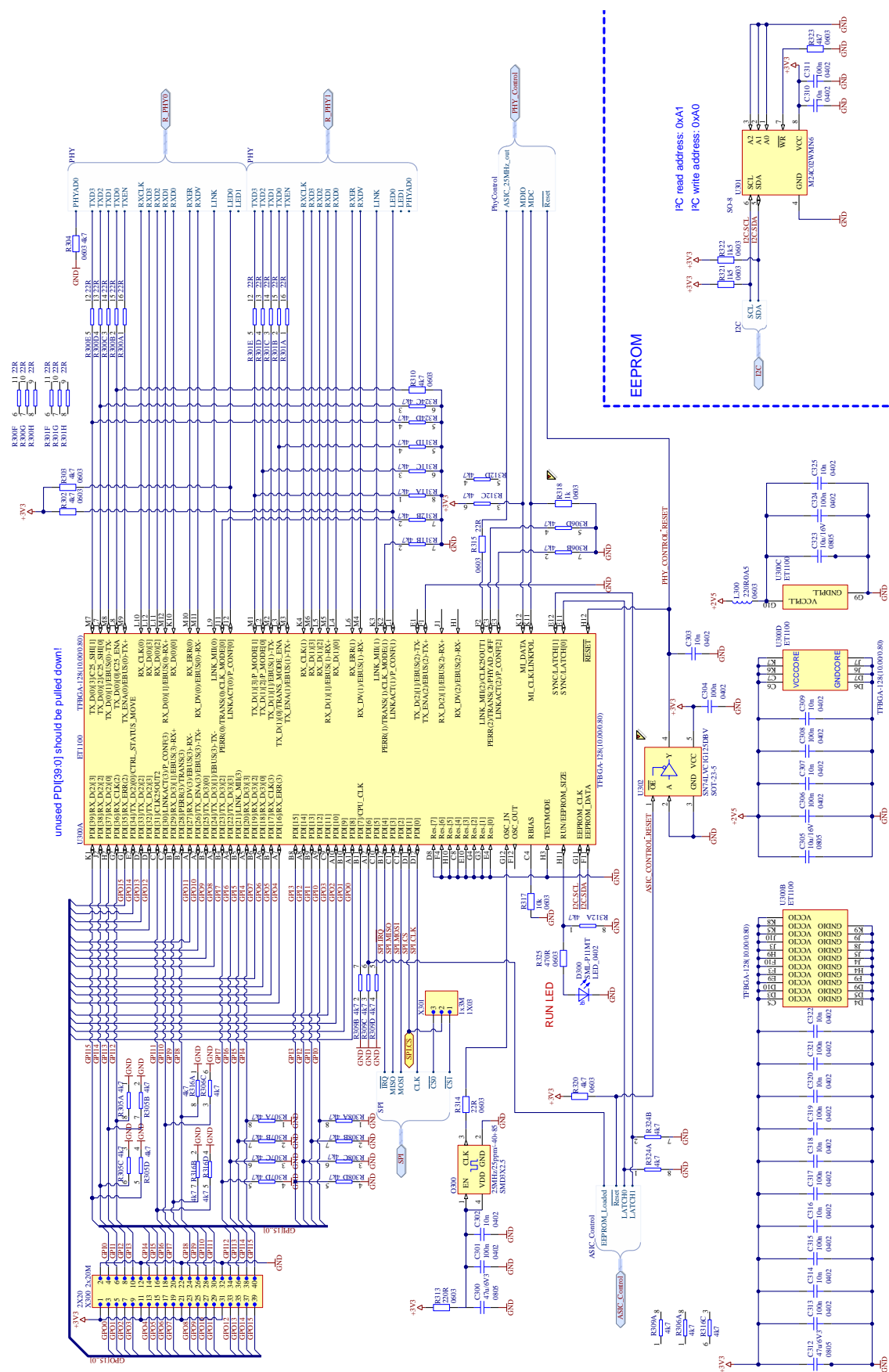
Connections between the different parts of the schematics:



4.2 Tower System Connection / Power

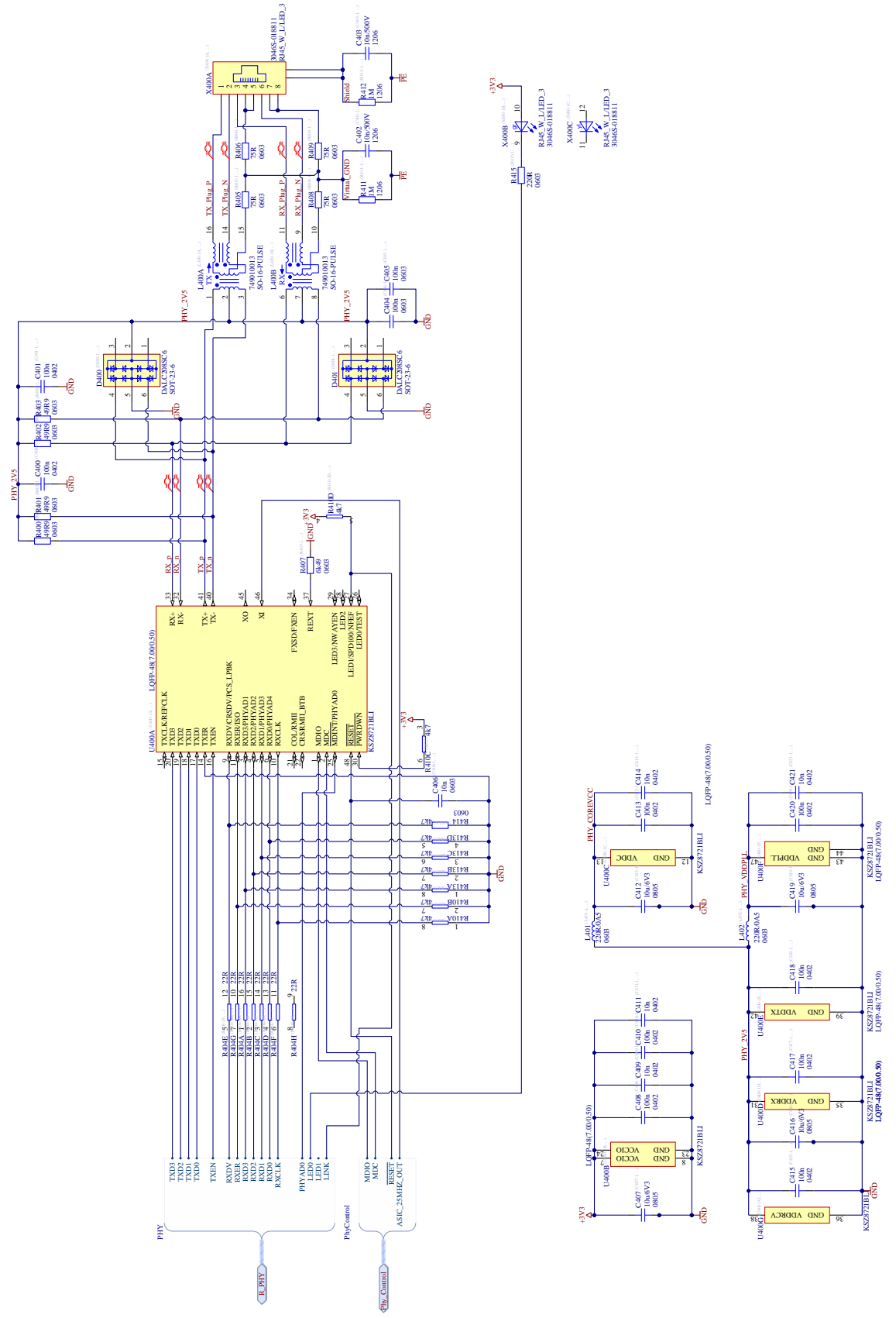


4.3 ET1100 / EEPROM



4.4 Ethernet PHY and RJ45

Note: This part of the schematics is implemented two times (Port0 / Port1).



5 Bill of materials

Pos	Reference	Value	Package
1	C300, C312	47u/6V3	0805
2	C301, C304, C306, C308, C311, C313, C315, C317, C319, C321, C324, C400-1, C400-2, C401-1, C401-2, C408-1, C408-2, C410-1, C410-2, C413-1, C413-2, C415-1, C415-2, C417-1, C417-2, C418-1, C418-2, C420-1, C420-2	100n	0402
3	C302, C303, C307, C309, C310, C314, C316, C318, C320, C322, C325, C409-1, C409-2, C411-1, C411-2, C414-1, C414-2, C421-1, C421-2	10n	0402
4	C305, C323	10u/16V	0805
5	C402-1, C402-2, C403-1, C403-2	10n/500V	1206
6	C404-1, C404-2, C405-1, C405-2	100n	0603
7	C406-1, C406-2	10n	0603
8	C407-1, C407-2, C412-1, C412-2, C416-1, C416-2, C419-1, C419-2	10u/6V3	0805
9	D200	SML-P11VT	LED_0402
10	D300	SML-P11MT	LED_0402
11	D400-1, D400-2, D401-1, D401-2	DALC208SC6	SOT-23-6
12	L300, L401-1, L401-2, L402-1, L402-2	220R/0A5	0603
13	L400-1, L400-2	749010013	SO-16-PULSE
14	O300	25MHz/25ppm/-40+85	SMD3X2.5
15	R200, R325	470R	0603
16	R300, R301, R404-1, R404-2	22R	RN0402X8
17	R302, R303, R304, R310, R320, R323, R414-1, R414-2	4k7	0603
18	R305, R306, R307, R308, R309, R311, R312, R316, R324, R410-1, R410-2	4k7	RN1206
19	R313, R415-1, R415-2	220R	0603
20	R314, R315	22R	0603
21	R317	10k	0603
22	R318	1k	0603
23	R400-1, R400-2, R401-1, R401-2, R402-1, R402-2, R403-1, R403-2	49R9	0603
24	R405-1, R405-2, R406-1, R406-2, R408-1, R408-2, R409-1, R409-2	75R	0603
25	R407-1, R407-2	6k49	0603

Pos	Reference	Value	Package
26	R411-1, R411-2, R412-1, R412-2	1M	1206
27	U300	ET1100	TFBGA-128(10.00/0.80)
28	U301	M24C02WMN6	SO-8
29	U302	SN74LVC1G125D BV	SOT-23-5
30	U400-1, U400-2	KSZ8721BLI	LQFP-48(7.00/0.50)
31	X300	2x20M	2X20
32	X301	1x3M	1X03
33	X400-1, X400-2	3046S-018811	RJ45_W_L/LED_3

6 Appendix

6.1 Support

For more information on IXXAT products, FAQ lists and installation hints, please refer to the support area on our homepage (www.ixxat.com). There you will also find information on current product versions and available updates.

For more information on the Freescale Tower System, visit www.freescale.com/Tower

6.2 Returning hardware

If it is necessary to return hardware to IXXAT, please download the relevant RMA form from the IXXAT homepage and follow the instructions on this form.

6.3 Information on EMC

This product is not tested or certified regarding EMC as it may not be operated as a standalone device. The user is responsible for taking adequate measures to ensure EMC when operating the product in a system.

If the product is used in office or home environment radio interference can occur under certain conditions. To ensure faultless operation of the device, the following instructions must be followed due to technical requirements of EMC:

- use only the included accessories
- the shield of the interfaces must be connected with the device plug and with the plug on the other side