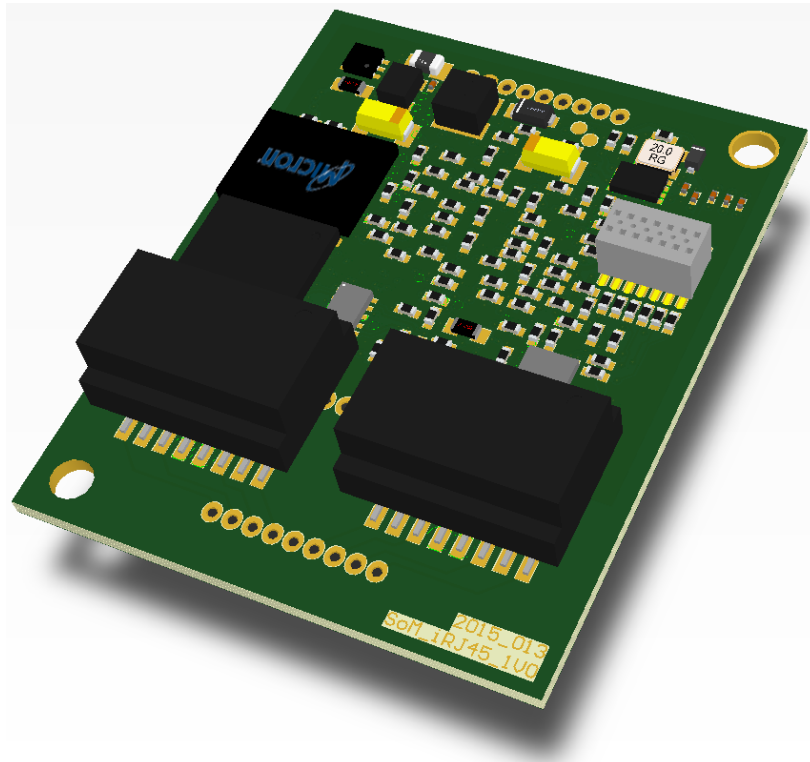


System on Module (SoM) IoT realtime communication on board

Version: 1.2



please note:

We reserve the right to make changes.

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Revision History

Version	Date	Status	Author	Updates
0.1	22.02.2018		STS	Initial document for PCB 1V0
0.5	01.08.2018		DRF	various adjustments
0.6	16.01.2019		STS	Virtual ground for J301 added
1.0	10.01.2020		STS	Section 4 added Section 7 added
1.1	21.01.2020		STS	Section 5.2.1 added and 5.3 updated Hyperlinks added
1.2	28.01.2020		STS	Section 4 updated

1. Scope

This document has the primary function to give an overview of the Intelligent RJ45 Module with focus to System on Module (SoM_IoT) variant.

2. Description

These SoM_IoT module is designed for 3.0V to 3.6V supply voltage. It offers ethernet based industrial communication which is redirectable via serial peripheral interface to external host controller MCU. The SoM_iRJ45 based on R-IN32M3-EC large-scale integrated (LSI) circuit which supports **PROFINET, EtherNet/IP and EtherCAT protocols**. Additional feature of SoM_IoT are two optional **CANopen** ports and variable connection of another two optional ethernet ports with free selectable network connectors.

3. Pin Assignment

Following Figure 1 shows the Intelligent RJ45 Module in SoM variant at bottom side. There are three 9 pin multipoint connectors readily identifiable (numerals 1 to 3).

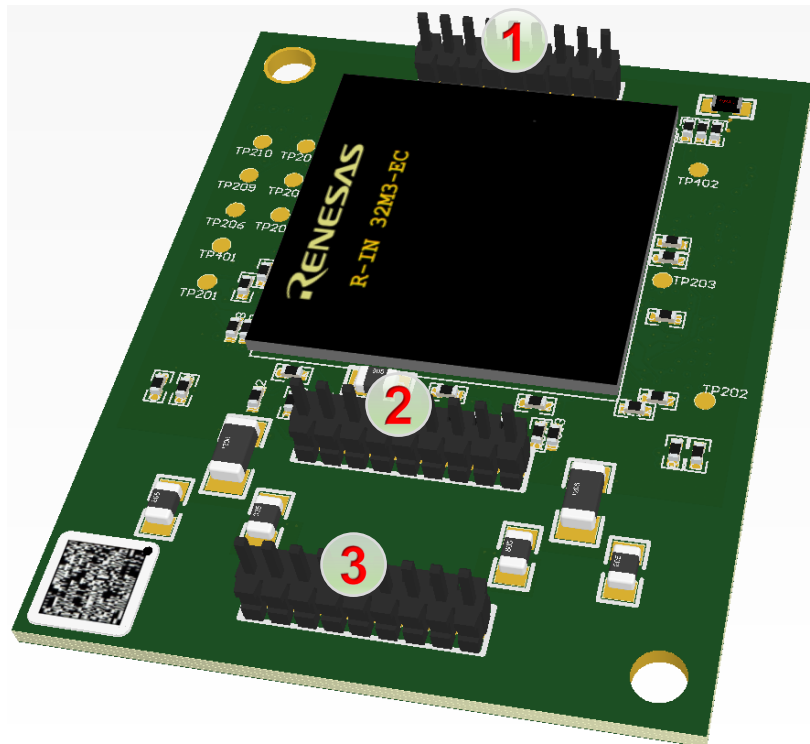


Figure 1: Bottom view SoM_iRJ45_1V2

The 9 pin connector (J202) marked by **1** numeral allocate the power supply pins, a Serial Peripheral Interface and two EtherCAT SYNC signals. Therefore is a connector with 1.27mm (50mil) pitch been deployed. All external signals are summarized in Table 1 on following page.

Note: Higher voltage (above 3.6V DC) at power supply pins may cause damage this module!

With 9 pin connector (J302) marked by **2** numeral are the CANopen and interface Indicator signals related. For usage of CANopen interface are additional components on target device required. This case will be described with more details in section 5.2.

The third 9 pin connector (J301), marked by **3** numeral, allocate the 2 port Ethernet signals. This signals are internal (on chip of R-IN32ME-EC) connected to an integrated IEEE802.3 dual-port Ethernet physical layer. Whereby 10BASE-T, 100BASE-TX/FX is supported. In this case you can find a more detailed description in section 5.3.

Table 1: Overview of all external available signals and pins

Connector	Pin	Signal	Function
J202	1	VCC33	3.3V DC Power supply
	2	GND	
	3	CS	
	4	RESET	Serial Peripheral Interface (R-IN32M3-EC specific Clocked Serial Interface H)
	5	MISO	
	6	MOSI	
	7	SCK	
	8	CATSYNCO	EtherCAT SYNC
	9	CATSYNC1	
J302	10	P1ACT	Ethernet Port 1 Indicator signals for connection with LED cathode (Link/Activity)
	11	P1LINK	
	12	P0ACT	Ethernet Port 0 Indicator signals for connection with LED cathode (Link/Activity)
	13	P0LINK	
	14	VCC33	Optional 3.3V DC connection
	15	CAN_CRXD0	CAN Port 0
	16	CAN_CTXD0	
	17	CAN_CRXD1	CAN Port 1
	18	CAN_CTXD1	
J301	19	RX0_N	Ethernet Port 0 Differential Pairs
	20	RX0_P	
	21	TX0_N	
	22	TX0_P	
	23	SHIELD	Virtual ground for SHIELD connection only
	24	RX1_N	Ethernet Port 1 Differential Pairs
	25	RX1_P	
	26	TX1_N	
	27	TX1_P	

4. Electrical Characteristics

Absolute Maximum Ratings for the Module

Stress exceeding maximum ratings even for short time may damage the module. Functional operation above the recommended operating conditions is not guaranteed. Extended exposure to stress above the recommended operating conditions may affect device reliability.

Table 2: Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.2 to +3.6	V
I/O voltage	V_I / V_O	-0.3 to +3.6	V
Storage temperature	T_S	-40 to +85	°C

Table 3: Operating Conditions for the Module

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply	V_{CC}	3.15	3.3	3.45	V
Power consumption (at 3.3V)	P		1.3	2.0	W
Ambient temperature	T_a	-40		-40 to +70	°C

Table 4: Operating conditions for application interface

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage high	V_{IH}	2.0		$V_{CC} + 0.3$	V
Input voltage low	V_{IL}	-0.3		0.8	V
Output voltage high	V_{OH}	$V_{CC} - 0.1$			V
Output voltage low	V_{OL}			0.1	V

All further specifications and timings assume the application of the above mentioned operating conditions.

Table 5: SPI (slave) operation

Parameter	Symbol	Min.	Typ.	Max.	Unit
SPI clock period	t_{cl}	60			ns
Setup time	t_{su}	10			ns
Hold time	t_h	15			ns

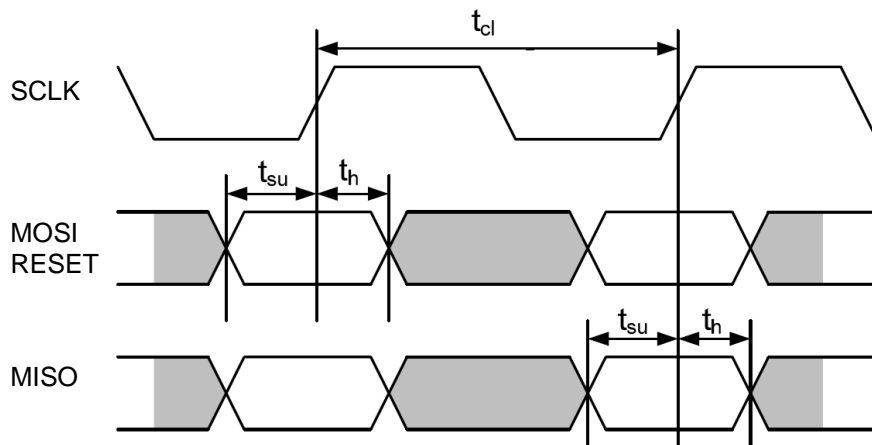


Figure 2: SPI timing

5. Detailed Interface description

Both available VCC33 power supply pins (1 or 14) give the possibility to connect 3,3V DC supply voltage. At least one of both pins has to connect with an external voltage source. To supply the SoM_iRJ45 a ground level connection is required at pin 2.

In following figures are all 27 available pins displayed and marked with red numbering for clear pin identification. All signal lines (Pin 3 to 13 and pin 15 to 18) of connector J202 and J302 respectively include a series resistor with 22 Ω resistance to protect internal circuits of R-IN32M3-EC.

For full description of register settings and mode control verify the datasheet of R-IN32M3 series (R-IN32M3 Series, User's Manual: Peripheral Modules, Document Number: **R18UZ0007EJ1000**, Issue date: Feb 28, 2017).

5.1. Serial Peripheral Interface and power supply

Figure 3 display the 9 pin connector **J202** on bottom side of SoM_iRJ45 printed circuit board. This connector allocate the large-scale integrated circuit R-IN32M3-EC with external SPI and additional SYNC signals. Furthermore the power supply pins VCC33 and GROUND are connected on J202.

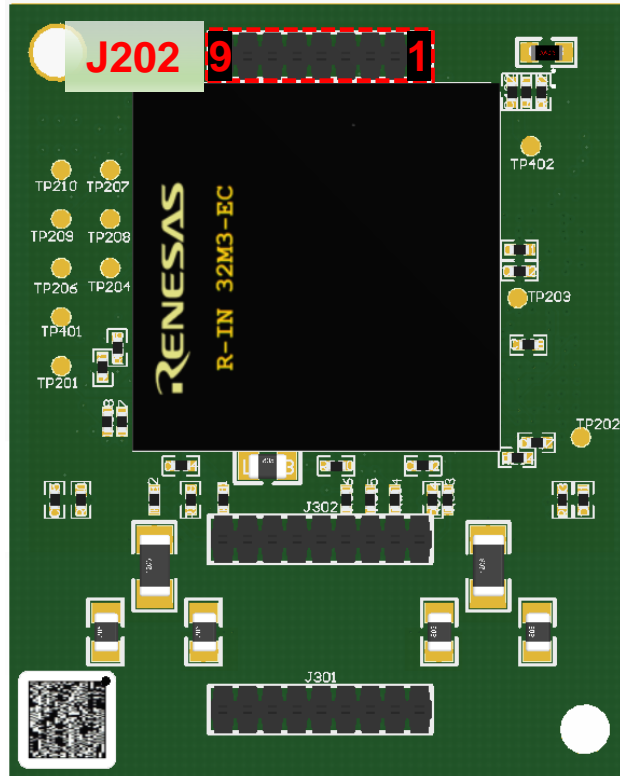


Figure 3: Bottom view SPI 9 pin connector J202

Pin 1 (VCC33) and pin 2 (GND) should be connect with external DC voltage source. The SoM_iRJ45 is specified for an input voltage range of 3,0V DC to 3,6V DC.

Note: Higher voltage (above 3.6V DC) at power supply pins may cause damage this module!

Pin 3 has chip select (CS) function for R-IN32M3-EC Clocked Serial Interface H (CSIH) which works in Slave Mode at CSIH channel 0. The used chip select sink for this R-IN32M3-EC based module is Port P70, Port P71 drives permanently to GND level.

Pin 4 connect the RESETZ ball of R-IN32M3-EC. So an external reset signal can initialize the CPU core and the internal peripheral modules.

Pin 5 complies the MISO function for SPI connection. This pin connect the R-IN32M3-EC CSIH serial data output signal at Port P47 (CSISO0).

Pin 6 complies the MOSI function for SPI connection. This pin connect the R-IN32M3-EC CSIH serial data input signal at Port P46 (CSISIO).

Pin 7 complies the SCK function for SPI connection. This channel 0 CSIH signal connect the serial clock of R-IN32M3-EC at Port P45.

Pin 8 (CATSYNC0) connect Port P11 of R-IN32M3-EC and is able to use as GPIO or EtherCAT Sync0 signal connection.

Pin 9 (CATSYNC1) connect Port P10 of R-IN32M3-EC and is able to use as GPIO or EtherCAT Sync1 signal connection.

5.2. CANopen and Ethernet indicator signals

With further development of Intelligent RJ45 Module, the SoM_iRJ45 supports additionally two CANopen ports. Both ports just offer the transceiver (TX) and receiver (RX) signals per port. For complete CAN connection, additional components are required. Following Figure 4 give an overview about the connection pins of J302. Subsequently all 9 pins will be described and a sample schematic for a complete CAN wiring represented.

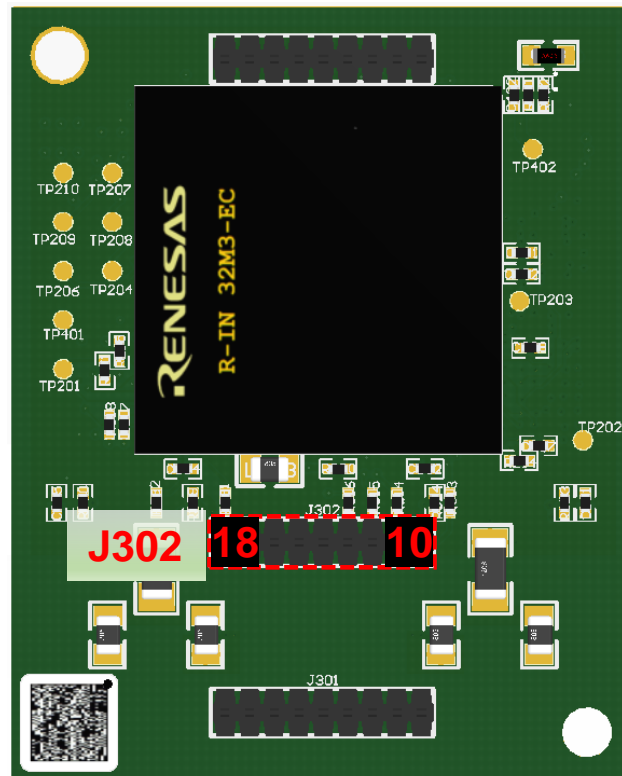


Figure 4: Bottom view CAN 9 pin connector J302

Pin 10 (P1ACT) offers ethernet port 1 activity indicator signal associated with R-IN32M3-EC Port RP04.

Pin 11 (P1LINK) offers ethernet port 1 link indicator signal and is connected with CATLINK1 signal for EtherCAT confirm indication requirements. This signals are associated with R-IN32M3-EC Port P05 and P07.

Pin 12 (P0ACT) offers ethernet port 0 activity indicator signal associated with R-IN32M3-EC Port RP02.

Pin 13 (P0LINK) offers ethernet port 0 link indicator signal and is connected with CATLINK0 signal for EtherCAT confirm indication requirements. This signals are associated with R-IN32M3-EC Port P04 and P06.

Pin 14 (VCC33) can be optional connected with external DC voltage source. The SoM_iRJ45 is specified for an input voltage range of 3,0V DC to 3,6V DC.

Note: Higher voltage (above 3.6V DC) at power supply pins may cause damage this module!

Pin 15 (CAN_RX0) is directly connected with CAN Controller Channel 0 (FCN0) of R-IN32M3-EC. This pin serve as CAN bus reception input and is connected to R-IN32M3-EC Port P53.

Pin 16 (CAN_TX0) is directly connected with CAN Controller Channel 0 (FCN0) of R-IN32M3-EC. This pin serve as CAN bus transmission output and is connected to R-IN32M3-EC Port P54.

Pin 17 (CAN_RX1) is directly connected with CAN Controller Channel 1 (FCN1) of R-IN32M3-EC. This pin serve as CAN bus reception input and is connected to R-IN32M3-EC Port P55.

Pin 18 (CAN_TX1) is directly connected with CAN Controller Channel 1 (FCN1) of R-IN32M3-EC. This pin serve as CAN bus transmission output and is connected to R-IN32M3-EC Port P56.

Following Figure 5 represents a sample schematic with additional components for CAN Channel 0. This component are **not** included on SoM_iRJ45 module. Other CAN transceiver are also possible to use.

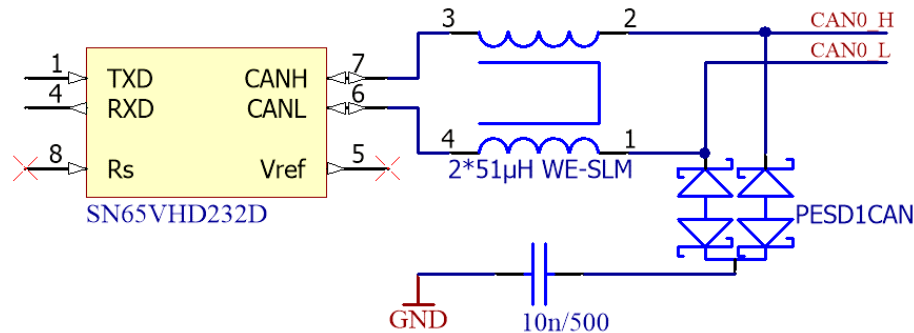


Figure 5: CAN transceiver SN65VHD232D + protection components

The TXD input (1) and RXD output (4) of SN65VHD232D CAN transceiver are to connect with both equivalent CAN Controller Channel signals. For example in addition to Channel 0 is TXD to connect with pin 16 (CAN_TX0) and RXD with pin 15 (CAN_RX0). It is recommended both CAN bus pins (CANH and CANL) for better signal integrity to connect with line filter (for example 2*51µH WE-SLM). For ESD issues and other transient protection, a TVS array (PESD1CAN) is recommended at bus lines. This device is to decouple from GND level via transient stable capacitor. CAN0_H and CAN0_L signals are able to connect at existing CAN bus environment.

Note: The SN65VHD232D has to connect with external voltage source, this pins are not displayed in Figure 5.

5.2.1. Exemplary indicator signal connection for Link and Activity

The defined 4 indicator signals of J302 pin 10 to 13 in previous section 5.2 are recommended to connect similar to the following Figure 6.

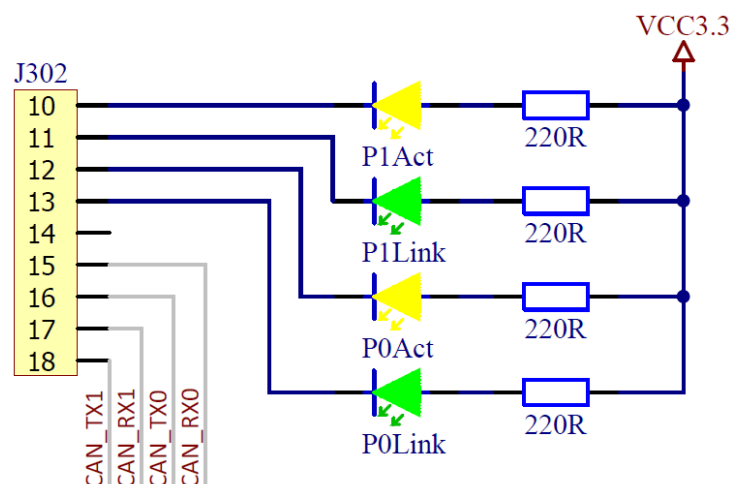


Figure 6: Exemplary Link/Activity-LED connection

5.3. Ethernet and Shield connection

With connector J301 are two 10BASE-T, 100BASE-TX/FX ethernet ports realized. The SoM-iRJ45 module includes the R-IN32M3-EC Ethernet Switch with additional TVS array connection for ESD and transient protection. Furthermore, the magnetic components for galvanic decoupling and signal integrity are offered too. Figure 7 pictured the bottom side of this module and clarify the correct pinning of J301.

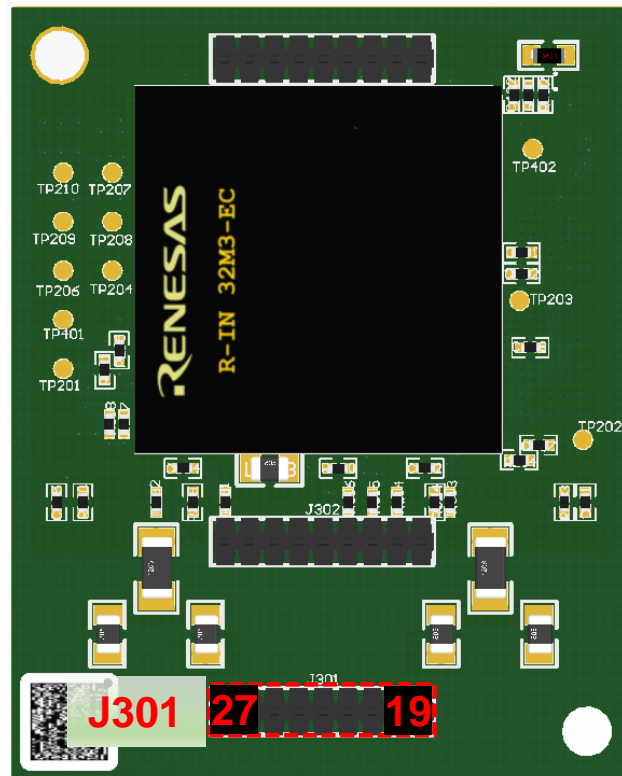


Figure 7: Bottom view Eth. 9 pin connector J301

Pin 19 (RX0_N) connect the differential receiver_N signal of ethernet port 0 and transfer this signal to target device. On following page are detailed information of decoupling components and connection at J301 pins given (Page 9 f.).

Pin 20 (RX0_P) connect the differential receiver_P signal of ethernet port 0 and transfer this signal to target device.

Pin 21 (TX0_N) connect the differential transceiver_N signal of ethernet port 0 and transfer this signal to target device.

Pin 22 (TX0_P) connect the differential transceiver_P signal of ethernet port 0 and transfer this signal to target device.

Pin 23 (SHIELD) connect the external Ethernet-Shield for both ethernet ports

Pin 24 (RX1_N) connect the differential receiver_N signal of ethernet port 1 and transfer this signal to target device.

Pin 25 (RX1_P) connect the differential receiver_P signal of ethernet port 1 and transfer this signal to target device.

Pin 26 (TX1_N) connect the differential transceiver_N signal of ethernet port 1 and transfer this signal to target device.

Pin 27 (TX1_P) connect the differential transceiver_P signal of ethernet port 1 and transfer this signal to target device.

Figure 8 pictured the used HX1188 magnetic circuit topology. Two of this component are on module PCB for both ethernet port integrated. The transmit part of HX1188 decouple both differential transmit signals (TxP/ TxN) for one ethernet port between MCU and RJ45 connector contacts. Equal to receive part of HX1188 for both differential receive signals (RxP/ RxN).

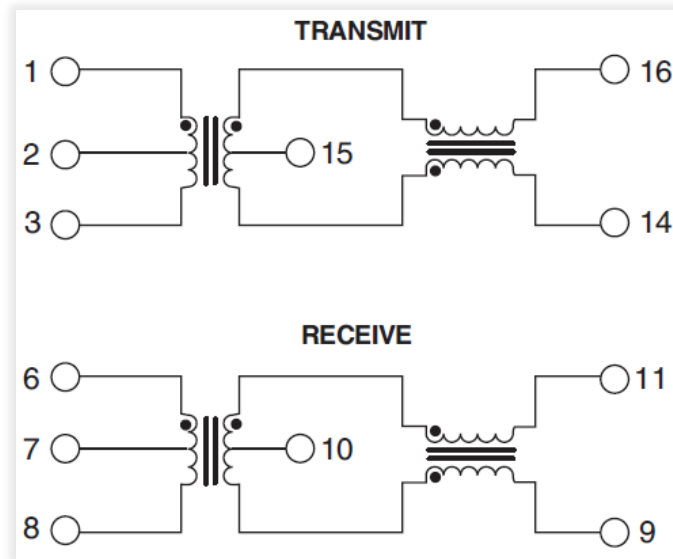


Figure 8: HX1188 internal circuit

Following Figure 9 show the wiring concept of ethernet port 0 between MCU (R-IN32M3-EC) and Ethernet jack connection contacts. A consistent differential signal cabling is recommended.

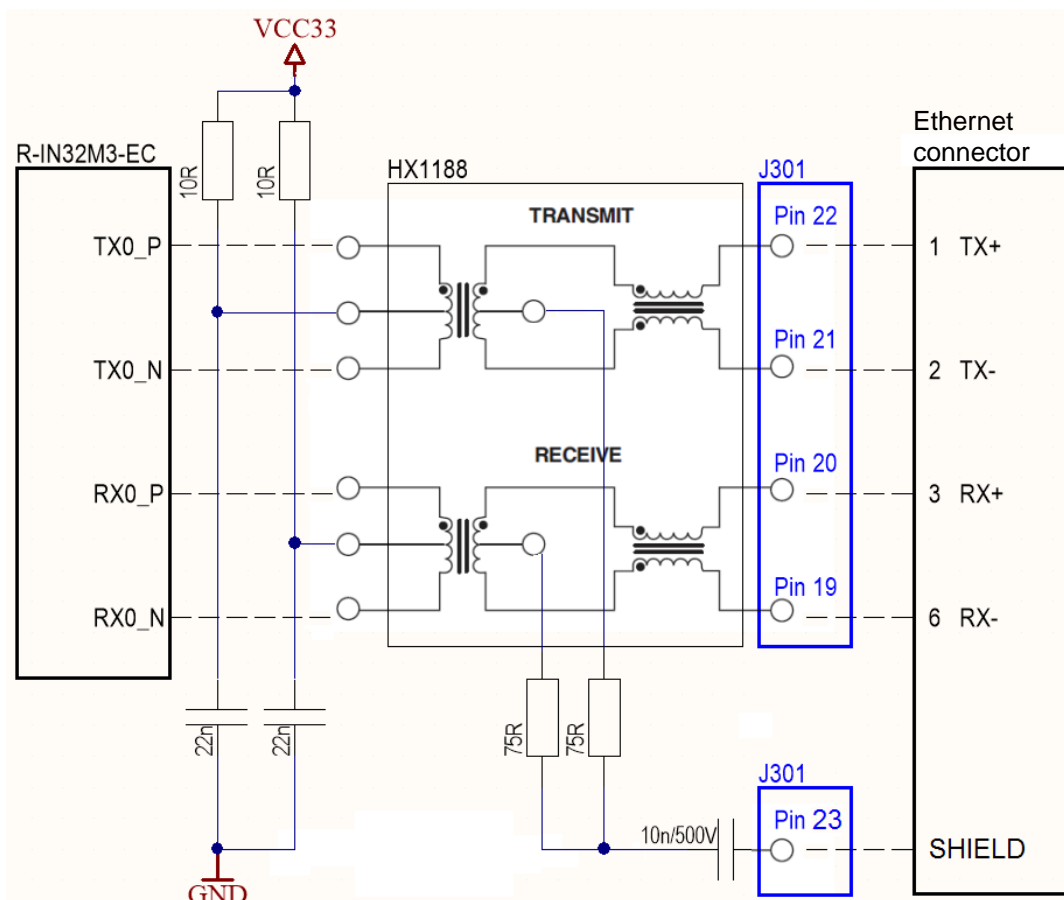


Figure 9: Connection of RJ45 jacket, M12, M8 or MINI I/O

All components on left side of blue marked J301 connector are equipped on SoM_iRJ45 module. The schematically pictured RJ45 connector has to be placed on target device and is **not** part of SoM module.

Note: It is recommended the open pins of the external Ethernet connectors on carrier board, for RJ45 the pin 4/5 and 7/8, to decouple with 75Ω resistors and 1MΩ resistor to shield potential.

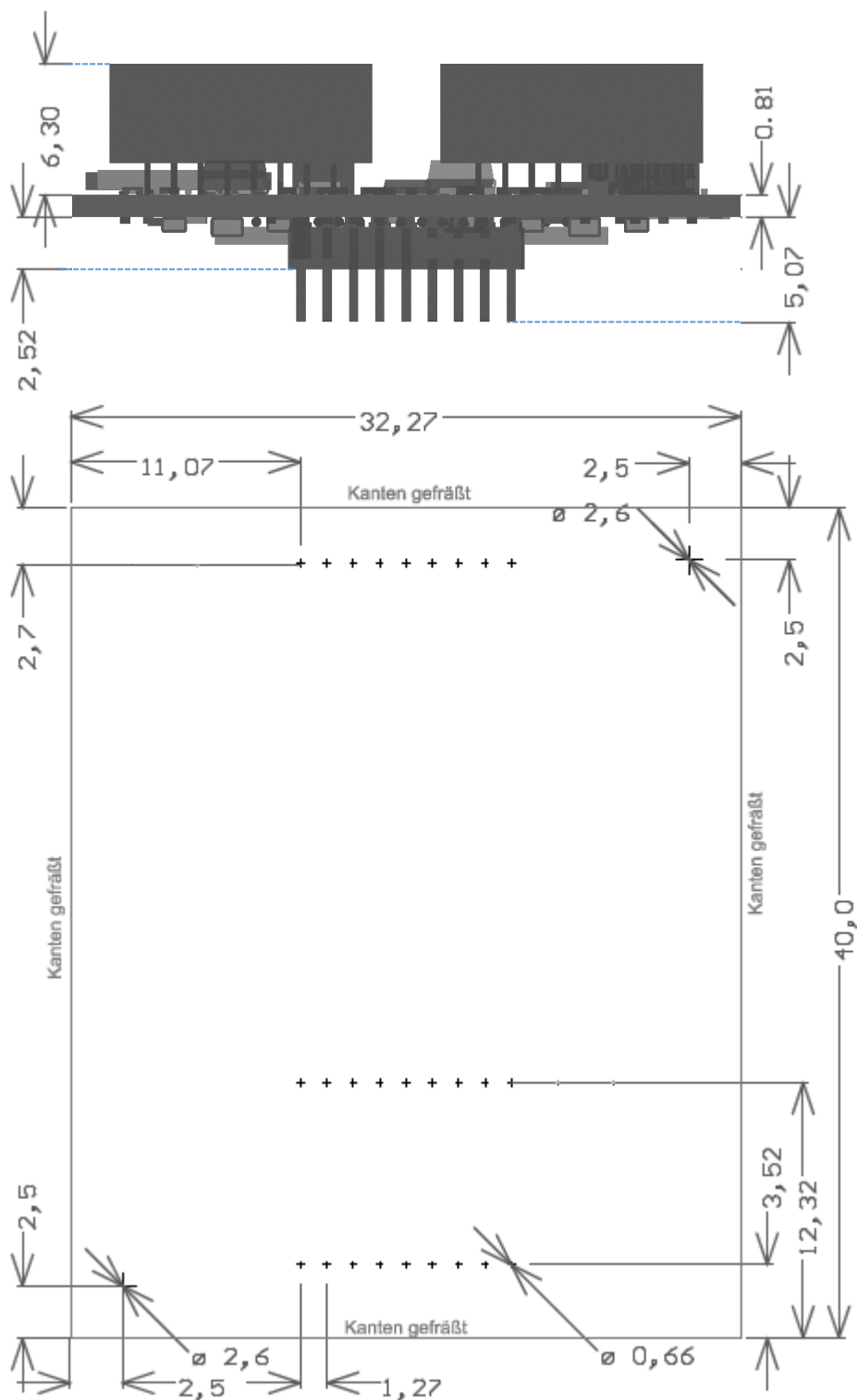
5.3.1. Ethernet Shield Connection

The Ethernet shielding connection for the external cabling shield has to be connected at J301 pin 23. This is schematically pictured in Figure 9 on prior page. This potential (J301_Pin23) is recommended to connect with functional earth in the local operating environment. This ensures an interference deflection and protect the module method of operating.

Note: Do not connect J301 pin 23 with GND, otherwise all cable interspersed disturbances will have negative influence to module circuit. This SHIELD is internal decoupled with resistor/capacitor network to system GND!

6. Module Dimensions

All dimensions are metric (mm)



7. Certifications

The System on Module complies with the following standards:

- RoHS:



- CE / EMI:

EN61000-4-2; EN61000-4-3; EN61000-4-4; EN61000-4-5; EN61000-4-6; EN61000-6-2;
EN61000-6-4

8. Related Links

Further information on available evaluation boards, food print's, example software can be found here:

SoM <https://www.port-automation.com/en/products/som-module-embedded/som-iot-based-on-renesas-rin32m3.html>

EVAL- Boards: <https://www.port-automation.com/en/products/arduino-pmod-boards.html>

9. Order Information

Art.-No.	Description	Note
2070/45	SoM - RIN32M3 - Real Time Multiprotocol - Solution	
2070/84	PORT - ARDUINO / PMOD Communication Board <u>SoM – RIN32M3</u>	Optimized for using STM32F4 NUCLEO and RENESAS SYNERGY S5/S7 Boards (other on Request)