ECX-ETH-Selector

EtherCAT® / Ethernet Selector for two Master or Networks

Hardware Manual

to Product E.3025.01

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Notes

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This manual contains important information and instructions on safe and efficient handling of the ECX-ETH-Selector. Carefully read this manual before commencing any work and follow the instructions.
The manual is a product component, please retain it for future use.

Document Information

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Document History

The changes in the document listed below affect changes in the hardware as well as changes in the description of the facts, only.

Rev.	Chapter	Changes versus previous version	Date
1.0	-	First English manual	2021-02-18

Technical details are subject to change without further notice.

Classification of Warning Messages and Safety Instructions

This manual contains noticeable descriptions, warning messages and safety instructions, which you must follow to avoid personal injuries or death and property damage.

This is the safety alert symbol.
It is used to alert you to potential personal injury hazards. Obey all safety messages and instructions that follow this symbol to avoid possible injury or death.

DANGER, WARNING, CAUTION

Depending on the hazard level the signal words DANGER, WARNING or CAUTION are used to highlight safety instructions and warning messages. These messages may also include a warning relating to property damage.

DANGER
Danger statements indicate a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING.
Warning statements indicate a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION
Caution statements indicate a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Notice statements are used to notify people on hazards that could result in things other than personal injury, like property damage.

NOTICE
This NOTICE statement indicates that the device contains components sensitive to electrostatic discharge.

NOTICE
This NOTICE statement contains the general mandatory sign and gives information that must be heeded and complied with for a safe use.

INFORMATION

INFORMATION
Notes to point out something important or useful.

Safety Instructions

- When working with the ECX-ETH-Selector follow the instructions below and read the manual carefully to protect yourself from injury and the ECX-ETH-Selector from damage.
- Do not use damaged or defective cables to connect the ECX-ETH-Selector.
- In case of damages to the device, which might affect safety, appropriate and immediate measures must be taken, that exclude an endangerment of persons and domestic animals and property.
- Current circuits which are connected to the device must be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
- ECX-ETH-Selector may only be driven by power supply current circuits, that are contact protected. A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with these conditions.

- Do not open the housing of the ECX-ETH-Selector .
- The ECX-ETH-Selector has to be securely installed before commissioning.
- The permitted operating position is specified as shown (Figure 2). Other operating positions are not allowed.
- Never let liquids get inside ECX-ETH-Selector. Otherwise, electric shocks or short circuits may result.
- Protect the ECX-ETH-Selector from dust, moisture, and steam.
- Protect the ECX-ETH-Selector from shocks and vibrations.
- The ECX-ETH-Selector may become warm during normal use. Always allow adequate ventilation around the ECX-ETH-Selector and use care when handling
- Do not operate the ECX-ETH-Selector adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.

Qualified Personnel

This documentation is directed exclusively towards personnel qualified in control and automation engineering. The installation and commissioning of the product may only be carried out by qualified personnel, which is authorized to put devices and systems and electric circuits into operation according to the applicable national standards of safety engineering.

Conformity

The ECX-ETH-Selector is an industrial product and meets the demands of the EU regulations and EMC standards printed in the conformity declaration at the end of this manual.

Warning: In a residential, commercial, or light industrial environment the ECX-ETH-Selector may cause radio interferences in which case the user may be required to take adequate measures.

Data Safety

This device is equipped with an Ethernet or other interface which is suitable to establish a connection to data networks. Depending on the software used on the device, these interfaces may allow attackers to compromise normal function, get illegal access or cause damage.
esd does not take responsibility for any damage caused by the device if operated at any networks. It is the responsibility of the device's user to take care that necessary safety precautions for the device's network interface are in place.

Intended Use

The intended use of the ECX-ETH-Selector is the operation as EtherCAT®/Ethernet Selector for two masters or networks.
The guarantee given by esd does not cover damages which result from improper use, usage not in accordance with regulations or disregard of safety instructions and warnings.

- The ECX-ETH-Selector is intended for indoor use only.
- The operation of the ECX-ETH-Selector in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the ECX-ETH-Selector for medical purposes is prohibited.

Service Note

The ECX-ETH-Selector does not contain any parts that require maintenance by the user. The ECX-ETH-Selector does not require any manual configuration of the hardware. Unauthorized intervention in the device voids warranty claims

Disposal

Devices which have become defective in the long run have to be disposed in an appropriate way or must be returned to the manufacturer for proper disposal. Please, make a contribution to environmental protection.

Typographical Conventions

Throughout this manual the following typographical conventions are used to distinguish technical terms.

Convention	Example
File and path names	**`/dev/null`** or **`<stdio.h>`**
Function names	***open()***
Programming constants	`NULL`
Programming data types	`uint32_t`
Variable names	*Count*

Number Representation

All numbers in this document are base 10 unless designated otherwise. Hexadecimal numbers have a prefix of 0x, and binary numbers have a prefix of 0b. For example, 42 is represented as 0x2A in hexadecimal and 0b101010 in binary.

Table of Contents

List of Tables

List of Figures

1 Overview

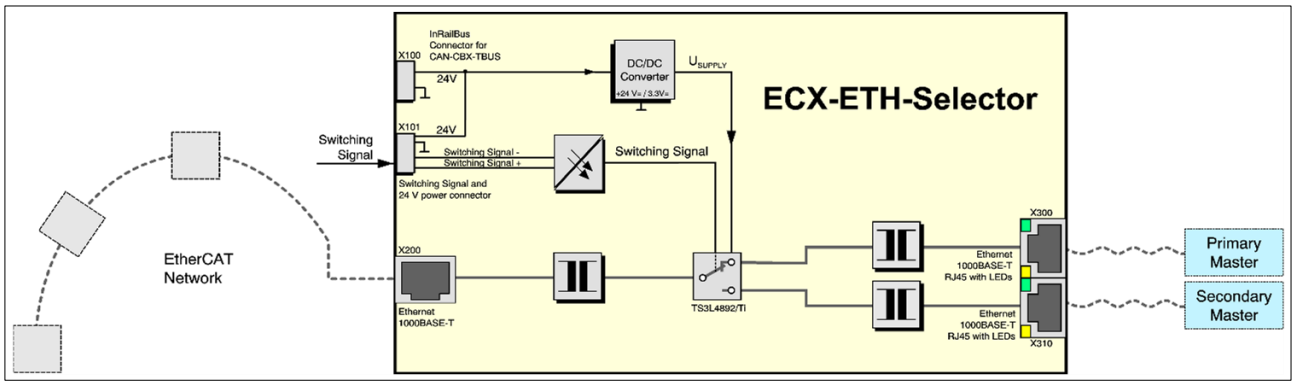


Figure 1: Block circuit diagram

The ECX-ETH-Selector is designed to build redundant EtherCAT-Master systems, and it is equipped with a LAN selector.
The flexible application range allows to switch one network between two Masters / PCs for all Ethernet based systems or field bus standards up to 1000BASE-T.
Controlled by a simple switching input signal, the ECX-ETH-Selector can connect for example an EtherCAT G network to one of two different EtherCAT Masters.

For example, if a failure of the primary master is detected in a safety-critical EtherCAT-System, it can be switched via the switching signal to the secondary master.

The control signal is optically isolated.

The ECX-ETH-Selector is designed for DIN-EN carrier rail mounting. The module provides service-friendly ‘wiring’ of the supply voltage. The power supply can be applied via the In-Rail-bus connector (TBUS-connector) integrated in the mounting rail or separately via the clamp-connection.

1.1 Glossary

Abbreviation	Term
API	Application Programming Interface
CAN	Controller Area Network
CPU	Central Processing Unit
CiA	CAN in Automation
HW	Hardware
I/O	Input/Output
LSB	Least Significant Bit
MSB	Most Significant Bit
n.a.	not applicable
OS	Operating System
SDK	Software Development Kit

2 PCB View with Connectors

2.1 Connecting Diagram

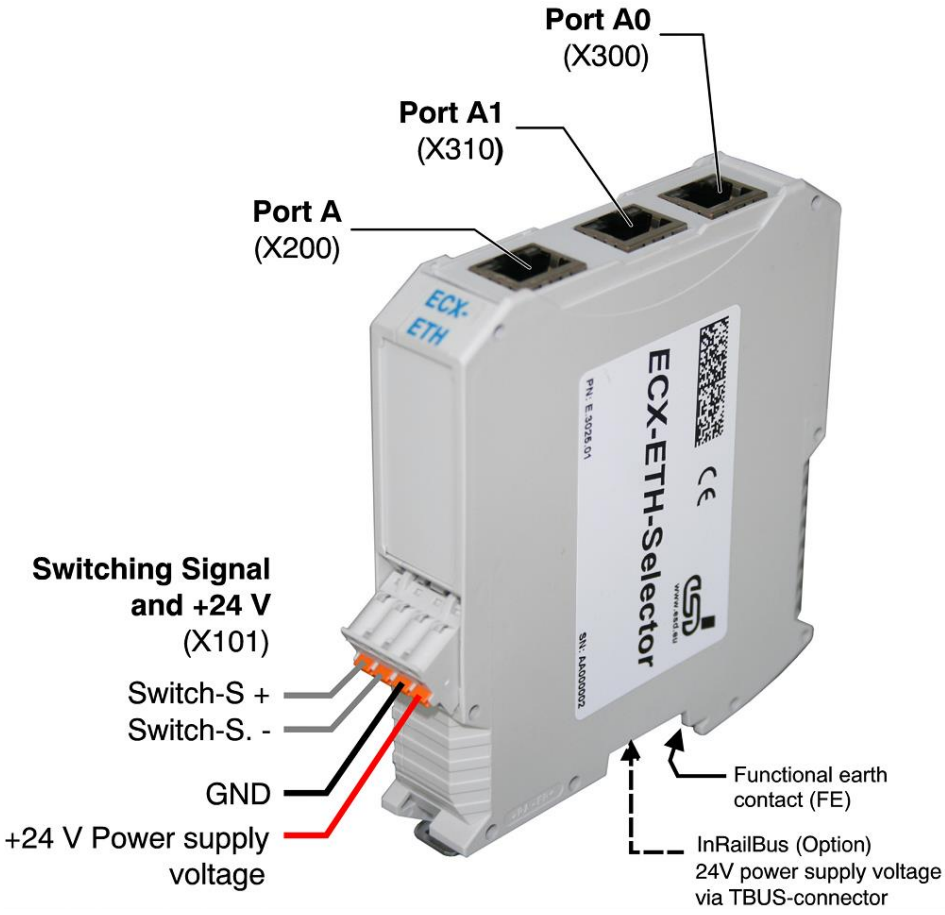


Figure 2: Connecting diagram of ECX-ETH-Selector

NOTICE
Read chapter “Hardware Installation” on page 12, before you start with the installation of the hardware!

See also page 15 for signal assignment of the connectors.
For conductor connection and conductor cross section see page 17.

2.2 Switching Signal

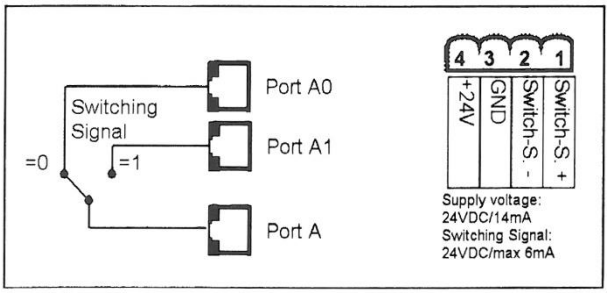
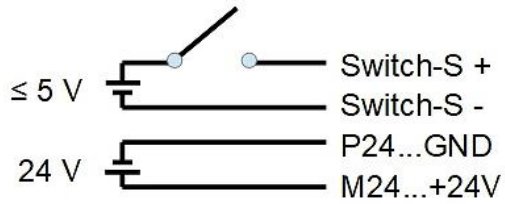


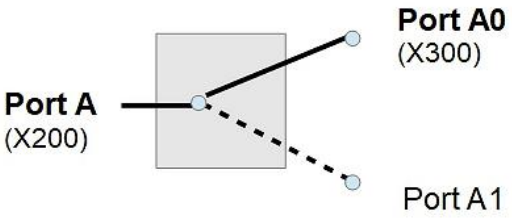
Figure 3: Label with switching signal

The switching signals (Switch-S + and Switch-S -) and the +24V power supply voltage are connected to connector X101 (see Figure 2, page 9).

Case 1: Switching Signal = 0

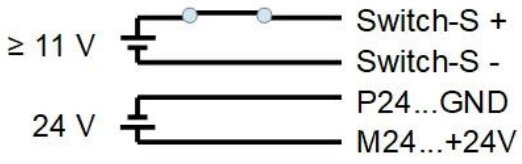
Switching signal **<** input switching threshold (5V) → The ECX-ETH-Selector connects the Ethernet/EtherCAT **Port A** (connector X200) with **Port A0** (connector X300).

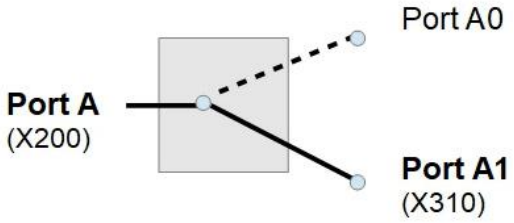




Case 2: Switching Signal = 1

Switching signal **>** input switching threshold (11V) → The ECX-ETH-Selector connects the Ethernet/EtherCAT **Port A** (connector X200) with **Port A1** (connector X310).





2.3 Front Panel View with LEDs and Connectors

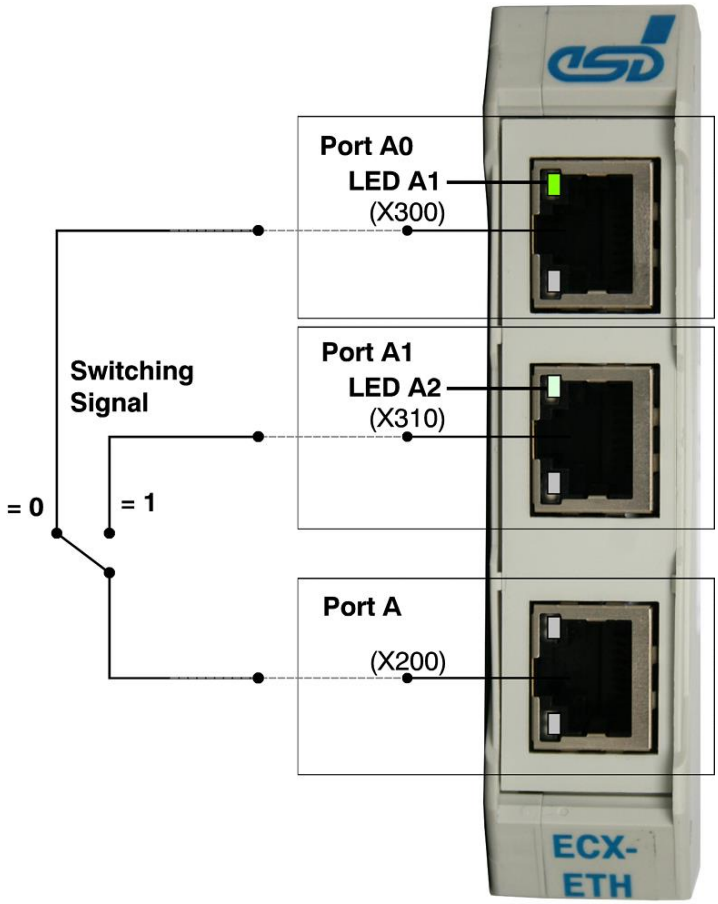


Figure 4: Front panel view with LEDs

LEDs

The ECX-ETH-Selector is equipped with 3 RJ45 sockets with integrated LEDs in the front panel. Only the green LEDs of Port A0 and Port A1 are used:
- LED 1#
- LED 2#.

Connector	LED	Colour	Indication when LED on
Port A0 (X300)	LED 1#	green	Ethernet/EtherCAT **Port A0** is connected to **Port A**
Port A1 (X310)	LED 2#	green	Ethernet/EtherCAT **Port A1** is connected to **Port A**

Table 1: Description of LEDs

3 Hardware Installation

To put the ECX-ETH-Selector into operation, please follow the installation notes.

Step	Procedure	See Page
	**NOTICE** **Read the safety instructions at the beginning of this document carefully before you start with the hardware installation!**	5
	**DANGER** Hazardous voltage - Risk of electric shock. Ensure the absence of voltage before starting any electrical work. All current circuits which are connected to the device have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1) before you start with the installation.	
1.	Mount the ECX-ETH-Selector module and connect the interfaces (EtherCAT, power supply voltage, switching signal).	9
2.	If you use the InRailBus, read and follow the instructions given in chapter: “InRailBus (Option)”.	19
3.	Apply the 24 V-power supply voltage.	-
4.	The Ethernet interfaces are hot-pluggable.	

4 Technical Data

4.1.1 General Technical Data

Power supply voltage	nominal voltage: 24 VDC ± 20% current consumption (24 V, 20°C): $I_{TYPICAL}$ = 14 mA, I_{MAX} = 20 mA	
Connectors	EtherCAT Network	RJ45 socket - Ethernet-A/EtherCAT-Slave port A (X200)
	Primary Master	RJ45 socket, - Ethernet-A.1/EtherCAT-Master port A0 (X300)
	Secondary Master	RJ45 socket, - Ethernet-A.2/EtherCAT-Master port A1 (X310)
	Control signal and 24 V power supply voltage	4-pin Phoenix Contact PCB plug connector with spring-cage connection (X101) - Control signal and +24V power supply voltage
	InRailBus	5-pin TBUS connector (X100) - Power supply voltage via InRailBus (Option)
Temperature range	0 ... 70 °C ambient temperature	
Humidity	max. 90%, non-condensing	
Protection class	IP20	
Pollution degree	maximum permissible according to DIN EN 61131-2: Pollution Degree 2	
Housing	plastic housing for carrier rail mounting NS35/7,5 DIN EN 60715	
Form factor / Dimensions	width: 22.5 mm, height: 99 mm, depth: 114.5 mm (dimensions without mating connectors)	
Mounting	DIN-EN carrier rail mounting (TS35)	
Weight	Ca. 150 g	

Table 2: General technical data

4.2 Ethernet Interface

Number	3
Standard	10BASE-T, 100BASE-TX, 1000BASE-T
Bit rate	10/100/1000 Mbit/s
Electrical isolation	via converter
Connector	RJ45 socket in the front panel with integrated LEDs

Table 3: Data of the Ethernet interfaces

4.3 Digital Inputs

Number	1
Connection technology	2-wire technology
Specification	EN 61131-2, Type 3
Nominal voltage	18 V … 30 V DC
Input switching threshold	U_{ON} = 11 V … 30V U_{OFF} = 5 V … -3V
Input current	I_{DigIN_TYP} = 3 mA (typical at 24 V), I_{DigIN_MAX} = 6 mA (maximum at 24 V)
Input low-pass filter	F_G = 2.8 kHz
Electrical isolation	1kV DC @ 1s (I < 1 mA)
Protective circuit	Overvoltage protection up to 40 V, reverse voltage protection
Connector	4-pin Phoenix Contact PCB plug connector with spring-cage connection (X101)

Table 4: Data of the digital input

5 Connector Assignments

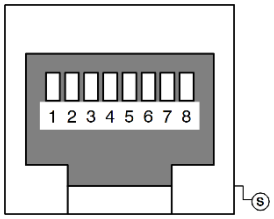
5.1 Gigabit Ethernet

The Ethernet interfaces have the same pin-assignment, each for the corresponding port.

Interface	Connector	Port	Signal
EtherCAT Network	RJ45 socket	A	Ethernet-port A/EtherCAT-Slave-A (X200)
Primary Master	RJ45 socket	A0	Ethernet-port A0/EtherCAT-Master_A0 (X300)
Secondary Master	RJ45 socket	A1	Ethernet-port A1/EtherCAT-Master_A1 (X310)

Device connector: RJ45 socket, 8-pin

Pin Position:



Pin Assignment:

Pin	Signal
1	MDI0+
2	MDI0-
3	MDI1+
4	MDI2+
5	MDI2-
6	MDI1-
7	MDI3+
8	MDI3-

S	Shield

Signal Description:

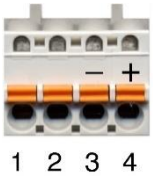
MDIx+/- ...	Ethernet data lines
Shield...	case shield, connected with the front panel of the ECX-ETH-Selector

NOTICE
Cables of category CAT5e or higher must be used to grant the function in networks with 1000 Mbit/s.
esd grants the EC conformity of the product if the wiring is carried out with shielded twisted pair cables of class SF/UTP or higher

5.2 24V Power Supply Voltage

Device socket: Phoenix Contact, MSTBO 2,5/4-G1L-KMGY
Cable plug: Phoenix Contact FKCT 2,5/4-ST, 5.0 mm pitch,
spring cage connection,
Phoenix Contact order No.: 19 21 90 0 (included in the scope of delivery)
For conductor connection and conductor cross section see page 17.

Pin Position:



Pin Assignment:

Device housing label of ECX-ETH-Selector			24V	
	Switch-S+	**Switch-S-**	**GND**	**+24V**
Connector label	(none)	(none)	-	+

Pin	1	2	3	4
Signal	Switch-S+	Switch-S-	M24 (GND)	P24 (+ 24 V)

Please refer to the connecting diagram page 9.

Signal Description:

Switch-S +,
Switch-S - … Switching Signal lines, 24 VDC / max. 6 mA
P24... power supply voltage +24 V ± 20 % / 20 mA
M24... reference potential

5.2.1 Conductor Connection / Conductor Cross Section

The following table contains an extract of the technical data of the cable plugs.

Characteristics	***Connector Type1*** [1] Power Supply Voltage 24 V
Connector type plug component (Range of articles)	FKCT 2,5/..-ST KMGY
Connection method	spring-cage connection
Stripping length	10 mm
Conductor cross section solid min./max.	0.2 mm²/2.5 mm²
Conductor cross section stranded min./max.	0.2 mm²/2.5 mm²
Conductor cross section stranded, with ferrule without plastic sleeve min./max.	0.25 mm²/2.5 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min./max.	0.25 mm²/2.5 mm²
Conductor cross section AWG/kcmil min./max.	24/12
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min./max.	0.5 mm²/1.5 mm²

1 Technical Data from Phoenix Contact website, printed circuit board connector, plug component

6 Notes on Switching

The switching delay time results, among other things, from the time caused by switching the ECX-ETH-Selector and the time that is needed to establish a link for example between the PC on the EtherCAT Master side and the first EtherCAT Slave on the EtherCAT Network side.

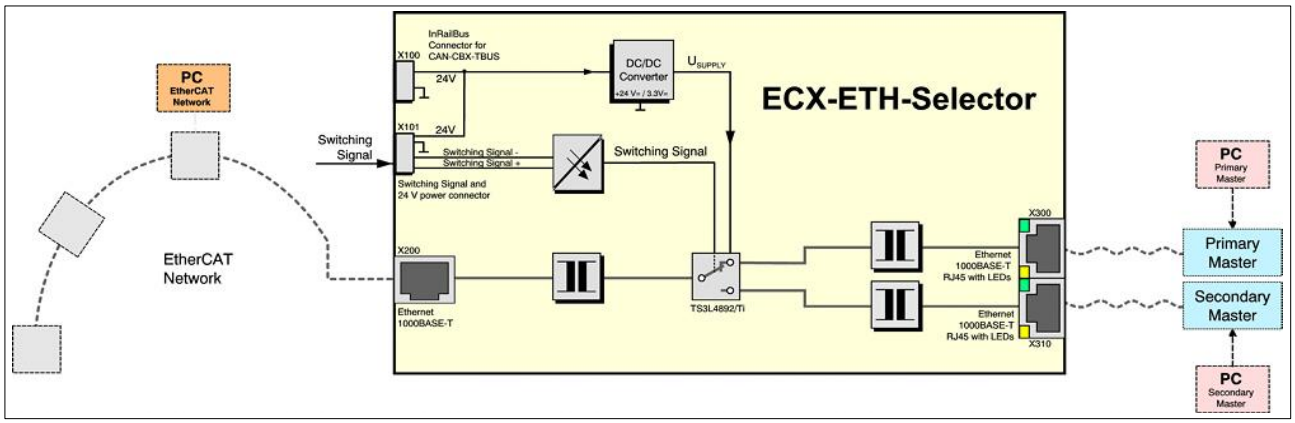


Figure 5: ECX-ETH-Selector and connection

Delay caused by ECX-ETH-Selector (Switching time)

Measurement	Delay time caused by ECX-ETH-Selector
Delay time for RF-signal fed to Primary Master, Secondary Master remains unconnected. Delay measured from Control Input (switching signal) to Slave_Out Signal_Valid/invalid	t_{Switch_M1} = max 20 µs
Delay time for RF-signal fed to Secondary Master, Primary Master remains unconnected. Delay measured from Control Input (switching signal) to Slave_Out Signal_Valid/invalid	t_{Switch_M2} = max 20 µs

The maximum measured delay caused by ECX-ETH-Selector is $t_{Switch\_M1/2}$ = max 20 µs

Delay caused by Link Establishment

After the signal is switched by the ECX-ETH-Selector, a link between the PHY of the new Master and the PHY of the EtherCAT Network must be established.
Normally this takes only t_{Link} = max 1s.

7 InRailBus (Option)

7.1 Using InRailBus Connector

7.1.1 Connecting the Power Supply Voltage

The power supply voltage can be connected via the +24V connector for the power supply voltage or via the InRailBus connector.

NOTICE
Read and observe the safety instructions to requirements on the supply current circuit (see page 5)

NOTICE
It is **not permissible** to feed through the power supply voltage through the ECX station from the InRailBus terminal plug to the 24 V power supply connector (and vice versa) to supply other ECX stations! A feed through of the +24 V power supply voltage can cause damage on the ECX modules.

NOTICE
The connections for the 24V power supply are internally connected and must not be supplied by two independent current sources at the same time!

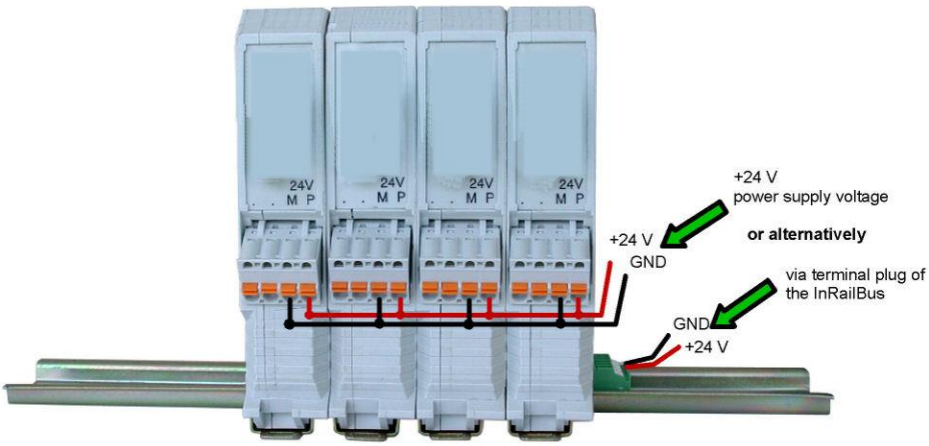


Figure 6: ECX-Station

NOTICE
Connect the mounting rail to functional earth potential. Please note that the impedance of the connecting cable must be kept as low as possible.

The functional earth contact is a current path of low impedance between current circuits and earth, that is not intended as protection measure, but improves the stability. It is not a protection against accidental contact for persons.

NOTICE
The EG conformity (see chapter “EU Declaration of Conformity”) can only be warranted if the earthing via the mounting rail is made as described herein.

7.1.2 Installation of the Module Using the InRailBus Connector

If the power supply voltage shall be fed via the InRailBus, please proceed as follows:

NOTICE
The pins 1,2 and 3 of the mounting rail bus connector are reserved and must not be connected!

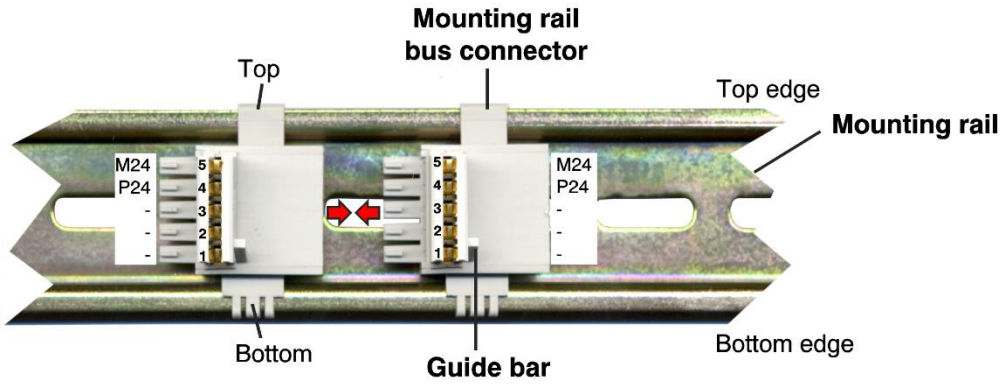


Figure 7: Mounting rail with bus connector

1. Position the InRailBus connector on the mounting rail and snap it onto the mounting rail using slight pressure.
   Plug the bus connectors together to contact the power signals (in parallel with one). The bus connectors can be plugged together before or after mounting the ECX module.

2. Place the ECX module with the DIN rail guideway on the top edge of the mounting rail.

Figure 8: Mounting ECX Modules

3. Swivel the ECX module onto the mounting rail in pressing the module downwards according to the arrow as shown in Figure 7. The housing is mechanically guided by the DIN rail bus connector.

4. When mounting the ECX module the metal foot-catch snaps on the bottom edge of the mounting rail. Now the module is mounted on the mounting rail and connected to the InRailBus via the bus connector. Connect the bus connectors and the InRailBus, if not already done.

Figure 9: Mounted ECX-module

7.1.2.1 Connecting Power Supply to InRailBus

To connect the power supply signals via the InRailBus, a terminal plug (order no.: C.3000.02) is needed. The terminal plug is not included in delivery and must be ordered separately.

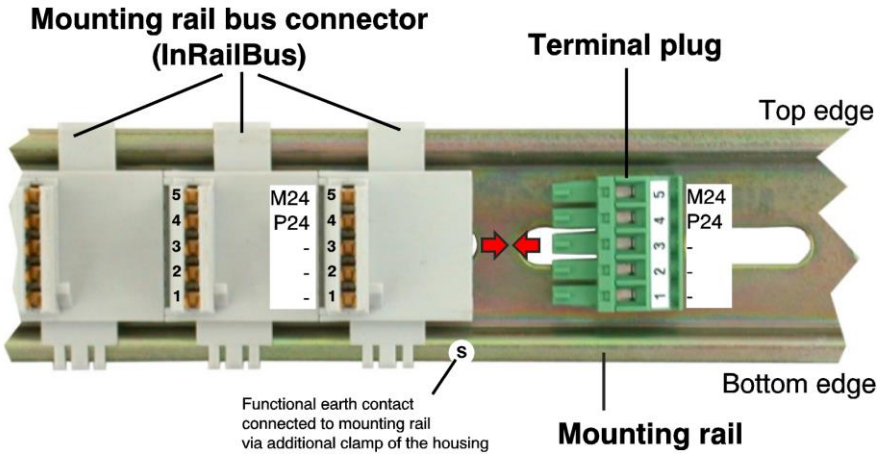


Figure 10: Mounting rail with InRailBus and terminal plug

NOTICE
The pins 1,2 and 3 of the mounting rail bus connector are reserved and must not be connected!

Plug the terminal plug into the socket on the right of the mounting-rail bus connector of the InRailBus, as described in Figure 10 Then connect the power supply voltage via the terminal plug. Please pay attention to the notes on the connection of the power supply voltage on page 19.

7.1.3 Remove the ECX Module from InRailBus

If the ECX-module is connected to the InRailBus please proceed as follows:

Release the module from the mounting rail in moving the foot catch (see Figure 9) downwards (e.g. with a screwdriver). Now the module is detached from the bottom edge of the mounting rail and can be removed.

INFORMATION
It is possible to remove individual devices from the whole without interrupting the InRailBus connection, because the contact chain will not be interrupted.

8 References

[1]
[1] Phoenix Contact GmbH & Co. KG, Blomberg.
Technical data taken from the Phoenix Contact website, http://www.phoenixcontact.com
PCB plug component - FKCT-2,5/4-ST KMGY - 1921900, download 2021-02-08

9 Declaration of Conformity

EU-KONFORMITÄTSERKLÄRUNG
EU DECLARATION OF CONFORMITY

Adresse / *Address*
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Vahrenwalder Str. 207
30165 Hannover
Germany

esd erklärt, dass das Produkt *esd declares, that the product*	Typ, Modell, Artikel-Nr. *Type, Model, Article No.*
ECX-ETH-Selector	**E.3025.01**
die Anforderungen der Normen *fulfills the requirements of the standards*	**EN 61000-6-2:2005,** **EN 61000-6-3:2007/A1:2011**
gemäß folgendem Prüfbericht erfüllt. *according to test certificate.*	**H-K00-0512-13**
Das Produkt entspricht damit der EU-Richtlinie „EMV" *Therefore the product conforms to the EU Directive 'EMC'*	**2014/30/EU**
Das Produkt entspricht den EU-Richtlinien „RoHS" *The product conforms to the EU Directives 'RoHS'*	**2011/65/EU, 2015/863/EU**

Diese Erklärung verliert ihre Gültigkeit, wenn das Produkt nicht den Herstellerunterlagen entsprechend eingesetzt und betrieben wird, oder das Produkt abweichend modifiziert wird.
This declaration loses its validity if the product is not used or run according to the manufacturer's documentation or if non-compliant modifications are made.

Name / *Name*	T. Bielert
Funktion / *Title*	QM-Beauftragter / *QM Representative*
Datum / *Date*	Hannover, 2020-11-04

Rechtsgültige Unterschrift / *authorized signature*

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10 Order Information

Type	Properties	Order No.
ECX-ETH-Selector	EtherCAT Master Selector, IEEE 802.3, 24 VDC, rail mounting	E.3025.01
Accessories for usage with InRailBus:		
 **CAN-CBX-TBUS**	Mounting-rail bus connector for the ECX-ETH-Selector module ME 22,5 TBUS 1,5/5-ST-3,81 KMGY	C.3000.01
 **CAN-CBX-TBUS-Connector**	Terminal plug of the InRailBus for the connection of the +24V power supply voltage and the CAN interface, Female type	C.3000.02
 **CAN-CBX-TBUS-Connection adapter**	Terminal plug of the InRailBus for the connection of the +24V power supply voltage and the CAN-Interface, Male type	C.3000.03

Table 5: Order information hardware

10.1 Manuals

PDF Manuals
For the availability of the manuals see table below.
Please download the manuals as PDF documents from our esd website https://www.esd.eu for free.

Manuals		Order No.
ECX-ETH-Selector-ME	Hardware manual in English	E.3025.21

Table 6: Available Manuals

Printed Manuals
If you need a printout of the manual additionally, please contact our sales team (sales@esd.eu) for a quotation. Printed manuals may be ordered for a fee.