

Documentation | EN

CU2508-0022

8-port port multiplier, Ethernet, 24 V DC, M12



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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.

The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.



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Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER

Hazard with high risk of death or serious injury.

⚠ WARNING

Hazard with medium risk of death or serious injury.

⚠ CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
recommendations for action, assistance or further information on the product.

1.3 Documentation issue status

Version	Comment
1.0	• First release

Firmware and hardware versions

This documentation refers to the firmware and hardware version that was applicable at the time the documentation was written.

The module features are continuously improved and developed further. Modules having earlier production statuses cannot have the same properties as modules with the latest status. However, existing properties are retained and are not changed, so that older modules can always be replaced with new ones.

The firmware and hardware version (delivery state) can be found in the batch number (D-number) printed on the side of the EtherCAT Box.

Syntax of the batch number (D-number)

D: WW YY FF HH

WW - week of production (calendar week)

YY - year of production

FF - firmware version

HH - hardware version

Example with D no. 29 10 02 01:

29 - week of production 29

10 - year of production 2010

02 - firmware version 02

01 - hardware version 01

Further information on this topic: [Version identification of EtherCAT devices \[► 55\]](#).

2 EtherCAT Box - Introduction

The EtherCAT system has been extended with EtherCAT Box modules with protection class IP67. Through the integrated EtherCAT interface the modules can be connected directly to an EtherCAT network without an additional Coupler Box. The high-performance of EtherCAT is thus maintained into each module.

The extremely low dimensions of only 126 x 30 x 26.5 mm (h x w x d) are identical to those of the Fieldbus Box extension modules. They are thus particularly suitable for use where space is at a premium. The small mass of the EtherCAT modules facilitates applications with mobile I/O interface (e.g. on a robot arm). The EtherCAT connection is established via screened M8 connectors.

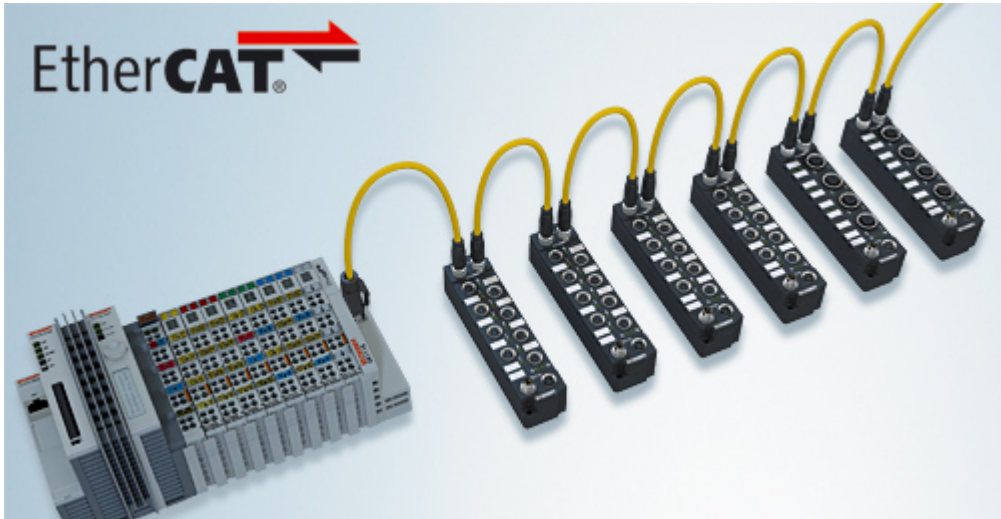


Fig. 1: EtherCAT Box Modules within an EtherCAT network

The robust design of the EtherCAT Box modules enables them to be used directly at the machine. Control cabinets and terminal boxes are now no longer required. The modules are fully sealed and therefore ideally prepared for wet, dirty or dusty conditions.

Pre-assembled cables significantly simplify EtherCAT and signal wiring. Very few wiring errors are made, so that commissioning is optimized. In addition to pre-assembled EtherCAT, power and sensor cables, field-configurable connectors and cables are available for maximum flexibility. Depending on the application, the sensors and actuators are connected through M8 or M12 connectors.

The EtherCAT modules cover the typical range of requirements for I/O signals with protection class IP67:

- digital inputs with different filters (3.0 ms or 10 μ s)
- digital outputs with 0.5 or 2 A output current
- analog inputs and outputs with 16 bit resolution
- Thermocouple and RTD inputs
- Stepper motor modules

XFC (eXtreme Fast Control Technology) modules, including inputs with time stamp, are also available.



Fig. 2: EtherCAT Box with M8 connections for sensors/actuators



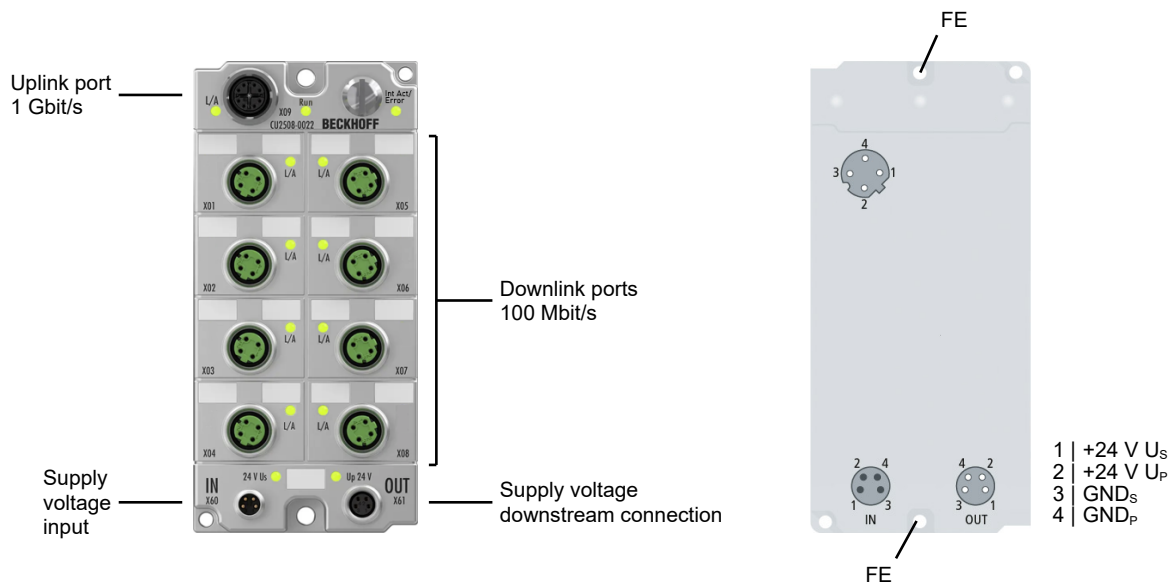
Fig. 3: EtherCAT Box with M12 connections for sensors/actuators

Basic EtherCAT documentation

i You will find a detailed description of the EtherCAT system in the Basic System Documentation for EtherCAT, which is available for download from our website (www.beckhoff.com) under Downloads.

3 Product overview

3.1 Introduction



The CU2508-0022 real-time Ethernet port multiplier allows connection of up to eight Ethernet networks. The CU2508-0022 is connected to the control industrial PC via a gigabit uplink. The PC offers high-performance data transfer to the multiplier, which allocates the data to the relevant 100BASE-TX port based on an analysis of a telegram prefix, and sends the data under timer control with μs precision. Frames received are also assigned a prefix, including timestamp, and transmitted to the PC via the gigabit line. From the point of view of the user, eight 100-Mbit ports with full real-time properties are available that can be used individually.

Similar to the CU2508 port multiplier in IP20, the CU2508-0022 8-port multiplier provides the ability to connect multiple Ethernet ports outside the PC via a 1 Gbit/s connection in the IP67 world. TwinCAT 3 supports communication via Ethernet (TCP/IP), EtherCAT, EAP (EtherCAT Automation Protocol) and real-time Ethernet – this eliminates the need for additional network ports on the PC.

In particular, the CU2508-0022 enables extensive EtherCAT installations. For extremely high data throughput requirements, these can be extended to up to eight segments, thus increasing performance several times over. The distributed clocks of the EtherCAT segments are synchronized. EtherCAT cable redundancy with simultaneous distributed clock use can also be implemented with two ports of the CU2508-0022.

Multiple CU2508-0022 units can be operated simultaneously on one controller if even higher data throughput is required.

Quick links

- [Technical data \[► 11\]](#)
- [Connections \[► 22\]](#)
- [Commissioning \[► 29\]](#)

3.2 Technical data

All values are typical values over the entire temperature range, unless stated otherwise.

Uplink port	
Connection	1 x M12 socket, 8-pin, X-coded
Cable length	max. 100 m
Data transfer rate	1 Gbit/s

Downlink ports	
Number	8
Connection	8 x M12 socket, 4-pin, D-coded
Cable length	max. 100 m per port, twisted pair cable
Data transfer rate	100 Mbit/s
Ethernet specification / standard	100BASE-TX

Ethernet	
Protocols	<ul style="list-style-type: none"> • Ethernet TCP/IP • Real-time protocols: <ul style="list-style-type: none"> ◦ EtherCAT, also with distributed clocks. ◦ PROFINET ◦ Others, depending on the driver.

Supply voltages	
Connection	Input: M8 connector, 4-pin, A-coded Downstream connection: M8 socket, 4-pin, A-coded
U_S nominal voltage	24 V _{DC} (-15 % / +20 %)
$I_{S,sum}$ sum current	max. 4 A
Current consumption from U_S	150 mA
Rated voltage U_P	24 V _{DC} (-15 % / +20 %)
$I_{P,sum}$ sum current	max. 4 A
Current consumption from U_P	None. U_P is only forwarded.

Housing data	
Dimensions W x H x D	60 mm x 126 mm x 26.5 mm (without plug connectors)
Weight	approx. 450 g
Installation position	variable
Material	PA6 (polyamide)

Environmental conditions	
Ambient temperature during operation	-25 ... +60 °C
Ambient temperature during storage	-40 ... +85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 conforms to EN 60529

Approvals/markings	
Approvals/markings *)	CE, cURus

*) Real applicable approvals/markings see type plate on the side (product marking).

Additional tests

The devices have undergone the following additional tests:

Test	Explanation
Vibration	10 frequency sweeps in 3 axes
	5 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 g, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	35 g, 11 ms

3.3 Scope of supply

Make sure that the following components are included in the scope of delivery:

- 1x CU2508-0022
- 1x protective cap for supply voltage input, M8, transparent (pre-assembled)
- 1x protective cap for supply voltage output, M8, black (pre-assembled)
- 20 x labels, blank (2 strips of 10)

i Pre-assembled protective caps do not ensure IP67 protection

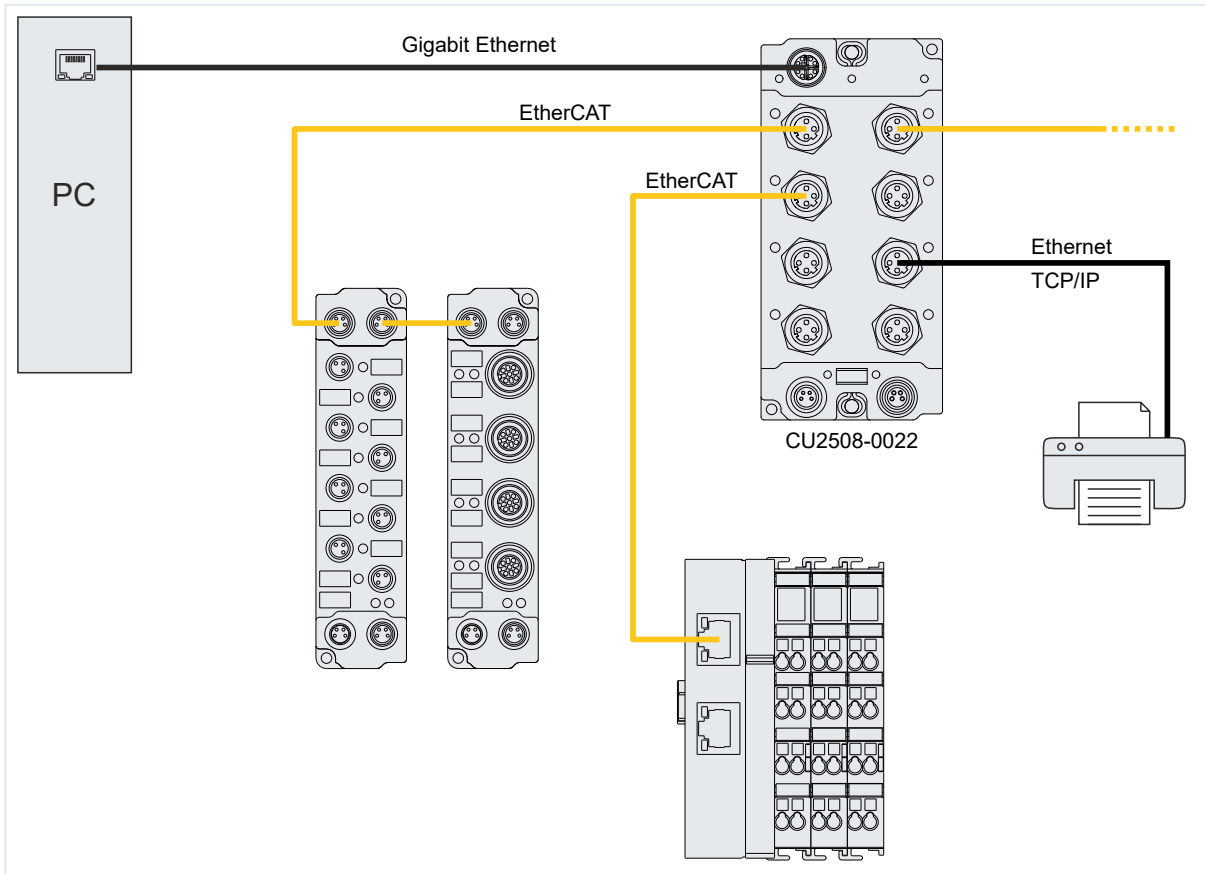
Protective caps are pre-assembled at the factory to protect connectors during transport. They may not be tight enough to ensure IP67 protection.

Ensure that the protective caps are correctly seated to ensure IP67 protection.

3.4 Technology

As the most transparent port multiplier possible, the CU2508-0022 expands a Gigabit Ethernet port on the controller to eight Fast Ethernet ports in the field. It transports IEEE802.3 compliant Ethernet frames with arbitrary contents.

Application example



Each port of the CU2508-0022 sends and receives Fast Ethernet frames (100 Mbit, 100BASE-TX) via up to 100 m of copper cable. The CU2508-0022 does not generate any frames itself or process their content, but only forwards frames sent to it by a software driver via its 8 ports to the field or forwards frames received from the field to the driver. The highly precise time information regarding when the frames are sent or received is thereby optional.

The CU2508-0022 has the following ports for this purpose:

- An uplink port X09 (Gigabit Ethernet) to the driver in the controller, which requires at least one Gigabit Ethernet connection on the opposite side.
- Eight downlink ports X01-X08 (10/100 Mbit) for real-time traffic to the connected field devices.

A CU2508-0022 system therefore consists of the CU2508-0022 and the CU2508-0022 driver, integrated in TwinCAT.

The CU2508 system does not replace master implementations of Ethernet-based fieldbuses, but instead tunnels specified data telegrams via the gigabit connection and then sends the frames at the specified time. It behaves transparently for the protocols routed via it, with exception of the EtherCAT protocol – in this case a CU2508-0022 device is visible as the first slave in the configuration. Each materially existent I/O system on the field side must therefore match a logical master component in the controller.

Several CU2508-0022s can be used in each TwinCAT system.

Some sub-functions of the CU2508-0022 and operation modes are described below.

Properties of the downlink ports

The basic setting of the CU2508-0022 is optimized for use with EtherCAT downlinks, in particular for operation with EtherCAT cable redundancy.

In the event of a link loss on the uplink port, the link is retained on the downlink ports, but incoming frames are discarded.

ESL protocol

The software driver in the controller is the counterpart to the CU2508-0022. It works on a Gigabit Ethernet port in the controller and “packs” the user data into the EtherCAT Switch Link Protocol (ESL) or unpacks the ESL protocol from the CU2508-0022 and forwards the user data to the application. This means that no separate telegram with control data for handling the user data is sent, but the user data generated by the user program is supplemented by a few bytes of control data and information data.

The CU2508-0022 driver is integrated in TwinCAT 3 and TwinCAT 2 from version 2.11R2, please refer to the information in the technical data. The ESL protocol is disclosed, see chapter [ESL Protocol \[► 52\]](#). In addition, it has been included in the Wireshark®-Installation since version 1.4.2.

EtherCAT time behavior

One possible use of the CU2508-0022 is the operation of several EtherCAT segments on a single port of the IPC, i.e. as a port multiplier.

When operating several EtherCAT segments on the ports of a CU2508-0022, temporal effects can be observed that may be relevant for the application. Some explanations are provided below.

The CU2508-0022 basically supports the following two operation modes:

- Operation without distributed clocks
 - The CU2508-0022 forwards frames received at the uplink port to the desired downlink port, and vice versa. There is no time control for the Ethernet frames.
 - The EtherCAT slaves of the lower-level systems work frame-triggered (or Free Run) and the timing of outputs is significantly dependent on frame delays/jitter, for example.
- Operation with distributed clocks
 - The forwarded EtherCAT frames are subject to temporal influence by the sending IPC, the CU2508-0022 and the EtherCAT slaves.
 - Ports X01...X08 are parameterized as reference clock for distributed clocks.
 - Thus, the EtherCAT slaves of the lower-level systems that support distributed clocks also work DC-synchronously. This means that the input/output operations in these slaves can be synchronized, even at the “same” time between the EtherCAT systems on ports X01..X08. In this case, the overall system is basically independent of frame delays/jitter, as long as these are not significant enough to impair the distributed clocks control.
 - This method is ultimately the most sensible (with regard to EtherCAT operation), because
 - the input/output operations of the EtherCAT devices are best defined in terms of time
 - no time buffers are required in the CU2508

Consider the following aspects to estimate time effects in these operation modes:

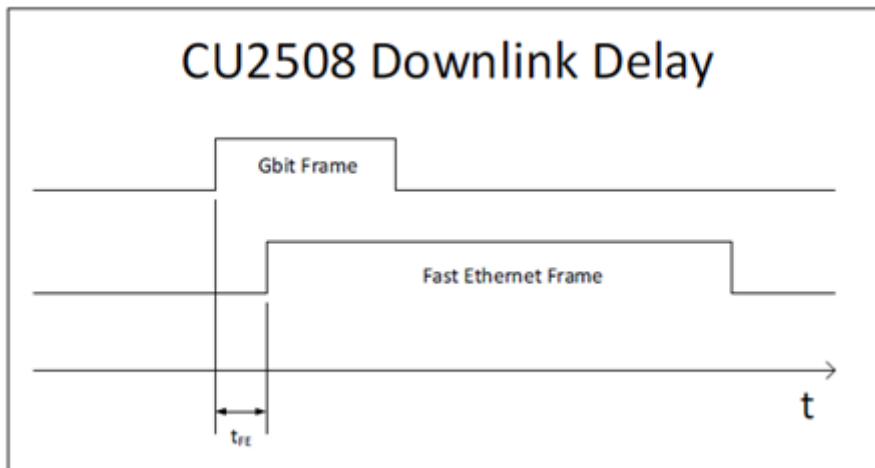
- Depending on the data content, Ethernet frames have a time length of
 - Fast Ethernet (downlink ports): 7...128 μ s, Interframe Gap (IFG) 9.6 μ s
 - Gigabit Ethernet (uplink port): 0.7...12 μ s, IFG 0.96 μ s
- Example scenario on the influence of the frame length:

An EtherCAT segment is connected to ports X01 and X02, each of which contains an EL2202 (2-channel digital output). The edges are to be measured with an oscilloscope for demonstration purposes. The bit of the EL2202 used is in a short 7 μ s frame for X01 and in a long 128 μ s frame for X02. This alone causes the signal on the EL2202 at X02 to be output 121 μ s later.

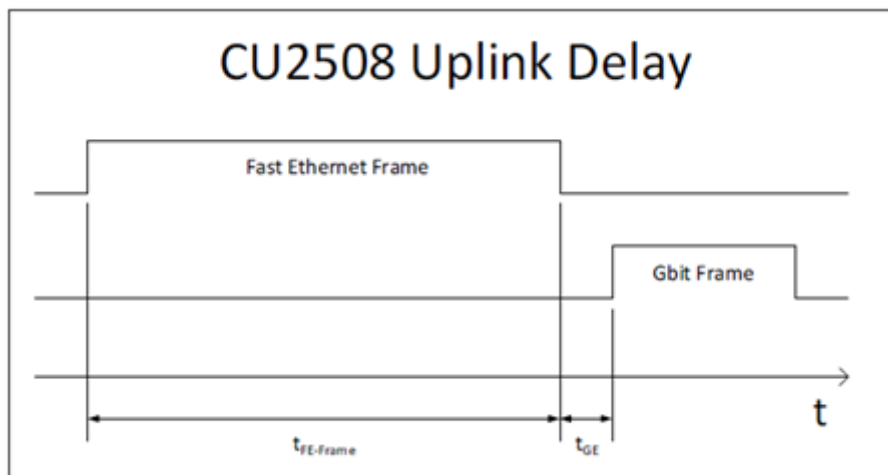
A remedy is the use of distributed clocks, see above.

(The position of the output data in the EtherCAT frame is usually irrelevant, as output data is only output once the frame has been completely passed through the output device after the checksum has been checked)

- The CU2508-0022 has an internal delaying data buffer for each port, due to the different transport speed.
- The frames are transmitted serially (one after the other) on the uplink line. The gigabit frame lengths can already be of a relevant order of magnitude in relation to any short TwinCAT cycle times.
- If several tasks are to be processed in TwinCAT, TwinCAT processes them serially (one after the other) in the standard setting. As a result, the gigabit frames are sent with a corresponding delay.
- Typical delays caused by the management of the CU2508-0022 are as follows:
 - In the downlink
 - Gbit X09 to FastEthernet X01..X04: $t_{FE} = 1 \mu s$
 - Gbit X09 to FastEthernet X05..X08: $t_{FE} = 1.6 \mu s$



- In the uplink
 - FastEthernet X01..X04 to Gbit X09: $t_{GE} = 0.7 \mu s$
 - FastEthernet X05..X08 to Gbit X09: $t_{GE} = 1.1 \mu s$



- These delays are therefore relatively insignificant compared to the other factors mentioned above. What is immediately apparent from the graphic, however, is the importance of the frame length and the necessary buffering in the uplink.

The CU2508-0022 as an EtherCAT slave

Each downlink port of the CU2508-0022 can be configured as a separate EtherCAT device, see chapter [Configuration of a port as an EtherCAT port \[► 33\]](#). In this case, the downlink port represents the first EtherCAT device in the system. It is Distributed Clocks-capable and can therefore serve as a reference clock in the segment.

By combining two such EtherCAT ports, the combination of EtherCAT cable redundancy and distributed clocks function is possible.

Time-controlled sending/receiving (in preparation)

The frame forwarding in the CU2508-0022 can be subjected to precise time control by the local clock:

- the driver or the user application specifies at which time and via which downlink port a frame is to be sent by the CU2508-0022.
This information is added to each frame by the driver as additional information.
- each frame received by the CU2508-0022 at a downlink port is supplemented by receive information (receive port, time) and forwarded to the controller via the uplink.

The local hardware-based clock in the CU2508-0022 then controls the sending of the frames with a high temporal quality. This allows the CU2508-0022 to set up a real-time Ethernet network (network variables, Profinet, ...) even if the control device cannot guarantee hard real-time in the transmission of protocol data. However, the control device must be able to deliver or accept the data with sufficient speed.

The time control uses the 64-bit time format known from the EtherCAT distributed clocks system: resolution 1 ns and thus sufficient for approx. 584 years, starting from 01/01/2000 at 00:00.

The timestamp information (sending and receiving) is currently only evaluated by the CU2508 driver and is not available to the user application.

The SFD (Start of Frame Delimiter) is interpreted as the start of an Ethernet frame according to the IEEE802.3 standard.

EoE and TCP/IP

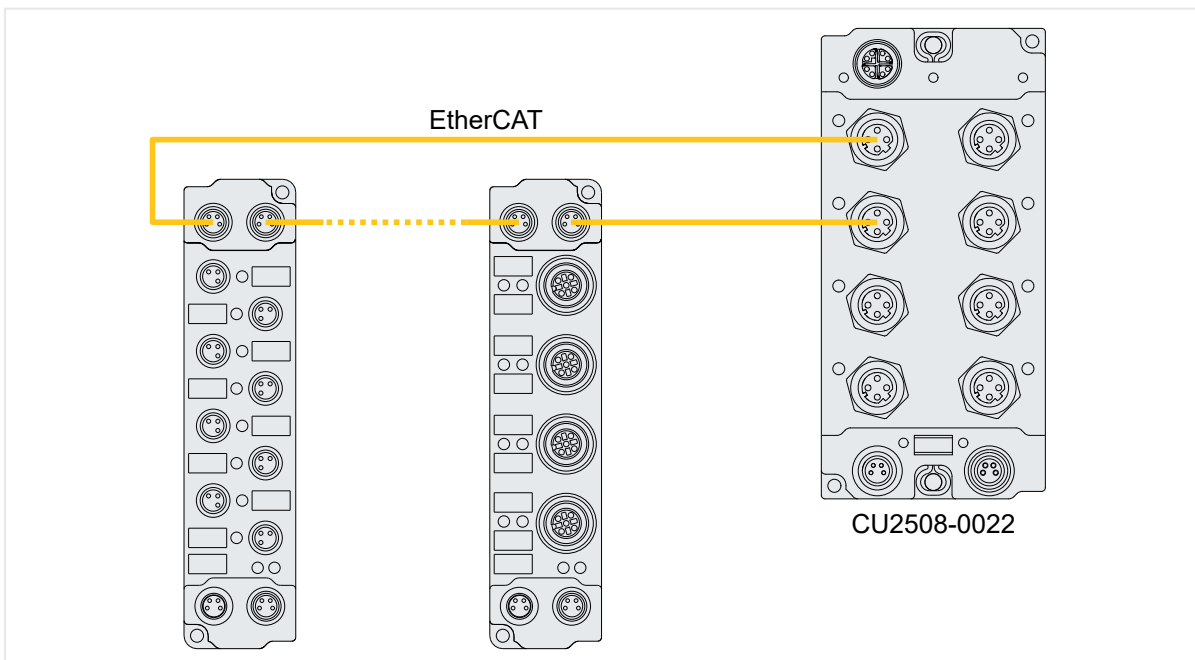
The CU2508-0022 is connected to the IPC via the Gigabit Ethernet interface. This interface appears in the operating system of the IPC with its properties (IP address, subnet mask, etc.). From the point of view of the operating system, there is therefore only this one network connection to which telegrams can be sent or from which telegrams can be received. The CU2508-0022 driver can now either forward data traffic at operating system level to a dedicated downlink port of the CU2508-0022 or feed it into the virtual switch (EoE). See also, for example, the documentation for EP6601-0002 or EL6601/EL6614. The selection is made via the setting in TwinCAT. Either the specific downlink port or *EoE* in general can be selected via "TCP/IP Port".

See chapter [Configuration of TCP/IP communication](#) [▶ 39].

Applications

The above-described functions permit the use of the CU2508-0022 for the following applications, among others:

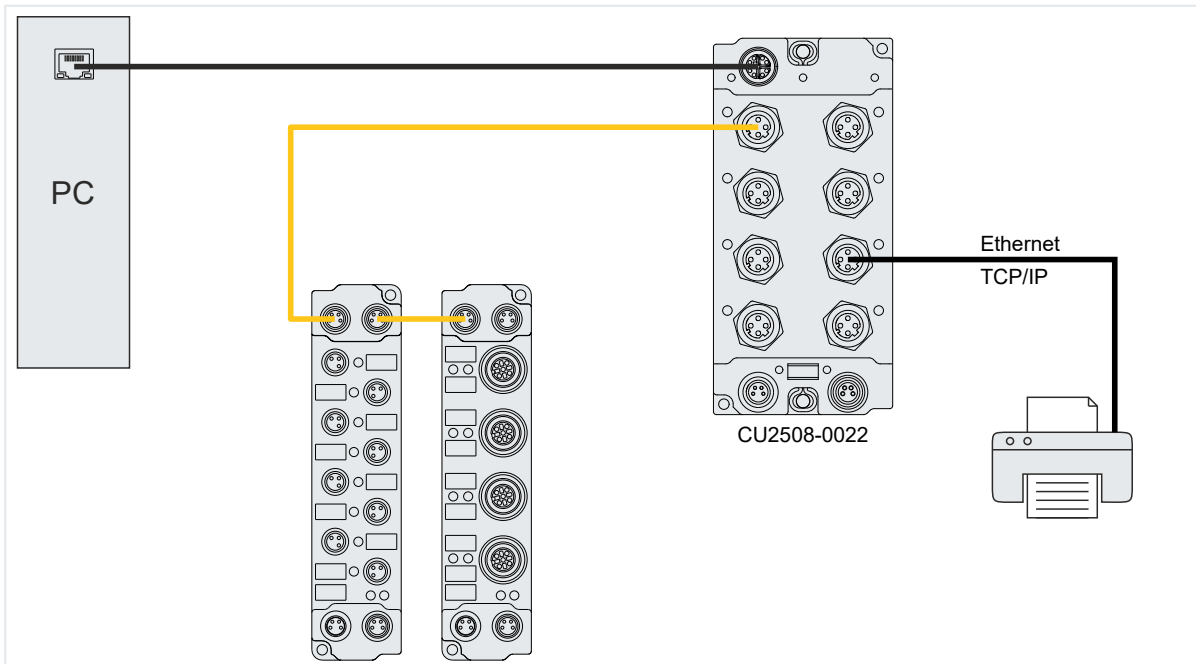
- Multi-EtherCAT adapter
Up to eight independent EtherCAT systems can be created.
- Synchronized EtherCAT systems
If the CU2508-0022 is selected as the reference clock, the EtherCAT systems connected to the CU2508-0022 are operated with the same synchronized time base.
- EtherCAT cable redundancy
Each two downlink ports of the CU2508-0022 can be combined to form a cable-redundant EtherCAT system. This means that fewer Ethernet ports are occupied on the controller, only *one* Gigabit Ethernet port is required for the uplink. This means that up to four cable-redundant EtherCAT systems are possible per CU2508-0022.



- EtherCAT cable redundancy with distributed clocks
Due to the common time base of the CU2508-0022, EtherCAT slaves that require distributed clocks are still subject to synchronization in the event of redundancy.

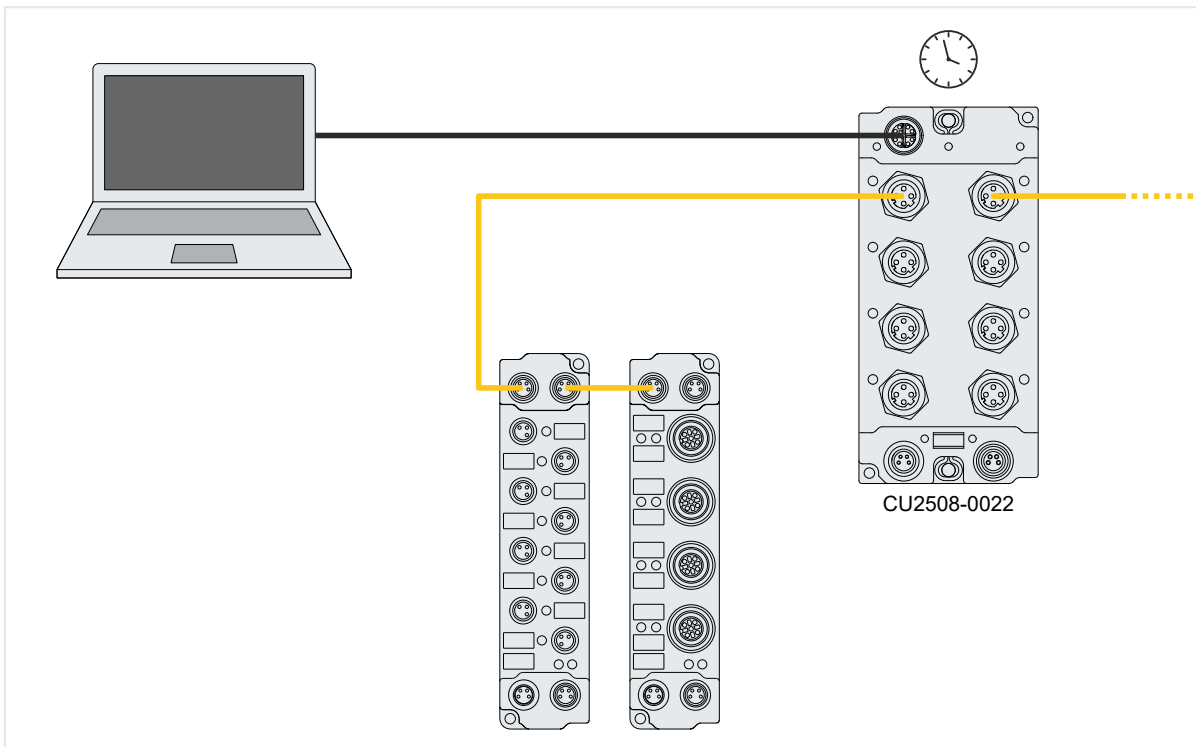
- TCP/IP use without real-time

A downlink port on the CU2508-0022 can be configured as a non-real-time Ethernet port, or the CU2508-0022 operates in the Ethernet over EtherCAT (EoE) network and forwards TCP/IP frames from the connected EtherCAT systems.



- Real-time fieldbus to non-real-time controller

If an Ethernet-based fieldbus requires reliable constancy with regard to the sending of communication telegrams, low jitter is required in the cyclical operations of the controller. If a high-performance controller is able to process the cyclic operations with sufficient frequency (= required short cycle time), but the jitter, i.e. the regular interval between the cycles, is unacceptably high, the CU2508-0022 system as a real-time frame handler can provide the constant interval in frame transmission if the new data is available in the CU2508-0022 in time.



Data traffic in the lower-level EtherCAT segments

Ports X01 and X05 have a larger data buffer of 16 kB instead of the usual 8 kB for EtherCAT segments with particularly high data traffic.

“High data traffic” is generated by I/O systems with a lot of cyclic data, e.g. if many devices (over 100) and/or devices with large data requirements (e.g. analog oversampling terminals) are used.

If a “large” I/O system is operated in EtherCAT redundancy mode, it is advisable to use ports X01 and X05.

The memory situation found is reported by TwinCAT with “Cu2508 fifo sizes...”:


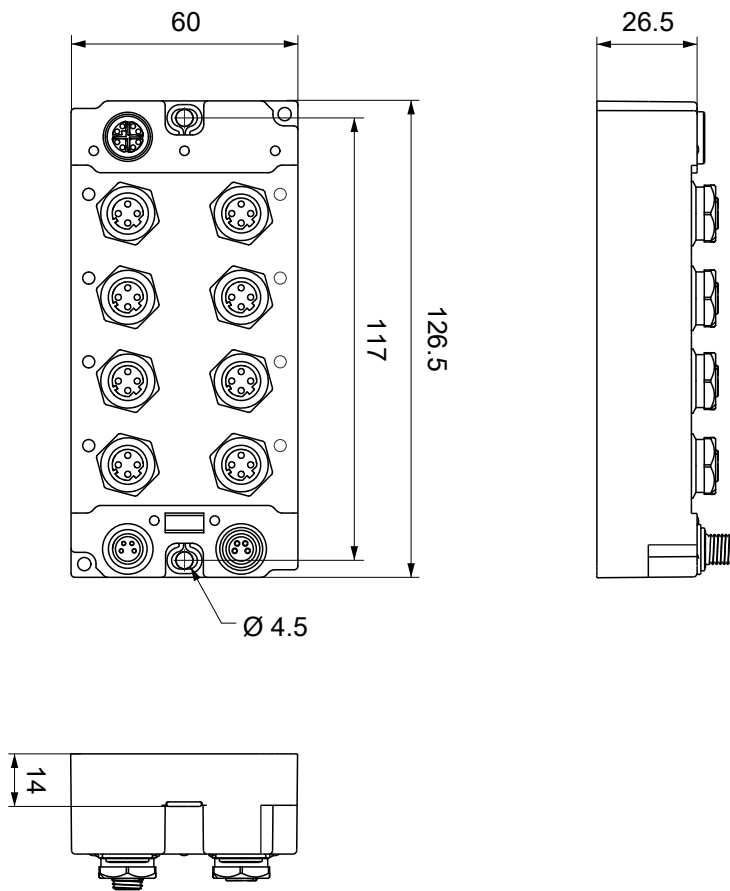
Server (Port)	Timestamp	Message
 TCOM Server (10)	8.03.2019 15:47:40 96 ms	Cu2508 fifo sizes: 1:16 2:8 3:8 4:8 5:16 6:8 7:8 8:8

Fig. 4: Message relating to CU2508 fifo sizes

4 Mounting and cabling

4.1 Dimensions



All dimensions are given in millimeters.
The drawing is not true to scale.

Housing features

Housing material	PA6 (polyamide)
Sealing compound	polyurethane
Mounting	two mounting holes $\varnothing 4.5$ mm for M4
Metal parts	brass, nickel-plated
Contacts	CuZn, gold-plated
Installation position	variable
Protection class	IP65, IP66, IP67 (conforms to EN 60529) when screwed together
Dimensions (H x W x D)	approx. 126 x 60 x 26.5 mm (without connectors)

4.2 Fixing

NOTICE

Dirt during assembly

Dirty connectors can lead to malfunctions. Protection class IP67 can only be guaranteed if all cables and connectors are connected.

- Protect the plug connectors against dirt during the assembly.

Mount the module with two M4 screws in the centrally located mounting holes.

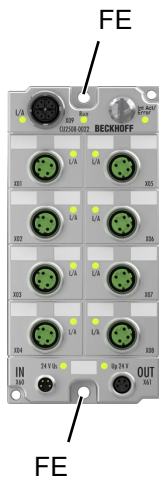
4.3 Tightening torques for plug connectors

Screw M12 connectors tight with a torque wrench. (e.g. ZB8801 from Beckhoff)
Torque: 0.6 Nm.

4.4 Functional earth (FE)

The [Fixing \[▶ 21\]](#) also serve as connections for the functional earth (FE).

Make sure that the box is earthed with low impedance via both fastening screws. You can achieve this, for example, by mounting the box on a grounded machine bed.



4.5 Connections

4.5.1 Supply voltages

⚠ WARNING

Power supply from SELV / PELV power supply unit!

SELV / PELV circuits (safety extra-low voltage / protective extra-low voltage) according to IEC 61010-2-201 must be used to supply this device.

Notes:

- SELV / PELV circuits may give rise to further requirements from standards such as IEC 60204-1 et al, for example with regard to cable spacing and insulation.
- A SELV supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor, a PELV supply also requires a safe connection to the protective conductor.

⚠ CAUTION

Observe the UL requirements

- When operating under UL conditions, observe the warnings in the chapter .

The EtherCAT Box has one input for two supply voltages:

- **Control voltage U_s**
The following sub-functions are supplied from the control voltage U_s :
 - the fieldbus
 - the processor logic
 - typically the inputs and the sensors if the EtherCAT Box has inputs.
- **Peripheral voltage U_p**
For EtherCAT Box modules with digital outputs the digital outputs are typically supplied from the peripheral voltage U_p . U_p can be supplied separately. If U_p is switched off, the fieldbus function, the function of the inputs and the supply of the sensors are maintained.

The exact assignment of U_s and U_p can be found in the pin assignment of the I/O connections.

Redirection of the supply voltages

The power IN and OUT connections are bridged in the module. Hence, the supply voltages U_s and U_p can be passed from EtherCAT Box to EtherCAT Box in a simple manner.

NOTICE

Note the maximum current!

Ensure that the permitted current for the connectors is not exceeded when routing the supply voltages U_s and U_p :

- M8 connector: max. 4 A
- 7/8" connector: max 16 A

NOTICE

Unintentional cancellation of the electrical isolation possible

In some types of EtherCAT Box modules the ground potentials GND_s and GND_p are connected.

- If several EtherCAT Box modules are supplied with the same electrically isolated voltages, check whether there is an EtherCAT Box among them in which the ground potentials are connected.

4.5.1.1 Connectors

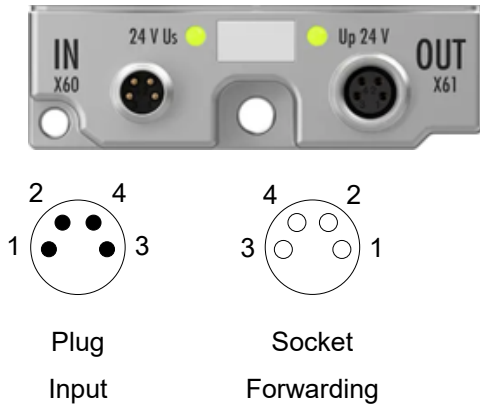


Fig. 5: M8 connector

Contact	Function	Description	Core color ¹⁾
1	U _s	Control voltage	Brown
2	U _p	Peripheral voltage	White
3	GND _s	GND to U _s	Blue
4	GND _p	GND to U _p	Black

¹⁾ The core colors apply to cables of the type: Beckhoff ZK2020-3xxx-xxxx

4.5.1.2 Status LEDs

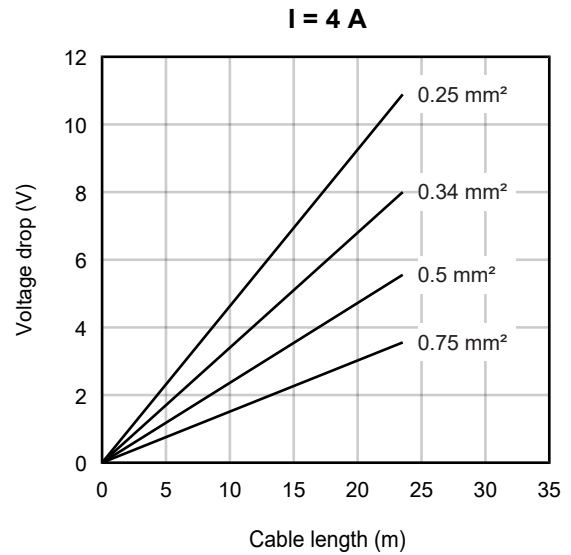
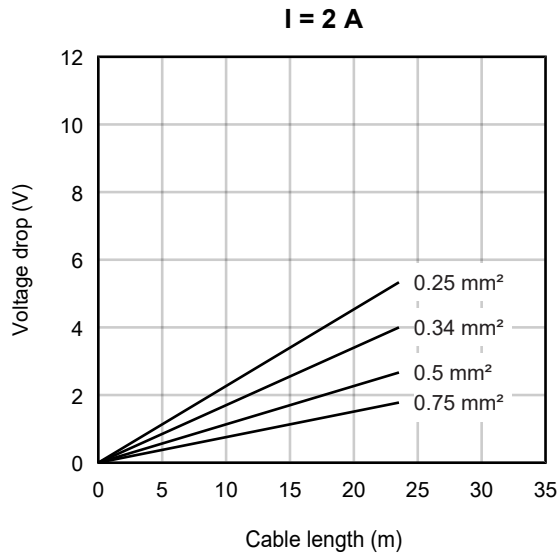


LED	Display	Meaning
U _s (control voltage)	off	The supply voltage U _s is not available.
	green illuminated	The supply voltage U _s is available.
U _p (peripheral voltage)	off	The supply voltage U _p is not available.
	green illuminated	The supply voltage U _p is available.

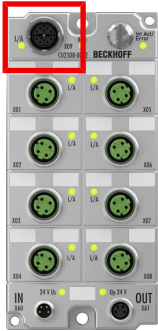
4.5.1.3 Conductor losses

Take into account the voltage drop on the supply line when planning a system. Avoid the voltage drop being so high that the supply voltage at the box lies below the minimum nominal voltage. Variations in the voltage of the power supply unit must also be taken into account.

Voltage drop on the supply line



4.5.2 Uplink port X09



The uplink port X09 is an X-coded M12 socket.

Connect the uplink port to a Gigabit Ethernet port on the PC. Suitable connection cables can be found in chapter [Accessories](#) [► 54].

Pin assignment

M12 socket, X-coded	Pin	Signal
	1	DA+
	2	DA-
	3	DB+
	4	DB-
	5	DD+
	6	DD-
	7	DC-
	8	DC+
Housing	Shield	

4.5.2.1 Status LEDs

The status LEDs “L/A”, “Run” and “Int Act / Error” indicate the communication status of the uplink port.



“L/A”

Color	Meaning
Green	Link/Act signal
Orange	Error

“Run”

This green LED shows the state of the EtherCAT State Machine when the CU2508-0022 is operating as an EtherCAT device.

Signal	Meaning
Off	“Init” or “Bootstrap” state
Flashes	“Preop” state
Single flash	“Safeop” state
Lit	“OP” state

“Int Act / Error”

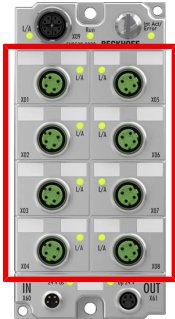
Color	Meaning
Green	Data traffic takes place.
Orange	Error.

4.5.3 Downlink ports X01 ... X08

NOTICE

Do not use angled plugs

The cable outlet of an angled plug would cover other downlink ports or collide with plugs on the other downlink ports.



Ports X01 ... X08 are D-coded M12 sockets.

Pin assignment

M12 socket, D-coded	Pin	Function
	1	Tx +
	2	Rx +
	3	Tx -
	4	Rx -
	Housing	Shield

LEDs

There is an LED labeled “L/A” on each downlink port.



Color	Meaning
Green	Link/Act signal
Orange	Error: Internal buffer overflow or alignment error

Ports for increased data throughput

Ports X01 and X05 have a larger data buffer than the other ports. This enables a higher data throughput.

These ports are particularly suitable for connecting EtherCAT segments with many devices (over 100) and/or devices with high data requirements (e.g. devices with analog channels and oversampling).

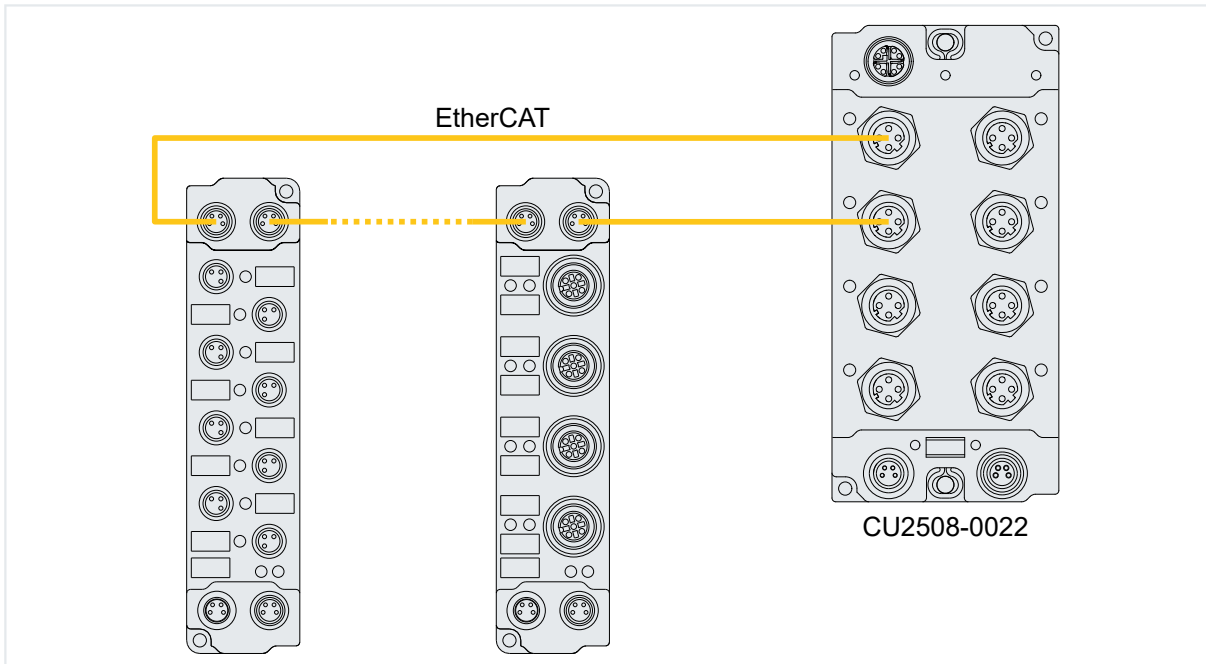
EtherCAT cable redundancy

If a downlink port of the CU2508-0022 is used as an EtherCAT port, another port can be used as a second EtherCAT port for the purpose of cable redundancy. The configuration is described in the chapter [Configuration of two ports for EtherCAT cable redundancy \[▶ 37\]](#).

Only the following combinations of ports can be used for cable redundancy:

- X01 and X02
- X03 and X04
- X05 and X06
- X07 and X08

Example for EtherCAT port X01 and redundancy port X02:

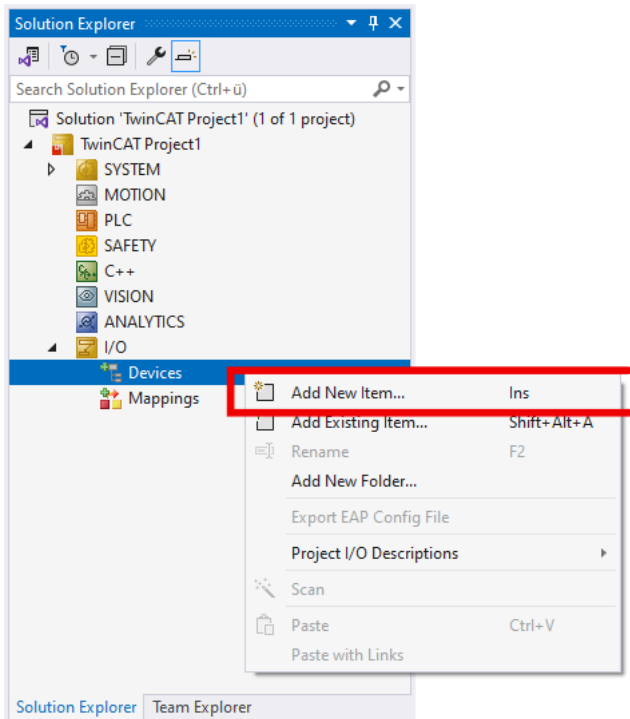


5 Commissioning

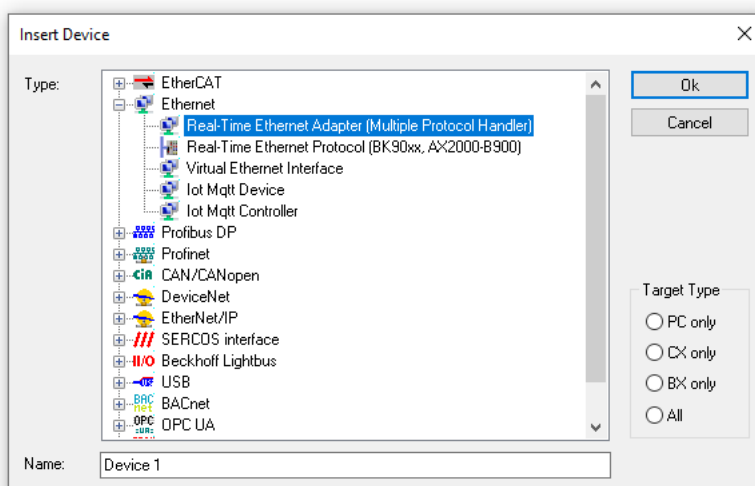
5.1 Integrating into a TwinCAT project

This chapter describes how to integrate the CU2508-0022 into a TwinCAT project.

1. Ensure that the “TwinCAT Ethernet Protocol” is installed on the Gigabit Ethernet port of the IPC to which the CU2508-0022 is connected or is to be connected.
Use the dialog window under the menu item “TwinCAT” > “Show Realtime Ethernet Compatible Devices...”.
2. Right-click on “Devices” under “I/O” in the Solution Explorer and select “Add New Item...”.

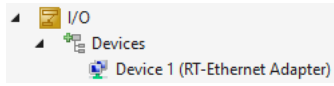


3. In the window that appears, select the type “Ethernet” > “Real-Time Ethernet Adapter (Multiple Protocol Handler)” and confirm with OK.



⇒ If several suitable ports are available on the IPC, a window with a selection of these ports will appear. Select the port to which the CU2508-0022 is connected. You can also select “(none)” and select the port later in the “Adapter” tab using the “Search” button.

⇒ The CU2508-0022 appears in Solution Explorer as “Device n (RT-Ethernet Adapter)”.

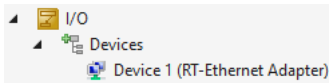


Continue with the configuration in the chapter [Basic configuration](#) [▶ 31].

5.2 Basic configuration

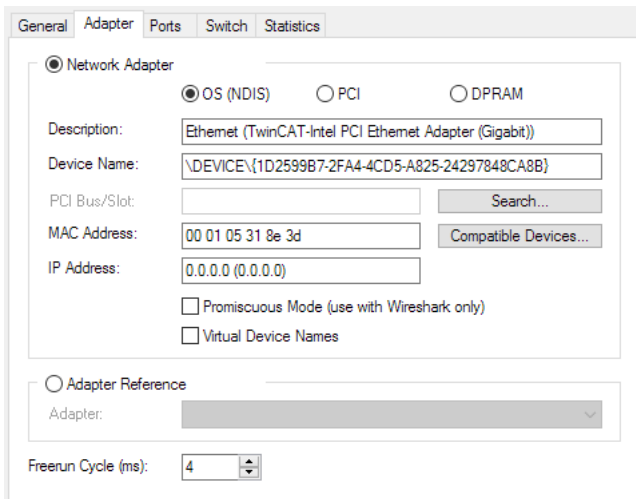
This chapter describes the basic configuration that is essential for operating the CU2508-0022.

In the Solution Explorer, click on the device “RT-Ethernet Adapter” that was created in the chapter [Integrating into a TwinCAT project](#) [▶ 29].



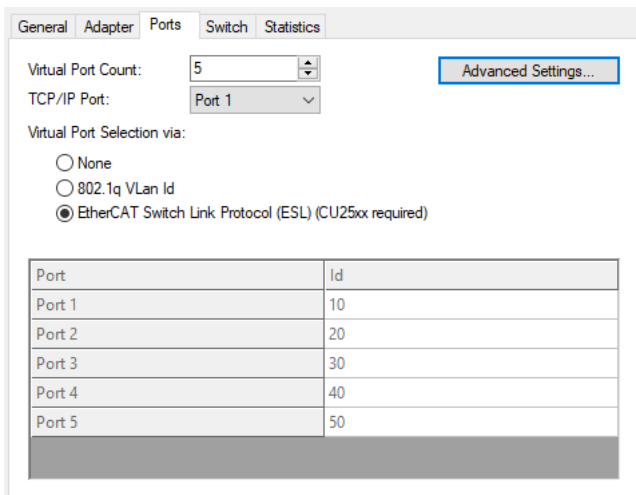
Configure the device in the following tabs:

“Adapter”



Make sure that the Gigabit Ethernet port to which the CU2508-0022 is or will be connected is set here.

“Ports”



1. Set the number of downlink ports of the CU2508-0022 that you require in the “Virtual Port Count” field.
2. If you want to use one of the ports of the CU2508-0022 exclusively for TCP/IP traffic, select the port in the “TCP/IP” field. Real-time traffic (e.g. EtherCAT) is then no longer possible via this port. Otherwise, select the “via EoE” option. TCP/IP communication is then possible via a virtual switch, see [Configuration of TCP/IP communication](#) [▶ 39].
3. Select “EtherCAT Switch Link Protocol (ESL) (CU25xx required)” under “Virtual Port Selection via”.

Completion of the basic configuration

1. Click on the “Reload Devices” button in the TwinCAT toolbar.



⇒ If the CU2508-0022 is connected and supplied with power, the “Run” LED lights up and the “Int Act/ Error” and “L/A” LEDs on X09 flash green.

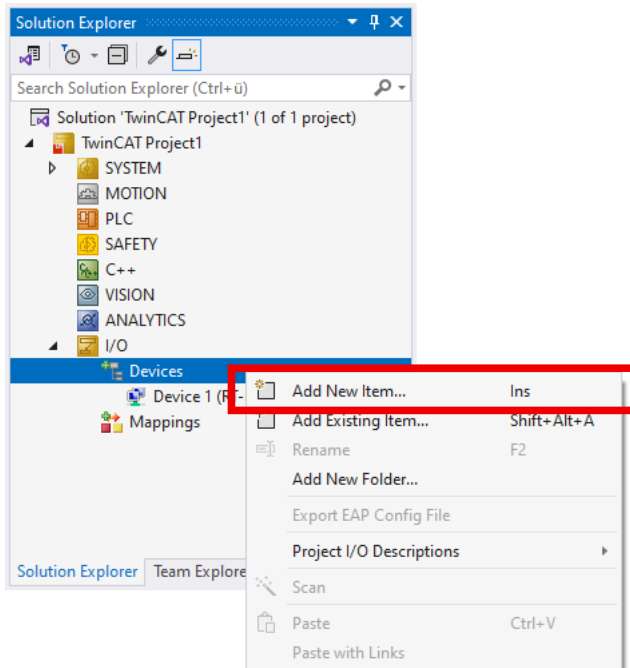
2. Configure the downlink ports of the CU2508-0022, see chapter [Configuration of the downlink ports](#) [► 33].

5.3 Configuration of the downlink ports

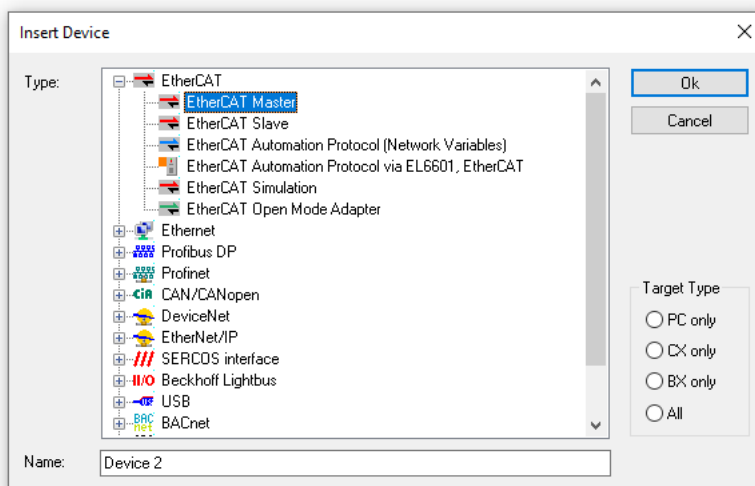
5.3.1 Configuration of a port as an EtherCAT port

Repeat the following instructions for each port that you want to configure as an EtherCAT port.

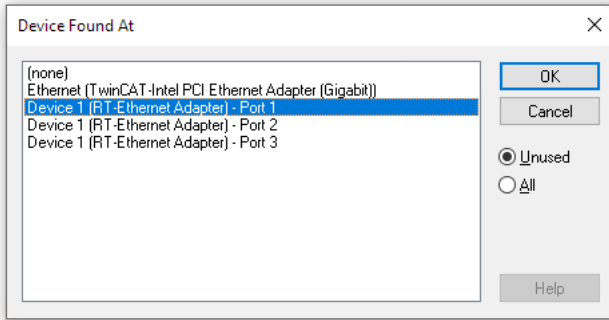
1. Right-click on “Devices” under “I/O” in the Solution Explorer and select “Add New Item...”.



2. In the window that appears, select the type “EtherCAT” > “EtherCAT Master” and confirm with OK.

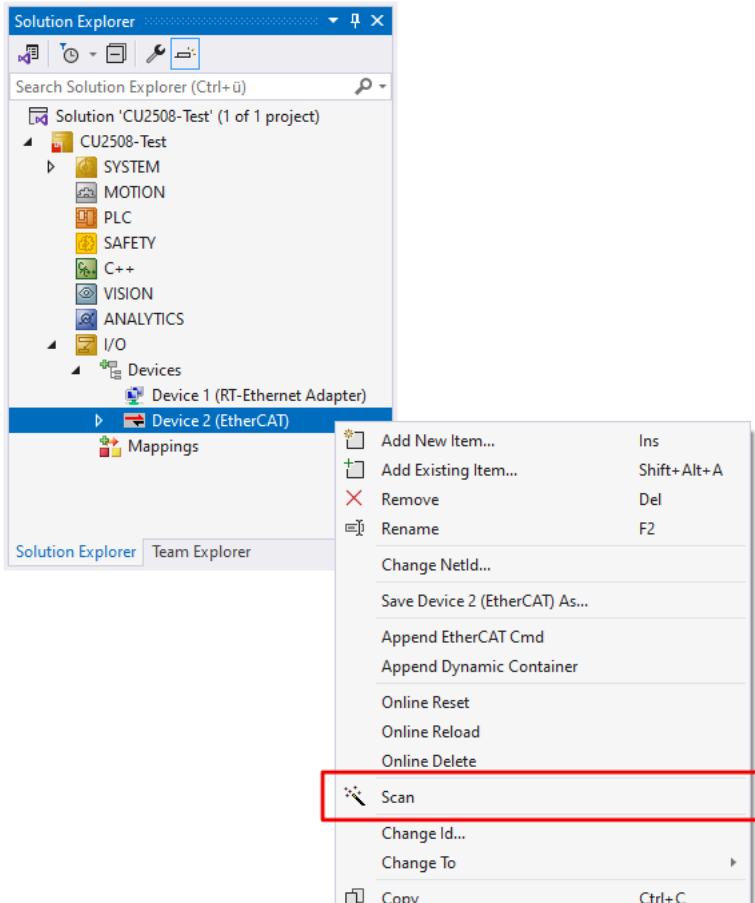


⇒ A list of the available ports of the PC and the downlink ports of the CU2508-0022 appears.



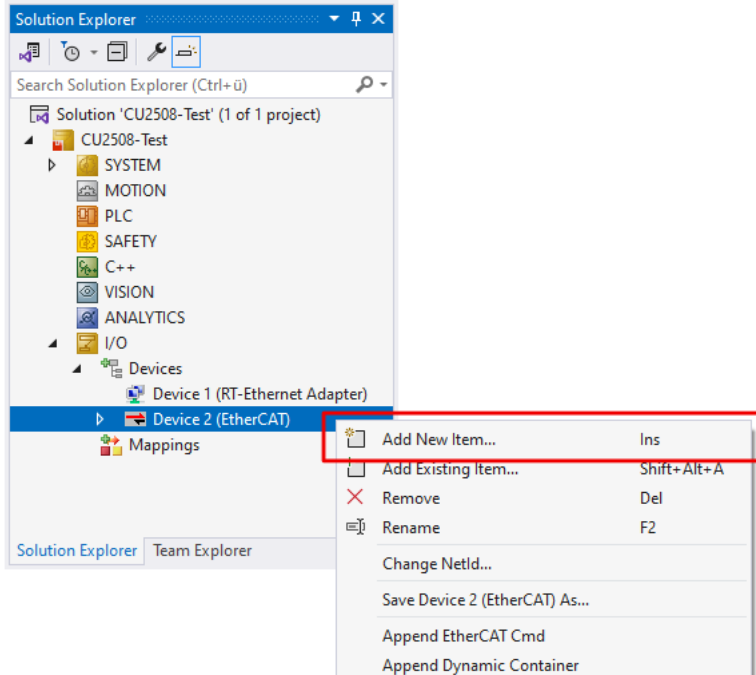
If no list appears, set the port subsequently in the “Adapter” tab of the device “EtherCAT Master” you have just created, see chapter [Changing the port of a device](#) [► 50]. Skip the following step.

3. Select the desired port of the CU2508-0022 in the list.
X01 is port 1, X02 is port 2, etc.
Please note that the selected port must not be configured as a TCP/IP port.
You can also select “(none)” and/or set the port afterwards. See chapter [Changing the port of a device](#) [► 50].
4. If the CU2508-0022 and the EtherCAT devices are present on this port, wired and supplied with power, you can have the connected EtherCAT devices automatically detected by a scan.
For EtherCAT segments with cable redundancy, you must temporarily disconnect the connection to the redundancy port before the scan, otherwise the scan will fail.

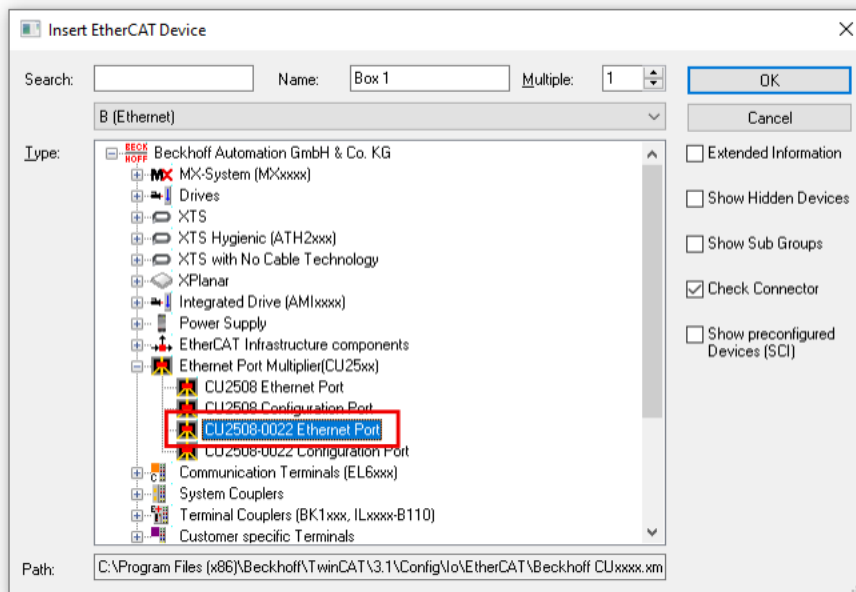


If a scan is not possible, continue with the following steps.

- Right-click on the “EtherCAT” device in the Solution Explorer and select “Add New Item...”.



- In the window that appears, select “CU2508-0022 Ethernet Port” and confirm with OK.

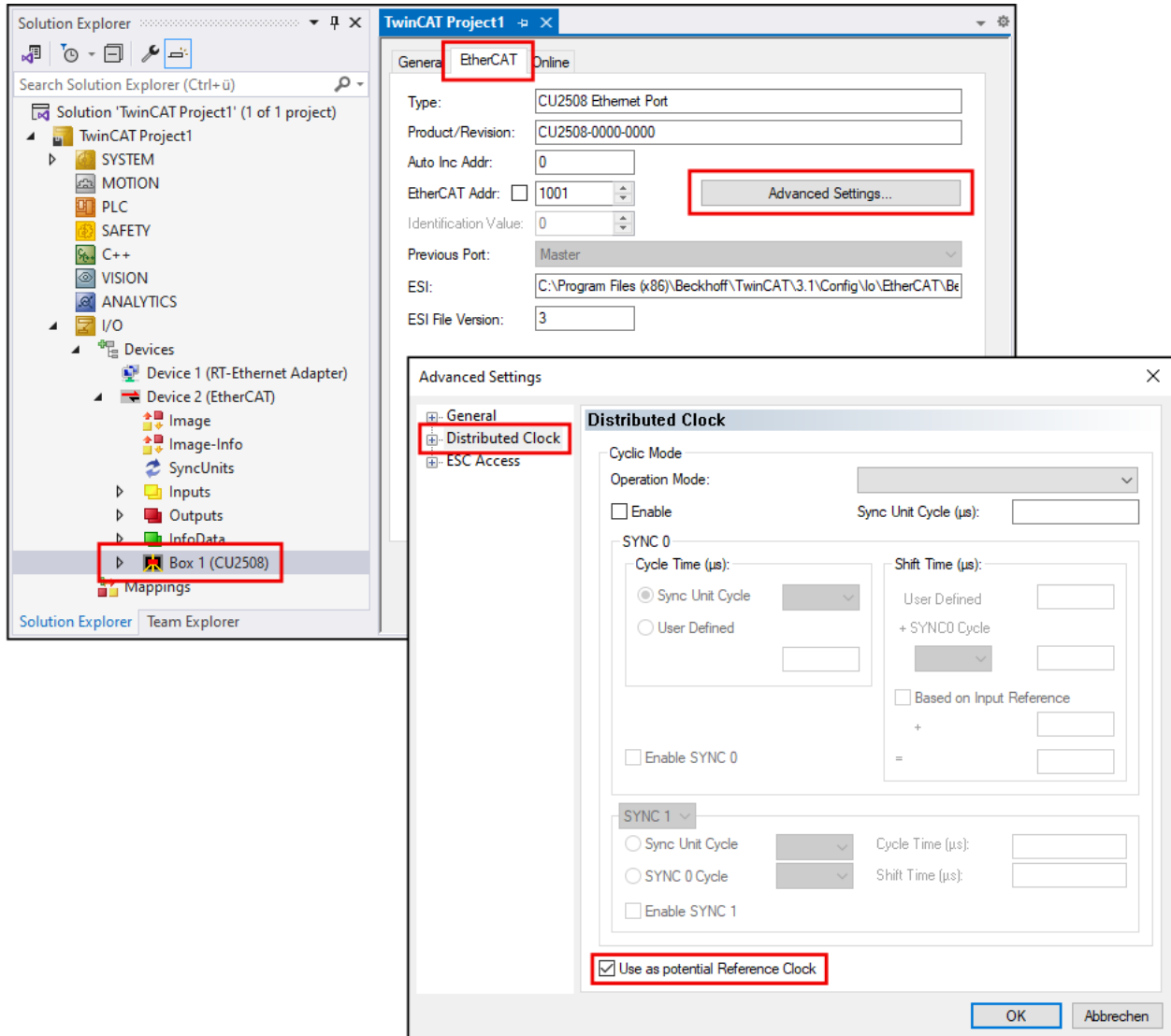


⇒ The port appears in the Solution Explorer as “Box 1 (CU2508-0022)”.

- If necessary, configure the port as Reference Clock for distributed clocks. See chapter [Distributed Clocks](#) [► 36].
- Right-click on the “EtherCAT” device again on the Solution Explorer, select “Add New Item...” and append the desired EtherCAT devices, e.g. EP1008-0001, EK1100 etc.

5.3.1.1 Distributed Clocks

The downlink ports are synchronized with each other. Each port can act as Reference Clock for the respective EtherCAT segment. To do this, click on “Advanced Settings” in the “EtherCAT” tab of the port’s device. Activate the “Use as potential Reference Clock” checkbox under “Distributed Clocks”.



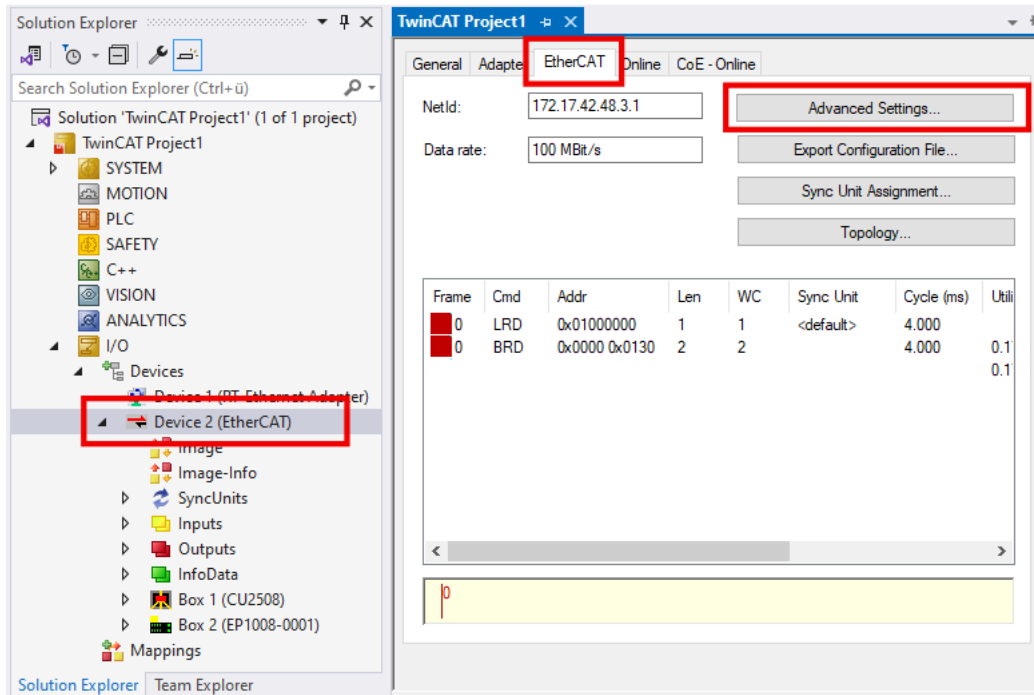
If you do not check this box, the first connected distributed clocks-capable device on this port will be used as Reference Clock.

5.3.2 Configuration of two ports for EtherCAT cable redundancy

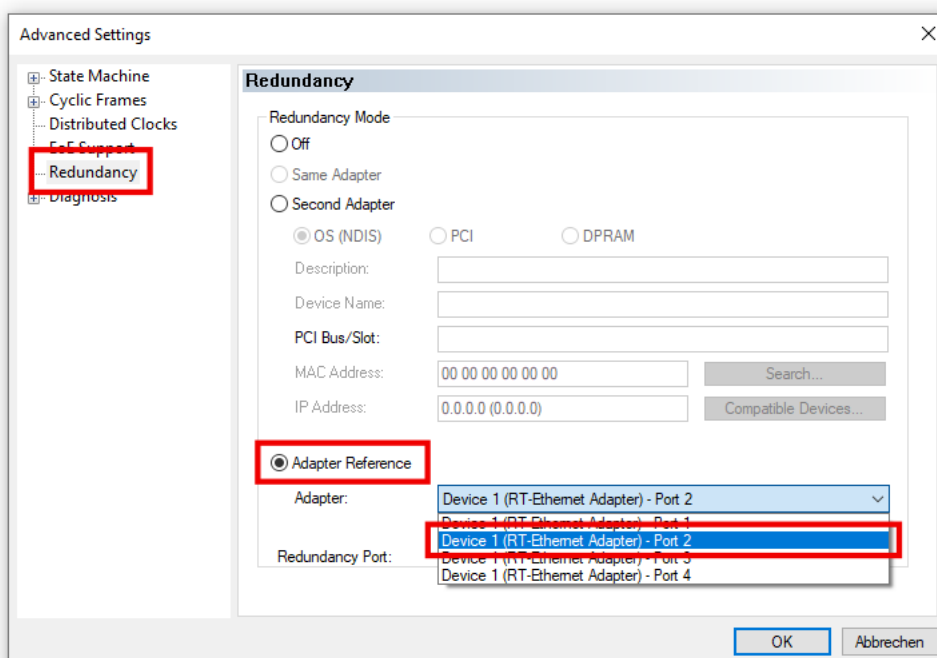
This chapter shows the configuration for ports X01 and X02 as an example.

Further information on cable redundancy can be found on the TwinCAT 3 Function TF6220 website: [Link](#).

1. Configure the first EtherCAT port as described in the chapter [Configuration of a port as an EtherCAT port](#) [▶ 33].
2. Select the EtherCAT device of the first EtherCAT port in the Solution Explorer and click on the “Advanced Settings...” button in the “EtherCAT” tab.



3. In the window that appears, click on the category “Redundancy”, activate “Adapter Reference” and select the redundancy port from the drop-down menu.
If the desired port is not available, you may need to increase the number of ports in the CU2508-0022 settings, see chapter [Basic configuration](#) [▶ 31].



Please note that only certain combinations of ports are possible for cable redundancy:

- X01 and X02
- X03 and X04
- X05 and X06
- X07 and X08

Distributed Clocks

The two ports are automatically configured as Reference Clocks for distributed clocks by activating cable redundancy. This ensures that synchronization can be maintained even in the event of a wire break.

See chapter [Distributed Clocks](#) [▶ 36].

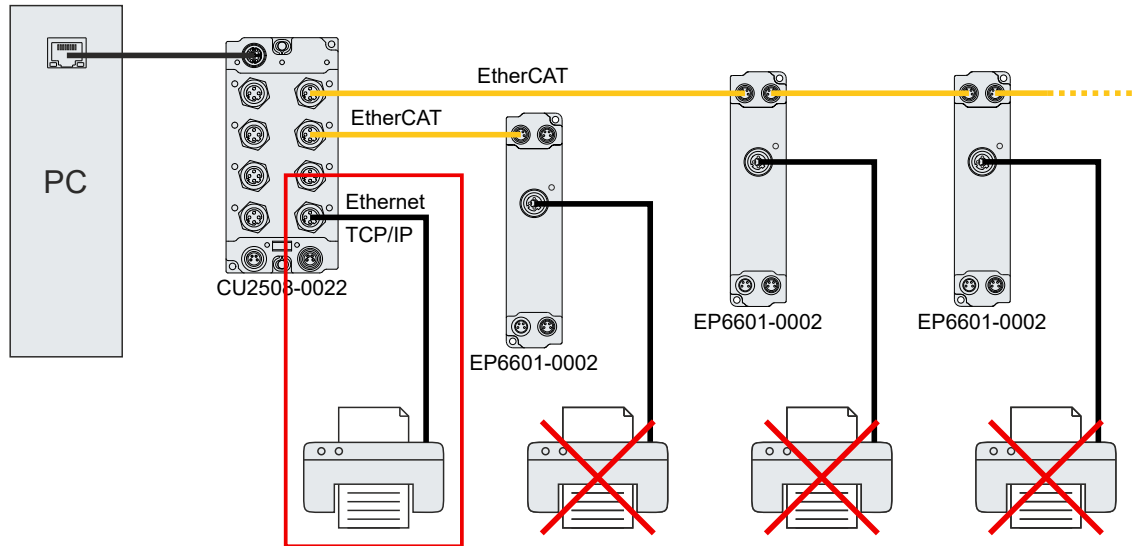
Synchronization with an external time source is currently not possible for EtherCAT segments with cable redundancy.

5.3.3 Configuration of TCP/IP communication

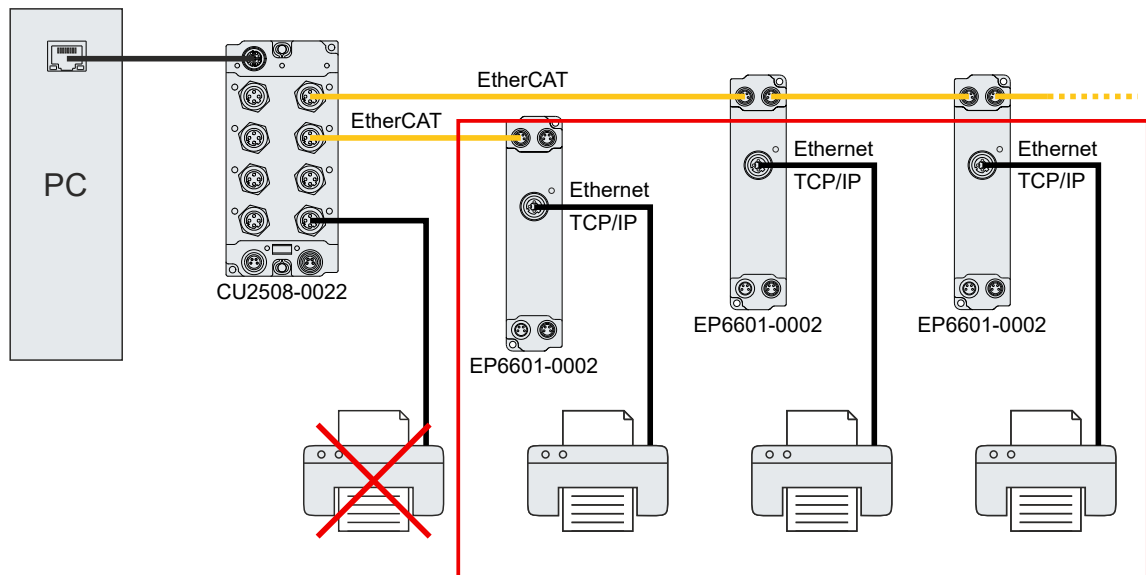
The CU2508-0022 can transmit TCP/IP frames between the IPC and one or more TCP/IP-capable Ethernet devices.

There are two ways to connect TCP/IP-capable devices. These options are mutually exclusive and cannot be combined:

- A device on one of the ports of the CU2508-0022. See chapter [A dedicated TCP/IP port](#) [▶ 40]



- Several devices on one EtherCAT device each, which serves as a communication interface for Ethernet via a virtual switch. E.g. EP6601-0002, EL6601 or EL6614. See chapter [TCP/IP via virtual switch](#) [▶ 41]



5.3.3.1 A dedicated TCP/IP port

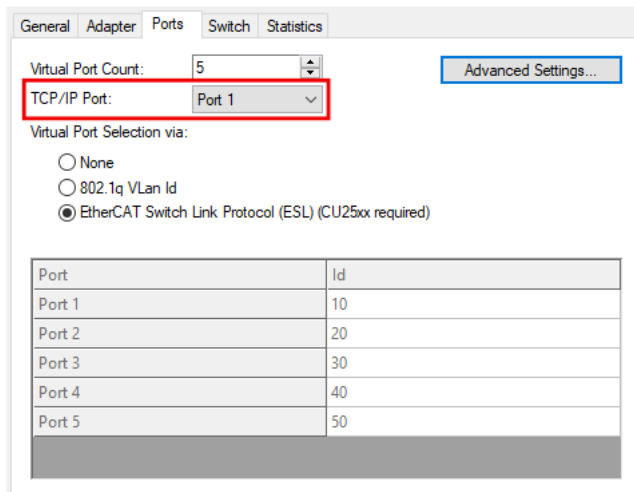
You can configure one of the downlink ports of the CU2508-0022 as a TCP/IP port and connect a TCP/IP device directly to it. This TCP/IP device can also be a switch, for example, to connect the CU2508-0022 to a larger network.

From the point of view of the operating system and the TCP/IP device, it appears as if the TCP/IP device is directly connected to the Ethernet port of the PC to which the CU2508-0022 is connected.

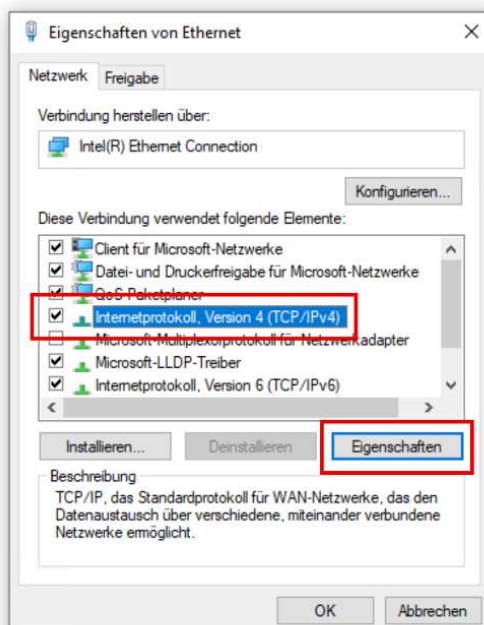
The CU2508-0022 is completely transparent and forwards the TCP/IP frames unchanged in both directions.

Configuration

1. Set the desired port of the CU2508-0022 in the “Ports” tab of the “RT-Ethernet-Adapter” device. See chapter [Basic configuration \[► 31\]](#) in the section “Ports”.



2. Configure the TCP/IP parameters of this port by configuring the TCP/IP parameters of the port to which the CU2508-0022 is connected in the operating system.

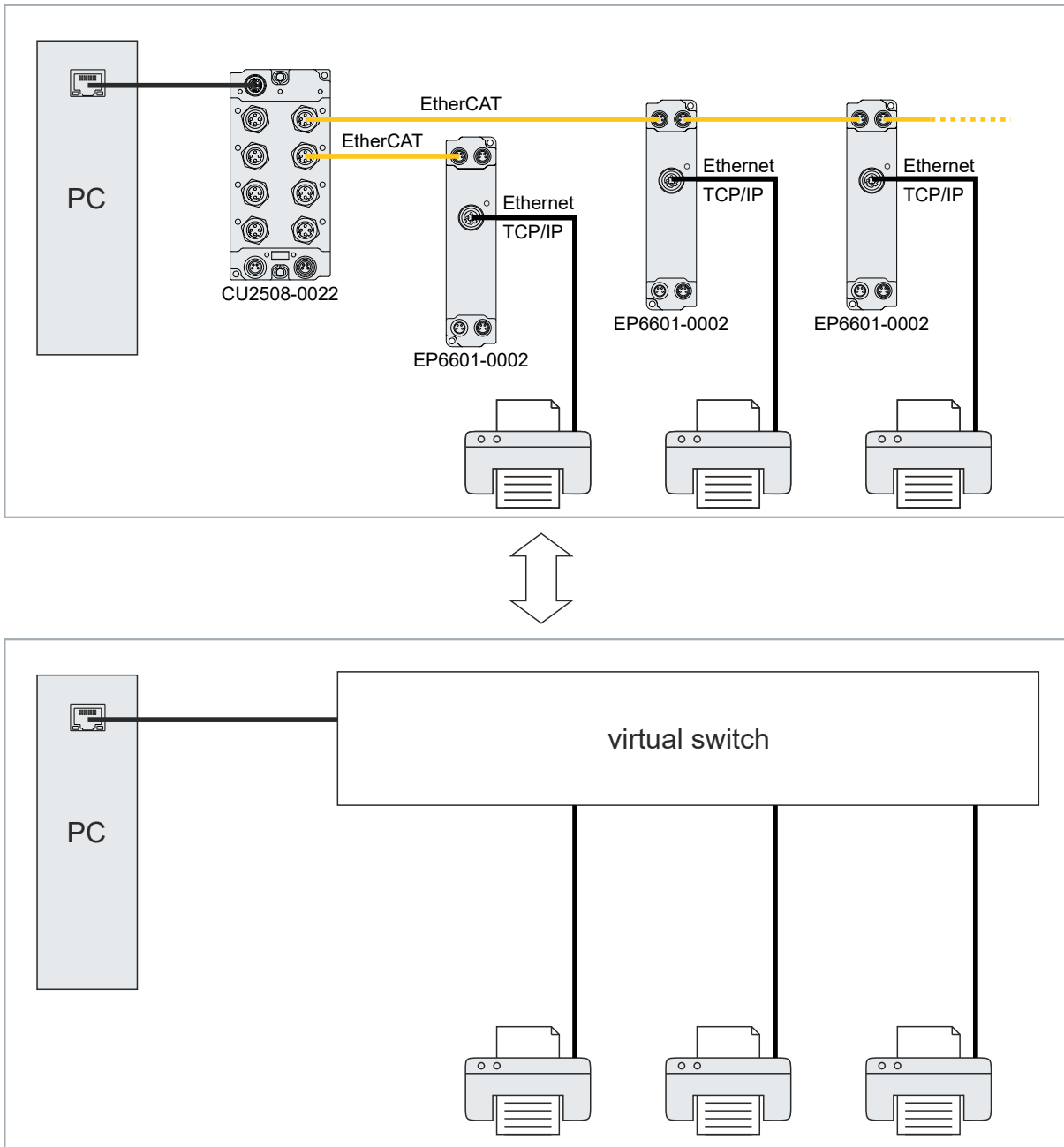


5.3.3.2 TCP/IP via virtual switch

The virtual switch is a software component in TwinCAT that acts as an Ethernet Switch. The ports of this virtual switch are the ports of all EoE-capable devices that are present in the connected EtherCAT networks, e.g. EP6601-0002, EL6601 or EL6614.

From the operating system’s point of view, it appears as if the Ethernet devices are connected to a switch that is connected to the Gigabit Ethernet port.

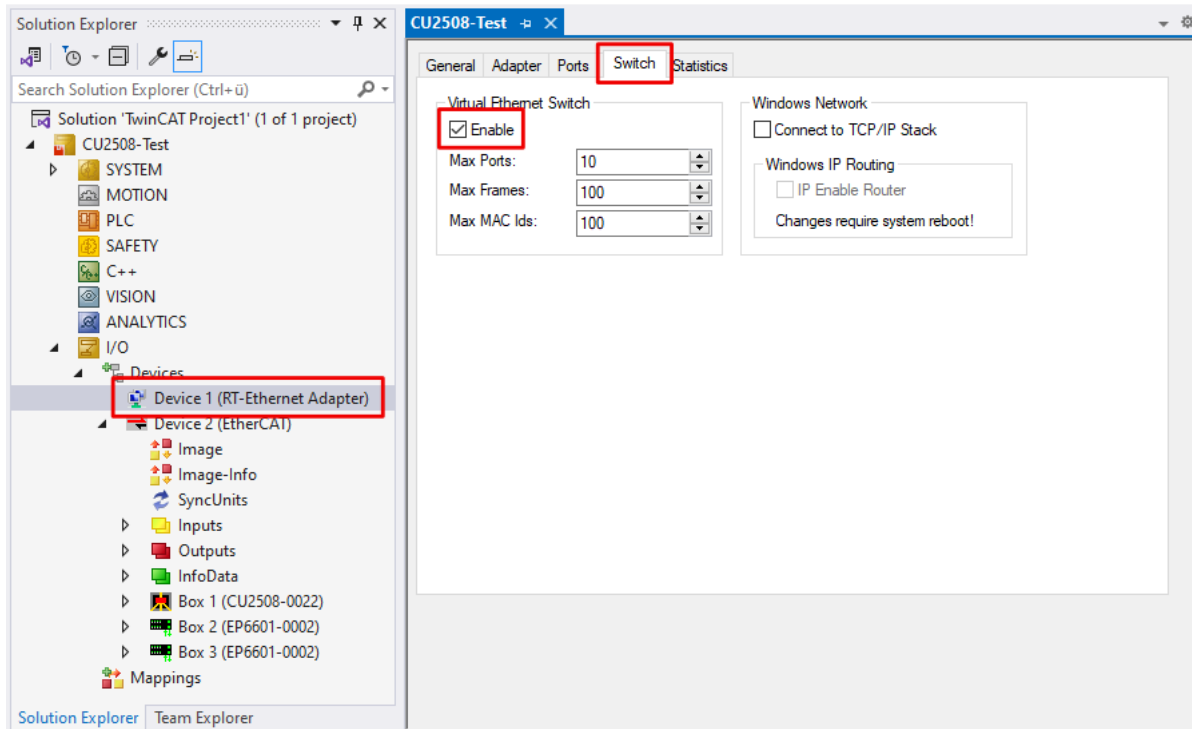
Example



Activating the virtual switch

1. In the Solution Explorer, click on the “RT-Ethernet Adapter” device that was created in the chapter [Integrating into a TwinCAT project](#) [► 29].
2. Select the “Ports” tab and select the value “via EoE” from the drop-down menu “TCP/IP-Port”.

3. Select the “Switch” tab and check the “Enable” box in the “Virtual Ethernet Switch” field.



⇒ The virtual switch is activated.

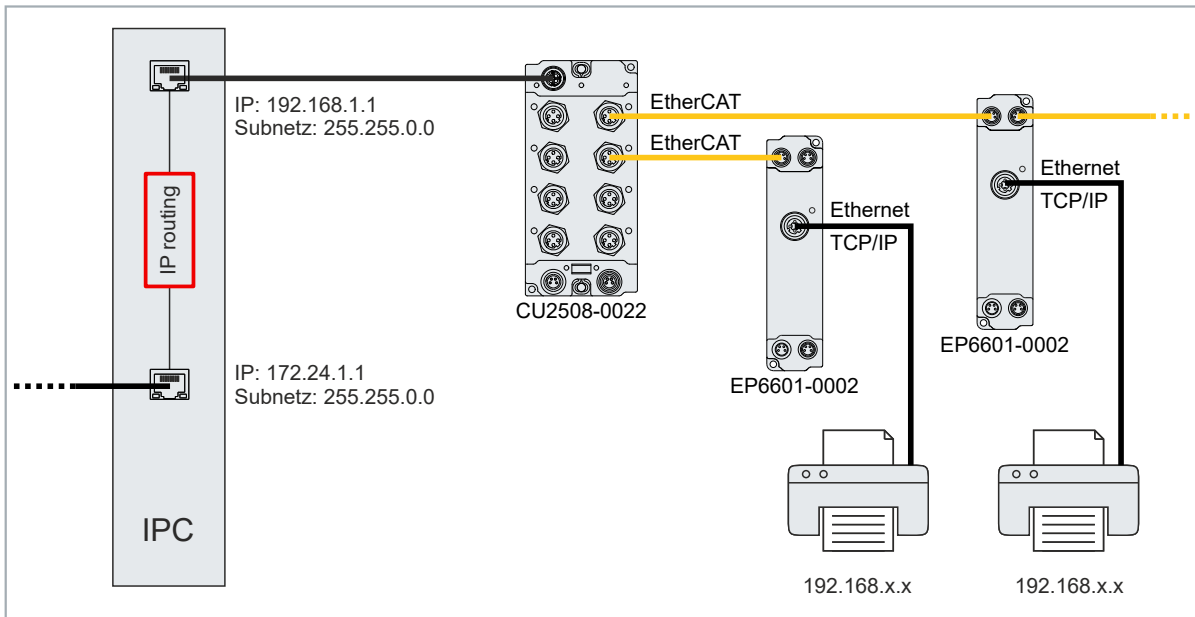
4. Configure the virtual switch using the other operating elements in this tab:

Name	Explanation
Max. Ports	Number of ports of the virtual switch. Each EoE device (e.g. EL6601, AX5000) in the lower-level EtherCAT systems occupies one port.
Max Frames	Max. number of buffered Ethernet frames. Can be increased if there are noticeable throughput bottlenecks.
Max MAC Ids	MAC addresses of the connected devices stored in the internal Switch-Look-Up table. Must be larger than the maximum number of Ethernet devices ever connected to all systems.
Connect to TCP/IP Stack	Connects the EoE switch to the internal Windows NDIS network layer IP range must match
IP Enable Router	This function is provided by the Windows operating system and is accessible via the registry or, in the case of embedded CX systems under Windows CE/WEC, via the CX-config tool. If activated, the NDIS network layer also mediates IP packets whose IP addresses do not correspond to the subnet mask.

Notes

- The IP address of the used Gbit adapter and the subnet mask is used for communication. The EoE devices (printer, scanner, remote PC etc.) must therefore have their address within this area.
- The throughput depends among other things on the EtherCAT cycle time, the number EoE devices and the extent of utilization of the individual connections. The relevant notes in the documentation of the EoE devices must be observed.
- The EoE system can be connected to the NDIS layer via the switch “Connect to TCP/IP Stack” (fig. *Data flow when using the CU2508 as an EoE switch, A*).
- IP routing is an operating system function for routing IP messages between networks that are not on the same subnet. For example, between the devices 192.168.1.1 and 172.168.1.1, which are each in the mask 255.255.0.0.

This function is activated with "IP enable Router" (Fig. *Data flow when using CU2508 as EoE switch, B*). It is also available under Windows CE (CXconfig tool).

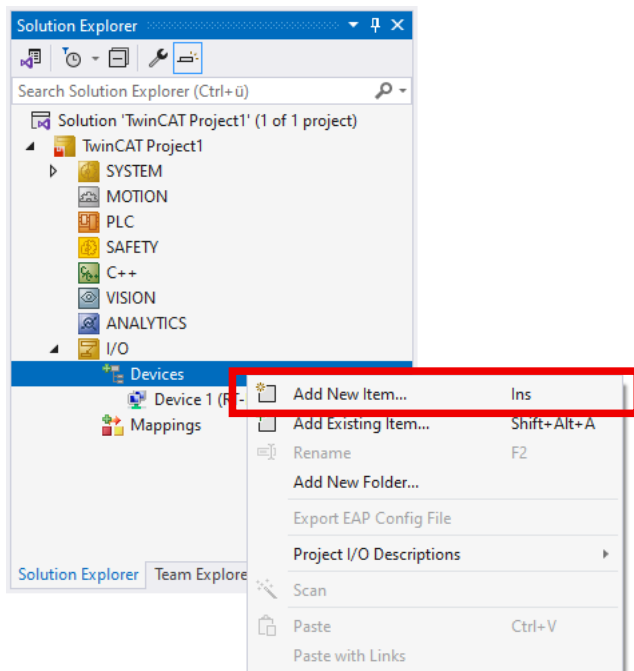


5.3.4 Configuration of a port for network variables

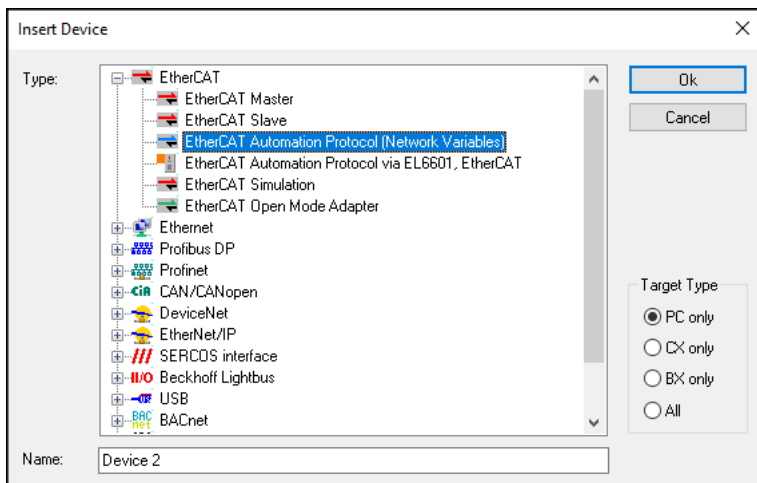
This chapter describes the configuration of a port of the CU2508-0022 for the cyclic exchange of network variables.

Detailed information on network variables can be found in the [“TwinCAT 3 | EAP”](#) documentation.

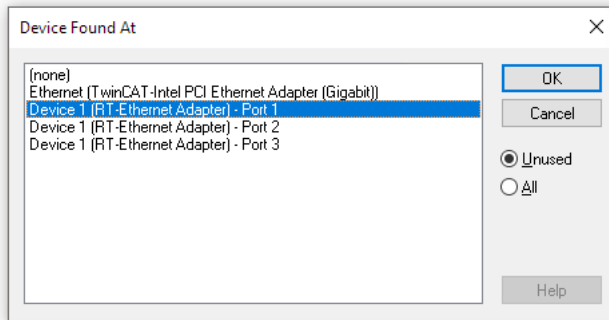
1. Right-click on “Devices” under “I/O” in the Solution Explorer and select “Add New Item...”.



2. In the window that appears, select the type “EtherCAT” > “EtherCAT Automation Protocol (Network Variables)” and confirm with OK.



⇒ A list of the available ports of the IPC and the CU2508-0022 appears.



If no list appears, set the port subsequently in the “Adapter” tab of the “EtherCAT Automation Protocol (Network Variables)” device you have just created, see chapter [Changing the port of a device](#) [► 50]. Skip the following step.

3. Select the desired port of the CU2508-0022 in the list.
X01 is port 1, X02 is port 2, etc.
Please note that the selected port must not be configured as a TCP/IP port.
You can also select “(none)” and/or change the port afterwards. See chapter [Changing the port of a device](#) [► 50].
4. Create and configure the required “Network Variable Publisher” and “Network Variable Subscriber” in accordance with the “[TwinCAT 3 | EAP](#)” documentation.

5.3.5 Configuration of a port as a PROFINET device

Requirement: TwinCAT 3 or TwinCAT from version 2.11R3 build 2234.

i Only one port per network segment

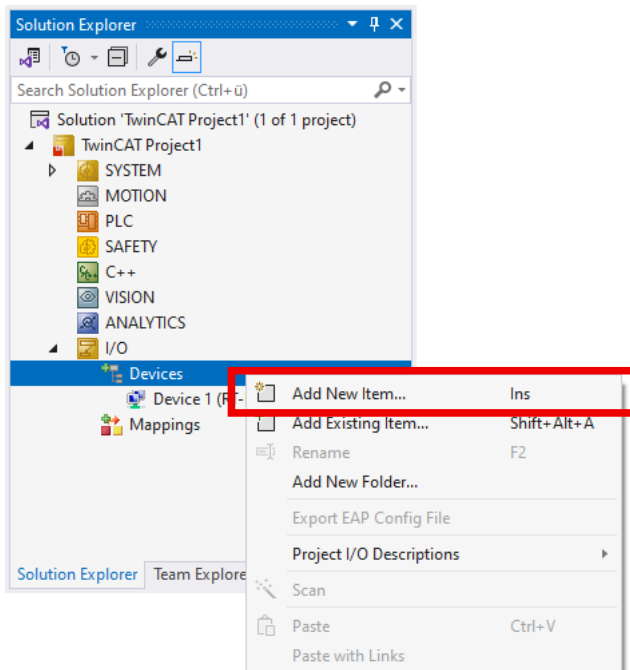
You can configure and use any number of ports on the CU2508-0022 as PROFINET devices.

However, two ports of the same CU2508-0022 cannot be used in the same PROFINET network segment.

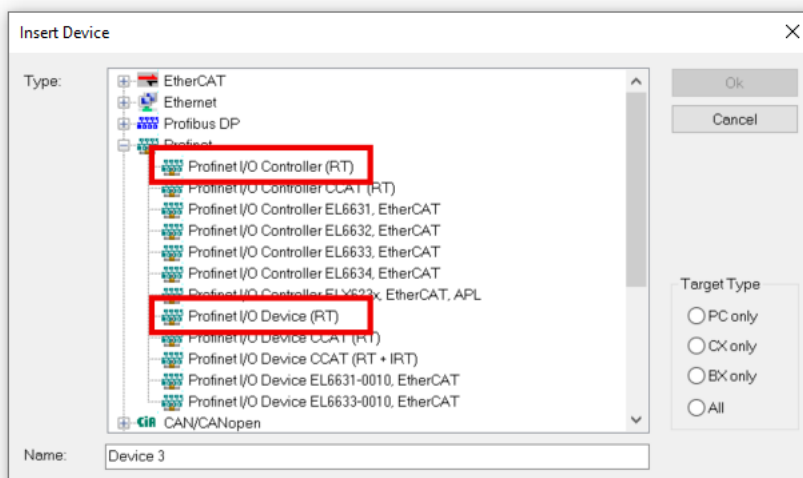
This is because all ports of the CU2508-0022 have the same MAC address. PROFINET does not allow two identical MAC addresses in one network segment.

A port can be configured either as a PROFINET controller or as a PROFINET device:

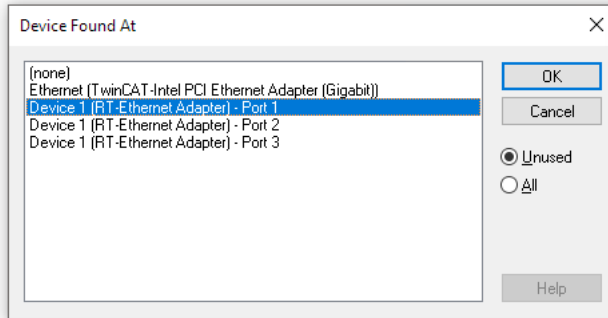
1. Right-click on “Devices” under “I/O” in the Solution Explorer and select “Add New Item...”.



2. In the window that appears, select either the type “Profinet I/O Controller (RT)” or “Profinet I/O Device (RT)” and confirm with OK.



3. A list of the available ports of the IPC and the CU2508-0022 appears.



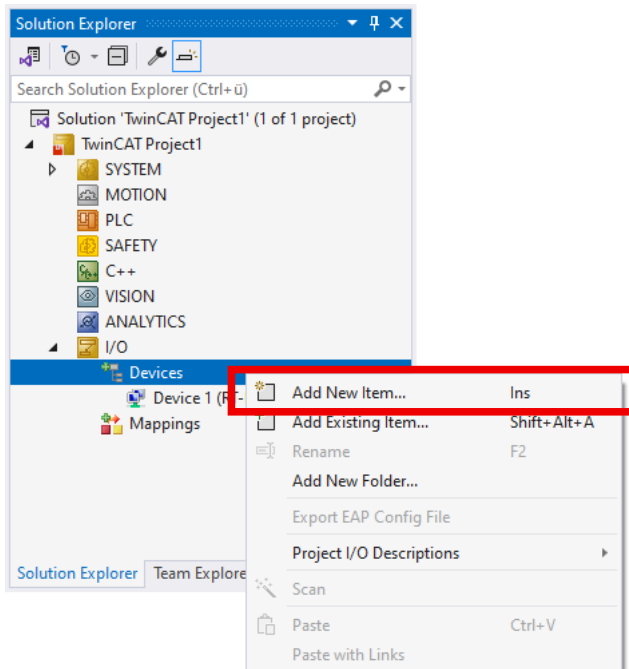
If no list appears, set the port subsequently in the “Adapter” tab of the device you have just created, see chapter [Changing the port of a device \[► 50\]](#). Skip the following step.

4. Select the desired port of the CU2508-0022 in the list.
X01 is port 1, X02 is port 2, etc.
Please note that the selected port must not be configured as a TCP/IP port.
You can also select “(none)” and/or change the port afterwards. See chapter [Changing the port of a device \[► 50\]](#).
5. Configure PROFINET communication via the device you have just created.

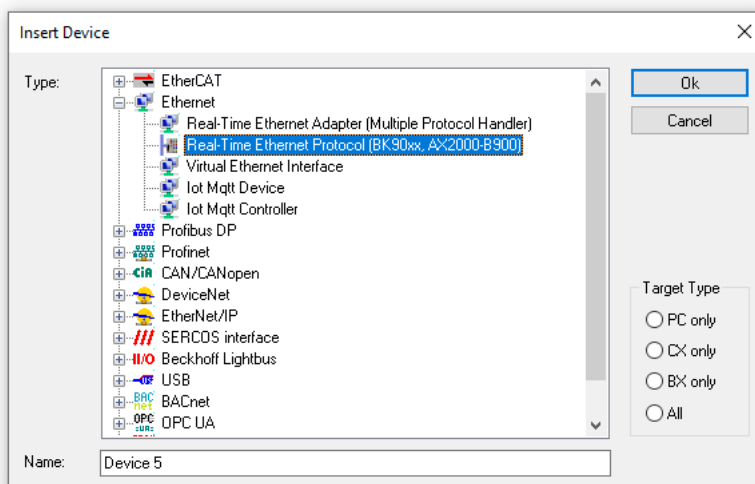
5.3.6 Configuration of a port for real-time Ethernet communication with a BK90xx

This chapter describes the configuration of a port of the CU2508-0022 for the connection of an Ethernet bus coupler of the BK9xxx series.

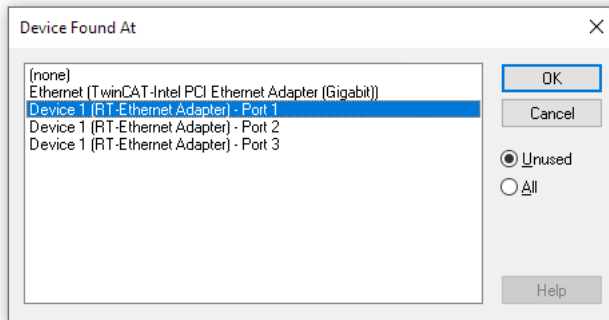
1. Right-click on “Devices” under “I/O” in the Solution Explorer and select “Add New Item...”.



2. In the window that appears, select the type “Real-Time Ethernet Protocol (BK90xx, AX2000-B900)”.



⇒ A list of the available ports of the IPC and the CU2508-0022 appears.



If no list appears, set the port subsequently in the “Adapter” tab of the “RT-Ethernet Protocol” device you have just created, see chapter [Changing the port of a device \[► 50\]](#). Skip the following step.

3. Select the desired port of the CU2508-0022 in the list.

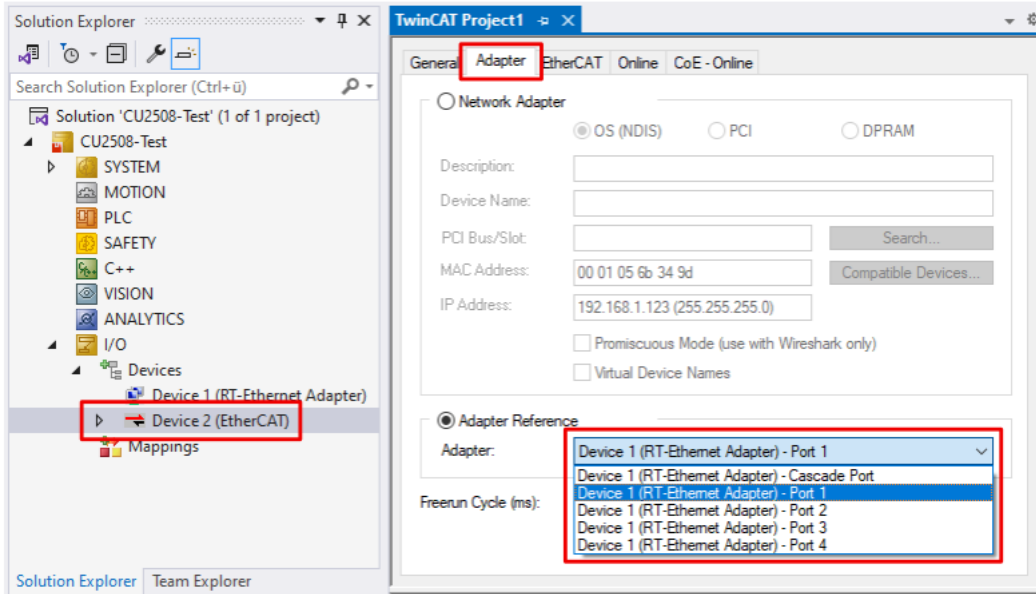
X01 is port 1, X02 is port 2, etc.

Please note that the selected port must not be configured as a TCP/IP port.

You can also select “(none)” and/or change the port afterwards. See chapter [Changing the port of a device \[► 50\]](#).

5.3.7 Changing the port of a device

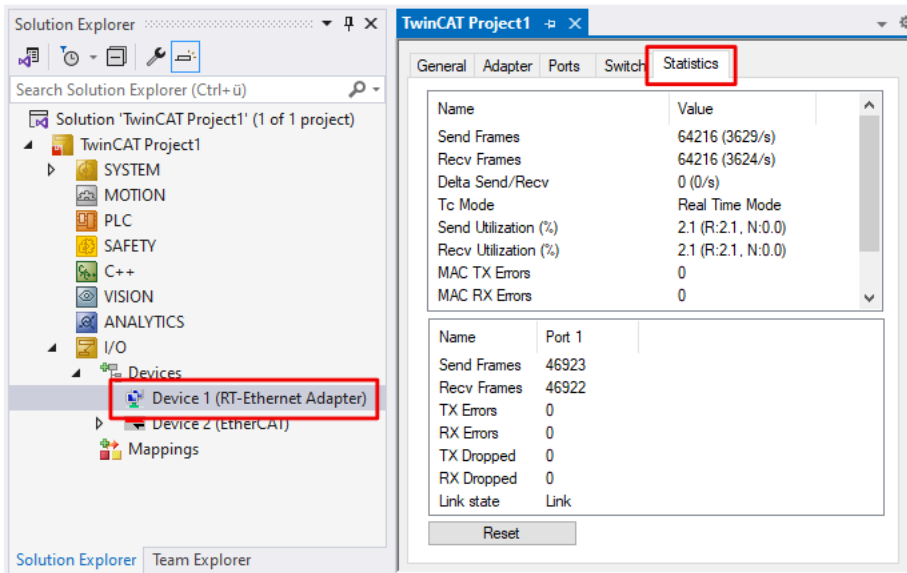
1. Click on the device in the Solution Explorer (e.g. "EtherCAT").
2. Select the "Adapter" tab.
3. Select the desired port under "Adapter Reference".



6 Diagnostics

6.1 Frame statistics

In the “Statistics” tab, you will find frame statistics that you can use for diagnostic purposes.

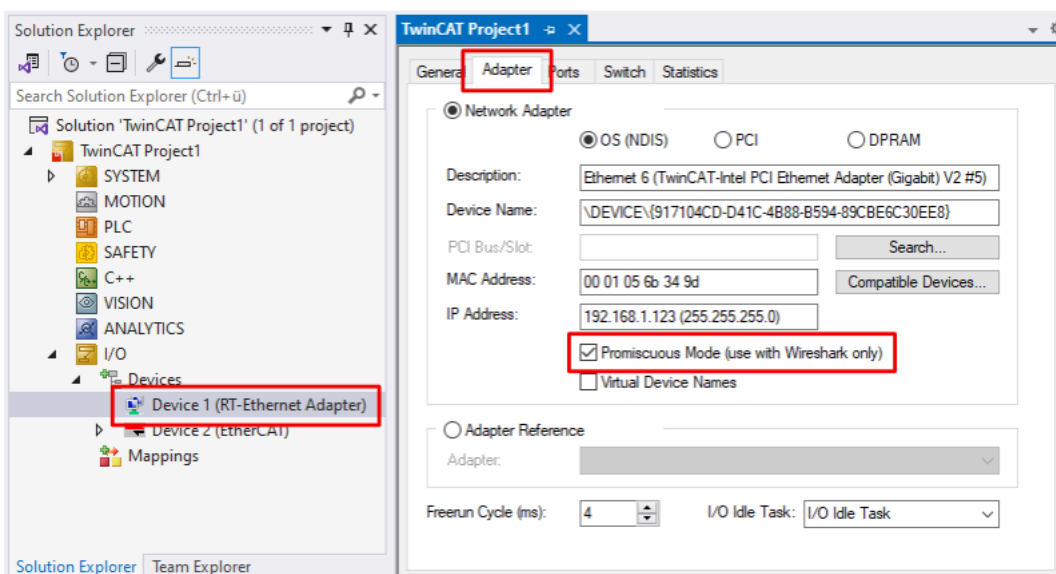


Name	Explanation
Send Utilization (%)	Utilization of the uplink connection in the transmit direction. R: real-time data, N: non-real-time data
Recv Utilization (%)	Utilization of the uplink connection in the receive direction. R: real-time data, N: non-real-time data

6.2 Netmon and Wireshark®

You can evaluate the data traffic between the IPC and CU2508-0022 using Netmon or Wireshark®. Wireshark® supports the ESL protocol since version 1.4.2.

To do this, check the “Promiscuous Mode” box in the “Adapter” tab. The Ethernet frames are then copied to the Windows NDIS layer.



7 Appendix

7.1 ESL Protocol

The EtherCAT Switch Link protocol (ESL) from Beckhoff is a simple extension for the control of EtherCAT infrastructure components. It is currently used (as of 2010) for the operation of the ET2000 Industrial Ethernet Multichannel Probe and the CU2508.

The ESL data consist of 16 bytes of control data and information, which are added as a prefix (in front) or as a postfix (to the end) of an existing Ethernet data frame. The check sum (CRC) is adapted accordingly.

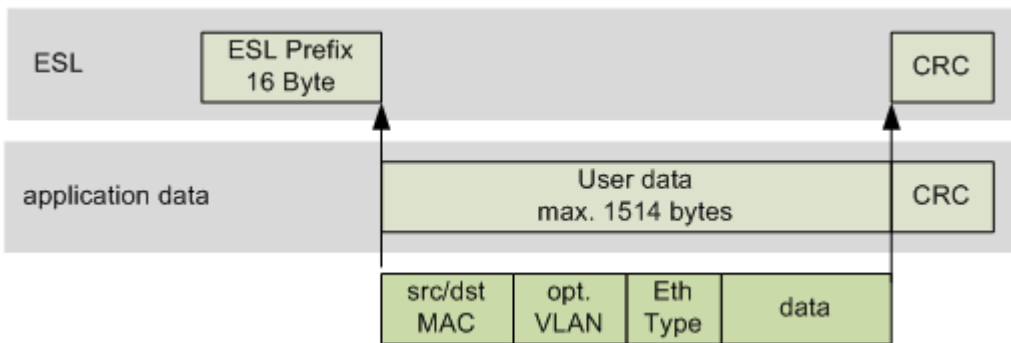


Fig. 6: CU2508 ESL prefix

The ESL data are structured as follows:

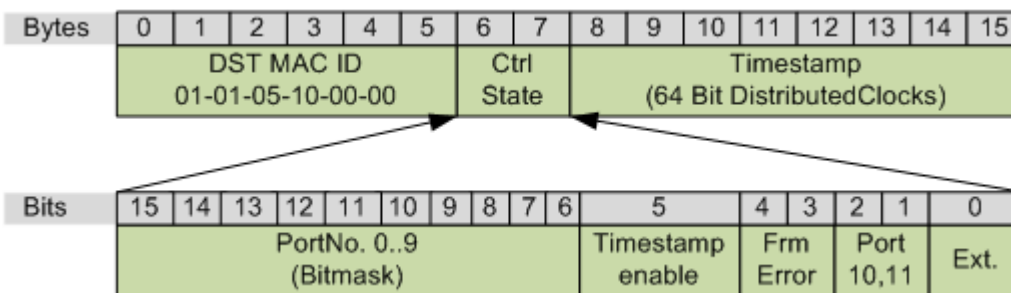


Fig. 7: ESL structure

Ethernet network monitors

The freely available network monitor Wireshark has contained an interpreter for the ESL protocol since the version 1.4.2.

7.2 General operating conditions

Protection rating according to IP code

The degrees of protection are defined and divided into different classes in the IEC 60529 standard (EN 60529). Degrees of protection are designated by the letters "IP" and two numerals: **IPxy**

- Numeral x: Dust protection and contact protection
- Numeral y: Protection against water

x	Meaning
0	Not protected
1	Protected against access to dangerous parts with the back of the hand. Protected against solid foreign objects of 50 mm Ø
2	Protected against access to dangerous parts with a finger. Protected against solid foreign objects of 12.5 mm Ø
3	Protected against access to dangerous parts with a tool. Protected against solid foreign objects of 2.5 mm Ø
4	Protected against access to dangerous parts with a wire. Protected against solid foreign objects of 1 mm Ø
5	Protection against access to dangerous parts with a wire. Dust-protected. Ingress of dust is not prevented completely, although the quantity of dust able to penetrate is limited to such an extent that the proper function of the device and safety are not impaired
6	Protection against access to dangerous parts with a wire. Dust-tight. No ingress of dust

y	Meaning
0	Not protected
1	Protection against vertically falling water drops
2	Protection against vertically falling water drops when enclosure tilted up to 15°
3	Protection against spraying water. Water sprayed at an angle of up to 60° on either side of the vertical shall have no harmful effects
4	Protection against splashing water. Water splashed against the enclosure from any direction shall have no harmful effects
5	Protection against water jets.
6	Protection against powerful water jets.
7	Protected against the effects of temporary immersion in water. Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is immersed in water at a depth of 1 m for 30 minutes

Chemical resistance

The resistance refers to the housing of the IP67 modules and the metal parts used. In the table below you will find some typical resistances.

Type	Resistance
Water vapor	unstable at temperatures > 100 °C
Sodium hydroxide solution (ph value > 12)	stable at room temperature unstable > 40 °C
Acetic acid	unstable
Argon (technically pure)	stable

Key

- resistant: Lifetime several months
- non inherently resistant: Lifetime several weeks
- not resistant: Lifetime several hours resp. early decomposition

7.3 Accessories

Mounting

Ordering information	Description	Link
ZS5300-0011	Mounting rail	Website

Labeling material, protective caps

Ordering information	Description
ZS5000-0010	Protective cap for M8 sockets, IP67 (50 pieces)
ZS5100-0000	Inscription labels, unprinted, 4 strips of 10
ZS5000-xxxx	Printed inscription labels on enquiry

Cables

A complete overview of pre-assembled cables can be found on the Beckhoff website: [Link](#).

Ordering information	Description	Link
ZK1090-6xxx-xxxx	EtherCAT cable, green, with D-coded M12 connector	Website
ZK1096-8xxx-xxxx	Ethernet/EtherCAT cable with X-coded M12 connector	Website
ZK2020-3xxx-xxxx	Power cable M8, 4-pin	Website

Tools

Ordering information	Description
ZB8801-0000	Torque wrench for plugs, 0.4... 1.0 Nm
ZB8801-0001	Torque cable key for M8 / wrench size 9 for ZB8801-0000



Further accessories

Further accessories can be found in the price list for fieldbus components from Beckhoff and online at <https://www.beckhoff.com>.

7.4 Version identification of EtherCAT devices

7.4.1 General notes on marking

Designation

A Beckhoff EtherCAT device has a 14-digit designation, made up of

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal 12 mm, non-pluggable connection level	3314 4-channel thermocouple terminal	0000 basic type	0016
ES3602-0010-0017	ES terminal 12 mm, pluggable connection level	3602 2-channel voltage measurement	0010 high-precision version	0017
CU2008-0000-0000	CU device	2008 8-port fast ethernet switch	0000 basic type	0000

Notes

- The elements mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
 - family key (EL, EP, CU, ES, KL, CX, etc.)
 - type (3314)
 - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
 In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
 Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
 From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. “EL2872 with revision 0022 and serial number 01200815”.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

7.4.2 Version identification of IP67 modules

The serial number/ data code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules of a batch.

Structure of the serial number: **KK YY FF HH**

KK - week of production (CW, calendar week)

YY - year of production

FF - firmware version

HH - hardware version

Example with serial number 12 06 3A 02:

12 - production week 12

06 - production year 2006

3A - firmware version 3A

02 - hardware version 02

Exceptions can occur in the **IP67 area**, where the following syntax can be used (see respective device documentation):

Syntax: D ww yy x y z u

D - prefix designation

ww - calendar week

yy - year

x - firmware version of the bus PCB

y - hardware version of the bus PCB

z - firmware version of the I/O PCB

u - hardware version of the I/O PCB

Example: D.22081501 calendar week 22 of the year 2008 firmware version of bus PCB: 1 hardware version of bus PCB: 5 firmware version of I/O PCB: 0 (no firmware necessary for this PCB) hardware version of I/O PCB: 1

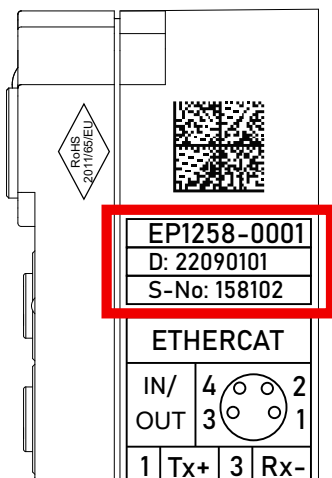


Fig. 8: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

7.4.3 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.

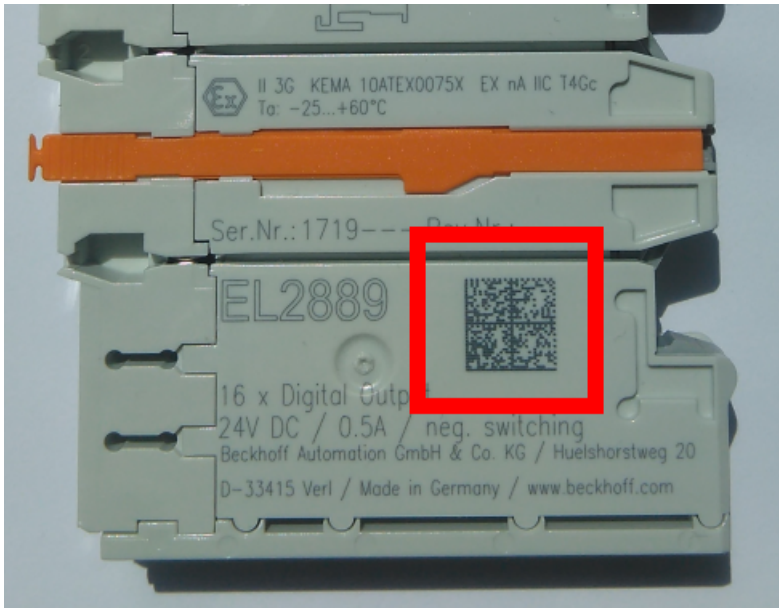


Fig. 9: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	Beckhoff order number	1P	8	1P 072222
2	Beckhoff Traceability Number (BTN)	Unique serial number, see note below	SBTN	12	S BTNk4p562d7
3	Article description	Beckhoff article description, e.g. EL1008	1K	32	1K EL1809
4	Quantity	Quantity in packaging unit, e.g. 1, 10, etc.	Q	6	Q 1
5	Batch number	Optional: Year and week of production	2P	14	2P 401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S 678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30P F971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:



Fig. 10: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this documentation.

7.4.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

The Beckhoff Identification Code (BIC) is applied to the outside of Beckhoff products in a visible place. If possible, it should also be electronically readable.

The interface that the product can be electronically addressed by is crucial for the electronic readout.

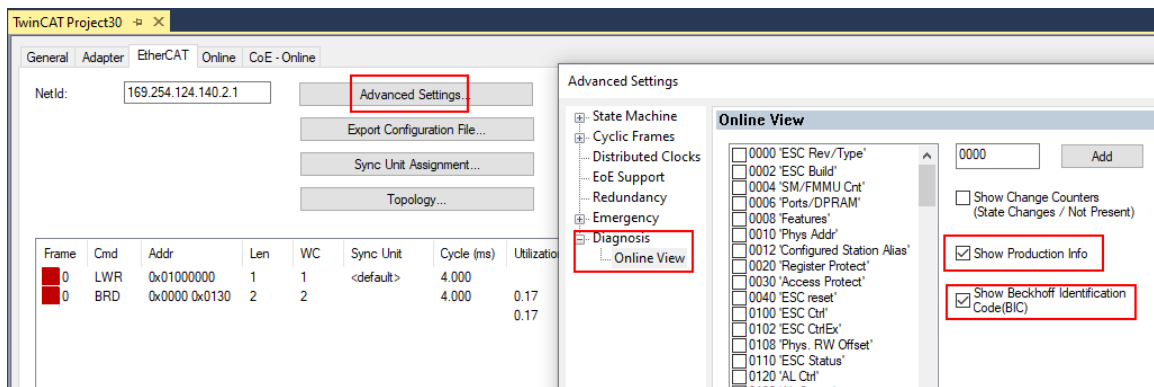
EtherCAT devices (IP20, IP67)

All Beckhoff EtherCAT devices have an ESI-EEPROM which contains the EtherCAT identity with the revision number. The EtherCAT slave information, also colloquially known as the ESI/XML configuration file for the EtherCAT master, is stored in it. See the corresponding chapter in the EtherCAT system manual ([Link](#)) for the relationships.

Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

The user can electronically access the eBIC (if present) as follows:

- With all EtherCAT devices, the EtherCAT master (TwinCAT) can read the eBIC from the ESI-EEPROM
 - From TwinCAT 3.1 build 4024.11, the eBIC can be displayed in the online view.
 - To do this, check the "Show Beckhoff Identification Code (BIC)" checkbox under EtherCAT → Advanced Settings → Diagnostics:



- The BTN and its contents are then displayed:

No	Addr	Name	State	CRC	Fw	Hw	Production Data	ItemNo	BTN	Description	Quantity	BatchNo	SerialNo
1	1001	Term 1 (EK1100)	OP	0,0	0	0	---						
2	1002	Term 2 (EL1018)	OP	0,0	0	0	2020 KW36 Fr	072222	k4p562d7	EL1809	1		678294
3	1003	Term 3 (EL3204)	OP	0,0	7	6	2012 KW24 Sa						
4	1004	Term 4 (EL2004)	OP	0,0	0	0	---	072223	k4p562d7	EL2004	1		678295
5	1005	Term 5 (EL1008)	OP	0,0	0	0	---						
6	1006	Term 6 (EL2008)	OP	0,0	0	12	2014 KW14 Mo						
7	1007	Term 7 (EK1110)	OP	0	1	8	2012 KW25 Mo						

- Note: As shown in the figure, the production data HW version, FW version, and production date, which have been programmed since 2012, can also be displayed with "Show production info".
- Access from the PLC: From TwinCAT 3.1. build 4024.24, the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0.
- EtherCAT devices with a CoE directory may also have the object 0x10E2:01 to display their own eBIC, which can also be easily accessed by the PLC:

- The device must be in PREOP/SAFEOP/OP for access:

Index	Name	Flags	Value
1000	Device type	RO	0x015E1389 (22942601)
1008	Device name	RO	ELM3704-0000
1009	Hardware version	RO	00
100A	Software version	RO	01
100B	Bootloader version	RO	J0.1.27.0
1011:0	Restore default parameters	RO	> 1 <
1018:0	Identity	RO	> 4 <
10E2:0	Manufacturer-specific Identification C...	RO	> 1 <
10E2:01	SubIndex 001	RO	1P158442SBTN0008jckp1KELM3704 Q1 2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <
10F3:0	Diagnosis History	RO	> 21 <
10F8	Actual Time Stamp	RO	0x170bfb277e

- The object 0x10E2 will be preferentially introduced into stock products in the course of necessary firmware revision.
- From TwinCAT 3.1. build 4024.24, the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC are available in the *Tc2_EtherCAT* library from v3.3.19.0
- The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Uilities* as of TwinCAT 3.1 build 4024.24
 - *F_SplitBIC*: The function splits the Beckhoff Identification Code (BIC) *sBICValue* into its components using known identifiers and returns the recognized substrings in the *ST_SplittedBIC* structure as a return value
 - *BIC_TO_BTN*: The function extracts the BTN from the BIC and returns it as a return value
- Note: If there is further electronic processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.
- Technical background
The new BIC information is written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50..200 bytes of memory.
- Special cases
 - If multiple hierarchically arranged ESCs are installed in a device, only the top-level ESC carries the eBIC information.
 - If multiple non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC information.
 - If the device consists of several sub-devices which each have their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

7.5 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Support

The Beckhoff Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline: +49 5246 963 157
e-mail: support@beckhoff.com
web: www.beckhoff.com/support

Service

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- spare parts service
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