BECKHOFF New Automation Technology

Documentation | EN

EP7402-0057

2-channel motor controller box for roller conveyor systems

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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.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

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.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

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.

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.1	• Hardware change at supply voltage output X60 • Accessories added
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.

Documentation version	Firmware	Hardware
1.1	01	03
1.0	01	02

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	Example with D no. 29 10 02 01:
WW - week of production (calendar week) YY - year of production FF - firmware version HH - hardware version	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 [▶ 49].

2 Product overview

2.1 Introduction

Fig. 1: EP7402-0057

2-channel motor controller box for roller conveyor systems

The EP7402-0057 EtherCAT Box offers two outputs with integrated controller for the direct connection of 24 V DC conveyor roller motors or other BLDC motors with max. 3.5 A. Eight additional digital inputs/outputs enable connection of e.g. photoelectric switches and communication between the box modules in operation without PLC.

The EP7402-0057 takes over the complete control of a roller motor independently of the manufacturer of conveyor or motor. Maximum rated current, acceleration or deceleration ramps and various other parameters can be configured and allow for a wide range of adaptations to different applications. The control of the motors is sensorless.

The EtherCAT Box with IP 67 protection rating measures only 174 mm x 60 mm x 36.5 mm and can be easily mounted in standard C-channel or L-brackets on the conveyor frame. It requires no additional protective covering. Power supply and EtherCAT communication are realized via a B23 ENP connector with a current carrying capacity of 28 A/45 °C. In conveyor operation the EP7402-0057 can also be operated without PLC and provides functions such as ZPA (Zero Pressure Accumulation), single or block discharge. Further EtherCAT devices such as digital and analog I/Os, barcode readers or safety devices can be connected to the additional EtherCAT junction.

Quick links

Technical data [▶ 9]
Process image [▶ 11]
Dimensions [▶ 15]
Connections [▶ 17]
Quick start [▶ 24]

2.2 Technical data

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

Technical data	EP7402-0057
Fieldbus	
Fieldbus	EtherCAT
Electrical isolation	500 V (fieldbus / IO)
Connectors	Input and forwarding: B23 hybrid connectors Junction: M8 socket, green
Distributed Clocks	yes
Supply voltages	
Connectors	B23 hybrid connectors
Control voltage U_S	
Nominal voltage	24 V_{DC} (-15 % / +20 %)
Sum current	max. 28 A at 45 °C [1]
Current consumption from U_S	150 mA at 24 V_{DC} + Current consumption of loads at digital outputs + Current consumption of devices connected to supply voltage output X60
Peripheral voltage U_P	
Nominal voltage	24 V_{DC} (-15 % / +20 %)
Sum current	max. 28 A at 45 °C [1]
Consumers	• Motors • Motor brake
Undervoltage detection threshold	18 V_{DC}
Overvoltage detection threshold	30 V_{DC}
Motor output stage	
Number of channels	2
Motor type	3-phase BLDC roller motors
Encoder	Encoder not required
Connectors	2x M8 socket, b-coded
Motor voltage	24 V_{DC} from the peripheral voltage U_P
Continuous current per channel	max. 3.5 A
Peak current per channel	max. 5 A (approx. 1 s)
Rotary field frequency	max. 72000 °/s = 12000 rpm [2]
Motor brake (digital output)	
Rated voltage	24 V_{DC} from peripheral voltage U_P
Output current	max. 1 A

[1] Sum current of consumers and power forwarding. This value corresponds to the current carrying capacity of the connectors for the supply voltages.

[2] Do not confuse the rotary field frequency with motor speed or roller speed.

Technical data	EP7402-0057
Digital in-/outputs	
Number of inputs / outputs	8
Connectors	4x M8 socket
Input specification	
Characteristics	Type 3 according to EN 61131-2, compatible with type 1
Input filter	10 µs
Output specification	
Nominal output voltage	24 V_{DC} (-15 % / +20 %) from control voltage U_S
Output current	max. 0.5 A per channel, short-circuit proof
Supply voltage output: U_{S1}	24 V_{DC} from control voltage U_S max. 0.5 A, short-circuit protected
Mechanics	
Weight	750 g
Installation position	variable
Environmental conditions	
Ambient temperature during operation	-25 .. +60 °C
Ambient temperature during storage	-40 .. +85 °C
Vibration / shock resistance	conforms to EN 600068-2-6 / EN600068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Approvals and conformity	
Approvals	CE, UL in preparation

2.3 Process image

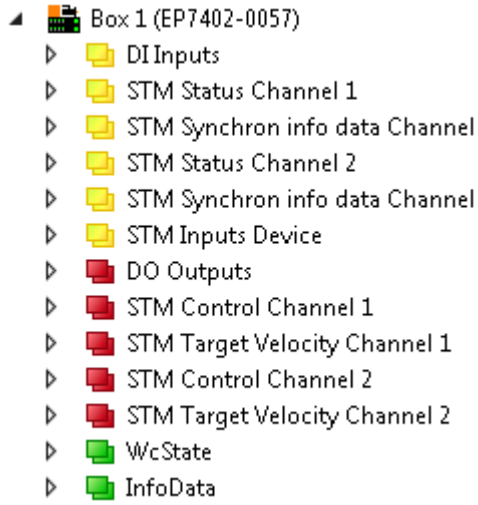
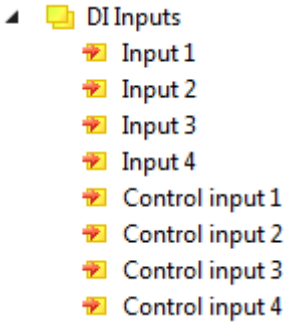


Fig. 2: Process image

In the following the letter *n* serves as a placeholder for the channel number.

Screenshots that display process data objects of channel 1 are representative for both channels. The process data objects of channel 1 and 2 have the same structure.

DI Inputs

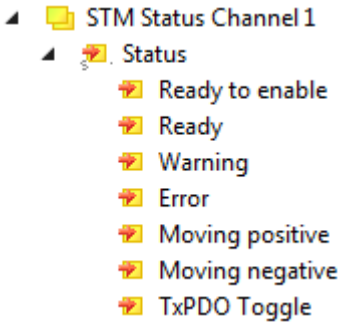


The input variables represent the logic level of the digital in/outputs.

Make sure that the value of the corresponding output variable [▶ 13] is set to 0 (default) if you want to use a digital in/output as an input.

Assignment of connectors to process data [▶ 14]

STM Status Channel *n*



The input variables “Status” contain the status bits of the motor channels.

Ready to enable

- TRUE: all requirements are met for enabling the motor.
- FALSE: The motor can not be enabled by the output variable “enable” due to an error [▶ 36].

Ready

- TRUE: the motor is energized.

Warning

- TRUE: The motor channel is in a borderline condition.

Error

- TRUE: The motor was switched off due to an error. [▶ 36]

Moving positive

- TRUE: The motor velocity is above zero.

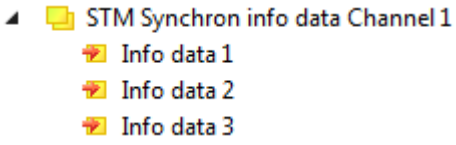
Moving negative

- TRUE: The motor velocity is below zero.

TxPDO Toggle

This bit is inverted on each update of the status bits.

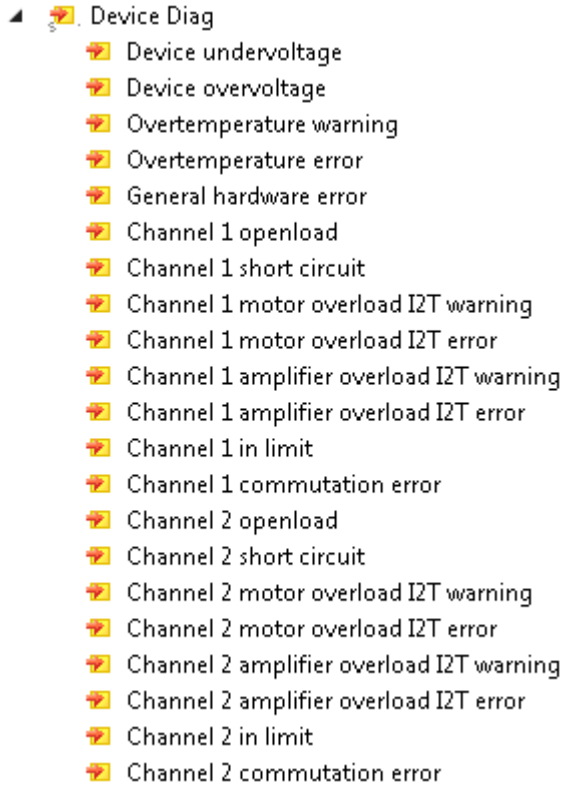
STM Synchron info data Channel *n*



The input variables “Info data *x*” contain measured values. You can choose which measured values are mapped to these variables in the CoE directory:

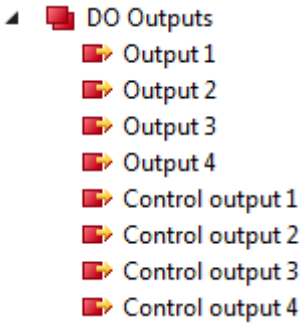
- Select the measured values for Channel 1 in CoE object 8022 [▶ 42].
- Select the measured values for Channel 2 in CoE object 8032 [▶ 42].

STM Inputs Device



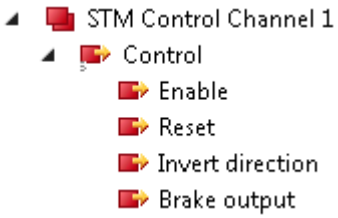
The input variable „STM Inputs Device“ contains the Diagnosis bits [▶ 37] that you can evaluate to isolate the reasons for warnings and errors.

DO Outputs



Output values for the digital in-/outputs.

STM Control Channel *n*



Enable

This bit activates the motor channel. It is without effect if the variable Ready to enable [▶ 12] is FALSE.

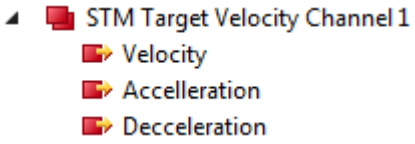
Reset

Apply a rising egde to this bit to acknowledge an error.

Invert direction

If this bit is set, the target velocity [▶ 14] is multiplied with "-1" to change the direction.

STM Target Velocity Channel *n*



Velocity

This is the target velocity for the velocity controller. However, any value below parameter 80n0:09 start velocity [▶ 41] is interpreted as zero.

Acceleration

This value specifies the maximum positive change in velocity. If the value is zero, acceleration is not limited.

Deceleration

This value specifies the maximum negative change in velocity. If the value is zero, deceleration is not limited.

2.3.1 Assignment of connectors to process data

Connector			Process data	
Name	**Pin**	**Function**	**Input**	**Output**
X01	2	Digital in-/output	DI Inputs Input 2	DO Outputs Output 2
	4		DI Inputs Input 1	DO Outputs Output 1
X02	2	Digital in-/output	DI Inputs Control input 2	DO Outputs Control output 2
	4		DI Inputs Control input 1	DO Outputs Control input 1
X05	2	Digital in-/output	DI Inputs Input 4	DO Outputs Output 4
	4		DI Inputs Input 3	DO Outputs Output 3
X06	2	Digital in-/output	DI Inputs Control input 4	DO Outputs Control output 4
	4		DI Inputs Control input 3	DO Outputs Control input 3
X20		Motor	STM Status Channel 1 STM Synchron info data Channel 1	STM Control Channel 1 STM Target Velocity Channel 1
X21		Motor	STM Status Channel 2 STM Synchron info data Channel 2	STM Control Channel 2 STM Target Velocity Channel 2

3 Mounting and cabling

3.1 Mounting

3.1.1 Dimensions

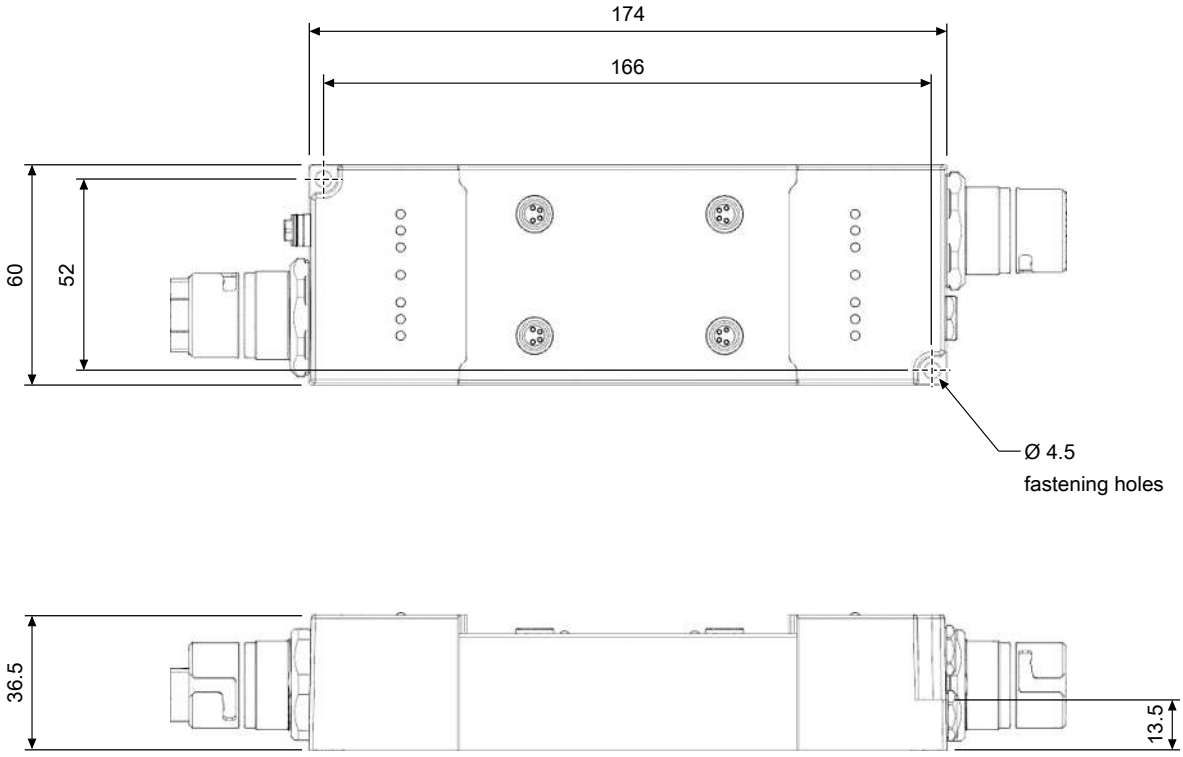


Fig. 3: Dimensions

All dimensions are given in millimeters.

Housing features

Housing material	PA66 (polyamide)
Sealing compound	polyurethane
Mounting	two fastening holes Ø 4.5 mm for M4
Metal parts	brass, nickel-plated
Contacts	CuZn, gold-plated
Power feed through	max. 30 A
Installation position	variable
Protection class	IP65, IP66, IP67 (conforms to EN 60529) when screwed together
Dimensions (H x W x D)	approx. 174 x 60 x 36.5 mm (without connectors)

3.1.2 Fixing

NOTE

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 on the fastening holes in the corners of the module. The fastening holes have no thread.

3.1.3 Functional earth (FE)

Earth the FE core of the supply line connected to X70 [▶ 18].

The FE potential is passed through to the FE pin of X71. So if multiple devices are connected in series, only the FE core of the first supply line needs to be earthed.

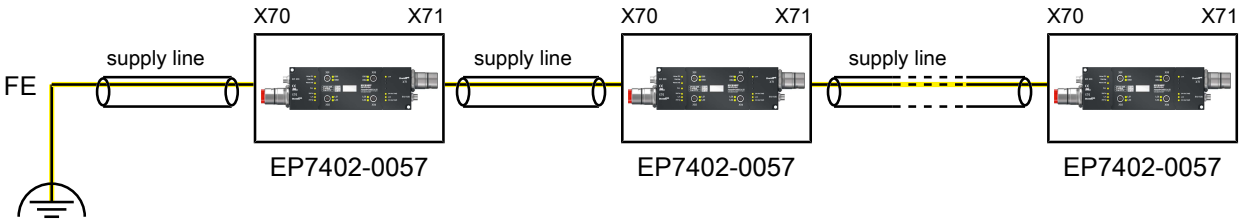


Fig. 4: Functional earth connection example

You can tap the FE potential at the housings of X70 and X71: use the nuts of X70 and X71 to screw on a sheet metal. So you can earth the machine part where the box is mounted.

3.2 Cabling

3.2.1 Connector overview

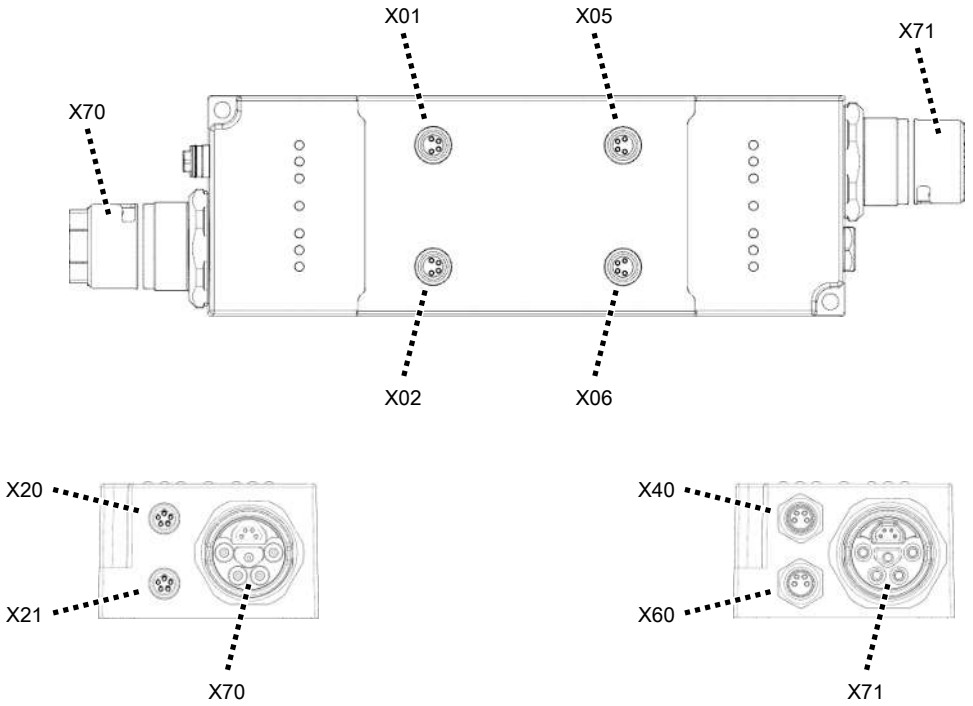


Fig. 5: EP7402-0057 Connectors

Name	Function	Connector type	Tightening torque
X01	Digital input/outputs [▶ 23]	M8 socket	0.4 Nm
X02		M8 socket	0.4 Nm
X05		M8 socket	0.4 Nm
X06		M8 socket	0.4 Nm
X20	Motor connection [▶ 22]	M8 socket, b-coded	0.4 Nm
X21		M8 socket, b-coded	0.4 Nm
X40	EtherCAT junction [▶ 20]	M8 socket	0.4 Nm
X60	Supply voltage output [▶ 21]	M8 socket	0.4 Nm
X70	Supply voltage and EtherCAT input [▶ 18]	B23 ENP	-
X71	Supply voltage and EtherCAT input [▶ 18]	B23 ENP	-

Suitable connection cables can be found in the chapter Accessories [▶ 48].

3.2.2 Supply voltages and EtherCAT

The EtherCAT Box is supplied with two supply voltages. The supply voltages are electrically isolated in the EtherCAT Box.

- Control voltage U_S
- Peripheral voltage U_P

3.2.2.1 Input and forwarding

Multiple devices can be connected in series by forwarding the supply voltages and EtherCAT via X71.

NOTE

U_P is not protected against reverse polarity

Defect possible through polarity reversal.

- Make sure that the supply voltage U_P is connected correctly.

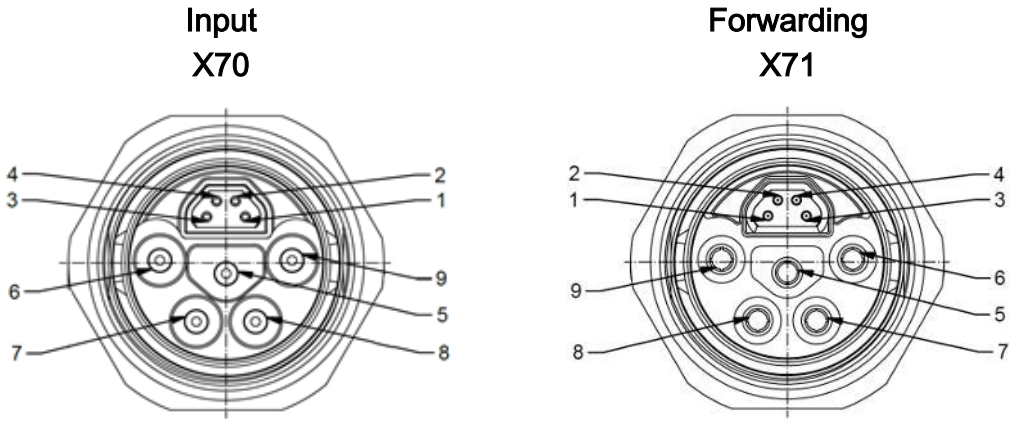


Fig. 6: B23 connectors

Pin	Core color [1]	Function
1	yellow	EtherCAT Tx +
2	white	EtherCAT Rx +
3	blue	EtherCAT Rx -
4	orange	EtherCAT Tx -
5	green/yellow	FE
6	grey	GND_P
7	black	U_P: 24 V_{DC}
8	blue	GND_S
9	brown	U_S: 24 V_{DC}

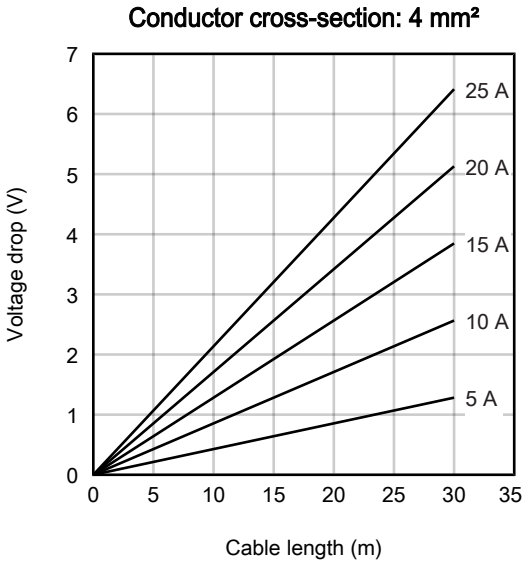
[1] The wire colors apply to cables of the type ZK7314-3xxx-Axxx. See chapter Accessories [▶ 48].

3.2.2.2 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



3.2.2.3 Output

NOTE

Risk of confusion

M8 connectors for supply voltages have the same design as M8 connectors for EtherCAT. Observe the color coding of the connectors in order to avoid incorrect insertion:

black: Supply voltages
green: EtherCAT

Fig. 7: M8 socket

EtherCAT	M8 connector	Core colors		
Signal	**Contact**	**ZB9010, ZB9020, ZB9030, ZB9032, ZK1090-6292, ZK1090-3xxx-xxxx**	**ZB9031 and old versions of ZB9030, ZB9032, ZK1090-3xxx-xxxx**	**TIA-568B**
Tx +	1	yellow[1)]	orange/white	white/orange
Tx -	4	orange[1)]	orange	orange
Rx +	2	white[1)]	blue/white	white/green
Rx -	3	blue[1)]	blue	green
Shield	Housing	Shield	Shield	Shield

[1)] Core colors according to EN 61918

Adaptation of core colors for cables ZB9030, ZB9032 and ZK1090-3xxxx-xxxx

For standardization, the core colors of the ZB9030, ZB9032 and ZK1090-3xxx-xxxx cables have been changed to the EN61918 core colors: yellow, orange, white, blue. So there are different color codes in circulation. The electrical properties of the cables have been retained when the core colors were changed.

Suitable connection cables can be found in the chapter Accessories [▶ 48].

3.2.2.4 Supply voltage output X60

The supply voltage output is intended for EtherCAT Box modules that are connected to EtherCAT junction X40 [▶ 20].

⚠ CAUTION

The outgoing peripheral voltage Up‘ is *not* switched off when the incoming peripheral voltage U_P is switched off. (from hardware version 03)

Actuators at the supply voltage output remain active.

- To safely switch off actuators at the supply voltage output, use TwinSAFE components.

NOTE

The outgoing supply voltages are *not* electrically isolated. (from hardware version 03)

The analog specifications of EtherCAT Box modules with analog inputs or outputs may not be met under certain circumstances.

Fig. 8: M8 socket

Contact	Symbol	Description	Wire color
1	24V Us'	Control voltage	Brown
2	24V Up'	Peripheral voltage [1]	White
3	GND	Common ground potential for both output voltages [2]	Blue
4	GND		Black

[1] Up‘ is branched off from different supply voltages, depending on the hardware version:

- From hardware version 03:
  Up‘ is branched off from the incoming control voltage U_S at X70 [▶ 18].
- Up to and including hardware version 02:
  Up‘ is branched off from the incoming peripheral voltage U_P at X70 [▶ 18].

[2] Up to and including hardware version 02: GND_S is connected to pin 3, GND_P to pin 4. Starting with hardware version 03, both pins are connected to the same ground potential GND_S.

Suitable connection cables can be found in the chapter Accessories [▶ 48].

3.2.3 Motors

X20 and X21

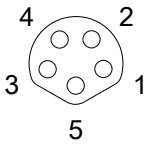


Fig. 9: M8 socket, b-coded

Pin	Wire color	Function
1	brown	Motor phase U
2	white	Motor phase V
3	blue	Brake output
4	black	Motor phase W
5	grey	GND_P

Connection example

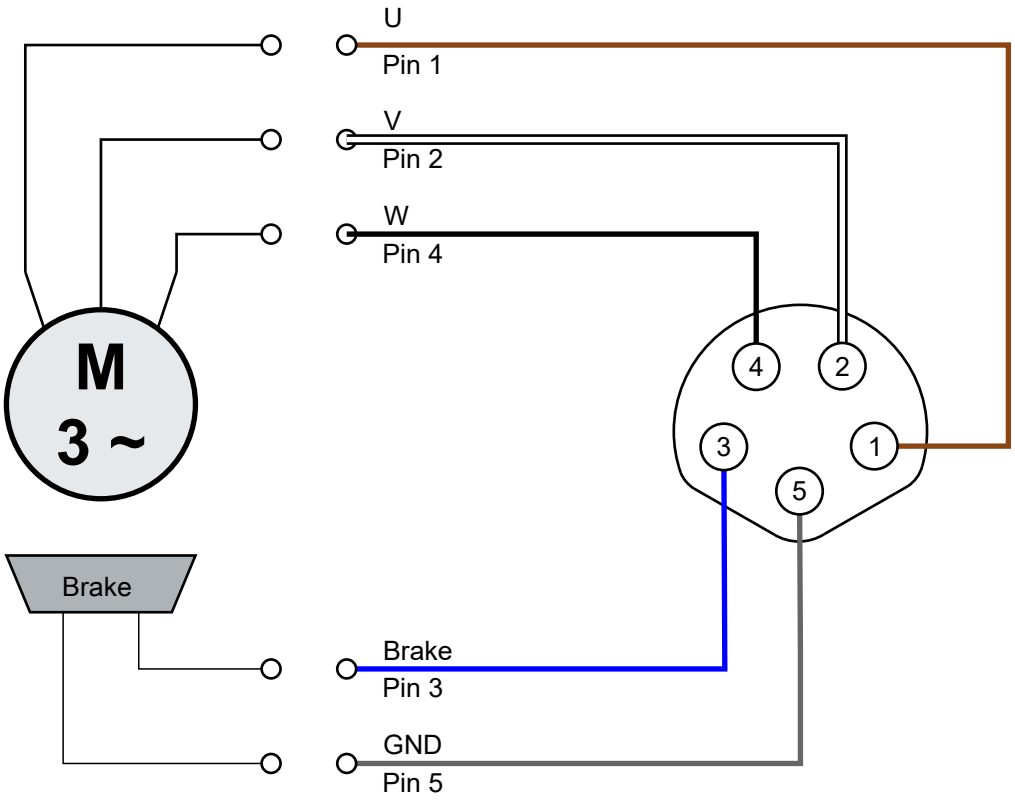


Fig. 10: Motor connection example

3.2.4 Digital input/outputs

M8 sockets X01, X02, X05, X06

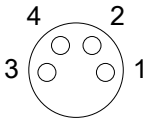


Fig. 11: M8 socket

Pin	Core color [1]	Function
1	brown	U_{S1}: 24 V_{DC} output
2	white	Input/output B [2]
3	blue	GND_S
4	black	Input/output A [2]

[1] The core colors apply to cables of the type ZK2000-3xxx. See chapter Accessories [▶ 48].

[2] Assignment to process data [▶ 14]

3.2.4.1 Connection examples

Digital sensor, 2-wire connection to channel A

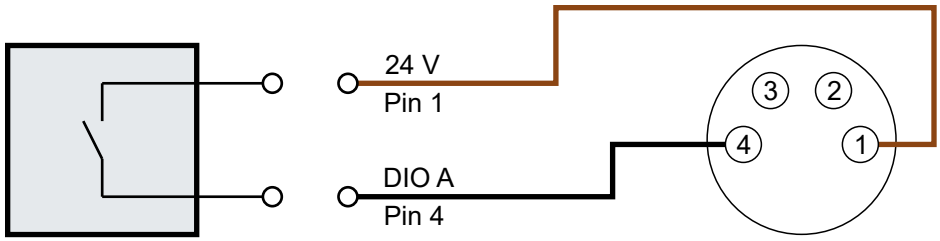


Fig. 12: Digital sensor, 2-wire connection

Digital sensor, 3-wire connection to channel A

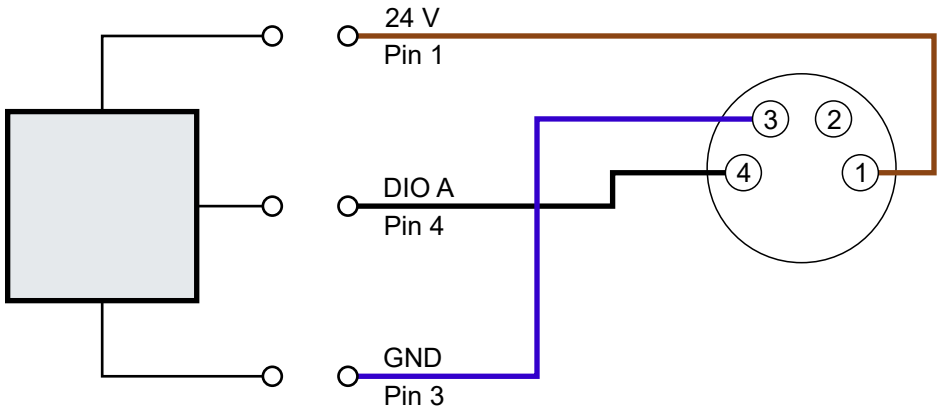


Fig. 13: Digital sensor, 3-wire connection

4 Commissioning

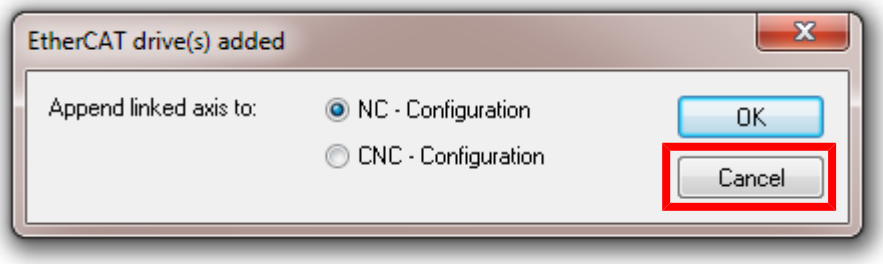
4.1 Quick start

4.1.1 Step 1: Hardware Setup

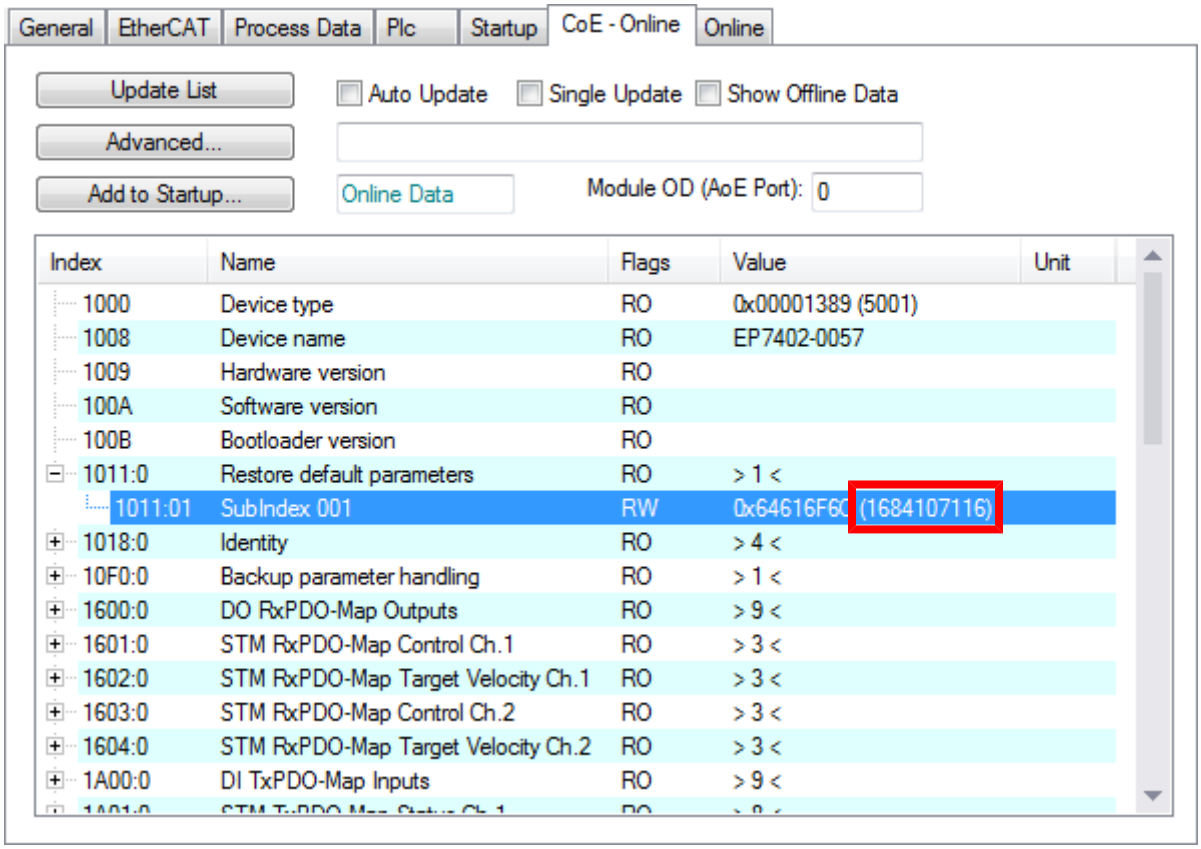
1. Connect a roller motor to socket X20 [▶ 22].
2. Connect the supply voltages and EtherCAT to socket X70 [▶ 18].
   ⇨ The LEDs next to X70 indicate whether both supply voltages are present:
   "24 V U_S"
   "24 V U_P"
   ⇨ The "L/A" LED next to X70 lights up or flashes, depending on the state of the EtherCAT Master.

4.1.2 Step 2: TwinCAT configuration

1. Integrate EP7402-0057 into a TwinCAT project. (Quick start guide)
   ⇨ A dialog box appears:



2. Click "Cancel" to close the dialog box.
3. Reset EP7402 to the factory settings:
   Change the value of the CoE parameter 1011:01 to 1684107116_{dec}



4.1.3 Step 3: Basic parameters

Open the “CoE – Online” tab. Set the parameters as described below. Leave the default value for all other parameters.

Example parameters for a servo motor from Beckhoff:

AM8111-0F20-0000 [▶ 46]

4.1.3.1 Index 8020 “STM Motor Settings Ch. 1”

8020:01 "Peak current"

Unit: mA

The peak current, which may only flow for a short time.

8020:02 "Rated current"

Unit: mA

The rated current is the current that the motor draws when it is operated at the rated speed and rated torque.

8020:04 "Phase to phase resistance"

Unit: 0.01 Ω

DC resistance, measured between two motor phases.

8020:09 “Start velocity”

Unit: °/s (degrees per second)

There are two ways to find the value for this parameter:

- If the nominal speed of the roller is known, use this formula:

$$n_{start} = \frac{1}{10} \times \frac{1}{i} \times \frac{v}{\pi \times d} \times 360°$$

n_{start}: value for parameter 8020:09 “Start velocity”
i: gear ratio. (i = 1 if no gear unit is used)
v: nom. speed in m/s (note: v[m/s] = v[fpm]/196,85)
d: roller diameter in m

- If the nominal rotational speed of the roller motor is known, use this formula:

$$n_{start} = \frac{1}{10} \times \frac{n_N}{i} \times \frac{360°}{60 \frac{s}{min}}$$

n_{start}: value for parameter 8020:09 “Start velocity”
n_N: nominal speed of the motor in rpm
i: gear ratio. (i = 1 if no gear unit is used)

  - Make sure to use the nominal speed that is specified for 24 V operation.

8020:13 “Mechanical to electrical ratio”

You can calculate or experimentally determine the value for this parameter.

- If the number of poles of the roller motor is known, use this formula:

$$p = \frac{\text{number of poles}}{2} \times i$$

p: value for parameter 8020:13 “Mechanical to electrical ratio”

i: gear ratio. (i = 1 if no gear unit is used)

  - Example:
    number of poles = 8
    gear ratio = 12:1
    → “Mechanical to electrical ratio” = (8 / 2) x 12 = 48
- If the number of poles is not specified in the data sheet:
  Determine the number of pole pairs experimentally [▶ 31].

8020:14 "Rated velocity"

Unit: °/s

Rated speed of the roller motor.

8020:19 “Motor thermal time constant”

Unit: 1/10 s (1/10 of a second)

4.1.3.2 Index 8023 "STM Controller Settings 4 Ch. 1"

8023:03 “Disable motor diagnosis”

Set this parameter to TRUE. This disables the diagnosis feature during align phase.

8023:12 „Velocity loop proportional gain“

Set this parameter to zero. This disables the velocity controller. Reenable it after Step 4: Test run [▶ 28] has been successfully completed.

8023:13 “Velocity feed forward”

Unit: %

Set this parameter to 100. This makes the target velocity value bypass the velocity controller.

8023:14 „Sensorless offset scaling“

Set this parameter to 80.

8023:19 “Rampup velocity”

Unit: °/s (degrees per second)

Set this parameter to the same value as parameter 8020:09 “Start velocity” [▶ 26].

8023:21 Rampup needed switchover events

Set this parameter to one.

4.1.4 Step 4: Test run

✓ Requirement: all previous steps have been completed successfully.

1. Remove any load from the conveyor roller.
2. If the motor has a holding brake, release the holding brake:
   Set "Brake output" to 1.
3. Set "Velocity" to 50% of the rated speed of the motor including gear unit:

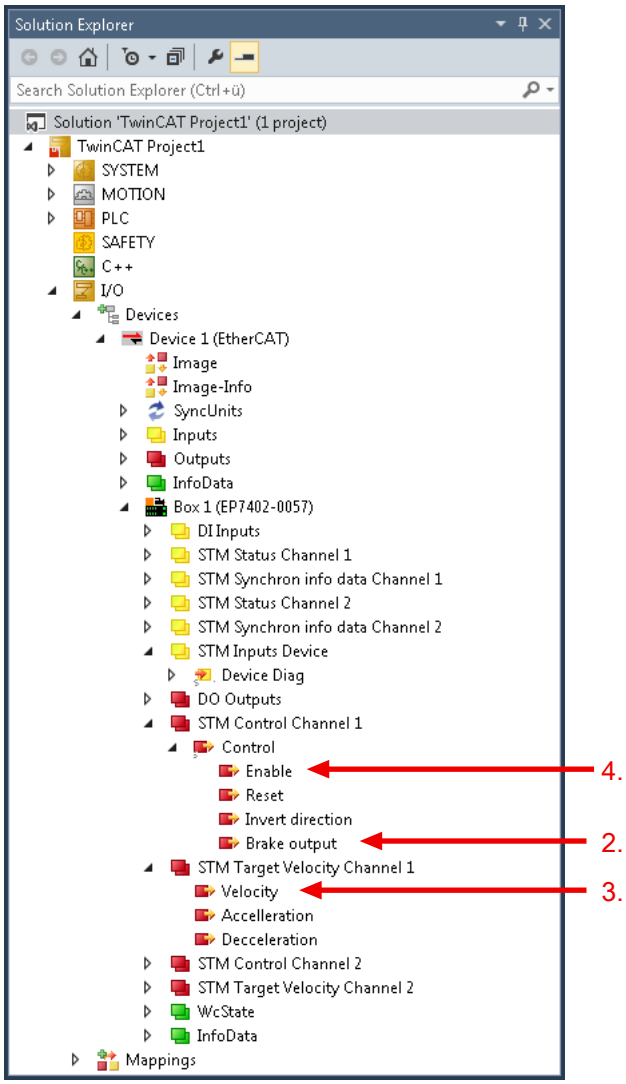
$$n = \frac{1}{2} \times \frac{n_N}{i} \times \frac{360°}{60\,\frac{s}{min}}$$

n: value for output variable “Velocity”

n_N: nominal speed of the motor in rpm

i: gear ratio (i = 1 if no gear unit is used)

4. Set "Enable" to 1.
   ⇨ The rotor is aligned for 1 second.
   ⇨ The box then attempts to turn the motor.
5. Assess the result. [▶ 29]



Possible results of the test run

- If the motor rotates continuously: jump to the next step [▶ 30] of the commissioning.
- If the motor does not rotate continuously:
  - Set the output variable "Enable" to 0
  - Check the status bits in the input variable "Device Diag"
  - Evaluate the status bits with the help of the table below.
  - Set the output variable "Reset" to 1 (this resets the status bits)
  - Set the output variable "Reset" to 0
  - Repeat the test run: Set the output variable "Enable" to 1

Set bit in "Device Diag"	Possible reasons	Solution
(none)	The output variable "Velocity" is smaller than the parameter 8020:09 "start velocity".	Check the calculations.
"Channel 1 motor overload I2T error"	The output current is too high.	Reduce the value of parameter 8023:14 "Sensorless offset scaling" [▶ 43]
„Channel 1 commutation error“	Too much load on the roller [1)]	Remove any load from the roller during the test run.
	The output current is too low.	Increase parameter 8023:14 “Sensorless offset scaling” [▶ 27]
	The ramp-up velocity is too high [1)]	Check the calculation for parameter 8023:19 “Rampup velocity” [▶ 27]. Decrease this parameter if the calculations are correct.
	Parameter “Rampup needed switchover events” is too low.	Increase parameter 8023:21 “Rampup needed switchover events” [▶ 27]
	Incorrect motor settings	Check motor settings [▶ 26]
	Motor too weak [1)]	Add a gear unit and re-calculate all parameters

[1)] Especially likely when the motor makes a sound with ascending pitch.

4.1.5 Step 5: Final steps

1. Set the output variable "Enable" to 0.
2. Set the parameter 8023:12 "Velocity loop proportional gain" to 100_{dec}.
   (Any value above zero activates the velocity controller).
   ⇨ You can now control the motor with the process variables "Enable" and "Velocity".
3. Fine-tuning of the parameters [▶ 32]

4.2 Determining the “Mechanical to electrical ratio” experimentally

The parameter 8020:13 “Mechanical to electrical ratio” [▶ 41] is an essential parameter for the operation of EP7402-0057. You can calculate the parameter [▶ 27], if the number of poles and the gear ratio are known. Otherwise you must determine the parameter experimentally:

1. Set the parameter 8023:03 "Disable motor diagnosis" to TRUE.
2. Set "Velocity" to 0.
3. Set "Enable" to 1.
   ⇨ A motor phase is powered.
   ⇨ You may hear a "click" noise from the roller motor.
4. Rotate the conveyor roller by hand. Do you feel defined snap steps?
   - Yes: Continue below
   - No: Increase the value of parameter 8023:14 "Sensorless offset voltage" by 10_{dec} and try again.
5. Rotate the conveyor roller by 360° by hand and count the number of snap steps.
   Tip: Make a mark on the roller. This makes it easier to rotate the roller by exactly 360°.
6. Set the output variable "Enable" to 0.
7. Set the parameter 8023:03 "Disable motor diagnosis" back to FALSE.
8. Enter the number of snap steps in parameter 8020:13 "Mechanical to electrical ratio".

4.3 Fine-tuning parameters

4.3.1 Alignment phase and ramp-up phase

Use the following diagram to adjust the parameters of the alignment phase and the ramp-up phase. The CoE indexes of the parameters are shown in the diagram. *n* is the number of the motor channel.

Best practice for tuning a parameter:

1. Set the output variable “Enable” to 0
2. Adjust the desired parameter
3. Set the output variable “Enable” to 1
4. - Evaluate the result
   - Check the Diagnosis bits [▶ 37] for warnings or errors
   - Try again if necessary.

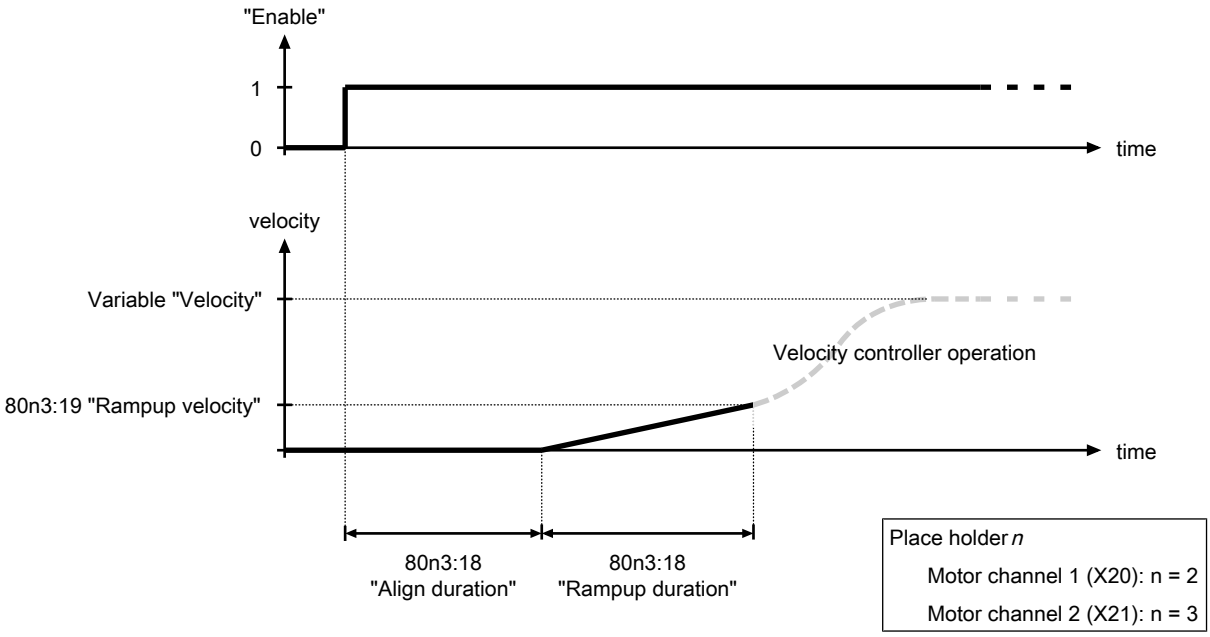


Fig. 14: Alignment phase and ramp-up phase parameters

4.3.2 Velocity controller

The velocity controller is a PI controller. The controller parameters are located in the CoE directory:

- Proportional gain K_p: parameter 80n3:11$_{hex}$ “Velocity loop integral time”
- Integral time T_i: CoE parameter 80n3:12$_{hex}$ “Velocity loop proportional gain”
- Parameter 80n3:13$_{hex}$ “Feed forward gain”

You can disable the velocity controller by setting the proportional gain K_P to zero.

4.4 Automatic restart after error

If a commutation error occurs, the motor channel affected is disabled. You can make settings so that the motor channel is automatically re-enabled and the motor restarted.

In the factory setting, the automatic restart is switched off.

Configuring automatic restart

There are two parameters with which the automatic restart can be configured:

Object		Parameter	
$80n3_{hex}$	STM Controller Settings 4 Ch. *n*	25_{hex}	Restart after error number of repetition
$80n3_{hex}$	STM Controller Settings 4 Ch. *n*	26_{hex}	Restart after error delay

- *n* = 2 for motor channel 1 (socket X20)
- *n* = 3 for motor channel 2 (socket X21)

4.5 Restoring the delivery state

To restore the delivery state for backup objects in ELxxxx terminals / EPxxxx- and EPPxxxx boxes, the CoE object *Restore default parameters, SubIndex 001* can be selected in the TwinCAT System Manager (Config mode).

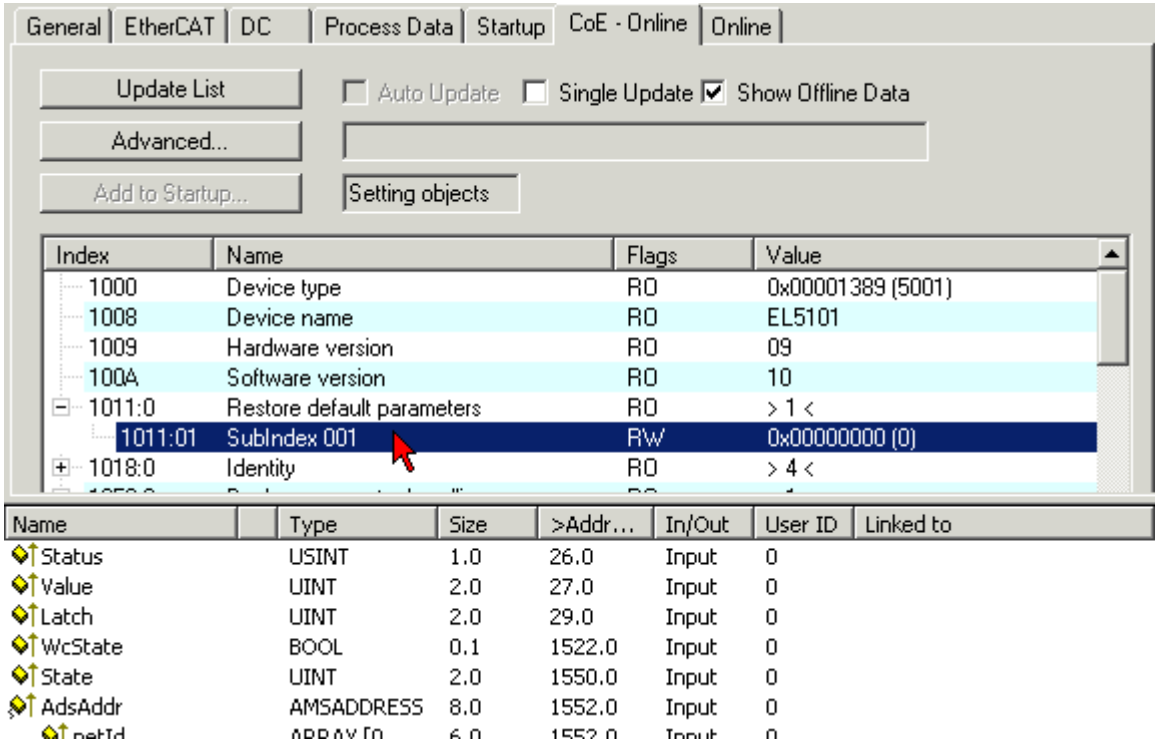


Fig. 15: Selecting the Restore default parameters PDO

Double-click on *SubIndex 001* to enter the Set Value dialog. Enter the value **1684107116** in field *Dec* or the value **0x64616F6C** in field *Hex* and confirm with OK.

All backup objects are reset to the delivery state.

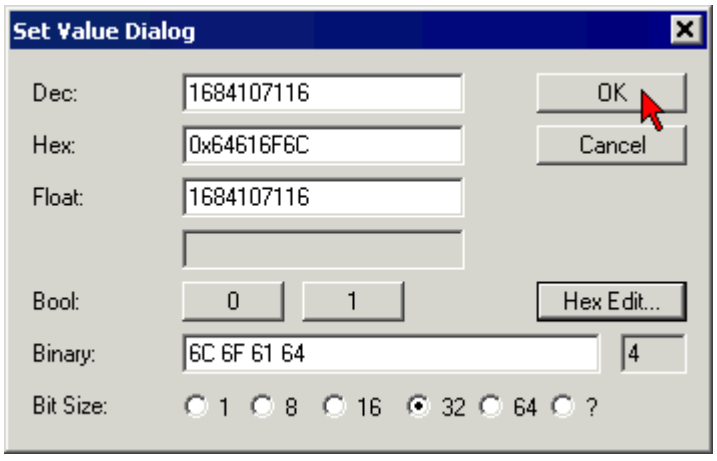


Fig. 16: Entering a restore value in the Set Value dialog

Alternative restore value

In some older terminals / boxes the backup objects can be switched with an alternative restore value:
Decimal value: 1819238756
Hexadecimal value: 0x6C6F6164

An incorrect entry for the restore value has no effect.

4.6 Decommissioning

⚠ WARNING

Risk of electric shock!

Bring the bus system into a safe, de-energized state before starting disassembly of the devices!

Disposal

In order to dispose of the device, it must be removed.

In accordance with the WEEE Directive 2012/19/EU, Beckhoff takes back old devices and accessories in Germany for proper disposal. Transport costs will be borne by the sender.

Return the old devices with the note "for disposal" to:

Beckhoff Automation GmbH & Co. KG
Service Department
Stahlstraße 31
D-33415 Verl

5 Troubleshooting

5.1 Common problems

Problems that may occur without a warning or an error:

Problem	Possible reasons	Possible solutions
The motor is not running	The corresponding motor channel is not enabled	Set the output variable “Enable” to TRUE.
	The output variable “velocity” is smaller than CoE index 80n0:09$_{hex}$ “Start velocity”.	Compare the values.
The motor does not react to changes of the output variable “velocity”. It is running at a constant velocity.	The velocity controller was disabled by setting proportional gain to zero.	Set the CoE index 80n3:12$_{hex}$ “Velocity loop proportional gain” to a value greater than zero.

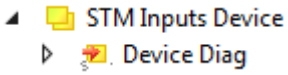
5.2 Warnings and errors

- **Warnings** are temporary. They indicate that a measured variable lies outside of the nominal operating range.
  A warning is canceled if the measured variable returns to within the nominal operating range.
- **Errors** are persistent.
  When an error occurs, the output stage of the corresponding channel is disabled until you reset the channel: Set the output variable “Reset” to 1 and back to 0.

Warnings and errors are indicated via the diagnosis variables [▶ 37].

5.3 Diagnosis bits

The diagnostic bits are located in the process data object "STM Inputs Device" [▶ 13].



Bit name	Description	Possible causes	Possible Solutions
Device undervoltage	The peripheral voltage U_P is lower than the undervoltage detection threshold [▶ 9].		Make sure that U_P is within the nominal voltage range.
Device overvoltage	The peripheral voltage U_P is higher than the overvoltage detection threshold [▶ 9].		
Overtemperature warning	The internal temperature currently exceeds the warning threshold: CoE index F80F:04 Default: 80 °C.	• The ambient temperature is too high. • The connected motor does not meet the specifications	Operate the device only under the conditions specified in the Technical data [▶ 9].
Overtemperature error	The internal temperature has exceeded the error threshold: CoE index F80F:05 Default: 100 °C.		
General hardware error	The device is not able to initialize successfully.	The device is defective.	None.
Channel *n* openload	At least one motor phase is high-impedance.	• A motor phase is not connected correctly. • A motor phase is burned out.	Check the motor connection. Replace the motor if it is defective.
Channel *n* short circuit	At least one phase current has exceeded the value of the parameter “Maximal current”: CoE index 80n0:01 [▶ 41]. The output stage was disabled.	• A motor phase is shorted. • The motor is defective.	
Channel *n* motor overload I2T warning	The calculated I^2T value currently exceeds the warning threshold: CoE index 80n0:16 [▶ 41]. Default: 80 %.	If the warning occurs during the ramp-up phase: The output current is too high.	Decrease the parameter “Sensorless offset scaling”: CoE index 80n3:14 [▶ 43].
		If the warning occurs during continuous operation: Mechanical overload.	Reduce the load.
Channel *n* motor overload I2T error	The calculated I^2T value has exceeded the error threshold: CoE index 80n0:18 [▶ 41]. Default: 110 %.	If the error occurs during the ramp-up phase: The output current is too high.	Decrease the parameter “Sensorless offset scaling”: CoE index 80n3:14 [▶ 43].
		If the error occurs during continuous operation: Mechanical overload.	Reduce the load.
Channel *n* amplifier overload I2T warning	The calculated I2T value of the amplifier currently exceeds the warning threshold:	Incorrect parameter setting: The thermal limit of motors that meet the specifications [▶ 9] is usually much lower than the thermal limit of the amplifier.	Check the motor parameters: CoE index 80n0 [▶ 41].
Channel *n* amplifier overload I2T error	The calculated I^2T value has exceeded the error threshold:		

Bit name	Description	Possible causes	Possible Solutions
Channel *n* in limit	The current is currently being limited because the I^2T value of the motor exceeds 97 %.	Mechanical overload	You can disable this protective function by setting the parameter 80n3:03 [▶ 43] to TRUE.
Channel *n* commutation error	The commutation algorithm has detected that the rotary field and the rotor are out of sync.	If the error occurs during the ramp-up phase: • Mechanical overload [1] → Check the load • The output current is too low. • The ramp-up velocity is too low.	• Check the roller load • Increase the parameter “Sensorless offset scaling”: CoE index 80n3:14 [▶ 43]. • Decrease parameter “Rampup velocity”: CoE index 80n3:19 [▶ 43] • …
		If the error occurs during continuous operation: The velocity is too low.	Retry with increased velocity. Increase the parameter “Start velocity” (CoE index 80n0:09 [▶ 41]) to make sure that the motor will not run at too low a velocity.

[1] Especially likely when the motor makes a sound with ascending pitch.

6 Application Notes

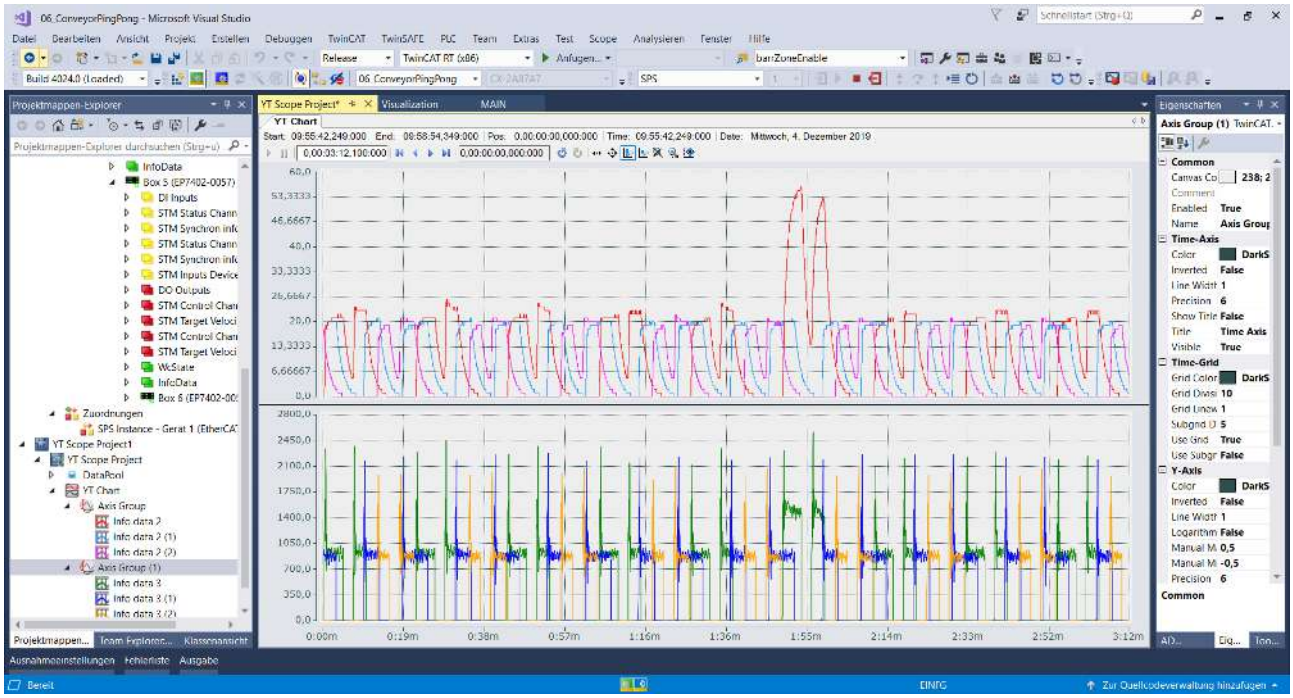
6.1 Motor Diagnosis

You can use the I^2T value for long-term diagnosis and wear-detection of the motor and attached mechanics.

1. Map the I2T value to one of the “Info data” variables in “STM Synchron info data Channel n”. CoE index 80n2 “STM Features” [▶ 42].
2. Monitor the “Info data” variable in a scope project.

⇨ This enables to recognize irregularities.

Example scope recording



7 CoE objects

7.1 Register

Index (hex)	Name
1000	Device type [▶ 45]
1008	Device name [▶ 45]
1009	Hardware version [▶ 45]
100A	Software version [▶ 45]
100B	Bootloader version
1011	Restore default parameters
1018	Identity
10F0	Backup parameter handling
1600	DO RxPDO-Map Outputs
1601	STM RxPDO-Map Control Ch. 1
1602	STM RxPDO-Map Target Velocity Ch. 1
1603	STM RxPDO-Map Control Ch. 2
1604	STM RxPDO-Map Target Velocity Ch. 2
1A00	DI TxPDO-Map Inputs
1A01	STM TxPDO-Map Status Ch. 1
1A02	STM TxPDO-Map Synchron info data Ch. 1
1A03	STM TxPDO-Map Status Ch. 1
1A04	STM TxPDO-Map Synchron info data Ch. 1
1A05	STM TxPDO-Map Inputs Device
1C00	Sync manager type
1C12	RxPDO assign
1C13	TxPDO assign
1C32	SM output parameter
1C33	SM input parameter
6000	DI Inputs
6020	STM Inputs Ch. 1
6030	STM Inputs Ch. 2
7010	DO Outputs
7020	STM Outputs Ch. 1
7030	STM Outputs Ch. 2
8020	STM Motor settings Ch. 1 [▶ 41]
8022	STM Features Ch. 1 [▶ 42]
8023	STM Controller Settings 4 Ch. 1 [▶ 43]
8030	STM Motor settings Ch. 2 [▶ 41]
8032	STM Features Ch. 2 [▶ 42]
8033	STM Controller Settings 4 Ch. 2 [▶ 43]
F000	Modular Device Profile
F008	Code word
F010	Module Profile List
F081	Download revision
F600	STM Device Diag data
F80F	STM Vendor data [▶ 44]
F900	STM Info data [▶ 44]

7.2 Object descriptions

7.2.1 Parameterization objects

Adjust these parameters during commissioning.

Index 8020: STM Motor Settings Ch. 1
Index 8030: STM Motor Settings Ch. 2

Access rights: read/write

Subindex (hex)	Name	Description	Unit	Data type	Default value
01	Peak current	If the motor current exceeds this value, the output stage of the affected channel is disabled and the diagnostic bit "Channel n short circuit" is set.	mA	UINT	1000_{dec}
02	Rated current	The rated current of the motor. See motor data sheet. This parameter is used for the I^2T calculation of the motor. (Thermal overload protection)	mA	UINT	1000_{dec}
03	Rated voltage	The rated voltage of the motor. See motor data sheet.	0.01 V	UINT	2400_{dec}
04	Phase to phase resistance	The ohmic resistance between two motor phases.	0.01 Ω	UINT	100_{dec}
09	Start velocity	Threshold value: the motor is kept in align state if the value of the output variable “velocity” is lower than this value. If this value is too low, a commutation error may occur.	°/s	UINT	3000_{dec}
13	Mechanical to electrical ratio	Set this parameter to the number of pole pairs of the motor multiplied by the gear ratio. The value for this parameter can also be determined experimentally [▶ 31].	-	UINT	1
14	Rated velocity				5000_{dec}
16	I2T warn level	I^2T limit monitoring: Warning threshold. If the I^2T value exceeds this threshold, the “Channel *n* overload I2T warning” bit is set.	%	USINT	80_{dec}
18	I2T error level	I^2T limit monitoring: Error threshold. If the I^2T value exceeds this threshold, the “Channel *n* overload I2T error” bit is set. The motor is switched torqueless.	%	USINT	110_{dec}
19	Motor thermal time constant	I^2T limit monitoring: Thermal time constant. The thermal time constant can be found in the motor datasheet.	0.1 s	UINT	15_{dec}

Index 8022: STM Features Channel 1
Index 8032: STM Features Channel 2

Access rights: read/write

Subindex (hex)	Name	Description	Unit	Data type	Default
11	Select info data 1	Define the measured values to be mapped to the input variables in “STM Synchron info data Channel n“ Enum: • “Motor velocity” = 7 • “Motor load” (I^2T value) = 11_{dec} • “Motor amplifier I^2T load” = 12_{dec} • “Motor dc current” = 13_{dec} • “Motor back EMF” = 17_{dec} • “Motor restart counter” = 18_{dec} • “Internal temperature” = 101_{dec} • “Motor supply voltage” = 104_{dec}	-	USINT	7_{dec}
19	Select info data 2		-	USINT	11_{dec}
51	Select info data 3		-	USINT	13_{dec}

Index 8023: STM Controller Settings 4 Ch. 1
Index 8033: STM Controller Settings 4 Ch. 2

Access rights: read/write

Subindex (hex)	Name	Description	Unit	Data type	Default value
02	Disable stop after unsuccessful rampup	This prevents a commutation error after unsuccessful ramping up the motor. The commutation is continued at Rampup velocity.	-	BOOL	FALSE
03	Disable motor diagnosis	This parameter disables the motor protection functions during the alignment phase.	-	BOOL	FALSE
04	Disable I2T current limiting	This bit disables the I2T current limiting above a 97% limit. This could be unstable during low velocities. FALSE: The output current is limited when the motor I^2T value exceeds 97 %. TRUE: no current limiting.	-	BOOL	FALSE
11	Velocity loop integral time	Velocity controller parameter: Integral time T_i	0.1 ms	UDINT	500_{dec}
12	Velocity loop proportional gain	Velocity controller parameter: Proportional coefficient K_P	µV (°/s)	UDINT	100_{dec}
13	Velocity feed forward gain	Bypasses the velocity controller directly with its Target voltage. With correct Rated voltage and speed the Actual velocity will be close to the Target velocity at 100% Feed Forward.	%	USINT	0
14	Sensorless offset scaling	This parameter affects the output current during alignment and rampup phase. The output current is specified in percent of the nominal current, CoE index 80n0:02 [▶ 41].	%	USINT	50_{dec}
15	Align duration	Duration of the alignment phase	ms	UINT	1000_{dec}
18	Rampup duration	Duration of the ramp-up phase	ms	UINT	1000_{dec}
19	Rampup velocity	Target velocity for the roller at the end of the ramp-up phase. See also subindex 02_{hex}.	°/s	UINT	3000_{dec}
21	Rampup needed switchover events	The amount successful commutations which are needed to switch from forced commutation (ramp-up phase) to regulated commutation.	-	UINT	20_{dec}
22	Commutation threshold	This value is to modify the commutation for different motors.	-	UINT	50_{dec}
23	Current loop proportional gain	Proportional component of current controller	0.1 V/A	UINT	2
24	Current loop integral time	Current controller integral action time (Tn)	0.1 ms	UINT	20_{dec}
25	Restart after error number of repetition	Automatic restart after error [▶ 33] If a commutation error occurs, the motor can be restarted automatically. This parameter determines the number of commutation errors and restarts that may occur before the motor is finally switched off. If this parameter is zero, the motor will be switched off immediately after a commutation error in nominal operation.	-	UINT	0
26	Restart after error delay	This parameter determines the time span between a commutation error and the automatic restart. See also subindex 25.	ms	UINT	1000_{dez}

7.2.2 Information objects

Index F80F: STM Vendor data

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Value
04	Warning temperature	Internal temperature: Warning threshold.	°C	USINT	80_{dec}
05	Switch off temperature	Internal temperature: Error threshold.	°C	USINT	100_{dec}
09	Amplifier rated current	The value of this parameter is the maximum continuous current that the output stage can provide. This parameter is used for the I^2T calculation of the output stage.	mA	UINT	4500_{dec}
0A	Amplifier maximal current	If the output current exceeds the value of this parameter, the output stage is switched off.	mA	UINT	18000_{dec}
0B	Amplifier minimal voltage	Threshold value of the undervoltage detection.	0.01 V	UINT	1800_{dec}
0C	Amplifier maximal voltage	Threshold value of the overvoltage detection.	0.01 V	UINT	3000_{dec}
0D	Amplifier thermal time constant	I^2T limit value monitoring: Thermal time constant of the output stage.	0.1 s	UINT	35_{dec}

Index F900: STM Info data

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Default value
01	Internal temperature	Internal temperature	°C	SINT	-
02	Motor supply voltage	Current value of the peripheral voltage U_P	0.01 V	UINT	-

7.2.3 Standard objects

Index 1000 Device type

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Value
-	Device type	Bit 0 .. 15: Device profile number Bit 16 .. 31: Module profile number (Device profile number 5001: Modular Device Profile MDP)	-	UDINT	5001_{dec}

Index 1008 Device name

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Value
-	Device Name	Device Name	-	String	EP7402-0057

Index 1009 Hardware version

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Value
-	Hardware Version	Hardware revision	-	String	[1]

[1] Refer to Firmware and hardware versions [▶ 7].

Index 100A Software version

Access rights: read only

Subindex (hex)	Name	Description	Unit	Data type	Value
-	Software Version	Firmware revision	-	tbd	[1]

[1] Refer to Firmware and hardware versions [▶ 7].

8 Appendix

8.1 Example motor parameters

Parameter		Beckhoff AM8111-0F20-0000
Index	**Name**	
8020:01$_{hex}$	Maximal current	3500
8020:02$_{hex}$	Nominal current	2850
8020:09$_{hex}$	Start velocity	666
8020:13$_{hex}$	Mechanical to electrical ratio	3
8020:19$_{hex}$	Motor thermal time constant	15
8023:11$_{hex}$	Velocity loop integral time	300
8023:12$_{hex}$	Velocity loop proportional gain	100
8023:14$_{hex}$	Align power	53
8023:15$_{hex}$	Align duration	1000
8023:16$_{hex}$	Rampup power	60
8023:18$_{hex}$	Rampup duration	666
8023:19$_{hex}$	Rampup velocity	2000
8023:21$_{hex}$	Rampup needed switchover events	10
8023:22$_{hex}$	Commutation threshold	45

8.2 General operating conditions

Protection degrees (IP-Code)

The standard IEC 60529 (DIN EN 60529) defines the degrees of protection in different classes.

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø 50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø 12.5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø 2.5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø 1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.

2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water!

Chemical Resistance

The Resistance relates to the Housing of the IP 67 modules and the used metal parts. In the table below you will find some typical resistance.

Character	Resistance
Steam	at temperatures >100°C: not resistant
Sodium base liquor (ph-Value > 12)	at room temperature: resistant > 40°C: not resistant
Acetic acid	not resistant
Argon (technical clean)	resistant

Key

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

8.3 Accessories

Cables and connectors

Ordering information	Description	Link
ZK1090-3xxx-xxxx	EtherCAT cable M8, green	Website
ZK1093-3xxx-xxxx	EtherCAT cable M8, yellow	Website
ZK2000-3xxx-xxxx	Sensor cable M8, 4-pin	Website
ZK2020-3xxx-xxxx	Power cable M8, 4-pin	Website
ZK7314-3xxx-Axxx	B23 ENP cable 5 G 4.0mm^2	Website
ZS2000-1314	Motor plug M8, 5-pin, B-coded, field assembly	Data sheet

Protective caps for connectors

Ordering information	Description
ZS5000-0010	Protective cap for M8 sockets, IP67 (50 pieces)
ZS7300-B001	Protective cap for B23, plastic
ZS7300-B002	Protective cap for B23, metal

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
ZB8802-0003	Assembly tool for B23 connectors

Further accessories

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

8.4 Version identification of EtherCAT devices

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. *“EL5021 EL terminal, standard IP20 IO device with batch number and revision ID (since 2014/01)”*.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

Identification number

Beckhoff EtherCAT devices from the different lines have different kinds of identification numbers:

Production lot/batch number/serial number/date code/D number

The serial number 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
Ser. no.: 12063A02: 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

Unique serial number/ID, ID number

In addition, in some series each individual module has its own unique serial number.

See also the further documentation in the area

- IP67: EtherCAT Box
- Safety: TwinSafe
- Terminals with factory calibration certificate and other measuring terminals

Examples of markings

Fig. 17: EL5021 EL terminal, standard IP20 IO device with serial/ batch number and revision ID (since 2014/01)

Fig. 18: EK1100 EtherCAT coupler, standard IP20 IO device with serial/ batch number

Fig. 19: CU2016 switch with serial/ batch number

Fig. 20: EL3202-0020 with serial/ batch number 26131006 and unique ID-number 204418

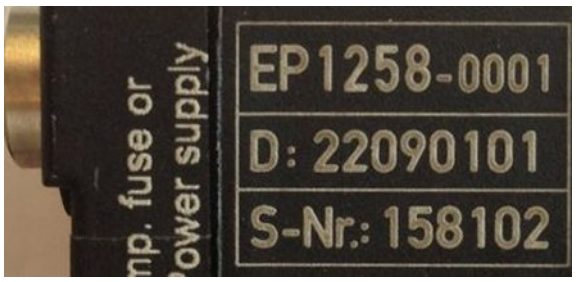


Fig. 21: EP1258-00001 IP67 EtherCAT Box with batch number/ date code 22090101 and unique serial number 158102

Fig. 22: EP1908-0002 IP67 EtherCAT Safety Box with batch number/ date code 071201FF and unique serial number 00346070

Fig. 23: EL2904 IP20 safety terminal with batch number/ date code 50110302 and unique serial number 00331701

Fig. 24: ELM3604-0002 terminal with unique ID number (QR code) 100001051 and serial/ batch number 44160201

8.4.1 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.

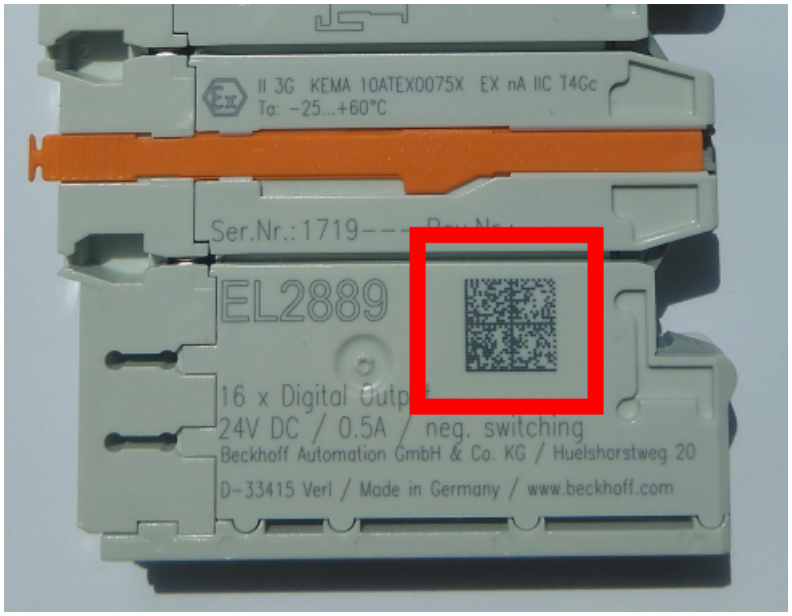


Fig. 25: BIC as data matrix code (DMC, code scheme ECC200)

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. The data under positions 1 to 4 are always available.

The following information is contained:

Item no.	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	S	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294104
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30PF971, 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 item 1 to 4 and 6. The data identifiers are marked in red for better display:

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, item no. 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.

NOTE

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 information.

8.5 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: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

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
Fax:	+49 5246 963 9157
e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
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- spare parts service
- hotline service

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