Instruction handbook

be in motion be in motion

BAUMÜLLER

b maXX 5000

Add-on modules

Modbus/TCP
MOD

Read the Instruction handbook before starting any work!

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Document No.: 5.19015.02   Baumüller Nürnberg GmbH

GENERAL

1.1   Information on this Instruction Handbook

The manual **b maXX 5000 add-on module MOD** is an addition to the Instruction handbook **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008) for devices with

Ethernet/IP
Type code: BM5XXX-XXXX-XX**08**-**00**XX

The basic prerequisite for safe working also is compliance with all the safety and handling instructions stated in the instruction handbooks **b maXX 5000** or **b maXX 5500**.

Additionally, the valid accident prevention regulations and general safety regulations applicable to the scope of application the device must be complied with.

Read this Instruction handbook and the Instruction handbooks **b maXX 5000** or **b maXX 5500**, particularly the safety notes chapter, completely before beginning any work on the device. Both Instruction handbooks are part of the product and must be kept accessible to the personnel at all times in the immediate vicinity of the device.

1.2 Key to symbols

Warning notes

Warning notes are identified by symbols in this Instruction handbook. The notes are introduced by signal words that express the extent of the danger.

It is imperative that these notes be complied with and are conscientiously regarded in order to prevent accidents, personal injury and material damage.

DANGER!

....this indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!

....this indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION!

....this indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE!

....indicates a hazardous situation which, if not avoided, may cause material damage.

Recommendations

NOTE!

....highlights useful hints and recommendations, as well as information for the efficient and trouble-free use.

1.3 Limitation of liability

All specifications and notes in these instruction handbook were compiled taking into account the applicable standards and regulations, the state of the art and our knowledge and experience of many years.

The manufacturer assumes no liability for damages due to:

- non-compliance with the instruction handbook
- usage for other than the intended purpose
- usage by untrained personnel

The actual scope of delivery can vary in case of optional equipment, laying claim to additional order options, or on account of the latest technical changes to the explanations and representations described herein.

The user bears the responsibility for performing service and initial operation in accordance with the safety regulations of the applicable standards and all other relevant governmental or local regulations concerning the dimensioning and protection of conductors, grounding, disconnectors, overcurrent protection, etc.

The person who carried out the mounting or installation is liable for any damage incurred when assembling or connecting the device.

1.4 Copyright protection

The instruction handbook must be treated confidentially. It is to be used exclusively by personnel who work with the device. The consignment of the instruction handbook to third persons without the written permission of the manufacturer is prohibited.

> **NOTE!**
>
> The specific contents, text, drawings, images and other representations are copyrighted and subject to industrial property rights. Any prohibited usage is punishable by law.

Modbus/TCP®   is a registered trademark of Modicon Company
(now: Schneider Electric)

b maXX®   is a registered trademark of Baumüller Nürnberg GmbH,
90482 Nürnberg, Germany

> **NOTE!**
>
> Please note, that BAUMÜLLER is not responsible to examine whether any (industrial property) rights of third parties are infringed by the application-specific use of the BAUMÜLLER products/components or the execution.

1.5 Other applicable documents

Components of other manufacturers are integrated into the device. For these purchased parts, hazard assessments have been performed by the respective manufacturers. The compliance of the design construction with the applicable European and national regulations has been declared for the components by the respective manufacturers.

1.6 Spare parts

WARNING!

False or flawed spare parts can lead to damage, malfunction or complete failure, thus endangering safety.

Therefore:

● Only use original spare parts of the manufacturer.

Procure spare parts through an authorized dealer or directly from the manufacturer.

1.7 Disposal

Insofar as no take-back or disposal agreement has been made, please disassemble units correctly and properly recycle the constituent parts.

See also **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008), chapter Disposal.

1.8 Guarantee provisions

The guarantee provisions are stated in a separate document of the sales documents.

The devices described herein may only be operated in accordance with the stipulated methods, procedures and conditions. Anything else not presented here, including the operation of devices in mounted positions, is not permitted and must be cleared with the plant on a case-by-case basis. If the devices are operated in any other manner than as described within this Instruction handbook, then all guarantee and warranty rights are rendered null and void.

1.9 Customer service

Our customer service is available to provide you with technical information.

Info on the responsible contact persons is available at all times via telephone, fax, mail or the Internet.

1.10 Used terms

A list of the abbreviations used can be found in **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008), Appendix A: Abbreviations.

1.11 List of associated documentations

Instruction Handbook

	Doc No.	Part No. German	Part No. English
Instruction handbook b maXX 5000	5.09021	**439682**	**439683**
Instruction handbook b maXX 5500/5600/5700	5.13008	**446683**	**446684**

Parameter Manual

	Doc No.	Part No. German	Part No. English
Parameter Manual b maXX 5000	5.09022	**428331**	**431082**

Instruction Handbooks Add-on modules

	Doc No.	Part No. German	Part No. English
Add-on module Modbus/TCP	5.19015	**485486**	**485487**

1.11 List of associated documentations

Instruction handbook **b maXX 5000 add-on module MOD**
Document No.: 5.19015.02

Baumüller Nürnberg GmbH

SAFETY

This section provides an overview of all of the important safety aspects for optimum protection of personnel as well as for the safe and problem-free operation.

2.1 Contents of the Instruction Handbook

Each person who is tasked with performing work on or with the device must have read and understood this Instruction Handbook and the Instruction Handbook of **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008) before working with the device. This also applies if the person involved with this kind of device or a similar one, or has been trained by the manufacturer.

2.2 Changes and modifications to the device

In order to prevent hazards and to ensure optimum performance, no changes, additions or modifications may be undertaken on the device that have not been explicitly approved by the manufacturer.

2.3 Use, compliant with intended purpose

The **Modbus/TCP add-on module** is considered as being used compliant with its intended purpose if all notes and information of this Instruction handbook and the Instruction handbook **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008) are adhered to.

WARNING!

Danger arising from usage for an unintended purpose!

Any usage that goes beyond the intended purpose and/or any non-compliant use of the device can lead to dangerous situations.

Therefore:

- Only use the device compliant with its intended purpose.
- Note all specifications of this Instruction handbook and the Instruction handbook **b maXX 5000** (5.09021).or **b maXX 5500** (5.13008)
- Ensure that only qualified personnel work with/on this device.
- When configuring, ensure that the device is always operated within its specifications.
- The device may only be operated in a technically flawless condition.
- Only operate the device in combination with components approved by Baumüller Nürnberg GmbH.

2.4 Responsibility of the operating company

The device will be used in commercial areas. Thus, the proprietor of the device is subject to the legal work safety regulations.

Along with the notes on work safety in this Instruction handbook and the Instruction handbooks **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008) the safety, accident prevention and environmental protection regulations valid for the area of application of this device must be complied with. Whereby:

- The operating company must inform himself about the applicable work health and safety regulations and ascertain, in a hazard assessment, any additional hazards that could arise from the special working conditions in the use area of the device. These must then be implemented in the form of operating instructions for operation of the device.
- This Instruction handbooks must be kept accessible to personnel working with the device at all times in the immediate vicinity of the device.
- The specifications of the Instruction handbooks must be adhered to completely and without exception.
- The device may only be operated in a technically faultless and operationally safe condition.

2.5 Training of the personnel

	WARNING!
⚠️	**Risk of injury due to insufficient qualifications!**
	Improper handling can lead to significant personal injury and material damage.
	Therefore:
	• Certain activities can only be performed by the persons stated in the respective chapters of this Instruction handbook.

In this Instruction handbook, the following qualifications are stipulated for various areas of activity:

- **Operating personnel**
  - The drive system may only be operated by persons who have been specially trained, familiarized and authorized.
  - Troubleshooting, maintenance, cleaning, maintenance and replacement may only be performed by trained or familiarized personnel. These persons must be familiar with the Instruction handbook and act accordingly.
  - Initial operation and familiarization may only be performed by qualified personnel.

- **Qualified personnel**
  - Electrical engineers authorized by Baumüller Nürnberg GmbH, and qualified electricians of the customer or a third party who have learned to install and maintain Baumüller drive systems and are authorized to ground and identify electrical power circuits and devices in accordance with the safety engineering standards of the company.
  - Qualified personnel have had occupational training or instruction in accordance with the respective locally applicable safety engineering standards for the upkeep and use of appropriate safety equipment.

2.6   Special hazards

In the following section, the remaining marginal risks will be stated that have been iden-
tified as a result of the hazard analysis.

Observe the safety notes listed here and the warning notes in the further chapters of this
manual to reduce health risks and dangerous situations.

Electrical current

	DANGER!
	Risk of fatal injury from electrical current!
	There is an immediate risk of fatal injury if live electrical parts are contacted. Damage to the insulation or individual components can be life-threatening.
	Therefore:
	● Switch off the electrical power immediately in case of damage to the power supply insulation.
	● Only allow work on the electrical system to be performed by qualified personnel.
	● Switch off the current when any kind of work is being performed on the electrical system and ensure safety before switching on again.

**Danger from re-
sidual energy**

	DANGER!
	Risk of fatal injury from electrical current!
	Stored electric charge.
	Discharge time of the system = discharge time of the device with the longest DC link discharge time connected to the DC link.
	See Instruction handbook **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008), chapter Electrical Data.
	Therefore:
	● Do not touch electrically live parts before taking into account the discharge time of the capacitors.
	● Pay attention to the corresponding notes on the device.
	● If additional capacitors are connected to the DC link, the DC link discharge can take a much longer time. In this case, the necessary waiting period must itself be determined or a measurement made as to whether the equipment is de-energized. This discharge time must be posted, together with an IEC 60417-5036 (2002-10) warning symbol, on a clearly visible location of the control cabinet.

**Moving
components**

⚠	**WARNING!** **Risk of injury from moving components!** Rotating components and/or components moving linearly can result in severe injury. Therefore: ● Do not touch moving components during operation. ● Do not open any covering during operation. ● The amount of residual mechanical energy depends on the application. Powered components still turn/move for a certain length of time even after the power supply has been switched off. Ensure that adequate safety measures are taken.

2.7 Fire fighting

⚠	**DANGER!** **Risk of fatal injury from electrical current!** There is a risk of electric shock if an electrically-conductive, fire-extinguishing agent is used. Therefore: ● Use the following fire-extinguishing agent: ABC powder / CO_2

2.8 Safety equipment

⚠️	**WARNING!** **Risk of fatal injury due to non-functional safety equipment!** Safety equipment provides for the highest level of safety in a facility. Even if safety equipment makes work processes more awkward, under no circumstances may they be circumvented. Safety can only be ensured by intact safety equipment. Therefore: ● Before starting to work, check whether the safety equipment in good working order and properly installed.

2.9 Behavior in hazardous situations or at accidents

Preventive measures

● Always be prepared for accidents or fire!
● Keep first-aid equipment (e.g. first-aid kits, blankets, etc.) and fire extinguishers readily accessible.
● Familiarize personnel with accident signalling systems, first aid equipment and life saving equipment.

And if something does happen: respond properly.

● Stop operation of the device immediately with an EMERGENCY Stop.
● Initiate first aid measures.
● Evacuate persons from the danger zone.
● Notify the responsible persons of the site.
● Alarm medical personnel and/or the fire department.
● Keep access routes clear for rescue vehicles.

TECHNICAL DATA

3.1 Operation conditions

The operation conditions of **b maXX 5000** are valid, see Instruction Handbook **b maXX 5000** (5.09021) or **b maXX 5500** (5.13008).

Transport temperature range	- 25 °C to + 70 °C
Transport climatic class EN 60721-3-2	2 K 3
Storage temperature range	- 25 °C to + 70 °C
Storage climatic class EN 60721-3-1	1 K 4

NOTICE!

Normally, non-conductive pollution occurs. Conductive pollution is unacceptable. Conductive pollution can lead to the destruction of the device. The customer is responsible for destructions, which were caused by pollution due to conductive materials or components.

3.2 Electrical data

3.2.1 Modbus/TCP, 2 channels

Supply voltage (external supply)	5 V ± 5 % (without load)
Supply current (external supply)	max. 100 mA (without load)
Signal level: output high voltage at I_{0H} = - 20 mA	2,5 V
Signal level: output high voltage at I_{0L} = + 20 mA	0,5 V
Output frequency, track signals	max. 500 kHz
Switching time: rising time	< 50 ns
Switching time: dropping time	< 50 ns
Delay time	$|t_d|$ = 1 ≤ 50 ns
Power input	0,525 W
Current output driver	max. 15 mA

The mentioned timings are available at the module output. When selecting a cable in order to transmit the signals to an adequate evaluation unit, it must be considered, that a real cable can reduce the maximum transferable output frequency by its attenuation (change of specified signal performance).

TTL square wave pulse cycles   Two TTL square wave pulse cycles A and B with a 90° electrical phase shifting and their inverted pulse cycles $\overline{A}$ and $\overline{B}$ as also a zero pulse 0 with the inverted signal $\overline{0}$ are available by way of output signals.
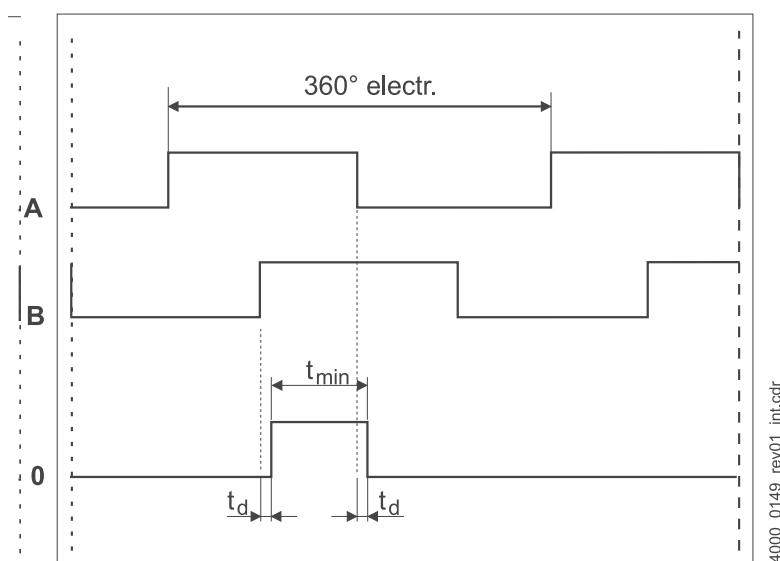
Figure 1:   Pulse cycles, incremental encoder emulation IEE

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DESIGN AND OPERATION

4.1 Design

The **b maXX 5000** series consists of an (active) mains rectifier unit and one or more axis units or a basic unit with/without axis units. The possible number of axis units depends on the connected load of the DC link of the mains rectifier unit or is limited by the signal bus to a maximum of 12 axis units.

b maXX 50XX   **Mains rectifier unit**
This is a mains rectifier unit for supplying axis units via the DC link.

b maXX 51XX   **Active mains rectifier unit**
This is an active mains rectifier unit for supplying axis units via the DC link.

b maXX 53XX   **Single axis unit safety, double axis unit safety**
This is a motor inverter that is supplied from the DC link via a mains rectifier unit or active mains rectifier unit.

b maXX 55XX   The **BM55XX** is a basic unit. The **BM55XX** is also available as a power module for the connection to the DC link.

b maXX 57XX   **BM5700** are basic units especially developed to maximize the available rated current by water cooling (cooling type -F and -Z) and with none peak current (only BM5773 with low peak current).

	NOTE!
ⓘ	Proper operation of the **b maXX axis units BM53XX** can only be ensured with Baumüller **mains rectifier units BM50XX, BM51XX** or **basic units BM4XXX / BM5XXX**.

Controller   The controller unit controls the inverter of the power unit. The controller is operated either by means of operating software or by means of a higher-level control unit.

The Modbus/TCP (MOD) is implemented in devices with type code:
BM5XXX-XXXX-XX**08-00**XX.

4.2 Add-on module MOD

	NOTE!
[icon]	Only devices with type code BM5XXX-XXXX-XX**08-00**XX provide the add-on module Modbus/TCP
	The module is built-in and cannot be changed. It is forbidden to remove the yellow front cover.

The Modbus/TCP provides 2 channels .
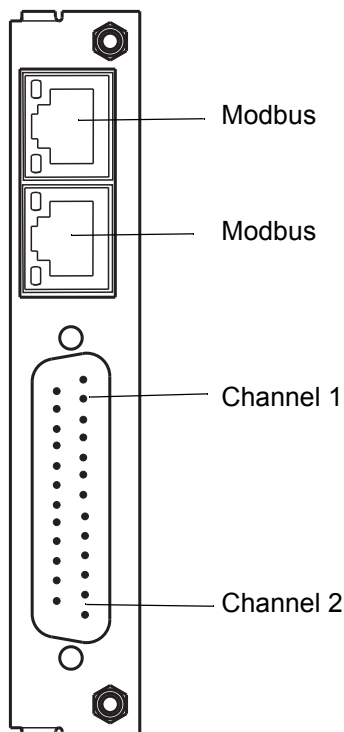
5000_0322_rev01_int.cdr

Figure 2:   Front view add-on module EIP

Set values for the incremental encoder emulation can be obtained from the sources given below:

- Position actual values encoder 1 or encoder 2,
  see examples 1 and 2 in ▷Figure 5◁ on page 27
- Position actual values (e. g. internal from positioning)
- Field bus set value (external set via bus),
  see example 3 in ▷Figure 5◁ on page 27.

The signal generated by **b maXX** can either be used for synchronization of the following axis, see examples 1 and 3 in ▷Figure 5◁ on page 27 or for position measuring of the axis by a master control, see example 2 in ▷Figure 5◁ on page 27.

4.3   Identification of the device

4.3.1   Part number

BM53XX

BM5323
310045678
06500141

5000_0241_rev01_int.cdr
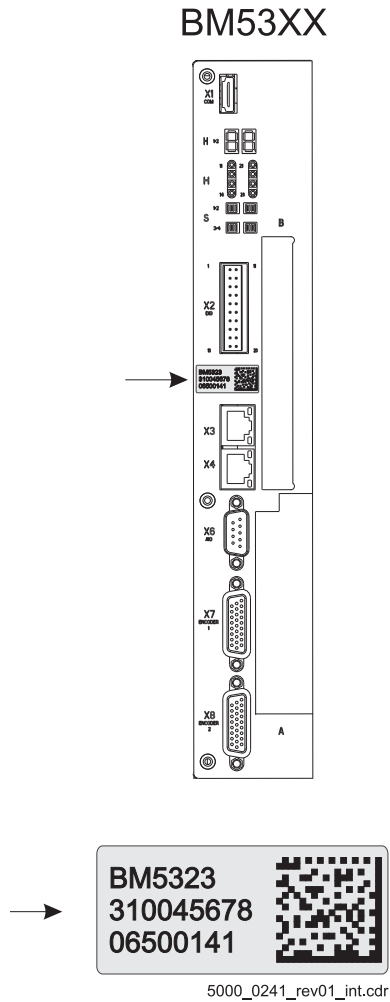
Figure 3:   Part number - front

4.3.2   Type plate

Examples of the locations where the type plate is affixed are shown in the figure. Among other things, the type plate also shows the type code of the device.

BM55XX
BM57XX

BM53XX

Einzelachseinheit Sicherheitstechnik

Typ: BM5327-XXXX-XXXX-XXXX-XX-XX

Eingang: 640 V DC (760 V DC)
Ausgang: 3*0...450 V AC (500 V AC), 3*20 A (16 A)
Betriebsart: KB 200%
S Nr.: S12345678   Art-Nr.: 12345678
Please refer to Instruction Manual No. 5.09021

BAUMÜLLER

5000_0242_rev01_int.cdr
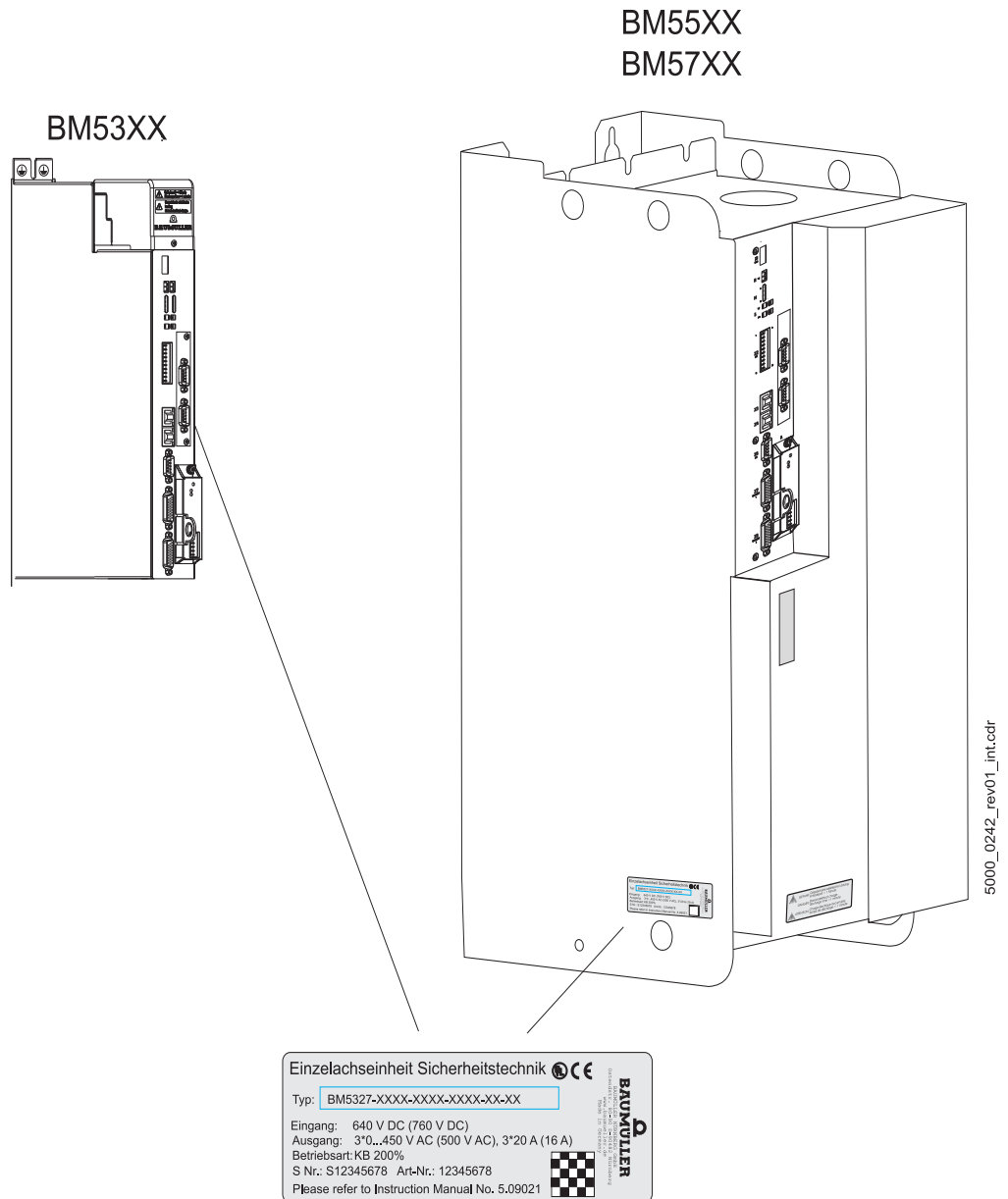
Figure 4:   Location of the type plate

4.3.3 Danger areas

Please comply to all safety notes of the instruction handbooks of **b maXX 5000** or **b maXX 5500**.

4.4 Display and operation elements

The add-on module **Modbus/TCP (MOD)** doesn't provide display or operation elements.

The LED H14 and H24 of **b maXX 5000** / **b maXX 5500** and the emulation of the LED in ProDrive displays all device errors, even the errors occurring in connection with the add-on modules **IEE** or **MOD**.

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INSTALLATION

This chapter describes the electrical installation of the **b maXX 5000** add-on module **MOD**.

5.1   Safety notes

	DANGER!
⚠	**Risk of fatal injury from electrical current!**
	Inevitably, when operating this electrical device, certain parts of it are energized with hazardous voltage.
	Therefore:
	• Pay heed to areas on the device that could be dangerous during the electrical installation.
	• Pay heed to areas on the device that could still be electrically energized after operation.

	WARNING!
⚠	**Danger because of faulty installation and initial commissioning!**
	Installation and commissioning require qualified personnel with adequate experience. A installation fault can cause danger situations or large damage of property.
	Therefore:
	• Only personnel from manufacturer or qualified personnel operate while installation and initial commissioning

5.2   Demands on the power supply

In order to comply with the standard EN 60 204-1 (electrical equipment of machines), the cable specified therein must be used. The connecting plugs must not drop - otherwise there is a danger of short circuits, external voltage, etc.

	NOTICE!
	The danger is: **electrical voltage.**
	1 Ensure that the electrical power connection parameters as specified in the Technical Data are adhered to and that the connections are made in accordance with the stipulated data.
	2 Avoid short circuit between input and output points.

	NOTE!
	Pay attention to EMC compatible cabling, see instruction handbook **b maXX 5000** or **b maXX 5500, 5600, 5700**, chapter Installation requirements with regard to EMC.

5.3   Demands on the connection cables

Completely assembled cables are not available, assembly of a connection cable see ▷Connecting cable MOD◁ from page 29.

5.4 Installation MOD

5.4.1 Connection diagram incremental encoder emulation

Example 1

- Set value IEE from encoder
- Signal IEE to following axis
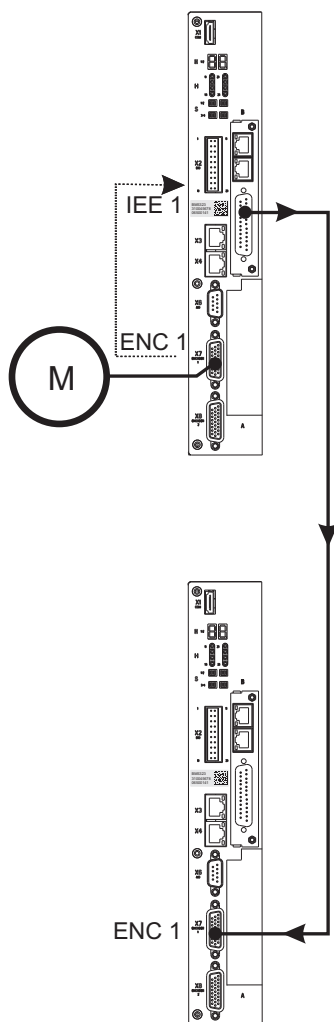
Example 2:

- Set value IEE from encoder
- Signal IEE to master control
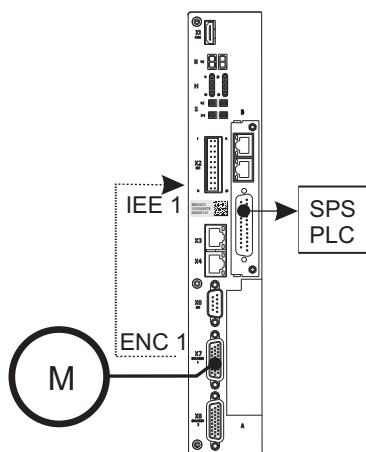
Example 3:

- Set value IEE from master control
- Signal IEE to following axis
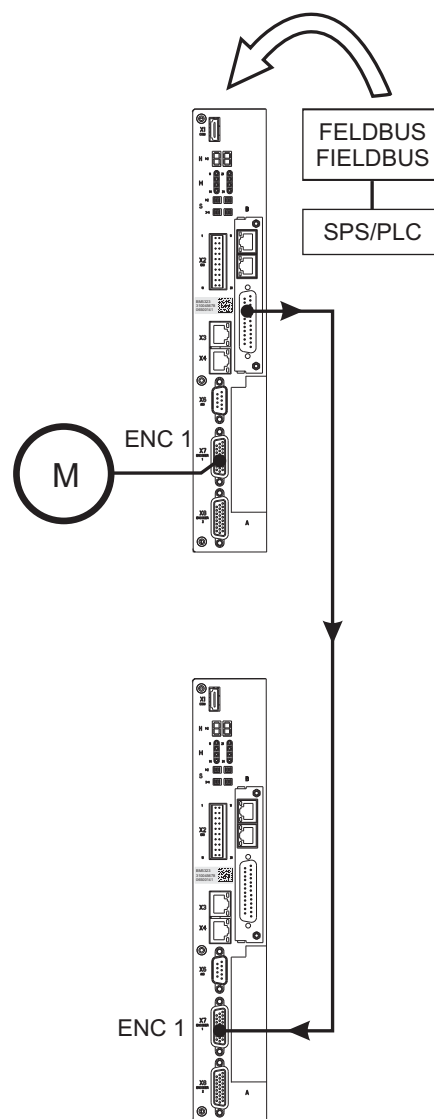
Figure 5: Connection diagram incremental encoder emulation

5.4.2 Installation procedure IEE

Depending on the desired application you now are able to connect the incremental encoder emulation with further system components (see ▷Figure 5◁ on page 27).
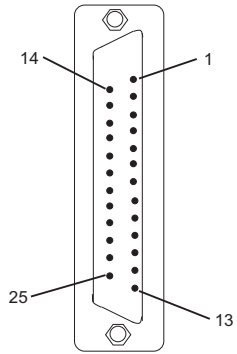
1 Make sure that the **b maXX BM5000** has been switched off voltage.

2 Connect an output (e.g. X1) of the incremental encoder emulation IEE with the encoder input of the higher-level control (see example 2 in ▷Figure 5◁ on page 27).
Pin assignment see ▷Pin assignment MOD◁ on page 29,
Cable see ▷Connecting cable MOD◁ on page 29;

or

3 Connect an output (e.g. X1) of the incremental encoder emulation IEE with the encoder input of the next b maXX drive (see example 1 in ▷Figure 5◁ on page 27).
Pin assignment see ▷Pin assignment MOD◁ on page 29,
Cable see ▷Connecting cable MOD◁ on page 29.

4 Tighten the lock screws of the sub-D connector.

5 Install the connecting cable(s) in the switching cabinet according the standards.

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5.4.3 Pin assignment MOD

Pin assignment of the Sub-D connectors (male) at the front of the Ethernet/IP slave EIP:

Pin assignment

14 — 1
25 — 13

Sub-D connector
25-pole, male

Pin No.	Meaning
1	Channel 1 Ground incremental encoder emulation
2	Channel 1 External power supply +5 V IEE
3	Channel 1 Incremental encoder emulation track 0
4	Channel 1 Incremental encoder emulation track -0
5	Channel 1 Incremental encoder emulation track B
15	Channel 1 Incremental encoder emulation track -A
16	Channel 1 Incremental encoder emulation track A
17	Channel 1 Incremental encoder emulation track -B
9	Channel 2 Ground incremental encoder emulation
10	Channel 2 External power supply +5 V IEE
11	Channel 2 Incremental encoder emulation track 0
12	Channel 2 Incremental encoder emulation track -0
13	Channel 2 Incremental encoder emulation track B
23	Channel 2 Incremental encoder emulation track -A
24	Channel 2 Incremental encoder emulation track A
25	Channel 2 Incremental encoder emulation track -B

5.4.4 Connecting cable MOD

The connection cable has to be manufactured by the user:

1 use following materials:
- cable: LiYCY LiYCY 3 x (2 x 0,14 mm²) + 2 x 0,34 mm² Cu-braiding.
- Sub-D connector: 25-pole, female (IEE side)
- e.g. Sub-D connector: 26-pole, male (b maXX 5000 side)
- cables from the incremental encoder emulation to the further control units must provide paired cables per track! (track -0/0, -A/A, -B/B)

2 connect
- the cable shield with the housing of the Sub-D male / Sub-D female connector
- the 25-pole female connector (IEE side) with the cable
- e.g. the 26-pole Sub-D male connector (b maXX 5000 side, pin assignment see Instruction handbook **b maXX 5000**) with the other end of the cable.

> **NOTE!**
>
> If both channels are used, a second cable with a further 26-pole sub D connector must be led through the 25-pole sub D connector (cable is splitted).

View on s

Channel 1

Channel 2

View on solder pin side
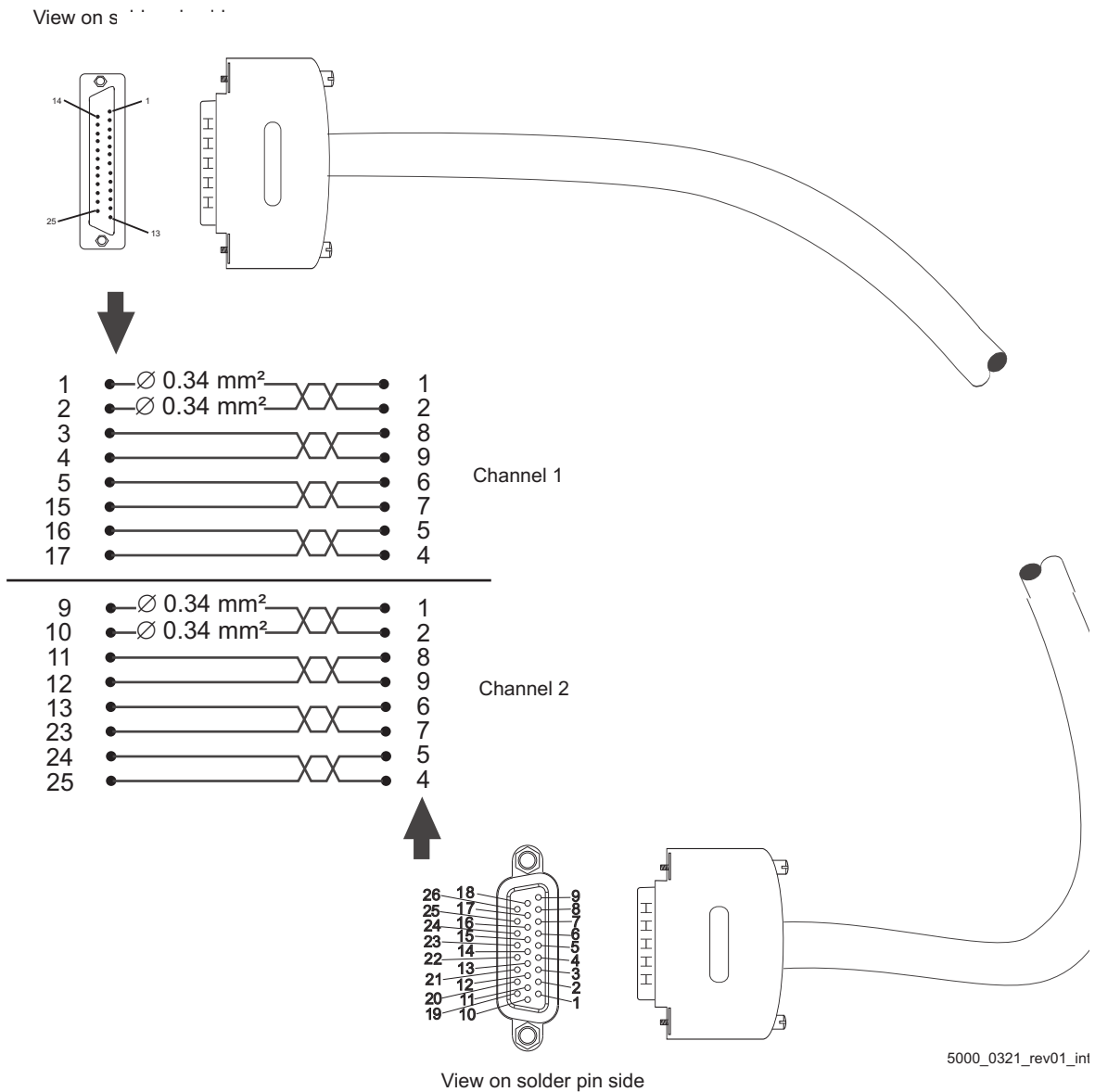
Figure 6: Connection cable MOD with b maXX 5000

> **NOTE!**
>
> The connection cable must be manufactured according the above mentioned instruction with the ▷Pin assignment MOD◁ on page 29!
> The cable is not working with another pin assignment!

COMMISSIONING/OPERATION

The commissioning ensures that the **b maXX 5000 add-on module MOD** was correctly detected and that it operates. For further information on commissioning and parameterization see parameter handbook **b maXX 5000**.

The following conditions must be complied with before commissioning:

1   Wiring of the **Modbus/TCP (MOD)** is done properly (MOD as shown in example in ▷Figure 5◁ on page 27).

2   The switching cabinet is closed properly and all the safety devices have also been put into operation.

3   The **b maXX 5000** is ready for use.

6.1   Safety notes

In general

	WARNING!
⚠	**Risk of injury due to improper operation!**
	Improper operation can lead to severe personal injury or material damage.
	Therefore:
	• Perform all operational steps according to the details of these instruction handbook.
	• Before beginning any work, ensure that all coverings and protective devices are installed and are functioning properly.
	• The control cabinet in which the device is installed should be protected against contact with electrically live parts. Keep all doors of the control cabinet closed during operation.

6.2 Commissioning procedure IEE

The commissioning is divided into the following tasks:

1 Recognition of the **incremental encoder emulation IEE**
2 Configuring the **incremental encoder emulation IEE**
3 Testing the function

6.2.1 Recognition of the incremental encoder emulation IEE

While starting the device, the controller reads out the identifier of the incremental encoder emulation(s) automatically.

After that, check with ProDrive whether the **incremental encoder emulation IEE** has been identified as correct:

1 Switch on **b maXX 5000**
2 Wait till the system has booted.
3 Open the window „**Startpage**" in ProDrive.
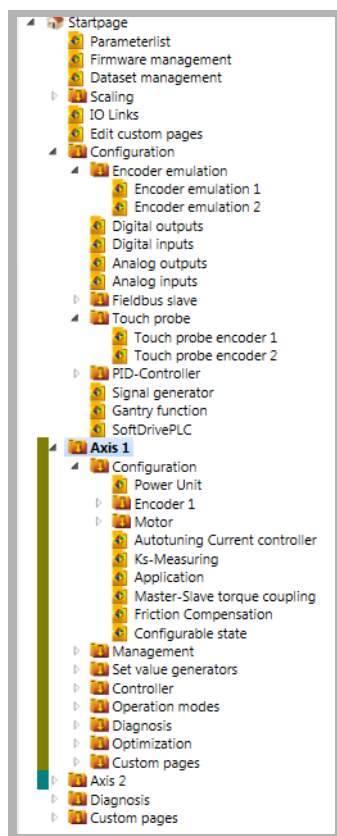
Figure 7:   .ProDrive Navigation

4 Select sub-menu „Axis 1/management"

and reset any faults/error messages eventually existing in the **b maXX 5000**.
These errors possibly were caused by faulty mounting (e.g. defect cables) or faulty installation (e.g. missing voltage supply). After the errors were removed commissioning can be continued.
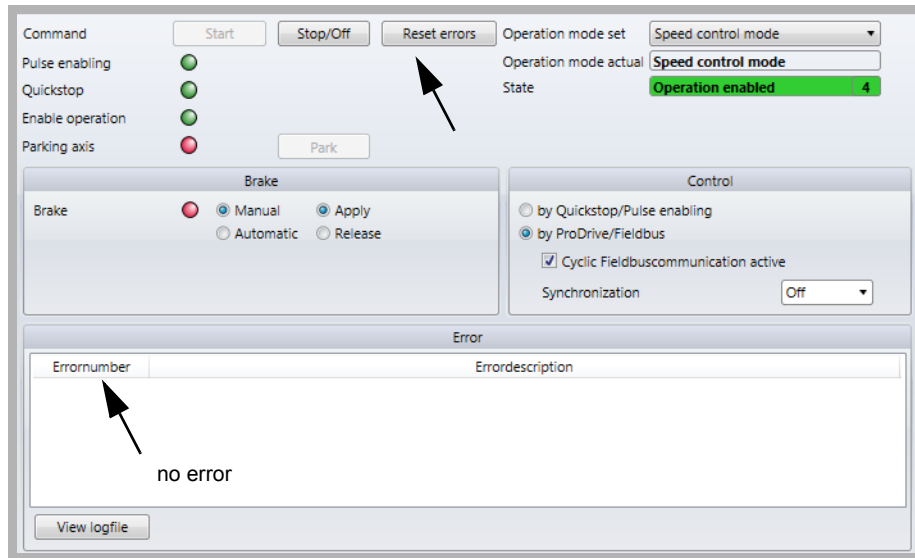
Figure 8:   Drive management, reset errors

5 Activate encoder emulation in Configuration/Encoder emulation
Choose „Encoder emulation 1" or „Encoder emulation 2"
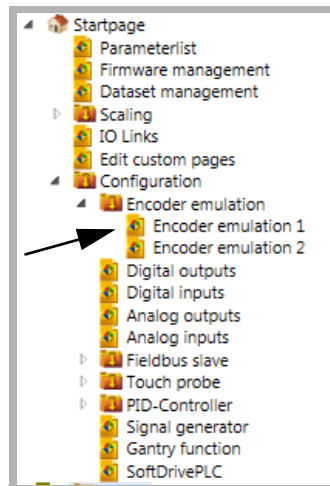
Figure 9:   ProDrive, activate encoder emulation

If the **b maXX 5000 add-on module MOD** has not been identified as correct or if it is not available, following error message is generated after activating the incremental encoder emulation.
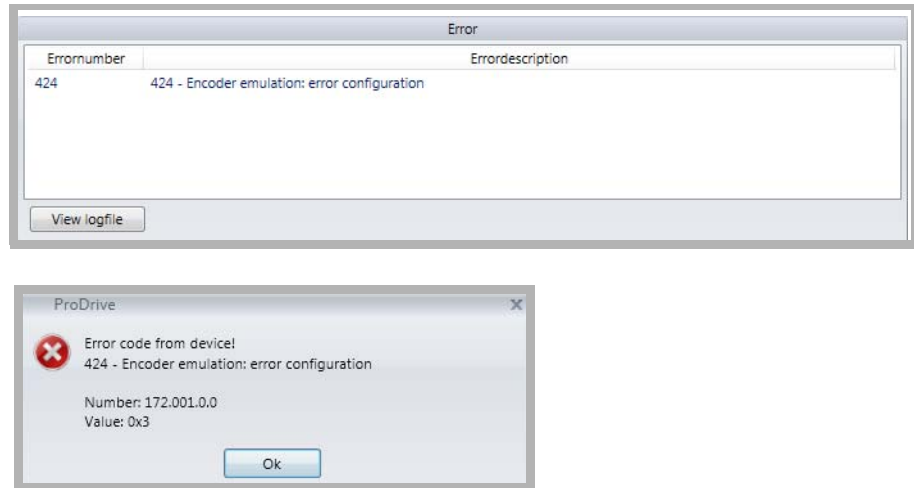
Figure 10:   Drive management, IEE cannot be identified

NOTE

All error parameters of the incremental encoder emulation can be found in chapter ▷Troubleshooting and fault correction◁ from page 77.

○ Check the type code of the **b maXX 5000**, whether the device provides an **add-on module MOD**.
Re-boot the device and check if the **add-on module MOD** is identified correctly, now.

○ The **b maXX 5000** with **add-on module MOD** is damaged if it is still not identified. For replacement, contact Baumüller Nürnberg GmbH.

6.2.2   Parameter setting IEE

The parameter setting influences the behavior of the incremental encoder emulation IEE while operating. The parameters are set in ProDrive.

1 Open ProDrive „Navigation"

2 Choose in configuration/Encoder emulation
„Encoder emulation 1" or „Encoder emulation 2"
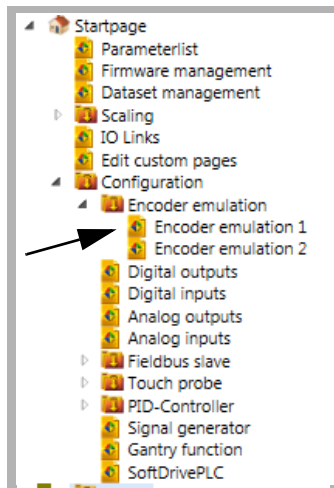
Figure 11:   ProDrive, encoder emulation

3 In window „Encoder emulation 1" all IEE relevant parameters referring to channel 1 (connector **X1**) can be set.
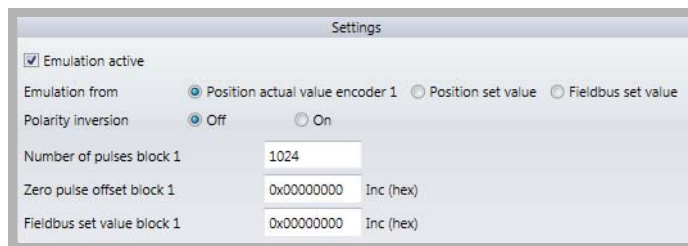
Figure 12:   IEE relevant parameters channel 1

4 In window „Encoder emulation 2" all IEE relevant parameters referring to channel 2 (connector **X2**) can be set.
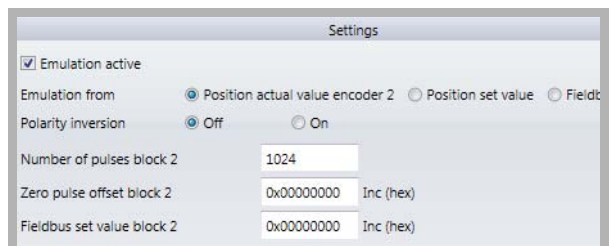
Figure 13:   IEE relevant parameters channel 2

6.2.3 Function test IEE

The incremental encoder emulation can be tested with **b maXX 5000**, motor and encoder, only.

Requirements

1 Drive is in operating state (see parameter manual **b maXX 5000**). Encoder 1 connected with **X7 Encoder 1** for motor control.

2 **b maXX 5000** switched off again after successful first commissioning.

3 Connect output of **add-on module MOD** with input of **X8 Encoder 2** (connecting cable see ▷Connecting cable MOD◁ auf Seite 29).
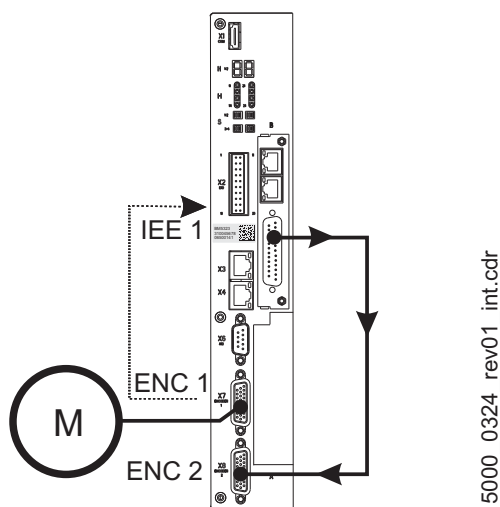
Figure 14:   Connection incremental encoder

NOTE

If you want to use some other configuration, please turn to examples 2 and 3 in ▷Figure 5◁ on page 27. In the following the above mentioned configuration is described, however.

---

4 Switch on **b maXX 5000**

5 Start ProDrive

6 Choose ProDrive Navigation, „Configuration/Encoder emulation 1"

7 All values and selections must be made according following ▷Figure 15◁ in this window. The settings correspond with the signal of a square wave incremental encoder with 1024 increments.
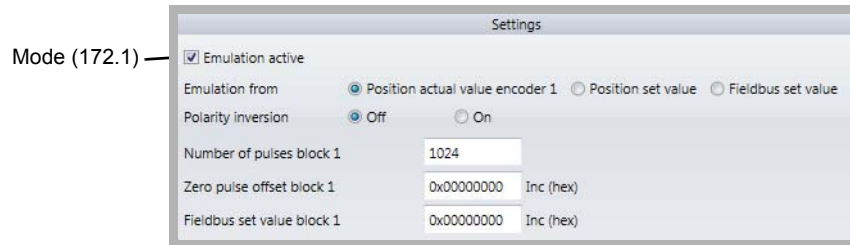
Mode (172.1) ——

Figure 15:   Encoder emulation 1 - settings

This corresponds with the following settings of the parameter list.

Parameter	Value
Mode (172.1)	0x0000 0001 (1_{dec})
No. of increments (172.3)	1024_{dec}
Zero pulse offset (172.4)	0x0000 0000 (0_{dec})

NOTE

If the set value for the IEE is not generated by an encoder, as described in example above, the „Source" (regarding **7**) in window encoder emulation must be set to „Position set value" or „Fieldbus set value".

8 Choose in ProDrive Navigation „Configuration/Encoder/Encoder 2"

9 Set all values and selections according ▷Figure 16◁ in this window.

Encoder data			State	
Encoder type	Square-wave incremental encoder	...	State	**active**
Number of pulses	1024		Actual values	
Number of revolutions	1	Rev	Encoder actual angle	0x00200000	Inc (hex)

Encoder type: Square-wave incremental encoder ...
Number of pulses: 1024
Number of revolutions: 1 Rev

Configuration
Mode: PT1-Filter
Time constant speed act. value filter: 0.00 ms
Time constant speed display: 10.00 ms
M0-Offset angle: 0x00000000 Inc (hex)
M0-Offset revolution: 0x00000000

State: **active**

Actual values
Encoder actual angle: 0x00200000 Inc (hex)
Speed: 0 Inc/ms
Speed filtered: 0.0000 rpm
Position actual angle 32 bit: 0x00200000 Inc (hex)
Position act value revolutions: 0 Rev
Position actual value: 0x00000020 Inc (hex)
Motor angle: 0x08AB0000 Inc (hex)
Motor angle SI: 12.19 degree

Figure 16:   Window Encoder 2 - Configuration

10 Choose in ProDrive Navigation „Set value generator/Ramp function generator".

Mode
☐ Disable negative set values
☐ Disable positive set values
☐ Inverting input value
☐ Speed actual value synchronization off
☐ With rounding-off

◉ Error message by active limit switch
○ Error message and stop by active limit switch
○ Stop by active limit switch

◉ Quickstop-time apply to 100% -> 0%
○ Quickstop-time apply to actual set value -> 0%

Speed profil
◉ Trapezoid   ○ S curve

Input selection
◉ 32 bit input   ○ 16 bit input

Control
[RFG Lock] Fix output to 0
[RFG Stop] Hold output value
[RFG Zero] Ramp-down to 0

Hardware limit switch
Negative hardware limit switch ○
Positive hardware limit switch ○

State
Ramp function generator active ○
RFG locked ○
RFG stopped ○
Set value reached ○
Ramp-up active ○
Ramp-down active ○
Setvalue lock at positive direction ○
Setvalue lock at negative direction ○
Limit switch lock in neg. direction ○
Limit switch lock in pos. direction ○
Set value locked ○
Quickstop ramp active ○
Input limited at min. amount ○
Input limited at max. amount ○

Maximum drive speed 6000.00 rpm

Input max. amount 100.0000 %
Input 32 bit 10.0000 %
Input min. amount 0.0000 %

Set value zone
Output
Smoothing

Input 32 bit additive 0.0000 %   Ramp-up time 500 ms   Ramp-down time 0 m

Figure 17:   Window Ramp function generator

11 Set following parameters:

● Ramp function generator input

◖ Set value „10" [%] beside „Input 32 bit". Accept with „Enter".

12 Click to the icon „Drive management".

In addition window „Drive manager dialog" appears.
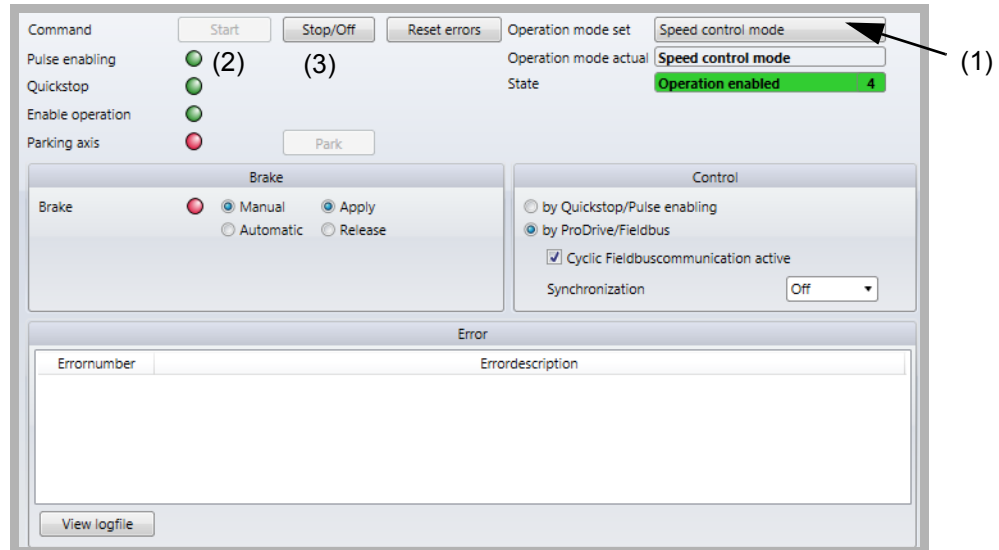
Figure 18:   Ramp function generator - window with drive manager dialog

13 Select in scroll list (1) the operation mode „Speed control"

14 Switch on Pulse enable and No Quickstop

15 Click on button „Start" (2) in drive management dialog.

The motor should rotate with 10 % of the maximum speed.

Control:

16 Choose in ProDrive Navigation „Configuration/Encoder/Encoder 1".

17 In this window:
Speed smoothed: approx. 10 %

> **NOTE**
>
> Do not click on button „Stop" (3) in the drive management dialog! First check, whether the speed actual value is transmitted to encoder 2 via the incremental encoder emulation IEE.

18 Choose in ProDrive Navigation „Configuration/Encoder/Encoder 2".

19 In this window:
Speed smoothed: approx. 10 %

NOTE

If the generated signal of the **add-on module MOD** is processed in a higher level control, please check the position values there.

Stop the drive after having checked the proper functioning of the **add-on module MOD**:

○ Click on „Stop" (3) in drive manager dialog menu

○ Disable Quickstop release and pulse enable

○ Switch off **b maXX 5000** and disconnect the connections

○ Record the successful commissioning.

GENERAL DESCRIPTION

7.1 Configure IP address

The IP address either can be configured via ProDrive permanently or defined via the fieldbus by DHCP or BOOTP.

Static IP addresses can be assigned via the ProDrive only.

Via the fieldbus statical IP addresses as well as DHCP or BOOTP addresses can be assigned.

If the address is accepted by ProDrive or is configured via the fieldbus depends of the host IP address which was configured in ProDrive.

If **host IP unequal 0**	The ProDrive settings are used for MOD
If **host IP equals 0**	The MOD- IP settings must be made via the fieldbus. Initially DHCP is used

Description of **Host-IP**:

Host-IP = A combination of network mask and IP address.

For example network mask = 255.255.0.0; IP address = 192.168.12.56 → Host IP = 12.56

NOTE

The IP settings that are in ProDrive are evaluated at startup, only. Therefore all settings here must be saved via ProDrive and the device must be started again.

A valid Gateway address must be assigned in parameter 131.16.

> **NOTE**
>
> A TCP communication with ProDrive is only possible as long as no cyclic communication via the EtherNet/IP scanner is established.
>
> Using version 1.16 and higher the TCP communication with ProDrive is possible at phases of cyclic communication if bit 0 in controller parameter 131.21 (fieldbus configuration profile 1) is set.

> **CAUTION!**
>
> An additional TCP communication added to an existing cyclic communication can result in collisions of telegrams and failure of cyclic data. New position values/speed values cannot be transmitted, under certain circumstances this can lead to damage of products to be produced or of machine /mechanics.

7.1.1 Accept the IP address of ProDrive

As long as from the IP address settings in ProDrive no host IP address of 0 results the IP settings in ProDrive for Modbus/TCP are accepted 1:1

Example 1: Network IP 192.168.1, host IP 21 via manually input

Via the following settings the device can be configured to the IP address 192.168.1.21

Settings	
IP address ○ Base IP address + DIP switch settings	
◉ Manual input	
MAC address	00-02-A2-34-0F-F5
Software IP address	192.168.1.21
Actual IP address	192.168.1.21
Gateway	192.168.1.0
Subnet mask	255.255.255.0
Slave error code	0 - No error
Fieldbus cycle time	1000 µs ▼
CoE-objectlist language selection	◉ Deutsch
	○ English
Division ratio fieldbus task	1 ▼

Figure 19: Manual input

Example 2: Network IP 17 via dip switch

Via the following settings the device can be configured to the IP address 192.168.0.17

Figure 20:   Setting via the dip switch
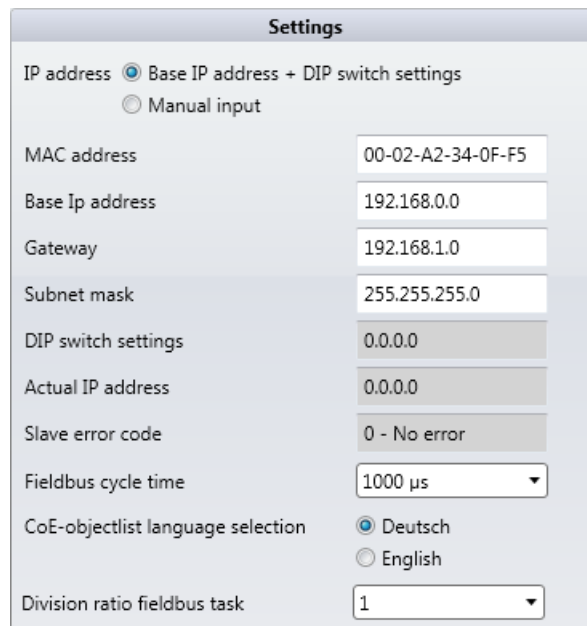
7.1.2 Accept IP setting of fieldbus

So that the fieldbus can control the IP settings via the ProDrive settings the host IP must be 0.

Then the IP settings can be made via DHCP or BOOTP.

Example 3: Host IP = 0 via the dip switch

All dip switches are on 0:

Settings	
IP address ⦿ Base IP address + DIP switch settings	
○ Manual input	
MAC address	00-02-A2-34-0F-F5
Base Ip address	192.168.0.0
Gateway	192.168.1.0
Subnet mask	255.255.255.0
DIP switch settings	0.0.0.0
Actual IP address	0.0.0.0
Slave error code	0 - No error
Fieldbus cycle time	1000 µs ▾
CoE-objectlist language selection	⦿ Deutsch
	○ English
Division ratio fieldbus task	1 ▾

Figure 21:   Settings of the fieldbus

Activate DHCP

DHCP is always activated if the configuration method changes from „ProDrive" to the „Fieldbus"

◖ The device starts with the host IP = 0, which was configured in the controller

◖ Via the ProDrive (or dip switch) the host IP is set to 0

◖ Device is started again

◖ Now the device operated in the DHCP mode

Activate BootP

BootP can be activated via the fieldbus, only.

7.2 Modbus function codes

The Modbus/TCP add on module supports word access (16 bits) to Modbus register, only.

The following function codes are supported:

Function code	Meaning
FC3	Read multiple register (WORD access)
FC4	Read input register (WORD access)
FC6	Write single register (WORD access)
FC16	Write multiple register (WORD access)
FC23	Read/Write multiple register

7.3 Process data (cyclic communication)

The cyclic communication can be configured by Modbus register 000 to 599. The communication exchanges defined parameters (objects) between the Modubus/TCP client and the b maXX 5000 Modubus/TCP server.The exchanged parameters are named process data objects (PDO).

Modbus register	Meaning
000 – 001	Modbus status word
002 – 065	Actual process data (Actual PDO)
066 – 099	Reserved
100 – 101	Modbus control word
102 – 165	Set process data (Set PDO)
166 – 199	Reserved
200 – 201	Error code
202	Cycle time of the process data communication
203	Actual value watchdog time
204	Set value watchdog time
205 – 209	Reserved
210 – 337	Actual process data mapping
338 – 409	Reserved
410 – 537	Set process data mapping
538 – 599	Reserved

7.3.1 Process data mapping

The process data mapping of the b maXX 5000 can be configured by the Modbus register 210 - 337 (actual process data mapping) and register 410 - 537 (set process data mapping). The mapping configuration sets the parameters mapped on the Modbus register addresses 2 - 65) (actual process data) and 102 - 165 (set process data).

The mapped parameters can be read or written via the process data register in state Pre-operational.

The writing of mapping register is only possible in state Pre-operational.

The mapped parameter is written to via function block (FB), parameter number (PNR), instance of the function block (FBI) and axis number. All mapped parameters are wirtten to in a list for actual process data (actual process data mapping) and another list for set process data (set process data mapping):

Actual process data mapping: Register 210 - 337

List of the parameter, which are mapped to the actual process data

- FB =   Register 210 + (PDO_number * 4)
- PNR =   Register 211 + (PDO_number * 4)
- FBI =   Register 212 + (PDO_number * 4)
- AXIS =   Register 213 + (PDO_number * 4)

Set process data mapping: Register 410 - 537

List of the parameter, which are mapped to the set process data

- FB =   Register 410 + (PDO_number * 4)
- PNR =   Register 411 + (PDO_number * 4)
- FBI =   Register 412 + (PDO_number * 4)
- AXIS =   Register 413 + (PDO_number * 4)

The last mapped parameter is followed by an FB value of 0. No FB value of 0 is allowed if all possible parameters should be mapped

An invalid mapping configuration is displayed not before the status is changed to Operational. An invalid configuration is shown by the set bit 5 in status word (▷Status word◁ on page 53) and a corresponding error code can be read in register address 200 - 201 (see ▷General errors◁ on page 58).

16 actual and set values can be mapped in b maXX 5000 single axis unit
32 actual and set values can be mapped in b maXX 5000 double axis unit

Mapping b maXX 5000 Single axis:

Modbus register	Name	Access	Meaning
210	Actual PDO Mapping 0 FB	Read-Write	FB of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
211	Actual PDO Mapping 0 PNR	Read-Write	PNR of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
212	Actual PDO Mapping 0 FBI	Read-Write	FBI of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
213	Actual PDO Mapping 0 axis	Read-Write	Axis of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
214	Actual PDO Mapping 1 FB	Read-Write	FB of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
215	Actual PDO Mapping 1 PNR	Read-Write	PNR of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
216	Actual PDO Mapping 1 FBI	Read-Write	FBI of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
217	Actual PDO Mapping 1 axis	Read-Write	Axis of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
…			
270	Actual PDO Mapping 15 FB	Read-Write	FB of the parameter, which is mapped on the last digit of the actual values. (Modbus address 32-33)
271	Actual PDO Mapping 15 PNR	Read-Write	PNR of the parameter, which is mapped on the last digit of the actual values. (Modbus address 32-33)
272	Actual PDO Mapping 15 FBI	Read-Write	FBI of the parameter, which is mapped on the last digit of the actual values. (Modbus address 32-33)
273	Actual PDO Mapping 15 axis	Read-Write	Axis of the parameter, which is mapped on the last digit of the actual values. (Modbus address 32-33)
410	Set PDO Mapping 0 FB	Read-Write	FB of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
411	Set PDO Mapping 0 PNR	Read-Write	PNR of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
412	Set PDO Mapping 0 FBI	Read-Write	FBI of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
413	Set PDO Mapping 0 axis	Read-Write	Axis of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
414	Set PDO Mapping 1 FB	Read-Write	FB of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
415	Set PDO Mapping 1 PNR	Read-Write	PNR of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
416	Set PDO Mapping 1 FBI	Read-Write	FBI of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)

Modbus register	Name	Access	Meaning
417	Set PDO Mapping 1 axis	Read-Write	Axis of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
…			
470	Set PDO Mapping 15 FB	Read-Write	FB of the parameter, which is mapped on the last digit of the set values. (Modbus address 132-133)
471	Set PDO Mapping 15 PNR	Read-Write	PNR of the parameter, which is mapped on the last digit of the set values. (Modbus address 132-133)
472	Set PDO Mapping 15 FBI	Read-Write	FBI of the parameter, which is mapped on the last digit of the set values. (Modbus address 132-133)
473	Set PDO Mapping 15 axis	Read-Write	Axis of the parameter, which is mapped on the last digit of the set values. (Modbus address 132-133)

Mapping b maXX 5000 Double axis:

Modbus register	Name	Access	Meaning
210	Actual PDO Mapping 0 FB	Read-Write	FB of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
211	Actual PDO Mapping 0 PNR	Read-Write	PNR of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
212	Actual PDO Mapping 0 FBI	Read-Write	FBI of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
213	Actual PDO Mapping 0 Axis	Read-Write	Axis of the parameter, which is mapped on the first digit of the actual values. (Modbus address 2-3)
214	Actual PDO Mapping 1 FB	Read-Write	FB of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
215	Actual PDO Mapping 1 PNR	Read-Write	PNR of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
216	Actual PDO Mapping 1 FBI	Read-Write	FBI of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
217	Actual PDO Mapping 1 Axis	Read-Write	Axis of the parameter, which is mapped on the second digit of the actual values. (Modbus address 4-5)
…			
334	Actual PDO Mapping 31 FB	Read-Write	FB of the parameter, which is mapped on the last digit of the actual values. (Modbus address 64-65)
335	Actual PDO Mapping 31 PNR	Read-Write	PNR of the parameter, which is mapped on the last digit of the actual values. (Modbus address 64-65)
336	Actual PDO Mapping 31 FBI	Read-Write	FBI of the parameter, which is mapped on the last digit of the actual values. (Modbus address 64-65)
337	Actual PDO Mapping 31 Axis	Read-Write	Axis of the parameter, which is mapped on the last digit of the actual values. (Modbus address 64-65)

Modbus register	Name	Access	Meaning
410	Set PDO Mapping 0 FB	Read-Write	FB of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
411	Set PDO Mapping 0 PNR	Read-Write	PNR of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
412	Set PDO Mapping 0 FBI	Read-Write	FBI of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
413	Set PDO Mapping 0 Axis	Read-Write	Axis of the parameter, which is mapped on the first digit of the set values. (Modbus address 102-103)
414	Set PDO Mapping 1 FB	Read-Write	FB of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
415	Set PDO Mapping 1 PNR	Read-Write	PNR of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
416	Set PDO Mapping 1 FBI	Read-Write	FBI of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
417	Set PDO Mapping 1 Axis	Read-Write	Axis of the parameter, which is mapped on the second digit of the set values. (Modbus address 104-105)
…			
534	Set PDO Mapping 31 FB	Read-Write	FB of the parameter, which is mapped on the last digit of the set values. (Modbus address 164-165)
535	Set PDO Mapping 31 PNR	Read-Write	PNR of the parameter, which is mapped on the last digit of the set values. (Modbus address 164-165)
536	Set PDO Mapping 31 FBI	Read-Write	FBI of the parameter, which is mapped on the last digit of the set values. (Modbus address 164-165)
537	Set PDO Mapping 31 Axis	Read-Write	Axis of the parameter, which is mapped on the last digit of the set values. (Modbus address 164-165)

Example

Two parameter should be mapped on the actual process data and a parameter should be mapped on the set process data.

Actual process data (Actual PDO):

> PDO 0: FB = 126; PNR = 61; FBI = 0; first axis
>
> PDO 1: FB = 126; PNR = 62; FBI = 0; second axis

Set process data (Set PDO):

> PDO 0: FB=126: PNR=41; FBI=0; first axis

The following values must be written in the Modbus registers;

- For Actual PDO 0:
    - Register 210 = 126
    - Register 211 = 61
    - Register 212 = 0
    - Register 213 = 1
- For Actual PDO 1:
    - Register 214 = 126
    - Register 215 = 62
    - Register 216 = 0
    - Register 217 = 2
- End of marking:
    - Register 218 = 0

- For Set PDO 0:
    - Register 310 = 126
    - Register 311 = 41
    - Register 312 = 0
    - Register 313 = 1
- End of marking
    - Register 314 = 0

7.3.2   Cycle time of the process data

The cycle time of the process data communication is configured via Modbus register 202. The following cycle times are supported by the b maXX 5000:

- 500 µs
- 1000 µs
- 2000 µs
- 4000 µs
- 8000 µs

7.3.3   Process data exchange

The b maXX process data can be read by Modbus register 2 to 65 (actual process data) and can be wirtten by Modus register 102 to 165 (set process data). The parameters are selected depending on the process data mapping (see ▷Process data mapping◁ on page 46).

Parameters are mapped not before state Operational on the process data register (see ▷Operational◁ on page 57).

In state Operational the process data is written cyclically to the Modbus register and is read ´cyclically from the Modbus register.

Each parameter is mapped to two 16 bit Modbus register.

Actual process data:

Actual PDO n Low Word = 2 + (2*n)

Actual PDO n High Word = 3 + (2*n)

Set process data:

Set PDO n Low Word = 102 + (2*n)

Set PDO n High Word = 103 + (2*n)

b maXX 5000 Single axis: n = 0 to 15; b maXX 5000 Double axis: n = 0 to 31

16 actual and set values can be transmitted using a b maXX 5000 single axis unit and 32 actual and set values can be transmitted using a b maXX 5000 double axis unit.

Process data b maXX 5000 Single axis:

Range	Modbus register	Name	Access	Meaning
Actual process data	2 – 3	Actual PDO 0	Read-only	First 32 bit Actual process data object. Depending on configured mapping.
	4 – 5	Actual PDO 1	Read-only	Second 32 bit Actual process data object. Depending on configured mapping.
	…			
	32 – 33	Actual PDO 15	Read-only	Last 32 bit Actual process data object. Depending on configured mapping.
Set process data	102 – 103	Set PDO 0	Read-Write	First 32 bit Set process data object. Depending on configured mapping.
	104 – 105	Set PDO 1	Read-Write	Second 32 bit Set process data object. Depending on configured mapping.
	…			
	132 – 133	Set PDO 15	Read-Write	Last 32 bit Set process data object. Depending on configured mapping.

Process data b maXX 5000 Double axis:

Range	Modbus register	Name	Access	Meaning
Actual process data	2 – 3	Actual PDO 0	Read-only	First 32 bit Actual process data object. Depending on configured mapping.
	4 – 5	Actual PDO 1	Read-only	Second 32 bit Actual process data object. Depending on configured mapping.
	…			
	64 – 65	Actual PDO 31	Read-only	Last 32 bit Actual process data object. Depending on configured mapping.
Set process data	102 – 103	Set PDO 0	Read-Write	First 32 bit Set process data object. Depending on configured mapping.
	104 – 105	Set PDO 1	Read-Write	Second 32 bit Set process data object. Depending on configured mapping.
	…			
	164 – 165	Set PDO 31	Read-Write	Last 32 bit Set process data object. Depending on configured mapping.

7.4 Status word and Control word

7.4.1 Status word

The system state and the error state can be requested in the status word. The status word and the actual process data can be transmitted withing the same Modbus function code because the status word is in Modbus register 0 directly previous to the actual process data.

Each reading access to the status word restarts the actual value watchdog (see ▷Actual Value Watchdog◁ on page 58).

Modbus register	Bit no.	Name	Access	Meaning
0	0	Status	Read-only	0 = Pre Operational 1 = Operational
0	1	Actual value Watchdog caused	Read-only	0 = Watchdog ok 1 = Watchdog caused
0	2	Set value Watchdog caused	Read-only	0 = Watchdog ok 1 = Watchdog caused
0	3	Actual values from the controller are not read out from the Modbus register	Read-only	0 = No error 1 = Error
0	4	Set values to the controller are not written in the Modbus register	Read-only	0 = No error 1 = Error
0	5	General error present -> Read out RC Code	Read-only	0 = No error 1 = Error
1	-	No function		

7.4.2   Control word

The system state can be changed and the error states acknowledged via the control word. The control word and the set process data can be transmitted withing the same Modbus function code because the control word is in Modbus register 100 directly previous to the set process data.

Each writing access to the control word restarts the set value watchdog (see ▷Set Value Watchdog◁ on page 58).

Modbus register	Bit no.	Name	Access	Meaning
100	0	Change of status	Write	0 = Pre-Operational 1 = Operational
100	1	Actual value Watchdog error acknowledgment	Write	1 = Acknowledge Watchdog error bit in status word
100	2	Set value Watchdog error acknowledgment	Write	1 = Acknowledge Watchdog error bit in status word
100	3	Acknowledge controller actual value error	Write	1 = Acknowledge controller error bit in status word
100	4	Acknowledge controller set value error	Write	1 = Acknowledge controller error bit in status word
100	5	Acknowledge general error	Write	1 = Acknowledge general error bit in status word
101	-	No function		

7.5   Service data (acyclic communication)

Independent to the process data the Modbus/TCP has access to all b maXX parameters.

The Modbus register 600 - 652 is used:

Modbus register	Name	Access	Meaning
600	F: Format	Read-Write	Permissible values: 0, 1
601	DS: Data set	Read-Write	Permissible values: 0 – 255
602	FB: Function block	Read-Write	Permissible values: 1 – 4095
603	PNR: Parameter number	Read-Write	Permissible values: 1 – 255
604	FBI: Instance / Index of the function block	Read-Write	Permissible values: 0 – 255
605	Index 0		
606	Index 1		
607	Index 2		
608	Index 3		
609	Axis	Read-Write	Permissible values: 1 – 2
610	Length	Read-Write	Length of the data in Byte which must be read/written Permissible values: 1, 2, 4, 8, 80
611 – 650	Data	Read-Write	Read or write access to register 611 reads/writes a b maXX parameter by means of the values which are configured in register 600 – 605. The data are written depending on the length in register 610 to address 611 -650 or The data are read depending on the length in register 610 from address 611 -650
651 – 652	Error code service data access	Read-only	Result of the service data read or write access as a b maXX error code

Register 600 - 609 contains which parameter is read or written to.

Register 611 - 650 contains the data of the parameters of register 600 - 609.

Register 610 contains the data length (bit length) of the parameter access. The length must be equal to the length of the selected b maXX parameter. Following lengths are permitted: 1, 2, 4, 8 and 80 Byte

The data access of the selected parameter is possible via register 611 - 650.

The data of register 611 to max. 650 (depending on the length setting in register 610) is written to the selected parameter in case of an writing access to register 611.

The b maXX firstly writes all values to the Modbus register and after that copies the values to the selected parameters in case of writing access to register 611 - 6xx with the function code "Write multiple register".

The data of register 611 to max. 650 (depending on the length setting in register 610) is copied to the selected parameter in case of an reading access to register 611.

The b maXX firstly copies all values to the register and after that sends the Modbus read answer with the updated data in case the of reading access to register 611 - 6xx with the function code "Read multiple register".

The result of the writing and reading access to register 611 is shown in b maXX error code in register 651 - 652. If no errors appeared, the register 651 and 652 is zero.

7.5.1 Example service data communication

To the following parameter the value 0x12345678 should be firstly written and after that should be read.

Parameter of the second axis: F = 0; DS = 0; FB = 126; PNR = 61; FBI = 0; index0-3 = 0; length = 4 Byte

1 Following values must be written to 600 - 610. The values can be written one by one or with the command „Write multiple register" :

  a) Reg. 600 (F)   = 0

  b) Reg. 601 (DS)   = 0

  c) Reg. 602 (FB)   = 126

  d) Reg. 603 (PNR)   = 61

  e) Reg. 604 (FBI)   = 0

  f) Reg. 605 - 608 (Index) = 0

  g) Reg. 609 (Axis)   = 2

  h) Reg. 610 (Length)   = 4

2 Writing of the value 0x12345678 with function code 16 "Write multiple register" to register 611 - 614.

  a) Reg. 611 = 0x78

  b) Reg. 612 = 0x56

  c) Reg. 613 = 0x34

  d) Reg. 614 = 0x12

3 Read register 651 and 652 in order to check whether the writing access has been without error.

4 Read register 611 - 614 with function code "Read multiple register". Register 600 - 610 contain the selected parameters from step 1, therefore this register must not written to again .

5 Read register 651 - 652 in order to check whether the reading access has been without error.

7.6 States of communication

7.6.1 Pre-Operational

In state Pre-Operational the device can be configured and an access to the controller parameters via register range 600 - 652 is possible.

No parameters are mapped to the process data register.

7.6.2 Operational

With the transition Pre-Operational to Operational the cyclic communication is parametrized according to the set configuration values (mapping, cycle time, watchdog time). The controller returns to state Pre-Operational automatically and sets bit 5 of the status word in case of an error in configuration. In register 200 - 201 the corresponding error code can be read.

In state Operational the mapped actual process data is written cyclically from the controller to the Modbus register 2 - 65 and the mapped set process data is read cyclically from Modbus register 100 - 165 and transfered to the b maXX parameters.

7.6.3 Switching of the state

With bit 0 of the control word the state switches from Pre-Operational to Operational and vice versa.

> Control word bit 0 = 0 -> Pre-Operational
>
> Control word bit 0 = 1 -> Operational

With bit 0 of the status word the current state can be requested

> Status word bit 0 = 0 -> Pre-Operational
>
> Status word bit 0 = 1 -> Operational

7.7 Watchdogs

Watchdogs can be configured checking whether the actual values are read in time and the set values are written in time via the Modbus.

Watchdogs are restarted in case of reading or writing to status and control word.

The status or control word must be read or written simultaneously with the process data via function code Read multiple register or Write multiple register (FC3, FC16, FC23) in order to monitor the process data transfer using this mechanism.

7.7.1 Actual Value Watchdog

- The actual value watchdog is configured by Modbus register 203
- A value of 0 deactivates the watchdog
- A value not equal 0 corresponds with the watchdog time in ms
- The watchdog can be configured in state Pre-Operational only
- The watchdog timer is restarted with the configured value in ms with every reading of the status word in state Operational. The monitoring starts with the first reading of the status word in state Operational.
- After the watchdog timer expires, bit 1 of the status word is set to 1.
- The error bit can be reseted via control word bit 1

7.7.2 Set Value Watchdog

- The set value watchdog is configured by Modbus register 204
- A value of 0 deactivates the watchdog
- A value not equal 0 corresponds with the watchdog time in ms
- The watchdog can be configured in state Pre-Operational only
- The watchdog timer is restarted with the configured value in ms with every writing of the control word in state Operational. The monitoring starts with the first writing of the control word in state Operational.
- After the watchdog timer expires, bit 2 of the status word is set to 1.
- The error bit can be reseted via control word bit 2

7.8 Controller timeout

The controller checks internally whether the mapped parameters still read or written cyclically from/to the Modbus registers. The corresponding error bit is set in the status word if the controller recognizes that the parameters are not read or written.

Status word bit 3: Actual values from the controller are not read from the Modbus register

Status word bit 4: Set values from the controller are not written to the Modbus register

The error bits can be reseted by the corresponding bits in the control word.

Control word bit 3: Resets actual value errors

Control word bit 4: Resets set value errors

7.9 General errors

Status word bit 5 is set to 1 in case an error occurs that is not displayed by another register. The corresponding b maXX error code can be read via Modbus register 200 - 201.

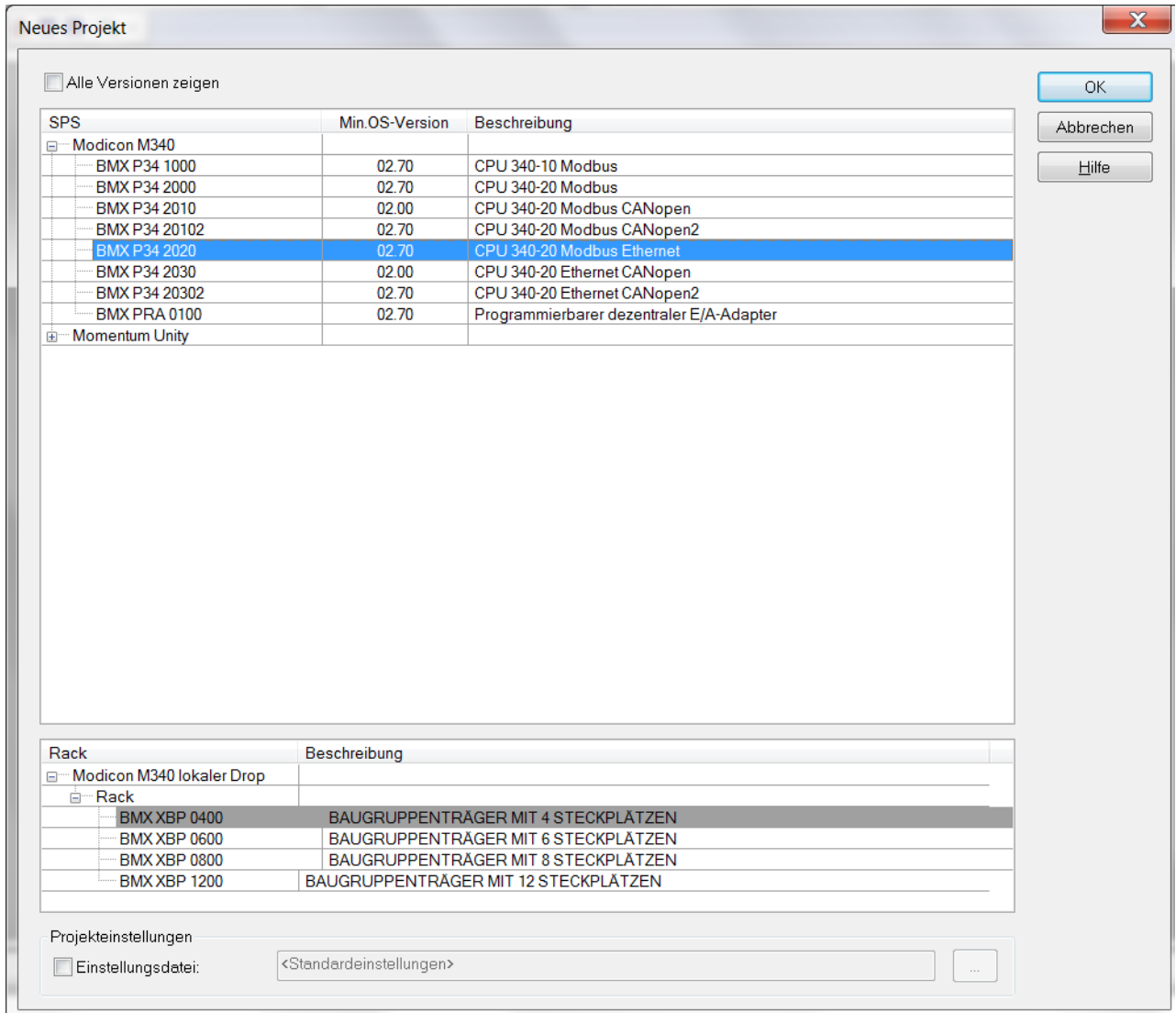Bit 5 in status word can be reseted by bit 5 in control word.

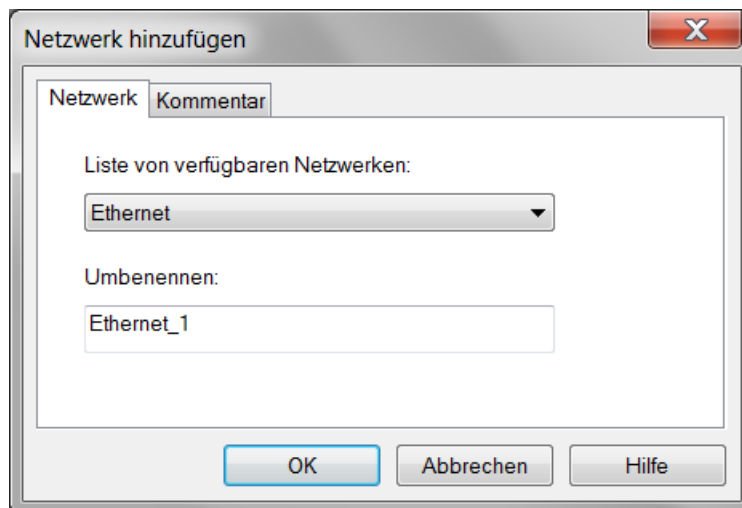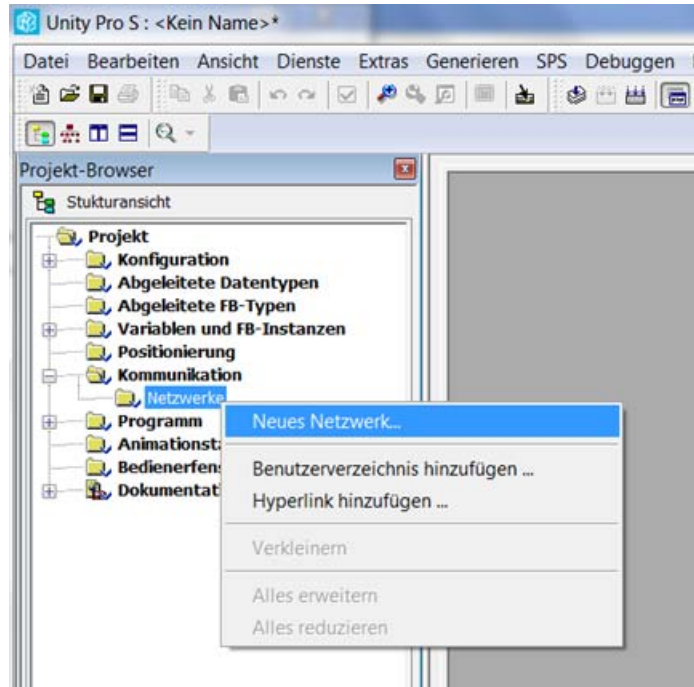# PROJECT EXAMPLE SCHNEIDER ELECTRIC UNITY PRO S

MODICON P34 2020

The b maXX 5000 was configured to the IP address 192.168.1.20 to demonstrate the following examples.

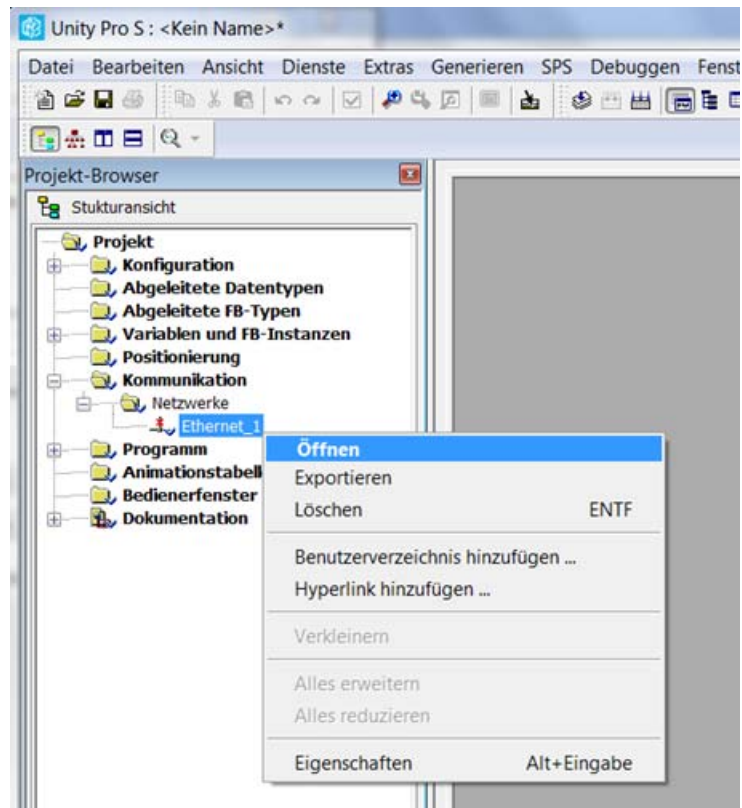## 8.1 Create projects using the corresponding Modbus client

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8.2   Add Modbus TCP Network

The model series and the IP address configuration of the Modbus TCP Client must be set in network settings. The address of the Modbus TCP Client is set via a DHCP Server in this example.The IP address of the Modbus TCP Client is set to 192.168.1.10 by the DHCP Server.
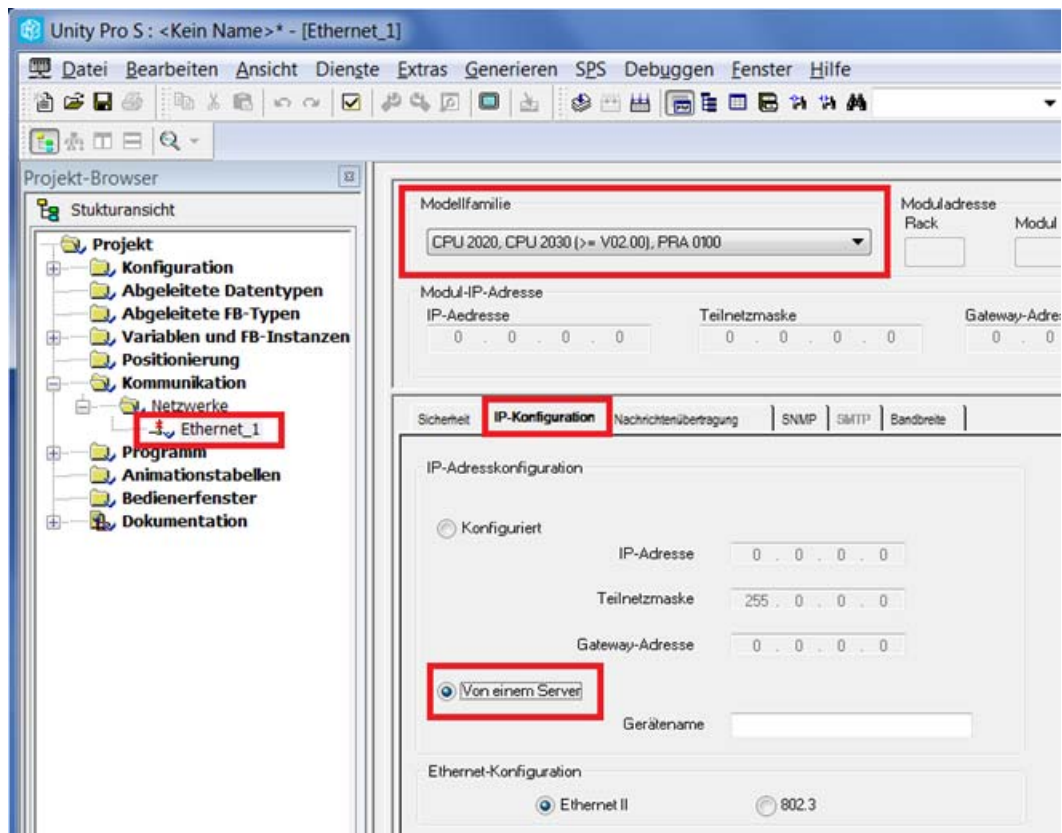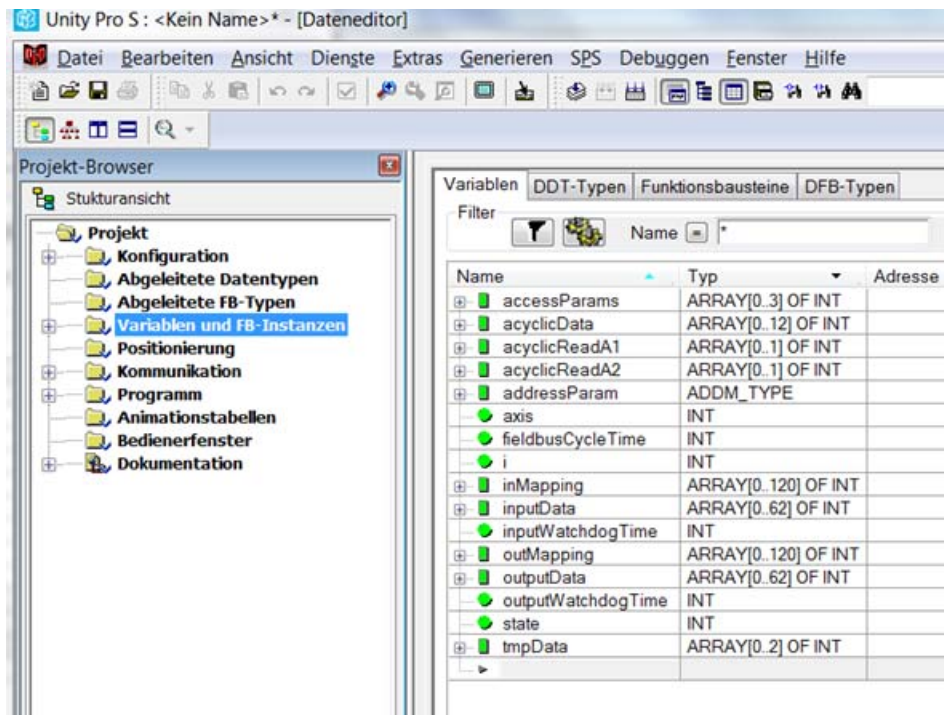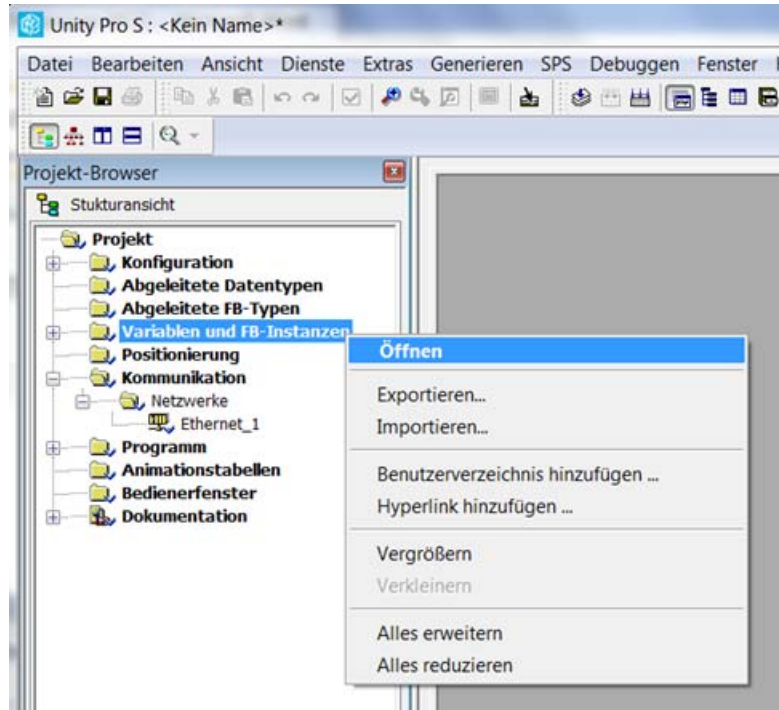
The provided network connection of the Ethernet interface must be assigned in the Ethernet configuration of the Modbus TCP Client.

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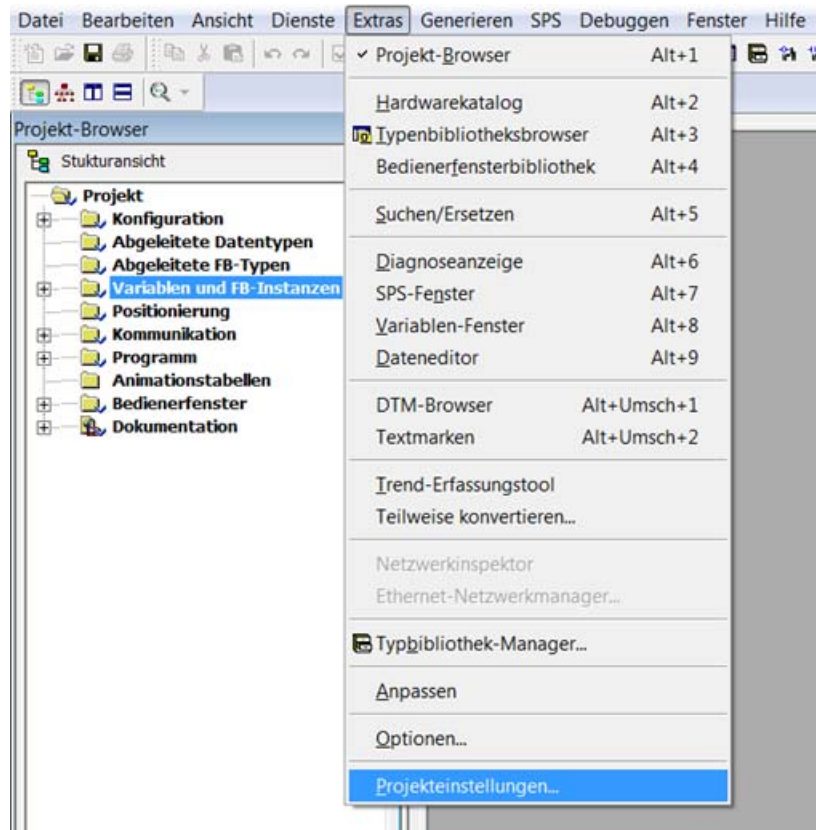
8.3 Create program
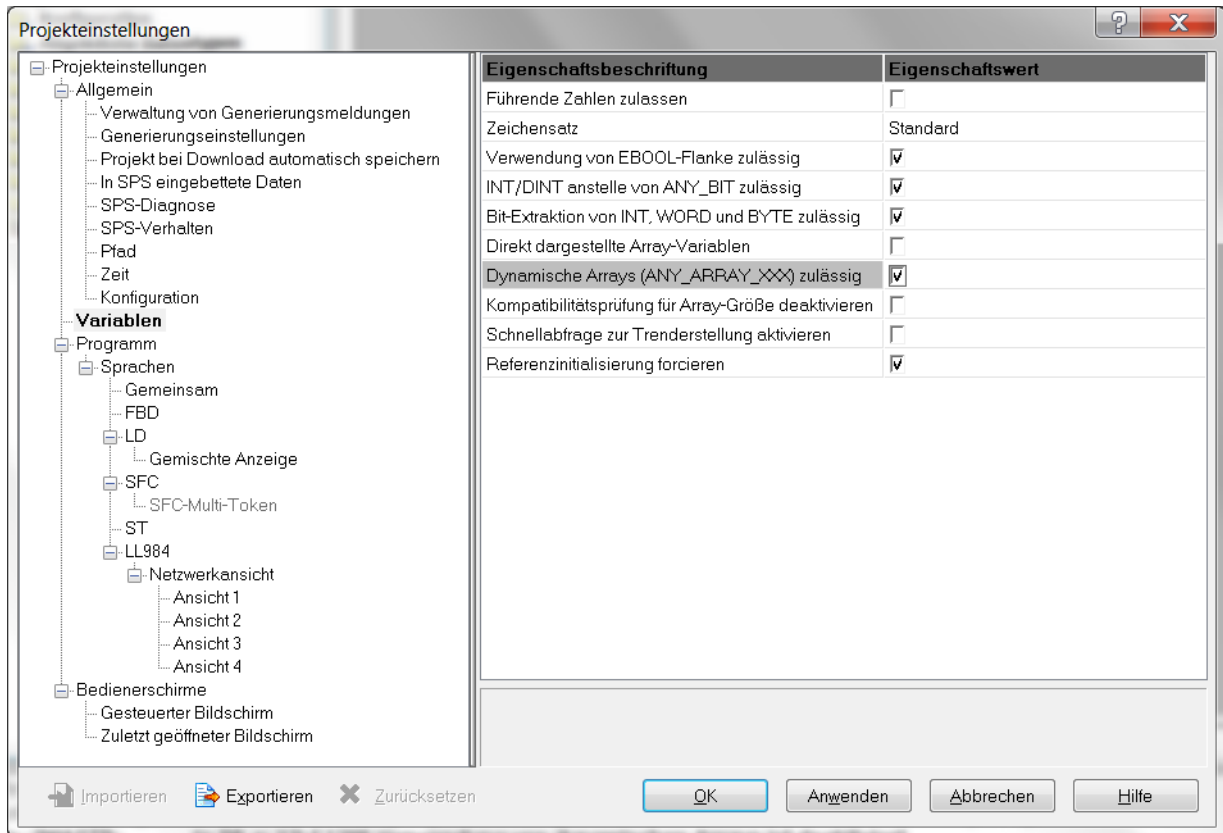
The variables used in the program must be defined.

The use of dynamic arrays must be activated within the project settings.

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A new program can be generated now. In this example a program with structured text (ST) is generated.
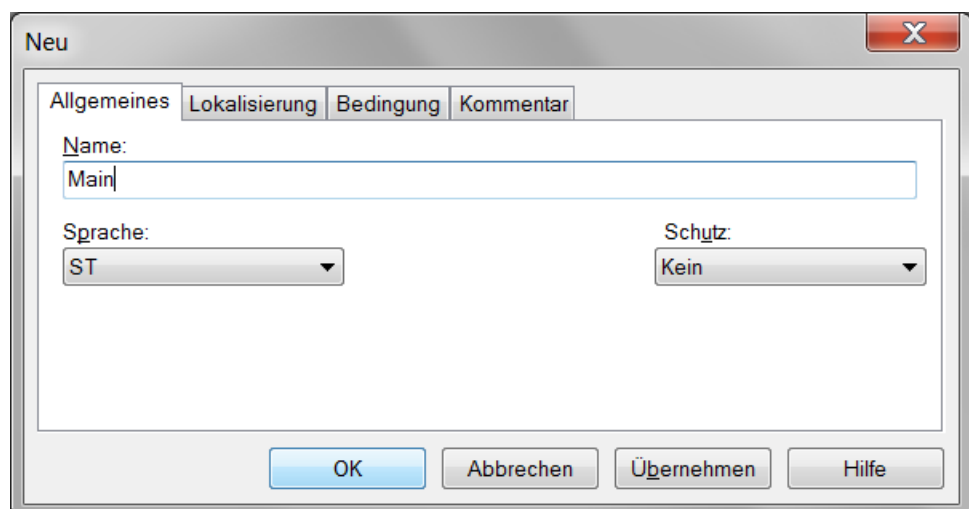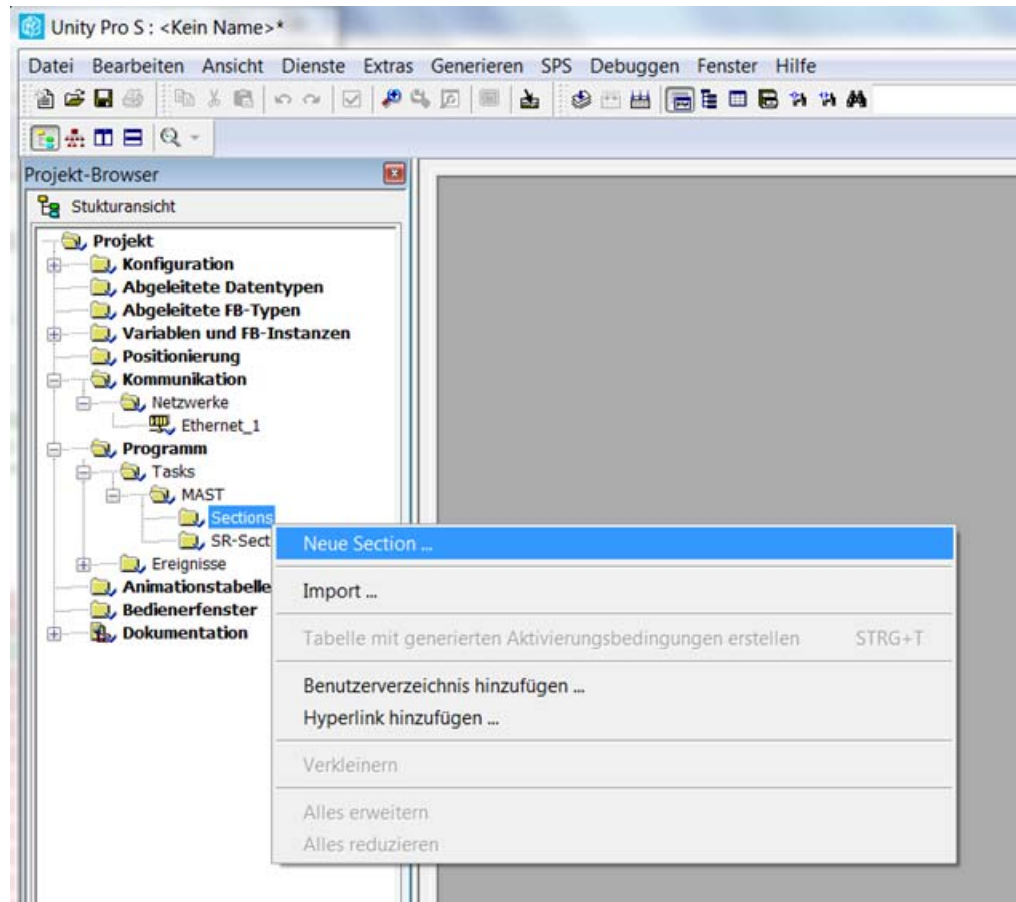
A cyclic communication with 4 ms is configured on Modbus TCP Server with address 192.168.1.20.

The parameters 126.1 of axis 1 and axis 2 are mapped cyclically as actual and set process data

Furthermore the parameter 126.63 of axis 1 and the parameter 126.64 of axis 2 are written and read acyclically.

The cyclic and acyclic set values are incremented automatically.

```
(*----Init variables----start*)
if state = 0 then
     addressParam := ADDM('Ethernet_1{192.168.1.20}');
     accessParams[0] := 0;
     accessParams[1] := 0;
     accessParams[2] := 2; (*Modbus access timeout in 100ms ->
200ms*)
     accessParams[3] := 0;

     (*Set timings*)
     fieldbusCycleTime  := 4000; (*4000µs*)
     inputWatchdogTime  := 80;   (*80ms*)
     outputWatchdogTime := 80;   (*80ms*)

     (*Fill up input mapping array with max 15 actual parameters
per axis*)
     (*                 -FB-              -PNR-            -
FBI-            -Axis-          *)
     InMapping[ 0] := 126; InMapping[ 1] := 1; InMapping[ 2] :=
0; InMapping[ 3] := 1; (*PDO 00*)
     InMapping[ 4] := 126; InMapping[ 5] := 1; InMapping[ 6] :=
0; InMapping[ 7] := 2; (*PDO 01*)
     InMapping[ 8] :=   0; InMapping[ 9] := 0; InMapping[10] :=
0; InMapping[11] := 0; (*PDO 02*)

     (*Fill up output mapping array with max 15 set parameters
per axis*)
     (*                 -FB-              -PNR-             -
FBI-            -Axis-          *)
     OutMapping[ 0] := 126; OutMapping[ 1] := 1; OutMapping[ 2]
:= 0; OutMapping[ 3] := 1; (*PDO 00*)
     OutMapping[ 4] := 126; OutMapping[ 5] := 1; OutMapping[ 6]
:= 0; OutMapping[ 7] := 2; (*PDO 01*)
     OutMapping[ 8] := 0;   OutMapping[ 9] := 0; OutMapping[10]
:= 0; OutMapping[11] := 0; (*PDO 02*)

     (* Set acyclic configuration setting*)
     acyclicData[0]  := 0;
     acyclicData[1]  := 0;
     acyclicData[2]  := 126;
     acyclicData[3]  := 63;
     acyclicData[4]  := 0;
     acyclicData[5]  := 0;
     acyclicData[6]  := 0;
     acyclicData[7]  := 0;
     acyclicData[8]  := 0;
     acyclicData[9]  := 1;
     acyclicData[10] := 4;
     acyclicData[11] := 0;
     acyclicData[12] := 0;
     axis := 1;

     state := state + 1;
```

```
            (*----Init variables----end*)


            (*----Set b maXX to PreOp----start*)
            elsif state = 1 then
                 (*Set control word to 16#3E -> go to PreOp and reset all
            errors*)
                 outputData[0] := 16#3E;
                 WRITE_VAR(addressParam, '%MW', 100, 1, outputData,
            accessParams);
                 state := state + 1;
            elsif state = 2 then
                 (*WRITE_VAR was finished?*)
                 if accessParams[0].0 = false then
                      (*Was any error while WRITE_VAR?*)
                      if accessParams[1] <> 0 then
                           (*Error happened -> go to error state*)
                           state := 100;
                      else
                           state := state + 1;
                      end_if;
                 end_if;
            (*----Set b maXX to PreOp----end*)


            (*----Write down mapping configuration----start*)
            elsif state = 3 then
                 (*Write down the input mapping configuration*)
                 WRITE_VAR (addressParam, '%MW', 210, 12, inMapping,
            accessParams);    (*Maximal 120 WORD*)
                 state := state + 1;
            elsif state = 4 then
                 (*WRITE_VAR was finished?*)
                 if accessParams[0].0 = false then
                      (*Was any error while WRITE_VAR?*)
                      if accessParams[1] <> 0 then
                           (*Error happened -> go to error state*)
                           state := 100;
                      else
                           state := state + 1;
                      end_if;
                 end_if;
            elsif state = 5 then
                 (*Write down the output mapping configuration*)
                 WRITE_VAR (addressParam, '%MW', 410, 12, outMapping,
            accessParams);    (*Maximal 120 WORD*)
                 state := state + 1;
            elsif state = 6 then
                 (*WRITE_VAR was finished?*)
                 if accessParams[0].0 = false then
                      (*Was any error while WRITE_VAR?*)
                      if accessParams[1] <> 0 then
                           (*Error happened -> go to error state*)
```

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```
                state := 100;
        else
                state := state + 1;
        end_if;
    end_if;
(*----Write down mapping configuration----end*)


(*----Write down timing configuration----start*)
elsif State = 7 then
    (*Write down the timing configuration*)
    tmpData[0] := fieldbusCycleTime;
    tmpData[1] := inputWatchdogTime;
    tmpData[2] := outputWatchdogTime;
    WRITE_VAR (addressParam, '%MW', 202, 3, tmpData,
accessParams);
    state := state + 1;
elsif state = 8 then
    (*WRITE_VAR was finished?*)
    if accessParams[0].0 = false then
        (*Was any error while WRITE_VAR?*)
        if accessParams[1] <> 0 then
            (*Error happened -> go to error state*)
            state := 100;
        else
                state := state + 1;
        end_if;
    end_if;
(*----Write down timing configuration----end*)


(*----DO IO exchange----start*)
elsif state = 9 then
    outputData[0].0 := true; (*Set control word to state op*)
    (*Counter in cyclic data*)
    for i := 2 to 61 by 2 do
            outputData[i] := outputData[i] + 1;
    end_for;
    outputData[0].0 := true; (*set control word to state op*)
    WRITE_VAR (ADR  := addressParam,
               OBJ  := '%MW',
               NUM  := 100,
               NB   := 62,
           EMIS := outputData,
               GEST := accessParams);
    state := state + 1;
elsif state = 10 then
    (*WRITE_VAR was finished?*)
    if accessParams[0].0 = false then
        (*Was any error while WRITE_VAR?*)
        if accessParams[1] <> 0 then
            (*Error happened -> go to error state*)
            state := 100;
```

```
                else
                        state := state + 1;
                end_if;
        end_if;
elsif state = 11 then
        READ_VAR (ADR  := addressParam,
                        OBJ  := '%MW', (*Wordwise access*)
                        NUM  := 0,
                NB    := 62,
                        GEST := accessParams,
                        RECP => inputData);
        state := state + 1;
elsif state = 12 then
        (*Has READ_VAR has finished?*)
        if accessParams[0].0 = false then
                (*Was any Error while READ_VAR?*)
                if accessParams[1] <> 0 then
                        (*Error happened -> switch to error state*)
                        state := 100;
                else
                        state := state + 1;
                end_if;
        end_if;
(*----DO IO exchange----end*)


(*----Check and quit error in status word----start*)
elsif state = 13 then
        if inputData[0].1 = true  then
                (*Input data watchdog expired
                   -> reset the error by setting the same bit in
control word*)
                outputData[0].1 := true;
        else
                outputData[0].1 := false;
        end_if;
        if inputData[0].2 = true  then
                (*Output data watchdog expired
                   -> reset the error by setting the same bit in
control word*)
                outputData[0].2 := true;
        else
                outputData[0].2 := false;
        end_if;
        if inputData[0].3 = true  then
                (*Input data timeout in b maXX
                   -> reset the error by setting the same bit in
control word*)
                outputData[0].3 := true;
        else
                outputData[0].3 := false;
        end_if;
        if inputData[0].4 = true  then
```
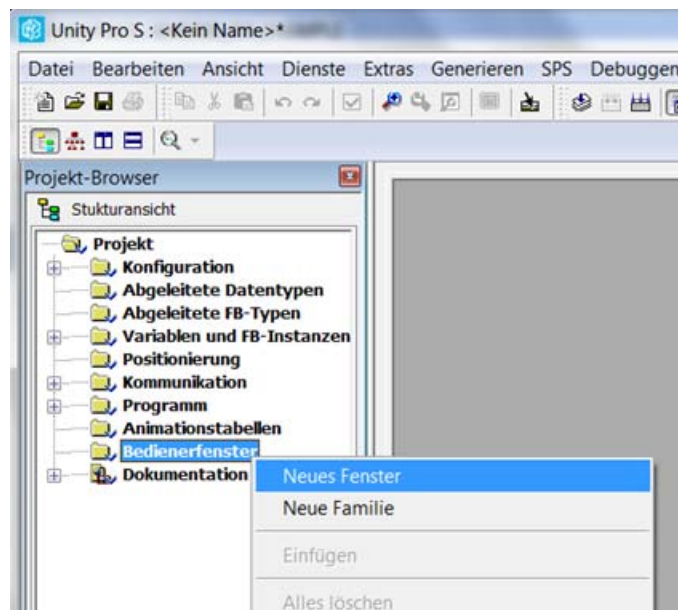
```
                (*Output data timeout in b maXX
                  -> reset the error by setting the same bit in
control word*)
               outputData[0].4 := true;
       else
               outputData[0].4 := false;
       end_if;
       state := state + 1;
(*----Check and quit error in status word----end*)


(*----Do acyclic communication write----Start*)
elsif state = 14 then
       if axis = 1 then  (*Axis 1*)
               acyclicData[3]  := 63;
               acyclicData[9]  := 1;
               acyclicData[11] := acyclicData[11] + 1;
               acyclicData[12] := acyclicData[12] + 1;
       else            (*Axis 2*)
               acyclicData[3]  := 64;
               acyclicData[9]  := 2;
       end_if;
       WRITE_VAR (ADR  := addressParam,
                  OBJ  := '%MW',
                  NUM  := 600,
                  NB   := 13,
                  EMIS := acyclicData,
                  GEST := accessParams);
       state := state + 1;
elsif state = 15 then
       (*WRITE_VAR was finished?*)
       if accessParams[0].0 = false then
               (*Was any error while WRITE_VAR?*)
               if accessParams[1] <> 0 then
                       (*Error happened -> go to error state*)
                       state := 100;
               else
                       state := state + 1;
               end_if;
       end_if;
(*----Do acyclic communication write----end*)


(*----Do acyclic communication read----start*)
elsif state = 16 then
       if axis = 1 then  (*Axis 1*)
               READ_VAR (ADR  := addressParam,
                         OBJ  := '%MW',
                         NUM  := 611,
                         NB   := 2,
                         GEST := accessParams,
                         RECP => acyclicReadA1);
               axis := 2;  (*Change to next axis*)
```
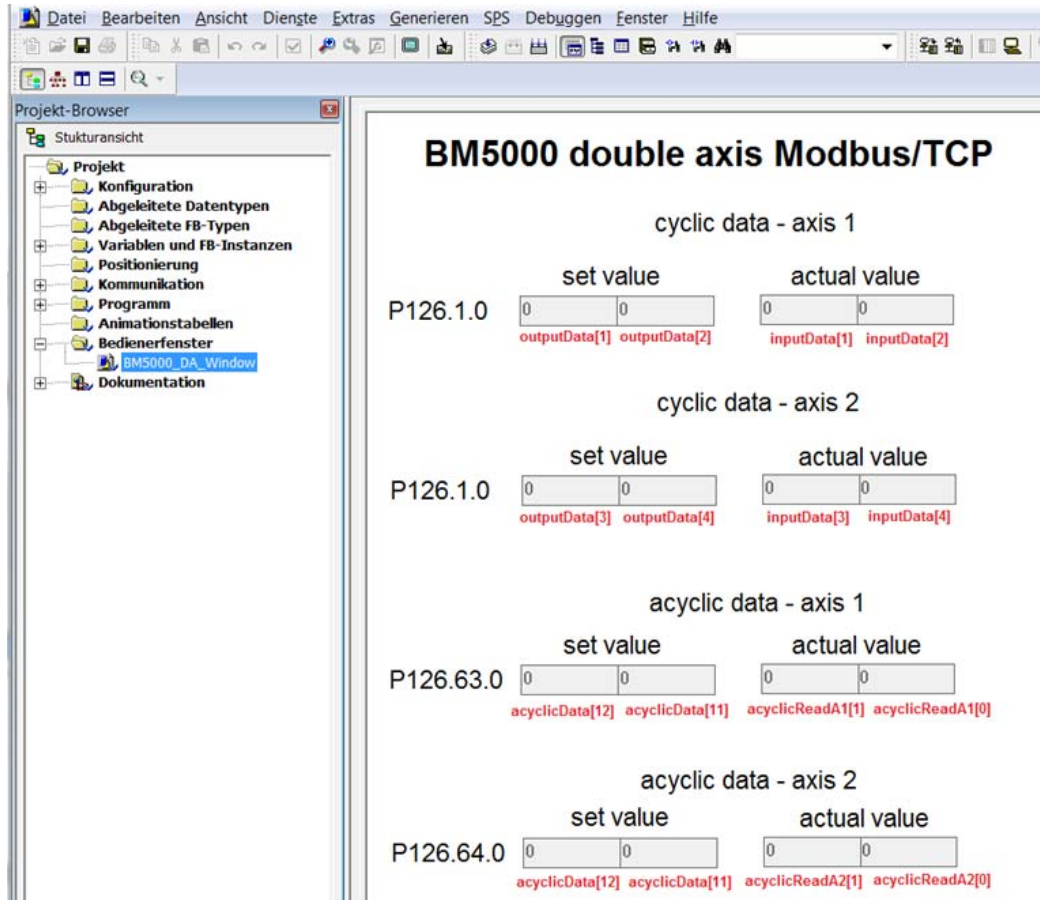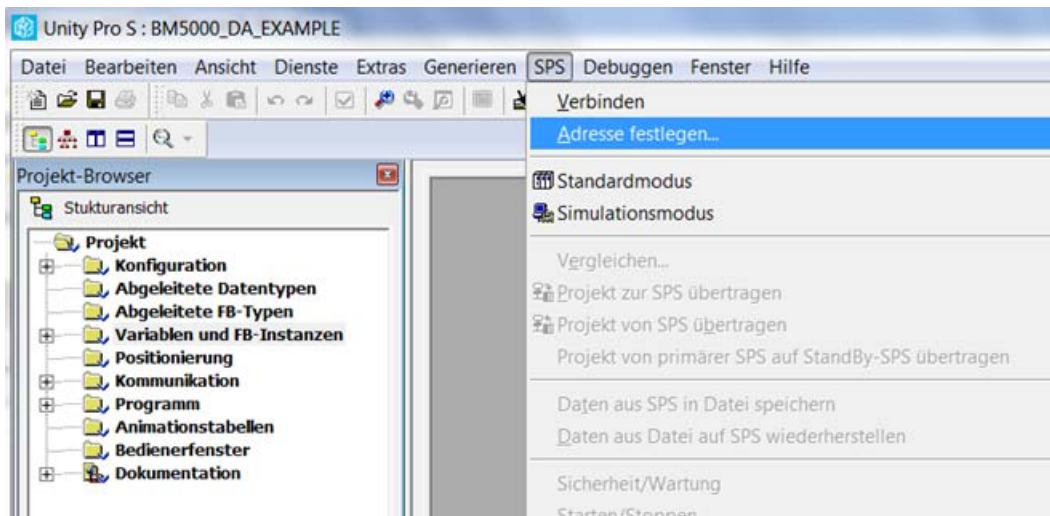
```
        else              (*Axis 2*)
            READ_VAR (ADR  := addressParam,
                      OBJ  := '%MW',
                      NUM  := 611,
                      NB   := 2,
                      GEST := accessParams,
                      RECP => acyclicReadA2);
            axis := 1;  (*Change to next axis*)
        end_if;
        state := state + 1;
    elsif state = 17 then
        (*WRITE_VAR was finished?*)
        if accessParams[0].0 = false then
            (*Was any error while READ_VAR?*)
            if accessParams[1] <> 0 then
                (*Error happened -> go to error state*)
                state := 100;
            else
                state := 9;
            end_if;
        end_if;
    (*----Do acyclic communication read----End*)
    end_if;
```

8.4   Create User Window

Cyclic and acyclic parameters can be displayed in a user window

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8.5 Transfer project to PLC

The project can be transmitted to the PLC and the programm can be started then.
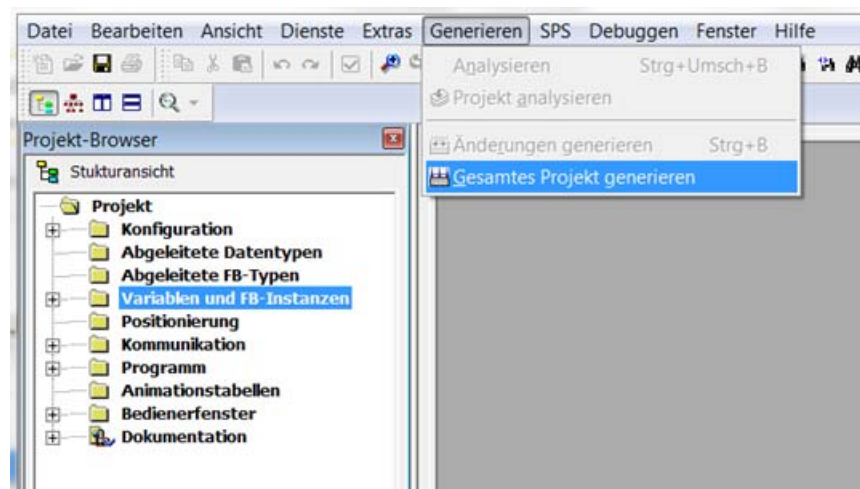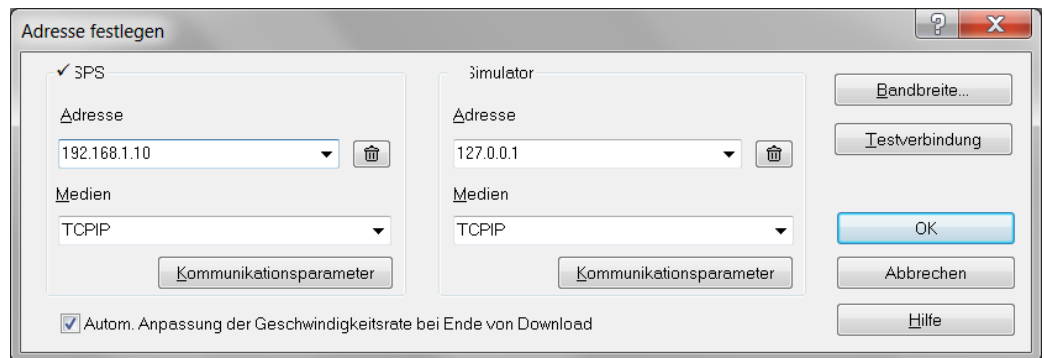
The project can be started with the commands

SPS $\rightarrow$ Connect

SPS $\rightarrow$ Transmit project to PLC

SPS $\rightarrow$ Start

The counters of the corresponding input arrays of the user window are incremented.

TROUBLESHOOTING AND FAULT CORRECTION

9.1 Behavior in case of malfunctions

Basic information

	DANGER!
⚠️	**Risk of fatal injury from electrical current!**
	Inevitably, when operating this electrical device, certain parts of it are energized with hazardous voltage.
	Therefore:
	• Pay heed to areas on the device that could be dangerous.

	WARNING!
⚠️	**Risk of injury due to improper fault correction!**
	Therefore:
	• Only qualified personnel may work on this device!
	• Personnel that work with the **b maXX** device must be trained in the safety regulations and the handling of the device, and be familiar with the correct operation of it. In particular, reacting to error indications and conditions requires that the operator must have special knowledge.

9.2 Error detection

The fault can be caused by mechanical or electrical malfunctions.

LED The occurrence of an error state is signalized by the lighting up of the red LED H14 or H24 on the front side of the housing.

> **NOTE!**
>
> In case of warnings or errors without error reactions, the LEDs H14 or H24 **blink** „Malfunction". Only error messages with error reaction will be signalized by **constant lighting up**.

7-segment display In the status error the error numbers are shown in the display. Depending on the state of bit No. 16 in parameter **P135.1** (further information see parameter handbook **b maXX 5000 add-on module MOD**) all error messages (with/without error reaction) or warnings are displayed.

The display of an error code starts therewith, that „F" is displayed for 1.5 s. Then the four characters of the error code are displayed. The separate characters are displayed for about 0.8 s, interrupted by a short break. If there are other errors, these are displayed in the same manner. The procedure is repeated as soon as all errors were displayed.

Example: Error 702 and 2418 are existing:
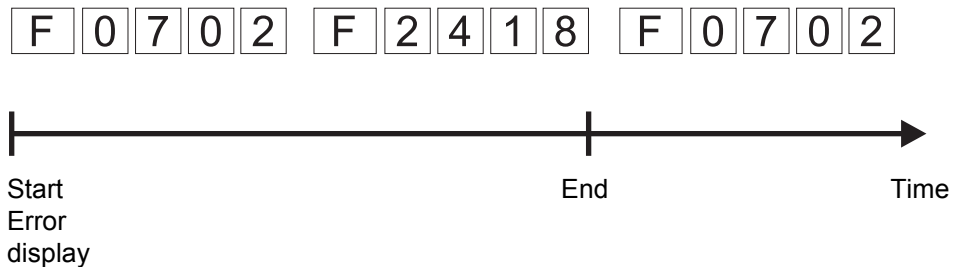
Figure 22:   7-segment display: errors and warnings

For further information on the subjects of error messages and error numbers, see „Parameter manual **b maXX 5000**".

Operating software ProDrive Furthermore the error message is shown in the operating software:

> **NOTE!**
>
> The controller software version and the operating software version must be compatible to use ProDrive with all functions.

9.3 Error handling

<table>
<tr>
<td>

(i)
</td>
<td>

NOTE!

The device is provided with predefined error reactions. You are able to set the error reaction of the device in „Depending on settings" in the column „Reaction" marked error messages. An exception here are errors, which have to have an immediate pulse inhibit as a consequence. This error reaction can not be changed due to safety reasons.
</td>
</tr>
</table>

9.3.1 Quit errors

If the red error LEDs H14 or H24 light up, at least one error exists.

Error acknowledgments cause all error messages to be reset. Individual acknowledgment of errors is not possible. An acknowledgment causes deletion of the errors, if deletion was possible on account of the error circumstances.

There are 4 methods of acknowledging an error:

- Via ProDrive:
  Button "Quit errors" (either in the dialogue box "Device manager" or on the page "Device manager".
  That means, that you inform the device, that you have noted the error, that you have removed it or that you want to pass over it. Due to error reset all error messages are reset. An individual error reset is not possible. The button Quit errors causes a resetting of the error, in case the cause for the error message exists no longer.
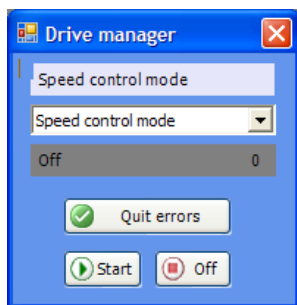
Figure 23:   ProDrive Drive manager

- Via writing access to control word
- Via a digital input
- Via the pulse enable input:
  Precondition is, that the drive is only controlled via the hardware inputs (that means that the motor guide is neither set via the operating software nor via another communication source). Furthermore the option "Quit error via pulse enable" must be active. With the first rising edge of pulse enable the errors then are reset. But the drive still does not start. Therefore you then need a second rising edge for the enable.

Additional data according the subject resetting of error messages is available in the „Parameter manual **b maXX 5000**".

9.3.2 Error messages

In the column „Reaction" the reaction of the system to the error is shown:

- „adjustable" = the error reaction can be set via ProDrive (Window „Drive management", toolbar button „Error reaction").

IEE

Error No.	Error description	Reaction	Troubleshooting
424	Configuration error, further details in status P172.2: ○ Bit10: IEE add-on module is not available ○ Bit11: Start after zero pulse selected and encoder is not an incremental encoder	adjustable	○ Bit10: Use controller with IEE add-on module ○ Bit11: Use incremental encoder for source encoder or select option „Start: immediately".
425	Run time error, further details in status P172.2: ○ Bit 8: Output frequency to high add-on module IEE cannot generate the required number of pulses Cause: The product from set value change and no. of increments is too high ○ Bit 9: Error in set value source IEE switches off, because of an error in set value source	adjustable	○ Bit 8: Reduce no. of increments of IEE or reduce the drive speed, from which the set value is generated or reduce the set speed from the higher-level control according following formula: $$f = n*N$$ f. no. of increments per sec n: Speed [revolution per sec.] N: No. of increments [inc/rev] $$n_{max} = f_{max}/N$$ Frequency limit=500 kHz, with N=10 000 inc/rev: $n_{max} \leq 50$ rev/s ≤ 3000 rev/min ○ Bit 9: Check set value source and correct problem

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Survey of Revisions

Version	Edition	Changes
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Notes

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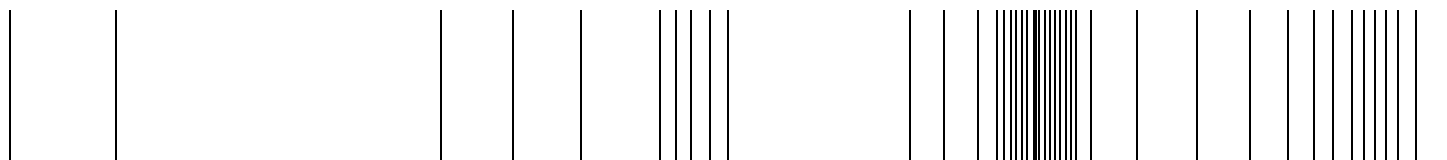
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