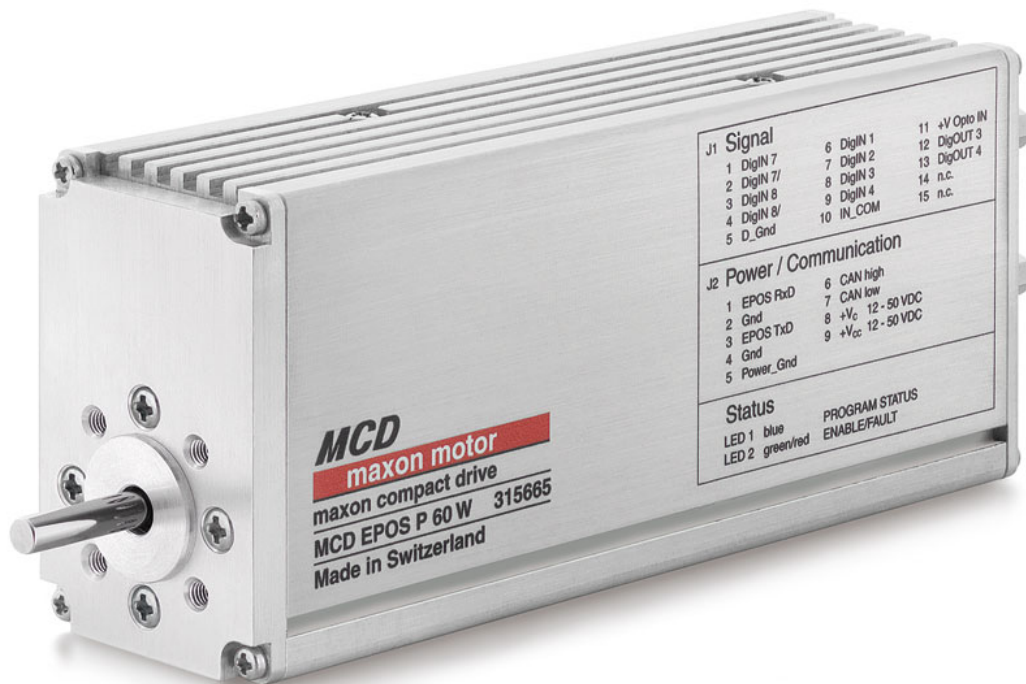


MCD EPOS P 60 W

Programmable Positioning Compact Drive

Documentation

Getting Started



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3 Introduction

This documentation 'Getting Started' provides the first steps in using the maxon compact drive MCD EPOS P 60 W programmable positioning compact drive. It describes the standard procedure when the device is put into operation. The document facilitates the installation and configuration of a basic MCD EPOS P 60 W system.



Figure 1: MCD EPOS P 60 W photo

The maxon MCD EPOS P 60 W is a small-sized free programmable compact drive. It contains a brushless EC motor with Hall-sensors, digital encoder and a digital position control unit. The optimized commutation by space vector control offers to drive the integrated brushless EC motor with minimal ripple and low noise. The integrated position-, velocity- and current control functionality allows sophisticated positioning applications. The MCD EPOS P 60 W is programmable with a very efficient

software tool. The programming languages are according to IEC 61131-3 standard. The built-in CANopen interface allows the design of an easy-to-use standalone multiple axis system, particularly with standard maxon MCD EPOS compact drives. In addition the unit can be operated through any RS-232 communication port.

The latest edition of these "Getting Started", additional documentation and software to the MCD EPOS compact drive may also be found on the internet in www.maxonmotor.com category <Service & Downloads>.

4 How to use this guide

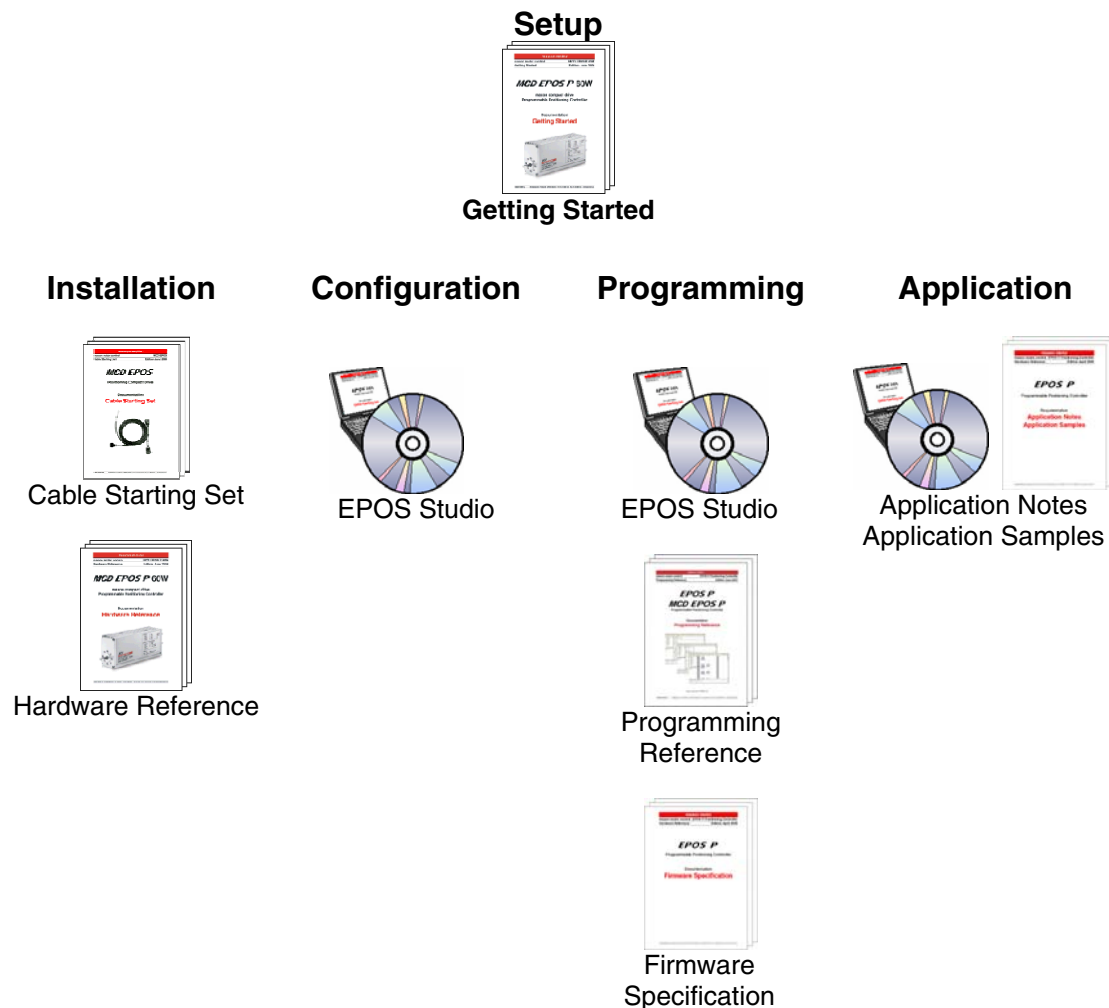


Figure 2: MCD EPOS P 60 W documentation hierarchy

5 Safety Instructions

**Skilled Personnel**

Installation and starting of the equipment shall only be performed by experienced, skilled personnel.

**Statutory Regulations**

The user must ensure that the positioning controller and the components belonging to it are assembled and connected according to local statutory regulations.

**Load Disconnected**

For primary operation the motor should be free running, i.e. with the load disconnected.

**Additional Safety Equipment**

An electronic apparatus is not fail-safe in principle. Machines and apparatus must therefore be fitted with independent monitoring and safety equipment. If the equipment breaks down, if it is operated incorrectly, if the control unit breaks down or if the cables break, etc., it must be ensured that the drive or the complete apparatus is kept in a safe operating mode.

**Repairs**

Repairs may be made by authorized personnel only or by the manufacturer. It is dangerous for the user to open the unit or make repairs to it.

**Danger**

Do ensure that during the installation of the MCD EPOS P 60W no apparatus is connected to the electrical supply. After switching on, do not touch any live parts!

**Max. Supply Voltage**

Make sure that the supply voltage is between 12 and 50 VDC. Voltages higher than 55 VDC or of wrong polarity will destroy the unit.

**Electrostatic Sensitive Device (ESD)**

6 Installation and Configuration

6.1 Step 1: Software Installation

Install the software from the EPOS P CD-ROM. The CD-ROM contains all necessary information and tools for installation and operation of the MCD EPOS P compact drives (Manuals, Firmware, Tools and Windows DLLs).

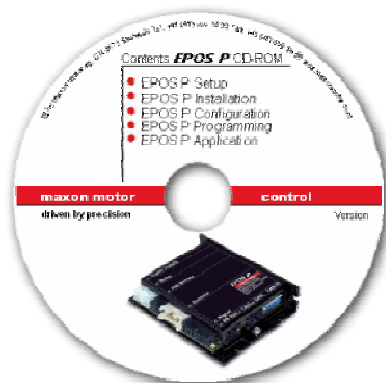


Figure 3: EPOS P CD-ROM

The latest edition of the software to the MCD EPOS P 60 W positioning compact drives may be downloaded from the internet under www.maxonmotor.com category <Service & Downloads>.

Minimum system requirements:

<p>Windows 2000 SP4, Windows XP SP1, Windows Vista Pentium 300 MHz processor, 256 MB RAM 200 MB free storage space on hard drive Screen resolution 1024 x 768 pixels at high colour (16-Bit)</p>
--

Follow the next instructions to install the whole software on your computer:

- 1. Insert CD-ROM**
Insert the EPOS P CD-ROM into the CD-ROM drive of your computer.
- 2. Start the installation program 'EPOS P CD-ROM.msi'**
Normally the installation program starts automatically after inserting EPOS P CD-ROM. Alternatively, double click the item in the explorer to start the installation program 'EPOS P CD-ROM.msi'
- 3. Follow the instructions during the installation program**
Please read each instruction carefully. During the installation procedure you will be asked for a working directory. (Recommendation: C:\Programme\maxon motor EPOS P CD-ROM)
- 4. Check the new shortcuts and items in the start menu**
All necessary files are copied to the hard drive 'maxon motor EPOS P CD-ROM' item allows accessibility to all 'Contents'. On the desktop, a new shortcut to the 'EPOS Studio.exe' will be added. Check the new shortcuts in the start menu and on the desktop.
- 5. Modify or remove the EPOS P software**
To change application features or to uninstall the EPOS P software, start the installation program 'EPOS P CD-ROM.msi' and follow the instructions.

6.2 Step 2: Minimum External Wiring

Install the MCD EPOS P 60W hardware. Use the maxon cable assemblies below for wiring.

You should have:

MCD EPOS P 60 W positioning controller..... order number **315665**

MCD EPOS Power / RS232-CAN Cable

(Connector J2)..... order number **325939**

The MCD EPOS Power / RS232-CAN cable (Order No. **325939**) integrates three cables in one:

- Power cable
- RS 232 communication cable
- CAN communication cable

Connect the MCD EPOS Power / RS232-CAN cable as follows (see also [figure 4](#)):

1. MCD EPOS P 60 W

Connect the MCD EPOS Power / RS232-CAN cable to the connector J2 of the MCD EPOS P 60 W.

2. Power

Connect the cable end sleeves of the power cable to a power supply (+12 ... +50 VDC).

The necessary output current is depending on load. (Continuous max. 2.6 A; acceleration, short-time max. 9 A)

Note! Make sure that the supply voltage is between +12 and +50 VDC. Voltages higher than +55 VDC or of wrong polarity will destroy the unit.

3. Communication

Connect the RS 232 cable to a free RS 232 port of your computer.

Note:

For minimum wiring, the CAN cable have not to be connected!

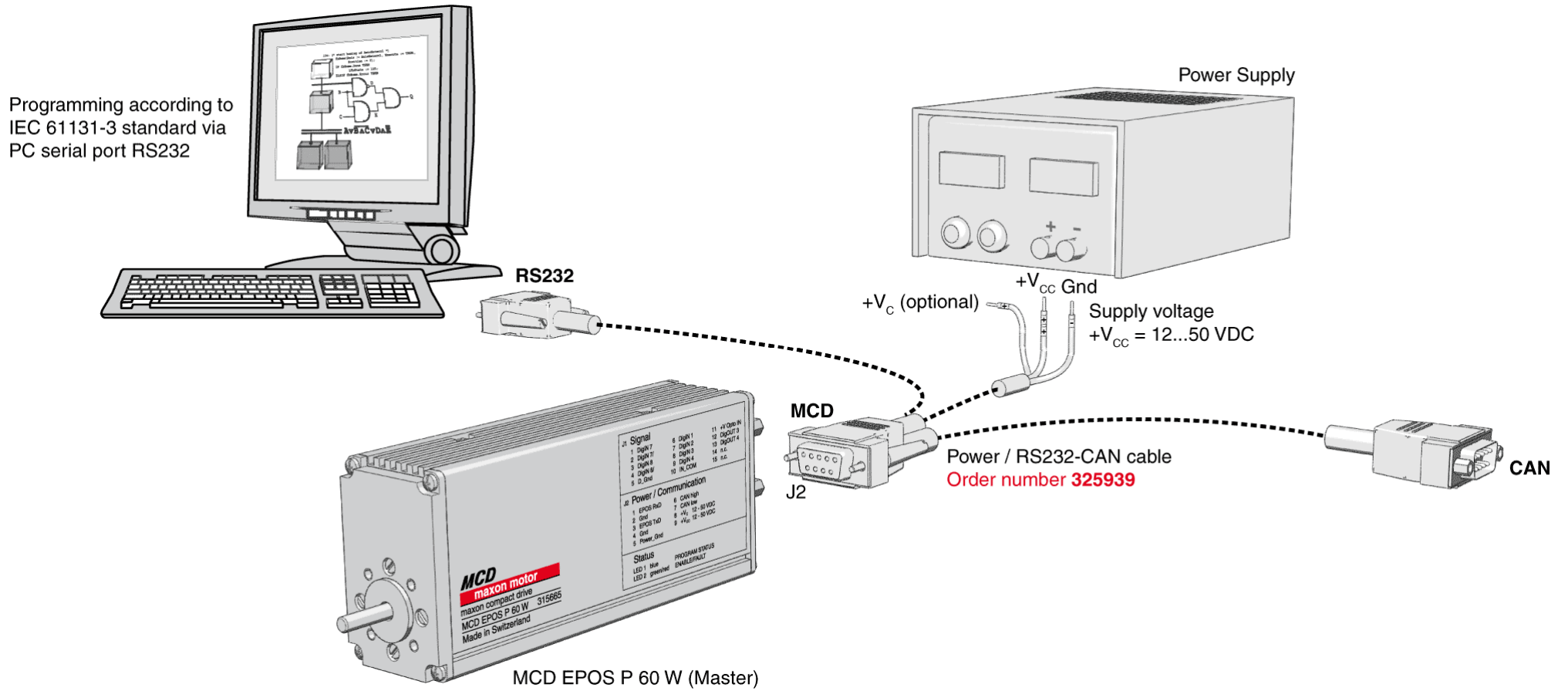


Figure 4: Minimum wiring for MCD EPOS P 60 W

6.3 Step 3: System Configuration

In this section you will configure the MCD EPOS P 60 W for your drive system.

Please note:

- You have to know some technical data about your system. Use the maxon catalogue or the datasheets of the components used.

To configure your drive system:

1. Power-up

Switch on the MCD EPOS P 60 W power supply.

2. Start the 'EPOS Studio' Version 1.00 or higher

Double click on the item 'EPOS Studio' on the desktop to start the 'EPOS Studio' Tool. By starting the 'EPOS Studio' the 'New Project' Wizard will be started automatically.

3. Load an existing EPOS P Project

a) Click on the item 'MCD EPOS P Project' in the list.

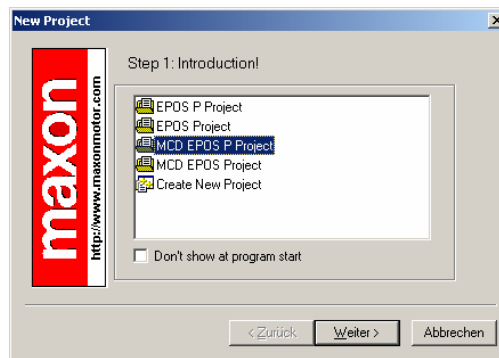


Figure 5: Project Configuration dialog for loading an existing project

b) Click on the button "Next" for the next step.

4. Set Project Settings

a) With Browse you can set the path and project name for your project

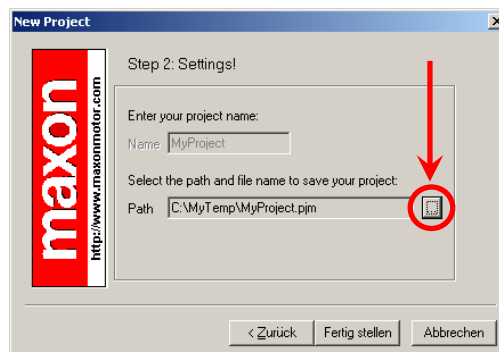


Figure 6: Set project path

b) Click on the button "Finish" to create your project.

5. Clear CAN warning

Your project tree is shown in the Page Navigator Window. In case of not connected CAN communication, the warning 'CanPassiveError on CAN Port' appears.

- a) Right click on warning and click on 'Clear All Entries' button.

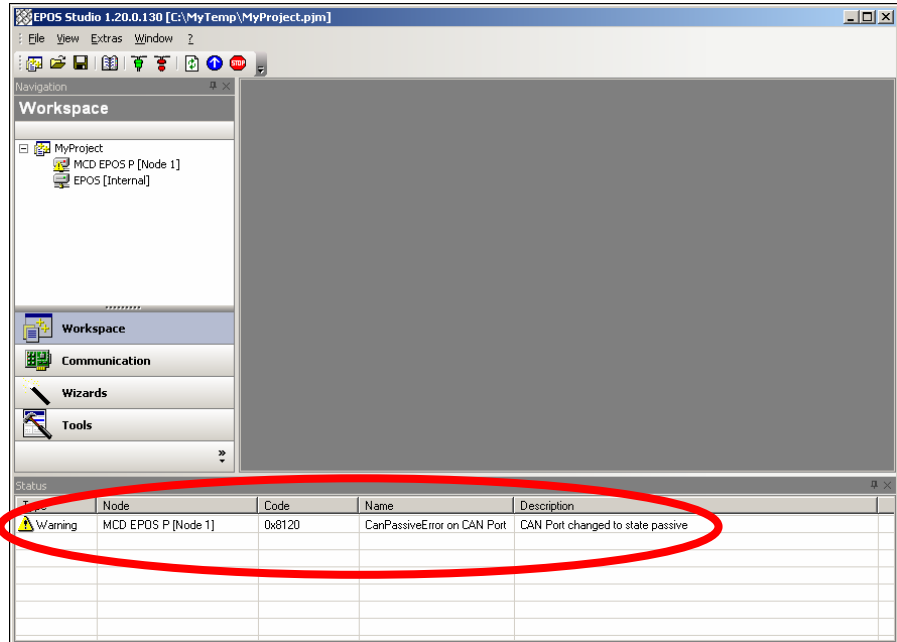


Figure 7: Project tree and CAN passive warning in the EPOS Studio

- b) If other errors or warnings occurred, please check wiring and startup configuration. For more information's about errors and warnings, refer to EPOS P firmware documentation.

6. Start 'Startup Wizard'

- a) Click in the Page Navigator Window on 'Wizards'.
- b) Select 'MCD EPOS P' in the 'Device Selection' Combo Box.
- c) Double click on the 'Startup Wizard' Item in the Wizard Tree.

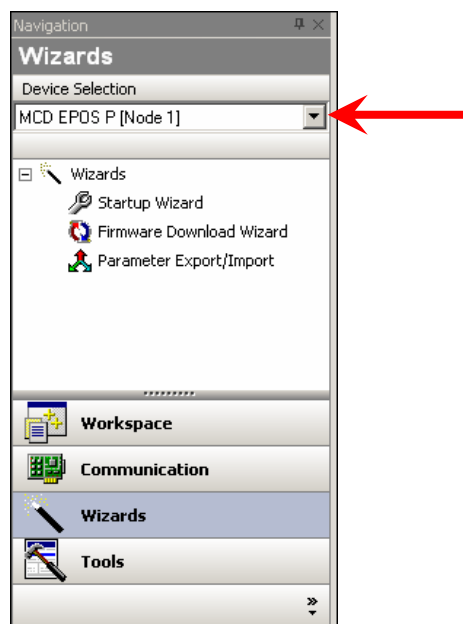


Figure 8: Page Navigator Window

7. 'Startup Wizard' Step 1: Minimum External Wiring!

- Verify that your hardware installation is correct. Please refer to chapter ['6.2 Step 2: Minimum External Wiring'](#).
- If you have already read the 'Getting Started' document, click on the button 'Confirm that you've read the 'Getting Started' document'.

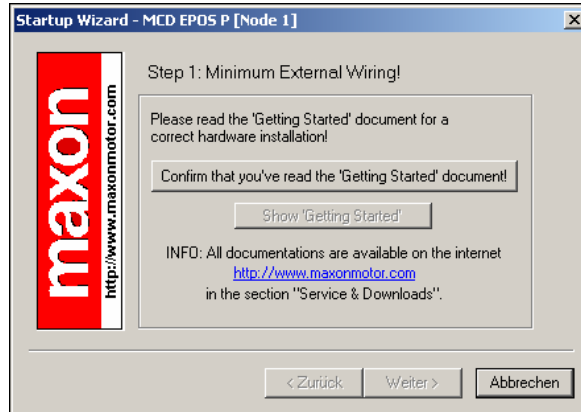


Figure 9: Startup wizard dialog for minimum external wiring

- Click on the button 'Next' for the next step.

8. 'Startup Wizard' Step 2: Communication Setting!

- Verify that your RS232 wiring is correct. Please refer to chapter ['6.2 Step 2: Minimum External Wiring'](#).
- Click on the button 'Search Communication Setting' to search the used COM port and the adjusted baud rate automatically.

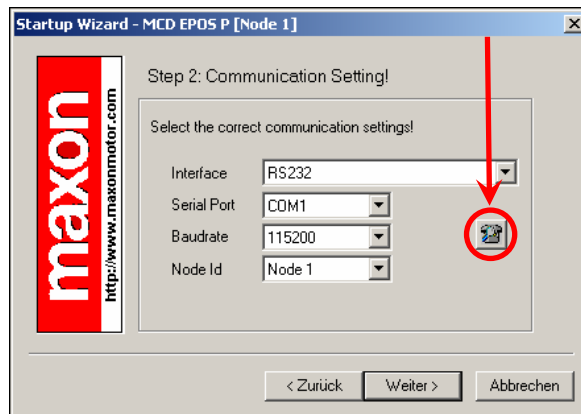


Figure 10: Startup wizard dialog for setting RS232 communication

- If a correct communication setting is found, the following dialog is displayed.

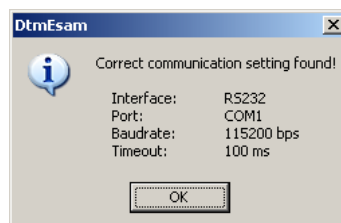


Figure 11: Communication settings found

- Click on the 'OK' button to confirm and accept the values.
- Click on the button 'Next' for the next step.

9. 'Startup Wizard' Step 3: Motor Type

- a) The MCD EPOS P 60 W contains a maxon EC motor. No other motor type can be selected.

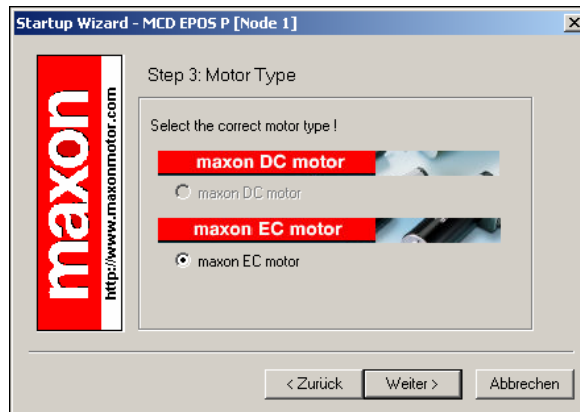


Figure 12: Startup wizard dialog for choosing motor type

- b) Click on the button 'Next' for the next step.

10. 'Startup Wizard' Step 4: Motor Pole Pair

- a) The used motor has 1 pole pair. No other pole pair number can be set.

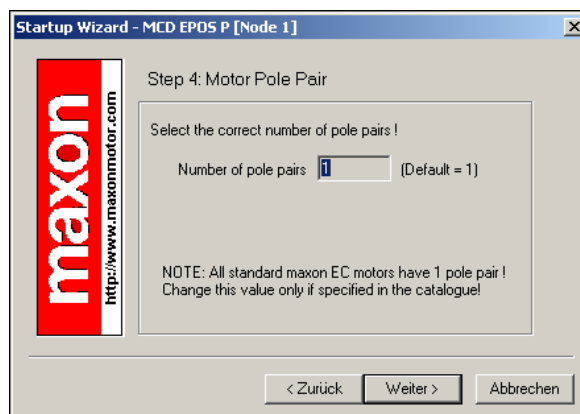


Figure 13: Startup wizard dialog for choosing EC motor pole pairs

- b) Click on the button 'Next' for the next step.

11. 'Startup Wizard' Step 5: Motor Data

- a) Select the maximum permitted speed.
- b) Select the nominal current (maximum continuous current).
- c) The thermal time constant of the winding of the used motor is 2.7 s and can not be changed.

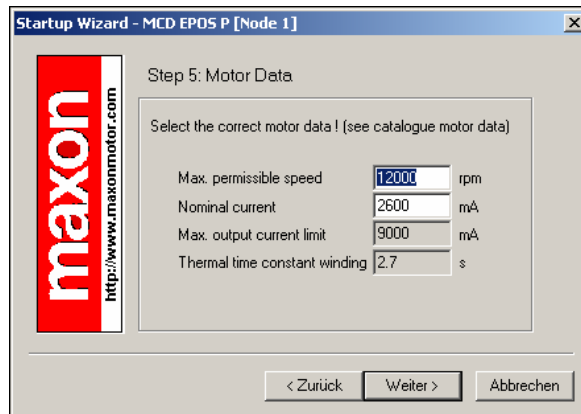


Figure 14: Startup wizard dialog for setting EC motor data

- d) Click the button 'Next' for the next step.

12. 'Startup Wizard' Step 6: Position Sensor Type

- a) A 3-channel incremental encoder with line driver is used. No other position sensor type can be selected.

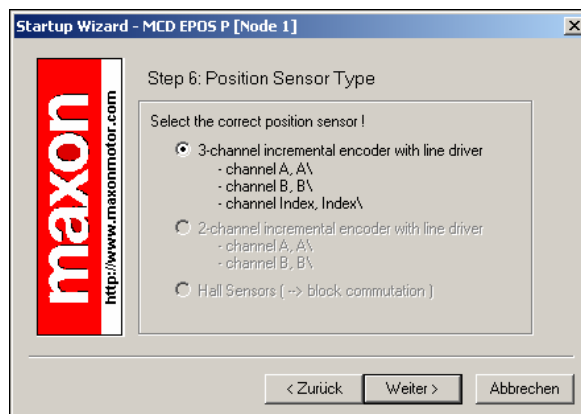


Figure 15: Startup wizard dialog for choosing EC motor position sensor type

- b) Click the button 'Next' for the next step.

13. 'Startup Wizard' Step 7: Position Resolution

- a) The resolution of the used encoder is 1000 pulse per turn. No other encoder resolution can be set.

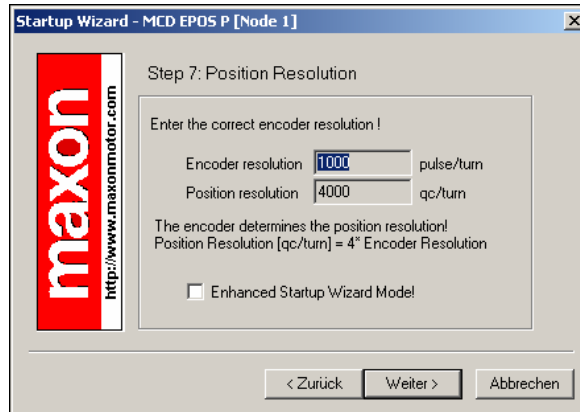


Figure 16: Startup wizard dialog for setting EC motor encoder resolution

- b) Click the button 'Next' for the next step.

14. 'Startup Wizard' Step 8: Summary

- a) A short summary of the most important configuration values is displayed in this window.
- b) If there are any mistakes in the configuration, you can go back and modify the values by clicking on the button 'Back'.

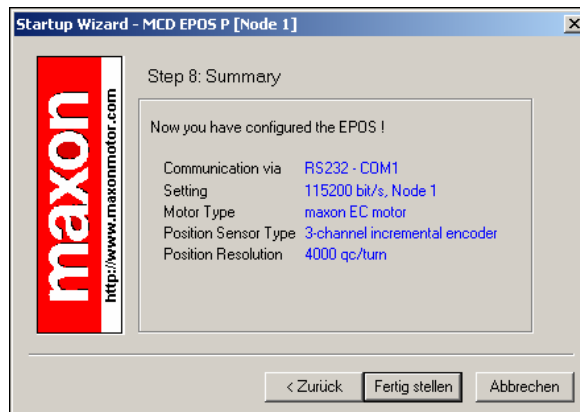


Figure 17: Startup wizard dialog for setting EC motor encoder resolution

- c) If all settings are correct, click the button 'Finish' closing the startup wizard.

15. Save and activate parameters

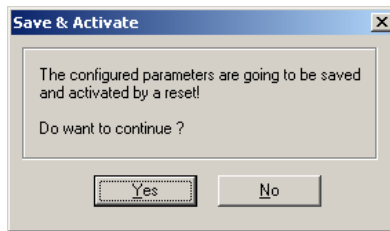


Figure 18: Save & Activate the configured parameters

- a) Click the button 'Yes' to accept the parameters.



Figure 19: Confirm parameter activation

- b) Confirm by clicking the 'OK' button.

6.4 Step 4: Regulation Gains Tuning

The MCD EPOS P 60 W offers a possibility to perform auto-tuning of the regulation gains. You can tune the current, velocity and position gains on the regulators. The auto-tuning function is a good help, but optimal regulation parameters can't be guaranteed. The auto-tuning is a good starting point for a manual tuning.

The following procedure is recommended for the tuning of the regulation gains.

6.4.1 Start the Auto-tuning Tool

- Click in the Page Navigator Window on 'Wizards'.
- Select 'EPOS [Internal]' in the 'Device Selection' Combo Box.
- Double click on Tree Item 'Regulation Tuning' to start the auto-tuning tool.

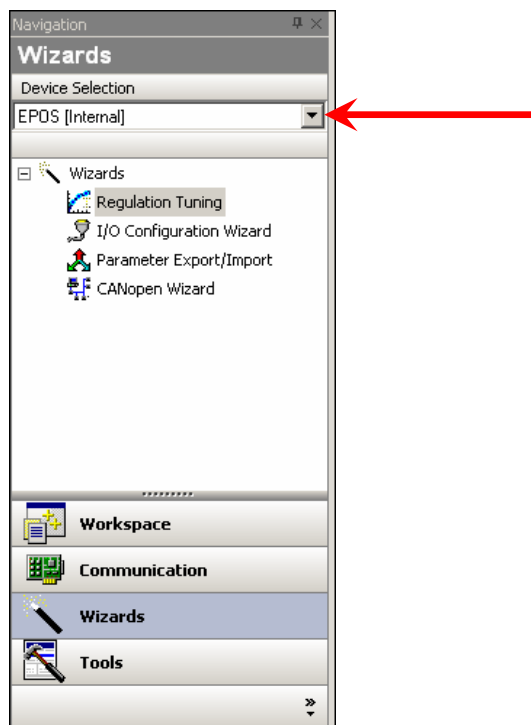


Figure 20: Start regulation tuning

6.4.2 Auto-tuning of the Current Regulator

In a first step, tune the current regulator.

- a) Leave all settings to default values.

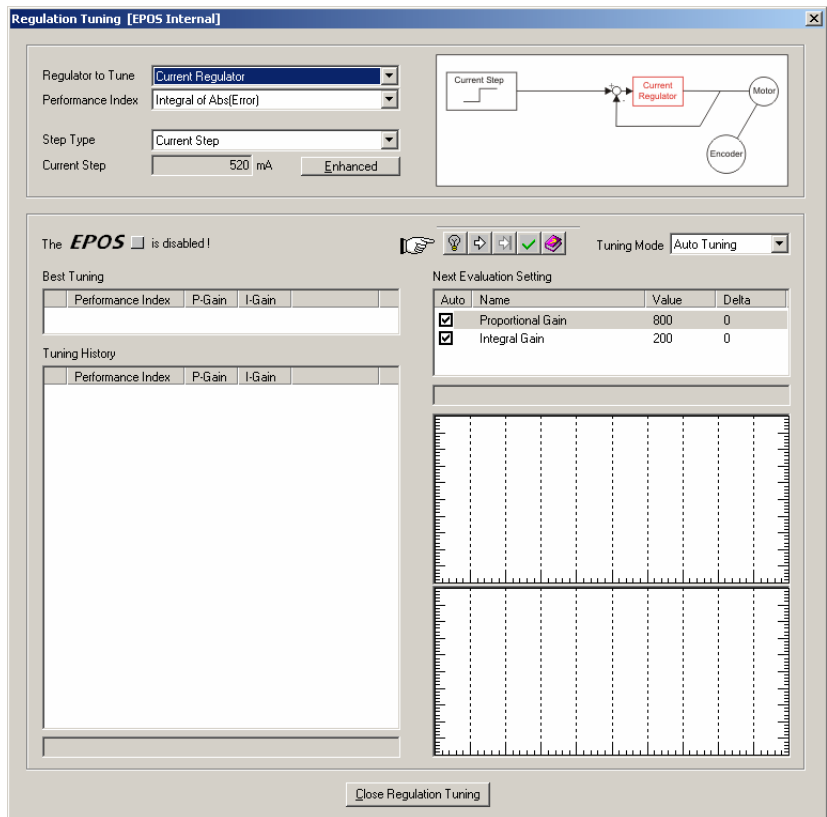


Figure 21: Auto-tuning of current regulator

- b) Click on 'Start Tuning' button to start the auto-tuning.

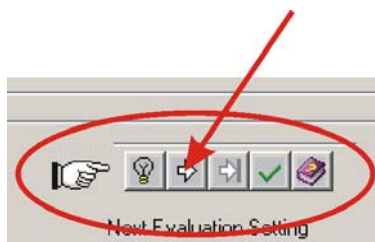


Figure 22: Auto-tuning button

- c) Block the motor shaft continuously until current regulator auto-tuning is finished.

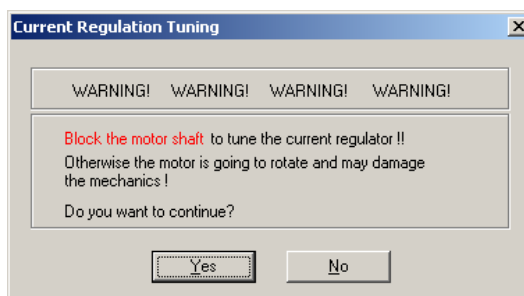


Figure 23: Confirm motor shaft blocking

- d) Confirm by clicking on 'Yes' button.

- e) Now, auto-tuning will start. It is searching suitable regulation gains for current regulation mode automatically. This procedure can take a few minutes. All tuning steps will be displayed for further analysis.
- f) Confirm the end of tuning by clicking on 'No' button.

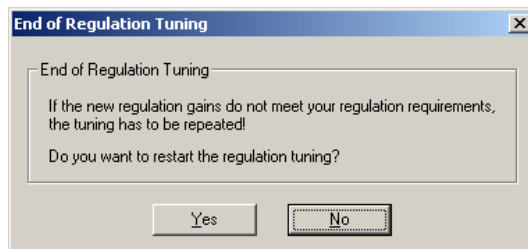


Figure 24: Confirm end of tuning

- g) If an error occurs and the auto-tuning will not start, please confirm and clear the error. Next adjust the starting parameters by referring to [chapter 6.4.5 'Manual Tuning'](#). Afterwards start the auto-tuning again.



Figure 25: Confirm tuning error

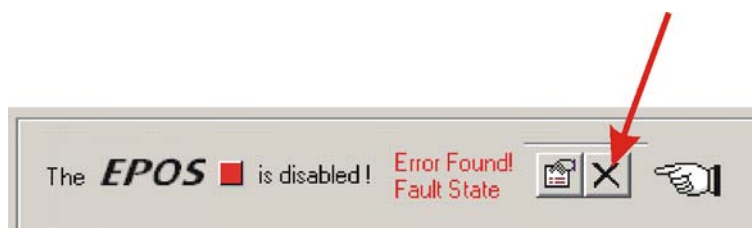


Figure 26: Clear tuning error

6.4.3 Auto-tuning of the Velocity Regulator

Now tune the velocity regulator.

- Select the menu item 'Velocity Regulator' in the menu 'Regulator to Tune'.
- Leave all other settings to default values.

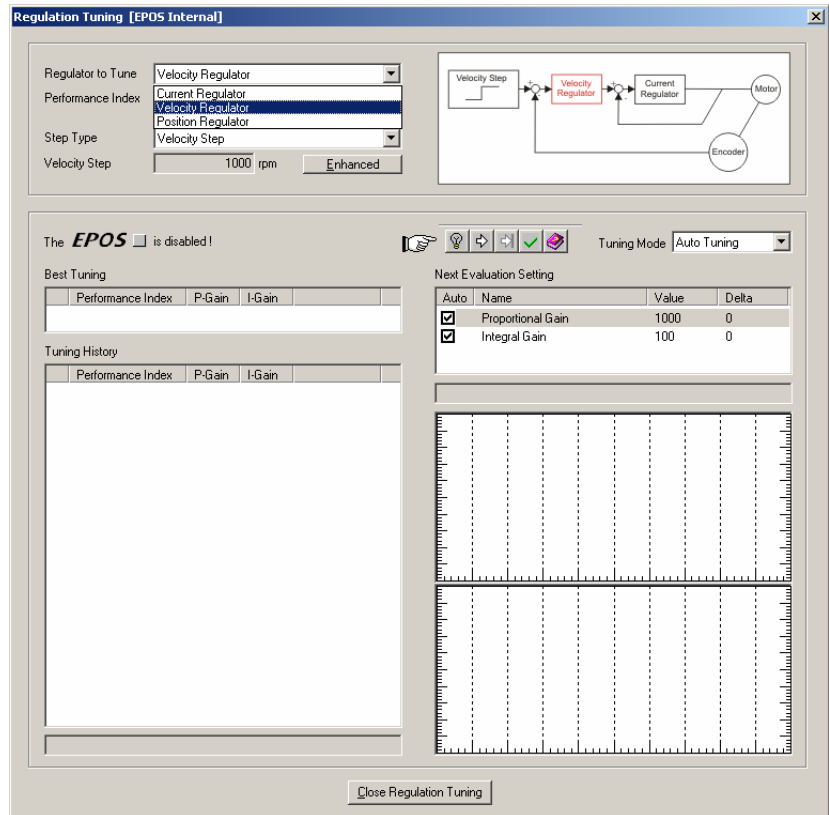


Figure 27: Auto-tuning of velocity regulator

- Click on 'Start Tuning' button to start the auto-tuning.

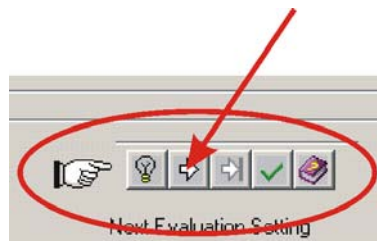


Figure 28: Auto-tuning button

- Be sure the motor shaft is free running (i.e. load disconnected)

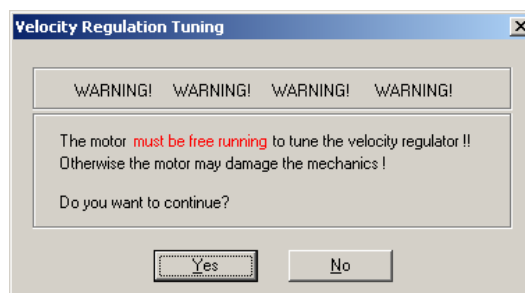


Figure 29: Confirm free running of motor

- Confirm by clicking on 'Yes' button.

- f) Now, auto-tuning will start. It is searching suitable regulation gains for velocity regulation mode automatically. This procedure can take a few minutes. During this procedure the motor is performing some rotations to both directions. All tuning steps will be displayed and recorded for further analysis.
- g) Confirm the end of tuning by clicking on 'No' button.

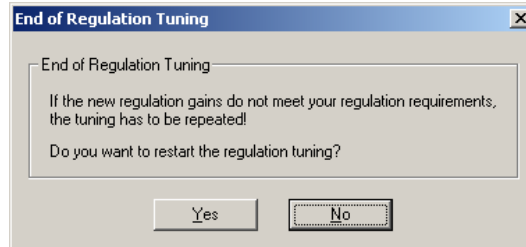


Figure 30: Confirm end of tuning

- h) If an error occurs and the auto-tuning will not start, please confirm and clear the error. Next adjust the starting parameters by referring to [chapter 6.4.5 'Manual Tuning'](#). Afterwards start the auto-tuning again.



Figure 31: Confirm tuning error



Figure 32: Clear tuning error

6.4.4 Auto-tuning of the Position Regulator

Now tune the position regulator.

- Select the menu item 'Position Regulator' in the menu 'Regulator to Tune'.
- Leave all other settings to default values.

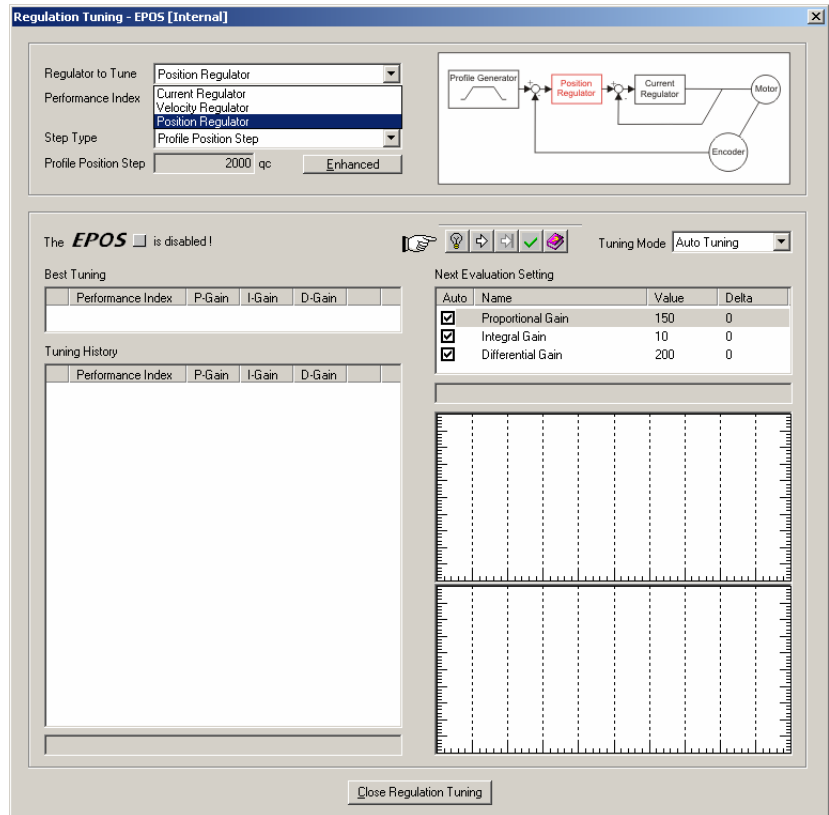


Figure 33: Auto-tuning of position regulator

- Click on 'Start Tuning' button to start the auto-tuning.

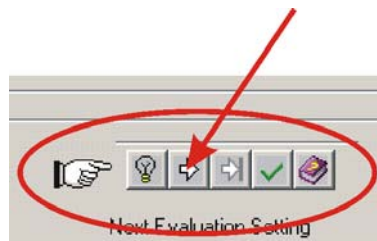


Figure 34: Auto-tuning button

- Be sure the motor shaft is free running (i.e. load disconnected).

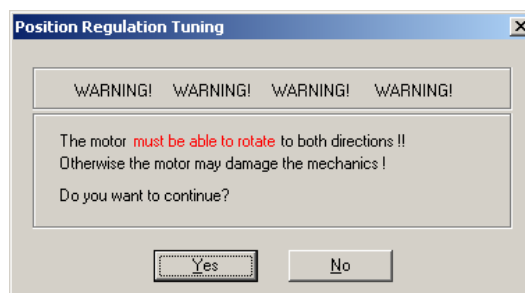


Figure 35: Confirm free running of motor

- Confirm by clicking on 'Yes' button.

- f) Now, auto-tuning will start. It is searching suitable regulation gains for position regulation mode automatically. This procedure can take a few minutes. During this procedure the motor is performing some rotations to both directions. All tuning steps will be displayed and recorded for further analysis.
- g) Confirm the end of tuning by clicking on 'No' button.

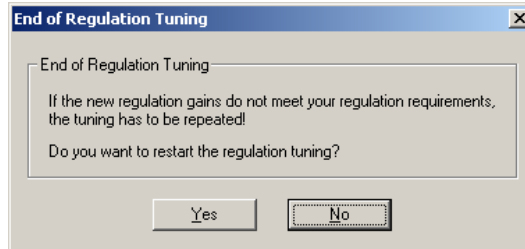


Figure 36: Confirm end of tuning

- h) If an error occurs and the auto-tuning will not start, please confirm and clear the error. Next adjust the starting parameters by referring to [chapter 6.4.5 'Manual Tuning'](#). Afterwards start the auto-tuning again.



Figure 37: Confirm tuning error

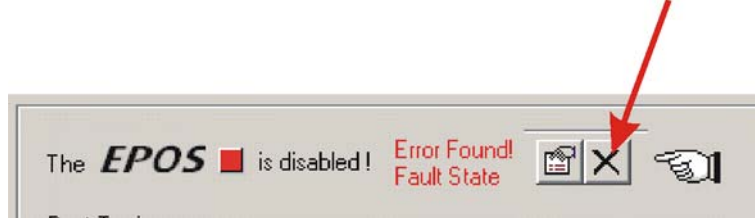


Figure 38: Clear tuning error

6.4.5 Manual Tuning

If the auto-tuning shows an error or the result of the auto-tuning is not sufficient, you have to tune the appropriate regulator manually. You have to start an iterative search of the regulation gains. Change the system parameters manually, start a single step movement and check the recorded data.

Follow the next instructions:

- a) Choose the 'Manual Tuning' mode in the regulation tuning screen and start the tuning.

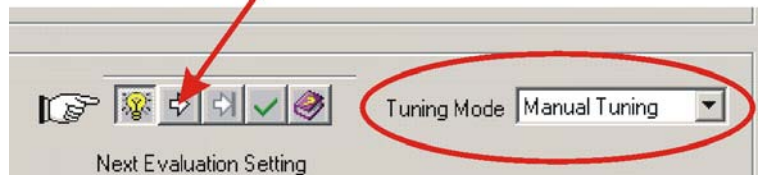


Figure 39: Manual tuning mode

- b) Go to the 'Next Evaluation Setting' and change the regulation gains of the appropriate regulator.

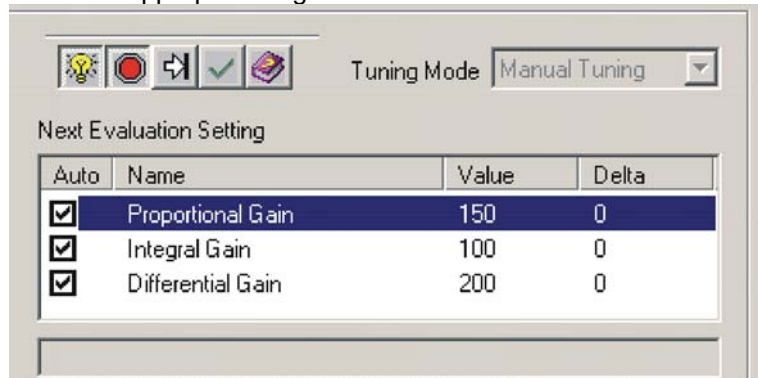


Figure 40: Manual tuning mode

Hints:

Start values for current and velocity regulator are normally not difficult to find.

For positioning regulator, following rule of thumb will be helpful:

Start values: 'Integral Gain' = 0 'Proportional Gain' = 2 x 'Differential Gain'

Overshoot: Reduce the 'Proportional Gain' or increase the 'Differential Gain'.

Position Error: Increase the 'Proportional Gain' and the 'Differential Gain'.

Integral Gain: Adjust the 'Integral Gain' at the end, if the other two gains are optimized. Increase the 'Integral Gain' until the static position error is small enough.

- c) Start a new movement and judge the recorded data.

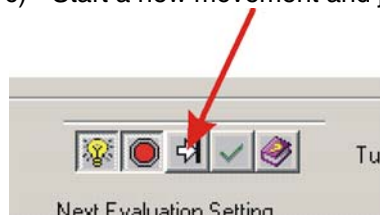


Figure 41: Next tuning step

- d) Repeat this iteration until all regulation gains are optimized.

6.4.6 Save all Regulation Gains

All the regulation gains found by the auto-tuning are stored locally (on your PC) up to now. To take effect permanently you have to store the values on the MCD EPOS P 60 W.

- a) Click on 'Save button' to save regulation gains.

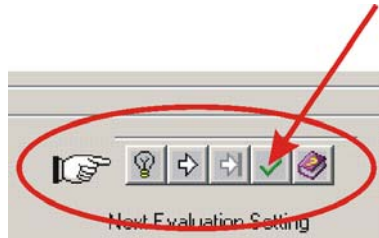


Figure 42: Save button

- b) Confirm the saving of regulation gains by clicking on 'Yes' button.

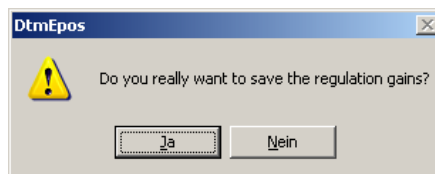


Figure 43: Confirm regulation gains saving

- c) Close regulation tuning by clicking on 'Close Regulation Tuning' button.

7 Programming

This chapter shows how to use the programming functionality. Considering as a sample programme the different necessary steps will be explained.

7.1 Step 1: Opening Sample Project

1. Open 'IEC-61131 Programming'

- Click in the 'Page Navigator Window on 'Tools'.
- Select 'MCD EPOS P' in the 'Device Selection' Combo Box.
- Double click on the 'IEC-61131 Programming' Item in the Tools Tree.

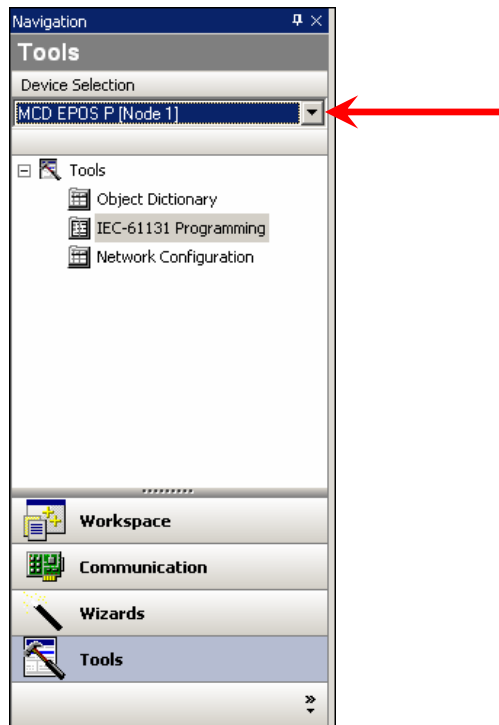


Figure 44: Page navigator window

2. Open Sample Project

- Select the sample project 'SimpleMotionSequence'.
- Click on 'Open Sample Project' button.

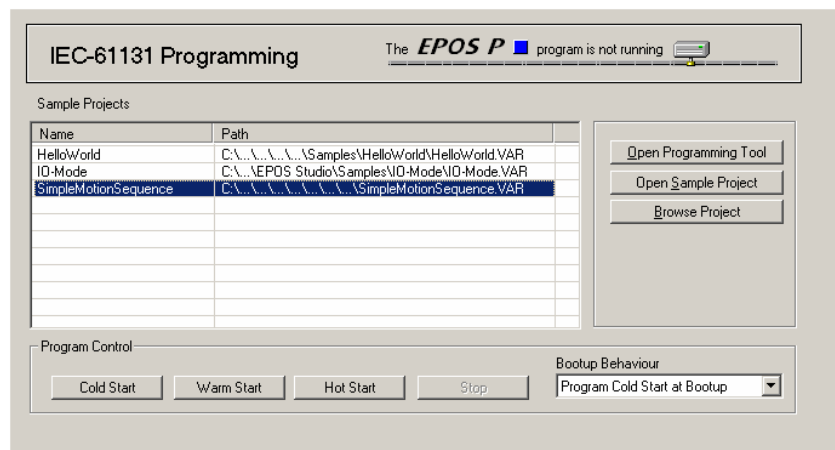


Figure 45: Tool 'IEC-61131 Programming'

The external programming tool 'OpenPCS' is opened.

3. Open Program Code

- Select the tab 'Files' in the project window.
- Double-click on the item 'SimpleMotionSequence.FBD'. The program code is opened.

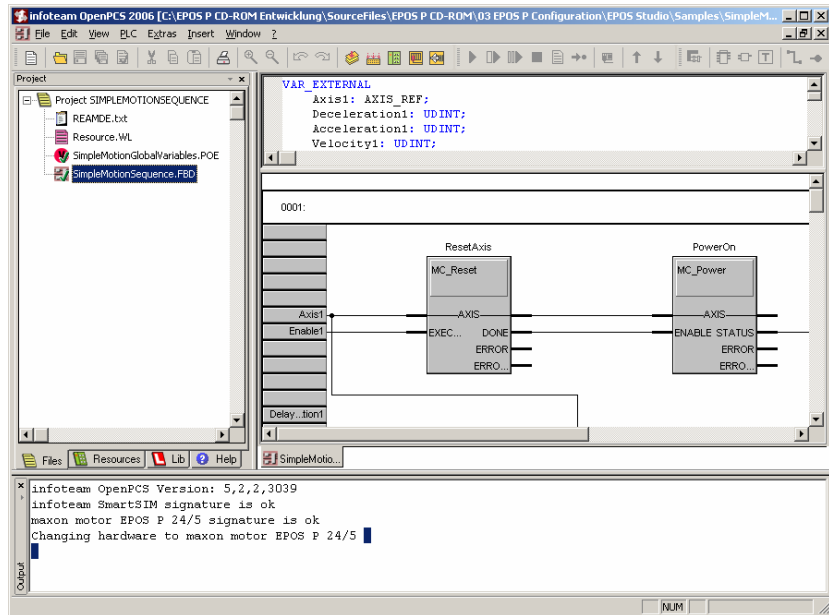


Figure 46: Program Code

7.2 Step 2: Programming Tool 'OpenPCS' Configuration

1. Licence Key Configuration

- Open the menu 'Extras' and the submenu 'Tools' to select the menu item 'Licence'.
- Check if a valid licence is available using the 'Info' button.
- If no licence is registered, enter a valid serial number and licence code. See file 'ReadMe.txt' in the 'EPOS Studio' directory for a correct licence.

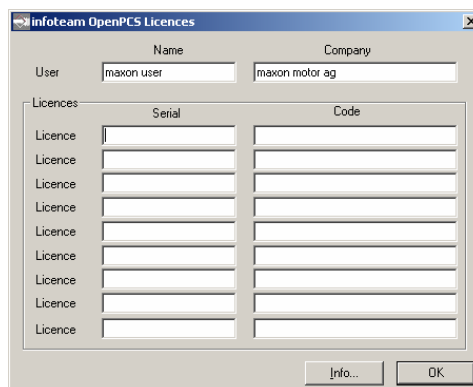


Figure 47: OpenPCS licence registration

Remark: If the licence code is out of date, download the latest EPOS Studio from the internet under www.maxonmotor.com category <Service & Downloads>.

2. Communication Setup

- Open the menu 'PLC' and select the menu item 'Connections'.
- Select the connection 'ProxyEpos' and click the button 'Edit'.

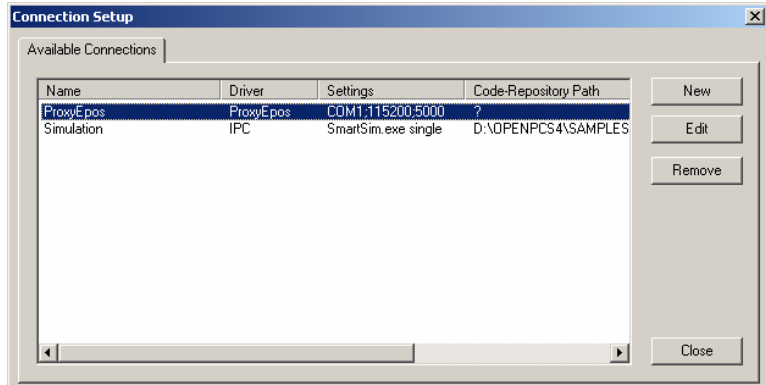


Figure 48: Connection setup window

- Click the button 'Settings' to change the communication settings.

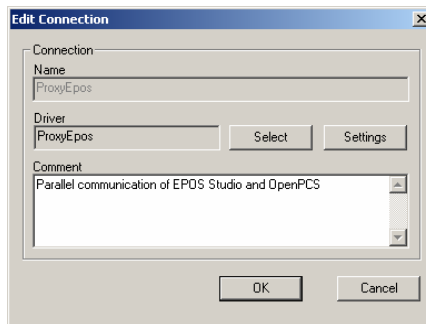


Figure 49: Edit connection window

- Select the same settings as in the EPOS Studio.
Remark: Default Baudrate is 115200 baud.

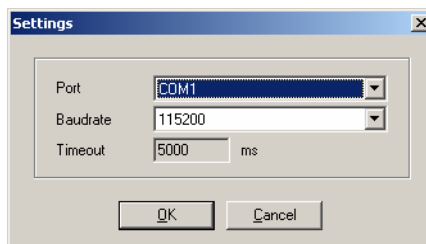


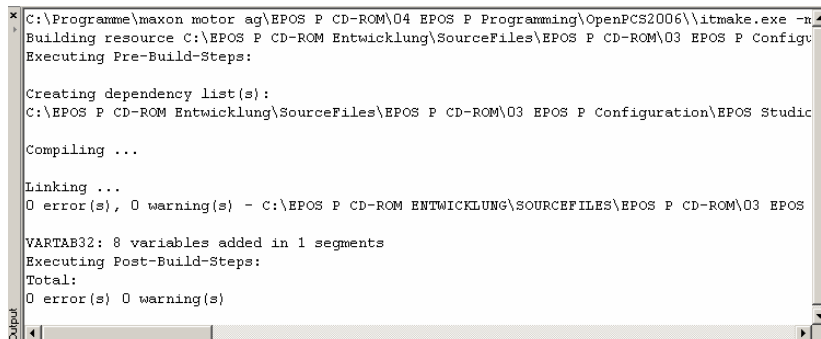
Figure 50: Communication settings

- Confirm the settings by clicking the 'OK' button and closing the dialog 'Edit Connection' and 'Connection Setup'.

7.3 Step 3: Compiling and Executing Sample Project

1. Compiling Sample Project

- Open the menu 'PLC' and select the menu item 'Build Active Resource'.
- A logging output similar to the figure below should appear.



```

C:\Programme\maxon motor ag\EPOS P CD-ROM\04 EPOS P Programming\OpenPCS2006\itmake.exe -n
Building resource C:\EPOS P CD-ROM Entwicklung\SourceFiles\EPOS P CD-ROM\03 EPOS P Config
Executing Pre-Build-Steps:

Creating dependency list(s):
C:\EPOS P CD-ROM Entwicklung\SourceFiles\EPOS P CD-ROM\03 EPOS P Configuration\EPOS Studic

Compiling ...

Linking ...
0 error(s), 0 warning(s) - C:\EPOS P CD-ROM ENTWICKLUNG\SOURCEFILES\EPOS P CD-ROM\03 EPOS

VARTAB32: 8 variables added in 1 segments
Executing Post-Build-Steps:
Total:
0 error(s) 0 warning(s)

```

Figure 51: Compiler logging output

2. Downloading Sample Project

- Open the menu 'PLC' and select the menu item 'Online'. An online connection is established.
- If a new code is detected, you will be asked whether you want to download the code or not. Click the button 'Yes'.

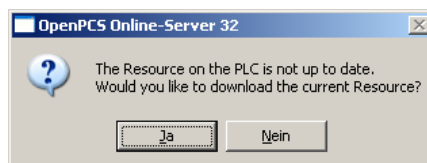


Figure 52: Confirm code download

3. Starting Sample Project

The following sample project is performing a motion sequence of two relative movements. Make sure the axis is free rotating.

- Open the menu 'PLC' and select the menu item 'Cold Start'.

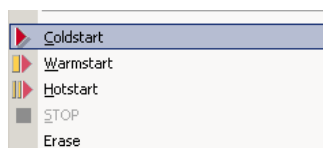


Figure 53: Select 'Cold Start'

- Stop the program by selecting the 'STOP' command in the menu "PLC".

7.4 Further Information

For more detailed information about programming, see the Document "**EPOS P Programming Reference**", available on the EPOS P CD-ROM or on the internet under www.maxonmotor.com category <Service & Downloads>.