

MCD EPOS 60 W

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 60 W 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 60 W system.



Figure 1: MCD EPOS 60 W photo

The maxon MCD EPOS 60 W is a small-sized 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 torque ripple and low noise. The integrated position-, velocity- and current control functionality allows sophisticated positioning applications. It is specially designed being commanded and controlled as a slave node in the CANopen network. 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

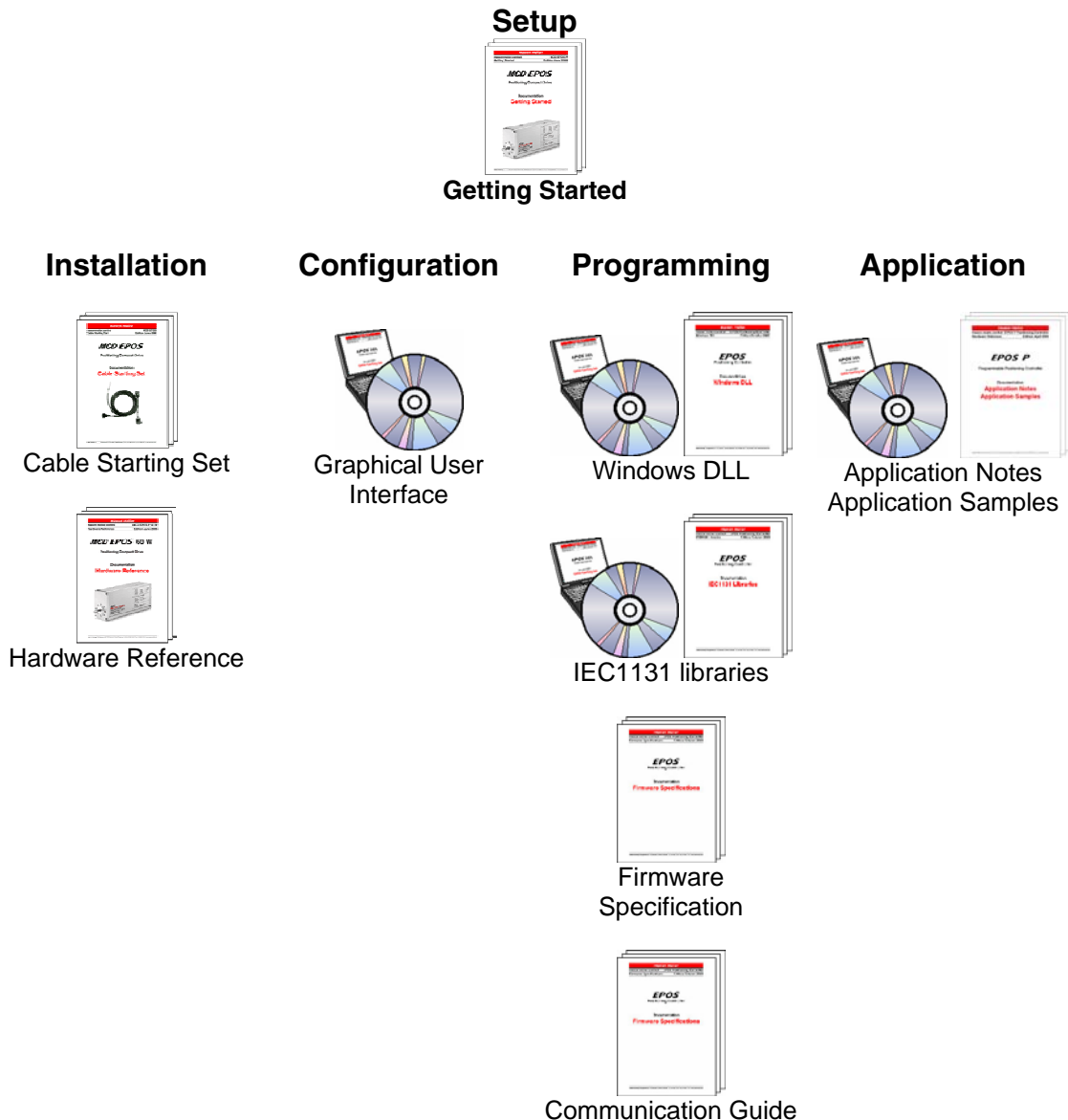


Figure 2: MCD EPOS 60 W documentation hierarchy

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 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 CD-ROM. The CD-ROM contains all necessary information and tools for installation and operation of the EPOS controllers (Manuals, Firmware, Tools and Windows DLLs).

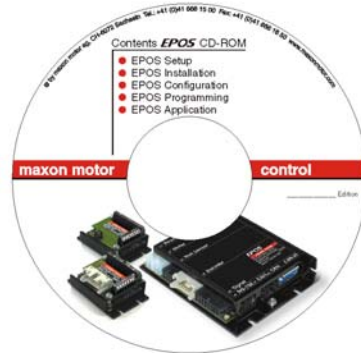


Figure 3: EPOS CD-ROM

The latest edition of the software to the EPOS positioning controller may be downloaded from the internet under <http://www.maxonmotor.com> category <Service & Downloads>.

Minimum system requirements:

Windows ME, Windows NT 4.0, Windows 2000, XP
486 processor, 128 MB RAM
200 MB free storage space on hard drive
Screen resolution 1024 x 768 pixels at 256 colors

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

- 1. Insert CD-ROM**
Insert the EPOS CD-ROM into the CD-ROM drive of your computer.
- 2. Start the installation program 'EPOS_CD-ROM.exe'**
Normally the installation program starts automatically after inserting EPOS CD-ROM. Alternatively, double click the item in the explorer to start the installation program 'EPOS_CD-ROM.exe'
- 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 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 CD-ROM' item allows accessibility to all 'Contents'. On the desktop, a new shortcut to the 'EPOS_UserInterface.exe' will be added. Check the new shortcuts in the start menu and on the desktop.
- 5. Modify or remove the EPOS software**
To change application features or to uninstall the EPOS software, start the installation program 'EPOS_CD-ROM.exe' and follow the instructions.

6.2 Step 2: Minimum External Wiring

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

You should have:

MCD EPOS 60 W positioning controller.....order number **326343**

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 60W

Connect the MCD EPOS Power / RS232-CAN cable to the connector J2 of the MCD EPOS 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!

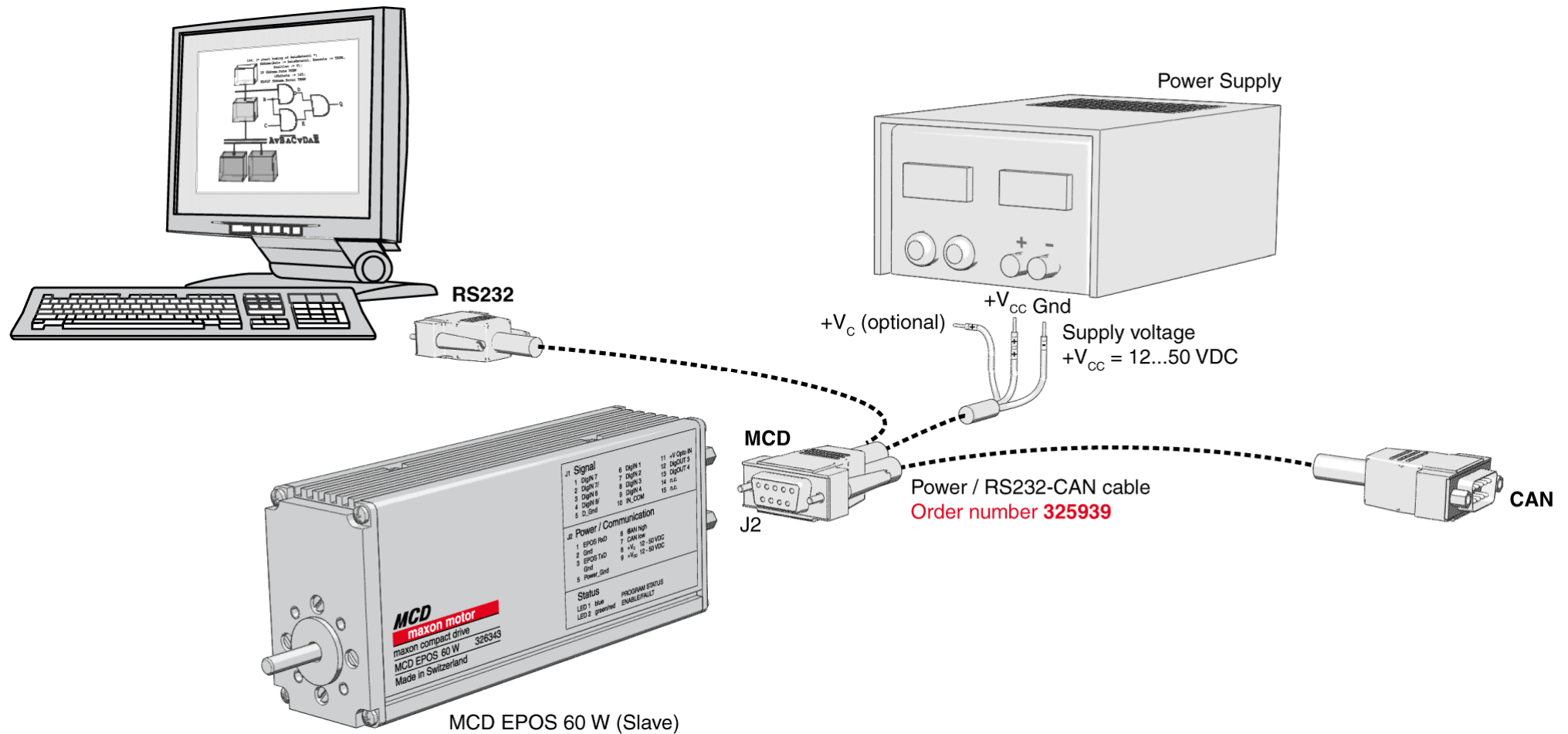


Figure 4: Minimum wiring for MCD EPOS 60 W

6.3 Step 3: System Configuration

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

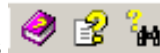
Please note:

- The EPOS_UserInterface provides an online help. It contains all available documentation.

To open online help functions:

- press F1

- **or** use the help buttons



- **or** click the right mouse button

- 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 60 W power supply.

2. Start the 'EPOS_UserInterface' Version 2.10 or higher

Double click on the item 'EPOS UserInterface.exe' on the desktop to start the graphical user interface (GUI). By starting the 'EPOS_UserInterface' the 'Startup Wizard' will be started automatically.

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

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

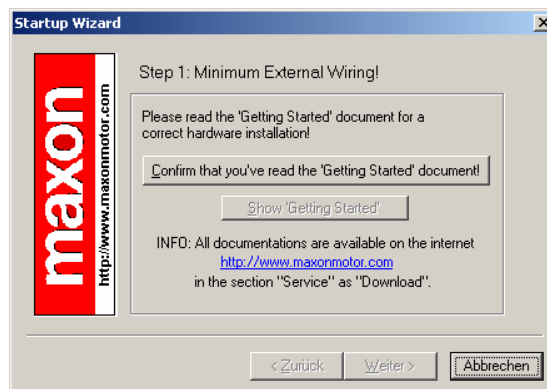


Figure 5: Startup wizard dialog for minimum external wiring

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

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

- a) Verify that your wiring is correct. Please refer to chapter ['6.2 Step 2: Minimum External Wiring'](#).
- b) Click on the button 'Search Nodes' to search the nodes of the selected communication.

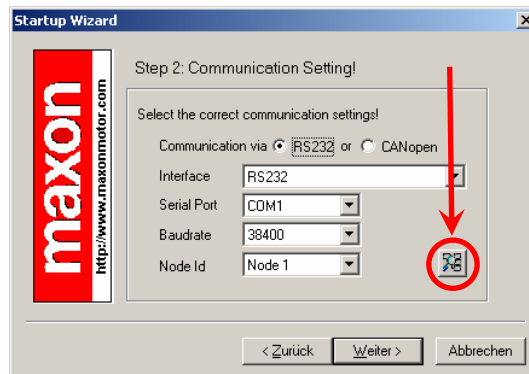


Figure 6: Startup wizard dialog for communication setting

- c) The selected communication is automatically searching for the connected node.
- d) If the node is found, click on the button 'Stop Scanning'.
- e) Select the node and click on the button 'OK'.

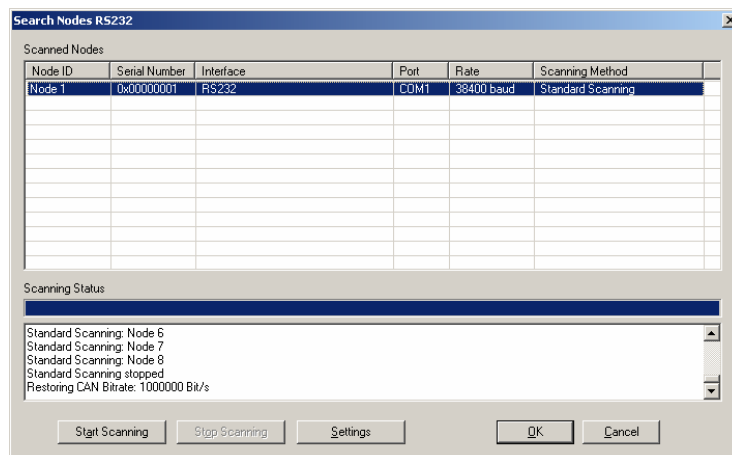


Figure 7: 'Search Nodes' dialog

- f) Select a Node-ID for your device.

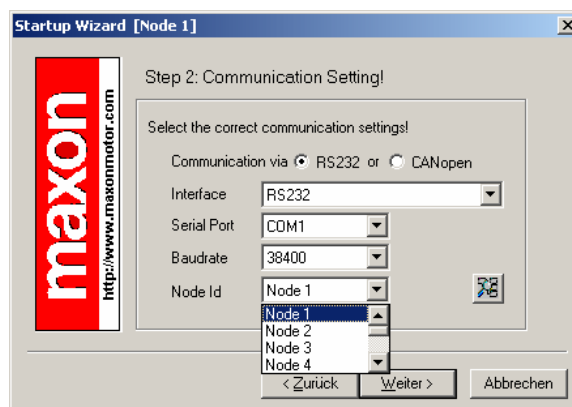


Figure 8: Startup wizard dialog for selecting node

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

7. '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.

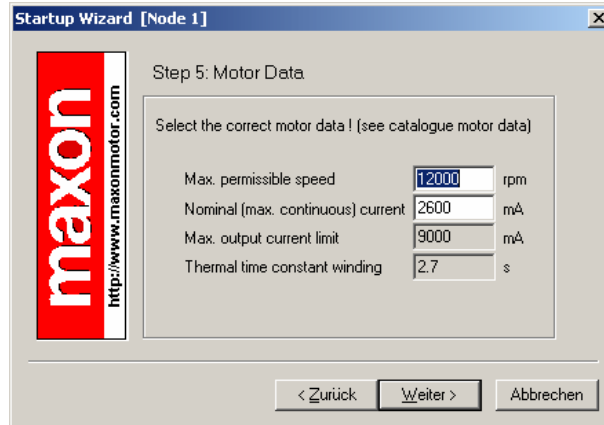


Figure 11: Startup wizard dialog for setting EC motor data

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

8. '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.

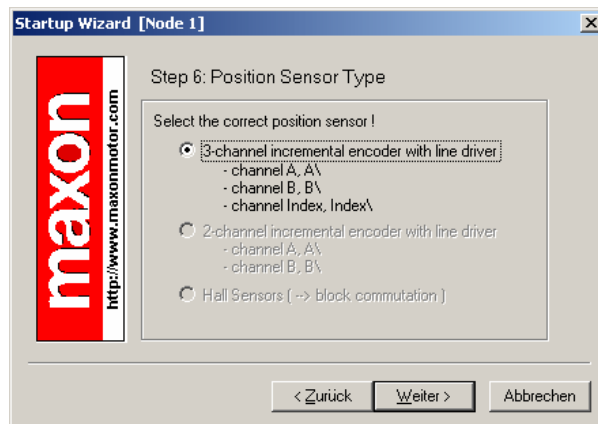


Figure 12: Startup wizard dialog for choosing EC motor position sensor type

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

9. '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.

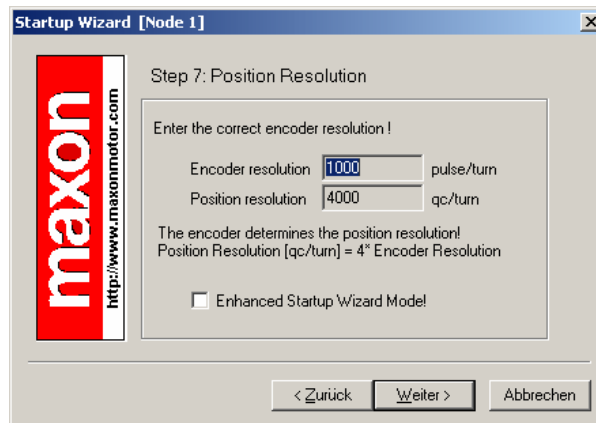


Figure 13: Startup wizard dialog for setting EC motor encoder resolution

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

10. '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'.

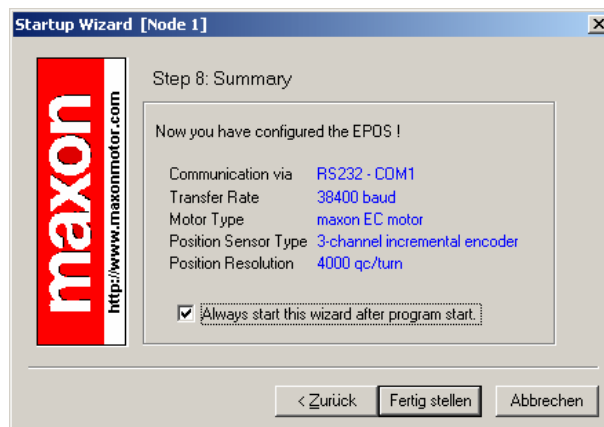


Figure 14: Startup wizard dialog for setting EC motor encoder resolution

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

11. Save and activate parameters

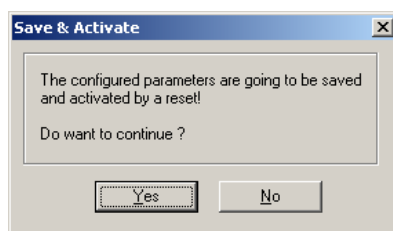


Figure 15: Save & Activate the configured parameters

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

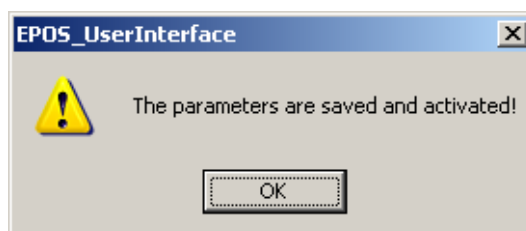


Figure 16: Confirm parameter activation

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

12. Clear CAN error

Now, the object dictionary will be loaded. In case of not connected CAN communication, the error 'CAN in Error Passive Mode' appears.¹

- a) Click on button 'Clear Errors' to clear the error 'CAN in Passive Error Mode'.

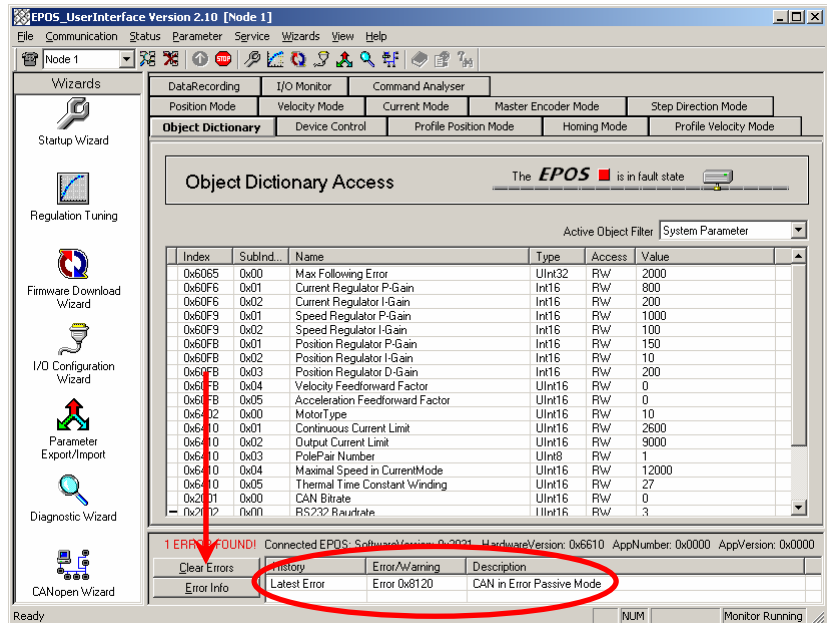


Figure 17: Clear CAN error

- b) If other errors occurred, please check wiring and startup configuration. For more information's about errors, refer to EPOS firmware documentation.
- c) Your MCD EPOS is now ready for regulation gains tuning.

¹ If the 'EPOS_UserInterface' is communicating via CANopen, this error will not appear.

6.4 Step 4: Regulation Gains Tuning

The MCD EPOS 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

- a) In the EPOS_UserInterface, double click the button 'Regulation Tuning' to start the auto-tuning tool.

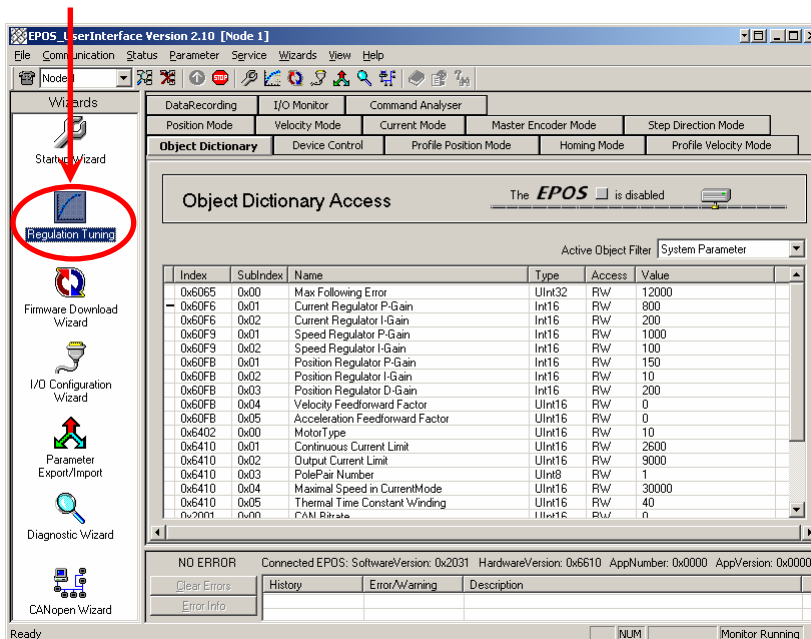


Figure 18: Start regulation tuning

6.4.2 Auto-tuning of the Current Regulator

In a first step, tune the current regulator.

- a) Leave all settings to default values.

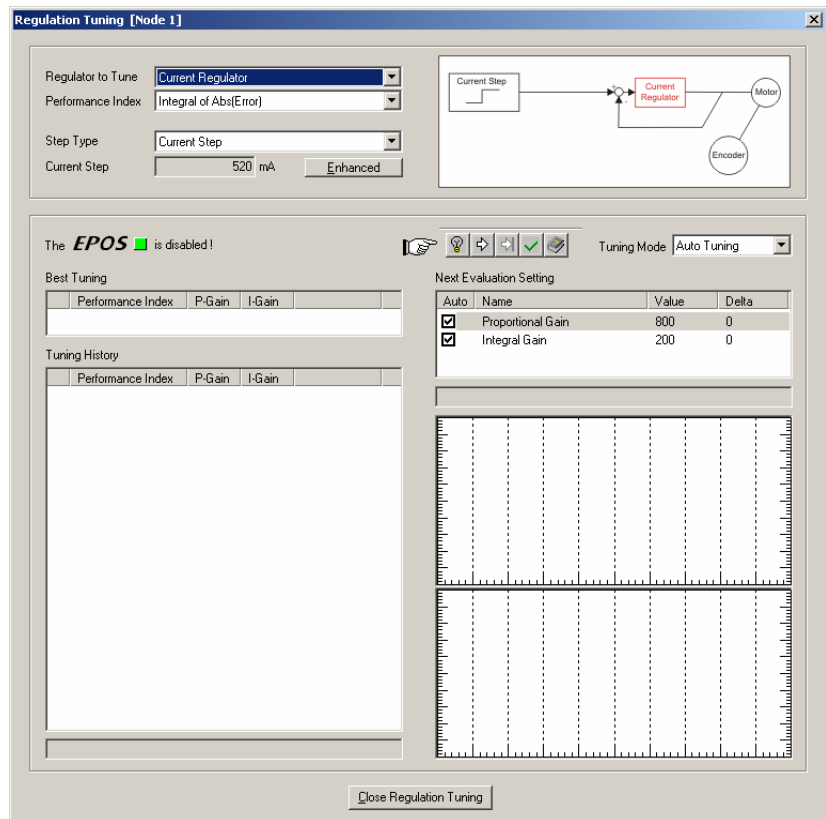


Figure 19: Auto-tuning of current regulator

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

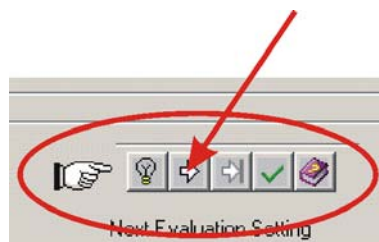


Figure 20: Auto-tuning button

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

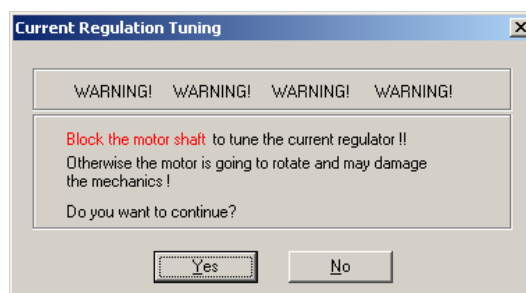


Figure 21: Confirm motor shaft blocking

- 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.

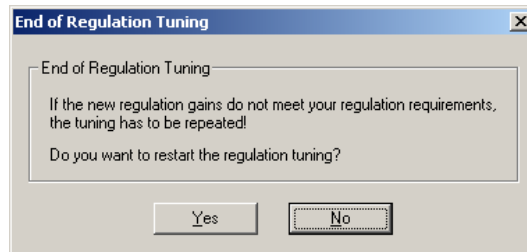


Figure 22: Confirm end of tuning

- 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 23: Confirm tuning error

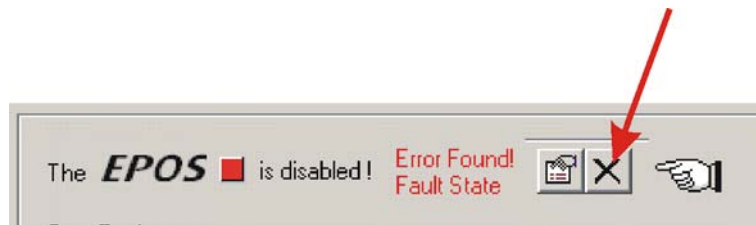


Figure 24: Clear tuning error

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.

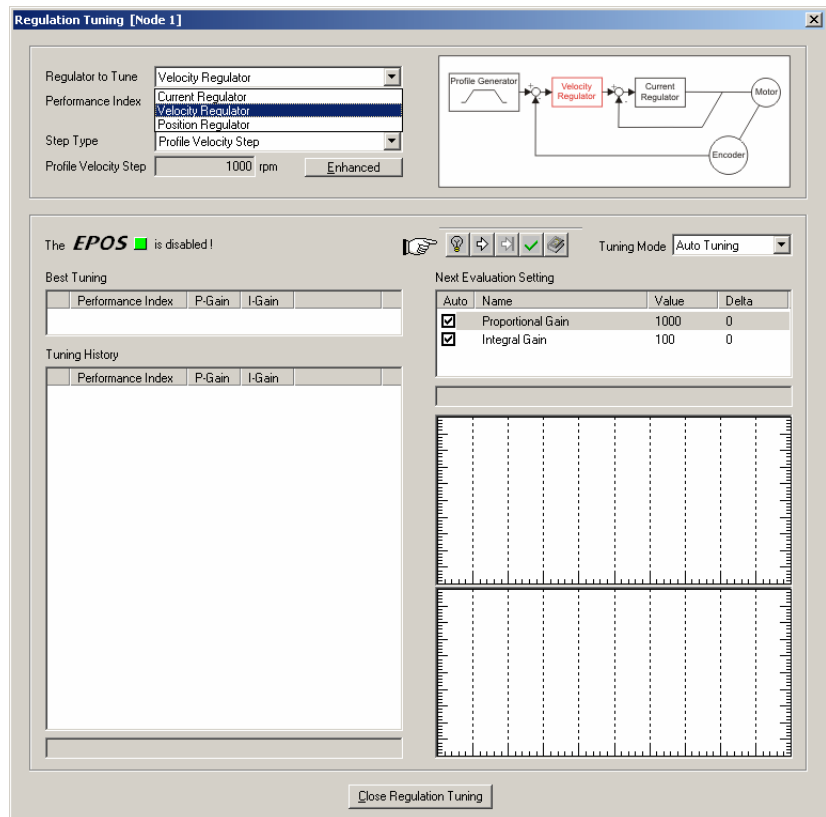


Figure 25: Auto-tuning of velocity regulator

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

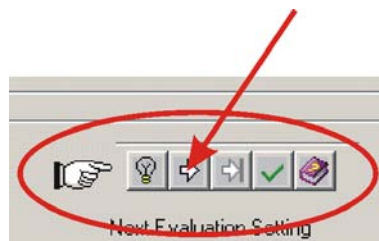


Figure 26: Auto-tuning button

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

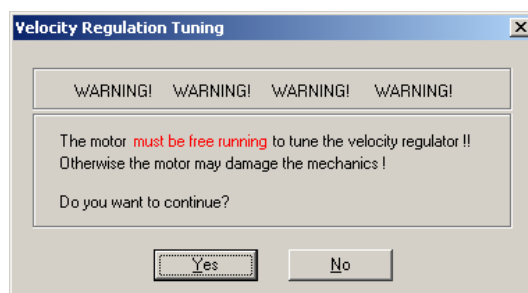


Figure 27: Confirm free running of motor

- 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.

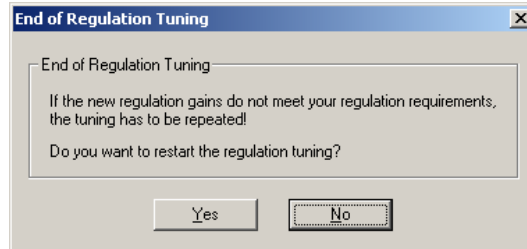


Figure 28: Confirm end of tuning

- 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 29: Confirm tuning error

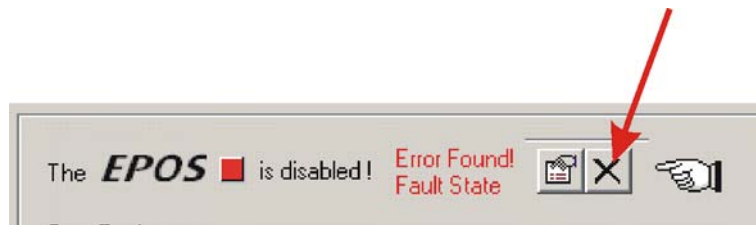


Figure 30: Clear tuning error

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.

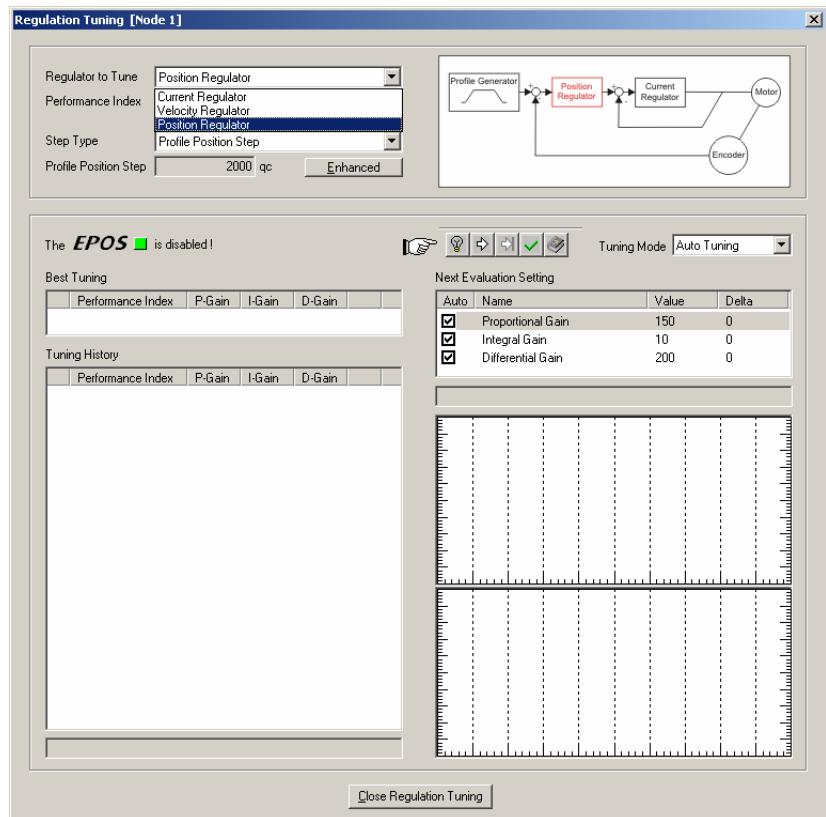


Figure 31: Auto-tuning of position regulator

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

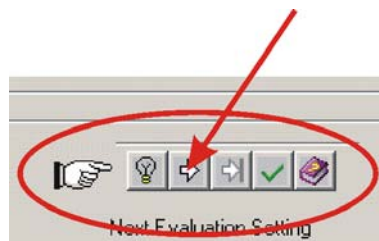


Figure 32: Auto-tuning button

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

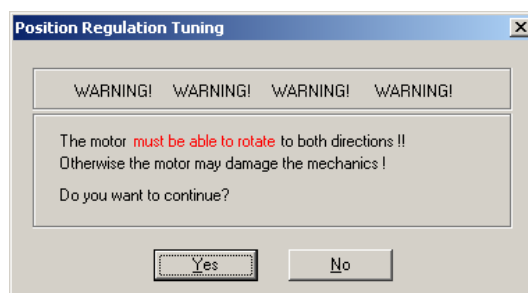


Figure 33: Confirm free running of motor

- 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.

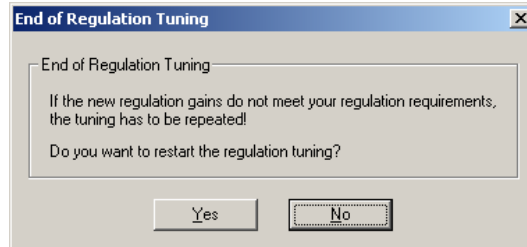


Figure 34: Confirm end of tuning

- 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 35: Confirm tuning error

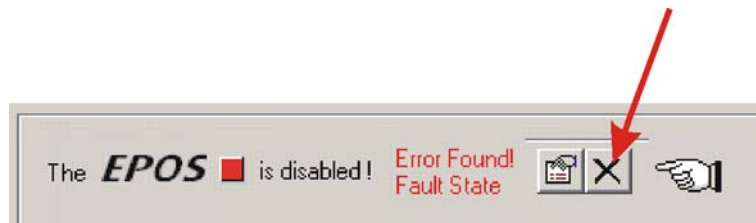


Figure 36: Clear tuning error

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.

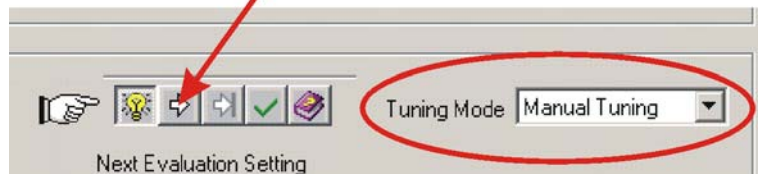


Figure 37: Manual tuning mode

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

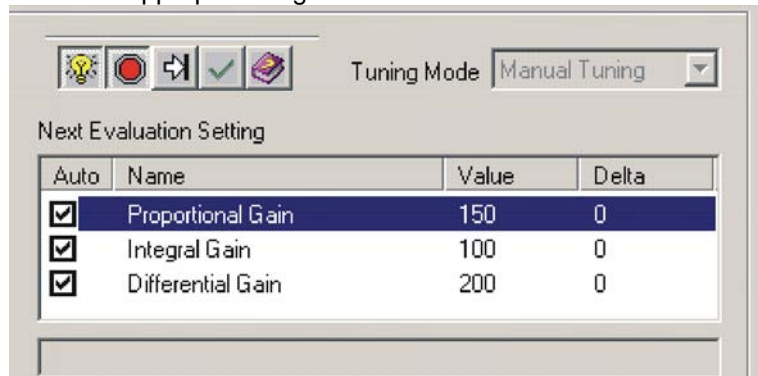


Figure 38: Manual tuning mode

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.

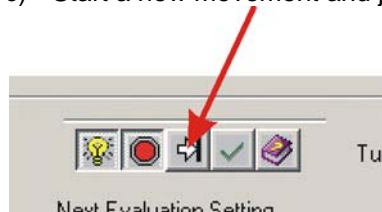


Figure 39: Next tuning step

- 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 60 W.

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

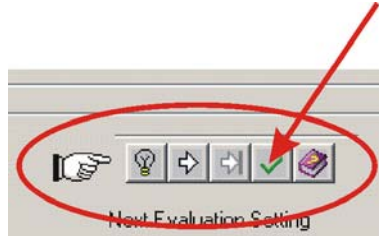


Figure 40: Save button

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

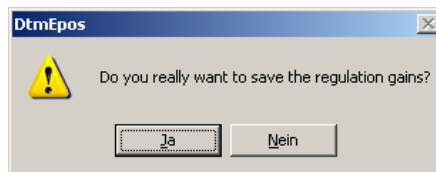


Figure 41: Confirm regulation gains saving

- c) Confirm saving of all parameters by clicking on 'OK' button.



Figure 42: Confirm saving of all parameters

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

7 Conclusion

Now the MCD EPOS 60 W is ready for operation in one of the supported regulation modes!

For further settings and more detailed information's, use online help by pressing F1 or refer to the [MCD EPOS 60 W documentation](#).