

Practical Training with the EPOS Studio

Purpose and goals

The purpose of the exercises is to get familiar with some of the tools and wizards of the EPOS Studio. In particular the download wizard for new firmware and the tools of the internal EPOS (i.e. the motion controller). These exercises are to be done after the Getting Started procedure.

Material and Documentation

- **EPOS2 P 24/5** Starter Kit or
- **EPOS2 24/5** Starter Kit or
- **EPOS2 Module 36/2** with evaluation board Starter Kit

Exercise overview

Group	No.	Exercise	EPOS2 P	internal	EPOS2	Page
Preparation	A	Latest EPOS Studio version	Yes		Yes	2
System configuration	1	System configuration Part 1	Yes		Yes	3
	2	Firmware Download Wizard	Yes		Yes	3
	3	System Configuration Part 2	Yes		Yes	4
	4	Tuning the control parameters	Yes		Yes	4
Standard motion control and data recorder	5	Profile Position Mode		Yes	Yes	5
	6	Homing Mode		Yes	Yes	6
	7	Profile Velocity Mode		Yes	Yes	6
	8	Position Mode		Yes	Yes	7
	9	Velocity Mode		Yes	Yes	7
	10	Current Mode		Yes	Yes	7
I/O and object dictionary	11	I/O Monitor		Yes	Yes	8
	12	Object Dictionary Access	Yes	Yes	Yes	9
	13	Position Compare (Trigger Output)		Yes	Yes	9
Particular motion control	14	Position Mode with analog set value		Yes	Yes	10
	15	Velocity Mode with analog set value and external enable		Yes	Yes	10
	16	Interpolated Position Mode (PVT)		Yes	Yes	11
Miscellaneous	17	Programming (EPOS2 P only)	Yes			12
	18	Command Analyzer		Yes	Yes	12

Remark

For the description of the standard buttons EPOS Studio uses the language of your Windows system. For computers at mmag the description will be in German. Therefore, the German expressions are added in brackets in this document.

Preparation

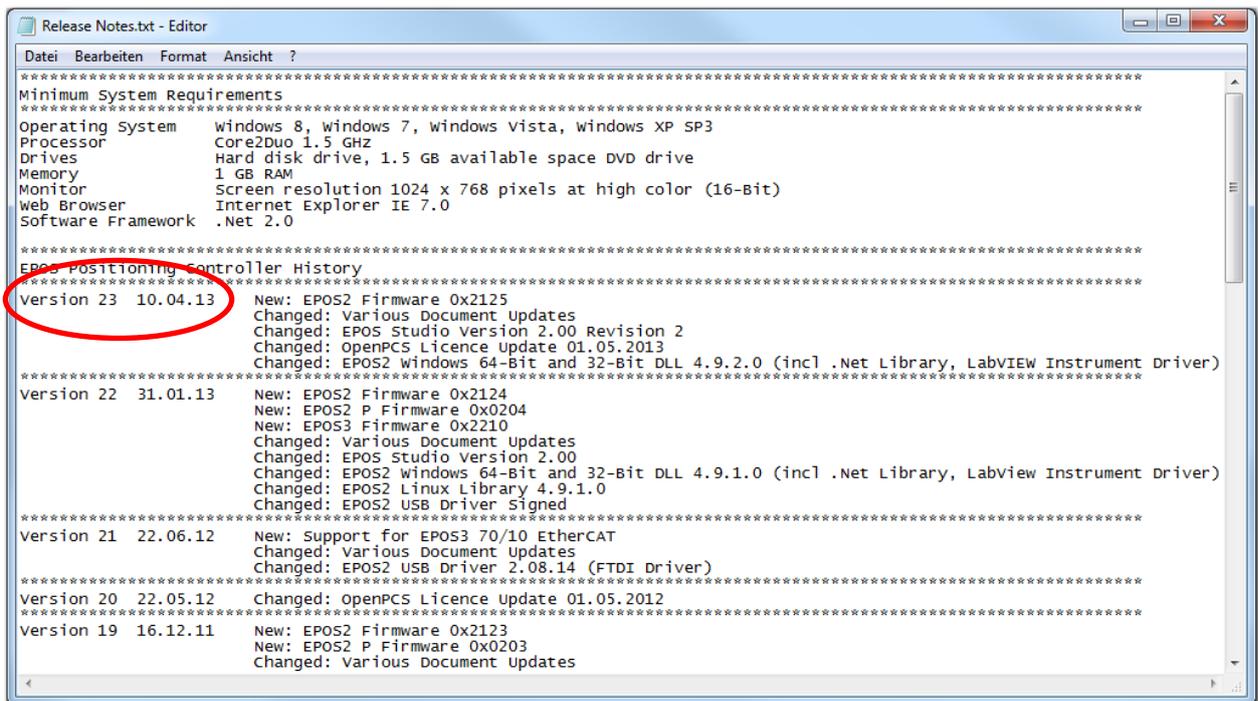
Exercise A: Latest EPOS Studio Version

Goal: Make sure you have the current EPOS Studio version installed on your computer.

1. Visit www.maxonmotor.com and check the current version of the EPOS Studio.



2. On your computer open “Start -> Programs -> maxon motor ag -> EPOS position controller -> Release Notes.txt” and compare the version with the one on www.maxonmotor.com. If you cannot find the document, your version is very old.



3. If the version on your computer is older than the one on www.maxonmotor.com, uninstall the current version on your computer and install the new version from www.maxonmotor.com or from the DVD.

System Configuration

Exercise 1: System Configuration Part 1

Goal: Start-up the EPOS system.

1. Work through **pages 1 – 3-16** of the “Getting Started” document (until chapter 3.4, Step 3)



For EPOS2 systems: USB communication

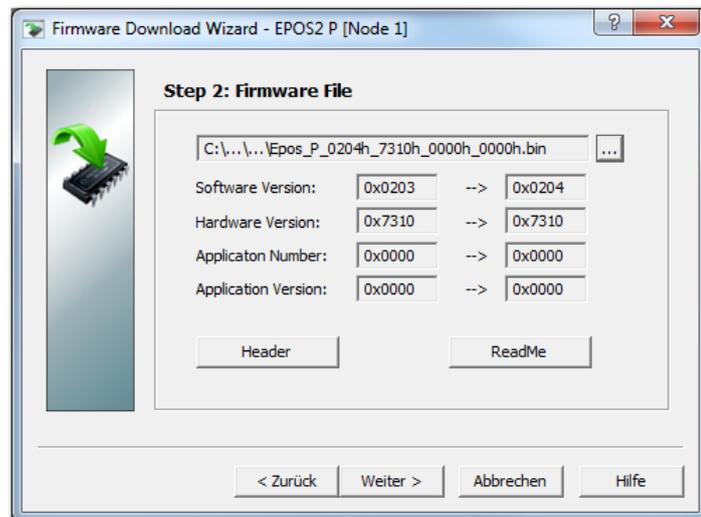
Step 1: Install the driver software according to the document «EPOS2 USB Driver Installation» that can be found on your local disc under “...\Driver Packages\EPOS2 USB Driver”.

Step 2: Wire the EPOS2 according to chapter 3.4 of the "Getting Started" document.

Exercise 2: Firmware Download Wizard

Goal: Download the current firmware to the **EPOS2 P** or **EPOS2 24/5**.

1. Download the current firmware from www.maxonmotor.com and save it to your computer. (**Remark:** By installing the latest EPOS Studio on your computer ([Exercise A](#)) the latest Firmware has been saved on your computer as well.)
2. Start the firmware download Wizard: (select EPOS P on the left side under Wizards)
Step 1: Read the warning, and confirm. Select 'Next' ('Weiter').
Step 2: The following dialog appears.



Select the new firmware file. Use the button (...) for other firmware versions which can be found in the directory.

- "... EPOS2 P \ 03 Configuration \ Firmware Files **EPOS2 P 24-5**".
- "... EPOS2 \ 03 Configuration \ Firmware Files **EPOS2 24-5**".

Press 'Next' ('Weiter') if the current version is older than the new one.

Step 3: If you want to keep the current system parameters of the EPOS, click on 'Export'. Save the current system parameters. Press 'Next' ('Weiter').

Step 4: Start the download with the 'Start' button. If the Download was successful go on clicking on 'Next' ('Weiter'), otherwise repeat the download.

Step 5: Click on 'Import'. Click on 'Next' ('Weiter').

Step 6: Summary: Click on 'Finish' ('Fertig stellen').

Remark: Downloading a new firmware version automatically overwrites the permanent parameter set.

Exercise 3: System Configuration Part 2

Goal: Configure the EPOS system.

1. Work through **pages 3-17 – 3-25** of the “Getting Started” document of the EPOS (until end of chapter 3.5: Step 4: System Configuration).

Exercise 4: Tuning the Control Parameters

Goal: Configure the EPOS system.

1. Work through **pages 3-26 – 3-29** of the “Getting Started” document (until end of chapter 3.6: Step 5: Regulation Gains Tuning)
2. Perform an "Expert Tuning" according to the document ‘Application Notes Collection’, chapter “Regulation Tuning”
Note the differences in the result between soft and stiff control parameter.
3. Try to improve the parameters. Perform a manual tuning on the **EPOS2**.

Standard Motion Control

Exercise 5: Profile Position Mode

Goal: Start a Point-to-Point movement and use of the Data Recorder.

(There is a chapter regarding the use of the Data Recorder in the document 'Application Notes Collection')

Go to the "Tools" Tab on the left hand side (select EPOS)

1. Recorder configuration:
 - Step 1: Change to Tab 'DataRecording'.
 - Step 2: Click the button 'Configure Recorder'.
 - Step 3: In the Configure Recorder window select the button 'Channel 1 Inactive' to activate Channel 1 and select the button 'Channel 2 Inactive' to activate Channel 2.
 - Step 4: Select the value 'Position Demand Value' in the pull down menu for Channel 1 and 'Position Actual Value' in the pull down menu for Channel 2.
 - Step 5: Change the sampling period to 2ms.
 - Step 6: Change to Trigger Mode 'Single Trigger Mode'.
 - Step 7: Click on the 'OK' button.

2. Point to point movement:
 - Step 1: Change to Tab 'Profile Position Mode' and activate the mode.
 - Step 2: Change Target Position to 4000qc.
 - Step 3: Change Profile Velocity to 2500 rpm.
 - Step 4: Change Profile Acceleration to 20000rpm/s.
 - Step 5: Change Profile Deceleration to 8000rpm/s.
 - Step 6: Enable the EPOS.
 - Step 7: Make the movement by clicking on the 'Move Relative' button.

3. Check the recorded data:
 - Step 1: Select the Tab 'DataRecorder'.
 - Step 2: Select 'Attached Cursor' and check the position values.
 - Step 3: Export the recorded data to a *.zip file (contains *.txt ASCII, *.rda Data recorder and *.bmp picture files).

Hint: Use right mouse button on diagram.
 - Step 4: Open the exported *.txt file in Microsoft Excel.

Exercise 6: Homing Mode

Goal: Know the different homing methods.

1. Change to Tab 'Homing Mode'
2. Activate Homing Mode (button);
'Enable' the EPOS.
3. Execute the homing method 'Current Threshold Positive Speed & Index':
Step 1: Select the homing method 'Current Threshold Positive Speed & Index'.
Step 2: Change the parameter 'Current Threshold' to 500mA.
Step 3: Start homing with the button 'Start Homing'.
Step 4: Try to block the motor shortly by hand to increase the current. -> home position is detected!
4. Repeat the homing with different parameters

Exercise 7: Profile Velocity Mode

Goal: Start a velocity profile and record the movement.

1. Select the Tab 'Data Recorder' and configure:
Step 1: Click on button 'Configure Recorder'.
Step 2: Set Channel 1,2 and 3 active.
Step 3: Channel 1 -> Velocity Demand Value, Left Scale
Step 4: Channel 2 -> Velocity Actual Value, Left Scale
Step 5: Channel 3 -> Current Actual Value, Right Scale
Step 6: Select 'Continuous Acquisition Mode'.
Step 7: Take a sampling time of 2ms..
Step 8: Press the 'OK' button.
2. Start a velocity profile:
Step 1: Select the Tab 'Profile Velocity Mode'.
Step 2: Activate Profile Velocity Mode.
Step 3: Change 'Target Velocity' to 1000rpm.
Step 4: Start Move with the button 'Set Velocity'.
3. Save a bitmap of the recorded data.
(right mouse click on the diagram of the data recorder)
Hint: Stop recorder first.

Exercise 8: Position Mode

Goal: Recognize the difference between 'Profile Position Mode' and 'Position Mode'.

1. Set the current position to 0. (e.g. by homing)
2. Configure the 'Data Recorder':
Step 1: Select 'Position Demand Value' and 'Position Actual Value'.
Step 2: Select the 'Single Trigger Mode': 'Movement Trigger'
3. Execute a position step:
Step 1: Change to Tab 'Position Mode'.
Step 2: Enable the device.
Step 3: Activate 'Position Mode' and start a move of 1000qc.
4. Reduce the maximum speed and velocity and observe the repressed system reaction.

Exercise 9: Velocity Mode

Goal: Recognize the difference between 'Profile Velocity Mode' and 'Velocity Mode'

1. Configure the 'Data Recorder':
Step 1: Select 'Velocity Demand Value' and 'Velocity Actual Value'.
Step 2: Select the 'Single Trigger Mode': 'Movement Trigger'
2. Execute a velocity step:
Step 1: Change to Tab 'Velocity Mode', activate 'Velocity Mode'.
Step 2: Enable the device.
Step 3: Move with 2000 rpm.
Step 4: Stop the motor.

Exercise 10: Current Mode

Goal: Use the 'Current Mode'

1. Configure the 'Data Recorder':
Step 1: Select 'Current Mode Setting Value' and 'Current Actual Value'.
Step 2: Select the 'Single Trigger Mode': 'Movement Trigger'.
2. Execute a current step:
Step 1: Change to Tab 'Current Mode', activate 'Current Mode'.
Step 2: Enable the device.
Step 3: Block the motor shaft! (Why?)
Step 4: Set the Current 'Setting Value' to 500mA.
Step 5: Disable the device.

I/O and Object Dictionary

Exercise 11: I/O Monitor

Goal: Use of the 'I/O Monitor' and practical understanding of the I/O-functionality.

(There is a chapter regarding the Input and Output configuration in the document 'Application Notes Collection')

1. Setting digital outputs:
 - Step 1: Click on purpose in the table and set the digital outputs 1 to 4 as 'General Purpose' A to D. Set the mask to 'Enabled' and the Polarity to 'High Active'.
 - Step 2: Set the 'State' of some of the digital outputs to 'Active' and observe the reaction of the outputs on the EPOS Starter Kit.
 - Step 3: Change the Mask to 'Disabled'. How does this affect the setting of the output?
 - Step 4: Change the Polarity to 'Low Active'. How does this affect the physical output.
2. Assigning functionality to a digital output:
 - Step 1: Set the 'Purpose' of the Digital Output 4 to 'Ready'.
 - Step 2: Watch the behavior of this output during the next steps, e.g. when an error occurs.
3. Reading analogue inputs:
 - Turn the potentiometers of the analogue inputs and observe the reading of the I/O Monitor.
4. Reading digital inputs:
 - Step 1: Set the digital inputs 1 to 6 as 'General Purpose' A to F. Set the mask to 'Enabled' and the Polarity to 'High Active'.
 - Step 2: Activate one of the digital inputs physically on the EPOS Starter Kit and observe the reaction in the I/O Monitor.
 - Step 3: Change the mask to 'Disabled'. How does this affect the reading of the input?
 - Step 4: Change the Polarity to 'Low Active'. How affects this the reading of the input?
5. Assigning functionality to a digital input:
 - Step 1: Set the 'Purpose' of the digital input 1 to 'Negative Limit Switch'.
 - Step 2: Activate digital input 1 and observe the reaction of the EPOS and the 'Ready' output.
 - Step 3: Clear the error in the EPOS Studio.
 - Step 4: What is the difference between the 'Mask' and the 'ExecMask'?
6. Use the functionality of a digital input:
 - Use the digital Input 1 to perform a homing onto the 'Negative Limit Switch'.

Remark: The changed parameter can be saved by right-clicking on the header of the I/O Monitor window.

Exercise 12: Object Dictionary Access

Goal: Generation of an object filter. Edit system parameters in the object dictionary.

1. Change to the Tab 'Object Dictionary' and activate the Object Filter 'All Objects'.
2. Define a new object filter:
Step 1: right-click to the object field and select 'Define ObjectFilter'.
Step 2: Select 'New' to generate a new object filter.
Step 3: Appoint the Object Filter with "MyRegGains".
Step 4: Select with the pressed Ctrl button the Objects:
 - 0x60F6 (Current Regulator P-Gain, I-Gain)
 - 0x60F9 (Speed Regulator P-Gain, I-Gain)
 - 0x60FB (Position Regulator P-Gain, I-Gain, D-Gain)Step 5: Press the button 'Add Objects'.
Step 6: Save the ObjectFilter.
Step 7: Exit with 'Exit' button.
3. Double click with the left mouse button on an object to edit it:
Step 1: Change Current P-Gain (e.g. P-Gain = P-Gain + 1).
Step 2: Click with the right mouse button on an object and select 'Save all Parameters'.
Step 3: Change Current I-Gain (e.g. I-Gain = I-Gain + 1).
4. Reset EPOS:
'Communication' (Navigation window) -> right mouse click on 'EPOS [Internal]' -> 'Reset Node'
5. Check if P-Gain holds the changed value and I-Gain the original value (P-Gain was saved to EEPROM, I-Gain was only changed in RAM).

Remarks:

- With the 'Object Directory Access' the parameters which you need and which are important to you can be displayed and arranged in a convenient way.
- Changes in the Object Dictionary tool will only be permanently stored in the EPOS after a 'Save Parameters' command.

Exercise 13: Position Compare (Trigger Output)

Goal: See how Position Compare needs to be set up. Working with the document 'Firmware Specification'.

1. Use the I/O Monitor to configure one of the digital outputs as 'Position Compare'.
2. Left click on button 'Show Attributes' to set up the 'Position Compare' (Details on Chapter 8.2.60 Firmware Specification):
Step 1: Tick 'Enable' checkbox.
Step 2: select 'Operational Mode': 'Single'
Step 3: select 'Direction Dependency': 'Positive'
Step 4: enter 'Reference Position': 2000
Step 5: enter 'Pulse Width': as long as possible (Firmware Specification)
3. Initiate movements and observe the Trigger Output.

Particular Motion Control Features

Exercise 14: Position Mode with Analogue Set Value

Goal: Know how an analogue set value and the enable input are set up. Operation without serial on-line commanding.

1. Use the I/O Monitor to configure an analogue input as the analogue position set value.
2. Use the I/O Monitor to configure a digital input as an enable switch.
3. Execute a positioning:
 - Step 1: Change to Tab 'Position Mode'.
 - Step 2: Activate 'Position Mode'.
 - Step 3: Enter a scaling factor between the analogue input voltage and the position. (e.g. 1000 qc/V)
 - Step 4 (optional): Save parameters (e.g. context menu on Object Dictionary tool window).
 - Step 5: Verify that the current position and the set position are sufficiently close in order to avoid a following error.
 - Step 6: Enable and start a motion with the potentiometer.
4. Reduce the maximum speed and velocity and observe the repressed system reaction.
5. Remove the USB connection to show offline operation.

Exercise 15: Velocity Mode with Analogue Set Value

Goal: Know how to set up the analogue speed control.

1. Use the I/O Monitor to configure a digital input as an enable switch.
2. Use the I/O Monitor to configure an analogue input as the analogue speed set value.
3. Start a motion:
 - Step 1: Change to Tab 'Velocity Mode'.
 - Step 2: Activate 'Velocity Mode'.
 - Step 3: Enter a scaling factor between analogue input voltage and speed (e.g. 1000 rpm/V).
 - Step 4 (optional): Save parameters (e.g. context menu on Object Dictionary tool window).
 - Step 5: Enable and start a motion with the potentiometer.

Exercise 16: Interpolated Position Mode (PVT)

Goal: Know how IPM works, what the tool can do and what the user still needs to do.

1. Change to the tool 'Interpolated Position Mode'.
2. Import a PVT-file (e.g. IPM_Sample#1.csv):
 - Step 1: What kind of movement is shown?
 - Step 2: Enable the EPOS device.
 - Step 3: Start the movement several times with different starting positions.
 - Step 4: What changes do you observe on the diagram and on the motor shaft? Explain.
3. Import a PVT-file: (e.g. IPM_Sample#5a.csv)
 - Step 1: What kind of movement is shown?
 - Step 2: Start the movement.
 - Step 3: Adjust the velocity values to get a more constant velocity profile.
 - Step 4: Verify the constancy by looking at the acceleration. What is the acceleration characteristic for a smooth and jerk-free velocity profile?
4. Try to expand the PVT-file (IPM_Sample#5a.csv) to higher amplitudes.
 - How many PVT positions are possible?

Remark: Use the 'Interpolated Position Mode' chapter of the document 'Application Notes Collection' for further details.

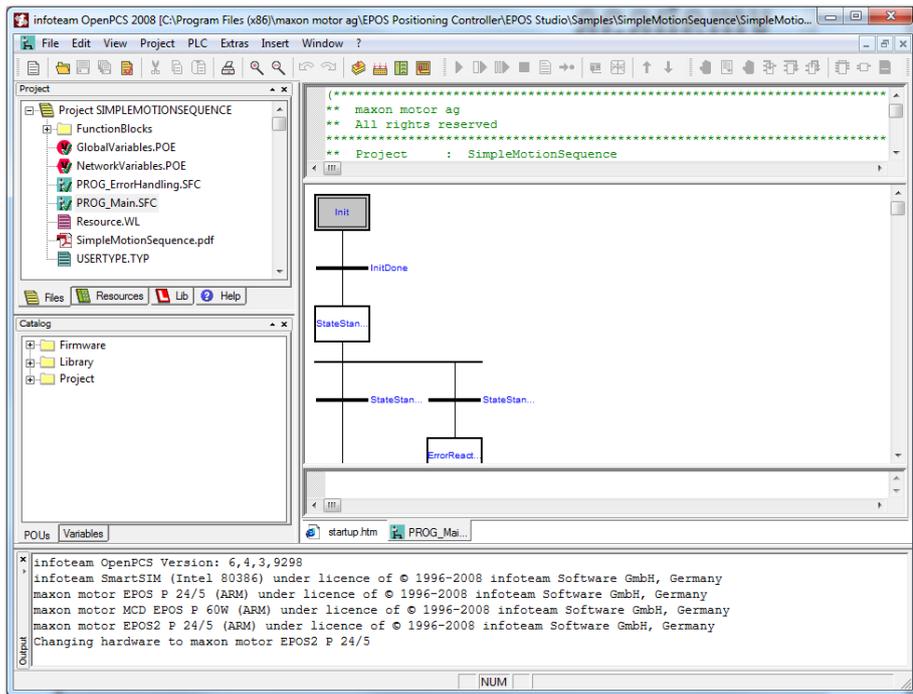
Miscellaneous

Exercise 17: Programming

EPOS2 P only

Goal: Get to know the programming functionality.

1. Work through **Chapter 4** of the “Getting Started” document of the EPOS2 P. Double-click on the item ‘PROG_Main.SFC’ in the project window. The program code is opened.



Exercise 18: Command Analyzer

Goal: See how the Command Analyzer works and what kind of information can be obtained.

1. Configure the EPOS2 in the 'Velocity Mode'.
2. Change to the tool 'Command Analyzer':
Step 1: Where can you find the commands for setting a speed in the 'Velocity Mode'?
Step 2: Where can you find the commands for 'Enable' and 'Disable'?
3. Enable the EPOS2 from the 'Command Analyzer' and set a speed of 500 rpm.
4. Analyze the commands:
Step 1: What do the commands look like on the different layer levels?
Step 2: Try to find out what the different layers mean and how the information on the different layers is connected.
For further details also use the document EPOS2 'Communication Guide' .
5. Additional exercise: Setup the EPOS2 for RS232 communication (e.g. by opening a new project in the EPOS Studio). Compare the duration of the same commands as before.