maxon motor

maxon motor control	**EPOS2 Positioning Controller**
Getting Started	**Edition December 2013**

EPOS2 70/10

Positioning Controller

Getting Started

Document ID: rel4269

PLEASE READ THIS FIRST

! ***These instructions are intended for qualified technical personnel. Prior commencing with any activities …***
- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

We have tried to provide you with all information necessary to install and commission the equipment in a **secure**, **safe** and **time-saving** manner. Our main focus is …

- to familiarize you with all relevant technical aspects,
- to let you know the easiest way of doing,
- to alert you of any possibly dangerous situation you might encounter or that you might cause if you do not follow the description,
- to **write as little** and to **say as much** as possible and
- not to bore you with things you already know.

Likewise, we tried to skip repetitive information! Thus, you will find things **mentioned just once**. If, for example, an earlier mentioned action fits other occasions you then will be directed to that text passage with a respective reference.

! ***Follow any stated reference – observe respective information – then go back and continue with the task!***

PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION

The EPOS2 70/10 is considered as partly completed machinery according to EU's directive 2006/42/EC, Article 2, Clause (g) and therefore **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

! ***You must not put the device into service, …***
- *unless you have made completely sure that the other machinery – the surrounding system the device is intended to be incorporated to – fully complies with the requirements stated in the EU directive 2006/42/EC!*
- *unless the surrounding system fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the stated requirements!*

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1 About this Document

1.1 Intended Purpose

The purpose of the present document is to familiarize you with the described equipment and the tasks on safe and adequate installation and/or commissioning.

Observing the described instructions in this document will help you …

- to avoid dangerous situations,
- to keep installation and/or commissioning time at a minimum and
- to increase reliability and service life of the described equipment.

Use for other and/or additional purposes is not permitted. maxon motor, the manufacturer of the equipment described, does not assume any liability for loss or damage that may arise from any other and/or additional use than the intended purpose.

1.2 Target Audience

This document is meant for trained and skilled personnel working with the equipment described. It conveys information on how to understand and fulfill the respective work and duties.

This document is a reference book. It does require particular knowledge and expertise specific to the equipment described.

1.3 How to use

Take note of the following notations and codes which will be used throughout the document.

Notation	Explanation
«Abcd»	indicating a title or a name (such as of document, product, mode, etc.)
¤Abcd¤	indicating an action to be performed using a software control element (such as folder, menu, drop-down menu, button, check box, etc.) or a hardware element (such as switch, DIP switch, etc.)
(n)	referring to an item (such as order number, list item, etc.)
➔	denotes "see", "see also", "take note of" or "go to"

Table 1-1   Notations used in this Document

1.4 Symbols and Signs

1.4.1 Safety Alerts

Take note of when and why the alerts will be used and what the consequences are if you should fail to observe them!

Safety alerts are composed of…

- • a signal word,
- • a description of type and/or source of the danger,
- • the consequence if the alert is being ignored, and
- • explanations on how to avoid the hazard.

Following types will be used:

1) **DANGER**
   Indicates an **imminently hazardous situation**. If not avoided, the situation will result in death or serious injury.

2) **WARNING**
   Indicates a **potentially hazardous situation**. If not avoided, the situation **can** result in death or serious injury.

3) **CAUTION**
   Indicates a **probable hazardous situation** and is also used to alert against unsafe practices. If not avoided, the situation **may** result in minor or moderate injury.

Example:

DANGER

High Voltage and/or Electrical Shock
Touching live wires causes death or serious injuries!
- • *Make sure that neither end of cable is connected to life power!*
- • *Make sure that power source cannot be engaged while work is in process!*
- • *Obey lock-out/tag-out procedures!*
- • *Make sure to securely lock any power engaging equipment against unintentional engagement and tag with your name!*

1.4.2 Prohibited Actions and Mandatory Actions

The signs define prohibitive actions. So, you **must not**!

Examples:

Do not touch!

Do not operate!

The signs point out actions to avoid a hazard. So, you **must**!

Examples:

Unplug!

Tag before work!

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1.4.3 Informatory Signs

Requirement / Note / Remark
Indicates an action you must perform prior continuing or refers to information on a particular item.

Best Practice
Gives advice on the easiest and best way to proceed.

Material Damage
Points out information particular to potential damage of equipment.

Reference
Refers to particular information provided by other parties.

1.5 Trademarks and Brand Names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the below list is not necessarily concluding) are protected by copyright and/or other intellectual property rights even if their legal trademarks are omitted in the later course of this document.

Brand Name	Trademark Owner
Adobe® Reader®	© Adobe Systems Incorporated, USA-San Jose, CA
CANopen® CiA®	© CiA CAN in Automation e.V, DE-Nuremberg
Internet Explorer®	© Microsoft Corporation, USA-Redmond, WA
Pentium®	© Intel Corporation, USA-Santa Clara, CA
Windows Vista® Windows®	© Microsoft Corporation, USA-Redmond, WA

Table 1-2   Brand Names and Trademark Owners

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1.6 Copyright

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2 Introduction

The present document provides you with information on the first steps using EPOS2 70/10 Positioning Controller. It describes the standard procedure when putting the device into operation and is meant to facilitate installation and configuration of a basic EPOS2 70/10 system.

maxon motor control's EPOS2 70/10 is a small-sized, full digital smart motion control unit. Due to its flexible and high efficient power stage, the EPOS2 70/10 drives brushed DC motors with digital encoder as well as brushless EC motors with digital Hall sensors and encoder.

The sinusoidal current commutation by space vector control offers to drive brushless EC motors with minimal torque ripple and low noise. The integrated position, velocity and current control functionality allows sophisticated positioning applications. The EPOS2 70/10 is specially designed being commanded and controlled as a slave node in a CANopen network. In addition, the unit can be operated via any USB or RS232 interface.

Find the latest edition of the present document, as well as additional documentation and software to the EPOS2 70/10 Positioning Controller also on the Internet: ➔www.maxonmotor.com

2.1 Documentation Structure

The present document is part of a documentation set. Please find below an overview on the documentation hierarchy and the interrelationship of its individual parts:
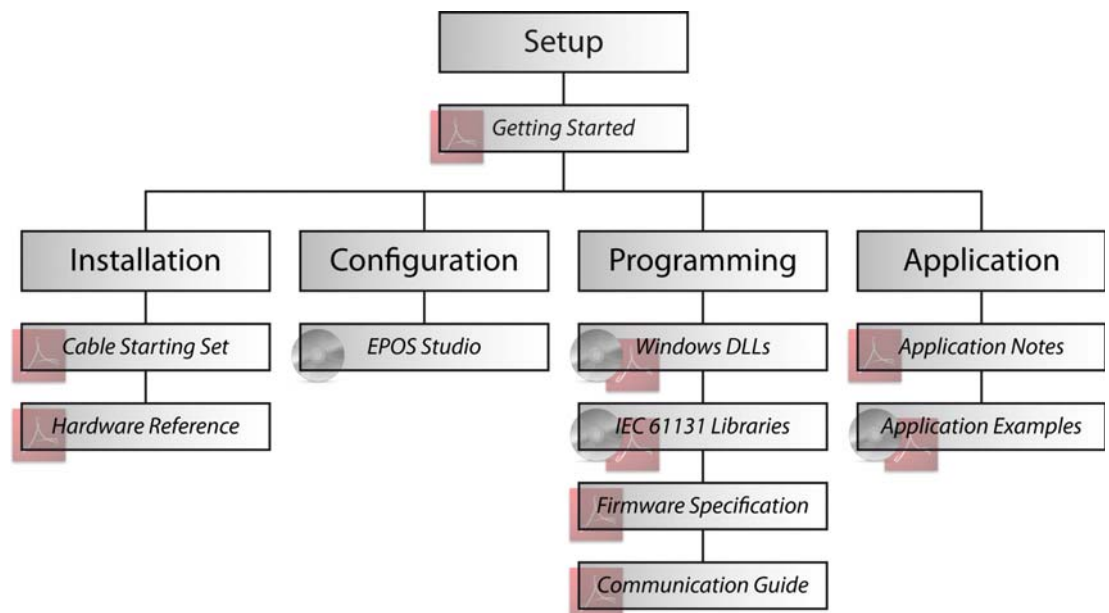

Figure 2-1   Documentation Structure

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2.2   Safety Precautions

Prior continuing …

- make sure you have read and understood chapter " PLEASE READ THIS FIRST" on page A-2,

- do not engage with any work unless you possess the stated skills (➔chapter "1.2 Target Audience" on page 1-5),

- refer to chapter "1.4 Symbols and Signs" on page 1-6 to understand the subsequently used indicators,

- you must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection,

- take note of the subsequently used indicators and follow them at all times.

DANGER

High Voltage and/or Electrical Shock
Touching live wires causes death or serious injuries!
- *Consider any power cable as connected to life power, unless having proven the opposite!*
- *Make sure that neither end of cable is connected to life power!*
- *Make sure that power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag with your name!*

Requirements
- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus can not be considered fail-safe. Therefore, you must make sure that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return – and be kept – in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon motor.*

Best Practice
- *For initial operation, make sure that the motor is free running. If not the case, mechanically disconnect the motor from the load.*

Maximal permitted Supply Voltage
- *Make sure that supply power is between 11…70 VDC.*
- *Supply voltages above 75 VDC will destroy the unit.*
- *Wrong polarity will destroy the unit.*

Electrostatic Sensitive Device (ESD)
- *Make sure to wear working cloth in compliance with ESD.*
- *Handle device with extra care.*

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3 Installation and Configuration

3.1 Important Notice: Prerequisites for Permission to commence Installation

The EPOS2 70/10 is considered as partly completed machinery according to EU's directive 2006/42/EC, Article 2, Clause (g) and therefore **is only intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

> **WARNING**
>
> *Risk of Injury*
> *Operating the device without the full compliance of the surrounding system with the EU directive 2006/42/EC may cause serious injuries!*
> • *Do not operate the device, unless you have made sure that the other machinery fulfills the requirements stated in EU's directive!*
> • *Do not operate the device, unless the surrounding system fulfills all relevant health and safety aspects!*
> • *Do not operate the device, unless all respective interfaces have been established and fulfill the stated requirements!*

3.2 Step 1: Software Installation

Install the software from the «EPOS Positioning Controller» DVD. It contains all necessary information and tools (such as manuals, firmware, tools, Windows DLLs, drivers) required for installation and operation of the EPOS2 Positioning Controller.

> *You can download the latest software version from the Internet (for URLs → chapter "2 Introduction" on page 2-9).*

3.2.1 Minimum System Requirements

Component	Minimum Requirement
Operating System	Windows 8, Windows 7, Windows XP SP3, Windows Vista
Processor	Core2Duo 1.5 GHz
Drives	Hard disk drive, 1.5 GB available space DVD drive
Memory	1 GB RAM
Monitor	Screen resolution 1024 x 768 pixels at high color (16-Bit)
Web Browser	Internet Explorer IE 7.0

Table 3-3   Minimum System Requirements

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3.2.2 Installation

1) **Insert «EPOS Positioning Controller» DVD** into DVD drive of your computer.
   Autorun will commence automatically. If autorun should fail to start, find the installation file named "EPOS Positioning Controller.msi" on your explorer, then doubleclick to start.

2) **Follow the instructions** during the installation program.
   Please read every instruction carefully. Indicate location of working directory when prompted.

Best Practice
We recommend following location as working directory: C:\Program Files\maxon motor ag (note that designation of program directory may vary depending on the system language installed).

3) **View new shortcuts and items in the start menu**
   • The files have been copied to the menu «maxon motor ag», where you can access the program as well as the entire documentation set.
   • Clicking the ¤EPOS Studio¤ shortcut on your desktop will launch the program.

4) If needed: Modify or remove the software.
   To change application features or to uninstall the software, start the installation program «EPOS Positioning Controller.msi» anew and follow the instructions given.

3.3 Step 2: Minimum External Wiring

Wiring depends on the type of motor you are using.

1) Decide on type of motor you wish to connect to your EPOS2 70/10 Positioning Controller.

2) Observe notes below.

3) Chose applicable chapter:
   ➔"Minimum Wiring for maxon EC motor" on page 3-13.
   ➔"Minimum Wiring for maxon DC motor" on page 3-14

Maximal permitted Supply Voltage
• *Make sure that supply power is between 11…70 VDC.*
• *Supply voltages above 75 VDC or wrong polarity will destroy the unit.*
• *Note that necessary output current is depending on load (continuous max. 10 A; acceleration/short-time max. 25 A).*

Note
• *For every motor variant, you will find a table stating type of cable to be used and respective from/to connections as well as a corresponding illustration (at the end of this chapter).*
• *If you decide not to use ready-made maxon cables, you must perform wiring according to separate document «Cable Starting Set».*

Note
The first time the device is connected using the USB interface, a respective driver needs to be installed.

For further information, please consult separate document ➔«EPOS2 USB Driver Installation» located in the folder "…\Driver Packages\EPOS2 USB Driver".

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3.3.1 Minimum Wiring for maxon EC motor

1) Install «EPOS2 70/10 Positioning Controller» (375711).

2) Connect maxon cable assemblies (→Table 3-4 and Figure 3-2).

Cable		Connection	
Designation	Order #	from …	… to
Power Cable	275829	J1	power supply +11…+70 VDC
Motor Cable	275851	J2	terminal blocks
Hall Sensor Cable	275878	J3	terminal blocks
Encoder Cable	275934	J4	encoder of the motor
USB Type A - mini B Cable	370513	J9	an available USB port of your computer

Table 3-4   Minimum Wiring: maxon EC motor
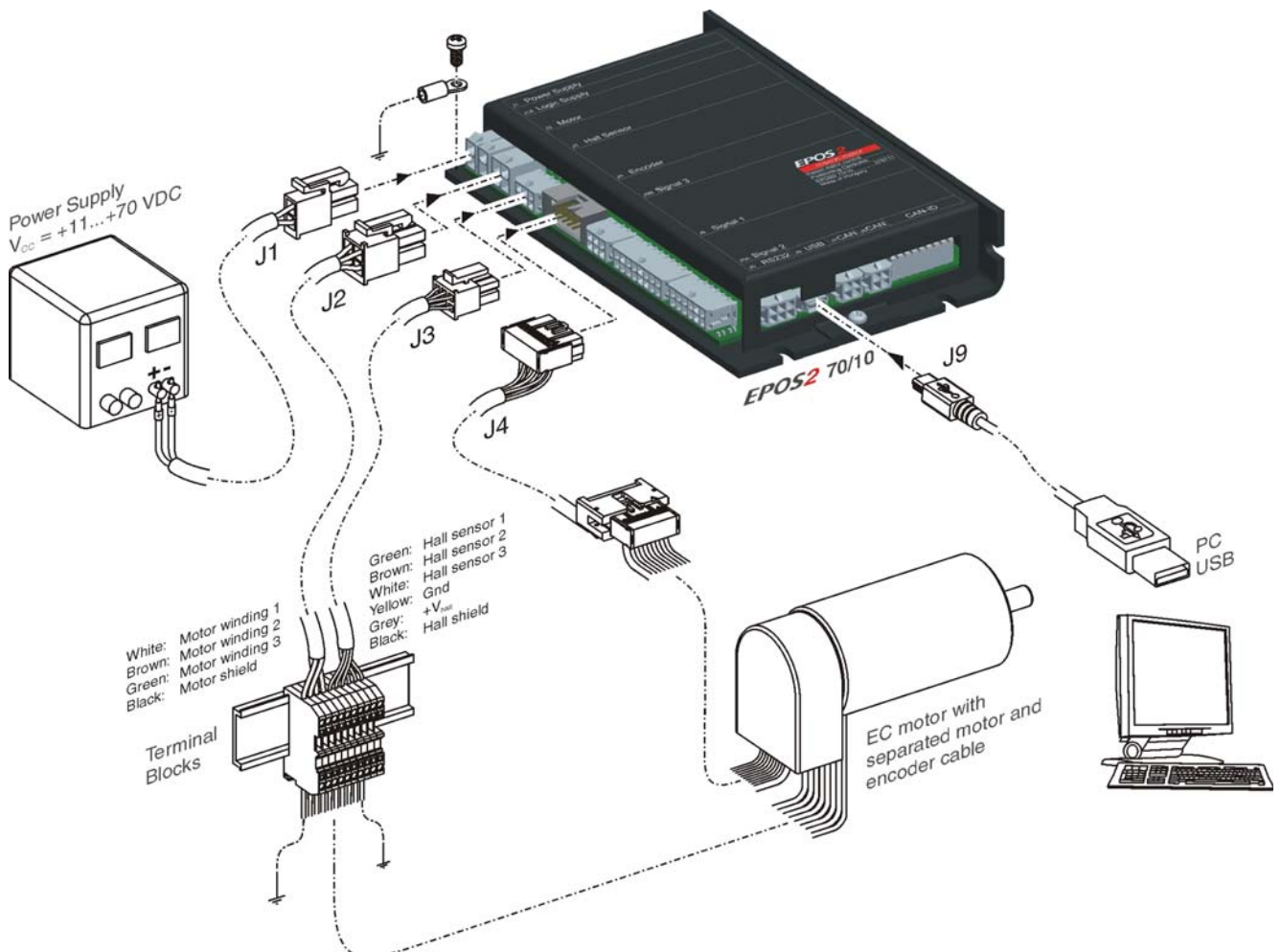
Figure 3-2   Minimum Wiring: maxon EC motor

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3.3.2 Minimum Wiring for maxon DC motor

1) Install «EPOS2 70/10 Positioning Controller» (375711).

2) Connect maxon cable assemblies (➔Table 3-5 and Figure 3-3).

Cable		Connection	
Designation	Order #	from …	… to
Power Cable	275829	J1	power supply +11…+70 VDC
Motor Cable	275851	J2	terminal blocks
Encoder Cable	275934	J4	encoder of the motor
USB Type A - mini B Cable	350392	J9	an available USB port of your computer

Table 3-5   Minimum Wiring: maxon DC motor
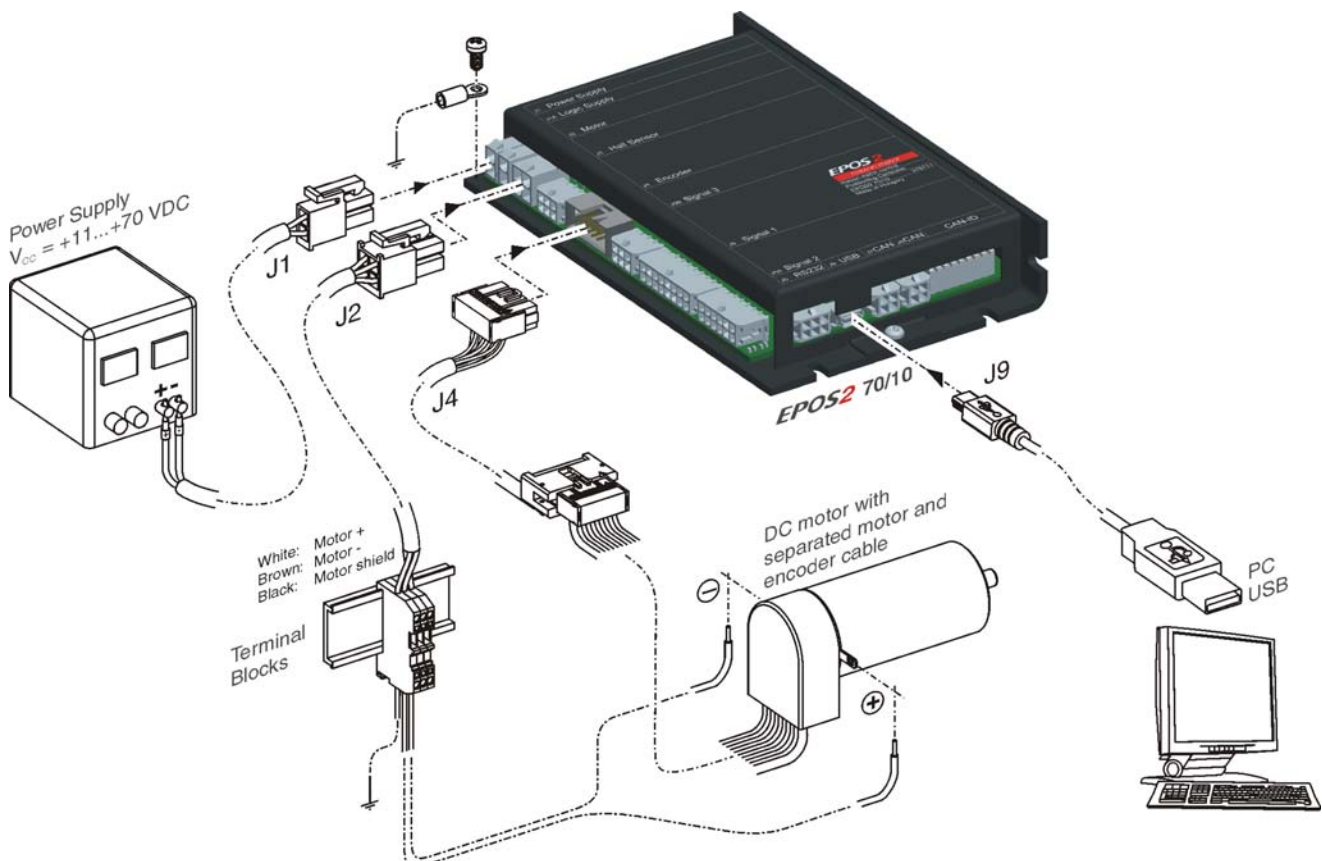
Figure 3-3   Minimum Wiring: maxon DC motor

3.4 Step 3: System Configuration

Read separate Instructions
You will need to know certain technical data of your system.

Refer to maxon catalog or respective data sheets of components used.

3.4.1 General initial Steps

1) Switch on EPOS2 70/10 power supply.

2) Doubleclick ¤EPOS Studio.exe¤ shortcut on your desktop.
   «EPOS Studio» will start and the "New Project Wizard" will automatically be launched.

3) Make sure that you are using the latest version of «EPOS Studio». If you are in doubt on the version you are currently using, proceed as follows:

   a) Click menu ¤Help¤, then select menu ¤About EPOS Studio¤. The currently installed version will be displayed.

   b) Click one of the displayed hyperlinks to find out on the latest version available. Download the latest version, if needed.

4) Load an existing EPOS2 Project:

   a) Select ¤EPOS2 Project¤ from list.

   b) Click ¤Next¤ to proceed.
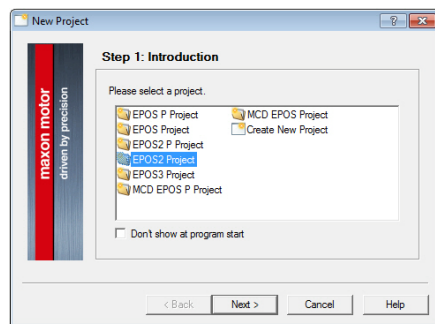
Figure 3-4   Project Configuration Dialog

5) Set project settings:

   a) Click browse icon (arrow) to set path and project name for your project.

   b) Click ¤Finish¤ to create new project.
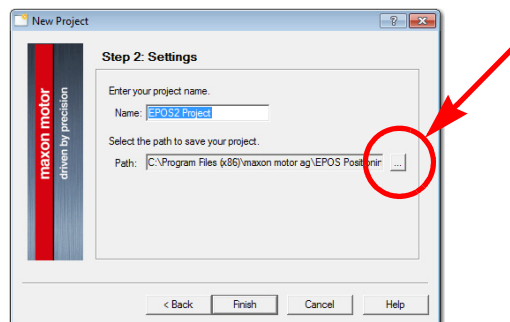
Figure 3-5   Project Path and Name

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6) Clear CAN Warning:
The Project Tree will be displayed in the "Page Navigator Window". If CAN is not connected, the warning "CanPassiveError on CAN Port" will appear (arrow).

a) Click right on warning.

b) Click ¤Clear All Entries¤.

c) If other errors or warnings appear, check wiring and startup configuration (for details on errors and warnings ➜separate document «EPOS2 Firmware Specification»).
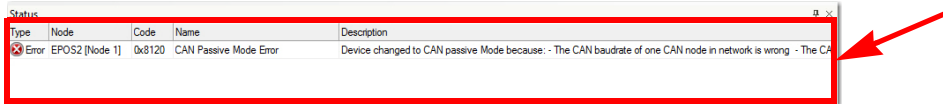
Figure 3-6   Warning "CAN Passive Mode Error"

7) Start "Startup Wizard":

a) Click ¤Wizards¤.

b) Select ¤EPOS2¤ from Device Selection Combo Box.

c) Doubleclick ¤Startup Wizard¤ item in Wizard Tree (arrow).
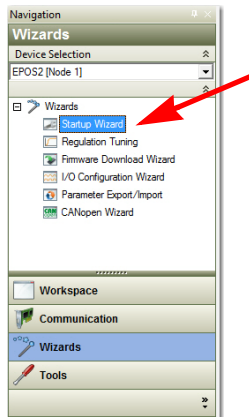
Figure 3-7   Page Navigator Window

8) Startup Wizard (Step 1): Minimum External Wiring:

a) Verify correct hardware installation (➜chapter "3.3 Step 2: Minimum External Wiring" on page 3-12).

b) Make sure you have read "Getting Started" and confirm by clicking ¤Confirm that you've read the "Getting Started" document¤.

c) Click ¤Next¤ to proceed.
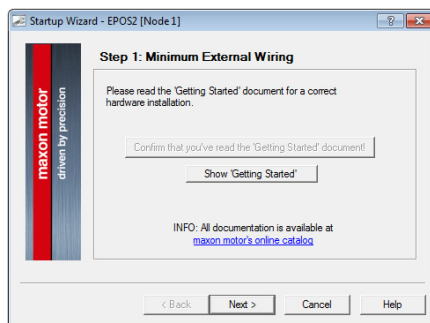
Figure 3-8   Startup Wizard Dialog: Minimum external Wiring

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9) Startup Wizard (Step 2): Communication Setting:

    a) Verify correct wiring to USB interface (➔chapter "3.3 Step 2: Minimum External Wiring" on page 3-12).

    b) Click ¤Search Communication Setting¤ to search USB port and to automatically adjust transfer rate (arrow).
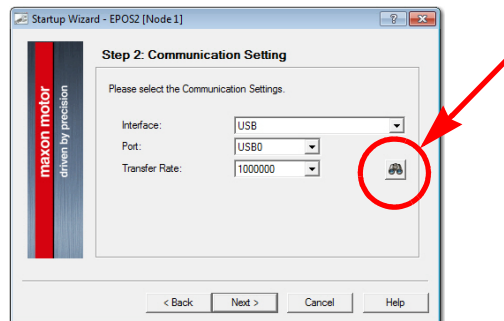
Figure 3-9   Startup Wizard Dialog: USB Communication

    c) If correct communication settings were found, a respective message will be displayed.
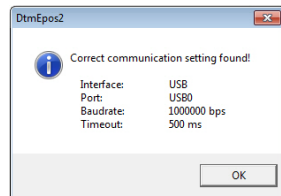
Figure 3-10   Communication Settings

    d) Click ¤OK¤ to confirm settings.

    e) Click ¤Next¤ to proceed.

10) Startup Wizard (Step 3): Auxiliary Regulation

    a) By default, no auxiliary regulation will be used.
Select ¤None¤.

    b) Click ¤Next¤ to proceed.
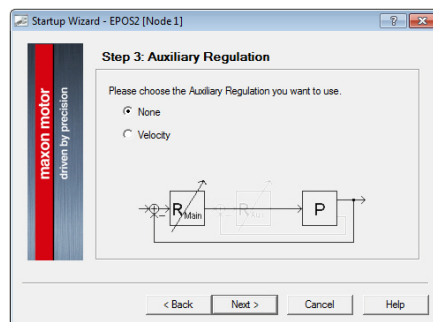
Figure 3-11   Startup Wizard Dialog: Auxiliary Regulation

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11) Startup Wizard (Step 4): Motor Type

    a) Select used motor type.

    b) Click ¤Next¤ to proceed.
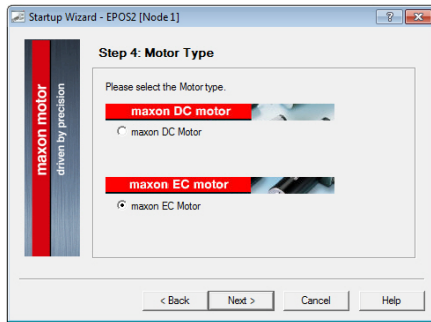
Figure 3-12   Startup Wizard Dialog: Motor Type

12) Decide on how to further proceed:
For **EC motors**:
Proceed to chapter "3.4.2 Configuration of EC Motors" on page 3-19,
then continue with chapter "3.4.4 General closing Steps" on page 3-23.
For **DC motors**:
Proceed to chapter "3.4.3 Configuration of DC Motors" on page 3-21,
then continue with chapter "3.4.4 General closing Steps" on page 3-23.

3.4.2   Configuration of EC Motors

1) Startup Wizard for EC motors (Step 5): Commutation

   a) Select type of commutation (example: "Sinusoidal Commutation").

   b) Click ¤Next¤ to proceed.
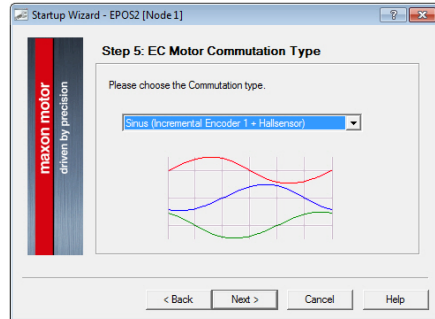
Figure 3-13   Startup Wizard Dialog for EC Motors: Commutation Type

2) Startup Wizard for EC motors (Step 6): Main Sensor Type

   a) Select type of main sensor (example: "Incremental Encoder").
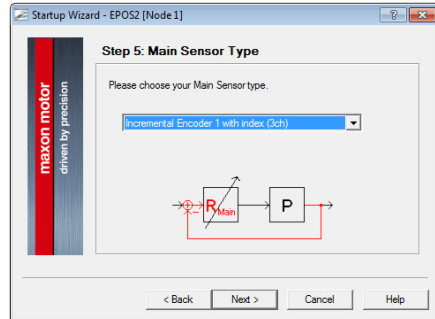
   b) Click ¤Next¤ to proceed.
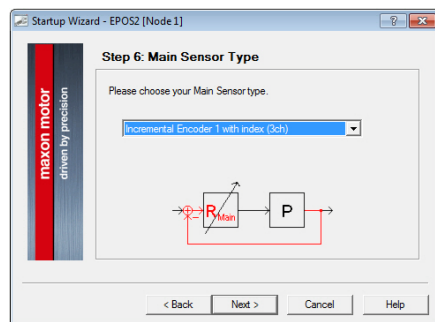
Figure 3-14   Startup Wizard Dialog for EC Motors: Main Sensor Type

3) Startup Wizard for EC motors (Step 7): Motor Data

   a) Enter maximum permissible speed.

   b) Enter nominal (maximum continuous) current.

   c) Enter thermal time constant of motor winding.

   d) Enter number of pole pairs.
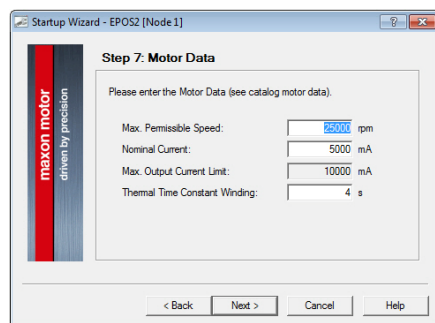
   e) Click ¤Next¤ to proceed.
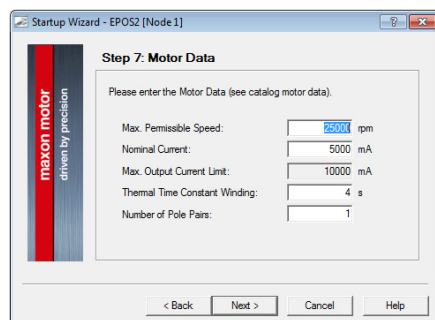
Figure 3-15   Startup Wizard Dialog for EC Motors: Motor Data

4) Startup Wizard for EC motors (Step 8): Incremental Encoder 1 Settings

    a) Enter resolution of encoder used.
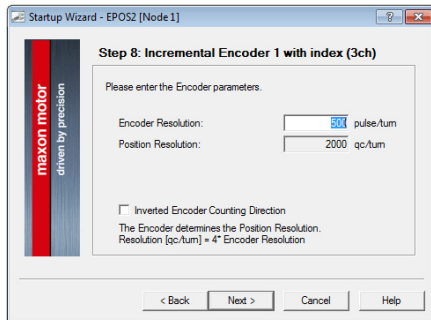
    b) Click ¤Next¤ to proceed.
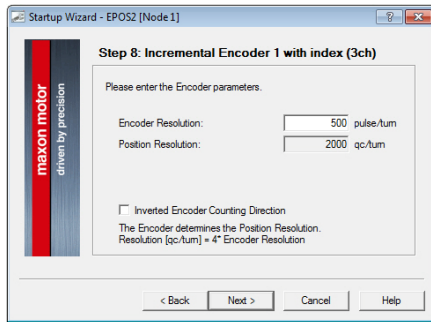
Figure 3-16   Startup Wizard Dialog for EC Motors: Incremental Encoder 1 Settings

5) Startup Wizard for EC motors (Step 9): Safety Parameter Position

    a) Enter maximum permitted following error.
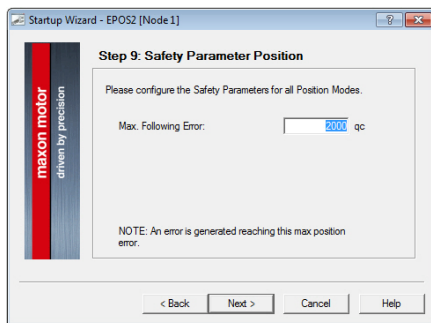
    b) Click ¤Next¤ to proceed.
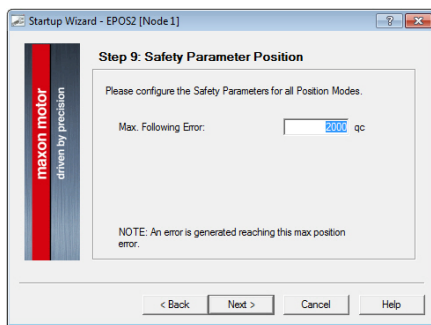
Figure 3-17   Startup Wizard Dialog for EC Motors: Safety Parameter Position

6) Startup Wizard for EC motors (Step 10): Configuration Summary
A short summary of most important configuration values will be displayed.

    a) If configuration is not correct: Click ¤Back¤ to modify settings.

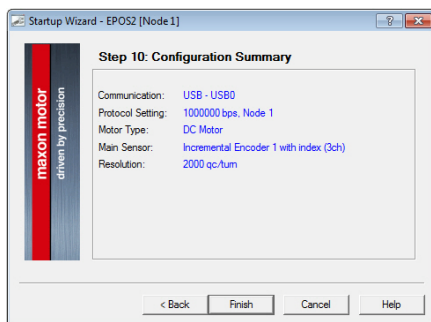   b) If configuration is correct: Click ¤Finish¤ to close the startup wizard.
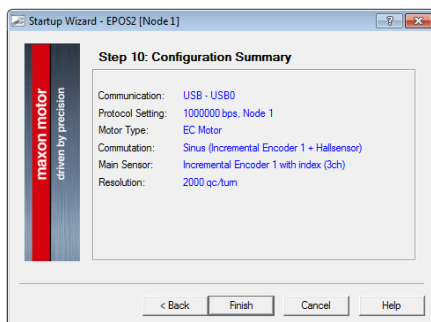
Figure 3-18   Startup Wizard Dialog for EC Motors: Configuration Summary

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3.4.3 Configuration of DC Motors

1) Startup Wizard for DC motors (Step 5): Main Sensor Type

    a) Select type of main sensor (example: "3-Channel Incremental Encoder").

    b) Click ¤Next¤ to proceed.

Figure 3-19   Startup Wizard Dialog for DC Motors: Main Sensor Type

2) Startup Wizard for DC motors (Step 6): Encoder Position

    a) By default, no gear is used.
       Leave ¤System with gear¤ unticked.

    b) Click ¤Next¤ to proceed.
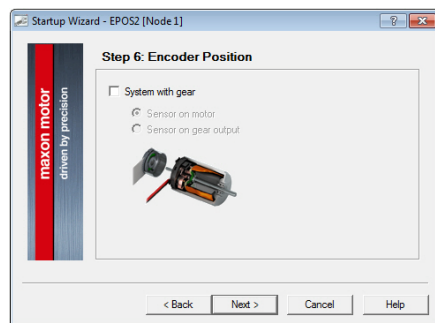
Figure 3-20   Startup Wizard Dialog for DC Motors: Encoder Position

3) Startup Wizard for DC motors (Step 7): Motor Data

    a) Enter maximum permissible speed.

    b) Enter nominal (maximum continuous) current.

    c) Enter thermal time constant of motor winding.

    d) Click ¤Next¤ to proceed.

Figure 3-21   Startup Wizard Dialog for DC Motors: Motor Data

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4) Startup Wizard for DC motors (Step 8): Incremental Encoder 1 Settings

    a) Enter resolution of encoder used.

    b) Click ¤Next¤ to proceed.

Figure 3-22   Startup Wizard Dialog for DC Motors: Incremental Encoder 1 Settings

5) Startup Wizard for DC motors (Step 9): Safety Parameter Position

    a) Enter maximum permitted following error.

    b) Click ¤Next¤ to proceed.

Figure 3-23   Startup Wizard Dialog for DC Motors: Safety Parameter Position

6) Startup Wizard for DC motors (Step 10): Configuration Summary
A short summary of most important configuration values will be displayed.

    a) If configuration is not correct: Click ¤Back¤ to modify settings.

    b) If configuration is correct: Click ¤Finish¤ to close the startup wizard.

Figure 3-24   Startup Wizard Dialog for DC Motors: Configuration Summary

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3.4.4 General closing Steps

1) Click ¤Yes¤ to accept and activate parameters.
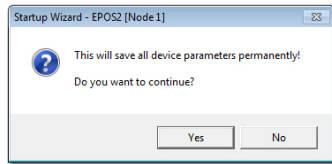
Figure 3-25   Save/activate configured Parameters

2) Clear CAN Warning
   If device is not connected to CAN network, following warning will appear (arrow).

   a) Click right on warning.

   b) Click ¤Clear All Entries.

   c) If other errors or warnings appear, check wiring and startup configuration (for details on errors and warnings →separate document «EPOS2 Firmware Specification»).
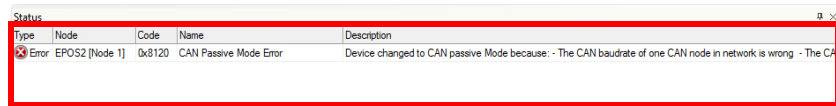
Figure 3-26   CAN Passive Mode Error

3) Your EPOS2 70/10 is now ready for regulation gains tuning.

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3.5 Step 4: Regulation Gains Tuning

EPOS2 70/10 offers a fast and reliable way to automatically tune the regulation gains of current, velocity and position regulators. The function provides a good starting point for further manual tuning.

Best Practice
- *The Auto Tuning function is a good way to start, nevertheless optimal regulation parameters cannot be guaranteed.*
- *Use following procedure to efficiently tune regulation gains.*

3.5.1 Starting Regulation Tuning

1) Click ¤Wizards¤ in Page Navigation Window.
2) Doubleclick ¤Regulation Tuning¤ item in Wizard Tree (arrow).
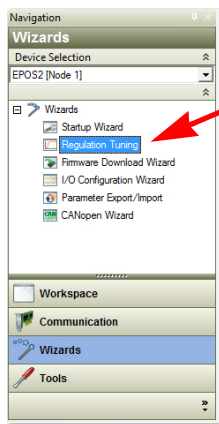
Figure 3-27   Page Navigator Window

3.5.2 Auto Tuning the Current, Velocity and Position Regulators

1) Select ¤Auto Tuning¤ (arrow).
2) Click ¤Next¤ to proceed.
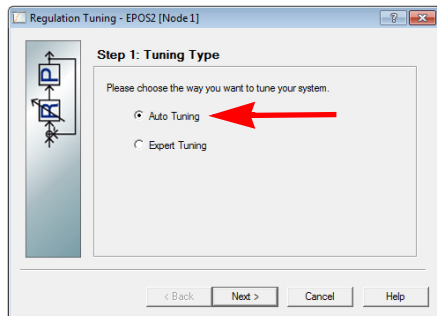
Figure 3-28   Type of Regulation Tuning

3) The Auto Regulation Tuning window will be displayed. The red bars indicate undimensioned regulators.

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4) Click ¤Start¤ (arrow).
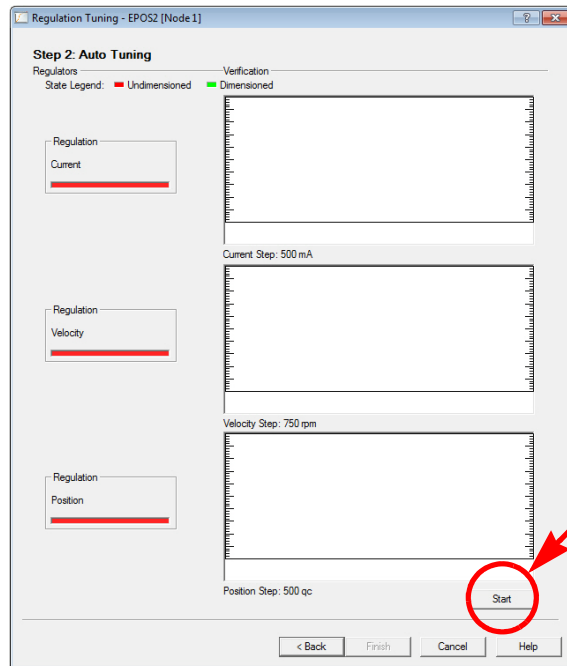
Figure 3-29   Starting Auto Tuning

⚠ **CAUTION**

Drawn-in and/or Affright Hazard
Unprepared attitude can lead to drawing-in or affright.
- *Remove any objects nearby and make sure none can possibly be drawn-in!*
- *Make sure that motor shaft is free running!*
- *Do not touch the motor shaft while Auto Tuning is in process – this can take up to several minutes!*

5) Consider message carefully.

a) Make sure that motor shaft is free running.

b) Click ¤Yes¤ to initiate Auto Tuning.
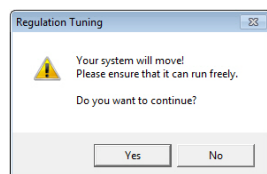
Figure 3-30   Confirmation of free running Shaft

6) Auto Tuning will now commence. In turn, for each regulator (current, velocity, position), a two step procedure will be executed:

- First, control parameters will be identified – during this process, the motor shaft will oscillate, the respective red status bar will be moving (➜Figure 3-31, left).
- Then, identified control parameters will be verified by evaluating their step response – during this process, the motor shaft will oscillate, the respective green status bar will be moving (➜Figure 3-31, right).

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- Once suitable regulation gains were found, the respective status bar changes to green.
- Auto Tuning is complete as all three status bars changed to green (➔Figure 3-32).
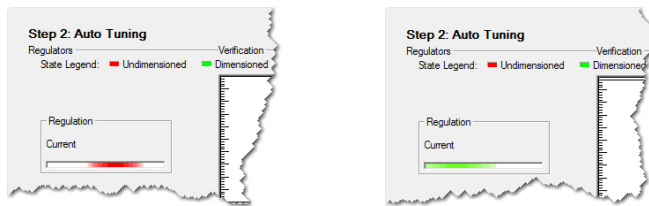
Figure 3-31   Regulation Tuning – Identification (left) / Verification (right)

7) Click ¤Finish¤ to confirm end of Auto Tuning.
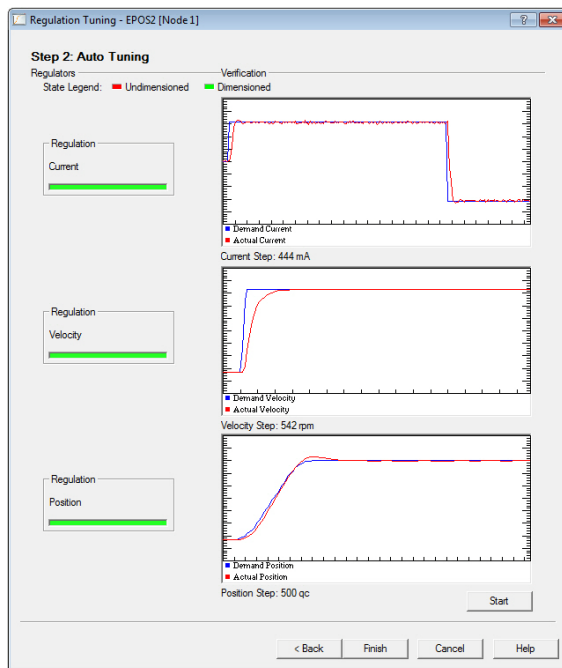
Figure 3-32   End of Auto Tuning

8) Click ¤Yes¤ to accept and save the parameters.
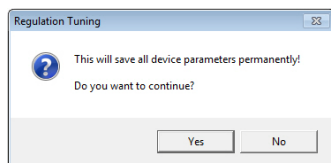
Figure 3-33   Save/activate configured Parameters

9) In case of error, Auto Tuning will be aborted:

    a) Click ¤OK¤ to confirm the error message.

    b) Repeat Auto Tuning (➜step 4).

    c) Should the error persist, use Expert Tuning (for details ➜separate document «Application Note EPOS2 Regulation Tuning»).
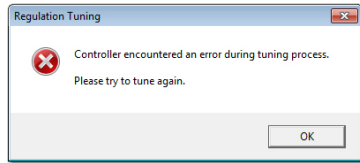
Figure 3-34   Confirm Tuning Error

10) The EPOS2 70/10 is now ready for operation in one of the supported regulation modes.

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