FAQ C6 RIO

# KEB Stepper/BLDC Module FAQ No.0001

| Part | Version | Revision | Date | Status |
|---|---|---|---|---|
| en | 3.5.4.10 | 006 | 2019-01-01 | Released |

## Content


Introduction ..... 2
Parameter adjustments ..... 2
Parameters which need to be adjusted to the used motor ..... 2
Sample projects in COMBIVIS studio 6 ..... 6
General ..... 6
Adjustments in the sample project general ..... 7
Settings for the example project PRO ..... 9
Settings for the example project Basic ..... 11
Auto-Setup Mode ..... 12
General ..... 12
Auto Setup with module ..... 13
Carry out Auto Setup manually ..... 15
Store the adjustments in the module ..... 16
Starting save process ..... 17
Disclaimer ..... 20



**KEB Automation KG**
Südstraße 38
32683 Barntrup, Germany
E-mail: info@keb.de
Tel. +49 5263 401-0
Fax +49 5263 401-116
**www.keb.de**

District Court Lemgo HRA 5649
DUNS-No. 314108728
VAT-No. DE309087075
Bank Details: Sparkasse Paderborn-Detmold
IBAN DE 19 4765 0130 0000 0060 07
BIC WELADE3L

General Partner:
Vittorio Tavella
KEB Verwaltungs-GmbH, Barntrup
District Court: Lemgo HRB 8965
Directors: Curt Bauer CMO,
Ralf Lutter COO, Vittorio Tavella CFO,
Wolfgang Wiele CTO

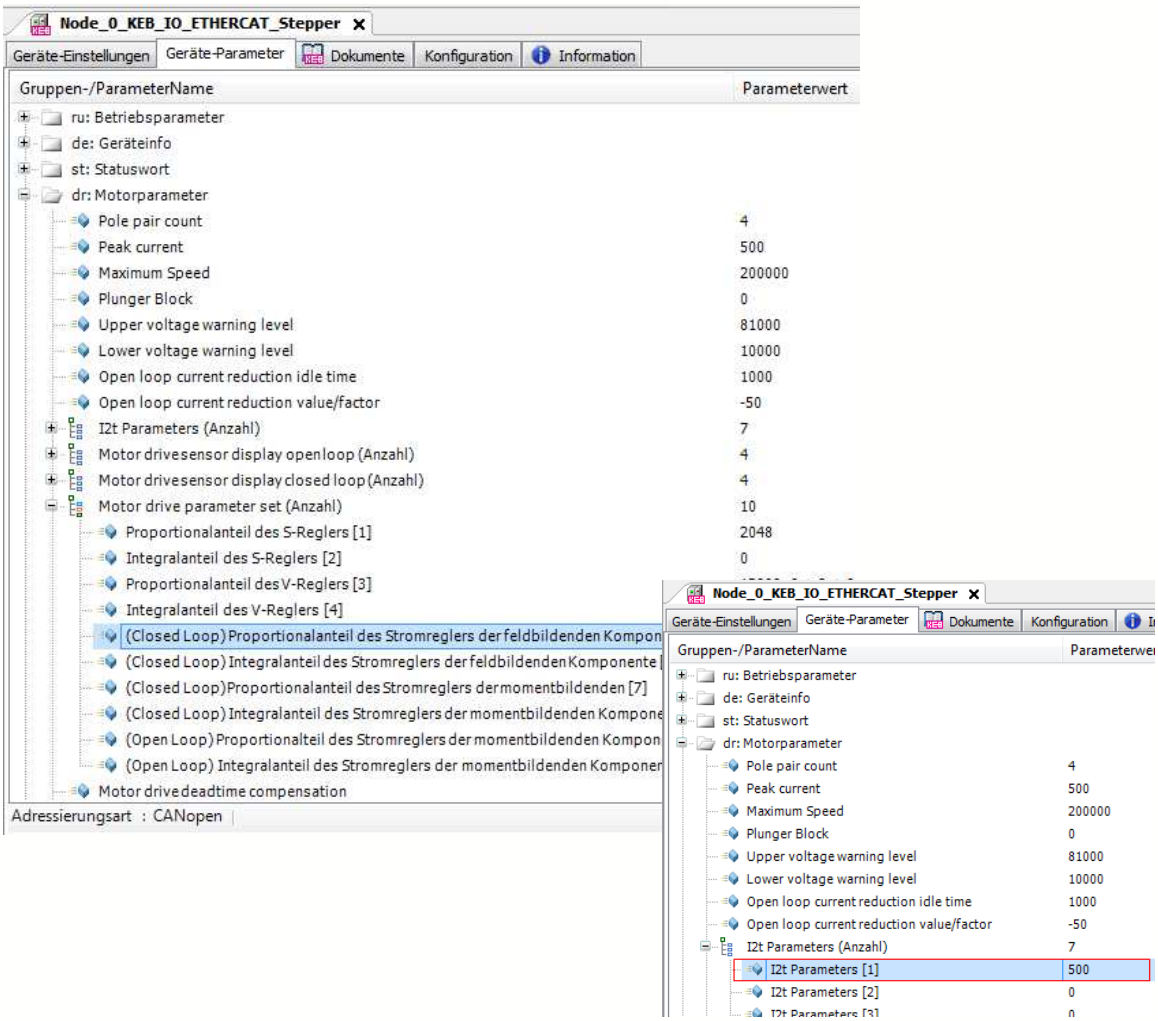
## Introduction

This quick start document describes how a KEB-I/O ETHERCAT Stepper/BLDC module can be taken into operation. Example projects are also available in COMBIVIS studio 6 for the use with CONTROL BASIC or CONTROL PRO license.

## Parameter adjustments

### Parameters which need to be adjusted to the used motor

Some parameters should be pre-adjusted in the module in order that the selected motor can communicate with the KEB-I/O ETHERCAT Stepper/BLDC module.This is required caused by the number of motors which can be used together with the module. To adjust the basic control parameters of the motor, please read the chapter 6.1.7 and 7.12.3 in the description for the brushless DC motor.



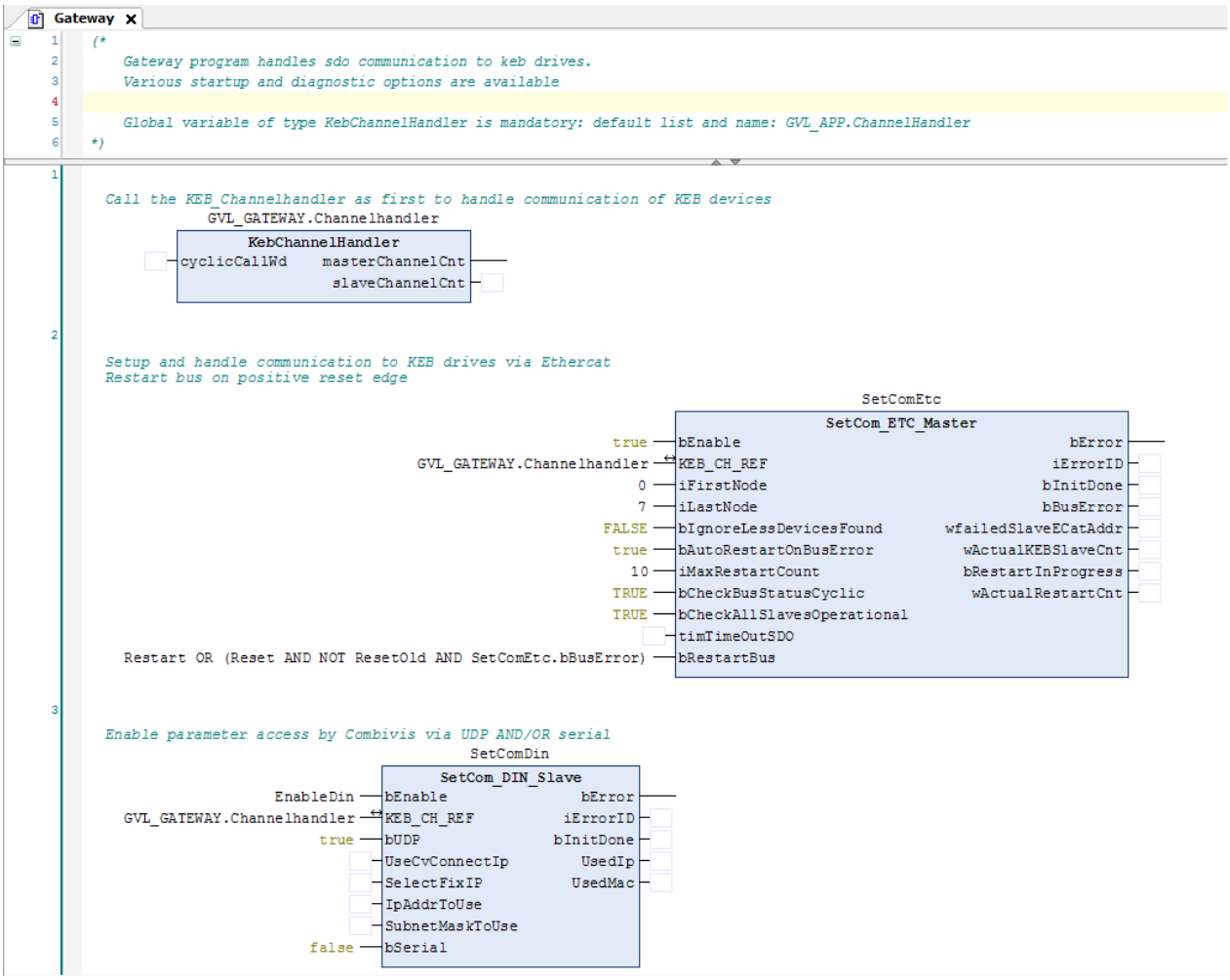

If you are operating the motor by means of just a Hall encoder, verify that the pole pair number is set correctly.

When you use a brushless DC Motor, it is absolutely necessary to carry out an auto setup.

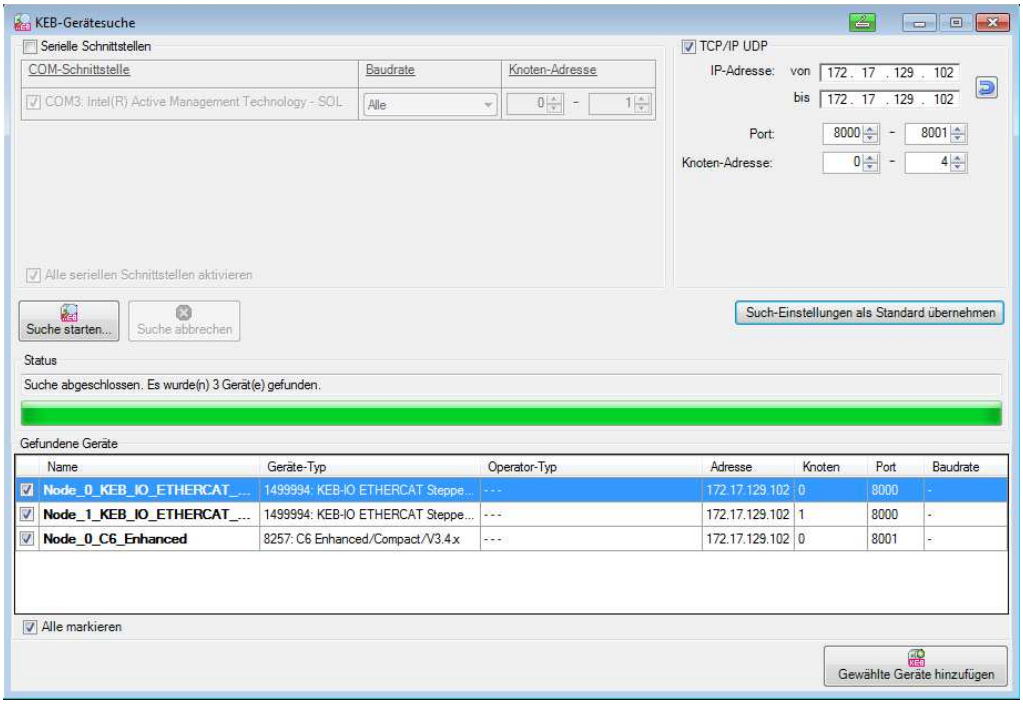
In order to perform this, it is imperative for the parameter “nominal current” $I^2t$ parameter[1] ($203B_h$ Subindex: $01_h$) entered a value <> 0.

Auto Setup is mandatory for operating a brushless DC motor. See the point "Auto-Setup mode" later in this document.

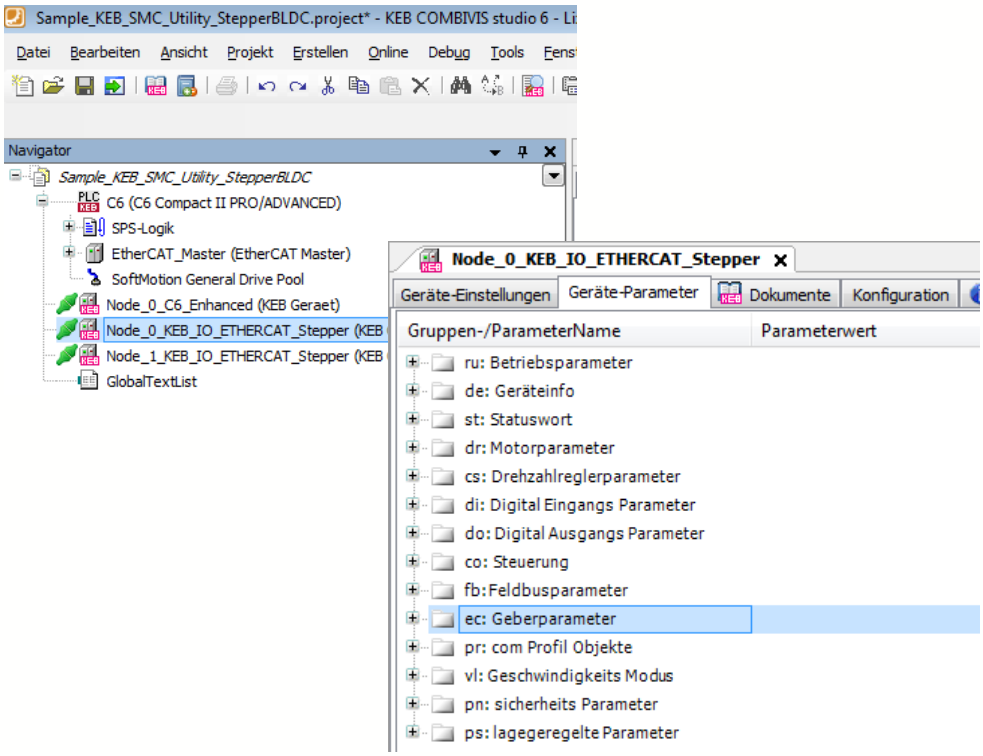
In addition a gateway should be added first to your project.
If the sample projects are used this gateway is already available, otherwise the structure can be seen there in detail. Then the project with the gateway must be downloaded into the control and started. With parameter wActualKEBSlaveCnt you can see if the SetCom_ETC_Master module has found modules at the EtherCAT bus after starting.



Then the modules can be added in COMBIVIS studio 6 by device scan for the control with the connected units.



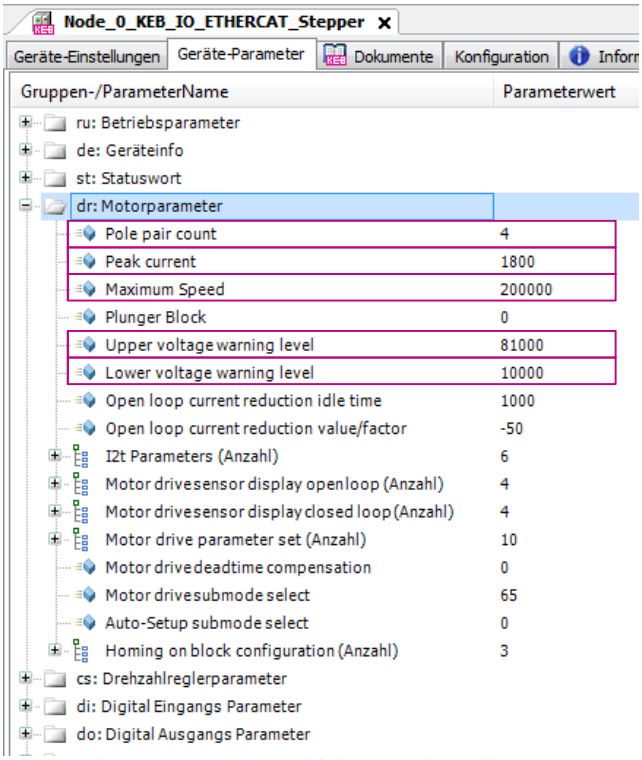

Now the devices can be added into the project with the button right below ("Add selected devices"), then you have access to the parameter list of the devices.



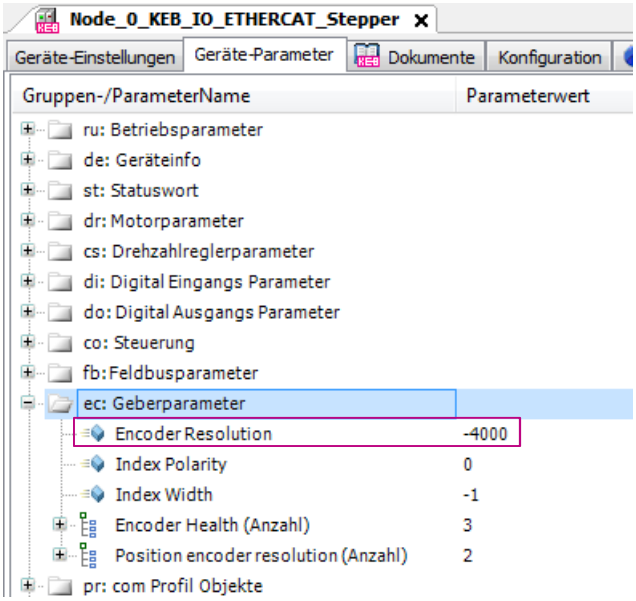
If the Auto Setup mode of the module shall be used, parameters pole-pair number and encoder resolution must not be entered manually, these values are automatically determined. The procedure is described in detail in the menu item "Auto Setup Mode".

Now open the "dr: motor parameter" structure in the parameter list, the following parameters are included which must be adapted according to the data of the used motor.

- Pole-pair number
- Peak current
- Max. speed
- Overvoltage warning level
- Undervoltage warning level




Additionally there is the parameter list "ec: encoder parameters" which contains all parameters of the used encoder. Parameter „Encoder Resolution“ should be adjusted here.



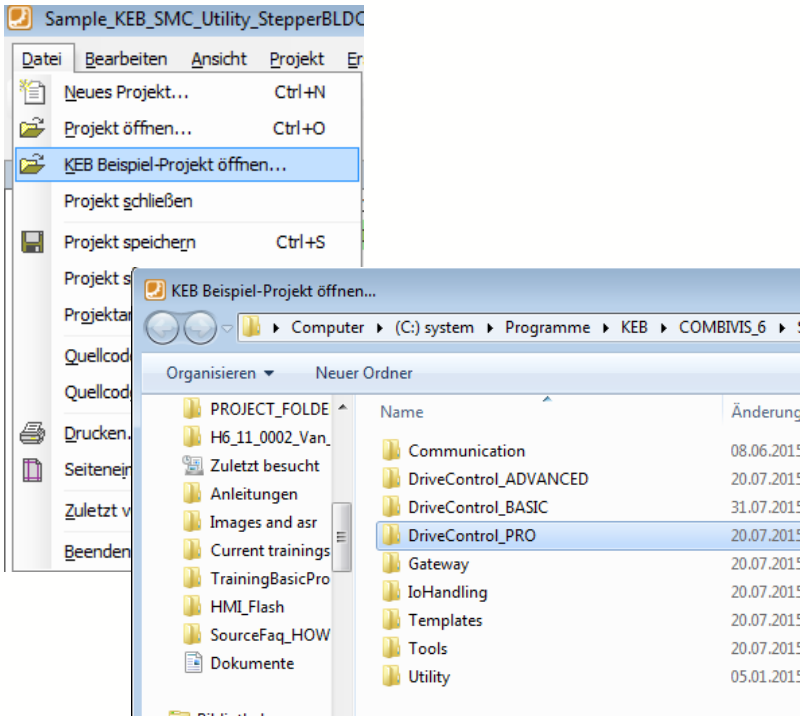
# Sample projects in COMBIVIS studio 6

## General

There are two sample projects integrated for the KEB-I/O ETHERCAT Stepper/BLDC module in COMBIVIS studio 6.

There is a selection between Basic and PRO project, which must be selected depending on the used control.

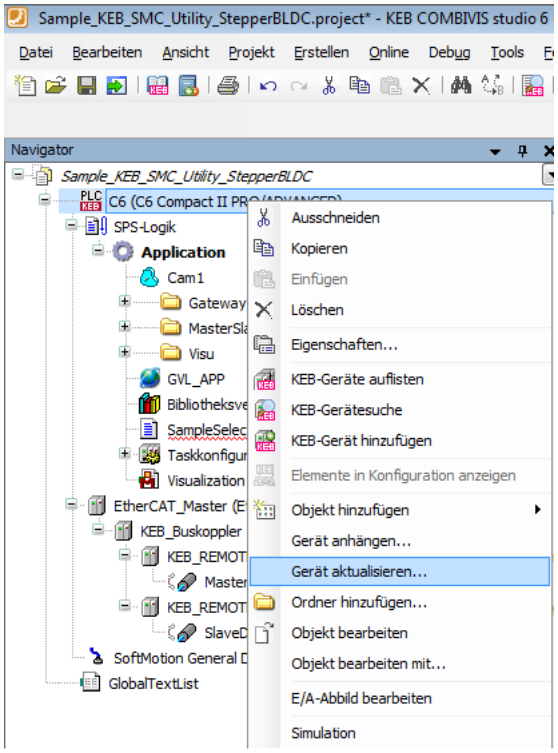
The CIA402 library is used for the basic project, the SMC_Utility of KEB is used for the PRO version.



## Adjustments in the sample project general

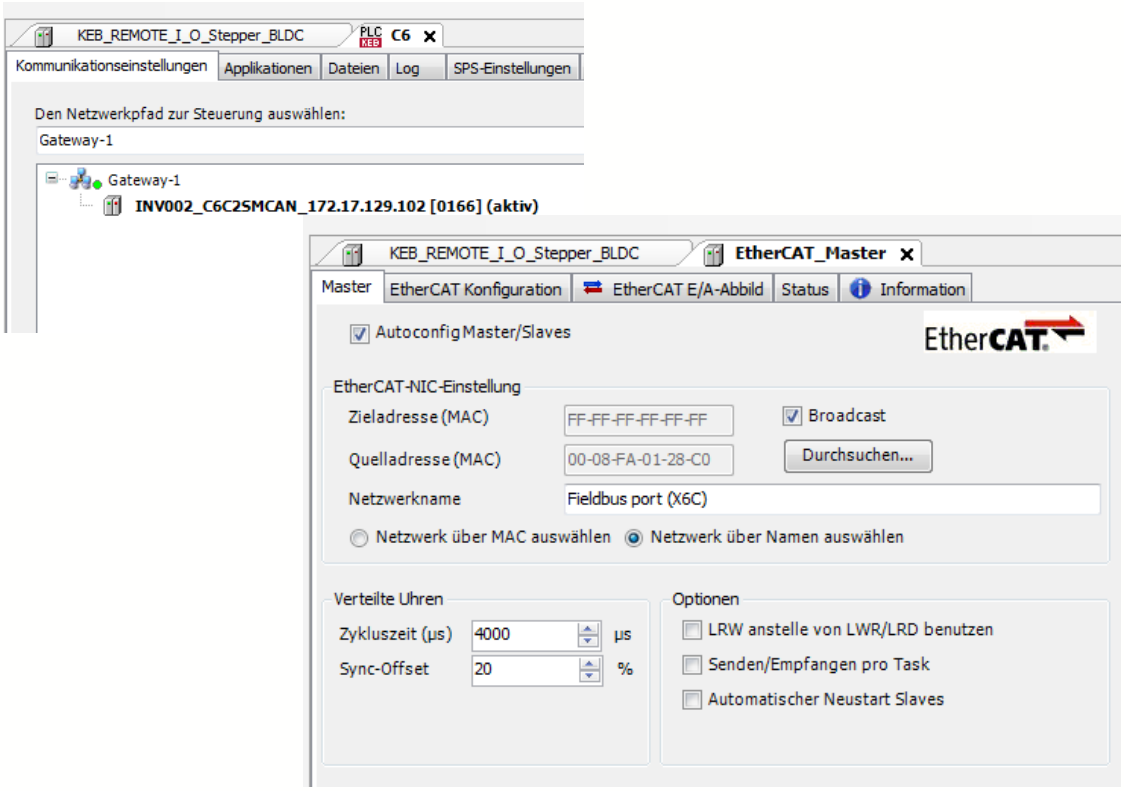
In the selected sample project (whether if Basic or PRO) the following adjustments must be adapted to your existing hardware situation.

The inserted control (in the sample project) can be adapted to the existing control via the function 'device update'. The sub-menu can be opened by right click to the installed control in the project.




A list with editable controls is displayed in the window which opens afterwards.

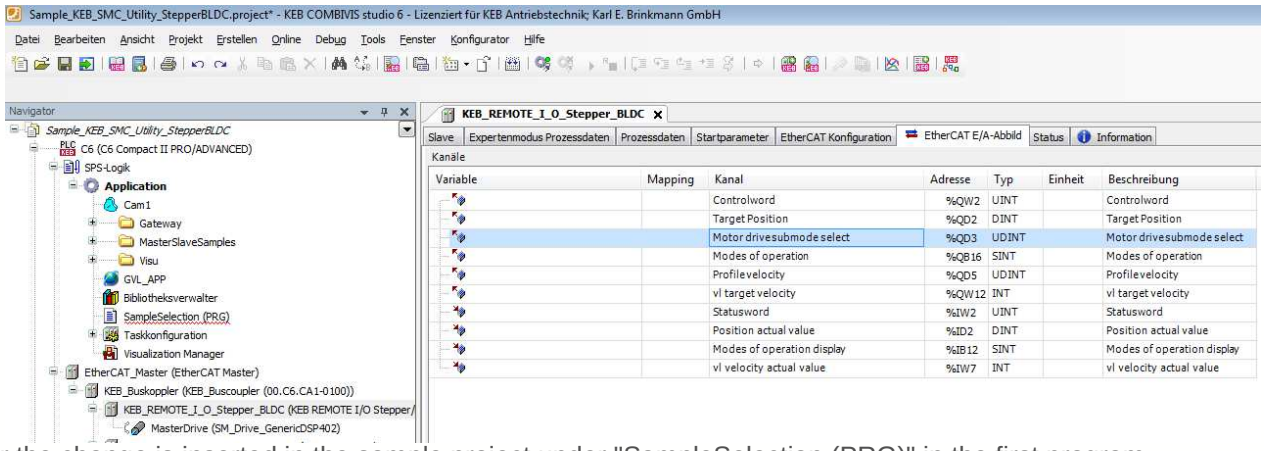
Subsequently, the control must be set to active by double-click on the control after search via the CoDeSys Gateway.
The MAC address of the EtherCAT_Master must be adjusted via the button "Browse" to the used control.



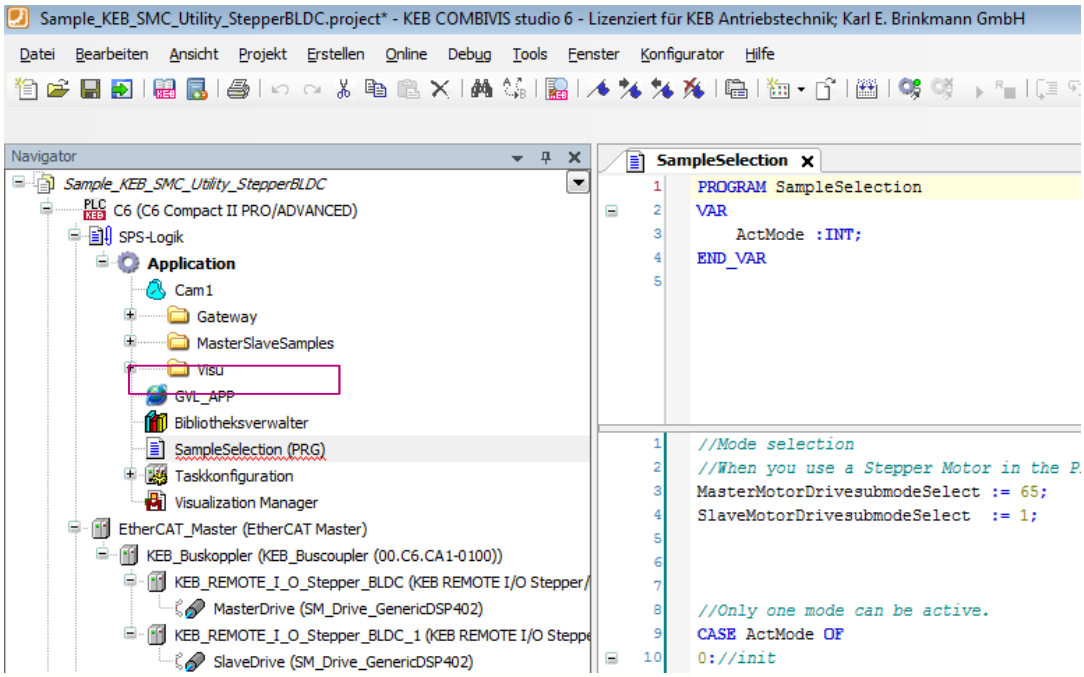

Example: C6 Compact EtherCAT master adjustment

## Settings for the example project PRO

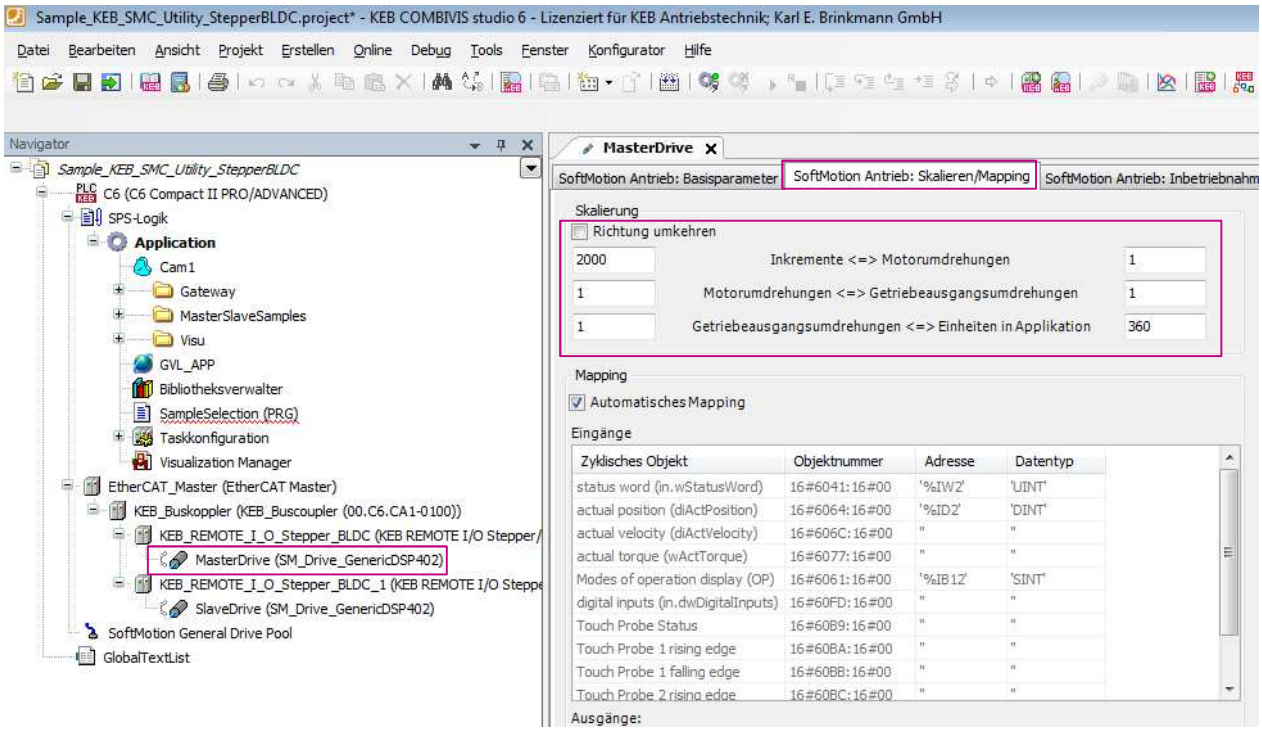
In order to operate the motors in Closed Loop operation, the "Drive submode Select" parameter of the KEB_REMOTE_I_O_Stepper_BLDC must be adjusted each to the used motor type (BLDC motor or Stepper motor). 1(dec) must be entered here for the Stepper motor, 65 (dec) for the BLDC motor. This can be entered for example directly in the EtherCAT E/A image,




or the change is inserted in the sample project under "SampleSelection (PRG)" in the first program lines. Both motors are involved in this sample project, the BLDC motor as MasterDrive, the Stepper motor as SlaveDrive. The variables which are changed there, are directly entered in the EtherCAT E/A image of the module.

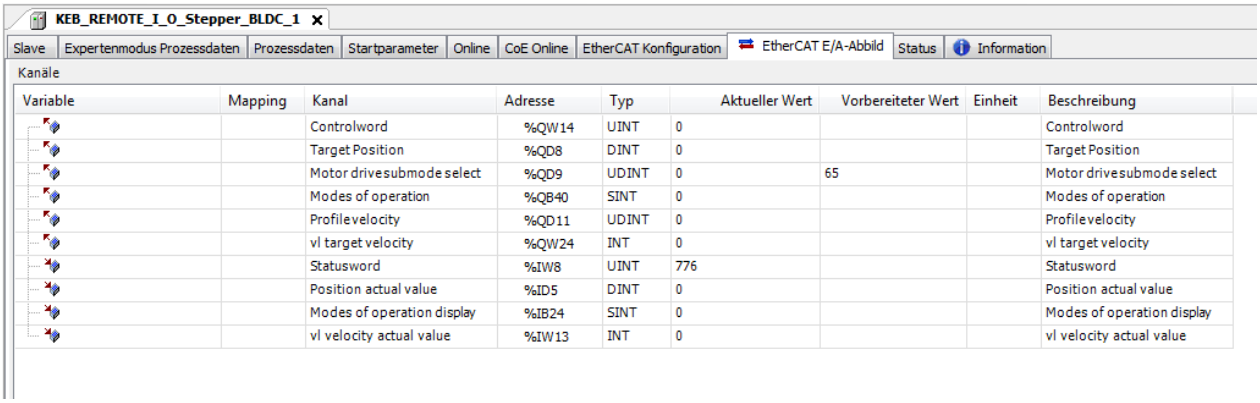


Following to this setting the scaling of the axis should be adjusted to the scaling of your project.
To this end the "increments" and the "units in application" should be entered. If a gear is used, this data can also be integrated.



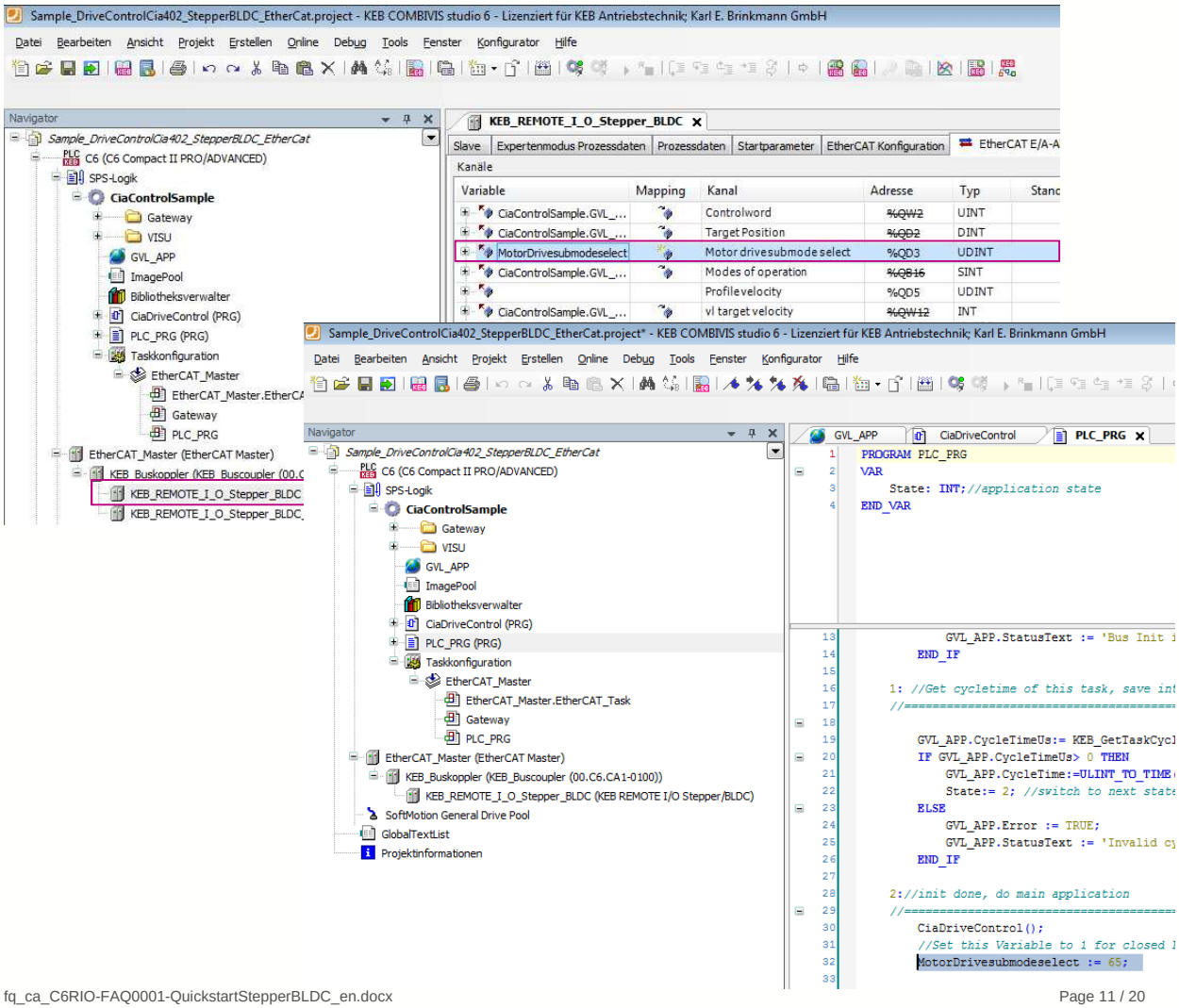
## Settings for the example project Basic

In order to operate the motors in Closed Loop operation, the "Drive submode Select" parameter of the KEB_REMOTE_I_O_Stepper_BLDC must be adjusted each to the used motor type (BLDC motor or Stepper motor). A 1(Dec) must be entered here for the Stepper motor, a 65 (Dec) for the BLDC motor. This can be entered (as seen below) directly in the EtherCAT E/A image and stored.




| Variable | Mapping | Kanal | Adresse | Typ | Aktueller Wert | Vorbereiteter Wert | Einheit | Beschreibung |
|---|---|---|---|---|---|---|---|---|
| | | Controlword | %QW14 | UINT | 0 | | | Controlword |
| | | Target Position | %QD8 | DINT | 0 | | | Target Position |
| | | Motor drive submode select | %QD9 | UDINT | 0 | 65 | | Motor drive submode select |
| | | Modes of operation | %QB40 | SINT | 0 | | | Modes of operation |
| | | Profile velocity | %QD11 | UDINT | 0 | | | Profile velocity |
| | | vl target velocity | %QW24 | INT | 0 | | | vl target velocity |
| | | Statusword | %IW8 | UINT | 776 | | | Statusword |
| | | Position actual value | %ID5 | DINT | 0 | | | Position actual value |
| | | Modes of operation display | %IB24 | SINT | 0 | | | Modes of operation display |
| | | vl velocity actual value | %IW13 | INT | 0 | | | vl velocity actual value |

The change can be made directly in the sample project under "PLC_PRG (PRG)" in the last program lines. The value which is given there to the variable is directly entered in the EtherCAT E/A image of the module.



## Auto-Setup Mode

***The connected motor is put in motion upon activation of the Autosetup. For this purpose, the motor should rotate freely and should not be connected with the mechanical drive.***
***If this cannot be realized there can be dangerous movements.***

***Auto Setup prerequisites:***

- **The motor must be load-free.**
- **The motor must not be touched.**
- **Verify that the motor is free to turn in any direction.**

***Auto Setup involves complicated computations***
***which may not leave enough computing power to serve the fieldbuses***
***as quickly as necessary - fieldbus operation may be compromised during the Auto-Setup.***

### General

If the Auto-Setup mode of the I/O module is running, motor and encoder data which are important for the I/O module are automatically determined. For this purpose, value -2 (dec) must be written in parameter "Modes of operation" (6060h). Then the module is in the Auto Setup mode and waits that the module state is booted up-to Operation Enabled. Now the module measures independently some values, this results in a rotary movement of the axis!

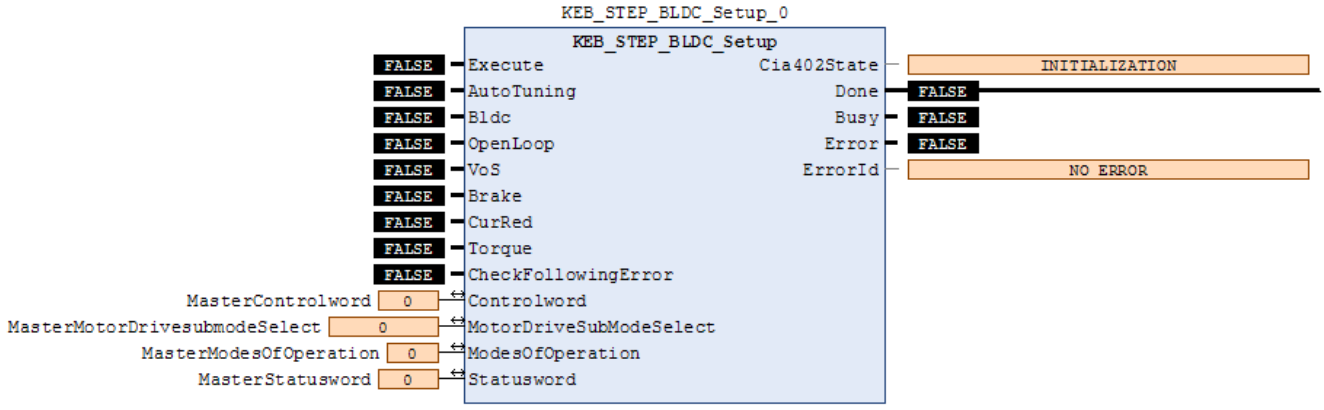
It is a matter of data which are automatically determined:

- pole-pair number (2030h)
- encoder resolution (2052h) in increments/revolution
- encoder adaption (2050h) offset angle between rotor and electric field

In order to use the Auto Setup mode, the following settings must be made in the project depending if the KEB module shall be used for this or if this should be carried out manually.

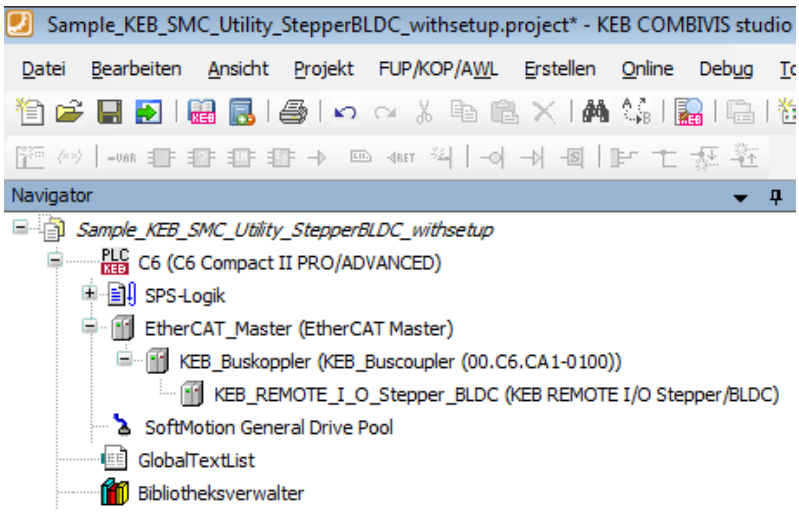
## Auto Setup with module

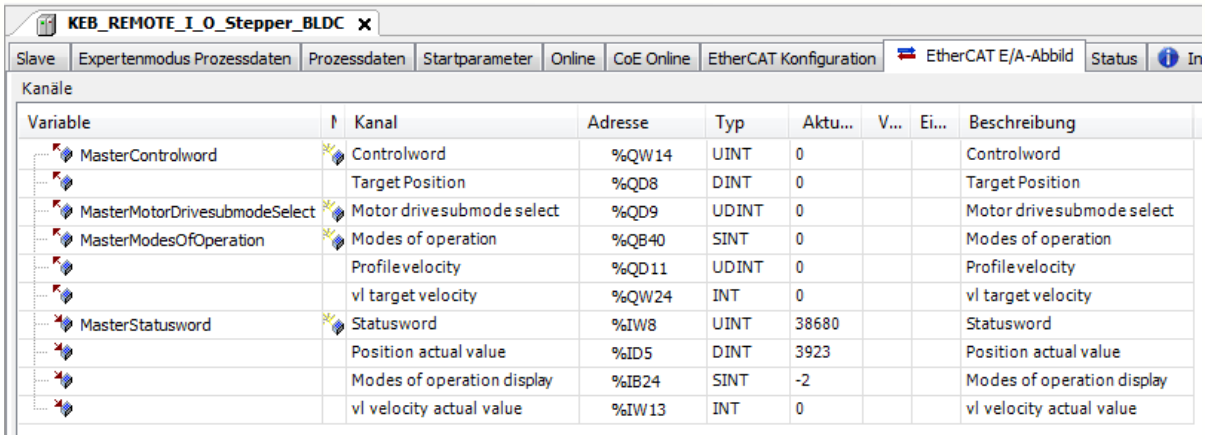
The easiest way to determine the motor data of the modules is by Auto Setup with the module from KEB. Only the options of the motor are selected at the module, then the real determination of the data takes place automatically.
The functionblock is available from the KEB_Drive_Utility version >= 3.5.6.31.




- Execute — Start stop of the function block
- AutoTuning — True = Auto Tuning is carried out, False = no Auto Tuning
- BLDC — True = BLDC Motor, False = Stepper Motor
- OpenLoop — True = closed Loop operation, False = open loop operation
- Brake — True = brake is used, False = without brake
- CurRed — True = current reduction at open loop operation, False = without reduction
- CheckFollowingError — True = error reset, False = no reset

If all information has been entered, a KEB_Buscoupler and one or several KEB_REMOTE_I_O_Stepper_BLDC modules can be inserted at the EtherCAT master. Then the IN/OUT variables of the Setup module must be connected under tab EtherCAT E/A image at this module.






| Variable | Kanal | Adresse | Typ | Aktu... | V... | Ei... | Beschreibung |
|---|---|---|---|---|---|---|---|
| MasterControlword | Controlword | %QW14 | UINT | 0 | | | Controlword |
| | Target Position | %QD8 | DINT | 0 | | | Target Position |
| MasterMotorDrivesubmodeSelect | Motor drivesubmode select | %QD9 | UDINT | 0 | | | Motor drivesubmode select |
| MasterModesOfOperation | Modes of operation | %QB40 | SINT | 0 | | | Modes of operation |
| | Profilevelocity | %QD11 | UDINT | 0 | | | Profilevelocity |
| | vl target velocity | %QW24 | INT | 0 | | | vl target velocity |
| MasterStatusword | Statusword | %IW8 | UINT | 38680 | | | Statusword |
| | Position actual value | %ID5 | DINT | 3923 | | | Position actual value |
| | Modes of operation display | %IB24 | SINT | -2 | | | Modes of operation display |
| | vl velocity actual value | %IW13 | INT | 0 | | | vl velocity actual value |

Now the mode can be started with the "Execute" button and the measurement routine starts to determine the required values. Attention! The motor moves during the Auto Setup!See note above.

Note when using the PRO driver:
The subordinate driver module SM_Drive_ETC_Generic must be deactivated before using the Autotuning (right-click to the driver → „deactivate“).
If the Auto-Setup process is finished, this process can be switched on again with the instruction "Activate".

## Carry out Auto Setup manually

The motor data for the module can also be determined manually with the Auto Setup mode of the module. In your project a buscoupler with a following KEB_REMOTE_I_O_Stepper_BLDC module must be inserted after the EtherCAT master.
If the PRO version of the KEB_REMOTE_I_O_Stepper_BLDC module should be inserted, the available driver must be deactivated in the module. This can be done, with a right-click to the driver, and then click "Deactivate".
Now the corresponding values listed below can be set directly at this module for the parameters at the tab EtherCAT E/A image. Then the Setup Mode of the module is running and determines the values described above.
If the Auto-Setup process is completed, it can be switched on again with a right-click and the instruction "Activate".

In this case -2 (dec) must be written to parameter "Modes of operation" for the Auto Setup Mode.
On parameter "Motor Drivesubmode select", 1(dec) must be entered for the Stepper motor, 65(dec) for the BLDC motor. These values cause that the module knows if a Stepper or BLDC motor is connected and they activate the Close Loop operation for each motor.

KEB_REMOTE_I_O_Stepper_BLDC_

Slave | Expertenmodus Prozessdaten | Prozessdaten | Startparameter | Online | CoE Online | EtherCAT Konfiguration | EtherCAT E/A-Abbild | Status

Kanäle

| Variable | Mapping | Kanal | Adresse | Typ | Aktue... | Vo... | Ein... | Beschreibung |
|---|---|---|---|---|---|---|---|---|
| | | Controlword | %QW2 | UINT | 0 | | | Controlword |
| | | Target Position | %QD2 | DINT | 0 | | | Target Position |
| | | Motor drivesubmode select | %QD3 | UDINT | 65 | | | Motor drivesubmode select |
| | | Modes of operation | %QB16 | SINT | -2 | | | Modes of operation |
| | | Profile velocity | %QD5 | UDINT | 0 | | | Profile velocity |
| | | vl target velocity | %QW12 | INT | 0 | | | vl target velocity |
| | | Statusword | %IW2 | UINT | 38680 | | | Statusword |
| | | Position actual value | %ID2 | DINT | 2531 | | | Position actual value |
| | | Modes of operation display | %IB12 | SINT | -2 | | | Modes of operation display |
| | | vl velocity actual value | %IW7 | INT | 0 | | | vl velocity actual value |

First an error reset should be performed at the module. To this end set bit 7 (128dez) of the "Controlword" to True. Then ramp-up the status of the module step by step (as described below), in order that the Auto Setup mode is carried out.

- Bit 1 - 2 (6dez) (Enable Voltage & Quick Stop)
- Bit 0 - 2 (7dez)(Enable Voltage, Quick Stop & Switched On)
- Bit 0 - 3 (15dez)(Enable Voltage, Quick Stop, Switched On & Enable operation)
- Bit 0 - 4 (31dez)(Enable Voltage, Quick Stop, Switched On, Enable operation & OMS)

When the measuring process has been completed can be recognized with bit 12 (OMS) of the "Statusword". If it is set to True, the Auto Setup has been completed.
It can be read with bit 15 (CLA) of the „Statusword“ if the motor is now ready for close loop operation or not, if the Auto Setup was successfully.

## Store the adjustments in the module

Some object dictionary entries may be saved to be restored automatically when the control unit restarts. Whereas saving always involves entire sets of objects (called "categories" below), you cannot save individual objects.

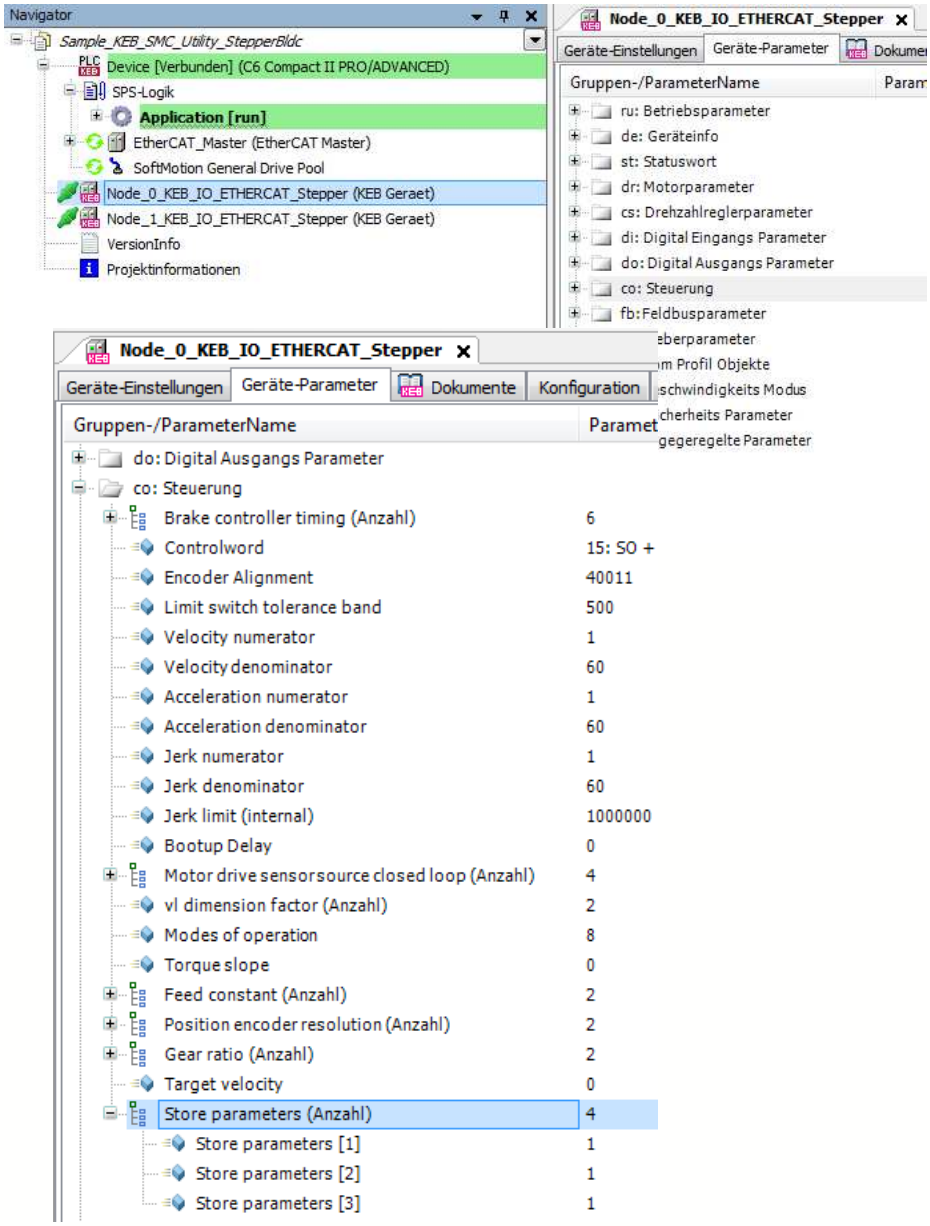
Every category has its own subindex in the object.
All you need to do to save all objects of a specific category is to enter 65766173h into the subindex. At the end of the saving process, the control unit sets the value to "1". Further information can be found under the point "7.12.4 Save objects" in the documentation of the module.

Sub-indices:
$01_h$: all categories
$02_h$: Communication
$03_h$: user objects

| | |
|---|---|
|  | ***NOTE*** |
| | ***Malfunction or destruction of C6 REMOTE Stepper/BLDC*** <br> *File system corruption of malfunction of the total system by interrupting the fieldbus functionality while saving. Saving may take up to 20s.* <br> ⇨ *Do not cut off the power supply during that time* <br> ⇨ *Verify that successful saving is indicated by the control unit in object $1010_h$.* <br> ⇨ *Verify that the motor is standing still and does not start while saving is in progress.* |

## Starting save process

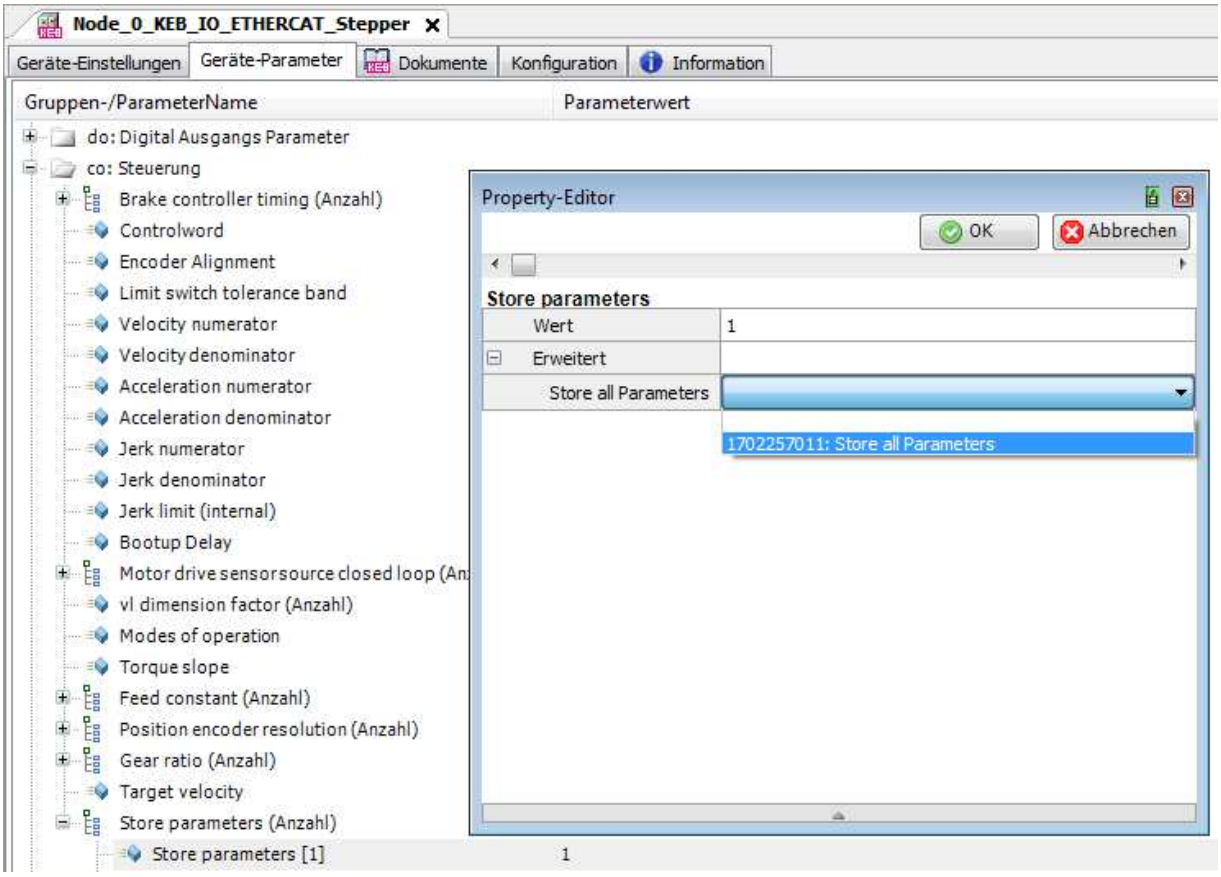
In order to store the settings which are made in the module non-volatile, go to parameter co: Control in the tab unit parameter.



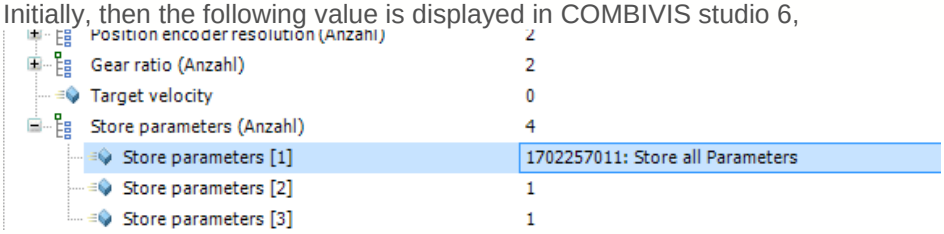

In order to store the actual settings, select "Store all Parameters" in the menu of the corresponding

Store Parameter set and confirm with OK.

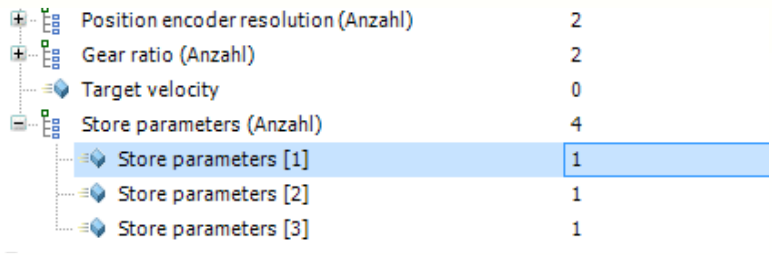
All settings of the module are stored if this is performed in "Store parameters [1]".
Only the communication parameters are stored with "Store parameters [2]", the user-specific parameters are stored with "Store parameters [3]".
Further information can be found under point „7.12.4 Save objects“ in the documentation.




Initially, then the following value is displayed in COMBIVIS studio 6,




"1" appears at the appropriate parameter if the storing is completed.
Now the settings are stored in the module and are automatically loaded at the next start.


Position encoder resolution (Anzahl) 2
Gear ratio (Anzahl) 2
Target velocity 0
Store parameters (Anzahl) 4
Store parameters [1] 1
Store parameters [2] 1
Store parameters [3] 1

## Disclaimer

KEB Automation KG reserves the right to change/adapt specifications and technical data without prior notification. The safety and warning reference specified in this manual is not exhaustive. Although the manual and the information contained in it is made with care, KEB does not accept responsibility for misprint or other errors or resulting damages. The marks and product names are trademarks or registered trademarks of the respective title owners.

The information contained in the technical documentation, as well as any user-specific advice in verbal or in written form are made to the best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

Inspection of our units in view of their suitability for the intended use must be done generally by the user. Inspections are particular necessary, if changes are executed, which serve for the further development or adaption of our products to the applications (hardware, software or download lists). Inspections must be repeated completely, even if only parts of hardware, software or download lists are modified.

**Application and use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the user.**

**KEB Automation KG**
Südstraße 38 • D-32683 Barntrup
fon: +49 5263 401-0 • fax: +49 5263 401-116
net: www.keb.de • mail: info@keb.de