



## 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

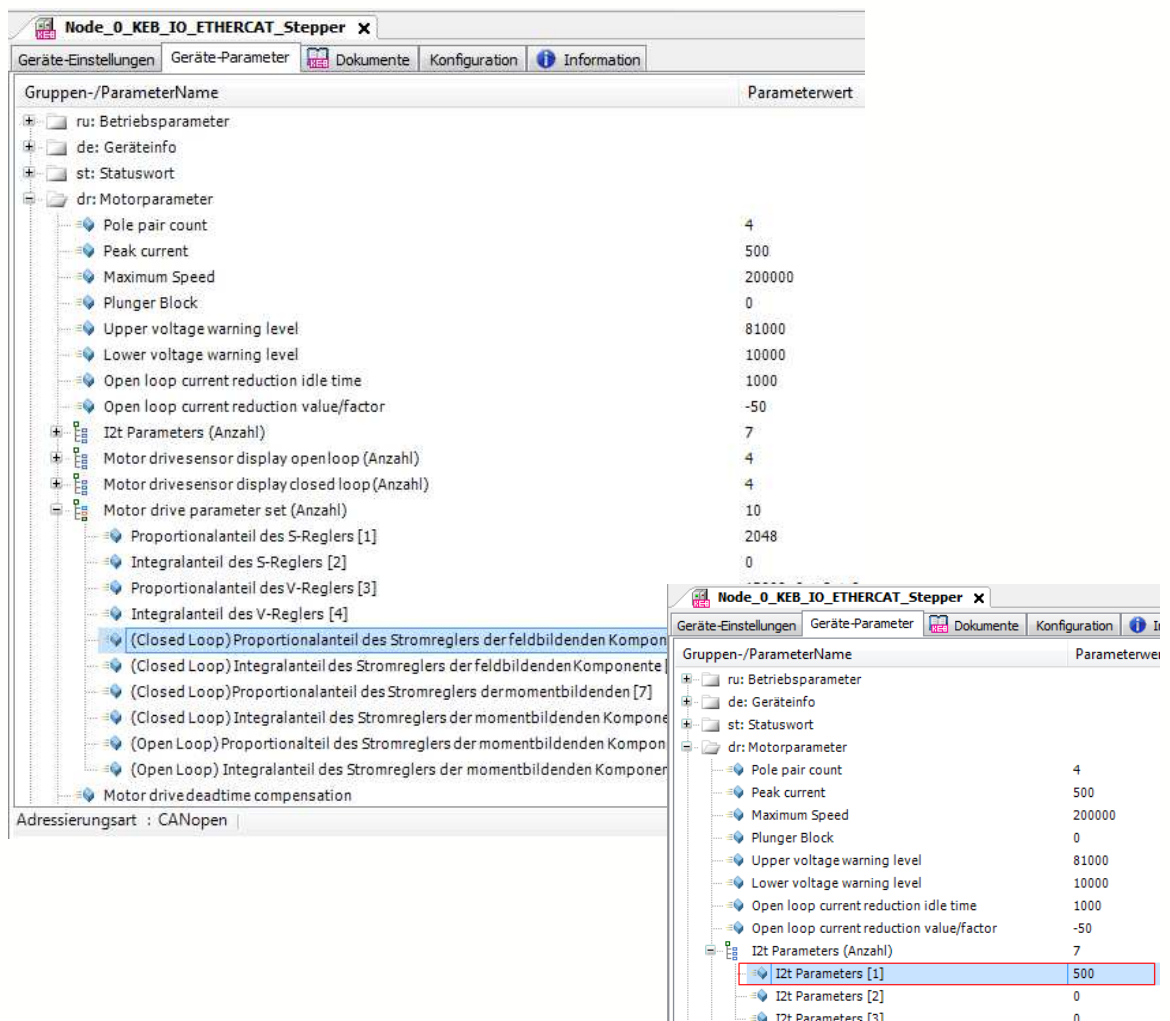
## Introduction

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.



Gruppen-/ParameterName	Parameterwert
ru: Betriebsparameter	
de: Geräteinfo	
st: Statuswort	
dr: Motorparameter	
Pole pair count	4
Peak current	500
Maximum Speed	200000
Plunger Block	0
Upper voltage warning level	81000
Lower voltage warning level	10000
Open loop current reduction idle time	1000
Open loop current reduction value/factor	-50
I2t Parameters (Anzahl)	7
Motor drivesensor display open loop (Anzahl)	4
Motor drivesensor display closed loop (Anzahl)	4
Motor drive parameter set (Anzahl)	10
Proportionalanteil des S-Reglers [1]	2048
Integralanteil des S-Reglers [2]	0
Proportionalanteil des V-Reglers [3]	
Integralanteil des V-Reglers [4]	
(Closed Loop) Proportionalanteil des Stromreglers der feldbildenden Komponente	
(Closed Loop) Integralanteil des Stromreglers der feldbildenden Komponente	
(Closed Loop) Proportionalanteil des Stromreglers der momentbildenden Komponente [7]	
(Closed Loop) Integralanteil des Stromreglers der momentbildenden Komponente	
(Open Loop) Proportionalanteil des Stromreglers der momentbildenden Komponente	
(Open Loop) Integralanteil des Stromreglers der momentbildenden Komponente	
Motor drive deadtime compensation	

Gruppen-/ParameterName	Parameterwert
ru: Betriebsparameter	
de: Geräteinfo	
st: Statuswort	
dr: Motorparameter	
Pole pair count	4
Peak current	500
Maximum Speed	200000
Plunger Block	0
Upper voltage warning level	81000
Lower voltage warning level	10000
Open loop current reduction idle time	1000
Open loop current reduction value/factor	-50
I2t Parameters (Anzahl)	7
I2t Parameters [1]	500
I2t Parameters [2]	0
I2t Parameters [3]	0

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.

# FAQ C6 RIO

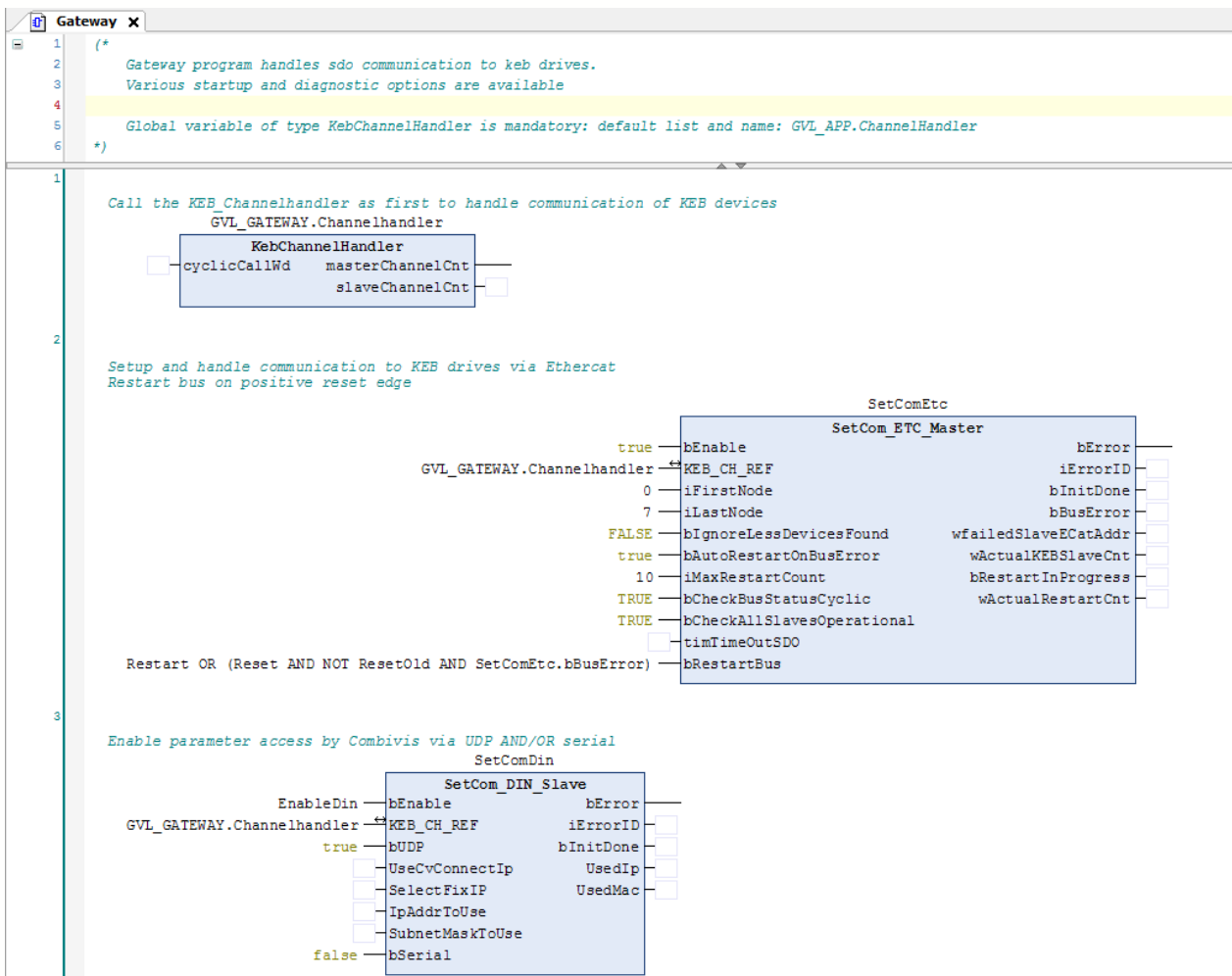


In order to perform this, it is imperative for the parameter “nominal current” I<sup>2</sup>t parameter[1] (203B<sub>h</sub> Subindex: 01<sub>h</sub>) entered a value <> 0.

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.

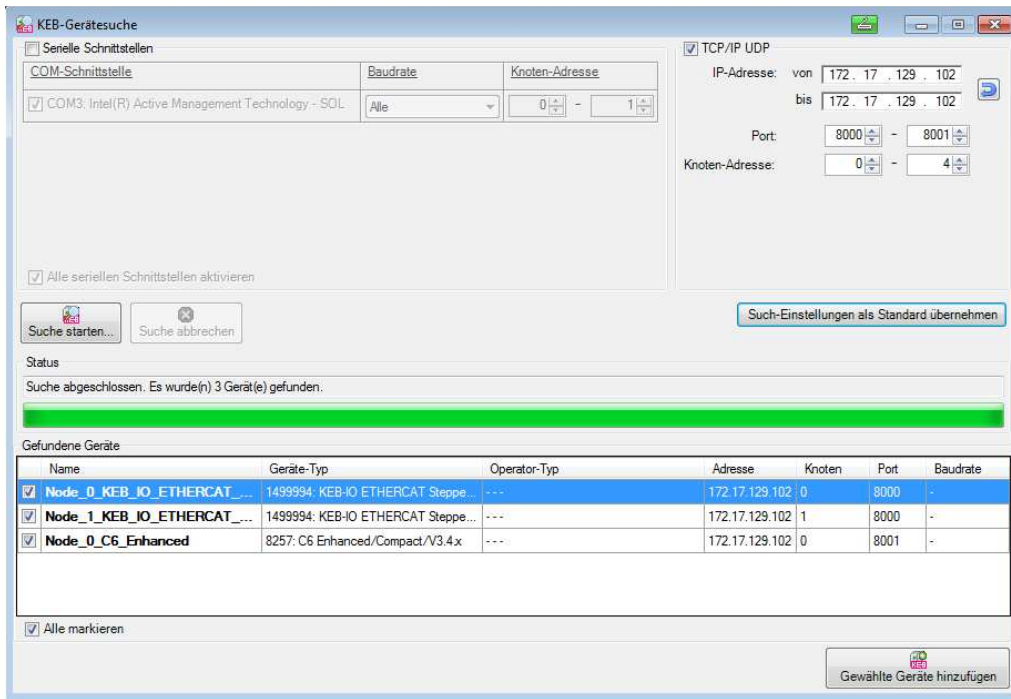
If the sample projects are used this gateway is already available, otherwise the structure can be seen there in detail. Then the project with the gateway must be downloaded into the control and started. With parameter wActualKEBSlaveCnt you can see if the SetCom\_ETC\_Master module has found modules at the EtherCAT bus after starting.



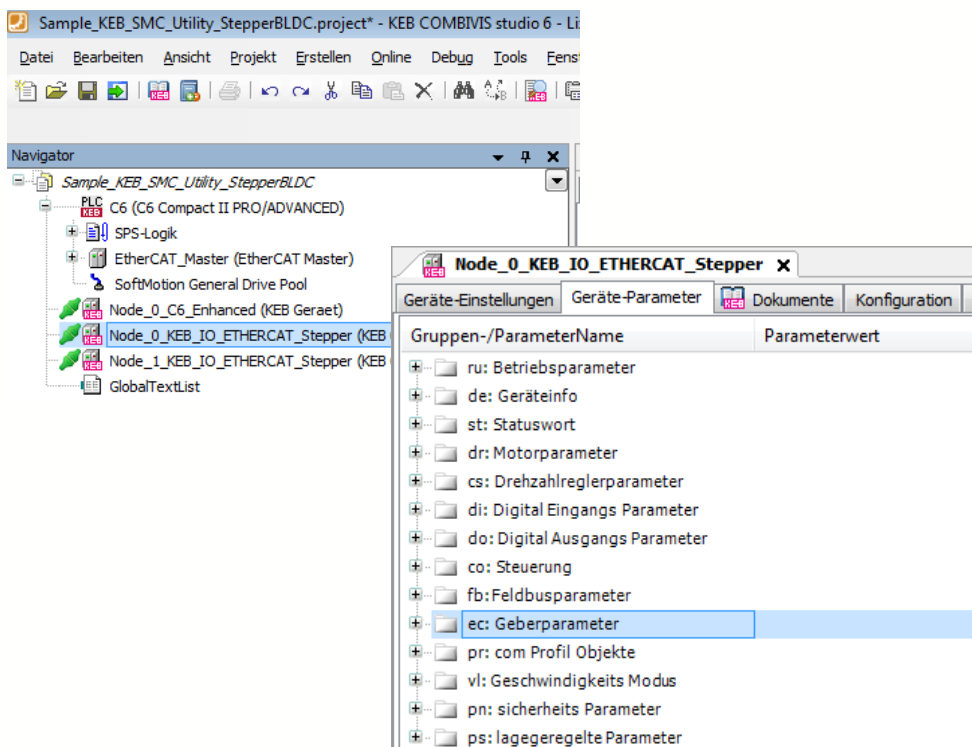
# FAQ C6 RIO



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.



# FAQ C6 RIO



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

Gruppen-/ParameterName	Parameterwert
ru: Betriebsparameter	
de: Geräteinfo	
st: Statuswort	
dr: Motorparameter	
Pole pair count	4
Peak current	1800
Maximum Speed	200000
Plunger Block	0
Upper voltage warning level	81000
Lower voltage warning level	10000
Open loop current reduction idle time	1000
Open loop current reduction value/factor	-50
I2t Parameters (Anzahl)	6
Motor drivesensor display openloop (Anzahl)	4
Motor drivesensor display closed loop (Anzahl)	4
Motor drive parameter set (Anzahl)	10
Motor drive deadtime compensation	0
Motor drivesubmode select	65
Auto-Setup submode select	0
Homing on block configuration (Anzahl)	3
cs: Drehzahlreglerparameter	
di: Digital Eingangs Parameter	
do: Digital Ausgangs Parameter	

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

Gruppen-/ParameterName	Parameterwert
ru: Betriebsparameter	
de: Geräteinfo	
st: Statuswort	
dr: Motorparameter	
cs: Drehzahlreglerparameter	
di: Digital Eingangs Parameter	
do: Digital Ausgangs Parameter	
co: Steuerung	
fb: Feldbusparameter	
ec: Geberparameter	
Encoder Resolution	-4000
Index Polarity	0
Index Width	-1
Encoder Health (Anzahl)	3
Position encoder resolution (Anzahl)	2
pr: com Profil Objekte	

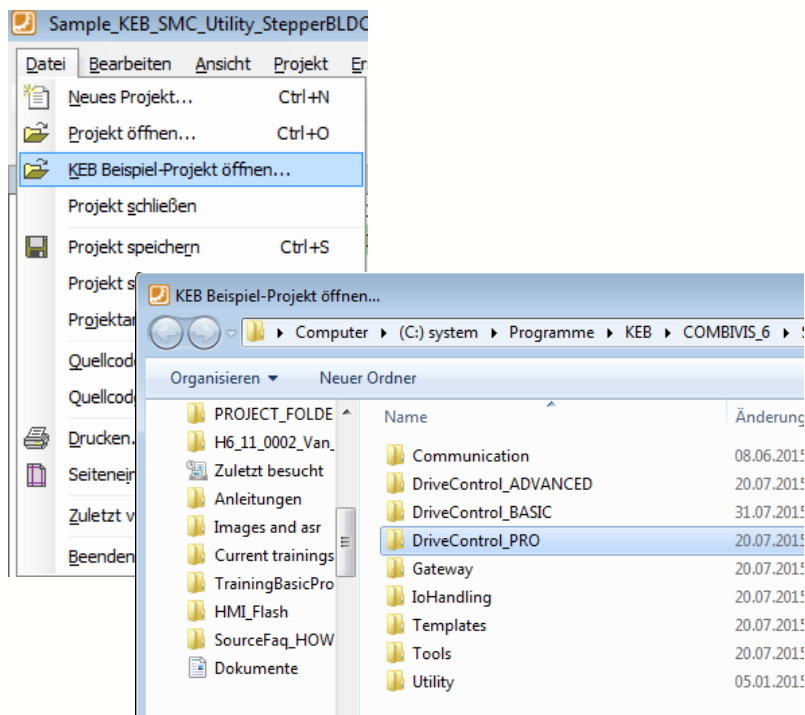
## Sample projects in COMBIVIS studio 6

### 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.



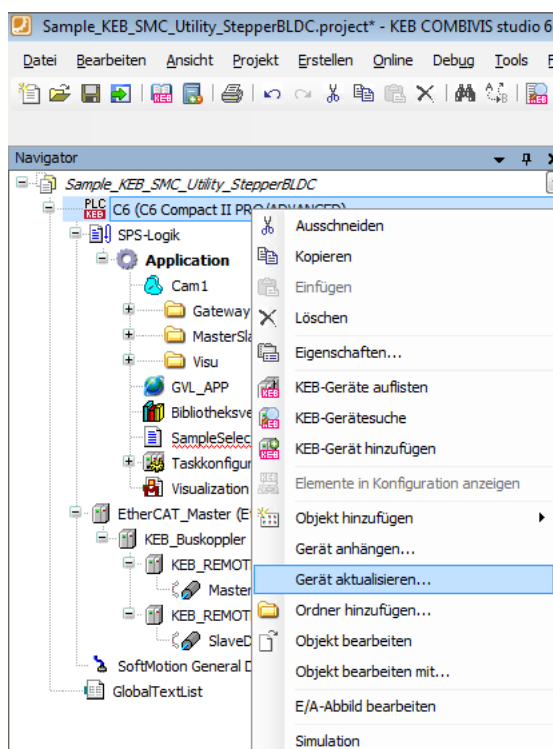
# FAQ C6 RIO



## 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.

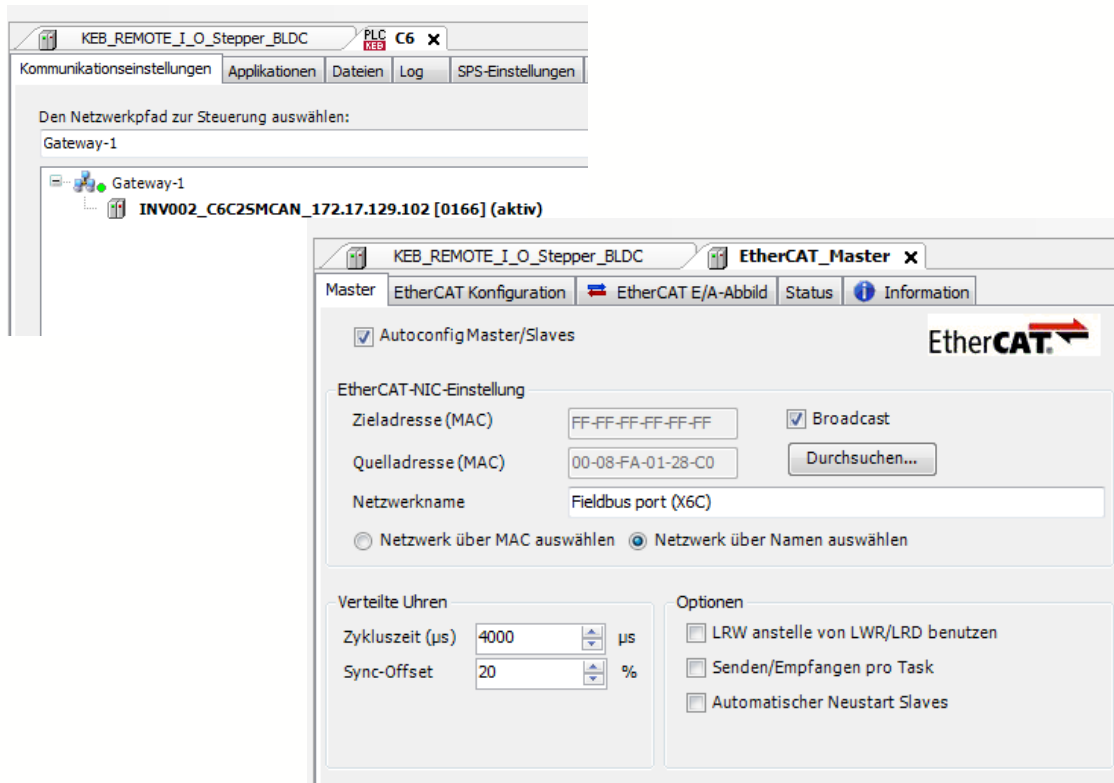


A list with editable controls is displayed in the window which opens afterwards.

# FAQ C6 RIO



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.

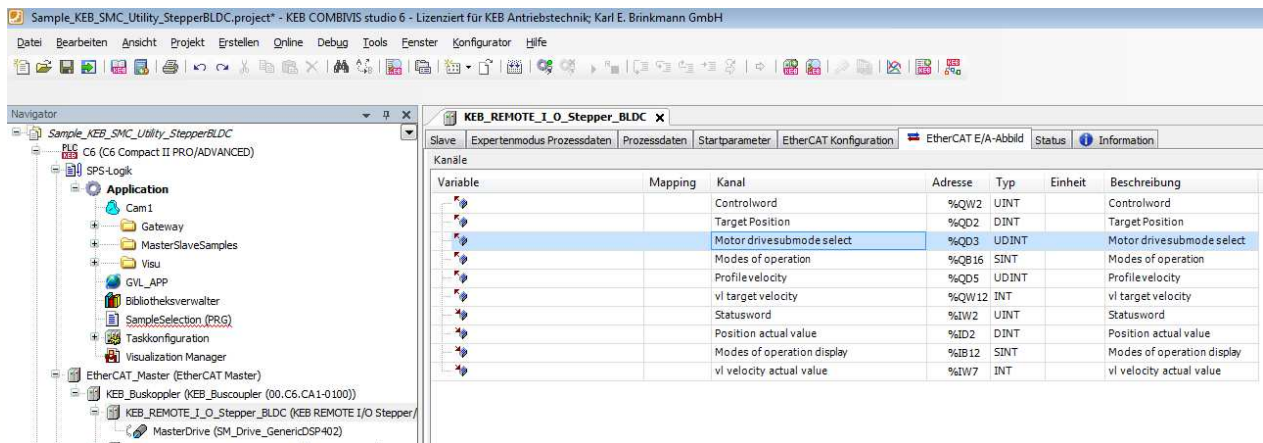


Example: C6 Compact EtherCAT master adjustment



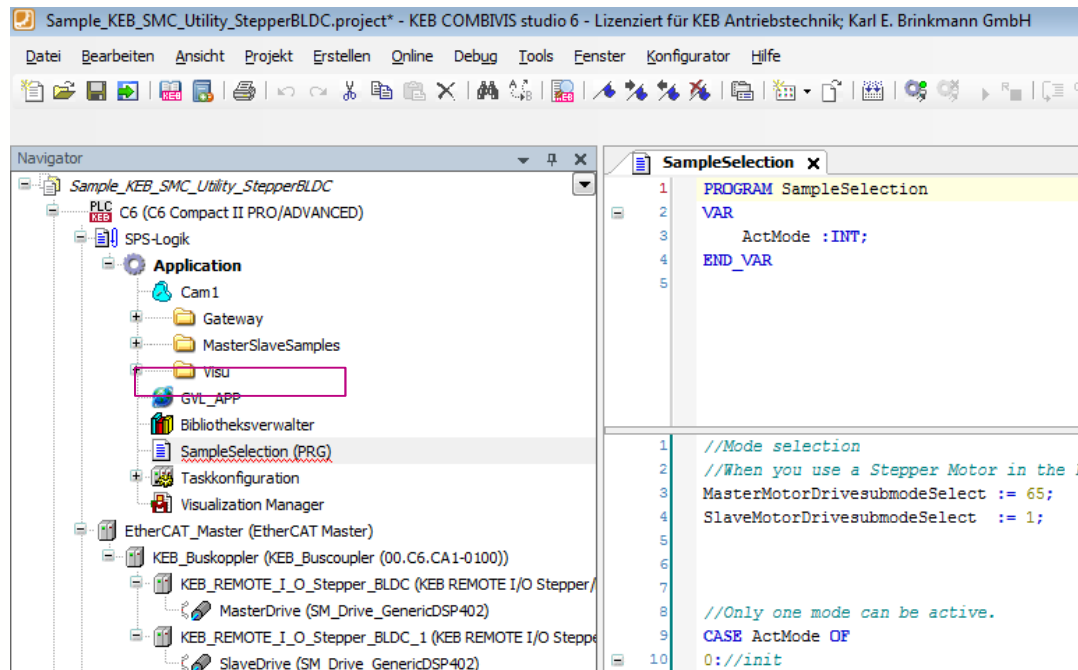
## Settings for the example project PRO

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,



Variable	Mapping	Kanal	Adresse	Typ	Einheit	Beschreibung
Controlword			%QW2	UINT		Controlword
Target Position			%QD2	DINT		Target Position
Motor drivesubmode select			%QD3	UDINT		Motor drivesubmode select
Modes of operation			%QB16	SINT		Modes of operation
Profilevelocity			%QD5	UDINT		Profilevelocity
vl target velocity			%QW12	INT		vl target velocity
Statusword			%IW2	UINT		Statusword
Position actual value			%ID2	DINT		Position actual value
Modes of operation display			%IB12	SINT		Modes of operation display
vl velocity actual value			%IW7	INT		vl velocity actual value

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.



```

1 PROGRAM SampleSelection
2 VAR
3     ActMode :INT;
4 END_VAR
5
6
7
8 //Mode selection
9 //When you use a Stepper Motor in the P.
10 MasterMotorDrivesubmodeSelect := 65;
11 SlaveMotorDrivesubmodeSelect := 1;
12
13
14 //Only one mode can be active.
15 CASE ActMode OF
16 0://init
    
```

# FAQ C6 RIO



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.

The screenshot shows the KEB COMBIVIS studio 6 interface. The Navigator on the left shows a project tree with a 'MasterDrive (SM\_Drive\_GenericDSP402)' highlighted. The main window displays the configuration for this drive, with the 'Skalierung' (Scaling) tab selected. The 'Skalierung' section contains three input fields for scaling factors, each with a dropdown menu set to '1':

- Inkremete <=> Motorumdrehungen: 1
- Motorumdrehungen <=> Getriebeausgangsumdrehungen: 1
- Getriebeausgangsumdrehungen <=> Einheiten in Applikation: 360

The 'Mapping' section is checked for 'Automatisches Mapping'. Below it is a table of inputs:

Zyklisches Objekt	Objektnummer	Adresse	Datentyp
status word (in.wStatusWord)	16#6041:16#00	'%I1WZ'	'UINT'
actual position (diActPosition)	16#6064:16#00	'%ID2'	'DINT'
actual velocity (diActVelocity)	16#606C:16#00	"	"
actual torque (wActTorque)	16#6077:16#00	"	"
Modes of operation display (OP)	16#6061:16#00	'%IB12'	'SINT'
digital inputs (in.dwDigitalInputs)	16#60FD:16#00	"	"
Touch Probe Status	16#60B9:16#00	"	"
Touch Probe 1 rising edge	16#60BA:16#00	"	"
Touch Probe 1 falling edge	16#60BB:16#00	"	"
Touch Probe 2 rising edge	16#60BC:16#00	"	"

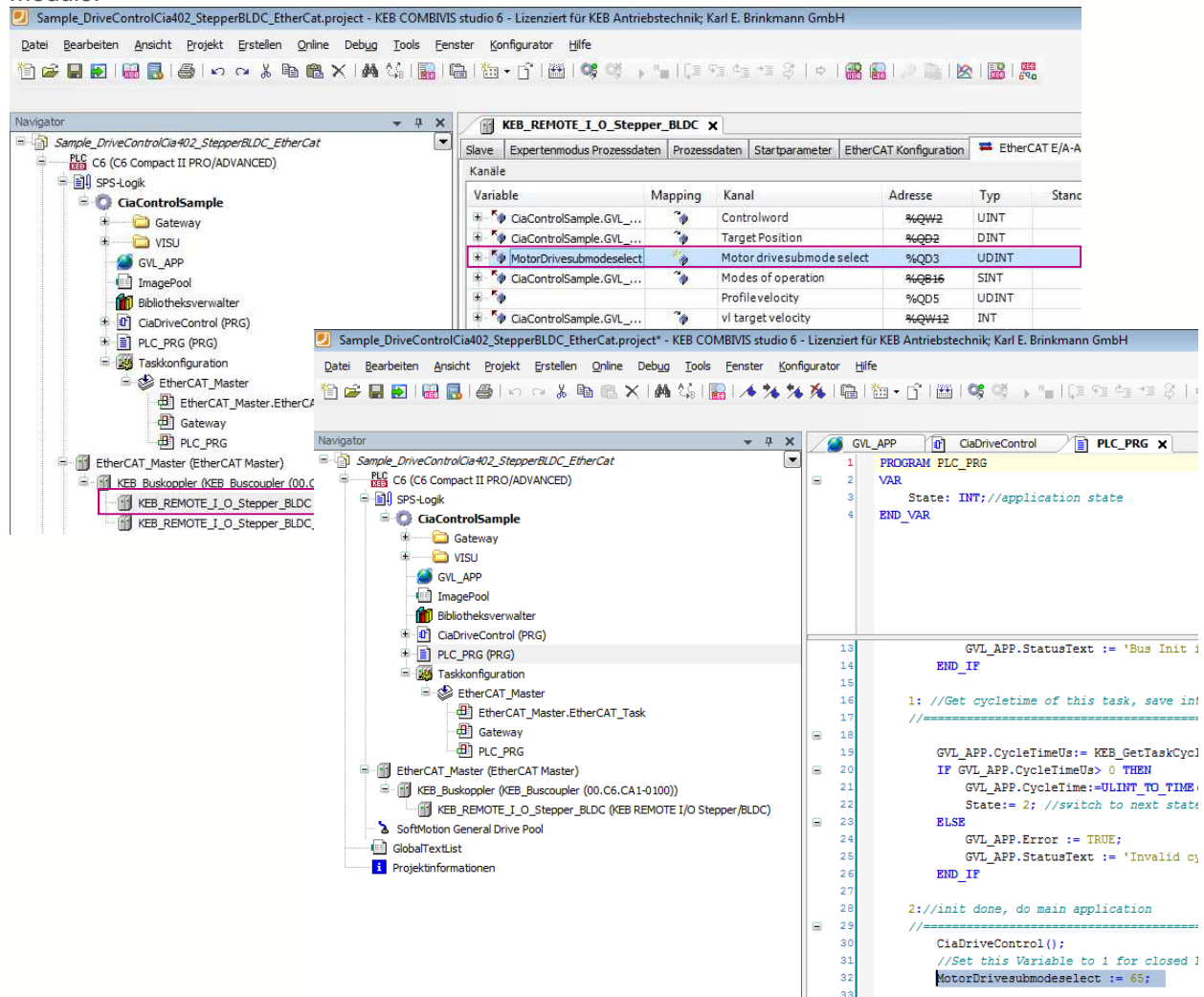
The 'Ausgänge' (Outputs) section is currently empty.

## 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	UJINT	0			Controlword
		Target Position	%QD8	DINT	0			Target Position
		Motor drivesubmode select	%QD9	UDINT	0	65		Motor drivesubmode select
		Modes of operation	%QB40	SINT	0			Modes of operation
		Profilevelocity	%QD11	UDINT	0			Profilevelocity
		vl target velocity	%QW24	INT	0			vl target velocity
		Statusword	%IW8	UJINT	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.



The screenshot shows the KEB COMBIVIS studio 6 interface. The left pane displays the project tree with the following structure:

- Sample\_DriveControlCia402\_StepperBLDC\_EtherCat
  - PLC C6 (C6 Compact II PRO/ADVANCED)
    - SPS-Logik
      - CiaControlSample
        - Gateway
        - VISU
        - GVL\_APP
        - ImagePool
        - Bibliotheksverwalter
        - CiaDriveControl (PRG)
        - PLC\_PRG (PRG)
        - Taskkonfiguration
          - EtherCAT\_Master
            - EtherCAT\_Master.EtherCAT
            - Gateway
            - PLC\_PRG

The right pane shows the EtherCAT E/A image for the module KEB\_REMOTE\_I\_O\_Stepper\_BLDC. The 'Motor drivesubmode select' variable is highlighted, showing its address as %QD3 and its current value as 65.

The bottom pane shows the ladder logic for the PLC\_PRG program. The relevant code is as follows:

```

1 PROGRAM PLC_PRG
2 VAR
3     State: INT;//application state
4 END_VAR

13 GVL_APP.StatusText := 'Bus Init i
14 END_IF
15
16 1: //Get cyclotime of this task, save int
17 //=====
18
19 GVL_APP.CycleTimeUs:= KEB_GetTaskCycl
20 IF GVL_APP.CycleTimeUs> 0 THEN
21     GVL_APP.CycleTime:=ULINT_TO_TIME(
22     State:= 2; //switch to next stat
23 ELSE
24     GVL_APP.Error := TRUE;
25     GVL_APP.StatusText := 'Invalid c3
26 END_IF

28 2://init done, do main application
29 //=====
30 CiaDriveControl();
31 //Set this Variable to 1 for closed l
32 MotorDrivesubmodeselect := 65;
33
    
```

## Auto-Setup Mode



*The connected motor is put in motion upon activation of the Autoseup. 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:

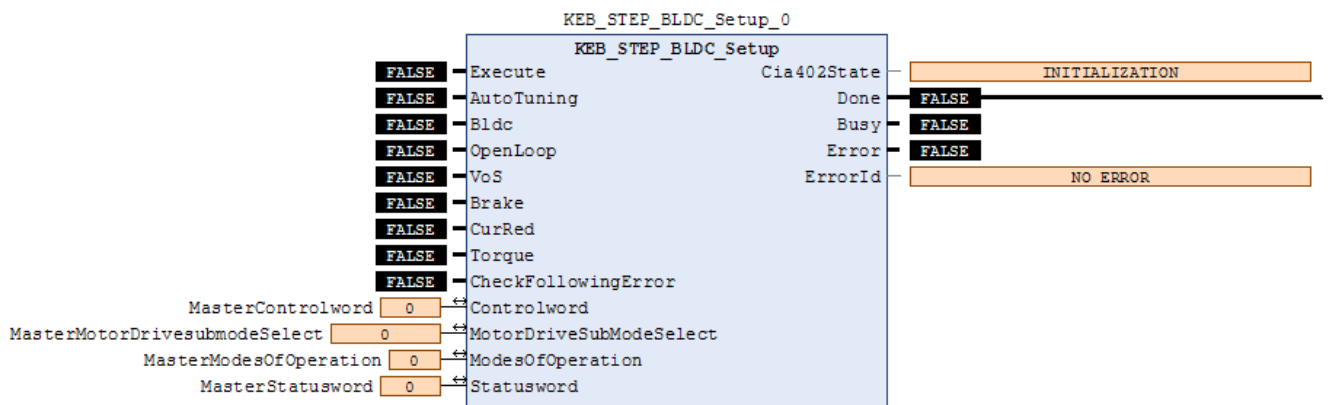
- pole-pair number (2030h)
- encoder resolution (2052h) in increments/revolution
- encoder adaption (2050h) offset angle between rotor and electric field

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

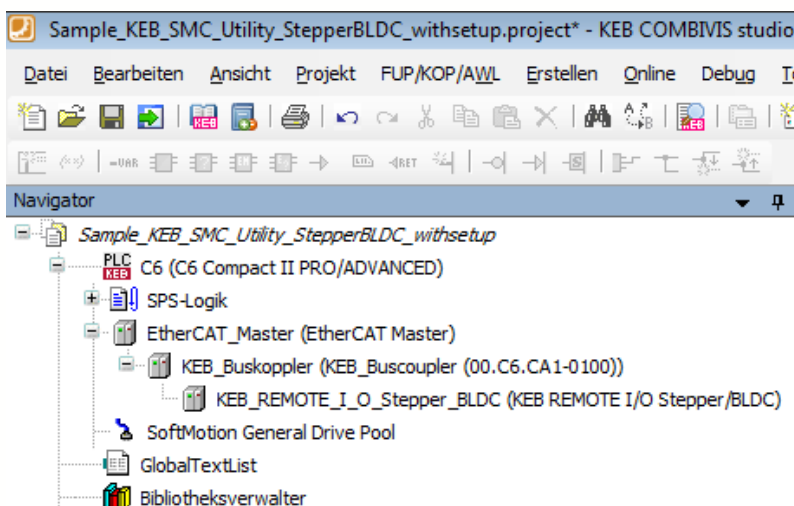
The easiest way to determine the motor data of the modules is by Auto Setup with the module from KEB. Only the options of the motor are selected at the module, then the real determination of the data takes place automatically.

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.



# FAQ C6 RIO



KEB_REMOTE_I_O_Stepper_BLDC x										
Slave		Expertenmodus Prozessdaten	Prozessdaten	Startparameter	Online	CoE Online	EtherCAT Konfiguration	EtherCAT E/A-Abbild	Status	In
Kanäle										
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			
MasterStatusword	vl target velocity	%QW24	INT	0			vl target velocity			
	Statusword	%IW8	UINT	38680			Statusword			
MasterStatusword	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_ X									
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	
		Profilevelocity	%QD5	UDINT	0			Profilevelocity	
		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:

01h: all categories

02h: Communication

03h: user objects



### NOTE

#### **Malfunction or destruction of C6 REMOTE Stepper/BLDC**

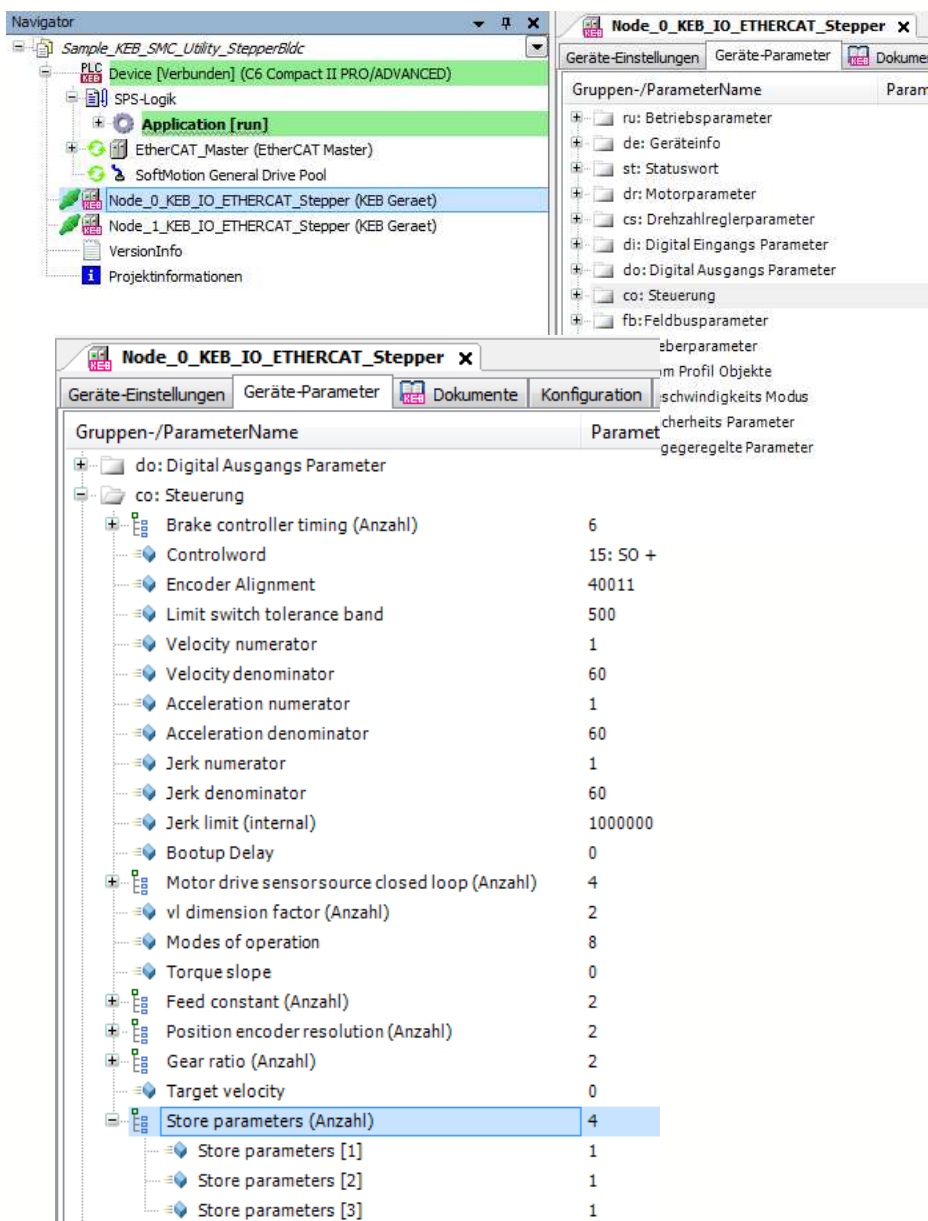
*File system corruption or malfunction of the total system by interrupting the fieldbus functionality while saving. Saving may take up to 20s.*

- ⇒ Do not cut off the power supply during that time
- ⇒ Verify that successful saving is indicated by the control unit in object 1010<sub>h</sub>.
- ⇒ 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.

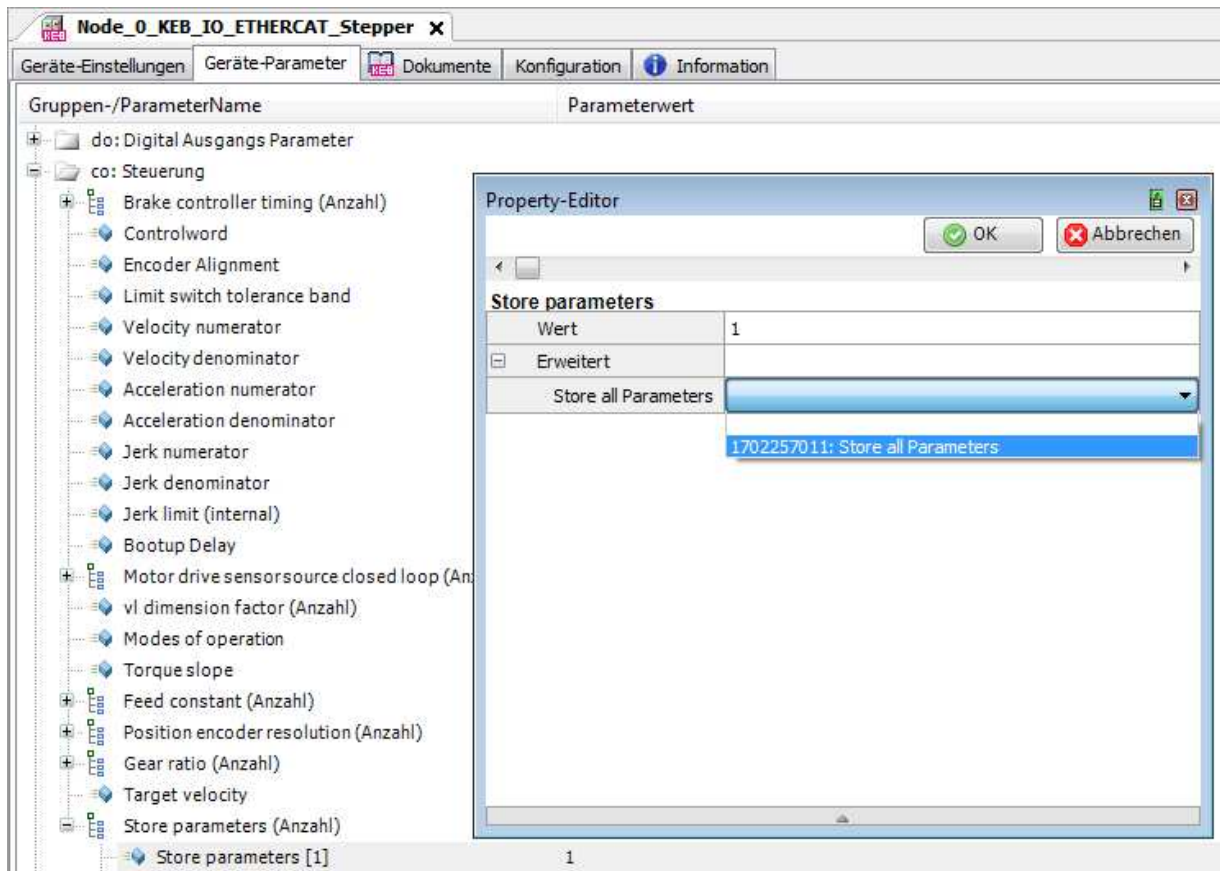


Gruppen-/ParameterName	Parameter
do: Digital Ausgangs Parameter	
co: Steuerung	
Brake controller timing (Anzahl)	6
Controlword	15: 50 +
Encoder Alignment	40011
Limit switch tolerance band	500
Velocity numerator	1
Velocity denominator	60
Acceleration numerator	1
Acceleration denominator	60
Jerk numerator	1
Jerk denominator	60
Jerk limit (internal)	1000000
Bootup Delay	0
Motor drive sensor source closed loop (Anzahl)	4
vl dimension factor (Anzahl)	2
Modes of operation	8
Torque slope	0
Feed constant (Anzahl)	2
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

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,

Position encoder resolution (Anzahl)	2
Gear ratio (Anzahl)	2
Target velocity	0
Store parameters (Anzahl)	4
Store parameters [1]	1702257011: Store all Parameters
Store parameters [2]	1
Store parameters [3]	1

"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.

# FAQ C6 RIO



 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](http://www.keb.de) • mail: [info@keb.de](mailto:info@keb.de)