Installation of the Multiturnencoder AEMT-12/16 L combined with MC V3.0 controller family

Summary

The document describes how to install a BLDC-motor with the multiturn encoder AEMT-12/16 L in combination with a FAULHABER motion controller of generation V3.0.
Topics are

- The connection of the components
- The procedure to reset the encoder
- The configuration of the motion controller
- The battery monitoring

Applies To

Motor[1)]	Encoder	Motion Controller	Accessories
• BX4 • BP4 • B • (BXT on request)	AEMT-12/16 L (connector special numbers: • 5419 for BX4 • 5418 for BP4, B)	Motion Controller MC V3.0, special number 6419, Firmware L	**Needed:** • 6501.00368 (battery adapter) • 6501.00369 (cable from Motion Controller to battery adapter L=150) • Battery with form factor 1/2AA, e.g. LS 14250, LS 14250 MLB **Optional 2m-cables** • 6501.00370 (cable AEMTL L=2m) • 6501.00338 (cable for BX4 L=2m) or 6501.00262 (cable for BP4/4490 L=2m)

[1)] for FAULHABER BLDC motors with outer diameter >= 22mm

Description

Descripion of the battery adapter 6501.00368

If the encoder's main power supply is switched off, the AEMT-12/16 L will change to a battery modus with strongly reduced power consumption (max. 10µA). As consequence the multiturn function is guaranteed with a suitable battery connected to the encoder.

The necessary battery cannot be obtained from FAULHABER and has to be installed external of the encoder housing.

The battery adapter 6501.00368 gives an example of how the connection of the battery to the encoder can look like:

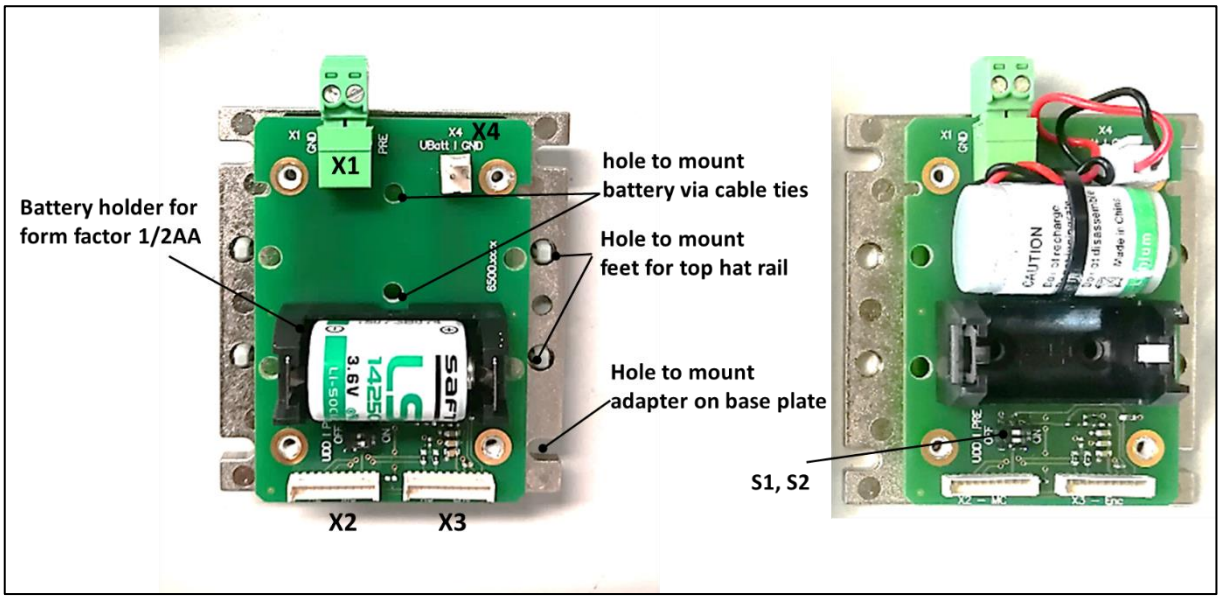

Figure 1: Adapter 6501.00368 with battery in holder (left) and with battery for connector X4 (right)

Suggested batteries for battery holder:

- LS 14250 (Saft)
- SL-350 (Tadiran)
- ER 14250 (EVE)

Suggested battery for connector X4:

- LS 14250 MLB (Saft)

Suggested feet for top hat rail

- Order number: 209-188 (WAGO)

Table 1: function of switches S1, S2

	Off (default)	**On**
S1 – Power Supply AEMTL	switched off	switched on
S2 – Preset Input AEMTL	pulled to GND	pulled to U_{DD}

Table 2: Pin-assignment connectors

X1 – Preset Pin- assignment		**X2 – MC50xx Pin-assignment**		**X3 – AEMTL Pin-assignment**		**X4 – Battery Pin-assignment**	
1	Preset	1	n.c.	1	Preset	1	GND
2	GND	2	U_{DD} (MC)	2	U_{DD}	2	U_{Bat}
		3	GND	3	GND		
		4	/CS	4	U_{Bat}		
		5	CS	5	/CS		
		6	/DATA	6	CS		
		7	DATA	7	/DATA		
		8	/CLK	8	DATA		
		9	CLK	9	/CLK		
		10	n.c.	10	CLK		

Mounting and wiring example

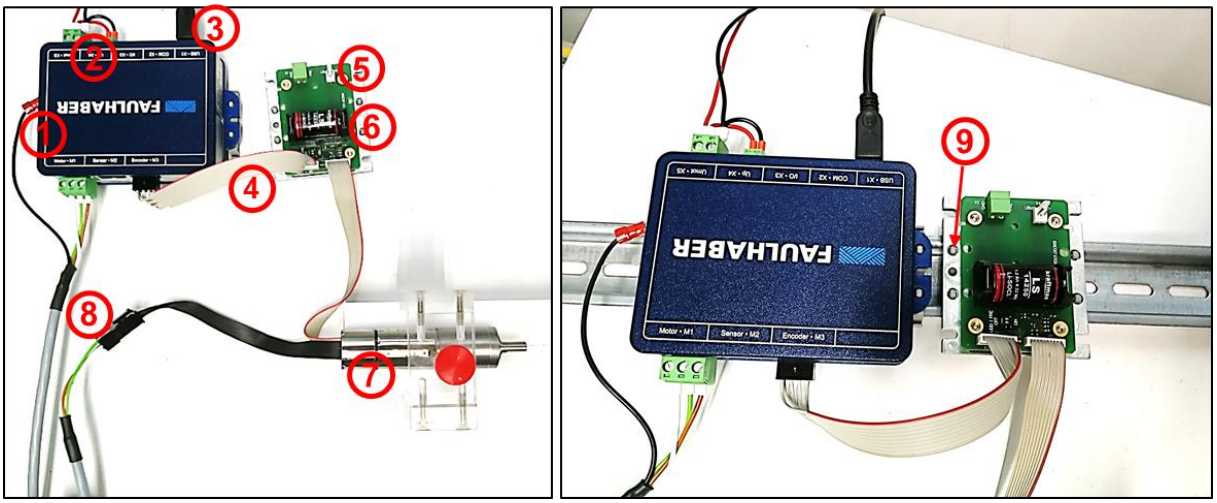

Figure 2: Wiring of the components (left) and example of mounting them on top hat rail (right)

1 MC 5005 S
2 Cable for power supply
3 USB cable
4 Cable from MC to battery adapter
5 Battery adapter 6501.00368
6 Battery
7 2232S012BX4 AEMT-12/16 L 5419
8 Motor cable 6501.00338
9 Feet for top hat rail 209-188 (WAGO)

Installation to the machine

Step 1 – preparation and wiring

The given numbers (x) refer to Figure 2.

a) *Preparation of the battery adapter (5)*
- Check if switch S1 and S2 are on position ‘off’
- Insert a battery either like option left or right in Figure 1

b) *Mounting of components (Controller (1), battery adapter (5), motor(7))*

c) *Connection*
- Connect the cable of the encoder (7) to the battery adapter (5) and the battery adapter to the connector M3 of the motion controller (1)
- Connect the motor phases (8) to the connector M1 of the motion controller (1)
- Connect the cable for power supply (2) with a suitable power supply according to the data sheet of the used motion controller. Power the motion controller up.
- Plug the USB cable (3) into the motion controller and a PC

⚠ Use shielded, twisted pair cables between motion controller and motor/encoder for longer transmission distances.
All components should have a proper ground and shield connection. (See the technical manual of the MC50xx and Application Note 187).

Step 2 – Encoder reset

When connected the first time the enoder's position counter is invalid due to the lack of battery. The encoder can send an error (encoder status = '0') and the position value '0' can appear constantly (Figure 3). Motor operation is not possible.

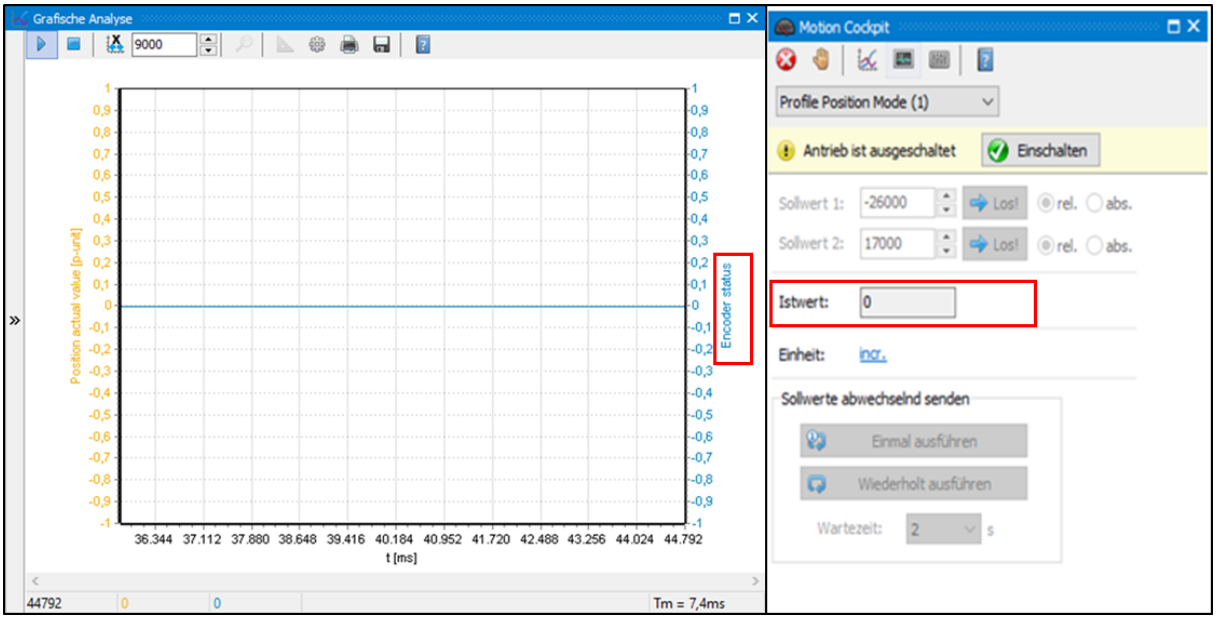

Figure 3: Encoder status (object 0x2315.07) and position after start up

Execute the next steps in order to reset the encoder and to run the driving system:

d) Switch on the Power supply of the encoder

- Switch S1 (Udd) at the battery adapter from 'off' to 'on'

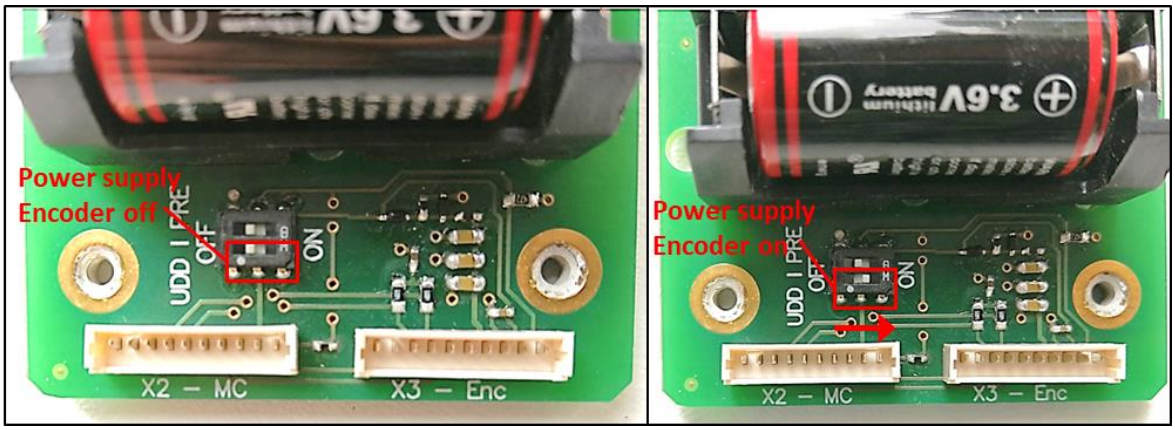

Figure 4: Switch on the power supply of the encoder

e) Execute the reset routine

→ Switch S2 (Pre) at the battery adapter from ‘off’ to ‘on’ and back to ‘off; S1 stays “on”.

Figure 5: Preset pulse

→ As consequence the multiturn counter of the encoder is reset

→ Switch S1 (Udd) at the battery adapter from ‘on’ to ‘off’ and back to ‘on’ in order to reset the encoder error

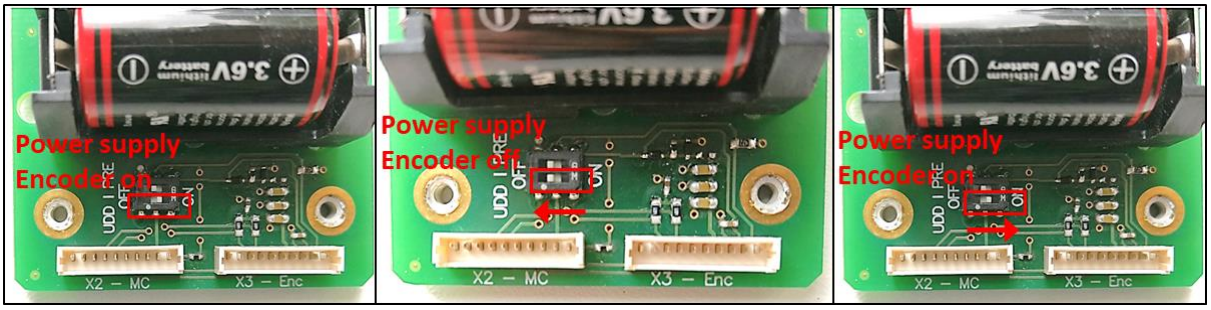

Figure 6: Reset encoder

➔ **The encoder is restarted and sends valid data to the controller**

After such a reset the multiturn counter is reset. The singleturn part is according to the actual magnet position.

Be aware that the reseting has to be repeated whenever encoder and battery were disconnected! The reseting can be left out under the following conditions:

- Change of battery takes place before battery is discharged
  (UBat >=2.8V, Error bit is not set)
- Main power supply is switched on (Udd=5V) during change of battery

Quick Guide to installation

- Insert Battery
- Connect X2 to controller
- Connect encoder to X3
- Power up the controller
- Reset the encoder using the two switches:
  - UDD: off-> on
  - Pre: off→ on→ off
  - UDD:on→ off→ on

Basic configuration of MC50xx

f) Open the FAULHABER Motion Manager (supported from version 6.7)

g) Establish the connection to the motion controller

h) Use the selection tool to properly select motor and encoder

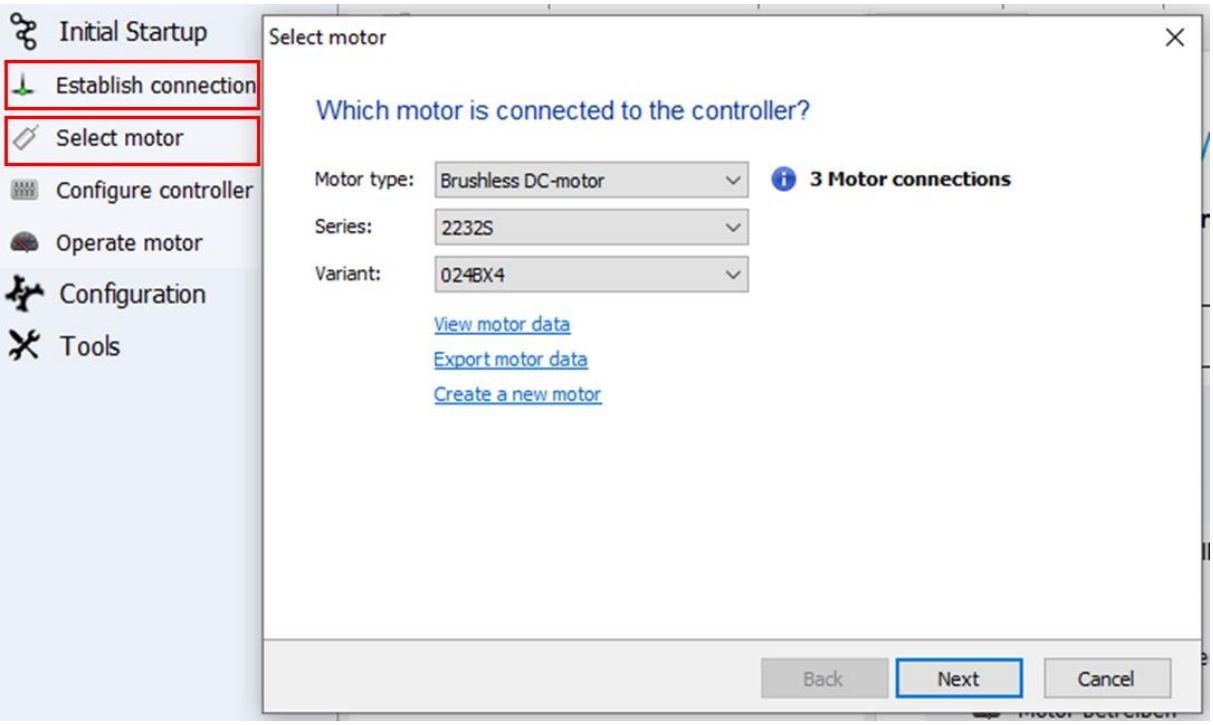

Figure 7: Select the motor

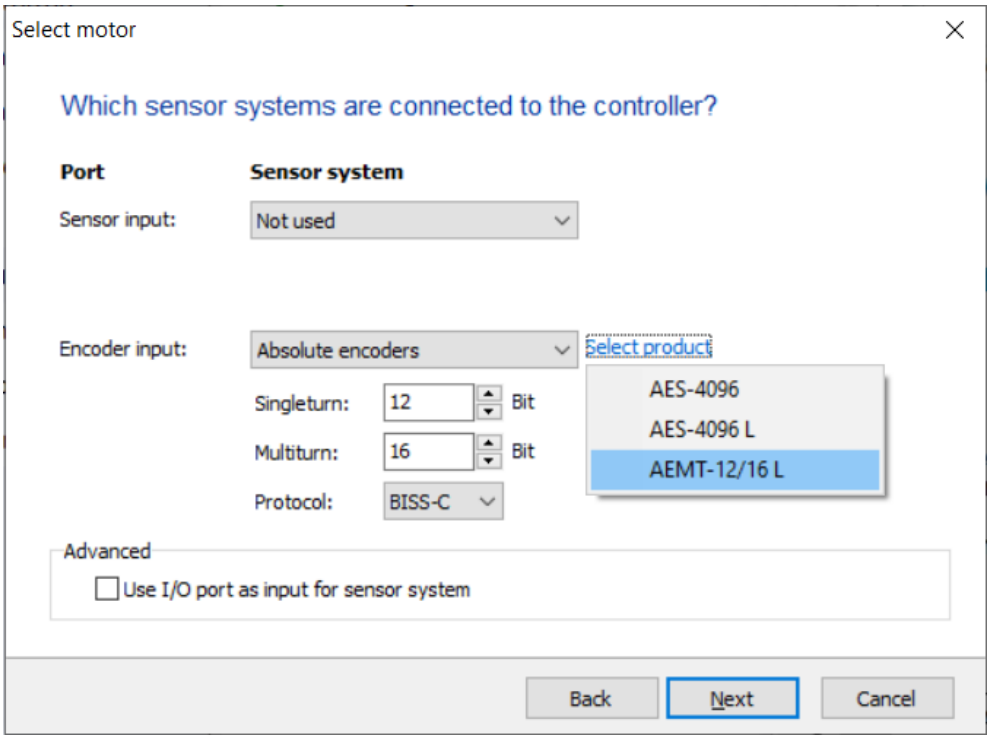

Figure 8: Select the encoder

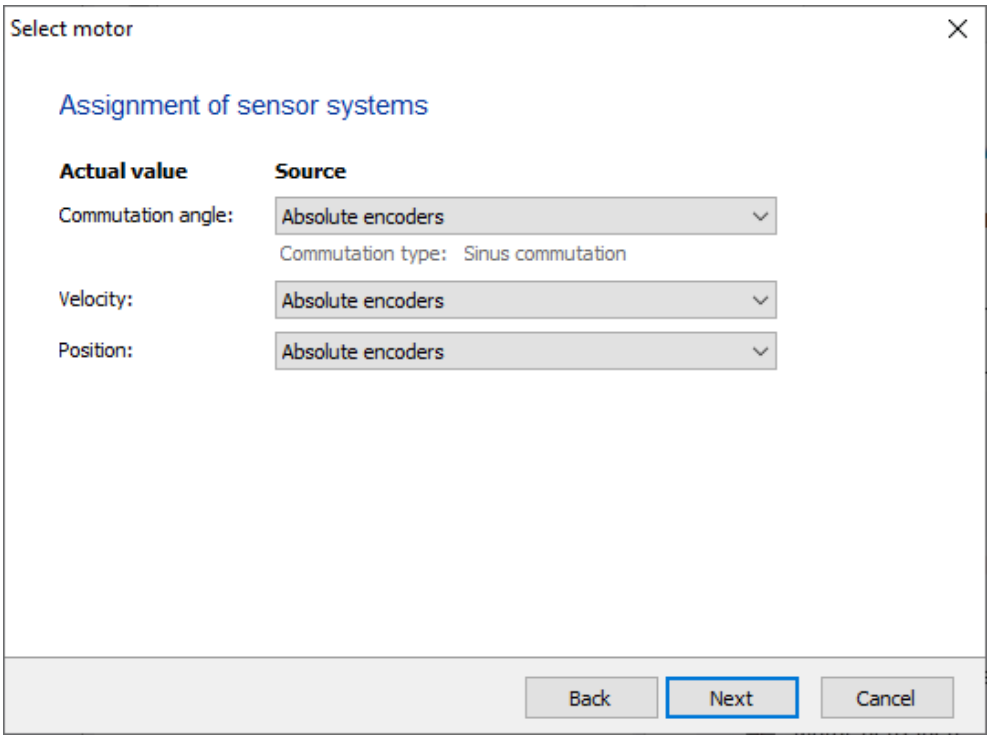

Figure 9: Select the encoder for commutation and control

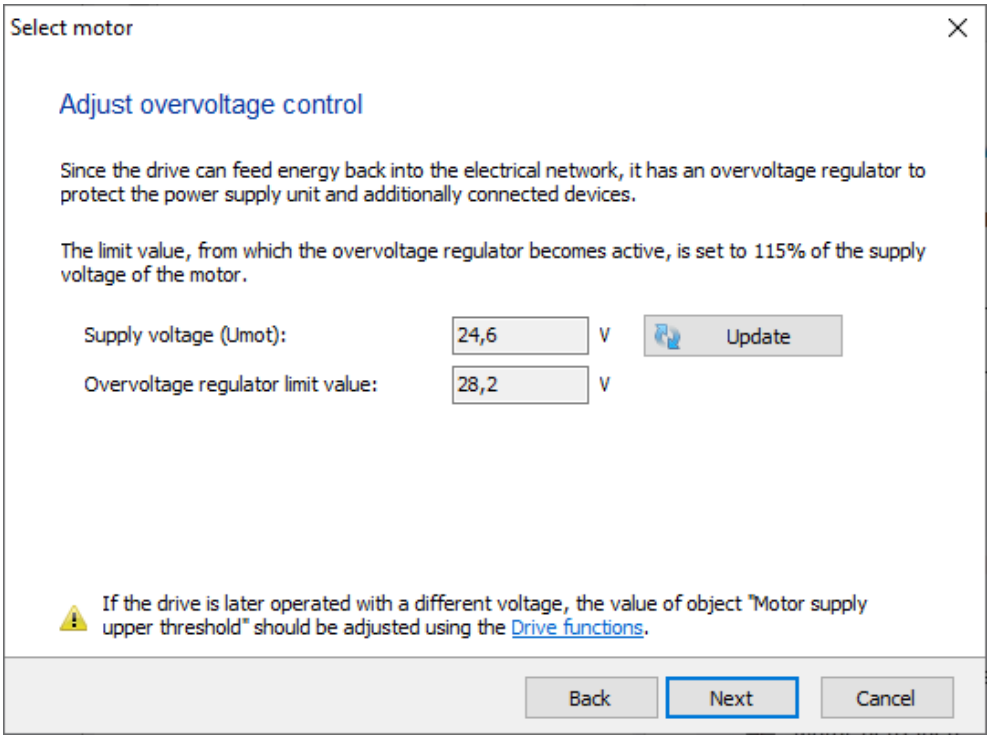

Figure 10: Continue with standard routine of motor selection

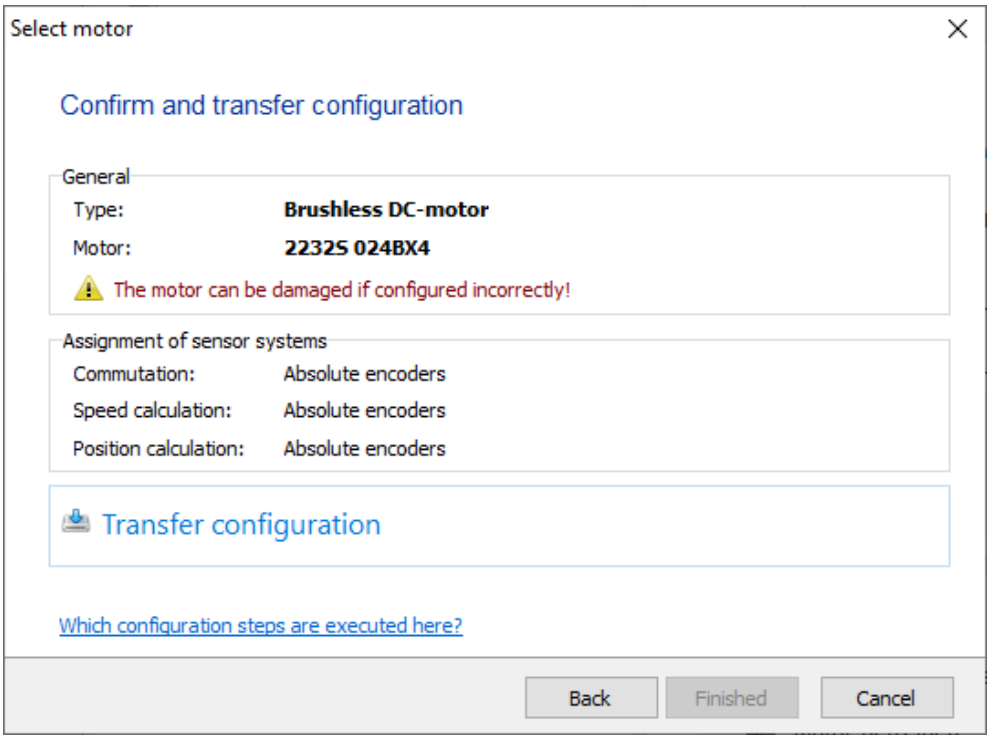

Figure 11: Continue with standard routine of motor selection

➔ **Basic Configuration of the controller is completed** ✓

Configure a position offset for your application

Before continuing with the next steps the configuration of the control parameters (AN151) should be completed.

In some applications it can be usefull to set the actual position at a homing point to zero.
This is possible with the motion controllers of the MC V3.0-famillly by adding an offset value to the encoder position.

Follow the next steps to configure this "*home offset*" (0x607C):

- Drive to the homing point
- Read the actual position value (Figure 12, 1.))
- Open the selection window "*Drive functions"* and go to "*Homing Mode"* (Figure 12, 2.))
- Write the actual position value in the field *"home offset"* (Figure 12, 3.))
- Send and save the changed value (Figure 12, 4.))

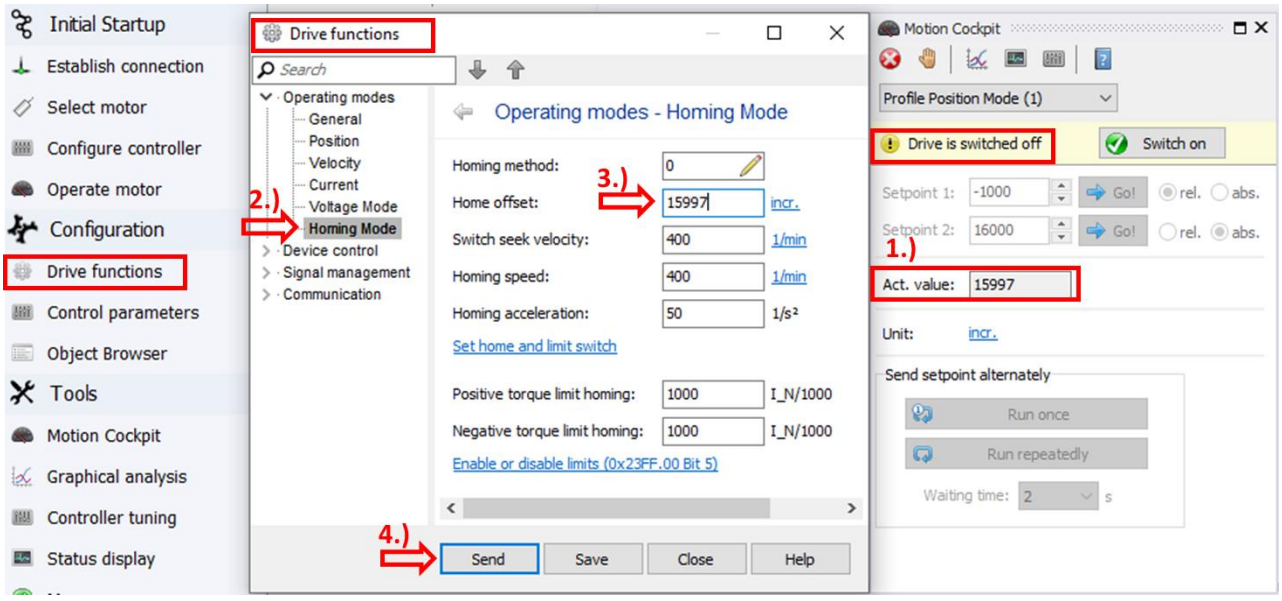

Figure 12: setting the home offset

➔ **The actual position value is set to '0'**

If a PLC is used as master, its internal home offset parameter can be used instead of the Motion Controller's object.

Adaption of the position limits

A positioning close to the encoder's roll over is to be prevented. Therefore the software position limits (0x607D) of the controller should be set.
The following limits are recommended if a home offset 0x607C is used:

- Min. position limit: -0.90 * 2^27 = -120.800.000 incr. **+ home offset**
- Max. position limit: +0.90 * 2^27 = +120.800.000 incr. **+ home offset**

The position limits can be changed in the selection window *"drive functions – Range limits"*, Figure 13:

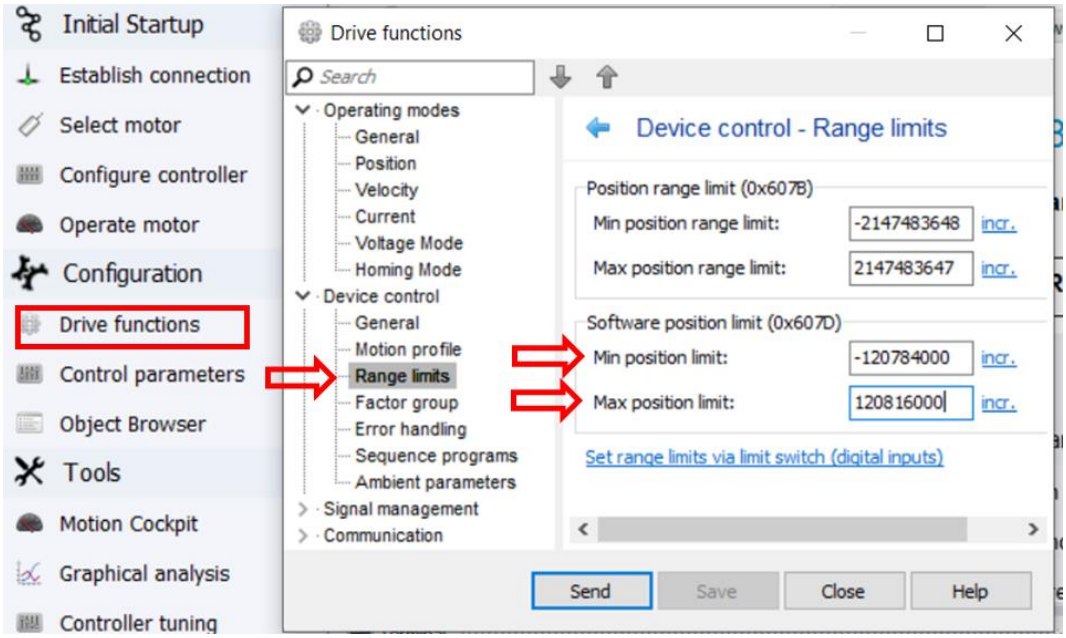

Figure 13: position limits with a home offset of 16.000incr.

➔ **The drive system is ready for use** ✓

Signed and unsigned position interpretation

Figure 14 shows the position range if the values are interpreted unsigned (left) or signed (right).

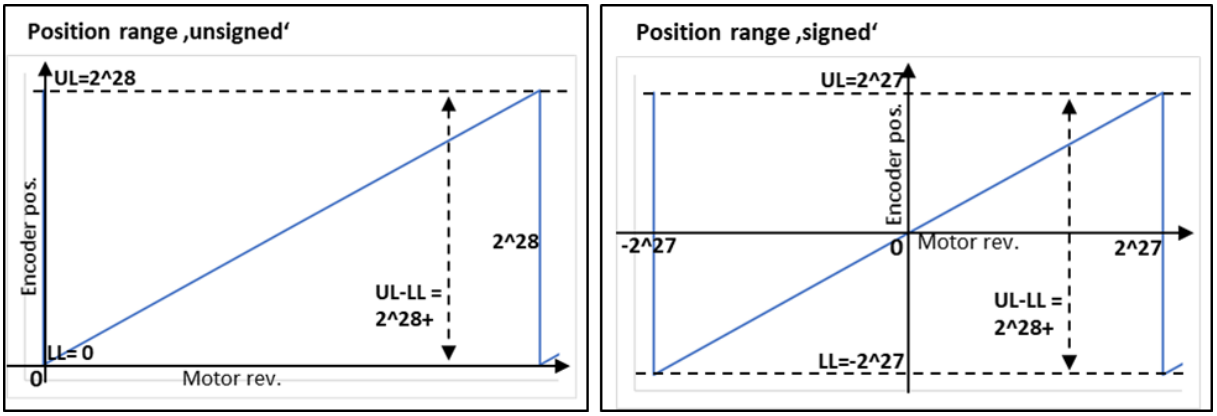

Figure 14: position values 'unsigned and 'signed'

Signed position values are received by taking the most significant bit as sign (MSB=0 → positive, MSB=1 → negative)

By default the motion controllers MC V3.0 interpret the position as signed values.
In the object 0x2315.01 it can be switched to ‘unsigned’:

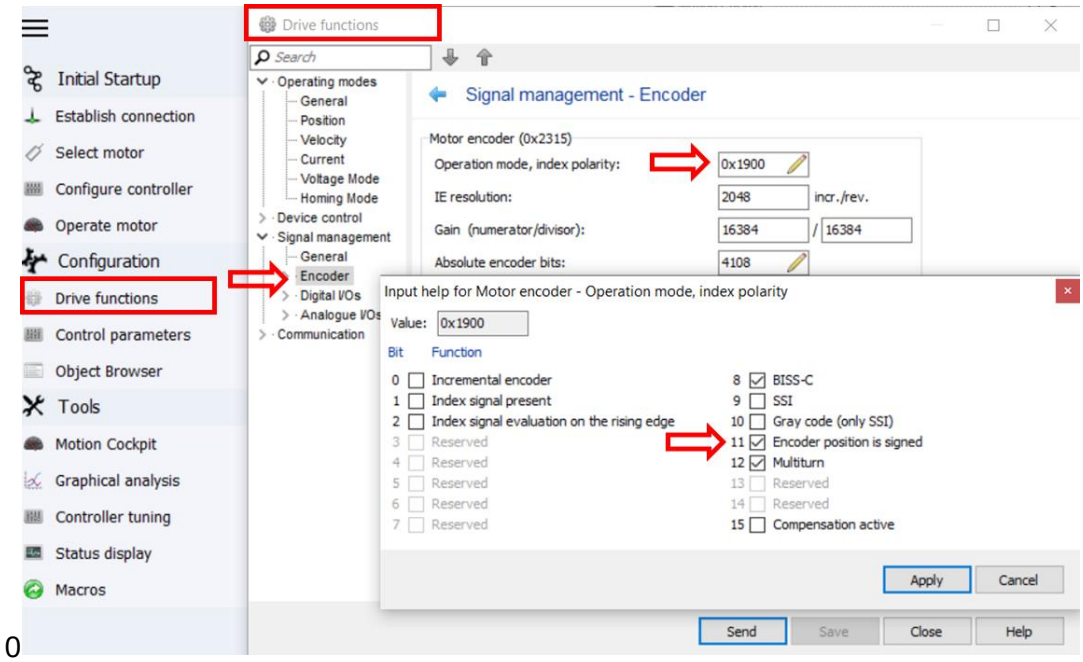

Figure 15: Switching from 'signed' to 'unsigned' encoder positions

If an ‘unsigned’ value is chosen, make sure the position does not roll over by moving to the left of the reset position.

Battery monitoring

If the voltage between Pin 4 (Ubat) and Pin 3 (GND) of the encoder falls below a level of 2.8V, an error bit (low active) will be set:

Nr.	Funktion
1	Preset
2	U_{DD}
3	GND
4	U_{BAT}
5	Reserviert
6	Reserviert
7	$\overline{DATA}$
8	DATA
9	$\overline{CLK}$
10	CLK

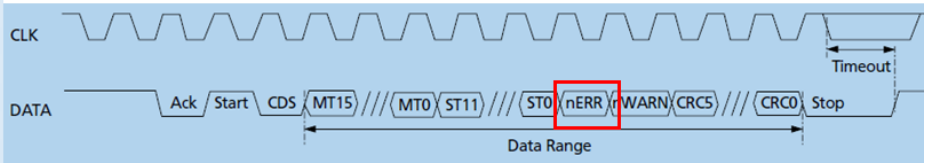

Figure 16: Pin assignment encoder and protocol

The error bit is evaluated by MC V3.0 controllers with a firmware release L or newer in *the encoder status* (object 0x2315.07).

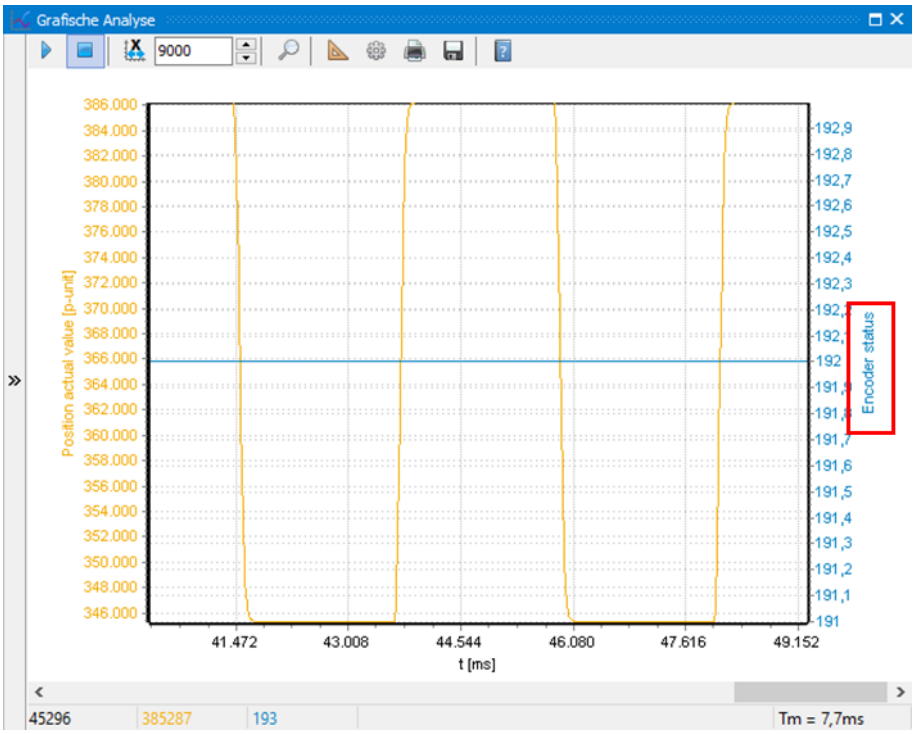

Figure 17: Encoder status (blue), object 0x2315.07

In Table 3 the values of the encoder status are explained.

Table 3: Interpretation of the encoder status

Encoder status value	Interpretation	Action
Encoder status = ‘192’	No error	Drive system is ready for use
Encoder status = ‘64’	a) Voltage @Ubat-Pin is below 2.8V b) Only encoder preset (step 2, d)), restart missing	a) Change battery and run the encoder preset/reset (step 2, d)-e)) b) Encoder reset (step 2, e))
Encoder status = ‘0’	No position values are sent by the encoder	Check whether • Battery is inserted • Cabeling is correct • Encoder power supply is switched on and run an encoder preset/reset (step 2, d)-e))

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