Application 5009: Commissioning Manual LV-servoTEC S2

Short Version	This commissioning manual describes work with the programmes: ■ S2 Commander ■ WINPAC The following are explained as well: ■ Quick start ■ LV-servoTEC S2 motor database ■ Settings for fieldbus (Profibus DP, CANopen) ■ Initial commissioning ■ Setting the drive parameters (euroLINE, ...) ■ Optimisation of the drive parameters ■ Adjustment of the drive to the mechanics

We are always grateful for suggestions for improvements and information about errors.

Table of Contents

1 Modification

Modifications of document and life cycle

Code of Document	Date	Generation and modification
APP5009_EN_1117809_servoTEC_S2_CommissioningManual_R1a.doc	2013-09-19	Translation of original German documentation: "APP5009_DE_1077750_servoTEC_S2_Inbetriebnahmehandbuch_D2e/R2e.doc "
APP5009_EN_1117809_servoTEC_S2_CommissioningManual_R1b.doc	2015-12-16	Data of euroLINE 120 and euroLINE 170 added and new layout of this application

2 Quick start

2.1 LV-servoTEC S2 via CANopen at the PA-CONTROL

	Task	Action	Comment
1	Prepare the amplifier for connection to the CAN-bus.	Use the S2 Commander to install the default parameter set on the amplifier.	Is done by IEF before delivery.
2	Connect amplifier to the CAN-bus of the PA-CONTROL.	Create connections	See "APP5010..." (Wiring)
3	Set CAN address at "DIN[0...3] as address offset	Set slider to "LV-servoTEC S2-IO-adapter" or wire firmly in X1-IO-plug	Input "DIN0-DIN3" serves as offset to the basic address (default parameter set)
	Set CAN address without offset via digital inputs	Set the address with the S2 Commander	
4	Include amplifier in the hardware configuration of the PA-CONTROL as axis 1 (1 to 16)	PA-CONTROL "new initialisation"	For "new initialisation", the PA-CONTROL transfers all participants at the CAN-bus to the hardware configuration
5	Install motor parameters on the amplifier	Use WINPAC to select the corresponding parameter file from the motor database. Use WINPAC to transfer all parameters to the PA-CONTROL.	Import with the right mouse button Menu: "Send parameters"
6	Optimising drive parameters	Use the S2 Commander to adjust the drive parameters to the geometry of the axis.	

2.2 LV-servoTEC S2 via Profibus-DP

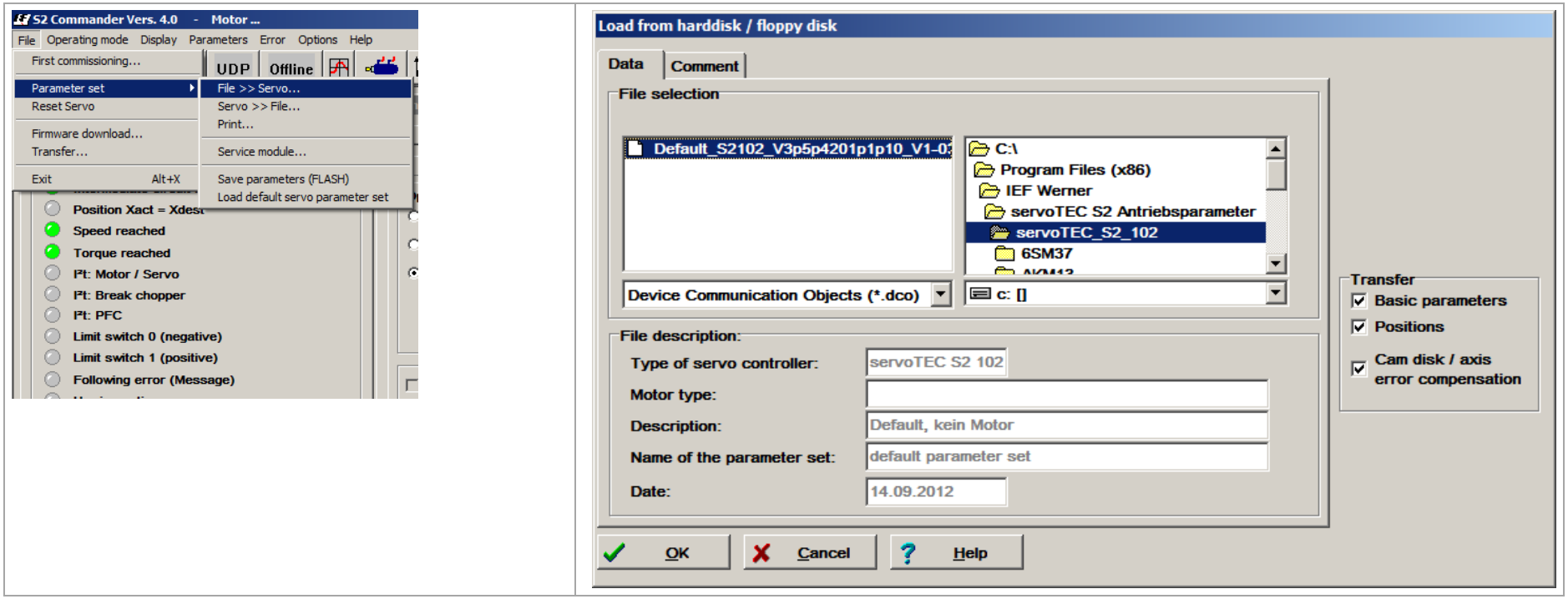
	Task	Action	Comment
1	Prepare the amplifier for connection to the Profibus-DP	Use the S2 Commander to install the default parameter set on the amplifier	Is done by IEF-Werner before delivery
2	Install motor parameters on the amplifier	Use the S2 Commander to select the corresponding parameter file from the motor database and send the parameters to the amplifier	
3	Set Profibus-DP address	Set slider to "LV-servoTEC S2 -IO-adapter" or wire firmly in X1-IO-plug	Input "DIN0-DIN3" serves as offset to the basic address (default parameter set)
	Set CAN address without offset via digital inputs	Set the address with the S2 Commander	
4	Connect amplifier to the Profibus	Create connections	See "APP5010..." (Wiring)
5	Set physical units for the Profibus-DP	Set the settings for ■ Display units ■ Infeed constant ... with the S2 Commander.	See: "MAN_DE_1083730_servoTECS2_ ProfibusDP_SiemensS7.pdf
6	Optimising drive parameters	Use the S2 Commander to adjust the drive parameters to the geometry of the axis.	

3 Loading parameter file from the motor database into the LV-servoTEC S2

3.1 Load with S2 Commander

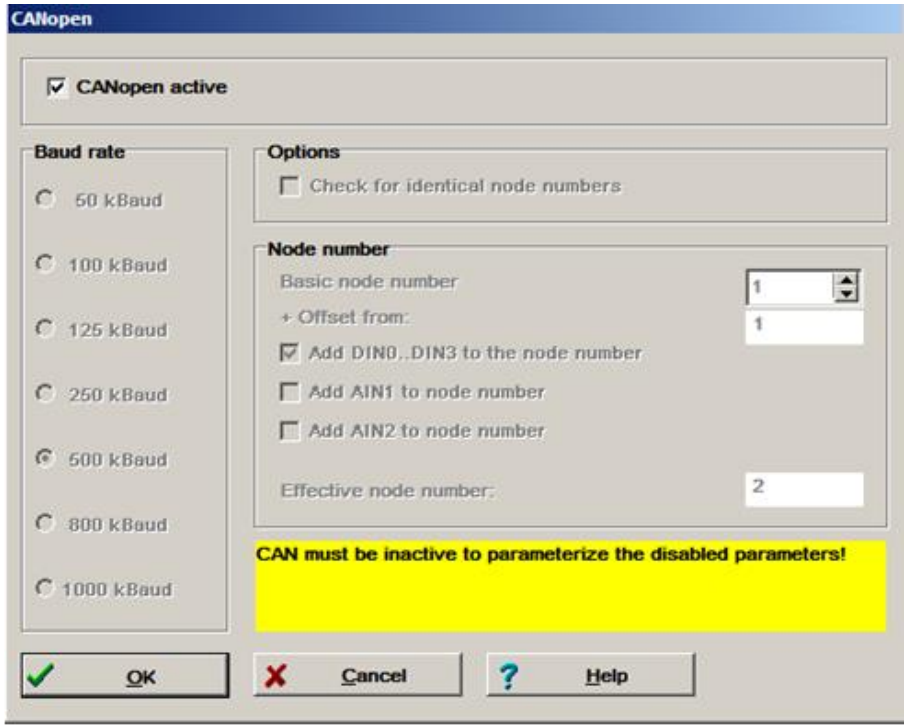
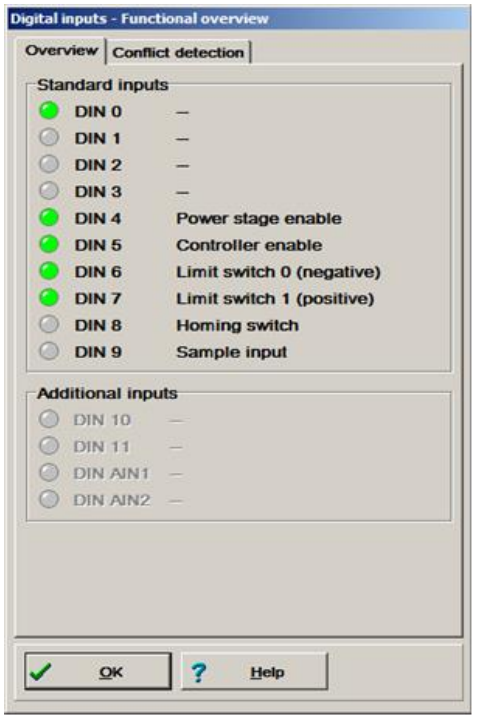
3.1.1 Default settings for connection to PA-CONTROL

There is a parameter file (*.DCO) in the motor data base with default settings for each controller type. This file can be transferred to the controller with the S2 Commander (File > Parameter record > File >> Servo...) (only necessary when initial commissioning is to take place).



Default settings: CAN Baud rate, CAN basic address, I/Os

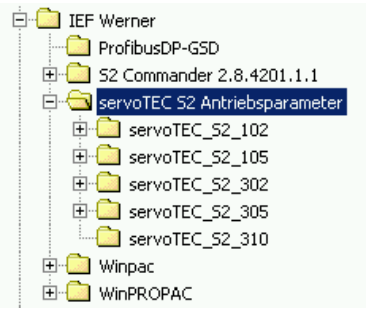
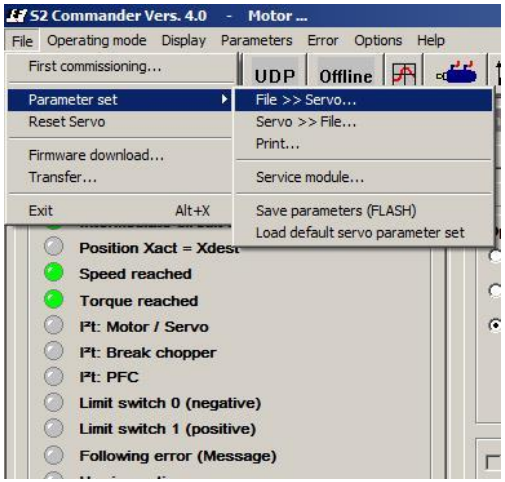
Note	The default settings are made during the production course of IEF-Werner GmbH.

Default setting: CAN	Default settings: Digital Inputs
	

- 500kBaud
- Basic node number = 1
- Addition of DIN0 to DIN3 to the node number

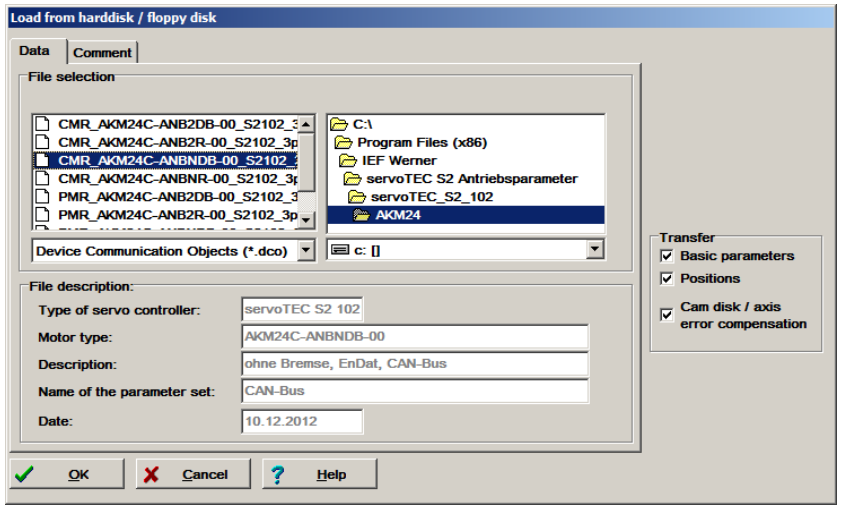
3.1.2 Select motor parameter file and load into the LV-servoTEC S2

The parameters are stored for many motor types in the motor database. If there is no parameter file for a motor, trained specialists must perform "initial commissioning" and the data record in the motor database must be supplemented.

When installing "WinPAC" or the "S2 Commander", the motor database of the drive parameters of the LV-servoTEC S2 controllers is installed in the directory "...\Programme\IEF Werner". The programme package "servoTEC S2 Motordatenbank" (Installshield,) permits installing a newer version of the motor data as an update. The current motor database can be downloaded via the internet.	
The S2 Commander is used to select the desired parameter file and transfer the controller.	

- The motor files for the PA-CONTROL (CANopen) start with "C.....V0-00.DCO"
- The motor files for Profibus-DP start with "P.....V0-00.DCO"

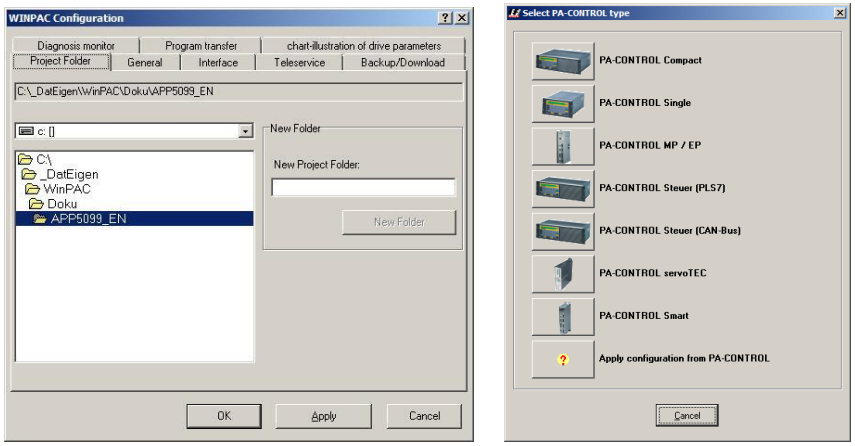
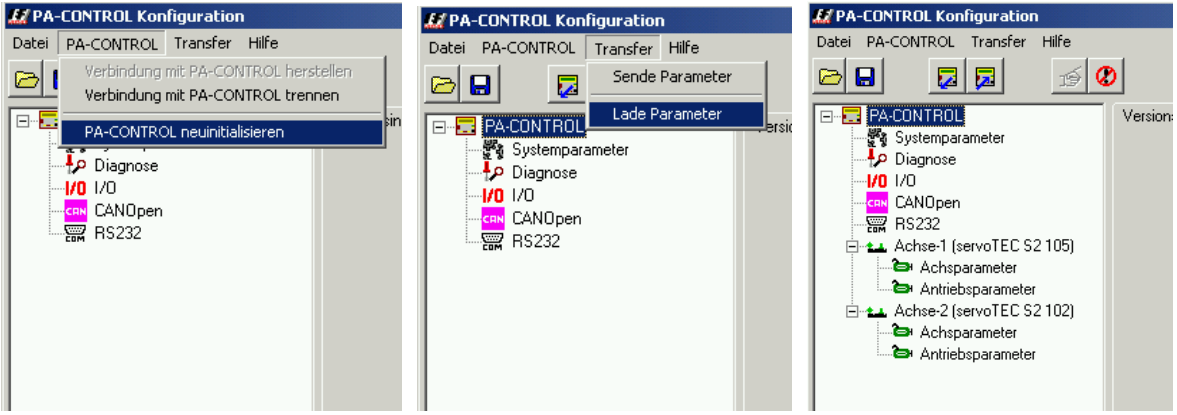
(Setup of the file name, see: "servoTEC_S2_Motordatenbank_V3-01.pdf“)



Note	For motors with “EnDat” as a return, the data for the commuting encoder may have to be determined and saved in the motor. See section 4 EnDat-Motors, page 15.

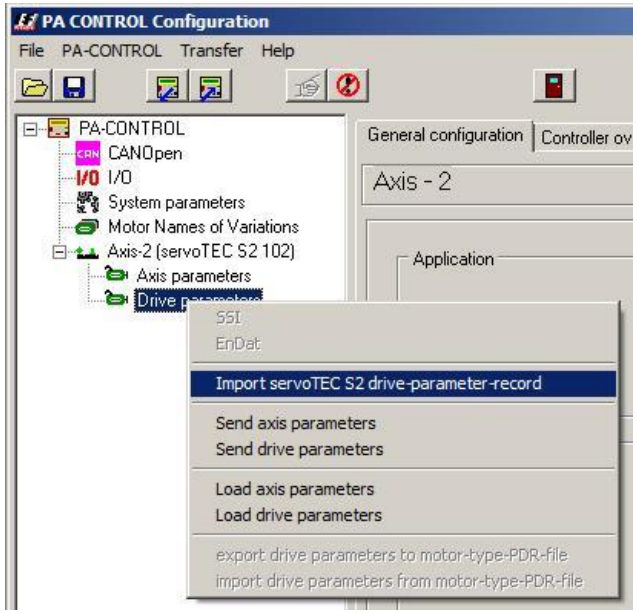
3.2 Loading with WINPAC

3.2.1 Load PA-CONTROL configuration

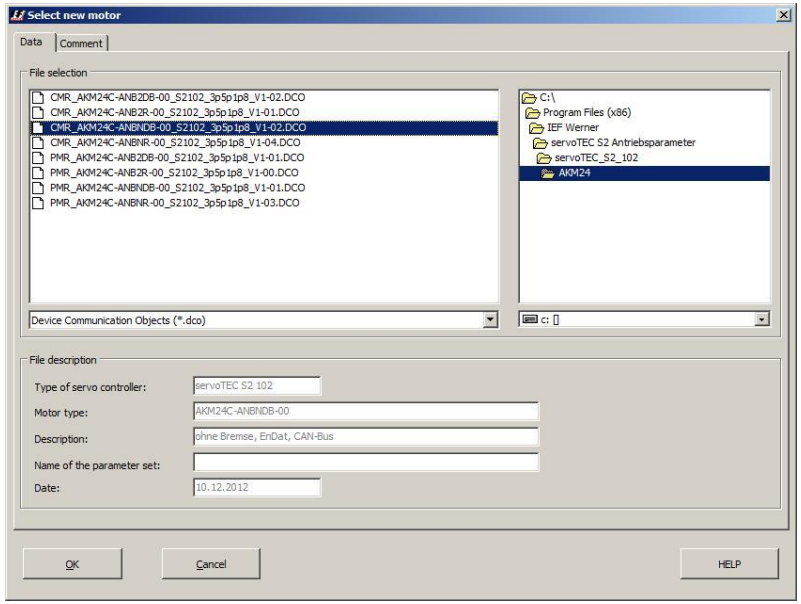
Set up new project directory and load "PA-CONTROL configuration".	
Neutralise PA-CONTROL and load the new "PA-CONTROL configuration".	

3.2.2 Select motor from database and load parameter file

Activate menu with the right mouse button...



... select parameter file and start the import with OK....

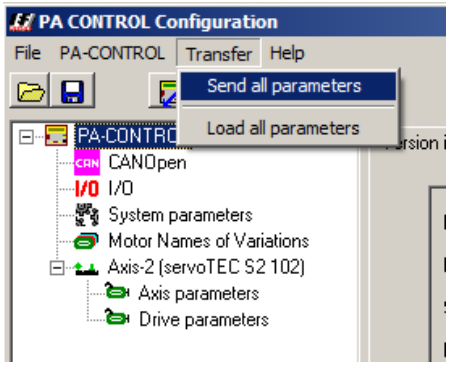


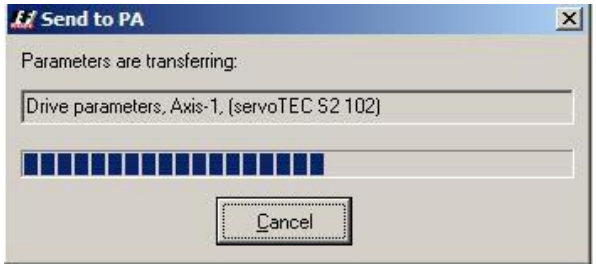
...and wait for confirmation.

This process must be repeated accordingly for every further axis.

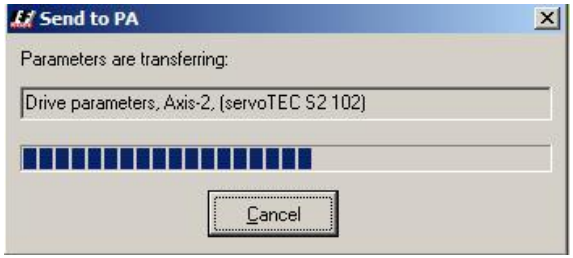
3.2.3 Send motor parameters to servo amplifier

Starting parameter transmission...





...Action Axis 1...



...Action Axis 2.

Then the parameters for the selected motors to the PA-CONTROL and the servo controller have been transferred and saved in the servo amplifier.

Note	For motors with "EnDat" as a return, the data for the commuting encoder may have to be determined and saved in the motor. See section 4 EnDat-Motors, page 15.

4 EnDat-Motors

The data structures in the EnDat memory (memory component in the motor) are not standardised. Every controller manufacturer has its own specific data structure with its own ID in the EnDat memory.

After switching on or RESET, the controller reads the data stored from the motor if the ID and the data structure is OK.

Stored data in the motor:

- Commuting encoder data (offset of the angle encoder, phase sequence, ...)
- Zero point offset (offset from the reference run) to calculate the absolute position of the drive

The commuting encoder data are motor specific and must be determined by first-time connecting the motor with a servoTEC S2 and then written into the motor at initial connection of the motor.

The zero point offsets are plant-specific data and result after referencing (unique after installation) of the axis. These data must be written into the motor after the reference run.

A PA-CONTROL with LV-servoTEC S2, the zero point offset is written into the motor by the PA-CONTROL after the reference run.

With a connection via Profibus-DP to an S7 and use of the IEF driver, the zero offset is written into the motor at the command “ServotecS2Cmd.ABS_NeuLernen” and “StandardCmd.RefStart”.

For the other interfaces, this action must take place manually with the S2 Commander.

4.1 Determining and saving commuting encoder data

Select ①:

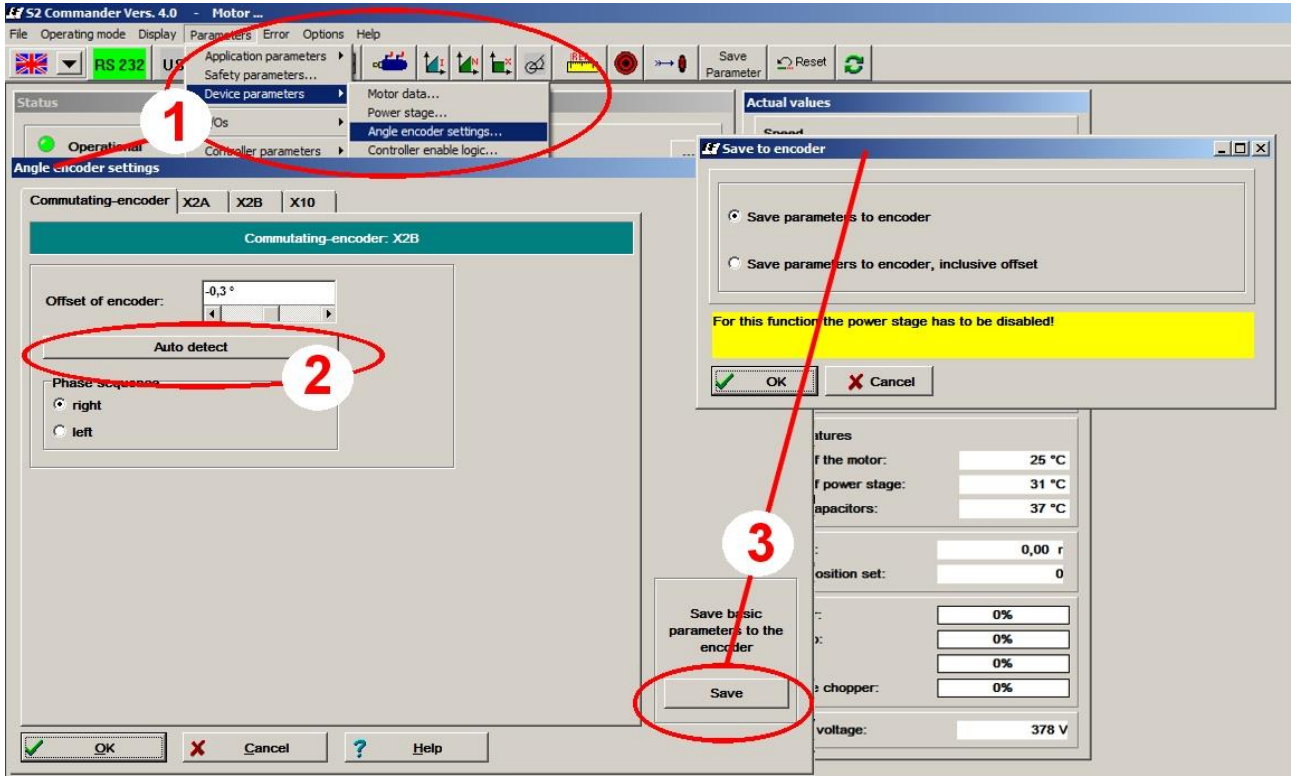
Parameters > Device parameters > Angle encoder settings

Determine automatically ②:

The motor must turn freely. The commuting encoder data are determined in this.

Secure basic parameters in encoder ③:

The commuting encoder data are written into the motor.



4.2 Save zero offset

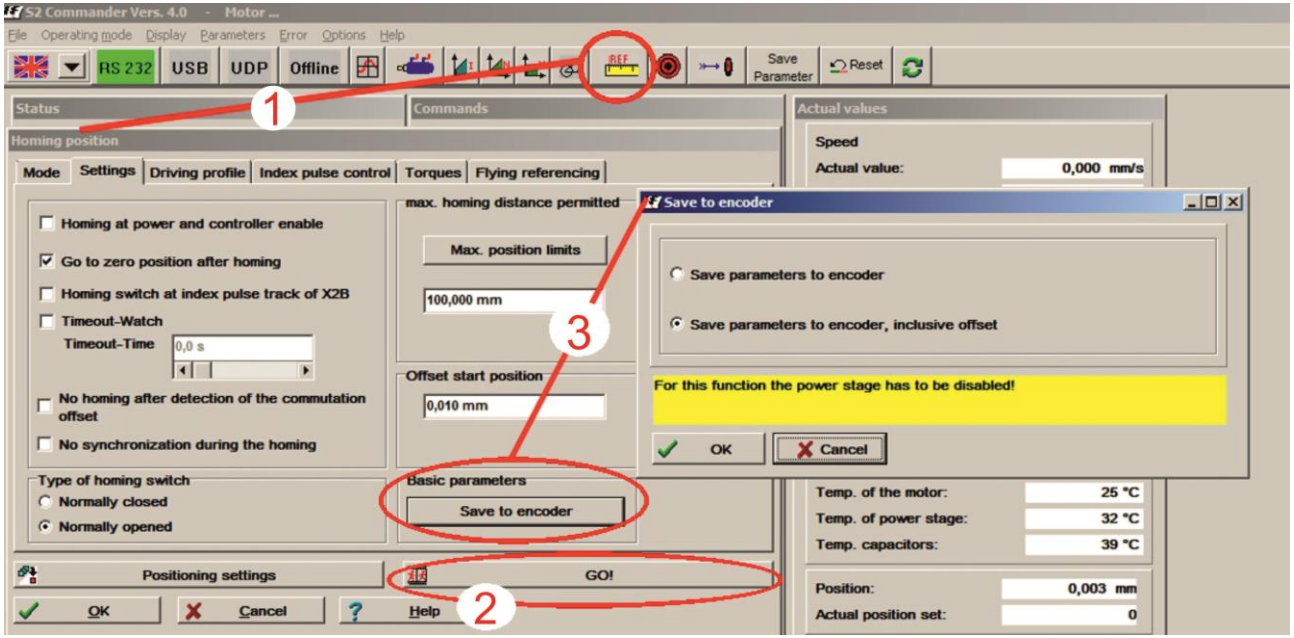
Select REF (reference position) button ①.

Perform reference run ②:

Perform reference run of the axis with the button "GO".

Save zero offset ③:

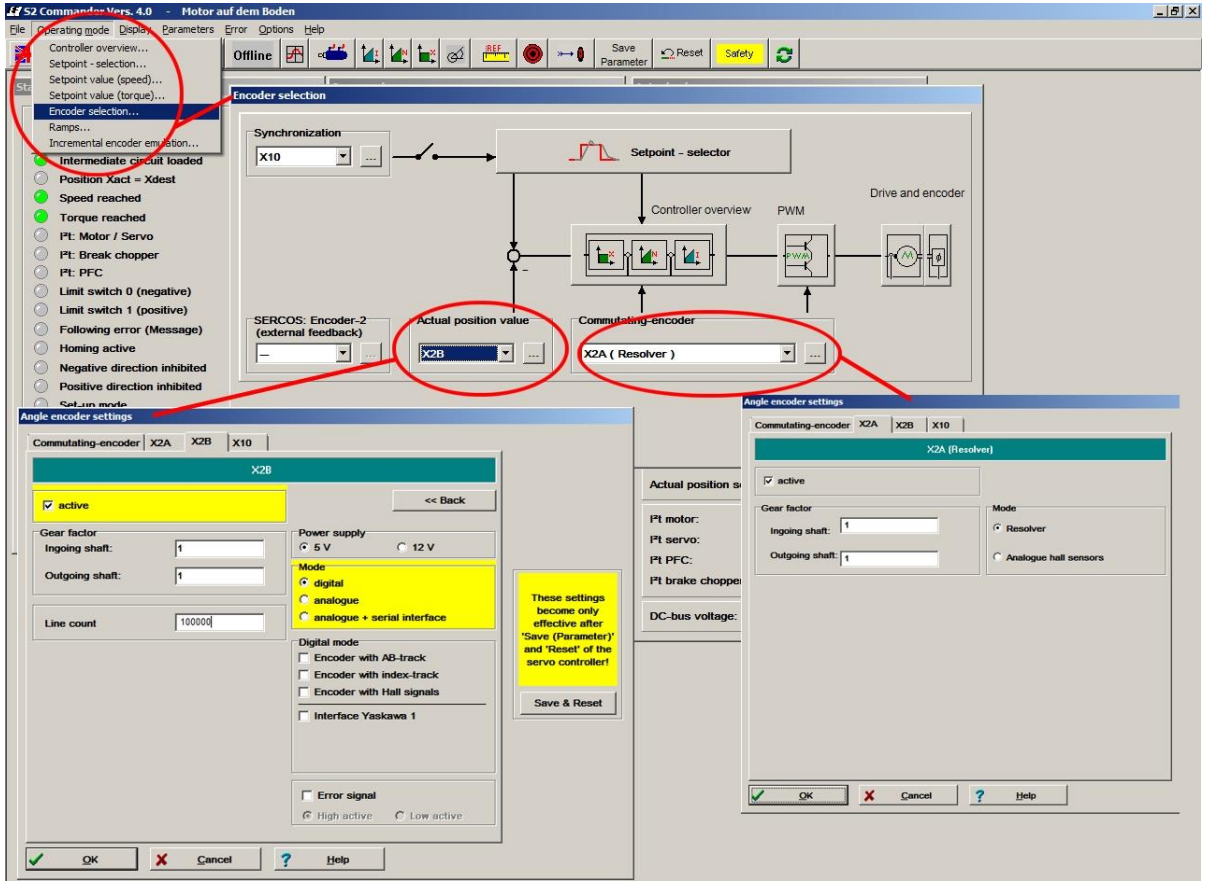
Use the button "Save in the encoder" to write the data into the motor.



5 Applications with several angle encoders (external glass scale)

Use of a separate angle encoder for the layer dissolution is sensible, e.g. in the following case:

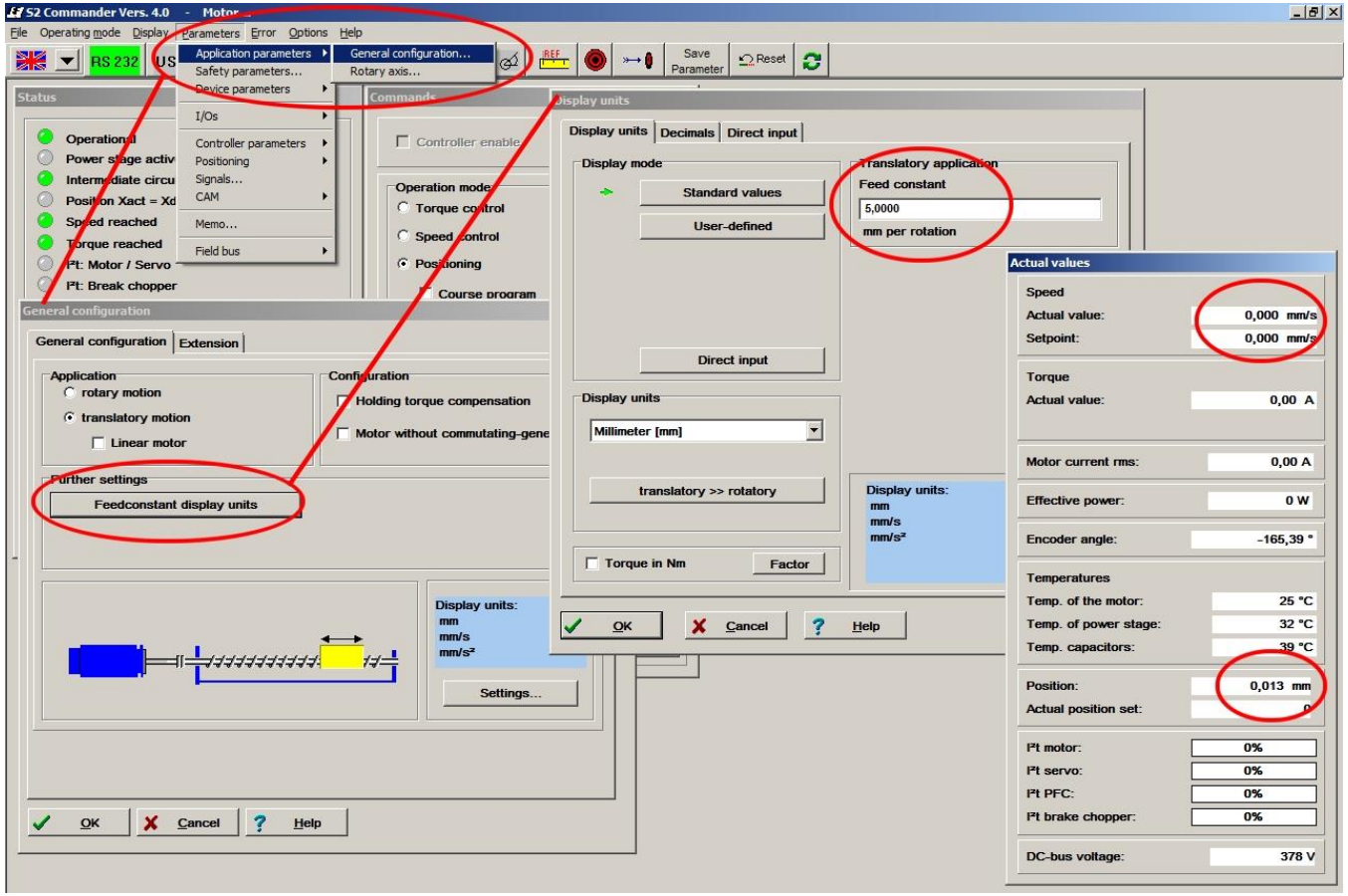
The motor is connected to a positioning mechanism subject to high accuracy requirements via a gearbox with tolerance. This positioning mechanism has an angle encoder with high resolution. In this case, it is sensible to use this information to determine the current position while the speed and commuting position continue to be provided by the motor encoder.



6 Adjusting drive to the mechanics

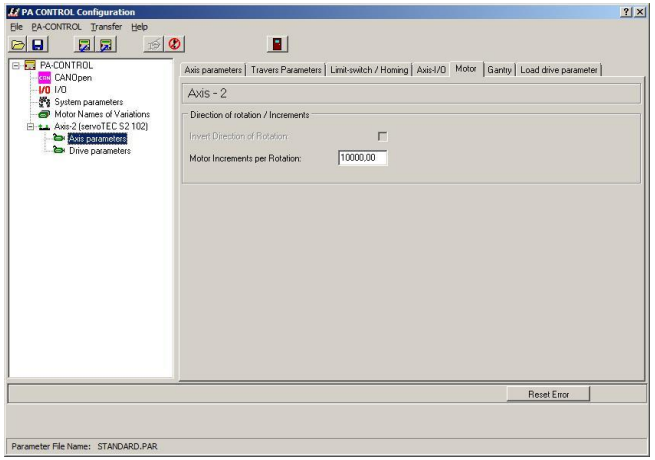
6.1 Basic configuration, resolution and axis parameters for motors (6SM...,DBL2...,SEW...)

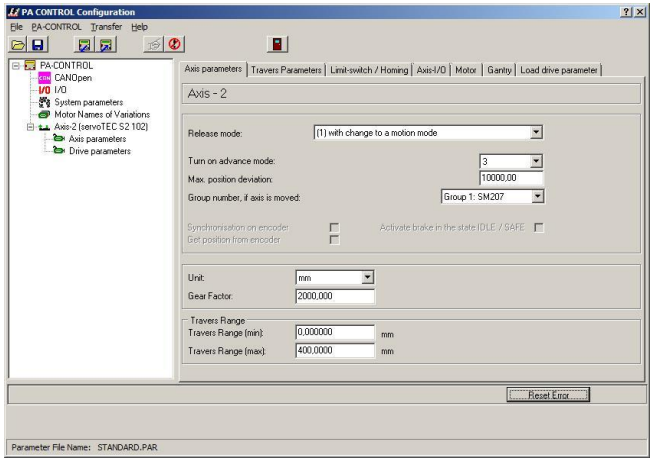
6.1.1 Basic configuration with the S2 Commander



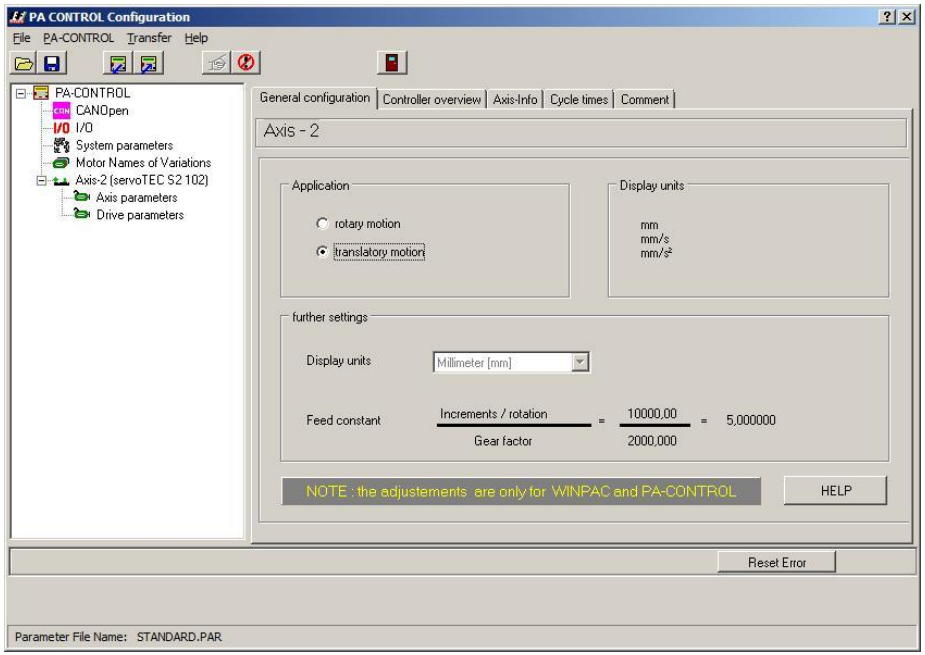
6.1.2 Basic configuration with WINPAC together with PA-CONTROL

For a LV-servoTEC S2 axis, the default setting for increments per turn is 10 000.



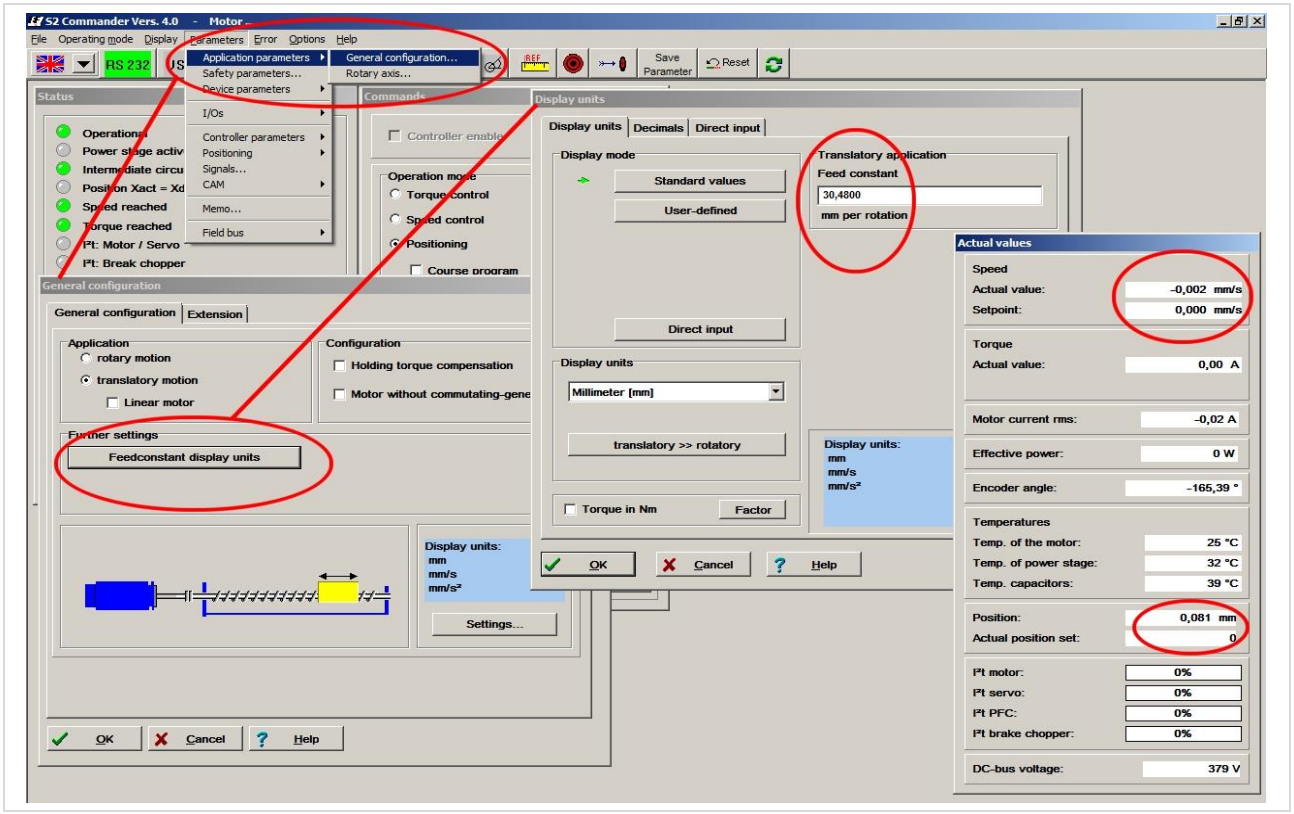


The gear factor must be set accordingly then.



6.2 Basic configuration, resolution and axis parameters for euroLINE

6.2.1 Basic configuration with the S2 Commander



Axis type	euroLINE KL32	euroLINE KL85	euroLINE 120	euroLINE 170
Infeed constant	30,480 mm	60,960 mm	24,00 mm	24,00 mm

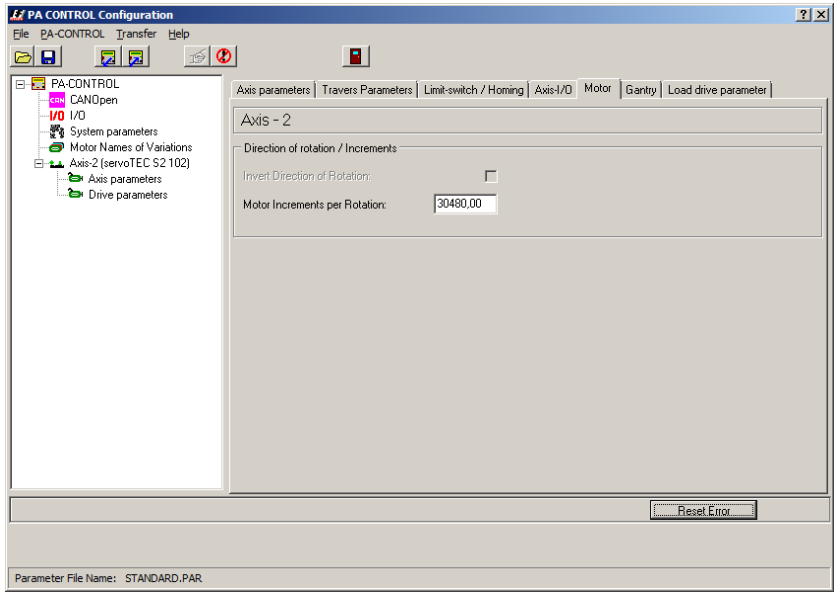
6.2.2 Basic configuration with WINPAC together with the PA-CONTROL

For a LV-servoTEC S2 axis, the default setting for increments per turn is 10 000.

To achieve the highest resolution (accuracy) of an euroLINE, the setting for increments per motor turn should be adjusted to the return system used.

In case of a visual encoder with 4µm resolution and 4-fold assessment it can be received a 1µm resolution of the return system.

Example: euroLINE 32KL

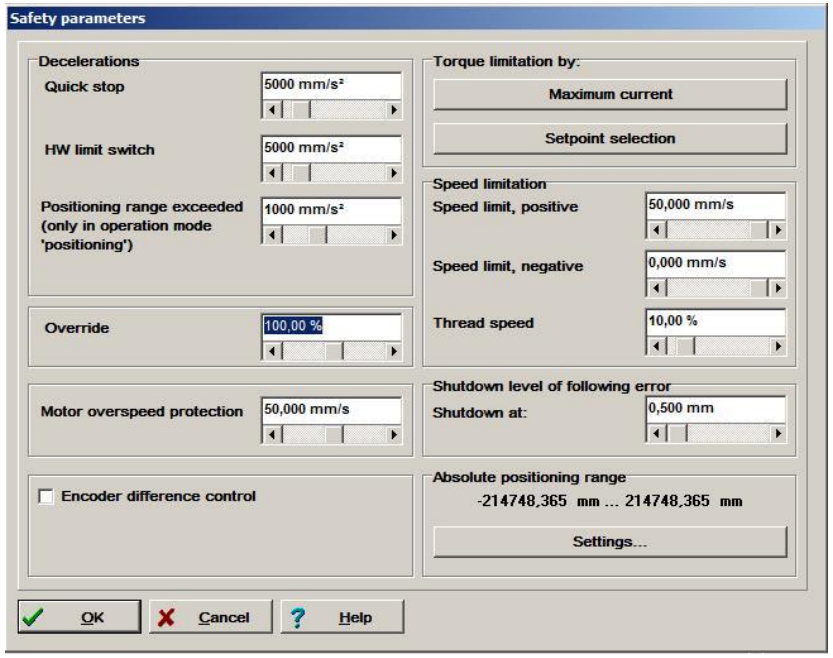


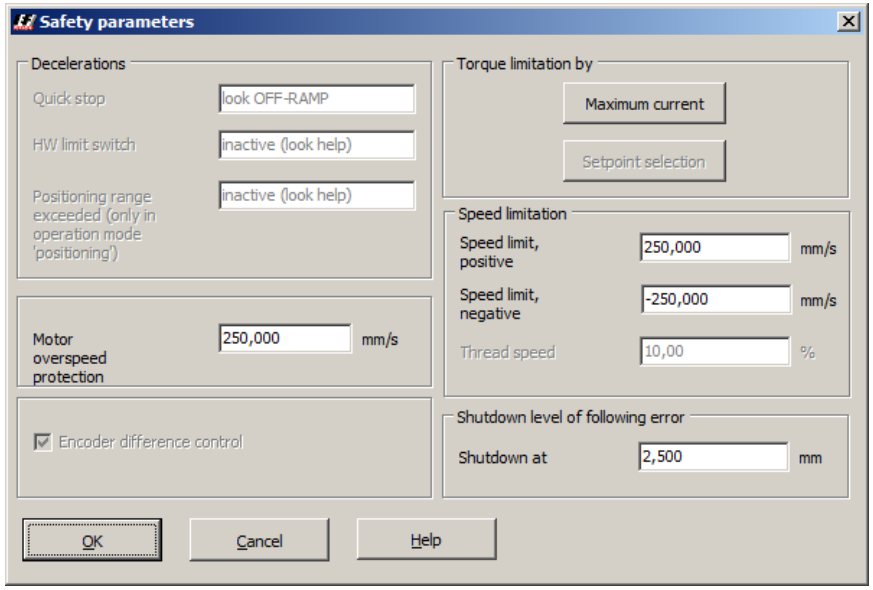
The following results for calculation of the gear factor:

Motor/Axis-Type	Resolution Return System	Infeed / pole distance	Increments per turn	Formula	Gear ratio
euroLINE KL32	1µm	30,48mm	30480	30480 / 30,48	1000
euroLINE KL85	1µm	60,96	60960	60960 / 60,96	1000
euroLINE 120	0,001µm	24,00 mm	24000000	24000000 / 24,0	1000000
euroLINE 170	0,001µm	24,00 mm	24000000	24000000 / 24,0	1000000

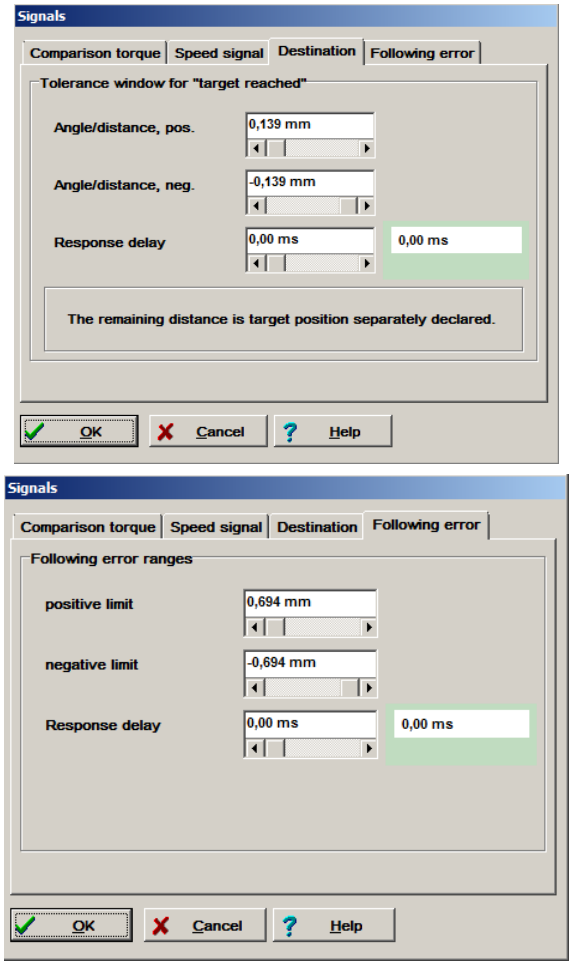
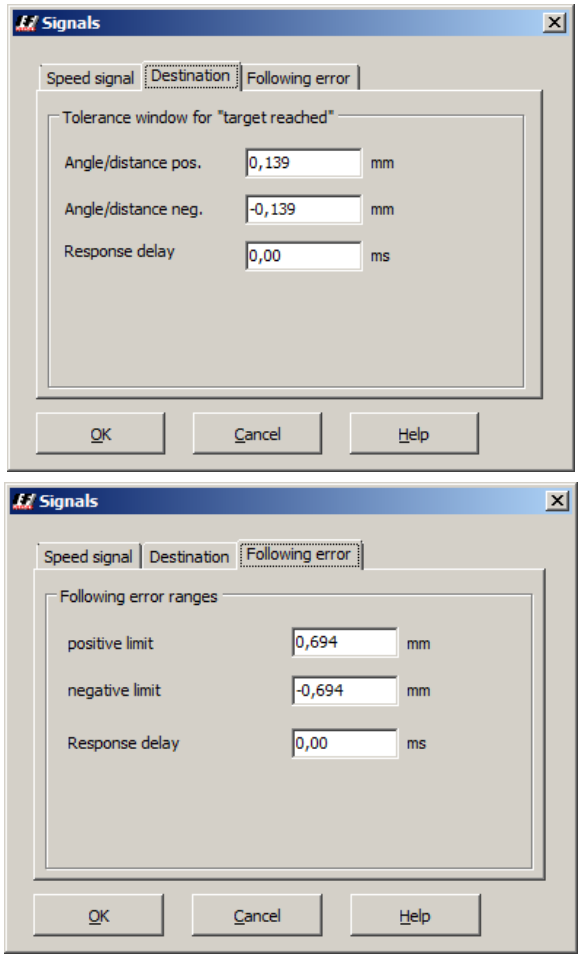
6.3 Safety parameters

With S2 Commander	With WINPAC





6.4 Reporting Parameters

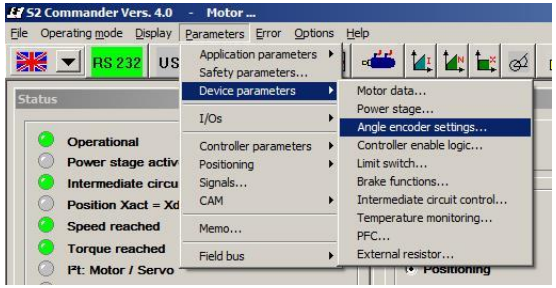
With S2 Commander	With WINPAC
	

6.5 Direction of rotation / movement

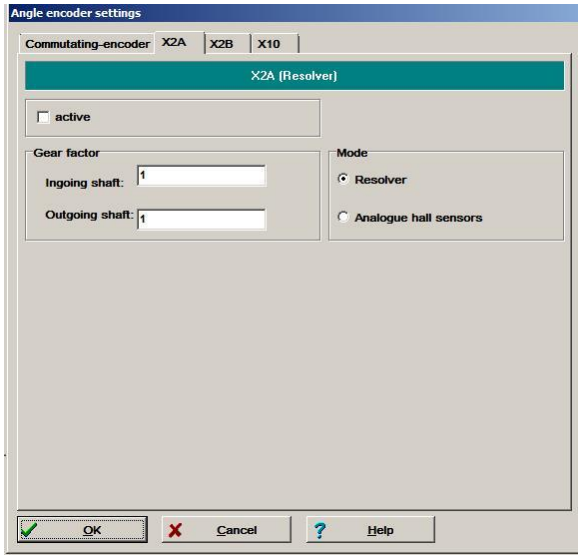
The change to the rotating or movement direction is implemented by "Inverting the return system" (Resolver, Encoder, ...).
The action is performed with the "S2 Commander" directly in the LV-servoTEC S2 or with WINPAC.

6.5.1 Rotating direction / movement direction with S2 Commander

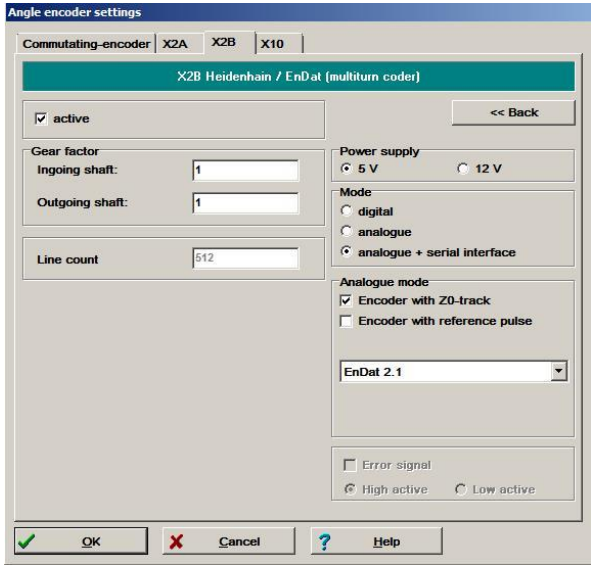
Reversal of direction takes place by changing the prefix of the value "Gear factor - drive" (e.g.: "1" becomes "-1").



For Resolver

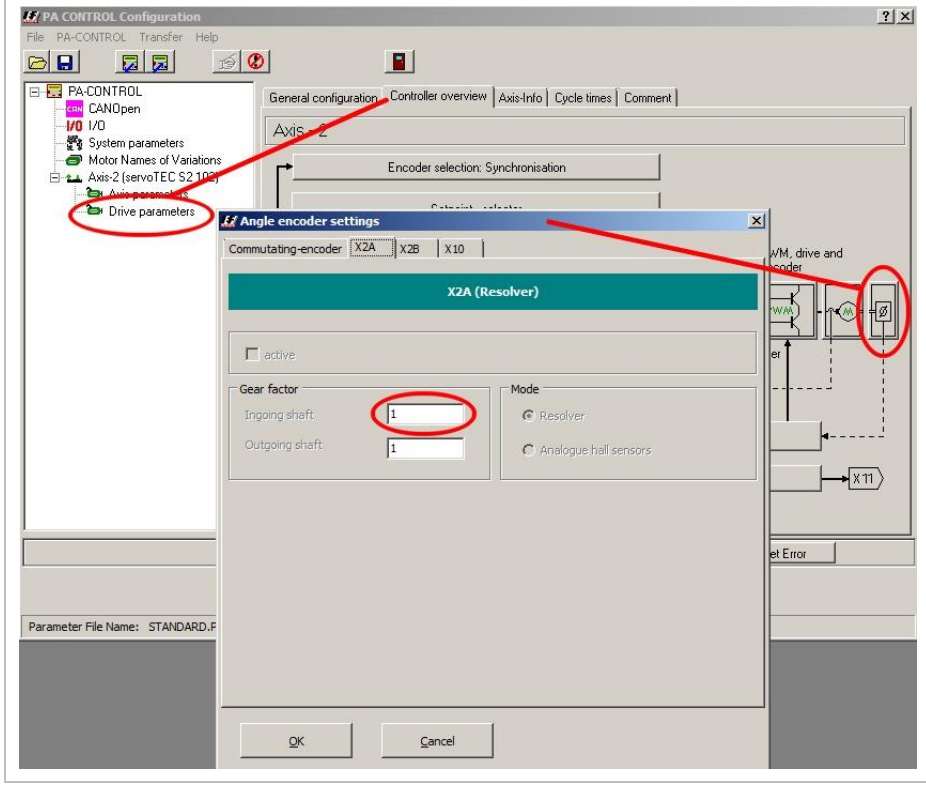
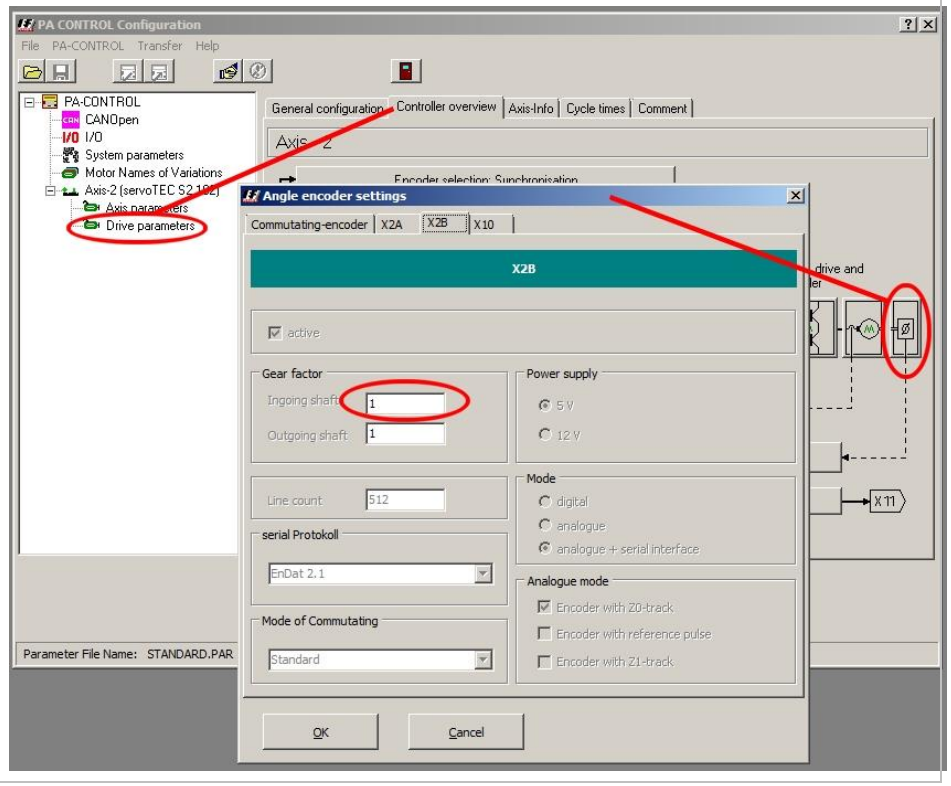


For Encoder

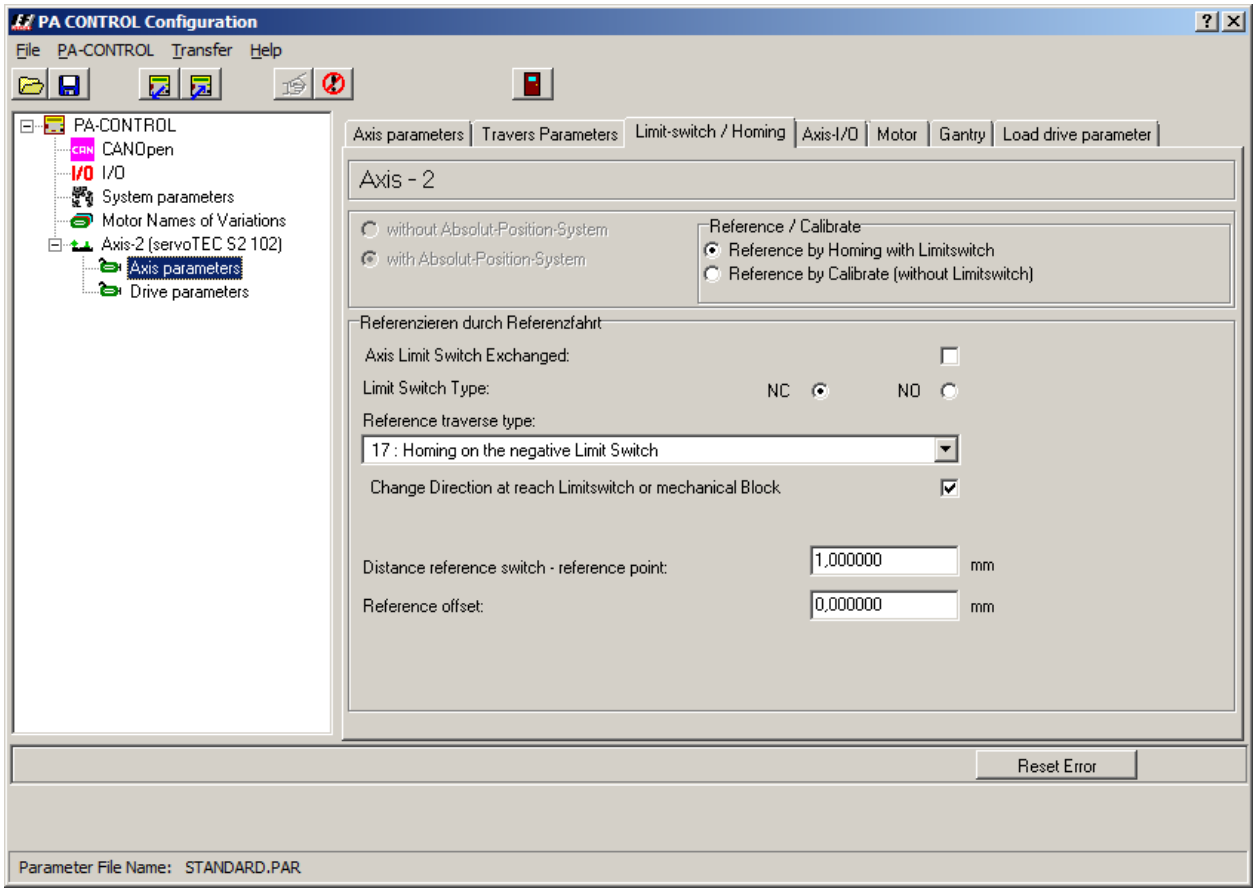


6.5.2 Rotating direction / movement with WINPAC

Reversal of direction takes place by changing the prefix of the value "Gear factor - drive" (e.g.: "1" becomes "-1")

For Resolver	For Encoder
	

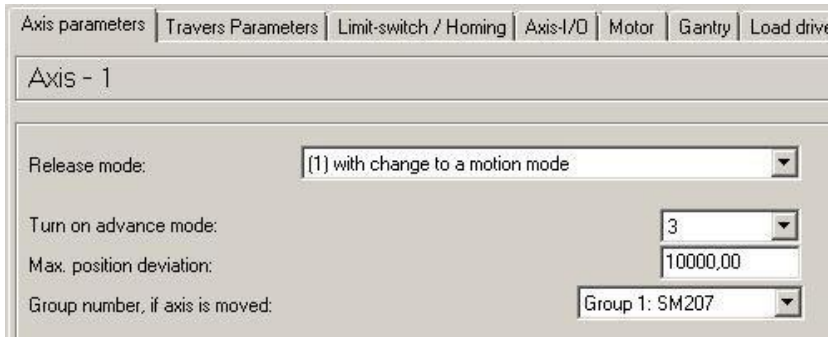
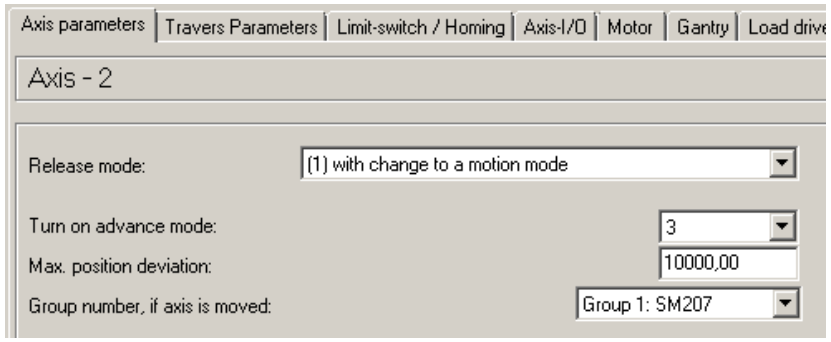
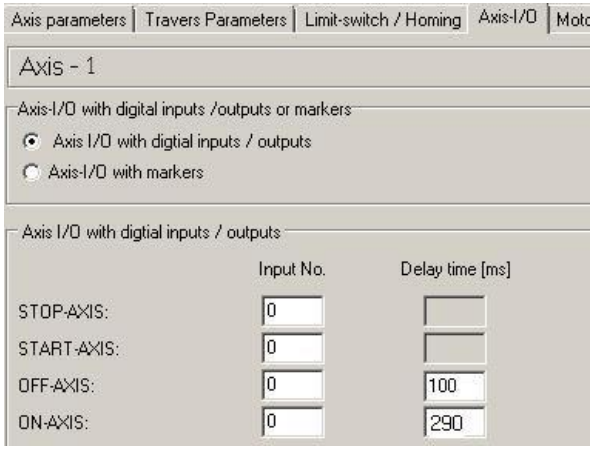
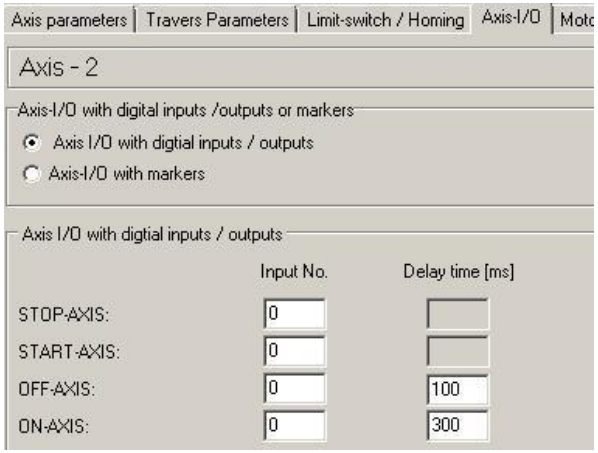
6.5.3 Reference run



6.6 Starting axes with a time offset

Depending on hardware constellation, it may happen that the axes interfering with each other during starting.

The PA-CONTROL receives the error message "E345 – A1 : FFFDhex - drivers (X3.2) or interim circuit voltage is missing“ for example. A remedy for this behaviour can be to activate the axes with a time offset. For this, there is the parameter "ON-AXIS : Delay time [ms]" in the axis parameters.

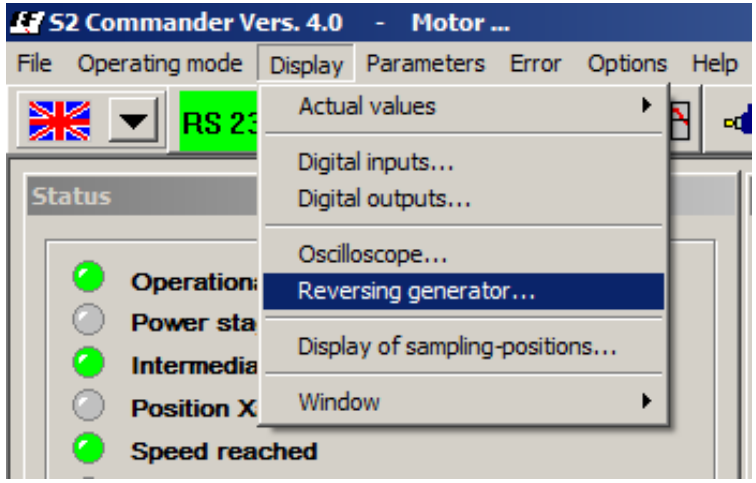
Axis parameter Axis 1	Axis parameter Axis 2
	
	
Axis 1: 290 ms	Axis 2: 300 ms

7 Optimise motor parameters with the S2 Commander

The motor parameters should be optimised with the S2 Commander. All parameters are accessible in the S2 Commander.
There is an oscilloscope in the S2 Commander for observation the effects of changes.

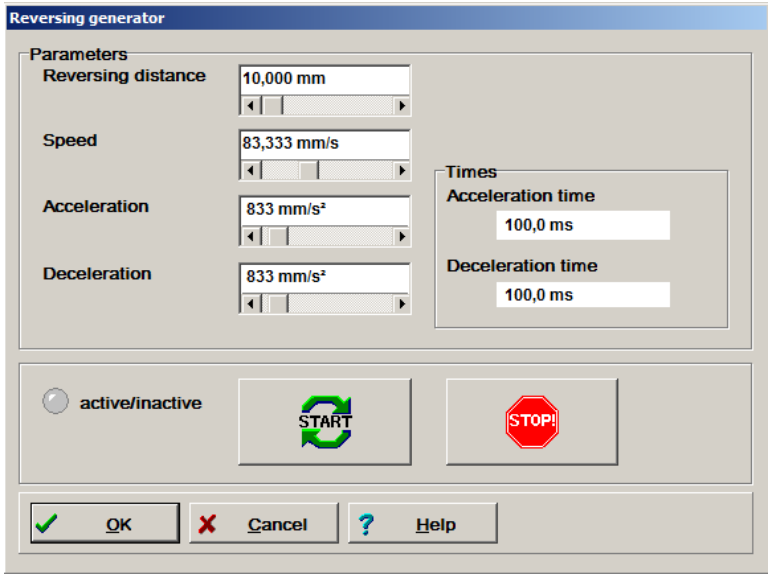
7.1 The reversing generator

The reversing generator window can be opened in the menu "Display – reversing generator"



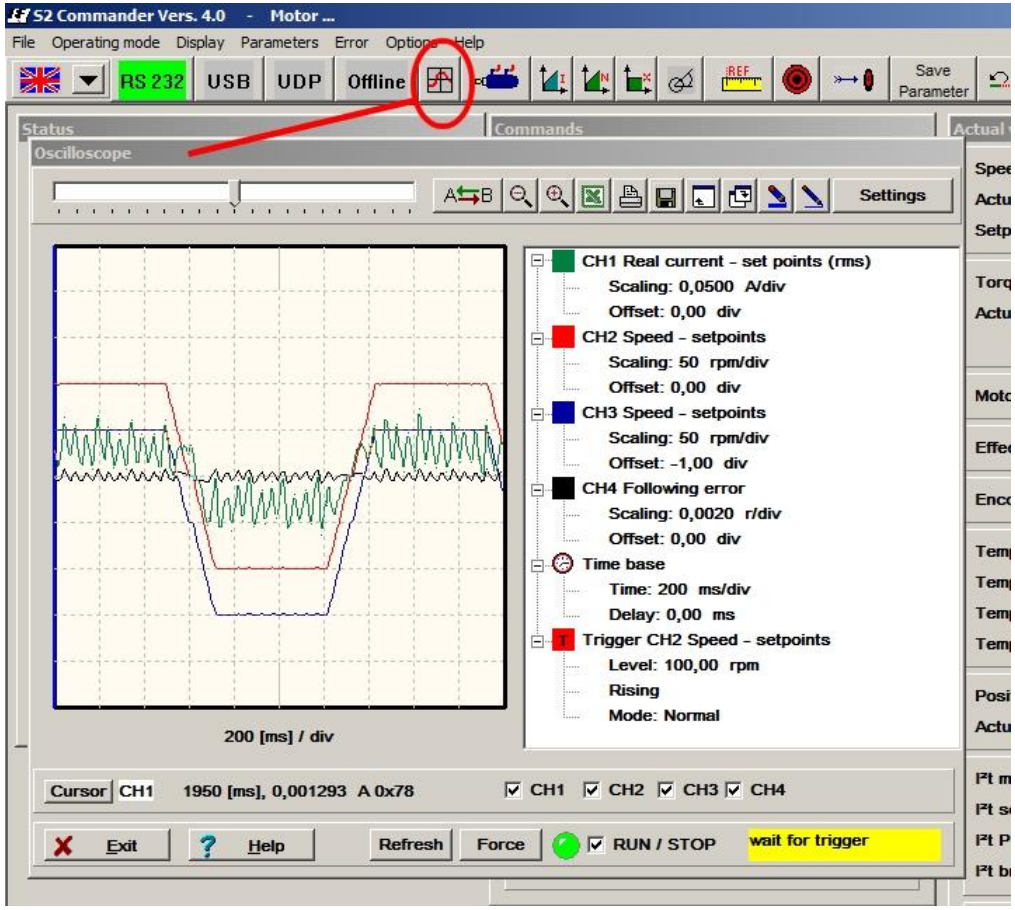
Depending on axis type, the settings are displayed in "U" (turns) or "mm" (linear axis).

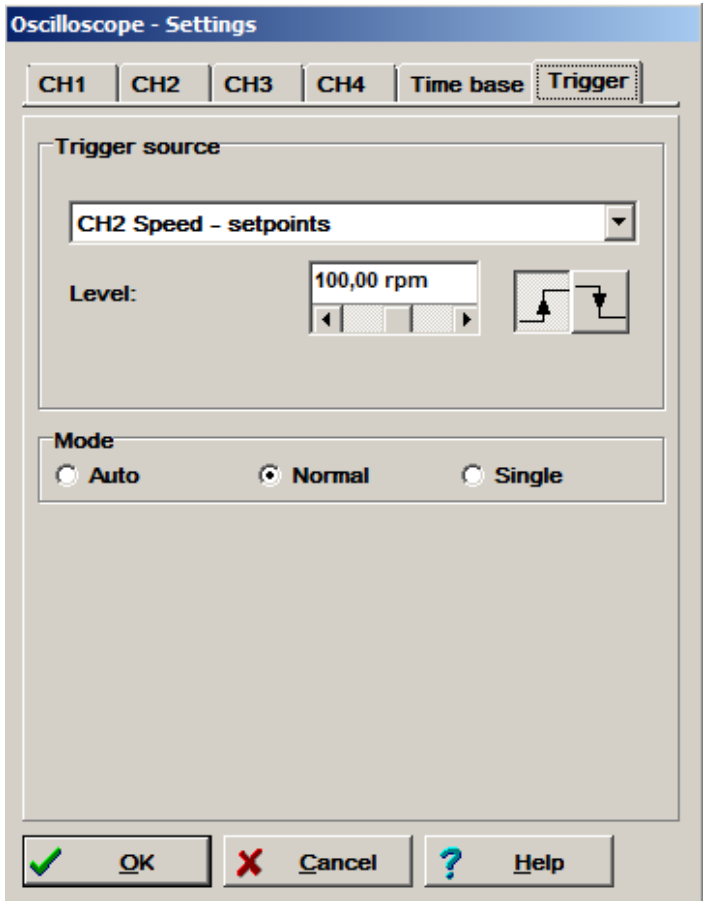
This window is very well suitable for optimising the settings for the rotating speed and position controllers.



7.2 The oscilloscope function

There is an oscilloscope in the S2 Commander for observation the effects of changes.





7.3 Optimising the speed controller

7.3.1 Optimising speed controller: Amplification and time constant

The time constant and amplification of the speed controller take place by specification of a target value jump. On the oscilloscope, you can observe the reaction of the speed controller to target value jumps and then set the controller parameters.

The speed controller has to be set so that only one runout of the rotating speed actual value occurs. The runout should be about 15% above the target speed. The dropping flank of the runout should, however, not undercut the speed target or do so only a little to then reach the rotating speed target. This setting applies to most motors that can be operated with the servo position controller. If an even stricter controller conduct is required, the amplification of the speed controller can be increased further. The amplification limit is specified by the drive tending to vibrate at high rotating speeds.

The amplification that can be achieved in the speed controller range depends on the load situation at the motor shaft. Therefore you need to inspect the speed controller settings again with the drive installed.

7.3.2 Strategies for optimisation (speed controller)

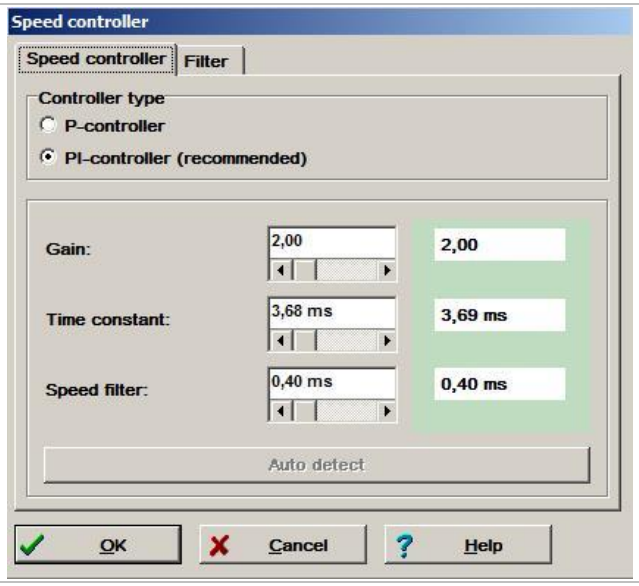
Note	Generally, amplification factor and time constant figures must not be changed in large intervals but only in small sequences.

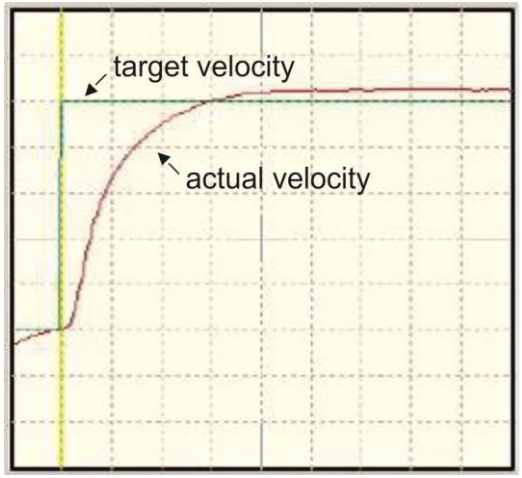
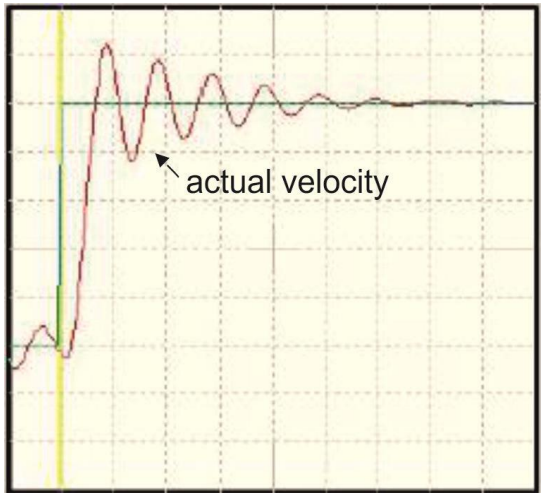
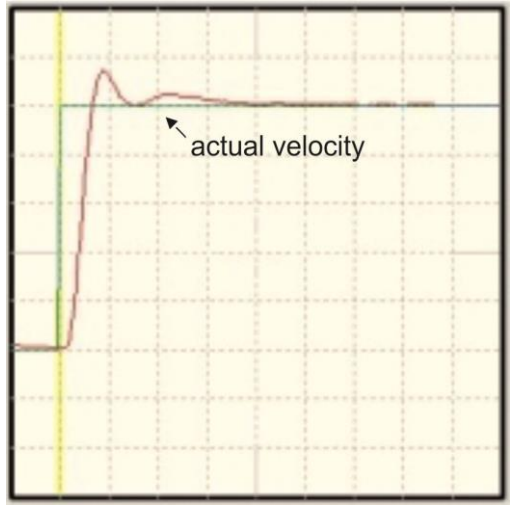
After the figures have been changed, two cases can be:

- If the setting is too hard, the speed controller becomes unstable.
- If the setting is too soft, the drive does not move stiffly enough; drag error in later operation is the consequence.

Note	The speed controller parameters are not independent of each other. A measuring curve that looks differently from try to try can therefore have several causes. Therefore, change only one parameter at a time, either only the amplification factor or only the time constant.

- To reconcile the speed controller, increase amplification until vibration occurs. Then reduce amplification in small steps until the vibration conduct disappears.
- Then reduce the time constant until the vibration conduct occurs, then increase the time constant in small steps until the controller is stable and stiff enough at the target value = 0.



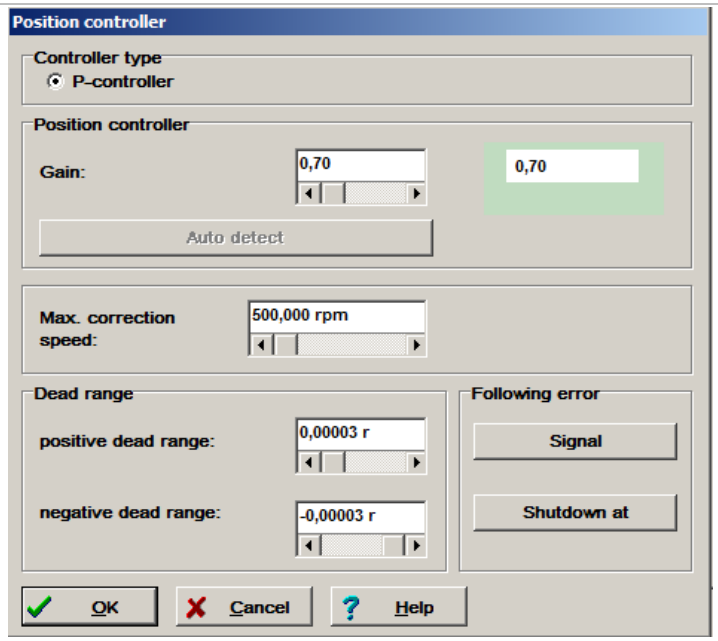
Case 1: Speed controller too soft:	Case 2: Speed controller too hard:	Case 3: Speed controller correctly set:
		
Remedy: Increase the amplification factor by 2 to 3 tenths, reduce the time constant by 2 to 3 ms.	Remedy: Reduce amplification by 2 to 3 tenths. Increase the speed constant by 2 to 3 ms.	

Note	Usually only the amplification in the speed controller is increased (changed). The time constant and the speed actual value filter are changed rarely or only a little.

7.3.3 Optimising the position controller

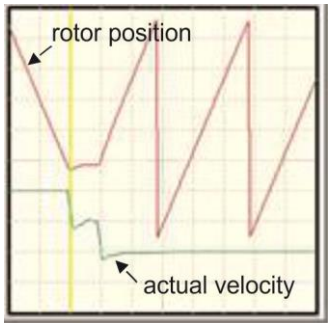
Note	This section can be skipped if you drive only works in speed an torque operation
Note	A requirement for reconciliation of the position controller are correctly set current and speed controllers (see above chapters)
Note	The position controller optimisation uses the reversing operation. Please ensure that the motor shaft can turn freely or that the movements of the drive cannot cause any damage. When optimising initial commissioning, it would be good if the motor shaft could be turned freely.

- The position controller (menu item: Parameters > Control parameters > Position controller) forms a resulting speed from the difference between target and actual position that is forwarded to the speed controller as a target value.
- The functions of the position controller are explained. This section explains how amplification is optimised.



The following steps are required for optimisation

First activate the position controller (menu item Parameters > Control parameters > Position controller) and set the amplification to value 0.5 first.

Optimisation: Assess speed and rotor position when stopping. If the settling process for the position takes too long, amplification has to be increased. If the rotating speed starts oscillating during stopping, amplification must be reduced. Observe that the runouts are caused by the defective acceleration and brake times.	

Note	For best design and adjustment of the control to the moving mass, the highest possible force/mass ratio is required. This ratio is not beneficial in the direct drives and leads to the control quickly becoming instable.

Examples for direct drives are:

- Torque motor without gear at a heavy turntable with large diameter
- Motor shaft connected directly to a load with a high mass E.g. a sprocket at the motor shaft that interlocks with the rack to move a large sledge.

The following procedure is recommended when adjusting the control in this kind of case:

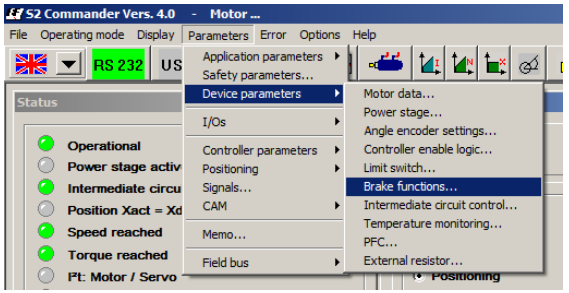
- Use of an encoder with a high resolution
- Increase of the amplification in the speed to the oscillation limit
- Lowering the amplification and correction speed in the position controller
- Reduction of the acceleration of the positioning set
- Activating and adjusting the torque pre-control of the positioning set

7.4 Settings for the brake

Once the controller is released, the contacts in the motor plug X6 "BR+ u. BR" become active and the brake is opened.

For vertical axes, the maintenance torque compensation in the application parameters/basic confirmation can be selected.

This prevents dropping of the axis at high loads.



- Delay of running start (delay time until brake is released):

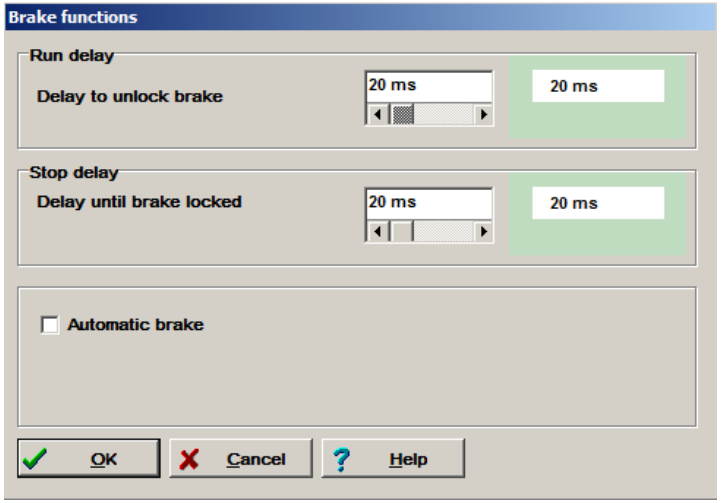
  This parameter serves to adjust the control of the retention brake to its mechanical inertia. The controller release is set to zero in the operating mode rotating speed control and position control/positioning during this delay time of the target rotating speed. This keeps the drive at a standstill until the brake is completely released again. Increased mechanical wear of the maintenance brake is avoided.

- Deactivation delay (delay until the brake is fixed):

  When taking away the controller release, the target rotating speed is set to zero. Once the actual speed is about zero, the maintenance brake drops in. From this time onward, the set delay time takes effect as well. During this time, the drive is kept in the current position until the maintenance brake develops its full torque. Only now will the controller release be deactivated internally. This prevents dropping due to premature deactivation of the control. Additional wear from dropping into the falling brake is avoided.

- Automatic brake:

  This function is only effective in the operating mode positioning. After completion of positioning, the time to the next positioning process is monitored with the automatic brake active. If no new request is present, the brake is activated after the end of the parameterised waiting time and the torque target is set to zero. The controller release and therefore the end stage remains active. This function reduces the thermal load of the motor. This can be of benefit specifically with smaller motors and/or in vertical applications.



8 Perform initial commissioning with S2 Commander

Initial commissioning is an aid to permit users who are not experts to commission the motor/drive. Several menus are gone through in a dialogue-oriented manner. Partially, they use automatic identification mechanisms of the firmware.

A description of the individual steps of initial commissioning can be taken from the documentation MAN_EN_1136180_LV-servoTEC_S2_SoftwareManual.pdf.

Some IEF-specific information is described in the following sections as well.

8.1 Settings for motors (AKM, DBL, ...)

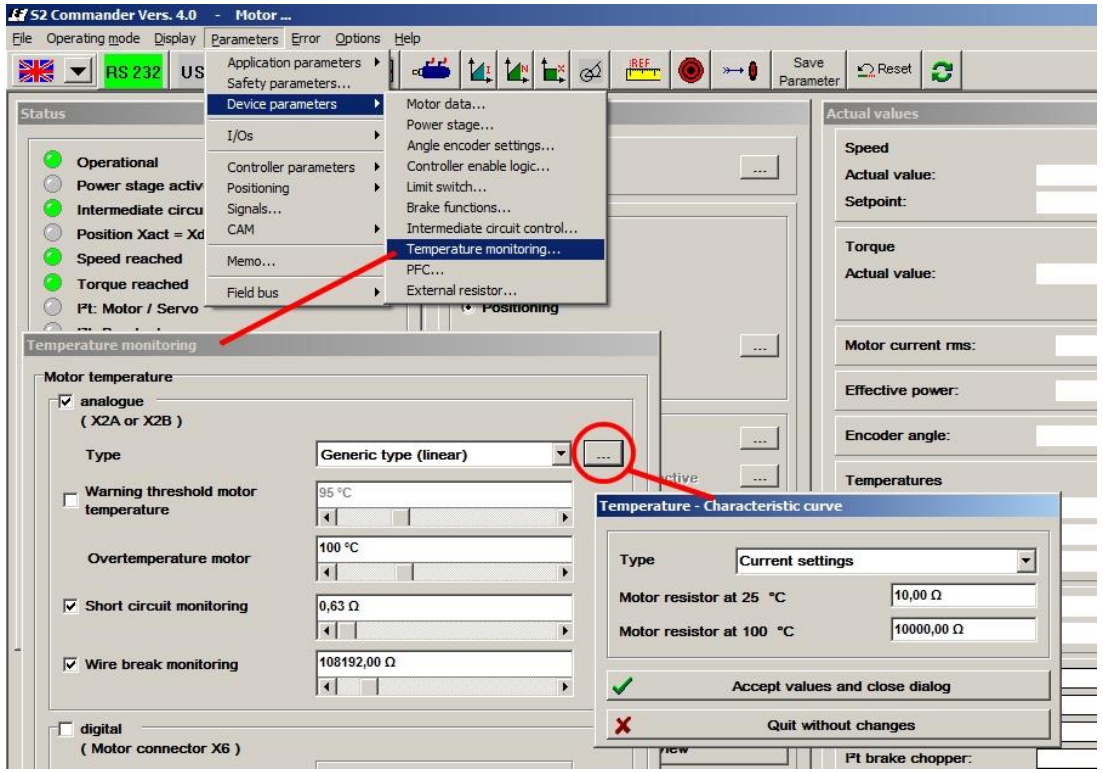
8.1.1 Temperature monitoring

In motors in which a switch is installed for temperature monitoring and if this switch is not wired to the motor plug [X6] but to the resolver or encoder plug, the monitoring is set as follows:

The temperature values for the "warning threshold (25°C) and the "Overtemperature motor" (100°C) are without function since the motor only has one switch and no temperature value can be derived via this switch.

- Motor temperature: analogue (X2A or X2B)"
- Type: Generic type (linear)
- Warning threshold: 25°C (value has no meaning)
- Overtemperature: 100°C (value has no meaning)

The temperature display is incorrect!



8.2 Settings for euroLINE

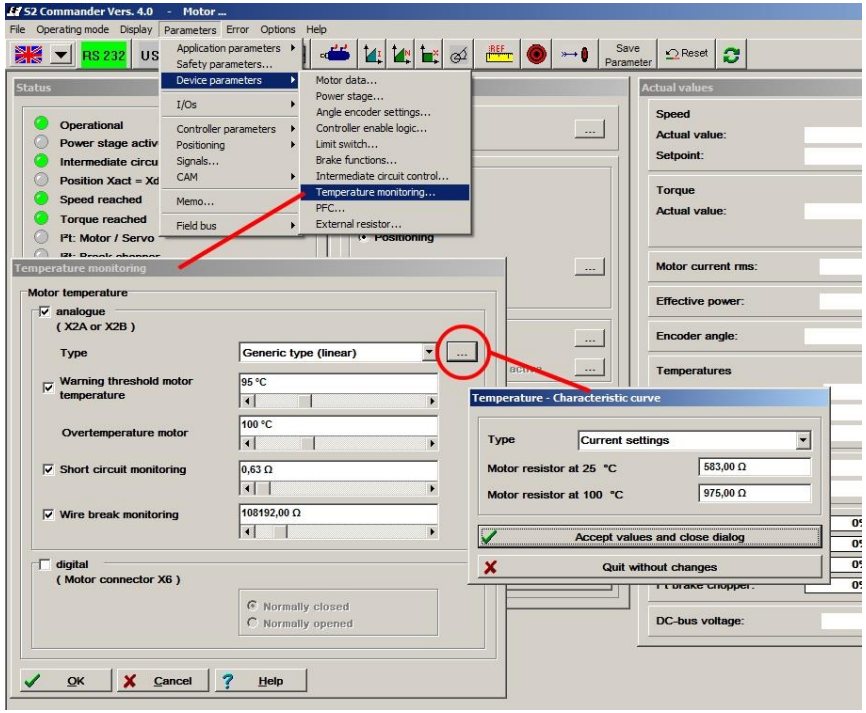
8.2.1 Temperature monitoring

The euroLINE-axes can be equipped with different temperature sensors (see type sign, enclosed datasheet, ...).

Installed temperature sensor	Setting in the menu: “Temperature monitoring“
NTC-resistance (old version)	"Generic type (non-linear)"
PTC-resistance	"Generic type (linear)"

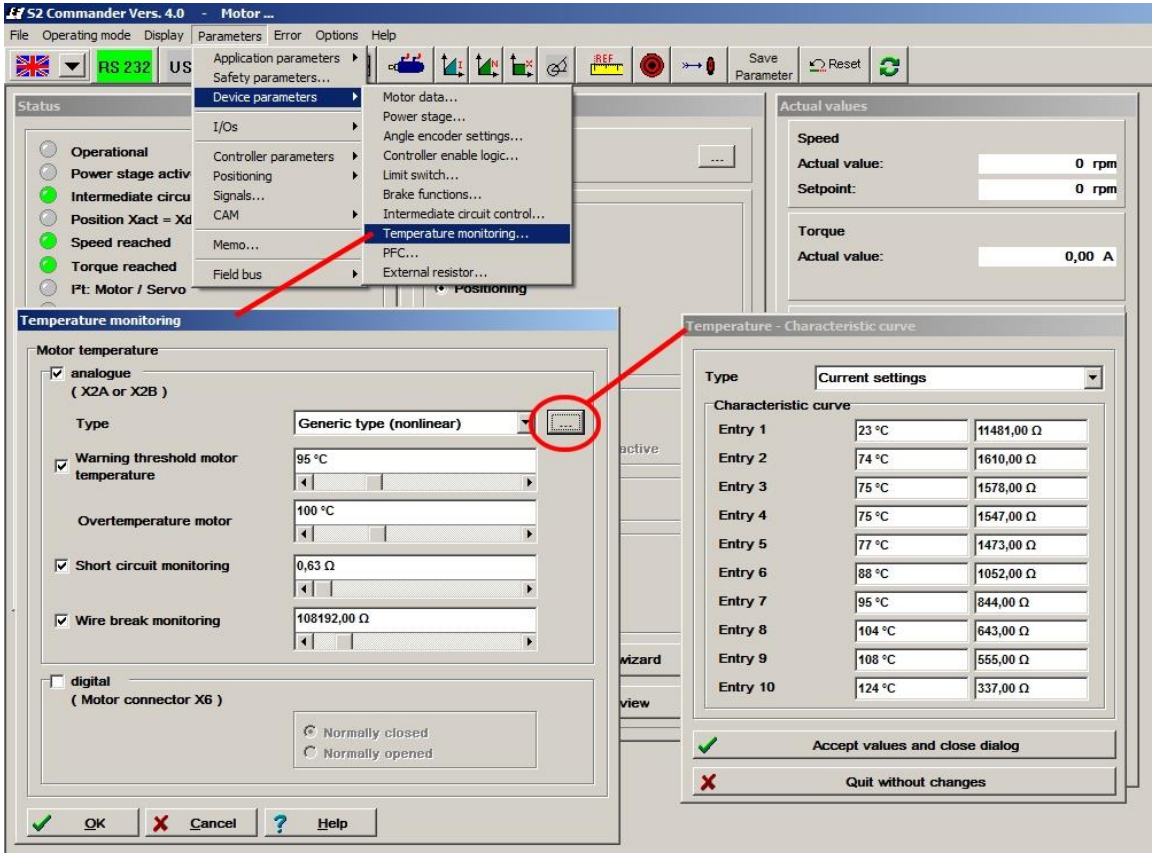
PTC-resistance

- Temperature monitoring to "analogue (X2A or X2B)“
- "Generic type (linear)"
- Set warning threshold to 95°C.
- Set overtemperature to 100°C
  (euroLINE coils: max. 110°C)



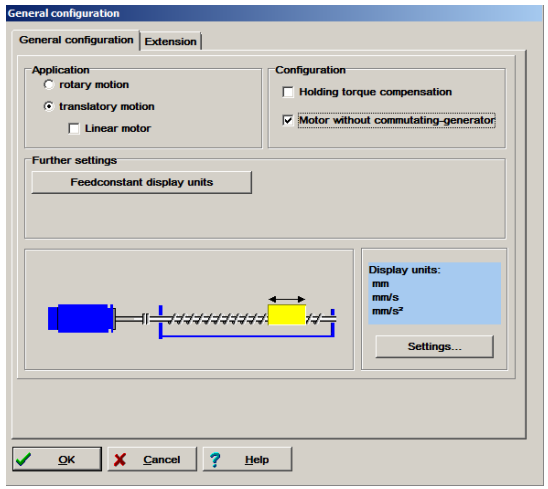
NTC-resistance (old version)

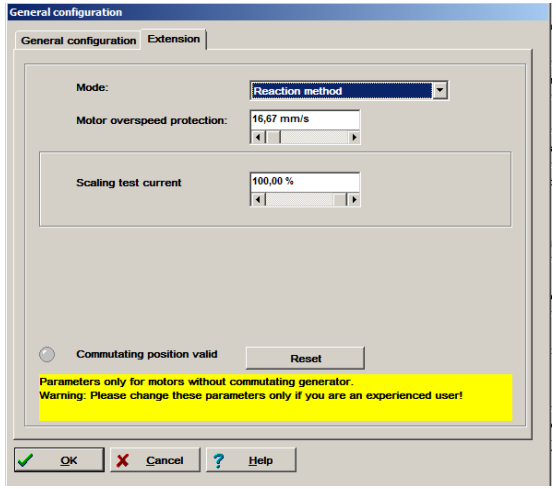
- Temperature motioning to "analogue (X2A or X2B)“
- "Generic type (non-linear)"
- Set warning threshold at 95°C.
- Set overtemperature to 100°C
  (euroLINE coils: max. 110°C)



8.2.2 Setting commuting

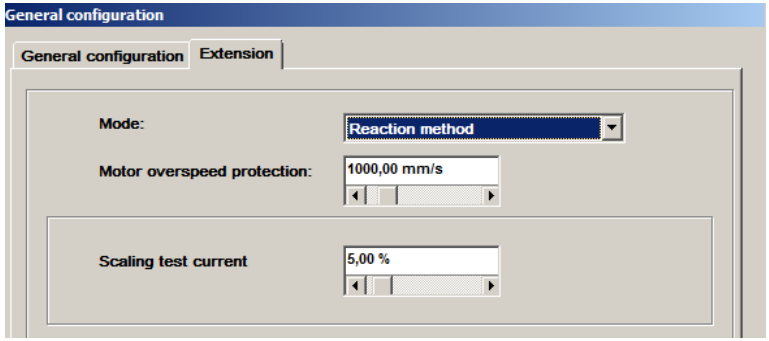
- The euroLINE have no "Resolver" and no "Analogue Hall sensors" for commuting.
- Commuting is determined according to the "reaction procedure" at first activation.
- Spinning prevention 10000 mm/s
- Scaling test current: 100%



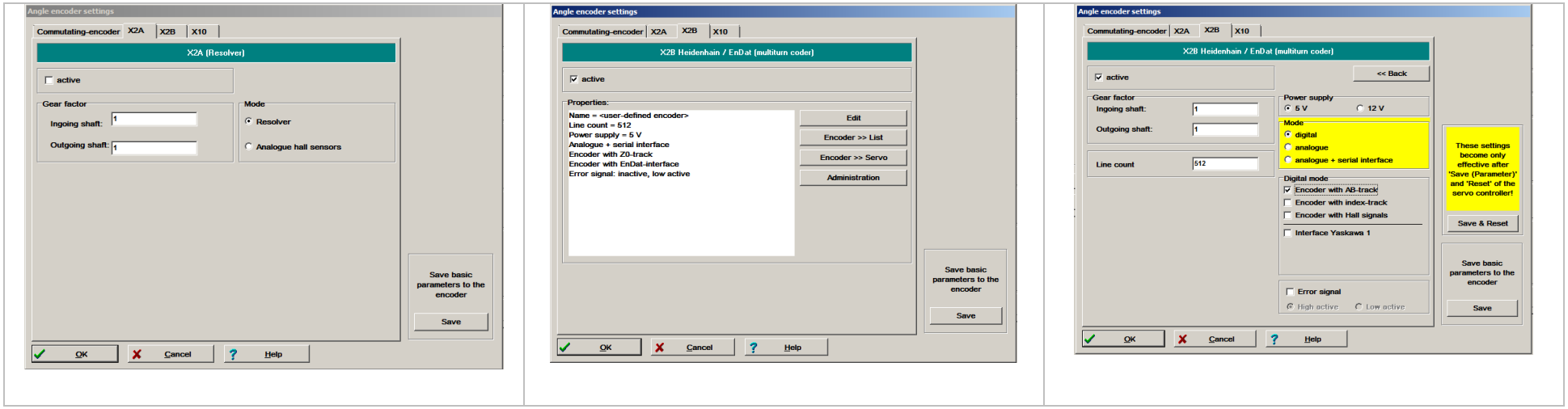


NOTE

At a very smooth-running axes, e.g. euroLINE with air bearing, the test current is reduced to 5% (scaling test current = 5 %).



8.2.3 Setting angle encoder (return system)



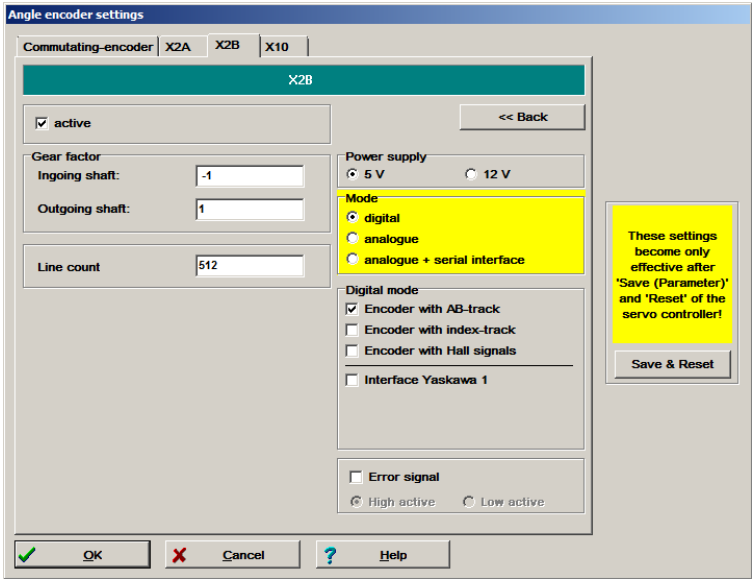
The stroke number is actuated according to the following formula: Stroke number = (encoder strokes per mm * infeed) / assessment procedure

- Encoder strokes per mm: Corresponds to the strokes on the measuring system per mm (e.g.: L5 Interpolator Numerik Jena = 1000, ...)
- Infeed: Corresponds to the motor infeed per turn or from pole to pole
- Assessment procedure: The encoders perform a 4fold assessment of the A-B-signals → 4

Motor/Axis-Type	Infeed / pole distance	Encoder strokes per mm	Encoder assessment	Calculation	Stroke number
euroLINE KL32	30,48mm	1000 strokes per mm	4-fold assessment	(1000 * 30,48) / 4	7620
euroLINE KL85	60,96	1000 strokes per mm	4- fold assessment	(1000 * 60,96) / 4	15240
euroLINE 120	24,00 mm	1000000 strokes per mm	1- fold assessment	1000000 * 24	24000000
euroLINE 170	24,00 mm	1000000 strokes per mm	1- fold assessment	1000000 * 24	24000000

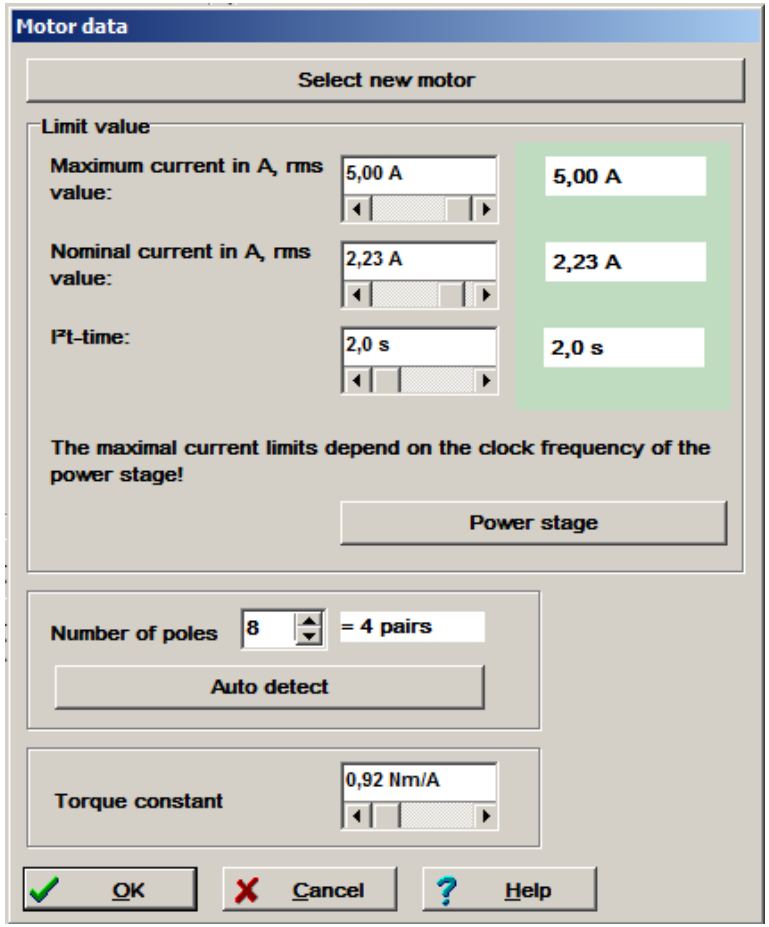
8.2.3.1 Invert rotating direction or movement direction

- The counting direction of the encoder and therefore the axis is determined by the wiring.
- If the rotating direction of the machine axis is to be adjusted, this may be implemented by a "-1“ in the gear factor drive (see graphic on the right).



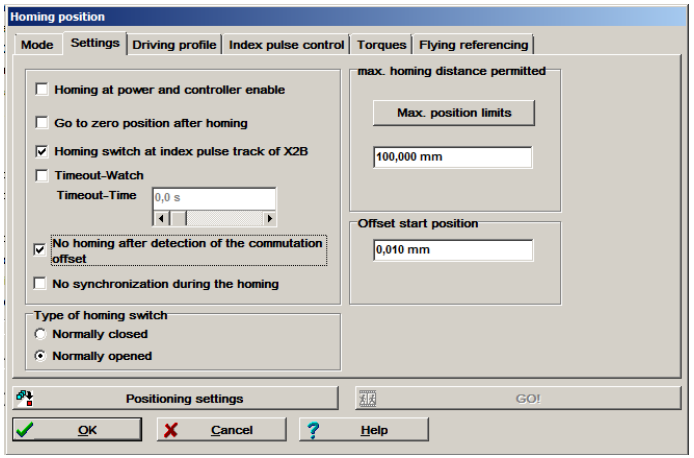
8.2.4 Settings for motor current

- The maximum current and the rated current are assumed according to the datasheet of the connected motor.
- The value for the torque constant is assumed from the datasheet of the connected motor.



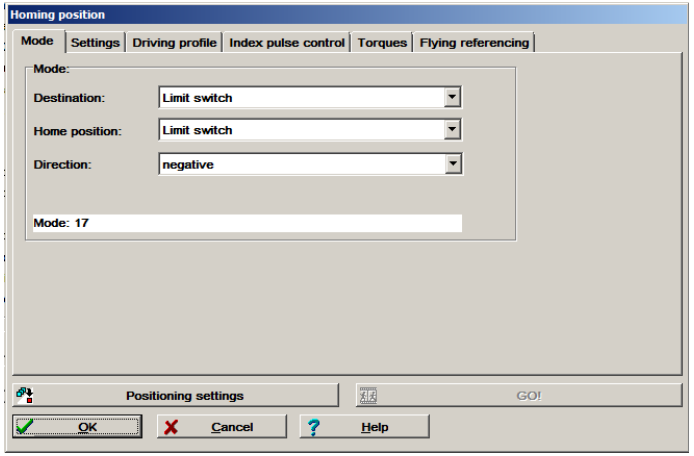
8.2.5 Settings for the reference run

- Reference switch to zero impulse track of X2B
- Suppress reference run after determination of the commuting position

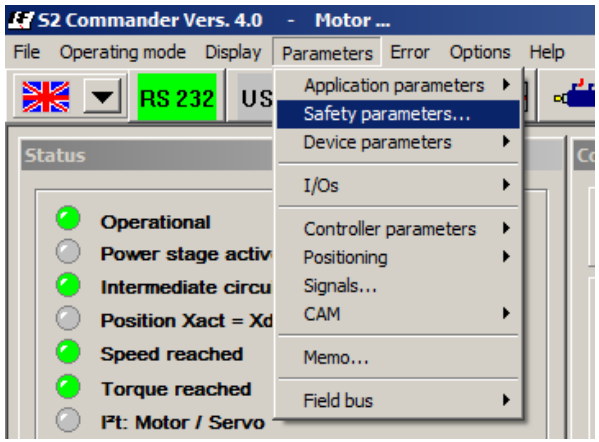


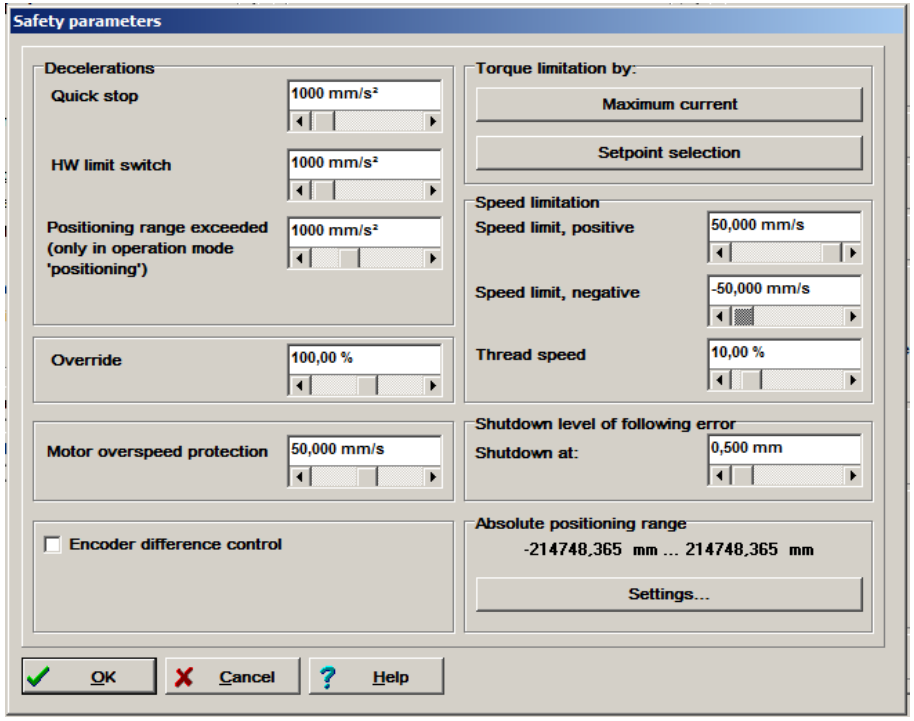
8.2.5.1 Reference run method

- If the PA-CONTROL does not perform the reference run via CAN-bus, the following settings must be made with the S2 commander:
- In an application with a Profibus-DP, reference run can be written via the Profibus
  (see German document: “MAN_DE_1083730_servoTECS2_ ProfibusDP_SiemensS7”)



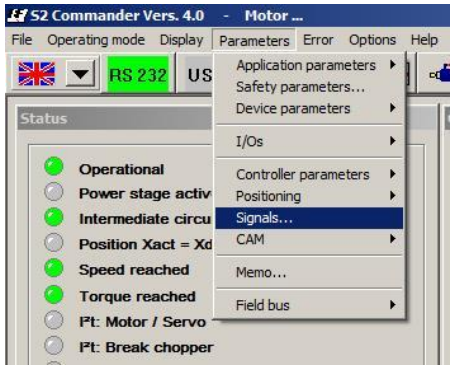
8.3 Set safety parameters

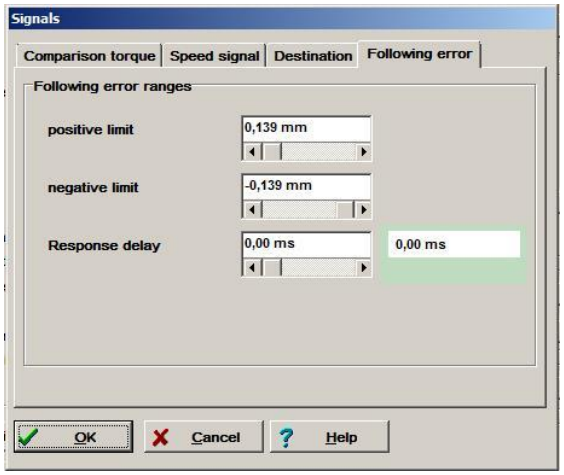




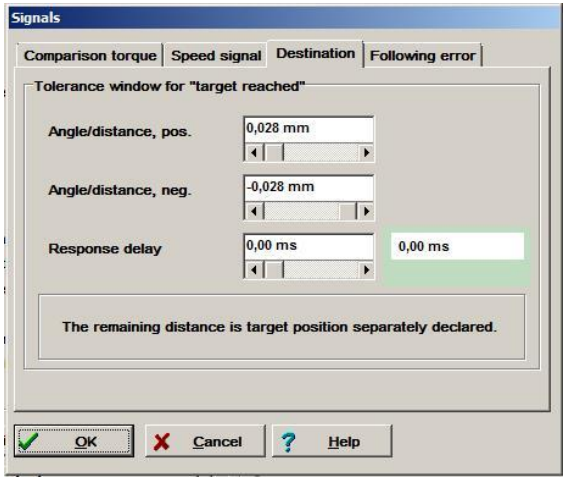
Note	The parameter "Emergency stop“ is overwritten by the PA-CONTROL with the axis parameter "OFF-ramp“.

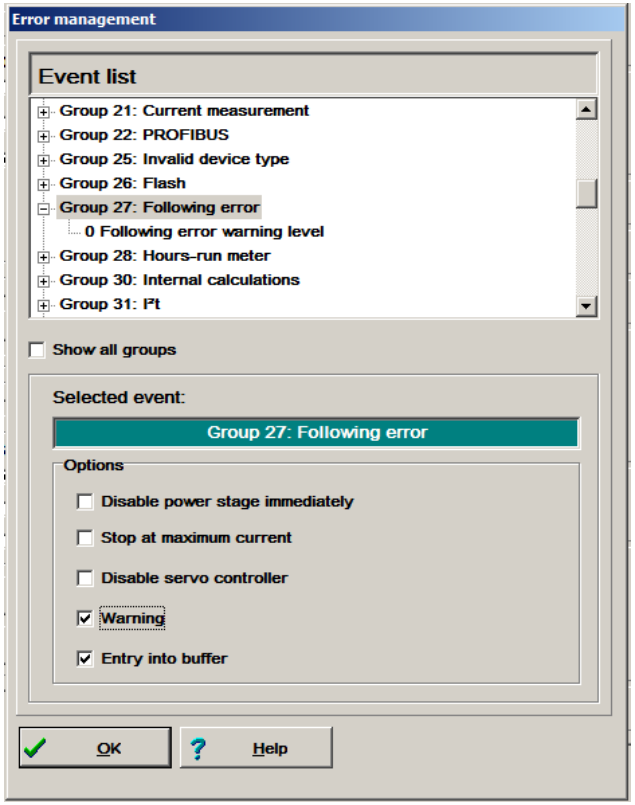
8.4 Set indicator parameters





Example: euroLINE: +/- 2,0 mm, 2,0 ms

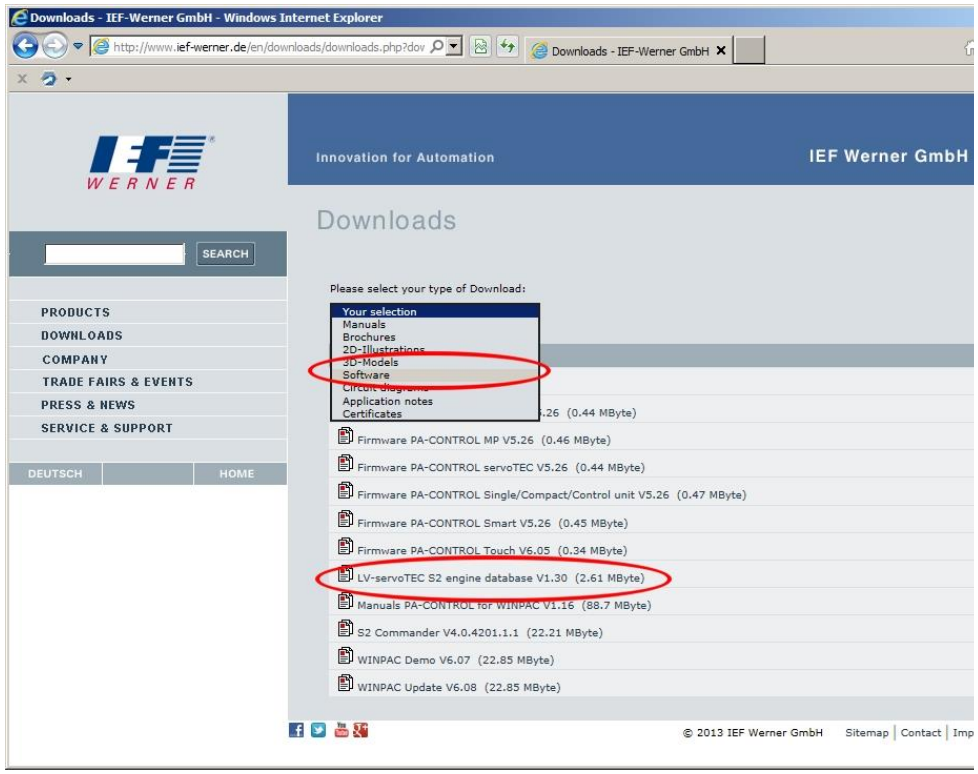




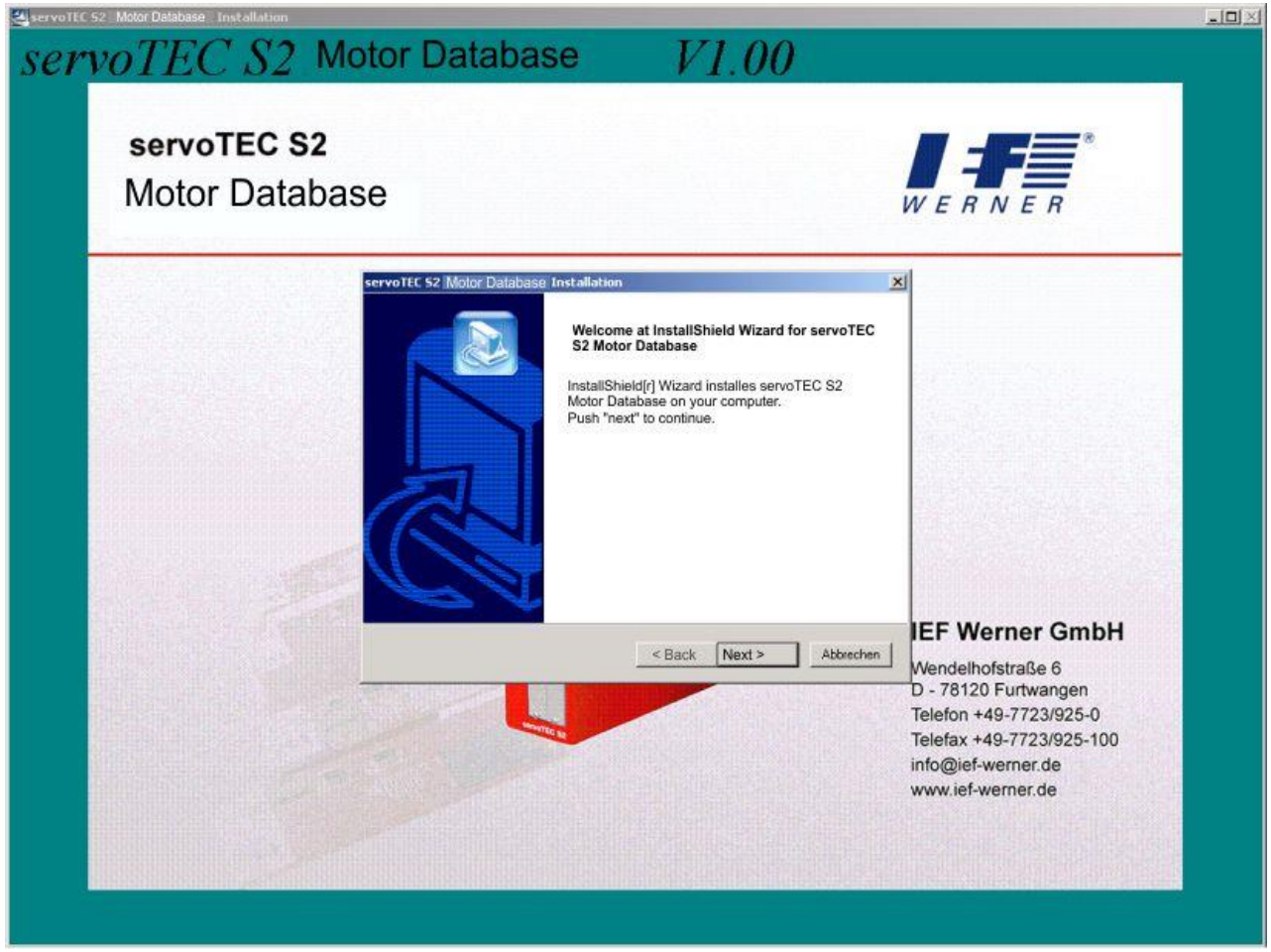
Determine, what is to happen at "drag error message"?

9 Installing LV-servoTEC S2 motor database or installing updates

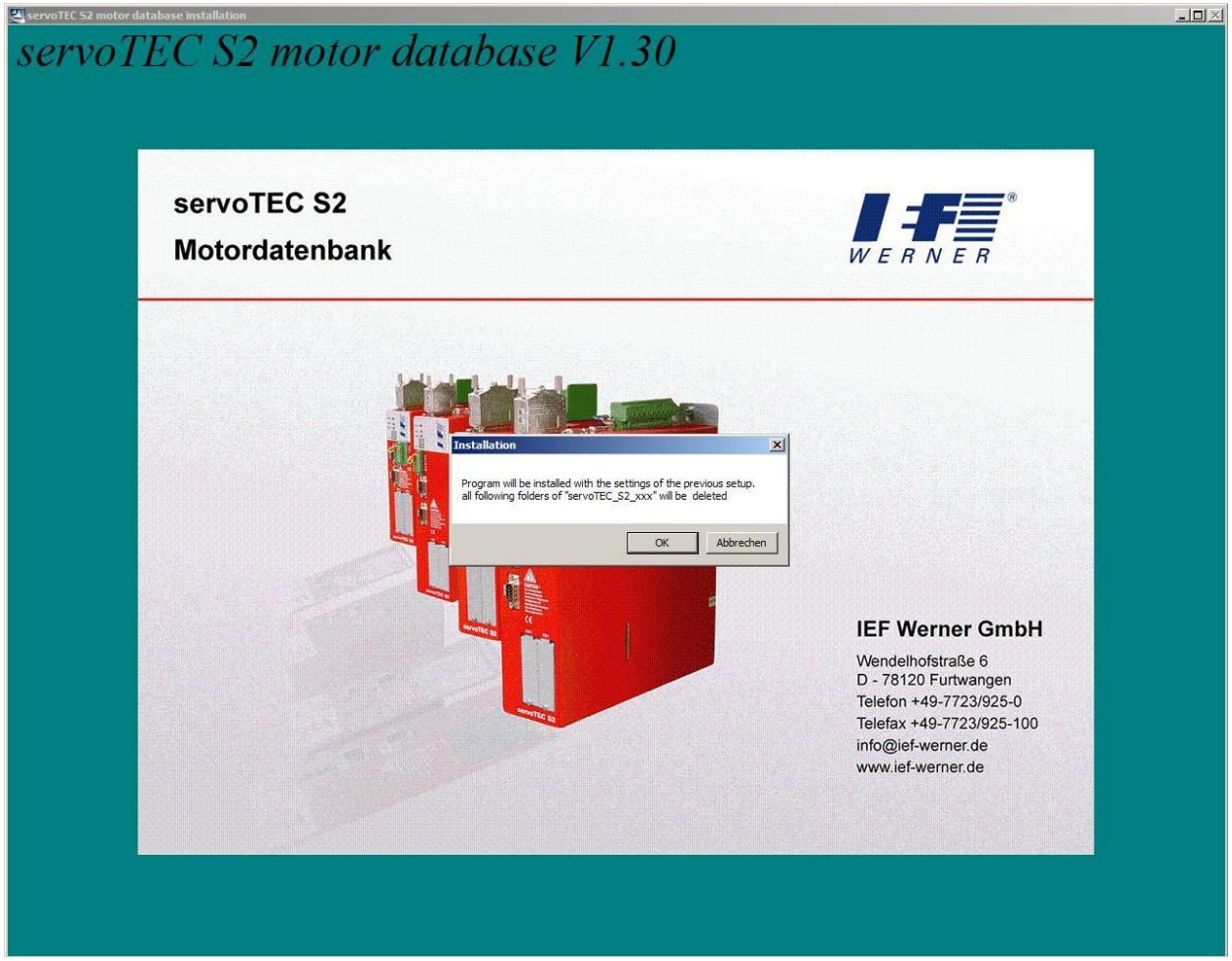
The LV-servoTEC S2 motor database can be loaded via the "INTERNET" or the "Product -DVD“.



9.1 Installation or Update of the Motor Database



9.2 Update motor database



10 Annex

10.1 Error messages and solutions

Error number	Error message	Suggested solution			
Error 80-2	Overflow speed controller:	Increase cycle times (e.g. to column 2 or 3) (Also see software manual "Cycle times of the control circuits")			
		Power controller [µs]	80	100	125
		Speed controller [µs]	160	200	250
		Position controller [µs]	320	400	500
		Interpolation calculation (position control) [µs]	640	800	1000
Error 11-5	Reference run : I^2T / drag error	Activate: Suppress reference run after determination of the commuting position (see section 8.2.5 Settings for the reference run, page 45) In the window messages: Set "drag error" small.			

PA-CONTROL-Error number	Error message	Suggested solution
E345	A1 : FFFDhex - drivers (X3.2) or interim circuit voltage is missing	Activate axes with a time offset (see section 6.5 Direction of rotation / movement, pp 25 et seq.)

10.2 Problems / features and solutions, tricks and advice

Problem / Feature	Suggested solution
Axis "vibrates (oscillates)" until balanced in position	Increase max. correction speed on the position controller.
Invert direction of rotation	See section 6.5 Direction of rotation / movement, pp 25 et seq.)