LV-servoTEC S2
Software Manual

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1 General

1.1 Documentation

This product manual serves the purpose of safe use of the parameterisation software for the servo positioning controller LV-servoTEC S2 series servo controller.

For more information, please refer to the following manuals of the LV-servoTEC S2 series products:

- **Product Manual “Servo Positioning Controller LV-servoTEC S2 1xx”:** Description of the technical specifications and the device functionality as well as notes on the installation and the operation of the servo positioning LV-servoTEC S2 1xx.
- **Product manual "Servo Positioning Controller LV-servoTEC S2 302 - LV-servoTEC S2 310":** Description of the technical data and the device functionality plus notes concerning the installation and operation of LV-servoTEC S2 302, LV-servoTEC S2 305 and LV-servoTEC S2 310 servo positioning controllers.
- **Product manual "Servo Positioning Controller LV-servoTEC S2 320 - LV-servoTEC S2 340":** Description of the technical data and the device functionality plus notes concerning the installation and operation of LV-servoTEC S2 320 and LV-servoTEC S2 340 servo positioning controllers.
- **CANopen Manual “Servo Positioning Controller LV-servoTEC S2“:** Description of the implemented CANopen protocol as per DSP402.
- **PROFIBUS Manual “Servo Positioning Controller LV-servoTEC S2”:** Description of the implemented PROFIBUS-DP protocol.
- **SERCOS Manual “Servo Positioning Controller LV-servoTEC S2”:** Description of the implemented SERCOS functionality.
- **Product manual "Ethernet Technology Module":** Description of the technical data and the device functionality plus notes concerning the installation and operation Ethernet Technology Module.

The implementation of the entire software functionality of the LV-servoTEC S2 series will be subject to a step-by-step development process.

This version of the software manual describes the functions of firmware 3.5 and those of firmware 3.x, which is currently being developed.

Some headings and text passages in this manual contain notes in the form of <FW3.x> indicating the availability of the functions in the corresponding firmware version.

Some of the shown windows of the parameterisation program S2 Commander do not yet correspond to the final version and may deviate from the actual parameterisation software S2 Commander.

1.2 Scope of Delivery

Table 1: **The scope of delivery includes:**

1	CD-ROM with installation program S2 Commander

2 Safety Notes for Electrical Drives and Controllers

2.1 Used Symbols

Information

Important information and notes.

Application

Additional Information for application purposes.

Caution!

Nonobservance may result in severe property damages.

DANGER !

Nonobservance may result in property damages and in personal injuries.

Caution! Dangerous voltages.
The safety note indicates a possible perilous voltage.

Further symbols:

Table 2: **General symbols**

	Floppy disk symbol:	All subsequent steps concern settings in the parameterisation program S2 Commander.
	Plug symbol:	All subsequent steps concern the hardware, i.e. the servo positioning controller LV-servoTEC S2.

2.2 General Notes

In case of damage resulting from non-compliance with the safety notes in this manual, IEF-Werner GmbH will not assume any liability.

Prior to the initial use you must read the chapters *Safety Notes for Electrical Drives and Controllers* starting on *page 12*.

If the documentation in the language at hand is not understood accurately, please contact and inform your supplier.

Sound and safe operation of the servo drive controller requires proper and professional transportation, storage, assembly and installation as well as proper operation and maintenance.

Only trained and qualified personnel may handle electrical devices:

TRAINED AND QUALIFIED PERSONNEL

in the sense of this product manual or the safety notes on the product itself are persons who are sufficiently familiar with the setup, assembly, commissioning and operation of the product as well as all warnings and precautions as per the instructions in this manual and who are sufficiently qualified in their field of expertise:

- Education and instruction or authorisation to switch devices/systems on and off and to ground them as per the standards of safety engineering and to efficiently label them as per the job demands.
- Education and instruction as per the standards of safety engineering regarding the maintenance and use of adequate safety equipment.
- First aid training.

The following notes must be read prior to the initial operation of the system to prevent personal injuries and/or property damages:

These safety notes must be complied with at all times.

Do not try to install or commission the servo drive controller before carefully reading all safety notes for electrical drives and controllers contained in this document. These safety instructions and all other user notes must be read prior to any work with the servo drive controller.

In case you do not have any user notes for the servo drive controller, please contact your sales representative. Immediately demand these documents to be sent to the person responsible for the safe operation of the servo drive controller.

If you sell, rent and/or otherwise make this device available to others, these safety notes must also be included.

The user must not open the servo drive controller for safety and warranty reasons.

Professional control process design is a prerequisite for sound functioning of the servo drive controller!

DANGER!

Inappropriate handling of the servo drive controller and non-compliance of the warnings as well as inappropriate intervention in the safety features may result in property damage, personal injuries, electric shock or in extreme cases even death.

2.3 Danger resulting from misuse

DANGER!

High electrical voltage and high current!

Danger to life or serious personal injury from electrical shock!

DANGER!

High electrical voltage caused by wrong connections!

Danger to life or serious personal injury from electrical shock!

DANGER!

Surfaces of device housing may be hot!

Risk of injury! Risk of burning!

DANGER!

Dangerous movements!

Danger to life, serious personal injury or property damage due to unintentional movements of the motors!

2.4 Safety Notes

2.4.1 General Safety Notes

The servo drive controller corresponds to IP20 class of protection as well as pollution level 1. Make sure that the environment corresponds to this class of protection and pollution level.

Only use replacements parts and accessories approved by the manufacturer.

The devices must be connected to the mains supply as per EN regulations, so that they can be cut off the mains supply by means of corresponding separation devices (e.g. main switch, contactor, power switch).

The servo drive controller may be protected using an AC/DC sensitive 300 mA fault current protection switch (RCD = Residual Current protective Device).

Gold contacts or contacts with a high contact pressure should be used to switch the control contacts.

Preventive interference rejection measures should be taken for control panels, such as connecting contactors and relays using RC elements or diodes.

The safety rules and regulations of the country in which the device will be operated must be complied with.

The environment conditions defined in the product documentation must be kept. Safety-critical applications are not allowed, unless specifically approved by the manufacturer.

For notes on installation corresponding to EMC, please refer to a product manual of the LV-servoTEC S2 family. The compliance with the limits required by national regulations is the responsibility of the manufacturer of the machine or system.

The technical data and the connection and installation conditions for the servo drive controller are to be found in this product manual and must be met.

DANGER!

The general setup and safety regulations for work on power installations (e.g. DIN, VDE, EN, IEC or other national and international regulations) must be complied with.

Non-compliance may result in death, personal injury or serious property damages.

Without claiming completeness, the following regulations and others apply:

VDE 0100 Regulations for the installation of high voltage (up to 1000 V) devices

EN 60204 Electrical equipment of machines

EN 50178 Electronic equipment for use in power installations

2.4.2 Safety Notes for Assembly and Maintenance

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:

The servo drive controller must only be operated, maintained and/or repaired by personnel trained and qualified for working on or with electrical devices.

Prevention of accidents, injuries and/or damages:

Additionally secure vertical axes against falling down or lowering after the motor has been switched off, e.g. by means of:

- Mechanical locking of the vertical axle,
- External braking, catching or clamping devices or
- Sufficient balancing of the axle.

The motor holding brake supplied by default or an external motor holding brake driven by the drive controller alone is not suitable for personal protection!

Render the electrical equipment voltage-free using the main switch and protect it from being switched on again until the DC bus circuit is discharged, in the case of:

- Maintenance and repair work
- Cleaning
- long machine shutdowns

Prior to carrying out maintenance work make sure that the power supply has been turned off, locked and the DC bus circuit is discharged.

The external or internal brake resistor carries dangerous DC bus voltages during operation of the servo drive controller and up to 5 minutes thereafter. Contact may result in death or serious personal injury.

Be careful during the assembly. During the assembly and also later during operation of the drive, make sure to prevent drill chips, metal dust or assembly parts (screws, nuts, cable sections) from falling into the device.

Also make sure that the external power supply of the controller (24V) is switched off.

The DC bus circuit or the mains supply must always be switched off prior to switching off the 24V controller supply.

Carry out work in the machine area only, if AC and/or DC supplies are switched off. Switched off output stages or controller enablings are no suitable means of locking. In the case of a malfunction the drive may accidentally be put into action.

Initial operation must be carried out with idle motors, to prevent mechanical damages e.g. due to the wrong direction of rotation.

Electronic devices are never fail-safe. It is the user's responsibility, in the case an electrical device fails, to make sure the system is transferred into a secure state.

The servo drive controller and in particular the brake resistor, externally or internally, can assume high temperatures, which may cause serious burns.

2.4.3 Protection against Contact with Electrical Parts

This section only concerns devices and drive components carrying voltages exceeding 50 V. Contact with parts carrying voltages of more than 50 V can be dangerous for people and may cause electrical shock. During operation of electrical devices some parts of these devices will inevitably carry dangerous voltages.

DANGER!

High electrical voltage!

Danger to life, danger due to electrical shock or serious personal injury!

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:

Before switching on the device, install the appropriate covers and protections against accidental contact. Rack-mounted devices must be protected against accidental contact by means of a housing, e.g. a switch cabinet. The regulations VGB4 must be complied with!

Always connect the ground conductor of the electrical equipment and devices securely to the mains supply. Due to the integrated line filter the leakage current exceeds 3.5 mA!

Comply with the minimum copper cross-section for the ground conductor over its entire length as per EN 60617!

Prior to the initial operation, even for short measuring or testing purposes, always connect the ground conductor of all electrical devices as per the terminal diagram or connect it to the ground wire. Otherwise the housing may carry high voltages which can cause electrical shock.

Do not touch electrical connections of the components when switched on.

Prior to accessing electrical parts carrying voltages exceeding 50 V, disconnect the device from the mains or power supply. Protect it from being switched on again.

For the installation the amount of DC bus voltage must be considered, particularly regarding insulation and protective measures. Ensure proper grounding, wire dimensioning and corresponding short-circuit protection.

The device comprises a rapid discharge circuit for the DC bus as per EN60204 section 6.2.4. In certain device constellations, however, mostly in the case of parallel connection of several servo drive controllers in the DC bus or in the case of an unconnected brake resistor, this rapid discharge may be rendered ineffective. The servo drive controllers can carry voltage until up to 5 minutes after being switched off (residual capacitor charge).

2.4.4 Protection against El. Shock by Means of Protective Extra-Low Voltage (PELV)

All connections and terminals with voltages between 5 and 50 V at the servo drive controller are protective extra-low voltage, which are designed safe from contact in correspondence with the following standards:

- International: IEC 60364-4-41
- European countries within the EU: EN 50178/1998, section 5.2.8.1.

DANGER!

High electrical voltages due to wrong connections!

Danger to life, risk of injury due to electrical shock!

Only devices and electrical components and wires with a protective extra low voltage (PELV) may be connected to connectors and terminals with voltages between 0 to 50 V.

Only connect voltages and circuits with protection against dangerous voltages. Such protection may be achieved by means of isolation transformers, safe optocouplers or battery operation.

2.4.5 Protection against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors, for different reasons:

- Improper or faulty wiring or cabling
- Error in handling of components
- Error in sensor or transducer
- Defective or non-EMC-compliant components
- Error in software in superordinated control system

These errors can occur directly after switching on the device or after an indeterminate time of operation.

The monitors in the drive components for the most part rule out malfunctions in the connected drives. In view of personal protection, particularly the danger of personal injury and/or property damage, this may not be relied on exclusively. Until the built-in monitors come into effect, faulty drive movements must be taken into account; their magnitude depends on the type of control and on the operating state.

DANGER!

Dangerous movements!

Danger to life, risk of injury, serious personal injuries or property damage!

For the reasons mentioned above, personal protection must be ensured by means of monitoring or superordinated measures on the device. These are installed in accordance with the specific data of the system and a danger and error analysis by the manufacturer. The safety regulations applying to the system are also taken into consideration. Random movements or other malfunctions may be caused by switching the safety installations off, by bypassing them or by not activating them.

2.4.6 Protection against contact with hot parts

DANGER!

Housing surfaces may be hot!

Risk of injury! Risk of burning!

Do not touch housing surfaces in the vicinity of heat sources! Danger of burning!

Before accessing devices let them cool down for 10 minutes after switching them off.

Touching hot parts of the equipment such as the housing, which contain heat sinks and resistors, may cause burns!

2.4.7 Protection during handling and assembly

Handling and assembly of certain parts and components in an unsuitable manner may under adverse conditions cause injuries.

DANGER!

Risk of injury due to improper handling!

Personal injury due to pinching, shearing, cutting, crushing!

The following general safety notes apply:

Comply with the general setup and safety regulations on handling and assembly.

Use suitable assembly and transportation devices.

Prevent incarcerations and contusions by means of suitable protective measures.

Use suitable tools only. If specified, use special tools.

Use lifting devices and tools appropriately.

If necessary, use suitable protective equipment (e.g. goggles, protective footwear, protective gloves).

Do not stand underneath hanging loads.

Remove leaking liquids on the floor immediately to prevent slipping.

3 General Information on the Parameterisation Program S2 Commander

3.1 Basic information to program S2 Commander

S2 Commander allows the parameterisation of the LV-servoTEC S2 series servo controller. Users already familiar with the parameterisation program WMEMOC 3.5 Gamma, will easily work with the S2 Commander since the user interface design as well as many functions are similar.

The information contained in this manual refers to the following firmware and hardware versions:

- Servo positioning controller LV-servoTEC S2 firmware versions up to 3.5
- Parameterisation software S2 Commander version up to 2.8

> If not explicitly documented, functions available in older versions are also avilable in new versions.

The firmware of the servo positioning controller LV-servoTEC S2 and the parameterisation program S2 Commander™ must be harmonised, i.e. functional extensions of a new firmware usually also require the corresponding new version of S2 Commander.

> The parameterisation program S2 Commander cannot be used to parameterise devices of the following series: DIS-2 or IMD/F!

3.2 IEF-Werner S2 Commander Features

The parameterisation program S2 Commander can be used to optimally adapt the servo positioning controller LV-servoTEC S2 to your applications.

The parameterisation program offers the following features:

- Parameterisation of the servo positioning LV-servoTEC S2 1xx and LV-servoTEC S2 3xx
- Configuration of all parameters via PC
- Display of operating parameters
- User-assisted commissioning
- Loading of new firmware versions
- Loading and storing of parameter sets
- Printing of parameter sets
- Offline parameterisation
- Oscilloscope functions
- Language support: german, english, french, spanish
- Windows®-based application
- Online help

3.3 Hardware and software requirements

Requirements for the installation of the parameterisation program:

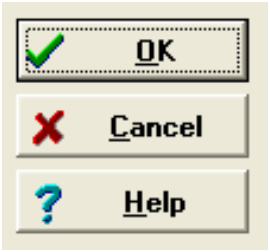
- IBM-compatible PC-AT, Pentium processor with minimum 32 MB RAM and minimum 200 MB of free hard disk space
- Operating system Windows® 95, Windows® 98, Windows NT®, Windows 2000 or Windows® XP
- CD-ROM drive or floppy disk drive
- One free serial port

Some languages (e.g. Chinese) need a special font (Arial Unicode MS). This font has to be selected for all display elements in the system configuration of your computer.

3.4 Using the parameterisation program

3.4.1 Standard Buttons

If a S2 Commander window is open, this window will have a button bar, which often looks like this:



The buttons have the following functions:

OK: All changes will be accepted and the window will be closed.

Cancel: All changes will be undone and even already transferred values will be restored and the window will be closed.

Help: Opens a help menu, which provides information on the currently open window.

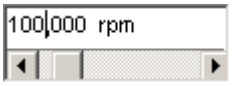
To actuate a button, click on it with your left mouse button or press the TAB key to activate it and then press the ENTER key to acknowledge. If the appearance of the buttons in some menus differs from the form described here, you will find more detailed information in the manual or the online help.

3.4.2 Numerical Input Fields

Many windows of the parameterisation program S2 Commander contain fields for numerical entries similar to the one shown below:

There are several ways of entering data:

1. Directly via the keyboard: Enter the value directly in the entry line. As long as the entry is not finalised, the text will appear in a thin font and has not yet been accepted by the parameterisation program (see illustration).



To finalize the entry, press ENTER or move on to another input field by pressing TAB. The numeric value will then appear in bold.

2. Clicking on the arrow buttons: The value will change in small increments. (fine adjustment)
3. Clicking on the scroll bar between the gray scroll box and the arrow buttons: The value will change in large increments. (coarse adjustment)
4. Clicking on the gray scroll box and moving it with the mouse while pressing the left mouse button: The value can be easily set within the entire value range.

3.4.3 Control Elements

Guiding the user is preferred by graphically orientated windows.

The following table shows and describes the control elements used in the individual windows:

Table 3: **Control elements**

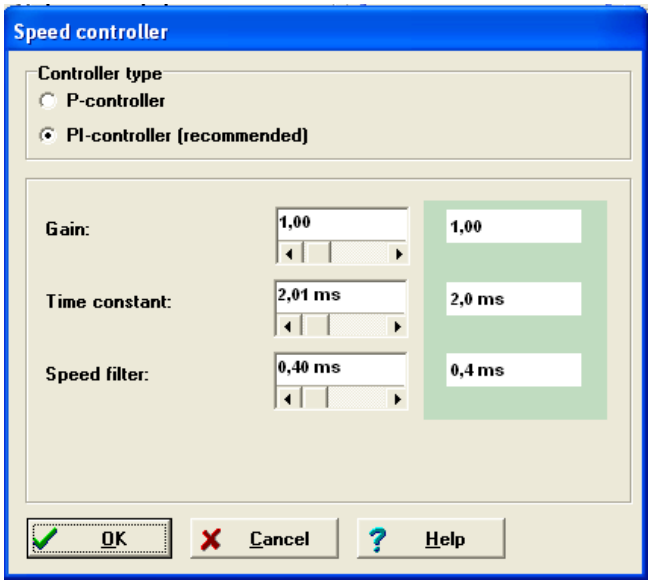
Control Element	Name	Description
	Check box	An option, which the user can activate or deactivate by checking the corresponding box. It is possible to check several boxes at once.
	Radio button	With this button the user can choose one of several options.
	General button	A button, which opens another menu or initiates an action when clicked on by the user.
	"..." button	A button, which opens another window when clicked on by the user.

3.4.4 Display of settings and actual values

As compared to WMEMOC, the parameterisation program S2 Commander uses a modified concept for displaying setpoints, corresponding to a desired user value, and the actual values used by the device.

The new mode of operation is the following:

1. The user changes the value in the input field by moving the scroll box on the scroll bar or by directly entering a new value.
2. S2 Commander transfers this value to the servo positioning controller LV-servoTEC S2.
3. S2 Commander immediately reads the currently valid parameter and displays it in the green field. The input field itself remains unchanged.



Definition of terms:

- Setpoint: Target value transferred to the servo positioning controller LV-servoTEC S2 (setting desired by the user)
- Actual value: This value is currently effective in the servo positioning controller LV-servoTEC S2. A deviation from the setpoint can have different reasons

Examples:

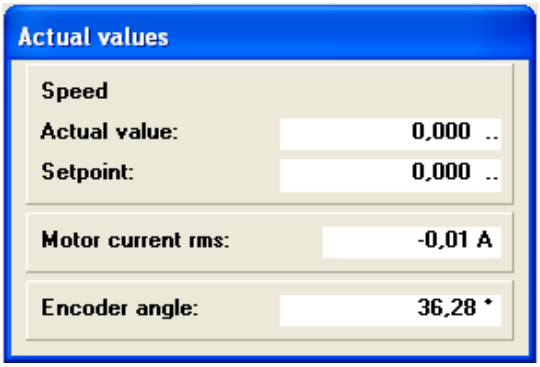
- Quantisation effects, truncation effects, etc.
- The changed parameter only has an impact after saving followed by a reset
- Temporary value range overrun, e.g. rated current > maximum current
- Wrong value ranges, e.g. during loading of a parameter set from a servo controller with a higher class of performance (rated current > device's rated current)

The idea behind the concept of different setpoints and actual values is the following: It is possible to load a parameter set from a servo controller of one class of performance to a servo controller of a different class of performance and back again. As long as no other parameterisation has been carried out, the setpoints remain unchanged. Only the actual values will be different due to the different classes of performance. This prevents a step-by-step change of a parameter set resulting from the device's class of performance.

3.4.5 Standard Windows

The default configuration always opens the S2Commands window, the Status window and the actual values window.

The actual values window displays the current controller parameters such as currents, speeds, etc. The actual values window is configured via the menu option display/actual values. All values to be displayed must be checked. With the options enable all or disable all the actual values window can be quickly minimised or maximised.



3.4.6 Directories

The installed version of S2 Commander uses the following directories:

Table 4: **Directory structure**

Directory	Contents
cam	Default directory for the tables of CAM and axis error compensation.
DCO	Default directory for the parameter files
documentation	Directory of the supplied documetation in a PDF file format
EDS	EDS-files for the application of the servo positioning controllers in a CANopen network. The EDS-files are also used by the PDO configuration menus.
FIRMWARE	Firmware versions of the different types of devices
PROFIBUS	GSD file, example projects for SIEMENS S7 with function and data modules
Tools	Tools for the application of the Ethernet technology module.
TXT	Default directory for plain text output of parameter data

3.4.7 Communication via communication objects

The parameterisation program S2 Commander accesses the servo positioning controller LV-servoTEC S2 by means of so-called communication objects via a standardised, internal software interface.

During the processing of the communication tasks, an internal check for the following errors will be performed:

- Write access to read-only communication objects
- Read access to write-only communication objects
- Overshooting or undershooting of the value range
- Erroneous data transfer (wrong check sum)

The first two cases are fatal errors, which should not occur in practice. In the case mentioned last, S2 Commander tries to perform the read or write process without bit error.

Overshooting and undershooting of the value range of a communication object are indicated by a warning.

4 Installation, First Program Start and Communication

4.1 Installation from CD-ROM

To install from CD-ROM proceed as follows:

1. Insert the CD-ROM into the CD-ROM drive of your computer.
2. Start Windows®-Explorer.
3. Go to the directory DEUTSCH or ENGLISH on your CD-ROM.
4. Start the program by double-clicking on SETUP.EXE.

The installation program creates a new program group named „S2 Commander“.
Complete and successful installation will be indicated by a corresponding window.

4.2 Configuring the communication (RS232)

The parameterisation program S2 Commander provides two communication paths to the servo positioning controller LV-servoTEC S2:

- Communication via serial port (RS232)
- Communication via UDP (Ethernet)

The communication via UDP needs for an Ethernet module in technology slot 1. First this has to be parameterized correctly which is normally done via RS232. Hence, the following chapters describe the communication via RS232 first. See chapter *Communication via Ethernet / UDP, page 92* describes the communication via UDP (Ethernet).

Communicating via RS232 the parameterisation program needs to know which serial interface (COM port number) and which transmission rate to use.

The default configuration at the time of delivery is:

- Interface COM1
- Transmission rate 9600 Baud (default configuration of servo controller)
- 8 data bits, 1 stop bit, no parity check. This configuration cannot be changed!

Once started, the program tries to establish communication via RS232 with a servo positioning controller. If this fails, S2 Commander will display an error message *(*see chapter *Troubleshooting Serial Communication Problems, Page 31)*.

In order to set the data for communication via RS232 correctly, the following steps must be completed:

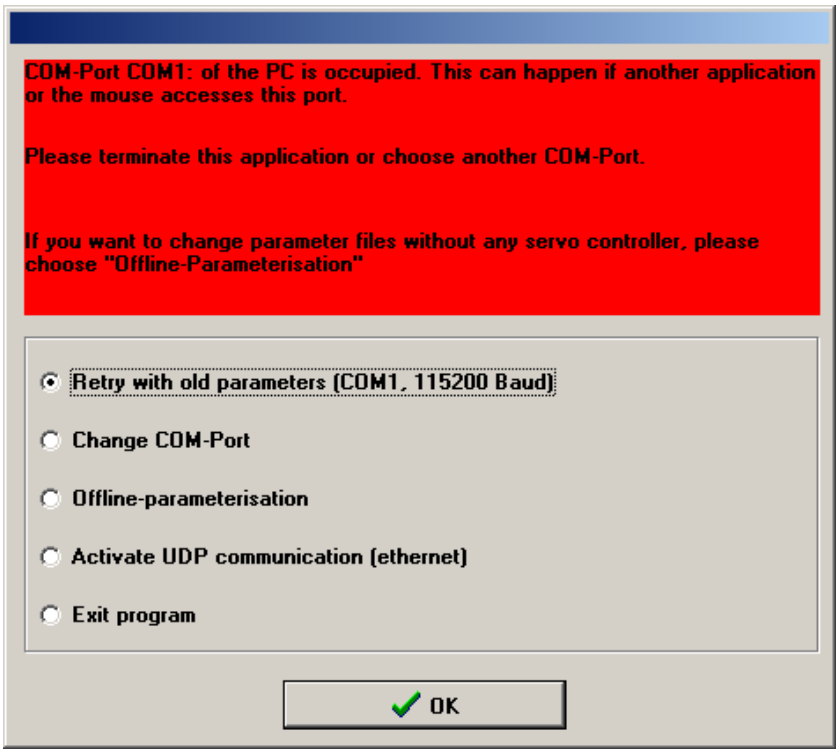
1. Connect the servo positioning controller LV-servoTEC S2 completly.
2. Connect a free COM port of the PC with the servo positioning controller LV-servoTEC S2 using a null modem cable.
3. Switch on the servo positioning controller LV-servoTEC S2.
4. Run the parameterisation program S2 Commander.

If the „RS 232”-button in the toolbar is green (see illustration), the communication parameters are correct.

If an error message appears instead, please read chapter *Configuration of the serial interface*, page *30 and chapter Troubleshooting Serial Communication Problems*, page *31*).

4.3 Configuration of the serial interface

If the parameterisation program S2 Commander cannot open the serial interface, the following error message will appear as you run the program:



This can be due either to a wrong interface setting (mostly mouse driver setting) or another Windows®- or MS-DOS®-based program accesses this serial interface.

To solve this access conflict, close the other programs (in the case of MS-DOS®-based programs also close the shell!) and then click on **Retry with old parameters**.

To correct the interface configuration, click on the radio button **Change COM-Port** and follow the instructions. (Please refer to Chapter *Selection of the RS232 Interface,* page *208).*

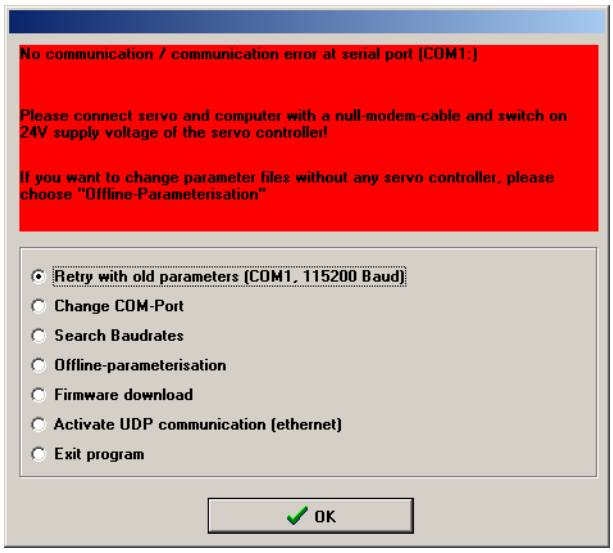
Offline-parameterisation is not a suitable option for commissioning. You find further information in Chapter *Offline Parameterisation,* page *100*.

Die Option **Activate UDP communication (Ethernet)** is also not a suitable option for commissioning. You find further information in Chapter *Communication via Ethernet / UDP,* page *92*.

Clicking on the radio button **Exit program** will immediately terminate S2 Commander.

4.4 Troubleshooting Serial Communication Problems

If the parameterisation program S2 Commander cannot establish communication with the servo positioning controller LV-servoTEC S2 via RS232, the following error message will appear:



The following table describes possible error causes and error recovery strategies:

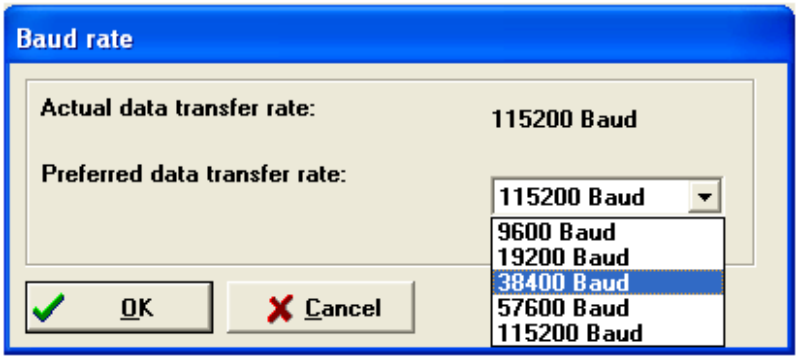
Table 5: **Recovering problems with serial communication**

Cause	Measure
Communication is 'choking'	Click on **Retry with old parameters**.
Wrong Com port selected	Click on **Change COM-Port** and follow the instructions.
Baud rates of parameterisation program S2 Commander and servo positioning controller LV-servoTEC S2 do not match	Click on **Search Baudrates**.
Servo positioning controller LV-servoTEC S2 communication malfunction	RESET the servo positioning controller LV-servoTEC S2, and then click on **Retry with old parameters**.
Servo positioning controller LV-servoTEC S2 has no or incomplete firmware.	Select **Firmware download** option and follow the instructions.
UDP-communication is desired instead of RS232-communication	Select the option **Activate UDP communication (Ethernet)**. (See also *chapter Communication via Ethernet / UDP,* page *92*).
Hardware error: Servo positioning controller LV-servoTEC S2 switched off	Recover the error, and then click on **Retry with old parameters**.
Connecting cable not plugged in	
Connecting cable broken	
Connecting cable too long	Reduce the baud rate or use a shorter cable.

Offline parameterisation only makes sense, if you want to edit parameter set files without the servo positioning controller LV-servoTEC S2. (Please refer to *chapter Offline Parameterisation,* page *100)*.

4.5 Optimizing of serial communication via RS232

The default transmission rate of the servo controller is 9600 Baud (RS232). This baud rate can be increased in the menu option **Options/Communication/Communication parameters RS232/Baudrate…** based on the current transmission rate.



The **Preferred data transfer rate** is selected and S2 Commander will try to establish communication at this baud rate. The desired transmission rate is then either accepted or the software switches back to a lower baud rate. The established baud rate is now shown as the **Actual data transfer rate**.

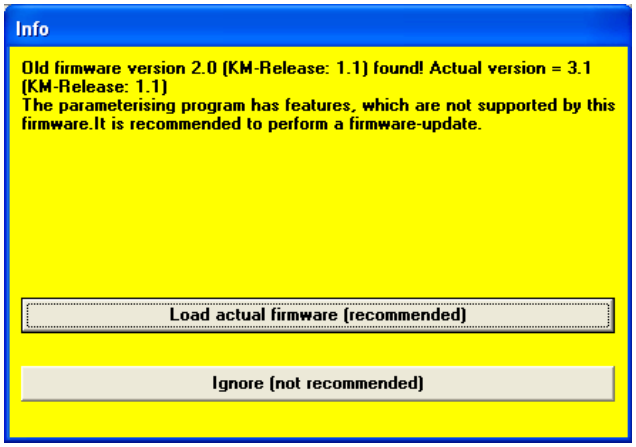
This baud rate applies for "normal" online communication. A special baud rate selection will be made for the firmware download.

5 Loading of Firmware and Performing Commissioning

5.1 Loading firmware

The firmware is the "operating system" of the servo positioning controller LV-servoTEC S2. By default, the servo positioning controller LV-servoTEC S2 are delivered with firmware. However, the following circumstances may require the loading of new firmware:

- **Updating to a new firmware version:** Due to continuous product developments, the parameterisation program S2 Commander may comprise options, which require a correspondingly advanced firmware version. If the version of the firmware is too old compared to S2 Commander, the following window appears:



Here, a firmware download is recommended! Choose the option **Load actual firmware**.

- **Loading of a custom specific firmware**: Here, start the download of the firmware from the main menu (see below).
- **Incomplete firmware (e.g. due to an interrupted firmware download):**
  If the servo positioning controller LV-servoTEC S2 has no firmware or just an incomplete version, the following window will appear:

Here, a firmware download is absolutely required! The firmware download window will open automatically.

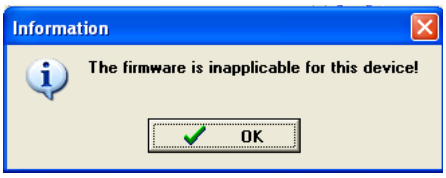
If the servo positioning controller already has the correct firmware, the upper given message windows do not appear. In this case, you can skip this chapter!

The firmware download may also be started from the menu **File/Firmware download**!

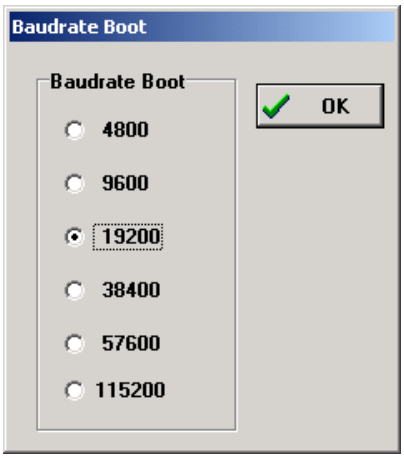
First, when starting the firmware download a window appears. Here, select the firmware file. The standard firmware is available for two different configurations:

- “Standard”. The firmware files for these devices have no name suffix (e.**g. LV-servoTEC S2 _3p4_1p1.MOT**). These are the (single-phase supplied) devices LV-servoTEC S2 1xx up to serial no. #999. Please contact the Technical Support for further information.
- Standard firmware for devices with integrated safe stop. The firmware files for these devices have the name suffix “_iS” **(e.g. LV-servoTEC S2 _3p4_1p1_iS.MOT**). These are all three-phase supplied devices LV-servoTEC S 2 3xx as well as the single-phase supplied devices LV-servoTEC S2 1xx starting with the serial no #1000. These devices also have the [X3] connector on the front side. Please contact the Technical Support for further information.

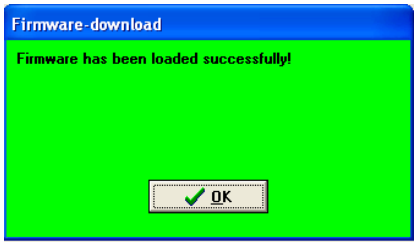
Due to the different hardware configurations of the devices the corresponding firmware has to be loaded. Unsuitable firmware will cause the following message to be displayed:



The next window to appear is the window for selecting the transmission rate (baudrate).



Try a baudrate of 115200 Baud. If there are problems with the data transfer (error messages), you must reduce the baudrate.
The following message will appear after a successful firmware download:



If the firmware download was not successful, the message Error at firmware boot will be shown. In most cases this can be attributed to a communication error during the data transfer to the servo positioning controller LV-servoTEC S2. Repeat the procedure described above at a lower baud rate.

5.2 Commissioning

Commissioning is a feature to help users, who are no experts, with the initial operation of the motor / drive. The user is guided through several dialog menus, some of which use automatic identification mechanisms of the firmware.

Commissioning of the servo positioning controller is possible, when

1. the parameterization program S2 Commander has been properly installed and
2. communication with the servo positioning controller LV-servoTEC S2 has been established

DANGER!
Carry out the steps for basic setting in the proper sequence shown in the manual!
Noncompliance can damage the motor and/or the servo positioning controller!

The following steps and menus are part of the commissioning process:

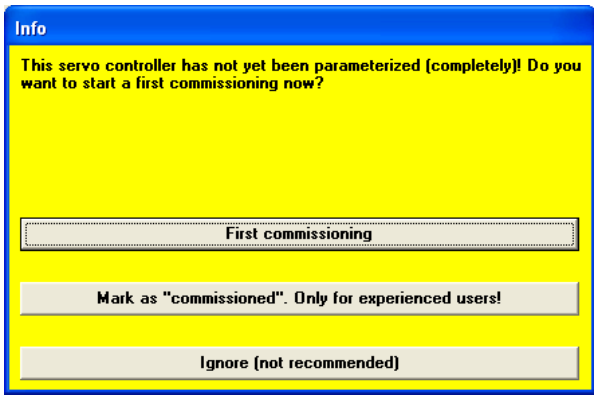
1. Resetting of the commissioning information (recommended)
2. Inquiry: "Standard" drive or special motor?
3. Loading of a parameter set (optional)
4. General configuration
5. Display units
6. Input limits
7. I/O configuration
8. Motor data / motor selection
9. Safety parameters
10. PFC parameters
11. Temperature monitoring
12. Commutation encoder
13. Angle encoder settings / angle encoder indentification
14. Current controller settings / current controller identification
15. Limit switch settings
16. Parameterization of speed controller
17. Parameterization of position controller
18. Saving of parameter set in the servo positioning controller / as file

Most of the functional elements described in the following chapters are also available directly in the parameterization software via the menu bar.

5.2.1 Commissioning warning

The parameterization program S2 Commander detects a missing commissioning of the servo positioning controller.

The following message will be displayed:



Inexperienced users should at this point perform a commissioning. The following chapters explain how to proceed.

You can also commission an LV-servoTEC S2 series servo positioning controller which has already been in operation. To do so, select the menu option **File/Commissioning**.

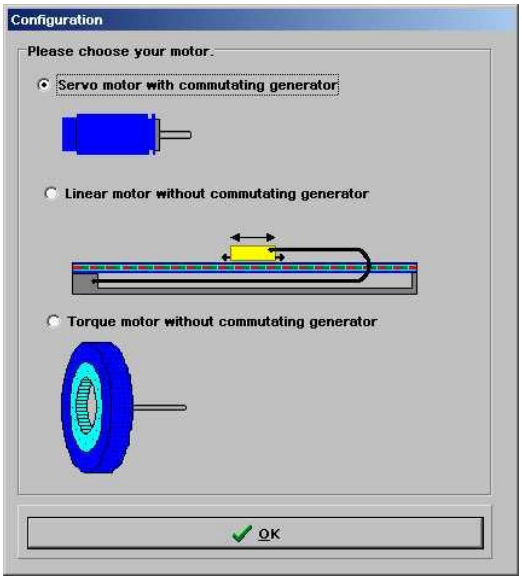
If the default parameter set is stored in the EEPROM of the controller (default setting) the controller status is „not commissioned“. In this case, the 7-segment display shows the letter "A".
As soon as one of the windows relevant for commissioning (e.g. the menu for setting the angle encoder) is opened and a value is changed, the displayed letter "A" will disappear again.

5.2.2 Resetting of commissioning information

The commissioning status of the issues to be handled will be stored in the servo positioing controller in separate bits. They show, whether the corresponding function or setting has been put into operation or not. Therefore, if complete commissioning is desired, we recommend resetting the entire commissioning information first.

5.2.3 Inquiry standard drive or special motor

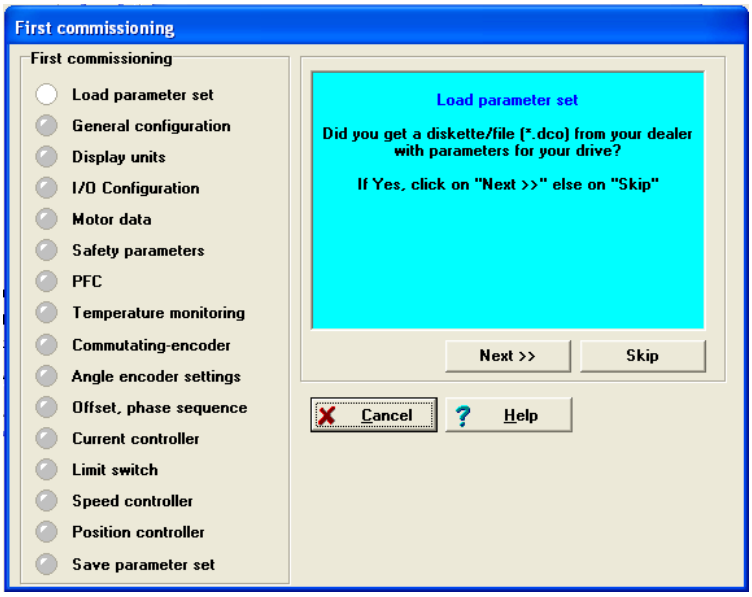
The menu-assisted commissioning procedure is optimized for motors with encoders that support commutation signal. So the first step is to determine the type of the encoder:

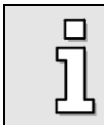


A menu-assisted commissioning procedure specifically adapted to linear motors or motors without a commutation encoder (e.g. some torque motors) is not supported in parameterisation software 2.7 and lower. Only a suitably preset parameter set can be loaded. If desired, the user can perform the remaining commissioning procedure and check or change parameters. Please select the appropriate configuration.

5.2.4 Loading of a preset parameter set

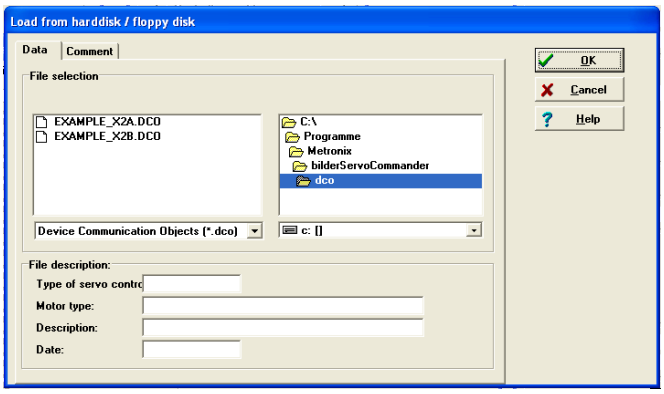
The commissioning control now provides you with the following information:





You can access this menu option directly via **File/Parameter set/Open file**.

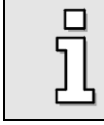
The following window will appear:



If you received a parameter set file for your drive from your sales partner, you can now load it:

1. Select the desired parameter set. Parameter sets have the extension ***.DCO**.
2. Click on **OK** to transfer the parameter set to the servo positioning controller LV-servoTEC S2.

Now, the parameter set is transmit to the servo positioning controller. A progress bar indicates the state of the transmission.

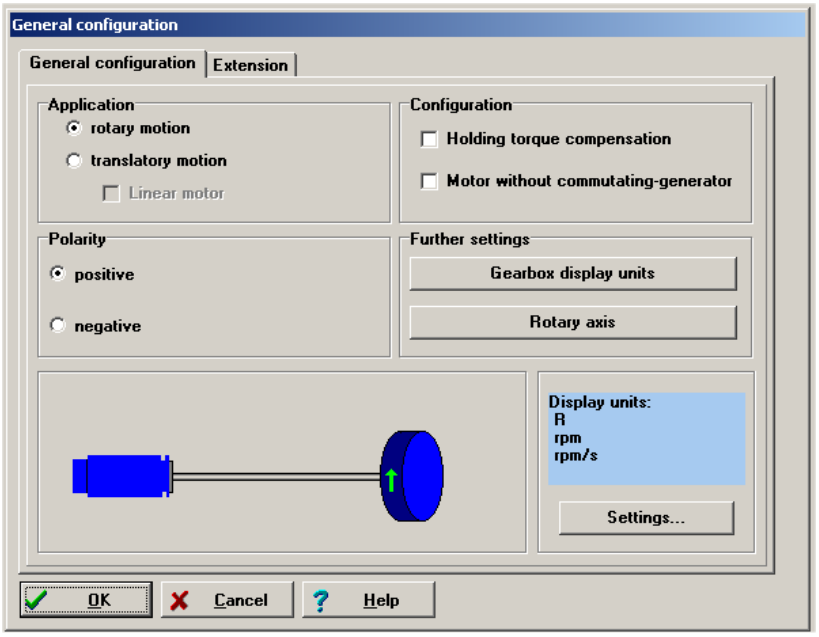


Depending on the contents of the *.DCO file, another commissioning is either necessary or just optional. We recommend performing a complete commissioning.

5.2.5 General Configuration

Outside of the commissioning procedure, the window can be opened via the menu **Parameters/Application parameter/General configuration**.

The following window appears:

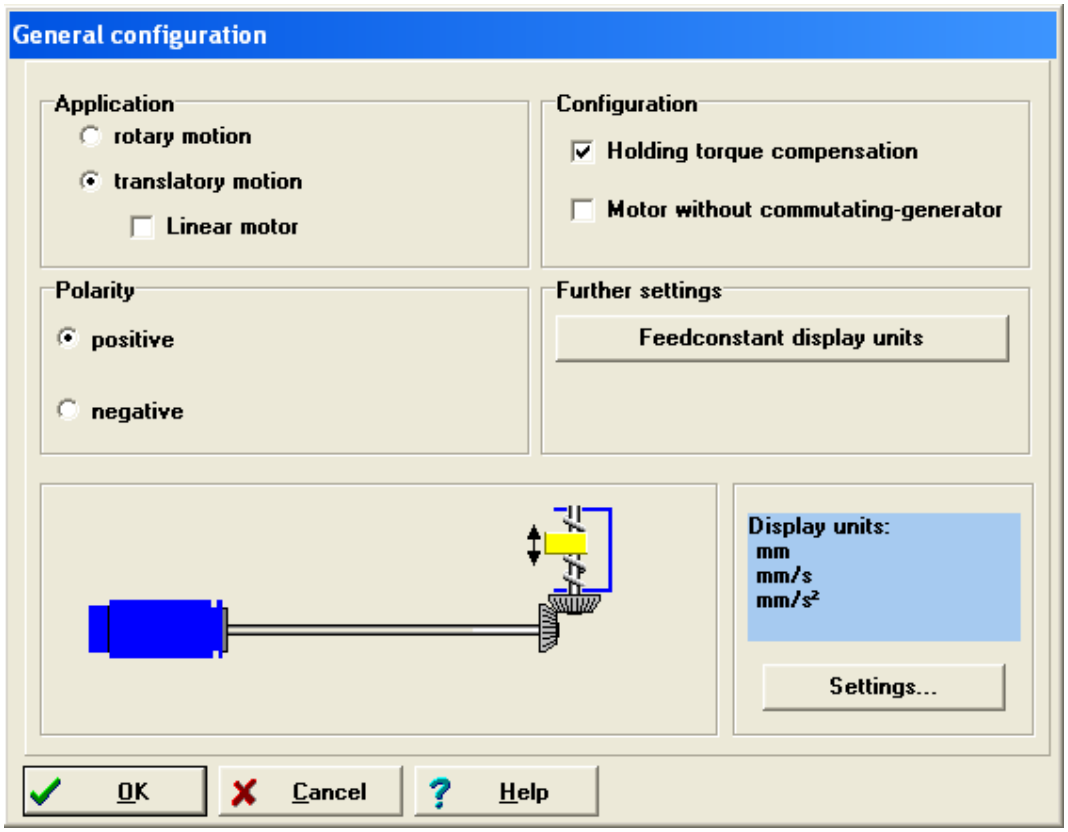


In the "commissioning" state, some window elements are blocked!

In the “Application” section the user can choose from a rotary application (display units in revolutions, degrees or radian) or a translational application (display in distance units). The check box “Linear motor” can be selected as an option. As a result, the picture in the lower window pane changes. When using linear motors, make sure to select the check box “Motor without commutating-generator”, see below.

The check box “Holding torque compensation” must be checked, in the case of permanent torque in either direction (e.g. weight in the case of a vertical axis.) In this case, the holding torque of a servo positioning controller of type LV-servoTEC S2 will be pilot-controlled when the holding brake is released during torque and position control or during positioning, in order to minimise the sagging of the axis due to its own weight. The LV-servoTEC S2 servo positioning controller automatically updates the required holding torque when the controller is enabled. As a result, possible load changes are continuously tracked. In the case of a controller enabling after the first activation of the holding torque compensation, the pilot-controlled holding torque is still zero. If the holding torque compensation is not activated, the pilot-control is automatically set to zero.

In torque control mode, no holding torque is pilot-controlled.



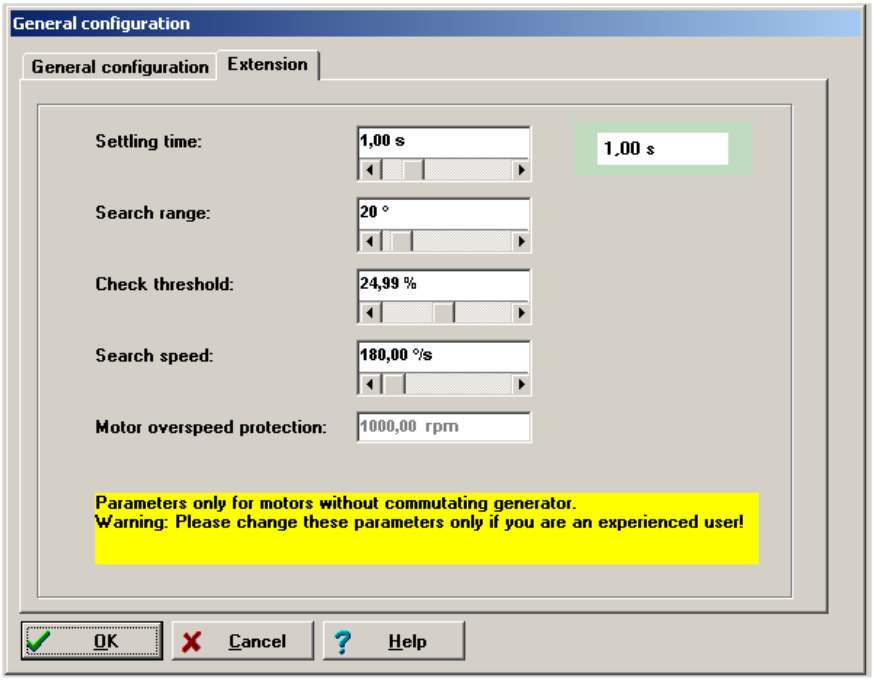
The checkbox **Motor without commutating-generator** must be activated for all drives, where the connected angle encoder does not provide any commutation signals, e.g. linear motors. The checkbox also has to be selected if it is a rotary application which does not supply any commutation signals.

The section **Polarity** still has no function yet.

The appearance of the section **Further settings** depends on the application:

Rotary:	The button **Gearbox display units** opens the menu **Display units**, where you can enter values for your gearbox. (See also chapter *Configuration of Display Units,* page *47*). The button **Rotary axis** is used in case of presetting the positioning ranges and to set the behaviour of a positioning run in case of having such a rotary positioning range. (See also Chapter *Configuration of Display Units,* page *47*).
Translatory:	The button **Feedconstant display units** opens the menu **Display units**, where you can enter values for your gearbox. (See also chapter *Configuration of Display Units,* page *47*).

The field displayed in light blue shows the display units that are currently valid. Clicking on the button Settings … will also open the window Display units (see chapter *Configuration of Display Units* , page *47*).



These parameters are only valid for applications with encoders without commutation signals, e.g. linear motors.

Unfavourable settings may cause an unsuccessful automatic determination of the commutation position. So change these settings only if you are an experienced user or after consultation!

Motor overspeed protection

Protection against counting errors when applying pure incremental encoders. The method monitors the drive against “uncontrolled movements“.

The mechanism of the motor overspeed protection depends on the operating mode:

Operating Mode	Mechanism
Torque control	Comparison to the actual speed value. There is no useful speed setpoint available.
Speed control Positioning	Comparison to the difference between speed setpoint and actual speed.

This parameter is not identical to the motor overspeed protection which is available by the menu **Parameters/Safety parameters...**

Mode

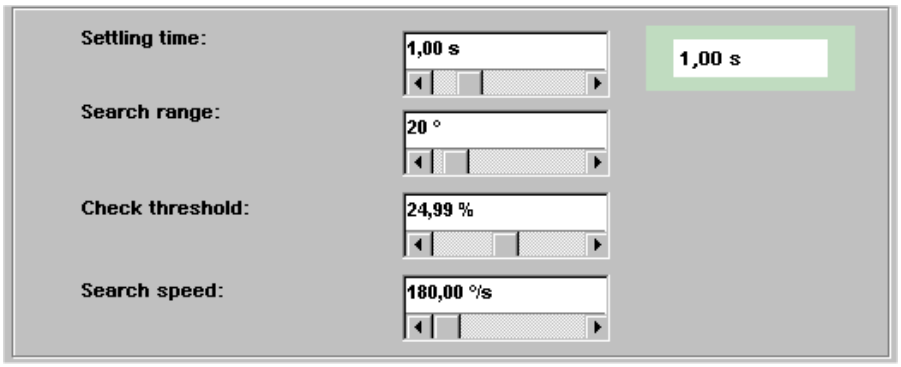
Before the first enabling after power-on of the servo positioning controller the commutation position has to be valid in order to ensure a correct commutation of the motor. This needs for the knowledge of the encoder angle correlated to 1 revolution. This is not true for pure incremental encoder systems for example. For these configurations there are different methods for the determination of the commutation position during the first enabling. These methods differ from each other by the specifically required movement and its edge conditions, e.g. the physical attributes of the drive.

The user can set following methods:

- **Self adjustment method**
  This method moves the motor over twice the search interval. Depending on the initial position a jerky movement may occur at the beginning. Not suitable for horizontal applications.
- **Reaction method (recommended)**
  Suitable for horizontal and vertical applications without brakes. A small movability is sufficient for the determination of the commutation position (virtually without movement).
- **Saturation method**
  This method is not suitable for ironless motors. Furthermore it requires a locked motor as there is not any movement allowed during the determination of the commutation position (without movement). Suitable for horizontal and vertical applications.

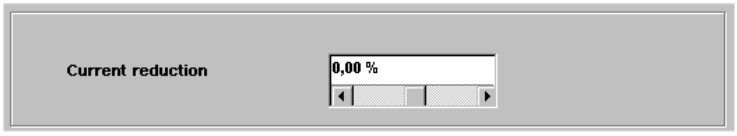
Each mode requires appropriate process parameters. Only the relevant parameters are displayed on the surface.

Self adjustment method



- **Settling time**
  Wear off delay of transients of e.g. the motor current, the mechanical start-up movement into the commutation position etc. Adapt this parameter to the particular inert mass of your application.
- **Search range**
  The search range determines the (electrical) angular range which the commutation angle covers during the determination of the commutation position.
- **Check threshold**
  The mechanical position must follow at least for this part of the search range. Due to pure setting of the commutation angle (no position control) the mechanical position may not change by the same absolute value e.g. due to cogging torques. Among others the check threshold serves for the detection of a mechanical end stop.
  Example:
  The mechanical position must follow by at least 30° for a search range of 60° and a check threshold of 50 %.
- **Search speed**
  Angular velocity of the commutation angle over the search range. Adapt this parameter to the particular inert mass, cogging torques etc. of your application.

Reaction method, saturation method



- **Scaling test current**
  If the application tends to oscillations, the current may need to be reduced when applying the reaction method. Otherwise the result is invalid and leads to an error message (35-5).
  If an error occurs during the identification process, the current should be reduced in a stepwise manner.

LED „Commutating position valid“

The LED indicates the successful evaluation of the commutating position. The status is cleared e.g. if an encoder error occurs. This signal is only relevant for drives with encoders without commutating signals.

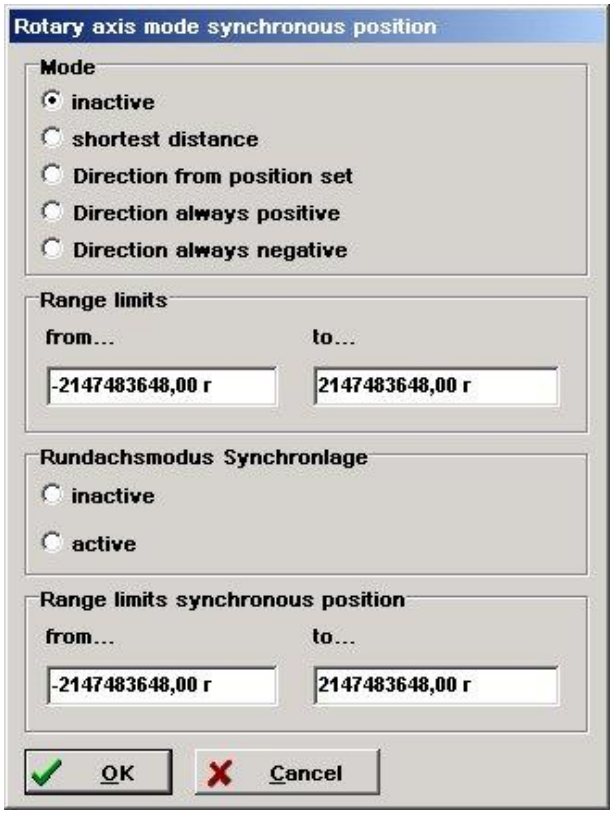
Reset

This button serves as a help during the first commissioning process. If the drive is adapted to the application for the first time, the adaptation of the parameters can be eased. By resetting the "Commutating position valid" status the identification process will be started again if the drive is enabled. So the identification process can be repeated in a controlled manner.

5.2.6 Rotary axis operation

Rotary axis applications can be activated in this menu. Such axes are used in case of having a rotation plate or turning arrangement for instance.

In an rotation plate application the actual position is restricted artificial to a certain interval. If the boundaries are reached on the right hand side it passed to the left maximum position and vice versa.



In the modes area of the rotary axis menu the following items are given:

1. inactive: The rotary axis is not active. The limitation does not happen.
2. shortest distance: The rotary axis is active. In case of positioning mode the shortest distance is used for travelling to the next target position. In case of having a rotary axis in the range of 0 ..5R and the actual position is 4.5R, a positioning run to 0.5R happens in positive direction because this is the shortest distance to the target.
3. Direction from position set: The rotary axis is active. The direction of the movement is taken from the positioning set. (See also chapter *Tab: Experts,* page *133*).
4. Direction always positive: The rotary axis is active. The positive direction is always taken during positioning runs
5. Direction always negative: The rotary axis is active. The negative direction is always taken during positioning runs

The area range limits is given to set the interval for limiting the actual position.

The lower limit is included in the interval and the upper limit is not included . This is for easily adjust the ranges of the rotary axis.

Example: A rotary axis for exactly one revolution should be defined:

A wrong set-up is : start = 0 R, end = 0,99999 R

The right set-up is: Start = 0 R, end = 1 R

Activate or deactivate a rotary axis functionality in the field **Rotary axis mode Synchronous position**. This can be separately applied for the selected synchronous position independently from the ranges set for the standard rotary axis functionality resp. its mode. So, master position (synchronous position) and slave position may use different position ranges.

Set the interval for the limitation of the synchronous position in the field **Range limits synchronous position**. The interval limits the numerical range of the position values. The current position value automatically switches over to the opposite if it exceeds one limit.

A rotary axis set-up has advantages in case of a given turning arrangement in addition with course programs and position triggers.

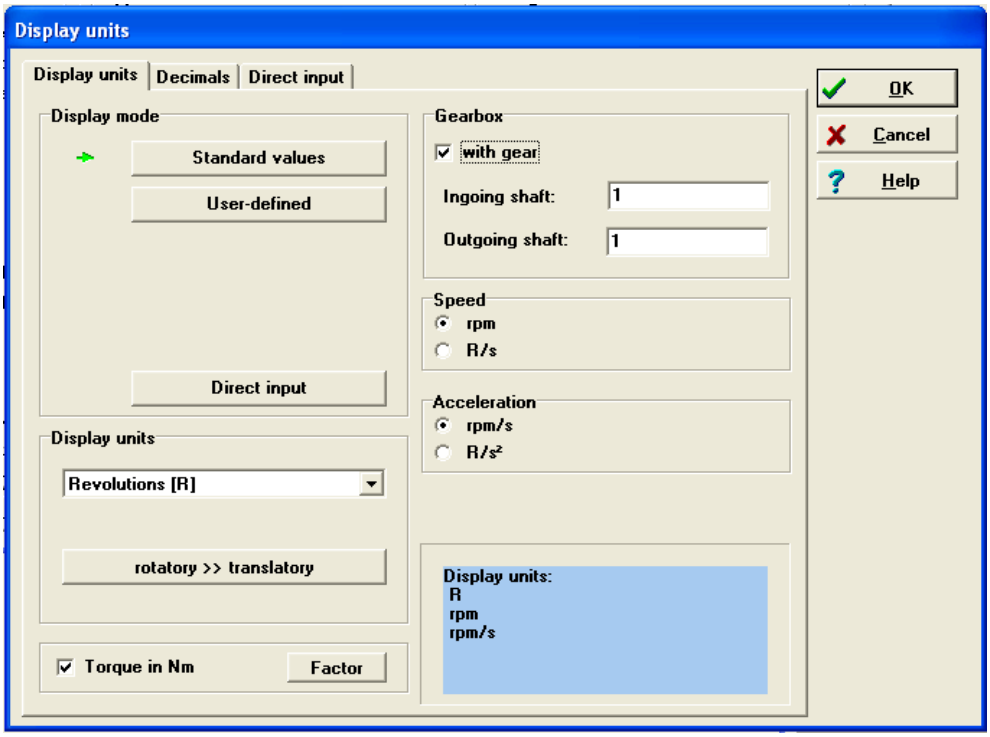
The following advantages are given:

- No added position shift in case of continuous strokes in the same direction (A gear factor with integer ratio is necessary to reach this).
- By use of a course program a stepping for clamping or relaxing of parts on the turning arrangement can be implemented
- Position trigger can be used for flagging certain positions or index points around the turning arrangements circumference
- Reduction of programming effort on the superposed PLC

5.2.7 Configuration of Display Units

As the configuration of the display units is a complex subject, only the basic principles will be discussed in this section. For a detailed description, please refer to Chapter *Display units* **(details)**, page *88*.

Outside of the commissioning procedure, the window can be opened via the menu **Options/Display units**. The following window appears:



In the "commissioning" state, some window elements are blocked!

In the section **Display mode** the display units can be set “roughly”. The mode **Standard values** covers 90 % of all applications. The modes **User-defined** and **Direct input** are explained in chapter *Display units (details),* page *88*.

5.2.7.1 Rotary Operation

The following is possible for rotary systems:

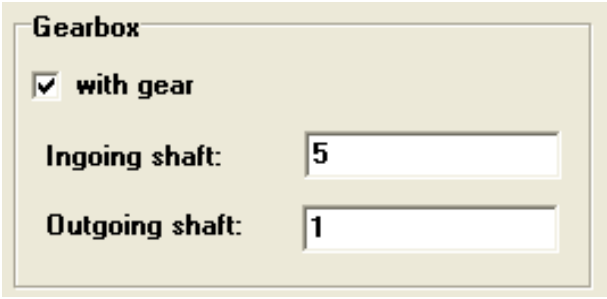
- Positions in revolutions, degree or radian
- Speed in [position units]/s (*)
- Acceleration in [position units]/s² (*)

(*): In “Revolutions” mode, the following combinations of speed and acceleration are possible:

Table 6: **Display units Rotary operation**

Combination	Position	Speed	Acceleration
1.	R	RPM	RPM/s
2.	R	RPM	R/s²
3.	R	R/s	R/s²

In rotary mode you can enter a gearbox, if you want to set your application on the output side. To do so, select the checkbox **with gear**.

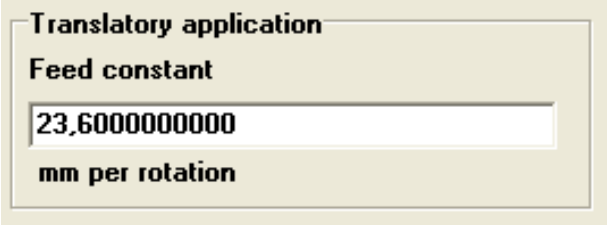


5.2.7.2 Translatory Operation

The following is possible for translation systems:

- Positions in distance units (m, mm, µm)
- Speed in [distance units]/s
- Acceleration in [distance units]/s²

In the translation mode, you need to define which distance unit corresponds to one motor revolution. This value has to be entered into the **Feed constant** field.

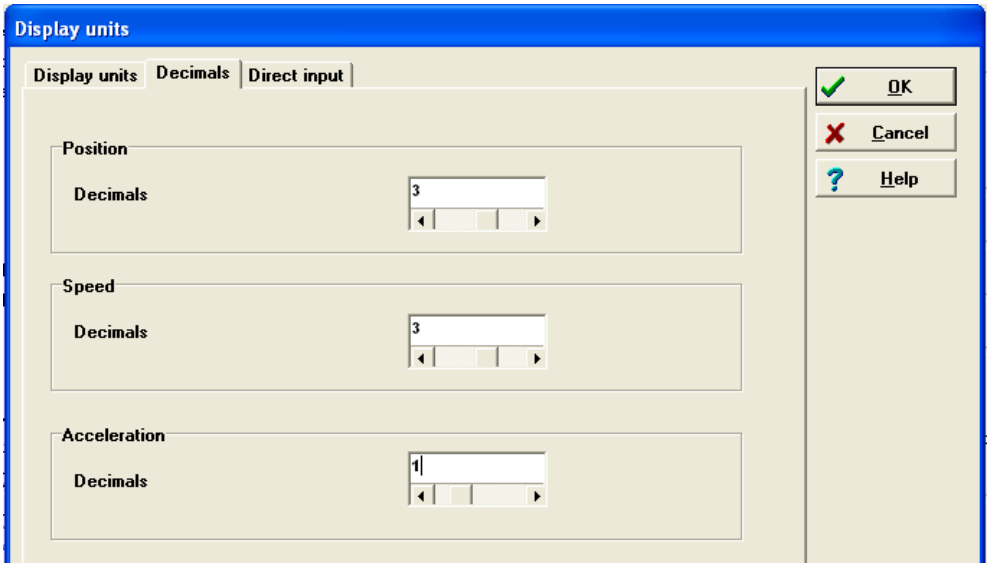


5.2.7.3 Other Possible Configurations

In the section **Display units** the appropriate units can be selected (rotary or translatory mode). If you want to change the default setting, click on the button **rotary >> translatory** or **translatory >> rotary**.

You can define whether you want torques to be displayed in A or Nm. For Nm select the checkbox **Torque in Nm**. This requires a correct conversion constant (A→Nm). You can set the conversion constant by clicking on the button **Factor**.

On the **Decimals** tab you can select, how many decimals are to be displayed for position, speed and acceleration values.



The tab **Direct input** is explained in chapter *Direct Input of the Distance, velocity and Acceleration Units,* page *90*.

5.2.7.4 Quitting the Menu (Applies only to Commissioning)

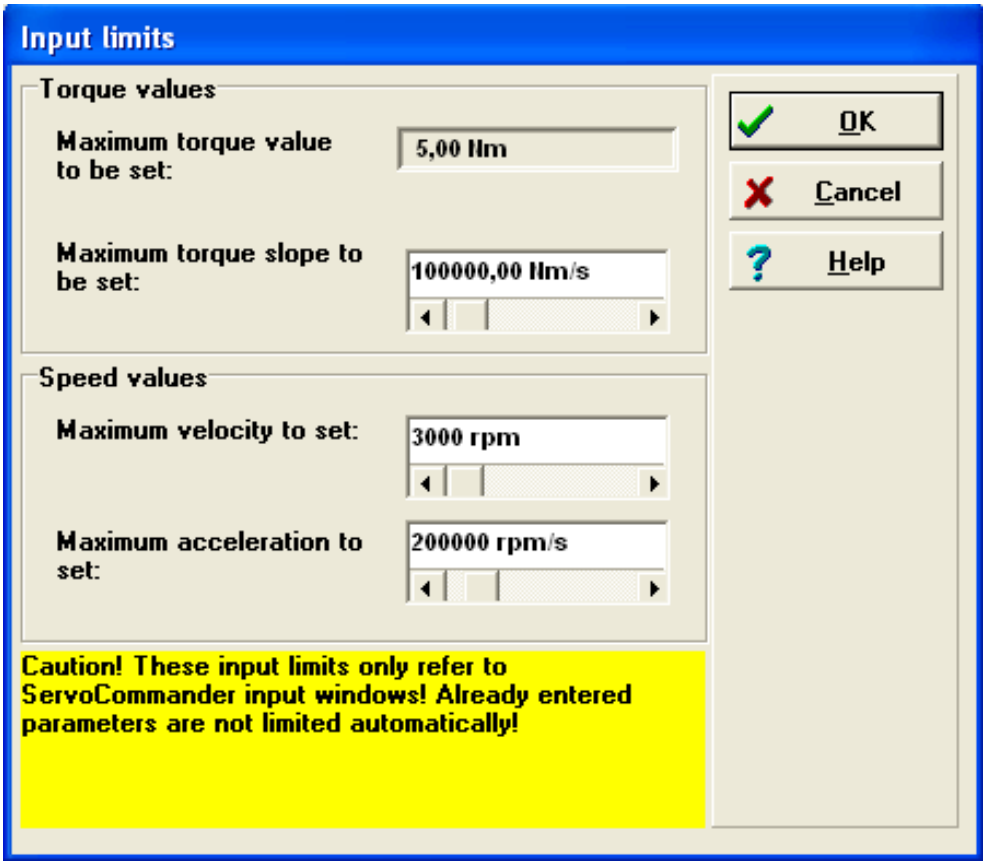
If you quit the menu during commissioning, the program will display the following question:

Caution!
If you select **No**, the input limits of the S2 Commander will not be adapted.
This setting may cause serious equipment damage.

Click **Yes** to open the window **Input limits** (see chapter *Configuration of Input Limits*, page 50).

5.2.8 Configuration of Input Limits

Select **Options/Input limits** to open the following window:

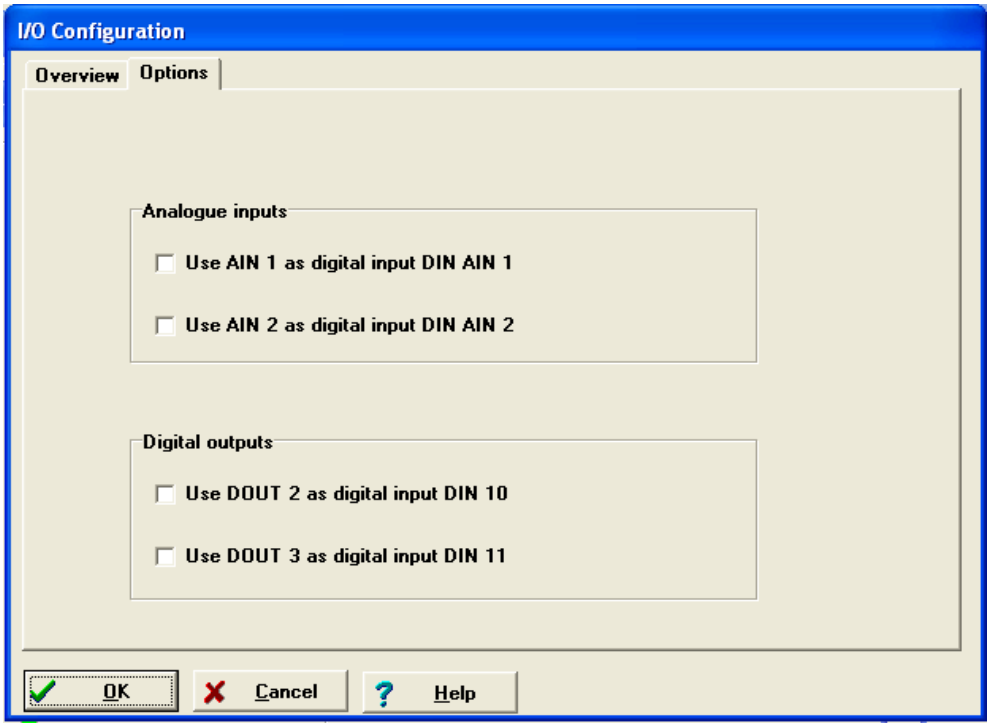


Enter the maximum speeds and accelerations you expect for your application. S2 Commander uses these inputs for the display of the input boxes.

- The input limits can be modified at any time.
- The input limits only affect the input fields of the parameterisation program!
- Speeds and accelerations will not be physically limited!

5.2.9 IO Configuration

The menu **Parameter/IOs/IO configuration** opens the following window:



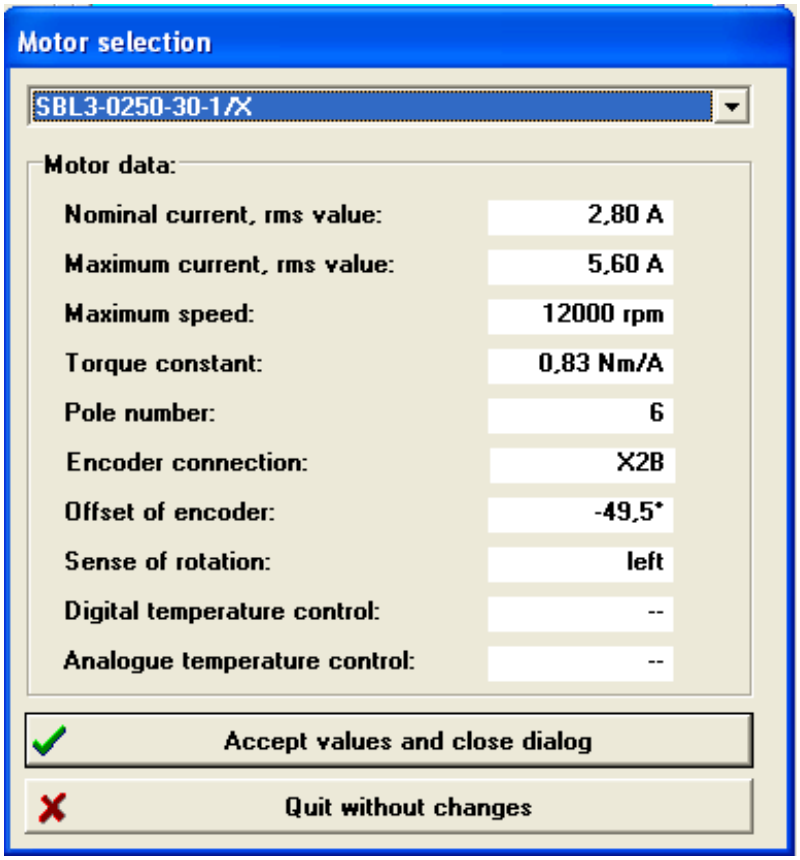
You can configure four additional digital inputs (if required) in this menu.
The following variants are possible:

- Analogue input AIN1 can be used as a digital input
- Analogue input AIN2 can be used as a digital input
- Digital output DOUT2 can be used as a digital input
- Digital output DOUT3 can be used as a digital input

Click on the **Overview** tab to view the current configuration of the inputs and outputs.

5.2.10 Motor Identification via List

As part of the commissioning process the motor specifications must now be determined. This function can also be accessed via **Parameters/Device parameters/Motor data/Select new motor**. A list will be shown, from which you can select the motor you are using:



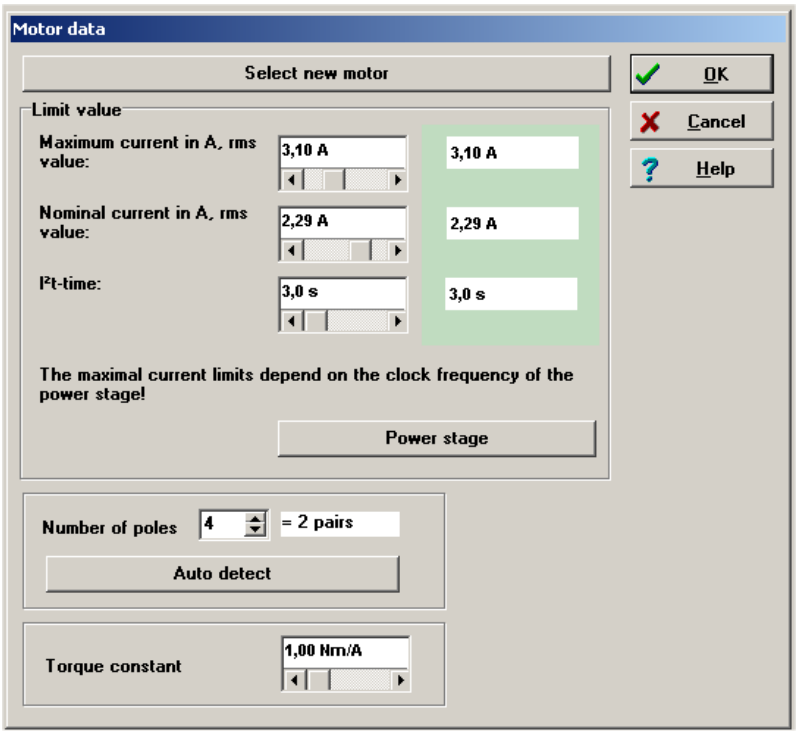
Select the motor if you can find it in the list and click on **Accept values and close dialog**. Otherwise click on **Quit without changes**. The specifications are then queried directly
(see next chapter *Configuration of motor specifications*, page *53*).

5.2.11 Configuration of motor specifications

> This window only opens during the commissioning, if the motor was not selected from the list.

(A similar function is also accessible via the menu **Options/Device parameters/Motor data**, see chapter *Motor Data Configuration,* page *174*).

During commissioning, the following window appears, where you can enter the maximum and nominal currents of the motor used as well as the torque constant:



Enter the specifications from the type plate. You can calculate the torque constant from the quotient of rated torque / rated current.

> Note that the values to be entered for the maximum current and the rated current are RMS-values! Excessive currents will destroy the motor, since the permanent magnets inside the motor will be demagnetised. Therefore the limits of the RMS-current range provided by the manufacturer must not be exceeded.

The maximum current limits depend on the clock frequency of the output stage. It can be selected via the **Power stage** button (see also chapter *Configuration of the Power Stage, page 175)*.

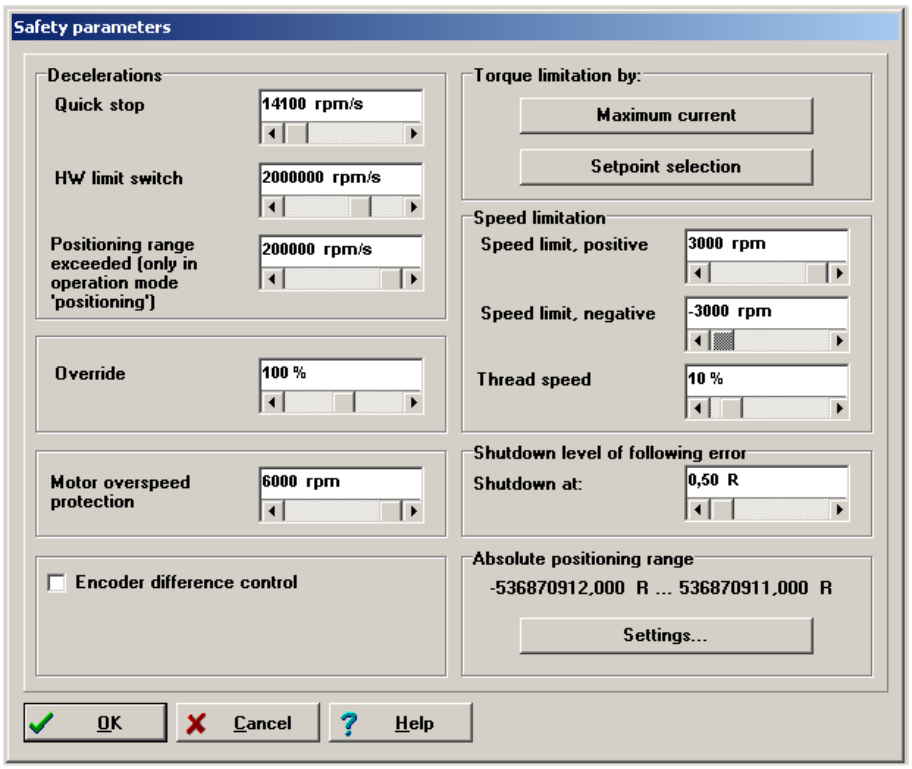
The **I²t-time** is identical to the intervall, in which the i²t-value rises to 100 %. The I²t value describes the current load of the servo positioning controller. The I²t increases when the current setpoint is higher than the nominal current. The value decreases when the current setpoint is lower than the nominal current. When the I²t value reaches 100 %, the current setpoint will be limited to the nominal current value. This limitation remains active until the I²t integral has reached 0 % once.

5.2.12 Safety Parameters

This menu is used to set safety parameters.

For commissioning some irrelevant fields are greyed out.

Outside of the commissioning procedure, the window can be opened via the menu **Parameters/Safety parameters**.



The deceleration of the drive under different conditions can be set in the **Decelerations** section.

Override: In the positioning mode, the driving speed of a running positioning run which is predefined by the positioning control system is also determined by a factor (override). Thus, the cyclic calculation takes into consideration the driving speed stored in the position set multiplied by the override. The override applies to all position sets and is also used during the homing run. If it has a value of 100 %, is has practically no effect.

The override is mainly used by field bus systems which overwrite this value cyclically. It can also be useful for start-up. It can be used to temporarily reduce the driving speed of all position sets without having to change every single position set individually.

The override will not be saved. Following a reset, it is automatically set to 100 %.

Motor overspeed protection: If the current speed exceeds the value stated in this field, error number 10 "overspeed (spinning protection)" will be issued.

Encoder difference control: This option is useful, if the encoder for the actual position differs from the encoder for the speed and commutation information. With this parameter you can set a maximum position difference value which may occur between these two encoders. If the value is exceeded, an error will be generated.

Torque limitation by: The maximum torque (or the maximum current) of the application can be limited by:

- The setting of the motor currents: Click on the Maximum current button to open the Motor data menu (see chapter *Configuration of motor specifications*, *page 53*).
- An explicit setpoint limitation. Click on the Setpoint selection button to open the corresponding menu (see chapter *Selecting Setpoints*, page 73).

Speed limitation:

Speed limit, positive: Here you can enter the maximum positive speed of your application. The effective speed limit, however, depends on the settings for the Override and for the Thread speed (please refer to the corresponding sections).

Speed limit, negative: Here you can enter the maximum negative speed of your application. The effective speed limit, however, depends on the settings for the Override and for the Thread speed (please refer to the corresponding sections).

Thread speed: In set-up mode, the maximum admissible speed setpoint is symmetrically decreased to a percentage value (0..100 %) of the maximum speed. For this process, the smaller value of the negative or positive speed limit will be used (see right hand box of the menu). In the operating mode speed control the speed setpoint is directly limited to this **Thread speed**. In the operating mode positioning the set-up modes even has effect on the positioning control. The profile velocity will be decreased so that a setpoint reserve (5 %) remains for the speed controller.

Example:

Positive speed limit	4900 rpm
Negative speed limit	4000 rpm
Thread speed	10 %

Operating mode speed control:
Maximum speed for set-up mode active = 4000 rpmin * 10 %
= **400 rp/min**

Operating mode position control:
Maximum profile velocity of a positioning for set-up mode:
= (4000 rpm * 10 %) – 5 % (setpoint reserve)
= 400 rpm * 0,95
= 380 rpm

The set-up mode is activated by a digital input (see also *chapter Digital Inputs, page 183)*.

The Shutdown level of the following error can deactivate the drive if the set position and the actual position differ from each other by an amount greater than the threshold value. The reaction has to be parameterised accordingly in the error management system.

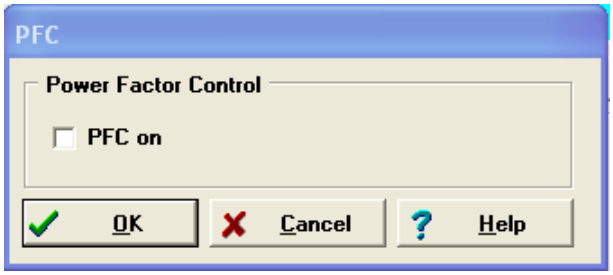
The Settings button the in the Absolute positioning range section leads you to the menu Global Positioning Settings (see chapter *Positioning,* page *128).*

A proper adjustment of the safety parameters is strongly recommended. The following steps are recommended:

- Proper set-up of the speed- and current control loops and adaptation of the acceleration and deceleration ramps of the positioning process.
- Analysing and adaptation of the following error during positioning profiles by use of the oscilloscope function.
- Selection of a suitable stopping mode in the error management, e.g. the stop with maximum current for linear motors.

5.2.13 PFC (Power Factor Control)

This menu is used to activate or deactivate the Power Factor Control (PFC) for single-phase LV-servoTEC S2100 devices. The menu can also be opened via **Parameters/Device parameters/PFC**.

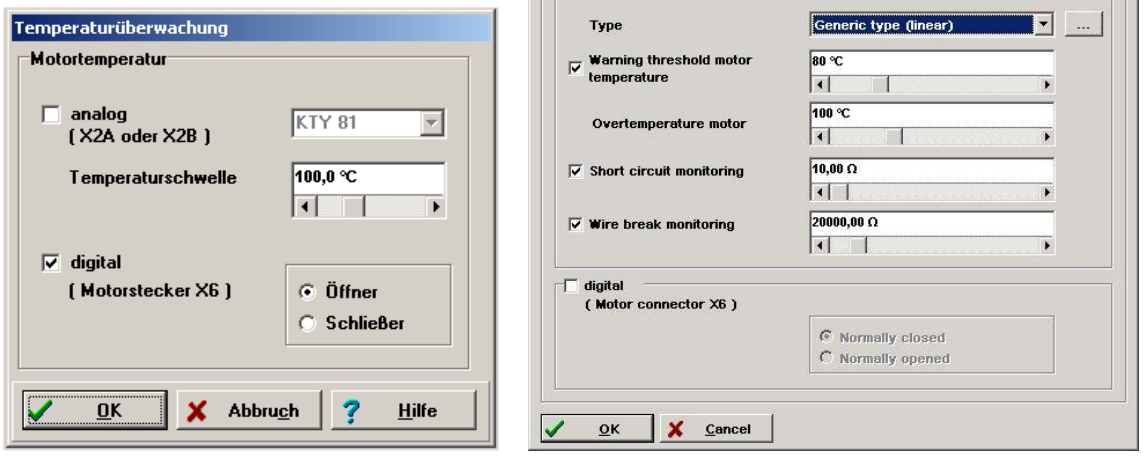


In stationary mode, PFC ensures the intake of a sinusoidal mains current. As a result, the relevant EN-standard (mains harmonics) are complied with. In addition, the higher DC-link voltage is a power reserve for your drive. PFC cannot be used in the following cases:

- You operate the servo positioning controller with a DC-link or
- the motor is not designed for the higher DC-link voltage.

5.2.14 Temperature Monitoring

This menu is used to adjust the temperature monitoring system. The menu can also be opened via **Parameters/Device parameters/Temperature monitoring**. Please state whether you are using an analogue or a digital temperature sensor.



As of product step 3.5 (firmware) the user can also parameterize resp. select a non-linear characteristic with up to 10 interpolation points for analogue motor temperature sensors. The appropriate extended representation illustrates the figure on the right. The interpolation points for temperature and the corresponding resistance are displayed by a separate window.

The pull down menu for **Type** offers the following varieties:

- Generic type (linear): Enter the values for the resistance at 25 °C and 100 °C via the command button „**...**“.
- Vishay compatible: The data of the characteristic are displayed when clicking onto the command button „**...**“.

  Generic type (non linear): Enter or modify the data of the characteristic by clicking onto the command button „**...**“.

Set the threshold temperature for generating a reaction in order to activate an analogue motor temperature monitoring.

As of product step 3.5 (firmware) the following additional monitoring functionalities may also be activated and set:

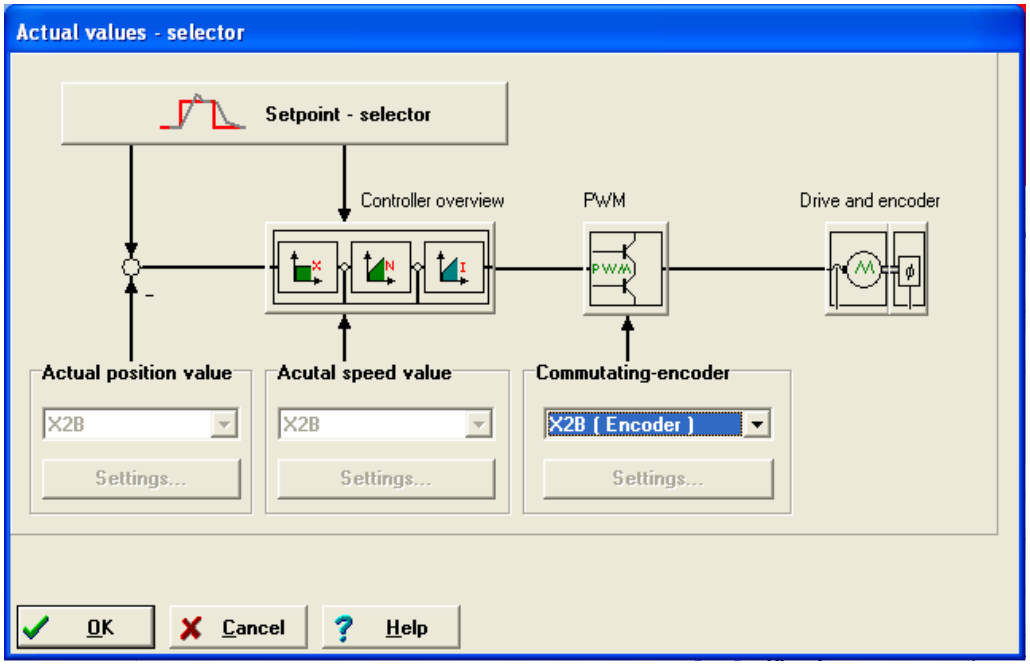
- Field Warning threshold motor temperature: Enter the threshold as of which the system shall detect a motor overtemperature.
- Field Short circuit monitoring: Enter the lower threshold of the value of the temperature sensitive resistor. For detected resistances below this value the servo positioning controller signals a short circuit.
- Field Wire break monitoring: Enter the upper threshold of the value of the temperature sensitive resistor. For detected resistances above this value the servo positioning controller signals broken wire.

In the case of digital temperature sensors, you have to state whether it is an normally closed or a normally opened contact.

5.2.15 Commutation Encoder

This menu is used to define the input through which the servo positioning controller is supplied with its commutation information. This menu can also be called up via **Operating mode/encoder selection**.

State the connection through which encoder the commutation information and the actual speed value is to be provided.



The actual value selection defines the encoder signal for feedback. The signals X2A, X2B and X10 are available. An angle encoder is assigned to these signals in the angle encoder menu (**Settings** button). You can select an extra encoder for the evaluation of the actual position value as well as the synchronization. For this, see chapter *Applications with Several Angle Encoders* , page *143*.

The selected configuration is shown in the form of an overview.

The setpoint selector and the controller overview are provided in the form of buttons used to activate the corresponding dialogs.

You can use the buttons to open quickly open associated menus (e.g. setpoint selection). This option is blocked during commissioning.

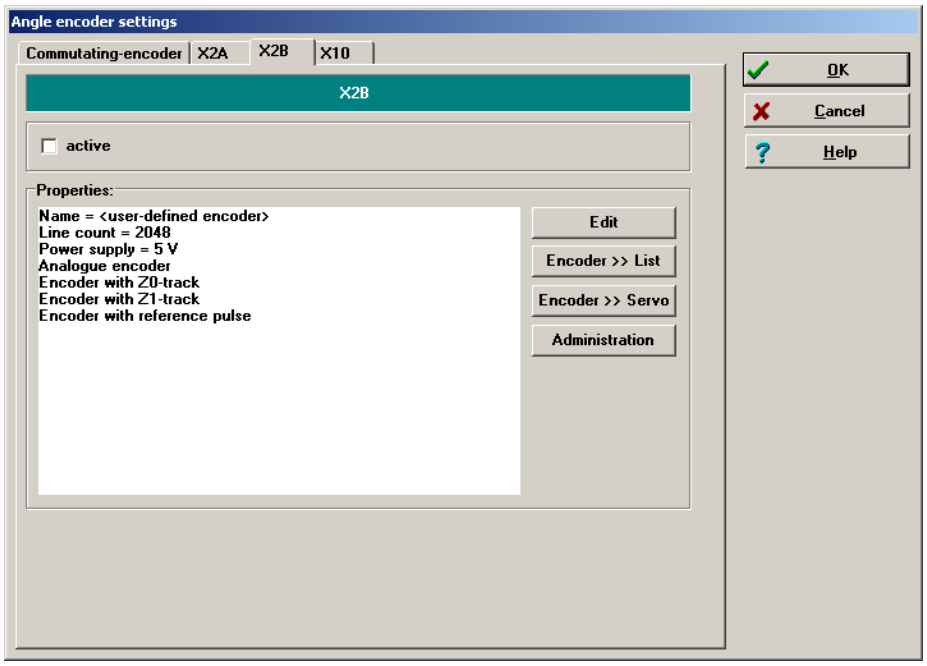
5.2.16 Configuration of the Motor Feedback

The menu is skipped during commissioning, if a resolver (X2A) is used as commutation encoder.

Further information concerning the angle encoder has to be entered if a commutation encoder is connected to X2B. Use this menu. The menu may also be opened by **Parameter/Device parameters/ Angle encoder settings/X2B**.

Select the connected encoder by clicking onto the button **Encoder >> Servo**. If the encoder is not included in that listing, set the encoder by clicking onto the button **Edit**.

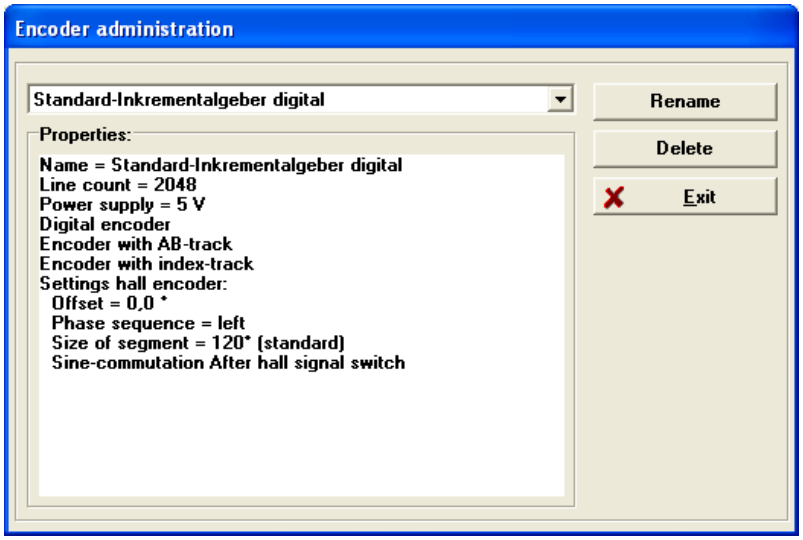
Following, the menu is explained in detail:



The menu has the following elements:

- Check box **active**: If the check box is selected, it means that the firmware analyses the encoder information on this connection. The check box has to be selected if the angle encoder is used for commutation and/or for determining positions or speeds.
- Field **Properties**: This field shows the properties of the encoder. The encoder has a **Name** which can be changed by the user. If the current encoder configuration has not been saved yet, the name is displayed as "<user-defined encoder>".
- Button **Edit**: This button opens another view where the individual options of the encoder can be changed.
- Button **Encoder >> List**: If you have configured a new encoder combination, you can save it under any desired name in a list which is managed by the parameterisation program. If you parameterize a new drive, you can quickly load this combination into the servo by clicking on the **Encoder >> Servo** and selecting the encoder name.
- Button **Encoder >> Servo**: This button is used for a quick setting of the encoder. Look for the name of your encoder on the list. When you select this entry, the entire configuration will be loaded into the servo positioning controller.

- Button **Administration**: The following menu will appear:



  - Use the **Rename** button if you want to rename one of the entries on the encoder list. First, you have to select the desired encoder from the list (upper scroll box).
  - Use the **Delete** button if you want to delete an entry from the encoder list. First, you have to select the encoder to be deleted from the list (upper scroll box).
  - Click on the **Exit** button to exit the encoder administration menu.
- Button **Save & Reset**: Under special conditions the settings have to be stored to the internal non-volatile memory of the servo positioning controller (SAVE). Then it has to be reset (RESET). In this case the yellow hint and the button is visible.
- Button **Save** (encoders with EEPROM only): If the connected encoder at X2B has an EEPROM a field with a button “Save” appears. Use this button to store encoder and motor parameters to the EEPROM of the angle encoder. Another menu opens when clicking on the button. Choose the option “Save parameters to encoder”.

5.2.17 Angle Encoder Identification (Automatic Determination)

During commissioning, the angle encoder is automatically identified. The identification process determines the following parameters:

- Number of pairs of poles
- Angle encoder offset
- Phase sequence of the angle encoder (left, right)

Outside commissioning, the function can also be called up in the following menus:

- Parameters/Device parameters/Motor data: button Auto detect
- Parameters/Device parameters/Angle encoder settings: button Auto detect

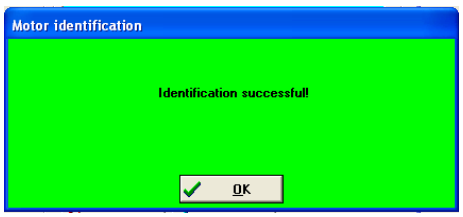
The following conditions have to be fulfilled for an automatic identification:

- The motor is completely wired.
- The DC-link voltage is present.
- The servo positioning controller is error-free.
- The power stage (DIN4) has been enabled.
- The shaft can move freely.

If the automatic determination cannot be performed during commissioning, the angle encoder data has to be entered manually. See the following chapter.

The following menu will appear:

A successful motor identification is indicated by the following message:



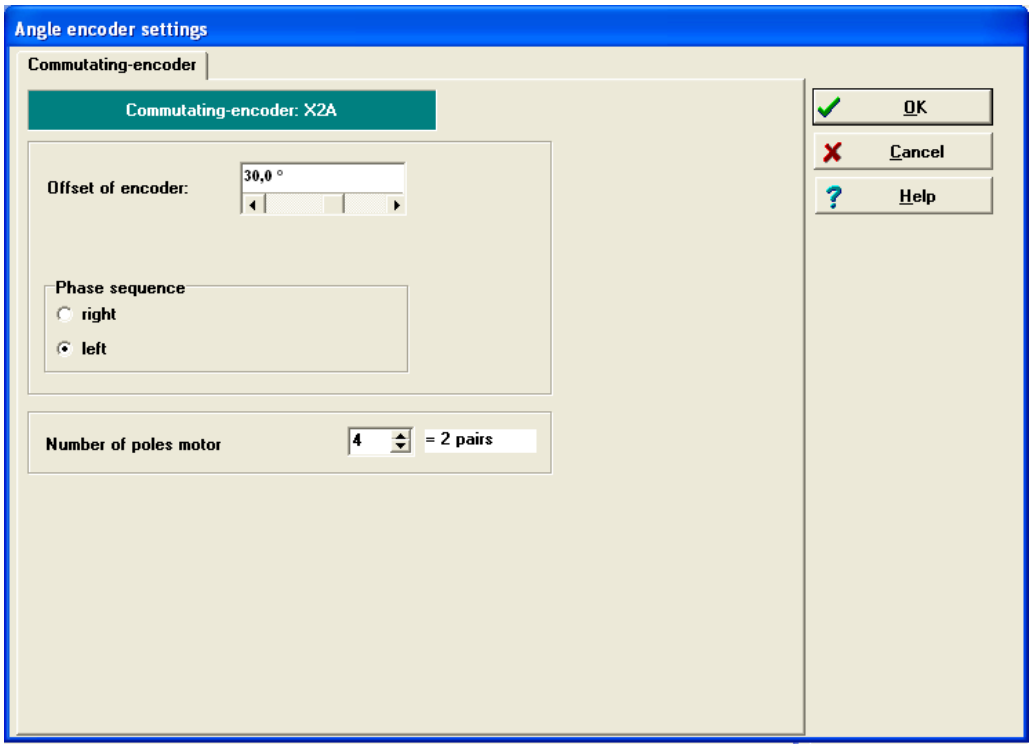
If problems occur during the angle detection, the following things should be taken into account:

- The nominal motor currents are parameterised to small or the motor shaft is not movable
- In case of having many servos in one rack, the encoder of a different motor is connected
- Wrong encoder set-up
- Defective motor (Check this by taking the motor impedance)
- Not all phases are connected: Check this by taking the motor impedance directly at the motor plug connected to the servo controller)

5.2.18 Angle Encoder Data (Manual Input)

If the angle encoder data are determined automatically, this point will be skipped!

The following window appears to enter the angle encoder data manually:



Enter the correct parameters.

Caution!

Incorrect angle encoder data may lead to uncontrolled movements of the drive. This may damage the motor or the entire system.

5.2.19 Automatic Identification of the Current Controller

During commissioning, the current controller is automatically identified. The identification process determines the following parameters:

- Current controller gain
- Current controller time constant

Outside commissioning, the function can also be called up through the following menu:

- Parameters/Controller parameters/Current controller: button Auto detect

The following conditions have to be fulfilled for an automatic identification:

- The motor is completely wired.
- The DC-link voltage is present.
- The servo positioning controller is error-free.
- The power stage (DIN4) has been enabled.
- The shaft can move freely.

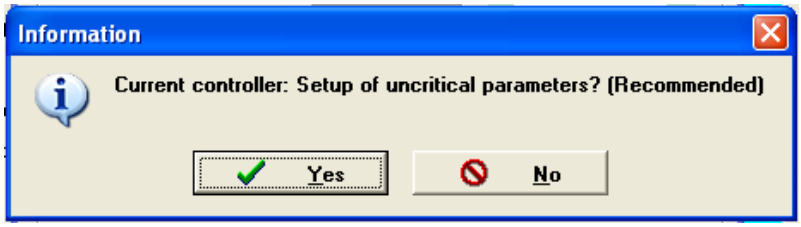
If the automatic determination cannot be performed during commissioning, the current controller parameters have to be entered manually. See the following chapter.

As far as the procedure and the menus are concerned, the automatic identification of the current controller is identical with the automatic angle encoder identification (see chapter *Angle Encoder Identification (Automatic Determination),* page *61).*

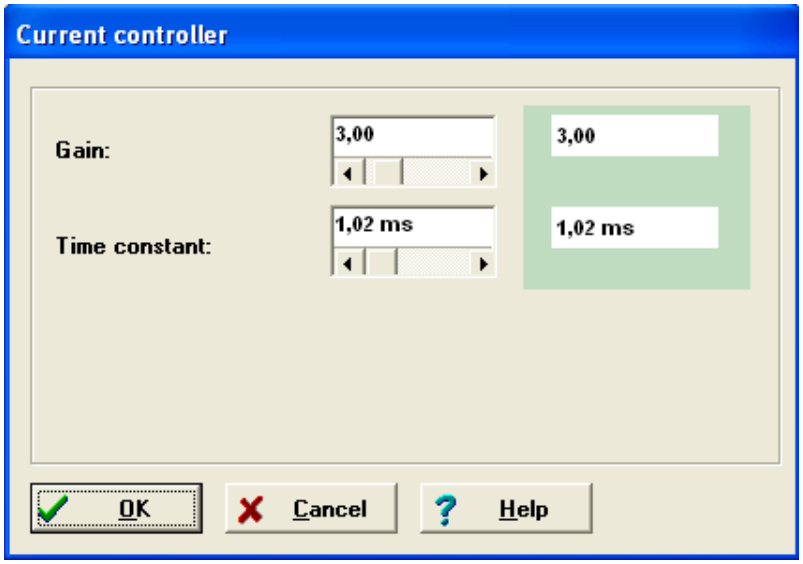
5.2.20 Manual Input of Current Controller Data

If the current controller data has been determined automatically, this point will be skipped!

The following window appears to enter the current controller data manually:



Click **Yes** to confirm. Then the following menu appears:



Enter the correct parameters. If you are unsure, keep the basic parameters.

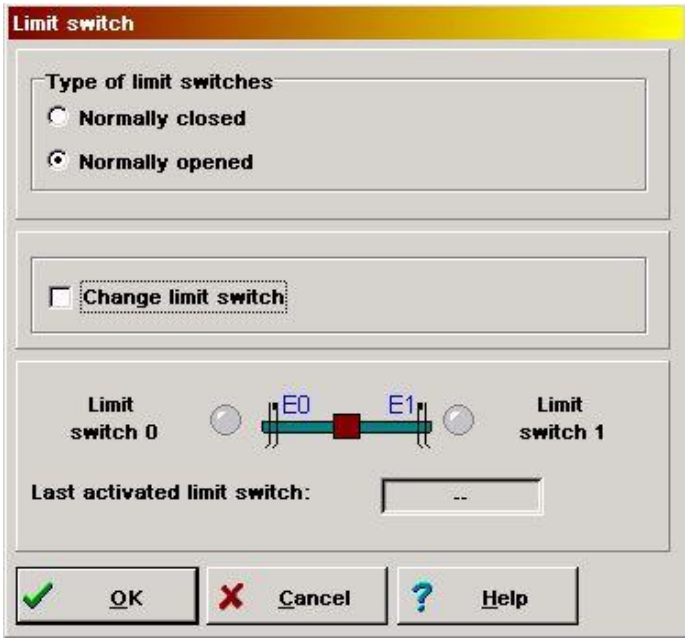
Caution!

Incorrect data for the current controller gain and the time constant may cause oscillations and destroy the motor and the servo positioning controller!

5.2.21 Setting the Limit Switch Polarity

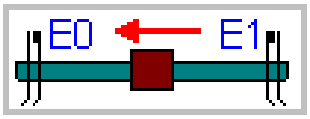
This menu can also be accessed **via Parameters/Device parameters/Limit Switch**.

Adjust your drive such that no limit switch is active. Make sure that no LED is active in the menu shown below. You can set this by clicking on **normally closed** or **normally opened**.



The assignment of the two digital inputs DIN6 and DIN7 to the limit switches E0 and E1 can be changed by the checkbox **Change limit switch**. The physical limit switch connected to DIN6 takes the physical effect of the limit switch connected to DIN7 and vice versa. The functional assignment can be exchanged flexibly without having to change the wiring at the servo positioning controller.

The small illustration in the middle shows a red arrow if the drive is moved in the direction of one of the limit switches.



Limit switches limit the movement range of the application. Apply the following rules for an optimum set-up of the limit switches:

- Consider the required stopping distance for movements at high velocity. Mount the limit switches in a position, so that a sufficient distance between limit switch and end stop results.
- For proper behaviour during indexing and for correct stopping of the movement, the limit switches must fit to the motion direction of the drive. This means that in positive movement direction (actual position in the actual value window increases) the limit switch 1 (E1) becomes active, i.e. limits the movement range.

5.2.22 Configuration of controller parameters

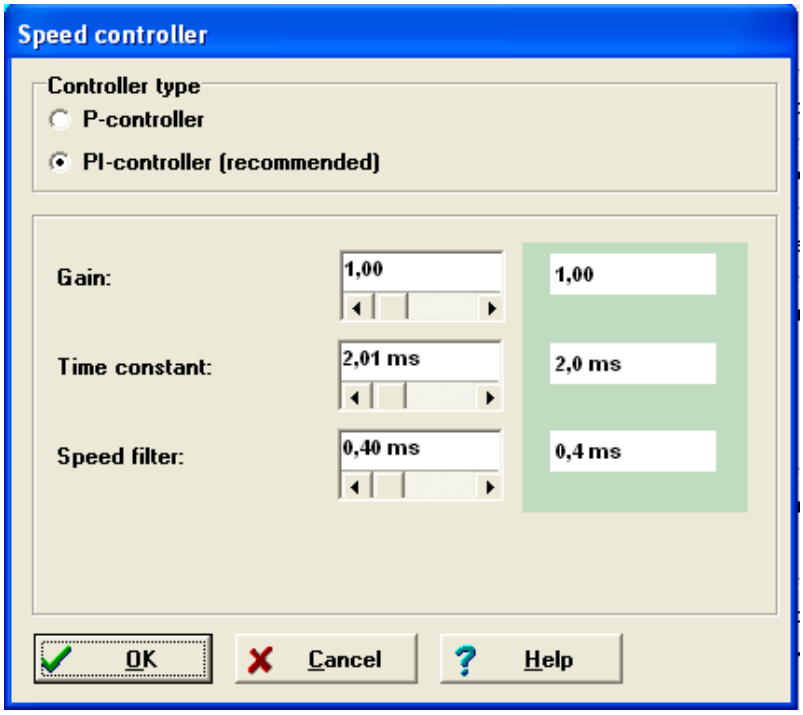
5.2.22.1 Configuration of the speed controller

5.2.22.1.1 Setting the speed controller to basic parameters

In the next step of the commissioning process the speed controller can be set to basic parameters. This is recommended. The parameters of the speed controllers are derived from the current controller parameters.

5.2.22.1.2 Manual configuration of the speed controller

The following window will appear under **Parameters/Controller parameters/Speed controller**:



Enter the following values:

- **Controller type** (PI controller recommended)
- **Gain**
- **Time constant** (PI controller)

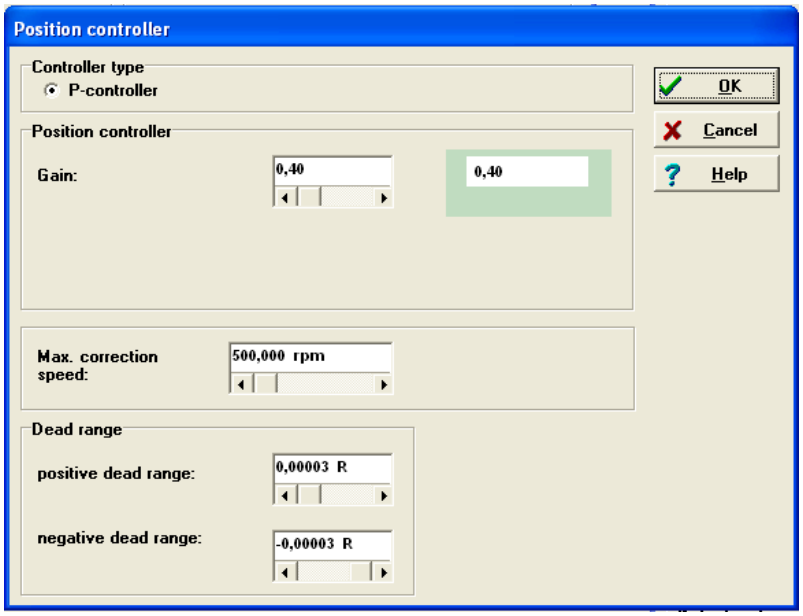
5.2.22.2 Configuration of the position controller

5.2.22.2.1 Setting the position controller to basic parameters

In the next step of the commissioning process the position controller can be set to basic parameters. This is recommended.

5.2.22.2.2 Manual configuration of the position controller

The following window will appear under Parameters/Controller parameters/Position controller:



For commissioning some irrelevant fields are greyed out.

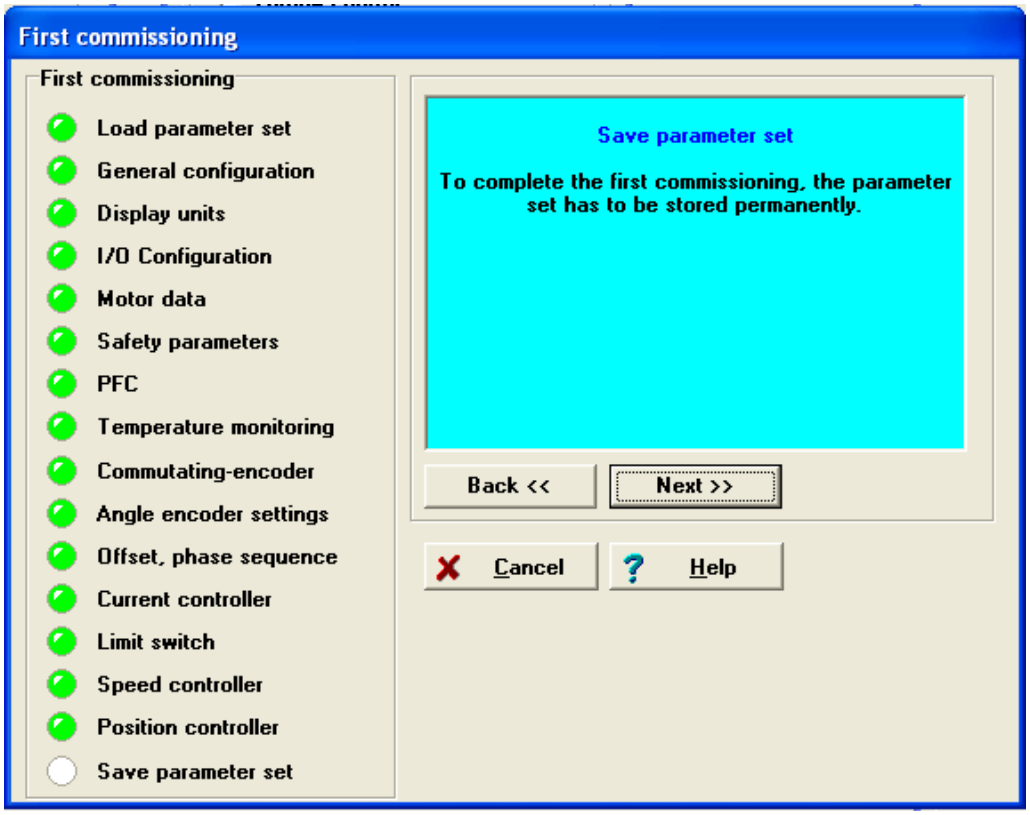
Enter the following values:

- **Gain**
- **Max. correction speed**: Here you can set the speed that will be added to the driving velocity in the case of a following error. This value should at first be set to approx. +/-500 rpm.
- **Dead range**:
  - **Negative** and **positive dead range**: A permissible distance between setpoint and actual value can be set here, within which the position controller does not become active.
- **Following error**
  - **Message**: Parameterisation of a positive and negative following error as well as a response delay. If the deviation between set point and actual value increases, a message is issued.
  - **Shutdown at**…:Here you can parameterise a second limit. If this limit is exceeded, the drive is switched off. The reaction has to be set accordingly in the fault management system.

5.2.23 Permanent storage of determined parameters

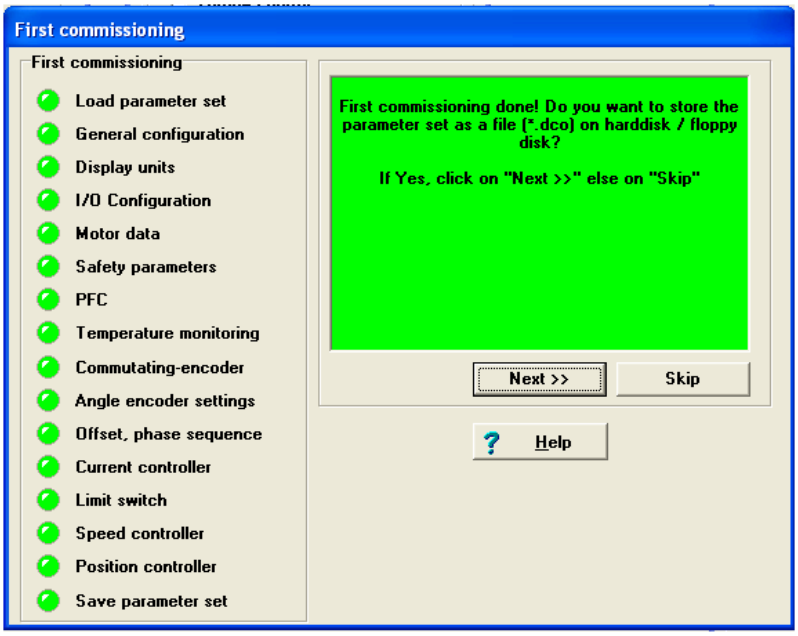
In order to complete the parameterisation, the parameters must be permanently stored in the servo positioning controller. This function can also be accessed via **File/Parameter set/Save parameter set (EEPROM)**.

Click on **Next >>**.

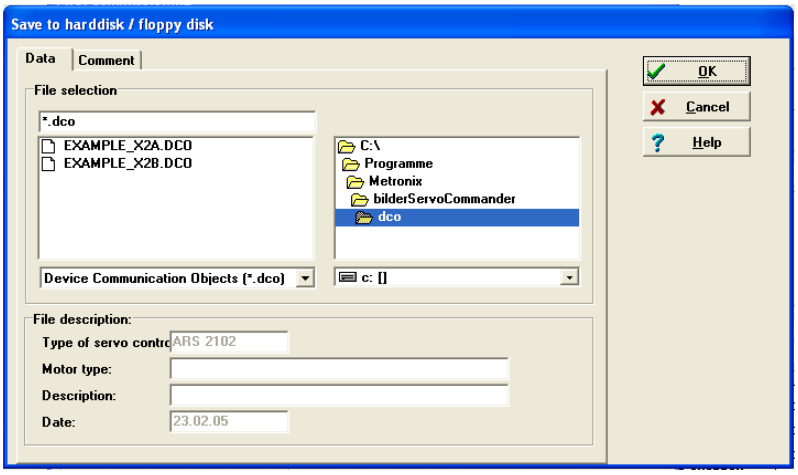


5.2.24 Saving as DCO File

The determined parameters can also be saved on the PC. The following window will appear:



You should archive the parameter set, in order to be able to e.g. put further drive packages with the same controller-motor combination into operation quickly and easily. It is also helpful to have a parameter set ready in case of malfunction or maintenance. To save the file on your PC as a *.DCO file, click on **Next >>**. The following window will appear:



Enter a file name with the extension DCO in the line that shows *.DCO. Also enter the **Motor type** and a brief **Description**. Click on **OK** to save the file.

If you choose not to archive the parameter set, click on **Skip**.

The commissioning procedure is now complete.

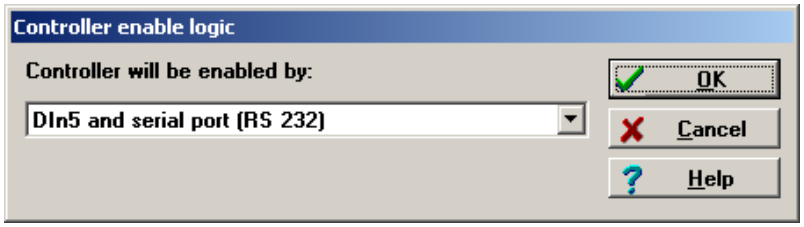
6 First Start and Optimisation of the Motor

It is the objective of this chapter to have the motor run at a constant speed. Afterwards speed and position controllers are to be optimised. The enabling shall be done via the digital input "controller enabling".

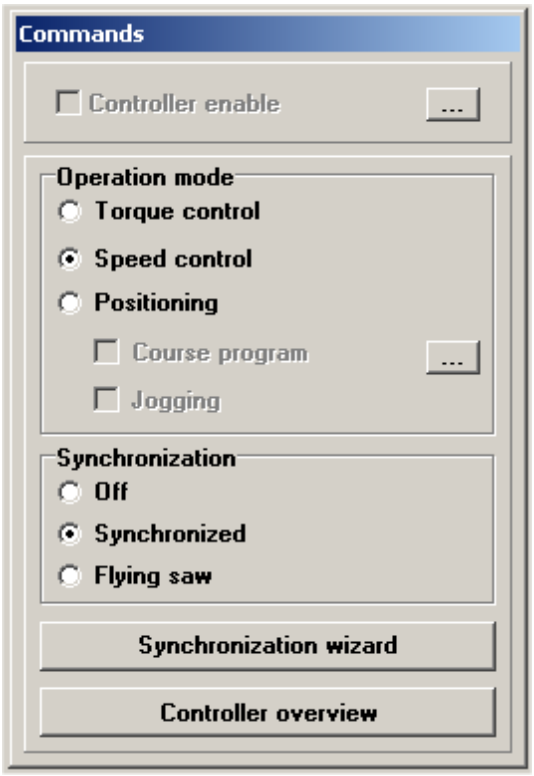
6.1 Configuration of the Controller Enabling Logic

In order to enable the servo positioning controller LV-servoTEC S2, the controller enabling logic must be set. The controller enabling logic decides which conditions must be fulfilled to enable the controller.

1. Select the menu option **Parameters/Device parameters/Controller enable**.
2. Select **Digital input (DIn5)**.
3. Click **OK**.



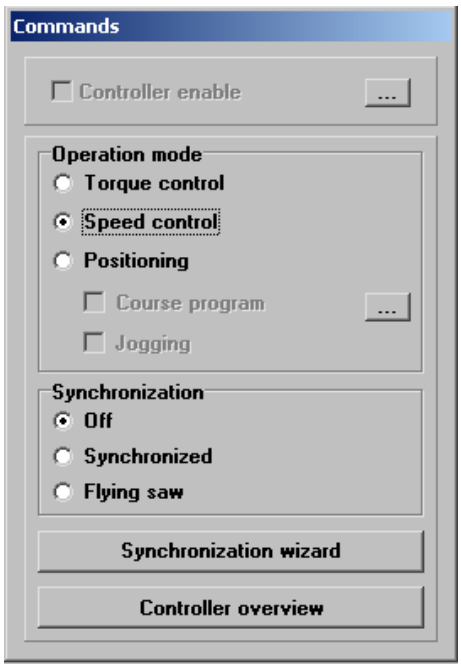
This menu can also be accessed via the Commands window: Click on the „**...**“-button in the field **Controller enable**.



6.2 Configuration of the Speed-Controlled Mode

The servo positioning controller LV-servoTEC S2 can operate in different modes, e.g. torque control (see chapter *Torque-controlled Mode,* page *110*) and speed control (see chapter *Speed-controlled Mode*, page *109*).

For operation at a constant speed the Commands window must be set as follows:



6.3 Preparing the actual value display

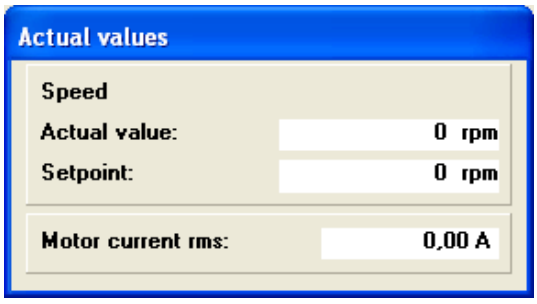
The parameterisation program S2 Commander allows you to numerically display all measured values on the screen of your PC simultaneously. For the first commissioning you should display at least speed and motor current.

The actual value display can be set in the Actual values window (see below) under **Display/Actual values**. All actual values that are to be displayed must be checked by clicking on them with the left mouse button or by pressing the corresponding underlined letter (e.g. S for **Speed**). Selecting the actual value again removes it from the display window (check mark will disappear).

1. Click on **Display/Actual values** in the menu bar.

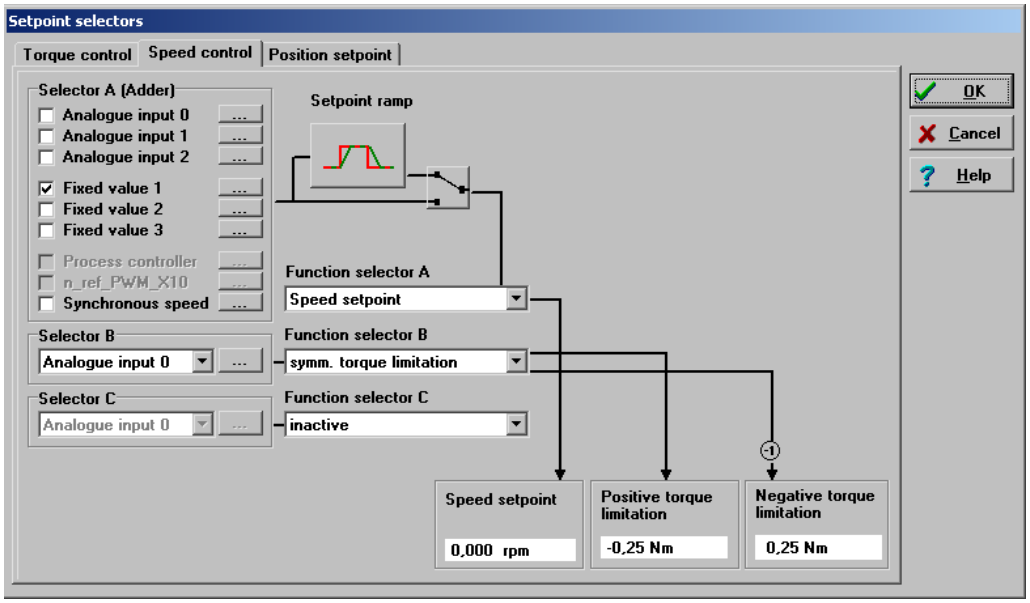
2. Check the entries **Motor speed** and **Motor current**.

The actual value display should now look like this:



6.4 Selecting Setpoints

Select **Operating mode /Setpoint selection** on the bar. The following window will appear:

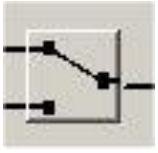


For the torque and speed control modes, the setpoint can be defined by means of setpoint management. Selectable setpoint sources are:

- 3 analog inputs:
  AIN 0, AIN 1 and AIN 2
- 3 fixed values:
  - 1st value: - configuration depending on controller enabling logic:
    - Fixed value 1 or
    - RS232 interface or
    - CANopen-Bus interface or
    - PROFIBUS-DP interface or
    - SERCOS interface
    - 2nd and 3rd value: Configuration of fixed values 2 and 3
- Process controller <not implemented yet>
- Synchronous speed
- Additional incremental encoder input X10 as PWM input

> If no setpoint source is activated the setpoint will be zero.

The setpoint management features a ramp generator with an upstream adder (**selector A**). Any of the above-mentioned setpoint sources can be selected using corresponding selectors and provided as a sum to the ramp generator. The ramp generator can be activated and deactivated using the button shown below.



By means of two more selectors (**selector B** and **selector C**) additional sources can be selected as setpoints and/or limitation values, which, however, will not be run through the ramp generator. The total setpoint is then the sum of all values. The speed and deceleration time of the ramp can be parameterised directionally.

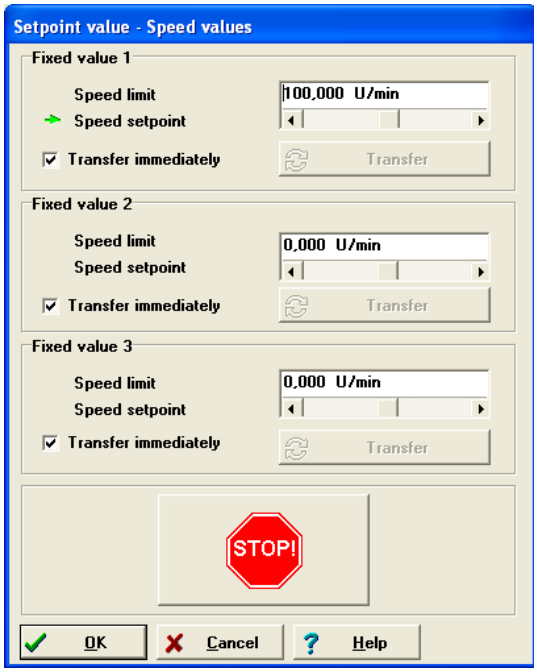
In the window shown above for the selection of the speed setpoint it is also possible to activate the torque limitation. This torque limitation can be asymmetrically or symmetrically with a free selection of the source of limitation. In the example mentioned above, **fixed value 2** was selected as the source for a symmetrical torque limitation.

Select the menu Operating mode/Setpoint - Selection.

1. In the field **Function selector A** select the function **Reference speed value**.
2. Activate **fixed value 1** as the setpoint source in the field **Selector A**.
3. In the field **Function selector B** activate the function symmetric torque limitation.
4. As source for the **symmetric torque limitation** activate **fixed value 2** in the field **Selector B.**

6.5 Enter Setpoints (Speed, Torque)

Now, in menu **Operating mode/Setpoint - Selection**, click on the „**...**“-button in the section **Selector A** for **fixed value 1** in order to enter the setpoints. The window below will appear. You can also open this menu by **Operating mode/Setpoint speed values**.



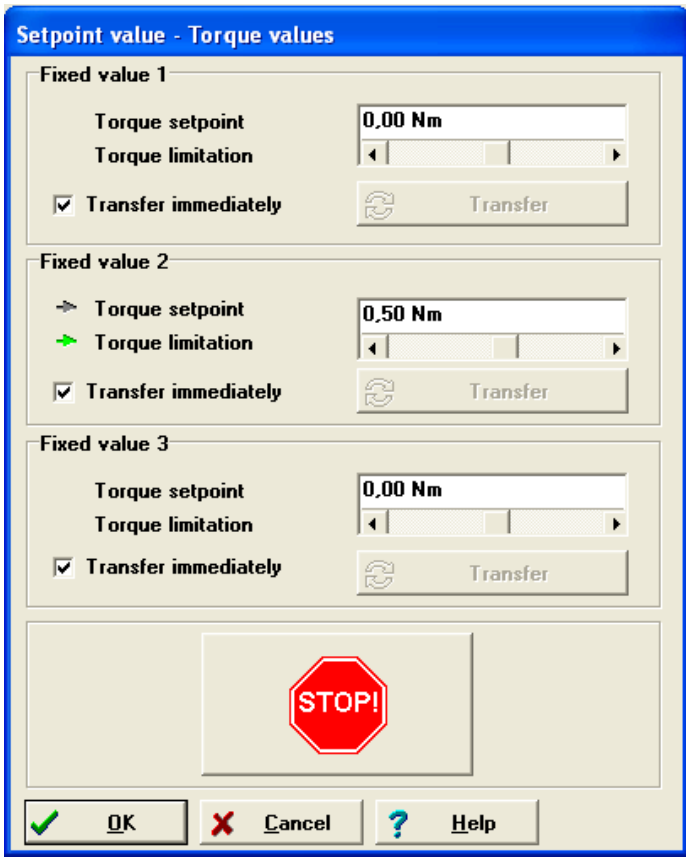
Here, enter setpoints or limit values numerically. Click onto the red **STOP** symbol in order to quickly delete incorrect values. The setpoint is immediately set to 0 and transferred.

Uncheck the check box **Transfer immediately** if the setpoint should not be transferred immediately. Then, new setpoints are transferred when clicking on the button **Transfer**.

Enter a setpoint of 100 rpm.

The fixed values 1..3 exist in fact twice for the operating modes torque control and speed control. Depending on the operating mode, the value is used as speed setpoint/speed limitation or torque setpoint/torque limitation. The setpoint dialogue shows either torque or speed values only. Close the dialogue and start it again by **Operating mode/Setpoint speed values** resp. **Operating mode/Setpoint torque values** if you want to set the other values. Furthermore it is possible to activate the other mode by clicking onto the “**…**” buttons in the setpoint selection dialogue.

Close the menu **Setpoint value**. Now, click onto the "**…**" button in **selector B** in the menu **setpoint selectors**. The following dialoge appears:

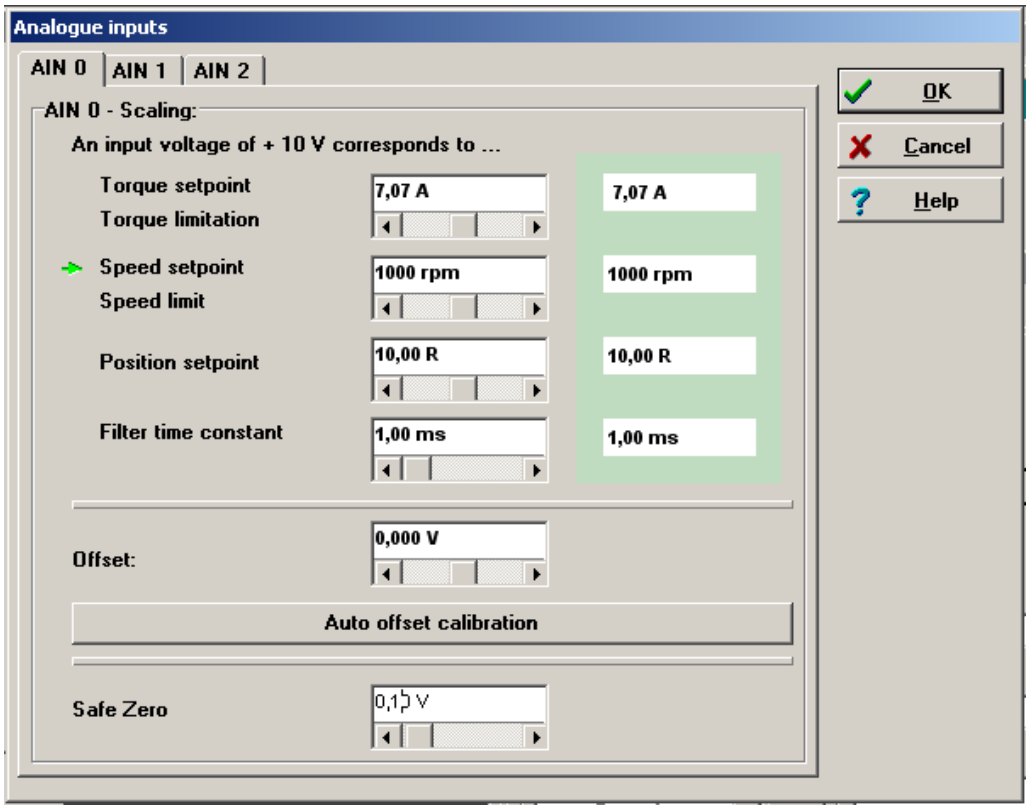


The previously activated source **fixed value 2** is indicated by a green arrow. In the example, the **Torque limitation** is set to 0.5 Nm.

Set a limitation of 0.5 Nm.

6.5.1 Configurations for Analogue Inputs

In the Setpoint-selectors window, click the „**...**“-buttons in the section for the analog inputs Analogue input 0 to Analogue input 2 or **Parameters/IOs/Analog inputs** to open the following window:



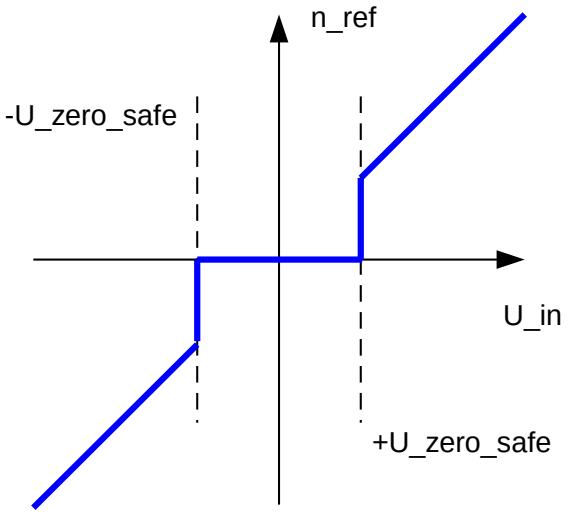
The values to be set here determine the ‘conversion factor’ between input voltage and the setpoint.

Enter how the input voltage is converted into the torque, speed or position in the three fields **Torque setpoint/Torque limitation**, **Speed setpoint/Speed limit** and **Position setpoint**. The small green arrow shows, which parameter is currently driven by the analogue input.

The analogue input AIN0 is a 16 bit input. Due to this high resolution a digital filter is located in front of it. Enter the time constant at which the input value will be filtered in the field **Filter time constant**.

In most cases the problem is that at an externally set voltage of 0 Volt a very small setpoint will still be generated. The offset must therefore be adjusted by some millivolts. This can only be done manually, by setting the offsetpoint correspondingly. It is recommended, however, to perform an automatic offset calibration. To do so, short-circuit the input or apply the potential corresponding to the setpoint of „zero“. Then click on the button Auto offset calibration.

In some cases it is desireable to have a real zero speed which do not depend on signal noise or offset drifts. This behaviour is effective for all modes of the input (speed-, torque- .. setpoints) for having a defined standstill of the speed for instance. The adjustable offset is also considered. If the item “Safe Zero” is set to values higher than 0, the following diagram shows the function e.g. for the speed setpoint n_ref with U_in = U_AIN0 – Offset.

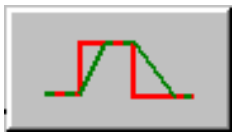


The resulting speed setpoint is zero for input voltages in the range [-U_zero_safe … +U_zero_safe]. “Safe zero” is only available for AIN0.

6.5.2 Setpoints and Setpoint Ramps

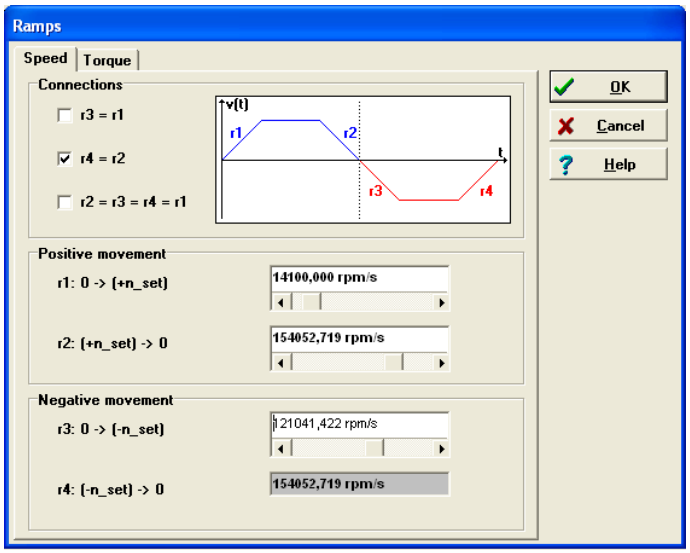
The servo positioning controller LV-servoTEC S2 can process setpoint leaps in different manners. The setpoint leap can be transmitted to the speed or torque controller without filtering. The positions controller can also calculate a function, which combines the different setpoints of selector A with a ramp of adjustable slope.

The menu itself can be activated in the menu **Operating mode/Setpoint - Selector** with the following icon



or via **Operating mode/Ramps**.

The following window will then appear:



The ramps can be set separately for positive and negative movements, and also for increasing and decreasing speeds or torques. If some of the ramp accelerations are identical, the input can be abbreviated by simply activating the corresponding checkboxes:

- r3 = r1
- r4 = r2
- r2 = r3 = r4 = r1

6.6 Starting the Drive in Speed-Controlled Mode

Caution!

This chapter may only be tried out, after *Chapter 4 Installation, First Program Start and Communication, Page 28* has been completed, particularly the configuration of the limit of the RMS-current range, the current controller and the mode of operation. Furthermore, *Chapter 6 First Start and Optimisation of the Motor, Page 71* must have been completed up to this point.

Wrong basic configurations can destroy the servo positioning controller/motor and the mechanical drive.

Caution!

With the controller enabling the motor can run at very high speeds!
Therefore lock the controller enabling after each test and wait until the shaft stands still again!
If the servo positioning controller LV-servoTEC S2 is wrongly parameterised, it is possible that you can only stop the motor by switching off the output stage enabling. If this input is wired without a switch, you must press `RESET`, to deactivate the servo positioning controller LV-servoTEC S2.

Before testing the controller enabling, save the parameters. This is done by clicking on the button shown below.

The button is located in the upper tool bar of the main window.

Briefly switch on the controller enabling.

The six outer segments of the seven-segment-display light up as a running bar around the horizontal centre bar indicating the direction of rotation and the speed of the motor.

After the control system has been enabled, the shaft has to start rotating. If the motor does not show this behaviour, there is either an error or the LV-servoTEC S2 servo positioning controller has been parameterised incorrectly. The following table shows typical mistakes and how you can eliminate them:

Table 7: **Troubleshooting: Speed control**

Error	Solution
The display shows no crossbar.	Check the 24 V voltage supply, set controller enabling logic
The display shows the letter P.	The mode position control is activated, deactivate them in the Commands window.
A 3-digit error code flashes in the display.	Refer to chapter *Error* / Warning Messages, page *224* on how to solve the problem
The brake cannot be enabled.	Check the connector X6 and the motor plug as well as the cable. Does the voltage source fulfill the specifications? See also *chapter "X6 Connection of motor"* in the product manual servo positioning controller LV-servoTEC S2.
The motor develops a holding torque, it "snaps" in different positions.	The pole pair number and/or the phase sequence is wrong, set the pole pair number correctly (chapter *Configuration of motor specifications,* page *53*) and/or switch the motor phases.
The motor oscillates or runs unevenly.	The angle encoder offset (see chapter *Angle Encoder Identification (Automatic Determination),* page *61* and *Angle Encoder Data (Manual Input),* page *63*) and/or the controller parameters (see chapter *Configuration of controller parameters ,* page *67)* are set incorrectly. Run the automatic identification again, as described in chapter *Commissioning, page 35*.
The motor does not turn	No DC bus voltage.
	Limit switches are active

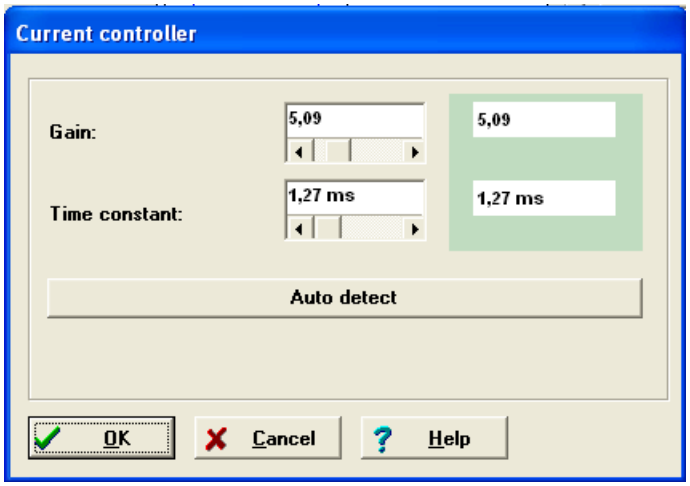
When connecting the motor phases, note that different manufacturers of servo motors use different phase sequences. If necessary, the phases U and W must be switched.

6.7 Current Controller Optimisation

Normally, the current controller is optimised during commissioning (see chapter Commissioning, page *35)*. A separate optimisation is not necessary.

Make sure that the maximum currents and the nominal currents of the motor have been adjusted correctly prior to optimising the current controller. If the currents are too high, the motor will be destroyed as the permanent magnets inside the motor will be demagnetised. The current limits stated by the manufacturer must not be exceeded (see chapter *Configuration of motor specifications,* page *53)*.

It is essential to adjust the current controller correctly in order to be able to the adapt the speed controller to the motor used. The parameters to be set is the gain and the time constant.



To determine the values of the current controller automatically, click on the **Auto detect** button. Make sure that the motor is in idle mode, i.e. that no load is connected to the shaft.

If a repeated parameter determination for the current controller leads to different values, there is no need to worry.

The parameters mentioned can also be configured manually. However, this is very time-consuming. This is not necessary in most cases. Please contact your distributor if you require additional information concerning this subject.

6.8 Speed Controller Optimisation

6.8.1 Overview

The optimisation of the speed controller is performed in two steps:

- Optimisation of the actual speed value filter (see chapter *Actual Speed Value Filter Optimisation*, page *83*)
- Optimisation of the parameters "Gain" and "Time constant" (see chapter *Optimisation Speed Controller: Gain and Time Constant*, page *84*)

A speed controller optimisation is possible for a not completely installed drive yet! If you parameterise the speed controller while the motor shaft runs at no load, you have to increase the controller gain after you have installed the drive.

6.8.2 Actual Speed Value Filter Optimisation

To optimise the control response, the measured actual speed value has to be smoothed. This is done using an actual speed value filter. The effective filter time constant can be parameterised:

1. Select the menu item **Parameters/Device parameters/Speed controller**.
2. Set the **time constant** of the actual speed value filter to 0.4 ms.
3. Click **OK**.
4. Save the setting using **File/Parameter set/Save parameters (EEPROM)**.

As the actual speed value filter will be included in the speed control circuit as an additional time constant, it should be as small as possible. This is why we recommend the value of 0.4 ms for commissioning.

If the time constant of the actual speed value filter is too high, the dynamic response deteriorates as disturbances are detected with a delay.

In certain unfavourable cases, an unsuitable time constant can have a negative effect on the stability of the speed control circuit. The additional run time may lead to oscillations.

This is why you should set the time constant as low as possible.

6.8.3 Optimisation Speed Controller: Gain and Time Constant

Optimizing the time constant and the gain of the speed controller is performed by applying a speed setpoint step. Monitor the reaction of the speed controller on the setpoint steps with the oscilloscope function and accordingly set the controller parameters.

The speed controller has to be adjusted such that there is only one overshoot of the actual speed value. The overshoot should be about 15% higher than the speed setpoint. The falling edge of the overshoot, however, should not be below the speed setpoint or just slightly below it and then reach the speed setpoint. This setting applies to most motors which can be operated using the servo positioning controller.

If a harder control response is required, the gain of the speed controller can be increased further. The gain limit is due to the fact that the drive tends to oscillate at high speed levels. The gain that can be reached in the speed control circuit depends on the load conditions at the motor shaft. This is why you have to check the speed controller setting again when the drive is installed.

You have to use the oscilloscope function and the integrated reversing generator for the optimisation. It is important to disconnect the motor from the mechanical drive.

The speed controller cannot be optimised until the commissioning has been performed. Otherwise the motor and the servo positioning controller may be damaged!
(See chapter *Commissioning,* page *35)*.

The reversing mode may damage a drive connected to the motor. Disconnect the motor!

1. Call up **Options/Input limits** and enter the maximum value for the acceleration under "Speed values".
2. Start the oscilloscope by activating the menu item **Display/Oscilloscope** and enter the following values:
   - Channel 1: Speed setpoint; scaling = 200 rpm / div; offset -2 div
   - Channel 2: Actual speed value; scaling = 200 rpm / div; offset -2 div
   - Channel 3: OFF
   - Channel 4: OFF
   - Time base: 5 ms / div; delay = -5 ms
   - Trigger: Source = speed setpoint; level = 50 rpm; mode = normal, rising trigger edge
3. Call up the reversing generator (**Display/Reversing generator**) and enter the following values:
   - Reversing distance: 10 R
   - Reversing speed: 1000 rpm
   - Acceleration: (maximum value)
   - Deceleration: (maximum value)
4. Activate the power stage and controller enabling. Start the reversing generator. The motor now reverses within the specified limits.
5. Observe the resulting oscillograms. Compare them to the patterns shown in the next chapter.
6. Start the speed controller (**Parameters/Controller parameters/Speed controller**). If the speed controller is set too soft or too hard, take the measures described in the next chapter. Try out different settings to find the optimal solution. See the following chapter.
7. Save the setting with the help of **File/Parameter set/Save parameter set**.

6.8.4 Optimisation Strategies (Speed Controller)

> Make sure that you do not change the numbers for the gain factor and the time constant in too large steps. Use small changes.

After the numbers have been changed, there may be two different situations:

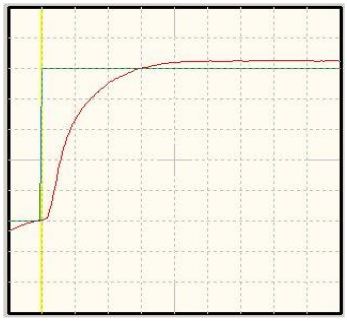
If the setting is too hard, the speed controller will become unstable.

If the setting is too soft, the drive will not be rigid enough which will lead to lag errors.

> The speed controller parameters are not independent of each other. A measurement curve which differs from trial to trial can have various reasons. This is why you should change only one parameter at a time: Either the gain factor or the time constant.

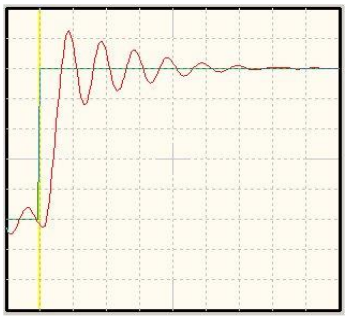
To adjust the speed controller, increase the gain until oscillation starts and then decrease the gain in small steps until oscillation ceases. Then decrease the time constant until oscillation starts and decrease it again in small steps until the controller is stable and rigid enough at a setpoint = 0.

Case 1: Speed controller too soft



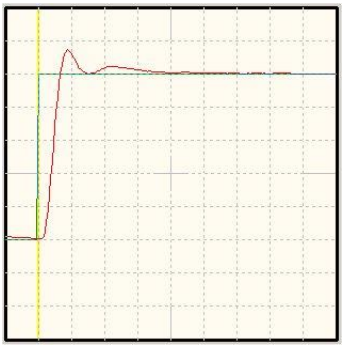
Remedy: Increase the gain factor by 2 to 3 tenths /
Decrease the time constant by 2 to 3 ms

Case 2: Speed controller too hard



Remedy: Decrease the gain factor by 2 to 3 tenths /
Increase the time constant by 2 to 3 ms

Case 3: Speed controller set correctly



6.8.5 Position Controller Optimisation

	You can skip this chapter if your drive is used only in speed or torque mode.
	To optimise the position controller it is essential that the current controller and the speed controller have been adjusted correctly. (See the preceding chapters)
	The reversing mode is required for optimising the position controller. Please make sure that the motor shaft can rotate freely and that the drive cannot be damaged.

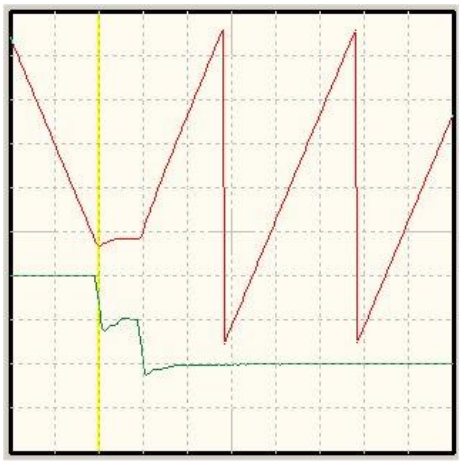
The position controller (menu item **Parameters/Controller parameters/Position controller**) generates a resulting speed on the basis of the difference between the set position and the actual position and transfers this resulting speed value as a setpoint to the speed controller. The functions of the position controller are explained in chapter *Configuration of the position controller,* page *68*.
This chapter explains how to optimise the gain.

The following steps have to be performed for the optimisation:

1. Activate the position controller (menu item **Parameters/Controller parameters/Position controller**) and set the **gain** to 0.5.
2. Call up the reversing generator (**Display/Reversing generator**) and enter the following values:
   - Reversing distance: 10 R
   - Reversing speed: (half nominal speed)
   - Acceleration: (maximum value)
   - Deceleration: (maximum value)
   - Do not start the reversing generator yet!

3. Start the oscilloscope by activating the menu item Display/Oscilloscope and enter the following values:
   - Channel 1: Actual speed value; scaling = 1000 rpm / div, -2 div
   - Channel 2: Rotor position; scaling = 50 ° / div; offset 1 div
   - Channel 3: OFF
   - Channel 4: OFF
   - Time base: 100 ms / div; delay = -200 ms
   - Trigger: source = actual speed value; level = half reversing speed; mode = normal; falling trigger edge
4. Activate the power stage and controller enabling. Start the reversing generator. The motor now reverses within the specified limits.

Optimisation: Evaluate the speed and the rotor position during stopping. If the transient process of the position takes too long, increase the gain. If the speed starts to oscillate during stopping, the gain has to be decreased.



Please note that the overshoots are due to missing acceleration and deceleration time values.

For an optimal adjustment of the control to the load, a high force/mass ratio is regarded or makes it easier to find a good controller parameter set-up. For the so called direct mode drives (without gear) this ratio is disadvantageous and leads to more instable behaviour. Some example for direct mode drives are:

- Torque motors without gear connected to a heavy turning arrangement with high diameter.
- Motor shaft drives a heavy load directly. For example, a gearwheel on a motor shaft moves a heavy sledge.

The adjustment of the control in such a case can be done as follows:

- Use an encoder with high resolution
- Enlarge the speed controller gain till the resonance is nearly reached
- Decrease the gain and the maximum correction speed of the position controller
- Decrease the acceleration and deceleration in the positioning set.
- Activation and set-up of the torque feed forward in the positioning set.

7 Display units (details)

The menu Display units is activated by **Options/Display units**. A basic introduction into that menu is given in chapter *Rotary axis operation, page 45)*. Here, the **Standard values** mode is explained that covers 90 % of all applications. In the following chapters you find information concerning the modes **User-defined** and **Direct input**. The following table shows which mode is needed in which case.

Table 8: **Setting of base configuration and display units**

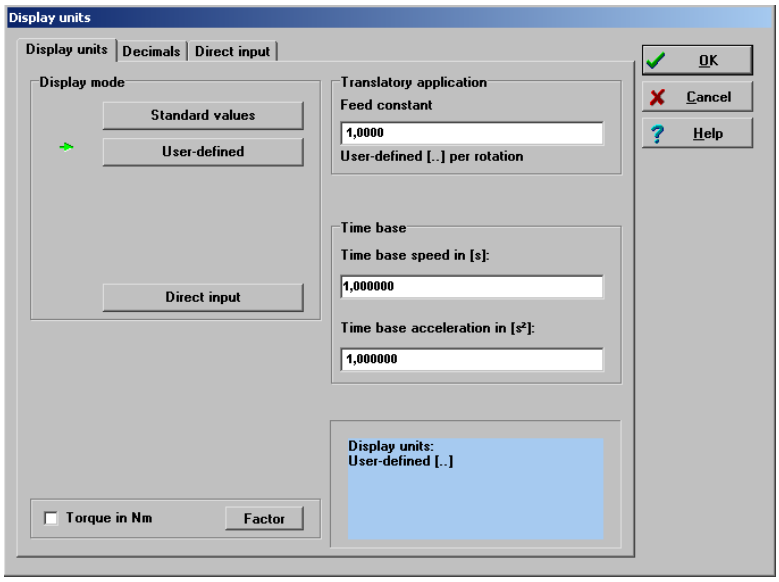
Selection	Units
Standard values	For translatory systems: positions in distance units, velocities in [distance units]/s; accelerations in [distance units]/s² For rotatory systems: positions in revolutions, degrees or radiant, different velocity and acceleration units
User-defined	Examples: ■ For translatory systems and non-metrical path, velocity and acceleration units (e.g. inch, inch/min) ■ For rotatory drives with special distance, velocity and acceleration units
Direct input	Free configuration of the distance, velocity and acceleration units. For experienced users only!

The configuration of the display units is independent of a possible setpoint definition via field bus. The configuration of the display units therefore has no influence on the factor group and the notation and dimension indices in field bus-specific protocols, see also chapter *Physical Units Profibus,* page *253*.
At the moment a support for CAN is not available.

7.1 User Defined Display Units

All user defined units ("User defined") are displayed by [..].

Enter the scaling in user-defined units per revolution in the field **Feed constant** in the tab **Display units**. In addition, the input fields **Time base speed** and **Time base acceleration** are available.



Use the field **Time base speed** to define your own speed units.

Example:

You have a drive with 20 mm per revolution, without a gearbox. You would like to enter the speed in mm/minute. The **Feed constant** must be set to 20, the value for **time base speed** is 60 (60 seconds = 1 minute).

Use the field **Time base acceleration** to define your own acceleration units.

Example:

You have a drive with 20 mm per revolution, without a gearbox. You would like to enter the acceleration in (mm/minute)/s. The **Feed constant** must be set to 20, the **Time base acceleration** has to be set to 60 (1 minute x 1s = 60 x 1 s^2 = 60 s^2).

7.2 Direct Input of the Distance, velocity and Acceleration Units

Caution! For experienced users only!

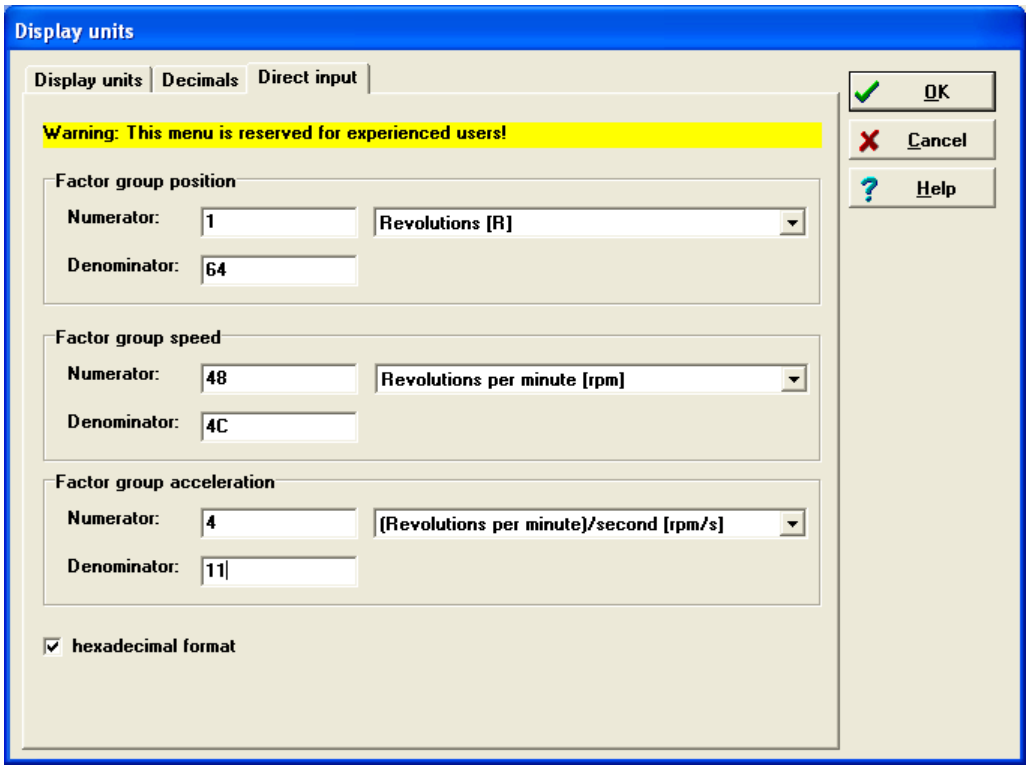
The direct input of the physical units allows drastic changes of the controller parameters for the servo positioning controller LV-servoTEC S2.

In the tab **Direct input** in the menu **Options/ Display units** you can directly describe the Factor groups of position, speed and acceleration, if you previously selected the option **Direct input** in the menu **Options/ Display units**.

For the display in the parameterisation program S2 Commander, you can also select from the following units:

- Increments
- Degrees
- Radiant
- Revolutions
- Meters
- Millimeters
- Micrometers
- User-defined
- No unit

Here for example in millimeters and hexadecimal display:



8 Communication

The following figure shows the general communication paths of the parameterisation program:

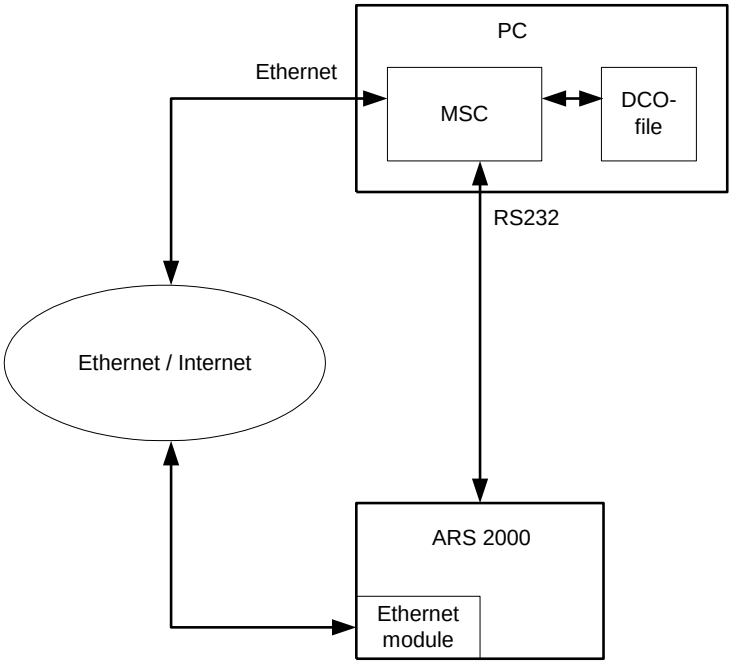


Figure 1: Communication paths

In general, there are three operating possibilities for the parameterisation program:

- **RS232**: The parameterisation program communicates with the servo positioning controller via the serial interface.
- **Ethernet / UDP**: The parameterisation program communicates with the servo positioning controller via Ethernet / Internet. For this operation an Ethernet technology module has to be installed and parameterized in technology slot 1!
- **Offline-parameterisation**: The parameterisation program operates (without a servo positioning controller) with a parameter set file (DCO-file) only.

Take the currently active communication mode from the symbol bar below the menu bar:

Table 9: **Representation of the operating states in the parameterisation program**

	Parameterisation via RS232
	Parameterisation via Ethernet / UDP
	Offline parameterisation

The following table shows which actions are available in each operating state:

Table 10: **Possible action depending on the operating state of the communication**

	RS232	Ethernet / UDP	Offline
Display and modification of the parameters currently available in the servo positioning controller	yes	yes	no
Display and modification of the parameters available to a file	no	no	yes
Printing of the current parameters (of a file or of the servo positioning controller)	yes	yes	yes
Save the current parameters in the Flash memory of the servo positioning controller	yes	yes	no
Save the current parameters (of a file or the servo positioning controller) to a file	yes	yes	yes
Load a parameter set into a servo positioning controller	yes	yes	no
Firmware download	yes	no	no

8.1 Communication via RS232

Take more information concerning the configuration of the RS232 communication as well as troubleshooting from the chapters *Configuring the communication (RS232),* page *28* up to *Optimizing of serial communication via RS232,* page *32*.

8.2 Communication via Ethernet / UDP

The following requirements are necessary for a communication with the servo positioning controller via UDP/ Ethernet:

- The PC with the installed parameterisation program has an Ethernet interface
- The servo positioning controller has a correctly parameterized Ethernet module
- The PC has read and write access rights to the network address under which the Ethernet module is registered. This concerns the items correct assignment of network addresses, access rights and possible configurations of firewalls etc.
- The communication parameters of the parameterisation program are correctly set.

8.2.1 Assignment of Network Addresses and Masks

You need to know the network address of the PC in order to assign a useful network address of the Ethernet module.

Proceed as follows in order to find out the network address of the PC: Start the MS-DOS® – command window and enter the command **IPCONFIG** in the command line. The network address of the PC is displayed under **IP-Adresse** (IP address). Alternatively find out the network address in the Windows® menu **Systemsteuerung/Netzwerkeinstellungen/Internetprotokoll (TCP/IP) (system control/network settings/internet protocol (TCP/IP))**.

In general there are two ways of accessing the address of the Ethernet module:

- Access without gateway: This access is possible if the IP address of the Ethernet module and the PC are “similar”. In detail, this means that the Ethernet address is logically “ANDed” with the network mask XXX.XXX.XXX.XXX.

Example:	own IP:	010.122.034.218	or	192.168.000.001
	subnet mask:	255.255.252.000		255.255.255.000
	Ethernet address:	010.122.034.082		192.168.000.090

- Access with gateway: This access is possible if the IP address of the Ethernet module and the PC are not “similar”. The participating gateways/routers have to be configured accordingly by your network administrator.

8.2.2 Configuring the ethernet communication parameters (Ethernet Module)

The Ethernet module can be configured by RS232 communication.

The menu for configuring the communication parameters of the Ethernet module is opened by **Options/Communication/Communication parameters UPD / Communication UDP (Ethernet)**. The following menu opens:

The single parameters have the following meaning:

Port number: Port number of the Ethernet communication via UDP. Select a free port number in the interval of 5000…65535.

IP address: IP address of the Ethernet communication via UDP. The address has to be unequivocal in the network segment of the Ethernet module.

Subnet mask: The subnet mask divides a network into subnets which are connected to the routers / gateways. Select the subnet for the Ethernet communication.

Gateway: IP of the gateway which is part of the subnet of the Ethernet module.

Please ask your network administrator for the network parameters in order to configure the Ethernet module for the access.

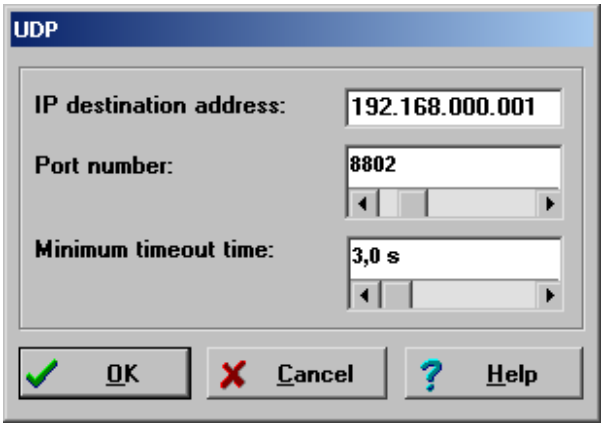
You may check the correct configuration of the Ethernet module and the accessibility in the network by a so called PING command. Therefore, proceed as follows:

Start the MS-DOS® – command window. Enter the command **PING** <IP address>.

The parameter is the IP-address of the Ethernet module to test.

8.2.3 Setting the Ethernet Communication Parameters (Ethernet Module)

Also set the parameterisation program as counter part correctly after the Ethernet module has been configured for the access. For this open the menu **Options/Communication/Communication parameters UDP (Ethernet)/Communication UDP (Ethernet)**. The following menu opens:



The single parameters have the following meaning:

IP address: Enter the IP address of the technology module, with which the UDP communication is to be set up, into this field.

Port number: Enter the IP address of the technology module, with which the UDP communication is to be set up, into this field.

Minimum timeout time: If you communicate on a very large network using the Ethernet module, the parameterisation program may detect a timeout as the packets cannot be exchanged quickly enough between the parameterisation program and the servo positioning controller. Use this parameter to enter a minimum time required for the exchange of packets.

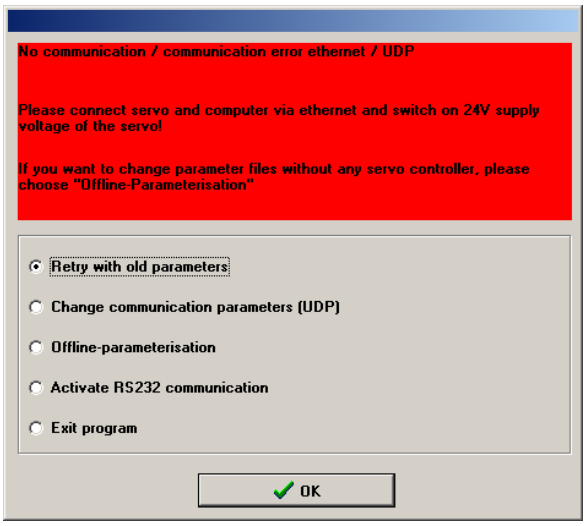
Please ask your network administrator for the network parameters in order to configure the parameterisation program for the access.

Calculate with increasing communication time in large network architectures due to the growing number of routers/gateways. Increase the timeout time accordingly.

8.2.4 Activation of the UDP Communication (Ethernet)

Activate the Ethernet communication by clicking the button UDP.

The following error window appears if the parameterisation program S2 Commander cannot establish a connection via UDP to the servo positioning controller LV-servoTEC S2:



The following table describes possible error causes and error recovery strategies:

Table 11: **Recovering problems with UDP communication**

Cause	Measure
Communication is 'choking'.	Click on **Retry with old parameters**.
Wrong IP address, port or Gateway selected.	Click on **Change communication parameters (UDP)** and follow the instructions.
Another parameterisation program communicates with the Ethernet module yet.	Check which parameterisation program has to communicate. Close the other parameterisation program.
Servo positioning controller LV-servoTEC S2 communication malfunction.	RESET the servo positioning controller LV-servoTEC S2, and then click on **Retry with old parameters**.
Servo positioning controller LV-servoTEC S2 has no or incomplete firmware.	In this case, first, a valid firmware has to be loaded into the servo positioning controller via RS232. Establish a connection via RS232 and then click on **Activate RS232 communication**.
Hardware-Error: Servo positioning controller LV-servoTEC S2 switched off	Recover the error, and then click on **Retry with old parameters**.
Connecting cable not plugged in	
Connecting cable too long	

Offline parameterisation only makes sense, if you want to edit parameter set files without the servo positioning controller LV-servoTEC S2 (please refer to chapter *Offline Parameterisation,* page *100)*.

9 Parameter Sets

This chapter explains functions concerning parameter sets.

Definition parameters / parameter set:

In order for the servo positioning controller LV-servoTEC S2 to operate the motor properly, the properties of the servo positioning controller LV-servoTEC S2 must be set correctly. The individual properties are in the following called **Parameters**; the total of all parameters for a servo positioning controller/motor combination is called a **parameter set**.

All parameter set functionalities are listed under File/Parameter set.

Which functions are available under this menu item depend on the communication type: RS232, UDP (Ethernet) or offline parameterisation, see also chapter *Communication,* page *91*.

The following table shows which functions are available in which operating state:

Table 12: **Overview parameter set functions**

RS232	UDP (Ethernet)	Offline parameterisation
File >> Servo	File >> Servo	---
Servo >> File	Servo >> File	---
Print	Print	Print
Load default parameter set	Load default parameter set	---
Save parameter set	Save parameter set	---
---	---	Open file...
---	---	Save file...
---	---	Save file as...

The functionalities of the operating states “RS232” and “UDP” are similar as can be taken from the table. So these functionalities are together named **Online parameterisation** in the following chapters.

9.1 Functionalities of the Online Parameterisation

Online parameterisation has the following functionalities:

Table 13: **Online parameterisation**

Function	Description
File >> Servo	The parameter set is read from a file and transmitted to the RAM of the servo positioning controller LV-servoTEC S2. It will also be stored in the non-volatile EEPROM and a RESET is carried out subsequently .
Servo >> File	The current parameter set of the RAM is transferred to the computer and stored there.
Print	The current parameter set of the RAM is generated as plain text. This text can be displayed on the screen, printed or saved as a text file. (see chapter *Printing of Parameter Sets,* page *102)*
Load default parameter set	The parameter set saved in the firmware is written to the EEPROM and RAM and saved there. The servo positioning controller LV-servoTEC S2 performs a reset initiated by an internal software command.
Save parameter set	The parameter set saved in the RAM is copied to the EEPROM and saved in a non-volatile form.

During handling of parameter sets the following items should be regarded:

- The reset to the default parameter set should be performed if a former parameterized servo positioning controller should be used in a new application or if undefined behaviour happens cause of parameter changes due to bus accesses. During applying of CAN Bus, PDO set-ups stored in the servo controller could result in access conflict by the superposed control
- The online changes in the RAM of the servo done by the user can be easily discarded by a reset of the servo positioning controller. Then the stored parameters are reloaded from the EEPROM. This is useful for doing fast tests. For instance, some changes of the speed controller set-ups without influencing the stored parameters in the EEPROM
- As far as a good set-up is found the parameters should be stored in the EEPROM.
- If a new firmware upgrade should be loaded to the servo positioning controller, it is recommended to first readout the parameters set-up. After upgrading the firmware the default parameter set should be loaded and after this the old parameter set should be stored to the servo positioning controller during the first set-up menu.

9.1.1 Online Parameterisation: General

The following illustration depicts the administration of parameter sets:

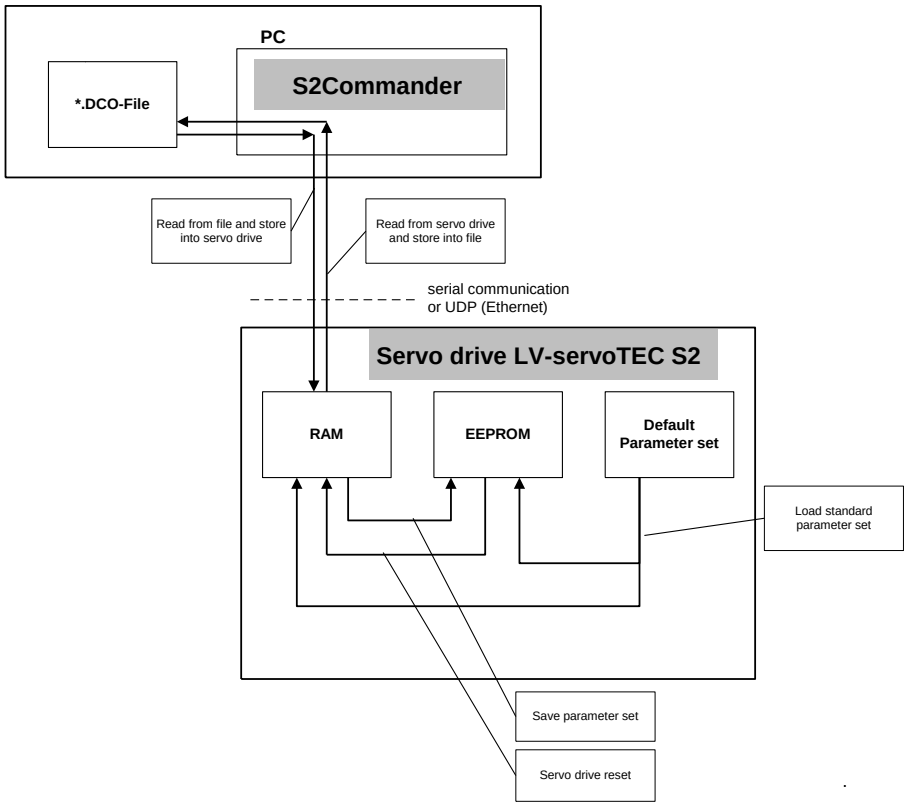


Figure 2: Online parameterisation

The current parameter set of the servo positioning controller LV-servoTEC S2 is available in the RAM (RAM = Random Access Memory). The RAM looses its content as soon as the supply voltage is switched off. In order to permanently save a parameter set, it can be copied to the EEPROM using the command **File/Parameter set/Save parameter set**. The EEPROM (Electrical Erasable Programmable Read Only Memory) does not loose its content, even if the voltage is switched off.

With each reset of the servo controller the content of the EEPROM is copied to the RAM.
A servo controller reset can be initiated by:

- Switching the 24 V supply voltage off and on again
- Pressing the Reset button on the casing of the servo positioning controller LV-servoTEC S2
- Activating the menu option **File/Reset Servo**
- Click on the RESET button in the toolbar

Each servo positioning controller LV-servoTEC S2 also has a default parameter set. This parameter set is permanently stored in the firmware and cannot be overwritten. If the parameterisation should fail for any reason, the standard parameter set can be loaded, to have a solid basis for a new parameterisation. The standard parameter set is activated by selecting **File/Parameter set/Load default parameter set**. The default parameter set is then copied into the EEPROM and the RAM.

9.1.2 Loading and saving of parameter sets

Referring to the previous chapters it is also possible to save and administer parameter sets externally (i.e. on hard disk or floppy disk). The parameter set is then read by servo positioning controller LV-servoTEC S2 and saved to a file or it is read from a file and saved in servo positioning controller LV-servoTEC S2.

The extension of the parameter files are *.DCO. Reading and writing of the *.DCO files in S2 Commander are initiated in the following menus:

- Reading of a *.DCO file: File/Parameter set/File >> Servo
- Writing to a *.DCO file: File/ Parameter set/Servo >> File

Note that when writing a parameter set to a file, you can fill out the fields Motor type and Description. You can also enter a comment of up to 100 lines, by selecting the tab Comment.

We highly recommend the generation of descriptions, to prevent confusions of parameter sets. The name of the parameter set should also be selected carefully to facilitate finding the right file later on.

Please use the comment field to save information.

*.DCO files can be sent via floppy disk, CD-ROM and/or e-mail.

9.2 Offline Parameterisation

Offline parameterisation has the following functions:

Table 14: **Offline parameterisation**

Print	The current parameter set of the parameterisation program is generated as plain text. This can be viewed on the screen, printed or saved as a text file, (see chapter *Printing of Parameter Sets,* page *102* for more information).
Open file...	The parameter set is read in from a file and displayed by the parameterisation program. Parameters are shown an can be modified.
Save file...	The parameter set currently active in the parameterisation program is saved under the last used filename. If no file has been saved before the name of the opened file is used.
Save file as...	The parameter set currently active in the parameterisation program is saved under a new filename. The user can define the filename in an appropriate menu.

9.2.1 Offline parameterisation: General

The illustration below depicts the principle of offline parameterisation:

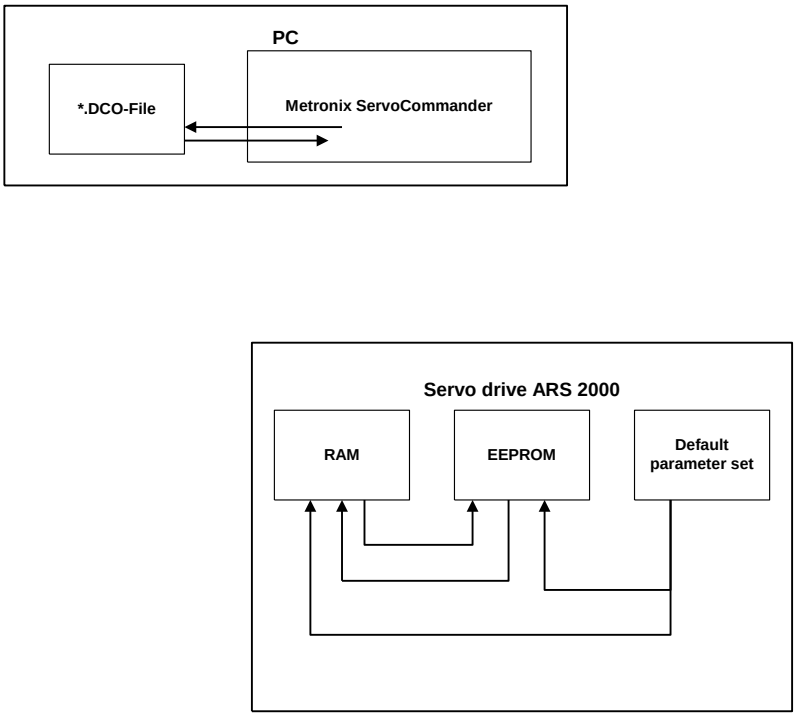


Figure 3: Offline parameterisation

To activate offline parameterisation, click on **Options/Communication/Offline-parameterisation**.

You will be asked which *.DCO file to open. Select the corresponding file.

The file *.DCO was generated for a specific type of servo positioning controller of the LV-servoTEC S2 series. If it is to be used with another type of controller, select the new type of servo controller now.

Caution!

If you use a DCO file for a different type of device, make sure to check the configurations for rated current, maximum current, current controller and speed controller, to prevent damages to the servo controller/motor!

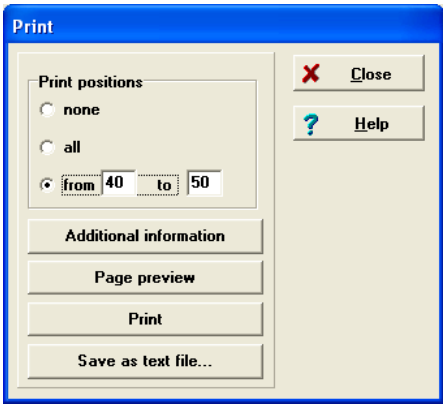
During offline parameterisation the parameterisation program S2 Commander may slightly deviate from the process of online parameterisation:

- Certain menus (e.g. firmware download) are inaccessible
- The menu **File/Parameter set** has different submenus:
- When exiting the program, you will be asked whether the currently open parameter file shall be saved.

Save the parameter set if you have performed your desired changes. In order to become effective load the modified parameter set into the servo positioning controller LV-servoTEC S2.
(see chapter *Functionalities of the Online Parameterisation, page 98*)

9.3 Printing of Parameter Sets

You can print, display and save parameter sets by selecting the menu option **File/Parameter set/Print**. The following window will open:



Define in the box **Print positions** which part of the position list is to be printed. The basic parameterisation is always printed. Optionally you can include the positioning data into the printout.

Click on the button **Additional information** to open a window, where you can enter the following data:

- Commission
- Comments
- Motor data
- Date

These data will always be used for the print and/or plain text output.

Click on the button **Page preview** to generate a preview of the print on the screen.

Click on the button **Print** to start the actual printing (with printer selection.)

If you want to print into a file, click the button **Save as text file...** to generate a *.txt file that you can save to disk or process further (e.g. send by e-mail).

By default, the text files are saved in the S2 Commander subdirectory TXT.
(See also chapter *Directories,* page *26)*.

Parameter sets can be printed in online and in offline mode.

10 Errors

10.1 Error window

The error window is a permanent window in the S2 Commander parameterisation program.
If there is no error, the window is minimised (see illustration).

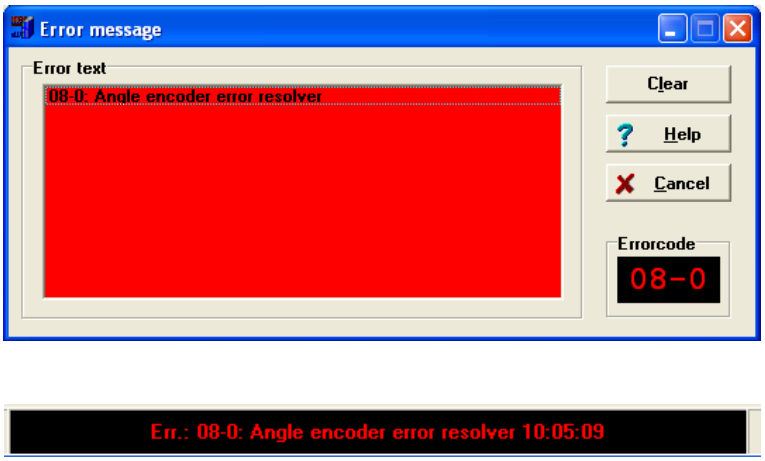
The error window can be maximised by the following events:

1. By clicking the maximisation button
2. By selecting the menu item **error/error window** (only if errors available)
3. By clicking the "error window" (second field on the left in the lower status bar)
4. Automatically when a fault occurs within the LV-servoTEC S2 servo positioning controller
5. Automatically in the event of a write or read error of a communication object

10.1.1 Behaviour in the event of an error

In the event of an error of the servo positioning controller, the S2 Commander interface changes in two ways:

1. The error window will be maximised and put to the surface
2. The error will be stated in red writing on the lower bar



Errors are handled in three steps:

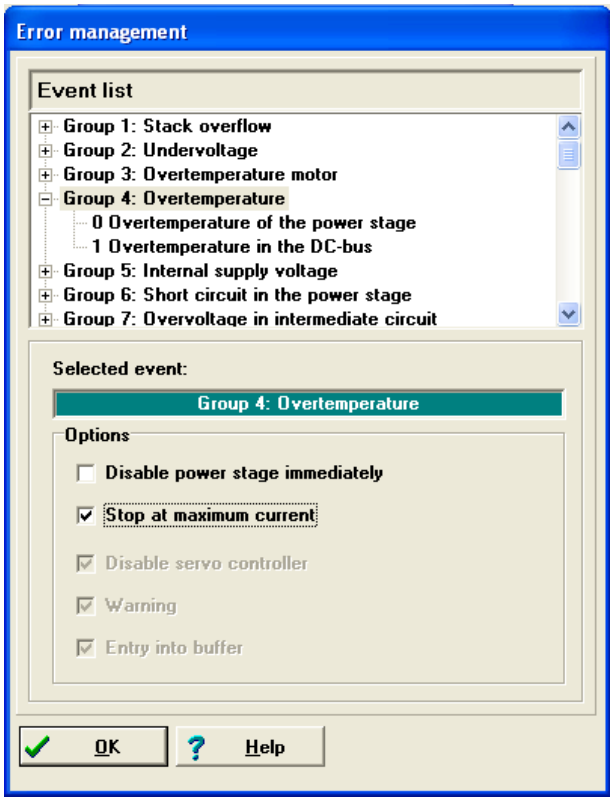
1. Error analysis: If the error text does not provide enough information and you require more tips on how to eliminate the error, click on **Help** in the error window. (In the example given here, the error is caused by a broken/unconnected connection to the angle encoder.)
2. Error elimination: Eliminate the cause of the error. (In this example, the correct connection to the angle encoder has to be provided.)
3. Error acknowledgement: Click on the **Clear** button in the error window. If the error was successfully eliminated, the window will be minimised. If the error still exists, it will be maximised again.

You can minimise the window by clicking on the **Cancel** button. Any existing error message (see *chapter Error / Warning Messages,* page *224)* will remain in the error window on the status bar.

The **Cancel** button does not eliminate any error!

10.2 Error management

In the **Error / Error management** window, you can define which operating states of the servo positioning controller will cause which reactions. The following window will appear:



You can use this window to define the way the servo positioning controller should respond to an error. Different responses can be assigned to every individual group. First select the group (mouse click) and then assign the responses. The following list shows the responses with a rising priority:

1. Entry into buffer: The event will simply be saved in the error buffer. See also chapter *Error buffer,* page *106)*. The event will not be displayed and the application continues to run unaffected.
2. Warning: The event will displayed briefly on the 7-segment-display of the servo positioning controller.
3. Disable servo controller: The application will be stopped with emergency-stop ramp. See also chapter *Safety Parameters,* page *54)*.
4. Stop at maximum current: The drive will be stopped to standstill with maximum current.
5. Disable power stage immediately: The drive will coast down as the power stage is disconnected from power.

Some of the events are so serious, that certain responses cannot be deselected. This is indicated by greyed-out check boxes (see the example: "Disable servo controller", "Warning", "Entry into buffer").

The configuration can be made for error groups only and not for individual error events.

10.3 Error buffer

The **Error / Error buffer** window shows errors, warnings and events which occurred since the last power-on / reset during the operation of the servo positioning controller.
The following information is available:

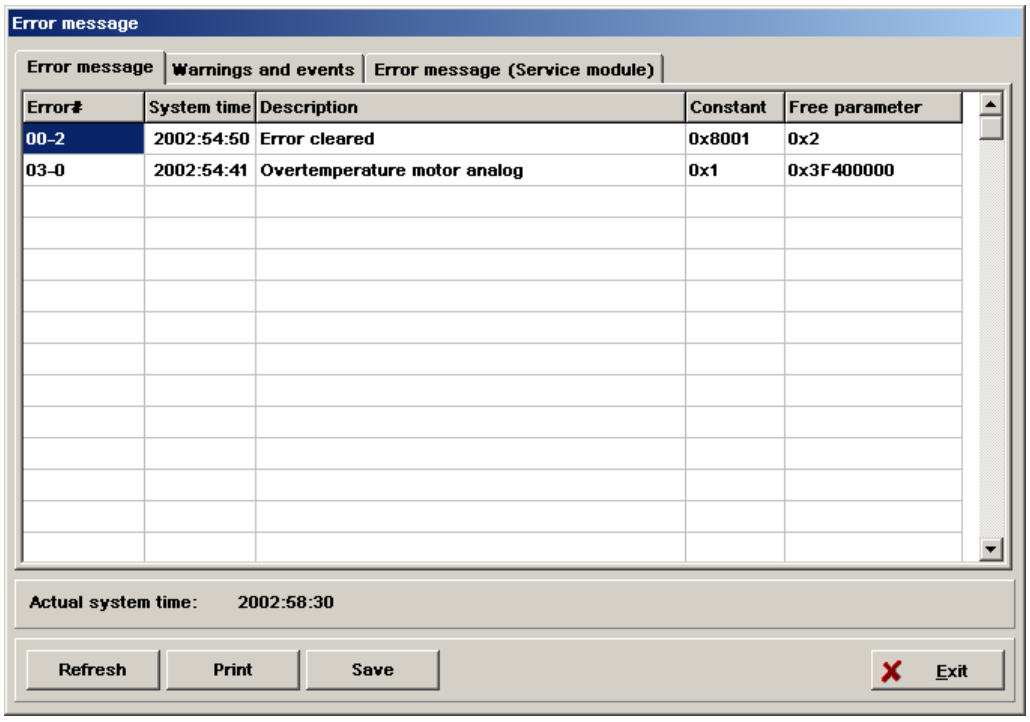
- Error number
- System time (hours, minutes, seconds)
- Error description (text)
- Constant and free parameter

> If you report an error to the application engineering, please state the constant and the free parameter!

The window itself does not check whether there are any new errors. If a new error occurs while the window is open, press the **Refresh** button to refresh the error buffer.

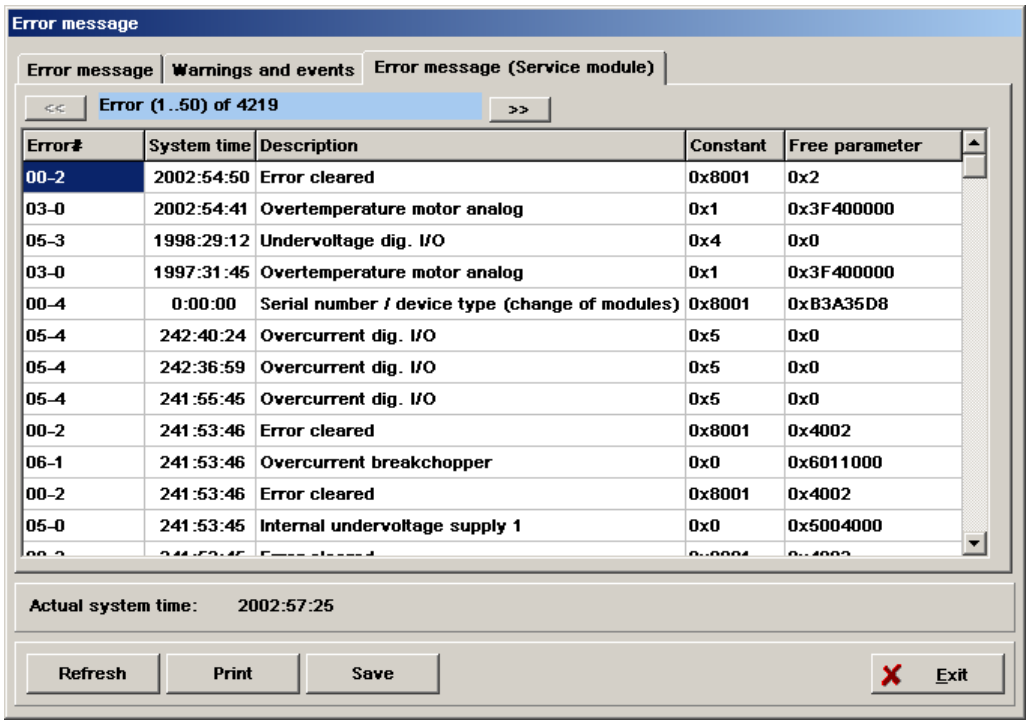
Click onto the button **Print** in order to print the list of the selected tab.

Click onto the button **Save** in order to save the list of the selected tab to a text file.



The **Error messages** tab shows the events that have been stored in the error buffer: errors, quitting active errors and other entries concerning error messages.

The **Warnings and events** tab shows the warnings and events stored in the according buffer.



The **Error messages (Service module)** tab shows error messages stored in the service module. Initially, it has to be configured correspondingly. The service module can store more than 7000 error messages. Each 50 messages are combined to a "block".

Error messages are stored to the service module under the condition of an appropriate configuration of an entry. Then, error messages, quitted errors etc. of the internal error buffer of the servo positioning controller are copied to the service module cyclically. The entries of the error buffer of the service module are checked e.g. for invalid entries during each reset. These entries are corrected. The corrected error message and the correction are written to the service module as an error message.

A message is stored in the error buffer of the service module if it is plugged into another servo positioning controller. This allows the user to identify corresponding blocks if the module is plugged and evaluated in another servo positioning controller.

The **Error messages (Service module)** tab additionally contains the buttons **<<** and **>>**. The button **<<** displays the previous 50 error messages. The button **>>** displays the next 50 error messages. If no more messages in the specific direction iare available, the corresponding button is disabled.

11 Standard Applications and S2 Commander Configurations

This chapter describes the following standard applications:

- Speed-controlled mode (see chapter *Speed-controlled Mode*, page *109*)
- Torque-controlled mode (see chapter *Torque-controlled Mode*, page *110*)
- Position-controlled mode and positioning mode (see chapter *Position-controlled Mode and Positioning Mode*, page *111*)
- Homing and positioning (see chapter *Homing* and *Positioning*, page *113* and page *128*)
- Speed synchronous mode (see chapter *Speed Synchronous Operation*, page *146*)
- Position synchronous mode (see chapter *Position Synchronous Operation*, page *147*)
- Flying saw (product step 3.4) (see chapter *Flying Saw (product level 3.4)*, page *147*)

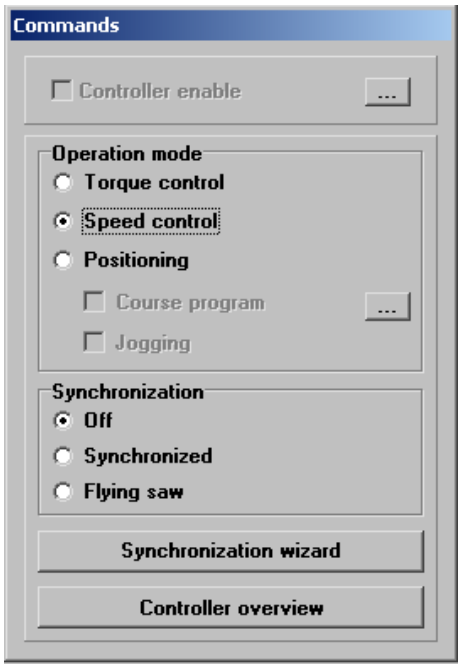
The detailed settings of the different modes of operation are made via:

- Setpoint selectors (see Chapter *Selecting* Setpoints, page *73)*
- Actual value selector (see chapter *Commutation Encoder*, page *58*)
- Brake triggering parameter (see chapter *Brake Control and Automatic Brake*, page *196*)

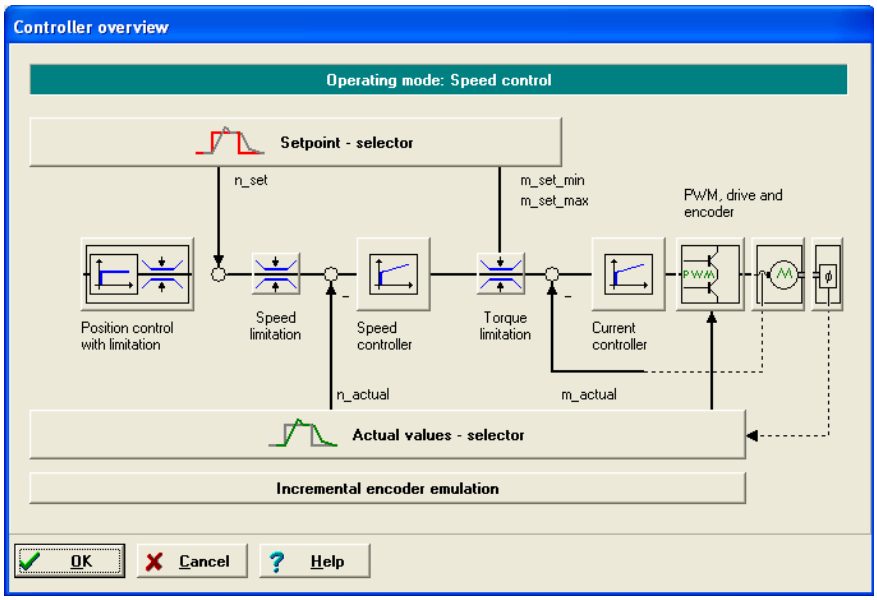
11.1 Speed-controlled Mode

In speed-controlled mode a certain desired speed is set. The servo positioning controller LV-servoTEC S2 determines the current actual speed n_actual by evaluating the encoder.
To keep the speed setpoint, the current setpoint i_set is determined. In speed-controlled mode there is always a torque or current limitation active.

In order to set the speed-controlled mode, the commands window must be configured as follows:



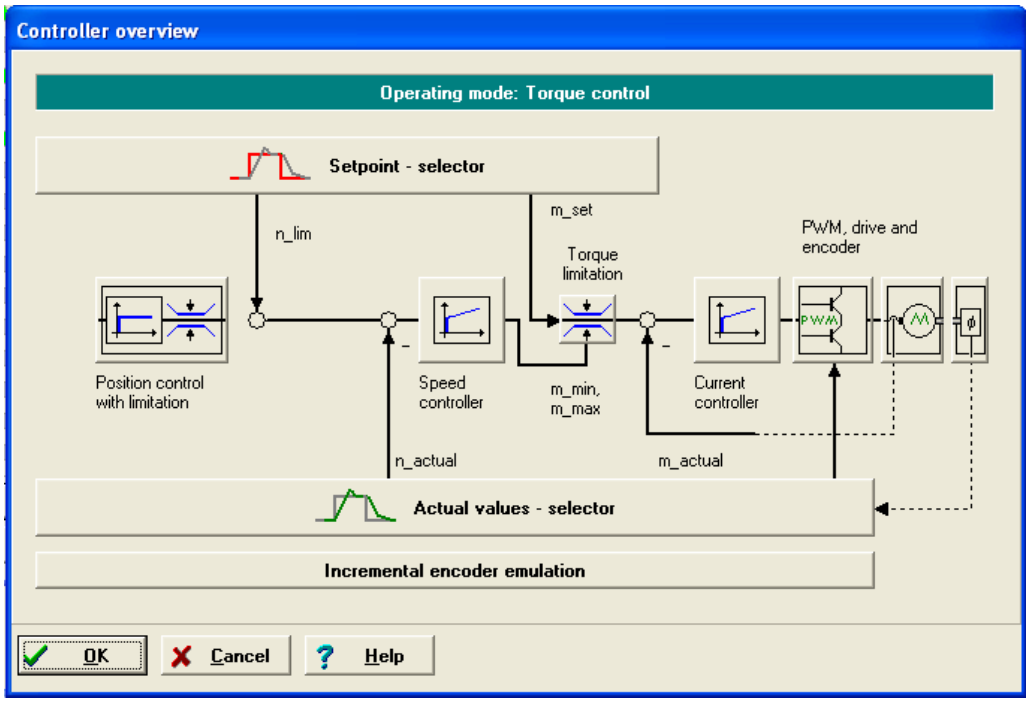
By selecting **Operating mode/Controller overview** you will get a simplified control depiction for this mode of operation, which details the further navigation:



11.2 Torque-controlled Mode

In torque-controlled mode a certain desired torque is set, which the servo positioning controller LV-servoTEC S2 generates in the motor. Since the torque is proportional to the motor current, in this case only the current controller is active. In addition, speed limitation is activated for this mode of operation.

By selecting **Operating mode/Controller overview** you will get a simplified control depiction for this mode of operation, which details the further navigation:



In order to set the torque-controlled mode, the Commands have to be configured correspondingly.

The set torque value can be supplied in A or Nm. This selection can be made under **Options/Display units**. The actual values and setpoints menus will then automatically convert to the selected unit.

If the torque is to be set in Nm, the torque constant, i.e. the conversion factor between current and torque must be made known. The torque constant is entered in the menu **Parameters/Device parameters/Motor data** and can in most cases be calculated with the help of the specifications on the type plate of the motor: simply divide the rated torque by the rated current.

A torque constant of 0 Nm/A is inadmissible, if “Torque in Nm” has been activated.

11.3 Position-controlled Mode and Positioning Mode

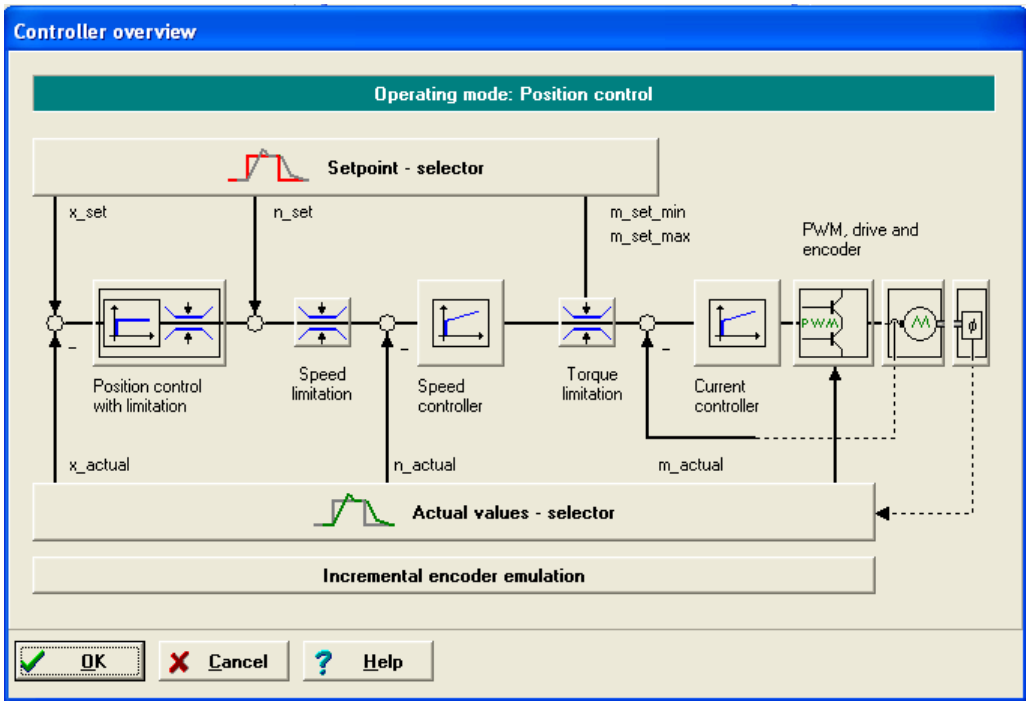
This chapter provides you with information concerning the following applications:

- Homing
- Positioning
- Jogging
- Course program

See chapter *Flying Saw (product level 3.4)*, page *147* deals with the topic "Flying Saw".

11.3.1 Setting the Operating Mode

In position controlled mode / positioning a superordinated position controller is active in addition to speed-controlled mode, which processes deviations between the set position and the actual position and converts those deviations into the corresponding setpoints for the speed controller. Again, the menu **Operating mode/Controller overview** provides you with a simplified control depiction for this mode of operation:



From the difference between the set position and the actual position, the position controller calculates a correction speed, which is passed on to the speed controller as the setpoint.

The position controller usually operates in connection with the positioning control or the synchronisation control. It is a P-controller with parameterisable input and output levels.

There are two ways of parameterizing the position controller (see chapter *Configuration of the position controller*, page *68*):

- Via the menu option Parameters/Controller Parameters/Position controller
- In the Controller overview window by clicking on the corresponding position controller button.

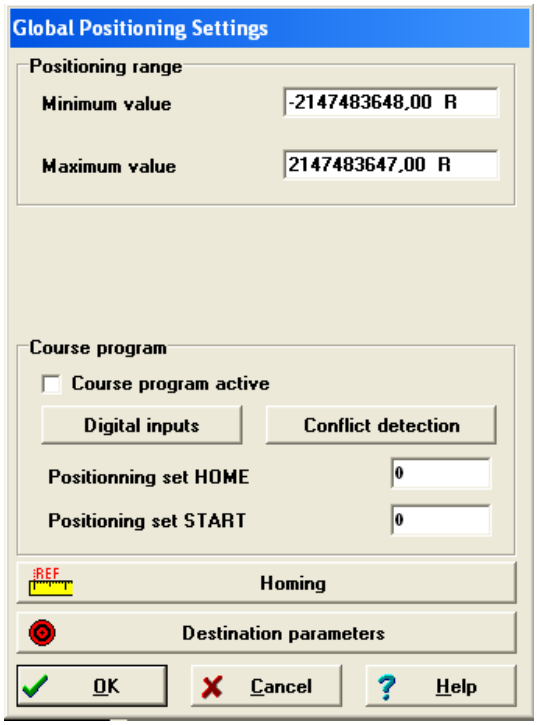
Correctly set current and speed controllers are required for adjusting the position controller.

The position control is activated by selecting the corresponding mode of operation in the Commands window:

The settings of the setpoint ramps have no influence onto the profiles during homing resp. positioning.

11.3.2 Global Positioning Settings

Some basic parameters have to be set for position-controlled mode or positioning applications. Open the following window by **Parameter/Positioning/Global positioning Settings**:



In the case of absolute positioning, each new destination is checked for keeping within the limits of the absolute positioning range. The parameters **Minimum value** and **Maximum value** in the field **Positioning range** show the absolute positioning limits for the set position and the actual position. The positioning range always relates to the zero position of the drive (see also chapter *Homing,* page *113).*

The possible settings in the **Course program** section are described in chapter *Course Program,* page *137*.

The buttons **Homing** and **Destination parameters** open new windows.

11.3.3 Homing

In most applications, in which the servo positioning controller LV-servoTEC S2 works in positioning mode, a zero position must be defined, which the position controller can use as a reference. This position is called **Home position** and must be newly determined each time the controller is switched on. This is done in the so called **Homing**. A number of different methods are available.

The Homing is started by setting the output stage and controller enabling, via field bus or a digital input. The successful completion of the run is indicated by a set status bit inside the device. This status can be evaluated via field bus or a digital output.

11.3.3.1 Homing Methods / Overview

In general homing can be described as follows: The drive moves into a defined **Direction** to a **Destination**. In most case the direction is inverted there. There is an additional **Home position** in order to increase the accuracy. In some cases this home position allows a higher position resolution than the destination. Depending on the method the drive system defines this home position.

Inside of this general description there are a number of variants. The following table roughly divides the homing methods by destination and home position. Take a detailed description from the following chapters.

Table 15: **Homing modes**

Destination	Home position	Methods
End stop	End stop	-18, -17
End stop	Index pulse	-1, -2
Limit switch	Limit switch	17, 18
Limit switch	Index pulse	1, 2
Home switch	Home switch	-23, -27, 23, 27
Home switch	Index pulse	7, 8, 10, 11, 12, 14
Index pulse	Index pulse	23, 33
Current position	--	34

11.3.3.1.1 Method 1: Negative Limit Switch and Index Pulse

With this method, the drive drives at search speed in negative direction until it reaches the negative limit switch. This is indicated in the illustration by the rising edge. The drive then moves back at crawl speed and searches for the exact position of the limit switch. The zero position refers to the first index pulse of the angle encoder in the positive direction from the limit switch.

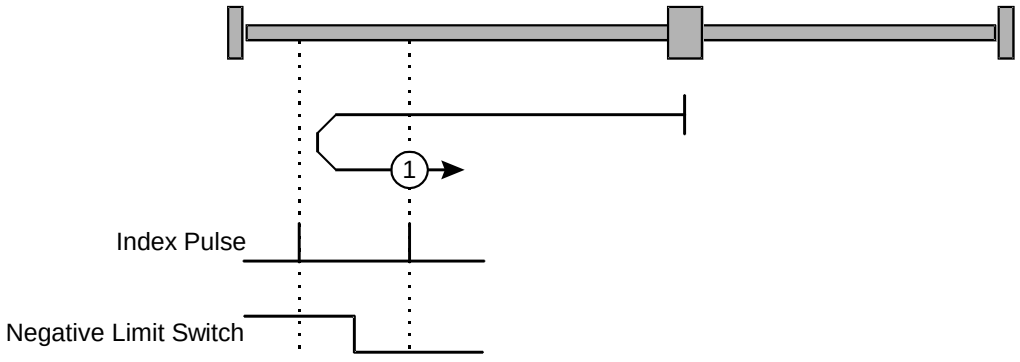


Figure 4: Homing to the negative limit switch with evaluation of the index pulse

11.3.3.1.2 Method 2: Positive Limit Switch and Index Pulse

With this method, the drive moves at search speed in positive direction until it reaches the positive limit switch. This is indicated in the illustration by the rising edge. The drive then moves back at crawl speed and searches for the exact position of the limit switch. The zero position refers to the first index pulse of the angle encoder in the positive direction from the limit switch.

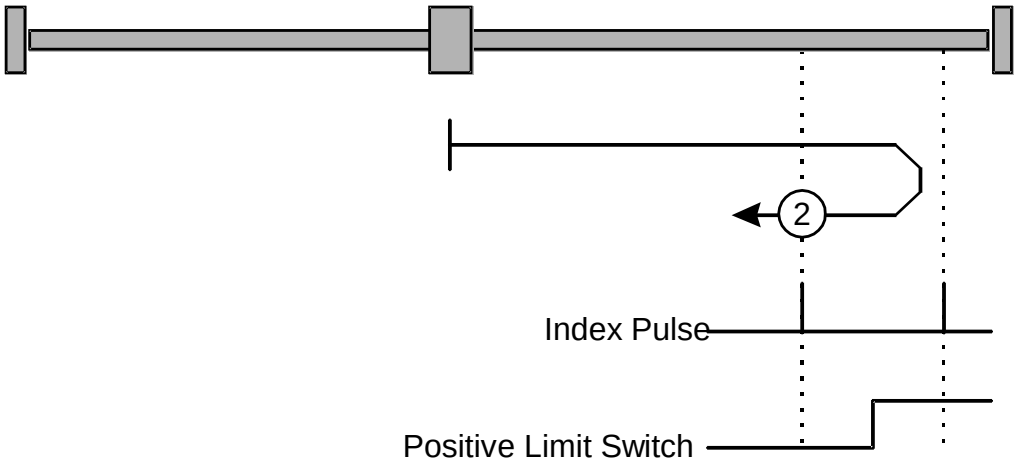


Figure 5: Homing to the positive limit switch with evaluation of the index pulse

11.3.3.1.3 Methods 7 and 11: Homing on Home Switch and Index Pulse

These two methods use the home switch, which is only active for part of the distance. These reference methods are particularly suitable for rotary axis applications, where the home switch is activated once per rotation.

With method 7 the drive at first moves in positive direction and with method 11 in negative direction. Depending on the direction, the zero position refers to the first index pulse in negative or positive direction from the home switch. This is shown in the following two illustrations.

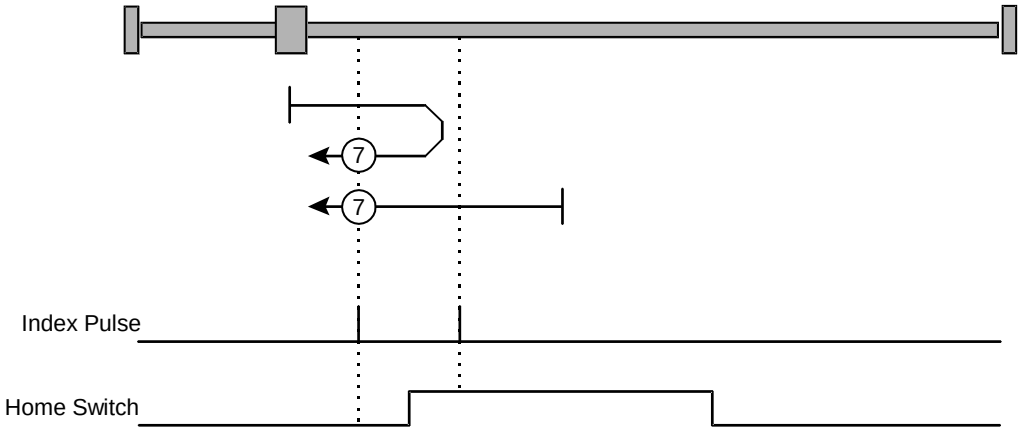
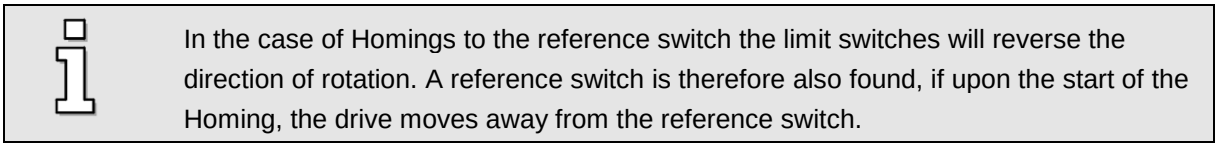


Figure 6: Homing on home switch with evaluation of the index pulse in the case of an initially positive movement



In the case of Homings to the reference switch the limit switches will reverse the direction of rotation. A reference switch is therefore also found, if upon the start of the Homing, the drive moves away from the reference switch.

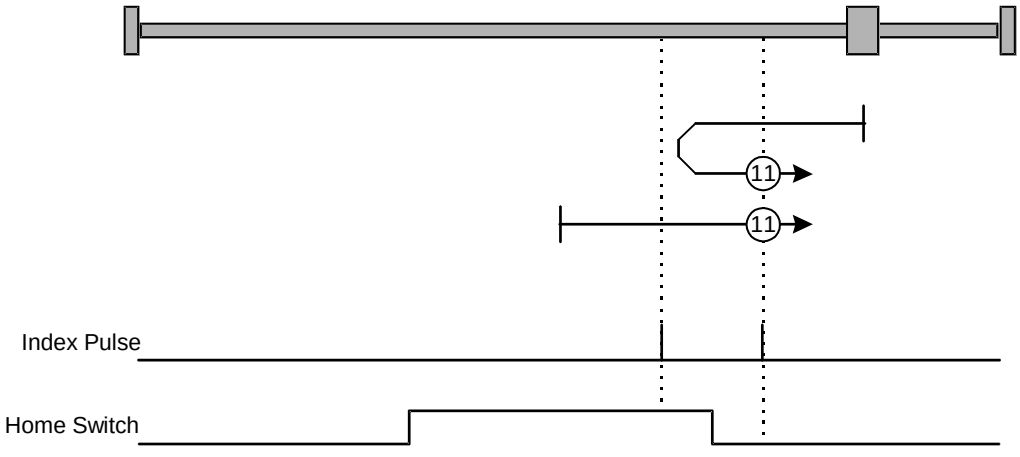


Figure 7: Homing on home switch with evaluation of the index pulse in the case of an initially negative movement

11.3.3.1.4 Method 17: Homing on the Negative Limit Switch

With this method, the drive moves at search speed in negative direction until it reaches the negative limit switch. This is indicated in the illustration by the rising edge. The drive then moves back at crawl speed and searches for the exact position of the limit switch. The zero position refers to falling edge from the negative limit switch.

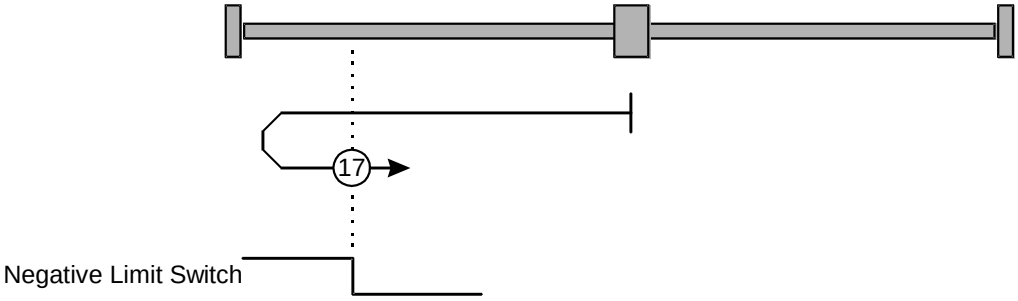


Figure 8: Homing on negative limit switch

11.3.3.1.5 Method 18: Homing on the Positive Limit Switch

With this method, the drive moves at search speed in positive direction until it reaches the positive limit switch. This is indicated in the illustration by the rising edge. The drive then moves back at crawl speed and searches for the exact position of the limit switch. The zero position refers to falling edge from the positive limit switch.

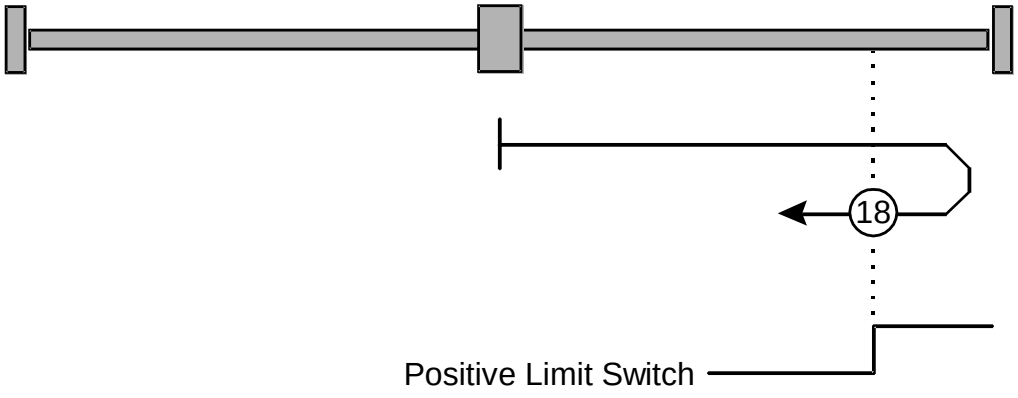


Figure 9: Homing on positive limit switch

11.3.3.1.6 Methods 23 and 27: Homing on Homing Switch

These two methods use the home switch, which is only active for part of the distance. These reference methods are particularly suitable for Rotary axis applications, where the home switch is activated once per rotation.

With method 23 the drive at first moves in positive direction and with method 27 in negative direction. The zero position refers to edge from the home switch. This is shown in the following two illustrations.

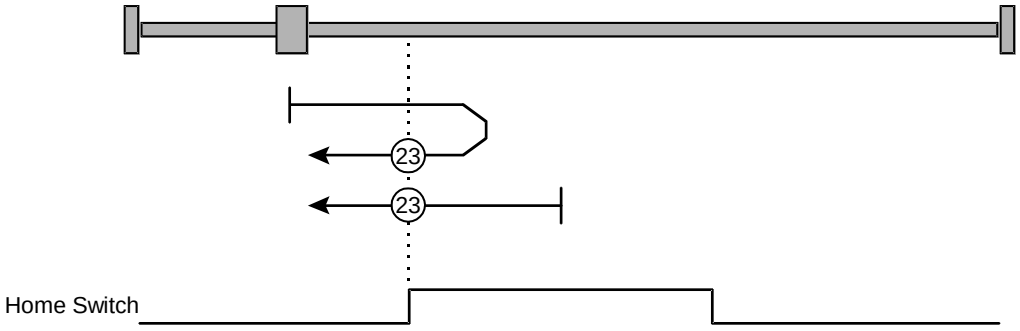


Figure 10: Homing on home switch with positive initial movement

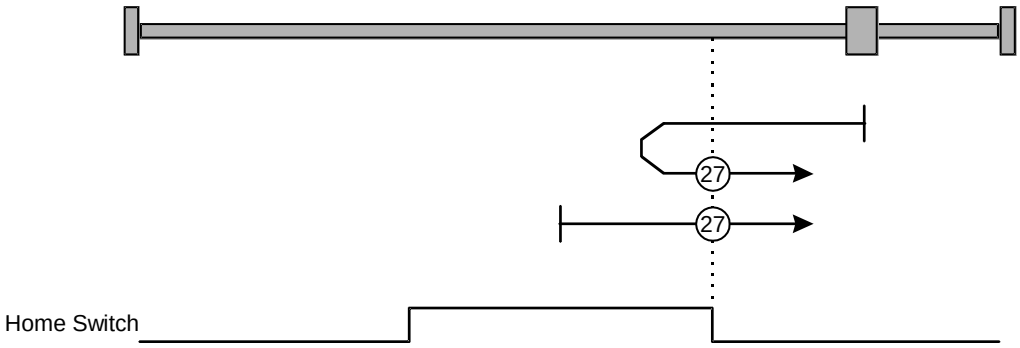


Figure 11: Homing to the home switch with negative initial movement

In the case of Homings to the reference switch the limit switches will reverse the direction of rotation. A reference switch is therefore also found, if upon the start of the Homing, the drive moves away from the reference switch.

11.3.3.1.7 Methods -23 and -27: Homing on Homing Switch

These methods are similar to the methods 23 and 27. But here, first, the drives moves to the end of the moving area which is defined by an end stop or a limit switch. Then, the drives searches for the homing switch. By this, more than one switch can be connected to the same input for the homing switch. Then, the “last” switch in search direction is applied as homing switch for the homing procedure.

The drive moves in positive direction first is method –23 is selected. It moves in negative direction first if method –27 is selected. The homing position refers to the edge of the home switch, see chapter *Methods 23 and 27: Homing on Homing Switch,* page *118* .

11.3.3.1.8 Methods 32 and 33: Homing on Index Pulse

In the case of methods 32 and 33 the direction of the Homing is negative or positive. The zero position refers to the first index pulse from the angle encoder in the direction of search.

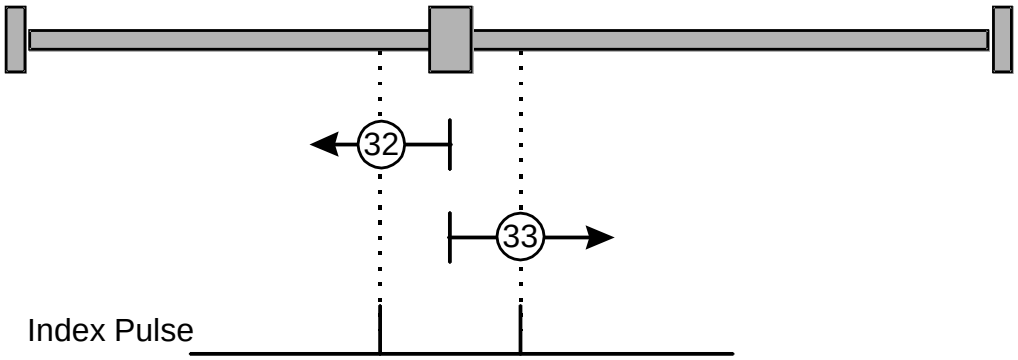


Figure 12: Homing on the index pulse

11.3.3.1.9 Method 34: Homing on the Current Position

With method 34 the zero position refers to the current position.

11.3.3.1.10 Method -1: Negative End Stop and Index Pulse

With this method the drive moves in negative direction until it comes to the end stop. In general, the I²t-value has to increase by 50 % from the current value at the start of homing in order to detect the end stop. The end stop must be mechanically dimensioned in a way that it will not be damaged by the parameterised maximum current. The zero position refers to the first index pulse of the angle encoder in positive direction from the end stop.

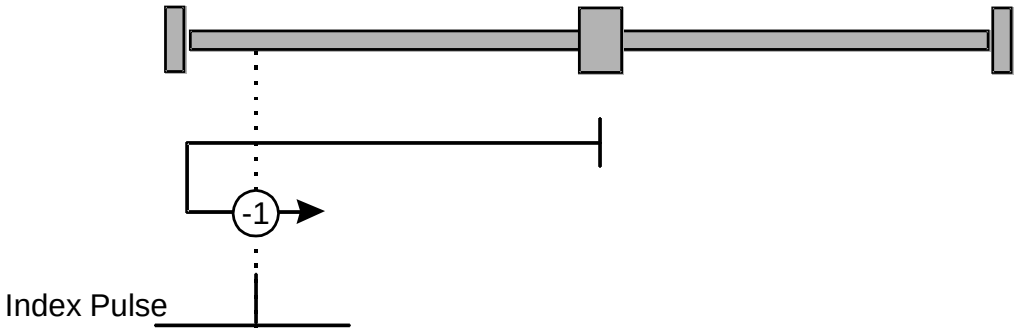


Figure 13: Homing to the negative end stop with index pulse evaluation

11.3.3.1.11 Method -2: Positive End Stop and Index Pulse

With this method the drive moves in positive direction until it comes to the end stop. In general, the I²t-value has to increase by 50 % from the current value at the start of homing in order to detect the end stop. The end stop must be mechanically dimensioned in a way that it will not be damaged by the parameterised maximum current. The zero position refers to the first index pulse of the angle encoder in negative direction from the end stop.

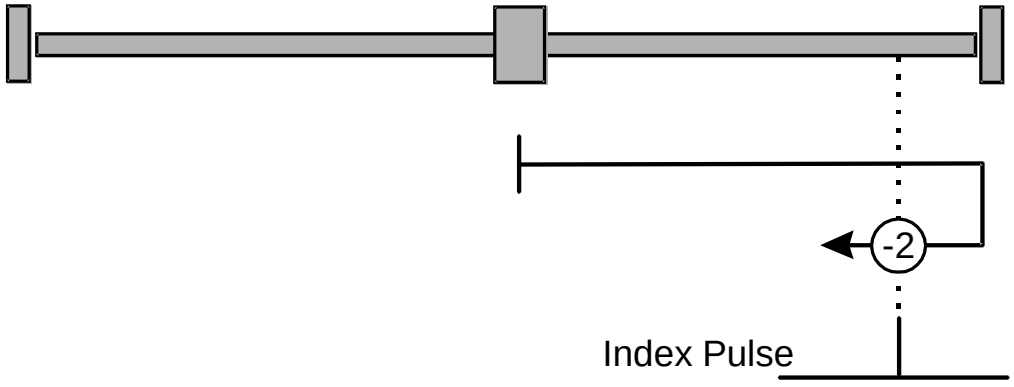


Figure 14: Homing to the positive end stop with index pulse evaluation

11.3.3.1.12 Method -17: Homing to the Negative End Stop

With this method the drive moves in negative direction until it comes to the end stop. In general, the I²t-value has to increase by 50 % from the current value at the start of homing in order to detect the end stop. The end stop must be mechanically dimensioned in a way that it will not be damaged by the parameterised maximum current. The zero position refers directly to the end stop.

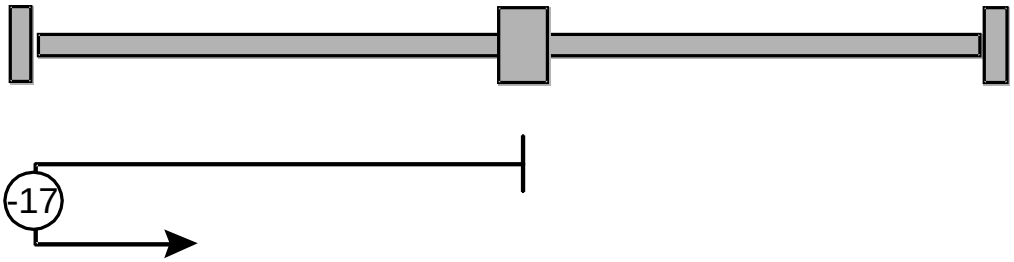


Figure 15: Homing to the negative end stop

11.3.3.1.13 Method -18: Homing to the Positive End Stop

With this method the drive moves in positive direction until it comes to the end stop. In general, the I²t-value has to increase by 50 % from the current value at the start of homing in order to detect the end stop. The end stop must be mechanically dimensioned in a way that it will not be damaged by the parameterised maximum current. The zero position refers directly to the end stop.

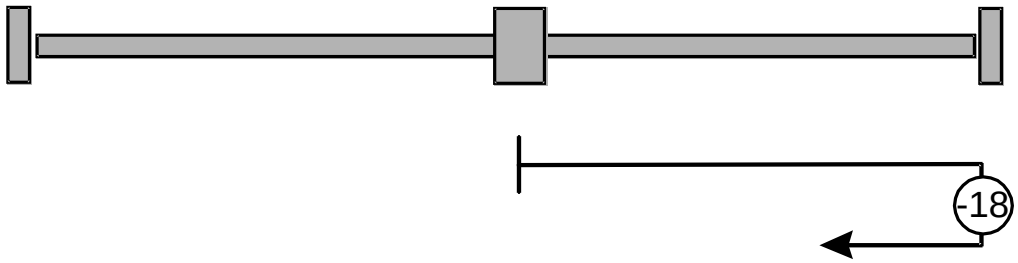
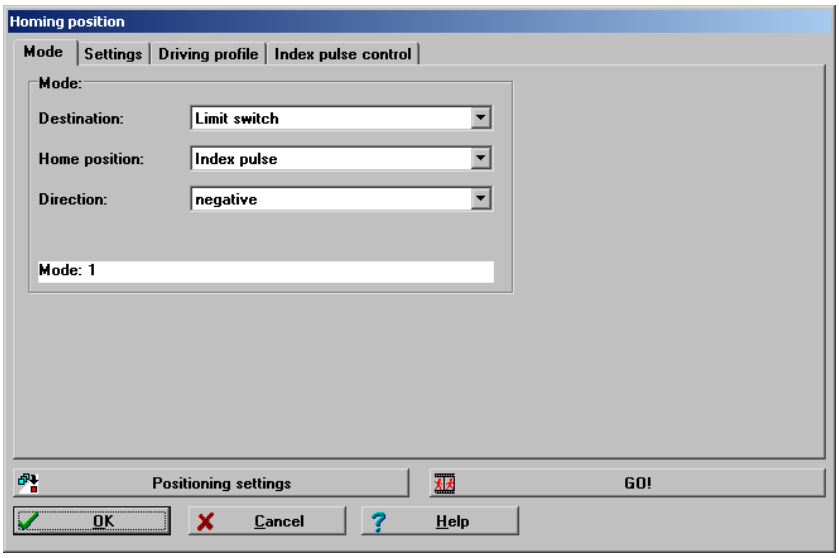


Figure 16: Homing to the positive end stop

11.3.3.2 Parameterisation of the Homing Method

The Homing method is parameterised in the menu Reference position, which is accessed via **Parameters/Positioning/Reference position** or via the REF button in the icon bar.

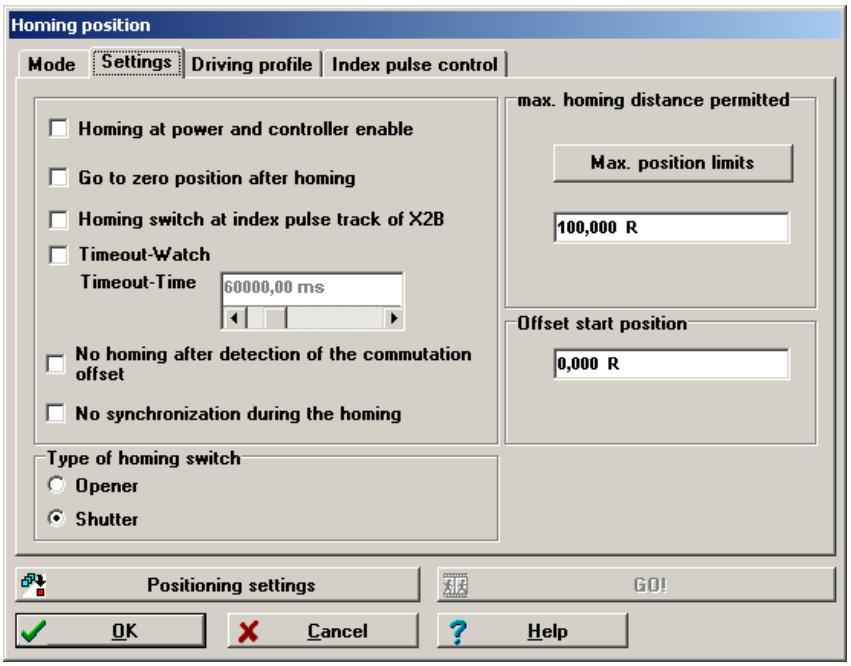
The following window will appear:



Here, select your homing method (see also chapter *Homing Methods / Overview*, page *114*).

11.3.3.3 Homing: Settings

The following window appears under the tab **Settings**:



The parameters have the following meaning:

- **Homing at power and controller enable**

  If this option is selected, the homing run will always be started automatically if the power stage and controller enabling signal are applied both after disabling the power stage.

- **Go to zero position after homing**

  If this option is selected, the drive will move to the zero position at driving speed when the destination and the home position of the homing run have been reached.

- **Homing switch at index pulse track of X2B**

  If this option is active, an index pulse of X2B will be evaluated as a homing pulse.

- **Timeout-Watch**

  If this option is active, the time will be monitored. If homing takes longer than specified, an error will be generated. At present, the time is monitored at intervals of 10 ms.

- **Timeout-Time**

  The time for the timeout-watch can be set in this field.

- **No homing after detection of the commutation offset**

  This option is only effective, if there is a encoder without commutation information. Normally a homing takes place, after the commutation information is found out. To suppress this homing run, activate this check box.

- **No synchronization during homing**

  If the drive is a slave within a synchronized application, the synchronization will be suppressed during the homing run.

- **Type of homing switch**

  Please state whether your homing switch is a normally closed contact or a normally opened contact.

- **Max. homing distance permitted**

  You can define a maximum search distance. If the system cannot detect any target signals (e.g. a limit switch) or the home position within this search distance, it will issue an error message.

- **Max. position limits**

  Clicking on this button the maximum homing distance is calculated from the maximum position limits.

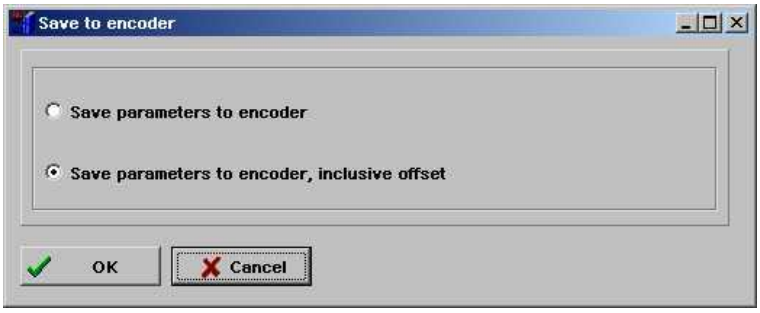
- **Offset start position**

  The actual home position - i.e. the mathematical zero point for the positioning run that follows - is slightly offset from the home position of the homing run. This offset is indicated under Offset start position.

- **Basic parameters (encoders with EEPROM only)**

  After a successful homing, use this button to actualise and save the zero offset stored in the EEPROM of the angle encoder. Here, all parameters which are saved in the encoder are also overwritten with current values.

Another menu opens when clicking on the button:

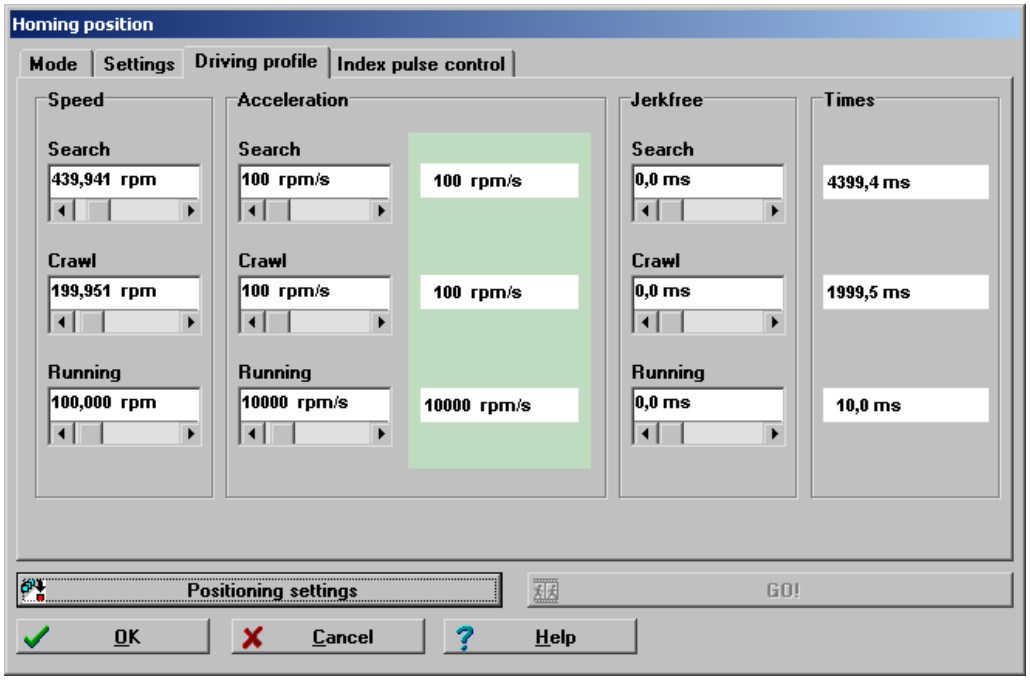


Choose the option “Save parameters to encoder, inclusive offset”. Then, if a multiturn absolute value encoder is applied, the actual position is not lost even if the supply voltage is switched off.

11.3.3.4 Homing: Profile

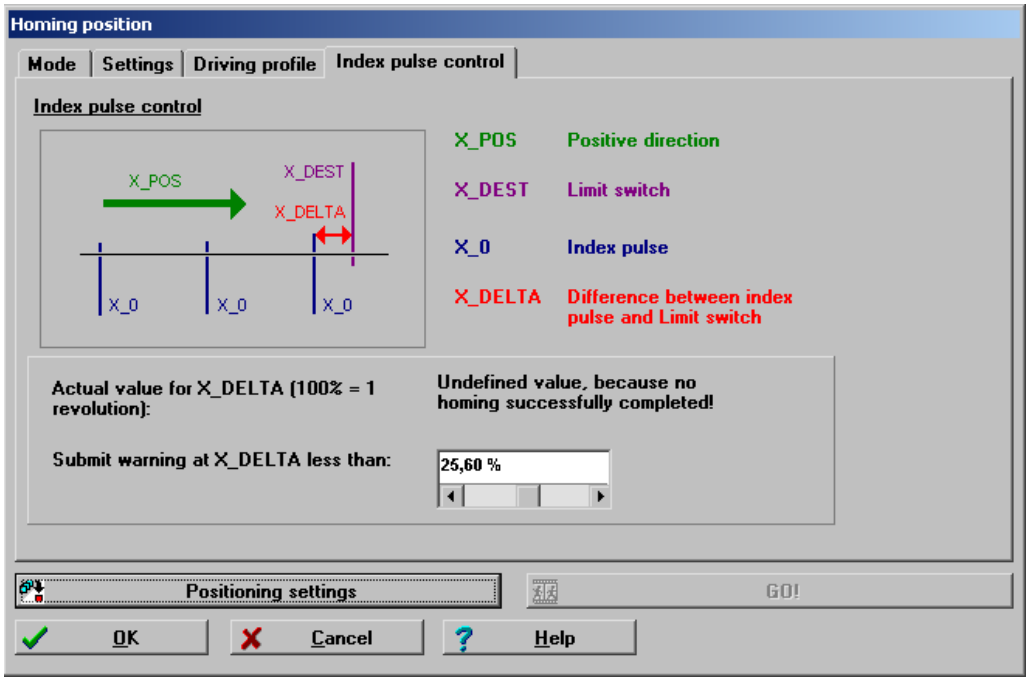
Here, enter speed, acceleration and jerkfree part for the following phases:

- Search: Run of drive towards destination (limit switch, home switch, end stop)
- Crawl: Reverse run (at slow speed) to determine contact threshold
- Running: Optional run to zero point (reference point) of application

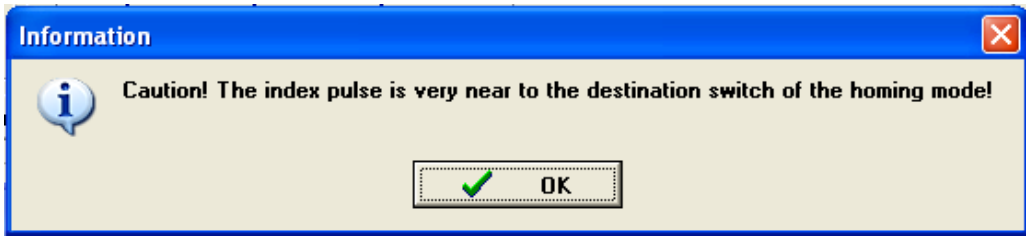


11.3.3.4.1 Homing: Index Pulse Control

The zero pulse control is important, if a destination other than "index pulse" has been selected and the reference is the "index pulse". If the destination is very close to the index pulse, a slight modification in the mechanics can provoke that during the next homing the index pulse is taken as a reference position “in front of” or “behind” the original index pulse. The zero pulse control displays the distance between the destination and the index pulse. The following window will appear:



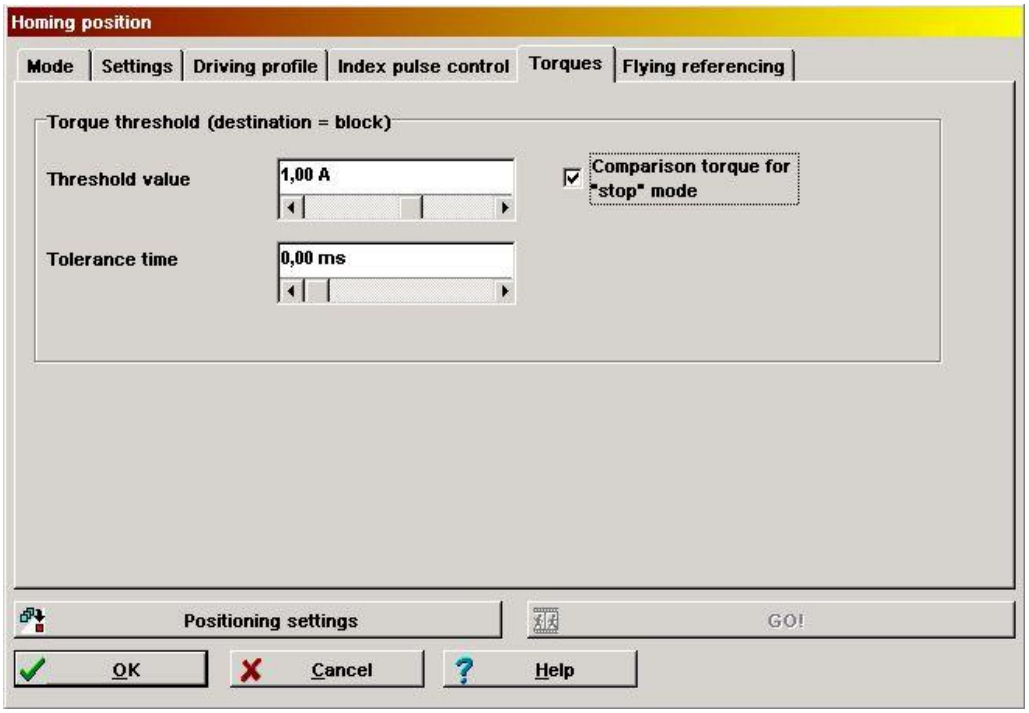
You can display the current distance between destination and index pulse and also parameterise a threshold, where a warning is issued in the case of a short-fall. 100% are one revolution. The error message looks as follows:



11.3.3.4.2 Tab: Torques

Optionally, the conventional homing method „Stop“ can be elaborated by „homing on a comparison torque“. Then, the destination of the homing procedure is detected by reaching the given comparison torque. In contradiction to that, the criterion of 50 % of raise of the i²t-value is not taken any more.

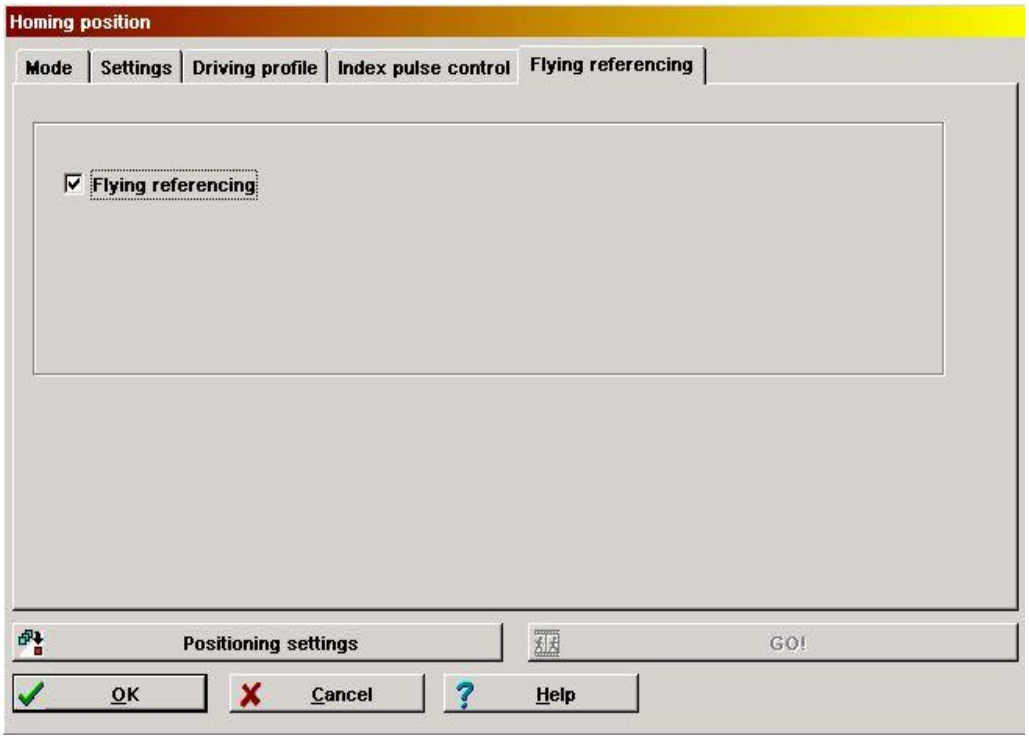
Another tab „Torques“ with a link to it is offered if the method „Stop“ is selected.



Enter the reference value of the comparison torque in the field **Threshold value**. Reaching this value is monitored during homing. Reaching the reference torque will be ignored during the **tolerance time**. This functionality is enabled for the homing procedure by marking the checkbox Comparison torque for “stop” mode.

11.3.3.4.3 Tab: Flying referencing

This menu activates a functionality of which its effect is similar to a homing procedure.



The checkbox activates the functionality „flying referencing“.

„Flying referencing“ may avoid accumulating errors in „endless“ applications. Here, a rising edge at the digital input SAMPLE sets the position setpoint and actual value to zero. The functionality is similar to a rotary axis application where the position overflow / underflow is externally triggered.

As far as the homing is concerned the following items should be taken into account:

- Applying so called absolute value encoders (encoders with serial interface e.g. HIPERFACE, EnDat) no homing after reset is required. The absolute position is always read from the encoder. But homing may be useful during the first set-up of the application in order to set the absolute position calculated to a specific position. Here, an internal zero position shift is calculated. This can be saved to the EEPROM of the encoder in order to maintain this unchanged after each reset. As an alternative, the motor shaft may be rotated in that way, so that the actual position has the desired value before mounting the motor to the drive.
- The speed during homing should be chosen in a way that the index marker can be detected during the homing run of the drive. Sometimes very slow speeds are required to fulfil this.
- The acceleration should be sufficiently high, so that the servo positioning controller does not exceed the targets to far during the direction inversion.
- After finishing the homing, the drive does not always stand on the zero position which depends on the selected homing method. A known difference to the index pulse is considered during the calculation if it is the reference of the homing process. Only after a final run to the zero position the drive is then also physically on the zero position.

11.3.4 Positioning

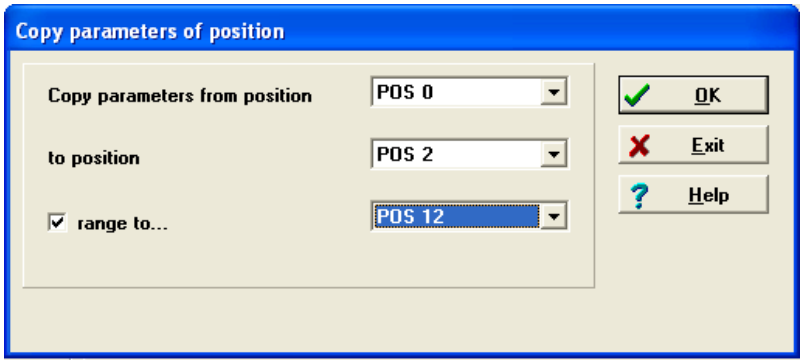
The servo positioning controller LV-servoTEC S2 has a table of 256 positions, which can be used to parameterise destinations in advance. There are further positioning sets for field bus and jogging mode.

11.3.4.1 Destination Parameters: General Buttons

Parameterize the destinations in menu **Parameters/Positioning/Destination parameters**.
This menu has the following general buttons:

General positioning settings (e.g. position limits) can be modified via the button **Positioning settings** (see chapter *Global Positioning Settings,* page *113*).

The complete settings of one destination can be copied from one destination to another destination by the button **Copy**. The following menu appears:

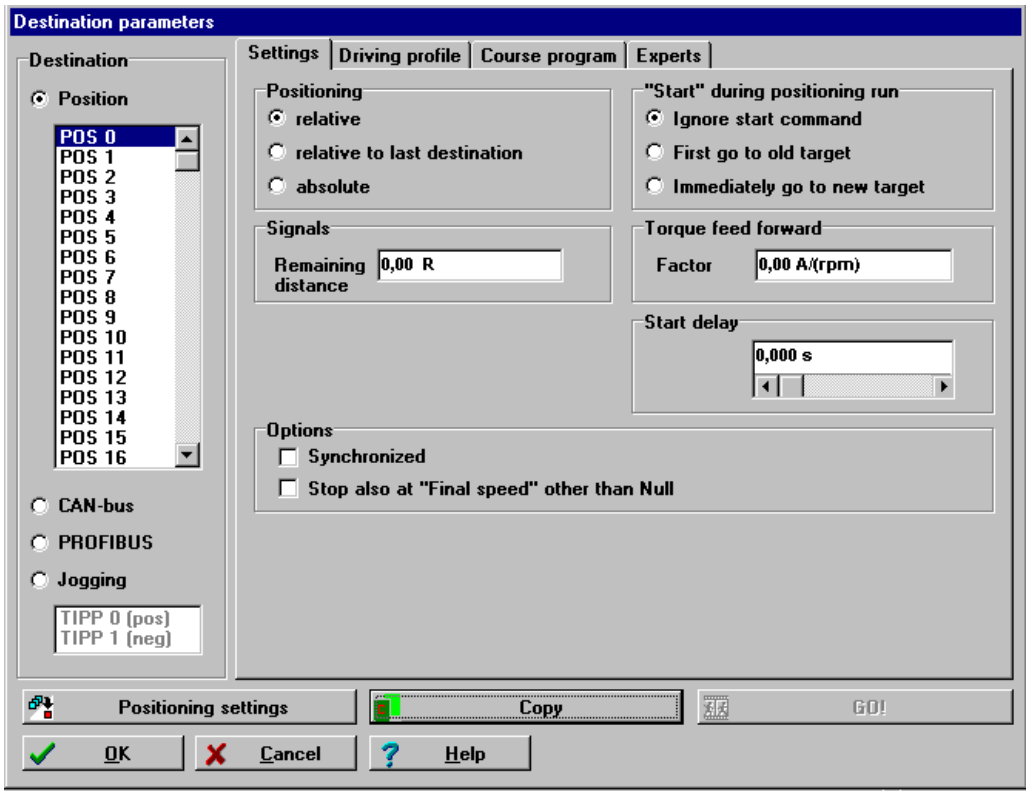


You can copy a source position to single target positions. Enter the upper two fields. If you want to copy a source to several positions select the check box range to…. Enter the last destination position in the third field.

Click on the button **GO**! to go to start a positioning to the currently displayed destination.

11.3.4.1.1 Tab: Settings

The destination positions are parameterised under **Parameters/Positioning/Destination parameters**. The window shown below will appear with the **Settings** tab selected:



The left field **Destination** shows a list of the destinations, which can be parameterised.

In the field **Positioning run** you can select, whether the destination shall be interpreted as being **absolute** (referring to the reference point) or relative. **Relative** refers to the current set position, for example for an ongoing positioning run. The option **relative to last destination** on the other hand calculates the new position based on the currently approached position or the destination to be approached.

The option **relative** yields different results, depending on the setting in the field **Start during positioning run** (see below). If the combination **relative/Wait for end of positioning run** has been selected, the new position refers to the destination position.

With the combination of **relative/Interrupt actual positioning run** the new destination position is calculated based on the current set position.

The field **Start during positioning run** determines the behavior of the servo controller if a positioning procedure goes on while the start command for a new destination position is received. It offers the following options:

- **Ignore start command**: The positioning order for the new position can only be selected and started after the previous positioning has been completed.
- **First go to old target**: The ongoing positioning is completed and the new positioning is then started. The next positioning can be selected prior to the ongoing positioning. It is then started automatically after the ongoing position has been completed. When starting a relative positioning the reference position for “relative” is in general the last target position.

- **Immediately go to new target**: The current positioning is interrupted and the new position is approached immediately. If the positioning mode is “relative” the reference position for the calculation of the new target position is the currently active position setpoint. In contrast to that the reference position for the option “relative to the last destination” is the (old) target position of the currently interrupted positioning cycle.

The field **Torque feed forward** allows higher dynamics during the positioning procedures.
The variable can be experimentally determined. The default setting is 0.

Note that a bouncing switch at the digital start input can cause problems, if “Wait for end of positioning run” or “Interrupt actual positioning run” is allowed during relative positioning. The drive may then move a little too far!

The **Start delay** input field is used to define a delay which passes after the start command of a positioning before the desired position is approached.

In the field **Messages** you can parameterise trigger messages, which are issued via field bus or a digital output. These trigger messages show the remaining distance to the end of an ongoing positioning run (see also chapter *Digital Outputs,* page *187)*.

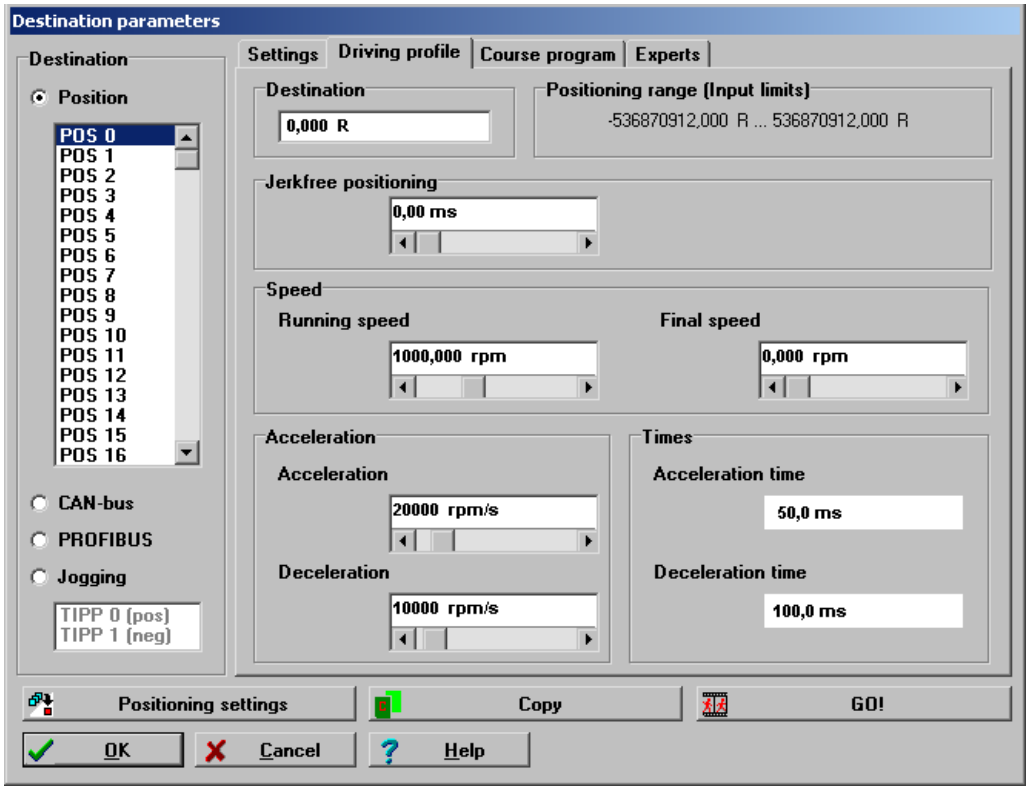
The **synchronized** check box is used for the application ”Flying Saw“. By starting a position set the synchronisation is activated or deactivated if the mode ”Flying Saw“ is active. With active synchronisation the position of the selected encoder for synchronisation (Master) is added to the position setpoint. Then, the drive follows the position of the Master drive.

Check box active: The synchronisation is switched on simultaneously to the start of the positioning if it has not been active before. If the Master is not at standstill the arising offset is balanced in a controlled manner. The applied running speed meets the speed of the Master plus the running speed entry of the position set as speed override. The entries of the started position set are also applied for the accelerations.

Check box inactive: The synchronisation is switched off simultaneously to the start of the positioning if it has not been inactive before. The positioning starts at the current speed setpoint which is the speed of the master. So the synchronized state is left in a controlled manner.

In most cases, the option **Stop also at "Final Speed" other than zero** makes sense only for position sequences. It means that the next position will be approached immediately after a position has been reached. If the function mentioned above is active and a final speed <> 0 has been parameterised, the drive will stop provided that no follow-up positioning has been requested.

11.3.4.1.2 Tab: Driving Profile



In the field **Destination** you can enter the target position. The target position is interpreted differently, depending on whether absolute or relative positioning has been selected (see **Settings** tab).

The positioning process is smoothed by a filter to eliminate jerks. Enter the filter time constant in the field **Jerkfree positioning**. The acceleration process as well as the deceleration process is extended by this time. The complete duration of the positioning process is also extended by this filter time. In some cases, e.g. for an oversteering, i.e. Jerkfree positioning > acceleration / deceleration time the entered profile velocity will not be reached.

In the field **Speed** you can enter the Running speed, at which the drive moves towards the target. The **Final speed** determines the speed at which the drive shall approach the target upon reaching it. In most cases it is set to zero. With a set final speed other than zero, the profile is calculated in a way that the drive upon reaching the target position has the set final speed and optionally keeps going at that speed.

The illustration below shows a profile in which the final speed upon reaching Position 1 has been set to a speed of v1.

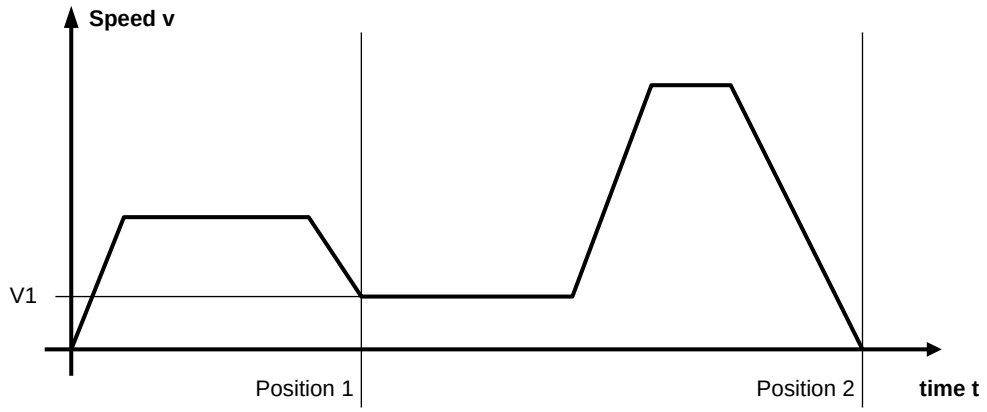
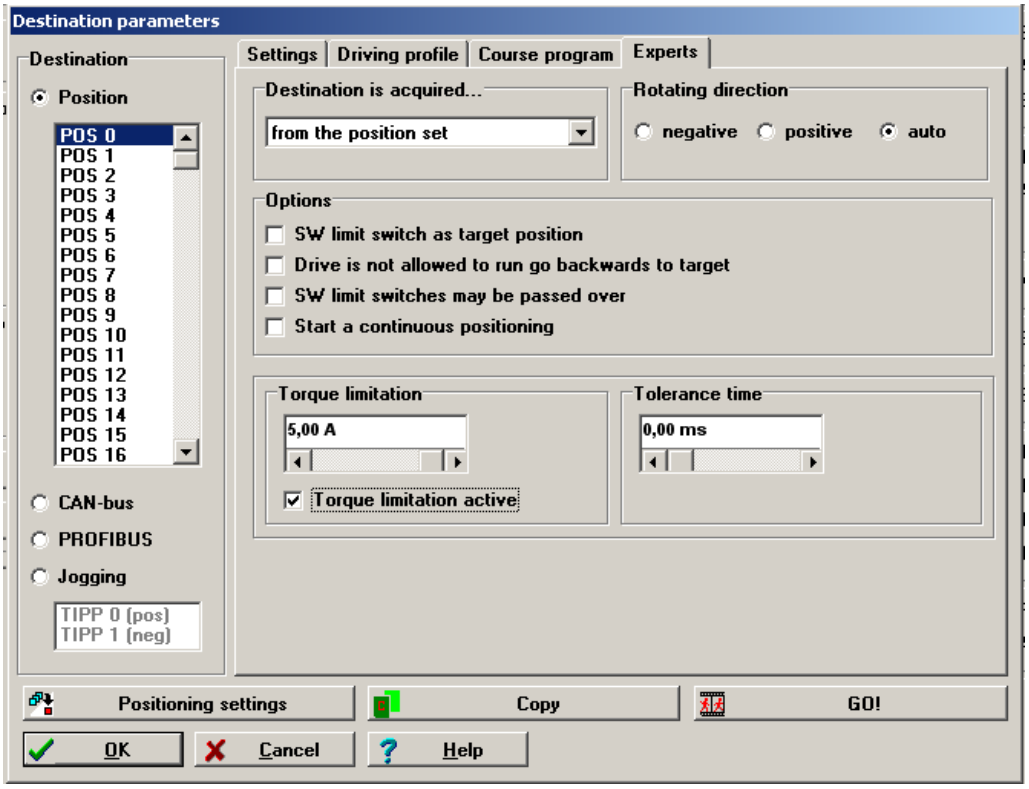


Figure 17: Positioning: Driving profile

In the fields **Acceleration** and **Deceleration** the accelerations for starting and braking can be set.

The field **Times** displays the resulting times.

11.3.4.1.3 Tab: Experts



You enter the source for the destination of the actual positioning process in the field **Destination is acquired**…:

from the position set:	This is the standard setting. The position set on the **Driving profile** tab will be used as the destination.
from analogue input AIN0:	The current value of the analogue input will be translated into a destination. See also the menu Analogue inputs.

Assign to the positioning process a fixed direction via the input field **Rotating direction**. This option becomes effective in combination with other options e.g. SW limit switch as target position. For normal relative or absolute positioning processes the positioning control determines the rotating direction itself. Available are:

positive:	The drive always moves in the direction of the positive limit switch, regardless of the target position value. Normally, this option only makes sense combined with the option **SW-limit switch as target position** (jogging mode).
negative:	The drive always moves in the direction of the negative limit switch, regardless of the target position value. Normally, this option only makes sense combined with the option **SW-limit switch as target position** (jogging mode).
auto(matic):	This is the standard setting. The direction of movement will be determined automatically using the current position, the target position and the additional options **(absolute, relative, relative to last destination etc.).**

Normally, the option **SW limit switch as target position** is used only for jogging mode position sets. Depending on the selected direction, either the negative or the positive end of the positioning range will be entered as the target position. Attention! This option has a higher priority than **Destination is acquired... from analogue input AIN0**.

In some cases it might be desirable to stop the drive as quickly as possible in the positioning mode. This happens, for example, during the synchronization in the "flying saw" application. The position set for synchronization can configured with "relative positioning, destination 0", for instance. If the drive is still moving when this position set is started, the drive goes past the target and has to reach the target by moving backwards. This behaviour is suppressed by the option **Drive is not allowed to run go backwards to target**.

Normally, the firmware checks whether the current position or the position to be approached lies within the authorized positioning range. If the function **SW-limit switches may be passed over** is active, the monitoring process is deactivated. In this case the user has to ensure that no damages may be caused. This option should be applied in special cases only.

Normally, the option **Start a continuous positioning** only makes sense if the option **from analogue input AIN0** has been selected under **Destination acquired...**. If this option is active, the positioning start command will be performed continuously in the firmware which means that the drive will continuously try to approach the position from AIN0, for example. Otherwise, the position would be adopted only when the start command is issued. A result of this option is that the current positioning is not completed. The message “target reached” is not generated. Accordingly, another positioning can only be started if it has the starting option “Immediately go to new target”.

A torque limitation can be performed in the positioning set if regarded.

As an alternative for the target reached event the torque limit can be configured. If this feature is needed, the item torque limitation active must be passive. If the tolerance time is higher than 0 the torque limitation becomes active after this time is elapsed. This allows accelerations with higher torque for the previous mentioned tolerance time. If the torque is reached or, if necessary, the tolerance time is elapsed, the target reached message is generated. The drive finishes the positioning and sets its position setpoint to the actual position. If the target position contained in the positioning set is reached the target reached messages is also set. For further information as far as a positioning to a torque is concerned contact the technical support.

11.3.4.2 Go to Destinations

There are different possibilities of selecting destinations and starting the positioning process:

- Via digital inputs
- Via the serial interface
- Via field bus

11.3.4.2.1 Positioning via Digital Inputs

The individual destinations are selected via digital inputs. A rising edge at the digital input selected for the start of a positioning takes over the destination and starts the positioning run.

The base devices of the LV-servoTEC S2 series have 4 digital inputs (DIN0...DIN3) for the target selection of 16 positions. To approach further target positions via digital inputs there is the option of inserting up to two EA88 extension modules with 8 additional inputs and outputs each. This allows direct access to all 256 positions. It is also possible to change the default function assignments of the base device's digital inputs. Depending on the application the other digital inputs can also be used for the positioning selection.

Default settings for the positioning selection via digital inputs:

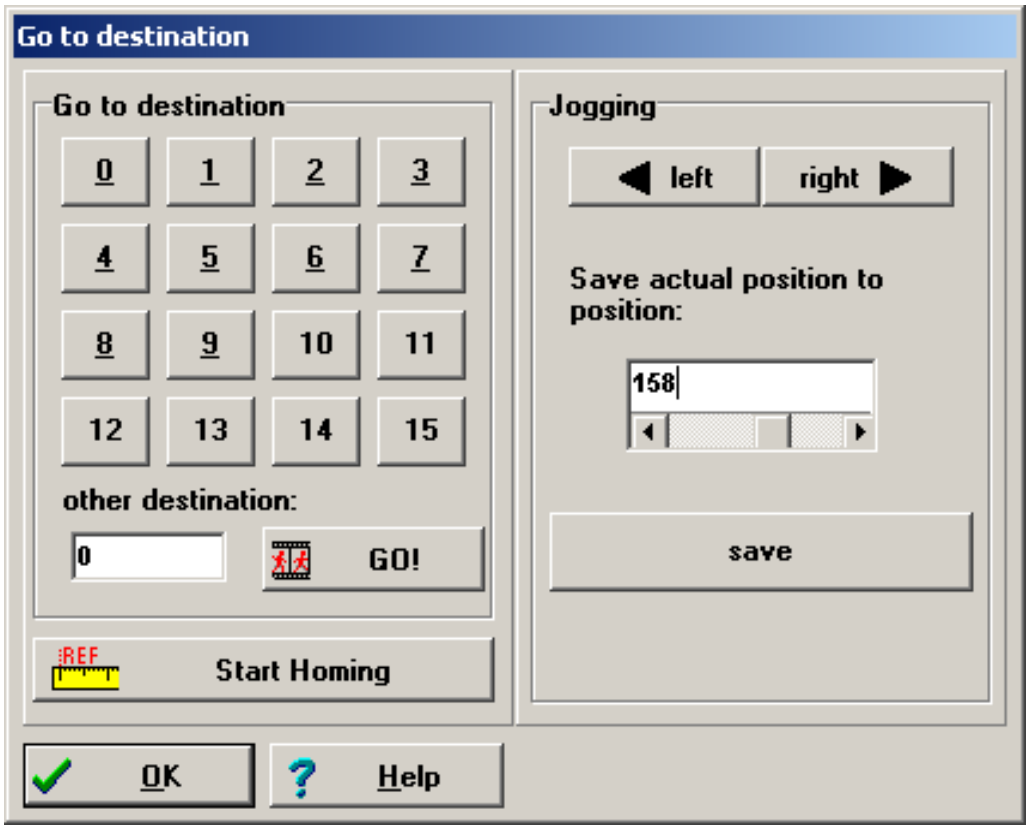
Table 16: **Positioning via digital inputs**

Digital input				**Position selector**
DIN3	DIN2	DIN1	DIN0	
Bit3	Bit2	Bit1	Bit0	
0	0	0	0	0
0	0	0	1	1
...	..	..	..	..
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
...	...	...	...	...
1	1	1	0	14
1	1	1	1	15

11.3.4.2.2 Positioning via RS232 (Serial Interface)

All 256 positions can be approached via the serial interface. Additionally, one position set is reserved for interfacing via RS232. The command syntax for the parameterisation of these positions as well as starting the positioning run is described in the Application Note RS232 commands for LV-servoTEC S2.

The run to the destinations and Homing can be initiated via S2 Commander. To do so, activate the menu option **Parameters/Positioning/Go to destination**:



Go to destination

- **Go to destination:** Click on the buttons to drive to the desired positions.
- **Other destination:** Enter the position number and click on the **GO!** button to drive to the corresponding position.
- **Start Homing:** Click on the button to start the homing run.

Jogging: Use the buttons **left** and **right** to move the drive to the desired position. The drive stops when you release the buttons.

Save actual position to position...: You can save the current actual position as a destination in a position set. Select the position set number from the scroll box and click on the **save** button.

11.3.5 Course Program

11.3.5.1 Overview

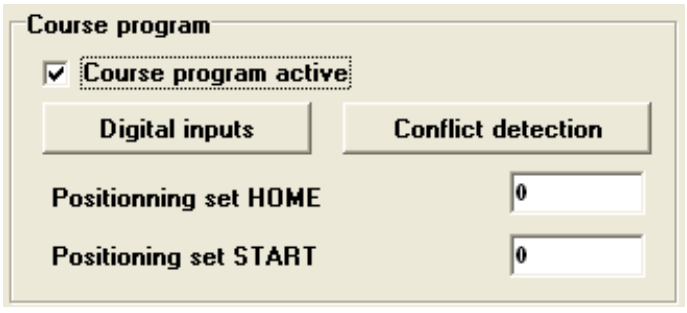
A course program allows several position sets to be linked together in one sequence. These positions will be approached one after the other.

Features:

- All positions can be linked in a course program
- Apart from linear sequences, which are terminated sooner or later, circular linking is also possible
- Up to 2 following positions can be set for each course program step (position). As a result, a course program can include branching. Branching occurs depending on the logic status of digital inputs.
- The course program can control two digital outputs. For this purpose, every course program step offers four different options (on, off, target reached, remaining distance message)
- A course program can be started through two standard entry points or through any position. This is done via digital inputs or the serial interface.
- A course program can be created and monitored in a comfortable manner in the parameterisation interface. The application created is saved in the parameter set and can be transferred to other servo positioning controllers.

11.3.5.2 Global Settings

The global settings for the course program have to be made in the menu
Parameters/Positioning/Global positioning settings
(see also chapter Global Positioning Settings, page *113*).
The window includes the following section which is relevant for the course program:

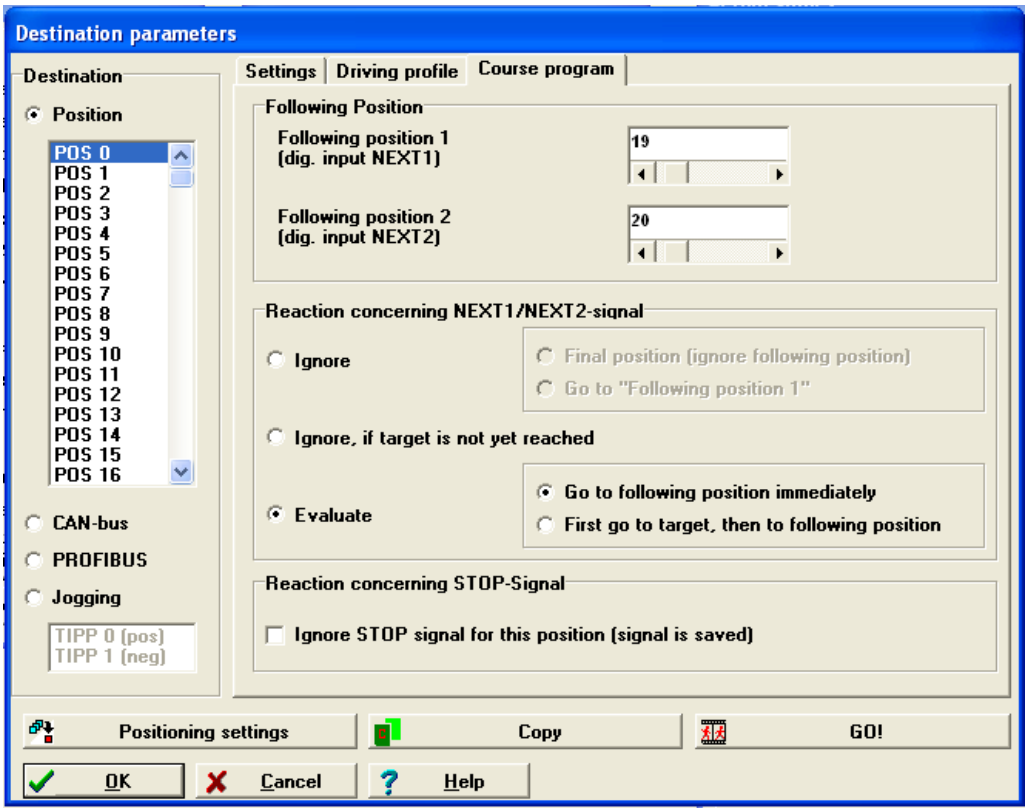


The **Course program active** check box determines whether positions will be linked in general or not. The element is identical with the **Course program** check box in the command window.

The inputs fields **Positioning set HOME** and **Positioning set START** can be used to define entry points into the course program. In order to link the positioning sets with corresponding digital inputs, click on the **Digital inputs** button (see chapter *Digital Inputs, page 140*).

11.3.5.3 Linking Positions

In the menu Parameters\Positioning\Destination parameters, the Course program tab shows the following window:



Here you can link the positions. You can enter two following positions for every position (fields: **Following position 1** and **Following position 2**). The section below defines whether and how the positions will be approached. This is explained with the following example:

Position 4: Following position 1 (NEXT1) = 19 Digital input DIN0

Following position 2 (NEXT2) = 20 Digital input DIN1

The assignment of the **NEXT1**/**NEXT2** signals to the digital inputs DIN0 and DIN1 is explained in chapter *Digital Inputs,* page *140*.

Table 17: **Following position NEXT1/NEXT2: Examples**

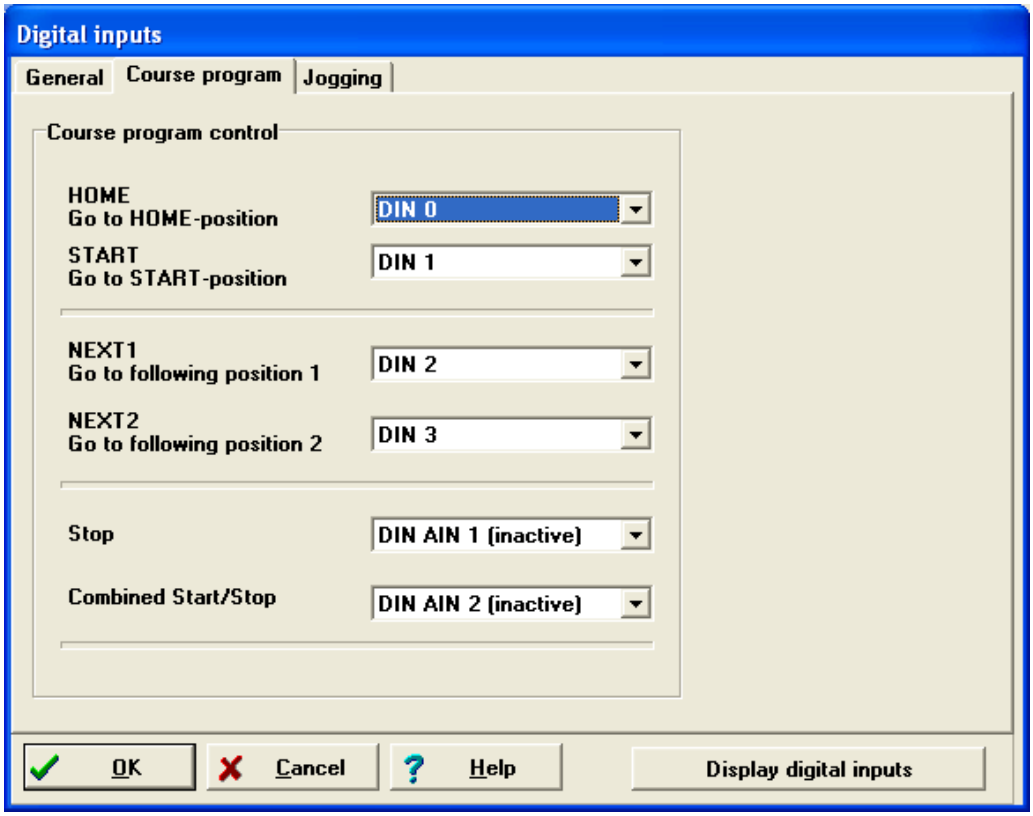
Option	Meaning	Example (see window)
Ignore NEXT1/NEXT2: Final position	This is the last position in the course program.	The course program stops after position 4 has been reached.
Ignore NEXT1/NEXT2: Go to "Following position 1"	The course program is performed in a linear manner. Following position 1 will be approached.	After position 4, position 19 will be approached immediately.
Ignore if target is not yet reached	The digital inputs NEXT1 and NEXT2 will be evaluated (branching). If the current positioning is not completed, the digital inputs will be ignored.	As long as position 4 is not reached, edge changes from DIN0 and DIN1 will be ignored. Once position 4 has been reached, DIN0 causes the drive to approach position 19 whereas DIN1 would cause the drive to approach position 20.
Evaluate: Go to following position immediately	The digital inputs NEXT1 and NEXT2 will be evaluated (branching). If the system detects a signal edge, the current positioning run may be interrupted and the drive may immediately go to the new target position.	If DIN0 is set, position 19 will be approached whereas DIN1 would cause the drive to go to position 20.
Evaluate: First go to target, then to following position	The digital inputs NEXT1 and NEXT2 will be evaluated (branching). If the current positioning run is not completed and the system detects a signal edge, the drive will first go to the current position. Then a new target position will be approached. If there are several signal edges during the current positioning run, the last signal edge will be valid.	Once position 4 has been reached, DIN0 causes the drive to approach position 19 whereas DIN1 would cause the drive to approach position 20. During the current positioning run 4, a signal edge first occurs at DIN0 and then also at DIN1. Then, after target position 4 has been reached, the positioning run of position 20 will be started.

The course program stops when a final position is reached or a stop signal is detected. The assignment of the stop signal is explained in *chapter Digital Inputs,* page *140)*.

In some cases it may be better to ignore the stop signal for certain positions as the course program as a whole should be stopped but not in this particular position. In this case, check the check box **Ignore STOP signal for this position** for this particular position. The drive will go to the next position and then it will stop (provided this option has not been set for this position, too).

11.3.5.4 Digital Inputs

You can make the following assignments on the **Course program** tab in the menu **Parameters\IOs\Digital inputs**:



You can define the two digital inputs triggering the entry in the course program in the fields **HOME** and **START**.

The fields **NEXT1** and **NEXT2** are used to define the two digital inputs responsible for position branching.

In the **STOP** field you define the digital input for stopping the course program.

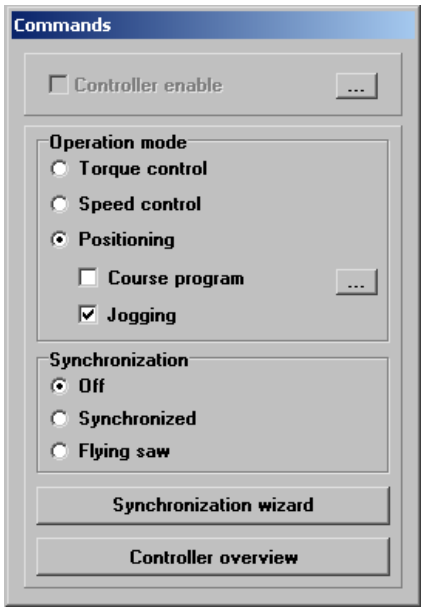
In the **Combined Start/Stop** field you define the digital input for starting and stopping the course program.

11.3.6 Jogging mode

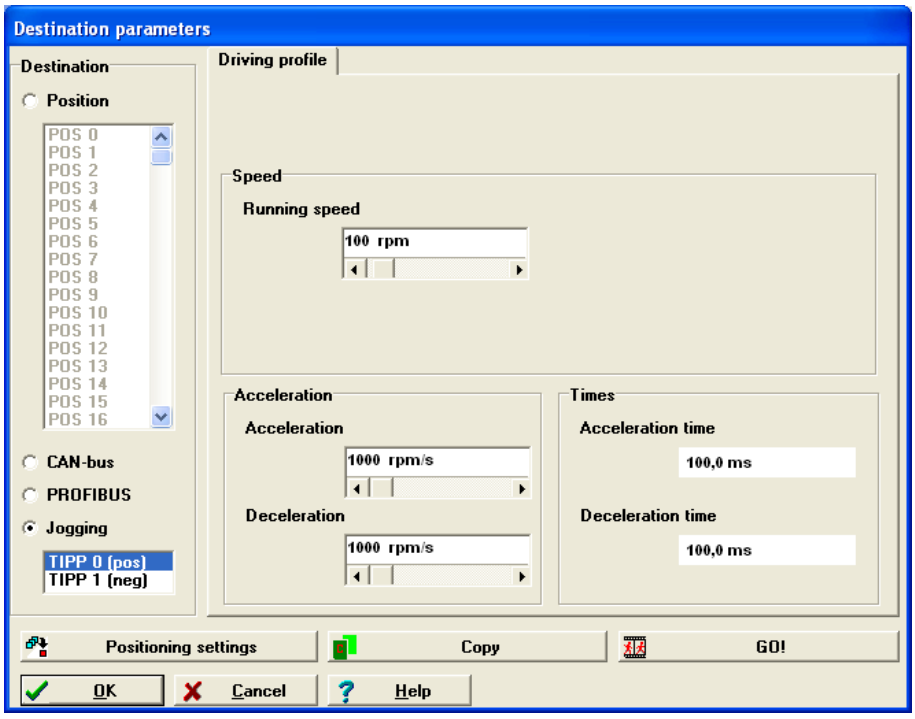
Jogging is the controlled driving of a drive to a specific position. The drive continues to move as long as a certain input signal is active.

The LV-servoTEC S2 servo positioning controller supports jogging in a positive and negative direction. You can define a separate running speed and separate accelerations for every directions. In addition, you can assign one input for jogging in a positive direction and one input for jogging in a negative direction.

The jogging mode has to be activated in the Commands window:



The running speed and the accelerations in a positive and negative direction are parameterised in the position window (**Parameters/Positioning/Destination parameters**):



The digital inputs are assigned in the window **Parameters/IOs/Digital inputs** on the **Jogging** tab:

11.3.7 Configuration of digital outputs

Setting digital outputs (**Parameters/IOs/Digital outputs**) in positioning mode can tell a superordinated control that a positioning process is being/has been completed:

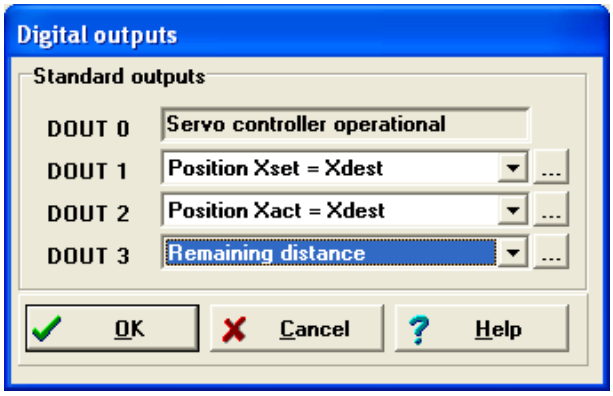
1st possibility: position setpoint = target position

2nd possibility: Actual position = target position

3rd possibility: Remaining distance to the end of the positioning procedure reached

4th possibility: Homing position valid

5th possibility: Position trigger



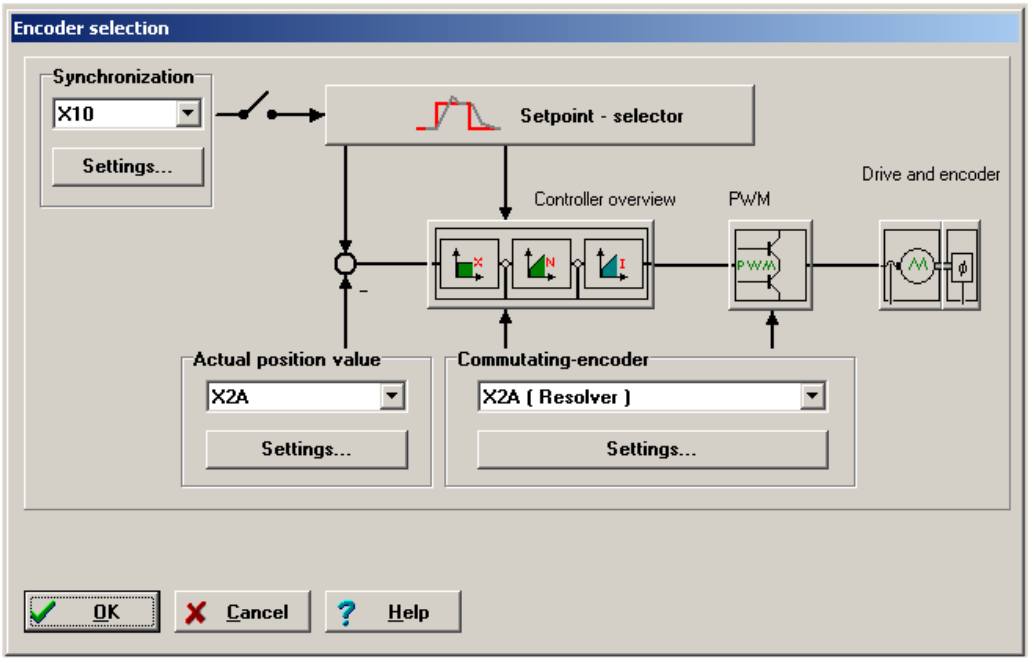
The configuration of the digital outputs is described in chapter *Digital Outputs,* page *187)*.

For the 2nd possibility (actual position = target position) a tolerance window can be defined, the limits of which are used to set the digital output (see *chapter Configuration of the Messages for the Digital Outputs,* page *189*).

For possibilities 3 you can parameterise trigger messages in the field Messages under **Parameters/Positioning/Destination parameters**, which will be issued via a digital output. These trigger messages show the remaining distance to the end of an ongoing positioning (see chapter *Digital Outputs,* page *187)*.

12 Applications with Several Angle Encoders

Chapter *Standard Applications and S2 Commander Configurations*, page *108* deals with applications with only one single angle encoder. It supplies the information concerning the commutation position, the actual speed and the actual position value. These information paths can be separated as of firmware product step 3.2. Open menu **Operating mode /Encoder selection**:



The encoder selected in the "Commutating-encoder" field is also used to determine the actual speed value!

The application of a separate angle encoder for the position is for example useful in following cases:

The motor is coupled to the positioning unit by a gear box with backlash whereas a high positioning accuracy is required. The positioning unit has an encoder with high accuracy. It is useful in this case that this information is used for the position evaluation whereas speed and commutation position are still calculated from the encoder signals of the motor encoder.

A further class of applications can be summarized under the heading “synchronisation”.

Here, several servo positioning controllers LV-servoTEC S2 are synchronized by coupling them by Master-Slave operation. The Master supplies the Slave with position information via the incremental encoder output (connector X11). The Slave reads in this signal by the external incremental encoder input (connector X10). The connectors have to be coupled by a 1:1 cable (pin 1 to pin1, pin 2 to pin 2, etc.).

The figure below shows the configuration for two servo positioning controllers:

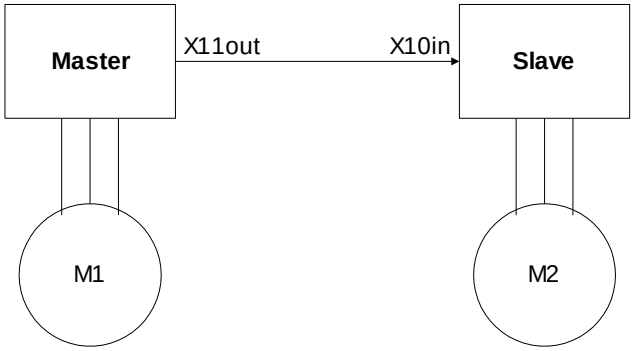


Figure 18: Master-Slave operation

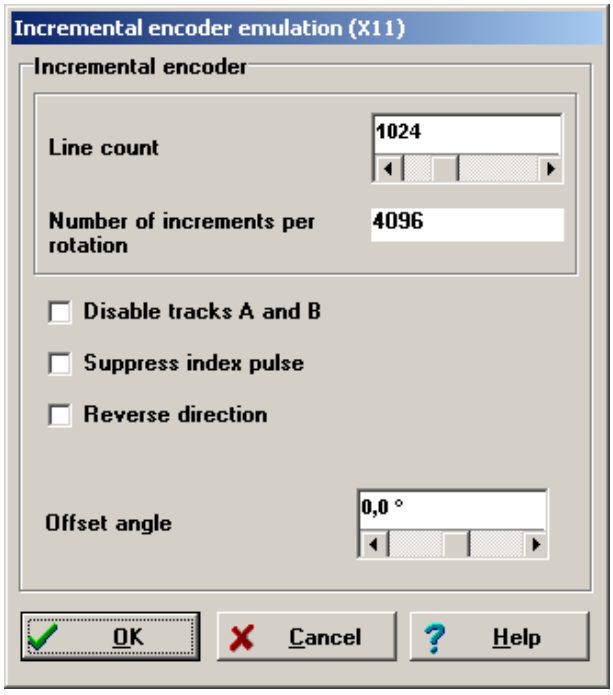
The Master operates in one of the preceding described operating modes (speed control, positioning) while the Slave is in a synchronized operating mode.

This configuration allows for example the following applications:

- Speed synchronous operation
- Position synchronous operation
- Flying Saw

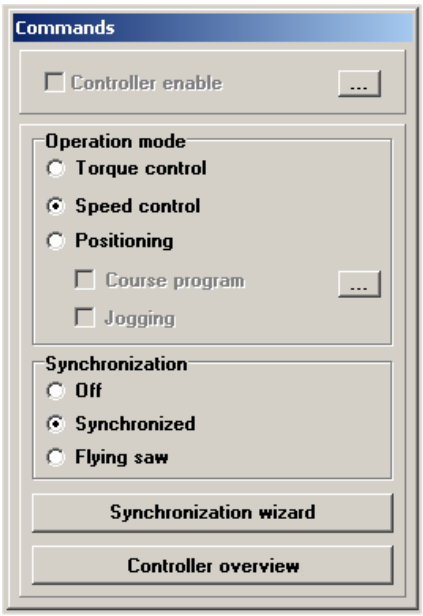
12.1 Synchronisation / Parameterisation of the Master

In Master-Slave operation the master emulates an incremental encoder. The incremental encoder is configured by the parameters of the menu **Operating mode/Incremental encoder emulation**:



12.2 Synchronisation / Parameterisation of the Slave

Signal to the slave for synchronized operation that angle encoder information is supplied via the incremental encoder input X10. Check the option **Synchronized** for speed an position synchronous applications resp. **Flying saw** (position synchronous operation only) in the commands window:

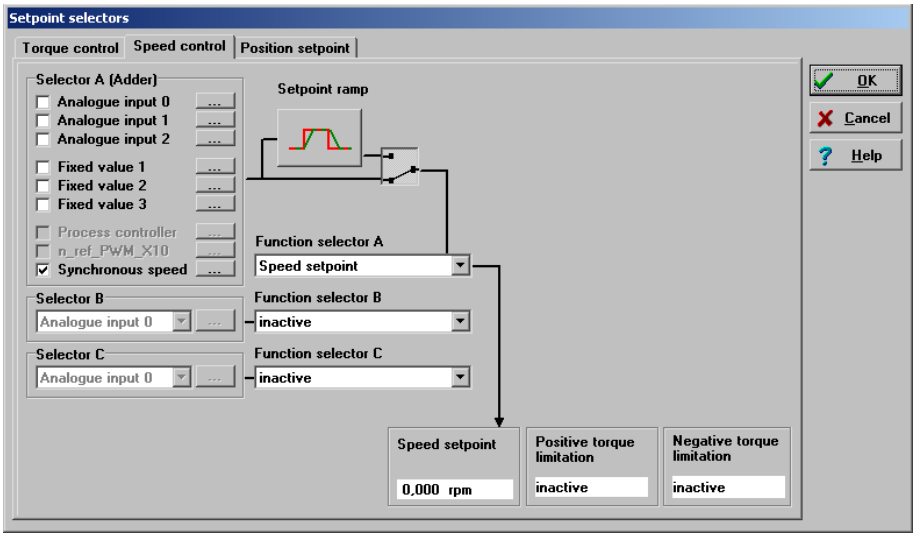


Click onto the button **Synchronisation wizard** and follow the instructions for a detailed configuration of the synchronous application. You can also configure the settings manually. In this case, check the following parameters:

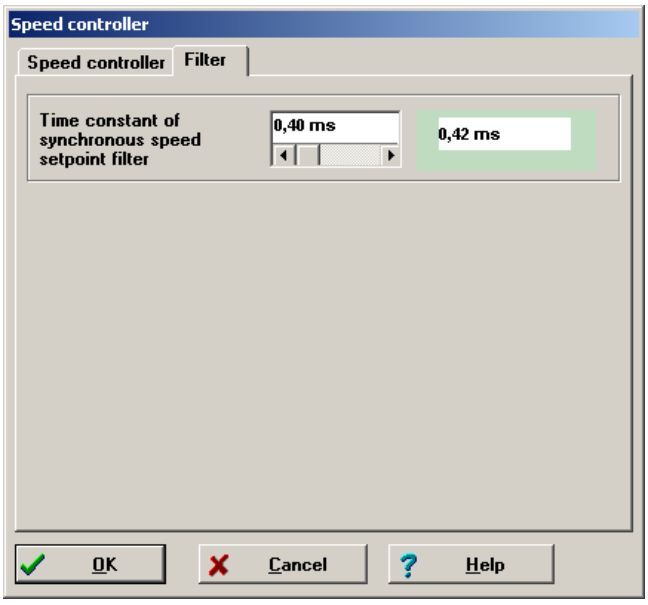
- Correct settings of the encoder configuration in menu **Operating mode/Encoder selection**
- Correct settings of the encoder parameters in menu **Parameters/Device parameters/Angle encoder settings**
- Correct settings of the setpoint management (e.g. in speed synchronous operation) in menu **Operating mode/Setpoint selection**
- Correct settings of the position sets (for Flying Saw: synchronized checked or not checked) in menu **Parameters/Positioning/Destination parameters**

12.3 Speed Synchronous Operation

Speed synchronous operation is a special application of the operating mode speed control.
The speed setpoint is passed from the Master to the Slave via an encoder interface.
Ensure that the speed signal of the Master is considered for the setpoint calculation of the Slave in menu **Operating mode/Setpoint selection**.
The following example shows a possible configuration if the speed setpoint from the Master is passed to the Slave via X10:



In most cases the resolution of the incremental signal is comparably small. Transmission problems of the digital signals may occur at too high frequencies resp. the appearing frequency has to be lower than the maximum input frequency of the incremental encoder input. This leads to a high quantisation of the synchronous speed signal. Again this causes a high setpoint noise audible in the Slave drive. This influence may be reduced by an appropriate filter. Click onto the button "**…**" next to **Synchronous speed** in order to enter the filter time constant. Alternatively open the menu by **Parameters/Controller parameters/Speed controller** and select the tab **Filter**:



12.4 Position Synchronous Operation

In pure position synchronous operation the slave takes the position setpoint directly from the encoder interface selected for the synchronisation. Here, the speed controller always gets a speed setpoint feed forward value by the synchronous speed value.

Select this pure position synchronous operation by the option **Synchronized** in the field **Synchronisation** of the **commands window**. Select the operating mode **Positioning**.

12.5 Flying Saw (product level 3.4)

The expression “Flying Saw” describes applications in which the synchronisation is activated and deactivated depending on the positioning sets: synchronous position sets for on-synchronisation to the active movement of the master are combined with non-synchronous position sets for the movement to the resting position/waiting position. Here, a process for on- and off-synchronisation avoids jerky movements.

Check the option **Flying Saw** in the Commands window.

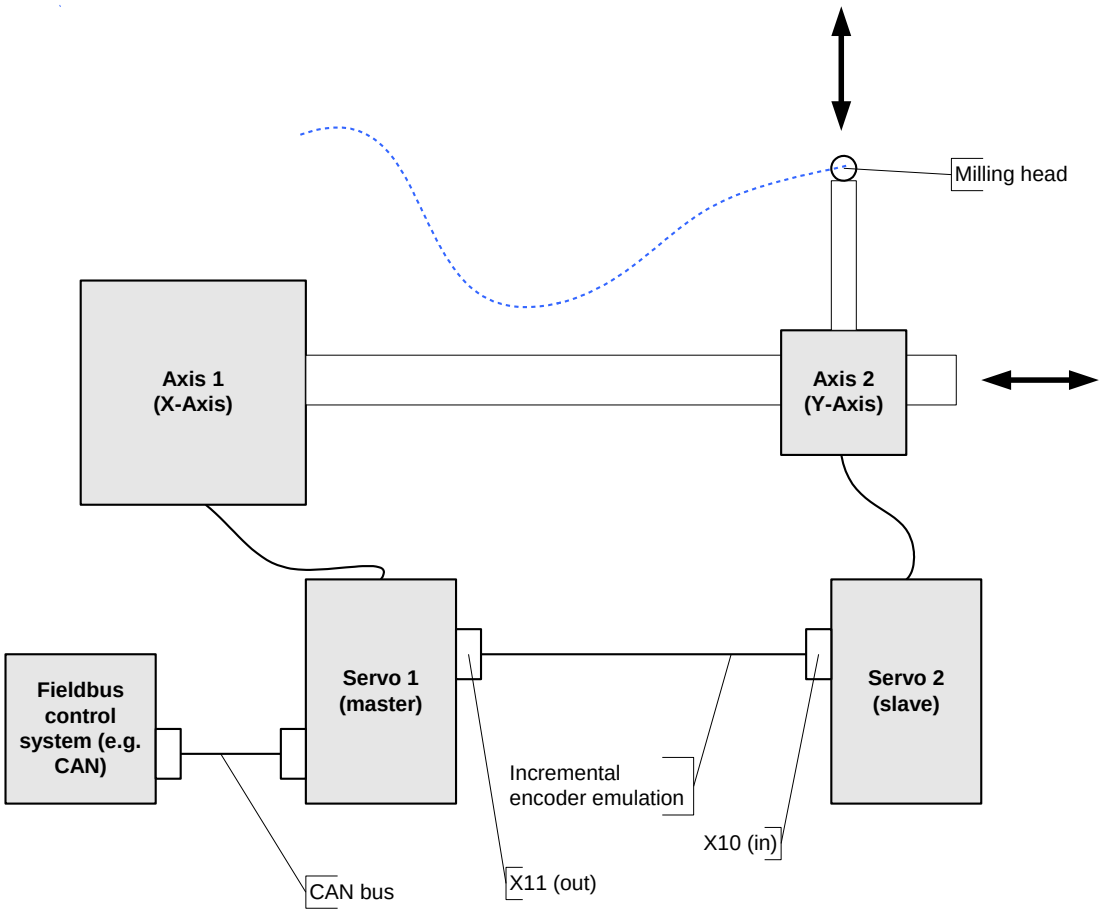
Check the option **Synchronized** for all synchronous position sets in menu **Parameters/Positioning/Destination parameters**.

The further parameterisation is application specific. Please contact the Technical Support for more information.

12.6 Cam disk / axis error compensation / cam switch

12.6.1 Cam disk principle

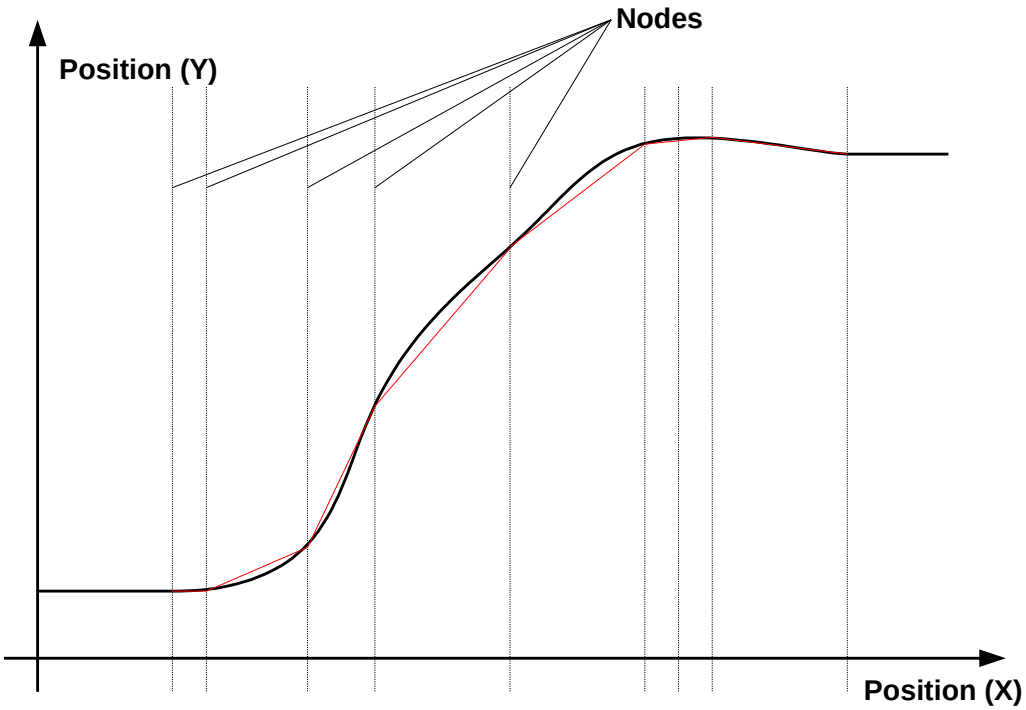
The term “(electronic) cam disk” describes applications in which an input angle or an input position is reproduced as an angle setpoint or as a position setpoint through a function. Typically, these applications are master-slave-applications.
See also the following example:



A milling head is to follow a certain curve (dotted line). For this purpose, an additional small linear axis is mounted on one linear axis (drive 1). This smaller linear axis controls the Y-advance. The milling head is installed at the end of this axis.

The Y-drive must be controlled as a function of the actual position value of the X-drive. The master position (Servo1) is transferred to the slave through the X10-X11-link. The slave calculates the actual “cam disk” (conversion of the master position into the position set npoint).

The actual function, which converts the input value of the position (“position X”) into the actual setpoint (“position Y”), is delivered through a table:



In the table, a certain output position is assigned to each of the position values. The input position values are called **interpolation points or nodes**. The servo positioning controller performs an interpolation (e.g. a linear one) between these interpolation points. This means that it does not follow the ideal curve, but the interpolated trace (red line).

Note: This example intentionally includes only very few interpolation points in order to explain the difference between an "ideal curve" and a "trace". In practice, one uses much more interpolation points in order to keep the difference between the ideal curve and the trace as small as possible.

	The interpolation points do not have to be equidistant (i.e. they do not have to have the same distance). We recommend using a particularly large number of interpolation points in "delicate areas" of the curve in order to achieve a good approximation to the predefined curve. These delicate areas are areas with sharp bends.

	If the input position is located outside the interpolation points (smaller than the minimum position or larger than the maximum position), the value of the minimum position or the value of the maximum position will be used.

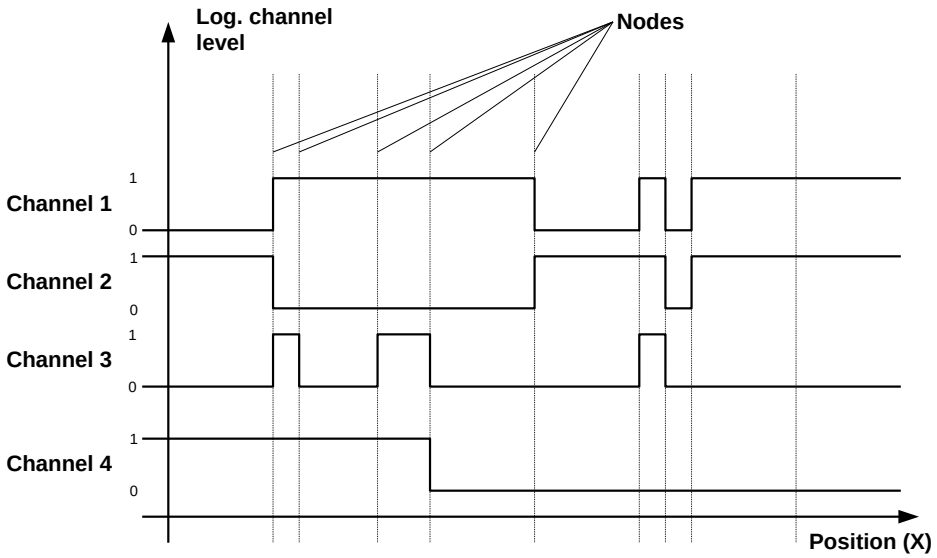
12.6.2 Axis error compensation principle

The term “axis error compensation” describes a function that compensates for an incorrect actual value feedback which is due to the system. The encoder system, which is used to determine the actual value, may show deviations between the calculated actual position and the physical position. These deviations may be due to mechanical tolerances or assembly defects, for example. The deviations are stored in the form of a table. The correction position is added to a reference position which corresponds to the position setpoint in this case. As a result, a modified position setpoint is generated. Due to the position controller operation, this modified position setpoint leads to a modified “compensated” actual position value. A linear interpolation is performed between the nodes. The axis error compensation is based on the same internal mechanism as the cam disk. This is why the same boundary conditions as described in chapter *Cam disk principle,* page *148* apply.

12.6.3 Cam switch principle

The term “cam switch” describes the assignment of a logic level to a position or angle information. The term stems from trip cams that are mounted on a shaft and actuate switching contacts in certain positions. An electronic cam switch uses a similar functionality.

See the following diagram of a four-channel cam switch:



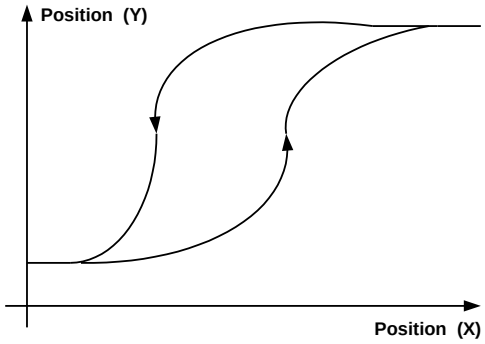
A level change is possible at the interpolation points. This is why the cam switch is implemented together with the cam disk.

If the input position is located outside the interpolation points (smaller than the minimum position or larger than the maximum position), the logic level of the minimum position or of the maximum position will be used.

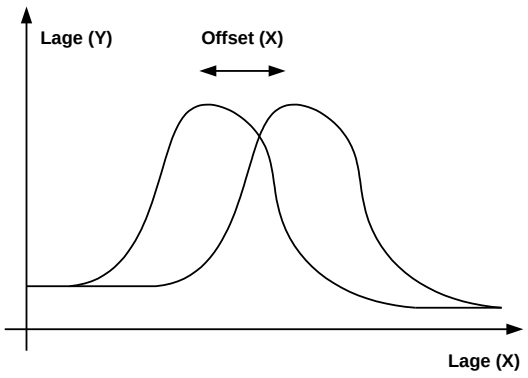
12.6.4 Implementation in the LV-servoTEC S2 range and in the parameterization program

The functionality implemented in the LV-servoTEC S2 product range has the following features (status of product level 3.3):

- The system can manage up to 16 tables with a total of up to 2048 nodes. The distribution of the tables and interpolation points on cam disks or axis error compensations is free.
- The interpolation points do not have to be equidistant. A linear interpolation is performed between the nodes.
- To every cam, a four-channel cam switch is coupled. Active trip cams require an active cam disk.
- The cam disk as well as the cam switch and the axis error compensation can be defined depending on the direction of rotation:

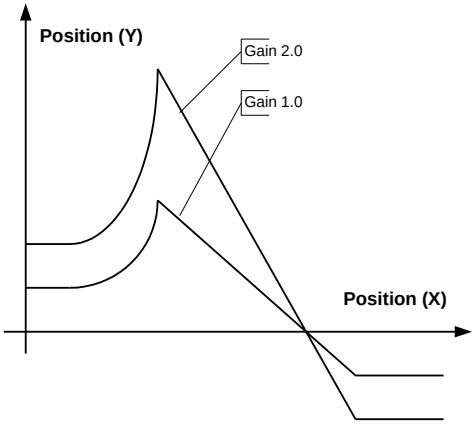


- The cam disk can be offset online by a certain amount:



An offset cam disk also influences the connected cam switch!

- For the cam disk table a “gain” is in preparation. The data can be scaled by a factor. The factor lies between 0.01 and 100. The factor can also be entered online.



- Cyclic cam disks, i.e. a repeating movement, can be realized by activating the rotary axis functionality. The rotary axis range of the master position (reference position in the table) should correspond to the rotary axis range in the servo positioning controller.
- The reference position corresponds to the position setpoint. It can be acquired through the incremental input (X10) or via the trajectory generator, for example. If the synchronization is activated, the reference position is automatically taken over from X10. If the trajectory generator is used, the position setpoints are generated when a positioning run is started. They are internally calculated as reference positions by the processor. In this way, a virtual master axis can be provided.

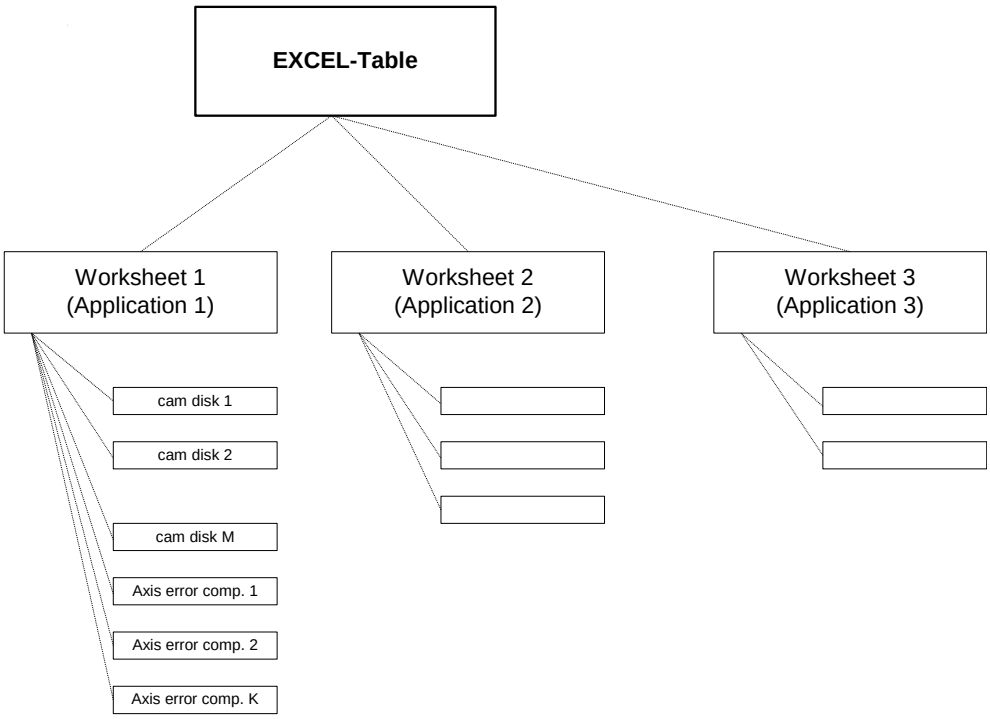
The parameterization program offers the following features:

- Cam disks with cam switches and axis error compensations can be loaded from an Excel table.
- Display, activation and online manipulation of cam disks
- Mapping of the trip cams on digital outputs.
- Display and activation of the axis error compensation
- Cam disks with cam switches and axis error compensations can be loaded and saved using DCO files.
- Displaying an active CAM or axis error compensation in the commands window

See also chapter *Menu for controlling the cam disks*, page *158*.

12.6.5 Structure of the table for cam disks, cam switches and axis error compensations

The interpolation points table is realized in Excel®. See the following illustration.



An Excel® file can comprise several worksheets. Every worksheet is an individual application. An application, on the other hand, can include several cam disks and / or axis error compensations.

	Only complete applications can be loaded into the servo. This means that if you need several cam disks and / or axis error compensations, they must be defined on one table sheet! Cam disks and axis error compensations cannot be loaded separately!

	In order to load cam disks and / or axis error compensations from a table, you need a valid Excel® installation on your PC!

The procedure for loading the cam disk tables is described in chapter *Menu for controlling the cam disks*, page *158*.

Examples for cam disks and / or axis error compensations can be found in the working directory of the parameterization program in the sub-folder “CAM”.

The following is a description of the structure of the **table header**:

CAM-Data			
Excel Format Version	1		
Application name:	Test Application		
Comment:	Test		
Number Tables:	2		
Document generated:	11.11.2006	Author:	M. Mustermann
Last change:	12.12.2006	Changed by:	M. Mustermann

Cell [A,1] must contain the keyword **CAM-Data**.

The name of the application should be entered into cell [B,3]. If the Excel® file comprises several sheets, these names are offered for selection.

Cell [B,5] must contain the correct number of tables (cam disks + axis error compensations!) of the application.

The following is a description of the **table headers**:

11	Table name	Cyclic table				
12	Comment					
13	Table length	17				
14	Table type	0	(Cam disk)			
15	Master Offset (RefIn)	0.1	(in RefIn position units)			
16	Polarity Hysterisis	30	(in RefIn position units)			
17	Switch Comparator	10	(in RefIn position units)			
18	Gain	1.234	(no dimension)			
19	Table data					
20	Columns	Master (RefIN)	Slave (RefOUT) pos.	Slave (RefOUT)	Cam (pos)	Cam (neg)
21	Factor Group numerator	1	4096	4096		
22	Factor Group divisor	16384	225	225		
23	Resolution numerator	1	1	1		
24	Resolution divisor	1073741824	10	10		
25	Position units	U	°	°		
26	1	-2,000	0,00000	0,00000	0000	1001
27	2	-1,750	10,00000	10,00000	1001	1001

If several tables are defined in an application, the tables are arranged horizontally next to each other. A cam disk covers 5 columns whereas an axis error compensation covers 3 columns. The table header information is located in lines 11 to 25.

A table name must be entered into the cell [column 1, line 11]. This name will also be shown later in the representation of the parameterization program.

Cell [column 1, line 12] may contain an optional comment.

The table length has to be entered into cell [column 1, line 13]. It is identical with the number of nodes.

Cell [column 1, line 14] contains the table type:

- 0 = cam disk
- 1 = axis error compensation

Cell [column 1, line 15] contains the offset of the reference position. See chapter *Implementation in the LV-servoTEC S2 range and in the parameterization program*, page *150*.

Cell [column 1, line 16] contains the hysteresis for the change of direction (polarity hysteresis). It controls the switching process to column 2 or column 3 of the table data for the slave position.
See chapter *Physical units / control parameters for cam disks and axis error compensation*, page *157*.

Cell [column 1, line 17 and 18] (switch comparator and gain) contain special cam disk parameters reserved for later extensions. This function is not supported at present. For reasons of compatibility, they are already included in the Excel table. At present, they are already transferred to and saved in the servo positioning controller. See chapter *Implementation in the LV-servoTEC S2 range and in the parameterization program*, page *151* for more information concerning the gain of the output position.

In column 1 / column 2, lines 21.24, the factor group and the resolution must be set correctly so that the cam disk uses the correct physical units. *See also* chapter *Physical units / control parameters for cam disks and axis error compensation,* page *157.*

It is possible to use different physical units for the ingoing shaft and / or the outgoing shaft. In this case, the values in column 1 and column 2 differ from each other!

It is **not** possible to define units in column 3 that differ from column 2!

Suggestion: Use names for the columns, e.g. “Master (ref/N)”

Column 1 / column 2 and line 25 must contain the corresponding position unit. It does not affect the behavior of the cam disk, but is used for display purposes on the parameterization interface.
The following units can be used:

- U or R: revolutions
- m, mm, µm : meter, millimeter, micrometer
- ° : degree
- rad : radian

The following is a description of the **table body:**

20	Columns	Master (RefIN)	Slave (RefOUT) pos.	Slave (RefOUT)	Cam (pos)	Cam (neg)
21	Factor Group numerator	1	4096	4096		
22	Factor Group divisor	16384	225	225		
23	Resolution numerator	1	1	1		
24	Resolution divisor	1073741824	10	10		
25	Position units	U	°	°		
26	1	-2,000	0,00000	0,00000	0000	1001
27	2	-1,750	10,00000	10,00000	1001	1001
28	3	-1,500	20,00000	20,00000	1001	1001
29	4	-1,250	40,00000	30,00000	0001	0011
30	5	-1,000	70,00000	40,00000	1001	1001
31	6	-0,750	100,00000	50,00000	0000	1001
32	7	-0,500	120,00000	60,00000	1001	1001
33	8	-0,250	140,00000	70,00000	1001	1001
34	9	0,000	160,00000	80,00000	1001	1111

The table body starts in line 26. One line must be filled out for every node. (See also the explanation for line 13!) The individual columns have the following meaning:

Column 1	Master position. The values in line 21..25 are used for the unit and the scaling.
Column 2	Represented position if the drive moves in the positive direction. The values in line 21..25 are used for the unit and the scaling.
Column 3	Represented position if the drive moves in the negative direction. The values in column 2 and in line 21..25 are used for the unit and the scaling.
Column 4	This column contains the status information of the individual cam switches if the drive moves in the positive direction. The number format is binary (only 0 and 1 are allowed). The right-hand bit represents channel 1 of the cam switch whereas the left-hand bit represents channel 4. If the curve is of the “axis error compensation” type, this column is omitted!
Column 5	This column contains the status information of the individual cam switches if the drive moves in the negative direction. As for the rest, please refer to the information given for column 4.

12.6.6 Physical units / control parameters for cam disks and axis error compensation

Numbers stated in the cam disk table usually are floating-point numbers. In addition, the user prefers to state the physical unit of the application, e.g. mm. For the transfer via RS232 / UDP, the data must be converted into a fixed-point format. The servo positioning controller then converts these data through a factor group and then uses them for the runtime calculation. The factor group is structured in the same way as it is already implemented in the servo positioning controller in accordance with CANopen DSP 402.

Therefore the user has to be parameterize two conversions in the table:

- From the table cells into “transfer units” with the form “ * (divisor / numerator) “.
- From the “transfer units” into the internal data in accordance with the factor group for positions.

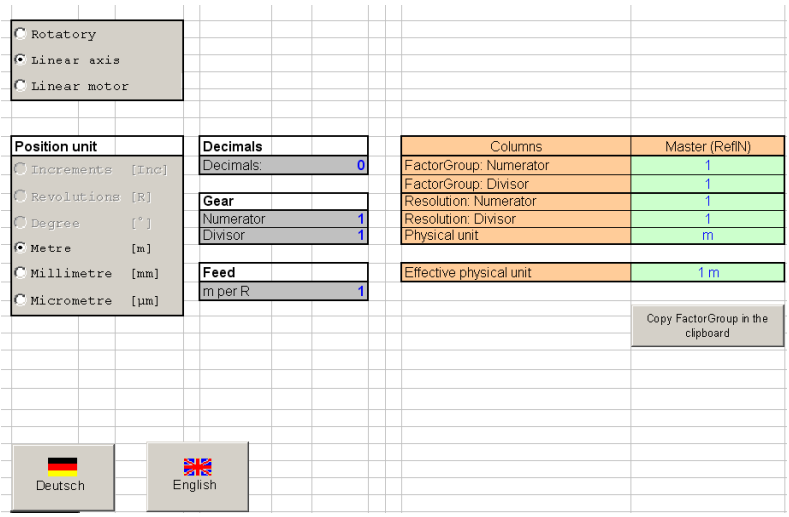
The use of the factor group for positions corresponds to the CANopen procedure. The CANopen manual includes examples and further information concerning the calculation of the factor group for “arbitrary” units. According to the procedure described in the manual, the user calculates a value for the factor group numerator and a value for the factor group divisor. These values have to be entered into the corresponding cell. If the factor group of the master differs from the factor group of the slave, the user has to be repeat the procedure for the slave.

It is possible to have a wizard calculate the Factor Group.

Proceed as follows:

- Select the “Assistent” worksheet of the Excel table.

The following input fields are displayed:



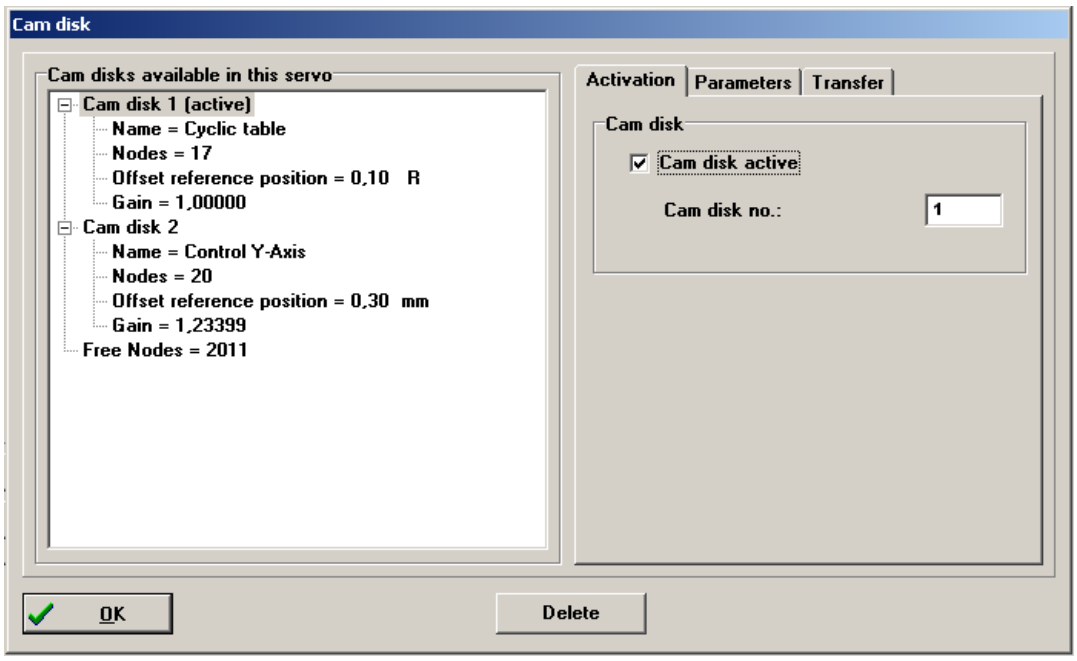
- Enter the boundary conditions of the drive. The resulting factor group is automatically determined.
- Click on the button Copy Factor to clipboard.
- Return to the worksheet and place the cursor in the upper line into which the factor group is to be copied.
- Press <Ctrl> + V. The calculated factor group will be copied.

The hysteresis (polarity hysteresis) controls the change in the table data to the slave pos column (RefOUT) or to the slave neg column (RefOUT).

In case of having problems with the computation in the “Assistent” worksheet please enter the Excel menu Extras/Add-Ins-Manager and enable the analysis functions.

12.6.7 Menu for controlling the cam disks

The graphical user interface for handling cam tables can be found in the menu **Parameter/CAM/Cam disk**. The following menu will appear:



12.6.7.1 "Activation" tab

The tree view shows the number of cam disks that are currently loaded.
The following additional information is displayed for every cam disk:

- Name of the cam disk
- Number of nodes used
- Offset of the reference position
- Gain

> Active cams are marked by the addition **active**!

In addition, the remaining number of free nodes is displayed.

12.6.7.2 Cam disk active

This check box can be used to activate or deactivate a cam disk. If the check box is selected, the activation applies to the cam disk number (see below!).

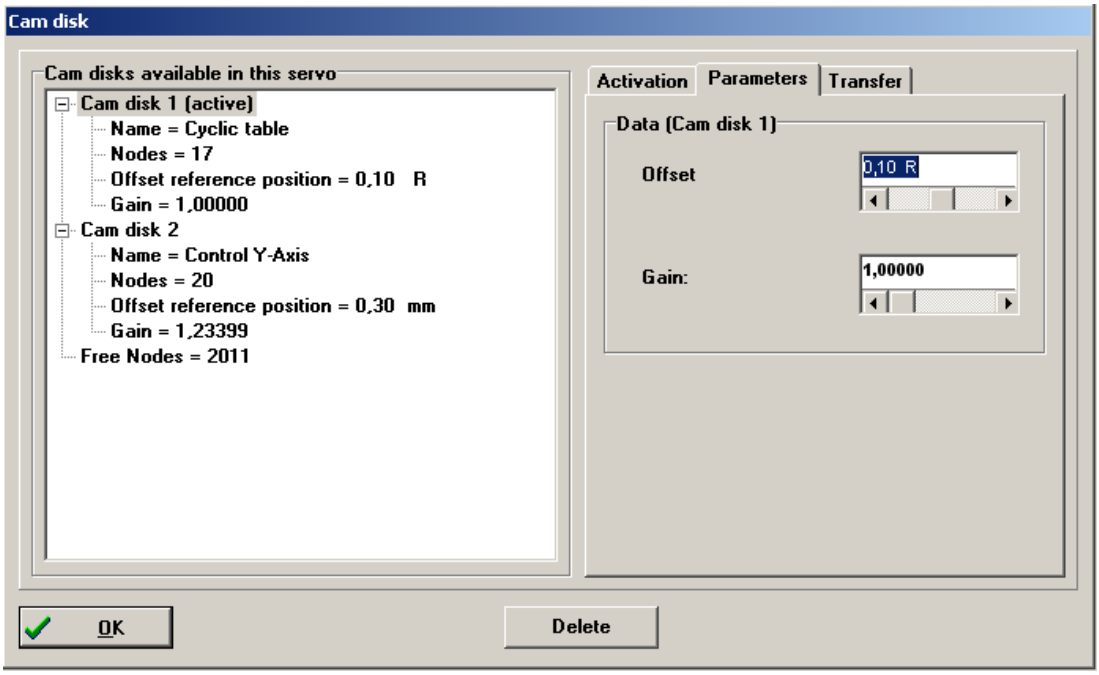
> Caution!
>
> If the cam disk is activated at a reference position at which the output position strongly deviates from the current actual position, the drive will immediately jerk and jolt if the controller is already enabled or when the controller enable is activated!

12.6.7.3 Cam disk no.

This input field can be used to state the desired cam disk number. If the cam disk function is active, the system switches immediately from the old cam disk to the new one.

> Caution!
>
> If the system switches from one active cam disk to another one while the controller enable is active, the drive may jerk and jolt.

12.6.7.4 "Parameters" tab



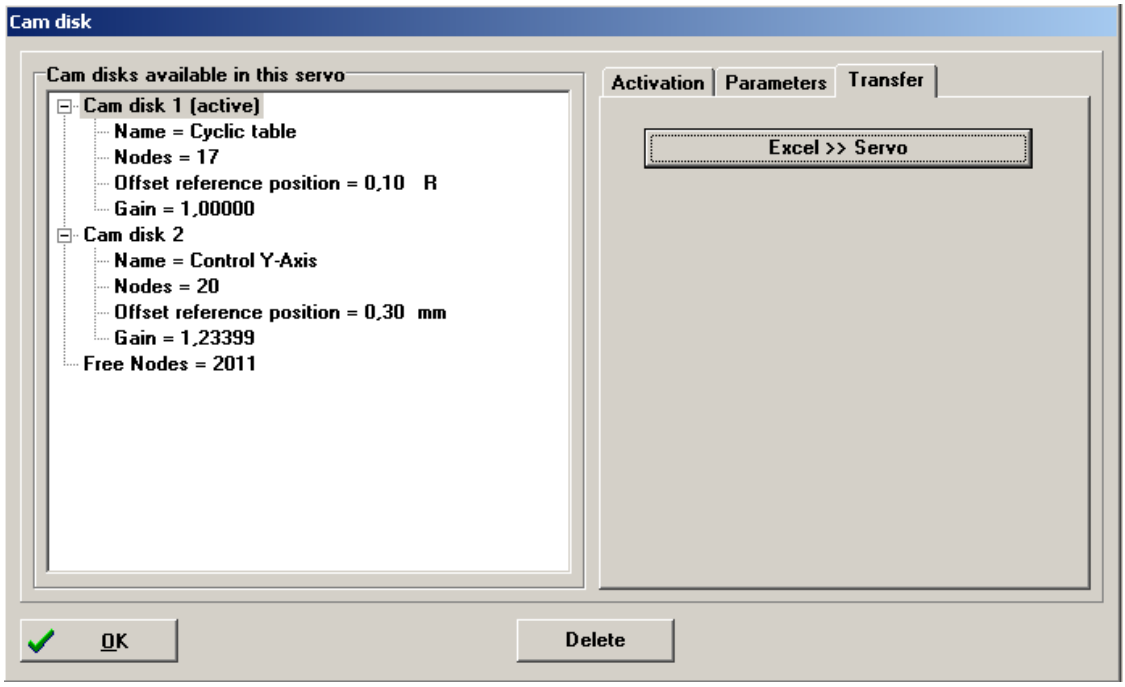
12.6.7.5 Offset reference position

This input area shows the offset of the reference position for the selected cam disk. (See also chapter *Implementation in the LV-servoTEC S2 range and in the parameterization program,* page *151)*. The cam disk can be selected by clicking on it in the tree diagram. The offset can be changed.
Any changes made are immediately effective.

12.6.7.6 Gain

This input area shows the gain of the output position for the selected cam disk. (See also chapter *Implementation in the LV-servoTEC S2 range and in the parameterization program,* page *151*.) The cam disk can be selected by clicking on it in the tree diagram. The gain can be changed. Any changes made are immediately effective.

12.6.7.7 "Transfer" tab



12.6.7.8 Excel >> Servo

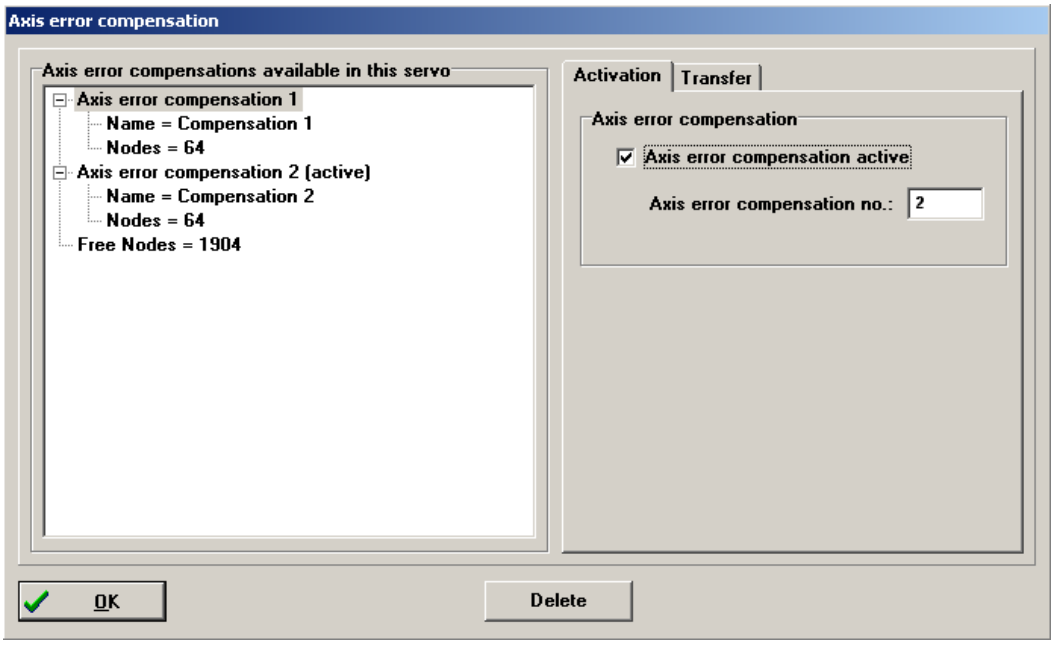
This button can be used to load an application (consisting of cam disks and / or axis error compensations) into the servo positioning controller. See also chapter *Structure of the table for cam disks, cam switches and axis error compensations153,* page *153*.

Click on the button and select an Excel file. If the Excel file includes several worksheets (applications), please select the desired application.

This feature requires a valid Excel® installation on your PC!

12.6.8 Menu for controlling the axis error compensation

The graphical user interface for handling the axis error compensation can be found in the menu **Parameter/CAM/Axis error compensation**.
The following menu will appear:



12.6.8.1 "Activation" tab

The tree view shows the number of axis error compensations that are currently loaded.
The following additional information is displayed for every axis error compensation:

- Name of the axis error compensation
- Number of nodes used

> Active axis error compensations are marked by the addition **active**!

In addition, the remaining number of free nodes is displayed.

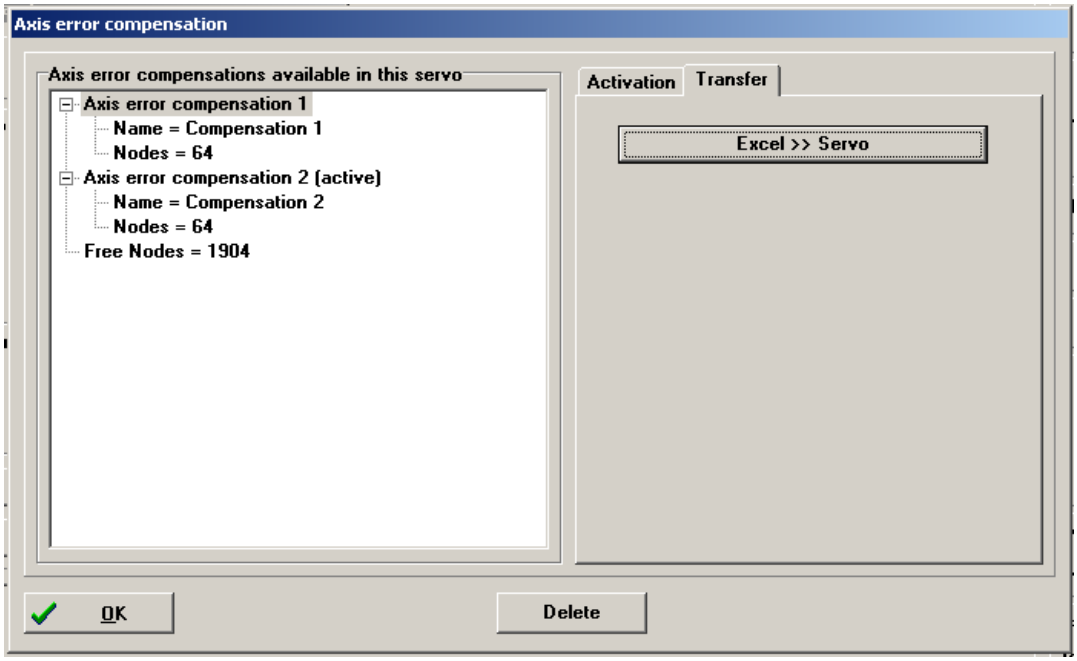
12.6.8.2 Axis error compensation active

This check box can be used to activate or deactivate an axis error compensation. If the check box is selected, the activation applies to the number of the axis error compensation (see below!).

12.6.8.3 Axis error compensation no.

This input field can be used to state the desired number of the axis error compensation. If the axis error compensation is active, the system switches immediately from the old axis error compensation to the new one.

12.6.8.4 "Transfer" tab



12.6.8.5 Excel >> Servo

This button can be used to load an application (consisting of cam disks and / or axis error compensations) into the servo positioning controller. See also chapter *Structure of the table for cam disks, cam switches and axis error compensations*, page *153.*

Click on the button and select an Excel file. If the Excel file includes several worksheets (applications), please select the desired application.

This feature requires a valid Excel® installation on your PC!

13 Further Functions of S2 Commander

13.1 Using the service module

The service module can be used to save data of the servo positioning controller and to transfer them to other servo positioning controllers. If certain boundary conditions are fulfilled, this data transfer can also be performed without a PC.

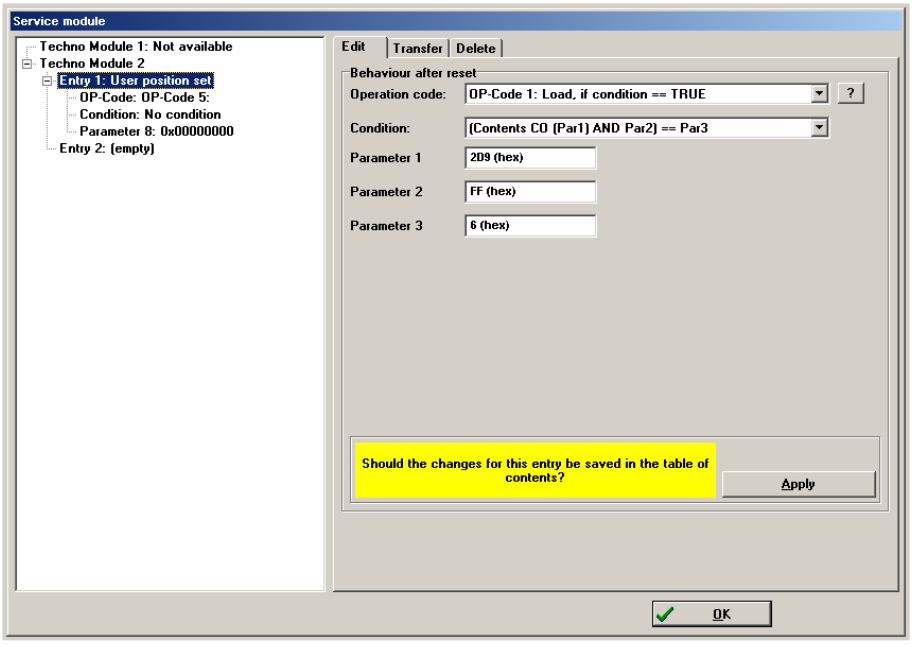
The following types of data are supported by the product level 3.3:

- **User parameter sets** (these include the entire parameterization of the servo positioning controller, i.e. controller parameters, safety parameters, setpoint management, but no position data sets)
- **Position data sets**
- **Error buffer** (as of product level 3.4)
  Each error message generates an entry in the internal error buffer. These entries are cyclically copied into the service module if an entry of it is configured as error buffer. The service module can store more than 7000 error messages. Please refer also to chapter *Error buffer, page 106.*

In the service module, the data are organized in so-called **entries**. Every entry can be assigned to a firmware (at planning level), a user parameter set or to position data sets. In addition, certain conditions can be defined that regulate the transfer from the service module into the servo positioning controller and vice versa.

The service module can be accessed via the menu **File/Parameter Set/Service-Modul**.

The following menu will appear:



The tree diagram on the left shows the technology slots in which a service module has been detected. You can double-click on the individual entries to check the associated details.

The characteristics of the individual entries can be defined on the **Edit** tab.

The content type can be defined in the **Typ** field.

See the following table:

Contents type
User parameter set (multi-purpose); access through special commands
User position data set (multi-purpose); access through special commands
Error buffer

The field **Operation Code** defines what will happen with the entries. See the table below:

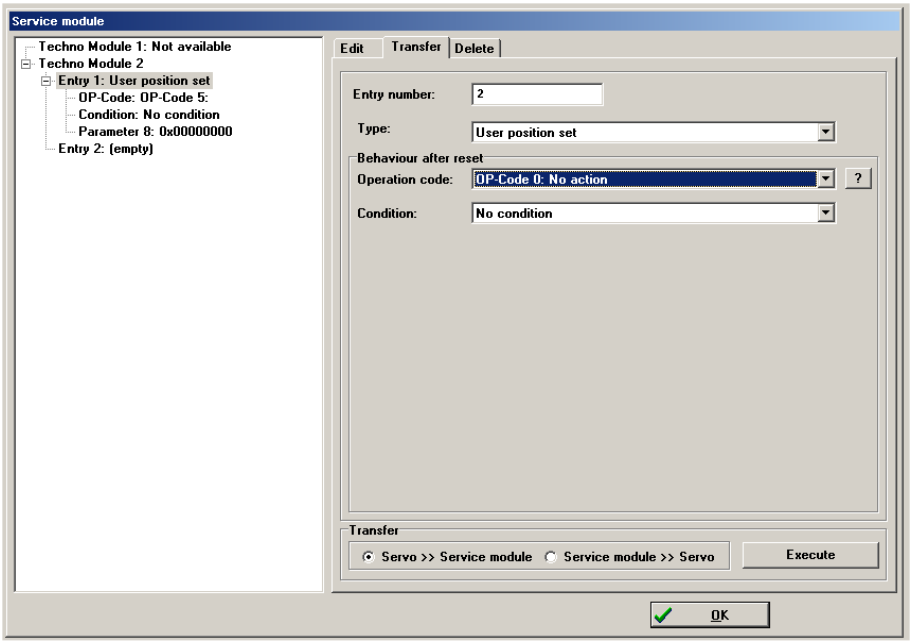
Operation Code	
Value	**Description**
0	passive, no action
1	The data are loaded from the service module into the servo positioning controller. **The action will be performed if the condition is fulfilled (see below).**
2	The data are loaded from the service module into the servo positioning controller and then they are saved (SAVE). **The action will be performed if the condition is fulfilled (see below).**
3	The data of the servo positioning controller are stored in the entry X of the service module. The number X of the entry is defined by parameter 7. The operation code, the condition and the parameters for this entry are taken from an internal data buffer. These data must have been entered beforehand. This action will be performed without consideration of a condition. It is used, for example, so that the user can load data once from a servo positioning controller into a service module. This will then be used in the field.
4	After a reset, the data of the servo positioning controller are stored in the entry X of the service module. The number X of the entry is defined by parameter 7. The parameters 1..6 are not changed by the transfer. This action will be performed without consideration of a condition. It is used, for example, so that the user can load data from a servo positioning controller into a service module in the field without a PC. The data originally stored in this entry will be overwritten.
5	After a reset, the data of the servo positioning controller are stored in the entry X of the service module. The number X of the entry is defined by parameter 7. The parameters 1..6 are not changed by the transfer. Parameter 8 will be entered and saved for the entry X as the new operation code (bit 8..15) and as the new condition (bit 16..23). This action will be performed without consideration of a condition. It is used so that the user can do the following things in the field without a PC: ■ Loading data from a servo positioning controller **once** into a service module. ■ Transferring the data to other servo positioning controllers. The data originally stored in this entry will be overwritten. **Note**: Since the original operation code will be overwritten by the value of parameter 8, special attention must be paid when entering parameter 8.

The execution of an action can be specifically adapted to the boundary conditions of an application with the help of the condition field. See the following table. See chapter *Applications with the service module / case examples*, page *168* for examples.

Only the actions of operation codes the execution of which is subject to a condition can be suppressed. See also the **Operation Codes** table.

Condition	
Value	**Description**
0	This action is always performed!
1	A communication object (CO) is read (CO number in parameter 1). Then a logic AND operation is performed with a mask (mask in parameter 2). The result of the operation is compared to a desired result (result in parameter 3). If the two results correspond with each other, the operation will be executed.
2	**Test A** A CO is read (CO number in parameter 1). Then a logic AND operation is performed with a mask (mask in parameter 2). The result of the operation is compared to a desired result (result in parameter 3). **Test B** A CO is read (CO number in parameter 4). Then a logic AND operation is performed with a mask (mask in parameter 5). The result of the operation is compared to a desired result (result in parameter 6). If the results from test A or the results from test B correspond with each other, the operation will be executed.
3	“Test A” and “Test B” are performed as described under 2. If the results from test A and the results from test B correspond with each other, the operation will be executed.
4	**Note:** This condition is reserved for the content type “firmware” and will be ignored for other content types. Reserved.

The following menu appears under the **Transfer** tab:



This menu is used to transfer data from the service module to the servo positioning controller and vice versa via the interface. In general, this is necessary in order to be able to automatically load a parameter set from the service module into the servo positioning controller. The transfer processes will then be automatically controlled by the firmware depending on the operation codes and on the conditions (see also the beginning of this chapter).

Transfer

Here you can select whether you want to transfer data from the service module into the servo positioning controller or vice versa.

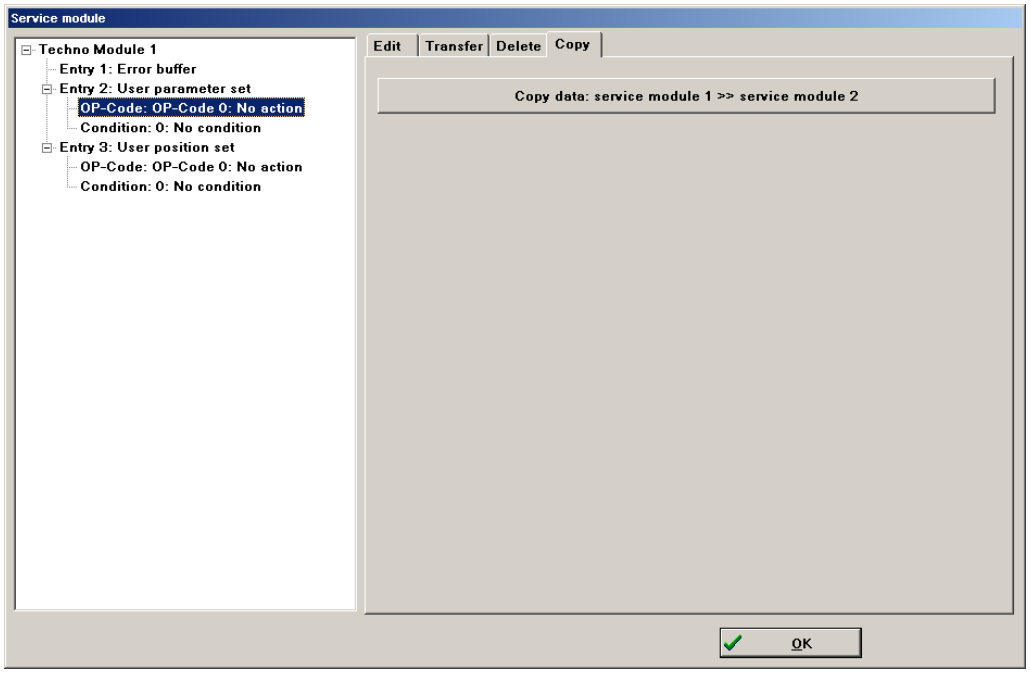
Please perform the following steps if you want to transfer data from the service module to the servo positioning controller:

- In the tree diagram, select the entry to be transferred.
- Select the box **Service-Modul >> Servo** in the **Transfer** area.
- Click on the button **Execute**.

Please perform the following steps if you want to transfer data from the servo positioning controller to the service module:

- Select the box **Servo** >> **Service-Modul** in the **Transfe**r area.
- Select the type of data to be stored in the entry in the **Typ** field.
- Select an operation code, a condition type and the necessary parameters.
- Click on the button **Execute**.

The following menu appears under the **Copy** tab:



The function can be started only if technology slots 1 and 2 are plugged with a service module. It is only possible to copy the data from service module 1 to service module 2. A copy can be processed only if the power stage of the servo positioning controller is not activated.

Copy data: service module 1 >> service module 2

Start the copying process with this button. The user is informed, if the process has been finished with or without success.

13.1.1 Applications with the service module / case examples

Case example A:

Situation

In the service module, a parameter set for an LV-sevoTEC S2102 servo positioning controller is stored under entry 1. You want the system to load this parameter set if the module is plugged into a corresponding servo positioning controller and if a power-on reset is performed.

At the same time, a parameter set for an LV-servoTEC S2310 servo positioning controller is stored under entry 2. This, too, should be loaded only if the module is plugged into a servo positioning controller of this type.

If a parameter set could be loaded (valid device type), the parameter set is to be saved permanently in the servo positioning controller (SAVE).

Parameterization

The content type of entry 1 is “2” (user parameter set).

The operation code for entry 1 is “2” (loading data from the service module into the servo positioning controller and saving them with SAVE).

The condition for loading the parameter set 1 is that the present servo positioning controller is a controller of the LV-servoTEC S2102 type. The value of a communication object (CO) has to be compared with a predefined value → condition type = 1.

The device type is stored in the CO “srvc_device_type”. This CO has the number 0x2D9. → Parameter 1 = 0x2D9.

This CO assignment is as follows:

Device	Contents of CO “srvc_device_type”
LV-servoTEC S2102	0x2005
LV-servoTEC S2105	0x2006
LV-servoTEC S2302	0x2009
LV-servoTEC S2305	0x200A
LV-servoTEC S2310	0x200B
LV-servoTEC S2320	0x200C
LV-servoTEC S2340	0x200D

All relevant bits can be selected from the CO (mask = 0xFFFFFFFF) → Parameter 2 = 0xFFFFFFFF

The target value for parameter set 1 is 0x2005 (LV-servoTEC S2102) → Parameter 3 = 0x2005.

The parameterization for entry 2 in the service module is the same. The only difference is parameter 3: The “target type” is an LV-servoTEC S2310 (srvc_device_type = 0x200B).

The following parameterization must be selected:

	Entry 1	Entry 2
Content type	2	2
Operation code	2	2
Condition type	1	1
Parameter 1	0x2D9	0x2D9
Parameter 2	0xFFFFFFFF	0xFFFFFFFF
Parameter 3	0x2005	0x200B

Case example B:

Situation

In the service module, parameter sets for an LV-servoTEC S2102 servo positioning controller are stored under the entries 1..3. The target is three identical devices. Their only difference is the coding connectors connected to the digital inputs:

	DIN 2..9	DIN 1	DIN 0
Device 1	X	0	0
Device 2	X	0	1
Device 3	X	1	0

The parameter set should be loaded at a power-on-reset, if the module is plugged into the servo positioning controller and if the corresponding combination is applied to the digital inputs of the servo positioning controller. After loading, the parameter set should be saved permanently (SAVE).

Parameterization

The content type of all entries 1..3 is “2” (user parameter set).

The operation code for all entries 1..3 is “2”. The parameter set is to be loaded from the service module into the servo positioning controller and saved with SAVE.

The condition for loading the parameter set is that the content of the CO has a certain specific value for the digital inputs → condition type 1.

The status of the digital inputs is stored in the CO “ioh_din”. This CO has the number 0x44C. → Parameter 1 = 0x44C.

In this CO, DIN0 is stored in bit 1. Since only these two bits can be evaluated, no other bits than bit 1 and bit 2 can be set in the mask. → Parameter 2 = 0x6

The target values for the operation can be derived from the device coding for the individual devices. This results in the following parameterization:

	Entry 1	Entry 2	Entry 3
Content type	2	2	2
Operation code	2	2	2
Condition type	1	1	1
Parameter 1	0x44C	0x44C	0x44C
Parameter 2	0x06	0x06	0x06
Parameter 3	0x00	0x02	0x04

Case example C:

Situation

You want to use the service module to transfer parameter sets from a servo positioning controller LV-servoTEC S into several other controllers of the same type. However, no PC is available at the location. This means the module has to be “activated” beforehand so that it reads the parameter set in the first servo positioning controller and then writes it to all the other servo positioning controllers.

Parameterization

The content type of entry 1 is “2” (parameter set).

The operation code of entry 1 is “5”: The parameter set is to be saved to entry 1 after a reset. Then the operation code and the conditions must be updated.

The condition will not be evaluated for this content type: Use the default value “0”.

Entry 1 is to be used: → Parameter 7 = 1.

After the transfer, a new operation code and a new condition are required:

After the reset, the data must be written into the servo positioning where they have to be saved permanently: operation code = 2 in bit 8..15.

This action is to be performed always: condition type = 0 in bit 16..23.

→ For parameter 8, this results in the value: 0x00000200

The following parameterization must be selected:

	Entry 1
Content type	2
Operation code	5
Condition type	0
Parameter 7	0x00000001
Parameter 8	0x00000200

13.2 Activating the Default Parameter Set

The servo positioning controller comes supplied with an active default parameter set. This default parameter set brings the servo positioning controller into a basic state. The servo positioning controller has the status "not commissioned" and the seven-segment-display shows the letter "A".

During commissioning, the parameter set has to be adapted to the specific application. Otherwise the servo positioning controller has the status "not commissioned".

The manufacturer settings in the default parameter set can be restored with the help of the menu **File/Parameter set/Load default Parameter set**.

When the default parameter set is loaded, the application-specific parameters will be overwritten and the controller status will be set to "not commissioned". This should be taken into consideration when using this function as it requires a new commissioning.

13.3 Transfer Window

The parameterisation program S2 Commander communicates with the servo positioning controller LV-servoTEC S 2 by a certain protocol. Here, the individual commands are defined. The Transfer window allows sending commands directly to the servo positioning controller LV-servoTEC S2 and to monitor the response.

The transfer window is activated via **File/Transfer**.

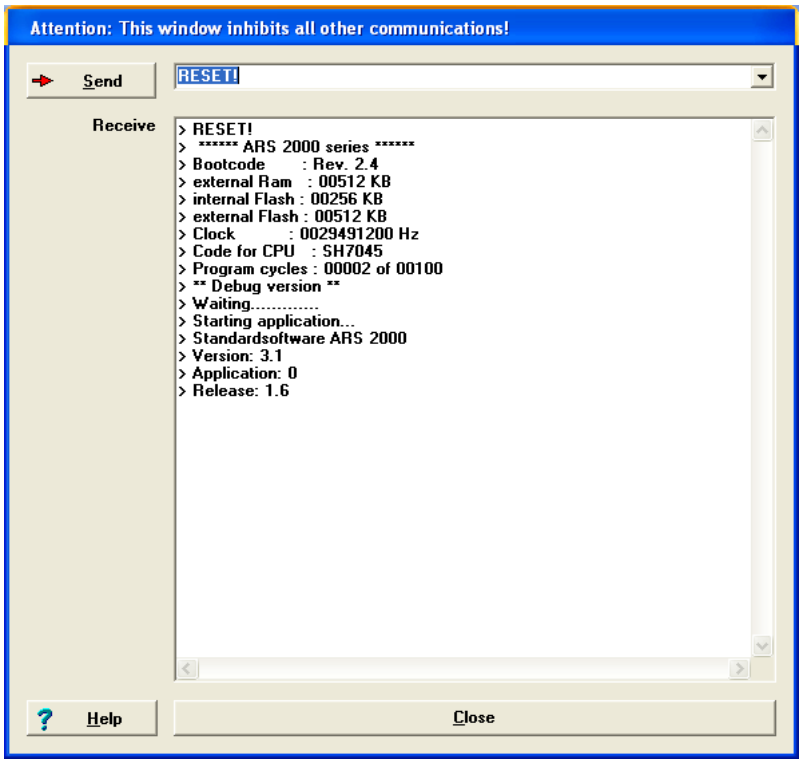
> While the Transfer window is active, other open windows are rendered inactive (e.g. actual values, oscilloscope). Close the Transfer window, if you no longer need it.

The Transfer window is usually only used to send commands, which are of no interest for normal operation. It can also be used to read and write storage location or communication objects. This also is only necessary in special cases.

It is also possible to monitor the switch-on message of the firmware.

To do so, proceed as follows:

- Open the Transfer window.
- In the input line enter **RESET!** and press <Enter> or click on **Send.**
- The message window will display the complete switch-on message of the firmware.
- Close the Transfer window.



13.4 Exiting the Program

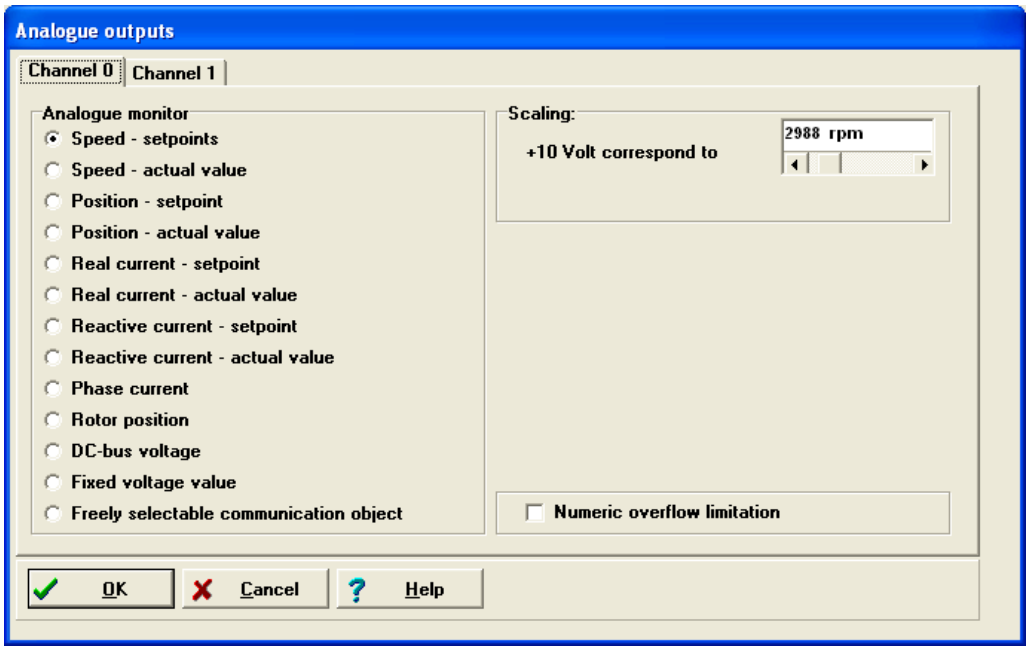
The program S2 Commander can be exited as follows:

- By selecting the menu option **File/Exit**
- By pressing the shortcut <Alt>+F4
- By clicking on the X-button on the upper right hand side of the main window.

13.5 Analogue monitor

The servo positioning controller LV-servoTEC S2 has two analog outputs for displaying control values, which can be displayed on an external oscilloscope. The output voltages are within a range of -10V to +10 V.

To configure the analog monitor, select the menu option **Parameters/IOs/Analogue outputs** and then the corresponding channel.



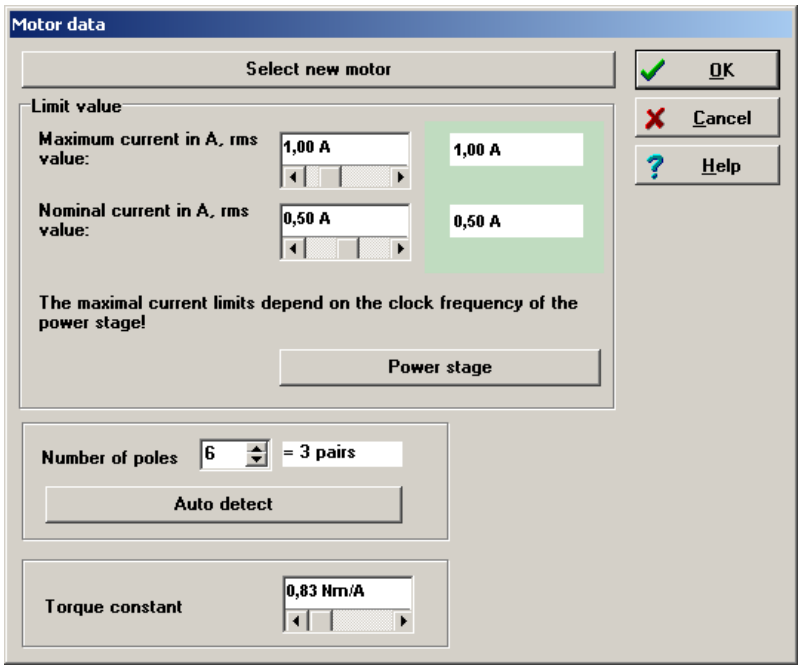
Select the value you wish to display on the analogue monitor. Set the scaling in the field **Scaling**.

> The option **Freely selectable communication object** is reserved for special applications.

If the check box **Numeric overflow limitation** is checked, computed values above +10 and below -10 V will be limited to this range. If the box is not checked, values exceeding the +10V value will be shown as negative voltages and vice versa.

13.6 Motor Data Configuration

This menu (**Parameters/Device parameters/Motor data**) is used to configure the fundamental motor data. The following menu will appear:



Enter the data shown on the type plate. You can calculate the **Torque constant** as the quotient of nominal torque / nominal current.

Please note that the values to be entered for the maximum current and the nominal current are effective values! If the currents are too high, the motor may be destroyed due to thermal overload or a demagnetisation of the permanent magnets inside the motor. The current limits stated by the manufacturer must not be exceeded.

The maximum current limits may depend on the clock frequency of the output stage. If you want to parameterize the power stage frequency, click on the button **Power stage** (see also chapter *Configuration of the Power StageConfiguration of the Power Stage,* page *175)*.

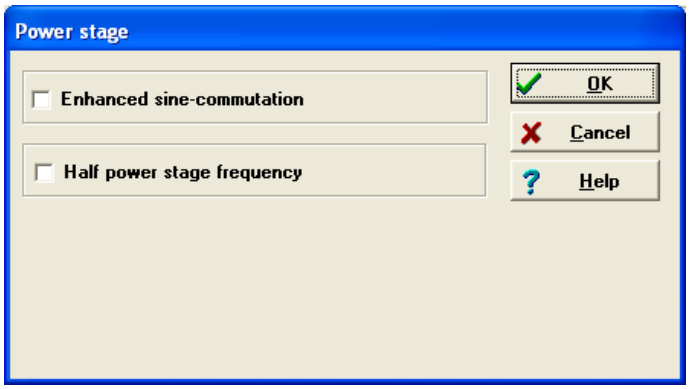
In addition you can enter the number of poles of your motor. There is also an automatic identification function which determines the number of poles and the offset angle of the angle encoder automatically. Simply click on the **Auto detect** button.

DANGER !

Prior to starting the motor identification, you have to set the current limits (menu **Parameters/Device parameters/Motor data**) as otherwise the motor may be destroyed!

13.7 Configuration of the Power Stage

This menu (**Parameters/Device parameters/Power stage**) configures some settings concerning the PWM of the power stage.



Enabling the option **Enhanced sine-commutation** allows better use of the DC-link voltage and thus ca. 14 % higher maximum speeds. In certain applications, the control behaviour and the running characteristics of the motor may be impaired at very low speeds.

Option **Half power stage frequency**: The LV-servoTEC S2 servo positioning controller allows the clock frequency to be halved.

Lower clock frequencies allow higher limits for the maximum current, but a singing sound may be audible while the motor is running. If you want the motor to run as quietly as possible, choose the full clock frequency. In addition, the losses in the motor are slightly reduce at full clock frequency (on the other hand the losses in the LV-servoTEC S2 servo positioning controller increase which is why the adjustable maximum current limits are slightly lower). The selection of the clock frequency has basically no influence on the control behavior.

Settings can only be changed, if the power stage is switched off.

13.8 Angle Encoder Settings

This menu is called by Parameters/Device parameters / Angle encoder settings.

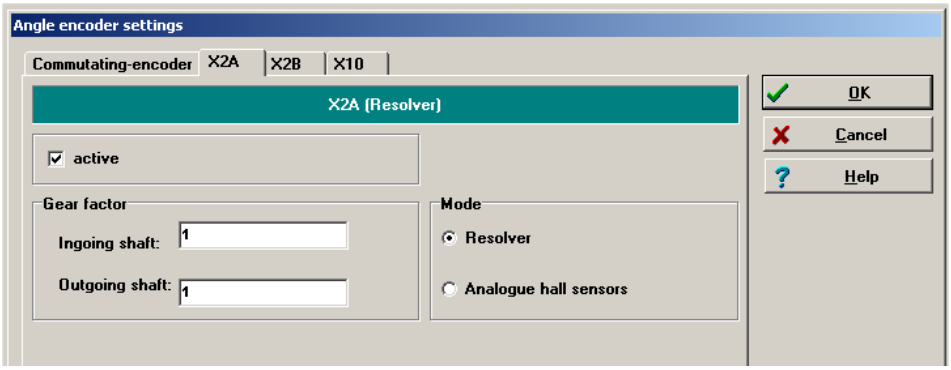
This menu is used to configure the parameters for the angle encoders X2A, X2B and X10.

Take the description of the basic functions from chapter *Configuration of the Motor Feedback, page 59.*

Tab Commutating-encoder:

- **Offset of encoder**
  The angle encoder offset is the angular difference between the electrical and mechanical position. The value must be entered correctly to make sure that the motor harmonizes correctly with the servo positioning controller. A manual determination of the angle encoder offset is difficult. We recommend performing an automatic determination.
- **Auto detect**
  This button is used to start the automatic identification process. Make sure that the current limits (see above) have been set correctly and that no errors are pending in the servo positioning controller. In addition, the shaft must move freely. The automatic identification process determines the following parameters:
  - Number of pairs of poles
  - Direction of rotation of the angle encoder
  - Angle encoder offset
- **Phase sequence**
  The phase sequence indicates the counting system ("direction of rotation") of the angle encoder and depends on the wiring among other things. The correct setting of the phase sequence is essential for operation. A manual determination of the phase sequence is difficult. We recommend performing an automatic determination (see above).

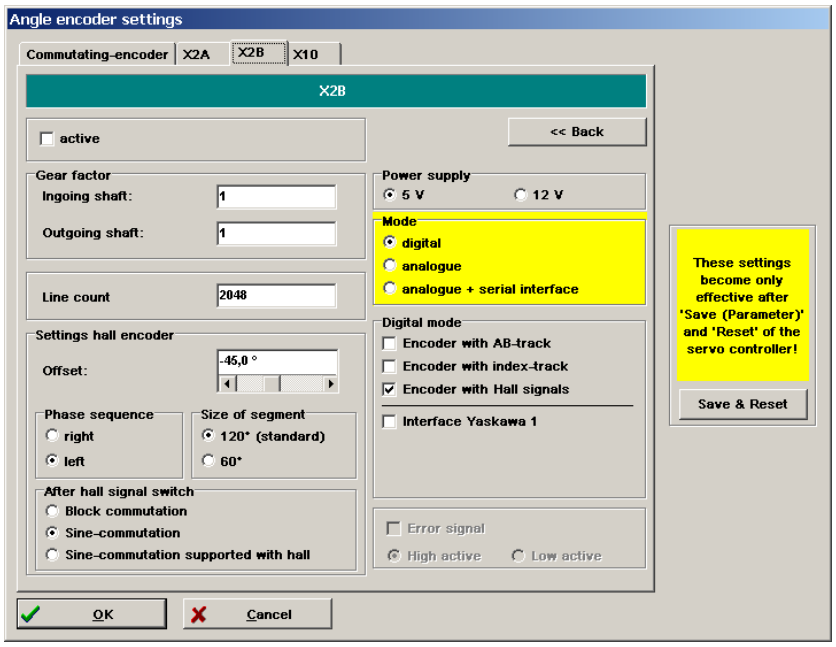
Tab X2A:



- **active**
  If the check box is selected, it means that the firmware analyses the encoder information on this connection. The check box has to be selected if the angle encoder is used for commutation and/or for determining positions or speeds.
- **Gear factor**
  Ingoing shaft/Outgoing shaftThe default setting is "Ingoing shaft" = "Outgoing shaft" = 1. Enter other values if you are using an angle encoder with a number of pairs of poles > 1.

  Attention: These settings apply only to the **gear factor of the angle encoder**! If you want to parameterize an application with a gear (parameters in units of the outgoing shaft), enter this gear factor into the menu Display units!

Tab X2B:



- **active**
  If the check box is selected, it means that the firmware analyses the encoder information on this connection. The check box has to be selected if the angle encoder is used for commutation and/or for determining positions or speeds.

- **Gear factor**
  The default setting is "Ingoing shaft" = "Outgoing shaft" = 1. Enter other values if you are using an angle encoder with a number of pairs of poles > 1. This is the case, for example, if there is more than one index pulse per rotation of the angle encoder.

  Attention: These settings apply only to the **gear factor of the angle encoder**! If you want to parameterize an application with a gear (parameters in units of the outgoing shaft), enter this gear factor into the menu **Display units**.

- **Line count**
  Incremental encoders supply their angular information with the help of track signals. They supply periodic square (digital) signals or sine (analogue) signals. The line count stands for the number of full periods of a track per revolution. In general, the line count is stated on a data sheet or the nameplate of the angle encoder. The line count itself does not take a possible high resolution into consideration. The resolution of digital incremental encoders is four times higher than the line count itself due to the fact that the incremental signals are evaluated four times. The resolution of analogue incremental encoders can be even higher.

  Some firmware versions allow an automatic determination of the angle encoder line count. However, this is only possible if the angle encoder has an index pulse. In this case, enter the value 0 into the line count field and then start the automatic identification of the angle encoder parameters. Note: After the parameter identification process has been completed, it might be necessary to close the window and to reopen it in order to update the line count parameter.

- **Power supply**
  Please state whether the angle encoder is supplied with 5V or 12V. You can find this information on the data sheet.

Attention: If the power supply is too high, the angle encoder can be destroyed! Make sure that you have set the correct supply voltage!

Mode

- **digital**
  This option must be selected if the angle encoder supplies track signals in a voltage range of 0…5 V. This information can be found on the data sheet. Often the information "digital" is directly stated on the data sheet.
- **analogue**
  This option must be selected if the angle encoder supplies analogue track signals in a voltage range of 0…1 V_{pp}. This information can be found on the data sheet. Often the information "analogue" is directly stated on the data sheet.

analogue + serial interface

This option must be selected if the angle encoder supplies track signals in a voltage range of 0…1 Vpp and is equipped with a serial interface, e.g. to determine the initial position after a reset. Examples of serial interfaces are HIPERFACE (Stegmann) or EnDat (Heidenhain). Angle encoders with a serial interface are often also so-called multiturn absolute value encoders. They can distinguish a certain number of revolutions. In addition, angle encoders with a serial interface have an EEPROM in which certain parameters can be stored. Information concerning a serial interface can be found on the data sheet of the angle encoder.
For Heidenhain encoders with EnDat 2.1 communication protocol we strongly recommend to activate the evaluation of the Z0-track. Under special conditions it is possible to deactivate this evaluation e.g. if the encoder does not support analogue signals.

Analogue mode

- **Encoder with Z0-track**
  The Z0 track is the actual analogue track signal. Some encoder manufacturers use the terms sine_0 and cosine_0 track or A and B track instead of the term Z0 track. The line count refers to the Z0 track. Information concerning the Z0 track can be found on the data sheet of the angle encoder.
- **Encoder with reference pulse**
  The reference pulse of an analogue incremental encoder corresponds to the index pulse of a digital incremental encoder. The information as to whether the angle encoder has such a pulse can be found on the data sheet of the angle encoder.
- **Encoder with Z1-track**
  The Z1 track is the commutation track of an analogue incremental encoder. It consists of two signal pairs allowing a clear angle determination referred to 1 revolution. This method is applied to determine the commutation position after a reset. Analogue incremental encoders without a serial interface usually have a Z1 track. Note: Digital incremental encoders have tracks with Hall signals to determine the commutation position. Some encoder manufacturers use the terms sine_1 and cosine_1 track or C and D track instead of the term Z1 track. Information concerning the Z1 track can be found on the data sheet of the angle encoder.

Digital mode

- **Encoder with AB-track**
  The AB track is the incremental track signal. The line count refers to this track. Information concerning the AB track can be found on the data sheet of the angle encoder.
- **Encoder with index-track**
  The index pulse of a digital incremental encoder usually occurs twice per revolution. The index track ensures consistent precision in the case of incremental encoder systems. If counting errors occur due to external interferences, they are corrected by the occurrence of the index pulse. The information as to whether the angle encoder has such a pulse can be found on the data sheet of the angle encoder. If an index track is present and connected, the function of the index pulse can be suppressed by deactivating this check box.
- **Encoder with Hall signals**
  Hall signals can be used for an initial determination of the commutation position if a digital incremental encoder is used. Following a reset, the commutation position can be determined with an accuracy of 30° using Hall signals. This is sufficient for start-up. The commutation position will then be corrected at the segment limits and when the index pulse occurs for the first time, so that it corresponds to the specified angle encoder offset.
- **Interface Yaskawa 1**
  Yaskawa® servomotors are equipped with a special angle encoder interface, the Yaskawa® 1 interface. Select this check box if you want to operate motors with this angle encoder system. In addition, the check boxes "Encoder with AB-track", "Encoder with index-track" and "Encoder with Hall signals" have to be selected.

Settings Hall encoder

This field is not displayed unless the check box "Encoder with Hall signals" is selected.

- **Offset**
  The offset describes the angular difference between the permanent magnets of the rotor and the zero position of the Hall signals. This value is determined in the course of the automatic angle encoder identification and should not be entered or optimized manually.
- **Phase sequence**
  The phase sequence indicates the counting system ("direction of rotation") of the Hall signals and depends on the wiring among other things. The correct setting of the phase sequence is essential for operation. A manual determination of the phase sequence is difficult. We recommend performing an automatic determination (see above).
- **Size of Segment**
  The segment size indicates the angular range covered by one segment of a Hall signal, e.g. U. For information concerning the segment size please refer to the data sheet of the angle encoder or contact the encoder manufacturer. Standard Hall systems have a segment size of 120°. A segment size of 60° is reserved for special variants.
- **After Hall signal switch**
  Here you can select various options to specify how the commutation shall be continued after the first Hall segment change.

  The **Block commutation** option means that the commutation position is determined solely on the basis of the Hall signals. As a result, the commutation position is quantized very roughly and the motor develops high losses. This option is reserved for special applications.

  The **Sine-commutation** option means that the commutation position will be corrected after the first Hall segment change. Then it will be determined on the basis of the incremental position information. This option leads to an optimum resolution and an optimum behaviour concerning the commutation position. We recommend using this option.

  The option **Sine-commutation supported with Hall** means that the commutation position is corrected at every Hall segment change. Up to the next change, the commutation position is calculated incrementally. This option is useful in the case of highly disturbed signals in order to be able to continuously update the commutation position.

Error signal

The option Error signal means that contamination or other faults of the measuring system can be determined over the AS or NAS signal. The evaluation of the error signal is possible with digital and analogue incremental encoders.
The evaluation at analogue incremental encoders is only possible if no commutating track is parametrised. When the evaluation of the error signal is active and an encoder error is determined, the following error occurs:

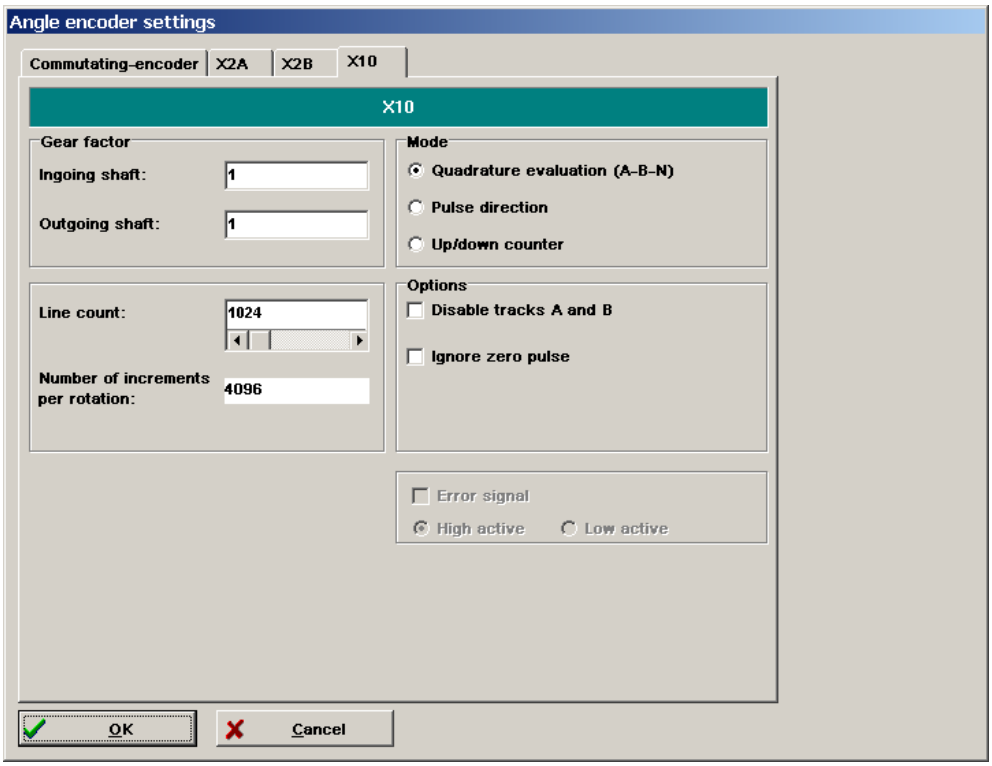
- Error 08-2 at analogue incremental encoders
- Error 08-4 at digital incremental encoders

The evaluation of the error signal can be inverted (Low active, NAS signal) or not inverted (High active, AS signal).

If the connected encoder at X2B has an EEPROM a field with a button “Save” appears. Use this button to store encoder and motor parameters to the EEPROM of the angle encoder. Another menu opens when clicking onto the button:

Choose the option “Save parameters to encoder” in order to save your settings.

Tab "X10":



In this menu external position sensors or frequencies for synchronisation can be adjusted.

Gear factor

The default setting is "Ingoing shaft" = "Outgoing shaft" = 1. This factor defines the adjustment of an external position to the actual position.

Line count

Digital incremental encoders supply their angular information with the help of track signals. They supply periodic square digital signals. The line count stands for the number of full periods of a track per revolution. In general, the line count is stated on a data sheet or the nameplate of the angle encoder.

The line count itself does not take a possible high resolution into consideration. The resolution of digital incremental encoders is four times higher than the line count itself due to the fact that the incremental signals are evaluated four times. This effective line count is shown under **Number of increments per rotation**.

It is recommended that in case of having an index puls, the linecount is equal to the number of lines between two zero pulses (north marker, index pulses) .

Mode : Quadrature evaluation (A-B-N)

These signals are interpreted as standard incremental signals. These are two rectangular track signals with a phase shift of 90° to each other. Optionally, this mode supports an index track with one periodical zero pulse per "line count".

Pulse direction

In this mode, one track describes the incremental change of the position. Another track determines the direction.
Due to the quadruple evaluation of the track signals enter the **line count** referring to 90° (not one revolution).

Incremental/reverse counter

This mode needs two tracks. Each one determines the change of the position in one direction. Hence, if one track is active, the other track should be inactive (constant level).
Due to the quadruple evaluation of the track signals enter the line count referring to 90° (not one revolution).

Options: Disable tracks A and B

The incremental signals are ignored. The interface sees an encoder at standstill.

Ignore zero pulse

In general, only incremental encoders resp. devices with an incremental encoder emulation generate a periodical zero pulse. If necessary, this option suppresses the evaluation of this input if it is not given.

A zero pulse initiate a step in the position in case of noisy AB encoder signals to correct a to a full revolution. It is recommended to connect a index line if happen.

Error signal

The option **Error signal** means that contamination or other faults of the measuring system can be determined. The zero pulse input is used as error signal, i.e. the evaluation is only possible, when no zero track is parametrised. When an error is determined the encoder error 08-7 occurs. The evaluation of the error signal can be inverted (Low active, NAS signal) or not inverted (High active, AS signal).

13.9 Digital Inputs

By default, the servo positioning controller LV-servoTEC S2 has 10 digital inputs (DIN 0 to DIN 9), four of which (DIN 0 to DIN 3) can be cofigurated freely and can e.g. be used as position selectors. The inputs DIN 4 to DIN 7 are allocated to certain functions:

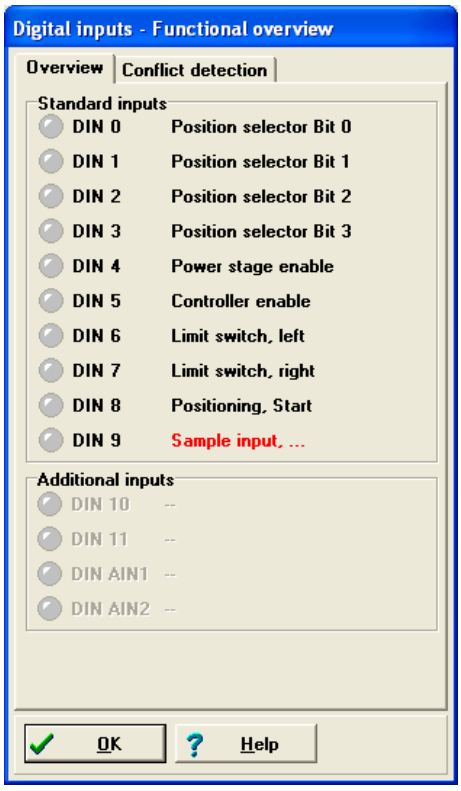
- DIN4: Power stage enabling
- DIN5: Controller enabling
- DIN6: Standard configuration: Limit switch E0, left (negative)
- DIN7: Standard configuration: Limit switch E1, right (positive)

The inputs DIN 8 and DIN 9 are reserved for the start and sample functions.

Additional inputs can be switched by using the analog inputs AIN 1 and AIN 2 as well as the digital outputs DOUT 1 and DOUT 2 as digital inputs.

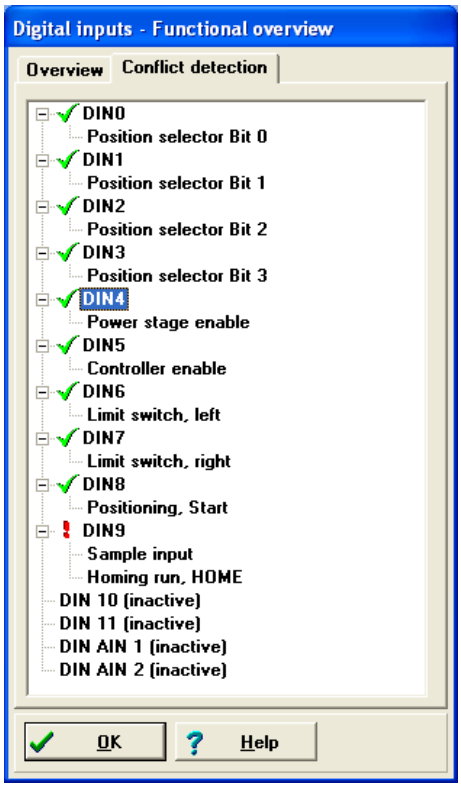
With the use of an EA88 technology module eight more digital inputs can be added. Up to two technology modules can be integrated into the servo positioning controller LV-servoTEC S2.

The menu option **Display/Digital inputs** provides an overview of the available digital inputs and the current settings.



If digital inputs are used multiple times, they are highlighted by red writing. You can now click on the "Conflict detection" tab to analyse the multiple use.

The following window will appear:



In this case, DIN9 is simultaneously used by the functions **Sample input** and **Homing run, HOME**.

Multiple use of digital inputs is tolerated by the firmware.
The user is responsible for checking whether the combinations make sense.

13.9.1 Configuration of the Digital Inputs

In the menu **Parameters/IOs/Digital inputs** certain functions can be allocated to the digital inputs. To address a destination position from the 256 freely programmable destinations, a **Position Selector** of up to 8 bits is possible. Also relevant for the positioning are the **Start** and **Sample Input**. The sample input can store the current position in the internal memory, to use it for calculations (e.g. length measurements). The **Digital Stop** affects the positioning and the speed control. With **Reverse directions** the direction of rotation can be reversed in the speed control. For the homing, the **Start** signal and **Reference switch** can be switched via digital inputs.

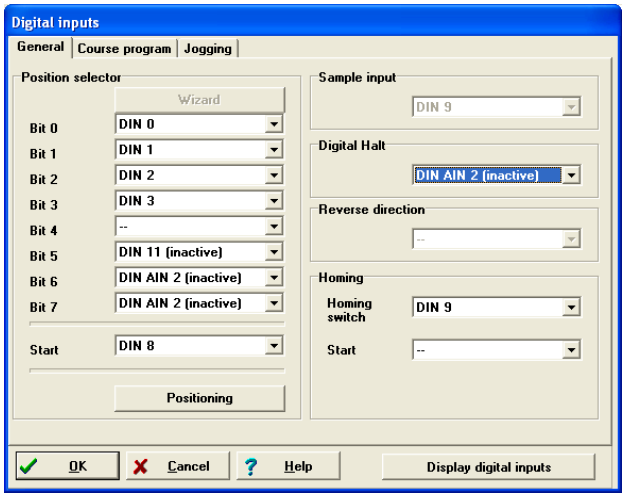
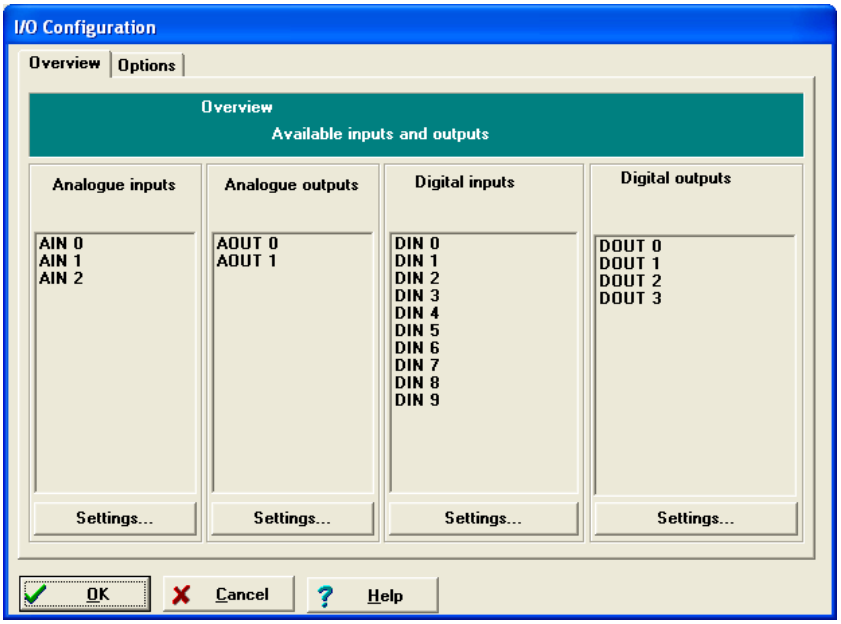


Table 18: **Configuration of the digital inputs**

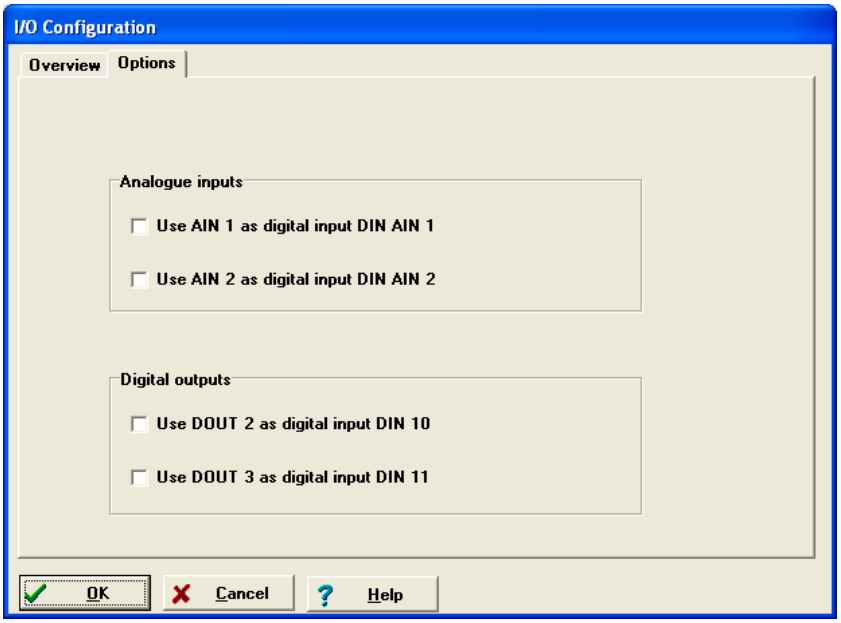
The digital input...	influences...	Chapter
Position Selector	Positioning control	11.3.4 *Positioning* (page *128*)
Start	Positioning control	11.3.4 *Positioning* (page *128*)
Sample Input	Positioning control	11.3.4 *Positioning* (page *128*)
Digital Stop	Speed control,	*Speed-controlled Mode* (page *109*)
	Positioning	11.3.4 *Positioning* (page *128*)
Reverse direction <FW3.x>	Speed control	*Speed-controlled Mode* (page *109*)
Homing Start	Homing mode	*Homing* (page *113*)
Reference switch	Homing mode	*Homing* (page *113*)
(Course program) HOME	Course program	*Digital Inputs* (page *140*)
(Course program) START	Course program	*Digital Inputs* (page *140*)
(Course program) NEXT1	Course program	*Digital Inputs* (page *140*)
(Course program) NEXT2	Course program	*Digital Inputs* (page *140*)
(Course program) Stop	Course program	*Digital Inputs* (page *140*)
(Course program) Combined Start/Stop	Course program	*Digital Inputs* (page *140*)
(Jogging) negative	Jogging	*Jogging mode* (page *141*)
(Jogging) positive	Jogging	*Jogging mode* (page *141*)

13.9.2 Extension of the Digital Inputs

By default, the servo positioning controller LV-servoTEC S2 has four freely configurable digital inputs. Additional inputs can be set by configuring the analog inputs AIN 1 and AIN 2 as well as the digital outputs DOUT 1 and DOUT 2 as digital inputs. The configuration of the I/Os is supported in the menu **Parameters/IOs/IO Configuration**. The menu offers an overview of the inputs and outputs available in the servo positioning controller LV-servoTEC S2. The EA88 technology modules are also displayed here, if used:



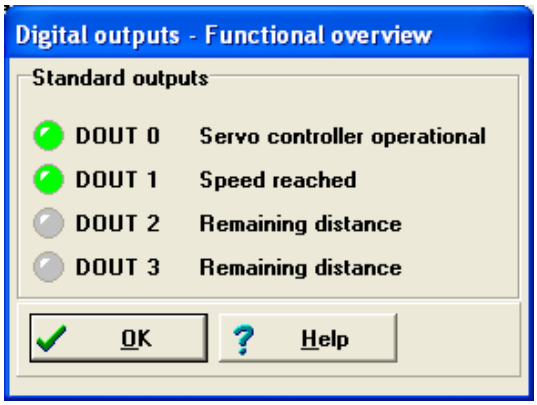
The selected configuration is shown in the **Overview** tab. In the tab **Options** the analogue inputs AIN 1 and AIN 2 can be configured as digital inputs DIN AIN 1 and DIN AIN 2. The digital outputs DIN 2 and DIN 3 can be configured as digital inputs DIN 10 and DIN 11.



13.10 Digital Outputs

By default, four digital outputs (DOUT 0 to DOUT 3) are available for displaying the selected operation statuses of the servo positioning controller LV-servoTEC S2. The output DOUT 0 is fixed and always indicates the operability of the servo positioning controller LV-servoTEC S2.

The menu **Display/Digital outputs** provides an overview of the available digital outputs and the current allocation of functions:



The number of digital outputs can be increased by eight by using an EA88 technology module. Up to two technology modules can be integrated into the servo positioning controller LV-servoTEC S2 and are displayed in the Functional overview in the menu **Display/Digital outputs**.

13.10.1 Configuring Digital Outputs

The digital outputs can be configured In the menu **Parameters/IOs/Digital outputs**.

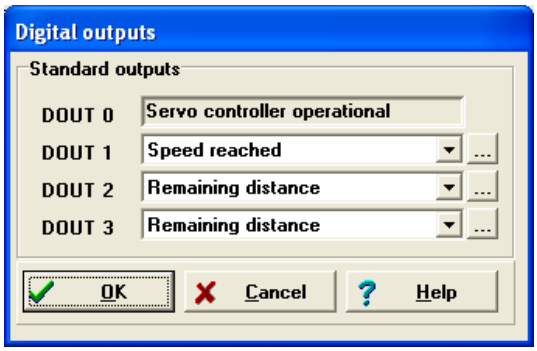


Table 19: **Configuration of the digital outputs**

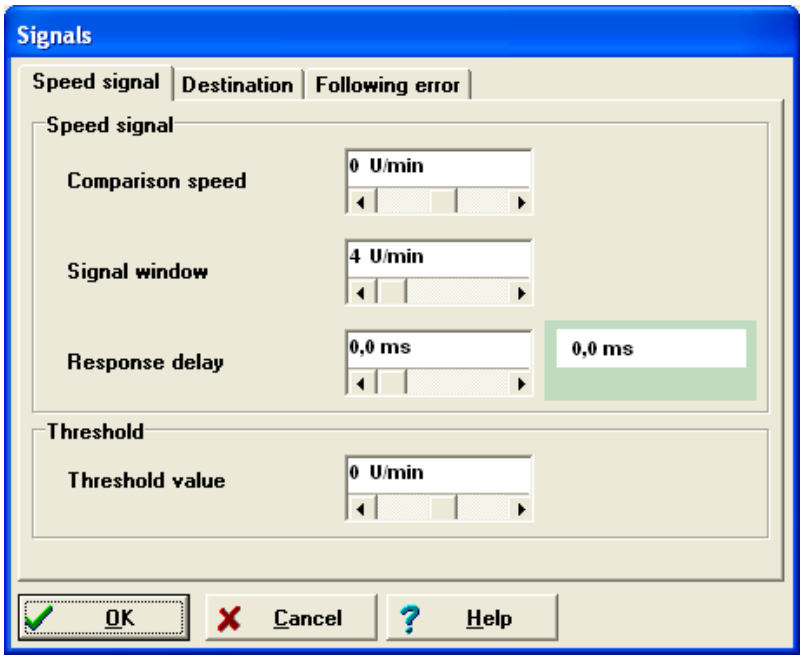
The digital output...	is influenced by...	Chapter
Off	Optional: fieldbus control	
On	Optional: fieldbus control	
I²t-examination active	Motor capacity utilisation in critical range	
Comparison speed reached	Speed control, etc.	*Speed-controlled Mode* (page *109*)
Xset = Xdest	Positioning control	*Positioning* (page *128*)
Xact = Xdest	Positioning control	*Positioning* (page *128*)
Remaining distance	Positioning control	*Positioning* (page *128*)
Homing active	Homing run	*Homing* (page *113*)
Homing position valid	Homing run	*Homing* (page *113*)
Undervoltage in intermediate control	Monitoring of DC-link voltage	*Configuration of the DC-link Monitoring* (page *199*)
Following error	Position control	*Configuration of the position controller* (page *68*)
Output stage enabled	Controller enabling logic	*Configuration of the Controller Enabling Logic* (page *71*)
Brake released	Holding brake / Automatic brake	*Activating the Default Parameter* Set (page *171*)
Linear motor identified	General configuration	*General Configuration* (page *39*)
Position trigger	Position trigger	*Position trigger* (page *192*)
Lock of the setpoint active	Limit switches	*Setting the Limit Switch Polarity* (page *66*)
Alternative target reached	Positioning control	*Positioning (*page *128*)

13.10.2 Configuration of the Messages for the Digital Outputs

Under the menu **Parameters/Positioning/Signals** a window appears in which speed signal, destination signals and following error signals can be parameterised.

13.10.2.1 Speed Signal Window: "Comparison Speed Reached"

The following configurations can be made on the **Speed signal** tab:



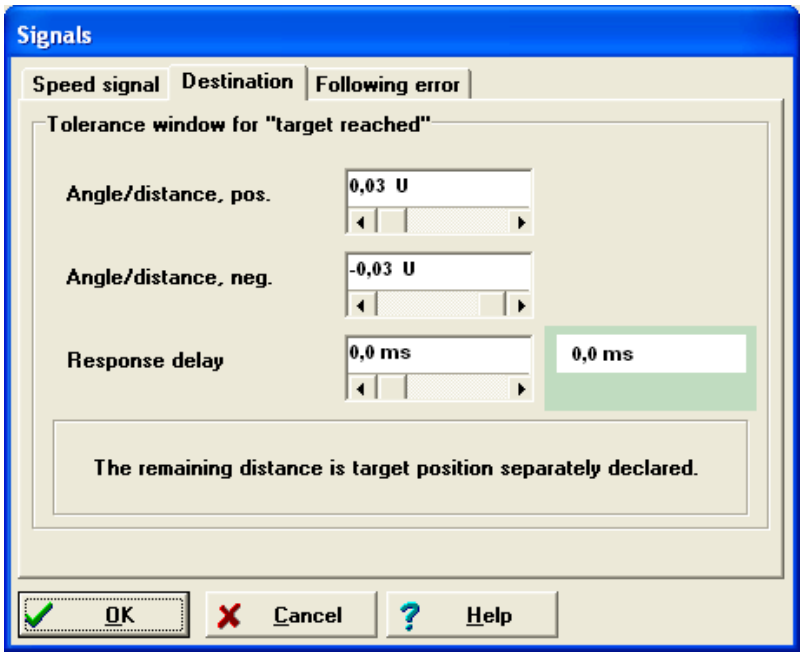
The parameters **Comparison speed**, **Signal window** and **Response delay** can be used to control the **Comparison speed reached** function of a digital output.

The output will be active when the current speed is in the range of (n_{comp} – n_{signal} .... n_{comp} + n_{signal}). However, it will only be activated if the range is not left at least for the time $t_{response}$.

The "Threshold value" parameter is used to set a second comparison speed. At present, this second speed is evaluated only by field bus systems using status words.

13.10.2.2 Destination Signal Window: "$X_{act} = X_{dest}$"

The following configurations can be made on the **Destination** tab:



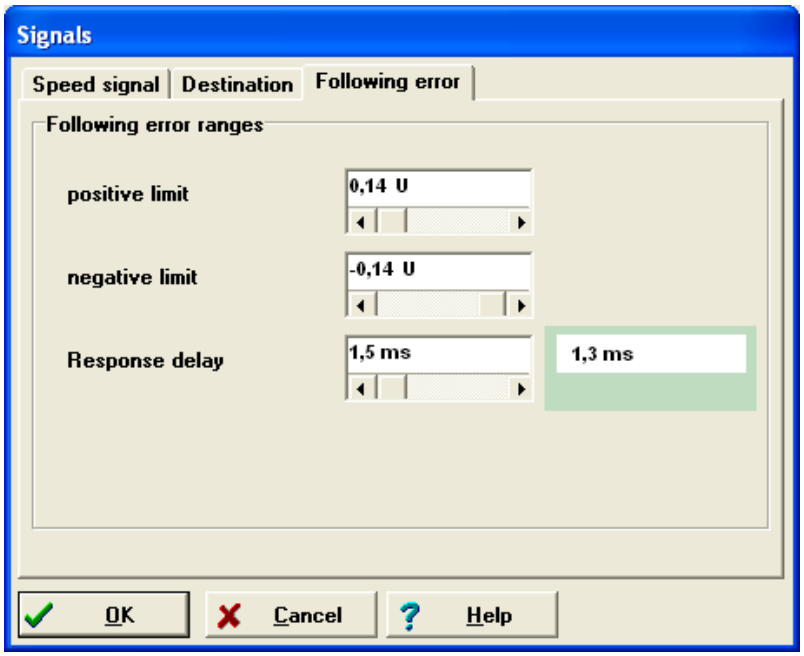
These parameters can be used to control the function $X_{act} = X_{dest}$ of a digital output.

The output will be active when the current position is in the range of ($X_{dest} – X_{neg}$ .... $X_{dest} + X_{pos}$). However, it will only be activated if the range is not left at least for the time $t_{resonse}$.

The output is not deactivated until the range of the target window is left. For example, the output remains active when a positioning run is started if the new target is still within the target window.

13.10.2.3 Following Error Signal Window: "Following Error"

The following configurations can be made on the **Following error** tab:



These parameters can be used to control the "following error" function of a digital output.

The output will be active when the actual position is beyond the range of ($X_{ref} – X_{neg}$ .... $X_{ref} + X_{pos}$). However, it will only be activated if the range is not left at least for the time $t_{response}$.

The following error signal is not the same as the "Following error" error. This has to be configured in the "Safety parameters" menu (see chapter *Safety Parameters , page 54)*.

13.11 Position trigger

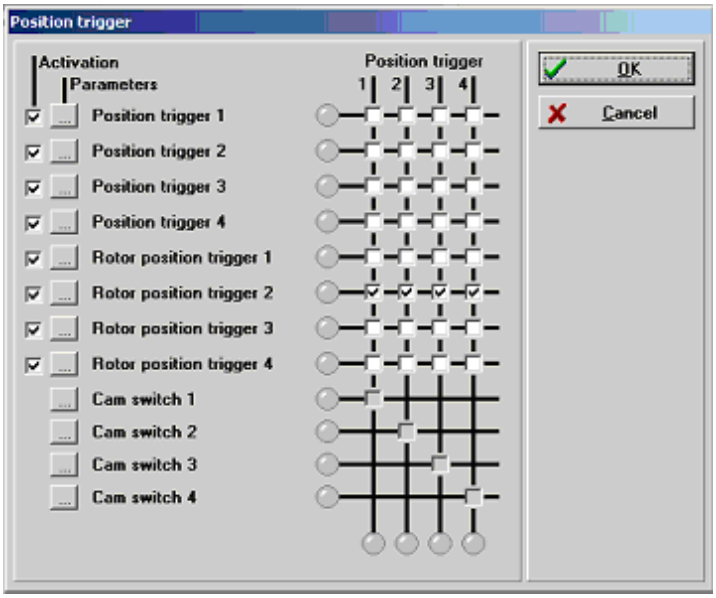
The position triggers can be used to transfer information concerning the logic states of the position trigger, the rotor position trigger and the cam switch to digital outputs. 4 position triggers can be configured(vertical lines).
The following sources are available (horizontal lines):

- 4 position triggers (see chapter *Position trigger*, page *194*)
- 4 rotor position triggers (see chapter Rotor position trigger, page *195*)
- 4 cam switches (see chapter *Cam switch principle* , page *150*)

Set the function of a digital output in the “Digital outputs” menu to “Position trigger 1..4” (see chapter *Configuring Digital Outputs,* page *188*) in order to mirror the information to a digital output of the servo positioning controller.

The position trigger can be configured in the menu **Parameter / I/Os / Position trigger**.

The following window will appear:



In order to assign a source to a position trigger, the associated check box must be checked in the corresponding column.

It is possible to assign several position triggers or rotor position triggers to a position trigger. The logic information will be combined by an OR function.

Please note that OR- function can only be performed for **1 group**. OR-function a position trigger and a rotor position trigger, for example, is **not possible**!

- **Position trigger**
  The vertical LEDs indicate the logic states of the sources. The horizontal LEDs indicate the resulting states.

  - **Activation**
    The check boxes are used to assign sources to the targets.

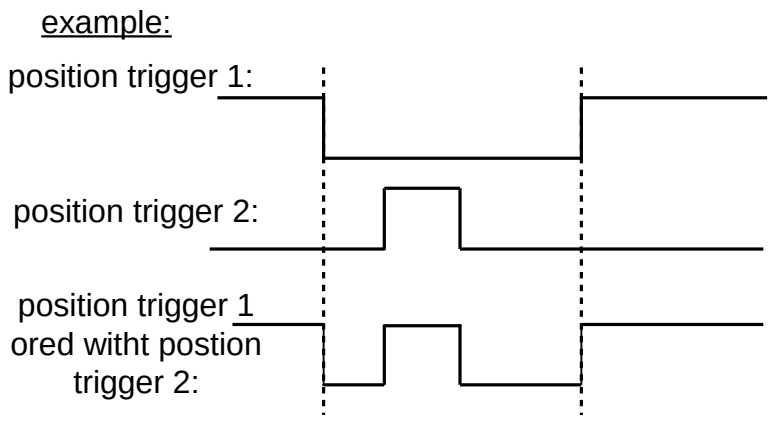
    If the check box is grey, there can be no connection with a higher group. In this case, delete all check boxes that are higher on this line.

    If there is no check box at all, this means that the source cannot be selected since it has not been activated. If you want to activate a source, select the corresponding check box on the left.

> In order to provide the servo positioning controller with as much processing time as possible for the control, unused sources should be deactivated!

  - **Option button** ...
    The option button can be used for a precise configuration of the position trigger or of the rotor position trigger, or to call up the cam disk (cam switch) menu.

The following is an example of a combination of signals by an OR function:



13.11.1 Position trigger

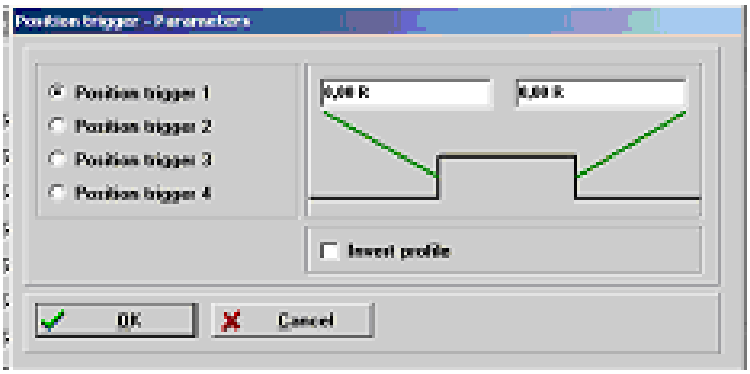
The menu can be found under **Parameter / I/Os / Positiontrigger-Parameters**.

This menu is used to configure the position trigger channels 1..4. The position trigger channels 1..4 are logic channels, i.e. they can have the logic values 0 and 1.

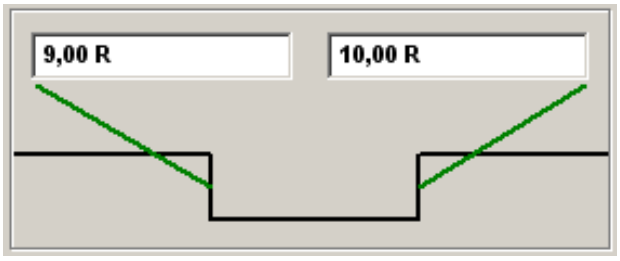
In order to use these position trigger channels, they can be combined logically in the position trigger menu and then assigned to a digital output.

The logic value of the position trigger depends on the current actual position values.

The following window will appear:



- **Position trigger – parameters**
  - **Position trigger 1…4**
    Here you can select the position trigger to be parameterized.
  - **(Input box: left-hand edge)**
    If the actual position is smaller than the position of the left-hand edge (in the example: 1.00 revolutions), the position trigger has the logic value 0 if the profile is not inverted (see below!). If the profile is inverted, the value is 1.
  - **(Input box: right-hand edge)**
    If the actual position is greater than the position of the right-hand edge (in the example: 2.3 revolutions), the position trigger has the logic value 0 if the profile is not inverted (see below!). If the profile is inverted, the value is 1.
  - **Invert profile**
    If the profile is not inverted, the logic level of the position trigger outside the two edges is “logic 0”.
    If the profile is inverted, the level outside the two edges is “logic 1”. An inverted profile is symbolized as follows:



13.11.2 Rotor position trigger

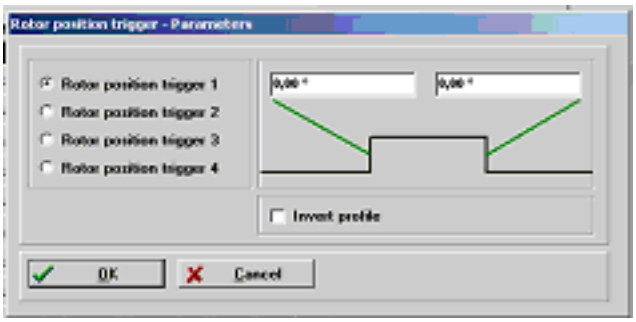
The menu can be found under Parameter / I/Os / Rotorpositionstrigger-Parameter.

This menu is used to configure the rotor position trigger channels 1..4. These channels are logic channels, i.e. they can have the logic values 0 and 1.

In order to use these rotor position trigger channels, they can be combined logically in the position trigger menu and then assigned to a digital output.

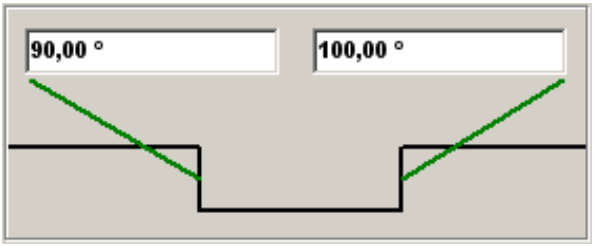
The logic value of the rotor position trigger depends on the current encoder angle of the rotor. This means that the state changes periodically with every revolution.

The following window will appear:



- **Rotor position trigger 1…4**
  Here you can select the rotor position trigger to be parameterized.
- **(Input box: left-hand edge)**
  If the encoder angle is smaller than the value of the left-hand edge (in the example: 13.22°), the rotor position trigger has the logic value 0 if the profile is not inverted (see below!). If the profile is inverted, the value is 1.

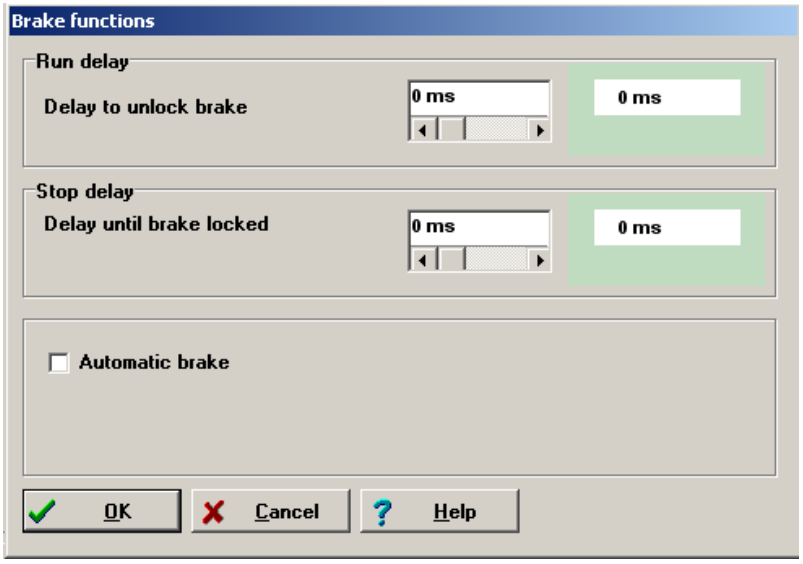
  You can enter values between -180.0° and +180.0°.
- (**Input box: right-hand edge**)
  If the encoder angle is greater than the value of the right-hand edge (in the example: 17.20°), the rotor position trigger has the logic value 0 if the profile is not inverted (see below!). If the profile is inverted, the value is 1.You can enter values between -180.0° and +180.0°.
- **Invert profile**
  If the profile is not inverted, the logic level of the rotor position trigger outside the two edges is “logic 0”.
  If the profile is inverted, the level outside the two edges is “logic 1”. An inverted profile is symbolized as follows:



13.12 Brake Control and Automatic Brake

If your motor is equipped with a holding brake, it can be triggered by the servo positioning controller LV-servoTEC S2. The servo positioning controller LV-servoTEC S2 can only drive holding brakes with a rated voltage of 24 V DC. To edit the parameters for triggering the holding brake, go to **Parameters/Device parameters/Brake functions**.

The following window will open:



A digital output is reserved in the servo positioning controller LV-servoTEC S2 for triggering the holding brake. The holding brake is always enabled, as the controller is enabled. For holding brakes with a high mechanical inertia a delay time can be set.

The **Run delay** serves the purpose of adapting the triggering of the holding brake to its mechanical inertia. For the controller enabling, in the modes of speed and position control or positioning, the speed setpoint is set to zero during this delay time. This way the drive remains idle until the brake is completely enabled.

After the controller enabling, speed setpoints or start commands for the positioning only come into effect after the run delay has run out.

In the operating mode torque control the torque setpoint is immediately active until, i.e. the delay times are inactive.

Stop delay: Upon deactivation of the controller enabling, the speed setpoint is immediately set to zero. As soon as the actual speed is about zero, the holding brake kicks in. Simultaneously, the **stop delay** of brake time starts. During this time the drive is kept at its current position, until the holding brake has developed its entire holding torque. After the stop delay time has run out, the controller enabling is switched off. In both cases the mechanical wear on the holding brake is reduced.

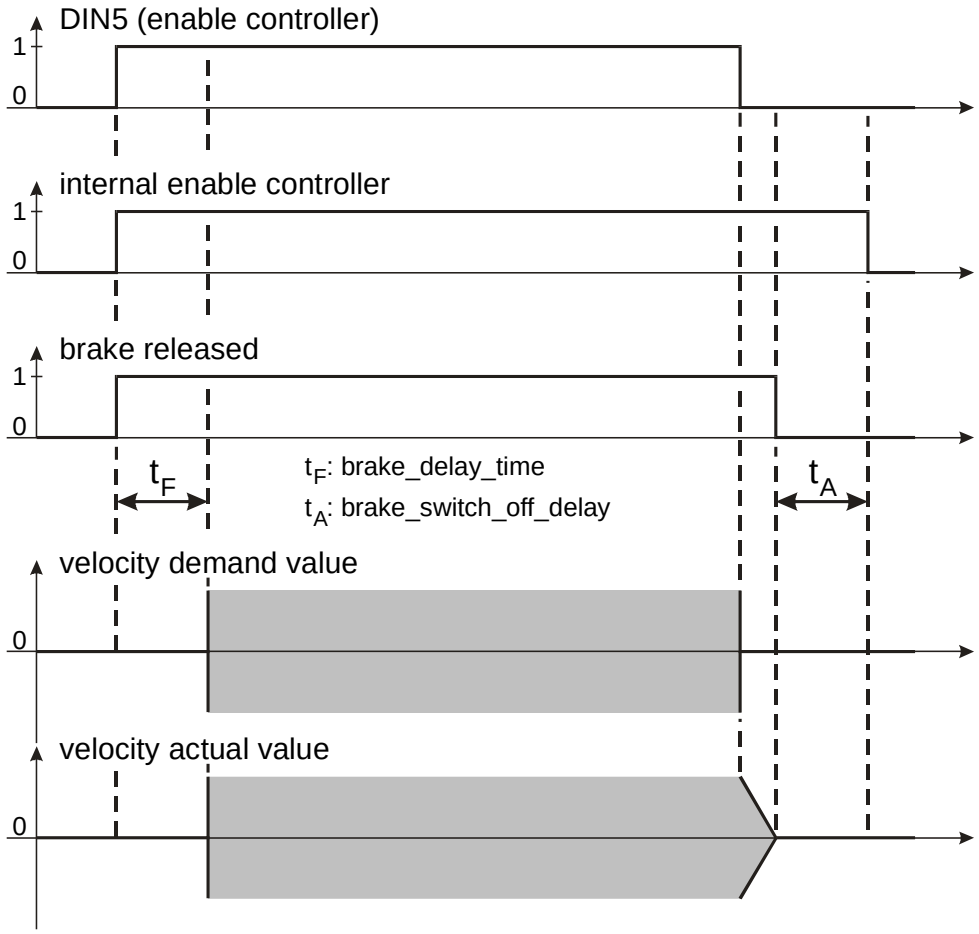


Figure 19: Brake control: Run delay and stop delay

The servo positioning controller LV-servoTEC S2 also features an **automatic brake mode** function. If it is activated in this window, another delay time can be set. With this delay time it is possible to set the set current value of on-load axes to zero, if there will not be any positioning for a longer period of time.

DANGER!
In certain applications (e.g. in synchronisation mode) the activation of the automatic brake can cause damages to the brake and/or system. In such cases, check the application conditions before activating the automatic brake.

If the automatic brake function is activated, the setting of the current value to zero and the first subsequent start command for the positioning will only come into effect after the run delay time has run out.

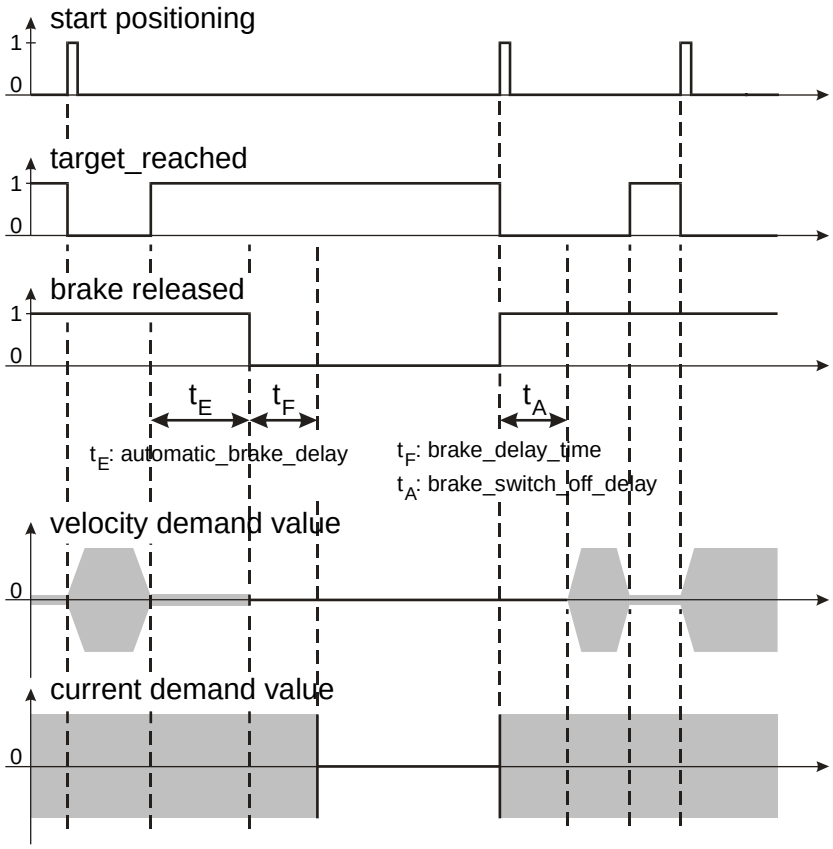


Figure 20: Brake control: Automatic brake

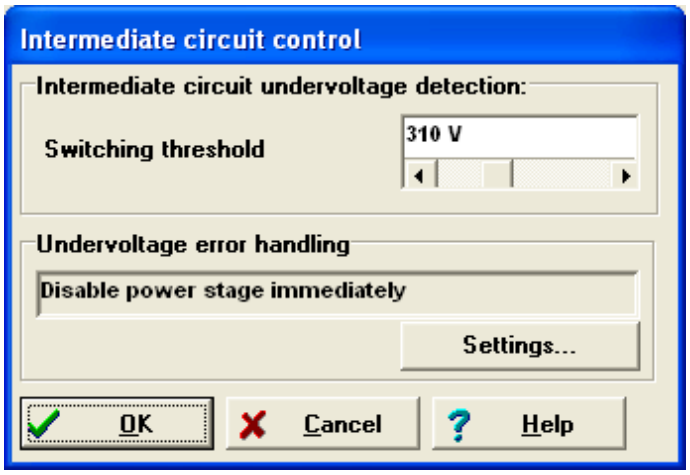
13.13 Configuration of the DC-link Monitoring

In special cases, the DC-link voltage may be too high or too low.

If the DC-link voltage is too high (overvoltage), an integrated brake chopper activates a parallel resistor, so that the voltage can decrease via this brake resistor. This brake resistor is already integrated into servo positioning controller of the LV-servoTEC S2 series. If the voltage increases further, the servo positioning controller LV-servoTEC S2 shuts down. This function cannot be parameterised.

Excessively low DC-link voltages can cause an error, if so parameterised by the user.

The menu is activated via **Parameters/Device parameters/Intermediate circuit control**.



In the field **Switching threshold** you can determine the value below which the voltage has to drop for the servo positioning controller to detect an undervoltage.

The flag set in the servo positioning controller LV-servoTEC S2 can be read via different status queries; a digital output, for example, can be parameterised to display the event of an undervoltage in the intermediate circuit (see also chapter *Digital Outputs,* page *187*)

In the field **Undervoltage error handling** you can determine whether in the case of an undervoltage an error message (see chapter *Error management,* page *105)* is to be generated with the shut-off of the servo positioning controller LV-servoTEC S2.

13.14 Selection of the External Braking Resistor

The servo positioning controller converts the mains voltage into a dc-bus, which stores the energy in order to drive your application. On the one hand if the application needs energy e.g. for accelerating an inert mass this energy is extracted from the dc bus. On the other hand if the inert mass is decelerated the extra energy is fed into the dc-bus. So the dc-bus voltage increases.

As the dc-bus voltage must not exceed an upper value an electronic switch (braking chopper) discharges the dc-bus using a braking resistor. So the extra energy of the application is finally converted into heat by the braking resistor.

In the menu **Parameters/Device parameters/External resistor** you can select or see whether an external braking resistor is connected. This is important for calculating the power loss of the brake chopper. The I²t-monitoring for the brake chopper is only active if the internal braking resistor is used.

In the case of LV-servoTEC S2 1xx, LV-servoTEC S2 320 and LV-servoTEC S2 340 servo positioning controllers, the check box has to be selected depending on the connection. If an external braking resistor is connected but the check box is not checked, the system will continue calculating the power loss for the internal braking resistor. As a result, the potentially higher load capacity of the external braking resistor will not be utilised.

Caution!
If the external resistor has been selected, the I²t-monitoring for the internal braking resistor of the LV-servoTEC S2 servo positioning controller is deactivated! For information on the connection, please refer to the product manual for your specific device.

In the case of LV-servoTEC S2 302, LV-servoTEC S2 305 and LV-servoTEC S2 310 servo positioning controllers, the system can automatically detect whether an external braking resistor is connected or not. The user does not have to check the check box. It automatically indicates the status detected.

Start the „braking resistor wizard“ by clicking onto the button **Brake resistor dimensioning**. The wizards supports the evaluation if the internal braking resistor is of sufficient dimension. It also calculates the characteristics of an eventually required external braking resistor.

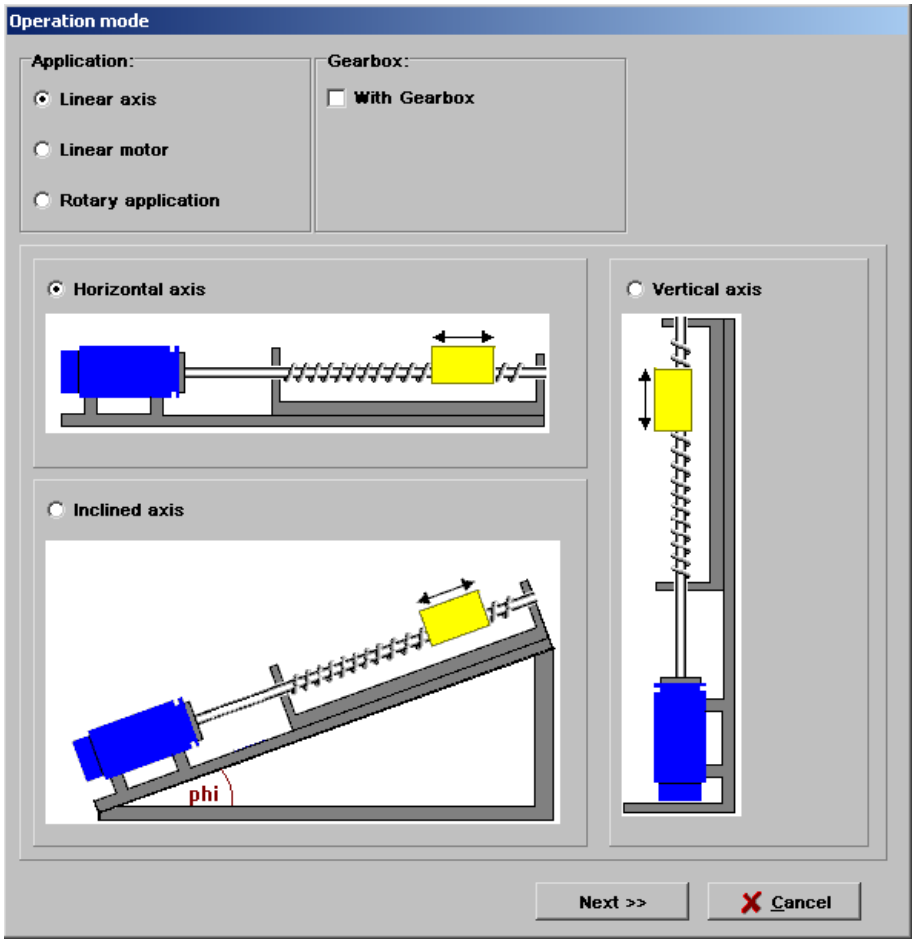
13.15 Braking Resistor Wizard

The braking resistor wizard evaluates the requirements for the braking resistor according to the following criteria:

- General configuration
- Moving profiles / loads

Start the braking resistor wizard in menu Parameters/Device parameters/External resistor by the following button:

First, the general configuration is requested with respect to application, gear box and arrangement:

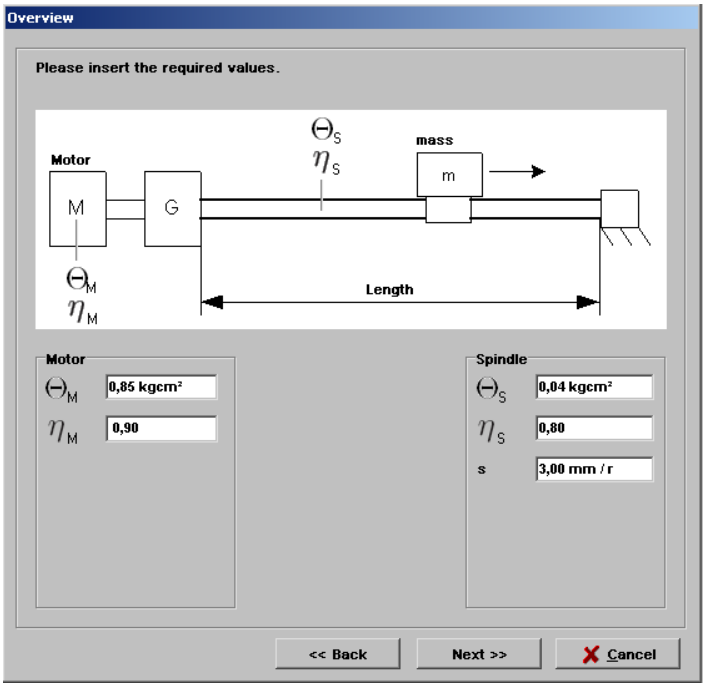


Select for **application** one of the following variations:

Linear axis:	The following changes in energy will be considered: Acceleration / deceleration of masses, changes of the potential (energy) if the masses are moved in a vertical application and energy changes due to the acceleration / deceleration of rotary components (motor, gear box, spindle).
Linear motor:	The following changes in energy will be considered: Acceleration / deceleration of masses, changes of the potential (energy) if the masses are moved in a vertical application.
Rotary application:	The following changes in energy will be considered: Acceleration / deceleration of rotary components (motor, gear box, spindle).

When applying a gear box enter the gear box ratio after activating the corresponding checkbox. Select the best suitable arrangement according to the real application.

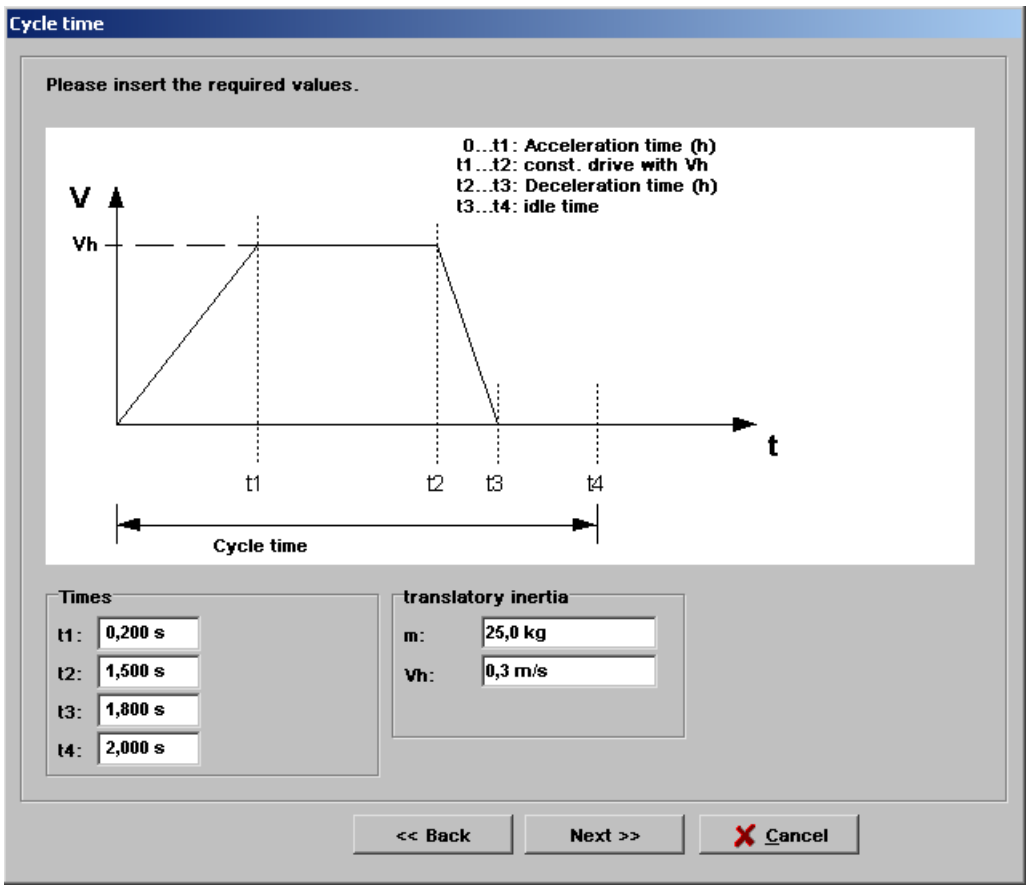
The next step requests the numerical values for the inertia and efficiency factors:



The applied symbols are:

Θ_M, Θ_S:	Inertia of the motor resp. of the spindle
η_M, η_S:	Efficiency factor of the motor resp. of the spindle
s:	Pitch of the spindle

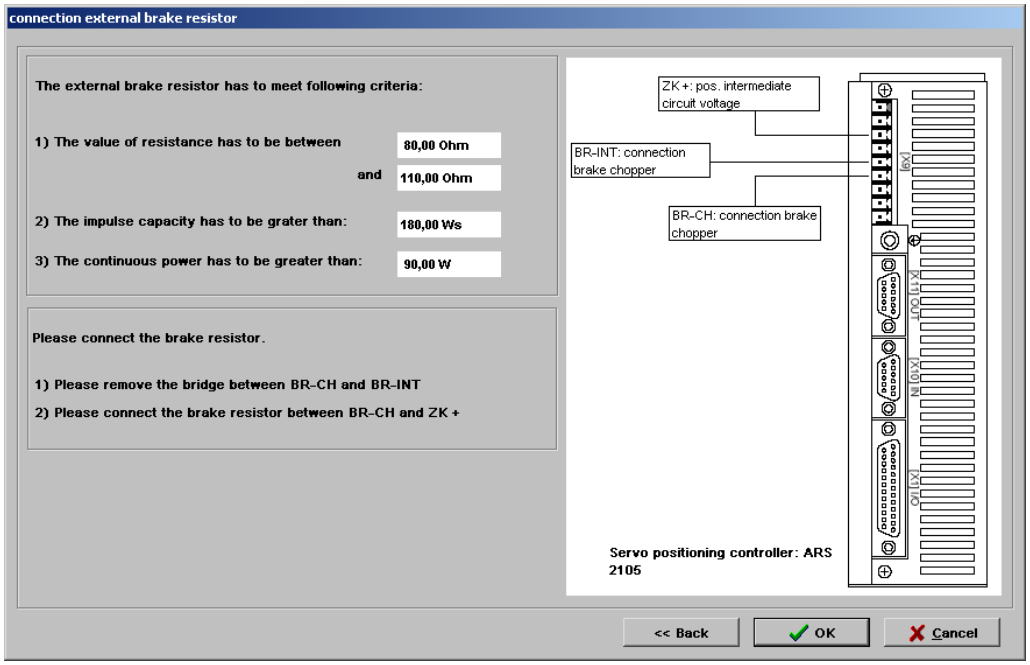
Finally enter the information concerning the moving profile (times) as well as concerning the masses to move. Here, the braking resistor wizard always assumes an application with cyclic recurrent profiles:



At last, the evaluation follows. Three results are possible:

The internal braking resistor is sufficient:	The internal braking resistor is able to convert the appearing energy resp. power.
External braking resistor required:	The internal braking resistor is not able to convert the appearing energy resp. power. The wizard calculates the data for the external braking resistor (resistor value, pulse capability and continuous power), see also the figure below.
No suitable external braking resistor found:	The internal braking resistor is not able to convert the appearing energy resp. power. Also the calculated data for the external braking resistor do not match the given characteristics of the device. Apply a device with higher power.

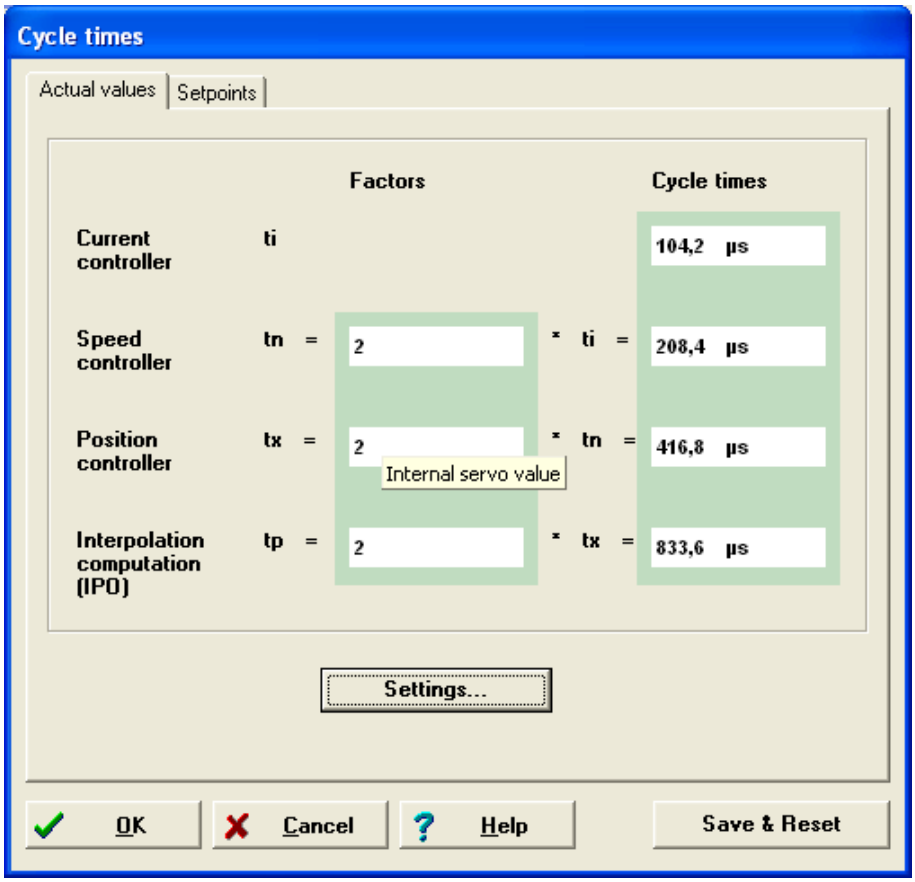
The following figure shows an evaluation with calculated data for an example where an external braking resistor is required:



13.16 Control Circuit Cycle Times

Caution!
Only experienced user should change the configuration. Incorrect configurations may cause the drive to oscillate and destroy the motor!

In the menu **Parameters/Controller parameters/Cycle times** you can change the cycle times of various internal control circuits, e.g. of the current control circuit. The following window will appear:



The **Setpoints** tab is invisible until the **Settings** button is pressed.

The time interval for the current controller can be configured. If the time interval is too short, an internal overflow may occur as in this case the processor does not have enough computing time. If the time interval is too long, the dynamic response will deteriorate which means that disturbances are compensated only very slowly.

The speed controller is superimposed on the current controller and will be called up normally in every second current controller cycle. If the factor is increased, the dynamic response will be decreased again as the calling frequency of the speed controller will be reduced. An increased factor increases the computing time reserves.

The position controller, on the other hand, is superimposed on the speed controller and will be called up normally in every second cycle. In this case, too, the information provided applies as it does for the last point "Interpolation computation".

Variable cycle times became necessary in order to be able to support functions requiring, for example, a synchronisation of the current controller intervals of several devices on a field bus system. In this case, the cycle time of the current controller is set once to an expected value. During operation, the cycle time will be automatically and continuously controlled within a very narrow correction range.

To extend the computing time, we recommend changing the cycle time of the current controller in the range of some µs. This is sufficient in most cases. The factors should be increased only for special areas of application, e.g. the "Interpolated Position Mode" under CANopen. In these cases, the necessary adaptations are normally performed automatically by the firmware so that the user does not have to change the cycle times. Please refer also to the information provided in the corresponding product manual.

Changed values have to be entered into the system with the help of Save and Reset. To do so, press the button at the bottom of the window.

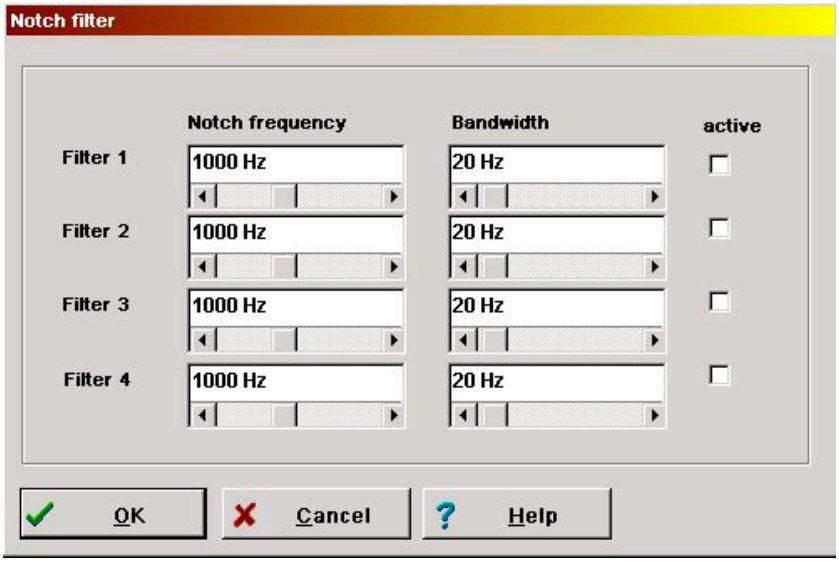
13.17 Notch Filter

Use menu **Parameters/Controller parameters/Notch filter** to display and change the notch frequency and bandwidth for the notch filters.

Notch filter have the goal to suppress resonances. The filters can be adapted by notch frequency and bandwidth. Hint: A larger bandwidth decreases the damping of the notch frequency.

Caution!
Only experienced user should change the configuration. Incorrect configurations may cause the drive to oscillate and destroy the motor!

Some applications tend to vibrations or resonances due to their construction. These may be even excited by stiffly set control loops. The goal of the notch filters are to hide these frequencies from the closed control loop. This may support a reduction of process cycle times.



Enter the center frequency of the notch filter (maximum damping) in the fields **Notch frequency**.

The fields **Bandwith** define the band of frequency which has a damping below -3dB.

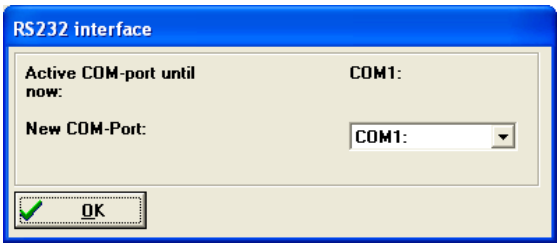
Activate the single notch filters by marking the corresponding checkbox. Please activate a notch filter only if the application requires it. Always activate as less notch filters as possible.

Caution!
The activation of a notch filter at a drive without resonances may cause instability!

13.18 Communication by RS232

13.18.1 Selection of the RS232 Interface

Under the menu item **Options/Communication/RS232-interface** you can select the serial interface (COM port) via which the PC is connected to the servo positioning controller.
The following menu will appear:

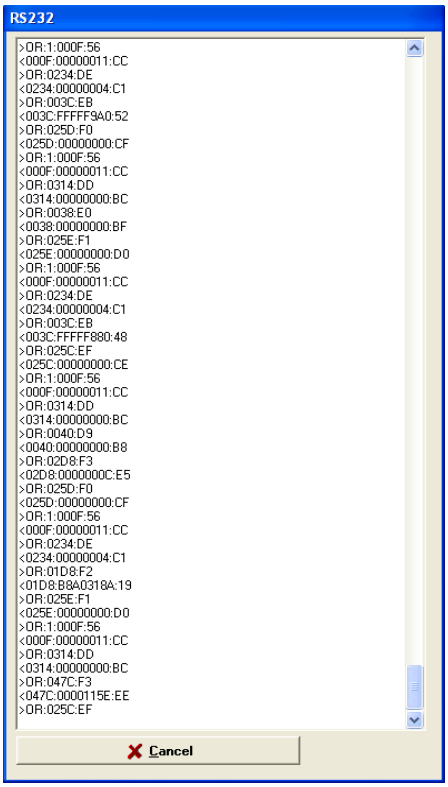


Select the correct COM port and click **OK**. The parameterisation program will try to set up a connection. To do so, it scans several baud rates. If it was impossible to set up a connection, the system will display an error message. Otherwise the program will communicate via the new port.

> By default the parameterisation program supports 256 COM ports. Sometimes, using special IO/extension cards may cause problems because some COM port numbers are not supported by a Windows® operating system.

13.18.2 Communication Window for RS232 Transmission

Selecting the menu option **Options/Communication/Show communication window** opens a window, in which the communication via the serial interface resp. UDP (Ethernet) can be monitored. This mainly serves the purpose of debugging, for the 'normal user' it is of no interest.



13.19 Oscilloscope

The oscilloscope function integrated in the parameterisation program allows signal courses and digital statuses to be represented and physical parameters to be optimised in the reversing mode.

To start the oscilloscope:

- select the menu item **Display/Oscilloscope** or
- click on this button

Two windows will open: the actual oscilloscope and the oscilloscope settings window.

13.19.1 Oscilloscope Settings

The "Oscilloscope-Settings" window includes six tabs for precise settings.

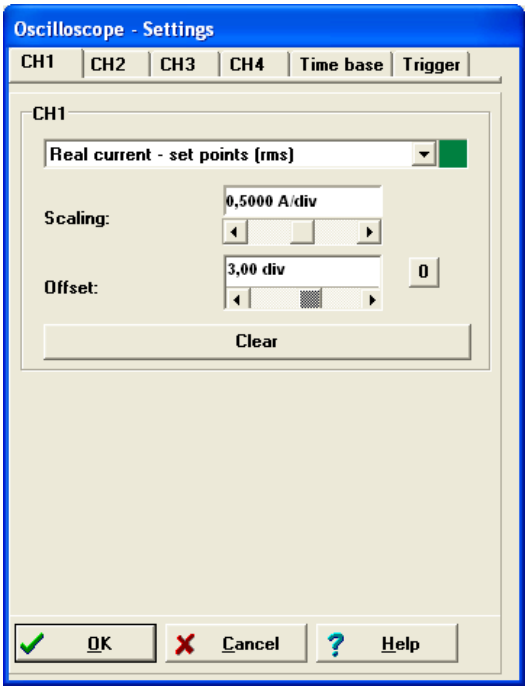
- Ch1: Selection of the measuring quantity on channel 1
- Ch2: Selection of the measuring quantity on channel 2
- Ch3: Selection of the measuring quantity on channel 3
- Ch4: Selection of the measuring quantity on channel 4
- Time base: Setting of the time base
- Trigger: Setting of the trigger

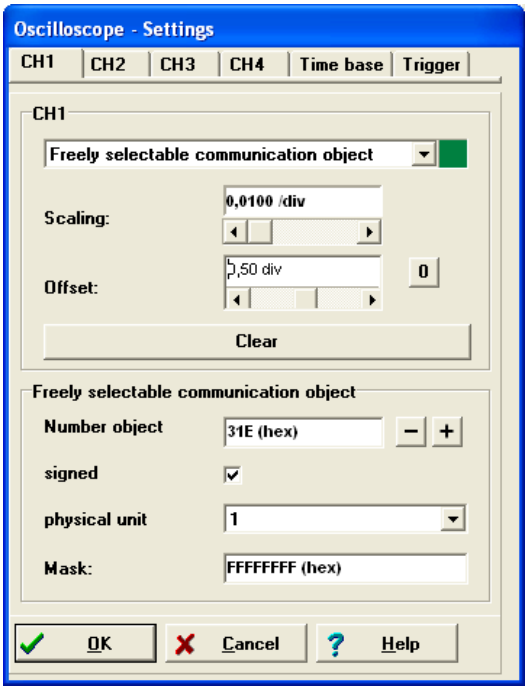
13.19.1.1 Tabs: CH1 ... CH4

The oscilloscope has four channels. The following settings can be selected on the tabs **CH1** … **CH4** for the corresponding channels:

- Quantity to be displayed: Click on the selection box of the individual channels and select the physical quantity or the event you would like to display graphically.
- Channel colour: Click on the coloured screen area. A dialog box for selecting a colour will be displayed.
- Y-Scaling: Use the slide next to **Scaling** to adjust the scaling in vertical direction.
- Offset / Y-Position : Use the slide next to **Offset** to shift the vertical position of the curve. Clicking the **0** button resets the offset to 0.

The representation of the two channels can be cleared by clicking on the **Clear** button.





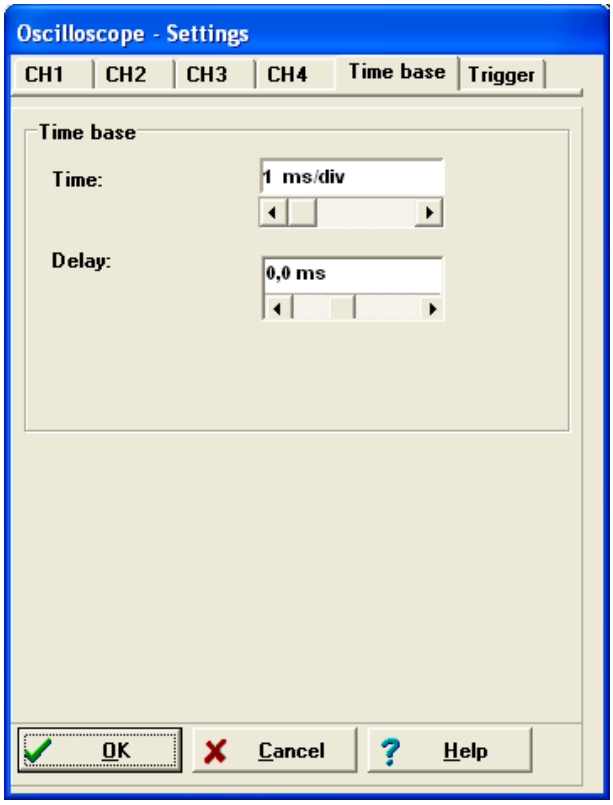
If **Freely selectable communication object** has been selected as the quantity to be displayed, you can display any desired communication object on the oscilloscope.
This requires the following additional information:

- The object number of the communication object
- Information as to whether the object returns a value with a sign. In this case check the **signed** check box.
- The physical unit of the object
- A mask. This mask is used to single out and display individual bits of a communication object. In the case of analogue values, this mask should be set to FFFFFFFF (hex). The main purpose of this mask is to display individual bits of a status word.

The display of freely selectable communication objects is recommended for special cases only and should be used by experts only.

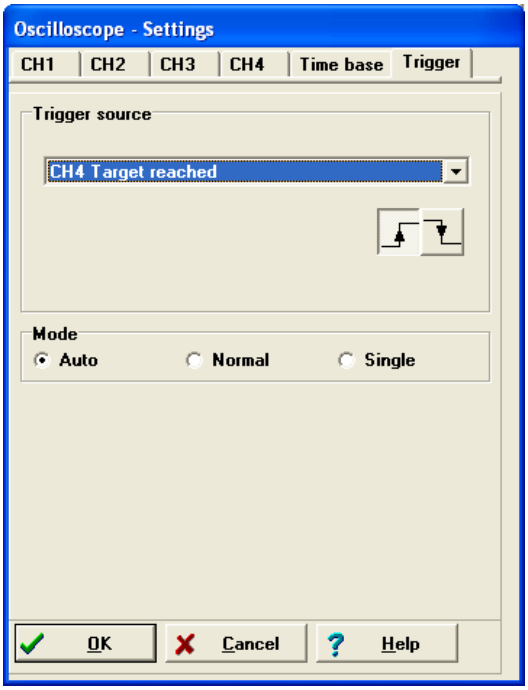
13.19.1.2 Tab: Time Base

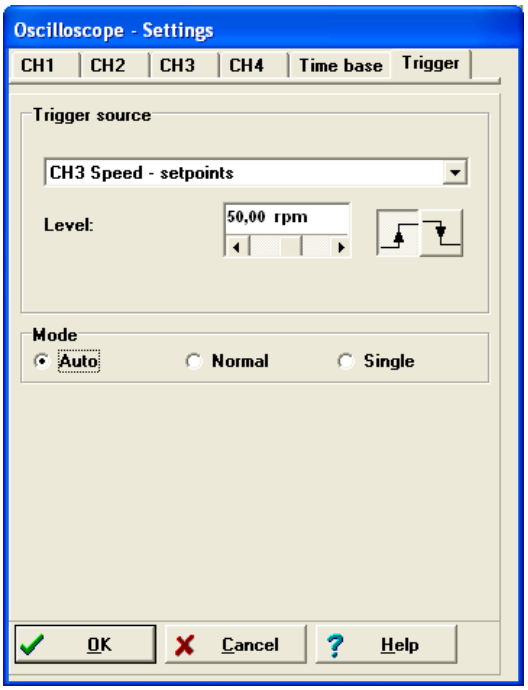
- The upper **Time** slide is used to define the time resolution. A value of 10 ms/div, for example, means that the width of one square on the oscilloscope display corresponds to a time of 10 ms.
- The **Delay** slide is used to determine the position of the trigger event on the oscilloscope screen. A value of 0 means that the trigger event will be plotted at the left edge of the oscilloscope screen. A negative delay value means that the events before the occurrence of the trigger conditions will also be recorded ("Pretrigger"). If the value is negative, the trigger mark will be shifted to the right into the oscilloscope screen.
- Change the number of recorded values per channel by the drop-down menu **Number of samples** in the field **Samples**. This functionality is available as of Firmware of product step 3.5. Please note that the period for the data transmission significantly increases for maximum number of samples.



13.19.1.3 Tab: Trigger

You can select a trigger source from the selection list in the **Trigger source** section.





A distinction is made between digital and analogue trigger sources. Digital trigger sources can only have the status yes or no (active or inactive). One example is "target reached". Analogue trigger sources on the other hand can take on any numerical value (e.g. speed setpoint).

Set the following options in the trigger menu:

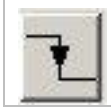
Level Only visible in the case of analogue trigger sources. The trigger process starts when the analogue value has exceeded or fallen below the level.

Trigger edge You can select a rising or a falling edge. See the table below.

Mode Used to select when triggering occurs. There are three different trigger modes:

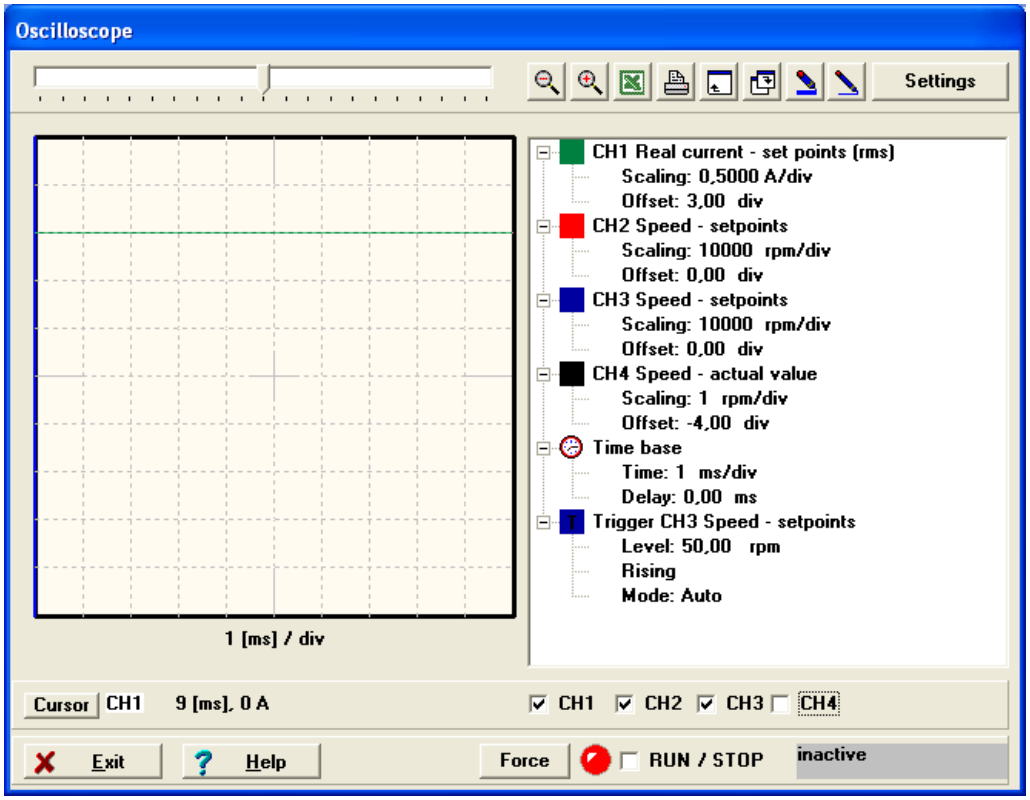
- Auto: Triggering occurs and is displayed continuously regardless of whether the trigger condition has been fulfilled or not.
- Normal: Triggering occurs and is displayed when the trigger condition is fulfilled. After the display and if the trigger condition reappears, triggering occurs again.
- Single: It is triggered only once when the trigger conditions has been fulfilled. Then the status is set to inactive by deselecting the Run check box (see below).

Table 20: Oscilloscope: Tab "Trigger edges"

	Rising edge	Digital trigger: Event occurs Analogue trigger: Level exceeded
	**Falling edge**	Digital trigger: Event disappears Analogue trigger: Below level

The trigger mode and the therefore the oscilloscope are only active if the **Run / Stop** check box in the oscilloscope window is checked!

13.19.2 Oscilloscope Window



13.19.2.1 Symbol Buttons of the Oscilloscope

The oscilloscope has various buttons to start certain activities. They are shown here.

Table 21: **Oscilloscope buttons**

Symbol	Meaning
	Shifts the area shown in the horizontal direction.
	Opens the menu reversing generator
	Terminates the zoom function.
	Zoom function: Help text
	Calls up Excel and creates a spreadsheet with values of the last measurement (Excel has to be installed on the PC).
	Prints the oscilloscope window.
	Saves the oscilloscope window as a bitmap.
	Maximises the oscilloscope window.
	Minimises the oscilloscope window.
	Uses thick lines on the oscilloscope display.
	Uses thin lines on the oscilloscope display.
	Calls up the "Oscilloscope-Settings" window.

The integrated oscilloscope is should be used for analysing the following items:

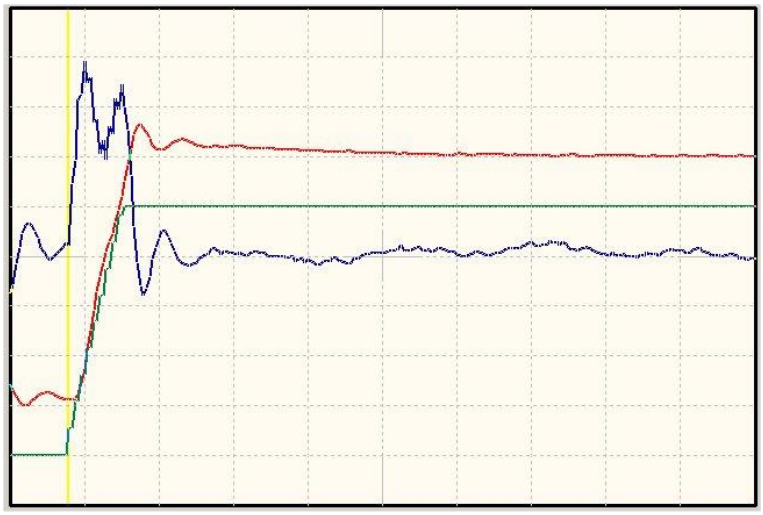
- Adjustments to the speed control loop
- Monitoring of the following error during position mode.
- Adjustments to positioning profiles
- Analysis of positioning process as far as the motor current s are concerned to find out current peaks
- Monitoring of the IO handling

13.19.2.2 Additional Buttons and Controls

	These controls are used to control and visualise the cursor of the oscilloscope. When the user opens the actual oscilloscope window, the current value of the selected channel (cursor position) is displayed in a numerical form. In this example, the channel CH2 has the value 0.366 rpm at the time t=103 ms. The **Cursor** button can be used to switch to another channel.
	These check boxes are used to show and hide the channels in a selective manner. A selected check box means: this channel is shown.
	The LED indicates the current operating status of the oscilloscope. A green LED means: the oscilloscope is active. An inactive oscilloscope is indicated by a red LED. The **RUN / STOP** check box is used to activate or deactivate the oscilloscope. Check this checkbox if you want to use the oscilloscope function.
	This coloured area indicates the current status of the oscilloscope. The following entries are possible: **inactive** The oscilloscope is not active right now **start** The oscilloscope is being started **wait for trigger** The oscilloscope is waiting for a trigger event **pretrigger** The recording of data has been started for the Pretrigger **trigger found** A trigger event has been found but the recording of data has not been started yet **data read** The channel data are being transmitted to the parameterization program

13.19.2.3 Curve Display

In the window shown below the measured values are displayed as a function of time.



To change the vertical scaling or to use the vertical position of a channel, use the setting options in the oscilloscope settings window. (See chapter *Tabs: CH1 ... CH4,* page *210).*

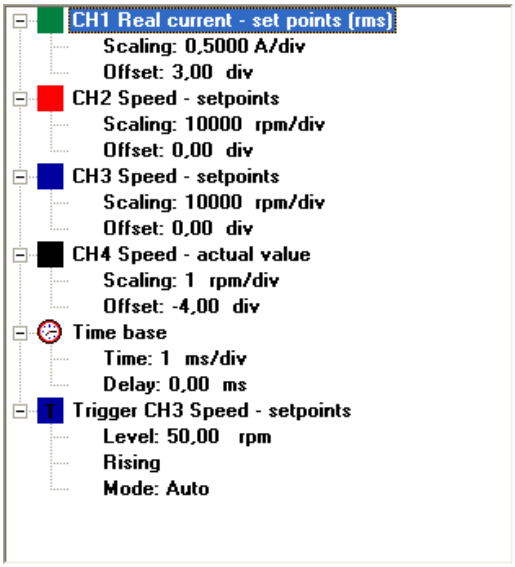
To change the horizontal scaling, choose another time base. Additional information can be found in chapter *Tab: Time Base* page *211).* It may be necessary to restart the trigger process.

The vertical line indicates the time when the trigger event was triggered. Such a line is only visible if a negative delay has been defined for the trigger event (pretrigger) (see also chapter *Tab: Time Base,* page *211).*

To get a detailed view of the curve (zoom), keep the right mouse button pressed and select the area you are interested in on the oscilloscope surface.

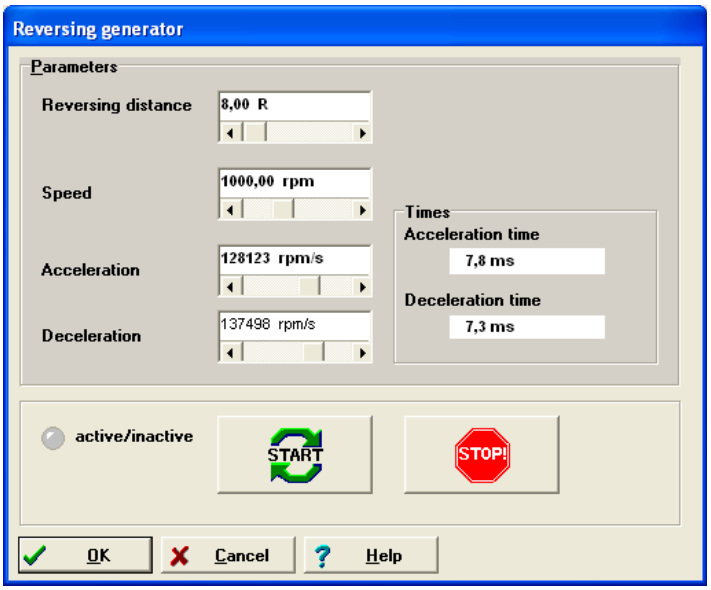
”Settings” Overview

The partial window shown below shows the current settings for the oscilloscope function. Double-clicking this window leads you back to the oscilloscope settings window.

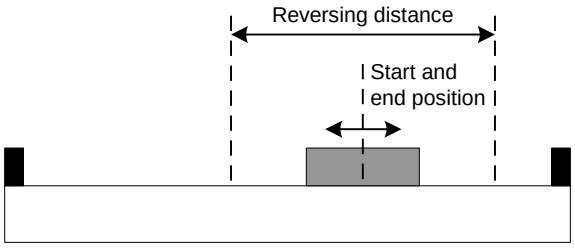


13.20 Reversing Generator

The reversing generator can be configured via the menu **Display/Reversing generator**. It is not used for normal operation but to optimise the speed and position controllers. In the reversing mode, the controller keeps running back and forth between two positions.



In the **Reversing distance** section, you can define a distance difference for travelling back and forth. The start point and the end point are located directly in the middle of this distance. As a result, the drive moves always symmetrically with regard to the position where the reversing generator is started. When it is deactivated, the drives moves back to its original start position. This allows the area of movement to be assessed in a better way, particularly in the case of linear arrangements with limited movement space. The drives starts always in the positive direction of movement.



Set the running speed in the **Speed** field.

Normally, a rectangular function is required for the speed setpoint. In this case the maximum values should be entered into the fields **Acceleration** and **Deceleration**. The speed and the accelerations are used to determine the resulting times for the start and brake process. These times are displayed.

Modifications of the reversing distance are ignored unless the reversing generator is restarted. Changes of the other parameters are adopted at the points of reversal. The drive stops for a few ms at the points of reversal.

	The LED indicates the current operating status of the reversing generator. A green LED means: the reversing mode is active. An inactive reversing generator is indicated by a grey LED.
	This button is used to start the reversing generator.
	This button is used to stop the reversing generator.

Be careful with linear movements with end stop!
When the generator is started, the servo positioning controller performs cyclic movements (see also the illustration above). We recommend bringing the slide manually into a position with the largest possible distance to the end stops and then starting with small running distances and low speeds.

13.21 Info Window

You can call up general information concerning the S2 Commander under **Help/Info**.

The following window will appear:

You can find the following information on the **Copyright** tab:

- Program name, version
  - Sales partner: Address and phone number
  - Internet link: Click on the button to activate it
  - Email: Click on the button to create an e-mail

You can find the following information on the **Firmware/Hardware** tab:

- Main board: Type, serial number, version, identification data
  - Bootloader: Version, current and maximum permissible number of write cycles (firmware downloads)
  - Firmware: Version

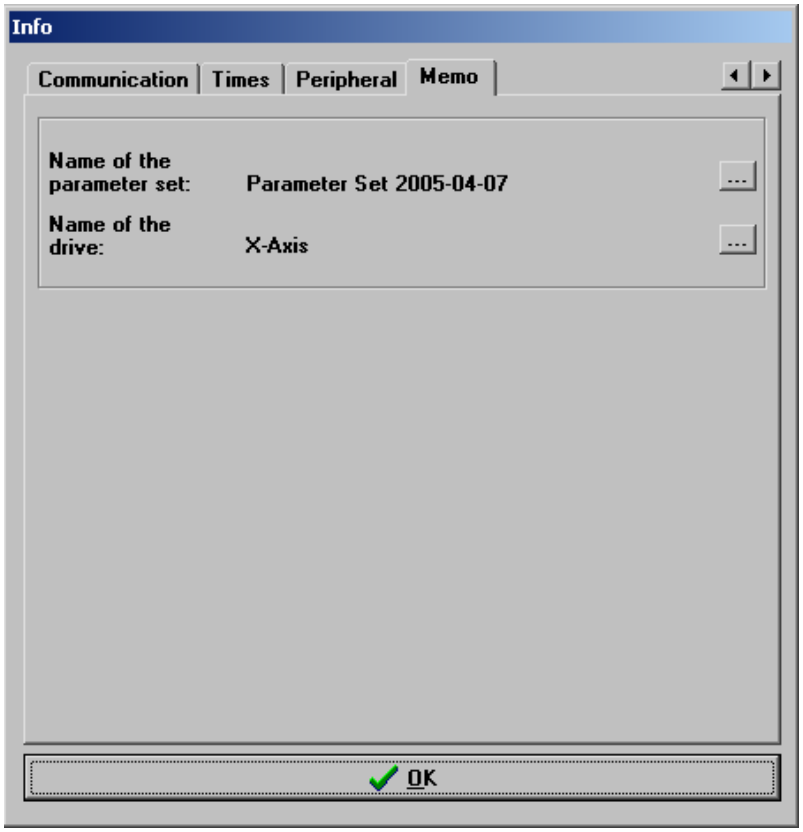
You can find the following information on the **Communication** tab:

- COM port and baud rate used (online parameterisation)
- File used (offline parameterisation)

The **Times** tab gives you information concerning the cycle times of the current controller, speed controller, position controller and interpolator.

The **Peripheral** tab includes information on angle encoders and technology modules (if inserted).

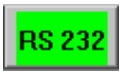
The tab **Memo** includes information concerning the parameter set and the applied servo positioning controller. Here, you can enter an name for the parameter set as well as for the servo positioning controller. Simply click on the "**…**"-button behind the appropriate name.



13.22 Fast Access via Icon Bar

Some functions of the parameterisation program S2 Commander can be accessed directly using the icons beneath the menu bar:

Table 22: **Fast access via icon bar**

Symbol	Meaning
	Setting the language. The language choice opens on a click onto the arrow button next to the flag Select the desired laguage via a click onto the flage or the name.
	Online parameterisation via RS232
	Online parameterisation via UDP / Ethernet

Continuation: Table 22

Symbol	Meaning
	Offline parameterisation
	Oscilloscope
	Motor data menu
	Current controller
	Speed controller
	Position controller
	Angle encoder settings menu
	Homing
	Set positions
	Approach position
	Save parameters
	Reset servo controller
	Refresh all windows

Some languages (e.g. Chinese) need a special font (Arial Unicode MS). This font has to be selected for all display elements in the system configuration of your computer.

14 Operating Mode and Error Message

14.1 Operating Mode and Error Display

A seven-segment display is supported. The following table shows the displayed symbols and their meaning:

Table 23: **Display of operating mode and errors**

Display	Meaning
	In this operating mode the outer bars “rotate”, depending on the speed resp. the position of the rotor. If the drive is enabled, the center bar of the seven-segment display is on.
	The servo positioning controller LV-servoTEC S2 is yet to be parameterised. (seven-segment display = A)
	Operating mode torque control, the two bars on the left hand of the display are on. (seven-segment display = I)
P xxx	Positioning, “xxx” stands for the position set number. The numbers are successively indicated.
PH x	Homing is active, „x“ stands for the active phase of the homing run. 0 : Search phase 1 : Crawling phase 2 : Positioning to zero position The figures are successively indicated.
E xxy	Error message / number with index “xx” and subindex “y”
-xxy-	Warning message / number with Index „xx“ and subindex „y“. A warning is displayed at least twice on the seven-segment-display.
	Option „Safe Stop“ active for the LV-servoTEC S2 devices. (seven-segment display = H, blinking with a frequency of 2Hz)

14.2 Error / Warning Messages

If an error occurs, the servo positioning controller LV-servoTEC S2 will cyclically show an error message in its seven-segment display. The error message is comprised of an E (for Error), a main index and a sub index, e.g.: E 0 1 0.

Warnings have the same code numbers as error messages. As a distinguishing feature, warnings have centre bar before and after the number, e.g. **- 1 7 0 -**.

The following Table 24 summarizes the meaning and corresponding measures. A subindex "*" means that there are a number of errors which are explained in further documentation.

The error messages with the main index 00 do not reflect run time errors. They contain information and in general there are no measures required by the user. They occur in the error buffer only but will not be shown on the 7-segment display.

Table 24: **Error / Warning messages**

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
00	0	Invalid error	Information: An invalid (corrupted) entry in the error buffer is marked by this error number. No measures required.
	1	Invalid error detected and corrected	Information: An invalid (corrupted) error entry is detected and corrected. The Debug information stores the initially found error number. No measures required.
	2	Error cleared	Information: The active errors have been cleared No measures required.
	4	Serial number / device type changed (change of modules)	Information: A flexible error buffer (service module) has been plugged into another device No measures required.
01	0	Stack overflow	Incorrect firmware? If necessary, reload the standard firmware again. Contact the Technical Support
02	0	Undervoltage of DC-bus	Error reaction set to "disable drive"? Check (measure) the intermediate circuit voltage

First continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	Sub-index		
03	0	Overtemperature analogue motor	Motor too hot? Check the parameterization (current controller, current limitation). Suitable sensor? Sensor defective? Error also occurs if sensor is bypassed: device defective.
	1	Overtemperature digital motor	
04	0	Overtemperature of the power stage	Plausible temperature display? Check the installation conditions, filter mats of fan dirty? Device fan defective?
	1	Overtemperature in the DC-bus	
05	0	Internal undervoltage supply 1	The error cannot be eliminated by the user. Contact the Technical Support and - if necessary - send the servo positioning controller to the sales representative.
	1	Internal undervoltage supply 2	
	2	Driver voltage fault	
	3	Undervoltage of digital I/O	Check the outputs for short-circuits or specific load. If necessary, contact the Technical Support.
	4	Overcurrent of digital I/O	
06	0	Short circuit in the power stage	Power stage defective? Motor defective? Short-circuit in cable?
	1	Overcurrent brake chopper	Check the braking chopper circuit (connections). Check the external brake resistor (if included). If necessary, contact the Technical Support.
07	0	Overvoltage	Check connection to braking resistor (internal / external) Braking resistor overloaded? Check rating.

Second continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
08	0	Angle encoder error resolver	See measures 08-2 .. 08-7
	1	Sense of rotation of the serial and incremental position evaluation is not identical	A and B-track are mixed up. Correct (check) the connection of the tracks.
	2	Error of track signals Z0 Incremental encoder	Angle encoder connected? Angle encoder cable defective? Angle encoder defective? Check the configuration of the angle encoder interface. The encoder signals are disturbed: check the installation for compliance with EMC recommendations.
	3	Error of track signals Z1 Incremental encoder	
	4	Error of track signals of digital incremental encoder	
	5	Error of Hall signals incremental encoder	
	6	Communication error encoder	
	7	Signal amplitude incremental track erroneous	
	8	Internal encoder error	Communication error? Check the encoder type, contact the Technical Support, if necessary.
	9	Encoder at X2B not supported	Please contact the Technical Support.

Third continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
09	0	Old encoder parameter set (type: LV-servoTEC S2)	Please read this documention or contact the Technical Support.
	1	Encoder parameter set cannot be decoded	
	2	Unknown encoder parameter set version	
	3	Corrupted encoder parameter set data	
	7	Encoder EEPROM has write protection	
	9	Too small memory size of encoder EEPROM	
10	0	Overspeed (motor overspeed protection)	Encoder offset angle correct? Overspeed protection limit too small?
11	0	Error at start of homing run	No controller enabling
	1	Error during homing run	Homing has been interrupted e.g. by disabling the drive.
	2	Homing run: No valid index pulse	The required index pulse is missing
	3	Homing run: timeout	The maximum time parameterized for homing has been consummated before the homing run has been completed.
	4	Homing run : Wrong or invalid limit switch	The associated limit switch is not connected. Limit switches mixed up
	5	Homing run: I^2t / following error	Unsuitable parameterisation of acceleration ramps. Invalid stop reached, e.g. because no homing switch is connected. Contact the Technical Support.

Fourth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	Sub-index		
11	6	Homing run: End of homming distance	The maximum homing distance has been travelled but the reference point of the destination of the homing run have not been reached.
12	0	CAN: Two nodes with the same ID	Check the configuration of the devices connected to the CAN bus.
	1	CAN: Communication error / bus OFF	The CAN chip has switched off the communication due to communication errors (BUS OFF).
	2	CAN: Communication error on send	The signals are disturbed during the transmission of messages.
	3	CAN: Communication error on receive	The signals are disturbed during the reception of messages.
	4	No Node Guarding-telegram during the parameterized time received	Equalize the cycle time of the remote frames with the PLC resp. failure of the PLC. Signals interfered?
	9	CAN: Protocol error	Please contact the Technical Support.
13	0	Timeout CAN-Bus	Check the timeout parameter for CAN bus.
14	0	Insufficient supply for indentification	The available intermediate circuit voltage is too low for the measurement.
	1	Identification current controller : measurement Cycle insufficient	The automatic parameter identification process delivers a time constant beyond the parameterisation value range. The parameters must be optimized manually.
	2	Power stage could not be enabled	The power stage has not been enabled. Check the connection of DIN4.
	3	Power stage prematurely disabled	The power stage has been disabled while the identification process was running.

Fifth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
14	4	Identification does not support selceted resolver	The identification cannot be performed with the present angle encoder settings. Check the configuration of the angle encoder. If necessary, contact the Technical Support.
	5	No index pulse detected	The index pulse could not be found after the maximum number of electrical rotations. Check the index pulse signal.
	6	Invalid hall signals	The pulse sequence or the segmentation of the Hall signals is unsuitable. Check the connection. If necessary, contact the Technical Support.
	7	Identification not possible	Ensure a sufficient intermediate circuit voltage. Rotor blocked?
	8	Invalid number of poles pairs	The number of pairs of poles calculated is beyond the parameterisation range. Check the motor data sheet. If necessary, contact the Technical Support.
	9	Automatic parameter identification: General error	Take further information from the additional error data and contact the Technical Support.
15	0	Division by zero	Please contact the Technical Support.
	1	Out of range error	
	2	Mathematical underflow	
16	0	Errorneous program execution	Please contact the Technical Support.
	1	Illegal interrupt	
	2	Initialization error	
	3	Unexpected state	
17	0	Max. following error exceeded	Increase error window. Acceleration parameterization too large
	1	Encoder difference control	Check the connection of the encoders. Check the parameterized gear.

Sixth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
18	0	Warning analogue motor temperature	warning threshold: analogue motor temperature overflowed
21	0	Error 1 current measurement U	The error cannot be eliminated by the user. Contact the Technical Support and - if necessary - send the servo positioning controller to the sales representative.
	1	Error 1 current measurement V	
	2	Error 2 current measurement U	
	3	Error 2 current measurement V	
22	0	PROFIBUS: Worng initialization	Technology module defective? Contact the Technical Support.
	1	PROFIBUS: reserved	
	2	Communication error PROFIBUS	Check the slave address. Check the bus terminators. Check the cabling.
	3	PROFIBUS: Invalid slave address	The communication was started with slave address 126. Select another slave address.
	4	PROFIBUS: Range overflow	Mathematical error during the conversion of physical units. The value range of the data and of the physical units do not match. Contact the Technical Support.
25	0	Invalid device type	Technical defect or unsuitable firmware. Contact the Technical Support and - if necessary - send the servo positioning controller to the sales representative.
	1	Device type not supported	
	2	HW revision not supported	
	3	Device function restricted	Contact the Technical Support and - if necessary - send the servo positioning controller to the sales representative.

Seventh continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
26	0	No user parameter set	Load the default parameter set. If the error continues, contact the Technical Support.
	1	Checksum error	Please contact the Technical Support.
	2	Flash: Error during write-operation	
	3	Flash: Error during erase-operation	
	4	Flash: Error in internal flash	The error cannot be eliminated by the user. Please contact the technical support team.
	5	No calibration data	
	6	Missing user position data sets	Simply perform save & reset. Load the default parameter set. If the error continues to occur, contact the Technical Support.
	7	Faulty data tables (CAM)	Load default parameter set, reload the parameter set if necessary. If the error continues, contact the Technical Support.
27	0	Following error warning level	Check the parameterisation of the following error. Motor blocked?
28	0	Hours-run meter missing	Please contact the Technical Support.
	1	Hours-run meter: write error	
	2	Hours-run meter correced	Acknowledge the error. If the error continues to occur, contact the Technical Support.
	3	Hours-run meter converted	
30	0	Internal calculation error	Please contact the Technical Support.

Eighth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	Sub-index		
31	0	I²t motor	Motor blocked?
	1	I²t servo controller	Check the power rating of the drive package.
	2	I²t-PFC	Check the power rating of the drive package. Select operation without PFC?
	3	I²t-Break resistor	Braking resistor overloaded. Use external braking resistor?
32	0	Loading period DC-bus exceeded	Please contact the Technical Support.
	1	Undervoltage for active PFC	
	5	Braking chopper overload. Intermediate circuit couldn't be discharged.	
	6	Discharge period DC-bus exceeded	
	7	Failure of Power supply for controller enable	No intermediate circuit voltage. Angle encoder not ready.
	8	Supply power breakdown at controller enable	Interruption / mains failure of power supply. Check the supply.
	9	Phase failure	Failure of one or several phases. Check the power supply.
33	0	Following error encoder emulation	Please contact the Technical Support.
34	0	No synchronisation via field bus	Failure of synchronization messages from master?
	1	Field bus synchronisation error	Failure of synchronization messages from master? Parameterization of synchronization interval too small?

Ninth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
35	0	Speed protection of Linear motor	The encoder signals are disturbed. Check the installation for compliance with EMC recommendations.
	5	Error during the determination of the commutation position	For this motor an improper method has been chosen. Please contact the Technical Support.
36	0	Parameter limited	Check the value range of the parameter stated.
	1	Parameter not accepted	
37	0 ... 9	SERCOS field bus	Refer to the SERCOS Manual or contact the Technical Support.
38	0 ... 9	SERCOS field bus	Refer to the SERCOS Manual or contact the Technical Support.
39	0 ... 6	SERCOS field bus	Refer to the SERCOS Manual or contact the Technical Support.
40	0	Negative SW limit switch	The position setpoint has reached or exceeded the respective software limit switch. Check the target data. Check the positioning range.
	1	Positive SW limit switch	
	2	Target position behind the negative SW limit switch	The start of a positioning run was suppressed as the target lies beyond the respective software limit switch. Check the target data. Check the positioning range.
	3	Target position behind the positive SW limit switch	
41	0	Course Program: Start synchronizing without former sampling pulse	Check parametrization of the pre-delay system

Tenth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
42	0	Positioning: Missing following position: Stop	The positioning target cannot be reached with the current positioning options or the current boundary conditions. Check the positioning parameters.
	1	Positioning: Reversing the direction not allowed: Stop	
	2	Positioning: Reversing the direction not allowed after stop	
	3	Start positioning rejected: wrong mode of operation	The change of the mode of operation could not be performed by the position set.
	5	Rotary axis: direction of rotation is not allowed	According to the selected mode of the rotary axis the calculated direction of rotation is not allowed. Check the selected mode.
43	0	Limit switch: Negative setpoint inhibited	The drive has left the intended motion range. Technical defect in the system?
	1	Limit switch: Positive setpoint inhibited	
	2	Limit switch: Positioning suppressed	
45	0	Supply voltage cannot be switched off	Technical defect? Contact the Technical Support.
	1	Supply voltage cannot be switched on	
	2	Supply voltage was activated	

Eleventh continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
47	0	Timeout (thread mode, Set-up mode)	The speed has not been fallen below the required value for the thread mode (set-up mode) in time. Check the processing of the request by the PLC.
50	0	CAN: Too much synchronous PDOs	Please contact the Technical Support.
	1	SDO error	
60	0	Ethernet user specific (1)	Please contact the Technical Support.
61	0	Ethernet user specific (2)	Please contact the Technical Support.
62	0	EtherCAT: general bus error	Please contact the Technical Support.
	1	EtherCAT: ESC-chip not detected	
	2	EtherCAT: protocol error	
	3	EtherCAT: invalid RPDO-length	
	4	EtherCAT: invalid TPDO-length	
63	0	EtherCAT: ESC20-chip not detected	Please contact the Technical Support.
	1	EtherCAT: invalid data	
	2	EtherCAT: TPDO-Data not read	
	3	EtherCAT: No clock signal	
64	0 .. 6	DeviceNet fieldbus (1)	Please contact the Technical Support.
65	0 .. 1	DeviceNet fieldbus (2)	Please contact the Technical Support.
70	1 .. 3	FHPP fieldbus (2)	Please contact the Technical Support.

Twelfth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
80	0	Time overflow current controller IRQ	Please contact the Technical Support.
	1	Time Overflow speed controller IRQ	
	2	Time Overflow position controller IRQ	
	3	Time Overflow interpolator IRQ	
81	4	Time overflow low-level IRQ	Please contact the Technical Support.
	5	Time overflow MDC IRQ	
82	0	Sequencing control	Normally just information. No measures required.
83	0	Invalid Technology module	Insert the technology module into the other slot, refer to the documentation of the module.
	1	Technology module not supported	Please contact the Technical Support.
	2	Technology module: HW revision not supported	
	3	Technology module: Write error	
	4	MC 2000 Watchdog	
90	0	Missing hardware component (SRAM)	Please contact the Technical Support.
	1	Missing hardware component (FLASH)	
	2	Error during booting of FPGA	
	3	Error during starting of SD-ADUs	

Thirteenth continuation: Table 24

Error messages		Meaning of error message	Measures
Main-index	**Sub-index**		
90	4	Synchronization error SD-ADU after start	
	5	SD-ADU not synchronous	
	6	Trigger error	
	9	DEBUG-Firmware loaded	
91	0	Internal initialisation error	Please contact the Technical Support.

15 Field Bus Coupling

15.1 Field Bus Systems

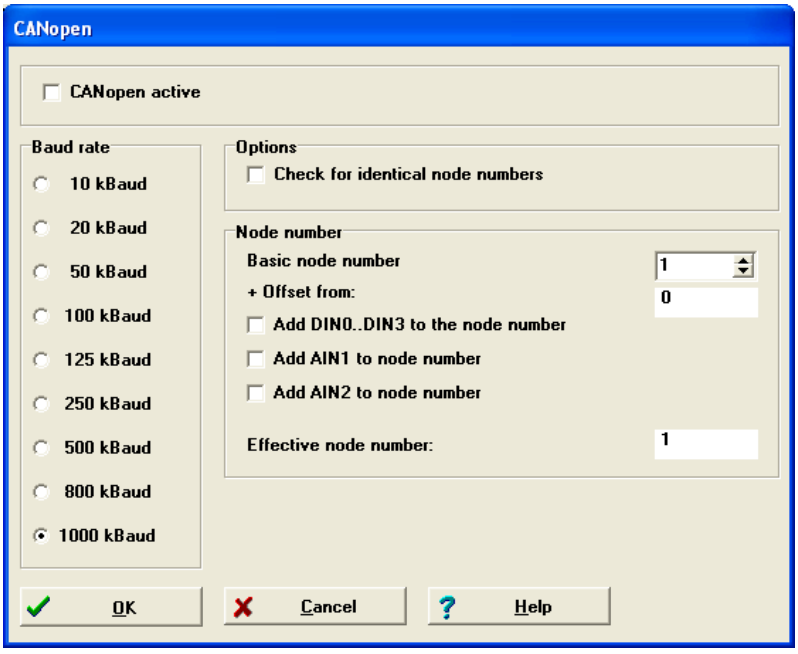
At the time of writing of this manual IEF-Werner GmbH supports the following field buses:

- CANopen bus, integrated in base device servo positioning controller LV-servoTEC S2
- PROFIBUS-DP
- SERCOS
- EtherCAT

The servo positioning controller LV-servoTEC S2 must, if necessary, be equipped with the corresponding field bus technology module.

15.1.1 Configuration of CANopen Communication Parameters

In the menu option **Parameters/Field bus/CANopen/Protocol** you can adapt the CANopen communication parameters of the servo positioning controller LV-servoTEC S2 to your CANopen bus network.



You can configure the following communication parameters:

- **Baud rate**: This parameter determines the baud rate to be used on the CANopen bus.
- **Basic node number**: This parameter contains the base node number of the corresponding device. The identifiers of the individual messages are based on this node number. Each node number must only be used once in a CANopen network. It is possible to also integrate the digital inputs into the calculation of the node number (see below).
- **Check identical node number**: The servo positioning controller LV-servoTEC S2 automatically checks if a node number has mistakenly been attributed twice in a CANopen network. In that case, an error will be displayed on the servo positioning controller LV-servoTEC S2.
- **Add DIN0...DIN3 on node number**: The value of the digital inputs DIN0..DIN3 is added to the base node number. The input combination is only read once directly after the RESET at the servo positioning controller LV-servoTEC S2. It is thus possible to use simple bridges to 24 V to assign up to 16 different device numbers in the connector housing of X1.
- **Add AIN1 on node number**: The analog input AIN1 is included in the generation of the node number with a valence of 16. For a low level it may remain blank, for the high level the input must be bridged to V_{ref} = 10V.
- **Add AIN2 on node number**: The analogue input AIN2 is included in the generation of the node number with a valence of 32. For a low level it may remain blank, for the high level the input must be bridged to V_{ref} = 10V.

The field bus communication using the set parameters can be switched on and off using the buttons activate or deactivate.

15.1.2 CANopen: Configuration of the Transmit PDOs

In the menu **Parameters/Field bus/CANopen/PDO Configuration…/Transmit…** you can configure the CANopen telegrams for the transmit data (transmit PDO) (PDO = **p**rocess **d**ata **o**bjects) according to your application. The Transmit PDOs are sent from the servo positioning controller to the host.

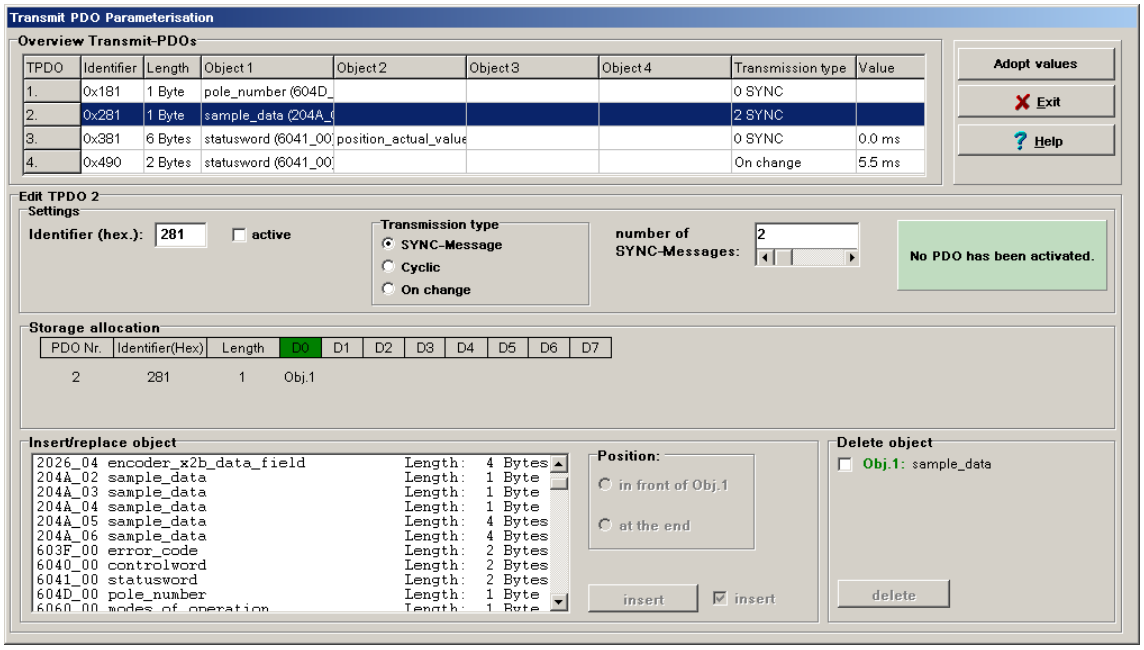
For further information concerning CANopen, see the CANopen manual.

The menu has the following elements:

- **Overview Transmit-PDO**

  You find the following entries for each PDO:

  - Identifier
  - Length
  - Objects
  - Transmission type
  - Value



- **Edit TPDO x**: Here you can modify the settings for that PDO which you have selected in the upper box.
- **Settings**:

  You find the following parameters for each PDO:

  - **Identifier (hex)**: Enter the ID of the new / changed PDO (hexadecimal number format).
  - **active**: If this box is checked, the transmission of the PDO is enabled.
  - **Transmission type**: Here you can choose between several modes:

    - SYNC Message: The servo positioning controller transmits the PDO, if it has received a certain number of SYNC messages from the host. Please also refer to **number of SYNC-Messages**.

    - Cyclic: The servo positioning controller transmits PDOs in cyclic intervals. The period of these intervals can be set by the parameter **time slice** (see below).

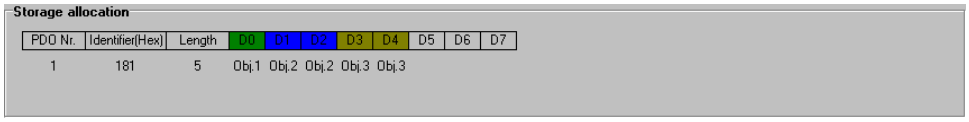
- **On change**: The servo positioning controller transmits PDOs, if the value of at least one object (mapped into the PDO) has changed. To detect a change, the current values of the objects are compared with the values of the last transmission. Define a minimum time interval between the transmission of two consecutive PDOs by the parameter time interval. If the time interval is zero the PDO is transmitted at each change of any mapped object.

  Frequent changes of the mapped objects cause large bus traffic. This traffic can be reduced by the parameter **time interval**. This can also be achieved by the use of a mask. If parts of the PDO are masked, they will be ignored during the evaluation of the change of object values. Please refer to the parameter **mask**.

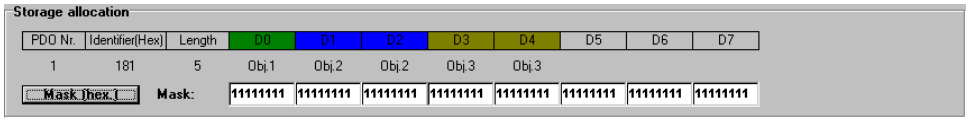
- **Number of SYNC-Messages**: The input box is visible only if the transmission type SYNC-Message was chosen. The PDO will be sent if the set numbers of SYNC-Messages were received. For further information see **Transmission type**:

  - **Time slice**: The input box is visible only if the transmission type selection is cyclic or on change. For further information see **Transmission type**.

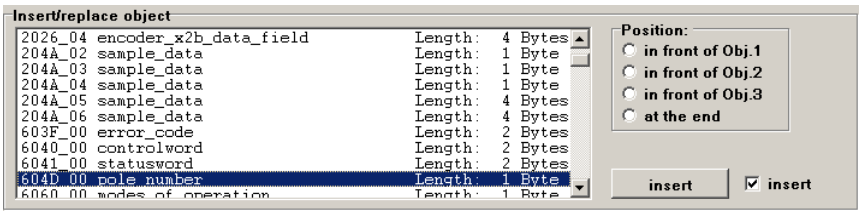
- **Memory mapping**: This part of the window shows the graphical representation of the memory mapping. For the transmission types **SYNC-Message** and **cyclic** the window appears as follows:



  For the transmission type **on change** the user can set a mask. Parts in which the mask is set to zero are ignored for the evaluation of the change of the mapped objects (logical AND operation between mask and object values). The display (hexadecimal or binary) can be changed via the button **Mask (hex.)** or **Mask (bin.)**



- **Insert/replace object**: In this part, the user can insert or replace objects. In the left part objects can be selected for insert or replace operations.

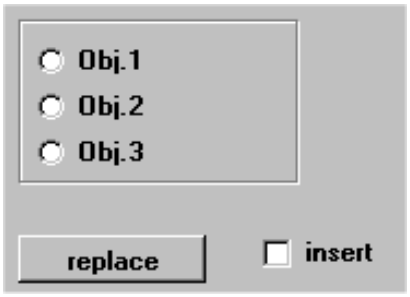


An object can be inserted only if the box **insert** is checked. Otherwise the object is replaced.

With a click onto the button **insert** an insert operation will be performed. This button is visible only if the checkbox **insert** is active.

With a click onto the button **replace** a replace operation will be performed. This button is visible only if the checkbox **insert** is not active.

For insert mode, the user can specify in the field **Position**, where the object has to be inserted. For replace mode the object is specified which is replaced:



- **Object delete**: Check the boxes of the objects you want to delete:

A click onto the button **delete** deletes the selected objects.

- **Adopt values**: The changes of the window are firstly stored in the parameterization software only. Click onto this button to transfer the new settings into the servo positioning controller.

15.1.3 CANopen: Configuration of the Receive PDOs

In the menu **Parameters/Field bus/CANopen/PDO Configuration…/Receive…** you can configure the CANopen telegrams for the receive data (receive PDO) (PDO = **p**rocess **d**ata **o**bjects) according to your application. The Receive PDOs are sent from the host to the servo positioning controller.

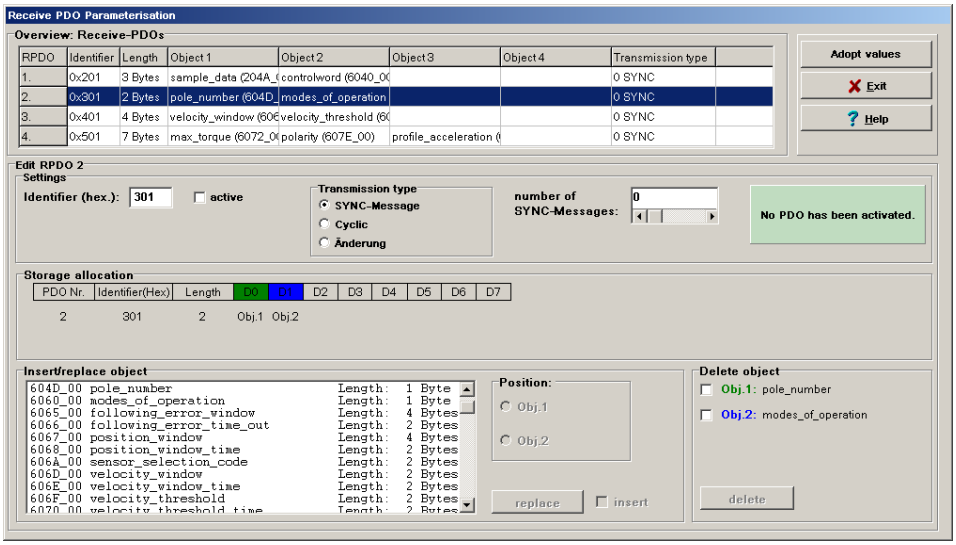
For further information concerning CANopen, see the CANopen manual.

The menu has the following entries:

- **Overview Receive-PDOs**:

  You find the following entries for each PDO:

  - Identifier
  - Length
  - Objects
  - Transmission type

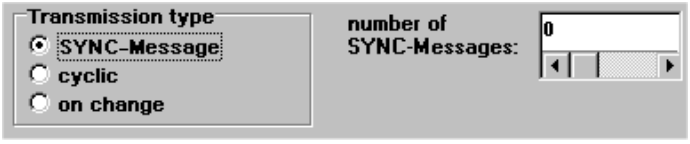


- **Edit RPDO x**: Here you can modify the settings for that PDO which you have selected in the upper box.
- **Settings**: You find the following parameters for each PDO:
  - **Identifier (hex)**: Enter the ID of the new / changed PDO (hexadecimal number format).
  - **active**: If this box is checked, the servo positioning controller evaluates the data of the received PDO.
  - **Transmission type**: Here you can choose between two modes:

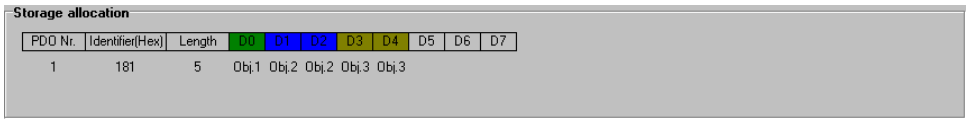
    - SYNC Message: The servo positioning controller evaluates the PDO, if it has received a certain number of SYNC messages from the host. Please also refer to **number of SYNC-Messages**.

    - Cyclic: Each PDO is evaluated

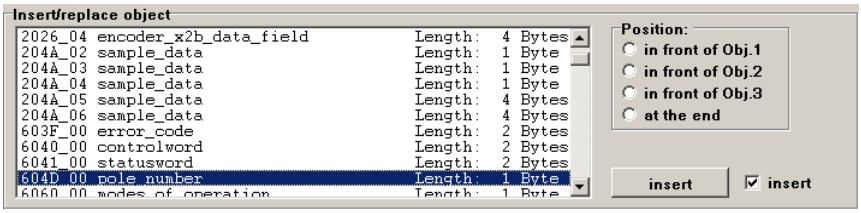
  - **Number of SYNC-Messages**: This input box is visible only if the transmission type **SYNC-Message** is selected. The PDO is evaluated, if the specified number of SYNC-messages has been received. For further information see **Transmission type**:



- **Memory mapping**: This part of the window shows the graphical representation of the memory mapping:



- **Insert/replace object**: In this part, the user can insert or replace objects. In the left part objects can be selected for insert or replace operations.



An object can be inserted only if the box **insert** is checked. Otherwise the object is replaced.

With a click onto the button **insert** an insert operation will be performed. This button is visible only if the checkbox **insert** is active.

With a click onto the button replace a replace operation will be performed. This button is visible only if the checkbox insert is not active.
For insert mode, the user can specify in the field Position, where the object has to be inserted.
For replace mode the object is specified which is replaced:

- **Object delete**: Check the boxes of the objects you want to delete:

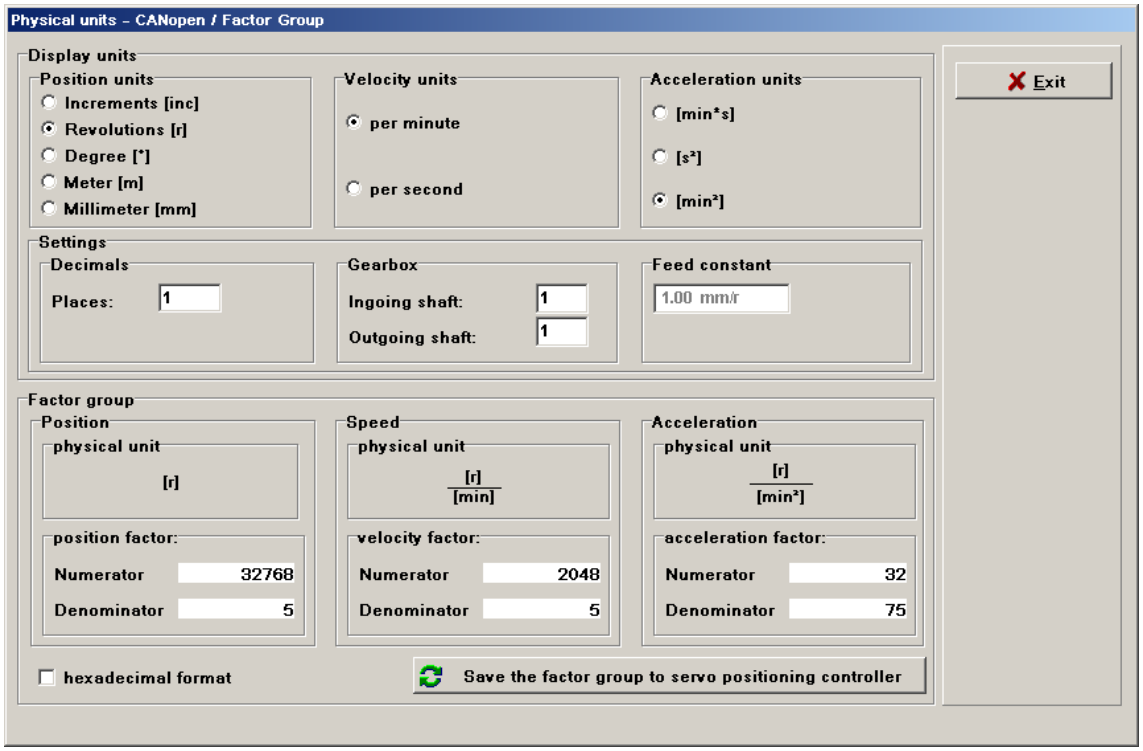
A click onto the button **delete** deletes the selected objects.

- **Adopt values**: The changes of the window are firstly stored in the parameterization software only. Click onto this button to transfer the new settings into the servo positioning controller.

15.1.4 CANopen: Configuration of the Factor Group

In the menu **Parameters/Field bus/CANopen/Display units…** you can configure the parameters for positions, speeds and accelerations directly in the desired physical units. The calculation from or into the internal units is done directly by the servo positioning controller. This calculation uses the factor group. In this menu the user can calculate and set the factor group for positions, speeds and accelerations.

> This window does not display the current factor group of the servo positioning controller! A non-ambiguous determination of the physical units from the factor group is not possible. To set the factor group of the servo positioning controller, firstly select the correct configuration then click on the button **Save the factor group to servo positioning controller**.



The menu has the following elements:

- **Display units**: Here the user can specify the units of his application:
  - **Position units**: In this field the unit of position parameters is specified.
  - **Velocity units**: In this field the time unit for the speed is selected.
    The corresponding position unit is specified in the upper field.

    Example: Position unit = "mm"
    Velocity unit = "per second"
    Resulting speed unit = "mm/s"

- **Acceleration units**: In this field the time unit for the acceleration is selected. The corresponding position unit is specified in the field **Position units**.

  Example: Position unit = "Revolution"
  Acceleration unit = "s²"
  Resulting acceleration unit = "r/s²"

- **Settings**:
  - **Decimals**: The number of the decimals specifies the maximum resolution.

    Example: Decimals = 2
    Position setpoint = 123,40 r

    The numerical value 12340 is transmitted. The minimum resolution is 0,01 r

  - **Gearbox**: If the application uses a gearbox and the user wants to view his application correlated to the outgoing shaft he must enter the ratio of **ingoing shaft** and **outgoing shaft**.
  - **Feed constant**: For translatory applications (e.g. linear axis), the conversion from motor revolutions to linear units must be specified. This field is disabled for rotary applications.

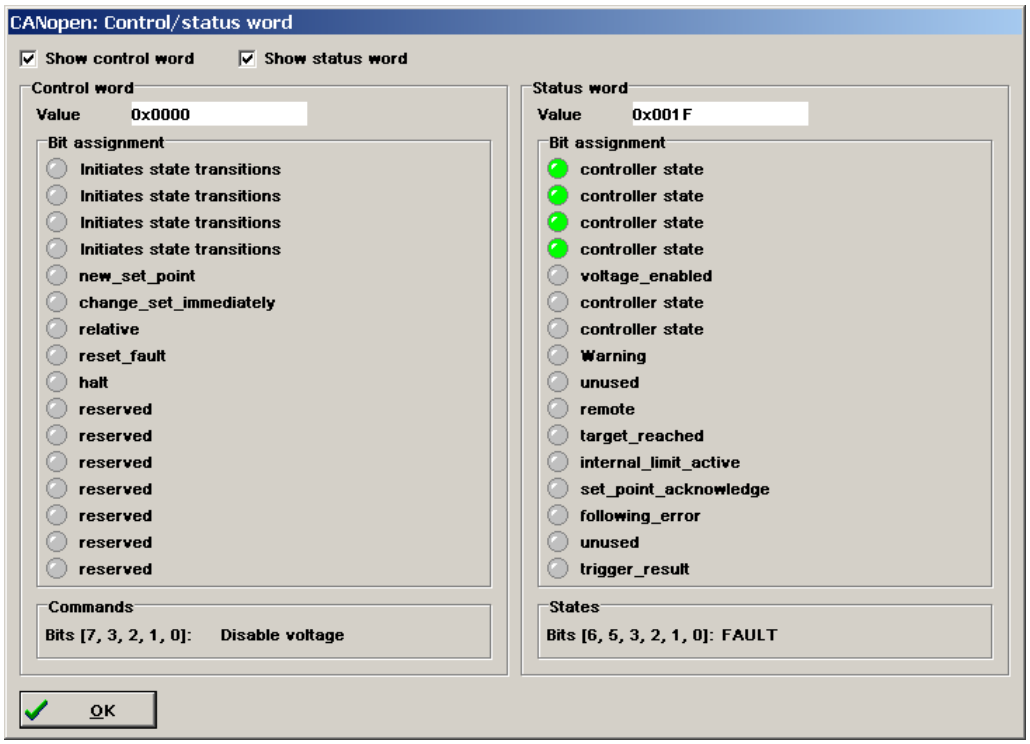
- **Factor groups**: The resulting Factor Group for **position**, **velocity** and **acceleration** is displayed. If desired, the user can display the factor group in hexadecimal or decimal format. Select the check box **hexadecimal format** in order to view the factor group in this format.

- **Save the factor group to the servo positioning controller**: The click on this button transfers the currently displayed values for the factor group into the servo positioning controller.

15.1.5 CANopen: Display of the control/status word

In the menu **Parameters/Field bus/CANopen/Diagnosis/Control/status word**… the actual values of the CANopen control/status word are displayed.

For further information concerning CANopen, see the CANopen manual.



The menu has the following elements/functions:

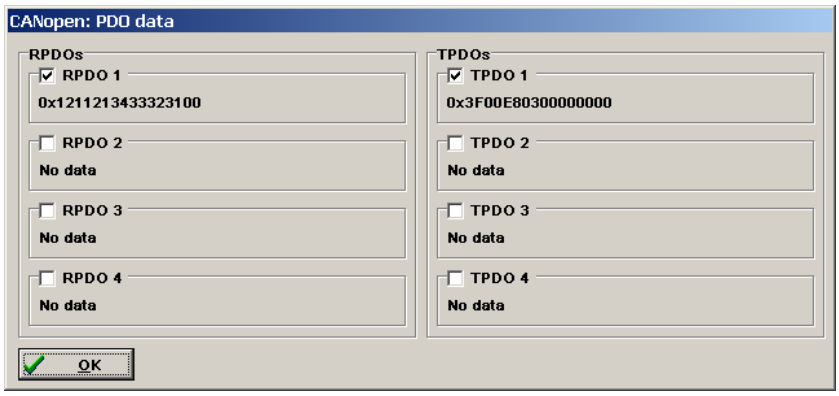
- **Show control word**
  The display of the control word can be activated or deactivated by this check box. The display of the control word cannot be deactivated when the display of the status word is deactivated.
- **Show status word**
  The display of the status word can be activated or deactivated by this check box. The display of the status word cannot be deactivated when the display of the control word is deactivated.
  The actual value of the control or status word is show as a hexadecimal number.

- The particular bits of the control/status word are shown as LEDs. The top LED represents bit 0 and the bottom LED bit 15 of the corresponding word. Since the bit assignment of the control/status word depends on the mode of operation the LEDs description will be adjusted corresponding to the actual mode of operation and the bit function.
  The last received command (see control word) and the actual state (see status word) is shown as plain text. The bits used to determine the command/state are displayed in the square brackets.

15.1.6 CANopen: Display of the PDO data

In the menu **Parameters/Field bus/CANopen/Diagnosis/PDO data…** the actual data of the RPDOs/TPDOs is displayed.

For further information concerning CANopen, see the CANopen manual.

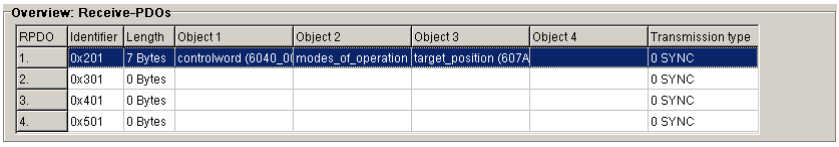


The displayed data can be used to recognize data mapping or data swapping. The byte order of 2 bytes/4 bytes data types is “low byte…high byte”. For better data interpretation we recommend to use the PDO mapping in menu **Parameters\Field bus\CANopen\PDO configuration**.

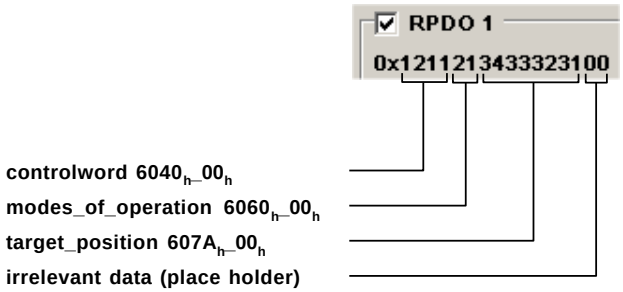
If the mapped objects allocate less than 64 bits the displayed data is filled with zeroes up to 64 bits.

The menu has the following elements:

- **RPDOs**
  The received data (master → servo positioning controller) is displayed here. Whether the data is displayed or not depends on the check box **RPDO x**. When the check box is checked, the data is displayed. The data is interpreted as described below.
  RPDO-Mapping used:



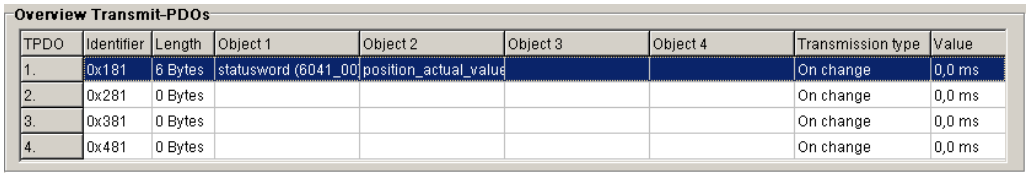
  The displayed RPDO data is assigned to the mapped CANopen objects as follows:



- **TPDOs**

  The transmitted data (servo positioning controller → master) is displayed here. Whether the data is displayed or not depends on the check box TPDO x. When the check box is checked, the data is displayed. The data is interpreted as described below.

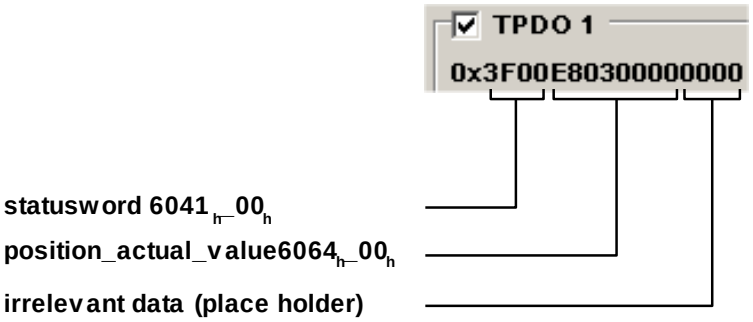
  TPDO-Mapping used:



Overview Transmit-PDOs

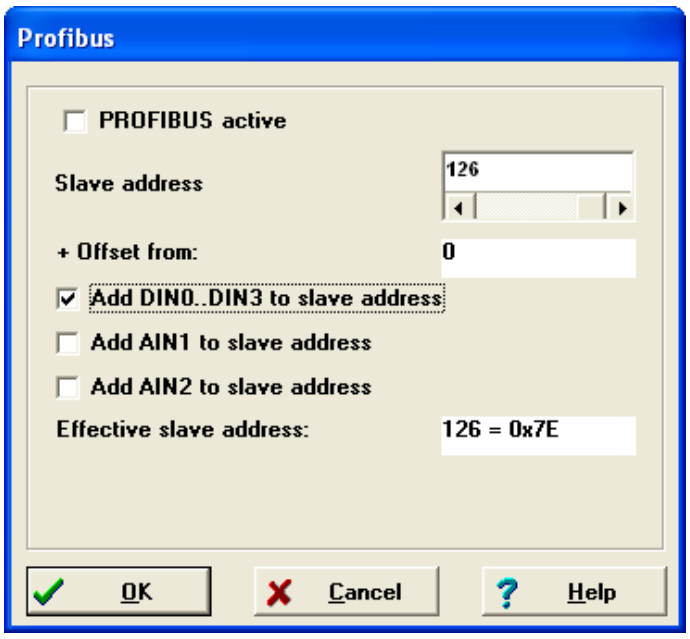
TPDO	Identifier	Length	Object 1	Object 2	Object 3	Object 4	Transmission type	Value
1.	0x181	6 Bytes	statusword (6041_00	position_actual_value			On change	0,0 ms
2.	0x281	0 Bytes					On change	0,0 ms
3.	0x381	0 Bytes					On change	0,0 ms
4.	0x481	0 Bytes					On change	0,0 ms

The displayed TPDO data is assigned to the mapped CANopen objects as follows:



15.1.7 Configuration of PROFIBUS-DP Communication Parameters

In the menu **Parameters/Field bus/PROFIBUS/operation parameters** you can adjust the PROFIBUS-DP communication parameters of the servo positioning controller LV-servoTEC S2 with the technology module PROFIBUS-DP to your PROFIBUS-DP network.



The PROFIBUS-DP communication can be activated and deactivated via the check box **PROFIBUS active**.

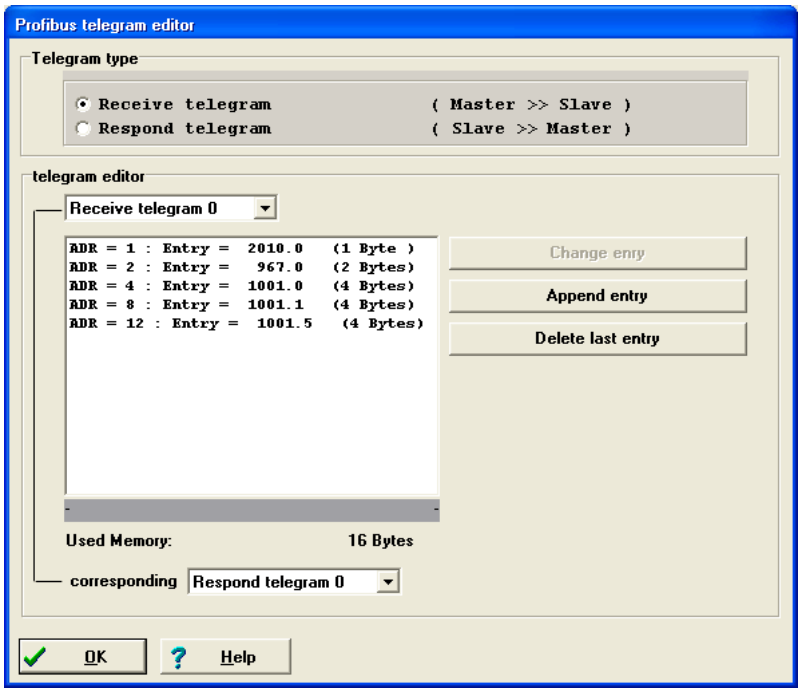
You can also configure the following parameters:

- **Slave address**: This parameter includes the base slave address of the corresponding device. The identifiers of the individual message are based on this address. Each address may only be used once in a network. It is possible to also include the digital inputs into the calculation of the slave address (see below).
- **Add DIN0...DIN3 to slave address**: The value of the digital inputs DIN0..DIN3 is added to the base slave address. The input combination is only read once after a device reset. It is thus possible to use simple bridges to 24 V to assign up to 16 different device addresses in the connector housing of X1.
- **Add AIN1 to slave address**: The analog input AIN1 is included in the generation of the slave address with a valence of 16. For a low level it may remain blank, for the high level the input must be bridged to V_{ref} = 10V.
- **Add AIN2 to slave address**: The analogue input AIN2 is included in the generation of the slave address with a valence of 32. For a low level it may remain blank, for the high level the input must be bridged to V_{ref} = 10V.

Certain Profibus parameters will not become active until a "Save" and "Reset" operation has been performed. The system indicates this with the help of a message and a button.

15.1.8 Configuration of Profibus Telegrams

In the menu **Parameters/Field bus/PROFIBUS/Profibus telegram editor** you can configure the Profibus telegrams for you specific application. The following menu will appear:



In the **Telegram type** field you can define whether you want to edit reception telegrams or response telegrams. Then you can select the reception telegram or the response telegram in the **Telegram editor** field. If it is a reception telegram (master → slave), you can select the corresponding response telegram.

The big area shows the structure of the telegram. The following information is provided for every entry:

- Address
- Communication object number
- Length of the entry in bytes

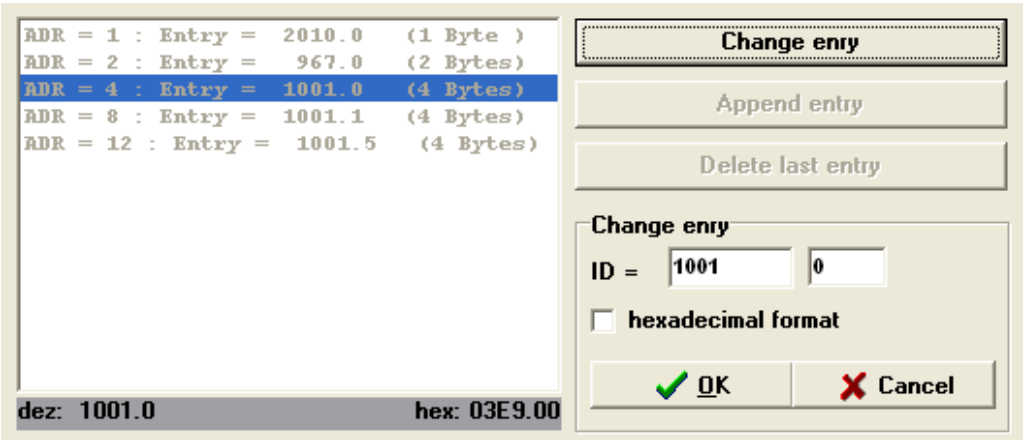
The address of the next entry is always the address of the current entry plus the length in bytes.

There are several ways to edit a telegram. The options can be accessed by pressing one of the following buttons:

- Change entry
- Append entry
- Delete last entry

In order to be able to click **Change entry**, you must have highlighted a line in the telegram window.

The following window will appear:



Enter a new **ID**. If you desire a hexadecimal presentation, check the check box. Click **OK** after the entry. The system checks whether the ID is valid. If it is, it will be taken over into the telegram. If it is not, the system will display an error message and the entry will not be changed. Clicking **Cancel** will abort this mode without changes.

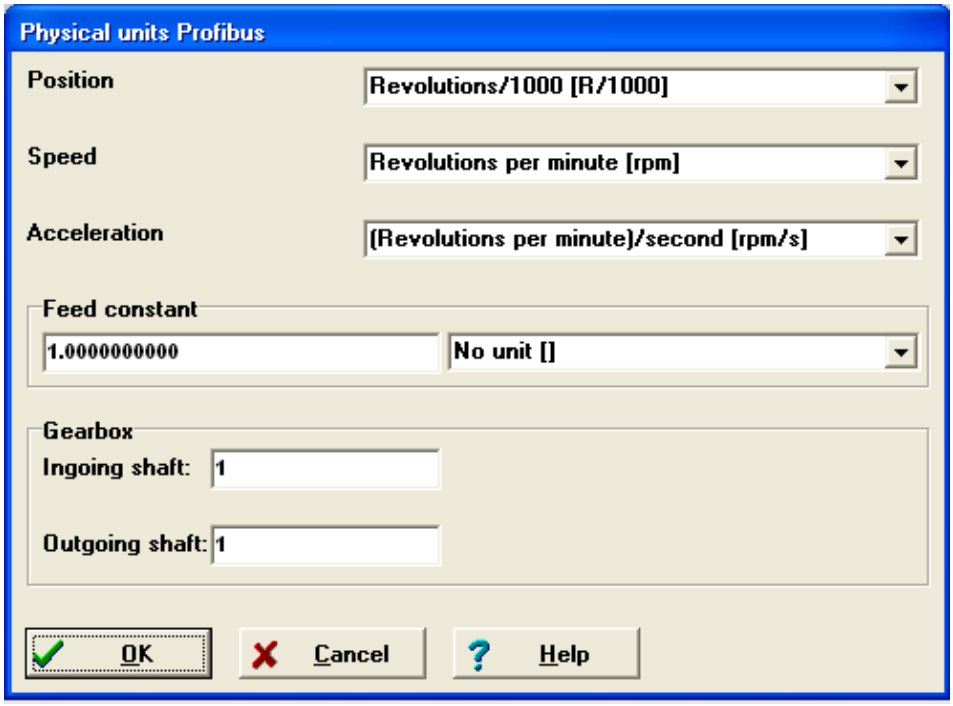
If you click **Append entry**, the system will create a new entry which will be added to the end of the list. Data can be entered in the same way as under **Change entry**.

If you click **Delete last entry**, the last entry on the list will be deleted.

The **Used memory** field (under the big display area) shows the amount of memory used by the current telegram.

15.1.9 Physical Units Profibus

You can define the display units for the Profibus under **Parameters/Fieldbus/PROFIBUS/Display units**. The following menu will appear:



You can define display units for the following quantities:

- Position
- Speed
- Acceleration

You can define a feed constant for translatory applications and a gear factor for rotary applications.

> Please note that the feed constant and the gear ratio will be taken into consideration for calculating the internal factors! This is why the feed constant should be set to 1.0, provided it is not required, and the gear ratio to 1:1.

15.1.10 Additional Support of PROFIBUS-DP Functionality

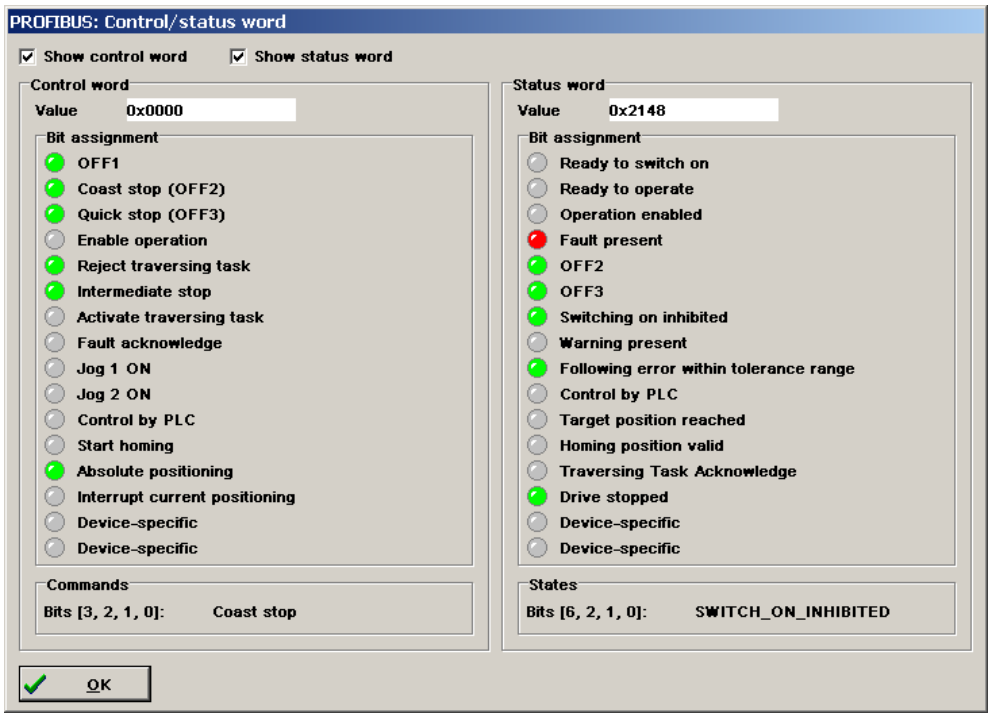
In the S2 Commander sub-directory ...*PROFIBUS* you can find:

- Example projects with function and data modules for SIEMENS S7 (compressed)
- Device master data

15.1.11 PROFIBUS: Display of the control/status word

In the menu **Parameters/Field bus/PROFIBUS/Diagnosis/Control/status word…** the actual values of the PROFIBUS control/status word are displayed.

For further information concerning PROFIBUS, see the PROFIBUS manual.

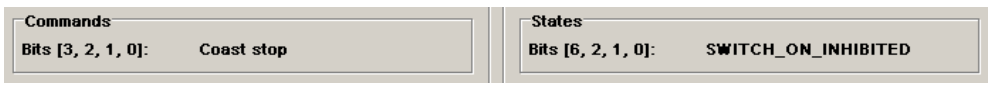


The menu has the following elements/functions:

- **Show control word**
  The display of the control word can be activated or deactivated by this check box. The display of the control word cannot be deactivated when the display of the status word is deactivated.
- **Show status word**
  The display of the status word can be activated or deactivated by this check box. The display of the status word cannot be deactivated when the display of the control word is deactivated.

  The actual value of the control or status word is show as a hexadecimal number.

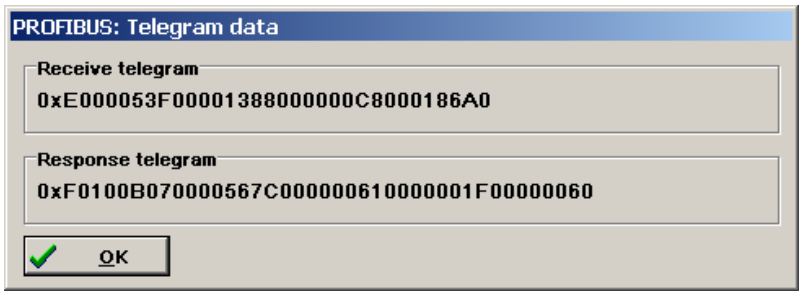
- The particular bits of the control/status word are shown as LEDs. The top LED represents bit 0 and the bottom LED bit 15 of the corresponding word. Since the bit assignment of the control/status word depends on the mode of operation the LEDs description will be adjusted corresponding to the actual mode of operation and the bit function.
  The last received command (see control word) and the actual state (see status word) is shown as plain text. The bits used to determine the command/state are displayed in the square brackets.



15.1.12 PROFIBUS: Display of the telegram data

In the menu **Parameters/Field bus/PROFIBUS/Diagnosis/Telegram data…** the data exchanged between the PROFIBUS master and the servo positioning controller is displayed.

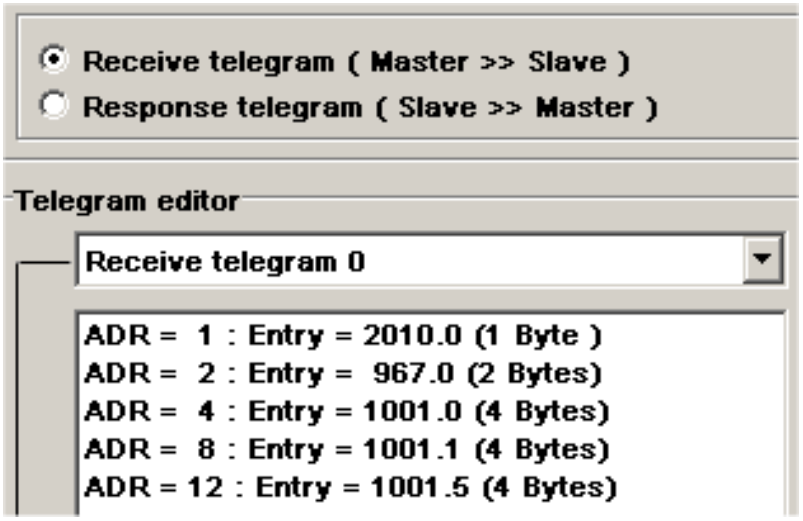
For further information concerning PROFIBUS, see the PROFIBUS manual.



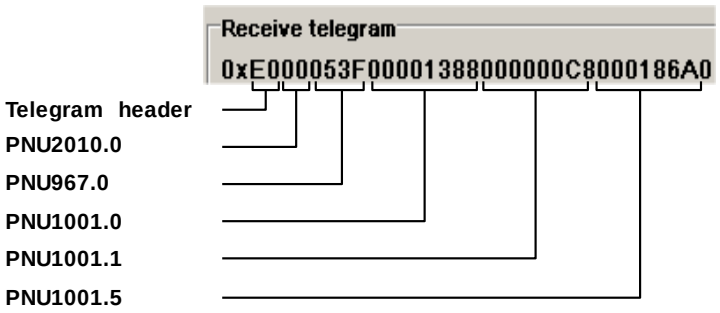
The displayed data can be used to recognize data mapping or data swapping. The byte order of 2 bytes/4 bytes data types is “high byte…low byte”. For better data interpretation we recommend to use the telegram mapping in menu **Parameters\Field bus\PROFIBUS\Telegram editor**.

The menu has the following elements:

- **Receive telegram**
  The received data (master → servo positioning controller) is displayed here. The data is interpreted as described below.Data mapping of the received telegram:

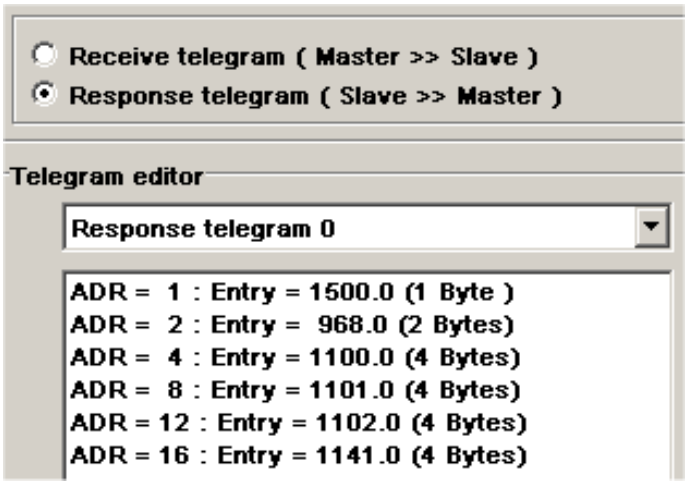


The displayed telegram data is assigned to the mapped parameter numbers (PNUs) as follows:

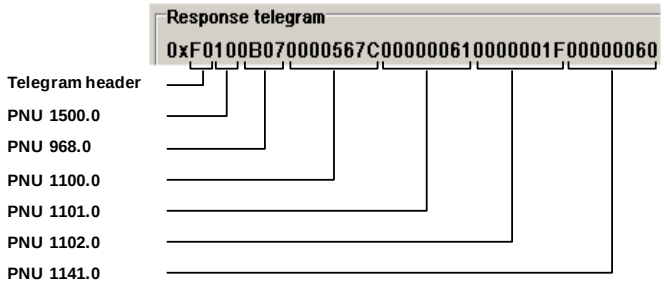


- **Response telegram**

  Display of the sent telegram data (servo positioning controller → master).
  The data is interpreted as described below. Data mapping of the response telegram:

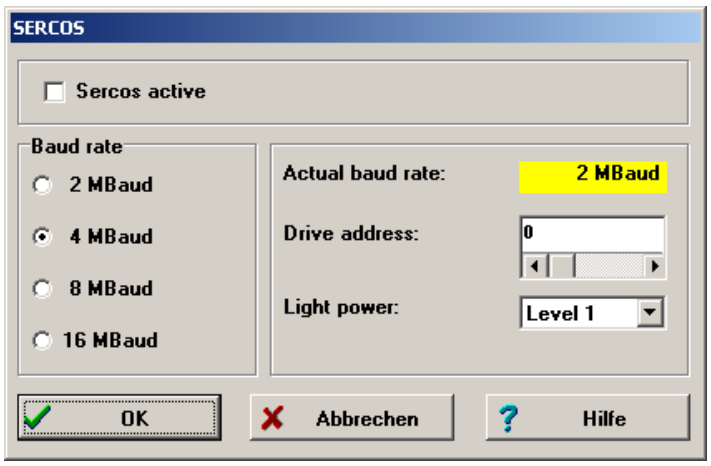


The displayed telegram data is assigned to the mapped parameter numbers (PNUs) as follows:



15.1.13 Configuration of SERCOS Communication Parameters

In the menu option **Parameters/Field bus/SERCOS** you can adapt the SERCOS communication parameters of the servo positioning controller LV-servoTEC S2 to your SERCOS bus network. The following menu will appear:



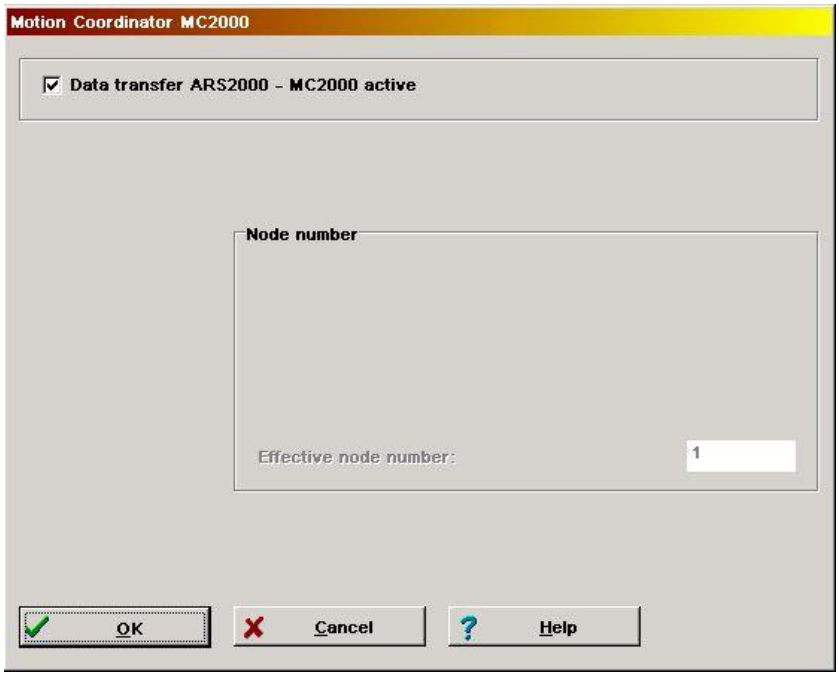
The SERCOS-communication is switched on and off by the check box **Sercos active**.

Furthermore, the following parameters can be configured:

- **Baud rate**: This field is used to set the baud rate with which the Sercos bus will communicate on the network. You have to select a uniform baud rate for the network. The field **Actual baud rate** shows the baud rate currently being used. As the baud rate will not be adopted until the Sercos communication is activated, it can deviate from the desired baud rate.
- **Drive address**: Enter the address under which the servo positioning controller should log into the Sercos network.
- **Light power**: In this field, the light power of the transmission diodes can be adapted to the optical fibres and the optical fibres lengths used. A low level corresponds to a low light power. More detailed information concerning the light power adjustment can be found in the Sercos manual.

15.1.14 Motion Coordinator MC 2000

In the menu option **Parameters/Field bus/MC2000/Operation parameters** you can change the communication parameters of the positioning controller LV-servoTEC S2 to the Motion Control technology module MC 2000. The following menu will appear:



The communication between the basic device (LV-servoTEC S2) and the Motion Control technology module (MC 2000) can be switched on and off by the check box **Data transfer LV-servoTEC S2 – MC2000 active.**

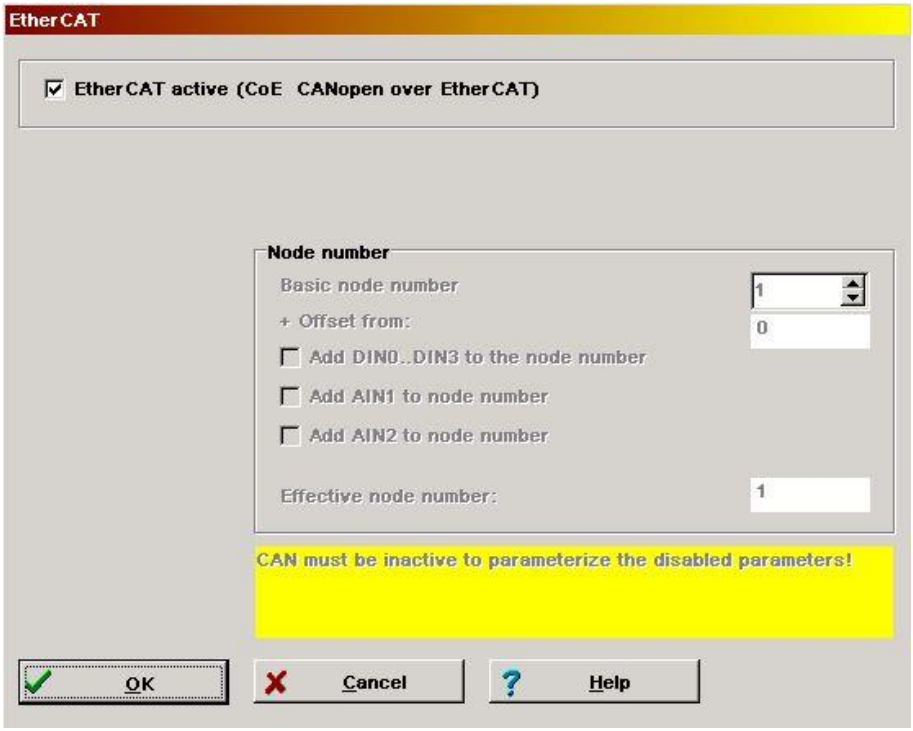
The servo positioning controller with the plugged MC 2000 technology module always has the node number 1. Therefore, this value cannot be changed. With a plugged MC 2000 technology module, a CAN communication via the integrated CAN-bus interface of the basic device is not available.

15.1.15 Configuration of EtherCAT Communication Parameters

In the menu option **Parameters/Field bus/EtherCAT/Operation parameters** you can adapt the EtherCAT communication parameters of the servo positioning controller LV-servoTEC S2 to your EtherCAT bus network.

EtherCAT is a real-time Ethernet technology. The servo positioning controller works as EtherCAT slave with supporting the CoE protocol (CANopen over EtherCAT)

The following menu will appear:



Use the check box **EtherCAT active (CoE CANopen over EtherCAT)** to activate or deactivate the EtherCAT communication using the CoE protocol (CoE: CANopen over EtherCAT).

CAN specific parameters are not relevant. The master of an EtherCAT network administrates all node numbers himself.

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