Product manual

RBD-325-4/6-S

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1 General

1.1 Symbols used

Information

Important information and references.

Caution!!

Non observance may result in severe property damage.

DANGER!

Non observance may result in **property damage** and **personal injury.**

Caution! Dangerous voltages.

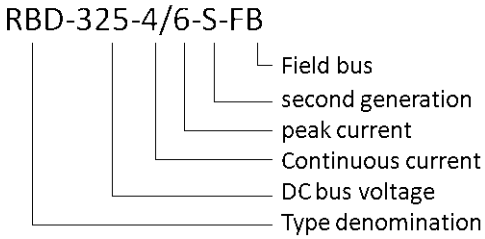
The safety note indicates a possible perilous voltage.

1.2 Area of application and intended use

1.2.1 Type description

The Servo positioning controller series RBD-S (**R**egulator for **B**rushless motors with permanent magnet rotor, **D**igital) are intelligent servo inverters with extensive parameterization options. Due to this flexibility, they can be adapted to numerous areas of application.

Key type:



1.2.2 Area of application and intended use

The servo positioning controller RBD-S was designed for the centralized control of three-phase magneto-electric synchronous machines. Thanks to numerous options for feedback like resolver and price inexpensive analogue hall sensing system methods with current controlling with "sinus commutation", the controller can be adapted optimally to the motor characteristics.

The RBD-S is designed for fixed mounting in a control cubicle. The motor is connected to the servo controller via a single cable which is constructed with screened motor wiring. Also the separately screened encoder cable carries the holding brake and temperature sensor. More information about mechanical installation can be found in the table of contents 12.15. Information about electrical installation can be found in table of contents.

The power supply of the RBD-S servo positioning controller requires 230 V AC power. At the controller connection, it supplies the synchronous machine with a pulse-width-modulated, symmetrical, 3-phase rotating field with variable frequency, current and voltage.

The controller unit is supplied with 24 V DC through a power supply unit.

The DC bus voltage will be loaded directly from the 230V power supply. An electric rectifier and a current regulator with thermistor are integrated in the controller. Additionally, a filter must be used in the power line to the controller to reduce electrical emissions in accordance with EMC rules.

The RBD-S was designed as a continuous torque, speed and position control for typical industrial applications such as:

- Positioning and feeding drives in machines
- Palletizing and packaging machines
- Wood-processing machines
- Reeling drives, wire drawing drives etc.
- Drives in tightening and press-fitting applications
- Conveying applications

Prior to using the RBD-S controller in specialist areas of application e.g. medical technology or avionics, requiring particularly high levels of device safety, the user should check whether the RBD-S meets the required standards. In case of doubt, please contact your local distributor.

The RBD-S may only be used in the environment described and with the technical data of the controller stated in the appendix in chapter 12.14.

1.2.3 Features of RBD-S

The RBD-S has the following features:

- Compact design, enclosed on all sides with protection class IP20 and ideal for mounting in control cubicles.
- Highly precise control thanks to a high quality sensor system.
- Full integration of all components for the controller and power sections including RS232 interface for PC communication and CAN open interface for integration with PLC's.
- RS232 interface for PC communication and a field bus interface (CAN open, Profibus or EtherCAT) are realized with an integrated interface which is plugged in and connected to the main board.
- Integrated driver stage for 24 V Holding brake (750 mA)
- Integrated universal rotary encoder evaluation for the following encoder types:
  - Resolvers
  - Analogue Hall sensors (Groschopp Volksservo®)
- Mounting plate with double function - strain relief and screen connection of cable
- Compliance with current CE and EN standards with an additional external line filter. Other filters e.g. filters for 24V-supply as well as inputs and outputs
- Can be used as a torque controller, speed controller or position controller
- Operation for synchronization with use of the digital I/O-interface
- Integrated positioning control with extensive functionality in accordance with CAN in automation (CiA) DSp402 and many more extended functionalities
- Jerk-free or time-optimal positioning, relative or absolute with regard to a reference point.
- Point-to-point positioning with and without spot tracing
- Speed and angle synchronous connection with electrical gears over field bus
- Pulse direction input for direct connection with stepper motors
- Incremental encoder emulation with programmable pulse quantity and more output options – differential 5 V Signal (RS422 Standard) or 24 V HTL-Signal output
- Several reference methods
- Integrated course program to implement easier destination movements with or without digital inputs
- Programmable outputs
- High intensive 12-Bit analogue output
- User friendly parameterization with PC-Program RBD-S ServoCommander™
- Motor auto detect
- Easy connecting to a PLC and possible to use I/O or field bus.
- Technologic additional place for Profibus or Ethercat.

- I²t-control for reduction of power looses in end stage and motor.
- Integrated brake chopper with connection of an external brake resistor.
- Extended RS 232 connection by PS2 female.
- Basic controller with CAN-bus connection

1.3 Specifications of RBD-S ServoCommander™

1.3.1 Basic Information

The parameter program gives a user friendly interface to parameterize the servo positioning controller RBD-S with the parameter software to optimize your application.

The software of the servo positioning controller RBD-S and the parameter software must be related to each other. In this way you can realise the best and latest modifications during parameterization.

With this parameter software it is not possible to program other Groschopp devices!

1.3.2 Specifications of RBD-S ServoCommander™

The parameter program has the following options:

- Parameterization of the servo position controller RBD-S
- Parameter settings across the PC
- Display units
- Loading of new software-version
- Load and save parameter sets
- Print parameter sets
- Offline parameterization
- Oscilloscope functions
- Languages: English, German, French (no manual), Dutch
- Windows-conforming user interface
- Course program

1.3.3 Hard- and Software Requirements

Requirements before the installation of the parameter program:

- IBM-compatible PC-AT, from Pentium II-Processor with min. 32 MB main memory and min. 10 MB free hard disk memory
- Available for Windows® 95, Windows® 98, Windows NT®, Windows 2000, Windows XP®, Windows 7
- CD-ROM-drive
- Free serial interface or high speed USB converter

1.4 Documentation

These manuals are for use with the parameter program RBD-S ServoCommander™ for the servo position controller RBD-S.

Additional information can be found in this manual for the RBD-S device:

- **CAN open manual "CanOpen_manual_DIS-2":**
  Description to implement CAN open protocol in accordance of DSP402, only for RBD-S with exception of collection allocation

The servo position controller works with the FLASH-program memory. With the software program you can after delivery and commissioning of the machine parameterise the controller. This functional software will be developed continuously by the supplier so we have a greater solution for client applications.

In these manuals the information described is based on the following versions of the parameter software and functional software of the RBD-S controller:

Servo position controller RBD-S-Software CAN: Version 3.3.4000.1.3
Profibus: Version 3.3.14000.2.1
EtherCAT: Version 3.3.24000.3.6

Parameterization / RBD-S ServoCommander: Version 2.4.0.5.1

1.5 Delivery and delivery package

The servo position controller RBD-S is within a CAN-Bus interface. Also available are devices with Profibus-Interface or with EtherCAT-Bus interface.

Table 1: Basic device package options

1x	Servo position controller **RBD-325-4/6-S** Basic with **CAN-Bus interface** incl. mounting angle plate and screen cage clamp. Basic default settings for resolver motors.	Groschopp no. RBD-S Can (Basic device)

1x	Servo position controller **RBD-325-4/6-S Profibus** Basic with **Profibus-Bus interface** incl. mounting angle plate and screen cage clamp. Basic default settings for resolver motors.	Groschopp no. RBD-S PB
1x	Servo position controller **RBD-325-4/6-S EtherCAT** Basic with **Ethercat-Bus interface** incl. mounting angle plate and screen cage clamp. Basic default settings for resolver motors.	Groschopp nr. RBD-S EC

The connectors for power, I/Os and encoder are not part of the contents. Also a line filter is required. Brake resistor or testing equipment (small box) can be purchased additionally.

Table 2: Additional parts RBD-S

1x	Connector set:			**Connector set RBD-S** Groschopp no.: RBDS connector set
	contents:	1x	1 x 4 and 1 x 5-pole Phoenix COMBICON MSTB 2,5/9-ST-5,08	
		2x	12-polig Phoenix MINICOMBICON MC 1,5/12-ST-3,81	
1x	Cage Clamp and angle mounting plate			Included with controller
1x	Testing equipment RBD-S			Groschopp no. On request!
1x	RS232 communication cable RBD-S, 150 cm Length; PS2 male connector to DSUB9			Groschopp no. RBDS RS232 cable
1x	Power line filter for RBD-S general type			Groschopp no. Small RBDS line filter
1 x	Fan			RBDS fan with connection cable
1 x	Fan is also available for direct mounting on the end stage for better cooling and higher power output.			Groschopp no. On request!
1x	Brake resistor for RBD-S 100 Ω / 100 W / 450 V			Groschopp no. RBDS brake resistor 100W/100Ohm

Table 3: Additional parameter program

1x	RBD-S ServoCommander Windows®-Parameter program Deutsch/English/France/Dutch	First delivery of RBD-S includes paper manual for first commissioning

2 Safety notes for electrical drives and controllers

2.1 General notes

Information

In case of damage resulting from non-compliance with the safety notes in this manual Groschopp BV do not assume any liability

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 such persons who are sufficiently familiar with the project, 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 concerning the standards and accident prevention regulations for the application, or authorization 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 safe engineering practice and 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 injury and/or property damage:

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 and immediately request that these documents are 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 injury, electric shock or, in extreme cases, even death.

2.2 Danger resulting from use

DANGER!

High electrical voltages and high load currents!

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!

2.3 Safety notes

2.3.1 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 300mA 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 maintained. Safety-critical applications are not allowed, unless specifically approved by the manufacturer.

For notes on installation corresponding to EMC, please refer to *chapter 12.18*. The compliance with standards 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 damage.

The following regulations or standards and others apply:

VDE 0100	Regulations for the installation of high voltage (up to 1000 V) devices
EN 60204-1	Electrical equipment in machines
EN 50178	Electronic equipment for use in power installations
EN ISO 12100	Safety of machinery – Basic terminology, general principles for design
EN 1050	Safety of machinery – Principles for risk assessment
EN 1037	Safety of machinery – Prevention of unexpected start-up
EN 954-1	Safety-related parts of control systems

2.3.2 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. Contact may result in death or serious personal injury.

Be careful during assembly. During assembly and also later during operation of the drive, make sure you prevent swarf, 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 enabling are not 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 damage e.g. due to the wrong direction of rotation.

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

The servo drive controller and in particular the brake resistor, external or internal, can reach high temperatures, which may cause serious burns.

2.3.3 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.

Comply with the minimum copper cross-section for the ground conductor over its entire length as per EN60617!

Prior to 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 Volts, 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.

2.3.4 Protection against electrical shock by means of protective extra-low voltage (PELV)

All connections and terminals with voltages between 5 and 50 Volts 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 Volts.

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

2.3.5 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 super ordinate 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 injury or property damage!

For the reasons mentioned above, personal protection must be ensured by means of monitoring or super ordinate 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. Also after disconnecting the power supply wait (minimum discharge time of 2 minutes) for discharging the capacitors of a level of 50 V DC before starting working on the servo position controller.

2.3.6 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!

2.3.7 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, and protective gloves).

Do not stand underneath hanging loads.

Remove leaking liquids from the floor immediately to prevent slipping.

3 First commissioning of drive

3.1 System overview

The servo position controller RBD-S is designed for use in control panels. To use the controller it is necessary to connect the motor, power, logic voltage and also if needed the I/O's or field bus. The components necessary for using the RBD-S are shown in the figure and declared in

Table 4 on the next side.

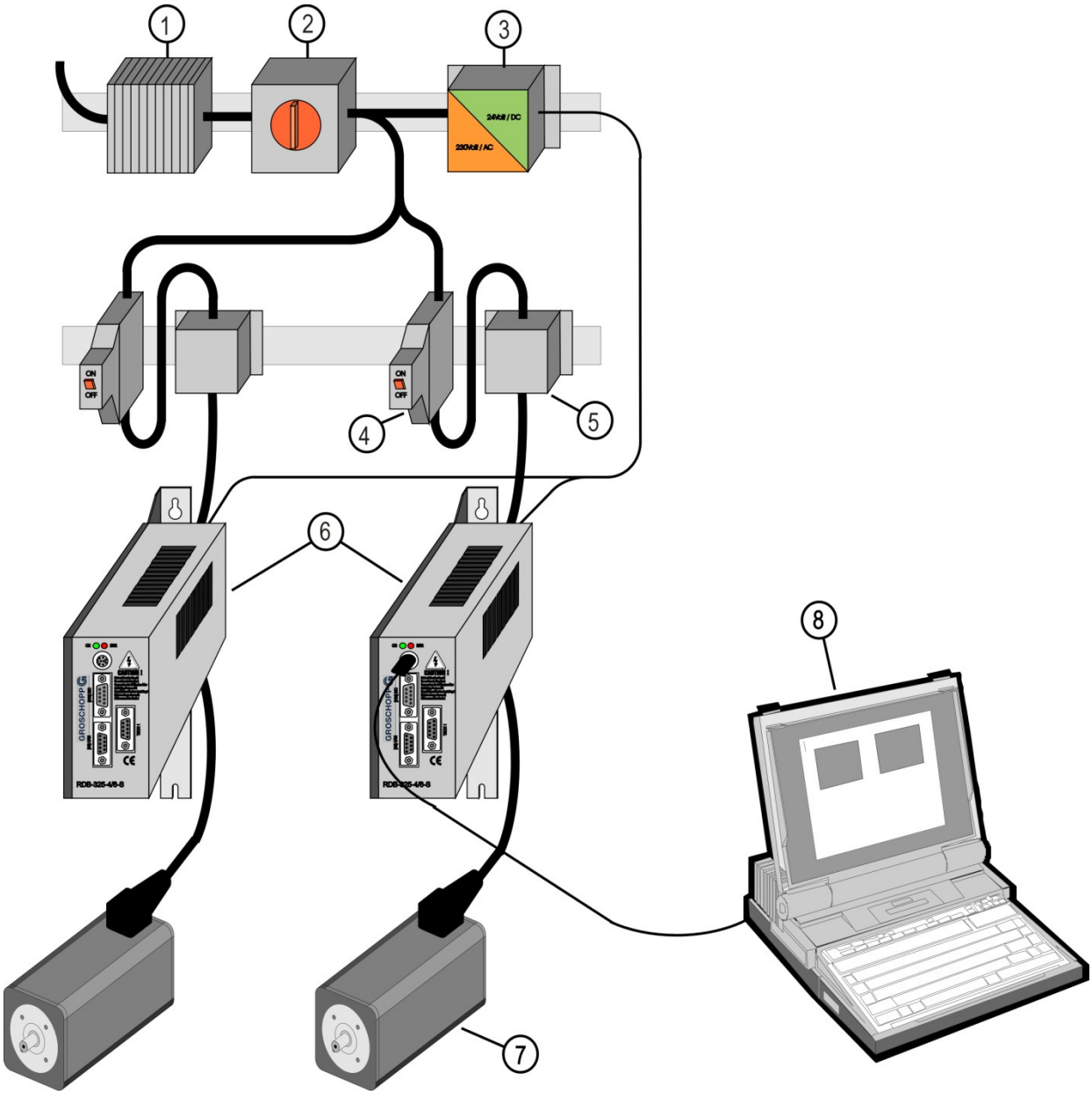


Figure 1: Overview RBD 325-4/6-S

Table 4: Overview total system RBD 325-4/6-S

No.	Denomination
1	Power supply (single phase 230 Volt AC)
2	Main switch
3	Logic supply (230 Volt AC // 24 Volt DC; 1 A Main current each RBD-S with holding brake)
4	Power fuse / electrical fuse / over current protection switch
5	Line filter NF 2
6	Servo position controller RBD 325-4/6-S
7	Motors
8	PC with Software RBD-S Commander for parameterization by RS 232

3.2 Connection of RBD-S communication interface

Before you switch on the power supply of the servo position controller RBD-S for the first time, you must have connected/wired the motor, PLC module / in- and outputs / field bus and the logic supply. Please read therefore chapter *12.16.1* **Fout! Verwijzingsbron niet gevonden.** also chapter **Fout! Verwijzingsbron niet gevonden.** Electrical installation of the RBD-S.

Before the servo position controller can be parameterised, the serial communication of the RBD-S must be connected to a COM-port from a notebook / PC.

Please check all wires and especially the connection of all screens also the maximum supply voltages before you switch on the first time!

Wiring errors are the most typical reasons for function errors. Wiring errors and overvoltage can damage the servo position controller!

3.3 Installation and start up RBD-S ServoCommander™

To install the software from the CD-ROM follow the next points:

1. Load the CD-ROM into the CD-ROM-drive of your Computer.
2. Start up Windows®-Explorer.
3. Select from the CD-ROM „ENGLISH“.
4. Start the program SETUP.EXE by double click.
5. Follow the descriptions of the installation program.

The installation program makes a new file with the name „Groschopp“. In this file you can find the program „RBD-S *[Version no.]* under „RBD-S ServoCommander“. With this opened you can start the parameter program.

4 First commissioning of drive

4.1 First commissioning

4.1.1 Parameter settings as delivered

Initially the servo position controller RBD-S has **Default-parameters** loaded. The Default-parameters have to be changed during the first commissioning of your application. Otherwise the servo position controller RBD-S has the wrong settings and can damage the machine.

The **default-parameter** is based on a speed controller with set points for using the analogue input AIN0. The controller settings such as the current settings and gains should be made without mechanical connection on the motor shaft. This will prevent the connected motor from damage or over current when enabling the controller.

The basic delivery **default-Parameters** can be restored by using the menu **File/parameters/default-parameters loaden**.

By loading **default-parameters** all application specified settings overwrite the existing settings and warnings. If you use this function you will have to make the first commissioning again.

4.1.2 Manual first commissioning

When you don't have motor or specified application parameters you have to follow the following points:

1. Parameter/application parameters/general configuration.
2. Options/display units...
3. Options/ input limits...
4. Parameter/device parameter/motor data...
   motor identification across a motor list
5. Parameter/device parameter/angle encoder adjustments...
6. Parameter/safety parameters...
7. Parameter/controller parameters/current controller...
8. Parameter/controller parameters/speed controller...
9. Parameter/controller parameter/position controller...
10. Parameter/device parameters/temperature monitoring...

11. File/parameter set/save parameters (Flash)
    Fixed saving parameters in internal flash of the controller
12. File/parameter set/ Servo >> File

13. Save parameters as File (optional)

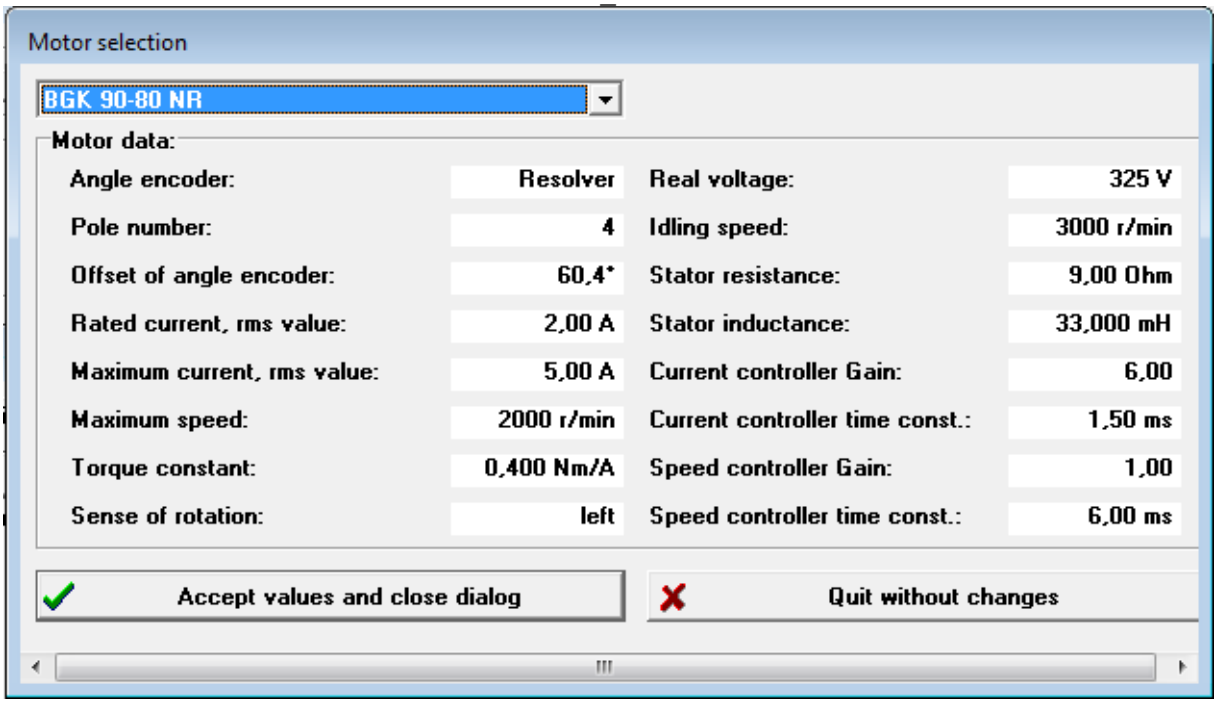
4.2 Parameterization across motor data file list

The parameter program RBD-S ServoCommander™ has the option of using a motor data file list with the most important motor types.

> This motor data file list can be made by the user but in general the supplier can make this file list. It is an additional tool for users. On the CD-Rom you will find only the DCO files of every existing Groschopp motor type. If there is no DCO applicable in the list please contact your supplier. We can make and deliver it (see quick manual in the package).

This function is reached by **parameter/device parameter/motor data/select new motor**.

Now the list is shown and you can select your motor:



Please select the motor, if the motor is shown accept it by using **Accept values and close dialog**. Otherwise you select **Quit without changes**.

4.3 Basic parameters of new motors

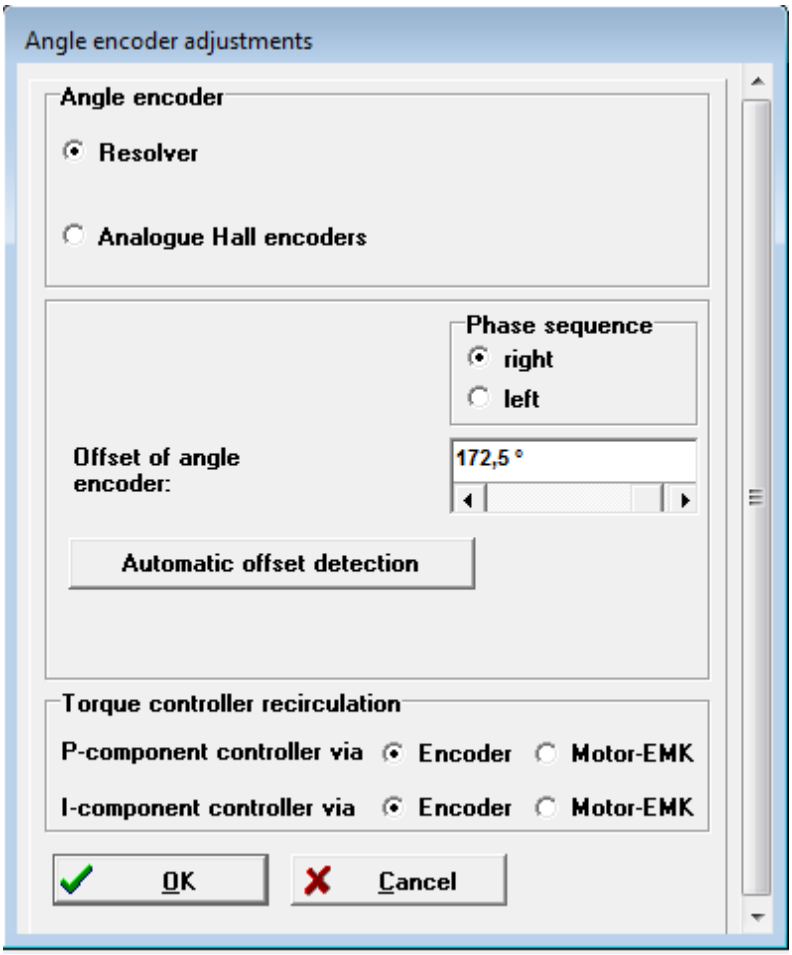
4.3.1 Angle encoder

The servo position controller RBD-S supports the following angle encoders.

- Resolver
- Analogue hall sensing with SIN-/COS-Signals (encoder system „Volksservo“)

Other encoder systems are not supported by the hardware of the RBD-S.

The menu for settings of the angle encoder is found at p**arameter/device parameter/angle encoder adjustments**.



Depending on the angle encoder it is possible to see other settings as different adjustments can be used.
The motor and **angle encoder** can be automatically or manually adjusted. When the motor isn’t built into the machine and the motor axes can rotate freely we advise making an automatic offset detection.

The function can be adjusted via the following paths:

- **Parameter/device parameter/motor data**: Button "Automatic offset detection"
- **Parameter/device parameter/angle encoder adjustment**: Button " Automatic offset detection "

During the automatic offset detection the controller will be automatically enabled for a few seconds and the motor will be loaded with a rotating field to give a movement and make a middle adjustment calculation.

The automatic offset detection calculates the following parameters:

- Number of poles of the motor (not with six-step-hall sensor).
- Angle encoder offset, it is the angle between zero point of the encoder and the magnetic symmetry axis of winding phase 1.
- Phase sequence of the angle encoder (left, right).

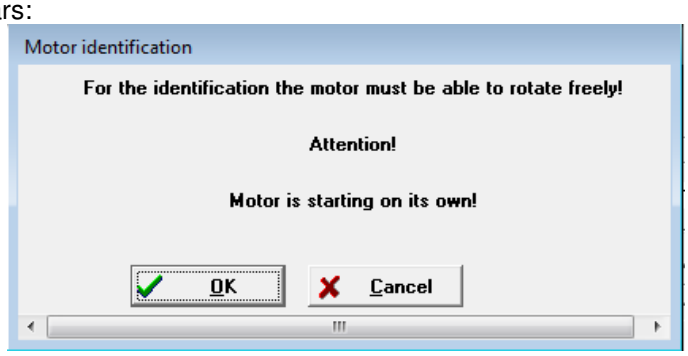
Following points should be checked before starting automatic offset detection:

- The motor is fully connected.
- The bus voltage is loaded.
- The servo position controller is error free.
- The motor axis must be free to rotate.

Danger!

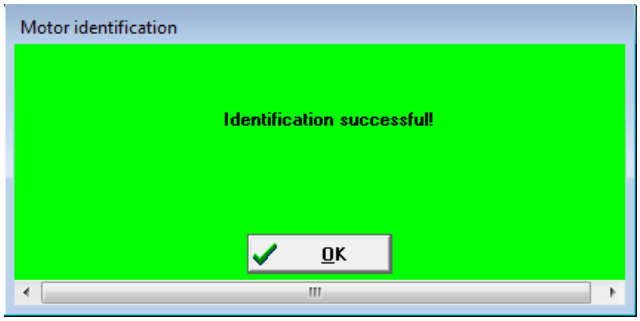
Before you start the motor identification, the current values (**Parameter/device parameter/motor data**) must be put in; otherwise the motor can be damaged!

Activate the angle encoder adjustment with **Automatic offset detection**.
The following window appears:



Caution! During this identification the axis will rotate automatically for a few seconds.

A successful identification will give you the following window:



When the identification detects an error the following message window appears:

When the automatic offset adjustment is not done, you have to adjust the angle encoder manually.
This problem can occur in the following situations:

- With „Special motors“ with very high number of poles
- With fixed not freely moveable motor axis
- When the motor inertia is very high and within the calculation time the position of its movement is not reached.

The manual adjustment of the angle encoder requires experience and knowledge of synchronized machines and the encoder in use. We advise you to contact your supplier to make the right adjustments,

Table 5: Parameter angle encoder (blank = not implemented)

	Resolver	**Analogue hall sensor**
Offset angle encoder	X	X
Phase line	X	X
Pulses		
Zero impulse (yes/no)		

Caution!

Wrong data for the angle encoder cause uncontrolled movements. These movements can damage the application or the motor.

In addition to the settings of the angle encoder it is possible to change the torque controller feedback like: P and I component controller over encoder or motor-EMK (spitted for P- and I-component).

When you use a motor with analogue hall sensors for commutation, it is possible to make an automatic identification with the **Automatic offset detection** function. The RBD-S calculates the optimum Offset-value and also the amplitude value of the SIN- and COS-pulse signals and saves these. The tolerance of the encoder and the encoder evaluation of the RBD-S will be reduced. This creates improvements of the motor rotation.

Caution! With this automatic identification the motor axis will rotate for approx 60 seconds.

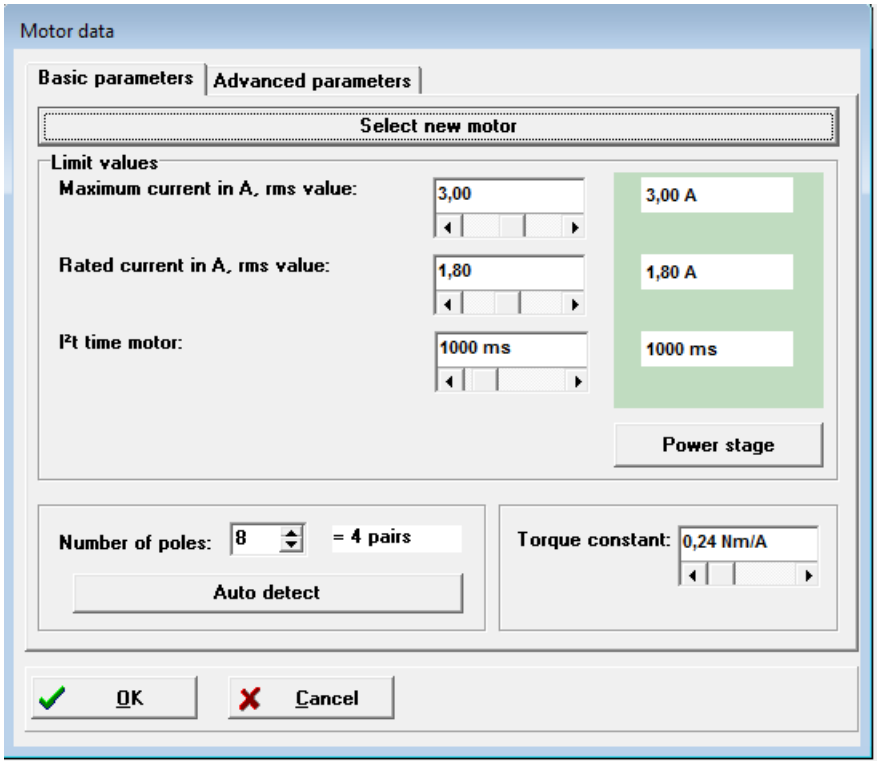
The settings over the motor-EMC can be a positive development for rotation of the motor when the motor has a lower encoder resolution (e.g. hall sensor Six Step) or a lower accuracy. The torque controller feedback over the motor-EMC can be arranged with **Parameter/device parameter/motor data**, see chapter 4.3.2 motor data.

Caution! By activating the torque controller feedback over the motor-EMC!
the real speed of the motor can deviate significantly from the desired value. When the function and the motor data do not have the right parameters the tolerances of the magnets and windings of the motors may not permit the result to work in line with the desired result.

The best compromise of smoothly rotating and constant accuracy gives the best result if the P-component in speed controller of EMC- is also selected.

4.3.2 Motor data

These points must be followed if the motor is not shown in the list.



These settings can be changed by **Parameter/device parameter/motor data**. In this window the maximum and the nominal current of the motor can be input. Use the values on the motor plate. The torque constant can be calculated from nominal torque / nominal current.

Caution, the input values for the maximum and nominal currents should be realistic values! Very high currents could damage the motor – the permanent magnets could be demagnetized. The supplied motor values should not be exceeded.

The maximum current value can be dependent on the clock frequency from the end stage. To show the clock frequency look to the input **power stage**. See also chapter *Chapter* ***Fout! Verwijzingsbron niet gevonden.*** Power stage.Further it is possible to input the motor poles. There is also an automatic identification route. The number of poles and angle encoder offset will be adjusted. See the button **Automatic identification**.

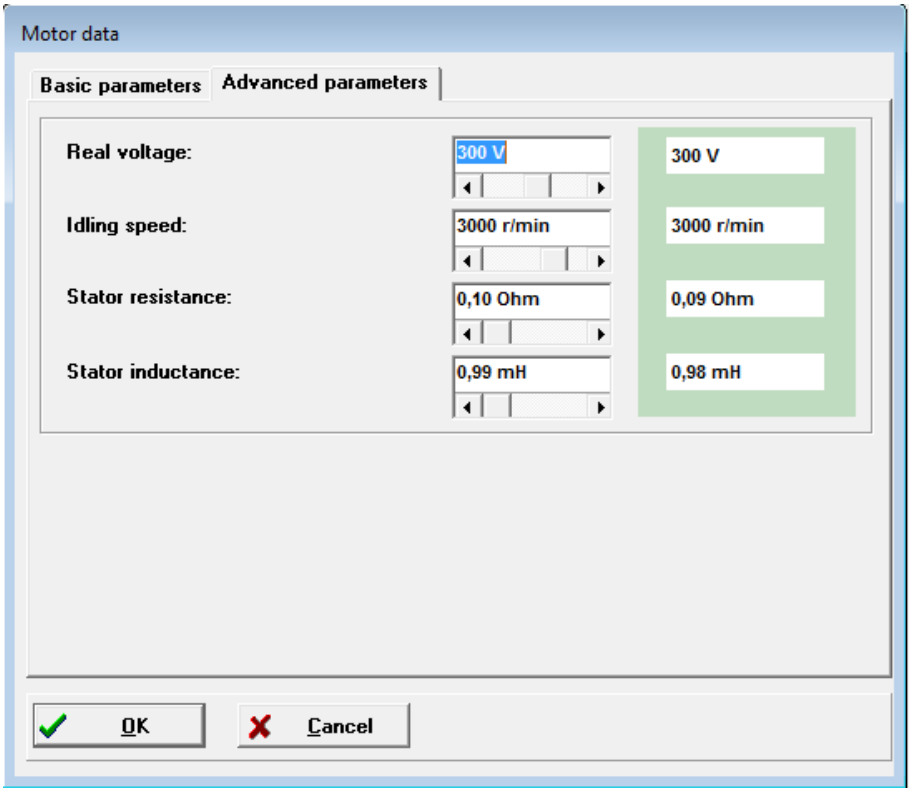
Danger!

Before starting the automatic identification, be sure to set the right current parameters via **Parameter/device parameter/motor data**), if not it can damage the motor!

With encoder with low resolution (e.g. hall sensors six step) it is possible that the torque control feedback over the motor EMK gives a positive movement of the motor axis. With speed controller application about motor-EMK you can calculate the connected voltage with input current with the motor parameters using the following formula

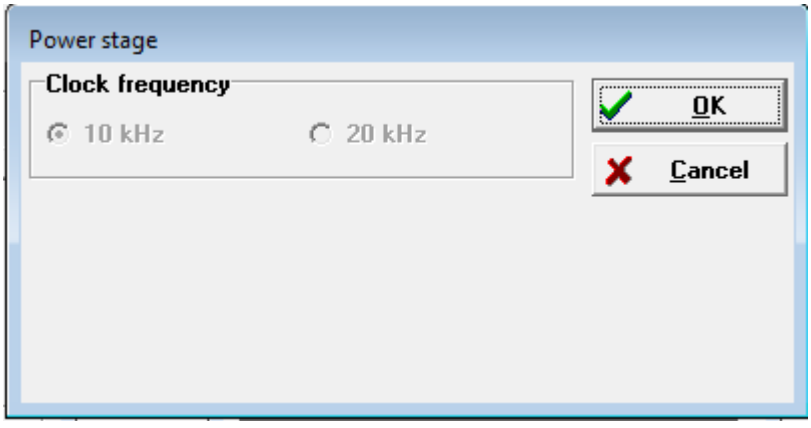
$$N_{EMK} = \left(U_{KL} - (I_q \times R_{mot})\right) \times \frac{N_{Nenn}}{U_{Nenn}}$$ To a Speed set point.

Over the selection **advanced parameter** you can input the calculated motor-EMK and other parameter settings..



4.3.3 Power stage

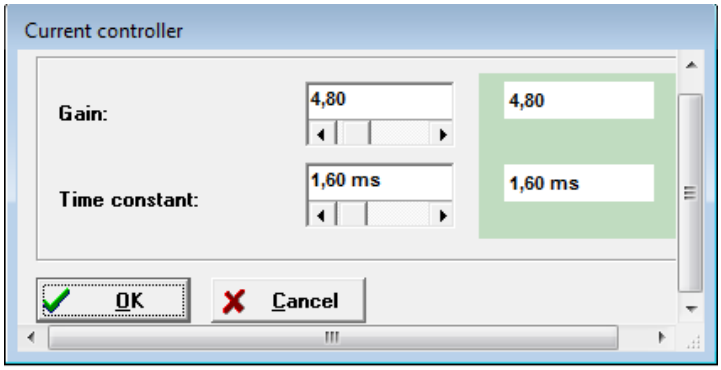
This menu **(parameter/device parameter/power stage)** determines the power stage behaviour. With small clock frequency the motor can sound like singing clay. This servo position controller has a fixed clock frequency of 10 kHz. By using higher frequencies the losses of the motor are a little bit lower. With the servo position controller RBD-S losses will also be decreased. Also the maximum current value is also slightly reduced. For the controller regulation behaviour the clock frequency has little influence. The basic clock frequency of the power stage is therefore fixed at 10 kHz.



The RBD-S controller has a fixed clock frequency of 10 kHz.

4.3.4 Current controller

The current controller can be parameterized by **parameter/controller parameter/current controller**:



The correct set up of the current controller is a very important first setting to make the right adjustment of your motor. The two parameter settings are the gain and time constant.
Put in the correct parameters. When you are not sure please use the general uncritical values.

Caution!

Wrong values can give heavy ripples or short over current and can damage the motor.
With the servo position controller you can activate the over current protection!

Danger!

The current controller may be adjusted above the correct maximum- and nominal motor currents. With too high currents the motor can be damaged as the permanent magnets can be demagnetized. The supplier given values should not be exceeded. (See chapter4.3.2*) motor data.*

With help of the oscilloscope function (See chapter ***Fout! Verwijzingsbron niet gevonden.*** Use of the oscilloscope functions*)* show the current overshoot, if you set up the channels of the oscilloscope on active current-set point and active current actual value.

Activate the **Torque control** by menu **commands** and input the nominal motor current value. Try to get the optimum overshoot. Change some values to reach the most optimum overshoot. In figure 2 you can see a nice example of the current overshoot.

The current must reach within 1 ms the set point and make a maximum of 20% overshoot. With motors with a bigger stator inductance it is possible that the reaction time is longer. It is important to reduce the overshoot and have a good damped current.

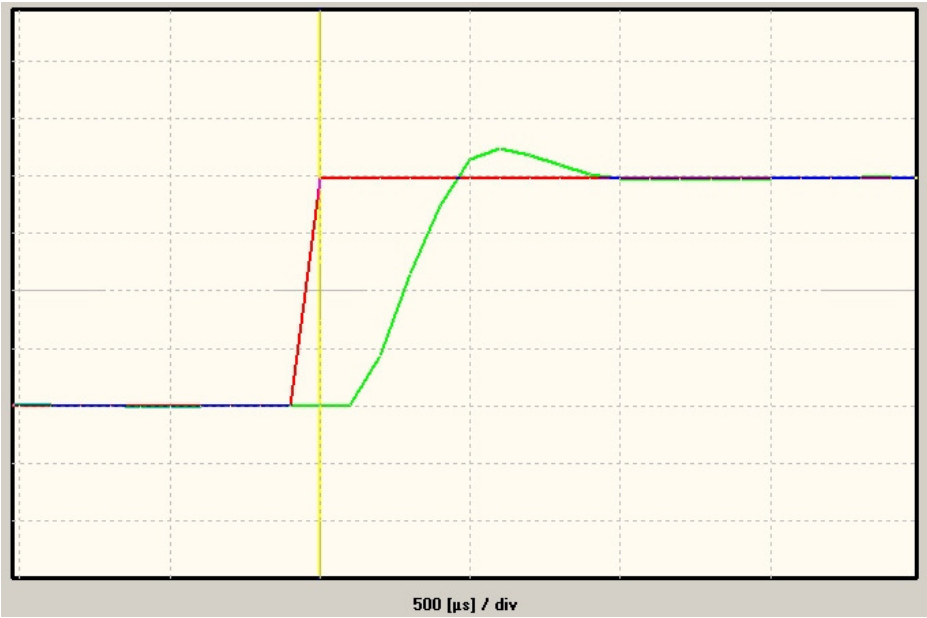


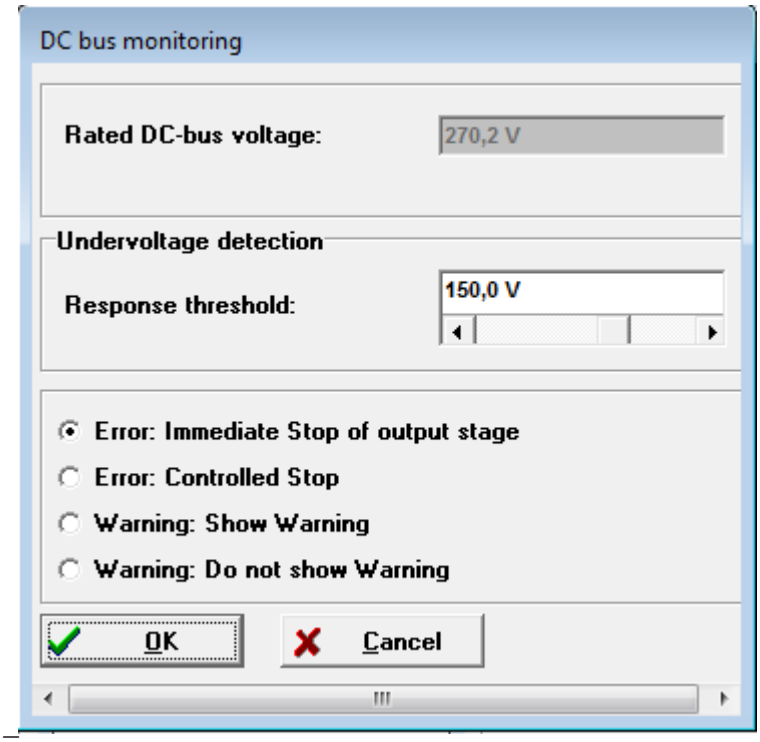
Figure 2: Overshoot current controller

4.3.5 DC bus monitoring

In special applications e.g. steep ramps or braking with high mass, it can happen that the DC bus voltage increases or decreases too much. When the DC bus is too high (over voltage > 440 V), the servo position controller shuts off. This safety function is for this reason not adjustable..

Too low DC bus voltage can cause an error and therefore this is adjustable.

The DC bus window can be activated with **parameter/device parameter/DC bus monitoring.**



Field **Rated DC-bus voltage** the voltage will be shown**.** This value is the working voltage of the power stage. This value isn't adjustable but can be different of the rated DC bus voltage.

In the field **under voltage detection** it is possible to put in the response threshold for the warning point. Best value is depending of the power supply approx 50%...70% of the rated DC bus voltage.

Danger!

When the under voltage detection is parameterized as a warning, the power stage in the situation of under voltage or a low power supply disconnection will not be activated. The controller steers the modulator to 100% and try to recalculate the DC bus voltage error.

By reconnecting the power supply the RBD-S initially moves the modulator down. Depending on the controller and motor settings it is possible to get a high inrush current, which can clearly be over the adjustment parameter values of the motor.

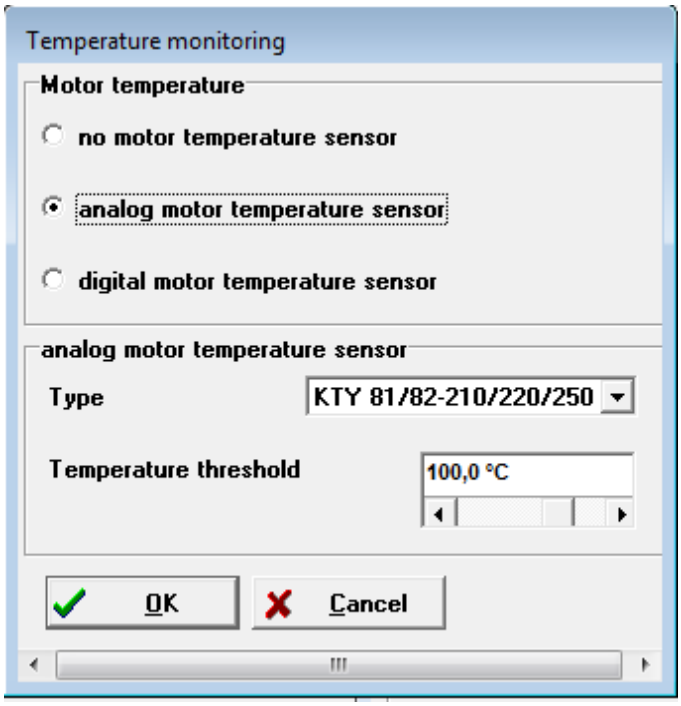
Continued use of the motor could damage it, e.g. by demagnetization. Also it is possible to get the warning/error „over current /short circuit DC bus "from the controller.

We advise the parameters **error: immediate stop of output stage**

In field **error management** you can select, how the servo position controller reacts to an under voltage (see chapter *11.5 Error* management).

4.3.6 Motor temperature monitoring

If your motor has a temperature sensor, you can adjust it by **parameter/device parameter/temperature monitoring**:



In window **Motor temperature** you can select, no sensor, analog sensor or digital motor temperature sensor.

The selection **digital motor temperature sensor** is applicable when the motor used has a normally open contact or a temperature sensor with PTC-curve. The sensor will be fed with a small metering current from the controller. The split voltage drop over the sensor will deactivate the end stage and activate the over temperature error.

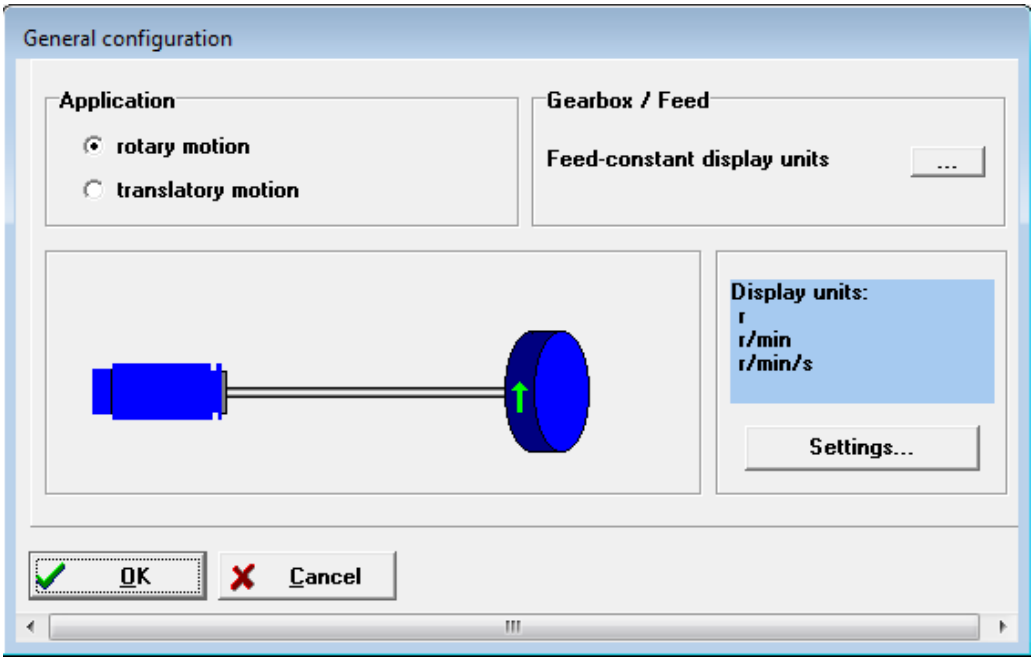
By (linear) analog temperature sensor the temperature threshold must be input. It is possible to do it through activated analog temperature sensor in field **analog motor temperature** settings. You can select the following generally used temperature sensors via the selection box:

- KTY 81/82-210/220/250
- KTY 81/82-110/120/150
- KTY 83-110/120/150
- KTY 84-130/150

4.4 Application parameters

4.4.1 General configuration

The possible attitudes are dependant on the general configuration, which can be input via **parameter/application parameter/general configuration**. The following application windows will be shown:



In field **Application** you can select **rotary** or **translatory** motion depending on your application

If you want to set up your display units for the output shaft side, please select the button **Gearbox** / **Feed** or **Settings**. You can in accordance of *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Adjustment of the display units. Select from the menu of **Display units**.

Application example:

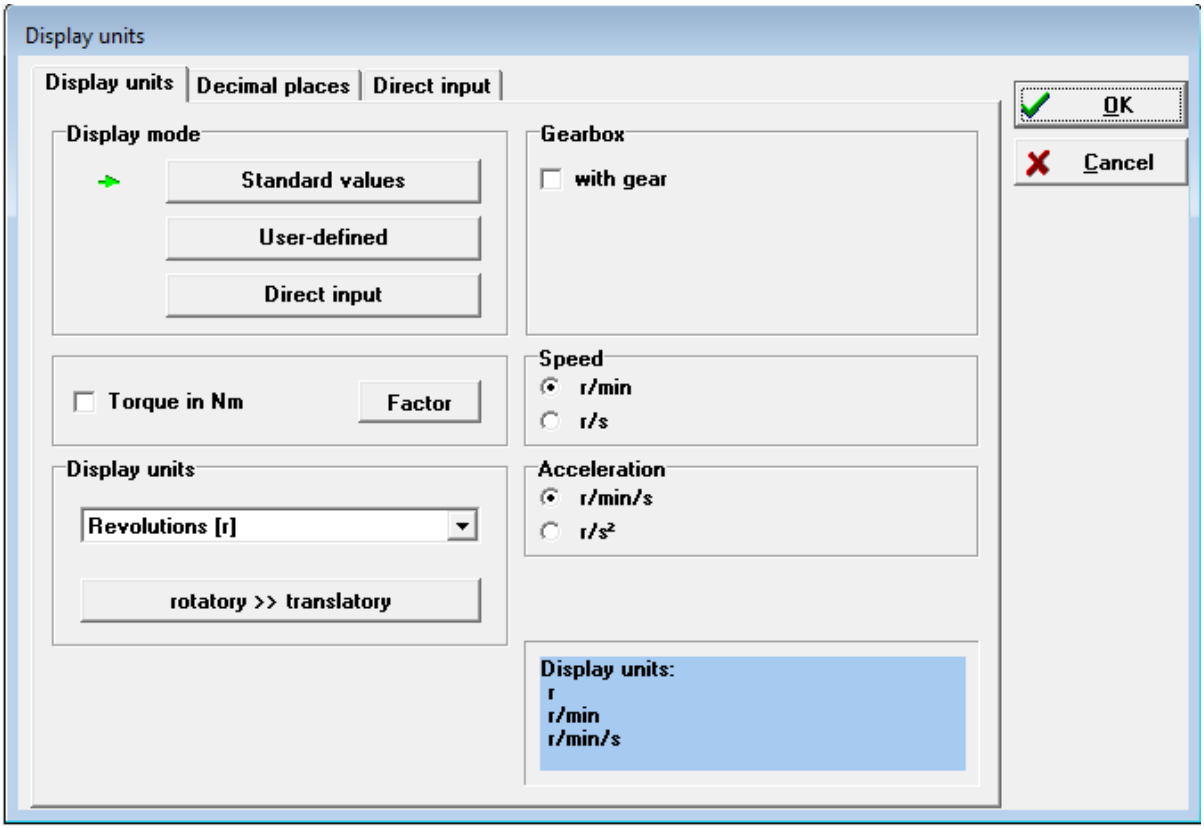
- Rotary with gear:
  to move a conveyor with fixed constantly rotating speed (load independent).
- Translatory with feed constant:
  Positioning to make holes or positioning welding machine.

4.4.2 Adjustment of the display units

Over the menu **Options/Display units** is it possible to make the display units for positioning, speed and ramps. These are the only units used in the parameter program. The parameter program communicates with the controller over communications objects, which has a fixed physical fundamental. Every access over RS232-interface will be done with these basic units..

The user has the possibilities to use the following physical units:

- Position / speed
- Speed
- Acceleration
- Torque (in Nm or A)



The adjustment of the display units is independent of an offset over a field bus. The input of the display units has no affect on the factor-group and their notation- and dimension-indices in field bus specified protocols, like e.g. the CAN open factor-group!

Table 6: Display units

Selection	Units
Default values	For linear axles: Positioning in distance units, speeds in [distance units]/s; acceleration in [distance unit]/s². For rotary axles: Positioning in revolutions, degrees or radians, and several speed- and acceleration units.
User defined	Example: ❖ For linear axle and not symmetrical distance, speed and acceleration units (e.g. inch, inch/min). ❖ For rotary gears with special distance, speed and acceleration units.
Direct input	Free input of distance, speed and acceleration units. **Only for experienced users!**

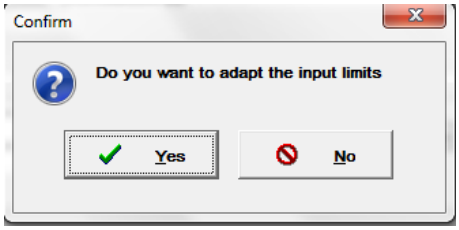
The tab **Decimal places** gives the opportunity for the user to adapt the represented sizes to „the physical “conditions**.**

The tab **Direct input** permits you to configure, the RBD-S ServoCommander™ so that different units from the displayed unit options can be used.

For more Information see chapter *12.8 Appendix possibilities display units.*

Caution! Only for experienced users!
The tab direct input you can input directly into the factor-group, when you have selected direct input.

By stopping the menu the next questions follow:

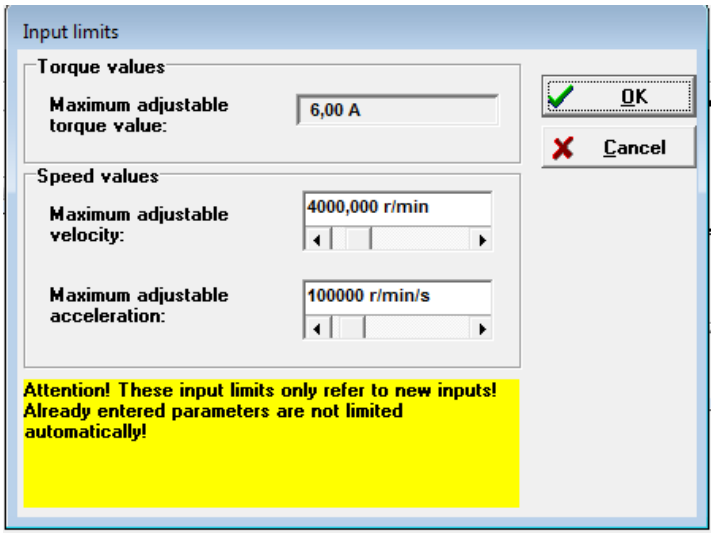


The input limits adapt automatically to the adjusted physical units, to allow you to control these. Click for this on the button

The input limits adapt automatically to the adjusted physical units, to allow you to control these. Click for this on the button Yes

4.5 Specification of input limits

Via **Options/input limits** the following menu is displayed:



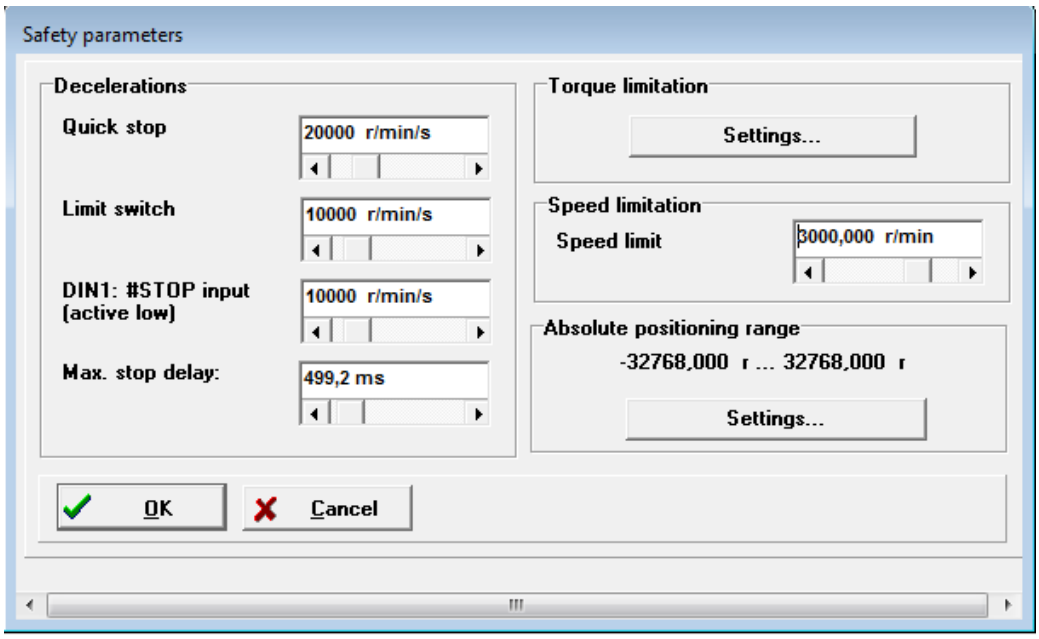
Put in the maximum speed value and the maximum acceleration which will be used in your application in balance with your selected motor. The program uses these values for input limits in the input boxes.

The inputs limits can be changed afterwards. They only show the display units in the parameter program!

It does not place a physical limit on speeds and accelerations in the drive. The limits of values in the drive can be made in accordance with *chapter 4.6 Safety parameter* described in the menu **Safety parameters**!

4.6 Safety parameter selection

To protect the system from overloading, the accelerations and speeds ranges can be limited. These limit ranges can be made in menu **Parameter/Safety parameter**.



The following safety parameters can be configured in this window:

- Decelerations:
  - Deceleration quick stop:
    This deceleration will be used by disconnecting the enable or in an error situation (should it occur).
  - Deceleration limit switch:
    This deceleration will be used when the gear is being moved against the limit switch.
  - Deceleration Stop input:
    This deceleration will be used when using jogging & teaching application - the digital input DIN1 will be connected to Low.
- Maximum stop delay:
  Cannot make a controlled stop of the gear by disconnecting the enable. (E.g. due to an error parameter setting), after this time the end stage will be shut down, the motor runs down, when the motor is not stopped on zero speed..

- Speed limitation:
  The speed offset can be limited here.
- Torque limitation:
  Via the button **settings** and window adjustment **motor data** (see chapter4.3.2*) motor data.*
  Here you can input the torque limitation in Amps via the **maximum current in A, rms value**.

Absolute positioning range:
Via the button settings and **window** adjustments **settings position sets** / **course program** (see *chapter* **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**). Here you can make the maximum positioning length (SW-limit switch functionality).

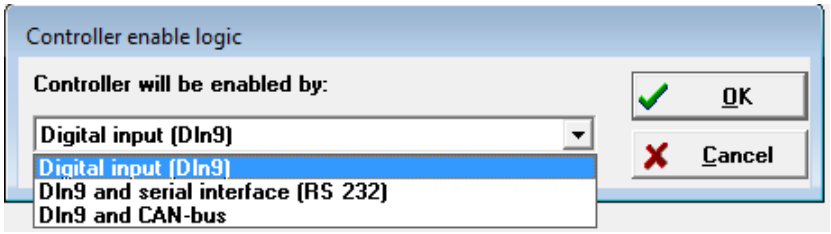
> Depending on the controller settings for current, speed and positioning, it is possible via „overshoot “to exceed the adjusted parameters for a short time.. These must be controlled during the first commissioning in your application to reach the most efficient and smoothly optimized controller.

4.7 Adjustment of controller enable logic

To enable the end stage with controlling of the servo position controller RBD-S, the controller enable logic must be configured. The controller enable logic gives a choice in of how the functionality can be controlled to enable the controller and supply the motor a current.

Via **Parameter/device parameter/Controller enable logic** you will find the menu to select the controller enable logic settings..

This menu is also found by the **Commands** window, click on the button **Controller enable logic**.



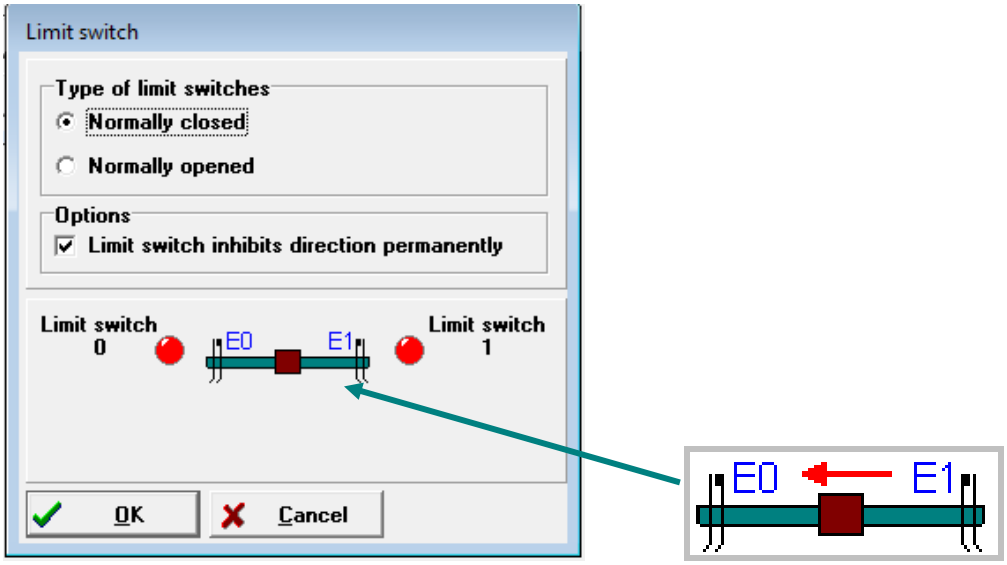
From the drop down box you can select the following options:

- Digital input (DIN9):
  The controller enable is just via digital input DIN9.
- DIN9 and serial interface:
  For a controller enable DIN9 must be connected and also a serial command must be made. These are possible by setting a flag in the field **controller enable** in the **Commands** window.
- By DIN9 and CAN-Bus:
  For a controller enable DIN9 must be connected and also a command over CAN-Bus must be sent.

4.8 Setting of the limit switch

The servo position controller supports limit switches with normally open or normally closed contacts.

Configure your application with no activated limit switches within the position range and do not activate limit switches. In menu ‘limit switch’ none of the Led’s may be lit. These can be changed by clicking of either **normally closed** (DIN7, DIN8 = +24 V → offset free connected) or
normally open (DIN7, DIN8 = +24 V → offset blocked).



The small right window shows with the **red** arrow the direction of the movement to a limit switch. You can see the movement direction in combination with the selected limit switch. And if necessary you can change the wiring of your limit switches.

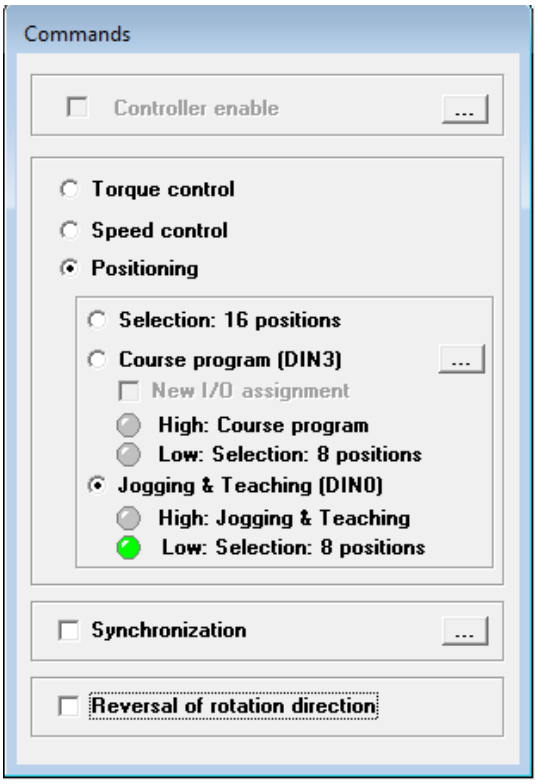
The limit switch 0 is the negative limit switch. It blocks rotations < 0.
The limit switch 1 is the positive limit switch. It blocks rotations > 0.

As long as the limit switch is active, the offset in that direction will be blocked in your application. By overriding the limit switch or swinging limit switch you have the option "**Limit switch inhibits direction permanently**". By selecting this option, the direction of an activated limit switch stays in a blocked situation after leaving the limit switch. In this situation you can move in the other direction but it isn’t possible to move again in the previous direction. The blocking can be removed by disconnecting and reconnecting the enable.

4.9 Set up the rotation direction

On the bottom of the **Commands** window there is an option to change the "**Reverse of rotation direction**". Here it is possible to get a movement direction according to the angle count, the right sign of speed and current.

Danger!
By activating this option, the gear rotates with the same settings in counter clockwise!



4.10 Ready for operation, enable the end stage

An aim of this chapter is to rotate the motor with a constant speed. After this other controller functions such as speed and position controller can be optimized.
The set point selections will be done by the analogue input.
The enable must be done via the digital input "Controller enable".

Danger!
This chapter may be performed only after the total settings as described in *chapter* **Fout! Verwijzingsbron niet gevonden.**. In particular the current limits of the current controller and the safety parameters.

Wrong basic settings can disturb the servo position controller / motor and mechanical parts!

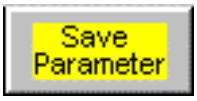
Experience has shown that the current limits, especially the maximum current of the controller, should be reduced to a small value „. -e.g. half nominal current, so that high torque to components as a result of incorrect settings cannot damage the system.

In order to be moveable the engine speed adjusted, they must stop the still following points
:

1) Activate the speed control (see *chapter 5.2 Speed control*).
2) Set the controller enable logic to “digital input (DIN9) “ only.
(see *chapter 4.7 Adjustment of controller enable logic*).

3) Activate the speed controller logic via analogue input 0 (see *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Set point over set point selectors) and set parameters of the speed range (*chapter 9.5* Analogue inputs AIN0 and AIN1).
If it is not possible to use the analogue input, it is possible to make the setting via the serial interface (see *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Set point over set point selectors*)*.

Before you control the enable, you must save first the parameters in the controller. You can do this with a mouse click on the button shown. It is found in the upper menu border of the main window.



4) Connect the enable.

The motor(s) start to rotate. When the motor makes no movement there is an error or the servo position controller RBD-S is wrongly parameterized. In the following table is an overview of errors and how they can be reset:

Table 7: Error message: Speed controller

Error	Remedy
The motor gives some torque, and "rests" in different situations.	The poles and/or the phase angle are wrong, adjust the phase angle and/or change the motor phases. Start the automatic detection again. (See *chapter* 4.3.2) motor data.
The motor shaft oscillates or runs jerkily.	The angle encoder offset and/or controller parameter (see *chapter 5.2 Speed control*) are wrongly adjusted. Please do the automatic detection again. (see *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Angle encoder)
The shaft doesn't rotate.	No Dc bus voltage.
	The limit switch is activated.
The shaft doesn't rotate. In the offset window the speed value is shown as „0".	The speed controller command does not have the right configuration. Read *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Set point over set point selectorsfor more information.

Pay attention to the connection of the motor phases, they can vary with supplier of servo motor. You may have to change the phases U and W.

5 Current and speed controller

5.1 Functions overview

The current and speed controller is like cascade logic with an internal current calculation loop and an overlaid speed controller. These controllers are developed like a PI-controller. With the offset selectors you can input offsets with different sources to the controller connections. (see chapter **Fout! erwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**).

The principal structure is shown in a block diagram on the next page.

With rotor oriented control they use two current phases and the rotor position. These currents will be first in the Clark-Transformation with imaginary and real parts transported and direct with the Park-Transformation in the rotor coordinate transformed. Now the rotor current can, with PI-controlling to an appropriate rotor voltage, be calculated and sent to the motor stator system. The driver signal voltage calculates with symmetrical pulse width modulation for the power stage in sinus commutating with 3 harmonic waves.

An integrator controls the current²-time-integral of the controller. If the maximum value (maximum current for 1 sec.) is exceeded, a warning shows and the current is reduced to the nominal current.

The substantial advantages of rotor oriented current regulation are explained in *chapter 1.2.3 Features of ..*

In torque controlled mode there will be an adjustment of **i_act** for the active current controller. In this mode only the current controller of the servo position controller is active. Because the motor rotor takes out torque and this is proportional to the active current of the motor and so we can speak of a torque controlled application.

Good torque control is essentially down to the motor and the sensor system for the rotor position collection adjusts..

With a good synchronized machine, a high resolution encoder (good resolver) and a well adjusted controller you can, with the RBD-S, reach a torque ranging from within 1% to 3% calculated from the maximum current or the available maximum torque of the motor.

In speed controller command we work with an offset speed value. The servo position controller RBD-S calculates the encoder resolution to an actual speed value **n_act.**. To realize the offset speed value the current offset **i_off** will be calculated.

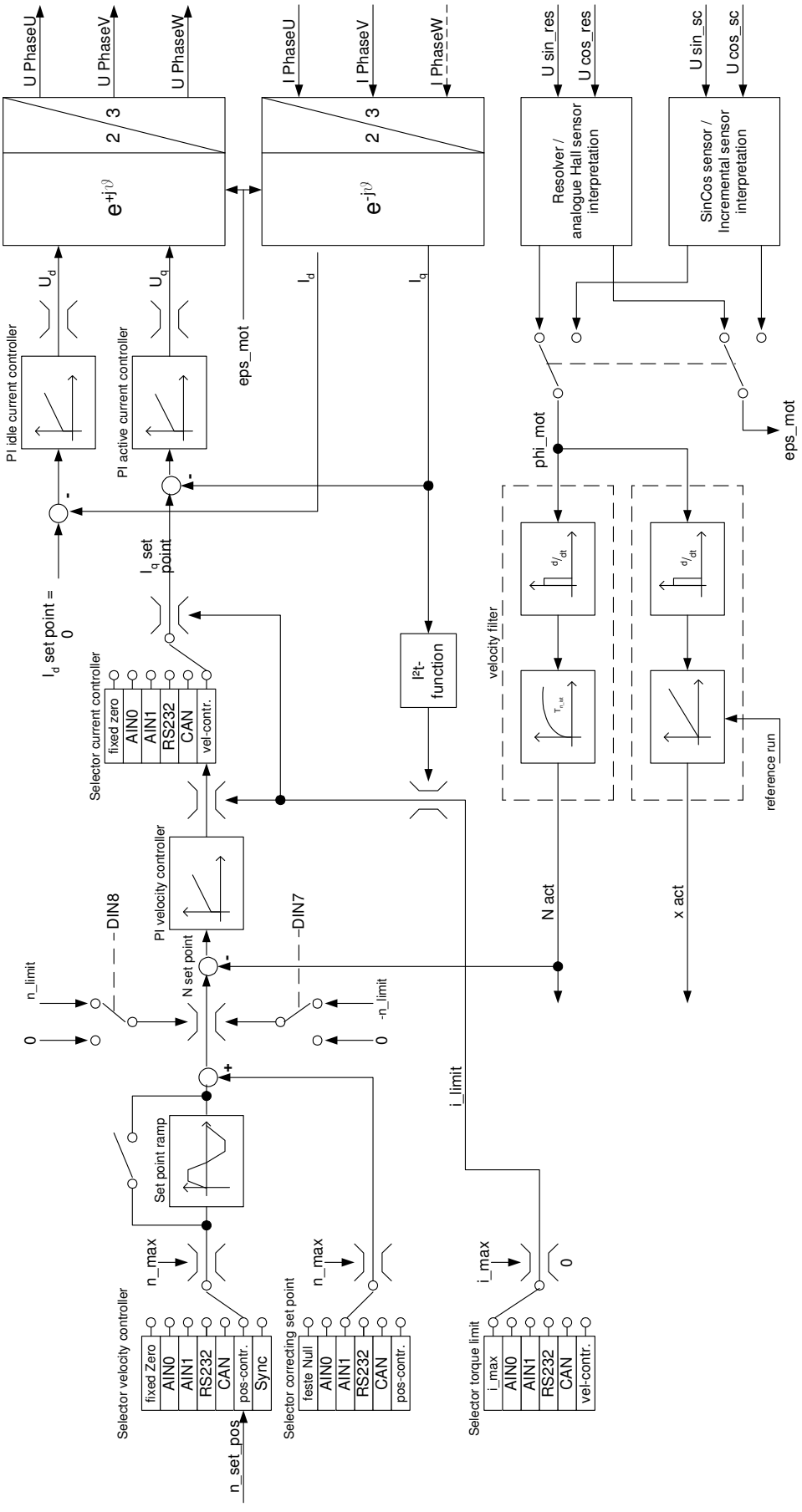
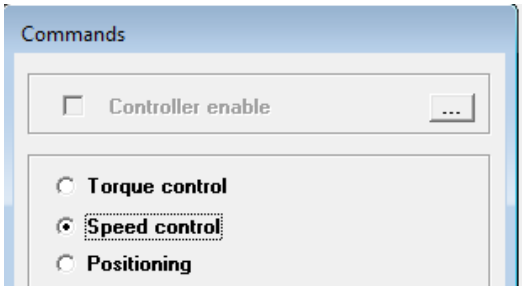


Figure 3: Block diagram controller cascade

5.2 Speed control command

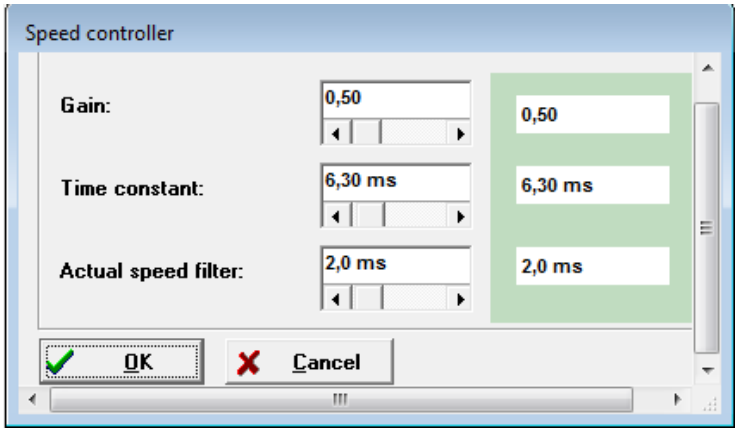
To parameterize the speed control, you must have configured speed control in the commands window:



For offset configuration in this command see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**.

5.2.1 Optimizing speed controller

To optimizing the speed controller in your application select **Parameter/ device parameters/speed controller** to open the window speed controller:



In this menu you can input the **gain** and **Time constant** for adjustment of the PI controller.

To optimize the controller behaviour the measured number of revolutions can be smoothed.

This can be achieved with **actual speed filter**. The active actual speed filter can be parameterized.

With too high an actual speed filter value you get a bad dynamic because variable disturbances delay the recalculation. In the most effective situation a high time constant value can worsen the stability of the control loop. The additional lead-time can cause oscillations.
With too low a time constant and a high gain value an acoustic noise and a light unstable rotor occurs. The motor will heat quickly. To minimize stability issues use a small as possible time constant. The border is given the noise downward. A typical practical value of the actual speed filter for resolver motors is approx 0,8 and for hall sensing motors is 1,8 ms. In general from 0,6 to 2,0 ms.

The speed controller must be adjusted so that the overshoot of the actual value must be approx 15% above the speed set point. The overshoot of the falling oscillation of the actual value may be a little under the set point value so it can return on the set point value. These adjustments are available for

most types of motor which are driven by servo controllers. When a harder adjustment is used it is possible to increase the gain. The gain extremes are limited by applications with high speeds or suggestions of the wave it could be gives axe oscillations. The gain in the attainable reinforcement in the number of revolutions automatic control loop depends on load conditions at the motor shaft. You have to check the speed controller adjustments with the gears in the machine.

When you set up the speed controller via stationary speed, you have to change the gain when the motor is built in.

5.2.2 Optimization strategy

Optimizing the time constant and the gain of the speed controller is performed by applying a speed set point step. Adjust the command on „speed controller “and select the set point selector to give in a set point and disconnect the acceleration time. A speed shoot will be reached e.g. by RS232-interface or by an analogue set point, during a small activating a jump will be shown.

Monitor the reaction of the speed controller on the set point steps with the oscilloscope function and accordingly set the controller parameters (See chapter ***Fout! Verwijzingsbron niet gevonden.*** Use of the oscilloscope functions). You can show the overshoot reaction by using the channels of the oscilloscope speed set point and actual speed (raw).

General advice, the value of the gain and time constant must be changed in small steps. Start with a range of 8 ms to 10 ms initially and decrease the gain in steps. After an acceptable gain adjustment the integer time should be reduced in small steps.

After changing the counter value there could be two situations which arise:

- With too harsh adjustments the speed controller can be unstable.
- With too soft adjustments the curve is not followed rigidly enough, following errors will exist.

The speed controller parameters are not independent of each other. From attempt to attempt every measured curve of several axes could be different in your application. Change just one parameter, the gain or time constant.

To adjust the speed controller degrease the gain, so the axes start oscillation; now reduce the gain in small steps. Carry on until the oscillation has gone. The next step is to reduce the time constant, to the point that oscillations start, then increase the time constant in small steps until the controller is stable at set point = 0.

Set up oscilloscope
Channel 1: Speed set point; scaling = 1000 rpm / div; offset -2 div
Channel 2: Actual speed value; scaling = 1000 rpm / div; offset -2 div
Time base: 5 ms / div; delay = -5 ms
Trigger: Source = speed set point; level = 50 rpm; mode = normal, rising trigger edge
Disconnect ramps in set point selectors and put in maximum acceleration time.

Case 1: speed controller too soft

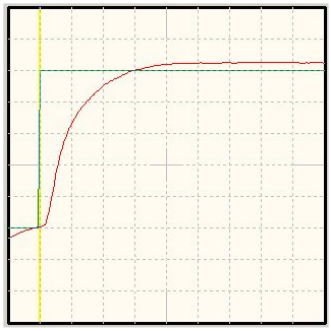


Figure 4: speed controller – to soft

Remedy: Increase the gain by 2 to 3 points of a tenth/
then reduce the time constant by 1 to 2 ms

Case 2: speed controller too hard

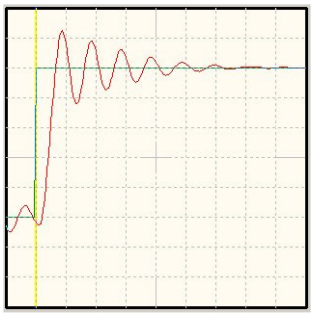


Figure 5: speed controller too hard

Remedy: Decrease the gain by 2 to 3 points of tenth/
then reduce the time constant by 1 to 2 ms

Case 3: speed controller set correctly

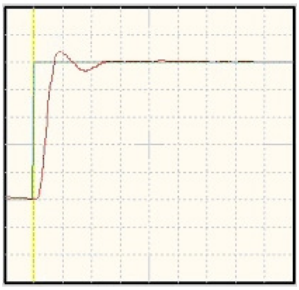
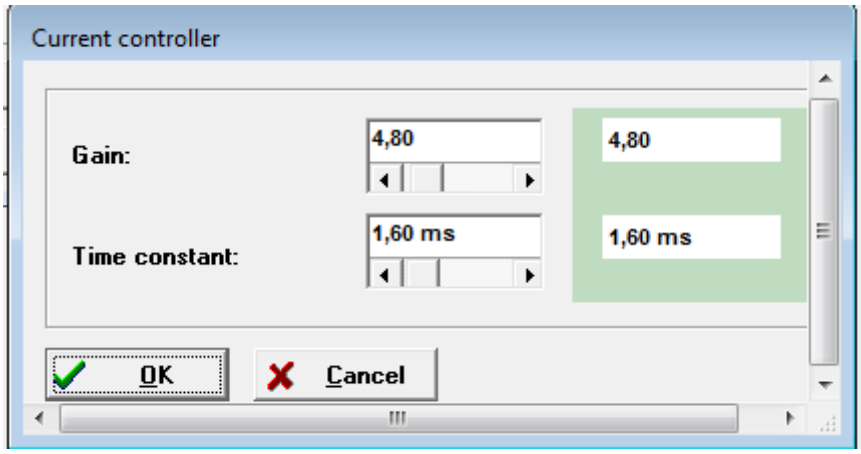


Figure 6: speed controller – set correctly

5.3 Current controller optimization

To adjust a torque controlled application it is necessarily to configure the command window.



The torque set point can be set in **A** or **Nm**. This can be changed with menu **Options/display units**. The menus concerned automatically apply the right units.
If the torque is to be given in Nm, it is important to know the **torque constant**, also calculation factor between current and torque. The torque constant can be adjusted with menu **Parameter/device parameter/Motor data** and could be calculated by using the motor rating plate values. So you can divide nominal torque by the rated current.

Torque constant of **0 Nm/A** is not possible when “torque in Nm” is activated.

5.4 Set point over set point selectors

The servo position controller RBD-S gives the options via the command torque speed control to manage it with set points by set points selectors. The right menu is **operating mode/Set point-Selections.**

As set points the following can be selected:

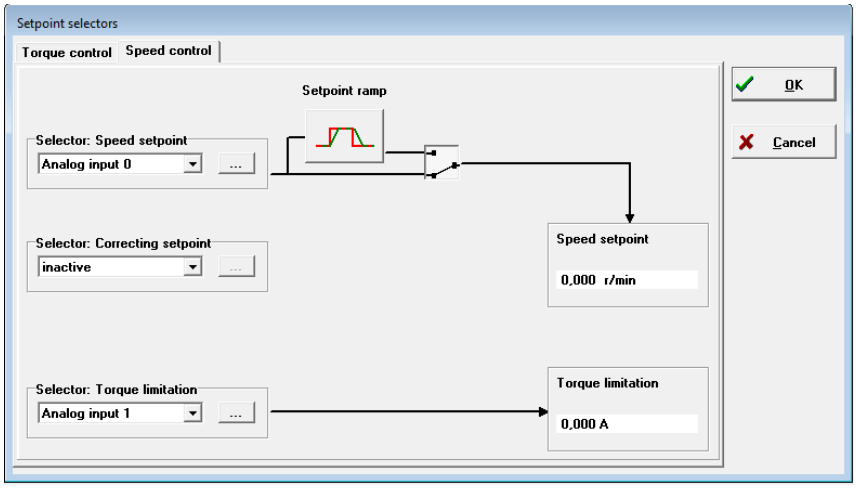
- 2 Analogue input:
  - AIN 0 and AIN 1 (Parameterization see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**)
- Fixed value RS232
- Fixed value CAN
- Position controller (in command mode speed controller)
- Speed controller (in command mode torque control)

If there is no source of desired value activated (inactive), then the set point is zero..

The selector management gives for every commands the spitted parameters. That means, by changing of command the set point selectors change automatically to the selected values concerning the application..

5.4.1 Speed controller application

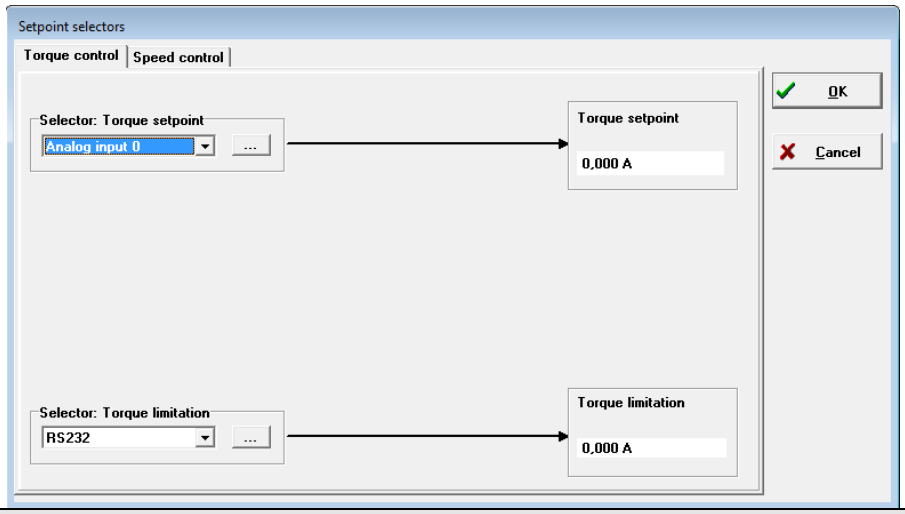
In set point selectors there is a set point ramp generator applicable with **Selector: speed set point** which can select a set point function and be controlled by the set point ramp generator. Additionally a second function is selectable **Selector: correcting set point** which is not controlled by the set point ramp generator. The total set point is the sum of both values. The ramps are direction dependant in acceleration and deceleration parameterization.



In this menu for the speed set point you can also activate the torque limitation. These is symmetrical with the free choose limitations.

5.4.2 Torque control command

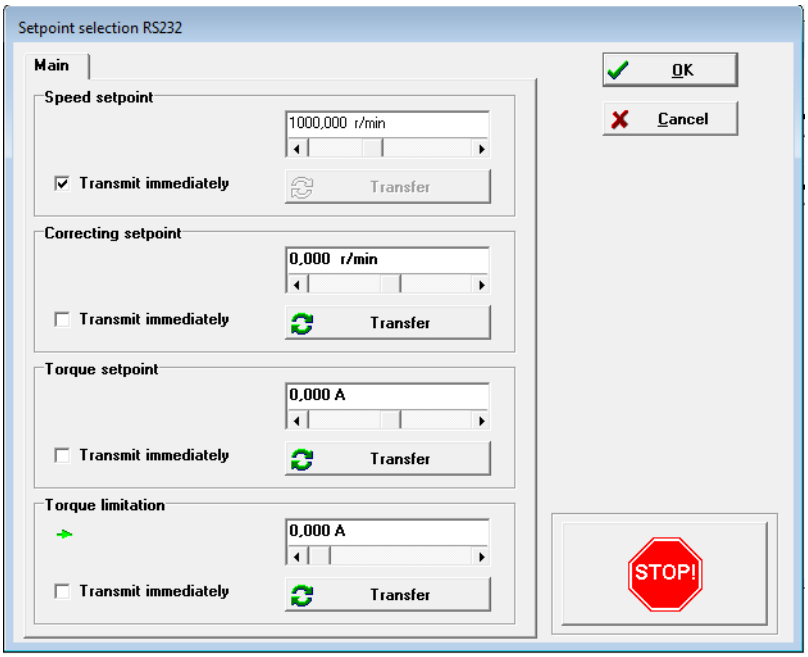
When the **torque control** button is selected you can adjust **Selector: Torque set point** and you can input the set points. In both situations the set point ramp generator is disconnected so that the torque limitation can be activated.



Analogue input is activated but no line is visible, then the digital inputs are activated ?? (see chapter *9.1.1 Attitude of the digital* inputs)

5.4.3 Settings via RS232

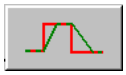
If you have activated the set points via RS232, than it is possible with menu **Operating mode/Set point selection RS232** to make the set points. You can also reach this menu by using the window ??? near the selector input.
The following windows show:



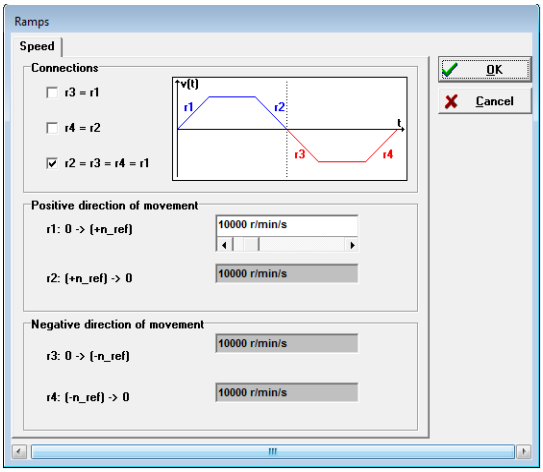
The previously activated RS 232 function will be shown by a green arrow.
Here can you put in the set point and limits. To halt a quick error input, you can click on the red symbol **STOP**. The set point goes directly to **0** and will be transmitting.
To stop the set point transmitting immediately, undo the tick in **transmit immediately.** New values will only be sent by clicking the **Transfer** button.

5.4.4 Set point ramps

The servo position controller RBD-S can preprogram several speed set points. It can send the jump unfiltered to the speed controller, or it can calculate functions, which can independent set points with a ramp adjustment over menu **Set point selectors**.

The set point ramp generator can be activated and deactivated with the switch  .
The menu for adjustment of the ramps can be set with set point selector menu over symbol  or by **Operating modus/Ramps**.

The following window shows:



The ramps can be separately adjusted for clockwise and counter clockwise, also for rising and falling speeds. When the ramp accelerations are the same, you can save time by using the connection box [r3 = r1], [r4 = r2] or [r2 = r3 = r4 = r1].

The set point ramp generator is always used when the controller command is selected as speed controller and no positioning – also by external logic. The ramps must be adjusted so the gear accelerates with realistic load conditions and isn't restricted by current limitations. With correct adjustment of set point ramps, overshoots of the speed controller relative to the set point reduce in relation to commands without set point ramp. In applications with position controller (internal or with external logic) the set point ramps must be deactivated. Now the controller works like a PT_1-filter and the stability can be worse.

5.4.5 Current controller with torque limitation

As previously mentioned, in the application Speed controller a Current controller with torque limitation can be parameterized. The adjusted offset value is the maximum available torque; herewith the offset for current/torque controller will be symmetrically produced.
Please ensure that the current offset additional value is produced in accordance with the Motor file selected values for nominal as well as maximum current. The current offset is herewith produced by a smaller torque limitation border in balance of the motor values.

Applications, with torque limitation control in all quadrants, even so adjustment of torque from zero to maximum in a rotation direction, can be in most situations favorably made in the speed controller application with torque limitation:

- The input of torque offset can be done by torque limitation
- The speed offset will be made by a separate offset input, so that if a „Rev up“ of the missing load occurs, the speed produced is not a dangerous value.

6 Position application

You can skip this chapter if using your application in speed or torque control function.

6.1 Functions overview

In the positioning function the speed controller a positioning controller overlaid. In the positioning function a fixed position is set, which will be moved to by the motor, without any input from an external controller or PLC. In this application the controller cascade in RBD-S is extended, as shown in

Figure 7:

- The positioning controller is implemented as a proportional controller (P-controller for short). The actual position comes from the internal encoder information. The position deviation will be recalculated in the position controller and is passed on as a speed offset to the speed controller.
- The course generator calculates the movement profile which is necessary to go from the present position and the actual speed required to reach the target position. It sends the offset position for the position controller and a pre-speed offset for the speed controller to give a better controller dynamic for high positioning movements.
- The positioning movements have many possible signals, which are be necessary when using external controllers/PLC, e.g. target reached message and a following error.

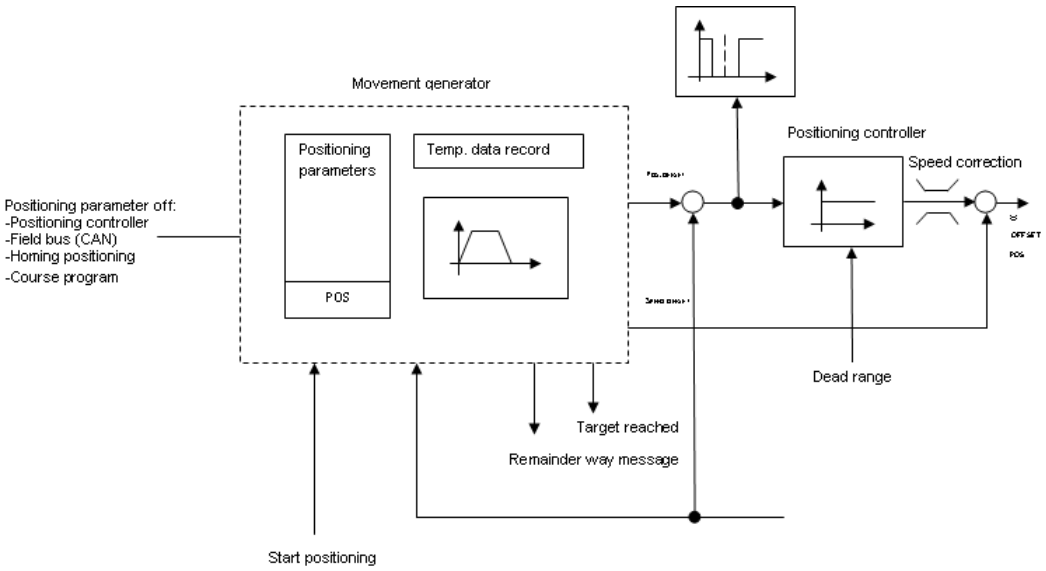


Figure 7: Positioning control block diagram

In contrast to previous RBD-S products the complete procedure in every controlling point is newly calculated. In this way, positioning procedure can be by movements on every time change or disconnect the procedure.
This concept is made possible by the high efficiency of the RBD-S used for Motion-Control-DSPs control.

The high efficiency positioning control in the RBD-S allows the options of many parameters and targets. Up to 64 target positions can be fixed programs and saved in the RBD-S and can be moved across to the trajectory generator.
Each of the 64 positions means every one is a separate target position. The extended parameters of 64 positions are split into 4 groups with general values for each block. For every 4 position group the following parameters can be adjusted:

- Acceleration
- Running speed
- Choice of acceleration type:
  jerkfree imitated speed profile or time optimal (constant acceleration)
- Relative or absolute positioning
- During positioning - wait, ignore or interrupt
- Start delay

Alternatively the RBD-S offers the possibility where all parameters of individual positions for every target position can be saved. It gives high flexibility to every movement profile. The maximum quantity of available positions will be reduced to 16.

The choice of maximum available positions, 16 or 64, can be parameterized over the RBD-S ServoCommander™ (see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**).

Additional positioning targets for positioning over CAN-Bus (DSP402) and homing positioning.
The positioning controller allows point to point movements with the end speed zero (stationary at target). The interrupt during a positioning will also allow direct change to the next position.

The selection of groups and positions can be via digital inputs (see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**). Alternatively the selection can be made over RS232-communication.

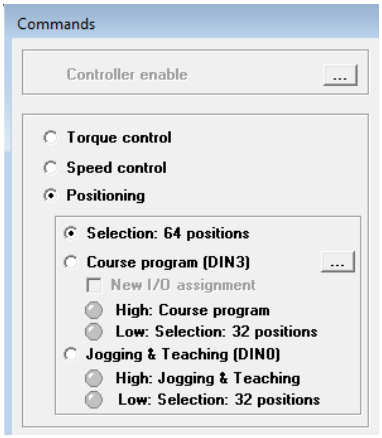
For the homing movement, or if positioning over CAN (DS402) is desired the appropriate position

Targets come direct from the trajectory generator.

6.2 Activate commands

For adjusting the homing and positioning application:-

You must configure the commands windows as follows:



DANGER!

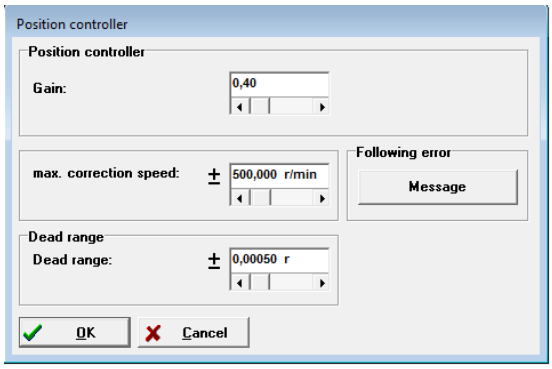
You should only activate the positioning application after adjustments to the motor parameters and also the current and speed controller.

Wrong basic set ups can harm the servo controller motor and the mechanical gears.

6.3 Positioning adjusting and optimizing

In positioning application is additional in function like speed controller with additional extended positioning controller active, the difference between offset and actual position calculated and in appropriate offset input to the speed controller inverted. The position controller rebuild between the difference offset- and actual position a correction speed, which like offset to the speed controller further die passed on.
The position controller will be connected into the position program. There is a P Controller with adjustable input and output limits.

Via the menu **Parameter/Controller parameter/Positioning controller** the window opens for parameterization of the position controller.



Input the following values:

- **Gain:**
- **Max. Correction speed:**
  You have the possibility to put in your speed, in case of differences between offset- and actual position it calculates to this speed. This value must be adjusted in order of ca. +/-500 r/min.
- **Dead range:**
  Here you can additionally input the distance between offset and actual position,
  where the position controller cannot be reactive. By adjusting the dead range we reduce the border oscillation be suppressed, which can be stand up by low dissolution, even e.g.. In block commutating gears with position feed exclusive motors with hall sensing systems. The dead range must be adjusted to the zero limits to give the best positioning accuracy.
- **Following error:**
  Parameterization of a following error, also a message delay. If the deviation between offset- and actual value is bigger than the adjusted limit, a message or an error will be shown. Also the reaction type can be selected in the error management.

6.3.1 Optimizing the positioning controller

The condition for optimizing the positioning controller is correctly adjusted current and speed controller. (See previous chapter)

Please be sure that the motor axes can freely rotate so that nothing can happen to the application..

To start the optimizing the following steps are necessary:

1. Actuate the positioning controller and put in a gain value of 0, 5.
2. Open the menu for parameterization of the destination parameters (See chapter *6.5 Destination)* and put in the following values for destination 0 and 1:
   - Destination 0: 10 R / Destination 1: -10 R
   - Running speed: (half nominal speed)
   - Acceleration: (maximum possible)
   - Negative acceleration: (maximum possible)
3. Start up the Oscilloscope (see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**) by activating menu Display/Oscilloscope and input the following values:
   - Channel 1: Running speed offset; Scaling = 1000 R/min / div, -2 div
   - Channel 2: Rotor positioning; Scaling = 50 ° / div; Offset 1 div
   - Time basis: 100 ms / div; delay = -200 ms
   - Trigger point = running speed actual; Level = half movement speed; Modus = normal, falling down Trigger point
4. Switch on the enable. Start the positioning alternately between destination 0 and 1 over menu go to destination (See *chapter* **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**). The motor has moved between the two selected destination limits.

Optimizing: Speed and rotor positioning by stop read out. When the start oscillation is too long the gain must be increased. When the speed starts to oscillate the gain must be reduced.

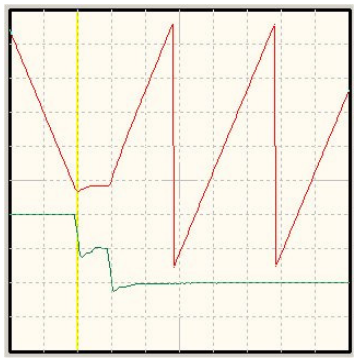
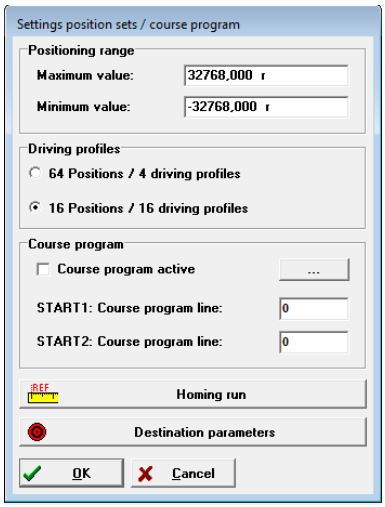


Figure 8: Optimize positioning controller

Consider by overshoot by inactive acceleration and braking time is caused.

6.4 General positioning settings

Via the menu **Parameter/Positioning/setting position sets** / **Course program** you get to the menu Settings position sets / course program to set up your position limits as global settings for all positions.



With absolute positioning every new destination will be checked for every absolute limit. The parameter minimum and maximum in the field p**ositioning range** shows the absolute position limits for the offset positioning and the actual position. The position window starts always from the zero positioning of the gear.
Via the button **Homing run** you arrive at the homing run menu (see *chapter 6.8* Homing mode)
Via the button **Destination parameters** you arrive in the menu Destination settings (see *Chapter 6.5 Destination settings*).
In the lower surface of the window you can input some settings for the course program. When **Course program active** is selected the positioning application will be activated. By using the button ... you arrive in the menu for course program (see *Chapter 7 Course program).* Also you can select two target points by using the course program.

With the option 16 / **64 positions** you can select how many destinations are to be used:

- Is the option **64 positions** active?, you can parameterize 64 free destinations. All other driving profiles (acceleration, start delay, options,) are split into blocks. There are 4 blocks for the following destinations (0...15), (16...31), (32...47) and (48...63).
- Is the option **16 positions** active?, you can parameterize 16 destinations with independent driving settings? For every destination you can parameterize the driving profile (acceleration, start delay, options,) individually.

For changing the function 64 positions to 16 positions or opposite the RBD-S must be organized with the internal file structure internal. In this situation the actual settings will be lost. All position settings will be changed to the factory settings.

After switching the destination parameters must be newly adjusted.

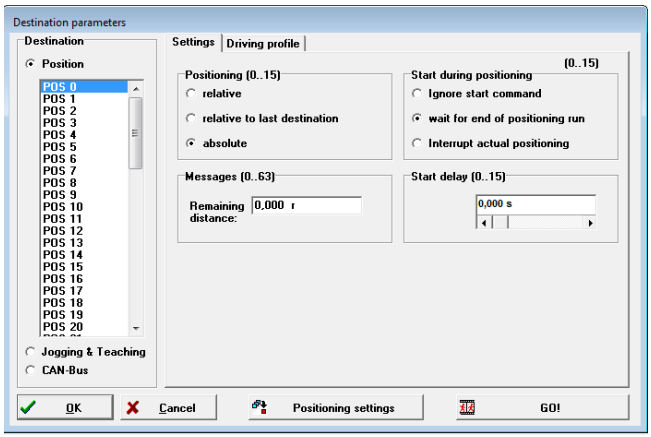
6.5 Destination parameters

In servo position controller RBD-S can be selected between 16 or 64 destination set parameters. The parameterization of the destination settings can be made via menu **Parameter/Positioning/destination parameters**.

With the button **GO!** Is it possible to start and go to the actual shows position?

With the button **Positioning-settings** you can change the general positioning settings (e.g.. Position limits) (see chapter ***Fout! Verwijzingsbron niet gevonden.*** Destination parameters*)*

Destinations overview: Settings



In the left field **position** you can select, which position set can be parameterized. When using 64 positions they are grouped in 4 blocks (0..15, 16..31, 32..47, 48..63).

If via the **Settings positions settings** / **Course program** menu the option "**16 positions /16 driving profiles**" is activated, only 16 positions settings are available. These 16 positions can be fully independently parameterized.

Alternatively to the standard position settings 0..15 or. 0..63 can be over selection points "**CAN-Bus**" and "**Jogging & Teaching**" also the actual parameterized driving profile can be read out over CAN-Bus, or the driving profile for using the digital inputs by "Jogging & Teaching" function (see chapter ***Fout! Verwijzingsbron niet gevonden.*** Extended functions of digital inputs (Jogging & Teach)can be shown and changed.

The indication (0..15) after e.g. field names **Positioning** shows the selection „**absolute“** is for every position in the group 0 to 15. The other parameters in this menu are valid also for all of the 64 positions. There the indications stand (0..63) behind the field names. If there is no indication behind the field name, it means this parameter is only for this destination.

In the **Positioning** field you can select of the destination setting **absolute** (related to the homing point) or **relative** interpretation. **Relative** refers to the current target position, for example by running positioning. The option **relative to last destination** however means the new position will be calculated from either the actual arrived destination or actual destination from which started.

The option **relative** obtains difference results, dependent on how the field **Start during positioning** is parameterized (see under). If the combination **relative/wait for end** is selected, the new position refers to the destination.

Via the combination **relative/interrupt actual positioning** the new destination will be calculated from the actual offset positioning.

The field **Start during positioning** gives the difference of the servo controller, when one positioning is running and the start interrupt for the new destination is received. It possesses the options:

- **Wait for end of positioning run**: The running positioning runs to the end and after that starts the new destination. The start begins automatically after closing the running positioning.
- **Interrupt actual positioning**: The running position will be interrupted and the new destination directly started.
- **Ignore start command**: the positioning order for new destinations can be started only after receiving the destination.

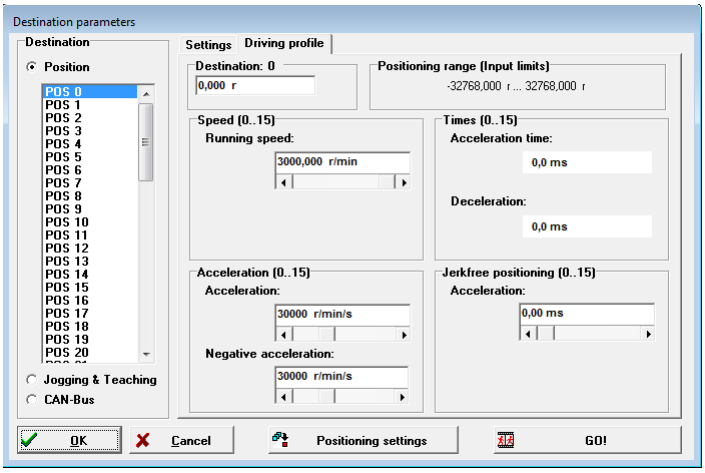
Attention, a bouncing switch input can give problems, when a relative positioning **Wait for end of positioning run** or **Interrupt actual positioning is accepted.** It is possible that the gear can be moved too far!

In the **messages** field you can parameterize a trigger message which can be read out across field bus or a digital output. This trigger message shows the **Remaining distance** to the end of a running positioning. The parameter remaining distance is available for all 64 destinations.

You can find how to get this message over the digital outputs in chapter **Fout! Verwijzingsbron niet gevonden.** Digital outputs DOUT0 to DOUT3.

In the field **Start delay** you can put in the time, the controller will wait after the initial command before it starts the positioning.

Destination overview: driving profile



In the field **Destinations** you can select the destination. The destination will be differently interpreted; dependent on whether the position is an absolute or relative selection. (See destination overview **settings**)

In the **Speed** field you can input the **running speed**, where this speed will be used to run to the destination. The **end speed** is always zero and cannot be changed.

In the **acceleration** field the accelerations can be put in for starting and braking.

In the **time** field you can read out the positive and negative acceleration times.

In the field **jerkfree positioning** you can set up a filter time. Here the acceleration time will be tailored so that a jerkfree acceleration is created. Both figures show the speed profiles with and without jerkfree positioning.

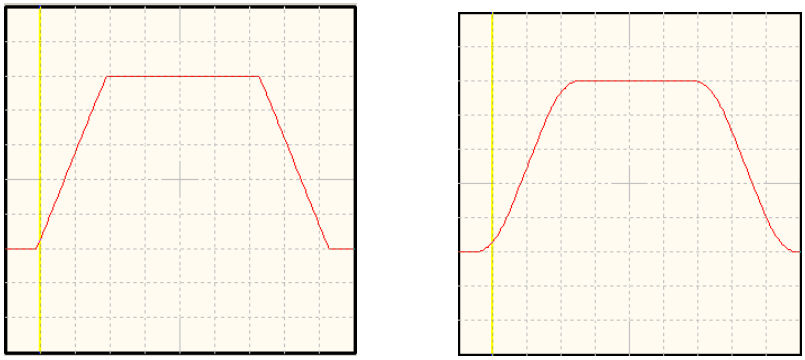


Figure 9: Time optimum and jerkfree positioning

The Parameter/Positioning/position settings /course program parameterized position range will be shown in the field position range (Input limits) only as information.

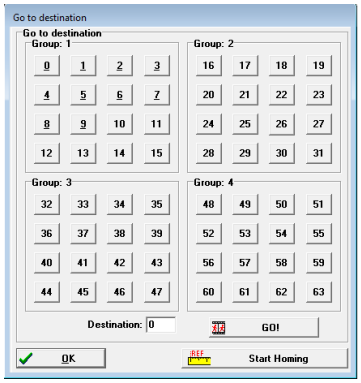
> The acceleration settings have no influence on the driving profile of the homing movement.

6.6 Move to destination

There are more possibilities, to select and start destinations:

- With digital inputs:
  The single destinations can be selected via the digital inputs (DIN0...DIN5).
  A rising edge of input DIN6 activates the function of the destination and starts the position running. Now the digital inputs for positioning can be parameterized, you can read about this in chapter***Fout! Verwijzingsbron niet gevonden.*** Digital inputs DIN0 to DIN9.

- Over the serial communication:
  The running and the destination also the homing movement can be started over the parameter program. Activating can be done by menu **Parameter/Positioning/go to destination**. You can move to the selected destination, when you click on the respective button.
  In addition you have the possibility to start a position by clicking the button **GO!** with the actual position ***Fout! Verwijzingsbron niet gevonden.***).



6.7 Settings of digital outputs

In positioning application a super ordinate control via digital outputs can give a signal when the destination is reached.

The digital outputs can give the following information:

- Target reached.
- Remaining distance message to reach the destination.
- Homing mode complete.

The configuration of the digital outputs is described in chapter **Fout! Verwijzingsbron niet gevonden.** *Digital outputs DOUT0 to DOUT3*.

6.8 Homing mode

In most applications, where the Servo controller RBD-S will be used as a positioning controller, you must select a homing setting so that the position controller can calculate using it. This position is called the homing **position a**nd must be chosen after every new start up of the controller. This happens in the **homing mode**. There are several possibilities available.

6.8.1 Homing movement

There are 4 modes for the homing destination:

- Homing mode destination over negative or positive end switch with or without zero impulse of the encoder.
- Homing mode (without additional signal) from the negative or positive stop.
- Homing mode of the zero impulse of the encoder.
- No run.

The Homing mode will be started after switching on the enable or over the field bus. The finishing conclusion will be stated in the controller by changing a status bit in the controller. This status can be read out over the field bus or digital output signal.

The method of the different homing modes can be arranged by the following figures. The numbers mentioned correspond to the homing mode. The numbers correspond also with the CAN open DSP402 fixed numbers of the homing mode.

How to activate and parameterize the homing mode is described in chapter *6.8.2 Setting homing movement*.

Method 1: Negative end switch with zero impulse

With this method the gear moves in search speed first into the negative direction until the negative end switch is reached. This is shown in Figure 10 by rising edge (movement from right to the left). After that in crawl speed it searches for the end switch in the other direction. The zero position is the first zero impulse from the positive direction from the end switch.

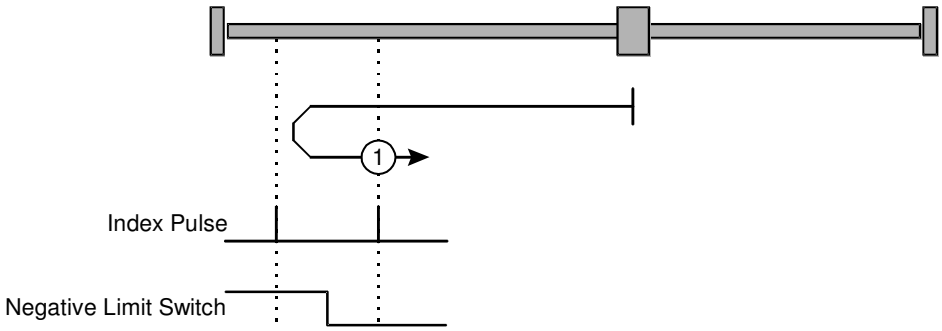


Figure 10: Homing mode to negative end switch with zero impulse

Method 2: Positive end switch with zero impulse

With this method the gear moves in search speed first into the positive direction until the positive end switch is reached. These will show in 11 by rising edge (movement from left to the right). After that in crawl speed it searches for the end switch in the other direction. The zero position is the first zero impulse from the negative direction from the end switch.

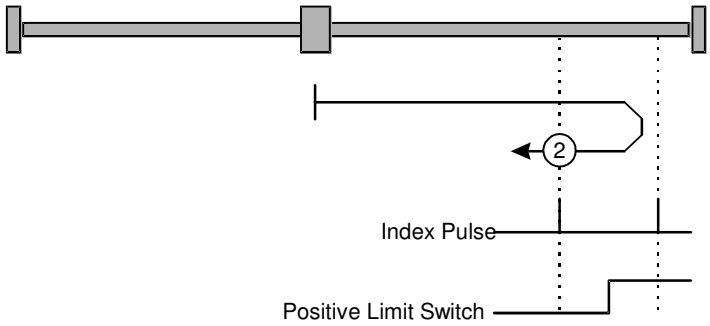


Figure 11: Homing mode to positive end switch with zero impulse

With homing mode 1 and 2 to be realized, the zero marking and/or the index pulse of the encoder are not the same as the edge of the end switch or in the surrounding of the end switch is. This homing point can be moved within one motor rotation.

Method 17: Homing mode with negative limit switch

With this method the gear moves in search speed first in the negative direction until reaching the negative end switch, this is shown in Figure 12 by the rising edge. After that in crawl speed it searches for the end switch in the other direction. The zero position comes from falling edge from the negative limit switch.

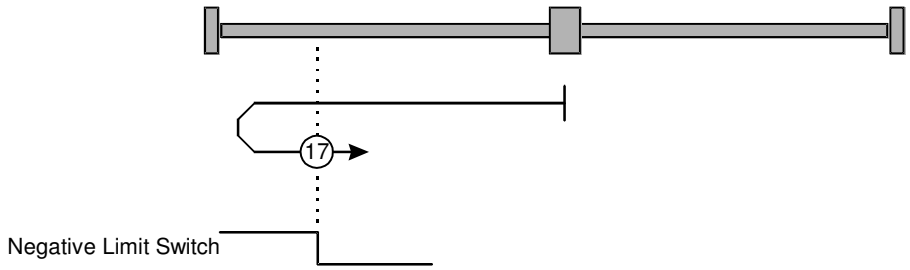


Figure 12: Homing mode with negative end switch

Method 18: Homing mode with positive limit switch

With this method the gear moves in search speed firstly in the positive direction until it reaches the positive end switch, this will shown in Figure 13 by the rising edge. After that in crawl speed it searches for the end switch in the other direction. The zero position comes from the falling edge from the positive limit switch.

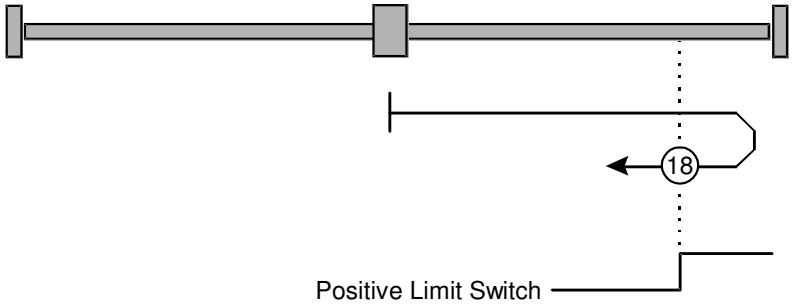


Figure 13: Homing mode with positive end switch

Method 33 and 34: Homing mode with zero impulse

For methods 33 and 34 the direction of homing method is negative or positive. The zero position comes from the first zero impulse of the encoder in the searched direction.

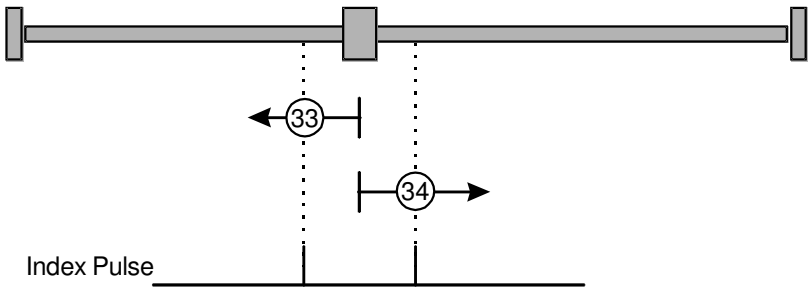


Figure 14: Homing mode only with zero impulse

Please be careful, in this case the gears **don't** move! The servo positioning controller calculates the actual position from the encoder signals. For a movement to the zero position the option **„Go to zero position after homing run** "must be activated. An additional offset of the zero position can be put in the field **„offset start position"**.

Method 1: homing mode with negative stop with zero impulse

With this method the gear moves in the negative direction until it reaches the mechanical stop. The servo positioning controller needs a minimum 1 second to recognize the mechanical stop. The stop must be dimensioned as the maximum current to avoid damage. The zero impulse comes from the encoder in positive direction from the stop.

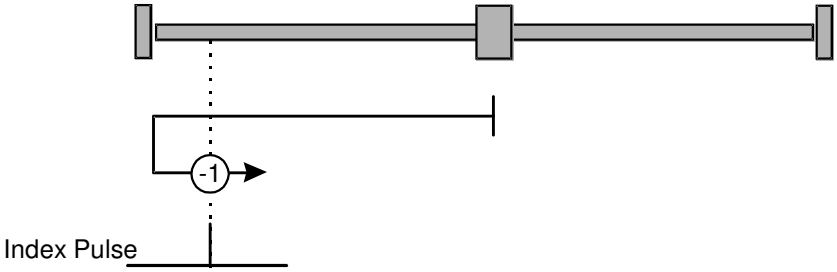


Figure 15: Homing mode with negative stop and zero impulse

Method 2: homing mode with positive stop with zero impulse

With this method the gear moves in the positive direction until it reaches the mechanical stop. The servo positioning controller needs a minimum 1 second to recognize the mechanical stop. The stop must be dimensioned as the maximum current to avoid damage. The zero impulse comes from the encoder in negative direction from the stop.

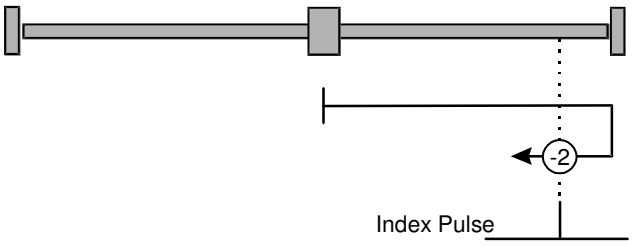


Figure 16: Homing mode with positive stop and zero impulse

Method 17: homing mode with negative stop

With this method the gear moves in the negative direction until it reaches the mechanical stop. The servo positioning controller needs a minimum 1 second to recognize the mechanical stop. The stop must be dimensioned as the maximum current to avoid damage. The zero position comes direct from the stop.

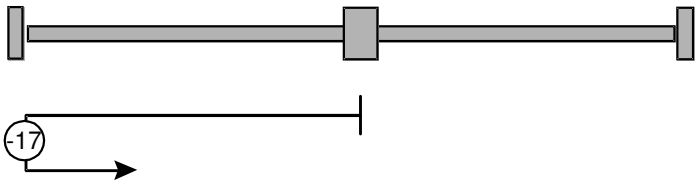


Figure 17: Homing mode with negative stop

Method 18: Homing mode with positive stop

With this method the gear moves in the positive direction until it reaches the mechanical stop. The servo positioning controller needs a minimum 1 second to recognize the mechanical stop. The stop must be dimensioned as the maximum current to avoid damage. The zero position comes direct from the stop.

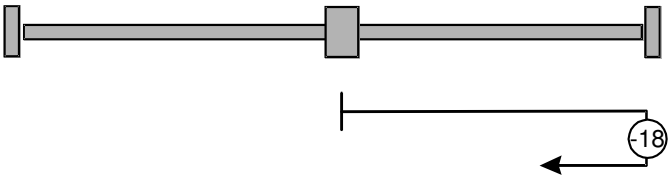


Figure 18: Homing mode with positive stop

The homing modes 17 and 18 can only be adjusted when the mechanical of the position axes is dimensioned in order of the motor current. Set the running speed as low as possible to reduce and limit the kinetic energy when the stop is reached.

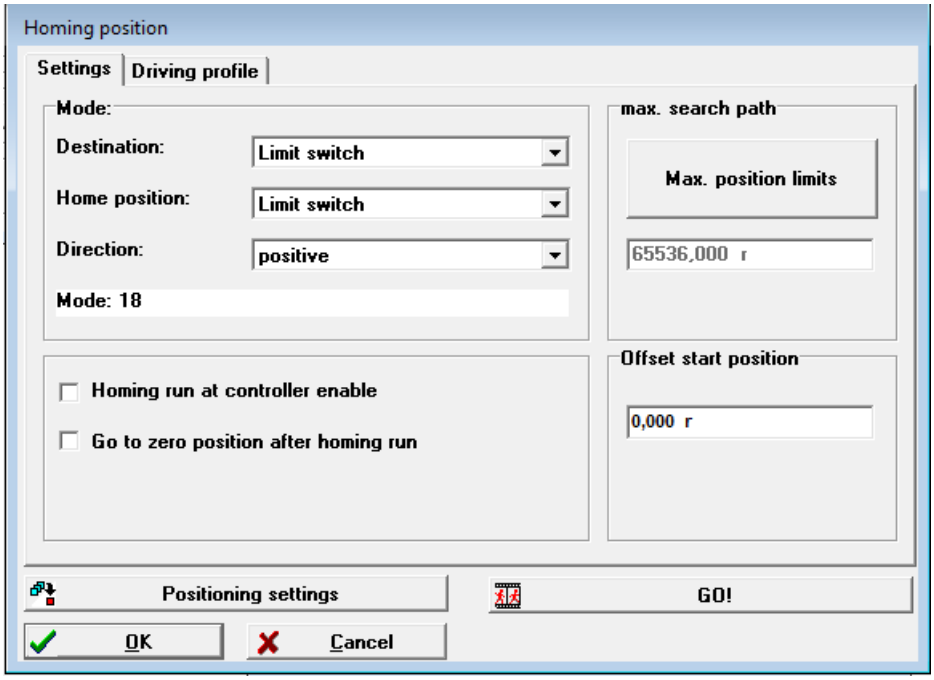
Method 35: Homing mode on actual positioning (No run)

With this method 35 the zero homing position is the actual start position.

6.8.2 Setting homing movement

The parameterization of homing mode is made in the homing position menu. This can be opened via **Parameter/Positioning/homing-Position** or with **REF**-surface in the symbol border 

.
The following window opens:



Via the button **Positioning settings** in the menu it is possible to input the general settings (e.g. position limits). See *chapter 6.4* **Fout! Verwijzingsbron niet gevonden.**.

The button **GO!** can be selected to start the homing run.

Homing position overview: settings

In the **Mode** field one can select the homing movement mode described in *chapter 6.8.1 Homing movement*. With homing run the motor's rotation to the destination is activated.

One special case **No run** only. The actual position will be defined as the homing position. The gear doesn't move in this situation.

Otherwise that becomes the homing destination via **Search speed**. After that the gear moves back with **crawl speed** to find the exact contact point. With the running **speed** you will reach the **Basic point** (zero point of the application). This can be different from the **destination** point. For example the zero impulse is favoured above the start point because a bigger accuracy is shown.

The settings can be found for search, crawl and run speeds or – acceleration in the overview **Speed/acceleration/times**. This overview will be accurately described in the following section.

In the case of homing position - also the calculated zero point for the following destinations – one defined distance from start point to the homing point with an offset, can be put in **Offset Start position.**

If the option **Go to zero position after homing run** is activated, the gear moves with **running speed** to the zero position when the homing run is completed.

When this option is activated, the zero position must not be positioned behind the homing position, otherwise a homing run error will exist.

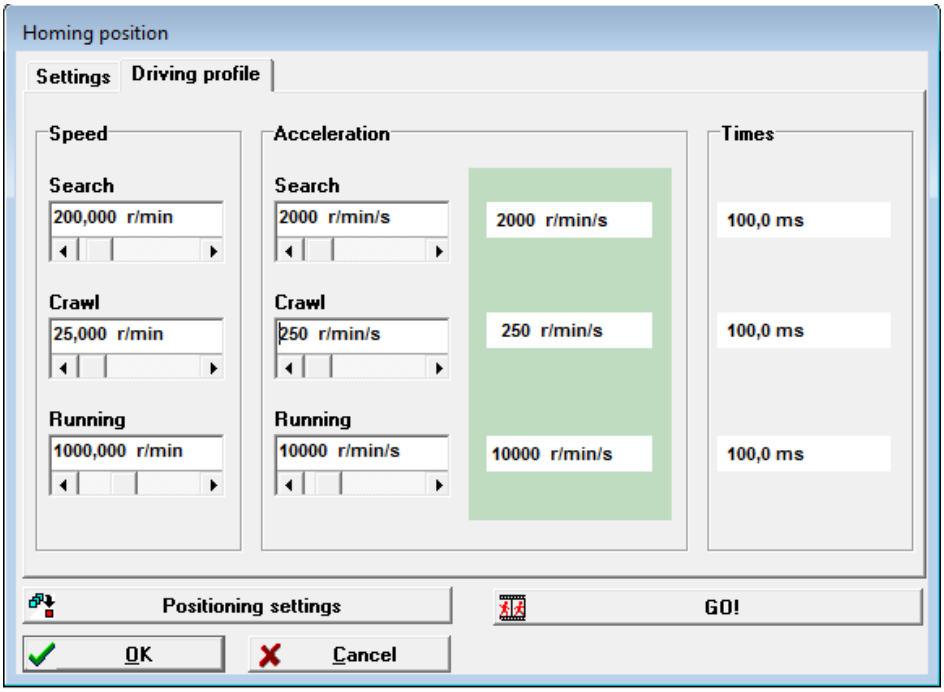
Also it is possible to define a **maximum position limit**. When in searching this length no limit switch is detected the servo positioning controller RBD-S gives an error message. The length searched will be calculated from the maximum position limits. By clicking on the button **Max. position limits** the menu can be parameterized for the general positioning settings (e.g. position limits). See *chapter 6.4* General positioning settings

If the option **homing run at controller enable** is activated, the homing runs starts automatically, when the enable is recognized.

Homing overview: Driving profile

Here are the settings for **speed** and **acceleration** for the following items:

- ❖ Search: Move the gear to the destination (limit switch, stop)
- ❖ Crawl: Running reversal (with reduced speed) to recognise the trigger point
- ❖ Running: Optional movement to the zero point (Basic point) of the application



7 Course program

The course program makes it possible to connect different positions in a sequence with two evaluation possibilities. This destination will be moved behind each other. The characteristics of the course program are:

- There are 32 adjustable course program steps.
- Apart from linear sequences, circular ones are also possible.
- Over a special digital input it is possible, within the course program to position “outside the window" to go to the destination. This position can also be selected by using digital inputs.
- Every course program step can be selected between 2 evaluation positions. So a bypass is possible. The bypass success is dependent on the logic status of the digital inputs.
- There are 2 digital outputs available in the course program. For these outputs 4 options are available (on, off, target reached and remaining distance message).

Attention: With RBD-S the digital outputs DOUT1 and DOUT2 are on the same connections as the digital inputs DIN2 and DIN3. By using these outputs you reduce the controlling options of the course program!

- In the course program are two alternative evaluation points. The evaluation points are freely programmable and can be set by using the digital inputs. Alternatively you can make 2 small course programs with a maximum of 32 total steps which are fully independent.
- The course program can easily be made and controlled by using the parameter button. The application created will be saved as a parameter set or alternatively in a course program file. This file can also saved in other RBD-S servo position controllers.
- The cycle time of the program destinations in the course program is every 1,6 ms. So it is certain that every course program output is high for minimum of 1,6 ms.

The application course program can be activated with the option button in the command window. (See chap. 6.2). This selection can be saved in the servo positioning controller.

The control of the course program follows the digital inputs. Digital input signals (High/Low) must be activated for a minimum of 1, 6 ms (cycle time control of the course program), so the signal can be clearly recognized. Signal sensitive inputs must be activated for a minimum 100µs.

The digital inputs used for start and selecting a destination will be, by activated course program, as follows:

Table 8: Course program: connection diagram of digital inputs (default)

DIN:	Function:	Description:
DIN 0	**NEXT2**	Rising edge: further with the following destination 2.
DIN 1	**NEXT1**	Rising edge: further with the following destination 1. (NEXT1 has priority over NEXT2, if activating both at the same time)
DIN 2	**#STOP**	Low = a running positioning will be stopped. The program stays in the actual course program.
DIN 3	**Course**	High = Activates course program. Low = Position running to the end, then normal position function with position selection from DIN0, DIN1, DIN2 also DIN4 and DIN5.
DIN 4	**START1**	Rising edge: Runs as set by the programmed start position. Start of course program.
DIN 5	**START2**	Rising edge: Runs as set by the programmed start position. Start of course program. (START1 has priority over START2, if activating both at the same time)
DIN 6	**Start Positioning / Homing movement**	Rising edge: If DIN 3 Low: Start positioning If DIN 3 High: Start homing movement

Table 9: Course program: Connection of digital inputs (New I/O assignment)

DIN:	Function:	Description:
DIN 0	**Course**	High = Activates course program. Low = Position running to the end, then normal position function with position selection from DIN0, DIN1, DIN2 also DIN4 and DIN5
DIN 1	**#STOP**	Low = a running positioning will be stopped. The program stays in the actual course program.
DIN 2	**NEXT2**	Rising edge: further with the following destination 2.
DIN 3	**START2**	Rising edge: Runs as set by the programmed start position. Start of course program. (START1 has priority over START2, if activating both at the same time)
DIN 4	**NEXT1**	Rising edge: further with the following destination 1. (NEXT1 has priority over NEXT2, if activating both at the same time)
DIN 5	**START1**	Rising edge: Runs as set by the programmed start position. Start of course program.
DIN 6	**Start Positioning / Homing movement**	Rising edge: If DIN 3 Low: Start positioning If DIN 3 High: Start homing movement

The new I/O-connection shown in table 9 makes it possible to use a better function of the course program in combination with the double signals DIN2 / DOUT1 and DIN3 / DOUT2 from connector X1. It can be activated by the commands window (see Chapter. 6.2).

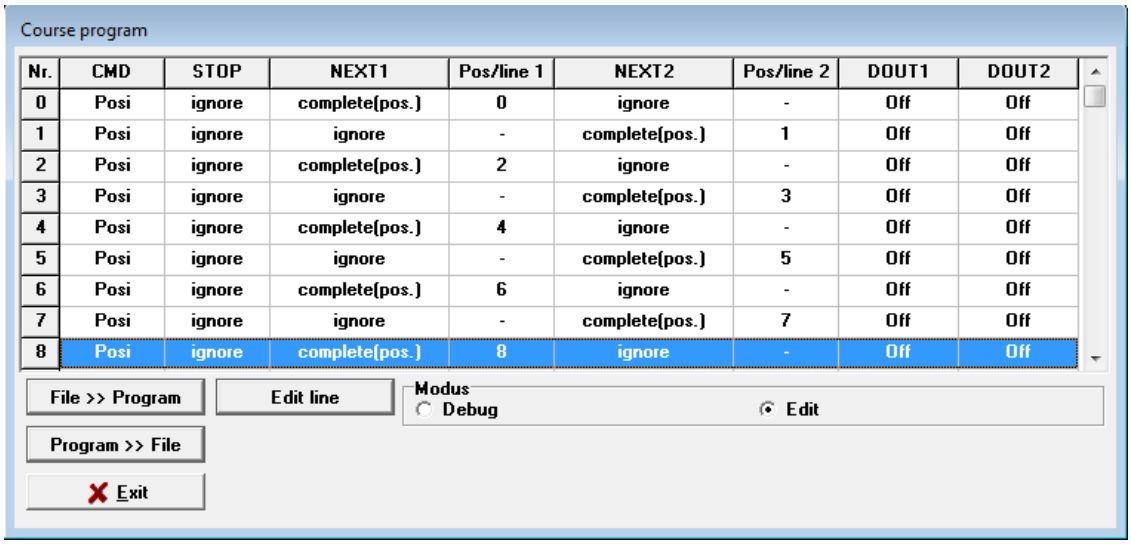
If the digital input **Course** is 0 V, the course program is inactive. Now it's possible to start positioning via the digital inputs, be careful the quantity of destination are be the half, depending on whether the application command is with 32 or the reduced 8 destinations as shown in Table 10..

Table 10: Available destinations via activated course program and input COURSE = 0

Connection :	64 Positions:	16 Positions:	specification:
Table 8	4 Groups of 8 positions Pos. 0..7, 16..23, 32..39, 48..65	8 single positions Pos. 0..7	General connection, Control signal Course on DIN 3
Table 9	4 Groups of 8 positions Pos. 0, 2, 4, 6,…60, 62	8 single positions Pos. 0, 2, 4, 6, 8, 10, 12, 14 16	New assignment, Control signal Course on DIN 0

7.1 Composing of Course program

Via the **Parameter/Positioning/Course program** you can access the window editor for choosing and composing your course program for up to 32 program destinations.



Here you have the possibility to select an existing course program via the menu **File >> Program** and to save it in the servo positioning controller, or save a composed program by using **Program >> File**.

In the field **Modus** it is possible to switch between Edit and control function Debug. A specific description of the control Modus can be found in chapter ***Fout! Verwijzingsbron niet gevonden.*** Course program debug.

When you select the button **Edit line** or a course program number a new window opens to allow composition of the settings in this course program number.

The basic course program orders are

- Position branch (and linear following position)
- Branch line
- Level test (and absolute program jump)
- End of program

In *chapter 12.9 Course program:* Example, we have composed 3 example applications.

In *chapter 7.1.2 End of program* to *7.1.5 Level test* we will explain several course programs.

7.1.1 Options of the course program

In the **Options** field you can set the digital inputs NEXT1 and NEXT2... when you have selected **Evaluate NEXT1** or **Evaluate NEXT2**; a new field will be shown in the lower part of the window with input options depending on the selected signal.

- **Ignore, if target not reached**: When this signal occurs during running it will be ignored. Is there no setting at the moment in function in the new following position X from which it will start?
- **Go to position immediately**: The new following position X will be reached directly. The running position will disconnect directly.
- **Complete position, then target**: The running position will be finished. Subsequently the following position X, depending on the new signal, will be run to directly.

The principle is valid as long as:

- If both NEXT signals are not on „evaluate “parameterized the following position 1 will run to target.
- If NEXT1 is on „evaluate“ and NEXT2 is otherwise parameterized, in this case NEXT1 will be used.
- If NEXT2 is on „evaluate“ and NEXT1 is otherwise parameterized, in this case NEXT2 will be used.

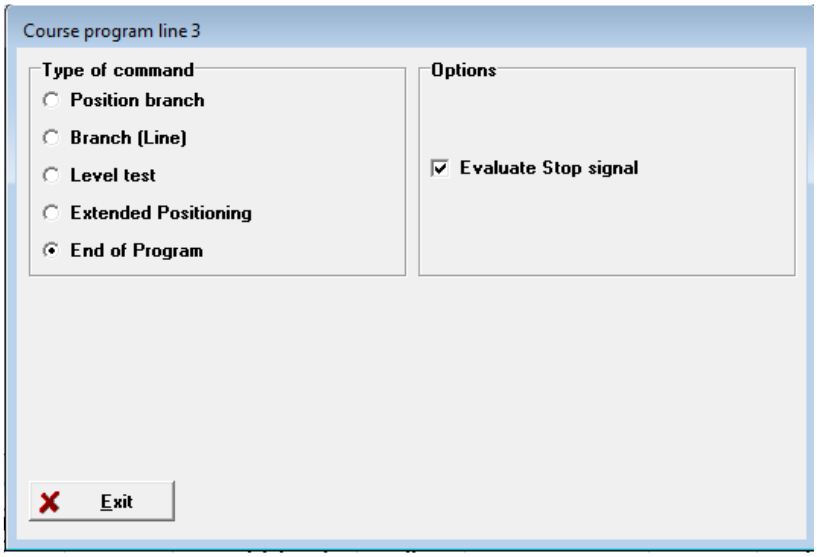
Additionally in **Optional** it is possible to select the functions of the digital outputs DOUT1/DOUT2.:

- On
- Off
- Target reached
- Remaining distance

If the principle is valid:

- The option „On “or „Off “will be used directly.
- The optional „Target reached“ or „Remaining distance“ will be used just after starting the course program number.
- The reaction of the Stop signal can also be activated via options. If this digital stop signal is evaluated, the following action will occur:
- The running positioning will be interrupted. The gear runs with negative accelerations to the stop. A soon as the stop signal is HIGH, the positioning movement is complete.
- The branch line will not be implemented, the program stays in the actual program target
- The level test via signals NEXT1 and NEXT2 will also start again, after the stop signal is activated.
- The output signals DOUT1 and DOUT2 have no influence on the stop signal.

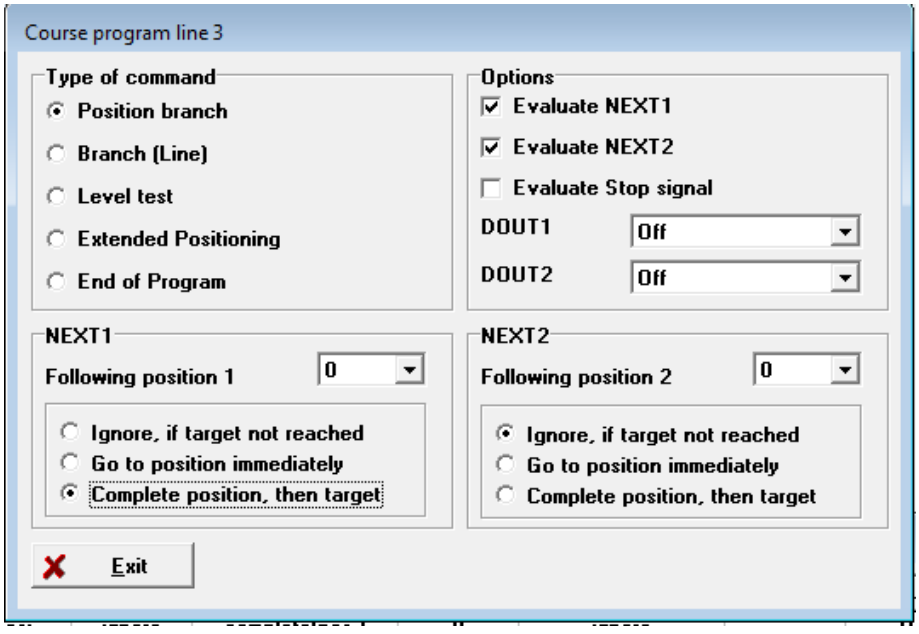
7.1.2 End of program



A running positioning will be finished, after that the program stops on this point. Also no digital outputs will be activated or deactivated. A new position should not be started.

If **Evaluate Stop-Signal** is activated, the running position can be interrupted.

7.1.3 Position branch



Depending on NEXT1 and NEXT2 you can run to two separate positions. The course program runs in order of its order option selection.

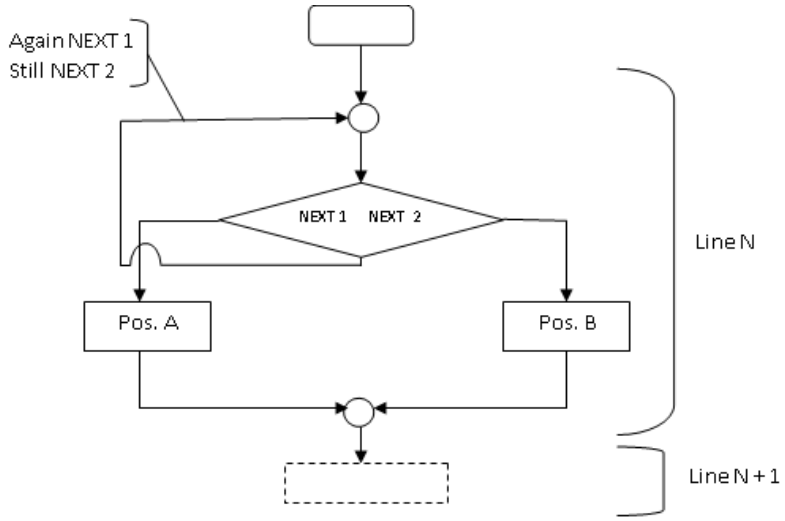


Figure 19: Course program – Position branch

If the digital signal NEXT1 go's HIGH (rising edge), it runs to target A. If the digital signal NEXT2 go's HIGH (rising edge), it runs to target B. If a rising edge isn't recognized the course program waits...

If again **NEXT1 evaluate** and **NEXT2 evaluate** is activated, it always runs to the target as parameterized under NEXT1. So a linear positioning (e.g. POS1→POS2→POS3) can be made.

In Figure 20 you can see that in program step 10 positioning is started. With the start of positioning (10) the course program changes to the next continuation line, program step 11.

On the assumption that NEXT1/2 is parameterized as "complete position, then target" control of NEXT1/2 input will be handled in the backside of the program steps, when the message "target reached " is sent. Only the edges will be evaluated, which will be detected by the start of the program movement. When signal "Target reached" is set, without recognizing rising edge of NEXT1/2, the program stays in program step 11 until detecting edge of NEXT1/2.

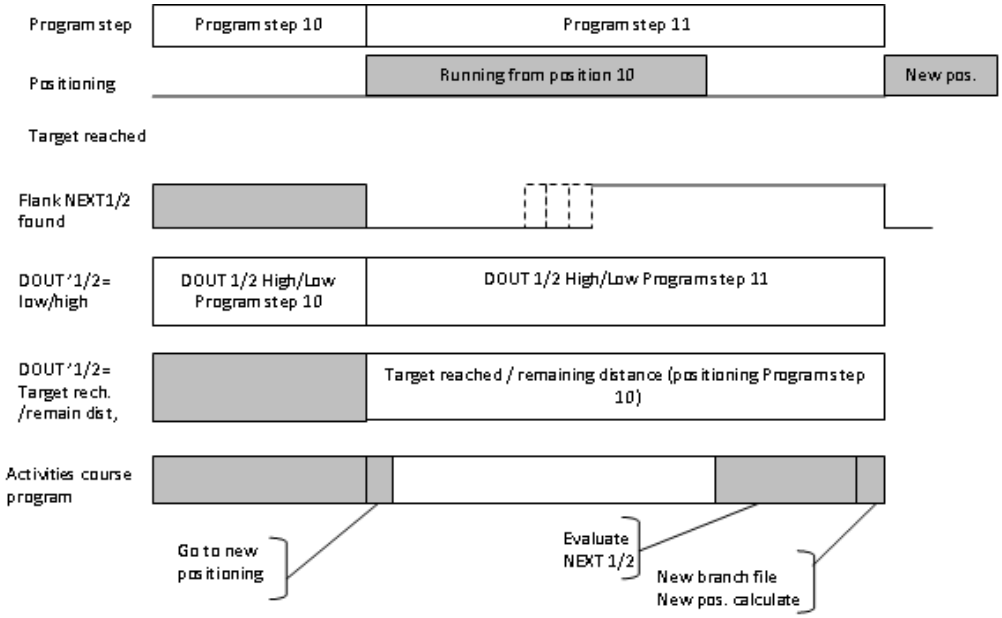
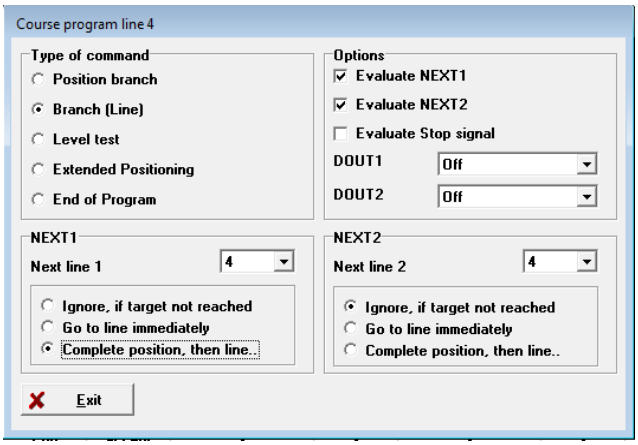


Figure 20: Time diagram position branch

7.1.4 Branch (line)



Depending on NEXT1 and NEXT2 the program runs between different targets. When the digital signal NEXT1 is HIGH (rising edge), the program runs with target X in line 1. When the digital signal NEXT2 is HIGH (rising edge), the program runs with target Y in line 2. Without a rising edge the program stays in a waiting situation.

If you evaluate again **NEXT1or NEXT2**, it is possible to go to the next line, which will start automatically as selected.

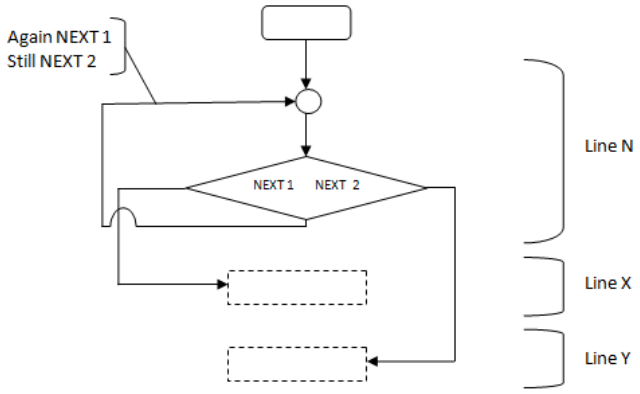


Figure 21: Course program - Branch line

In Figure 22 you can see positioning starts in program step 10. With start positioning (10) the course program changes in the following step.

With NEXT1/2 parameterized as "Go to line immediately" found the evaluating of NEXT1/2 input in active positioning process place. Again one expects that NEXT1/2 –signal will be active, before the positioning will be stopped. The evaluation will be started, and the selected course program target (next line 1 or 2, depending on which of NEXT1 or NEXT2 is selected first) will be started and finished.

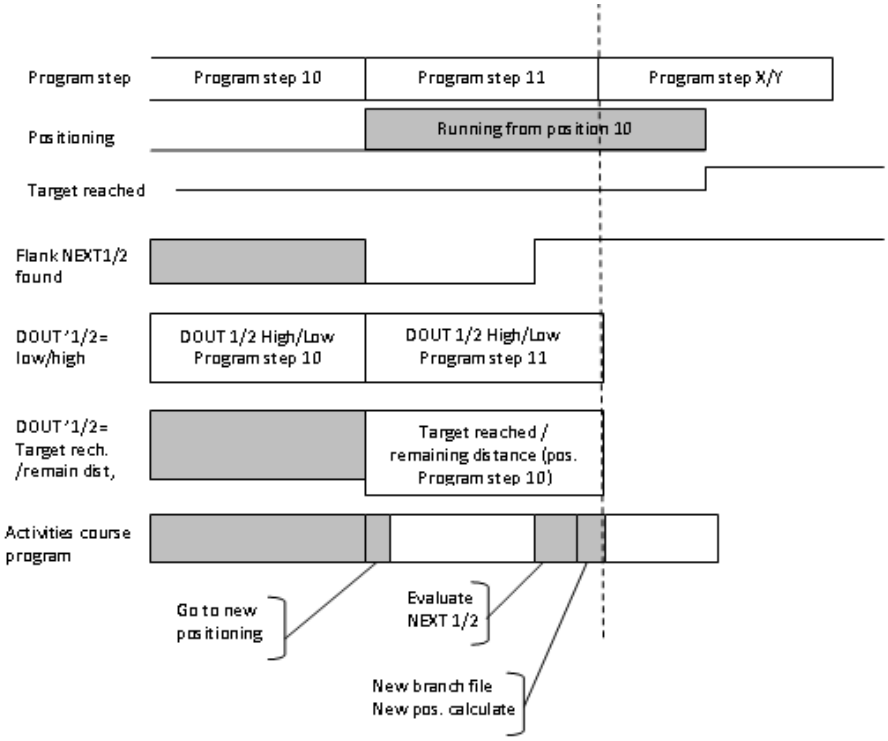
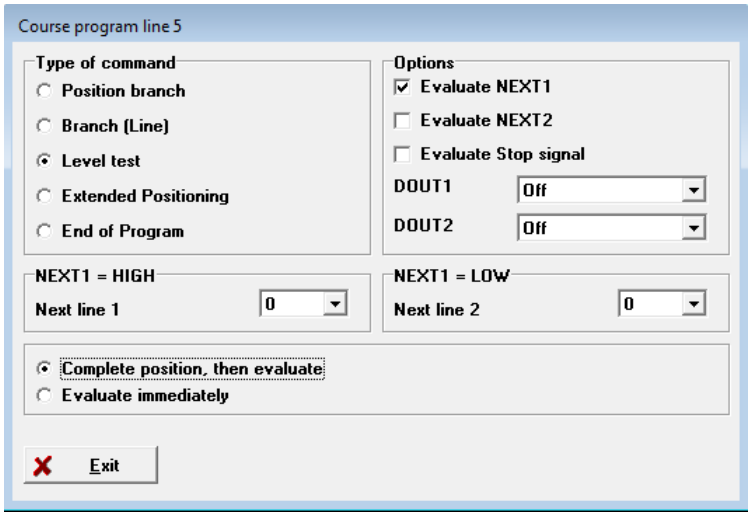


Figure 22: Time diagram branch line

7.1.5 Level test



Depending on the level test of NEXT1 the program runs to different targets.

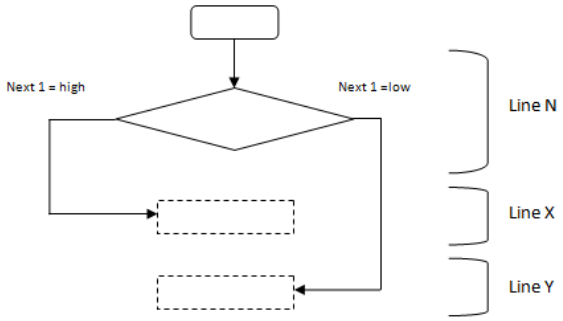


Figure 23: Course program level test

If digital signal NEXT1 is HIGH, the program runs in line X. If the digital signal NEXT1 is LOW, the program runs in line Y.

Absolute program skips (e.g. Endless sharpen) can be realized if you select NEXT1=HIGH and NEXT1=LOW at the same target.

In Figure 24 is the level test of NEXT1/2 with the same beginning as program step 11; depending on the line it will determine the following course program order..

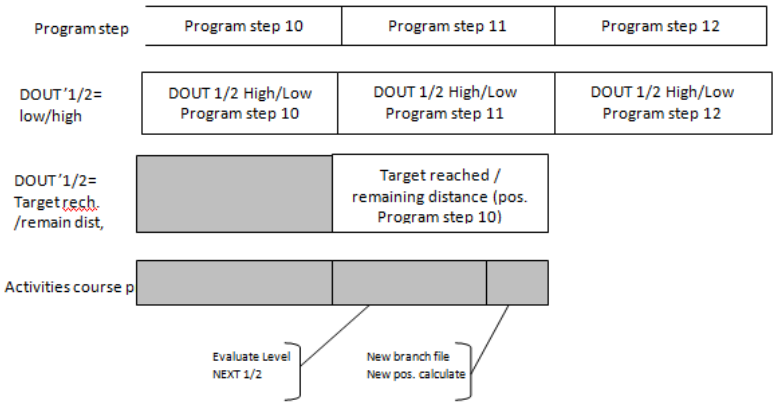


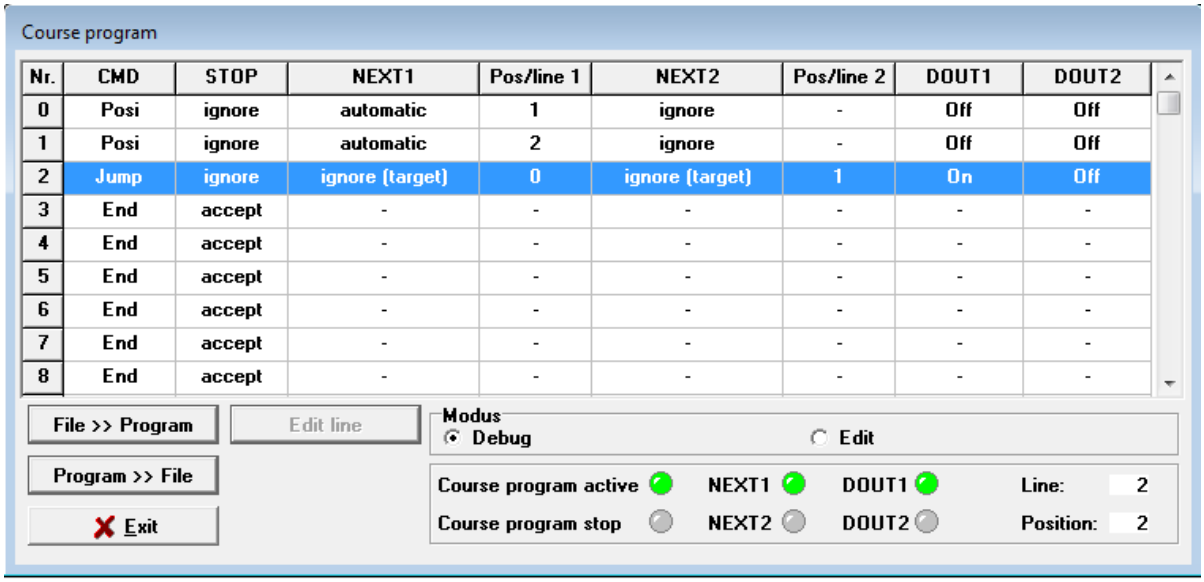
Figure 24: Time diagram Level test

7.2 Course program debug

If you select command Debug, additional information is shown in the window of the course program:

- Course program active: shows if the course program is running and in progress.
- Course program stop: shows the stop by activated stop signal of the course program.
- NEXT1 / NEXT2: shows the actual situation of the digital inputs of NEXT1 & 2.
- DOUT1 / DOUT2: shows the actual situation of the digital outputs of DOUT1 & 2.
- Line: shows the line, where the course program is at the moment. Additionally the actual line turns blue in the register table.

❖ Position: shows the last reached position.



8 Gear synchronization over X10

8.1 Introduction

For complex servo controlling is it possible to connect two or more servo position controller in synchronizing order, when you want a Master/Slave situation when using the incremental encoder signal. The servo position controller RBD-S can be used like a Master function as well as like a slave. The following figure shows the principle configuration:

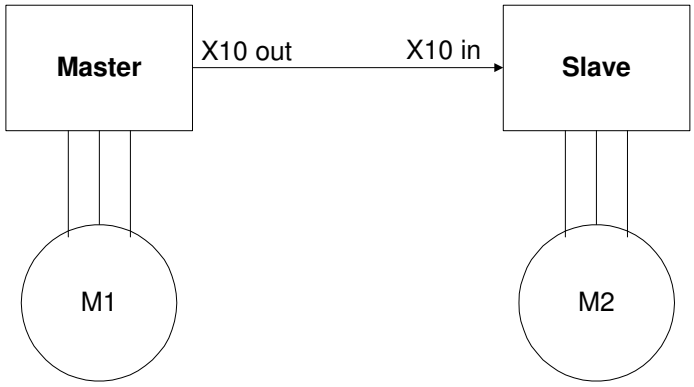


Figure 25: Connection incremental encoder emulation.

As master the RBD-S gives the position information of the incremental encoder line signal communication over [X10] or by output DOUT1 (line signal A) and DOUT2 (line signal B) to the slave, where the similar incremental encoder input is received. The configuration of the RBD-S for the transmission of the incremental encoder signals is described in the next *chapter* ***Fout! Verwijzingsbron niet gevonden.*** Incremental encoder emulation (occasionally as encoder emulation designated).

As a slave the RBD-S receives the position information over signal line [X10] and uses it as the desired value for its own controlling. The RBD-S can process the following signals:

- Incremental encoder signal A / B / N
- Pulse-Direction-Signal CLK / DIR

Depending on the function the slave turns with synchronous rotation or a synchronous angle with the master. The configuration of the RBD-S to function as a slave is described in the next *chapter* **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**.

8.2 Incremental encoder emulation

8.2.1 Description of the function and application.

The incremental encoder emulation has functions in different applications of the RBD-S, such as torque control, rotation control and in positioning mode. By activating incremental encoder emulation the following applications are possible:

- Rotation synchronous movement of slave synchronous to the RBD-S
- Position synchronous movement of slave synchronous to the RBD-S
- Flying saw of basics of the RBD-S generated guidance frequency

Also the classic servo application, rotation controller in servo controller, position controller in the logic, realizing a feedback of the actual position of the servo to the logic. Here the increment encoder emulation of the servo controller will be used.

From the motor encoder (resolver, analogue Hall sensors) measured rotation angle the RBD-S generates the line signals A and B and also the zero impulse N like an incremental encoder. The DSP used here for an internal Timer like NCO (numeric controlled oscillator). These generate the „Edges“-Tact of the incremental encoder signal. A logic connecting change these tact in a incremental encoder signal, whereby also a further internal Timer of the DSP will be used, to realize a counter for the incremental encoder signals. Via an automatic control loop in the DSP the incremental encoder counter will be constantly compared with the rotor position. By deviations NCO-frequency adapted and also the counter corrected. It thus acts as a follow up control. It is implemented in such a way that at zero speed and with continuously changing speeds there is practically no following error produced between the measured rotor position and the output incremental encoder position.

The signals A and B correspond as an incremental encoder. The lines are selectable in steps of 1024 / 512 / 256 / 128 / 64 / 32 lines per rotation. The selection will be accepted just after RESET of the controller. The count direction (Phase sequence of A/B-signals) and the position of the zero signal in reference to the rotor position is freely configurable.

The signals of X10 will be like differential signals with 5 V levels in accordance with RS422 standard. The level signals A and B from the digital 24 V outputs DOUT1 and DOUT2 are also available.

The outputs DOUT1 and DOUT2 deliver signals with 24 V level (HTL-signals). So it is possible to use old or low cost PLCs which can use this signal directly. A lot of simple PLC with high-speed counter inputs can be used.

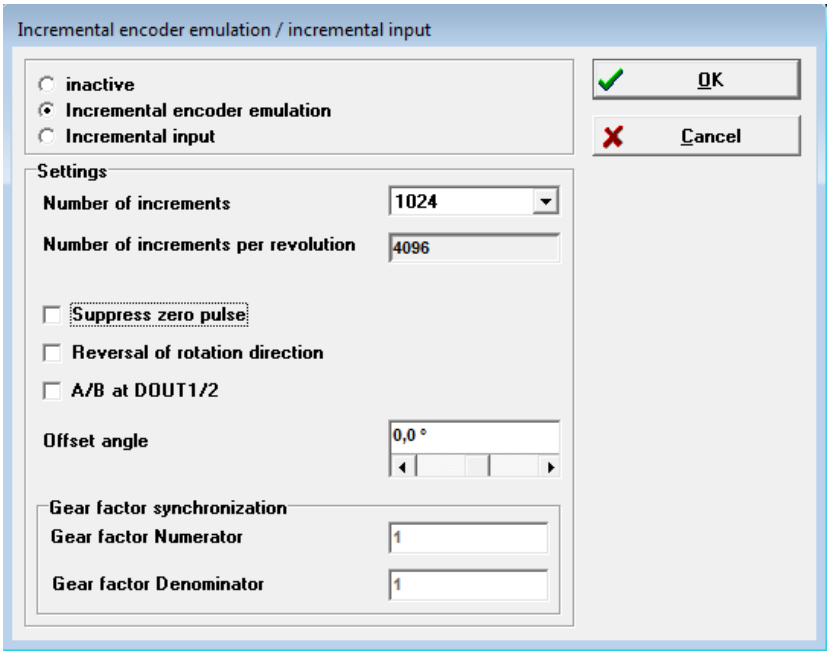
To realize the signals for using high speeds with high level settings DOUT1 and DOUT2 have to be connected with a resistance of 1 kΩ to 0 V. Then the maximum signal frequency of the level signals $f_{max,A,B}$ = 50 kHz.

DOUT1 == Level signal A

DOUT2 == Level signal B

8.2.2 Activating and altitude

The altitude and activation can be done by parameter settings over register **Operating mode /Incremental encoder emulation – Synchronization**.



Here you have the possibility to activate the **Incremental encoder (X10 = Output)** over connection X10 and for using a synchronization application.

In the field **Incremental encoder** you can adjust the following settings:

- **Increments**: The increment amounts can be adjusted to the following values 32, 64, 128, 256, 512 or 1024.
- **Suppress zero pulse**: if the box is ticked, no zero pulse will be given.
- **Reversal of rotation direction**: if the box is ticked, the rotation direction of the incremental encoder will be reversed.
- **A/B at DOUT1/2**: additionally the incremental encoder signal comes from output DOUT1 and DOUT2 as an HTL signal, just after ticking the box.
- **Offset angle**: Here you can make a file between zero point of encoder from servo positions of controller RBD-S and the emulated zero pulse.

8.3 Synchronization over [X10]

8.3.1 Description of the function and application

The RBD-S can also be realized as a slave in a master-slave application. It supports these modes of operation:

- **Rotation synchronous movement** calculated from the synchronization offset. The RBD-S is selected in modes of operation speed control + synchronization.

- **Positioning synchronous movement** is calculated from the synchronization offset. The RBD-S is selected in modes of operation position control (activated position mode) + synchronization.

The mode of operation **rotation synchronous movement** will be used in different winding applications, e.g. when wire must be pulled or foils stretched. When the slave opposite the master is a little bit behind, it will be accelerated as soon as possible from the master synchronous rotation speed, with trying but not reaching the developed position difference correction.

The mode of operation **position synchronous movement** will be used when an electrical gear must be built. When the slave gear stays somewhere or somehow behind the master, it tries to correct the position difference run to zero. As the position controller in RBD-S is active, it can be used to e.g. transport a product between two belts (leakage testing system).

In both situations the RBD-S determines the offset in accordance with Figure 26.

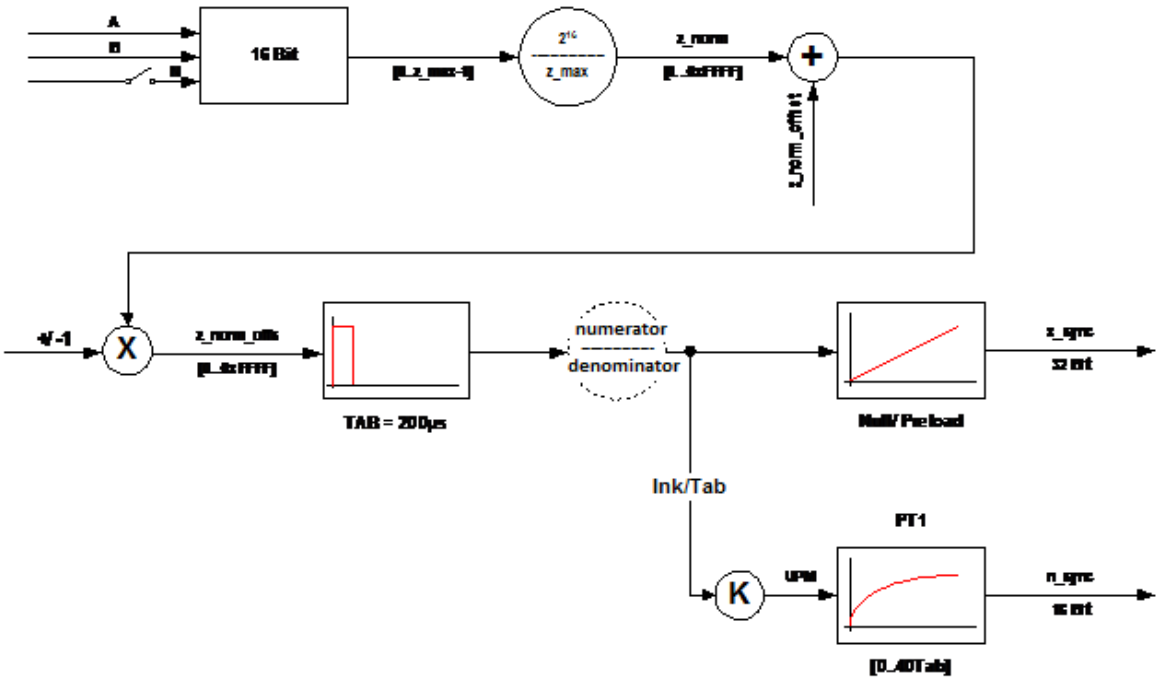


Figure 26: Synchronization – determination of offset for rotation speed and positioning control

With the help of the quadrature decoder in the DSP the signal A and B from the hardware right countered, with their zero impulse with or without can be disconnect. The zero impulse loads the16 Bit counter with zero by positive numerator and by negative numerator with the quantity of the increments minus 1 (z_max – 1). For one clear numerator by breakdown affected input signals in the DSP will be used an integrated digital input filter for the quadrature decoder. It will be programmed on a border frequency of 500 kHz. From the determined counter value of the internal resolution of the angle encoder (16 Bit) will be standardized. Enclosed the offset of the slaves added and also the rotation speeds will be reserved.

The determined angle first one differentiated, enclosed will the electrical gear with spitted parameterized numerator and denominator calculated. The on this way determined angle difference will be changed to the actual position offset of the synchronization, x_sync, integrated (Integrator). In

the same time will be determined the angle difference for the appropriate rotation speed n_sync calculated and with the help of PT1 –filters filtered.

In this situation the positions offset x_sync and also the associated rotation speed offset n_sync stays in the internal controller basic units for applicable for further processing of the order.

In the mode of operation **rotation speed synchronizing** only n_sync is used and as offset connected to the rotation controller. In the mode of operation **Angle synchronous** the position controller is also activated. It delivers the controller size for the speed controller, whereby the n_sync has pre controller size on the output of the position controller locked on.

The connector X10 will be used in both operation modes as input for the synchronization offset. The following functions are supported:

- Processing of A/B-spur signals with or without zero pulse
- Processing of pulse-direction-signals, as with stepper motor controllers
- Processing differential signal level test (RS422) for the trace signals of an interference proof information transfer
- Changeover of des direction of rotation/counting per software
- Alternatively speed controlled or angle synchronous mode of operation of the RBD-S
- Level counts of connected encoders parameterization in the following steps:
  32 / 64 / 128 / 256 / 512 / 1024
- Additional electrical gearing with numerator (N) and denominator (D) in range of 1:1000 to 1000:1 adjustable.

The electrical gear can be used to connect other encoders with different levels to adepts, e.g. encoder with 360 levels / rpm:

Adjust the level of the connected encoder on 1024

Adjust the electrical gear on N = 1024 and D = 360

Now the RBD-S uses each motor rotation of the reference encoder with 360 levels for each motor rotation.

To ensure the error free processing of the controller signals on X10 to the RBD-S, is it necessary to realize the controller signals timings, as shown in the following diagrams:

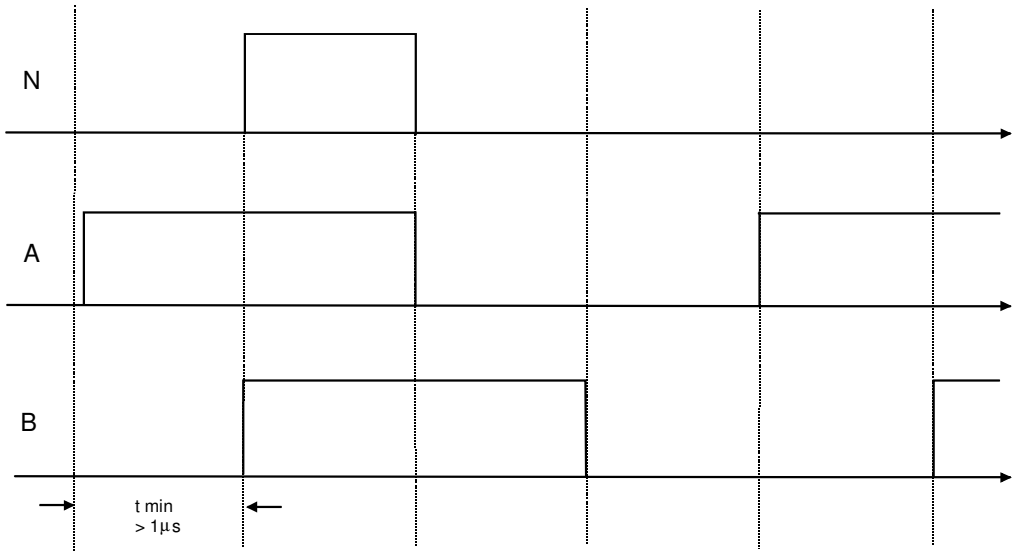


Figure 27: Synchronization – minimum times for A / B / N signals

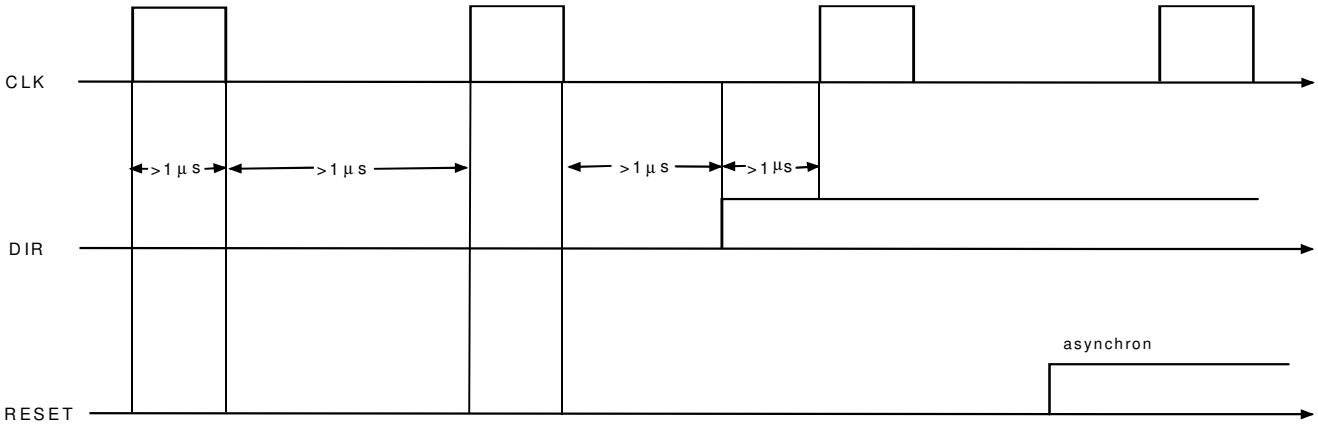


Figure 28: Synchronization – minimum times for CLK / DIR signals

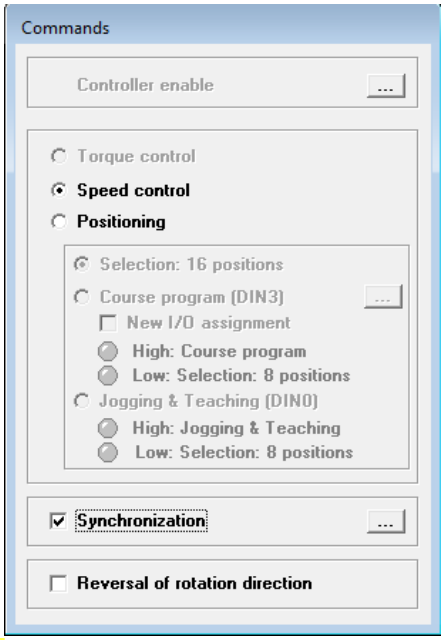
Caution!

If the minimum time has fallen below $t_{min} \geq 1\mu s$, it is possible to get a counter error in the RBD-S and with that there could be a misalignment in the actual position!

On the fallen below time results in a theoretical maximum inputs frequency of $f_{max} = 1 / (4 \times T_{min})$, thus $f_{max} = 250$ kHz. This value is only valid for an „ideal “increment encoder. In practice, you get phase errors between the A and B level signals of the increment encoder. We advise a from there the enterprise $f_{max} < 100$ kHz.

8.3.2 Activating and altitude

The activating of the synchronization application is done in the command window by ticking the box in the **Synchronization** field.



In the commands window you can select the following options:

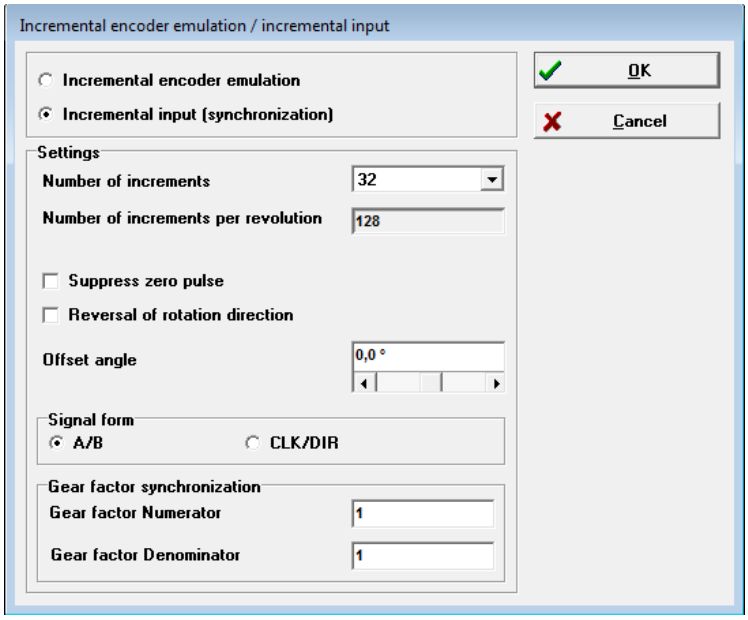
Speed torque control	Speed control	Positioning	Synchronization	Mode of operation
X				M-controlling
	X			N-controlling
		X		Positioning
X			X	1)
	X		X	2)
		X	X	3)

1) This combination isn‘t allowed and comes from software and the parameterize software intercepted. The selection "synchronization" will again be neglected.

2) This combination realizes a rotation synchronous application. The field "set point selection" must be changed to synchronization (N_SYNC). The adjustment of rotation synchronous application will be described in this manual.

3) This combination realizes a position synchronous application. A position plan can be overlaid.

One touch on "..."-button by "synchronization" opens the window "incremental encoder simulation/synchronization" (see below). Alternatively it is possible to adjust these parameters via register **Operation mode/Incremental encoder simulation – synchronization**.



Here you can select the possibility of using the incremental encoder selection (X10 = output) or using the connector X10 for the **synchronization (X10 = input)**.

In the field **incremental encoder** you can select the following values:

- **Level**: Here you can select the following levels 32, 64, 128, 256, 512 or 1024 for the evaluation of the master-rotating encoder.
- **Suppress zero pulse**: When the box is ticked, the zero pulse is not evaluated...

The suppression of the zero pulse has one disadvantage, the slave in situation of disturbances from A / B level signals and from this resulting counter errors, is not synchronized after each rotation from master with the master.

The suppression of the zero pulse has an advantage that you can use an encoder with a level count of $z \neq 2^n$.

- **Reversal of rotation direction**: When the box is ticked, the counting direction of the incremental encoder signal or level direction signal is inverted.
- **Offset angle**: Here it is possible to make an offset between the zero point of the master encoder and the rotor-zero position of the servo positioning controller RBD-S.
- **Signal form A/B or CLK/DIR**: Here can you select which type of signals you want to feed via X10 in the RBD-S.

A/B-Signals are suitable for the connection of an incremental encoder or another controller, e.g. one other RBD-S.

CLK/DIR –Signals are suitable for the connection of the RBD-S to a step motor controller. The synchronous motor on the RBD-S behaves like a stepper motor. An advantage of this function is in overload situation except steppes o fall do not known.

- **Gear factor synchronization**: Here you can input the values for numerator and denominator of the electrical gear separately.

With the RBD-S it isn‘t possible at the same time to use the synchronization and Incremental encoder emulation because for both functions we used X10 as input or as output. When the incremental encoder emulation is active, the following will happen by clicking on "synchronization":

- The parameterize program gives a warning with the following text: "A simultaneous operation of synchronization and incremental encoder emulation is not possible! Do you want to deactivate the incremental encoder emulation?"
- In the situation that the user doesn’t want to deactivate the incremental encoder emulation, the synchronization will be deactivated.
- If the user wants to deactivate the incremental encoder emulation, the software automatically switches the incremental encoder emulation off.

In the application of the machine with the RBD-S, when used in **angle synchronous movement**, will work best in the following order:

- Controller enable master, master homing, minimum one times across the master zero pulse moving so that the slave can seize the correct reference position
- Master stationary after reference movement
- Controller enable slave, slave homing
- Slave stationary after reference movement
- Offset release master / master started
- The slave follows the master

9 Function of in- and outputs

Information over connector layout of the in- and outputs you can found it in *chapter 12.16* **Fout! Verwijzingsbron niet gevonden.**.

9.1 Digital inputs DIN0 to DIN9

The servo position controller RBD-S has ten digital inputs (**DIN0** to **DIN9**).

Due to the limited quantity of the connectors not all digital inputs are available to be parameterized.

The next table shows an overview in which situation the digital inputs are not available in the wanted application (X = not available):

Table 11: RBD-S Digital inputs – combination possibilities

	DIN0	DIN1	DIN2	DIN3	DIN4	DIN5	DIN6	DIN7	DIN8	DIN9
Analogue input active	X	X	X	X						
Incremental encoder emulation active (24 V-output)			X	X						
Analogue monitor active							X			
Digital outputs 1 & 2 active			X	X						

An overview of available digital inputs and the actual activated situation are shown on menu **Display/digital inputs:**

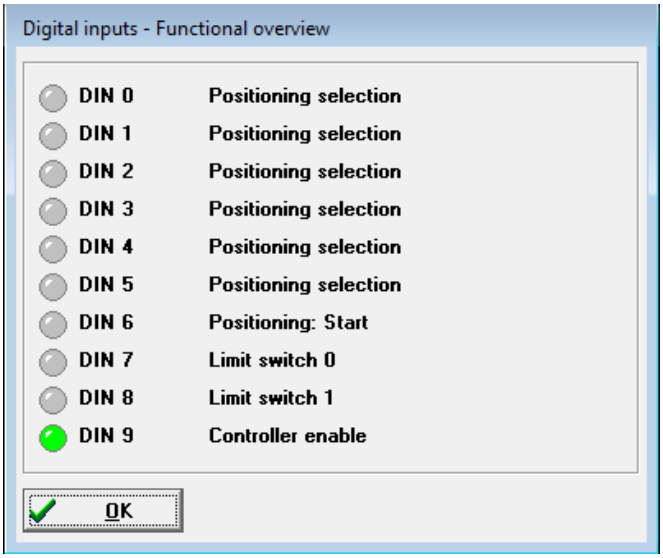


Table 12: Digital inputs – wiring

Input	Function	Description
DIN0 DIN1 DIN2 DIN3 DIN4 DIN5	Selection of Position parameter setting or controlling course program	Positioning mode of operation: • DIN2 & DIN3: could also be a digital output. In this case the digital inputs 2 & 3 are not available. • DIN0 – DIN5: selection of a position within a specified group Course program mode of operation: • Layout see *chapter* **Fout! Verwijzingsbron niet gevonden.**
DIN6	Start Positioning	With a rising edge the positioning in order of the position selection will be ordered
DIN7 DIN8	Limit switch negative Limit switch positive	Positive (DIN8), or negative (DIN7) value will be free of order if the limit switch is passive. (+24V when NO / 0V when NC) With no signal the gear brakes with the current limit to speed value zero, the output stage stays enabled.
DIN9	Controller enable Error reset Limit switch reset	With a rising edge the controller will be initialized and will subsequently activate the power stage. With a falling edge the motor brakes to zero speed and the power stage will be disabled. If the controller has an error, the falling edge will be used for resetting the error message. Depending on this the controller goes to the status „ready for operation“ and with the following rising edge the power stage will be enabled. When the motor is moved on a limit switch, the falling edge will be used, to prevent driving further in the same direction.

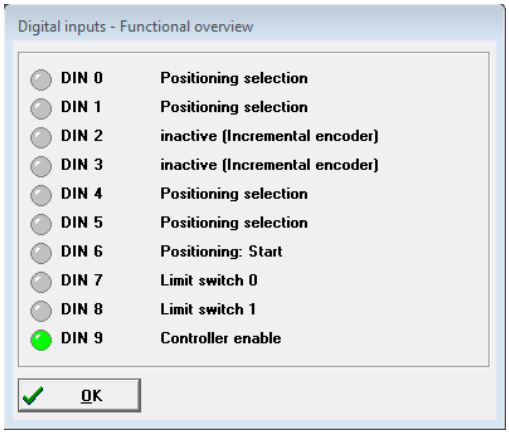
The digital inputs **DIN0 – DIN5** can be used in all positioning applications, in order to derive from them a Can node number. (See *chapter* 9.1.1 *Attitude of the digital* inputs)

9.1.1 Attitude of the digital inputs

In menu **Parameter/I/O‘s/digital inputs** you can arrange the functionalities of the digital inputs DIN0 – DIN5.

For addressing the destinations of 64 freely programmable targets you can use, in the mode of operation positioning, a 6 Bit p**osition selector** (DIN0 – DIN5). For positioning the additional **Start input** (DIN6) is also relevant.

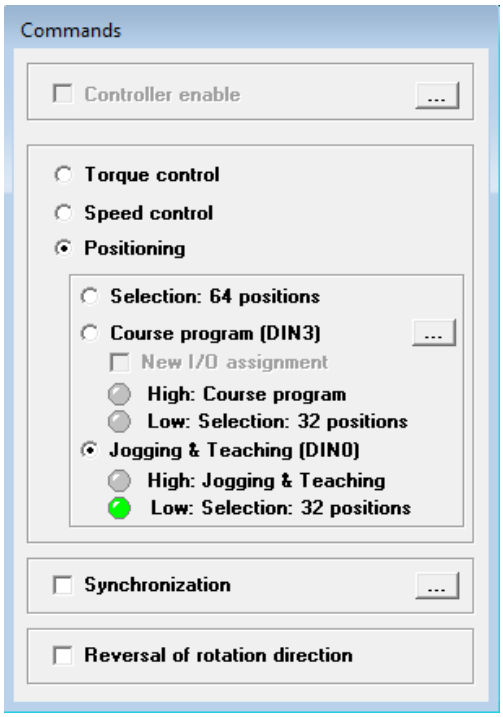
The digital inputs DIN0 – DIN5 can also be used as an Offset for selection of a CAN-node number.



This functionality of DIN0 – DIN5 can only be used if the analogue inputs AIN0 and AIN1 are activated as digital inputs.
When the incremental encoder emulation is active, DIN2 & DIN3 are not available as digital inputs.

9.2 Extended functions of digital inputs (Jogging & Teach)

In **commands** window when the option **Jogging & Teach** is selected, the extended wiring of the digital inputs can be used.



These functions allow the possibilities of using the digital inputs to go to the destination and to program the destinations. This programming procedure will be described in chapter***Fout! Verwijzingsbron niet gevonden.*** Position Teaching. Extended possible is to start a homing movement, or by using another extended input to interrupt the positioning and stop the gear without disconnecting the power stage.

The digital inputs used for starting and selecting positions, if activated, can be used in the following range:

Table 13: Jogging & Teaching: wiring of the digital inputs

DIN:	Function:	Description:
DIN 0	**Spec. / Posit**	High = Activates the new layout. Low = Normal position operation with selection over DIN1, DIN2, DIN3 as well as position group selection over DIN4 and DIN5 (Only possible by position number).
DIN 1	**#STOP (low active)**	Low = a running positioning will be interrupted. #STOP has priority over jogging POS, jogging NEG and Start homing. The dependent negative acceleration can de adjusted in the window **Safety parameters**. (see chapter *4.6 Safety parameter*)
DIN 2	**-**	-
DIN 3	**TEACH**	High = Activates the teaching function. (see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**)
DIN 4	**Jogging (nag)**	High = Positioning in negative direction with jogging & teaching. Movement parameters. (see chapter *6.5 Destination*)
DIN 5	**Jogging (pos)**	High = Positioning in positive direction with jogging & teaching. Movement parameters. (see chapter *6.5 Destination*)
DIN 6	**Start Positioning / Homing**	Rising edge: If DIN 0 Low: Start positioning If DIN 0 High: Start homing

9.2.1 Position Teaching

With the next described operational sequence you can, by using the digital inputs moved (jogging) and in the controller memory, save 64 position destinations (Teaching):
The controller enable for teaching must be enabled.

(1) Activate jogging & teaching mode with DIN 0
(see chapter***Fout! Verwijzingsbron niet gevonden.*** Extended functions of digital inputs (Jogging & Teach)).
(2) Move to the selected positioning with DIN 4 / DIN 5.
(3) Activate the teaching function (Step 1) by switching DIN 3 to high.
So the function „**homing: start**“ of the digital input DIN 6 will be deactivated and the teaching function can be activated.
(4) Activate teaching function (Step 2) by switching DIN 6 to high.
(5) By selecting the digital inputs DIN 0 to DIN 5 for the destination position, saving as offset destination parameter.
(6) With the falling edge DIN 6 the actual position will be taken to the selected position.
(7) The digital inputs will be ignored for a specified time, before they apply again. This time can be set in the window **destination parameters** under destination **jogging & teaching**.

Attention!

These destination(s), via the teaching function which will be written in the destination parameters are not automatically stored permanently.

With the button **Save Parameter** they can be saved permanently.

The following diagram shows time schedule for teaching of a target position:

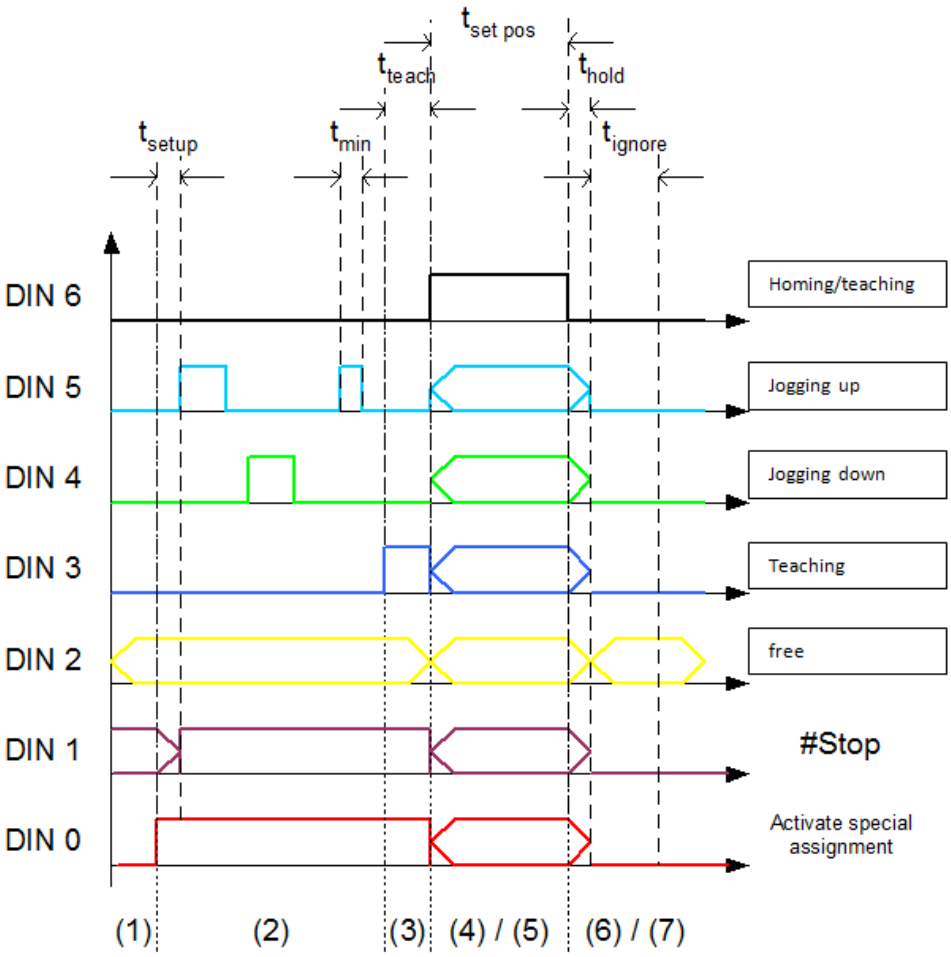


Figure 29: Teaching of a destination position

- t_{min} >= 1,6 ms
- t_{setup} >= 1,6 ms
- t_{teach} >= 1,6 ms
- $t_{set\ pos}$ >= 5 ms
- t_{hold} >= 1,6 ms
- t_{ignore} >= 200 ms (Parameter adjustable)

Attention!

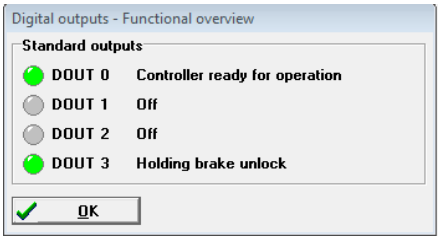
After expiration of time t_{ignore} the digital inputs return to their functionality as used for the teaching modes.

9.3 Digital outputs DOUT0 to DOUT3

To show the selected operation conditions of the servo position controller RBD-S there are four digital outputs (DOUT0 - DOUT3) available:

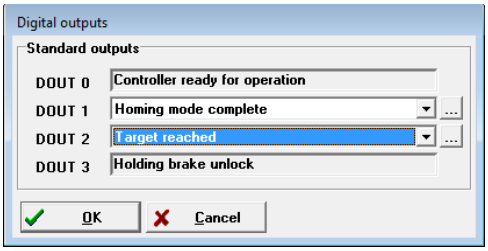
- The output DOUT0 is fixed and shows the ready for operation status of the servo position controller. Ready for operation shows, when the servo position controller RBD-S is switched on and no error is recognized, or when an existing error of the user is corrected.
- On the digital outputs (DOUT1 & DOUT2) you can be choose several functionalities (see chapter: *9.3.1 Settings of digital outputs*).
- The digital output DOUT3, marked with BRAKE, shows the status of the holding brake (see chapter *9.4 Holding brake DOUT3*).

An overview of the available digital outputs and the actual function selection is shown in the menu **Display/Digital output**.



9.3.1 Settings of digital outputs

Via the menu **Parameters/I/Os/Digital** outputs can be adjusted for the digital outputs DOUT1 & DOUT2:



DOUT1 and DOUT2 can be set separately with the following uses:

- Off, the output is inactive, LOW-level over enclosed Pull-Down resistance
- ON, the output is active, 24 V HIGH-level over the enclosed High-Side-switch
- Output stage active, also output stage connected
- I^2T message motor / servo
- Warning
- Collective error
- Following error
- Remaining distance message
- Target reached
- Homing mode complete
- Course program
- Declared speed achieved

With some selections a 3 dotted button appears behind the selection. When you push this button, an appropriate window opens to adjust the additional values.

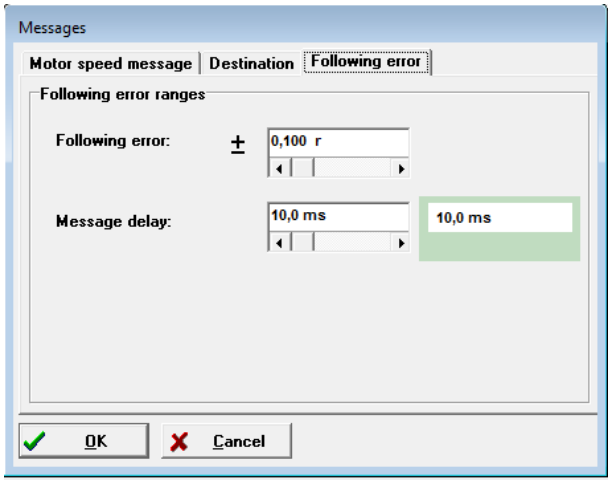
Activated incremental encoder emulation works after the configuration also on the digital outputs DOUT1 and DOUT2. DOUT1 and DOUT2 are not useable for other function because when these digital inputs DIN2 and DIN3 are connected, it isn't possible to use DOUT1 and DOUT2 with activated incremental encoder emulation.

9.3.2 Settings of messages for the digital outputs

In combination with a controller it is useful in many applications that the servo position controller generate messages when the intended operating conditions are reached. On the menu titled **Parameters/Messages** a window displays for adjusting these messages. Here you can input the ranges for the messages „Motor speed messages", „Destination "and „Following error".

Register card: Following error

- Following error: Range for the acceptable following error.
- Message delay: Time delay, where the actual position must be in the range, before the message „following error "is given.

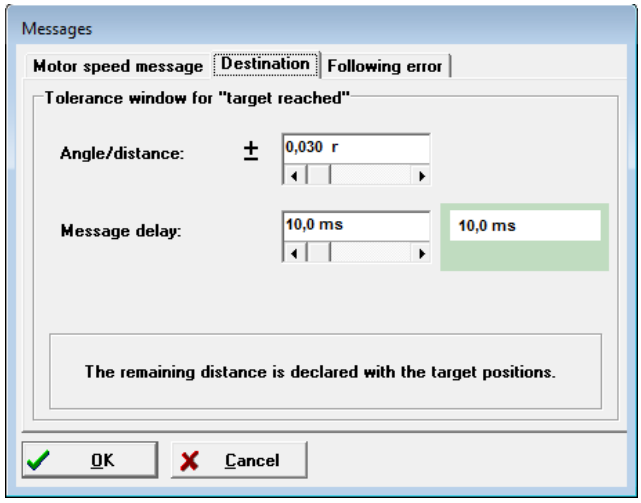


The following error message must be activated in all position applications. The meaningful size of the range depends on many parameters, like controller gains in speed and position controller, dissolution of the position collection, a.s.o.

Via the parameter "message delay" it is possible to make the system „Robust" , so that not every short time following error gives a following error message.

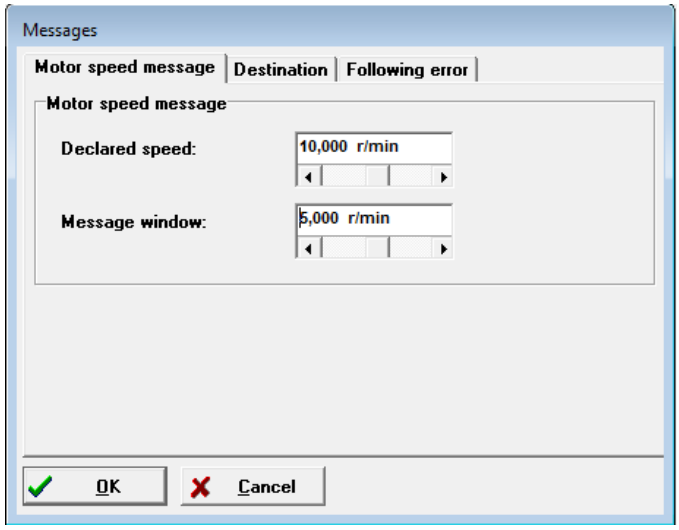
Register card: Distention

- Angle/distance: Tolerance window, of the message „target reached " is given.
- Message delay: Time delay, where the actual position must be in the range, before the message „target reached " is given.



Register card: Motor speed message

- ❖ Declared speed: Speed, of the message „Declared speed“ will given
- ❖ Message window: Tolerance window, where the actual speed must be in the range, before the message „declared speed“ is given.

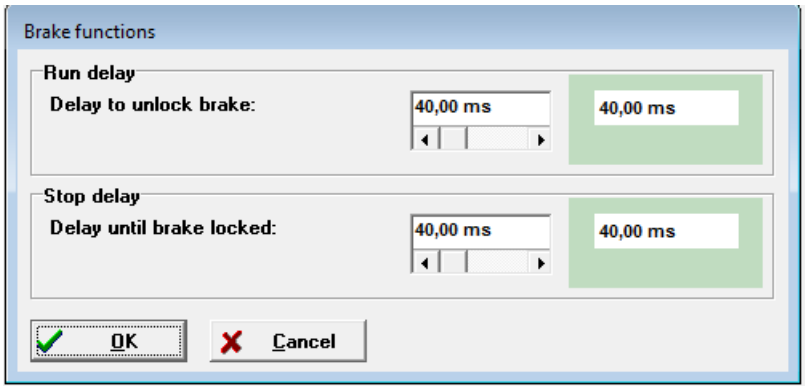


9.4 Holding brake DOUT3 (BRAKE)

Deeside the motor is a holding brake, so the servo position controller RBD-S can manage the control of the brake. The servo position controller RBD-S can only manage holding brakes with a supply voltage of 24 V DC. The current supply for the holding brake comes from the RBD-S 24V DC logic supply and is independent of the DC voltage bus in the power stage.
The connection is fixed on the digital output DOUT3 from connector X2A. A specific description of the wiring and the maximum current of the holding brake can be found in chapter *12.16.2 Pin configuration: Angle encoder and holding brake* [X2A].

9.4.1 Brake functions

The holding brake will be de-energized as soon as the controller enable is enabled and the power stage of the servo position controller is activated. Holding brakes have a built-in time delay due to their mechanical inertia and the electrical time constant of the coil. The servo position controller allows for this in the activity. Appropriate deceleration times can be parameterized. As Figure 30 shows to parameterize the control of the holding brake, can be activated via the menu **Parameter/Device parameters/Brake function**. The next windows appear.



The **Run delay t_F** is therefore to control the holding brake's mechanical inertia. With controller enabled in the mode of operation speed control and positioning control during the time delay status the rotation speed offset on zero. Therefore the motor will be getting a heavy current; the gear will be stalled with its holding torque in a no running situation until the point that the holding brake is totally de-energized (free for rotating).

By disconnecting the enable the rotation speed goes to zero. As soon as the actual speed is zero; switch the RBD-S controller output for the holding brake down. From this timing point you can set the **Stop delay t_A** . During this time the gear stays in this actual position, to the point of energizing the holding brake (brake on). After this time delay the enable will disconnect. In both situations the mechanical wear of the holding brake will be minimized.

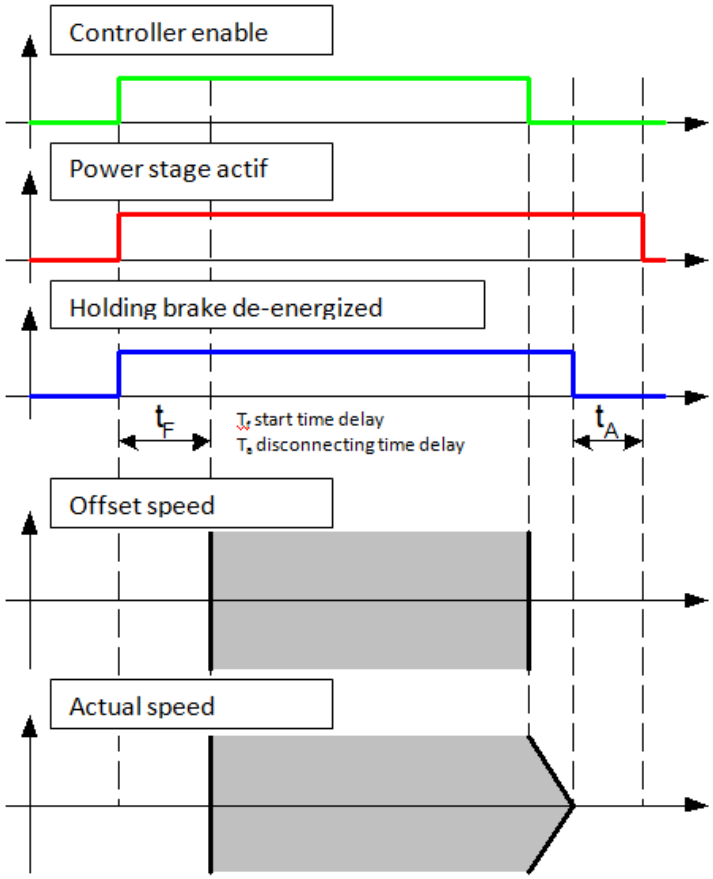


Figure 30: Time performance of holding brake

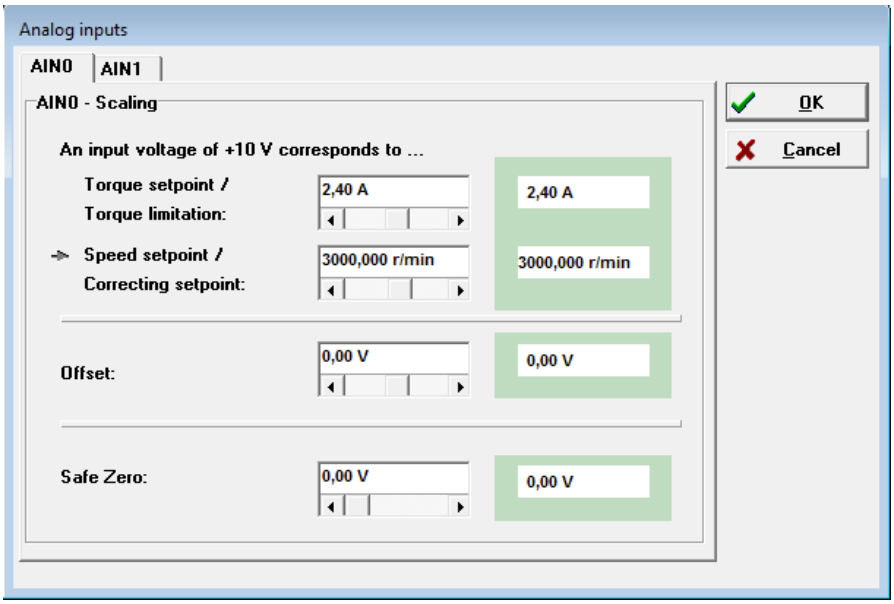
Rotation speed offset or start order of positioning will be active after enable and time performance are set.

In the mode of operation torque control will be the torque control offset after timing point the internal enable active or inactive.

9.5 Analogue inputs AIN0 and AIN1

The servo position controller has two analogue inputs available for an input voltage range of ± 10 V and coding of 12 Bit. These inputs can be flexibly used for the offset of rotation speed and torque set points.

Via **Parameter/I/Os/Analogue inputs** or the „...“ Button with activated analogue inputs menu for the offset selectors can be found in the following menu:



Here you can input the 'conversion factor' between the input voltage and the **Torque**- or **Speed set point**.

In the field **Offset** you can adjust the voltage which will automatically be added to the analogue input measured voltage. This can be used for example to compensate the analogue offset controller voltage of a PLC and the offset of an analogue input of the servo position controller RBD-S. So we have solved the problem of an external voltage which is given a voltage 0 V and realized with a very small offset.

An additional application is possible, via an input voltage of 0..10V. Positive and negative set points can be made.

The function **„safe zero"** sets the general set point to zero, when the voltage stays in range of this safe voltage. So you can reach, a gear with an analogue set point of 0 V over a long period whereby the gear stays still and does not slowly drift.

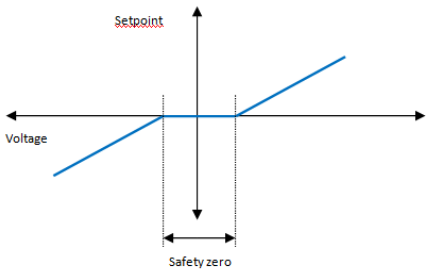


Figure 31: Safety zero

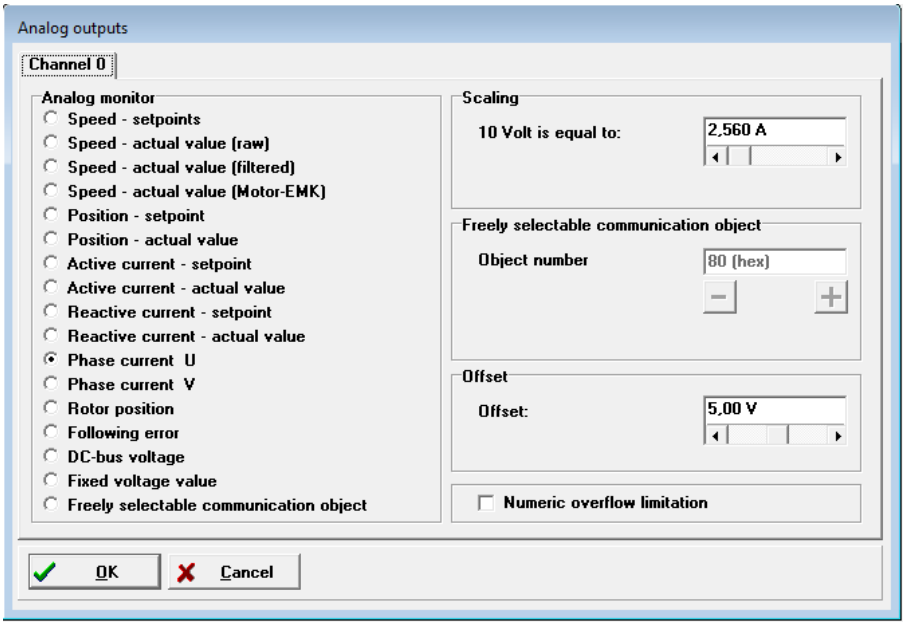
In applications with position controlling (internal or through an external controller) the function „safety zero" may not need to be activated. Because the controller detects a dead range or „Hole" in the controlled system – see Figure 31. This is realized in the processing as an instable controller system.

In this menu there are two register cards for both analogue inputs, so you have the possibility of scaling every register card.

9.6 Analogue output AMON

The servo position controller RBD-S has an analogue output for the AMON output and shows the internal controlled variables, which can be seen with an external oscilloscope. The output voltage range is 0 V to +10 V. The coding is 8 Bit.

To configuration the analogue monitor the menu **Parameter/I/Os/Analogue output** is available.



Here you have a range of values that can be used. Selected the necessary variables which you want sent to the analogue monitor output...

The scaling can be put in the field **Scaling**. The units will be changed automatically by selecting another variable.

In the field **Offset** you can adjust the offset voltage to e.g. positive and negative values.

Is the box **Numeric overflow limitation** ticked, calculated values, which across the +10 and under 0 V, to this limits reduced. By a not activated box exceeds the +10V- values as voltage from 0V represented, and turned around.

The option freely selectable communication objects is reserved for special applications. It is possible to use internal variables of the controller for other analysis.

10 Communication interfaces

10.1 Controlling over the CAN-Bus

10.1.1 Function overview

The servo position controller RBD-S works with the CAN open protocol in accordance with DS301 / DS402.

So the following CAN open specified applications are supported:

- profile torque mode
- profile velocity mode
- homing mode
- profile position mode
- interpolated position mode

For the exchange of data the following access methods are supported:

SDO	**S**ervice **D**ata **O**bject	Will be used for normal parameterization of the controller (There will be approx 150 SDO‘s supported)
PDO	**P**rocess **D**ata **O**bject	Quick exchange of process data (e.g.. actual speed). There will be 2 PDO‘s supported)
SYNC	**Sync**hronization Message	Synchronisation of several CAN-Knoten.
EMCY	**Em**ergen**cy** Message	Transmission of error message.
NMT	**N**etwork **M**anagemen**t**	Network management: it is possible e.g.all CAN- adresses to influences on the same time.
HEARTBEAT	Error Control Protocol	Controlling of communications participant by regular messages.

10.1.2 Processing of CAN-messages

The RBD-S has a command interpreter for the received CAN-messages. This command interpreter calls every **1, 6 ms**. It has the possibility in every call of a SDO or one special message, like e.g. SYNC-message or an emergency message to be processed. The processing of PDO‘s can stressed of every complexity just two time slices of the command interpreter. With this structure it gives some restrictions in the speed, with which the RBD-S can be handle CAN-Objects.

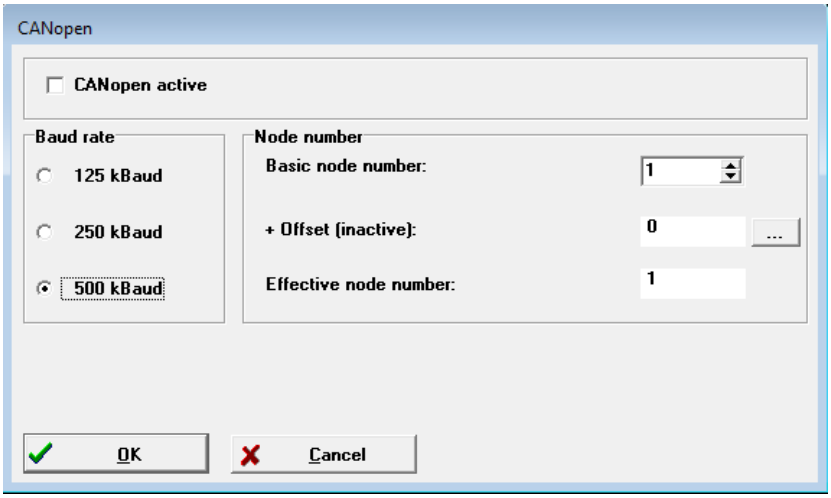
- The PLC may not send more frequently than **4ms**, otherwise the situation can be that the RBD-S doesn’t register a PDO or process. This can be shown, for example, in a jumping in the controlling or a jerking of the motor.

- In a bad situation a PDO will be activated in the controller after **4, 8 ms** (e.g. as speed set point). These situations exist if two time slices for processing are necessary and the PDO immediately sends to the called command interpreter of the controller.
- Between sending of SDOs and the reaction of the controller can be a time of **8 ms**, because the reaction data of the controller must be arranged.

More information on the communication and controlling of the servo position controller RBD-S over the CAN-Open communication interface can be found in **CAN open manual for the servo positioning controller DIS-2**.

10.1.3 Attitudes of the CAN open communications parameters

Via the menu **Parameter/Field bus/CAN open** can the attitude of the CAN open communications parameters of the servo position controller RBD-S in your CAN Bus Network.



So you can acknowledge the next communications parameters:

- **Baud rate**: This parameter is the communication speed of the CAN open Baud rate interface.
- **Basic node number**: These parameters enclose the "Basic node number" of the appropriate equipment which will be used for calculation of the last one the later "effective" Node number. It is possible, for calculation purposes of the effective node number to use the digital inputs (see next).
  On these node numbers are based identifiers of single messages. Every node number may be used one time in the CAN open network.
- **Addition of DIN0...DIN3 as node number:** To the basic node numbers will be added the value of the digital inputs DIN0...DIN3. The inputs combination will be activated by the CAN open interface or read out directly after RESET of the servo positioning controller RBD-S. So it is possible, with easy connections of the 24V to the digital inputs, to use 16 different device numbers.
  To use this function, you must have parameterized the digital inputs (see chapter *9.1.1*

Attitude of the digital inputs). When you click the „...“ button, you enter the menu for setting the digital inputs.

In the field **effective node number** the basic node number is shown and the resulting Offset node number.

Via the selector **CAN open active** you can switch on or off the field bus communication with the adjusted parameters. These attitudes will be used directly. Here for it isn't insecurely to Reset to activate or deactivate the CAN-Open interface.

10.2 Controlling over the serial interface.

10.2.1 Functions overview

The servo position controller RBD-S works via an asynchronous serial interface, which will be used in most situations for parameterization of the servo position controller.
The interface can also be used to control the controller in the application if there are not insecurely high speed reaction times of the gears.
The communications made with it are called communications objects. You make communication objects over the variables of state, e.g. to read out the current or rotation speed. Using other communication objects can be read or right other parameters.

One communication object exists for the following values:

- Permissible minimum settings
- Permissible maximum settings
- Adjust value of the parameters
- Controller internal value of the parameters

Information concerning the command-syntax can be found in chapter *12.6 Serial communication protocol*. In chapter *12.7 Use of communication objects* there is a list of all supported communication objects.

The controller internal value of a parameter can deviate slightly from the adjusted value of the servo position controller used internal other unit displays and standardizations as the communication objects.

10.2.2 Serial communication via RBD-S ServoCommander™

The parameter program communicates with the servo position controller RBD-S over the serial interface.

The delivery situation of the controllers the parameter program expects the following data:

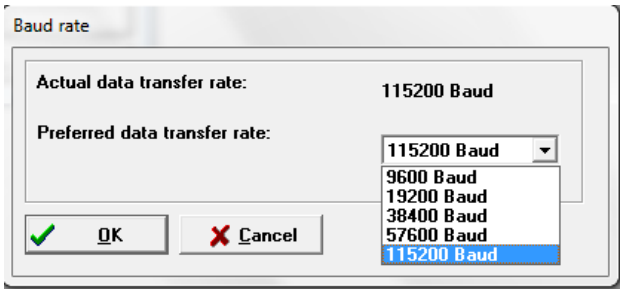
- Interface COM1
- Data transfer rate 9600 Baud (Adjust settings of the servo position controller)
- 8 Data bits, 1 Stop bit, no parity examination. These settings are fixed!

Therefore will be used a specified protocol, in the single fixed instructions. An overview of instructions can be found in chapter *12.6 Serial communication* protocol.

At program start the program searches for the best communication with the servo position controller. If this fails, an error message shows. In this case you must correct the communication data. Therefore you have to know, which **serial interface** (COM-Port-Number) and which **data transfer rate** is in use.

10.2.3 Settings via RS232 communication parameters

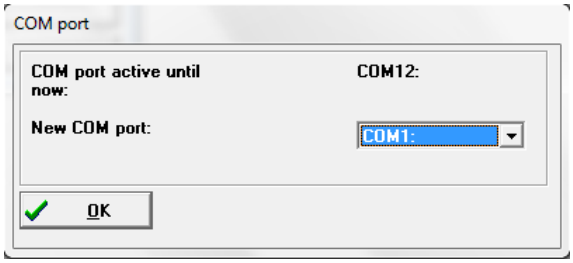
In the menu **Options/Communication/Baud rate** the Baud rate based on the **actual data transfer rate** can be increased:



So you can select a **Preferred data transfer rate.** The program tries with the selected data transfer rate to make a communication. The preferred transfer rate will be accepted or returned to a lower data transfer rate and the resulting Baud rate will be shown as **actual data transfer rate**.

This Baud rate is valid for "normal" online communication with the servo position controller. For the Software-Download you use a special Baud rate selection.

In menu **Option/Communication/Interface** you can select the interface (COM-Port) and over the parameter program it will try to communicate with the servo position controller:



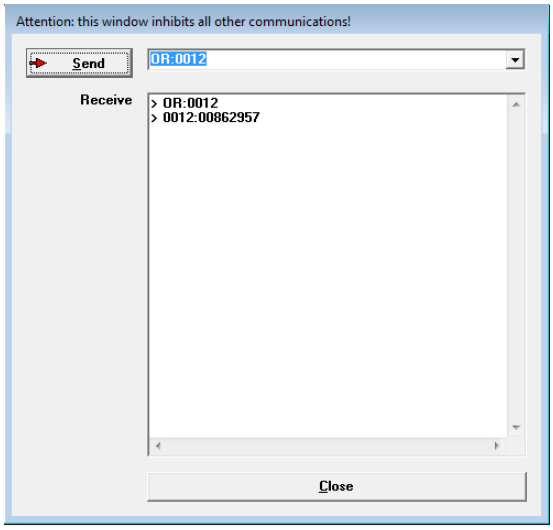
10.2.4 Transfer window

The transfer-window allows you to send and read orders directly to/from the servo position controller RBD-S.

The transfer window will be activated via menu **File/Transfer**.

During the activated window, open windows will not be served (e.g. actual value, Oscilloscope).
Close the transfer window, if you don't need it anymore.

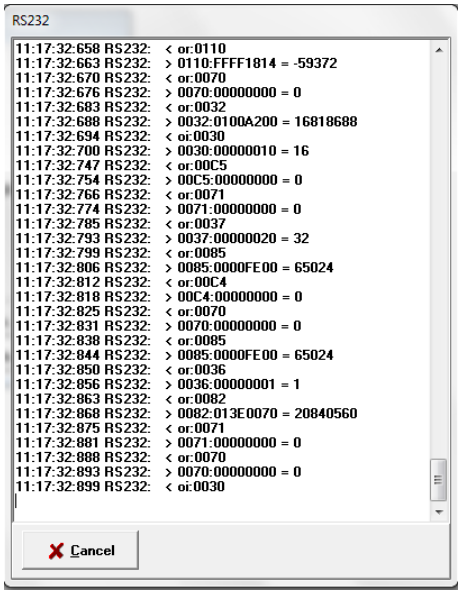
The transfer window is only for controlling orders and is not interesting for normal use. Furthermore you can read and send memory settings and communication objects. Also these are for special situation insecurely.



To send an order put in your syntax in the opposite place and click <ENTER> or on the **Send** button.

10.2.5 Communication window via RS232 transfer

The selection via menu **Option/Communication/Display communication window (RS232)** opens a window where you can see the communication over the serial interface. These are mainly for debugging cases, for 'Normal users' it isn't of interest.



10.3 Controlling by technological interface

The servo position controller RBD-S has an additional technological interface which can be used for synchronous serial interface e.g. Profibus- or Ethercat communication and Client specified modules.

So it is possible to develop and deliver client specified technological modules.

This is only of interest for quantities.

Please contact your supplier.

11 Error message/Error management

11.1 Error control by RBD-S

The servo position controller RBD-S uses an extensive sensor system, which maintains an error free function in the control, power stage, motor and communications with the outside world. All arising errors will be saved in the error memory.
The most important monitoring functions are described shortly in the following chapter.

In the easy menu error management it is possible to change the reaction of an error (see chapter *11.5 Error management*).

11.1.1 Over current and short-circuit control

- **Over current and short-circuit control:** The over current and short circuit current activates as soon as the current in the DC bus exceeds twice the maximum current of the controller. It recognizes a short circuit between two motor phases and also short circuits on the motor output connections to the positive reference potential of the DC bus. If the error monitor recognizes an over current, it disconnects the power stage immediately, so the short-circuit resistance is ensured.
- **I²T current monitoring with warning of the controller:** The servo position controller RBD-S has one I²t-monitor to limit the general power losses in the power stage. As the existing power losses in the power electronic and in the motor in most bad situations grow squarely with the flowing current, it will take the square current value as unit for the power losses. On reaching 80% of the maximum integral value a warning exists (to parameterize). By reaching 100% the maximum current will be limited to the nominal current.
- **Testing current measuring and Offset alignment by enabling the power stage:** By enabling the power stage you will automatically align the Offset and current measuring. If the value is out of order of the range, the error will be produced.

11.1.2 Monitoring DC-bus voltage

- **Over voltage monitoring:** The over voltage monitoring for the DC-bus is activated, as soon the DC-bus exceeds the functional voltage range. The power stage will be disconnected.
- **Under voltage monitoring:** The DC-bus voltage will be monitored on the under border (see chapter **Fout! Verwijzingsbron niet gevonden. Fout! Verwijzingsbron niet gevonden.**). The reaction on this error is for applications with „learning movement “of the DC-bus voltage or an application with reduced DC-bus voltage to parameterize.

11.1.3 Monitoring logic supply

- **24V over / under voltage monitoring:** The logic supply of the servo position controller RBD-S is supervised. In event of a high or low logic voltage an error message appears.
- **Internal power supply:** All internal operating voltages e.g. the 3, 3 V supply for the processor are supervised.

11.1.4 Monitoring of the heat sink temperature

- **Disconnecting by over temperature:** The heat sink temperature of the power stage is measured with a linear temperature sensor. When it reaches the temperature limit of approx. 85°C an error message is activated. In addition a warning is activated at approx 5°C before the maximum temperature limit is reached.

11.1.5 Monitoring of the motor

- **Monitoring of the encoder:** An error from the encoder disables the power stage. Resolver and analogue hall sensing systems will also monitor the amplitude of the level signal. When one signal level is missing, this is recognized within one motor cycle and the motor is switched off.
- **Measuring and monitoring of the motor temperature:** The servo position controller RBD-S has an analogue input for collection and monitoring of the motor temperature. Via this analogue level collection, non linear sensing systems are also supported. The disable temperature needs to be parameterized. Alternatively a monitoring of the motor temperature is possible with a normally open contact or PTC. In this case the disabling does not need to be parameterized.
  - **I²T current monitoring with warning for the motor:** The servo position controller RBD-S also has an I²t-monitoring to limit the general power looses in the motor. Because the existing power losses in the power electronic and in the motor, in most bad situations, grow squarely with the flowing current, the squarely current value will be taken as the unit for the power losses. On reaching 80% of the maximum integral value a warning occurs (to parameterize). On reaching 100% the maximum current will be limited to the nominal current.
- **Monitoring of auto detecting (motor):** Monitoring of a successful identification of the auto detecting phase lines, number of poles and the angle encoder offset.

11.1.6 Monitoring course of motion

- **Following error:** The differences between offset and actual position will be monitored.
- **Positioning range:** A running position will be monitored on an adjustable position range.
- **Limit switch:** If both limit switches are activated then an error occurs.
- **Course program:** The course program monitored during processing on wrong orders.

11.1.7 Additional internal monitoring functions

- **Memory test** / **Check sums:** The internal FLASH memory (program- and Data flash) is monitored with help of a check sum calculation, also the stack of the processor.
- **Application:** Depending on the application, a special monitoring function will be activated.
- **Communication:** Communication via serial interface as over the field bus (CAN-Open) will be monitored.

11.1.8 Operating time counter

The servo position controller RBD-S has an operating time counter. It will be shown via the parameterized software RBD-S ServoCommander™ in menu /**about** on the register card **Times**.

The actual time of the operating time counter will be saved in the internal flash memory every minute. This can give deviations of up to 60 seconds after a reset or after reconnecting.

11.2 Error message overview

The next table shows an overview of how all errors can arise.

In the column **reaction** you find the reaction possibilities, which the user can parameterize, marked with "**X**".

The parameterization of the error possibilities is described in *chapter 11.5 Error management*!

The abbreviations **C**, **E** and **W** have the following meaning:

- **C**ritical error: proper control of the motor cannot occur.
  The power end stage will be disconnected directly; the motor fades away...
- **E**rror: The motor brakes with its safety deceleration.
  After that the power stage is shut down.
- **W**arning: The controlling of the motor is possible for a limited period of time. It is to parameterize, of warnings should be shown:
  - Show: The disturbance will be shown, nothing further happens.
  - Do not show: The disturbance will be ignored.

The column **error** shows a red blinking code ERR-LED on the front of the RBD-S

Table 14: error overview

Error number.	CAN Error Code	Show error	Description	Possible cause / measures	Time lag	Reaction		
						C	E	W
3	4310	3	Over temperature motor	Controlling configuration of temperature monitoring. Temperature sensing system correctly wired? Mechanical difficulties, motor too hot	100ms	X	X	X
4	4210	3	Over temperature electronic	Temperature power electronic < -40°C or > 85°C. Strong rising heating RBD-S? Build in and improve heat sink/controlling	100ms	X	X	
8	7380	8	Error resolver signal level or reference losses	Resolver connected? Angle encoder cable defective? Angle encoder defective? Configuration angle encoder interface?	< 5ms	X		
9	5113	1	error 5V-electronic-supply	Error can exist if defective angle encoder / Hall sensing or one wiring error of X2 Possible error of technologic-module X8 3. Possibilities: Electronic error in equipment - can't solve itself. Return servo position controller.	< 5ms	X		
10	5114	1	error 12V-electronic-supply	Electronic error in equipment - can't solve itself. Return servo position controller.	< 5ms	X		
11	5112	1	error 24 V-logic-supply	24 V logic supply too high or too low? 24 V logic supply not loadable, e.g. by activating holding brake? Error in the holding brake, or wiring to X2A or overload on the brake output by using a brake with too high nominal current. 3. Possibilities: Electronic error in equipment - can't solve itself. Return servo position controller.	< 5ms	X		
13	5210	1	error offset current measuring	Error can't solved. Return servo position controller.	< 5ms	X		
14	2320	6	Over current DC-bus / power stage	Motor defective, e.g. winding overloaded and burnt out, short circuit between winding and housing? Short circuit in cable between two phases or between phase and screen? Test isolation of motor phase connections? Defective RBD-S (power stage or isolation error – isolation foil)	< 10µs	X		

Error number.	CAN Error Code	Show error	Description	Possible cause / measures	Time lag	Reaction		
						C	E	W
15	3220	2	Under voltage DC-bus	DC-bus-supply too low? DC-bus-supply not sufficiently loadable, e.g. acceleration with full current? Configuration testing DC-bus monitor, advice adjusts on approx. 50% to 70% of the power supply.	< 1ms	X	X	X
16	3210	7	Overvoltage DC-bus	DC-bus voltage > 400V. DC-bus supply in nominal speed too high? Testing interpretation. Too high brake energy by braking the gears.	< 1ms	X		
19	2312	10	I^2t-error motor (I^2t by 100%)	Angle encoder, number of poles and direction correctly adjusted - automatic motor identification accomplished? Motor stalled? Check the power dimensioning of the gear application.	100ms	X	X	X
20	2311	10	I^2t-error controller (I^2t by 100%)	See error 19	100ms	X	X	X
26	2380	1	I^2t by 80%	Motor stalled? Control the power dimensioning of the gear application.	100ms	X	X	X
27	4380	1	Temperature motor 5°C under maximum	Control the dimensioning of the gear application on basic power.	100ms	X	X	X
28	4280	1	Temperature power stage 5°C under maximum	Control the dimensioning of the gear application on basic power. Build in/improve heat sink and controlling.	100ms	X	X	X
29	8611	9	Following error monitor	Motor stalled? Controller optimized - especially the internal controller circuit for current and speed? Acceleration parameterized too high? Error window adjusted too small – increase	< 5ms	X	X	X
31	8612	1	Error limit switch	Limit switch correctly wired? Limit switch broken? Control configuration of limit switch.	< 1ms	X	X	X
35	6199	1	Time Out by quick stop	Angle encoder error appears? Motor identification not successfully accomplished? Acceleration parameterized too high?	< 5ms	X		

Error number.	CAN Error Code	Show error	Description	Possible cause / measures	Time lag	Reaction		
						C	E	W
36	8A80	1	error Homing movement	Homing movement cannot be successfully accomplished. Test the homing configuration. Parameterization of the controller includes angle encoder adjustment OK?	< 5ms	X	X	X
40	6197	1	Error: Motor- and angle encoder - identification	Angle encoder connected? Angle encoder cable broken? Angle encoder broken? Controlling of the angle encoder interface	< 5ms	X		
43	6193	1	Course program: unknown order	Please contact you technical supplier.	< 5ms	X	X	
44	6192	1	Course program: invalid level destination	The digital inputs for START1 & START2 are enabled at the same time. Therefore an inadmissible target / destination has been set.	< 5ms	X	X	
55	8100	1	Error CAN-communication	Communication is disrupted: Controlling installation under EMC rules. Adjust control of the Baud rate Control the node number – Nodes doubled used in network?	< 5ms	X	X	X
56	7510	1	Error RS232-communication	Communication is disrupted: Controlling installation under EMC rules...	< 5ms	X	X	X
57	6191	1	Error destination parameters	Conflict between acceleration and adjusted speed. Please contact your technical supplier.	< 5ms	X		
58	6380	1	Wrong application	Change the application with enabled power stage.	< 5ms	X	X	X
60	6190	1	Error in recalculation positioning	Internal error. Please contact your technical supplier.	< 5ms	X		
62	6180	5	Stack-Overflow	Internal error. Please contact your technical supplier.	< 5ms	X		
63	5581	15	Checksum error	Internal error. Please contact your technical supplier.	< 5ms	X		
64	6187	15	Initialization error	Internal error. Please contact your technical supplier.	< 5ms	X		

The servo position controller uses internally the error of nr. 1 to error nr. 64.

In event that the equipment shows an error which is not described in the table and in chapter *11.5 Error management* as „Unknown error“, please contact your technical supplier.

It is possible that the error number is used in new software or client developed software versions with additional monitoring functions.

11.3 Error signals on RBD-S

The RBD-S has on the front a red LED with the description **ERR**. As long as the RBD-S is ready for operation, the **ERR** does not blink. With an error the **ERR** blinks...

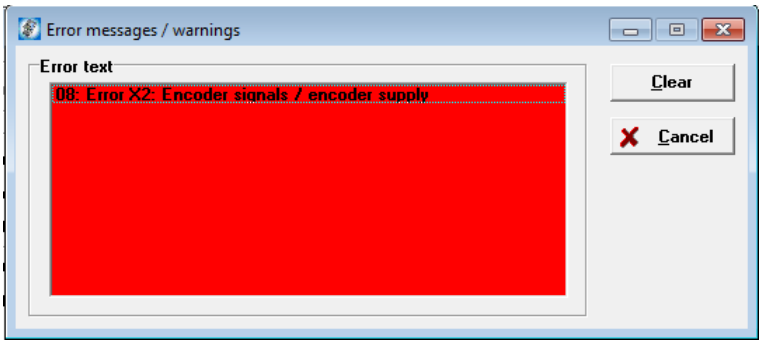
Example: Following error, Error nr. 29 – Error message 9 in order Table 14
=> ERR blinked 9 x wit to the end a small break
ERR: O O O O O O O O O O O O O O O O O O O O

11.4 Error window in RBD-S ServoCommander™

The **error window** is one permanent window of the parameter program. When there is no error available, the window is in minimized.

As soon as there is a controller error; there will be two changes in the display:

1. The error window increases and stays in the display.
2. In the lower part of the window the error is shown in red.



The error handling takes place in three steps:

1. **Error analysis:** In this error example i.e. by a broken / not connected angle encoder.
2. **Error solution:** Repair the cause of the error. (In this example connect the angle encoder.)
3. **Error clearing:** Click on the surface **Clear** in the error window. If the error is successfully repaired, the error window will be minimized. If the error isn't repaired the error stays high.

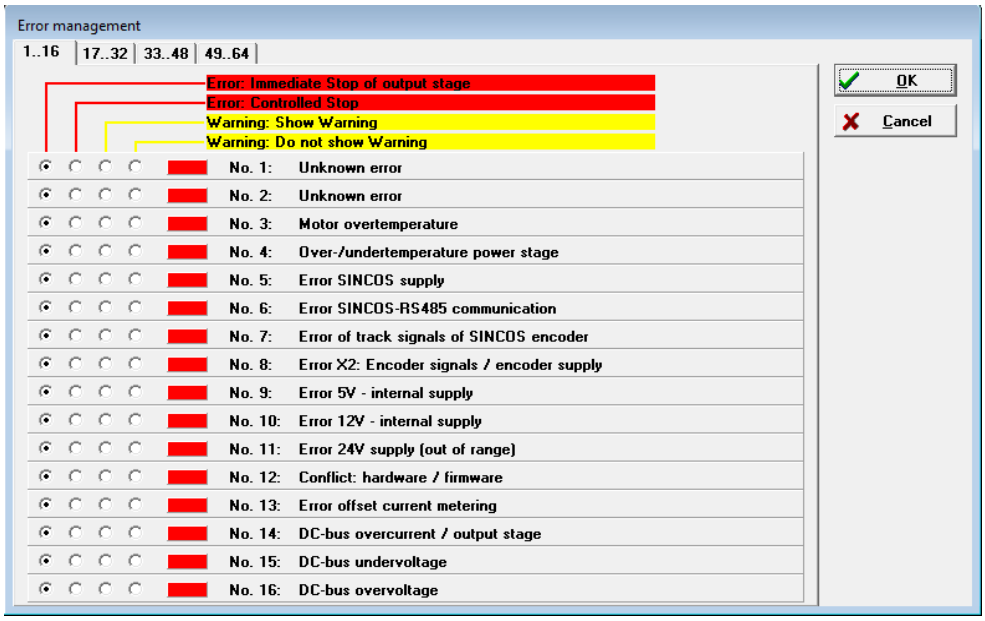
By clicking on the button **Cancel** the window can be minimized. Existing error stays in the error window.

Clicking the **Cancel** button does not eliminate the errors!

11.5 Error management

The error management window and the error window are available for error messages and warnings.

The error management window can be opened via **Error/Error management**:



With help from the window you can acknowledge how the servo position controller reacts to error situations. All of these 64 possibilities have four kind of reactions.

1. The power stage disabled (The motor runs down).
2. Controlled disabling (The motor brakes to zero speed).
3. Warning shows (The error window opens automatically).
4. A warning does not show (a warning will be put in the error window but the error window does not open automatically).

Some of the events are so important that the user can't change it to a warning or one specified reaction is inevitable. In this case the user can select the option button but changing online parameterization will be corrected directly by the servo position controller. During offline parameterization these reaction types can be parameterized and saved but the servo position controller won't accept them.

12 Appendix

12.1 Operating the RBD-S ServoCommander™

12.1.1 Standard buttons

If a window opens during your work, you may see the following buttons:

Or

These buttons have the following meanings:

OK:	All changes will be accepted and the window closed.
Cancel:	All changes are ignored, and the window will close.

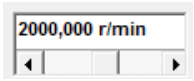
You select one of these buttons by:

- Clicking on it with the left mouse button
- Or select with **Tab** key and hit **ENTER** button
- Or with the keyboard select the underlined letter in combination with **ALT** button.

Sometimes the buttons are different in some menus or in another form to that shown here. You can find more specific information in this manual.

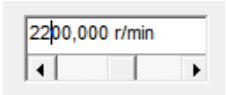
12.1.2 Numeric input field

In the windows of the parameter program you will find fields for numeric inputs as shown in this figure:



There are the following input options:

1. Directly via the keyboard: put in the value in the input line. Until the input is finished, the characters are thinner and not taken into the parameter program (see figure).

   To close the input push the ENTER button or change to another input field with Tab key. The numerical value is bold...

2. Clicking on the arrow: The value will change in small steps (micro-adjustment).
3. Clicking on the surface between the grey slider and the arrow: The value changes in bigger steps (macro-adjustment).

4. Clicking on the grey marker and moving it with the mouse with left button held down: The value can be changed quickly in big steps.

12.1.3 Control elements

The user interface is based on graphic based windows.

In the following table the control elements used are shown with their respective descriptions:

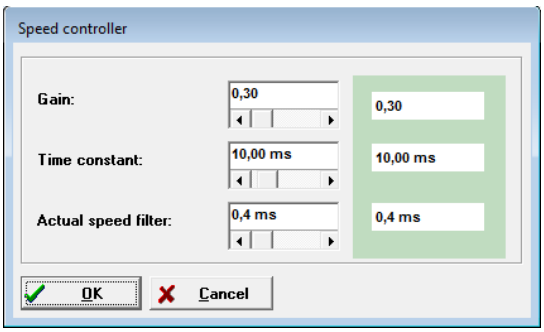
Table 15: Control element

Control element	Name	Description
	Control unit	An option that can be activated or deactivated by the user by ticking the unit. It is possible to activate more units in the same way.
	Options unit	An option interface where the user can select only one of a row.
	"..."-button	A button where a new menu will open if the user clicks on it.
	General button	A button where a new menu will open if the user click on it.

12.1.4 Representation of settings and actual values

The parameter program adjusts the main values, to correspond with the desired user input and the actual values are used in the equipment.

1. The user changes the scroll box, in the window by pulling the scrollbars or by direct input of a new value.
2. The parameter program transfers the value to the servo position controller RBD-S.
3. The parameter program reads the now up-to-date valid parameter immediately and indicates these in the green field. The scroll box remains unchanged.



Definition:

- Goal value:
  - The goal value is transferred to the servo position controller RBD-S (from user defined adjustment)
- Actual value:
  - This value is sent to the servo position controller RBD-S.
    A deviation from the goal value can have different effects.
    Examples:
  - Quantization effects, roundness effects, etc.

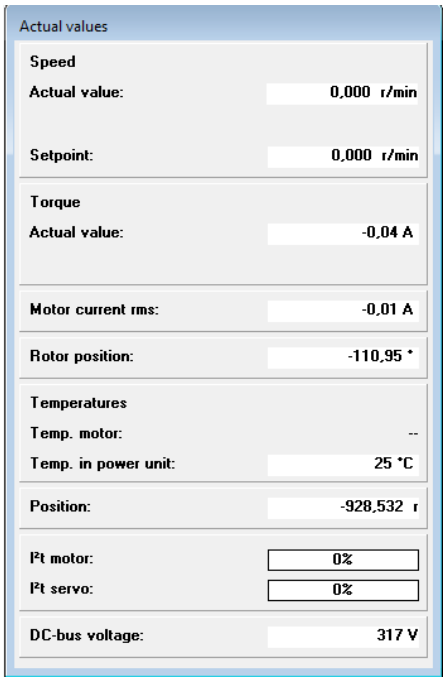
- The changed parameter will be activated just after saving parameters and RESET
- Temporary range of excess values e.g. nominal current > maximum current
- Wrong value range, e.g. by loading a parameter file of the servo position controller with an incorrect value (e.g. nominal current > device current)

With the concept of different goal and actual values note the following. One parameter file can be loaded from a specified servo position controller with one power class into another servo position controller of another power class and back. So if no parameterizing is done, the goal values will **not** change. Only different actual values due to the different performance classes. A gradual change of a parameter file as a function of the equipment performance class is therefore largely avoided.

12.1.5 Actual window

In the basic settings of the online-parameterization the commands window, the status window and the actual value windows are open. With offline parameterization only the commands window is available.

In the actual **value window** which shows the actual controller parameters such as current, speed etc. the configuration of the actual value window can be changed via menu **Display/actual values**. All values shown must be set with ticks. With the option enable or **disable** you can quickly minimize or maximize the actual value window.



12.1.6 Listings

The parameter program possesses the following subjects in the installed version:

Table 16: Listings structure

Listing	Contents
SOFTWARE	Software-version
TXT	Default listing for the expenditure for plain language of the parameter data
DCO	Default-listing for the parameter files

12.1.7 Communication across communications objects

The parameter program accesses by means of communication objects via standardized internal equipment software interface the servo position controller RBD-S. With the completion of tasks of communication, monitoring is made internally on the following error conditions:

- Write accesses on read-only communication objects
- Read accesses on write-only communication objects
- Over or falling below of the value range
- Incorrect data communication

In the first two situations concern fatal errors which in practice never normally occur. In the latter case of the parameter program one tries several times to accomplish the reading and/or writing procedure without bit errors.

The over and/or falling below of the range of values of a communication object is indicated with a warning. There is an internal value for this object, then the value as desire value secure, internally however the original value is maintained, otherwise the value is rejected.

12.1.8 Finishing the program

The program can be finished as follows:

- By selecting menu **File/Exit**
- By the combination **<Alt>x**
- By clicking the X in the upper right corner of the main window.

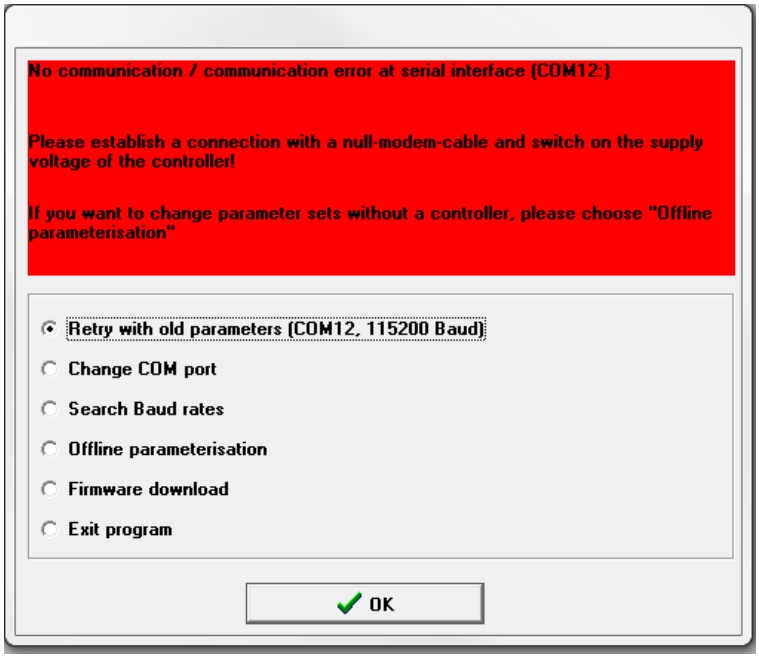
12.2 Renew the serial communication

To set up the correct communication it is necessary to use the following steps:

1. Connect the servo position controller RBD-S completely.
2. Connect the free serial interface of the PCs with the serial communication cable (enclosed with delivery) with the servo position controller RBD-S.
3. Switch on the servo position controller RBD-S.
4. Start the parameter program

If the surface in the symbol border „Online “is marked green (see figure), the communication parameters are correctly adjusted...

If the parameter program can’t start the serial communication, the program shows the following error window:



The reason for this error could be a wrongly adjusted interface (usually an attitude of the mouse driver) or another Windows®- or MS-DOS® ᵖrogram, which the serial interface accesses..

In order to solve the access conflict with a program working on the interface, close the other program (correctly !!) and then click on **Retry with old parameters**.

To correct a wrongly adjusted interface, click in the option interface **Change COM port** and follow the instructions (see *chapter 10.2.3 Settings via RS232 communication parameter*).

In some cases is it possible that the servo position controller works with other Baud rates if it is adjusted in the parameter program. When you want to search the communication range select **Search Baud rates**, the parameter program tries to find all possible Baud rates to make the communication.

The **Offline parameterization** is only useful if the parameter data without a servo position controller must be changed. See here for *chapter 12.12 Offline* **.**

If the servo position controller does not have the right software, or you want to download software, it is possible to download software by using the option **Firmware-Download**.

By clicking the option **Exit program** the program stops immediately.

The following table describes possible error causes and strategies to eliminate them:

Table 17: Problem solving of serial communication

A cause	**Possible solution**
Communication has itself 'swallowed'	Click on **Retry with old parameters**.
Selected COM port is wrong	Click on **Change COM port** and follow the instructions.
Baud rates of parameter program and servo position controller don't match	Click on **Search Baud rates**.
Communication with servo position controller is disrupted.	**RESET** servo position controller, switch it off and switch on again and click on **Retry with old parameters**.
Hardware error: ❖ Servo positioning controller isn't switched on	Repair error, after that click on **Retry with old parameters**.
❖ Connection cable disconnected	
❖ Connection cable broken	
❖ Wrongly wired connector for serial connection	
❖ Connection cable too long	Reduce baud rate or use a shorter cable.

12.3 Info-Window

Under **about/about** you can find the general information for the RBD-S ServoCommander™ . The following window appears:

In the map **Copyright** the following information appears:

- Program name, version number
- Supplier: Address and phone number
- Internet address: to get to it click on the button
- Email address: to send an Email click on the button

In the map **Software/Hardware** the following information appears:

- Main board: Type, serial number, version number
- Boot loader: version number
- Software: version number

In the map **Communication** the following information appears:

- Com port used, Baud rate (with Online-parameterization)
- File used (with Offline parameterization)

In the map **Times** the information concerning cycle times will show:

- Current controller
- Speed controller
- Position controller
- Also the actual operation time

In event of a complaint it is helpful to have this information available.

12.4 Quick access via symbol

In the symbol underneath the menu border is it possible to start several functions of the parameter program:

Symbol	Description
	Angle encoder menu (auto detect) Motor data menu (auto detect) Oscilloscope Offline parameterization Online parameterization Arrow, language selection (DE, UK, FR, NL) English language selected
	Refresh actual values Reset servo position controller Save parameter Go to destination Destination parameters Reference movement Position controller Speed controller Current controller

12.5 Use of the oscilloscope functions

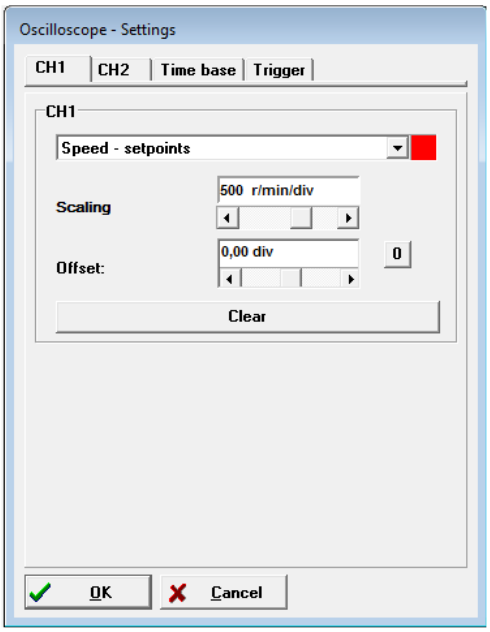
The parameter program's integrated oscilloscope functions permit the representation of signals and digital conditions as well as the optimization of physical parameters.

The curves, e.g. step responses, can be printed, stored as bit-map or can be exported to Microsoft® Excel.

The oscilloscope can be accessed via menu **Display/Oscilloscope** or by clicking the button  .

Two windows open: the original oscilloscope and the main surface to adjust the oscilloscope function.

12.5.1 Oscilloscope settings



The oscilloscope window settings has four tabs for detailed settings

- **Ch1**: Selection of the measured variable on channel 1
- **Ch2:** Selection of the measured variable on channel 2
- **Time base:** Attitude on the time base
- **Trigger**: Attitude on the trigger base

The oscilloscope has two channels. In the tab **CH1** and **CH2** you can set up the following for each channel:

- Measured variables which can be represented. Click the selection map of the represented channel and select your physical dimension or the event that you want to plot.
- Color of the channel. Click on the colored surface. A new color window appears.
- Y-scaling. Use the slider switch **scaling** to change the enlargement in vertical axis.

- Offset / Y position. Use the slider switch **Offset** to move the vertical position of the curve. One click on the button **0** restores the offset to 0.

The representation of the two channels can be deleted, if you click the **Clear** button.

When you represent the **freely detectable communication object**, you can use every communication object on the oscilloscope. So it is necessary to put in the following additional data:

- The object number of the communication object
- The information as to whether the object returns the delivery a signed value, places a tick behind signed set.
- The physical unit of the object
- A masked. With this mask individual bits of a communication object can be out-masked and brought to the announcement. At similar values this mask should be stopped on FFFFFFFF (hex). This mask essentially serves to representing individual bits of a status word.

The representation of freely communication objects is only necessary in special situations. Some objects are delivered on the software CD-rom.

In the **map time base** you can adjust the plot time and the delay of plotting time:

- With the slider switch **Time**, under the time surface, you can arrange the time. A value of 10 msec/div means for example, every box width in the oscilloscope screen has a time base of 10 milliseconds.
- With the slider switch **Delay** the position of the trigger event in the oscilloscope screen can be determined. A value of 0 means that the trigger event at the left hand side of the oscilloscope screen is noted. A negative value for delay means that the events before the occurrence of the trigger conditions with are noted ("Retrigger").

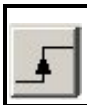
The source of trigger can be selected in the map **Trigger** from the selection list field **source** of trigger.

As also with CH1 and CH2 the trigger event from the list of pre-defined standard events can be selected. Alternatively you can select **freely selectable communication objects** and trigger on each communication object.

It differentiates between **digita**l and **analogue** trigger sources. Digital sources of trigger can accept only the condition or not (and/or actively or inactively). An example is Din 7 limit switch 0. In contrast to it similar sources of trigger can take arbitrary numeric values (e.g. rotation speed actual value).

Via analogue source of trigger an attitude box for trigger **level** appears. The trigger procedure begins as soon as the similar value of the level exceeds or falls below it.

With the trigger edge you can adjust the reaction of the event:

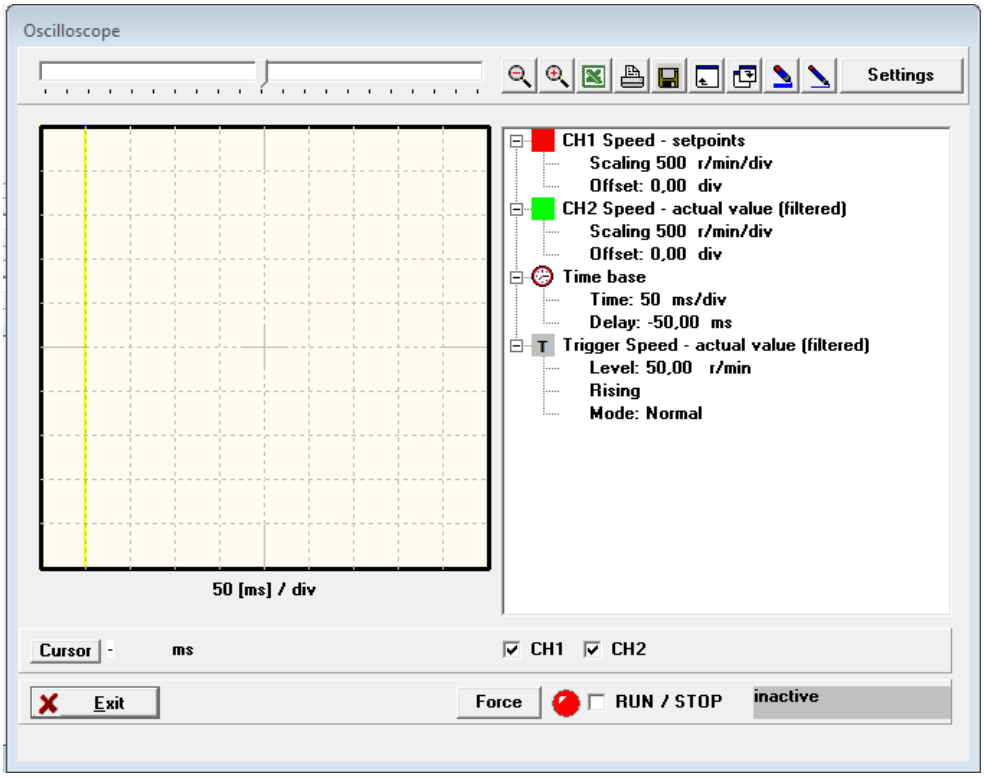
	Rising edge	Digital trigger: event start Analogue trigger: Level above
	Falling edge	Digital trigger: event stop Analogue trigger: Level below

The trigger mode and therefore the oscilloscope is only active, if the Run / Stop in oscilloscope windows is marked!
By opening the transfer window or parameters will be saved, the oscilloscope will be deactivated. In this case the marking must be reset afterwards and again set or clicked on to activate the oscilloscope again..

In the field **mode** you can select the method of triggering. There are three trigger modes:

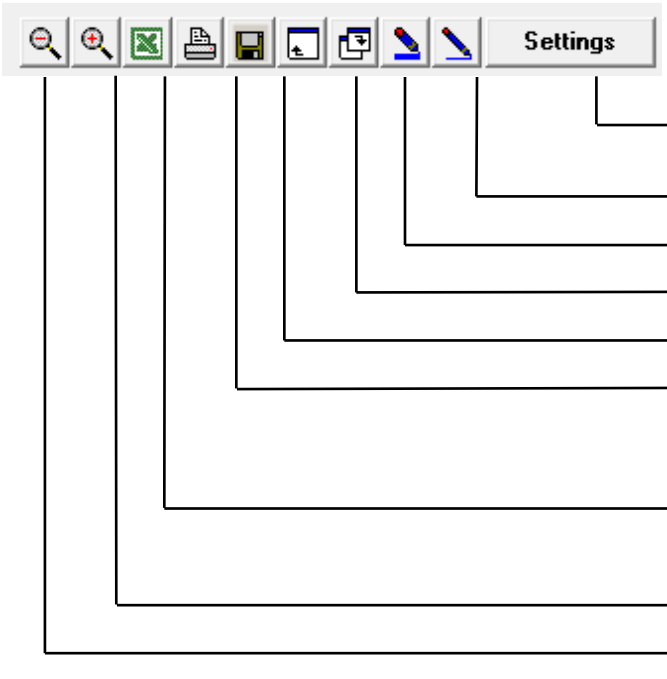
- **Auto**: It is continually triggered and indicated, regardless of whether the trigger conditions were fulfilled or not.
- **Normal**: It is triggered and plots as soon as the trigger condition is fulfilled. After announcement and with new occurrence of the trigger condition again one trigger.
- **Single**: It is triggered just one time as soon the trigger condition is fulfilled. After that the trigger switches to inactive. After marking with a tick by the run/stop option the measuring starts again one time.

12.5.2 Oscilloscope window



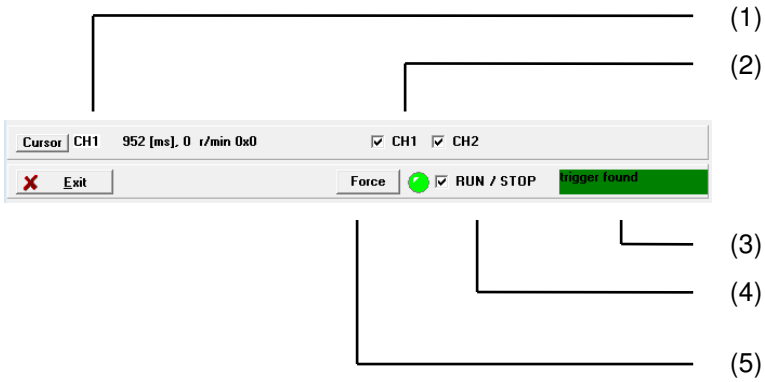
The oscilloscope has several symbol lists. With these you can select activities. They are shown in the following overview:

Symbol	Description



Further buttons and options:

Symbol	Description



(1) This option controls and displays the cursor control of the oscilloscope. If the user moves to the oscilloscope window, the value of the selected channel is shown at this actual time (position of the cursor) numerically. In the current example the channel **CH1** has the value **0 r/min t=952 ms**.
By manipulation of the button the cursor can switch channels.

(2) Via this button the channels can be faded in and out selectively. An activated button means : The

channel is shown.

(3) Via this button can one manual trigger source be prepared. The oscilloscope starts as soon as possible with plotting of the data.

(4) The LED shows in three ways the process status of the oscilloscope.
A **green** LED means: The oscilloscope is active. A **Yellow** LED means for “waiting on trigger”.
An inactive Oscilloscope is shown by a **red** LED.

Over the button **RUN** / **STOP** can the user activate or inactivate the oscilloscope. Switch this surface on for using the oscilloscope.

(5) These colored surfaces show the actual status of the oscilloscope. The following situations are possible:

Inactive	The oscilloscope is not active at the moment
start	The oscilloscope is running
wait for trigger	It is still waiting for a trigger
retrigger	For the Retrigger the plotting is started
trigger found	A trigger source is found but it hasn’t started with the plot
data read	The channel data will be sent to the parameter program

12.6 Serial communication protocol

The communication between the servo position controller RBD-S and the program window RBD-S ServoCommander™ takes place via a serial communication protocol, in ASCII format. An order will always close with <CR>.
The technical data of the serial interface is described in *chapter 12.14.10*.
In general the communication takes place via communication objects.
Via these communication objects you can access the actual values and parameters of the servo position controller. All physical dimensions are handled in standardized units. In the following table the commands syntax of the communications objects is defined:

Table 18: Commands syntax OK's

Commands	Answer	Description
Object write: **OW:NNNN:DDDDDDDD**	**OK!** **Or.** **OW:FFFF FFFF**	In an error free situation OK!' should always be returned. In an error situation an error code will be returned.
Object read: **OR:NNNN**	**NNNN:DDDDDDDD** **or.** **OR:FFFF FFFF**	Answer standardizes 32 Bit. In an error situation an error code will be returned.
Read internal value: **OI:NNNN**	**NNNN:DDDDDDDD** **or.** **OI:FFFF FFFF**	Answer standardizes 32 Bit. In an error situation an error code will be returned..
Read minimum value: **ON:NNNN**	**NNNN:DDDDDDDD** **or.** **ON:FFFF FFFF**	Answer standardizes 32 Bit. In an error situation an error code will be returned.
Read maximum value: **OX:NNNN**	**NNNN:DDDDDDDD** **or.** **OX:FFFF FFFF**	Answer standardizes 32 Bit. In an error situation an error code will be returned.

Table 19: Text description of command syntax

Text	Description (all in hexadecimal)
NNNN	Communication object-number
DD...D	Data bytes
FF...F	Error code: 0x00000002 Data value too small > not written 0x00000003 Data value too big > not written 0x00000004 Data value too small > written but limited 0x00000005 Data value too big > not written but limited 0x00000008 Bit constant value not permissible 0x00000009 Bit-Data value is momentarily (in this application) not permitted 0x00000010 Read or write error in Flash 0x00020000 Lower limit for this object doesn't exist 0x00030000 Upper limit for this object doesn't exist 0x00040000 No object with this number available (object doesn't exist) 0x00050000 Object isn't permissible to write

Additional to the commands for accessing the communication objects are several additional commands for controlling the servo position controller.

The following table gives an overview of the command data used:

Table 20: Order syntax RS232

Command	Answer	Description
BAUDbbbb	**OK!**	Baud rate search
BOOT?	**SERVICE / APPLICATION**	Status queries: Boot loader active?
BUS?	**xxxx:BUS:nn:bbbb:mmmm**	CAN-Bus Status
INIT!	**Switch on warning**	Default parameter file load
RESET!	**Switch on warning**	HW-Reset release
SQT+	**xxxx:CQT+**	Delete error memory
SAVE!	**DONE**	Save parameter data in FLASH
SEP!	**DONE**	Load parameter data in FLASH
TYP?	**TYP:dddd**	Type release
VERSION?	**xxxx:VERSION:dddd**	Version release
=iiiiss:dd..	**=iiiiss:dd..**	Simulation SDO write access
?iiiiss	**=iiiiss:dd..**	Simulation SDO read access
	ERROR!	Command unknown / error

Table 21: Text description in the command syntax

Text	Description (all hexadecimals)
xxxx	Status-message
dddd	Data bytes
nn	Node number
bbbb	Baud rate
mmmm	Mode
iiii	Index of CAN-Open SDO objects
ss	Sub index of CAN-Open SDO objects

12.7 Use of communication objects

In this chapter are listed the communication objects by which the window *RBD-S* ServoCommander™ exchanges data with the servo position controller *RBD-S*.

In *chapter 12.7.1 Basic units* you can find the list of the communication objects and the basic units used.

Table 22: List of all KOs

Nr.	Name	Description	Scaling
0000	currc_cyc_time_currc	Cycle time current controller	Basic unit time
0001	currc_cyc_time_spdc	Cycle time speed controller	Basic unit time
0002	currc_cyc_time_posc	Cycle time position controller	Basic unit time
0003	main_abtast_ablauf	Cycle time communications manager	Basic unit time
0004	ioh_uzk_nenn	Nominal DC-bus voltage controller	Basic unit voltage
0005	currc_i_nom_dev	Device nominal current (peak value)	Basic unit current
0006	currc_i_max_dev	Device maximum current (peak value)	Basic unit current
0007	pfc_uzk_min	Minimum DC-bus voltage controller	Basic unit voltage
0010	srvc_device_type	Device recognizing	None
0011	main_cpu_time_remaining	Remaining time CPU	Basic unit Percent
0012	srvc_operation_time	Operation time	in seconds
0013	srvc_commiss_state	Commission state	None
0014	srvc_device_serial_num	Serial number device	None
0015	srvc_device_revision	Hardware revision	Upper16 Bit: main revision lower 16 Bit: sub revision
0016	srvc_encoder_type	Selected angle encoder type	Upper16 Bit: main revision lower 16 Bit: sub revision
0017	srvc_soft_main	Software main and sub revision number of software used	Upper16 Bit: main revision lower 16 Bit: sub revision
0018	srvc_custom_main	Custom application numbers sub revision number.	Upper16 Bit: main revision lower 16 Bit: sub revision
0019	main_bootloader_version	Main and sub number boot loader version	Upper16 Bit: main revision lower 16 Bit: sub revision
001A	srvc_motid_ctrl	Control word for angle encoder identification	0: Identification restore 1: Angle encoder identification
001B	srvc_u_nenn_mot	Nominal voltage of the motor	Basic unit voltage
001C	currc_i_nom	Nominal current (peak value) of the motor	Basic unit current
001D	currc_i_max	Maximum current (peak value) of the motor	Basic unit current
001E	currc_iit_mot_time	I^2t-Integration time motor	Basic unit time
001F	srvc_torque_const	Torque constant	Basic unit torque constant
0020	srvc_nenn_mot_speed	Nominal speed motor	Basic unit rotation speed
0021	spdc_n_ref_lim_pos	Limitation offset speed	Basic unit rotation speed
0022	eeval_enc_polp_num	Number of Poles encoder system (motor)	Pole pair, not pole quantity!
0023	ioh_l_mot	Winding inductivity Ls motor	Basic unit inductivity
0024	ioh_r_mot	Winding resistance Rs of Motors	Basic unit resistance
0025	ioh_mot_temp_max	maximum motor temperature	Basic unit temperature

Nr.	Name	Description	Scaling
0026	srvc_soft_prod_step	Software-main and sub revision number	Uper16 Bit: main revision lower 16 Bit: sub revision
0030	seqc_opmode	Parameterization mode of operation and ramps	None
0031	stat_conf2_1	Configurations word of gear	None
0032	rs232_stat_sum	Status word of status window	None
0033	seqc_brake_unlock_time	Time delay to unlock the brake.	Basic unit time
0034	seqc_brake_lock_time	Time delay to lock the brake	Basic unit time
0035	seqc_auto_brake_time	Minimum waiting time to activate the brake. Not supported at the moment.	Basic unit time
0036	commh_ctrlenab_log	Parameter describes the components which enable the controller.	0: only DIN9 1: DIN9 and RS232 2: DIN9 and CAN
0040	commh_null	Help object, so always zero returned	None
0050	rs232_baudrate	Baud rate for RS232 communication	Baud rate RS232
0051	rs232_para_conf	Configuration word for parameter software	None
0052	rs232_unit_x_var_i	Physical unit position	None
0053	rs232_unit_x_conv_i	Physical unit position	None
0054	rs232_unit_x_numerator	Factor-group position numerator	None
0055	rs232_unit_x_divisor	Factor-group position denominator	None
0056	rs232_unit_x_decimals	Decimal places	None
0057	rs232_unit_n_var_i	Physical unit: speed	None
0058	rs232_unit_n_conv_i	Physical unit: speed	None
0059	rs232_unit_n_numerator	Factor-group speed numerator	None
005A	rs232_unit_n_divisor	Factor-group speed denominator	None
005B	rs232_unit_n_decimals	Decimal place speed	None
005C	rs232_unit_a_var_i	Physical unit: acceleration	None
005D	rs232_unit_a_conv_i	Physical unit: acceleration	None
005E	rs232_unit_a_numerator	Factor-group acceleration numerator	None
005F	rs232_unit_a_divisor	Factor-group acceleration denominator	None
0060	rs232_unit_a_decimals	Decimal place acceleration	None
0061	rs232_kommando	Command word	None
0062	rs232_osc_screen_time	Total time	Basic unit time
0063	rs232_display_free_adr	Free KO-Address	KO-Number "free KO"
0070	errh_err_field_0	Bit field main error number 1 to 32	Bit = 0: Error not active Bit = 1: Error active
0071	errh_err_field_1	Bit field main error number 33 to 64	Bit = 0: Error not active Bit = 1: error active
0072	errh_prio_field_0	Bit field main error number 1 to 32	Error Bit = 0: Motor brake power stage off
0073	errh_prio_field_1	Bit field main error number 33 to 64	Bit = 1: Power stage off
0074	errh_warn_field_0	Bit field main error number 1 to 32	Warning Bit = 0: Warning not shown
0075	errh_warn_field_1	Bit field main error number 33 to 64	Bit = 1: Warning shown
0080	currc_i_u_act	Measured phase current phase U	Basic unit current
0081	currc_i_v_act	Measured phase current phase V	Basic unit current

Nr.	Name	Description	Scaling
0082	ioh_uzk_volt	Voltage in DC bus	Basic unit voltage
0083	ioh_mot_temp	Motor temperature	Basic unit temperature
0084	ioh_power_stage_temp	Temperature power stage	Basic unit temperature
0085	ioh_din	Connection status of the digital inputs	None
0086	ioh_dout_data	Actual situation of the digital outputs Bit field,	DOUT0 ready for operation, fixed wired DOUT1 Programmable DOUT2 Programmable DOUT3 Holding brake. Fixed wired
0087	ioh_aout_range	Value range analogue monitor (Maximum) for both channels	Basic unit voltage
0088	ioh_aout_resolution_volt	Resolution analogue monitor, projection voltage for one Bit calculated from value range	Basic unit voltage
0089	ioh_dout2_1_func	Specifies functionality of which digital output is selected.	None
008A	ioh_aout0_ko_nr	Analogue monitor 0: number of communication objected the spent size.	Number of communication objects of spent size
008B	ioh_aout0_scale	Analogue monitor 0: Scaling	Basic unit gain
008C	ioh_aout0_offset	Offset voltage for analogue monitor	Basic unit voltage
008D	ioh_aout1_ko_nr	Analogue monitor 1: number of communication objects the spent size.	Number of communication objects of spent size
008E	ioh_aout1_scale	Analogue monitor 1: scaling	Basic unit gain
008F	ioh_aout1_offset	Offset voltage for the analogue monitor	Basic unit voltage
0090	ioh_ain0_offs	Offset AIN0	Basic unit voltage
0091	ioh_ain1_offs	Offset AIN1	Basic unit voltage
0092	ioh_ain0_safezero	safety zero	Basic unit voltage
0093	ioh_ain1_safezero	Safe zero	Basic unit voltage
0094	ioh_control	Configuration of analogue monitor & temperature sensing	None
0095	ioh_pins_used	The value for DIN0... DIN3, can be optionally parameterized as AIN0, #AIN0, AIN1, #AIN1	None
00A0	eeval_enc_phi	Return the encoder position without angle encoder offset	Basic unit degree
00A1	enc_config	Encoder configuration word	None
00A2	emu_ctrl	Selecting application mode	None
00A3	eeval_enc_phi_offs	Offset angle encoder U	Basic unit degree
00A4	eeval_x2b_line_cnt	Quantity levels of an analogue Incremental encoder	Level increment = 4 x level quantity
00A5	emu_enc_line_cnt	Output level quantity encoder emulation	Level increment = 4 x level quantity (32 ...1024)
00A6	emu_enc_offset	Offset between actual angle and output angle of the encoder emulation	Basic unit degree
00A7	eeval_motid_w_status	Status of Motid_w	None
00A8	enc_sync_num	Numerator for gear factor by synchronization	None

Nr.	Name	Description	Scaling
00A9	enc_sync_div	Denominator for gear factor by synchronization	None
00AA	enc_encoder_status	Status of the angle encoder	None
00AB	enc_hiperface_line_cnt	Level quantity of a SINCOS encoder	None
00AC	eeval_enc_phi_offs_2	Offset angle 2e signal e.g. Hall sensing encoder by incremental encoder	Basic unit degree
00C0	currc_i_q_act	Active current-actual value in rotor coordinates	Basic unit current
00C1	currc_i_d_act	Reactive current-actual value in rotor coordinates	Basic unit current
00C2	currc_i_q_ref	Reactive current-set point value in rotor coordinates	Basic unit current
00C3	currc_i_d_ref	Reactive current-set point value in rotor coordinates	Basic unit current
00C4	currc_iit_pwr_level	actual situation of i2t-Integrator for the power stage	Basic unit percent
00C5	currc_iit_mot_level	Actual situation of i2t-Integrator for the motor	Basic unit percent
00C6	currc_i_lim_act	actual torque limitation limited on 0 - i_max	Basic unit current
00C7	currc_i_ref_rs232	Set point torque RS232	Basic unit current
00C8	currc_i_ref_can	Set point torque CAN	Basic unit current
00C9	currc_i_ref_ftd	Set point torque FTD	Basic unit current
00CA	currc_i_ref_profi	Set point torque Profi	Basic unit current
00CB	currc_i_lim_rs232	Parameterize torque limitation RS232	Basic unit current
00CC	currc_i_lim_can	Parameterize torque limitation CAN	Basic unit current
00CD	currc_i_lim_ftd	Parameterize torque limitation FTD	Basic unit current
00CE	currc_i_lim_profi	Parameterize torque limitation Profi	Basic unit current
00CF	currc_ctrl	Curry Control/Configword	....
00D0	currc_ctrl_gain_q	Active current controller P-gain	Basic unit gain
00D1	currc_ctrl_time_q	Active current controller time constant I-part	Basic unit time
00D2	currc_ctrl_gain_d	Reactive current controller P-gain	Basic unit gain
00D3	currc_ctrl_time_d	Reactive current controller time constant I-part	Basic unit time
00D4	currc_sel_i_switch	Selection torque set point	None
00D5	currc_sel_i_lim_switch	Selection torque limitation	None
00D6	ssel_ain0_i_per_volt	Torque set point scaling AIN0: Ampere each Volt	Basic unit current
00D7	ssel_ain1_i_per_volt	Torque set point scaling AIN1: Ampere each Volt	Basic unit current
00D8	currc_i_ref_jog1	Jogsetpoint1 (is not supported)	Basic unit current
00D9	currc_i_ref_jog2	Jogsetpoint2 (is not supported)	Basic unit current
00E0	ssel_n_ref	Speed set point (input size DZ-controller)	Basic unit speed
00E1	ssel_n_act	Rotation speed-actual value	Basic unit speed
00E2	ssel_n_act_disp	Rotation speed actual value (filtered) for showing	Basic unit speed
00E3	spdc_n_ref_rs232	Set point rotation speed RS232	Basic unit speed
00E4	spdc_n_ref_can	Set point rotation speed CAN	Basic unit speed

Nr.	Name	Description	Scaling
00E5	spdc_n_ref_ftd	Set point rotation speed FTD	Basic unit speed
00E6	spdc_n_ref_profi	Set point rotation speed Profi	Basic unit speed
00E7	spdc_n_ref_hilf_rs232	connecting set point speed RS232	Basic unit speed
00E8	spdc_n_ref_hilf_can	connecting set point speed CAN	Basic unit speed
00E9	spdc_n_ref_hilf_ftd	connecting set point speed FTD	Basic unit speed
00EA	spdc_n_ref_hilf_profi	connecting set point speed Profi	Basic unit speed
00EB	ssel_ctrl_stat	configuration DZ-controller	None
00EC	spdc_ctrl_gain	Controller P-gain	Basic unit gain
00ED	spdc_ctrl_time	Controller time constant I-part	Basic unit time
00EE	spdc_sel_n_switch	Selection speed controller for speed set point	None
00EF	spdc_sel_h_n_switch	Selection connection set point for speed set point	None
00F0	ssel_ain0_n_per_volt	Speed set point scaling AIN0: DZ each Volt	Basic unit speed
00F1	ssel_ain1_n_per_volt	Speed set point scaling AIN1: DZ each Volt	Basic unit speed
00F2	ssel_time_c_n_act_filter	Filter time constant of speed actual filters	Basic unit time
00F3	ssel_n_acc_pos	Ramp generator – rising by: pos. speed - rising edge	Basic unit acceleration
00F4	ssel_n_dec_pos	Ramp generator – rising by: pos. speed - falling edge	Basic unit acceleration
00F5	ssel_n_acc_neg	Ramp generator – rising by: neg. speed – rising edge	Basic unit acceleration
00F6	ssel_n_dec_neg	Ramp generator – rising by: neg. speed – falling edge	Basic unit acceleration
00F7	ssel_lim_sw_ramp_dec	Neg. acceleration for limit switch-ramp	Basic unit acceleration
00F8	ssel_enab_off_ramp_dec	Neg. acceleration for quick stop-ramp	Basic unit acceleration
00F9	spdc_n_target_speed	Comparison speed for warning, by reaching n_mel +/- n_mel_hyst a Bit stays in status word	Basic unit speed
00FA	spdc_n_target_win_speed	Hysteresis for the speed warnings: n_ist = n_mel and n_ist = n_soll	Basic unit speed
00FB	spdc_ramp_brake_max_time	Maximum time by quick stop	Basic unit time
00FC	n_ramp_brake_min	DZ by quick stop successfully terminated	Basic unit speed
00FD	spdc_n_ref_jog1	Jogsetpoint1 (isn't supported)	Basic unit speed
00FE	spdc_n_ref_jog2	Jogsetpoint2 (isn't supported)	Basic unit speed
00FF	ssel_n_act_ixr	DZ-actual value calculated from machine model	Basic speed
0100	ssel_n_act_filter	DZ-actual value with the actual speed filter filtered	Basic unit speed
0110	psel_x_act	Position-actual value	Basic unit position
0111	ioh_pos_selector	Value of destination selector, also actual valid	0...63 = destinations
0112	posi_bus0_pointer	Shows on actual position parameter by rs232	0...63 = destinations
0113	posi_bus1_pointer	Shows on actual position parameter by CAN	0...63 = destinations

Nr.	Name	Description	Scaling
0114	posi_bus2_pointer	Shows on actual position parameter by FTD	0...63 = destinations
0115	posi_bus3_pointer	Shows on actual destination parameter by Profi	0...63 = destinations
0116	posc_ctrl_gain	Position – gain	Basic unit gain
0117	posc_n_lim_pos	Symmetrical limits of maximum output speed of position controller	Basic unit speed
0118	pos_sel_parameter	Set point selection position controller	None
0119	posc_x_diff_time	Time to reset following error	Basic unit time
011A	posc_x_diff_lim_pos	Following error (position difference off set/act)	Basic unit position
011B	posc_x_dead_rng_pos	Dead end position difference	Basic unit position
011C	ipo_sw_lim_pos	Position limit positive - software limit switch	Basic unit position
011D	ipo_sw_lim_neg	Position limit negative - software limit switch	Basic unit position
011E	posi_bus0_start_delay	Start delay after start of a positioning / valid for all destinations	Basic unit time
011F	posi_bus0_x_trig	Remaining distance for remaining distance triggered valid for all destinations	Basic unit position
0120	posc_x_target_win_pos	Window range "target reached"	Basic unit position
0121	posc_x_target_time	Time constant "target reached"	Basic unit time
0122	psel_home_offs	Offset for homing movement	Basic unit position
0123	posi_bus0_ctrl	Control word for characteristics and the expirations actual position	None
0124	posi_bus0_x_end_h	Target in actual selected destination	Basic unit position
0125	posi_bus0_v_max	Moving speed by positioning destination group parameter	Basic unit speed
0126	posi_bus0_v_end	End speed by positioning z. Z. = 0 destination group parameter	Basic unit speed
0127	posi_bus0_a_acc	acceleration motor range of the gear destination group parameter	Basic unit acceleration
0128	posi_bus0_a_dec	Acceleration generator range of the gear; negative acceleration destination group parameter	Basic unit acceleration
0129	posi_bus0_a_acc_jerkfree	Jerk free part by acceleration Destination group parameter	Basic unit time
012A	posi_bus0_a_dec_jerkfree	Jerk free part by negative acceleration destination group parameter	Basic unit time
012B	seqc_homing_method	Homing movement-mode	Selection in order CAN open DSP 402
012C	ssel_ain0_x_per_volt	Position set point scaling AIN0: rotation each Volt	Basic unit position
012D	ssel_ain1_x_per_volt	Position set point scaling AIN1: rotation each Volt	Basic unit position
012E	seqc_home_sw_zero_dist	Distance from zero pulse to sequence (limit switch, homing switch) (isn't supported)	Basic unit position

Nr.	Name	Description	Scaling
012F	seqc_home_sw_zero_min	Minimum from zero pulse to sequence (limit switch, homing switch) (isn't supported)	Basic unit position
0130	pos_x_ref	Actual position set point	Basic unit position
0131	pos_control_n_korr	Output of position controller	Basic unit speed
0132	posi_rev_dist	Reverse course (isn't supported)	Basic unit position
0133	pos_sel_x_switch	Selection position controller for position set point	None
0134	pos_sel_n_switch	Selection set point for speed pre controlling	None
0135	pos_can_x_ip	Position set point in actual selected designation	Basic unit position
0136	pos_bus0_delay	Start delay after start of a destination / valid of all destinations	Basic unit time
0137	posc_x_diff_32b	Actual position difference between actual position set point and actual position	Basic unit position
0138	pos_sel2_x_switch	Selection position controller for position set point	None
0139	pos_sel2_n_switch	Selection set point for speed pre controlling	None
0140	can_node_id	Resultant node address on basic and Offset	1 ... 127
0141	can_node_id_offset	Node number-Offset by digital inputs	0 ... 63
0142	can_node_id_base	Basic node address for CAN	0 ... 127
0143	can_baudrate	Setting Baud rate for the CAN-Bus in kBaud	kBaud 125; 250; 500
0144	can_comm_active	Activated CAN open- or protocol	1: CAN open
0145	can_options	Setting different options	None
0146	can_pdo_tx0_mapped	Identifier mapped SDO objects 0 (Sent)	None
0147	can_pdo_tx1_mapped	Identifier mapped SDO objects 1 (Sent, optional)	None
0148	can_pdo_rx0_mapped	Identifier mapped SDO objects 0 (received)	None
0149	can_pdo_rx1_mapped	Identifier mapped SDO objects 1 (received, optional)	None
014A	can_sync_time_slot	nominal Interval between two SYNC-Frames on the CAN-Bus (is necessarily for interpolated position mode)	None
014B	can_pos_fact_num	Numerator factor for Pos. representation	None
014C	can_pos_fact_div	Denominator factor Pos. representation	None
014D	can_val_fact_num	Numerator factor for DZ representation	None
014E	can_vel_fact_div	Numerator of the Factor for the DZ representation	None
014F	can_acc_fact_num	Denominator factor for acceleration representation	None
0150	can_acc_fact_div	Numerator factor for acceleration representation	None
0160	osc_control	Control word oscilloscope, application mode	None
0161	osc_status	Status word oscilloscope, application mode	None
0162	osc_samples	Quantity samples	Quantity of samples each channel

Nr.	Name	Description	Scaling
0163	osc_sample_time	Min. time between two samples	Basic unit time
0164	osc_triggermask	Trigger mask oscilloscope for digital trigger	Exceptions are '01L, '02L, '04L, a.s.o., 'FFL
0165	osc_triggerconfig	Bit field trigger configuration	None
0166	osc_triggerlevel	Trigger level ('analogue') or level ('digital')	According to the size which can be noted
0167	osc_timebase	Quantity cycles to the next presentation	Multiple of the action period t(sample) = osc_timebase * osc_sample_time
0168	osc_delay	Replacing of the trigger	Quantity samples Value > 0 : elevator of the stored trigger invents. Value < 0 : elevator of the stored trigger invents
0169	osc_data0	Function number for channel data	None
016A	osc_KO_nr0	Free KO-Address	KO-number "free KO"
016B	osc_KO_mask0	Optional mask, to read specified communication object necessary Bits or value range.	None
016C	osc_data1	Function number for channel presentation	None
016D	osc_KO_nr1	Free KO-Address	KO-number "free KO"
016E	osc_KO_mask1	Optional Mask, to read specified communication objects necessary Bits or value range...	None
016F	osc_data2	Function number for channel presentation	None
0170	osc_KO_nr2	Free KO-Address	KO-number "free KO"
0171	osc_KO_mask2	Optional Mask, to read specified communication objects necessary Bits or value range...	None
0190	ftd_pointer_course_prog	Shows on input of course program	None
0191	ftd_line_course_prog	Input line in course program	None
0192	ftd_line_course_prog_akt	Shows on actual changed line in course program	None
0193	ftd_line_course_prog_start	Set up the start line for 1 and 2	None

12.7.1 Basic units

Table 23: List of the basic units

Size	Representation	Resolution	Resulted value range
Current	32 Bit	$1 / 2^{16}$ A	+- 2^{15} A
Acceleration	32 Bit	$1 / 2^{8}$ rpm/s	+- 2^{23} rpm/s
Speed	32 Bit	$1 / 2^{12}$ rpm	+- 524.288 rpm
Position	32 Bit	$1 / 2^{16}$ r	+- 2^{15} r
Torque constant	32 Bit	$1 / 2^{12}$ Nm/A	+- 524.288 Nm/A
Voltage	32 Bit	$1 / 2^{16}$ Volt	+- 2^{15} Volt
Power	32 Bit	$1 / 2^{8}$ VA	+- 2^{23} VA
Gain	32 Bit	$1 / 2^{16}$	+- 2^{15}
Time constant	32 Bit	0,1 µs = 10^{-7} s	430 s
Temperature	16 Bit	$1 / 2^{4}$ °C	+- 2^{11} °C
32Bit-factor	32 Bit	$1 / 2^{16}$	+- 2^{15}
16Bit-factor (%)	16 Bit	$1 / 2^{16}$	0...1 (0...+100%)
Resistance	32 Bit	$1 / 2^{8}$	0...16,7 MΩ
Torque changing.	32 Bit	$1 / 2^{8}$ A /s	+- 2^{23} A/s

12.7.2 Bit allocation command word / control word / error word

Command word (seqc_opmode)	
Bit	**Description**
31	Controller reset (Hardware Reset via commh)
30	Debug Modus 0 = off; 1= on
29	
28	Default parameter from program memory loading (init!)
27	
26	
25	
24	
23	
22	
21	
20	
19	
18	Set point block (acknowledge by internal controller)
17	Direction bit 0 =Left rotation, 1 = Right rotation (rotate DZ-set point as well the position set point), in the mode torque controlling also the torque set point
16	Reset error
15	
14	
13	
12	Start positioning or homing movement
11	
10	Reversal of rotation direction (inverted rotation direction by same set points)
9	
8	
7	
6	Activated in mode synchronous positioning
5	Activated homing movement
4	Activated positioning
3	Activated speed controller
2	Activated torque controller
1	Activated position controller
0	Controller enable

control word (rs232_stat_sum)	
Bit	**Description**
31	
30	
29	
28	
27	MOTID-operation
26	
25	
24	Enable controller and power stage Internal
23	
22	
21	Automatic encoder detection active
20	Homing valid
19	Positive direction blocked
18	Negative direction blocked
17	Collector error message
16	Warning message (non collector error and non disconnecting)
15	Ready for operation
14	Power stage is enabled
13	Speed warning n_ist = (0 +/- n_mel_hyst)
12	SinCos encoder activated
11	iit-controlling → Limited on nominal current; IIT-Motor / Servo
10	Positioning started (will be made during one IPO-cycle)
9	Speed message n_ist = (n_soll +/- n_mel_hyst)
8	1 = speed message n_ist = (n_mel +/- n_mel_hyst)
7	
6	Remaining distance positioning valid (will be zero by start next position)
5	Target reached message (x_ist = x_soll +/- x_mel_hyst)
4	Message positioning finished (x_soll = pos_x_soll) (will be zero by start next position)
3	Positive limit switch reached DIN8
2	Negative limit switch reached DIN7
1	Homing switch reached
0	Homing switch active

error word (low) (errh_err_field_0)	
Bit	**Description**
31	
30	Error limit switch
29	
28	Following error control
27	Temperature power stage 5°C under maximum
26	Temperature motor 5°C under maximum
25	I^2T by 80%
24	
23	
22	
21	
20	
19	I^2t-error controller (I^2t by 100%)
18	I^2t-error motor (I^2t by 100%)
17	
16	Error SINCOS-level signal
15	Over voltage DC-bus
14	Under voltage DC-bus
13	Over current DC-bus / Power stage
12	Error Offset current measuring
11	
10	Error 24V-supply (out of range)
9	Error 12V-electronic supply
8	Error 5V-electronic supply
7	Error resolver level signal / ref. losses
6	Error SINCOS-level signal
5	Error SINCOS-RS485-communication
4	Error SINCOS-supply
3	Under-/over temperature power electronic
2	Over temperature motor
1	
0	

Error-word (high) (errh_err_field_1)	
Bit	**Description**
31	Error by initializing
30	Checksum error
29	Stack-overflow
28	
27	Error in recalculation pos.
26	
25	Error application
24	Error destination
23	Error RS232-communication
22	Error CAN-communication
21	
20	
19	
18	
17	
16	
15	
14	
13	
12	
11	Error course program branch
10	Error course program unknown order
9	
8	
7	Error motor identification
6	
5	
4	
3	Error homing movement
2	Time Out by quick stop
1	
0	

12.7.3 RS232-command word / overview important orders

In the following overview the most important control commands for using RS232-interface to control the controller are described:

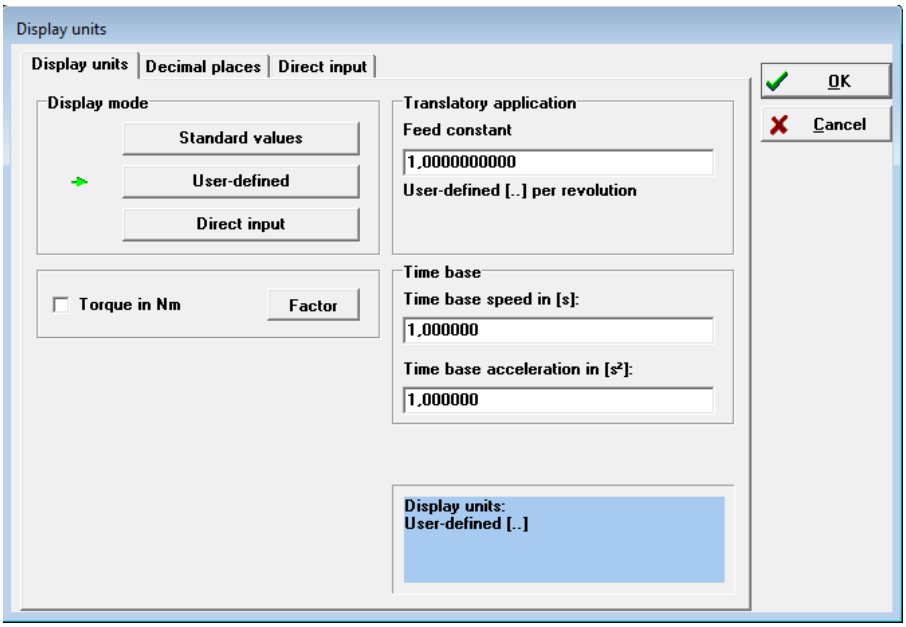
Table 24: List of RS232- control orders (RS232-command word)

RS232-command word (rs232_command, KO 0x0061$_h$)	
Command	**Description**
0x00000001$_h$	Controller enable ON (switch on)
0x00000002$_h$	Controller enable OFF (switch off)
0x00000008$_h$	Controller enable blocked (By loading / saving parameters)
0xxxx0021$_h$	Positioning started („GO“); xxxx give the destination, which will be reached
0xxxx0022$_h$	Homing start („GO“);
0x00000040$_h$	Error reset
0x00000050$_h$	Course program end
0x00000051$_h$	Course program with start position 1 start
0x00000052$_h$	Course program with start position 2 start

12.8 Appendix possibilities display units

12.8.1 Settings of user specified display units

In the field **Display units** the **User defined** button can be selected and the unit display adjusted to suit your application.



All user defined units will be shown with [...].

The field **Translatory application Feed constant** can be scaled in **user defined units each rotation**.

Example:

You have a gear with 1,76 Inch each rotation, without gearbox. You can enter the position in Inches. Under **Feed constant** enter 1,76.

Furthermore there are input fields **Time base speed** and **Time base acceleration** available.

Use the field **Time base speed** to define a speed unit.

Example: (rotary motion)

You have a gear with 20 mm each rotation, without gearbox. You can enter the speed in mm/minute. Under **Feed constant** 20 can be entered and under **Time base speed** the value 60. (60 seconds = 1 minute).

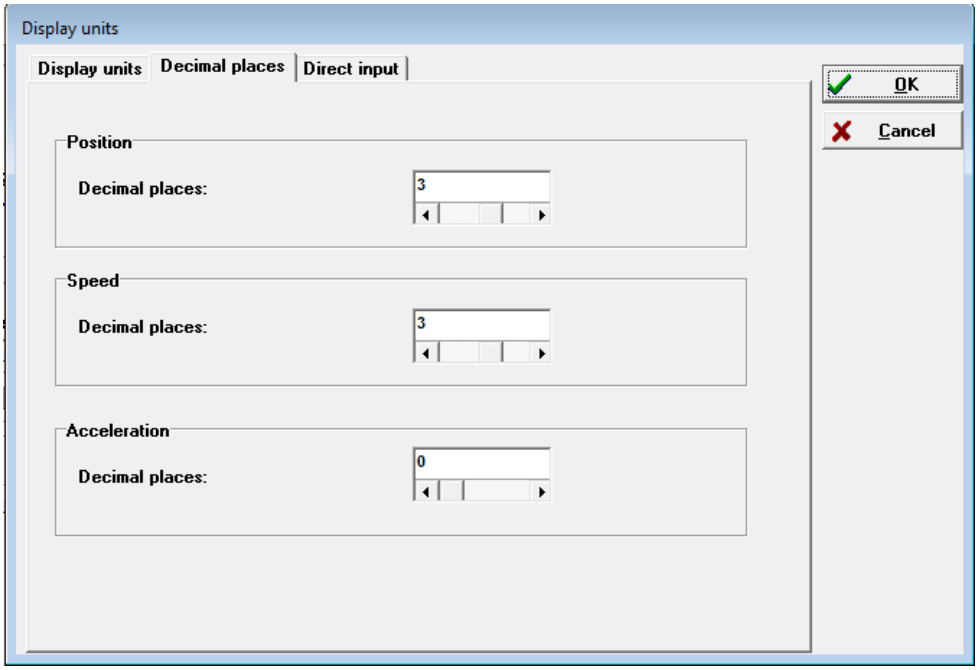
In field **Time base acceleration**, the acceleration can be defined.

Example:

You have a gear with 20 mm each rotation, without gearbox. You have to enter an acceleration in (mm/minute)/s. Under **Feed constant** 20 must be entered, under **Time base speed** the value 60. (1 minute x 1s = 60 x 1 s^2 = 60 s^2)

12.8.2 Decimal places

For further adjustments to the units a **decimal places** card is available in menu **Option/Display units** for position-, speed- and acceleration (from 0 to 5).



12.8.3 Direct input position-, speed- and acceleration units

In the card **direct input** you can adjust the factor-group of **position**, **speed** and **acceleration**, if you have selected the card **Display unit**, the tab **display units** and the button **direct input**.

Be care! Only for experienced users!

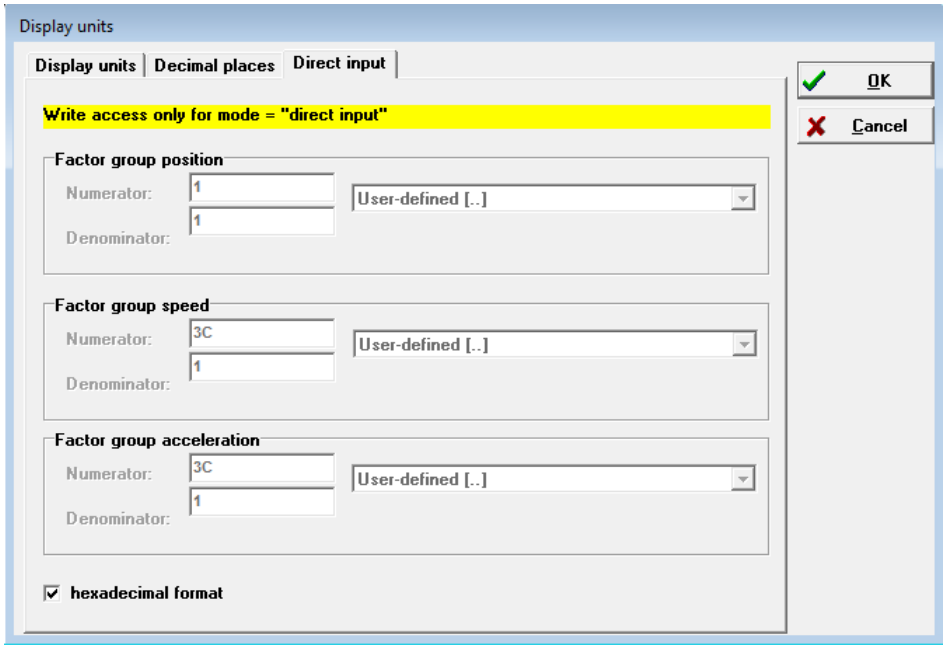
The direct input of physical units can cause a large change of the controller parameters of the servo position controller *RBD-S*.

You also have the opportunity to display the following units from the parameter program:

- Increments
- Degrees

- Radians
- Revolutions
- Meter
- Millimeter
- Micrometer
- User defined
- Non unit

Here is an example in millimeter and hexadecimal format:



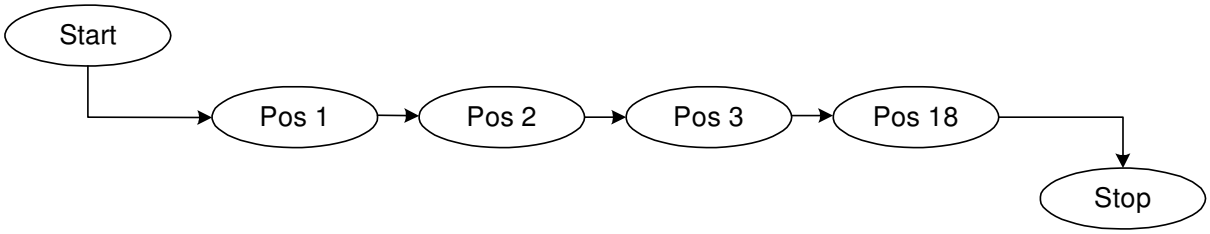
12.9 Course program: Example

With these examples we can demonstrate some flexible solutions which are possible with your course program.

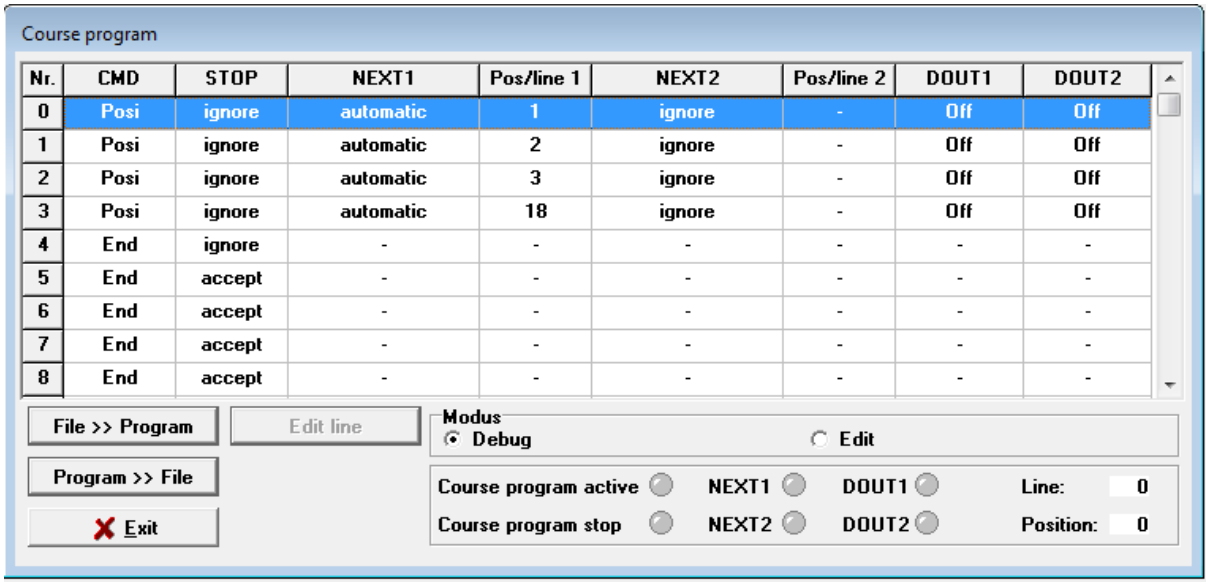
The input of the course program is described in *chapter 7.1 Composing of* Course program

12.9.1 Example 1: Linear connected positions

Here the positions 1 – 2 – 3 – 18 will be moved to. The gear stops on every position for 1 second. After that the course program will stop.



Realization:



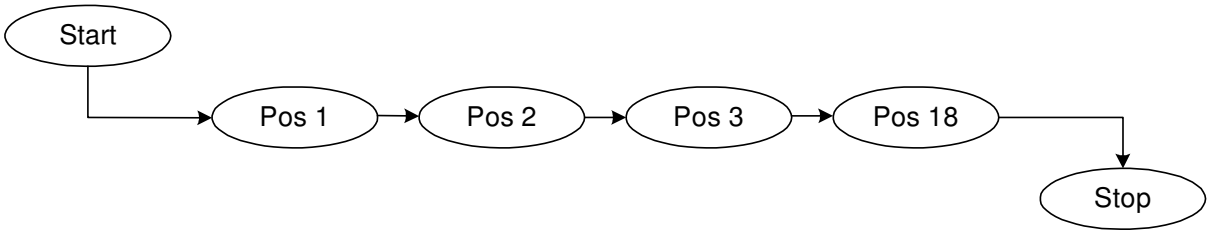
Implementation:

- The start delay for positions 1, 2, 3 and 18 must be parameterized in the destination parameters.

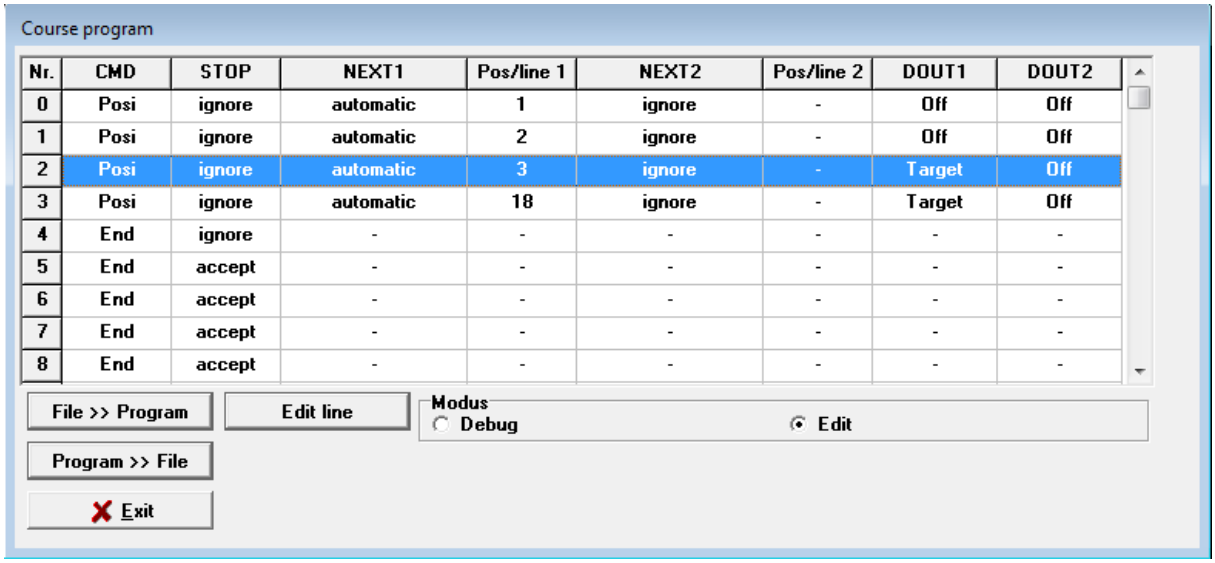
12.9.2 Example 2: Linear connection of positions with switching of a digital output

Here the positions 1 – 2 – 3 – 18 will be moved to. The gear will stop for 1 second at every destination. After that the course program will stop.

If position 3 is reached, the digital output DOUT1 will be switched for one second to HIGH.



Realizing:



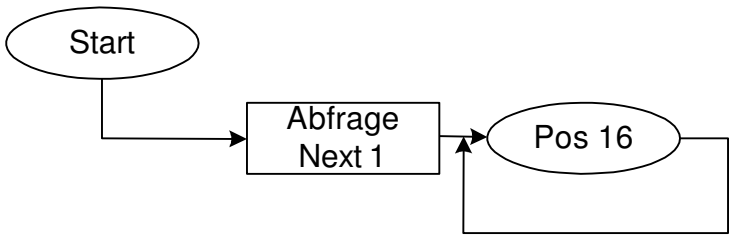
Implementation:

- The positions 1, 2, 3 and 18 are to be parameterized with 1 second delay.
- The adjustment „Target reached“ for DOUT1 must be set in lines 3 and 4, because the adjustments „On “or „Off “will be taken directly and if that signal isn’t on for one second when position 18 is reached DOUT1 will be off.

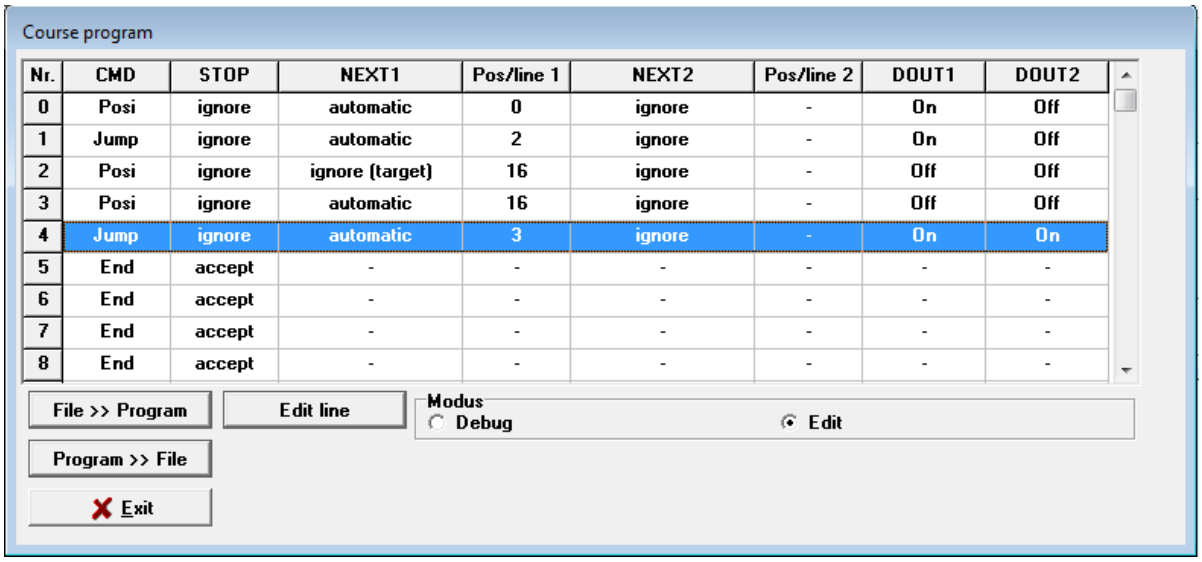
12.9.3 Example 3: Settings and querying of digital in- and outputs; continuous loop

First of all DOUT1 should be set for 1 second on HIGH. After that it is still waiting on the activating of NEXT1.

As soon as that happens, position 16 will be moved to continuously (3 seconds start delay).



Realizing:



Implementation:

- To reach the defined setting of DOUT1, a trick will be used: position 0 will on 0 rotations relatively settle, with a start delay of 1 second. As it follows position 0 will be "moved" and activates DOUT1 on HIGH. After that it jumps to line 2.
- For a continuous loop to connect a jump from line 4 to line 3 is necessary.

12.10 Timing overview

In the following overview are some typical applications of the servo position controller *RBD-S* with the pertinent timings of digital in- and outputs represented. Because some times are dependent on the operation situation and only indicating times can be given, in this case the controller must request the status of the *RBD-S*.

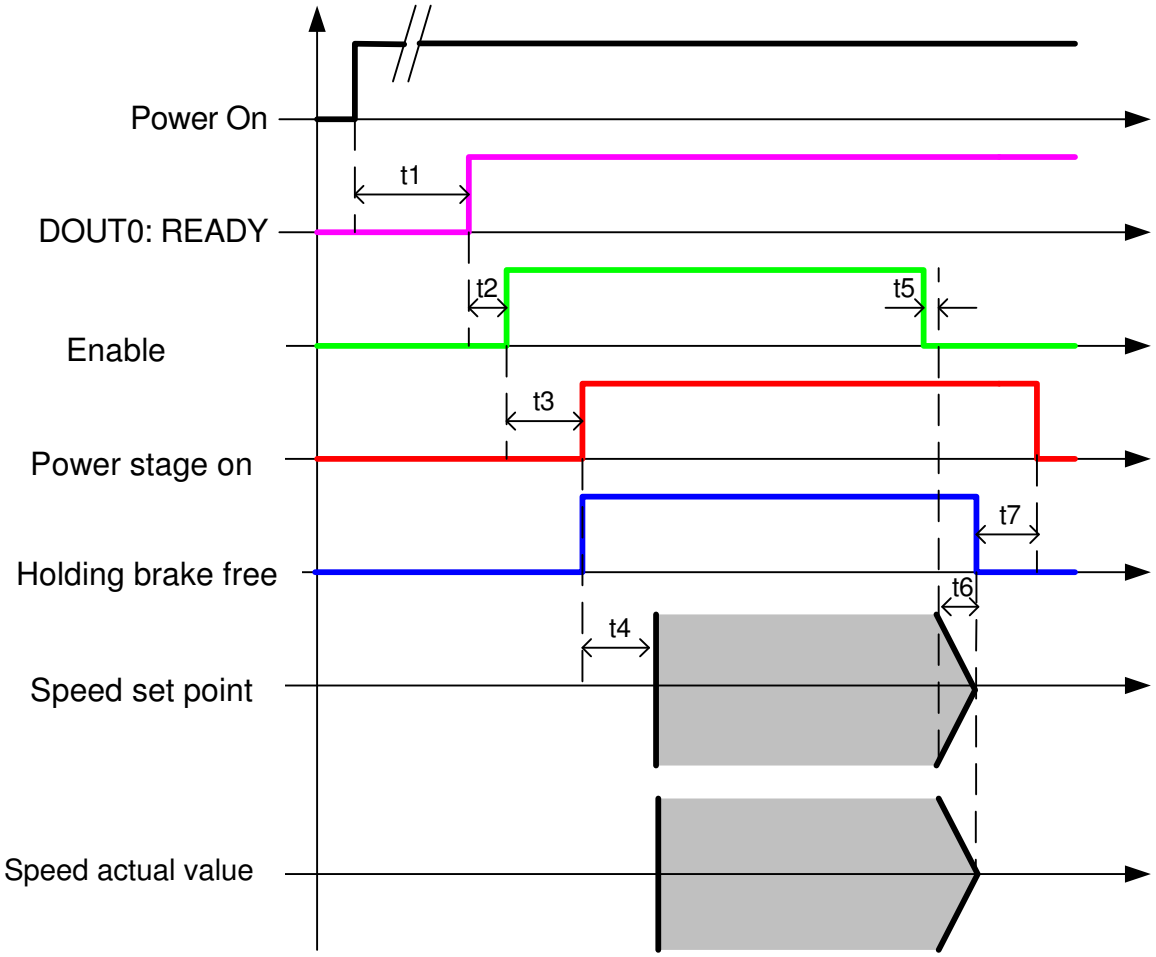
The times in the overview shown times have a tolerance range of +/- 100 µs. This tolerance range is additional time which must be calculated in the timing overview!

The positioncontroller *RBD-S* has a flow control with a time base of 1, 6 ms. The situation of the digital in- outputs is set and refreshed every cycle.

The cycle time of the PLC must be **< (1, 6 ms – 100 µs) = 1, 5 ms** so the PLC can recognize the setting of the *RBD-S*. Otherwise the PLC output signals must be kept during **> (1, 6 ms + 100 µs) = 1, 7 ms**, so it is certain to recognize this signal via the *RBD-S.*

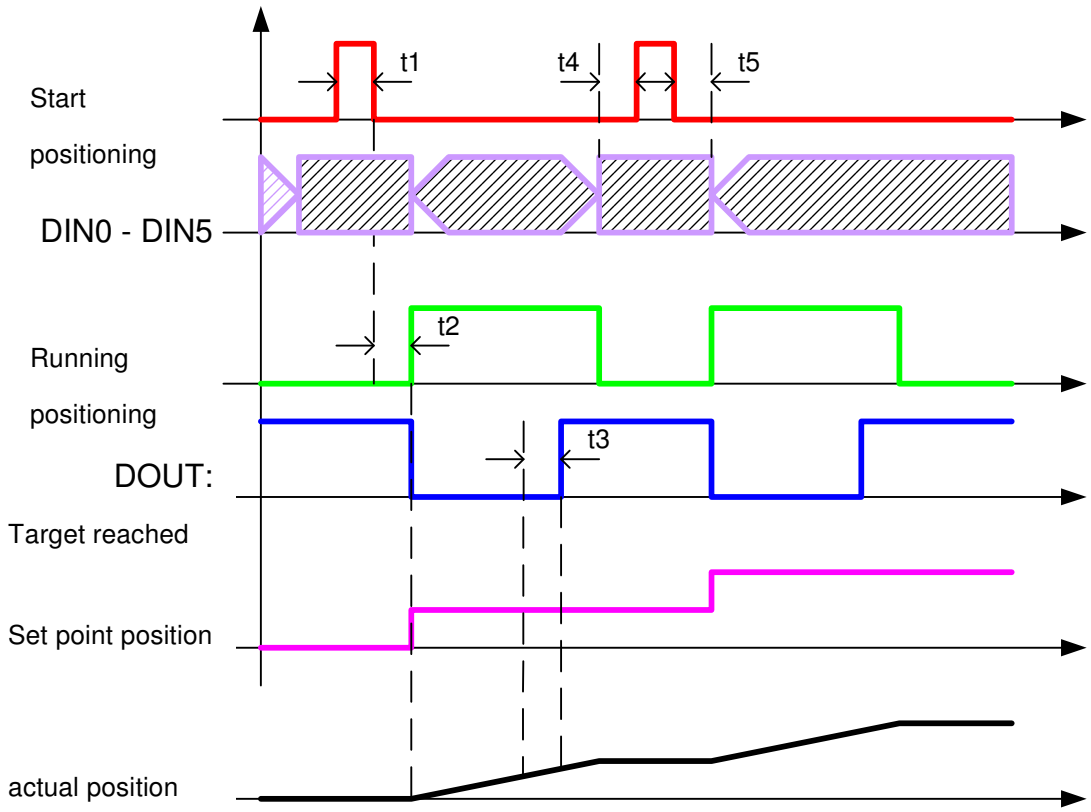
Example: PLC with t_{Cycle} = 1 ms → Setting the PLC-output for minimum. 2 x t_{Cycle} = 2 ms

12.10.1 Switching sequence



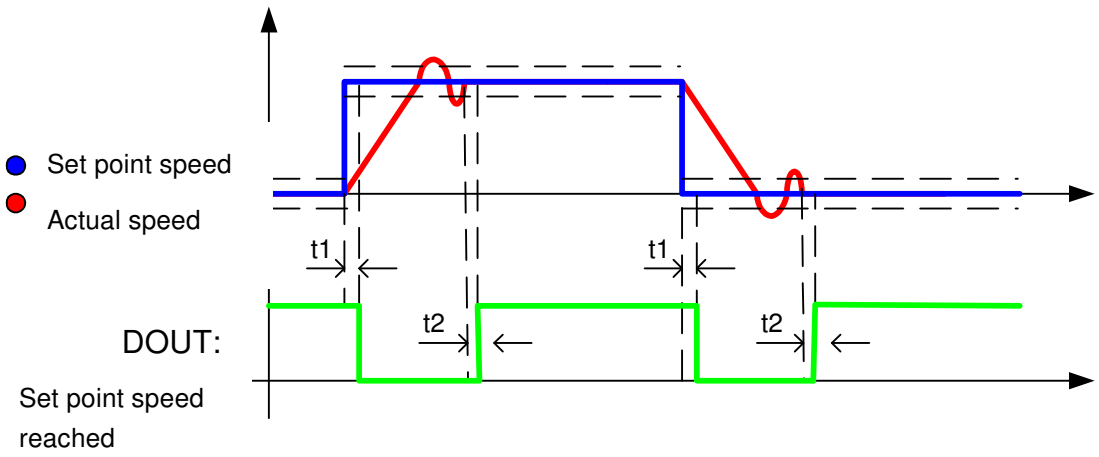
- t1 ≈ 500 ms — Run of Boot program and start application
- t2 > 1,6 ms
- t3 ≈ 10 ms — Depend of mode of operation and status of the gear
- t4 = N x 1,6 ms — Parametrizable (Brake parameter start delay t_F)
- t5 < 1,6 ms
- t6 = N x 0,2 ms — Depend of the quick stop neg. acceleration
- t7 = N x 1,6 ms — Parametrizable (Brake parameter disconnect delay t_A)

12.10.2 Positioning / destination reached



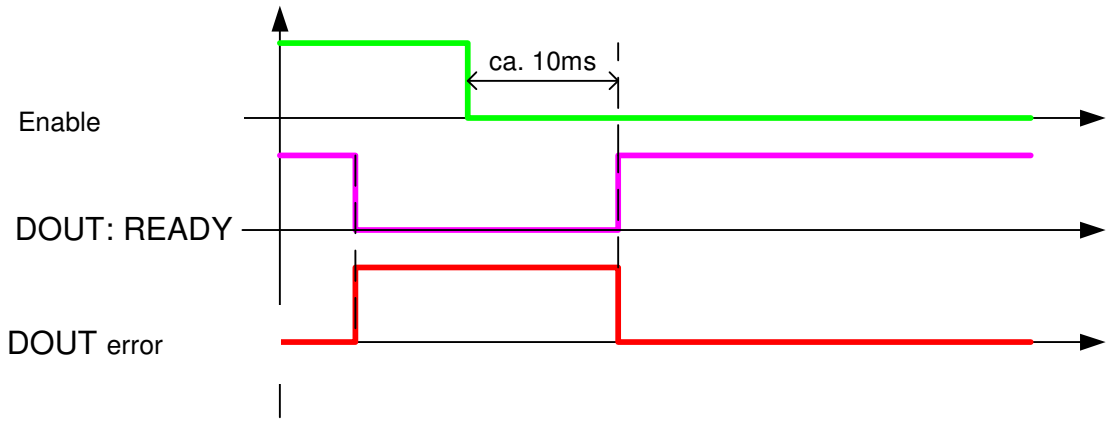
- t1 > 1,6 ms Impulse length of START level
- t2 < 1,6 ms Delay to starting gear
- t3 = N x 1,6 ms Target reached window + respond lag
- t4 > 1,6 ms Setup time position selection
- t5 > 1,6 ms Holding time position selection

12.10.3 Speed message

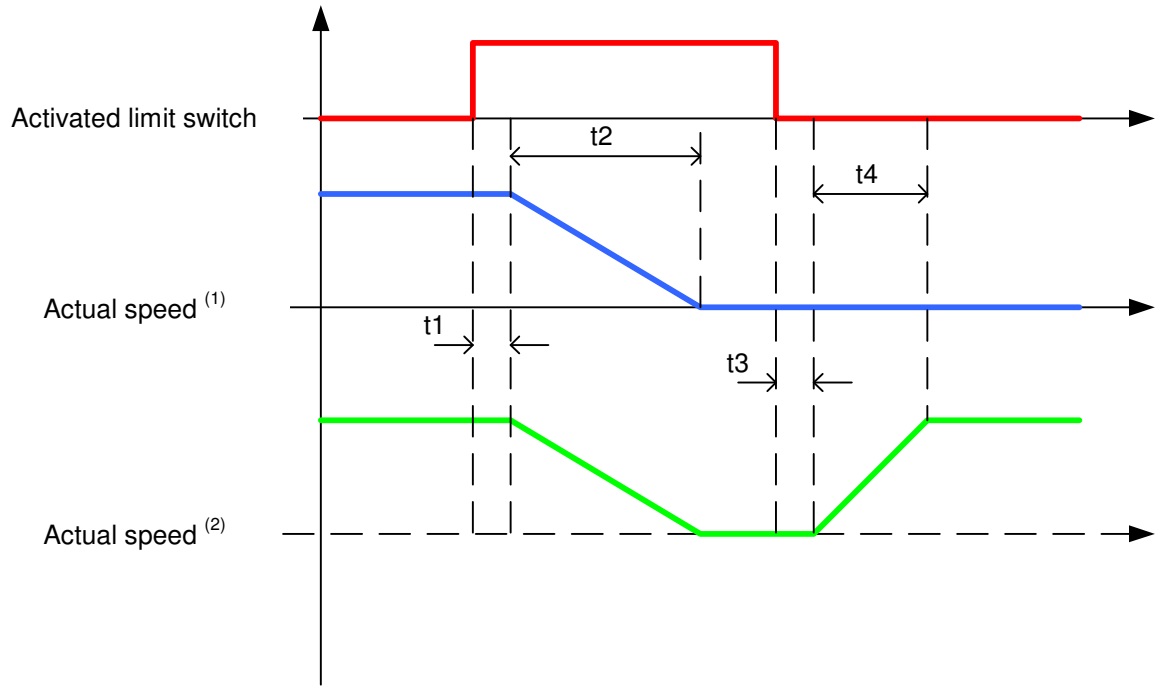


- t1 < 1,6 ms
- t2 < 1,6 ms

12.10.4 Error reset



12.10.5 Limit switch



- t1 < 0,2 ms
- t2 = N x 0,2 ms Dependent on quick stop neg. acceleration
- t3 < 0,2 ms
- t4 = N x 0,2 ms Dependent on speed acceleration

Actual speed (1): During stalled rotation direction by limit switch.
Actual speed (2): Without stalled rotation direction by limit switch.

12.11 Parameter set administration

12.11.1 General

To control the motor perfectly with the servo position controller *RBD-S*, the basic values must be adjusted as well. Some adjusted values will be described with **Parameter**; and all of these parameters in total for one servo position controller/motor-combination are in the **Parameter file**.

The following figure shows how these parameter files will be used:

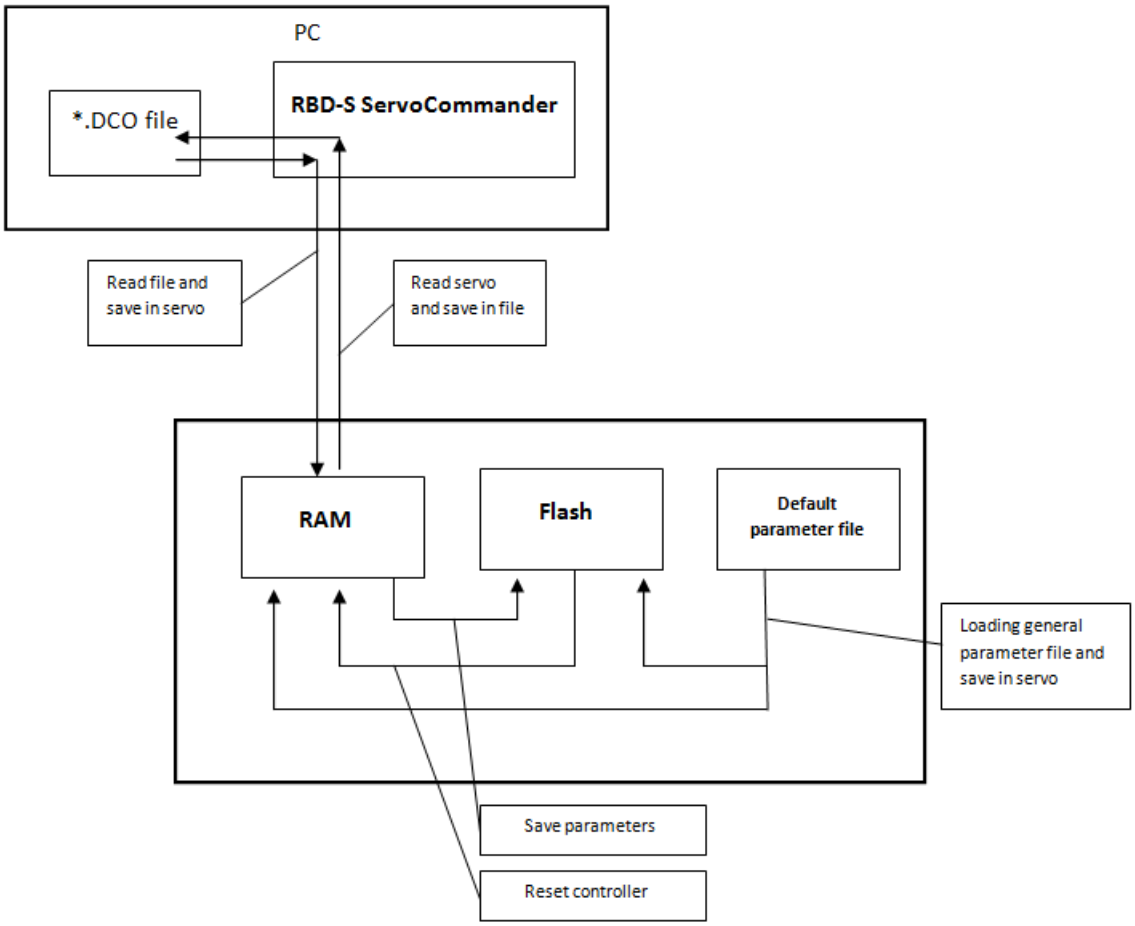


Figure 32: Online-Parameterization

The actual parameter file of the servo position controller *RBD-S* is in the RAM-memory (RAM = Random Access Memory). The RAM loses its memory content as soon the voltage supply is switched off. You can save the parameter file via the order **File/parameter set/ save parameters** (in Flash) copied in the controller. The memory will not now lose its contents if the voltage supply is switched off.

With every reset order in servo position controller the content will be copied from Flash to RAM. This reset can be done by:

- Switching off and on the voltage supply
- Activating via menu **File/Reset Servo**

- Activating RESET button in the menu border of the parameter program.

The *RBD-S has also a* **Default-parameter set**. This parameter set is fixed in the Software and cannot be overwritten. In situations on ground of not available settings the general parameters can be restored to default conditions. The activating of these general parameter settings can be done via menu **File/parameter set/Load default parameter set**. The default parameter set will be copied in FLASH and in RAM.

12.11.2 Load and save parameters

There is a possibility to save parameter files externally e.g. hard disk, Diskette etc.). In this case the parameters from servo position controller *RBD-S* will be read and saved in a file or read in a file and stored in the servo position controller *RBD-S*.

The parameter files in the PC are called ***.DCO**. The reading or loading of the *.DCO files will be done in the parameterization program with menu titles:

- **File/parameter set/File >> Servo** : send a *.DCO file from PC to servo
- **File/parameter set/ Servo >> File** :: write a *.DCO file from servo to the PC

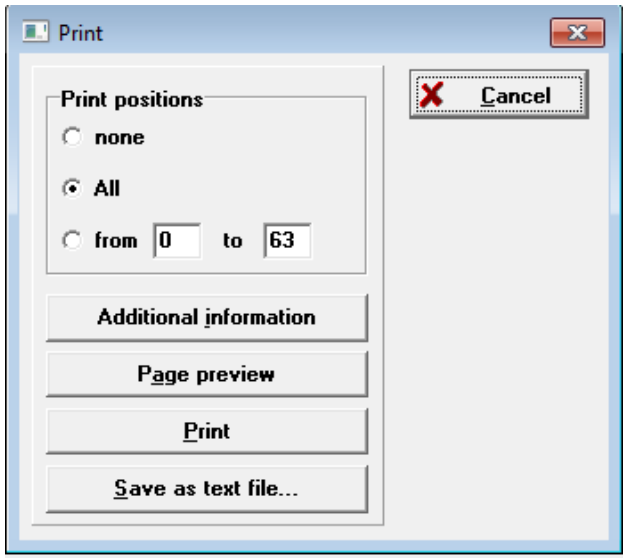
Attention - you have the possibility to write a parameter set in a file to the PC with additional fields of **motor type a**nd **Description**. Furthermore you can put in 100 lines of comment, if you select the card **Comment**. We recommend you make descriptions in order to prevent a later mistake of parameter set. Also a name for the parameter file must be chosen so you can easily recognize the right files at a later stage.

Please use comments field to save additional information.

*.DCO files can be saved on diskette, CD-ROM and/or sent by E-mail.

12.11.3 Print parameter settings

You can print the parameter settings in text format or read and save them if you select the menu **File/parameter set/Print**. See window below:



From the menu field **Print positions** you can print the selected positions which will be printed on the end of the parameter list.

You can select printed text as follows:

- None — The parameter list will be printed without positions.
  Extent: ca. 5 pages
- All — All of the 64 positions will be printed.
  Extent: ca. 7 pages
- from...to — The position range can be specified explicitly

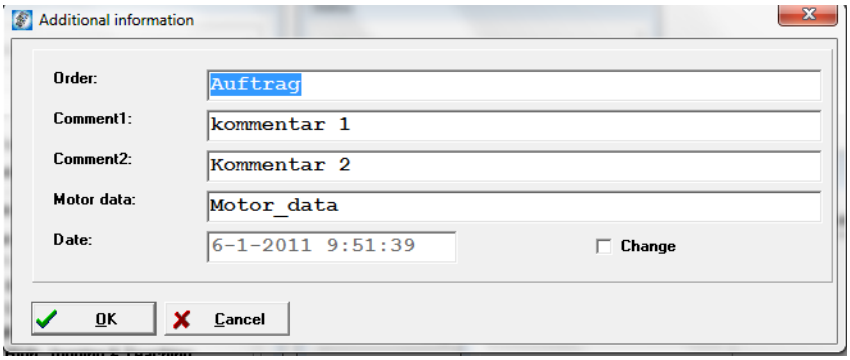
The buttons of the print menu have the following meanings:

- Additional information — Calls up sub menu of the same name.
- Page preview — Previews the printed text on the screen.
- Print — Shows text and sends it to the printer.
- Save as text file — Saves text under a user defined name. Default text
  File with extension \txt.

By production of text in page preview and printing it will be sub listed \txt the file write as $$$.txt.

Additional information

In this menu the user can be put in additional references to the parameters. This information will be stored as text. You can overwrite the date.



The fields **Order, Comment1/2, Motor data** will be saved as is unless you change the text. They should be completed as follows:

Field	**Contents**
Order	Project /order number for which these parameters are to be made.
Comment1, Comment2	Characteristics of the parameters
Motor data	Characteristics of the motor data settings (from file motor.ini)

Due to the format every line must be no longer than half the line (approx. 40 characters).

For date of the text, the actual date will be shown. By clicking the **Change** function the date field can be overwritten. This date will be saved.

Page preview

After selection of the described button in the Print menu the text will be produced and the page preview will be shown.

Save as text file

By using the button **Save as text file** the print preview can be saved as *.txt file on the hard disk and used further (e.g. sending by E-mail).

The text file will be saved with extension TXT from the parameter program.

Parameter sets can be printed by using the Online and Offline versions.

12.12 Offline parameterization

When the Offline- or Online parameterization is activated, it will be shown in the symbol border:

Table 25: Online-Offline activating

Online Offline	Online parameterization active
Online Offline	Offline parameterization active

The actual mode is shown by a green color.

The parameter program also gives the opportunity to access parameters also when non serial communication to the servo position controller *RBD-S* is available. A condition is however the presence of an appropriate *.DCO file (See *chapter 12.11.2 Load and save parameters*).

The following possibilities are:

- Controller parameters read out the *.DCO file.
- Change controller parameters.
- Load changed values in the same or other *.DCO file.
- Parameter settings printing. (See *chapter 12.11.3 Print parameter settings*).

To activate the change, these modified parameters must be loaded into the servo position controller *RBD-S* (See *chapter 12.11.2 Load and save parameters*).

The following figure shows the principle of Offline parameterization:

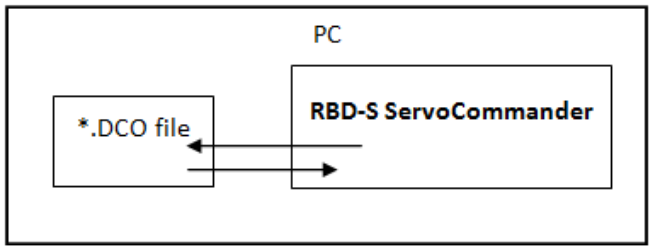


Figure 33: Offline-Parameterization

To activate the Offline-Parameterization, click on menu **Option/Communication/ Offline-Parameterization** or the Offline symbol in the symbol border. You will be asked which *.DCO file must be opened. Select the appropriate file.

DANGER!

If you use a DCO file for another device, you MUST adjust the set point for nominal current, maximum current, angle encoder offset, phase sequence, number of poles, current controller and speed controller. If not you could damage the servo position controller/motor!

During the Offline parameterization the parameter program has a behaviour which deviates from the online parameterization:

- Specific menus (e.g. Software-Download) are blocked.
- The menu **File/Parameter set** have other sub menus:
  - **Open file**
  - **Save file**
  - **Save file as...**
- When leaving the program you will be asked if these opened parameters must be saved.

The Offline parameterization can be closed by **Option/communication/Online Parameterization** or by clicking on the online symbol in symbol border.

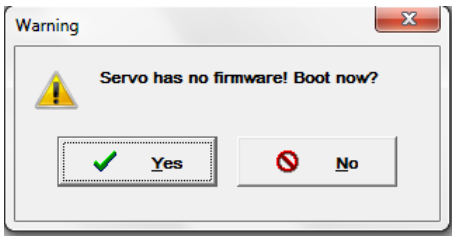
12.13 Software in den *RBD-S* laden / Software-Update

The software is the "operating program" of the servo position controller RBD-S. The RBD-S is always delivered with Software. The following situations can be necessary for loading new software:

- Update to a new software version.
- Loading software with client specified functions so you can use additional useful functions.
- Incomplete software (e.g. faulty software-Downloads).

The parameter program changes in the course of product development which only corporate with later on developed software version.

In case of no or incomplete software version in the servo position controller RBD-S the following pop-up warning shows:



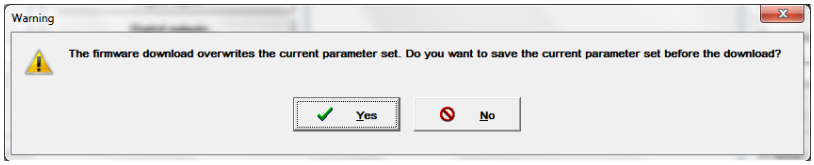
If the correct software is in the servo position controller RBD-S, this warning doesn't appear. In this situation the following chapter can be skipped!

Also the software version loaded in the controller can be seen by opening the menu **Info/Info** via tab software / **Hardware**.

12.13.1 Software loading

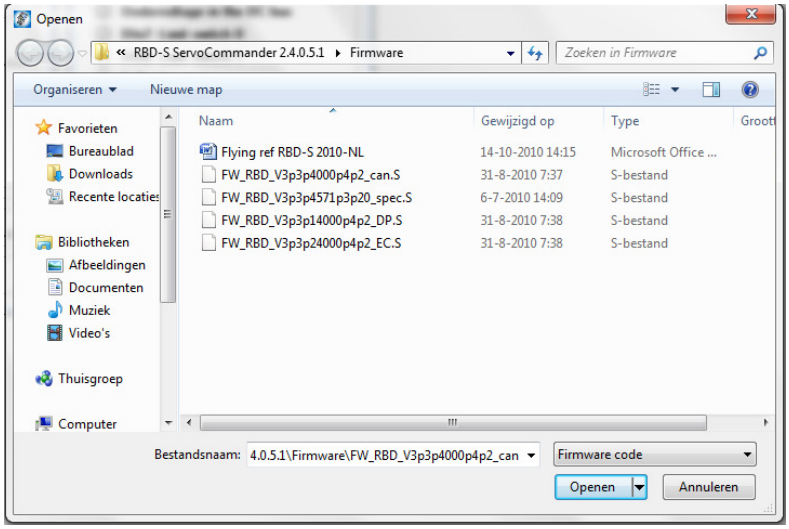
Via the menu **File/Software-Download** a new software can be loaded.

Loading of new software overwrites the servo position controller parameters so the following warning appears:

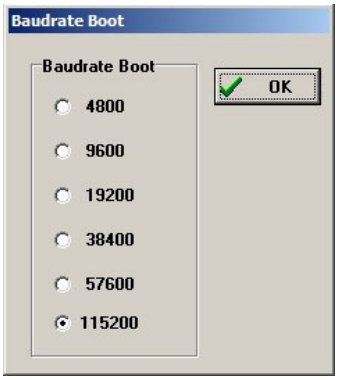


Here you can select of you want to save the existing parameters on your hard disk from the PC. If you select **yes**, the window **save parameters** will open.

After that the following section menu opens:

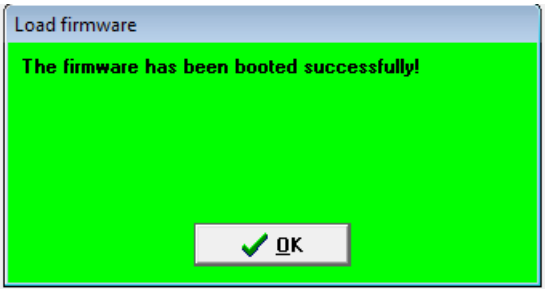


1. Select the necessary software and click on **Open**.
2. The next screen to open selects the communication speed (Baud rate):

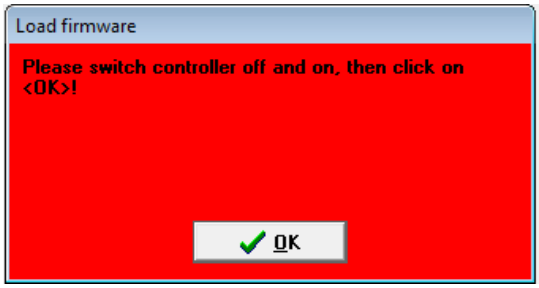


3. Try the Baud rate of 115200 Baud first. If problems appear with this communication speed (error message), the communication speed must be reduced.

A successful download will be shown by the following window:



If the software download is not successful, the following message appears **Error by software download**.



The reason is most likely a communication error during download of the data in the servo position controller *RBD-S*. Try again with a reduced communication speed as described above.

12.14 Technical specifications

12.14.1 Site conditions and qualifications

Range	**Value**
Permissible temperature range	Store temperature: -25°C to +70°C
	Operational temperature: 0°C to +40°C +40°C to +50°C with power reduction 2,5% /K
Permissible altitude	To 1000 m above sea level, 1000 to 4000 m above sea level with power reduction
Air humidity	Relative air humidity to 90%, not continuous
Protection class	IP20
Contamination class	1
CE-conformity:	In accordance with EMC-law (2006/95/EG) and low voltage guidelines (2004/108/EG) in accordance EN50178
EMC-approved:	With external supply filter in accordance EN61800-3 (correspondent EN 55011, EN 55022) Motor cable length l ≤ 10 m: The limit value of breakdown radiation for first environmental with reduced availability are kept. With motor cable length l > 10 m there are additional/other filter dimensioning necessary (e.g. other supply filter, dU/dt motor filter throttle) (under conditioning: motor cable with a cable capacity of C' < 200 pF/m)
Additional certification	**UL Approved, UL file nr. E219816 vol.1, project nr. 10CA29271**

12.14.2 Dimensions and weight

Parameter	**Value**
Dimension (H*B*D)	103 x 66 x 170 mm (without cable connector and mounting plate)
Dimension mounting plate small	170 x 37 x 52 mm
Dimension mounting plate large	265 x 35 x 64 mm
Weight	Approx. 950 g

12.14.3 Power data [X6], [X2A]

Parameter	Value
Power supply	230 VAC [± 10%] / 45 Hz…65 Hz / 5 A [1]
24V supply	24 V DC [± 20%] / ca. 200 mA [2] / $U_{Ripple} > 1,5\ V_{ss,100Hz}$ + 700 mA [3] + 100 mA [4] protected internally by a polyswitch which switches at approx. 1 A
Connection external brake resistor	Resistance: $R_{BR} \geq 100\ \Omega$ Nominal power: $P_{nom} = 100$ W [5] Peak power: $P_{Pulse} = 1,5$ kW @ 100ms / 5% ED
Brake chopper RBD-S	Switch level ON: $U_{CHOP\_EIN} = 400$ V [± 5%] Switch level OFF: $U_{CHOP\_AUS} = 380$ V [± 5%]

[1] A slow fuse of 6,3 A (T) is necessary.
[2] Current consumption of the RBD-S without additional connections
[3] Maximum acceptable current consumption for example the holding brake
[4] Maximum current consumption by consumption of DOUT0 to DOUT2 also CAN bus
[5] For a higher continuous power you need a thermal overload protector of the brake chopper in RBD-S

12.14.4 Motor temperature control [X2A]

Parameter	Value	
Digital sensing	Normally open contact: $R_{cold} < 500\ \Omega$	$R_{Hot} > 100\ k\Omega$
Analogue sensing	Silicon temperature feeler, KTY Serial	
	KTY81-2x0; KTY82-2x0	$R_{25} \approx 2000\ \Omega$
	KTY81-1x0; KTY81-2x0; KTY83-1xx	$R_{25} \approx 1000\ \Omega$
	KTY84-1xx	$R_{100} \approx 1000\ \Omega$

12.14.5 Motor phases [X6]

Parameter	value
Data for operation with 230 VAC / $T_{U,max} = 40°C$	
Output nominal power	500 VA
Max. output nominal power for 2 s	2000 VA
Output current	4 A_{eff}
Max. output current for 2 s	6 A_{eff}
Output voltage (U_{LL})	Approx. 190 V_{eff} @ 300 V DC-bus voltage and I_{Nom}
Clock frequency	10 kHz / symmetrical PWM

12.14.6 Resolver [X2A]

Parameter	Value
Suitable Resolver	Industrial standard
Speed ratio	0,5 ± 10%
Reference frequency	10 kHz
Resolution	> 12 Bit (typ. 15 Bit)
Speed resolution	ca. 4 min^{-1}
Absolute accuracy	< 10´ (Without consideration of resolver error)
Max. speed	16.000 min^{-1}

12.14.7 Analogue Hall sensing [X2A]

Parameter	Value
Suitable Hall sensors	HAL400 (Micronas), SS495A (Honeywell) and others Type: differential analogue output, V_{CM} = 2.0 V...3.0 V Signal amplitude: max. 4,8 V_{ss} differential
Resolution	> 12 Bit (typ. 15 Bit)
Time delay signal collection	< 200 µs
Speed resolution	ca. 10 min^{-1}
Absolute accuracy	< 30´ (Without consideration of resolver error)
Max. speed	16.000 min^{-1}

12.14.8 Incremental encoder output [X10]

Parameter	Value
Output levels	Programmable 32 / 64 / 128 / 256 / 512 / 1024 level each rotation
Connection levels	Differential A / B / N level signal in accordance with RS422 (5 V level) on X10 Single-Ended A / B level signal with 24 V level on X2B (output over the digital output DOUT1 and DOUT2)
Output impedance	$R_{a,diff} \approx 120\ \Omega$
Limit frequency by output over X10	f_{Grenz} > 100 kHz (line/s); f_{Grenz} dependent on cable length, Data measured with R_{Load} = 300 kΩ and C_{Load} = 1 nF
Limit frequency by output	$f_{Grenz} \approx$ 50 kHz (line/s); f_{Grenz} dependent on cable length, data measured

Parameter	Value
over X2B	with R_{Load} = 1 kΩ und C_{Load} = 1 nF (accordance cable length l = 5m)

12.14.9 Incremental encoder input [X10]

Parameter	Value
Inputs level	32 to 1024 level each rotation, also level quantity $z \neq 2^n$ acceptable.
Connection levels	Differential level signal in accordance RS422 (5 V-level) on X10
Signal form	Incremental encoder signal A / B / N or... Level direction signal CLK / DIR
Input impedance	$R_{i,diff} > 1$ kΩ
Limit frequency	$f_{Grenz} > 100$ kHz (level/s)
Minimum level edge distance	$f_{Grenz} > 1$ µs

12.14.10 RS232 [X5]

Parameter	Value
RS232	Null modem interface, RS232-Standard, 9600 Bit/s to 115,2 k Bit/s

12.14.11 CAN-Bus [X4]

Parameter	Value
CAN open Controller	TJA 1050 , Full-CAN-Controller, 1M Bit/s ; adjustable are max. 500kBit/s
CAN open Protocol	In accordance of DS301 and DSP402
Closing resistance	External / in cable connector

12.14.12 Analogue in- and output [X2B]

Parameter	Value
High resolution analogue input	±10V input range, 12 Bit, differential, < 250µs time delay, inputs protection switching to 30V
Analogue input: AIN0 / #AIN0	Analogue input, can be used for input set points current- or speed. (Multi point reservation with DIN0 and DIN1)
Analogue input: AIN1 / #AIN1	Analogue input, can be used for input set points current or speed. (Multi point reservation with DIN2 / DOUT1 and DIN3/ DOUT2)

Parameter	Value
Analogue output: AMON0	0... 10V output range, 8 Bit resolution, $f_{Grenz} \approx 1kHz$

12.14.13 Digital in- and output [X2B]

Parameter	Value	
Signal level	24V (8V...30V) active high, conform EN 1131-2	
Logic inputs general DIN0 DIN1 DIN2 DIN3	 Bit 0 \ Bit 1, \ destination selection for the positioning Bit 2, / 16 positions from position table selectable Bit 3 /	
DIN4 DIN5	Bit 4 \ \ destination selection for positioning / 4 Groups with separate position parameters Bit 5 / (e.g. speed, acceleration, position mode) selectable.	
DIN6	Control signal start positioning	
DIN7	Limit switch input 0	
DIN8	Limit switch input 1	
DIN9	Power stage enabled by rising edge; error reset by falling edge.	
Logic output general	24V (8V...30V) active high, short circuit fixed to GND	
DOUT0	Ready for operation	24 V, max. 20 mA
DOUT1	freely configurable, to use as encoder output signal A (Pin is multi point reservation with DIN2 and AIN1)	24 V, max. 20 mA
DOUT2	freely configurable, to use as encoder output signal A (Pin is multi point reservation with DIN3 and #AIN1)	24 V, max. 20 mA
DOUT3 **[X2A]**	Holding brake	24 V, max. 700 mA

12.14.14 Warning and status LED RBD-S

Element	Function	
LED1	ON	Shows the switched on logic supply of the RBD-S
LED2	ERR	Error warning (blinking error code)

12.15 Mechanical installation

12.15.1 Important notes for mounting

- The servo position controller RBD-S is designed to be used as a built in device for mounting in cabinets.
- The mounting possibilities are horizontal or vertical so you can use the mounting plate shown in Figure 36.
- Try to build in free space – leave enough free space around the device, see Figure 37.
- The servo position controller RBD-S is designed so that when installed with a free minimum space of **10 mm** around the controller and the mounting wall it will not cause thermal problems.
- We advise that overheating reduced the life of the controller and can damage the device. The housing temperature must not exceed 70℃ in operation.. The temperature of the power stage can rise to 85℃ (Temperature monitor parameter software).
- For higher thermal demands of the servo position controller RBD-S or a higher environmental temperature a fan must be used. The fan can be mounted on the controller and positioned so that it blows cold air through the controller. You can use a 24V = papst blower with a small connector; Connection +24 V left; mounting with 4 screws M3x22.
- For heavy applications with higher motor load we can have a controller with forced cooling which can be mounted externally on the power stage mounting plate. The electrical connection is the same small connector on the same controller +24V output connector.

12.15.2 Front side – dimensions – position connectors

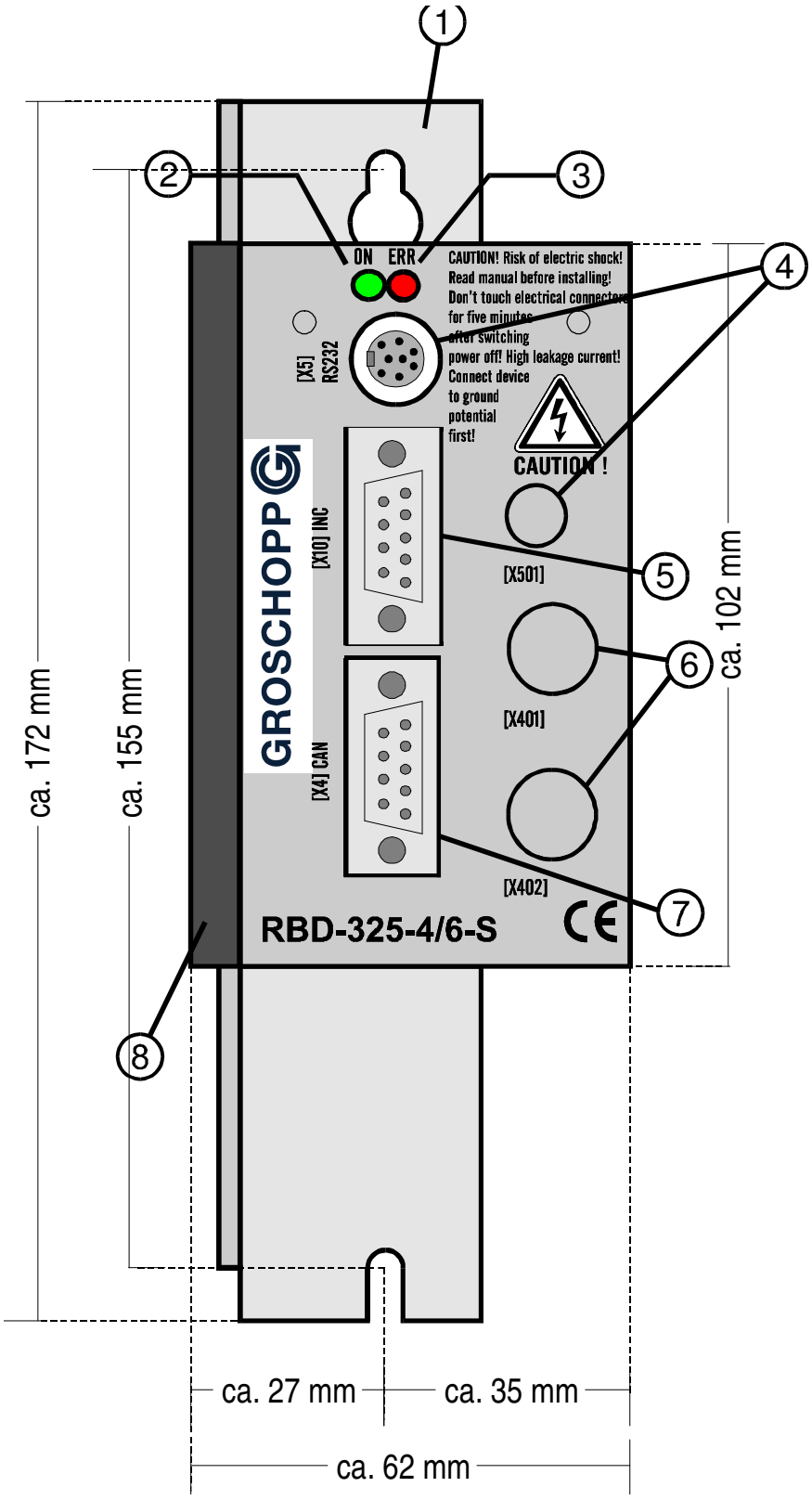


Figure 34: Front side RBD 325-4/6S

Table 26: Front side RBD 325-4/6-S (position of the connection)

Number	Name	Description
1	-	Mounting plate for mounting wall
2	ON	LED to show status „power stage on”
3	ERR	LED to show the error code on occurrence of an error in the controller (error will be shown by different blinking sequence)
4	[X5] RS232 / COM	PS2 interface to connect the controller with a PC or Notebook/Laptop via a serial RS232 connection, By using a technology module is the RS232 interface parallel also connected to [X501] (Technologic module, Top).
5	[X10] INC	Incremental encoder input and output
6	[X401], [X402]	Interface to additional technology module Profibus or EtherCAT (n basic device not available) [X401] (Technology module, middle) [X402] (Technologic module, down)
7	[X4] CAN	CAN Bus interface in accordance CAN open DSP402 and DS301
8	-	Finned heat sink

12.15.3 Back side – position of the connector

Table 27: Back side RBD 325-4/6-S (position of the connections)

Number	Name	Description
1	[X6]	230V AC Main supply for power part incl. PE
2	[X6]	Connection possibility brake resistor
3	[X6]	0 ... 230V AC / 0...6 A AC Connection for the motor (three phase) incl. PE
4	[X2A]	24V DC supply for Logic part
5	[X2A]	24 V DC controlling the holding brake in motor
6	[X2A]	Connection for motor temperature sensing
7	[X2A]	Angle encoder (Resolver / Hall sensing)
8	[X2B]	Control interface with input and output (analogue / digital)

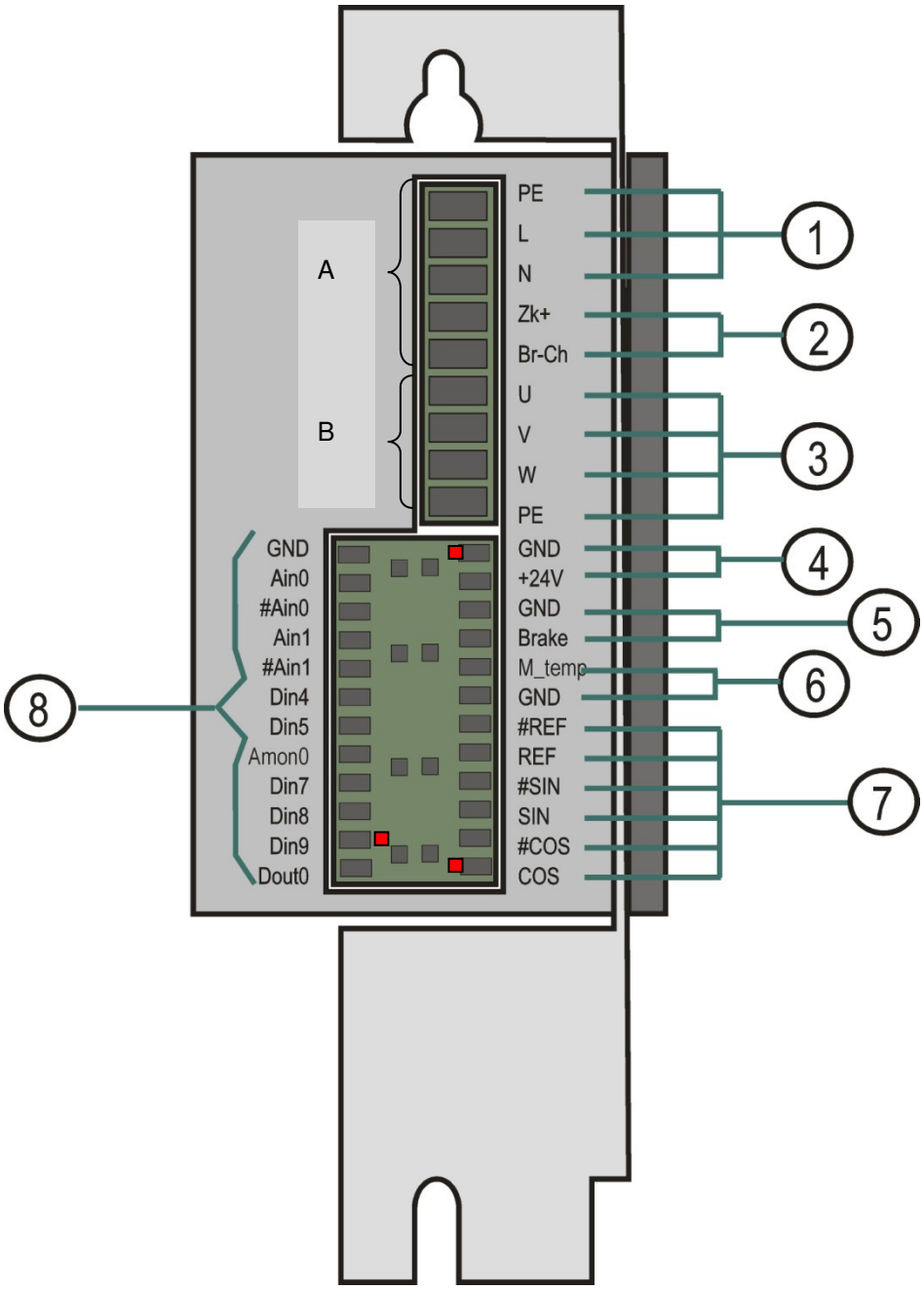


Figure 35: Back side RBD 325-4/6S

12.15.4 Side view – dimension – position of the connectors when using small mounting plate

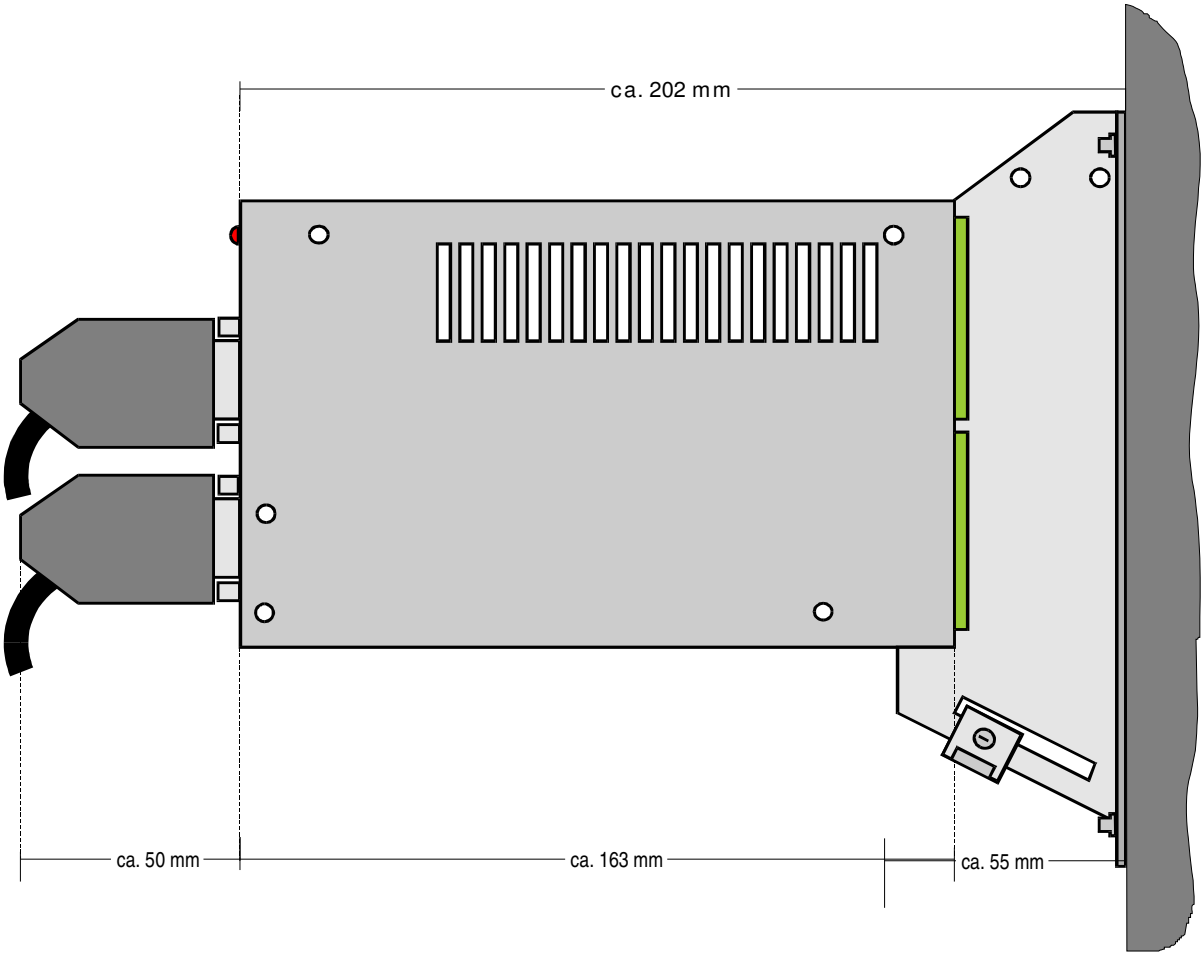


Figure 36: Side view RBD 325-4/6S

12.15.5 Smallest mounting distance

When mounting of the controller the minimum distances must be considered in accordance with Figure 37 to give the best cooling of the power stage of the servo position controller RBD-S. Side clearance of the device must be a minimum distance of **10 mm** for good cooling.

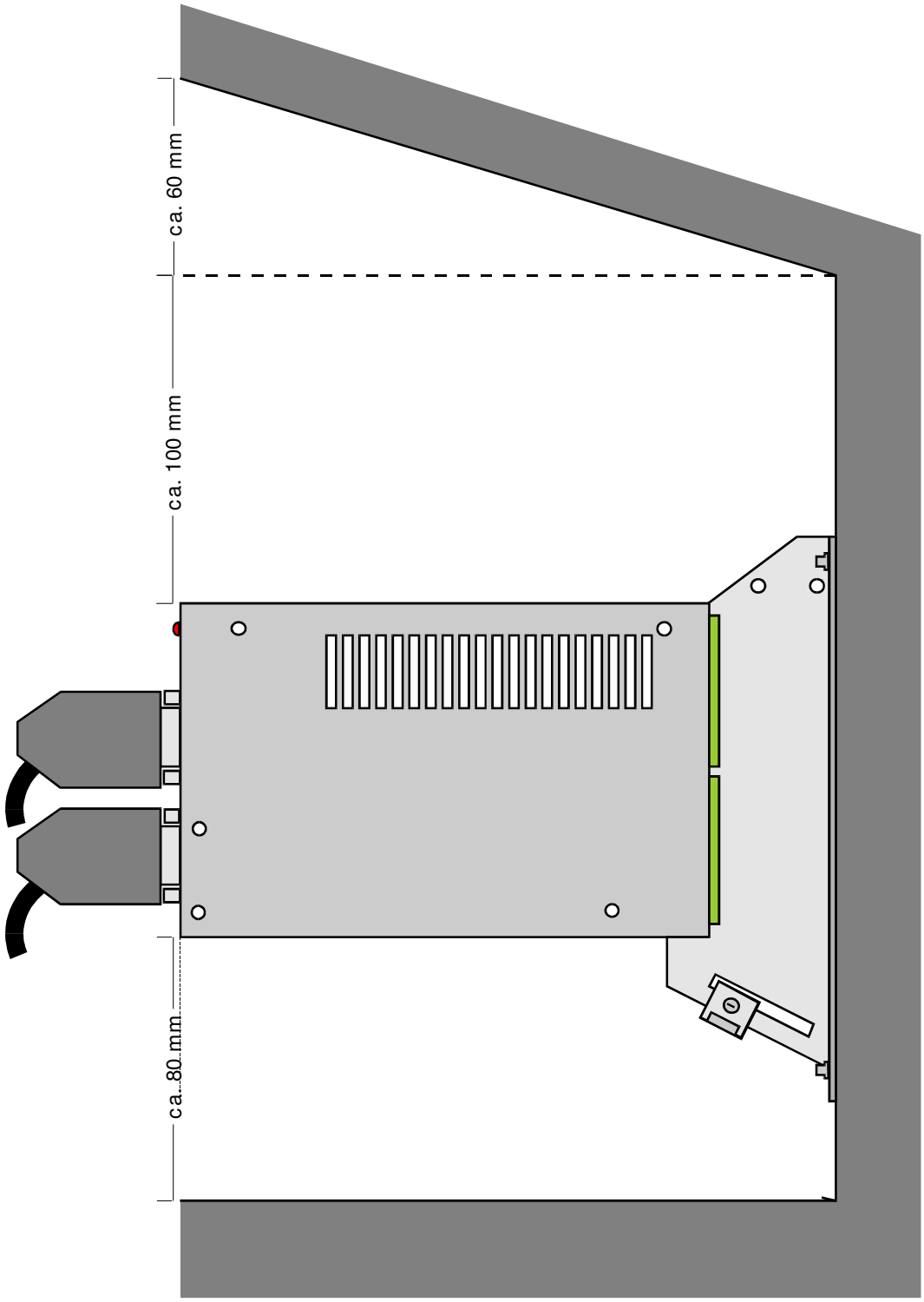


Figure 37: Minimum clearance distances of RBD-S with wall mounting

12.16 Connectors on the RBD-S

12.16.1 Pin configuration: Analogue and digital I/Os [X2B]

This interface makes it possible to connect the digital and analogue inputs and outputs to control the RBD-S. Most of the connection has a double user interface. It is important to set the correct parameters of the I/O's by using the RBD-S - ServoCommander™.

- Connector on RBD-S: Phoenix MINI-Combicon MCD 1,5/12-G1-3,81 (X2B == top line, pin 2 coded)
- Cable connector [X1]: 1x MC 1,5/12-ST-3,81, pin 1 and 12 coded
- Counting method: pin 1 (DOUT0) down

Table 28: Pin lay out [X2B] – command signal (analog / digital)

Pin Nr.	description	Value	Specification
1	DOUT0	0V/24V	Digital output – ready for operation
2	DIN9	0V...24V	Digital input – controller enable
3	DIN8	0V...24V	Digital input – positive limit switch 1 (blocked n > 0)
4	DIN7	0V...24V	Digital input – negative limit switch 0 (blocked n < 0)
5	AMON0 (DIN6)	0V...10V; 2mA	Analogue monitor to show internal units, such as current, speed, position (alternative: digital input DIN6)
6	DIN5	0V...24V	Digital input DIN5 (optional: selection destination)
7	DIN4	0V...24V	Digital inputs DIN4 (optional: selection destination)
8	#AIN1 (DIN3) (DOUT2)	-10V...10V	In combination with AIN1: differential analogue input 1 (alternative: digital input DIN3) (alternative: Digital output DOUT2)
9	AIN1 (DIN2) (DOUT1)	-10V...10V	In combination with #AIN1: differential analogue input 1 (alternative: digital input DIN2) (alternative: digital output DOUT1)
10	#AIN0 (DIN1)	-10V...10V	In combination with AIN0: differential analogue input 0 (alternative: digital input DIN1)
11	AIN0 (DIN0)	-10V...10V	In combination with #AIN0: differential analogue input 0 (alternative: digital input DIN0)
12	GND	0V	Zero potential for control signals 1)

12.16.2 Pin configuration: Angle encoder and holding brake [X2A]

The encoder interface makes it possible to connect the following encoder types and control signals:

- Resolver
- SIN-COS-Analogue signal of analogue Hall sensing (Groschopp BGK-NV motors)
- Holding brake in motor
- Temperature sensor
- Additionally also the 24 V logic supply connected via X2A.

- Connector on RBD-S: Phoenix MINI-Combicon MCD 1,5/12-G1-3,81 (X2A == down line, pin 1 coded)
- Cable connector [X2]: 1x MC 1,5/12-ST-3,81, pin 1 coded

- Counting method: pin 1 (S1) down

Table 29: Pin lay out [X2A] – encoder interface and logic supply

Pin Nr.	Description	Value	Specification
1	S1	1,5V_{eff} / 10kHz R_i > 5kΩ	COSINUS-level signal, differential
2	S3		
3	S2	1,5V_{eff} / 10kHz R_i > 5kΩ	SINUS- level signal, differential
4	S4		
5	REF (+5V)	ca. 5,6 $V_{eff,diff}$ max. 20mA_{eff} R_i ≈ 120 Ω (5 V / 40 mA)	Reference signal for Resolver, f_{Tr} = 10 kHz, Middle voltage approx 5V (for Hall sensing operation +5 V supply voltage for the Hall sensing)
6	#REF (+5V)	ca. 5,6 $V_{eff,diff}$ max. 20mA_{eff} R_i ≈ 120 Ω (5 V / 40 mA)	Inverted reference signal for Resolver, f_{Tr} = 10 kHz, Middle voltage approx.5V in opposite phase REF
7	GND	0V	Connection of inside screen of the encoder signal and reference signal for the Hall sensing / temperature sensor
8	M_temp	R_{PU} = 1 kΩ	Motor temperature sensor PTC / KTY83
9	Brake (DOUT3)	24 V / 700 mA	Digital output: (High active) for holding brake, supplied by internal 24 V logic supply
10	GND	0V	Reference potential for holding brake
11	+24 V	24 V ± 20% ca. 300 mA	Logic supply 24 V DC
12	GND	0V	Reference potential logic supply

Be careful when connecting the encoder connector on X2!

Before connection to the controller you should have set up the correct angle encoder (Resolver or analogue Hall sensing). This can be adjusted via the menu Parameter\device parameter\angle encoder adjustments in RBD-S ServoCommander™. Please don't forget to save this parameter set.

Only connect the encoder when the controller is switched off.

12.16.3 Pin configuration: Motor and power supply [X6]

The three motor phases with shielded cable and also the power supply and earth can be connected to this interface. It also has additional contacts to connect an external brake resistor.

- Connector on RBD-S: Phoenix COMBICON MSTBA 2,5/9-GF-5,08
- Cable connector

  [X301 – X303]: Phoenix COMBICON MSTB 2,5/9-ST-5,08,
  or
  1x MSTB 2,5/4-ST-5,08 (Motorcade A connector) +
  1x MSTB 2,5/5-ST-5,08 (Supply B connector)
- Counting method: pin 1 (PE) down
- Type of brake resistor: $R_{BR} \geq 100\ \Omega$ / $P_{nom} = 100$ W

Table 30: Pin configuration [X6] – Motor- and power supply

Pin Nr.	Designation	Value	Specification
1	PE	PE	Connection for cable shielding from motor
2	W	0…300 V max. 6 Aeff 0…300 Hz	Connection motor phase W / 3
3	V		Connection motor phase V / 2
4	U		Connection motor phase U / 1
5	BR-CH	< 440V DC	Brake chopper connection for external brake resistor to ZK+
6	ZK+	320 VDC	Positive potential DC-bus for brake resistor connection
7	N	230 V AC ± 10%	Power supply for the power DC-bus
8	L	230 V AC ± 10%	Power supply for the power DC-bus
9	PE	PE	Connection for cable shielding from power supply

12.16.4 Pin configuration: Internal technologic module connection [X8]

With this connection point you can use a technologic module on the RBD-S with additional functionality e.g. Profibus or Ethercat. The external interface of this technologic module is available via [X401], [X402] and [X501]. Because the pin configuration of both modules is different we explain only the internal interface [X8]. This interface is found on the main board of the RBD-S and not accessible externally.

- Connector in RBD-S: 2 x 26 RM 1.27 mm female
- Interface connector [X2]: 2 x 26 RM 1.27 mm female
- Configuration over double connection lines:

X8	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52

Table 31: Pin configuration connector [X8]

The additional connecting point X8 is not accessible externally. It is built for deliveries from factory with a technologic module. It isn't intended for connecting to afterwards.

Pin Nr.		Designation	Value	Specification
1		-		n. c.
	2	+24V		Voltage supply technologic module max. 100 mA
3		DIN_8		Digital input processor, buffered
	4	DIN_7		Digital input processor, buffered
5		GND		Reference potential
	6	GND		Reference potential
7		RXD		Optional asynchrony serial interface (3.3 V level, max. 115 Kbit/s)
	8	TXD		
9		CAN_HI		Optional connection for CAN
	10	CAN_LO		Optional connection for CAN
11		+3,3V		Voltage supply technologic module max. 100 mA (total with 5 V)
	12	+5V		Voltage supply technologic module max. 100 mA
13		D14	All signals with 3,3 V CMOS logic level	Data bus of DSP, address 14
	14	D15		Data bus of DSP, address 15
15		D12		Data bus of DSP, address 12
	16	D13		Data bus of DSP, address 13

Pin Nr.		Designation	Value	Specification
17		D10	All signals with 3,3 V CMOS logic level	Data bus of DSP, address 10
	18	D11		Data bus of DSP, address 11
19		D8		Data bus of DSP, address 8
	20	D9		Data bus of DSP, address 9
21		D6		Data bus of DSP, address 6
	22	D7		Data bus of DSP, address 7
23		D4		Data bus of DSP, address 4
	24	D5		Data bus of DSP, address 5
25		D2		Data bus of DSP, address 2
	26	D3		Data bus of DSP, address 3
27		D0		Data bus of DSP, address 0
	28	D1		Data bus of DSP, address 1
29		A11		Address bus of DSP, address 11
	30	A12		Address bus of DSP, address 12
31		A9		Address bus of DSP, address 9
	32	A10		Address bus of DSP, address 10
33		A7		Address bus of DSP, address 7
	34	A8		Address bus of DSP, address 8
35		A5		Address bus of DSP, address 5
	36	A6		Address bus of DSP, address 6
37		A3		Address bus of DSP, address 3
	38	A4		Address bus of DSP, address 4
39		A1		Address bus of DSP, address 1
	40	A2		Address bus of DSP, address 2
41		#DS		Control order of DSP (???)
	42	A0		Address bus of DSP, Address 0
43		#RD		Control order of DSP (read)
	44	#WR		Control order of DSP (write)
45		#IRQB (Sync)		IO- / Interrupt signal of DSP
	46	#IRQA		IO- / Interrupt signal of DSP
47		MOSI		SPI Serial Master Output
	48	SCLK		SPI Serial Clock (max. 20 MBit/s)
49		MISO		SPI Serial Master Input
	50	#SS		SPI Slave Select
51		GND	0 V	Reference potential
	52	GND		Reference potential

12.16.5 Pin configuration: CAN-Bus [X4]

Via the interface CAN-Bus you can connect with the RBD-S.
The RBD-S supports the CAN open protocol DSP402 and DS301.

- ❖ Connector on RBD-S: DSUB-9polig male
- ❖ Cable connector: DSUB-9polig female
- ❖ Position: Front side, lower

Table 32: Pin configuration [X4] – CAN - Bus

Pin Nr.		Designation	Value	Specification
1		-	-	n. c.
	6	CAN_GND	0V	CAN-GND, galvanic connected with GND in controller
2		CANLO	5V / RI ≈ 60 Ω	CAN-Low signal wire
	7	CANHI	5V / RI ≈ 60 Ω	CAN-High signal wire
3		CAN_GND	0V	CAN-GND, see pin Nr. 6
	8	-	-	n. c.
4		-	-	n. c.
	9	-	-	n. c.

12.16.6 Optional: connection: CAN-Bus in- and output |X401, X402]

The servo position controller can be delivered with an optional module for CAN-Bus connection with M12 round connector. In this it case can be connected via [X401] and [X402].

- ❖ Connector on RBD-S: [X401] M12 Round connector, pin, 5-poles, A-coded
  [X402] M12 Round connector, female, 5-poles, A-coded
- ❖ Cable connector: Confected M12 Bus cables, e.g. Phoenix Contact Serial SAC-5P-MS/xxx-920/FS SCO
- ❖ Position: Front side top, middle and lower

Table 33: Pin configuration [X401, X402]

Pin Nr.	Designation	Value	Specification
1	Screen	PE	In RBD-S connected with housing
2	--	--	Not used
3	CAN_GND	0 V	Reference potential for the CAN-Bus, internally connected with GND of the 24 V logic supply
4	CAN_HI	0 V / 5 V	Signal CAN_HI in accordance with CAN-specification
5	CAN_LO	0 V / 5 V	Signal CAN_LO in accordance with CAN-specification

12.16.7 Pin configuration: PROFIBUS [X401, X402]

The Profibus interface of the servo position controller correspondent the normalization EN 50170.

- Connector on RBD-S: [X401] M12 Round connector, pin, 5-poles, B-coded
  [X402] M12 Round connector, female, 5-poles, B-coded
- Cable connector : Concentric M12 Bus cables, e.g. Phoenix Contact Series SAC-2P-MSB/xxx-910/FSB SCO
- Position: Front side top, middle and lower

Table 34: Pin configuration [X401, X402]

Pin Nr.	Designation	Value	Specification
1	+5V	+5V	Auxiliary supply +5V for Bus termination, galvanic splitter of the 24 V logic supply of the controller
2	A-line	green	Signal A in accordance of PROFIBUS specification
3	0V	0 V	Reference potential for the A/B signal, galvanic splitter of the 24 V logic supply of the controller
4	B-line	rot	Signal B in accordance of PROFIBUS specification
5	Schirm	PE	In RBD-S connected with the housing

12.16.8 Pin configuration: EtherCAT [X401, X402]

The EtherCAT interface of the servo position controller corresponds to the standard IEC 61076-2-101.

- Connector on RBD-S: [X401] M12 Round connector, female, 4-poles, D-coded
  [X402] M12 Round connector, female, 4-poles, D-coded
- Cable connector : Concentric M12 Ethernet Bus cable,
  e.g. Phoenix Contact, M12, 4-poles, D-coded
- Position: Front side top, middle and lower

Table 35: Pin configuration [X401, X402]

Pin Nr.	Designation	Value	Specification
1	TX+	0 ... 2,5 VDC	Transmission Data +
2	RX+	0 ... 2,5 VDC	Receive Data +
3	TX-	0 ... 2,5 VDC	Transmission Data -
4	RX-	0 ... 2,5 VDC	Receive Data -

12.16.9 Pin configuration: Serial parameterization interface [X5]

With this interface the RBD-S can communicate via RS232 protocol with a PC. This connection will be mainly used for parameterization of the RBD-S with the RBD-Commander PC Software. You need to use a special communication cable connected to the COM port of the PC or to a High-speed USB/serial converter.

- Connector on RBD-S: PS2 female
- Cable connector : PS2 male
- Position: Front side, top
- PC side : DSUB9 female connector, connecting to COM port of the PC

Table 36: Pin configuration [X5] – serial interface

Pin Nr.	Designation	Value	Specification
1	-	-	n. u.
2	RxD	10 V / RI > 2kΩ	Received wire, RS232 specification
3	GND	0V	Interface GND, galvanic with GND connected with digital part
4	VCC	+5V±5% 50mA	Auxiliary supply, maximum with 50mA load
5	-	-	n. c.
6	TxD	10 V / RA < 2kΩ	Transmit wire, RS232 specification

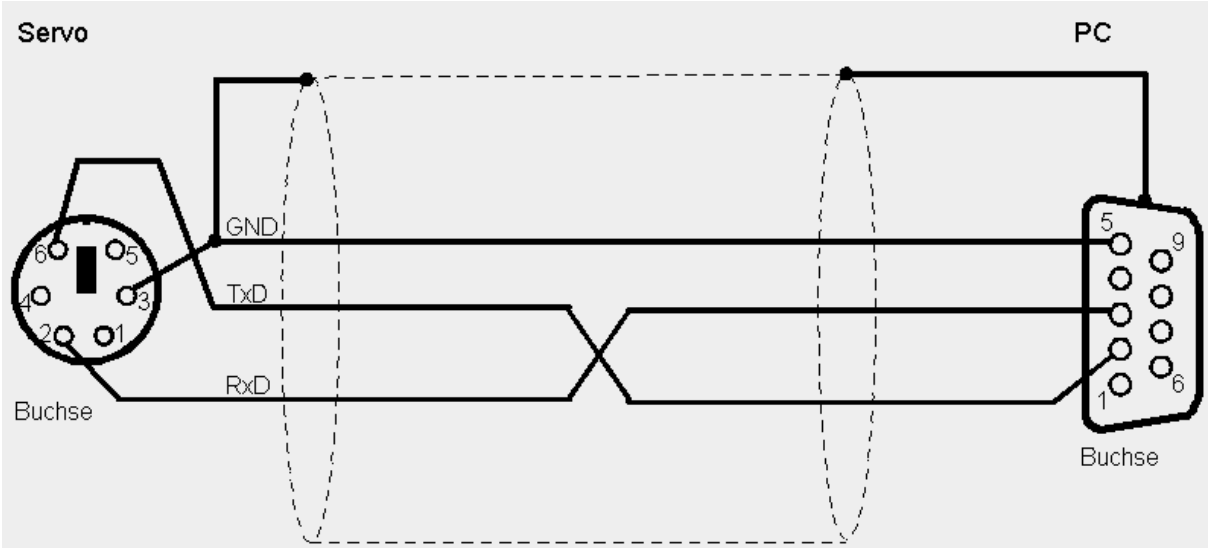


Figure 38: wiring communication cable RBD-S [X5] to COM port interface of the PCs

12.16.10 Pin configuration: Incremental encoder input and output [X10]

This interface is for exchanging of the encoder information in synchrony applications. The interface is with the Software program adjustable as output or as input:

- Signal output – output of incremental encoder signals A / B / N
- Signal input – Processing of incremental encoder signals A / B / N
- Signal input – Processing of pulsee direction signals CLK / DIR

- Connector on RBD-S: DSUB-9 poles female
- Cable connector : DSUB-9 poles male
- Position: Front side, middle

Table 37: Pin layout [X10] – Incremental encoder input and output

Pin Nr.		Designation	Value	Specification
1		A / CLK	5V / RI ≈ 120Ω	Incremental encoder signal A / stepper motor signal CLK pos. polarity gem. RS422
	6	A# /CLK#	5V / RI ≈ 120Ω	Incremental encoder signal A / stepper motor signal CLK neg. polarity gem. RS422
2		B / DIR	5V / RI ≈ 120Ω	Incremental encoder signal B / stepper motor signal DIR pos. polarity gem. RS422
	7	B# /DIR#	5V / RI ≈ 120Ω	Incremental encoder signal B / stepper motor signal DIR neg. polarity gem. RS422
3		N	5V / RI ≈ 120Ω	Incremental encoder signal zero impulse N pos. polarity gem. RS422
	8	N#	5V / RI ≈ 120Ω	Incremental encoder signal zero impulse N neg. polarity gem. RS422
4		GND	-	Reference GND for encoder
	9	GND	-	Screen for connection cable
5		VCC	+5V ±5% 50mA	Auxiliary supply, maximum 50mA load

12.17 Electrical installation of the RBD-S

12.17.1 Connecting to supply [X6] and the motor [X6], [X2B]

The following figure shows a typical application with the servo position controller RBD-S. Represented is the connection to 230 V AC power supply, the connection with 24V logic supply and the external brake resistor. The connection of the motor and the encoder is shown simplified, you can also find details in chapter 12.17.2 and **Fout! Verwijzingsbron niet gevonden.**.

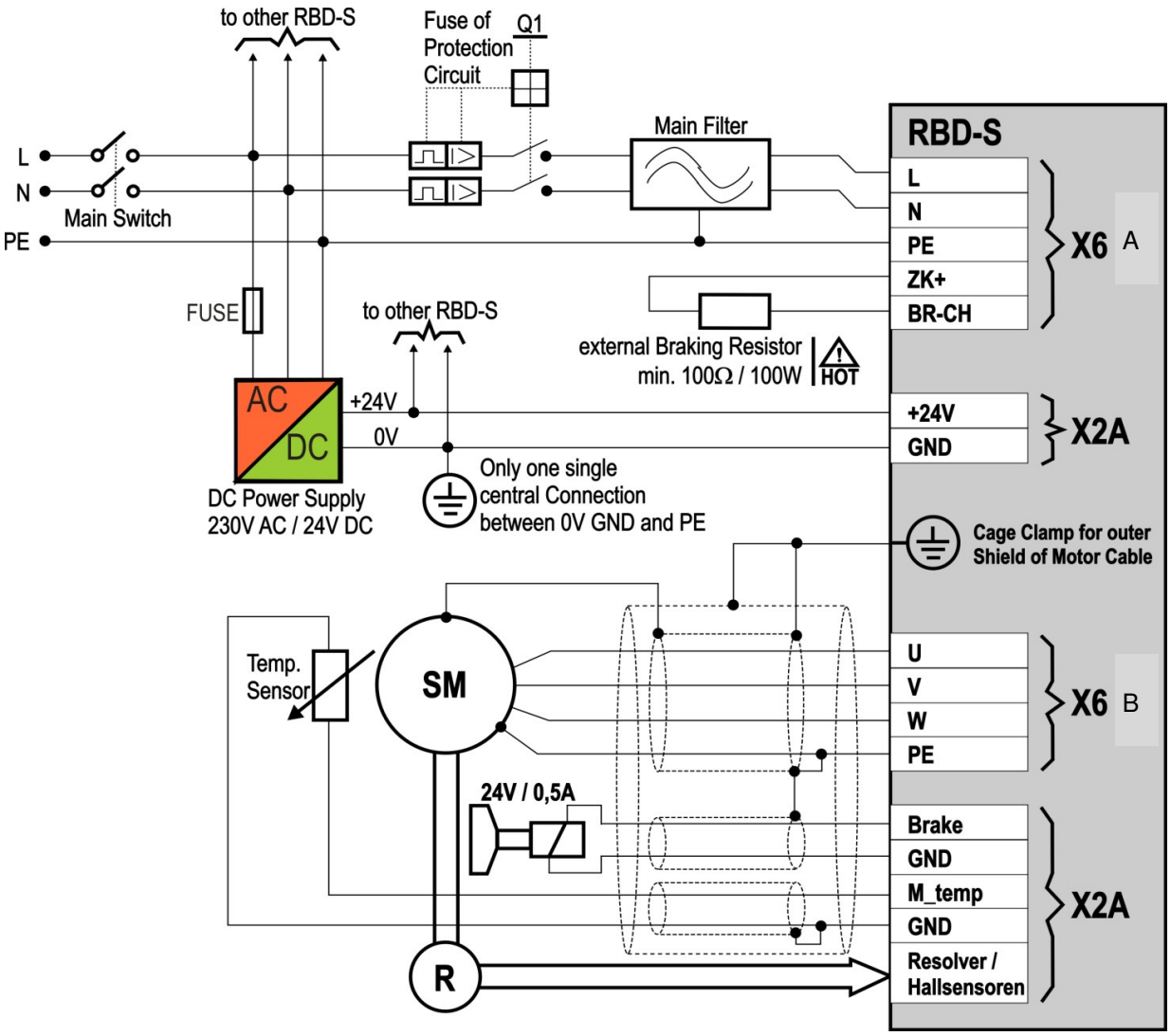


Figure 39: Connection power and logic supply, simplified

The connection to the power supply takes place over the following components:

The main switch (or main fuse) is necessary to disconnect the RBD-S of the power supply. There is minimum one main switch necessary to disconnect the controller voltage in event of an error (Emergency stop). Further, more switches and fuses can be necessary depending on your application. Every RBD-S should be connected to the power supply and protected by its own fuse Q1. We advise a 2 pole protection fuse (automatic). The fuses must be able to handle the peak current of the servo gear including the inrush current when switching on the power supply:

- Nominal current RBD-S in operation: 5 A
- Input power supply in operation: 10 A / 2 s
- Inrush current on 230 V AC: 30 A / 10 ms

The external filter must be mounted between the fuse Q1 and the RBD-S. The EMC compatibility is described under accessories (see chapter 1.5) for example filter NF 2. Depend of the number of the RBD-S and complexity of the application a general filter can be used for the total application which is, in this case, a more economic solution..

The RBD-S has an internal brake chopper which can handle the external brake resistor. During braking the generator energises the DC bus capacitors in the RBD-S. As soon as the voltage in the DC bus exceeds the switching level (by approx 400 V) the braking chopper connects the braking resistor to the DC bus and the surplus energies will be converted to heat.

DANGER!
Please use the selected brake resistor as described or delivered from your supplier. The brake resistor used must have a high impulse stress capability to manage these short duty load peaks. The wrong brake resistor will fail earlier than expected. This can cause fire or dangerous electrical situations and also damage the RBD-S.

The RBD-S has a separate connection [X2A] for the 24 V logic supply. This is advantageous in some applications for disconnecting the power supply under certain circumstances (e.g. emergency stop), where new homing isn't necessary after reconnecting the power supply. The 24 V supplies in general the machine controlling and other components such as sensing systems, actuators, protectors, valves, etc. Please be careful to use the correct wiring cross section and on a star projected wiring of the 24 V supply to all components. If a connection between 0 V potential of the logic supply and the earth protection PE is necessary, this must these connected on the central side and also possible direct to the power supply. Multiple connections between 0 V and PE should be avoided because it can disturb currents from servo position controller.

The RBD-S must be connected before the power supply and the logic supply is switched on.

Check the available voltage supplies for the power and logic part and the specifications for the RBD-S are suitable.

Power supply: 230 V AC ±10%, 45 Hz...66 Hz

Logic supply: 24 V DC ±20%, min. 0,3 A (min. 1 A with holding brake)

DANGER!
Wrong connection of the voltage supply disturbs the servo position controller RBD-S. In particular the wrong connection of the power voltage, the cable shielding, the motor phases and the brake resistor.

Also too high an auxiliary supply can disturb the devices. An excessive power voltage can exist when the zero core isn't connected/broken in the control cabinet or externally

The RBD-S controls an optional holding brake via connection [X2A], the connection of the encoders

and temperature sensor are made via a connector. The motor phase connections are via [X6]. Only screened and suitable servo position controller cables should be used.

The combined motor-encoder cable (blue) of the company Groschopp is developed especially for using with the RBD-S and is certified in accordance with the EMC rules. You only need one (round) cable for motor with encoder and brake.

The next notes for connecting of the motor cable and the screen apply to the motor-encoder cable of the company Groschopp. These notes are similar for the cables of other suppliers. The screen connections shown in figures 39, 40 & 42 all apply.

- The connection of the motor phases must **always** be connected with screened cable.
- The screen of the motor cables will be connected on both sides of controller and motor to PE. Try to use a short, low inductance connection.
- The control wires for the holding brake should be separately screened. The screen is only connected on the controller side to PE potential.
- The sensing wires for the temperature measuring are also separately screened. This screen should be connected on the controller side to GND (which is also the reference potential of control logic!). This is important when using an analogue temperature sensor.
- The outer cable screen of the motor cable must be connected on both sides to PE potential. If the motor connector is plastic and therefore PE isn't available, then the screen should be connected to the PE connection in the motor connector.
- The outer screen of the cable on the RBD-S device must be connected with the aid of the cable clamp on the mounting plate angle, see Figure 40 and Figure 42
- The encoder wiring must also be screened. For the connection of the encoder three screened twisted pairs are used. The screen of each pair should be connected on the controller side to GND potential. On the motor side the screen does not need to be connected.
- The connection of each pair should be as shown in Figure 40 and Figure 42.
- For motors with analogue Hall sensors connect the + 5V supply through the REF connection. The reference signal of the encoder supply will be on the GND of the temperature sensor.

References to the cable screens

The screens of the motor temperature sensor and of the encoder wires must be isolated from the other screens so there isn't a short circuit connection between GND and PE! There should be just one central connection between GND and PE on the power supply.

It is not acceptable to have the wires for the holding brake or for the temperature sensor together with the motor phases in one central screen as:

- In event of cable error there can be a connection between power supply potential (motor phases) and safety low voltage (24 V logic potential)
- The fields of the motor phases create strong disruptive signals in the brake or temperature sensor.

12.17.2 Detail view – Connection motor with resolver [X6], [X2A]

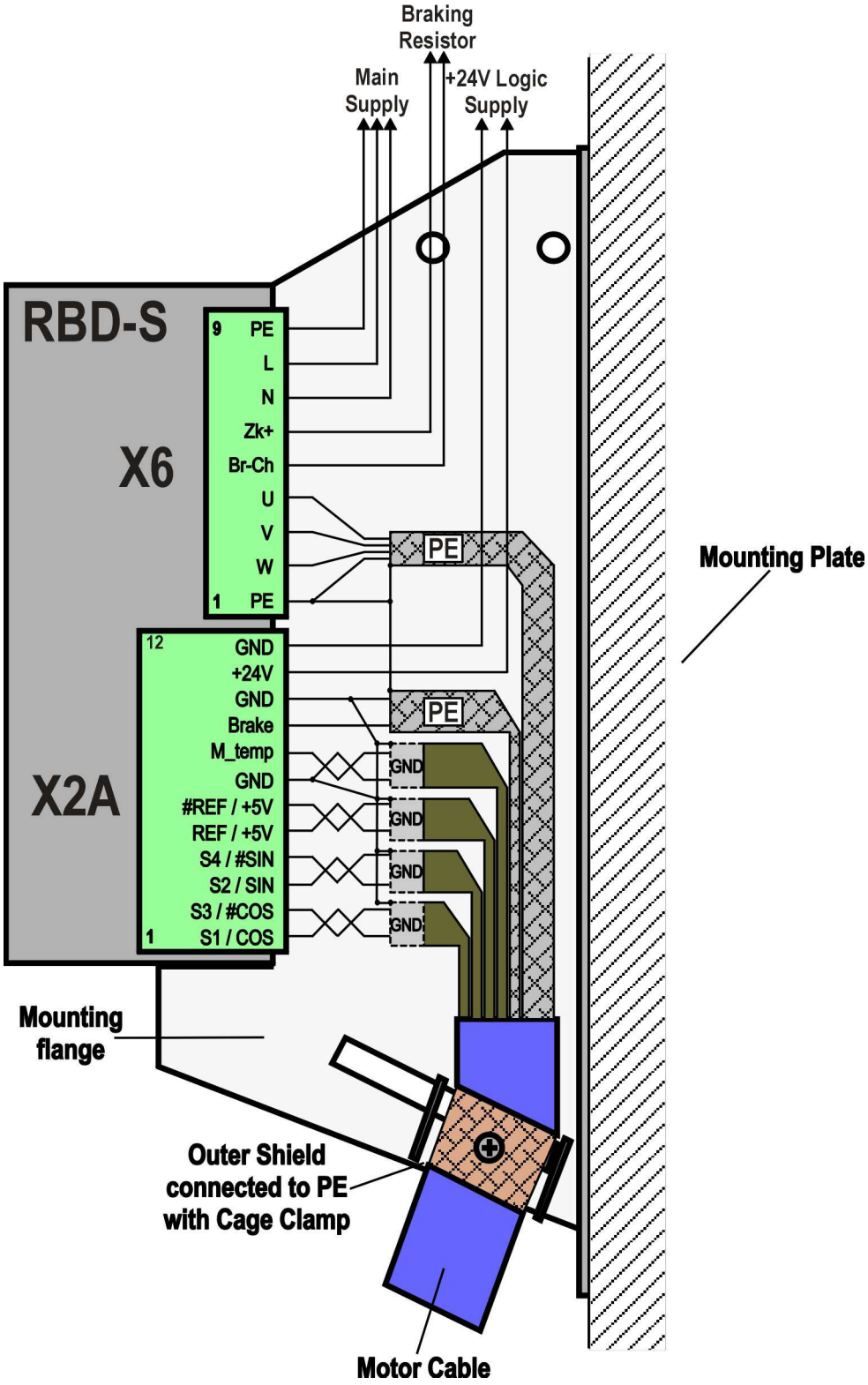


Figure 40: Connection motor with resolver and holding brake

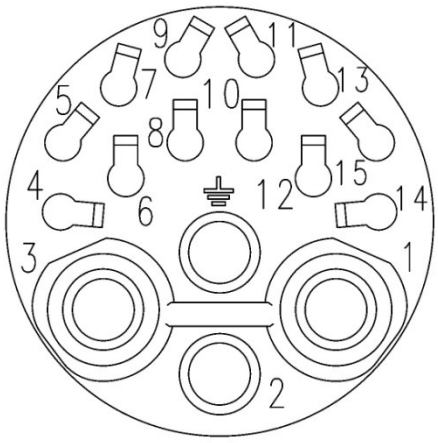


Figure 41: Motor connection – Pin layout

Amphenol – Cable connector C16-3 (Type C01610D0150135) with Pg – screw connection 13,5 mm

Table 38: Pin layout connector on motor – motor with resolver

Pin Nr.	color / index	Description	Value	Specification
PE	Green/Yellow	PE	PE	Connection protection wire motor
1	Black	U	0…300 v max. 6 Aeff 0…300 Hz	Connection motor phase U / 1
2	Blue	V		Connection motor phase V / 2
3	Brown	W		Connection motor phase W / 3
4	Yellow	#REF (+5V)	ca. 5,6 $V_{eff,diff}$ max. 20mA_{eff} $R_i \approx 120\ \Omega$	Inverse reference signal for resolver, f_{Tr} = 10 kHz, middle voltage approx. 5V in opposite phase to REF
5	Red	REF (+5V)	ca. 5,6 $V_{eff,diff}$ max. 20mA_{eff} $R_i \approx 120\ \Omega$	Reference signal for resolver, f_{Tr} = 10 kHz, middle voltage approx. 5V
6				Free
7	Blank	S2	1,5V_{eff} / 10kHz $R_i > 5k\Omega$	SINUS-Level signal, differential
8	White	S4		SINUS- Level signal, differential
9	Green	S1	1,5V_{eff} / 10kHz $R_i > 5k\Omega$	COSINUS- Level signal, differential
10	Violet	S3		COSINUS- Level signal, differential
11	Red/Black	M_temp	R_{PU} = 1 kΩ	Motor temperature sensor PTC / KTY83
12	Yellow/Black	Gnd	0 V	Reference potential motor temperature sensor
13	Blue/Green	Gnd	0 V	Reference potential for holding brake
14	Red/Green	Brake	24 V / 700 mA	Control signal holding brake

12.17.3 Detail view – Connection motor with Hall sensing system [X6], [X2A]

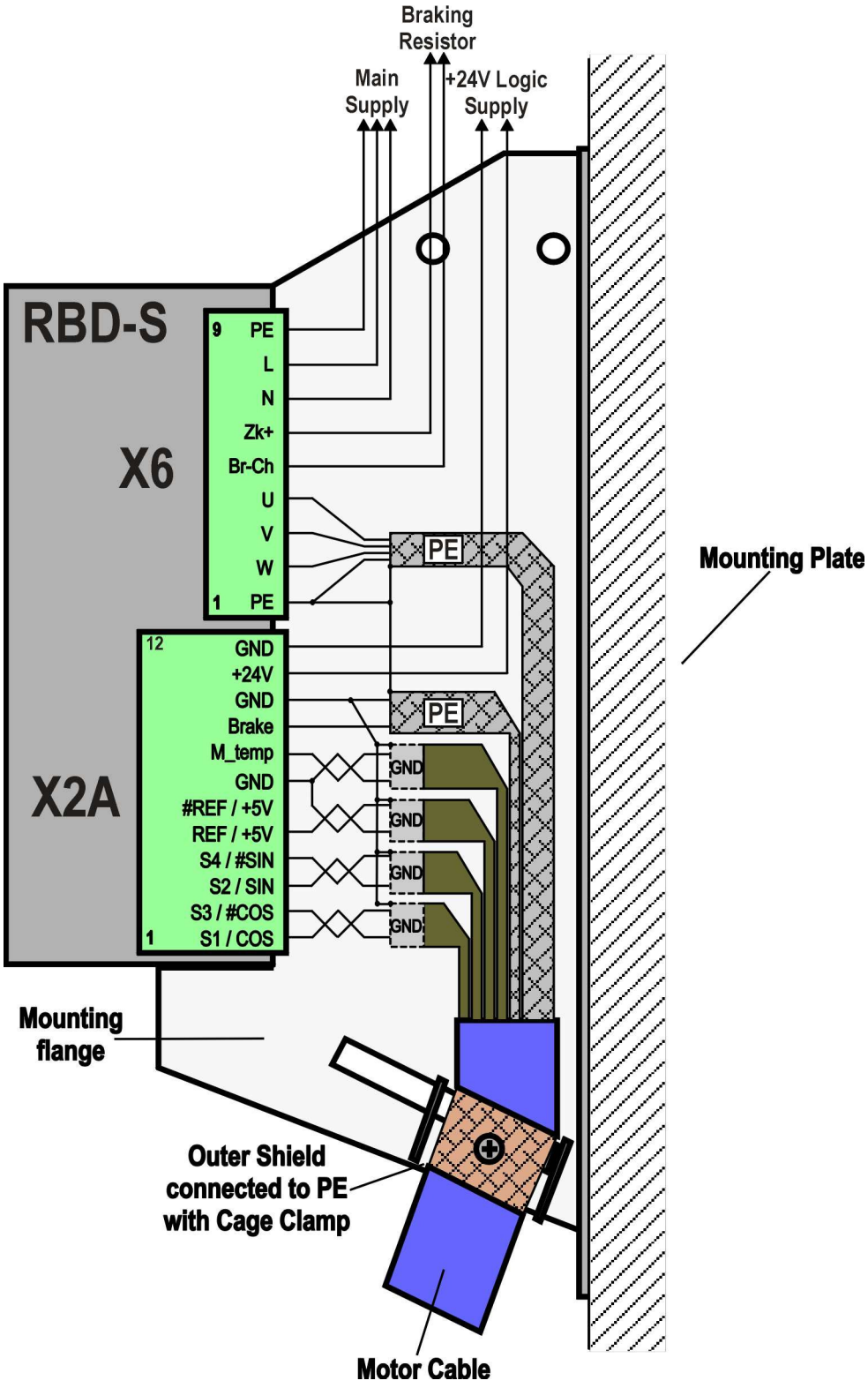


Figure 42: Connection of analogue Hall sensing system and holding brake

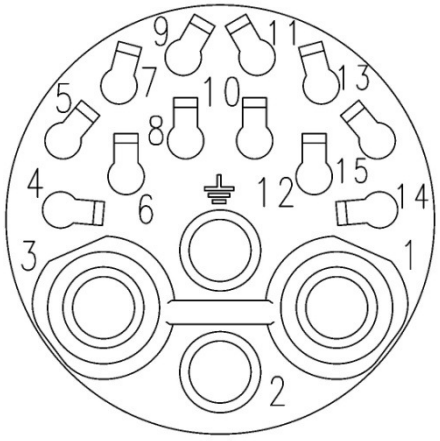


Figure 43: Motor connection – Pin lay out

Amphenol – Cable connector C16-3 (Type C01610D0150135) with Pg – screw connection 13,5 mm

Table 39: Pin lay out connector on motor – motor with analogue Hall sensing system

Pin Nr.	Color / index	Description	Value	Specification
PE	Green/ Yellow	PE	PE	Connection protection wire motor
1	Black	U	0…300 v max. 6 Aeff 0…300 Hz	Connection motor phase U / 1
2	Blue	V		Connection motor phase V / 2
3	Brown	W		Connection motor phase W / 3
4	Yellow	Gnd	0 V	Reference signal for analogue Hall sensing
5	Red	REF (+5V)	5 V / 40 mA	+5 V auxiliary supply for the analogue Hall sensing
6				Free
7	Blank	S2	1,5V_{eff} / 10kHz R_i > 5kΩ	SINUS- Level signal, differential
8	White	S4		SINUS- Level signal, differential
9	Green	S1	1,5V_{eff} / 10kHz R_i > 5kΩ	COSINUS- Level signal, differential
10	Violet	S3		COSINUS- Level signal, differential
11	Red/Black	M_temp	R_{PU} = 1 kΩ	Motor temperature feeler PTC / KTY83
12	Yellow/ Black	Gnd	0 V	Reference potential motor temperature sensor
13	Blue/Green	Gnd	0 V	Reference potential for holding brake
14	Red/Green	Brake	24 V / 700 mA	Control signal holding brake

12.17.4 Connection of analogue and digital in- and output [X2B]

The following picture shows the connection possibilities of the digital and analogue I/Os on the RBD-S. The pins and a description of the interface are shown where the connector is positioned. On the right side of the picture you can see the RBD-S with a simplified view of the internal connections of the I/Os. Thereby stays the e.g. DINx for all digital inputs (DIN0 to DIN9).

The connection of the supplies and motor are not shown in this picture. Refer to Figure 39 for this. Using one central star point close to the power voltage for all GND connections reduces the „ground bouncing“ effect between the controllers.

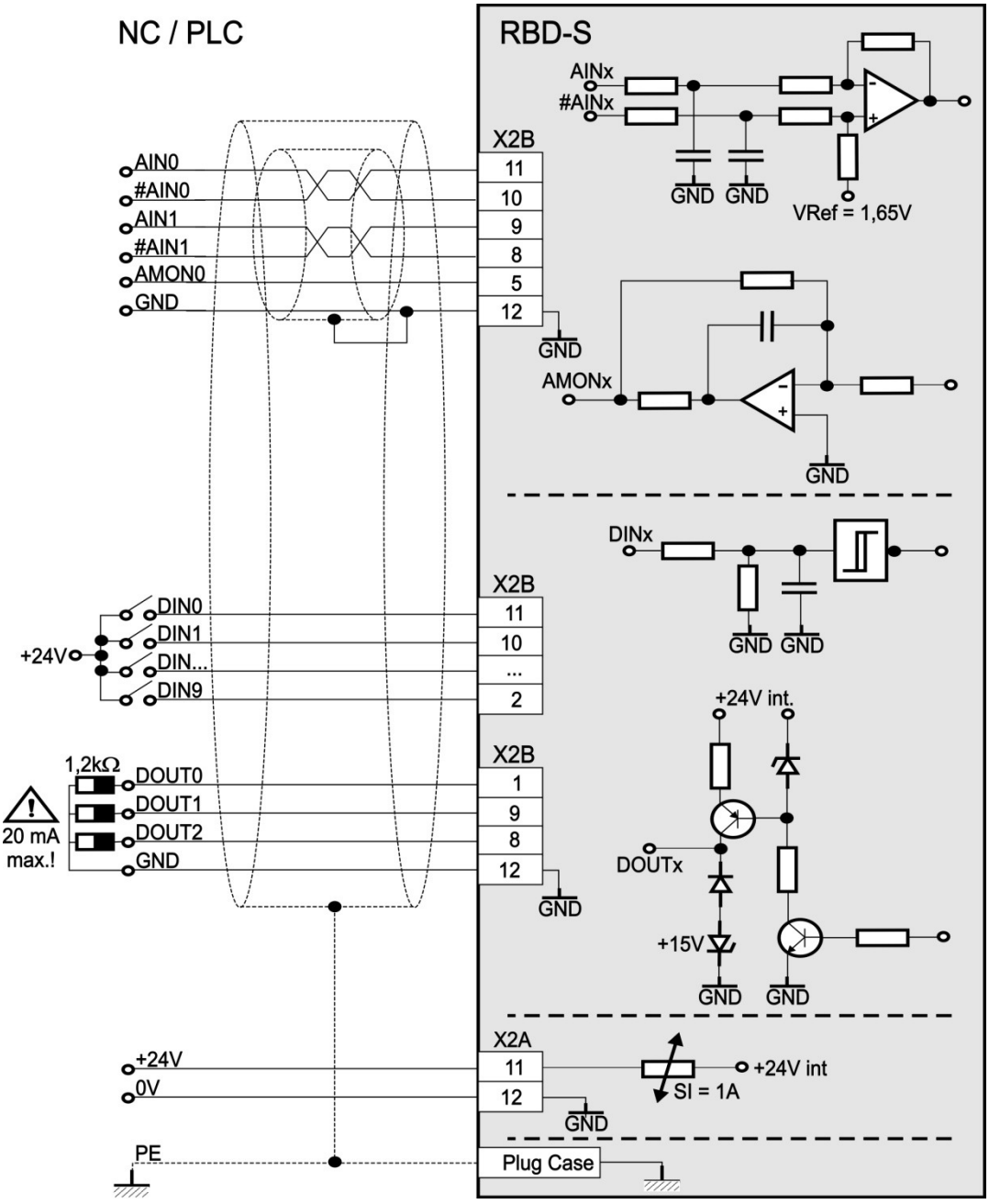


Figure 44: Connection of digital and analogue I/Os

The RBD-S has an internal fuse for the 24 V logic supply so an external 24 V fuse isn't necessary.

The digital outputs DOUT0 to DOUT2 are short circuit protected. They can support a maximum output current of 20 mA and can also manage inductive loads, so small relays can be used and also IEC1131 compatible PLC inputs can be connected directly.

The signals for the digital IOs, DINx and DOUTx, don't need screens for protection against disturbing signals, but screened cables between the servo position controller and the controller make a better EMC compatible system, especially with regard to radiation disturbances. Between the PLC and servo position controller must, as a minimum, the signal to DIN9 (controller enable) and DOUT0 (Ready for operation) be wired.

If the analogue input for set up is used (speed/torque controller) then screened and twisted cores for AINx / #AINx must be used so that the controller does not give a distorted signal. Via connection #AINx to the reference potential 0V to the controller „equal clock disturbances", realized by high currents, which be flows through the external cable are be blocked. The screen prevents radiating disturbances and must be connected on both sides (on housing of the servo position controller RBD-S and the PLC controller).

The servo position controller RBD-S must be fully connected before the voltage for the DC bus and logic is switched on.

12.17.5 Connection: CAN – Bus [X4]

The CAN interface is integrated as standard with the RBD-S family and therefore always available. The CAN-Bus connection is via the installed 9-pole DSUB connector (controller side).

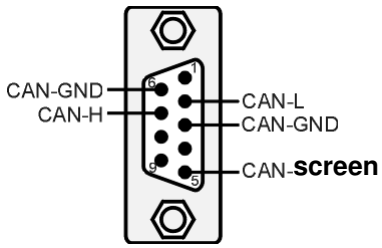


Figure 45: CAN connection for RBD-S

CAN-Bus cabling

By the cabling of the controller by CAN-Bus you must follow these guide lines and references to get a stable, error free system. Inappropriate cabling can give errors and disturbances during operation on the CAN-Bus which can be followed by disconnecting on safety grounds of the controller.

The CAN-Bus offers a possible disturbance free connection between all components in your application. A condition in front to alert on the right way of cabling:

- The used node Id's of your network are in basic in line connected, so the CAN cable runs from servo position controller to the other, see Figure 46.
- On both sides of the CAN, the cable must be connected a closing resistance of 120Ω +/- 5%. Also possible is the availability to have closing resistance in the CAN module or in the PLC. Please take note.

120Ω Closing resistance

In the RBD-S a closing resistance isn't available.

- For the cabling you must use screened and two twisted core cables.
- A twisted pair for connecting CAN-H and CAN-L must be used.
- The other pair are used for the CAN-GND.
- The screen of the cables must be connected via every node to the CAN screen.
- Technical data of recommended CAN bus cable:
  2 Pairs of 2 twisted cores, d ≥ 0,22 mm — Loop resistance < 0,2 Ω/m
  Screened — Characteristic impedance 100-120 Ω
- The use of joint connectors for CAN-Bus cables is not recommended. If it is necessary to use joint connectors please use metallic housings to connect the screen as well as possible.

To reduced disturbances the following points should be noted -

- Motor cable is not positioned parallel with the signal cables.
- Motor cable is in accordance with the Groschopp specification.
- Motor cable is screened and earthed.
- For more information about mounting of disturbance free CAN-Bus cables we refer to „Controller Area Network protocol specification", Version 2.0 of Robert Bosch GmbH, 1991.

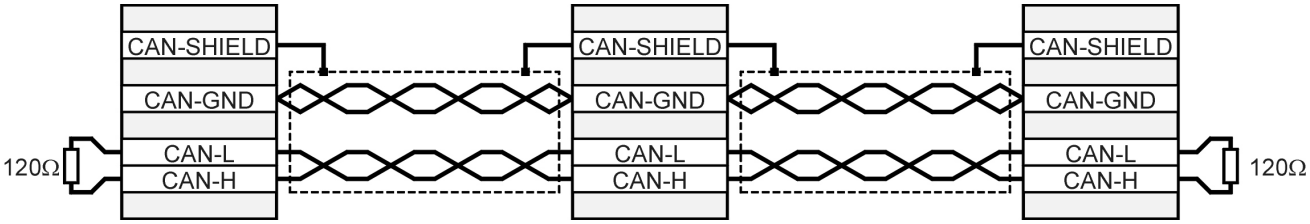


Figure 46: Cabling example CAN-Bus

12.18 Notes concerning safe and EMC-compliant installation

12.18.1 Definitions and terminology

The electromagnetic compatibility EMC or EMI (electromagnetic interference) has the following requirements:

- A sufficient **disturbance resistance** of an electrical application or electrical device from external electrical input, magnetic or electromagnetic disturbance or influence across cables or over the entire area
- A sufficient small **disturbance resistance** of electrical, magnetic or electromagnetic disturbances of electrical applications or electrical device to another device in the environment across cables and over the area.

12.18.2 General information concerning EMC

The radiation and disturbance resistance of the servo position controller is always viewed as from the total concept of the gear application, which consists of the following components:

- Voltage supply
- Servo position controller
- Motor
- Electromechanical components
- Execution and type of the wiring
- Overlaid control

The servo position controller RBD-S is in accordance with the for electrical gears available product normalization EN 61800-3 qualifications. The compatibility requirements to EMC guide line 89/336/EWG is available from the producer.

12.18.3 EMC ranges: first and second environment

The servo position controller RBD-S when suitably mounted and wired fulfills the regulations of the associated, product standard EN 61800-3. In this standard is not more of „Limit value classes“ those talks, separate from environments so called. The „first“ environment covers mains domestic electricity, the “second” environment covers industrial mains electricity.

12.18.4 Connection between RBD-S and Motor

Please consider the wire references in chapter12.17.1. In addition, the following guidelines apply:

- Use only screened cables - the encoder cable must also have an internal as well as external screen.
- Used two separate cables for the motor phases and angle encoder cable. Alternatively use the combination Groschopp cable for motor phases and angle encoder with spliced screen.
- Connect all (outside) screens with the housing of the RBD-S, and with the mounting plate, which gives a good connection to the RBD-S.
- Connect the outside screen of the motor cables with the motor housing.
- Connect the internal screens from encoder cable to the GND [X2A].
- Be sure of a good PE connection between motor and RBD-S.

12.18.5 Connection between RBD-S and power and also logic supply

Connection to the logic supply:

- Use cable with a sufficient cross section to reduce „ground bouncing“ on the 24 V supply. 0,75 mm² should be enough for a length of 5 meters between power supply and RBD-S.
- Use a star point wiring, if more than one RBD-S is connected to the same power supply.
- The supply for the logic must have a Y capacitor of minimum 100 nF between GND and PE.

Connection to the power supply:

- Be sure of a „good“ PE connection between the RBD-S and power supply. This is important for a feedback of high frequency leakage current created by the clocked power end stage in RBD-S in connection of the windings capacity between motor phase and PE in motor.
- Use copper cable with sufficient cross section and a minimum conductor temperature of 60/75 ^{0}C or equivalent.

A „good” PE connection will have a small impedance where there are high disturbance frequencies. The cabinet mounting plate must be a good conductor, e.g. mounting plate of non painted aluminum or zinc plate steel. The mounting plate must have a good contact with other parts in the machine, which will be mounted on the motor.

- If multiple RBD-S are built with each other on one wall mounting plate there must be a good conductive PE rail (Cu rail) around the RBD-S (e.g. use central or direct to the RBD-S, to bundle the power side PE).
- The supply filter must mount near to the RBD-S and on the same mounting plate. The connection cable between filter and power supply input must be as short as possible –no more than 20 cm additional screening is necessary.
- To be sure of limited values of radiation a screened cable must be used.

DANGER!

All PE protected cores must on safety grounds be connected before starting the first commissioning. The rules of EN 50178 for the safety earth must certainly be considered for the installation!

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