

USER MANUAL

MDS AC SERVO DRIVE

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1 Safety instructions

The flawless and safe operation of the device requires a proper and professional transportation, storage, assembly, project planning as well as careful operation and maintenance. Only trained and qualified personnel should handle electrical installations.

Maintenance work on the device may only be carried out by trained professionals after the supply power has been turned off.

The non-observance of these instructions can cause serious injuries in the case of a malfunction.

1.1 Used symbols



Information:
Important information and advice!



Caution!
The non-observance of this advice can cause high property damage.



Caution, lethal voltage!
The safety advice contains a remark on a possibly occurring lethal voltage.

1.2 Intended use

As a component of a drive control system, the MDS Drive by Brunner Elektronik AG is intended for the fixed installation in switch cabinets or machines. The earth leakage current might exceed 3.5mA.

Any specifications on technical data and environment conditions have to be strictly adhered to.

The device may not be used in explosive areas and in the vicinity of oils, acids, gases, vapours, dusts, radiation, etc. unless expressly permitted in these areas due to special protection measures.

The manufacturer of the machine and/or the systems has to prepare a risk assessment and has to take actions which guarantee the safe operation of the entire system based on this risk assessment.

The entire system and/or the machine into which one or several MDS Drives have been integrated may only be used according to their intended use after it has been determined that any relevant provisions of the EC directives and any country-specific regulations for the prevention of industrial accidents are observed. This applies in particular to the EC Machinery Directive 98/37/EC and the EC EMC Directive 89/336/EEC.

2 Introduction

2.1 Target audience

This document describes the interfaces and the functionality of the device "MDS Drive". The target audience are application developers who want to use this device.

2.2 Specifications



CANopen description: CanOpen_Programmers_Manual.pdf

CANopen EDS file: micro_drive.eds

ESI File: ACServoDrive_ESI.xml

2.3 Functional overview

The MDS Drive by Brunner Elektronik AG is a compact, intelligent servo controller with comprehensive parameter setting possibilities.

Point-to-point positioning or master-slave applications are possible as easily as synchronised rail travel on multiple axes. The integrated field bus interfaces enable the communication with a superordinate control system

In addition to the standard CANopen operation modes "Profile Position", "Profile Velocity", "Profile Torque", "Interpolated Position", "Cyclic Synchronous Position", "Cyclic Synchronous Velocity" and "Homing", a mode for simulation applications "Force Feedback" has been integrated. Client-specific modes can be implemented upon request.

The parameter setting tool "DriveSetup" enables the easy operation and commissioning of the drive via USB or with a gateway via TCP/IP. Graphic displays and client-specific profiles allow for an intuitive parameter setting.

2.4 Product features

2.4.1 Supply

Input voltage 3x110-380VAC 50-60Hz for power stage

Optional: 200-700VDC

External 24VDC/300mA \pm 10% power supply

2.4.2 Output power

Max. 5kW / 50A peak

2.4.3 Interfaces

CAN or EtherCAT CoE

USB (RS232)

2.4.4 Software

Win32 configuration tool for parameter setting via RS232 or CAN

2.4.5 Feedback

Resolver SIN/COS 12bit
Hall Encoder
HIPERFACE®

2.4.6 Protective functions

Temperature control, drive & motor
I²T over-current
Over- and under voltage monitoring
Software error handling

2.4.7 Digital I/O

8 digital inputs / 3 digital outputs
1 analogue input
24VDC Motor Brake Output

2.4.8 Safety according to EN 954-1 category 3

STO: Safe Torque Off

The STO function is the most common and basic drive-integrated safety function. It ensures that no torque-generating energy can continue to affect a motor and prevents unintentional start-ups

SS1: Safe Stop 1

The SS1 function causes a motor to stop rapidly and safely and switches the motor to torque-free mode after the standstill, i.e. STO is activated.

SLS: Safety Limit Speed

The SLS function ensures that the drive does not exceed a pre-set speed limit (planned)

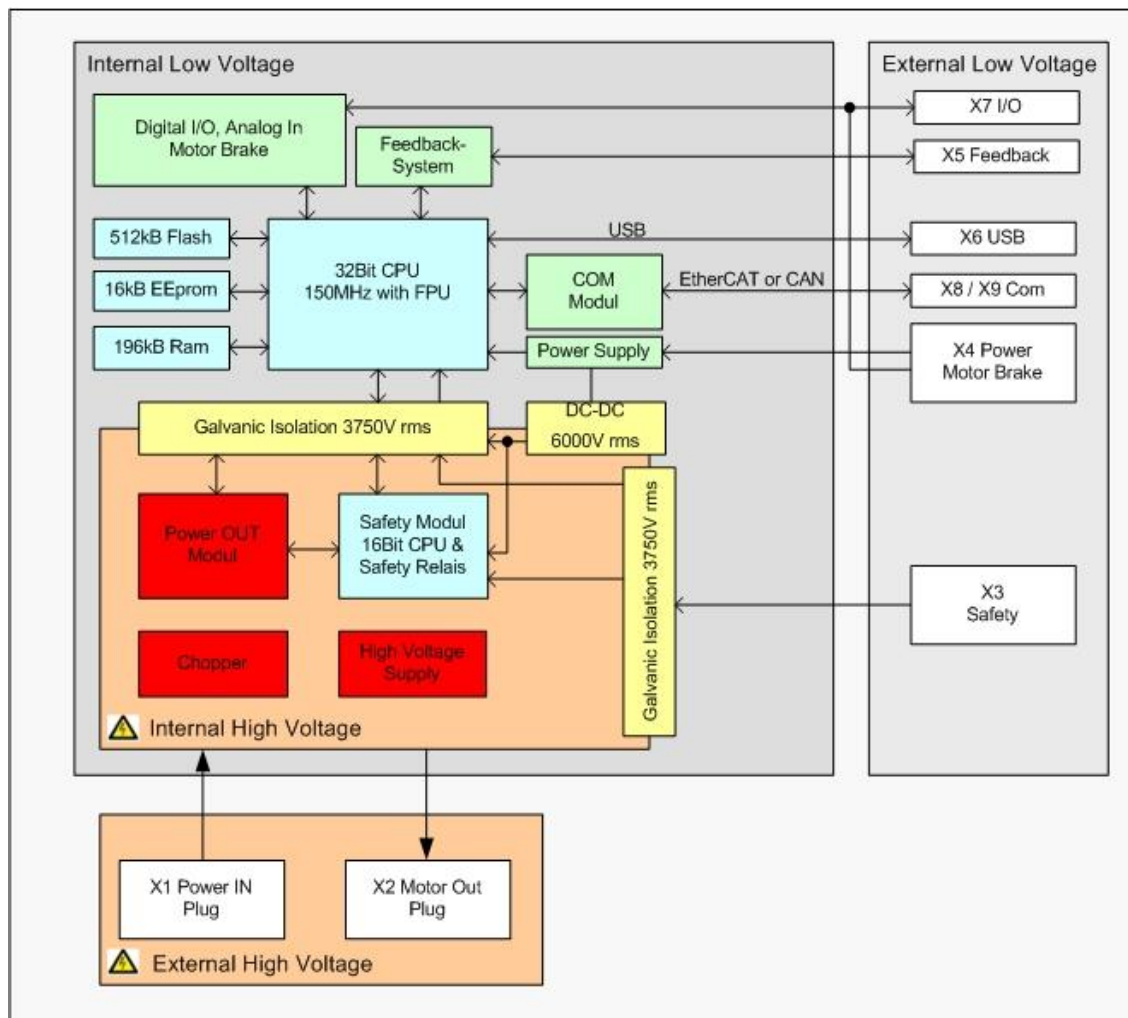
SBC: Safe Brake Control

The SBC function permits the safe control of a holding brake. SBC is always activated in parallel with STO.

2.4.9 Others

Inrush current limit
Software update over EtherCat / USB / CAN
Support for synchronous / asynchronous motor
Integrated vector control (sensorless) for asynchronous motor
Space vector modulation
Low power consumption in standby mode (average 3W)
Position regulator 10 kHz / Control loop 20 kHz
Compact size: (mm) 189x113x67 without cooling

2.5 Block Diagramm



3 Specifications

3.1 Operating conditions

Parameter		Remarks	Min.	Typ.	Max.	Unit
Ambient temperature	T _{amb}		0		45	°C
Relative humidity	φ	Non-condensing	15		80	%

3.2 Supply voltage power stage

Parameter		Conditions	Min.	Typ.	Max.	Unit
Input voltage power stage	U _{In}		110	380	450	VAC
Input frequency	f _{In}		45	50	60	Hz

3.3 Supply voltage control

Overvoltage and reverse voltage protection

External connected hardware such motor brake or outputs increase the power supply current

T_{amb}=25°C, unless otherwise specified.

Parameter		Conditions	Min.	Typ.	Max.	Unit
24V supply voltage	V _{bb}		22.5	24	28	V
	I _{In}	No motor brake connected No Outputs connected	120	150	300	mA

3.4 Engine output

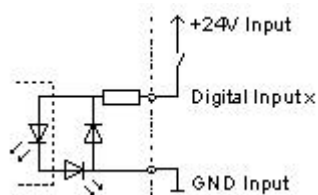
Parameter		Conditions	Min.	Typ.	Max.	Unit
Output voltage (RMS)	U _{Out}	@U _{In} =380V	0		380	VAC
Output current (RMS)	I _{Out}	@U _{In} =380V	0		10	AAC
PWM frequency	f _{PWM}			20		kHz
Max. current	I _{max}				50	AAC

3.5 Isolation

All external available low voltage interfaces (<30V) are electrically isolated from the internal high voltage supply. The momentary (1 minute) withstand voltage is 3750 V rms

3.6 Digital inputs

3.6.1 Connection



3.6.2 Electrical parameters

@ V_{bb}=24V, T_{amb}=25°C, unless otherwise specified.

ESD Protection: ±8kV-IEC 61000-4-2, Contact Discharge

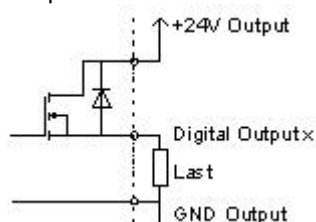
±15kV-IEC 61000-4-2, Air-Gap Discharge

Parameter		Conditions	Min.	Typ.	Max.	Unit
Input voltage low	V _{IL}		0		5	VDC
Input voltage high	V _{IH}		12		32	VDC
Input current low	I _{IL}	@V _I =0V		0		mA
Input current high	I _{IH}	@V _I =24V		2		mA

3.7 Brake output

3.7.1 Connection

Output driver: ISP752R



3.7.2 Electrical parameters

@ V_{bb}=24V, T_{amb}=25°C, unless otherwise specified. ESD Protection: Human Body Model ±5kV

Parameter		Conditions	Min.	Typ.	Max.	Unit
Output voltage low	V _{OL}	@I _L =open load		0.3	0.6	V
Output voltage high	V _{OH}	@I _L =I _L (NOM)			V _{bb}	V
On-state resistance	R _{ON}	@T _J = 25°C		150	200	mΩ
Continuous output current				1.3	1.7	A
Peak short circuit current limit	I _L (lim)		4	6.5	9	A

3.8 Analogue input

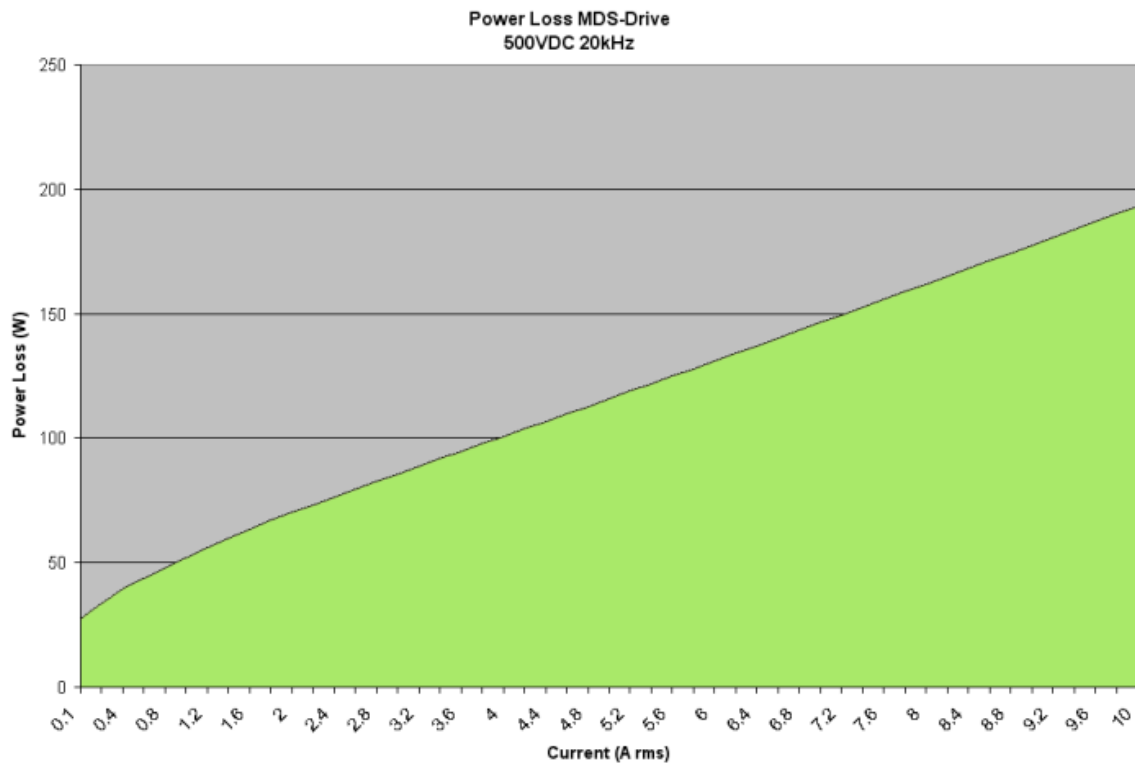
The 12bit analogue input is electrically isolated from internal high voltage supply.

3.8.1 Electrical parameters

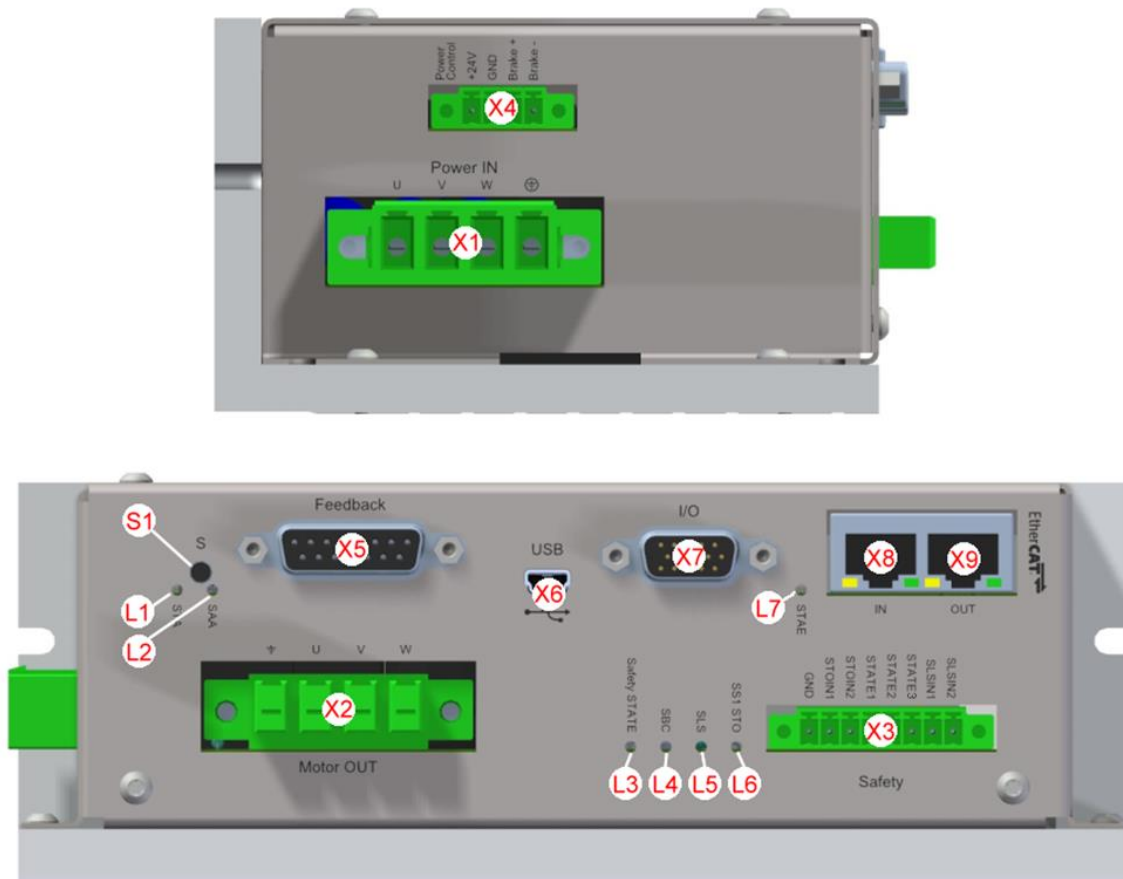
@ V_{bb}=24V, T_{amb}=25°C, unless otherwise specified.

Parameter		Conditions	Min.	Typ.	Max.	Unit
Input voltage range	VI		0	0	10	V

3.9 Power Loss



4 Interfaces / Plugs



4.1 X1 Main Connection



Always connect the protective earthing conductor or the earth wire before starting the device even for temporary measurement and test purposes. Otherwise, voltages which occur at the casing can cause a lethal electric shock.

Counterpart Type: Phoenix-Nr. 1777859 (Brunner-Elektronik: Nr. STB.PC5S.TF04)


Limitation of the switch-on current:

The peak switch-on current is limited to 8A at the most with a temperature-sensitive resistance. After the intermediate circuit capacitor has been charged, the limitation resistance is bypassed with a relay contact and can thus cool down during normal operation. There has to be an interval of at least 3 seconds between switching on and switching off. A cyclical switching on and off of the servo amplifier with a mains contactor (>10/min) is not permissible.

4.2 X2 Motor

Counterpart Type: Phoenix-Nr. 1709173 (Brunner-Elektronik: Nr. STS.PC5S.TF04)

Only original cables by Brunner Elektronik should be used.

Pin #	Designation	Function	
1	Phase W	Engine Output Phase W	
2	Phase V	Engine Output Phase V	
3	Phase U	Engine Output Phase U	
4	Earth	Earth	

4.3 Safety

Counterpart Type: Würth-Nr. 691 364 100 004 (Brunner-Elektronik: Nr. STB.3641.0008)

Pin #	Designation	Function
1	GND	GND
2	STOIN1	Safety STO/SS1 IN1
3	STOIN1	Safety STO/SS1 IN2
4	STAE1	Safety State Relay Contact 1
5	STAE2	Safety State Relay Contact 2
6	STAE3	Safety State Relay Contact 3
7	SLSIN1	Safety SLS IN1
8	SLSIN2	Safety SLS IN2

4.4 X4 Control Power / Motor Brake

Counterpart Type: Würth-Nr. 691 364 100 004 (Brunner-Elektronik: Nr. STB.3641.0004)

Pin #	Designation	Function
1	+24V	Control Power Supply Input
2	GND	GND
3	Brake Out +	Brake Output + 24V@1.5A
4	Brake Out -	Brake Output - (do not connect to GND!)

4.5 X5 Feedback

Counterpart Type: DSUB 15Pol Manufacturer any (Brunner-Elektronik: Nr. DSU.S15H.0003)

Only original cables by Brunner Elektronik should be used.

Pin #	Resolver	Hall Encoder	HIPERFACE®
1	NC	HALL W	NC
2	NC	HALL U	NC
3	GND	GND	GND
4	NC	+5VDC	7.5VDC
5	SIN- Input	CHA-	SIN
6	SIN+ Input	CHA+	REFSIN
7	SIN- Output	CHZ-	DATA + (RS485)
8	SIN+ Output	CHZ+	DATA - (RS485)
9	Shield	Shield	Shield
10	NC	HALL V	NC
11	GND	GND	GND
12	NC	NC	7.5VDC
13	NC	NC	NC
14	COS+ Input	CHB-	COS
15	COS- Input	CHB+	REFCOS
CASE	Shield	Shield	Shield

4.6 X6 USB

Standard plug USB MiniB

4.7 X7 I/O

Counterpart Type: DSUB 15-poles HD female (Brunner-Elektronik: Nr. DSU.S15Y.0001)

Pin #	Designation	Function
1	+24V	Control Power Supply Input
2	IN1	Input1
3	IN2	Input2
4	IN3	Input3
5	IN4	Input4
6	IN5	Input5
7	IN6	Input6
8	IN7	Input7
9	IN8	Input8
10	OUT1	Output1
11	OUT2	Output2
12	OUT3	Output3
13	ANIN1+	Analogue Input
14	GND	GND
15	GND	GND
Geh.	Earth	Earth

4.8 X8 / X9 EtherCAT or CAN

Use an RJ45 Cat5 cable.

EtherCAT: X8=Port0 / X9 Port1

Pin #	Designation	Function
1	TX+	Transmit Data +
2	TX-	Transmit Data -
3	RX+	Receive Data+
6	RX-	Receive Data-

CAN

Pin #	Designation	Function
1	CAN H	Can High Level
2	CAN L	Can Low Level
3 / 7	GND/CAN	Earth
4	X4-X5	Connected internally
5	X4-X5	Connected internally
6	X4-X5	Connected internally
8	NC	Not connected
8	GND	GND

4.9 Push Button

Load default values: Push the button for more than 4 seconds during operation
Firmware update: Push the button when switching the supply on

4.9.1 L1 Status LED

LED on: Hardware not initialised
LED off: Hardware error (switch supply off/on)
LED on>3s: Hardware error (switch supply off/on)
LED flashes 1Hz: Hardware runs, no error
LED flashes 5Hz: Hardware runs, error
This LED is connected to CPU1 Safety Master

4.9.2 L2 Safety Active LED

LED on: Safety enabled (any STO, SS1, SBC, SLS)
LED off: No Safety
This LED is connected to CPU1 Safety Master

4.9.3 L3 Safety State LED

LED on: Hardware error (switch supply off/on)
LED off: Hardware error (switch supply off/on)
LED @ 1Hz: Safety CPU2 is working normally
LED @ 5Hz: Redundant safety Relay error (the Relay state is internally monitored)
LED 2x short / 1x long: Power supply error (check the connected 24V supply)
This LED is connected to CPU2 Safety Slave

4.9.4 L4 SBC Safe Brake Control LED

LED on: SBC enabled (in STO Mode)
LED off: SBC disabled (if SBC not activated or STO not active)
This LED is connected to CPU2 Safety Slave

4.9.5 L5 SLS Safely Limited Speed LED

LED on: SLS Active (Speed over the Limit)
LED off: SLS not active
This LED is connected to CPU2 Safety Slave

4.9.6 L6 STO / SS1 Safe Torque Off / Safe Stop 1 LED

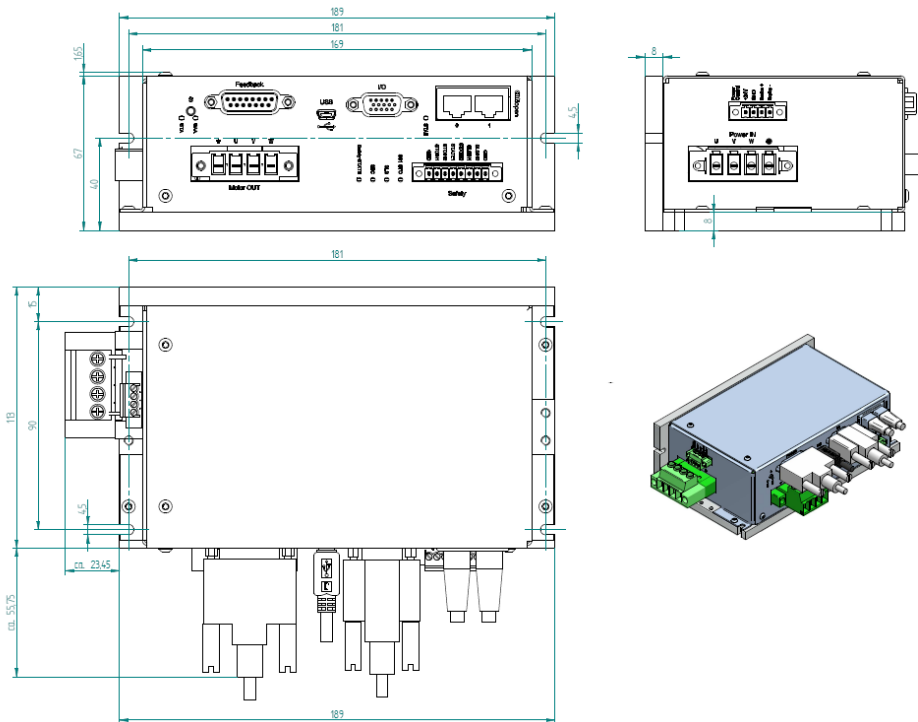
LED on: STO / SS1 Active
LED off: STO / SS1 not active
This LED is connected to CPU2 Safety Slave

4.9.7 L7 EtherCat Status LED

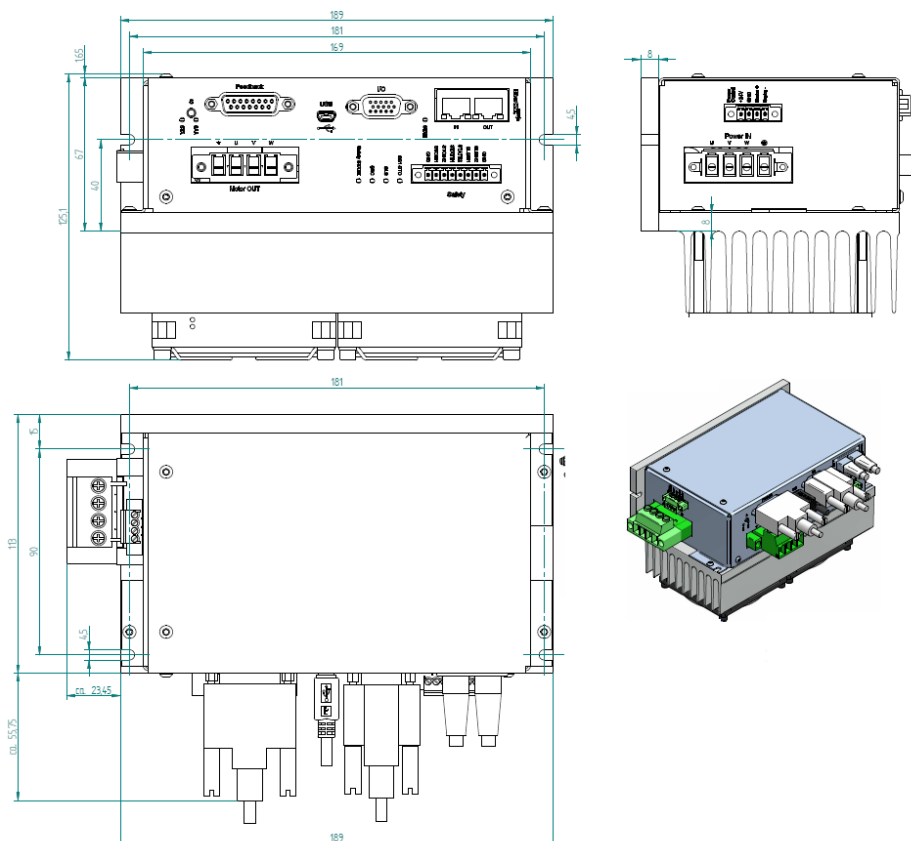
Indicates the status of the EtherCAT State Machine (see EtherCAT Indicator and Labelling Specification ETG.1300). This LED is connected to the EtherCat controller

5 Mechanical data

5.1 Outputpower up to 1kW



5.2 Outputpower up to 3.5kW



6 Safety

The safety functions from MDS Drive are implemented redundantly according to EN ISO13849-1.

Two CPUs (DSP), monitor and control the security functions. All 100ms CPU1 (Master) communicate with CPU2 (Slave) and exchange information about safety state and errors. In case of communication breakdown (CPU failure) the STO function is triggered after 2s.

The safety settings are written from CPU1 to CPU2 on the boot up sequence.

The parameterizing in the CPUs is checked by a CRC-8-ATM checksum. If the checksum between the CPUs is not matching, Checksum Error is triggered and the drive switch to STO State.

Parameters such as relay status, power-supply, brake status, are monitored periodically.

In case of a malfunction the STO function is triggered.

Status queries, configuration and fault reset is done via the connected bus (EtherCAT, CAN, USB).

6.1 Safety relevant figure

DCavg: 90%

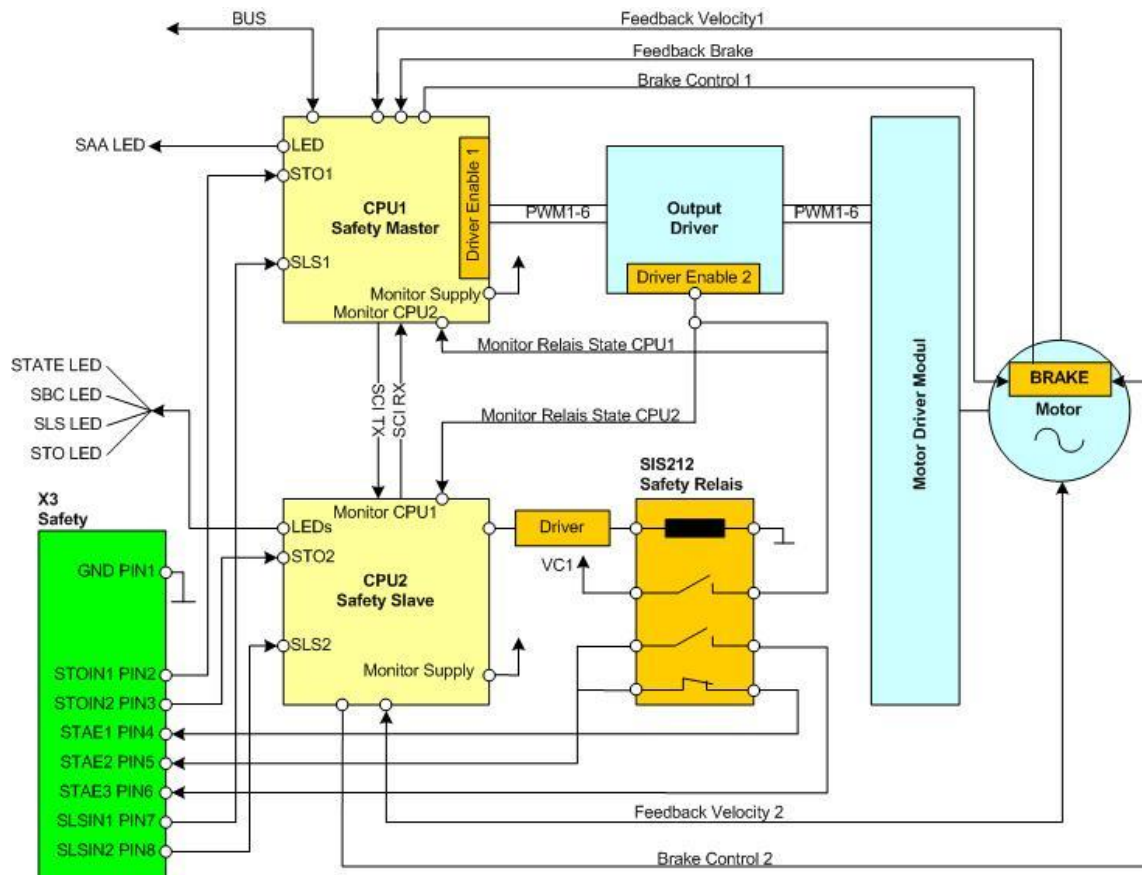
MTTF Safety Channel1 STO 42 years (high)

MTTF Safety Channel2 STO 87 years (high)

MTTF Safety Channel1 SLS 42 years (high)

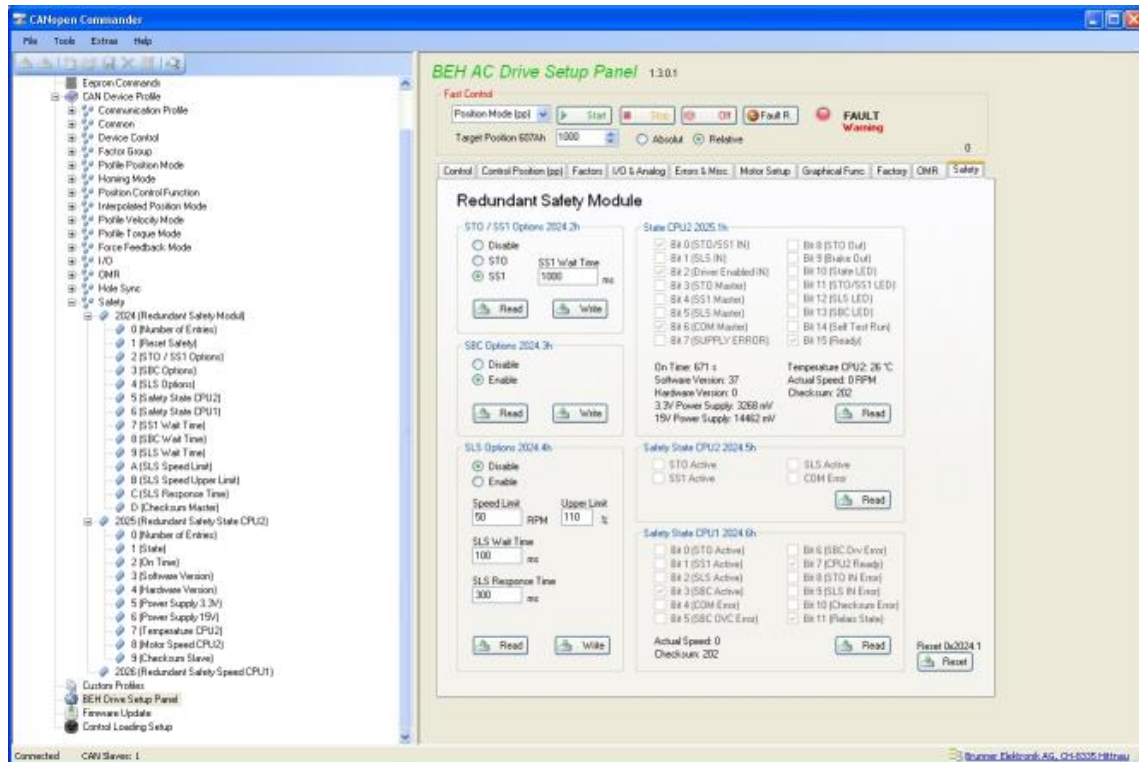
MTTF Safety Channel2 SLS 70 years (high)

6.2 Block Diagram



6.3 Safety Configuration

CANopen Commander BEH Drive Setup Panel



6.3.1 PDO Mapp able Objects Safety

0x2024.1 (16 Bit) Redundant Safety Modul.Reset Safety (Read/Write)

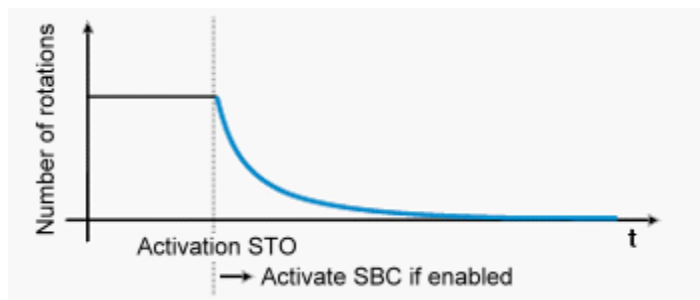
A rising edge reset the safety state

0x2024.6 (16Bit) Redundant Safety Modul.Safety State CPU1 (Read only)

- Bit0 STO Active
- Bit1 SS1 Active
- Bit2 SLS Active
- Bit3 SBC Active
- Bit4 COM Error
- Bit5 SBC OVC Error
- Bit6 SBC DRV Error
- Bit7 CPU2 Ready
- Bit8 STO IN Error
- Bit9 SLS IN Error
- Bit10 Checksum Error
- Bit11 Relay State

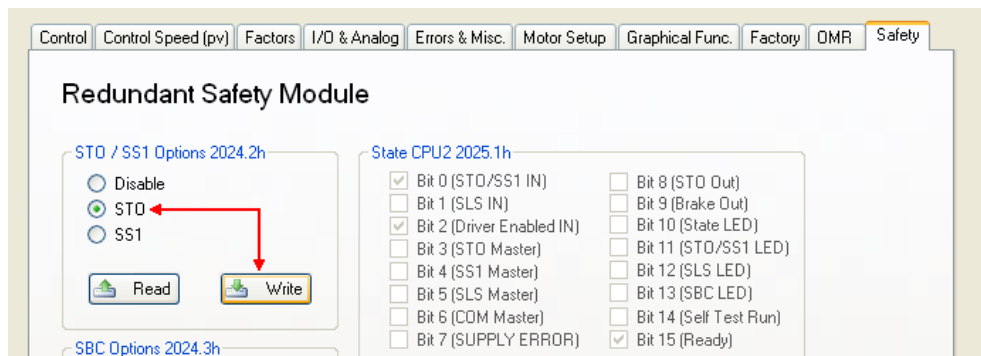
6.3.2 Safe Torque Off (STO)

The STO function is the most common and basic drive-integrated safety function. It ensures that no torque-generating energy can continue to affect a motor and prevents unintentional start-ups



Configuration

- Connect with CANopen Commander and select **BEH Drive Setup Panel**
- Move to **Safety tab**
- Select STO and press **Write** Button
Attention: The drive performs a reset and restart with the new settings
- Test the configuration



STO Truth Table

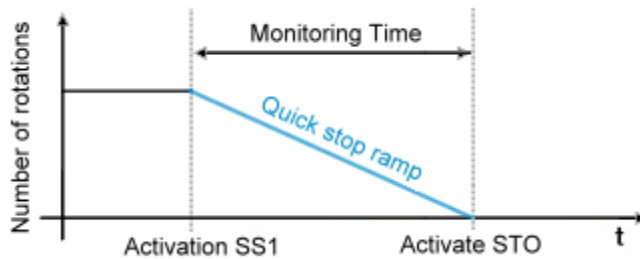
STOIN1	STOIN2	STO/SS1 LED	Description
0	0	Active	STO active No error in STO Function
1	0	Active	STO active The inputs must be equal before 3s otherwise STO Error (0x2024.6 Bit7) Set both inputs to 0 for resetting the error
0	1	Active	STO active The Inputs must be equal before 3s otherwise STO IN Error (0x2024.6 Bit8) Set both inputs to 0 for resetting the error
1	1	Inactive	STO not active No error in STO Function

6.3.3 Safe Stop 1 (SS1)

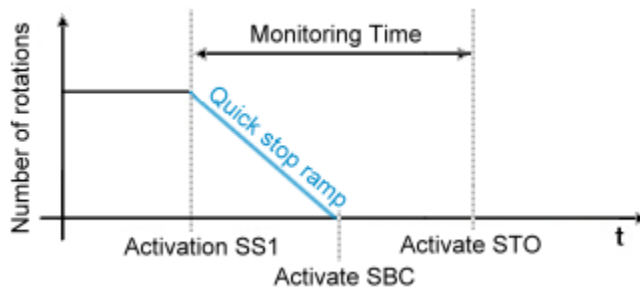
The SS1 function causes a motor to stop rapidly and switches the motor to torque-free mode after the standstill, i.e. STO is activated. This function is time monitored.

If SBC is enabled the brake function is activated after 50% of monitored time. Make sure that the engine stop before 50% of the monitoring time has expired, by configuring a fast enough Quick Stop Ramp (See pictures below)

SS1 without SBC



SS1 with SBC



Monitoring Time = SS1 Wait Time (ms)

Configuration

- Connect with CANopen Commander and select BEH Drive Setup Panel
- Move to Control tab and Option Codes
- Select Halt (605D)
- In Options select Quick stop ramp

The screenshot shows the 'Control' tab of the BEH Drive Setup Panel. The 'Option Codes' section is active, displaying a dropdown menu with 'Halt (605Dh)' selected. Below the dropdown, the 'Options' section shows 'Quick stop ramp / Operation Enabled' selected. The 'Statusword 6041h' section shows various status bits, and the 'Controlword 6040h' section shows control bits. The 'Write' button is visible in the 'Controlword 6040h' section.

- Move to Control Mode
- In Ramps set Quick stop deceleration 6085 for SS1 mode and press Write Button

The screenshot shows the 'Control' tab of the BEH Drive Setup Panel. The 'Ramps' section is active, displaying various ramp parameters. The 'Quick stop deceleration 6085h' parameter is set to 50000 mm/s^2. The 'Write' button is visible in the 'Ramps' section.

- Move to Safety tab and STO / SS1 Options
- Select SS1
- Set SS1 Wait Time and press Write Button
- Attention: The drive performs a reset and restart with the new settings
- Test the configuration

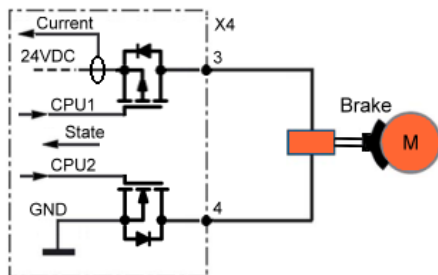
The screenshot shows the 'Safety' tab of the BEH Drive Setup Panel. The 'Redundant Safety Module' section is active, displaying various safety options. The 'SS1' option is selected, and the 'SS1 Wait Time' is set to 2000 ms. The 'Write' button is visible in the 'Redundant Safety Module' section.

SS1 Truth Table

STOIN1	STOIN2	STO/SS1 LED	Description
0	0	Active	SS1 active / after SS1 Wait Time STO active No error in STO Function
1	0	Active	SS1 active / after SS1 Wait Time STO active The inputs must be equal before 3s otherwise STO Error (0x2024.6 Bit7) Set both inputs to 0 for resetting the error
0	1	Active	SS1 active / after SS1 Wait Time STO active The Inputs must be equal before 3s otherwise STO IN Error (0x2024.6 Bit8) Set both inputs to 0 for resetting the error
1	1	Inactive	SS1 not active No error in STO Function

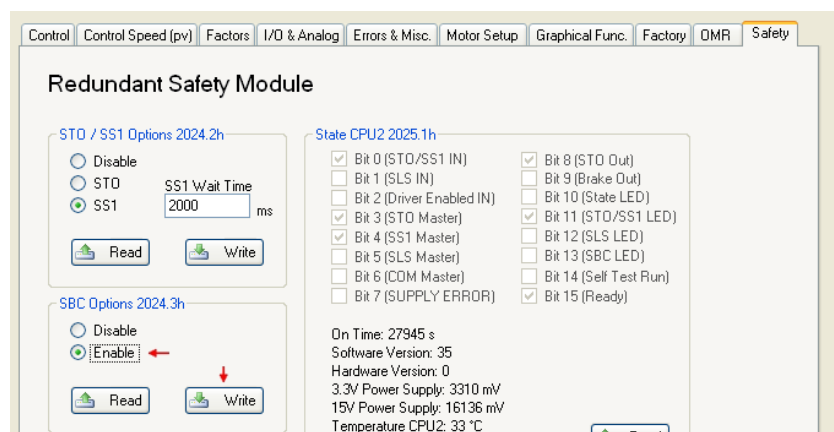
6.3.4 Safe Brake Control (SBC)

The SBC function permits the safe control of a holding brake. SBC is activated parallel with the functions STO or SS1. The holding brake which is active in a de-energized state is controlled and monitored using two-channel driver. An Error in the driver circuit is detected by the state. An over current error (short circuit) is detected by measuring the current.



Configuration

- Connect with CANopen Commander and select **BEH Drive Setup Panel**
- Move to **Safety tab** and **SBC Options 2024.3**
- Select **Enable** and press **Write** Button
Attention: The drive performs a reset and restart with the new settings
- Test the configuration



Errors SBC

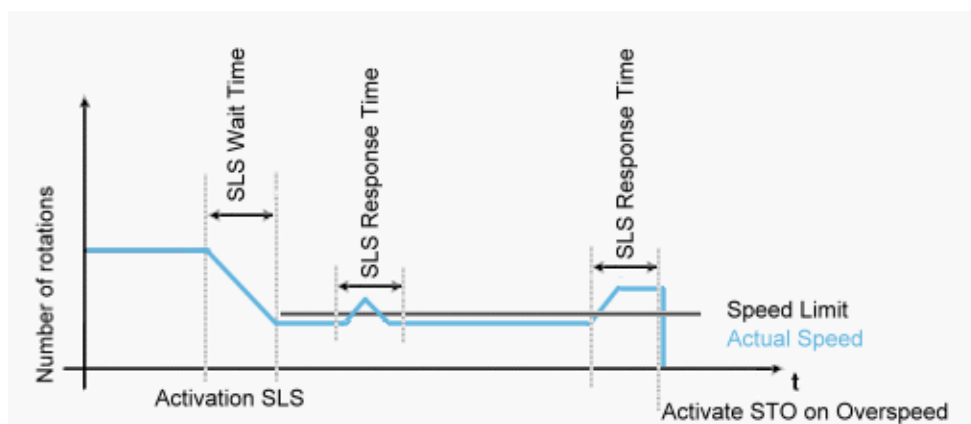
Read Object Safety State CPU1 0x2024.6 (PDO Mapping)
 Bit 5: SBC Current Error (Resolve error and restart power supply)
 Bit 6: SBC Driver Error (Resolve error and restart power supply)

6.3.5 Safely Limited Speed (SLS)

The SLS function prevents the drive to exceed a specified speed. If the speed limit is exceeded the motor driver is disabled and SLS State activated. If SLS monitoring is activated the speed is automatically reduced to the Speed Limit with the Profile Deceleration Ramp. The motor can be operated in positive and negative direction within the speed limit.

Exceptions:

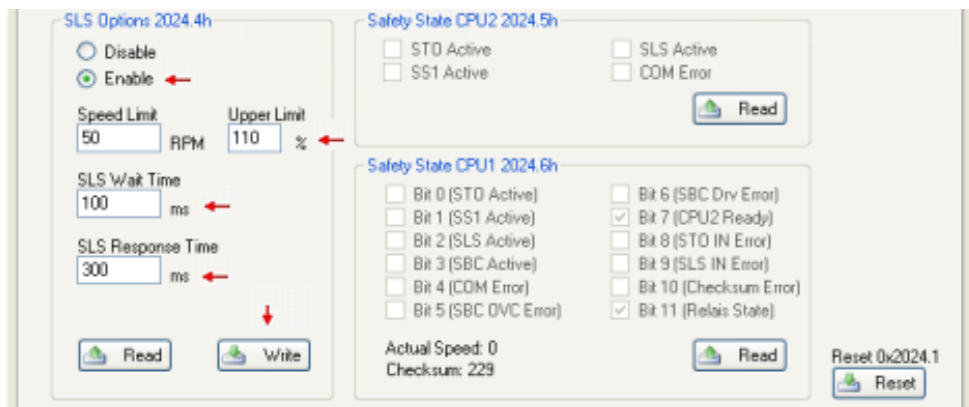
- Interpolated Position Mode (IP): The master is responsible to reduce the speed to the limit
- Profile Position Mode (Move Curves Mode): The master is responsible to reduce the speed to the limit
- Force Feedback Mode (FF): Motor stop if SLS is activated
- Torque Profile Mode (TP): Motor stop if SLS is activated



Configuration

- Connect with CANopen Commander and select BEH Drive Setup Panel
- Move to Safety tab and SLS Options 2024.4
- Select Enable
- Adjust Parameters (Speed Limit / Upper Limit / SLS Wait Time / SLS Response Time)
- Press Write Button

Attention: The drive performs a reset and restart with the new settings



SLS Options 2024.4h

☐ Disable
☒ Enable

Speed Limit: 50 RPM
Upper Limit: 110 %

SLS Wait Time: 100 ms
SLS Response Time: 300 ms

Safety State CPU2 2024.5h

☐ STO Active
☐ SS1 Active
☐ SLS Active
☐ COM Error

Safety State CPU1 2024.6h

Bit 0 (STO Active)
Bit 1 (SS1 Active)
Bit 2 (SLS Active)
Bit 3 (SBC Active)
Bit 4 (COM Error)
Bit 5 (SBC OVC Error)
Bit 6 (SBC Drv Error)
Bit 7 (CPU2 Ready)
Bit 8 (STO IN Error)
Bit 9 (SLS IN Error)
Bit 10 (Checksum Error)
Bit 11 (Relais State)

Actual Speed: 0
Checksum: 229

SLS Parameters

Speed Limit:

The speed Limit is calculated by following parameters and formula

0x2024.4= Speed Limit (max. 2000 RPM / min. 15 RPM)

0x2024.5= Upper Limit (Tolerance)

Max Speed Limit = (Speed Limit x Upper Limit) / 100

SLS Wait Time:

After activation of SLS, and expiration of the "SLS Wait Time" speed monitoring is started

SLS Response Time:

If the actual speed is longer then "SLS Response Time" over the Max Speed Limit, STO is triggered

SLS Truth Table:

SLSIN1	SLSIN2	SLS LED	Description
0	0	Inactive	SLS monitoring active
1	0	Inactive	SLS monitoring active The inputs must be equal before 3s otherwise SLS IN Error (0x2024.6 Bit9) Set both inputs to 0 for resetting the error
0	1	Inactive	SLS monitoring active The inputs must be equal before 3s otherwise SLS IN Error (0x2024.6 Bit9) Set both inputs to 0 for resetting the error
1	1	Inactive	SLS not active

In case of an over speed SLS LED is activated

6.3.6 Safety Reset

The reset of the Safety State (STO / SS1 / SLS) is done by a write command to the Object 0x2024.1. A rising edge (0 to 1) clears the Safety State

Conditions for Reset:

In STO/SS1 State: STOIN1 & STOIN2 = activated

In SLS State: SLSIN1 & SLSIN2 = activated

No Safety Errors active

6.3.7 Safety Faults

Fault	Object	State	Action	Description
Communication Error	0x2024.6 Bit4	STO	Safety Reset or Power off/on	Communications between the CPUs has been interrupted
SBC OVC Error	0x2024.6 Bit5	STO	Power off/on	Overcurrent Brake-Output
SBC Driver Error	0x2024.6 Bit6	STO	Power off/on	Error of 1 brake driver (Signs of a hardware defect)
STO IN Error	0x2024.6 Bit8	STO	Fault Reset CMD & Safety Reset	The safety inputs (STOIN1 & STOIN2) has switch in the wrong manner
SLS IN Error	0x2024.6 Bit9	STO	Fault Reset CMD & Safety Reset	The safety inputs (SLSIN1 & SLSIN2) has switch in the wrong manner
Checksum Error	0x2024.6 Bit10	STO	Power off/on	The checksum in CPU1 and CPU2 does not match

7 Communication

7.1 CAN interface

The CAN bus is provided for the communication with the device. 11bit identifiers are used, 29bit identifiers are not supported. The default bit rate is set to 1000kbit.

Each device has 2 CAN connectors which means that no T-fitting is necessary.

The CAN interface conforms to the CAN bus specification 2.0 or to the standard ISO 11898

7.2 EtherCAT interface

This device is an EtherCAT slave according to the "EtherCAT Slave Device Description".

The specific features of the EtherCAT bus and the data exchange are not described here. You can find further information on this on the EtherCAT Technology Group website www.ethercat.org.

7.3 EtherCAT-specific communication

This communication is described in the EtherCAT specifications. The supported scope of operation is specified in the file Device Description (.XML). CANopen over EtherCAT (COE) is used as the transmission protocol whereas SDO, PDO and EMCY frames are supported.

7.4 USB interface

The USB interface is realised with an FT232R USB to RS232 converter. Therefore, a driver has to be installed on the PC which provides a (virtual) RS232. The communication is carried out via the BEP2 protocol (CANopen over BEP2) (see description BEP2_Protokoll_Manual.pdf).

8 Installation

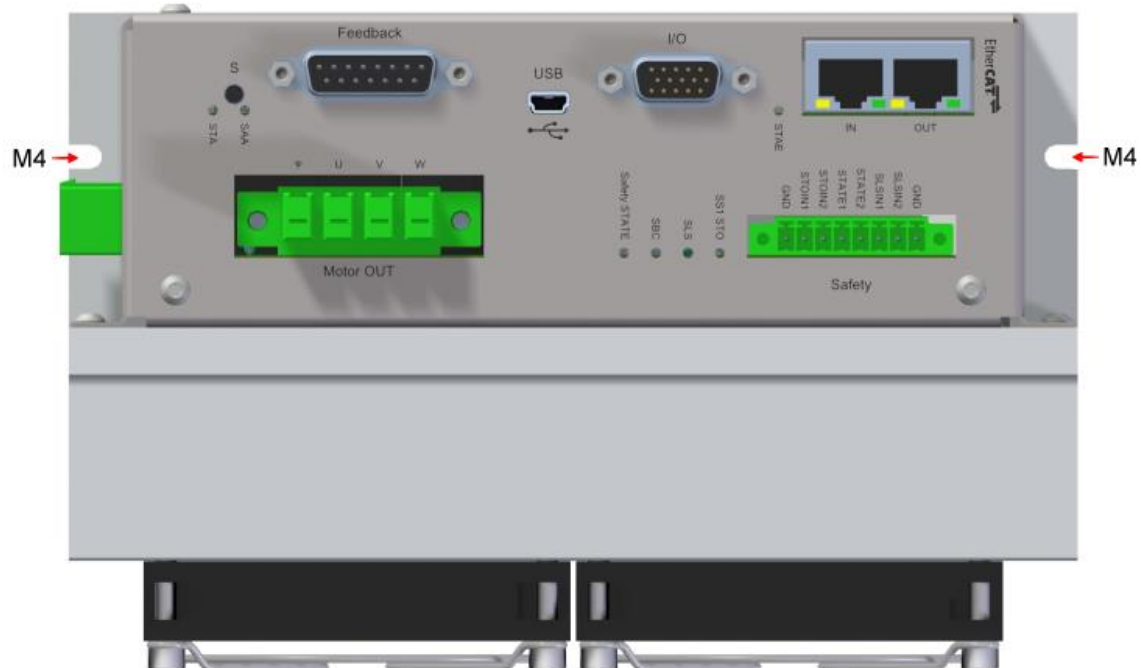
8.1 Assembly

8.1.1 With Cooling Plate (-1kW)



Mounting the device with 4 M4 screw to a plane surface (cooling element) with the cooler plate.

8.1.2 With Cooler (3.5kW - 5kW)



Mounting the device with 2 M4 screw to a plane surface.

8.2 Electrical installation

8.2.1 Important information

Installation work may only be carried out when the system is free from tension and has been secured against accidental restarting.

The maximum admissible nominal voltage at the connections of X1 may not be exceeded!

($U_{In_max} = 400 \text{ VAC} + 15 \%$)

The AC supply as well as the 24V control voltage is secured externally by the user. The servo amplifier and the connected engine have to be earthed adequately.

The earth wire has to have at least the same cross-section as the supply lines. The devices should be screwed on a metallic, conductive (not coated) assembly plate.

8.2.2 EMC-compatible installation

An adequate radio interference filter (Schaffner FN354 – 6 / 05) has to be installed at the machine's power input and shielded wires have to be used. Relays, air gap switches, electromagnetic valves, etc. installed in the system have to be connected with overvoltage limiting components. Power and engine lines have to be installed separately from the control lines.

8.2.3 Operation with earth leakage circuit breakers

In the case of a fault to frame via the internal mains rectifier of a servo amplifier, the leakage direct current can block the protective function of an earth leakage circuit breaker sensitive to alternating current and/or pulsed current. Leakage direct currents create a magnetic bias of the transformer core in the earth leakage circuit breaker and therefore increase the response threshold for leakage alternating currents.

Depending on the application, we therefore recommend the use of the following earth leakage circuit breakers in order to comply with the standard DIN EN 61800-5-1:

Earth leakage circuit breaker sensitive to pulsed current (type A)

A leakage current which is too high can also inadvertently trigger the earth leakage circuit breaker in a faultless condition.

High leakage currents can be caused by the following:

- Capacitive equalising currents through the shielding in the case of very long engine lines
- Simultaneous connection of several servo amplifiers
- Use of noise filters with high leakage current

Please note: The earth leakage current of the MDS Drive might exceed 3.5mA.

Measures for reducing leakage currents:

- Avoiding the asymmetrical load of the phases; several single-phase operated devices should be distributed evenly to the three phases.
- Keeping the shielded engine lines as short as possible
- Not switching on all devices at the same time in systems with several servo amplifiers.

8.2.4 Operation

8.2.5 Starter kit

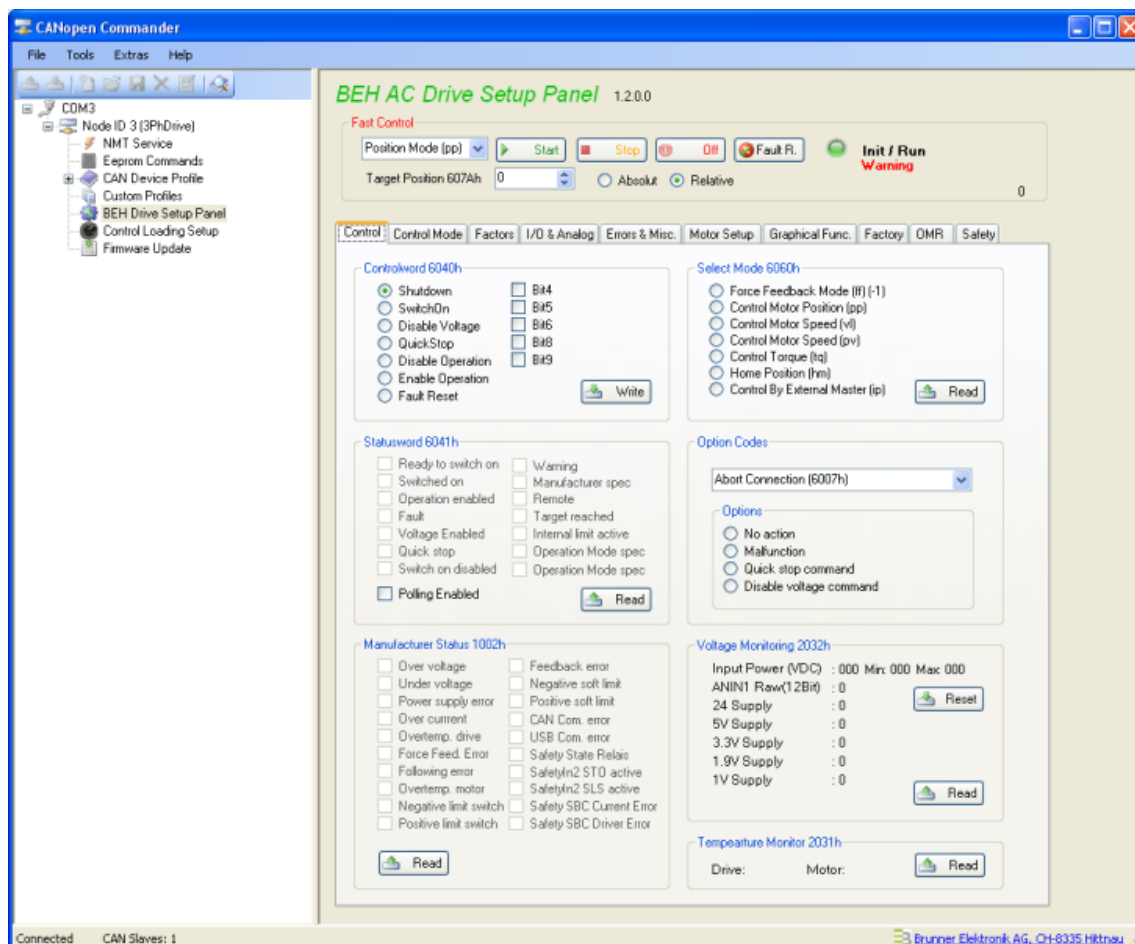
- USB cable
- MDS Drive with engine
- Power cable
- 24VDC Power supply
- PC with CANopen Commander & BEH Drive Setup Panel plug-in

8.2.6 First steps

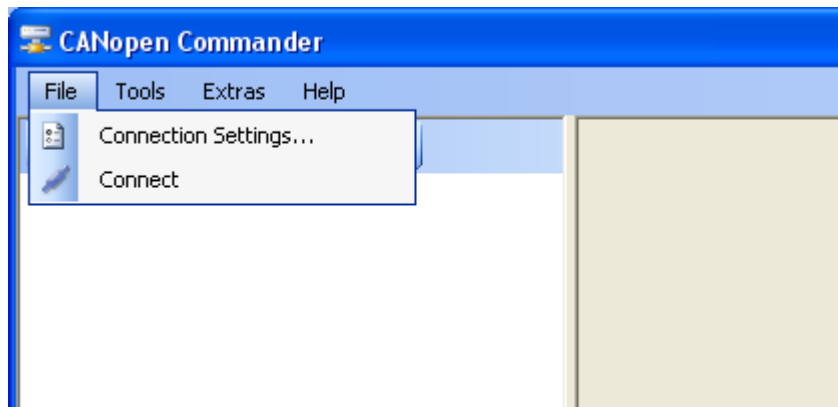
- Connect the drive with the USB cable to the PC
- Install / connect the engine
- Connect the power cable / turn the device on
- Start CANopen Commander

8.3 CANopen Commander

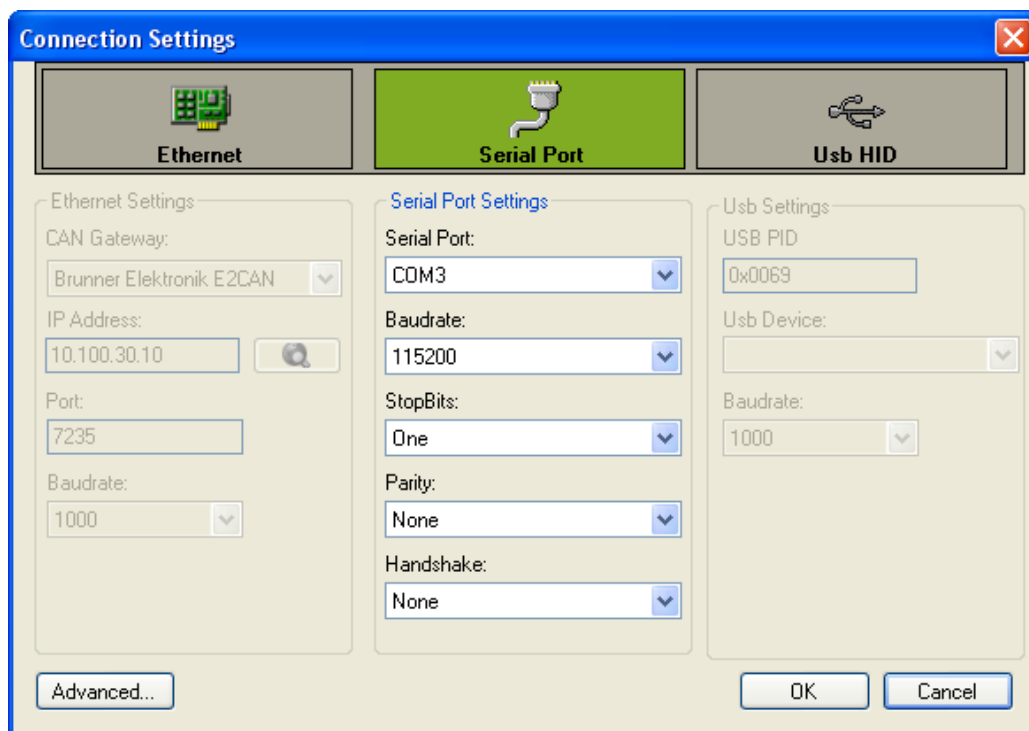
The Software CANopen Commander is a high-capacity application which enables the configuration of complex CANopen devices. Several device-specific plug-ins are available which allow for an easy and quick parameter setting. One particular feature is the flexible expandability with optional plug-in modules.



8.3.1 Connecting



Click on "Connection Settings" in the menu "File".



Select "Serial Port" and configure the settings in "Serial Port Settings".

Click on "OK": The settings will be saved in a file. If you leave the dialogue with "Cancel", the settings which you changed here will be lost again.

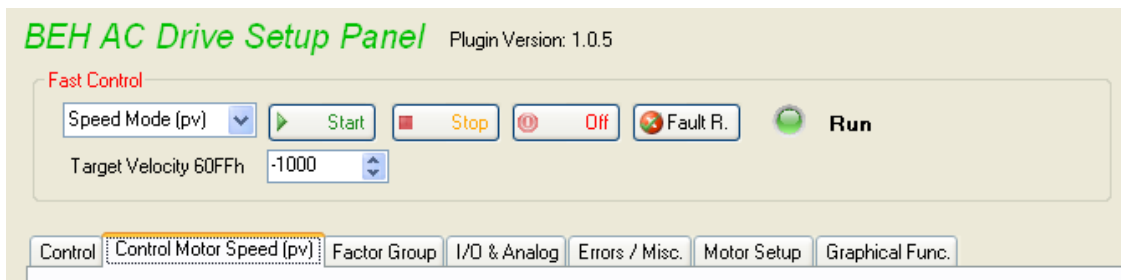
In order to connect to the device, click on "Connect" in the menu "File".

8.3.2 Velocity Mode (turning)



The Velocity Mode controls the speed of the engine. Select the "Speed Mode (pv)" in "Fast Control" in order to change to this mode.

Click on the button "Start" and select the required speed in "Target Velocity 60FFh".



The status indicator changes to "Run" and the engine turns.

Mode-specific parameters can be set in the tab "Control Motor Speed (pv)".

8.3.3 Position Mode (positioning)



The Position Mode starts a stipulated position. Select the "Position Mode (pp)" in "Fast Control" in order to change to this mode.

Select the required positioning mode with "Absolut / Relative" and enter the required position (absolute) or the distance to be run (relative) in "Target Position 607Ah".

Set the positioning speed in the tab "Control Motor Position (pp)".



8.4 Configuration of the EtherCAT interface with "TwinCAT"

For the process control and visualisation for EtherCAT devices, we recommend the operation of the MDS Drive with the PC software "TwinCAT" by the company Beckhoff.

8.4.1 Preparation

- Install TwinCAT with axis interpolation NCI on the operating computer.
- Copy the XML device description AcServoDrive_ESI.xml to ..\TwinCAT\Io\ EtherCAT.
- Start the TwinCAT system manager in the "Config Mode".
- Check and configure the network settings under "Optionen\Liste Echtzeit Ethernet kompatible Geräte" (Options\List Real-Time Ethernet-Compatible Devices).
- Establish a network connection and turn the servo amplifier on.

8.4.2 Project settings

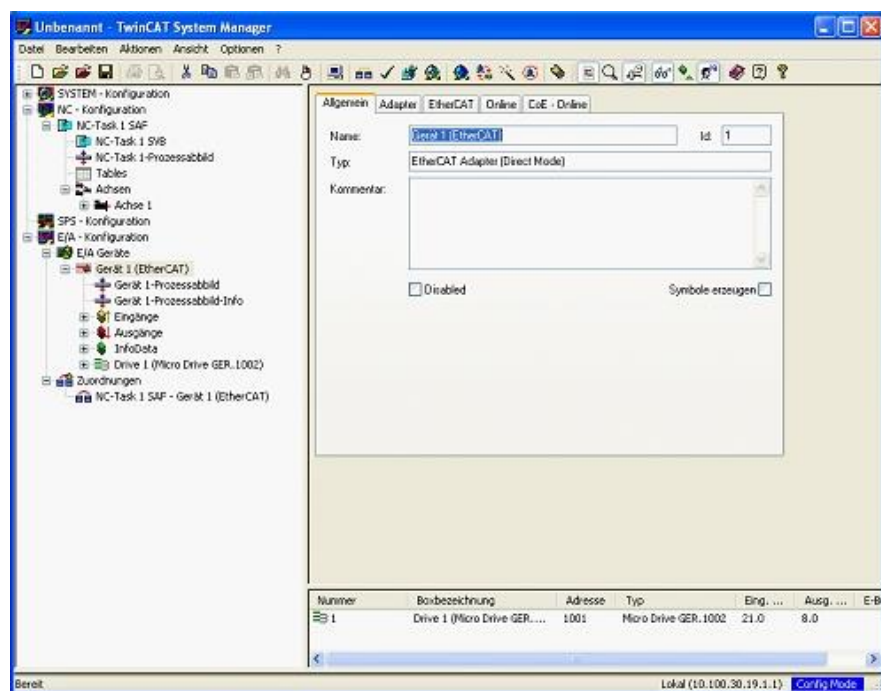
The project settings can be set in two ways: automatically or manually.

8.4.3 Automatic configuration:

- Search for the devices in the selection tree under "E/A Geräte" (I/O Devices) in the context menu (right mouse button) and select EtherCAT.
- Acknowledge the inquiry "nach neuen Boxen suchen" (Search for new boxes) with "Ja" (Yes).
- Acknowledge the inquiry "EtherCAT-Antriebe gefunden. Sollen entsprechende NC-Achsen erstellt werden?" (EtherCAT drive found. Should the respective NC axes be established?) with "Ja" (Yes).
- Acknowledge the inquiry "Aktiviere Free Run" (Activating Free Run) with "Nein" (No).

8.4.4 Manual configuration:

- Select "Gerät anfügen" (Add Device) in the selection tree under "E/A Geräte" (I/O Devices) with the context menu (right mouse button).
- Select the "EtherCAT Direct" mode in the displayed window.
- Select "Boxen scannen" (Scan Boxes) in the selection tree under the device name (e.g. "Gerät 1" (Device 1)) with the context menu (right mouse button). -> MDS AC-Servo Drive will be found.



8.4.5 TwinCAT-specific settings

- In the selection tree under "E/A Geräte" (I/O Devices) the sub-items <device name>\<axis name> (MDS AC-Servo Drive). Check the PDO assignment for all AC Servo Drives in the tab "Prozessdaten" (Process Data) and tick the two checkboxes "PDO-Zuordnung" (PDO Assignment) and "PDO-Konfiguration" (PDO Configuration) in "Download".
- The control word and the status word will be assigned by TwinCAT according to the NC axis.
- Link the position actual value with the axis encoder. In order to do this, select the sub-items Achsen\Achse n\Achse n_Enc\Eingänge\Achse n_Enc_In\InData1 (Axes\Axis n\Axis n_Enc\Inputs\Axis n_Enc_In\InData1) in "NC-Konfiguration" (NC Configuration). Click on "**Verknüpft m.**" (**Links w.**) in the displayed window, select the value "Position actual value" of the assigned servo amplifier in the window "Variablenverknüpfung für Achse n (MDS AC-Servo Drive)" (Variables connection for axis n (MDS AC-Servo Drive)) and confirm it with "OK".
- Link the position target value with the axis n_Drive. In order to do this, select the sub-items Achsen\Achse n\Achse n_Drive\Ausgänge\Achse n_Drive_Out\OutData1 (Axes\Axis n\Axis n_Drive\Outputs\Axis n_Drive_Out\OutData1) in the selection tree under "NC-Konfiguration" (NC Configuration). Click on "**Verknüpft m.**" (**Links w.**) in the displayed window, select the value "Interpolation data X1" of the assigned servo amplifier in the window "Variablenverknüpfung für Achse n (MDS AC-Servo Drive)" (Variables connection for axis n (MDS AC-Servo Drive)) and confirm it with "OK".
- Select the unit of measurement according to the used measuring system (mm, degree, etc.) in the selection tree under "Achse n" (Axis n) in the tab "Einstellungen" (Settings).

8.4.6 Configuration MDS Drive

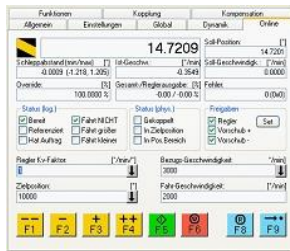
Set the drive-specific SDOs. We recommend to carry out this setting in the tab "Startup" in order to save it permanently in the project.

- Select the sub-items <device name>\<axis name> (MDS AC-Servo Drive) in the selection tree under "E/A Geräte" (I/O Devices). In order to do this, click on "**Neu**" (**New**) in the displayed window and add the following object-specific parameters:
- Set the cycle time (60C2 Interpolation time period) in the servo amplifier (see CanOpen_Programmers_Manual.pdf).
The time to be set can be found in the selection tree under "NC Task nSAF" in the tab "Task Zyklusticks" (Task Cycle Ticks).
- Set the operation mode 7 for the interpolating mode, set (Modes of operation) 0x6060.00 to 07.

8.4.7 Turning on the axis and set application-specific settings

- Select the item "Aktiviert Konfiguration" (Activates Configuration) in the menu bar under "Aktionen" (Actions). Acknowledge the following three inquiries with "Ja" (Yes) or "OK". TwinCAT is now in the "Run Mode".
- Adjust the encoder resolution in the selection tree under "Achse n_Enc" (Axis n_Enc) in the tab "Global" under "Skalierungsfaktor" (Scaling Factor). For instance for rotating systems, the scaling factor is calculated from the division $360^\circ / \text{encoder increments per revolution}$. Click on "Download" when you have entered the factor.
- Adjust the speed as well as other application-specific parameters, such as the contouring error for manual procedures, in the selection tree under "Achse n" (Axis n) in the tab "Global". Click every time on "Download" when you have entered a parameter.

8.4.8 Manual and NC-controlled drive



The following operating steps in TwinCAT are necessary in order to actuate the axis/axes:

- Select the tab "Online" in the selection tree under "NC-Task 1 SAF\Achsen\Achse n" (NC task 1 SAF\Axes\Axis n), select all checkboxes in the group field "Freigaben" (Releases) by clicking on "Set" and set "Override" to 100%.
- The axis can now be moved with the control buttons.

9 Order information / accessories

9.1 Order information

Number	Article	Specification
GER.1066.0.0.0.0.0.0.0	MDS Drive	0 = CAN 0 = Resolver 0 = No safety 0 = No encoder output 0 = No braking resistor 0 = Output power up to 1kW 0 = 3 x 380VAC Input
(0.0.0.0.0.0.0 = order key)		

9.1.1 Order Options

Option 1 Communication

- 0 = CAN (CANopen)
- 1 = EtherCAT (CoE)

Option 2 Feedback System

- 0 = Resolver SIN/COS (max 16Bit)
- 1 = Incremental Encoder
- 2 = HIPERFACE®

Option 3 Safety

- 0 = NO
- 1 = STO / SS1 / SBC
- 2 = STO / SS1 / SBC / SLS

Option 3 Encoder Output

- 0 = No
- 1 = Yes

Option 4 Braking Resistor

- 0 = No
- 1 = Yes

Option 5 Power range

- 0 = Output power up to 1kW (No Cooler)
- 1 = Output power up to 3.5kW (Standard Cooler)
- 2 = Output power up to 5kW (High Performance Cooler)

Option 6 Input Voltage

- 0 = Up to 3x 380VAC
- 1 = Up to 700VDC