WITTENSTEIN | cyber motor

cyber® simco® drive
SIM2002D, SIM2010D, SIM2015D

Operation Manual

4022-D033499

Revision: 13

Revision history

Revision	Date	Comment	Chapter
01	17.10.2013	New version	All
02	10.06.2014	IP20 variant inserted	All
03	15.12.2014	General review	All
04	02.03.2015	General review	All
05	21.01.2016	General review, STO safety function expanded, power supply requirements expanded	All
06	01.06.2016	SIM2015D variant inserted	All
07	22.08.2016	Ethernet/IP variant inserted	All
08	22.03.2016	WCM EN ISO 13849-1:2015	All 2
09	19.06.2017	Supporthotline; Risk Assessment Conformity with UL; Ventilation / Cooling IP20	All; 7 2; 5
10	17.04.2018	General Revision	All
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13	30.03.2022	cTÜVus approval	2.1.2, 3.1, 6.5.2

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Contents

1 About this manual

This manual contains necessary information to safely use the **cyber® simco® drive** amplifier, hereinafter referred to as the drive amplifier.
The operator must ensure that this operating manual is read through by all persons assigned to install, operate, or maintain the drive amplifier, and that they fully comprehend them.
Store these instructions within reach of the drive amplifier.
Pass the safety instructions on to other persons as well.
The original manual was created in German; all other language versions are translations of these instructions.

1.1 Signal words

The following signal words are used to indicate possible hazards, prohibitions, and important information:

	⚠ DANGER **This signal word indicates an imminent danger that could cause serious injuries and even death.**
	⚠ WARNING **This signal word indicates a potential hazard that could cause serious injuries and even death.**
	⚠ CAUTION **This signal word indicates a potential hazard that could cause minor or serious injuries.**
	NOTICE **This signal word indicates a potential hazard that could lead to property damage.**
	A note without a signal word indicates application hints or especially important information for handling the product.

1.2 Safety symbols

			
General danger	Hot surface	Electric voltage	Electrostatic discharge sensitive component

1.3 Design of the safety instructions

⚠ CAUTION

Explanatory text describes the consequences of not complying with the instructions.

- Instructional text describes directly what to do.

1.4 Information symbols

The following information symbols are used:

- Indicates an action to be performed

➲ Indicates the results of an action

ⓘ Provides additional information on handling

2 Safety

This operating manual, especially the safety instructions, and the rules and regulations valid for the operating site must be observed by all persons working with the drive amplifier.
In addition to the safety instructions in this manual, also observe any (legal and otherwise) applicable environmental and accident prevention rules and regulations (e.g. personal safety equipment).

2.1 Approvals

2.1.1 CE conformity

The drive amplifier was tested in authorized testing laboratories in accordance with the requirements of this documentation. Deviations and non-conformance with requirements in this documentation mean that the drive amplifier may not fulfill statutory requirements under certain circumstances.

The drive amplifier is in conformity with the following directives:

- Machinery Directive (2006/42/EC)
- Electromagnetic compatibility (EMC) (2014/30/EU)
- RoHS Directive (2011/65/EU)

In terms of interference immunity, the drive amplifier fulfills the requirement for the category "second environment" (industrial environment).
In the area of interference emission, the drive amplifier fulfills the requirements for category C3.

NOTICE

- In a residential environment, the drive amplifier may cause radio interference, necessitating interference suppression measures such as an external EMC filter.

2.1.2 Conformity with cTÜVus (NRTL)

This drive amplifier is approved under the TÜV reference number 713225793 and falls under the category Power Conversion Equipment. The following products are approved:

SIM2002D-CCSA-CA00-0000-0000, SIM2002D-CCSA-EC00-0000-0000, SIM2002D-CCSA-PN00-0000-0000, SIM2002D-CCSA-EI00-0000-0000, SIM2002D-CCSA-SC00-0001-0000, SIM2010D-CCSA-CA00-0000-0000, SIM2010D-CCSA-EC00-0000-0000, SIM2010D-CCSA-PN00-0000-0000, SIM2010D-CCSA-EI00-0000-0000, SIM2010D-CCSA-SC00-0001-0000, SIM2015D-CCSA-CA00-0000-0000, SIM2015D-CCSA-EC00-0000-0000, SIM2015D-CCSA-PN00-0000-0000, SIM2015D-CCSA-EI00-0000-0000, SIM2015D-CCSA-SC00-0001-0000.

Explanations:

NRTL: Approval according to standards of the United States in accordance with UL 61800-5-1
Approval according to national Canadian standards in accordance with C22.2 No. 274-13, 1st edition

cTÜVus markings:

- Maximum Altitude: 2000m
- Maximum Surrounding Air Temperature: 40 °C
- These devices are intended to be used in a pollution degree 2 environment
- Use minimum 75 °C copper wire
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes
- For Canada (CSA): Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code, Part I
- Use only UL listed Class G Fuse with a rating of minimum 300 Vdc and max fuse rating of 60 A and an DC interrupt rating of 10 kA or higher, e.g. Bussmann SC-60. Alternately use an UL listed fuse with an lower I^2t rating of 25 kA and an Ip value of 10.5 kA
- Tightening torque for field wiring terminals: 0.5 Nm
- These products are intended for operation within circuits not connected directly to the supply mains (galvanically isolated from the supply, i.e. on transformer secondary)
- This EUT is for use in non-hazardous locations, operated by qualified personell skilled in its use
- This EUT shall be supplied with the specific rated voltages according to the user manual.
- The EUT fulfils the requirements of the tested standards only, if it is supplied with a source that has a prospective short-circuit current of at least 5000 A.
- When installing requirements of test standards and installation guide must be fulfilled
- An overall enclosure (fire protection) must be provided in end use.

2.1.3 Safety conformity (STO) in accordance with the Machinery Directive

The drive amplifier provides a two-channel, functionally safe STO function (**S**afe **T**orque **O**ff). The function disables the firing pulses of the power transistors so that the drive can be switched safely to torque OFF.

The circuit design has been tested and subsequently assessed by TÜV Süd. According to that assessment, the circuit design used for the "Safe Torque Off" safety function in the cyber® simco® drive series of drive amplifiers is suitable for meeting the requirements for SIL 3 in accordance with EN 61508 and category 4 PLe in accordance with EN ISO 13849-1:2015.

The subsystems (drive amplifiers) are fully described in terms of safety by the following characteristics:

Operating mode	EN 13849-1	EN 61508	PFH_D [1/h]
Single-channel	PLd, cat 3	SIL 2	1E-10
Two-channel	PLe, cat 4	SIL 3	1E-10

2.2 EC directive

The drive amplifier is subject to the following EC directive:

- Machinery Directive (2006/42/EC)
- Electromagnetic compatibility (EMC) (2014/30/EU)
- RoHS Directive (2011/65/EU)

Startup is prohibited within the scope of the EC directives until it has been determined that the machine/system in which this drive amplifier is installed corresponds to the regulations within these directives.

2.3 Startup

For installation in machines and systems, start of intended use of the drive amplifier is prohibited until it has been determined that the machine or system complies with the provisions of the EC Machinery Directive 2006/42/EC and the EC EMC Directive 2014/30/EU. For use in residential areas, additional EMC measures are necessary.
It is the responsibility of the manufacturer of the machine or system to ensure that the threshold values, as stipulated by the EMC regulations, are adhered to.

2.4 Dangers

The drive amplifier has been constructed according to current technological standards and accepted safety regulations.
To avoid danger to the operator or damage to the machine, the drive amplifier may be put to use only for its intended usage (see Chapter 2.6 "Intended use") and in a technically flawless and safe state.

2.5 Personnel

Only qualified specialist staff who have read and understood these instructions may carry out work on the drive amplifier.

Information on the drive amplifier, in particular the safety instructions, must be accessible to all persons who work with the drive amplifier.

Qualified technicians are characterized by their education and training in the use of electronic drive technology. They know the relevant standards and accident prevention regulations for drive technology and can evaluate its use. Potential hazards are recognized immediately. The local regulations (ICE, VDE, VGB) are known to the technicians and are taken into account during their work.

In case of ambiguities and functions that are not described or not sufficiently described in the documentation, the manufacturer or retailer must be contacted.

2.6 Intended use

The drive amplifiers are intended for operation of permanent magnet EC synchronous servo motors with compatible feedback systems in stationary machines and systems.

Other uses must first be approved by the manufacturer.

Installation of the drive amplifiers is only permitted in stationary electrical cabinets or stationary machine frames. They are used in industrial environments. For use in residential areas, additional EMC measures are necessary. The user must prepare a hazard analysis of the final product.

2.7 Improper use

The drive amplifiers are not suitable for operation of motors other than EC synchronous servo motors or motors with non-compatible feedback systems.
In addition, the following applications are excepted from intended use:

- Life-sustaining medical devices
- Applications in explosive areas
- Use in nuclear plants
- Use in airplanes

2.8 Risks

The manufacturer must strive to reduce residual risks associated with the drive amplifier as much as possible using appropriate measures. Nonetheless, known residual risks must be taken into account for the risk assessment of machines and systems.

2.8.1 Prohibited movements

Prohibited movements can be caused by:

- The failure or shut-down of safety monitoring
- Software fault in associated controllers or bus systems
- Error during parameterization
- Wiring fault
- Limited reaction time of the controller
- Operation outside of the specifications
- Electromagnetic interference, lightning strike
- Component failure

2.8.2 Dangerous temperatures

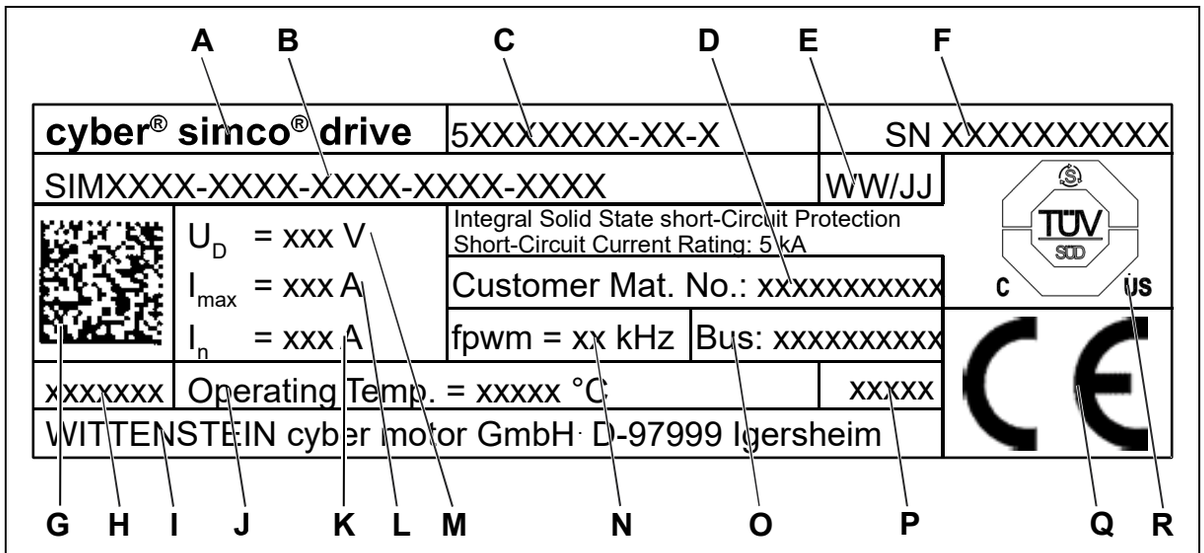
Dangerous temperatures on the surface of the device can be caused by:

- Faulty installation
- Incorrect installation site
- Faulty electrical protection
- Conductive pollution, condensation

3 Description of the cyber® simco® drive

3.1 Identification of the drive amplifier

The identification plate is fitted on the side or the front of the drive amplifier.

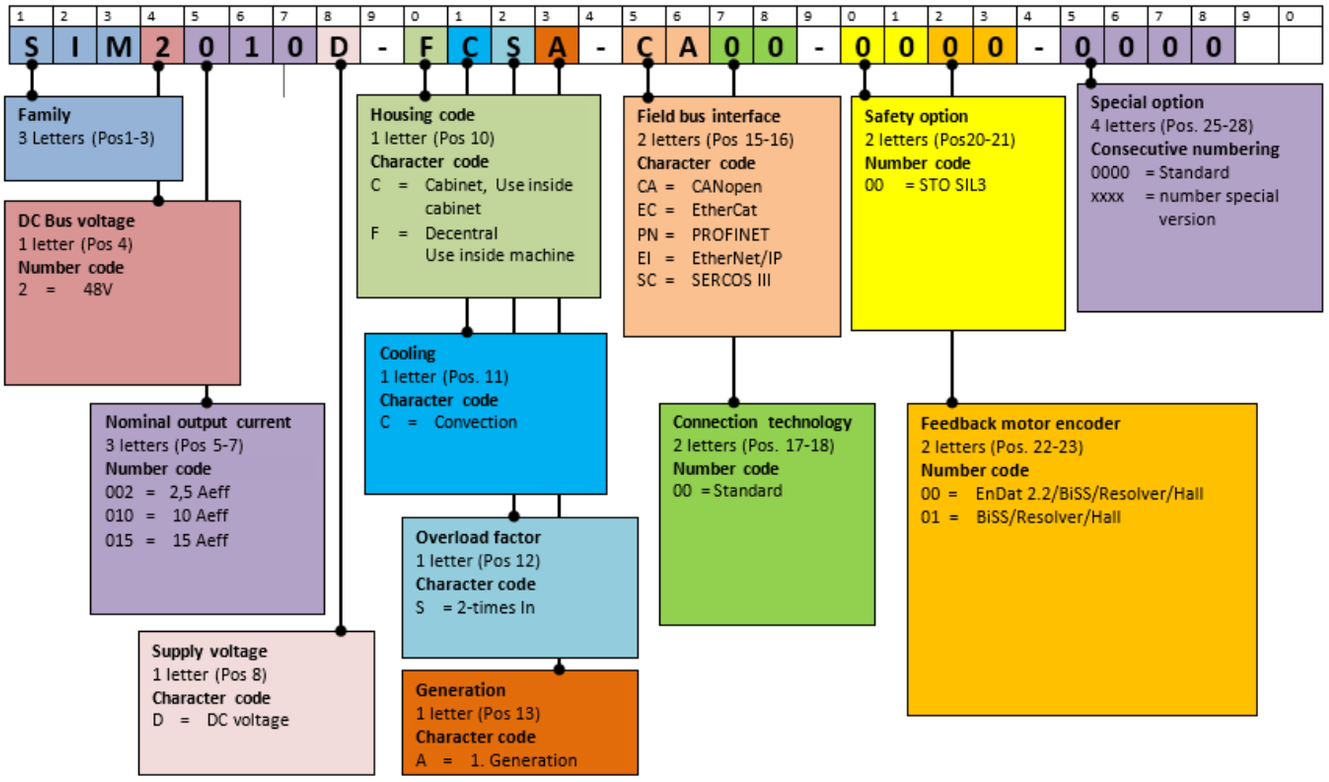


	Designation		Designation
A	Product designation	J	Permissible ambient temperature
B	Type code	K	Rated current I_n
C	Material number	L	Maximum current I_{max}
D	Customer material number	M	Intermediate circuit voltage U_D
E	Calendar week and year of production	N	PWM frequency
F	Serial number	O	Bus interface
G	Data-Matrix-Code (DMC)	P	Protection class
H	Flux-Code	Q	CE mark
I	Manufacturer	R	cTÜVus marking (optional)

Tabelle 3.1: Identification plate (sample values)

3.2 Code

Using the following code, the properties of the drive amplifier can be determined.



3.3 Electrical data

Electrical data	Unit	SIM2002D	SIM2010D	SIM2015D
Nominal supply voltage, intermediate circuit	V DC	48	48	48
Nominal power	W	125	500	750
Maximum intermediate voltage	V DC	16.. 56	16.. 56	16.. 56
Logic power supply	V DC	24 ± 10%	24 ± 10%	24 ± 10%
Current consumption logic supply	mA DC	< 250	< 250	< 250
Nominal output current of drive	Arms	2,5[1]	10[1]	15[1]
Peak output current of the drive	Arms	5	20	30
Switching frequency of the drive	kHz	8 .. 32	8 .. 32	8 .. 32
Electrical rotary field frequency	Hz	0 .. 1000	0 .. 1000	0 .. 1000

[1] The nominal output current of the output stage is achieved at the installation positions described in chapter 5 and a PWM frequency of 8 kHz. The nominal output current may reduce considerably in the case of other mounting positions or PWM frequencies.

3.4 Description of the cyber® simco® drive series

WITTENSTEIN cyber® simco® drive is an intelligent drive amplifier series for sine-commutated servo motors with a continuous power of up to 750 W and peak output of up to 1.5 kW.
The different types of housing in the cyber® simco® drive series allow for a high degree of flexibility in installation.
The housing with protection class IP65 enables decentralized assembly, so that the drive technology can be integrated modularly and flexibly in the machine structure, reducing wiring. The drive amplifier with protection class IP20 on the other hand is designed for central installation in the control cabinet.
Depending on the device version, CANopen/DS402, EtherCAT with CoE, PROFINET RT / IRT, Ethernet/IP IO or SERCOS III with FSP Drive are available as communication interfaces.
The intelligence is reflected in the wide range of encoder interfaces, such as ENDAT 2.2, BISS C or Resolver, high resolution current regulation and event logging with real-time clock.
Intuitive startup and diagnosis is possible using a PC-based, graphic user interface.

3.4.1 Integrated safety

- Comprehensive diagnostic functions to protect the drive amplifier, such as overvoltage, overcurrent, short circuit or ground fault.
- Temperature monitoring of the drive amplifier, motor and optionally the gearhead.

3.4.2 Digital control

- Digital d-q current controller (PI) with a sampling rate of up to 32 kHz
- Digital position and speed controller (PI) with a sampling rate of 8 kHz
- Feed forward control of speed and current possible
- Adjustable pulse width modulation with a clock rate of 8 .. 32 kHz
- Anti-windup structure for all controllers

3.4.3 Inputs and outputs

- 4 programmable galvanically isolated digital inputs, 24 V
- 2 programmable galvanically isolated digital outputs, 24 V (short-circuit proof)
- Output for controlling a 24 V holding brake

3.4.4 Ambient conditions

- Ambient temperature during operation: 0 ... 45 °C for nominal data; for the cTÜVus compliance to be fulfilled, the ambient temperature during operation must not exceed 40 °C
- Air humidity during operation: Relative humidity < 85%, non-condensing
- Installation altitude: < 1000 m above sea level without affecting performance
- Type of protection: IP65 or IP20 in accordance with EN60529, depending on the product
- For IP20 version, the following applies: Degree of pollution 2 to EN 60204 / EN 50178

3.5 Requirements for cables and wiring

- In general, use high-quality, shielded motor and encoder cables to avoid EMC problems.

Wire type	Maximum length	Capacitance Core to shield
Motor wire	20 m	< 150 pF/m
Encoder line	20 m	< 120 pF/m
Resolver line	20 m	< 120 pF/m

Further requirements regarding cTÜVus compliance are listed in chapter 2.1.2.

3.6 STO safety function

The STO safety function (**S**afe **T**orque **O**ff) is used for safe torque shutdown and to reliably protect drives from restarting. The drive amplifier is fitted with a two-channel STO function as standard in the basic model.

ⓘ Instructions for the STO safety function can be found in the appendix (see Chapter 10 "Instructions for STO safety function").

4 Transport and storage

4.1 Transport

- Transportation only in original packaging by qualified personnel
- Avoid hard impacts and vibrations
- Transport temperature: -20 .. 60 °C, max. 20 K/hour fluctuation
- Transport air humidity: Relative humidity max. 95%, non-condensing
- If the packaging is damaged, check the drive amplifier for visible damage. Contact the responsible shipping company

The drive amplifier contains components that are sensitive to electrostatic charge and can be damaged when handled improperly.

- Ensure proper ESD handling by qualified personnel.

4.2 Packaging

- ESD-compatible box
- Identification: Label attached to the outside of the box

4.3 Storage

- Storage only in ESD-compatible original packaging
- Storage temperature: -20 .. 50 °C, max. 20 K/hour fluctuation
- Air humidity: Relative humidity max. 95%, non-condensing

5 Mechanical installation

5.1 Safety instructions

- For the mechanical installation, the ESD instructions must be observed.
- The drive amplifier (control cabinet version) must be protected from fog, water and penetration of metallic dust in the electrical cabinet.
- The drive amplifier must be checked for mechanical damage before installation. Only install undamaged drive amplifiers.
- During installation in a control cabinet, sufficient ventilation must be provided.
- The operation of drive amplifiers exposed to condensation is not permitted.

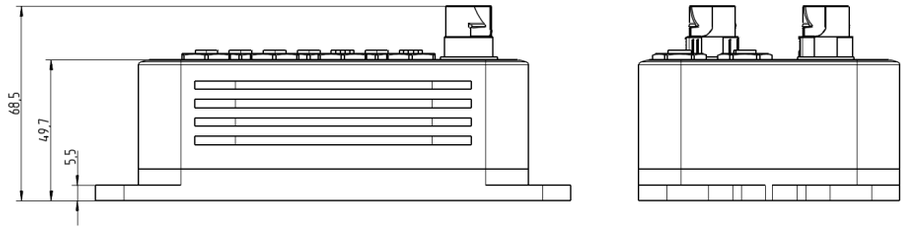
⚠ CAUTION

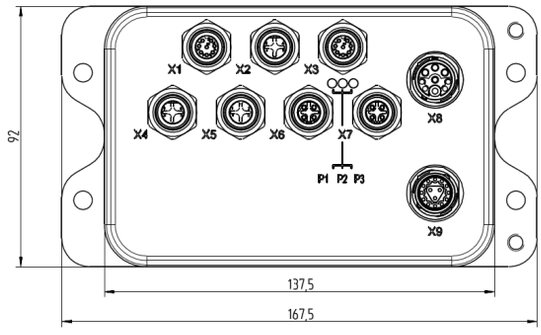
- Installation may only be performed in a de-energized state!
- Systems that are electrically connected must be properly secured so they cannot be switched back on and warning signs must be put up. Assembly may only be performed by trained personnel.

5.2 Device version IP65 decentral SIM20xxD-FC...

5.2.1 Dimensions IP65

Mechanical specifications	
Weight (kg)	0,85
Height [mm]	92
Width [mm]	167,5
Depth without plug [mm]	49,7 / 68,5
Depth with plug [mm]	Approx. 150





5.2.2 Mounting options IP65

Mounting material: 4 cylinder head screws with hexagon socket ISO 4762 - M 6 – 8.8
Required tool: Hex key AF 5
Tightening torques see Chapter 9.1 Tightening torques

5.2.3 Installation space IP65

The installation size must be sufficiently large.
A minimum distance of 25 mm on all sides of the drive amplifier must be provided.

5.2.4 Mounting position IP65

Any mounting position can be selected

5.2.5 Ventilation/cooling IP65

Sufficient convection for cooling of the drive amplifier must be ensured at the installation location.

To avoid overheating, closed installation sites with low volume flow are not suitable for installation of the drive amplifier.

The drive amplifier is to be mounted on a flat, metallic surface.

5.2.6 Environmental conditions for vibration/shock IP65

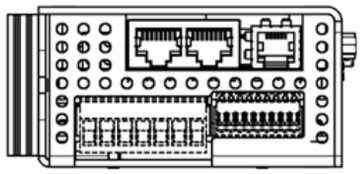
The drive amplifier fulfills the following specifications:

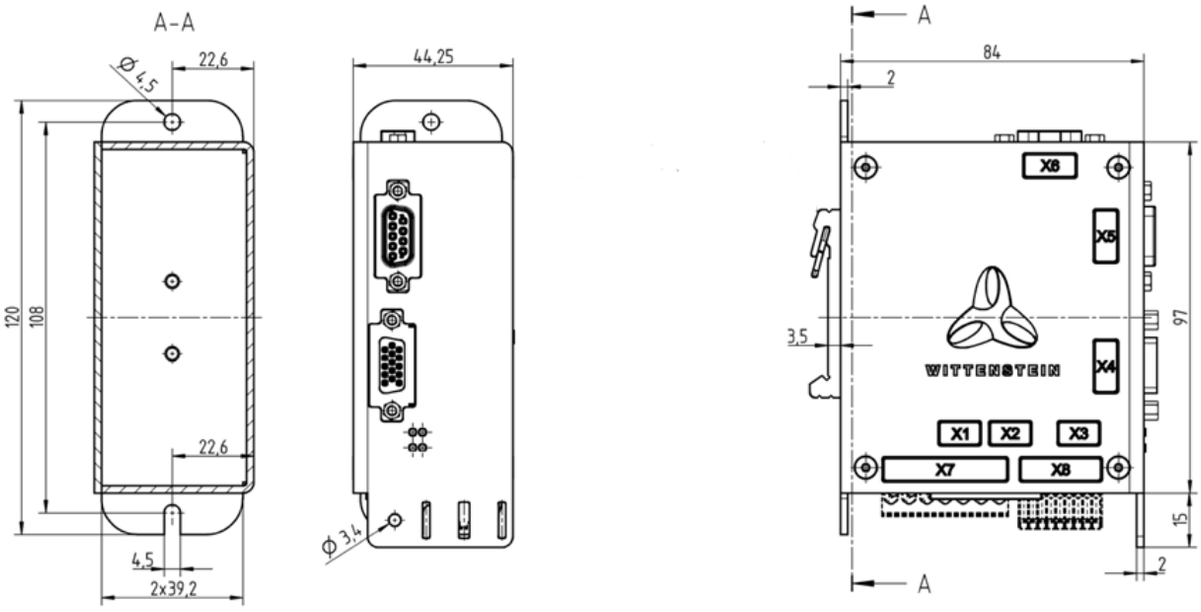
- Vibration according to DIN EN 60068-2-6:2008
  - Frequency range 10 Hz – 150 Hz
  - Acceleration: 5 g
- Shock according to DIN EN 60068-2-27:2010
  - Shock form: Semi-sinusoidal
  - Acceleration: 50 g
  - Duration of the shock: 11 ms

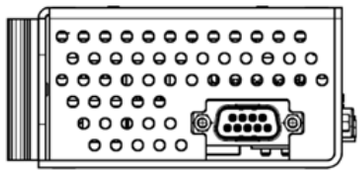
5.3 Device version IP20 decentral SIM20xxD-CC...

5.3.1 Dimensions IP20

Mechanical specifications	
Weight (kg)	0,3
Height without plug [mm]	120
Width [mm]	44,25
Depth without plug [mm]	84







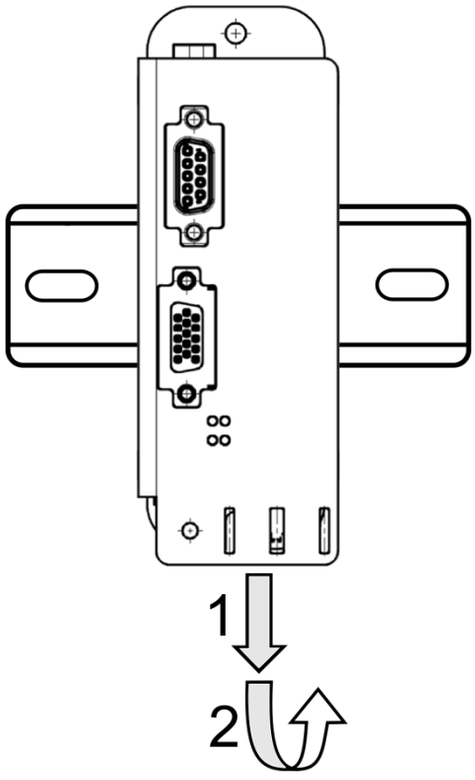
5.3.2 Mounting options IP20

The drive amplifier may be mounted on a top-hat rail of type TS 35 using the integrated top-hat clip.

Alternatively the drive amplifier can be connected to the mounting plate using a screw connection:
Mounting material: 2 cylinder head screws with hexagon socket ISO 4762 - M 4 – 8.8
Required tool: Hex key AF 3
Tightening torques see Chapter 9.1 Tightening torques

5.3.3 Demounting IP20

The demounting of the drive can be done by pressing down and pulling the drive out of the top-hat rail.



5.3.4 Installation space IP20

The central variant of the drive amplifier is designed for installation in the control cabinet.

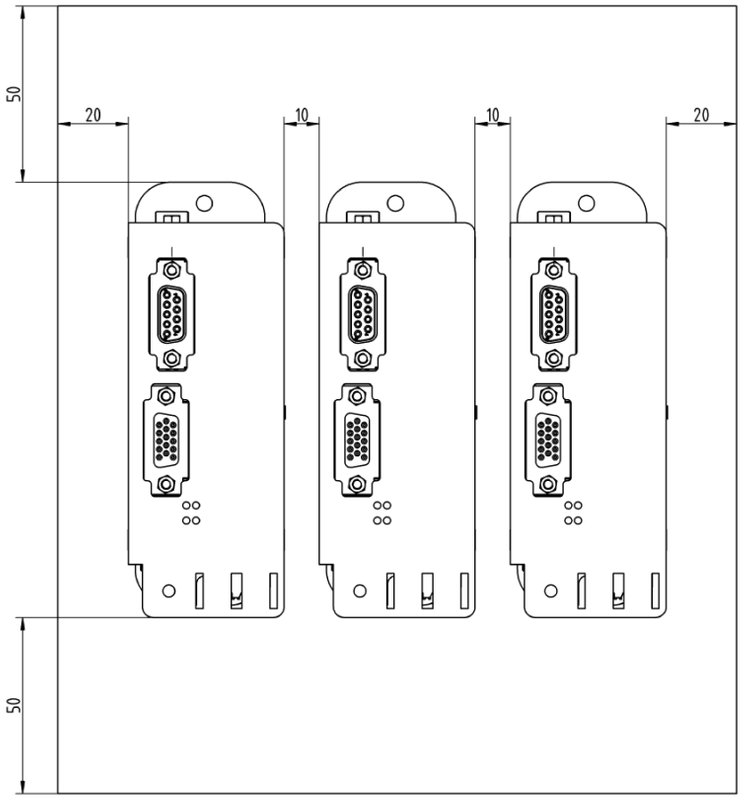
5.3.5 Environmental conditions for vibration/shock IP20

The drive amplifier fulfills the following specifications:

- Vibration according to DIN EN 60068-2-6:2008
  - Frequency range 10 Hz – 150 Hz
  - Acceleration: 1 g
- Shock according to DIN EN 60068-2-27:2010
  - Shock form: Semi-sinusoidal
  - Acceleration: 15 g
  - Duration of the shock: 11 ms

5.3.6 Mounting position IP20

The mounting position and minimum clearance must be established as in the following figure:



5.3.7 Ventilation/cooling IP20

Ensure that there is sufficient air circulation in the closed control cabinet.

The airflow at the bottom air intake of the device has to be at least 0.8 m/s so that the device is sufficiently cooled under standard operational conditions.

6 Electrical installation

6.1 Safety instructions

- For the electrical installation, the ESD instructions must be observed.

⚠	**⚠ CAUTION** • Systems that are electrically connected must be properly secured so they cannot be switched back on and warning signs must be put up. Installation may only be performed by trained personnel. • Before startup, it must be checked that the wiring is correct and is free of mechanical damage. Only drive amplifiers with wiring in perfect condition may be put into operation. • Incorrect voltage, reverse polarity and defective wiring can damage or destroy the drive amplifier. • Excessive or inadequate protection of the power supply can damage the cables or the drive amplifier.

	• Observe the separate instructions for the STO safety function (see Chapter 10 "Instructions for STO safety function")

6.2 Requirements for power adapters and supply voltage

The drive amplifier's 24 VDC logic supply and 48 VDC power supply must be provided using power adapters or supply voltage sources with safe extra low voltage in SELV/PELV design to IEC 60950 / EN 60204. Power adapters or supply voltage sources having only basic installation and not permissible.

⚠ DANGER

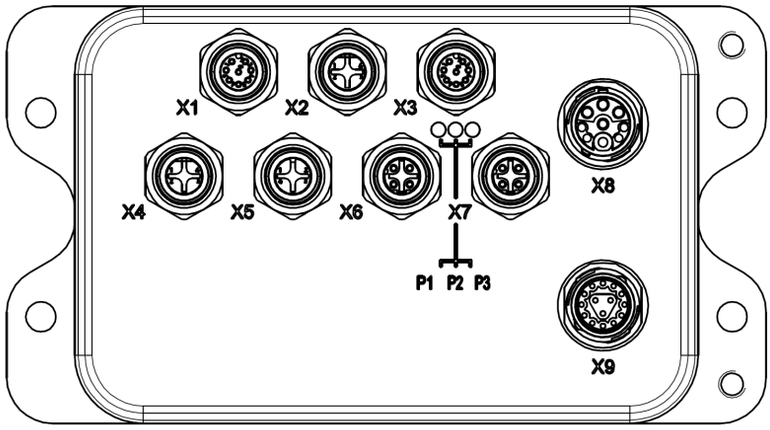
The use of unsuitable power adapters not in SELV/PELV design can lead to dangerously high voltages in the event of a fault, which could lead to dangerous electric shocks resulting in injuries or death.

The drive amplifier can generate a voltage of up to 60 VDC at the power adapter terminals for power supply when operating as a generator. The power adapter should be designed for such operation. Otherwise suitable action must be taken to prevent feedback.

6.3 Connection assignments device version IP65 decentral SIM20xxD-FC...

6.3.1 Overview of plug connections decentral

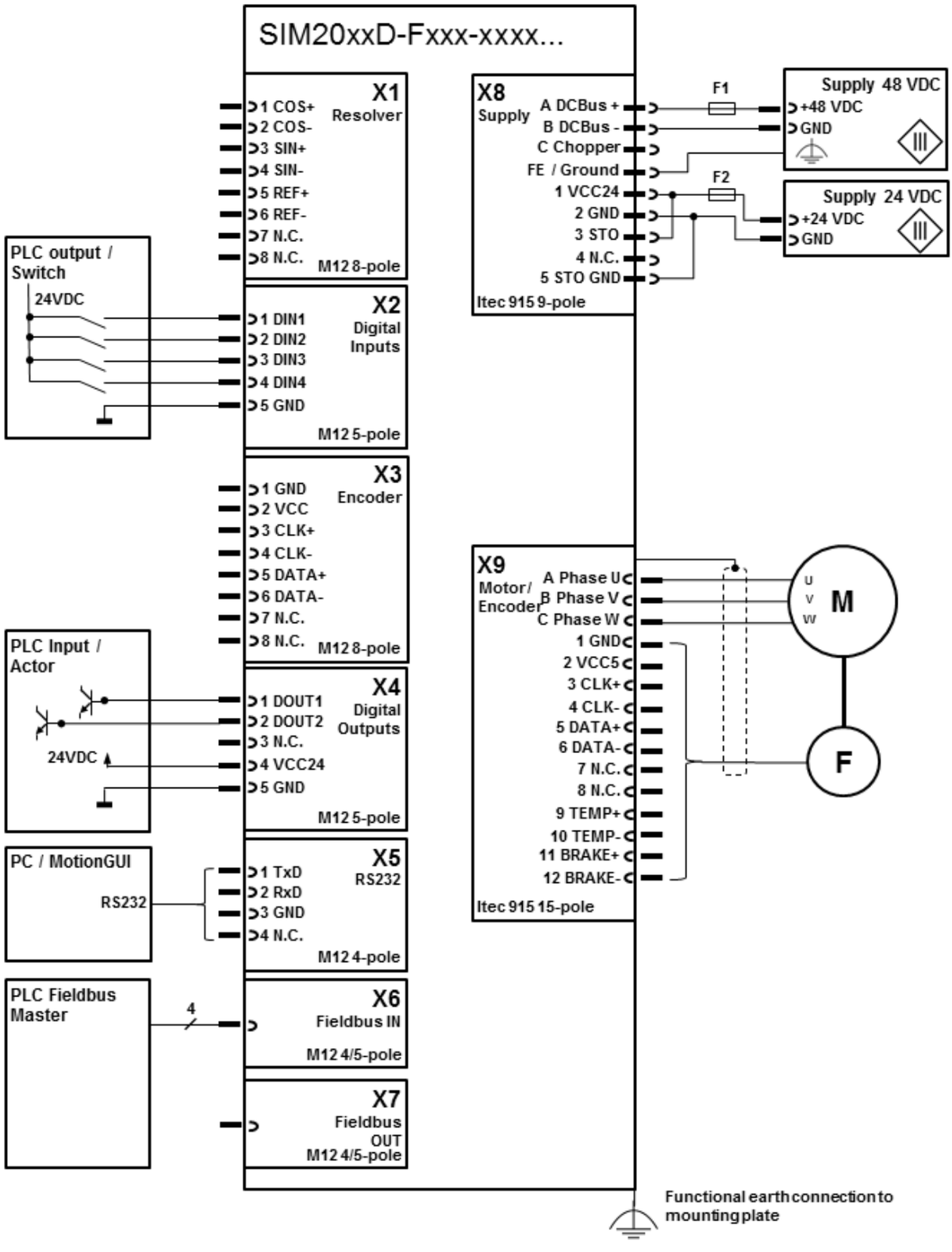
The following illustration shows the arrangement of the plug connections with associated label on the drive amplifier:



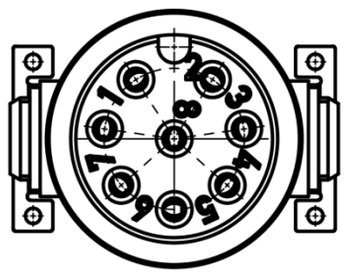
No.	Function	Connector type at device	Connector type at cable
X1	Resolver interface	M12 8-pin female A-coded	M12 8-pin male A-coded
X2	Digital inputs	M12 5-pin female B-coded	M12 5-pin male B-coded
X3	Encoder interface	M12 8-pin female A-coded	M12 8-pin male A-coded
X4	Digital outputs	M12 5-pin female B-coded	M12 5-pin male B-coded
X5	Diagnostic interface RS232	M12 4-pin female A-coded	M12 4-pin male A-coded
X6	Fieldbus interface input	CAN: M12 5-pin female A-coded EtherCat, PROFINET, EtherNet/IP, SERCOS III: M12 4-pin female D-coded	CAN: M12 5-pin male A-coded EtherCat: M12 4-pin male D-coded
X7	Fieldbus interface output	CAN: M12 5-pin female A-coded EtherCat, PROFINET, EtherNet/IP, SERCOS III: M12 4-pin female D-coded	CAN: M12 5-pin male A-coded EtherCat: M12 4-pin male D-coded
X8	Power supply	Intercontec itec 915 9-pin male	Intercontec itec 915 9-pin female
X9	Motor connection	Intercontec itec 915 15-pin female	Intercontec itec 915 15-pin male

6.3.2 Connection diagram IP65

The following illustration shows the principal connection diagram of the drive amplifier:



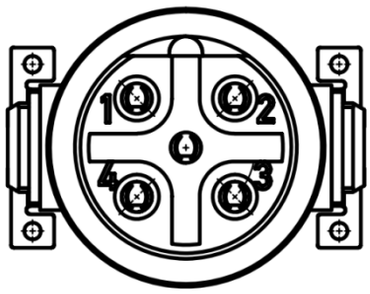
6.3.3 X1: Resolver

Figure	Pin no.	Signal name	Function	Input/output
	1	COS+	Cosine trace S1	Input
	2	COS-	Cosine trace S3	Input
	3	SIN+	Sine trace S2	Input
	4	SIN-	Sine trace S4	Input
	5	REF+	Reference trace R1	Output
	6	REF-	Reference trace R2	Output
	7	N.C.		
	8	N.C.		
Plug type on drive amplifier: M12, 8-pin, female, A-coded				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
Reference trace	Excitation frequency	kHz		10	
	Output voltage	Vpk	4	5	5,5
	Output current	mA			30
Sine/cosine	Input resistance	kOhm		100	
	Input voltage	Vpk		2,5	5
	Resolution	Bit	10	12	14

6.3.4 X2: Digital inputs

- An external reference potential most be connected to supply the digital outputs.
  - The digital inputs are galvanically isolated from the logic and power of the drive amplifier.

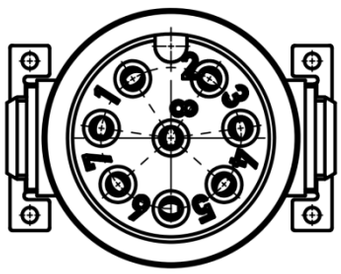
Figure	Pin no.	Signal name	Function	Input/output
	1	DIN1	Digital input 1	Input
	2	DIN2	Digital input 2	Input
	3	DIN3	Digital input 3	Input
	4	DIN4	Digital input 4	Input
	5	GND	Reference ground	
Plug type on drive amplifier: M12, 5-pin, female, B-coded				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
DINx	Input voltage	V DC	20	24	28
	Input current	mA DC	3	4	5
	Input resistance	kOhm		5,6	
	Sample time	msec			1
GND	Reference ground				

6.3.5 X3: Encoder

- The plug may only be inserted when the drive amplifier is in a de-energized state.

  – Via the encoder interface X3, fully digital encoder systems with the protocols EnDat 2.2 and BISS C are supported.
  – The encoder interface has a 5 V power supply, secured with a self-resetting fuse, with a current rating of 250 mA.

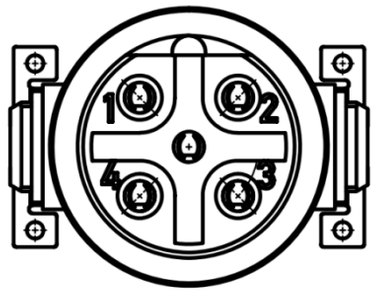
Figure	Pin no.	Signal name	Function	Input/output
	1	GND	Reference ground	Output
	2	VCC	Encoder power supply	Output
	3	CLOCK+	Clock output	Output
	4	CLOCK-	Clock output inverted	Output
	5	DATA+	Data channel	Input
	6	DATA-	Data channel inverted	Input
	7	N.C.		
	8	N.C.		
Plug type on drive amplifier: M12, 8-pin, female, A-coded				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
VCC	Output voltage	V DC	4,5	5	5,5
	Output current	mA DC			250
A+, A-, B+, B-, Z+, Z-	Input voltage	V DC		5	
	Input current	mA DC		42	
	Input resistance	ohm		120	

6.3.6 X4: Digital outputs

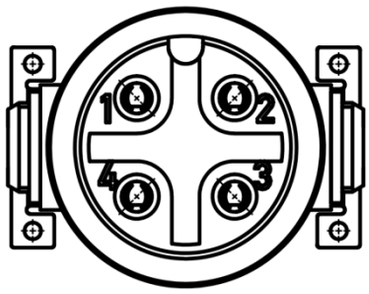
- An external power supply most be connected to supply the digital outputs.

  – The digital outputs are galvanically isolated from the logic and power of the drive amplifier.
  – The digital outputs are short-circuit proof.

Figure	Pin no.	Signal	Function	Input/output
	1	DOUT1	Digital output 1	Output
	2	DOUT2	Digital output 2	Output
	3	N.C.		
	4	VCC24	Digital output supply	Input
	5	GND	Reference ground	
Plug type on drive amplifier: M12, 5-pin, female, B-coded				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
DOUTx	Output voltage	V DC	18	24	26
	Output current	mA DC			40
	Output resistance	kOhm	1	1,5	2
	Refresh rate	Hz			1
VCC24	Voltage	V DC	20	24	28
	Current	mA DC			80
GND					

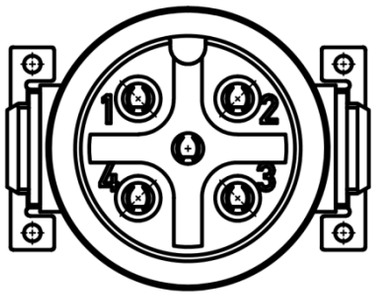
6.3.7 X5: Diagnostic interface RS232

Figure	Pin no.	Signal	Function	Input/output
	1	TxD	Transmit Data	Output
	2	RxD	Receive Data	Input
	3	GND	Reference ground	-
	4	N.C.		
Plug type on drive amplifier: M12, 4-pin, female, A-coded				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
TxD / RxD	Baud rate	baud		115200	

6.3.8 X6/X7: Fieldbus interface CANopen

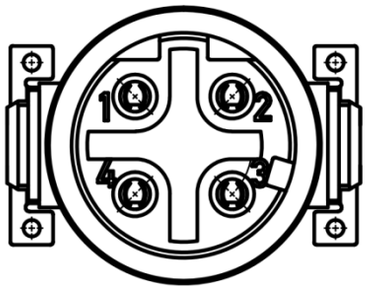
- The CAN reference ground is identical to the logic reference ground.
- The CAN signals are galvanically isolated from the power of the drive amplifier.

Figure	Pin no.	Signal	Function
	1	Shield	Screen
	2	N.C.	
	3	CAN_GND	CAN reference ground
	4	CAN_H	CAN High
	5	CAN_L	CAN Low
Plug type on drive amplifier: M12, 5-pin, female, A-coded at X6 and X7			

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
	Baud rate	kbaud	100	500	1000

6.3.9 X6/X7: Fieldbus interface EtherCat, PROFINET, EtherNet/IP and SERCOS III

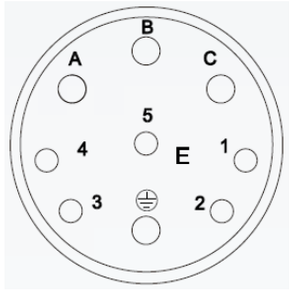
– The signals are galvanically isolated from the logic and power of the drive.

Figure	Pin no.	Signal name	Function
	1	TD+	Transmit Data +
	2	RD+	Receive Data +
	3	TD-	Transmit Data -
	4	RD-	Receive Data -
Plug type on drive amplifier: M12, 4-pin, female, D-coded at X6 and X7			

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
	Transmission speed	MBit/s		100	

6.3.10 X8: Power supply

– The logic supply (pin 1 + 2) is galvanically isolated from the intermediate voltage (pin A + B).
– The safety input STO is galvanically isolated from the intermediate voltage (pin A + B).
– The intermediate voltage - (pin B) is connected inside the device to the housing as a functional ground.

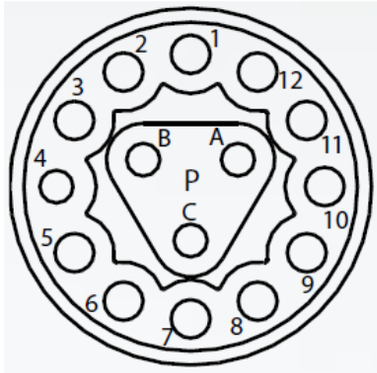
Figure	Pin no.	Signal name	Function	Input/output
	A	DCBus+	Intermediate voltage +	Input
	B	DCBus-	Intermediate voltage -	Input
	C	CHOPPER	External brake resistor	Output
	FE	FE	Functional earth	Functional earth
	1	VCC24	Logic supply + 24 VDC	Input
	2	GND	Logic reference ground	Input
	3	STO	Safe Torque off input	Input
	4	N.C.		
	5	STO GND	Reference ground STO	Input
Plug type on drive amplifier: Intercontec, itec 915, 9-pin, male (EEGA 201 NN00 00 0508 000)				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
DCBus+ / -	Voltage	V DC	16	48	56
	Current	A DC			25
Chopper	Voltage	V DC			52
	Current	A DC			5
VCC24	Voltage	V DC	22	24	26
	Current	mA DC			200
STO	Voltage	V DC	22	24	26
	Current	mA DC			80

6.3.11 X9: Motor connection

- The plug may only be inserted when the drive amplifier is in a de-energized state.

  – The encoder supply (pin 1 + 2) and encoder signals (pin 3 .. 8) are galvanically isolated from the power of the drive amplifier.

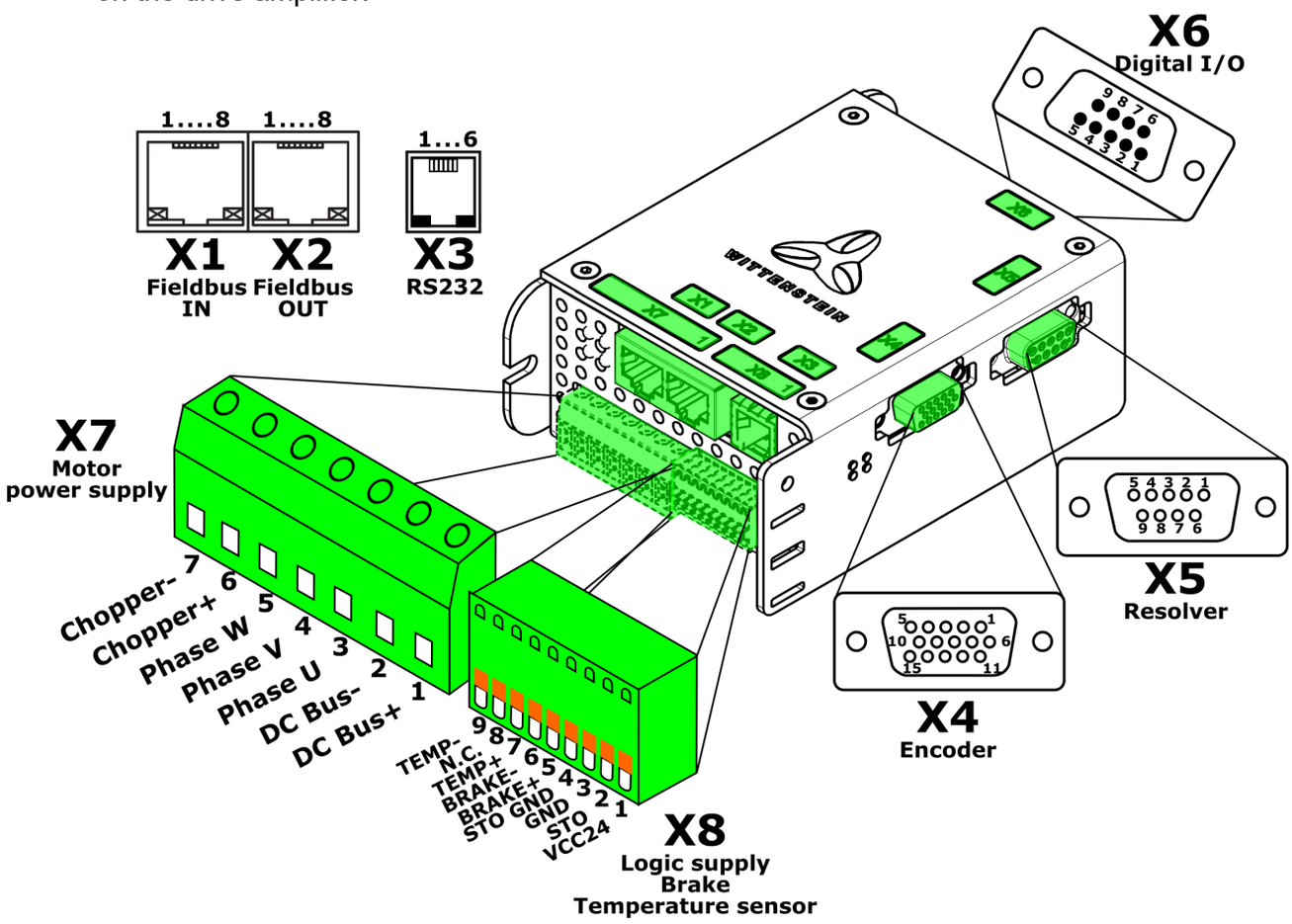
Figure	Pin no.	Signal name	Function	Input/ output
	A	PHASE_U	Motor phase U	Output
	B	PHASE_V	Motor phase V	Output
	C	PHASE_W	Motor phase W	Output
	1	GND	Reference ground	-
	2	VCC5	Encoder voltage 5 VDC	Output
	3	CLOCK+	Clock signal	Output
	4	CLOCK-	Clock signal inverted	Output
	5	DATA+	Data signal	Input
	6	DATA-	Data signal inverted	Input
	7	N.C.		Input
	8	N.C.		Input
	9	TEMP+	Motor temperature sensor +	Input
	10	TEMP-	Motor temperature sensor -	Input
	11	BRAKE+	Holding brake +	Output
	12	BRAKE-	Holding brake -	Output
Plug type on drive amplifier: Intercontec, itec 915, 15-pin, female (EEGA 205 NN00 00 0012 000)				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
PHASE_x	Current	Aeff		10	20
VCC5	Voltage	V DC	4,5	5	5,5
	Current	mA DC			250
BRAKE+/-	Voltage	V DC		24	
	Current	A DC			0,8

6.4 Connection assignments device version IP20 central SIM20xxD-CC...

6.4.1 Overview of plug connections IP20

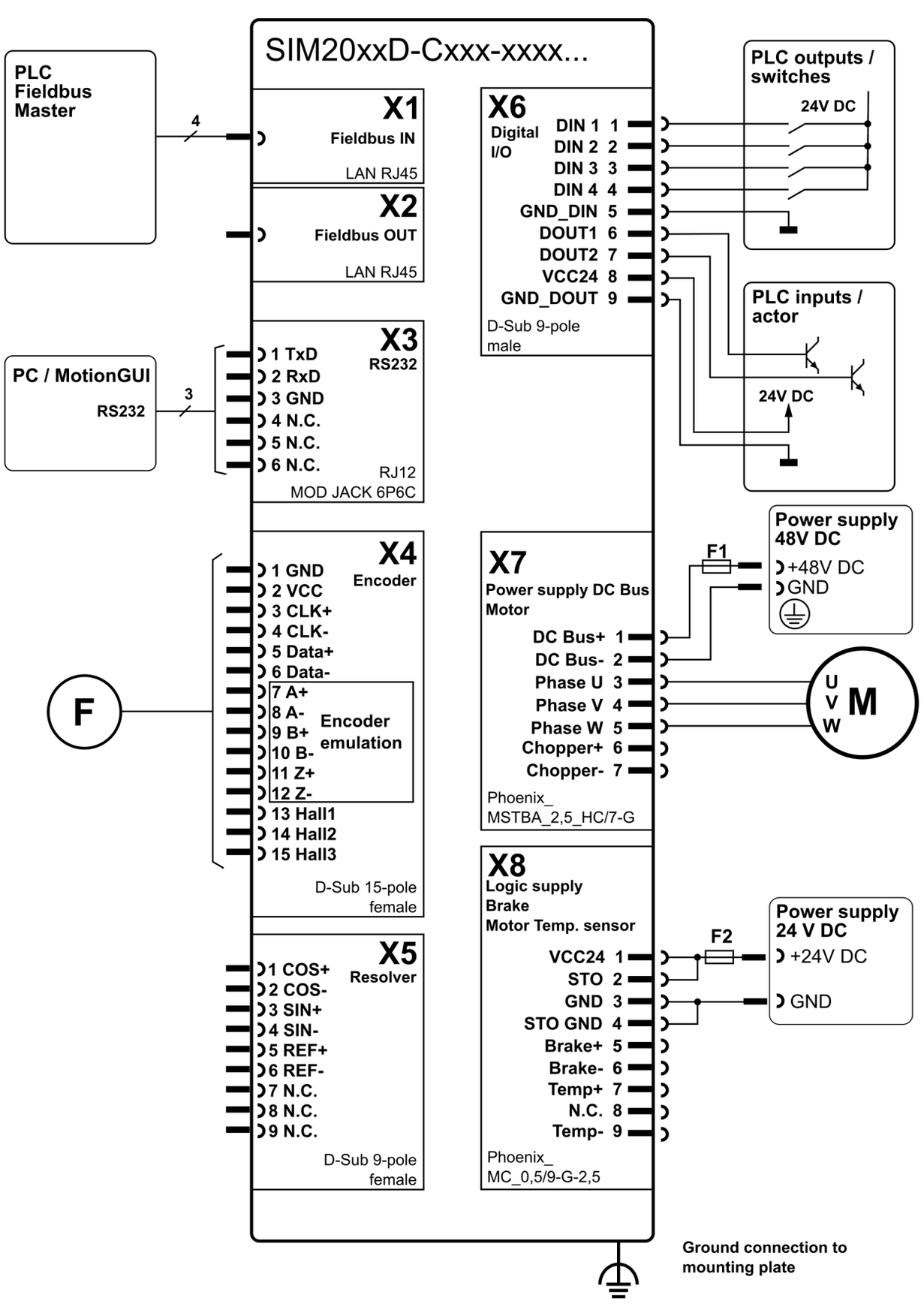
The following illustration shows the arrangement of the plug connections with associated label on the drive amplifier:



No.	Function	Connector type at device	Connector type at cable
X1	Fieldbus interface input	RJ45 socket	RJ45 plug
X2	Fieldbus interface output	RJ45 socket	RJ45 plug
X3	Diagnostic interface RS232	RJ12 socket	RJ12 plug
X4	Encoder interface	D-Sub 15-pole female	D-Sub 15-pole male
X5	Resolver interface	D-Sub 9-pole female	D-Sub 9-pole male
X6	Digital inputs/outputs	D-Sub 9-pole male	D-Sub 9-pole female
X7	Motor connection	Phoenix Contact MSTBA 2,5 HC/7-G	Phoenix Contact MSTBT 2,5 HC/ 7-ST
X8	Power supply	Phoenix Contact MC 0,5/9-G-2,5	Phoenix Contact FK-MC 0,5/ 9-ST-2,5

6.4.2 Connection diagram IP20

The following illustration shows the principal connection diagram of the drive amplifier:



6.4.3 Grounding and functional ground

In order to maintain conformity with the EMC limit values and ensure the functioning of the drive amplifier the housing of the drive amplifier must be connected to the control cabinet's functional ground with low impedance.
When mounting the drive amplifier on a metallic and conductive top-hat rail it must be ensured that the top-hat rail is connected to the control cabinet's functional ground with sufficiently low impedance.

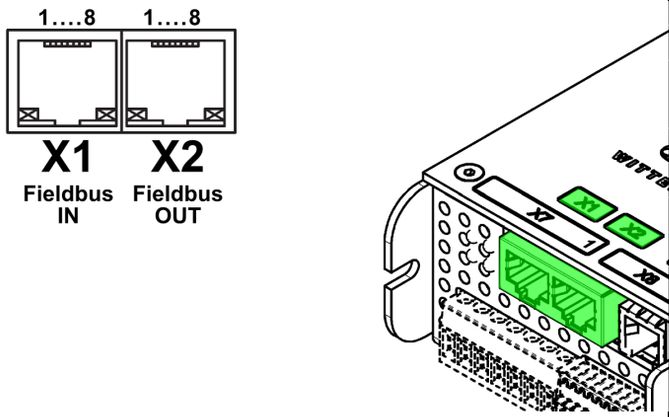
	NOTICE
	• If the drive amplifier is not sufficiently grounded this may cause radio interference, leading to non-conformity with the EC EMC Directive. This can result in malfunctions in the drive amplifier and other electronic systems.

6.4.4 Shield connection IP20

The Fig. shows connection of the outer shield of the motor cable to the housing of the drive amplifier. The most favorable way to connect the outer shield of the motor cable to the housing in terms of EMC is using a metal cable tie or using the shield clamp available as an accessory.

6.4.5 X1/X2: Fieldbus interface CANopen

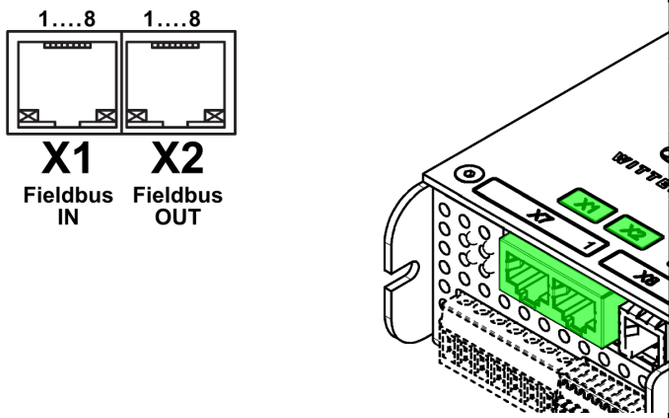
- The CAN reference ground is identical to the logic reference ground.
- The CAN signals are galvanically isolated from the power of the drive amplifier.

Figure	Pin no.	Signal	Function
	J1	CAN_H	CAN High
	J2	CAN_L	CAN Low
	J3	CAN_GND	CAN reference ground
	J4	N.C.	
	J5	N.C.	
	J6	N.C.	
	J7	N.C.	
	J8	N.C.	
Plug type on drive amplifier: LAN RJ45			

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
	Baud rate	kbaud	100	500	1000

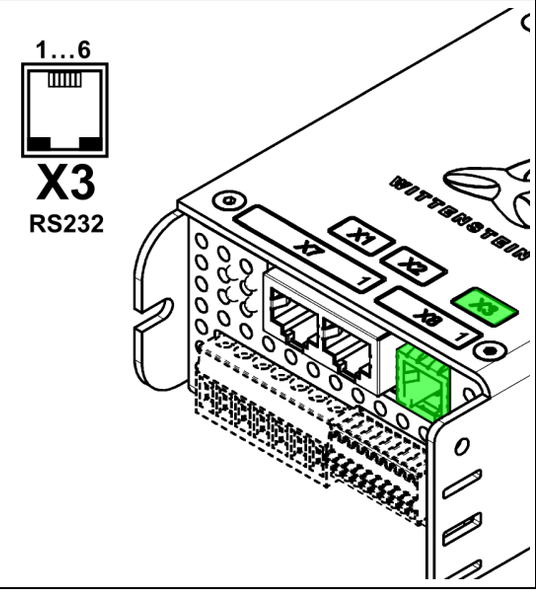
6.4.6 X1/X2: Fieldbus interface EtherCat, PROFINET, EtherNet/IP and SERCOS III

- The signals are galvanically isolated from the logic and power of the drive.

Figure	Pin no.	Signal name	Function
	J1	RD+	Receive Data +
	J2	RD-	Receive Data -
	J3	TD+	Transmit Data +
	J4	N.C.	
	J5	N.C.	
	J6	TD-	Transmit Data -
	J7	N.C.	
	J8	N.C.	
Plug type on drive amplifier: LAN RJ45			

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
	Transmission speed	MBit/s		100	

6.4.7 X3: RS232

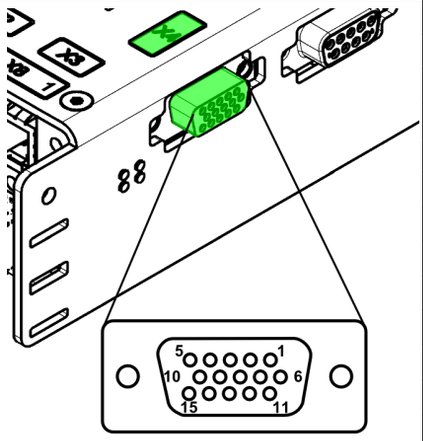
Figure	Pin no.	Signal	Function	Input/ output
	1	TxD	Transmit Data	Output
	2	RxD	Receive Data	Input
	3	GND	Reference ground	
	4	N.C.		
	5	N.C		
	6	N.C		
Plug type on drive amplifier: MOD JACK – MJLS 6P6C				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
TxD / RxD	Baud rate	baud		115200	

6.4.8 X4: Encoder

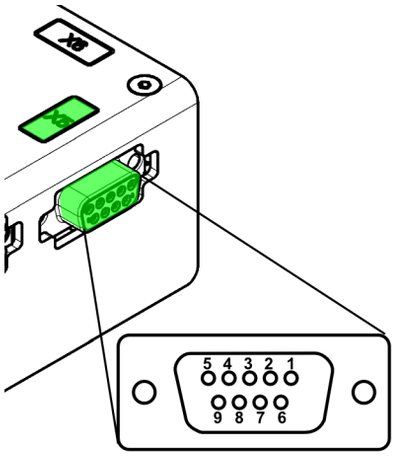
- The plug may only be inserted when the drive amplifier is in a de-energized state.

  – Via the encoder interface X4, fully digital encoder systems with the protocols EnDat 2.2 and BISS C are supported.
  – The encoder interface has a 5 V power supply, secured with a self-resetting fuse, with a current rating of 250 mA.
  – Encoder emulation is also available via encoder interface X4.

Figure	Pin no.	Signal name	Function	Input/output
 **X4** **Encoder**	1	GND	Reference ground	Output
	2	VCC	Encoder power supply	Output
	3	CLOCK+	Clock output	Output
	4	CLOCK-	Clock output inverted	Output
	5	DATA+	Data channel	Input
	6	DATA-	Data channel inverted	Input
	7	A+	Encoder emulation A+	Output
	8	A-	Encoder emulation A-	Output
	9	B+	Encoder emulation B+	Output
	10	B-	Encoder emulation B-	Output
	11	Z+	Encoder emulation Z+	Output
	12	Z-	Encoder emulation Z-	Output
	13	Hall U	Hall sensor phase U	Input
	14	Hall V	Hall sensor phase V	Input
	15	Hall W	Hall sensor phase W	Input
Plug type on drive amplifier: D-sub 15-pin female				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
VCC	Output voltage	V DC	4,5	5	5,5
	Output current	mA DC			250
A+, A-, B+, B-, Z+, Z-	Input voltage	V DC		5	
	Input current	mA DC		42	
	Input resistance	ohm		120	

6.4.9 X5: Resolver

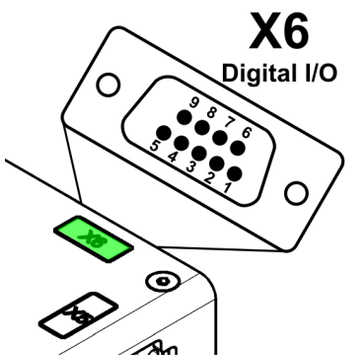
Figure	Pin no.	Signal name	Function	Input/output
 **X5** **Resolver**	1	COS+	Cosine trace S1	Input
	2	COS-	Cosine trace S3	Input
	3	SIN+	Sine trace S2	Input
	4	SIN-	Sine trace S4	Input
	5	REF+	Reference trace R1	Output
	6	REF-	Reference trace R2	Output
	7	N.C.		
	8	N.C.		
	9	N.C.		
Plug type on drive amplifier: D-sub 9-pin female				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
Reference trace	Excitation frequency	kHz		10	
	Output voltage	Vpk	4	5	5,5
	Output current	mA			30
Sine/cosine	Input resistance	kOhm		100	
	Input voltage	Vpk		2,5	5
	Resolution	Bit	10	12	14

6.4.10 X6: Digital I/O

- An external power supply most be connected to supply the digital outputs.

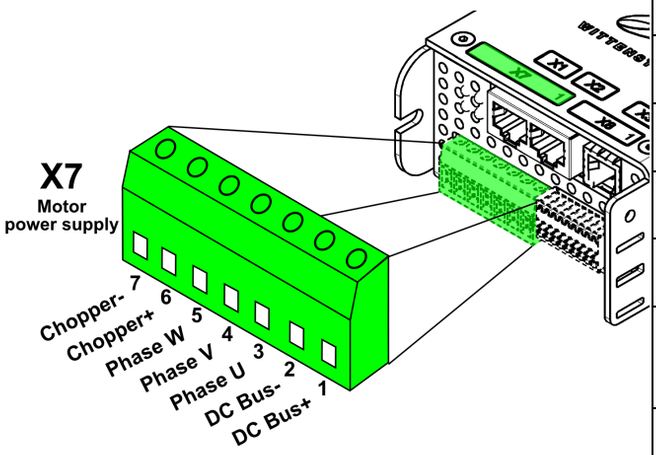
  – The digital outputs are galvanically isolated from the logic and power of the drive amplifier.
  – The digital outputs are short-circuit proof.

Figure	Pin no.	Signal	Function	Input/output
	1	DIN1	Digital input 1	Input
	2	DIN2	Digital input 2	Input
	3	DIN3	Digital input 3	Input
	4	DIN4	Digital input 4	Input
	5	GND	Reference ground	
	6	DOUT1	Digital output 1	Output
	7	DOUT2	Digital output 2	Output
	8	VCC24	Digital output supply	Input
	9	GND	Reference ground	
Plug type on drive amplifier: D-sub 9-pin male				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
DINx	Input voltage	V DC	20	24	28
	Input current	mA DC	3	4	5
	Input resistance	kOhm		5,6	
	Sample time	msec			1
GND	Reference ground				
DOUTx	Output voltage	V DC	18	24	26
	Output current	mA DC			40
	Output resistance	kOhm	1	1,5	2
	Refresh rate	Hz			1
VCC24	Voltage	V DC	20	24	28
	Current	mA DC			80
GND					

6.4.11 X7: Motor connection

– The intermediate voltage - (pin 2) is connected inside the device to the housing as a functional ground.

Figure	Pin no.	Signal name	Function	Input / output
	1	DCBus+	Intermediate voltage +	Input
	2	DCBus-	Intermediate voltage -	Input
	3	PHASE_U	Motor phase U	Output
	4	PHASE_V	Motor phase V	Output
	5	PHASE_W	Motor phase W	Output
	6	Chopper +	External brake resistor	
	7	Chopper -	External brake resistor	
Plug type at cable: Phoenix Contact MSTBT 2,5 HC/ 7-ST Permissible conductor cross-section: 0,25 .. 2,5 mm² Stripping length: 7 mm Tightening torque: 0.5 ... 0.6 Nm; the tightening torque must be 0.5 Nm to conform to the cTÜVus requirement				

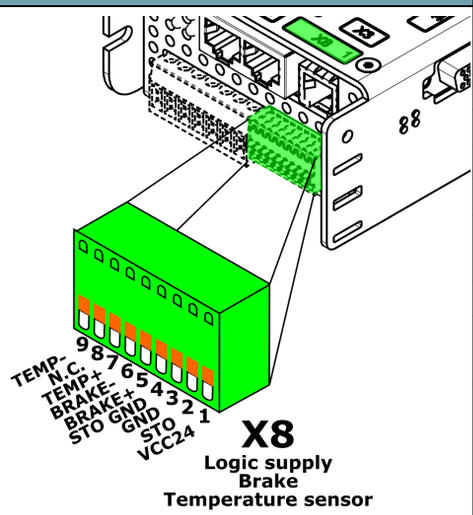
Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
PHASE_x	Current	A eff		15	30
DCBus+ / -	Voltage	V DC	16	48	56
	Current	A DC			36,6
Chopper	Voltage	V DC			52
	Current	A DC			5

The following overview shows the correct wiring of the motor phases of the cyber® dynamic line via the adapter cables S/L-cable xxxHI-xxxx-BA0-6/3:

wiring diagram	
U	red
V	white
W	black

6.4.12 X8: Power supply

- The logic supply is galvanically isolated from the intermediate voltage.
- The safety input STO is galvanically isolated from the intermediate voltage.

Figure	Pin no.	Signal name	Function	Input/ output
	1	VCC24	Logic supply + 24 VDC	Input
	2	STO	Safe Torque off input	Input
	3	GND	Logic reference ground	Input
	4	STO GND	STO reference ground	Input
	5	BRAKE+	Holding brake +	Output
	6	BRAKE-	Holding brake -	Output
	7	TEMP+	Motor temperature sensor +	Input
	8	N.C.		
	9	TEMP-	Motor temperature sensor -	Input
Plug type at cable: Phoenix Contact FK-MC 0,5/ 9-ST-2,5 Permissible conductor cross-section: 0,25 .. 0,5 mm² Stripping length: 8 mm				

Connection	Properties	Unit	Minimum value	Nominal value	Maximum value
VCC24	Voltage	V DC	22	24	26
	Current	mA DC			200
STO	Voltage	V DC	22	24	26
	Current	mA DC			80
BRAKE+/-	Voltage	V DC		24	
	Current	A DC			0,8

6.5 Fuses

6.5.1 Fuses on device version decentral IP65

- The power supplies are to be secured with the fuses specified in the table:

Fuses	
Logic supply (F2) X8 (pin 1 + 2)	Fuse or similar with max. 4 AT
Power supply (F1) X8 (pin A + B)	Fuse or similar with max. 10 AT
Brake chopper X8 pin (C)	Fuse or similar with max. 5 AT

6.5.2 Fuses on device version central IP20

- The power supplies are to be secured with the fuses specified in the table:

Fuses	
Logic supply (F2) X8 (pin 1 + 2)	Fuse or similar with max. 4 AT
Power supply (F1) X7 (pin 1)	Fuse or similar with max. 10 AT
Brake chopper X7 pin (6 + 7)	Fuse or similar with max. 5 AT

Further requirements regarding cTÜVus compliance are listed in chapter 2.1.2.

6.5.3 Motor circuit protection

Circuit breaker hardware to protect the motor is not required as the motor is protected from overloading by an I^2t function in the software and by an optional motor temperature sensor.

7 Startup and operation

7.1 Safety instructions

For secure application of the drive amplifier, the following regulations must be observed:

- Connection and operating instructions
- Local regulations
- EC regulations and the EC Machinery Directive

⚠ CAUTION

- **The housing temperature on the drive amplifier can reach 80 °C during operation.**
- **Wait until the housing temperature has cooled down to 40 °C before touching the drive amplifier.**

⚠ CAUTION

- **Before startup, the machine manufacturer must prepare a risk assessment for the machine and take appropriate measures so that unforeseen movements cannot lead to personal injury or property damage.**

⚠ CAUTION

- **Only technicians with extensive experience with electrical and electronic systems and drive technology may start up the drive amplifier.**

7.2 Startup software

For parameterization and startup of the drive, the startup software *motion gui* is available as well as an interactive, html-based help.

The startup software *motion gui* is used to change and save the operating parameters of the drive amplifier. The connected drive amplifiers can be put into operation with the help of software.

In the html-based help, all parameters and the function of the drive amplifier are described.

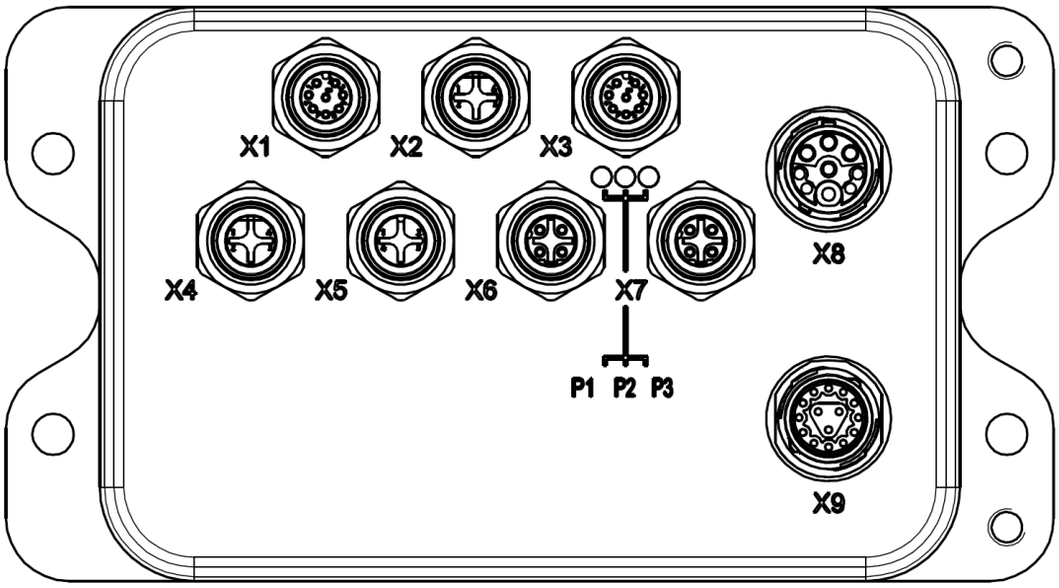
⚠ CAUTION

- **Incorrect parameterization can cause uncontrolled movements. For this reason, never change parameters whose meaning you do not completely understand.**

7.3 Displays on the drive amplifier

7.3.1 Displays on device version decentral IP65

Three multicolor LEDs (P1-P3) in the colors green and red are available on the drive amplifier for status and fault messages.



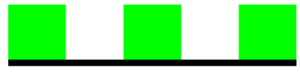
LED	Function
P1	Status of the drive
P2	Status of the fieldbus
P3	Fault status of the fieldbus

7.3.1.1 LED P1 Status drive

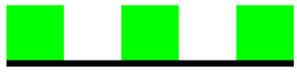
Status LED	P1 P2 P3	Meaning
Off		Drive amplifier has no power supply or is defective
Flashes green		Drive amplifier is in functional state and output stage disabled
Green		Drive amplifier is in functional state and output stage enabled
Flashes red		Drive amplifier is in defective state and output stage disabled

7.3.1.2 LED P2 Status fieldbus

CANopen:

Status LED	P1 P2 P3	Meaning
Off		Drive amplifier has no power supply or is defective
Flashes green (rapidly)		The CAN node is in the status PRE-OPERATIONAL
Green		The CAN node is in the status OPERATIONAL
Flashes green (slowly)		The CAN node is in the status STOPPED

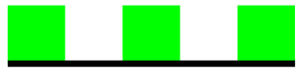
EtherCAT:

Status LED	P1 P2 P3	Meaning
Off		Drive amplifier is in the status INIT
Flashes green (slowly)		The drive amplifier is in the status PRE-OPERATIONAL
Lights up green once		The drive amplifier is in the status SAFE-OPERATIONAL
Lights up green		The drive amplifier is in the status OPERATIONAL
Flashes green (rapidly)		Drive amplifier is in the status BOOTSTRAP

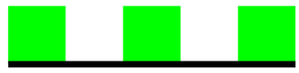
PROFINET:

State LED	P1 P2 P3	Meaning
off		Profinet interface not ready
flashes green		Profinet interface ready

EtherNET/IP:

State LED	P1 P2 P3	Meaning
off		Servo drive is not connected to supply voltage or EtherNet/IP – Interface not ready
flashes green		The EtherNet/IP – Interface is ready to communicate, but has not an active connection
glows green		The servo drive has establihed an active EtherNet IP I/O-connection

SERCOS III:

State LED	P1 P2 P3	Meaning
off		Sercos communication not available
flashes green		SERCOS communication will be established
glows green		Sercos phase 4 attained

7.3.1.3 LED P3 Fault status fieldbus

CANopen:

Status LED	P1 P2 P3	Meaning
Off		The CAN node is ready for operation
Red		The CAN node is defective

EtherCAT:

Status LED	P1 P2 P3	Meaning
Off		The bus is ready for operation
Red		The bus is defective

PROFINET:

State LED	P1 P2 P3	Meaning
off		Existing communication with a Profinet Controller
glows red		No connection available
flashes red		Connection available, but no active communication with an I/O controller

EtherNet/IP:

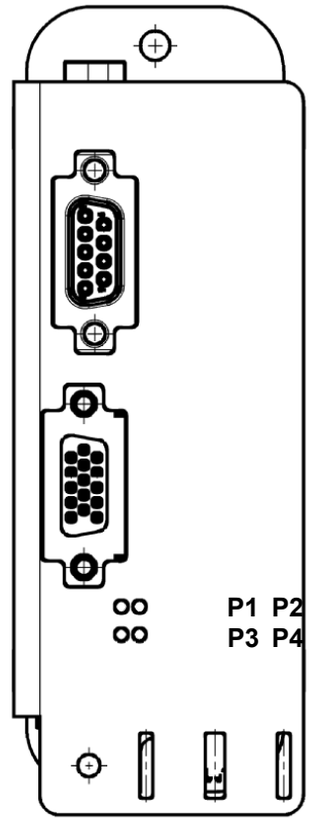
State LED	P1 P2 P3	Meaning
off		Existing communication with EtherNet/IP-Controller
flashes red		Connection-timeout. A former active connection is has been interrupted.

SERCOS III:

State LED	P1 P2 P3	Meaning
off		the fieldbus is ready
glows red		Sercos communication error or Sercos connection is not established yet

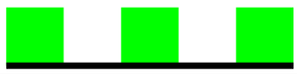
7.3.2 Displays on device version central IP20

Three multicolor LEDs (P1-P4) are available on the drive amplifier for status and fault messages.



LED	Function
P1	Status of the drive (green)
P2	Fault status of the drive (red)
P3	Status of the fieldbus (green)
P4	Fault status of the fieldbus (red)

7.3.3 LED P1 Status drive

Status LED	P1 P2 P3 P4	Meaning
Off		Drive amplifier has no power supply or is defective
Flashes green		Drive amplifier is in functional state and output stage disabled
Green		Drive amplifier is in functional state and output stage enabled

7.3.4 LED P2 Fault status drive

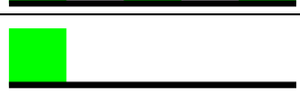
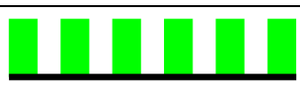
Status LED	P1 P2 P3 P4	Meaning
Off		Drive amplifier is in functional state
Flashes red		Drive amplifier is in defective state and output stage disabled

7.3.5 LED P3 Status fieldbus

CANopen:

Status LED	P1 P2 P3 P4	Meaning
Off		Drive amplifier has no power supply or is defective
Flashes green		The CAN node is in the status PRE-OPERATIONAL
Green		The CAN node is in the status OPERATIONAL

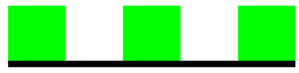
EtherCAT:

Status LED	P1 P2 P3 P4	Meaning
Off		Drive amplifier is in the status INIT
Flashes green (slowly)		The drive amplifier is in the status PRE-OPERATIONAL
Lights up green once		The drive amplifier is in the status SAFE-OPERATIONAL
Lights up green		The drive amplifier is in the status OPERATIONAL
Flashes green (rapidly)		Drive amplifier is in the status BOOTSTRAP

Profinet:

Status LED	P1 P2 P3 P4	Meaning
Off		Profinet interface not ready
Green		Profinet interface is ready

EtherNet/IP:

Status LED	P1 P2 P3 P4	Meaning
Off		Drive amplifier has no power supply or EtherNet/IP interface not ready
Flashes green		EtherNet IP - Interface is ready for communication however there is no active communication
Green		Drive amplifier has EtherNet IP I/O-Connection

SERCOS III:

State LED	P1 P2 P3 P4	Meaning
off		No Sercos communication available
flashes green		Sercos communication will be established
single green flash		The servo drive is in state SAFE-OPERATIONAL
glows green		Sercos phase 4 attained

7.3.6 LED P4 Fault status fieldbus

CANopen:

Status LED	P1 P2 P3 P4	Meaning
Off		The CAN node is ready for operation
Red		The CAN node is defective

EtherCAT:

Status LED	P1 P2 P3 P4	Meaning
Off		The bus is ready for operation
Red		The bus is defective

Profinet:

Status LED	P1 P2 P3 P4	Meaning
Off		There is communication with a Profinet controller
Red		No connection available
Flashes red		Connection available however there is no active communication with an I/O controller

EtherNet/IP:

Status LED	P1 P2 P3 P4	Meaning
Off		There is communication with a EtherNet/IP controller
Flashes red		Connection timeout. Previously active communication is interrupted.

LED SERCOS III:

State LED	P1 P2 P3 P4	Meaning
off		The fieldbus is ready
glows red		Sercos communication error or Sercos connection is not established yet

8 Maintenance and disposal

8.1 Maintenance

The drive amplifiers are maintenance free. Opening the drive amplifier voids the warranty.

8.2 Repairs

The drive amplifier may only be repaired by the manufacturer. Opening the drive amplifiers voids the warranty and safety according to the specified standards is no longer ensured.

8.3 Disposal

In accordance with WEEE-2002/96/EC directive, we take back old equipment for proper disposal as long as the transport costs are paid by the sender.

9 Appendix

9.1 Tightening torques

Property class	Tightening torque [Nm] for threads...													
	M 3	M 3.5	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
8.8	1,28	1,96	2,9	5,75	9,9	24	48	83	132	200	275	390	530	675
10.9	1,8	2,75	4,1	8,1	14	34	67	117	185	285	390	550	745	950
12.9	2,15	3,3	4,95	9,7	16,5	40	81	140	220	340	470	660	890	1140

Table 9.1

10 Instructions for STO safety function

The STO safety function (**S**afe **T**orque **O**ff) is used for safe torque shutdown and to reliably protect drives from restarting. The drive amplifier is fitted with a two-channel STO function as standard in the basic model.

Advantages of the STO safety function:

- Intermediate circuit and main circuit can remain active
- No contact wear because only control voltages are switched on and off
- Less wiring required
- Single-channel or two-channel control possible
- SIL 2 or SIL 3 systems possible

The STO safety function equates to stop category 0 (uncontrolled stoppage) defined by EN 60204-1. The STO safety function of the servo drive can be triggered by external safety relays or by an external safety control with safe outputs.

The circuit design has been tested and subsequently assessed by TÜV. According to that assessment, the circuit design used for the "Safe Torque Off" safety function in the cyber® simco® drive series of drive amplifiers is suitable for meeting the requirements for SIL 3 in accordance with
EN 61508 and category 3 PLe in accordance with EN ISO 13849-1.

10.1 Installation space

A drive amplifier in IP20 design should be installed in a space that will ensure reliable operation of the drive amplifier. The installation space must meet the requirements of protection class IP54 at least.

10.2 STO wiring

In the case of single-channel control, if the wiring for the STO signals is situated outside a control cabinet, it must be routed in a permanent installation and protected from external damage (e.g. by means of a cable duct or hard conduit). Further instructions for wiring can be found in the standard DIN EN 60204-1.

10.3 Important information for STO

⚠ CAUTION

If the STO function is actuated during operation, the drive will coast to a stop in an uncontrolled manner and the drive amplifier reports the "Error_amp_sto_active" fault. Controlled braking of the drive will not be possible.

- If an application requires controlled braking before the use of STO, the drive must first be braked under control and then the STO function must be triggered with a time delay.

⚠ CAUTION

Danger from short-term limited movements when STO function is activated.

Simultaneous breakdown of two power transistors in the output stage can cause short-term movement up to 180° / pole pair number of the motor.

- Make sure that a limited movement of this kind cannot cause any damage.

10.4 Intended use of STO

The STO function is designed only for functionally safe switching of a drive to torque OFF and to prevent restarting. In order to achieve functional safety, the wiring of the safety circuit must meet the safety requirements of EN 60204, EN 12100, EN 61508 and/or EN 13849-1.

10.5 Improper use of STO

The STO function must not be used if the drive needs to be stopped for the following reasons:

1. Cleaning, maintenance, or repair work; long interruptions in operation:
   In such cases the entire machine or system should be de-energized and secured (at the main switch).
2. Emergency stop situations:
   In emergency stop situations the power supply must be cut off by a line contactor (with emergency stop pushbutton).

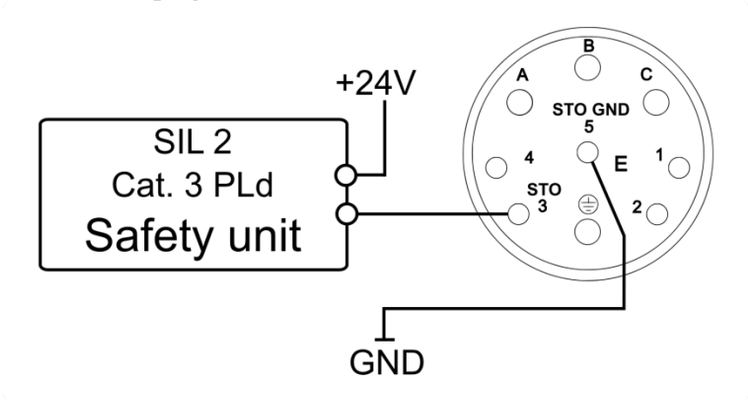
10.6 Technical specifications and STO pin assignment

STO input	Specifications
STO inactive input voltage	21.6 to 26.4 VDC
STO active input voltage	open
Input current	25 to 45 mA
Response time (time between activation of STO function and motor being free of torque)	< 15 ms

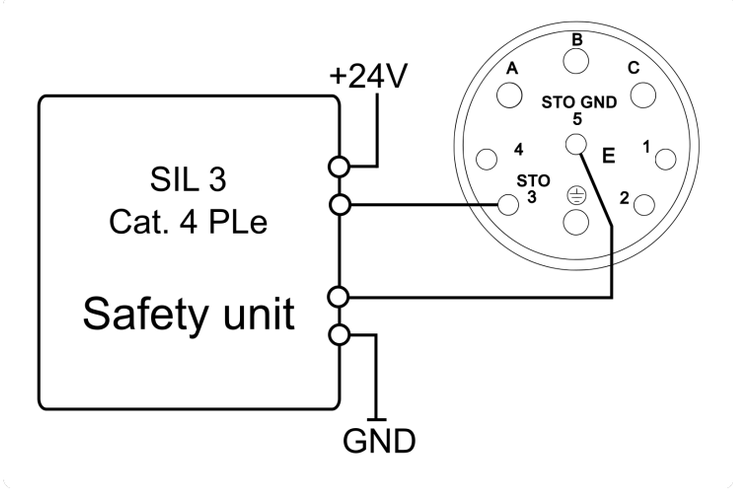
10.7 STO pin assignment

10.7.1 STO device version: IP65 decentral SIM20xxD-FC…

SIL 2 / category 3 PLd:

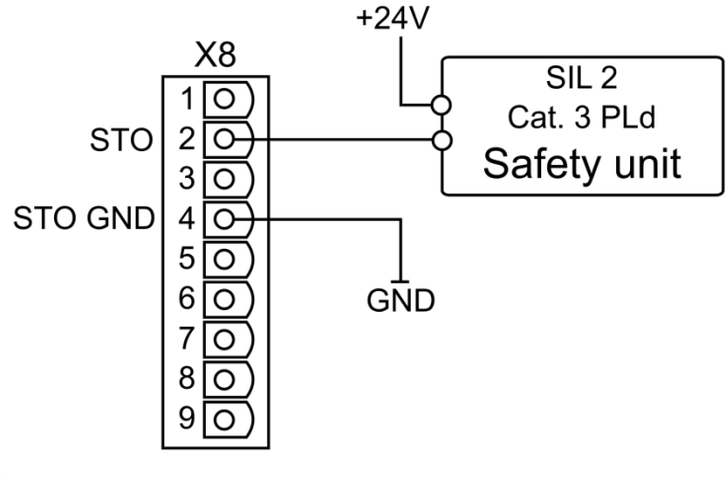


SIL 3 / category 4 PLe:

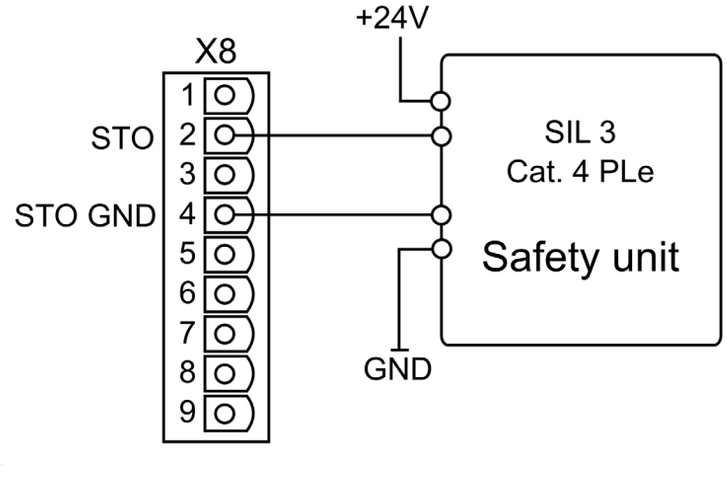


10.7.2 STO device version: IP20 central SIM20xxD-CC…

SIL 2 / category 3 PLd:



SIL 3 / category 4 PLe:



10.8 Function description

Use of the STO safety function requires the inputs STO and STO GND to be connected to the outputs of a safety control or safety relay that fulfills at least the requirements of PLd to EN 13849-1 or SIL 2 to EN 61508.

Single-channel control SIL 2 / PLd:
With single-channel control of the STO safety function, the STO input is switched on by an output of a safety relay. The STO GND is permanently connected to the GND of the safety relay.

STO +24V status	STO GND status	Motor torque possible
Open	0 VDC	No
+24 VDC	0 VDC	Yes

Two-channel control SIL 3 / PLe:
With two-channel control of the STO safety function, the STO and STO GND shutdowns are switched separately by two outputs of a safety control. To achieve PLe or SIL3, the outputs and lines must be monitored for short circuits by means of test signals from the safety control.

STO +24V status	STO GND status	Motor torque possible
Open	Open	No
+24 VDC	0 VDC	Yes

NOTICE

- When wiring the STO inputs inside an installation space, make sure that both the wiring used and the installation space itself meet the requirements of EN 60204-1.
- If the wiring is outside the installation space, it must be routed in a permanent installation and protected from external damage.

NOTICE

- If the STO safety function is not required in an application, the STO input must be permanently connected directly to +24 VDC and the STO GND input must be permanently connected directly to GND. The STO function is thus shunted out and cannot be used. The drive amplifier is then no longer a safety component as defined by the Machinery Directive.

10.8.1 Safe operation sequence

If an application requires controlled braking before the use of the STO function, the drive must be braked first and the STO function must be triggered with a time delay:

1. Controlled braking of drive
2. Once standstill is reached, disable the drive amplifier
3. In the case of a suspended load, mechanically lock the drive as well
4. Trigger STO

⚠ CAUTION

The drive amplifier cannot hold the load with the STO function activated because the motor no longer supplies any torque. Risk of injury from suspended load.

- Drives with a suspended load must be securely locked mechanically as well (e.g. with a suitable holding brake)

⚠ CAUTION

If the STO function is actuated during operation, the drive will coast to a stop in an uncontrolled manner. Controlled braking of the drive will not be possible. Danger from uncontrolled movement.

10.9 Functional check

NOTICE

- The STO function must be checked at initial startup, after any work on the system's wiring, and after replacing one or more components of the system.

Steps to follow for a functional check:

1. Stop the drive. The drive amplifier remains enabled and under control.
2. Activate the STO function by triggering an emergency stop of the machine. The drive amplifier should enter its fault state and should issue the "ERROR_AMP_STO_ACTIVE" fault.
3. Reset the fault using the "clear fault" function
4. Acknowledge the emergency stop and deactivate the STO function
5. Enable the drive and check that the drive is functioning

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