WITTENSTEIN | cyber motor

cyber® simco® drive 2

Operating manual

5022-D057946

Revision: 06

Revision history

Revision	Date	Comment	Chapter
01	16/04/2020	New version	All
02	16/07/2020	Connection diagrams, standards	6.3, 6.4, 6.5.1, 6.6, 10.2, 10.4
03	15/03/2021	Connection diagram, pin no.	6.4, 6.5, 6.6
04	02/03/2023	SIM2050 / SIM2100	All
05	06/02/2024	Connection diagrams, standards	All
06	16/05/2024	Connection diagrams, Safety functions added for PROFIsafe, New hardware variants added with improved temperature sensor evaluation	All

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If you have any questions about installation, commissioning or optimization, please contact our support hotline.

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Contents

1 About this manual

This manual contains information which is necessary for the safe use of the drive amplifier **cyber® simco® drive 2**, hereafter known as 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 it.
If this manual is supplied with amendment sheets (e.g. for special applications), then the information in the amendment is valid. Contradictory specifications in this manual are therefore void.
The operator must ensure that this operating manual is read through by all persons assigned to install, operate, or maintain the drive system, and that they fully comprehend its content.
Store this manual within reach of the drive amplifier.
Inform colleagues who work in the area around the machine about the **safety instructions** so that no one sustains injuries.
The original was prepared in German, all other language versions are translations of the original instructions.

1.1 Signal words

The following signal words are used to indicate hazards, things that are forbidden and important information:

	⚠ DANGER **This signal word indicates an imminent danger that will cause serious injuries or 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	Electrostatically sensitive device

1.3 Structure of the safety information

Safety information in this manual has been structured according to the following template:

⚠ CAUTION

Explanatory text shows the consequences of disregarding this information.

- Instructive text uses direct address to indicate 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 handling information

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 nonconformity 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 TÜV NRTL

This drive amplifier is approved under the TÜV reference number 713265357 and falls under the category Power Conversion Equipment.

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

NRTL Markings:

- Maximum Altitude: 2000 m
- Maximum Surrounding Air Temperature:

Product type	Protection class	
	IP 20	IP 65
SIM2007 / SIM2015	45 °C	55 °C
SIM2050 / SIM2100	-	45 °C

Table 1: Maximum Surrounding Air Temperature

- These devices are intended to be used in a pollution degree 2 environment
- Use minimum 90 °C copper wire
- Integral Solid State short circuit Protection
- 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
- **SIM2007 / SIM2015:** Use only UL listed Class G Fuse with a rating of minimum 300 Vdc and max fuse rating of 25 A and an DC interrupt rating of 10 kA or higher, e.g. Bussmann SC-series. Alternately use an UL listed fuse with an lower I²t rating of 25 kA and an Ip value of 10.5 kA
  SIM2050 / SIM2100: Use only UL listed Class J Fuse with a rating of minimum 300 Vdc and max fuse rating of 150 A and an DC interrupt rating of 100kA, e.g. Bussmann LPJ-series or higher. Alternately use an UL listed fuse with an lower I²t rating of 62.5 kA and an Ip value of 2.5 kA
- Tightening torque for factory wiring terminals
  SIM2007 / SIM2015: 0.5 Nm
  SIM2050 / SIM2100: 2.2 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 personnel skilled in its use.
- This EUT shall be supplied with the specified 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.

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

The basic version of 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.

For **SIM2050/SIM2100**, further safety functions are possible in the extended version with optional safety card. For further details and safety-related key figures, see chapter 11 "Functional safety instructions (SIM2050 / SIM2100)."

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 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 directives

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 Commissioning

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 limit values, as stipulated by the EMC regulations, are adhered to.

2.4 Hazards

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 technicians who have read and understood this manual 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 industrial systems. The drive amplifiers may only be operated when protected from the effects of the weather and with proper consideration of the ambient conditions (see chapter 3.4.4 „Environmental conditions“).

Other applications must first be approved by the manufacturer.

The place of use is in industrial environments with a dedicated low-voltage power supply.

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.
Use in residential areas or in a public low-voltage network for residential areas is not permitted. When used in such areas, impermissible high-frequency interference may occur.
In addition, the following applications are excepted from intended use:

- Life-sustaining medical devices
- Applications in potentially explosive atmospheres
- 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 by taking appropriate action. 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 nonconformity in associated controllers or bus systems
- Nonconformity during parameterization
- Nonconformity in wiring
- 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:

- Nonconformity in installation
- Incorrect installation site
- Nonconformity in electrical protection
- Conductive pollution, condensation

2.8.3 General safety instructions

⚠ DANGER

Faulty electrical connections or unapproved, live components can cause serious injuries and even death:

- Have all electrical connection work performed by trained technicians only. The valid standards and directives must be observed for this.
- Only suitable tools may be used for connection work.
- Immediately replace damaged cables or plugs.

ⓘ Electrical connection work refers to all work on the electrical circuit for which faults and associated hazards cannot be excluded.

⚠ WARNING

Connecting the power and signal supply lines under voltage is not permitted and can lead to machine damage, serious injury or even death.

- Make sure that the power supply unit is always in a voltage-free state before connecting.

⚠ WARNING

Separation of the power and signal supply lines under voltage is not permitted and can lead to machine damage, serious injury or even death.

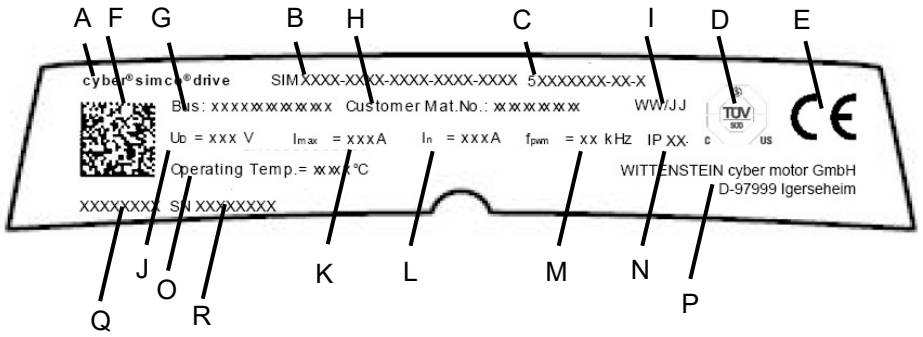
- Make sure that the drive is always in a voltage-free state before disconnecting its power and signal supply.

3 Description of the simco® drive

3.1 Identification of the drive amplifier

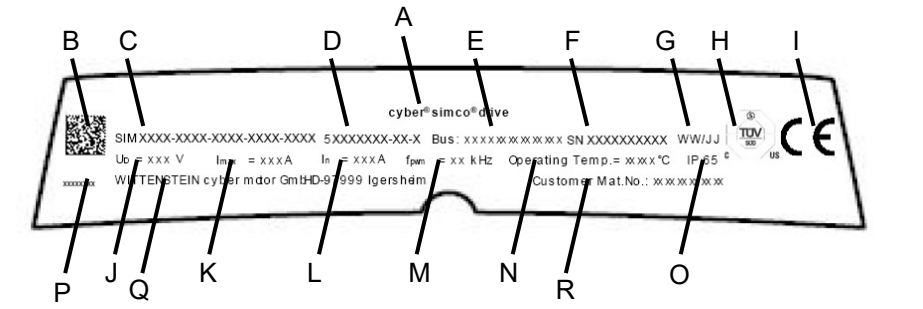
3.1.1 Name plate SIM2007/SIM2015

The name plate is fitted on the side of the drive amplifier.



	Designation		Designation
A	Product designation	J	Intermediate circuit voltage U_D
B	Type code	K	Maximum current I_{max}
C	Material number	L	Continuous stall current I_n
D	TÜV logo	M	PWM frequency
E	CE mark	N	Protection class
F	Data matrix code (DMC)	O	Ambient temperature
G	Bus interface	P	Manufacturer
H	Customer material number	Q	Service portal code
I	Calendar week and year of production	R	Serial number

Table 2: Name plate IP20 (SIM2007/SIM2015)

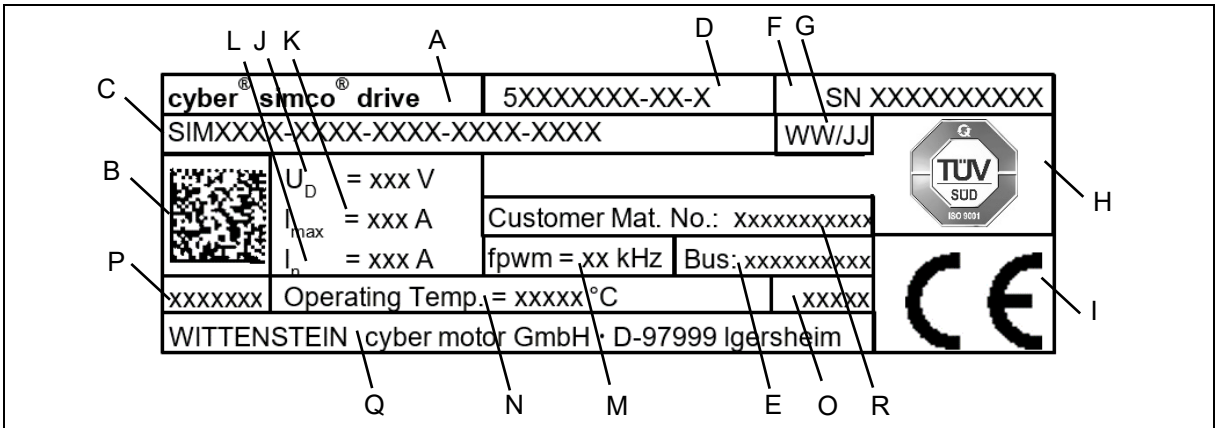


	Designation		Designation
A	Product designation	J	Intermediate circuit voltage U_D
B	Data matrix code (DMC)	K	Maximum current I_{max}
C	Type code	L	Continuous stall current I_n
D	Material number	M	PWM frequency
E	Bus interface	N	Ambient temperature
F	Serial number	O	Protection class
G	Calendar week and year of production	P	Service portal code
H	TÜV logo	Q	Manufacturer
I	CE mark	R	Customer material number

Table 3: Name plate IP65 (SIM2007/SIM2015)

3.1.2 Name plate SIM2050 / SIM2100

The name plate is attached to the power connections on the drive amplifier. In addition, a second name plate is included with the drive controller, which can be freely placed by the customer.



	Designation		Designation
A	Product designation	J	Intermediate circuit voltage U_D
B	Data matrix code (DMC)	K	Maximum current I_{max}
C	Type code	L	Continuous stall current I_n
D	Material number	M	PWM frequency
E	Bus interface	N	Ambient temperature
F	Serial number	O	Protection class
G	Calendar week and year of production	P	Service portal code
H	TÜV logo	Q	Manufacturer
I	CE mark	R	Customer material number

Table 4: Name plate SIM2050 / SIM2100

3.2 Code

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

Hardware:

Series			Performance data						HW Design				Fieldbus		Connection			Safety		Encoder			Generation / special				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
S	I	M	2	0	1	5	D	-	F	C	S	-	C	A	0	0	-	0	0	0	0	-	B	0	0	0	0

Product type
SIM = cyber simco drive

DC bus voltage
2 = 48 V

Nominal output current
007 = 7.5 A
015 = 15 A
050 = 50 A
100 = 100 A

Voltage supply
D = DC voltage

Housing version
C = IP20 (SIM2007/ SIM2015 only)
F = IP65

Cooling
C = Convection

Overload factor
S = 2x

Fieldbus interface
CA = CANopen
ET = Ethernet

Connection technology
00 = Standard

Safety version
00 = STO to SIL 3
01 = extended safety functions *

Feedback system encoder
00 = EndDat 2.2 / BiSS-C / SSI / Resolver / Sin/Cos (SIM2007/SIM2015 only)
01 = EndDat 2.2 / BiSS-C / SSI / Resolver / Sin/Cos / Incremental + Hall (SIM2050 / SIM2100 with safety version 00),
EndDat 2.2 FS (SIM2050 / SIM2100 with safety version 01)

Device generation
B = 2nd generation

Special
0000 = without

* see chapter 11 "Functional safety instructions (SIM2050 / SIM2100)

Image 3.1: Hardware code

Firmware:

Product type			Software			Fieldbus			Generation			Version			Sub-version	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
C	Y	D	F	W	-	C	A	-	0	2	-	0	1	-	0	1

Product type
CYD – cyber drive

Software class
FW – Firmware

Fieldbus interface
CA = CANopen
EC = EtherCAT
PN = PROFINET
EI = EtherNet/IP
SC = SERCOS III
ME = Multi-Ethernet

Generation
02 = 2nd Generation
03 = 3rd Generation

Version
XX = Latest version
01 = Version 1
02 = Version 2
...

Sub-version
XX = Latest sub-version
01 = Sub-version 1
02 = Sub-version 2
...

Image 3.2: Firmware code

3.3 Electrical data

Electrical data	Unit	SIM2007D	SIM2015D	SIM2050D	SIM2100D
Nominal supply voltage, intermediate circuit	V DC	48	48	48	48
Nominal power	W	375	750	2500	5000
Intermediate circuit voltage	V DC	12 ... 60	12 ... 60	12 ... 60	12 ... 60
Logic power supply	V DC	12 ... 60	12 ... 60	12 ... 60	12 ... 60
Nominal output current of the output stage	Aeff	7.5[1]	15[1]	50[1]	100[1]
Peak output current of the output stage (for 5 s)	Aeff	15	30	100	200
Clock frequency of the output stage	kHz	16	16	16	16
Recommended electrical rotary field frequency	Hz	0 ... 1600	0 ... 1600	0 ... 1600	0 ... 1600

Table 5: Electrical data

[1] In the case of the mounting position described in chapter 5 and a PWM frequency of 16 kHz, the nominal output current is achieved. The nominal output current may reduce considerably in the case of other mounting positions.

3.4 Description of the simco® drive series

WITTENSTEIN cyber® simco® drive 2 is an intelligent drive amplifier series for sine-commutated servo motors with a continuous power of up to 5.0 kW and a peak output of up to 10.0 kW.
The different types of housing in the **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 according to DS402, EtherCAT with CoE, PROFINET RT/IRT, Ethernet/IP Cip Sync or SERCOS III with FSP Drive is available as a communication interface.
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.
Intuitive startup and diagnosis is possible using the PC-based, MotionGUI 2 graphic user interface.

3.4.1 Integrated safety

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

3.4.2 Digital regulation

- 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
- Pulse width modulation with a clock rate of 16 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 (only if logic and/or power supply voltage >= 24 V DC)

3.4.4 Environmental conditions

- Ambient temperature during operation:

Product type	Protection class	
	IP 20	IP 65
SIM2007/SIM2015	0 … 45 °C	0 … 55 °C
SIM2050/SIM2100	-	0 … 45 °C

Table 6: Ambient temperature during operation

- Air humidity during operation: Relative humidity < 85 %, non-condensing
- Installation altitude: < 2000 m above sea level without affecting performance
- Protection class: IP65 or IP20 in accordance with EN60529, depending on the product
- For IP20 version, the following applies: Degree of pollution 2 according 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 per unit length Core to shield
	SIM2007 / SIM2015	SIM2050 / SIM2100	
Motor wire	20 m	3 m	< 150 pF/m
Encoder line	20 m	3 m	< 120 pF/m
Resolver line	20 m	3 m	< 120 pF/m

Table 7: Cabling and wiring

Further requirements regarding TÜV NRTL are listed in chapter 2.1.2 “Conformity with TÜV NRTL”.

3.6 Safety function

The **WITTENSTEIN cyber® simco® drive 2** series includes drive-integrated safety functions according to EN 61800-5-2. The drive amplifier already offers a two-channel STO (**S**afe **T**orque **O**ff) function in the basic version. The STO safety function (**S**afe **T**orque **O**ff) is used for safe torque shutdown and to reliably protect drives from restarting.

ⓘ Instructions for the STO safety function can be found in the appendix (see chapter 10 “STO safety function instructions”).

4 Transport and storage

4.1 Scope of delivery

- Check the completeness of the delivery against the delivery note.
  ⓘ Immediately notify the carrier, the insurance company, or
  WITTENSTEIN cyber motor GmbH in writing of any missing parts or damage.

4.1 Packaging

The drive amplifier is delivered packed in foil and/or cardboard boxes.

- Dispose of the packaging materials at the recycling sites intended for this purpose. Please observe the valid national regulations for waste disposal.
- Labeling: Label attached to the outside of the box

4.2 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

NOTICE

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

- Observe the directives concerning ESD protection.

4.3 Storage

- Only store the drive amplifier in the ESD-compliant original packaging
  - Storage temperature: -20 ... 50 °C, max. 20 K/hour fluctuation
  - Air humidity: Relative humidity max. 95%, non-condensing
- Store the drive system for a maximum of 2 years.

For storage logistics, we recommend the “first in – first out” method.

5 Mechanical installation

5.1 Safety instructions

- For the mechanical installation, the ESD information 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 flawless 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

- The drive system may only be assembled with the power disconnected.
- 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 SIM20007D-FC... / SIM2015D-FC…

- Identify your product (product type) from the name plate.

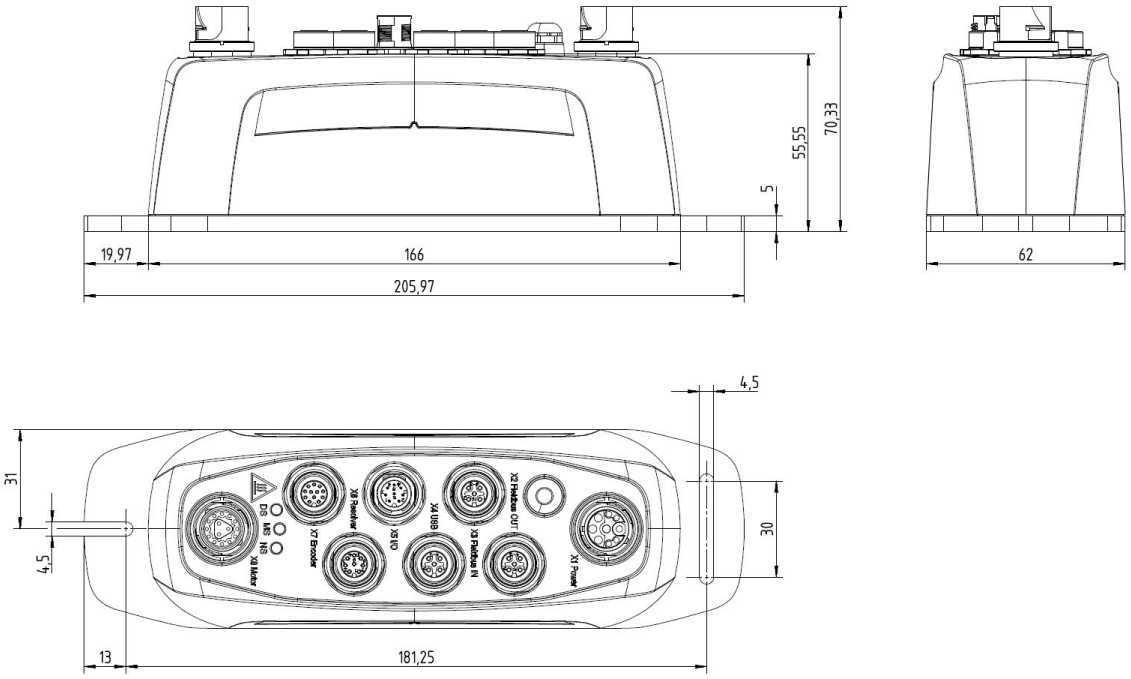
This chapter with its sub-chapters applies **only** to product types SIM2007D-FC.../SIM2015D-FC...

ⓘ Information about SIM2050D-FC.../SIM2100D-FC... can be found in chapter 5.4 "Device version IP65 decentral SIM2050D-FC.../SIM2100D-FC...."

5.2.1 IP65 dimensions(SIM2007 / SIM2015)

Mechanical data	
Weight [g]	620
Length [mm]	205.97
Width [mm]	62
Height without plug [mm]	55.55
Height with plug [mm]	70.33

Table 8: IP65 dimensions (SIM2007 / SIM2015)



5.2.2 IP65 mounting options

Mounting material: 2 cylinder head screws with hexagon socket ISO 4762 - M 4 – 8.8
Required tool: Inner hexagonal bolt SW 3
For tightening torques, see chapter 9.1 “Tightening torques”

5.2.3 IP65 installation space

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 IP65 mounting position

Any mounting position can be selected.

5.2.5 IP65 ventilation / cooling

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 IP65 Environmental conditions for vibration/shock

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
  - Shock duration: 11 ms

5.3 Device version IP20 central SIM2007D-CC... / SIM2015D-CC…

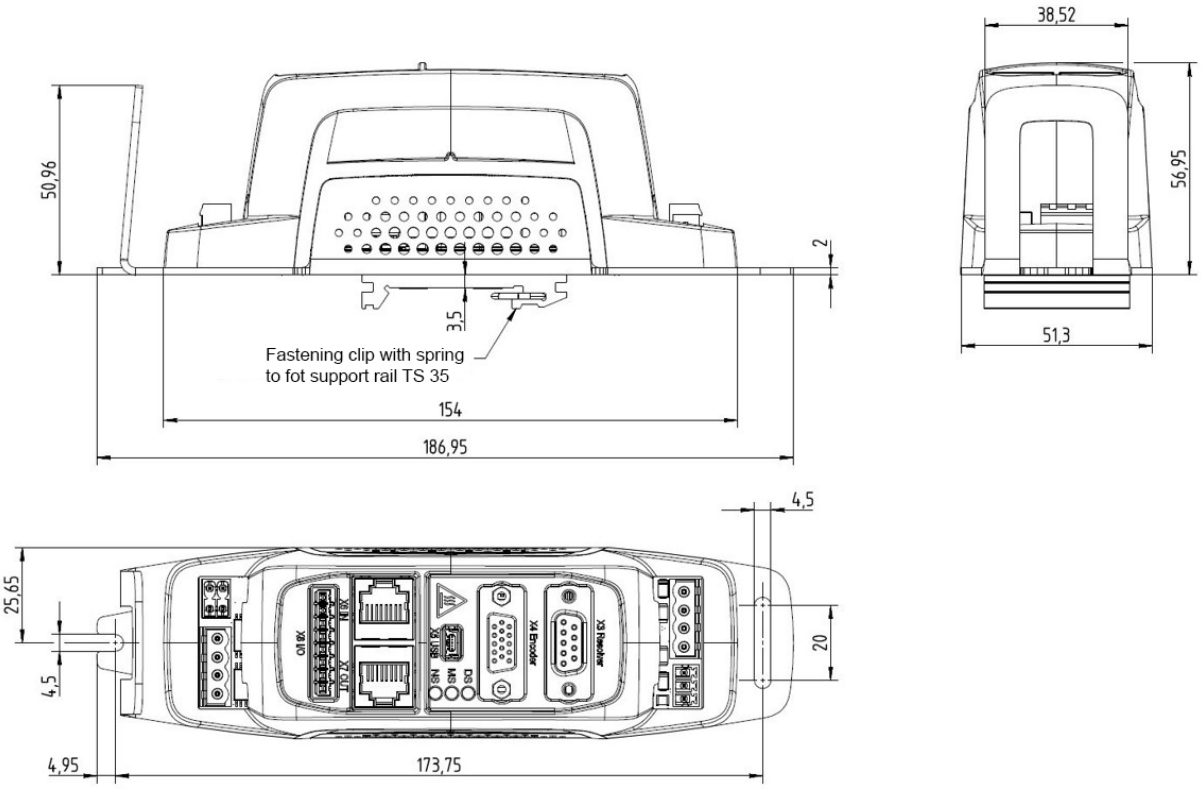
- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2007D-CC.../ SIM2015D-CC...

5.3.1 IP20 dimensions

Mechanical data	
Weight [g]	360
Length [mm]	186.95
Width [mm]	51.3
Height without plug [mm]	56.95

Table 9: IP20 dimensions



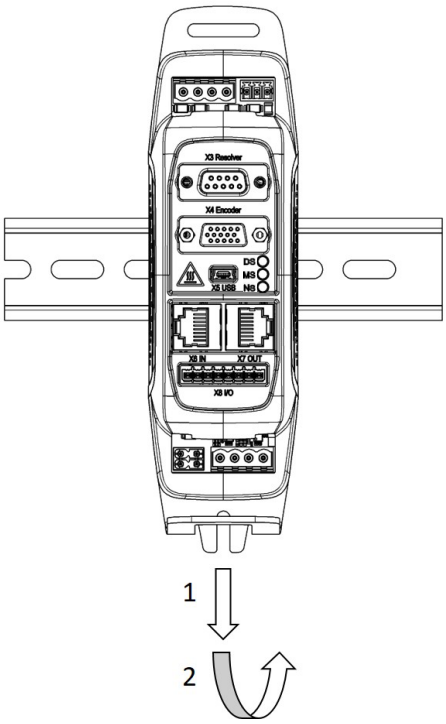
5.3.2 IP20 mounting options

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

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: Inner hexagonal bolt SW 3
For tightening torques, see chapter 9.1 “Tightening torques”

5.3.3 IP20 disassembly

The drive amplifier is disassembled from the top-hat rail by pushing downwards and removing the drive amplifier. See following figure.



5.3.4 IP20 installation space

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

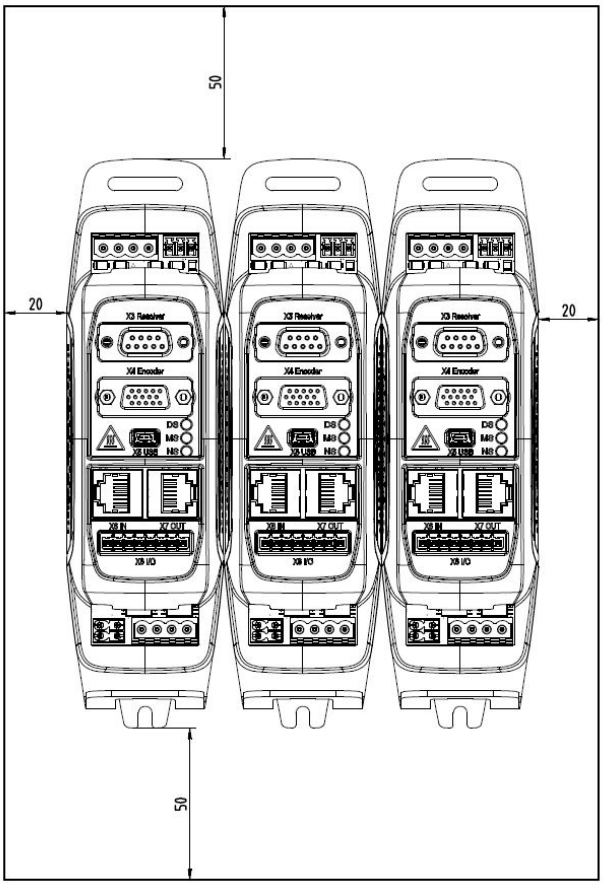
5.3.5 IP20 Environmental conditions for vibration/shock

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
  - Shock duration: 11 ms

5.3.6 IP20 mounting position

The mounting position and minimum distances must be selected according to the following illustration:



5.3.7 IP20 ventilation / cooling

Ensure that there is sufficient forced 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.

5.4 Device version IP65 decentral SIM2050D-FC.../SIM2100D-FC...

- Identify your product (product type) from the name plate.

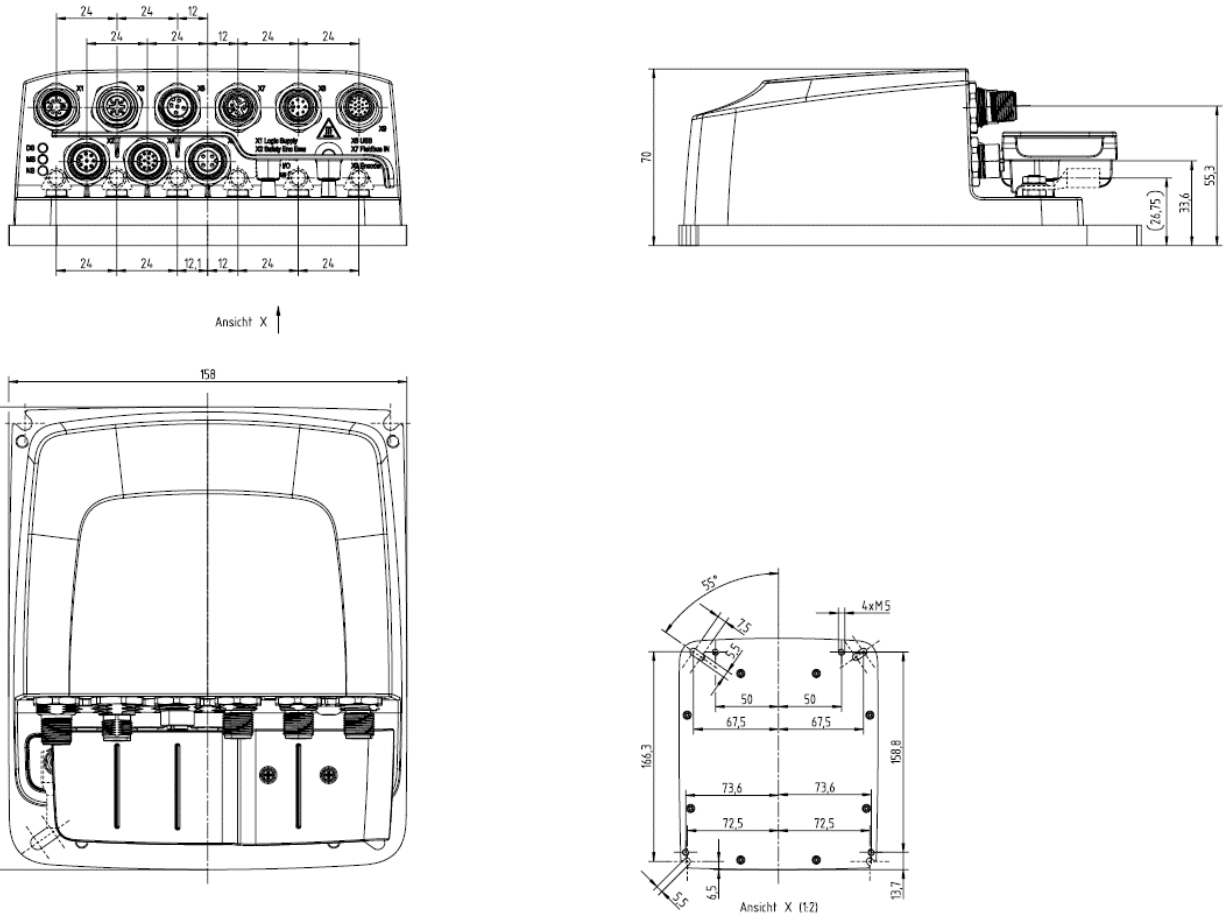
This chapter with its sub-chapters applies **only** to product types SIM2050D-FC.../ SIM2100D-FC...

ⓘ Information about SIM2007D-FC.../SIM2015D-FC... can be found in chapter 5.2 "Device version IP65 decentral SIM20007D-FC... / SIM2015D-FC…".

5.4.1 IP65 dimensions (SIM2050 / SIM2100)

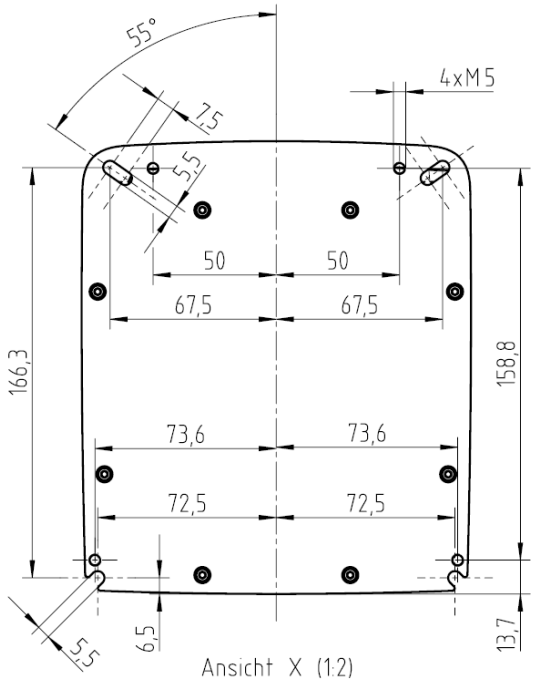
Mechanical data	
Weight [kg]	1.52
Length [mm]	183.5
Width [mm]	158
Height [mm]	70

Table 10: IP65 dimensions (SIM2050 / SIM2100)



5.4.2 IP65 mounting options

Mounting material: 4 cylinder head screws with hexagon socket ISO 4762 - M 5 – 8.8
Required tool: Inner hexagonal bolt SW 4
For tightening torques, see chapter 9.1 “Tightening torques”



5.4.3 IP65 installation space

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

5.4.4 IP65 mounting position

Any mounting position can be selected.

5.4.5 IP65 ventilation / cooling

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.
Performance data measurement was carried out with heat sink with a thermal resistance of 0.16 °C/W.

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

5.4.6 IP65 Environmental conditions for vibration/shock

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
  - Shock duration: 11 ms

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 flawless condition may be put into operation.
- Incorrect voltage, reverse polarity and nonconforming wiring can damage or destroy the drive amplifier.
- Excessive or inadequate protection of the power supply can damage the cables or the drive amplifier.
- To comply with protection class IP65, connections which are not being used must be fitted with dummy connectors which are included in delivery.

Observe the separate instructions for the STO safety function (see chapter 10 ”STO safety function instructions”).

6.2 Installing the electrical connections

⚠ DANGER

Electrically live components may result in electric shocks if touched and can cause serious injuries and even death.

- Observe the five safety rules of electrical engineering before starting electrical installation work:
  - Switch off the power supply.
  - Secure against being switched on again.
  - Check that there is no voltage.
  - Ground and short-circuit.
  - Cover neighboring and electrified parts.
- Before switching the voltage back on, check that all electrified parts are equipped with suitable and undamaged contact protection.
- Check whether there are protective caps on the plugs. If protective caps are missing, check the plugs for damage and soiling.

⚠ DANGER

Electrical work performed in damp areas may result in electric shocks and can cause serious injuries and even death.

- Carry out the electrical assembly only in dry areas.

6.3 Requirements for power adapters and supply voltage

The drive amplifier's logic supply and power supply must be provided using power adapters or supply voltage sources with safe extra low voltage in SELV/PELV design according to IEC 60950 / EN 60204. Power adapters or supply voltage sources having only basic installation are 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.

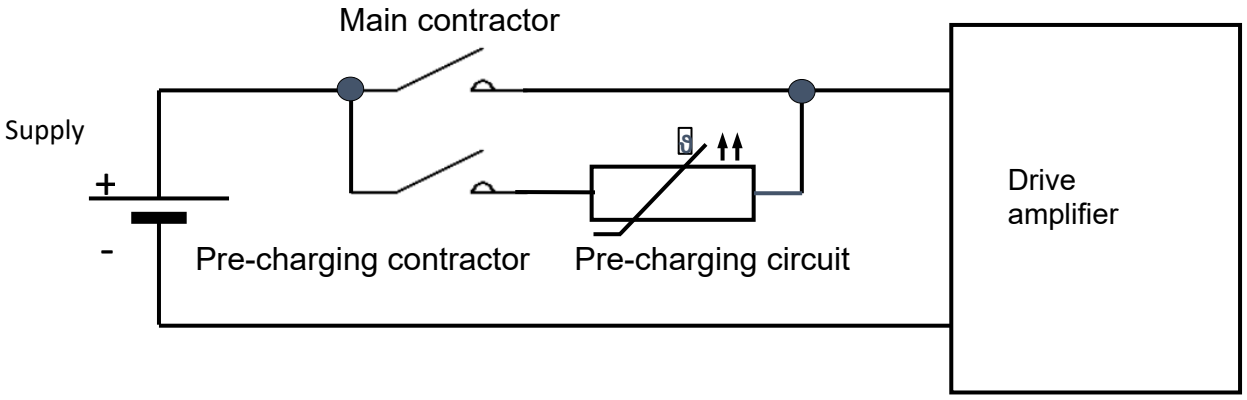
6.3.1 Requirement for switch-on behavior of the voltage supply

- Identify your product (product type) from the material number.
  This sub-chapter does not apply for the following material numbers:
  - 50023015-01-0
  - 50023036-02-0
  - 50023037-01-0
  - 50023038-02-0
  - 50023766-01-0
  - 50023767-02-0
  - 50023768-01-0
  - 50023769-02-0

  These devices already feature integrated switch-on current limitation in the logic supply. For this reason, an external pre-charging circuit is not required.

For the logic supply and power supply of the drive amplifier, ensure that the voltage of 60 VDC is not exceeded due to supply inductances. When a power supply unit is used, this is ensured by its start-up. Connecting via a contactor or similar switch can generate impermissible voltage transients and damage the drive amplifier. These transients can be prevented, for example, by a pre-charging circuit. The following illustration shows a schematic example with battery, main contactor, pre-charge contactor, pre-charge resistor and drive amplifier.

Pre-charging circuit scheme



Design of the pre-charging circuit
The design of the pre-charging circuit is based on the connection capacitance of the drive amplifier.

The drive amplifiers have the following connection capacitances:

- SIM2007 / 2015: 1100 µF
- SIM2050 / 2100: 2800 µF

The pre-charging resistor is designed so that the connection capacitance is charged with the time constant T ~167 ms.

The resistance value can be calculated with the following formula:
$R=\tau/C$

For the SIM2050 / 2100, this results in a resistance value of 59.5 Ω as an example.

The pre-charging circuit is then deactivated after 500 ms when the terminal capacitance is 95% charged. This corresponds to approx. 3 T.
For safety reasons, it is recommended to use a temperature-dependent PTC instead of a fixed resistor for pre-charging. In the event of a short circuit, the current is limited at the PTC, which then becomes warm and consequently highly resistive. This limits the current to a few mA.

Before the main contactor is switched on, it must be checked whether the pre-charging was successful and the voltage is present at the drive amplifier. Here, for example, an auxiliary relay could be used to block the main contactor if the pre-charging voltage is not present.

Ideally, however, the pre-charging is controlled by a PLC. This can start the pre-charging and monitor the voltage during ramp-up. After the run-up, the main contactor can then be switched or the pre-charging can be deactivated if the voltage does not rise.

6.4 Connection assignments device version IP65 decentral SIM2007D-FC... / SIM2015D-FC…

- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2007D-FC SIM2015D-FC...

ⓘ Information about SIM2050D-FC.../SIM2100D-FC... can be found in chapter 6.6 "Connection assignments device version IP65 decentral SIM2050D-FC.../SIM2100D-FC...."

6.4.1 Overview of IP65 plug connections (SIM2007 / SIM2015)

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

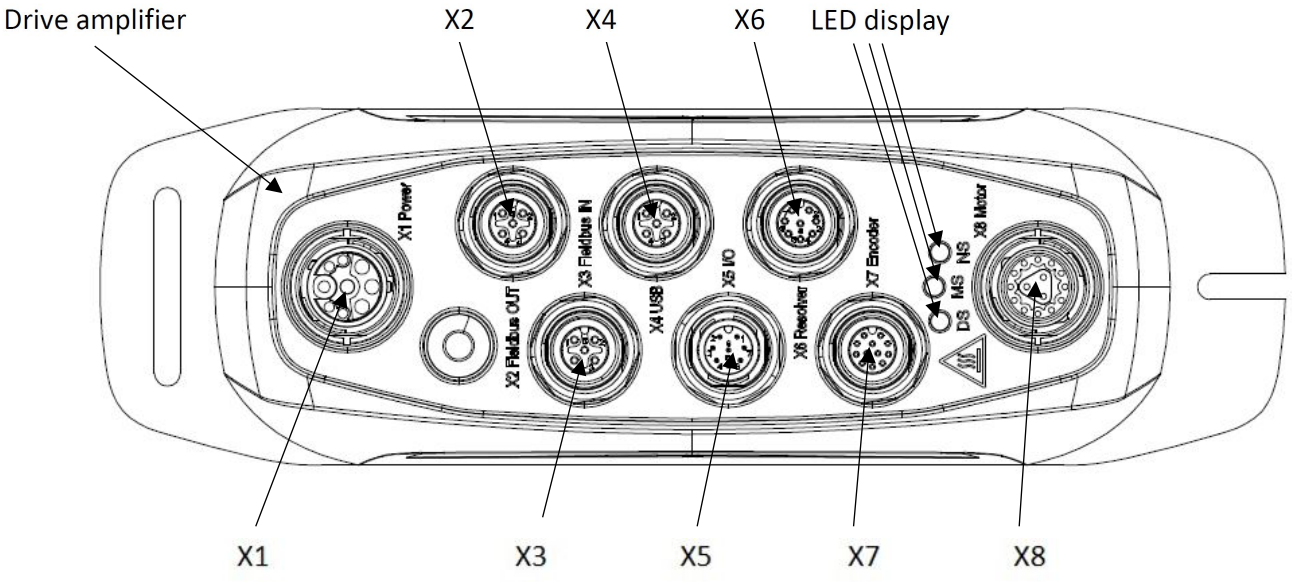


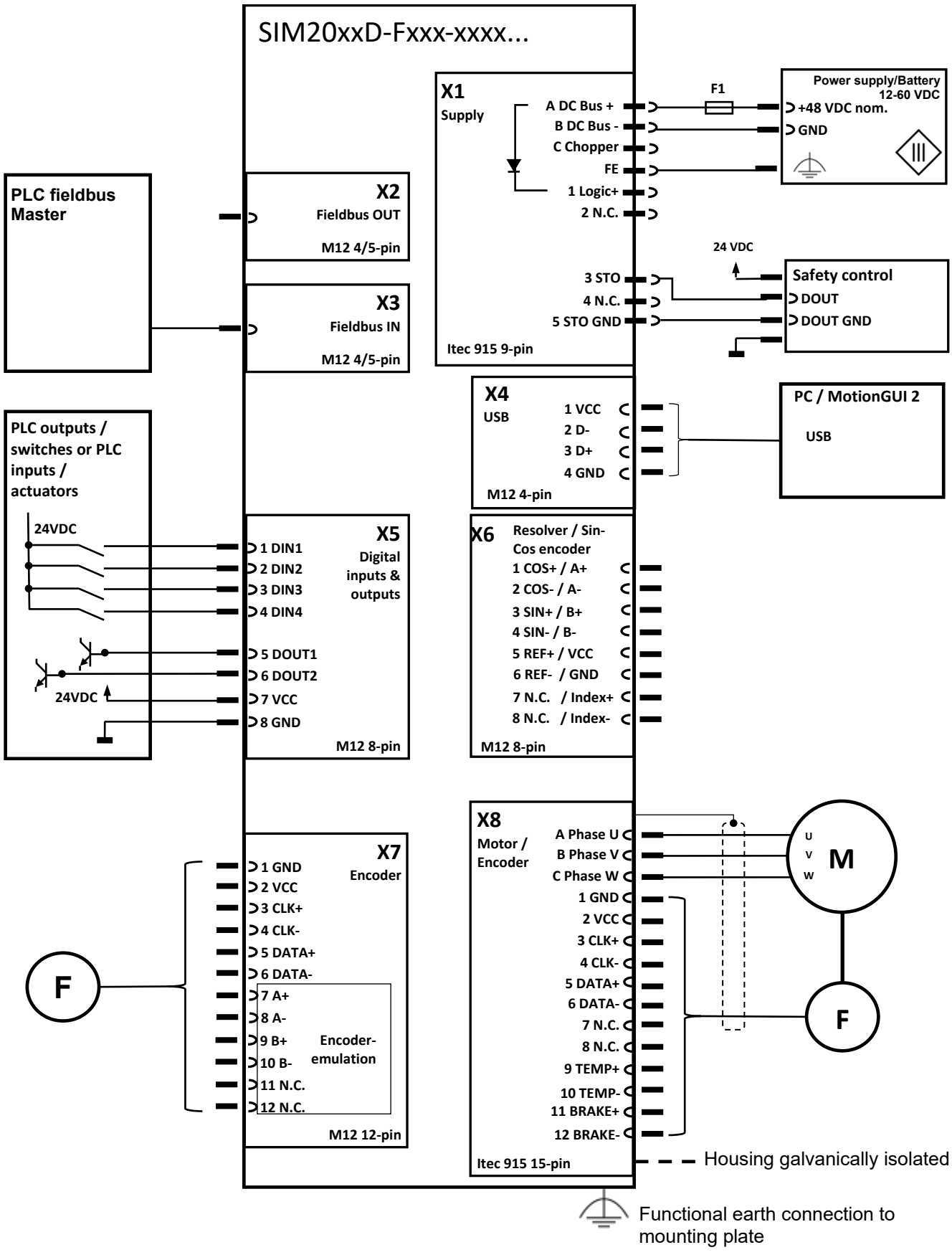
Image 6.1: IP65 plug connection (SIM2007 / SIM2015)

No.	Function	Connector type on the device	Connector type on the cable
X1	Power supply	Intercontec itec 915 9-pin, male	Intercontec itec 915, 9-pin, female
X2	Output fieldbus interface	CAN: M12 5-pin, female, A-coded Ethernet-based: M12 4-pin, female, D-coded	CAN: M12 5-pin, male, A-coded Ethernet-based: M12 4-pin, male, D-coded
X3	Input fieldbus interface	CAN: M12 5-pin, male, A-coded Ethernet-based: M12 4-pin, female, D-coded	CAN: M12 5-pin, female, A-coded Ethernet-based: M12 4-pin, male, D-coded
X4	USB diagnostic interface	M12 4-pin, female, A-coded	M12 4-pin, male, A-coded
X5	Digital inputs/outputs	M12 8-pin, male, A-coded	M12 8-pin, female, A-coded
X6	Resolver / Sin-Cos encoder interface	M12 8-pin, female, A-coded	M12 8-pin, male, A-coded
X7	Encoder interface	M12 12-pin, female, A-coded	M12 12-pin, male, A-coded
X8	Motor connection	Intercontec itec 915 15-pin, female	Intercontec itec 915, 15-pin, male

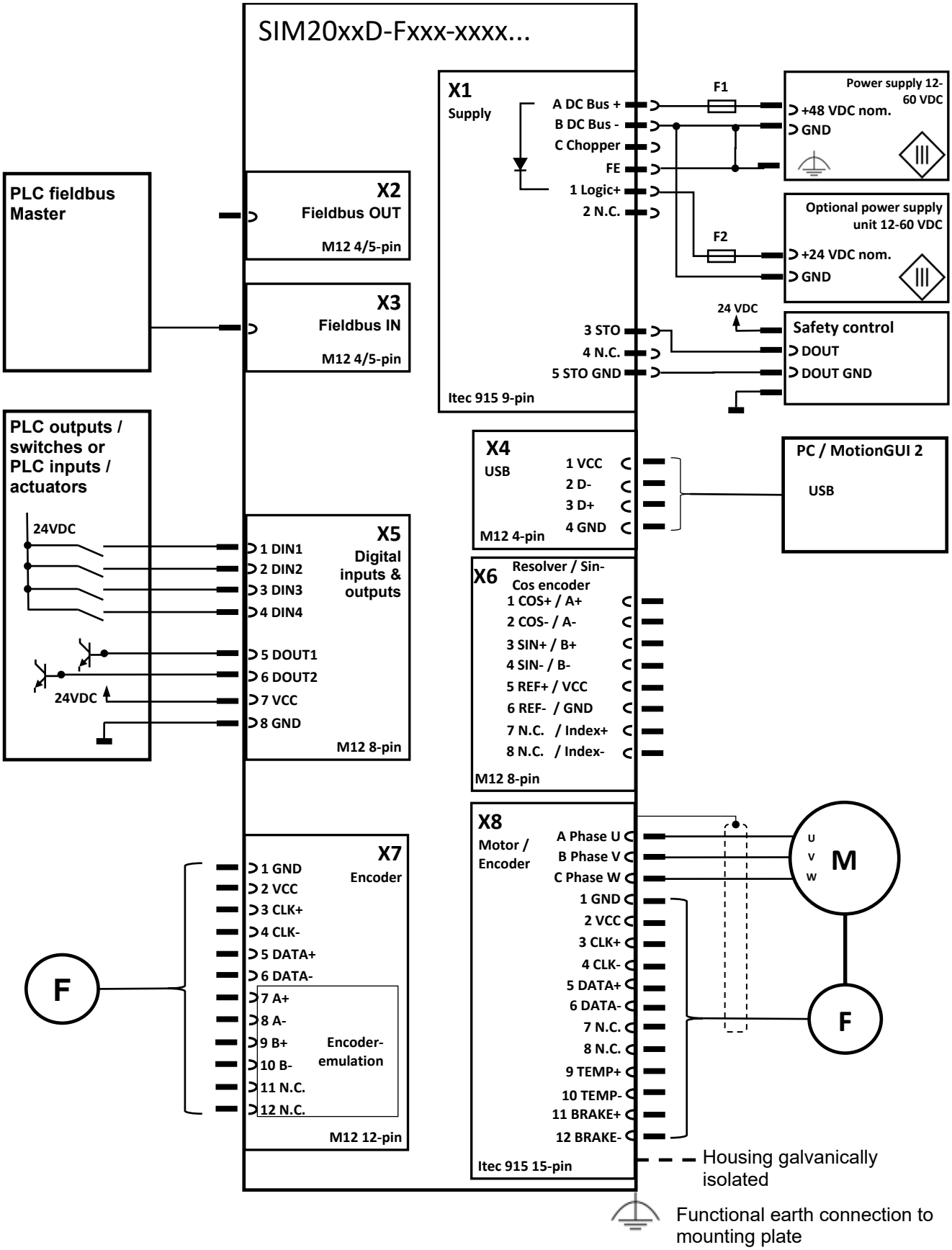
6.4.2 IP65 Connection diagram

The following illustrations show the key connection diagrams of the drive amplifier when supplied with SELV and PELV power supply units.
For applications in automated guided vehicles (AGV), the standard DIN EN 1175:2020-10 (VDE 0117:2020-10) must be applied. If simco® drive 2 is to be used in a DTS application, the wiring illustrated in the following must be used due to missing galvanic isolation between logic and power. In this respect, simco® drive 2 is fully supplied from the battery. This is enabled by a wide range voltage input of 12-60 VDC and the possible use of a power source (logic supply is realized via an internal diode).

Connection diagram IP 65 with one power supply unit for power and logic



Connection diagram IP 65 with two power supply unit for power and logic



6.4.3 Earthing and functional earth

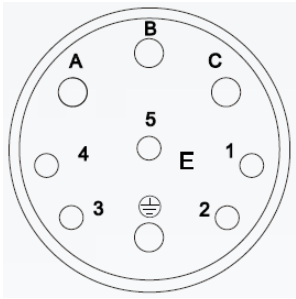
In order to maintain conformity with the EMC limit values and ensure the functioning of the drive amplifier, the housing of the drive amplifier must be connected to the control cabinet's functional earth with low impedance.
When mounting the drive amplifier on a metallic and conductive top-hat rail it 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 X1: Power supply

The safety input STO (pin 3+5) is galvanically isolated from the intermediate circuit voltage (pin A) and the logic power supply (pin 1). DCBus- or GND (pin B) is not connected with the functional earth and the housing within the device.

Figure	Pin no.	Signal name	Function	Input / output
	A	DCBus+	Intermediate circuit voltage +	Input
	B	DCBus-	Intermediate circuit voltage -	Input
	C	CHOPPER-	External brake resistance	Output
	FE	FE	Functional earth	Functional earth
	1	Logic+	Logic supply	Input
	2	N.C.		
	3	STO	Safe torque off input	Input
	4	N.C.		
	5	STO GND	STO ground reference	Input
Plug type on drive amplifier: Intercontec, itec 915, 9-pin, male (EEGA 201 NN00 00 0506 000)				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
DCBus+ / -	Voltage	V DC	12	48	60
	Current	A DC			30[1] / 15[2]
Chopper	Voltage	V DC			56[3]
	Current	A DC		9[4]	15 (für 15s)[4] / 25 (für 5s)[4]
Logic+	Voltage	V DC	12	24	60
	Current	mA DC			200
STO	Voltage	V DC	12	24	60
	Current	mA DC			80

[1] : SIM2015D
[2] : SIM2007D
[3] : The chopper switches on at 56 V and off at 52 V as standard (4 V hysteresis, average value 54 V); for other voltages and settings, please hold backrap with the support.
[4] : A minimum braking resistor of 2.2 Ohm with 500 W_{nom} / 1,400 W_{PEAK} must be used. Lower resistance values must not be connected, a higher current could destroy the chopper control. Larger resistance values can be used, thus reducing the chopper peak power accordingly.

The braking resistor must be connected between chopper- and an external connection with DC+.
The power connections do not have reverse polarity protection. Reversing the polarity will destroy the device.

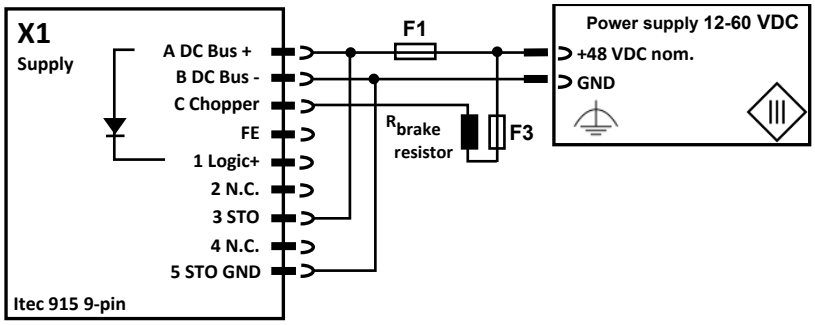
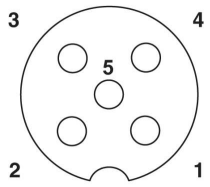


Image 6.2: Chopper

6.4.5 X2: CANopen fieldbus interface (output)

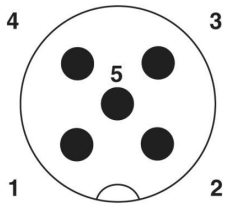
– The CAN ground reference (CAN_GND) and the CAN signals CAN_H and CAN_L are galvanically isolated from DC BUS signals.

Figure	Pin no.	Signal	Function
	1	Shield	Screen
	2	N.C.	
	3	CAN_GND	CAN ground reference
	4	CAN_H	CAN High
	5	CAN_L	CAN Low
Plug type on drive amplifier: M12 5-pin, female, A-coded at X2			

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

6.4.6 X3: CANopen fieldbus interface (input)

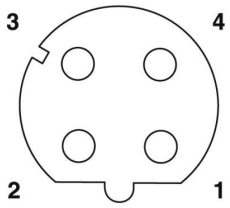
– The CAN ground reference (CAN_GND) and the CAN signals CAN_H and CAN_L are galvanically isolated from DC BUS signals.

Figure	Pin no.	Signal	Function
	1	Shield	Screen
	2	N.C.	
	3	CAN_GND	CAN ground reference
	4	CAN_H	CAN High
	5	CAN_L	CAN Low
Plug type on drive amplifier: M12 5-pin, male, A-coded at X3			

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

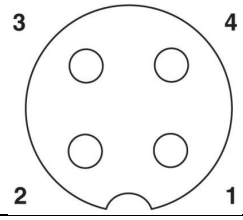
6.4.7 X2/X3:Fieldbus interface EtherCat, PROFINET, EtherNet/IP and SERCOS III

– 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 X2 and X3			

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

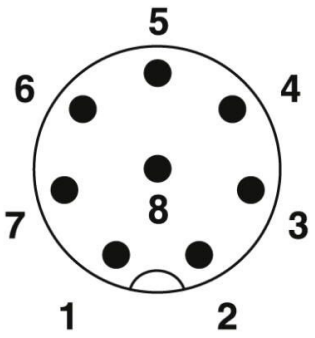
6.4.8 X4: USB diagnostic interface

Figure	Pin no.	Signal	Function	Input/output
	1	VCC	Supply voltage	Input
	2	D-	Data -	Input / output
	3	D+	Data +	Input / output
	4	GND	Ground reference	
Plug type on drive amplifier: M12 4-pin, female, A-coded				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
USB 2.0					

6.4.9 X5: Digital inputs and outputs

- An external reference potential must be connected to supply the digital inputs.
  – The digital inputs are galvanically isolated from the logic and power of the drive amplifier.
- An external power supply must 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 name	Function	Input / output
	6	DIN1	Digital input 1	Input
	1	DIN2	Digital input 2	Input
	8	DIN3	Digital input 3	Input
	2	DIN4	Digital input 4	Input
	7	GND	Ground reference	
	3	DOUT1	Digital output 1	Output
	4	DOUT2	Digital output 2	Output
	5	VCC	Digital output supply	Input
Plug type on drive amplifier: M12 8-pin, male, A-coded				

Connection	Feature	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
DOUTx	Output voltage	V DC	18	24	26
	Output current	mA DC			40
	Output resistance	kOhm	1	1.5	2
	Refresh rate	kHz			1
VCC24	Voltage	V DC	20	24	28
	Current	mA DC			80
GND	Ground reference				

6.4.10 X6: Resolver / Sin-Cos Encoder

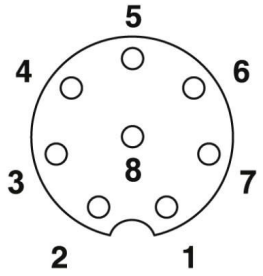
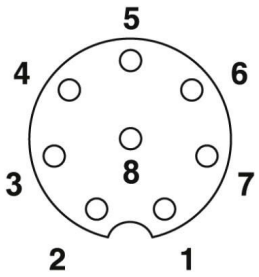
Figure	Pin no.	Signal name	Function	Input / output
	1	COS+	Cosine trace S1	Input
	2	COS-	Cosine trace S3	Input
	3	SIN+	Sine trace S2	Input
	4	SIN-	Sine trace S4	Input
	5	REF+	Reference trace R1	Output
	6	REF-	Reference trace R2	Output
	7	N.C.		
	8	N.C.		
Plug type on drive amplifier: M12 8-pin, female,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

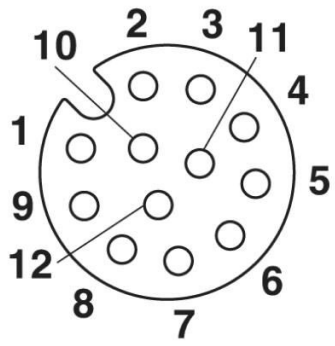
Figure	Pin no.	Signal name	Function	Input/output
	1	A+	Cosine trace	Input
	2	A-	Cosine trace	Input
	3	B+	Sine trace	Input
	4	B-	Sine trace	Input
	5	VCC	Encoder power supply	Output
	6	GND	Ground reference	Output
	7	Index+	Zero pulse	Input
	8	Index-	Zero pulse inverted	Input
Plug type on drive amplifier: M12, 8-pin, female, A-coded				

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
Resolver					
Ref+; Ref-	Excitation frequency	kHz		8	
	Output voltage	Vpk	3.0	3.5	5
	Output current	mA			50
Sin+; SIN-; Cos+; Cos-	Input voltage	Vpk			1.75
	Input resistance	kOhm		10	
Sine/cosine					
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500*
A+; A-; B+; B-	Input resistance	kOhm		10	
	Input voltage	Vpk		1	1.75
Index+; Index-	Input voltage	Vpk		1	5.3
	Input resistance	kOhm		22	
	Resolution	Bit			12
* The voltage supply has a self-resetting fuse.					

6.4.11 X7: Encoder

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

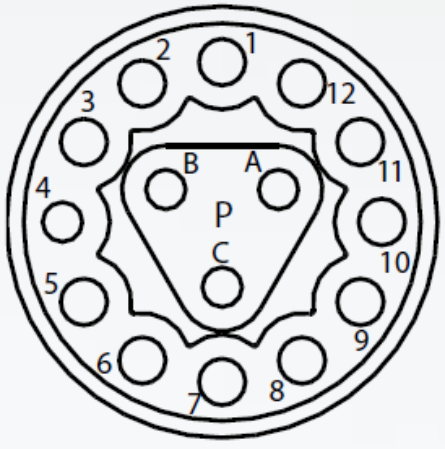
  – The encoder interface X7 can be used to evaluate fully digital encoder systems with the protocols EnDat 2.2, BISS C and SSI.
  – The encoder interface has a 5 V power supply, secured with a self-resetting fuse, with a current rating of 500 mA.

Figure	Pin no.	Signal name	Function	Input / output
	1	GND	Ground reference	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	N.C.		
	12	N.C.		
Plug type on drive amplifier: M12 12-pin, female, A-coded				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500
Clock+; Clock-	Output voltage	V DC			3.3
	Output current	mA DC			60
Data+; Data-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	
A+, A-, B+, B-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	

6.4.12 X8: 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	Ground reference	
	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.		
	8	N.C.		
	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, 9-pin, female (EEGA 205 NN00 00 0008 000)				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
PHASE_x	Current	Aeff		15[1] / 7[2]	30[1] / 15[2]
VCC	Voltage	V DC	4.5	5	5.5
	Current	mA DC			500
BRAKE+/-	Voltage	V DC		24	
	Current	A DC			0.8

[1] : SIM2015D
[2] : SIM2007D

Identify your product (product type) from the material number.
The following information only applies to material numbers with dash versions 00 and 01, e.g. 50020164-**00**-0 and 50020164-**01**-0.
In these hardware versions, the temperature sensor input has an increased sensitivity to EMC interferences. For correct temperature display on motors with a temperature sensor, the following must be taken into account:

- The lines of the temperature sensor must be separately and fully shielded
- The entire surface of the temperature sensor shield must be placed on the drive amplifier
- The motor lines must be separated and fully shielded

6.5 Connection assignments device version IP20 central SIM2007D-CC... / SIM2015D-CC…

- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2007D-CC.../ SIM2015D-CC...

6.5.1 Overview of IP20 plug connections

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

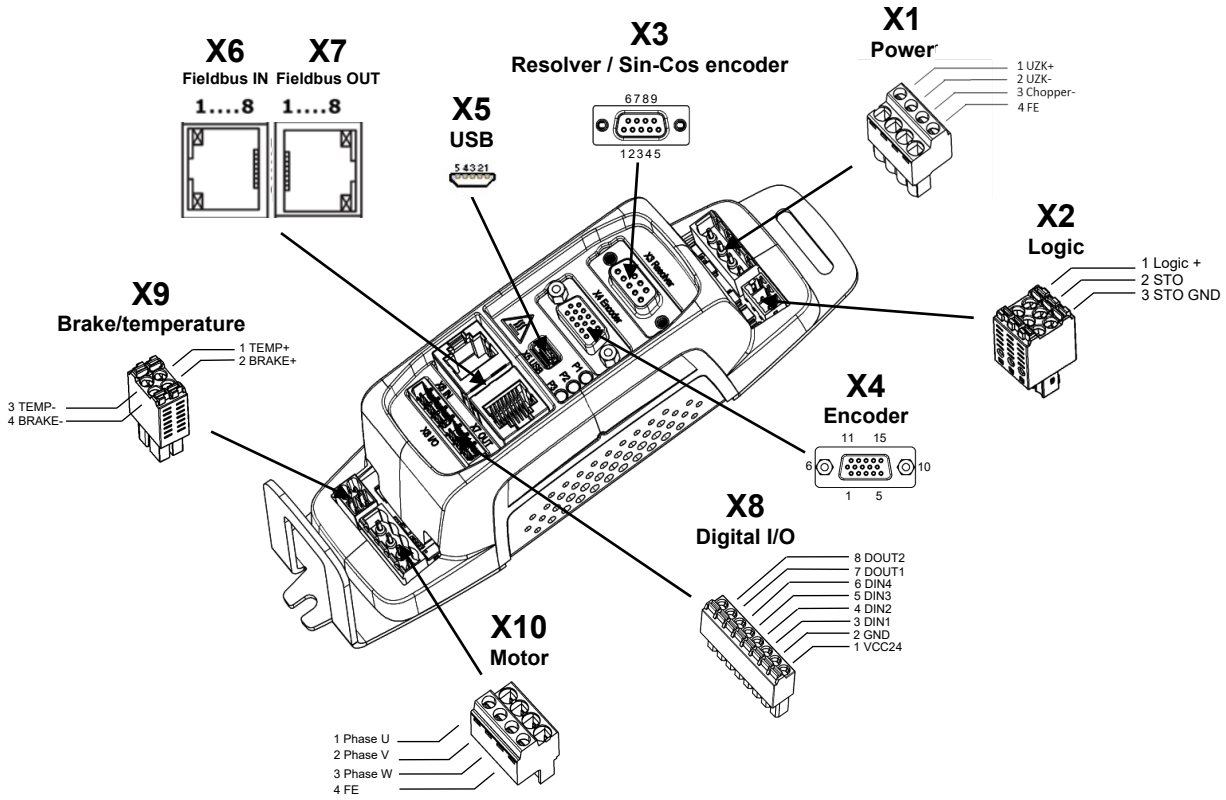


Image 6.3: Overview IP20 plug connections

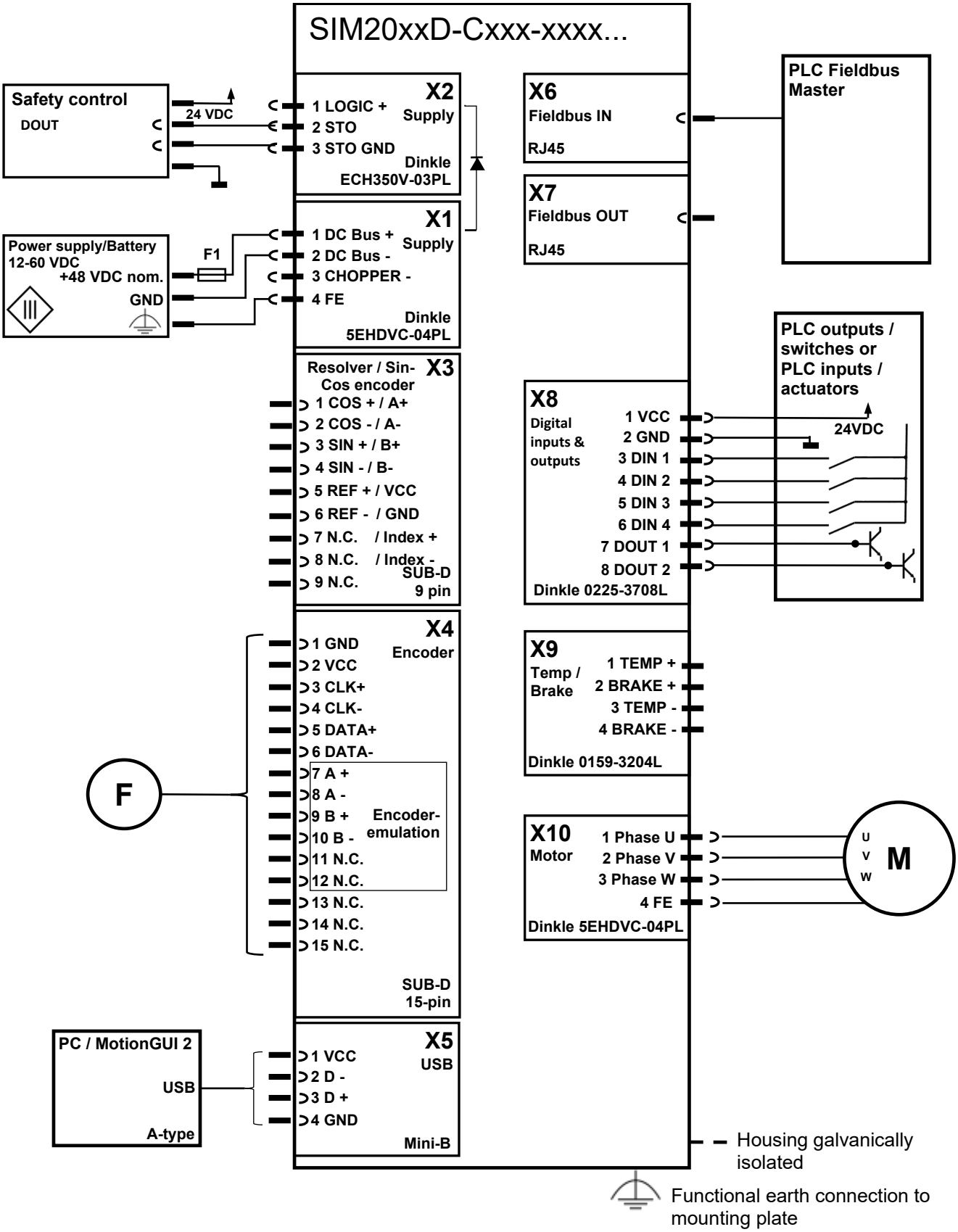
No.	Function	Connector type on the device	Connector type on the cable
X1	Power	Dinkle 5EHDVC-04PL	Dinkle 5ESDF
X2	Logic supply	Dinkle ECH350V-03PL	Dinkle 0181-A303
X3	Resolver interface	D-Sub, 9-pin, female	D-Sub, 9-pin, male
X4	Encoder	D-Sub, 15-pin, female	D-Sub, 15-pin, male
X5	Diagnostic interface	Mini-B socket	Mini-B plug
X6	Input fieldbus interface	RJ45 socket	RJ45 plug
X7	Output fieldbus interface	RJ45 socket	RJ45 plug
X8	Digital I/O	Dinkle 0225-3708L	Dinkle 0225-0808
X9	Brake / temp	Dinkle 0159-3204L	Dinkle 0159-0304
X10	Motor	Dinkle 5EHDVC-04PL	Dinkle 5ESDF

6.5.2 IP20 connection diagram

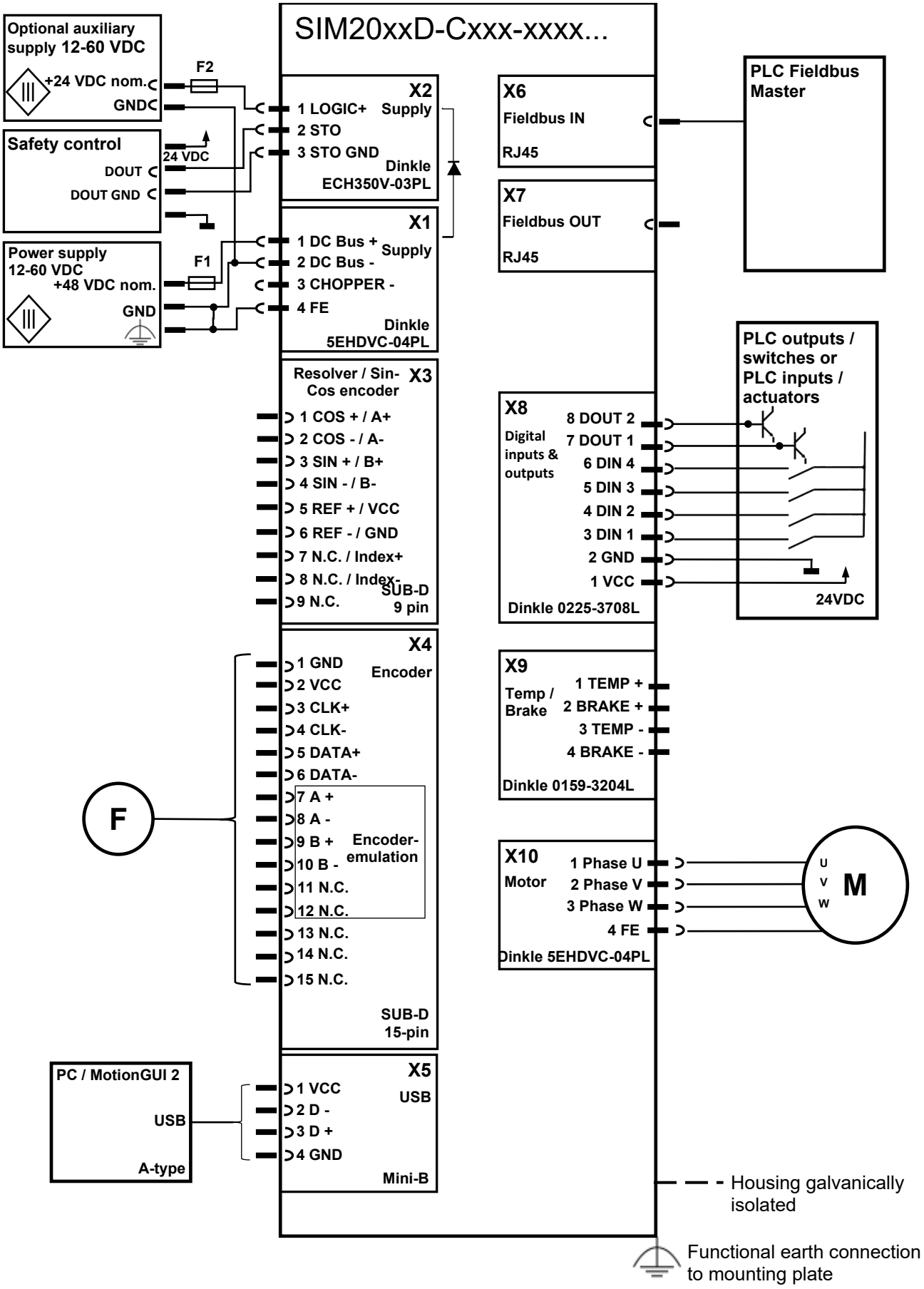
The following illustrations show the key connection diagrams of the drive amplifier when supplied with SELV and PELV power supply units.
For applications in automated guided vehicles (AGV), the standard DIN EN 1175:2020-10 (VDE 0117:2020-10) must be applied. If simco® drive 2 is to be used in a DTS application, the wiring illustrated in the following must be used due to missing galvanic isolation between logic and power. In this respect, simco® drive 2 is fully supplied from the battery. This is enabled by

a wide range voltage input of 12-60 VDC and the possible use of a power source (logic supply is realized via an internal diode).

Connection diagram IP 20 with one power supply unit for power and logic



Connection diagram IP 20 with two power supply unit for power and logic



6.5.3 Earthing and functional earth

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 earth 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.

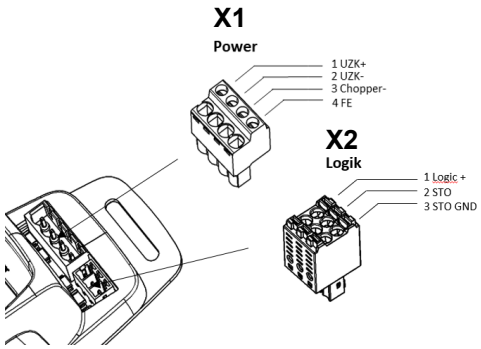
	NOTICE
	• If the drive amplifier is not sufficiently grounded, this may cause radio interference, leading to non-conformity with the EC EMC Directive. This can result in malfunctions in the drive amplifier and other electronic systems.

6.5.4 IP20 shield connection

The figure shows the connection of the outer shield of the motor cable to the housing of the drive amplifier.
The preferred 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.

6.5.5 X1/X2: Power supply

The safety input STO (X2 pin 2+3) is galvanically isolated from the intermediate circuit voltage (X1 pin 1) and logic voltage (X2 Pin1). DCBus- or GND (X1 pin 2) is not connected with the functional earth and the housing within the device.

Figure	Pin no.	Signal name	Function
	Power connector X1		
	1	DCBus+	Intermediate circuit voltage +
	2	DCBus-	Intermediate circuit voltage -
	3	Chopper-	External brake resistance
	4	FE	Functional earth
	Logic plug X2		
	1	Logic+	Logic supply
	2	STO	Safe torque off input
	3	STO GND	STO ground reference
Plug type X1 at Dinkle 5ESDF-04P-BK **Permissible wire cross-section: AWG 24 ... 12** **Stripping length: 8 mm** **Plug type X2 at Dinkle 0181-A303** **Permissible wire cross-section: AWG 24 ... 26** **Stripping length: 8 mm**			

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
Logic+	Voltage	V DC	12	24	60
	Current	mA DC			200
STO	Voltage	V DC	12	24	60
	Current	mA DC			80
DCBus+ / -	Voltage	V DC	12	48	60
	Current	A DC			30[1] / 15[2]
Chopper	Voltage	V DC			56[3]
	Current	A DC		9[4]	15 (für 15s)[4] / 25 (für 5s)[4]
The power connections do not have reverse polarity protection. Reversing the polarity will destroy the device.					

[1] : SIM2015D
[2] : SIM2007D
[3]: The chopper switches on at 56 V and off at 52 V as standard (4 V hysteresis, average value 54 V) For other voltages and settings, please consult the support.
[4]: A minimum braking resistor of 2.2 Ohm with 500 W_{nom} / 1,400 W_{PEAK} must be used. Lower resistance values must not be connected, a higher current could destroy the chopper control. Larger resistor values can be used, thus reducing the chopper peak power accordingly.

The braking resistor must be connected between chopper- and an external connection with DC+.

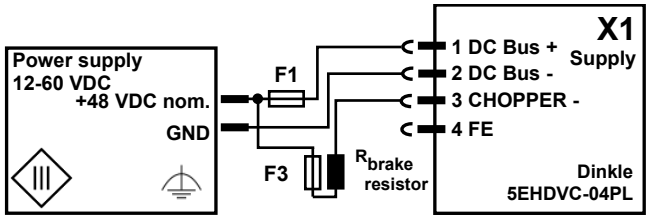


Image 6.4: Chopper

6.5.6 X3: Resolver / Sin-Cos encoder

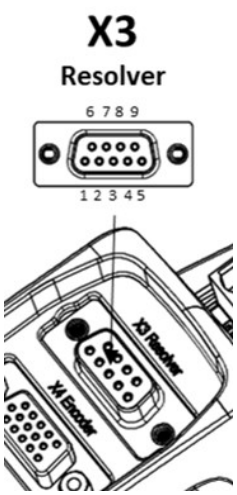
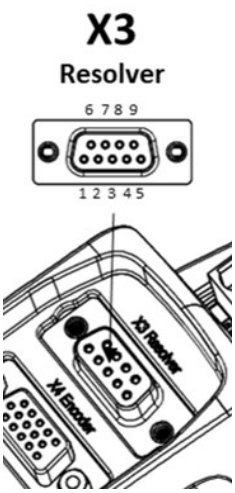
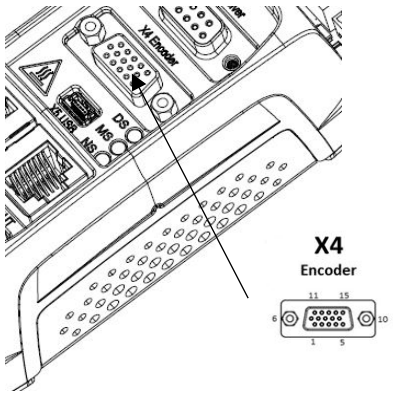
Figure	Pin no.	Signal name	Function	Input / output
	1	COS+	Cosine trace S1	Input
	2	COS-	Cosine trace S3	Input
	3	SIN+	Sine trace S2	Input
	4	SIN-	Sine trace S4	Input
	5	REF+	Reference trace R1	Output
	6	REF-	Reference trace R2	Output
	7	N.C.		
	8	N.C.		
	9	N.C.		
Plug type on drive amplifier: D-Sub,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

Figure	Pin no.	Signal name	Function	Input / output
	1	A+	Cosine trace	Input
	2	A-	Cosine trace	Input
	3	B+	Sine trace	Input
	4	B-	Sine trace	Input
	5	VCC	Encoder power supply	Output
	6	GND	Ground reference	Output
	7	Index+	Zero pulse	Input
	8	Index-	Zero pulse inverted	Input
	9	N.C.		
Plug type on drive amplifier: D-Sub, 9-pin, female				

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
Resolver					
Ref+; Ref-	Excitation frequency	kHz		8	
	Output voltage	Vpk	3.0	3.5	5
	Output current	mA			50
Sin+; SIN-; Cos+; Cos-	Input voltage	Vpk			1.75
	Input resistance	kOhm		10	
Sine/cosine					
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500*
A+; A-; B+; B-	Input resistance	kOhm		10	
	Input voltage	Vpk		1	1.75
Index+; Index-	Input voltage	Vpk		1	5.3
	Input resistance	kOhm		22	
	Resolution	Bit			12
* The voltage supply has a self-resetting fuse.					

6.5.7 X4: Encoder

- The plug may only be inserted when the drive amplifier is in a de-energized state.
  - The encoder interface X4 can be used to evaluate fully digital encoder systems with the protocols EnDat 2.2, BISS C and SSI.
  - The encoder interface has a 5 V power supply, secured with a self-resetting fuse, with a max. current rating of 500 mA.
  - Encoder emulation is also available via encoder interface X4.

Figure	Pin no.	Signal name	Function	Input / output
	1	GND	Ground reference	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	N.C.		
	12	N.C.		
	13	N. C.		
	14	N. C.		
	15	N.C.		
Plug type on drive amplifier: D-Sub, 15-pin, female				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500
Clock+; Clock-	Output voltage	V DC			3.3
	Output current	mA DC			60
Data+; Data-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	
A+, A-, B+, B-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	

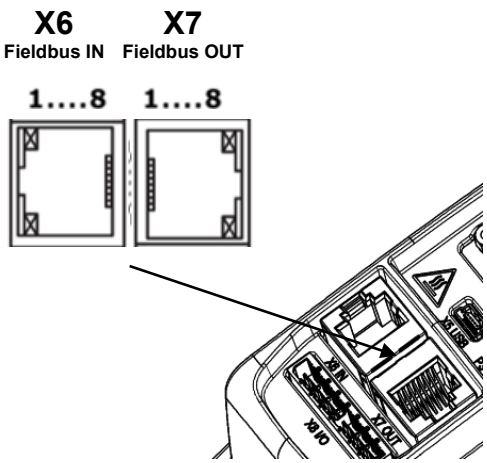
6.5.8 X5: Diagnostic interface USB

Figure	Pin no.	Signal	Function	Input/Output
	1	VCC	Supply voltage	Input
	2	D-	Data -	Input / output
	3	D+	Data +	Input / output
	4	N.C.		
	5	GND	Ground reference	
Plug type on drive amplifier: Mini-USB B socket				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
USB 2.0					

6.5.9 X6/X7: Fieldbus interface CANopen

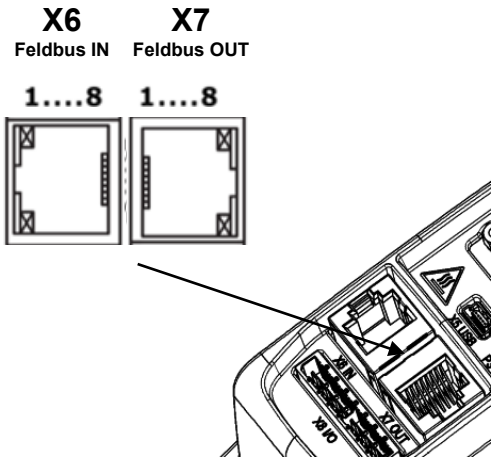
The CAN ground reference (CAN_GND) and the CAN signals CAN_H and CAN_L are galvanically isolated from DC BUS signals.

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

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

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

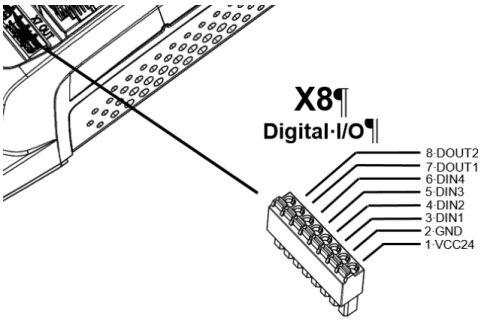
– The signals are galvanically isolated from the logic and power of the drive.

Figure	Pin no.	Signal name	Function
	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	Feature	Unit	Minimum value	Nominal value	Maximum value
	Transmission speed	MBit/s		100	

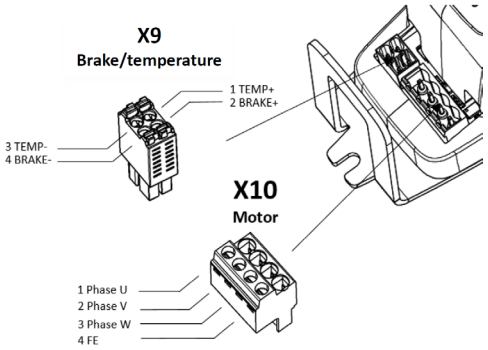
6.5.11 X8: Digital I/O

- An external power supply must 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	VCC	Digital output supply	Input
	2	GND	Ground reference	
	3	DIN1	Digital input 1	Input
	4	DIN2	Digital input 2	Input
	5	DIN3	Digital input 3	Input
	6	DIN4	Digital input 4	Input
	7	DOUT1	Digital output 1	Output
	8	DOUT2	Digital output 2	Output
Plug type on drive amplifier: Dinkle 0225-3708L 8-pin				

Connection	Feature	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	Ground reference				
DOUTx	Output voltage	V DC	18	24	26
	Output current	mA DC			40
	Output resistance	kOhm	1	1.5	2
	Refresh rate	kHz			1
VCC	Voltage	V DC	20	24	28
	Current	mA DC			80
GND					

6.5.12 X9/X10: Motor / brake / temperature connection

Figure	Pin no.	Signal name	Function
	Motor plug X10		
	1	PHASE_U	Motor phase U
	2	PHASE_V	Motor phase V
	3	PHASE_W	Motor phase W
	4	FE	Functional earth
	Brake/temperature plug X9		
	1	TEMP+	Motor temperature sensor +
	2	BRAKE+	Holding brake +
	3	TEMP-	Motor temperature sensor -
	4	BRAKE-	Holding brake -

Plug type X9 Dinkle 0159-0304
Permissible wire cross-section: AWG 24..26
Stripping length: 8 mm

Plug type X10 on Dinkle 0181-A303
Permissible wire cross-section: AWG 24..12
Stripping length: 8 mm
Tightening torque: 0.5 ... 0.6 Nm; the tightening torque must be 0.5 Nm to conform to the UL requirement

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
PHASE_x	Current	Aeff		15[1] / 7.5[2]	30[1] / 15[2]
BRAKE+/-	Voltage	V DC		24	
Connection	Current	A DC			0.8

[1] : SIM2015D
[2] : SIM2007D

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

Connection schematic	
U	Red
V	White
W	Black

Identify your product (product type) from the material number.
The following information only applies to material numbers with dash versions 00 and 01, e.g. 50020164-**00**-0 and 50020164-**01**-0.
In these hardware versions, the temperature sensor input has an increased sensitivity to EMC interferences. For correct temperature display on motors with a temperature sensor, the following must be taken into account:

- The lines of the temperature sensor must be separately and fully shielded
- The entire surface of the temperature sensor shield must be placed on the drive amplifier
- The motor lines must be separated and fully shielded

6.6 Connection assignments device version IP65 decentral SIM2050D-FC.../SIM2100D-FC...

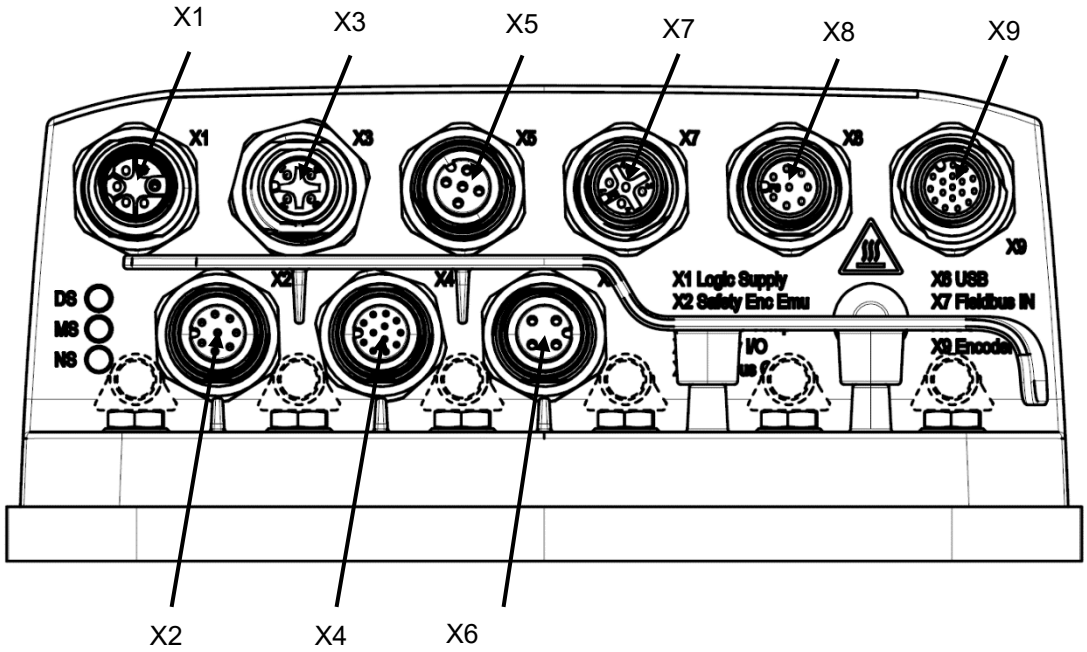
- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2050D-FC.../ SIM2100D-FC...

ⓘ Information about SIM2007D-FC.../SIM2015D-FC... can be found in chapter 6.4 "Connection assignments device version IP65 decentral SIM2007D-FC... / SIM2015D-FC…".

6.6.1 Overview of IP65 plug connections

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

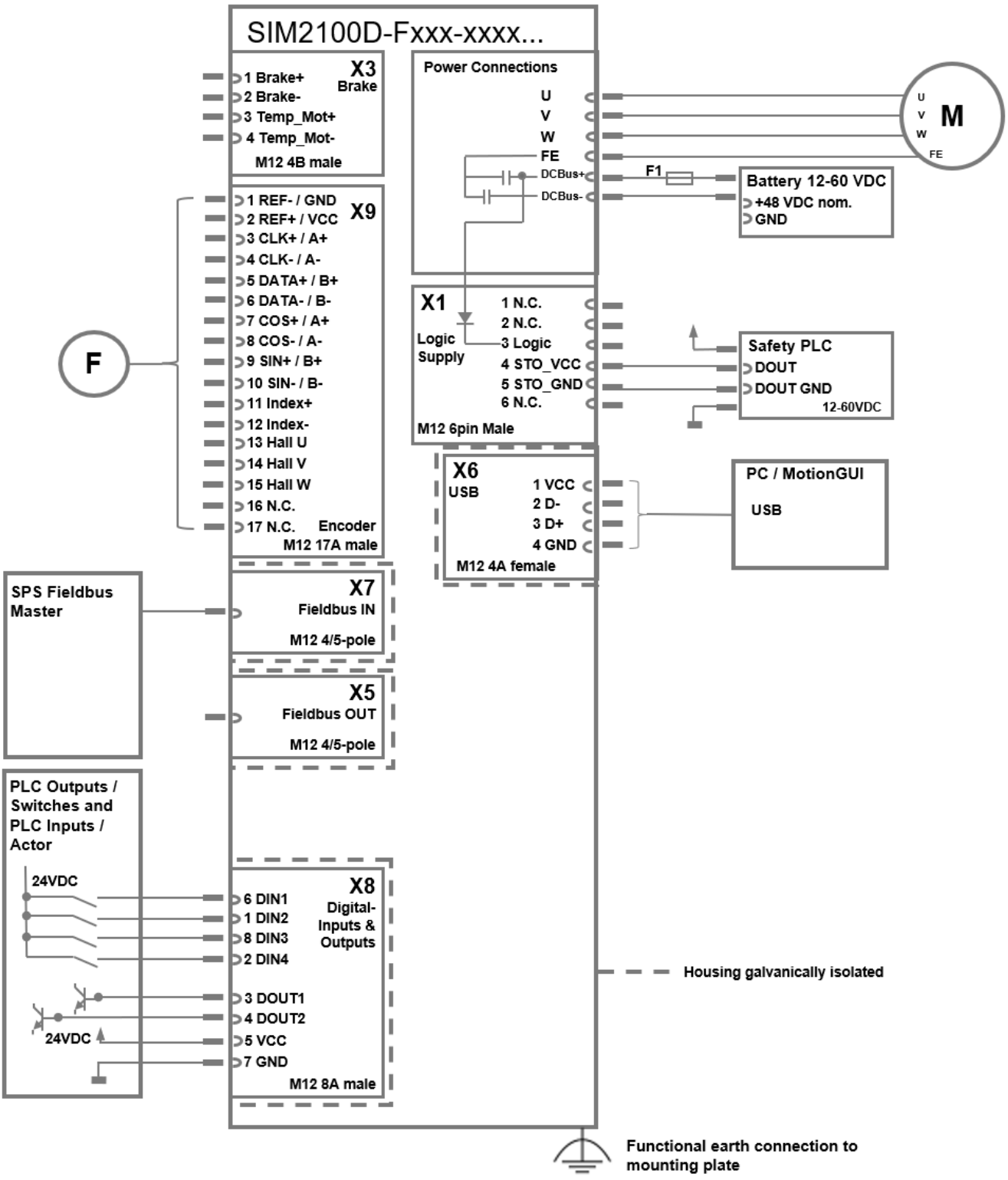


No.	Function	Connector type on the device	Connector type on the cable
X1	Power supply	M12 6-pin, male	M12 6-pin, female
X2	Safety encoder emulation	M12 8-pin, female, A-coded	M12 8-pin, male, A-coded
X3	Motor/brake temperature sensor	M12 4-pin, male, A-coded	M12 4-pin, female, A-coded
X4	Safety I/O	M12 12-pin, female, A-coded	M12 12-pin, male, A-coded
X5	Output fieldbus interface	CAN: M12 5-pin, female, A-coded Ethernet-based: M12 4-pin, female, D-coded	CAN: M12 5-pin, male, A-coded Ethernet-based: M12 4-pin, male, D-coded
X6	USB diagnostic interface	M12 4-pin, female, A-coded	M12 4-pin, male, A-coded
X7	Input fieldbus interface	CAN: M12 5-pin, male, A-coded Ethernet-based: M12 4-polig, female, D-coded	CAN: M12 5-pin, female, A-coded Ethernet-based: M12 4-pin, male, D-coded
X8	Digital inputs/outputs	M12 8-pin, male, A-coded	M12 8-pin, female, A-coded
X9	Encoder interface	M12 17-pin, male, A-coded	M12 17-pin, female, A-coded
	Motor connection U, V, W, PE and voltage supply DCBus+/DCBus-	Threaded connections M5	Terminal M5 up to 25 mm²

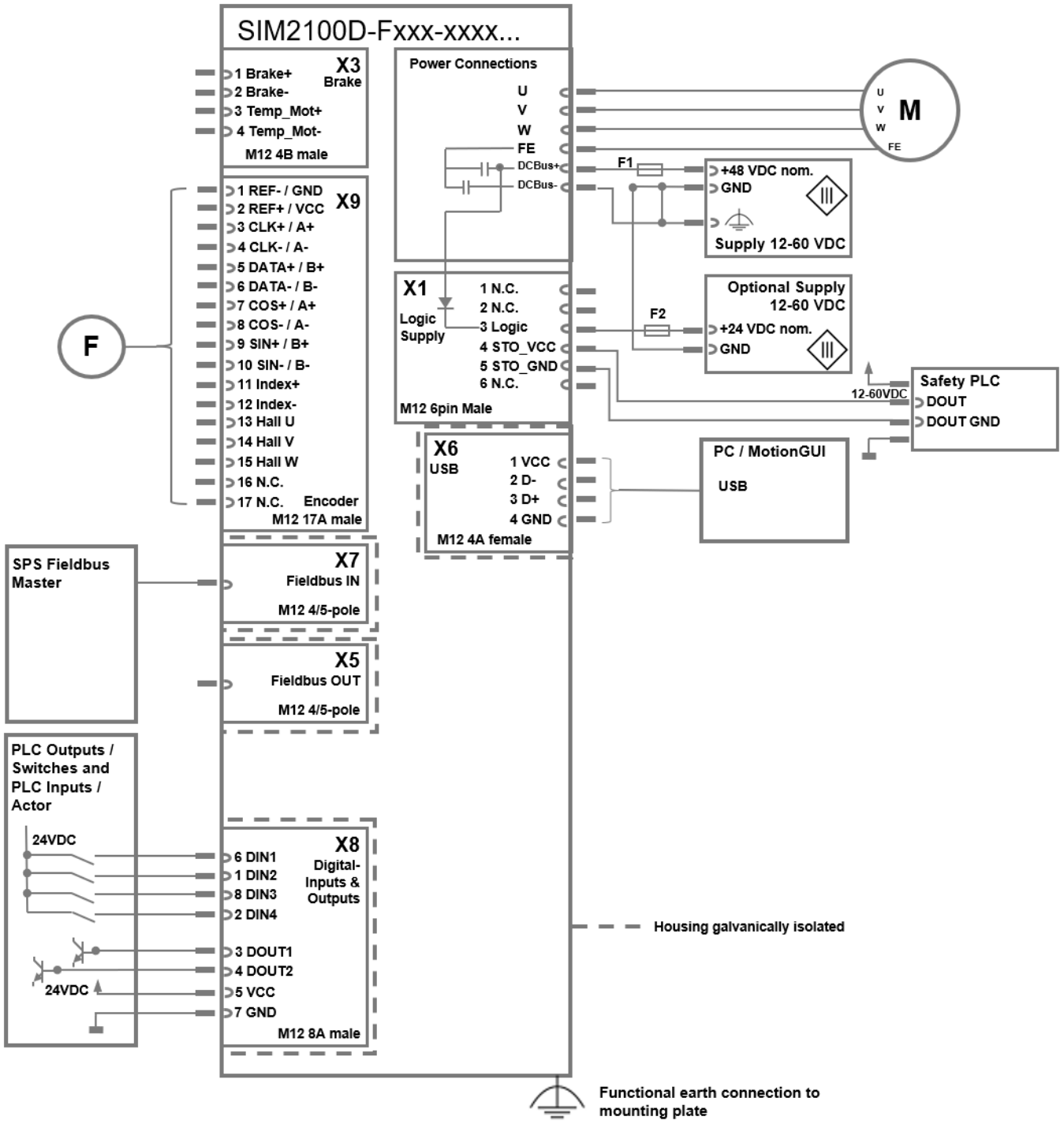
6.6.2 IP65 Connection diagram

The following illustrations show the key connection diagrams of the drive amplifier when supplied with SELV and PELV power supply units.
For applications in automated guided vehicles (AGV), the standard DIN EN 1175:2020-10 (VDE 0117:2020-10) must be applied. If simco® drive 2 is to be used in a DTS application, the wiring illustrated in the following must be used due to missing galvanic isolation between logic and power. In this respect, simco® drive 2 is fully supplied from the battery. This is enabled by a wide range voltage input of 12-60 VDC and the possible use of a power source (logic supply is realized via an internal diode).

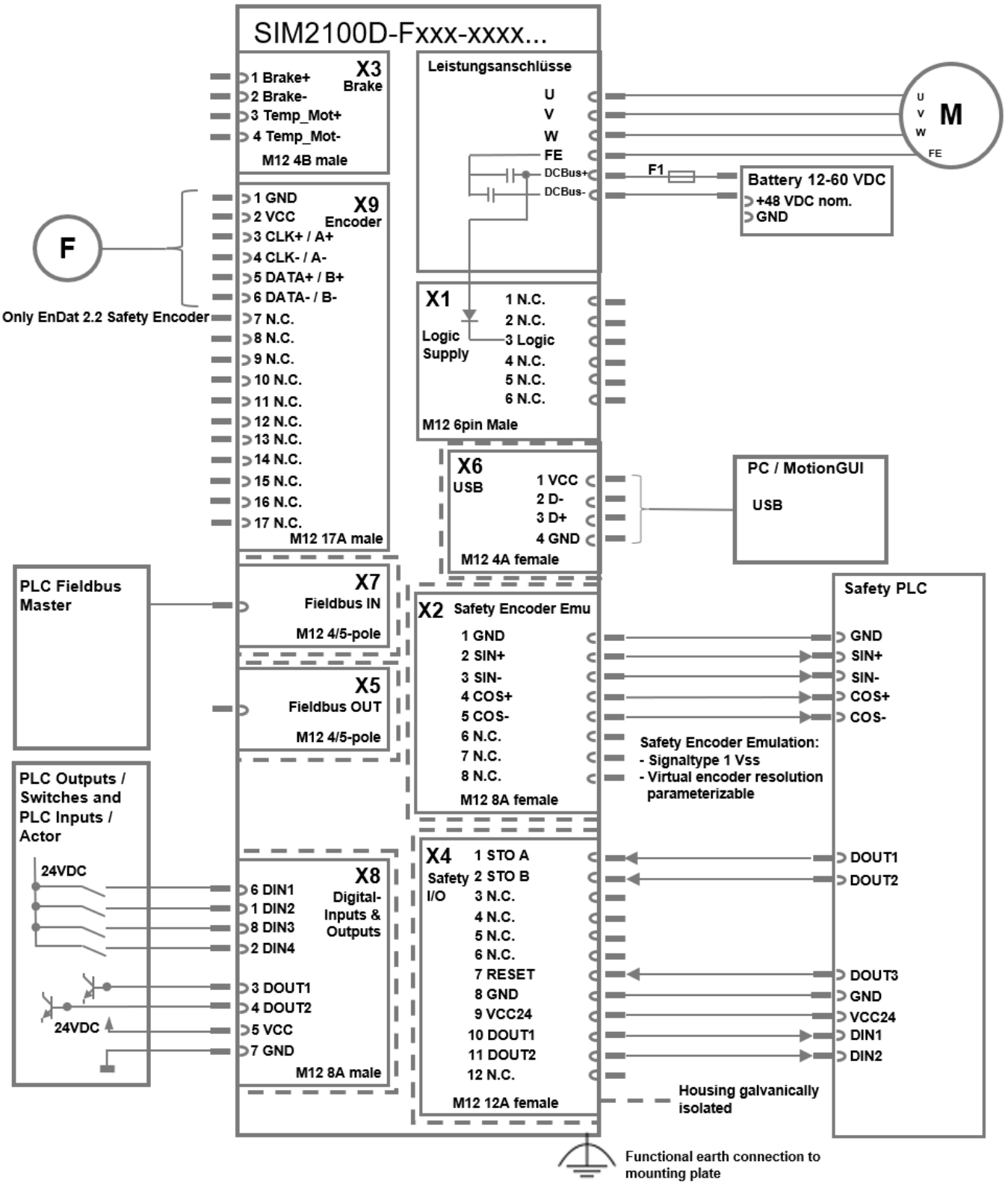
Connection diagram IP65 basic version (without optional safety card) in battery operation



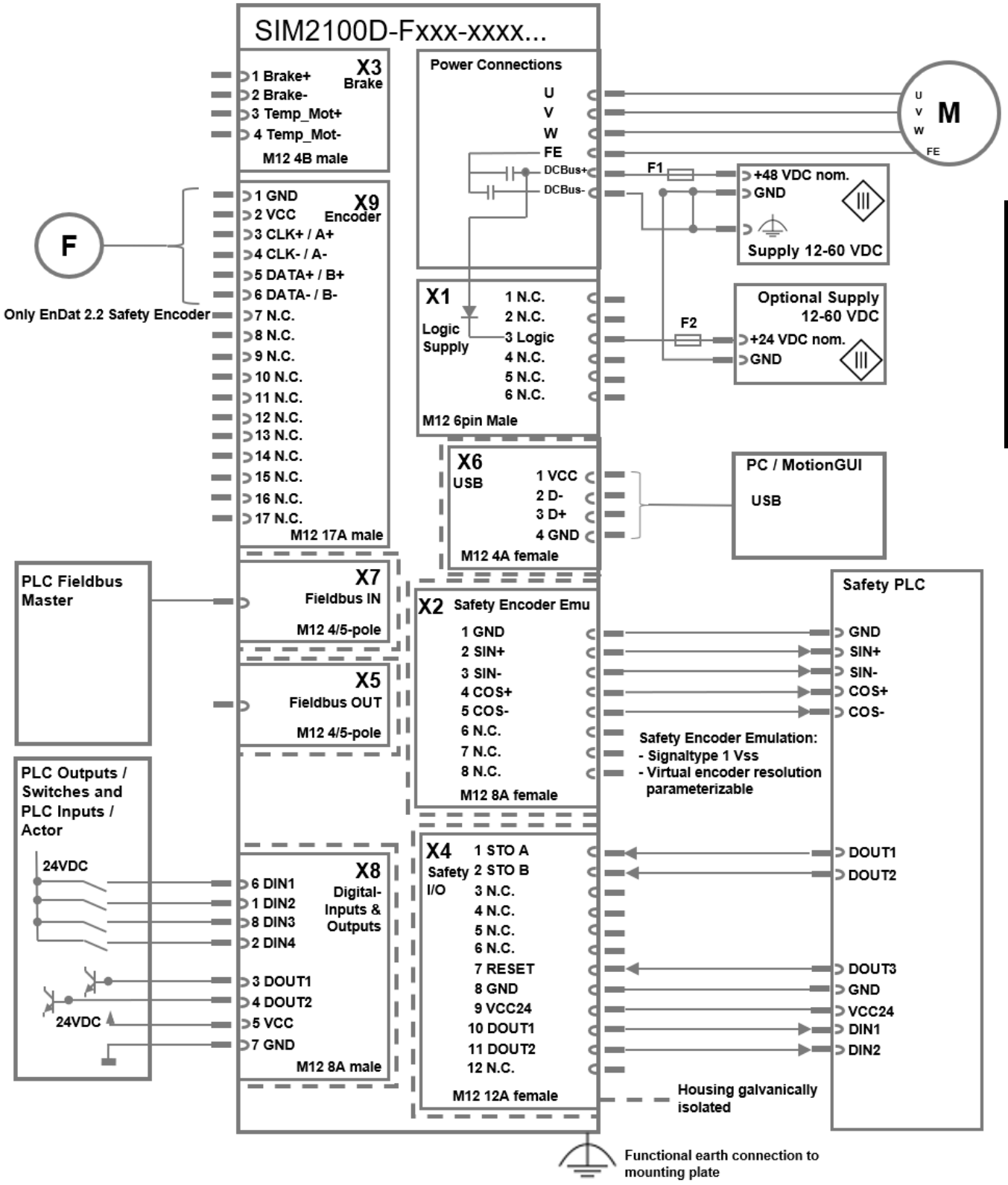
Connection diagram IP65 basic version (without optional safety card) in PSU operation



Connection diagram IP65 (with optional safety card) in battery operation



Connection diagram IP65 (with optional safety card) in PSU operation



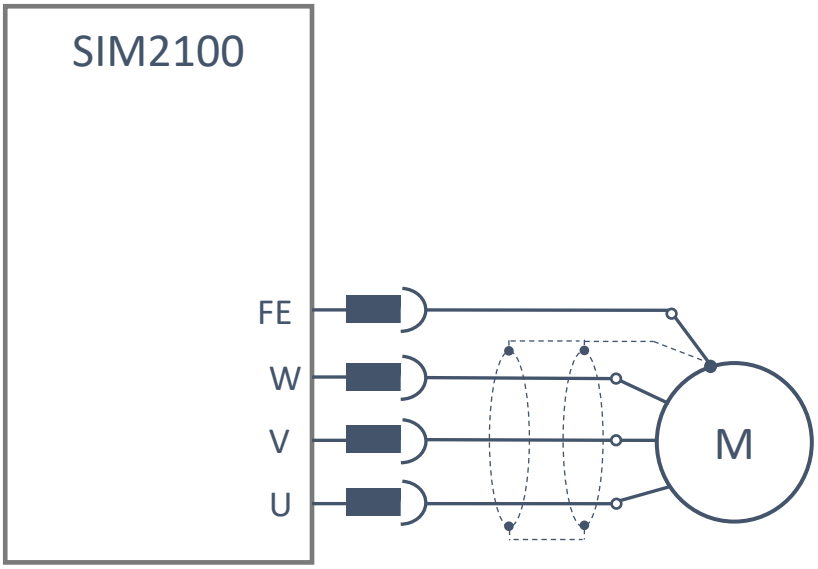
6.6.3 Earthing and functional earth

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 earth 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.

6.6.4 IP65 shield connection

With external drives, in order to maintain conformity with the EMC limit values and ensure the functioning of the drive amplifier, the shielding of the motor cable must be connected to the FE connection (threaded connection M5 with terminal M5 up to 25 mm²) of the drive amplifier.
ⓘ For tightening torques, see chapter 9.1 "Tightening torques", table 23.

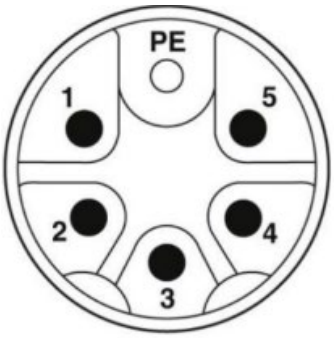


6.6.5 X1: Power supply

Basic version (without optional safety card):

In the basic version without optional safety card, STO supply is provided via this interface. Connection of the logic supply is optional. The logic supplies itself automatically via the voltage supply of the DC bus. Connection of the logic supply is necessary if the logic of the drive (e.g., communication) is to be maintained after switching off the DC bus voltage.

The safety input STO (pin 4+5) is galvanically isolated from the DC bus voltage and the logic power supply (pin 3).

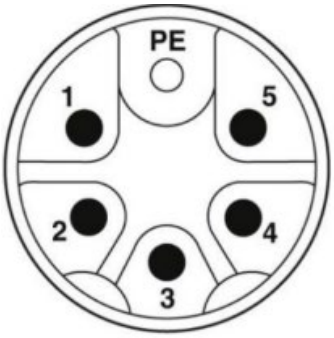
Figure	Pin no.	Signal name	Function
	1	N.C.	
	2	N.C.	
	3	LOGIC	Logic supply
	4	STO_VCC	Safe torque off input
	5	STO_GND	STO ground reference
	6	FE	Functional earth
Plug type on drive amplifier: M12, 6-pin, male, M-power			

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
LOGIC*	Voltage	V DC	12	24	60
	Current @ 12 V	mA DC	150	175	322
	Current @ 24 V	mA DC	80	100	175
	Current @ 60 V	mA DC	40	70	100
STO	Voltage	V DC	12	24	60
	Current nom.	mA DC	48	24	11

*LOGIC current consumption excludes any potentially connected brake loads. See chapter 6.6.7.

Variant with optional safety card:

For the variant with optional safety card, connection of the logic supply is optional. The logic supplies itself automatically via the voltage supply of the DC bus. Connection of the logic supply is necessary if the logic of the drive (e.g., communication) is to be maintained after switching off the DC bus voltage.

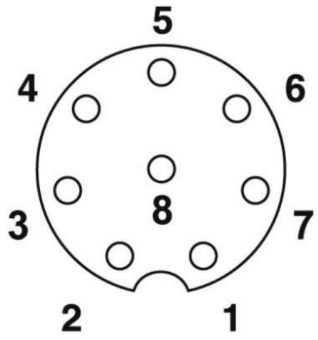
Figure	Pin no.	Signal name	Function
	1	N.C.	
	2	N.C.	
	3	LOGIC	Logic supply
	4	N.C.	
	5	N.C.	
	6	FE	Functional earth
Plug type on drive amplifier: M12, 6-pin, male, M-power			

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
LOGIC*	Voltage	V DC	12	24	60
	Current @ 12 V	mA DC	230	310	460
	Current @ 24 V	mA DC	120	172	250
	Current @ 60 V	mA DC	63	110	140

*LOGIC current consumption excludes any potentially connected brake loads. See chapter 6.6.7.

6.6.6 X2: Safety encoder emulation

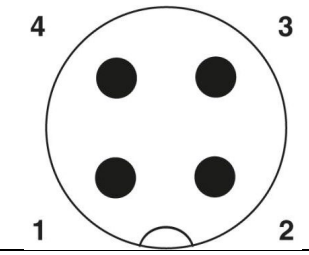
The signals are galvanically isolated from the logic and power of the drive.

Figure	Pin no.	Signal name	Function
	1	GND	Ground reference
	2	SIN+	Encoder emulation SIN+
	3	SIN-	Encoder emulation SIN-
	4	COS+	Encoder emulation COS+
	5	COS-	Encoder emulation COS-
	6	N.C.	
	7	N.C.	
	8	N.C.	
Plug type on drive amplifier: M12, 8-pin, female, A-coded			

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
SIN+; SIN-; Cos+; Cos-	Voltage	Vpk	0,8	1,0	1,2
	Current	mA			20

This interface is not assigned in the basic version without optional safety card.

6.6.7 X3: Motor/brake temperature sensor

Figure	Pin no.	Signal name	Function
	1	BRAKE+	Holding brake +
	2	BRAKE-	Holding brake -
	3	TEMP_MOT+	Motor temperature sensor +
	4	TEMP_MOT-	Motor temperature sensor -
Plug type on drive amplifier: M12, 4-pin, male, A-coded			

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
BRAKE+/-	Voltage	V DC		24	
	Current	A DC			2

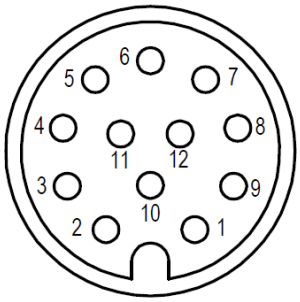
KTY84 and PT1000 type sensors can be used as temperature sensor.
The 24 V brake can be operated over the entire supply range 12 VDC ... 60 VDC (DCBus/Logic).
For operation of the brake with LOGIC supply, its power must be provided in addition to the values specified in chapter 6.6.5.
Note: Logic and brake supply are always realized via the higher LOGIC or DCBus voltage applied.

Instructions for releasing the brake on automated guided vehicles in the event of a fault:
To ensure that the vehicle can be pushed away manually in the event of a fault (driving not possible), the following measures can be carried out to release the brakes of the drives:

Fault	Measure	Remarks
Drive amplifier functional and operating voltage connected, but driving not possible.	Brake can be released via digital input function.	Only possible for basic version with hardware STO. Not possible for devices with extended safety functions.
Drive amplifier defective or no operating voltage	Supply the brake from external power supply (battery / 24V power supply unit).	Can also be used for devices with extended safety functions. The brake does not need to be disconnected from the drive amplifier. A Y-cable can be used.

6.6.8 X4: Safety I/O

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

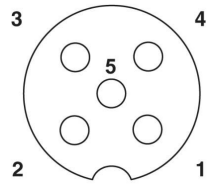
Figure	Pin no.	Signal name	Function
	1	STO_A	Digital input for STO channel A
	2	STO_B	Digital input for STO channel B
	3	N.C.	
	4	N.C.	
	5	N.C.	
	6	N.C.	
	7	RESET	Digital input for reset
	8	GND	Ground reference
	9	VCC	Digital output supply
	10	DOUT1	Digital output for status
	11	DOUT2	Digital output for safety function status
	12	N.C.	
Plug type on drive amplifier: M12, 12-pin, female, A-coded			

This interface is not assigned in the basic version without optional safety card.

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
STO_A, STO_B, RESET	Input voltage	V DC	15	24	30
	Input current	mA DC	4	4.5	5
	Sample time	msec			2
DOUTx	Output voltage	V DC	15	24	30
	Output current	mA DC			40
	Refresh rate	Hz			500
VCC	Voltage	V DC	15	24	30
	Current	mA DC			100
GND	Ground reference				

6.6.9 X5: CANopen fieldbus interface (output)

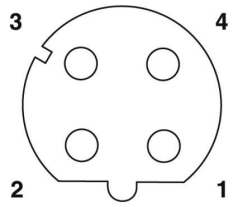
The CAN ground reference is identical to the logic ground reference.

Figure	Pin no.	Signal	Function
	1	Shield	Screen
	2	N.C.	
	3	CAN_GND	CAN ground reference
	4	CAN_H	CAN High
	5	CAN_L	CAN Low
Plug type on drive amplifier: M12, 5-pin, female, A-coded at X2			

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

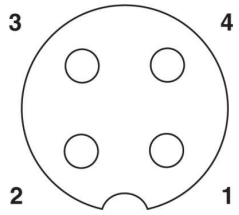
6.6.10 X5 / X7: Fieldbus interface EtherCat, PROFINET, EtherNet/IP und SERCOS III

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

Figure	Pin no.	Signal	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 X5 and X7			

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

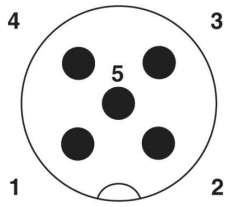
6.6.11 X6: USB diagnostic interface

Figure	Pin no.	Signal	Function	Input/output
	1	VCC	Supply voltage	Input
	2	D-	Data -	Input / output
	3	D+	Data +	Input / output
	4	GND	Ground reference	
Plug type on drive amplifier: M12, 4-pin, female, A-coded				

Connection	Feature	Unit	Minimum value	Nominal value	Maximum value
USB 2.0					

6.6.12 X7: CANopen fieldbus interface (input)

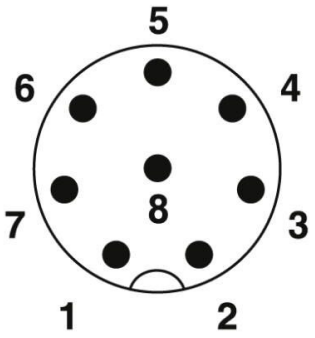
The CAN ground reference is identical to the logic ground reference.

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

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

6.6.13 X8: Digital inputs and outputs

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

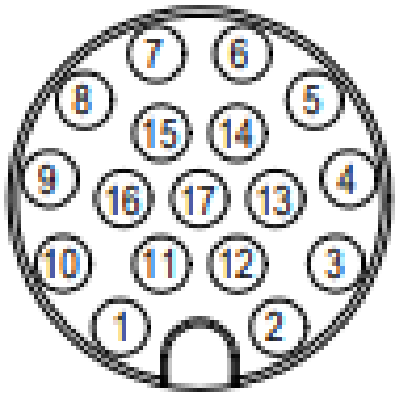
Figure	Pin no.	Signal name	Function	Input / output
	6	DIN1	Digital input 1	Input
	1	DIN2	Digital input 2	Input
	8	DIN3	Digital input 3	Input
	2	DIN4	Digital input 4	Input
	7	GND	Ground reference	
	3	DOUT1	Digital output 1	Output
	4	DOUT2	Digital output 2	Output
	5	VCC	Digital output supply	Input
Plug type on drive amplifier: M12 8-pin, male, A-coded				

Connection	Feature	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
DOUTx	Output voltage	V DC	18	24	26
	Output current	mA DC			40
	Output resistance	kOhm	1	1.5	2
	Refresh rate	kHz			1
VCC	Voltage	V DC	20	24	28
	Current	mA DC			80
GND	Ground reference				

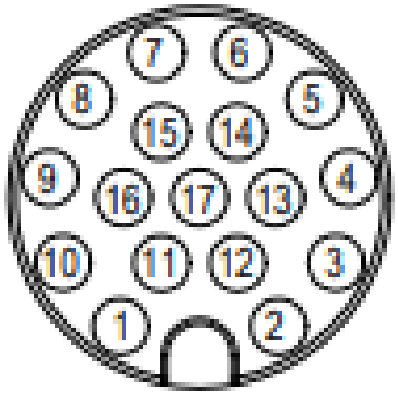
6.6.14 X9: Encoder, Resolver, SIN/COS, Incremental and Hall interface

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

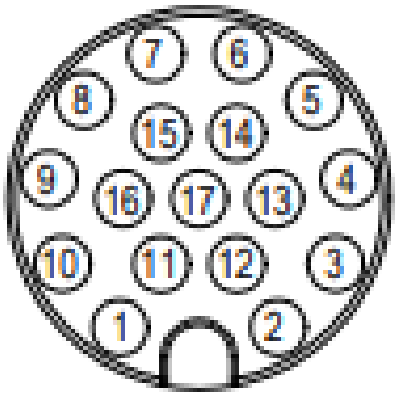
Resolver

Figure	Pin no.	Signal name	Function	Input/ output
	1	REF-	Reference trace R2	Output
	2	REF+	Reference trace R1	Output
	3			
	4			
	5			
	6			
	7	COS+	Cosine trace S1	Input
	8	COS-	Cosine trace S3	Input
	9	SIN+	Sine trace S2	Input
	10	SIN-	Sine trace S4	Input
	11			
	12			
	13			
	14			
	15			
	16			
	17			
Plug type on drive amplifier: M12, 17-pin, male, A-coded				

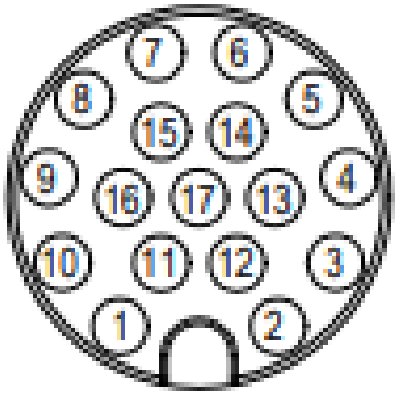
SIN/COS

Figure	Pin no.	Signal name	Function	Input/ output
	1	GND	Ground reference	Output
	2	VCC	Encoder power supply	Output
	3			
	4			
	5			
	6			
	7	A+	Cosine trace	Input
	8	A-	Cosine trace	Input
	9	B+	Sine trace	Input
	10	B-	Sine trace	Input
	11	Index+	Zero pulse	Input
	12	Index-	Zero pulse inverted	Input
	13			
	14			
	15			
	16			
	17			
Plug type on drive amplifier: M12, 17-pin, male, A-coded				

EnDAT2.2 / BISS C / SSI

Figure	Pin no.	Signal name	Function	Input/ output
	1	GND	Ground reference	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			
	8			
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			
	17			
Plug type on drive amplifier: M12, 17-pin, male, A-coded				

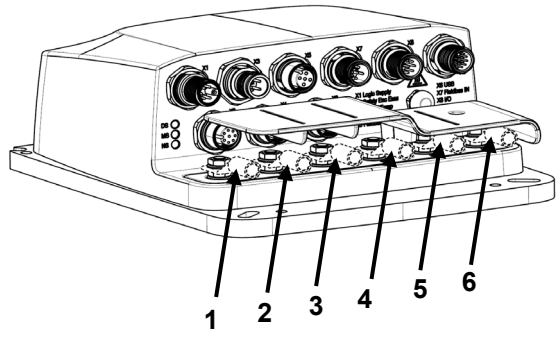
Incremental + Hall

Figure	Pin no.	Signal name	Function	Input/ output
	1	GND	Ground reference	Output
	2	VCC	Encoder power supply	Output
	3	A+	Incremental track A+	Input
	4	A-	Incremental track A-	Input
	5	B+	Incremental track B+	Input
	6	B-	Incremental track B-	Input
	7			
	8			
	9			
	10			
	11			
	12			
	13	Hall U	Hall sensor phase U	Input
	14	Hall V	Hall sensor phase V	Input
	15	Hall W	Hall sensor phase W	Input
	16			
	17			
Plug type on drive amplifier: M12, 17-pin, male, A-coded				

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
Resolver					
Ref+; Ref-	Excitation frequency	kHz		8	
	Output voltage	Vpk	3.0	3.5	5
	Output current	mA			50
Sin+; SIN-; Cos+; Cos-	Input voltage	Vpk			1.75
	Input resistance	kOhm		10	
Sine/cosine					
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500**
A+; A-; B+; B-	Input resistance	kOhm		10	
	Input voltage	Vpk		1	1.75
Index+; Index-	Input voltage	Vpk		1	5.3
	Input resistance	kOhm		22	
	Resolution	Bit			12
EnDAT2.2 / BISS C / SSI					
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500**
Clock+; Clock-	Output voltage	V DC			3.3
	Output current	mA DC			60
Data+; Data-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	
Incremental + Hall					
VCC	Output voltage	V DC	5.0	5.3	5.5
	Output current	mA DC			500**
A+, A-, B+, B-	Input voltage	V DC			3.3
	Input resistance	Ohm		120	
Hall U, V, W	Input voltage*	V DC	3.3		5.3
	Output voltage*	V DC			5.3
	Output resistance	kOhm		2	

* Can be used as open-collector or push-pull interface.
** The voltage supply has a self-resetting fuse.

6.6.15 Power connections

Figure	Terminal	Signal name	Function	Input/ output
	1	U	Motor phase U	Output
	2	V	Motor phase V	Output
	3	W	Motor phase W	Output
	4	FE	Functional earth	
	5	DCBus-	DC bus voltage -	Input
	6	DCBus +	DC bus voltage +	Input

Connection bolt with diameter D= 5 mm on the device
Usable conductor types: Flexible conductor with ring terminal (Bore diameter 6 mm)

ⓘ For tightening torques, see chapter 9.1 "Tightening torques", table 23.

Connection	Property	Unit	Minimum value	Nominal value	Maximum value
U, V, W	Current	Aeff		100[1] / 50[2]	200[1] / 100[2]
DCBus+, DCBus-	Voltage	V DC	12	48	60
	Current	A DC		122	244

[1] : SIM2100D
[2] : SIM2050D

The DC bus voltage DCBus- (terminal 2) is galvanically isolated from the housing. Capacitive coupling via ceramic capacitors (1000 V; with soft termination) is provided between the housing/FE and DCBus+ / DCBus- to dissipate high-frequency interference.

Terminals are not included in the scope of delivery. The power connections may only be connected in a de-energized state.

The power connections do not have reverse polarity protection. Reversing the polarity will destroy the device.

6.7 Fuses

6.7.1 Fuses on device version IP65 decentral (SIM2007D-FC… / SIM2015D-FC…)

- Identify your product (product type) from the name plate.

This chapter applies **only** to product types SIM2007D-FC.../SIM2015D-FC...

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

Fuses	
Logic supply (F2) X1 (pin 1)	Fuse or similar with max. 4 AT
Power supply (F1) X1 (pin A)	Fuse or similar with max. 16 AT
Brake chopper (F3) X1 (pin C)	Fuse or similar with max. 10 AT

Further requirements regarding NRTL compliance are listed in chapter 2.1.2.

6.7.2 Fuses on device version IP20 central (SIM2007D-CC… / SIM2015D-CC…)

- Identify your product (product type) from the name plate.

This chapter applies **only** to product types SIM2007D-CC…/SIM2015D-CC…

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

Fuses	
Logic supply (F2) X1 (pin 1)	Fuse or similar with max. 4 AT
Power supply (F1) X2 (pin 1)	Fuse or similar with max. 16 AT
Brake chopper (F3) X2 (pin 3)	Fuse or similar with max. 10 AT

Further requirements regarding NRTL compliance are listed in chapter 2.1.2.

6.7.3 Fuses on device version IP65 decentral (SIM2050D-FC…/SIM2100D-FC…)

- Identify your product (product type) from the name plate.

This chapter applies **only** to product types SIM2050D-FC…/SIM2100D-FC…

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

Fuse protection	
Logic supply (F2) X1 (pin 3)	Fuse or similar with max. 4 AT
Power supply (F1) Threaded connection M5 "DCBus+"	Fuse or similar with max. 150 AT

Further requirements regarding NRTL compliance are listed in chapter 2.1.2.

6.7.4 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 action 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 MotionGUI 2 is available as well as an interactive, html-based guide.

The startup software MotionGUI 2 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 functions of the drive amplifier are described.

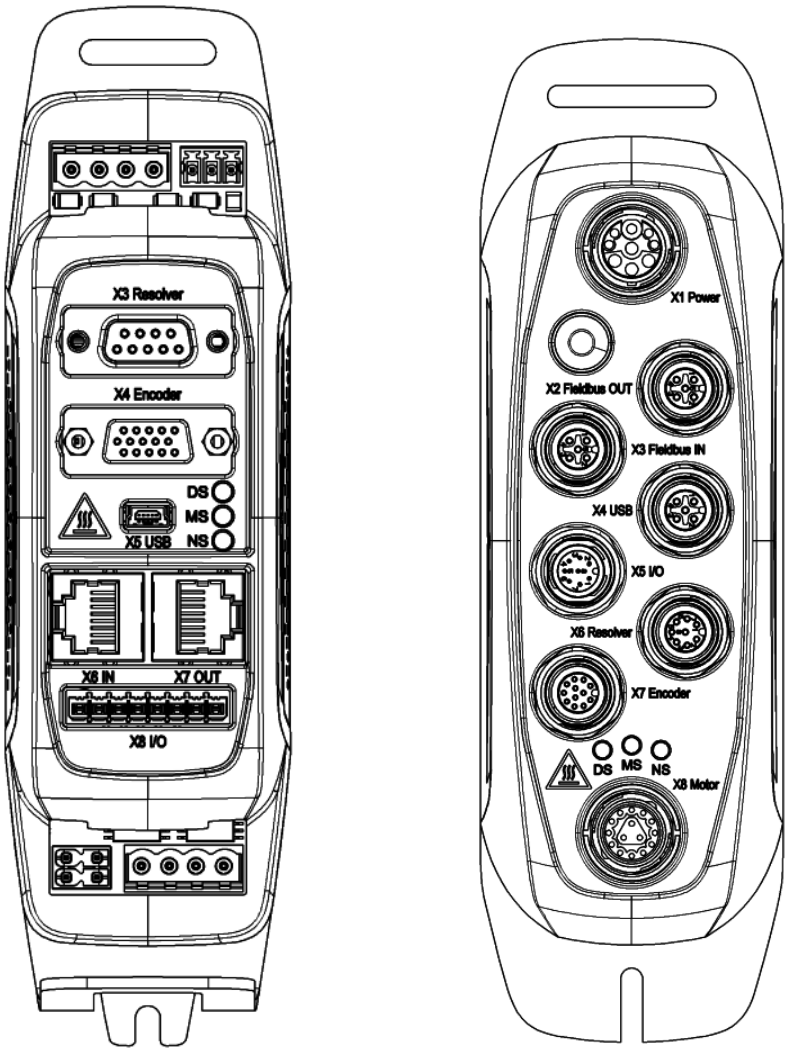
⚠ CAUTION

- **Nonconforming 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

Three multicolor LEDs represent status and fault messages on the drive amplifier. (DS, MS, NS) in the colors green and red are available.

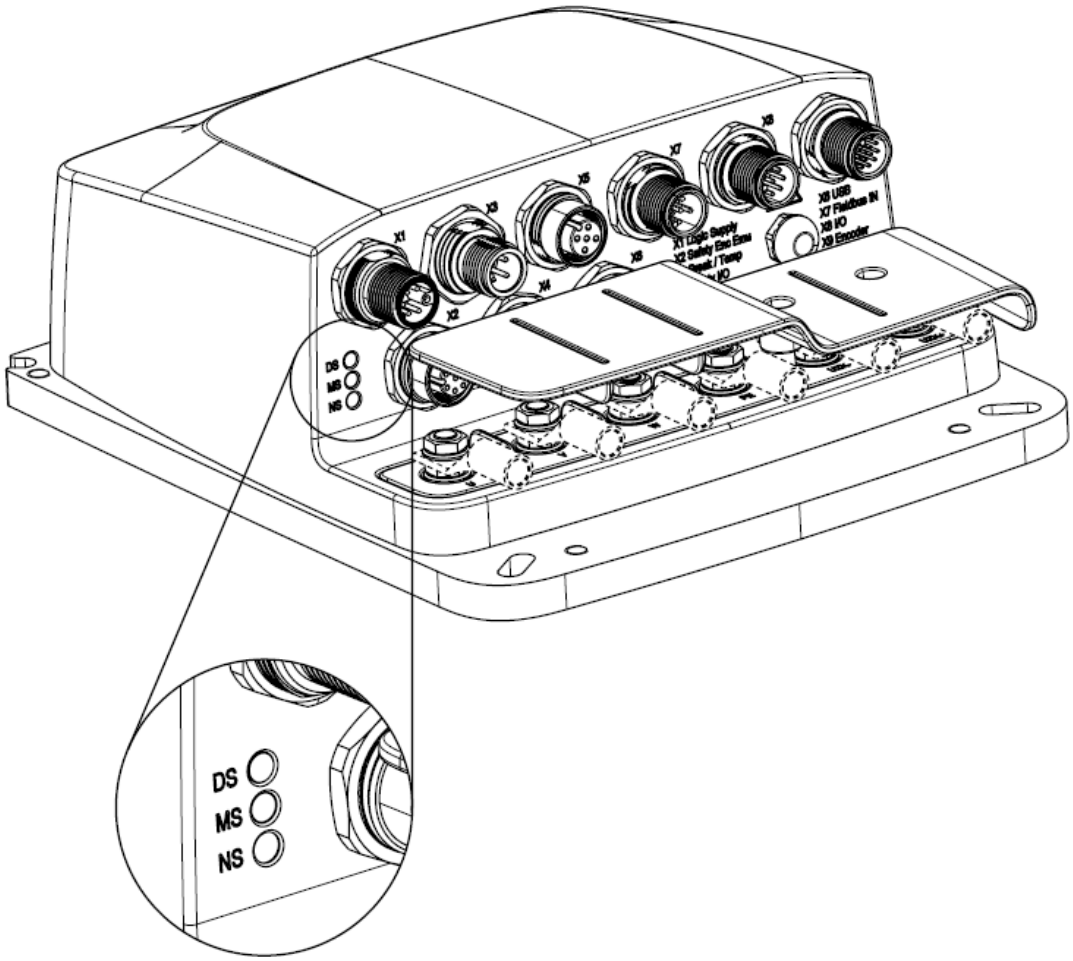
7.3.1 Drive amplifier SIM2007 / SIM2015



LED	EtherCAT	Ethernet/IP	PROFINET
DS	Drive Status	Drive Status	Drive Status
MS	RUN-LED (EtherCAT Drive Statemachine)	Module State	System Failure
NS	ERR-LED (EtherCAT Error State)	Fieldbus State	Bus Failure

Table 11: Displays on the drive system (SIM2007 / SIM2015)

7.3.2 Drive amplifier SIM2050 / SIM2100



LED	EtherCAT	Ethernet/IP	PROFINET
DS	Drive Status	Drive Status	Drive Status
MS	RUN-LED (EtherCAT Drive Statemachine)	Module State	System Failure
NS	ERR-LED (EtherCAT Error State)	Fieldbus State	Bus Failure

Table 12: Displays on the drive system (SIM2050 / SIM2100)

7.3.3 LED codes DS

LED DS is the drive LED which is identical for all bus system types.

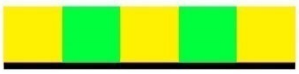
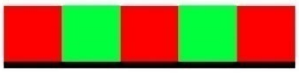
Status LED	LED DS	Meaning
Off		Drive amplifier has no power supply or drive is defective
Flash: Green		Drive amplifier is in functional state but output stage is disabled
Flash: Red		Drive amplifier is in fault state and output stage is disabled
Flash: Yellow		Drive amplifier is in warning state and output stage is disabled
Flash: Yellow, Green		Drive amplifier is in warning state and output stage is enabled
Constant: Green		Drive amplifier is in functional state and output stage is enabled
Flash: Red, Green		Drive amplifier is in Firmware Update state

Table 13: LED codes DS

7.3.4 LED codes MS

LED MS is dependent on the bus system type.

EtherCAT: LED MS indicates the EtherCAT state machine state

Status LED	LED MS	Meaning
Off		The EtherCAT bus is in INIT (or the drive amplifier has no power supply or is defective)
Flash: Green (2,5 Hz)		The EtherCAT bus is in PRE-OPERATIONAL
Flash: Green (single flash)		The EtherCAT bus is in SAFE-OPERATIONAL
Constant: Green		The EtherCAT bus is in OPERATIONAL

Table 14: LED codes MS EtherCAT

Ethernet/IP: LED MS indicates the module state

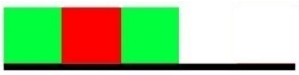
Status LED	LED MS	Meaning
Off		The bus module has no power supply or is defective
Flash: Green, Red, Green		The bus module is performing its power up testing
Flash: Green		Standby: The bus module is not configured (e. g. no network cable connected)
Flash: Red		The bus module is in fault state but fault can be reset
Constant: Red		The bus module is in fault state and fault can't be reset. Restart drive.
Constant: Green		The bus module is operating correctly.

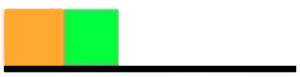
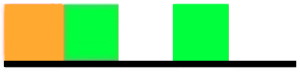
Table 15: LED codes MS Ethernet/IP

PROFINET: LED MS (SF) indicates the system failure

Status LED	LED MS	Meaning
Off		The device has no error (or has no power supply or is defective).
Flash: Red (1 Hz, 3 s)		DCP signal service is initiated via the bus.
Constant: Red		Watchdog timeout; channel, generic or extended diagnosis present; system error

Table 16: LED codes MS PROFINET

SERCOS: LED MS (SF) indicates the status of SERCOS

Zustand LED	LED MS	Bedeutung
Off		The device has no power supply, is defective or is doing a reset.
Flash: green (2 Hz)		The CAN bus is in PRE-OPERATIONAL.
Constant: orange		The CAN bus is STOPPED.
Flash: orange, green (1xgreen/3s)		The CAN bus is in OPERATIONAL.
Flash: orange, green (2xgreen/3s)		The device is in state Bus OFF.

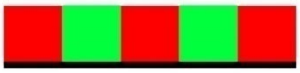
Zustand LED	LED MS	Bedeutung
Flash: orange, green (3xgreen/3s)		Warning limit reached: At least one of the error counters of the CAN controller has reached
Constant: green		Error control event: A guard event (NMT Slave or NMT Master) or a heartbeat event (Heartbeat consumer) has occurred.
Flash: orange (2 Hz)		Auto baud rate detection active: The Device is in the auto baud rate detection mode.
Flash: red, green		The device has no power supply, is defective or is doing a reset.
Constant: red		The CAN bus is in PRE-OPERATIONAL.
Flash: red, orange (2 Hz)		The CAN bus is STOPPED.
Flash: red (2 Hz)		The CAN bus is in OPERATIONAL.

Tabelle 17: LED MS PROFINET

CANopen: LED MS indicates the CANopen status

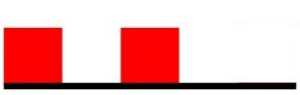
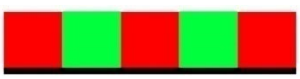
Zustand LED	LED MS	Bedeutung
Off		The device has no power supply, is defective or is doing a reset.
Flash: green (2,5 Hz)		The CAN bus is in PRE-OPERATIONAL.
Flash: green (single flash)		The CAN bus is STOPPED.
Constant: green		The CAN bus is in OPERATIONAL.
Constant: red		The device is in state Bus OFF.
Flash: red (single flash)		Warning limit reached: At least one of the error counters of the CAN controller has reached
Flash: red (double flash)		Error control event: A guard event (NMT Slave or NMT Master) or a heartbeat event (Heartbeat consumer) has occurred.
Flash: red, green		Auto baud rate detection active: The Device is in the auto baud rate detection mode.

Tabelle 18 LED MS CANopen

7.3.5 LED codes NS

LED NS is dependent on the bus system type.

EtherCAT: LED NS indicates the error state

Status LED	LED NS	Meaning
Off		The device has no error (or has no power supply or is defective)
Flash: Red (2,5 Hz)		Invalid configuration: Maybe the master has sent a configuration which can not be activated by the slave
Flash: Red (single flash)		Local error: The slave changed its state independent. Maybe a host watchdog timeout or synchronization error occurred
Flash: Red (double flash)		Process data watchdog timeout

Table 19: LED codes NS EtherCAT

Ethernet/IP: LED NS indicates the fieldbus state

Status LED	LED NS	Meaning
Off		The bus module has no IP address (or has no power supply or is defective)
Flash: Green, Red, Off		The bus module is performing its power up testing
Flash: Green		An IP address is configured but no CIP connection is active
Flash: Red		An IP address is configured but the timeout limit was exceeded
Constant: Red		The bus module has detected that its IP address is already in use
Constant: Green		The bus has an IP address ant at least one CIP connection is active (without timeout)

Table 20: LED codes NS Ethernet/IP

PROFINET: LED NS (BF) indicates the bus failure

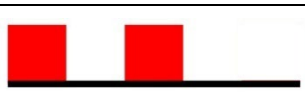
Status LED	LED NS	Meaning
Off		The device has no error (or has no power supply or is defective).
Flash: Red (2 Hz)		No data exchange
Constant: Red		No configuration; or low speed physical link; or no physical link

Table 21: LED codes NS PROFINET

LED NS is not used for SERCOS and CANopen.

8 Maintenance and disposal

8.1 Maintenance work

8.1.1 Maintenance

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

8.1.2 Cleaning

- Clean the drive amplifier IP65 with a grease-dissolving, non-aggressive detergent.

8.1.3 Visual inspection

Perform a **monthly** visual inspection:

- Check the drive system and moving cables for damage.

Check whether the cable ends are completely labeled.

8.1.4 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.

8.2 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] with thread													
	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 22: Tightening torques

Screw size	Max. tightening torque [Nm]	See chapter
M5	1.5	– 6.6.15 "Power connections" – 6.6.4 "IP65 shield connection"

Table 23: Tightening torques SIM2050 / SIM2100

10 STO safety function instructions (SIM2007 / SIM2015)

- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2007/SIM2015.

ⓘ For information on SIM2050/SIM2100, refer to chapter 11 "Functional safety instructions (SIM2050 / SIM2100)."

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 server amplifier 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 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.

10.1 Installation space

A drive amplifier in protection class 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). Observe all instructions on connections in the standard DIN EN13849-2 table D.4 to exclude any faults. 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 61800-5-2, 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 data and STO pin assignment

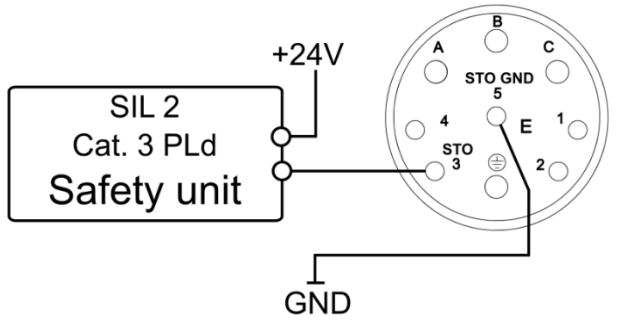
STO input	Data
STO inactive input voltage	12 ... 60 VDC
STO active input voltage	Open
Input current	25 ... 45 mA
Response time (time between activation of STO function and motor being free of torque)	< 15 ms
Test time for STO dark test at 24 VDC STO power supply	< 3 ms

Table 24: Technical data and STO pin assignment

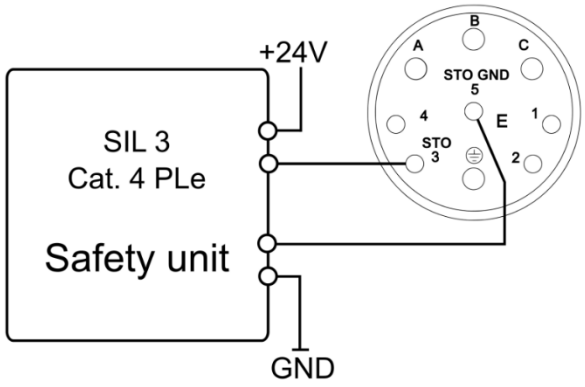
10.7 STO pin assignment

10.7.1 STO device version IP65 decentral SIM20xxD-FC…

SIL 2 / category 3 PLd:

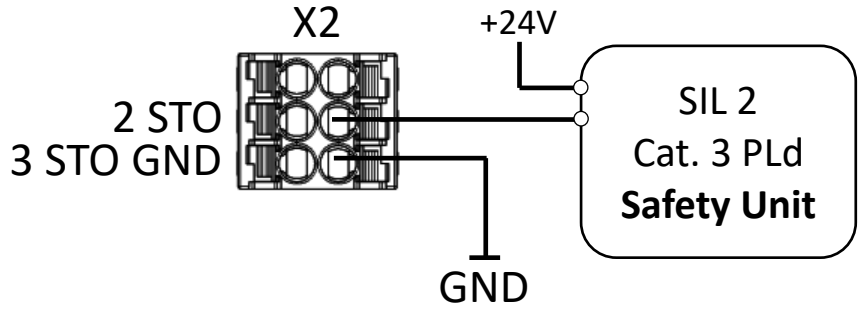


SIL 3 / category 4 PLe:

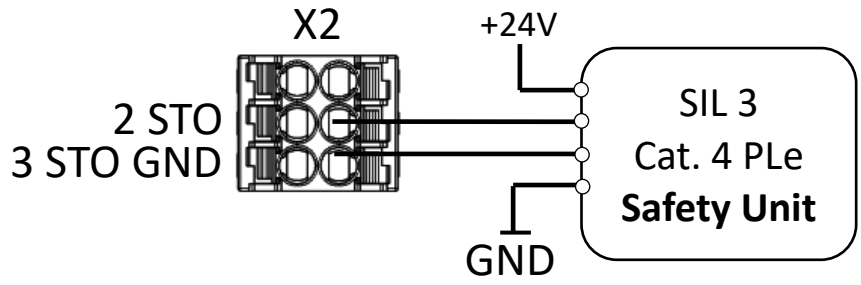


10.7.2 STO device version IP20 central SIM20xxD-CC…

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 +24 V 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.

STO +24 V 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.

11 Functional safety instructions (SIM2050 / SIM2100)

- Identify your product (product type) from the name plate.

This chapter with its sub-chapters applies **only** to product types SIM2050/SIM2100.

ⓘ For information on SIM2007/SIM2015, refer to chapter 10 "STO safety function instructions (SIM2007 / SIM2015)".

The drive amplifier is available in two versions with different safety functions. Once in the basic version and once in the version with extended safety functions. The version being used can be determined by the code. See index number "Safety version" in chapter 3.2 "Code".

Basic version:
The basic version of the drive amplifier only includes the STO safety function implemented in the hardware.

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:

- DC bus 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 server amplifier can be triggered by external safety relays or by an external safety control with safe outputs.

Version with extended safety functions:
The optional safety card extends the functionality of the drive amplifier with drive-integrated safety functions according to EN 61800-5-2. See chapter 11.2 "Safety functions".

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

11.1 Structure

The optional safety card has a two-channel structure with internal diagnostic tests, so that safety can be achieved without any external device. Non-safe characteristics and functions of the servo amplifier do not have any effect on the functional safety of the safety card.

11.2 Safety functions

Basic version:
The basic version of the drive amplifier includes the following safety function:

- STO (**S**afe **T**orque **O**ff) (SIL3, category 4, PLe)

Version with extended safety functions:
The following extended safety functions are included in the optional safety card in the cyber® simco® drive 2 (SIM2050/SIM2100):

- STO (**S**afe **T**orque **O**ff) (SIL3, category 4, PLe)
- SBC (**S**afe **B**rake **C**ontrol) (SIL3, category 4, PLe)
- Safe 1 Vss sine/cosine encoder emulation (SIL2, category 2, PLd)
- PROFISafe (SIL3, category 4, PLe)
- Safe multiturn counter via PROFIsafe (SIL3, category 4, PLe)
- Safe position and speed via PROFIsafe (SIL3, category 4, PLe)

11.3 Characteristics

The drive amplifier with optional safety card has the following characteristics:

- A two-channel safe digital input for selection of the STO safety function
- A single-channel non-safe digital input for resetting the safety card
- Safe EnDatFS encoder interface for determination of the safe position
- Two single-channel non-safe outputs for status output of the safety card
- Safe analog 1 Vss sine/cosine encoder emulation for output of the safe position
- Safe brake output

11.4 Installation space

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

11.5 Mounting position

Any mounting position can be selected.

11.6 Ventilation/cooling

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.

11.7 IP65 Environmental conditions for vibration/shock

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
  - Shock duration: 11 ms

11.8 Control signal wiring

In the case of single-channel control, if the wiring for the control 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). Observe all instructions on connections in the standard DIN EN13849-2 table D.4 to exclude any faults. Further instructions for wiring can be found in the standard DIN EN 60204-1.

11.9 Important information on the use of the safety functions

⚠ CAUTION

If the STO function is activated during operation, the drive will coast to a stop in an uncontrolled manner and the drive amplifier will report 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.

⚠ CAUTION

Danger due to use of unsuitable EnDat encoders and incorrect mounting

If unsuitable EnDat encoders (no safety certification) or encoders that were mounted in a mechanically unsafe manner are used, this can lead to an incorrect safe position. The incorrect position can lead to exceeding of application limits and serious injuries.

- Make sure that only suitable EnDat encoders are used and that their mechanical attachment also meets the safety requirements.

11.10 Intended use of STO

The optional safety card in the cyber® simco® drive 2 (SIM2050/SIM2100) is a safety component in accordance with Machinery Directive 2006/42/EC and intended for use in safety-related applications.
Intended use also includes compliance with

- this operating manual
- the chm help for parameterization via the MotionGUI2 software
- EMC-compliant assembly/installation and wiring

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 61800-5-2, EN 61508 or EN 13849-1.

11.11 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 (emergency stop push-button).

11.12 Qualification of personnel

Installation, assembly, programming, commissioning, operation, decommissioning and maintenance of the products may only be carried out by competent personnel. Competent personnel are qualified and knowledgeable persons who, through their professional training, their professional experience and recent professional activity have the required specialist knowledge. For inspection, evaluation and handling of devices, systems, machines and plants, this personnel must have knowledge about the state of the art and the applicable national, European, and international laws, directives and standards.
The operator is also obliged to use only persons who are

- familiar with the basic regulations on occupational safety and accident prevention,
- have read and understood the section on safety in this documentation, and
- are familiar with the basic and technical standards applicable to the specific application.

11.13 Technical data of safety functions

11.13.1 Basic version (without optional safety card)

STO input	Data
STO inactive input voltage	12 .. 60 VDC
STO active input voltage	Open
Input current	25 .. 45 mA
Response time (time between activation of the STO function and the motor being free of torque)	< 15 ms
Test time for STO dark test at 24 VDC STO power supply	< 3 ms

Table 25: Technical data of basic device

General safety data	Data
Single-channel safety integrity level	SIL2, Cat. 3 PLd
Two-channel safety integrity level	SIL3, Cat. 4 PLe
PFHD [1/h] (EN 61508)	1E-10

11.13.2 Device with safety card and extended safety functions

STO (Safe Torque off) via secure digital input	Data
Safety integrity level	SIL3, Cat. 4 PLe
STO inactive input voltage	15 .. 30 VDC
STO active input voltage	< 5 VDC
Input current	< 15 mA
Response time (time between activation of the STO function and the motor being free of torque) [1]	< 15 ms
Maximum test time for STO dark test	<= 1 ms
PFHD [1/h] (EN 61508) [2]	8.17E-9

SBC (Safe Brake Control)	Data
Safety integrity level	SIL3, Cat. 4 PLe
Maximum permitted current	2 A
Response time (time between activation of the SBC function and disconnection of the brake output) [1]	< 15 ms
PFHD [1/h] (EN 61508) [2]	8.94E-9

Safe sine/cosine encoder emulation	Data
Safety integrity level	SIL2, Cat. 2 PLd
Output voltage	0.7 .. 1.2 Vss
Maximum permitted current	20 mA
Maximum permissible output frequency	55 kHz
PFHD [1/h] (EN 61508)	58E-9

Safe position / speed (PROFIsafe)	Data
Safety integrity level	SIL3, Cat. 4 PLe
PFHD [1/h] (EN 61508) [2]	19,3E-9

Safe position / safe (filtered) speed / multiturn revolutions (via PROFIsafe)	Data
Safety integrity level	SIL3, Cat. 4 PLe
PFHD [1/h] (EN 61508) [2]	19,3E-9
Resolution of safe position	Corresponds to the safe measuring step of the encoder
Resolution of multiturn counter	16 Bit

General safety data	Data
TM [years] (EN 13849-1:2015)	20 years

[1] : To control safety functions via PROFIsafe, the PROFIsafe monitoring time (F_WD_Time) must be added to the specified response time of the safety function. This value then corresponds to the worst-case response time in case of fault (WCDT: Worst Case Delay Time).
[2] : The specified PFHD values do not include the PFHD value of the PROFIsafe communication channel. The PFHD value of the communication is 10^-9 and must be added to the specified PFHD values if PROFIsafe is used.

11.14 Connection assignment

ⓘ For information on the pin assignment, see chapters 6.6.2 "IP65 Connection diagram" and 6.6.5 "X1: Power supply".

11.15 Function description

11.15.1 Overview

When using the drive amplifier with the optional safety card, the system is referred to as a safe drive amplifier.
A safe drive system consists of:

- A safe drive amplifier
- A motor with safe EnDatFS motor encoder
- A suitable mechanical brake
- A safety control
- The MotionGUI2 configuration tool

11.15.2 Parameterization of the safety card

The safety card is parameterized via the MotionGUI2 configuration tool. To be able to use the safety functions of the safety card, correct parameterization must be ensured. The parameterization is described in the chm help of the MotionGUI2 software as of version 3.0.0.

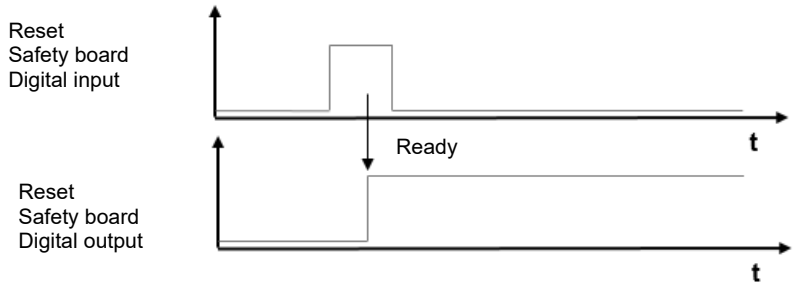
NOTICE

- Before parameterizing the safety card, please read all the instructions in the chm help of the MotionGUI2 software and familiarize yourself with parameterization.

11.15.3 Reset/acknowledgment of the safety card

After the correct parameterization and after a restart of the drive amplifier, the safety card must be switched to "Normal Operation" via the Reset digital input (rising edge).
The Status digital output indicates that the safety card is ready for operation when a high level is returned here.

See following figure:

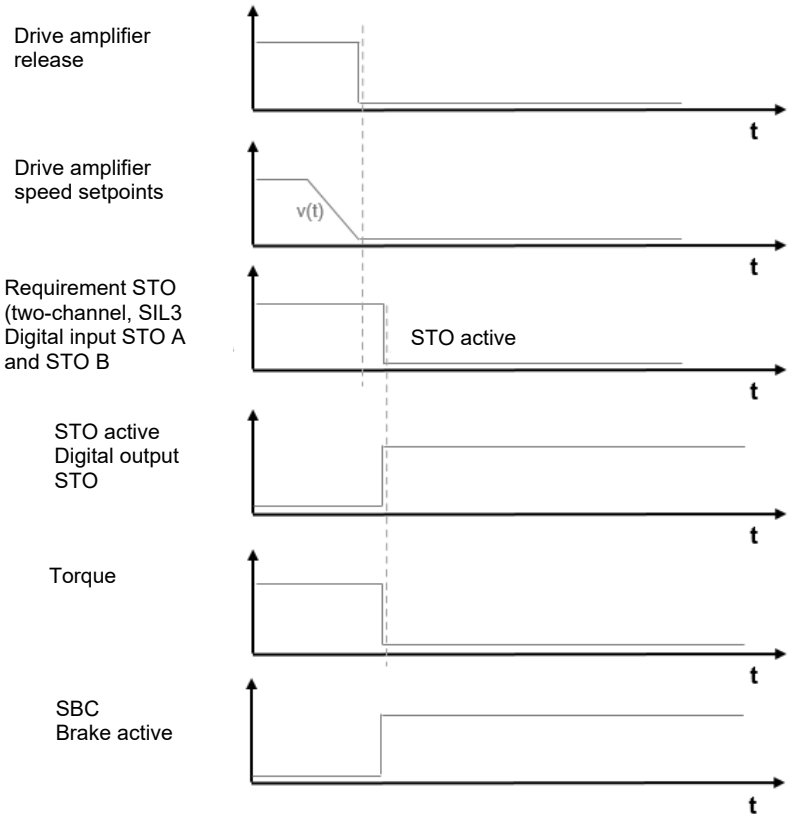


11.15.4 STO/SBC safety function with prior shutdown

For regular controlled shutdown, the drives should be shut down in a controlled manner using the setpoints and then the release of the drive amplifier should be removed. Subsequently, the STO can be activated via digital inputs 1 and 2 (STO_A and STO_B) in two channels according to SIL3.

Switching off the voltage (0 V) at the inputs activates the safety function.
For diagnostic purposes, the STO digital output indicates whether the STO is active. High level at the output means that STO is active

In this case, triggering the STO safety function does not set any faults in the drive amplifier. After removing the STO function, the drive amplifier can be enabled again without prior fault reset.
See following figure:



	NOTICE • The signals STO_A and STO_B must be switched simultaneously. If the signals STO_A and STO_B are switched with a time difference greater than 1s, the safety card goes into the fault state.

	NOTICE • To ensure the brake function, the brake must be tested regularly at least once every 24 hrs.

11.15.5 STO/SBC safety function without prior shutdown

The STO safety function can also be activated without prior controlled shutdown. However, the drive then coasts down in an uncontrolled manner or, depending on the parameterization of the SBC function, the brake is applied and decelerates the drive.

⚠ 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.

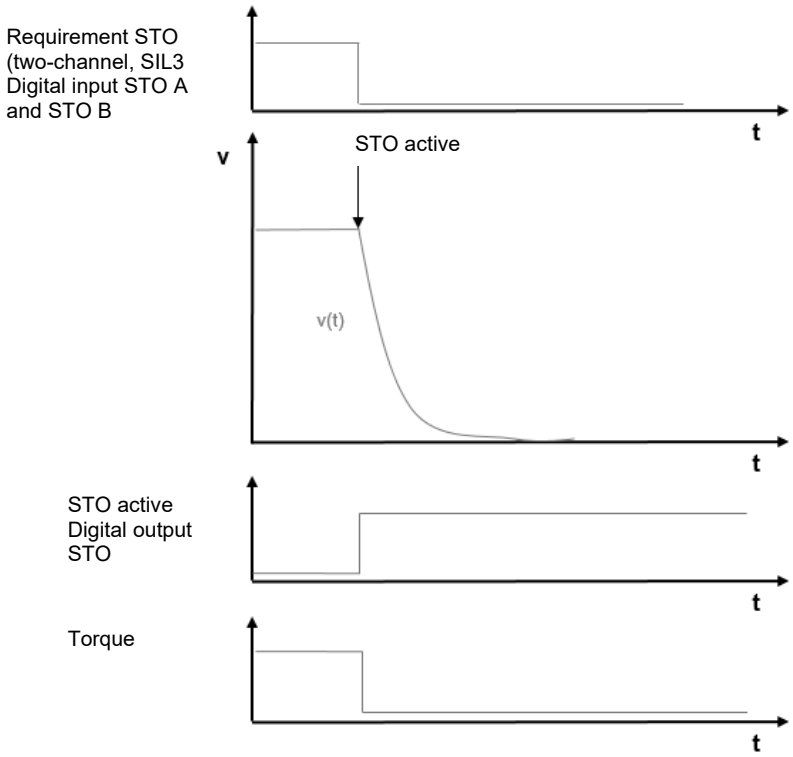
- Ensure that drives with a suspended load are also securely locked mechanically (e.g., with a suitable holding brake)

⚠ 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.

The STO can be activated via digital inputs 1 and 2 (STO_A and STO_B) in two channels according to SIL3.
Switching off the voltage (0 V) at the inputs activates the safety function.
For diagnostic purposes, the STO digital output indicates whether the STO is active. High level at the output means that STO is active

If the drive is activated and in control at this time, an "STO active" fault is set on the drive. For restart, this fault must be acknowledged, the STO must be deactivated via the safety card and the drive must be brought back into control.
See following figure:



11.15.6 SBC safety function

The SBC safety function can be activated via the "STO Activates SBC" safety parameter and is then always activated together with the STO safety function.
Activation of the SBC safety function alone without coupling to the STO safety function is not provided for, since otherwise the motor can work against the brake.

11.15.7 Sine/cosine encoder emulation

Sine/cosine encoder emulation is active as soon as the safety card is in the "Normal Operation" or "Safe Operation" state. Via the sine/cosine encoder emulation, the safe position is output with the number of periods defined in the "Encoder Emulation Periods" safety parameter. A higher-level safety controller with sine/cosine encoder input can be used to reliably determine the position and also the speed.

⚠ CAUTION

If the safety card goes into a "Fault" state due to an internal fault, then no valid position signal (sine and cosine are at 0 V) is returned at the output of the encoder emulation. This means that if the drive is still in motion, the motion can no longer be detected by the safety controller. The incorrect position can lead to exceeding of application limits and serious injuries.

- Ensure that drives with a suspended or coasting load are also securely locked mechanically (e.g., with a suitable holding brake)

NOTICE

- The position evaluated via a controller and encoder emulation can only be interpreted as safe as accurately as it corresponds to the safe position resolution of the EnDat Safety Encoder (safety-relevant measuring step SM in encoder data sheet). All positions interpolated more accurately from the encoder emulation must be assumed to be unsafe.
- The controller which evaluates the encoder emulation must monitor the vector length of the sine/cosine signal and bring the system into a safe state if the vector length shows a deviation outside the tolerance.

11.15.8 PROFIsafe

Devices with a PROFIsafe interface support the PROFIsafe profile V2.6 with 4 bytes CRC length (XP profile). Older versions are not supported.
The following safety functions can be used via PROFIsafe:

- STO (safe torque off)
- SBC (safe brake control)
- Safe position (SP)
- Safe speed
- Safe filtered speed
- Safe multiturn counter

For detailed information on parameterization and use of the PROFIsafe interface, please refer to the CHM help of the MotionGUI2 software.

11.15.9 Safe multiturn counter via PROFIsafe

The safe multiturn counter counts the multiturn revolutions based on the safe singleturn position of the encoder. The counter has a resolution of 16 bits.

The multiturn revolutions are not remanently stored and the counter starts from zero after restart.

For detailed information on parameterization and use of the safe multiturn counter, please refer to the CHM help of the MotionGUI2 software.

NOTICE

- The counter only works up to a maximum motor speed of 7500 rpm. If this speed is exceeded, the counter is set to zero and a flag indicates that the multiturn counter is invalid.

11.15.10 Safe filtered speed via PROFIsafe

A safe filtered speed is available via PROFIsafe. The filter frequency for the low-pass filter can be set between 0 and 75 Hz.

For detailed information on parameterization and use of the filtered speed, please refer to the CHM help of the MotionGUI2 software.

11.15.11 Hardware STO safety function in the basic device

Use of the STO safety function in the basic device 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 according to EN 13849-1 or SIL 2 according 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 +24 V 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.

STO +24 V 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. This bypasses the STO function which than cannot be used. The drive amplifier is then **no longer a safety component** as defined by the Machinery Directive.

11.15.12 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, lock the drive mechanically 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.

- Ensure that drives with a suspended load are also securely locked mechanically (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.

11.16 STO basic device functional check

NOTICE

- Check the STO function 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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