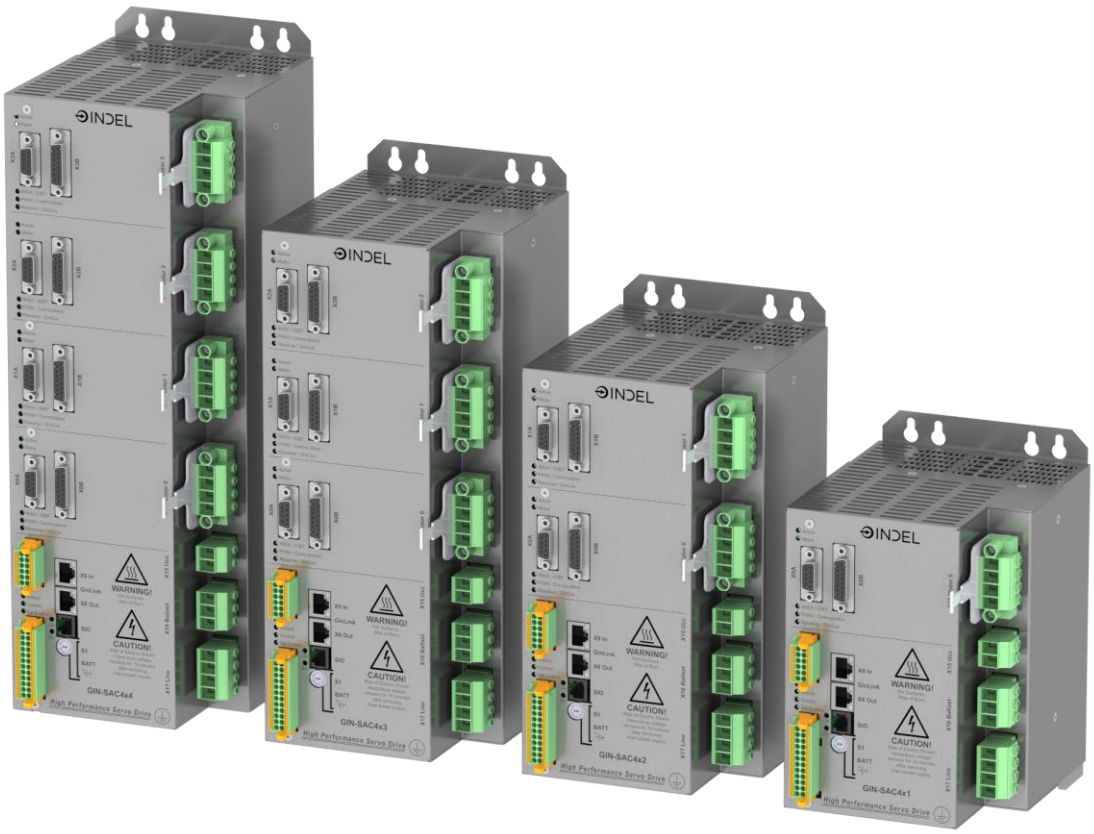
GIN-SAC4xX



Hardware

User Manual

Version: 1.49en
Date: 24.09.2024
Language: English
Issue: Translation of the original instructions

Table of contents

1. General

1.1. About this manual

This user manual describes the Indel servo drives of the SAC4 series. This document is a translation of the German version of the original user manual.

This user manual is only valid for Devices with the Safety-Function STO.
This user manual **is not valid for** Devices that support the enhanced Safety Function **Option FS**.

1.2. Sales and Service

1.2.1. Manufacturer

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1.2.2. Support

Indel AG provides you with extensive technical support:

- Engineering for hardware and software
- Worldwide support via Team Viewer
- Worldwide on-site technical support
- Commissioning of controls and drives on site

1.3. Disclaimer

The documentation was created to the best of our knowledge and belief. However, the products described are constantly being developed and improved. The documentation should therefore never be considered complete. All information in the documentation is without guarantee. We reserve the right to make changes at any time without notice. No claims can be made regarding changes to products which have already been delivered.

1.4. Copyright

1.5. Documentation versions

Version	Datum	Author	Comments
Rev pr		M. Suter	All draft versions issued before the first release.
Rev 1.00	26.02.2014	M. Suter	· Release
Rev 1.10	19.05.2014	M. Suter	· Incorporation of the GIN-SAC4x3
Rev 1.11	20.05.2014	M. Suter	· Addition of assembly instructions, rotary option switch and rotary switch description
Rev 1.12	13.06.2014	M. Suter	· Correction GIN-SAC4x3 only 3x output stage
Rev 1.20	09.07.2014	M. Suter	· Chapter 6.1 deleted · Issue: Original added to cover page · Chapter 2.3 not to be used in explosion hazard areas · Chapter 2.3 Only for use in industrial contexts · Chapter 2.1.1 extended · Chapter 2.2.2 added · Chapter 7.3.8, fuse protection of the relay 1A · Chapters 5.1.1 and 5.1.2 for illustrative purposes only
Rev 1.21	28.07.2014	M. Suter	· Change to interactive PDF format
Rev 1.22	06.08.2014	M. Suter	· Various corrections · Standards updated
Rev 1.23	11.08.2014	M. Suter	· Adaptations to EMC standard
Rev 1.24	12.08.2014	M. Suter	· Declaration of Conformity added
Rev 1.25	11.11.2014	M. Suter	· Chapter 7.3.4, Power consumption of logic power supply < 2A
Rev 1.26	25.11.2014	M. Suter	· Type certificate for SAC4x4 and SAC4x3 added
Rev 1.27	02.04.2015	M. Suter	· Status LED chapter 10.1 on page 78 added
Rev 1.28	02.04.2015	M. Suter	· Reaction time t_{OFF} of the STO in chapter 7.3.8 on page 42 corrected from 3ms to 15ms
Rev 1.29	15.04.2015	M. Suter	· Modification to conductor cross-sections chapter 8.11.1 · Modification to motor overload protection chapter 8.12 · Modification to assembly instructions chapter 9.2
Rev 1.30	31.07.2015	M. Suter	· Suva approval on rating plates · Incorporation GIN-SAC4x1 · Various corrections
Rev 1.31	28.10.2015	M. Suter	· PT100 and PT1000 can now also usable as temperature sensors, chapter 8.9.5
Rev. 1.32	19.04.2016	M. Bleuler	· Declaration of Conformity adjusted according to current guidelines, chapter 11.1 · Intermediate circuit capacity added for SAC4x3, SAC4x2 and SAC4x1, chapter 7.3.2
Rev. 1.33	17.10.2016	M. Bleuler	· D-Sub mating connector corrected in chapters 4.1.1, 4.1.2, 4.1.3 and 4.1.4 · GIN-SAC4x2 in chapter 4, chapter 4.1.3, chapter 6.2.1, chapter 7.3.1, chapter 7.3.3, chapter 8.2.3 and chapter 9.5 added · Type-examination certificate GIN-SAC4x2 and GINSAC4x1 added in chapters 11.4 and 11.5

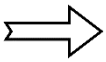
Version	Datum	Author	Comments
Rev. 1.34	13.12.2016	M. Bleuler	· New sketch added under assembly instructions in chapter 9.2 · EC Declaration of Conformity adapted only for STO option in chapter 11.1
Rev. 1.35	15.06.2017	M. Bleuler	· Old Indel logo replaced with new Indel logo · Relinking the URLs
Rev. 1.36	06.02.2018	M. Bleuler	· Former Chapter 8.3.3 "three parallel ouput stages" deleted, as not implemented to date. · Additional note added under chapter 6.2.2 in connection with internal evaluation. · Chapter 6.2.3 added for better understanding in conjunction with Chapter 6.1. · Overvoltage category standard in chapter 7.3.2 adjusted. · Overvoltage category standard in chapter7.4 adjusted. · Pin assignment of positions in image in chapters 8.2.2 and 8.2.3 corrected.
Rev. 1.37	02.04.2019	S. Bärtschi	· Converted Document to «MS-Word» · Removed the Fuse in the N-Line of drawing (chapter) · Corrected some typos · Illustrations of the devices with the new Indel Logo · Illustrations of the devices with rating plates with the new Indel Logo · Remark to FS-Option Devices in chapter 1.1 · Added feature Biss C and Endat 2.2 · Added feature Dout und DIN as GPIO (chapter 8.7) · Constraints for DC-Motor and STO (chapter 2.1.9, 7.3.5, 8.3.3) · Detail wording of the STO description (chapter 6.1) · Illustration EC Declaration of Conformity: new Logo
Rev. 1.38	16.07.2019	S. Bärtschi	· Clarified diagnostic path of STO function (chapter 6.5) · Changed safety checking interval period according the latest EN61800-5-2:2016 (chapter 2.2.2)
Rev. 1.39	11.09.2019	S. Bärtschi	· Renewed Type-examination certificate SUVA
Rev. 1.40	27.09.2019	S. Bärtschi	· Rating Plates with new Indel Logo
Rev. 1.41	19.11.2019	S. Bärtschi	· Added chapter “hot surface” (chapter 2.2.5.1) · added Power S1 and remark to external fuse and mains filter (chapter 7.3.2) · added leakage current information (chapter 7.3.1.1) · added information “residual current circuit-breaker” (chapter 2.1.7)
Rev. 1.42	01.04.2020	S. Bärtschi	· Updated the English Version · minor enhancements in Drawings for German/English support · Added CB Test Certificate (chapter 11.6)
Rev. 1.43	06.10.2020	M. Bleuler	· Update EC Declaration of Conformity (chapter 11.1)
Rev. 1.44	18.11.2020	S. Bärtschi	· New Frontpage · Chapter 8: Updated Illustrations of Devices · Chapter: Optional accessories, added SAC4-AD-2X

Version	Datum	Author	Comments
			· Chapter 7.5: Information according US market
Rev. 1.45	15.09.2021	M. Bleuler	· Correction of Sincos interpolation Resolution from 10 Bit to 12 Bit in section 7.3.6.1, 8.9.1, 8.9.4.1 and 8.9.4.2 · Updated EC declaration of conformity in section 11.1
Rev. 1.46	24.05.2022	S. Bärtschi	· Added Short Circuit Current Rating of mains supply in section 7.3.2.
Rev. 1.47	30.09.2022	M. Bleuler	· Updated EC declaration of conformity in section 11.1
Rev. 1.48	14.09.2023	M. Fischer	· Updated EC declaration of conformity in section 11.1 · Renewed Standards in section 12
Rev. 1.49	25.09.204	M. Fischer	· Replaced of EC declaration of conformity with link in section 11.1 · Renewed Type-examination certificates SUVA in section 11.2, 11.3,11.4, 11.5

1.6. Used terms

Abbreviation	Meaning
GinLink	Indel communication Fieldbus, 1GBit/s Ethernet based
PE-Leiter	Protective Earth conductor
GIN-SAC4xX	Designation for entire GIN-SAC4 series
GIN-SAC4	Designation for entire GIN-SAC4 series
GIN-SAC4x4	Designation for GIN-SAC4 with 4 output stages
GIN-SAC4x3	Designation for GIN-SAC4 with 3 output stages
GIN-SAC4x2	Designation for GIN-SAC4 with 2 output stages
GIN-SAC4x1	Designation for GIN-SAC4 with 1 output stage
+DC / -DC-	Intermediate DC circuit tapped onto the servo drives
Fieldbus Master	Master of the GinLink fieldbus
STO	Safe Torque Off

1.7. Symbols used

	**Important notice for the user** The symbol indicates important information for the user. All instructions must be observed
	**Attention** The symbol indicates information which, if not observed, could lead to damage to property and/or personal injury.
	**Danger** This symbol indicates information which, if not observed, could result in personal injury caused by electricity.
WWW.	**Hyperlink** Indicates a hyperlink to a file or information on the Internet
	**Reference** Reference to a chapter within the documentation

2. Safety

2.1. Safety Instructions

The following safety instructions male no claim to completeness. If you have any questions, uncertainties or problems, please contact us.

2.1.1. Qualified personnel

All work such as transport, installation, commissioning and service may only be carried out by qualified specialist personnel. Qualified specialist personnel are persons who are familiar with the transport, installation, assembly, commissioning and operation of the product and who have the qualifications required for their job. National accident prevention regulations must be observed. The safety instructions, the information on the connection conditions (rating plate and documentation) and the limit values specified in the technical data must be read carefully before installation and commissioning and must be strictly adhered to.

2.1.2. Documentation

Before installation and commissioning, please read this documentation as well as the documentation which is referenced in their entirety. Incorrect handling can lead to personal injury or damage to property. Be sure to comply with the technical specifications, connection conditions and environmental conditions.

2.1.3. ESD- Schutz

The servo amplifiers contain electrostatically sensitive components that can be damaged by improper handling. Discharge your body before touching the servo amplifiers. Avoid contact with highly insulating materials (synthetic fibers, plastic films etc.). Place the servo amplifiers on a conductive surface in a voltage-free state. Do not touch the contacts of the connector on the drive and the connected cables or the contact pins on the conductors.

2.1.4. Protection against contact with electrical components

For the operation of the servo amplifier it is necessary that certain parts carry voltages of more than 50VAC, exceeding extra-low voltage limit. If such parts are touched, life-threatening electric shocks may occur. There is a risk of death or serious damage to health.

Before switching on a drive, make sure that the device is properly connected to the PE conductor. The earth connection must always be connected, even if the drive is only put into operation for a short time. Before switching on, live parts with more than 50VAC must be protected against direct contact by means of suitable measures.

Connections can also carry dangerous voltages when the motor is not turning. Touching the terminals when they are switched on is therefore prohibited. Before working on the drive, disconnect it from the mains and secure it against being switched on again.

Contact with live parts (e.g. terminals) may result in death or serious health or material damage. Never disconnect the electrical connections of the modules whilst live. In unfavorable cases, arcing can occur, harming people and hardware such as contacts.

2.1.5. Turn off

After switching off the mains supply, residual voltages can be present for several minutes. Measure the intermediate circuit voltage and wait until the voltage has fallen below 50V.

2.1.6. High voltage test, insulation resistance test

Do not perform a high voltage test or an insulation resistance test on the mains connection and motor connection of the drives, otherwise the drive will be damaged.

2.1.7. Residual Current Circuit Breaker (RCCB)

When this product is supplied by a 3phase mains supply, a defect can cause a DC Current at the protective earth conductor. If an RCCB is installed in the grid connection system, only “RCCB Type B” are allowed. Only type B universal current-sensitive Residual Current Circuit Breakers may be used.

2.1.8. Safe Torque off (STO)

The safety function STO as described in chapter 6 is designed as a safety pulse inhibitor. The drive may restart after resetting the pulse inhibitor, depending on the application.

Activating the safety function is not suitable for de-energising the drive.
Activating the safety function does not provide protection against electric shock.

In case of multiple faults (hardware defects of power semiconductors inside the output power stage) the motor can move a certain limited angle/distance even in the safe STO state. See chapter 2.1.9 for more information.

2.1.9. Maximum movement in the event of an error

It should be noted that a multiple fault in the IGBT bridge could cause the motor to advance for a short period. The maximum rotational angle of the motor shaft or maximum linear distance occurring when advancing depends on the number of pole pairs in the motor used.

For permanent-magnet synchronous servo motors:

$$\varphi = \frac{360°}{2 \cdot p} \qquad \varphi = \text{angle of ratation}; \quad p = \text{pole pairs}$$

For linear motors:

$$d = \frac{P}{2} \qquad d = \text{linear movement}; \quad P = \text{pole pitch}$$

For DC-Motors:
DC-Motors connected to GIN-SAC4xX devices **shall not be used for dangerous or safety relevant applications**.
As a matter of principle the STO Safety-function can get completely ineffective when using DC-Motors in case of faults in the IGBT bridge or the motor wiring.

2.2. Safety requirements

During the installation and operation of Indel Drives in applications with stop category 0 or 1 safety related Torque off of the drive according to EN 60204-1 and fail-safe protection against restart in accordance with EN ISO 13849-1 cat. 3 / PL d, all conditions inside this Manual apply and all conditions that are referred to apply, are compulsory and must be observed.

Indel servo drives with the STO function have been developed according to the relevant standards.

2.2.1. Risk analysis

The machine manufacturer must prepare a risk analysis for the machine and take appropriate measures so that unforeseen movements do not lead to damage to persons or property.

There are also indications in this document regarding possible dangers. All information on dangers, warnings, precautionary measures and information must be observed.

2.2.2. Checking the safety function

See chapter 6.5 “Monitoring of the diagnostic path (K1-K2) by the user”.

Periodic test cycle:
The EN 61800-5-2 2016 Standard defines the following maximum time between 2 test cycles depending on the required safety Performance Level (PL) and Category:

- For SIL 2, PL d Category 3 at least 1 test per year
- For SIL 3, PL e Category 3 at least 1 test every 3 months
- For SIL 3, PL e Category 4 at least 1 test per day

PL and Category as specified in ISO 13849-1.

2.2.3. Run-on

If application-dependent dangers arise as a result of the run-on, additional protective measures must be taken (e.g. movable guards with locks), in order to cover the danger area until there is no danger to persons or property. It must be taken into account that, without a mechanical brake or with a defective brake, drive run-on is possible.

2.2.4. Braking or Ballast resistance

The braking resistor is not safely controlled by the Indel servo drives. A defective or improperly connected braking resistor will cause the motor to stop outside the expected timespan. In the worst case, this can lead to personal injury and damage to property.

2.2.5. Residual energy in the DC intermediate circuit

Residual charge in the intermediate circuit capacitors can be retained for up to 10 minutes after switching off the power supply (opening the main contactor or motor contactor). It is possible to move the motor with this residual charge. This can potentially lead to dangerous situations. If additional external capacitor modules are used, it will take longer for the intermediate circuit capacitors to discharge.
The following warning is attached to the drives.

2.2.5.1 Hot Surface

Under high load the device will run hot and some parts of the case reach temperatures up to 80°C.
Warning: Risk of burn.

The following warning is attached to the drives

2.2.6. Safety covers

Additional safety covers must be designed and integrated in accordance with the safety category required for the machine according to EN ISO 13849-1. After the stop command has been triggered, depending on the danger posed, access must remain locked until the drive has come to a complete stop.

2.2.7. Protection against dangerous movements

Incorrect activation of motors can trigger unintended and dangerous movements.

- Incorrect installation
- Faulty design
- Faulty or incomplete wiring
- Defective devices or cables
- Incorrect control by the software

As a rule, after switching on the drive, motor movement is to be expected. Protection of persons and machines can only be guaranteed by means of overarching measures. Suitable measures are to be taken in order to protect the range of motion of machinery against unintentional access by people. Removing, bridging, or bypassing safety devices is strictly prohibited. A sufficient number of easily accessible Emergency Power Off switches is to be attached to the machine. Keep all covers and cabinet doors closed during operation.

2.2.8. Suspended loads

In the case of suspended loads, addition measures must be taken in order to ensure that the axis stays in place. The Indel servo drives do not offer any outputs which allow you to safely control securing brakes. Holding brakes provide no protection when slowing down the motor.

2.2.8.1 Loss of the logic power supply

If the 24V logic power supply fails on the drive, the motor may spin out. If this is not permitted, external measures must be taken to prevent the axis from spinning out.

2.2.9. Power failure of the mains supply

In the event of a power failure of the mains supply or the supply for the motors, the motor may spin out. If the intermediate circuit voltage Ucc drops below the configured limit Ucc MIN, the servo drive will signal an error and the motors will be deactivated.

2.2.10. EMC

For EMC-compliant wiring, see further document INDEL Wiring Guidelines and INDEL installation Guideline and all wiring instructions in this document.

www. INDEL Wiring Guidelines

www. INDEL Installation Guideline (only available in German)

The machine or system manufacturer must take additional measures for EMC protection if the product standard contains lower limit values applicable to the machine in question. In the case of machines which contain many Indel servo drives, additional EMC protection measures may also be required.

The Gin-SAC4 devices are intended for use in industrial environment. A line filter is required on the mains connection preceding the GIN-SAC4. See also chapter 8.10.2

In a residential environment (first environment), this product may cause high frequency interference, which may require further suppression measures.

2.2.11. Commissioning

Before switching on a servo drive, make sure that the device is properly connected to earth. The earth connections must always be provided, even if the drive is only put into operation for experimental purposes.

Control and power connections can carry voltage even when the motor is not moving. Touching the terminals when the power is on is prohibited. Before working on the drives, they must be disconnected from the mains and secured against being switched on again.

Documented commissioning and demonstration of the safety functions must take place. For Indel servo drive applications with stop category 0 or 1 safety-related cut-out of the drive according to EN 60204-1 and fail-safe protection against restart in accordance with EN ISO 13849 cat. 3, commissioning of the cut-out mechanism and the correct wiring must always be carried out and recorded.

During commissioning, signal detection must be included in the functional test. The status of the auxiliary contacts of the safety relays can be viewed in the “actual parameters” in the servo drive. However, these contacts and displayed values are for diagnostic purposes only and not part of the safety function.

2.2.12. Service life

Fifteen years after delivery at the latest, the safety module in the servo drives must be replaced. If used for more than 15 years, safe operation is no longer guaranteed. This applies not only to the operating time, but also to standstill and storage time.

2.2.13. Simple protection against bypassing

Measures must be taken to prevent bypassing of the safety functions in accordance with EN ISO 138491 Cat.3 / PL d.

2.2.14. Responsibility

The servo drives are not completely fail-safe. In the event of a failure, the operator is responsible for ensuring that the machine / system is put into a safe condition.

All of the diagnostic and monitoring functions can only interrupt the control of the motor. As a consequence of this, the motor is de-energised and can no longer be controlled and braked. Depending on the application, additional measures may be required to slow down or stop the motor.

The operator is responsible for safety.

2.2.15. Defective drives

Defective and damaged drives must under no circumstances be taken into operation. This can lead to serious personal injury and property damage.

2.3. Intended use

- **Indel Servo Drives may only be used as specified in this document and in the documents to which reference is made.**
- **The intended use is prohibited until it has been established that the machine complies with the provisions of Machinery Directive 2006/42/EC and the EMC Directive 2004/108/ EEC, or the relevant current version of said directives. Otherwise, the Indel servo drives cannot be placed on the market.**
- **Indel Servo Drives must only be used in industrial contexts.**
- **The servo drives are designed for installation in stationary electrical machines/systems that comply with the Machinery Directive, Low Voltage Directive and the EMC Directive.**
- **Indel Servo Drives must be installed in a control cabinet that can only be opened using a tool. The drives must be installed so that no live parts can be touched.**
- **It is imperative that the environmental conditions listed on page 43 in chapter 7.4 be observed. Ventilation or cooling measures may be necessary to keep the cabinet temperature below 40°C.**
- **The GIN-SAC4 servo drives can be used directly in three-phase, earthed industrial grid networks (TN system, TT system with earthed star point at 400V +10%). The servo drives must not be operated on unearthed networks, nor on asymmetrically earthed networks.**
- **The machine manufacturer is obliged to carry out a risk analysis of the machine and to take appropriate measures to prevent unforeseen movements from causing damage to persons or property.**
- **The drives must not be used in an explosion hazard area.**

3. Handling

3.1. Storage

The Indel SAC4 Drives can be stored for up to 12 months without restrictions. If the drive is stored for more than 12 months, the capacitors must be reformed before commissioning. For this purpose, all electrical connections must be disconnected and fed to L1 / L2 for 20min 230VAC.

3.2. Maintenance

Do not immerse or spray the housing when cleaning. If contamination is present inside the unit: Cleaning by the manufacturer

3.3. Repair Service

Repairs to the servo drives must be made by the manufacturer. Indel control components can be returned to Indel for repair. Following repair, the configuration files required for operation are deleted from the drive.

In all cases, opening the housing of Indel servo drives will void the warranty.

3.4. Disposal

The servo drives are made of the following materials:

- Steel housing
- Aluminium heat sink
- Electronic circuit boards

The individual components must be disposed of properly. All servo drives can be returned to Indel AG for proper disposal. The transport costs are borne by the sender.

4. Product identification

The GIN-SAC4xX is available in the following different versions.

Typ	Option	Art. Nr.	Beschreibung
GIN-SAC4x4	5A/230V	611349420	Servo-Drive, STO, 1x230Vac/325Vdc, 4x output stages, total 20 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x4	5A/230V/PRO	611349425	Servo-Drive, STO, 1x230Vac/325Vdc, 4x output stages, total 20 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x4	5A/400V	611349440	Servo-Drive, STO, 3x400Vac/565Vdc, 4x output stages, total 20 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x4	5A/400V/PRO	611349445	Servo-Drive, STO, 3x400Vac/565Vdc, 4x output stages, total 20 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x3	5A/230V	611349320	Servo-Drive, STO, 1x230Vac/325Vdc, 3x output stages, total 15 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x3	5A/230V/PRO	611349325	Servo-Drive, STO, 1x230Vac/325Vdc, 3x output stages, total 15 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x3	5A/400V	611349340	Servo-Drive, STO, 3x400Vac/565Vdc, 3x output stages, total 15 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x3	5A/400V/PRO	611349345	Servo-Drive, STO, 3x400Vac/565Vdc, 3x output stages, total 15 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x2	5A/230V	611349220	Servo-Drive, STO, 1x230Vac/325Vdc, 2x output stages, total 10 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x2	5A/230V/PRO	611349225	Servo-Drive, STO, 1x230Vac/325Vdc, 2x output stages, total 10 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x2	5A/400V	611349240	Servo-Drive, STO, 3x400Vac/565Vdc, 2x output stages, total 10 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x2	5A/400V/PRO	611349245	Servo-Drive, STO, 3x400Vac/565Vdc, 2x output stages, total 10 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter

Typ	Option	Art. Nr.	Beschreibung
GIN-SAC4x1	5A/230V	611349120	Servo-Drive, STO, 1x230Vac/325Vdc, 1x output stages, total 5 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x1	5A/230V/PRO	611349125	Servo-Drive, STO, 1x230Vac/325Vdc, 1x output stages, total 5 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter
GIN-SAC4x1	5A/400V	611349140	Servo-Drive, STO, 3x400Vac/565Vdc, 1x output stages, total 5 Arms continuous current, single-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, GinSlave
GIN-SAC4x1	5A/400V/PRO	611349145	Servo-Drive, STO, 3x400Vac/565Vdc, 1x output stages, total 5 Arms continuous current, dual-core ARM 800MHz CPU, 8MB Flash, 256MB RAM, 0.5MB NVRAM, GinSlave/GinMaster, SD-Card adapter

4.1. Scope of delivery

4.1.1. GIN-SAC4x4

When ordering the GIN-SAC4x4 with the options 230V, 400V, 230V / PRO and 400V / PRO, the following components are included:

- Servo-Drive GIN-SAC4x4
- Mating connector X7:
  PHOENIX CONTACT DFMC 1,5 / 6-ST-3,5-LR with specific Indel labeling
- Mating connector X17:
  PHOENIX CONTACT PC 4 HV / 4-ST-7,62 with specific Indel labeling
- Mating connector X10, X11, X12, X13
  PHOENIX CONTACT PC 5 / 4-STF-SH1-7,62 with specific Indel labeling
- Mating connector X15
  PHOENIX CONTACT PC 4 HV / 2-ST-7,62 with specific Indel labeling
- Mating connector X16
  PHOENIX CONTACT PC 4 HV / 3-ST-7,62 with specific Indel labeling
- Mating connector X100
  PHOENIX CONTACT DFMC 1,5 / 12-ST-3,5-LR with specific Indel labeling

The following are not included within the scope of delivery:

- Male 9 pin D-Sub mating connector for X0A, X1A, X2A, X3A
- Male 15 pin D-Sub mating connector for X0B, X1B, X2B, X3B
- Motor configuration files which are absolutely necessary for the operation of the motors or the axes.
- Ethernet cable

4.1.2. GIN-SAC4x3

When ordering the GIN-SAC4x3 with the options 230V, 400V, 230V / PRO and 400V / PRO, the following components are included:

- Servo-Drive GIN-SAC4x3
- Mating connector X7:
  PHOENIX CONTACT DFMC 1,5 / 6-ST-3,5-LR with specific Indel labeling
- Mating connector X17:
  PHOENIX CONTACT PC 4 HV / 4-ST-7,62 with specific Indel labeling
- Mating connector X10, X11, X12
  PHOENIX CONTACT PC 5 / 4-STF-SH1-7,62 with specific Indel labeling
- Mating connector X15
  PHOENIX CONTACT PC 4 HV / 2-ST-7,62 with specific Indel labeling
- Mating connector X16
  PHOENIX CONTACT PC 4 HV / 3-ST-7,62 with specific Indel labeling
- Mating connector X100
  PHOENIX CONTACT DFMC 1,5 / 12-ST-3,5-LR with specific Indel labeling

The following are not included within the scope of delivery:

- Male 9 pin D-Sub mating connector for X0A, X1A, X2A
- Male 15 pin D-Sub mating connector for X0B, X1B, X2B
- Motor configuration files which are absolutely necessary for the operation of the motors or the axes.
- Ethernet cable

4.1.3. GIN-SAC4x2

When ordering the GIN-SAC4x2 with the options 230V, 400V, 230V / PRO and 400V / PRO, the following components are included:

- Servo-Drive GIN-SAC4x2
- Mating connector X7:
  PHOENIX CONTACT DFMC 1,5 / 6-ST-3,5-LR with specific Indel labeling
- Mating connector X17:
  PHOENIX CONTACT PC 4 HV / 4-ST-7,62 with specific Indel labeling
- Mating connector X10, X11
  PHOENIX CONTACT PC 5 / 4-STF-SH1-7,62 with specific Indel labeling
- Mating connector X15
  PHOENIX CONTACT PC 4 HV / 2-ST-7,62 with specific Indel labeling
- Mating connector X16
  PHOENIX CONTACT PC 4 HV / 3-ST-7,62 with specific Indel labeling
- Mating connector X100
  PHOENIX CONTACT DFMC 1,5 / 12-ST-3,5-LR with specific Indel labeling

The following are not included within the scope of delivery:

- Male 9 pin D-Sub mating connector for X0A, X1A
- Male 15 pin D-Sub mating connector for X0B, X1B
- Motor configuration files which are absolutely necessary for the operation of the motors or the axes.
- Ethernet cable

4.1.4. GIN-SAC4x1

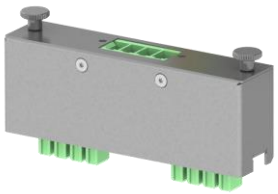
When ordering the GIN-SAC4x1 with the options 230V, 400V, 230V / PRO and 400V / PRO, the following components are included:

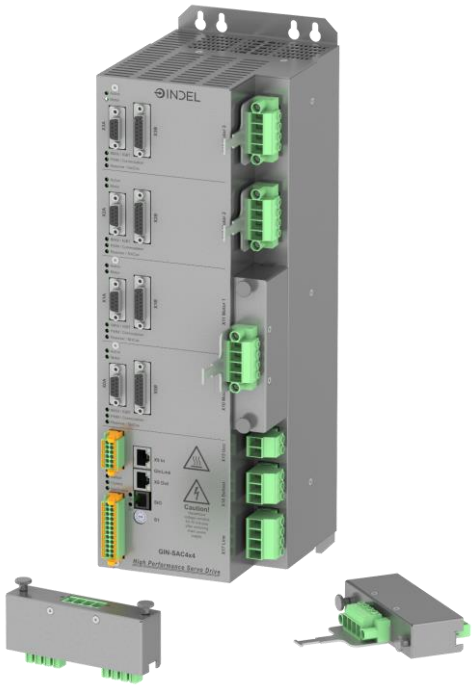
- Servo-Drive GIN-SAC4x1
- Mating connector X7:
  PHOENIX CONTACT DFMC 1,5 / 6-ST-3,5-LR with specific Indel labeling
- Mating connector X17:
  PHOENIX CONTACT PC 4 HV / 4-ST-7,62 with specific Indel labeling
- Mating connector X10
  PHOENIX CONTACT PC 5 / 4-STF-SH1-7,62 with specific Indel labeling
- Mating connector X15
  PHOENIX CONTACT PC 4 HV / 2-ST-7,62 with specific Indel labeling
- Mating connector X16
  PHOENIX CONTACT PC 4 HV / 3-ST-7,62 with specific Indel labeling
- Mating connector X100
  PHOENIX CONTACT DFMC 1,5 / 12-ST-3,5-LR with specific Indel labeling

The following are not included within the scope of delivery:

- Male 9 pin D-Sub mating connector for X0A
- Male 15 pin D-Sub mating connector for X0B
- Motor configuration files which are absolutely necessary for the operation of the motors or the axes.
- Ethernet cable

4.2. Optional Accessories

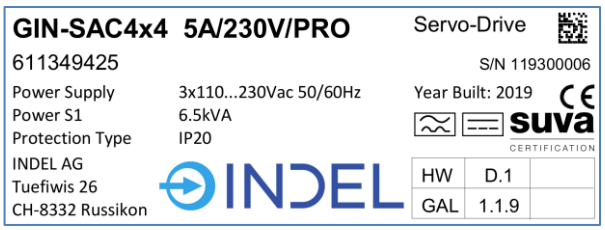
	SAC4-AD-2X	611755000	Compact pluggable Adaptor for GIN-SAC4xX devices, connects 2 Motor Outputs in parallel to get higher output motor currents. Installation is toolless by simply plug the adapter onto the SAC and fixing the knurled screw. The original motor connector from the SAC4 is reused as Motor Connector.



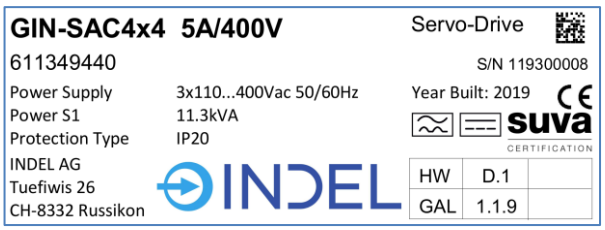
Application example of SAC4-AD2X adaptors

4.3. Rating plates

4.3.1. SAC4x4 230V



4.3.2. SAC4x4 400V



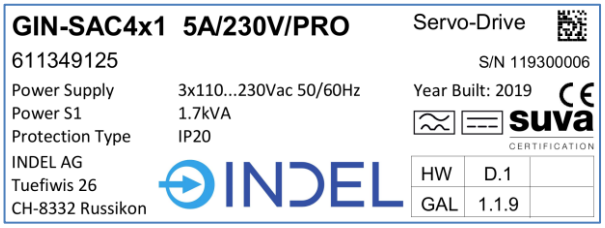
4.3.3. SAC4x3 230V

4.3.4. SAC4x3 400V

4.3.5. SAC4x2 230V

4.3.6. SAC4x2 400V

4.3.7. SAC4x1 230V



4.3.8. SAC4x1 400V

5. Stop/Emergency Power Off functions in accordance with EN 60204

In the case of the Indel GIN-SAC4 Servo Drives, additional external safety switching devices can be used to implement category 0 and 1 stop functions in accordance with EN 60204-1. The different stop categories as explained in EN 60204 are listed below.

Stop Category 0
Stop by immediately switching off the power supply to the machine drives. Uncontrolled stop of the axis.
Stop Category 1
A controlled stop of the axis. The power supply to the machine drives is maintained in order to decelerate the axis in a controlled manner within a defined period of time. After this defined period, the power supply is interrupted.
Stop Category 2
A controlled stop, in which the power supply to the machine drives is maintained. The braking ramp and the stop are monitored.

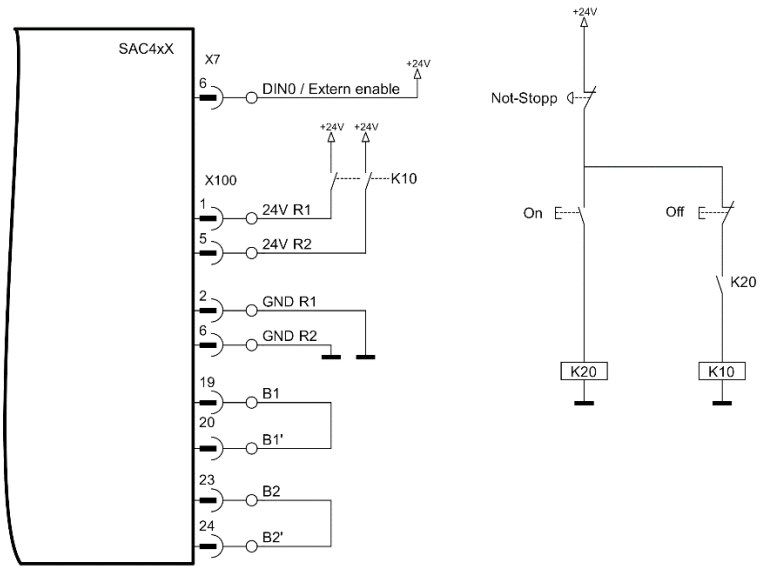
5.1. Emergency stop

According to EN60204, an emergency stop is defined as a stop of category 0 or 1. The choice of the appropriate category depends on the risk assessment of the machine.

5.1.1. Implementing emergency stop category 0

The following example of use is non-binding and is for illustrative purposes only. Only the implementation of category 0 emergency stop is shown, and this bears no relation to the final performance level.

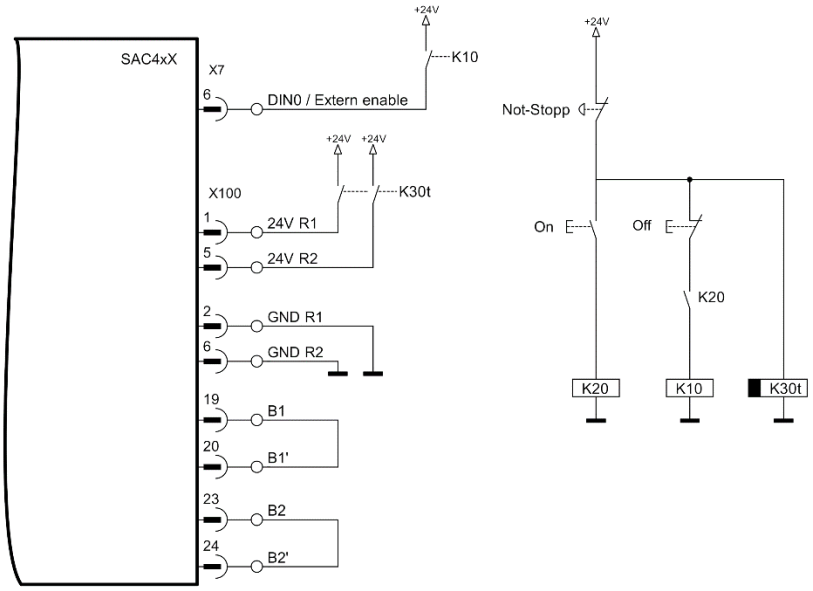
- Immediate switching off of the power supply to the machine drives by the STO
- Axes can spin out
- Emergency Stop Category 0



5.1.2. Implementing emergency stop category 1

The following example of use is non-binding and is for illustrative purposes only. Only the implementation of category 1 emergency stop is shown, and this bears no relation to the final performance level. To initiate an emergency braking ramp, the external enable would not necessarily have to be used. The emergency braking ramp can also be configured to any digital input in the system.

- Controlled braking of the axes via external enable
- Time-delayed switching off of the power supply to the machine drives by the STO
- Emergency Stop Category 1



5.2. Emergency halt

An emergency halt is also an emergency stop, but with further requirements. The following must also be considered:

- The emergency halt must take precedence over all other functions and operations in all operating modes
- The power supply to the machine drives, which can cause a dangerous situation, must either be interrupted immediately (stop category 0) or controlled so that the dangerous movement is stopped as soon as possible (stop category 1) without creating other hazards.
- Resetting must not initiate a restart

5.3. Emergency Power Off

In the case of an Emergency Power Off, the power supply of the servo drive is interrupted by means of electromechanical switching devices. This results in a stop of category 0. Emergency Power Off must be provided where:

- Protection against direct contact can only be achieved by spacing or obstacles (e.g. with conductor lines, slip rings, switching devices in electrical operating rooms).
- There is the possibility of other hazards or damage from electrical power.

If stop category 0 is not permitted, other measures can be taken so that an Emergency Power Off is no longer necessary. For example, protection against direct contact (EN 60204).

6. Safety functions with the SAC4

The contents of this manual applies only to the devices listed in chapter 6.3.
The following information are especially not valid for SAC4 Devices with option “FS”!

6.1. Safe Torque Off (STO)

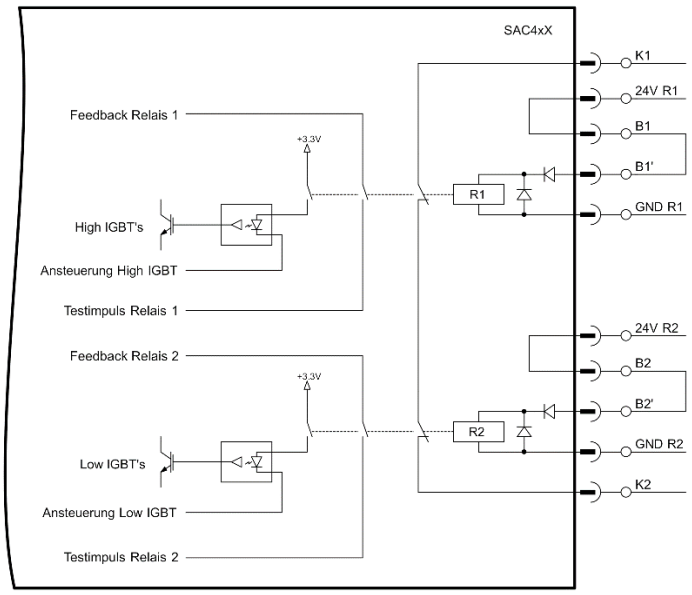
The STO safety function shifts all to the drive connected motors into a de-energized state. As a result, the motors are torque-free and thus force-free. Since the drive can no longer initiate a torque or force, no dangerous movement can occur.

The STO function is technically implemented with two safe pulse inhibitors. The figure below illustrates the functional principle of the safety pulse inhibitors.
The two pulse inhibitors act independent by using its own relay each. The first pulse inhibitor can suppress the control signals of all the high side IGBTs of the power stages while the other pulse inhibitors can suppress the control signals of all low side IGBTs.

All contacts of each relay are forcibly guided contacts. The auxiliary contacts reflect the state of the main contacts and can be used as feedback channels.
The correct state of the relays must be checked by the user by monitoring the diagnose Path (Pin K1 to K2). If any impermissible state is detected, there must be a defect and the machine must be shut down.

For diagnostic purposes and debugging, the state of the relays are also displayed on (not reliable) variables inside the system software.

For the terminals B1 B1' and B2 B2', external wire jumpers must be installed. These wire jumpers are a safety feature and they prevent the unnoticed operation of SAC4 drives with enhanced Safety option “FS” in case of a mix-up.



6.2. Connection example

A non-binding connection example can be found in the commissioning manual in chapter 4.

WWW. Commissioning Manual

6.3. SAC4 drives with STO

The following servo drives are equipped with the STO.

Type	Option	Item. No.
GIN-SAC4x4	5A/230V	611349420
GIN-SAC4x4	5A/230V/PRO	611349425
GIN-SAC4x4	5A/400V	611349440
GIN-SAC4x4	5A/400V/PRO	611349445
GIN-SAC4x3	5A/230V	611349320
GIN-SAC4x3	5A/230V/PRO	611349325
GIN-SAC4x3	5A/400V	611349340
GIN-SAC4x3	5A/400V/PRO	611349345
GIN-SAC4x2	5A/230V	611349220
GIN-SAC4x2	5A/230V/PRO	611349225
GIN-SAC4x2	5A/400V	611349240
GIN-SAC4x2	5A/400V/PRO	611349245
GIN-SAC4x1	5A/230V	611349120
GIN-SAC4x1	5A/230V/PRO	611349125
GIN-SAC4x1	5A/400V	611349140
GIN-SAC4x1	5A/400V/PRO	611349145

With the safe torque off and the corresponding external safety relays, category 0 or category 1 stops can be realised in accordance with EN 60204. See chapter 5.1.1 and 5.1.2.

6.4. Diagnostic function in the servo drive

The two auxiliary contacts of the safety relays (feedback relays) are evaluated within the servo drive. The result is used to inhibit an unintended restart of the motors caused by the drives software at the moment when switching back from STO State to normal operation by reapplying the STO-Inputs:

- If an attempt is made from the fieldbus master to “activate” any axis of the drive without the safety relays being powered, a corresponding error is issued and the axis of the drive stay “deactivated”.
- If one or both of the two Safety inputs goes low during normal operation (change to STO state) the software inside the drive will put the state of all axes to “deactivated”.

This internal evaluation is performed by the device’s software and is not considered reliable (not a safety function).

6.5. Monitoring of the diagnostic path (K1-K2) by the user

The STO function of the SAC4 device family requires the user to monitor the diagnostic contact K1-K2 on the X100 connector and check for correctness. Only then can the calculated diagnostic coverage DC of the device be achieved. See Suva type examination certificates in chapter 11.2.

- In STO state (both relays inputs without power), the diagnosis contact must be closed, signalling that both relays are working correctly and both pulse inhibitors are working.
- During normal operation, the diagnostic contact must be open. This checks the correct function and wiring of the diagnostic contact.

Every correctly evaluated switch from STO to normal operation and back is a completed test cycle of the diagnostic test.

If, in one of the cases described above, the behaviour of the diagnostic contact deviates from what is expected, this means that a fault is present and the machine must no longer be taken into operation.

Periodic test cycle
Depending on the safety requirements of the application the maximum time between test cycles is restricted. See chapter 2.2.2 for more information.

7. Technical description

7.1. SAC4xX option PRO

Each SAC4xX with the PRO option is equipped with a dual-core processor. This makes it possible to operate the motor control on one core, while the second core can be used for a customer-specific application. This means that the SAC4xX can also be used as a master or GinLink master for simpler applications.

7.2. Rotary option switch

Each SAC4xX is equipped with a rotary option switch (S1). This can be used to determine the state in which the master is to be booted. The following table shows the different states with regard to the rotary option switch and the possible combinations.
If the LAN interface is activated, it is automatically activated on the X8 GinLink out socket.

Rotary switch position	Recovery System	GinLink Master [1)]	LAN	Default IP	Comment
0x0					Standard slave
0x1		X	X		
0x2		X	X	X	
0x3	X				
0x4			X		Standard stand-alone
0x5	X		X		
0x6			X	X	
0x7	X		X	X	
0x8 … 0xF	Reserved				

1) Only the GIN-SAC4xX with the option PRO can be used as the GinLink Master

7.3. Technical specifications

7.3.1. General

Allgemeine Bedingungen		GIN-SAC4xX	
		230 V	400 V
Vibration max		Sinus, 10 Hz bis 150 Hz, Amplitude 0.075 mm	
Shock max		1g	
Emitted interference with mains filter		EN 61800-3, category C2 (industry)	
Immunity with mains filter		EN 61800-3, second environment (industry)	
Electrical safety (voltage clearances)		EN 61800-5-1	
Weight GIN-SAC4x4	Kg	7.04	
Weight GIN-SAC4x3	Kg	5.70	
Weight GIN-SAC4x2	Kg	4.45	
Weight GIN-SAC4x1	Kg	3.12	

7.3.1.1 Leakage Current

The final leakage current of the complete drive system is depending on the several components:

- Leakage current of the mains filter
- Leakage current of the SAC4, cause by the Y-Capacitors.
- Leakage current caused by the parasitic motor cable capacitors (wire to shield)
- Leakage current components with PWM frequency cause by parasitic motor cable capacitors

Typical Leakage current of an SAC4x4 used at a 1ph 230V / 50Hz mains

Leakage current of the SAC4x4 nominal, 50 Hz component:	2.0 mA
Leakage current per Meter motor cable, 50 Hz component:	0.012 mA / m
+ Leakage current of the mains filter	
+ Leakage current components with PWM frequency	

Typical Leakage current of an SAC4x4 used at a 3ph 400V / 50Hz mains

Leakage current of the SAC4x4 nominal, 150 Hz component:	1 mA
Leakage current per Meter motor cable, 150 Hz component:	0.015 mA / m
+ Leakage current of the mains filter	
+ Leakage current components with PWM frequency	

Note:
By operating 3-phase mains filters the leakage current is defined during operation with symmetrical voltage on all 3 phases. If 1 or 2 phases are missing, the leakage current can be a lot higher than specified by the manufacturer.
Caution: This condition can also occur while switching on or off a machine with a mechanical power switch. When not all 3 mains phases are switched exactly the same time, a leakage current may trigger an RCD.

7.3.2. Mains connection and intermediate circuit

Rated data		GIN-SAC4xX	
		230 V	400 V
Rated 1-phase mains voltage	V_{AC}	1 x 110$_{-10\%}$ ... 230$_{+10\%}$	1 x 110$_{-10\%}$ ... 400$_{+10\%}$
Rated 3-phase mains voltage	V_{AC}	3 x 110$_{-10\%}$ ... 230$_{+10\%}$	3 x 110$_{-10\%}$ ... 400$_{+10\%}$
Rated Power S1 SAC4x4 230V/400V 3ph	kVA	6.5	11.3
Rated Power S1 SAC4x3 230V/400V 3ph	kVA	4.9	8.5
Rated Power S1 SAC4x2 230V/400V 3ph	kVA	3.3	5.7
Rated Power S1 SAC4x1 230V/400V 3ph	kVA	1.7	2.9
Overvoltage cut-out	V_{DC}	400	800
Maximum network asymmetry		± 3%	
Mains frequency	Hz	50...60	
Intermediate DC circuit capacity GIN-SAC4x4	µF	3760	940
Intermediate DC circuit capacity GIN-SAC4x3	µF	2820	705
Intermediate DC circuit capacity GIN-SAC4x2	µF	1880	470
Intermediate DC circuit capacity GIN-SAC4x1	µF	940	235
Permitted network types star point earthed		TT, TN	
Switch-on interval	s	> 10	
External fuse protection SAC4x4	AT	25 A	
External fuse protection SAC4x3	AT	16 A	
External fuse protection SAC4x2	AT	16 A	
External fuse protection SAC4x1	AT	16 A	
Switch-on current	A	< 2	
Overvoltage category		III (EN 61800-5-1)	
Maximum Short Circuit Current Rating of Mains Circuit	A	5000	

See Chapter 8.4 on page 57 and chapter 8.5 on page 59.

For operation of the Device an external mains filter and an external Fuse is required on the mains connection.
The rating of the fuse are maximum values. In cases where the real application does not require the full power of the drive, a fuse and mains filter with lower current rating can be calculated and installed by the machine developer.

The Device is designed to be operated on Mains Circuit that cannot deliver more than a maximum Short Circuit current of 5000 A.

7.3.3. Nominal currents of output stages

The following tables show the theoretically possible nominal and maximum currents of the output stages. The data is based solely on theoretical calculations. The individual load must therefore always be tested by the user. Above all, strict adherence to the environmental conditions in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** must be observed.

Nominal currents		GIN-SAC4x4	
		230 V	400 V
I_{RATED} at 8 kHz PWM frequency	A_{RMS}	22	
I_{MAX} at 8 kHz PWM frequency	A_{RMS}	33	
I_{RATED} at 12 kHz PWM frequency	A_{RMS}	18	
I_{MAX} at 12 kHz PWM frequency	A_{RMS}	27	
I_{RATED} at 16 kHz PWM frequency	A_{RMS}	13	
I_{MAX} at 16 kHz PWM frequency	A_{RMS}	19.2	
I_{RATED} at 24 kHz PWM frequency	A_{RMS}	9	
I_{MAX} at 24 kHz PWM frequency	A_{RMS}	13.5	
I_{RATED} at 32 kHz PWM frequency	A_{RMS}	6	
I_{MAX} at 32 kHz PWM frequency	A_{RMS}	9	
I_{MAX} Ballast IGBT	A_{RMS}	24	
Minimum external ballast resistor	Ω	15	30
Maximum power dissipation	W	250	

The drives can be operated for 5s at I_{MAX}.

Nominal currents		GIN-SAC4x3	
		230 V	400 V
I_{RATED} at 8 kHz PWM frequency	A_{RMS}	16.5	
I_{MAX} at 8 kHz PWM frequency	A_{RMS}	24.5	
I_{RATED} at 12 kHz PWM frequency	A_{RMS}	13.5	
I_{MAX} at 12 kHz PWM frequency	A_{RMS}	20	
I_{RATED} at 16 kHz PWM frequency	A_{RMS}	10	
I_{MAX} at 16 kHz PWM frequency	A_{RMS}	14.5	
I_{RATED} at 24 kHz PWM frequency	A_{RMS}	6.5	
I_{MAX} at 24 kHz PWM frequency	A_{RMS}	10	
I_{RATED} at 32 kHz PWM frequency	A_{RMS}	4.5	
I_{MAX} at 32 kHz PWM frequency	A_{RMS}	6.75	
I_{MAX} Ballast IGBT	A_{RMS}	24	
Minimum external ballast resistor	Ω	15	30
Maximum power dissipation	W	185	

The drives can be operated for 5s at I_{MAX}.

Nominal currents		GIN-SAC4x2	
		230 V	400 V
I_{RATED} at 8 kHz PWM frequency	A_{RMS}	11	
I_{MAX} at 8 kHz PWM frequency	A_{RMS}	16.5	
I_{RATED} at 12 kHz PWM frequency	A_{RMS}	9	
I_{MAX} at 12 kHz PWM frequency	A_{RMS}	13.5	
I_{RATED} at 16 kHz PWM frequency	A_{RMS}	6.7	
I_{MAX} at 16 kHz PWM frequency	A_{RMS}	9.6	
I_{RATED} at 24 kHz PWM frequency	A_{RMS}	4.5	
I_{MAX} at 24 kHz PWM frequency	A_{RMS}	6.7	
I_{RATED} at 32 kHz PWM frequency	A_{RMS}	3	
I_{MAX} at 32 kHz PWM frequency	A_{RMS}	5.5	
I_{MAX} Ballast IGBT	A_{RMS}	24	
Minimum external ballast resistor	Ω	15	30
Maximum power dissipation	W	130	

The drives can be operated for 5s at I_{MAX}.

Nominal currents		GIN-SAC4x1	
		230 V	400 V
I_{RATED} at 8 kHz PWM frequency	A_{RMS}	5.5	
I_{MAX} at 8 kHz PWM frequency	A_{RMS}	8.25	
I_{RATED} at 12 kHz PWM frequency	A_{RMS}	4.5	
I_{MAX} at 12 kHz PWM frequency	A_{RMS}	6.75	
I_{RATED} at 16 kHz PWM frequency	A_{RMS}	3.25	
I_{MAX} at 16 kHz PWM frequency	A_{RMS}	4.8	
I_{RATED} at 24 kHz PWM frequency	A_{RMS}	2.25	
I_{MAX} at 24 kHz PWM frequency	A_{RMS}	3.38	
I_{RATED} at 32 kHz PWM frequency	A_{RMS}	1.5	
I_{MAX} at 32 kHz PWM frequency	A_{RMS}	2.25	
I_{MAX} Ballast IGBT	A_{RMS}	24	
Minimum external ballast resistor	Ω	15	30
Maximum power dissipation	W	65	

The drives can be operated for 5s at I_{MAX}.

7.3.4. Logic power supply

Logic power supply		GIN-SAC4xX	
		230 V	400 V
Operating voltage		24 $V_{DC\ -5\%...+15\%}$	
External fuse protection	A	8, fast blow	
Power consumption	A	< 2 [1)]	
Max. Potential between GND and earth	V_{DC}	50 [2)]	

1) The current required depends on the load of feedback systems, internal fans, etc.
2) The Logic power supply “0V” must be connected to Earth at the Power supply side (GND and PE)

See chapter 8.6 on page 59

7.3.5. Motor

Motor		GIN-SAC4xX	
		230 V	400 V
Minimum inductance ph-ph	mH	1	
Minimum resistance ph-ph	Ω	0.2	
Maximum cable length without choke	m	20	
Motor cable type		shielded	
Minimum motor nominal voltage	V	325	565
Supported motor types 1)		• DC motors (not for safety applications) • Synchronous servomotors • Linear motors • Brushless asynchronous motors	

See chapter 8.3 on page 56

ATTENTION

DC motors connected to the GIN-SAC4xX cannot be used for safety relevant applications!
Because of the design principle of DC motors, at multiple faults in the motor wiring and/or power stage of the drive, even the Safety function STO will not be able to stop the motor!

7.3.6. Feedback

7.3.6.1 SinCos

SinCos Interface		GIN-SAC4xX	
		230 V	400 V
Level	V_{RMS}	1	
Differential input resistance	Ω	120	
Max. input frequency	kHz	200	
Max. current load 5V output	mA	200	
Max. current load 12V output	mA	200	
Resolution of analogue input	Bit	16	
Utilising analogue input	Bit	12	
Connection cable		double shielded, pair twisted	

See chapter 8.9.1 on page 61

7.3.6.2 Resolver

Resolver Interface		GIN-SAC4xX	
		230 V	400 V
Generator output voltage level	V_{RMS}	4	
Sine / cosine input voltage level	V_{RMS}	2	
Resolution of analogue input	Bit	16	
Utilising analogue input	Bit	16	
Multipole resolver		√	
Connection cable		double shielded, pair twisted	

See chapter 8.9.2 on page 62

7.3.6.3 Incremental encoder

Incremental encoder on absolute value interface		GIN-SAC4xX 230 V	GIN-SAC4xX 400 V
Level		RS422	
Input resistance	Ω	120	
Max. input frequency	MHz	2.5	
Max. current load 5V output	mA	200	
Max. current load 12V output	mA	200	
Connection cable		shielded	

See chapter 8.9.3.1 on page 63

Incremental encoder on SinCos interface		GIN-SAC4xX 230 V	GIN-SAC4xX 400 V
Level		RS422	
Input resistance	Ω	120	
Max. input frequency	kHz	200	
Max. current load 5V output	mA	200	
Max. current load 12V output	mA	200	
Connection cable		shielded	

See chapter 8.9.3.2 on page 64

7.3.6.4 Absolute value feedback

The following absolute value feedback systems are supported by the SAC4xX

- Hiperface See chapter 8.9.4.1 on page 66
- EnDat 2.1 See chapter 8.9.4.2 on page 67
- SSI See chapter 8.9.4.3 on page 68
- BissC See chapter 8.9.4.3 on page 68
- EnDat 2.2 See chapter 8.9.4.3 on page 68

7.3.7. Digital IOs

Digital inputs		GIN-SAC4xX	
		230 V	400 V
Input voltage	V_{DC}	$24_{\pm 25\%}$	
Switching threshold	V_{DC}	12	
Analogue input filter	kHz	3	
Reactive current	mA	2	

See chapter 8.7.1 on page 60

Digital outputs		GIN-SAC4xX	
		230 V	400 V
Max. output current	A	1	
Nominal voltage of external supply	V_{DC}	$24_{\pm 25\%}$	
Switching delay	ms	0.5	

See chapter 8.7.2 on page 60

7.3.8. Safe Torque Off (STO)

The diagnostic coverage depends directly on the external evaluation of the diagnose contacts K1-K2!
To reach a specific performance level of the whole safety system, additional external measures are necessary.
See chapter 6.5 on pageon page 36, and the “SUVA Supplementary Sheet to Certificate” on chapter 11.2.

STO		GIN-SAC4xX	
		230 V	400 V
Architecture		Cat. 4 as per EN ISO 13849-1	
Diagnostic coverage DC		Hoch	
MTTFd	Years	100	
CCF		Fulfils	
Performance Level		e	
PFH	1/h	2.47 x 10^{-8}	
Relay type		Elesta SIF 312	
Input voltage to 24V R1 und 24V R2	V	$24_{\pm 10\%}$	
Nominal current per relay @ $24V_{DC}$	mA	25	
Max current on K1-K2 contact	A	1	
Fuse protection of the safety supply circuits	A	1	
Relay reaction time	ms	10	
Reaction time t_{ON}	ms	10	
Reaction time t_{OFF}	ms	15	
Switching cycles @ $24V_{DC}$ / 300mA / resistive Load		10 x 10_6	
Bounce time	ms	< 15	

7.4. Ambient conditions

Compliance with ambient conditions is the responsibility of the user. Indel disclaims any liability for non-compliance.

Ambient temperature storage	°C	-20…80
Ambient temperature operation	°C	0…40
Maximum heat sink temperature	°C	80
Protection class		IP20
Mounting position		Vertical
Permitted installation altitude without reduction in performance	Metres above sea level	1000
Permitted installation altitude with reduction in performance	Metres above sea level	2000 -1.0% / 100m (above 1000 m)
Relative humidity, no condensation		80%
Degree of contamination		2 (EN 50178)
Overvoltage category		III (EN 61800-5-1)

7.5. Information according US market

SAC4 Drives are currently not UL certified.

The SAC4 Drives went through an IEC CB-Scheme Type examination and fulfil the requirements of the IEC 61800-5-1 product standard. The Type examination was done by TüV Süd. The Certificate is attached in chapter 11.6 on page 93.

The special requirements of the UL 61800-5-1 were also included into the type examination. The SAC4xX drives technically fulfil the requirements of the UL 61800-5-1 standard.

On request, INDEL can deliver the relevant parts of the SAC4xX Type examination report as Confirmation.

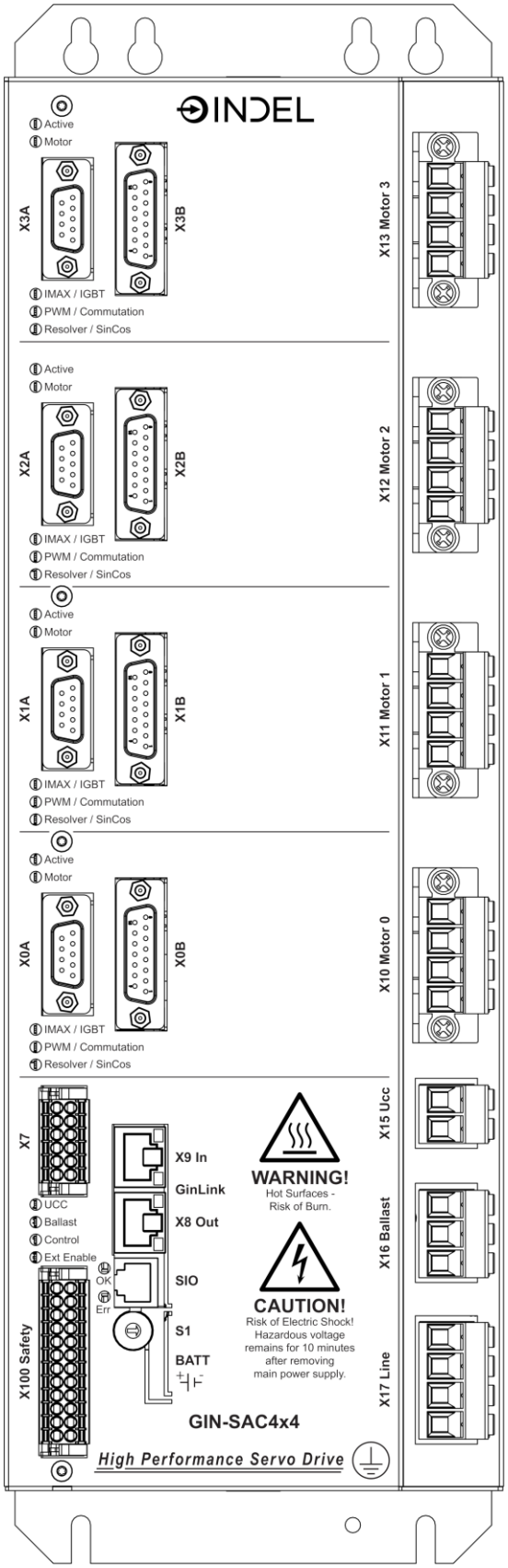
8. Electrical installation

8.1. Notes

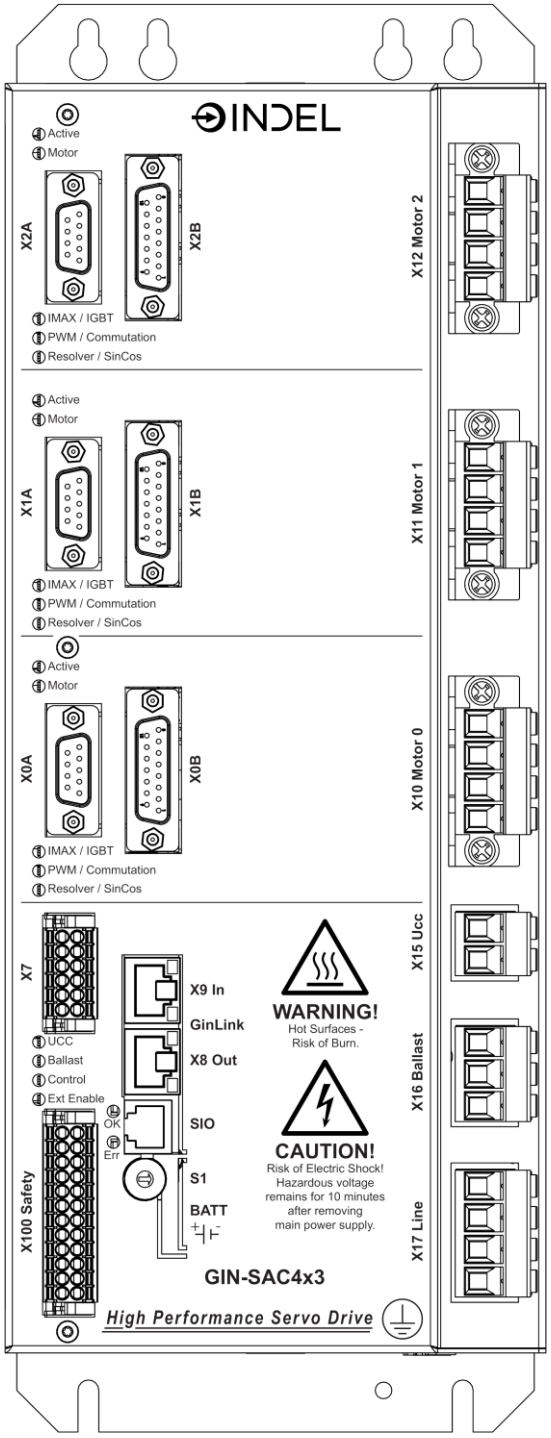
- **When wiring the drive, the control cabinet must be secured against being switched on again**
- **The national accident prevention regulations must be observed**
- **The electrical installation must be carried out in accordance with national regulations (wire colours, cross-sections, fuses, protective earth connection, etc.)**

8.2. Pin assignment of SAC4xX

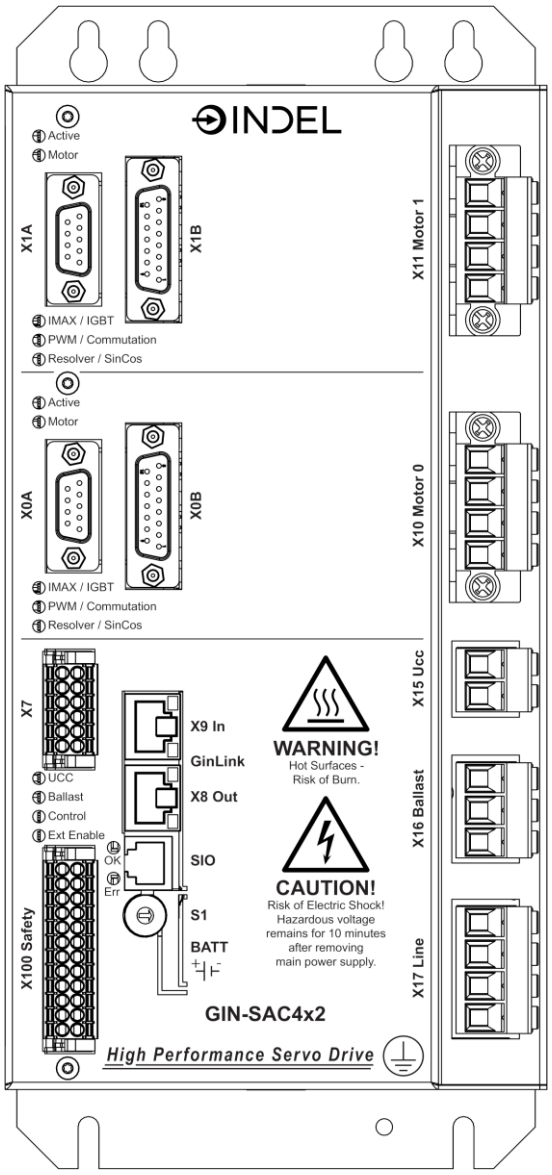
8.2.1. GIN-SAC4x4 overview



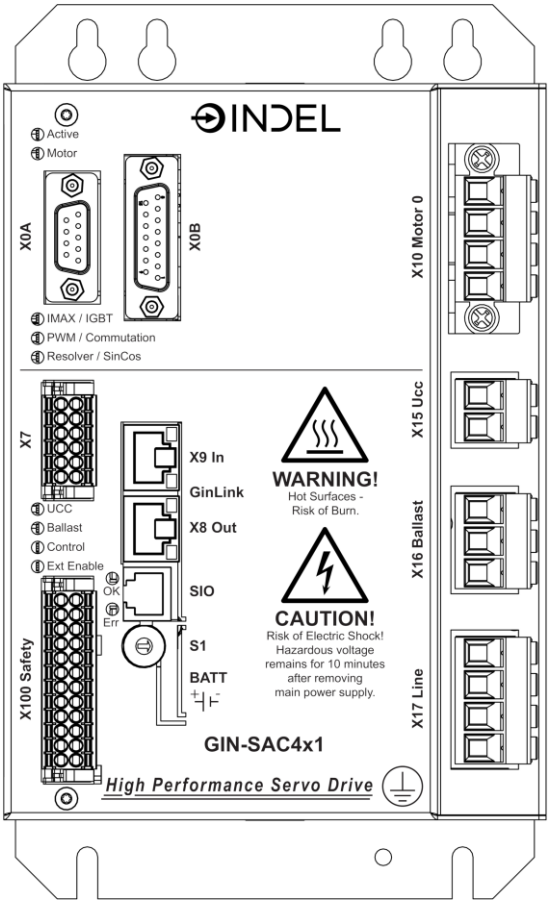
8.2.2. GIN-SAC4x3 overview



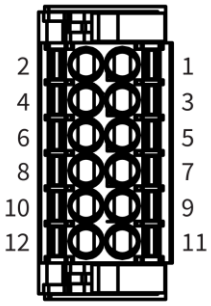
8.2.3. GIN-SAC4x2 overview



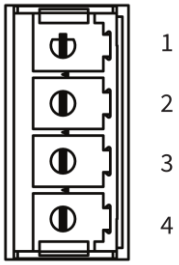
8.2.4. GIN-SAC4x1 overview



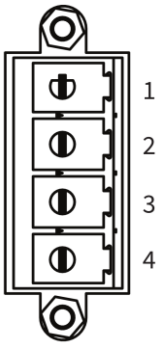
8.2.5. Logic power supply / Digital IOs

Connector name	Figure	Pin-No.	Pin designation
X7		1	24 V (Main PWR Supply)
		2	GND
		3	DIN 3
		4	DIN 2
		5	DIN 1
		6	DIN 0 / ext. Enable
		7	DOUT 3
		8	DOUT 2
		9	DOUT 1
		10	DOUT 0
		11	VCC DOUT (DOUT Supply)
		12	GND DOUT

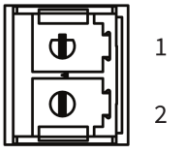
8.2.6. Mains connection

Connector name	Figure	Pin-No.	Pin designation
X17 Line		1	PE
		2	L1
		3	L2
		4	L3

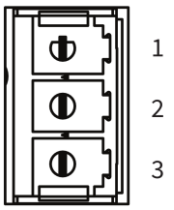
8.2.7. Motor connections

Connector name	Figure	Pin-No.	Pin designation
X10 Motor 0 X11 Motor 1 X12 Motor 2 X13 Motor 3		1	W
		2	V
		3	U
		4	PE

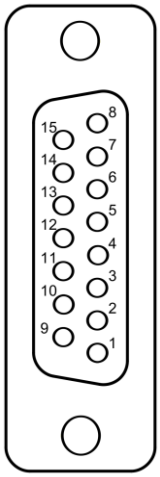
8.2.8. Intermediate circuit voltage

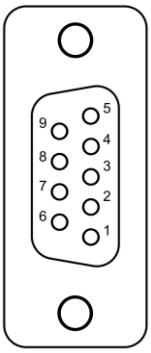
Connector name	Figure	Pin-No.	Pin designation
X15 UCC		1	DC +
		2	DC -

8.2.9. Ballast Resistance

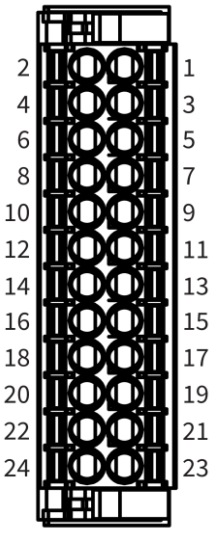
Connector name	Figure	Pin-No.	Pin designation
X16 Ballast		1	PE
		2	RB -
		3	RB +

8.2.10. Feedback interfaces

Connector name	Figure	Pin-No.	Pin designation
X0B X1B X2B X3B		1	Sin+ (SinCos)
		2	GND
		3	Cos+ (SinCos)
		4	+12V
		5	Data+ (RS422)
		6	Ref+ (RS422)
		7	MTmp
		8	CLK - (RS422)
		9	Sin- (SinCos)
		10	GND
		11	Cos- (SinCos)
		12	+5V
		13	Data- (RS422)
		14	Ref- (RS422)
		15	Clk+ (RS422)

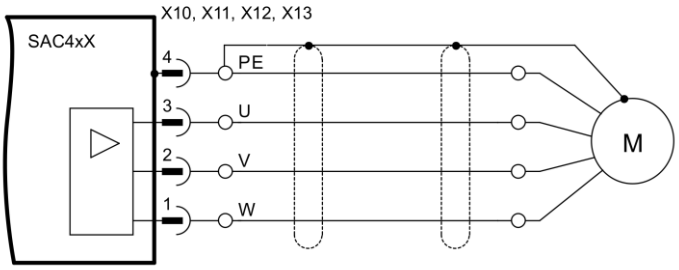
Connector name	Figure	Pin-No.	Pin designation
X0A Resolver 0 X1A Resolver 1 X2A Resolver 2 X3A Resolver 3		1	Shield / Schirm
		2	MTmp+
		3	Cos + (Resolver)
		4	Sin + (Resolver)
		5	Ref+ (Resolver)
		6	MTmp-
		7	Cos- (Resolver)
		8	Sin- (Resolver)
		9	Ref- (Resolver)

8.2.11. Safety Connector STO

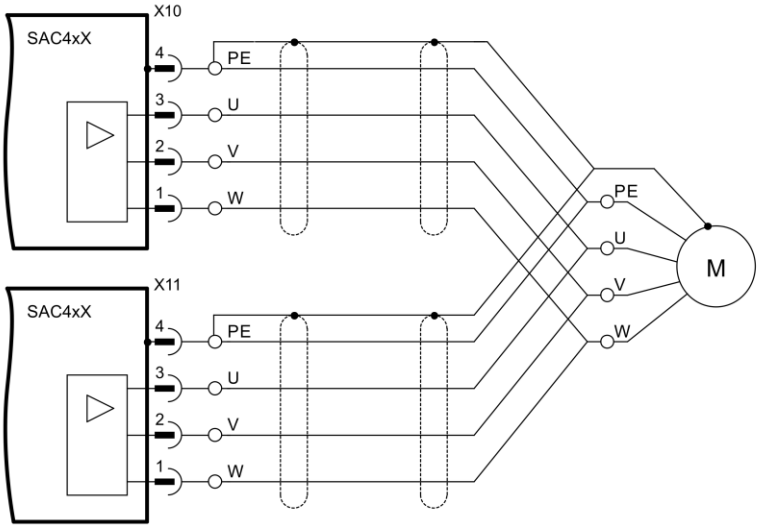
Connector name	Figure	Pin-No.	Pin designation
X100		1	24V R1 Input
		2	GND R1
		3	
		4	
		5	24 V R2 Input
		6	GND R2
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	K1 Diagnose contact
		16	K2 Diagnose contact
		17	
		18	
		19	B1
		20	B1‘
		21	
		22	
		23	B2
		24	B2‘

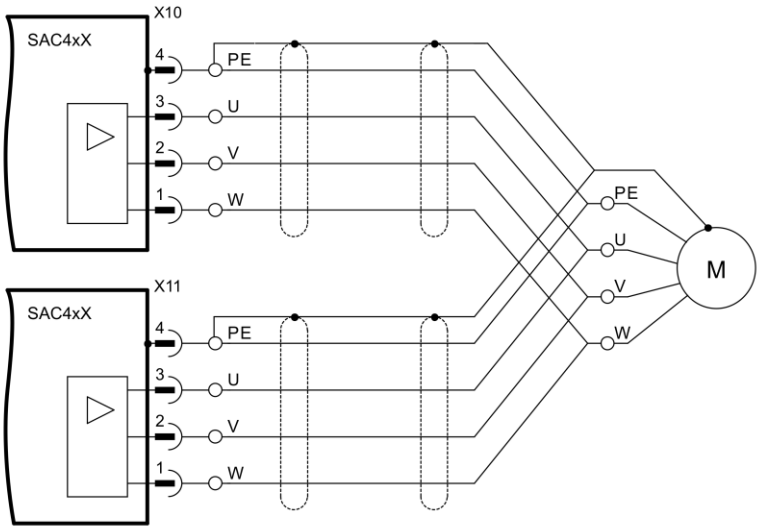
8.3. Motor connection

8.3.1. 3-phase motor on one output stage



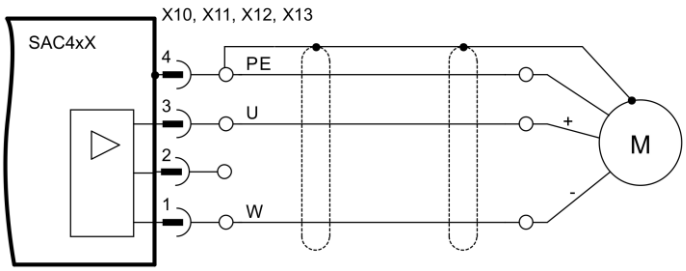
8.3.2. 3-phase motor on two parallel output stages





Usage of the optional available Adapter “SAC4-AD-2X” is recommended. See chapter 4.2 for more information.

8.3.3. DC motor at an output stage

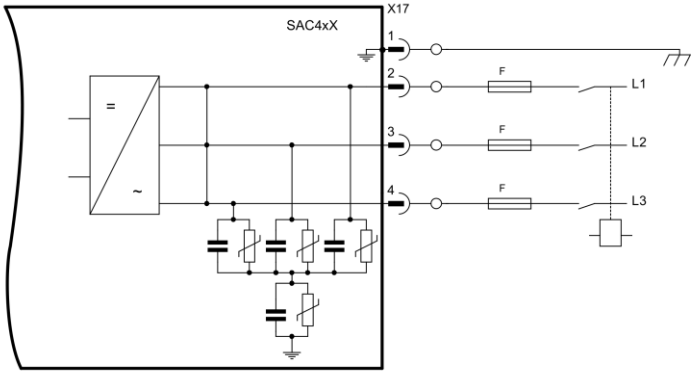


ATTENTION

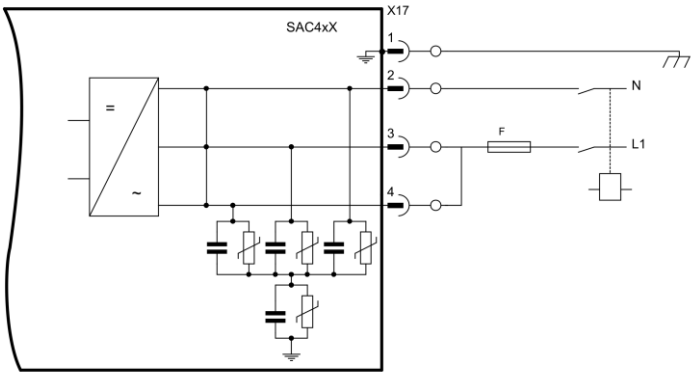
DC motors connected to the GIN-SAC4xX cannot be used for safety relevant applications!
Because of the design principle of DC motors, at multiple faults in the motor wiring and/or power stage of the drive, even the Safety function STO will not be able to stop the motor!

8.4. Mains connection

- 3-phase supply from the three-phase mains
- Suitable for GIN-SAC4xX-400V



- 1-phase supply from the mains
- Suitable for GIN-SAC4xX-230V



For operation of the Device an external mains filter and an external Fuse is required on the mains connection. See chapter 7.3.2 on page 39.

8.5. Intermediate circuit

ATTENTION

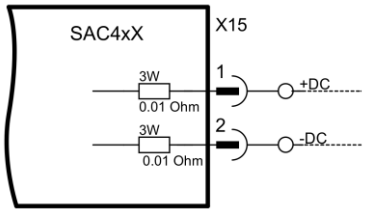
The intermediate circuit voltage of the drive is routed to connector X15. This allows the intermediate circuits of several SAC drives to be connected in parallel. But this is only permitted if the mains supply is identical for all drives. Otherwise, the drives can be destroyed.

For single-phase powered drives, all drives must be powered on the same phase, otherwise the DC link voltage may increase and the drives will be destroyed due to overvoltage.

Due to the DC link capacities intermediate circuit capacities, a maximum of 4 SAC4xX drives may be connected in parallel. Otherwise, the switch-on current will be too high and external protections may stick or be destroyed.

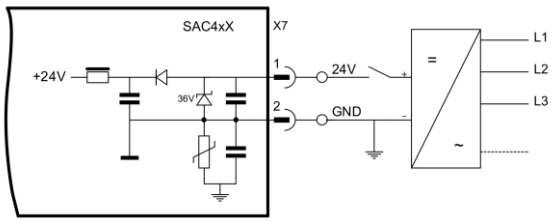
Internally there are resistors to limit equalising currents.

- Parallel connection of intermediate circuit of SAC4 Drives
- Connection of additional external capacitance if the intermediate circuit capacity is insufficient for acceleration phases
- Supply of the intermediate circuit by means of external DC voltage supply



8.6. Logic power supply

The Servo Drives must be provided with a 24V supply for operation.



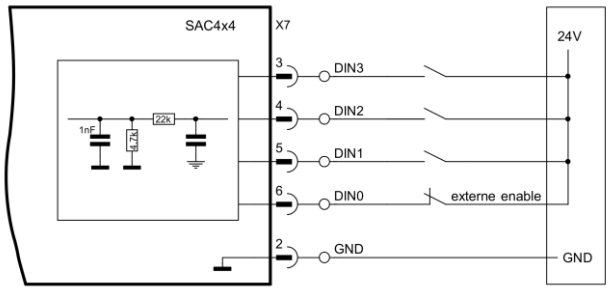
If the power supply is capable to source more than 8 A, an external 8A Fuse must be installed in the 24V Supply path. See chapter 7.3.4 on page 42.

8.7. Digital IOs

8.7.1. Inputs

The digital inputs are used as external enabler. This allows the servo drive to be deactivated externally. If an emergency stop braking ramp has been configured, this is triggered after on the deactivation of the enable input, and the motor brakes.
This is handled by normal software functionality and it is **not a reliable “safety” function**.

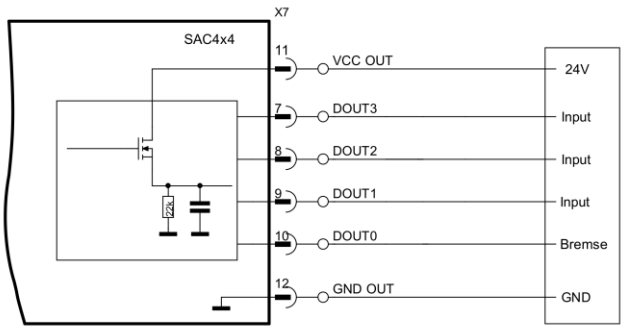
- DIN0 can be used as extern Enable for all Axis of the SAC4xX drive
- Implementation of a category 1 emergency stop by inclusion of the external enabler in the external safety circuit
- Reference Potential for the Inputs is GND
- The inputs are also visible inside the system software as “General Purpose Input”



8.7.2. Outputs

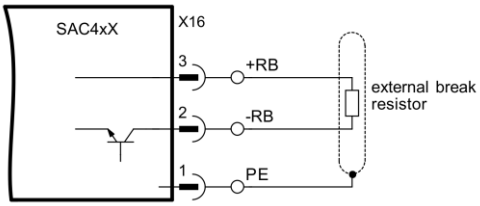
The digital outputs are designed as high-side drivers. The outputs are supplied by an external 24V voltage connected to the VCC_Out Pin.

- Configuration and connection of holding brake at the output.
- Configurable to display the State „reduced current mode “
- Individual configurable assignment of axis to an output
- In parallel (as OR-Function) controllable as General Purpose Output over the system software
- Reference potential is GND OUT (internally connected to GND)



8.8. External Ballast Resistor (brake resistor)

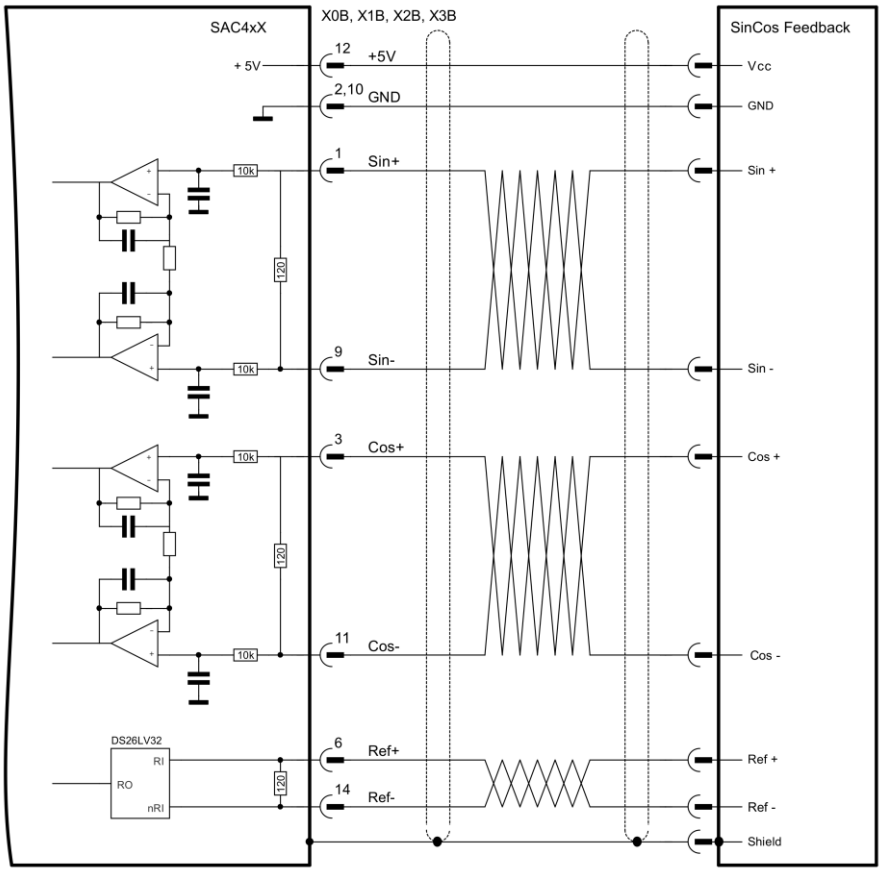
When deaccelerating the motors, the mechanical dynamic energy is converted back in to electricity an feed back into the intermediate circuit. This leads to an increase in the intermediate circuit voltage. A ballast resistor connected to the Ballast Output is used to dispose the surplus energy and keep the voltage in a acceptable range.



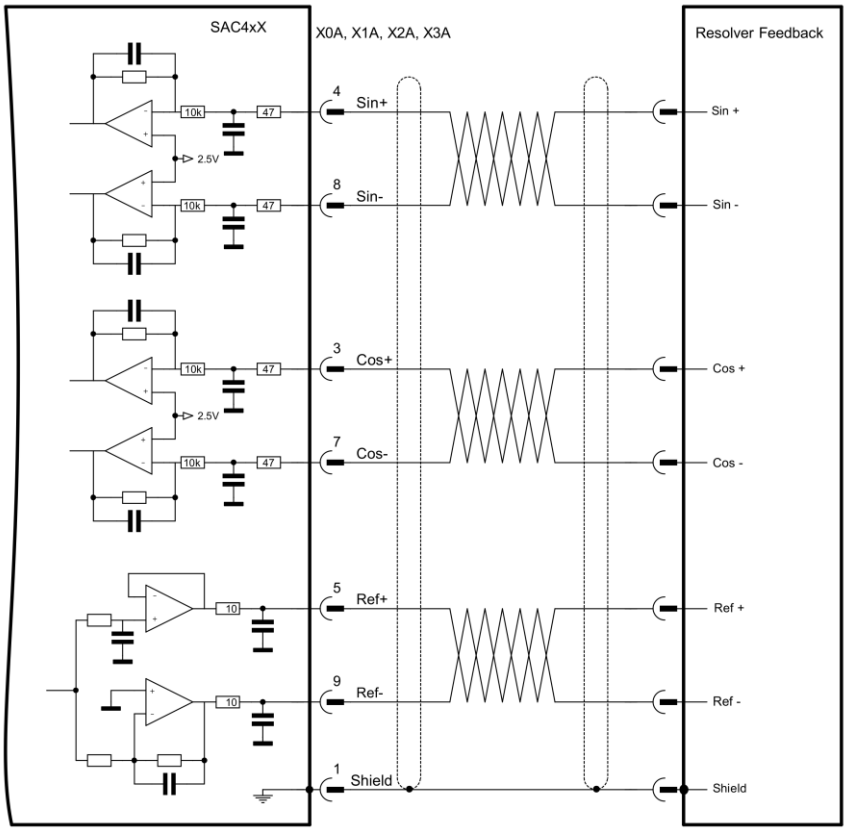
8.9. Feedbacks

8.9.1. SinCos Feedback

- Connection of standard SinCos feedback with 1 V_{RMS}
- Supply of the position encoder via the Servo Drive
- 16 Bit ADC measurement of position signals
- Utilisation of 12 bit, i.e. 4096 values per sine or cosine periode



8.9.2. Resolver Feedback



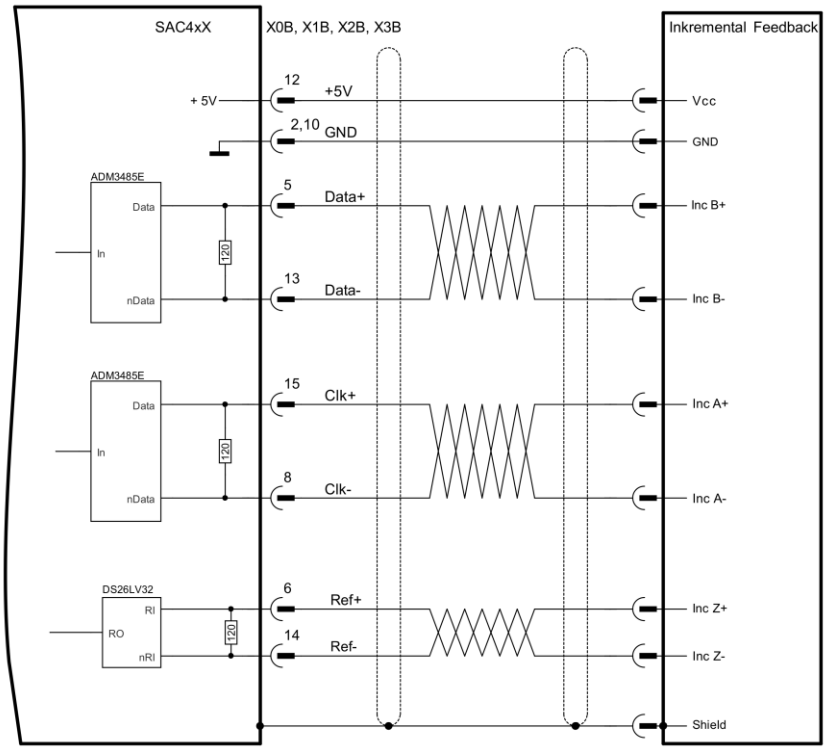
8.9.3. Incremental encoder feedback

Incremental encoders can be connected to the Servo Drive in two different ways. At the SinCos as well as at the absolute value interface. The difference lies in the signal sampling rate and thus in the maximum possible signal frequency of the incremental encoder. Depending on the resolution and speeds achieved, the maximum values are exceeded.

It is recommended to always connect the incremental encoder to the absolute value feedback if possible.

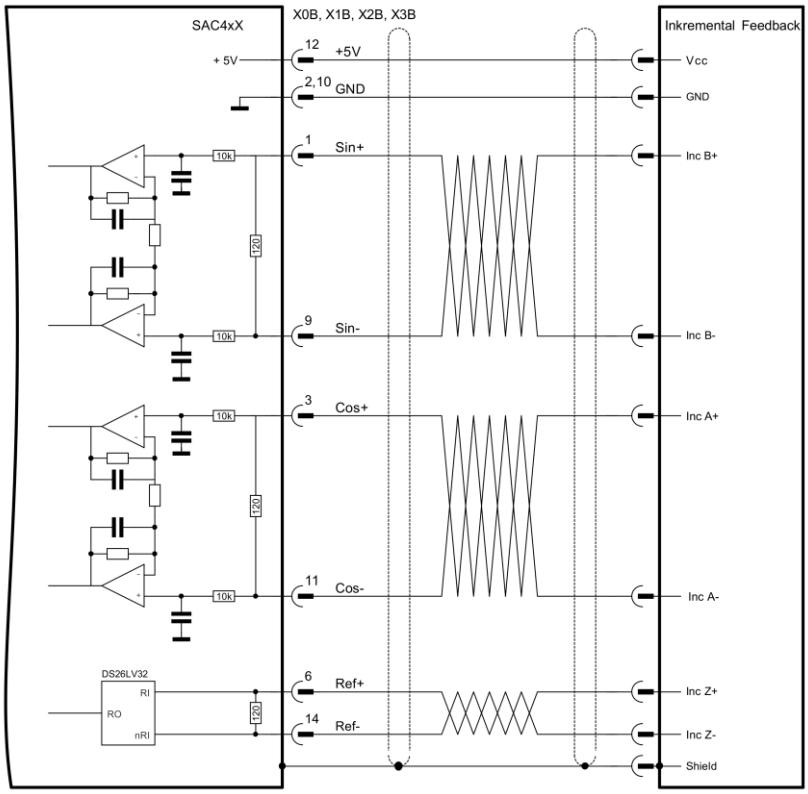
8.9.3.1 Connection to absolute value interface

- Maximum signal limit frequency at the input is 2.5 MHz
- RS422 standard with 120Ω terminating resistance
- Connection of single-ended incremental encoders see chapter 8.9.3.3 on page 65
-



8.9.3.2 Connection to SinCos interface

- Maximum signal limit frequency at the input is 200 kHz
- RS422 standard with 120Ω terminating resistance
- Connection of single-ended incremental encoders see chapter 8.9.3.3 on page 65

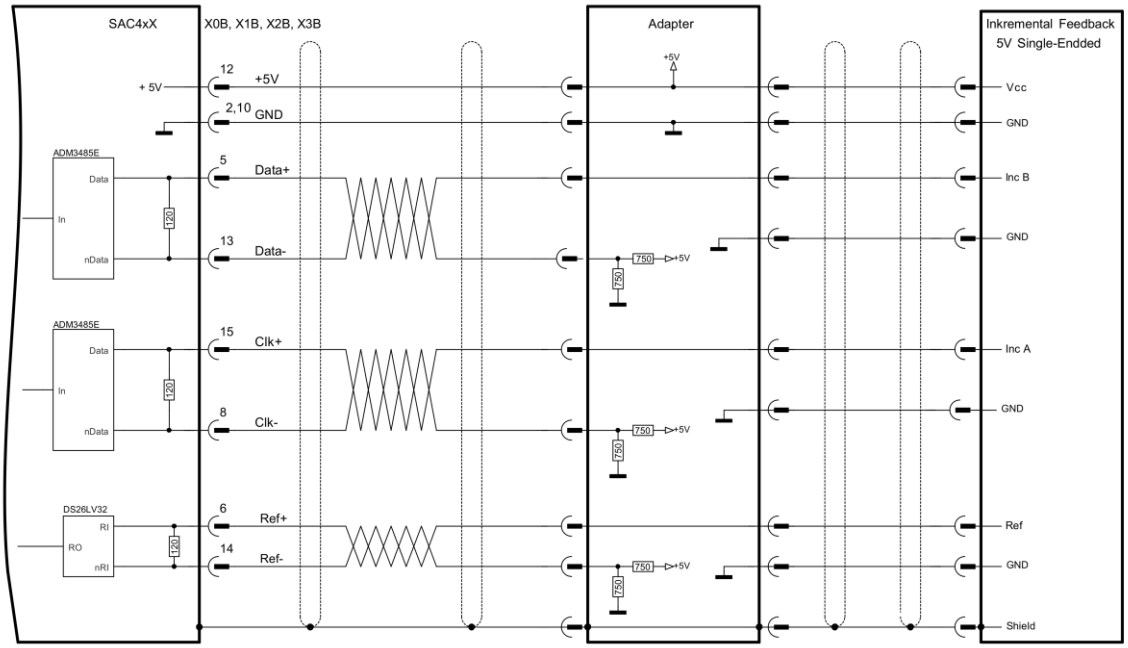


8.9.3.3 Connection of single-ended incremental encoder

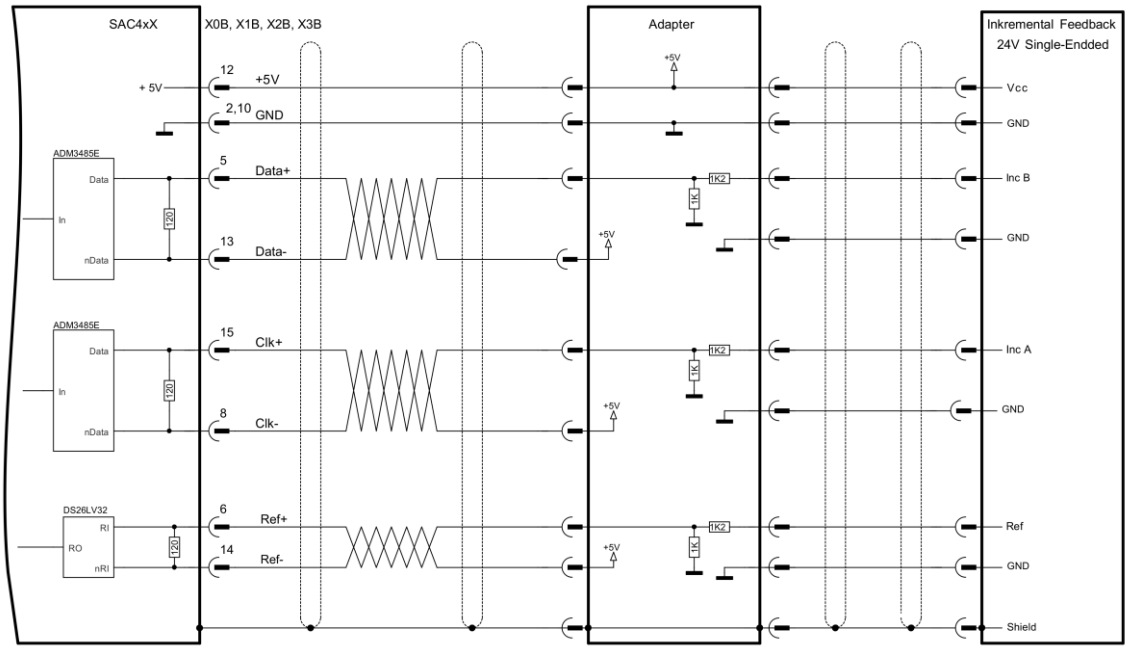
For the connection of incremental encoders which have a single-ended interface, a level adjustment must be connected upstream. Thus, such an encoder can also be operated at the absolute value interface. The adapter can be integrated into the plug, for example. The encoder must be able to supply/sink the current for the 120Ω terminating resistor.

Indel recommends the use of differential incremental encoders with an RS422 interface as per the current industry practice.

- Connection of a 5V single-ended incremental encoder



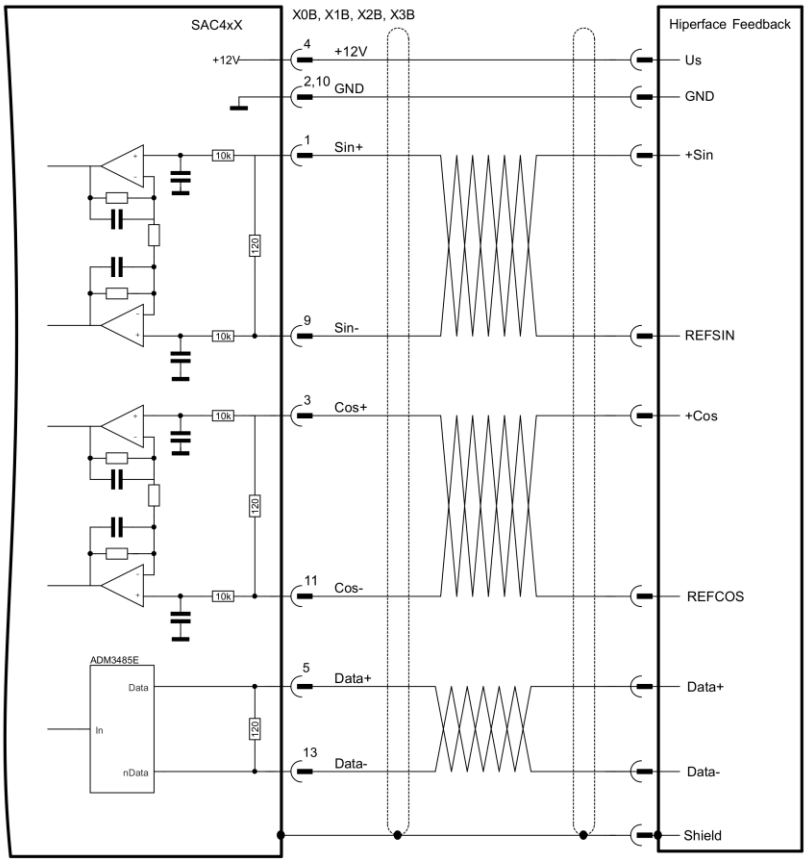
- Connection of a 24V single-ended incremental encoder



8.9.4. Absolute value feedbacks

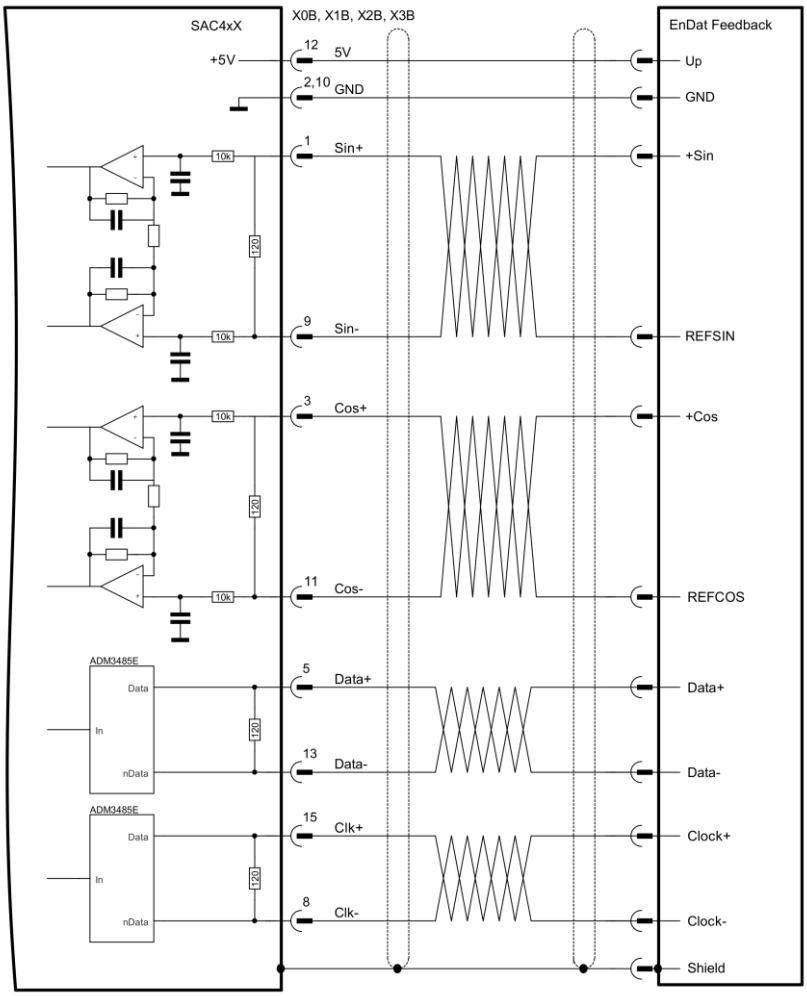
8.9.4.1 Hiperface

- Support for single-turn and multi-turn encoders
- 16-bit ADC measurement of the analogue signals
- Utilization of 12 bits, i.e. 4096 values per sine / cosine oscillation
- Data line in accordance with RS422 / RS485 standard
- Direct supply of the encoder by means of 12V power supply

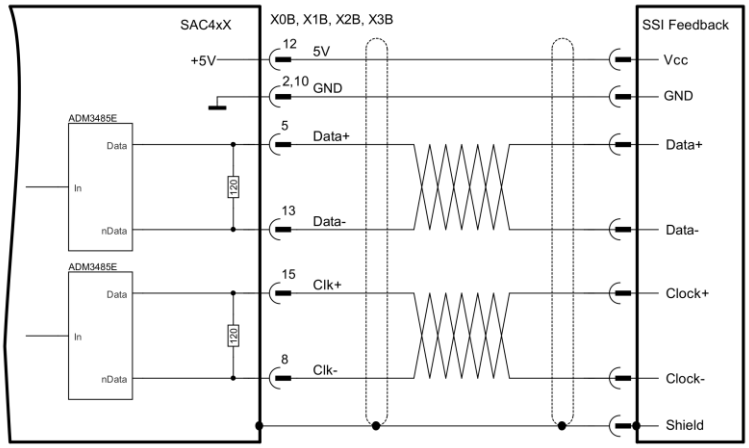


8.9.4.2 EnDat 2.1

- Support for single-turn and multi-turn encoders
- 16-bit ADC measurement of the analogue signals
- Utilization of 12 bits, i.e. 4096 values per sine / cosine oscillation
- Data and clock line in accordance with RS422 / RS485 standard
- Direct supply of the encoder via 5V supply



8.9.4.3 SSI / Biss C / EnDat 2.2

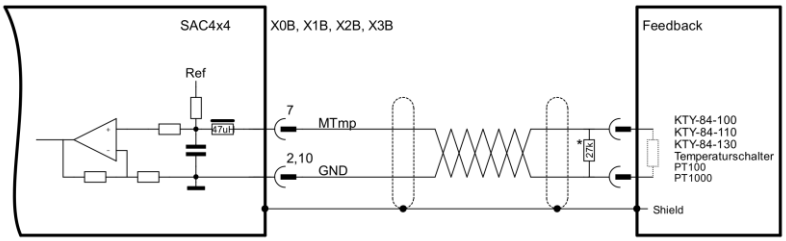


8.9.5. Temperature sensors

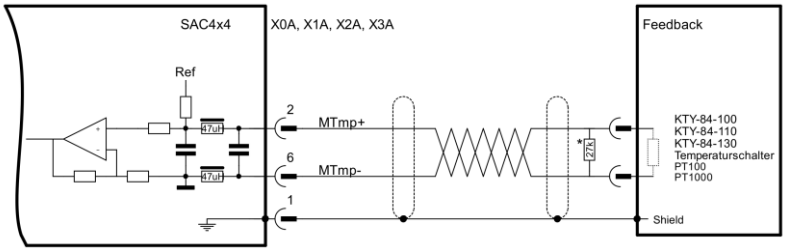
Motor temperature sensors can be connected directly to the feedbacks.

Temperature sensors installed in motor cables must not be wired to the feedback sockets. The insulation class of the sockets permits 50V max. The isolation between temperature sensor and motor winding or motor phase wire must be type double, or reinforced Isolation.

- Connection to feedback connector X1B, X2B, X3B, X4B



- Connection to feedback connector X1A, X2A, X3A, X4A



* For connecting a KTY-84-130 sensor, a 27kΩ resistor must be connected in parallel

8.10. Voltage supply

8.10.1. Logic power supply

For the logic supply of the servo drives, a regulated 24V power supply with sufficient power reserves is recommended. In addition, suitable mains filters must be used.

For safety-related 24V power supplies, the maximum current must be limited to 1A.

In the event of power failure of the 24V power supply, all to the drive connected motors may spin out. If this is not permitted, external measures must be taken to prevent the axis from spinning out.

8.10.2. Mains connection

Operation of the Indel Servo Drives is only permitted on earthed TN and TT networks.

Operation on delta networks (TN-S networks with an earthed phase) or IT networks (isolated earth) is not permitted. For operation on networks other than TN or TT, an isolating transformer must be used, whereby the secondary-side star point must be earthed.

A fuse and a EMC Mains filter must be used.

The mains supply must be provided with a filter so that the EMC limits for emissions and immunity can be met in accordance with EN61800-3 (industrial environments).

Emissions depend on the motors, length and capacity of the motor cables and the controller load. At most, an emission measurement is required in the application to ensure compliance with relevant product standards.

8.11. Wiring

8.11.1. Conductor cross-sections SAC4x4

The conductor cross-sections are to be regarded as guideline values and must always be adapted to the given circumstances such as cable length and power.

Power supply	Cross-section 4 mm^2	600V, 105°C
DC intermediate circuit / ballast resistor	Cross-section 4 mm^2	600V, 105°C, shielded
Motor cables up to 20m	Cross-section 2.5 mm^2	600V, 105°C, shielded, capacity < 150pF/m
Resolver	Cross-section 0.25 mm^2	double shielded pair twisted, capacity < 120pF/m
SinCos	Cross-section 0.25 mm^2	double shielded pair twisted, capacity < 120pF/m
Encoder	Cross-section 0.25 mm^2	shielded, pair twisted, capacity < 120pF/m
Holding brake	Cross-section 0.75 mm^2	600V, 105°C, shielded
Logic power supply	Cross-section max 2.5 mm^2	
Digital IOs	Cross-section max 2.5 mm^2	

8.11.2. Routing of motor cables

Motor lines must be routed separately from the signal and power lines. Do not route motor lines over terminals. If necessary, use metallic connectors. Motor cables must be laid with shielded lines. The shielding of the motor cables must be attached with all-round contact in the plug.
See also the INDEL Wiring Guidelines and INDEL Installation Guidelines documentation.

8.11.3. Cable routing of the safety function related Circuits

For applications with stop category 0 or 1 safety-related cut-out of the drive according to EN 60204-1 and fail-safe protection against restart in accordance with EN ISO 13849 category 3 of the servo drives, the power lines and the safety-related 24V power supply must be laid in separate cables. The cable for the safety-related 24V power supply must be designed as follows in order to avoid errors.

- Use shielded cables
- Place the shield on both sides
- Laying the cables in metal cable ducts or pipes
- Limit the maximum cable length to 100m

8.11.4. Routing of SinCos, incremental, and resolver lines

The signals from resolver and SinCos feedback systems are extremely susceptible to interference. Therefore, these cables must be laid with a twisted pair and double shielded cable. Incremental encoders must be wired with shielded cables. The shield must always be applied on both sides.

The encoder cables must not be separated in order to get to the control cabinet via clamps. The D-SUB plugs of the encoder cables must be screwed tightly onto the Servo Drive. The shield must be attached to the metallic connector housings.

8.11.5. Potential equalisation

All shielding must always be applied on both sides. In order to avoid unwanted leakage currents via the shield, an equipotential bonding conductor may have to be provided. Especially in the case of longer distances or with a different feed. See also Indel Wiring Guidelines.

8.11.6. Protective earth connection

The protective earth must be designed in accordance with EN 61800-5-1.

Cross-section S of the outer conductor [mm²]	Minimum cross-section of the associated protective earth conductor [mm2]
S ≤ 16	S
16 < S ≤ 35	16
35 < S	S / 2

8.12. Motor overload protection

The motor must be protected against overload by the user. Additional overload protection for motors by means of temperature sensors is provided for. It is the responsibility of the user to apply this overload protection.

8.12.1. I^2t cut-out

An additional protection against overloading is provided by the I2t cut-out. Further details can be found in the commissioning manual.

8.12.2. Ballast resistor

The ballast resistor must be protected against thermal overload. The braking resistor can generate voltages of up to 800V. The braking resistor must be designed for this purpose. The control of the braking resistor is not considered reliable (no safety function).

9. Mechanical installation

9.1. Notes

The following instructions must be observed and complied with by the user.

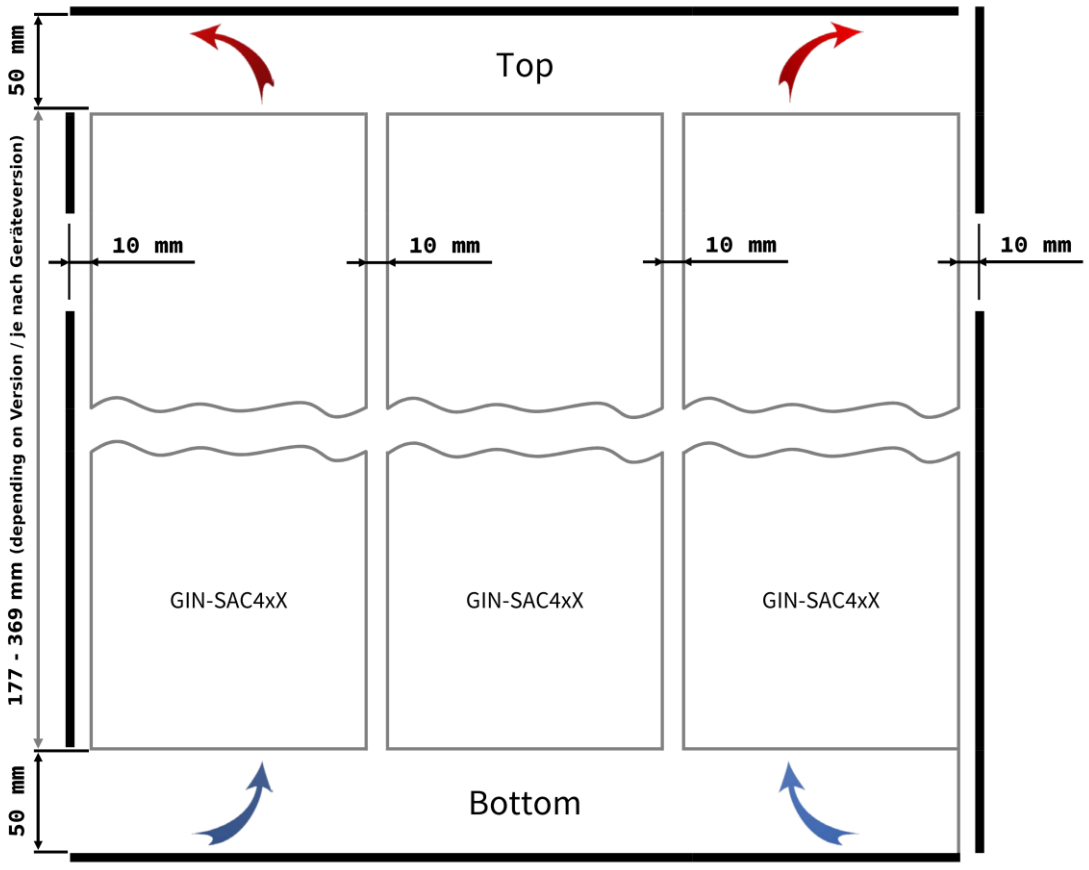
- Assembly must be carried out with a suitable tool
- The devices may only be installed in a voltage-free state.
- Sufficient cold air must be provided in the control cabinet from below
- The air supply must be filtered so that no dirt particles can get into the drives

When using cooling units, the following must be observed

- It must be ensured that the outflowing cold air from cooling units is not blown directly towards the servo drives
- The condensate from cooling units must not drip into the control cabinet
- The condensate from cooling units must not drip on electrical or electronic components

9.2. Assembly instructions

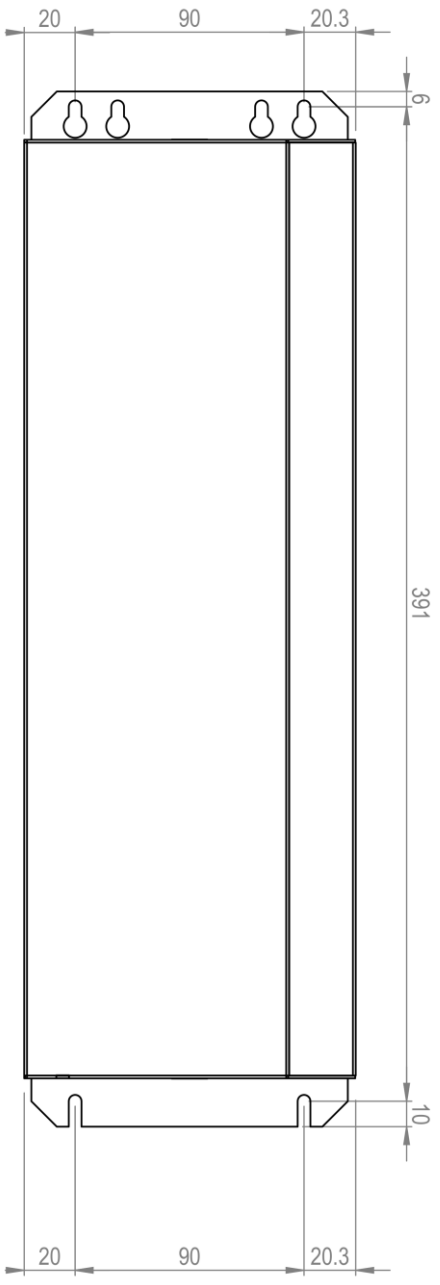
During operation, ensure sufficient cooling or ventilation of the drives. The environmental conditions listed in chapter 7.4 must be observed. The drives must be installed vertically. The waste heat from the drives is blown upwards and away by the two integrated fans. The minimum distances described in the figure below must be observed.



9.3. GIN-SAC4x4

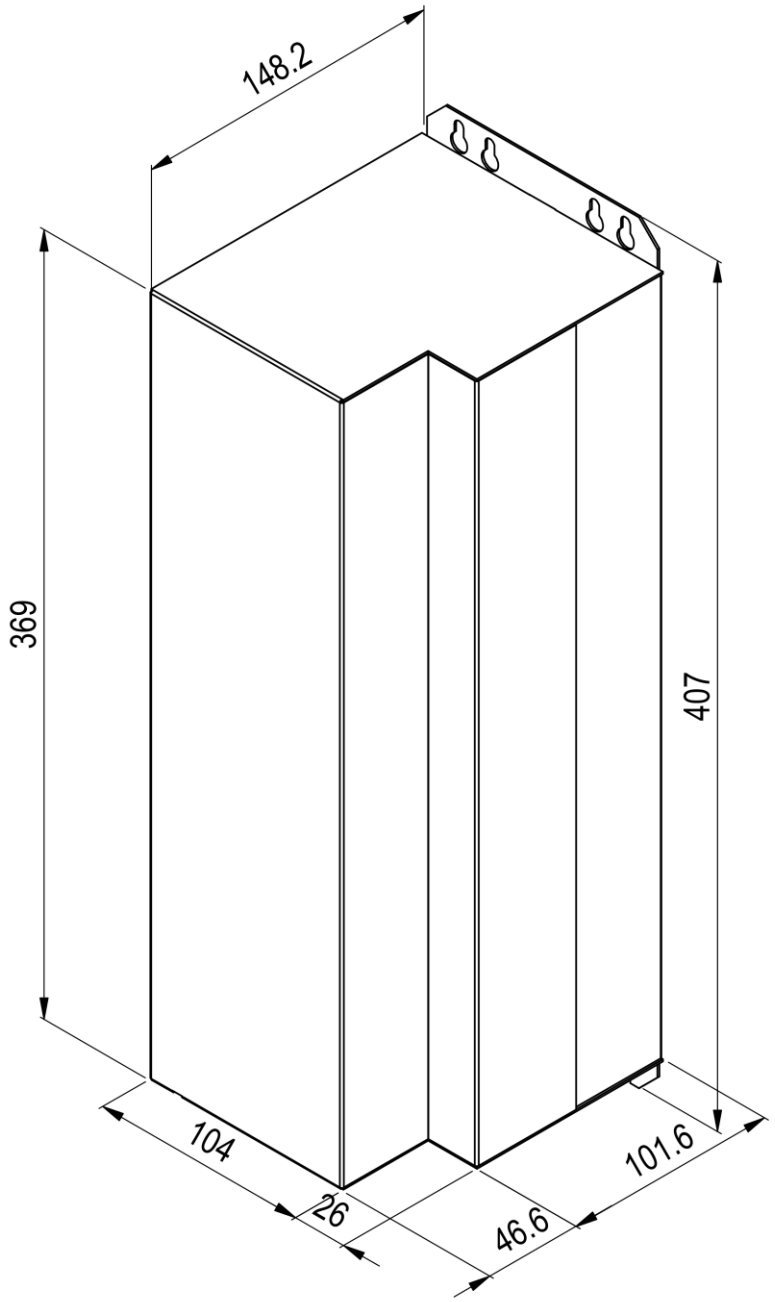
9.3.1. Assembly

The GIN-SAC4x4 Drives must be secured with at least four M5 cheese head screws. Always use the upper two outer and the lower two mounting tabs.



Alle Masse in mm
All dimensions in mm

9.3.2. Dimensions

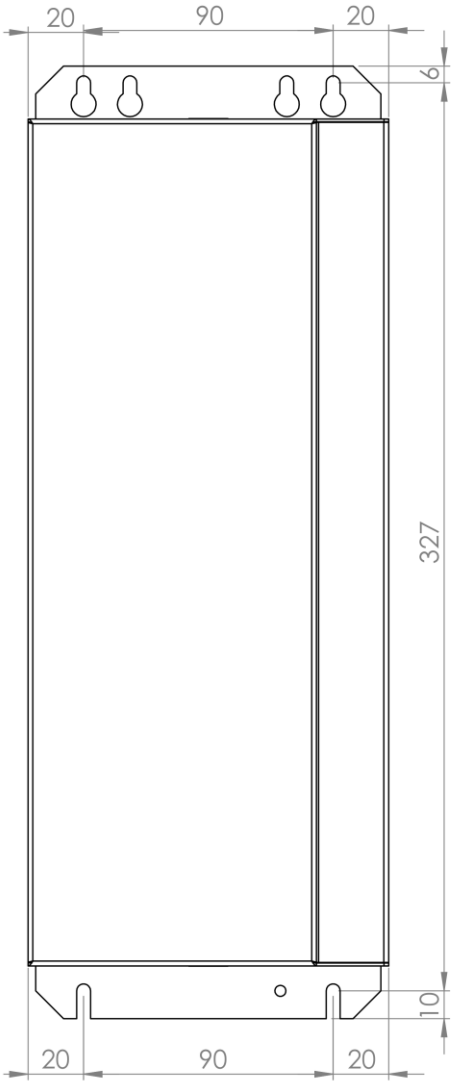


Alle Masse in mm
All dimensions in mm

9.4. GIN-SAC4x3

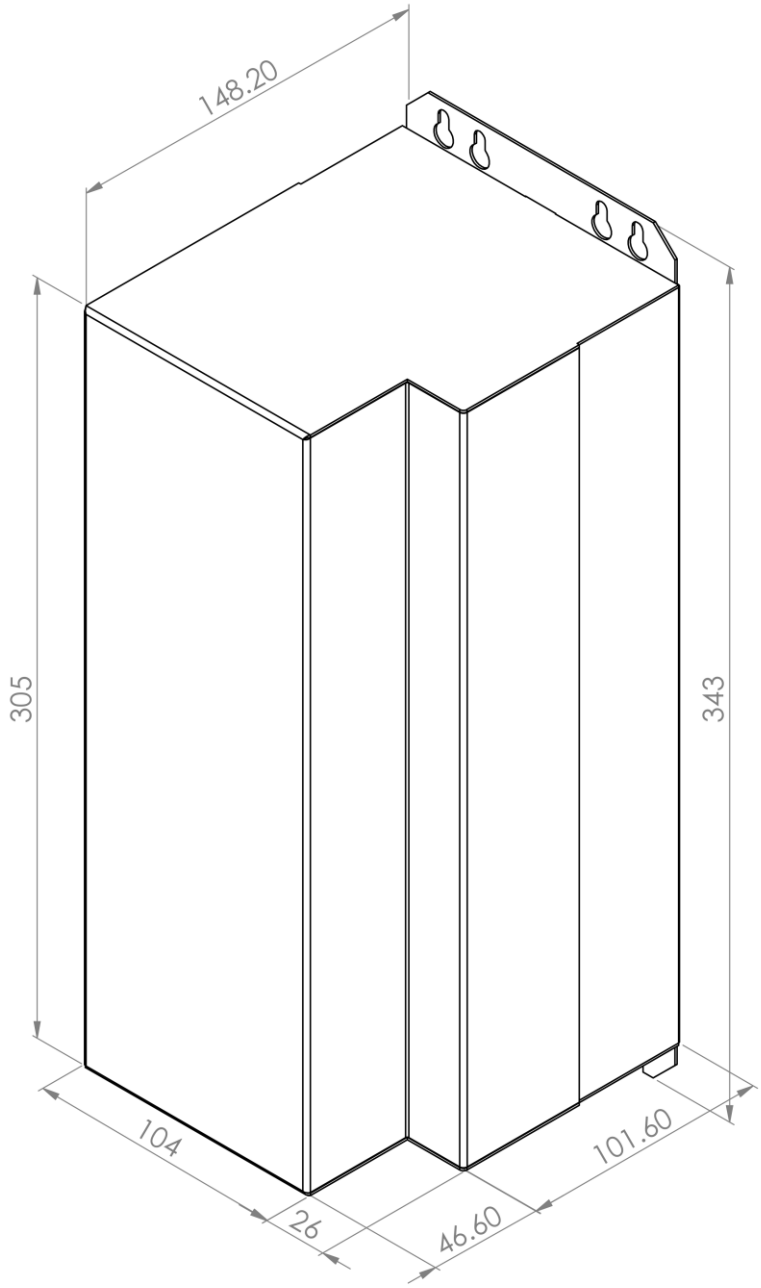
9.4.1. Assembly

The GIN-SAC4x3 Drives must be secured with at least four M5 cheese head screws. Always use the upper two outer and the lower two mounting tabs.



Alle Masse in mm
All dimensions in mm

9.4.2. Dimensions

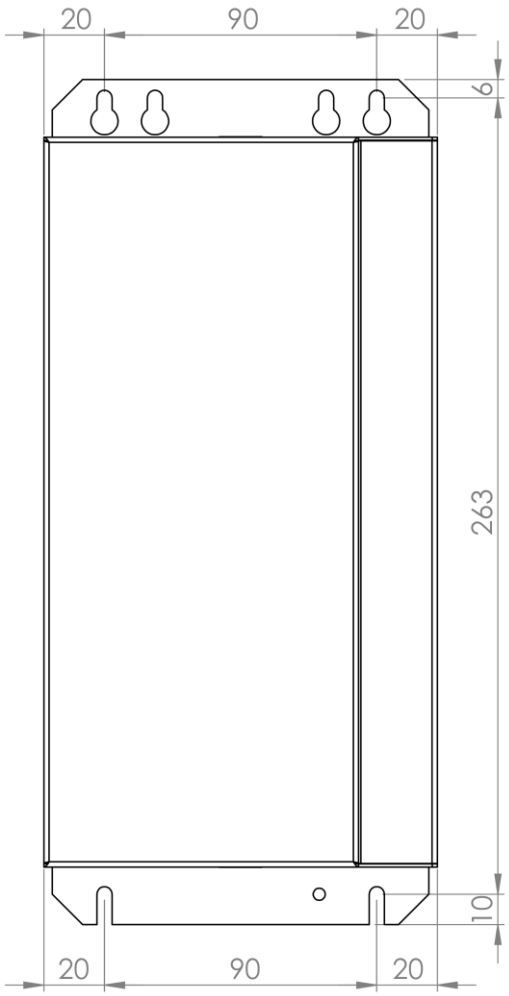


Alle Masse in mm
All dimensions in mm

9.5. GIN-SAC4x2

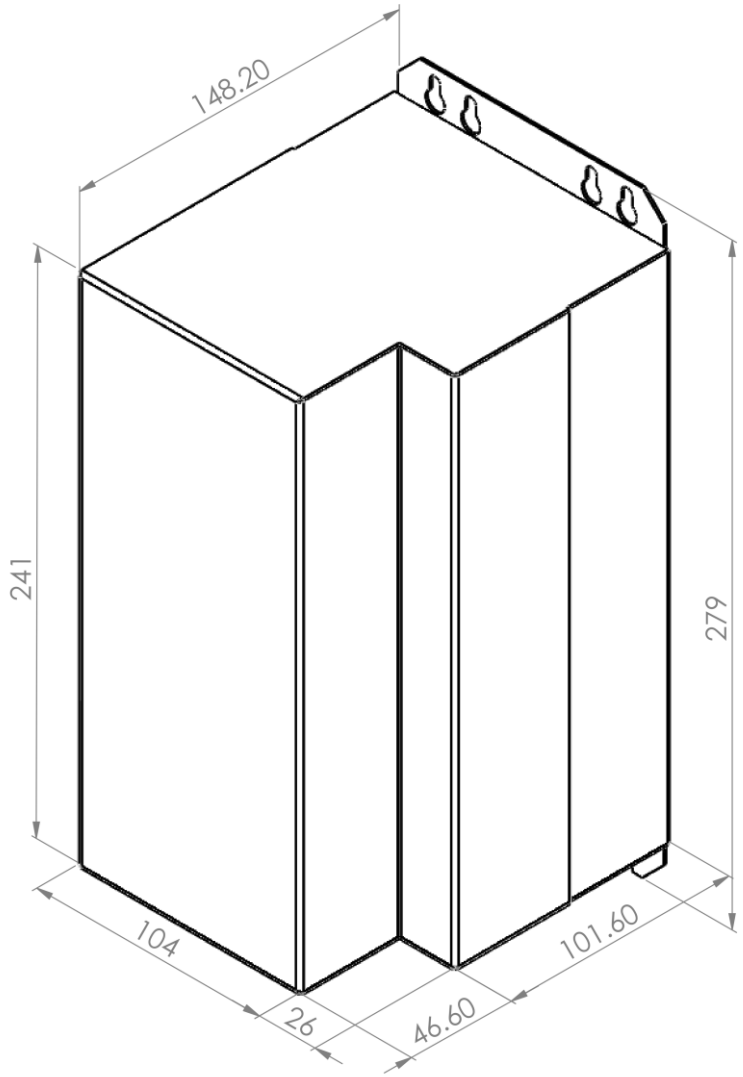
9.5.1. Assembly

The GIN-SAC4x2 Drives must be secured with at least four M5 cheese head screws. Always use the upper two outer and the lower two mounting tabs.



Alle Masse in mm
All dimensions in mm

9.5.2. Dimensions

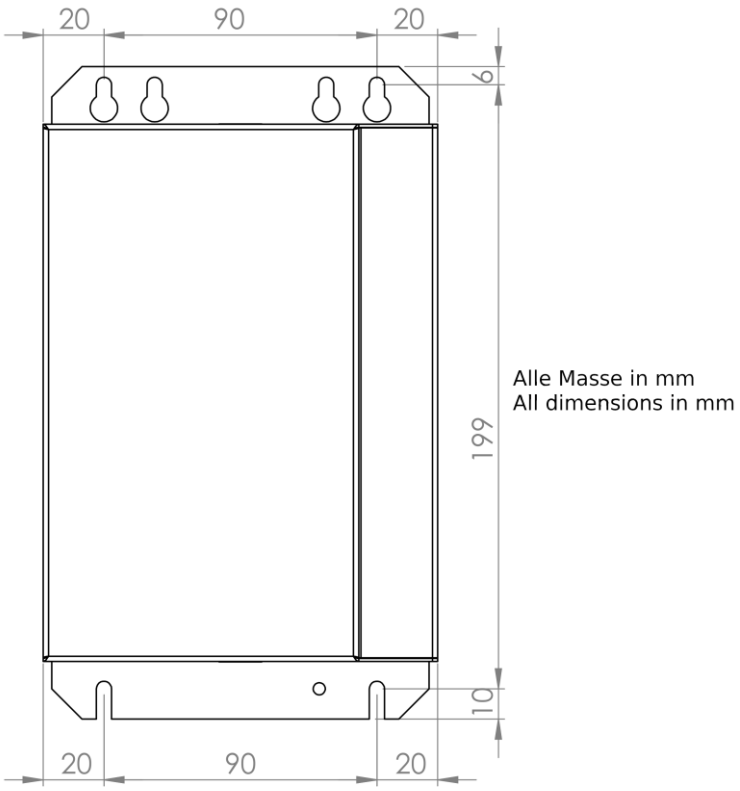


Alle Masse in mm
All dimensions in mm

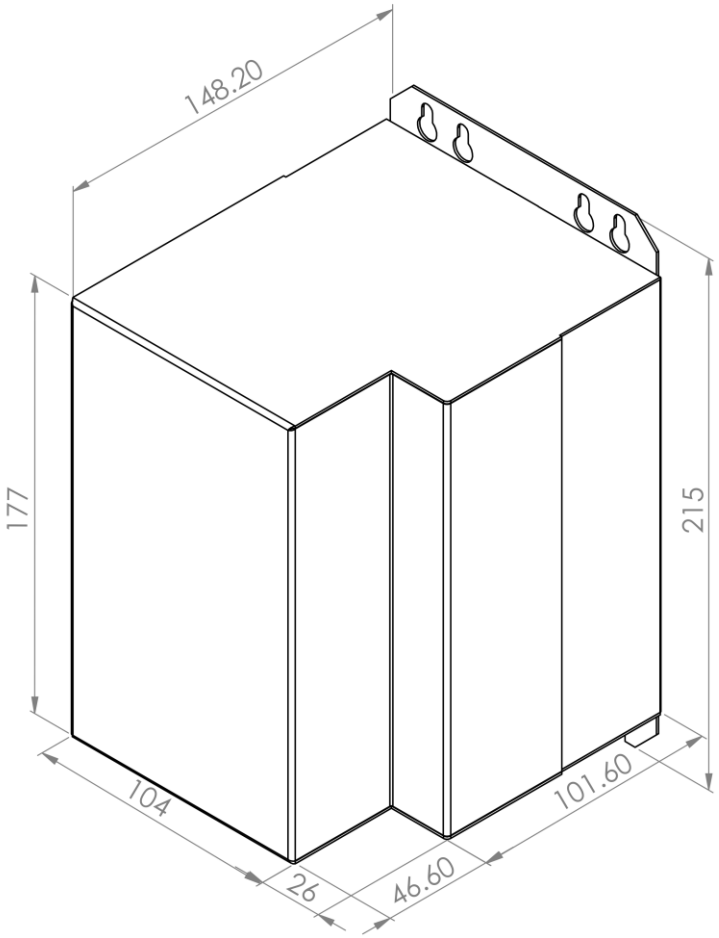
9.6. GIN-SAC4x1

9.6.1. Assembly

The GIN-SAC4x3 Drives must be secured with at least four M5 cheese head screws. Always use the upper two outer and the lower two mounting tabs.



9.6.2. Dimensions



Alle Masse in mm
All dimensions in mm

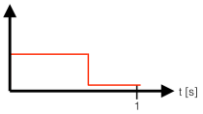
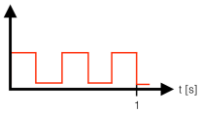
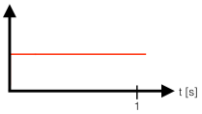
10. Troubleshooting

Fundamentally, a distinction is always made between warnings and errors. If there are any warnings, the controller is essentially still operational and remains active. In the event of an error, the controller is automatically switched to inactive and the error must be acknowledged in the software before the controller can be switched back to active.

10.1. Status LED

The servo drives have various LEDs from which various errors and warnings can be read. For accurate fault analysis, an Indel tool should be used in addition.

Chapter not yet complete!

LED	Flashes the same as OK LED 	Flashes about 1.5 times per second 	Flashes about 3 times a second 	Constantly lit up 
Ucc	1.1	1.2	1.3	1.4
Ballast			2.3	
Control			3.3	3.4
Ext Enable				4.4
IMAX / IGBT			5.3	5.4
PWM / Commutation	6.1		6.3	6.4
Resolver				7.4
Active				8.4
Motor		9.2	9.3	9.4

10.2. Table of faults

No.	Type	Description	Possible causes
1.1	Fault	Intermediate circuit voltage U_{CC} is smaller than the configured $U_{CC\ MIN}$	· Mains supply is not available · Mains voltage too
1.2	Warning	Intermediate circuit voltage is less than $U_{CC\ OK}$	
1.3	Fault	Intermediate circuit voltage is greater than $U_{CC\ MAX}$	· Ballast does not work · No ballast resistor connected
1.4	OK	Intermediate circuit voltage is between $U_{CC\ MIN}$ and $U_{CC\ MAX}$	

No.	Type	Description	Possible causes
2.3	Fault	Ballast does not work. The intermediate circuit voltage UCC does not become smaller although the ballast resistor is switched on	· No braking resistor connected · External feed, Ucc is bridged to other SAC

No.	Type	Description	Possible causes
3.3	Warning	Output stage is warm (about 85°C)	· High utilisation and / or · Poor cooling of the device
3.4	Fault	Output stage is too hot (about 100°C)	· High utilisation and / or · Poor cooling of the device

No.	Type	Description	Possible causes
4.4	OK	External enable Input is in high	

No.	Type	Description	Possible causes
5.3	Warning	I^2t is high (between 100 and 110%) or I_{MAX} has been reached	· Motor current is high / over limit · I^2t is not correct configured
5.4	Fault	I^2t has been exceeded (> 110%)	· Motor current/load is over limit · I^2t is not correct configured

No.	Type	Description	Possible causes
6.1	Warning	PWM modulation reaches 100%	· Intermediate circuit voltage is insufficient for the required speed
6.3	Fault	Maximum mechanical motor speed has been reached	· Motor turns faster than allowed in Speed Max
6.4	Fault	Auto-commutation error	· Wrong configuration · Mechanical problem

No.	Type	Description	Possible causes
7.4	Fault	The signal strength of the resolver or SinCos is outside the $Sin^2Cos^2{}_{Min}$ and $Sin^2Cos^2{}_{Max}$ range	· Cable interruption of the feedback · Soiled SinCos scale · Distance between sensor and scale is too big or too small

No.	Type	Description	Possible causes
8.4	OK	Axis is activated and controls	

No.	Type	Description	Possible causes
9.2	Warning	Motor temperature is higher than the configured temperature warning	· Motor too hot
9.3	Fault	Motor temperature is higher than the configured maximum temperature	· Motor too hot
9.4	Fault	Overcurrent or short circuit	· Motor overloaded (too much load) · Short circuit in the motor or wiring · Output stage defective

11. Further documents

11.1. EC Declaration of Conformity

The current EC declaration of conformity can be found here:

https://indel.ch/en/documentation#conformity

11.2. SUVA Type-examination certificate for SAC4x4

suva
CERTIFICATION

Type-examination certificate no. E 7070/2.e

Object:	Power Drive System
Mark:	Indel
Type designation:	Servo Drive SAC4x4
Technical details concerning safety:	The STO safety function according to EN 61800-5-2 meets the requirements of EN ISO 13849-1, Category 4, PL e.
Manufacturer's address:	Indel AG Tüfiwis 26 CH-8332 Russikon
Address of applicant:	Indel AG Tüfiwis 26 CH-8332 Russikon
Special conditions, enclosures:	For more information see attached sheet 1/1
Expires on:	30 September 2029

The prototype examined corresponds to the basic requirements of Directive 2006/42/EC and the amendments of the European Parliament and the Council of 17 May 2006 for the harmonization of Member States' legal and administrative regulations relating to machinery.
This certificate is valid in conjunction with the general conditions listed on the back and any possible enclosures mentioned above.

European notified body, identification number 1246

Place and date:
Lucerne, 1 October 2024

Suva
Accredited Certification Body SCESp 0008
Technology Sector

The Safety Engineer
Urs Bühlmann

Head of Certification
Daniel Vock

Supplementary sheet to Certificate no. E 7070/2.e **Lucerne, 1 October 2024**
Page 1 / 1

The STO safety function according to EN 61800-5-2 meets the following requirements:

EN ISO 13849-1:	Category	4
	Performance Level	e
	*Diagnostic coverage DC	99% (high)
	PFH	2.47 E-8 / h
	MTTFd	100 years (high)
	CCF	fulfilled
EN 62061:	SIL	3

*The diagnostic coverage DC is directly dependent on the external signal evaluation. The integrator hast to recalculate and confirm the DC.

The use of the safety function requires the observance of all manufacturer information. It is an electronic device, suitable measures (shielding, filters, etc.) against disturbances (EMC) have to be taken.
When commissioning, the integrator must perform a complete function check of the safety function in conjunction with the equipped object. The state of the art according to EN ISO 13849-1 /-2 and / or EN 62061 must be observed.

11.3. SUVA Type-examination certificate for SAC4x3

suva
CERTIFICATION

Type-examination certificate no. E 7069/2.e

Object:	Power Drive System
Mark:	Indel
Type designation:	Servo Drive SAC4x3
Technical details concerning safety:	The STO safety function according to EN 61800-5-2 meets the requirements of EN ISO 13849-1, Category 4, PL e.
Manufacturer's address:	Indel AG Tüfiwis 26 CH-8332 Russikon
Address of applicant:	Indel AG Tüfiwis 26 CH-8332 Russikon
Special conditions, enclosures:	For more information see attached sheet 1/1
Expires on:	30 September 2029

The prototype examined corresponds to the basic requirements of Directive 2006/42/EC and the amendments of the European Parliament and the Council of 17 May 2006 for the harmonization of Member States' legal and administrative regulations relating to machinery.
This certificate is valid in conjunction with the general conditions listed on the back and any possible enclosures mentioned above.

European notified body, identification number 1246

Place and date:
Lucerne, 1 October 2024

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Accredited Certification Body SCESp 0008
Technology Sector

The Safety Engineer
Urs Bühlmann

Head of Certification
Daniel Vock

Supplementary sheet to Certificate no. E 7069/2.e **Lucerne, 1 October 2024**
Page 1 / 1

The STO safety function according to EN 61800-5-2 meets the following requirements:

EN ISO 13849-1:	Category	4
	Performance Level	e
	*Diagnostic coverage DC	99% (high)
	PFH	2.47 E-8 / h
	MTTFd	100 years (high)
	CCF	fulfilled
EN 62061:	SIL	3

*The diagnostic coverage DC is directly dependent on the external signal evaluation. The integrator hast to recalculate and confirm the DC.

The use of the safety function requires the observance of all manufacturer information. It is an electronic device, suitable measures (shielding, filters, etc.) against disturbances (EMC) have to be taken. When commissioning, the integrator must perform a complete function check of the safety function in conjunction with the equipped object. The state of the art according to EN ISO 13849-1 /-2 and / or EN 62061 must be observed.

11.4. SUVA Type-examination certificate for SAC4x2

suva
CERTIFICATION

Type-examination certificate no. E 7107/2.e

Object:	Power Drive System
Mark:	Indel
Type designation:	Servo Drive SAC4x2
Technical details concerning safety:	The STO safety function according to EN 61800-5-2 meets the requirements of EN ISO 13849-1, Category 4, PL e.
Manufacturer's address:	Indel AG Tüfiwis 26 CH-8332 Russikon
Address of applicant:	Indel AG Tüfiwis 26 CH-8332 Russikon
Special conditions, enclosures:	For more information see attached sheet 1/1
Expires on:	30 September 2029

The prototype examined corresponds to the basic requirements of Directive 2006/42/EC and the amendments of the European Parliament and the Council of 17 May 2006 for the harmonization of Member States' legal and administrative regulations relating to machinery.
This certificate is valid in conjunction with the general conditions listed on the back and any possible enclosures mentioned above.

European notified body, identification number 1246

Place and date:
Lucerne, 1 October 2024

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Technology Sector

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Urs Bühlmann

Head of Certification
Daniel Vock

Supplementary sheet to Certificate no. E 7107/2.e **Lucerne, 1 October 2024**
Page 1 / 1

The STO safety function according to EN 61800-5-2 meets the following requirements:

EN ISO 13849-1:	Category	4
	Performance Level	e
	*Diagnostic coverage DC	99% (high)
	PFH	2.47 E-8 / h
	MTTFd	100 years (high)
	CCF	fulfilled
EN 62061:	SIL	3

*The diagnostic coverage DC is directly dependent on the external signal evaluation. The integrator hast to recalculate and confirm the DC.

The use of the safety function requires the observance of all manufacturer information. It is an electronic device, suitable measures (shielding, filters, etc.) against disturbances (EMC) have to be taken.
When commissioning, the integrator must perform a complete function check of the safety function in conjunction with the equipped object. The state of the art according to EN ISO 13849-1 /-2 and / or EN 62061 must be observed.

11.5. SUVA Type-examination certificate for SAC4x1

suva
CERTIFICATION

Type-examination certificate no. E 7106/2.e

Object:	Power Drive System
Mark:	Indel
Type designation:	Servo Drive SAC4x1
Technical details concerning safety:	The STO safety function according to EN 61800-5-2 meets the requirements of EN ISO 13849-1, Category 4, PL e.
Manufacturer's address:	Indel AG Tüfiwis 26 CH-8332 Russikon
Address of applicant:	Indel AG Tüfiwis 26 CH-8332 Russikon
Special conditions, enclosures:	For more information see attached sheet 1/1
Expires on:	30 September 2029

The prototype examined corresponds to the basic requirements of Directive 2006/42/EC and the amendments of the European Parliament and the Council of 17 May 2006 for the harmonization of Member States' legal and administrative regulations relating to machinery.
This certificate is valid in conjunction with the general conditions listed on the back and any possible enclosures mentioned above.

European notified body, identification number 1246

Place and date:
Lucerne, 1 October 2024

Suva
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Technology Sector

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Urs Bühlmann

Head of Certification
Daniel Vock

Supplementary sheet to Certificate no. E 7106/2.e **Lucerne, 1 October 2024**
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The STO safety function according to EN 61800-5-2 meets the following requirements:

EN ISO 13849-1:	Category	4
	Performance Level	e
	*Diagnostic coverage DC	99% (high)
	PFH	2.47 E-8 / h
	MTTFd	100 years (high)
	CCF	fulfilled
EN 62061:	SIL	3

*The diagnostic coverage DC is directly dependent on the external signal evaluation. The integrator hast to recalculate and confirm the DC.

The use of the safety function requires the observance of all manufacturer information. It is an electronic device, suitable measures (shielding, filters, etc.) against disturbances (EMC) have to be taken.
When commissioning, the integrator must perform a complete function check of the safety function in conjunction with the equipped object. The state of the art according to EN ISO 13849-1 /-2 and / or EN 62061 must be observed.

11.6. CB Test Certificate

IEC IECEE CB SCHEME

Ref. Certif. No.

DE 3 - A0021

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

CB TEST CERTIFICATE

Product	Power Conversion Equipment
Name and address of the applicant	**Indel AG** Tüfiwis 26 8332 Russikon SWITZERLAND
Name and address of the manufacturer	Indel AG Tüfiwis 26, 8332 Russikon, SWITZERLAND
Name and address of the factory	Indel AG Tüfiwis 26, 8332 Russikon, SWITZERLAND
Ratings and principal characteristics	Complete ratings please see page 2
Trade mark (if any)	Indel
Customer's Testing Facility (CTF) Stage used	CTF STAGE 1
Model/type Ref.	GIN-SAC4xa 5A/b/c/d GIN-SAC4x is product group Where: a is number of motor axes and gerber inputs and can be "1", "2", "3" or "4" b is input voltage and can be "230V" or "400V" c is CPU version and can be empty for Single-Core CPU-Module or "PRO" for Dual-Core CPU-Module d is safety module version and can be empty for relay safety module or "FS" CPU-based safety module with SLS function
A sample of the product was tested and found to be in conformity with	IEC 61800-5-1:2007 IEC 61800-5-1:2007/AMD1:2016
as shown in the Test Report Ref. No. which forms part of this certificate	028-713174177-000

This CB Test Certificate is issued by the National Certification Body

CB 107535 0001 Rev. 00
Date, 2020-03-03

(Abdul Sabbagh)

TÜV SÜD Product Service

Page 1 of 2

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CB-1 03.06

IEC IECEE CB SCHEME

Ref. Certif. No.

DE 3 - A0021

Ratings and principal characteristics (continued)

GIN-SAC4x4 5A/230V and GIN-SAC4x4 5A/230V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-230 VAC 50/60 Hz
Output-Ratings:	Power	6.5 kVA

GIN-SAC4x4 5A/400V and GIN-SAC4x4 5A/400V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-400 VAC 50/60 Hz
Output-Ratings:	Power	11.3 kVA

GIN-SAC4x3 5A/230V and GIN-SAC4x3 5A/230V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-230 VAC 50/60 Hz
Output-Ratings:	Power	4.9 kVA

GIN-SAC4x3 5A/400V and GIN-SAC4x3 5A/400V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-400 VAC 50/60 Hz
Output-Ratings:	Power	8.5 kVA

GIN-SAC4x2 5A/230V and GIN-SAC4x2 5A/230V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-230 VAC 50/60 Hz
Output-Ratings:	Power	3.3 kVA

GIN-SAC4x2 5A/400V and GIN-SAC4x2 5A/400V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-400 VAC 50/60 Hz
Output-Ratings:	Power	5.7 kVA

GIN-SAC4x1 5A/230V and GIN-SAC4x1 5A/230V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-230 VAC 50/60 Hz
Output-Ratings:	Power	1.7 kVA

GIN-SAC4x1 5A/400V and GIN-SAC4x1 5A/400V/PRO

Input-Ratings:	Rated Voltage Rated Frequency	3x 110-400 VAC 50/60 Hz
Output-Ratings:	Power	2.9 kVA

All versions

Derating	from 1000 m to 2000 m: output power reduction by 1 % each 100 m
Protection Class:	I
T ambient:	0 to +40 °C
Degree of Protection:	IP 20

CB 107535 0001 Rev. 00
Date, 2020-03-03

TÜV SÜD Product Service

(Abdul Sabbagh)

CB-2 03.06

Page 2 of 2

TÜV SÜD Product Service GmbH • Certification Body • Ridlerstraße 65 • 80339 Munich • Germany

12. Standards

The following standards have been used

EN 60204-1: 2006 / A1: 2009
Safety of machinery - Electrical equipment of machines Part 1: General requirements for safety-related cut-out according to stop category 1 and protection against re-start

EN ISO 13849-1: 2015
Safety of Machinery - Safety-related Parts of Control Systems
Part 1: General design principles

EN ISO 13849-2: 2012
Safety of Machinery - Safety-related Parts of Control Systems
Part 2: Validation

EN 61800-3:2004 + A1:2012
Adjustable speed electrical power drives.
Part 3: EMC requirements including special test methods

EN 61800-5-1: 2007 + A11:2021 +
UL 61800-5-1:2012/R:2018-06
Adjustable speed electrical power drive systems –
Part 5-1: Safety requirements - Electrical, thermal and energy

EN 61800-5-2: 2017
Adjustable speed electrical power drive systems
Part 5-2: Safety requirements - Functional safety

SN EN ISO 12100-1: 2010
Safety of Machinery - General Principles for Design - Risk Assessment and Risk Mitigation

EN 62061:2005 + A2:2015
Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems