Inverter

i950 cabinet servo inverter

0.37 ... 110 kW
0.5 hp ... 150 hp
1-phase mains connection 230/240 V
3-phase mains connection 230/240 V
3-phase mains connection 400 V
3-phase mains connection 480 V

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About this document

Document description

This document is intended for all persons who want to configure inverters with the products described.

This document assists you with the configuration and selection of your product. It contains information on mechanical and electrical installation, on product expansions, and on accessories.

Further documents

For certain tasks, information is available in further documents.

Document	Contents/topics
Commissioning document	Setting and parameterising the inverters
Mounting and switch-on instructions	Basic information on mounting and initial switch-on of the product • Is supplied with each component.

More information

For certain tasks, information is available in other media.

Medium	Contents/topics
Engineering Tools	For commissioning
AKB articles	Additional technical information for users in the Application Knowledge Base
CAD data	Download in different formats from the EASY Product Finder
EPLAN macros	Project planning, documentation and management of projects for EPLAN P8.
Device descriptions	Standardized files for network configuration

Information and tools with regard to the Lenze products can be found on the Internet:
www.Lenze.com → Downloads

Notations and conventions

Conventions are used in this document to distinguish between different types of information.

Numeric notation		
Decimal separator	Point	Generally shown as a decimal point. Example: 1 234.56
Warnings		
UL Warnings	UL	Are used in English and French.
UR warnings	UR	
Text		
Engineering Tools	" "	Software Example: "Engineer", "EASY Starter"
Icons		
Page reference	🕮	Reference to another page with additional information. Example: 🕮 16 = see page 16
Documentation reference	ⓚ	Reference to other documentation with additional information. Example: ⓚ EDKxxx = see documentation EDKxxx

Layout of the safety instructions

⚠DANGER!

Indicates an extremely hazardous situation. Failure to comply with this instruction will result in severe irreparable injury and even death.

⚠WARNING!

Indicates an extremely hazardous situation. Failure to comply with this instruction may result in severe irreparable injury and even death.

⚠CAUTION!

Indicates a hazardous situation. Failure to comply with this instruction may result in slight to medium injury.

NOTICE

Indicates a material hazard. Failure to comply with this instruction may result in material damage.

Product information

Product description

The i950 servo inverter is an expansion for our automation platform and can easily be integrated into servo drive systems.

- The i950 servo inverter is a high-quality servo inverter.
  - Already today, the standard for efficiency classes (IE) in accordance with EN 50598-2, which will apply in the future, has been met.
- The i950 servo inverter is based on the standards of IEC 61131-3, PLCopen, and CiA 402, and can be employed for a comprehensive range of machine tasks.
  - This future-proof platform architecture ensures maximum reusability.
  - This guarantees the security of investment in engineering.
- Highly user-friendly
  - Innovative interaction options enable better commissioning times than ever.
- Using an SD card as a storage medium makes it easy to transfer data from and to the device.
  - Backup of the firmware version running on the device.
  - Copy of device settings and/or application data.
  - Rapid restoration if a device replacement becomes necessary.
- Standard onboard EtherCAT connection
  - for connecting the i950 as Distributed Clocks (DC)-capable EtherCAT slave for process and safety data under a standard EtherCAT motion control

    or
  - for connecting the i950 to the EtherCAT system bus.

    Via the onboard EtherCAT connection, an EtherCAT system bus offers the simple possibility to synchronize up to 16 servo inverters of the i950 inverter series without additional motion control. One i950 acts as an EtherCAT master and sends identical master values to the other connected i950 devices, which have a "slave" function. The connection is made automatically without configuration effort (plug-and-play). The preset device profile CiA 402 and the technology application "CiA 402 Advanced" are not supported.

Centralized control (controller-based automation) or decentralized control (drive-based automation)

- Both control types are possible, as previous limitations have been lifted.
- i950 servo inverters can easily be employed in multi-axis systems with controllers.
- Integration and commissioning with a Lenze control unit take place according to a similar principle.
- This promotes the trend towards autonomous machine modules.

Preferred applications:

- Conveying drives
- Traveling drives
- Winding drives
- Hoist drives
- Handling
- Robotics
- Packaging technology
- Drives for forming processes
- Drives in machine tools

Other properties:

- Power spectrum of 0.37 ... 110 kW
- A DC-bus connection on DC voltage level with feedback operation is possible.
- The i950 servo inverter can be used to enhance performance in controller-based multi-axis systems, e.g. in systems with controllers and i700 servo inverters.
- All diagnostics tasks can be performed with the Lenze software »EASY Starter«. The "engineering port" interface is provided by default for this purpose.
- Space-saving design saves space in the control cabinet. ▸ Dimensions 📖 114

The i950 servo inverter is equipped with the following interfaces by default:

- Control connections 📖 64
- onboard EtherCAT 📖 70
- Engineering Port (Standard Ethernet) for operation and diagnostics

Product expansions can be used to adapt the technical features to the needs of the applications:

▸ Motor encoder connection 📖 129

▸ Load encoder/master encoder connection 📖 131

▸ Networks 📖 132

▸ Accessories 📖 195

▸ Memory modules (SD card) 📖 196

The i950 servo inverter supports the CiA 402 device profile by default. In addition, prepared technology applications can be adjusted.

- The technology applications are selected and parameterized with Easy Starter.
- The technology applications for the i950 servo inverter use similar processes as the technology modules for Lenze controllers.
- For the use of the technology applications, licensing is necessary. Lenze SD cards with various scopes for our licensing model are available.
  ▸ Memory modules 📖 196
- Description of the available technology applications:
  ▸ Technology applications (TA) 📖 21

Product variants

Two variants allow for a wide scope of use of the integrated "functional safety":

- i950 with basic safety - STO
  - In this case, STO is the only usable safety function.
- i950 with extended safety
  - Numerous safety functions are available here.

▸ Functional safety 🕮 136

i950 - variant with basic safety - STO

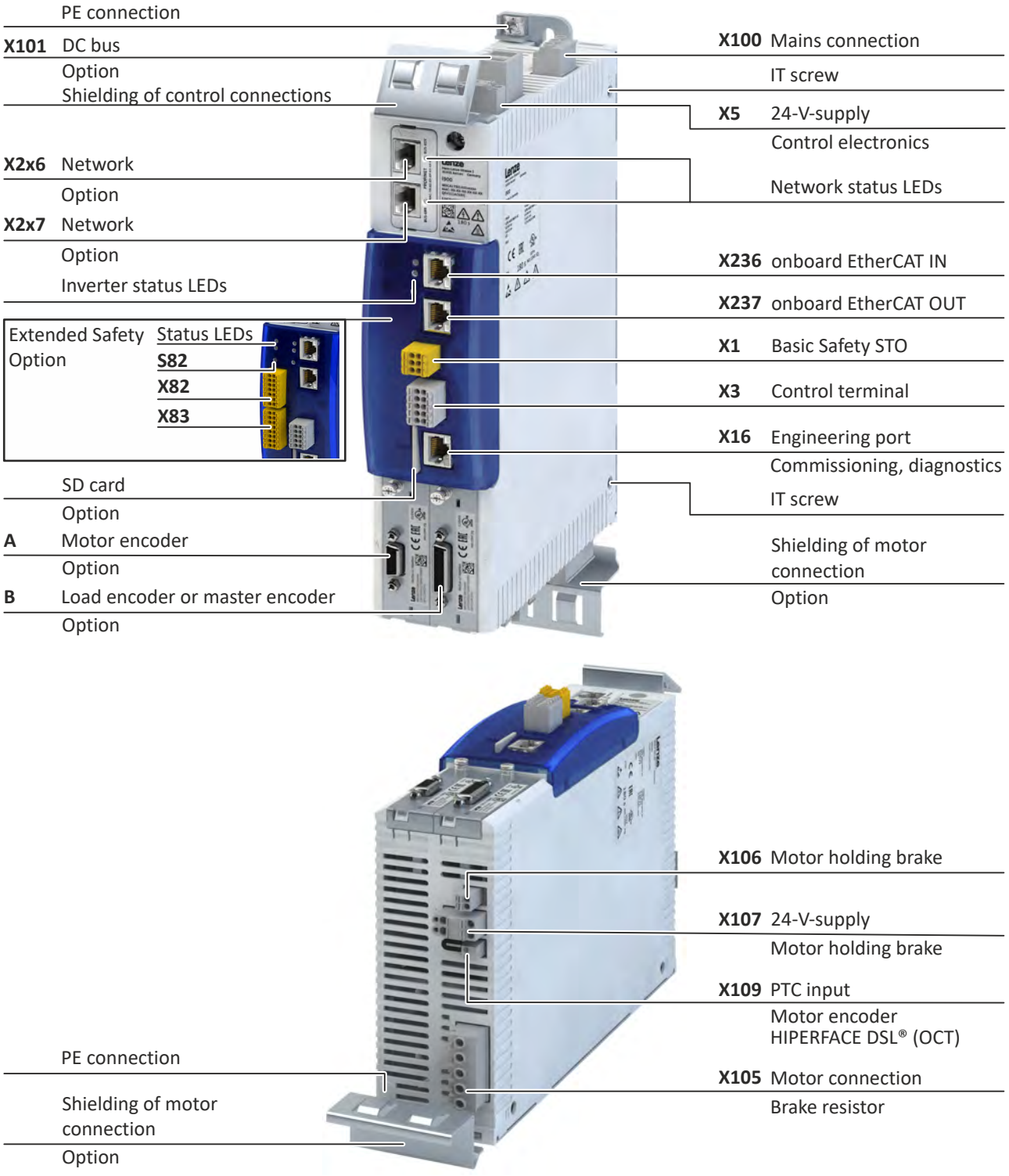
i950 - variant with extended safety

Features

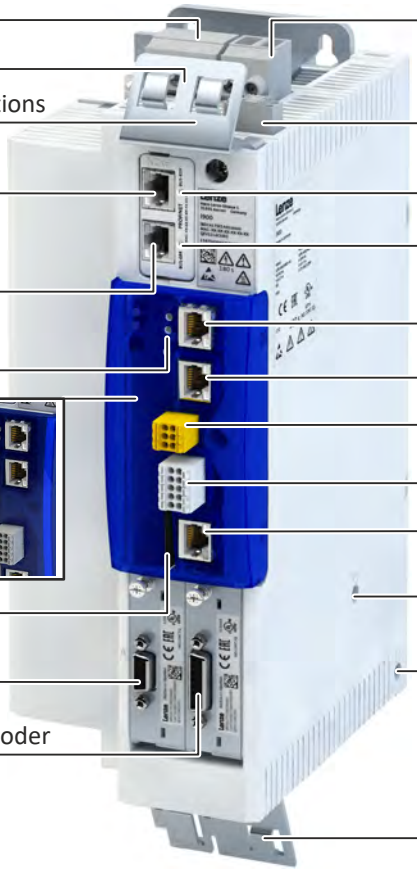
The following figures give an overview of the elements and connections on the devices. Position, size and appearance of elements and connections may vary depending on the capacity and size of the equipment.

Some equipment may be optional.

Power range 0.37 kW ... 4 kW



Power range 5.5 kW ... 15 kW



X100 Mains connection

PE connection

Shielding of control connections

X2x6 Network

Option

X2x7 Network

Option

Inverter status LEDs

Extended Safety Option — Status LEDs
S82
X82
X83

SD card

Option

A Motor encoder

Option

B Load encoder or master encoder

Option

X101 DC bus

Option

X5 24-V-supply

Control electronics
Network status LEDs

X236 onboard EtherCAT IN

X237 onboard EtherCAT OUT

X1 Basic Safety STO

X3 Control terminal

X16 Engineering port

Commissioning, diagnostics

IT screw

Shielding of motor connection

Option

X105 Motor connection

Brake resistor

PE connection

Shielding of motor connection

Option

X106 Motor holding brake

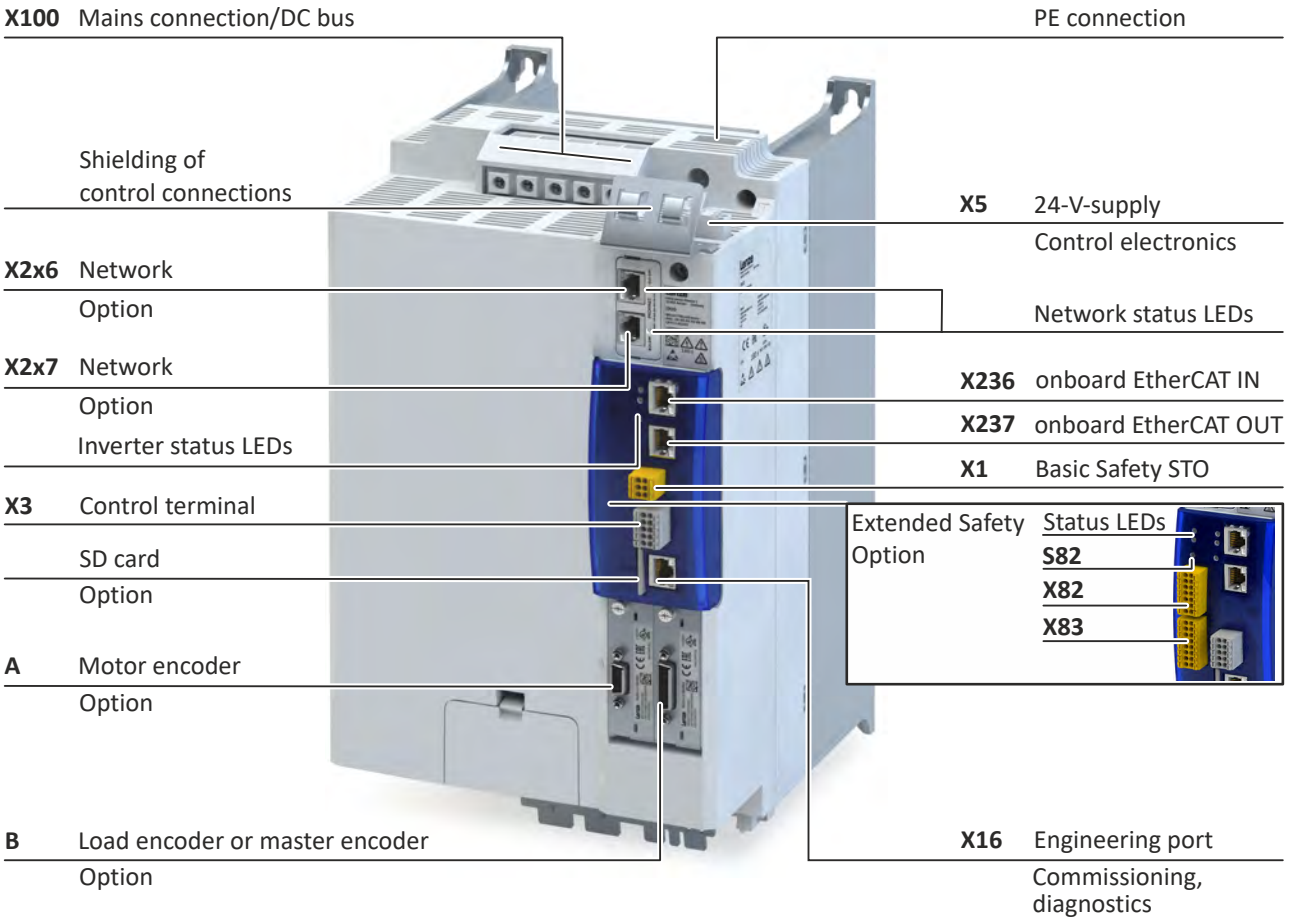
X107 24-V-supply

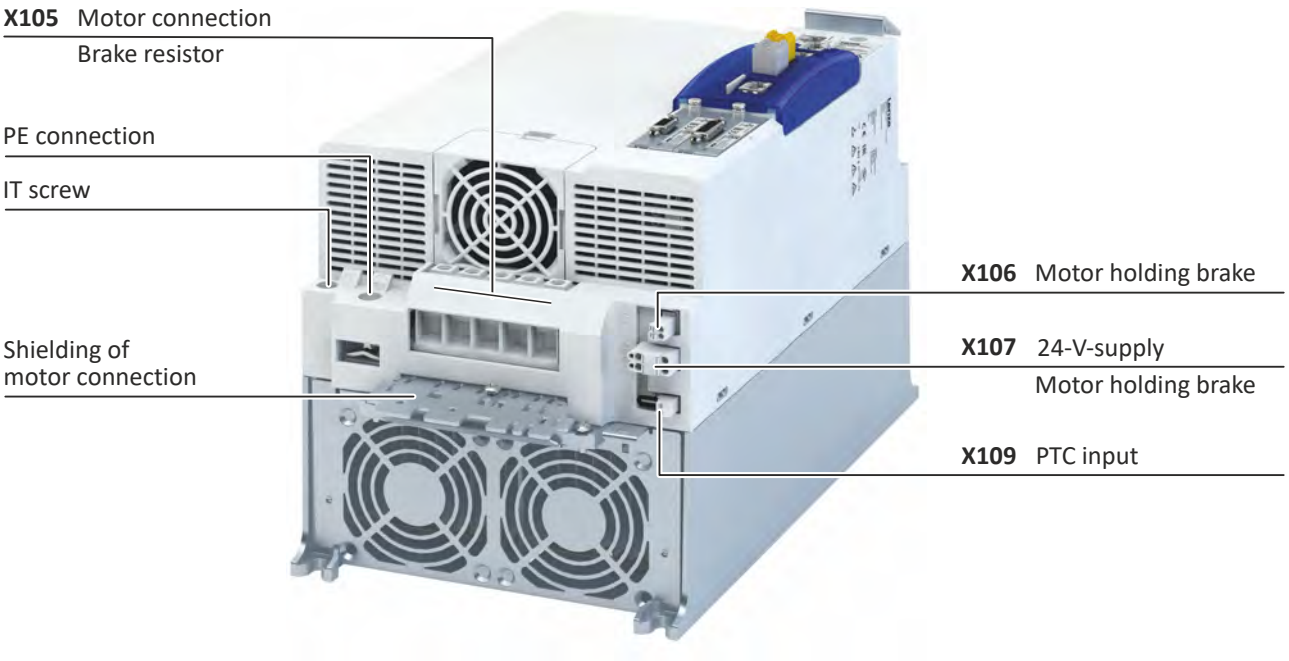
Motor holding brake

X109 PTC input

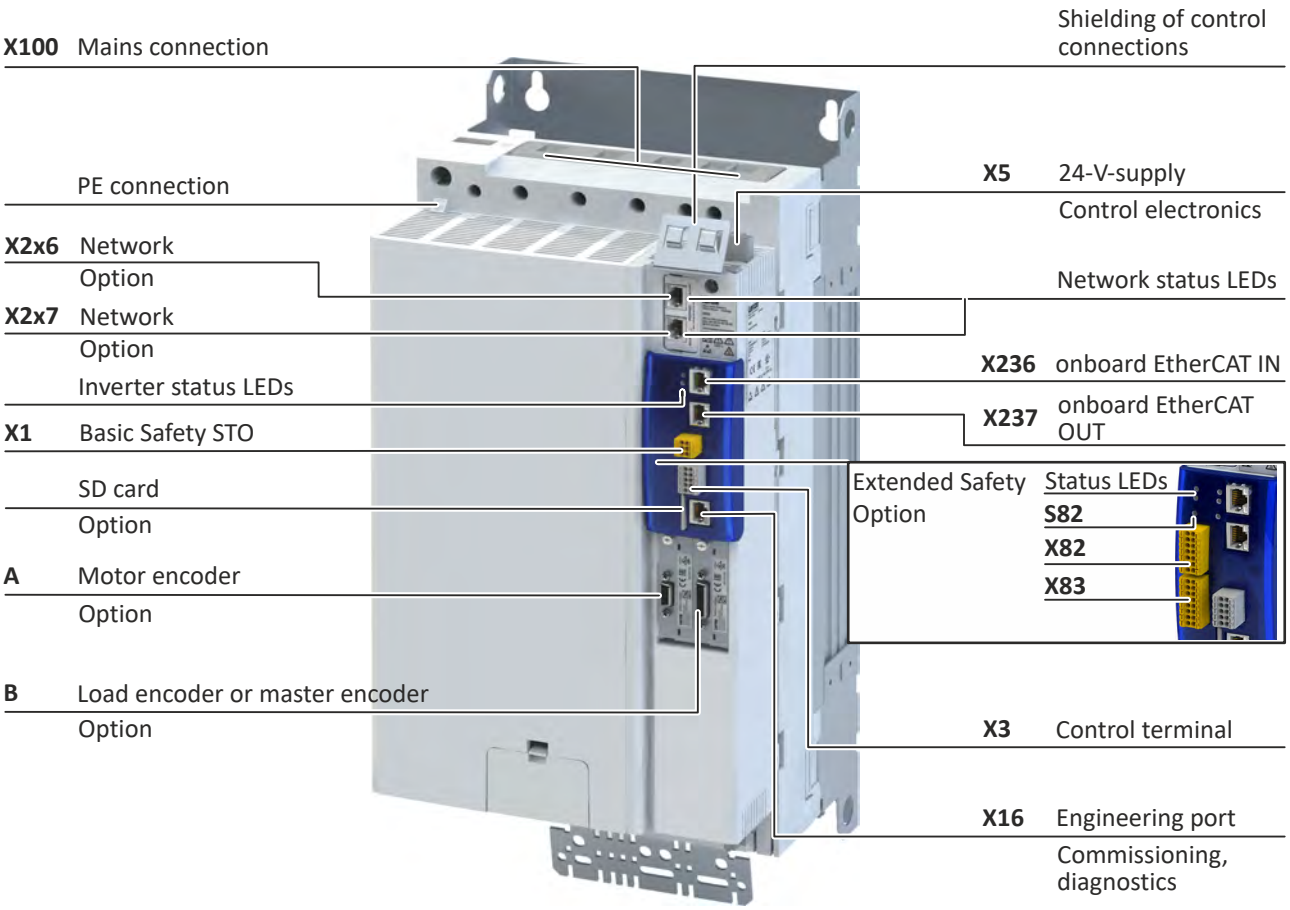
Motor encoder
HIPERFACE DSL® (OCT)

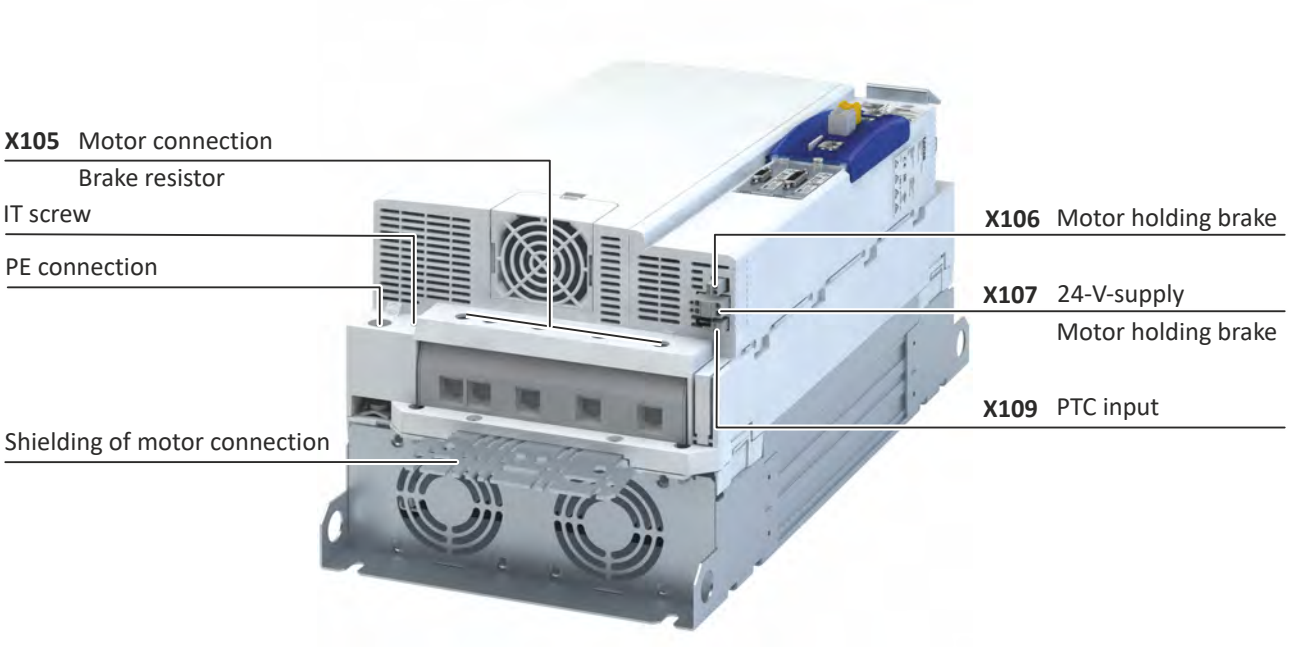
Power range 22 kW



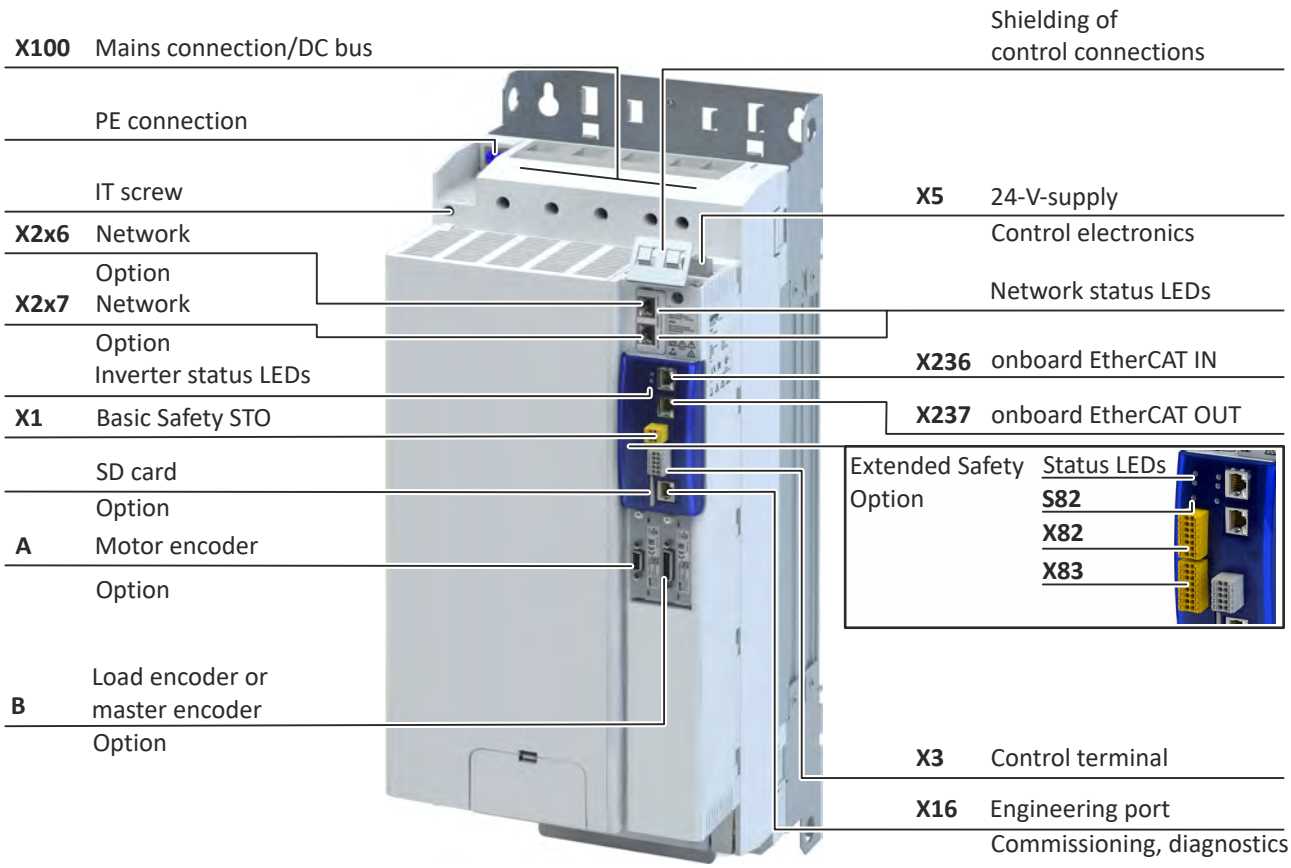


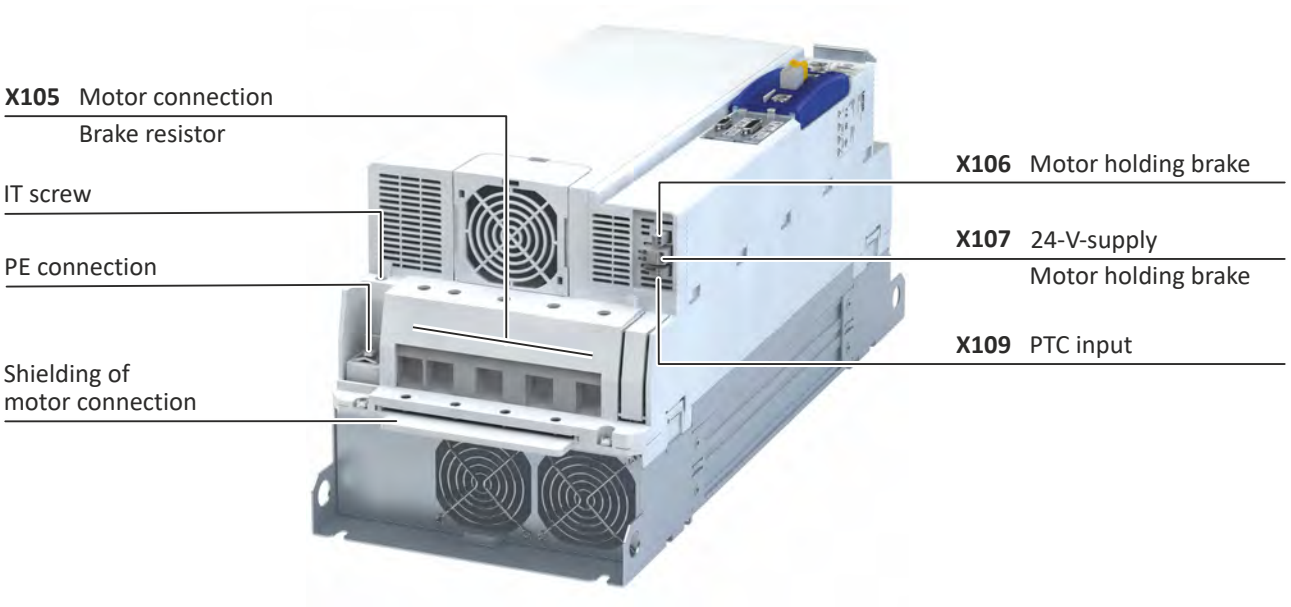
Power range 30 kW ... 45 kW



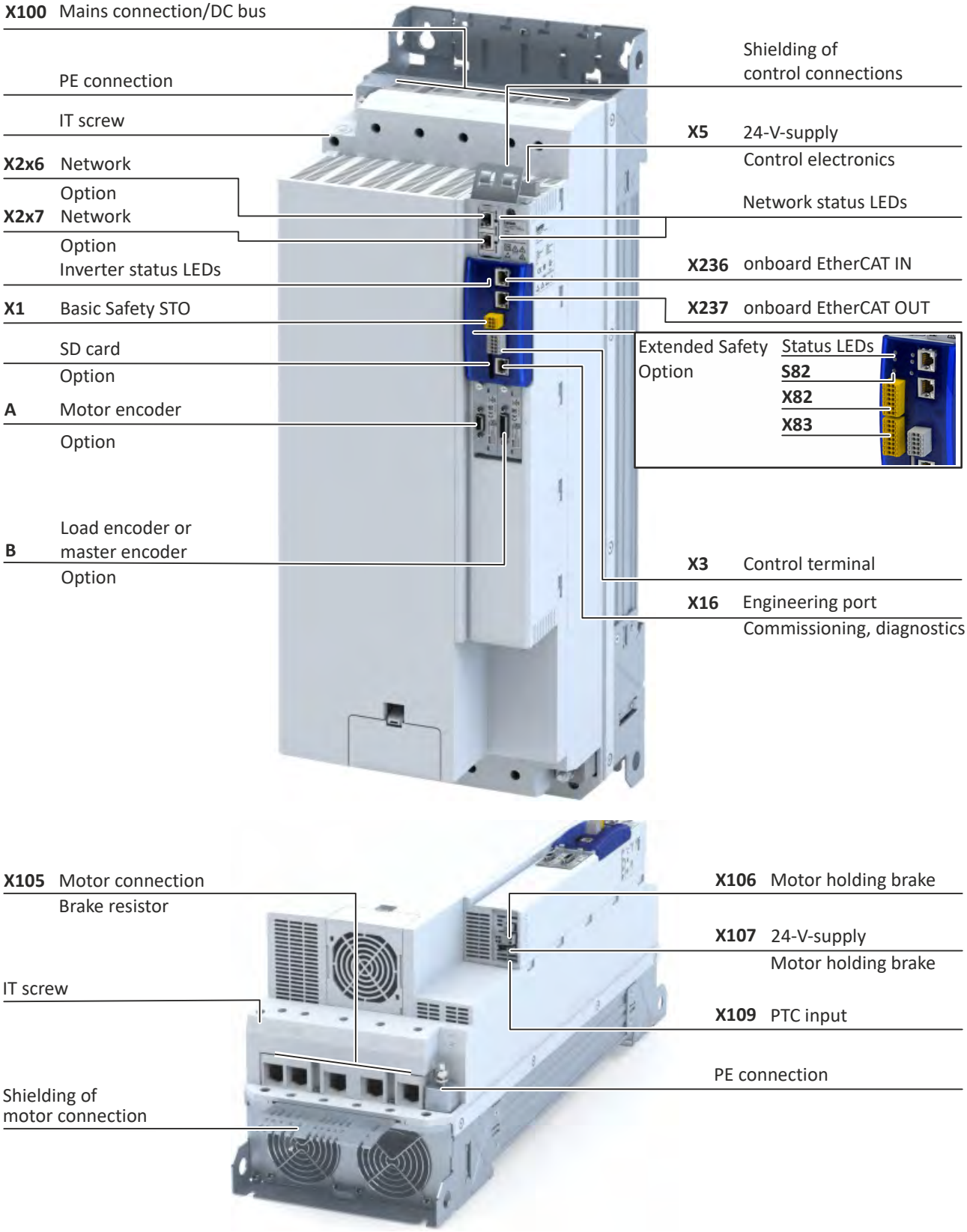


Power range 55 kW ... 75 kW





Power range 90 kW ... 110 kW



Topologies / network

The inverters can be equipped with different fieldbus networks.

The topologies and protocols typical for the prevailing networks are supported.

Currently available networks:

EtherCAT	EtherCAT® (Ethernet for Controller and Automation Technology) is an Ethernet-based fieldbus system which fulfils the application profile for industrial realtime systems EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Device descriptions for the download: XML/ESI files for Lenze devices
Safety over EtherCAT	Fail-safe-over-EtherCAT (FSoE) enables the transmission of safe information via FSoE protocol according to ETG.5100 S specification, version 1.2.0 of the EtherCAT user organisation (ETG). Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
EtherNet/IP ODVA CONFORMANT	EtherNet/IP™ (EtherNet Industrial Protocol) is an Ethernet-based fieldbus system that uses Common Industrial Protocol™ (CIP™) to exchange data. EtherNet/IP™ and Common Industrial Protocol™ (CIP™) are trademarks and patented technologies, licensed by the user organization ODVA (Open DeviceNet Vendor Association), Inc., USA. Device descriptions for the download: EDS files for Lenze devices
PROFINET INDUSTRIAL ETHERNET	PROFINET® (Process Field Network) is a real-time capable fieldbus system based on Ethernet. PROFINET® is a registered trademark and patented technology licensed by the PROFIBUS & PROFINET International (PI) user organisation. Device descriptions for the download: GSDML files for Lenze devices
PROFIsafe	The certified safety protocol for the transfer of safety-related data via PROFINET®.

More information on the supported networks can be found at:

www.Lenze.com

Technology applications (TA)

Overview

The i950 servo inverter supports the CiA 402 device profile by default. In addition, prepared technology applications can be adjusted.

- Device profile CiA 402 Advanced ("CiA 402 Advanced")
- Electronic gearbox ("Electronic Gearbox")
- Synchronism with mark correction ("Sync and Correction")
- Speed control ("Speed Control")
- Table positioning ("Table Positioning")
- Winder with dancer control ("Winder Dancer")
- Winder with tension control ("Winder Tension")

The basic movement functions can be used independently of the technology application.

The basic movement functions can be used to perform the following actions:

- Homing(Homing)
  - Movement of reference markers to determine the measurement system of the machine within the physically possible travel range.
  - Referencing is generally only necessary once during commissioning and during a restart of the machine.
- Manual movement (Jogging)
  - Manual control of the drive.
- Normal stop and quick stop (QSP)
  - The drive will be brought to a standstill regardless of the specified setpoint. Deceleration takes place at the value set for normal stop or quick stop.
  - A switch is made to the device state "Normal stop active" or "Quick stop active".
- Restriction of torque
  - This function limits the motor torque during ongoing operation, e. g. as overload protection for the mechanical transmission path and transmission elements from the motor shaft onwards.
- Limitation of kinematics via hardware and software
  - This function limits the speed, the rotational speed, and where applicable, the position of kinematics or a motor.

"CiA 402 Advanced" technology application

The technology application "CiA 402 Advanced" expands the CiA 402 functions of the i950 servo inverter. The following additional functions are implemented in the technology application CiA 402 Advanced:

- Homing according to CiA 402
- Position control for application encoder Slot B
- Separate application quick stop
- Interface to the fieldbus and use of the safety functions via PROFIsafe or FSoE

This technology application enables the i950 to be optimally operated as a CiA device with control units of other manufacturers.

"Electronic Gearbox" technology application

For precise speed- and position-synchronized drives in a network

- Continuous transport of continuous materials such as paper, films, or textiles
- High concentricity factor
- Synchronism in drive network
- Precise control technology via the master
- Speed trimming

"Speed Control" technology application

For conveyor drives and traveling drives

- Operation at constant speed with high concentricity factor
- High control performance with speed stability
- Start-up and deceleration profiles
- Process control/torque control
- Speed control with and without feedback

"Sync and Correction" technology application

For precise speed- and position-synchronized drives in a network

- Continuous material transport of continuous and arch-shaped materials or piece goods
- Concentricity and synchronism in the drive network
- Fiducial control
- Intermittent operation
- Phase trimming

"Table Positioning" technology application

For discontinuously running conveying, hoist, and handling drives

- Dynamic positioning processes
- Profile generation and position at target
- Profile generator and motion control
- Management of profile data sets
- Sequence profile control
- Override function
- Residual path positioning on marks

"Winder Dancer" technology application

For speed-controlled drives for the storage or dispensing of continuous materials such as paper, film, or textiles

- DC-bus operation as electronic gearbox
- Large speed and torque setting range
- High concentricity factor
- Good disturbance behaviour
- Operation in field weakening range
- Process control/dancer control
- Reading in of sensors

"Winder Tension" technology application

Tension-controlled (open loop or closed loop) drives for the storage or dispensing of continuous materials such as paper, film, or textiles

- DC-bus operation as electronic gearbox
- Large speed and torque setting range
- High concentricity factor
- Good disturbance behaviour
- Operation in field weakening range
- Process control/tension control
- Reading in of sensors

One cable technology (OCT) via HIPERFACE DSL®

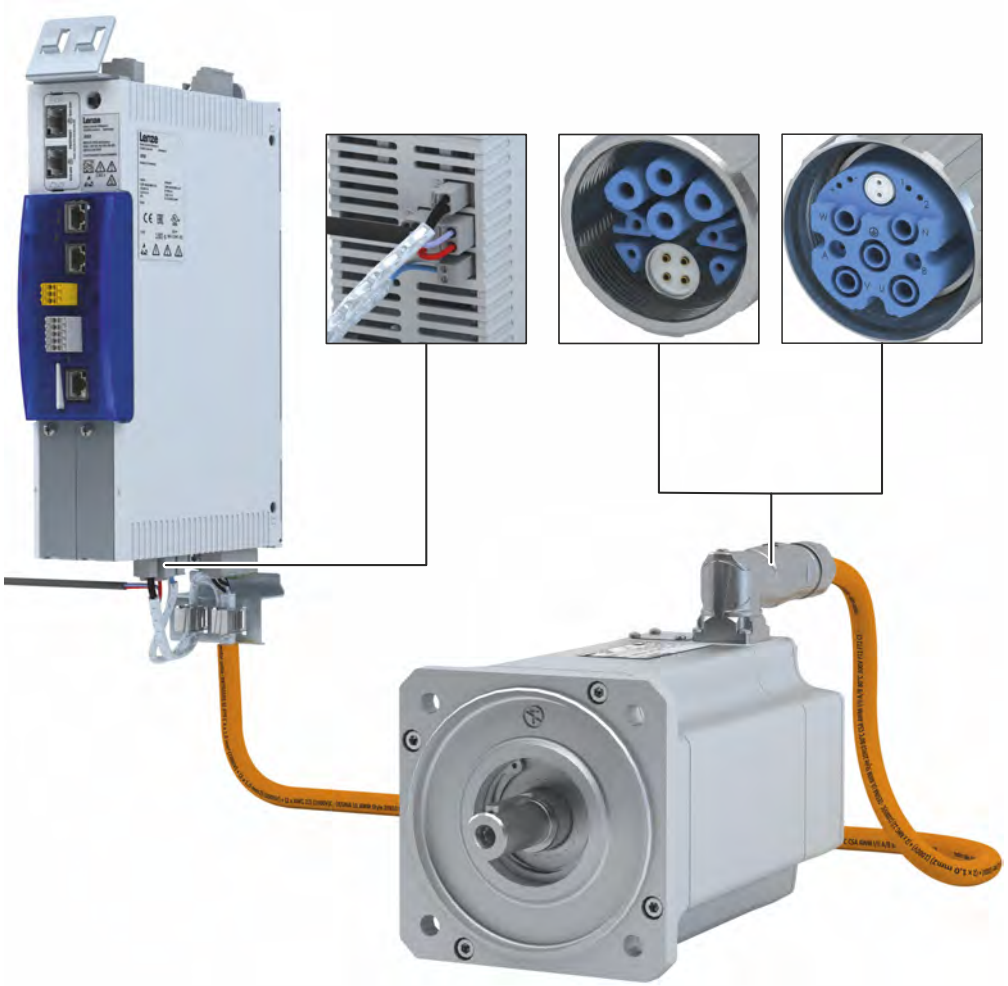
With the aid of the open motor feedback protocol HIPERFACE DSL®, the Servo Inverter i950 allows for the use of future-oriented One Cable Technology.

Advantages

- The use of hybrid cables allows for combined servo and rotary transducer cables.
- This intelligently minimizes connecting cables, cable variants, and connection costs.
- The motor temperature is digitally transferred together with the encoder signal. There is no need for an additional connection of a thermal motor sensor.
- HIPERFACE DSL® is characterized by a high degree of fault resistance and the efficient detection and remedy of faults.

Preconditions

- The One Cable Technology is only available in the devices < 22 kW.
- The One Cable Technology (OCT) is possible with MCS and m850 servo motors.
- The motor must be provided with a HIPERFACE DSL® encoder.
- Make sure that no motor encoder module is plugged in slot A.
- Connection cable
  - The EYP008xxxxxxM11A00 or EYP008xxxxxxM12A00 hybrid cable must be used.
  - Different lengths up to 100 m are available. ▸ System cables 🕮 202
- Application range:
  - Until device firmware V1.5.x: Only together with the "Basic Safety - STO" device variant.
  - From device firmware V1.6.x: Together with the "Basic Safety - STO" and "Extended Safety" device variants.



Identification of the products

When listing the technical data of the various variants, the easily legible product name is used.
This also applies for the categorisation of accessories.

- You can find the corresponding product names and order codes here: ▸ Purchase order 📖 203
- The product name contains the power in kW, the mains voltage class, and the number of phases.
- "C" marks the "Cabinet" version = inverter for the installation into the control cabinet.

Device series	Type	Rated power	Rated mains voltage	No. of phases	Inverter
		kW	V		
i950	C	0.37	230	1/3	i950-C0.37/230-2
		0.55			i950-C0.55/230-2
		0.75			i950-C0.75/230-2
		1.5			i950-C1.5/230-2

Device series	Type	Rated power	Rated mains voltage	No. of phases	Inverter
		kW	V		
i950	C	0.37	240	1/3	i950-C0.37/230-2
		0.55			i950-C0.55/230-2
		0.75			i950-C0.75/230-2
		1.5			i950-C1.5/230-2
		2.2		3	i950-C2.2/230-3
		4			i950-C4.0/230-3
		5.5			i950-C5.5/230-3

Device series	Type	Rated power	Rated mains voltage	No. of phases	Inverter
		kW	V		
i950	C	0.55	400	3	i950-C0.55/400-3
		0.75			i950-C0.75/400-3
		2.2			i950-C2.2/400-3
		4			i950-C4.0/400-3
		7.5			i950-C7.5/400-3
		11			i950-C11/400-3
		15			i950-C15/400-3
		22			i950-C22/400-3
		30			i950-C30/400-3
		45			i950-C45/400-3
		55			i950-C55/400-3
		75			i950-C75/400-3
		90			i950-C90/400-3
		110			i950-C110/400-3

Device series	Type	Rated power	Rated mains voltage	No. of phases	Inverter
		kW	V		
i950	C	0.55	480	3	i950-C0.55/400-3
		0.75			i950-C0.75/400-3
		2.2			i950-C2.2/400-3
		4			i950-C4.0/400-3
		7.5			i950-C7.5/400-3
		11			i950-C11/400-3
		15			i950-C15/400-3
		22			i950-C22/400-3
		30			i950-C30/400-3
		45			i950-C45/400-3
		55			i950-C55/400-3
		75			i950-C75/400-3
		90			i950-C90/400-3
		110			i950-C110/400-3

Information on project planning

Project planning process

Operation in motor and generator mode

The energy analysis differs between operation in motor mode and generator mode.

During operation in motor mode, the energy flows from the supplying mains via the inverter to the motor which converts electrical energy into mechanical energy (e. g. for lifting a load).

During operation in generator mode, the energy flows back from the motor to the inverter. The motor converts the mechanical energy into electrical energy - it acts as a generator (e. g. when lowering a load).

The drive brakes the load in a controlled manner.

The energy recovery causes a rise in the DC-bus voltage. If this voltage exceeds an upper limit, the output stage of the inverter will be blocked to prevent the device from being destroyed.

The drive coasts until the DC-bus voltage reaches the permissible value range again.

In order that the excessive energy can be dissipated, a brake resistor or a regenerative module is required.

Overcurrent operation

The inverters can be driven at higher amperages beyond the rated current if the duration of this overcurrent operation is time limited.

Two utilisation cycles of 15 s and 180 s are defined. Within these utilisation cycles, an overcurrent is possible for a certain time if afterwards an accordingly long recovery phase takes place.

Cycle 15 s

During this operation, the inverter may be loaded for 3 s with up to 200 % of the rated current if afterwards a recovery time of 12 s with max. 75 % of the rated current is observed. A cycle corresponds to 15 s.

Cycle 180 s

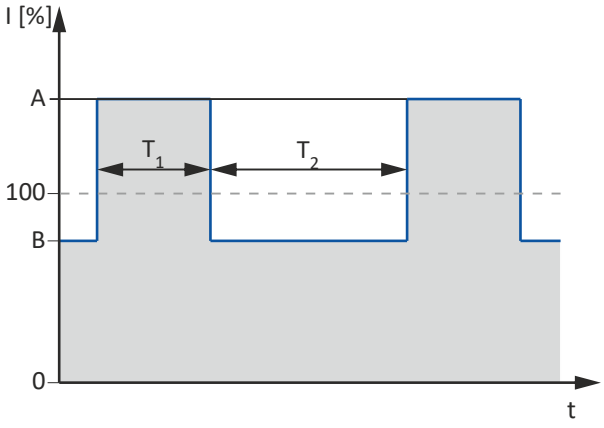
During this operation, the inverter may be loaded for 60 s with up to 150 % of the rated current if afterwards a recovery time of 120 s with max. 75 % of the rated current is observed. A cycle corresponds to 180 s.

The monitoring of the device utilization (Ixt) triggers an error if the utilization value exceeds a threshold of 100 %.

The maximum output currents correspond to the switching frequencies and the overload behaviour of the inverters are given in the rated data.

In case of rotating frequencies < 10 Hz, the time-related overload behaviour may be reduced.

The graphics shows a cycle. The basic conditions given in the table (graphics field highlighted in grey) have to be complied with in order that the inverter will not be overloaded. Both cycles can be combined with each other.



Overcurrent cycle	Max. output current	Overload time	Max. output current during the recovery time	Recovery time
	A	T_1	B	T_2
s	%	s	%	s
Overcurrent cycle 15 s	200	3	75	12
Overcurrent cycle 180 s	150	60	75	120

Safety instructions

Disregarding the following basic safety measures and safety information may lead to severe personal injury and damage to property!

Observe all specifications of the corresponding documentation supplied. This is the precondition for safe and trouble-free operation and for obtaining the product features specified.

Please observe the specific safety information in the other sections!

Basic safety instructions

⚠ DANGER!

Dangerous electrical voltage

Possible consequences: Death or severe injuries from electric shock

- ▶ Any work on the device must only be carried out in a deenergized state.
- ▶ After switching off the mains voltage, observe the signs on the product.

Product

- The product must only be used as directed.
- Never commission the product in the event of visible damage.
- The product must never be technically modified.
- Never commission the product before assembly has been completed.
- The product must never be operated without required covers.
- Connect/disconnect all pluggable terminals only in de-energized condition.
- Only remove the product from the installation in the de-energized state.

Personnel

Only qualified and skilled personnel are allowed to work with the product. IEC 60364 and/or CENELEC HD 384 define the qualifications of these persons as follows:

- They are familiar with the installation, mounting, commissioning, and operation of the product.
- They possess the appropriate qualifications for their tasks.
- They are familiar with all regulations for the prevention of accidents, directives, and laws applicable at the location and are able to apply them.

Process engineering

The procedural notes and circuit details described are only proposals. It is up to the user to check whether they can be adapted to the particular applications. Lenze does not take any responsibility for the suitability of the procedures and circuit proposals described.

Device protection

- The maximum test voltage for insulation tests between a control potential of 24 V and PE must not exceed 110 V DC (EN 61800−5−1).

Application as directed

- The product serves as a component for the control of three-phase AC motors and servo motors.
- The product must only be actuated with motors that are suitable for the operation with inverters.
- The product is not a household appliance, but is only designed as electrical equipment for commercial or professional use in terms of EN 61000−3−2.
- The product is exclusively suitable for installation in control cabinets or similarly closed operating areas.
- The product must only be operated under the operating conditions prescribed in this documentation.
- The product meets the protection requirements of 2014/35/EU: Low-Voltage Directive.
- The product is not a machine in terms of 2006/42/EC: Machinery Directive. With the exception of all functional safety functions.
- Commissioning or starting the operation as directed of a machine with the product is not permitted until it has been ensured that the machine meets the regulations of the EC Directive 2006/42/EC: Machinery Directive; observe EN 60204−1.
- Commissioning or starting operation as directed is only permissible if the EMC Directive 2014/30/EU is complied with.
- As the product may cause EMC interferences in residential areas, the operator is responsible for taking interference suppression measures.

Additional information for the intended use in North America:

The cables must be installed in accordance with US National Electrical Code NFPA 70 or Canadian Electrical Code C22.1.

Foreseeable misuse

Inverters are not to be operated with DC motors.

Handling

Transport, storage

Observe the notes regarding transport, storage and correct handling. Ensure proper handling and avoid mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electronic components and contacts. Inverters contain electrostatically sensitive components which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since thereby your health could be endangered!

Installation

The technical data and supply conditions can be obtained from the nameplate and the documentation. They must be strictly observed.

The inverters must be installed and cooled according to the instructions given in the corresponding documentation. Observe the climatic conditions according to the technical data. The ambient air must not exceed the degree of pollution 2 according to EN 61800−5−1.

Electrical connection

When working on energized inverters, comply with the applicable national accident prevention regulations.

The electrical installation must be carried out according to the appropriate regulations (e. g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the documentation.

The documentation contains information about installation according to EMC regulations (shielding, grounding, filters and cable routing). Please also observe this information for CE-marked inverters. The manufacturer of the system or machine is responsible for adherence to the limit values required in connection with EMC legislation. The inverters must be installed in housings (e. g. control cabinets) to meet the limit values for radio interferences valid at the site of installation. The housings must enable an EMC-compliant installation. Observe in particular that e. the control cabinet doors should have a circumferential metal connection to the housing. Reduce housing openings and cutouts to a minimum.

Protection in the event of short circuit or earth fault

To ensure protection in accordance with IEC 61800-5-1 in the event of an electrical short circuit or earth fault (protection against electric shock, thermal hazards and fire), the following must be taken into account in the installation:

- Use fuses according to the technical data.
- The installation must comply with the requirements of the IEC/HD 60364 (DIN VDE 0100; VDE 0100).
- The continuity of all associated protective conductors and equipotential bonding conductors including all connection points must be ensured.
- If the maximum permissible switch-off time according to IEC 60364-4-41 is exceeded with a high system impedance (especially with TT mains) or a high loop impedance with the prescribed fuses, a residual current device (RCD) can be used. Alternatively, other protective measures can be used, e. g. isolation from the environment by means of double or reinforced insulation, or isolation from the supply system by using a transformer.
- If a residual current device (RCD) is connected upstream of the inverter for protection in the event of an earth fault, only type B/B+ is permitted for 3-phase devices.

Operation

If necessary, systems including inverters must be equipped with additional monitoring and protection devices. Also comply with the safety regulations and provisions valid at the installation site.

After the inverter has been disconnected from the supply voltage, all live components and power terminals must not be touched immediately because capacitors can still be charged. Please observe the corresponding stickers on the inverter.

All protection covers and doors must be shut during operation.

You may adapt the inverters to your application by parameter setting within the limits available. For this, observe the notes in the documentation.

Safety functions
Certain inverter versions support safety functions (e. g. ”safe torque off”, formerly ”safe standstill”) according to the requirements of the EC Machinery Directive 2006/42/EC. The notes on the integrated safety provided in this documentation must be observed.

Maintenance and servicing
The inverters do not require any maintenance if the prescribed operating conditions are observed.

Disposal
In accordance with the current provisions, Lenze products and accessories have to be disposed of by means of professional recycling. Lenze products contain contain recyclable raw material such as metal, plastics and electronic components.

Residual hazards

Even if notes given are taken into consideration and protective measures are implemented, the occurrence of residual risks cannot be fully prevented.

The user must take the residual hazards mentioned into consideration in the risk assessment for his/her machine/system.

If the above is disregarded, this can lead to severe injuries to persons and damage to property!

Product

Observe the warning labels on the product!

Dangerous electrical voltage:
Before working on the product, make sure there is no voltage applied to the power terminals!
After mains disconnection, the power terminals will still carry the hazardous electrical voltage for the time given next to the symbol!

Electrostatic sensitive devices:
Before working on the product, the staff must ensure to be free of electrostatic charge!

High leakage current:
Carry out fixed installation and PE connection in compliance with:
EN 61800−5−1 / EN 60204−1

Hot surface:
Use personal protective equipment or wait until the device has cooled down!

Protection of persons

Before working on the inverter, check if no voltage is applied to the power terminals.

- Depending on the device, the power terminals X105 remain live for up to 3 ... 20 minutes.
- The power terminals X100 and X105 remain live even when the motor is stopped.

Degree of protection - protection of persons and device protection

- Information applies to the mounted and ready-for-use state.
- Information does not apply to the wire range of the terminals.
  - Terminals that are not wired have low protection against physical contact.
  - Terminals for large cable cross-sections have lower classes of protection, e. g. from 15 kW IP10 only.

Motor protection

With some settings of the inverter, the connected motor can be overheated.

- E. g. by longer operation of self-ventilated motors at low speed.
- E. g. by longer operation of DC-injection braking.

Protection of the machine/system

Drives can reach dangerous overspeeds.

- E. g. by setting high output frequencies in connection with motors and machines not suitable for this purpose.
- The inverters do not provide protection against such operating conditions. For this purpose, use additional components.

Switch contactors in the motor cable only if the controller is inhibited.

- Switching while the inverter is enabled is only permissible if no monitoring functions are activated.

Motor

If there is a short circuit of two power transistors, a residual movement of up to 180°/number of pole pairs can occur at the motor! (e. g. 4-pole motor: residual movement max. 180°/2 = 90°).

NOTICE

High input voltage at the device.

Destruction of the device.

- Observe maximum permissible input voltage.
- Fuse device at the input against too high input voltage.

NOTICE

Short circuit at the device due to electrostatic discharge.

Destruction of the device.

- The personnel must be free of electrostatic charge prior to working on the device.

Commissioning

If you use the Application Loader as a download tool for safety-related parameter sets, validate the parameter sets after the download.

Device exchange without tool

Exchange a maximum of one safe device before recommissioning.

Exchange of devices

Test the compatibility of the devices before exchanging.

Risks when exchanging devices

⚠WARNING!

Incorrect handling of devices.

Device damage.

- Check the compatibility of the devices before exchanging.
- Check the memory cards of the devices before exchanging.
- Set the safety address.
- Undertake a functional check after the exchange.

Control cabinet structure

Control cabinet requirements

- Protection against electromagnetic interferences
- Compliance with the ambient conditions of the installed components

Mounting plate requirements

- The mounting plate must be electrically conductive.
  - Use zinc-coated mounting plates or mounting plates made of V2A.
  - Varnished mounting plates are unsuitable, even if the varnish is removed from the contact surfaces.
- When using several mounting plates, make a conductive connection over a large surface (e. g. using grounding strips).

Arrangement of components

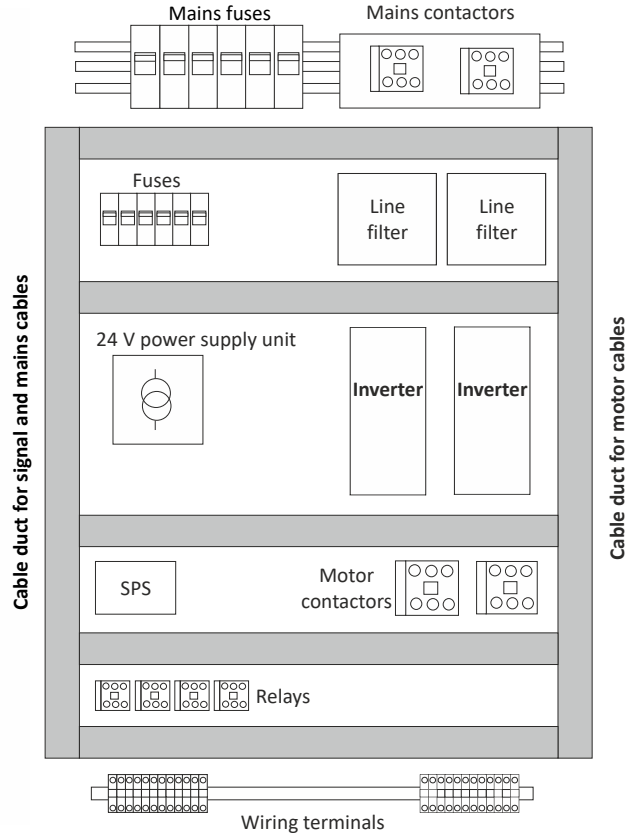


Fig. 1: Example for the ideal arrangement of components in the control cabinet

Cables

Requirements

- The cables used must correspond to the requirements at the location (e. g. EN 60204−1, UL).
- The cable cross-section must be dimensioned for the assigned fusing. Observe national and regional regulations.
- You must observe the regulations for minimum cross-sections of PE conductors. The cross-section of the PE conductor must be at least as large as the cross-section of the power connections.

Installation inside the control cabinet

- Always install cables close to the mounting plate (reference potential), as freely suspended cables act like antennas.
- Use separated cable ducts for motor cables and control cables. Do not mix up different cable types in one cable duct.
- Route cables so that they are straight-lined to the terminals (do not form cable bundles).
- Minimize coupling capacities and coupling inductances by avoiding unnecessary cable lengths and reserve loops.
- Short-circuit unused cores to the reference potential.
- Install the cables of a 24 V DC supply (positive and negative cable) close to each other or twisted over the entire length to avoid loops.
- Before leaving the control cabinet, connect the shield of the fieldbus cable to the mounting plate in accordance with EMC requirements.

Installation outside the control cabinet

- In the case of greater cable lengths, a greater cable distance between the cables is required.
- In the case of parallel routing (cable trays) of cables with different types of signals, the degree of interference can be minimized by using a metallic cable separator or isolated cable ducts.

Earthing concept

- Set up the earthing system with a star topology.
- Connect all components (inverters, filters, chokes) to a central earthing point (PE rail).
- Comply with the corresponding minimum cross-sections of the cables.
- When using several mounting plates, make a conductive connection over a large surface (e. g. using grounding strips).

Information on mechanical installation

Important notes

Measures for cooling during operation

- Ensure unimpeded ventilation of cooling air and outlet of exhaust air.
- If the cooling air is polluted (fluff, (conductive) dust, soot, grease, aggressive gases), take adequate countermeasures.
  - Install filters.
  - Arrange for regular cleaning of the filters.
  - Use air conditioners with hermetic separation of the inside and outside air of the control cabinet.
- If required, implement a separate air guide.

Preparation

Further data and information for mechanical mounting:

▸ Control cabinet structure 📖 34

▸ Dimensions 📖 114

Mounting position

- Vertical alignment - all mains connections are at the top and the motor connections at the bottom.

Free spaces

- Maintain the specified free spaces above and below to the other installations.

Mechanical installation

- The mounting location and material must ensure a durable mechanical connection.
- Do not mount onto DIN rails!
- In case of continuous vibrations or shocks use vibration dampers. If non-conductive vibration dampers are used, an EMC-compliant design must be ensured.

How to mount the inverters onto the mounting plate.

Preconditions:

- Mounting plate with conductive surface

Required:

- Tool for drilling and thread cutting
- Screwdriver
- Screw and washer assemblies or hexagon socket screws with washers.

1. Prepare mounting plate with corresponding threaded holes.
2. Fit screws and washers (if applicable).
3. Do not yet tighten the screws.
4. Mount the inverter on the prepared mounting plate via keyhole suspension.
5. Only tighten the screws hand-tight.
6. Pre-assemble further units if necessary.
7. Adjust the units.
8. Screw the units onto the mounting plate.

The inverter and any other units are mounted on the mounting plate. You can begin with the wiring.

Screw and washer assemblies or hexagon socket screws with washers are recommended..

M5 x ≥ 10 mm for devices up to and including 2.2 kW

M5 x ≥ 12 mm for devices up to and including 11 kW

M6 x ≥ 16 mm for devices up to and including 22 kW

M8 x ≥ 16 mm for devices up to and including 110 kW

Information on electrical installation

Important notes

⚠ DANGER!

Danger to life due to electric shock!

Death or serious injuries

- Deenergize the inverter before working on the inverter.
- Inverter up to 45 kW (60 hp): After switching off the mains voltage, wait for at least 5 minutes before you start working.
- Inverter from 55 kW (75 hp): After switching off the mains voltage, wait for at least 20 minutes before you start working.

⚠ DANGER!

Dangerous electrical voltage

The leakage current against earth (PE) is > 3.5 mA AC or > 10 mA DC.

Possible consequences: Death or severe injuries when touching the device in the event of an error.

- Implement the measures requested in EN 61800−5−1 or EN 60204−1. Especially:
- Fixed installation
- The PE connection must comply with the standards (PE conductor diameter ≥ 10 mm^2 or use a double PE conductor)

⚠ DANGER!

Use of the inverter on a phase earthed mains with a rated mains voltage ≥ 400 V

The protection against accidental contact is not ensured without external measures.

- If protection against accidental contact according to EN 61800-5-1 is required for the control terminals of the inverters and the connections of the plugged device modules, ...
- an additional basic insulation has to be provided.
- the components to be connected have to come with a second basic insulation.

⚠ WARNING!

Dangerous electrical voltage

Device error causes an overvoltage in the system.

- For a voltage supply with DC 24 V (± 20 %), use only a safely separated power supply unit according to the valid SELV/PELV requirements.

NOTICE

No protection against excessively high mains voltage

The mains input is not fused internally.

Possible consequences: Destruction of the product in the event of excessively high mains voltage.

- Take note of the maximum permissible mains voltage.
- On the mains supply side, use fuses to adequately protect the product against mains fluctuations and voltage peaks.

NOTICE

Overvoltage at devices with 230-V mains connection

An impermissible overvoltage may occur if the central supply of the N conductor is interrupted if the devices are connected to a TN three-phase system.

Possible consequences: Destruction of the device

- Provide for the use of isolating transformers.

NOTICE

The product contains electrostatic sensitive devices.

Possible consequences: Destruction of the device

- Before working in the connection area, the personnel must be free of electrostatic charge.

NOTICE

Use of mains filters and RFI filters in IT systems

Mains filters and RFI filters from Lenze contain components that are interconnected against PE.

Possible consequences: The filters may be destroyed when an earth fault occurs.

Possible consequences: Monitoring of the IT system may be triggered.

- Do not use mains filters and RFI filters from Lenze in IT systems.
- Before using the inverter in the IT system, remove the IT screws.

NOTICE

Overvoltage at components

In case of an earth fault in IT systems, intolerable overvoltages may occur in the plant.

Possible consequences: Destruction of the device.

- Before using the inverter in the IT system, the contact screws must be removed.
- Positions and number of the contact screws depend on the device.

When implementing machines and systems for the use in the UL/CSA scope, you have to observe the relevant special notes.

These notes are marked with "UL marking".

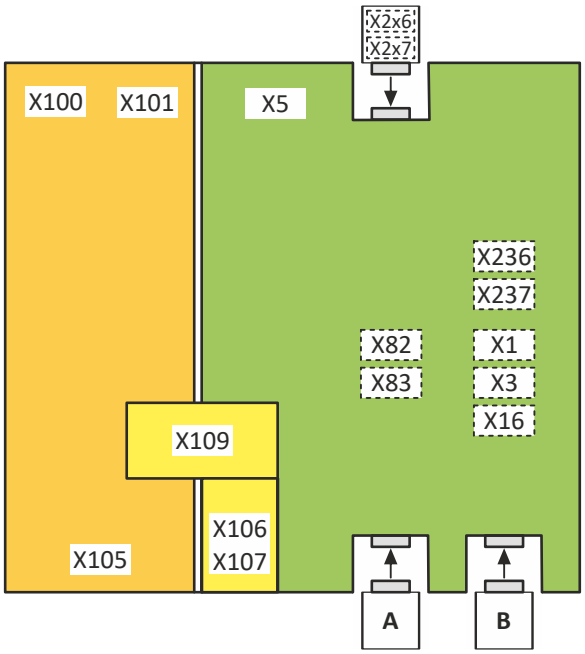
You have to install the devices into housings (e. g. control cabinets) to comply with valid regulations.

Stickers with warning notes must be displayed prominently and close to the device.

Electrical isolation

Ensure a trouble-free operation:

Carry out the total wiring so that the separation of the separate potential areas is preserved.



Legend	
- - - -	Isolation by functional insulation
——	Isolation by basic insulation
═══	Safe isolation by double or reinforced insulation. Protection against accidental contact is guaranteed without any further measures.
X100	Mains connection
X101	DC-bus (option)
X105	Motor connection/brake resistor
X106	Motor holding brake
X107	24 V supply for motor holding brake
X109	PTC input / HIPERFACE DSL® (OCT)
X1	Basic Safety - STO
X3	Control terminals
X5	24 V supply for control electronics
X16	Engineering Port
X82 / X83	Extended Safety (option)
X236 / X237	onboard EtherCAT
X246 / X247	EtherCAT (option)
X256 / X257	PROFINET (option)
X266 / X267	EtherNet/IP (option)
A	Motor encoder (option)
B	Load encoder or master encoder (Option)

Preparation

Further data and information

- EMC-compliant installation 📖 42
- Standards and operating conditions 📖 79

EMC-compliant installation

The drive system (inverter and drive) only complies with the EMC Directive 2014/30/EU if it is installed according to the guidelines for CE-typical drive systems.

These guidelines should also be followed in installations requiring FCC Part 15 or ICES 001 compliance.

EMC-compliant installation must be implemented with shielded motor cables with low capacitance.

Capacitance per unit length:

- C-core-core/C-core-shielding: < 75/150 pF/m ≤ 2.5 mm² (≥ AWG 14)
- C-core-core/C-core-shielding: < 150/300 pF/m ≥ 4 mm² (≤ AWG 12)

Mains connection, DC supply

- Inverters, mains chokes, or mains filters may only be connected to the mains via unshielded single cores or unshielded cables.
- When a line filter is used, shield the cable between mains filter or RFI filter and inverter if its length exceeds 300 mm. Unshielded cores must be twisted.
- In DC-bus operation or DC supply, use shielded cables.

Motor cable

- Only use low-capacitance and shielded motor cables with braid made of tinned or nickel-plated copper.
  - The overlap rate of the braid must be at least 70 % with an overlap angle of 90 °.
  - Shields made of steel braids are not suitable.
- Shield the cable for motor temperature monitoring (PTC or thermal contact) and install it separately from the motor cable.
  - In Lenze system cables, the cable for the brake control is integrated into the motor cable. If this cable is not required for brake control, it can also be used to connect the motor temperature monitoring up to a length of 50 m.
  - Only certain inverters are provided with this connection facility.
- Connect the shield with a large surface and fix it with metal cable binders or conductive clamp. The following is suitable for the connection of the shield:
  - The mounting plate
  - A central grounding rail
  - A shield plate, if necessary, optional
- This is optimal:
  - The motor cable is separated from the mains cables and control cables.
  - The motor cable only crosses mains cables and control cables at right angles.
  - The motor cable is not interrupted.
- If the motor cable must be opened all the same (e. g. by chokes, contactors, or terminals):
  - The unshielded cable ends must not be longer than 100 mm (depending on the cable cross-section).
  - Install chokes, contactors, terminals etc. spatially separated from other components (with a minimum distance of 100 mm).
  - Install the shield of the motor cable directly before and behind the point of separation to the mounting plate with a large surface.
- Connect the shield with a large surface to PE in the terminal box of the motor at the motor housing.
  - Metal EMC cable glands at the motor terminal box ensure a large surface connection of the shield with the motor housing.

Control cables

- Install the cables so that no induction-sensitive loops arise.
- Distance of shield connections of control cables to shield connections of motor cables and DC cables:
  - At least 50 mm
- Control cables for analog signals:
  - Must always be shielded
  - Connect the shield on one side of the inverter
- Control cables for digital signals:

	Cable length		
	< ca. 5 m	**ca. 5 m ... ca. 30 m**	**> ca. 30 m**
Type	unshielded option	unshielded twisted option	always shielded connected on both sides

Fieldbus cables

- Before leaving the control cabinet, connect the shield of the fieldbus cable with the equipotential bonding system (e. g. mounting plate) on a large surface.
- See also the recommendations for action of the respective user organization.

Detecting and eliminating EMC interferences

Trouble	**Cause**	**Remedy**
Interferences of analog setpoints of your own or other devices and measuring systems	Unshielded motor cable has been used	Use shielded motor cable
	Shield contact is not extensive enough	Carry out optimal shielding as specified
	Shield of the motor cable is interrupted, e. g. by terminal strips, switches etc.	• Separate components from other component parts with a minimum distance of 100 mm • Use motor chokes or motor filters
	Additional unshielded cables inside the motor cable have been installed, e. g. for motor temperature monitoring	Install and shield additional cables separately
	Too long and unshielded cable ends of the motor cable	Shorten unshielded cable ends to max. 40 mm
Conducted interference level is exceeded on the supply side	Terminal strips for the motor cable are directly located next to the supply terminals	Spatially separate the terminal strips for the motor cable from mains terminals and other control terminals with a minimum distance of 100 mm
	Mounting plate varnished	Optimize PE connection: • Remove varnish • Use zinc-coated mounting plate
	HF short circuit	Check cable routing
Malfunctions of the fieldbus communication or exceedance of the permissible interference levels	Shield contact is not extensive enough	Before leaving the control cabinet, connect the shield of the fieldbus cable with the equipotential bonding system (e. g. mounting plate) on a large surface.
	Shield connection on the inverter only	
	Shield of fieldbus cable connected on one side only	Shield connection on both sides

Connection according to UL

Important notes

⚠WARNING!

- **UL/CSA marking**
- Secondary circuit shall be supplied from an external isolating source.
- Maximum surrounding air temperature is 45 °C.
- Maximum surrounding air temperature with derating is 55 °C.
- **Marquage UL/CSA**
- Le circuit auxiliaire doit être alimenté par une source de tension externe isolée galvaniquement.
- Température ambiante maximale : 45 °C.
- Température ambiante maximale avec dèclassement : 55 °C.

⚠WARNING!

- **UL marking**
- The integral solid state short circuit protection included in the inverter does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- **Marquage UL**
- La protection statique intégrée contre les courts-circuits n’offre pas la même protection que le dispositif de protection du circuit de dérivation. Un tel dispositif doit être fourni, conformément au National Electrical Code / Canadian Electrical Code et aux autres dispositions applicables au niveau local.

⚠WARNING!

- **UL marking**
- Use 75 °C copper wire only, except for control circuits.
- **Marquage UL**
- Utiliser exclusivement des conducteurs en cuivre 75 °C, sauf pour la partie commande.

⚠WARNING!

- **UL marking**
- Suitable for motor group installation or use on a circuit capable of delivering not more than the RMS symmetrical amperes (SCCR) of the drive at its rated voltage.
- Approved fusing is specified in SCCR tables below.
- **Marquage UL**
- Convient pour l'utilisation sur une installation avec un groupe de moteurs ou sur un circuit capable de fournir au maximum une valeur de courant efficace symétrique en ampères à la tension assignée de l'appareil.
- Les dispositifs de protection adaptés sont spécifiés dans les SCCR tableaux suivants.

NOTICE

- **UL marking**
- The opening of the Branch Circuit Protective Device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, current carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- **Marquage UL**
- Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défault. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur et les remplacer s'ils sont endommagés. En cas de grillage de l'élément traversé par le courant dans un relais de surcharge, le relais tout entier doit être remplacé.

NOTICE

- **UL marking**
- Internal overload protection rated for 125 % of the rated FLA.
- **Marquage UL**
- Protection contre les surcharges conçue pour se déclencher à 125 % de l'intensité assignée à pleine charge.

Fusing data

Branch Circuit Protection (BCP)

Short Circuit Current Ratings (SCCR) with Standard Fuses and Circuit Breaker

(Tested per UL61800-5-1, reference UL file E132659)

These devices are suitable for motor group installation when used with Standard Fuses or Circuit Breaker. For single motor installation, if the fuse value indicated is higher than 400 % of the motor current (FLA), the fuse value has to be calculated. If the value of the fuse is below two standard ratings, the nearest standard ratings less than the calculated value shall apply.

Inverter			Standard Fuses (UL248)			Circuit Breaker (UL489)			
Mains	Rated power		Max. SCCR	Max. rated current	Class	Max. SCCR	Max. rated current	Min. cabinet dimensions	
	kW	hp	kA	A		kA	A	m³	ft³
230 V, 1/3-ph	0.37	0.5	65	35	CC, CF, J, T	65	25	0.042	1.48
230 V, 1/3-ph	0.55	0.75	65	35	CC, CF, J, T	65	25	0.042	1.48
230 V, 1/3-ph	0.75	1	65	35	CC, CF, J, T	65	25	0.042	1.48
230 V, 1/3-ph	1.5	2	65	35	CC, CF, J, T	65	25	0.042	1.48
230 V, 3-ph	2.2	3	65	35	CC, CF, J, T	65	25	0.042	1.48
230 V, 3-ph	4	5	65	60	CC, CF, J, T	65	60	0.042	1.48
230 V, 3-ph	5.5	7.5	65	60	CC, CF, J, T	65	60	0.042	1.48
480 V, 3-ph	0.55	0.75	65	35	CC, CF, J, T	65	25	0.042	1.48
480 V, 3-ph	0.75	1	65	35	CC, CF, J, T	65	25	0.042	1.48
480 V, 3-ph	2.2	3	65	35	CC, CF, J, T	65	25	0.042	1.48
480 V, 3-ph	4	5	65	35	CC, CF, J, T	65	25	0.042	1.48
480 V, 3-ph	7.5	10	65	60	CC, CF, J, T	65	60	0.042	1.48
480 V, 3-ph	11	15	65	60	CC, CF, J, T	65	60	0.042	1.48
480 V, 3-ph	15	20	65	60	CC, CF, J, T	65	60	0.042	1.48
480 V, 3-ph	22	30	65	70	CC, CF, J, T	65	70	0.17	6
480 V, 3-ph	30	40	22	125	CC, CF, J, T	35	125	0.57	20
480 V, 3-ph	45	60	22	125	CC, CF, J, T	35	125	0.57	20
480 V, 3-ph	55	75	22	200	CC, CF, J, T	35	200	0.57	20
480 V, 3-ph	75	100	22	200	CC, CF, J, T	35	200	0.57	20
480 V, 3-ph	90	125	22	300	CC, CF, J, T	10	300	0.57	20
480 V, 3-ph	110	150	22	300	CC, CF, J, T	10	300	0.57	20

Short Circuit Current Ratings (SCCR) with Semiconductor Fuses

(Tested per UL61800-5-1, reference UL file E132659)

These devices are suitable for standard installation when used with Semiconductor Fuses. For single motor installation, if the fuse value indicated is higher than 400 % of the motor current (FLA), the fuse value has to be calculated. If the value of the fuse is below two standard ratings, the nearest standard ratings less than the calculated value shall apply.

Inverter			Alternate Fuse (Semiconductor Fuse)	
Mains	Rated power		Max. SCCR	Max. rated current
	kW	hp	kA	A
230 V, 1/3-ph	0.37	0.5	100	6
230 V, 1/3-ph	0.55	0.75	100	10
230 V, 1/3-ph	0.75	1	100	16
230 V, 1/3-ph	1.5	2	100	25
230 V, 3-ph	2.2	3	100	35
230 V, 3-ph	4	5	100	63
230 V, 3-ph	5.5	7.5	100	80
480 V, 3-ph	0.55	0.75	100	6
480 V, 3-ph	0.75	1	100	6
480 V, 3-ph	2.2	3	100	20
480 V, 3-ph	4	5	100	35
480 V, 3-ph	7.5	10	100	63
480 V, 3-ph	11	15	100	80
480 V, 3-ph	15	20	100	80
480 V, 3-ph	22	30	100	100
480 V, 3-ph	30	40	100	125
480 V, 3-ph	45	60	100	125
480 V, 3-ph	55	75	100	200
480 V, 3-ph	75	100	100	200
480 V, 3-ph	90	125	100	350
480 V, 3-ph	110	150	100	350

Approved manufacturers for BCP fusing

Manufacturer	Max. rated current	Designation
	A	
Eaton/Bussmann	6	FWC-6A10F
		FWP-5A14Fa, FWP-5B
	10	FWC-10A10F
		FWP-10A14Fa, FWP-10B
		170M1308, 170M1358, 170M1408
	16	FWC-16A10F
		FWP-15A14Fa, FWP-15B
		170M1309, 170M1359, 170M1409
	20	FWC-20A10F
		FWP-20A14Fa, FWP-20A22F, FWP-20B
		170M1310, 170M1360, 170M1410
	25	FWC-25A10F
		FWP-25A14Fa, FWP-25A22F, FWP-25B
		170M1311, 170M1361, 170M1411
	35	FWC-32A10F
		FWP-32A14Fa, FWP-32A22F, FWP-35B
		170M1312, 170M1362, 170M1412
	63	FWP-63A22F, FWP-60B
		170M1315, 170M1365, 170M1415
	80	FWP-80A22F, FWP-80B
		170M1316, 170M1366, 170M1416
	100	FWP-100A22F, FWP-100B
		170M1317, 170M1367, 170M1417
	125	FWP-125A
		170M1318, 170M1368, 170M1418
	200	FWP-200A
		170M1320, 170M1370, 170M1420
	350	FWP-350A
Littelfuse	35	L70QS035
	63	L70QS060
	80	L70QS080
	100	L70QS100
	125	L70QS125
	200	L70QS200
	350	L70QS350
Mersen	6	A70QS6-14F, A70QS6-14FI
	10	A70QS10-14F, A70QS10-14FI, A70QS10-22F, A70QS10-22FI
	16	A70QS16-14F, A70QS16-14FI, A70QS15-22F, A70QS15-22FI
	20	A70QS20-14F, A70QS20-14FI, A70QS20-22F, A70QS20-22FI
	25	A70QS25-14F, A70QS25-14FI, A70QS25-22F, A70QS25-22FI
	35	A70QS32-14F, A70QS32-14FI, A70QS32-22F, A70QS32-22FI, A70QS35-4
	63	A70QS63-22F, A70QS63-22FI, A70QS60-4
	80	A70QS80-22F, A70QS80-4, A70QS80-22FI
	100	A70QS100-4, A70QS100-22F, A70QS100-22FI
	125	A70QS125-4, A70QS125-4K
	200	A70QS200-4, A70QS200-4K
	350	A70QS350-4

DC Circuit Protection

Short Circuit Current Ratings (SCCR) with Semiconductor Fuses

(Tested per UL61800-5-1, reference UL file E132659)

Inverter			Alternate Fuse (Semiconductor Fuse)	
Mains	Rated power		Max. SCCR	Max. rated current
	kW	hp	kA	A
230 V, 1/3-ph	0.37	0.5	50	50
230 V, 1/3-ph	0.55	0.75	50	50
230 V, 1/3-ph	0.75	1	50	50
230 V, 1/3-ph	1.5	2	50	50
230 V, 3-ph	2.2	3	50	50
230 V, 3-ph	4	5	50	100
230 V, 3-ph	5.5	7.5	50	100
480 V, 3-ph	0.55	0.75	50	50
480 V, 3-ph	0.75	1	50	50
480 V, 3-ph	2.2	3	50	50
480 V, 3-ph	4	5	50	50
480 V, 3-ph	7.5	10	50	100
480 V, 3-ph	11	15	50	100
480 V, 3-ph	15	20	50	100
480 V, 3-ph	22	30	50	200
480 V, 3-ph	30	40	50	250
480 V, 3-ph	45	60	50	250
480 V, 3-ph	55	75	50	315
480 V, 3-ph	75	100	50	315
480 V, 3-ph	90	125	50	350
480 V, 3-ph	110	150	50	350

Manufacturer	Max. rated current	Designation
	A	
Eaton/Bussmann	50	FWP-50A14Fa, FWP-50A22F, FWP-50B
		170M1314, 170M1364, 170M1414, 170M1733, 170M1753
	100	FWP-100A22F, FWP-100B
		170M1317, 170M1367, 170M1417, 170M1736, 170M1756
	200	FWP-200A
		170M1320, 170M1370, 170M1420, 170M1739, 170M1759
	250	FWP-250A
		170M1321, 170M1371, 170M1421, 170M1740, 170M1760
	315	170M1322, 170M1372, 170M1422, 170M1741, 170M1761
	350	FWP-350A
		170M1742, 170M1762
Littelfuse	50	L70QS050
	100	L70QS100
	200	L70QS200
	250	L70QS250
	350	L70QS350
Mersen	50	A70QS50-22F, A70QS50-14F, A70QS50-14FI, A70QS50-22FI, A70QS50-4
	100	A70QS100-4, A70QS100-22F, A70QS100-22FI
	200	A70QS200-4, A70QS200-4K
	250	A70QS250-4
	350	A70QS350-4

Mains connection

Single inverters are connected directly to the **AC system** or via upstream filters. RFI filters are already integrated in many inverters. Depending on the requirements, mains chokes or mains filters can be used.

In a **DC-system**, several inverters are operated in a network. This enables an energy exchange between motor and generator driven single drives.

▸ DC-bus connection 🕮 63

The following examples contain the connection options for the variant Basic Safety - STO.

1-phase mains connection 230/240 V

The connection plan is valid for the inverters i950-Cxxx/230-2.

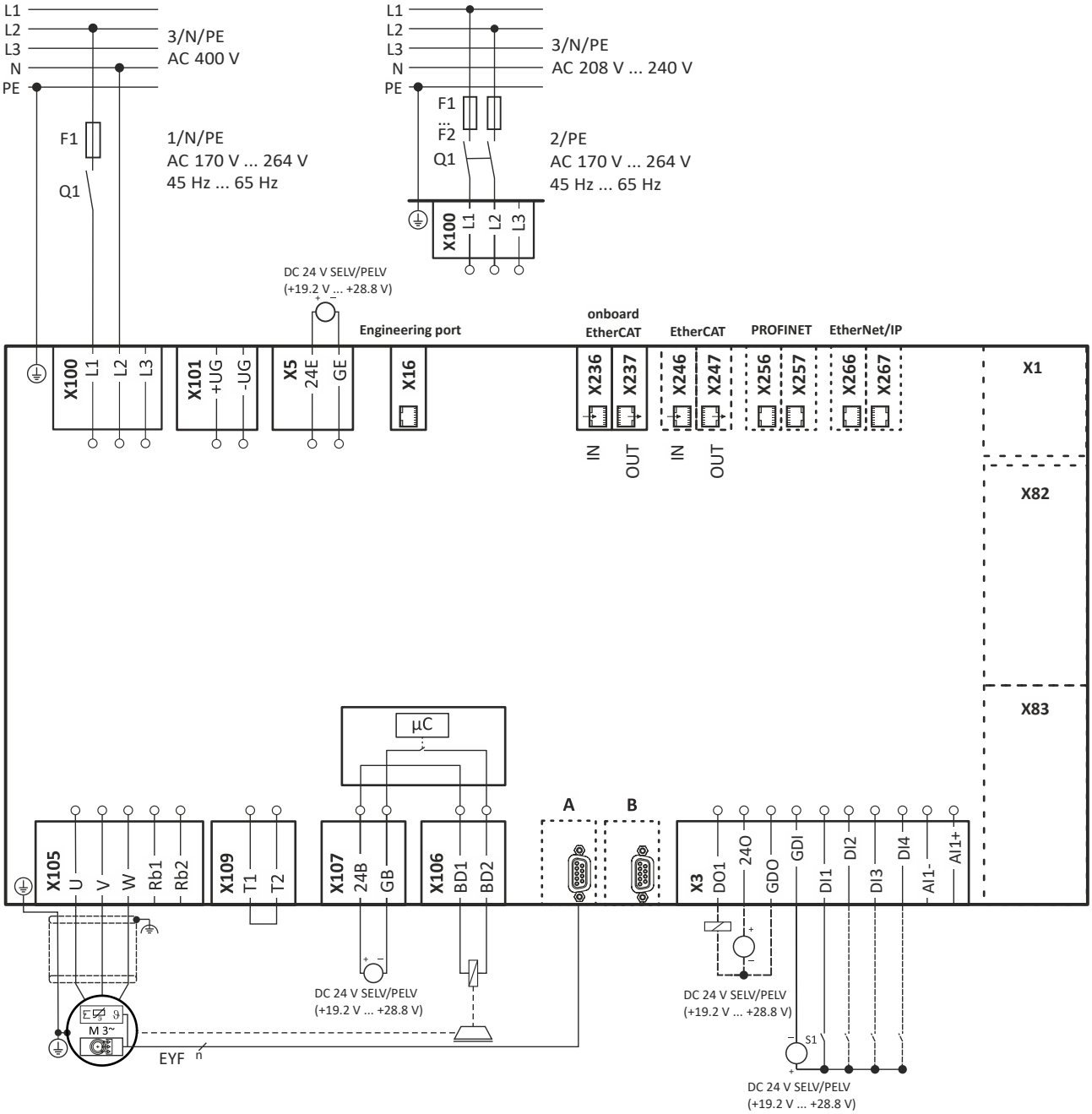


Fig. 2: Wiring example

S1	Start/stop	EYF	Lenze system cable
Fx	Fuses	---	Dashed line = options
Q1	Mains contactor		

A connection diagram for the terminal X1 can be found under: ▸ Basic Safety - STO 🕮 74

A connection plan for the terminals X82 and X83 can be found under: ▸ Extended Safety 🕮 77

3-phase mains connection 230/240 V

The connection plan is valid for the inverters i950-Cxxx/230-3 and i950-Cxxx/230-2.

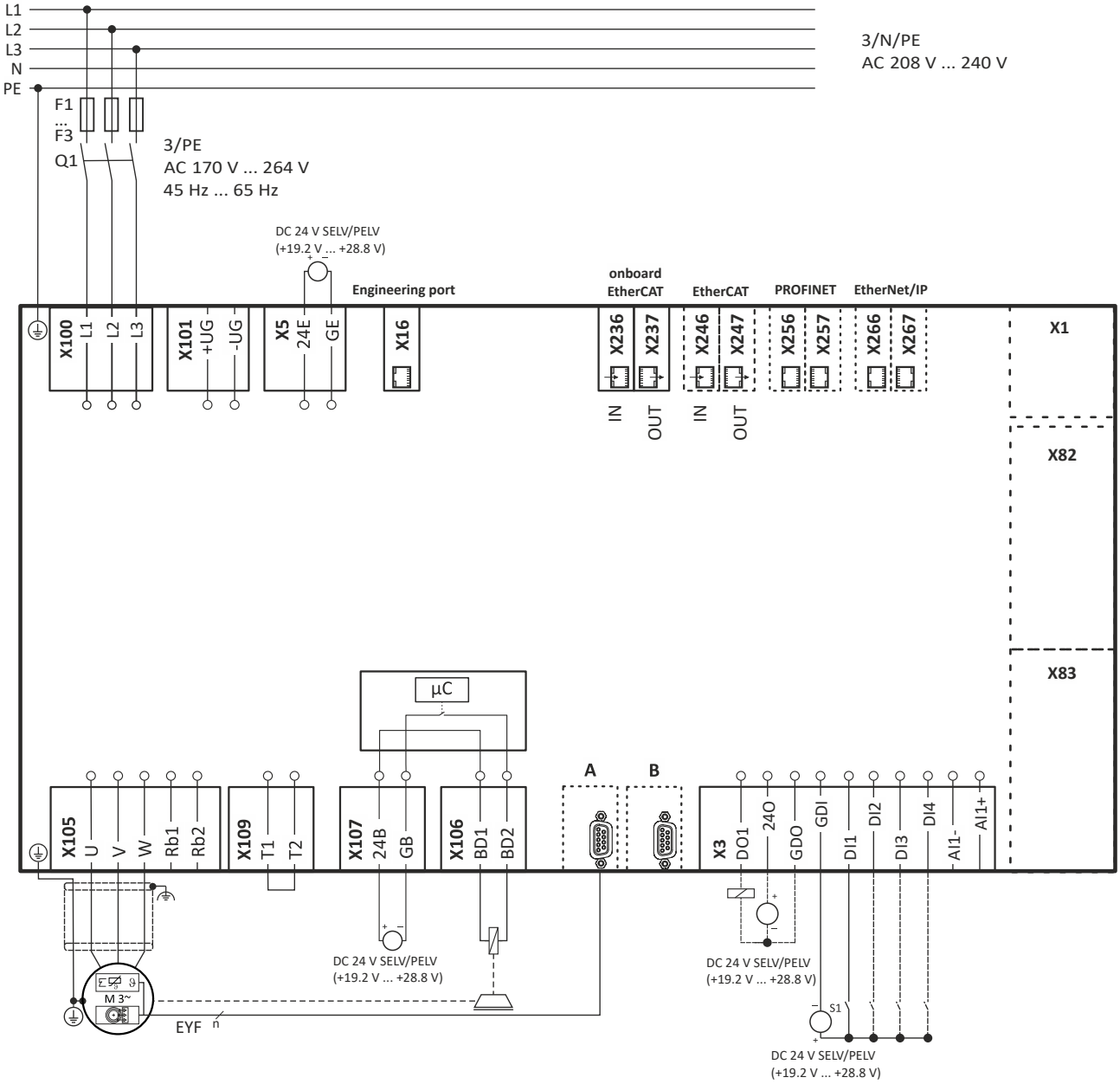


Fig. 3: Wiring example

S1	Start/Stop	EYF	Lenze system cable
Fx	Fuses	---	Dashed line = options
Q1	Mains contactor		

A connection diagram for the terminal X1 can be found under: ▸ Basic Safety - STO 📖 74

A connection plan for the terminals X82 and X83 can be found under: ▸ Extended Safety 📖 77

3-phase mains connection 400 V

A mains choke is required for the operation of inverters ≥ 15 kW.

The connection plan is valid for the inverters i950-Cxxx/400-3.

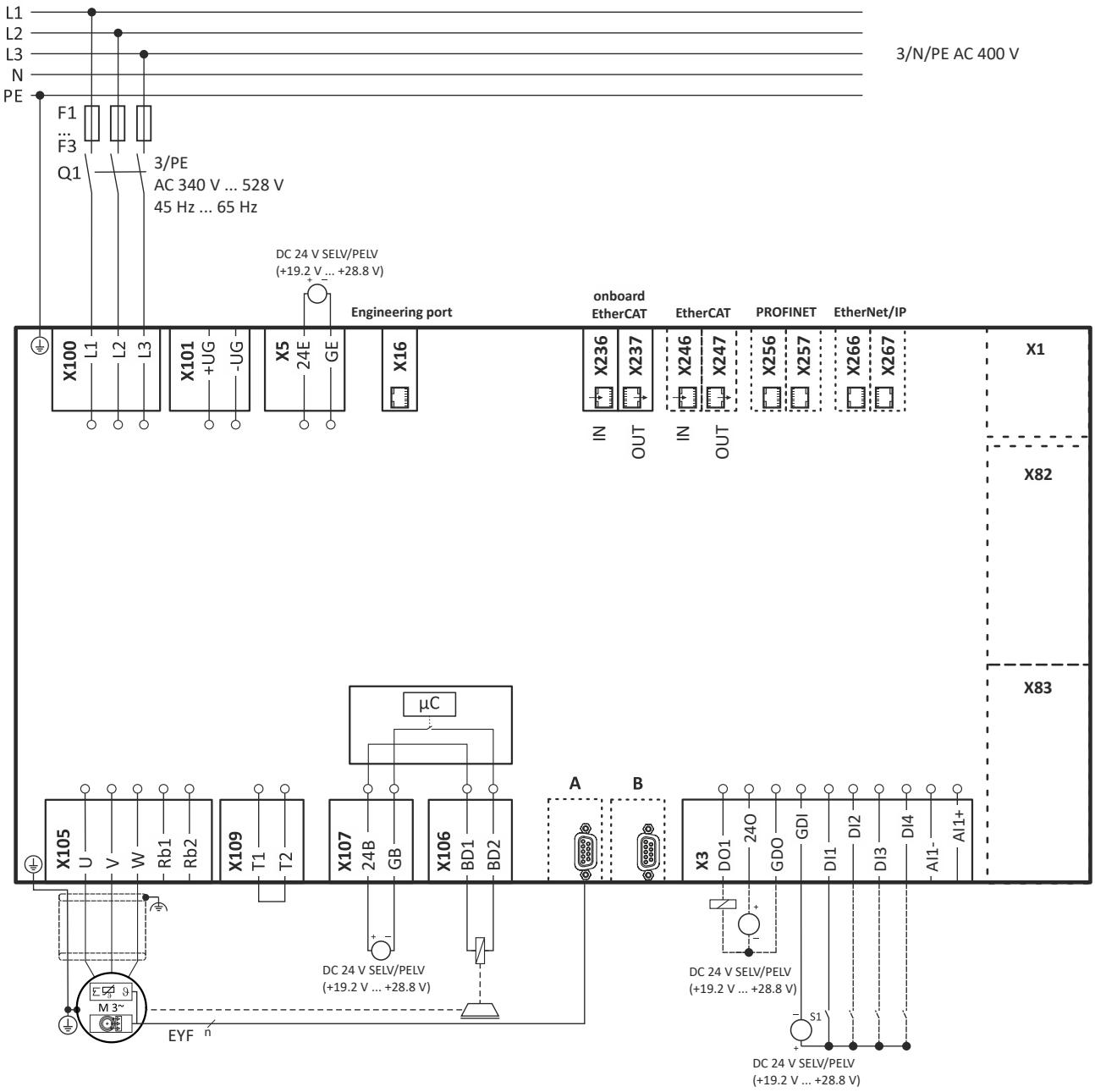


Fig. 4: Wiring example

S1	Start/Stop	EYF	Lenze system cable
Fx	Fuses	---	Dashed line = options
Q1	Mains contactor		

A connection diagram for the terminal X1 can be found under: ▸ Basic Safety - STO 📖 74

A connection plan for the terminals X82 and X83 can be found under: ▸ Extended Safety 📖 77

3-phase mains connection 480 V

A mains choke is required for the operation of inverters ≥ 15 kW.

The connection plan is valid for the inverters i950-Cxxx/400-3.

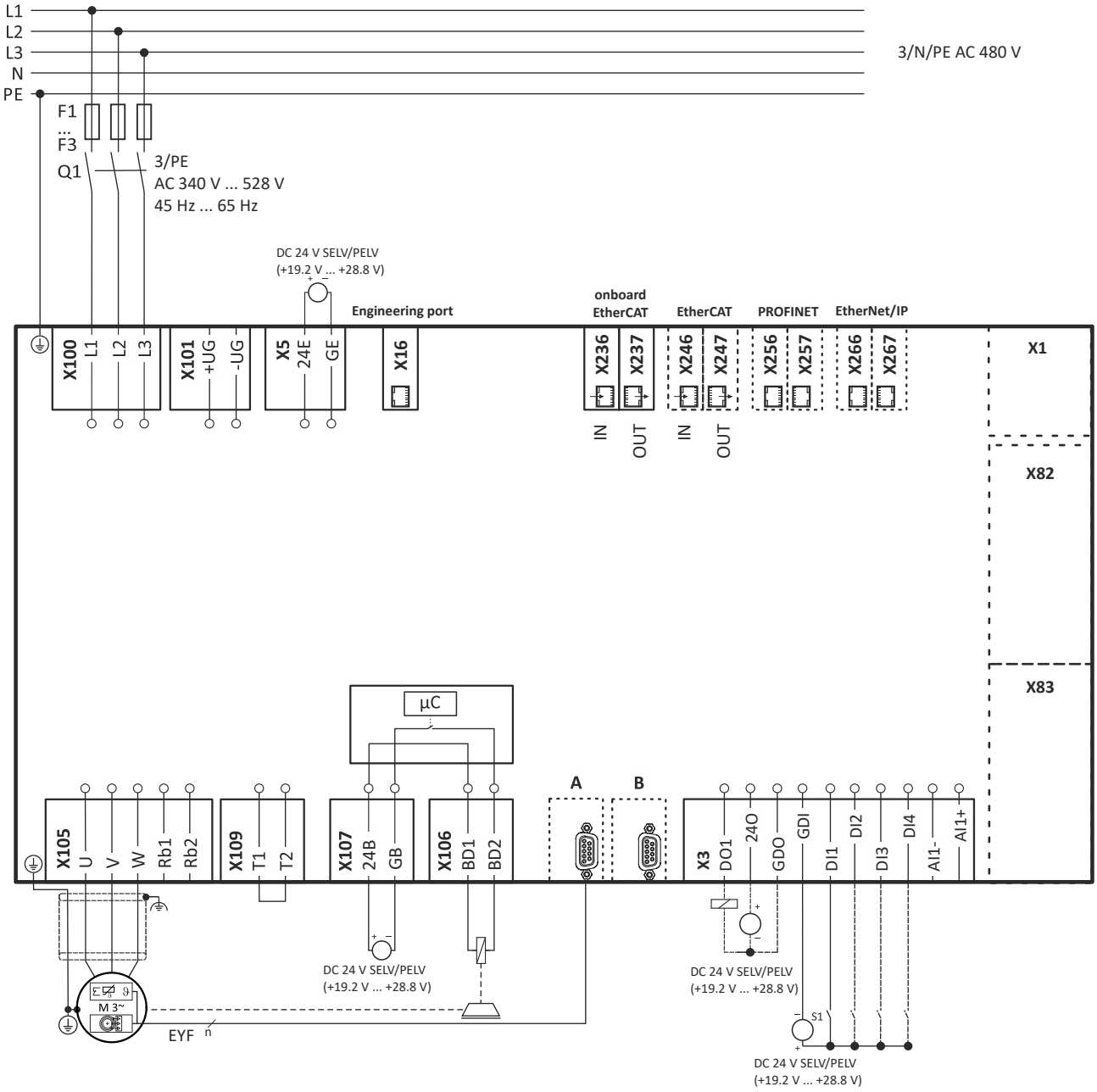


Fig. 5: Wiring example

S1	Start/Stop	EYF	Lenze system cable
Fx	Fuses	---	Dashed line = options
Q1	Mains contactor		

A connection diagram for the terminal X1 can be found under: ▸ Basic Safety - STO 74

A connection plan for the terminals X82 and X83 can be found under: ▸ Extended Safety 77

Motor connection

Only use motors suitable for the inverter operation.

Insulation resistance (EN 60034): max. û ≥ 1.5 kV, max. du/dt ≥ 5 kV/µs

Motor cable lengths

- The rated data for the motor cable length must be observed.
- Keep the motor cable as short as possible as this has a positive effect on the drive behaviour and the EMC.

Switching in the motor cable

Switching on the motor side of the inverter is permissible:

For safety shutdown (emergency stop).

In case several motors are driven by one inverter (only in V/f operating mode).

Please note the following:

The switching elements on the motor side must be dimensioned for with the maximum occurring load.

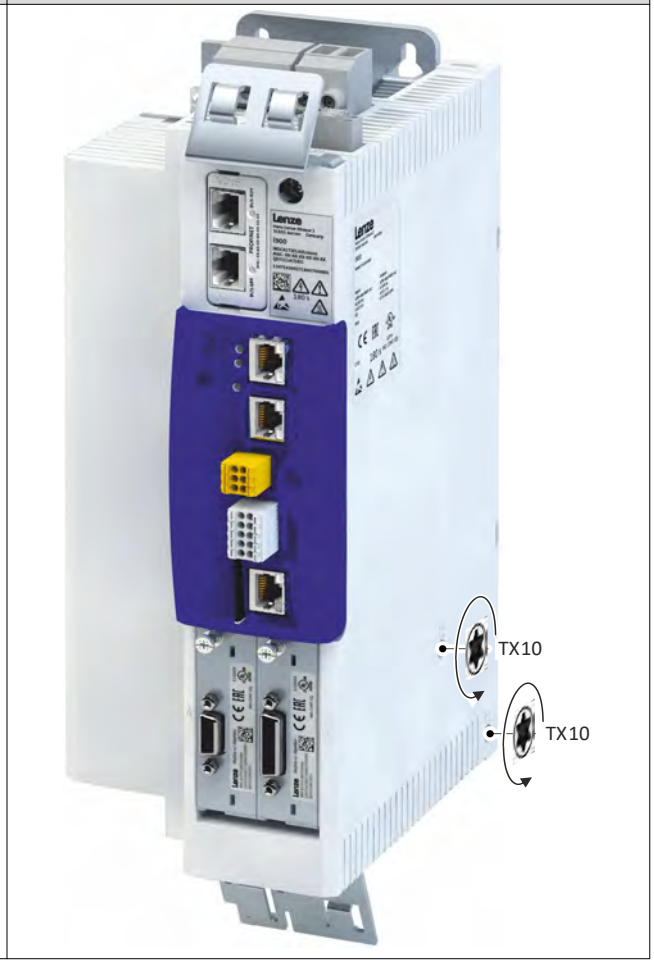
Connection to the IT system

NOTICE

Internal components have earth/ground potential

Possible consequence: The monitoring devices of the IT system will be triggered.

- Upstream an isolation transformer.
- Before connection to an IT system be absolutely sure to remove the screws labeled with "IT" on the product.

I95AE137D, I95AE155x, I95AE175x, I95AE215D, I95AE222x, I95AE240F	I95AE240C, I95AE255C, I95AE275F, I95AE311F, I95AE315F
	

I95AE322F

I95AE330F, I95AE345F	I95AE355F, I95AE375F
	

I95AE390F, I95AE411F

Supply voltage connection

An external 24 V supply voltage to X5:24E/GE is necessary for supplying the control electronics.

If the control electronics are supplied independently of the AC grid of the inverter, the inverter can also be configured when the AC grid is turned off. Communication via existing networks also remains available.

⚠ DANGER!

Loss of the safe isolation

Safe isolation of the control card from the mains potential is deactivated when the motor and motor holding brake are connected via a system cable AND X5 and X107 are supplied by a common power supply unit. This also applies when using a SELV/PELV power supply unit.

Possible consequences: Electric shock in the event of a fault.

- Supply X107 and X5 by separate SELV/PELV power supply units if the motor and motor holding brake are connected via a system cable.

Connection of motor temperature monitoring

In the Lenze setting, the motor temperature monitoring is activated! By default, a wire jumper is installed between the terminals T1 and T2. Before connecting a thermal sensor, remove the wire jumper.

The inverter can optionally be outfitted with a module for motor feedback (motor encoder). In this case, it is not necessary to connect an external PTC thermistor (PTC) or a thermal contact, since temperature monitoring is already integrated in the motor feedback module.

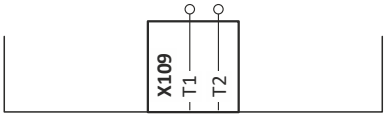
▸ Product extensions, Motor encoder connection 📖 129

Terminal X109 can be used with inverters < 22 kW either for temperature monitoring or for One Cable Technology (OCT).

▸ Connection of one cable technology (OCT) via HIPERFACE DSL® 📖 67

If the terminal X109 is used, e. g. to connect an external PTC thermistor (PTC) or a thermal contact, ensure at least one basic insulation to the potentials of motor, mains and control terminals to not restrict the safe separation of the control terminals.

Use	Connection of PTC or thermal contact
Connection	Terminal X109: T1 Terminal X109: T2
Sensor types	PTC single sensor (DIN 44081) PTC triple sensor (DIN 44082) Thermal contact



Motor holding brake connection

The inverter is designed for 24 V brakes. A motor holding brake is connected to X106 and supplied via X107.

⚠ DANGER!

Loss of the safe isolation

Safe isolation of the control card from the mains potential is deactivated when the motor and motor holding brake are connected via a system cable AND X5 and X107 are supplied by a common power supply unit. This also applies when using a SELV/PELV power supply unit.

Possible consequences: Electric shock in the event of a fault.

- ▸ Supply X107 and X5 by separate SELV/PELV power supply units if the motor and motor holding brake are connected via a system cable.

X107 and X5 can be supplied by a common SELV/PELV power supply unit if the motor and motor holding brake are connected via safely isolated installed cables.

When the motor holding brake is open, a slight knocking sound can be noticed in the motor. This stems from test pulses for monitoring the motor brake control.

Functions for controlling motor holding brakes:

- Recognition of the brakes
- Default setting of motor torque
- Manual mode
- Automatic mode
- Logical inversion

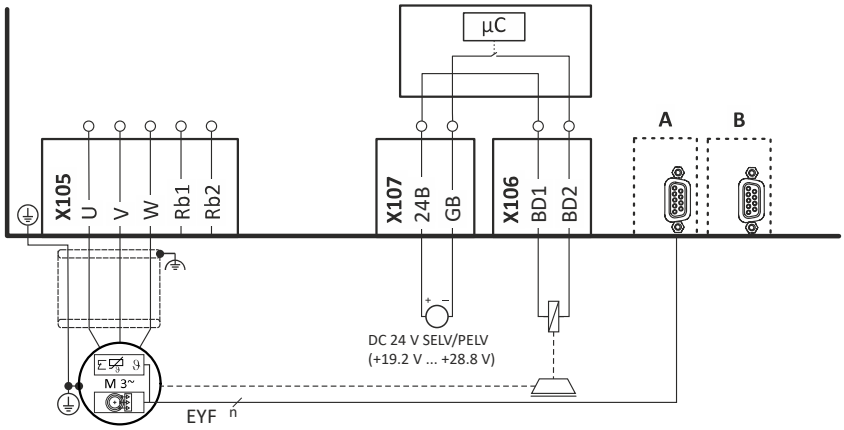


Fig. 6: Connection diagram - motor holding brake

Motor holding brake connection

Terminal			X106: temperature connection T1 / T2 BD1, BD2	Controlling a motor holding brake with or without brake voltage reduction
Level		V	LOW: < +5, HIGH: > +15	
Max. Output current	0.37 ... 15 kW	A	2.5	
	22 ... 110 kW		5.0	
Cycle time		ms	1	
Short-circuit-proof			Unlimited period	
Suppressor circuit			Integrated freewheeling diode and spark suppressor	
Max. Breaking energy	0.37 ... 15 kW	Ws	5	
	22 ... 110 kW	Ws	20	
Max. Switching rate			6/min. at max. output current	Depending on the output current: Switching frequency doubles if the output current is halved
Insulation			Basic insulation	Connection via system cable
			Double/reinforced insulation	Connection via separated cable

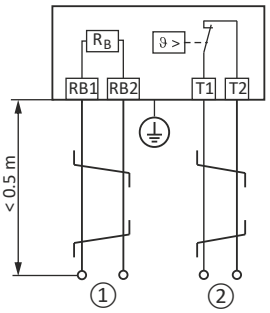
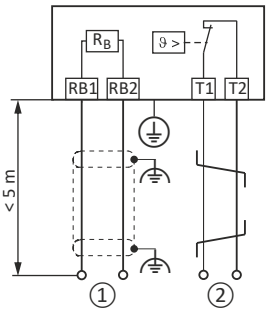
24 V supply for motor holding brake

Terminal			X107: supply voltage brake + / - 24B, GB	DC supply of X106
External power supply unit specification			SELV/PELV	
Rated input voltage		V	+24 ± 20 %	
Max. Input current	0.37 ... 15 kW	A	2.5	Typical: according to the load at X106
	22 ... 110 kW	A	5.0	
Polarity reversal protection			Yes	
Suppressor circuit			Yes	Suppressor diode 30 V, bidirectional

Connection description			**Motor brake**	**24 V supply for motor brake**
Connection			**X106**	**X107**
Connection type			Pluggable	Pluggable
Max. cable cross-section		mm²	1.5	2.5
Max. cable cross-section		AWG	16	12
Stripping length		mm	9	10
Stripping length		in	0.35	0.39
Required tool			Screwdriver 0.4 x 2.5	Screwdriver 0.6 x 3.5

Brake resistor connection

Use intrinsically safe brake resistors to be able to dispense with a separate switch-off device (e.g. a contactor).

Short connection cables up to 0.5 m	Long connection cables up to max. 5 m
Up to a cable length of 0.5 m, the cable for the brake resistor and that of the temperature monitoring can be twisted. Doing so reduces problems due to EMC interference.	The cable of the brake resistor must be shielded. The maximum length is 5 m. Twisting is sufficient for the temperature monitoring cable.
	

① Wiring to the "brake resistor" connection on the inverter or another component with brake chopper.

② Optional: Wiring to a control contact that is set to monitor the thermal contact.
If the thermal contact responds, the voltage supply to the inverter must be disconnected (e.g. switch off the control of the mains contactor).

DC-bus connection

If multiple inverters are operated in a DC-bus connection, energy exchange between individual drives working as motors and generators is possible. Groups of inverters are connected to the DC bus.

Preconditions:

- The inverters must have an appropriate connection facility, e. g. terminal +UG/-UG.
- The inverters connected to the DC bus must be designed for the same DC-bus voltage and have the same number of phases on the mains side.

The DC system can be provided by power supply modules (AC/DC converters) or inverters with a power reserve. The technical data provide information on possible applications.

Error-free operation of the inverters in a DC-bus connection is only possible with meticulous design.

Further information can be found in the Application Knowledge Base.

AKB article "Information on i950 interconnected operation"

Control connections

In case of long cables and/or high interference the effect of the shielding can be improved. To do this, connect the shield of cables for the analog inputs and outputs at one end of the cable via a capacitor with PE potential (e. g. 10 nF/ 250 V).

Connection description			**Control terminals**	**24 V supply for control electronics**	**PTC input**
Connection			**X3**	**X5**	**X109**
Connection type			Pluggable	Pluggable	Pluggable
Max. cable cross-section		mm²	1.5	2.5	1.5
Max. cable cross-section		AWG	16	12	14
Stripping length		mm	9	10	6
Stripping length		in	0.35	0.39	0.2
Required tool			Screwdriver 0.4 x 2.5		

Motor encoder connection

The inverter can optionally be outfitted with a module for motor feedback (motor encoder).

Prefabricated system cables are recommended.

Available modules:

▸ Product extensions, Motor encoder connection 📖 129

Pin assignment of resolver connection

Connection	Connection description	Connection type	Pin	Resolver
X7	Resolver	Sub-D, 9-pole	1	+REF
			2	- REF
			3	n.c.
			4	+COS
			5	-COS
			6	+SIN
			7	-SIN
			8	TEMP+
			9	TEMP-

Pin assignment multi-encoder connection

Connection	Description of connection	Connection type	Pin	Encoder type	
				SinCos	TTL
				incremental	incremental
X8	Encoder	Sub-D 15-pole	1	COS	A
			2	GND	GND
			3	SIN	B
			4	Vcc	Vcc
			5	Z	Z
			6	n.c.	n.c.
			7	TEMP-	TEMP-
			8	n.c.	n.c.
			9	REFCOS	/A
			10	n.c.	n.c.
			11	REFSIN	/B
			12	n.c.	n.c.
			13	/Z	/Z
			14	TEMP+	TEMP+
			15	n.c.	n.c.

Connection	Description of connection	Connection type	Pin	Encoder type		
				HIPERFACE®	SSI encoder	SinCos+SSI
				Absolute	Absolute	Absolute
X8	Encoder	Sub-D 15-pole	1	COS	n.c.	COS
			2	GND	GND	GND
			3	SIN	n.c.	SIN
			4	Vcc	Vcc	Vcc
			5	DATA+	DATA+	DATA+
			6	n.c.	n.c.	n.c.
			7	TEMP-	TEMP-	TEMP-
			8	n.c.	CLOCK+	CLOCK+
			9	REFCOS	n.c.	REFCOS
			10	n.c.	n.c.	n.c.
			11	REFSIN	n.c.	REFSIN
			12	n.c.	n.c.	n.c.
			13	DATA-	DATA-	DATA-
			14	TEMP+	TEMP+	TEMP+
			15	n.c.	CLOCK-	CLOCK-

Load encoder/master encoder connection

The inverter can optionally be outfitted with a module for position feedback. This is used to realize application feedback via a load encoder or master encoder.

Prefabricated system cables are recommended.

Available modules:

The same modules are used for the load encoder/master encoder as for the motor encoder.

▸ Product extensions, Motor encoder connection 🕮 129

Connection of one cable technology (OCT) via HIPERFACE DSL®

Preconditions

- The One Cable Technology is only available in the devices < 22 kW.
- The One Cable Technology (OCT) is possible with MCS and m850 servo motors.
- The motor must be provided with a HIPERFACE DSL® encoder.
- Make sure that no motor encoder module is plugged in slot A.
- Connection cable:
  - The hybrid cable EYP008xxxxxxM11A00 or EYP008xxxxxxM12A00 must be used.
  - Various lengths up to 100 m are available. ▸ System cables 🕮 202

The hybrid cables have only basic insulation to the power electronics.

- The use of One Cable Technology (OCT) depends on the combination of the basic device firmware with the safety firmware:

	Use of One Cable Technology (OCT)							
Basic device firmware	As of V01.06.04	V01.05.03	V01.05.02	V01.04.02	V01.04.01	V01.03.07	V01.02.03	V01.01.03
Safety firmware	As of V01.03.03	V01.02.03	V01.02.03	V01.02.03	V01.02.03	V01.01.01	V01.00.01	-
With device variant								
"Basic Safety - STO"	●	●	●	●	●	●	-	-
"Extended Safety"	●	-	-	-	-	-	-	-

Cable preparation

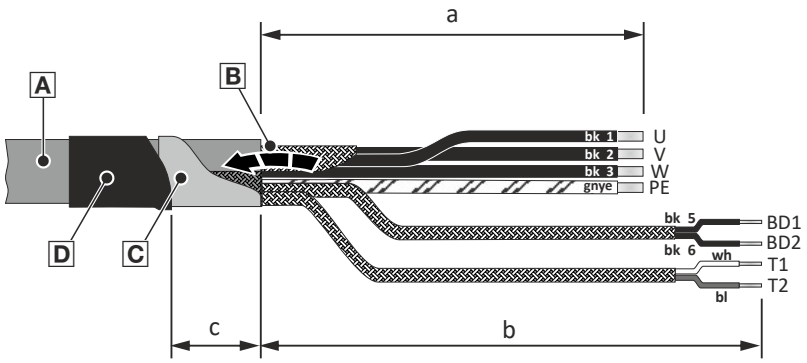


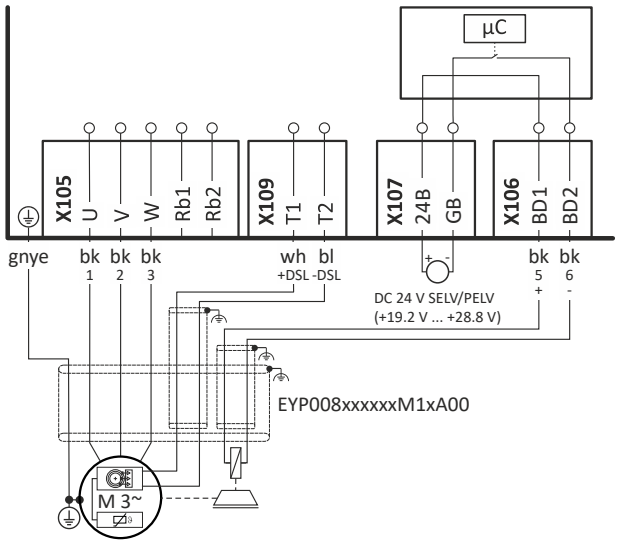
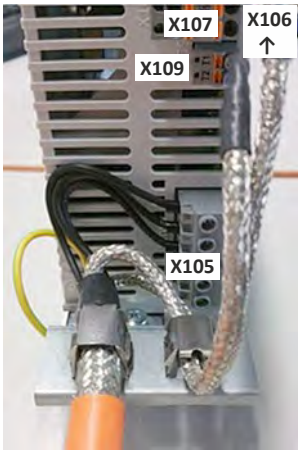
Fig. 7: Cable assembly

A Hybrid cable
B Shield
C Conductive foil
D Heat-shrinkable tube

Inverter			I95AE									
			137D	155D	175D	215D	222C	240C	255C			
				155F	175F		222F	240F		275F	311F	315F
Rated power	P_N	kW	0.37	0.55	0.75	1.5	2.2	4	5.5	7.5	11	15
Rated power	P_N	HP	0.5	0.75	1	2	3	5	7.5	10	15	20
Stripping length	a	mm	100						140			
	b	mm	200						220			
	c	mm	25						30			

Connection diagram and shield connection

Connect all shields with a large surface and fix it with cable ties or fixing clips.

Connection diagram HIPERFACE DSL® (OCT)	Shield connection
	

Networks

When planning networks, please observe the following recommendations for trouble-free operation, especially in the event of Ethernet-based networks.

- Lay communication cables separately from power cables. Maintain as large a distance as possible to the motor cables which are subject to interference.
- To avoid compensating currents via the shielding of the communication cable, install an independent, low-impedance equipotential bonding over the shortest possible distance parallel to the communication cable. This applies in particular to long cables.
- CAT5 cables according to specification establish the shield connection via the RJ45 plug connection. Additional shield connections are not required.
- Cables must comply with CAT5 and be suitable for ≥ 10 Mbps.
- Only certified, tested and fully assembled patch cables from well-known manufacturers are recommended.
- Observe bending radii according to manufacturer information. Minimum bending radii of 10 x cable diameter or 20 x diameter for frequent manipulation of the cables are standard.
- RJ45 plug connections only function properly if they are not subjected to mechanical stress or lateral forces.
- Patch cables of 25 cm length are suitable for the network connection of inverters ≤ 4 kW installed side by side. When wiring from right to left, a sufficient bending radius can be maintained.
- Fix longer cables 30 cm after the connection point.

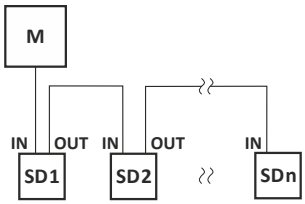
onboard EtherCAT

The standard onboard EtherCAT connection provides EtherCAT as the standard bus system of the i950. Due to the synchronization mechanism, the "distributed clocks" and the short cycle times, it offers excellent real-time properties. This enables highly accurate synchronization of the connected devices.

Typical use:

- Connecting the i950 as Distributed Clocks (DC)-capable EtherCAT slave for process and safety data (FSoE) under a standard EtherCAT motion control
- Connecting the i950 to the EtherCAT system bus.

Typical topologies

Line


M Master
SD Slave Device

Connection description			EtherCAT system bus	
Connection			**X236**	**X237**
Connection type			RJ45	

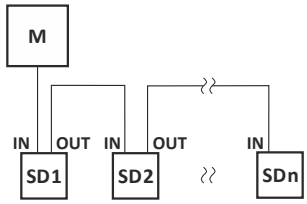
Bus-related information			
Name		onboard EtherCAT	
Communication medium		Ethernet 100 Mbps, full duplex	
Use		Connection as standard EtherCAT slave or connection to EtherCAT system bus	For details see commissioning document, chapter "Configuring the network", subchapter "onboard EtherCAT".
Status display		1 LED (RUN)	
Connection designation		IN: X236 OUT: X237	

Bus-related information			
Designation		On-board EtherCAT	
Communication medium		Ethernet 100 Mbps, full duplex	
Use		Connection of the inverter to the system bus cross communication or as standard EtherCAT slave	
Status display		1 LED (RUN)	
Connection designation		IN: X236 OUT: X237	

Technical data			
Communication profile		EtherCAT	
		CANopen over EtherCAT	
Safety over EtherCAT (FSoE)		Yes	
Vendor ID [hex]		0x3B	
Network topology		Line, tree, star	
Device			
Type		EtherCAT slave	
Max. number		65535	In the entire network
Address		Automatically assigned by the master	
Max. cable length	m	Not limited	The length between the devices is decisive.
Max. cable length between two devices	m	100	
Process data			
Transmit PDOs		0 ... 100 words	200 bytes per direction (Standard and Safety-PDOs)
Receive PDOs		0 ... 100 words	
Cycle time	ms	250 ms, 250 µs, 1 ms and an integer multiple of 1 ms, max. 10 ms	Support of distributed clocks (DC)
Optional EtherCAT functions		FoE (File over EtherCAT) EoE (Ethernet over EtherCAT) Device profile CiA 402	

EtherCAT

Typical topologies

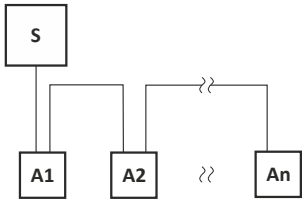
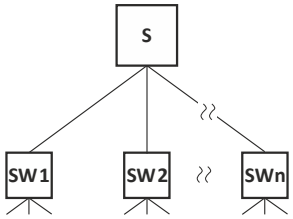
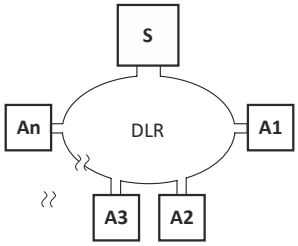
Line


M Master
SD Slave Device

Connection description			EtherCAT	
Connection			X246	X247
Connection type			RJ45	

EtherNet/IP

Typical topologies

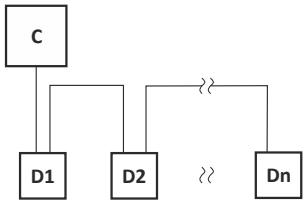
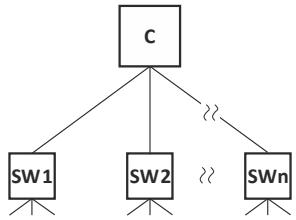
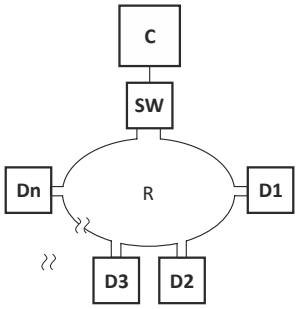
Line	Tree	Ring
		

S Scanner
A Adapter
SW Switch

POWERLINK

PROFINET

Typical topologies

Line	Tree	Ring
		

C	IO controller	SW	Switch SCALANCE (MRP capable)
D	IO device	R	Redundant domain

Connection description			**PROFINET**	
Connection			**X256**	**X257**
Connection type			RJ45	

Functional safety

⚠ DANGER!

Improper installation of the safety engineering system can cause an uncontrolled starting action of the drives.

Possible consequence: Death or severe injuries

- Safety engineering systems may only be installed and commissioned by qualified personnel.
- The complete wiring must be designed in accordance with EMC requirements.
- All control components (switch, relay, PLC, ...) must comply with the requirements of EN ISO 13849−1 and the EN ISO 13849−2.
- Switches, relays with at least IP54 degree of protection.
- Always mount devices with a degree of protection lower than IP54 in control cabinets with a minimum degree of protection of IP54.
- The wiring must be shielded.
- It is essential to use insulated wire end ferrules for wiring.
- All safety-relevant cables outside the control cabinet must be protected, e.g. by means of a cable duct.
- Ensure that no short circuits can occur according to the specifications of the EN ISO 13849−2.
- All further requirements and measures can be obtained from the EN ISO 13849−1 and the EN ISO 13849−2.
- If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!
- For safety-related braking functions, use safety-rated brakes only.
- The user has to ensure that the inverter will only be used in its intended application within the specified environmental conditions. This is the only way to comply with the declared safety-related characteristics.

⚠ DANGER!

Automatic restart if the request of the safety function is deactivated.

Possible consequences: Death or severe injuries

- You must provide external measures according to EN ISO 13849−1 which ensure that the drive only restarts after a confirmation.

NOTICE

Overvoltage

Destruction of the safety component

- Make sure that the maximum voltage (maximum rated) at the safe inputs does not exceed 30 V DC.

NOTICE

Excessively high humidity or condensation

Malfunction or destruction of the safety component

- Only commission the safety component when it has acclimated.

Basic Safety - STO

Basic Safety - STO is part of the product version i95AExxxF1A.

⚠ DANGER!

With the "Safe torque off" (STO) function, no “emergency stop" can be executed according to EN 60204−1 without additional measures. There is no electrical isolation between the motor and inverter and no service switch or maintenance switch!

Possible consequences: Death or severe injuries

▸ "Emergency stop" requires electrical isolation, e. g. via a central mains contactor.

Safe state

When the pulse width modulation of the inverter is switched off by the safety equipment, the motor is rendered free of torque. The inverter switches to the device state "STO active".

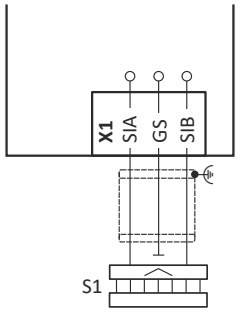
▸ Safe torque off (STO) 🕮 148

Connection diagram

The connection diagrams shown are only example circuits. The user is responsible for the correct safety-related design and selection of the components!

Active sensors

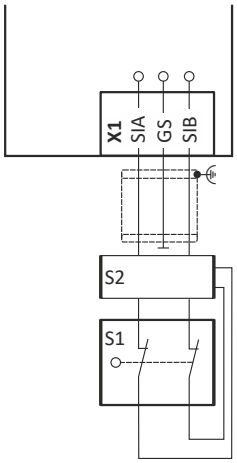
STO



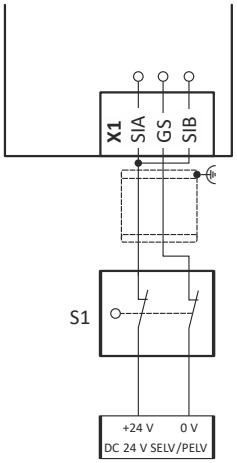
S1 Active sensor - example of lightgrid

Passive sensors

STO



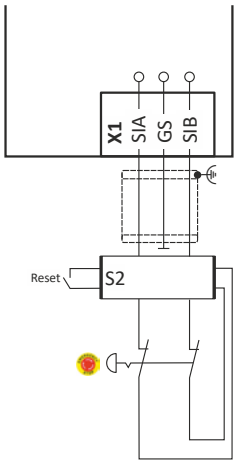
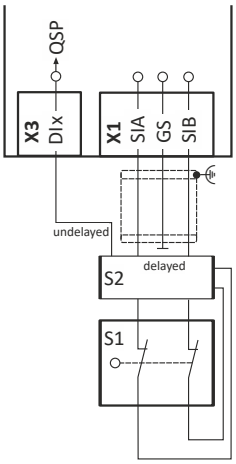
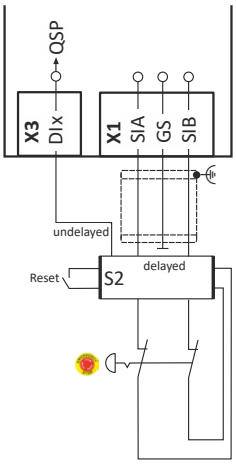
S1 Passive sensor
S2 Safety switching device



External power supply unit or 24 V output of X3

S1 Passive sensor

Passive sensors - further examples

Emergency stop (STO)	SS1c/SS1-t	Emergency stop (SS1c/SS1-t)
		

S2 Safety switching device

S1 Passive sensor
S2 Safety switching device with delayed contacts

S2 Safety switching device with delayed contacts

Terminal data

X1	Specification	Unit	min.	typ.	max.
SIA, SIB	LOW signal	V	-3	0	+5
	HIGH signal	V	+15	+24	+30
	Switch-on time	ms		10	
	Clear time	ms		15	30
	Input current	mA		8	12
	Input peak current	mA		400	
	Input capacitance SIA	µF		5	
	Input capacitance SIB				
	Test pulse duration	ms			1
	Test pulse interval	ms	10		
GS	Reference potential for SIA and SIB				

Runtime = Start of rising edge at SIA, SIB until internal HIGH signal is detected.

Switch-off time = Start of falling edge at SIA, SIB until internal LOW signal is detected.

Connection description			Basic Safety - STO
Connection			**X1**
Connection type			Pluggable
Max. cable cross-section		mm²	1.5
Max. cable cross-section		AWG	16
Stripping length		mm	9
Stripping length		in	0.35
Required tool			Screwdriver 0.4 x 2.5

Extended Safety

Extended safety is part of the product version i950AExxxF1C.

⚠ DANGER!

Loss of the safety function.

A loss of the safety function causes an unsafe condition of the machine. The machine condition cannot be controlled via the safety function.

- Always install the cables S1 and S2 in a protective manner according to EN ISO 13849-2, category 4.

Connection diagram

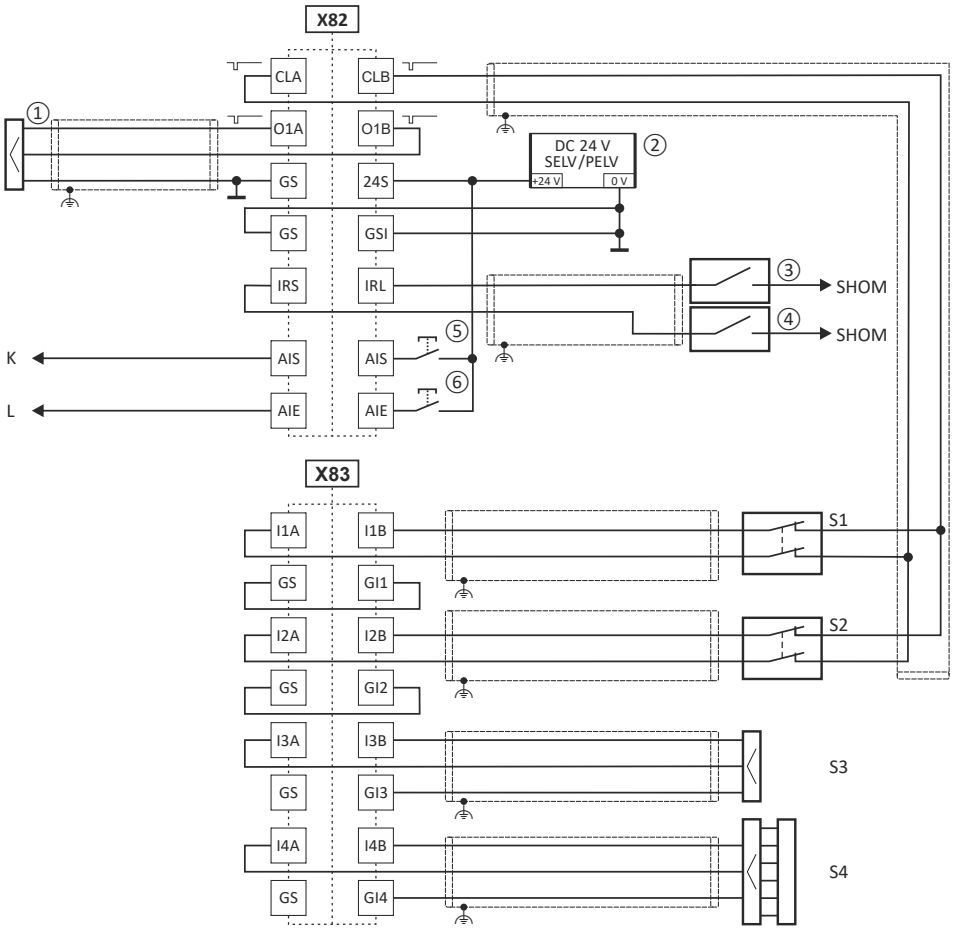


Fig. 8: Sample circuit

Name	Meaning
S1	Passive sensor with channel A and B Protected installation for category 4 according to EN ISO 13849-2 required.
S2	
S3	Active sensor: Higher-level safety controller
S4	Active sensor: Lightgrid
①	Safe output to upstream safety control
②	External 24-V-supply of the safe output and the clock outputs (SELV/PELV)
③	Reference switch; see function "SHOM"
④	Reference switch; see function "SHOM"
⑤	Button for restart acknowledgement
⑥	Button for fault acknowledgement
K	To "AIS" connection of next device
L	To "AIE" connection of next device

Terminal data

X82	Specification	Unit	Min.	Typ.	Max.
CLA, CLB	PLC output, IEC-61131-2, 24 V DC, 50 mA				
	Low signal output voltage	V		0	+0.8
	High signal output voltage	V	+17	+24	+30
	Output current	mA			60
	Cable capacity	nF			100
	Cable resistance of a passive sensor	Ω			200
O1A, O1B	PLC output, IEC-61131-2, 24 V DC				
	Low signal output voltage	V		0	0.8
	High signal output voltage	V	17	24	30
	Output current	mA			500
	Cable capacity	nF			100
	Cable resistance	Ω			200
GS	Reference potential for terminals • CLA, CLB • O1A, O1B • 24S				
24S	Supplies the clock outputs and the safe output via a safely separated power supply unit (SELV/PELV)	V	18	24	30
	Input current	mA			1100
GSI	Reference potential terminals IRS/IRL/AIS/AIE				
IRS IRL AIS AIE	PLC input, IEC-61131-2, 24 V, type 1				
	Low signal input voltage	V	-3	0	5
	High signal input voltage	V	15	24	30
	Input current	mA	2		15
	Input capacitance	nF			3.5
	Input delay (operating time) for AIE and AIS	s	0.3		10
The inputs and outputs must be wired with shielded cables.					

X83	Specification	Unit	Min.	Typ.	Max.
I1A, I1B I2A, I2B I3A, I3B I4A, I4B	PLC input, IEC-61131-2, 24 V, type 1				
	Low signal input voltage	V	-3	0	5
	High signal input voltage	V	15	24	30
	Input current	mA	2		15
	Input capacitance	nF			3.5
	Repeat rate of test pulses	ms	50		
GI1 GI2 GI3 GI4	Reference potential for terminals • I1A ... I4B				
The inputs and outputs must be wired with shielded cables.					

Connection description			SOC	
Connection			**X82**	**X83**
Connection type			Pluggable	Pluggable
Max. cable cross-section		mm²	1.5	1.5
Max. cable cross-section		AWG	16	16
Stripping length		mm	9	9
Stripping length		in	0.35	0.35
Required tool			Screwdriver 0.4 x 2.5	

Technical data

Standards and operating conditions

Conformities and approvals

Conformities			
CE	2006/42/EC		Machinery Directive, only relevant for (permissible) safety components such as encoder or brake
	2014/30/EU		EMC Directive (reference: CE-typical drive system)
EAC	TP TC 020/2011		Eurasian conformity: Electromagnetic compatibility of technical means
	TP TR 004/2011		Eurasian conformity: Safety of low voltage equipment
RoHS	2011/65/EU		Restrictions on the use of certain hazardous substances in electrical and electronic devices
Approvals			
UL	UL 61800-5-1		File No. E132659
			for USA and Canada (requirements of the CSA 22.2 No. 274)

Protection of persons and device protection

Degree of protection			Data applies to operationally ready mounted state and not in wire range of terminals
EN	EN 60529	IP20	
UL	UL 50	Type 1	protection against accidental contact only
	UL 61800-5-1	Open type	Only in UL-approved systems
Insulation resistance			
Overvoltage category	EN 61800-5-1	II	>2000 m amsl
		III	0 … 2000 m amsl
Insulation of control circuits			
	EN 61800-5-1	Safe mains isolation	double/reinforced insulation
Leakage current			
AC	EN 61800-5-1	> 3.5 mA	Please observe regulations and safety instructions!
DC		> 10 mA	
Starting current			
		≤ 3 x rated mains current	
Protective measures			
Earth fault resistance			
Motor stall protection			
Short-circuit strength			
Overvoltage resistance			
Overtemperature of motor			PTC or thermal contact, I^2xt monitoring

EMC data

Operation on public supply systems			The machine or system manufacturer is responsible for compliance with the requirements for the machine/system!
> 1 kW, mains current ≤ 16 A	EN 61000-3-2	no additional measures	
< 1kW		with mains choke	
Mains current > 16 A	EN 61000-3-12	With mains choke or mains filter	When designed for rated power.
Noise emission			
Category C1	EN 61800-3		See rated data
Category C2			
Category C3			
Noise immunity			
	EN 61800-3	Requirements fulfilled	

Motor connection

Requirements for the shielded motor cable			
Capacitance per unit length		< 150/300 pF/m	C core-core/C core-shield ≤ 4 mm² / AWG 12
		< 75/150 pF/m	C core-core/C core-shield ≤ 2.5 mm² / AWG 14
Electric strength		Uo/U = 0.6/1.0 kV	U = r.m.s. value from external conductor to external conductor
			Uo = r.m.s. value external conductor to PE
	UL	U ≥ 600 V	U = r.m.s. value from external conductor to external conductor

Environmental conditions

Energy efficiency			
High Efficiency	EN 50598-2	Class IE2	
Climate			
Storage	EN 60721-3-1	1K3 (-25 ... +60°C)	
Transport	EN 60721-3-2	2K3 (-25 ... +70°C)	
Operation	EN 60721-3-3	3K3 (-10 ... +55°C)	Operation at a switching frequency of 2 or 4 kHz: Above +45°C: reduce rated output current by 2.5 %/°C
			Operation at a switching frequency of 8 or 16 kHz: Above +40°C: reduce rated output current by 2.5 %/°C
Site altitude			
0 … 1000 m amsl			
1000 … 4000 m amsl			Reduce rated output current by 5 %/1000 m
Pollution			
	EN 61800-5-1	Degree of pollution 2	
	UL 61800-5-1		
Vibration resistance			
Transport	EN 60721-3-2	2M2 (sine, shock)	in original packaging
Operation	EN 61800-5-1	Amplitude 0.075 mm	10 ... 57 Hz
		acceleration resistant up to 1 g	57 ... 150 Hz
	German Lloyd	Amplitude ±1 mm	5 ... 13.2 Hz
		acceleration resistant up to 0.7 g	13.2 ... 100 Hz
			up to 15 kW

Electrical supply conditions

Power systems			
IT			Apply the measures described for IT systems!
			IT systems not relevant for UL-approved systems
TN			Voltage to earth: max. 300 V
TT			

The connection to different supply forms enables a worldwide application of the inverters.

The following is supported:

- 1-phase mains connection 230/240 V 📖 82
- 3-phase mains connection 230/240 V 📖 87
- 3-phase mains connection 400 V 📖 94
- 3-phase mains connection 480 V 📖 102

Certification of the integrated safety

The certification of the integrated safety is based on these test fundamentals:

- EN ISO 13849−1: Safety of machinery − safety-related parts of control systems − Part 1
- EN ISO 13849−2: Safety of machinery − safety-related parts of control systems − Part 2
- EN 60204−1: Safety of machinery − electrical equipment of machines − Part 1
- EN 61508, Part 1−7: Safety of machineryFunctional safety of electrical/electronic/ programmable electronic safety-related systems
- EN 61800−3: Electric variable-speed drives − Part 3: EMC requirements including specific test procedures
- EN 61800−5−1: Adjustable speed electrical power drive systems − Part 5−1: Safety requirements − electrical, thermal and energy requirements
- EN 61800−5−2: Adjustable speed electrical power drive systems − Part 5−2: Safety requirements − functional safety
- EN 62061: Safety of machinery − functional safety of safety-related electrical/electronic/ programmable electronic systems

Declarations of Conformity and certificates can be found on the internet:

www.Lenze.com

1-phase mains connection 230/240 V

Rated data

These inverters do not have an integrated RFI filter in the AC mains supply.

In order to meet the EMC requirements according to EN 61800−3, an external EMC filter according to IEC EN 60939 must be used.

The user must verify that the conformity with EN 61800−3 is fulfilled.

Inverter			i950-C0.37/230-2	i950-C0.55/230-2	i950-C0.75/230-2	i950-C1.5/230-2
Rated power	**P_{rated}**	**kW**	**0.37**	**0.55**	**0.75**	**1.5**
Rated power	**P_{rated}**	**hp**	**0.5**	**0.75**	**1**	**2**
Mains voltage range			1/PE AC 170 V ... 264 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 230/240 V			
Rated mains current						
without mains choke		A	5.7	7.6	10	-
with mains choke		A	4.8	7.1	8.8	13.9
Apparent output power		kVA	0.9	1.2	1.6	2.6
Rated output current						
2 kHz		A	2.4	3.2	4.2	7
4 kHz		A	2.4	3.2	4.2	7
8 kHz		A	2.4	3.2	4.2	7
16 kHz		A	1.6	2.1	2.8	4.7
Power loss						
2 kHz		W	34	39	48	73
4 kHz		W	35	42	53	81
8 kHz		W	40	47	61	98
16 kHz		W	40	47	61	98
Overcurrent cycle 180 s						
Max. output current		A	3.6	4.8	6.3	10.5
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	1.8	2.4	3.2	5.3
Overcurrent cycle 15 s						
Max. output current		A	4.8	6.4	8.4	14
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	1.8	2.4	3.2	5.3
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	3.9			12
Min. brake resistance		Ω	100			33
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	50			
Max. motor cable length unshielded						
without EMC category		m	-			

Fusing data

A residual current device (RCD) is optional.

Fusing data for UL/NEC compliant installations: ▸ Fusing data 46

Inverter	Fuse			Circuit breaker			RCD	
	Max. SCCR	Characteristic	Max. rated current	Max. SCCR	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
i950-C0.37/230-2		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.55/230-2		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.75/230-2		gG/gL, gRL	16		B	10	≥30	Typ B
i950-C1.5/230-2		gG/gL, gRL	16		B	16	≥30	Typ B

The connection data according to UL can be found under: ▸ Connection according to UL 44

Terminal data

Rated power	P_{rated}	kW	0.37 ... 1.5
Connection description			**Mains connection**
Connection			**X100**
Connection type			Pluggable
Max. cable cross-section		mm²	2.5
Max. cable cross-section		AWG	12
Stripping length		mm	8
Stripping length		in	0.3
Tightening torque		Nm	0.5
Tightening torque		lb-in	4.4
Required tool			Screwdriver 0.5 x 3.0

Rated power	P_{rated}	kW	0.37 ... 1.5
Connection description			**PE connection**
Connection			**PE screw**
Max. cable cross-section		mm²	6
Max. cable cross-section		AWG	10
Stripping length		mm	10
Stripping length		in	0.4
Tightening torque		Nm	2
Tightening torque		lb-in	18
Required tool			Torx key 20

Rated power	P_{rated}	kW	0.37 ... 1.5
Connection description			**Motor connection**
Connection			**X105**
Connection type			Pluggable
Max. cable cross-section		mm²	2.5
Max. cable cross-section		AWG	12
Stripping length		mm	8
Stripping length		in	0.3
Tightening torque		Nm	0.5
Tightening torque		lb-in	4.4
Required tool			Screwdriver 0.5 x 3.0

The terminal data for the terminal X1 can be found under: ▸ Basic Safety - STO 🕮 74

The terminal data for the terminals X82 and X83 can be found under: ▸ Terminal data 🕮 78

Brake resistors

Inverter	Brake resistor					
	Order code	Rated resistance	Rated power	Thermal capacity	Dimensions (H x W x D)	Weight
		Ω	W	kWs	mm	kg
i950-C0.37/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.37/230-2	ERBM100R100W	100	100	15	235 x 20.6 x 40	0.37
i950-C0.55/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.55/230-2	ERBM100R150W	100	150	22.5	238 x 80 x 59	0.54
i950-C0.75/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.75/230-2	ERBM100R150W	100	150	22.5	238 x 80 x 59	0.54
i950-C1.5/230-2	ERBP033R200W	33	200	30	240 x 42 x 122	1.0
i950-C1.5/230-2	ERBP033R300W	33	300	45	320 x 42 x 122	1.4

Mains chokes

Inverter	Netzdrossel					
	Order code	No. of phases	Rated current	Inductance	Dimensions (H x W x D)	Weight
			A	mH	mm	kg
i950-C0.37/230-2	ELN1-0900H005	1	5.0	9.000	82 x 66 x 75	1.1
i950-C0.55/230-2	ELN1-0500H009		9	5.000		
i950-C0.75/230-2						
i950-C1.5/230-2	ELN1-0250H018		18	2.500	90 x 96 x 96	2.1

RFI filters / Mains filters

Basic information on RFI filters, mains filters and EMC: 📖 198

Short distance filter

- Filter type: RFI filter
- Operation with 300 mA residual current circuit breaker (type F or B)

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg			m
i950-C0.37/230-2	I0FAE222B100S0000S	22.5	346 x 60 x 50	1.4	-	-	50
i950-C0.55/230-2	I0FAE222B100S0000S	22.5	346 x 60 x 50	1.4	-	-	50
i950-C0.75/230-2	I0FAE222B100S0000S	22.5	346 x 60 x 50	1.4	-	-	50
i950-C1.5/230-2	I0FAE222B100S0000S	22.5	346 x 60 x 50	1.4	-	-	50

Long distance filter

- Filter type: RFI filter
- Operation with 300 mA residual current circuit breaker (type F or B)

3-phase mains connection 230/240 V

Rated data

These inverters do not have an integrated RFI filter in the AC mains supply.

In order to meet the EMC requirements according to EN 61800−3, an external EMC filter according to IEC EN 60939 must be used.

The user must verify that the conformity with EN 61800−3 is fulfilled.

Technical data

3-phase mains connection 230/240 V
Rated data

Inverter			i950-C0.37/230-2	i950-C0.55/230-2	i950-C0.75/230-2	i950-C1.5/230-2
Rated power	**P_{rated}**	**kW**	**0.37**	**0.55**	**0.75**	**1.5**
Rated power	**P_{rated}**	**hp**	**0.5**	**0.75**	**1**	**2**
Mains voltage range			3/PE AC 195 V ... 264 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 230/240 V			
Rated mains current						
without mains choke		A	3.9	4.8	6.4	9.5
with mains choke		A	3	3.8	5.1	6.8
Apparent output power		kVA	0.9	1.2	1.6	2.6
Rated output current						
2 kHz		A	2.4	3.2	4.2	7
4 kHz		A	2.4	3.2	4.2	7
8 kHz		A	2.4	3.2	4.2	7
16 kHz		A	1.6	2.1	2.8	4.7
Power loss						
2 kHz		W	34	39	48	73
4 kHz		W	35	42	53	81
8 kHz		W	40	47	61	98
16 kHz		W	40	47	61	98
Overcurrent cycle 180 s						
Max. output current		A	3.6	4.8	6.3	10.5
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	1.8	2.4	3.2	5.3
Overcurrent cycle 15 s						
Max. output current		A	4.8	6.4	8.4	14
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	1.8	2.4	3.2	5.3
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	3.9			12
Min. brake resistance		Ω	100			33
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	50			
Max. motor cable length unshielded						
without EMC category		m	-			

Inverter			**i950-C2.2/230-3**	**i950-C4.0/230-3**	**i950-C5.5/230-3**
Rated power	**P_{rated}**	**kW**	**2.2**	**4**	**5.5**
Rated power	**P_{rated}**	**hp**	**3**	**5**	**7.5**
Mains voltage range			3/PE AC 195 V ... 264 V, 45 Hz ... 65 Hz		
Output voltage			3 AC 0 - 230/240 V		
Rated mains current					
without mains choke		A	-	20.6	28.8
with mains choke		A	9.8	15.7	21.9
Apparent output power		kVA	3.6	6.2	8.7
Rated output current					
2 kHz		A	9.6	16.5	23
4 kHz		A	9.6	16.5	23
8 kHz		A	9.6	16.5	23
16 kHz		A	6.4	11	15.3
Power loss					
2 kHz		W	96	151	207
4 kHz		W	107	172	235
8 kHz		W	130	211	293
16 kHz		W	130	211	293
Overcurrent cycle 180 s					
Max. output current		A	14.4	24.8	34.5
Overload time	T_1	s	60	60	60
Recovery time	T_2	s	120	120	120
Max. output current during the recovery time		A	7.2	12.4	17.3
Overcurrent cycle 15 s					
Max. output current		A	19.2	33	46
Overload time	T_1	s	3	3	3
Recovery time	T_2	s	12	12	12
Max. output current during the recovery time		A	7.2	12.4	17.3
Cyclic mains switching			3 times per minute		
Brake chopper					
Max. output current		A	12	29	
Min. brake resistance		Ω	33	13.5	
Max. motor cable length shielded					
without EMC category		m	50	100	
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-		
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	-		
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	50		
Max. motor cable length unshielded					
without EMC category		m	-		

Fusing data

A residual current device (RCD) is optional.

Fusing data for UL/NEC compliant installations: ▸ Fusing data 📖 46

Inverter	Fuse			Circuit breaker			RCD	
	Max. SCCR	Characteristic	Max. rated current	Max. SCCR	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
i950-C0.37/230-2		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.55/230-2		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.75/230-2		gG/gL, gRL	16		B	10	≥30	Typ B
i950-C1.5/230-2		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C2.2/230-3		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C4.0/230-3		gG/gL, gRL	50		B	50	≥300	Typ B
i950-C5.5/230-3		gG/gL, gRL	50		B	50	≥300	Typ B

The connection data according to UL can be found under: ▸ Connection according to UL 📖 44

Terminal data

Rated power	P_{rated}	kW	0.37 ... 2.2	4 ... 5.5
Connection description			**Mains connection**	
Connection			**X100**	
Connection type			Pluggable	
Max. cable cross-section		mm²	2.5	16
Max. cable cross-section		AWG	12	6
Stripping length		mm	8	14
Stripping length		in	0.3	0.55
Tightening torque		Nm	0.5	1.8
Tightening torque		lb-in	4.4	16
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0

Rated power	P_{rated}	kW	0.37 ... 2.2	4 ... 5.5
Connection description			**PE connection**	
Connection			**PE screw**	
Max. cable cross-section		mm²	6	16
Max. cable cross-section		AWG	10	6
Stripping length		mm	10	11
Stripping length		in	0.4	0.4
Tightening torque		Nm	2	3.4
Tightening torque		lb-in	18	30
Required tool			Torx key 20	Crosstip screwdriver PZ2

Rated power	P_{rated}	kW	0.37 ... 2.2	4 ... 5.5
Connection description			**Motor connection**	
Connection			**X105**	
Connection type			Pluggable	
Max. cable cross-section		mm²	2.5	16
Max. cable cross-section		AWG	12	6
Stripping length		mm	8	14
Stripping length		in	0.3	0.55
Tightening torque		Nm	0.5	1.8
Tightening torque		lb-in	4.4	16
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0

The terminal data for the terminal X1 can be found under: ▸ Basic Safety - STO 🕮 74

The terminal data for the terminals X82 and X83 can be found under: ▸ Terminal data 🕮 78

Brake resistors

Inverter	Brake resistor					
	Order code	Rated resistance	Rated power	Thermal capacity	Dimensions (H x W x D)	Weight
		Ω	W	kWs	mm	kg
i950-C0.37/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.37/230-2	ERBM100R100W	100	100	15	235 x 20.6 x 40	0.37
i950-C0.55/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.55/230-2	ERBM100R150W	100	150	22.5	238 x 80 x 59	0.54
i950-C0.75/230-2	ERBM100R086W	100	86	3.4	110 x 80 x 28	0.49
i950-C0.75/230-2	ERBM100R150W	100	150	22.5	238 x 80 x 59	0.54
i950-C1.5/230-2	ERBP033R200W	33	200	30	240 x 42 x 122	1.0
i950-C1.5/230-2	ERBP033R300W	33	300	45	320 x 42 x 122	1.4
i950-C2.2/230-3	ERBP033R200W	33	200	30	240 x 42 x 122	1.0
i950-C2.2/230-3	ERBP033R300W	33	300	45	320 x 42 x 122	1.4
i950-C4.0/230-3	ERBS015R800W	15	800	120	710 x 114 x 105	4.0
i950-C4.0/230-3	ERBS015R01K2	15	1200	180	1020 x 114 x 105	5.6
i950-C5.5/230-3	ERBS015R800W	15	800	120	710 x 114 x 105	4.0
i950-C5.5/230-3	ERBS015R01K2	15	1200	180	1020 x 114 x 105	5.6

Mains chokes

Inverter	Netzdrossel					
	Order code	No. of phases	Rated current	Inductance	Dimensions (H x W x D)	Weight
			A	mH	mm	kg
i950-C0.37/230-2	EZAELN3004B742	3	4	7.350	60 x 80 x 116	1.31
i950-C0.55/230-2						
i950-C0.75/230-2	EZAELN3006B492		6	4.900	69 x 80 x 117	1.45
i950-C1.5/230-2	EZAELN3008B372		8	3.680	85 x 120 x 135	1.90
i950-C2.2/230-3	EZAELN3010B292		10	2.940		2.00
i950-C4.0/230-3	EZAELN3016B182		16	1.840	95 x 120 x 135	2.70
i950-C5.5/230-3	EZAELN3025B122		25	1.180	110 x 155 x 167	5.80

RFI filters / Mains filters

Basic information on RFI filters, mains filters and EMV: 📖 198

Short distance filter

- Filter type: RFI filter
- Operation with 300 mA residual current circuit breaker (Type B)
- Up to 2.2 kW: Operation with 30-mA residual current circuit breaker (type B SK) possible.
  Type B SK: All-current sensitive with special properties, with high insensitivity to high-frequency currents (no fire protection)

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg			m
i950-C0.37/230-2	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	-	-	50
i950-C0.55/230-2	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	-	-	50
i950-C0.75/230-2	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	-	-	50

Long distance filter

- Filter type: RFI filter
- Operation with 300 mA residual current circuit breaker (Type B)

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg			m
i950-C1.5/230-2	I0FAE240F100D0000S	12.5	346 x 60 x 50	1.35	-	-	50
i950-C2.2/230-3	I0FAE240F100D0000S	12.5	346 x 60 x 50	1.35	-	-	50
i950-C4.0/230-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	-	-	50
i950-C5.5/230-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	-	-	50

3-phase mains connection 400 V

Rated data

Inverter			i950-C0.55/400-3	i950-C0.75/400-3	i950-C2.2/400-3	i950-C4.0/400-3
Rated power	**P_{rated}**	**kW**	**0.55**	**0.75**	**2.2**	**4**
Rated power	**P_{rated}**	**hp**	**0.75**	**1**	**3**	**5**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	2.5	3.3	7.8	12.5
with mains choke		A	2	2.6	5.3	9
Apparent output power		kVA	1.2	1.6	3.8	6.4
Rated output current						
2 kHz		A	1.8	2.4	5.6	9.5
4 kHz		A	1.8	2.4	5.6	9.5
8 kHz		A	1.8	2.4	5.6	7.1
16 kHz		A	1.2	1.6	2.6	2.9
Power loss						
2 kHz		W	33	39	71	111
4 kHz		W	34	41	75	117
8 kHz		W	40	49	94	149
16 kHz		W	40	49	94	149
Overcurrent cycle 180 s						
Max. output current		A	2.7	3.6	8.4	14.3
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	1.4	1.8	4.2	7.1
Overcurrent cycle 15 s						
Max. output current		A	3.6	4.8	11.2	19
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	1.4	1.8	4.2	7.1
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	2		5.2	16.6
Min. brake resistance		Ω	390		150	47
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	-			

Inverter			**i950-C7.5/400-3**	**i950-C11/400-3**	**i950-C15/400-3**	**i950-C22/400-3**
Rated power	**P_{rated}**	**kW**	**7.5**	**11**	**15**	**22**
Rated power	**P_{rated}**	**hp**	**10**	**15**	**20**	**30**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	20	28.4	-	
with mains choke		A	15.7	22.3	28.8	42
Apparent output power		kVA	11	16	22	32
Rated output current						
2 kHz		A	16.5	23.5	32	47
4 kHz		A	16.5	23.5	32	47
8 kHz		A	16.5	23.5		47
16 kHz		A	11	12	11	31.3
Power loss						
2 kHz		W	186	256	342	505
4 kHz		W	197	272	363	536
8 kHz		W	252	351	471	694
16 kHz		W	252	351	471	694
Overcurrent cycle 180 s						
Max. output current		A	25	35	48	71
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	12.4	17.6	24	35
Overcurrent cycle 15 s						
Max. output current		A	33	47	64	94
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	12.4	17.6	24	35
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	29		43	52
Min. brake resistance		Ω	27		18	15
Max. motor cable length shielded						
without EMC category		m	100			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	-			

Technical data

3-phase mains connection 400 V
Rated data

Inverter			i950-C30/400-3	i950-C45/400-3	i950-C55/400-3	i950-C75/400-3
Rated power	**P_{rated}**	**kW**	**30**	**45**	**55**	**75**
Rated power	**P_{rated}**	**hp**	**40**	**60**	**75**	**100**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	-			
with mains choke		A	54.9	80	99	135
Apparent output power		kVA	41	60	75	100
Rated output current						
2 kHz		A	61	89	110	150
4 kHz		A	61	89	110	150
8 kHz		A	61	89	110	150
16 kHz		A	40.6	59.3	76.6	95
Power loss						
2 kHz		W	653	934	1151	1553
4 kHz		W	694	994	1224	1654
8 kHz		W	898	1292	1593	2157
16 kHz		W	898	1292	1593	2157
Overcurrent cycle 180 s						
Max. output current		A	92	134	165	225
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	46	67	83	113
Overcurrent cycle 15 s						
Max. output current		A	122	178	220	300
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	46	67	83	113
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	104		166	
Min. brake resistance		Ω	7.5		4.7	
Max. motor cable length shielded						
without EMC category		m	100		200	
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35		100	
Max. motor cable length unshielded						
without EMC category		m	-			

Inverter			**i950-C90/400-3**	**i950-C110/400-3**
Rated power	**P_{rated}**	**kW**	**90**	**110**
Rated power	**P_{rated}**	**hp**	**125**	**150**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz	
Output voltage			3 AC 0 - 400/480 V	
Rated mains current				
without mains choke		A	-	
with mains choke		A	168	198
Apparent output power		kVA	121	142
Rated output current				
2 kHz		A	180	212
4 kHz		A	180	212
8 kHz		A	162	191
16 kHz		A	99	106
Power loss				
2 kHz		W	1855	2177
4 kHz		W	1975	2319
8 kHz		W	2326	2731
16 kHz		W	2326	2731
Overcurrent cycle 180 s				
Max. output current		A	270	318
Overload time	T_1	s	60	60
Recovery time	T_2	s	120	120
Max. output current during the recovery time		A	135	159
Overcurrent cycle 15 s				
Max. output current		A	360	424
Overload time	T_1	s	3	3
Recovery time	T_2	s	12	12
Max. output current during the recovery time		A	135	159
Cyclic mains switching			3 times per minute	
Brake chopper				
Max. output current		A	275	
Min. brake resistance		Ω	2.4	
Max. motor cable length shielded				
without EMC category		m	200	
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-	
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20	
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	100	
Max. motor cable length unshielded				
without EMC category		m	-	

Fusing data

A residual current device (RCD) is optional.

Fusing data for UL/NEC compliant installations: ▸ Fusing data 📖 46

Inverter	Fuse			Circuit breaker			RCD	
	Max. SCCR	Characteristic	Max. rated current	Max. SCCR	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
i950-C0.55/400-3		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.75/400-3		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C2.2/400-3		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C4.0/400-3		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C7.5/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C11/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C15/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C22/400-3		gG/gL, gRL	63		B	63	≥300	Typ B
i950-C30/400-3		gG/gL, gRL	80		B	125	≥300	Typ B
i950-C45/400-3		gG/gL, gRL	125		B	125	≥300	Typ B
i950-C55/400-3		gR	160		B	160	≥300	Typ B
i950-C75/400-3		gR	160		B	160	≥300	Typ B
i950-C90/400-3		gR	300		B	300	≥300	Typ B
i950-C110/400-3		gR	300		B	300	≥300	Typ B

The connection data according to UL can be found under: ▸ Connection according to UL 📖 44

Terminal data

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22	30 ... 45	55 ... 75	90 ... 110
Connection description			**Mains connection**					
Connection			**X100**					
Connection type			Pluggable		Non-pluggable			
Max. cable cross-section		mm²	2.5	16	35	50	95	150
Max. cable cross-section		AWG	12	6	2	1/0	4/0	-
Stripping length		mm	8	14	18	19	22	28
Stripping length		in	0.3	0.55	0.7	0.75	0.87	1.1
Tightening torque		Nm	0.5	1.8	3.8	4	10	18
Tightening torque		lb-in	4.4	16	34	35	89	160
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0	Screwdriver 0.8 x 5.5	Hex key 5.0	Hex key 6.0	Hex key 8.0

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22 ... 75	90 ... 110
Connection description			**PE connection**			
Connection			**PE**			
Max. cable cross-section		mm²	6	16	25	150
Max. cable cross-section		AWG	10	6	2	-
Stripping length		mm	10	11	16	-
Stripping length		in	0.4	0.4	0.6	-
Tightening torque		Nm	2	3.4	4	10
Tightening torque		lb-in	18	30	35	89
Required tool			Torx key 20	Crosstip screwdriver PZ2		Wrench size 13

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22	30 ... 45	55 ... 75	90 ... 110
Connection description			**Motor connection**					
Connection			**X105**					
Connection type			Pluggable		Non-pluggable			
Max. cable cross-section		mm²	2.5	16	35	50	95	150
Max. cable cross-section		AWG	12	6	2	1/0	4/0	-
Stripping length		mm	8	14	18	19	22	28
Stripping length		in	0.3	0.55	0.7	0.75	0.87	1.1
Tightening torque		Nm	0.5	1.8	3.8	4	10	18
Tightening torque		lb-in	4.4	16	34	35	89	160
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0	Screwdriver 0.8 x 5.5	Hex key 5.0	Hex key 6.0	Hex key 8.0

The terminal data for the terminal X1 can be found under: ▸ Basic Safety - STO 🕮 74

The terminal data for the terminals X82 and X83 can be found under: ▸ Terminal data 🕮 78

Brake resistors

Inverter	Brake resistor					
	Order code	Rated resistance	Rated power	Thermal capacity	Dimensions (H x W x D)	Weight
		Ω	W	kWs	mm	kg
i950-C0.55/400-3	ERBM390R100W	390	100	15	235 x 20.6 x 40	0.37
i950-C0.75/400-3	ERBM390R100W	390	100	15	235 x 20.6 x 40	0.37
i950-C2.2/400-3	ERBP180R200W	180	200	30	240 x 42 x 122	1.0
i950-C2.2/400-3	ERBS180R350WNQN000	180	350	53	382 x 124 x 122	2.1
i950-C4.0/400-3	ERBM047R135W	47	135	6.3	216 x 80 x 28	0.67
i950-C4.0/400-3	ERBS047R400W	47	400	60	400 x 114 x 105	2.3
i950-C4.0/400-3	ERBS047R800W	47	800	120	710 x 114 x 105	4.0
i950-C7.5/400-3	ERBP027R200W	27	200	30	240 x 42 x 122	1.0
i950-C7.5/400-3	ERBS027R600W	27	600.00	90	550 x 114 x 105	3.1
i950-C7.5/400-3	ERBS027R01K4	27	1400	210	1110 x 114 x 105	6.3
i950-C11/400-3	ERBS027R600W	27	600.00	90	550 x 114 x 105	3.1
i950-C11/400-3	ERBS027R01K2	27	1200.00	180	1020 x 114 x 105	5.6
i950-C11/400-3	ERBS027R01K4	27	1400	210	1110 x 114 x 105	6.3
i950-C15/400-3	ERBP018R300W	18	300	45	320 x 42 x 122	1.4
i950-C15/400-3	ERBS018R01K4	18	1400	210	1110 x 114 x 105	6.3
i950-C15/400-3	ERBG018R04K3	18	4300	645	302 x 486 x 426	13.5
i950-C22/400-3	ERBS015R800W	15	800	120	710 x 114 x 105	4.0
i950-C22/400-3	ERBS015R02K4	15	2400	360	1020 x 204 x 105	10
i950-C22/400-3	ERBG015R06K2	15	6200	930	302 x 486 x 526	17.0
i950-C30/400-3	ERBG075D01K9	7.5	1900	285	302 x 486 x 236	9.5
i950-C45/400-3	ERBG075D01K9	7.5	1900	285	302 x 486 x 236	9.5
i950-C55/400-3	ERBG005R02K6	5	2600	390	302 x 486 x 326	11.0
i950-C75/400-3	ERBG005R02K6	5	2600	390	302 x 486 x 326	11.0
i950-C90/400-3	ERBG028D04K1	2.8	4100	615	302 x 486 x 426	12.8
i950-C110/400-3	ERBG028D04K1	2.8	4100	615	302 x 486 x 426	12.8

Mains chokes

Inverter	Netzdrossel					
	Order code	No. of phases	Rated current	Inductance	Dimensions (H x W x D)	Weight
			A	mH	mm	kg
i950-C0.55/400-3	EZAELN3002B153	3	2	14.700	56 x 74 x 116	0.53
i950-C0.75/400-3	EZAELN3004B742		4	7.350	60 x 80 x 116	1.31
i950-C2.2/400-3	EZAELN3006B492		6	4.900	69 x 80 x 117	1.45
i950-C4.0/400-3	EZAELN3010B292		10	2.940	85 x 120 x 135	2.00
i950-C7.5/400-3	EZAELN3016B182		16	1.840	95 x 120 x 135	2.70
i950-C11/400-3	EZAELN3025B122		25	1.180	110 x 155 x 167	5.80
i950-C15/400-3	EZAELN3030B981		30	0.980		5.85
i950-C22/400-3	EZAELN3045B651		45	0.650	112 x 185 x 196	8.25
i950-C30/400-3	EZAELN3063B471		63	0.470	117 x 210 x 241	9.65
i950-C45/400-3	EZAELN3080B371		80	0.370	125 x 210 x 238	12.5
i950-C55/400-3	EZAELN3100B301		100	0.300	173 x 267 x 200	16.3
i950-C75/400-3	EZAELN3160B191		160	0.190	189 x 291 x 210	22.1
i950-C90/400-3	EZAELN3180B171		180	0.170	164 x 316 x 235	26.0
i950-C110/400-3	EZAELN3200B151		200	0.150	194 x 352 x 260	25.0

RFI filters / Mains filters

Basic information on RFI filters, mains filters and EMC: 198

RFI filters/mains filters can be used both in the side structure and in the substructure.

Short distance filter

- Filter type: RFI filter
- Reduced leakage current, operation on 30-mA residual current circuit breaker possible
- To reduce the mains and capacitor current (service life), the i950-C15/400-3 must be equipped with a mains choke in addition to the RFI filter.

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg	m	m	
i950-C0.55/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C0.75/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C2.2/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C7.5/400-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	25	50	-
i950-C11/400-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	25	50	-
i950-C15/400-3	I0FAE318F100D0000S	50.4	436 x 202 x 90	7.1	25	25	-

Long distance filter

- Filter type up to 15 kW: RFI filter
- Filter type from 22 kW: Mains filter (combination of RFI filter and mains choke)
- Operation with 300 mA residual current circuit breaker

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg	m	m	
i950-C0.55/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C0.75/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C2.2/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C4.0/400-3	I0FAE240F100D0000S	12.5	346 x 60 x 50	1.35	50	50	-
i950-C7.5/400-3	I0FAE311F100D0000S	29	371 x 120 x 60	2.5	50	100	-
i950-C11/400-3	I0FAE311F100D0000S	29	371 x 120 x 60	2.5	50	100	-
i950-C15/400-3	I0FAE318F100D0000S	50.4	436 x 202 x 90	7.1	50	100	-
i950-C22/400-3	I0FAE322F100D0000S	43	436 x 205 x 90	7.1	50	100	-
i950-C30/400-3	I0FAE330F100D0000S	55	590 x 250 x 105	23	50	100	-
i950-C45/400-3	I0FAE345F100D0001S	100	590 x 250 x 105	32	50	100	-

3-phase mains connection 480 V

Rated data

Inverter			i950-C0.55/400-3	i950-C0.75/400-3	i950-C2.2/400-3	i950-C4.0/400-3
Rated power	**P_{rated}**	**kW**	**0.55**	**0.75**	**2.2**	**4**
Rated power	**P_{rated}**	**hp**	**0.75**	**1**	**3**	**5**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	2.1	2.8	6.5	10.5
with mains choke		A	1.7	2.2	4.4	7.5
Apparent output power		kVA	1.2	1.6	3.8	6.4
Rated output current						
2 kHz		A	1.6	2.1	4.8	8.2
4 kHz		A	1.6	2.1	4.8	8.2
8 kHz		A	1.6	2.1	4.8	6.2
16 kHz		A	1.1	1.4	2.2	2.5
Power loss						
2 kHz		W	33	39	71	111
4 kHz		W	34	41	75	117
8 kHz		W	40	49	94	149
16 kHz		W	40	49	94	149
Overcurrent cycle 180 s						
Max. output current		A	2.4	3.2	7.2	12.3
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	1.2	1.6	3.6	6.2
Overcurrent cycle 15 s						
Max. output current		A	3.2	4.2	9.6	16.4
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	1.2	1.6	3.6	6.2
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	2		5.2	16.6
Min. brake resistance		Ω	390		150	47
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	-			

Inverter			**i950-C7.5/400-3**	**i950-C11/400-3**	**i950-C15/400-3**	**i950-C22/400-3**
Rated power	**P_{rated}**	**kW**	**7.5**	**11**	**15**	**22**
Rated power	**P_{rated}**	**hp**	**10**	**15**	**20**	**30**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	16.6	23.7	-	47.4
with mains choke		A	13.1	18.6	24	35.3
Apparent output power		kVA	11	16	22	32
Rated output current						
2 kHz		A	14	21	27	40.4
4 kHz		A	14	21	27	40.4
8 kHz		A	14	21	19.8	40.4
16 kHz		A	7.8		7.2	26.9
Power loss						
2 kHz		W	186	256	342	505
4 kHz		W	197	272	363	536
8 kHz		W	252	351	471	694
16 kHz		W	252	351	471	694
Overcurrent cycle 180 s						
Max. output current		A	21	31.5	40.5	61
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	10.5	15.8	20.3	30
Overcurrent cycle 15 s						
Max. output current		A	28	42	54	81
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	10.5	15.8	20.3	30
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	29		43	52
Min. brake resistance		Ω	27		18	15
Max. motor cable length shielded						
without EMC category		m	100			
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	-			

Technical data

3-phase mains connection 480 V
Rated data

Inverter			i950-C30/400-3	i950-C45/400-3	i950-C55/400-3	i950-C75/400-3
Rated power	P_{rated}	**kW**	**30**	**45**	**55**	**75**
Rated power	P_{rated}	**hp**	**40**	**60**	**75**	**100**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	-			
with mains choke		A	45.7	66.7	83	113
Apparent output power		kVA	41	60	75	100
Rated output current						
2 kHz		A	52	77	96	124
4 kHz		A	52	77	96	124
8 kHz		A	52	77	96	124
16 kHz		A	34.6	51.3	66.8	78.5
Power loss						
2 kHz		W	653	934	1151	1553
4 kHz		W	694	994	1224	1654
8 kHz		W	898	1292	1593	2157
16 kHz		W	898	1292	1593	2157
Overcurrent cycle 180 s						
Max. output current		A	78	116	144	186
Overload time	T_1	s	60	60	60	60
Recovery time	T_2	s	120	120	120	120
Max. output current during the recovery time		A	39	58	72	93
Overcurrent cycle 15 s						
Max. output current		A	104	154	192	248
Overload time	T_1	s	3	3	3	3
Recovery time	T_2	s	12	12	12	12
Max. output current during the recovery time		A	39	58	72	93
Cyclic mains switching			3 times per minute			
Brake chopper						
Max. output current		A	104		166	
Min. brake resistance		Ω	7.5		4.7	
Max. motor cable length shielded						
without EMC category		m	100		200	
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-			
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20			
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	35		100	
Max. motor cable length unshielded						
without EMC category		m	-			

Inverter			**i950-C90/400-3**	**i950-C110/400-3**
Rated power	**P_{rated}**	**kW**	**90**	**110**
Rated power	**P_{rated}**	**hp**	**125**	**150**
Mains voltage range			3/PE AC 340 V ... 528 V, 45 Hz ... 65 Hz	
Output voltage			3 AC 0 - 400/480 V	
Rated mains current				
without mains choke		A	-	
with mains choke		A	146	168
Apparent output power		kVA	121	142
Rated output current				
2 kHz		A	156	180
4 kHz		A	156	180
8 kHz		A	140	162
16 kHz		A	85.8	90
Power loss				
2 kHz		W	1855	2177
4 kHz		W	1975	2319
8 kHz		W	2326	2731
16 kHz		W	2326	2731
Overcurrent cycle 180 s				
Max. output current		A	234	270
Overload time	T_1	s	60	60
Recovery time	T_2	s	120	120
Max. output current during the recovery time		A	117	135
Overcurrent cycle 15 s				
Max. output current		A	312	360
Overload time	T_1	s	3	3
Recovery time	T_2	s	12	12
Max. output current during the recovery time		A	117	135
Cyclic mains switching			3 times per minute	
Brake chopper				
Max. output current		A	275	
Min. brake resistance		Ω	2.4	
Max. motor cable length shielded				
without EMC category		m	200	
Category C1 (2 kHz, 4 kHz, 8 kHz)		m	-	
Category C2 (2 kHz, 4 kHz, 8 kHz)		m	20	
Category C3 (2 kHz, 4 kHz, 8 kHz)		m	100	
Max. motor cable length unshielded				
without EMC category		m	-	

Fusing data

A residual current device (RCD) is optional.

Fusing data for UL/NEC compliant installations: ▸ Fusing data 📖 46

Inverter	Fuse			Circuit breaker			RCD	
	Max. SCCR	Characteristic	Max. rated current	Max. SCCR	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
i950-C0.55/400-3		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C0.75/400-3		gG/gL, gRL	10		B	10	≥30	Typ B
i950-C2.2/400-3		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C4.0/400-3		gG/gL, gRL	16		B	16	≥30	Typ B
i950-C7.5/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C11/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C15/400-3		gG/gL, gRL	50		B	50	≥30	Typ B
i950-C22/400-3		gG/gL, gRL	63		B	63	≥300	Typ B
i950-C30/400-3		gG/gL, gRL	80		B	125	≥300	Typ B
i950-C45/400-3		gG/gL, gRL	125		B	125	≥300	Typ B
i950-C55/400-3		gR	160		B	160	≥300	Typ B
i950-C75/400-3		gR	160		B	160	≥300	Typ B
i950-C90/400-3		gR	300		B	300	≥300	Typ B
i950-C110/400-3		gR	300		B	300	≥300	Typ B

The connection data according to UL can be found under: ▸ Connection according to UL 📖 44

Terminal data

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22	30 ... 45	55 ... 75	90 ... 110
Connection description			**Mains connection**					
Connection			**X100**					
Connection type			Pluggable		Non-pluggable			
Max. cable cross-section		mm²	2.5	16	35	50	95	150
Max. cable cross-section		AWG	12	6	2	1/0	4/0	-
Stripping length		mm	8	14	18	19	22	28
Stripping length		in	0.3	0.55	0.7	0.75	0.87	1.1
Tightening torque		Nm	0.5	1.8	3.8	4	10	18
Tightening torque		lb-in	4.4	16	34	35	89	160
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0	Screwdriver 0.8 x 5.5	Hex key 5.0	Hex key 6.0	Hex key 8.0

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22 ... 75	90 ... 110
Connection description			**PE connection**			
Connection			**PE**			
Max. cable cross-section		mm²	6	16	25	150
Max. cable cross-section		AWG	10	6	2	-
Stripping length		mm	10	11	16	-
Stripping length		in	0.4	0.4	0.6	-
Tightening torque		Nm	2	3.4	4	10
Tightening torque		lb-in	18	30	35	89
Required tool			Torx key 20	Crosstip screwdriver PZ2		Wrench size 13

Rated power	P_{rated}	kW	0.55 ... 4	7.5 ... 15	22	30 ... 45	55 ... 75	90 ... 110
Connection description			**Motor connection**					
Connection			**X105**					
Connection type			Pluggable		Non-pluggable			
Max. cable cross-section		mm²	2.5	16	35	50	95	150
Max. cable cross-section		AWG	12	6	2	1/0	4/0	-
Stripping length		mm	8	14	18	19	22	28
Stripping length		in	0.3	0.55	0.7	0.75	0.87	1.1
Tightening torque		Nm	0.5	1.8	3.8	4	10	18
Tightening torque		lb-in	4.4	16	34	35	89	160
Required tool			Screwdriver 0.5 x 3.0	Screwdriver 0.8 x 4.0	Screwdriver 0.8 x 5.5	Hex key 5.0	Hex key 6.0	Hex key 8.0

The terminal data for the terminal X1 can be found under: ▸ Basic Safety - STO 🕮 74

The terminal data for the terminals X82 and X83 can be found under: ▸ Terminal data 🕮 78

Brake resistors

Inverter	Brake resistor					
	Order code	Rated resistance	Rated power	Thermal capacity	Dimensions (H x W x D)	Weight
		Ω	W	kWs	mm	kg
i950-C0.55/400-3	ERBM390R100W	390	100	15	235 x 20.6 x 40	0.37
i950-C0.75/400-3	ERBM390R100W	390	100	15	235 x 20.6 x 40	0.37
i950-C2.2/400-3	ERBP180R200W	180	200	30	240 x 42 x 122	1.0
i950-C2.2/400-3	ERBS180R350WNQN000	180	350	53	382 x 124 x 122	2.1
i950-C4.0/400-3	ERBM047R135W	47	135	6.3	216 x 80 x 28	0.67
i950-C4.0/400-3	ERBS047R400W	47	400	60	400 x 114 x 105	2.3
i950-C4.0/400-3	ERBS047R800W	47	800	120	710 x 114 x 105	4.0
i950-C7.5/400-3	ERBP027R200W	27	200	30	240 x 42 x 122	1.0
i950-C7.5/400-3	ERBS027R600W	27	600.00	90	550 x 114 x 105	3.1
i950-C7.5/400-3	ERBS027R01K4	27	1400	210	1110 x 114 x 105	6.3
i950-C11/400-3	ERBS027R600W	27	600.00	90	550 x 114 x 105	3.1
i950-C11/400-3	ERBS027R01K2	27	1200.00	180	1020 x 114 x 105	5.6
i950-C11/400-3	ERBS027R01K4	27	1400	210	1110 x 114 x 105	6.3
i950-C15/400-3	ERBP018R300W	18	300	45	320 x 42 x 122	1.4
i950-C15/400-3	ERBS018R01K4	18	1400	210	1110 x 114 x 105	6.3
i950-C15/400-3	ERBG018R04K3	18	4300	645	302 x 486 x 426	13.5
i950-C22/400-3	ERBS015R800W	15	800	120	710 x 114 x 105	4.0
i950-C22/400-3	ERBS015R02K4	15	2400	360	1020 x 204 x 105	10
i950-C22/400-3	ERBG015R06K2	15	6200	930	302 x 486 x 526	17.0
i950-C30/400-3	ERBG075D01K9	7.5	1900	285	302 x 486 x 236	9.5
i950-C45/400-3	ERBG075D01K9	7.5	1900	285	302 x 486 x 236	9.5
i950-C55/400-3	ERBG005R02K6	5	2600	390	302 x 486 x 326	11.0
i950-C75/400-3	ERBG005R02K6	5	2600	390	302 x 486 x 326	11.0
i950-C90/400-3	ERBG028D04K1	2.8	4100	615	302 x 486 x 426	12.8
i950-C110/400-3	ERBG028D04K1	2.8	4100	615	302 x 486 x 426	12.8

Mains chokes

Inverter	Netzdrossel					
	Order code	No. of phases	Rated current	Inductance	Dimensions (H x W x D)	Weight
			A	mH	mm	kg
i950-C0.55/400-3	EZAELN3002B153	3	2	14.700	56 x 74 x 116	0.53
i950-C0.75/400-3	EZAELN3004B742		4	7.350	60 x 80 x 116	1.31
i950-C2.2/400-3	EZAELN3006B492		6	4.900	69 x 80 x 117	1.45
i950-C4.0/400-3	EZAELN3008B372		8	3.680	85 x 120 x 135	1.90
i950-C7.5/400-3	EZAELN3016B182		16	1.840	95 x 120 x 135	2.70
i950-C11/400-3	EZAELN3020B152		20	1.470	95 x 155 x 162	3.80
i950-C15/400-3	EZAELN3025B122		25	1.180	110 x 155 x 167	5.80
i950-C22/400-3	EZAELN3040B741		40	0.740	102 x 185 x 195	6.80
i950-C30/400-3	EZAELN3050B591		50	0.590	112 x 185 x 207	8.35
i950-C45/400-3	EZAELN3080B371		80	0.370	125 x 210 x 238	12.5
i950-C55/400-3	EZAELN3090B331		90	0.330	149 x 267 x 200	10.95
i950-C75/400-3	EZAELN3125B241		125	0.240	179 x 291 x 210	17.1
i950-C90/400-3	EZAELN3160B191		160	0.190	189 x 291 x 210	22.1
i950-C110/400-3	EZAELN3180B171		180	0.170	164 x 316 x 235	26.0

RFI filters / Mains filters

Basic information on RFI filters, mains filters and EMC: 📖 198

RFI filters/mains filters can be used both in the side structure and in the substructure.

Short distance filter

- Filter type: RFI filter
- Reduced leakage current, operation on 30-mA residual current circuit breaker possible
- To reduce the mains and capacitor current (service life), the i950-C15/400-3 must be equipped with a mains choke in addition to the RFI filter.

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg	m	m	
i950-C0.55/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C0.75/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C2.2/400-3	I0FAE222F100S0000S	7.8	346 x 60 x 50	1.1	25	50	-
i950-C7.5/400-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	25	50	-
i950-C11/400-3	I0FAE311F100S0000S	29	371 x 120 x 60	2.5	25	50	-
i950-C15/400-3	I0FAE318F100D0000S	50.4	436 x 202 x 90	7.1	25	25	-

Long Distance filter

- Filter type up to 15 kW: RFI filter
- Filter type from 22 kW: Mains filter (combination of RFI filter and mains choke)
- Operation with 300 mA residual current circuit breaker

Inverter	Filter				Max. motor cable length shielded		
	Order code	Rated current	Dimensions (H x W x D)	Weight	C1	C2	C3
		A	mm	kg	m	m	
i950-C0.55/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C0.75/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C2.2/400-3	I0FAE222F100D0000S	7.8	346 x 60 x 50	1.1	50	50	-
i950-C4.0/400-3	I0FAE240F100D0000S	12.5	346 x 60 x 50	1.35	50	50	-
i950-C7.5/400-3	I0FAE311F100D0000S	29	371 x 120 x 60	2.5	50	100	-
i950-C11/400-3	I0FAE311F100D0000S	29	371 x 120 x 60	2.5	50	100	-
i950-C15/400-3	I0FAE318F100D0000S	50.4	436 x 202 x 90	7.1	50	100	-
i950-C22/400-3	I0FAE322F100D0000S	43	436 x 205 x 90	7.1	50	100	-
i950-C30/400-3	I0FAE330F100D0000S	55	590 x 250 x 105	23	50	100	-
i950-C45/400-3	I0FAE345F100D0001S	100	590 x 250 x 105	32	50	100	-

Ecodesign regulation

Product information acc. to REGULATION (EU) 2019/1781 (ANNEX I, Section 4)

Legend

Operating point (f; I)	f = relative motor stator frequency; I = relative torque-producing current
Power losses	The power losses at the operating points (f; I) and in the standby state refer to the rated apparent output power. The power losses for options (e.g. for diagnostics) and for accessories (e.g. mains chokes) can be found in the additional product documentation on the Internet.

Performance losses										
0; 25	f; I	%	2.9	2.5	1.6	1.1	1.0	1.2	0.8	4.2
0; 50	f; I	%	2.9	2.5	1.7	1.2	1.1	1.3	1.0	4.2
0; 100	f; I	%	3.1	2.7	2.0	1.5	1.5	1.7	1.5	4.5
50; 25	f; I	%	2.9	2.5	1.6	1.2	1.1	1.2	0.9	4.3
50; 50	f; I	%	3.0	2.6	1.8	1.3	1.3	1.4	1.1	4.3
50; 100	f; I	%	3.3	2.9	2.2	1.7	1.7	2.0	1.8	4.6
90; 50	f; I	%	3.1	2.7	1.9	1.4	1.4	1.5	1.2	4.4
90; 100	f; I	%	3.4	3.1	2.4	2.0	2.1	2.2	2.0	4.8
In standby mode		%	1.5	1.3	0.9	0.5	0.3	0.2	0.2	1.3
Efficiency level			IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2
Manufacturer			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY							
Commercial register number			Hannover HRB 204803							
Model identifier of the product			I95AE137D	I95AE155D	I95AE175D	I95AE215D	I95AE222C	I95AE240C	I95AE255C	I95AE155F
Apparent output power		kVA	0.9	1.2	1.6	2.6	3.6	6.2	8.7	1.2
Indicative rated output power of the motor		kW	0.37	0.55	0.75	1.5	2.2	4	5.5	0.55
Rated output current		A	2.4	3.2	4.2	7	9.6	16.5	23	1.8
Maximum operating temperature		°C	45							
Rated input frequency		Hz	50							
Rated input voltage		V	230							400
Switching frequency		kHz	4							
Rated apparent output power		kVA	0.977	1.19	1.71	3.3	4.44	7.38	9.95	1.19

Performance losses										
0; 25	f; l	%	2.5	1.3	1.3	0.8	0.6	0.7	0.6	0.6
0; 50	f; l	%	2.7	1.5	1.4	0.9	0.8	0.9	0.8	0.8
0; 100	f; l	%	2.9	1.8	1.8	1.3	1.1	1.4	1.2	1.2
50; 25	f; l	%	2.6	1.4	1.3	0.8	0.7	0.7	0.6	0.6
50; 50	f; l	%	2.7	1.6	1.5	1.0	0.8	0.9	0.8	0.8
50; 100	f; l	%	3.1	2.0	1.9	1.5	1.3	1.5	1.4	1.4
90; 50	f; l	%	2.8	1.7	1.6	1.1	0.9	1.0	0.9	0.9
90; 100	f; l	%	3.2	2.4	2.1	1.7	1.6	1.8	1.6	1.7
In standby mode		%	0.9	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Efficiency level			IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2
Manufacturer			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY							
Commercial register number			Hannover HRB 204803							
Model identifier of the product			I95AE175F	I95AE222F	I95AE240F	I95AE275F	I95AE311F	I95AE315F	I95AE322F	I95AE330F
Apparent output power		kVA	1.6	3.8	6.4	11	16	22	32	41
Indicative rated output power of the motor		kW	0.75	2.2	4	7.5	11	15	22	30
Rated output current		A	2.4	5.6	9.5	16.5	23.5	32	47	61
Maximum operating temperature		°C	45							
Rated input frequency		Hz	50							
Rated input voltage		V	400							
Switching frequency		kHz	4							
Rated apparent output power		kVA	1.71	4.44	7.38	14.4	19.5	23.9	38.2	47

Performance losses							
0; 25	f; I	%	0.5	0.5	0.5	0.5	0.4
0; 50	f; I	%	0.7	0.6	0.7	0.7	0.5
0; 100	f; I	%	1.2	1.1	1.2	1.3	1.0
50; 25	f; I	%	0.5	0.5	0.6	0.6	0.4
50; 50	f; I	%	0.7	0.7	0.8	0.8	0.6
50; 100	f; I	%	1.3	1.2	1.5	1.5	1.2
90; 50	f; I	%	0.8	0.8	0.9	0.9	0.7
90; 100	f; I	%	1.6	1.5	1.9	1.8	1.5
In standby mode		%	0.1	0.0	0.0	0.0	0.0
Efficiency level			IE2	IE2	IE2	IE2	IE2
Manufacturer			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY				
Commercial register number			Hannover HRB 204803				
Model identifier of the product			I95AE345F	I95AE355F	I95AE375F	I95AE390F	I95AE411F
Apparent output power		kVA	60	75	100	121	142
Indicative rated output power of the motor		kW	45	55	75	90	110
Rated output current		A	89	110	150	180	212
Maximum operating temperature		°C	45				
Rated input frequency		Hz	50				
Rated input voltage		V	400				
Switching frequency		kHz	4				2
Rated apparent output power		kVA	68.4	92.8	111	135	162

Data of control connections

Digital inputs

X3: DI1, DI2, DI3, DI4 / GI			
Switching type		Positive/negative logic (parameterizable)	
Use case 1		Standard digital input	
Use case 2		Touch probe input	Maximum of 8 markers per ms detectable with a temporal resolution of 10 ns.
Switching level PNP			
LOW	V	< + 5	IEC 61131-2, type 1
HIGH	V	> + 15	
Input resistance	kΩ	4.6	
Sampling frequency of digital inputs	kHz	4	When used as standard digital input.
	MHz	100	When used as touch probe.
External-voltage protection	V	± 30	

Digital outputs

X3: DO1 / 24O / GO			
Switching level			
LOW	V	< + 5	IEC 61131-2, type 1
HIGH	V	> + 15	
Max. output current, DO1	mA	50	
Cycle time	ms	0.25	
Short-circuit strength		No time limit	
External-voltage protection	V	± 30	
Suppressor circuit		Integrated varistor	
Overload behavior		Voltage reduction or switching off and on periodically	
Time response	µs	250	LOW - HIGH / HIGH - LOW
Reset or switch-on behavior		Output is switched off	LOW

Analog inputs

X3: AI1+ / AI1-			
Sampling frequency	kHz	4	
Resolution of A/D converter	Bit	10	
Operation as voltage input			
Connection designation		X3/AI1+, X3/AI1-	
Input voltage DC	V	0 … 10	
Input resistance	kΩ	> 100	
Accuracy	mV	± 100	Typical
Input voltage in case of open circuit	V	- 0.2 … 0.2	Display "0"
Electric strength of external voltage	V	± 30	
Operation as current input			
Connection designation		X3/AI1+, X3/AI1-	
Input current	mA	0 … 20	
		4 … 20	Open-circuit monitored
Accuracy	mA	± 0.4	Typical
Input current in case of open circuit	mA	2	
Input resistance	Ω	250	
Electric strength of external voltage	V	± 7.5	

24-V input

X5: 24E / GE			
Used for...		Input for mains-independent DC supply of the control electronics (incl. communication)	
Input voltage DC			
Typical	V	24	IEC 61131-2
Area	V	19.2 … 28.8	
Input power			
Typical	W	20	
Max.	W	45	Depending on the use and state of inputs and outputs.
Input current			
Typical	A	0.8	
Max.	A	2	When switching on for 50 ms
Capacity to be charged	µF	5500	
Polarity reversal protection		When polarity is reversed: No function and no irreparable damage.	
Suppression of voltage pulses		Suppressor diode 30 V, bidirectional	
Power supply unit		SELV/PELV	Externally to create a mains-independent DC supply.
Max. current	A	12.0	While looping-through.

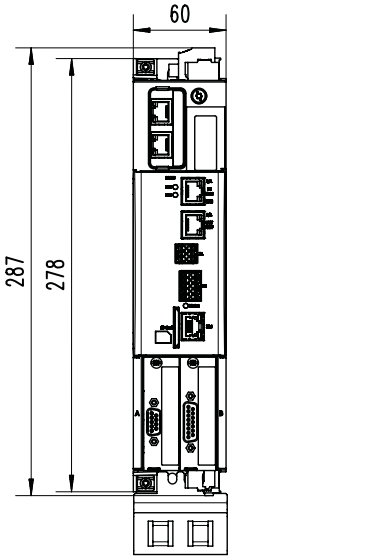
Dimensions

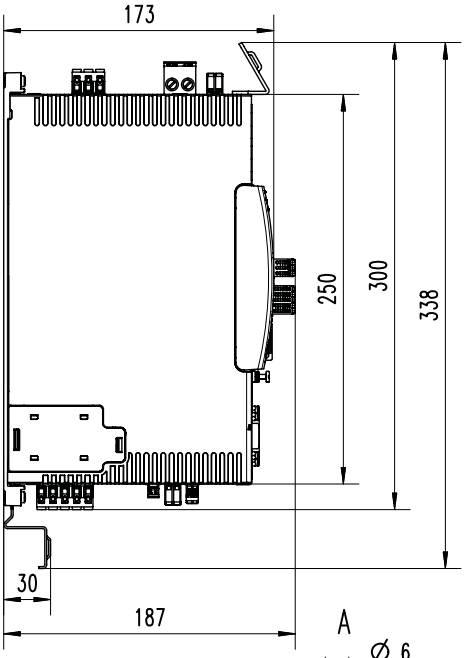
The specified installation clearances are minimum dimensions to ensure a sufficient air circulation for cooling purposes. They do not consider the bend radiuses of the connecting cables.

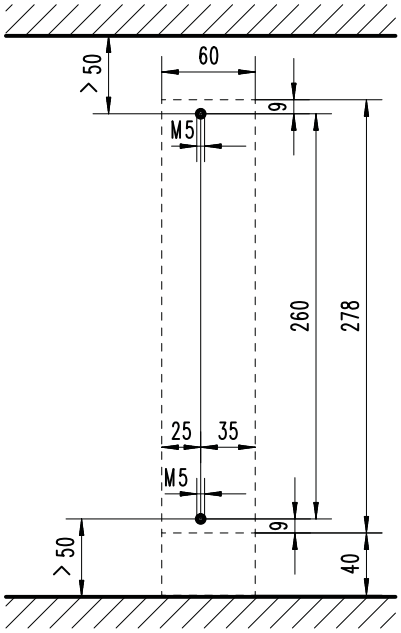
0.37 kW ... 4 kW

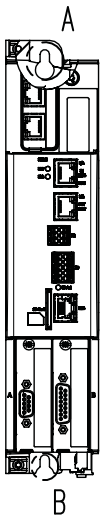
The dimensions in mm apply to:

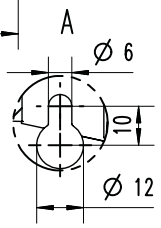
0.37 kW	i950-C0.37/230-2		
0.55 kW	i950-C0.55/230-2		i950-C0.55/400-3
0.75 kW	i950-C0.75/230-2		i950-C0.75/400-3
1.5 kW	i950-C1.5/230-2		
2.2 kW		i950-C2.2/230-3	i950-C2.2/400-3
4 kW			i950-C4.0/400-3
Weight	1.6 kg	1.6 kg	1.6 kg

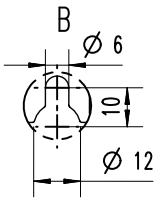










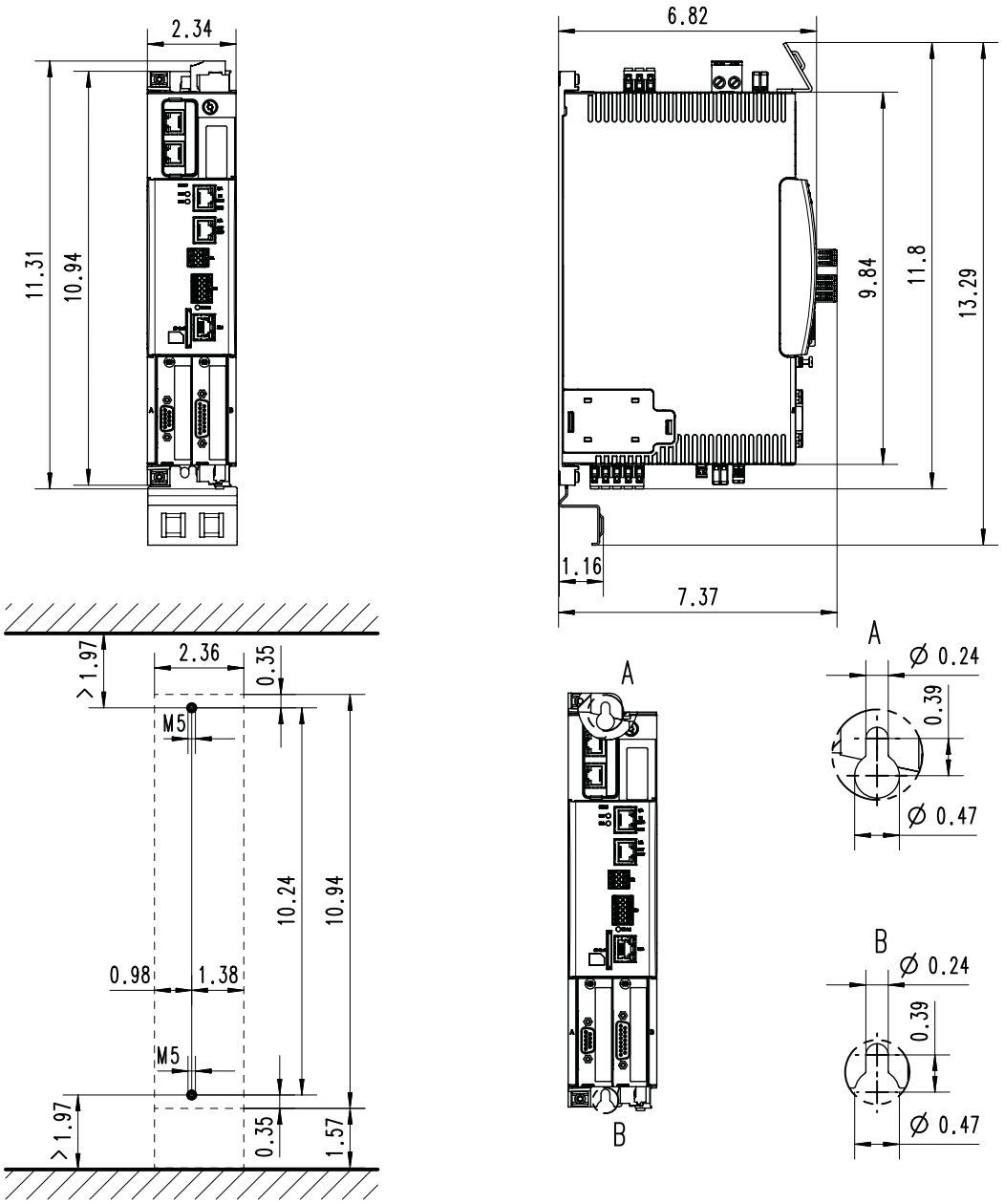


8800508

0.5 hp ... 5 hp

The dimensions in inch apply to:

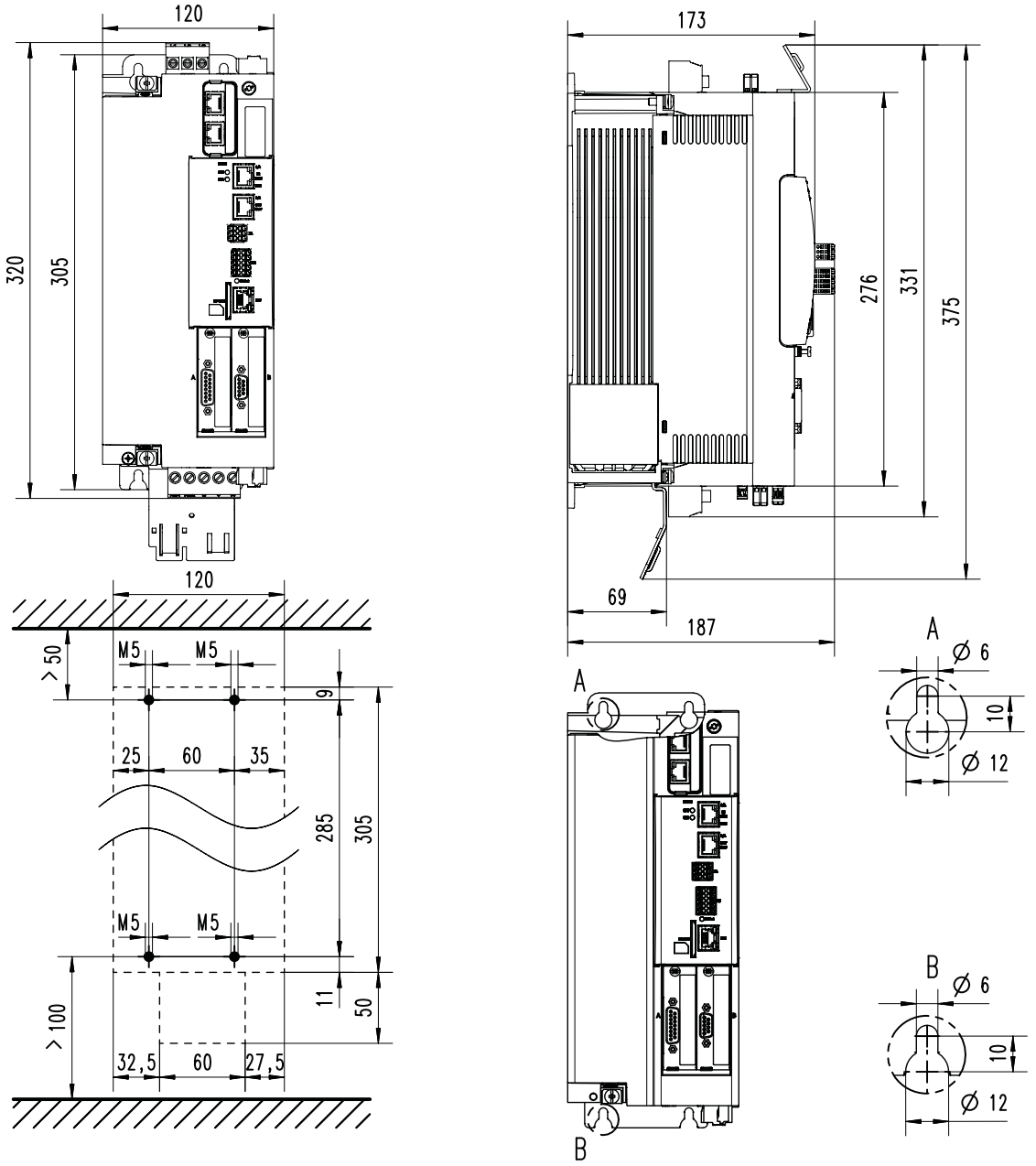
0.5 hp	i950-C0.37/230-2		
0.75 hp	i950-C0.55/230-2		i950-C0.55/400-3
1 hp	i950-C0.75/230-2		i950-C0.75/400-3
2 hp	i950-C1.5/230-2		
3 hp		i950-C2.2/230-3	i950-C2.2/400-3
5 hp			i950-C4.0/400-3
Weight	3.5 lb	3.5 lb	3.5 lb



4 kW ... 15 kW

The dimensions in mm apply to:

4 kW	i950-C4.0/230-3	
5.5 kW	i950-C5.5/230-3	
7.5 kW		i950-C7.5/400-3
11 kW		i950-C11/400-3
15 kW		i950-C15/400-3
Weight	3.9 kg	3.9 kg

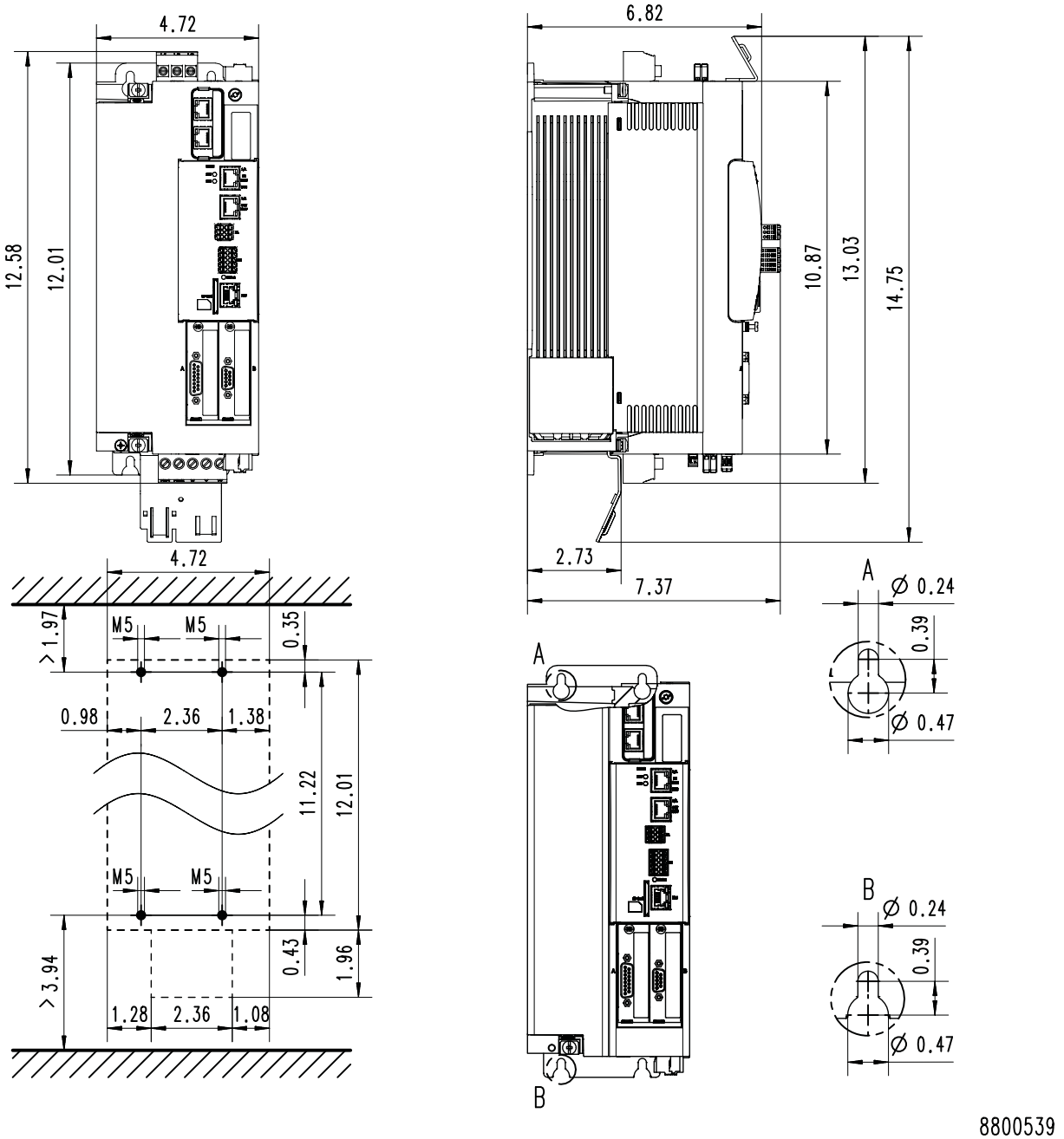


8800509

5 hp ... 20 hp

The dimensions in inch apply to:

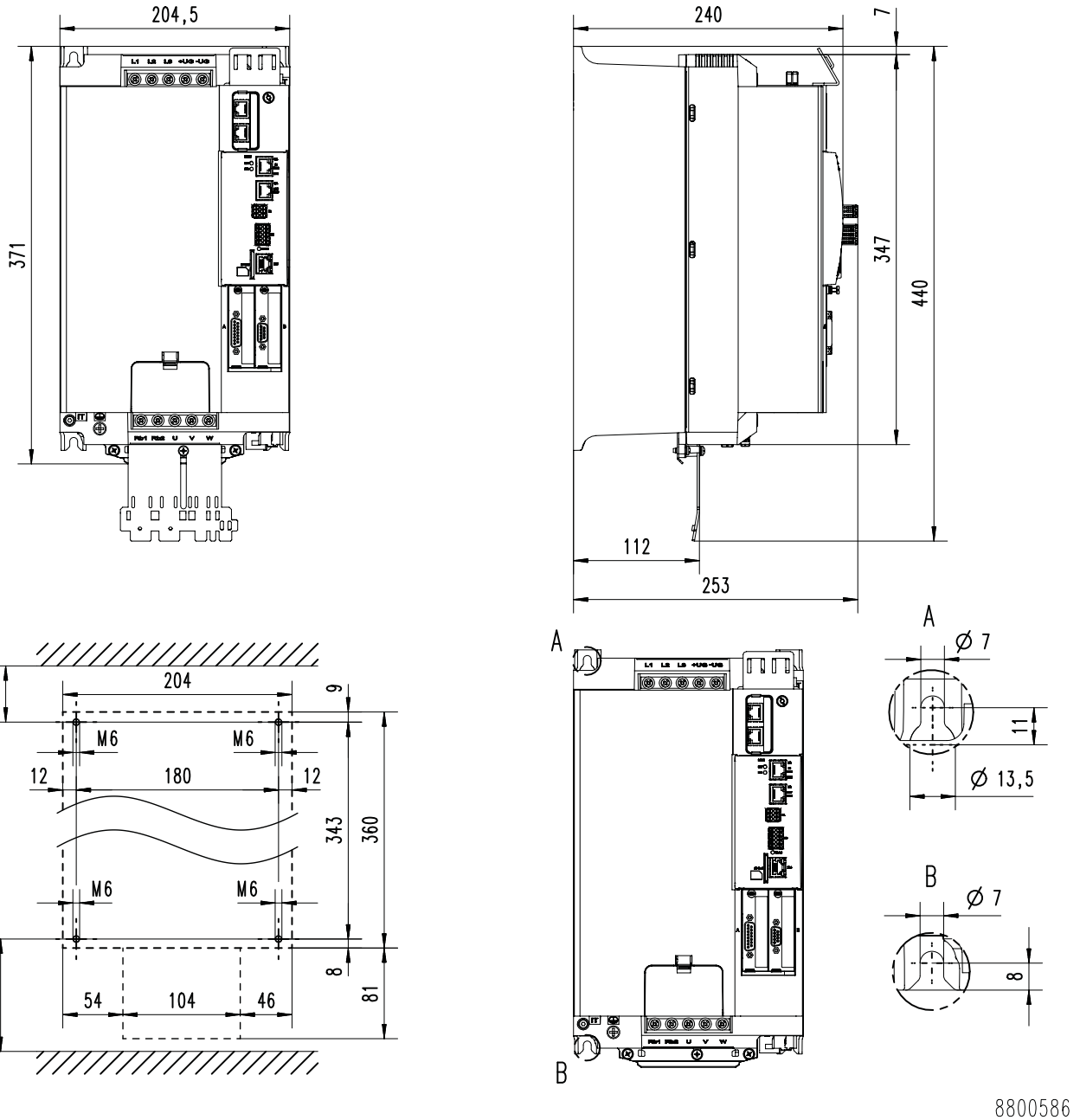
5 hp	i950-C4.0/230-3	
7.5 hp	i950-C5.5/230-3	
10 hp		i950-C7.5/400-3
15 hp		i950-C11/400-3
20 hp		i950-C15/400-3
Weight	8.6 lb	8.6 lb



22 kW

The dimensions in mm apply to:

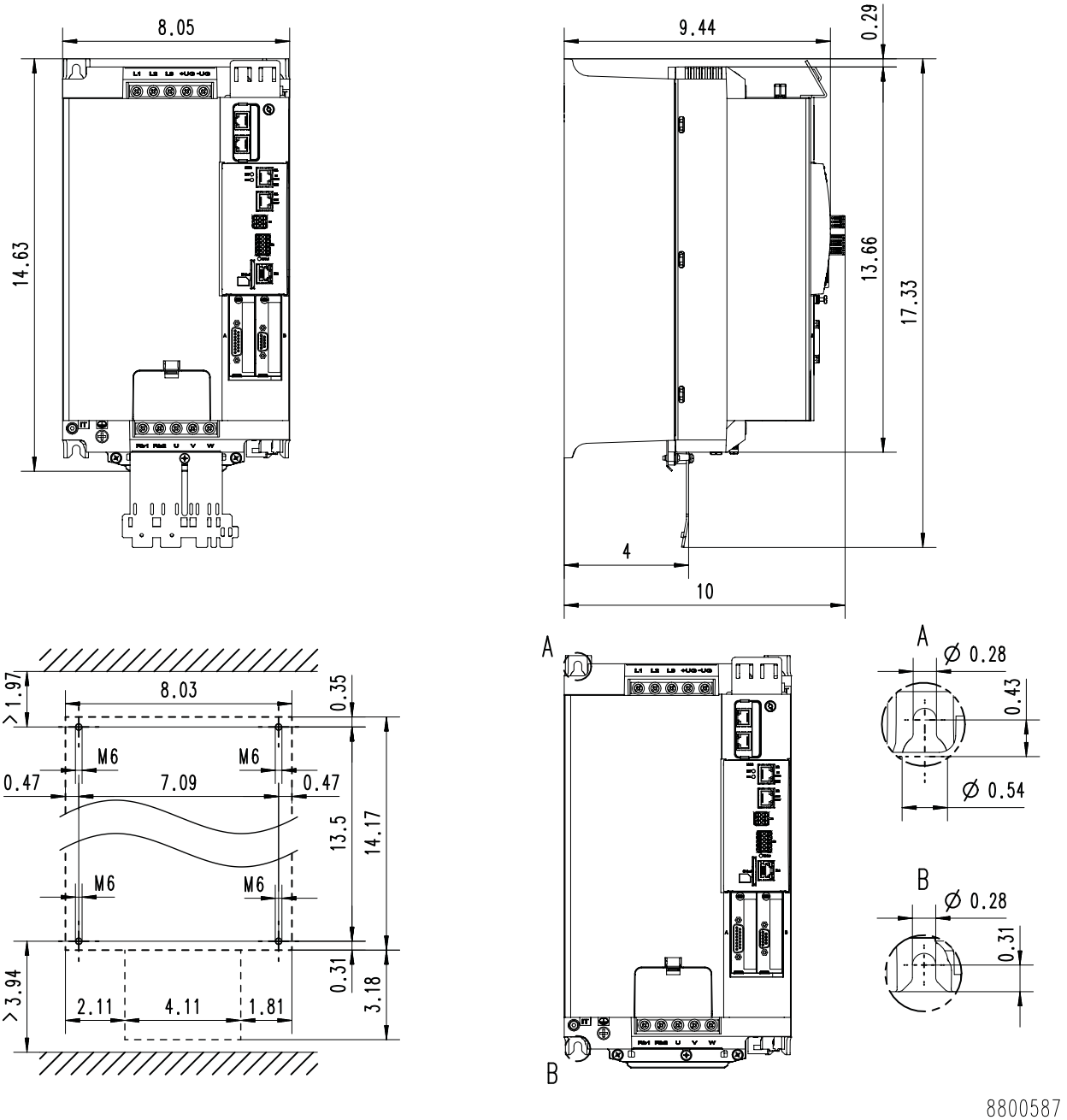
22 kW	i950-C22/400-3
Weight	10.7 kg



30 hp

The dimensions in inch apply to:

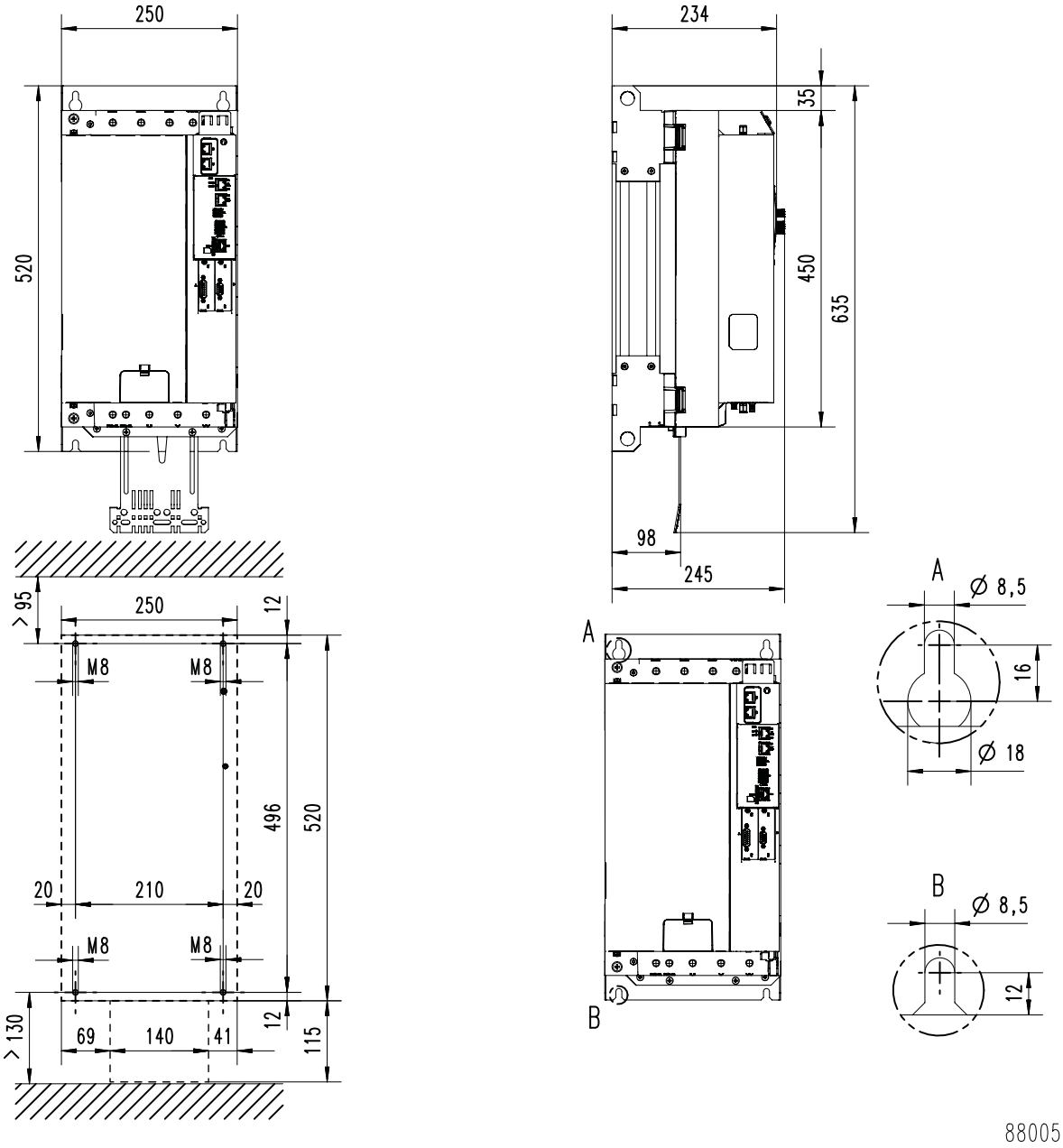
30 hp	i950-C22/400-3
Weight	23.6 lb



30 kW ... 45 kW

The dimensions in mm apply to:

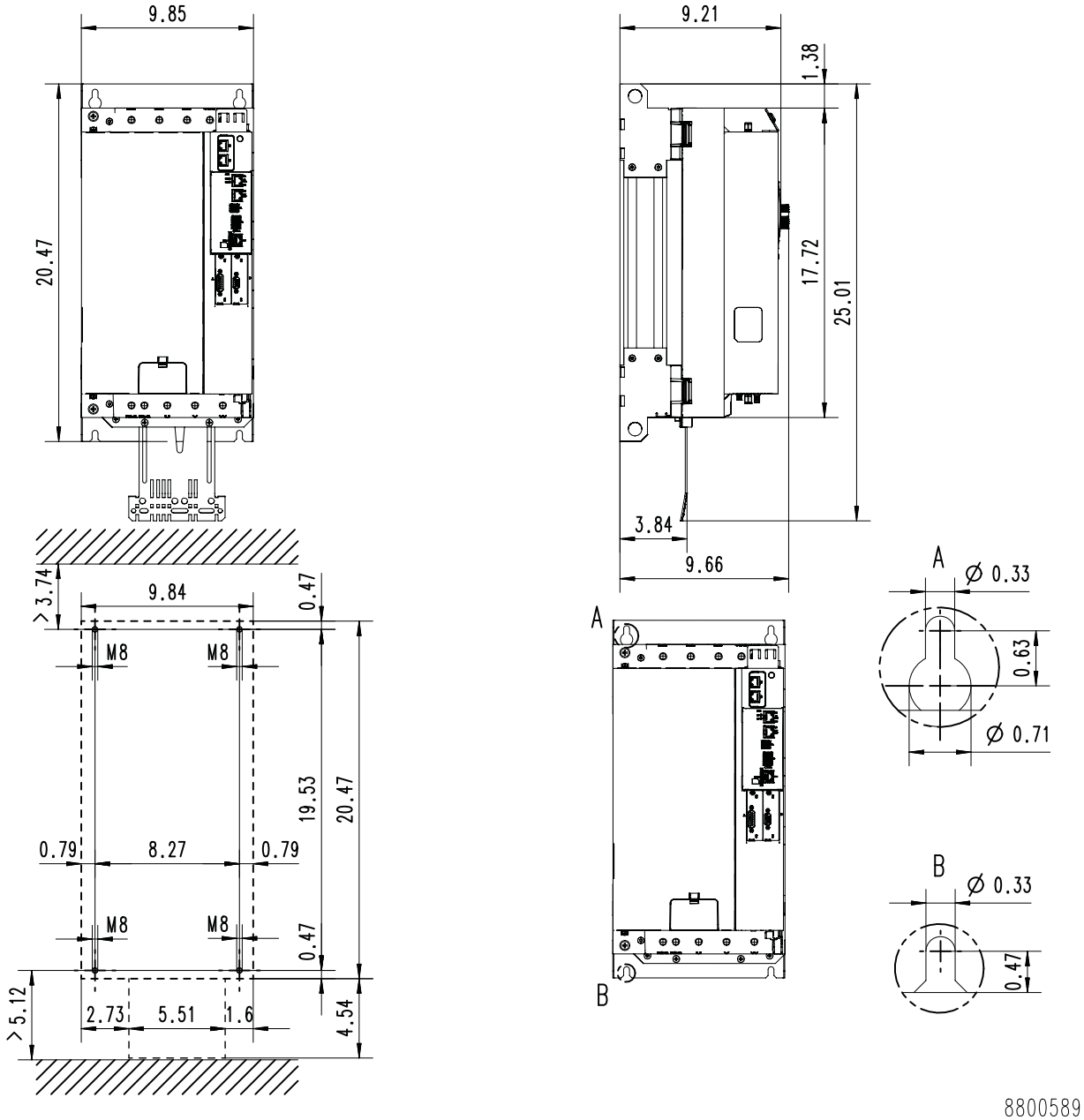
30 kW	i950-C30/400-3
45 kW	i950-C45/400-3
Weight	16.7 kg



40 hp ... 60 hp

The dimensions in inch apply to:

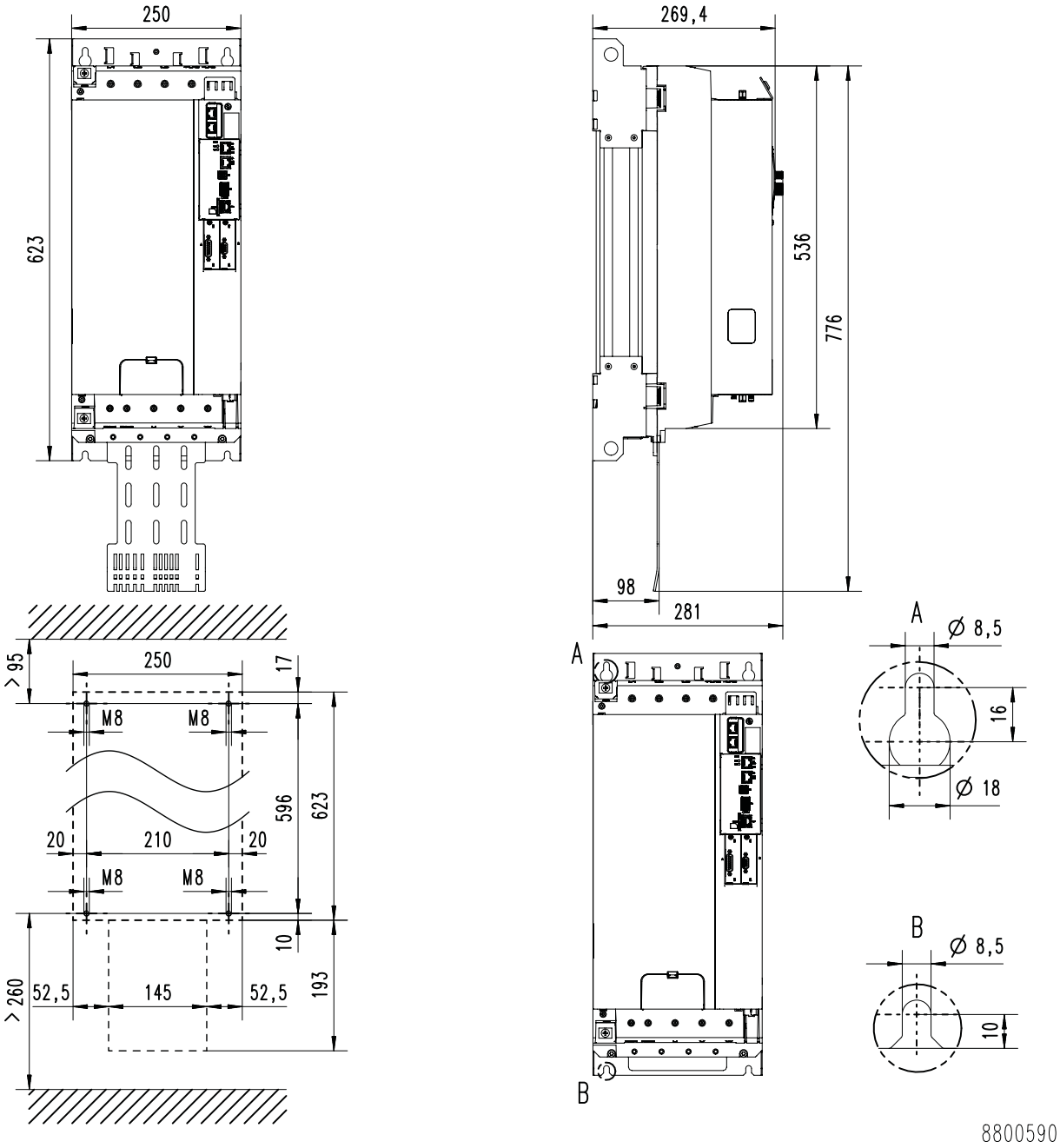
40 hp	i950-C30/400-3
60 hp	i950-C45/400-3
Weight	37 lb



55 kW ... 75 kW

The dimensions in mm apply to:

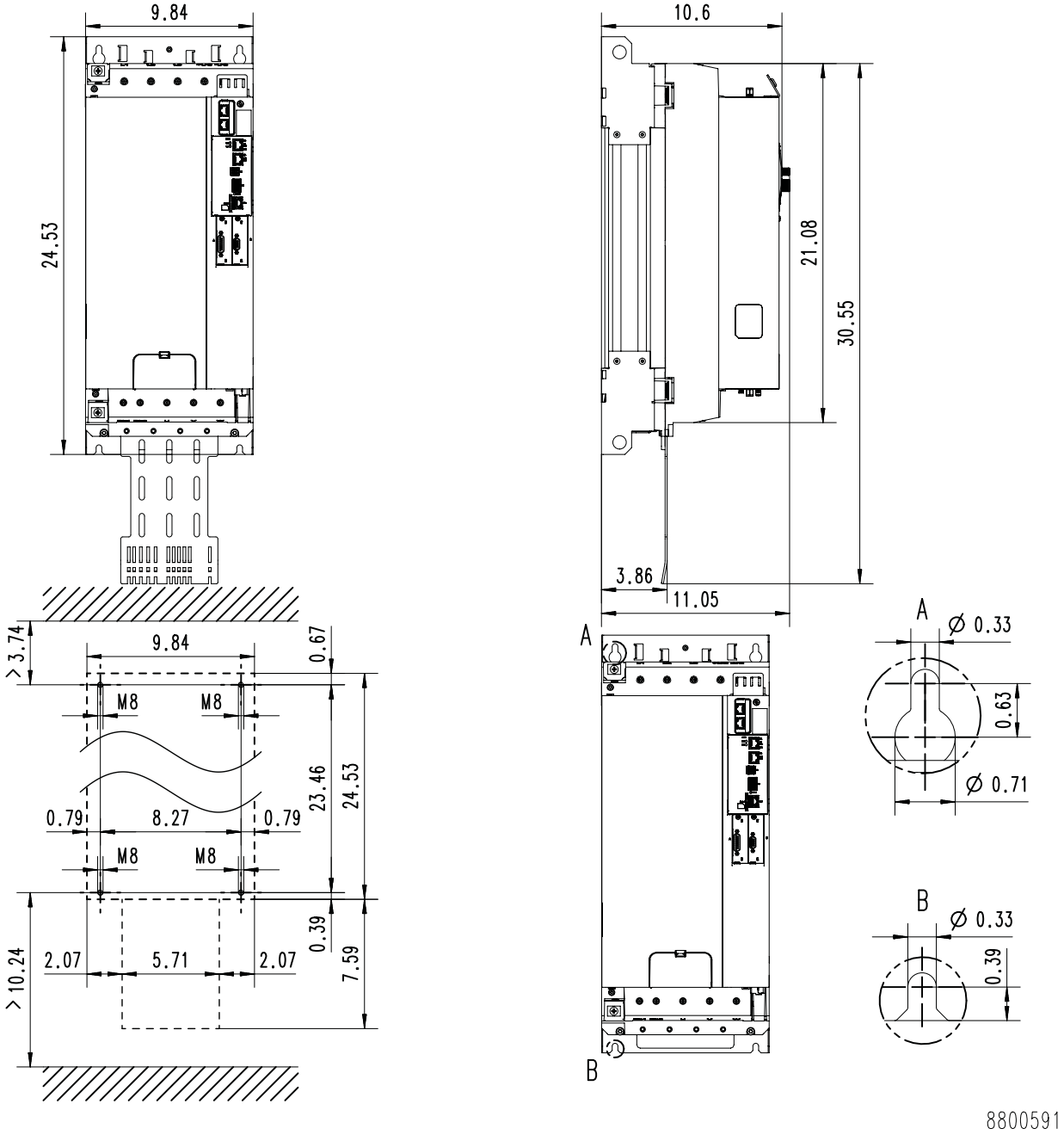
55 kW	i950-C55/400-3
75 kW	i950-C75/400-3
Weight	24 kg



75 hp ... 100 hp

The dimensions in inch apply to:

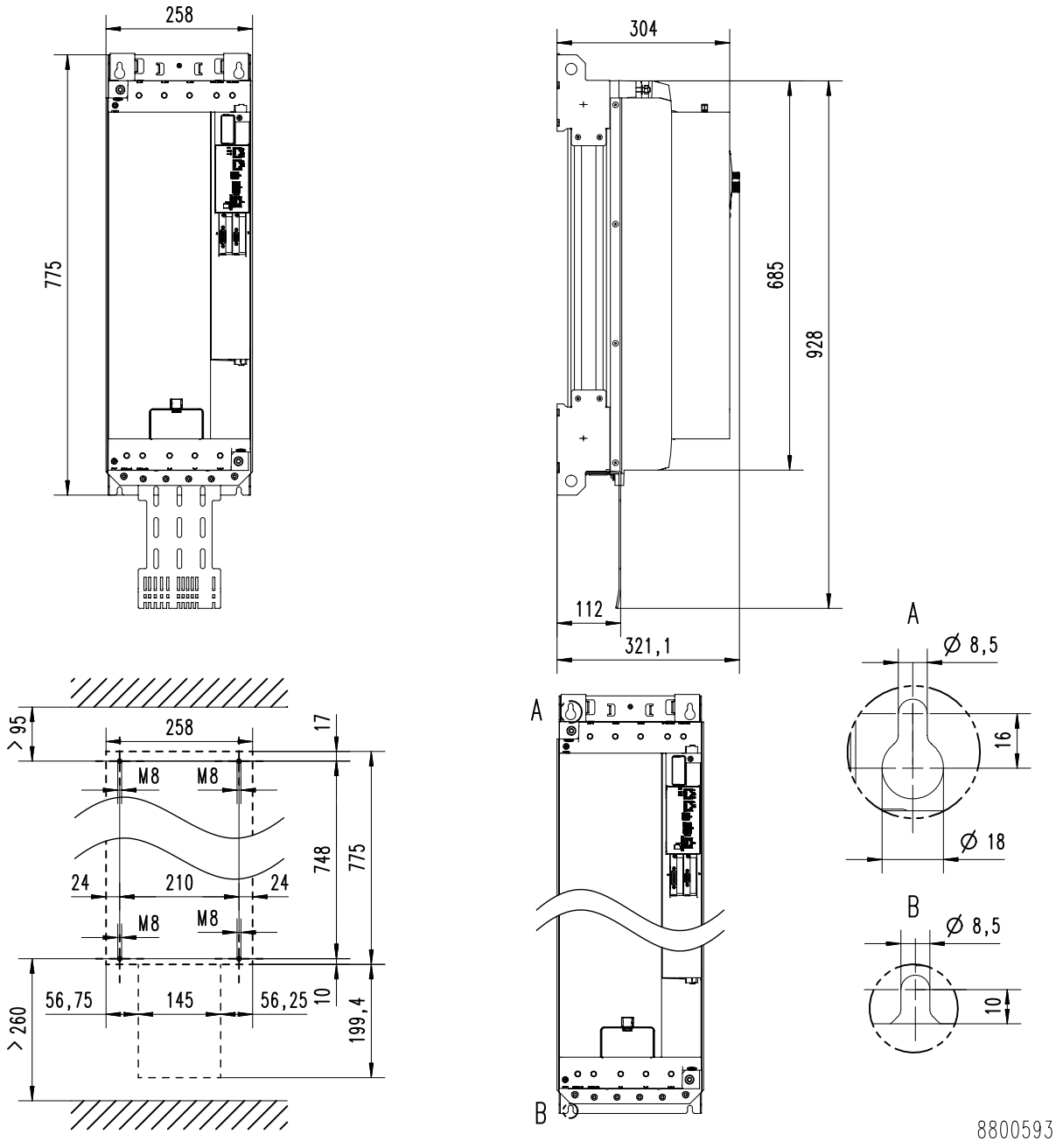
75 hp	i950-C55/400-3
100 hp	i950-C75/400-3
Weight	53 lb



90 kW ... 110 kW

The dimensions in mm apply to:

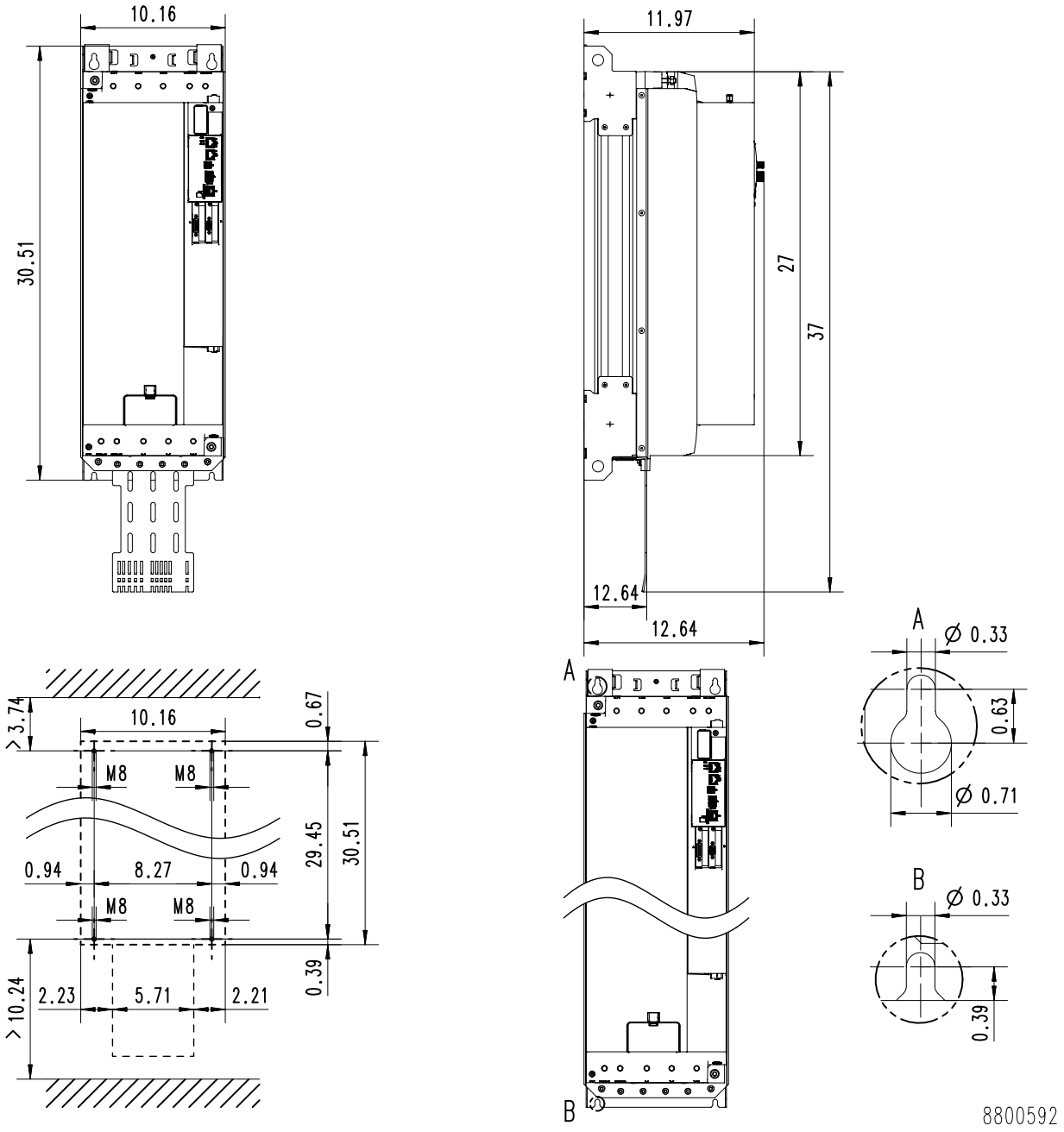
90 kW	i950-C90/400-3
110 kW	i950-C110/400-3
Weight	35.6 kg



125 hp ... 150 hp

The dimensions in inch apply to:

125 hp	i950-C90/400-3
150 hp	i950-C110/400-3
Weight	78.5 lb



Performance indicators motor control

Functionality	Key figures	Data
Torque control	Repeat accuracy	< 0.1 %
	Internal resolution	30 bit ≡ 100 % M_{max}
	Setting range (tolerance range 5 % M_n and 5 % M_{set}	1:60 (without field weakening range)
	Linearity (temperature-compensated)	<1 % (without field weakening range)
	Cycle time for the control	16 kHz (62.5 µs)
	Rise time	62.5 µs
	Temperature compensation of the magnets (PSM)	Available
Current control	Settling time (5 % tolerance range)	62.5 µs
	Internal resolution	30 bit = 100 % I_{max}
	Absolute resolution	14 Bit
	Bandwidth	6 kHz
	Cycle time for the control	16 kHz (62.5 µs)
Speed control	Repeat accuracy	<< 1 per mille
	Internal resolution	30 bit = 240 000 rpm 1 LSB = 0.000224 rpm
	Cycle time for the control	16 kHz (62.5 µs)
Position control	Resolver accuracy	5 angular minutes (resolver-dependent)
	SinCos encoder accuracy	2 angular seconds (1024 SinCos encoder)
	Internal resolution	32 bit ≡ 1 revolution 1 LSB = 83.3 * 10^{-9} degree
	Resolution to one revolution	CiA parameter 0x608F:1 (16 to 30 bit)
	Cycle time for the control	16 kHz (62.5 µs)
Dynamics	Maximum acceleration 0-N_{Rated}	7 ms
	Shortest response time to a fault	62.5 µs
Modulation	Voltage resolution of the PWM	100 MHz
	Switching frequencies	2, 4, 8, 16 kHz (fixed, drive-optimized)
Phase voltage measurement		from 22 kW
Field weakening operation	Asynchronous machine	Typical 3.0 fold (motor-dependent)
	Synchronous machine	Typical 1.5 fold (motor-dependent)
Device data	Service life	40 000 h
	Overload capacity	2-fold
	Efficiency in the rated point	> 95 %

Product extensions

Overview

Product expansions allow you to flexibly tailor the inverter to your application.

- Motor encoder connection 🕮 129
- Load encoder/master encoder connection 🕮 131
- Networks 🕮 132
- Functional safety 🕮 136

Motor encoder connection

The i950 can optionally be outfitted with a module for motor feedback (motor encoder).

Two modules are available:

- Resolver module
- Multi encoder module

Resolver module

Resolvers are connected to X7 (9-pole Sub-D socket).

Electrical data		
General	Cable length	max. 150 m
TEMP+, TEMP-	Connection of thermal sensor (KTY/PT1000)	
+REF, -REF	Excitation voltage and carrier frequency	8 kHz, fixed
±COS, ±SIN	Sine and cosine track	

Operation of resolvers of other manufacturers is permissible. The number of resolver pole pairs must be adapted to the resolver used. When the stator coils are excited with 8 kHz, the apparent impedance of the connected resolver must not fall below 90 Ohms. If smaller impedances are connected, the overload protection integrated in the resolver output limits the output current and may blur the resolver evaluation.

Multi encoder module

Encoders are connected to X8 (15-pole Sub-D socket). Absolute and incremental encoders are supported:

- SinCos incremental encoder 1 Vss
- SinCos absolute value encoder 1 Vss with HIPERFACE® protocol
- SSI encoder
- SinCos-SSI absolute value encoder
- TTL incremental encoder

Electrical data		
General	Cable length	max. 150 m
	Protocols	Hiperface SSI
	Number of increments	1 ... 131072
	Input frequency	Max. 500 kHz
Vcc, GND	Supply voltage	5 ... 12 V
	Max. output current	330 mA to 9 V 250 mA at 12 V
	Max. output power	3 W

Encoders with SinCos tracks are wire break monitored, SSI encoders and TTL encoders are not.

Pin assignment of resolver connection

Connection	Connection description	Connection type	Pin	Resolver
X7	Resolver	Sub-D, 9-pole	1	+REF
			2	- REF
			3	n.c.
			4	+COS
			5	-COS
			6	+SIN
			7	-SIN
			8	TEMP+
			9	TEMP-

Pin assignment multi-encoder connection

Connection	Description of connection	Connection type	Pin	Encoder type	
				SinCos	TTL
				incremental	incremental
X8	Encoder	Sub-D 15-pole	1	COS	A
			2	GND	GND
			3	SIN	B
			4	Vcc	Vcc
			5	Z	Z
			6	n.c.	n.c.
			7	TEMP-	TEMP-
			8	n.c.	n.c.
			9	REFCOS	/A
			10	n.c.	n.c.
			11	REFSIN	/B
			12	n.c.	n.c.
			13	/Z	/Z
			14	TEMP+	TEMP+
			15	n.c.	n.c.

Connection	Description of connection	Connection type	Pin	Encoder type		
				HIPERFACE®	SSI encoder	SinCos+SSI
				Absolute	Absolute	Absolute
X8	Encoder	Sub-D 15-pole	1	COS	n.c.	COS
			2	GND	GND	GND
			3	SIN	n.c.	SIN
			4	Vcc	Vcc	Vcc
			5	DATA+	DATA+	DATA+
			6	n.c.	n.c.	n.c.
			7	TEMP-	TEMP-	TEMP-
			8	n.c.	CLOCK+	CLOCK+
			9	REFCOS	n.c.	REFCOS
			10	n.c.	n.c.	n.c.
			11	REFSIN	n.c.	REFSIN
			12	n.c.	n.c.	n.c.
			13	DATA-	DATA-	DATA-
			14	TEMP+	TEMP+	TEMP+
			15	n.c.	CLOCK-	CLOCK-

Feedback	Order code	
Resolver	I9MAG2V000000S	

Feedback	Order code	
SinCos incremental SinCos Hiperface absolute SSI TTL SinCos + SSI absolute	I9MAG3V000000S	

Load encoder/master encoder connection

The i950 can optionally be outfitted with a module for application feedback (load encoder or master encoder).

The modules used for the load encoder/master encoder and the motor encoder are the same. The data can be found under: ▸ Product extensions, Motor encoder connection 🕮 129

Networks

The i950 can optionally be equipped with a network module. It is used to realize communication at the "fieldbus" level.

Network modules are available for connecting the following:

- EtherCAT®
- EtherNet/IP™
- PROFINET®

The i950 is equipped with an engineering port (standard Ethernet) for setting and diagnostics via software.

Notes on ordering

Which network module the i950 servo inverter should be equipped with can be optionally configured when ordering. The delivery takes place as a complete device.

Network modules can also be ordered separately as replacement components.

Network (fieldbus)	Order code for replacement component
EtherCAT	I9MAFT0000000S
EtherNet/IP	I9MAFG0000000S
PROFINET	I9MAFR0000000S

EtherCAT

EtherCAT® (Ethernet for Controller and Automation Technology) is an Ethernet-based fieldbus system which fulfils the application profile for industrial plant systems.

EtherCAT network module

Bus-related information			
Name		EtherCAT	
Communication medium		Ethernet 100 Mbps, full duplex	
Use		Connection as EtherCAT slave	
Status display		2 LEDs (RUN, ERR)	
Connection designation		IN: X246 OUT: X247	

Technical data			
Communication profile		EtherCAT	
		CANopen over EtherCAT	
Safety over EtherCAT (FSoE)		Yes	
Vendor ID [hex]		0x3B	
Network topology		Line, tree ring	
Device			
Type		EtherCAT slave	
Max. number		65535	In the entire network
Address		Automatically assigned by the master	
Max. cable length	m	Not limited	The length between the devices is decisive.
Max. cable length between two devices	m	100	
Process data			
Transmit PDOs		0 ... 16 double words	Max. 64 bytes
Receive PDOs		0 ... 16 double words	
Cycle time	ms	Integer multiple of 1 ms	

EtherNet/IP

EtherNet/IP is a common fieldbus for the connection of inverters to different control systems in plants.

EtherNet/IP network module

Bus-related information			
Name		EtherNet/IP	
Communication medium		Ethernet 10 Mbps, 100 Mbps, half duplex, full duplex	
Use		Connection as EtherNet/IP adapter	
Status display		2 LEDs (CIP Module Status, CIP Network Status)	
Connection designation		X266, X267	

Technical data			
Communication profile		EtherNet/IP	
Vendor ID		587	
Device type		43 (0x2B), Generic device	
Product code		950	
Network topology		Line, tree, ring	
Device			
Type		Adapter (slave)	
Max. number		254	Per subnetwork
Address		IP address is assigned by the scanner or via Lenze engineering tools	
Max. cable length	m	-	Not limited The length between the devices is decisive.
Max. cable length between two devices	m	100	
Process data	Byte	4, 8, 12, 16, 20, 24, 28, 32, ..., 64	
Cycle time	ms	> 4	
Switching method		Cut-Through	
Other data		Additional TCP/IP channel	

PROFINET

PROFINET is a common fieldbus for the connection of inverters to different control systems in plants.

PROFINET network module

Bus-related information			
Name		PROFINET RT	
Communication medium		Ethernet 100 Mbps, full duplex	
Use		Integration as PROFINET IO-Device	
Status display		2 LEDs (Ready, Error)	
Connection designation		X256, X257	

Technical data			
Communication profile		PROFINET	
PNO identification number [hex]		0x0106	
Device identification (Device ID)		0x0900	
Network topology		Line, tree, ring	
Device			
Type		IO device with real time (RT) communication properties Conformance Class B, NetloadClass III	
Max. number		255	Per subnetwork
Address		Station name	
Max. cable length	m	Not limited	The length between the devices is decisive.
Max. cable length between two devices	m	100	
Process data	Byte	4, 8, 12, 16, 20, 24, 28, 32, ..., 64	
Cycle time	ms	1, 2, 3, 4, ...	
Switching method		Cut-through	
Other data		Additional TCP/IP channel	
Optional PROFINET functions		PROFIsafe PROFIenergy Class 3 Shared device MRP (Media Redundancy Protocol)	

Functional safety

General information and basics

The functional safety describes the necessary measures that need to be taken by means of electrical or electronic equipment to prevent or eliminate dangers due to malfunctions.

Protective devices prevent any human access to danger areas during normal operation. However, persons may have to be in the danger areas in certain operating modes. The machine operator is protected by internal drive and control measures in these operating modes.

Integrated safety

The integrated safety technology fulfils the control and drive conditions for implementing the protective functions. The expenses for planning and installation decrease. Integrated safety equipment increases machine functionality and availability. The integrated safety system can be used for the protection of persons working on machines in accordance with the Machinery Directive.

The motion functions continue to be executed by the inverter. The integrated safety system monitors the safe compliance with the limit values and provides the safe inputs and outputs. If monitored limit values are exceeded, the integrated safety system in the inverter reacts with safety functions according to EN 61800−5−2.

Standards

Safety regulations are confirmed by laws and other governmental guidelines and measures and the prevailing opinion among experts, e.g. by technical regulations.

The regulations and rules to be applied must be observed in accordance with the application.

Risk assessment

This documentation can only accentuate the need for a risk assessment. The user of the integrated safety system must read up on standards and the legal situation.

Before a machine can be put into circulation, the manufacturer of the machine has to conduct a risk assessment according to the 2006/42/EC: Machinery Directive to determine the hazards associated with the use of the machine.

The Machinery Directive refers to three basic principles for the highest possible level of safety:

- Hazard elimination / minimisation by the construction itself.
- Taking the protective measures required against hazards that cannot be removed.
- Existing residual hazards must be documented and the user must be informed of them.

Detailed information on the risk assessment is provided in the DIN EN ISO 12100:2013−08: Safety of machinery − general principles for design − risk assessment and risk reduction . The result of the risk assessment determines the category for safety-related control systems according to EN ISO 13849−1. Safety-oriented parts of the machine control must be compliant.

Mission time

The mission time of the used components must be complied with.

In case of a defect or when the mission time of a component has expired, the complete component must be replaced. Continued operation is not permitted!

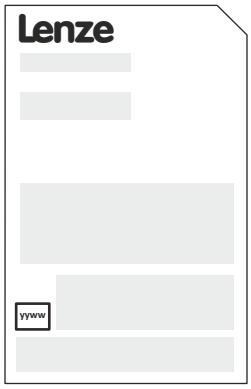
The mission time for the safety functions cannot be reset by a special proof test.

The specified mission time starts at the date of manufacture.

Mission time ▸ Technical data 🕮 189

Manufacturing date

- The manufacturing date is permanently stored in the device. You can read it out using the »EASY Starter«. (Parameter 0x2000:003)
- The manufacturing date can be found on the nameplate as well.



yyww Year of manufacture and week of manufacture (1841 = KW 41 2018)

Identification of the terminals

The terminals of the safety system can be recognized by the yellow connectors.

Stop functions

The stop functions include:

▸ Safe stop emergency (SSE) 📖 150

▸ Safe stop 1 (SS1) 📖 151

▸ Safe stop 2 (SS2) 📖 153

▸ Safe operating stop (SOS) 📖 156

The stop functions differ according to how they are triggered:

- Normal stop (simple stop)
  - Triggered by a safe input with the parameterized functions STO, SS1, or SS2.
  - Triggered by the activated bits STO, SS1 or SS2 via the safety bus.
- Emergency stop
  - Triggered by a safe input with the parameterized function SSE.
  - Triggered by the activated bits SSE via the safety bus.
  - STO or SS1 can be configured as the function to be executed via the parameter "SSE: Emergency stop function".
- Error stop
  - Triggered as a response to an error.
- Repair Mode Select

Prioritisation

Stop functions with higher priority influence the flow of lower-order functions which have already been initiated.

Hierarchy:

1. Safe torque off (STO)
   - The function STO has the highest priority and hence precedence over all other functions.
   - Functions that have already been initiated (e. g. SS1 or SS2) are aborted and the drive is switched off.
2. Safe stop 1 (SS1)
   - The function SS1 has priority over SS2.
   - Observing the defined stopping time for SS1 and SS2 as well as the SS1 mode, the drive is rendered torqueless.
3. Monitoring functions
   - The monitoring functions have equal priorities and can be executed simultaneously with the stop function.

Restart

The restart sets the drive in motion after it was previously brought to a standstill via a stop function.

Whether the restart needs to be acknowledged or if it launches automatically can be parameterized in a manner dependent on the preceding stop function:

- Restart behavior according to STO / SS1 (0x2892:001)
- Restart behavior according to SS2 / SOS (0x289F:002)

⚠ DANGER!

The requirement for the safety function is lifted.

The drive may automatically restart when the requirement for the safety function is lifted!

▶ In the case of automatic restart, you must take external measures to ensure that the drive only restarts after a confirmation in accordance with EN ISO 13849−1.

The restart behaviour after an emergency stop corresponds to that for the restart behaviour parameterised for the stop function STO / SS1.

Prerequisites for restart

- Setting "Acknowledged restart"
  - After a normal stop, a Restart acknowledgement (AIS) via terminal or safety bus is necessary. 📖 143
  - After an error stop, an Fault acknowledgement (AIE) is necessary before the restart can be acknowledged with AIS. 📖 143
- Setting "Automatic restart"

When the safety function "Safe cascading" is active, the plausibility check rejects the automatic restart after STO.

  - The drive must be in a stopped state (see status bit STO or SOS).
  - The higher-level control must ensure that the drive only restarts after a confirmation.

Safe inputs

Sensor inputs

Safety sensors can be connected to the safe inputs on terminal X83. The sensor inputs I1A/I1B ... I4A/I4B are suitable for active and passive sensors.

- Sensor type and sensor function are parameterizable.
- The inverter evaluates the sensors according to the parameterization.
- If a safety bus is activated, the sensor signals are sent to the higher-level control as status information.
- Deactivated sensor inputs must not be connected. An input that is not connected is in the "OFF state".
- If a signal is detected at a deactivated sensor input during initialization, the drive remains disabled (STO).
- Faulty input signals set the input to the "OFF state".

Monitoring modes

Specification	Passive sensor	Active sensor
Discrepancy time	parameterizable 0 ... 30000 ms (increment: 2 ms)	
Input delay	parameterizable 0 ... 100 ms (increment: 2 ms)	
Input filter time for test pulses	fixed, 2 ms	
Repetition rate of test pulses	defined by the clock outputs CLA and CLB	> 50 ms
Error response	Sensor output is switched to "OFF state". Acknowledgement via safety bus or the AIE input	

Explanations of the information:

- Discrepancy time 0x2119:
  - Maximum time within which both channels of a safe input are permitted to be in antivalent states without the safety technology triggering an error response.
- Input delay 0x211A:
  - Time between the detection of the signal change and the effective evaluation of an input signal. This does not take into account multiple and short signal changes due to bouncing of contact components.
  -
  - The input delay time affects the response time.
- Input filter time:
  - Time during which interference pulses and test pulses from e.g. switched-on active sensors are not recognized.
  - The input filter time affects the response time.

Connection of active sensors

- For connection diagram, see ▸ Extended Safety 🕮 77
- PN-switched input signals are permissible.
- The circuit monitoring must correspond to the requirements of category 3 or category 4. No circuit monitoring takes place via the integrated safety equipment.
- Detected errors:
  - Antivalent input signals after discrepancy time has elapsed.

Connection of passive sensors

- For connection diagram, see ▸ Extended Safety 77
- The safe sensor inputs are suitable for equivalent switching passive sensors.
- Channels A and B are tested cyclically with a time delay by briefly switching LOW.
  - Cycle time approx. 2 s, test pulses < 1 ms
- In order to monitor passive sensors according to EN ISO 13849-1, cat. 3 or cat. 4, you will need to wire the clock outputs X82/CLA and X82/CLB:
  - The clock outputs are only suitable for monitoring passive sensors.
  - Connect X82/CLA via the sensor with X83/IxA (channel A of sensor input).
  - Connect X82/CLB via the sensor with X83/IxB (channel B of sensor input).
  - Connect X82/GS with X83/GIx of the sensor input.
  - X82/24S and X82/GS must be connected to an external 24 V supply.
- Detected errors:
  - Short circuit to the supply voltage.
  - Short circuit between the input signals when different clock outputs are used.
  - Antivalent input signals after discrepancy time has elapsed.
- Undetected errors:
  - Short circuit between the input signals, if the same clock outputs are used

⚠ DANGER!

Loss of safety function when input signals are short-circuited.

The loss of the safety function leads to an unsafe condition of the machine. The machine status cannot be controlled via the safety function.

▸ Lay the cables protected according to category 4 of EN ISO 13849-2.

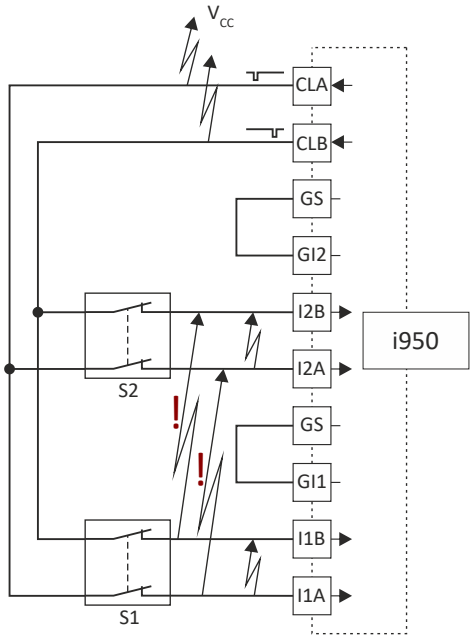


Fig. 9: Ways to detect errors

! Undetectable errors

Contact function test

An internal contact function test is carried out at the safe inputs.

Safe input in the ON state

- A LOW level on a channel sets the input to the OFF state; discrepancy monitoring starts at the same time.
- A LOW level must be detected on both channels within the discrepancy time; if it is not, a discrepancy error is reported.
- In order to be able to acknowledge a discrepancy error, a LOW level must previously have been detected on both channels.

Safe input in the OFF state

- A HIGH level on a channel triggers discrepancy monitoring.
- A HIGH level must be detected on both channels within the discrepancy time; if it is not, a discrepancy error is reported.
- To be able to acknowledge the discrepancy error, a HIGH level must be detected before at both channels.

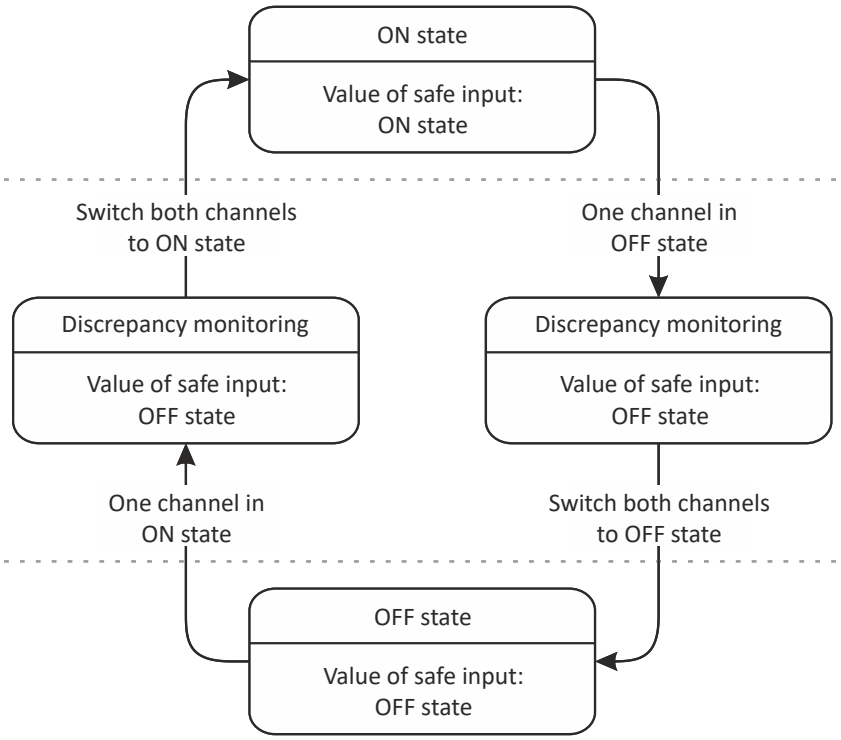


Fig. 10: Contact function test − state behavior

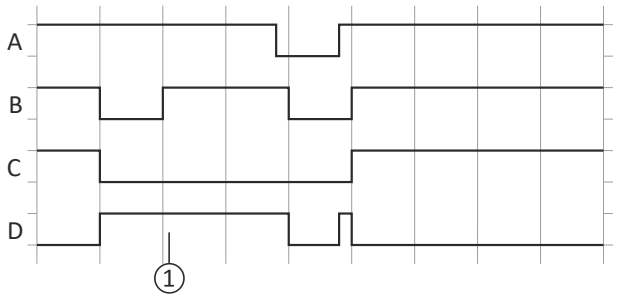


Fig. 11: Contact function test – error-free input signals

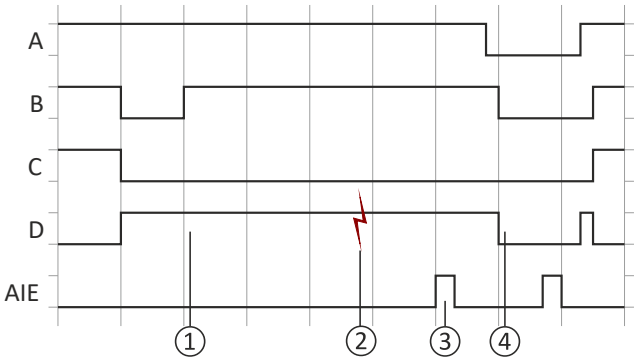


Fig. 12: Contact function test – faulty input signals

A, B	Safe input, channel A and channel B	②	Discrepancy monitoring time-out
C	Internal valuation of the safe input	③	Error acknowledgement impermissible
D	Discrepancy monitoring	④	Error acknowledgement permissible
AIE	Error acknowledgement		
①	Discrepancy monitoring active		

Homing inputs

Before the execution of safety functions that require an absolute reference point, a safety evaluated reference point must be available in the system. The input signals IRS and IRL are available for generating a safe reference point.

Input IRS

An action at reference input IRS starts the referencing process.

- Before use, the IRS reference input must be activated in 0x2880:001 and the signal edge that starts the referencing process must be set in 0x2880:002.
- Other equivalent option:
  - "SHom_Start" signal via a safety bus.
  - The referencing process starts with the positive edge (0↗1).

Input IRL

An action at reference input IRL sets the safe reference point and ends the safe reference run.

- Before use, the IRL reference input must be activated in 0x2881:001 and the signal edge that sets the safe reference point must be set in 0x2881:002.
- Other equivalent option:
  - "SHom_Load" signal via a safety bus.
  - The safe reference point is set with the positive edge (0↗1).

Further information

▸ Extended Safety (connection diagram) 🕮 77

▸ Safe homing (SHom) 🕮 167

▸ Safe network interfaces 🕮 182

Restart acknowledgement (AIS)

After a stop function has been executed, the restart requires an acknowledgement at input AIS if "acknowledged restart" is set:

- Positive signal impulse of 0.3 ... 10 s. The acknowledgement is done with the negative edge.
- Other equivalent option:
  "AIS" signal via a safety bus (if communication via safety bus is preferred).
  Acknowledgement is done with the positive edge (0↗1). The bit must be set for at least one S bus cycle. ▸ Safe network interfaces 🕮 182

A connection diagram can be found here: ▸ Extended Safety 🕮 77

Fault acknowledgement (AIE)

Errors require an acknowledgement at AIE input:

- Positive signal impulse of 0.3 ... 10 s. The acknowledgement is done with the negative edge.
- Other equivalent option:
  "PS_AIE" signal via a safety bus (if communication via safety bus is preferred).
  Acknowledgement is done with the positive edge (0↗1). The bit must be set for at least one S bus cycle. ▸ Safe network interfaces 🕮 182

A connection diagram can be found here: ▸ Extended Safety 🕮 77

Safe output

Via the safe output O1A/O1B information can be output to a higher-level unit (e .g. safety PLC) or external switching elements (actuators) can be controlled.

For an application according to cat. 3 or cat. 4, the use of both output channels (O1A and O1B) is required.

The feedback output is configured to be potential-free. If electrical isolation is required, a separate supply line must be used.

- The status of the safe output is controlled by two ways:
  - directly from the integrated safety technology (parameterization required)
  - via a safety bus
- The safe output is PP switching, i e. two plus channels are switched.
- The safe output in ON state is cyclically tested by quick LOW switching.
  - The channels A and B are tested with a time offset, in cycles of approx. 2 s, with test pulses of < 1 ms.
  - When selecting the downstream control elements, ensure that the test pulses will not be detected as LOW signal.

These errors will be detected and set the output to OFF state:

- Short circuit to the supply voltage.
- In the ON state: Short circuit between the output signals.
- In the ON state: Missing 24-V voltage supply at terminal 24S is detected as "Stuck-at-Low" error.

These errors are not detected:

- In the OFF state: Short circuit between the output signals.

Through parameterization, the status of the safety functions can be assigned to the feedback output.

The 0x2122 parameter contains information on the status of the feedback output.

A connection diagram can be found here: ▸ Extended Safety 🕮 77

Safe speed and position analysis

Drive systems which are outfitted with Lenze inverters of the "Extended Safety" variant provide speed-dependent safety functions for reliable speed monitoring and for reliable position monitoring.

For safe speed and position detection, you must connect a safety-rated motor/encoder combination.

Alternatively, you can connect a 2-encoder system consisting of a motor encoder and position encoder.

For drive systems affected by slip between load and motor encoder, please refer to the chapter "Slip compensation". 📖 170

Important notes

⚠ DANGER!

Slip, shaft fracture etc. between the motor and encoder system interfere with the reliability of speed and position detection.

Speed-dependent and direction-dependent functions are executed incorrectly.

- ▸ Reliably exclude functional errors via design measures.
- ▸ Utilize motors and encoder systems with guaranteed features.

In order to enable the reavailability of the absolute position after mains switching without a new reference run (load stored reference), encoders with absolute value information that covers the entire traversing range must be used.

If you use a 2-encoder system, the load encoder must provide the absolute value information.

Operation with 2-encoder system

A 2-encoder system is a machine constellation that mostly uses the following components:

- Motor encoder: Resolver
- Load encoder Absolute value encoder (SinCos), incremental encoder (TTL) or digital encoder (SSI/Bus)

Preconditions

- The inverter must be parameterized so that the position values of the load encoder are transmitted to the safety technology.

  The parameter depends on the selected technology application:
  - The preset device profile CiA 402 cannot evaluate a 2-encoder system.
  - "CiA 402 Advanced" technology application: 0x500D:092 = 1
  - All other technology applications: 0x500A:092 = 1

  Otherwise, an error message is generated and the drive cannot be put into operation.
- Status and value of the load encoder position can be read out: 0x287A:007
  - Status (valid/invalid): 0x287A:007
  - Value: 0x287A:006

Operation with 1-encoder system with resolver

When using only one encoder in safety applications, theEN 61800−5−2 standard places separate requirements on the connection between the feedback system and the motor shaft. The oversized design prevents operational failures caused by encoder shaft fracture or encoder slippage on the motor shaft. The acceleration limit values in the drive solutions with a resolver are not to be exceeded.

Limit values

Synchronous servo motors	Encoder type	Encoder product code	Maximum permissible angular acceleration	Minimum time per 1,000 1/min speed stroke
MCS 06	Resolver	RV03	56,000 rad/s^2	1.9 ms
MCS 09 ... 19			19000 rad/s^2	5.5 ms
MDXKS 56 / 71			17000 rad/s^2	6.2 ms

Asynchronous servo motors	Encoder type	Encoder product code	Maximum permissible angular acceleration	Minimum time per 1,000 1/min speed stroke
MCA 10 ... 19	Resolver	RV03	22000 rad/s^2	4.8 ms
MCA 20 ... 26				
MQA 20 ... 26				

Motor-encoder combinations

The achievable risk reductions (PL/SIL) also depend on the safety function used.

Match the values specified here with the values for the safety functions:

▸ Safety-related characteristics Extended Safety 🕮 190

Permissible motor-encoder combinations for safe speed and position monitoring

Synchronous servo motors

Synchronous servo motor	Safety-rated encoder			
Type	**Encoder type**	**Encoder product code**	**Max. speed [rpm]**	**Risk mitigation**
MCS 06 ... 19 MDXKS 56 / 71	SinCos absolute value, single-turn	AS1024−8V−K2	±16000	PL d / SIL 2
	SinCos absolute value, multi-turn	AM1024−8V−K2		
MCS 06 ... 19 m850S120 ... m850S190	SinCos absolute value, multi-turn	AM128−8V−K2		
	HIPERFACE DSL® (OCT)	AM20-8V-D2	±15000	
MCS 06 ... 19 MDXKS 56 / 71 m850S120 ... m850S190	Resolver	RV03	±10000/number of pole pairs	PL e / SIL 3

Asynchronous servo motors

Asynchronous servo motor	Safety-rated encoder			
Type	**Encoder type**	**Encoder product code**	**Max. speed [rpm]**	**Risk mitigation**
MCA 10 ... 26 MQA 20 ... 26	SinCos incremental	IG1024-5V-V3	±16000	PL e / SIL 3
MCA 10 ... 26 MQA 20 ... 26	Resolver	RV03	±10000/number of pole pairs	PL e / SIL 3

Three-phase AC motors

Three-phase AC motor	Safety-rated encoder			
Type	**Encoder type**	**Encoder product code**	**Max. speed [rpm]**	**Risk mitigation**
MDxMA063 ... MDxMA225 MHxMA063 ... MHxMA225 MFxMA063 ... MFxMA132 m550P080 ... m550P225	SinCos incremental	IG2048-5V-V2 IG1024-5V-V2	±16000	PL d / SIL 2
		IG2048-5V-V3		PL e / SIL 3

Also observe the documentation of the encoder manufacturer.

Safety functions

Supported safety functions for "Basic Safety-STO"

- Safe torque off (STO) 148

Extended Safety

Supported safety functions

- **Safe stop functions**
  - Safe torque off (STO) 148
  - Safe stop 1 (SS1) 151
  - Safe stop 2 (SS2) 153
  - Safe operating stop (SOS) 156
  - Safe stop emergency (SSE) 150
- **Safe speed**
  - Safe maximum speed (SMS) 157
  - Safe speed monitor (SSM) 159
  - Safely-limited speed (SLS) 158
- **Safe direction**
  - Safe direction (SDI) 162
- **Safely limited increment**
  - Safely-limited increment (SLI) 160
- **Safely limited position**
  - Safely-limited position (SLP) 164
- **Safe position evaluation**
  - Safe homing (SHom) 167
- **Safe cam**
  - Safe cam (SCA) 172
- **Safe position-dependent speed**
  - Position-dependent safe speed (PDSS) 165
- **Safe brake control**
  - Safe brake control (SBC) 179
- **Cascading**
  - STO cascading (CAS) 178
- **Operating mode selection**
  - Operation mode selector (OMS) 173
  - Repair mode selector (RMS) 176
  - Enable switch (ES) 175
- **Muting**
  - Safe Muting (MUT) 181

Safety bus (S-Bus)

- PROFIsafe connection 182
- FSoE connection 184

Safe hardware

- Safe inputs 139
- Safe output 143

Safe torque off (STO)

This function corresponds to a "Stop 0" according to EN 60204.

The motor cannot generate torque and movements of the drive.

⚠ DANGER!

With the "Safe torque off" (STO) function, no "emergency- off" in terms with EN 60204−1 can be executed without additional measures. There is no isolation between the motor and inverter and no service switch or maintenance switch!

Possible consequence: Death or severe injuries

- ▸ "Emergency-off" requires electrical isolation, e. g. by a central mains contactor.

⚠ DANGER!

Automatic restart if the request of the safety function is deactivated.

Possible consequences: Death or severe injuries

- ▸ You must provide external measures according to EN ISO 13849−1 which ensure that the drive only restarts after a confirmation.

⚠ DANGER!

The power supply is not safely disconnected.

Death or serious injury due to electrical voltage.

- ▸ Turn off the power supply.

Preconditions

Motion caused by external forces must be prevented by additional measures such as mechanical braking.

The restart must be set. See chapter "Restart". 🕮 138

Functional description

How to safely disconnect the drive:

1. A safety sensor requests the safety function.
2. The transmission of the pulse width modulation is safely switched off by the safety unit. The power drivers do not generate a rotating field anymore.
3. The inverter switches to the STO active device status (status word 0x6041, Bit15 = 0).

The motor is safely switched to torqueless operation (STO).

The functional principle STO depicted applies to Basic Safety and Extended Safety.

The terminals shown apply to Basic Safety.

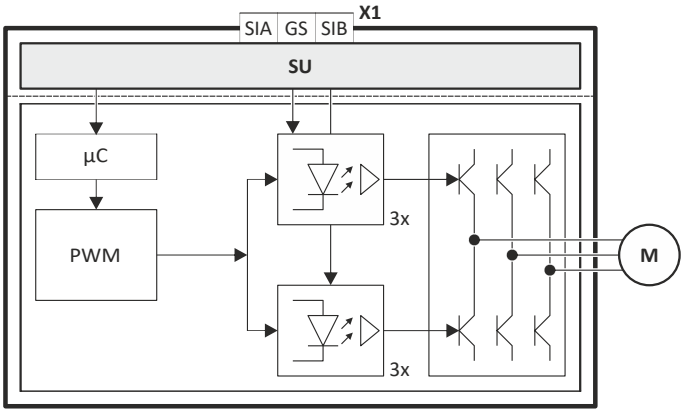


Fig. 13: Functional principle STO

X1	Control terminals of the safety unit	PWM	Pulse width modulation
SU	Hardware interface	M	Motor
µC	Microcontroller		

Function chart

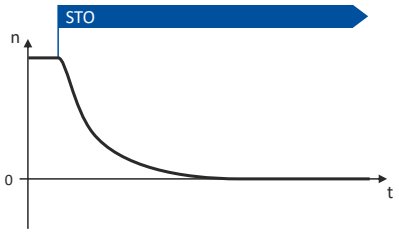


Fig. 14: Safety function STO

Functional sequence and error response have no adjustable parameters.

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182
- As response to the error stop request.
- As response to the emergency stop request.

Safe stop emergency (SSE)

The safety function SSE has the highest priority. The safety function SSE is controlled primarily from all states, operating modes or safety functions. Depending on the parameter setting in 0x28A3:001, SSE activates one of these functions:

- Safe torque off (STO)
- Safe stop 1 (SS1)

Exception

One exception is the tripping source parameterized with SSE that can be deactivated by the "Safe Muting" function. In this case, the SSE function is not effective.

Connect the emergency stop buttons which must not be overruled by special operation or repair mode select (RMS) to the SSE function. For this purpose, parameterize the safe input in 0x28A1 as the trigger source for the SSE function.

The SSE function can also be requested with the "SSE" bit via the safety bus.

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182

Safe stop 1 (SS1)

This function corresponds to a "Stop 1" according to EN 60204.

The function monitors the parameterized stopping time of the drive (n = 0) and switches the drive to torque-free operation via the mode parameterized in 0x2897:001.

Preconditions

The drive is brought to standstill via the application.

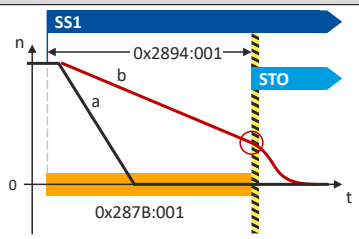
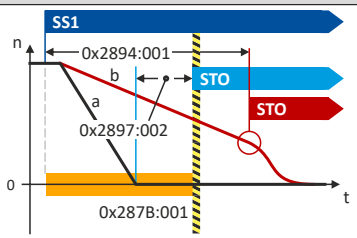
Movements caused by external forces require additional measures. When the stopping time is defined, the application time of the brake must be taken into consideration.

The restart is possible after the stopping time has completely elapsed. An exception from this is the special operation.

Functional description

n = 0 means that the speed of the motor is lower than the motor speed parameterized in the tolerance window. 0x287B:001

The deceleration ramp can be parameterized and monitored for the SS1 stop function.

SS1-t **0x2897:001 = 0 (STO after stopping time)**	**SS1-t** **0x2897:001 = 1 (STO at n = 0)**
	
The safety function SS1 switches the inverter to STO when the set stopping time has elapsed. 0x2894:001 The switching operation is triggered regardless of whether the motor is at a standstill or not!	With this parameterization the motor comes to a standstill. The deceleration n = 0 selection is parameterized in the following parameter: 0x2897:002
Curve (a): The motor comes to a standstill within the parameterized stopping time.	Curve (a): The deceleration parameterized in 0x2897:002 starts when the speed is lower than the tolerance window of the motor speed parameterized in 0x287B:001. The inverter switches to STO after the speed threshold has reached n=0 and the deceleration time 0x2887:002 has elapsed.
Curve (b): The motor is not yet at a standstill at the moment of STO. Switching off with STO causes the motor to coast to a halt.	Curve (b): If the deceleration ramp is set too long, the system switches to STO after the stopping time has elapsed. In the case shown here, the motor coasts to a halt.

Notes on setting the stopping time

Please note the following dependency when setting the stopping time 0x2894:001:

- If an encoder is available:
  - The speed is calculated from the encoder data.
  - In 0x2897:001, selection "1": STO at n = 0, a waiting time 0x2897:002 can be set to determine when the STO status is assumed. This delay specifies the time between the motor coming to a standstill and STO being activated.
- If no encoder is available:
  - The function evaluates the speed status from the inverter. "n = 0" is reached at speed n ≤ 5 rpm.
  - The stopping time 0x2894:001 monitored by the safety device must be parameterized 0.5 s greater than the stop time parameterized in the inverter.

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182
- As response to the error stop request.
- As response to the emergency stop request.

Response of the function under normal circumstances

When the stopping time has elapsed (0x2894:001or after falling below the tolerance window (0x287B:001) a standard stop is activated.

The power supply for generating the rotating field is safely interrupted (STO). The motor cannot generate torque and movements of the drive.

Behavior of the function in the event of an error

An error message and an error stop are triggered if:

- The standstill is not reached with the expiry of the stopping time (0x2894:001).
- The parameterized deceleration ramp is exceeded while ramp monitoring is active.

The power supply for generating the rotating field is safely interrupted (STO). The motor cannot generate torque and movements of the drive.

Canceling the Safe Stop request prematurely does not terminate the error stop function.

Safe stop 2 (SS2)

This function corresponds to a "Stop 2" according to EN 60204.

The function monitors whether the drive has reached the set tolerance margin (n = 0) within the parameterized stopping time. After the stopping time has elapsed or the value has fallen below the tolerance window, the monitoring system switches to safe operating stop (SOS). In the safe operational stop, the drive is not switched to torque-free operation. All control functions remain active to maintain the reached position.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▸ Use a safety rated encoder system to use this function.

Preconditions

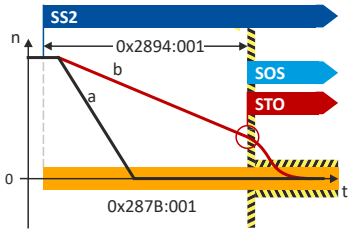
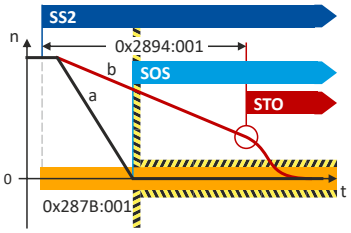
The drive is brought to standstill via the application.

Movements caused by external forces require additional measures. When the stopping time is defined, the application time of the brake must be taken into consideration.

The restart is possible after the stopping time has completely elapsed. An exception from this is the special operation.

Functional description

The deceleration ramp can be parameterized and monitored for the SS2 stop function.

SS2-t 0x289B:001 = 0 (SOS after stopping time)	SS2-t 0x289B:001 = 1 (SOS at n = 0)
	
The safe operating stop is activated if the stopping time parameterized in 0x2894:001 has elapsed and the motor speed is lower than the value parameterized in 0x287B:001.	
Curve (a): For details see Safe operating stop (SOS) 🕮 156	
Curve (b): STO is also activated if, after the stopping time 0x2894:001 has elapsed, the speed is not lower than the value parameterized in 0x287B:001.	

Activation of the function

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 🕮 182
- As response to the error stop request.

Response of the function under normal circumstances

When the stopping time has elapsed (0x2894:001or after falling below the tolerance window (0x287B:001), the safety functionSafe operating stop (SOS) is activated.

Behavior of the function in the event of an error

An error message and an error stop are triggered if:

- The standstill is not reached with the expiry of the stopping time (0x2894:001).
- The parameterized deceleration ramp is exceeded while ramp monitoring is active.

The power supply for generating the rotating field is safely interrupted (STO). The motor cannot generate torque and movements of the drive.

Canceling the Safe Stop request prematurely does not terminate the error stop function.

Ramp monitoring

In addition, the deceleration ramp can be parameterised and monitored for the stop functions SS1 and SS2. If the parameterised ramp is not exceeded, it is then switched to the parameterised stop function STO or SOS.

Condition

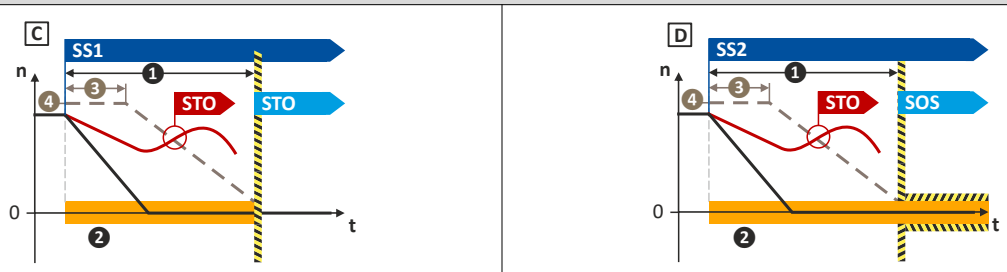
- Safe speed evaluation via the parameterized encoder system.
- Ramp monitoring is activated. 0x2894:002
- The starting value of the ramp and the S-ramp time must be specified.

Functional description

Monitoring the deceleration process achieves a higher level of safety.

- The application guides the drive to standstill.
- If the speed exceeds the parameterized deceleration ramp within the stopping time or before the tolerance window (n = 0) is reached, an error message is triggered and an error stop is initiated.

Safe ramp monitoring for SS1-r and SS2-r



①	0x2894:001	SS1, SS2: Stopping time
②	0x287B:001	Speed monitoring: Tolerance window (n=0)
③	0x2894:003	SS1, SS2: S-ramp time
④	0x2894:005	SS1, SS2: Start offset ramp

The parameterized monitoring ramp considers the parameters of the deceleration ramp in the application.

0...30 % of the actual speed are added to the actual speed as start offset. The sum is used as constant starting value.

Alternative: An absolute value can be parameterized as start offset. 0x2894:006.

The following parameter determines whether the relative or the absolute offset value is to be used. 0x2894:004

In the Lenze setting of the start offset, the tolerance window (n=0) is considered as the offset.0x2894:005

The monitoring ramp starts after an internal deceleration time has elapsed. The internal deceleration time depends on “SS1, SS2”: smoothing time” and “SS1, SS2”: stopping time”.

Activation

If the stop functions SS1/SS2 are requested, a monitoring ramp is calculated and placed over the current speed characteristic.

Normal behavior

While the stopping time elapses or before the tolerance window (n = 0) is reached, the parameterized speed ramp is not exceeded.

If the stopping time has elapsed and the parameterized speed ramp is not exceeded, the parameterized stop function STO or SOS is triggered.

Error behaviour

An error message and an error stop are triggered if:

- the current speed exceeds the stopping time of the speed ramp parameterised.
- the current speed exceeds the parameterised speed ramp before the tolerance window is reached.

The power supply for generationg the rotating field is safely interrupted (STO). The motor cannot generate torques and movements of the drive.

Safe operating stop (SOS)

In the safe operational stop, the drive is not switched to torque-free operation. All control functions are maintained. The reached position remains active.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▶ Use a safety rated encoder system to use this function.

Preconditions

The drive is brought to standstill via the application.

Functional description

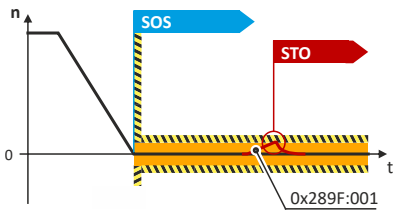


Fig. 15: SOS function

SOS is activated if the motor speed is lower than the tolerance window parameterized in 0x287B:001. In SOS state, relative position changes are added and stored in 0x289F:003. The value in 0x289F:003 is continuously compared with the permissible value in 0x289F:001. If in SOS state the position leaves the safely monitored tolerance window, an error message is generated and STO is activated.

When the SOS state is left, the maximum relative position change is displayed in 0x289F:003. The parameter 0x289F:002 defines the restart behavior after SOS has been deactivated.

When the SOS state is requested again, the sum of the last position changes is reset to zero in 0x289F:003.

Example:

The "SS2 active" state is interrupted by a STO request. If the STO request is reset, the transition to the SOS state occurs. The position deviation is reset to p = 0.

Activation of the function

The following options are available to activate the function:

- Via the function Safe stop 2 (SS2) 🕮 153
- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 🕮 182

Behavior of the function in the event of an error

In the "Safe operational stop (SOS)" final state, an error message is triggered if the position leaves the set tolerance window p = 0. 0x289F:001

Safe maximum speed (SMS)
This function monitors the compliance with the safe maximum motor speed set.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▸ Use a safety rated encoder system to use this function.

Functional description

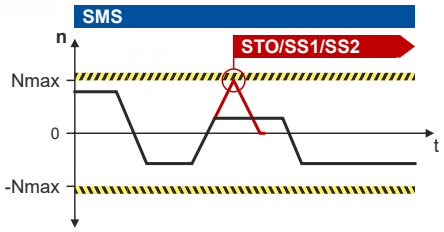


Fig. 16: SMS function

Activation of the function

The function can only be activated via parameterisation.

The function is activated by a value > 0 in 0x28B0:001.

Response of the function in the event of an error
If the speed exceeds the maximum speed set in 0x28B0:001, an error message is triggered.
The following error responses can be parameterized as safe stop:

- Safe torque off (STO) 🕮 148
- Safe stop 1 (SS1) 🕮 151
- Safe stop 2 (SS2) 🕮 153

Safely-limited speed (SLS)

This function monitors the parameterized speed Nlim if the following states are reached:

- The values have fallen below the parameterized speed.
- The set braking time has elapsed.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▸ Use a safety rated encoder system to use this function.

Preconditions

The drive must be braked by the application.

If the SLS function is combined with the Safe direction (SDI) function, the values for the delay times (0x28C4:001 ... 0x28C4:004) must be coordinated. The braking time Nlim (0x28C3:001 ... 0x28C3:004) starts simultaneously with the SDI delay time. See function Safe direction (SDI). 📖 162

Functional description

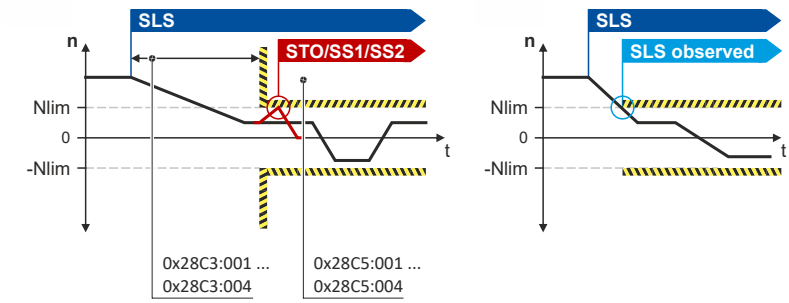


Fig. 17: SLS function

For operation within the limit values the "SLS1...4 monitored" status is set in 0x2870:002.

The status can be

- assigned to the safe output as a safe speed monitor.
- reported via the safety bus.

The permissible direction of movement is set via 0x28C4:001 ... 0x28C4:004.

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182
- Via internal status signals. (From Safety Firmware V1.1 with parameter set version V1.1)

Response of the function in the event of an error

If the speed is exceeded in the monitored state, an error message is triggered. The following error responses can be parameterized as safe stop:

▸ Safe torque off (STO) 📖 148
▸ Safe stop 1 (SS1) 📖 151
▸ Safe stop 2 (SS2) 📖 153

Safe speed monitor (SSM)

This function monitors the amount of a set speed value.

The function is activated when the speed value is set > 0 rpm.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▸ Use a safety rated encoder system to use this function.

NOTICE

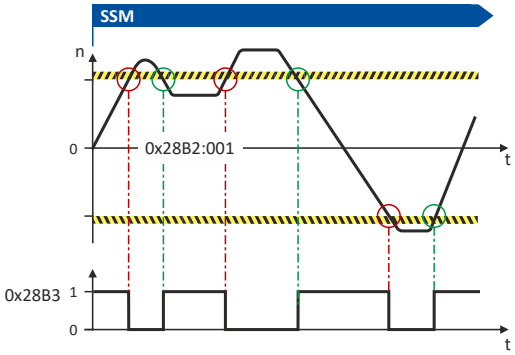
The SSM function has no hysteresis.

Possible consequences: The safe output can switch frequently when the speed of the drive is near the monitoring limit.

Mechanical actuators at the safe output could wear out more quickly due to frequent switching.

▸ In this case, avoid continuous operation at the monitoring limit.

Functional description



- The speed of the drive is within the monitoring limits: 0x28B2:001
  - The status "SSM within limits" is output.
  - Safety bus: Bit 5 is set in the status word. 0x2870:002
  - Safe output: The output switches depending on the parameterization. 0x28B3
- The speed of the drive is outside the monitoring limits: 0x28B2:001
  - The status "SSM within limits" is reset.
  - No error stop is triggered.

Safely-limited increment (SLI)

With this function, a maximum permissible position change [incr] can be set.

Within the position window, the increments parameterised can be traversed in positive and negative directions. There is no time limit for executing this function. If the increment limits parameterised are exceeded, an error stop is initiated.

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

▸ Use a safety rated encoder system to use this function.

Functional description

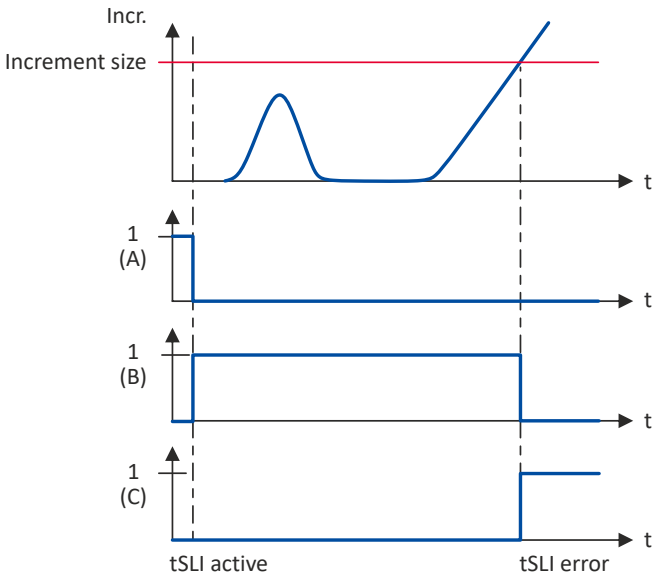


Fig. 18: SLI function

A	Triggering of the function	C	Error status
B	Monitoring active		

If the drive exceeds the increment parameterized in 0x28CA:001 (normal operation) or 0x28CA:003 (special operation), the stop function set in 0x28CA:002 is excecuted.

Activation of the function

The function cannot be activated if the drive is in the "Safe operating stop (SOS)" state.

The function can be activated during operation.

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182
- Depending on the operating mode selector (OMS) by activating the special operation. See chapter "Operation mode selector (OMS)". 📖 173

Response of the function in the event of an error

If the maximum permissible position change is exceeded, an error message is triggered. The following error responses can be parameterized as safe stop:

- Safe torque off (STO) 📖 148
- Safe stop 1 (SS1) 📖 151
- Safe stop 2 (SS2) 📖 153

When exceeding the position change in OMS mode, the error stop set there is used. See chapter "Operation mode selector (OMS)". 📖 173

Safe direction (SDI)

This function monitors the direction of rotation of the motor. A parameterisable tolerance threshold ensures that the drive does not change the permissible direction of rotation. Within the limits parameterised, the drive can rotate in the impermissible direction of rotation.

NOTICE

The delay in 0x28BA:002 is parameterised with a value > 0.

Machine parts and parts of the facility can be destroyed if this setting is not taken into consideration for the calculation of the safety distance.

- ▸ Only utilise this function if the safety distance has been calculated previously, taking the delay set into consideration.
- ▸ If necessary, the "SDIpos observed" or "SDIneg observed" feedback must be evaluated (via the safety bus or via a safe output).

⚠ DANGER!

Uncontrolled rotation of the motor possible if no safety rated encoder system is used.

Possible consequence: Death or severe injuries

- ▸ Use a safety rated encoder system to use this function.

Conditions

- The risk analysis must ensure that the delay does not pose any hazard.
- The application leads the drive to the permissible direction of rotation.

Functional description

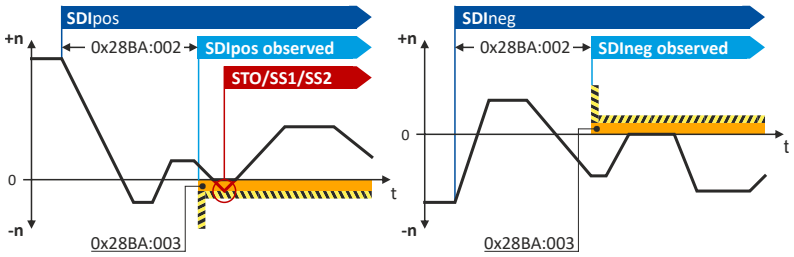


Fig. 19: SDI configuration modes

For operation within the limit values, the SDIpos observed (0x28BB:001) or SDIneg observed (0x28BB:002) status is set.

The status can

- be assigned to the safe output (0x28BB:001 or 0x28BB:002) or
- can be reported via the safety bus (0x28B9:001 or 0x28B9:002).

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182
- For normal operation, the safe direction can be set via a safe parameter.
- The safe direction can be combined with the Safely-limited speed (SLS) function. 📖 158

Response of the function in the event of an error

If the tolerance threshold for the set SDIpos or SDIneg direction (0x28BA:002) is exceeded after the delay time has elapsed (0x28BA:003), an error message is triggered. The following error responses can be parameterized as safe stop:

- Safe torque off (STO) 📖 148
- Safe stop 1 (SS1) 📖 151
- Safe stop 2 (SS2) 📖 153

Safely-limited position (SLP)

This function monitors the lower and upper position limit.

Preconditions

The following function must be executed:

- Set upper position value.
- Set lower position value.
- Safe homing (SHom)

Functional description

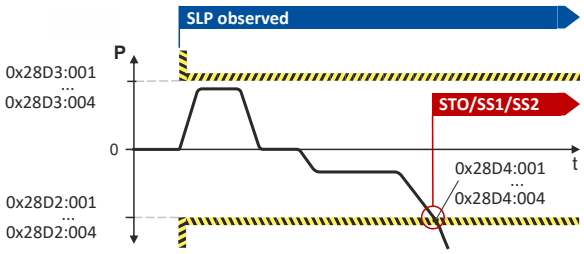


Fig. 20: SLP function

For operation within the upper limit value, the SLPpos observed status is used. 0x28D3:000

For operation within the lower limit value, the SLPneg observed status is used. 0x28D2:000

The upper and lower position limits parameterised are monitored at the time of the request, see SLPx observed status bit.

The status can

- be assigned to the safe output (0x28BB:001 or 0x28BB:002).
- be reported via the safety bus (0x28B9:001 or 0x28B9:002).

This function can be executed during normal operation and special operation. See Operation mode selector (OMS) . 📖 173

Up to four absolute position setpoint pairs can be parameterised and monitored at the same time.

In connection with this function, please also observe the information with regard to safe homing in chapter "Safe homing (SHom)". 📖 167

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182

Response of the function in the event of an error

If the Plim position limit is exceeded during monitoring, an error message is triggered. The following error responses can be parameterized as safe stop:

- Safe torque off (STO) 📖 148
- Safe stop 1 (SS1) 📖 151
- Safe stop 2 (SS2) 📖 153

Position-dependent safe speed (PDSS)

This function

- monitors the speed of a drive as a function of of the absolute position along a motion range.
- allows for the utilisation of a physically limited motion range without the use of mechanical buffers and limit switches.
- can be parameterised as permanently active.

⚠WARNING!

When using the slip compensation: The slip compensation may not be suitable for the application.

Serious injuries when exceeding the travel path.

- ▸ As part of the risk assessment for the machine, make sure that the application is suitable for slip compensation.
- ▸ Traverse the diagnostics markers cyclically when using the slip compensation.
- ▸ Define a diagnostics interval with the help of the risk assessment. The diagnostics interval must be determined via an upstream control component.

In connection with this function, please also note the information on slip compensation and safe homing:

▸ Slip compensation 🕮 170

▸ Safe homing (SHom) 🕮 167

Functional description

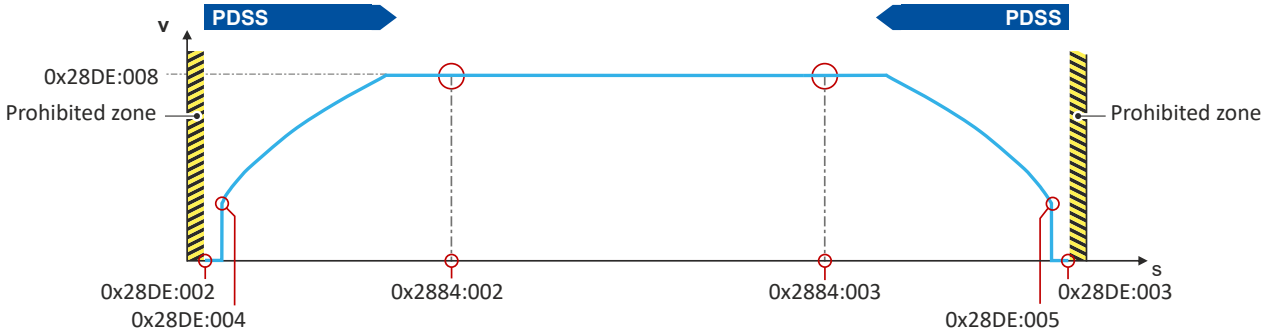
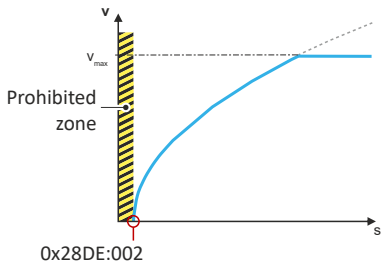
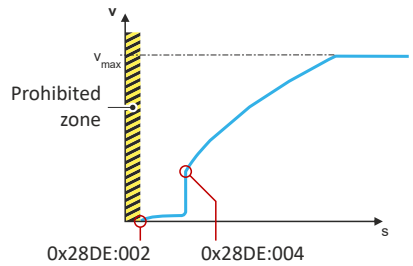


Fig. 21: PDSS function, representation of the most important parameters

Safe creeping speed (SCS)	
	
It depends on the application whether the drive travels to the position limit (0x28DE:002) with the limited speed v_{max} (0x28DE:008). The limited speed is determined by the monitoring function.	By parameterizing a safe creeping speed (SCS), the forbidden zone can be almost approached. The distance to the position limit (0x28DE:002) and the parameterized tolerance must be selected large enough to exclude a collision. The direction-dependent switching of the speed allows the drive to move away from the prohibited zone at maximum speed.

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182

Error behavior

An error message is triggered if the envelope is exceeded or if the absolute position limits are left. The following error responses can be parameterized as safe stop:

▸ Safe torque off (STO) 📖 148

▸ Safe stop 1 (SS1) 📖 151

▸ Safe stop 2 (SS2) 📖 153

Safe homing (SHom)

Safety functions based on absolute positions require an absolute reference point to calculate and monitor the position. This function is required because the encoder systems used for position evaluation do not provide a safe absolute position.

During the reference run, the drive moves exclusively at a parameterizable, safely limited speed (SLS1 ... SLS4). When the reference position is traversed, the parameterized position value is adopted as the "Home Position".

The home position is the absolute reference point for these safety functions:

- Safely-limited position (SLP) 📖 164
- Position-dependent safe speed (PDSS) 📖 165
- Safe cam (SCA) 📖 172

By parameterization it can be set whether the current position is stored non-volatilely when the voltage supply is switched off. If the restart conditions are fulfilled after the voltage supply is switched on again and after a minimum movement (minireference run), no new reference run is performed.

▸ Mini-homing 📖 169

For the operation of a drive system with slip, consisting of motor encoder and load encoder, the slip between the calculated absolute positions of the motor encoder and load encoder can be compensated with parameterizable diagnostic positions.

▸ Slip compensation 📖 170

⚠ DANGER!

When switched off, the motor position must not be changed by external forces.

A change in motor position will result in injury or even death.

▸ Make sure that the motor position does not change.

NOTICE

Undetected local change of the home position.

An unrecognized local change of the home position leads to incorrect values of the absolute position.

▸ Mount the components for detecting the reference position mechanically so that the home position cannot change due to external influences.

Preconditions

In applications with only one position switch, this switch must be connected in parallel to the inputs X82/IRS and X82/IRL.

Functional description

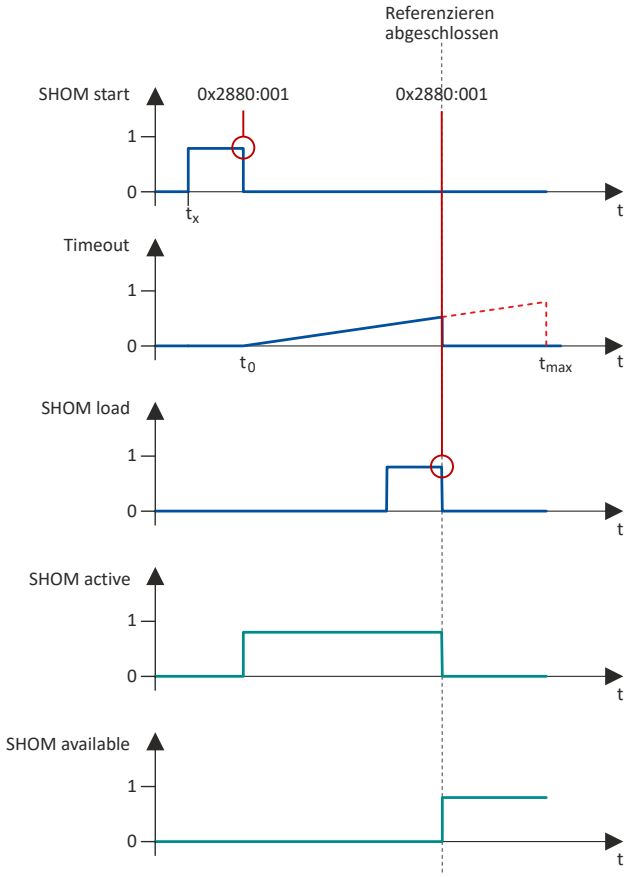


Fig. 22: Timing of the SHOM function

Activation and sequence of the reference run

1. The reference run process is started via the defined input source: 0x2880:001
2. The superimposed application must start the reference run. The drive independently takes over the motion control.
3. Homing is performed with the set safely limited speed (SLS): 0x2882:003
4. Within the defined "Timeout" period, the reference signal "SHom_Load" is expected, which sets the safe reference point "Home Position" in the absolute position range:
   - "Timeout" definition: 0x2882:002
   - Source for "SHom_Load": 0x2881:001
   - "Home Position" display: 0x2882:001
5. Once the reference point is set, the reference run is ended.
6. The drive changes to normal operation.

Display of the function status: 0x2882:006

Behavior of the function in the event of an error

A faulty reference run, e.g. due to a missing signal edge or a violation of the timing requirement, triggers STO.

Mini-homing

The minireference travel is a minimum movement to plausibilize absolute position values. It is performed and safely monitored with the Safely-limited speed (SLS) function. After a successful minireference run, the axis switches to normal operation.

The minireference run can replace the complete reference run in certain operating states:

- After mains switching
- After acknowledgement of an SSI encoder error
  - The short-time interruption of the optical signal triggers the parameterized safety function, which stops the affected axis.
  - Regardless of the triggered error reaction and the associated overtravel, however, the absolute position data continues to be determined on both channels.
- After returning from the repair mode select (RMS). ▸ Repair mode selector (RMS) 🕮 176

Preconditions

- The minireference run is only possible if a complete reference run was performed before the first call.
- The safely limited speed for the reference run must be parameterized. 0x2882:003
- "Load stored reference" is set as a restart condition. 0x2884:004 = 1
- The minimum distance for the minireference run is calculated automatically:

  Minimum distance ≥ 4 x tolerance window for the position comparison 0x287C:001

Functional description

- Operating states in which the minireference run starts automatically:
  - After mains switching
  - After acknowledgement of an SSI encoder error
  - After returning from the repair mode select (RMS)
- Sequence of the plausibility check during the minireference run:
  1. Are the saved position and the current position within the parameterized tolerance window for the starting position? 0x2882:005
  2. Are the position value currently received from the inverter and the internal position value within the parameterized tolerance window for the position comparison? 0x287C:001
  3. If the plausibility check is successful, the status bit "SHom present" is set. 0x2882:006
  4. The drive changes to normal operation.

If complete homing is to be performed via the home position switch despite the "SHom present" status bit being set, the status bit must be reset with the "Clear home position" command. 0x2110:014

Only the status bit is reset via this path. The superimposed application must start the reference run. ▸ Safe homing (SHom) 🕮 167

Behavior of the function in the event of an error

A faulty minireference run triggers STO.

A complete reference run is required.

Slip compensation

If slip between the motor encoder and load encoder is to be expected due to operation, e.g. in the case of a friction wheel drive, the slip can be cyclically evaluated and compensated for by this function.

The function is intended especially for the travel ranges outside the buffer zones. The function leads to a reduction in buffer end areas and serves to improve the availability of the system.

Slip compensation can also be permanently activated independently of a safety function.

It can be deactivated for the areas between the diagnostic positions and the end of the travel path by setting the appropriate parameters.

⚠WARNING!

The slip compensation may not be suitable for the application.

Serious injuries when exceeding the travel path.

- ▸ As part of the risk assessment for the machine, make sure that the application is suitable for slip compensation.
- ▸ Traverse the diagnostics markers cyclically when using the slip compensation.
- ▸ Define a diagnostics interval with the help of the risk assessment. The diagnostics interval must be determined via a master control component.

Preconditions

- It must be ensured that the boundary to the impermissible area A is not crossed.

  Therefore, the buffer end range must be increased by the maximum compensated slip (range B).
- The maximum compensated slip must be parameterized. 0x2885:001 > 0

  This setting activates the slip compensation.
- Upper and lower diagnostic position must be parameterized. 0x2884:002, 0x2884:003

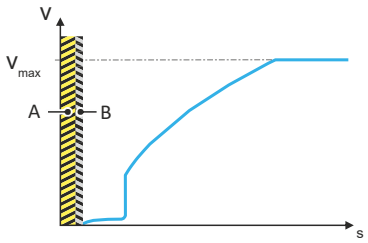


Fig. 23: End zone using the example of the PDSS safety function

A Prohibited area B Buffer end zone

Functional description

- For slip compensation, the diagnostic positions ① and ② are required so that the freedom from error of the load encoder is verified cyclically.
  - To ensure that sufficient braking distance is available in the event of an error, it must be ensured that the diagnostic positions are arranged in such a way that error detection takes place in the range of the maximum permissible speed.
  - The cycle for traversing the diagnostic positions must be controlled by the application. The cycle must be monitored in terms of safety.
- Between the diagnostic positions ① and ②, a cyclic position comparison is performed between the motor encoder and load encoder in each calculation cycle of the safety function.
- The diagnostic positions must be located in front of the buffer areas at the ends of the travel path:

Fig. 24: Position of the diagnostic marks using the example of the PDSS safety function

- When traversing the diagnostic positions, the diagnostic position is compared with the current absolute value encoder position.
- If the difference is outside the parameterized tolerance window, the parameterized error reaction is triggered.
  - Definition of tolerance window: 0x2884:004
  - Definition of error response: 0x2884:005

Safe cam (SCA)

This function monitors the lower and upper position limit.

Preconditions

The following function must be executed:

- Set upper position value.
- Set lower position value.
- Safe homing (SHom)

Functional description

In connection with this function, please also observe the information with regard to safe homing in chapter "Safe homing (SHom)". 📖 167

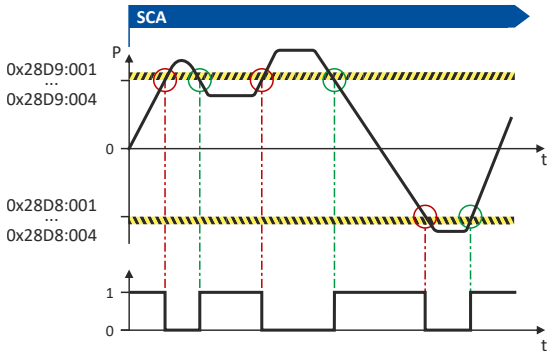


Fig. 25: SCA function

When this function is executed, the current absolute position is compared to the position limits parameterised.

- Upper position limit parameterised (0x28D9:001 ... 0x28D9:004)
- Lower position limit parameterised (0x28D8:001 ... 0x28D8:004)

The status of the position comparison is specified in a binary fashion in 0x2870:002, bit12 ... bit15.

The status is transmitted to the safety and standard application.

Activation of the function

The function is activated by entry of a parameter value (≠ 0) for the upper and lower position limit.

Operation mode selector (OMS)

This function can be used to switch between normal operation and special operation of the drive.

The special operation makes it possible to override a normal stop (STO, SS1, SS2) by enabling it via the enable switch (ES). The "emergency stop" function also has the highest priority in special operation.

For special operation, the motion function SLS and the monitoring function SLI can be parameterized separately.

If the monitoring function SMS is active, special operation is also monitored.

⚠ DANGER!

When returning to normal operation, the automatic restart is not permissible.

Severe injuries and death.

▶ Parameterize the acknowledged restart.

Preconditions

- A source for activating the function must be configured. 0x28A8
  - Only one safe input or the safety bus can be configured as a source.
  - If a safe input is configured as a source, 0x28A9:003 Function at low level must be selected carefully, since according to the closed-circuit principle, no additional danger may emanate from normal operation or special operation.
- A source for the ES enable switch must be configured. 0x28AE
- A stop function for special operation must be configured. 0x28A9:001
- A motion function for special operation must be configured. 0x28A9:002
- If the movement is to be monitored in special operation, theSLI and SMS functions can be activated for this purpose.
  - SLI: 0x28CA:003
  - SMS: 0x28B0:001 > 0 rpm

Functional description

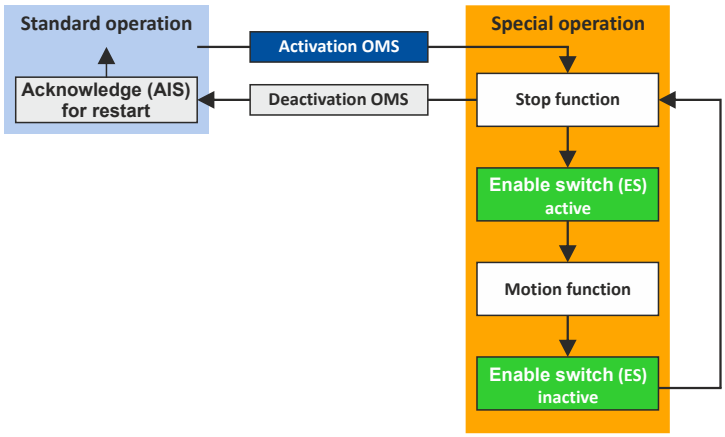


Fig. 26: OMS function

Sequence of the special operation

1. Activate OMS via the configured trigger source.
   The stop function configured for OMS is activated.
2. Activate the enable switch ES via the configured trigger source.
   The stop function is now overruled.
3. The drive can be moved with the configured motion function.
   If monitoring functions are activated, the movement is monitored.
4. When the action is complete, deactivate the ES enable switch.
   The drive can no longer be moved.
   The stop function configured for OMS is activated.
5. Deactivate the trigger source for OMS.
   The special operation is finished.
6. The drive waits for the restart to be acknowledged.
7. Acknowledge the restart via terminal AIS or the safety bus.

The drive changes to normal operation.

Behavior of the function in the event of an error

Activation of OMS via a safe input

- In case of a wire breakage at the safe input when OMS is activated via a HIGH signal:
  - OMS is deactivated.
  - The drive changes to normal operation. No stop function is triggered.
- In the event of an error at the safe input (e.g. discrepancy error):
  - OMS is deactivated.
  - The "ERR" LED is blinking.
  - The drive changes to normal operation. No stop function is triggered.
  - Once the error has been corrected and acknowledged, the special operation can be reactivated.

Activation of OMS via the safety bus

- In case of failure of safe communication:
  - OMS is deactivated.
  - The drive changes to normal operation. No stop function is triggered.

Error when executing the movement function

- When a parameterized monitoring responds:
  - The parameterized stop function for special operation is triggered.
  - The drive does not change to normal operation.

Enable switch (ES)

This function makes it possible to override the normal stop functions

- Safe torque off (STO),
- Safe stop 1 (SS1) and
- Safe stop 2 (SS2)

in special operation.

Preconditions

A safe input or the safety bus can be used for connecting an enable switch. If the safe input is used, the **ES** bit of the safety bus must be deactivated. If no safe input is parameterised, the safety bus can be used for activation.

- Activate special operation Operation mode selector (OMS).
- Activate special operation Repair mode selector (RMS).

The plausibility check rejects ambiguous settings until they are parameterised correctly.

Functional description

The enable switch activates the motion function parameterised during special operation (OMS) and the repair mode (RMS). The drive can be traversed.

The stop times assigned to the stop functions are directly deactivated or stopped.

Activation of the function

The function is activated by the ON state of a safe input if the safe input has been set as the trigger source for the function.

Only if no safe input is used, the safety bus can be set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182

Repair mode selector (RMS)

This function moves the drive from a situation that is blocking it ("Deadlock").

For example, if the load encoder or motor encoder fails, the associated drive must be moved to a position where it can be repaired.

The connected encoders are not evaluated safety-related.

Only the stop functions configurable for RMS and the enable switch ES are active. All other safety functions are deactivated.

⚠ DANGER!

Unexpected motions with unexpected speed.

Violation of the permissible movement limits.

Possible consequences: Death or severe injuries

- ▸ Use RMS exclusively to free an axis from a "deadlock".
- ▸ If necessary, take additional safety measures to ensure that no persons can be endangered, since all monitoring functions are deactivated except for the ES enable switch.
- ▸ Use the OMS function to move the drive when it is not in a "deadlock"!

⚠ DANGER!

When returning to normal operation, the automatic restart is not permissible.

Severe injuries and death.

- ▸ Parameterize the acknowledged restart.

Preconditions

- A source for activating the function must be configured. 0x28AB
  - Only one safe input or the safety bus can be configured as a source.
- A source for the ES enable switch must be configured. 0x28AE
- A stop function for special operation must be configured. 0x28A9:001

Functional description

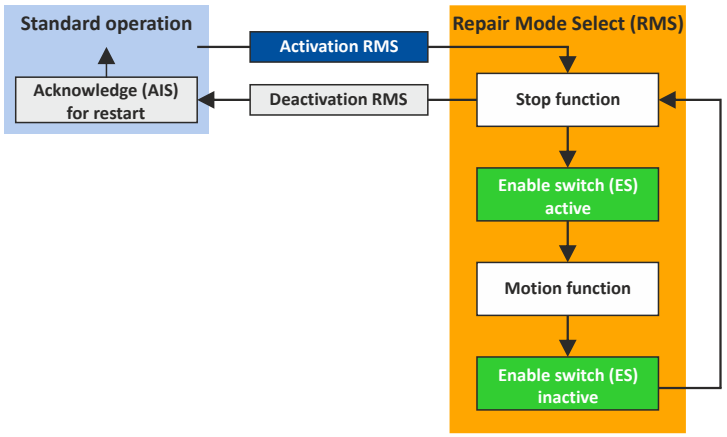


Fig. 27: RMS function

Repair mode select procedure

1. Activate RMS via the configured trigger source.
   The stop function configured for RMS is activated.
   Speed functions and absolute position functions are deactivated.
   The SHom status is reset.
2. Activate the enable switch ES via the configured trigger source.
   The stop function is now overruled.
3. The drive can now be released from the "deadlock".
4. When the action is complete, deactivate the ES enable switch.
   The drive can no longer be moved.
   The stop function configured for RMS is activated.
5. Deactivate the trigger source for RMS.
   The encoder evaluation is switched active again.
   The repair mode is finished.
6. The minireference run starts automatically.
7. **Procedure for successful minireference run**
   1. The drive waits for the restart to be acknowledged.
   2. Acknowledge the restart via terminal AIS or the safety bus.
      The drive changes to normal operation.
8. **Procedure in the event of an incorrect minireference run**
   1. STO is triggered.
   2. A complete reference run is required. ▸ Safe homing (SHom) 🕮 167
      After completion of the reference run, the drive switches to normal operation.

Behavior of the function in the event of an error

A faulty minireference run after the end of the repair mode triggers STO.

A complete reference run is required before normal operation can be resumed. ▸ Safe homing (SHom) 🕮 167

STO cascading (CAS)

This function allows for the synchronised shutdown of an entire drive network.

Preconditions

- Input SD-In4 must be parameterized in 0x2124 as source for requesting cascading.
- A value ≤ 10 ms must be parameterized for SD-In4 as the active input for the "Emergency Stop" function and the input delay.
- The function "Safe stop emergency (SSE)" must be parameterized in Safe torque off (STO) as the stop function to be executed.
- As restart behavior of the drive after executing the function "Safe torque off (STO)", "Acknowledged restart" must be parameterized in 0x2892:001.
- The control of the output SD-OUT1 via a parameterized safety bus must be locked. See chapter "Safe network interfaces". 📖 182

The plausibility check rejects other settings until the plausibility check is correctly parameterized.

- When using the cascading safety function in connection with a special operation, "SS2" must be parameterized as stop function in operating mode selector switch (OMS).

The stop function STO will trigger the "Cascading" function. Confirmation with the enable switch (ES) is not possible.

Description of the principle

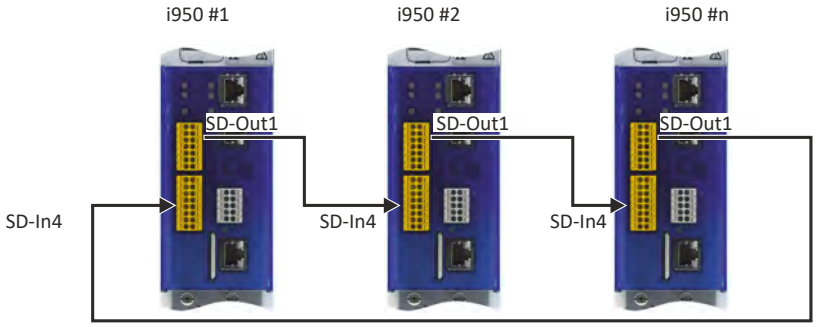


Fig. 28: CAS function

With 0x2125:001, the time period is shown, which elapses from switching the SD-Out1 output to the OFF state to recording the OFF state at the SD-In4 input.

- If, after a stop, the time period "0 ms" is shown, another safety function has triggered the stop via the cascade.
- The time period is shown until the next system acknowledgement takes place.

Activation of the function

The function is activated by parameterisation of the SD-In4 input as source for a cascading request in 0x2124.

Safe brake control (SBC)

(From standard device firmware V1.3, safety firmware V1.1 with parameter set version V1.1)

This function provides for a safe brake control by the inverter.

The internal test rate of the brake output (X106) restricts the request rate to max. 1 brake request/10 seconds.

An application-dependent test rate of the connected brake reduces the request rate accordingly.

Conditions

In order to use the SBC function, the following conditions must be fulfilled:

- The brake is connected to X106.
- Brake function and monitoring of the brake control are controlled via X106. ▸ Motor holding brake connection 📖 61
- Parameter 0x2820:023 and 0x2820:005:
  - Both parameters must be set to "0".
  - Other settings are not compatible with the SBC function.

    The warning "Incompatible SBC device configuration - 0x6187" is output.

    STO stop function is activated.

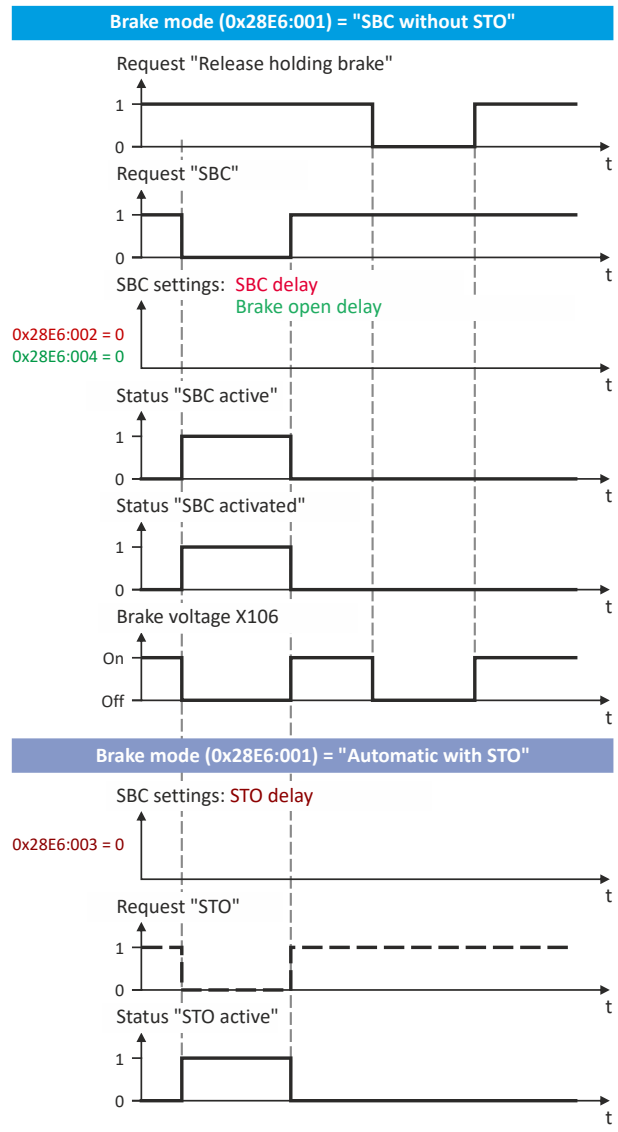
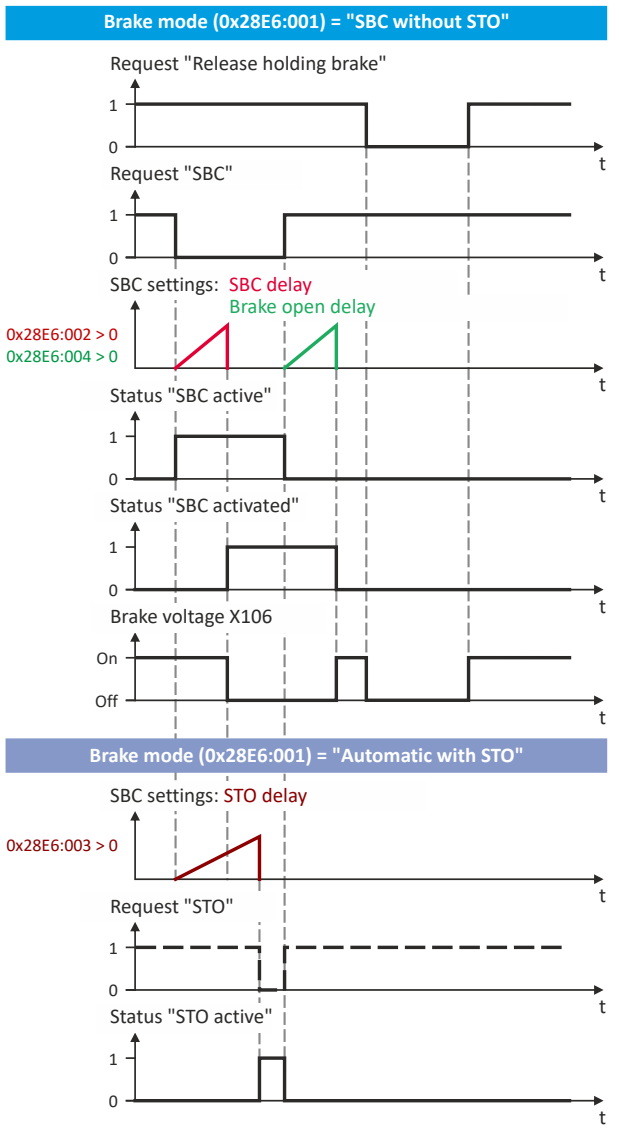
⚠ DANGER!

Use of non-safety-rated brakes

Severe injuries or death.

▸ Only use safety-rated brakes with suitable safety-related parameters according to EN ISO13849-1 and/or EN 62061 or IEC 61508.

Functional description

Control of the SBC function without time delay	Control of the SBC function with time delay
	

Activation of the function

The following options are available to activate the function:

- Via a safe input, if the safe input has been set as the trigger source for the function.
- Via the safety bus, if the safety bus has been set as trigger source for the function. See also chapter "Safe network interfaces". 📖 182

Response of the function in the event of an error

If an error is detected, the brake control is switched off.

In the "SBC without STO" mode (0x28E6:001 = 1), no stop function is activated in the event of an error.

Safe Muting (MUT)
(From standard device firmware V1.3, safety firmware V1.1 with parameter set version V1.1)

The “safe muting” safety function may only be used during commissioning or maintenance work.

It serves to move the motor even if the inverter is in a safety state.

The safe muting function deactivates selected safe inputs and all functions of the safety bus.

The safe muting function can only be activated via the LSPE (Lenze Safety Parameter Editor). For this purpose, a special muting password must be entered.

Within a network, the safe muting function can always only be activated for one inverter.

The safe muting function is maximally active for 30 minutes. It can be interrupted or stopped anytime.

Please note the following:

If the safe muting function is stopped or interrupted by an error, the inverter automatically changes to the monitored state.

All safety functions that have been deactivated before become active again.

⚠ DANGER!

Activating the safe muting function deactivates safety functions!

This may result in severe injuries or death!

- ▸ Only authorized personnel is permitted to activate the safe muting function.
- ▸ One input must be parameterized as emergency stop. This input must not be deactivated by safe muting.

Conditions

In order to activate the safe muting function, you need the following:

- A PC with »EASY Starter« (1.16 or higher) or »PLC Designer« with LSPE (Lenze Safety Parameter Editor).
- A permanent communication link between LSPE and inverter.

  If the connection is interrupted during safe muting, safe muting is aborted immediately with an error message. The inverter changes to the monitored operation where all safety functions are active again.
- A valid parameter set that contains the settings for safe muting:
  - The sources to be hidden. 0x213A
  - The muting password. 0x213B:001

Activation of the function

Activate safe muting

1. Go to the »EASY Starter« or »PLC Designer« and open the **Safety parameter list** tab.
2. Select safe muting.
3. Enter password.
4. Check information in the window and ensure that the correct device has been selected.
   The optical device detection is activated automatically. The blinking blue LED indicates the inverter with activated safe muting.
5. **Start** activates the safe muting function.

The safe muting function is active now.

Deactivation of the function

Deactivate safe muting

1. **Close** deactivates the safe muting function for the input.

The safe muting function is inactive now.

Safe network interfaces

PROFIsafe connection

From safety firmware V1.1 with parameter set version V1.1

PROFIsafe is the certified safety protocol for the transmission of safety-related data via PROFINET®.

The function supports the transfer of secure information via the PROFIsafe protocol according to the specification "PROFIsafe Profile for Safety Technology", Version 2.0, of the PROFIBUS user organization (PNO). The inverter forwards the PROFIsafe information to the function for secure evaluation.

Operation with PROFIsafe via PROFINET is only permitted according to the specification PROFIsafe Profile for Safety Technology Version 2.x!

Addressing

In order to ensure that a data telegram reaches the right node, a unique PROFIsafe destination address is necessary. If PROFIsafe has been chosen as the safety bus, the safety address will be used as the PROFIsafe destination address. This address must match the corresponding configuration of the safety PLC.

PROFIsafe Frame

The PROFIsafe data is transmitted in the second slot of a PROFINET data telegram. This must be taken into account during the hardware configuration of the safety PLC.

PROFINET data telegram			
Header	**Slot 1**	**Slot 2**	**Trailer**
	Data	PROFIsafe data	

PROFIsafe data

In the PROFIsafe data, a bit is used to control a safety function. The structure of the PROFIsafe data is described in the PROFIsafe profile. The length of the PROFIsafe data (or PROFIsafe message) is 16 bytes.

PROFIsafe message V2 mode								
	Bit offset							
Byte offset	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0...11	PROFIsafe process data (PROFIsafe output data/PROFIsafe input data)							
12	Control byte or status byte							
13...15	CRC2 Signature from PROFIsafe process data, the PROFIsafe parameters and the running numbers.							

The meaning of the PROFIsafe process data is described separately in the following chapters according to PROFIsafe output data and PROFIsafe input data.

PROFIsafe output data

The PROFIsafe output data (control data) is transmitted from the control.

The "S bus: display control data" parameter (0x2874) displays the control data.

If not stated otherwise in the table, the functions are LOW active, i. e. the bit state "0" activates the respective function.

	Bit offset							
Byte offset	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	SDIpos	SLS4	SLS3	SLS2	SLS1	SS2	SS1	STO
Byte 1	SLP4	SLP3	SLP2	SLP1	OMS (HIGH active)	SLI	ES (HIGH active)	SDIneg
Byte 2	SSE	PDSS	SHOM Load (0↗1)	SHOM Start (0↗1)	RMS (HIGH active)	SOS	AIE (0↗1)	AIS (0↗1)
Byte 3	-	-	-	-	-	-	SBC	SD-Out1 (HIGH active)
Byte 4	-	-	-	-	-	-	-	-
Byte 5	-	-	-	-	-	-	-	-
Byte 6	-	-	-	-	-	-	-	-
Byte 7	-	-	-	-	-	-	-	-
Byte 8	-	-	-	-	-	-	-	-
Byte 9	-	-	-	-	-	-	-	-
Byte 10	-	-	-	-	-	-	-	-
Byte 11	-	-	-	-	-	-	-	-
Byte 12	Status byte							
Byte 13	CRC2 (consecutive number)							
Byte 14								
Byte 15								

PROFIsafe input data

The PROFIsafe input data (status information) is transmitted to the control.

The status information is HIGH active.

	Bit offset							
Byte offset	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	SDIpos active	SLS4 active	SLS3 active	SLS2 active	SLS1 active	SS2 active	SS1 active	STO active
Byte 1	SLP4 monitored	SLP3 monitored	SLP2 monitored	SLP1 monitored	SOS active*	SLI active	ES active	SDIneg active
Byte 2	SSE active	SDIneg monitored	SDIpos monitored	SLS4 monitored	SLS3 monitored	SLS2 monitored	SLS1 monitored	SOS monitored
Byte 3	Fault active	SMS monitored	OMS active	RMS active	SD-In4	SD-In3	SD-In2	SD-In1
Byte 4	SCA4 within the limits	SCA3 within the limits	SCA2 within the limits	SCA1 within the limits	PDSSneg monitored	PDSSpos monitored	SHOM available	SHOM active
Byte 5	MUT active	SBC activated	SBC active	SD-Out1	Positive direction of movement	n=0	Safe speed OK	SSM within the limits
Byte 6	n safe, byte 0							
Byte 7	n safe, byte 1							
Byte 8	p safe, byte 0							
Byte 9	p safe, byte 1							
Byte 10	p safe, byte 2							
Byte 11	p safe, byte 3							
Byte 12	Status byte							
Byte 13	CRC2 (consecutive number)							
Byte 14								
Byte 15								

FSoE connection

FSoE availability

i950 extended safety Technology application		FSoE via onboard EtherCAT		FSoE via EtherCAT module I9MAFT0000000S	
		From safety firmware V1.1 with parameter set version V1.1		From safety firmware V1.2 with parameter set version V1.2	
		With Lenze components	With Beckhoff components	With Lenze components	With Beckhoff components
	EtherCAT master	Lenze Controller	Beckhoff PLC	Lenze Controller	Beckhoff PLC
	FSoE master	Lenze c250-S	TwinSAFE	Lenze c250-S	TwinSAFE
Device profile CiA 402 (0x4000 = 0)		From device firmware V01.04.01 Without SD card	-	-	
CiA 402 Advanced (0x4000 = 1)		From device firmware V01.04.01 With SD card	From device firmware V01.03.07 With SD card	-	
All other technology applications (0x4000 > 1)				From device firmware V01.04.01 With SD card	

Safety over EtherCAT®

Fail-safe-over-EtherCAT (FSoE) enables the transmission of safe information via FSoE protocol according to ETG.5100 S specification, version 1.2.0 of the EtherCAT user organisation (ETG).

Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

ESI file

The ESI file can be used to integrate Lenze EtherCAT devices into the EtherCAT configuration software of PLC manufacturers.

The ESI file is NOT required for Lenze controllers with EtherCAT master functionality. For Lenze controllers, all device description files are installed with Lenze PLC Designer and Lenze Package Manager.

Download of the current ESI file → www.lenze.com

Addressing

A definite FsoE address ensures that a data frame reaches the correct node. If "FSoE" has been selected as safety bus, the safety address is at the same time accepted as the FSoE target address. This address must match the corresponding configuration of the safety PLC.

The checksums (CRC) of a parameter set are calculated via the set safety parameters. The calculated checksums of the safety parameter set must match the corresponding configuration of the safety PLC.

FSoE frame

Range	Values
FSoE data	Safety outputs: 11 bytes
	Safety inputs: 31 bytes

FSoE output data

The FSoE output data (control data) is transmitted from the control.

	Bit offset							
Byte offset	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	Command (CMD)							
Byte 1	AIE	SDIneg	SDIpos	-	SOS	SS2	SS1	STO
Byte 2	SSE	SLI	ES	RMS	OMS	SHOM load	SHOM start	AIS
Byte 3	CRC_0 (low-byte)							
Byte 4	CRC_0 (high-byte)							
Byte 5	SLP4	SLP3	SLP2	SLP1	SLS4	SLS3	SLS2	SLS1
Byte 6	-	-	-	-	-	SBC	SD-Out1	PDSS
Byte 7	CRC_1 (low-byte)							
Byte 8	CRC_1 (high-byte)							
Byte 9	Connection-ID (low-byte)							
Byte 10	Connection-ID (high-byte)							

FSoE input data

The FsoE input data (status information) is transmitted to the control.

	Bit offset							
Byte offset	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	Command (CMD)							
Byte 1	Error active	SDIneg active	SDIpos active	-	SOS active	-	-	STO active
Byte 2	SSE active	SLI active	ES active	RMS active	OMS active	SOS observed	SS2 active	SS1 active
Byte 3	CRC_0 (low-byte)							
Byte 4	CRC_0 (high-byte)							
Byte 5	SLS4 observed	SLS3 observed	SLS2 observed	SLS1 observed	SLS4 active	SLS3 active	SLS2 active	SLS1 active
Byte 6	SCA4 withinLimit	SCA3 withinLimit	SCA2 withinLimit	SCA1 withinLimit	SLP4 observed	SLP3 observed	SLP2 observed	SLP1 observed
Byte 7	CRC_1 (low-byte)							
Byte 8	CRC_1 (high-byte)							
Byte 9	SSM within limits	SMS observed	PDSSneg obs.	PDSSpos obs.	SDIneg observed	SDIpos observed	SHom available	SHom active
Byte 10	-	-	-	-	MUT active	Positive direction	n=0	Safe speed OK
Byte 11	CRC_2 (low-byte)							
Byte 12	CRC_2 (high-byte)							
Byte 13	-	-	-	-	SD-In4	SD-In3	SD-In2	SD-In1
Byte 14	-	-	-	-	-	SBC activated	SBC active	SD-Out1
Byte 15	CRC_3 (low-byte)							
Byte 16	CRC_3 (high-byte)							
Byte 17	Actual Speed n_safe, Byte 0							
Byte 18	Actual Speed n_safe, Byte 1							
Byte 19	CRC_4 (low-byte)							
Byte 20	CRC_4 (high-byte)							
Byte 21	Actual Position p_safe, Byte 0							
Byte 22	Actual Position p_safe, Byte 1							
Byte 23	CRC_5 (low-byte)							
Byte 24	CRC_5 (high-byte)							
Byte 25	Actual Position p_safe, Byte 2							
Byte 26	Actual Position p_safe, Byte 3							
Byte 27	CRC_6 (low-byte)							
Byte 28	CRC_6 (high-byte)							
Byte 29	Connection-ID (low-byte)							
Byte 30	Connection-ID (high-byte)							

Acceptance

If parameters of the safety functions are changed, the inspector must repeat the test and record the results in the test report.

Description

The machine manufacturer must check and prove the operability of the safety functions used.

Inspector

The machine manufacturer must authorize a person with expertise and knowledge of the safety functions to carry out the test.

Inspection report

The test result of every safety function must be documented and signed by the inspector.

Scope of inspection

A complete test comprises the following:

- Documenting the plant including the safety functions:
  - Creating an overview of the installation
  - Describing the installation
  - Describing the safety equipment
  - Documenting the safety functions used
- Checking the function of the safety functions used.
- Preparing the test report:
  - Documenting the functional test
  - Checking the parameters
  - Signing the test report
- Preparing the appendix with test records
  - Logs from the installation
  - External recording

Periodic inspections

After installation and after every modification, the user must check and validate the safety function.

The user must document these tests.

Check the operational flow of the safety-related functions at regular intervals. The risk analysis or prevailing regulations determine the time intervals between the inspections.

LED status display

The LEDs "RDY" and "ERR" show the current safety status:

LED display after initialization/during operation

LED "RDY" (yellow)	Status	Meaning
off	-	No status message active
on (yellow)	Restart acknowledgement requested	
blinking yellow 2 Hz	SOS active	
blinking yellow 1 Hz	Service status	Transfer of parameter set requested.

"ERR" LED (red)	Status	Meaning
off	-	The device is working correctly.
blinking red 2 Hz	Safety bus error	Communication via the safety bus is not established: • There is no valid configuration. • The start-up has not been completed yet.
blinking red 1 Hz	Safety technology error	One of the following errors has been detected: • Monitoring device was activated • Discrepancy of the inputs • Acknowledgeable errors

LED display for critical device errors

LED "RDY" (yellow)	"ERR" LED (red)	Status	Meaning
From safety firmware 1.0.x			
off	on (red)	Critical	The device is defective. It must be replaced.
From safety firmware 1.3.x			
blinking yellow	blinking red	Critical	The device is defective. It must be replaced.

For more information on diagnostics and fault elimination, refer to the inverter commissioning document.

LED status during parameter set transfer

LED "RDY" (yellow)	"ERR" LED (red)	Meaning
on	blinking 1 Hz	A modified parameter set was detected during start-up. Acknowledge with button S82.
	blinking 2 Hz	A modified safety address has been detected during the parameter set transfer in the "Init" state. Acknowledge with button S82.

Acknowledging the parameter set or the safety address

The parameter set and the safety address are acknowledged by the same procedure.

The parameter set transfer is aborted if the response time of 2.5 seconds is exceeded.

The parameter set transfer must be repeated.

How to acknowledge the parameter set or the safety address.

- The "RDY" LED is lit.
- The "ERR" LED is blinking.

1. Press and hold the S82 button.
   The "RDY" LED starts blinking.
2. The "RDY" LED goes off after 3 seconds.
3. Release the S82 button within the space of 2.5 seconds.
   The "RDY" LED is lit.
4. Press and hold the S82 button within the space of 2.5 seconds.
   The "RDY" LED starts blinking.
5. The "RDY" LED goes off after 3 seconds.
6. Release the S82 button within the space of 2.5 seconds.
   The new parameter set or new safety address has been acknowledged.

The action is recorded in the inverter logbook.

If the parameter set is invalid, an error is reported and the "ERR" LED starts blinking.

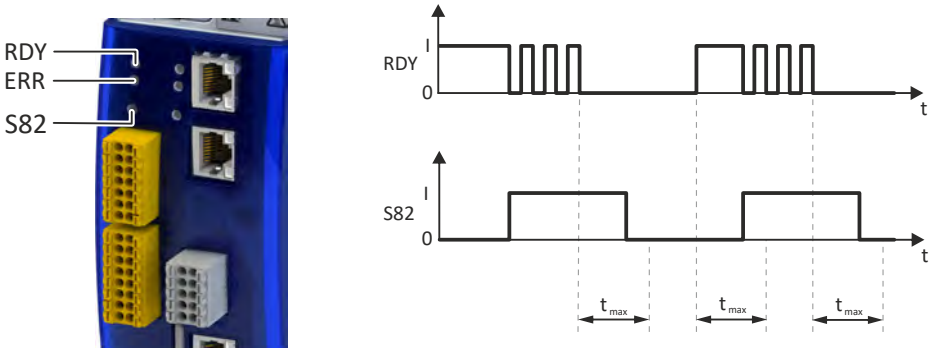


Fig. 29: Sequence of the acknowledgement procedure

RDY	"RDY" LED	tmax	Maximum permissible response time
S82	S82 button		
t	Time axis		

Technical data

Safety-related characteristics Basic Safety - STO

Safety-related characteristics according to EN 61508, Part 1–7 and EN 62061

Specification	Value	Comment
Safety Integrity Level	SIL 3	
PFH [1/h]	< 1 E−09	< 1 % of SIL 3
PFD_{avg} (T)	< 1 E−04	< 10 % of SIL 3 after T = 20 years
SFF	99 %	
Proof test interval T	20 years	Mission time

Safety-related characteristics according to EN ISO 13849–1

Specification	Value	Comment
Performance Level	e	
Category	4	
$MTTF_d$	High	> 100 years
Mean diagnostic coverage DC_{avg}	High	99 %

Basics of the safety-related characteristics

Basics	Value	Comment
Source of failure rates	SN 29500	When no values from the component manufacturers were available.
Average max. ambient temperature	60 °C	

Safety-related characteristics Extended Safety

The achievable risk reductions (PL/SIL) also depend on the motor/encoder combination used.

Match the values given here with the values for the motor/encoder combinations:

▸ Motor-encoder combinations 📖 146

Safety-related characteristic values for all safety functions except SBC for drive systems with motors with resolvers and SinCos encoders

Safety-related characteristics according to IEC 61508, Part 1–7 and EN 62061

Specification	Value	Comment
Safety Integrity Level	SIL 3	
PFH [1/h]	< 1 E–09	< 1 % of SIL 3
PFD_{avg} (T)	< 1 E–04	< 10 % of SIL 3 after T = 20 years
SFF	99 %	
Proof test interval T	20 years	Mission time

Safety-related characteristics according to EN ISO 13849–1

Specification	Value	Comment
Performance Level	e	
Category	4	
$MTTF_d$	High	> 250 years
Mean diagnostic coverage DC_{avg}	High	95 %

Characteristic safety values for all safety functions except SBC for drive systems with motors with all HIPERFACE DSL® encoders (OCT)

Safety-related characteristics according to IEC 61508, Part 1–7 and EN 62061

Specification	Value	Comment
Safety Integrity Level	SIL 2	
PFH [1/h]	< 5 E–09	< 0.5 % of SIL 2
PFD_{avg} (T)	< 5 E–04	< 5 % of SIL 2 after T = 20 years
SFF	> 90 %	
Proof test interval T	20 years	Mission time

Safety-related characteristics according to EN ISO 13849–1

Specification	Value	Comment
Performance Level	d	
Category	3	
$MTTF_d$	High	> 300 years
Mean diagnostic coverage DC_{avg}	Medium	> 90 %

Basics of the safety-related characteristics

Basics	Value	Comment
Source of failure rates	SN 29500	When no values from the component manufacturers were available.
Average max. ambient temperature	60 °C	

Safety-related characteristic values for the SBC safety function independent of the parameterized motor encoder system

Safety-related characteristics according to IEC 61508, Part 1–7 and EN 62061

Specification	Value	Comment
Safety Integrity Level	SIL 2	
PFH [1/h]	< 1 E–08	< 1 % of SIL 2
PFD_{avg} (T)	< 1 E–03	< 10 % of SIL 2 after T = 20 years
SFF	99 %	
Proof test interval T	20 years	Mission time

Safety-related characteristics according to EN ISO 13849–1

Specification	Value	Comment
Performance Level	d	
Category	2	
$MTTF_d$	High	> 230 years
Mean diagnostic coverage DC_{avg}	High	95 %

Basics of the safety-related characteristics

Basics	Value	Comment
Source of failure rates	SN 29500	When no values from the component manufacturers were available.
Average max. ambient temperature	60 °C	

Response times

The overall system must be taken into account when determining the response time following a safety function request.

Decisive for the reaction time are:

- Response time of the connected safety sensors.
- Input delay of the safety inputs.
- Internal processing time.
- Deceleration times, braking times, and stopping times from the parameterized safety functions.
- When a feedback system is used:
  - The response time of encoder monitoring. 0x2878:004
- When a safety bus is used:
  - Monitoring time for cyclic services.
  - Monitoring time in the safety PLC.
  - Processing time in the safety PLC.
- Delay times due to further components.

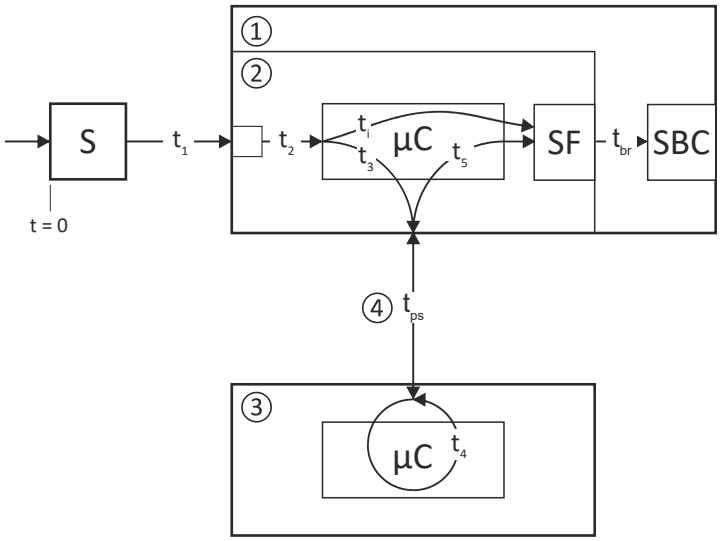


Fig. 30: Response times to the request of a safety function

1	Standard device	µC	Microcontroller
2	Integrated safety	S	Safety sensors
3	Safety PLC	SF	Activated safety function
4	Safety bus	SBC	Safe Brake Control

Response times of safe inputs

Response time to an event in the safety sensors			[ms]
t_1	Response time of the safety sensors		according to manufacturer information
t_2	Input delay of the safe inputs		
		Parameterizable via: 0x211A:001, 0x211A:002, 0x211A:003, 0x211A:004	0...100
		Input filter	2
t_i	Processing time in drive-based safety sensor technology		4
	Safety function starts after		$t_1 + t_2 + t_i$

Tab. 1: Response time to an event in the safety sensors

Response time of the safe output

Response time of the safe output to a safety function		[ms]
	Safe output SD-Out 1 switches to	4

Tab. 2: Response time - safe output

Response times of safe SBC brake control

Response time from the detection of the SBC safety function to the switch-off of the safe brake control			[ms]
t_{br}	Delay time between request and activation of the brake control		
		Parameterizable via: 0x28E6:2	0 ... 30000
t_i	Processing time in drive-based safety sensor technology		4
	Control X106 starts after		$t_{br} + t_i$

Test pulse interval and error response time		[ms]
	Test pulse interval, brake control	100
	Error response time, min. time for error detection and error triggering	200

Response time of encoder monitoring

Time required to detect faults caused by continuous signal errors at the encoder interface.			[ms]
		Default setting	50
		Parameterizable via: 0x2878:004	12/50/100

It must be evaluated for each application what minimum response time is possible.

The longer the reaction time, the more the safe speed is filtered. For dynamic processes (acceleration, deceleration), this behavior must be taken into account in the safe parameterization of speed limit values.

Response times of the safety bus

Response time to an event on the safety sensors (input data)			[ms]
t_1	Response time of the safety sensors		See manufacturer information
t_2	Input delay of the safe inputs		
		Parameterizable via: 0x211A:001, 0x211A:002, 0x211A:003, 0x211A:004	0...100
		Input filter	2
t_3	Processing time in integrated safety technology		
	Main Task cycle time	Technology application	1
		PLC project	As set
	Internal transmission time PROFIsafe	Safety: from firmware 1.0.1 Standard device: from firmware 1.2	40
	Internal transmission time FSoE	Safety: from firmware 1.1.x Standard device: from firmware 1.3	8
Input data ready for transmission			$t_1 + t_2 + t_3$
t_{ps}	PROFINET cycle time		See manufacturer information
	EtherCAT cycle time		See manufacturer information
Input data ready for processing in the safety PLC			$t_1 + t_2 + t_3 + t_{ps}$

Tab. 3: Response time to an event on the safety sensors

Response time to a control word (output data)			[ms]
t_4	Processing time in the safety PLC		Calculate
t_{ps}	PROFINET cycle time		See manufacturer information
	EtherCAT cycle time		See manufacturer information
t_5	Processing time in integrated safety technology		
	Main Task cycle time	Technology application	1
		PLC project	As set
	Internal transmission time PROFIsafe	Safety: from firmware 1.0.1 Standard device: from firmware 1.2	108
	Internal transmission time FSoE	Safety: from firmware 1.1.x Standard device: from firmware 1.3	16
Safety function starts after			$t_4 + t_{ps} + t_5$

Tab. 4: Response time for request via the safety bus

Information on how to calculate the processing time and transmission time of the safety bus can be found in the documentation of the safety PLC used.

When the safety bus communication is disturbed, it is changed to the fail-safe state after the safety bus monitoring time (F_WD_Time) has elapsed. The safety bus communication is passivated.

Example

- After an event at a safe input, the message is fed back to the integrated safety technology via the safety PLC.
- The integrated safety technology then triggers a safety function.
- The maximum response time to the event is then calculated to:
  - $t_{max} = t_1 + t_2 + t_3 + \max (F\_WD\_Time; t_{ps} + t_4 + t_{ps} + t_5)$
  - Include the times of the safety functions in the calculation, e.g. for SS1 the stopping time until STO is active. 0x2894:001

Parameter set acceptance from the SD card

Safe parameter set acceptance is supported by means of a safe parameter set saved in the device.

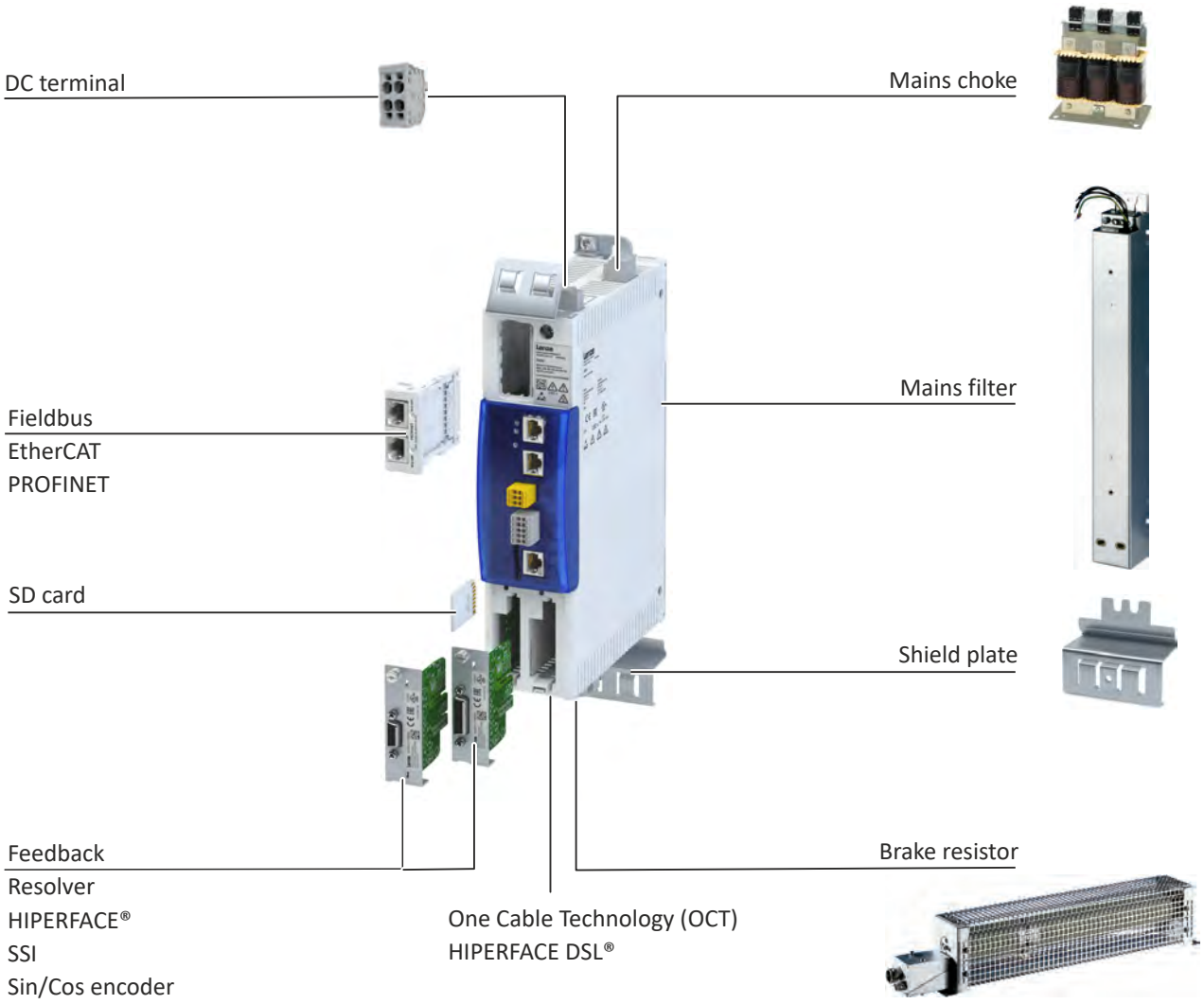
Accessories

Purpose-built accessories support the realisation of drive tasks with the inverter.

Overview

For the i950 servo inverter, the following accessories are available:

- Potentiometer 196
- Memory modules 196 (as SD card)
- Brake resistors 197
- RFI filters / Mains filters 198
- Regenerative modules 199
- Power supply units 199
- Mounting 200 (kits for installation)
- System cables 202 (cable and system cables)



Operation and diagnostics

Control and display elements

Potentiometer

For the external selection of an analog setpoint.

The setpoint selection (e.g. motor speed) can be manually set via the external potentiometer. The potentiometer is connected to the analog input terminals of the inverter.

The position is displayed on the scale via the rotary knob.

The components have to be ordered separately.

Potentiometer		
Order code	**Name**	**Type**
ERPD0010K0001W	Potentiometer	10 kΩ/1 W
ERZ0001	Rotary knob	Diameter 36 mm
ERZ0002	Scale	Scale 0 … 100 %, Diameter 62 mm

Memory modules

All settings can be stored in a storage module.

The servo inverter uses an SD card as its storage module.

This SD card is not commercially available, as it contains Application Credit. Application Credit is required for the use of technology applications (TA).

SD card with Application Credit

Application Credit	Order code
50	EPCZEMSD0L1005
100	EPCZEMSD0L1010
150	EPCZEMSD0L1015
200	EPCZEMSD0L1020
300	EPCZEMSD0L1030
400	EPCZEMSD0L1040

Overview of the required Application Credit

	Technology applications	Technology modules	Required Application Credit
Actuating drive	CiA 402	-	0
	CiA 402 Advanced		50
Parameterizable	Speed control Electronic gearbox Table positioning	-	50
	Synchronism with mark correction Winder with dancer control Winder with tension control		100
Programmable	Speed control Electronic gearbox Table positioning	Speed control Electronic gearbox Table positioning Flex CAM	≥ 150
	Synchronism with mark correction Winder with dancer control Winder with tension control	Sync & correction Winder dancer Winder tension Cross cutter	≥ 200
	-	User	≥ 300

Brake resistors

- To decelerate greater moments of inertia or with a longer operation in generator mode an external brake resistor is required.
- The brake resistor absorbs the produced brake energy and converts it into heat.

The matching assignment of these accessories is specified in the technical data of the devices.

RFI filters / Mains filters

RFI and mains filters are used to ensure compliance with the EMC requirements of European Standard EN 61800-3. This standard defines the EMC requirements for electrical drive systems in various categories.

- RFI filters are capacitive accessory components. RFI filters reduce conducted noise emissions. RFI filters are also called EMC filters.
- Mains filters are a combination of mains choke and RFI filter. Mains filters reduce the conducted noise emission.

Definition of the environments

(EN 61800−3)

First environment

The first environment comprises residential buildings or locations that are directly connected to a low-voltage system for supplying residential areas.

Second environment

The second environment comprises facilities or locations that are not directly connected to a low-voltage system for supplying residential areas.

Category C1

Category C1 defines the requirements for drive systems that are intended for the use in the first environment at a rated voltage lower than 1000 V.

The limit values of the EN 61800−3 comply with EN 55011 class B.

Category C2

Category C2 defines the requirements for permanently installed fixed drive systems that are intended for the use in the first environment at a rated voltage lower than 1000 V. Installation and commissioning may only be carried out by specialist personnel with EMC knowledge.

The limit values of the EN 61800−3 comply with EN 55011 class A group 1.

Category C3

Category C3 defines the requirements for drive systems that are exclusively intended for the use in the second environment at a rated voltage lower than 1000 V.

The limit values of the EN 61800−3 comply with EN 55011 class A group 2.

The matching assignment of these accessories is specified in the technical data of the devices.

Regenerative modules

For feeding energy from the DC bus of a drive system back into a 3-phase AC system

r750 regenerative module

Device features:

- Self-synchronizing with the AC system
- Automatic operation
  - Self-optimizing
  - Self-parameterizing
  - No parameterization of operating conditions required
- Scaling of the regenerative power by parallel operation of further regenerative modules of this series
- Controlling power peaks by parallel operation of a brake chopper is possible
- High peak regenerative power
- High efficiency
- Operation without external filters possible
- Polarity reversal protection of the device is integrated in the DC-bus connection.
- Operation without external supply voltage
  - Direct supply from the DC bus or from the AC system
- Measured value via the regenerated energy

Further information can be found in the mounting and switch-on instructions for the r750 regenerative module.

Power supply units

For the external supply of the control electronics of the inverter.

The parameterization and diagnostics can be executed when the mains input at the inverter is deenergized.

Order code		EZV1200-000	EZV2400-000	EZV4800-000	EZV1200-001	EZV2400-001	EZV4800-001
Rated voltage	V	230			400		
Rated mains current	A	0.8	1.2	2.3	0.3	0.6	1.0
Input voltage	V	AC 85 - 264 DC 90 ...350			AC 320 ... 575 DC 450 ...800		
Output voltage	V	DC 22.5 - 28.5					
Rated output current	A	5.0	10.0	20.0	5.0	10.0	20.0

Mounting

Shield mounting kit

Motor cable

If the shielding of the motor cable is centrally connected to an earthing busbar in the control cabinet, no shielding is required.

For a direct connection of the shielding of the motor cable to the inverter, the optionally available accessories can be used consisting of shield sheet and fixing clips or wire clamps.

From 22 kW onwards, the shield sheet is integrated.

Inverter	Shield mounting			
	Order code	Packaging unit	Order code	Packaging unit
		Piece		Piece
i950-C0.37/230-2	EZAMBHXM018/M	5x motor shield plate 5x fixing clip 5x terminal clamp (cable diameter 4 ... 15 mm)	EZAMBHXM018/S	1x motor shield plate 1x fixing clip 1x terminal clamp (cable diameter 4 ... 15 mm)
i950-C0.55/230-2				
i950-C0.75/230-2				
i950-C1.5/230-2				
i950-C2.2/230-3				
i950-C0.55/400-3				
i950-C0.75/400-3				
i950-C2.2/400-3				
i950-C4.0/400-3				
i950-C4.0/230-3	EZAMBHXM016/M	5x motor shield plate 5x fixing clip 5x terminal clamp (cable diameter 10 ... 20 mm) 5x screw M4x12	EZAMBHXM016/S	1x motor shield plate 1x fixing clip 1x terminal clamp (cable diameter 10 ... 20 mm) 1x screw M4x12
i950-C5.5/230-3				
i950-C7.5/400-3				
i950-C11/400-3				
i950-C15/400-3				
i950-C22/400-3	EZAMBHXM003/M	10x terminal clamp (cable diameter 10 ... 20 mm)	EZAMBHXM004/M	10x terminal clamp (cable diameter 15 ... 28 mm)
i950-C30/400-3	EZAMBHXM004/M	10x terminal clamp (cable diameter 15 ... 28 mm)	EZAMBHXM005/M	10x terminal clamp (cable diameter 20 ... 37 mm)
i950-C45/400-3				
i950-C55/400-3	EZAMBHXM004/M	10x terminal clamp (cable diameter 15 ... 28 mm)	EZAMBHXM005/M	10x terminal clamp (cable diameter 20 ... 37 mm)
i950-C75/400-3				
i950-C90/400-3	-	-	-	-
i950-C110/400-3				

Terminal strips

For connecting the inverter, the connections are equipped with pluggable terminal strips.
Pluggable terminal strips are available separately for service purposes or if cable harnesses need to be physically separated.

Inverter	Terminal strips			
	Basic Safety - STO version		Extended Safety version	
	Order code	Packaging unit Piece	Order code	Packaging unit Piece
i950-C0.37/230-2	I9ZAA0014S	1x X1 (Basic Safety - STO) 1x X5 (24 V) 1x X3 (I/O control terminal) 1x X100 (supply terminal) 1x X105 (motor/brake resistor) 1x X109 (PTC, bridged) 1x X107 (24-V brake) 1x X106 (motor holding brake) 1x shield support for control connections	I9ZAA0017S	1x X82 (Extended Safety) 1x X83 (Extended Safety) 1x X5 (24 V) 1x X3 (I/O control terminal) 1x X100 (supply terminal) 1x X105 (motor/brake resistor) 1x X109 (PTC, bridged) 1x X107 (24-V brake) 1x X106 (motor holding brake) 1x shield support for control connections
i950-C0.55/230-2				
i950-C0.75/230-2				
i950-C1.5/230-2				
i950-C2.2/230-3				
i950-C0.55/400-3				
i950-C0.75/400-3				
i950-C2.2/400-3				
i950-C4.0/400-3				
i950-C4.0/230-3	I9ZAA0015S		I9ZAA0018S	
i950-C5.5/230-3				
i950-C7.5/400-3				
i950-C11/400-3				
i950-C15/400-3				
i950-C22/400-3	I9ZAA0016S	1x X1 (Basic Safety - STO) 1x X5 (24 V) 1x X3 (I/O control terminal) 1x X109 (PTC, bridged) 1x X107 (24-V brake) 1x X106 (motor holding brake) 1x shield support for control connections	I9ZAA0019S	1x X82 (Extended Safety) 1x X83 (Extended Safety) 1x X5 (24 V) 1x X3 (I/O control terminal) 1x X109 (PTC, bridged) 1x X107 (24-V brake) 1x X106 (motor holding brake) 1x shield support for control connections
i950-C30/400-3				
i950-C45/400-3				
i950-C55/400-3				
i950-C75/400-3				
i950-C90/400-3				
i950-C110/400-3				

Inverter	0.37 kW ... 15 kW	
Connection	Terminal strip X101	
	Order code	Packaging unit Piece
DC bus	I9ZAA0013/M	5
DC-Bus, daisy chain	I9ZAA0012/M	5

DIN rail

In accordance with EN 60175, the inverter can be mounted onto a DIN rail 35 mm x 7.5 mm.
For this purpose, a mounting set is available.

Order code	Description
I5ZAB0DR2S	Mounting of the inverters 0.37 kW to 4 kW on DIN rail

System cables

Hybrid cable for motor connection with One Cable Technology (OCT)

The One Cable Technology (OCT) is possible with MCS and m850 servo motors. You need a special hybrid cable for this:

Order code	Length	Description		
EYP0080A0020M11A00	2 m	Motor end M23 connector 3 power wires, 1 PE Cable cross-section 1.5 mm²	1 pair of control wires for controlling the motor holding brake Cable cross-section 0.75 mm²	1 pair of control wires for transferring the Hiperface DSL® protocol Cable cross-section 0.32 mm²
EYP0080A0035M11A00	3.5 m			
EYP0080A0050M11A00	5 m			
EYP0080A0075M11A00	7 m			
EYP0080A0100M11A00	10 m			
EYP0080A0150M11A00	15 m			
EYP0080A0200M11A00	20 m			
EYP0080A0500M11A00	50 m			
EYP0080A1000M11A00	100 m			
EYP0081A0020M11A00	2 m	Motor end M23 connector 3 power wires, 1 PE Cable cross-section 2.5 mm²	1 pair of control wires for controlling the motor holding brake Cable cross-section 1 mm²	
EYP0081A0035M11A00	3.5 m			
EYP0081A0050M11A00	5 m			
EYP0081A0075M11A00	7 m			
EYP0081A0100M11A00	10 m			
EYP0081A0150M11A00	15 m			
EYP0081A0200M11A00	20 m			
EYP0085A0020M12A00	2 m	Motor end M40 connector 3 power wires, 1 PE Cable cross-section 4 mm²		
EYP0085A0035M12A00	3.5 m			
EYP0085A0050M12A00	5 m			
EYP0085A0075M12A00	7 m			
EYP0085A0100M12A00	10 m			
EYP0085A0150M12A00	15 m			
EYP0085A0200M12A00	20 m			
EYP0085A0500M12A00	50 m			
EYP0085A1000M12A00	100 m			
EYP0086A0020M12A00	2 m	Motor end M40 connector 3 power wires, 1 PE Cable cross-section 6 mm²		
EYP0086A0035M12A00	3.5 m			
EYP0086A0050M12A00	5 m			
EYP0086A0075M12A00	7 m			
EYP0086A0100M12A00	10 m			
EYP0086A0150M12A00	15 m			
EYP0086A0200M12A00	20 m			
EYP0086A0500M12A00	50 m			
EYP0086A1000M12A00	100 m			

Information on further motor cables is provided in the "System cables and system connectors" manual (→ Download).

More information about the One Cable Technology (OCT):

▸ Connection of one cable technology (OCT) via HIPERFACE DSL® 67

Purchase order

Notes on ordering

The i950 servo inverter is ordered as a complete device in the previously chosen "safety" variant. The following two device variants are available:

- Inverter with "Basic Safety - STO"
- Inverter with "Extended Safety"

Additional feature options can be optionally configured during order placement.

- Modules for connecting to a network
- Modules for connecting motor encoders
- Modules for connecting load/master encoders
- SD card with Application Credit

The delivery takes place as a complete device.

»EASY Product Finder«

The »EASY Product Finder« helps you to configure your required product in next to no time. In addition, you can retrieve all important technical details such as data sheets, CAD data, and EPLAN data.

The link and the QR code lead directly to the "EASY Product Finder": EASY Product Finder

Order code

The following is a list of the necessary information when ordering a Servo Inverter i950.

Order example

Description of the component	Order code
Complete inverter	i95A E 222 F 1 A V10 0000
Three-phase mains connection 400 V	
Power 2.2 kW (i950-C2.2/400-3)	
Safety technology: Basic safety - STO	
Interference suppression: Integrated RFI filter	
Network: none	
Feedback: none	

Assignment of product name and order code

When listing the technical data of the various variants, the easily legible product name is used.

The product name contains the power in kW, mains voltage class and the number of phases.
This information results in the first 9 characters of the order code:

Power		Product name	Order code (only the first 9 characters)
kW	HP		
Single-phase mains connection 230 V			
0.37	0.5	i950-C0.37/230-2	I95AE137D1
0.55	0.75	i950-C0.55/230-2	I95AE155D1
0.75	1	i950-C0.75/230-2	I95AE175D1
1.5	2	i950-C1.5/230-2	I95AE215D1
Three-phase mains connection 230 V			
0.37	0.5	i950-C0.37/230-2	I95AE137D1
0.55	0.75	i950-C0.55/230-2	I95AE155D1
0.75	1	i950-C0.75/230-2	I95AE175D1
1.5	2	i950-C1.5/230-2	I95AE215D1
2.2	3	i950-C2.2/230-3	I95AE222C1
4	5	i950-C4.0/230-3	I95AE240C1
5.5	7.5	i950-C5.5/230-3	I95AE255C1
Three-phase mains connection 400/480 V			
0.55	0.75	i950-C0.55/400-3	i95AE155F
0.75	1	i950-C0.75/400-3	i95AE175F
2.2	3	i950-C2.2/400-3	i95AE222F
4	5	i950-C4.0/400-3	i95AE240F
7.5	10	i950-C7.5/400-3	i95AE275F
11	15	i950-C11/400-3	i95AE311F
15	20	i950-C15/400-3	i95AE315F
22	30	i950-C22/400-3	i95AE322F
30	40	i950-C30/400-3	i95AE330F
45	60	i950-C45/400-3	i95AE345F
55	74	i950-C55/400-3	i95AE355F
75	100	i950-C75/400-3	i95AE375F
90	120	i950-C90/400-3	i95AE390F
110	150	i950-C110/400-3	i95AE411F

The other positions of the order code indicate options and design variants. The following table shows the structure of the complete order code.

Purchase order
Order code

		I	9	5	A	E	□□□	F	1	□	□	□	0	□	□	□	□
Product type	Inverter	I															
Product family	i900		9														
Product	i950			5													
Product generation	Generation 1				A												
Mounting type	Control cabinet mounting					E											
Rated power (Examples)	0.55 kW						155										
	4.0 kW						240										
	30 kW						330										
	110 kW						411										
Mains voltage and connection type	3/PE AC 230/240 V							C									
	1/N/PE AC 230/240 V 3/PE AC 230/240 V							D									
	3/PE AC 400 V 3/PE AC 480 V							F									
Motor connections	Single axis								1								
Integrated functional safety	Basic Safety - STO									A							
	Extended Safety									C							
Protection class	IP20										0						
	IP20, coated										V						
Interference suppression	Without											0					
	Integrated RFI filter											1					
Design types													0				
SD card	Without SD card													Z			
	0 Application Credit													0			
	50 Application Credit													1			
	100 Application Credit													2			
	150 Application Credit													3			
	200 Application Credit													4			
	300 Application Credit													5			
	400 Application Credit													6			
Load encoder (slot B)	Blanking cover, without load encoder														0		
	Resolver														2		
	Encoder (SinCos/HIPERFACE®/SSI/TTL)														3		
Motor encoder (slot A)	Blanking cover, without motor encoder															0	
	Resolver															2	
	Encoder (SinCos/HIPERFACE®/SSI/TTL)															3	
	Blanking cover, One Cable Technology (OCT)															Q	
Networks	Without network																0
	PROFINET																R
	EtherCAT																T
	Ethernet/IP																G

Environmental notes and recycling

Lenze has been certified to the worldwide DIN EN ISO 14001 environmental management standard for many years. As part of our environmental policy and the associated climate responsibility, please note the following information on hazardous ingredients and the recycling of Lenze products and their packaging:

Lenze products are partly subject to the EU Directive 2011/65/EU on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS). This is documented accordingly in the EU declaration of conformity and with the CE mark.

Lenze products are not subject to EU Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), but some contain batteries/rechargeable batteries in accordance with EU Directive 2006/66/EC (Battery Directive). The disposal route, which is separate from household waste, is indicated by corresponding labels with the "crossed-out trash can".
Any batteries/rechargeable batteries included are designed to last the life of the product and do not need to be replaced or otherwise removed by the end user.

Lenze products are usually sold with cardboard or plastic packaging. This packaging complies with EU Directive 94/62/EC on packaging and packaging waste (Packaging Directive). The required disposal route is indicated by material-specific labels with the "recycling triangle".
Example: "21 - other cardboard"

REACH Lenze products are subject to the European Regulation EC No. 1907/2006 (REACH Chemicals Regulation). When used as intended, exposure of substances to humans, animals and the environment is excluded.

Lenze products are industrial electrical and electronic products and are disposed of professionally. Both the mechanical and electrical components such as electric motors, gearboxes or inverters contain valuable raw materials that can be recycled and reused. Proper recycling and thus maintaining the highest possible level of recyclability is therefore important and sensible from an economic and ecological point of view.

- Coordinate professional disposal with your waste disposal company.
- Separate mechanical and electrical components, packaging, hazardous waste (e.g. gear oils) and batteries/rechargeable batteries wherever possible.
- Dispose of the separated waste in an environmentally sound and proper manner (no household waste or municipal bulky waste).

What?	Material	Disposal instructions
Pallets	Wood	Return to manufacturers, freight forwarders or reusable materials collection system
Packaging material	Paper, cardboard, pasteboard, plastics	Collect and dispose of separately
Products		
Electronic devices	Metal, plastics, circuit boards, heatsinks	As electronic waste give to professional disposer for recycling
Gearbox	Oil	Drain oil and dispose of separately
	Casting, steel, aluminium	Dispose as metal scrap
Motors	Casting, copper, rotors, magnets, potting compound	As engine scrap give to professional disposer for recycling
Dry-cell batteries/rechargeable batteries		As used batteries give to professional disposer for recycling

Further information on Lenze's environmental and climate responsibility and on the topic of energy efficiency can be found on the Internet:

www.Lenze.com → search word: "Sustainability"

Appendix

Declarations of Conformity

Lenze

2366856.03

EU-Konformitätserklärung

EU Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

erklärt in alleiniger Verantwortung die Übereinstimmung der Produkte

declares under sole responsibility compliance of the products

I95Axxxxx1Axxxxxxx (x=0-9/A-Z)

mit der

with the

Maschinenrichtlinie
2006/42/EG Anhang VIII und IX

Machinery Directive
2006/42/EC Annex VIII and IX

Angewandte harmonisierte Normen:

Applied harmonized standards:

Sicherer Halt	Stopp Kategorie 0	**EN 60204-1**	**:2018**	Stop category 0	Safe torque off
	Kategorie 4 Performance Level (PL): PL e	**EN ISO 13849-1**	**:2015**	Category 4 Performance Level (PL): PL e	
		EN 61508 1-7	**:2010**		
Sicherheitsfunktionen siehe Betriebsanleitung.	SIL 3	**EN 62061** **+AC +A1 +A2**	**:2005** **:2010 :2013 :2015**	SIL 3	For safety functions see manual.
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Konformitätsbewertung

Conformity assessment

CE 0035

Benannte Stelle	**notified body**
	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln / Germany
Zertifikate	Certificates
	01/205/5605.00/17
Gültigkeit	Date of expiry
	2022-08

EMV- Richtlinie
2014/30/EU

EMC Directive
2014/30/EU

Angewandte harmonisierte Normen:

Applied harmonized standards:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

RoHS- Richtline
2011/65/EU

RoHS Directive
2011/65/EU

Angewandte harmonisierte Normen:

Applied harmonized standards:

EN IEC 63000:2018

Die Sicherheitshinweise der Betriebanleitung sind zu beachten.

The safety instructions of the manual are to be considered.

Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EU-Richtlinie entsprechen.

These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EU Directive.

Ort / Datum
Place / date

Aerzen 20.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Dokumentationsverantwortlicher
Responsible for documentation

i.V. T. Wedemeyer

2366856.03

Déclaration UE de conformité

Dichiarazione di conformità UE

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

Déclare, sous sa seule responsabilité, que les produits

dichiara sotto la propria esclusiva responsabilità la conformità dei seguenti prodotti

I95Axxxxx1Axxxxxxx (x=0-9/A-Z)

respectent la

alla

Directive Machines
2006/42/CE Annexes VIII et IX
Normes harmonisées appliquées :

Direttiva macchine
2006/42/CE Allegato VIII e IX
Standard armonizzati applicati:

Arrêt sécurisé	Catégorie d'arrêt 0	**EN 60204-1**	**:2018**	Categoria di stop 0	Arresto sicuro
	Catégorie 4 Niveau de performance(PL): PL e	**EN ISO 13849-1**	**:2015**	Categoria 4 Livello di prestazioni (PL): PL e	
		EN 61508 1-7	**:2010**		
Fonctions de sécurité : voir manuel d'utilisation.	SIL 3	**EN 62061**	**:2005**	SIL 3	Per le funzioni di sicurezza vedere le istruzioni operative.
		+AC +A1 +A2	**:2010 :2013 :2015**		
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Évaluation de conformité

CE 0035

Organisme notifié
Certificats
Date d'expiration

Valutazione della conformità

Ente notificato TÜV Rheinland Industrie Service GmbH
Am Grauen Stein
51105 Köln / Germany
Certificati 01/205/5605.00/17
Validità 2022-08

Directive CEM
2014/30/UE
Normes harmonisées appliquées :

Direttiva EMC
2014/30/UE
Standard armonizzati applicati:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

Directive RoHS
2011/65/UE
Normes harmonisées appliquées :

Direttiva RoHS
2011/65/UE
Standard armonizzati applicati:

EN IEC 63000:2018

Respecter impérativement les consignes de sécurité contenues dans le manuel d'utilisation.
Ces produits sont destinés à être installés au sein de machines. Leur mise en service est interdite tant qu'il n'a pas été attesté que la machine destinée à les accueillir respecte les dispositions de la directive UE susmentionnée.

Osservare assolutamente le informazioni sulla sicurezza riportate nelle istruzioni operative.
I prodotti elencati sono destinati all'installazione su macchine e non possono essere messi in funzione fintanto che non sia stata verificata la conformità delle macchine su cui dovranno essere installati alla suddetta direttiva UE.

Lieu / date
Luogo / data

Aerzen 20.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Responsable de documentation
Responsabile della documentazione

i.V. T. Wedemeyer

2366856.03

Declaración UE de conformidad

Declaracão UE de Conformidade

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

declara bajo su propia responsabilidad, que los productos

declara, sob sua exclusiva responsabilidade, a conformidade dos produtos

I95Axxxxx1Axxxxxxx (x=0-9/A-Z)

cumplen con la

com a

Directiva de Máquinas
2006/42/CE Anexo VIII y IX
Normas harmonizadas aplicables:

Paro seguro	Categoría de paro 0	**EN 60204-1**	**:2018**	Paragem categoria 0	Paragem segura
	Categoría 4			Categoria 4	
	Nivel de rendimiento (PL): PL e	**EN ISO 13849-1**	**:2015**	Nível de performance (PL): PL e	
		EN 61508 1-7	**:2010**		
Las funciones de seguridad se encuentran en el manual de instrucciones.	SIL 3	**EN 62061**	**:2005**	SIL 3	Consulte as funções de segurança no manual de operação.
		+AC +A1 +A2	**:2010 :2013 :2015**		
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Directiva de Máquinas
2006/42/CE Anexo VIII e IX
Normas harmonizadas aplicadas:

Evaluación de conformidad

CE 0035

Entidad notificada
Certificados
Validez

Avaliação da conformidade

Organismo notifica TÜV Rheinland Industrie Service GmbH
Am Grauen Stein
51105 Köln / Germany
Certificados 01/205/5605.00/17
Validade 2022-08

Directiva CEM
2014/30/UE
Normas harmonizadas aplicables:

Directiva CEM
2014/30/UE
Normas harmonizadas aplicadas:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

Directiva RoHS
2011/65/UE
Normas harmonizadas aplicables:

Directiva RoHS
2011/65/UE
Normas harmonizadas aplicadas:

EN IEC 63000:2018

Deben tenerse en cuenta las instrucciones de seguridad del manual.
Los productos están diseñados para su instalación en máquinas. Está prohibida la puesta en marcha hasta que se pueda determinar que la máquina en la que se instale éste producto cumpla con las directivas anteriormente indicadas.

Devem ser observadas as instruções de segurança do manual de operação.
Os produtos são destinados à incorporação em máquinas. A colocação em serviço permanece proibida até que seja constatado que a máquina, na qual estes produtos devem ser incorporados, corresponde às disposições da Directiva de Máquinas UE acima citada.

Lugar / Fecha
Local / Data

Aerzen 20.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Responsable de la documentación
Responsável pela documentação

i.V. T. Wedemeyer

Lenze

2402288.03

EU-Konformitätserklärung

EU Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

erklärt in alleiniger Verantwortung die Übereinstimmung der Produkte

declares under sole responsibility compliance of the products

I95Axxxxx1Cxxxxxxx (x=0-9/A-Z)

mit der

with the

Maschinenrichtlinie
2006/42/EG Anhang VIII und IX

Machinery Directive
2006/42/EC Annex VIII and IX

Angewandte harmonisierte Normen:

Applied harmonized standards:

		EN 60204-1	**:2018**		
	Kategorie 4 Performance Level (PL): PL e	**EN ISO 13849-1**	**:2015**	Category 4 Performance Level (PL): PL e	
		EN 61508 1-7	**:2010**		
Sicherheitsfunktionen siehe Betriebsanleitung.	SIL 3	**EN 62061**	**:2005**	SIL 3	For safety functions see manual.
		+AC +A1 +A2	**:2010 :2013 :2015**		
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Konformitätsbewertung

Conformity assessment

CE 0035

Benannte Stelle	**notified body**
	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln / Germany
Zertifikate	Certificates
01/205/5657.00/18	
Gültigkeit	Date of expiry
2023-12	

EMV- Richtlinie
2014/30/EU

EMC Directive
2014/30/EU

Angewandte harmonisierte Normen:

Applied harmonized standards:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

RoHS- Richtline
2011/65/EU

RoHS Directive
2011/65/EU

Angewandte harmonisierte Normen:

Applied harmonized standards:

EN IEC 63000:2018

Die Sicherheitshinweise der Betriebanleitung sind zu beachten.

The safety instructions of the manual are to be considered.

Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EU-Richtlinie entsprechen.

These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EU Directive.

Ort / Datum
Place / date

Aerzen 16.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Dokumentationsverantwortlicher
Responsible for documentation

i.V. T. Wedemeyer
i.V. T. Wedemeyer

Lenze

2402288.03

Déclaration UE de conformité

Dichiarazione di conformità UE

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

Déclare, sous sa seule responsabilité, que les produits

dichiara sotto la propria esclusiva responsabilità la conformità dei seguenti prodotti

I95Axxxxx1Cxxxxxxx (x=0-9/A-Z)

respectent la

alla

Directive Machines
2006/42/CE Annexes VIII et IX

Direttiva macchine
2006/42/CE Allegato VIII e IX

Normes harmonisées appliquées :

Standard armonizzati applicati:

		EN 60204-1	**:2018**		
	Catégorie 4 Niveau de performance(PL): PL e	**EN ISO 13849-1**	**:2015**	Categoria 4 Livello di prestazioni (PL): PL e	
		EN 61508 1-7	**:2010**		
Fonctions de sécurité : voir manuel d'utilisation.	SIL 3	**EN 62061**	**:2005**	SIL 3	Per le funzioni di sicurezza vedere le istruzioni operative.
		+AC +A1 +A2	**:2010 :2013 :2015**		
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Évaluation de conformité

Valutazione della conformità

CE 0035

Organisme notifié		**Ente notificato**	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln / Germany
Certificats		Certificati	01/205/5657.00/18
Date d'expiration		Validità	2023-12

Directive CEM
2014/30/UE

Direttiva EMC
2014/30/UE

Normes harmonisées appliquées :

Standard armonizzati applicati:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

Directive RoHS
2011/65/UE

Direttiva RoHS
2011/65/UE

Normes harmonisées appliquées :

Standard armonizzati applicati:

EN IEC 63000:2018

Respecter impérativement les consignes de sécurité contenues dans le manuel d'utilisation.

Ces produits sont destinés à être installés au sein de machines. Leur mise en service est interdite tant qu'il n'a pas été attesté que la machine destinée à les accueillir respecte les dispositions de la directive UE susmentionnée.

Osservare assolutamente le informazioni sulla sicurezza riportate nelle istruzioni operative.

I prodotti elencati sono destinati all'installazione su macchine e non possono essere messi in funzione fintanto che non sia stata verificata la conformità delle macchine su cui dovranno essere installati alla suddetta direttiva UE.

Lieu / date
Luogo / data

Aerzen 16.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Responsable de documentation
Responsabile della documentazione

i.V. T. Wedemeyer

Lenze

2402288.03

Declaración UE de conformidad

Declaracão UE de Conformidade

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

declara bajo su propia responsabilidad, que los productos

declara, sob sua exclusiva responsabilidade, a conformidade dos produtos

I95Axxxxx1Cxxxxxxx (x=0-9/A-Z)

cumplen con la

com a

Directiva de Máquinas
2006/42/CE Anexo VIII y IX

Normas harmonizadas aplicables:

Directiva de Máquinas
2006/42/CE Anexo VIII e IX

Normas harmonizadas aplicadas:

	EN 60204-1	**:2018**		
Categoría 4 Nivel de rendimiento (PL): PL e	**EN ISO 13849-1**	**:2015**	Categoria 4 Nível de performance (PL): PL e	
	EN 61508 1-7	**:2010**		
Las funciones de seguridad se encuentran en el manual de instrucciones. SIL 3	**EN 62061** **+AC +A1 +A2**	**:2005** **:2010 :2013 :2015**	SIL 3	Consulte as funções de segurança no manual de operação.
	EN 61800-5-2	**:2017**		
	EN 61800-5-1 +A1	**:2007 :2017**		

Evaluación de conformidad

CE 0035

Entidad notificada
Certificados
Validez

Avaliação da conformidade

Organismo notifica TÜV Rheinland Industrie Service GmbH
Am Grauen Stein
51105 Köln / Germany
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Directiva CEM
2014/30/UE

Normas harmonizadas aplicables:

Directiva CEM
2014/30/UE

Normas harmonizadas aplicadas:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

Directiva RoHS
2011/65/UE

Normas harmonizadas aplicables:

Directiva RoHS
2011/65/UE

Normas harmonizadas aplicadas:

EN IEC 63000:2018

Deben tenerse en cuenta las instrucciones de seguridad del manual.

Los productos están diseñados para su instalación en máquinas. Está prohibida la puesta en marcha hasta que se pueda determinar que la máquina en la que se instale éste producto cumpla con las directivas anteriormente indicadas.

Devem ser observadas as instruções de segurança do manual de operação.

Os produtos são destinados à incorporação em máquinas. A colocação em serviço permanece proibida até que seja constatado que a máquina, na qual estes produtos devem ser incorporados, corresponde às disposições da Directiva de Máquinas UE acima citada.

Lugar / Fecha
Local / Data

Aerzen 16.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Responsable de la documentación
Responsável pela documentação

i.V. T. Wedemeyer

Good to know

Approvals and directives

CCC	China Compulsory Certification documents the compliance with the legal product safety requirements of the PR of China - in accordance with Guobiao standards.
$_{C}CSA_{US}$	CSA certificate, tested according to US and Canada standards
UE	Union Européenne documents the declaration of the manufacturer that EU Directives are complied with.
CEL	China Energy Label documents the compliance with the legal energy efficiency requirements for motors, tested according to the PR of China and Guobiao standards
CSA	CSA Group (Canadian Standards Association) CSA certificate, tested according to Canada standards
$UL^{Energy}{}_{US\ CA}$	Energy Verified Certificate Determining the energy efficiency according to CSA C390 for products within the scope of energy efficiency requirements in the USA and Canada
$_{C}UL_{US}$	UL certificate for products, tested according to US and Canada standards
$_{C}UR_{US}$	UL certificate for components, tested according to US and Canada standards
EAC	Customs union Russia / Belarus / Kazakhstan certificate documents the declaration of the manufacturer that the specifications for the Eurasian conformity (EAC) required for placing electronic and electromechanical products on the market of the entire territory of the Customs Union (Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan) are complied with.
UL	Underwriters Laboratory Listed Product
UL_{LISTED}	UL Listing approval mark as proof that the product has been tested and the applicable safety requirements have been confirmed by UL (Underwriters Laboratory).
UR	UL Recognized Component approval mark as proof that the UL approved component can be used in a product or system bearing the UL Listing approval mark.

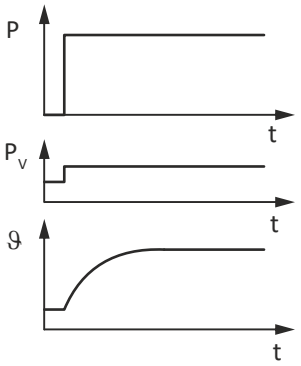
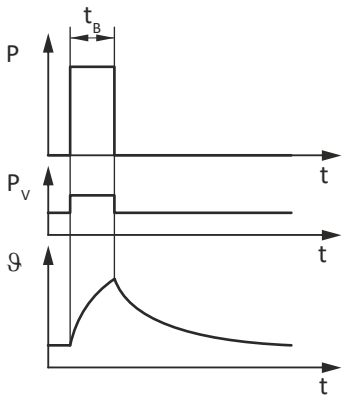
Operating modes of the motor

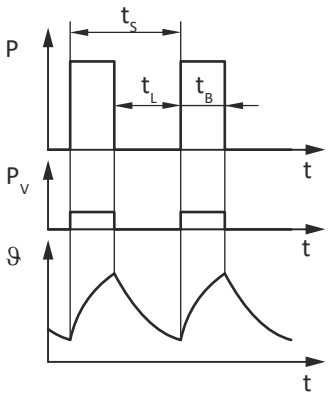
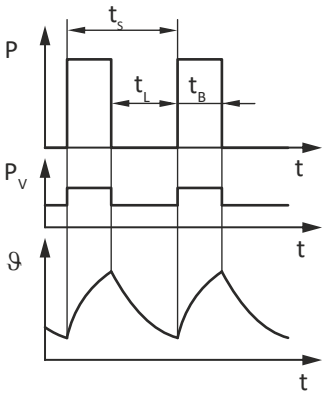
Operating modes S1 ... S10 as specified by EN 60034-1 describe the basic stress of an electrical machine.

In continuous operation a motor reaches its permissible temperature limit if it outputs the rated power dimensioned for continuous operation. However, if the motor is only subjected to load for a short time, the power output by the motor may be greater without the motor reaching its permissible temperature limit. This behaviour is referred to as overload capacity.

Depending on the duration of the load and the resulting temperature rise, the required motor can be selected reduced by the overload capacity.

The most important operating modes

Continuous operation S1	Short-time operation S2
	
Operation with a constant load until the motor reaches the thermal steady state. The motor may be actuated continuously with its rated power.	Operation with constant load; however, the motor does not reach the thermal steady state. During the following standstill, the motor winding cools down to the ambient temperature again. The increase in power depends on the load duration.

Intermittent operation S3	Non-intermittent periodic operation S6
	
Sequence of identical duty cycles comprising operation with a constant load and subsequent standstill. Start-up and braking processes do not have an impact on the winding temperature. The steady-state is not reached. The guide values apply to a cycle duration of 10 minutes. The power increase depends on the cycle duration and on the load period/ downtime ratio.	Sequence of identical duty cycles comprising operation with a constant load and subsequent no-load operation. The motor cools down during the no-load phase. Start-up and braking processes do not have an impact on the winding temperature. The steady-state is not reached. The guide values apply to a cycle duration of 10 minutes. The power increase depends on the cycle duration and on the load period/idle time ratio.

P	Power	P_V	Power loss
t	Time	t_B	Load period
t_L	Idle time	t_S	Cycle duration
ϑ	Temperature		

Switching frequencies

On an inverter, the term "switching frequency" is understood to mean the frequency with which the input and outputs of the output module (inverter) are switched. On an inverter, the switching frequency can generally be set to values between 2 and 16 kHz, whereby the selection is based on the respective power output.

As switching the modules cause heat losses, the inverter can provide higher output currents at low switching frequencies than at high frequencies. Additionally, it is distinguished between the operation at a permanently set switching frequency and a variably set switching frequency. Here, the switching frequency is automatically reduced as a function of the device utilization.

At a higher switching frequency, the noise generation is less.

Options for the switching frequency:

- 2 kHz
- 4 kHz
- 8 kHz
- 12 kHz
- 16 kHz
- variable (automatic adaptation)

Enclosures

The degree of protection indicates the suitability of a motor for specific ambient conditions with regard to humidity as well as the protection against contact and the ingress of foreign particles. The degrees of protection are classified by EN 60529.

The first code number after the code letters IP indicates the protection against the ingress of foreign particles and dust. The second code number refers to the protection against the ingress of humidity.

Code number 1	Degree of protection	Code number 2	Degree of protection
0	No protection	0	No protection
1	Protection against the ingress of foreign particles d > 50 mm. No protection in case of deliberate access.	1	Protection against vertically dripping water (dripping water).
2	Protection against medium-sized foreign particles, d > 12 mm, keeping away fingers or the like.	2	Protection against diagonally falling water (dripping water), 15 ° compared to normal service position.
3	Protection against small foreign particles d > 2.5 mm. Keeping away tools, wires or the like.	3	Protection against spraying water, up to 60 ° from vertical.
4	Protection against granular foreign particles, d > 1 mm, keeping away tools, wire or the like.	4	Protection against spraying water from all directions.
5	Protection against dust deposits (dust-protected), complete protection against contact.	5	Protection against water jets from all directions.
6	Protection against the ingress of dust (dust-proof), complete protection against contact.	6	Protection against choppy seas or heavy water jets (flood protection).

Glossary

Abbreviation	Meaning
AIE	Acknowledge In Error, error acknowledgement
AIS	Acknowledge In Stop, restart acknowledgement
OFF state	Triggered signal status of the sensors
CCF	Common Cause Error (also β-value)
EC_FS	Error Class Fail Safe
EC_SS1	Error-Class Safe Stop 1
EC_SS2	Error-Class Safe Stop 2
EC_STO	Error-Class Safe Torque Off Stop 0
ON state	Signal status of the safety sensor in normal operation
FIT	Failure In Time, 1 FIT = 10-9 Error/h
FMEA	Failure Mode and Effect Analysis
FSoE	FailSafe over EtherCAT
GSDML	Device description file with PROFINET-specific data to integrate the configuring software of a PROFINET controller.
HFT	Hardware Failure Tolerance
Cat.	Category in accordance with EN ISO 13849-1
OSSD	Output Signal Switching Device, tested signal output
PELV	Protective Extra Low Voltage, extra-low voltage with safe isolation
PL	Performance Level according to EN ISO 13849-1
PM	Plus−Minus − switched signal paths
PP	Plus−Plus − switched signal paths
PS	PROFIsafe
PWM	Pulse width modulation
SCS	Safe crawling speed
SD−In	Safe Digital Input
SD−Out	Safe Digital Output
SELV	Safety Extra Low Voltage
SFF	Safe Failure Fraction
SIL	Safety Integrity Level in accordance with IEC 61508